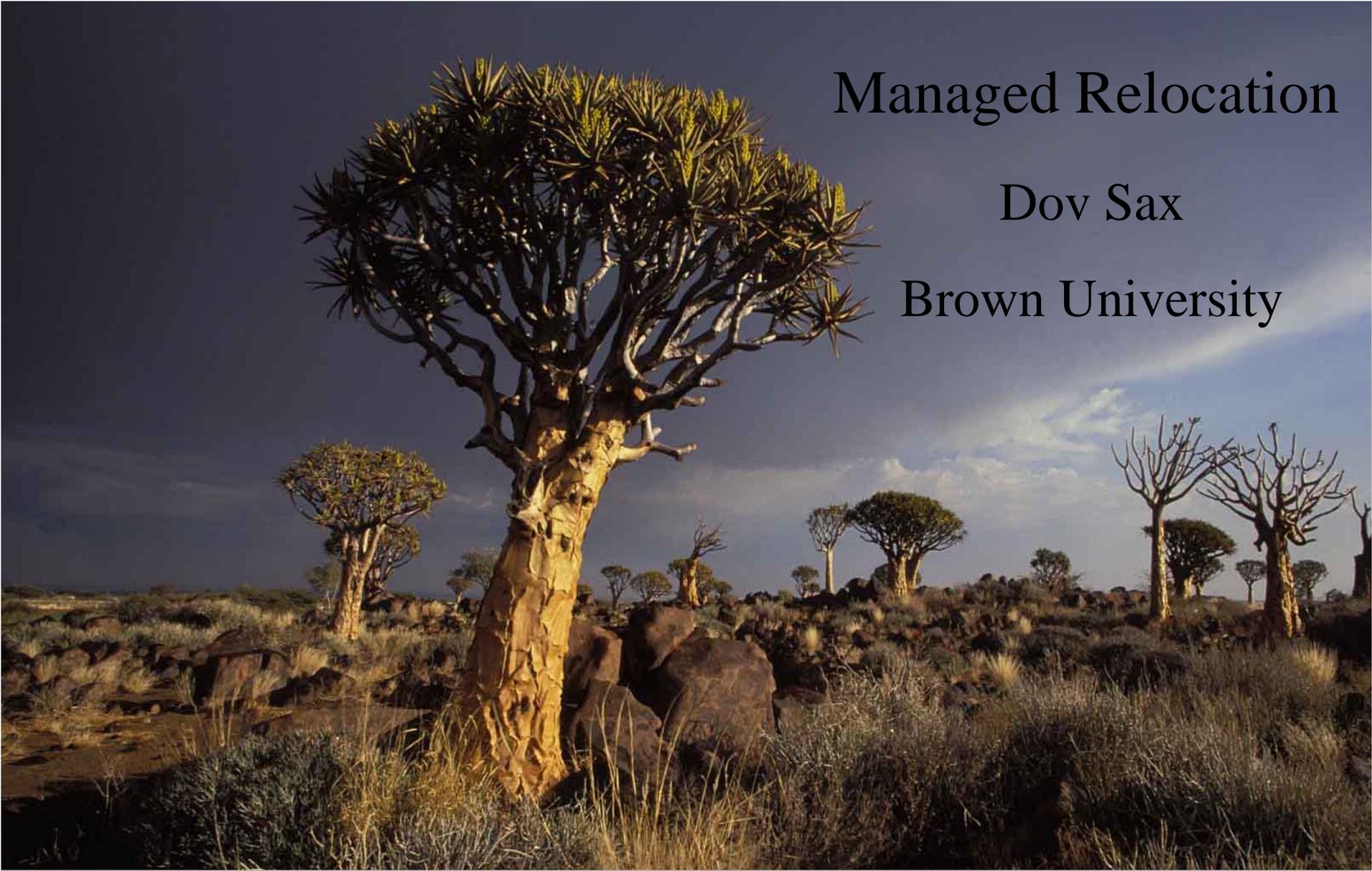


Managed Relocation

Dov Sax

Brown University



Managed Relocation

Dov Sax

Brown University

Managed Relocation =
Assisted Migration = Assisted Colonization

Collaborators: Working Group on Managed Relocation



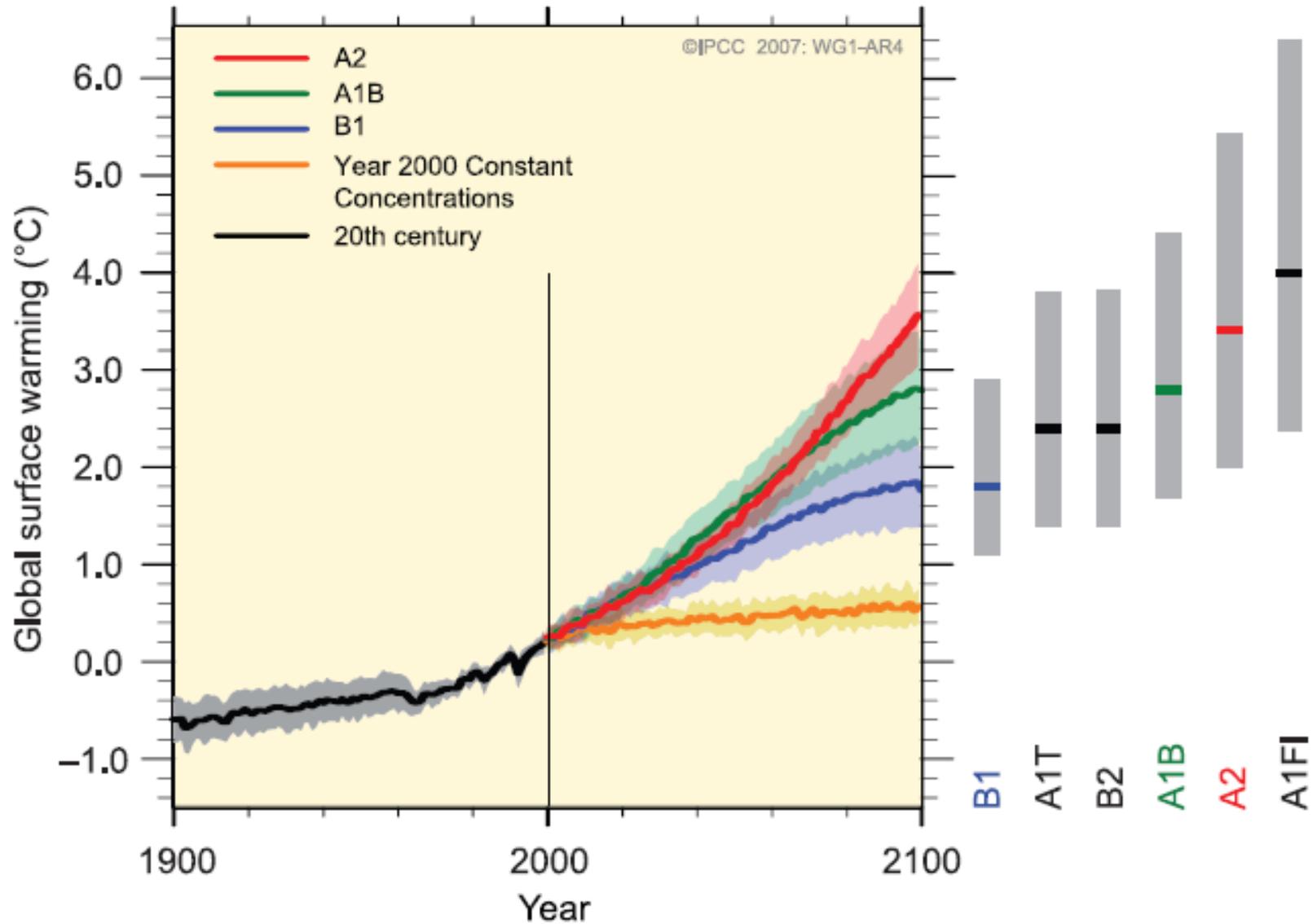
Collaborators:

Working Group on Managed Relocation



Natural and social scientists, ethicists, lawyers
Academia, NGOs & Government

MULTI-MODEL AVERAGES AND ASSESSED RANGES FOR SURFACE WARMING



What does this mean for species extinction?

What does 3 or 4 degree temperature change mean?

Last Ice-age: 4 degrees colder than today

What happened to existing habitats?

How did species respond?

Not just climate shifts – but radical changes:

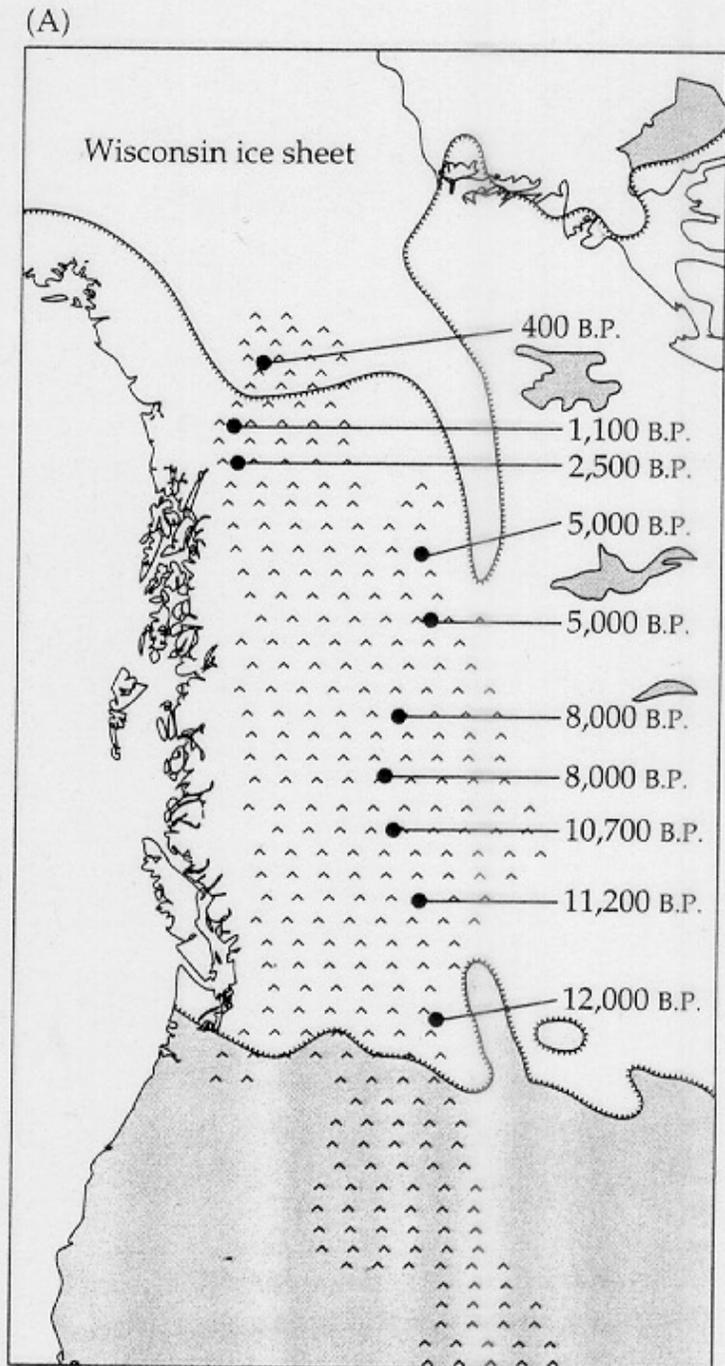
Death Valley

Now

Then



The lodgepole pine (*Pinus contorta*) migrating as the glacier retreated



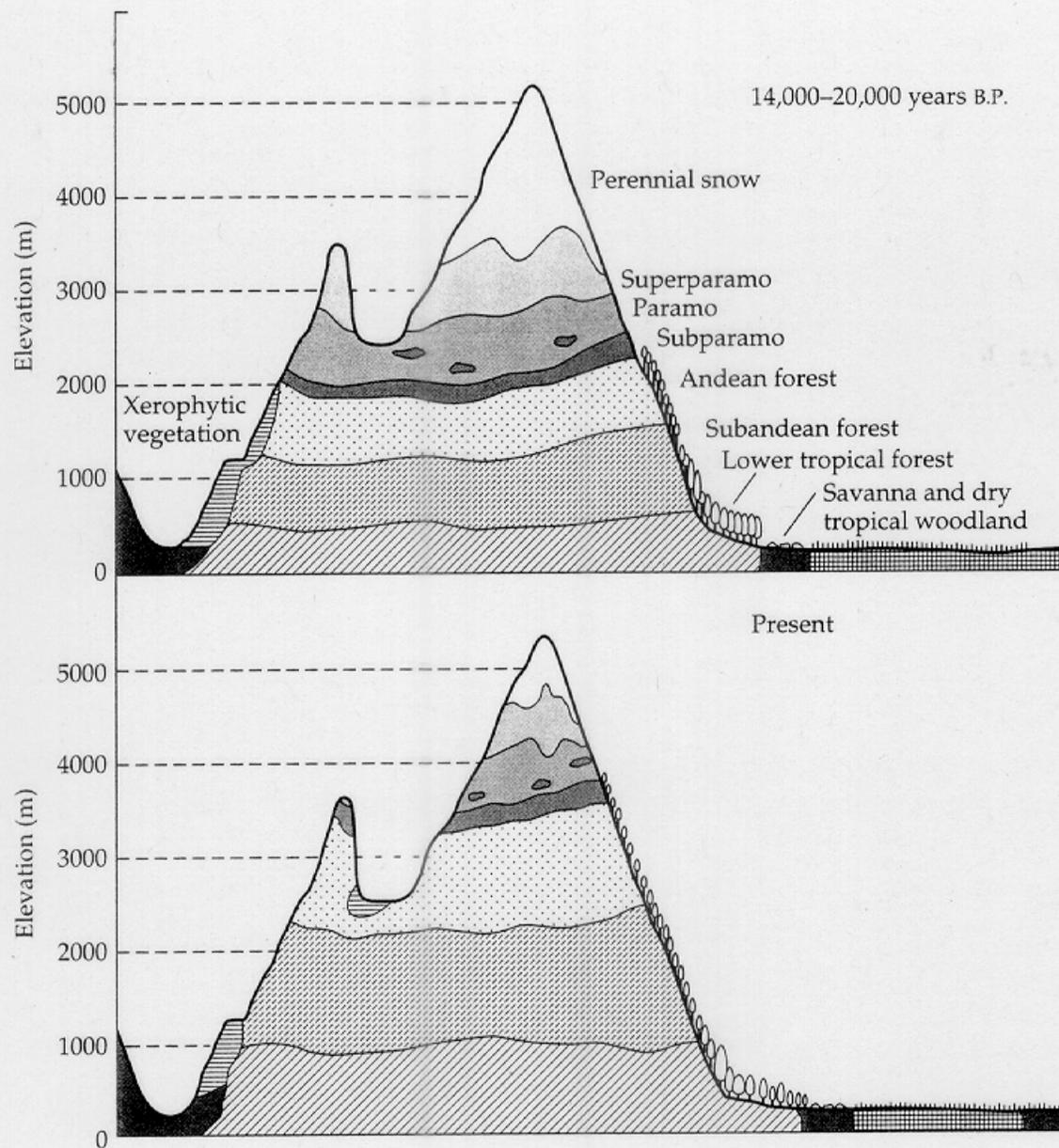
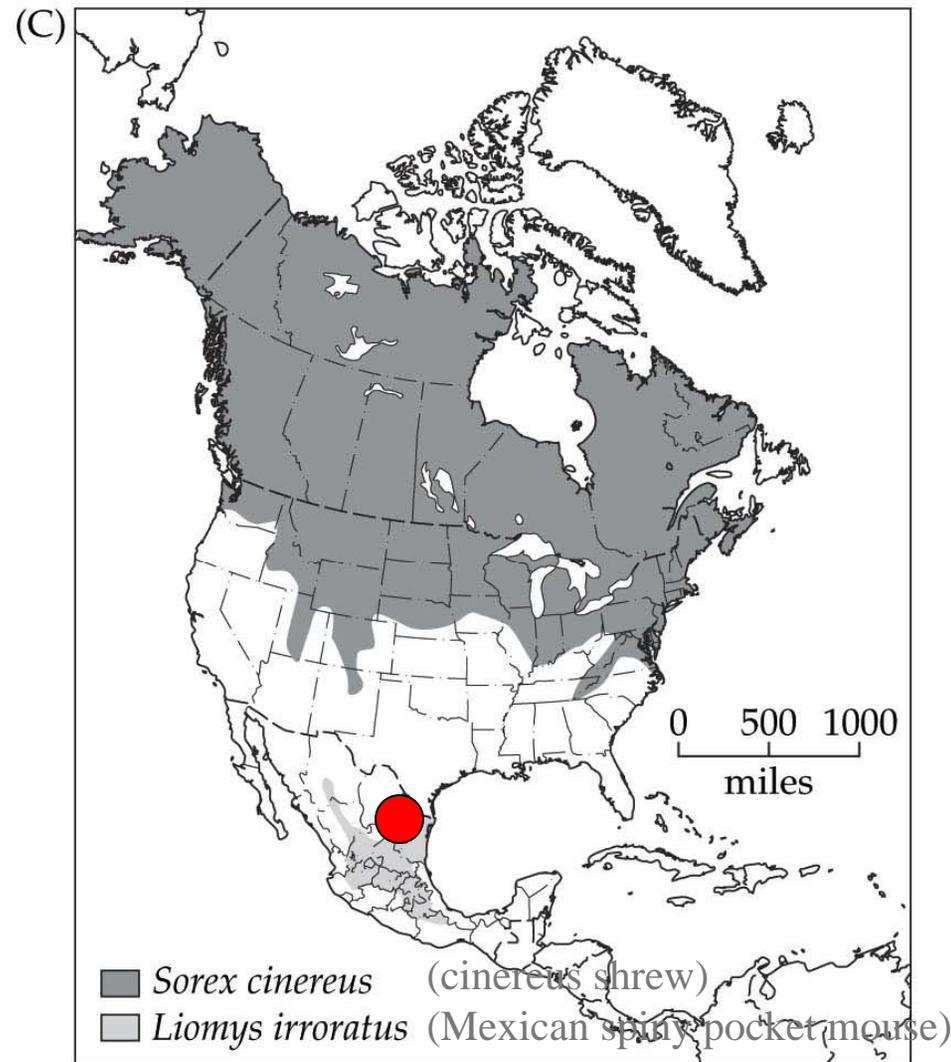


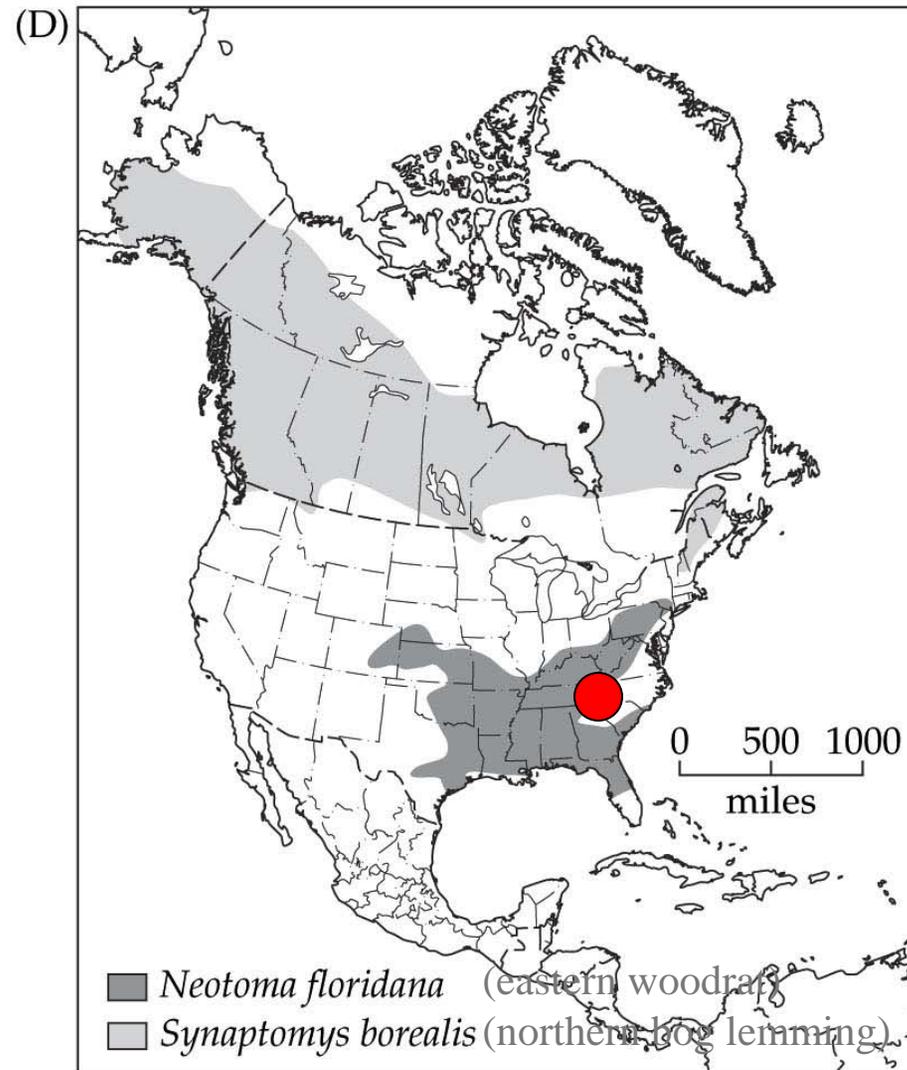
Figure 7.15 Elevational shifts in vegetation zones in the eastern Cordillera of the Andes in Colombia in response to climatic change following the most recent glacial maximum. Note that while all zones tended to shift in concert, the upper zones became narrower as they shifted upward in response to global warming. (After Flenley 1979a.)

Species
shifted their
altitudinal
distributions

Some species moved great distances – others stayed put



Some species moved great distances – others stayed put



Tree diversity in North America is approximately double that of Europe. Why?

Tree diversity in North America is approximately double that of Europe. Why?

Barriers are oriented:

North-South in North America (Sierra Nevada and Rocky Mountains) and

East-West in Europe (Alps and Pyrenees Mountains; Mediterranean Sea)

Over the next century

Many species will need to shift their geographic distributions by great distances

In the modern world:

Natural barriers still exist -

Mountains, rivers, coastlines, etc.

Anthropogenic barriers are also important -

Urban sprawl and agricultural regions

Agricultural Barriers to Migration:



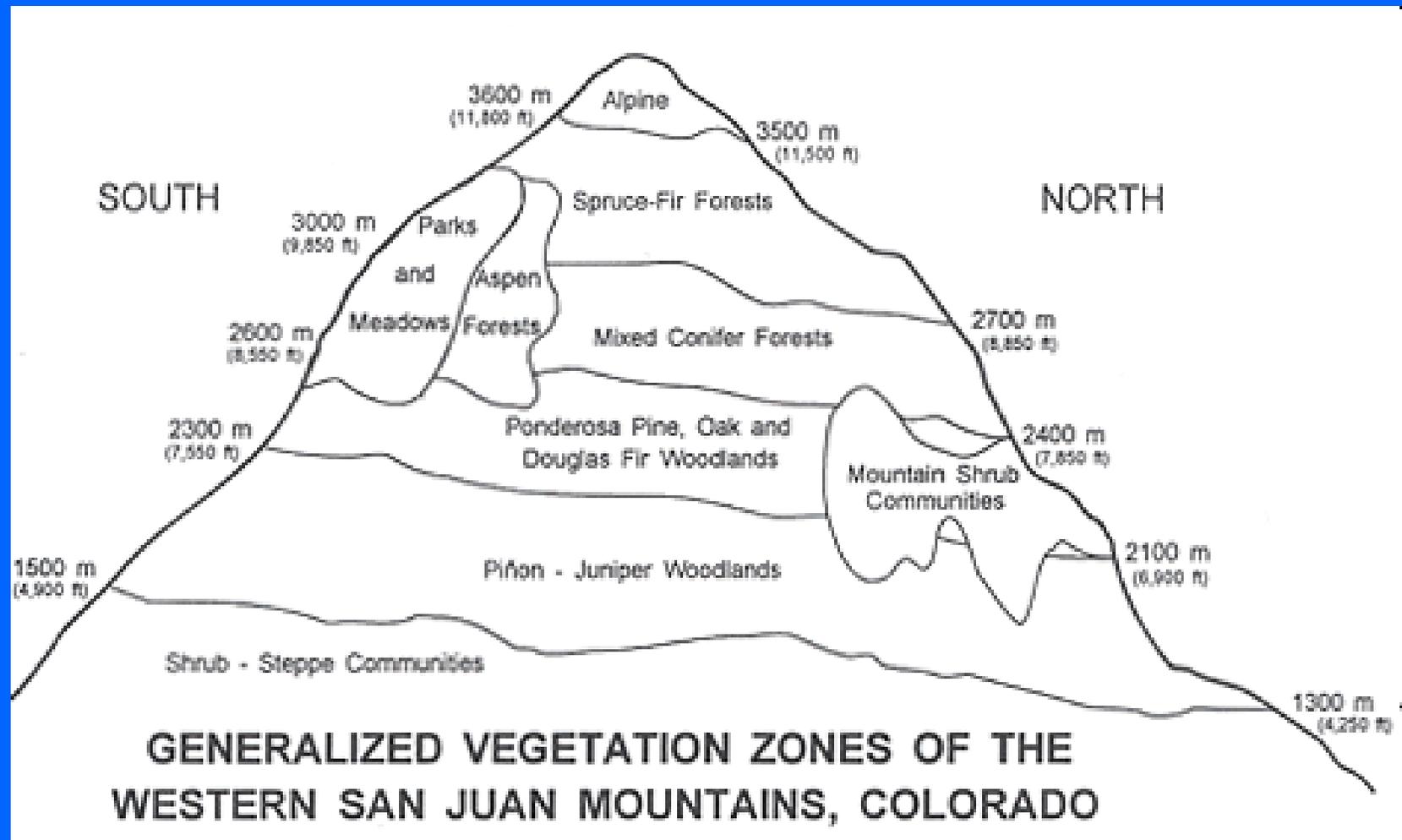
© Getmapping plc

Urban Barriers to Migration:

narrow-faced kangaroo rat



Sometimes there's no where to go!



Extinction risk from climate change

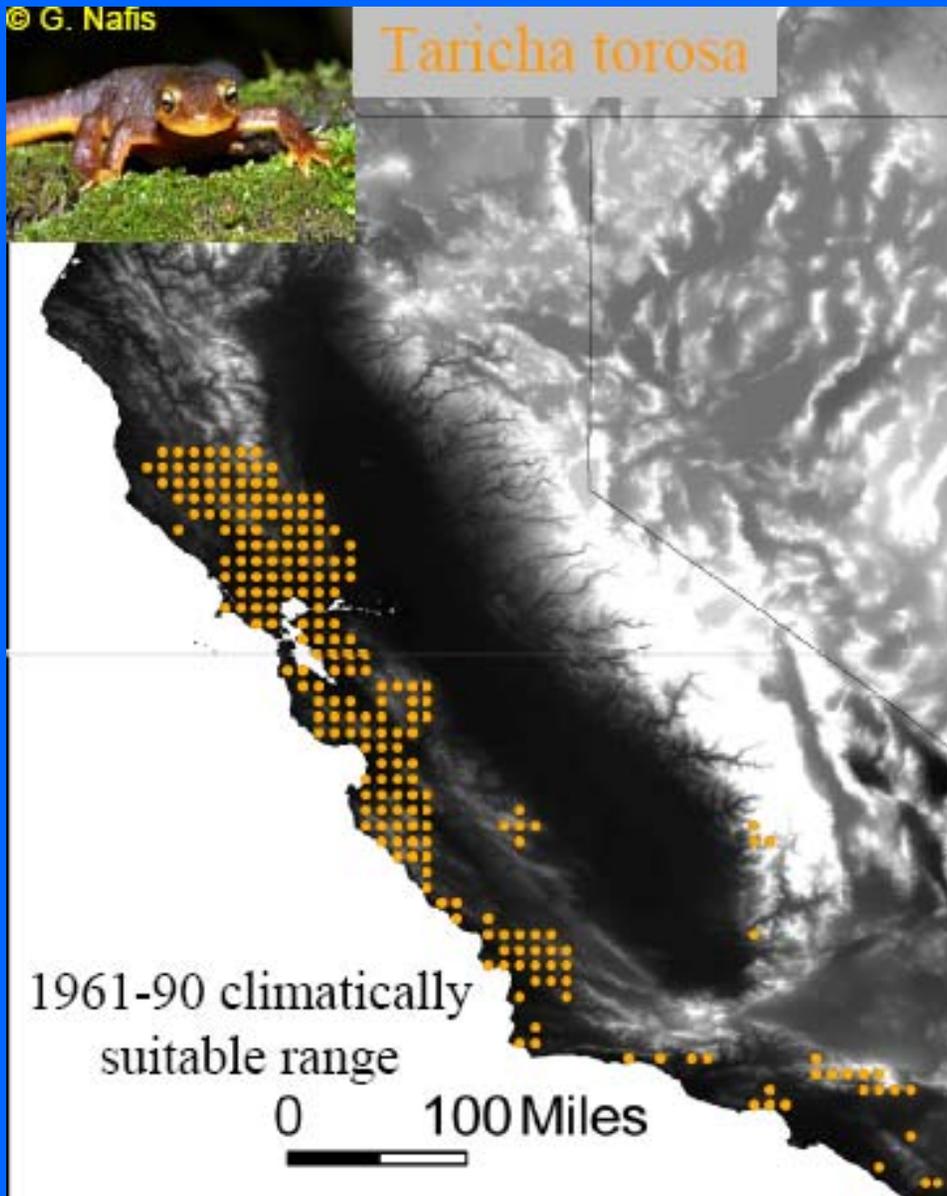
**Chris D. Thomas¹, Alison Cameron¹, Rhys E. Green², Michel Bakkenes³,
Linda J. Beaumont⁴, Yvonne C. Collingham⁵, Barend F. N. Erasmus⁶,
Marinez Ferreira de Siqueira⁷, Alan Grainger⁸, Lee Hannah⁹,
Lesley Hughes⁴, Brian Huntley⁵, Albert S. van Jaarsveld¹⁰,
Guy F. Midgley¹¹, Lera Miles^{8*}, Miguel A. Ortega-Huerta¹²,
A. Townsend Peterson¹³, Oliver L. Phillips⁸ & Stephen E. Williams¹⁴**

mid-range climate-warming scenarios for 2050

15–37% of species ‘committed to extinction’

Climate Niche/Envelope Models

Climate Niche/Envelope Models



- Building a model:
- tabulate conditions where it occurs
 - tabulate conditions where it doesn't occur
 - estimate total range of climate conditions a species can tolerate

Problems with climate niche models:

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1. We don't know how inaccurate they are

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1. We don't know how inaccurate they are
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3. Many species are dispersal-limited

In some cases the only way to save species may be to move them beyond their historic distribution

Literature History/Summary:

A Framework for Debate of Assisted Migration in an Era of Climate Change 2007

JASON S. McLACHLAN,^{*†‡} JESSICA J. HELLMANN,[†] AND MARK W. SCHWARTZ^{*}

Assisted Colonization and Rapid Climate Change 2008

O. Hoegh-Guldberg,^{1*} L. Hughes,² S. McIntyre,³ D. B. Lindenmayer,⁴ C. Parmesan,⁵
H. P. Possingham,⁶ C. D. Thomas⁷

Literature History/Summary:

Assisted colonization is not a viable conservation strategy 2009

Anthony Ricciardi¹ and Daniel Simberloff²

Managed relocation: a nuanced evaluation is needed

Dov F. Sax¹, Katherine F. Smith¹ and Andrew R. Thompson^{2*} 2009

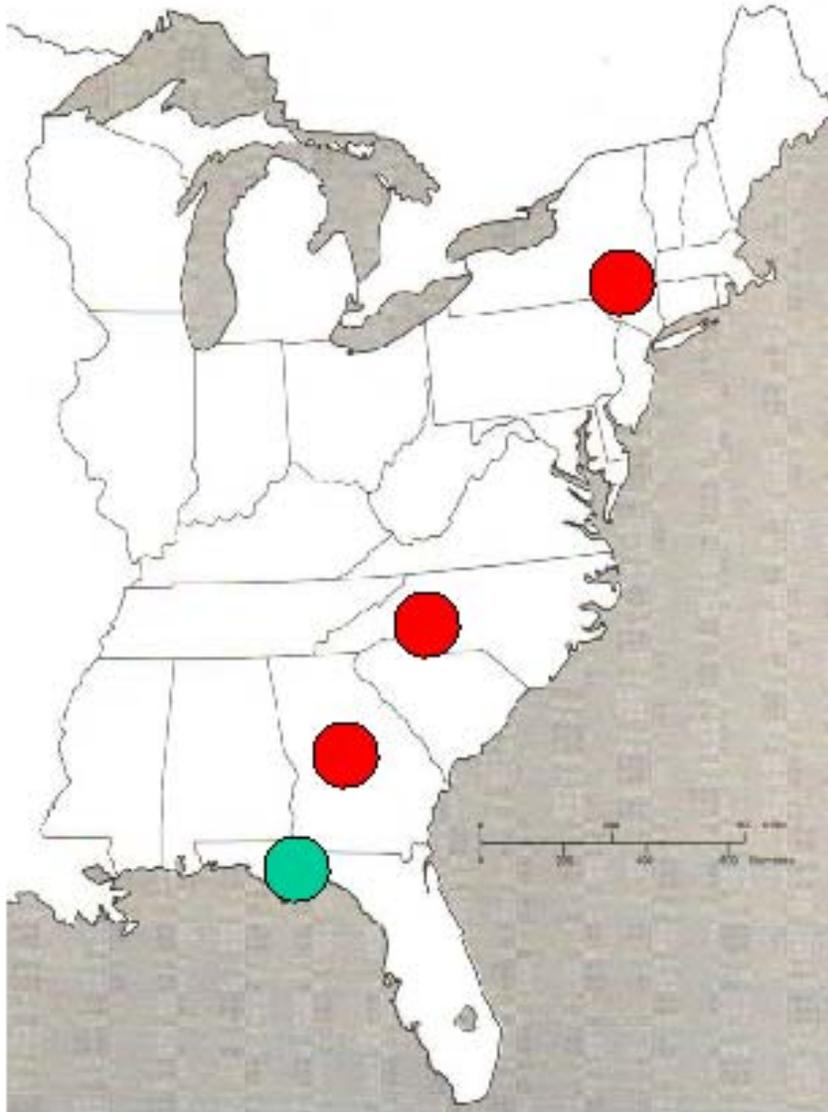
One central tension of managed relocation:

If we move species they may become invasive

If we don't move species they become extinct

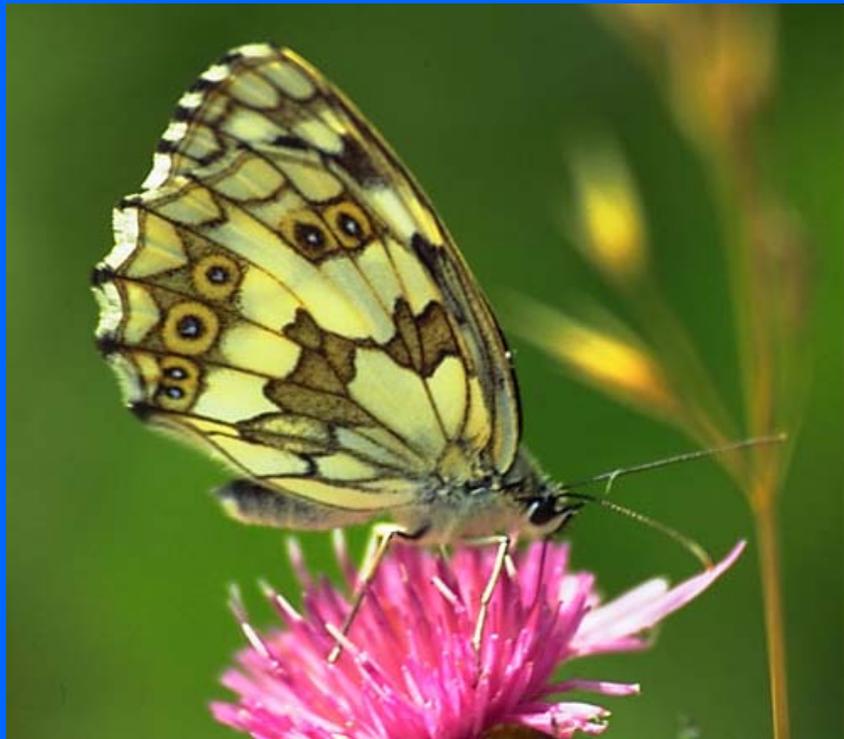
Who is doing managed relocation?

Torreya taxifolia and the ‘Torreya Guardians’:

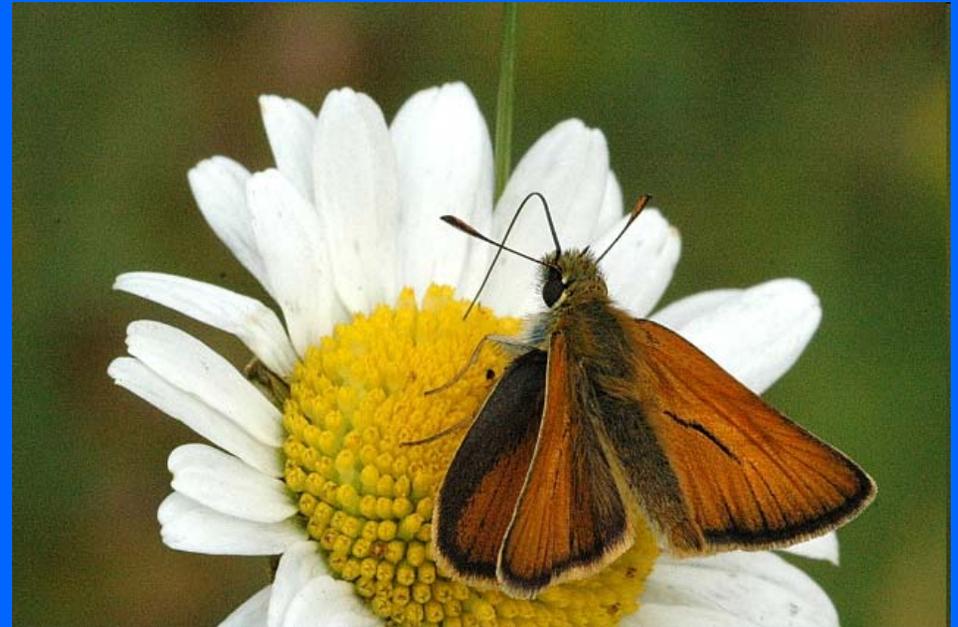


Assisted colonization in a changing climate: a test-study using two U.K. butterflies

Stephen G. Willis¹, Jane K. Hill², Chris D. Thomas², David B. Roy³, Richard Fox⁴, David S. Blakeley⁵, & Brian Huntley¹



Marbled White
Melanargia galathea



Small skipper
Thymelicus sylvestris

Evaluation and visualization tool –

First product of our working group

Available at

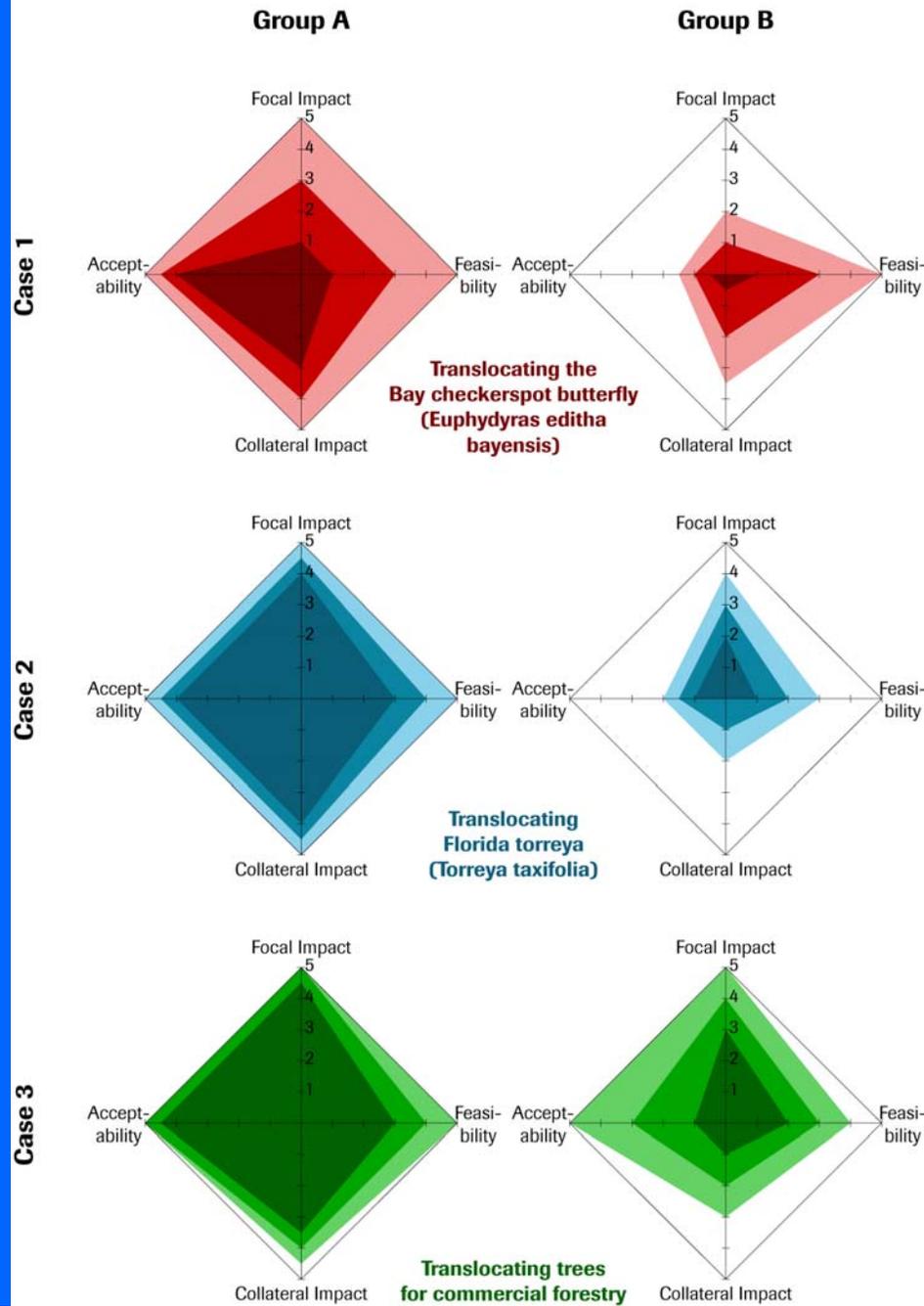
<http://www.pnas.org/content/106/24/9721.abstract>

Four Classes of Criteria for Evaluation:

1. Focal Impact: impact on focal unit and its community from climate change and exacerbating effects of MR
2. Collateral Impact: effect of focal unit in recipient region
3. Feasibility: constraints on or opportunities for MR
4. Acceptability: societal willingness to pursue MR

	Ecological Criteria	Social Criteria
1. Focal Impact: impact on focal unit and its community from climate change and exacerbating effects of MR	<p>a. Likelihood of outcome:</p> <ul style="list-style-type: none"> --- extinction --- decline in geographic distribution --- decline in abundance within geographic distribution ---- indirect effects of decline on community members and community composition <p>b. Consequence of outcome:</p> <ul style="list-style-type: none"> --- uniqueness (phylogenetic, functional, etc.) --- geographic distribution (common versus rare; small versus large range) --- the potential for reversibility (e.g., if no action were taken and the species went extinct in the wild, are there <i>ex situ</i> individuals available for population re-establishment) 	<p>Likelihood and consequence of outcome:</p> <ul style="list-style-type: none"> --- cultural importance of the target and its community (e.g., is the target a flagship or iconic species? is the historic integrity of the community important?) --- equity of the impact on particular groups of people --- concerns about the harm to individual organisms subjected to MR --- financial loss if focal unit declines in abundance or goes extinct

Figure 1



Whitepaper –

Comprehensive treatment of the topic

- Identify key research gaps
- Make key policy recommendations

Due out this summer

Managed Relocation?

