Sustainable Fisheries Goal Implementation Team Meeting Summary

Winter 2022

Chesapeake Bay Program
Science. Restoration. Partnership.

Purpose of the Sustainable Fisheries Goal Implementation Team and Our Biannual Meeting

- Deliver emerging science and improve cross-jurisdictional collaboration to improve fishery management decisions
- Lead forums that bring the management and science communities together to learn about the latest fisheries and habitat science, discuss management implications, identify new science priorities, and identify funding opportunities
- Learn more about the Sustainable Fisheries Goal Implementation Team (Fisheries GIT)

Our Team and Workgroups

Fisheries GIT Staff:

- Chair: Sean Corson (NOAA)
- Vice Chair: Marty Gary (Potomac River Fisheries Commission)
- Coordinator: Bruce Vogt (NOAA)
- Staffers: Mandy Bromilow (NOAA) & Justin Shapiro (CRC/NOAA)

Workgroup Contacts:

- Chesapeake Bay Stock Assessment Committee (Pat Geer, VMRC)
- Fish Habitat Action Team (Chris Moore, CBF)
- Maryland and Virginia Oyster Interagency Teams (Stephanie Westby, NOAA/Andrew Larkin, NOAA)
- Forage Action Team (Justin Shapiro, CRC/NOAA)
- Invasive Catfish Workgroup (Mandy Bromilow, NOAA)

Contents

Day 1: Oyster Restoration Updates, Science, and Future Directions

Day 1 focused on progress towards the Fisheries GIT's oyster restoration outcome. Topics covered included oyster restoration accomplishments from 2021; ongoing science efforts surrounding monitoring, restoration, and ecosystem service valuation; and a group discussion focused on the future of oyster restoration in the Chesapeake Bay.

Oyster Restoration: 2021 Progress in Maryland and Virginia

Presenters: Stephanie Westby (NOAA) and Andrew Button (VMRC)

Progress toward ten restored tributaries: All ten tributaries have been selected and have completed restoration blueprints. Restoration has been completed in six tributaries (Harris Creek, Tred Avon, Little Choptank, Great Wicomico, Piankatank, and the Lafayette). In-water restoration is ongoing for the remaining four tributaries (St. Mary's, Manokin, Lower York, Lynnhaven). In Maryland, the St. Mary's is slated for completion in 2022, with the Manokin aiming for a 2025 completion. In Virginia, the Lower York is slated for 2022 completion, with the Lynnhaven completion expected in 2025. A bonus restoration effort of 21 acres in the Eastern Branch of the Elizabeth River was completed in 2020. From an area perspective, 1,220 of the 1,770 acre goal have been restored Bay-wide. This amounts to nearly 70% of the Bay-wide goal, or about 924 football fields of oyster reefs. A NOAA Fisheries Technical Memorandum on Oyster Restoration Ecosystem Services highlights and contextualizes the true value of the acreage values mentioned above.

Green tributaries are restored. Blue tributaries are under construction (Stephanie Westby, NOAA)

Oyster Restoration Highlights 2021

Reefs produced a good natural spat set in 2021.

Restoration efforts were completed in the Great Wicomico, Piankatank, and Tred Avon rivers. 30% of all Virginia acreage targets were met in 2021 alone.

Monitoring of restored reefs three and six years after restoration is completed indicates success metrics are being met or exceeded.

UMCES' Horn Point hatchery produced ~700 million spat-on-shell for restoration sanctuaries.

Next steps/challenges:

The collaborative partnership plans to better communicate the success of this large-scale, cutting-edge regional effort. Pockets of opposition and expensive final acres will be challenges to take on in the coming years.

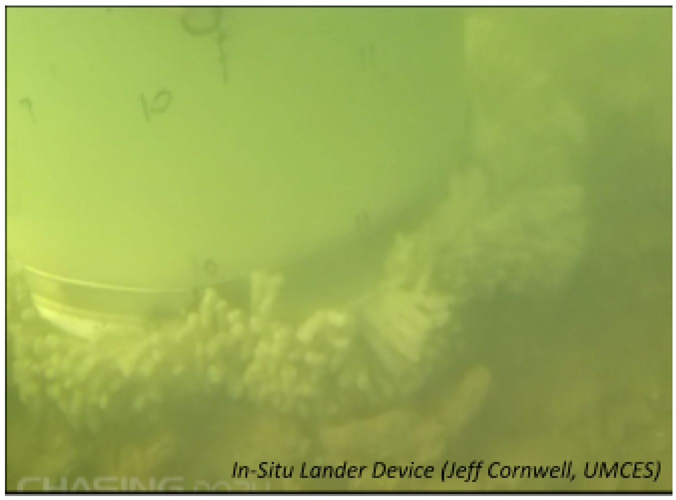
USACE Chesapeake Bay: Virginia Oyster Restoration

Presenter: Keith Lockwood (USACE–Norfolk District)

The U.S. Army Corps of Engineers' Norfolk District provided a more-detailed overview of oyster restoration work specifically led by their office. As discussed above, restoration in the Piankatank River is complete, but there may be an opportunity to restore additional acres there in the near future. In the Lynnhaven River, hard-bottom restoration of 8 acres is complete and also includes wetland and reef ball habitat construction. A next phase will include ~24 acres of restoration in Broad Bay. The Great Wicomico has met restoration completion metrics, but USACE is looking to rehab areas that have experienced poaching. Lastly, Tangier Island presents possibilities for restoration with the use of incoming federal dollars. There is a substantial amount of data from a 2001 restoration effort that may be used to guide future projects.

Development of Site-Specific Methods to Measure Oyster Denitrification Rates

Presenter: Jeff Cornwell (UMCES)


In-Situ Lander Device (Jeff Cornwell, UMCES)

Chesapeake Bay oyster restoration best management practices (BMPs), currently under panel review, include default rates for denitrification at restored reefs and a number of other factors. Current approaches to measure these denitrification rates are based upon *ex-situ* incubations where divers collect samples via trays and incubate collections in a lab setting. This method provides extremely accurate/effective data, but is a time-consuming and expensive effort. This raises the question: Can we measure denitrification rates in the field and account for the lack of sealing on uneven bottom structure? It is this question that led to the ongoing study headed by the University of Maryland's Center for Environmental Science and funded through the Chesapeake Bay Program's GIT-funding process. The research team has developed a field lander, using mop heads to account for an unsealed bottom, to collect *in-situ*, site-specific oyster denitrification rates. Under this lander approach, inflow, oxygen, and leakage rates are all measured. To account for leakage rates, a tracer element is used. Under limited field application, the methods have been effective at measuring denitrification rates, despite leakage. The process requires about 1/3 the cost/person effort of the intensive *ex-situ* process and causes less bottom disruption. Preliminary result rates match closely to default rates measured at Harris Creek, a promising sign. This approach could also have future application in aquaculture settings. One disadvantage is the lack of biomass estimation that is gathered during the lab approach. Work will continue through early 2022 with a final report expected in spring.

Impacts of Ocean Acidification on Oysters

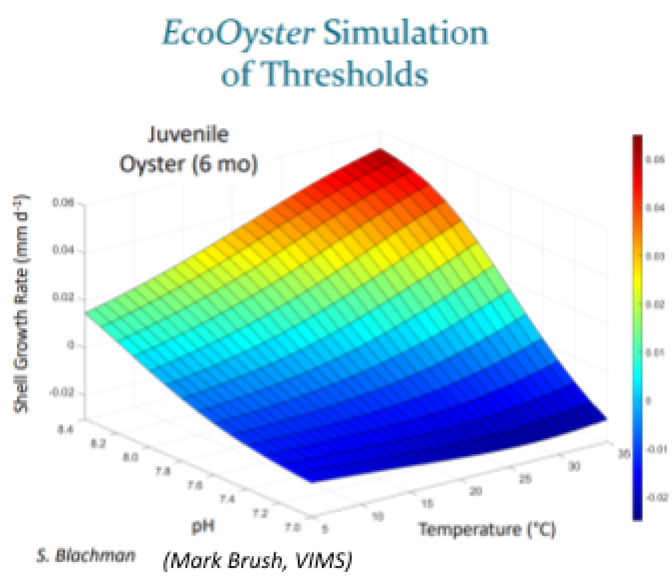
Presenter: Emily Rivest (VIMS)

This ongoing work, headed by the Virginia Institute of Marine Science and funded by NOAA, explores threshold levels of ocean acidification that negatively affect oyster growth. Acidification rates are rising more rapidly in the Chesapeake Bay compared to rates in the global ocean because of a number of local drivers, and the presence of other co-stressors may make oysters more sensitive to acidification. Negative effects on oyster growth, strength, and feeding are well documented, but questions about threshold levels have not yet been answered. Understanding where, and for how long, oysters spend time in highly acidic conditions is key, and could help us better spatially plan restoration and aquaculture efforts. Lab experiments under a number of scenarios helped establish acidification thresholds for juvenile and adult oysters (net shell dissolution rates represent threshold line). Initial experiments found that adults were more sensitive to acidification; that spring is the most likely time for oysters to be below the acidic exposure threshold; and that some oysters can spend upwards of 16-24 hours per day below this threshold. Explorations surrounding mitigation efforts are ongoing, including the concept of co-locating oysters and SAV beds (unsure if enhanced oyster growth is connected to acidification reduction). This preliminary work is not yet available, but the lead researcher, Emily Rivest, can be contacted by email at ebrivest@vims.edu.

EcoOyster Model – Modeling Oyster Growth, Condition, and Ecosystem Services

Presenter: Mark Brush (VIMS)

EcoOyster is a model that, at its core, examines a number of factors to simulate individual oyster growth in response to environmental parameters such temperature and dissolved oxygen. This oyster growth model is embedded in an estuarine ecosystem model (the same one used to establish Harris Creek oyster restoration nitrogen removal numbers). It is being applied in this context to examine how various biological processes of oysters may be affected by sensitivity to acidification (filtration/respiration are not sensitive to acidification, but impacts to shell growth/calcification are, as we heard in the above presentation). Running the model with multiple cooccurring factors, like acidification and temperature, can paint a 3-D picture of interacting effects and may help identify places and times where oyster shell dissolution can be expected. Next steps include model simulation and identification of thresholds, exploration of corestoration potential with SAV, and simulation of tributary-scale benefits.



Validating a Rapid Assessment Protocol for Monitoring Subtidal Oyster Reefs

Presenter: Allison Tracy (SERC)

This pilot study, headed by the Smithsonian Environmental Research Center, explores the potential of cost-effective and time-efficient methods to monitor oyster restoration success. The framework uses a GoPro-based tool that captures top-down and side images to be studied and qualitatively scored (looking at a number of success metrics). The concept aims to provide cost-effective and faster monitoring capabilities, but how do these qualitative image scores compare to traditional monitoring metrics? This approach was validated by testing a number of harvested/restored sites with traditional methods and comparing results to the rapid GoPro scores. At these test sites, the rapid assessment protocol effectively captured biomass, density, size class, reef height, and rugosity success metrics. This GoPro approach is four to eight times faster than traditional monitoring. Next steps involve continuing to communicate these results and exploring the potential for hybrid monitoring approaches at restored reefs. These presentation results are still preliminary, but further questions can be directed to Allison Tracy by email at tracyal@si.edu.

Oyster Restoration Science Needs

Presenter: Bruce Vogt (NOAA)

The Fisheries GIT, and its corresponding oyster restoration workgroups, are currently reviewing and amending their documented strategic science and research needs for the Chesapeake Bay Program. Spatial restoration planning, three- and six-year monitoring of restored reefs, and success/progress tracking are current needs that the team feels are being addressed adequately. The current approach to monitoring is yielding high success metrics at restored sites, but the team is looking for a more streamlined/efficient approach as the number of restored acres continues to accumulate. This need highlights the importance of the rapid assessment protocol pilot discussed in the previous presentation. Another ongoing need is continued work on the quantification of ecosystem services/economic benefits from oysters. The NOAA Chesapeake Bay Office completed an Oyster Restoration Ecosystem Services Report (ORES) and is also funding additional work to quantify the economic value of oysters in Virginia's Middle Peninsula. The ongoing *in-situ* oyster denitrification project, discussed above, also helps to address this need. Additional emerging science needs include better understanding climate impacts on oysters in Chesapeake Bay, as well as the continued refinement of restoration approaches.

(Chris Moore, CBF)

Oyster Restoration in the Future: Planning Past 2025
Facilitator: Sean Corson (NOAA)

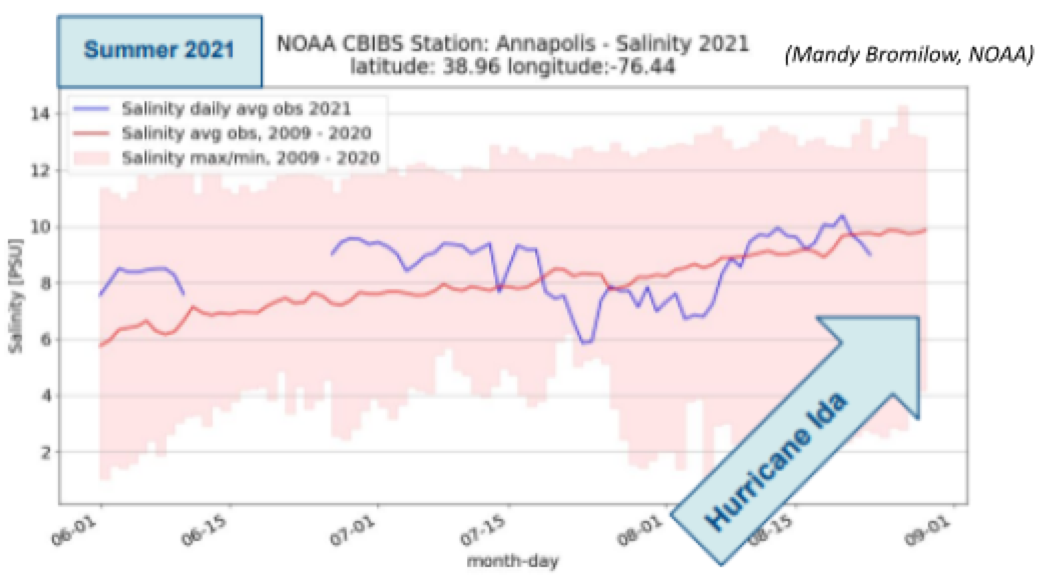
To round out Day 1's oyster restoration and science updates, the Fisheries GIT leadership facilitated a discussion highlighting successes from the current Bay-wide restoration effort, what we as a community have learned over the duration of this "ten tributaries" goal, and what future restoration planning may look like. All in all, there were many positive takeaways from this team's restoration success, and many participants would like to see continued large-scale planning and partnership into the future. The summarized feedback from the discussion can be seen below, in Appendix A.

Day 2: Linking Environmental Observations to Fish Habitat/Living Resources and Updates from across the Chesapeake Bay Program

Day 2 highlighted a number of ongoing efforts linking environmental observations to living resources in the Chesapeake Bay. Beyond research updates, the Fisheries GIT heard about multiple social science/engagement projects aimed to communicate the importance of fish habitat and its impact on living resources. The day ended with a few updates from other Chesapeake Bay Program workgroups, with an emphasis on potential connections to the Fisheries GIT's work.

2022 State of the Ecosystem: Chesapeake Bay Year in Review
Presenter: Mandy Bromilow (NOAA)

The NOAA Chesapeake Bay Office's (NCBO) Ecosystem Science team has compiled four seasonal environmental reports for 2021, published on a quarterly basis and highlighted in NOAA's annual Northeast State of the Ecosystem report. These summaries analyze environmental conditions (from a number of state/federal observation sources) compared to long-term averages and provide a narrative about how these observed conditions may affect key fisheries resources. They aim to provide applicable information for



state and coast-wide fisheries managers. This is the first year of report production from the NCBO team. Additional feedback on parameters/observational data for inclusion or effects on specific species would be welcome.

Highlights from 2021 seasonal analyses:
- Warmer than average winter and fall water temperatures were observed and may have reduced striped bass recruitment despite high flow in the early spring. The warm fall may have delayed southward resident migrations.
- Salinity was higher than average in summer, and lower than average in the fall (most likely caused by fall precipitation). This high summer salinity may have been beneficial to oyster recruitment/growth.
- Freshwater discharge was above average in winter and in the early spring.
- Hypoxia was below average in the early summer but higher than average at the summer's end.

Developing Forage and Climate Indicators

Presenter: Ryan Woodland (UMCES)

This ongoing indicator development project is supported, and was put forward for GIT-funding, by the Fisheries GIT's Forage Action Team, with the established goal of providing updated forage population and climate indices. The UMCES team is first updating, and exploring new variants of, bay anchovy and polychaete indicators through the testing/selection of modeling approaches. There is interest in connecting these forage indices to two different climate signals; the Atlantic Multi-Decadal Oscillation (phenomena of long-term sea surface temperature swings) and the annual degree-day index (essentially an integer number capturing the speed at which the water warms in a given year). Earlier work has shown a preliminary connection between the noted degree-day index and annual forage abundance. Next steps will include model selection of the climate indices of interest and continued exploration of how to best present this information visually on a dashboard/indicator page.

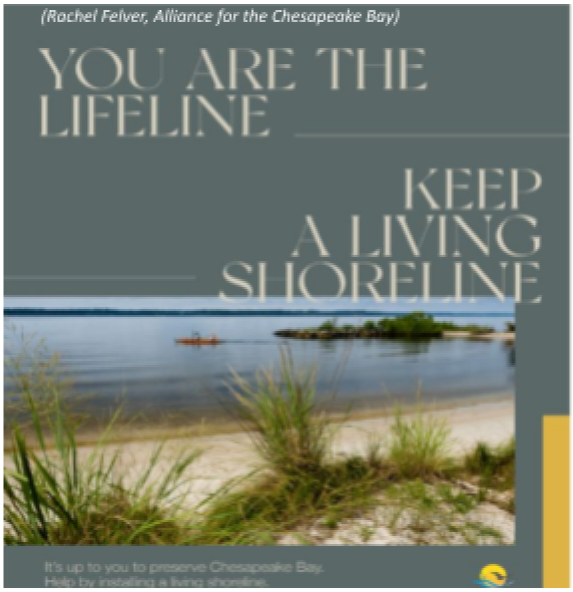
Utilization of Telemetry Arrays: Tracking Key Chesapeake Bay Species

Presenter: Matthew Ogburn (SERC)

Acoustic tagging of fish can provide scientists/managers with unique information about how species' movement metrics correlate to environmental/habitat condition, and provide data to help researchers predict future species movement/habitat utilization. This current project, led by the Smithsonian Environmental Research Center, focuses on juvenile striped bass habitat use. The researchers were interested in answering questions like "*how long do these striped bass utilize shallow-water tributaries*'' and "*can we understand the spatial and temporal trends of their movement*." To address these questions, 40 juvenile striped bass were caught and tagged in the Rhode River (average size was 35 cm). The extensive array of receivers in the Chesapeake Bay (including the new backbone array highlighted at recent Fisheries GIT meetings) are key to this data collection effort. Most fish have more than 1,000 individual detections. Preliminary results found that most fish remained where they were tagged and utilized the shallow-water tributaries. Next steps include incorporating final data received at the end of 2021 for full analysis. The same team is also kicking off a project that is leveraging multispecies and multiyear telemetry datasets to identify seasonal, ontogenetic, and habitat shifts of Chesapeake Bay fishes. The team plans to estimate common metrics of movement/habitat use and how they correlate with the environment. The goal is to develop life/season-specific habitat distribution models and predict future habitat use under warming scenarios. These slides are not yet publicly available, but questions can be directed to Matthew Ogburn at OgburnM@si.edu.

Social Marketing to Improve Shoreline Management

Presenters: Gina Hunt (MDNR) and Rachel Felver (Alliance for the Chesapeake Bay)



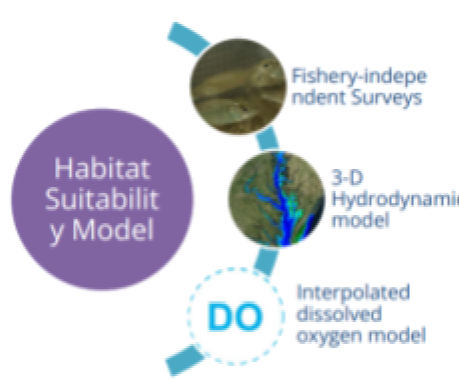
(Rachel Felver, Alliance for the Chesapeake Bay)

Shifting gears from fish habitat science to communication, the team leads presented on this recently completed project funded through the Chesapeake Bay Program's GIT-funding process. This social science-based project aims to reduce shoreline development by creating community-based social marketing techniques aimed at coastal landowners. The first iteration of the project investigated and summarized behavioral decisions of land owners and defined strategies to address these individuals. Initial surveys of property owners found the most prevalent barriers to living shoreline installation to be cost, permitting complications, and not viewing the project as effective for erosion control. Interestingly, people did view these installations as key to protecting the Bay and found them to be aesthetically pleasing. Recommendations from this initial surveying phase were used to provide an outreach plan focused on owners who had not yet armored their shorelines (it is more cost-effective to pursue individuals who have not yet armored, as dearmoring is expensive). The team also noted that behavior change comes not just from education and authority organizations, but from observing behaviors from neighbors, friends, and families. The second phase, completed in late 2021, built off of these initial behavior analyses to develop a suite of communications products for the identified target audience. "Toolkits" were developed so on-the-ground organizations and contractors had the correct resources to answer the questions/concerns/misconceptions surrounding living shoreline construction. A few items in the "toolkit" are individual commitment cards, public posters for community spaces, applicable case studies, large shoreline signs visible to neighbors and from the water, and online resources about contractors and permitting. Materials, and a corresponding video, will all be made publicly available.

Assessing Striped Bass Nursery Habitat Suitability in the Chesapeake Bay

Presenter: Rachel Dixon (VIMS)

Staying with the theme of fish habitat, this is another Chesapeake Bay Program GIT-funded study, headed by VIMS. In 2019 the Atlantic States Marine Fisheries Commission (ASMFC) classified striped bass as overfished with overfishing occurring, as stock declines continue even with average levels of recruitment. Cooler and high-flow springs are connected to better recruitment classes, but recruitment in specific nurseries vary year to year. All of that said, understanding how habitat changes and how nursery availability may affect species productivity and population resilience is key. This research hopes to answer questions such as, *"has the spatial extent of suitable habitat*

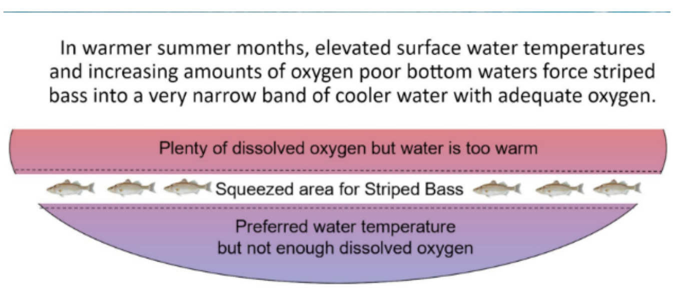


(Rachel Dixon, VIMS)

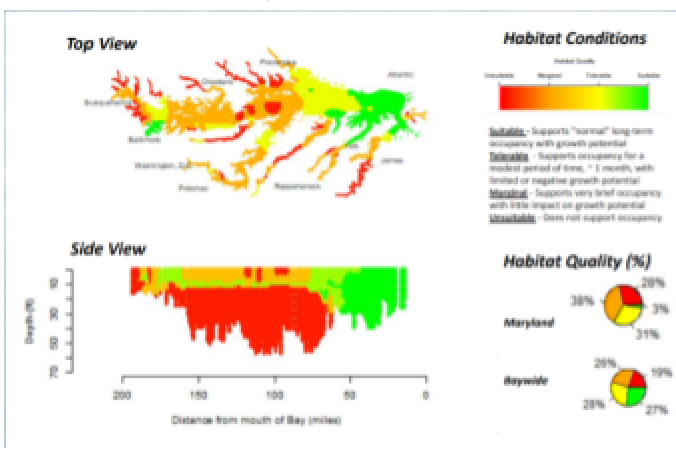
changed over time?" and *"what habitat conditions support the production of young-of-year and resident subadults in Chesapeake Bay?"* To answer these questions, the research team is using habitat suitability models (using five fisheries independent surveys from Maryland and Virginia spanning 1996-2019) and looking at 30 environmental variables that may affect striped bass across size-specific datasets. Early results show suitability varying on a seasonal and annual basis. Boosted regression tree analysis has highlighted variables like bottom DO, DO stratification, salinity, current speed, and depth as important suitability factors. Better understanding seasonal and interannual variability may help target critical nursery areas for restoration or conservation. As the project wraps up, the team will continue to explore the communication of results and the potential for a decision support tool.

Developing Water Temperature and Dissolved Oxygen Thresholds for Striped Bass Summer Habitats (Maryland)

Presenter: Tom Parham (MDNR)



The goal of this MDNR-led project is to provide fisheries managers (and possibly anglers) with tools to better understand striped bass and their changing summer habitats. During summers, striped bass experience habitat "squeezes" where the Bay's bottom is hypoxic and the surface temperature is too hot. Historically, closures of the striped bass fishery in late July, when hypoxia is most severe, have been a management solution to address this issue. Managers believe this approach can be refined spatially and temporally. To investigate potential improvements to temperature/dissolved oxygen threshold levels, the research team performed a literature review on striped bass, specifically focusing on the sized-fish present in the Bay (21-29 inch resident fish). From the literature review results, four suitability categories were established with assigned DO and temperature levels (suitable habitat was defined as DO above 4 mg/L and temperature below 28 degrees C). Next was a comparison between these established categories/thresholds and data from long-term monitoring sites (2010-2020 at 165 unique sites). Overlaying of temperature and DO provides a picture of percent of available habitat for striped bass. Continually increasing temperatures will reduce these available habitats in the future. Next steps involve extending datasets back to 1986 and coordinating with Chesapeake Bay Program modelers to assess Bay conditions for striped bass in relation to Bay restoration (water quality) scenarios. Hopefully this will help to answer key questions such as, "*will a restored Bay help with striped bass habitat availability?*" *"by how much?"* and "*can these thresholds be useful to the public for identifying popular fishing spots based on seasonal shifts in temperature/DO trends?"*



Example of suitability maps and conceptual diagram of a "hypoxia squeeze" (Tom Parham, MDNR)

Fish Habitat Assessments in Both Nontidal and Tidal Waters of the Chesapeake Bay

Presenters: A.K. Leight (NOAA) and Stephen Faulkner (USGS)

Separate tidal and nontidal efforts: Addressing stated actions from the Fish Habitat Action Team's outcome language, teams from USGS and NOAA NCCOS are helping to assess and characterize fish habitat in a tidal and nontidal context. Early work from these individual efforts was presented during last January's virtual Fisheries GIT meeting. By way of reminder, tidal and nontidal biological data sets were inventoried for a 2018 STAC workshop. The nontidal assessment methodology combines freshwater fish data and landscape predictors, which are both inputs for a predictive model helping us obtain a holistic view of fish habitat condition. The tidal team developed a hexagonal approach, differing from the linear approach used in the non-tidal assessment. A number of products from these respective efforts are available on the Fish Habitat Action Team webpage (nontidal species watershed observation map, recommendations for conducting a tidal assessment, and the metadata inventories mentioned above). USGS's nontidal assessment is still under internal review, but will be distributed to the Fisheries GIT when available.

Joint tidal/nontidal assessment effort: Because of different monitoring programs, and analytical approaches, attempting a coordinated joint pilot across tidal/nontidal waters was an action of interest in the Fish Habitat work plan. The first step was the selection of a pilot geography. Major criteria for selection were the presence of all four habitat types, biological data availability, complexity (how many jurisdictions does the system span), and stakeholder needs/engagement potential. The Patuxent River met all four of these criteria and was selected as the pilot location. An initial literature review is complete and a review of collected metadata inventories are underway. The team will continue to work, and provide progress updates, through 2023.

Chesapeake Bay Program Monitoring Review (Living Resources Considerations)

Presenters: Peter Tango (USGS), Breck Sullivan (USGS), and Bruce Vogt (NOAA)


(Bob Murphy, Tetra Tech)

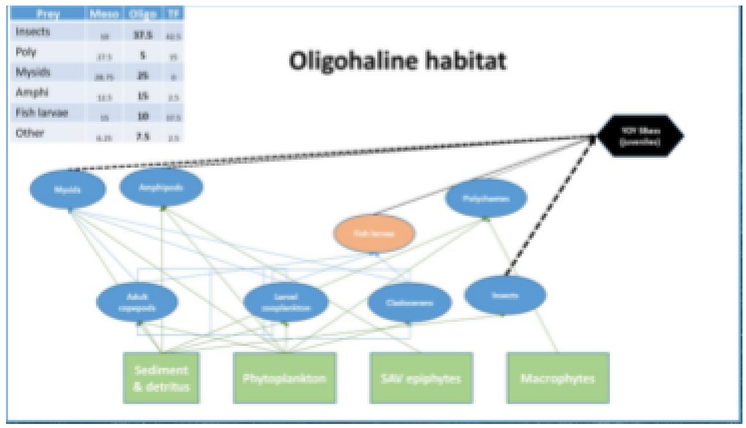
Background on the impending monitoring review: The Principals' Staff Committee has requested a current status and threats assessment of the Chesapeake Bay's monitoring network. STAR has been tasked with addressing the questions "*what is needed to improve the program's sustainability*?" and "*what is available to address current capacity shortfalls?*" This coordinated response will be presented to Bay Program leadership in the spring of 2022. GITs are currently working to formulate short summaries that help to address these stated monitoring questions. For example, a Hypoxia Collaborative team was assembled to design a sample monitoring program recommending eight new observational arrays to help meet necessary water quality and living resources needs. It is important to remember that a comprehensive monitoring review hasn't been conducted in more than 10 years, so providing explicit, well-defined needs for this review is very important.

Fisheries GIT monitoring needs: The Fisheries GIT has compiled a short list of monitoring needs focused on hypoxia, plankton, and shallow water. Monitoring all species, in all places, at all times is not feasible from a monetary or capacity perspective. That being said, are there spatial and temporal specifics that can be provided about the best ways to leverage existing efforts? Are there species of interest that should be of focus when putting forward the GIT's highest-priority monitoring needs? Participants were asked these questions via Jamboard. The results are summarized below in Appendix B. These collected responses were considered when the Fisheries GIT monitoring needs were summarized and submitted in late January.

Plastic Pollution Action Team (PPAT): Progress Updates for the Fisheries GIT

Presenters: Bob Murphy (Tetra Tech) and Justin Shapiro (CRC/NOAA)

Semiquantitative food web interaction from juvenile striped bass risk assessment (Bob Murphy, Tetra Tech)



We know from two completed STAC workshops, as well as from an expanding body of literature, that plastics are an emerging concern to the Chesapeake Bay and its living resources. To address these growing concerns and questions the PPAT, formed by Bay Program leadership, has completed a microplastics science strategy document, as well as a preliminary ecological risk assessment with juvenile striped bass as the biological endpoint. This risk assessment pulls literature on the Potomac River and surrounding region to establish semiquantitative food web relationships. Recommendations from the science strategy include designing and implementing a plastics monitoring program, supporting research to better understand microplastics pathways, and ensuring resources/infrastructure are available to process/analyze collected plastics samples. These results/recommendations were presented to Chesapeake Bay Program leadership, which led to new directives of identifying strategic investments in science, sending science needs signals to regional institutions/labs, and identifying a strategy surrounding plastics source assessment. These directives are currently being addressed within the PPAT through the formation of technical working groups. An important aspect of integrating plastics monitoring into the Bay Program restoration effort is to better link microplastics impacts to fisheries and living resources. There is ongoing work looking at the effects of plastics on oysters, blue crabs, and other predator fish, but many gaps still exist. Current needs include better identifying trophic linkages, extensive fish sampling for plastics presence, and exploring physiological responses to plastics. The PPAT asks that the Fisheries GIT membership consider potential opportunities for collaboration, and consider available funding opportunities that may help address these monitoring and science gaps.

Connecting Outreach to Diversity, Equity, Inclusion, and Justice (DEIJ) at the Fish Habitat Action Team

Presenter: Chris Moore (CBF)

Considerations surrounding DEIJ have become a prevalent, and timely, issue across the Chesapeake Bay Program and its GITs. The Fisheries GIT has been considering these implications under the umbrella of the Fish Habitat Action Team, now chaired by the Chesapeake Bay Foundation (CBF). This presentation highlights CBF's Rod and Reef Slam Tournament, a fishing tournament that focuses on species biodiversity and the benefit of fish habitat/oyster restoration. This tournament, in particular, promotes inclusion because participants can join from the shoreline and do not require expensive equipment/gear. Participant catches are logged on an app called "iAngler," which provides spatial data on species presence. As the team begins planning for the tournament in the fall of 2022, The Fish Habitat Action Team asks for any membership feedback to help make this tournament more inclusive. Communicating the value of fish habitat to a wider range of watershed constituents continues to be a goal of the Fish Habitat Action Team and Fisheries GIT.

(Chris Moore, CBF)

Appendix A: Oyster Restoration in the Future: Planning past 2025

Takeaways from discussion and Jamboard facilitated by the Fish GIT Chair, Sean Corson. In summary, membership was supportive of continued partnership and collaboration to accomplish large-scale restoration.

1) What do we know now that we didn't know when the 10 tributary goal was set?
   a) *Partnerships:* State-federal-NGO-public-industry partnerships and collective goal setting are effective and may be essential for success.
   b) *Environmental:* Despite current challenges from environmental variability, large-scale oyster projects can be successful.
   c) *Technical:* Large, planned, well-designed projects can be successful, and do accrue ecosystem service benefits that can be difficult to communicate.
2) What Policy, fiscal, or climatic factors are key now, or will be in 5-15 years?
   a) *Goal Setting:* Clear practitioner commitment, metrics, and accounting are key.
   b) *Ecosystem:* New services linking multiple benthic habitats (SAV), and objectives (green infrastructure) should be considered. New approaches may be needed to address increased rainfall and temperature.
   c) *Fiscal:* Historic funding opportunity over the next 5 years is available.
3) What has been working well that should continue?
   a) *Goal Setting/Partnerships:* Members like the idea of clearly-stated, mutual goals for large-scale success.

   b) *Metrics/Accounting:* Comments from membership favor going big (as far as project ambitions), maintaining standards, and improving restoration design through applied science.
   c) *Substrate:* Enhance the use of alternative substrate.
4) Are there current areas for improvement?
   a) *Ecosystem Services:* More emphasis on nutrient reduction, communications products to highlight what we have learned, shoreline resiliency, and SAV co-location.
   b) *Stakeholders:* Collective goals are key, and need to be more inclusive to benefit communities (DEIJ), industry, and ecology. Perhaps broader, more inclusive goals should be written.
   c) *Data:* Consider revising metrics to address ecosystem services and/or to understand reef-level trends and connectivity issues.
5) What should not be a focus going forward?
   a) Gaining insights into shell budget to avoid reseeding if unnecessary.
   b) Trimming the current monitoring burden.
   c) Balance the need for bottom survey/stock assessment with implementing restoration.
6) Other thoughts
   a) *Changes to approach:* Consider fishery management changes, standardize and use more alternative substrate, and direct setting.
   b) *Science/monitoring:* Bay bottom surveys, revise monitoring approaches, analyze trotline concerns
   c) *Stakeholders:* Find ways to be more inclusive of industry.

Appendix B: Fisheries GIT Monitoring Needs Discussion

Takeaways from discussion and Jamboard facilitated by the Fisheries GIT coordinator, Bruce Vogt. Membership feedback was incorporated into the monitoring needs summaries recently submitted to the Chesapeake Bay Program's STAR Team. These needs assessments can be adjusted, so please feel free to reach out with any questions/concerns.

Forage and Fish Habitat:

Determining abundances and trends in forage fishes and benthic invertebrates that serve as forage for managed predator species are important to understand their dynamics and dependence on habitats in Chesapeake Bay. Forage and fish habitat outcomes have related monitoring needs that fall under shallow-water surveys, plankton surveys, and fish habitat assessments. Addressing these monitoring needs would support ecosystem based fishery management and contemporary assessments of ecological responses to water quality actions. The monitoring data generated would be used to update and develop new habitat suitability models and forecasts of forage trends under changing bay conditions.

Fishery and benthic invertebrate survey gaps (shallow water and smaller fish sampling): The Sustainable Fisheries GIT, including the Forage and Fish Habitat Action Teams, have identified the need for shallow water fishery independent monitoring that would support both stock assessments and ecosystem based approaches to fishery management. The need for mainstem smaller size fish monitoring has also been raised to aid forage base assessment. With respect to fishery survey interests, shallow water monitoring is broken into two categories 1) Shallow (~8 ft to ~20 ft) mainstem and tributaries 2) Littoral zone (<8 ft). These surveys should target both managed and unmanaged species and both adult and juvenile life stages. They would also include collection of supplementary environmental data to aid analysis of how habitat conditions may be influencing the abundance, distribution and other key parameters. Trawl and seine surveys are the best probable candidates for general application of these surveys baywide. Such surveys provide data on multiple species from multiple habitats; however additional approaches such as underwater video may be included in sampling designs. Shallow water surveys would also require standardization and coordination across jurisdictions. Specific sampling designs, opportunities to link habitat and fish surveys (such as SAV and sampling at shoreline and oyster restoration sites), and cost estimates would need to be developed. Some recommendations are provided in the 2006 STAC workshop report.

Specific examples of needs include sampling specific structural shoreline habitat such as SAV, restored oyster reefs, natural and develop shorelines to develop species utilization and species assemblages across this full range of shoreline habitats, and shallow water overwinter blue crab surveys. New opportunities include coordinating fish sampling at SAV sentinel sites, using mainstem and shallow water telemetry arrays, exploring underwater camera and acoustic methods of evaluating fish utilization, and engaging citizen science.

In addition to fish sampling, benthic infauna in shallow waters are also under-sampled due to the vessel limitations of the Bay Program monitoring effort, as well as the difficulty in monitoring benthos in any structured habitats (e.g., SAV, oyster reefs). These are highly productive areas for benthos and should be included.

Plankton monitoring: Phytoplankton and zooplankton are key components of the food web and ecosystem. Plankton respond to changes in temperature, precipitation and other environmental factors and serve as prey for key fishery species such as oysters, menhaden, striped bass and bay anchovy. The timing, species composition, abundance, variability and distribution of plankton are all important as well as evaluating how water quality and climate factors may be affecting plankton populations. Previous workshops have outlined monitoring approaches but were deemed too costly and therefore have not been supported. One option is to develop a reduced survey over a series of years that duplicates some of the stations monitored in the past which showed declines in key zooplankton species and a shift in dominant phytoplankton to cyanobacteria. Another approach is to explore new in situ and remote (satellite) technologies that are available today and could allow for faster cheaper sampling along a bay transect and/or in targeted locations (such as striped bass spawning areas, mysid surveys, and harmful algal blooms). However, these more targeted surveys might require intensive sampling and be more suited for research. Both options require further discussion to ensure they are coupled to fishery and other management objectives.

Fish Habitat Assessment: The National Fish Habitat Partnership and the Bay Program's Fish Habitat Action Team have identified fish habitat assessments as a critical need for mapping and analyzing the quality of fish habitat. These assessments can be used to identify degraded and high value habitat areas which may be used to inform restoration, water quality, land use practices, conservation, and fishery management decisions. NOAA and USGS are currently piloting a coupled nontidal and tidal fish habitat assessment in the Patuxent watershed, informed by fish habitat studies on the Choptank River and in nontidal waters of the watershed. This pilot will provide a spatial analysis of in water fish habitat quality at the finest resolution possible based on the best available data. Outcomes of the Patuxent pilot will guide decisions about the utility and approach for future assessments in other targeted watersheds or bay wide.

USGS and NOAA gathered and evaluated existing monitoring data to conduct the estuary and watershed assessments, and undertake the joint assessment in the Patuxent. The data evaluation revealed finer-resolution monitoring and spatial data are needed for future watershed-estuary assessments in additional locations. The enhanced monitoring data needed at finer spatial scales includes fish species, fish habitat, and stressor data (such as water quality and land use). Monitoring of these conditions would also be needed over time to evaluate effects of management approaches and effects from changing land use and climate. in the build from existing monitoring data identified the needs for improved monitoring data.

Oyster Restoration: Monitoring to evaluate the performance of restored oyster reefs is critical to guiding continued restoration design and communicating successes. All restored reefs are monitored per the success metrics at 3 and 6 years post restoration. As more reefs across the 10 restoration tributaries have been restored, the monitoring needs and costs have increased significantly. Divers and patent tong are the primary methods for monitoring the reefs with high sampling density. This monitoring has been supported by Maryland, Virginia, NOAA and USACE. As a result of the increased level of effort and costs, the oyster workgroups commissioned a study to evaluate what changes could be made for faster, cheaper approaches that still meet the success metric requirements. The study resulted in a reduction in the number of sampling sites required and some cost savings. In addition, the oyster workgroups are pursuing new approaches utilizing underwater video called a rapid assessment protocol. The new approach is still being developed and its application to restoration monitoring will need to be reviewed. Additional funding to support testing and implementation of the rapid assessment protocol or potentially other sampling methods is needed to enhance oyster monitoring.

Blue Crab Abundance: The winter dredge survey (WDS) is the primary monitoring that measures blue crab abundance (juvenile and adult) annually on a bay wide scale. The WDS samples 1500 sites throughout the bay and is run during the winter each year. The resulting data is analyzed by the Chesapeake Stock Assessment Committee (CBSAC) and provided to managers and the public via the Blue Crab Advisory Report. The Blue Crab Advisory Report is used by the management jurisdictions to develop and coordinate their harvest regulations for each season. The summer trawl survey has also been used to track the blue crab population over the summer as juveniles recruit into the fishery. Gaps in these surveys include shallow water sampling, and includes temperature, salinity and dissolved oxygen monitoring to evaluate impacts on overwintering mortality. The former would focus on juveniles to get better recruitment estimates since the WDS is not very effective at sampling smaller crabs. The latter parameters could also help assess climate change effects and guide refinements to the existing winter dredge survey.