# Rising Watershed and Chesapeake Bay Water Temperatures—Ecological Implications and Management Responses

## STAC Workshop Recommendations and Next Steps

**Stream Health Workgroup**
**February 17th, 2023**

Presented by Katie Brownson, USFS

# Ecological Impacts of Rising Water Temperatures

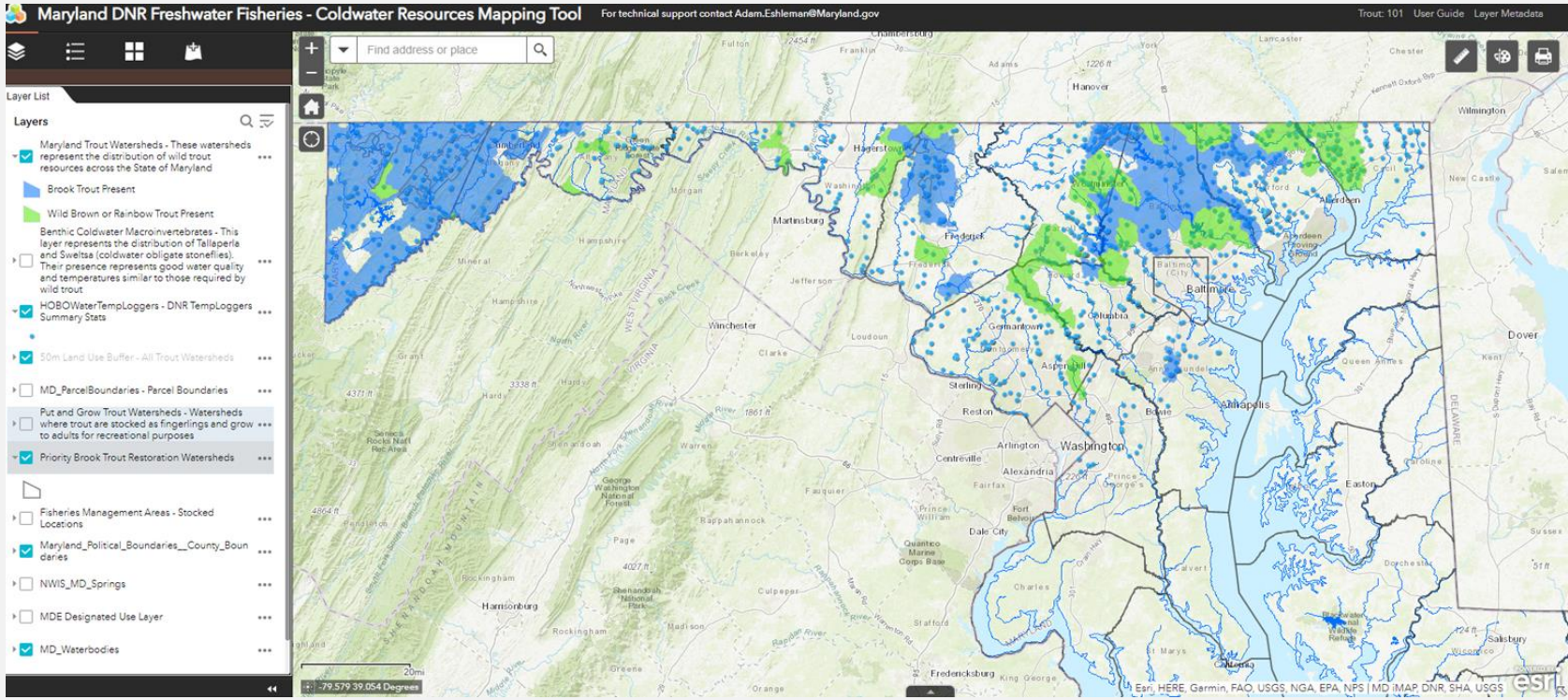
- **Strongest negative impacts** on coldwater species (e.g., trout, sculpin) and their habitats (esp. where streams aren't driven by groundwater )

- 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 **strategically restore forests and aquatic habitats** while promoting **good agricultural stewardship** practices that can reduce the amount of heated runoff being generated by farms

- *The Stream Health Workgroup could help develop design guidance for restoration practitioners that would improve the benefits of restoration for buffering aquatic biota from the impacts of aquatic heatwaves*

# Urban Waters and Habitats Recommendation

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

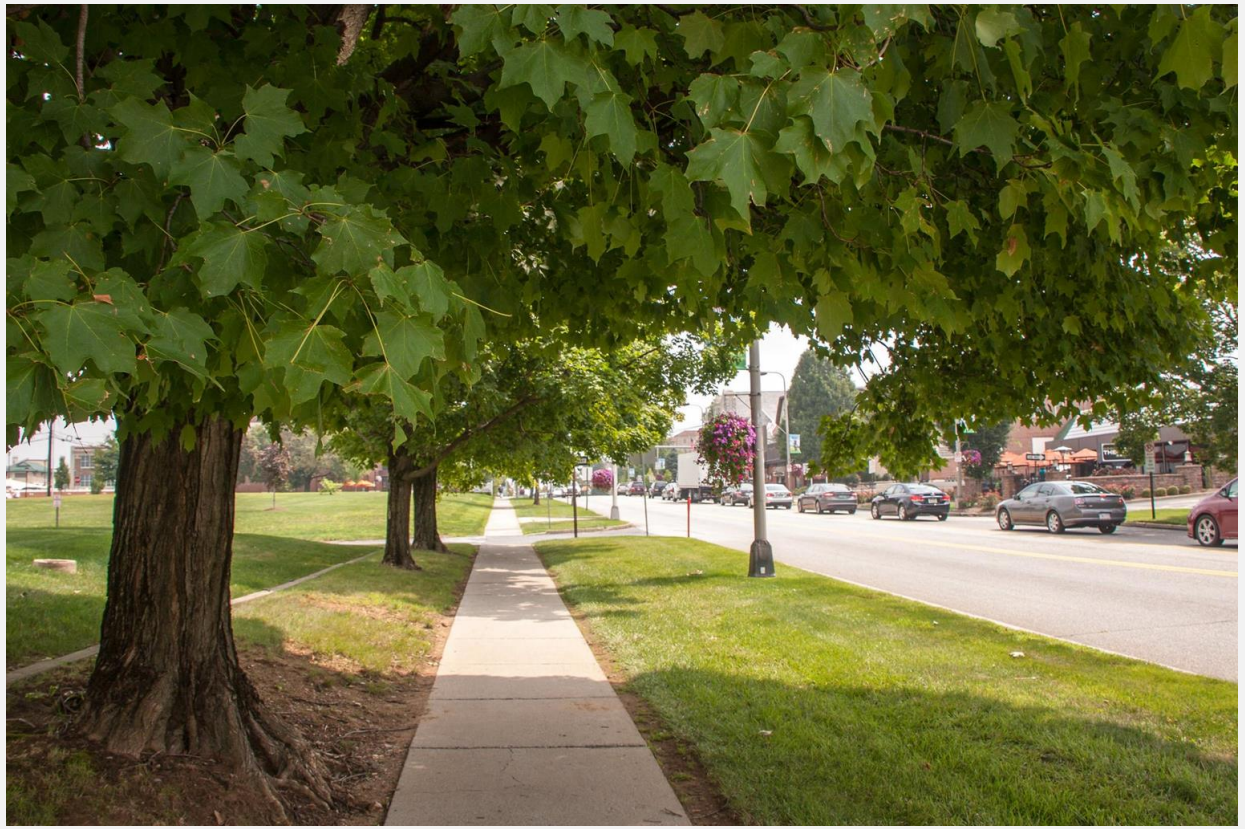
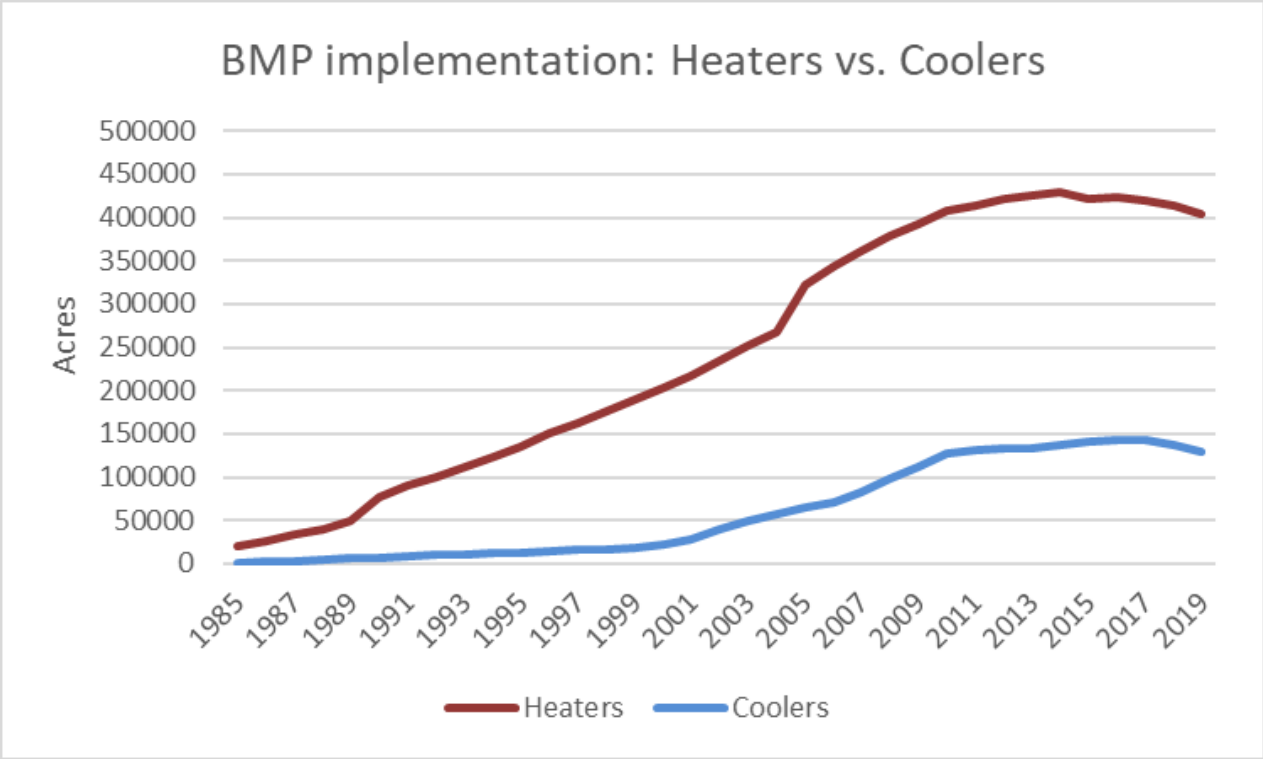


Photo Credit: Leslie Robertson, NASF

# 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

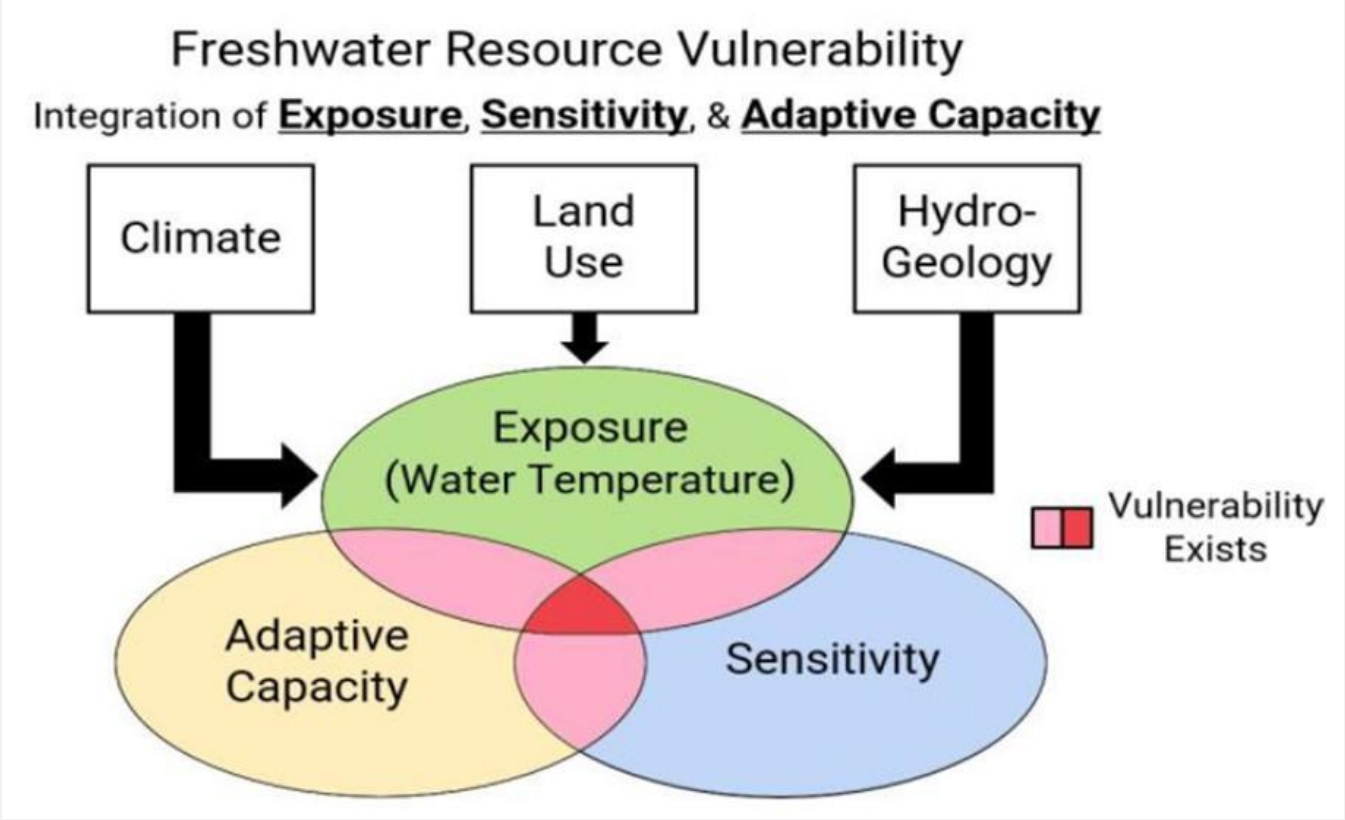


# State Temperature Water Quality Standards Recommendation

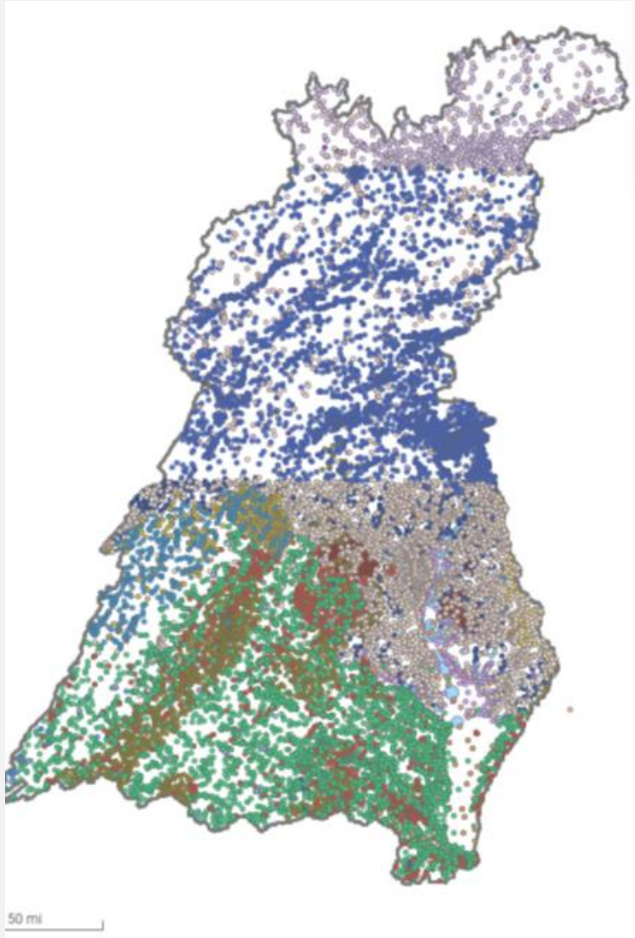
- Given the vital role of Clean Water Act water quality standards (WQS) in focusing federal, state, local and private actions to protect water quality and aquatic life, the states and EPA should **review and modernize the components of current WQS systems** that would strengthen their capability **to 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

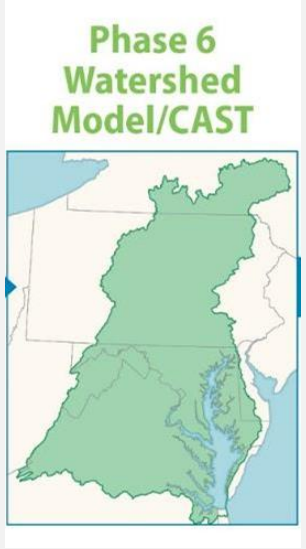



- The CBP partners should **increase monitoring of water temperature in smaller streams**, and further analyze existing data from larger streams and rivers, to **improve understanding of the effectiveness of restoration and conservation of stream communities and fisheries** in the face of land-use and 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* | *Health Indicators* |
|---|---|
| ➢ Future development | ➢ Landscape condition |
| ➢ Forest Loss | ➢ Habitat |
| ➢ Extent of land protection | ➢ Hydrology |
| ➢ Water use | ➢ Geomorphology |
| ➢ Wildfire risk | ➢ Water quality |
| ➢ Climate change | ➢ Biological condition |

# Potential science needs for the SHWG:

- Research efficacy of other potential cooling mitigation strategies, including wetland creation, dam/pond removal, floodplain restoration, beaver analogue projects, and improved roadside ditch management
- Determine how landscape characteristics and project design mediate the temperature effects of stream restoration practices and develop siting/design criteria to improve thermal outcomes
- Conduct climate vulnerability assessments to better understand the exposure and sensitivity of species/habitats to rising temperatures, including indirect effects, to better understand overall vulnerability

# Questions for the SHWG

- Will the SHWG help us refine these science needs and add them to the Chesapeake Science Needs database?
- What role can the SHWG play in helping to implement some of these management recommendations?

# 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