Expert Elicitation

Jennie Hoffman
EcoAdapt

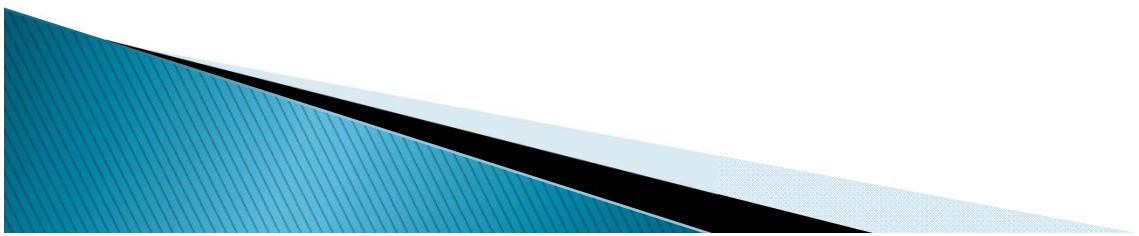
Situation:

- You have incomplete or inadequate data
- You're unsure of which models to use or how to parameterize them
- There are all kinds of other uncertainties
- You need to make a decision anyway

?

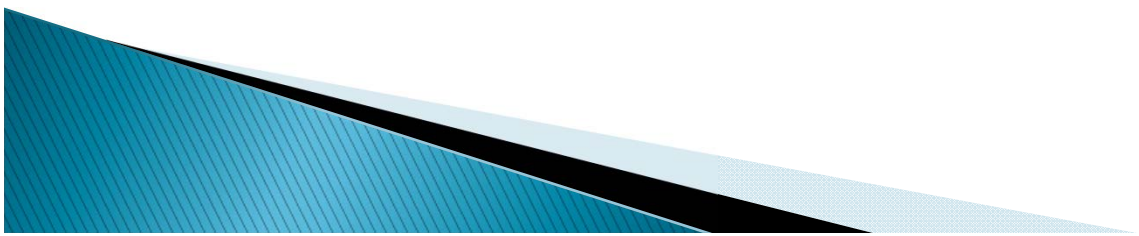
Expert elicitation to the rescue!

- Good for informing decision-making when:
  - Empirical data are missing or incomplete
  - Uncertainties are large
  - More than one conceptual model can explain existing data
  - Technical judgments are needed to evaluate assumptions



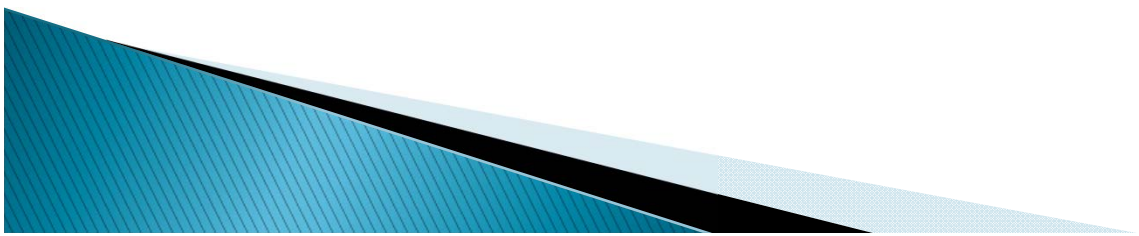
Other benefits

- Can take advantage of integrated and contextual knowledge and understanding
- Generates buy-in, ownership
- Can be rapid, relatively low cost



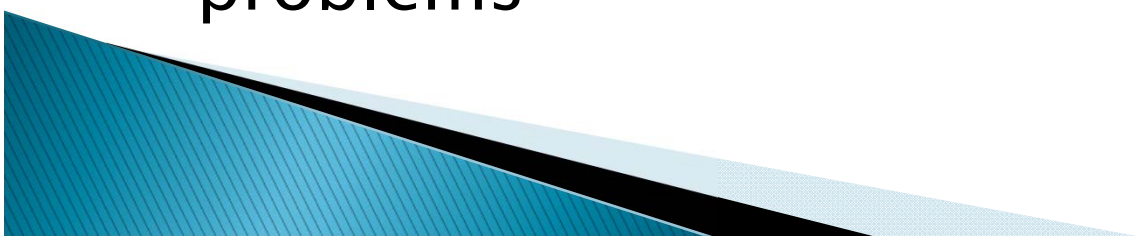
History

- Legally defensible examples
  - ESA: listing species and critical habitat designation
  - CERCLA: ecological risk assessment
  - NRDA: injuries to resources
- Not necessarily legal-quality examples
  - State-level: identifying habitat acquisitions
  - Developing adaptation options



A few cautions

- If you're trying to quantify subjective judgment, you need a solid process
- Cutting corners leads to shoddy results
- Beware expert overconfidence and other common errors made by experts
- Won't solve political or value-dependent problems



General approach

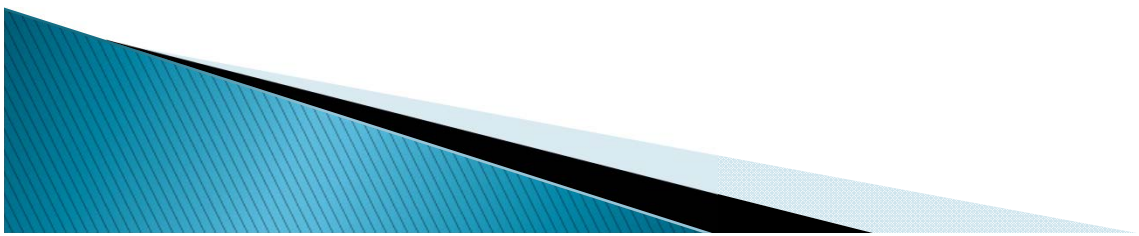
- Pre-elicitation:
  - Define problem
  - Structure problem/question
  - ID and select experts
  - Develop protocol
  - Develop briefing book
- Elicitation (Individual or group)
  - Motivate and train experts
  - Encode judgments
  - Verify judgments
- Post-elicitation
  - Document it all

Climate change example: NEAFWA

- Northeast Association of Fish and Wildlife Agencies Regional Habitat Model
- Objective: map geographical variation in habitat vulnerability across 13 NE States
- Combined EE with formal modeling

NEAFWA model

- Six major elements
  - Assessment of vulnerability to climate change
  - Assessment of vulnerability to non-climate stressors
  - Interaction potential
  - Assessment of overall future vulnerability
  - Confidence evaluation
  - Narratives



NEAFWA process: panel formation

- 40 participants from states, feds, and NGOs
- Wildlife biologists, ecologists, habitat specialists, regulators
- Given education in likely future climates in NE, how species/systems already reacting

NEAFWA process: panel tasks

- Review and comment on draft model
- Help finalize model
- Participate in habitat work groups
- Review and critique model runs from Manomet
- Help produce consensus habitat VAs

Climate change example: Climate Ready Estuaries "EE-type exercise"

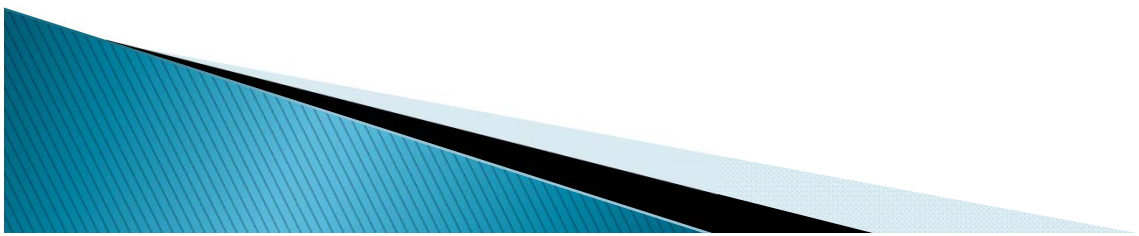
- Piloted in two locations: SF Bay, MA Bay
- Wanted qualitative judgments on:
  - **Relative influences** of physical and ecological variables that regulate key climate-sensitive processes
  - **Sensitivities** of influences under current and future climate change scenarios
  - **Degree of confidence** in judgments about relationships
  - Implications for **management**

Characterizing influences

- How well do we ***understand*** each influence?
  - Influence Types: Direct or Inverse
  - Influence Degrees: Proportional or Disproportional
- How ***sensitive*** is each influence?
  - Low Sensitivity: Disproportionately Weak Response
  - Medium Sensitivity: Proportionate Response
  - High Sensitivity: Disproportionately Strong Response
- What influences have the greatest relative impact on the endpoint? (***importance***)

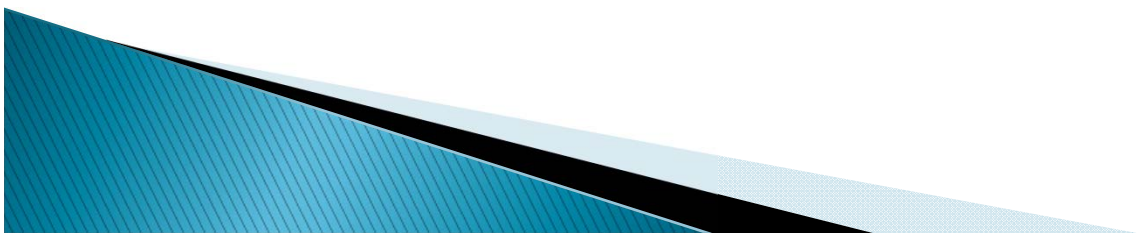
CRE Process: panel formation

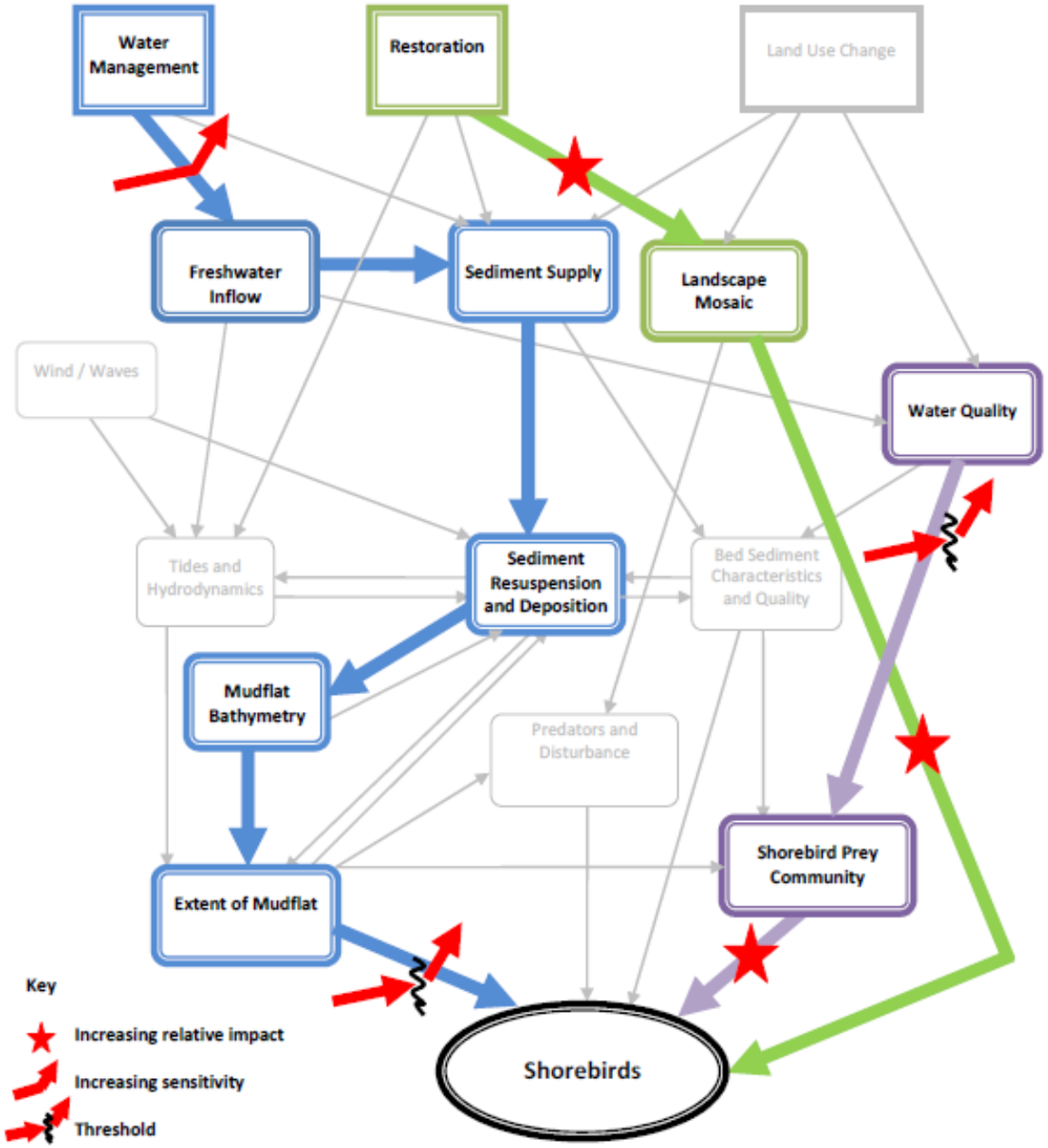
- Created 2 expert panels for each site:
  - community interactions group
  - sediment retention group
- 7 experts each, mix of academia, NGOs, feds
- Elicited opinions in a 2-day workshop



CRE Process: panel tasks

- Individually evaluate “straw dog” influence diagrams showing key process variables, interrelationships (influences)
  - characterized type, sensitivity, importance of each influence
- Discuss as group, generated “consensus” diagrams
- ID most likely management options




Water Management
Restoration
Land Use Change
Freshwater Inflow
Sediment Supply
Landscape Mosaic
Wind / Waves
Water Quality
Tides and Hydrodynamics
Sediment Resuspension and Deposition
Bed Sediment Characteristics and Quality
Mudflat Bathymetry
Predators and Disturbance
Shorebird Prey Community
Extent of Mudflat
Shorebirds
Key
Increasing relative impact
Increasing sensitivity
Threshold

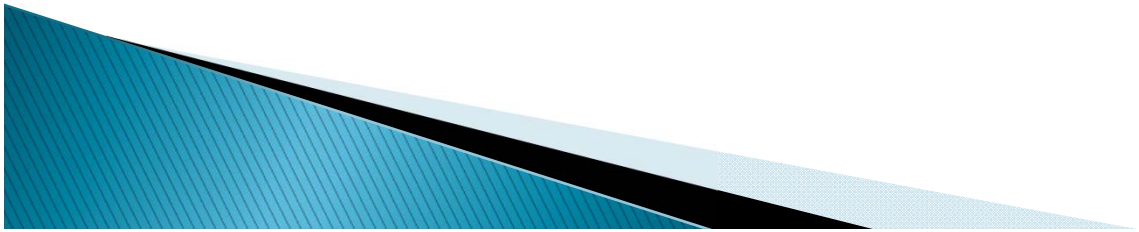
CRE Conclusions

- Look at all types of information when analyzing management paths: influences, sensitivity, importance
- Based on expert judgment, can ID “top pathways” for which there are available adaptation options.
- Variation between participants was greater than between scenarios

"The process of expert elicitation must never be approached as a routine procedure amenable to cookbook solutions … Each elicitation problem should be considered a special case and be dealt with carefully on its own terms."

Morgan and Henrion 1990

And yet …

Commonalities

- Capture expert assumptions, thought process
  - NEAFWA: Excel model
  - CRE: influence diagrams
- Evaluate confidence
  - NEAFWA: condensed 5-point IPCC scale to 3
  - CRE: reflect agreement and availability of evidence
- Focus on transparency