Science to support planning, managing, monitoring, and adapting at the landscape scale

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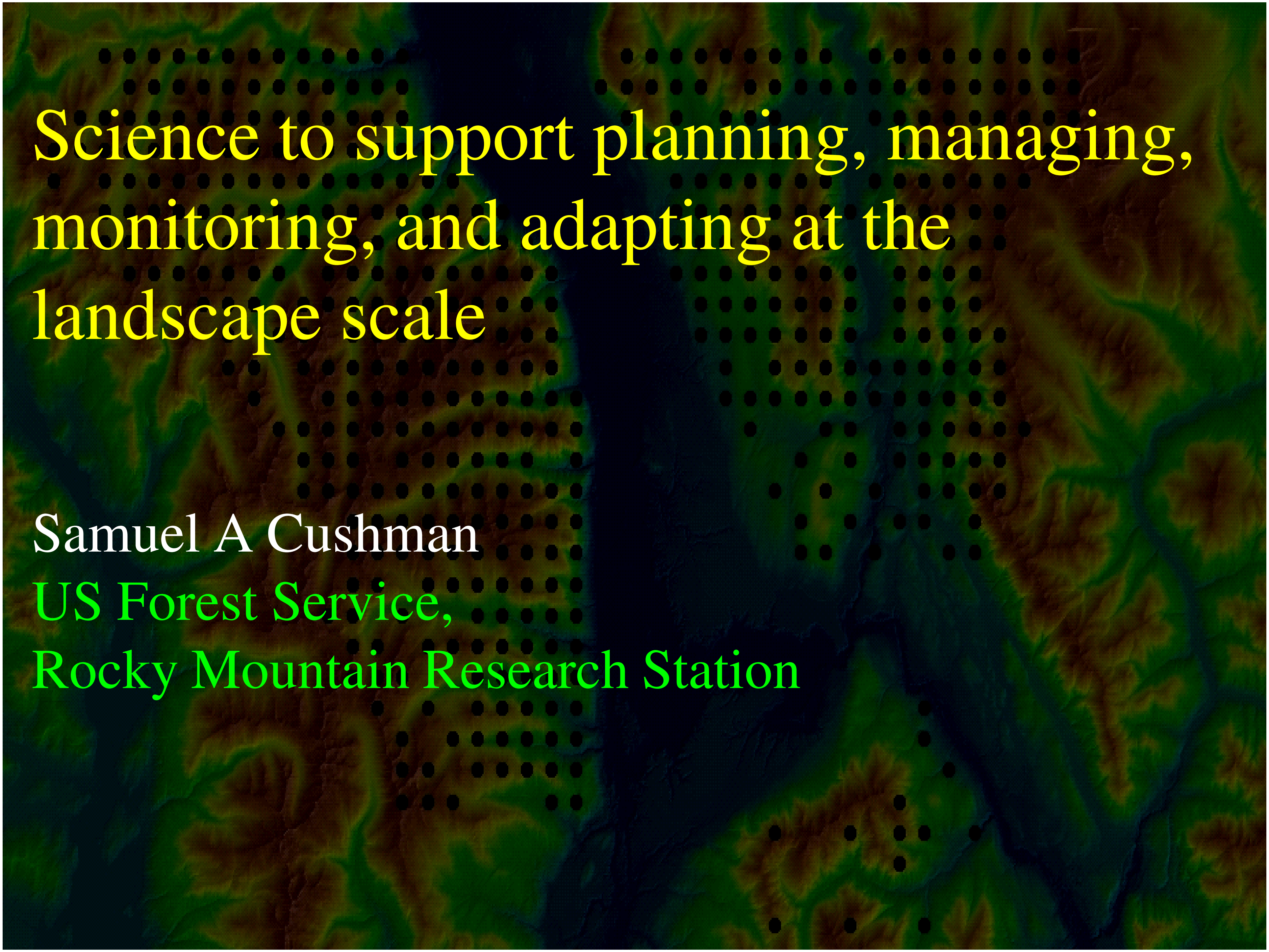

Selected Topics

- Indicator species
- Ecosystem diversity as a surrogate for species diversity
- Improved ways to represent ecosystem diversity for meaningful Desired Conditions
- Predicting effects of climate change on ecosystem and species diversity
- Reconnecting fragmented landscapes
- Monitoring to support adaptive management

Selected Topics

- **Indicator species**

Conservation Biology

Contributed Paper

Use of Abundance of One Species as a Surrogate for Abundance of Others

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Abstract: *Indicator species concepts have a long history in conservation biology. Arguments in favor of these approaches generally stress expediency and assume efficacy. We tested the premise that the abundance patterns of one species can be used to infer those of other species. Our data consisted of 72,495 bird observations on 55 species across 1046 plots distributed across 30 sub basins. We analyzed abundance patterns at two spatial scales (plot and sub basin) and for empirical and a priori grouping. There were few significant indicator relationships at either scale or under either grouping rule, and those few we found did not explain a substantial portion of the abundance of other species. Coupled with the lack of proven efficacy for species surrogacy in the literature, our results indicate the utility of indicators and similar types of surrogate approaches must be demonstrated rather than assumed.*

Indicator Species?

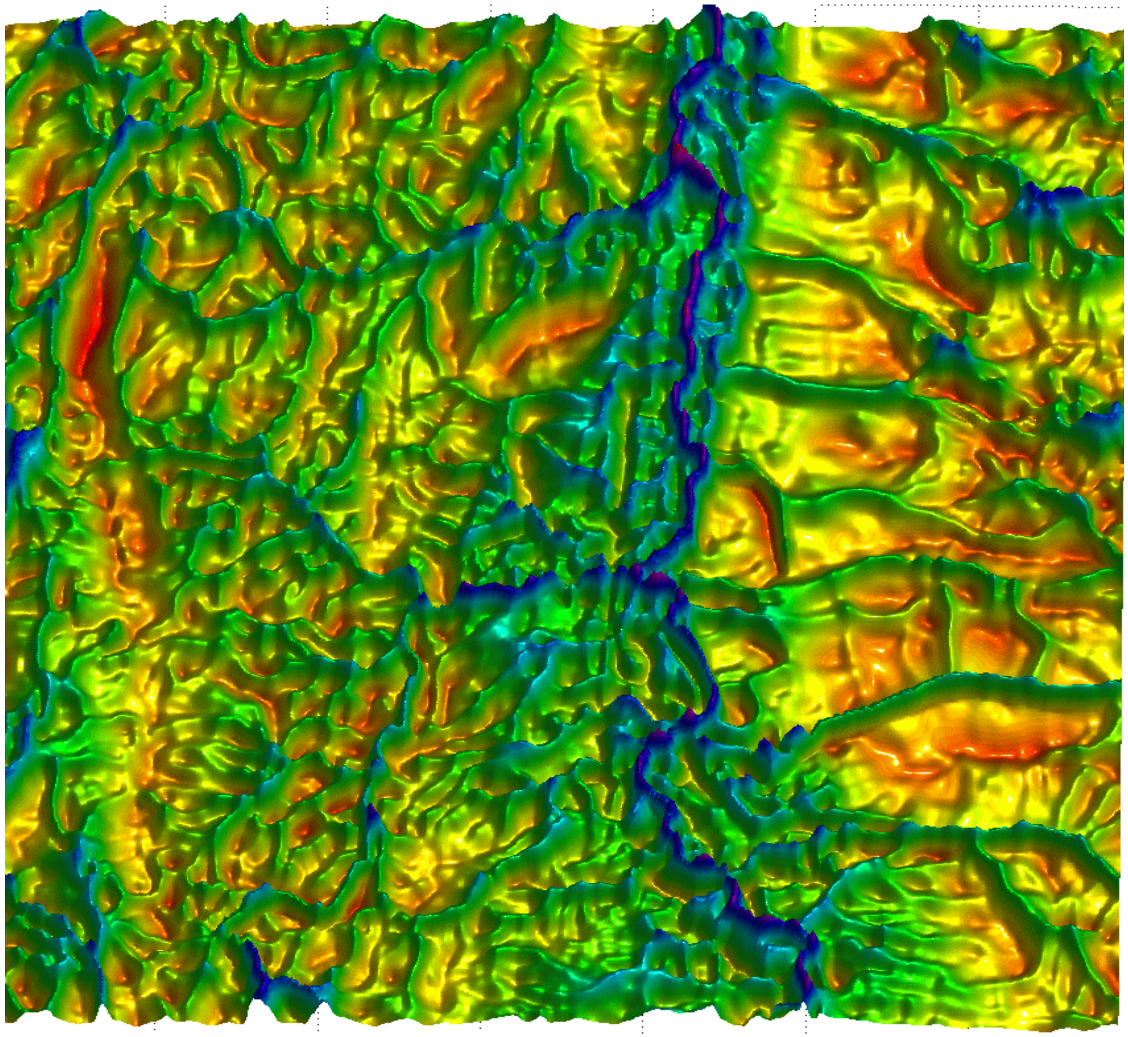
- No species can explain more than 5% of the variability of the bird community.
- Even select poolings of species fail to explain more than 10% of the variability among species.
- Conclusion. Indicator Species?

Selected Topics

- **Ecosystem diversity as a surrogate for species diversity**

Ecosystem/Landscape Heterogeneity

Ecosystem Diversity includes:



Vegetation cover type, seral stage, stand structure;

Landscape patterns, disturbance regimes and ranges of variability;

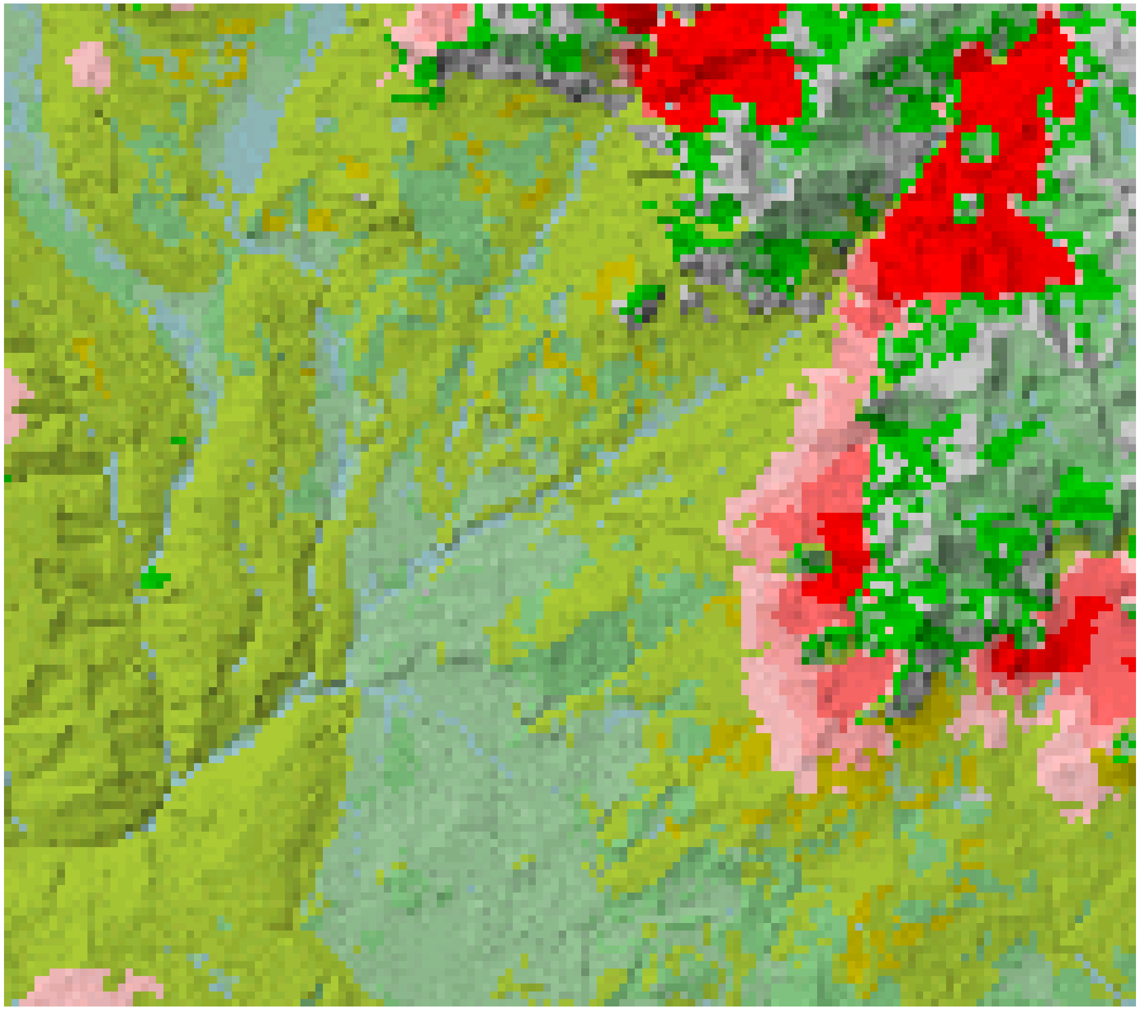
Wildlife habitat quality, area and pattern;

Aquatic ecosystem condition and pattern; etc.

Ecosystem Diversity REDUX

Ecosystem diversity conundrum – specificity, sample size, spatial scale

In practice some Forests defined Desired Conditions in terms of the Area of coarse vegetation cover types.



Extent of Habitats = Species Viability????

 RESEARCH COMMUNICATIONS

Do forest community types provide a sufficient basis to evaluate biological diversity?

Samuel A Cushman[1*], Kevin S McKelvey[1], Curtis H Flather[2], and Kevin McGarigal[3]

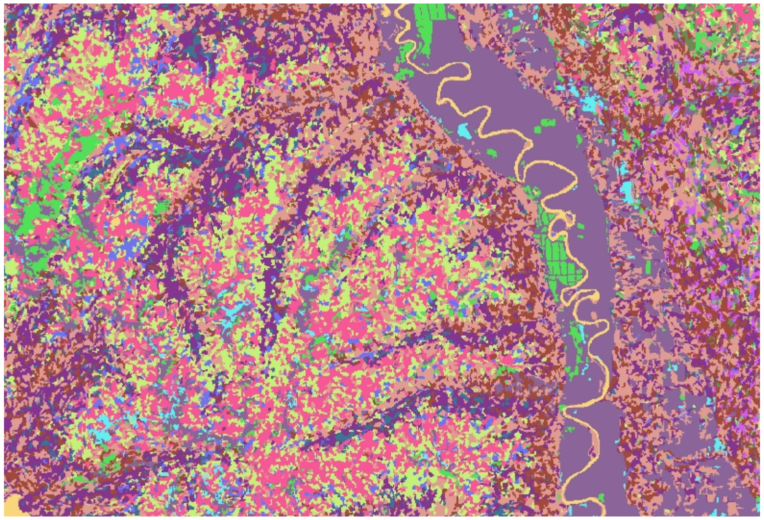
Forest communities, defined by the size and configuration of cover types and stand ages, have commonly been used as proxies for the abundance or viability of wildlife populations. However, for community types to succeed as proxies for species abundance, several assumptions must be met. We tested these assumptions for birds in an Oregon forest environment. Measured habitat was a weak proxy for species abundance and vegetation cover type was a weak proxy for habitat, explaining only 4% of the variance in species abundance. The adequacy of forest community types as habitat proxies was highly dependent on classification rules and the spatial scales at which communities were defined. Habitat was perceived differently by species guilds and a single, generalized characterization of habitat is therefore unlikely to provide a reliable basis for multi-species conservation efforts. Given the weak relations between forest vegetation and species abundance, evaluation of landscape pattern is unlikely to be an effective replacement for the direct monitoring of species population size and distribution.

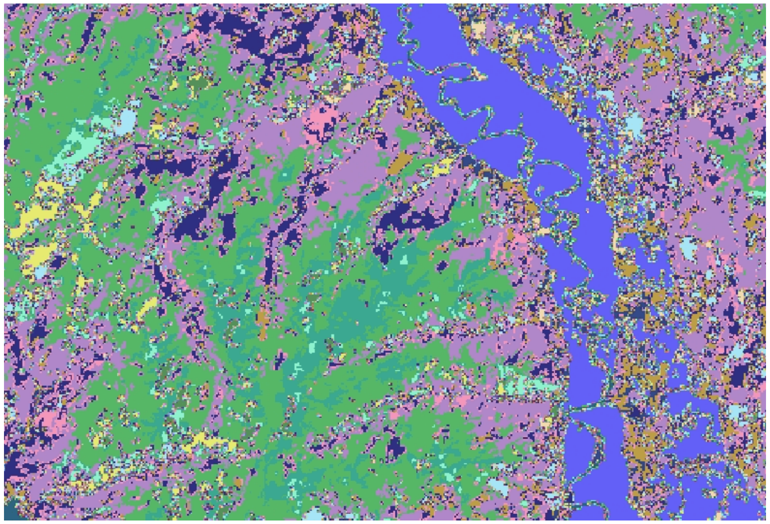
Front Ecol Environ 2008; 6, doi: 10.1890/070039

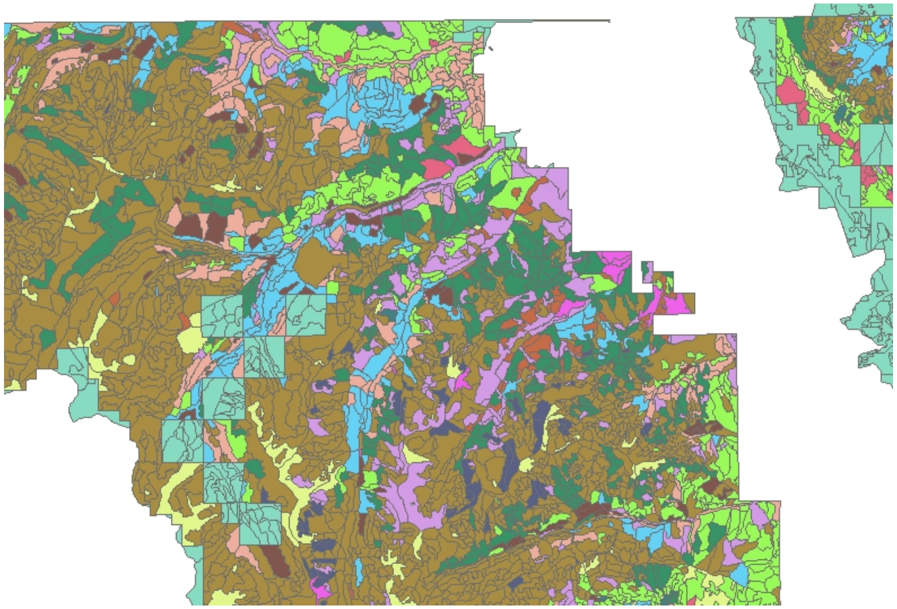
Take-home message

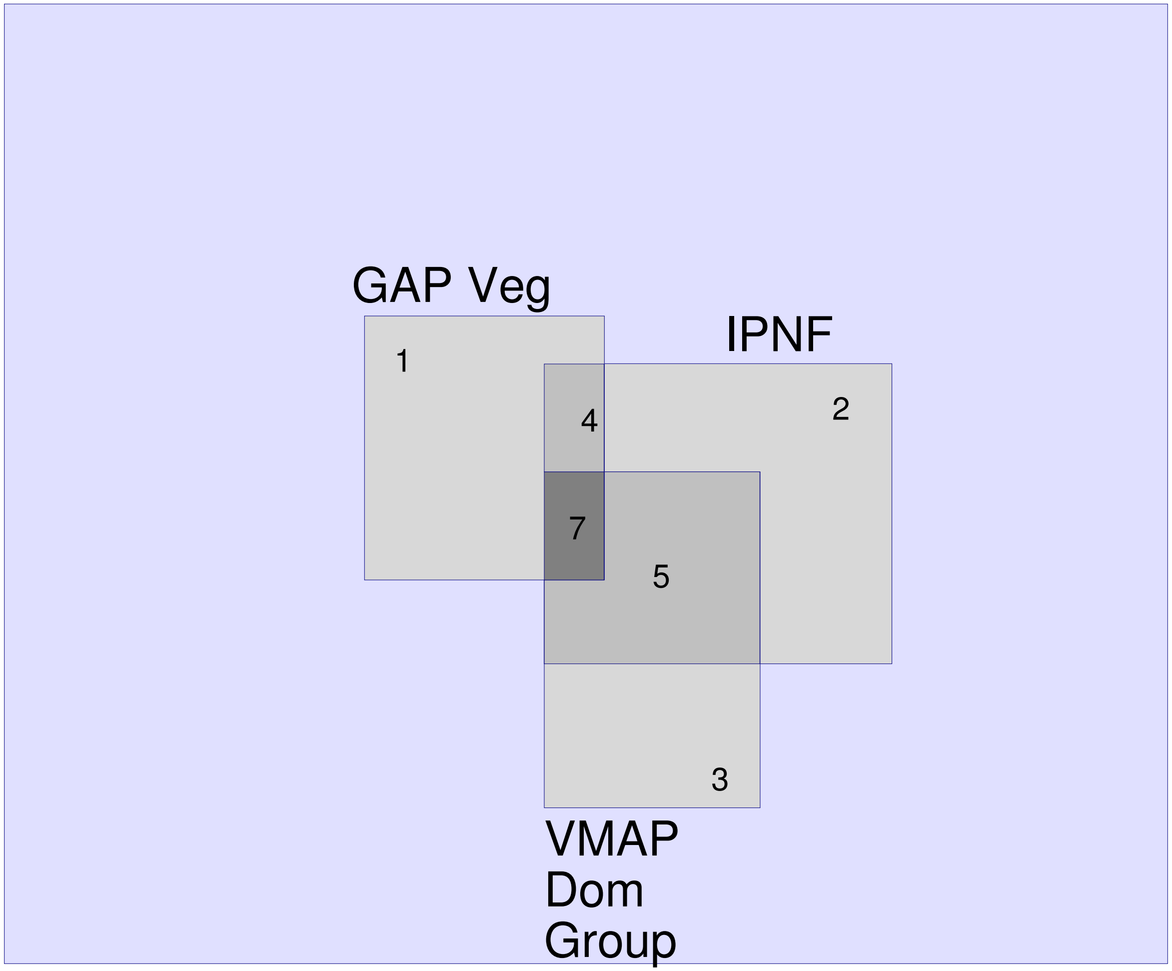
- Habitat explains less than half of species abundance – therefore it is not a surrogate for viability.
- Mapped cover types are inconsistent surrogates for habitat – therefore we should monitor, map and model environmental variation at a higher resolution.
- Species-habitat relationships change fundamentally with disturbances – therefore habitat relationships models may not accurately predict future effects.

Do vegetation cover type maps predict the occurrence and dominance of forest trees?









1 - 5.1%
2 - 5.7%
3 - 3.1%
4 - 0.4%
5 - 5.2%
6 - 0.0%
7 - 0.6%

Residual = **80.0%**

Take-home message

- Classified cover type maps are surprisingly poor predictors of forest vegetation.
- 80% variability in tree species importance among plots was not explained even by a combination of three maps.
- Any of the three maps by itself would explain less than 12% of the variability in tree species.
- Are these maps therefore useful indicators of Ecosystem Diversity? If so, what and why?

Meaningful Desired Conditions?

- To be useful desired conditions statements should be
  - Detailed
  - Specific
  - Quantitative
  - Appropriately scaled
- Research shows that detailed composition and structure of vegetation and seral stages and its pattern across the landscape has strong relationships to biodiverstiy.
- Area of coarsely defined cover and seral classes does not.

Selected Topics

- **Improved ways to represent ecosystem diversity for meaningful Desired Conditions**

Given climate change how can we robustly assess ecological conditions?

A Present Day Plant Community

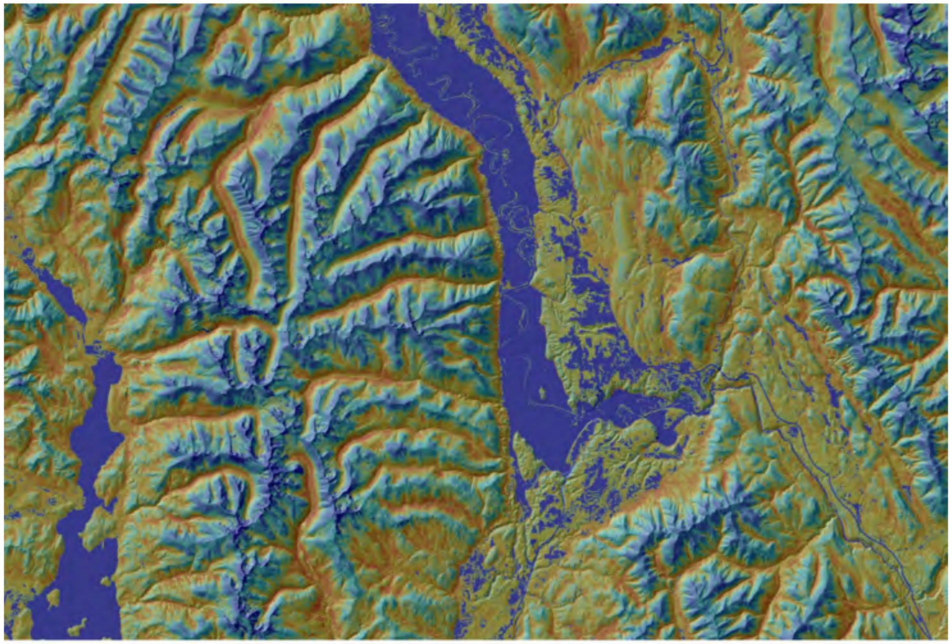
Climate changes; Community disassembles

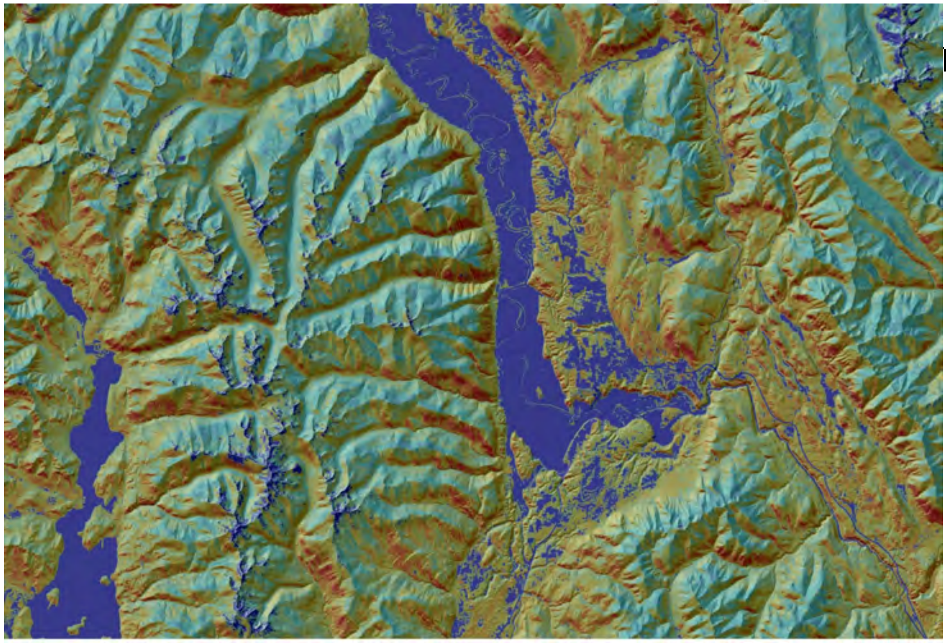
A Future Community; no modern analog

RESEARCH ARTICLE

Gradient modeling of conifer species using random forests

Jeffrey S. Evans · Samuel A. Cushman





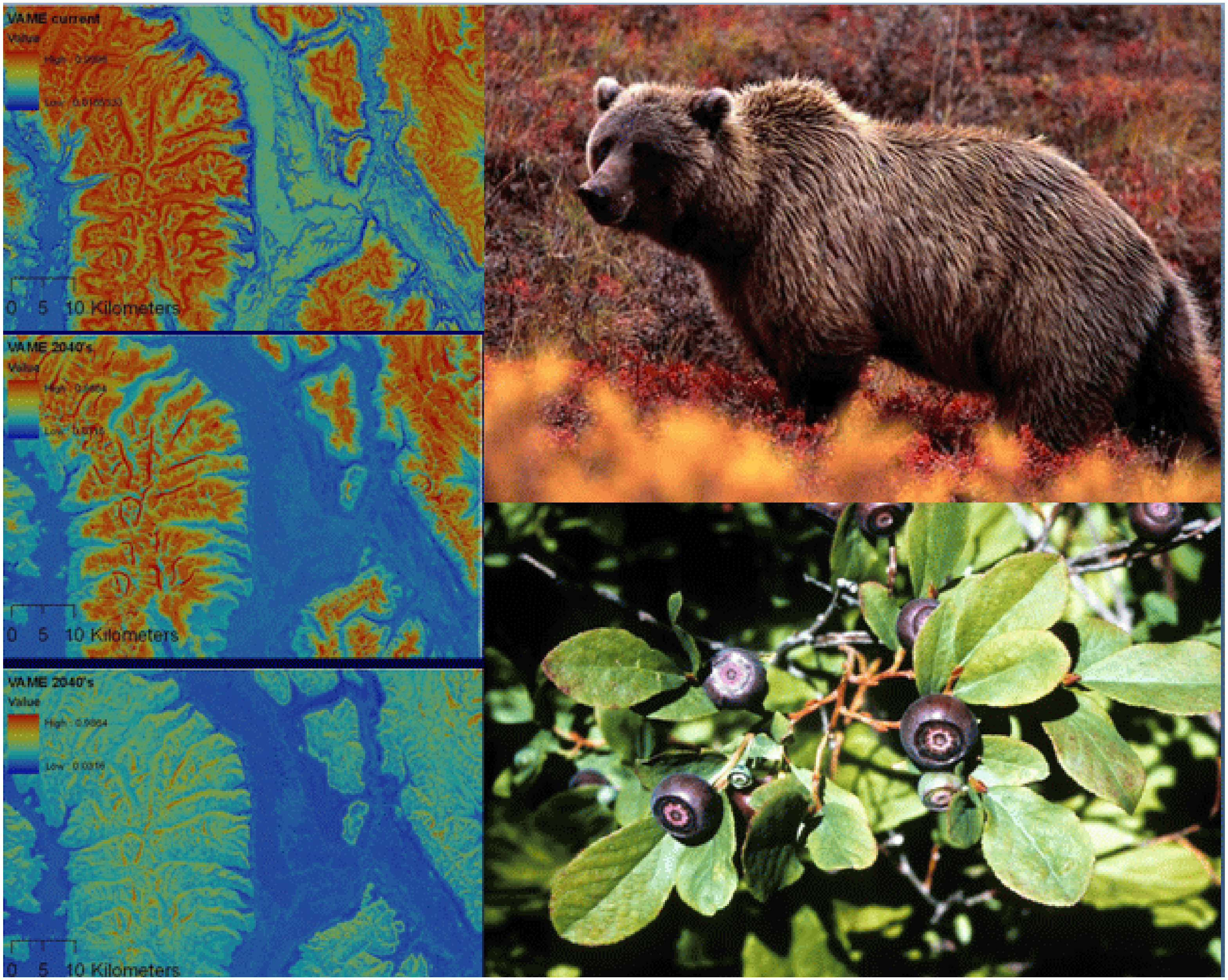
- Climate-resilient Ecosystem Diversity
- From communities to species
- From patches to pixels

Selected Topics

- **Predicting effects of climate change on ecosystem and species diversity**

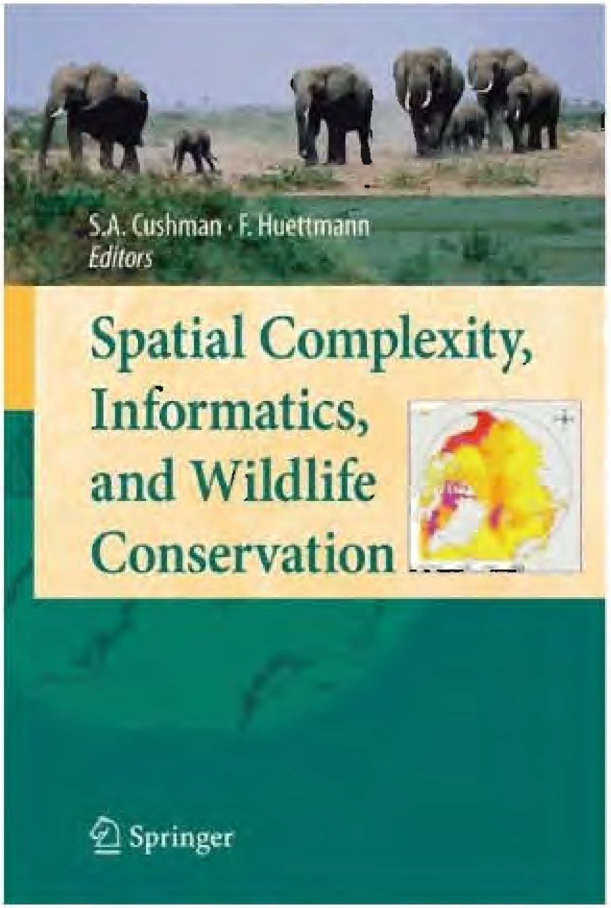
Bears, berries and climate change.

Cushman and Holden, in prep.



Selected Topics

- **Reconnecting fragmented landscapes**

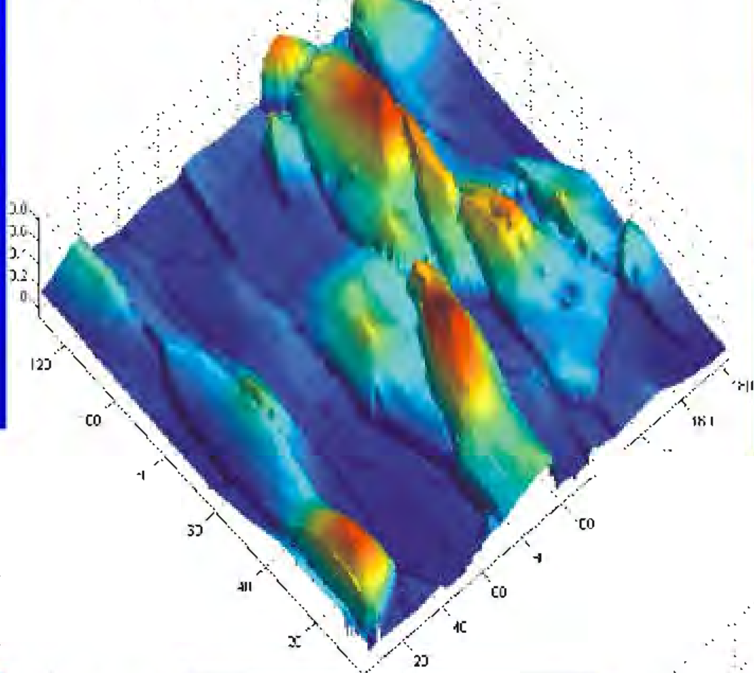


Chapter 20
Habitat Fragmentation Effects Depend on Complex Interactions Between Population Size and Dispersal Ability: Modeling Influences of Roads, Agriculture and Residential Development Across a Range of Life-History Characteristics

Samuel A. Cushman, Bradley W. Compton, and Kevin McGarigal

Visualization of three scenarios in a small section of the Worcester-North Ecoregion

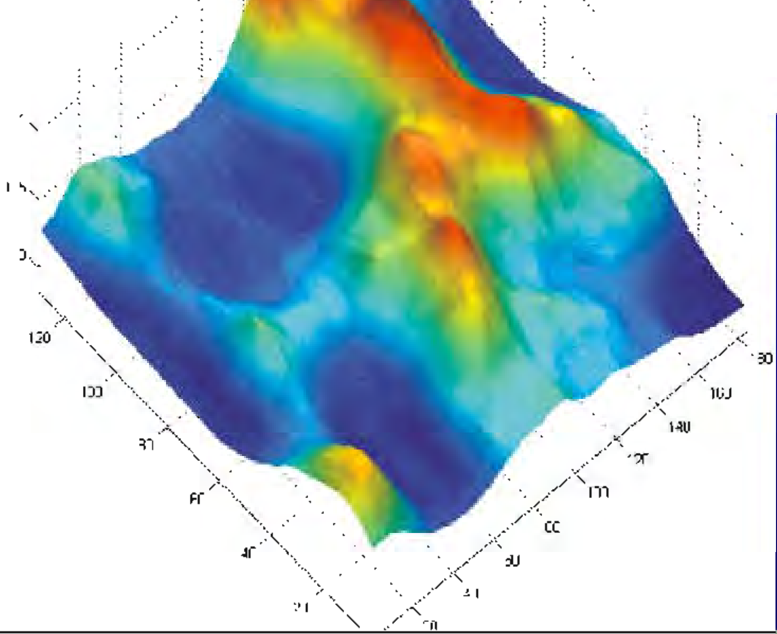
Roads



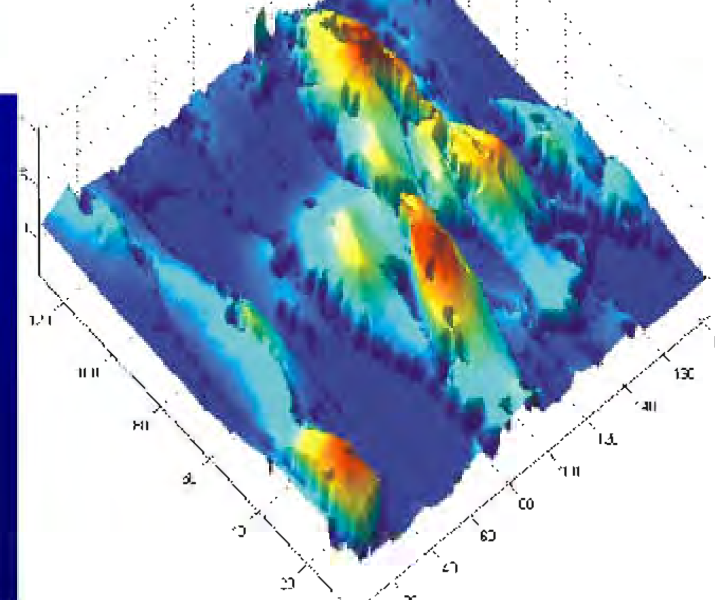
Dispersal ability = 800

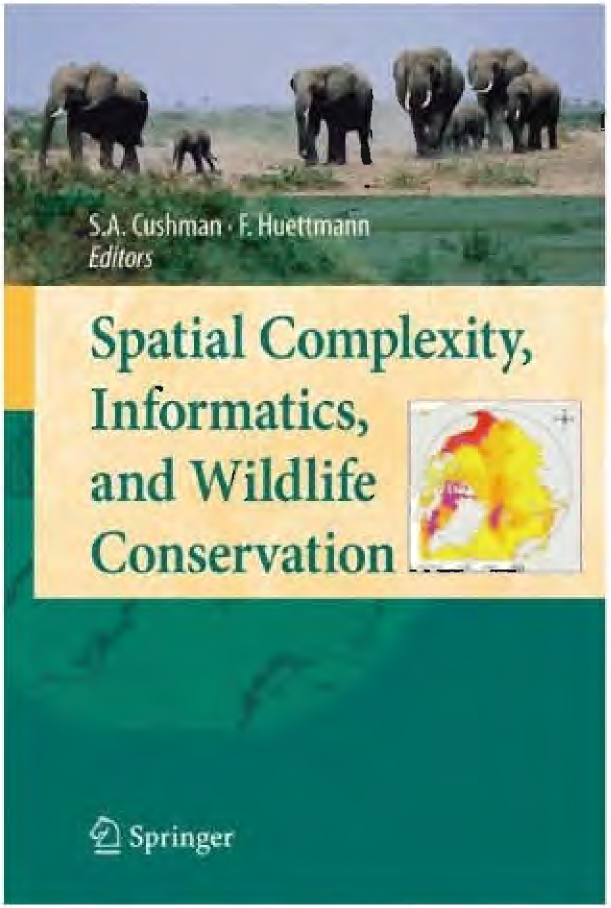
Population Size = 1000

Null



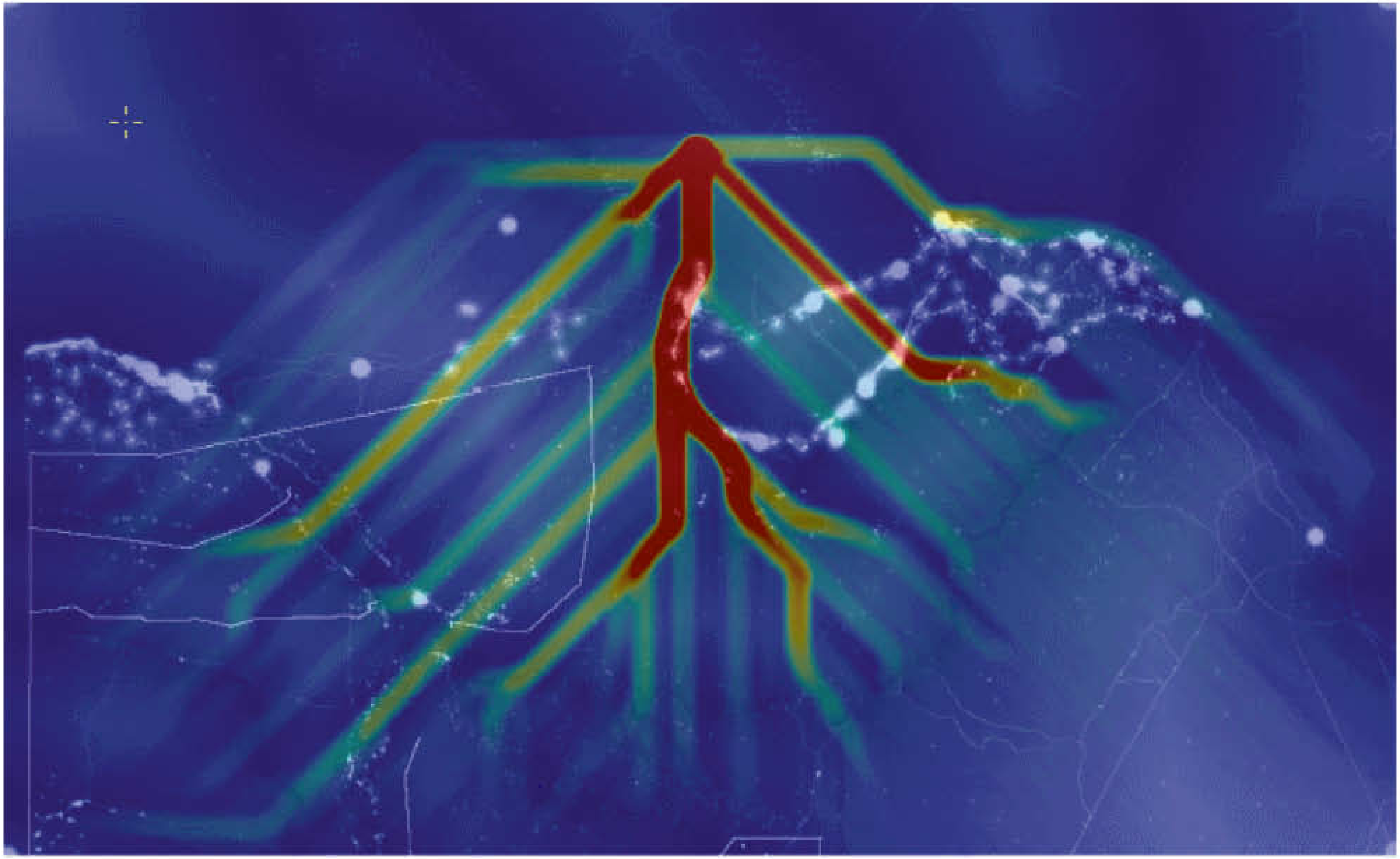
Roads + Landuse

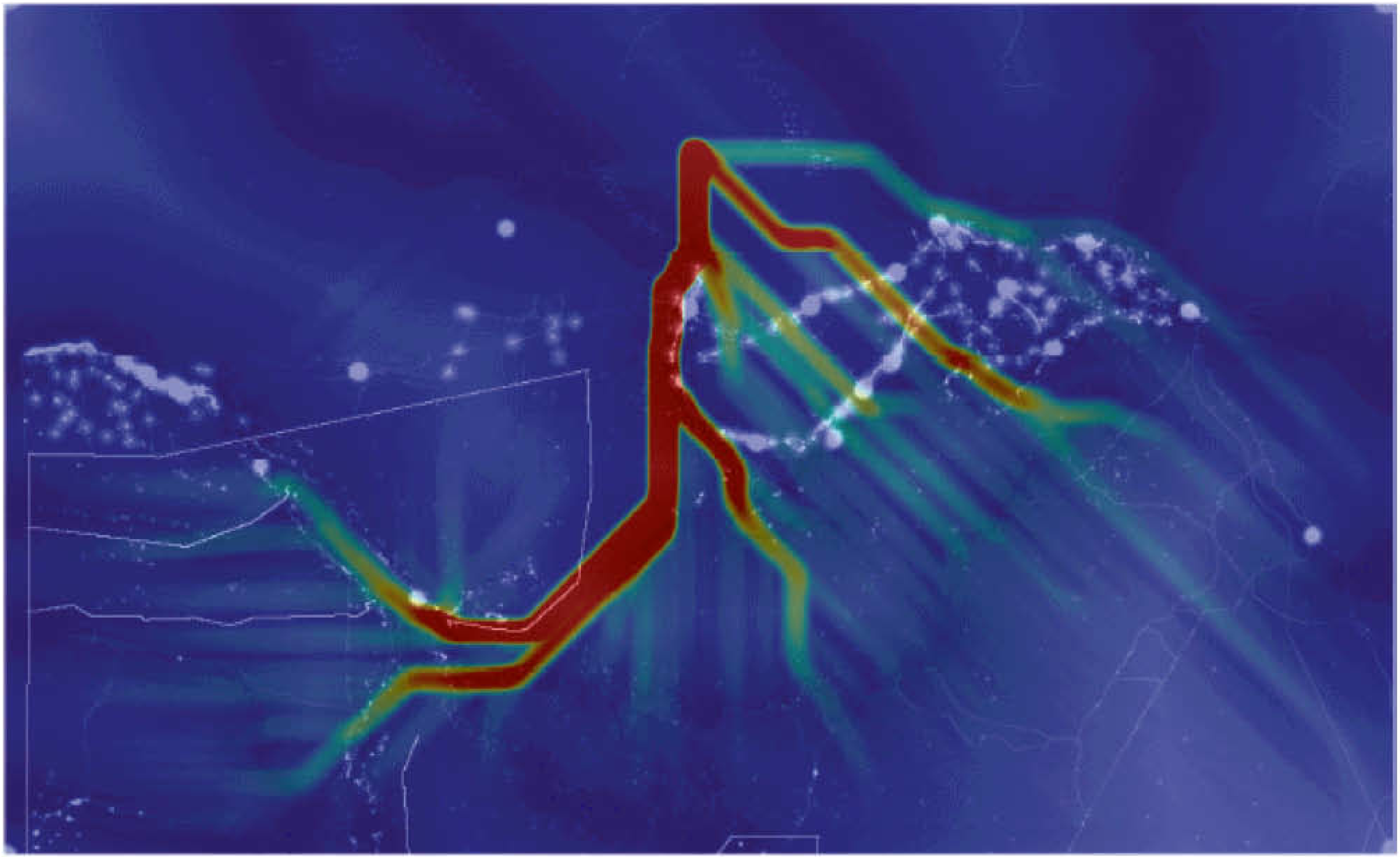




Chapter 19
Mapping Landscape Resistance to Identify Corridors and Barriers for Elephant Movement in Southern Africa

Samuel A. Cushman, Michael Chase, and Curtice Griffin





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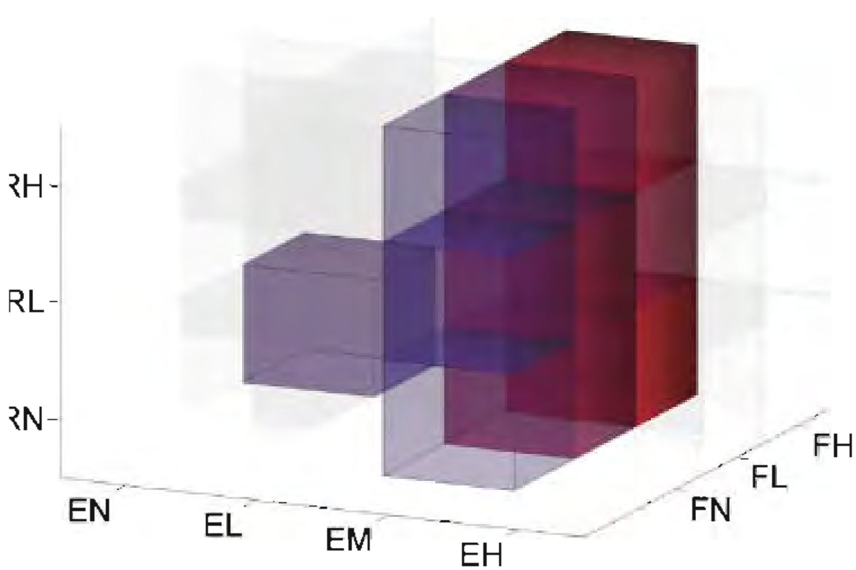
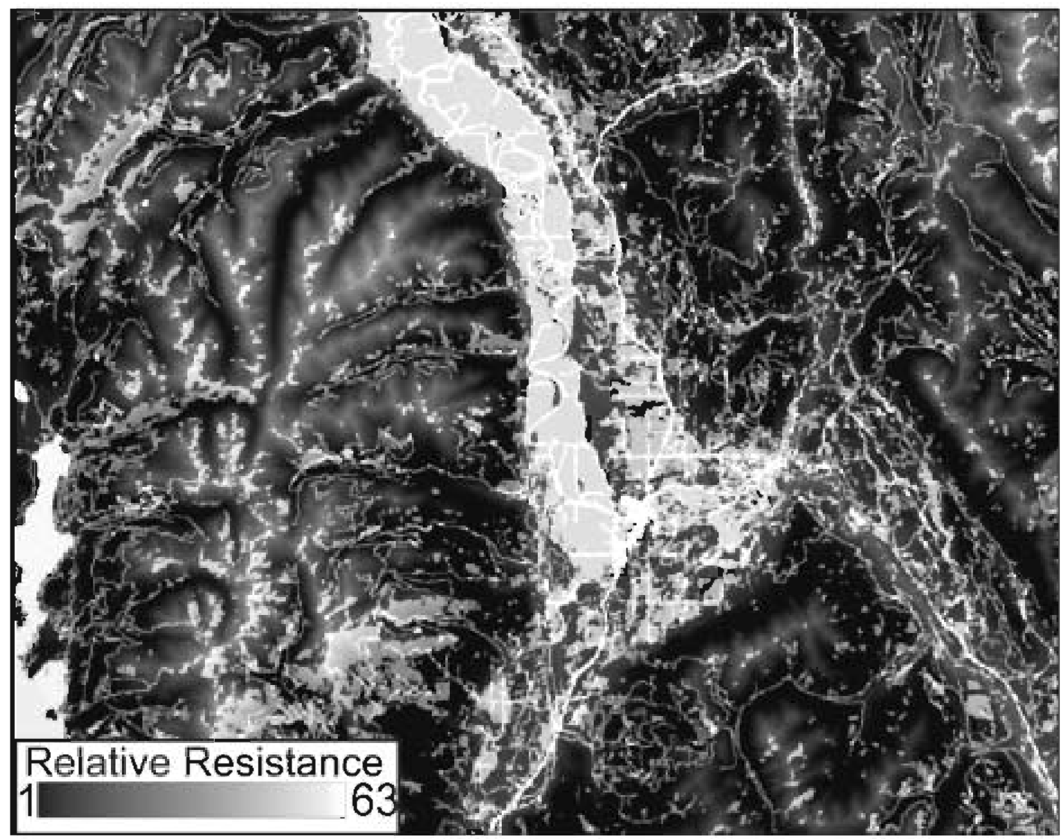
Gene Flow in Complex Landscapes: Testing Multiple Hypotheses with Causal Modeling

Samuel A. Cushman,[1,*] Kevin S. McKelvey,[1,†] Jim Hayden,[2,‡] and Michael K. Schwartz[1,§]





Conservation Biology

Contributed Paper

Use of Empirically Derived Source-Destination Models to Map Regional Conservation Corridors

SAMUEL A. CUSHMAN,* KEVIN S. McKELVEY, AND MICHAEL K. SCHWARTZ

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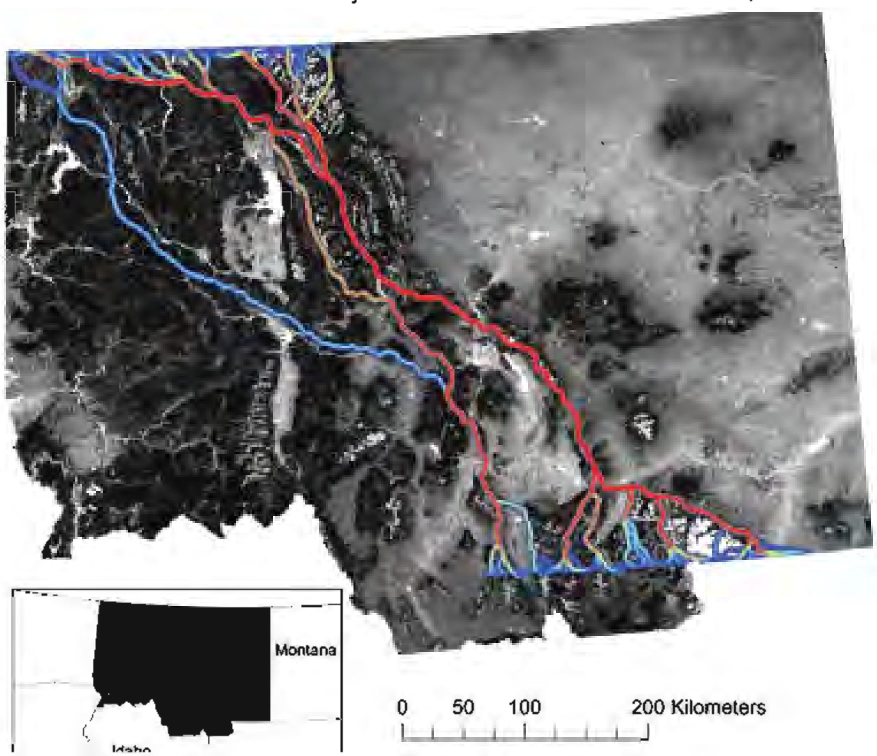
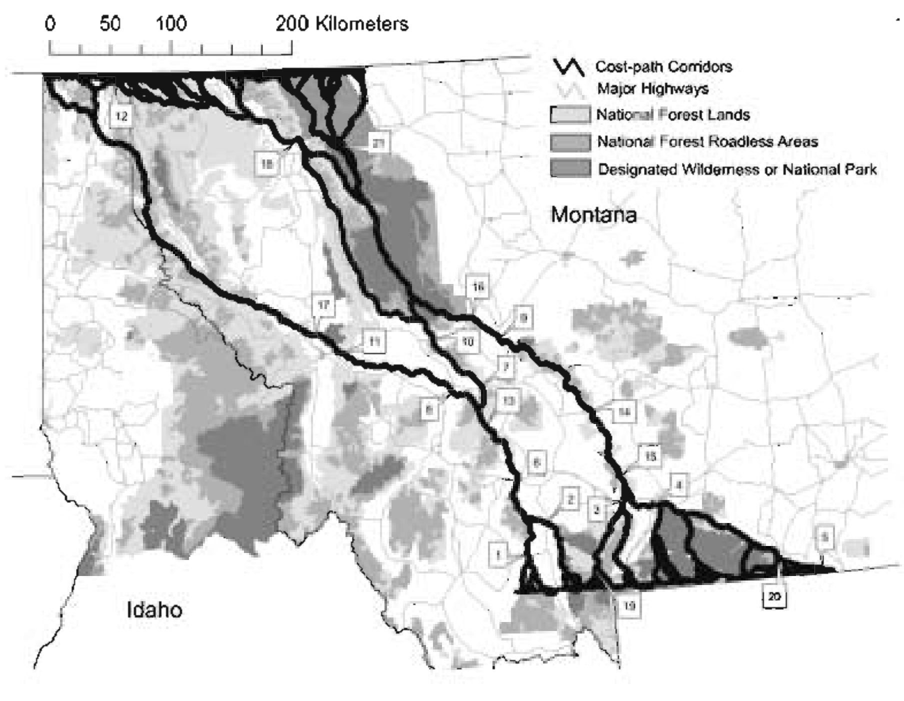


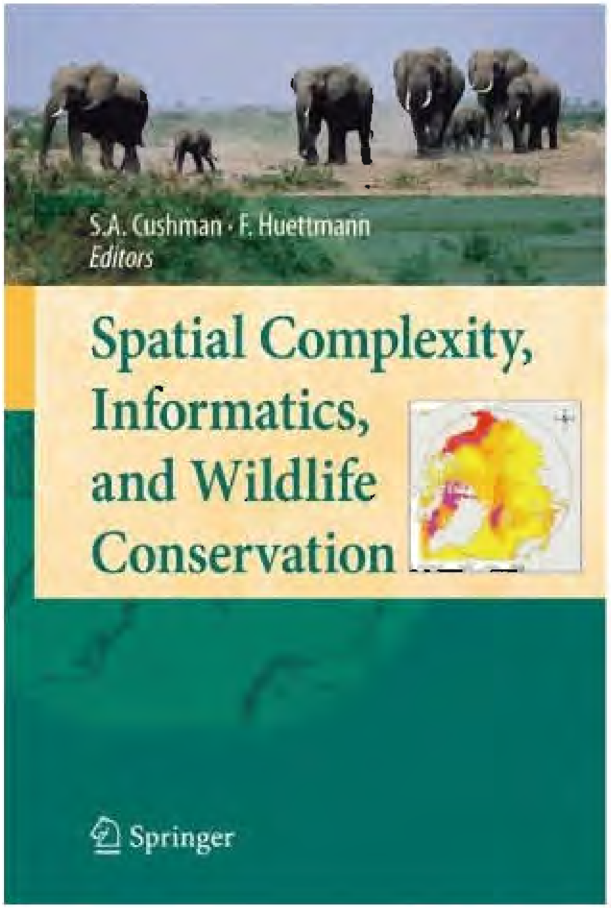


Selected Topics

- **Monitoring to support adaptive management**

Unknown Current Conditions and Unknown Trend?

- If Desired Conditions are specified in detail with quantitative benchmarks at appropriate scales:
- How do we assess current conditions and assess trend over time.
- Assessing current condition and trend relative to desired conditions is the foundation of adaptive management.



Chapter 6
Data on Distribution and Abundance: Monitoring for Research and Management

Samuel A. Cushman and Kevin S. McKelvey

- **A Technical Guide for Monitoring Wildlife Habitat**

Chapter 5. Using Habitat Models for Habitat Mapping and Monitoring.

Cushman, Mersman, Moisen, McKelvey, Vojta

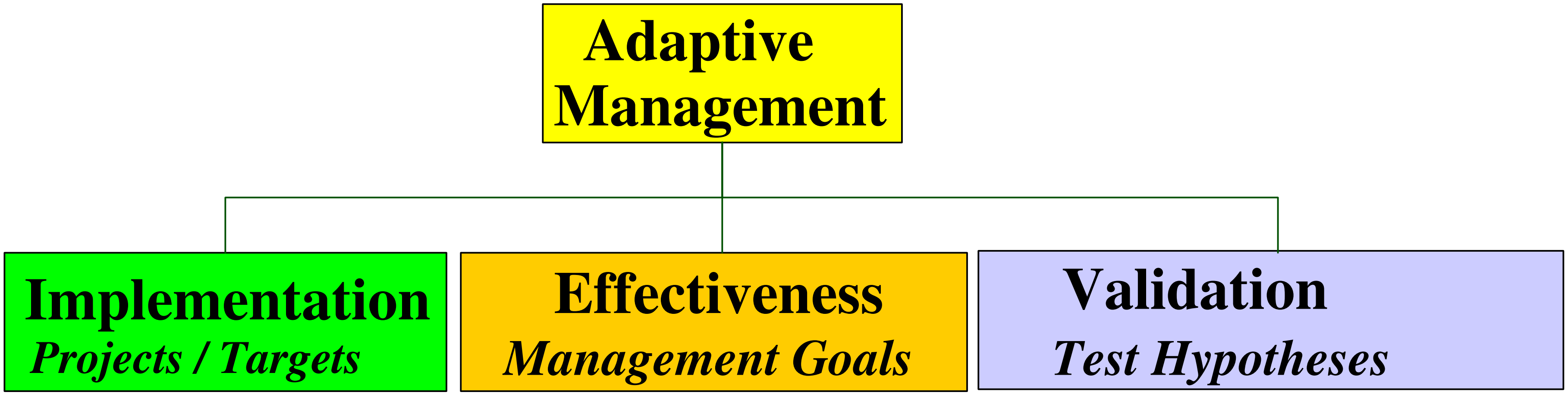
Chapter 6: Protocols for Landscape Analysis.

Cushman, McGarigal, McKelvey, Regan, Vojta

Essential Characteristics of Monitoring

- **Representative data**
- **Recent data**
- **Large samples**
- **Appropriate spatial scale**
- **Standardized protocols**
- **Statistical power**
- **High precision**
- **Resources themselves or strong proxies**
- **Long term**
- **Cost effective**

The Three Pillars of Monitoring



- Monitoring is foundation of adaptive management
- "This final Rule prioritizes Agency resources to monitoring" 2005
- Adaptive management requires timely, representative, precise monitoring