Integrated Trends Analysis Team (ITAT)
Meeting

Wednesday, November 9, 2022
10:00 AM – 12:00 PM

Meeting Materials: Link

This meeting was recorded for internal use only to assure the accuracy of meeting notes.

ACTION ITEMS

- **To support the connection between living resources and water quality, the NOAA Seasonal Summaries will be linked in the tributary summaries going forward.**
- **Alex Gunnerson will work with Breck Sullivan to include relevant questions from the Jamboard into the Science Needs database.**
    - **Members are encouraged to share the names and contact information of experts and researchers in these fields who may be interested in working to address these questions.**
    - **One of these major questions is picking up where Jeni Keisman left off on answering: "What is causing water clarity attenuation in the Bay?", "What is changing, since Secchi Depth and KD trends are not doing the same thing? Is it the dissolved organic carbon side that is changing these things?" These questions need to be answered before you can solve the chlorophyll-nutrient disconnect. – Claire Buchanan**
        - **Rebecca Murphy said science needs on this topic should draw from the STAC Water Clarity workshop findings and the results of Jesse Turner's work (Jesse is a student of Carl Friedrichs).**
- **Claire Buchanan will share the paper she wrote on historic chlorophyll bio volume ratios with Lew Linker.**
- **Peter Tango will ask Cindy Johnson Elgin Perry's questions (see below) regarding the station change in the tidal fresh Rappahannock.**
    - **How long has the water depth at these stations been decreasing and have we tried to quantify the effect of that?**
    - **Is there a possibility of monitoring the new and old locations for a year for the sake of comparison?**

Meeting Minutes

10:00 – 10:05 **Welcome – Kaylyn Gootman** (EPA) and **Breck Sullivan** (USGS)

Announcements –

- Conferences of potential interest
    - Coastal and Estuarine Summit – December 4-8, 2022. New Orleans, LA.
    - A Community on Ecosystem Services – December 12-15, 2022, Washington, DC. Abstracts were due July 15, 2022.

- National Water Quality Monitoring Council's 13th National Monitoring Conference – April 24-28, 2023. Location TBD. Session proposals were due June 24, 2022.
- Species on the Move – May 15-19, 2023. Everglades National Park, FL.
- CERF 2023 Conference: Resilience & Recovery – November 12-16, 2023, Portland, Oregon. Session and workshop proposals due September 19, 2022. Abstracts due May 10, 2023.
- Citizen Science Association conference, C*Sci 2023 - May 22-26, 2023, Arizona State University campus in Tempe/Phoenix, Arizona.

Summary

Breck shared that December 15th is the Maryland Water Monitoring Council, which is a nearby conference.

10:05 – 10:40 **NOAA Seasonal Summaries – Mandy Bromilow** (ERT-NOAA)

Mandy presented on the content, purpose, and audience of the NOAA seasonal summaries. Following the presentation, the discussion focused on collaboration with the seasonal summaries, such as making connections with the tidal trends and tributary summaries to bridge the gap between water quality and living resources syntheses. The seasonal summaries can be accessed here.

Summary

Mandy began with some background on the seasonal summaries. They got their start when the Northeast Fisheries Science Center (NEFSC) was interested in incorporating estuarine habitats into the annual Mid-Atlantic State of the Ecosystem Report and the contributions were requested to be provided regularly for each season.

Mandy provided an overview of what the seasonal summaries are, explaining they are a summary of seasonal environmental conditions relative to long-term averages and the potential impacts on key fishery resources. The target audience for the seasonal summaries is state and coast-wide fishery resource managers. The purpose of the seasonal summaries is to guide habitat and fishery management decisions in an ecosystem context in the face of changing environmental conditions.

Mandy described the various data sources used to inform the reporting on the following metrics covered in the seasonal summaries: water temperature, salinity, freshwater flow, and dissolved oxygen.

Mandy then showcased the impacts on natural resources and how they vary for each season. For example, in winter the focus is on blue crab overwintering mortality (temperature), but the results also provide insight into striped bass recruitment (temperature and flow) and bay anchovy abundance and production (salinity). The rest of the objectives for each season can be found on slide 11.

Mandy concluded with some potential next steps and where the team plans on taking the seasonal summaries next.

Discussion

Kaylyn Gootman said the presentation was insightful and expressed how the foursquare on slide 11 was good for identifying audiences.

Peter Tango asked if crabs are buried in the sediment in deep waters of the bay, how does the surface anomaly relate to sediment temperature conditions where the crabs are. Mandy replied that bottom temperature would be more useful, but that data is not available. They assume that if the temperature at the top of the water column is warmer during an anomaly, then the bottom probably is too. Mandy emphasized that the most important part is the anomaly, and they only assume the direction, not the magnitude. Mandy said the team will try to acquire water temperature data from the diver surveys if possible. Peter replied that makes sense because there is more mixing in the winter due to less resistance to mixing.

Peter Tango asked if there are any winter crab survey assessment results that find an increased proportion of dead crabs in the catch of scraped crabs to help tell the story of potential versus actual impacts. Mandy replied the Winter Dredge Survey (WDS) is used to determine the percentage of dead blue crabs, also known as overwintering mortality. Peter asked specifically how long and when the WDS is done, and if it is possible to see changes in mortality throughout the duration of the survey. Mandy said she does not know since she is provided with the final number, but Mandy can ask Chesapeake Bay Stock Assessment Committee (CBSAC) to break out the periods of the WDS. Mandy said she imagines the mortality is primarily happening in January and February because that is when waters get the coldest.

Peter Tango expressed his appreciation for the NOAA Seasonal Summaries and how they tie in the coastal and Atlantic influences into the Bay.

Kaylyn Gootman asked to what extent the tidal tributaries have an influence on temperature in the mainstem Bay and if there are visualizations with the sea surface temperature in the tidal tributaries. Mandy replied that the remote sensing expert on the project, Ron Vogel, said to be cautious about temperature assumptions or inferences the farther one goes up into the tributaries because the data is not as great. Mandy added that they do not pull too much temperature information from buoys in the tributaries either, and all the buoys they use are in the mainstem or mouths of tributaries. Alex Gunnerson said there might be a lot of mixed pixels up in the tributaries for sea surface temperature from the satellite imagery.

Tom Parham said a few years ago, Rebecca Murphy presented on depth of the largest long term temperature changes. It might be interesting to look at dredge survey mortality in relation to the areas of with largest bottom long-term water temperature changes.

Breck said we do have bottom water temperature annual trends through our Bay-wide tidal trends, but it would be a year behind the data the NOAA Seasonal Summaries are currently using. Peter Tango replied maybe there is potential for "crowd sourcing" of sediment temperature info by placing temperature sensors on the crabs, and as they are harvested. We could download the data to get overwinter habitat insights. Peter added he read a paper about outfitting tiger sharks in the Bahamas with GPS tracking which allowed researchers to outline the bed habitat. Kaylyn said hopefully temperature sensors on Blue Crabs would be inexpensive and people who harvest them could be incentivized to return the sensors.

Kaylyn suggested exploring future ways of collaborating between the NOAA Seasonal Summaries and ITAT's tributary summaries. Breck said at the very least ITAT could

include links to the seasonal summaries in the tributary summary document, so the two sets of documents are being associated with each other and links between water quality and living resources are strengthened.

Breck asked if they have been seeing changes in the seasonality, specifically with low levels of dissolved oxygen continuing into September and October. Mandy said they have not really seen these trends and have kept the seasons the same. They might see in the fall report some hypoxia information, but the content dictates the message of the seasonal summary.

If you have any further questions about the seasonal summaries, you can reach Mandy at mandy.bromilow@noaa.gov.

10:40 – 11:30 Discussion on 2021 Tidal Trends Results – Breck Sullivan and Kaylyn Gootman

Breck and Kaylyn facilitated a discussion about the 2021 Tidal Trends Results that Rebecca Murphy presented at the October ITAT meeting. This discussion included further research questions, how the tidal trends can be better integrated with the nontidal trends, and other related topics as desired by ITAT members. Members put some of their questions on this Jamboard page. The 2021 Tidal Trends can be found on the ITAT webpage.

Peter Tango shared some news about the topping of two tidal stations and the potential for implementing a new one. The discussion included the implications of this action.

Summary

Rebecca Murphy shared that Baytrends map still needs to be updated, but once it has been, it will be a good vehicle for examining these trends and asking questions because it includes concentrations and magnitudes.

Questions and comments on the Jamboard included:

- Nutrient and CHLA Relationships:
  - When looking at nutrient-chlorophyll a relationships in the tributaries, separate tributaries with extensive wetlands (e.g. Patuxent) from those with less wetlands. Consider that wetlands equal nutrient sinks.
    - Peter Tango said some systems have stronger wetland interactions than others and he does not know if we have compared systems with abundant wetlands versus systems without.
    - Breck replied that is an interesting question and with us losing wetlands that could be impacting it.
  - Chlorophyll a (CHLA) and flow is something Larry Harding has published on with Elgin - low flows and we see compression of CHLA regions, high flows more broadly distribute CHLA.
  - Do improvements in Summer CHLA precede improvements in Spring CHLA?
  - Why do we have CHLA-nutrient disconnects in so many places?
  - Can we show that improving CHLA lags behind improving Nutrients?
- Is temperature driving degrading DO?
  - The temperature question - see Frankel et al. 2022, suggestion being that temperature is constraining the degree of improvement of D.O. over time.
- Why is mid Rappahannock trending opposite to upper and lower in Nutrients?
- Linkages to water clarity.

    - What portion of water clarity attenuation can confidently be attributed to phytoplankton?
    - What is causing water clarity attenuation in the Bay?
    - Total Suspended Solids (TSS) composition, percentage of fine particles.
- We need to add TN loads on to the same plot. This is necessary for context. What we'll likely find is that the loads over time, high or low, are less effective in generating Bay hypoxia
    - Check with Qian on the system efficiency improving over time. We can quantify the hypoxia metric trends then add the efficiency assessment to explain mgt progress.

Breck mentioned that at a STAC meeting, Denice Wardrop asked if temperature is driving degrading Dissolved Oxygen (DO) trends. Rebecca said this is something we need to consider doing. Rebecca wanted to explore that question this year, but due to many competing priorities there was not enough time. Rebecca said it would be wise to investigate the saturation concentrations of DO and to compute the trends since this will continue to be relevant under climate change warming conditions. Breck said when working with the shallow water monitoring data, she found temperature was an influencing factor and wanted to explore nearshore characteristics, but other priorities came up that prevented the work from being completed.

Lew emphasized the importance of providing context on these loads given all the investment into the Bay Program, such as adding flow or precipitation inputs in addition to total nitrogen (TN) loads and concentrations. Lew said it would be important to add these considerations graphically. Rebecca said the team always looks at these considerations and includes them in the tributary summaries, but do not include them in the current graph. Rebecca published a paper this year linking the loads of TN and total phosphorus (TP) to the tidal trends at every tidal station. Lew asked a follow up question to see if flow will be added to a split axis plot and what the intentions of graphing TN and TP are. Rebecca replied they produce flow adjusted trends in the tidal waters where they compare to the average flow. The results also include observed conditions as those are important and relevant regardless of flow. Lew said there are two problems with flow adjusted: 1) non-stationarity is a limitation because the long-term upward trend in precipitation volume and intensity is not being adjusted for and 2) flow adjusted does not account for phenology. Rebecca replied that for simplicity, they call flow adjustment the average flow, but that average is adjusted to the current flow conditions. Rebecca says she understands the seasonality of DO is changing and the results are fit to an entire year's worth of data, so she thinks the phenology is not as big of a concern with this method, unless the suggestion is to change how the summer season is set (June-September). Rebecca said the team has considered the phenology question. Lew said he still thinks non-stationarity is a problem for flow adjusted trends from 1985-2020 and maybe it can be listed as a limitation until the data can be adjusted when the work becomes more mature. Lew added that the temperature trend on slide 31 is much better defined now and shows that the respiration is increasing in deep waters and DO solubility decreases. Lew said it might be useful to disentangle temperature effects from management effects, which could be a helpful nuance or addition to the DO story and might be worthwhile to pursue. Rebecca added this is important and it has been added to the to-do list. Lew said if we categorize this as information for managers, it would be helpful.

Lew said if we have TN concentrations that represent input, flows, and management actions, we could see, over time, the high flows and the low flows represented in certain levels of hypoxia. If we put that in a figure, we could quantify that and perhaps show that both high and low flows in more recent times produce less hypoxia. Rebecca said that reminds her of a figure Jeremy Testa created. Elgin Perry said this functionality is already built into the baytrends software, and there is an ability to drill down into high flow versus low flow years. Rebecca showed her plots from the October ITAT Meeting and explained the figures on slides 7-10 get at what Elgin was talking about. Lew said this is helpful and asked if there is something more beyond a binary wet year and dry year. Rebecca showed the figure on slide 12 which provides more information on flow.

Peter Tango said Qian has an analysis we could look at in a future meeting and consider the state of the efficiency and tell the story. Trends in hypoxia metrics are hard thus far challenging to see, but the efficiency change would be the next level of explanation in trend over time in response to management.

Rebecca said a related question is why are chlorophyll-nutrient disconnects present at many stations which result in a lack of direct 1 to 1 matching of trends. Rebecca said this question on the Jamboard requires further investigation.

Elgin suggested creating some storylines relating some trends to other trends. For example, Elgin asked about the connections between nutrients and chlorophyll since he almost never sees an example where decreasing nutrients leads to decreasing chlorophyll. Even in instances where both nutrients and chlorophyll go down, like in the tidal fresh, the nutrient levels are still way above the limiting factors on chlorophyll. Lew said this is a good point and what Jian Shen has been finding in Virginia is that the more quiescent periods of high temperatures and low flows in the summertime tend to create higher chlorophyll concentrations across the tidal fresh, specifically in the James. Peter Tango said the relationship is mediated by flow and wind in the tidal fresh for sure. Elgin replied he thinks that is true across the Bay and that high flows tend to lead to lower concentrations in the tidal fresh because of a flushing effect. Elgin said what puzzles him is that the disconnect between nutrients and chlorophyll happens even when adjusting for flow. Claire agreed, saying Qian's work on nutrient limitation would be helpful here, and nutrient limitation is a good perspective to tell this story. Lew said there are lots of issues with chlorophyll, and the field is wrestling with this challenge. In addition to nutrient limitation, Lew said light attenuation should be considered in looking at the chlorophyll issue. Lew argued that a problem with the current assessment of secchi depth is that the relevant light field is more of a function of light attenuation (KD - diffuse attenuation coefficient) with depth not scattering but the downwelling irradiance. Lew said they do not use secchi since it is degrading because of greater light scattering, which is not relevant for Submerged Aquatic Vegetation (SAV) since they can still convert that light into fixed carbon. Lew said to improve the chlorophyll assessment, it might be better to rely on a KD value. Claire Buchanan said she disagreed, saying scattering is very important to phytoplankton, which are more important in biomass than SAV. Claire said when water clarity is degrading, no matter how it is being measured, the phytoplankton are building up large amounts of chlorophyll per bio-volume. Claire emphasized that when the status of nutrients is way above nutrient limitation thresholds and secchi depth is insufficient for happy phytoplankton growth, it leads to confusing trends. Claire said she would use both secchi depth and KD to explain

some of these issues but agreed that phytoplankton can get light from the sides. Lew agreed, saying that adding KD while keeping secchi depth and focusing on nutrient limitation would be helpful for explaining trends.

Elgin asked if chlorophyll was considered to be a poor measure of phytoplankton biomass. Claire said yes and said there are other ways of improving measurements of phytoplankton biomass. Elgin asked what is needed to improve monitoring of phytoplankton. Claire said the original estimates of phytoplankton bio volumes were done by very meticulous measurements by monitoring groups to come up with formulas that give the current structure. Claire said now there are better ways of counting phytoplankton biomass, such as flowcams which would give a much better volume estimate. Tom Parham said VIMS and VADEQ have flowcams. MD DNR is in the process of purchasing a unit to help answer your question. Peter said that he is aware of the technology but have yet to see data from one or analysis of such data. Peter likes the concept of what could be available for us and can use some examples of seeing the data used to help explain system behavior, show improved measures of responsiveness to management of metrics derived from it versus CHLA, etc. Lew and Claire said the literature is replete with reasons why chlorophyll is a poor substitute for phytoplankton.

Lew asked if there is historic information on chlorophyll bio volume ratios. Claire wrote a paper on this topic and will share it with Lew for him to review. Lew asked if there was modern instrumentation and technique to fix these issues. Claire replied that one of the major questions is picking up where Jeni Keisman left off on answering: “What is causing water clarity attenuation in the Bay?”, “What is changing, since Secchi Depth and KD trends are not doing the same thing? Is it the dissolved organic carbon side that is changing these things?” Claire said these questions need to be answered before you can solve the chlorophyll-nutrient disconnect. Lew asked how would one do that, if they measure random parts of the Bay or look at areas with nutrient limitation and compare with areas without nutrient limitation. If that were the strategy, would one need to examine different salinity regimes. Claire said Jeni did a wonderful job of starting down this path, but more work needs to be down and there may need to be more monitoring. Claire said she thinks the answer is lying in the TSS, dissolved organic carbons, and the organic particulates as they will explain much about the physical light environment. Claire said then you can look at how phytoplankton responds to those environments. Lew said if we have nutrient limitation, chlorophyll bio volume, secchi depth, and KD, there is solid footing to begin answering Elgin’s chlorophyll question. Claire said she once looked at how large or small the chlorophyll molecule is compared to TSS volume, and the chlorophyll molecule is miniscule in comparison. Breck asked if this is something we can discuss with our work on enhancing the monitoring networks. Peter said yes and we should discuss this since the explanatory capacity of our results is a priority of the community with our data and when we cannot explain, but we need to fill a gap in assessment, that highlights a key science need, new or old. Breck replied that either through the monitoring effort or the science needs effort we can have this work captured.

Rebecca said there was a STAC workshop on water clarity and as a result they created Generalized Additive Models (GAM) trends for the KD data available and consulted relevant experts about these dynamics. Rebecca said science needs on this topic should

draw from the STAC workshop findings and the results of Jesse Turner's work (Jesse is a student of Carl Friedrichs).

Elgin said another story line to investigate is that in the past, we only saw nutrient improvements up by the fall line, but now we are seeing those TN and TP improvements almost bay wide, which seems to support the idea that it takes time for nutrient reductions to propagate down through the Bay.

Elgin emphasized the need to create a list of questions and then speak with other scientists to address them. Breck said maybe we could take the list of questions for this and include them in the science needs database as part of the Strategic Science and Research Framework to find capacity to answer these questions. Kaylyn added that if they know researchers or other experts interested in working on these questions, they are encouraged to share their names and contact information with Kaylyn and Breck.

On slide 33, Lew asked if flow adjusted approaches are used for DO. Rebecca said there are flow adjusted results for DO, but they are not being shown here because they do not perform as well and there are not meaningful differences.

Tish Robertson said TSS is trending down in a lot of places and that makes her wonder if changes in the composition of TSS (i.e., percent fines) could be behind the degrading secchi trends. Kaylyn said she is very interested in how the composition of TSS relates also.

Peter Tango said CHLA (plankton) are not the only primary producers. Microphytobenthos, macroalgae, SAV, emergent SAV, epiphytic algae on SAV - there is more biology pulling on nutrient resources than just phytoplankton.

Peter Tango made an announcement that two of the tidal fresh Rappahannock stations are having issues due to a bar that has formed. Peter said that in addition to stationarity issues from temperature and sea level rise, there are also bathymetry challenges. Peter walked through the two stations on the Rappahannock (TF3.1B and TF3.1E) to explain how they have become shallower over time and potential locations for new stations. Peter asked the group if it would it be better to remain at the current sites and continue to obtain surface and bottom samples 1 meter apart or if the group would prefer a deeper site that would provide additional DO data at depths that were historically available to sample but are no longer there. Peter said there is not a lot of precedent for these questions, and this is a question of operations and maintenance. Peter emphasized that this is just an introduction to this topic, and that it will be discussed in more depth at the Criteria Assessment Protocol Workgroup later in November. Peter also said this decision will be made collectively and will consider the needs of the monitoring and modeling team.

Tish Robertson asked if there is a plan for incorporating updated bathymetry data into the 4-D Interpolator and/or estuarine model. Peter replied they have not yet discussed this with the 4-D interpolator. Lew said for the model, they are data limited and would like better bathymetry data but are doing the best they can with the data available. Tish said she thinks setting up a downstream station would result in future assessments that are comparable to past assessments. Rebecca said for the GAM trends, they have an intervention approach where they put a date on when the station moved and then allow for the model to shift if necessary, between those 2 dates. This has been

implemented for some stations with TN and Rebecca wanted to emphasize that the method is available and has been implemented for LE 5.5.

Peter and Breck discussed whether there is the option to keep the station in place while acknowledging there is only a meter's gap between the surface and bottom. Peter will ask to see if this is a feasible option.

Peter said in the past nontidal flow stations have been moved locally due to necessary changes, so this is not quite fully unprecedented. It is rare, so he wanted to consult with a broader audience.

Elgin Perry asked how long the water depth at these stations has been decreasing and have we tried to quantify the effect of that. Elgin also asked if there is a possibility of monitoring the new and old locations for a year. Rebecca Murphy said she really likes that idea of monitoring both for a year as that would help a lot. Peter said those are wise questions to ask, and they probably can be asked because that sort of comparative analysis is within our scope of work. Peter said he will ask Cindy about these questions. Elgin said even with a step trend noting the date in GAMs, overlap in the two stations would help with discern real versus confounding changes.

11:30 – 11:45 Check in on Tributary Summary Updates – All

An opportunity was provided for those updating the tributary summary pilot in the James to share their progress, ask questions, share concerns, or make notes about the process.

Summary

Breck went through and explained the procedures for organizing and storing files in the Microsoft Teams while updating the tributary summaries. Breck also walked through any new additions to the format of the tributary summaries, such as where the cluster analyses will go and the glossary. Breck also displayed the excel spreadsheet being used to track which portions of the tributary summary updates are completed.

Olivia Devereux shared she has completed her portions of work and made the necessary changes to GitHub. Olivia emphasized the need to keep the formatting consistent across the new updates to the tributary summaries. Olivia provided the reminder that the Tributary Summaries are posted here and can be updated anytime.

Elgin confirmed he will be able to do the cluster analysis for the James with 2021 results once Rebecca has provided him with the updated results and he has about a week to run his code.

Breck and Kaylyn emphasized the James is serving as a pilot for updating the tributary summaries more regularly and that there is no expectation to get this work done immediately.

There were no objections to continuing to have time on the ITAT agenda for these check ins.

11:45 – 12:00 Open floor to share research, publications, or other ITAT member work – All

ITAT members had the opportunity to share any recent projects, publications, or research they have been involved in that may be of interest to other attendees.

Summary

Breck shared Qian's new publication on nutrient limitation.

Kaylyn shared that she is planning a meeting with both tidal and nontidal groups for January 4th, 2023 from 12pm-1pm.

12:00 Adjourn

Participants: Alex Gunnerson, Amy Goldfischer, Andrew Keppel, Breck Sullivan, Carl Friedrichs, Claire Buchanan, Efeturi Oghenekaro, Elgin Perry, George Onyullo, Jeremy Hanson, Jimmy Webber, Jon Harcum, Justin Shapiro, Karl Berger, Kaylyn Gootman, Lew Linker, Mandy Bromilow, Mukhtar Ibrahim, Olivia Devereux, Peter Tango, Phong Trieu, Qian Zhang, Rebecca Murphy, Renee Karrh, Rikke Jepsen, Tish Robertson, Tom Butler, Tom Parham.

Next Meeting: Wednesday, December 7, 2022