FORAGE FISH OUTCOME – NOVEMBER 14, 2019

THE NARRATIVE ANALYSIS SUMMARIZES THE FINDINGS OF THE LOGIC AND ACTION PLAN AND SERVES AS THE BRIDGE BETWEEN THE LOGIC AND ACTION PLAN AND THE QUARTERLY PROGRESS MEETING PRESENTATION. BASED ON WHAT YOU LEARNED OVER THE PAST TWO YEARS FROM YOUR SUCCESSES AND CHALLENGES, YOU WILL DESCRIBE WHETHER THE PARTNERSHIP SHOULD MAKE ADAPTATIONS OR CHANGE COURSE.

USE YOUR COMPLETED PRE-QUARTERLY LOGIC AND ACTION PLAN TO ANSWER THE QUESTIONS BELOW. AFTER THE QUARTERLY PROGRESS MEETING, YOUR RESPONSES TO THESE QUESTIONS WILL GUIDE YOUR UPDATES TO YOUR LOGIC AND ACTION PLAN. ADDITIONAL GUIDANCE CAN BE FOUND ON CHESAPEAKEDECISIONS.

1. EXAMINE YOUR RED/YELLOW/GREEN ANALYSIS OF YOUR MANAGEMENT ACTIONS. WHAT LESSONS HAVE YOU LEARNED OVER THE PAST TWO YEARS OF IMPLEMENTATION?

   SUMMARIZE WHAT YOU HAVE LEARNED ABOUT WHAT WORKED AND WHAT DIDN'T. FOR EXAMPLE, HAVE YOU IDENTIFIED ADDITIONAL FACTORS TO CONSIDER OR FILLED AN INFORMATION GAP?

The Forage Fish Outcome states: "Continually improve the Partnership's capacity to understand the role of forage fish populations in the Chesapeake Bay, and by 2016, develop a strategy for assessing the forage fish base available as food for predatory species in the Chesapeake Bay." In a 2014 STAC workshop, diet analyses identified benthic invertebrates as an important dietary component for some predatory species, such as Atlantic croaker, which suggested that the Forage "Fish" Outcome was not an accurate representation of the scope of interest. Therefore, in 2018, the Forage Action Team (FAT) successfully redefined "forage fish" in the management strategy to include not only fish, but also benthic invertebrates, to better represent the broad range of taxa that comprise the forage base.

To date, the Forage Action Team has been most successful conducting scientific research that provides insight into the importance of forage in the Bay, and in developing a strategy for assessing forage status, which will be used to guide future indicator development. Throughout 2018-2019, members of the FAT received funding for three studies relevant to Chesapeake Bay forage. A GIT-funded shoreline study has collected valuable data on the impacts of shoreline hardening and development on forage, providing quantitative thresholds for individual species. Members of the FAT played an advisory role in the study and will work to identify applications of these thresholds in the next SRS cycle. Additional studies proposed by members of the FAT were funded by NOAA

Chesapeake Bay Office (NCBO), including a study of striped bass in forage habitat and a quantitative assessment of habitat quality for forage fishes. The team intends to use these data to inform forage indicator development.
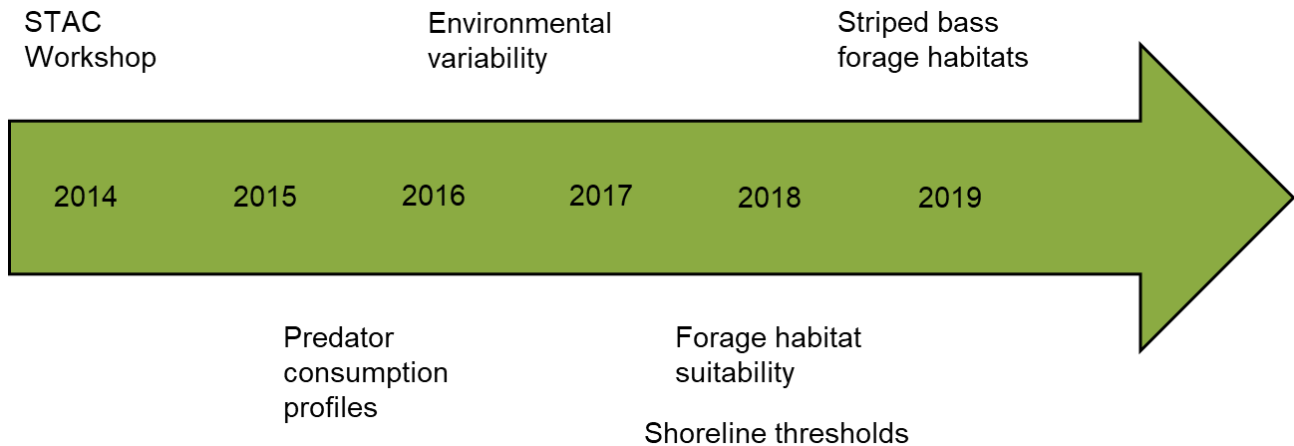
The Forage Action Team has also continued with an unfunded, opportunistic citizen science sampling effort, primarily through the Patuxent Environmental and Aquatic Research Laboratory (PEARL). The goal of this effort is to fill gaps in shallow-water monitoring and habitat use of forage species. While this small-scale project has provided some data on the habitat use of small forage species in the Patuxent River, ideally the scope of the work would be enlarged by engaging partners, such as recreational anglers and riverkeepers, in other regions and potentially increasing nearshore sampling efforts. There may also be opportunities to elicit help from graduate students, interns, and PIs at academic institutions throughout the Bay. The FAT is actively looking for new opportunities to extend this scope of work and improve data collection to fill this knowledge gap.

Despite the successful research studies, the FAT has faced some challenges in evaluating the status of the forage base in Chesapeake Bay. The biggest challenge is developing indicators that are meaningful to fishery management and Chesapeake Bay Program (CBP) initiatives. Although the 2014 STAC workshop report listed more than 10 potential indicators, the FAT has been limited by data (i.e. uncertainty in estimates), analytical capacity, and management-driven endpoints (i.e. how will managers utilize the indicators to inform fishery, habitat, water quality, and other ecosystem-level decisions). The FAT requires further insight from managers and other CBP outcomes to create indicators that will actually be useful to management.

2. REGARDLESS OF HOW SUCCESSFUL YOUR SHORT-TERM PROGRESS HAS BEEN OVER THE PAST TWO YEARS, INDICATE WHETHER WE ARE MAKING PROGRESS AT A RATE THAT IS NECESSARY TO ACHIEVE THE OUTCOME YOU ARE WORKING TOWARD. THE EXAMPLE GRAPH BELOW ILLUSTRATES THIS CONCEPT.
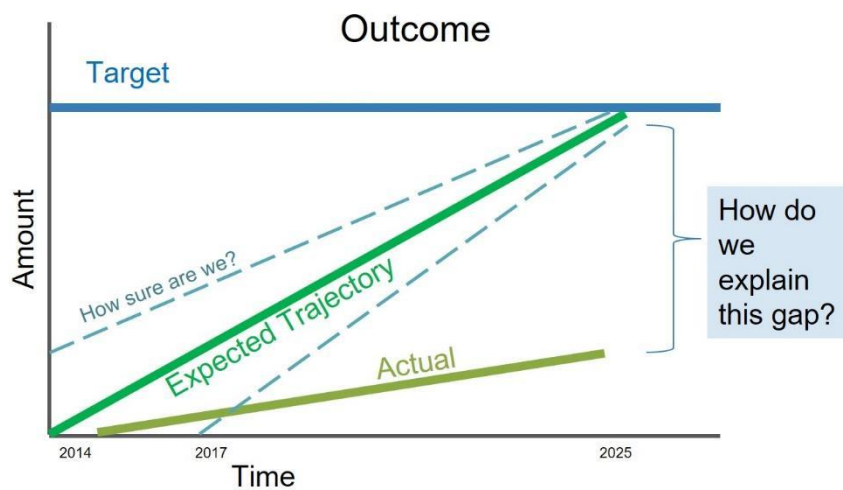
*USE THE **EDITABLE** GRAPH BELOW (OR YOUR OWN CHART) TO ILLUSTRATE YOUR PROGRESS. EXPLAIN ANY GAP(S) BETWEEN OUR ACTUAL PROGRESS AND OUR ANTICIPATED TRAJECTORY.*

STAC
Workshop

Environmental
variability

Striped bass
forage habitats

2014   2015   2016   2017   2018   2019

Predator
consumption
profiles

Forage habitat
suitability

Shoreline thresholds

The Forage Fish Outcome does not have quantifiable metrics of success, making it difficult to evaluate; however, we have created a timeline that reflects our progress to date. The FAT has made significant gains, continually adding to our understanding of the role forage play in Chesapeake Bay. The steep slope of our progress line from 2014 to 2016 represents the initial STAC workshop and GIT-funded studies that provided the foundation for the FAT's current work on indicator development.

The STAC workshop identified the most important prey species based on the diets of several key predators in Chesapeake Bay; 65% of these prey species are unmanaged. A GIT-funded study conducted by Buccheister and Houde (2016) developed a suite of indicators and consumption profiles for important predators to quantify prey availability and examine trends in prey consumption. The results suggested that there are enough prey to support predator populations in Chesapeake Bay, but prey abundances vary such that predators must shift their diet to focus on available prey. For example, as pelagic prey abundance decreases, benthic prey become increasingly important in predator diets. The consequences of these diet shifts are uncertain, but could result in short-term changes in habitat use and affect predator bioenergetics in the long-term.

In 2017 and 2018, indicator development progress slowed but three more studies were funded to examine connections between forage and habitat. Two of these projects are still in progress, but the shoreline study was recently completed. The results suggest that shoreline hardening has a negative impact on important forage species, including blue crab, spot, and Atlantic croaker, likely due to changes in the nearshore habitat. The threshold of impact ranged from 10-30%, depending on the species examined.

Progress leveled off in 2019 as we waited for results from these studies and were challenged to identify useful indicators for management. The development of ecosystem-level indicators of forage status is taking longer than anticipated and, in some circumstances, will require additional data and resources.

3. WHAT SCIENTIFIC, FISCAL AND POLICY-RELATED DEVELOPMENTS WILL INFLUENCE YOUR WORK OVER THE NEXT TWO YEARS?

THIS MAY INCLUDE INFORMATION LEARNED AT THE PREVIOUS BIENNIAL SRS MEETING OR MORE SPECIFIC INFORMATION ABOUT YOUR OUTCOME SUCH AS AN INCREASE OR DECREASE IN FUNDING, NEW PROGRAMS THAT ADDRESS GAPS, AND NEW SCIENTIFIC DATA OR RESEARCH. DESCRIBE HOW THESE DEVELOPMENTS ARE LIKELY TO IMPACT YOUR RECOMMENDED

MEASURE(S) OF PROGRESS, THE FACTORS YOU BELIEVE IMPACT YOUR ABILITY TO SUCCEED, AND NEWLY CREATED OR FILLED GAPS. THESE CHANGES SHOULD BE REFLECTED IN THE FIRST THREE COLUMNS OF YOUR REVISED LOGIC AND ACTION PLAN AFTER YOUR QUARTERLY PROGRESS MEETING.

Several scientific developments will likely play a significant role in the FAT's efforts over the next two years. Results from the aforementioned research studies will add to our knowledge of forage in Chesapeake Bay. We are hoping that these data will allow us to incorporate the impacts of shoreline hardening, habitat, and water quality on forage species into our indicators. Additional research conducted at the University of Maryland Center for Environmental Science (UMCES) may also inform future indicator development. Several PIs at UMCES are conducting studies on important benthic prey (e.g. mysids), and another proposal that is currently under review could, if funded, provide abundance data on river herrings, which are historically important forage species.

In a recent meeting, the Forage Action Team discussed the possibility of conducting a study to determine the efficiency of the sampling methods used in the shallow-water citizen science effort led by PEARL. This would involve a field crew from NCBO deploying a center-bagged haul seine with a mullet skiff at each of the sample sites in the Patuxent River, and then comparing the diversity and abundance of catch with that of the traps used in the citizen science project. This methodology has also been considered for additional nearshore sampling throughout the Bay to provide more data on forage species in shallow-water habitats and potentially link habitat to fish productivity. NCBO has also suggested conducting a literature review of habitat use and creating a summary about forage-habitat connections, which would provide more insight into knowledge gaps and provide focus for the nearshore sampling efforts.

The Atlantic States Marine Fisheries Commission (ASMFC) Biological and Ecological Reference Point Work Group will publish ecological reference points later in the fall, which may also inform our indicator development. Plankton and shallow-water monitoring have been identified as priority science gaps by the FAT and the Fish Habitat Action Team (FHAT) and are included in the STAR science prioritization process.

In terms of policy, only 6 of the 17 important prey taxa identified in the 2014 STAC workshop report are managed at the state or federal level. Therefore the management hook for fisheries is potentially more focused on affected predators such as striped bass. The FAT is also examining ways to use research results to inform TMDL and BMP targeting and implementation (e.g. negative impacts of shoreline hardening on forage, creating incentives to install living shorelines).

4. BASED ON YOUR RESPONSE TO THE QUESTIONS ABOVE, HOW WILL YOUR WORK CHANGE OVER THE NEXT TWO YEARS?

DESCRIBE THE ADAPTATIONS THAT WILL BE NECESSARY TO MORE EFFICIENTLY ACHIEVE YOUR OUTCOME AND EXPLAIN HOW THESE CHANGES WILL LEAD YOU TO ADJUST YOUR MANAGEMENT STRATEGY OR THE ACTIONS DESCRIBED IN COLUMN FOUR OF YOUR LOGIC AND ACTION PLAN. CHANGES THAT THE WORKGROUP, GIT OR MANAGEMENT BOARD CONSIDER SIGNIFICANT SHOULD BE REFLECTED IN YOUR MANAGEMENT STRATEGY.

Over the next two years, the Forage Action Team will continue to focus on the science of forage in Chesapeake Bay and find meaningful applications of research results. In particular, the team will continue taking full

advantage of the ongoing science findings to develop meaningful indicators that can inform fisheries management, planning, and policy (e.g. shoreline hardening thresholds and BMPs).

The Forage Action Team will also take advantage of new and existing partnerships to help meet objectives. As previously mentioned, the team will look into new partners for the citizen science project, including students, interns, anglers, and PIs around the Bay. There may also be an opportunity to work with The Nature Conservancy, examining relationships between forage abundance/production and structured habitat. The Forage Action Team will also consider conducting a literature review of habitat-forage connections to inform indicator development.

To improve the effectiveness of our efforts to develop meaningful forage indicators, the Forage Action Team will strive to make purposeful connections with the Fish Habitat Action Team, the Fish Passage Workgroup, the Invasive Catfish Workgroup, and shad and river herring restoration/conservation efforts. The team will also communicate openly with NOAA Fisheries Science Centers on indicator development and management application in an effort to overcome the challenge of developing forage indicators that are useful for fisheries management.

5. WHAT, IF ANY, ACTIONS CAN THE MANAGEMENT BOARD TAKE TO HELP ENSURE SUCCESS IN ACHIEVING YOUR OUTCOME?

PLEASE BE AS SPECIFIC AS POSSIBLE. DO YOU NEED DIRECT ACTION BY THE MANAGEMENT BOARD? OR CAN THE MANAGEMENT BOARD DIRECT OR FACILITATE ACTION THROUGH OTHER GROUPS? CAN YOU DESCRIBE EFFORTS THE WORKGROUP HAS ALREADY TAKEN TO ADDRESS THIS ISSUE? IF THIS NEED IS NOT MET, HOW WILL PROGRESS TOWARD YOUR OUTCOME BE AFFECTED? THIS ASSISTANCE MAY INCLUDE SUPPORT FROM WITHIN A MANAGEMENT BOARD MEMBER'S JURISDICTION OR AGENCY.

As mentioned previously, the Forage Action Team has been very successful in conducting research to address knowledge gaps about forage in Chesapeake Bay and the factors that might affect forage status. Given that habitat appears to have a significant influence on forage species, we ask that the Management Board help us make connections with other GIT outcomes (e.g. habitat, water quality) to develop useful, meaningful indicators. We are particularly interested in identifying who our audience should be, what our indicators should look like, and how will they be used by CBP and/or management.

The FAT has also expressed interest in conducting shallow-water monitoring of forage throughout Chesapeake Bay as these habitats are critical nurseries and spawning grounds for many species, both predator and prey. In the previous SRS cycle, we asked that the Management Board and STAR commit to prioritizing and supporting a shallow-water monitoring effort. This year, we ask that Management Board make connections with state jurisdictions and engage with them to determine if/how a shallow-water monitoring effort might address some of their needs. Similar support for a plankton survey would also provide invaluable data on a missing link in the Chesapeake Bay food web. We also ask that the Management Board identify and facilitate connections with the local engagement group to support and expand the citizen science project.

Another challenge with indicator development is that the initial assessments require extensive analytical skills, including knowledge of population and ecosystem models. Many new tools are available to simplify and improve the efficiency of this work, but would require additional training and resources. Training of GIT staff would create more opportunities to conduct analyses and make progress in forage indicator development. Therefore, we ask the Management Board to provide funding or a platform for workshops and training opportunities

focused on ecosystem modeling, R statistical software packages, and other useful analytical tools and apps that would streamline indicator development.