

CONFRONTING CLIMATE CHANGE IN THE NORTHEAST

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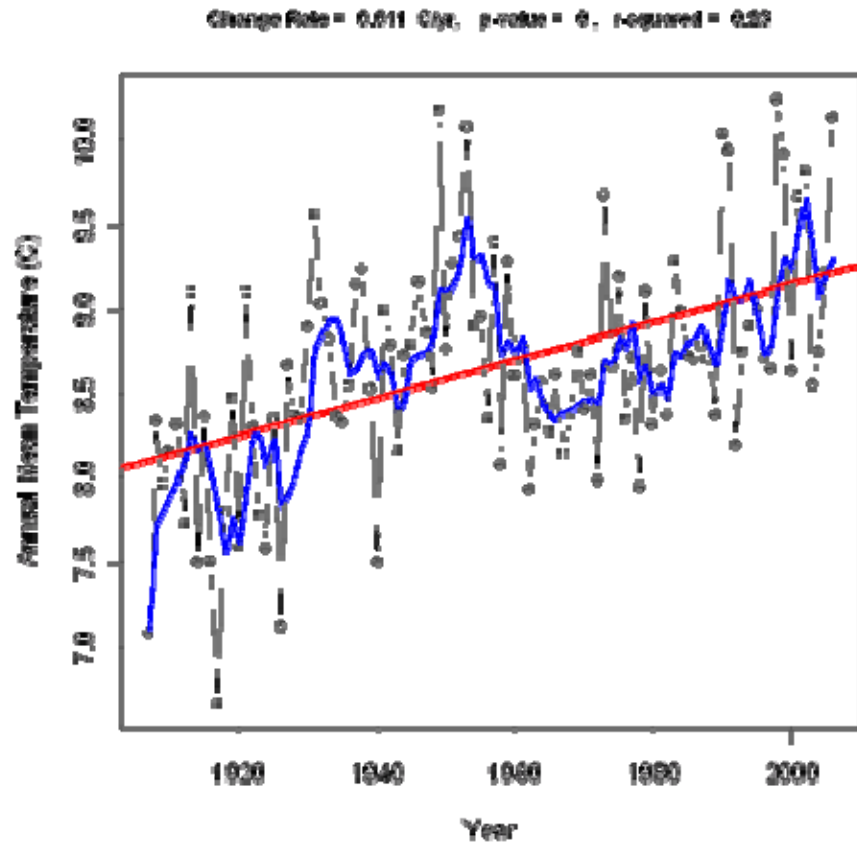
CREDENTIALS – WHO IS THIS GUY?

- Training in avian ecology
- Prior to 1990s researched mainly avian population ecology – shorebirds and seabirds
- Beginning about 1993 began working on effects of climate change
- Work funded by EPA, Pew, FWS, NPS, state agencies, etc.
- Now heading up Manomet's Climate Change Initiative
- Particularly interested in adaptation approaches

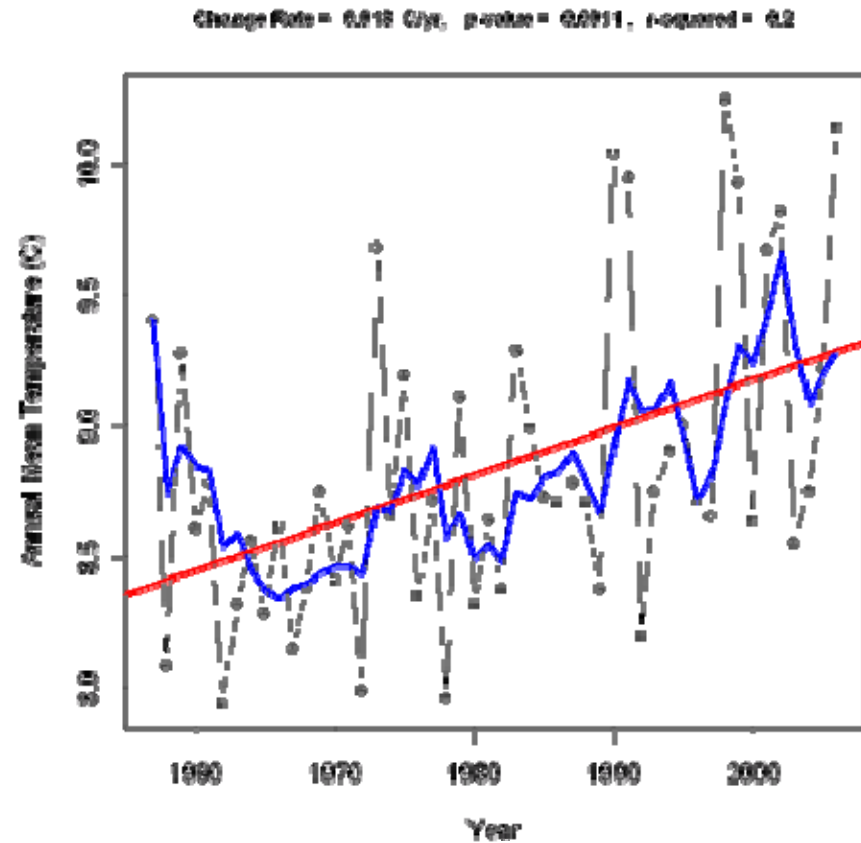
ELEMENTS OF TALK

1. The climate is already changing in the Northeast
2. Emissions control is not silver bullet – we need to adapt!
3. Need to evaluate ecosystem vulnerabilities
4. Future challenges

Massachusetts Annual Mean Temperature



+1.1°C (~2°F)



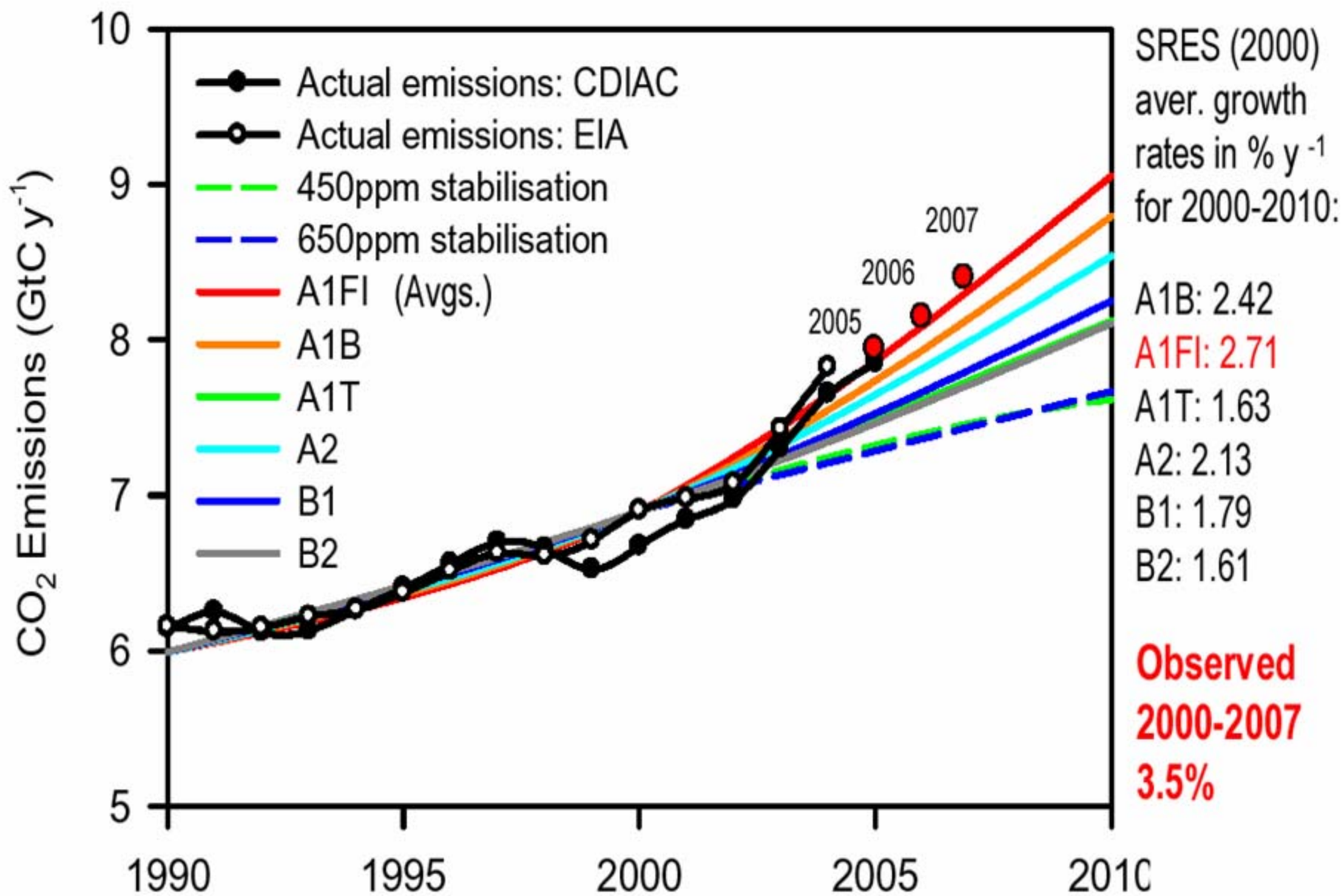
+0.9°C (~1.6°F)

FUTURE CLIMATE CHANGE IN MASSACHUSETTS

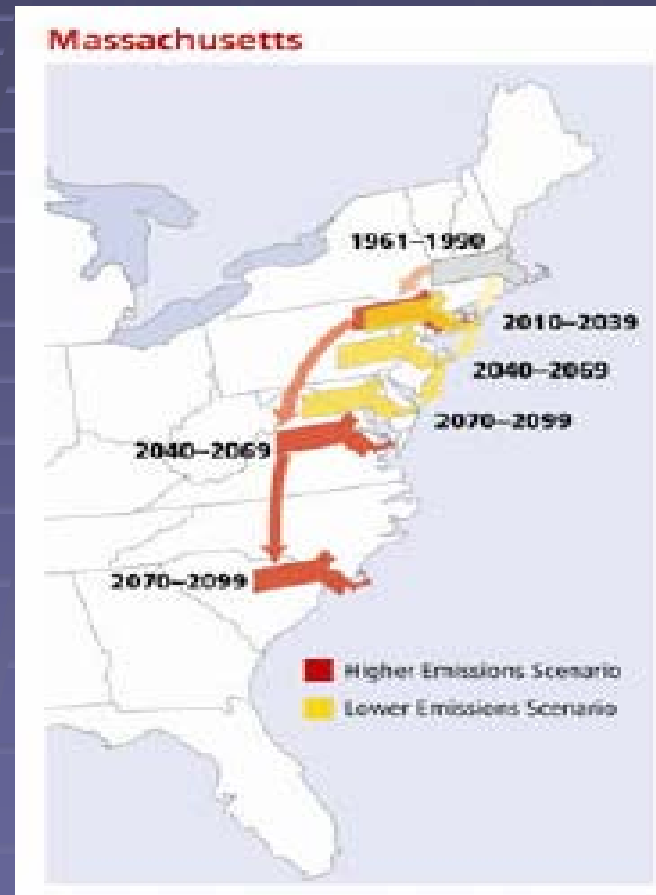
- Most recent modeling by Hayhoe *et al.* 2006
- Projected T, precipitation, etc, for next few decades, until mid-century, until 2100 under:
 - Low emissions scenario (B1). Doubling of CO₂
 - High emissions scenario (A1F1). Tripling of CO₂

RESULTS OF GCM/EMISSIONS MODELING - TEMPERATURE

Projected Temperature Change (°F)			
	2030	2050	2100
Winter:			
Low emissions	+2.5-4.0	+4.0-5.0	+5.0-8.0
High emissions	+2.5-4.0	+4.0-7.0	+8.0-12.0
Summer:			
Low emissions	+1.5-3.5	+2.0-5.0	+3.0-7.0
High emissions	+1.5-3.5	+4.0-5.0	+6.0-14.0



MIGRATION OF CLIMATE INDEX



UCS, 2007

SNOW-DAYS UNDER CLIMATE CHANGE

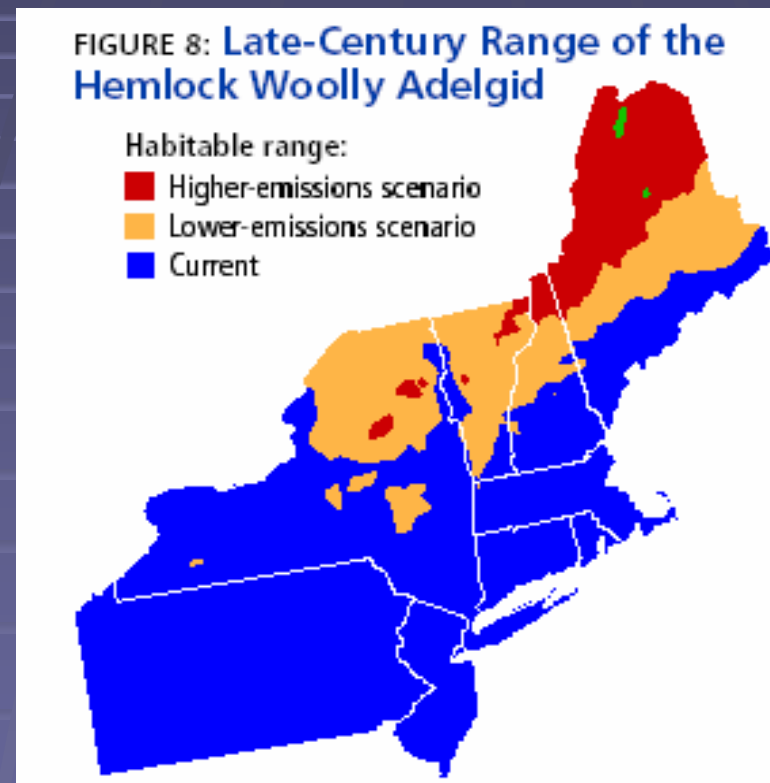
FIGURE 3: The Changing Face of Winter



If higher emissions prevail, a typical snow season may become increasingly rare in much of the Northeast toward the end of the century. The red line in the map captures the area of the northeastern United States that, historically, has had at least a dusting of snow on the ground for at least 30 days in the average year. The white area shows the projected retreat of this snow cover by late-century to higher altitudes and latitudes, suggesting a significant change in the character of a Northeast winter.

UCS (2007)

WOOLY ADELGID UNDER CLIMATE CHANGE



IMPACTS AND ADAPTATION

- Spent last decade thinking mainly about likely impacts on ecosystems
- We have fairly good idea of what is likely occur
- Emissions reductions are vital, but not a silver bullet
- We need to adapt!

ADAPTATION QUESTIONS

- Which ecosystems/species/sites are more or less vulnerable to cc?
- Ecological trajectories under climate change?
- Roles of other stressors?
- How well will traditional conservation tools work in climate changed future?
- How do we avoid cures as bad as the illness?

MASSACHUSETTS ADAPTATION PROJECT

Logistics:

- Funding source – Doris Duke grant administered by Wildlife Conservation Society
- Timeline – 18 month project begun in April/May 2008. Will conclude in October/November 2009
- Collaborative – Manomet, DFW, TNC

CONSERVATION PLANNING - MASSACHUSETTS

- State has already developed (2005) Wildlife Action Plan – “roadmap” for future conservation of wildlife and habitat
- Identifies 22 critical habitat types and 257 animals in “greatest conservation need”
- Priority strategy – Proactive Habitat Protection
- Acknowledges that climate change is likely to be major stressor and needs to be included

OBJECTIVES OF PROJECT

- ❖ Big Picture: to ensure that future conservation planning and implementation is “Climate-Smart”
 1. Determine how climate has changed in last century and how it will change in the next – fine spatial scale
 2. Map “exposure” and risk to important state resources
 3. Quantify vulnerabilities and likely trajectories of fish and wildlife habitats to climate change
 4. Build a GIS tool to support future acquisition decisions

PROGRESS SO FAR – VULNERABILITY EVALUATION

Objective to evaluate the comparative vulnerabilities of fish and wildlife habitats

- Focus-group approach involving state habitat experts

WHY FOCUS GROUP APPROACH?

- We are projecting into the future
- Projections based on best current knowledge about climate change and Massachusetts habitats
 - ecology
 - current extents and change
 - threats
- “Ownership”

FOCUS GROUP PROCESS

1. Habitat sub-groups formed (forests, wetlands, aquatic, coastal)
2. Provided latest information on future climates (2 scenarios)
3. Identified important variables that link climate change and ecosystems (elevation, cold-adapted, etc.)
4. Manomet developed preliminary sketch of likely vulnerabilities of each habitat
5. Sub-groups meet to review and comment on preliminary evaluations
6. Preliminary evaluations rewritten in light of sub-group comments
7. Evaluations to be submitted for final review to entire panel.

HABITATS BEING EVALUATED

Table 4. Habitat types evaluated.			
Forested habitats		Freshwater wetland habitats	
Spruce-fir forest	C	Emergent marsh	C
Northern hardwood forest	C	Shrub swamp	C
Southern/central hardwood forest	C	Spruce-fir boreal swamp	C
Pitch pine-scrub oak forest	C	Atlantic white cedar swamp	C
Freshwater aquatic habitats		Riparian forest	P
Cold water Rivers and Streams	C	Hardwood swamp	C
Large cold water lakes	C	Vernal pools	C
Smaller cold water lakes and ponds	C	Coastal habitats	
Cold water kettle ponds	C	Intertidal mud/sandflats	P
Warm water ponds, lakes and rivers	C	Saltmarsh	P
Connecticut and Merrimack mainstems	C	Dune habitats	P

EMISSIONS SCENARIOS

- Doubling of CO₂ (LES)
- Tripling of CO₂ (HES)

Pre-industrial atmospheric CO₂ was 275ppm. Now at 390ppm – well on way to doubling.

Vulnerability scores

Habitat likely to be eliminated entirely	7
Majority of habitat likely to be eliminated	6
Extent will be reduced but by <50%	5
Extent may not change appreciably	4
Habitat may become established	3
Habitat may expand moderately (<50%)	2
Habitat extent may expand greatly	1

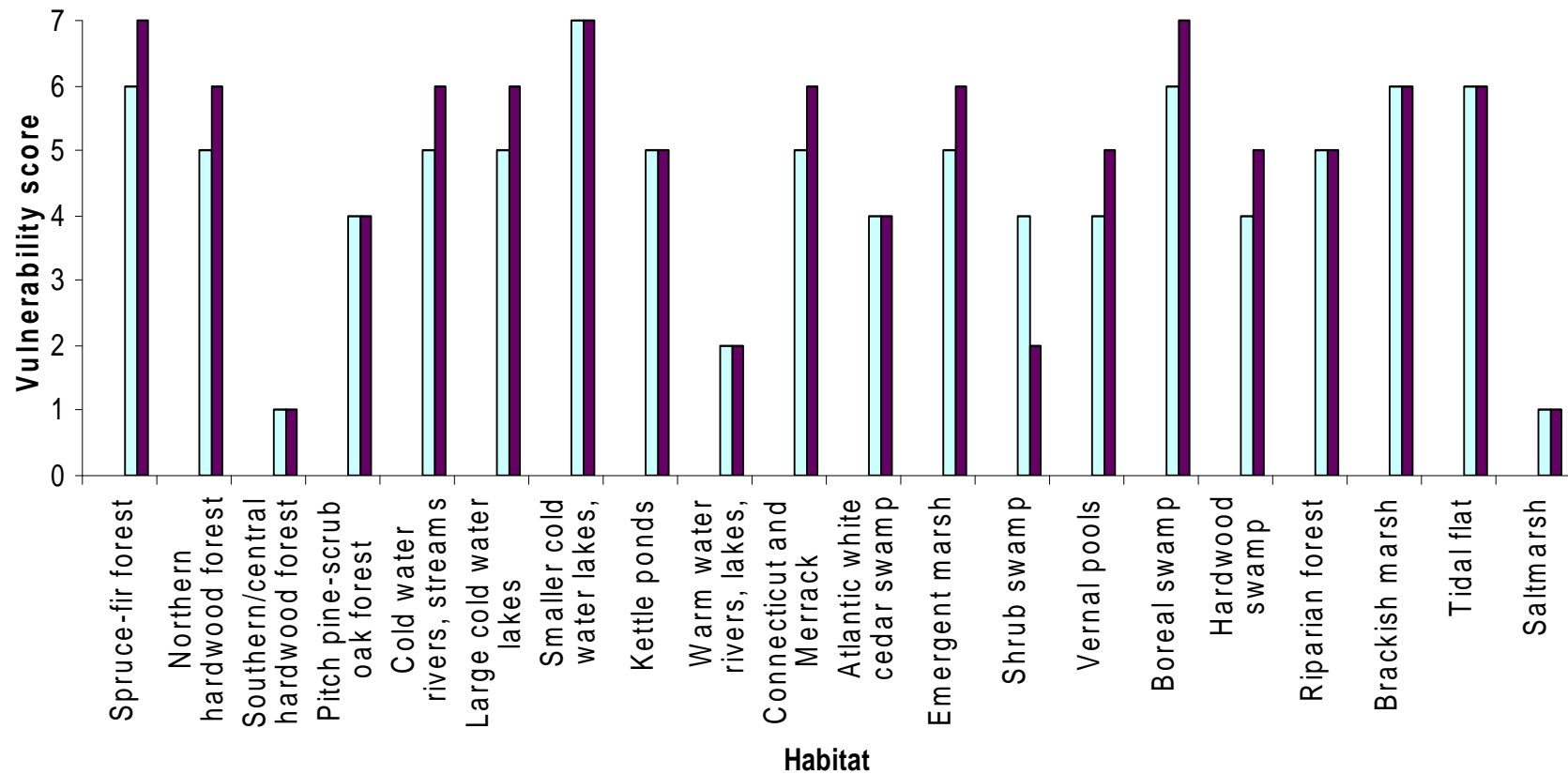
CONFIDENCE?

Three confidence scores (modified from IPCC):

High	>70%
Medium	30-70%
Low	<30%

HABITAT VULNERABILITIES

Figure 1. Habitat Vulnerability to Climate Change



VULNERABILITY FACTORS

Habitat	Cold-adapted	High elevation	Northern habitat	Southern habitat	Low elevation	Fire-vulnerable	Pest outbreaks
Spruce-fir	XX	XX	XX			XX	XX
Boreal swamp	XX	XX	XX			XX	X
Coldwater lakes	X	X	X				
Northern hardwood	X	X	X				X
Coldwater rivers	X	X					
Pitch pine scrub-oak				XX	X	Dependent	
Atlantic white cedar				XX	XX	Dependent	
Central/southern hardwoods				XX	XX	Tolerant	
Warm water aquatic				XX	XX		

CONFIDENCE SCORES

Vulnerability Score				
	4	5	6	7
High			Northern hardwoods	Spruce-fir forest Boreal swamp Cold water rivers and streams Cold water lakes and ponds
Medium	Atlantic white cedar Shrub swamp	Hardwood swamp	Large cold water rivers and lakes Merrimack and Connecticut mainstems	
Low	Pitch pine-scrub oak	Vernal pools		

ADAPTATION OPTIONS

Table 7. Non-climate stressors currently affecting vulnerable habitats.

Habitat	Non-climate Stressors
Spruce-fir forest	<ul style="list-style-type: none"> • Fire • Pest outbreaks • Fragmentation
Boreal swamp	<ul style="list-style-type: none"> • Fire • Pest outbreaks
Northern hardwood forest	<ul style="list-style-type: none"> • Fire • Pest outbreaks • Invasive species • Fragmentation
Riparian forest	<ul style="list-style-type: none"> • Water management/withdrawals
Small coldwater lakes and ponds	<ul style="list-style-type: none"> • Adverse management practices • Non-point contaminants • Dams and culverts
Large coldwater lakes	<ul style="list-style-type: none"> • Adverse management practices
Coldwater rivers	<ul style="list-style-type: none"> • Water withdrawals • Elimination of shade vegetation • Impervious surfaces

VULNERABILITY ASSESSMENT

- VA is essential first step in adaptation planning
- Can be relatively rapid and “easy” (using existing expert knowledge)
- Helps us to focus on essentials
- We need to apply it throughout Northeastern states
- Is step toward management of resources

NEXT ESSENTIAL STEPS - REGIONALIZATION

Regionalization is crucial:

- We need to take regional view to optimally conserve resources
- Many agencies working in this field but communication could be better
- We are strengthened if we work together
- Right now we do not have a vehicle

NEXT ESSENTIAL STEPS – TOOLS AND SOLUTIONS

- Enough with the polar bears!
- We already know a lot about the *theory* of adaptation
- What we do not have are effective on-the-ground tools and solutions
- We need to develop these tools by combining efforts and knowledge of scientists and managers

NEXT ESSENTIAL STEPS –MAN IN THE LANDSCAPE

- We have lots of ideas about how cc will affect ecosystems
- Economies of many communities depend on the goods and services provided by these systems
- We have at best rudimentary ideas about how cc will affect flow and quality of goods and services
- We need to close the loop by moving beyond “bugs ‘n bunnies”