

**Scale
Space, Time, &
Complexity**

Scanning the Conservation Horizon

A Guide to Climate Change Vulnerability Assessment



tion) increasingly is an important framework for assessing the vulnerability of natural systems (National Academy of Sciences 2005). Ecological assemblages (e.g., between pollinators and plants, or between fertilize, or breeding birds and their food) will be affected under future climate change. Component species respond differently, a combined strategy for assessing species and ecosystems in many situations (Root et al. 2002).

One key matter is the fact that the impacts of climate change are not in isolation, but they can exacerbate other stresses on ecosystems. Leading threats to ecosystems include habitat destruction, changes in ecological processes, the spread of harmful invasive species, and the emergence of new diseases. The health and diversity of our species and ecosystems are already seriously threatened. Changes in climate will increase their impact in predictable ways. As noted in the assessment, some aspects of climate change, and adaptive capacity, must be taken into account to some systems and depending on users' needs. It is important to take an approach that more specifically addresses the intersecting effects of all the stressors.

Understanding the vulnerability of ecosystems to climate change is inherently complex, and the advances in modeling have made

such assessments more accessible. For example, some dynamic global vegetation models (DGVM) can simulate ecosystem processes such as carbon dioxide (CO₂) uptake and fluxes in nutrients and water (Bachelet et al. 2001).

Chapter IV provides more detail about the use of these and other models in conducting a climate change vulnerability assessment for species, habitats, and ecosystems.

Space and Time: Selecting the Right Scales

Setting the appropriate geographic scale for your vulnerability assessment and determining over what time scale the analysis should cover are two key factors in designing a successful assessment.

Geographic Extent

Climate change vulnerability assessments can be done at local, regional, and national scales. As with the identification of the relevant assessment targets, a number of factors can determine the spatial scale on which you will focus. By its very nature, however, climate change will require that we think and plan within the context of larger landscapes, even when our management needs are very local. For example, many species are expected to shift their ranges in response to shifting climates,

An inverse relationship exists between the geographic scale of an assessment and the certainty of projections.

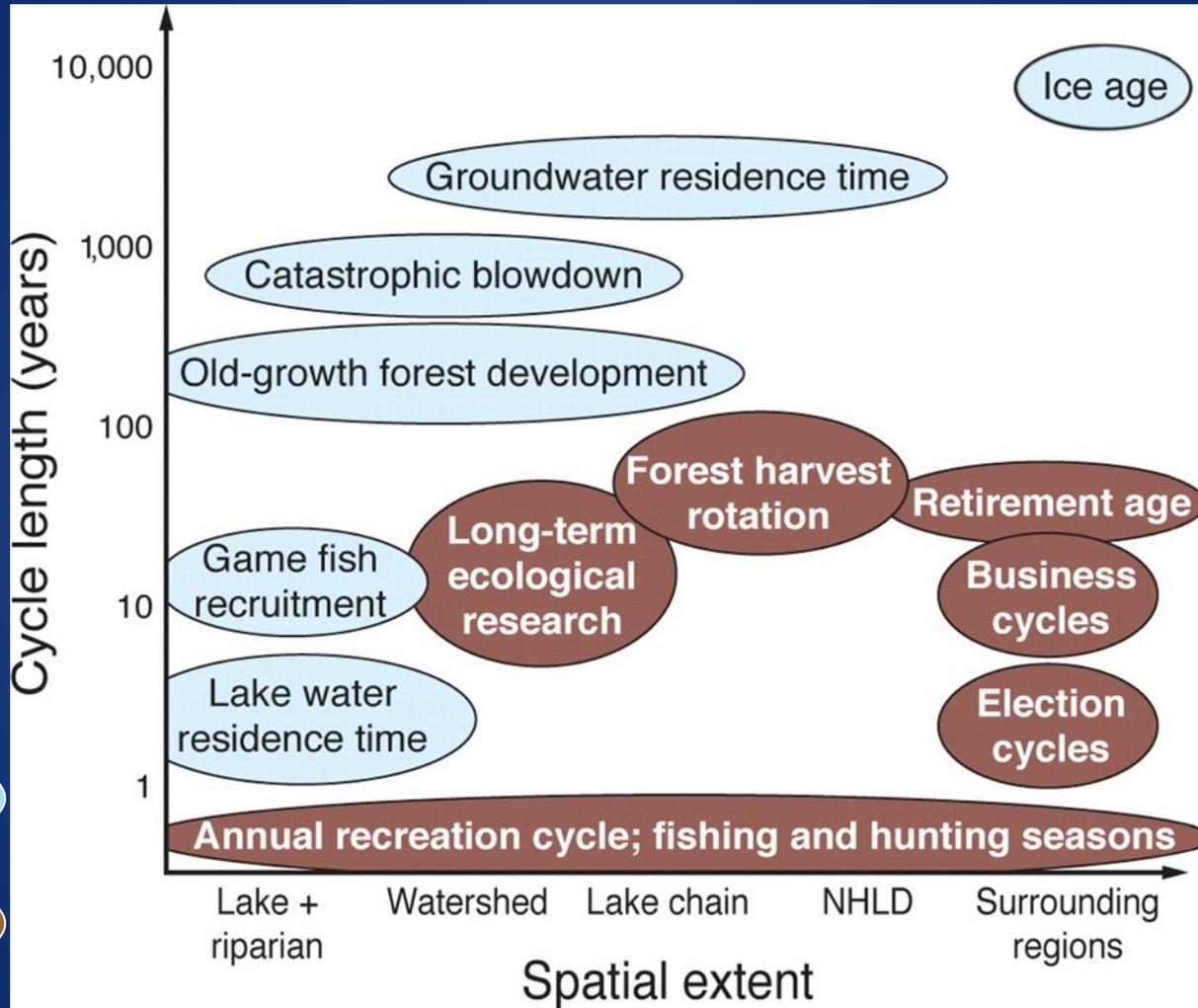
SCALE: the bigger (and smaller) picture

Space

Time

Resolution/grain

Temporal scale (measured as return time)
 vs.
 spatial scale (measured as extent of spatial patterns)



Brock W A , Carpenter S R PNAS 2007;104:15206-15211

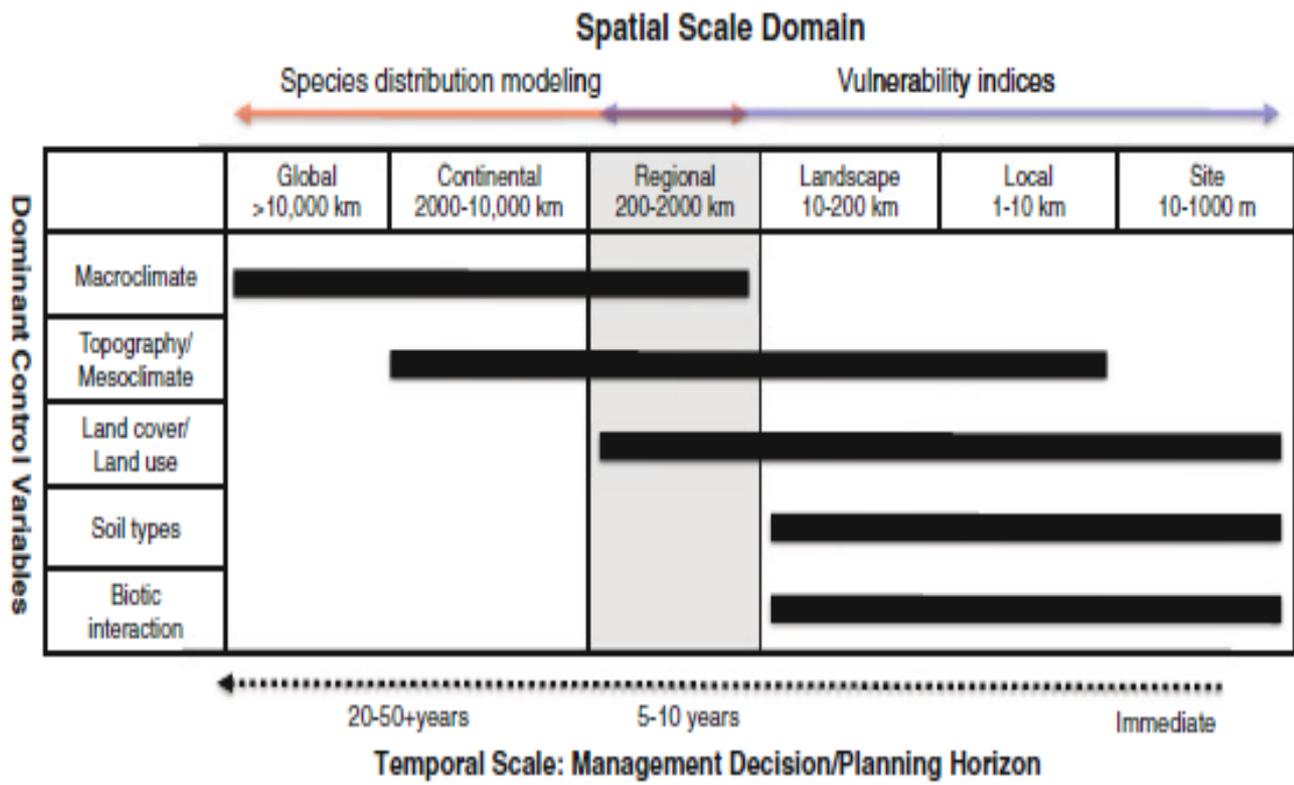
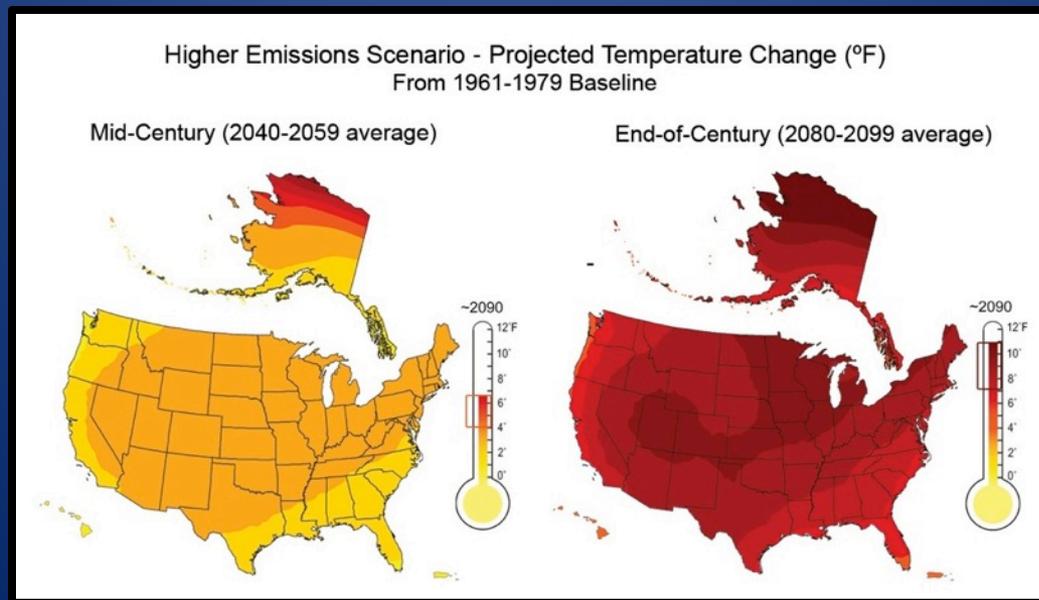
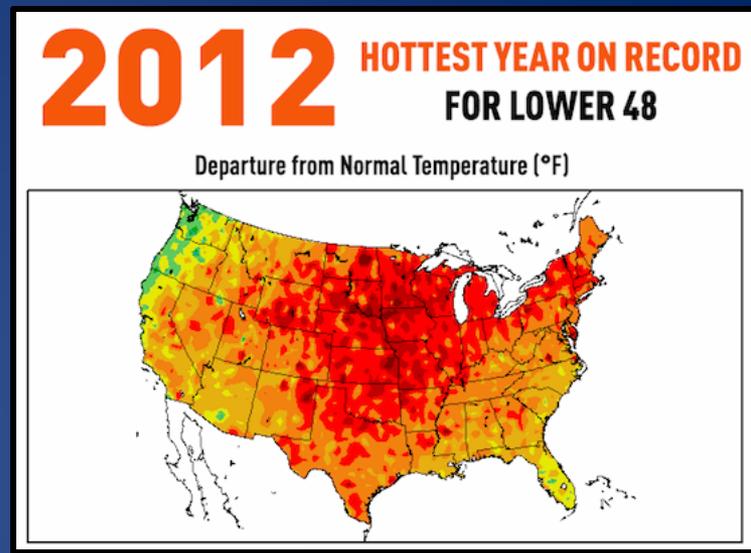
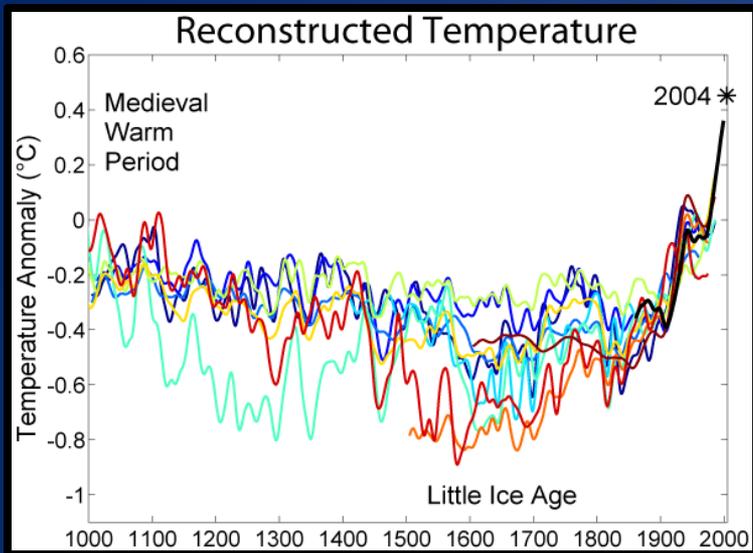


Fig. 2 Matrix for evaluating the suitability of the vulnerability assessment approaches to key elements of project scope (Modified from Pearson and Dawson 2003)

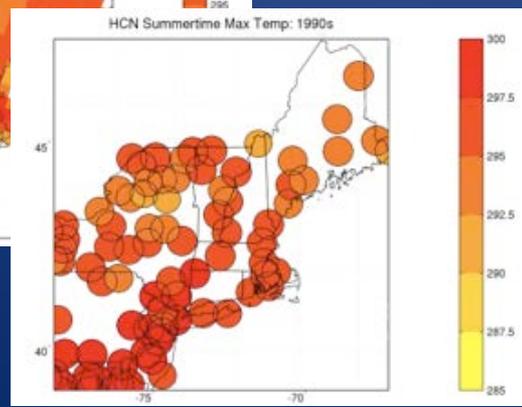
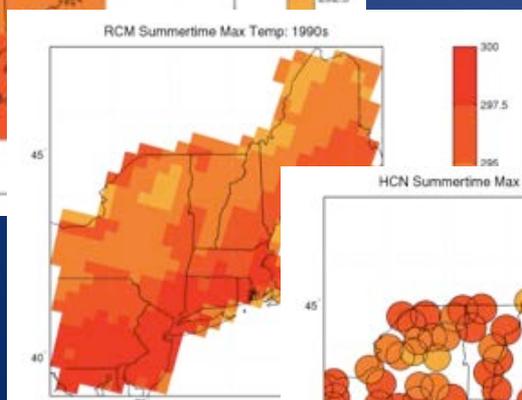
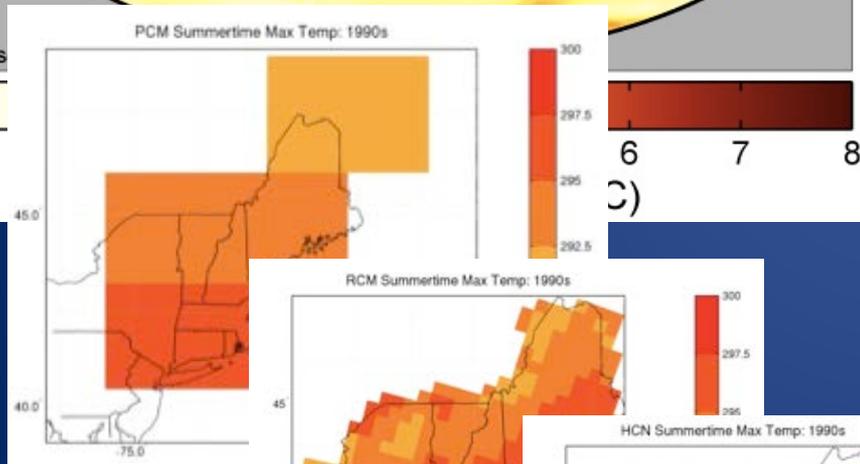
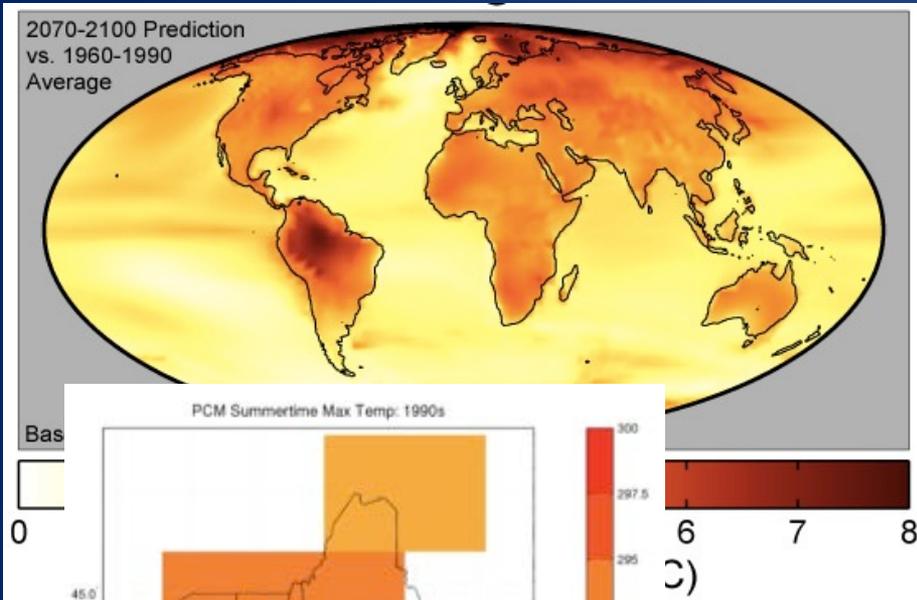
TIME: species and habitats



TIME: climate



SPACE: Climate

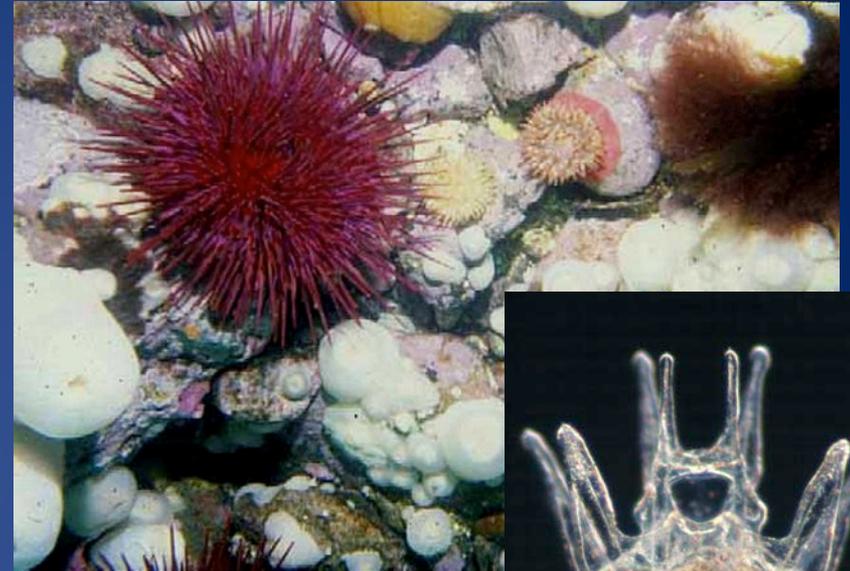
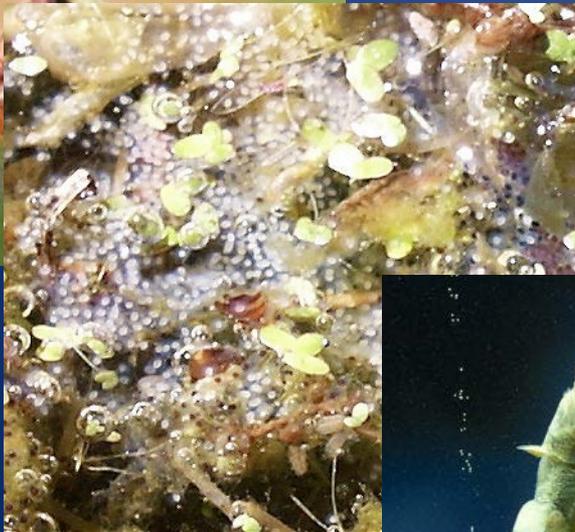


SPACE and TIME: Migratory pathways

Red Knot



SPACE and TIME: Development



CYTIXE COMP

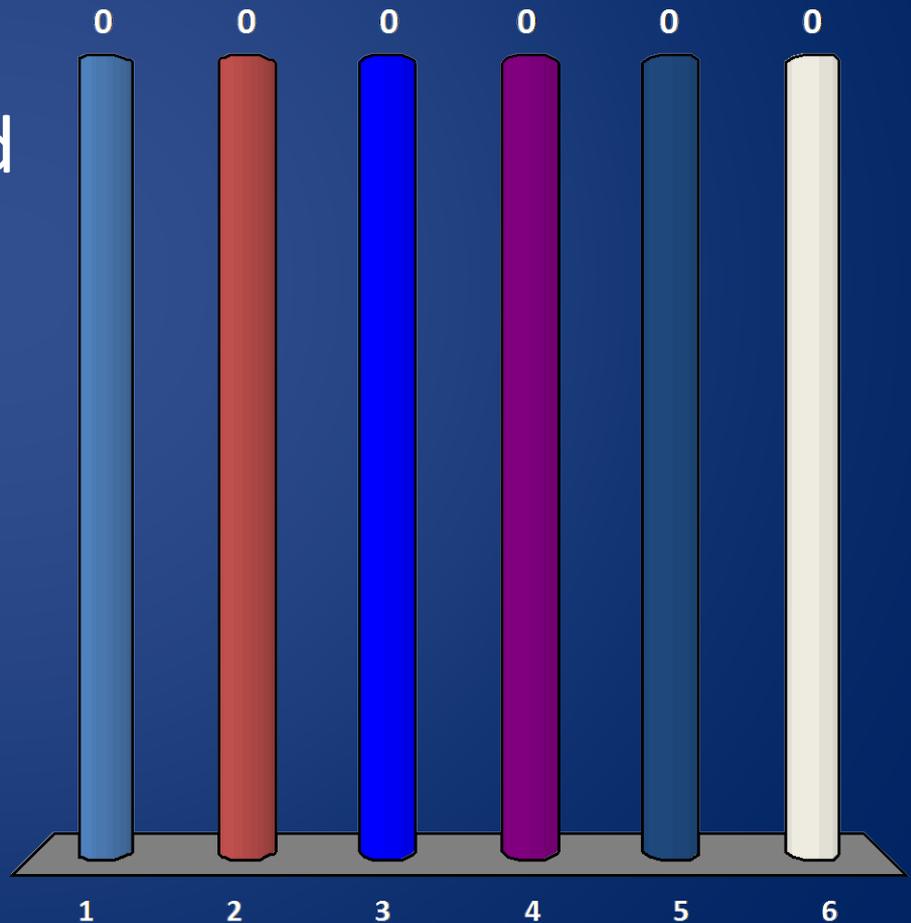
- Everything should be made as simple as possible, but not simpler.
- ...or, more is not always better
- One size fits no one.

Bottom line: consider the scale of Implementation

- Consider time and space relative to...
 - resource of interest
 - domain of possible management actions
 - effect of actions
- Type of implementation
 - Broad brush policy
 - Comprehensive use/management planning
 - Narrow site scale project design or regulation

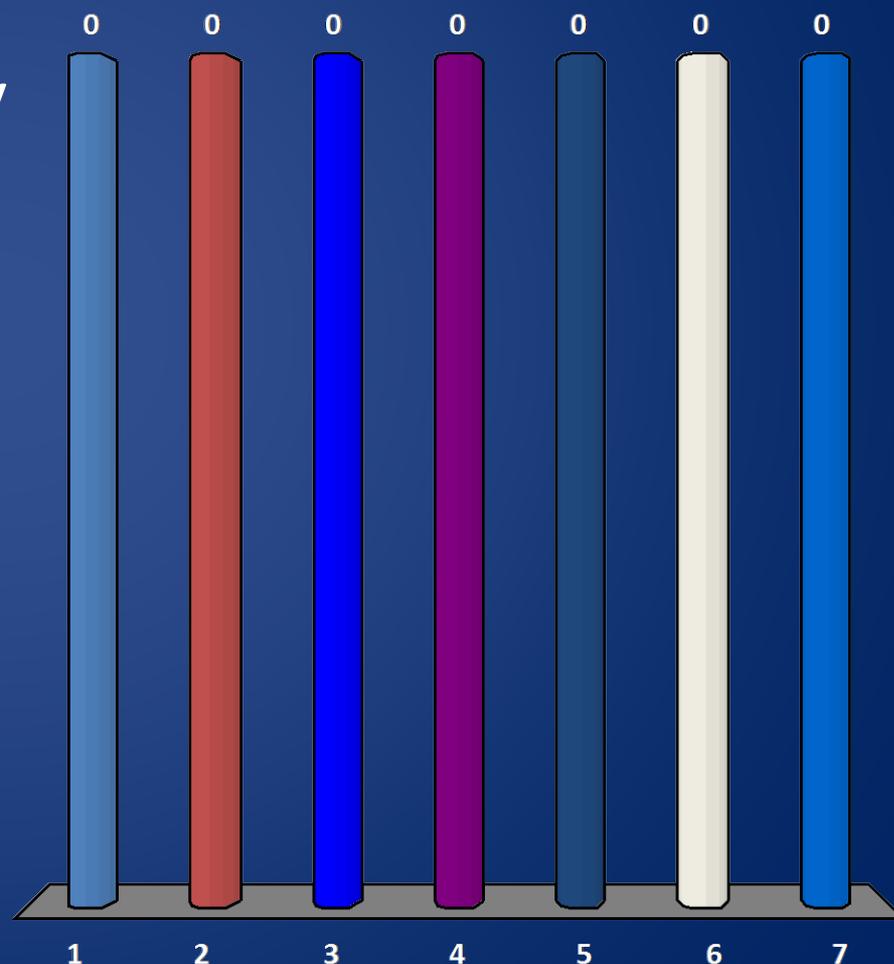
You are asked to do a VA for Chesapeake Bay-Virginia NERR. Do you assess exposure at the scale of:

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



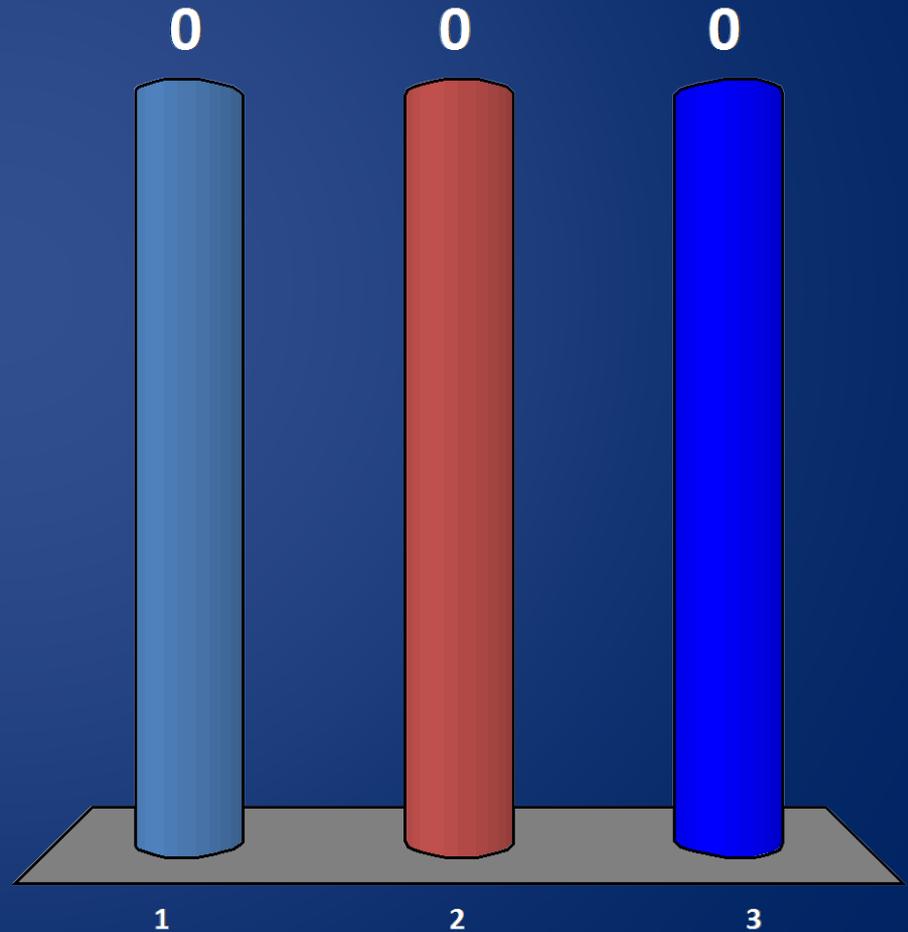
You work for CBNERR-VA & are asked to do a VA for the constructed oyster reef in the Goodwin Islands component. Do you assess exposure at the scale of:

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

