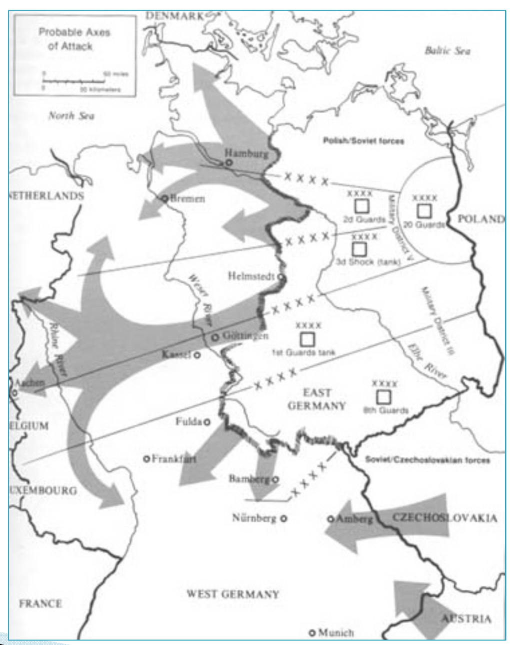
Module 7 – Applying Scenarios

Robert Glazer, Florida Fish and Wildlife Conservation Commission

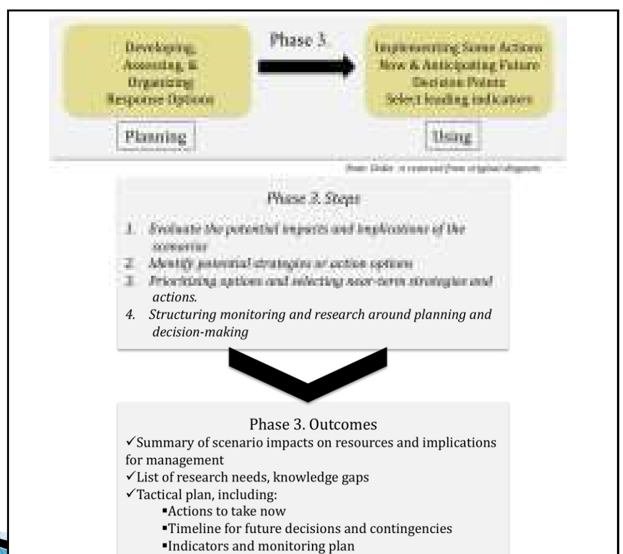


Phase III – Applying Scenarios

The context of this Module

- Assess Impacts
- Consider Implications for Management
- Develop Responses

An Overview of the Module



"More decisive? How can I be more decisive?
- I live by the uncertainty principle!"

By the end of the session, you should be able to:

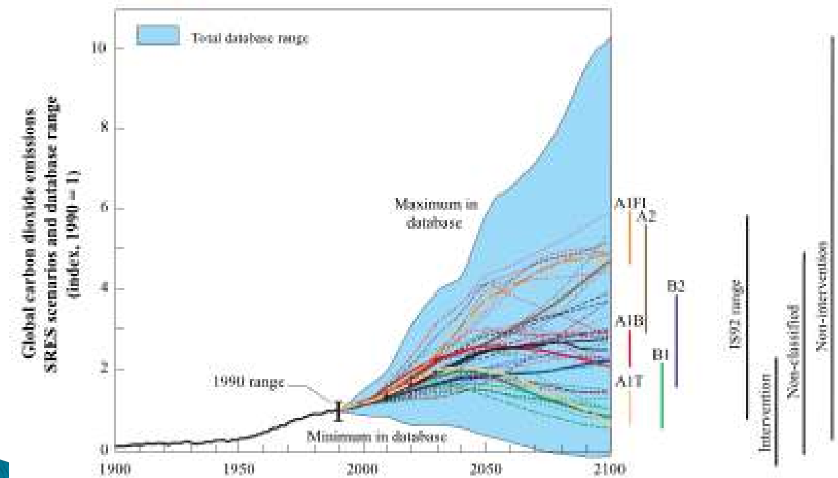
- Understand how different scenarios may impact different resources
- Integrate scenarios into decision-making processes
- Understand how scenarios influence the viability of alternative management strategies
- Apply scenarios to understand implications of specific decisions
- Develop specific strategies and actions related to management objectives
- Develop monitoring programs to evaluate scenarios structured around decision-making
- Evaluate and prioritize specific short-term actions related to outcomes of monitoring plan
- Understand the concept of triggers (hard triggers and soft triggers)

Step 1 – Evaluate the Potential Impacts and Implications of the Scenarios

- Can be based on
  - Models
  - Expert Opinions
  - Workshops
  - Observations
  - Paleoecology

- Model-Based
  - SLAMM (Sea Level Affecting Marshes Model)
  - SLOSH (Sea, Lake, and Overland Surges from Hurricanes)
  - Downscaled models (statistical or dynamic)
    - Examples include rainfall, snowpack, sea surface temperature, winds, impacts on hurricanes

IPCC AR4 SLR Scenarios



How the models can be used

Models average - Total sea level change (mm)

Year	A1B	A1T	A1FI	A2	B1	B2
1990	0	0	0	0	0	0
2000	17	17	17	17	17	17
2010	37	39	37	38	38	38
2020	61	66	61	61	62	64
2030	91	97	90	88	89	94
2040	127	134	126	120	118	126
2050	167	175	172	157	150	160
2060	210	217	228	201	183	197
2070	256	258	290	250	216	235
2080	301	298	356	304	249	275
2090	345	334	424	362	281	316
2100	387	367	491	424	310	358

Model maximum - Total sea level change (mm)

Year	A1B	A1T	A1FI	A2	B1	B2
1990	0	0	0	0	0	0
2000	29	29	29	29	29	29
2010	63	63	65	64	64	65
2020	103	104	110	104	105	109
2030	153	153	164	149	151	159
2040	214	214	228	204	203	216
2050	284	291	299	269	259	277
2060	360	386	375	343	319	344
2070	442	494	453	430	381	414
2080	527	612	529	526	444	488
2090	611	735	602	631	507	566
2100	694	859	671	743	567	646

Extending the SRES to SLR


SLAMM 6 beta Technical Documentation

Release 6.0.1 beta

Draft, May 2010

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Richard A. Park, Eco Modeling
Roger Fuller, The Nature Conservancy

Initializing models

Parameter	Subsite 1a	Subsite 1b	Subsite 2a	Subsite 2b	Subsite 3a	Subsite 3b	Site 4	Site 4 South	Site 5	Site 6
Description	Lower Keys - Gulf side	Lower Keys - Ocean Side	Middle Keys - Gulf Side	Middle Keys - Ocean Side	Upper Keys - Bayside	Upper Keys - Ocean Side	Southwest Coast	Southwest Coast	Southeast Coast	Southern Everglades
Direction Offshore	N	S	N	S	N	S	S	S	E	S
Historic Trend (mm/yr)	2.27	2.27	2.94	2.94	2.39	2.39	2.02	2.02	2.39	
MTL-NAVD88 (m)	-0.321	-0.247	-0.161	-0.289	-0.232	-0.265	-0.187	-0.187	-0.265	
GT Great Diurnal Tide Range (m)	0.563	0.432	0.358	0.542	0.529	0.305	1.068	1.068	0.682	
Salt Elev. (m above MTL*)	0.431	0.359	0.291	0.227	0.31	0.31	0.7802	0.7802		
Marsh Erosion (horiz. m/yr)	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8		
Swamp Erosion (horiz. m/yr)	1	1	1	1	1	1	1	1		
T. Flat Erosion (horiz. m/yr)	0.1	0.1	2	2	0.5	2	0.5	0.5		
Reg. Flood Marsh Accr. (mm/yr)	3.8	3.9	3.8	3.9	3.8	3.9	4	4		
Irreg. Flood Marsh Accr (mm/yr)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7		
Tidal Fresh Marsh Accr (mm/yr)	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9		
Mangrove Accr (mm/yr)	3.3	3.3	3.3	3.5	3.3	3.3	N/A	N/A		
Beach Sed. Rate (mm/yr)	1	1	0.5	0.5	0.5	0.5	0.5	0.5		
Freq. Overwash (years)	25	25	25	25	25	25	50	50		

*Mean Tide Level (MTL)

References:
Clough, J. & Propato M. (2012 May). Demonstration of uncertainty analysis using the sea-level affecting marshes model (SLAMM). Presentation for an ecosystem-based management (EBM) tools network webinar.

Hardy D. (2011). Guide to the basics of the sea level affecting marshes model (SLAMM). University of Georgia, Athens, Georgia.

Clough, J., Park, R., & Fuller, R. (2010). SLAMM6 beta technical documentation. (Draft)

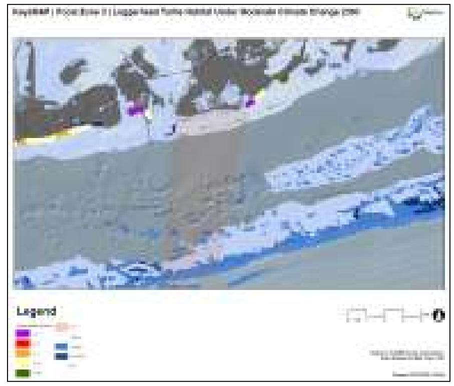
Visualizing Sea Level Rise

SLAMM Converts To Table

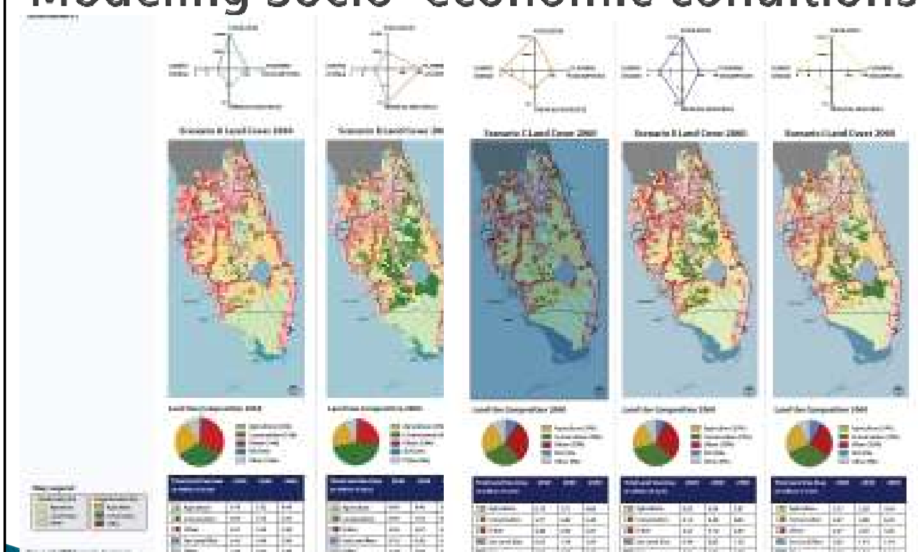
Table 3: Assumed Effects of Inundation and Erosion.

	Inundation: *Non-adjacent to open water or Fetch < 9km (not erosional)*	Erosion: *Adjacent to Open Water and Fetch > 9km (erosion)*
Converting From	Converts To	Converts To
Dry Land	Transitional salt marsh, ocean beach, or estuarine beach, depending on context (see below)	Erosion of dry land is ignored.
Swamp	Transitional salt marsh	Erosion to Tidal Flat
Cypress Swamp	Open Water	Erosion to Tidal Flat
Inland Fresh Marsh	Transitional salt marsh	Erosion to Tidal Flat
Tidal Swamp	Tidal Fresh Marsh	Erosion to Tidal Flat
Tidal Fresh Marsh	Irregularly Flooded Marsh	Erosion to Tidal Flat
Scrub-Shrub, Irregularly Flooded Marsh	to Regularly Flooded Marsh	Erosion to Tidal Flat
Regularly Flooded Marsh	to Tidal Flat	Erosion to Tidal Flat
Mangrove	to Estuarine Water	Erosion & Inundation to Estuarine Water
Ocean Flat	to Open Ocean	Erosion to Open Ocean
Tidal Flat	Erosion, Inundation to Estuarine Water	Erosion to Estuarine Water
Estuarine Beach, Ocean Beach	open water	Erosion to open water

Example 1 – SLR Impacts on Loggerhead Turtle Nesting

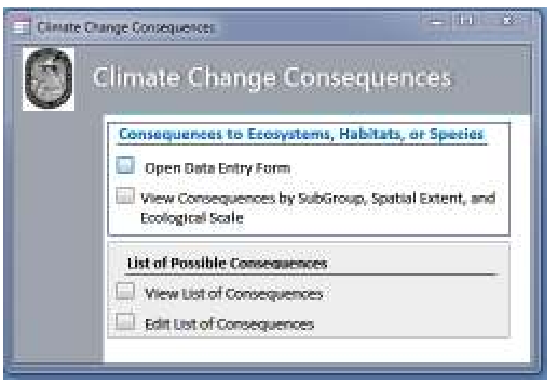


Modeling Socio-economic conditions



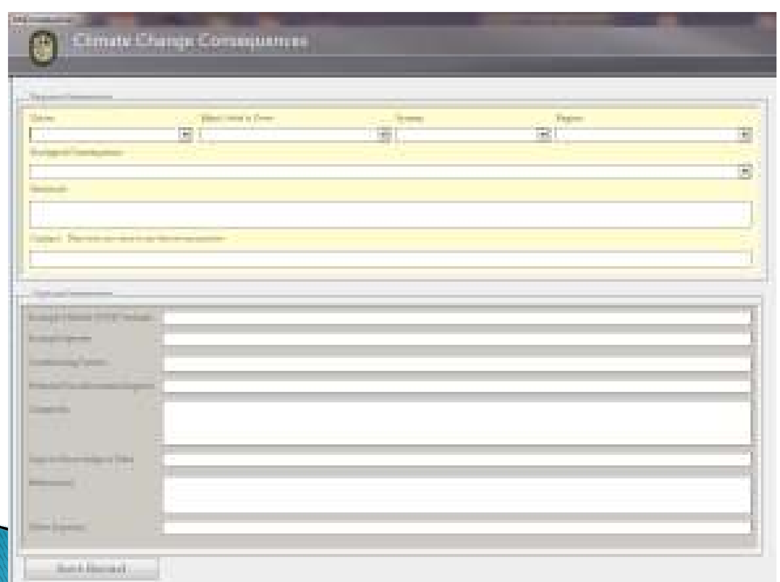
Expert Opinion

Understanding the Effects

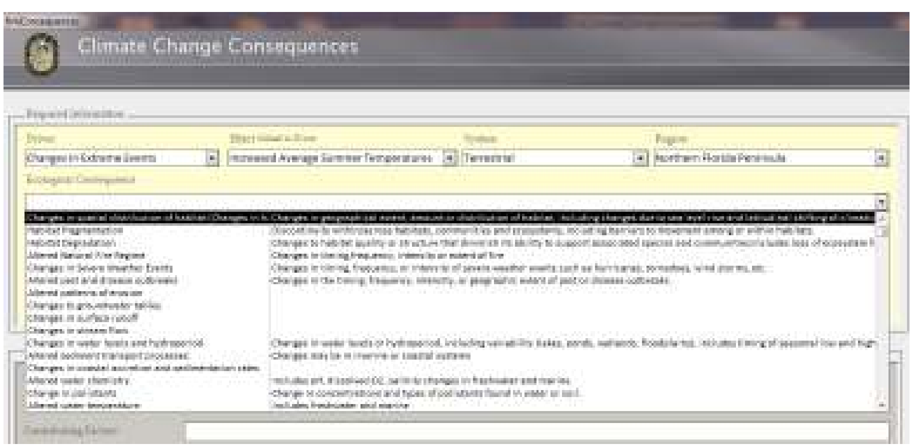


How the model works

Visualizing Effects



Climate Change Consequences
Climate Change Consequences
Changes in Precipitation
Changes in Amount of Rainfall - Increase
Changes in Amount of Rainfall - Decrease
Changes in Duration - Longer Wet periods
Changes in Timing



Climate Change Consequences
Changes in Extreme Events
Increased Average Summer Temperatures
Terrestrial
Northern Florida Peninsula
Habitat Fragmentation
Habitat Degradation

Example 1 – Identifying Exogenous Stressors in Marine Systems

What other information can experts provide?

Example 2 – Spiny Lobster Thresholds

- Temperature > 31 C
- Salinity
  - *These combine to limit distribution*

Lobster settlement under Sea Level Rise

What to Monitor

1. Water temperature
2. Salinity
3. Larval Collectors
4. Juvenile

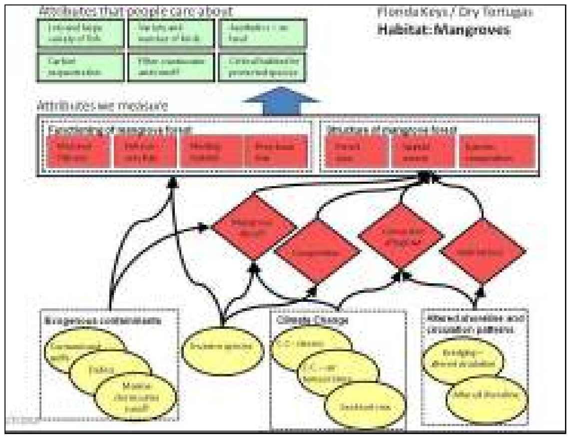
Range Expansion under Different SLR Scenarios – The American Crocodile

Observational Information

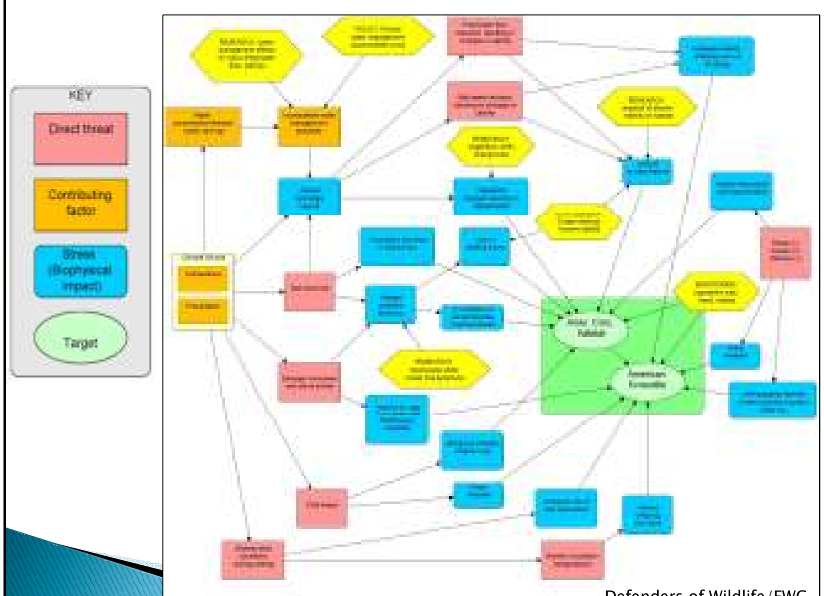
Workshops

Workshop outputs

How Climate Change interacts with Mangrove habitats – MARES



American Crocodile & Intervention Points

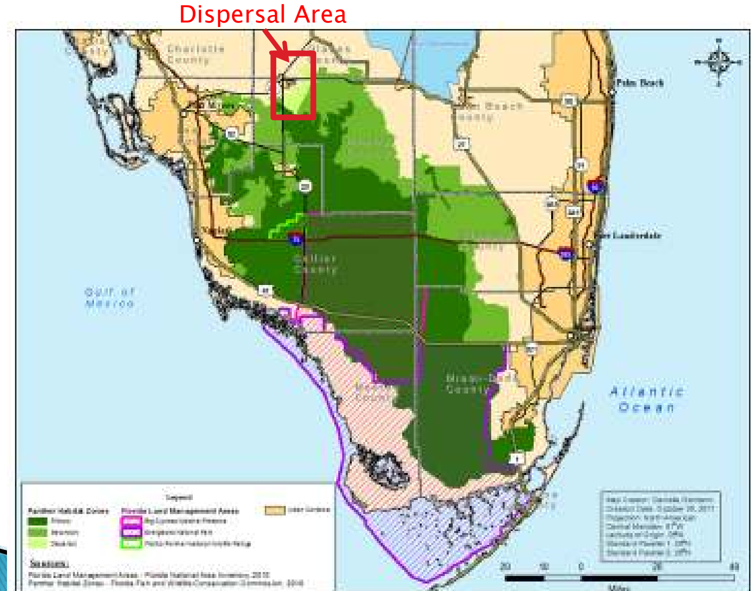


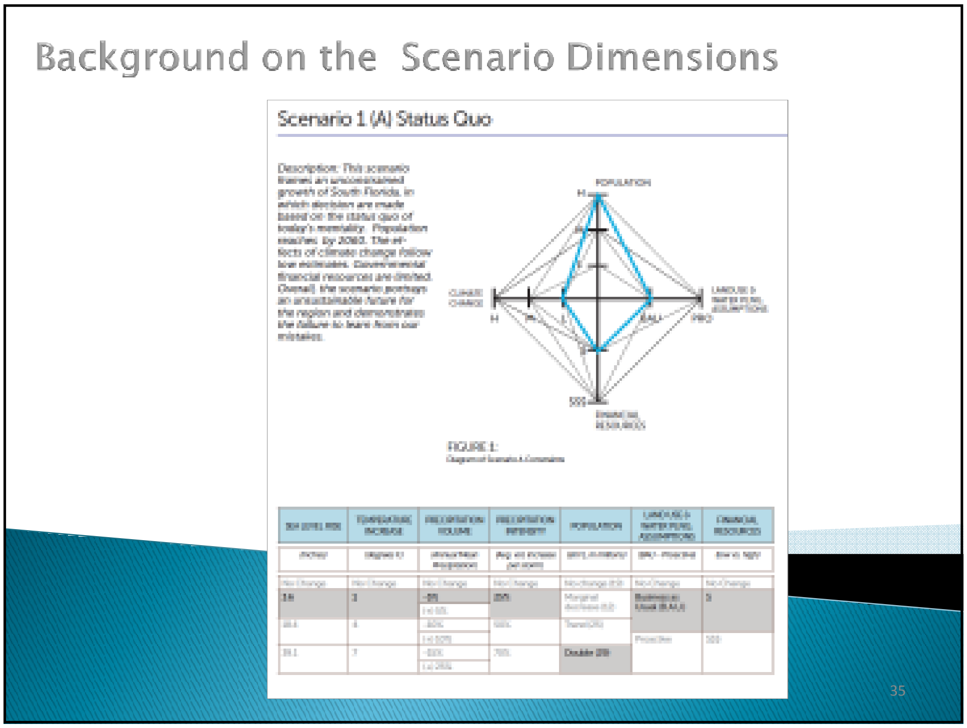
Defenders of Wildlife/FWC

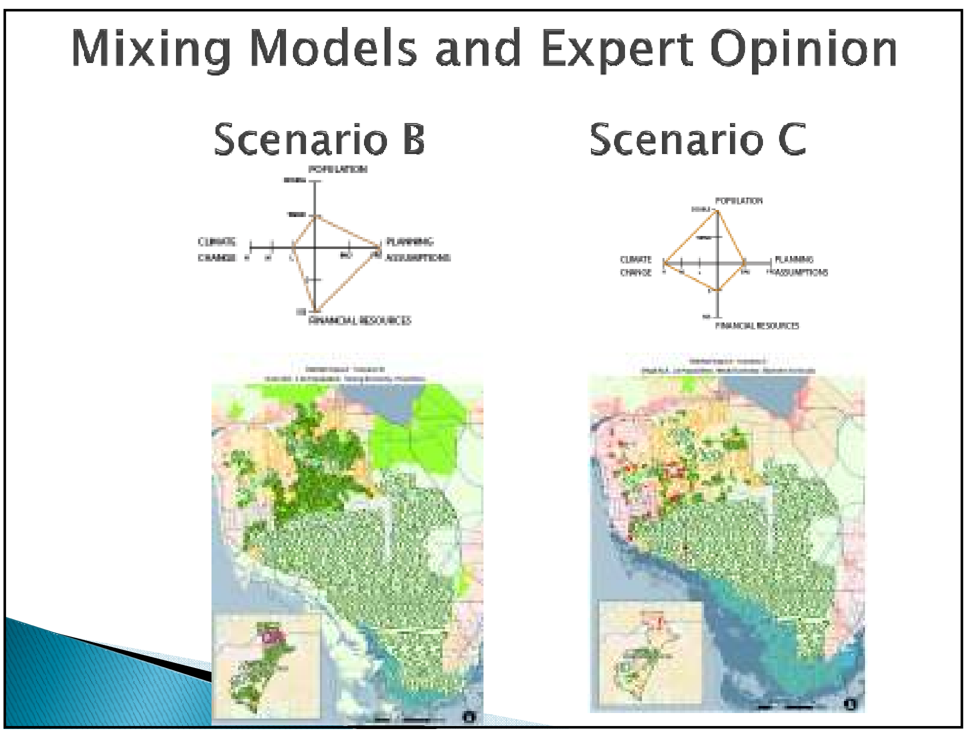
Example 2 – Effects of Scenarios on Future Distribution of Florida Panther

Current Distribution of Florida Panther

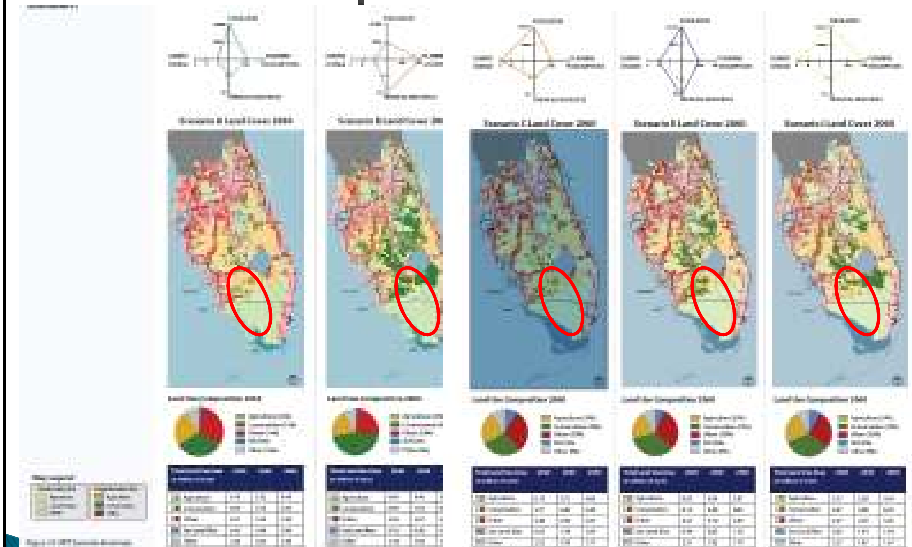
Dispersal Area




Background on the Scenario Dimensions
Scenario 1 (A) Status Quo
POPULATION
FIGURE 1:
35


Mixing Models and Expert Opinion
Scenario B
Scenario C
POPULATION
CLIMATE CHANGE
PLANNING ASSUMPTIONS
FINANCIAL RESOURCES

Scenarios vs. panthers



Paleo-ecology

- What can the past teach us about the future
  - Species distributions
  - Species/habitat associations

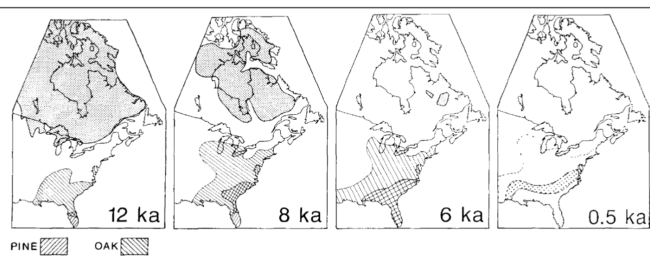


Figure 1. Location of regions with 5% beech (Fagus) pollen and 5% hemlock (Tsuga) pollen (in the upper row maps) and 20% southern pine (Pinus) pollen and 20% oak (Quercus) pollen (in the lower row of maps) at 12,000, 8,000, 6,000, and 500 yr B.P. with the stippled area in the north showing the shrinking Laurentide ice sheet from 12,000 to 6,000 yr B.P. Source: Modified from Plates 1 and 2 in Jacobson, Webb, & Grimm 1987.

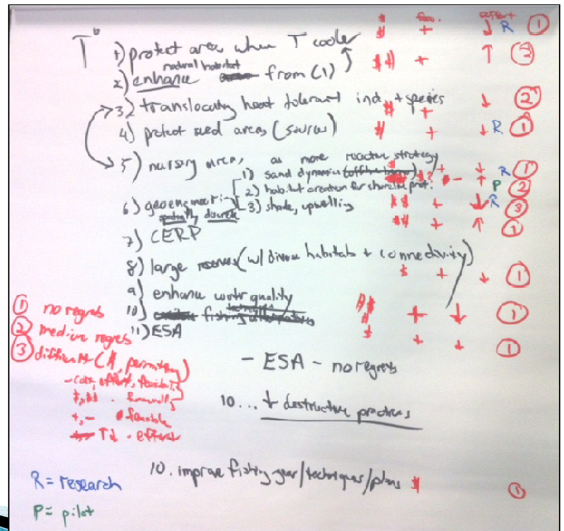
Front Ecol Environ 2007; 5(9): 475–482, doi:10.1890/070037

How do you study an ecosystem no ecologist has ever seen? This is a problem for both paleoecologists and global-change ecologists, who seek to understand ecological systems for time periods outside the realm of modern

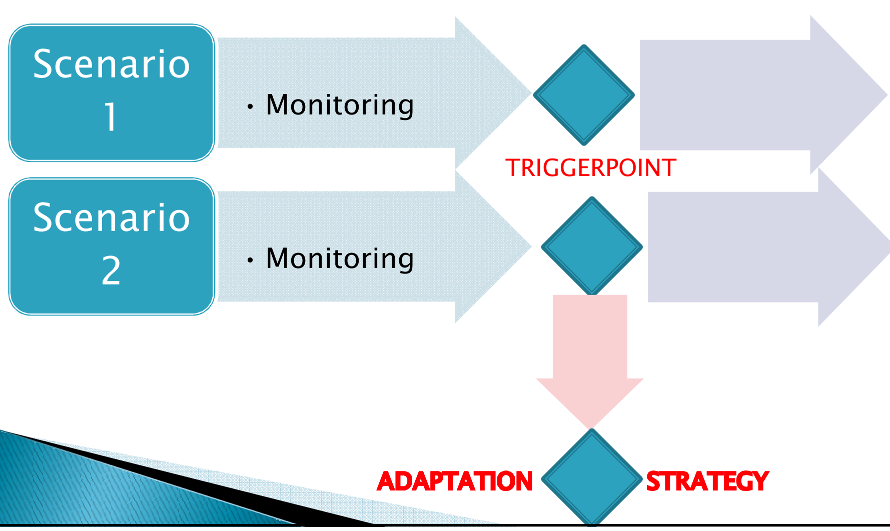
past or future, is heavily conditioned by our current observations and personal experience.

The further our explorations carry us from the present, the murkier our vision becomes. This is not just because

Step 2 – *Develop Responses*



Conceptualizing Actions



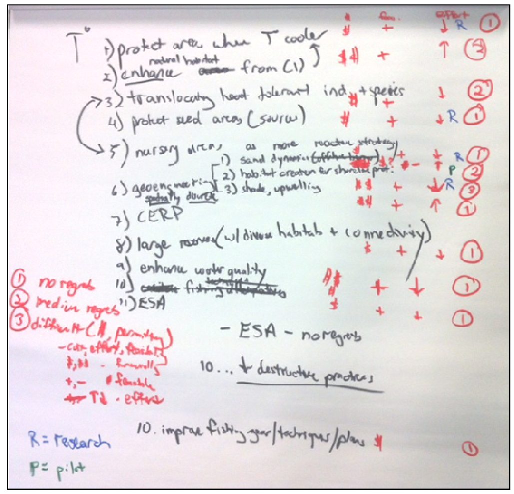
Triggerpoints

- Triggers (hard), when tripped, will activate near and long-term actions (e.g., shift in species composition, tipping point on SST)
  - hydro operations, predator control, harvest, safety-net hatchery programs, and long-term contingency actions that may be taken.
- 'Soft triggers' (Non-discrete changes along a continuum)
  - "Early warning indicator" will alert agencies for example to a decline in species' abundance level that warrants further scrutiny because it indicates that a significant decline may be reached in one to two years. (Indicators that indicated decline)

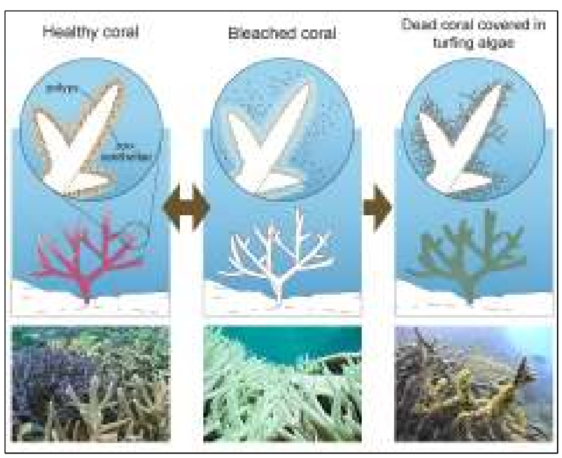
Examples of triggers?

Action Development

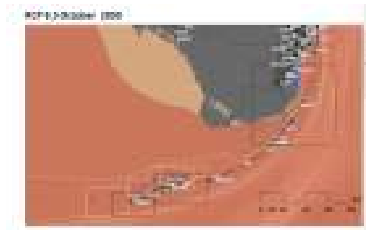
- Can be based on
  - Expert Opinions
  - Workshops
  - Similar examples



Workshops – Coping with Increased SST



What the models can tell us about SST



Water Temperatures under Different RCPs based on models

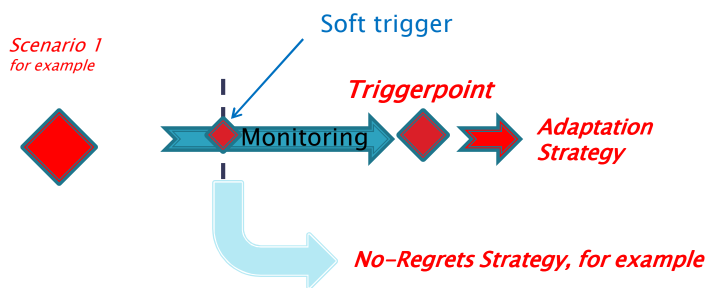
Workshop-based Adaptation Strategies for Increases to SST

	Approach
1	**Protect area(s) where Temperature is cooler**
2	**Enhance natural habitat where temperature is cooler**
3	**Translocating heat tolerant individuals and species**
4	**Protect seed areas (population sources)**
5	**Geoengineering**
a	Sand dynamics
b	Habitat creation for shoreline protection
c	Shade, upwelling to protect specific locations when threshold is reached
6	**CERP**
7	**Large reserves with diverse habitats and connectivity**
8	**Enhance water quality**
9	**Endangered Species Act**

No-Regrets Strategies – what can we do now to prepare?

- Permitting
- Engineering designs
- Modeling
- ?

The Soft Triggers and No-Regrets Strategies



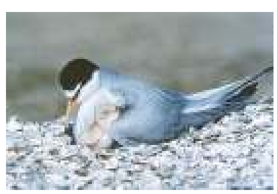
Some questions to consider:

- Some questions to consider:
  - Should we be thinking about this issue or resource of concern differently
  - Do our current actions or strategies associated with this resource still make sense in light of the ways that the future might unfold? If not, how should we modify them?
  - Are there opportunities created by the scenario(s)?

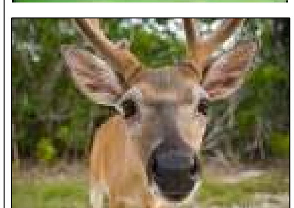
Broadening the Relevancy

Fighting with the Neighbors

Room to Move



Surrounded on all Sides



Step 3 – Prioritizing Options

- How can I prioritize options?
- What options are the low-hanging fruit?
- What options are more difficult
- What are no-regrets strategies that should be employed immediately to prepare you for the actions actuated by the triggers?

Prioritizing Options for SST

	Issue	$	Feasibility	Effort Required	Priority	Other	
1	**Protect area(s) where Temperature is cooler**	$	+	low	1	Research	
2	**Enhance natural habitat where temperature is cooler**	$$	+	high	2		
3	**Translocating heat tolerant individuals and species**	$	+	low	2		
4	**Protect seed areas (population sources)**	$	+	low	1	Research	
5	**Geoengineering**						
a	Sand dynamics	$	+	low	1	Research	
b	Habitat creation for shoreline protection	$?	-	high	2	Pilot	
c	Shade, upwelling to protect specific locations when threshold is reached	$$	+	Low	3	Research	
6	**CERP**	$$	+	high	1		already occurring
7	**Large reserves with diverse habitats and connectivity**	$	+	low	1		already occurring
8	**Enhance water quality**	$$	+	low	1		already occurring
9	**Endangered Species Act**	$	+	low	1		already occurring

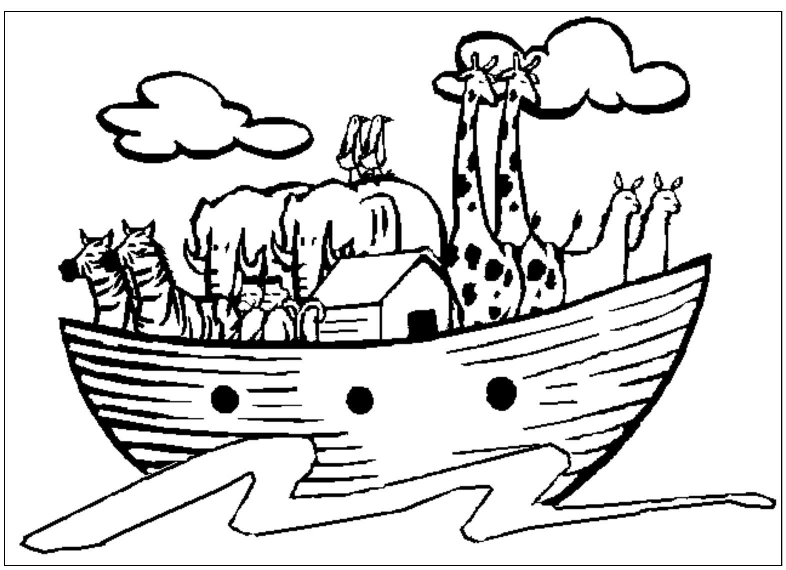
Revisiting the approach

- Are the right people at the table?
- Do we have the best information available?
- Are the goals still relevant?

Are current actions or strategies still relevant in light of the ways that the future might unfold?

- As scenarios develop or the science evolves, what new actions may be available or required?
- Can new technologies change actions?
- Are political changes captured in existing actions?
- This links to Module 12

- Some questions to consider:
  - Should we be thinking about this issue or resource of concern differently
  - Do our current actions or strategies associated with this resource still make sense in light of the ways that the future might unfold? If not, how should we modify them?
  - Are there opportunities created by the scenario(s)?



Break-Out Excercise1

- You are a manager of Dry Tortugas National Park tasked with managing cultural resources
- Changes in hurricane frequency are unknown but frequency of major hurricanes (Category 3) are predicted to increase proportional to increased SLR
- Currently the fort is slowly crumbling but being maintained by full-time crew of masons

Break-Out Excercise1

- You are a manager of Dry Tortugas National Park tasked with managing cultural resources.
- Changes in hurricane frequency are unknown but frequency of major hurricanes (Category 3) are predicted to increase proportional to increased SLR
- Fort maintained by masons

Group 1: low SLR - storm surge Cat 3+ hurricane severely crumbles Fort Walls, fort floods

Group 2: medium SLR - walls seriously damaged with Cat 1-2 hurricane, sand around fort moves extensively, fort floods on high tides (6x/year)

Group 3: high SLR - Fort flooded, walls crumble extensively on ongoing basis, winter storms -> large chunk of wall fall

Excercise1

Create 2-3 adaptation strategies based on your scenario

Break-Out Excercise1

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Exercise 2

Determine triggerpoint(s) that will actuate strategies. Are there any soft triggers that can be employed

Break-Out Excercise1

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Exercise 3

Develop monitoring program to determine when triggerpoints (hard and soft) are reached

Break-Out Excercise1

- You are a manager of Dry Tortugas National Park tasked with managing cultural resources.
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Exercise 4

What no-regret strategies can be enacted now?

Break-Out Excercises

- You are charged with identifying strategies to conserve the Key Deer.

  Questions

  1. How could you assess the potential impacts?
  2. What strategies could you employ to address impacts?
  3. What are some potential triggerpoints to actuate actions?
  4. What monitoring programs could you put into place to monitor for triggers?
  5. How would you prioritize the strategies?