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

STAC Workshop Draft Findings

Healthy Watersheds GIT
April 11, 2022

Presented by Katie Brownson, USFS

Objectives

Pre-Workshop (June 2021)

Special Climate Resiliency Workgroup meeting—supported development of *state of science* synthesis papers

STAC Workshop DAY 1 (Jan 2022)

Goals:

- Discuss *drivers* of rising water temperatures
- Identify *ecological impacts*
- Identify *management implications* for living resources and habitats

STAC Workshop DAY 2 (March 15, 2022)

Goals:

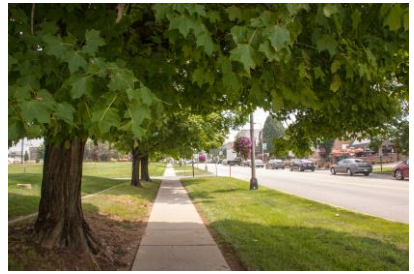
- Identify management/policy *recommendations* related to implications from Day 1
- Identify *research, monitoring, or analyses* needed to support recommendations

See Synthesis Papers & Briefing Papers for More Information

BMPs

Conservation

Land use practices



Watershed

Mitigation
Lowering of Water Temps

Tidal &
Watershed

Adaptation
Minimize Impacts & Adjust

Submerged Aquatic Vegetation (SAV)

Oysters

Blue Crabs

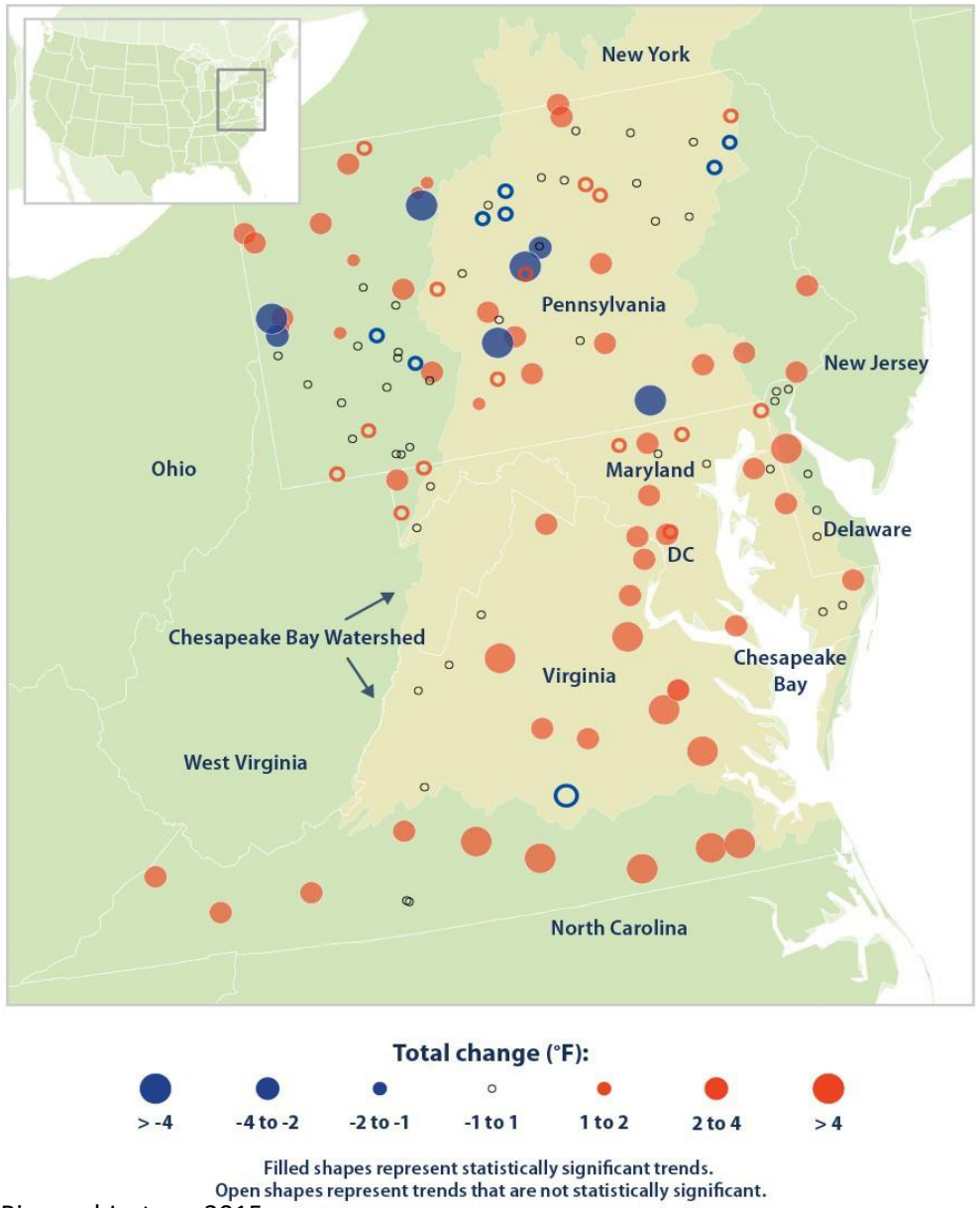
Forage

(Menhaden, Bay anchovy, benthic invertebrates)

Striped Bass

Brook Trout

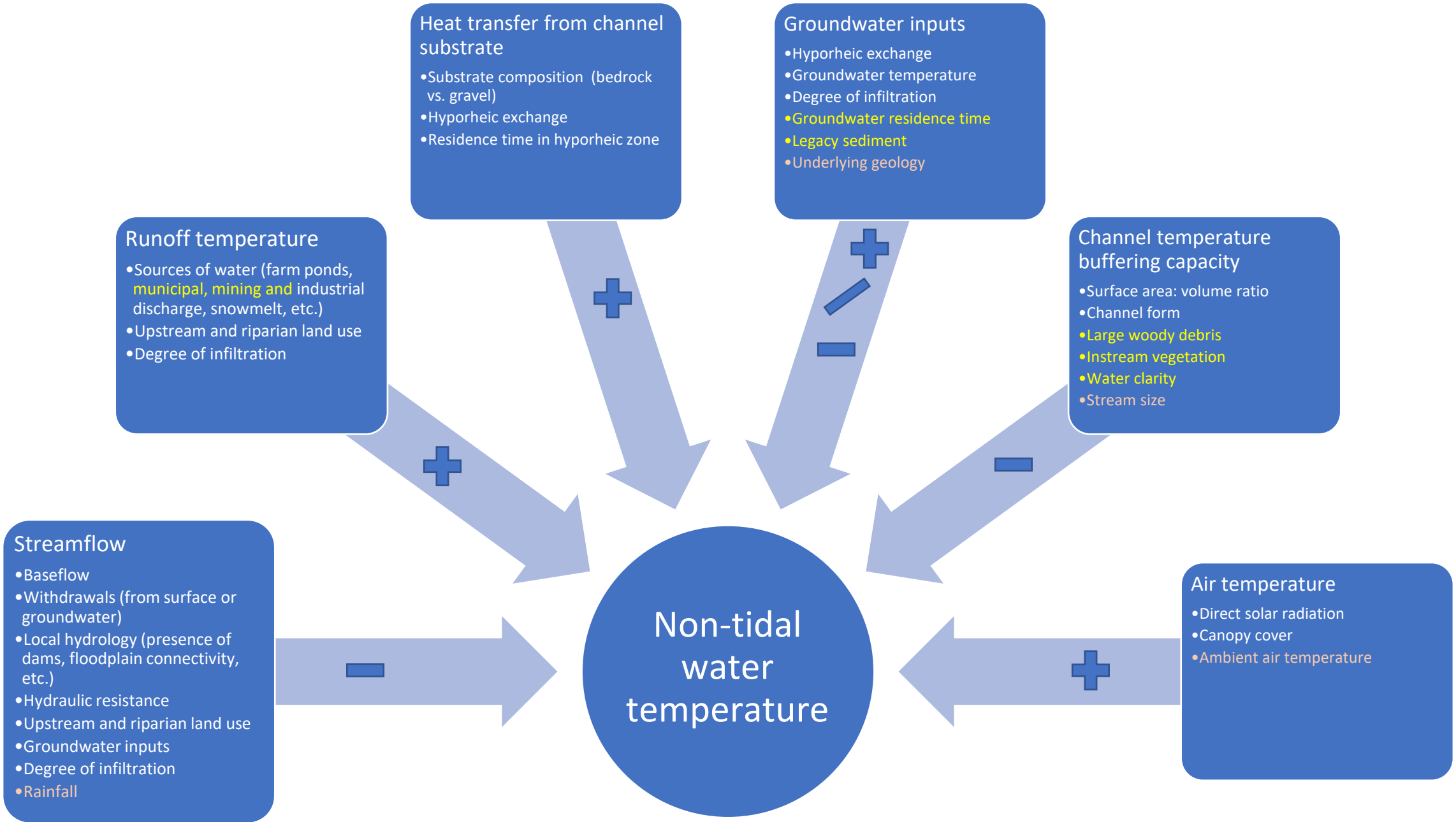
Water temperatures have been increasing in streams and rivers of the Chesapeake Bay watershed – even more than in the Bay's tidal waters



- Sites differed, but across the watershed, water temperatures increased more than air temperatures
- USGS found an average increase of 1.98° F in air temperatures and 2.52° F in nontidal freshwater stream temperatures (from 1960 to 2010)
- Air to water temperature ratios at sites showed influence of land uses

Source: Rice and Jastrow 2015

Increasing stream and river temperatures have been driven by rising air temperatures, but other drivers have a strong influence



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
        - Life stages, & predator/prey interactions

Ecological Impacts - Other Stressors

- Co-occurring Stressors
  - Low dissolved oxygen
  - Invasive species
  - Algal blooms
  - Bacterial/viral outbreaks
  - Distribution & toxicity of other pollutants (e.g., heavy metals, pesticides, ammonia, etc.)
  - Expansion of invasives

Photo credit: Driscol Drones

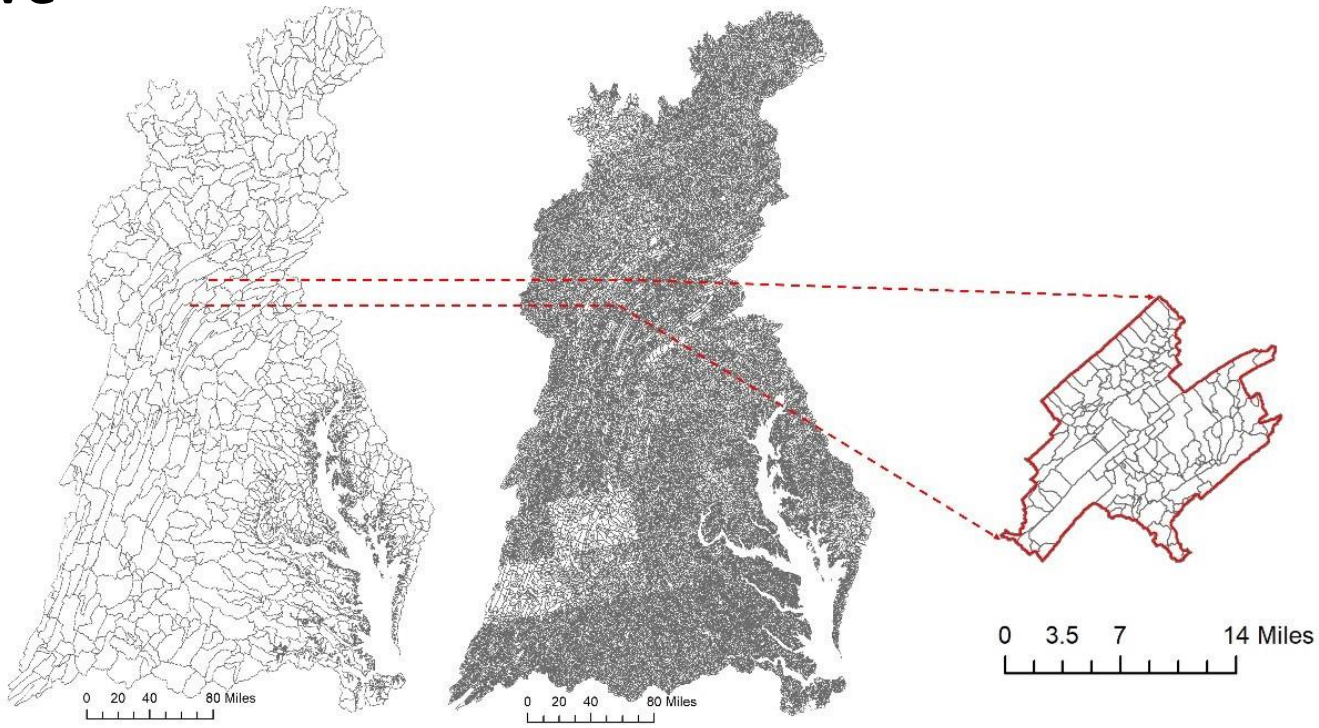
Management implications: policies and practices to address rising water temperatures

- Policies that promote the protection and maintenance of natural lands that provide cooling benefits, including forests, wetlands and healthy watersheds.

- Best Management Practices (BMPs) included in Watershed Implementation Plans (WIPs)

Management implications: Priority information needs

- Improved understanding of the relative influence of BMPs and habitat restoration on water temperature, including cost-effectiveness
- Additional data/modeling capacity to predict future changes in stream temperature
- Additional research to better understand how stream temperature and living resources will respond to management

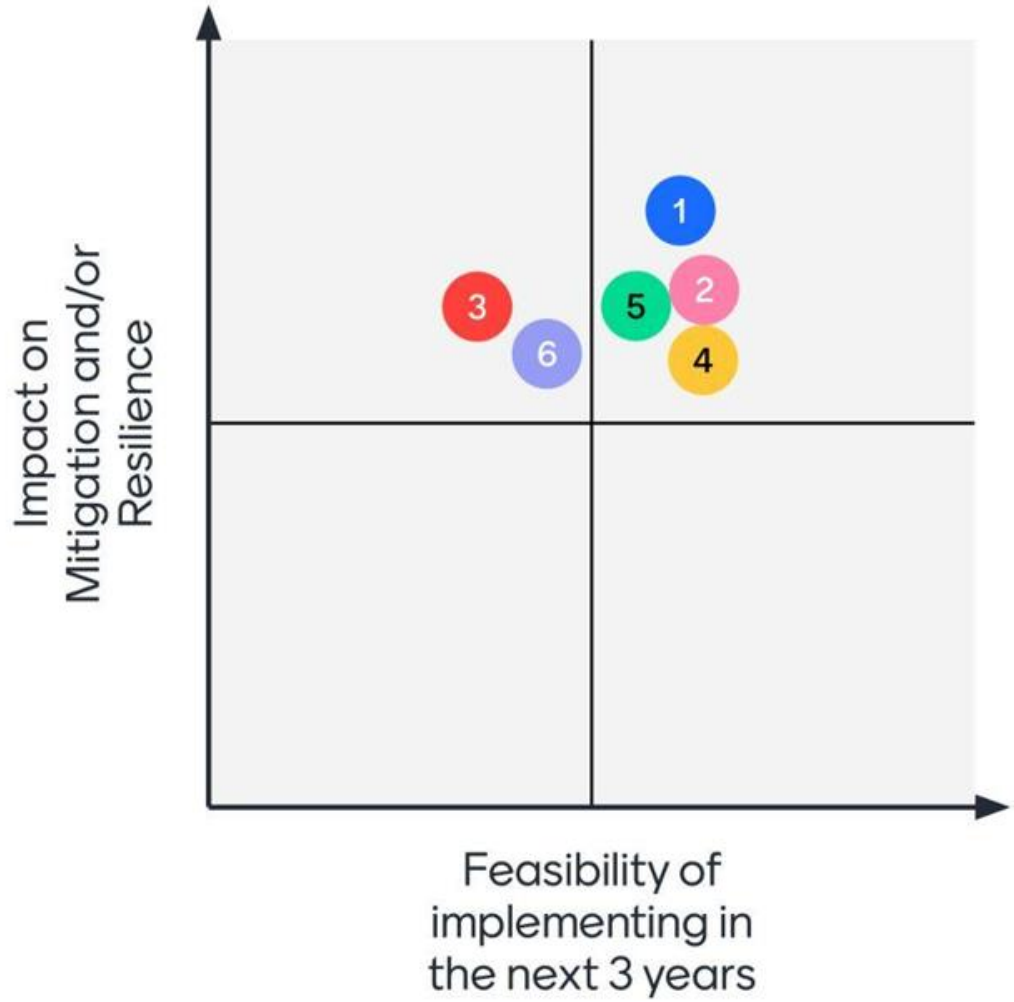


Day 2 Themes for Discussion

- Coldwater fisheries and habitats
- Rural waters and habitats
- Urban waters and habitats
- Cross-watershed topics
  - State temperature water quality standards (WQS), monitoring and implementation
  - Monitoring and modeling

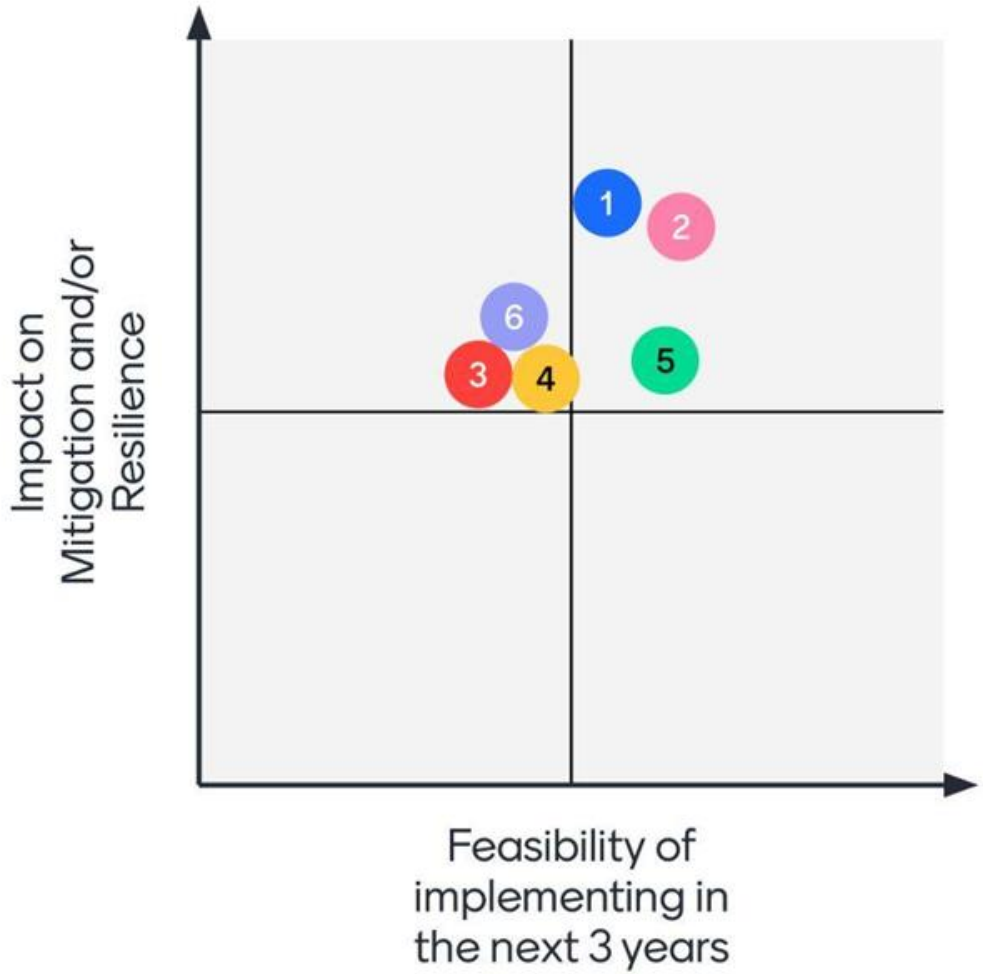
Photo credit: Joel Prince, NASF

Please rank recommendations for management actions: Coldwater Fisheries and Habitats



1. Protect forest watersheds
2. Promote good agricultural stewardship
3. Minimize impervious land use impacts
4. Improve engagement with private landowners
5. Work with local governments on land use planning
6. Restore degraded streams and landscapes

Please rank recommendations for management actions: Rural Waters and Habitats



1. Improve forest cover
2. Prioritize buffer plantings to maximize cooling
3. Integrate temperature into whole farm planning
4. Improve connectivity through habitat restoration
5. Improve technical assistance and programs for landowners
6. Work with local governments to improve codes/laws

Please rank recommendations for management actions: Urban Waters and Habitats

1. Incentivize stacking multiple cooler BMPs for pollutant reduction
2. Convert lawns to trees
3. Update plant lists for climate resilience
4. Conserve and expand tree cover in under-served areas
5. Improve connectivity through habitat restoration
6. Communicate multiple co-benefits of cooler BMPs

Selected Science Needs

1. Quantify BMP effectiveness (and cost-effectiveness) for cooling water temperatures, including the impacts of stream restoration and agricultural infiltration practices
2. Establish science-based targets for restoration and conservation, including % watershed forest cover and the needed forest buffer width to provide cooling benefits
3. Develop geospatial modeling/mapping tools to identify stream reaches with thermally resilient groundwater inputs.
4. More research is needed on the ecological implications of rising water temperatures in non-tidal systems, including impacts on non-trout species and lower parts of the food web, as well as how temperature interacts with other stressors
5. Develop multi-species prioritization tools to target conservation and restoration activities across the landscape based on local conditions and drivers of rising water temperatures

Next Steps

- Steering Committee will review & synthesize information, including management recommendations and associated science needs, from synthesis papers and both workshop days and draft final report

- Participant review of draft report (~May-June 2022 timeframe)

- Release final report (~summer 2022 timeframe)

- Conduct outreach with Bay Program and partners to discuss strategies to implement the report's 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