Biodiversity in a Changing Climate: Assessing Uncertainties

• Aspen Global Change Institute
• the IUCN-World Conservation Union
• QUEST Quantifying and Understanding the Earth System
Purposes of this Workshop

• Provide qualitative (not quantitative) assessment of current state of science of biodiversity impact projections (from data, from models, from expert opinion)

• Use above assessment to provide guidance to applied conservation biologists on best/worst uses of biodiversity projections

• New research priorities
Outputs and Audiences

- Short turnaround high-impact: *e.g.* Science Policy Forum
- Conservation Biology, Biological Conservation,
- White paper / report - distributed by IUCN, AGCI and QUEST (websites and / or info sheet)
- Scientists in field
- Scientists in other disciplines
- NGOs, national policy-makers (DC)
- IPCC
- basic and applied conservation biologists
- Funding agencies
- managers
- local policy makers
Priority for this weekend is to develop a consensus on state of science - connect climatological and biological literature

- Identify sources of uncertainty and error in data & models, climate & biological
- Identify existing approaches & tools that are being used
- Identify existing approaches and tools from other disciplines that could be adapted
- Identify areas where new approaches and tools are needed
### IPCC jargon: Quantitative Levels of Confidence

<table>
<thead>
<tr>
<th>Confidence Level</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high confidence</td>
<td>At least 9 out of 10 chance of being correct</td>
</tr>
<tr>
<td>High confidence</td>
<td>About 8 out of 10 chance</td>
</tr>
<tr>
<td>Medium confidence</td>
<td>About 5 out of 10 chance</td>
</tr>
<tr>
<td>Low confidence</td>
<td>About 2 out of 10 chance</td>
</tr>
<tr>
<td>Very low confidence</td>
<td>Less than 1 out of 10 chance</td>
</tr>
</tbody>
</table>
Intergovernmental Panel on Climate Change

**Attribution question**
Causal link between biological changes and anthropogenic climate change?

**Impacts question**
Are changes negative, neutral or beneficial?
Global effects on biodiversity?

**Vulnerability question**
Which species most at risk?
Which regions most sensitive?
<table>
<thead>
<tr>
<th>Level of Agreement/Consensus</th>
<th>Established but Incomplete</th>
<th>Well established</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speculative</td>
<td>Competing Explanations</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amount of evidence (Observations, model output, theory, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
</tr>
<tr>
<td>Category</td>
</tr>
<tr>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Low-agreement-little-evidence</td>
</tr>
<tr>
<td>Low-agreement-much-evidence</td>
</tr>
<tr>
<td>High-agreement-little-evidence</td>
</tr>
<tr>
<td>High-agreement-much-evidence</td>
</tr>
</tbody>
</table>
**Confidence ≠ likelihood**

### Quantitative Statements of Likelihood

<table>
<thead>
<tr>
<th>Statement</th>
<th>Probability Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtually certain:</td>
<td>&gt;99% probability of occurrence</td>
</tr>
<tr>
<td>Very likely:</td>
<td>90 – 99% probability</td>
</tr>
<tr>
<td>Likely:</td>
<td>66 – 90% probability</td>
</tr>
<tr>
<td>About as likely as not:</td>
<td>33 – 66% probability</td>
</tr>
<tr>
<td>Unlikely:</td>
<td>10 – 33% probability</td>
</tr>
<tr>
<td>Very unlikely:</td>
<td>1 – 10% probability</td>
</tr>
<tr>
<td>Exceptionally unlikely:</td>
<td>&lt;1% probability</td>
</tr>
</tbody>
</table>
State of Science: IPCC Uncertainty Framework

- **Established but incomplete**: Low level of agreement with low amount of evidence.
- **Well-established**: High level of agreement with high amount of evidence.
- **Speculative**: Low level of agreement with high amount of evidence.
- **Competing explanations**: High level of agreement with low amount of evidence.

**Attribution Question**

**Impacts & Vulnerabilities**

Amount of evidence (observations, theory, model outputs, etc.)
Layers of uncertainty

Climate
- Data
  - 20% of precipitation trend due to instrument change
- Emission scenarios
- Climate sensitivity
  - threshold responses?
  - clouds?
- Models
  - 3°C difference in model output for same emission scenario

Biology
- Data
  - sampling gaps (space & time)
  - bias (taxon, observer)
  - data absence = real absence?
- Basic knowledge (lack of knowledge of processes)
- Models

output
Thought questions

1) Are climate data being appropriately used by biological community? RE inhomogeneities, data gaps

2) Are climate projections being appropriately used by biological community? RE scale issues, differences in projections

3) Downscaling climate projections - state of science?

4) How to assess species with poor distribution data?

5) How deal with disagreements among biomodels - lessons from climate community? RE consensus, ensemble, weighting, pdfs

6) Approaches from economic theory? RE: low prob, high risk or irreversible outcomes, robust approaches

7) use of ipcc framework on uncertainty - useful for conservation?

8) others ????