PRESERVING BIODIVERSITY: ANY MESSAGES FOR CLIMATE POLICY MAKING?

First, complex systems are never fully understood—especially coupled human-natural systems—thus we will have aspects of knowledge that are well established, others best categorized as competing explanations and yet others in the speculative realm. We have all three present in our estimation of climate changes, and I will briefly highlight a few in each category. Second, the impacts of climate on biodiversity is a synergistic interaction of the rate and magnitude of climate changes along with other disturbances like land fragmentation and invasives, which together determine the threatened status of some species. Third, to adapt to such threats takes action on several fronts: habitat restoration, sufficient reserves, migration corridors and, yes, more controversially, some managed relocation of priority species—the latter being a very divisive normative debate. Finally, there is mitigation, the reduction of exposure of species to climatic changes, and these can be complementary to adaptation activities. Unlike some of my economist friends who see adaptation and mitigation as tradeoffs, I see them as complements. That is, we must adapt to what we can't mitigate and mitigate what we can't adapt to. To define the latter we need bottom up studies of individual systems to define "dangerous thresholds", which in turn can help to define needed levels of mitigation. I think that is about all I'll possibly be able to squeeze into 20 minutes—though I talk fast! Let me know if any of you have suggestions to modify any of this. Cheers, Steve
Stephen H. Schneider*

Melvin and Joan Lane Professor for Interdisciplinary Environmental Studies,
Professor, Department of Biology
Senior Fellow, Woods Institute for the Environment
Stanford University

PRESERVING BIODIVERSITY: ANY MESSAGES FOR CLIMATE POLICY MAKING?

*[Website for more info: climatechange.net.]*
Is the Science “Settled”?
Is The Science “Settled”?

-Well-established components
Is The Science “Settled”?

- Well-established components
- Competing Explanations
Is The Science “Settled”? 

- Well-established components
- Competing Explanations
- Speculative components
The great “greenhouse gamble”…

Source: MIT Joint Program on the Science and Policy of Climate Change
Little adaptive capacity

<table>
<thead>
<tr>
<th>Temperature Range</th>
<th>Probability</th>
<th>Odds</th>
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</thead>
<tbody>
<tr>
<td>&lt;1°C</td>
<td>4.1%</td>
<td>1 in 24</td>
</tr>
<tr>
<td>1 to 1.5°C</td>
<td>11.4%</td>
<td>1 in 9</td>
</tr>
<tr>
<td>1.5 to 2°C</td>
<td>20.6%</td>
<td>1 in 5</td>
</tr>
<tr>
<td>2 to 2.5°C</td>
<td>22.5%</td>
<td>1 in 4</td>
</tr>
<tr>
<td>2.5 to 3°C</td>
<td>16.8%</td>
<td>1 in 6</td>
</tr>
<tr>
<td>3 to 4°C</td>
<td>16.2%</td>
<td>1 in 6</td>
</tr>
<tr>
<td>4 to 5°C</td>
<td>4.6%</td>
<td>1 in 22</td>
</tr>
<tr>
<td>&gt;5°C</td>
<td>3.8%</td>
<td>1 in 26</td>
</tr>
</tbody>
</table>

Source: MIT Joint Program on the Science and Policy of Climate Change
Some adaptive capacity

<1°C (4.1%; 1 in 24 odds)
1 to 1.5°C (11.4%; 1 in 9 odds)
1.5 to 2°C (20.6%; 1 in 5 odds)
2 to 2.5°C (22.5%; 1 in 4 odds)
2.5 to 3°C (16.8%; 1 in 6 odds)
3 to 4°C (16.2%; 1 in 6 odds)
4 to 5°C (4.6%; 1 in 22 odds)
>5°C (3.8%; 1 in 26 odds)

Source: MIT Joint Program on the Science and Policy of Climate Change
Adaptation and Mitigation are Complements, not Trade-offs!
Adaptation and Mitigation are Complements, not Trade-offs!

-Adaptation to unavoidable climate changes
Adaptation and Mitigation are Complements, not Trade-offs!

-Adaptation to unavoidable climate changes

-Mitigation of changes that are too difficult to adapt to
Hundreds Gather to Protest Global Warming
Hundreds Gather to Protest Global Warming
Cascade of Uncertainties

[Schneider, 1983]
NEED ADDITIONAL RESEARCH PARADIGM:

Not just top down—linear cascade
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Not just top down—linear cascade but bottom up: regional, sectoral and groups’ vulnerability analysis mapped to top down analyses
NEED ADDITIONAL RESEARCH PARADIGM:

Not just top down—linear cascade but bottom up: regional, sectoral and groups’ vulnerability analysis mapped to top down analyses [all in development pathways context]
Sky Islands in NM & AZ
Threatened, Endangered & Sensitive Species in SW National Forests

Animals

Plants

-- Sky Islands
Managed Relocation?

Pika

2004
9,500 ft

1900
7,800 ft
To adapt to such threats takes action on several fronts:

- habitat restoration
- sufficient reserves
- migration corridors
- and, yes, more controversially, some managed relocation of priority species (a very divisive normative debate)
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- and, yes, more controversially, some managed relocation of “priority species” (a very divisive normative debate)
IMPACTS:
A Brief Litany
“Very High Confidence” Global Warming Impacts

• North American Impacts Projected (cont’d)
  – Fire & Pest Impacts: “Disturbances from pests, diseases, and fire are projected to have increasing impacts on forests, with an extended period of high fire risk and large increases in area burned.”

IPCC, Summary for Policymakers, Working Group II Contribution to the Fourth Assessment Report, April, 2007
Wildfires Frequency increased four fold in last 30 years.

Source: Westerling et al. 2006
Extreme Events: Wildfires

Late Snowmelt Years
- Fewer, smaller fires

Early Snowmelt Years
- More, larger fires

Westerling
Diminishing Sierra Snowpack

% Remaining, Relative to 1961-1990

- 2020-2049
  - Lower Emissions: 74% remaining
  - Higher Emissions: 60% remaining

- 2070-2099
  - Lower Emissions: 27% remaining
  - Higher Emissions: 11% remaining

Remaining Snowpack (%)

100  80  60  40  20  0
Wine Grape Quality
Temperature Impacts

Wine Country (Sonoma, Napa Counties)
Cool Coastal (Mendocino, Monterey Counties)
Northern Central Valley (San Joaquin, Sacramento Counties)
## Decreasing Wine Grape Quality

### Temperature Impacts

<table>
<thead>
<tr>
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<td>Marginal</td>
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**Wine Country** (Sonoma, Napa Counties)

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<td>PCM</td>
<td>HadCM3</td>
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<tr>
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**Wine Country (Sonoma, Napa Counties)**

**Cool Coastal (Mendocino, Monterey Counties)**

**Northern Central Valley (San Joaquin, Sacramento Counties)**
Type of Changes

- Range Shifts
- Phenology Shift
- Other Shifts
- Extinction
Type of Changes

- Range Shifts:
  - Poleward
  - Up in Elevation
• and 1,100 heat related deaths per year

Source: Climate Change Health Impacts in Australia, ACF & AMA
• and 8,000 - 15,000 heat related deaths per year

Source: Climate Change Health Impacts in Australia, ACF & AMA
• and 8,000 - 15,000 heat related deaths per year

Source: Climate Change Health Impacts in Australia, ACF & AMA
• and 4,000 - 8,000 heat related deaths per year

Source: Climate Change Health Impacts in Australia, ACF & AMA
Extreme Events: Heat

Switzerland Summer T, 1860-2003

After Schaer et al., 2004
Extreme Events: Heat

The diagram illustrates the change from a previous climate to a new climate, with an increase in mean temperature. It shows a shift from less cold weather to more hot weather and more record hot weather. The probability of occurrence is represented on the y-axis, withcold, average, and hot temperatures on the x-axis.
A cool Arctic winter has brought sea ice back to broad expanses that melted clear during last summer's unusual warmth. However, the amount of thick "perennial ice" has declined sharply across the Arctic, and climate experts say that global warming is the cause.
Good news! At the current rate of global warming we should be able to just swim over there and eat him in under five years...!
OSLO (Reuters) - Inuit hunters threatened by a melting of the Arctic ice plan to file a petition accusing Washington of violating their human rights by fueling global warming, an Inuit leader said Wednesday.
Sheila Watt-Cloutier, chair of the Inuit Circumpolar Conference (ICC), also said Washington was hindering work to follow up a 2004 report by 250 scientists that said the thaw could make the Arctic Ocean ice-free in summer by 2100.
Watt-Cloutier, in Oslo to receive an environmental prize, said the inuits' planned petition to the 34-member Organization of American States (OAS) could put pressure on the United States to do more to cut industrial emissions of heat-trapping gases.
"It's still in the works, the drafting is still going on," she said of a long-planned petition to the OAS' human rights arm, the Inter-American Commission on Human Rights.
A young male walrus rests on the beach near Barrow, Alaska, in September, 2007.
The “Real” Cause of Global Warming
The “Real” Cause of Global Warming

Victims As Villains
The bad news is the ice cap is melting and it’s going to be almost impossible to catch seals.

The good news is if we keep moving south, there’s tons of fat animals called “humans” who can’t run very fast.
Meaningful dollar value for the polar bear ecosystem to use in a C/B??
Role of Geoengineering? Where dealt with in NAS/IPCC...?
Ocean Acidification

HadOCC model: decrease in surface ocean pH 1860-2100

Ocean & Seasonal Variation

Annual Global Average

Hadley Centre for Climate Prediction and Research
Ocean Acidification

HadOCC model: decrease in surface ocean pH 1860-2100

Ocean & Seasonal Variation

Annual Global Average

Dollarized valuation of avoided acidification?
RECOMMENDATION:

Policy makers, assessment groups, agencies, commissions, etc. need to be better coordinated to take into account the interactions among the drivers of global change, and their separate and synergistic impacts. This would include international level conventions, secretariats, etc.
Risk = Probability \times \text{Consequence}

[What metrics of harm?]
Risk = Probability \times \text{Consequence}

[What metrics of harm?]

-$/\text{ton C avoided}$

*Subjective probability density functions

**Any weights on each metric are normative
Risk = Probability \times \text{Consequence}

[What metrics of harm?]

-\$/\text{ton C avoided}
-\text{lives lost/ton C avoided}
-\text{species lost/ton C avoided}
-\text{increased inequity/ton C avoided*}
-\text{quality of life degraded/ton C avoided*}

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-quality of life degraded/ton
Risk = Probability* x Consequence

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-quality of life degraded/ton

*Subjective probability density functions
**Any weights on each metric are normative
Vulnerability

Vulnerability (potential for harm)

Function of:

- Exposure
- Sensitivity
- Adaptation capacity
Vulnerability (potential for harm)

Function of:

- Exposure (Climate Dynamics)
- Sensitivity (Mix, Natural and Social Issues)
- Adaptation capacity (Largely Social Issues—Except for Ecosystems)
Mechanism for upstream integration across disciplinary-oriented working groups

- Exposure *(Climate Dynamics)*
- Sensitivity *(Mix, Natural and Social Issues)*
- Adaptation capacity *(Largely Social Issues—Except for Ecosystems)*
Questions?

Comments??