Managing Tidal Creeks to Address Climate Change: Vulnerability Assessment and Adaptation Options

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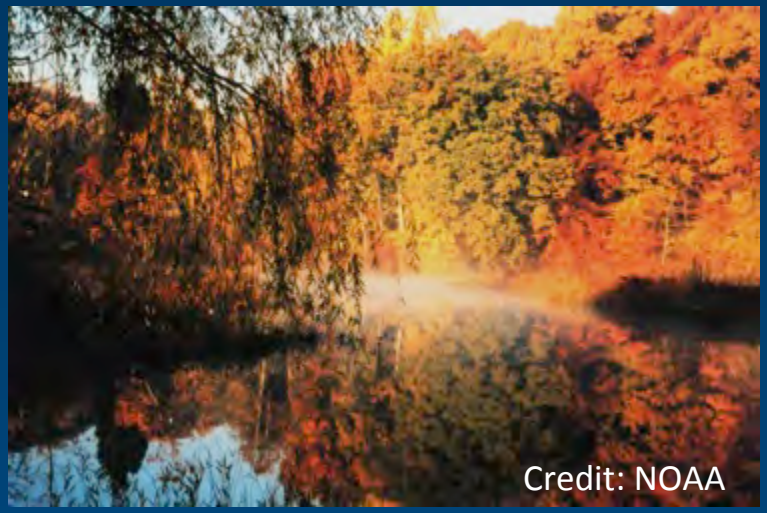
Expert Elicitation

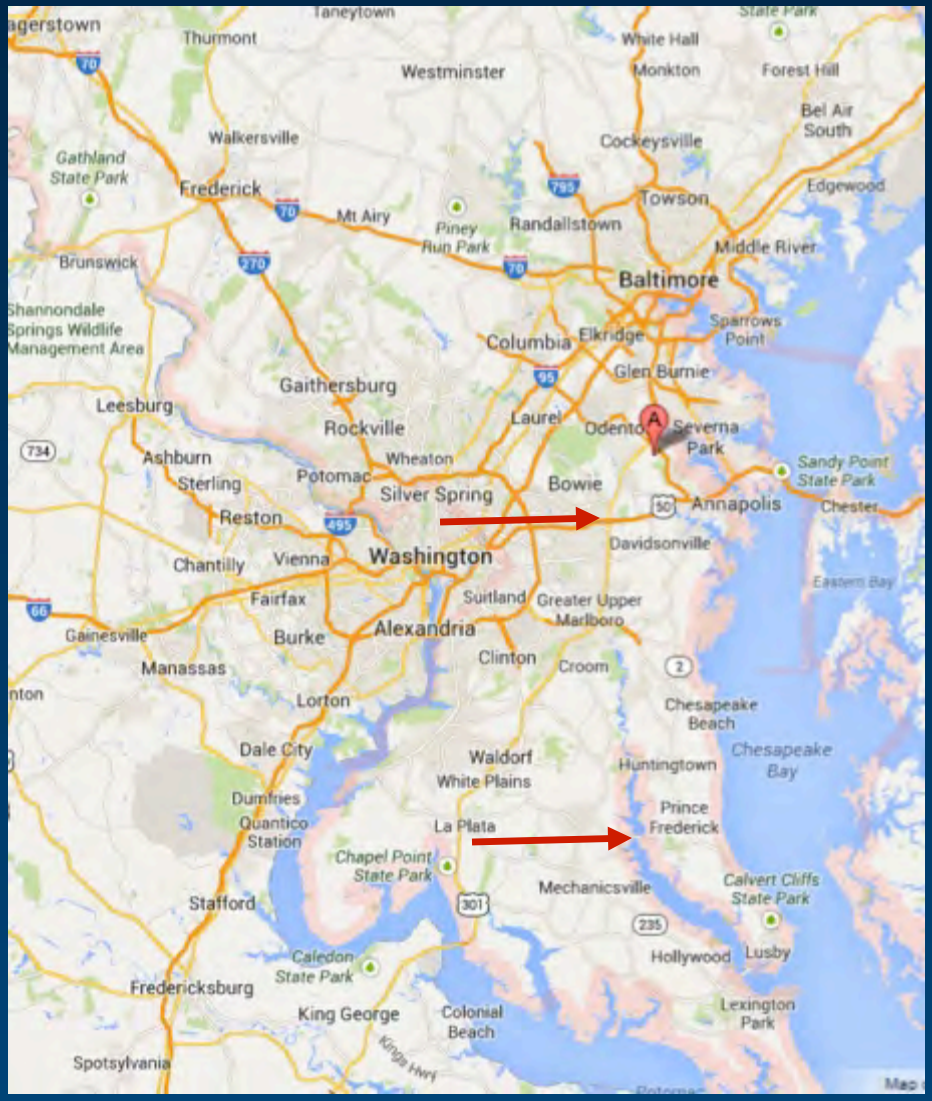
- Use experts in relevant fields and on the ground experience
- Provide detail and fill gaps in research
- Allows for descriptive narratives
- Builds support and increases knowledge

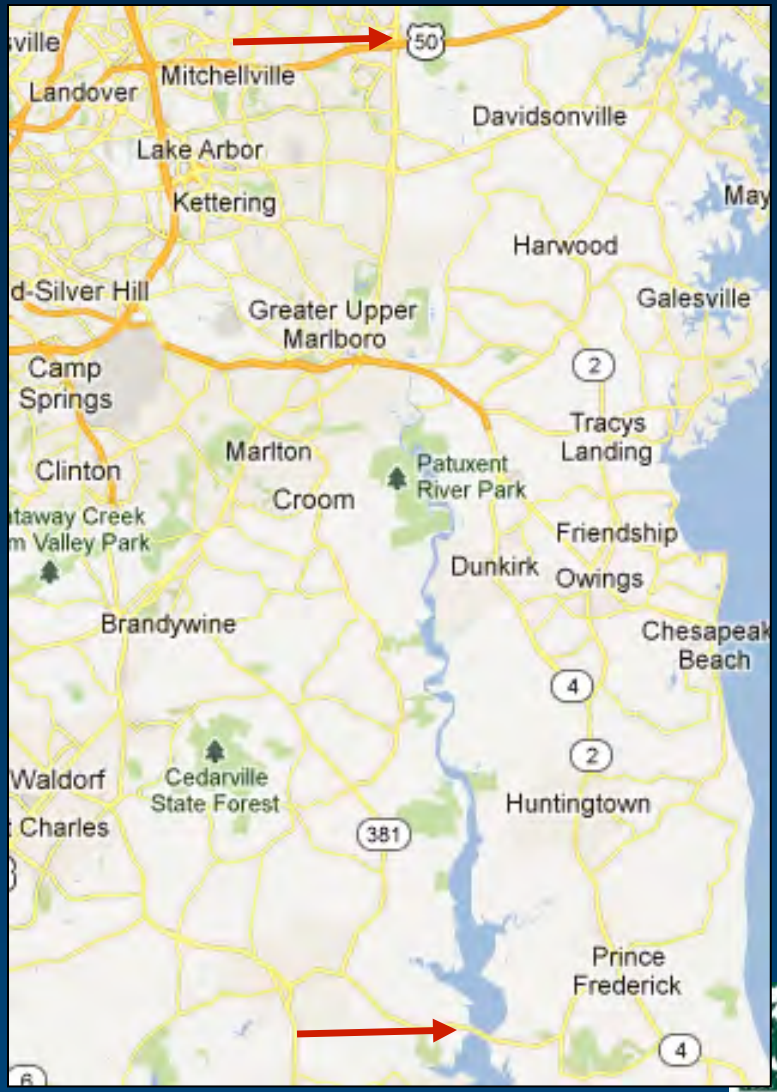


Site Selection

- Developed criteria to assist with selection
  - Subwatershed advances at least one of NOAA's strategic objectives
  - Area contains priority species and/ or habitats of importance
  - Area contains opportunities for conservation and restoration; and
  - Habitats and species are projected to be sensitive to climate change to some degree.
- Narrowed to 3 sites and panel made selection.

Middle Patuxent Subwatershed



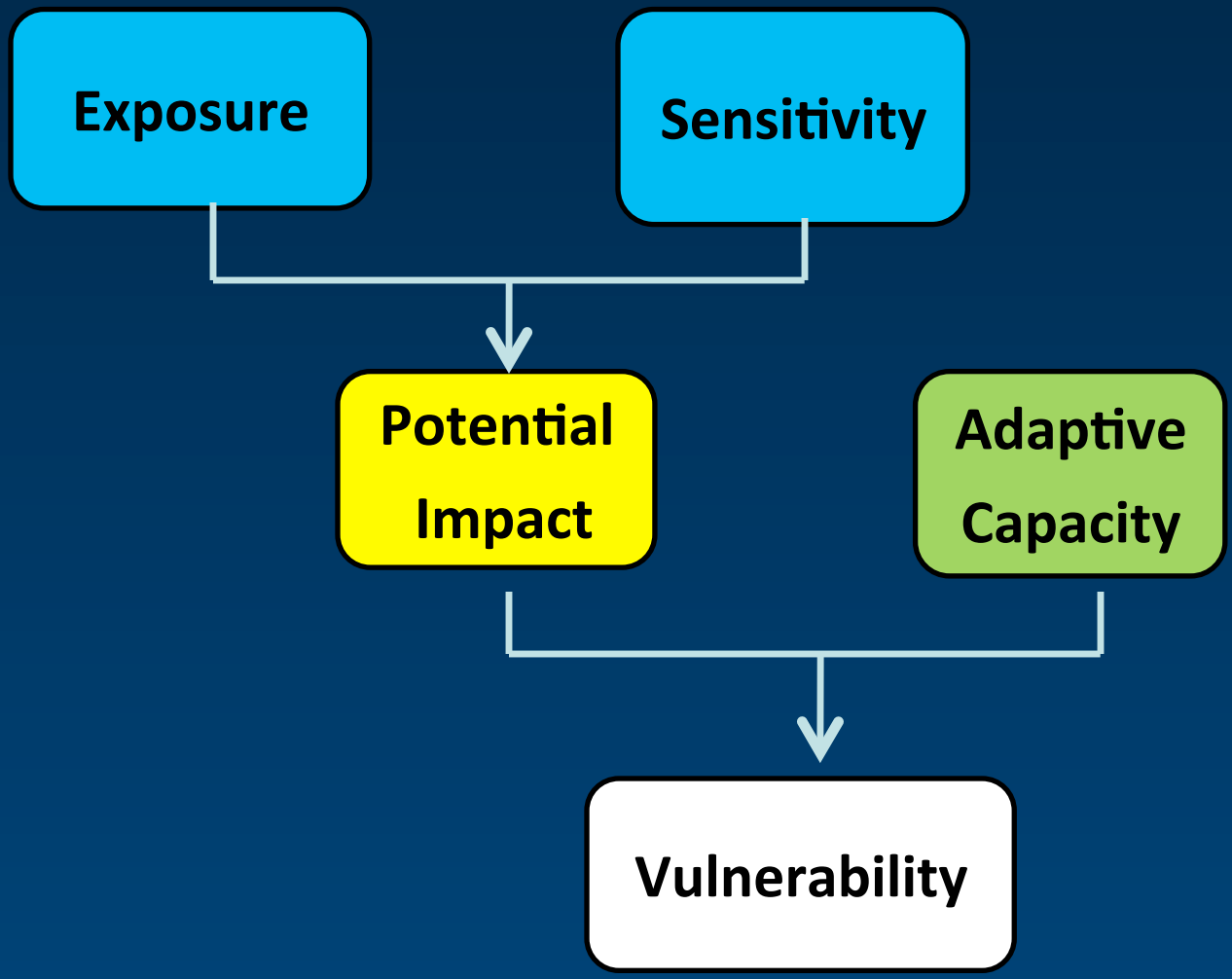


Vulnerability Assessment and Adaptation Option Development

"I skate to where the puck is going to be, not where it has been."

--- Wayne Gretzky

Vulnerability Assessment Framework

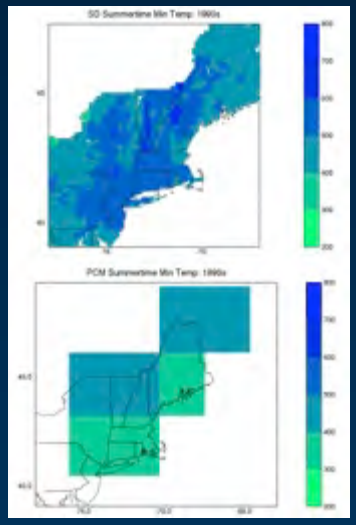


Assessing Sensitivity
Focus on Intrinsic Factors

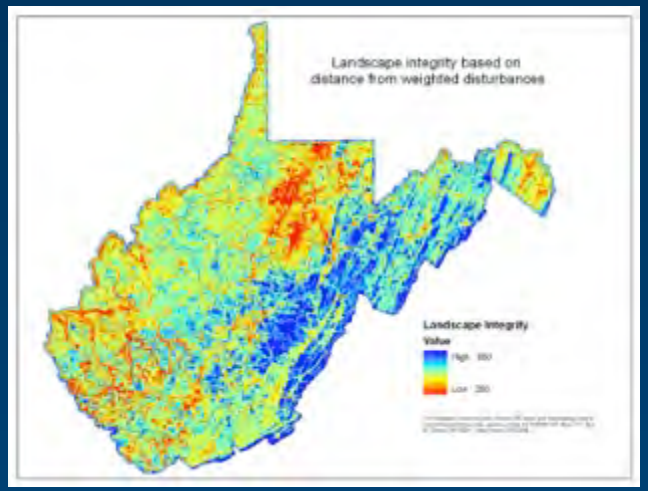
- Specialized habitat or microhabitat requirements
- Narrow environmental tolerances or physiological thresholds
- Dependence on specific environmental triggers
- Dependence on interactions with other species
- Poor dispersal ability

Assessing Exposure
Focus on Extrinsic Factors

- Climate models
  - Shifts in temperature, precipitation
  - Increasing availability of finer scale data (e.g., downscaling)
- Ecological response models
  - Climate related vegetation shifts
  - Sea-Level Rise Affecting Marshes Model (SLAMM)



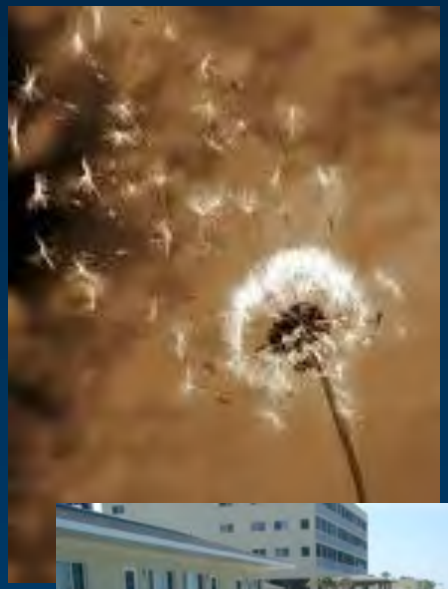
Downscaled climate data



Landscape integrity

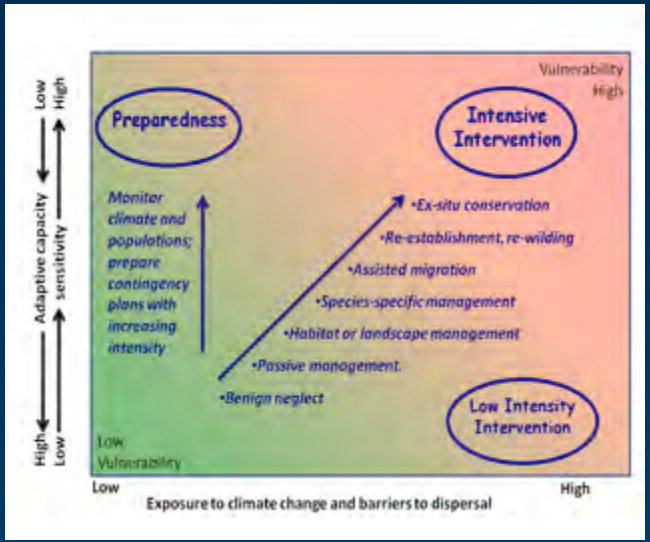
Assessing Adaptive Capacity
Intrinsic and Extrinsic

- Intrinsic factors
  - Dispersal abilities
  - Evolutionary potential
- Extrinsic factors
  - Existence of barriers to habitat migration
  - Loss of natural functions



Identify *Possible* Adaptation Options

- Depends on an understanding of system dynamics
- Link actions to climate impacts
  - Reduce exposure
  - Reduce sensitivity
  - Enhance adaptive capacity
- Need to think outside the box
  - What is not feasible now may be in a climate-altered future



Source: Dawson et al. 2011

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Middle Patuxent Subwatershed Vulnerability Assessment

Target Selection

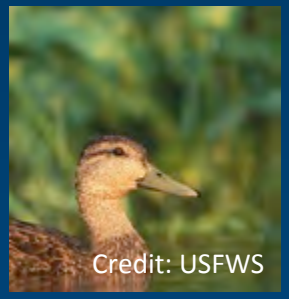
Wild rice (Zizania aquatic)

Blue crab (Callinectes sapidus)

Oyster (Crassostrea virginica) restoration

Yellow perch (Perca flavescens)

Tidal freshwater wetland



Black duck (Anas rubripes)

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Target-Specific Vulnerability Template

Table 6. Vulnerability Assessment for Submerged Aquatic Vegetation	
Scope and Objectives	
• Status/ baseline information	
• Current conservation/ restoration goals and targets	
• Conservation/ restoration approaches to improve the status of targets	
Components of Vulnerability	
Sensitivity	
• To what degree are targets sensitive to climate conditions/ variables	
• To what degree conservation/ restoration approaches sensitive to climate conditions/ variables	
Exposure	
• Projected climate change impacts	
• Observed climate change impacts in the area	
Adaptive Capacity	
• Adaptive capacity relative to climate change	
Vulnerability Summary	
• Relative vulnerability ranking	
• Vulnerability summary	

Yellow Perch Vulnerability

Table 1. Vulnerability Assessment for Yellow Perch	
Scope and Objectives	
Status/ baseline information	Yellow perch are relatively stable within the Chesapeake Bay region and the project area.
Current goals and targets	Goals: Restore and enhance habitat; Targets: Conserve yellow perch spawning habitat
Conservation/ restoration approaches	Stream restoration, total allowable catch by area, closed fishing areas/seasons
Components of Vulnerability	
Sensitivity	
To what degree is target sensitive to climate conditions/variables	Temperature: Yellow perch adults have a relatively broad temperature tolerance and salinity tolerance; however, spawning tolerances are narrower (MDDNR, 2002). Adults must be exposed to an **extended period of cold water temperatures to ensure ripening of eggs**. Minimum winter water temperatures (4-10° C) should be maintained for 145-175 days to allow for normal gonadal development of adults so that viable gametes will be produced.
Degree to which restoration approaches sensitive	Restoration efforts involving stream buffers could be affected by sea-level rise and more intense storm events

Yellow Perch Vulnerability

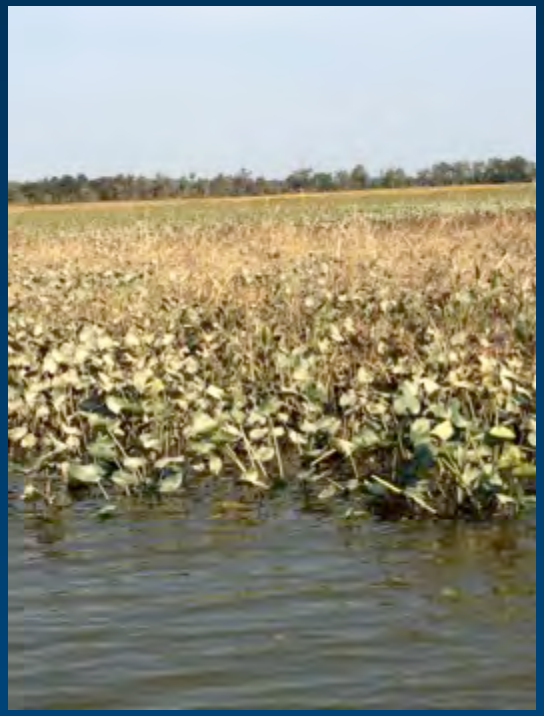
Exposure	
Projected climate change impacts	Sea-levels are expected to rise at least 2.7 to 3.4 feet by 2100, which will affect areas into the Patuxent watershed (i.e., not just at the mouth of the river).
Observed climate impacts in the area	The high tide line at Jug Bay has been observed as increasing by 3 inches over the last 10 years (Delgado, 2011).
Adaptive Capacity	
Adaptive capacity relative to climate change	Adaptive capacity for yellow perch is relatively high as yellow perch are found throughout the Chesapeake Bay and their movements are not inhibited in the watershed except where there are dams or other structures.
Vulnerability Summary	
Relative Vulnerability Ranking	**Highly Vulnerable**
Vulnerability Summary	Spawning and egg development require relatively narrow requirements for temperatures, salinities, DO, and sediment levels (e.g, if winter temperatures rise by 7°F in the winter that could be problematic for spawning).

Stream Habitat

- Stream habitat
  - *Storm events*: stormwater runoff, nutrient and sediment run off, erosion, etc.
  - *Temperature*: fish spawning, juvenile development, vegetation growth, disease, invasive species, and HAB
- Restoration activities
  - *Stabilization*: erosion, inundation, water flows
  - *Buffers*: salt water intrusion, inundation, temperature tolerances

Submerged Aquatic Vegetation

- Sea-level rise and salinty levels
  - Increased salinity levels and inundation
- Increased rainfall and intense storm events
  - More sediment and nutrient runoff
- Temperature less significant



Example Strategies: Yellow Perch

- Focus on restoration above Jug Bay
- Take advantage of projected new shallow water habitat
- Encourage upriver reservoir managers to consider climate change
- Adjust catch limits and regulations

Stream Habitat

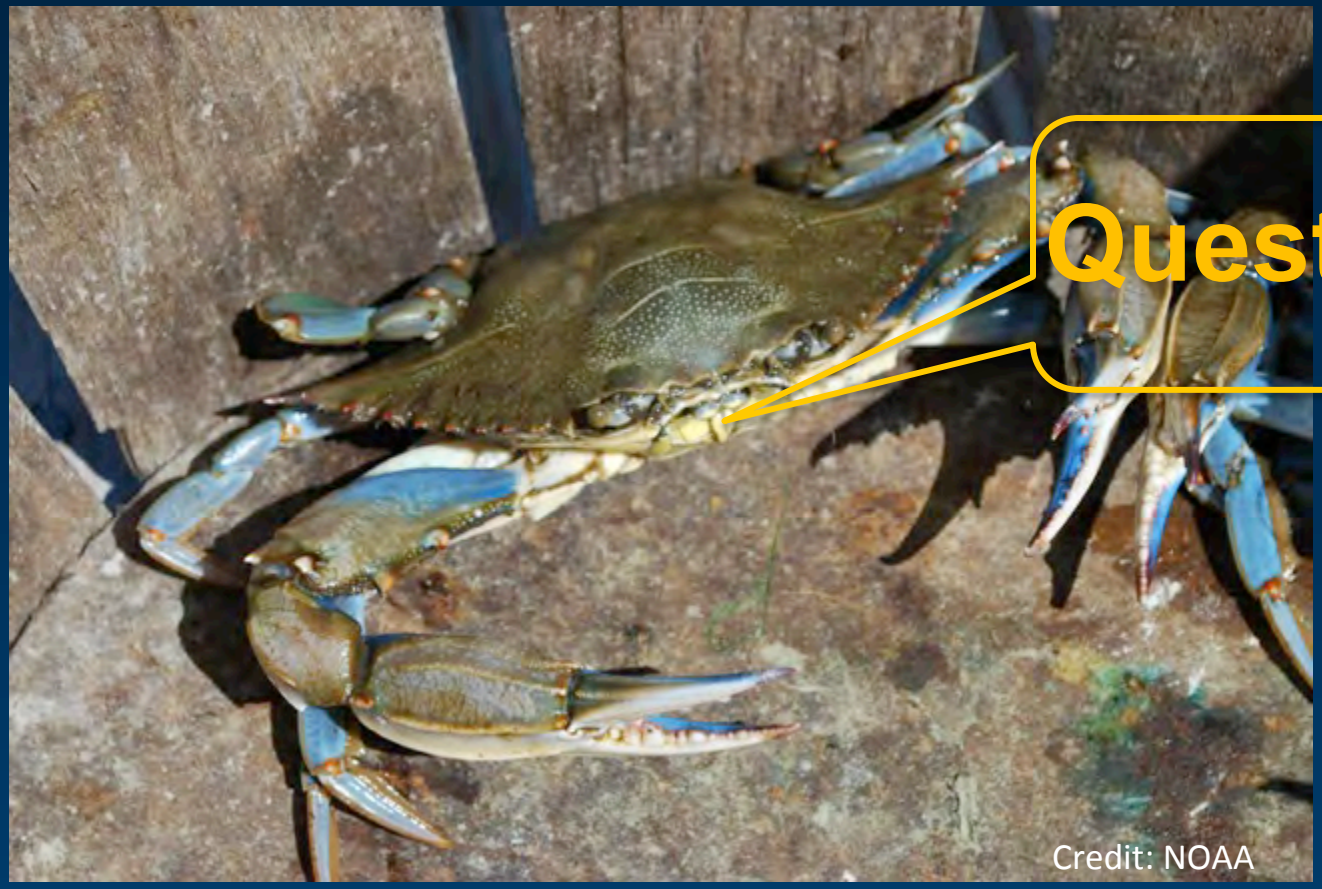
- Use plants that can tolerate a range of conditions
- Consider changing flood-year calculations
- Design wider channels and/ or flood plains in stream restoration projects
- Encourage efforts to improve stormwater management

Submerged Aquatic Vegetation

- Improve water quality to ensure SAV are maintained in this region
- Focus on small scale restoration efforts targeting specific SAV
- Monitor changes in SAV as conditions change to determine how natives and Hydrilla respond

Lessons Learned

- Consider existing stressors throughout process
- Communicate objectives and targets early
- Ensure coordination among partners
- Optimize expert elicitation process



Report Available at
http://www.nwf.org/What-We-Do/Energy-and-Climate/Climate-Smart-Conservation/Adaptation-Reports.aspx

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Ranking System

- ***Critically vulnerable***: likely experience a complete loss of ecological function or be extirpated;
- ***Highly vulnerable***: likely be greatly reduced or impaired by climate change;
- ***Vulnerable***: likely be minimally affected by climate change;
- ***Less vulnerable***: likely experience a slight benefit from climate change; and
- ***Least vulnerable***: likely extend their range or greatly benefit, maximizing ecological function.