Sustainable Fisheries Goal Implementation Team Meeting Summary

Summer 2022, Solomons, Maryland

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 (Chesapeake Research Consortium/NOAA)

Workgroup Chairs/Coordinators

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

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Day One: Linking Fisheries Research and Environmental Observations to Assess Risk in Chesapeake Bay

The Fisheries GIT spent the first section of day one examining relationships among fisheries, habitat, and environmental conditions. Following research updates from our region's science community, questions were posed about how the Fisheries GIT can leverage existing opportunities to connect research results and existing observational tools to track change and assess risk in the Bay.

Developing Chesapeake Bay-specific Abundance Estimates for Striped Bass and Spot

Presenter: Mike Wilberg, University of Maryland Center for Environmental Science (UMCES)

Main Message: Work is under way to model Chesapeake Bay-specific abundance estimates for key species such as striped bass and spot. Establishing population estimates is an important first step to better understand how the Chesapeake Bay's environmental conditions affect key species.

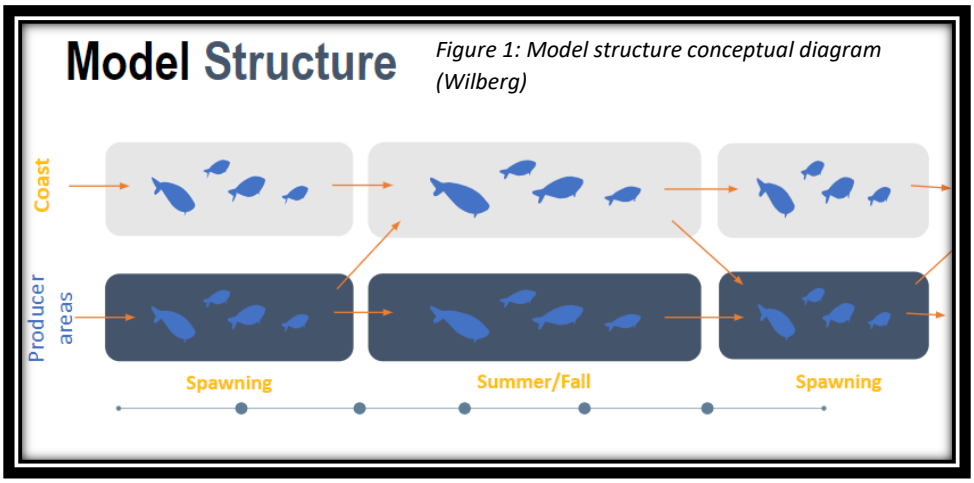


Figure 1: Model structure conceptual diagram (Wilberg)

Summary: This NOAA Chesapeake Bay Office (NCBO)-funded work aims to understand how the Bay environment is affecting fish populations by developing Bay-level abundance estimates, which are lacking for most species that use the Bay as part of their life cycle. The project team is developing spatial models for these abundance estimates, and plan to make these publicly available to the regional science and management communities.

This initial modeling will create estimates for two species, the first of which is under way for striped bass. One component of these estimates is an age-structured model, with underlying inputs from traditional survey and catch data, as well tagging data (1985-2017). The model accounts for recruitment in the Bay and from the coastal ocean. The team is currently developing a spatially explicit version. Next steps will include testing the model performance and evaluating environmental effects on striped bass dynamics. Researchers also plan on using tagging data to model movement rates from producer regions, all of which will help inform this age-structured model.

The second species recently selected for estimation is spot, an important prey species. Unlike striped bass, there is not currently an accepted stock assessment for spot, and full population assessments are very small scale, presenting new challenges. Data requests will be sent out in the near future, followed by the development of a model similar to striped bass described above. The team hopes to create models that can be applied to a number of species in the future, making Bay-specific estimates a more obtainable management tool.

Summer Flounder Habitat Suitability in Chesapeake Bay and Impacts of Hypoxia

Presenter: Jim Gartland, Virginia Institute of Marine Science (VIMS)

Main Message: Abiotic habitat conditions do not seem to be the reason behind Bay-specific declines in summer flounder relative abundance, although increasing hypoxic conditions may affect habitat availability.

Summary: Researchers from VIMS, funded through NCBO, built off previously completed modeling work to explore potential environmental impacts on summer flounder declines in the Chesapeake Bay. Summer flounder are seasonal residents that use the Bay in summer as key nursery areas. Their relative abundance in the Bay has been low since 2012, seemingly mismatched with mid-Atlantic coast wide trends. Is this a habitat issue, as temperature, hypoxia (duration and extent) and storms are increasing?

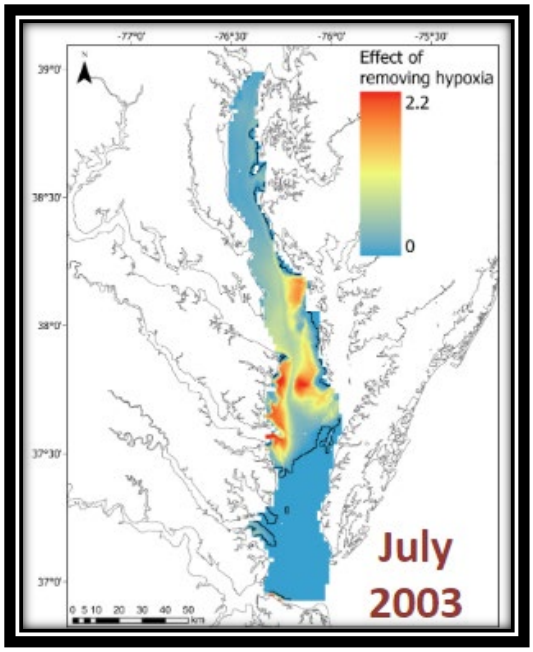


Figure 2: Increase in suitability by eliminating hypoxia (Gartland)

To help answer these questions, suitability models were developed. By building an ecological niche model, the team was able to develop an annual index for summer flounder for each month/year across the spatial extent of the Bay. The index showed that the "best" spatial areas for summer flounder were consistent across years. Building off initial results, the team wanted to explore the impact of hypoxia on suitability indices. This was done by looking at indices with hypoxia "turned off." Results showed that, on average, the absence of hypoxia increased habitat by about 5.5% (with increases closer to 21% in extreme years). This concept was also explored for July, the strongest hypoxic month. In conclusion, declines in summer flounder relative abundance do not appear to be related to habitat parameters, but hypoxia does seem to affect summer flounder available habitat. This mismatch between suitability and relative abundance will continue to be explored, as results are shared with the Mid-Atlantic Fisheries Management Council.

Habitat Suitability Modeling for Striped Bass in Chesapeake Bay

Presenter: Rachel Dixon, Virginia Institute of Marine Science (VIMS)

Main Message: The extent of high-quality habitat may be limiting for striped bass recruitment/abundance, but results are not significant at this time. Water-quality parameters were key for predicting seasonal/annual suitability, and highlight the need for continued Bay-wide management commitments (as well additional surveys in key tributary nursery areas). Over a 25-year period, there have been decreases in the extent of suitable habitat, but striped bass will tolerate non-ideal habitat areas.

Summary: This Fisheries GIT-funded project also explores species-specific habitat suitability modeling. We know that complex environmental factors affect striped bass growth, but factors connected to post-larval recruitment are largely unknown. Is extent of suitable habitat connected to production? What conditions represent suitable habitat for juvenile (age 0 and resident 1-4) fish? Have these conditions changed over time? To answer these key questions, the team from VIMS looked at a 25-year period of multiple striped bass surveys and projected expected habitat suitability Bay-wide. Environmental covariates of consideration included salinity, temperature, current speed, water depth, dissolved oxygen, and distance to shore. Boosted regression trees were used to select the most influential environmental covariates, leading to the creation of said suitability indices spanning from 0-1 (suitable habitat scoring 0.5 or above). Takeaways can be seen in the "main message" above.

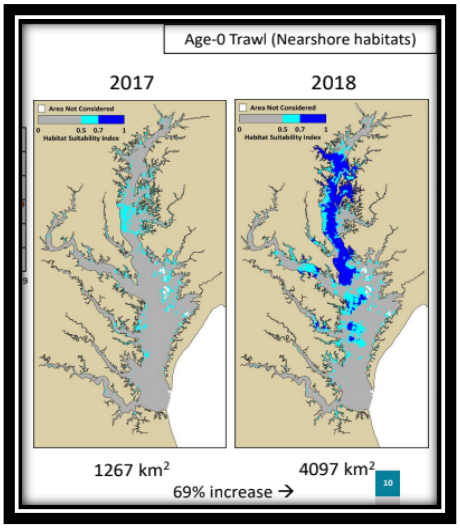


Figure 3: Striped bass habitat suitability (Dixon)

Integrative Assessment of Quality for Shallow Tributary Forage Habitat for Striped Bass in Chesapeake Bay

Presenter: Matt Ogburn, Smithsonian Environmental Research Center (SERC)

Main Message: Juvenile striped bass in the Bay's shallow-water tributaries have diet compositions that closely align with forage taxa consumed by predators in the mainstem identified in a 2014 STAC report. Some new underrepresented species were identified, and the team confirmed diet differences among spatial area and salinity regime.

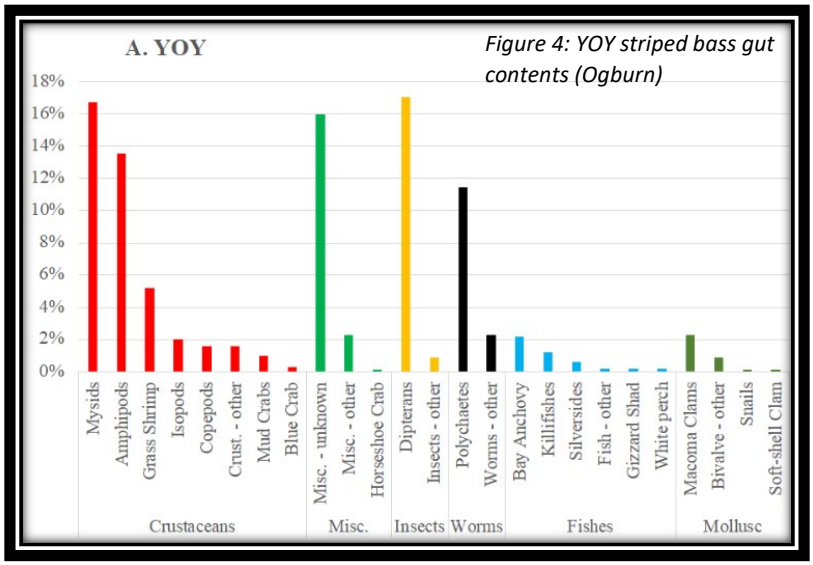


Figure 4: YOY striped bass gut contents (Ogburn)

Summary: The genesis of this work came from a 2014 Chesapeake Bay Scientific and Technical Advisory Committee (STAC)-supported forage report, identifying key taxa/species for the top predator species in the main-stem of Chesapeake Bay. With the support of NCBO, the team from SERC explored the top forage/prey for striped bass in shallow-water tributaries. Beyond mainstem vs. shallow-water diet differences, the team also planned to explore diet variation among different tributaries and salinity regimes. This project used genetic methods to perform gut analysis on young-of-year striped bass (collected via seine surveys) across nine tributaries, and on older fish from the Rhode, Choptank, and upper Bay (via Maryland Striped Bass Survey).

Results showed that young-of-year fish rely heavily on the consumption of mysids, amphipods, insects, and polychaetes. Older fish had stomach contents highest in polychaetes, crustaceans, and menhaden. Many of these findings align closely with the previously mentioned STAC report. It was also found that diets did vary across tributaries and salinity regimes. In conclusion, this shallow-water exploration did confirm key underrepresented forage from the original STAC report and added new key groups, such as insects.

Forage Indicator Development: Using Environmental Drivers to Assess Forage Status in Chesapeake Bay

Presenter: Ryan Woodland, University of Maryland Center for Environmental Science (UMCES)

Main Message: Relative abundance indices for Bay anchovy and polychaeates were developed (both key Chesapeake Bay forage). These indices were explored in the context of their relationship to various climate signals. The research team and Forage Action Team are discussing options to communicate these relationships.

Summary: The team from UMCES presented on a recently completed Fisheries GIT-funded project focused on the development of Bay anchovy and polychaete abundance indices and their relationships to climate signals (link to final report).

The first major step was considering how these forage indices of interest should be approached (life stage, spatial extent, etc.). For polychaetes, the PIs calculated a Bay-wide polychaete biomass index, as well as a separate index looking specifically at the Neredidae family. For Bay anchovy, data were split into a number of separate spawning and recruit indices, as well as total population (this approach works because of the annual turnover in population). These new indices were examined in the context of degree-day warming trends, as well as the Atlantic multidecadal oscillation (AMO). Earlier modeling efforts showed relationships between cooler springs and forage abundance, but these new models presented the opposite (possibly due to different covariates driving the model). While the relationship between warming and abundance is clear, there should not be an oversimplified takeaway that warming trends are "good" for the Bay's forage species. The AMO showed correlation with climate intensity indicators. It is important to note that "good" climate conditions differ among species/life stages.

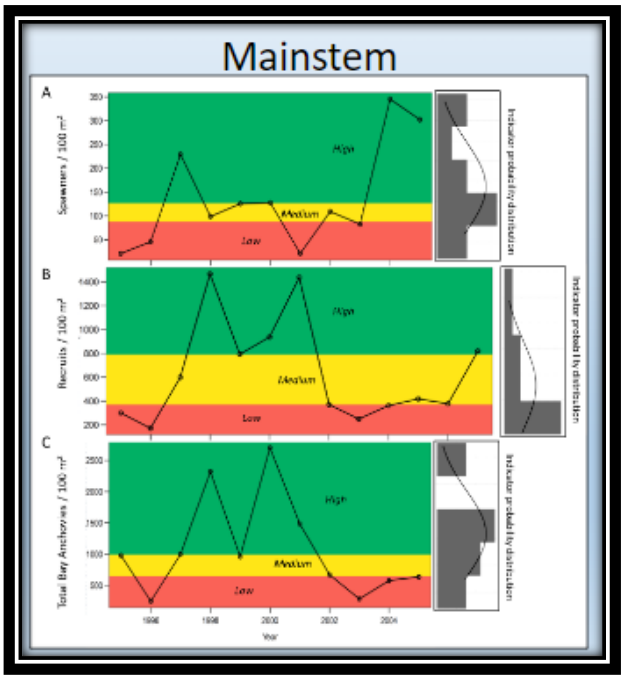


Figure 5: Polychaete relative abundance in mainstem of Bay (Woodland)

Attention then turned to communicating these results. The species' indicators were classified with a "stop-lighted" tercile approach (showing high, medium, or low abundance). These tercile thresholds will obviously change based on the spatial extent being explored. Questions still remain when considering how to best present this information in a digestible format. What is our spatial extent, life stage, taxonomic group of focus? How do we communicate current directionality of climate signals? Can an integrated indicator be created that takes into account both climate signals in relationship to forage abundance?

Hypoxia Array Deployment: Update on NOAA Chesapeake Bay Office Observational Capabilities

Presenter: Jay Lazar, NOAA Chesapeake Bay Office

Main Message: Two hypoxia profilers are currently deployed in the mainstem measuring real-time, high-resolution dissolved oxygen levels. NOAA, EPA, and a Chesapeake Bay Program Collaborative plan to add additional profilers to the mainstem/tributaries in 2023. These profilers will provide key insights about fish habitat condition.

Summary: Building off an exploratory pilot, NCBO and partner Caribbean Wind deployed two hypoxia profilers measuring real-time dissolved oxygen (across a ~20 meter depth gradient). With the consultation of the Chesapeake Bay Program Hypoxia Collaborative—a group of water-quality managers and modelers—two Bay monitoring sites, CB4.3E and CB4.3W, were selected. The NCBO observations team is working on the data cleaning process, visualization tool development, buoy maintenance troubleshooting, and data QA/QC.

Figure 6: Hypoxia profiler in water (Lazar)

These sensors give us high temporal resolution and highlight daily variability in DO, providing new insights for living resources and water-quality managers. Funding is secured for the next two years as the team looks to expand the network to 10 total profilers (plans are to have seven in the water in 2023). These new profilers are part of NCBO's Chesapeake Bay Interpretive Buoy System (CBIBS) observations suite, which includes acoustic telemetry arrays and continuous water column monitoring buoys in addition to the traditional CBIBS buoys that track meteorological and oceanographic parameters. As conversations continue around 2023 deployments, the team is looking for additional input about site selection, not only from water-quality scientists, but from living resource and fish habitat experts.

Membership Discussion: Using Research and Observational Tools to Assess Risk

Main Message: Please see Appendix A for full discussion takeaways.

Summary: There is interest in advancing ecosystem based fishery management in the Chesapeake Bay. While new information on the impacts of changing climate and environmental conditions on living resources is increasingly available, that information is not integrated and made available in a form that managers can best apply to decision making. An ecosystem status and risk assessment product is an approach to bring multiple information sources together to quantify the state of a system and prioritize risks to the system. Participants discussed the concept, need and application of an ecosystem status and risk planning tool for improving the ability to consider interactions within the ecosystem when making management decisions by the Chesapeake Bay Program and jurisdictional fishery managers. Participants identified several applications of the assessment spanning habitat restoration targeting, informing local land use decisions, adjusting fishery management approaches, and managing stakeholder expectations.

Day One: Blue Crab Status Updates

The second section of day one kicked off with an overview of the annual Blue Crab Advisory Report. With multiple years of population declines, the membership discussed potential drivers and modeling assumptions that could be affecting stock status and the mismatch between reference points and recruitment.

2022 Blue Crab Advisory Report Preview

Presenter: Pat Geer, Virginia Marine Resources Commission (VMRC)

Main Message: 2022 Winter Dredge Survey results highlighted some of the lowest juvenile and male population numbers on survey record. Although female abundance and exploitation reference points are being met, consecutive years of decline warrant notice. The Chesapeake Bay Stock Assessment Committee (CBSAC) will host a technical workshop this fall to discuss population drivers and stock assessment model concerns.

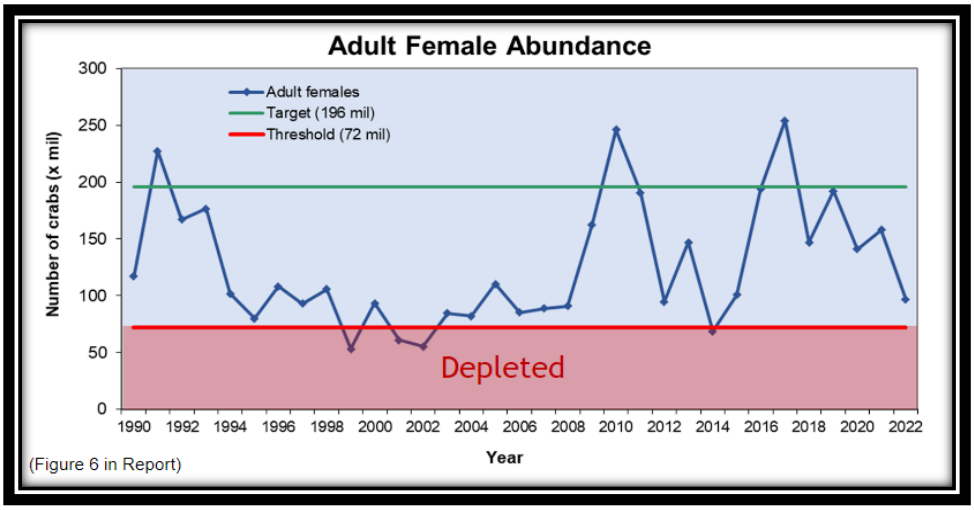


Figure 7: Blue crab female abundance and reference points (Geer)

Summary: The Blue Crab Winter Dredge Survey has been conducted jointly by VIMS and the Maryland Department of Natural Resources (MDNR) every year since 1989. Results are compiled by the states and reviewed by CBSAC. The 2022 report showed that blue crab abundance is down across all life stage (a 20% drop since last year). Juveniles, specifically, recorded one of their worst years on record, after two previous years of low recruitment (down 59% from long term average). Adult males, meanwhile, were at their lowest abundance on survey record. Adult females, on which management reference points are based, are still under exploitation targets and above the recommended abundance threshold, meaning the stock is not currently overfished (although abundance is nearing the lower reference point threshold).

It has become clear that years of poor recruitment are now affecting the spawning stock/adult males. The concerning numbers appear in a year where overwintering mortality and commercial harvest were both down. The last benchmark stock assessment, where reference points were set, was in 2011 (with slight updates in 2020). The mismatch between reference points and the stock remains noteworthy, meaning it is potentially time for a new assessment. We will explore this possibility in later presentations, and at a September workshop. In the meantime, state managers will closely watch the Summer Trawl Survey as these juvenile crabs begin to enter the fishery. Although management reference points are being met, there may be need for near-term actions. Some commercial bushel and recreational harvest limits are already approved in Maryland and Virginia.

Exploring Blue Crab Stock Assessment Model Assumptions

Presenter: Mike Wilberg, University of Maryland Center for Environmental Science (UMCES)

Main Message: Blue crab recruitment has been down, even with female reference points being met. Are these reference points still useful as a management tool? We revisit assumptions made during a 2011 benchmark assessment where these reference points were set.

Summary: As was presented in the 2022 Blue Crab Advisory Report, blue crab stock recruitment is down even though female reference points are being met. With this in mind, are these reference points still useful to our management community? To consider this mismatch, Dr. Wilberg reflects on the 2011 benchmark stock assessment, its underlying assumptions, and ways the model can be improved during the next iteration. Below are some assumptions that should be revisited:

1. There may be a model mismatch of sex composition in the fishery catch vs. the Winter Dredge Survey (too few females and too many males). There are a number of hypotheses as to why, such as survey calibration, catch reporting, sex ratio at recruitment, differing natural mortality rates, and inaccurate fishery mortality assumptions.
2. There may be underlying issues with the reference point models.
3. Assumptions about historical catch could be off/inaccurate.

All in all, there are new data and areas for model structure changes to use this new data. Some potential new approaches could be:

1. A length-based, short time-step approach (monthly as opposed to annual).
2. Include new impacts on juvenile blue crab (revisit newer mortality rates over winter).

Predation Impacts of Blue Catfish on Blue Crabs in Estuarine Environments

Presenter: Mary Fabrizio, Virginia Institute of Marine Science (VIMS)

Main Message: Blue crabs and blue catfish are increasingly experiencing overlapping ranges in the tidal James River. Through gut analysis, this study estimated the removal of 2.3 million crabs annually from predation (from this area alone). The highest proportion of predation is resulting from intermediate-sized catfish.

Summary: Blue crab abundance is low across all life stages. With these declines in mind, Dr. Fabrizio and team were interested in exploring increased predation mortality from invasive blue catfish. This study took place in the tidal James River, which has more than a million blue catfish. Objectives included characterizing and quantifying predation impacts on blue crab by analyzing stomach contents and estimating rates of consumption. The team deployed gill nets over two sections of the James River for approximately two years. Down-river (higher-salinity areas) fish were 1.75 times more likely to have some prey in stomachs and more likely to have blue crabs in their stomachs. Large fish were most likely to consume blue crab, but were less prevalent relative to small/intermediate catfish.

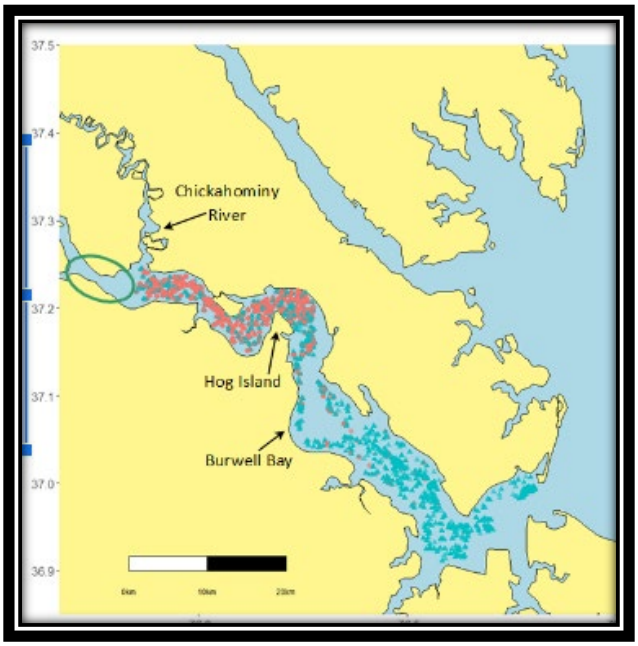


Figure 8: Blue catfish and blue crab presence in study area of the James River (Fabrizio)

Proportionally, small blue catfish made up the vast majority of population, but had a low incidence of blue crab consumption. Intermediate-sized catfish (300-500mm) are eating the highest proportion of blue crabs in this tributary. Results showed a total of 2.3 million crabs removed annually from this 200 square kilometer area.

Potential Drivers of Blue Crab Population Dynamics

Presenter: Mandy Bromilow, NOAA Chesapeake Bay Office

Main Message: Potential drivers of blue crab population declines were reviewed. These drivers, as well as others, will be explored in greater detail during a CBSAC-led technical workshop in September, 2022.

Summary: This presentation previewed potential drivers of blue crab population dynamics, serving as a primer for a fall workshop exploring the disconnect between spawning stock, recruitment, and fishery performance.

- Factors affecting recruitment variability
    - Stock/recruitment assumptions
    - Sperm limitation from too many male removals
    - Climate change impacts on wind and currents regulating recruitment into Bay
- Factors affecting natural mortality:
    - Predation from red drum and blue catfish (introduced species)
    - Potential of cannibalism serving as a key component of juvenile mortality
    - Disease outbreaks (particularly concerning in shedding facilities)
- Factors impacting growth survival
    - Prey availability
    - Loss of key sea grass habitats
    - Water-quality concerns (ex. hypoxia)
- Uncertainties around fishing mortality
    - Inaccuracy in reporting

Day Two: Oyster Restoration and Science Updates

The second day of the biannual meeting began with updates on the ongoing oyster best management practices (BMP) report. This was followed by science updates on cost-effective methods for BMP crediting and restoration monitoring. The day ended with a panel discussion on the future of collaborative, large-scale restoration.

Overview of the Finalized Oyster BMP Crediting Report

Presenter: Olivia Caretti, Oyster Recovery Partnership (ORP)

Main Message: Work continues on the collaborative Oyster Best Management Practices (BMP) report. This second report should be released for public comment in the next few months.

Summary: This multi-year, panel-led effort, coordinated by ORP, is focused on assigning oyster nutrient sequestration value for the watershed states' TMDLs. In the panel's first report, 96 oyster practice-protocol combinations for BMPs were considered (in the realms of aquaculture, wild harvest, and restoration). The panel also developed a decision framework for approval of BMPs, effectiveness, and verification guidelines.

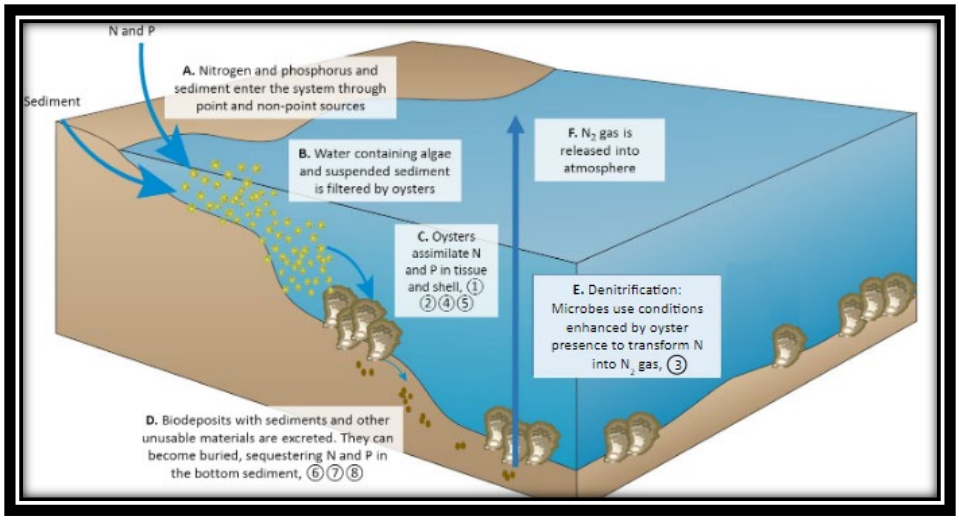


Figure 8: Oyster nutrient sequestration conceptual diagram (Caretti)

In the panel's second report, they will provide 12 practice/protocol recommendations for harvest and restoration. These 12 recommendations fall into the categories of harvest and restoration-assimilation (nutrient uptake into shell and tissues during growth) and restoration-denitrification (denitrification occurring at the individual/reef level). The panel's second report concludes that oyster biomass and site verification are required to estimate reductions and determine if activity improves oyster production. The panel also concluded that crediting values should be intentionally conservative to ensure over-crediting is not occurring. As discussions continue at the panel level, please contact Olivia Caretti (ocaretti@oysterrecovery.org) for more information about the above determination steps, crediting processes, and release timeline for the report.

Site-specific Methods for Measuring Oyster Reef Denitrification Rates

Presenter: Jeff Cornwell, University of Maryland Center for Environmental Science (UMCES)

Main Message: An *in situ* approach for the measurement of oyster reef denitrification rates is cost-effective and can be relatively accessible for others to use. This site-specific tool may allow localities to calculate denitrification rates above the established BMP defaults.

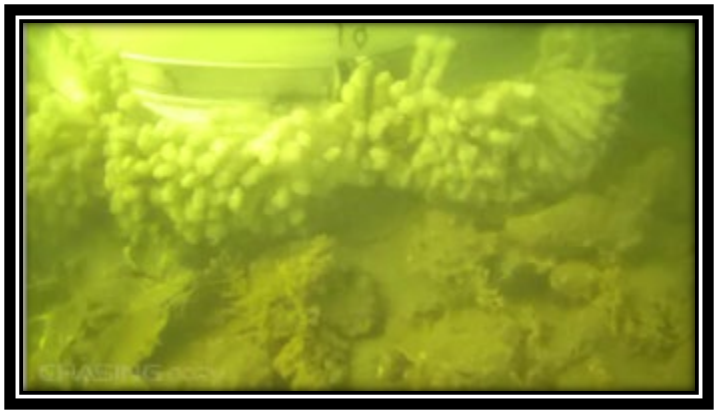


Figure 9: Lander with mop head seal (Cornwell)

Summary: Chesapeake Bay oyster restoration BMPs, near finalization from panel review, include default rates for denitrification at restored reefs. 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 recently completed 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. 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. Exploring this methods applicability to use as a crediting tool will be a next step to consider. A final report on this work is under Fisheries GIT review and will be distributed to membership in the next month.

Hybrid Approach to Oyster Reef Monitoring

Presenter: Allison Tracy, Smithsonian Environmental Research Center (SERC)

Main Message: Rapid, camera-based restoration monitoring has proven to be efficient and effective in many field scenarios. A hybrid approach, using traditional monitoring and qualitative rapid scoring, is explored as an effective option.

Summary: Traditional oyster restoration monitoring, such as patent tonging and diving, provides detailed data on restoration success, but is often labor intensive and inefficient. This study defines a potential hybrid approach to monitoring that combines traditional methods with camera-based qualitative scoring. The research team from SERC explored the effectiveness of this qualitative approach, and created "use-scenario" guidance for pre-restoration monitoring and ground-truthing. The camera-based scoring approach proved to be more efficient, cost-effective, non-destructive, and can be easily used by

organizations with less training/capacity. Traditional monitoring still proved to have value when attempting to differentiate between low and medium scoring reefs. These use-case scenarios can be applied to tributary-specific efficiency tables to calculate total hours spent using the hybrid vs. traditional approach. The team will continue discussing best uses and potential applications of this exciting monitoring development. The PI, Allison Tracy, can now be reached at the Institute of Marine and Environmental Technology (amtracy@umbc.edu).

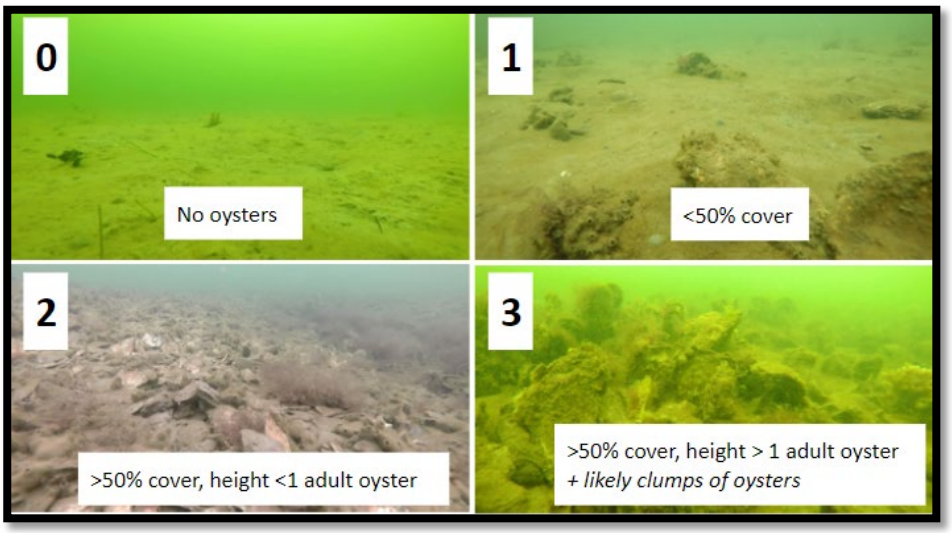


Figure 10: Camera-based qualitative scoring (Tracy)

Oyster Restoration in the Future: Expert Panel

Facilitator: Sean Corson, NOAA Chesapeake Bay Office
Panelists: Andy Lacatell (The Nature Conservancy), Allison Colden (Chesapeake Bay Foundation), Andrew Button (Virginia Marine Resources Commission), Chris Judy (Maryland DNR), Angie Sowers (U.S. Army Corps of Engineers–Baltimore), Keith Lockwood (U.S. Army Corps of Engineers–Norfolk)

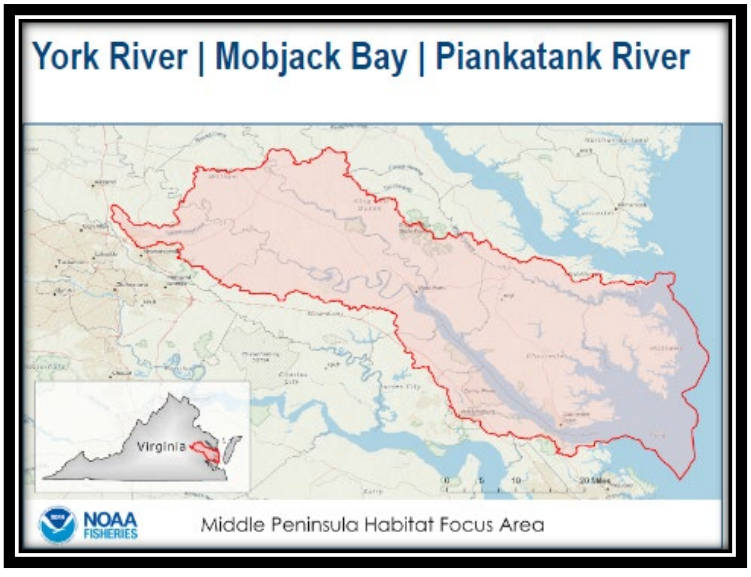
Main Message: Panelists and Fisheries GIT members agreed that large-scale, collaborative restoration should continue as our initial "10 tributaries goal" comes to an end. Stephanie Westby (NOAA) has agreed to convene an oyster sub-working group to explore future goal setting and the Fisheries GIT's role.

Summary: The panel's full conversation can be viewed in Appendix B.

Habitat Restoration Opportunities in Virginia's Middle Peninsula

Presenter: Andrew Larkin, NOAA Chesapeake Bay Office

Main Message: NOAA has announced Virginia's Middle Peninsula as its newest Habitat Focus Area. There are opportunities to collaborate with NOAA and the local communities to implement restoration and engagement projects.



Summary: NOAA has announced Virginia's Middle Peninsula (comprised of the York River, Piankatank River, and Mobjack Bay) as its

newest Habitat Focus Area (HFA). These HFA selections are in geographies where resources will help address habitat issues with an emphasis on partner and community collaboration. The Middle Peninsula is an important area for oyster restoration as well as essential habitat for 12 federally managed fish species. This is also a predominantly rural region with coastal flooding issues. The HFA priority in this region is to restore habitat for fisheries and for community/coastal resiliency.

Project investments under way include:

- Oyster restoration in the lower York and Mobjack Bay (including near-shore resiliency concepts)
- Economic analysis of oyster reef and SAV ecosystem services
- Living shoreline designs for marsh preservation on Hog Island
- Engagement of recreational anglers and underserved communities through education and outreach projects
- Collaboration with the York River Round Table Group (WIP implementation considerations)

If you have interest in future collaborations with this HFA effort, please contact Andrew Larkin (andrew.larkin@noaa.gov) to learn more.

Appendix A: Applying Research and Observations to Assess Risk

Participants discussed a set of questions in small breakout groups. The results to the questions are summarized below. *(Italicized text represents points that were raised by multiple members)*

What do you see as the major threats to fishery and habitat resources in the Chesapeake Bay that should be included in a risk assessment?

- *loss of bay grasses*
- *hypoxia volume*
- sufficient forage
- *climate change, increases in temperature, thermal habitat, increase frequency of storms*
- shoreline development/hardening, loss of nearshore nursery habitat
- *water quality-nutrient loading*
- *invasive species and disease*
- *population growth*
- community pushback against management
- fishing effort, overharvesting
- ability to regulate development, land use
- lack of data, funding for research and science communication
- habitat connectivity
- changing species distributions
- toxics, emerging pollutants, microplastics
- marsh loss

What species should be the focus of a risk assessment?

- look at species sensitive to climate change (what species will we lose and gain); emerging species red drum, cobia, shrimp
- consider species complexes (resident, migratory, demersal, pelagic)
- *striped bass* is a good sentinel species
- *blue crabs*
- *oysters*
- *important forage species (bay anchovy, menhaden)*
- *blue catfish*, snakehead
- sturgeon
- alosines (American and hickory shad, herring)
- white shrimp
- canary species (silver perch, sea robin)
- croaker, spot, trout

What research and observational capabilities can be applied to evaluating threats and risk to fishery and habitat resources?

- ecosystem modeling-look at fishery specific threats, predictive models
- fishery independent surveys
- water quality
- acoustic telemetry arrays
- forage fish surveys
- shallow water fisheries data (diet, abundance)

- citizen science programs
- zooplankton surveys
- basic monitoring T, S, DO
- simple trophic interaction models
- better catch reporting
- tracking trends in predation pressure, stable isotope analysis of key prey species
- mapping spatial range of invasive species over best habitat for ecologically valuable prey
- at first conduct qualitative risk assessment, focus on a few high risk categories and develop conceptual models, follow IEA approach
- high resolution spatial and temporal of habitat variables
- ChesMMAP
- CBIBS
- long term benthic monitoring
- VIMS SAV survey
- land use, healthy watersheds assessment
- ph, ocean acidification

What are the priority research and monitoring needs to develop a risk assessment?

- how changing environmental condition impact abundance, distribution, habitat
- quantified impacts on land use actions, changes in water quality on fish production?
- productivity of structured habitats-how do changes in structured habitat affect fish production?
- how are changes in timing and seasonal patterns affecting distribution and abundance
- blue crab-nearshore, shallow water juvenile nursery habitat survey, red drum predation, determine percent reductions from previous year's harvest (season closures, sanctuary, increase minimum size)
- oysters-what's restored, where's aquaculture, what's fished, -looking at all together
- better leveraging hydrodynamic models to link habitat availability, suitability
- use remote sending or continuous monitoring to monitoring condition
- ecosystem models
- blue catfish- standardize monitoring bay wide, impacts on other species
- better define monitoring needs for water quality
- reliable abundance estimates for menhaden, striped bass, blue crab, bay anchovy
- paradigm shift in fishery management
- environmental threshold/parameters for menhaden, striped bass, blue crab, bay anchovy
- habitat variables measured in conjunction with species relative abundance data
- list of critical uncertainties
- economic and ecological value of species
- effective science communication

How could a risk assessment inform management?

- support time and area closures, seasonal fishery closures, open and close areas based on conditions-real time
- develop fishery thresholds
- build in risk buffers
- regulatory consultations (land use, shoreline development, etc.)
- present, communicate results to stakeholders to get support working with management
- prioritize management actions (restoration, research and monitoring, regulation, resources needs)
- evaluate management tools (size regulations, new closures, new fisheries)

- forecast proactive harvest of species of concern for target monitoring
- developing flexible management strategy to avoid greater risks on species
- understand connections between species (predators, forage)
- define policies
- identify when parameters or populations are reaching defined thresholds and possibly predict short/long term consequences
- annual assessment of environmental status relative to reference points, followed by decisions/decision tree.
- educate managers to improve, change management
- provide a roadmap for potential responses when a system state is observed
- identify highest risk stock and devote resources to them
- influence precautionary management

Appendix B: Collaborative Oyster Restoration Beyond 2025

How do we avoid going back to small, one-off restoration efforts?

- Allison Colden: Communities are excited and want to find ways to get engaged with oyster restoration. Interested to see how we, collectively, harness can we harness that energy
- Andrew Button: Seeing more small scale efforts happening as a result of enthusiasm. We should think about ways of accounting for these smaller efforts under a bigger umbrella.
- Chris Judy: Maryland DNR wants to continue, and complete, the 10 tributaries by 2025 effort. Mentions embracing small community groups and putting smaller projects together in tributaries. We may not always have high funding levels, so need to consider alternative materials, proper sizing, increase acceptance, and finding agreed upon suitable substrate.
- Andy Lacatell: We as a community need to really highlight our successes, and not understate the global standard we have set for large-scale restoration. We also need to compel other places to ramp up their restoration by highlighting added benefits of restoration. The restoration economy is highly decentralized, while coordination seems high, more coordination could be beneficial.
- Angie Sowers: We should continue to think about planning on a tributary and system basis. It is important to identify why restoration is needed, what the objectives of the restoration are, and if the work/projects are sustainable. Can the smaller projects be integrated with larger efforts to enhance/create a network?
- Keith Lockwood: Agrees with this enthusiasm but also sees concern about infringement (recreational use, NIMBY). Agrees to embrace small scale, but keep coordination meetings (interagency working group) going to keep overall effort moving in the same direction.
- Alison Colden: Mentions that small groups want to help/be involved, but don't usually have capacity. Can we hand them a road map to help with implementation? We should also consider the temporal component of restoration (has putting so many oysters in a system so quickly contributed to success)?

What are things we have learned over this current Watershed Agreement? What worked well?

- Angie Sowers: We were able to organize and mobilize to achieve results over the long term. The workgroups functioned well, provided helpful implementation updates, and served as a venue to collective track progress. Moving forward, we need to include other interest groups (like industry) and consider projects with multiple objectives.

- Andy Lacatell: Agrees that we need to engage industry and others early in the process as we develop the next set of goals. The next set of goals should be even more ambitious.
- Chris Judy: Agrees about engaging industry and building in more multi use objectives/projects (ex. portions of tributary for harvest and a portion as sanctuary) combined to provide multiple benefits. We need to consider low functioning tributaries and see if we can make improvements through restoration efforts.
- Andrew Button: We did well to distill goals down to acres and dollars. VA worked well to build support outside the restoration community. We avoided competing with high value harvest areas and were able to show how alternative substrate could work alongside harvest areas. In general, we saw limited public push back.

Are there additional restoration services (economic, resilience) that should be considered?

- Keith Lockwood: Corps has interest in focus on resilience/coastal storm risk management (VA Beach study). There is a push to use nature-based features to protect community infrastructure (funding is available for this). At Tangier Island, the Corps put in a beneficial use pilot project (15m) to place material offshore of the island and then added oyster reef on dredge material to help with resilience.
- Allison Colden: Although the overall restoration footprint is smaller in shoreline resilience projects, we should still pursue because of all the other benefits the projects can provide. We should put forward ecosystem service goals, publicly, that are clear for those designing and implementing projects.

What is the role of Fisheries GIT in this process, moving forward?

- Andrew Button: It has worked well to use the Fish GIT to bring ideas together and then allow organizations/jurisdictions to carry forward
- Chris Judy: The Fish GIT is highly functional in organizing and keeping collective goals on track. The GIT will continue to be important in bringing in the community, considering additional benefits, and including industry.
- Andy Lacatell: Leave the door open for an external process that involves a third party. GoM and panhandle Florida where priorities for the community may be different from ours. Create inclusive processes and stakeholder driven priorities.

Other Comments on Goal Setting:

- Stephanie Westby (NOAA): Agrees about the need to be more inclusive in the planning process moving forward. Also mentions that we should be cautious about assuming we will still work together (as a collective) in the absence of clear leadership. This large-scale effort led to leadership and coordination from the GIT, and don't want to lose this. Lastly, we could still generate more enthusiasm publicly. Oysters should be our redwoods and the public should be engaged in sustaining them.
- Kristin Saunders (CBPO): Interested in considering broader ecosystem services. The Bay program talks about targeting restoration based on multiple benefits. This holistic approach will likely resonate with other GITs and can help leverage funding. Bringing in other GITs as we move forward on goal setting and targeting will be key.

Appendix C: Presenter Contact Information

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