RISING WATER TEMPERATURES: Ecological Implications and Management Recommendations from the STAC Workshop

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LGAC Quarterly Meeting

Watershed Acknowledgements

- **Synthesis Element #1 Paper (Water Temperature Effects on Fisheries and Stream Health in Nontidal Waters):** Stephen Faulkner, Kevin Krause, Rosemary Fanelli, Matthew Cashman, Than Hitt and Benjamin Letcher, USGS; Frank Borsuk and Greg Pond, EPA
- **Synthesis Element #1 Addendum (Temperature Criteria in CBP Jurisdictions' Water Quality Standards and Information on Warmwater Species):** Rebecca Hanmer, EPA-retired; Jonathan Leiman, Maryland Department of the Environment; Daniel Goetz, Maryland Department of Natural Resources; Robert Breeding, Virginia Department of Environmental Quality; and Matthew Robinson, DC Department of Energy and Environment
- **Synthesis Element #4 Paper** (Watershed Characteristics and Landscape Factors Influencing Vulnerability and Resilience to Rising Stream Temperatures): Renee Thompson, USGS; Nora Jackson, CRC/CBP; Judy Okay, J&J Consulting; Nancy Roth, Tetra Tech; Sally Claggett, USFS
- **Synthesis Element #5 Paper (Trends)**: Rich Batiuk, CoastWise Partners; Nora Jackson, CRC/CBP; John Clune, USGS; Kyle Hinson, VIMS; Renee Karrh, Maryland Department of Natural Resources; Mike Lane, Old Dominion University; Rebecca Murphy, University of Maryland Center for Environmental Science/CBP; and Roger Stewart, Virginia Department of Environmental Quality
- **Synthesis Element #6 Paper (Model Projections)**: Rich Batiuk, CoastWise Partners; Gopal Bhatt, Pennsylvania State University/CBP; Lewis Linker, U.S. EPA CBP; Gary Shenk, USGS/CBP; Richard Tian, University of Maryland Center for Environmental Sciences/CBP; and Guido Yactayo, Maryland Department of the Environment
- Synthesis Element #7/8 Paper (Impacts of BMPs and Habitat Restoration on Water Temperatures): Katie Brownson and Sally Claggett, USFS; Tom Schueler, CSN; Anne Hairston-Strang and Iris Allen, Maryland Department of Natural Resources-Forestry; Frank Borsuk and Lucinda Power, EPA; Mark Dubin, UMD; Matt Ehrhart, Stroud; Stephen Faulkner, USGS; Jeremy Hanson, VT; Katie Ombalski, Woods & Waters Consulting
- **Synthesis Element #10 Paper (Monitoring)**: Peter Tango, Breck Sullivan, John Clune, and Scott Phillips, USGS

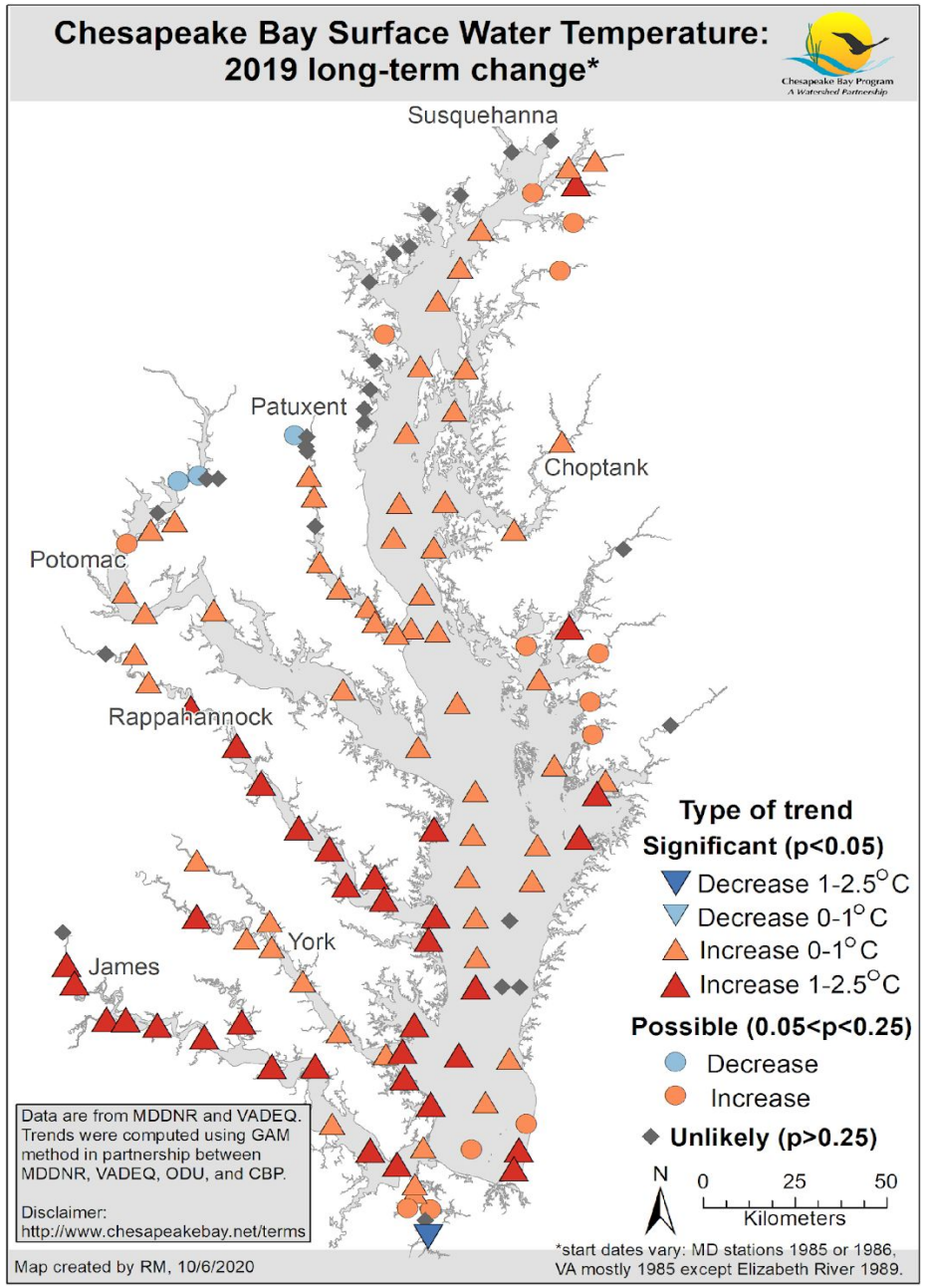
Thank you to all the contributors and workshop participants!

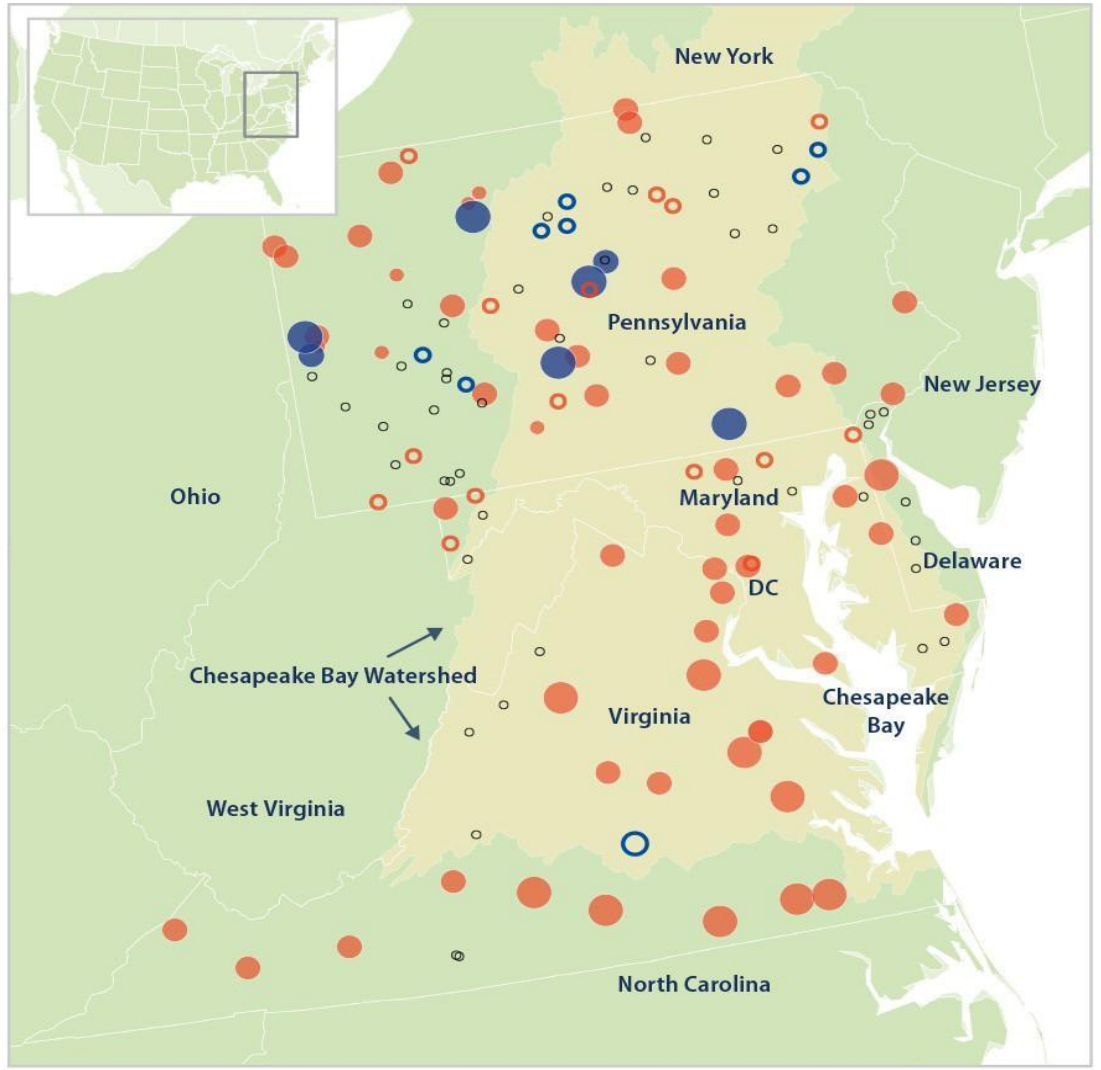
Tidal Acknowledgements

- **Synthesis Element #2 Paper (Tidal Fisheries and Habitat Impacts)**: Bruce Vogt, Jay Lazar, and Emily Farr, NOAA; Mandy Bromilow, NOAA Affiliate; Justin Shapiro, CRC
- **Synthesis Element #3 Paper (SAV Impacts)**: Brooke Landry and Becky Golden, Maryland DNR; Marc Hensel and Chris Patrick, VIMS; Dick Zimmerman and Rhianne Cofer, Old Dominion University; Bob Murphy, TetraTech
- **Synthesis Element #5 Paper (Trends)**: Rich Batiuk, CoastWise Partners; Nora Jackson, CRC/CBP; John Clune, USGS; Kyle Hinson, VIMS; Renee Karrh, Maryland Department of Natural Resources; Mike Lane, Old Dominion University; Rebecca Murphy, University of Maryland Center for Environmental Science/CBP; and Roger Stewart, Virginia Department of Environmental Quality
- **Synthesis Element #6 Paper (Model Projections)**: Rich Batiuk, CoastWise Partners; Gopal Bhatt, Pennsylvania State University/CBP; Lewis Linker, U.S. EPA CBP; Gary Shenk, USGS/CBP; Richard Tian, University of Maryland Center for Environmental Sciences/CBP; and Guido Yactayo, Maryland Department of the Environment
- **Synthesis Element #9 Paper (Indicators)**: Julie Reichert-Nguyen and Bruce Vogt, NOAA; Mandy Bromilow, NOAA Affiliate; Ron Vogel, UMD for NOAA Satellite Service; Breck Sullivan, USGS; Anissa Foster, NOAA-CRC Internship Program
- **Synthesis Element #10 Paper (Monitoring)**: Peter Tango, Breck Sullivan, John Clune, and Scott Phillips, USGS

Thank you to all the contributors and workshop participants!

Chesapeake Bay tidal and non-tidal water temperatures have been increasing.





(Rice and Jastram, 2015)

Watershed

Ecological Impacts and Recommendations

Leads: Katie Brownson, U.S. Forest Service & Rebecca Hanmer, Forestry Workgroup Chair

Ecological Impacts - Species

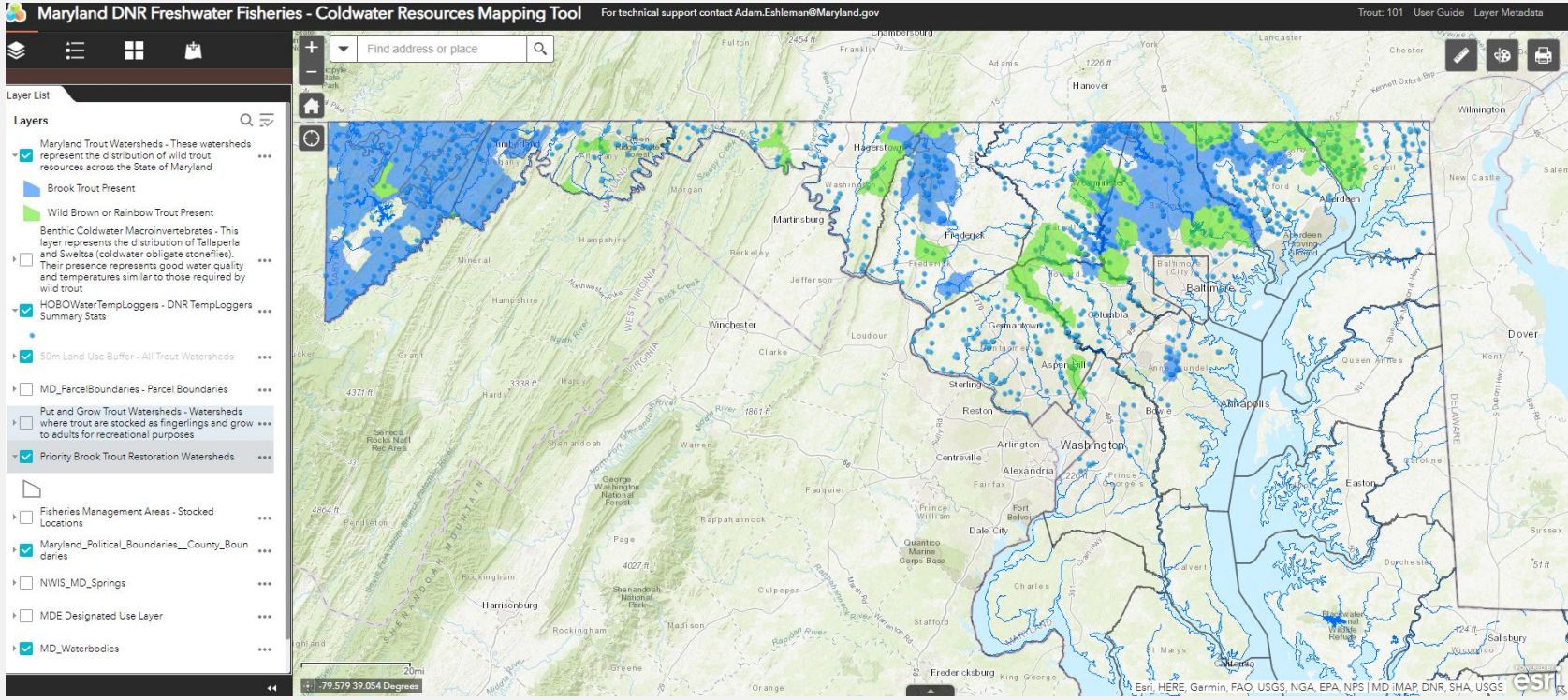
- **Strongest negative impacts** on coldwater species (e.g., trout, sculpin) and their habitats (esp. where streams aren't driven by groundwater)

- Watershed-wide, warmwater aquatic species are most common. Although more tolerant to temperature increases, they are **sensitive to extreme temperatures** including rapid changes and to indirect effects (e.g., invasives, pathogens) from higher temps.

- **More study needed** of temperature effects on lower foodweb
  - Algae, biofilms, zooplankton
  - Macroinvertebrates
  - Freshwater mussels & host species

Coldwater Fisheries and Habitat Recommendation

- Chesapeake Bay Program partners need to **accelerate conservation** to protect the coldwater streams now supporting healthy aquatic life, especially native brook trout, which are extremely sensitive to rising water temperatures, and **continue resiliency analyses and mapping to focus coldwater habitat restoration efforts.**



Rural Waters and Habitats Recommendation

- In rural areas, CBP partners should work to s**trategically restore forests and aquatic habitats** while promoting **good agricultural stewardship practices** that can reduce the amount of heated runoff being generated by farms

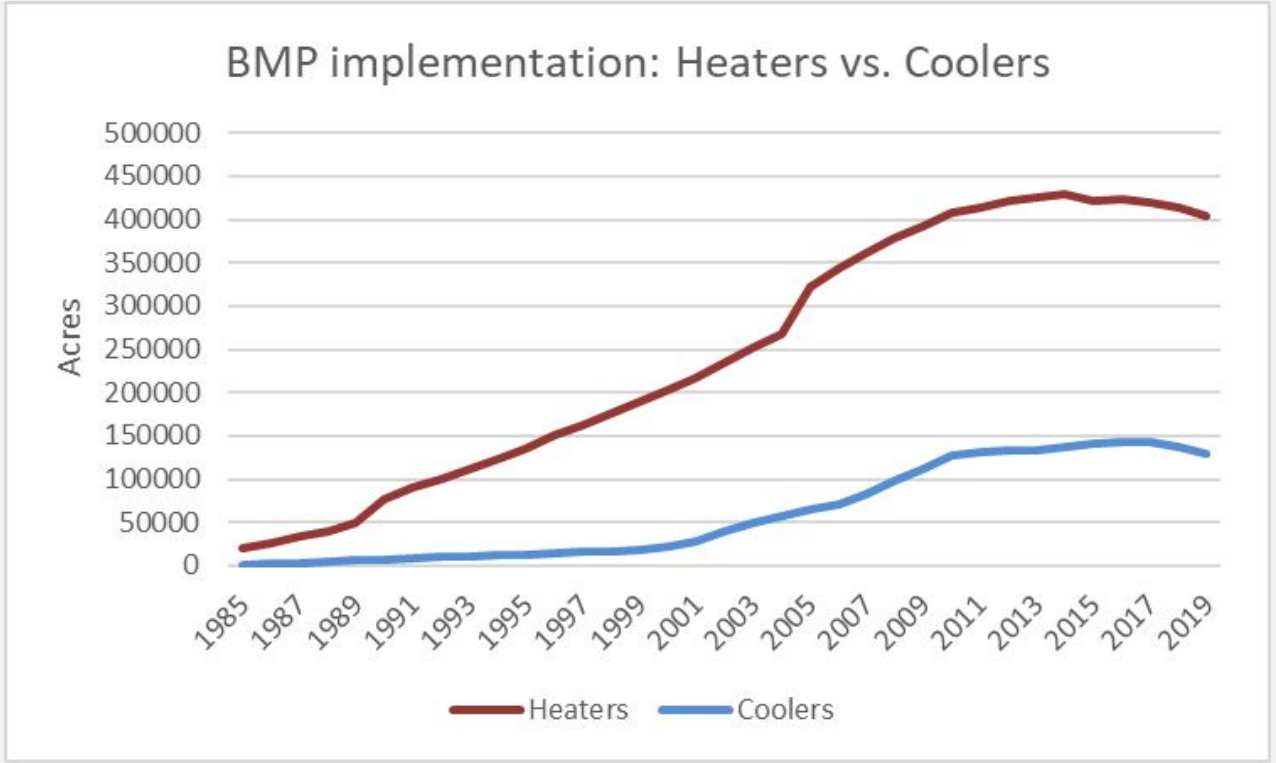
Urban Waters and Habitats Recommendation

- In urban areas, the CBP partners should i**ncrease tree canopy, vegetation and practices favoring infiltration** to reduce the amount of heated runoff entering waterways, p**aying attention to underserved urban areas** which historically suffer the worst heating and human health outcomes.

Photo Credit: Leslie Robertson, NASF

Best Management Practices (BMPs) Recommendation

- The CBP partners should work to **minimize the extent to which water quality BMPs are further heating waterways and strategically use cooling BMPs** to counteract the warming effects of climate change and land use where possible

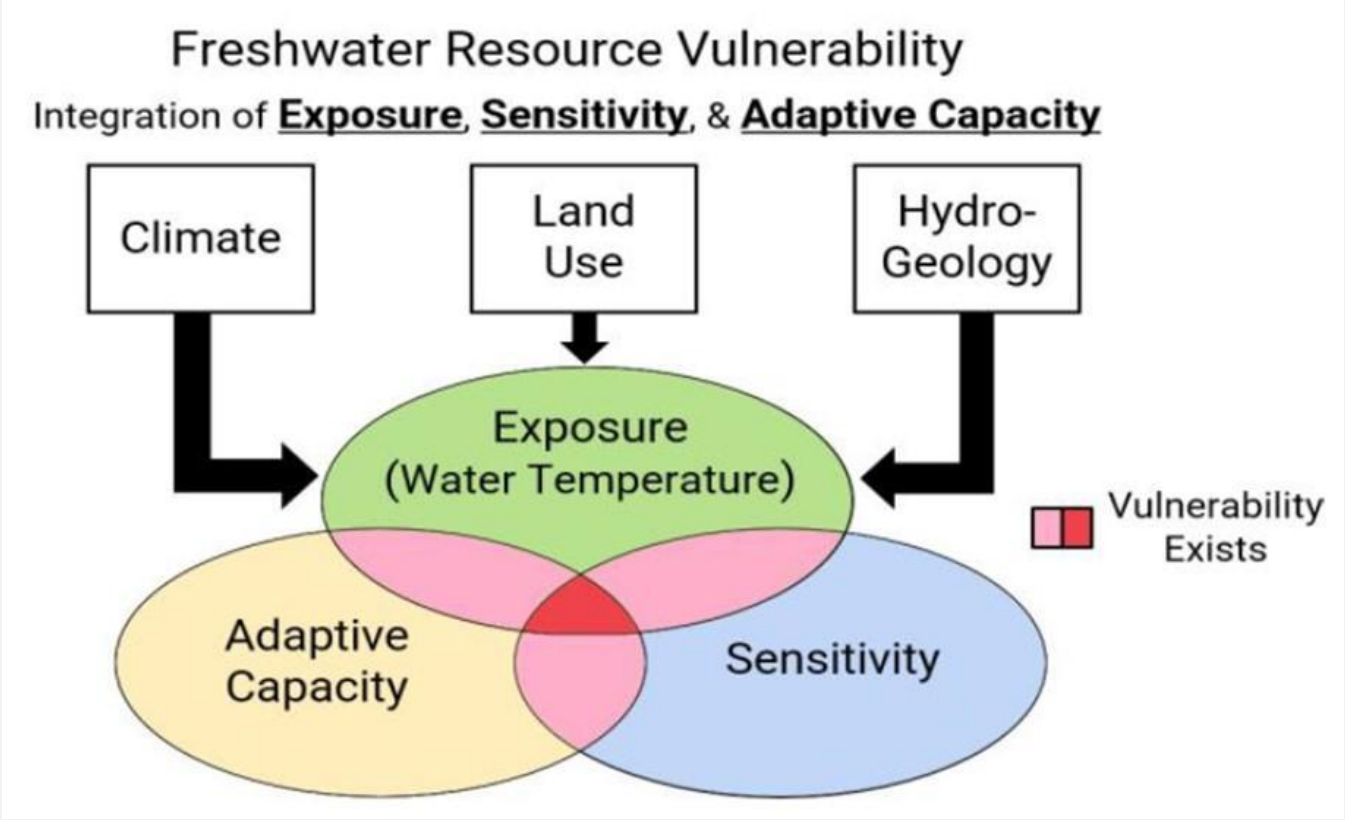


State Temperature Water Quality Standards Recommendation

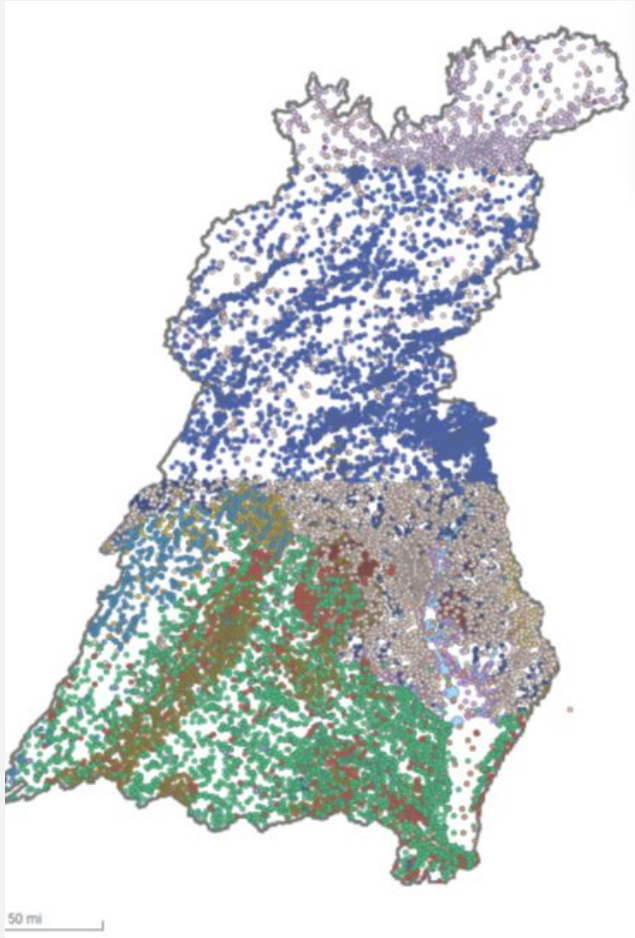
- Given the vital role of Clean Water Act water quality standards (WQS) in focusing federal, state, local and private actions to protect water quality and aquatic life, the states and EPA should **review and modernize the components of current WQS systems** that would strengthen their capability **to address climate-related rising water temperatures and drive area-targeted protection and restoration strategies.**

Overarching Recommendation for Research

- The CBP partners should enhance and facilitate partnership efforts to collect data and develop tools needed to fill critical knowledge gaps, **improve understanding of the impacts of rising temperatures on aquatic ecosystems, and inform management decisions.**



Overarching Recommendation for Monitoring and Analysis

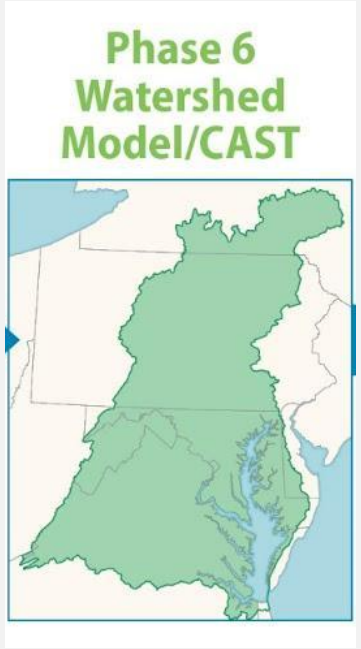


- The CBP partners should **increase monitoring of water temperature in smaller streams**, and further analyze existing data from larger streams and rivers, to **improve understanding of the effectiveness of restoration and conservation of stream communities and fisheries** in the face of land-use and climate change.

Source: John Clune, Tammy Zimmerman, James Colgin, Charlie Sandusky, USGS

Overarching Recommendation for Watershed Modeling

- The CBP partnership should develop new modeling tools and expand the use of CAST and the Chesapeake Healthy Watershed Assessment to better inform the management of watershed fisheries and ecosystems.



Vulnerability Indicators

- Future development
- Forest Loss
- Extent of land protection
- Water use
- Wildfire risk
- Climate change

Health Indicators

- Landscape condition
- Habitat
- Hydrology
- Geomorphology
- Water quality
- Biological condition

TIDAL

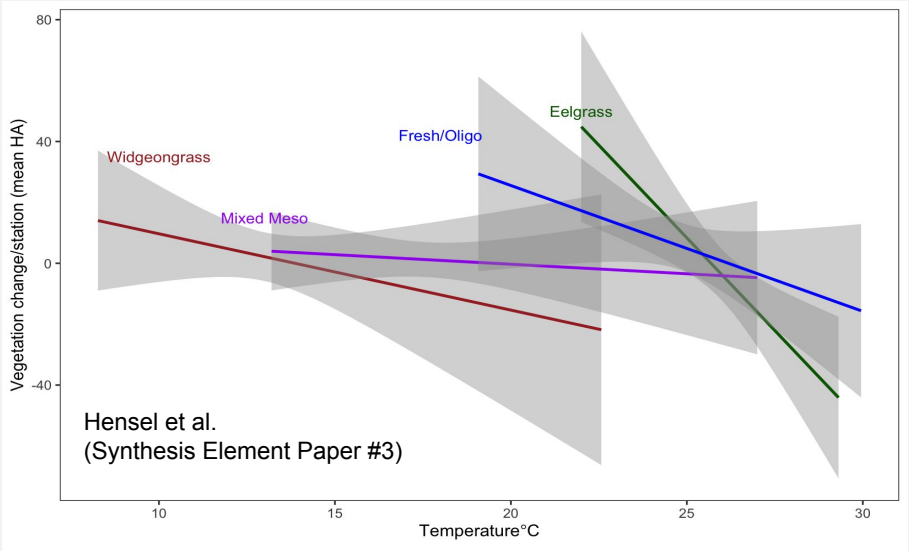
Ecological Impacts, Science Needs &

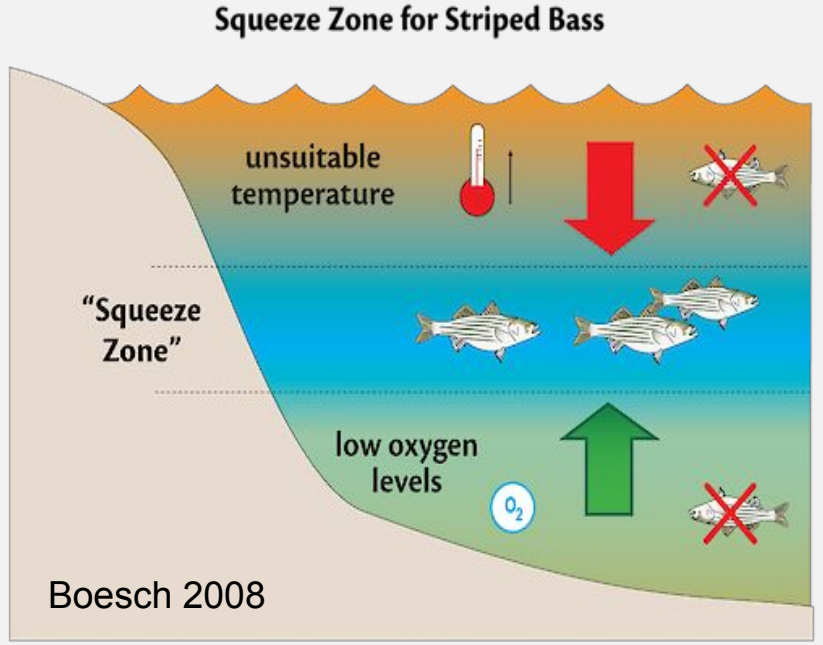
Recommendations

Leads: Julie Reichert-Nguyen (NOAA), Bruce Vogt (NOAA), Brooke Landry (MD DNR), Rich Batiuk (Coastwise Partners) & Jamileh Soueidan (CRC/NOAA)

Rising Tidal Water Temperatures:
Ecological Impacts to Living Resources and Habitats

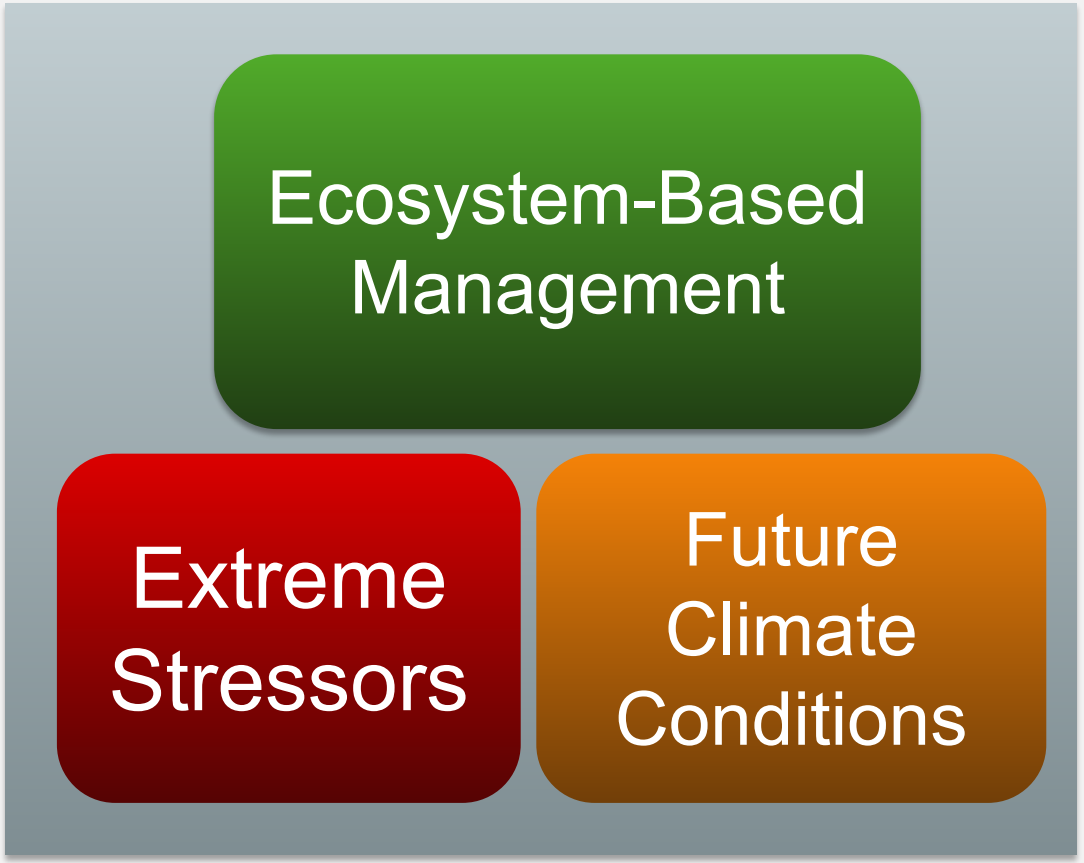
- Changes in habitat suitability for vulnerable species (e.g., striped bass, eelgrass) from multiple stressors and extreme events
- Shifts in species range and habitats





- Species level impacts from rising water temperature may be positive or negative depending on species, life stage, and location in the estuary
- Eelgrass is negatively impacted by rising water temperature, while other species (e.g., widgeongrass, freshwater species) may be more heat tolerant

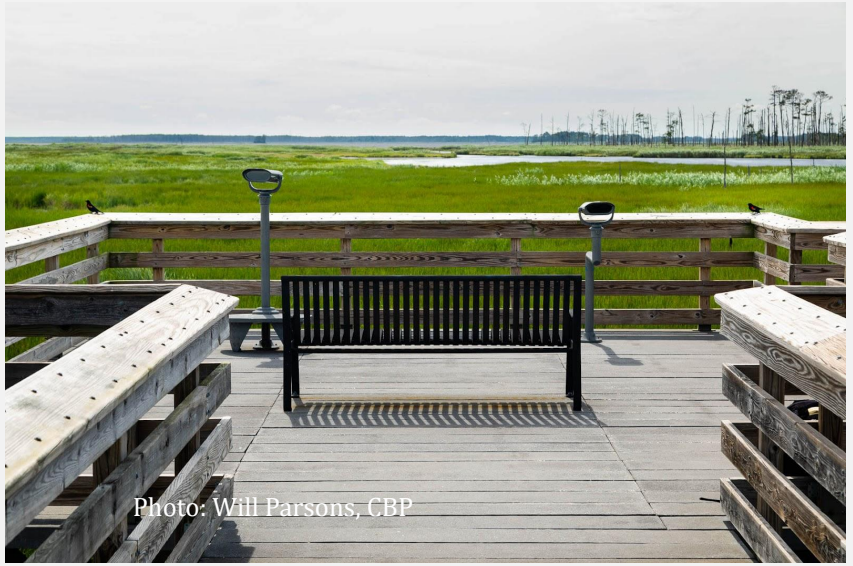
Themes for Actionable Recommendations

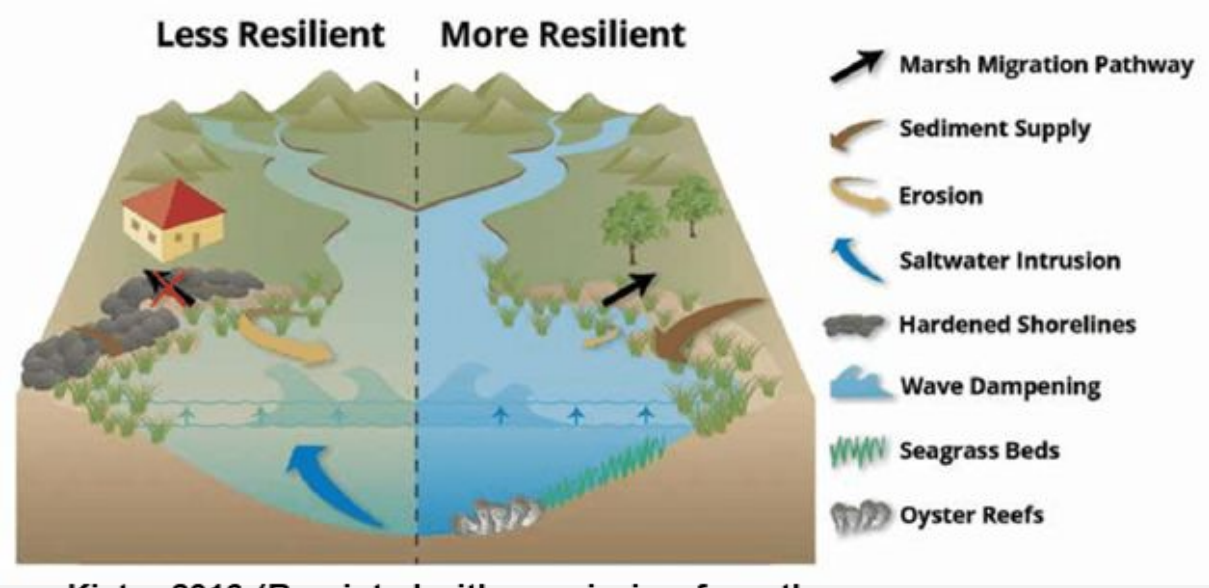


Nearshore Habitats

Recommendations: Nearshore Habitat

- Develop common criteria and metrics to help target, site, and design natural infrastructure projects, such as living shorelines, where both communities and ecosystems can benefit.
- Support research to investigate grouping of natural resource restoration strategies (e.g., seagrass, marshes, oyster reefs) to maximize resilience.





Kister 2016 (Reprinted with permission from the Integration & Application Network, 2013)

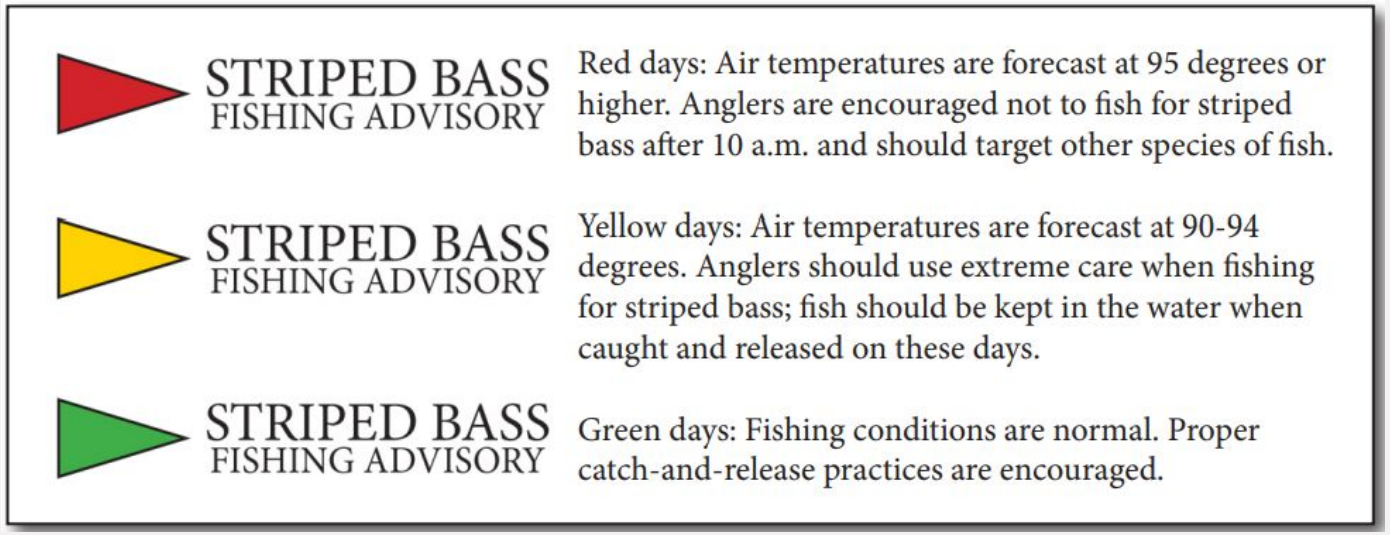
Recommendations: Ecosystem-Based Management

- Establish fishing guidance based on temperature and dissolved oxygen and habitat condition thresholds to reduce catch and release mortality during periods of poor environmental condition.
- Hold workshop with fishery stakeholders to explore long-term strategies to advance ecosystem approaches that incorporate climate change considerations; include discussions on potential new fisheries and adaptation needs.

Photo: Eric Packard

Recommendations: Extreme Stressors

- Convene an interdisciplinary team of scientists, resource managers, meteorologists, and communicators to design and create a publicly available marine heat wave alert system.
- Connect alert system with habitat preferences of key species and guidance on fishing behavior; consider incorporating other key parameters (e.g., dissolved oxygen, salinity).



Example from Maryland Department of Natural Resources

Recommendations: Future Climate Conditions

- Develop and implement strategy to improve communications on expected scenarios for existing species and information on emerging species from the south.
- Support social science research and develop targeted communication for specific audiences (policymakers, managers, residents, local partners).

Photo: Dave Harp, *Bay Journal*

Identified Science Needs:
Nearshore Habitat—Strategic Restoration

- Increase understanding of watershed practices (e.g., cooler BMPs) that can reduce local warming effects upper tidal tributaries.
- Use models to increase understanding of habitat change from sea level rise to inform restoration strategies.


Photo: Peter McGowan, USFWS

Identified Science Needs: Ecosystem-Based Management

Photo: Doug Wilson

- Improve environmental and biological (predator/prey) monitoring to assess changes in fish habitat conditions.
- Consider establishing monitoring stations where there are significant fisheries habitat and spawning grounds.
- Develop habitat suitability models and indicators for key fisheries resources, which incorporates information on extreme stressors, such as marine heat waves.
- Research how loss of late-winter/spring eelgrass habitat will affect blue crab populations.

Common Themes Across the Workshop: Implementation

- Comprehensive Jurisdictional and Land Use Plans
  - E.g., ensure that land-use planning decisions and county comprehensive plans incorporate science and evidence-based practices in regard to water temperature
- Targeting
  - E.g., incorporate water temperature considerations when planning, siting, and implementing restoration and conservation efforts
- Nature-Based Features
  - E.g., restore nature-based and natural features on land and in the water to help mitigate or build resilience to rising water temperatures
  - Support efforts to implement living shorelines, cooling BMPs, and natural infrastructure where appropriate and feasible (e.g., on public land or develop incentive programs for private land)
- Communication
  - E.g., ensure open communication with stakeholders (e.g., communities, decision makers, scientists, practitioners) to ensure that rising water temperatures are taken into consideration

(Marcy Damon, Chesapeake Bay Foundation)

Role for Local Governments

- Are there other roles that local government officials or LGAC can play in implementing the report's recommendations?
- What can the Bay Program do to support local governments in the implementation of these recommendations?
- Are there programs in place at the local government level that are already supporting these recommendations?

Contact Information:

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Find the report here:

- https://www.chesapeake.org/stac/wp-content/uploads/2023/01/STAC-Report_-Rising-Temps.pdf