Chesapeake Bay Fish Habitat

Summary of Stakeholder Feedback and Identified Needs

Based on Interviews of Fisheries Managers, Permitting Agencies, and Land Planners

Conducted May 2019 through August 2019

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Executive Summary

The Sustainable Fisheries goal of the 2014 Chesapeake Bay Watershed Agreement[1] aims to "protect, restore and enhance finfish, shellfish and other living resources, their habitats and ecological relationships to sustain all fisheries and provide for a balanced ecosystem in the watershed and Bay." A subset of this goal is the Fish Habitat Outcome, which seeks to better understand fish habitat and improve the effectiveness of conservation and restoration efforts. In order to help achieve this outcome, partners on the Fish Habitat team, specifically National Oceanic and Atmospheric Administration (NOAA) and the U.S. Geological Survey (USGS), are working with other Bay partners to develop a regional Chesapeake Bay watershed assessment of fish habitat.

In order to determine how a fish habitat assessment might be used, a targeted effort to interview stakeholders within the Chesapeake Bay watershed began in May 2019. These targeted interviews were conducted to focus on stakeholders whose management or project jurisdictions were in three habitat types: non-tidal, tidal fresh and tidal estuarine waters of the Chesapeake Bay. These stakeholders included fishery/resource managers, land-use planners, and environmental consultants/reviewers.

The results of this targeted effort to reach out to stakeholders is summarized under the groupings of Common Messages (Section 2.1), Common Threats (Section 2.2), Common Challenges (Section 2.3) and Data Gaps (Section 2.4). Most stakeholders agreed that a Chesapeake Bay Fish Habitat Assessment would assist them further in their decision-making process. Habitat information is currently used by a number of natural resource agencies and organizations involved in the protection, conservation, and restoration of Chesapeake Bay fish and aquatic ecosystems including but not limited to: state agencies, the U.S. Army Corps of Engineers, NOAA Fisheries Habitat Conservation Division, NOAA Fisheries Office of Protected Resources, U.S. Fish and Wildlife Service, and non-governmental organizations. Any information updates, advances in the integration of data, or development of user friendly decision tools would be an asset to these groups and achievement of Sustainable Fisheries goals in the 2014 Chesapeake Bay Agreement.

Some recommendations for the Chesapeake Bay fish habitat assessments based on the feedback are as follows:

- Assess habitat at the finest spatial scale reasonably possible. Spatial scale is important in utilizing fish habitat information. Even if a jurisdiction is currently using a habitat map or tool, they have commented that the scale was often not sufficient to make decisions

[1] Chesapeake Bay Program (2014). Chesapeake Bay Watershed Agreement 2014. www.epa.gov/sites/production/files/2016-01/documents/attachment1chesapeakebaywatershedagreement.pdf (accessed 2/10/2020)

(e.g. conservation, restoration, permitting) with a high degree of certainty. There is strong interest to work towards a habitat assessment that provides information at a finer scale (such as 1:24,000 for non-tidal waters).

- Include data and factors (i.e. groups of data, for instance various pollutants, fine scale land use classes, or biological variables) available in the watershed that were not available on a national level, and as a result were not incorporated in the National Fish Habitat Assessment for the region which includes the Chesapeake Bay watershed.
- Correlate biological outcomes/metrics of fish response and where possible quantify stressor impacts on habitat condition and fish response.
- Integrate with other available tools when appropriate and possible.
- Engage with assessment users early, often, and throughout assessment development to ensure the tool meets user needs.

Section 1. Introduction

The Chesapeake Bay and its streams and rivers provide billions of dollars every year to the U.S. economy through seafood harvest, recreation, tourism, and clean-water industries.[2] In the Chesapeake Bay watershed jurisdictions, recreational fishing contributed $265 Million to the Gross Domestic Product in 2017.[3] However, the natural resources and condition of the Bay have decreased over many decades. In 2014, the leaders of all six states and the District of Columbia that are part of the Chesapeake Bay watershed signed an agreement to take specific actions towards the "healthy and vibrant" Chesapeake Bay. The agreement includes eleven broad goals, each with particular desired outcomes. The 2014 Chesapeake Bay Watershed Agreement includes a goal for maintaining sustainable fisheries. Under that goal there is a specific outcome for fish habitat (Fish Habitat Outcome) which states:

> *"Continually improve effectiveness of fish habitat conservation and restoration efforts by identifying and **characterizing critical spawning, nursery and forage areas within the Bay** and its tributaries for important fish and shellfish, and use existing and **new tools to integrate information and conduct assessments** to inform restoration and conservation efforts."*

In order to help achieve this outcome, an assessment team comprised of Chesapeake Bay Program partners from the National Oceanic and Atmospheric Administration (NOAA), and U.S. Geological Survey (USGS) are working with Bay partners to develop a Chesapeake Bay watershed assessment of fish (i.e., finfish and shellfish) habitat. The purpose of the assessment is to:

> *"Identify and assess the quantity and condition of fish habitat in the Chesapeake Bay and its watershed at the finest scale possible to inform conservation, restoration, and fishery management decisions"*

Concurrent with the Chesapeake Bay Fish Habitat Assessment are three other habitat assessments. They vary in scale and scope, but all attempt to discern the condition of aquatic habitats that are necessary to support robust fish and shellfish communities, and in some cases they attempt to identify the factors affecting those habitats. These concurrent assessments include the 1) Atlantic Coastal Fish Habitat Partnership Northeast Assessment, 2) Northeast Regional Habitat Assessment, and 3) Habitat Climate Vulnerability Assessment. The Atlantic Coast Fish Habitat Partnership Northeast Assessment is being led by the Atlantic Coast Fish Habitat Partnership through the Atlantic States Marine Fisheries Commission (ASMFC) with the purpose of identifying priority fish habitat areas in tidal waters from Maine to Virginia using a

[2] National Marine Fisheries Service. 2018. Fisheries Economics of the United States, 2016. U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-F/SPO-187a, 243 p.

[3] U.S. Bureau of Economic Analysis, "Table 1. Outdoor Recreation Value Added by Activity, Thousands of Dollars," https://apps.bea.gov/regional/orsa/stateMap.cfm (accessed April 27, 2020).

relatively small number of variables, to direct ASMFC funding for priority areas. The Northeast Regional Habitat Assessment is being led by the Mid-Atlantic Fishery Management Council. The purpose of this assessment is to analyze the quantity and quality of inshore (i.e. estuarine) and offshore habitats from Maine to the North Carolina/South Carolina border. The third assessment, the Habitat Climate Vulnerability Assessment, is being led by NOAA National Marine Fisheries Service. Its purpose is to score the vulnerability (i.e., sensitivity and exposure) of key habitats (e.g., rock cobble, salt marsh, riverine water column) to climate stressors for marine habitats from Maine to North Carolina. Although there may be some overlap to these assessments, the purpose of each of these assessment is different. In order to avoid any duplication of efforts, members of the Chesapeake Bay Fish Habitat Assessment team coordinate with and are engaged with these other concurrent assessments and programs.

In 2010 and 2015, National Habitat Assessments were conducted by the National Fish Habitat Partnership. The 2015 National Habitat Assessment built upon the 2010 Assessment to 1) improve the analytical basis for the assessment, 2) improve integration of available data, and 3) be more responsive to regional science needs.[4] The 2015 Assessment included assessments of 1) stream habitats for the conterminous United States, Alaska, and Hawaii, and 2) estuaries (regional and national). The regional estuary assessment focused on the northern Gulf of Mexico and used regional data, including fish data. The national assessment was limited to nationally available data sets, had a relatively coarse geographic scale and, in the case of the estuarine assessment, did not include fish and shellfish data. Therefore, the national assessment is insufficient to guide local decisions in the Chesapeake Bay region. Furthermore, the National Fish Habitat Assessment will not be continuing its inland habitat assessment therefore placing an increased need for the Chesapeake Bay Fish Habitat Assessment.

The Chesapeake Bay Fish Habitat Assessment is intended to draw from a richer set of data, including fish and habitat data, then was available on larger regional and national scales and to be focused at a finer spatial scale. In addition, the Chesapeake Bay Fish Habitat Assessment will make an effort to address stakeholder needs such as 1) local planning and land-use decisions, 2) state permitting, 3) federal consultations, and 4) highlight ecological factors important to natural resource managers. As part of the effort to address stakeholder needs, a targeted effort was undertaken to interview stakeholders within the Chesapeake Bay watershed. The process and results are described and summarized in this report.

[4] Crawford, S., Whelan, G., Infante, D.M., Blackhart, K., Daniel, W.M., Fuller, P.L., Birdsong, T., Wieferich, D.J., McClees-Funinan, R., Stedman, S.M., Herreman, K., and Ruhl, P. 2016. Through a Fish's Eye: The Status of Fish Habitats in the United States 2015. National Fish Habitat Partnership. http://assessment.fishhabitat.org/ (accessed on 4/30/2020)

Section 2. Stakeholder Engagement

In 2018, the Scientific and Technical Advisory Committee (STAC) of the Chesapeake Bay Program funded a Workshop to develop a Fish Habitat Assessment Framework for the Chesapeake Bay and its watershed. The workshop's objective was to identify the necessary information and analytical approaches needed to assess the condition and vulnerability of fish habitat in the watershed. Prior to the workshop a questionnaire was developed to understand the scientific information and decision support needs of policymakers responsible for conserving fish and fish habitat throughout the Watershed. Input on the support and informational needs for such an assessment was obtained from state and federal fishery managers and scientists, state, local and federal land use planners and managers, and non-governmental organizations interested in the conservation of fish and habitat services in the Watershed. A complete summary of the questionnaire results can be found in Hunt et al. (2018).[5]

A total of 148 responses were received from the questionnaire. There were responses from all Watershed jurisdictions, but most (41%) of the respondents were from local government compared to other sectors. With regards to existing tools used by respondents and data needs, the questionnaire responses highlighted the needs of the target audience (i.e., land use and restoration planners, and habitat and fish managers). The responses showed an awareness of existing spatial tools, but few respondents actually use these tools regularly for decision making. However, there was a clear desire for the development of one tool that included more types of data and could provide information for various decision-making scenarios. This 'all-in-one' need comes through from respondents when asked the types of information they would want a habitat assessment tool to provide. There is very little preference between habitat vulnerability/risk to degradation, condition of fish habitat, fish species utilization, and driving factors influencing habitat change. Respondents want a tool that can provide all of this information.

Although the questionnaire results provided insights into the needs and utility of a Chesapeake Bay Fish Habitat Assessment, fishery managers and state agencies may have been under-represented. Therefore, a targeted effort to conduct in-person interviews with stakeholders within the Chesapeake Bay watershed was begun in June 2019. These targeted interviews were conducted to gather more refined information from stakeholders whose management or project jurisdictions were in waters of the Chesapeake Bay Watershed. The process deliberately sought input from fishery/resource managers, land-use planners, and environmental consultants/reviewers (Table 1). The meetings were open discussions about how each stakeholder considers habitat in the decisions they make and what data/tools they may utilize to make these decisions. A set of questions was developed to guide the interviews, based on whether the participants work primarily in tidal or non-tidal waters, but may not have been

[5] Hunt, G., D. Bilkovic, S. Faulkner, T.F. Ihde, M. McGinty, M. Monaco, T. O'Connell, P. Tango, et al. 2018. Factors Influencing the Headwaters, Nontidal, Tidal, and Mainstem Fish Habitat Function in the Chesapeake Bay Watershed: Application to Restoration and Management Decisions. STAC Publication Number 18-006, Edgewater, MD. 112 pp.

explicitly asked during the process (Appendices B-D). One group received modified questions via email; this is the only group to respond electronically. While the interviews focused on fish habitat and assessment needs, the conversations were organic and included other information needs that could be provided by Chesapeake Bay Program partners with additional research or projects in the future.

Between June and August 2019, A.K. Leight from NOAA NOS and Erin Markin from NOAA NMFS conducted twenty-two interviews with tidal water stakeholders. The majority of these individuals primarily work in tidal estuarine waters, though some have jurisdiction and interest in tidal fresh waters. The majority of these interviews were in-person, small-group discussions, while a couple interviews were conducted over the phone or email. Interviews were conducted with twelve groups of fishery/natural resource managers located in Maryland (8), Virginia (2), and the District of Columbia (1) plus the Potomac River Fisheries Commission. The agencies represented include Maryland Department of Natural Resources, Virginia Department of Wildlife Resources, Virginia Marine Resources Commission, Potomac River Fisheries Commission, and The District of Columbia Department of Energy and Environment. Three groups of land-use planners were interviewed; two in Maryland and one in Virginia. This group included Maryland Department of Planning which provides guidance, analysis, outreach, and support to counties and local governments. During these interviews, it became clear there was a need to also speak to environmental consultants and reviewers during this process. To that end, interviews were also conducted with seven groups whose work included permitting, consulting, or recommending mitigation for projects. These groups included agencies in Maryland (3), the District of Columbia (1), and federal agencies - NOAA Fisheries/Habitat Conservation Division (2) and NOAA Restoration Center (1). Although there were many other stakeholder groups whose input would have been valuable to this effort, particularly non-profits and other non-governmental organizations, the focus was to interview individuals in local, state, and federal agencies where management or project decisions are made.

Separately, the Chesapeake Bay Fish Habitat Action Team Coordinator Gina Hunt and USGS staff met with state agency program managers whose primary focus is in non-tidal and tidal fresh waters to discuss jurisdiction needs in a fish habitat assessment. This team conducted an interview session in each of the States of Maryland, Virginia, and Delaware between May and August 2019. These discussions were held with larger groups of state resource managers from multiple disciplines in the agency. While the NOAA staff interviewed local, state, and federal agency staff, the USGS interviews were with individuals that work for a state agency with jurisdiction in mostly freshwater and some in tidal fresh water areas. These meetings also included discussion of other USGS Chesapeake Bay Plan priorities including aquatic invasive species and fish passage; however, this report only captures the discussion relevant to the stakeholder needs of a regional fish habitat assessment.

Section 2.1. Common Messages

One goal of this outreach process was to determine the utility of a Chesapeake Bay Fish Habitat Assessment to stakeholder groups. Currently, these groups use a variety of existing tools and

models to help make or justify their decisions. Most fisheries management decisions are based primarily on species population trends and not on habitat availability or quality. Habitat information that is typically monitored or taken into account for projects that might impact fisheries include water quality, identification of spawning, staging and overwintering areas, migratory routes, fish passage, and/or aquatic vegetation. Each state has biological and water quality datasets, but they are typically not well integrated or readily available. Most interviewees agreed that information on habitat condition and vulnerability and a Chesapeake Bay Fish Habitat Assessment would assist them in integrating habitat information into their decision-making process. While there were common messages and requests among states, responses were often specific to the type of habitat in the agency's purview. These responses are described below and summarized based on habitat type in Table 1.

Non-tidal Waters

Changes to the landscape, water withdrawals, and discharges were suggested as some of the biggest threats to non-tidal fisheries. All states interviewed have a process to evaluate proposed projects and activities and work directly (or indirectly) with regulatory agencies to avoid temporary and long-term environmental impacts. However, fishery managers are often consulted on projects after a site is selected and design is completed. Even in well-intentioned habitat projects, there is some disconnect between those leading restoration efforts and fisheries staff. All jurisdictions indicated an assessment with data at a fine scale would be useful for project review and permitting. In addition, a map that shows areas that should be protected or restored would be useful in educating local jurisdictions before permit applications are submitted to the state. It was also suggested that a map/product noting "red flag" issues, e.g. populations or habitats at risk or high value, would be helpful for permitting decisions. This information could be part of a pre-application page so contractors and local government could see the concerns for high value areas in advance.

Maryland has a Use Classification System for surface waters of the state, which is used to describe the appropriate intended use by humans or aquatic life of a waterbody.[6] These "designated uses" span all natural waterbodies and may include shellfishing, water supply, non-tidal warmwater, estuarine and marine aquatic life, non-tidal coldwater, and recreational trout waters. This system has significant importance to the projects and permits approved in these habitat types. Stakeholders commented that the designated use layer could be improved with habitat data and habitat condition information that fish habitat assessment(s) could provide, especially in the areas of brook trout.

Of particular concern to all jurisdictions is how stream temperatures may respond to increasing air temperatures related to climate change. Coldwater stream mapping tools and brook trout prioritization tools have been developed to help improve restoration, protection, and conservation efforts specific to coldwater habitat; however, the tools do not include watershed characteristics, groundwater-surface water interactions, and climate change scenarios. In

[6] Maryland's Designated Uses for Surface Waters, https://mde.maryland.gov/programs/Water/TMDL/WaterQualityStandards/Pages/wqs_designated_uses.aspx (accessed 4/23/2020)

addition, the states could use the fish habitat assessment to expand these efforts to include cool and warmwater habitat.

Habitat information is currently utilized to determine the feasibility of removing barriers to fish migration. More robust and finer spatial-scale fish habitat assessment(s) may help with these existing efforts and would assist with habitat for prioritization of culvert replacements as well as determining if there is suitable habitat above a dam.

Invasive aquatic species was identified as the biggest fisheries management challenge in the states in all habitat types. It was recommended that the assessment include the presence of aquatic invasive species and habitat requirements to forecast areas at risk for range expansion. Beyond the fish habitat assessment information, the USGS utilized the interviews to increase partner engagement and understand state fish and aquatic ecosystem priority management and science needs. Given the priority, USGS provided additional invasive species questions for the interviews and the results are reported in a separate publication, *Aquatic invasive species in the Chesapeake Bay drainage: Research-based needs and priorities of USGS partners and collaborators.*[7]

Tidal Fresh Waters and Tidal Estuarine

As is the case for non-tidal waters, habitat information is currently used in tidal waters (both fresh and estuarine) for various water-body uses and permitting consultations with State agencies, the U.S. Army Corps of Engineers, the US Fish and Wildlife Service, NOAA Fisheries Habitat Conservation Division, and NOAA Fisheries Office of Protected Resources. This data can be used to resolve user conflicts, such as project siting, or establish mitigation measures to reduce impacts to protected species, essential fish habitat and critical habitat designations, habitat areas of particular concern, and diadromous species, as examples. In addition, habitat information may be used for aquaculture siting. Information such as bottom type, water depth, and salinity are useful parameters to know when selecting sites for oyster restoration and aquaculture sites. In addition, the extent of existing oyster beds is valuable information to managers who manage restoration efforts or to those who review and consult on in-water projects. Submerged aquatic vegetation (SAV) maps are used by many stakeholders and accurate maps and ground-truthing are necessary to avoid user conflicts and make decisions on in-water project siting and mitigation. Improved SAV maps would be useful for tidal largemouth bass management decisions (e.g. supplemental stocking). Opportunities may exist to incorporate SAV mapping and forecasting with associated fishery management decisions based upon the distribution and abundance of SAV. The identification and prioritization of habitats critical to fish production are particularly important to these stakeholders.

Stakeholders also agree that the assessment should provide information about fish species distribution, abundance, and migration timing. This information is particularly useful when consultants and reviewers require a time-of-year restriction on when in-water project activities

[7] Densmore, C.L. 2020. Aquatic invasive species in the Chesapeake Bay drainage: Research-based needs and priorities of USGS partners and collaborators. USGS Publication Series, In preparation

(e.g., construction, pile driving) can occur. These time-of-year restrictions are usually required during the migration and spawning of diadromous species. Shorelines, both living and hardened, were discussed by several stakeholders as a topic needing more research or an area where a regional habitat assessment may be useful. Most stakeholders acknowledged that living shorelines provide more benefits to the environment (e.g. fish nursery, shoreline stabilization) than hardened shorelines and suggested a Chesapeake Bay Fish Habitat Assessment could be used to determine siting for these projects. Several stakeholders highlighted that cumulative impacts from multiple habitat stressors are important, but are not typically taken into account when making regulatory decisions; data on cumulative impacts from shoreline alteration, wetland loss within a watershed, and other such substantive changes would be useful.

In addition to project siting, an assessment may help with the consultation process since these projects may affect essential fish habitat (EFH) which could result in a project not going forward, varying permit requirements, or mitigation requirements. For urban areas where hardened shoreline is unavoidable (e.g. sea walls in the District of Columbia), the Chesapeake Bay Fish Habitat Assessment should take shoreline structure into consideration when scoring or ranking habitat within the Bay and its tributaries.

Similar to the feedback heard from managers in non-tidal waters, the impacts of changing climate on habitat are of interest to managers in tidal waters but most decisions are focused on current habitat conditions rather than future habitat conditions. This may be for a variety of reasons such as 1) need for review and comment on proposed in-water projects that occur within a short time period, 2) fisheries managers tend to use ‘recent’ data in their decision-making process, and 3) historical and current distributions are often better defined than future distributions. However, there was definite interest among some stakeholders to know or at least have the acknowledgment of how distribution or migration timing may change under future climate regimes.

Some stakeholders are interested in qualitative or semi-quantitative rankings of habitat condition (e.g. good or poor) to help them make decisions on project siting or determine mitigation measures. In some cases, projects may be able to be moved within a small area so knowing if habitat conditions vary in the area could be useful information to justify the precise location of projects. It was acknowledged that this information would have to be available on a small spatial scale to really be relevant to these managers.

Table 1. Summary of Needs Expressed by State Fisheries Managers

Non-tidal Waters ● A more accurate layer for cold water systems especially in the areas of brook trout, watershed characteristics, groundwater-surface water interactions, and climate change scenarios ● A warmwater assessment tool/layer (as opposed to an assessment that does not consider warmwater) ● A map of populations or habitats at risk or high value to inform permitting decisions ● A map that shows areas that should be protected or restored, especially for educating local jurisdictions ● A map that includes or improves the accuracy of Rare, Threatened, Endangered (RTE) species distributions ● A map of invasive species presence or habitat requirements
Tidal Fresh Waters ● Areas of shoreline hardening ● Improve SAV mapping and forecasting and associated fishery management targets/ thresholds ● More information about abundance and distribution of invasive species ● Species assemblages – habitat condition and stressors ● RTEs – historical occurrences – predicted occurrence based on habitat condition
Tidal Estuarine Waters ● Habitat information that could be used for aquaculture and restoration siting ● Habitat information that could be used in consultations - with other state agencies, with the US Army Corps of Engineers (USACE), NOAA's Office of Habitat Conservation (OHC) and Office of Protected Species (OPR), US Fish and Wildlife Service ● Habitat information that could help resolve or mitigate user conflict issues ● An assessment that provides information about fish species distribution, abundance, and migration timing ● Current habitat conditions, more so than future habitat conditions ● Rankings of habitat condition (e.g., good/poor quality) would be sufficient in many cases for making decisions ● Hardened shorelines identification and impacts ● Development of thresholds beyond impervious surface

Priority Species

A question provided during the non-tidal waters and some of the tidal fresh water interviews was to list the manager's priority species of interest. Common priority species were trout, walleye, northern pike, largemouth bass, and smallmouth bass. It was recommended by several fisheries managers that the assessment focus on an index of biological integrity (IBI) rather than individual species, and that representative species be utilized across habitat types in conjunction with an IBI. In addition, there was a strong interest in developing a warmwater river IBI. For estuarine assessments the primary feedback was the need for a multi-species assessment, with priority given to all managed species. During both the non-tidal and tidal

discussions, the managers often mentioned the invasive species northern snakehead, blue catfish, zebra mussel, water chestnut, and grass carp.

Section 2.2. Common Threats

During the interviews, managers and planners in both tidal and non-tidal waters mentioned habitat threats that are of growing concern and recommended types of data that would be useful as part of any habitat assessments (Table 2). These included particular land uses (e.g. increasing impervious surface, loss of forests), impacts from toxins, and changes to water quality resulting from human activities, among others. In addition, several stakeholders noted that an assessment should include information about the presence and distribution of species listed as Rare, Threatened, and Endangered.

Table 2. Threats to Living Resources that Might be Captured in an Assessment

Threat	Recommendation
Alterations to land cover	Include increases in impervious surface and loss of forest cover, including characterization of forest cover (young, mature, disturbed, monoculture)
Loss of habitat connectivity	Include maps of habitat connectivity
Presence of toxins, particularly endocrine disruptors	Include information about toxins and highlight data gaps
Loss and changes to wetlands	Include maps of wetlands and explore wetland quality
Shoreline Alteration	Include maps of shoreline change from natural to hardened
Cumulative impacts from marinas and docks	Include locations/maps of these structures
Climate variability	Include model outputs for sea level rise, salt water intrusion, stream temperature changes
Agricultural ditches and water withdrawals	Include locations of water withdrawals.
Water quality	Include water quality variables, particularly areas of low dissolved oxygen and changes to salinity
Stream flow data	Include variability of flow events (drought, storms) and spring flow data

Section 2.3. Common Challenges

Each stakeholder group we spoke to had challenges to face when making decisions. Some of these challenges, unfortunately, will not be solved with the development of a Chesapeake Bay

Fish Habitat Assessment. For example, most agencies and groups have a limited capacity in both personnel and funds to expand their current scope of capability to meet additional resource management related needs. Although this assessment will not help agencies to increase personnel, it may improve the efficiency and quality of project design, review, and, therefore, outcome. Additionally, this assessment may help provide information necessary to justify the prioritization of available funding to specific projects to meet agencies' needs. For example, the habitat assessment may help focus available resources to improve management certainty associated with stressors of high potential risk but with currently low scientific certainty. Another example includes the justification for increased study of invasive species which were a concern for all fishery/natural resource managers interviewed; however no one had a program or staff dedicated only to invasive species. Most managers acknowledged the need to know more about the distribution and abundance of invasive species, and the need to know the impacts these invasive species are having on native species and the ecosystem. Blue catfish (*Ictalurus furcatus*) and northern snakehead (*Channa argus*) are two invasive fish species found within the Chesapeake Bay with expanding distributions. Currently, fisheries managers we spoke to tended to be more concerned with blue catfish and would like more information on this species. For the Chesapeake Bay Fish Habitat Assessment, incorporation of distribution and presence/absence (or abundance) of this invasive species may help direct research or justify management decisions.

Fisheries management is still struggling with ecosystem-based fisheries management. One challenge identified by stakeholders is the historic management emphasis on a relatively small set of species, based primarily on abundance estimates. Related to this problem is the lack of availability of data for a large suite of species and habitat conditions at the spatial and temporal scale needed to make decisions. The need for this data was a common message we heard and is a common challenge faced by managers who need to make daily decisions. Although this assessment will not immediately generate new fisheries or habitat data, it will highlight existing data gaps and the specific needs for additional research and resources, potentially leading to an increase in such data through direction of new research. Currently, the data that is available to stakeholders is not maintained in one specific database so they have to collate data from numerous sources to adequately inform management decisions, and this can be a prohibitively time-consuming process. This is the same message we received about existing tools that are used by stakeholders. The list of these tools is extensive, supporting the resource management position that there is a need for one integrative tool with the capability to address their informational needs. Instead, resource managers must rely on various available tools and attempt to synthesize their use to answer he important questions for informed decision making.

Fish habitat modeling or forecasting for climate change is a common challenge for stakeholders. Future impacts to fish and aquatic ecosystems by shifts in water temperatures, loss of quality habitat from changing water quality and runoff from impervious surfaces, or increase variability of extreme flow events (drought, storms) is difficult to incorporate into the decisions of today. For example, it would be useful for brook trout management and restoration planning efforts to model how coldwater habitat may be reduced through time with increasing air temperatures while accounting for the resilience of some coldwater streams with groundwater driven systems.

Understanding which streams are not as resilient, but are important to protect, is useful so that management actions (reforestation, forested buffers, etc.) could be taken to incorporate resiliency.

Common to most stakeholders is the fact that multiple agencies are involved in most decision-making processes. This requires collaboration and coordination among agencies as well as the mutual need to use the best available science upon which to base management decisions. Agencies also may have substantially different constituent needs and demands they must address which can be an added challenge to finding a common solution. In some cases, elected officials make the final decisions so stakeholders need to present the best data available to justify their recommendations.

Although the Chesapeake Bay Fish Habitat Assessment will not be able to immediately solve all of the common challenges discussed by stakeholders, we were able to identify some of the data gaps and needs to direct future efforts. These data gaps are discussed in the next section.

Section 2.4. Data Gaps

Specific data gaps and needs by stakeholders varied, but some categories overlapped with multiple stakeholder groups. One example is the need for highly resolved maps. Sediment structure/benthic maps are used by several groups. Although these maps exist for most areas of the Chesapeake Bay, they are piecemealed together and many have not been updated recently and/or are not at the resolution needed for decision-making. For example, managers need to know the extent of oyster beds and where shell exists for restoration purposes and aquaculture leasing. Although maps exist of natural oyster bars (NOBs) and Yates bars, there is a need to ground-truth these maps. However, NOBs are the regulatory boundary of oyster beds and these boundaries are not likely to change, but knowing where live oysters and/or shell exist within NOBs would be useful to managers. For example, if an in-water project is proposed to go through a NOB, mitigation measures and project siting would be different depending on the impact to the NOB (e.g., shell vs live oysters). Several stakeholders said that data is lacking for shallow water habitat (<6ft deep). Due to the methods used to conduct high resolution benthic mapping, it can be difficult to accurately map shallow waters. It’s not only benthic maps that are needed for this habitat but also spatially and temporally resolved dissolved oxygen and salinity maps. Living shoreline, SAV and oyster restoration projects occur in shallow-water habitats so the additional data would help managers determine the sites best suited for these types of projects. Updated and spatially resolved wetland maps are also needed by managers and planners. Again, these maps exist (e.g. FWS National Wetlands Inventory) but are typically not useful at the spatial scale (e.g. subwatershed) needed for managers and land-planners to make decisions within the Chesapeake Bay. Another point made by several stakeholders is that habitat quality parameters should be accounted for in habitat assessments, such as SAV bed composition and within-bed grass density, but that this type of data may not be available in all areas.

Statistical relationships between stressors, such as some of the threats mentioned in Section 2.2, and natural resources are also something stakeholders are interested in knowing. For example, analyses conducted by the Fish Habitat and Ecosystem Program within Maryland Department of Natural Resources have shown that watershed levels of impervious surface greater than 10% are associated with poor fish outcomes. One goal of the Chesapeake Bay Fish Habitat Assessment is to statistically evaluate the relationship between stressors and natural resources. However, the extent to which this can be accomplished will be dependent upon the available data. Several stakeholders mentioned the need for the establishment of monitoring programs that provided important habitat and stressor data.

With regard to fish data, the Chesapeake Bay Fish Habitat Assessment team is in the process of compiling existing fisheries data. Some of the stakeholders we spoke with would find the compilation of this data very helpful as they currently use many sources to access this data. Although the specific data may not be available to the public, a comprehensive inventory of what exists, where it can be found, and/or who has possession of it may be a useful product of this assessment. There are many geographic areas in which there is no fish community data, but managers are asked to provide informed recommendations to minimize impacts to fish habitat. In the absence of site specific data, there is a desire to have information on the predicted condition or potential fish occupancy of an area.

Section 3. Summary and Recommendations

Feedback gained by both the questionnaire and in-person interviews provided a wealth of information that may be used to design and conduct fish habitat assessments within the Chesapeake Bay. It also provided an opportunity for federal partners to develop a relationship with jurisdiction partners and identify future opportunities for coordination.

Perhaps the most important take away from this outreach process is that there exists a real need for better fish habitat information in the Chesapeake Bay, for both tidal and non-tidal waters. Additionally, the spatial scale of the assessment is important for many decisions being made by both natural resource and land planners. A third very important message was that any information should be constructed or integrated into a universal ‘one-stop’ tool. There was also a recognition that changes in climate will affect habitat conditions in the watershed, and that any habitat assessment should, where possible, support the development of future descriptions of habitat trends over time.

Based on the feedback provided during our interviews, the authors worked to identify and describe the intended uses of the Chesapeake Bay Fish Habitat Assessment. These ‘use cases’ include to 1) improve restoration and conservation project siting (e.g., Best Management Practices and shoreline protection), 2) identify and influence factors affecting fish resources

outside the authority of fishery managers, and 3) document the spatial extent and distribution of significant fish and habitat resources. More specific potential use cases are provided in Table 3.

Table 3. Potential Use Cases of the Chesapeake Bay Fish Habitat Assessment

Conservation ● Guidance for land use planning/ comprehensive plans ● Integrate fish habitat indicator into healthy watershed assessments (i.e. assessments of watershed condition and vulnerability) and trends if possible. ● Inform project permitting/environmental review decisions ● Inform pre-listed (proposed for listing consideration) species status assessments and listed species recovery plans
Restoration ● Selection and targeting of Best Management Practices to reduce nutrients, sediments, and contaminants ● Understanding fish habitat condition that would be made accessible by a fish passage project would be useful in further prioritizing projects ● Guide restoration planning
Fishery Management ● Identification of areas currently inhabited by an invasive plant or animal species ● Informing Essential Fish Habitat consultations ● Advancing ecosystem-based fisheries management ● Track progress or establish baseline towards the Fish Habitat Outcome ● Identification of key species in an area. ● Habitat condition to guide stocking decisions ● Guide public water access decisions (to ensure access is provided in areas that have habitat supportable for fish and fishing) ● Incorporate habitat condition and availability into population stock assessments ● Improved understanding of habitat condition, and drivers and stressors to focus conservation and restoration activities

While feedback about the use of an assessment was positive, it was recognized that how the information is communicated is important. Partners would appreciate communication tools and training to educate the public and decision makers to minimize any misuse or misunderstanding of the assessment information. There is a need for communication materials that include the assessment information, as well as the trade-offs with certain land-use activities and quality fish and aquatic ecosystems. It was suggested that modeling scenarios of poor land-use decisions or the absence of restoration action would be helpful for communicating habitat condition and importance. Having communication products, training tools, and establishing a community of practices for users to benefit from each other's experiences would promote and extend the utility of the tool.

In conclusion, the majority of stakeholders agreed that a Chesapeake Bay Fish Habitat Assessment would be utilized by them or their agency. The common messages we received through the interviews will assist us in the development of the assessment. Recognizing the challenges faced by fisheries and natural resources planners, land-use planners, and consultants and environmental reviewers when making decisions that factor in fish habitat, it is important to develop an assessment tool that stakeholders understand and that meets their needs.

Appendices

Appendix A. Stakeholders interviewed as part of the Chesapeake Bay Fish Habitat Assessment.

Name, Title	***Department and Address***	***Mission Statement or Program Description***	***Interview Session (Tidal v. Non-Tidal)***
Fisheries/Natural Resource Managers			
Martin Gary, Executive Secretary	Potomac River Fisheries Commission (PRFC) Colonial Beach, VA	PRFC regulates the fisheries of the main stem of the tidal Potomac River from the Maryland/Washington D.C. boundary line (near the Woodrow Wilson Bridge), to the mouth of the river at Point Lookout, MD and Smith Point, VA.	Tidal
Lynn Fegley, Division Director	Maryland Department of Natural Resources, Fishing and Boating Services, Stock Health, Data Management and Analysis Division Annapolis, MD	Maintain sustainable fisheries by using biological, technical, and socio-economic data to develop science based management strategies for commercial, recreational, and ecologically important species.	Both
Chris Judy, Director Mitch Tarnowski, Biologist Frank Marenghi, Biologist Laurinda Smith, Biologist	Maryland Department of Natural Resources, Shellfish Division Annapolis, MD	Provide information for the conservation and enhancement of valuable natural resources (i.e., shellfish). Rehabilitate degraded habitat using natural oyster shell and/or alternate substrates and to target the planting of hatchery-produced oysters.	Tidal

Christine Conn, Director	Maryland Department of Natural Resources, Office of Science and Stewardship, Chesapeake and Coastal Service Unit Annapolis, MD	Developing and managing conservation and restoration policies, strategic plans and decision-support tools to ensure the long term protection of Maryland's high value natural resources and outdoor recreational assets.	Tidal
Daniel Ryan, Chief Luke Lyon, Biologist Joseph Swann, Biologist Eric Thadley, Biologist Chris Adriance, Biologist Shellie Spencer, Biologist	Department of Energy and Environment, Fisheries Research Branch Washington, DC	The Fisheries and Wildlife Division develops, supports, and implements programs for urban fish and wildlife conservation, protection, recreation, and sustainability.	Tidal
Pat Geer, Deputy Chief	Virginia Marine Resources Commission, Fisheries Management Division Fort Monroe, VA	Carries out current and long-term State policies effecting saltwater fisheries--recreational and commercial in Virginia's tidal waters. The Division's goal is to provide the maximum benefit and long-term use of the Commonwealth's finfish and shellfish resources through conservation and enhancement.	Tidal
Randy Owen, Environmental Engineer	Virginia Marine Resources Commission, Habitat Management Division Fort Monroe, VA	Manage the state of Virginia's submerged bottom lands, tidal wetlands, sand dunes and beaches in order to preserve and protect Virginia's natural resources and the habitat our saltwater fisheries depend on.	Tidal
Aaron Bunch, Tidal Rivers Project Leader	Virginia Department of Wildlife Resources Henrico, VA	VDWR is responsible for the management of inland fisheries, wildlife, and recreational boating	Both

		for the Commonwealth of Virginia.	
Brian Richardson, Director	Maryland Department of Natural Resources, Fish Health and Hatcheries Program Annapolis, MD	Responsible for production of nearly two dozen species for fish stock enhancement, education and outreach, shellfish production, cooperative fish culture projects, and restoration of anadromous species in Maryland waters of the Chesapeake Bay.	Tidal
Tom Parham, Director	Maryland Department of Natural Resources, Tidewater Ecosystem Assessment Annapolis, MD	Oversees several water quality monitoring programs in the Chesapeake Bay. These programs build on historical monitoring efforts and provide some of the most direct linkages to management programs that aim to reduce the impacts of pollution on the Bay.	Tidal
Andrew Button, Lead	Virginia Marine Resources Commission, Conservation and Replenishment Department Fort Monroe, VA	Tasked with the management and replenishment of the public oyster grounds in Virginia.	Tidal
Jim Uphoff, Fisheries Biologist Margaret McGinty, Fisheries Biologist	Maryland Department of Natural Resources, Fish Habitat and Ecosystem Program (FHEP) Annapolis, MD	The FHEP is working to understand how habitat changes impact Maryland's fisheries in the Chesapeake Bay. Their focus has been primarily on understanding how urbanization limits habitat for fish.	Tidal
Tony Prochaska, Freshwater Fisheries Director	Maryland Department of Natural Resources, Freshwater Fisheries Program	Mission is to manage Maryland's freshwater resources using scientifically valid, standardized assessments and management techniques	Non-Tidal

		to provide high quality, diverse, and accessible fisheries for Maryland residents and visitors.	
Mike Bednarski, Fisheries Chief Bob Greenlee, Region 1 Fisheries Manager Paul Bugass, Region 4 Fisheries Manager Alan Weaver, Fish Passage Coordinator Ray Fernald, Environmental Program Manager, Invasive Species Coordinator Jeff Trollinger, Deputy Director for Statewide Resources, Bureau of Wildlife Resources	Virginia Department of Wildlife Resources (VDWR) Henrico, VA	VDWR is responsible for the management of inland fisheries, wildlife, and recreational boating for the Commonwealth of Virginia.	Non-Tidal
Edna Stetzar. Fisheries Biologist	Delaware, Department of Natural Resources and Environmental Control, Division of Fish and Wildlife	DNREC DFW conserves and manages Delaware's fish and wildlife and their habitats, and provides fishing, hunting, wildlife viewing and boating access on public land.	Both
Land-use Planners			
Jason Dubow, Manager Deborah Cornwell, Resource Conservation Planner	Maryland Department of Planning, Resource Conservation and Management Baltimore, MD	Provides guidance, analysis, outreach and support to ensure that all of the state's natural resources, built environment and public assets are preserved and protected to achieve its goals for economic, community and environmental vitality.	Tidal
Helen Spinelli, AICP/Principle Planner (*retired*)	Queen Anne's County Community and Environmental Planning Centreville, MD	Implements the goals and objectives of the County's Comprehensive Plan through the administration of the	Tidal

		zoning ordinance, subdivision regulations, critical area ordinance and forest conservation regulations.	
Lewis Lawrence, Executive Director	Middle Peninsula Planning District Commission Saluda, VA	Promoting the economic, social and physical development of Virginia's Middle Peninsula.	Tidal
Environmental Consultants/Reviewers			
David O'Brien, Marine Habitat Resource Specialist	NOAA National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office, Habitat Conservation Division Gloucester Point, VA	Working to protect, restore, and promote stewardship of marine, estuarine, and riverine habitat to support our nation's fisheries for future generations.	Tidal
Heather Nelson, Associate Program Manager Tammy Roberson, Division Chief Jon Stewart, Regional Chief Matthew Stover, Chief	Maryland Department of the Environment, Wetlands and Waterways Program, Water and Science Administration Baltimore, MD Tidal Wetlands Division, Water and Science Administration Water Quality Standards, Water and Science Administration	Protects Maryland wetlands and waterways from loss and degradation through the regulation of the draining, dredging and filling of tidal and nontidal wetlands, the nontidal wetland buffer and waterways. The purpose of water quality standards is to protect, maintain and improve the quality of Maryland surface waters.	Tidal
Kristy Beard, Marine Habitat Resource Specialist	NOAA National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office, Habitat Conservation Division Annapolis, MD	Working to protect, restore, and promote stewardship of marine, estuarine, and riverine habitat to support our nation's fisheries for future generations.	Tidal
Mary Andrews, Environmental Engineer	NOAA Restoration Center Annapolis, MD	Focus on four priority habitat restoration approaches, where they	Tidal

		can have the biggest impact to fishery production: opening rivers, reconnecting coastal wetlands, restoring shallow corals, and rebuilding shellfish populations.	
Roland Limpert, Natural Resources Planner Greg Golden, Natural Resources Planner	Maryland Department of Natural Resources, Environmental Review Program Annapolis, MD	Protect historic habitat, address broad habitat and fish life cycle categories, and address relationships between habitat and various construction activity types.	Tidal
Steven Saari, Associate Director Matt Robinson, Environmental Protection Specialist Steve Reiling Josh Burch	Department of Energy and Environment, Watershed Protection Division Washington, DC	Works to protect and restore the environmental health of the District's waterways.	Tidal
Christina Lyerly, Natural Resources Planner Pat Depkin, Environmental Compliance Specialist	Maryland Department of the Environment, Water and Science Administration, Sediment and Stormwater Review Baltimore, MD	Issues permits to protect Maryland's water resources by controlling industrial and municipal wastewater discharges.	Tidal
John Cargill, TMDL & toxics Ellen Dicky, Division of Water Brian Galvez, Environmental review Katie Kadlubar, Environmental review Matthew Jones, Regulatory and Shoreline projects	Delaware Department of Natural Resources and Environmental Control	The mission of the Department of Natural Resources and Environmental Control (DNREC) is to: Engage all stakeholders to ensure the wise management, conservation and enhancement of the State's natural resources; Protect public health and the environment;	Non-Tidal

Alison Rogerson, Wetlands		Provide quality outdoor recreation; Improve the quality of life; Lead energy policy and climate preparedness; And educate the public on historic, cultural and natural resource use, requirements and issues.	
Anna Smith	Delaware Department of Transportation, Environmental Studies	Preparation of all levels of environmental reports and analysis including environmental assessments, EIS, natural resource and wetland evaluations, Also consider historic preservation, hazardous waste areas and assessment, water quality, and abatement.	Non-Tidal

Appendix B. Questions used to guide interviews with fisheries and natural resource managers in tidal waters.

Q1: What does ‘habitat’ mean for your agency?

Q2: Do you currently consider habitat when making fisheries decisions?

Q3: Do you (would you) consider variables other than temperature, salinity, oxygen and stock assessment information?

Q4: Do you have habitat maps that you use? Do you have a GIS tool you currently use, and does your agency host it?

Q5: What spatial scale would you like information? (tributary, subtributary, reach, etc.)

Q6: Are there issues that trump habitat when making decisions (e.g. competitive invasive species, climate change)

Q7: Have you been or are you now engaged with any fish habitat work?

Q8: There has been some state specific modeling efforts to answer specific species or area questions. Do you think there is utility in broadening those efforts on a bay-wide scale?

Q9: Are there species specific questions related to habitat that you think we can help answer? What would be on your wish list?

Q10: Do you think we can move beyond single species management? How?

Q11: Is habitat part of your fishery management plans, and how do you use that section for management decisions?

Q12: Do you see any progress towards including habitat in your regulatory decisions? What would you need?

Q13: Are you interested more in the current state of habitat or future projections of habitat (or trends over time)? What time scale of fisheries information do you use to make decisions?

Q14: Do you know of conflicting aquatic habitat uses (e.g. SAV and aquaculture gear)? Is there a precedent or procedure for dealing with these issues?

Q15: How would you best receive information? Do you have trusted sources?

Q16: What limits the work you do and the decisions you make?

Appendix C. Questions used to guide interviews with land-use planners in tidal waters

Q1: What does ‘habitat’ mean for your agency?

Q2: How do you decide which areas/habitats to conserve? Is that ad hoc or targeted? Are land-based conservation/restoration decisions made one project at a time or do they share characteristics?

Q3: Do you (or local planners) currently consider impact on aquatic habitat when making decisions? If so, does that include aquatic resources (fish, shellfish, etc.)? How far from your project do you consider potential impacts?

Q4: What are the various goals and considerations you take into account? What are the most important things you consider for conservation?

Q5: Is it easier/harder to consider land based habitat versus aquatic habitat?

Q6: Do you have habitat maps that you use? Do you have a GIS tool you currently use, and does your agency host it?

Q7: Are you aware of any aquatic habitat tools? If so, which ones?

Q8: Do you see any progress towards including habitat in your regulatory decisions? What would you need?

Q9: Are you interested more in the current state of habitat or future projections of habitat (or trends over time)?

Q10: How would you best receive information? How do you currently receive information and from whom?

Q11: How well connected are planners? Do they share experiences and opportunities?

Q12: What limits the work you do?

Q13: Who else do you think we should talk with?

Q14: Do you consider intertidal/shoreline habitat restoration or protection in your decisions?

Appendix D. Questions used to guide interviews with managers in non-tidal waters

Fish Habitat

Q1: To what extent do you currently consider habitat when making fish conservation, management and restoration decisions? Environmental review/Permitting decisions? How could a fish habitat assessment help those efforts?

Q2: Do you have habitat maps that you use? Do you have a GIS tool you currently use, and does your agency host it?

Q3: What spatial scale would you like information? (tibutary, subtributary, reach, etc)

Q4: Have you been or are you now engaged with any fish habitat restoration work? If so how do you identify projects?

Q5: Is habitat part of your fishery management plans, and how do you use that section for management decisions?

Q6: Do you see any progress towards including fish habitat in policy decisions of your Department and/or State or

Q7: Are you interested more in the current state of habitat or future projections of habitat (or trends over time)?

Q8: As you consider the following habitat types, what are your priority species of interest and what do you believe are some of the most significant stressors of fish habitat? Cold headwater streams; warm water streams and rivers, tidal fresh, estuary?

Q9: Do you have a need for any state specific fish habitat modeling and/or forecasting to answer specific species or area questions?

Q10: Are there any science needs we have not discussed that you think could be achieved with a USGS partnership?

Invasive Species

Q1: Using the 2018 Virginia Invasive Species Management Plan as a reference, are there any other such documents that guide your program related to invasive species management? Are there any substantial changes to Virginia's invasive species programs since its publication?

Q2: What other agencies in the Commonwealth are involved in invasive species management (i.e. for plants, insects, pathogens)?

Q3: What currently are your most pressing priorities related to aquatic nuisance species? (species-specific priorities or regional/ecosystem-based priorities)

Q4: What currently are your greatest challenges or obstacles related to aquatic nuisance species management?

Q5: Who are the state, federal, and regional partners of the Commonwealth for aquatic nuisance species management in Chesapeake Bay and its drainage?

Q6: What are your science needs pertaining to aquatic nuisance species management and any related information gaps (e.g. - species impacts, surveillance tools, risk assessment, mitigation techniques)?

Q7: Are you currently partnering with USGS to address any science needs? Are there any other areas where we might explore the potential for partnerships between DGIF and USGS to address science needs or other aquatic nuisance species related issues?

General Fish and Aquatic Ecosystem Science Needs:

Q1: What are some of the most significant and complex management challenges facing your State or Commonwealth fish and aquatic resources today and looking forward?

Q2: Are there any science capabilities for which your State or Commonwealth is not able to provide for which USGS may be able to assist with?