Climate Resiliency Workgroup

June 15th, 2023

1:30-3:30 PM EST

Event webpage:

https://www.chesapeakebay.net/what/event/climate-resiliency-workgroup-meeting-june-2023

This meeting will be recorded for internal use to assure the accuracy of meeting notes.

Workgroup Actions

- *Julie sends email to workgroup on opportunity to provide advisory support on Sea Level Rise-Wetland Impact Climate Change Indicator.*
- *During future CRWG meeting, invite Taylor Woods to present on streamflow change effects on fish species and communities and web application on climate change and land use/land cover web application for viewing data.*
- *CRWG staff with work with STAR staff to see about having a monitoring needs-themed meeting related to temperature and living resource impacts (based on findings from the Rising Water Temperature STAC Workshop Report).*

Partner-Partner Connections

- *Katie Walker (Chesapeake Conservancy) and Taylor Woods (USGS) expressed interest in connecting on using the data outputs from Taylor's research in state agency products like Green Print to help inform decisions related to climate change impacts on nontidal fish.*
- *Denise Clearwater (Maryland Department of the Environment) offered to share information on the Maryland Watershed Resource Registry to Taylor Woods (USGS). Registry has a wide variety of environmental and resource related data layers (e.g., stream and wetland maps, priority areas for restoration and preservation, ecologically significant areas).*
- *Peter Tango (USGS) offered to introduce Taylor Woods (USGS) to Stephen Faulkner (USGS), who is the chair of the Brook Trout Workgroup. They have been working on climate change indicators for brook trout.*

Minutes

1:30 PM **Welcome, Opening Remarks, and Announcements – Mark Bennett, Co-Chair (USGS), Jackie Specht, Co-Chair (The Nature Conservancy), Julie Reichert-Nguyen, Coordinator (NOAA), and Jamileh Soueidan, CRWG Management**

Staffer (CRC) [15 minutes]

Focus of meeting:

- *Share recent partner efforts around climate change impacts on nontidal watershed regions of the Chesapeake Bay and recommendations to address these impacts.*
- *Provide Taylor Woods (USGS) and her team with input and feedback on their web application, which focuses summarizing their research on Chesapeake Bay stream fish vulnerability and land-use/land cover change.*

Workgroup Announcements:

- *Welcome to Emily O'Keefe, summer intern with the CRC/NOAA program. Emily will be working on a project that will help advance our workplan actions 1.2a and 1.6a related to evaluating water temperature change/marine heat wave with fish habitat metrics.*
- ***Opportunity: Participate on cross-workgroup advisory committee to assist with the conceptual development of a sea level rise-tidal wetland impact indicator for Chesapeake Progress. Status and Trends Workgroup will be organizing a special meeting with members from the Climate Resiliency Workgroup, Wetlands Workgroup, and Land Use Workgroup. Potential contractor support available to create the indicator.***
- *EPA-ORD recently published the proceedings for their May 2022 Resilient Coastal Wetlands and Communities Workshop. The workshop brought together USEPA researchers along with a host of other partners and stakeholders virtually, for a cross-organizational and cross-regional exploration of three scientific themes: characterizing and measuring wetlands resilience; adapting management to support wetlands resilience; and linking wetlands resilience to the health and resilience of coastal communities, including those that are overburdened and underserved.*

Summary

Jamileh welcomed the Climate Resiliency Workgroup members and interested parties to the June meeting. She mentioned that the meeting will be focused on recent partner efforts around climate change impacts on the nontidal regions of the Chesapeake Bay watershed and recommendations to address these impacts. She then welcomed Emily O'Keefe, who is the summer climate intern at NCBO; Emily's work is helping link marine heatwaves to important living resources and will inform the development of a heatwave alert system. Julie Reichert-Nguyen then discussed an opportunity for workgroup members to serve on an advisory committee, which will support the conceptual design of a sea level rise indicator related to wetland impacts. Julie mentioned that she will send an email with the details about this opportunity and to reach out to her if interested (email: julie.reichert-nguyen@noaa.gov).

1:45 PM **Impacts of Climate and Land-use/Land Cover Change on Stream Fishes and Instream Habitat in the Chesapeake Bay Watershed (Taylor Woods, USGS) [35 Minutes]**

Taylor will present an overview of her recently published research investigating Chesapeake Bay stream fish vulnerability to climate change and land-use/land cover change. Additionally, she will present on upcoming research modelling climate and land-use/land-cover change on streamflow characteristics throughout the Chesapeake Bay watershed. The presentation will be followed by a discussion to provide feedback to guide development of a stream fish vulnerability web application as a part of a USGS Community for Data Integration grant and to determine needs for upcoming instream habitat modelling efforts related to climate and land-use change drivers.

Summary

Jamileh introduced Taylor Woods, who works with USGS. Her presentation focused on the impacts of climate change and land-use/land cover (LULC) change on stream fishes in the Chesapeake Bay watershed. Taylor first reviewed upcoming research efforts investigating thresholds in fluvial fish vulnerability to climate change-induced flow alteration. This research is expected to run from 2023-2025 and is comprised of a large, national, collaborative team. The research is focused on five different priority regions (i.e., Puget Sound, desert southwest, Great Lakes, Chesapeake Bay, and Gulf of Mexico). Studies at each of these locations will be compiling metrics for a number of biological endpoints that are either species or assemblage specific. The goal of the project are to predict streamflow alterations at all streams within the five regions for both contemporary and future time periods. The metrics measured include high flow and low flow magnitude, duration, frequency, and timing. They hope to relate streamflow alteration to fish species and community characteristics. She mentioned she would be happy to share more information about the project for those interested.

Taylor then presented on her recently published research, which is a climate and LULC change vulnerability assessment that was conducted for the Chesapeake Bay watershed stream fishes. The research aimed to understand what species and what habitats may be most vulnerable to global change. To understand which species are most vulnerable, they used a variety of functional traits (i.e., reproductive strategy, substrate preference, temperature preference, velocity preference, and trophic guild) that would describe how a species may be vulnerable or resilient to changes. These traits were used to group the 200+ species into five categories; species within the groups are more similar to each other than they are to species in the other groups and may respond similarly to global change. For each functional group, they selected a focal species that was used for modeling. For each species, they modeled abundance as a function of LULC and climate change predictors for a baseline in 2005 and in the future in 2030, 2060, and 2090. The results were used to infer potential habitat suitability (e.g., low abundance indicates low habitat suitability) for each functional group throughout the watershed for 2005, 2030, 2060, and 2090. They summarized that functional groups who are generalists and prefer warm water, fine substrates, and slow water are less vulnerable to global change, while

functional groups who prefer cold water, clean substrate, and fast water are more vulnerable to global change.

At the end of the presentation, Taylor reviewed the key messages from this research, including: not all species respond similarly to climate and LULC change, but functional trait information can shed light on why they respond differently; habitat stressors vary spatially on the landscape; and understanding trait-environment relationships may help generalize effects of global change on ecological communities. Taylor mentioned that their next steps include development of a web application to present the results of this research, which she requested feedback from the workgroup to help inform the development.

Discussion

Taylor began the discussion by asking what information would be useful in the web application (i.e., downloading raw data, summaries by ecoregion or stream size, information on functional grouping assignments for fishes, maps of model inputs and outputs, interactive or static graphics, and which temporal results). Denise Clearwater mentioned that all the options presented would be useful for a web application. Taylor responded that all options are available, but they wanted to make sure that adding all this information does not take away from the utility of the tool. Sophie Waterman mentioned that summaries would be helpful to include for folks who might not be as experienced with working with raw data. She also mentioned that this information would be a great overlay to include in the Chesapeake Healthy Watershed Assessment 2.0.

Peter Claggett asked if they were able to differentiate the effects of land use from those of climate change. Taylor responded that they are able to differentiate the effects, but she did not include them in this presentation. She mentioned that one can use varying climate and LULC change scenarios and combine them in a way that when compared to each other, they can assess relative contribution. Essentially, one can compare model results from the same climate scenario to those of differing LULC change scenarios to dig into the differences between the climate and LULC change effects. She mentioned that all this information is in the supplementary materials for the article and can be included in the web application. Peter clarified that they have not actually run these analyses, and Taylor confirmed that, but mentioned it can be made available for others to do so.

Katie Walker said that model outputs would be useful to include in the web application. Katie mentioned that as someone who works with GIS, she mentioned that it would be helpful to look at how other data layers could be informed by the results from this research, especially as it pertains to future projections. She also mentioned that it would be really interesting for state agencies to start looking at some of the programs they have (e.g., Maryland Greenprint), and how this information can inform decisions at the state agency level. Taylor mentioned that she would connect with Katie offline to discuss this more.

Robert Hirsch commented that functional grouping assignments for fishes would help us relate these results to other measures of fish communities. He mentioned that when he sees this information, it reminds him of the Index of Biotic Integrity (IBI) that is used in Maryland to assess the water quality. He would like to see these projected future trends passed through a filter of IBIs to see if the projected LULC and climate changes will have an impact on the impaired listings in Maryland. Taylor commented that this was helpful feedback and can inform the development of future research. Taylor mentioned that the functional group assignments were not only useful for monitoring but also that it provides some sort of mechanistic link to climate change, and can be used to see which factors within the IBI may be impacted.

Olivia Devereux commented that they could put a link to the R Shiny application on CAST, as it would be helpful to have a map of where people could target best management practices (BMPs) for water quality improvements. Olivia mentioned that they highlight other applications on CAST that assist with targeting BMP placement and understand ecosystem benefits, and this application would add to that suite.

Denise Clearwater inquired about the completion of this application. Taylor mentioned that they will be developing this application through September, with a beta version by the end of September. She mentioned that should would be happy to come present the application to the workgroup and share the link once it is developed. Denise also mentioned that the map outputs would be very helpful in the Maryland Watershed Resource Registry. She explained that the resource registry has a wide variety of environmental and resource related data layers (e.g., stream and wetland maps, priority areas for restoration and preservation, ecologically significant areas). The registry a great tool for looking at these various data layers in relation to each other. Taylor asked if this resources was just for Maryland; Denise responded that Virginia, Pennsylvania, and Delaware also have registries. She added the caveat that they might not all have the same data layers but offered to send the link to Taylor.

Julie commented that she liked how the results were displayed with both the current conditions and future projections and characterizing the information by habitat areas within the streams as well as by functional group traits. She wanted to clarify that they were classifying most resilient as fish that are tolerant to warming and slow moving waters. She was curious if precipitation was captured in this analysis as well. Taylor mentioned that they did have seasonal precipitation in their models; they were seeing interesting patterns in seasonal precipitation (e.g., decreases in precipitation during summer). They used flow preference as a way to infer how those changes in precipitation might select on species flow preference. Additionally, their sedimentation metric was used to infer precipitation impacts (e.g, species that prefer clean substrates might be more sensitive to influxes of sediment from precipitation). The Request for Proposals for their upcoming research incorporates means of measuring stream flow change.

2:20 PM Raindrops and Rivers: Stacking Climate Resilient Practices Informed by River Flow Data (Olivia Devereux, Devereux Consulting, Inc.) [30 Minutes]

Olivia will present on her work utilizing river flow data to help inform climate resiliency strategies. This work aimed to: 1) discover where to access river flow data that can illustrate trends leading to nuisance flooding; 2) learn an approach for identifying and quantifying multiple benefits of climate resilient management practices; and 3) amass resources for and examples of community engagement successes that improve climate resiliency.

Summary

Olivia Devereux (Devereux Consulting, Inc.) presented on her work around stacking climate resilient practices informed by river flow data. Her work focuses on how to synthesize various information sources to help managers and community leaders make informed decisions; she mentioned that this is in an effort to prevent silo-ing of information. She requested that the workgroup provide guidance and feedback on how this information can be packaged so that climate resiliency considerations are integrated into the information that is provided to decision-makers.

This work focused on understanding where to access river flow data which can inform how to address nuisance flooding, learn about and identify which climate resilient BMPs can provide multiple benefits, and amass resources and examples of community engagement successes that improve climate resiliency.

River flow data can be found on CAST under the monitoring tab. Data is sourced from the USGS tidal and nontidal monitoring networks. There are associated StoryMap tools that show the various stations and their nutrient trends overtime. The stations can then be searched on USGS's website and will show gage height and river flow trends over time. Users can also subscribe to alerts on gage heights, so users can be informed on when there may be nuisance flooding.

To address the problem, CAST has an *Eco-Health Relationship Browser* available to identify useful BMPs that can be implemented. Furthermore, the tool shows the relationships between these BMPs, and all the goals and outcomes in the Chesapeake Bay Watershed Agreement. This allows users to identify BMPs that could support more than one outcome in the Watershed Agreement. The tool is evolving to include more ecosystem benefits. Once a BMP is identified, users can use CAST to investigate the amount of nutrient reduction the BMP supports and the costs to implement. In regard to nuisance flooding, conservation landscaping and trees and infiltration are good options for cost effectiveness and nitrogen reduction.

Olivia then highlighted the importance of community engagement, stating that decision-makers need to solicit community involvement as a part of the implementation planning and project development. She underscored the importance of being aware of the history in these communities, so that flooding is addressed in a way that is sensitive to residential needs.

She gave examples of community-based projects that addressed flooding though using the CBP's Beyond Environmental Benefits Database and Search Tool. One such example was the

Bellmeade Walkable Watershed; this project worked with the community's schools and residents to build walking and bike paths to schools through the parks. These parks included playgrounds for the children and also doubled as flood control infrastructure, and the bike and walking paths were built with drainage.

Olivia then highlighted the need to quantify the impact of these strategies to either receive funding or to describe how their projects are helping improve water quality. Through CAST, there is the ability to quantify the water quality benefits of the BMPs that are implemented.

Olivia summarized that this work really focused on understanding the data that is out there in regard to river flow trends, understanding what BMPs exist to address flooding from rivers, engaging with the community to understand their priorities and needs, and building on community partnerships to implement a co-developed strategy. Finally, she highlighted that CAST can then be used to quantify these water quality benefits of the BMPs.

Discussion

Olivia began the discussion by asking folks how they could better shape their messaging about this effort and products so it can better reach target audiences.

Jamileh asked if Olivia and her team have worked with the jurisdictions to implement the use of the Eco-health tools. Olivia said that she has worked with the water quality folks in each of the districts to develop these tools, but has not connected with others working outside of the water quality space.

Julie Reichert-Nguyen asked if there were plans to develop any types of StoryMaps or guidance on how to navigate these various data sources and tools to identify and implement BMPs. Olivia mentioned that she could develop a manual or StoryMap, but wanted to check with the group about its utility. Julie highlighted that she hears a lot from folks that the CBP produces a lot of great information but it is not accessible or easy for users to navigate or bring together. She thinks that creating a guide showing users how to build upon this information and then target resiliency strategies would be useful. Olivia mentioned that she wants to reach out to the Local Leadership Workgroup, as they would be a good way to reach the right people in the jurisdictions.

Rebecca Hanmer highlighted that one of the issues is that the Chesapeake Bay TMDL is controlling nutrients and sediment for the benefit of the Bay, which is done at a state level, but there has not been an effort to convey strategies that localities can take to help reduce nutrients and sediment, while building resiliency and addressing local needs. Olivia thanked Rebecca for summarizing this need in a concise way.

Denise Clearwater connected the information Olivia presented to the work Taylor Woods presented earlier. She suggested that it would be useful to incorporate stream characteristics and fish functional groups while deciding which BMPs to use, as certain BMPs do not support

certain functional groups. She gave an example around if a community wanted to preserve cold-water resources that need cooler, faster flowing water, then some BMPs would not support that (e.g., they slow or heat the water). Olivia responded that it could beneficial to also incorporate negative impacts of the BMPs so that there a full picture of impacts when deciding which BMPs to select.

2:50 PM **STAC Rising Water Temperature Workshop Watershed Management Implications, Recommendations and Associate Science and Research Needs (Rebecca Hanmer, Forestry Workgroup Chair/Retired EPA) [30 minutes]**
Rebecca will present on the watershed findings from the STAC Rising Water Temperature Workshop. These findings include management implications, recommendations, and their associated science needs, which all aim to address increasing water temperatures in the nontidal portions of the Chesapeake Bay Watershed.

Summary
Rebecca Hanmer (Forestry Workgroup Chair) presented the watershed findings from the STAC Rising Water Temperature Workshop. The workshop was a partnership wide effort to assess the impacts of rising water temperatures on the Chesapeake Bay Program's living resource outcomes and develop management recommendations and their associated implementation steps and science needs.

For the watershed, water temperatures have been increasing throughout most of the region since 1960, with the 1985-2010 period experiencing significantly warmer temperatures for both mean air and streams temperatures. She underscored that land-use has a significant impact on stream and runoff temperatures, and that trees are an important strategy in addressing these temperatures through shading, evapotranspiration and facilitating rainwater infiltration; conserving forests and implementing the tree best management practices (BMPs) are highlighted in the recommended actions. She highlighted the importance of reporting land-use around monitoring sites along with temperature data to provide a comprehensive understanding of the factors impacting temperature at those locations.

The participants of the Watershed portion of the workshop also highlighted the impact that BMPs may be having on water temperatures, as some BMPs (e.g., tree canopy and forest buffers) cool the water that enters streams, while other BMPs (e.g., practices that use surface ponding of water) may heat the water that enters streams. They categorized these BMPs as "heaters" and "coolers" and noted the fact that significantly more "heater" BMPs have been installed than "cooler" BMPs.

The watershed recommendations focused on three different types of habitats (i.e., coldwater, rural, and urban) and two cross-cutting recommendations on Best Management Practices and Water Quality Standards. To inform the recommendations, participants reviewed the ecological impacts, which include negative impacts to coldwater species (e.g., trout, sculpin) and their habitats, increases in warm water aquatic species, although they are sensitive to extreme

temperature fluctuations, and the need for more research into the ecological impacts to lower trophic species. The coldwater recommendation urges the Bay Program partners to accelerate conservation of currently forested watersheds containing high quality coldwater habitat, and maximize riparian forest buffers in all coldwater watersheds. The rural recommendation focuses on implementing a strategic approach to conserve and restore forests and aquatic habitats, while promoting good agricultural stewardship practices that can reduce heated runoff from farms. In Urban areas, the Bay Program has been promoting tree canopy expansion, urban forest buffers, lawn conversion or "Bayscaping" and urban stormwater infiltration practices for years. All of these practices help to moderate rising water temperatures from heated runoff in urban areas. The STAC report recommends intensifying all these efforts to reduce the amount of heated runoff entering waterways. When addressing BMPs, the participants recommended that the Bay Program needs to pay systematic attention to the temperature effect of its water quality BMPs, minimizing the extent to which water quality BMPs are further heating waterways, and strategically using cooling BMPs to counteract the warming effects of climate change and land use, where possible. There is a need for more a more robust assessment of which BMPs are heaters and coolers, targeted to various landscape characteristics. Lastly, State Water Quality Standards approved by EPA under the Clean Water Act are a significant tool for protecting streams. They have temperature components: water use designations for cold and warm water fisheries and temperature criteria and monitoring. It was recommended that states and EPA should review and modernize current WQS systems to address climate-related rising water temperatures and drive area protection and restoration strategies.

Rebecca concluded the presentation by reviewing common themes that were heard across both the tidal and watershed sessions of the workshop. There is a need for comprehensive jurisdictional and land-use plans to ensure that temperature is incorporated. Temperature considerations need to be incorporated when targeting restoration and conservation efforts. The participants recommend promotion of the use of nature-based features to build a more climate-resilient landscape in the Bay region. Additionally, it is important that this information is communicated to governments, organizations and the public about the nature and impact of rising water temperatures. Common science needs heard across both sides of the workshop included modeling tool improvements as it's important to develop finer-scale, process-based local models in selected areas that better simulate the influence of land use and groundwater on local stream temperatures. Expanded monitoring is needed because while there is much general knowledge about temperature effects on species, and possible temperature impacts from BMPs, an effective response to rising water temperatures will require a place-based, and perhaps critical season-based, strategy for monitoring. Lastly, the report recommended climate vulnerability assessments to improve understanding of both exposure and sensitivity of species/habitats to rising temperatures.

<u>Discussion</u>

Julie Reichert-Nguyen commented on a common theme across this presentation and Olivia's presentation; she highlighted the point that Rebecca made about more "heater" BMPs have

been implemented compared to “cooler” BMPs, and that it relates back to what Denise Clearwater commented on, which is there needs to be some understanding of what the benefits are of these practices and what might be the trade-offs or negative impacts that affect other outcomes. She commented that this is something that the Bay Program should be thinking about as the 2025 and Beyond discussions move forward. She added that there should be considerations about incorporating this information in to CAST as well, which could be included in the Eco-Health tool that Olivia presented.

Sean Emmons asked if the methodology to classify BMPs as “heaters” and “coolers” is publically available. He is interested in potentially incorporating this classification into modelling work he is conducting with BMPs. Rebecca responded that this was an initial analysis and can be found in *appendix K* of the STAC report. Rebecca commented that generally, the “cooler” BMPs tend to be the nature-based strategies such as tree canopy or forest buffer. She added that nature-based BMPs are typically harder to sell, as the idea is they require more maintenance and may not be as reliable as an engineering solution.

Taylor Woods commented that their group has been discussing the need for an expanded monitoring of stream temperature data at a finer scale. She was curious if through the STAC report and effort, the watershed session identified any ongoing efforts to predict stream temperature at all stream reaches based on climate and land-use change. And if no effort were identified, she wondered if this would be something that would be useful to pursue. Rebecca responded that with the WQS implementation, Maryland has been working on developing a temperature TMDL for its streams, with models being used for that work and are highlighted in *appendix I*. Peter Tango responded as well, saying that the Brook Trout Workgroup created scenarios of climate change with temperature rise up to +6°C and its effects on habitat availability. He mentioned that Stephan Faulkner or the Habitat GIT staff would be good to connect with. Peter also mentioned that Taylor look into the work that Than Hitt (USGS) is doing with temperature monitoring at local scales and coordinating with citizen monitoring to get stream reach level information.

Jim George asked if anyone has looked into artificial shading for localized areas. Rebecca responded that there was a presentation a few years back at a Forestry Workgroup meeting, where researchers looked into shading options during heatwaves for Washington DC, and the findings indicated that trees were a good way to shade and cost effective compared to other kinds of built shelters. This was in connection with public health considerations however, and she has not heard of anyone researching shading alternatives for stream temperature.

Rebecca also commented about whether to consider wetlands, which do have still water, as “heater” or “cooler” BMPs. While compiling the state-of-the-science leading up to the workshop, they found in the literature that the answer is variable and dependent on the type of wetlands and the nature of the plants.

Julie commented that maybe there can be a planned meeting with STAR to highlight these modeling and monitoring needs that were identified during the workshop. Both the Modeling

and Monitoring Workgroups sit beneath STAR, so it would be a great way to discuss these items with these groups doing the work.

3:20 PM Partner Announcements and Wrap Up [10 minutes]

3:30 PM Adjourn

Participants:

First Name	Last Name	Affiliation
Ahmed	Shehu	
Ahsley	Kelly	DoD
Alex	Gunnerson	CRC
Amanda	Small	MDNR
Amy	Freitag	NOAA
August	Goldfischer	CRC
Bailey	Robertory	NOAA/CRC
Ben	McFarlane	HRPDC
Breck	Sullivan	USGS
Brock	Reggi	VADEQ
Cassandra	Davis	NYSDEC
David	Saavedra	Chesapeake Conservancy
David	Byrd	USFWS
Debbie	Herr Cornwell	MDP
Dede	Lawal	CRC
Denise	Clearwater	MDE
Elliot		
Emily	O'Keefe	NOAA
Erin	Watts	Baltimore County EPS
Erin	McNally	EA Engineering
Grace	Hansen	HRPDC
Jackie	Specht	MDNR
Jamileh	Soueidan	NOAA/CRC
Jian	Zhao	UMCES
Jim	George	MDE
Julie	Reichert-Nguyen	NOAA
Katherine	Rainone	MWCOG/TPB
Katie		
Katie	Walker	Chesapeake Conservancy
Kelly	Maloney	USGS
Marina	Metes	USGS

Mark	Bennett	USGS
Mary	Andrews	NOAA
Matthew	Konfirst	EPA
Molly	Mitchell	VIMS
Moriah	Baybrick	
Olivia	Devereux	Devereux Consulting Inc.
Peter	Tango	USGS
Peter	Claggett	USGS
Rebecca	Murphy	CBP
Rebecca	Hanmer	Forestry WG
Renee	Thompson	USGS
Robert	Hirsch	Baltimore County EPS
Ryland	Taylor	MDNR
Sarah	Widman	MDNR
Sean	Emmons	USGS
Sophie	Waterman	CRC
Tammy	O'Connell	MDNR
Taryn	Sudol	MD Sea Grant
Taylor	Woods	USGS
Xin		
Yulai	Yang	Morgan State University