Chesapeake Bay Program
Science. Restoration. Partnership.

Invasive Catfish
Management Strategy
August 2020

A team from the Virginia Department of Game and Inland Fisheries uses electrofishing to monitor invasive blue catfish in the James River in 2011. (Photo by Matt Rath/Chesapeake Bay Program)

I. Introduction

This management strategy portrays the outcomes of an interactive workshop (2020 Invasive Catfish Workshop) held by the Invasive Catfish Workgroup at the Virginia Commonwealth University (VCU) Rice Rivers Center in Charles City, Virginia on January 29-30, 2020. The workshop convened a diverse group of stakeholders to share the current scientific understanding and priority issues associated with invasive catfishes in Chesapeake Bay. The perspectives shared and insights gained from the workshop were used to develop practical, synergistic recommendations that will improve management and mitigate impacts of these species across jurisdictions within the watershed.

Blue catfish (*Ictalurus furcatus*) and flathead catfish (*Pylodictis olivaris*) are native to the Ohio, Missouri, Mississippi, and Rio Grande river basins, and were introduced into the Virginia tributaries of Chesapeake Bay in the 1960s and 1970s to establish a recreational fishery. These non-native species have since spread, inhabiting nearly all major tributaries of the Bay watershed. Rapid range expansion and population growth, particularly of blue catfish, have led to increasing concerns about impacts on the ecology of the Chesapeake Bay ecosystem.

Blue and flathead catfishes are long-lived species that can negatively impact native species in Chesapeake Bay through predation and resource competition. Blue catfish are generalist feeders that prey on a wide variety of species that are locally abundant, including those of economic importance and conservation concern, such as blue crabs, alosines, Atlantic menhaden, American eels, and bay anchovy. Blue catfish may also outcompete native white catfish for prey, as the two species exhibit high dietary overlap (primarily bivalves) and native white catfish populations declined while blue catfish abundance increased in the region. The diet of flathead catfish consists primarily of ecologically important forage fishes including gizzard shad, river herring (i.e. blueback, alewife), and white perch. In addition to ecological impacts, invasive catfishes affect other fisheries by interfering with gill nets and pound nets and reducing catches of targeted species such as striped bass and white perch. The growing abundance and expansion of blue and flathead catfishes suggests that these two species have the potential to negatively impact important fishery resources (e.g. blue crabs, striped bass) and impede recovery efforts (e.g. American shad, river herring) in Chesapeake Bay.

II. Goal, Outcome, and Current Condition

This management strategy identifies approaches for achieving the following goal and outcome:

Sustainable Fisheries Goal

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.

Invasive Catfish Outcome

Reduce the abundance and mitigate the spread and ecological impacts of invasive catfishes in Chesapeake Bay through increased public education and awareness and development of fishery management strategies that ensure ecosystem health and productivity.

Current Condition

Introduction and Monitoring

Blue catfish were first introduced into the James, Rappahannock, and York rivers in Virginia in the 1970s and 1980s. Live transport (i.e. repeated introductions) and extended periods of high freshwater flow, combined with their high salinity tolerance, have since resulted in the spread of blue catfish to all major tributaries on the western shore of Chesapeake Bay as well as several tributaries on the eastern shore of Maryland and Delaware. Flathead catfish primarily occupy the fresher reaches of Chesapeake Bay tributaries. Since their introduction into the James River in the late 1960s, flathead catfish have been found in the upper reaches of the York and Rappahannock rivers in Virginia, the Potomac and Susquehanna rivers in Maryland, and throughout the Susquehanna and Schuylkill rivers in Pennsylvania.

Several jurisdictions and academic institutions across the Bay have monitored invasive catfish populations over the years to track changes in distribution and relative abundance, including the Virginia Institute of Marine Science (VIMS), Virginia Tech (VT), Penn State University (PSU), the Virginia Department of Game and Inland Fisheries (VDGIF), the Maryland Department of Natural Resources (MDNR), the DC Department of Energy and Environment (DOEE), and the Pennsylvania Fish and Boat Commission (PFBC). In 2013, VIMS researchers conducted a mark-recapture study to develop an

extrapolated abundance estimate of nearly 20 million blue catfish in the James River based on a density of 544 fish/hectare within a 12-kilometer study area. For comparison, population models developed by another group of scientists at VIMS estimated a total abundance of 145,000 (± 94,000) adult striped bass in the Rappahannock River in 2016. An additional cooperative study by VDGIF and VCU in 2015 estimated blue catfish densities of 1,127 and 565 fish/hectare in the Rappahannock and Pamunkey rivers, respectively. While flathead catfish are not as abundant nor as well-studied as blue catfish in Chesapeake Bay, they are of primary concern in the fresher waters of Pennsylvania, Maryland, and Virginia.

Recreational Fishery

Blue and flathead catfishes have supported valuable recreational fisheries in Virginia since their introduction in the 1960s and 1970s, and are particularly popular in the James River. VDGIF angler surveys indicate that 40% of recreational effort in the James River focuses on blue catfish, exceeding the popularity of other species such as largemouth bass, crappie, and shad (i.e. American, hickory). The James River recreational fishery supports guide services, with approximately 20 charter captains hosting clients from across the United States to catch trophy-sized catfishes. National and regional catfishing tournaments are also held on the James River annually, which may draw 200 or more participants for a single event. Although the total economic impact is difficult to evaluate, VDGIF estimated the economic value of the blue catfish recreational fishery in the James River to be $2.5 million in 2002, which would exceed the ex-vessel value of the entire Virginia commercial fishery, assuming a price of $0.60/pound and a maximum landings of 2.5 million pounds. However, participation in the recreational fishery on the James River has slowed in recent years, and the number of guides operating has decreased since reaching a peak in 2015. Decreased participation in the trophy fishery may be due to a decline in the number of trophy-sized catfishes, as the high densities of invasive catfishes in the established tributary result in decreased growth rates. However, this would only explain the recent decrease in trophy angling and not the decrease in overall recreational effort as captured by the VDGIF angler surveys.

The Potomac River is also a hotspot for recreational catfish angling, which occurs nearly year-round. Like the James River, at least four guide services run expeditions to provide patrons an opportunity to catch trophy-sized catfishes. Although the popularity of targeting blue catfish has not been quantified specifically, MDNR has estimated that catfishes (i.e. blue catfish, channel catfish, flathead catfish, bullheads, white catfish) comprised the second most popular targeted group of fish by tidal freshwater anglers in 2017, distantly second to black bass (*Micropterus* spp.). These fishing target estimates are similar to those estimated by MDNR surveys conducted 25 years ago.

While blue catfish are abundant throughout Chesapeake Bay tributaries, flathead catfish are less abundant and widespread, and are therefore caught less frequently by recreational anglers. Flathead catfish are currently most prevalent in Quantico Creek and portions of the non-tidal Potomac River, the lower Susquehanna River (below Conowingo Dam), and Conowingo Reservoir. Flathead catfish are typically consumed when caught in their native range, and MDNR has identified cases of flathead catfish consumption in the Chesapeake Bay sustenance fishery through angler intercepts and monitoring the MDNR Angler's Log.

Commercial Fishery and Marketing

In the 2000s, low market demand and a lack of consumer awareness, as well as lower abundance, limited the commercial value and harvest of invasive catfishes in Chesapeake Bay. However, recent efforts in market development have increased demand of wild-caught blue catfish from the Bay and increased abundances have led to increased catch in commercial gear. As the population in the Potomac

River began to increase in abundance in the early 2010s, Maryland initiated an aggressive marketing campaign. Harvest of blue catfish biomass has been increasing since 2013, with approximately 53,000 pounds sold from Maryland rivers in 2018, not including the Potomac River. The Virginia Marine Resources Commission (VMRC) and the Potomac River Fisheries Commission (PRFC) also observed increases in harvests, with 1.4 million pounds of blue catfish harvested in the James River in 2012 and more than 1 million pounds of harvest each year from 2015-2017 in the Potomac River, respectively. In 2018, commercial harvest of blue catfish from the Potomac River was approximately 2.8 million pounds. To further expand commercial harvests, an experimental fishery using low-frequency electrofishing (LFE) was established in the James and Pamunkey rivers in 2014, and was found to be an efficient method of removal. Despite recent advances in marketing and harvest techniques, United States Department of Agriculture (USDA) inspection requirements mandated by the 2014 Farm Bill have reduced processing capabilities and, according to the processors, have created a bottleneck in the market.

Increased consumer awareness through programs such as Seafood Watch has allowed the commercial fishery for blue catfish to expand in recent years, with fillets being sold at grocery stores such as Whole Foods. The Maryland Departments of General Services, Agriculture, and Natural Resources successfully partnered in 2018 to establish a supply chain of blue catfish to state-owned institutions with food services, such as correctional facilities. Other supply chains to Maryland universities and small businesses are currently being considered, with such partnerships requiring support from watermen, fish processors, state regulators, vendors, and consumers. Flathead catfish, however, remain a marketing challenge. The unappealing, yellowish color of the fillets and the perception of flathead catfish as unpalatable, not to mention the difficulty of processing the fish, make establishing a commercial market particularly difficult. Therefore, flathead catfish currently only support recreational fisheries in Chesapeake Bay, but the Invasive Catfish Workgroup will explore opportunities to further expand markets for this species both regionally and internationally. It should also be noted, however, that flathead catfish are prolific in habitats that cannot be legally sampled with commercial gear and it is unlikely that commercial harvest will be a possible mechanism unless restrictive harvest regulations are first addressed.

Workgroup Efforts

In 2012, a previous workgroup called the Invasive Catfish Task Force was established by the Sustainable Fisheries Goal Implementation Team, and in 2014, the group developed a list of recommendations for jurisdictions to address invasive catfish issues Bay-wide, including:

- Targeted removal from priority areas
- Develop large-scale commercial fisheries
- Evaluate removal methods
- Develop monitoring and response plans
- Evaluate habitat connectivity
- Review fishing policies and regulations
- Develop communication strategies

At the 2020 Invasive Catfish Workshop, the Invasive Catfish Workgroup agreed to focus on several of these recommendations moving forward, particularly development of communication strategies to increase public awareness and market demand, and development of fisheries management strategies that will ensure ecosystem health and productivity. One of the primary goals of this management strategy is to examine the potential to use commercial and recreational harvest of invasive catfishes as a

means to reduce their abundance and mitigate their range expansion and ecological impacts. While this overarching goal pertains to both blue and flathead catfishes, the approaches recommended and/or implemented to reach this goal may differ for these two species, given their differences in abundance, distribution, and market demand. It should also be noted that there is a substantial degree of uncertainty in how this management strategy will play out long-term, given the current lack of population models, socio-economic data, and other pertinent information.

III. Participating Partners

Stakeholder Engagement

Stakeholder engagement is critical to ensure that the management strategy for invasive catfishes considers the needs and concerns of all interested parties. Catfish regulations, management plans, and public campaigns are the responsibility of the management jurisdictions. Academic institutions, non-profits, and federal agencies support research efforts to better understand the impacts of invasive catfishes and to increase public awareness. Commercial fishers, recreational anglers, processors, and marketing experts provide valuable insights on the interests of the public and seafood industry that may inform the development of effective fisheries management strategies.

The following stakeholders participated or expressed interest in the development of this management strategy.

Management Jurisdictions

- Atlantic States Marine Fisheries Commission (ASMFC)
- DC Department of Energy and Environment (DOEE)
- Delaware Department of Natural Resources and Environmental Control (DNREC)
- Maryland Department of Natural Resources (MDNR)
- Pennsylvania Fish and Boat Commission (PFBC)
- Potomac River Fisheries Commission (PRFC)
- Virginia Department of Game and Inland Fisheries (VDGIF)
- Virginia Marine Resources Commission (VMRC)

Participants and Interested Parties

- Chesapeake Bay Foundation (CBF)
- Chesapeake Bay Program (CBP)
- Commercial fishers
- James River Association (JRA)
- Maryland Department of Agriculture (MDA)
- Maryland Department of Environment (MDE)
- Maryland Sea Grant (MDSG)
- Mid-Atlantic Panel on Aquatic Invasive Species (MAPAIS)
- Morgan State University, Patuxent Environmental & Aquatic Research Laboratory (PEARL)
- National Oceanic and Atmospheric Administration, Chesapeake Bay Office (NCBO)
- Nixon Fishery Inc. (Wholesale/retail)

- Pamunkey Indian Tribe
- Pennsylvania Sea Grant (PASG)
- Recreational anglers
- Reliant Fish Co. (Processing/distribution)
- Smithsonian Environmental Research Center (SERC)
- The Nature Conservancy (TNC)
- United States Department of Agriculture (USDA)
- United States Fish and Wildlife Service (USFWS)
- United States Geological Survey (USGS)
- University of Maryland Center for Environmental Science (UMCES)
- University of Maryland Eastern Shore (UMES)
- Virginia Commonwealth University (VCU)
- Virginia Institute of Marine Science (VIMS)
- Virginia Marine Products Board
- Virginia Sea Grant (VASG)
- Virginia Tech (VT)
- Wide Net Project

IV. Factors Influencing Success

Invasive catfish populations and their associated fisheries are impacted by a variety of natural and human factors that present logistical, social, and economic challenges to meeting the objectives of this management strategy. While some of these factors may be addressed directly through this strategy, others will require managers and policy-makers to use the best available science to make informed management decisions. The following are factors that influence invasive catfish populations and the workgroup's ability to develop a strategy to meet the aforementioned outcome: reduce the abundance and mitigate the spread and ecological impacts of invasive catfishes in Chesapeake Bay through increased public education and awareness and development of fishery management strategies that ensure ecosystem health and productivity.

Ecology and Life History

The ecology and life-history characteristics of blue and flathead catfishes make them particularly successful invaders in Chesapeake Bay. These catfishes have a broad tolerance of environmental conditions. For example, blue catfish can survive low food rations for several months while maintaining body condition; furthermore, they can survive 3-day exposures to salinities up to 15.7 ppt. Flathead catfish have a similar salinity tolerance of up to 15.8 ppt. These catfishes are also long-lived and have a reproductive strategy that optimizes juvenile survival by producing large eggs and providing parental care. Both blue and flathead catfishes are opportunistic predators that feed on locally abundant species; blue catfish are generalist feeders, consuming a wide variety of fishes, invertebrates, and plants, while flathead catfish are largely piscivorous. These characteristics not only make blue and flathead catfishes successful invaders, but also present challenges to our ability to mitigate their spread and reduce their abundance and ecological impacts in Chesapeake Bay.

Climate Change

Climate change has shifted species distributions and altered the abundance of key species around the world, and is expected to significantly impact the Chesapeake Bay ecosystem in the coming years, including direct impacts on invasive catfish populations. The Bay region has experienced increases in mean water temperatures and increased frequency and severity of storm events that deliver freshwater input to the Bay. In particular, the Chesapeake Bay watershed experienced the wettest years on record in 2018 and 2019, resulting in an unprecedented range expansion of blue catfish. With continued increases in freshwater inputs, blue catfish are likely to continue their range expansion into and across the Bay and its tributaries, and could become established in new areas such as Delaware Bay by movement through the Chesapeake and Delaware (C&D) Canal. Increased freshwater inputs would also increase inputs of run-off into the Bay, leading to higher rates of eutrophication. While eutrophication is detrimental to many species, blue catfish are tolerant of eutrophic conditions and therefore may exploit these degraded habitats, leading to further increases in abundance. Flathead catfish did not exhibit the same response to the high freshwater flows in 2018 and 2019, possibly due to differences in behavior and habitat preference. Increasing water temperatures may result in increased invasive catfish biomass as warmer temperatures often promote faster growth rates. More than anything, the uncertainty surrounding climate change impacts will continue to pose a major challenge to fisheries managers as they work to control invasive catfish populations.

Scientific and Technical Understanding

To increase public education and awareness and develop effective fishery management strategies for invasive catfishes, managers and industry leaders throughout the region need to have a solid, science-based understanding of consumption benefits and risks, population dynamics, and other fishery characteristics (i.e. socio-economics, catch composition, catchability). More specific, quantitative information about the impacts of blue and flathead catfish predation and competition on native populations is also necessary to understand how these species affect the ecology of the Chesapeake Bay ecosystem. The lack of comprehensive scientific and technical studies on invasive catfishes in Chesapeake Bay poses a major challenge to fishery managers. This section identifies and describes topics surrounding invasive catfishes that require further scientific research in order to achieve the invasive catfish outcome.

Consumption Benefits and Risks

Increased and sustained market demand is necessary to develop and maintain commercial fisheries for invasive catfishes. Science-based information about the nutritional benefits and potential health risks of consumption is a key component of an effective marketing strategy that encourages people to eat more catfish. Coordinating consistent messaging about the benefits and risks of catfish consumption will be an essential aspect of public outreach and education programs once this information becomes available.

Population Dynamics

Despite various efforts to monitor and study invasive catfishes in tributaries across the Bay, scientists and managers still lack an in-depth understanding of blue and flathead catfish population dynamics. Population models with appropriate size- and age-structure and stock-recruitment relationships are necessary to develop reference points that will meet management objectives. Stage-based or age-based population models are also necessary to determine how changes in abundance (e.g. enhanced removals) may affect future population size and age structure. This requires an understanding of density-dependent growth and maturation rates, as well as estimates of both natural and fishing

mortality rates. Previous research on blue catfish has shown that growth rates and other aspects of population dynamics vary across Chesapeake Bay tributaries, which suggests that population models and estimates need to be developed individually for each system, and connectivity and movement between systems should be considered. Less is known about flathead catfish population biology; more research should be conducted if a fishery management strategy is to be developed for flathead catfish.

Understanding how environmental factors affect population dynamics (i.e. reproduction, recruitment) is also a critical research need, particularly in the face of climate change. Scientists and managers should consider how populations will respond to increasing water temperatures and freshwater inputs from more frequent and intense precipitation events. Such climate-related changes may also affect the efficiency of gears used to harvest catfishes (e.g. LFE). Identification of aggregation areas (i.e. spawning grounds, nursery habitats) may also improve harvest efficiency of catfishes through targeted removals.

Fishery Conditions and Economics

In addition to understanding population dynamics, managers need to monitor and assess fishery characteristics for effective management of invasive catfishes. Understanding annual harvest fluctuations and factors that affect fishery operations is critical to meet fishery management objectives. Managers are specifically interested in standardizing catch rates for LFE methods and collecting age- or size-based catch composition data. Exploitation rates and annual mortality rates may also be of interest to managers. An assessment model should be developed to estimate allowable harvests and fishing mortality rates based on management objectives.

Managers and other stakeholders also have great interest in quantifying the economic value of the commercial and recreational fisheries for invasive catfishes in Chesapeake Bay, as well as comparing these values with the values of harvests or recreational opportunities foregone due to invasive catfishes. There is particular interest in a comparative assessment of the economic value of trophy catfishes and their impacts on other important fisheries due to predation. To fully assess the trade-offs associated with different management options, it is necessary to determine the monetary value of ecological impacts, benefits from recreational angling, benefits from the development of a commercial fishery, and health impacts from consumption of large, potentially contaminated catfishes.

Ecological Impacts

The greatest concerns regarding invasive catfishes in the Chesapeake Bay region are the impacts on native species and habitat, particularly those that are managed or protected. Throughout the Bay, blue and flathead catfishes feed on ecologically and economically important species such as blue crabs and alosines. Although these prey species have been observed in gut contents, a lack of population data for many of these native species has made it difficult to quantify the impacts of invasive catfishes. Population estimates of blue and flathead catfishes as well as their native prey are necessary to truly understand the extent of the ecological impacts of invasive catfishes in the Chesapeake Bay ecosystem. Bioenergetics models can also be used to explore the effects of invasive catfish predation on native species; however, because of the generalist and opportunistic nature of the catfish diets, particularly blue catfish, such models may yield estimates of predatory impact with low precision. Nonetheless, current tools exist that could improve understanding of the ecological impacts of invasive catfishes in the absence of such information.

Partner Coordination

At the 2020 Invasive Catfish Workshop, it was agreed that the consideration and understanding of all stakeholder perspectives would be the key to developing a comprehensive and inclusive management strategy. Continued collaboration and coordinated support, particularly across jurisdictions, is critical for achieving our outcome of reducing the abundance and mitigating the spread and ecological impacts of invasive catfishes in Chesapeake Bay through increased public education and awareness and development of fisheries management strategies that ensure ecosystem health and productivity.

Public Engagement

Blue catfish are a tasty and nutritional source of protein, but a pervasive negative perception of blue catfish as a "dirty fish" has inhibited market demand and, consequently, limited harvest in Chesapeake Bay. Increasing market demand and recreational interest in blue catfish is necessary to develop and maintain profitable fisheries that remove biomass from the ecosystem. Therefore, public education and outreach campaigns that inform consumers and anglers about the palatability, nutritional value, health benefits, and ecological benefits of eating blue catfish are critical. Information about potential contaminant risk and consumption advisories for larger size classes of blue catfish should also be provided to the public. Maryland and Pennsylvania provide consumption advisories for flathead catfish, but further studies would be beneficial if jurisdictions want to market them for human consumption.

Policy and Regulations

Current federal policy and state-specific management regulations may be limiting commercial and recreational harvest of blue and flathead catfishes in the Chesapeake Bay region. In 2017, all catfishes were placed under the regulatory jurisdiction of the USDA's Food Safety and Inspection Service, including wild-caught, domestic blue catfish. The establishment of this inspection program placed constraints on catfish processing in the Bay region. The mandatory inspections are typically scheduled for standard business hours, which is a reasonable condition for poultry, beef, and pork industries given their relatively predictable production and processing schedules. The harvest and processing of blue catfish, however, is much more variable, depending on weather and other environmental conditions, and often results in processors working unusual hours. In these instances, processors are required to pay costly overtime fees for inspectors in order to comply with the inspection regulation. Between the limited inspection hours and the unavoidable fees due to processing times, the number of blue catfish processors, particularly smaller operations, in the Chesapeake Bay region has significantly declined, placing constraints on the commercial fishery. It is worth noting that catfishes are the only wild-caught fishery species that are required to undergo this inspection process.

State-level management regulations, such as gear and harvest restrictions, also affect the ability to remove invasive catfish biomass. For example, Virginia and Pennsylvania do not currently allow use of recreational fish trotlines, and in Pennsylvania, invasive catfishes fall under the same hook-and-line creel limits as other populations in the Commonwealth where they are native.

Funding and Resources

Availability of funding, staff, and other resources limits the Invasive Catfish Workgroup's ability to attain certain objectives of this outcome. Financial and staff support are required to conduct scientific research, establish and maintain monitoring programs, and develop and deliver effective education programs and marketing campaigns.

V. Current Efforts and Gaps

Scientific and Technical Understanding

Consumption Benefits and Risks

Understanding the health benefits and risks of catfish consumption is crucial to effectively market the product to consumers and increase market demand. In 2011, VIMS researchers conducted a study of contaminants in blue catfish in Virginia tributaries and the Potomac River, which found that larger fish tend to have higher contaminant concentrations; however, the correlation is relatively weak and varies by location. Fish from the upper reaches of the tributaries also tended to exhibit higher contaminant concentrations than fish from the lower reaches. Results from a nutritional study on blue catfish fillets will soon be released by Virginia Sea Grant, along with more contaminant information, to be used for marketing purposes. The Virginia Marine Advisory Service has also examined the feasibility of marketing blue catfish roe for human consumption.

In Maryland, the Department of Environment (MDE) has conducted contaminant studies of blue and flathead catfishes from various locations throughout Chesapeake Bay, and routinely tests tissues to establish consumption advisories, which are posted online. A factsheet detailing nutritional information and fishing tips for blue catfish has been produced by the University of Maryland Eastern Shore and is currently being reviewed by MDE. This factsheet will be an important outreach product for consumers and others in the supply chain. MDNR and MDE are also exploring ways of preparing large catfish by removing red muscle to lower the contaminant risk, similar to recommendations for striped bass.

These efforts are a good starting point, but there is interest in gathering more location- and size-specific information about nutritional value and contaminant risk of blue catfish for consumers and anglers. More data are also needed to assess the health benefits and risks for different groups of people and methods of preparation (i.e. fillets vs. whole frying). Although flathead catfish are not widely available in commercial markets of the Mid-Atlantic region, MDE testing of flathead catfish from the Susquehanna River drainage for polychlorinated biphenyls (PCBs) has indicated that consumers are able to safely eat two meals per month. If jurisdictions want to explore the possibility of developing a market for flathead catfish, either regionally or internationally, more extensive nutrition and contaminant studies should be conducted throughout the Bay.

Population Dynamics

Several studies and surveys have been conducted to assess the relative abundance, growth, survival, and movement of invasive catfishes in Chesapeake Bay and its tributaries. These studies indicate that population characteristics vary spatially, suggesting that population models need to be developed for each tributary in order to generate reference points that will meet management objectives. However, critical information required for effective fishery management is still lacking. The following is a list of gaps identified by scientists and researchers throughout the Bay, and some of the efforts to address them.

Gaps:

- Population estimates, size- and age-structure, and stock-recruitment relationships for all major tributaries in Chesapeake Bay
- Estimates of harvest rates, effort, and economic value of the recreational fishery, including the trophy fishery

- Detection probabilities associated with fishery-independent surveys
- Better understanding of movement and connectivity between tributaries
- Environmental effects on population dynamics (i.e. reproduction, recruitment)
- Identification of aggregation areas (e.g. spawning grounds, nursery habitats) for targeted removal
- Identification of fishery interests (i.e. commercial, trophy, consumption) in each major tributary of the Bay to inform tributary-specific management
- Use of ecosystem models to examine trade-offs of management objectives and/or various harvest scenarios
- Better understanding of flathead catfish biology, distribution, and population dynamics

Completed Efforts:

- VIMS tagging study estimated the population size of blue catfish in the James River
- VT developed indices of relative abundance for blue catfish in the James, York, and Rappahannock rivers and used results to assess predation impacts on native species
- SERC telemetry study examined blue catfish movement patterns and habitat use in the Patuxent River
- MDNR examined growth, maturation, age structure, and feeding habits of blue catfish in the Potomac River
- VIMS and MDNR tagging study examined blue catfish movement in the Potomac River
- VIMS conducted study on blue catfish salinity tolerance and modeled habitat suitability
- VIMS examined blue catfish growth, maturation, fecundity, metabolic rate, and body condition through a series of experiments and tributary-specific modeling exercises
- VT examined distribution, growth, and feeding habits of invasive catfishes

Ongoing Efforts:

- VCU collects abundance data in the James and Pamunkey rivers using LFE surveys
- VIMS trawl survey collects abundance and size (length) data in the James, York, and Rappahannock rivers
- VIMS ChesMMAP survey collects abundance, size (length and weight), and age data from the mainstem of the Bay
- VDGIF conducts LFE surveys, angler surveys, and age and growth research
- MDNR collects presence/absence data from fisheries surveys
- PFBC conducts abundance surveys, age and growth analysis, and diet research for flathead catfish in cooperation with PSU
- MDNR collects blue catfish from the Potomac and Patuxent rivers for diet analysis
- MDNR collects flathead catfish from Conowingo Reservoir and lower Susquehanna River (below dam) to assess growth, age distribution, and feeding habits
- VT is developing a size-based assessment model for blue catfish
- VIMS is developing a full life-cycle bioenergetics model for blue catfish
- VIMS is conducting a diet study of blue catfish predation on blue crabs in the mesohaline portion of the James River

- MDNR tagging project aims to identify blue catfish spawning grounds and improve harvest efficiency of catfishes through targeted removals

Fishery Conditions and Economics

A key aspect of fishery management is the development and implementation of plans and regulations that are based on the best available science. This requires a solid understanding of the fishery characteristics including total harvest, catch compositions (i.e. age, size, sex), harvest locations, fishing effort, market price, and catchability. Much of this information is lacking for both blue and flathead catfishes in Chesapeake Bay. While MDNR receives some recreational catch and harvest data from their Volunteer Angler Survey, their online Angler's Log, and state record and award programs, sampling surveys that monitor and verify catch compositions throughout the Bay would provide further insight into fishery operations. A routine angler intercept survey is being planned for the Potomac River through a partnership between DOEE, VDGIF, and MDNR, which should begin in 2021.

Although managers and scientists have a solid understanding of factors that affect LFE catchability, more data on these factors (i.e. temperature, salinity) are needed to standardize catch rates. Population models and assessments for each fishery (e.g. James River blue catfish) would allow for estimation of allowable harvests and fishing mortality rates, and also improve understanding of annual harvest fluctuations. As mentioned in the previous section, a size-based assessment model for blue catfish is currently being developed by scientists at VT, which would support this endeavor.

Invasive catfish management can be optimized by assessing the economic value generated by both the commercial and recreational fisheries and the negative ecosystem impacts of invasive catfishes. Maryland Sea Grant researchers may conduct these economic analyses in the future. Chesapeake Bay ecosystem models may also provide some insight into this knowledge gap and may be used to inform fishery management objectives.

Ecological Impacts

Understanding and mitigating the ecological impacts of invasive catfishes on Chesapeake Bay's native species is one of the primary objectives of the Invasive Catfish Workgroup. While scientists have a good grasp of blue and flathead catfish diets (to a lesser extent in Pennsylvania) from studies conducted throughout the Bay, the information needed to quantify these predation impacts is lacking. To assess the impacts of catfish consumption on native species, scientists and managers require reliable abundance data and complex population models for both invasive catfishes and their prey species. VIMS and MDNR fisheries surveys can provide some of this information for blue catfish and their prey species, but these surveys are spatially limited to sampled tributaries; a Bay-wide analysis is not possible at this time without initiation of further sampling efforts. Scientists are also interested in evaluating how the magnitude of predatory impact changes as invasive catfishes grow and increase prey consumption.

Ecosystem models are useful tools that may identify ecosystem impacts of invasive catfishes in Chesapeake Bay. Given the tributary-specific population characteristics of invasive catfishes and the lack of funding needed to perform surveys and studies in every tributary, the application of these models could be a good first step in evaluating invasive catfish impacts. The greatest benefit of applying ecosystem model approaches is that they integrate the best available science (i.e. population dynamics, life history, predator-prey dynamics, habitat impacts) for invasive catfishes and other species to identify ecological impacts that might not otherwise be identified, or expected. Such approaches can also be important for identifying the most critical research gaps for meeting fishery management goals.

Two ecosystem modeling tools are currently available for the Chesapeake Bay system: the Chesapeake Atlantis Model (CAM), a Bay-wide biogeophysical model that includes predator-prey interactions; and the Chesapeake Bay Fisheries Ecosystem Model (CBFEM), a predator-prey mass-balance approach. Current versions of both models allow the spatial simulation of catfish populations in the major tributaries of each Chesapeake Bay jurisdiction, allowing animals to optimize their movements based on available resources. Both models can also estimate contaminant biomagnification and quantify effects of invasive catfishes on habitat (i.e. SAV) and other living resources. Ecosystem models and indicators developed from model estimates could inform the status, risk, and ecological impacts of invasion over time, and potentially assist in the development of triggers for management actions.

Partner Coordination

In 2019, the Invasive Catfish Workgroup was revitalized after the Sustainable Fisheries Goal Implementation Team expressed concerns about increasing abundances of invasive catfishes in the Chesapeake Bay region. The workgroup was reorganized to be collaborative and membership was expanded to include diverse interests; current members represent management jurisdictions throughout the watershed, commercial and recreational fishers, seafood processors and distributors, federal agencies, academic institutions, and conservation organizations. The primary objectives of the newly-established Invasive Catfish Workgroup were to: (1) coordinate, synthesize, and communicate scientific research on invasive catfishes in Chesapeake Bay; and (2) develop a science-based management strategy that mitigates the growth, spread, and negative impacts of invasive catfish populations in the Chesapeake Bay ecosystem.

In the past, conflicting interests among stakeholders hindered identification of a common goal and, consequently, the development of a management strategy for invasive catfishes in Chesapeake Bay. The 2020 Invasive Catfish Workshop aimed to overcome this challenge by bringing together all stakeholders to discuss their interests and develop collaborative solutions that could be implemented in a Bay-wide management strategy. The table below provides a summary of stakeholder interests in invasive catfishes as discussed at the workshop. Progress on this Bay-wide issue will be realized only with continued communication and coordination, particularly across jurisdictions and stakeholder groups.

Table 1. Summary of stakeholder interests identified at the 2020 Invasive Catfish Workshop.

Stakeholder Group	Blue Catfish	Flathead Catfish
Processors	Mid-sized fish: 19-28”	None
Commercial fishery	Small- to mid-sized fish: ≤ 30”	None
Recreational fishery	Trophy fish: ≥ 32” Consumption: ≤ 24”	Trophy fish: ≥ 32” Consumption: < 30”
Conservationists	Reduce biomass to minimize impacts	Reduce biomass to minimize impacts
Scientists	Provide best available science to guide development of effective fisheries management strategies	Provide best available science to guide development of effective fisheries management strategies

Note: These are averages based on notes from the workshop - there are some differences within stakeholder groups and across jurisdictions.

Public Engagement

In the last decade, consumption of Chesapeake Bay blue catfish has been promoted across the region through social media, seafood festivals, chef demonstrations, restaurant showcases, recipe sharing, and programs like Seafood Watch. For example, MDNR has hosted derbies and staffed outreach booths to promote harvest of invasive catfishes in partnership with the Maryland State Fair and Maryland Office of Tourism. Blue catfish have also been displayed at the Seafood Expo North America in Boston; the Virginia Marine Products Board will be providing samples of fillets at this expo, as well as the Seafood Expo Global, for the first time in 2021. Developing new partnerships with organizations focused on invasive species (e.g. Mid-Atlantic Panel on Aquatic Invasive Species), consumer education, and outreach could provide additional support for this strategy. Similar efforts should be considered for flathead catfish if jurisdictions choose to market the species for consumption.

Recreational angling could also be a powerful platform for public engagement. Several anglers and guides in Virginia are currently working to promote catfish angling both for recreation and consumption. Jurisdictions should continue to engage leaders of local recreational fishing communities and catfish guide operations (e.g. Discover the James) to provide outreach support and encourage recreational angling and consumption of invasive catfishes. In addition to sharing information about the benefits and risks of catfish consumption, these leaders can also educate anglers about the risks of live transport to help prevent the spread of invasive catfishes.

Policy and Regulations

The USDA inspection requirements for wild-caught Chesapeake Bay catfishes need to be addressed because current requirements appear to limit processing capabilities and, consequently, removal of biomass in the region. The 2020 Invasive Catfish Workshop initiated the conversation with USDA, but the workgroup will need to continue working with the USDA and local and state governments to create flexibility in the inspection process. Efforts are currently underway at the state level; for example, a Senate bill introduced in January 2020 that would exempt wild-caught catfishes from certain inspection requirements was passed in March 2020 and is now going through the House reading process.

Jurisdictions should also explore options for relaxing gear restrictions for blue and flathead catfishes to increase harvests. For example, Maryland does not currently restrict blue or flathead catfish harvest with creel limits, size limits, or seasonal limits. The state has recently permitted two new opportunities aimed at increasing harvest of invasive catfishes: (1) individuals may secure a $15 permit to commercially harvest catfishes using trotlines in tidal waters; and (2) individuals may now harvest catfishes using jugs in tidal waters, in addition to other legal gear such as hook-and-line and bow-and-arrow. This new commercial license is much cheaper, and therefore more accessible, than other commercial licenses in Maryland (e.g. hook-and-line). States throughout the watershed also have regulations to help prevent the spread of blue and flathead catfishes in the Bay. For example, individuals are not permitted to release live invasive catfishes into a waterbody other than the one where it was caught, and individuals are not allowed to stock ponds or impounded waters without a stocking permit.

Funding and Resources

Several potential sources of funding and support for invasive catfish research and outreach were identified at the 2020 Invasive Catfish Workshop. Sea Grant, The Nature Conservancy (TNC), the Mid-Atlantic Panel on Aquatic Invasive Species (MAPAIS), and the United States Geological Survey (USGS) are interested in supporting research that will lead to improved understanding and mitigation of invasive

catfish impacts in the Chesapeake Bay region. Virginia Sea Grant has funded the research of at least two graduate students (VT, VIMS) whose dissertations focused on the ecology of blue catfish. USGS has provided telemetry equipment and molecular analysis support to MDNR diet and population studies in the Patuxent and Potomac rivers, and also coordinated an acquisition of $27,000 in blue catfish research funds to MDNR from the Atlantic States Marine Fisheries Commission. MAPAIS distributes an annual request for proposals dedicated to invasive species research in the Mid-Atlantic region; however, these funds are limited (<$10,000). Members of the Invasive Catfish Workgroup have expressed interest in submitting a proposal to MAPAIS to support invasive catfish outreach and education efforts. Annual funding to conduct invasive catfish work in Maryland has been obtained from the Aquatic Nuisance Species Task Force via the National Invasive Species Act and the United States Fish and Wildlife Service (USFWS) via the Sport Fish Conservation Act. The National Oceanic and Atmospheric Administration (NOAA) also offers funding for fishery development, marketing, and science supporting fishery sustainability through the annual Saltonstall-Kennedy Grant Program; several members of the workgroup have committed to submitting a blue catfish proposal for FY21.

VI. Management Approaches

At the 2020 Invasive Catfish Workshop, stakeholders identified and prioritized several approaches to address the gaps and factors influencing our ability to mitigate the spread and impacts of invasive catfishes in Chesapeake Bay. The Invasive Catfish Workgroup recommends the following actions and strategies to achieve the invasive catfish outcome.

Improve Public Awareness through Outreach and Marketing Campaigns

Public misperceptions and a lack of understanding are the greatest barriers to achieving the invasive catfish outcome. To address these challenges, the Invasive Catfish Workgroup recommends conducting coordinated outreach and marketing campaigns that aim to educate anglers and the general public about invasive catfishes in Chesapeake Bay. The primary objectives of this approach are to: (1) improve understanding of the ecological impacts of invasive catfishes in Chesapeake Bay; (2) increase market demand for blue catfish; and (3) increase participation in the recreational fishery for blue and flathead catfishes.

Clear, concise, and consistent messaging is the key to effective outreach and marketing campaigns. The following is a list of messages that the Invasive Catfish Workgroup recommends focusing on to meet the objectives of this management approach.

- Ecological impacts of invasive catfishes in the Bay
- Ecological benefits of harvesting invasive catfishes for consumption
- Taste and nutritional value of blue catfish
- Contaminant risk of consuming larger blue catfish with specific recommendations
- How to catch, clean, and cook blue catfish

Informative brochures and news articles, social media (e.g. Facebook, Twitter, YouTube), and outreach events (e.g. festivals, expos, conferences, fishing tournaments) will be the primary methods of communication to implement this strategy. Recreational angling and guide services should also be considered as a platform for education and outreach to get the public hooked on catfishing. For consistency in marketing, the Invasive Catfish Workgroup recommends developing a common brand

that can be used to promote Chesapeake Bay blue catfish products across the region as a healthy, eco-friendly choice (e.g. wild-caught Chesapeake Bay blue catfish).

While seemingly straightforward, we need to acknowledge two caveats to this approach. Flathead catfish are not currently on the market for human consumption, nor do we have the information required to develop effective outreach and management strategies for flathead catfish (i.e. nutritional value, contaminant risk). This approach is therefore primarily focused on blue catfish; however, other options for marketing flathead catfish, such as international trade, may be considered. It should also be acknowledged that standard communication methods may not reach underserved communities, such as subsistence fishers who are of greatest concern for contaminant consumption. Alternative methods of communication (i.e. signage at public access points) should be considered to overcome this barrier. Public surveys should also be distributed to evaluate and improve the effectiveness of outreach and marketing campaigns.

Remove Processing Barriers

A major barrier to developing consistent, profitable fisheries in Chesapeake Bay is the USDA inspection regulation, which is limiting the ability to process large volumes of blue catfish. The Invasive Catfish Workgroup recommends continued discussions with USDA representatives to explore the possibility of relaxing the inspection requirements for wild-caught, domestic catfishes to reduce costs to processors. The Invasive Catfish Workgroup also recommends continued communication about the concerns and impacts of this inspection regulation on the blue catfish fishery to the appropriate federal and state government officials. An economic impact analysis of the inspection requirements on the fishery would also strengthen the argument for an exemption.

Conduct and Synthesize Scientific Research

Science-based information is necessary to effectively market and manage invasive catfishes in Chesapeake Bay. A collaborative effort to synthesize the current knowledge of ecological impacts and evaluate options to quantify those impacts will be a key objective of the Invasive Catfish Workgroup. The workgroup recommends developing scorecards to indicate the status and risk of blue and flathead catfish invasions in each major tributary of the Bay to track their range expansion and potential ecosystem impacts. These indicators would likely be developed with the use of Chesapeake Bay ecosystem models, and may be coordinated with the Chesapeake Bay Program's Climate Assessment Model to better understand the effects of climate change on invasive catfish distribution. The catfish invasion scorecards could be used as a communication and management tool across the Bay, and could inform other workgroup indicators (e.g. forage, climate resilience). In addition to quantifying ecological impacts of invasive catfish, members of the workgroup should identify sources of population data and evaluate alternative survey methods for abundance data and early detection. Academic researchers, federal agencies (e.g. USGS), and other interested parties (e.g. TNC, Sea Grant) should collaborate on this effort and discuss the potential to leverage funding sources. Finally, modeling and assessing the economic benefits from both the commercial and recreational catfish fisheries should help inform optimal removal and allocation decisions.

Tributary-Specific Management

Development of management plans for invasive catfishes will be necessary to mitigate their spread and ecological impacts within the Chesapeake Bay watershed. Given the spatial variation in key population

rates (i.e. recruitment, growth, survival, reproduction) and contaminant concentrations, jurisdictions should develop a management plan that considers each tributary (population) individually. To develop effective, tributary-specific management plans, each jurisdiction should define their management objectives for each tributary. Management objectives may be determined with the use of Chesapeake Bay ecosystem models, which can examine economic and ecological trade-offs of invasive catfish removal throughout the Bay. Once management objectives are identified, the Invasive Catfish Workgroup will help compile and evaluate potential sources of data that can be used to generate preliminary population models and estimate targets for removals. These management plans may also reflect the catfish interests in a given location (i.e. consumption, trophy, commercial). For example, trophy angling would likely be a major consideration for invasive catfish management in the James River, but not necessarily the Patuxent River, where there are fewer trophy-sized fish. To determine the catfishing interests in each tributary, jurisdictions should assess existing fisheries data and/or work with leaders of the recreational angling community to conduct surveys to gather that information. Management plans that incorporate allowances for a particular type of fishery (e.g. consumption, trophy, commercial) should be based on the best available science. Jurisdictions should also evaluate the potential to incorporate flexibility in gear and catch limitations for invasive catfishes to promote greater harvest in appropriate locations.

VII. Monitoring and Assessing Progress

The Invasive Catfish Workgroup identified the following approaches that can be used to monitor and assess progress toward the invasive catfish outcome:

- Track sales of blue catfish
- Conduct public opinion and consumer surveys to evaluate effectiveness of outreach and marketing campaigns
- Collect data on recreational fisheries using angler surveys and voluntary reports to assess participation (i.e. trophy, consumption, general) and harvest characteristics (i.e. total harvest, species, gear, location)
- Track volume of blue catfish processed and/or the number of processors to assess processing capabilities
- Develop tributary-specific scorecard indicators to assess the status and/or risk of invasion by blue and flathead catfishes throughout the Bay
- Track research projects focused on blue and flathead catfishes
- Run ecosystem models (e.g. CAM, CBFEM) to evaluate competing interests and harvest scenarios for each tributary
- Develop management objectives for each major tributary
- Develop simplified, preliminary blue catfish population models for each tributary, using VT's assessment model framework

VIII. Adaptively Manage

The Invasive Catfish Workgroup is committed to adaptive management of blue and flathead catfishes in Chesapeake Bay. The workgroup will continually evaluate the effectiveness of these management

approaches in reaching outcome objectives based on fishery and ecosystem indicators. Specifically, the Invasive Catfish Workgroup will:

- Annually evaluate commercial and recreational fishery performance based on harvest levels, and work with jurisdictions to establish tributary-specific harvest targets
- Explore development of tributary-specific indicators and/or invasive catfish "report card"
- Recommend changes to the management strategy and advise jurisdictions on fishery management plans to better achieve the desired outcome as new science and information become available.

Appendix I

Table 1. A stoplight analysis of jurisdiction plans to implement approaches outlined in this management strategy. Each jurisdiction was asked to fill out their respective column with the appropriate color corresponding to their intentions. **Green** indicates that the jurisdiction is actively working on or planning to implement an approach in the near future. **Yellow** indicates that the jurisdiction is interested in implementing the approach, but not likely in the near future and may even require additional resources (but it's feasible). **Red** indicates that the jurisdiction does not support the approach and will not attempt to implement it, OR it is highly unlikely that sufficient resources will be available in the foreseeable future. An **X** indicates that the jurisdiction believes the action will require additional coordination and support from the Invasive Catfish Workgroup.

		DNREC	DOEE	MDNR	PFBC	PRFC	VDGIF	VMRC
Outreach and Marketing Campaigns	Print/Journalism		TBD				X	
	Social Media		TBD				X	
	Outreach Events		TBD				X	
	Signage		TBD					
	Common Branding		TBD	X				
	International Trade		TBD					
Remove Processing Barriers	Communicate w/ state/federal gov officials		TBD	X				
	Economic impact analysis		TBD					X
Scientific Research	Scorecard indicator		TBD			?		
	Ecosystem modeling of ecological impacts		TBD	X	X			
	Economic assessment of optimal removal and allocation		TBD					X
Tributary-Specific Management	Develop a management plan		TBD			X		
	Consider tributaries individually		TBD	X				
	Angler interest survey or assessment		TBD	X		X		
	Ecosystem model aplication		TBD		X			X

Table 2. Guiding questions developed to clarify the meaning of each management approach presented in the stoplight analysis.

Outreach and Marketing Campaigns	Print/Journalism	Will the jurisdiction develop print or online news articles, brochures, etc. to inform the public about invasive catfish issues (ecological impacts, consumption advisories, etc.)?
	Social Media	Will the jurisdiction create and/or share social media posts to spread awareness about invasive catfish issues in the Bay?
	Outreach Events	Will the jurisdiction coordinate and/or attend public events (seafood festivals, expos, conferences, tournaments, etc.) to spread awareness about invasive catfish issues in the Bay?
	Signage	Will the jurisdiction place signage at public access points to inform the public about invasive catfish presence, consumption, handling, etc.?
	Common Branding	Is the jurisdiction interested in developing/implementing a common brand for catfish in the Bay (e.g. wild-caught Chesapeake Bay blue catfish) in coordination with other relevant groups?
	International Trade	Is the jurisdiction interested in examining the potential to develop an international market for Chesapeake Bay blue and/or flathead catfish in coordination with other relevant groups?
Remove Processing Barriers	Communicate w/ state/federal gov officials	Will the jurisdiction communicate with state and/or federal government officials in an effort to create flexibility for invasive species in the USDA inspection requirements?
	Economic impact analysis	Will the jurisdiction conduct an economic impact analysis of the USDA inspection requirements on the fishery? Would the jurisdiction use this information to support arguments for an invasive species exemption?
Scientific Research	Scorecard indicator	Would the jurisdiction develop or use a scorecard indicator of invasive catfish status/risk as a communication and/or management tool?
	Ecosystem modeling of ecological impacts	Is the jurisdiction interested in developing or using an ecosystem model to examine tributary-specific ecological impacts of invasive catfish on native species?
	Economic assessment of optimal removal and allocation	Is the jurisdiction interested in developing or using an ecosystem model to examine tributary-specific tradeoffs of commercial and recreational harvest?
Tributary-Specific Management	Develop a management plan	Will the jurisdiction develop a management plan for invasive catfishes? Or include catfishes in an invasive species management plan?
	Consider tributaries individually	Will the jurisdiction consider each tributary as an individual population and tailor the management strategy to fit the needs of each tributary as appropriate?
	Angler interest survey or assessment	Will the jurisdiction conduct an angler interest survey or fishery assessment to determine the primary motivations for catfishing in each tributary/region (i.e. commercial, trophy, subsistence, general angling)? If yes, will these data be used to inform tributary management objectives?
	Ecosystem model aplication	Is the jurisdiction interested in developing or using an ecosystem model to determine tributary-specific economic and ecological tradeoffs of invasive catfish removals to determine optimal removal targets for individual tributaries?

Table 3. Additional comments about the stoplight analysis provided by each jurisdiction.

	Comments
DNREC	N/A
DOEE	TBD
MDNR	Consensus among managers is to promote harvest and use of blue catfish as a new resource in the Bay while also regarding it as an invasive species. Managing the resource may include tributary-specific population metrics or ecosystem-based metrics, but these data are not currently collected and will require significant financial and staffing resources. Ongoing monitoring data or specific studies might inform a scorecard risk assessment per river, but these data are not currently comprehensive throughout the Bay and appropriate widespread monitoring is not possible without additional financial and staffing resources. However, if scorecards were available, then they should be used as part of outreach. Note, though invasive catfishes are considered a risk to the Bay ecosystem, in general, it may not be appropriate to assess risk of each particular river. It is not desired to invest financially into a comprehensive management strategy that maximizes harvest for recreational and commercial harvest and provide a trophy fishery. We placed x-marks for actions where regional or interstate coordination would improve the outcome, but these actions do not require regional or interstate coordination.
PFBC	Red values do not necessarily note that we would not support efforts, more that commercial fisheries do not exist in PA and so communication is a moot point or we don't have bay-specific jurisdiction. We are on board with most of the tributary-specific aspects (since we don't have bay "frontage"). We are still in data gathering mode so still aquiring data to inform most questions.
PRFC	PRFC Commissioners have discussed the concept of developing a managemnt plan for invasive catfish for PRFC jurisdictional waters. While not opposed in principle, it was determined that staff do not have sufficeint time and resources to engage in such an effort and it might be prudent to wait to see the outcome of MD's efforts on an ICMP.
VDGIF	Some concern about broad nature of Outreach items. Support science based management that considers importance and impact of recreational fishery. Operate within the bounds of our jurisdiction (i.e. seafood festivals).
VMRC	Would like to see a regional approach in developing a management plan. Three jurisdictions have an interest in VA catfish management (VMRC, DWR - formerly DGIF, and PRFC). Any activities, policies, and management should be a cooperative effort between the three.