Developing a Tool to Assess Wildlife Species Vulnerability to Climate Change

Karen E. Bagne
Deborah M. Finch
Rocky Mountain Research Station
Albuquerque, NM

RMRS
ROCKY MOUNTAIN RESEARCH STATION

FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE

Cooperators

- The Nature Conservancy
- University of Arizona
- Forest Guild
- US Forest Service Southwest Region
- Arizona State University Polytechnic
- U.S. Fish and Wildlife Service
- New Mexico Game and Fish?
- Department of Defense?

Team Members

- Deborah Finch (RMRS)
- Karen Bagne (RMRS)
- Carolyn Enquist (TNC)
- David Gori (TNC)
- Lisa Graumlich (U of A)
- Jack Triepke (USFS)
- Howard Gross (FG)
- Heather Bateman (ASU)
- Darin Law (U of A)
- Megan Friggens (RMRS/NAU)

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2. Bosque Improvement Grant = $19,084
3. RJ/KOSE with TNC = $?
4. DoD Legacy Proposal = $ 115,529

Climate Change Evidence

- Mounting evidence for 20th century climate change, including biotic species responses (e.g., polar bear, pika, frogs)
- Convincing models of future climate change (e.g., Nielson et al)
- Suggestive evidence of a potential extinction crisis resulting from climate change (e.g. Thomas et al).

Climate Change Effects on Species

- Shifting Habitats / Spp. Distributions
- Altered Migration Dates
- Interrupted Corridors
- Earlier Breeding
- Reduced Snow Pack, Glaciers & Sea Ice
- Desiccation & Heat Stress

Climate Change in the Southwest

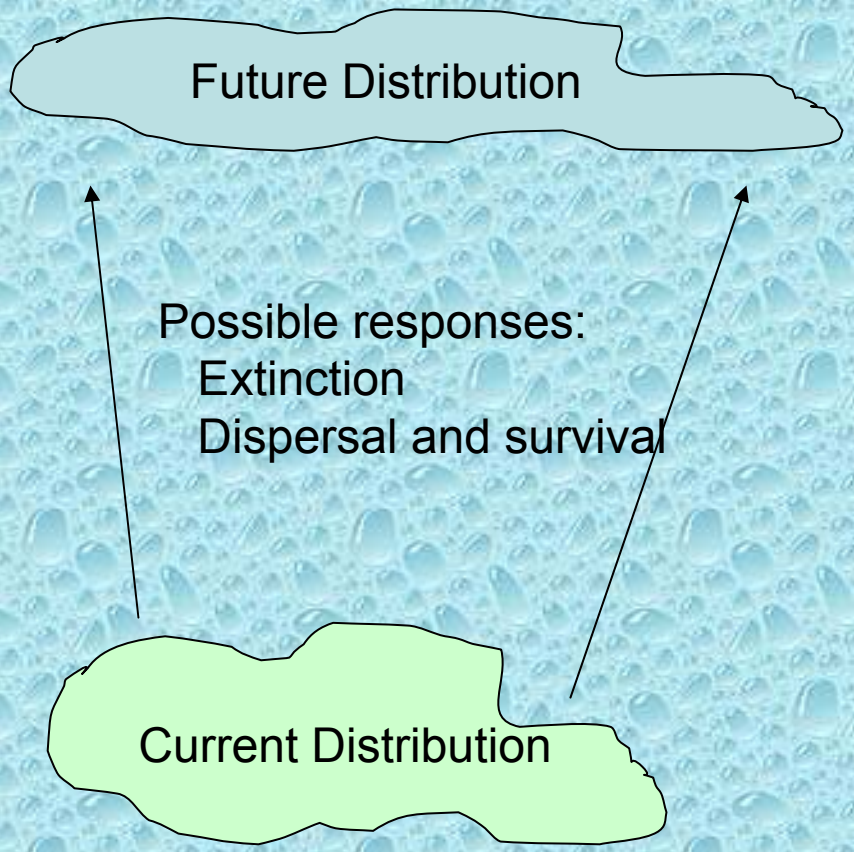
- More frequent drought
- Warmer temperatures
- More evaporation
- Earlier snow melt and reduced snow pack
- Drying of wetlands, rivers and streams
- Potential loss of rare habitats and species
- Shifts in spp. altitudinal distributions
- Expanding human populations

The Challenge of Management under Climate Change

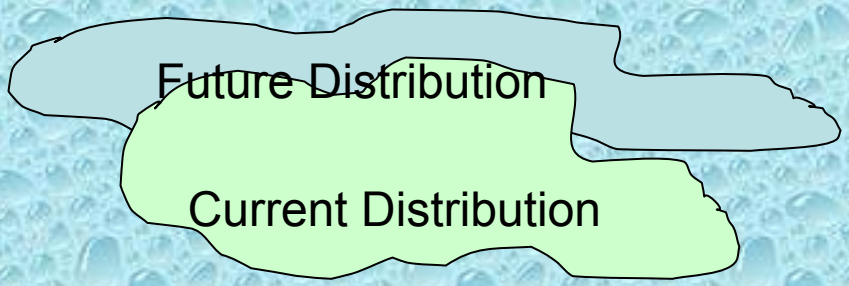
- Effects on habitats & species uncertain
- Climate models vary in predictions
- Large numbers of species at risk
- Change occurring rapidly
- Complex organisms & communities
- Tools needed to manage affected spp.
- Highest priorities are unknown
- Management costs are unclear

Extinction Threats

10 km



1000 km



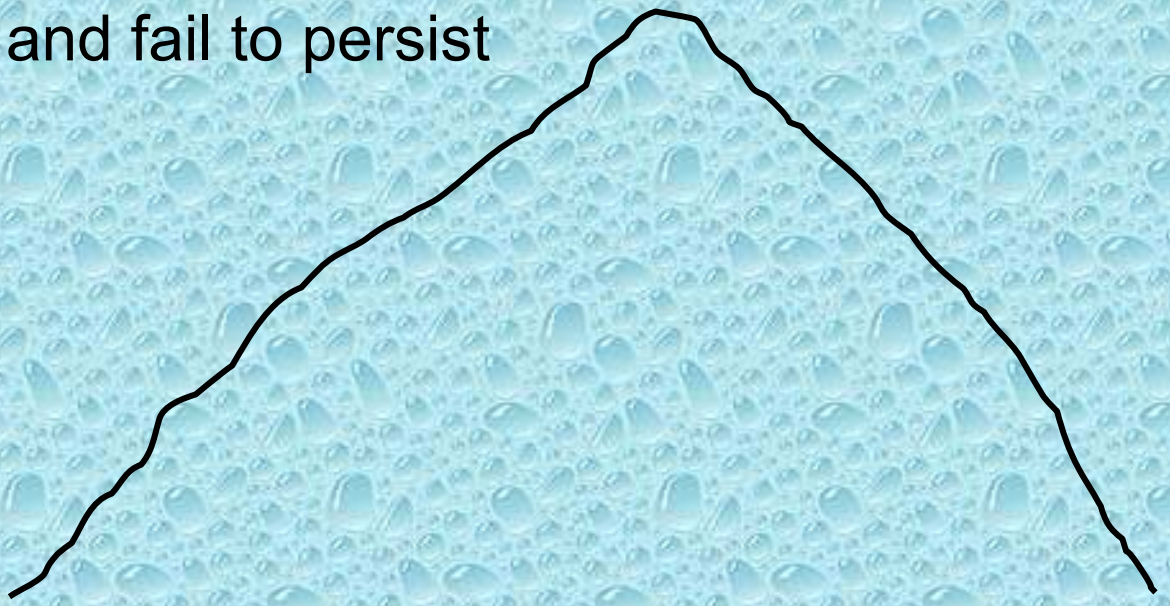
Possible responses:
range shrinkage to overlapping region
dispersal and saturation

Management Action Choices?

- In response to changing climate, do we:
  - Redistribute managed ecosystems? (*a new restoration ecology paradigm*)
  - Manage ecosystem properties (e.g., disturbance) to facilitate community change (e.g., changing fire regimes)? (*ecological engineering*)
  - Introduce species to new locations in order to alleviate dispersal limitations and keep pace with climatic shifts? (***assisted migration***)

The classic montane example

Warming pushes species up of the top of mountains, they lose habitat and fail to persist



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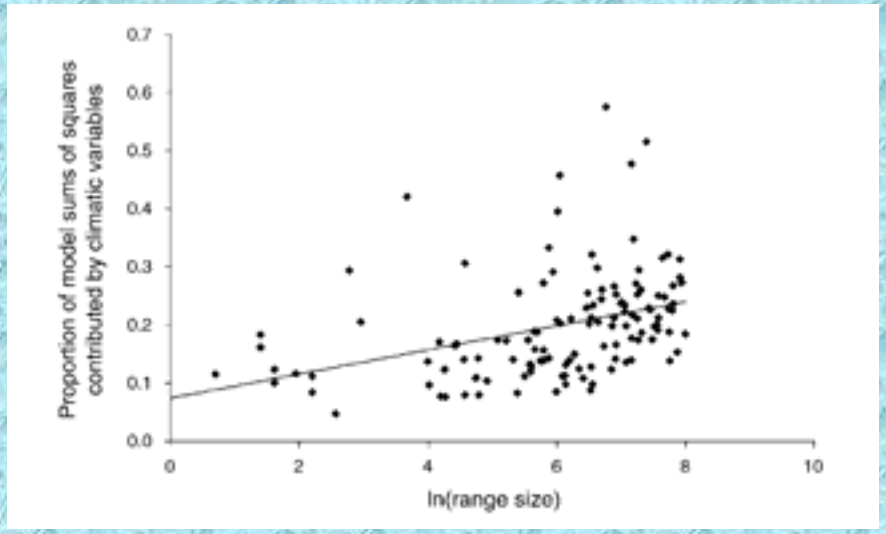
PREDICTING EXTINCTIONS AS A RESULT OF CLIMATE CHANGE

MARK W. SCHWARTZ,[1,5] LOUIS R. IVERSON,[2,3] ANANTHA M. PRASAD,[2] STEPHEN N. MATTHEWS,[2,3,4] AND RAYMOND J. O'CONNOR[4]

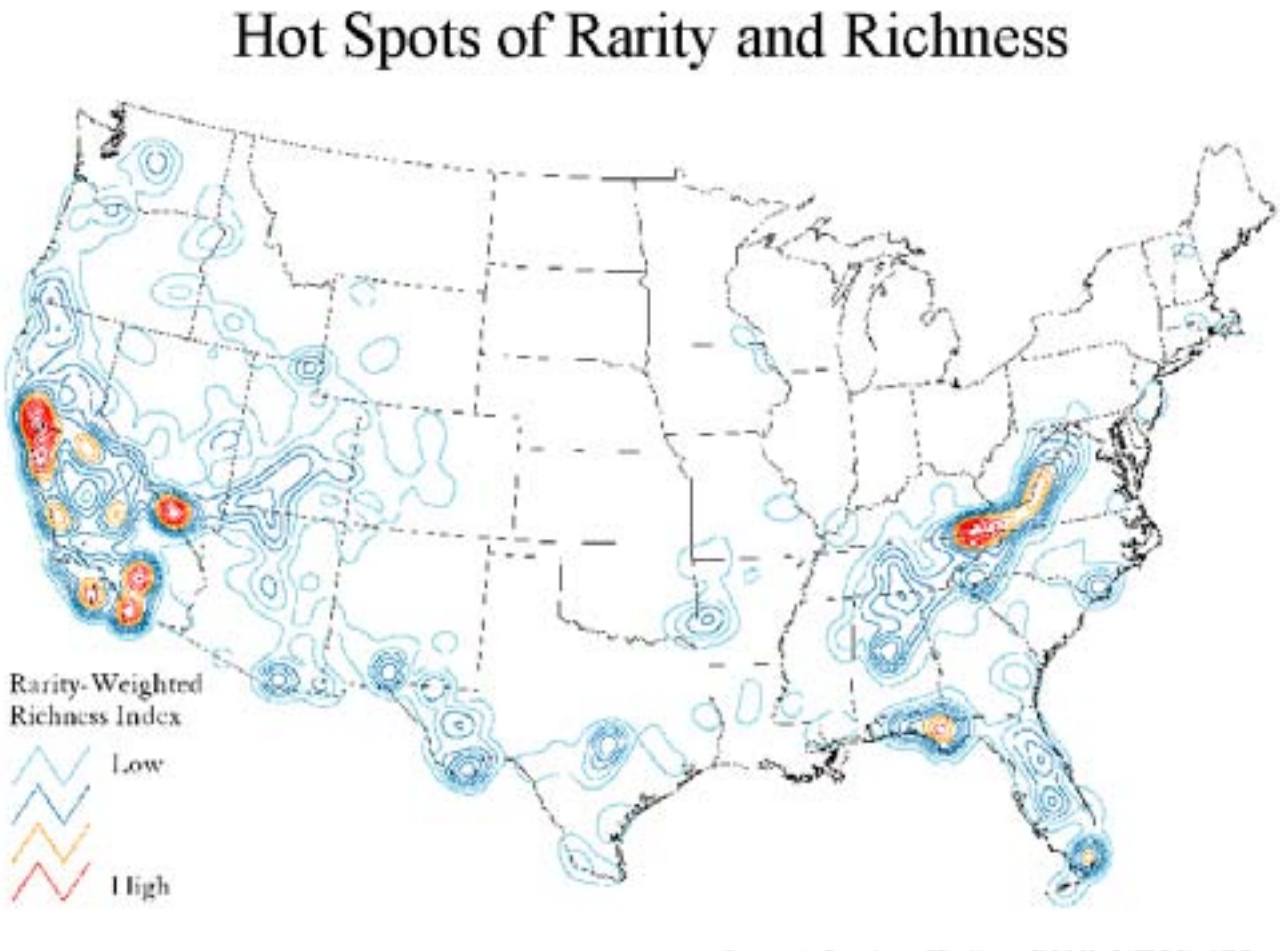
[1]*Department of Environmental Science and Policy, University of California, Davis, California 95616 USA*
[2]*USDA Forest Service, Northeastern Research Station, Delaware, Ohio 43015 USA*
[3]*School of Natural Resources, Ohio State University, Columbus, Ohio 43210 USA*
[4]*Department of Wildlife Ecology, University of Maine, Orono, Maine 04469-5755 USA*

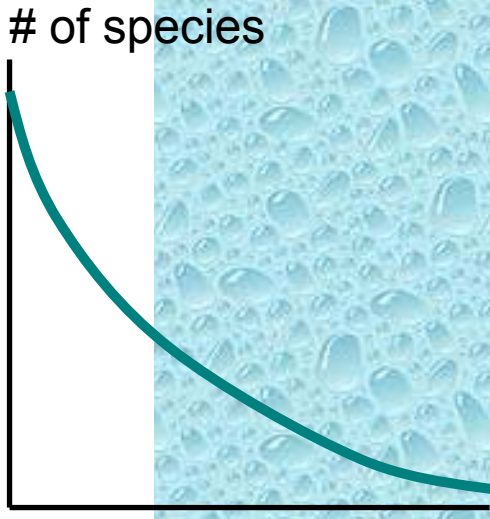
Three main points.

1. Species with narrow distributions have poor model fit (poorer prediction)
2. Climate plays less of a role in predicting distributions in species with smaller distributions
3. All species have some climatic constraints. We don't know for certain what they are in most cases. The more narrowly distributed a species is, the less likely that it is climate that constitutes a proximate constraint to distribution, making prediction uncertain



The problem of 'giving up' on species (triage) modeled to be 'committed to extinction' may be as extensive a problem as losing species to warming





Predicting Vulnerability

Already broad predictions of vulnerable groups where changes are predicted to be greatest:

1. Polar species
2. High elevation species
3. Coastal species

RMRS Proposal Strategy

1. Identify vulnerable species: scoring
2. Prioritization: vulnerability + laws + economics + feasibility
3. Identify management options: available tools and new strategies

⇨ Planning: priority and anticipatory actions

Species Assessments

- Synthesis of factors related to vulnerability
- Ability to integrate complex information
- Ranking and prioritization
- Example: Partners In Flight
- None available for climate change

Tool Development Issues

- Variation in climate predictions
- Quantitative vs. qualitative data
- Anticipating an unknown future
- Large numbers of potential traits
- Complex biological interactions

Dealing with Uncertainty

- Include uncertainty with scores
- Flexible system to integrate new information
- Identify areas where research is needed

From Moss and Schneider

Scoring Strategy

- How is fitness related to temperature and moisture?
- Identify factors related to vulnerability
  - Identified
  - Predicted
- Components for each factor related to prediction
- Integrate regional climate projections
- Literature search
- Expert opinion

Factors

Habitat

Breeding

Non-breeding

Organismal Biology

Physiology

Phenology

Interspecific Interactions

Potential for Resilience

Resilience Traits

Current Vulnerability

Habitat

- Shifts in habitat area, distribution, and quality
- Loss of habitat elements
- Alterations due to disturbance
- Exposure to extreme weather
- Snowpack and ice

Organismal Biology: Physiology

- Temperature tolerances
- Moisture tolerances
- Hibernation/torpor
- Temperature-mediated sex ratios
- Coping with extreme weather

Organismal Biology: Phenology

- Timing of activities matched to key events
- Alteration of cues related to temperature and moisture
- Potential for mismatch

Interspecific Interactions

- Predator/Prey interactions
- Symbionts
- Competition
- Introduced species

Potential for Resilience

- Resilience traits
  - Dispersal ability
  - Behavioral and phenotypic plasticity
  - Alternative life history strategies

- Current vulnerability
  - Potential for Allee effects
  - Current population status
  - Proximity to growing human populations

Example of Scoring

1. Does this species use temperature or moisture cues to initiate activities related to fecundity or survival?

   YES NO

2. Is timing of activities related to fecundity or survival known to coincide with the timing of other events (i.e. insect outbreaks, warm weather, etc.)?

   YES NO

3. Timing closely tied to events OR breeding attempts/yr ≤ 1

   YES NO

4. Species eruptive of opportunistic breeder?

   YES NO

Example of Scoring

1. Does this species use temperature or moisture cues to initiate activities related to fecundity or survival?

   YES = 1 if cues expected to change NO = no score go to 4

2. Is timing of activities related to fecundity or survival known to coincide with the timing of other events (i.e. insect outbreaks, warm weather, etc.)?

   YES = go to 3 NO = go to 4

3. Timing closely tied to events OR breeding attempts/yr ≤ 1

   YES = 1 NO = 0

4. Species eruptive of opportunistic breeder?

   YES = -1 NO = 0

Score = 21

Scoring Limitations

- Accuracy of regional climate predictions
- Unforeseen effects
- Lack of quantitative data
- Limited by available information
- Relative influence of factors (weighting problems)
- Limited in selection of complex interactions

Next Steps

- Test and finalize scoring
- Apply scoring regionally
- Guide to setting priorities
- Integrate with spatial information
- May workshop: management options (sign up on email list)