

UNCERTAINTY



Areas of Uncertainty



What is similar to non-climate natural resources work:

- Data quality and precision issues
- How species actually respond to stressors
- How decision makers, managers, public will actually react
- Whether our management responses actually work

Areas of Uncertainty

What is novel about climate change work:

- Stressors based on future models with little applicable prior experience
- Limited ability to model effects at traditional planning scales with sufficient certainty
- A blanket stressor where traditional management techniques only help so much
- How CC effects will react with other stressors & the potential to remake human land use patterns in many regions due to SLR and water availability

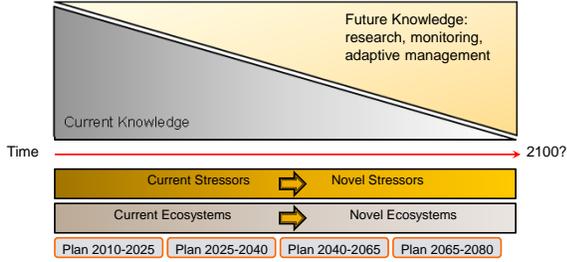
Whether adaptation responses will actually work

Airlines Pressed Into Species Translocation!



Interaction of climate effects knowledge, uncertainty, and timing of action

- Some key questions to grapple with:
- If a change isn't forecast to happen for 30 years how should it affect management now?
 - If a forecast has high uncertainty what should I do about it?
 - If we're going to lose a species anyway should I still manage for it?



Certain: death and taxes
Uncertain: everything else



Responses to uncertainty

- Ignore it and observe what actually happens
- Outcome: get caught offguard and miss opportunities to mitigate bad effects



Responses to uncertainty

- Ignore it/wait until it disappears
- Pretend you can get rid of it (usually by doing more detailed models)
- Outcome: perhaps make bad decisions because of false sense of certainty—do the wrong things in the wrong places

Beware spurious precision!

Reducible vs. irreducible uncertainty

- Reducible: uncertainty you can reduce through changes in inputs or operations of a model
- Irreducible: uncertainty you can't control because it is inherent in the system

May I have the ability to reduce the uncertainties I can, the willingness to work with the uncertainties I cannot, and the scientific knowledge to know the difference.

Joe Barsugli, Cheis Anderson, Joel Smith and Jason Vogel

Reducible vs. irreducible uncertainty

- Future greenhouse gas emissions:
Reducible or irreducible?
vs
- How global temperatures respond to
increases in GHG concentration:
Reducible or irreducible?
vs
- How global precipitation regimes
respond to increases in GHG
concentration: Reducible or irreducible?



Responses to uncertainty

- Ignore it/wait until it disappears
- Pretend you can get rid of it
- Understand it

Directionality vs. magnitude

- All climate models say things will get warmer;
they disagree on just how much warmer
- Models disagree on whether things get
wetter or drier overall



Controllability

- Whether or not to buy a car
- Greenhouse gas emissions
- Massive methane belch from the deep sea



Uncertainty as information

Being uncertain is not the same as knowing nothing

Known unknowns vs. Unknown unknowns

- Use of SDM and scenario-based planning helps with process
- Describing missing information and knowledge informs understanding of uncertainty, e.g.,
 - Missing data
 - Lack of knowledge of resource responses
 - Lack of knowledge of synergistic effects



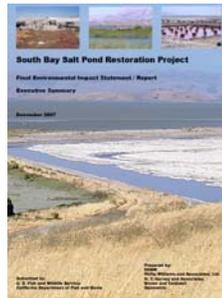
Responses to uncertainty

- Ignore it/wait until it disappears
- Pretend you can get rid of it
- Understand it
- Surf the wave!
 - Adaptive management
 - Scenario planning
 - Risk management



Adaptive Management Plan for South Bay Salt Pond Restoration Project

- Specified **key uncertainties** and research to address them
- Specified **triggers** for action
- Specified necessary **science and institutional structure** for adaptive management to work

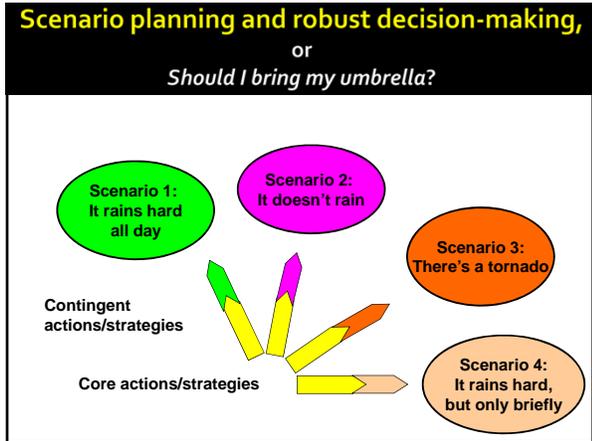


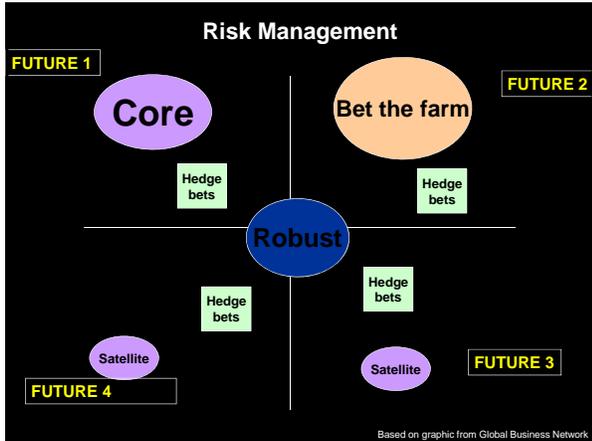
Really cool table!

For each goal/target:

- What they'll monitor and where
- When they'll make decisions
- What observations would trigger a re-examination of their plans
- Action options once a trigger is tripped
- Key knowledge gaps and how they're filling them

MANAGEMENT TRIGGER	APPLIED STUDIES
<ul style="list-style-type: none"> • Outboard mudflat decreases greater than the range of natural variability + observational variability sensor. 	<ul style="list-style-type: none"> • Will sediment movement into restored tidal areas significantly reduce habitat area and/or ecological functioning (such as plankton, benthic, fish or bird diversity or abundance) in the South Bay? • Development of a 2- and 3-D South Bay tidal habitats evolution model.
<p>POTENTIAL MANAGEMENT ACTION</p> <ul style="list-style-type: none"> • Convene study session to review and interpret findings to assess if observed changes are due to restoration actions or system-wide changes in the sediment budget (e.g., effects of sea level rise). • Study biological effects of loss of mudflat, subtidal channels, and/or subtidal channel habitat. • Adjust restoration phasing and design to reduce net loss of tidal mudflats. Potential actions include remove byfront levees to increase wind fetch and restore tidal mudflats, phase branching to match demand and supply; sand or beach only high-sediment ponds to limit sediment demand • Reconsider movement up structure 	





- ### How much Uncertainty am I Willing to Accept?
- Important to clearly define environmental endpoints and the types of decisions that will be made using the results of the vulnerability assessment
 - Prioritization and targeting vs. prediction and forecasting
 - Structured Decision Making
 - Economic ramifications (politics, job security, risk of lynching)

A Possible Solution

Confronting the impulse to “wait and see” because VA assessments are too uncertain

APPLYING THESE ANALYSES TO SCALES OF DECISION MAKING

Assessment	Phases of Decision Making			
	Identify Issues & Education	Regional Strategy	Land Use Plan	Site/Activity Plan
Current impacts on ecological integrity	Y	Y	Y?	N?
Current impacts on ecological connectivity	Y	Y	Y?	Y?
Forecast future impacts from non-climate stressors	Y	Y	Y?	N?
Forecast climate stresses	Y	Y	Y?	N
Forecast climate refugia	Y	Y	Y	N?
Map enduring features	Y?	Y?	Y?	N?

Example from NatureServe/BLM Yale Framework pilot project, Comer et al., 2012

Conclusion

- There is, always has been, and always will be uncertainty in natural resource assessment and planning
- VA assessments are useful at different stages of decision making
- Documenting areas of uncertainty will assist in applying the results at the appropriate stages and informing I&M and adaptive management
