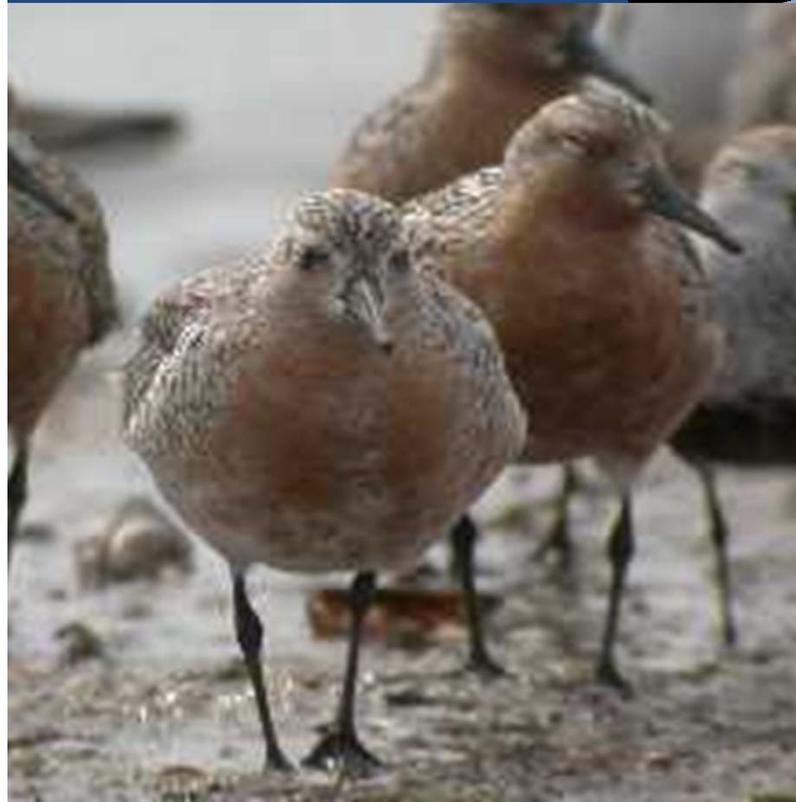


Approaches to Vulnerability Assessment Scale





WHERE ARE THE VULNERABILITIES?

- Tierra del Fuego?
- Argentina coast?
- Brazil?
- Mid-Atlantic states?
- Hudson's Bay?
- High Arctic?
- Fall or spring?
- Wind patterns?
- Synchronicities?

Comprehensive VA needed

Vulnerabilities of Shorebirds to Climate Change

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²Dalton State College

³Tufts University

Our Approach

- Evaluates threats to shorebirds by species
- Works within the context of the Partners-in-Flight & U.S. Shorebird Conservation Plan risk systems
 - based on population size & trend, breeding & non-breeding distributions, threats to breeding & non-breeding sites





Vulnerability Factors

- 1) Loss/gain in breeding habitat under climate change
- 2) Loss/gain in wintering habitat under climate change
- 3) Loss/gain in migration habitat under climate change
- 4) Degree of dependence on ecological synchronicities
- 5) Migration distance
- 6) Degree of breeding, wintering, or migration habitat specialization

Risk Factors

1) Loss/gain in breeding habitat under climate change:

	Score	Arrow
Major loss (>50%)	5	↑↑
Moderate loss (10-50%)	3	↑
Limited or no loss (-10-10%)	0	0
Moderate increase (10-50%)	-1	↓
Major increase (>50%)	-2	↓↓

Note: risk could decrease



Semipalmated Sandpiper

	Score	Arrow
1) Loss/gain in breeding habitat under climate change	3	↑
2) Loss/gain in wintering habitat under climate change	5	↑↑
3) Loss/gain in migration habitat under climate change	3	↑
4) Degree of dependence on ecological synchronicities	5	↑↑
5) Migration distance	4	↑
6) Degree of breeding, wintering, or migration habitat specialization	4	↑↑

Change in status from 'moderate concern' to 'highly imperiled'

Results for 50 North Am. Shorebirds

- 43 species (86%) predicted to ↑ risk level due to climate change
 - 34 increased by 1 level
 - 9 increased by 2 levels
- 3 species at lower risk
 - Solitary sandpiper – more breeding habitat
 - Bristle-thighed curlew – more breeding & wintering habitat
 - White-rumped sandpiper – more wintering habitat



U.S. Shorebird Conservation Plan

Risk Category	Current	Expected with climate change
Not at risk	0	0
Low concern	7	2
Moderate concern	15	7
High concern	23	13
Highly imperiled	4	17
Critical	–	10

SCALE: the bigger (and smaller) picture

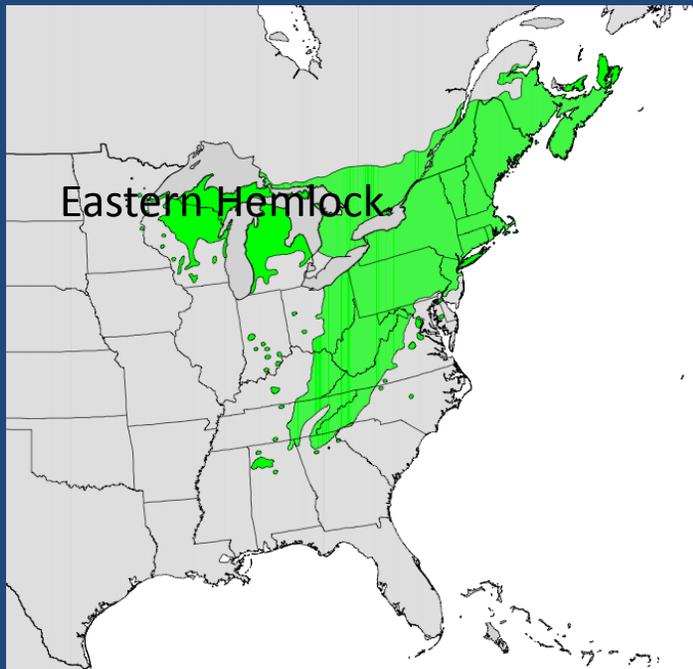
Space

Time

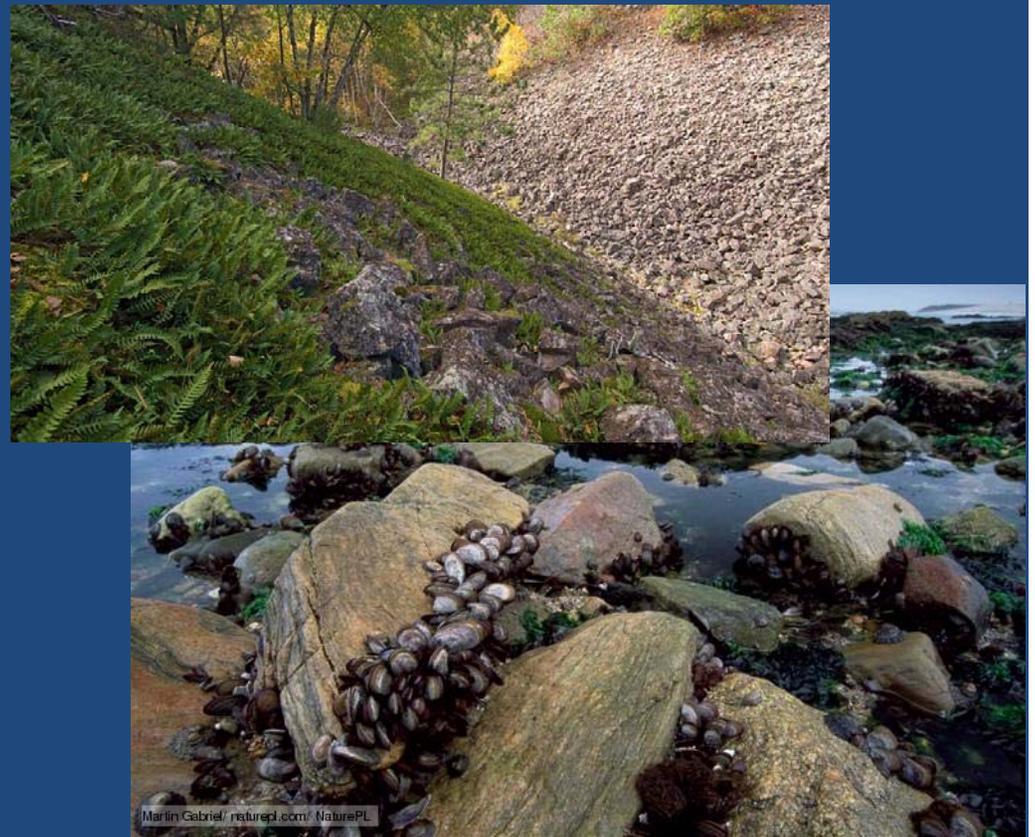
Resolution/grain

SPACE: Species

Macroclimates

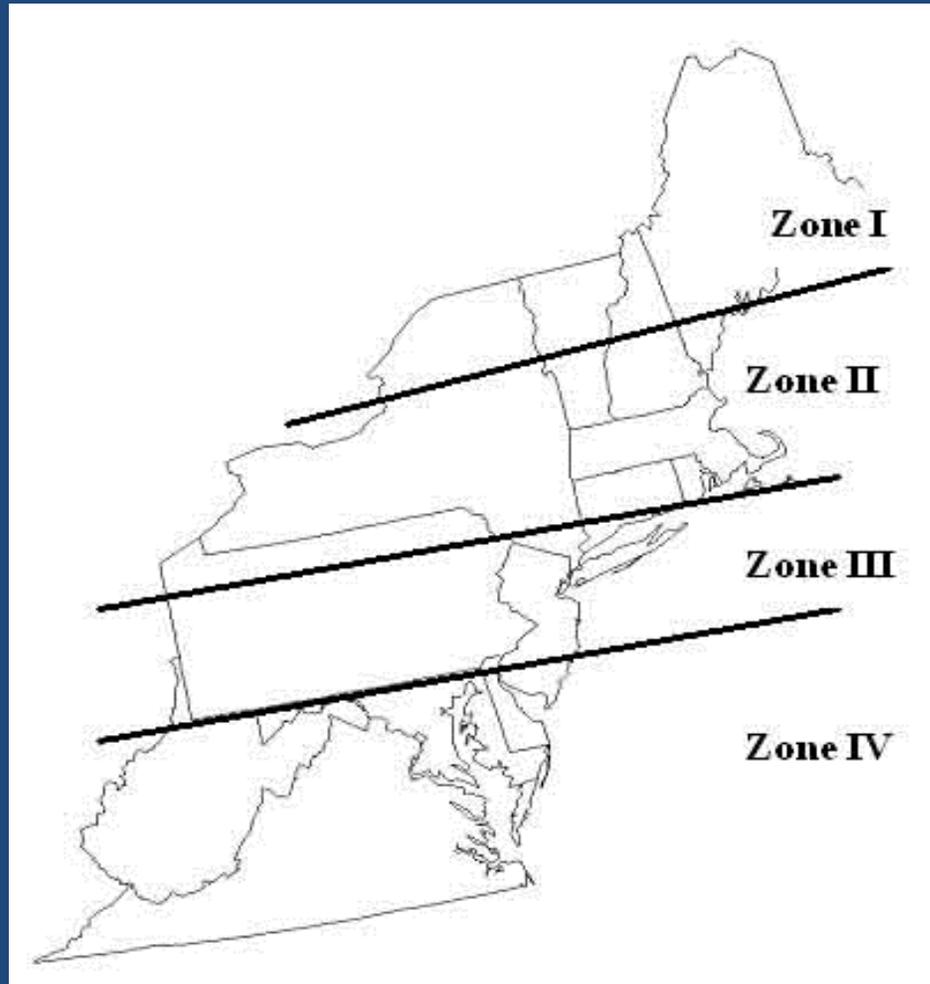


Microclimates



SPACE: Habitats

NEAFWA zones

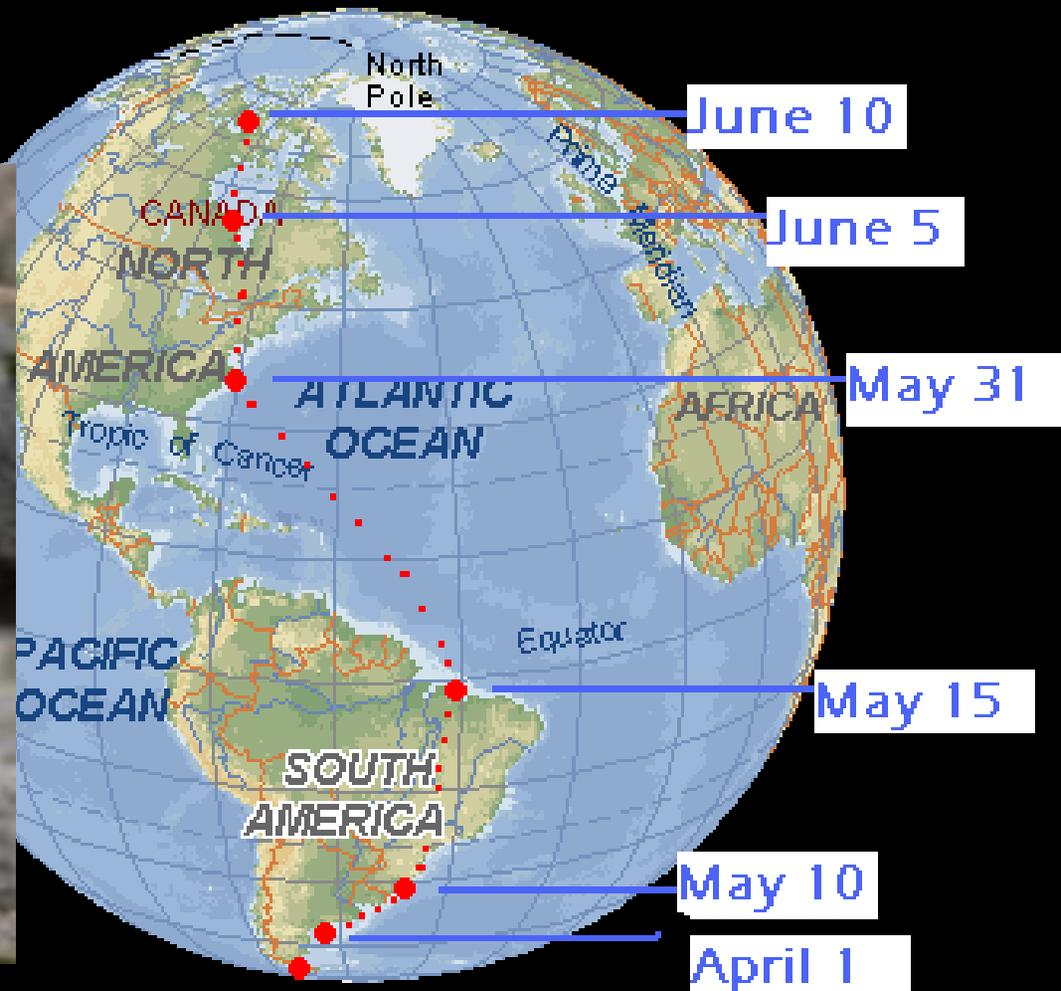
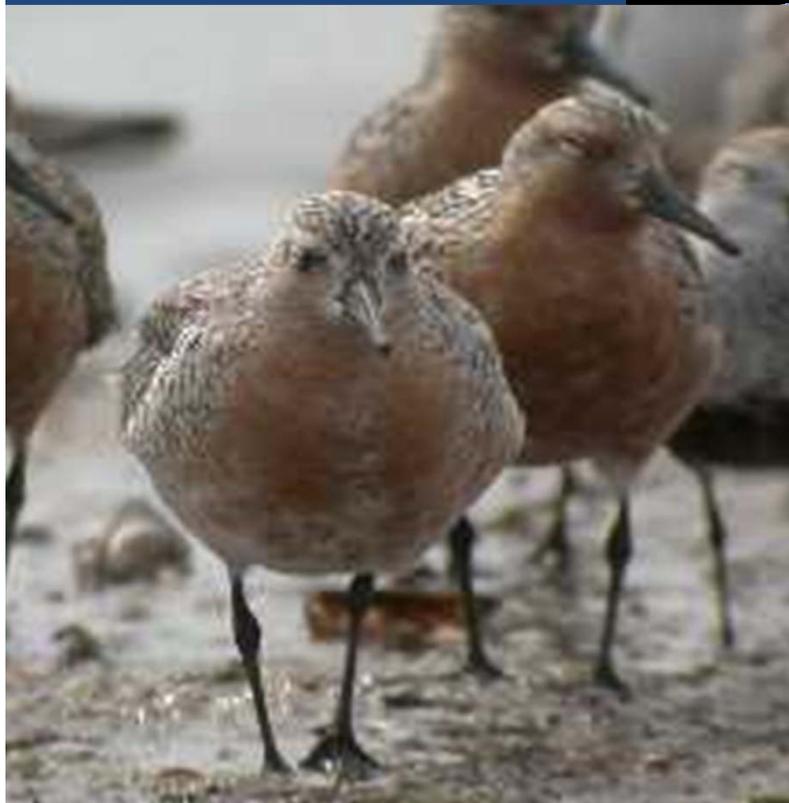


Habitat Vulnerability Across Zones

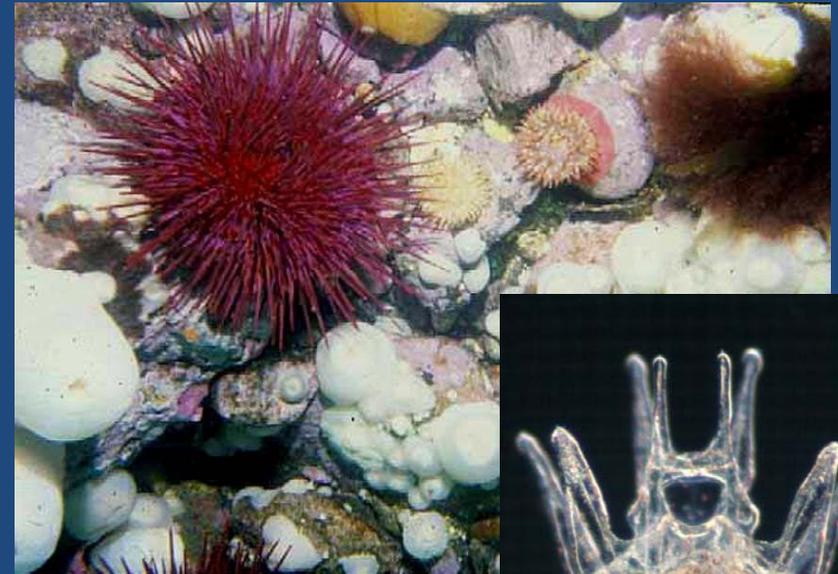
	Zone I	Zone II	Zone III	Zone IV
Acadian-Appalachian Alpine Tundra	Highly Vulnerable			
Acadian-Appalachian Montane Spruce-Fir Forest	Vulnerable	Critically Vulnerable		
Laurentian-Acadian Northern Hardwood Forest	Less Vulnerable	Vulnerable	Vulnerable	Critically Vulnerable
Central Mixed Oak-Pine Forests	Least Vulnerable	Least Vulnerable	Less Vulnerable	Vulnerable
Pitch Pine Barrens		Less Vulnerable	Less Vulnerable	Less Vulnerable
Northern Atlantic Coastal Plain Basin Peat Swamp		Less Vulnerable	Less Vulnerable	Less Vulnerable
Central and Southern Appalachian Spruce-Fir Forest				Critically Vulnerable
Boreal-Laurentian Bog	Highly Vulnerable	Highly Vulnerable		
Shrub Swamp	Vulnerable	Vulnerable	Vulnerable	Vulnerable
Emergent Marsh	Vulnerable	Vulnerable	Vulnerable	Vulnerable

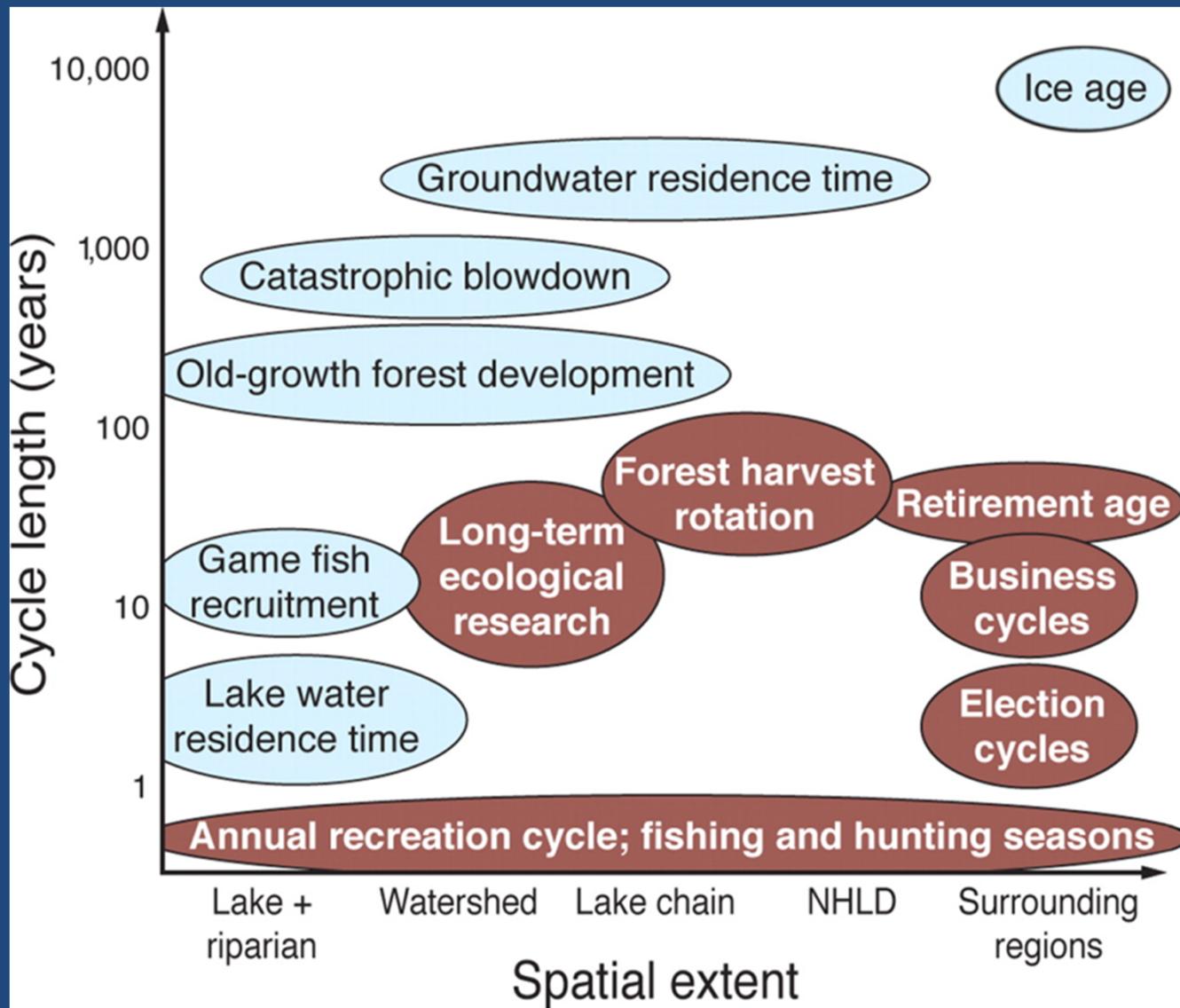
SPACE and TIME: Migratory pathways

Red Knot

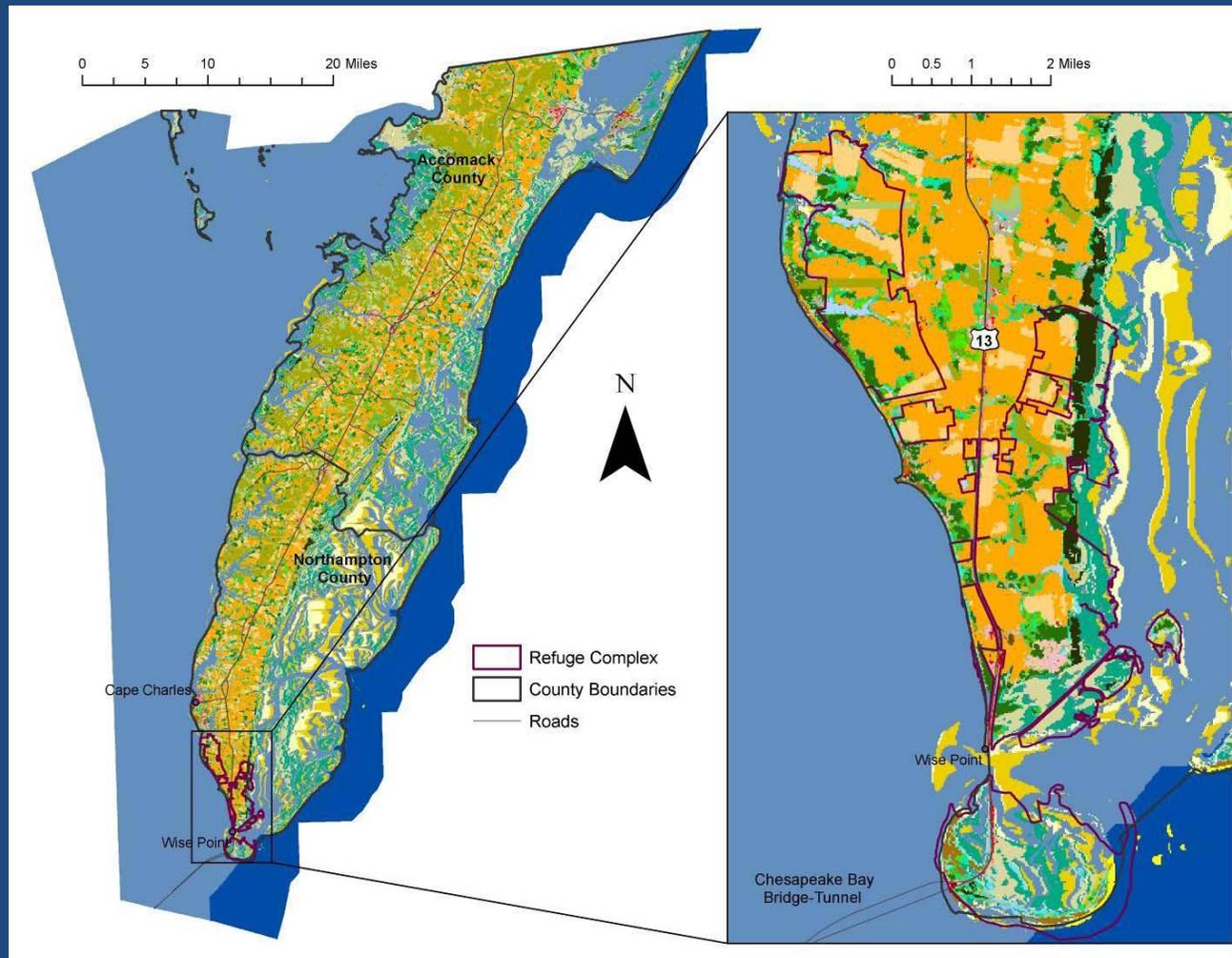


SPACE and TIME: Development



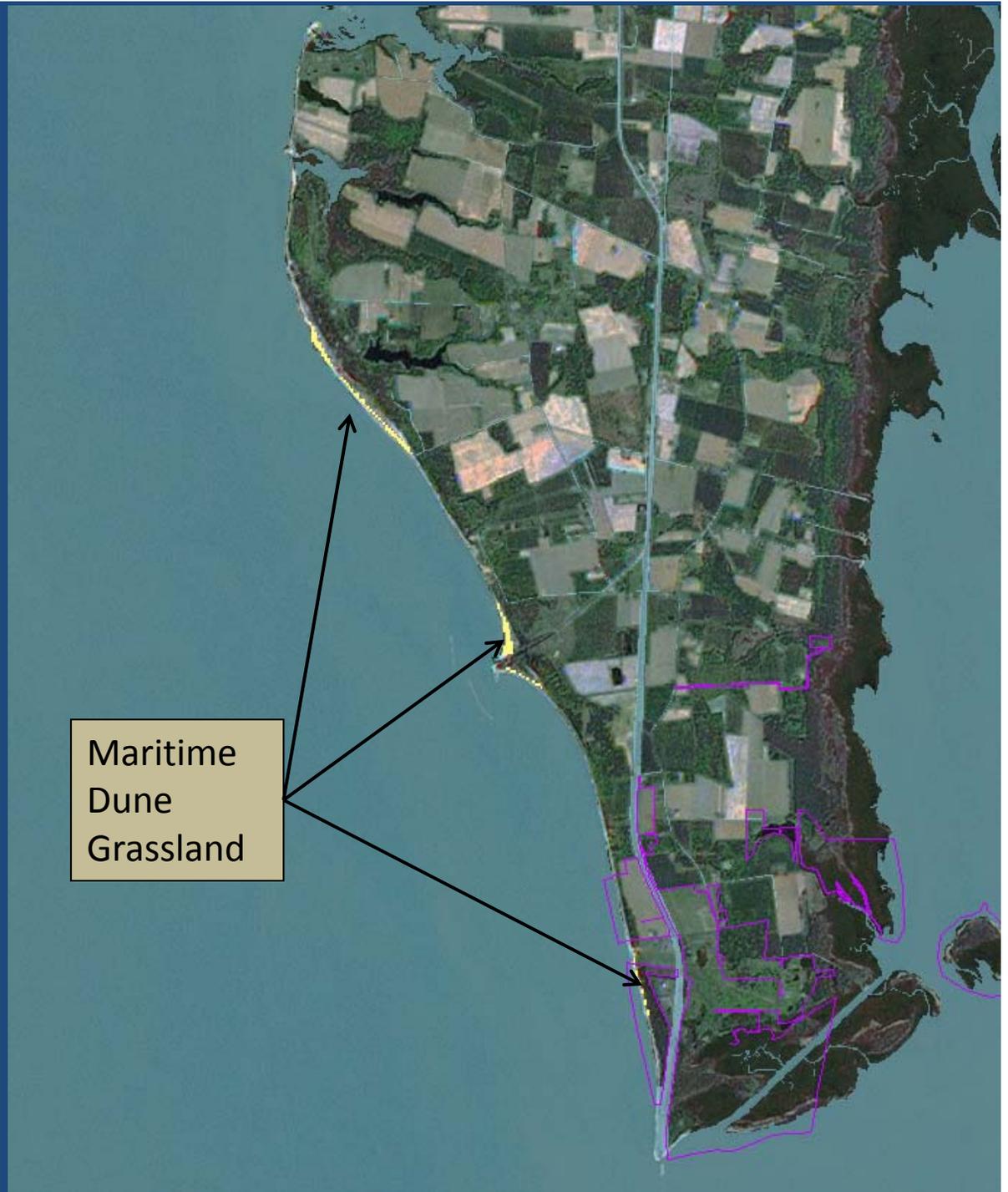
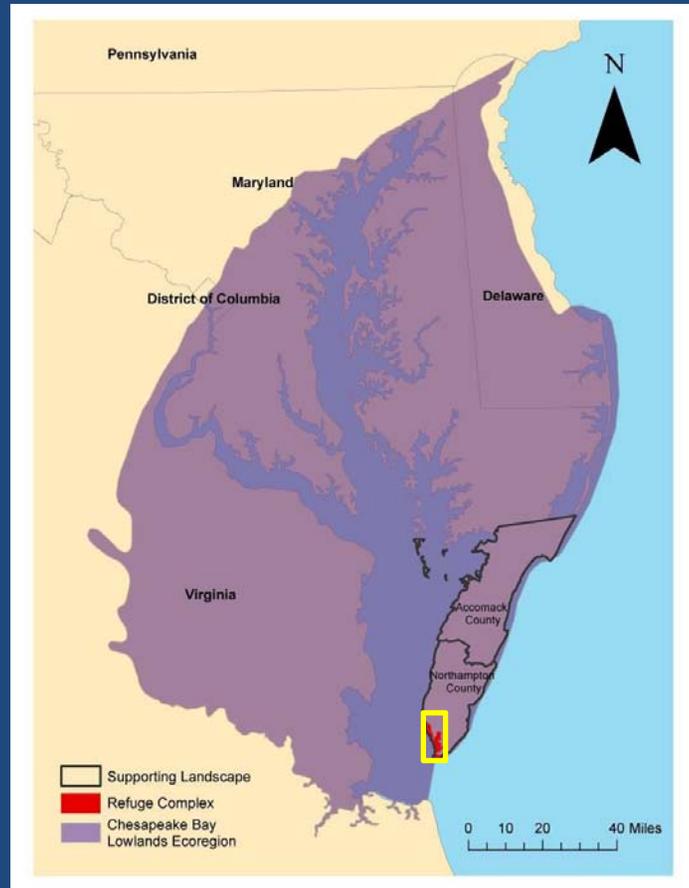


RESOLUTION: Grain of resource distribution



Grain of resources vs. type of assessment:

- Spatial/quantitative: stressors ~ match scale of resource distribution
- Qualitative: examine stressor scenarios and “hypothesize” vulnerability outcome



Scale of Implementation

Informs what are the useful types and scale of products to inform decision making

- Geographic position can matter:
 - On the coast vs upland
 - Implementers with small or narrowly defined jurisdictions (e.g., only river management)
- Type of implementation
 - Broad brush policy
 - Comprehensive use/management planning
 - Narrow site scale project design or regulation

Scale of Implementation

- Scales often mixed within the same landscape:

- Federal region
- State government
- Local governments
- Agency jurisdiction
- Watershed management
- Individual land owner
- Project site



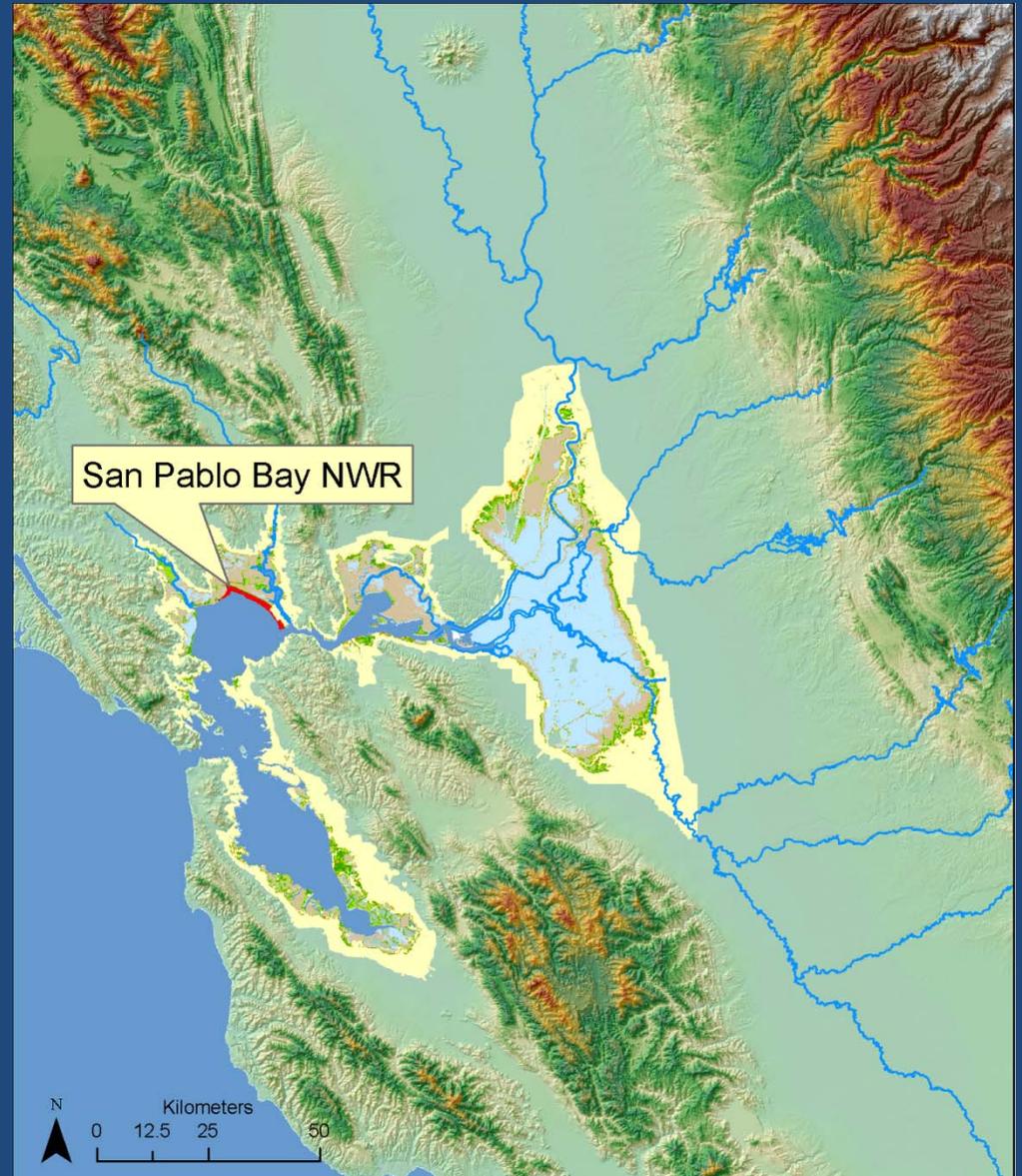
All in same planning area

Context vs Scale of Implementation

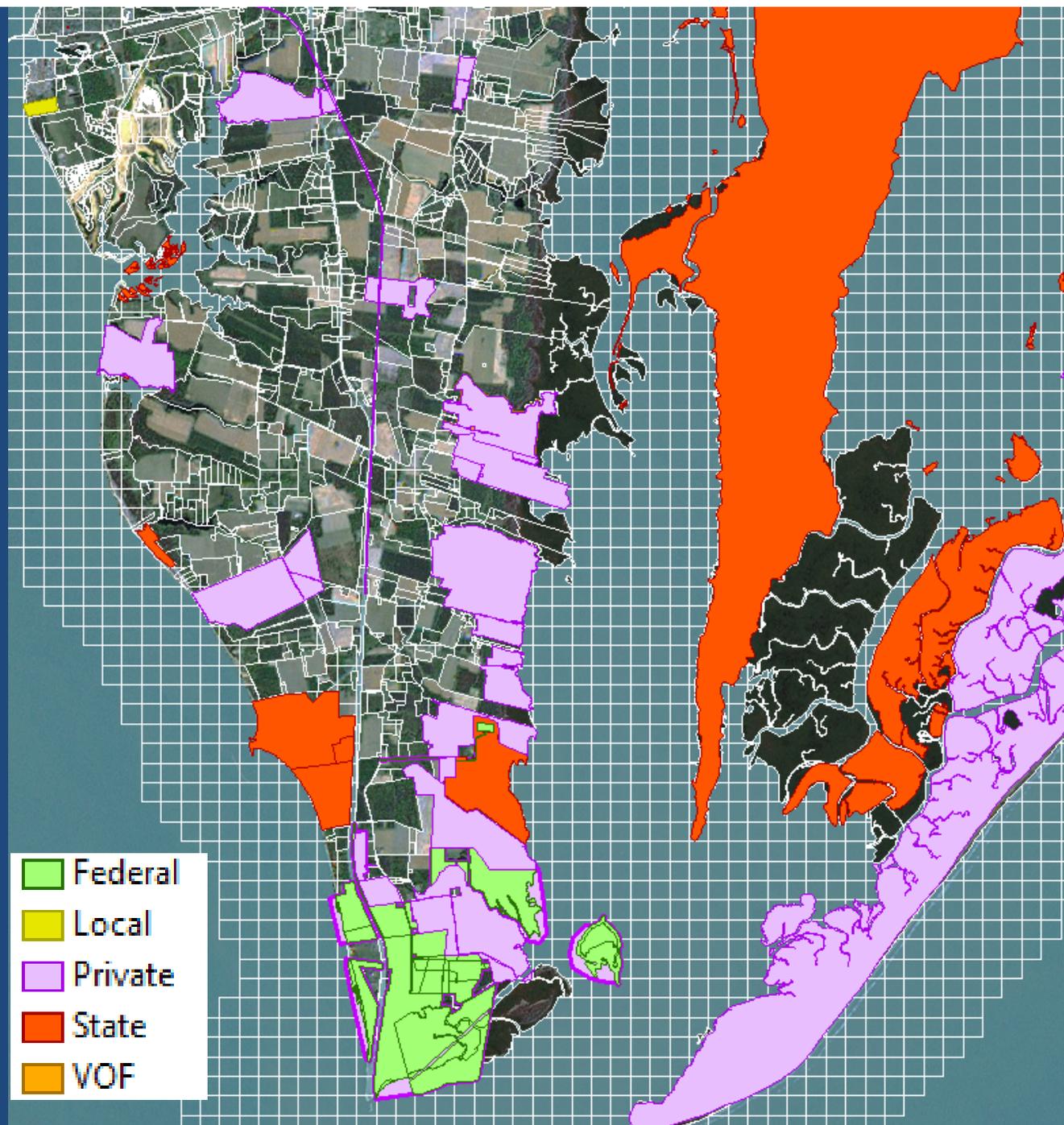
San Pablo Bay National Wildlife Refuge

Region influences policies and broader ecosystem function

- Implementation: highly influenced by surrounding land planners, owners, other NGOs activities



Grain of Implementation



Conclusion

- Scale has large implications
 - Types of possible assessments
 - Data needed
 - Uncertainty
 - Applicability to different scales and purposes
- Scale can only be somewhat controlled
 - Downscaling and modeling
 - New data collection and mapping
 - But projects will inherently contain resources and processes functioning at a variety of scales

Massachusetts Wildlife Habitat Climate Change Vulnerability Assessment

- **NORTHERN HARDWOODS FOREST VULNERABILITY EVALUATION**

- *NTWHCS category: Appalachian northern hardwood forest*

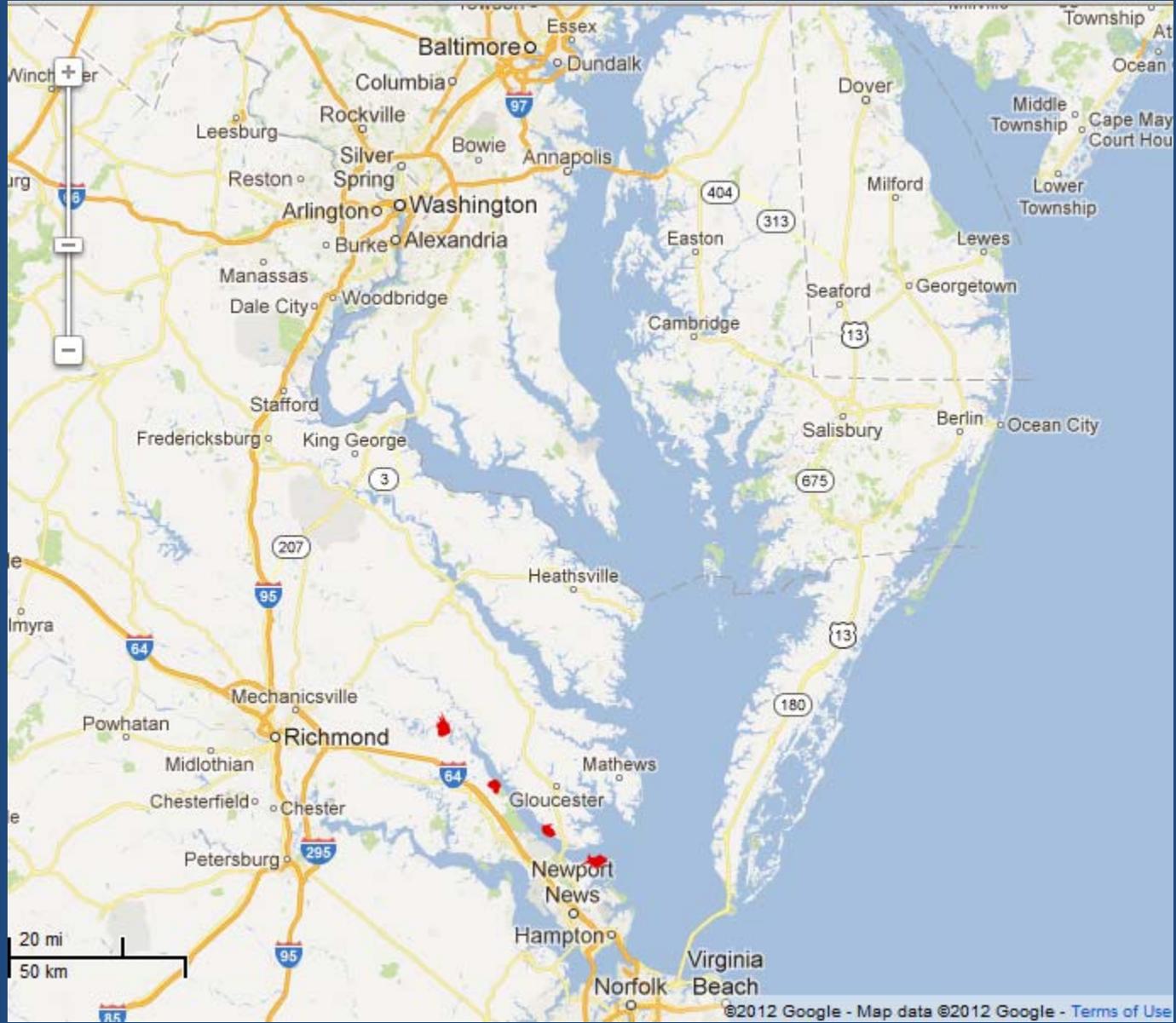
- *State ranking* *S5*

- **Vulnerability score** **5 and 6 (lower and higher emissions scenarios, respectively)**

- **Confidence evaluation** **Medium**

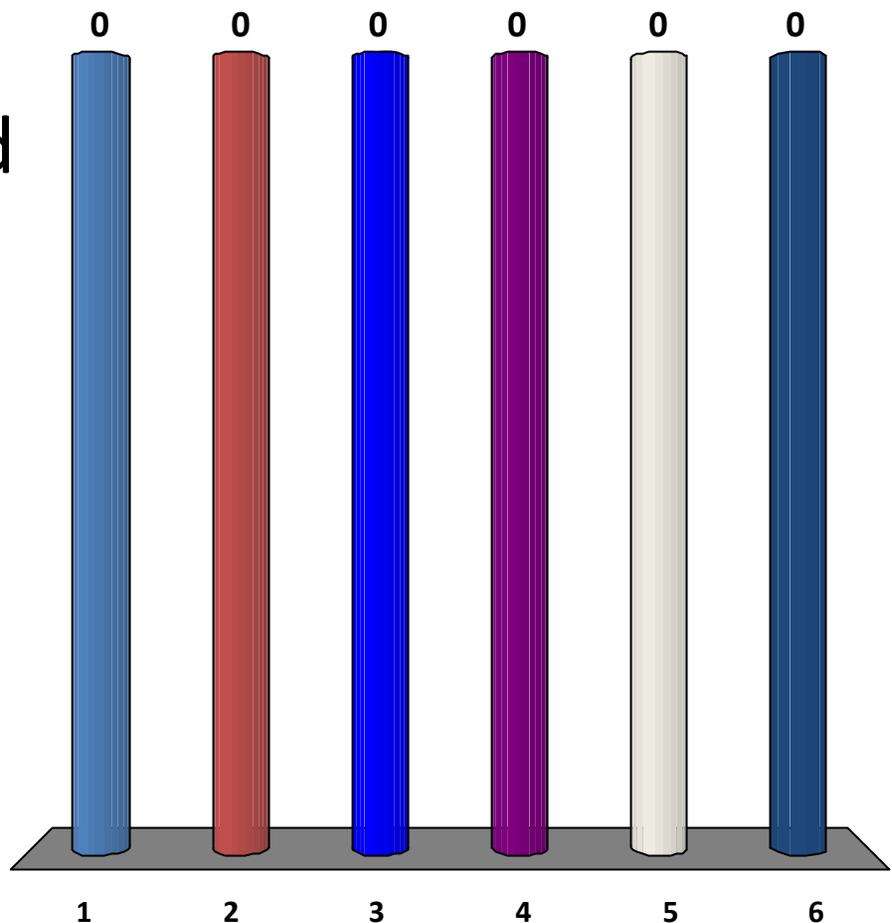
- **Rationale**

- With the distributional range of this habitat extending from Quebec in the north to high-elevation areas of Virginia and West Virginia, Massachusetts is close to the center of this community type's geographical distribution. In Massachusetts, where it is the predominant hardwood forest (see map below from the Massachusetts Natural Heritage and Endangered Species Program [NHESP]) in many areas, it is generally restricted to an altitudinal range of about 1,000-3,000 feet, being more adapted to colder temperatures and shorter growing seasons than southern/central hardwood forest (but less so than spruce-fir forest). It is dominated by Sugar Maple, Yellow Birch, and American Beech mixed with White Pine; with Eastern Hemlock at lower elevations; and with Red Spruce and Balsam Fir becoming important at the highest elevations where it grades into spruce-fir forest (Swain and Kearsley, 2001). Within the broad matrix of northern hardwood forest a number of variants occur, depending on local conditions. These include rich mesic forests dominated by Sugar Maples, Eastern Hemlock groves on cool, north-facing slopes or in ravines, and transition forests that include some species more typical of southern/central hardwood forest. It is not a fire-adapted community and fire suppression may have extended the range of this habitat in New England (J. Scanlon, Massachusetts DFW, *pers comm.*). This forest type is vulnerable to attack by insects, including gypsy moth and hemlock woolly adelgid, and to beech scale disease. Disturbance from blowdown, logging, or fire can lead to the (at least temporary) dominance of White Pine over other species. In areas closer to human habitation or powerline cuts, non-native plant species, including Japanese Barberry, Japanese Knotweed, etc., can form dense growths.



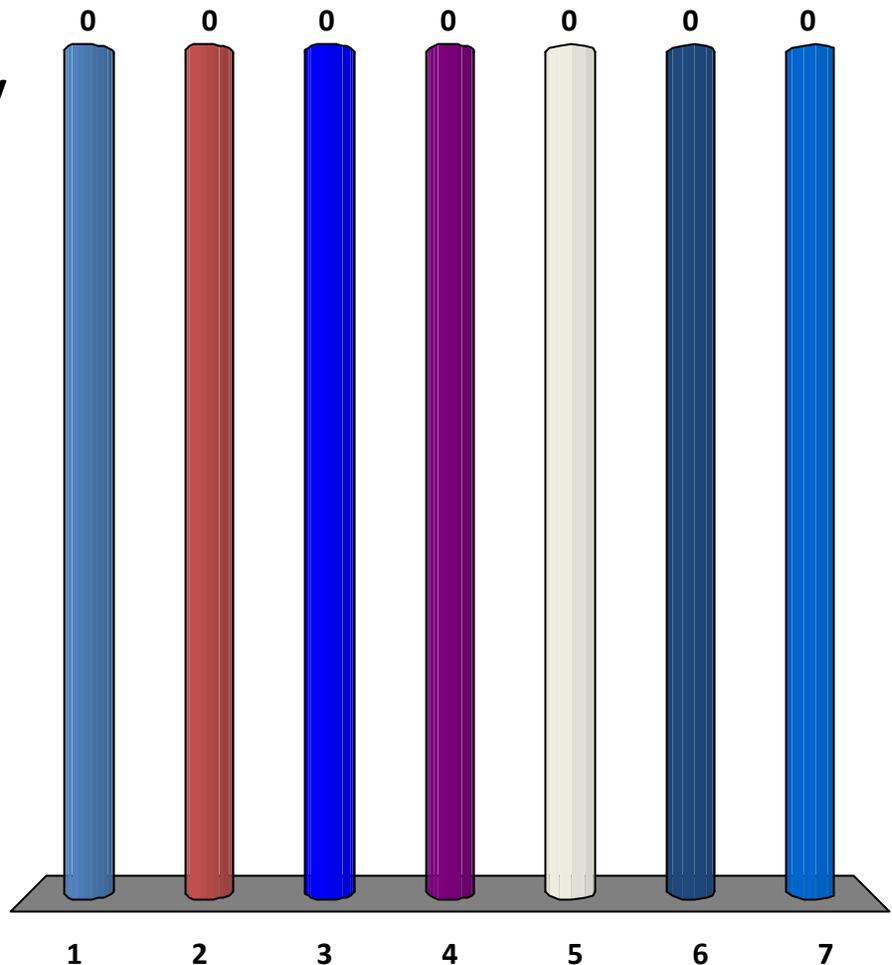
You are asked to do a VA for Chesapeake Bay-Virginia NERR. Do you assess exposure at the scale of:

1. CBNERR-VA
2. CBNERR-VA watershed
3. CBNERR-VA + MD
4. CBNERR-VA + MD and watersheds
5. The entire Bay
6. The entire Bay and its watershed



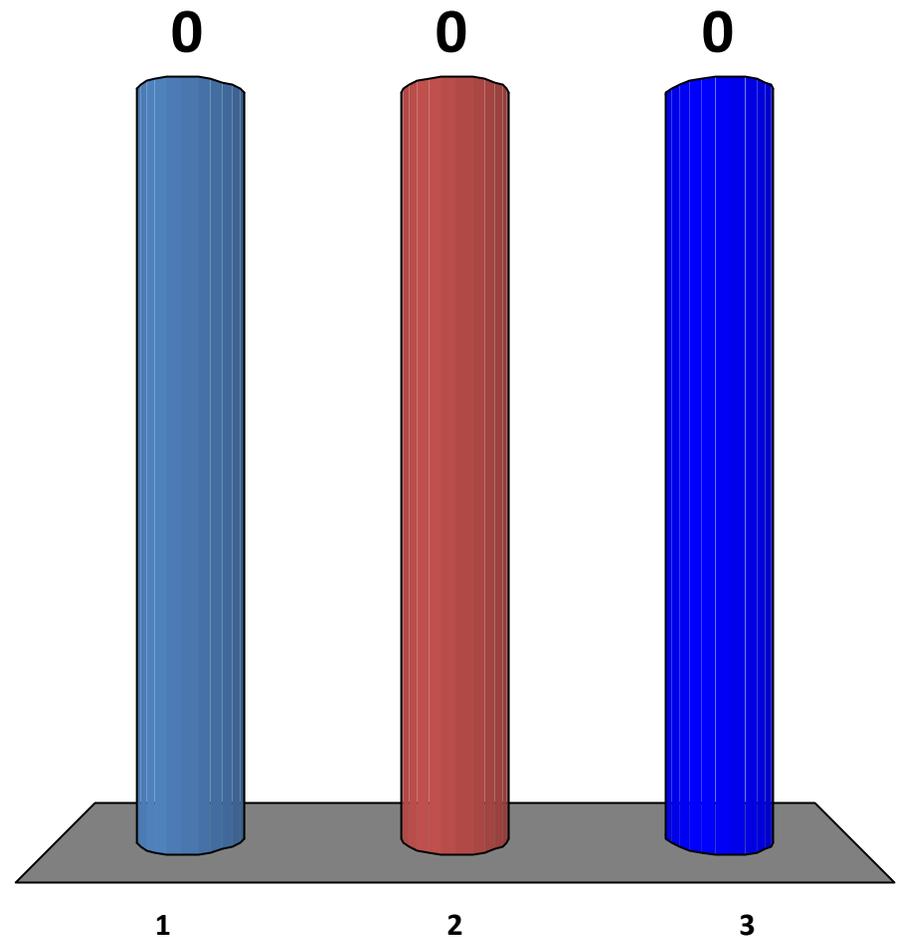
You work for CBNERR-VA & are asked to do a VA for the constructed oyster reef in the Goodwin Islands component. Do you assess exposure at the scale of:

1. The Goodwin Islands only
2. CBNERR-VA
3. CBNERR-VA & watershed
4. CBNERR-VA + MD
5. CBNERR-VA + MD and watersheds
6. The entire Bay
7. Bay & watershed



You work for CBNERR-VA & are asked to do a VA for loggerhead turtles to inform the Recovery Plan. Do you assess exposure at the scale of:

1. CBNERR-NA
2. Chesapeake Bay
3. Their entire range



You work for CBNERR-VA & are asked to do a VA for loggerhead turtles to inform Reserve management.

Do you assess exposure at the scale of:

1. CBNERR-VA
2. Chesapeake Bay
3. Their entire range

