Fishery Management Plan
for
Tidewater Catfish (December 2021)

Prepared by
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Executive Summary

Catfish thriving in the Chesapeake Bay watershed support popular recreational and commercial fisheries. Given increasing environmental threats including invasive species, strategies to monitor and manage catfish populations are needed in Maryland's tidewater. Catfish in tidal freshwater areas of Maryland include native catfish, non-native but non-invasive catfish, and invasive catfish. A regional Invasive Catfish Management Strategy to address invasive catfish was adopted by the Chesapeake Bay Program in 2020. Actions related to mitigation and research identified in the strategy are also incorporated into this statewide management plan. The goal of Maryland's Catfish Fishery Management Plan is to maintain the ecological integrity of Chesapeake Bay ecosystems, ensure recreational and commercial harvests that support fishing and seafood industries, ensure sustainability of native and non-native, non-invasive catfish populations, and deplete invasive catfish populations. Additionally, this plan provides background information on the occurrence and natural histories of catfish inhabiting tidewater in Maryland's Chesapeake Bay, describes current recreational and commercial fisheries for catfish, and identifies existing data sources and gaps for monitoring populations of catfish.

The objectives of this plan are to:

1. Develop scientifically defensible data streams that can be used to assess management strategies for four native and non-native, non-invasive catfish species as well as two invasive catfish species occurring in targeted rivers of Maryland's Chesapeake Bay.
2. Promote fishing for tidal populations of catfish in the Chesapeake Bay using available tools for disseminating information.
3. Create a framework for routinely soliciting public input when reviewing progress toward the goal of this plan.
4. Implement adaptive management strategies that are compatible with the management objectives of this plan and are periodically reviewed to ensure their effectiveness at achieving the goal of this plan.

The objectives of the plan will be achieved by numerous actions prioritized by the Maryland Department of Natural Resources and other stakeholders in the fishing industry. Strategic actions to be implemented are detailed in a table and reviewed periodically to assess progress. Successful execution of this fishery management plan will be achieved by completing strategic actions that yield productive and profitable recreational and commercial catfish fisheries while keeping invasive catfish populations suppressed.

Terms and Definitions

Invasive Species and Aquatic Nuisance Species: Considered synonymous terms for this plan, these are non-native species whose introduction causes, or is likely to cause, economic or environmental harm or harm to human, animal, or plant health (Executive Order 13112).

Fishery Management: The integrated process of information gathering, analysis, planning, consultation, decision-making, allocation of resources and formulation and implementation, with enforcement as necessary, of regulations or rules which govern fisheries activities in order to ensure the continued productivity of the resources and the accomplishment of other fisheries objectives (Food and Agriculture Organization, Cochrane 2002).

Native Species: An animal or plant indigenous to a place, such as those that occurred pre-colonially or occurs in a particular ecosystem other than as a result of introduction.

Naturalized: Any species of fish which, though not indigenous to Maryland, has acclimated, or adapted to life in Maryland's waters so that the species has been documented as having lived, grown, and reproduced in Maryland for more than 10 years.

Non-native: Originating in or characteristic of a region other than the one in question.

Tidewater (Tidal): An area of water that is affected by tides.

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Section 1. Goal of Management Plan

The goal of Maryland's Catfish Fishery Management Plan is to maintain the ecological integrity of Chesapeake Bay ecosystems, ensure recreational and commercial harvests that support fishing and seafood industries, ensure sustainability of native and non-native, non-invasive catfish populations, and deplete invasive catfish populations.

Section 2. Purpose of Management Plan

1. Protect fishing opportunities for a traditional, wild-caught food source for Marylanders;
2. Generate data streams and population metrics for ensuring conservation of native and non-native, non-invasive catfish species;
3. Provide management strategies that protect native and non-native, non-invasive catfish populations;
4. Increase recreational and commercial harvest rates of invasive and nuisance catfish via promotion, removal of hindrance regulations, producing innovative methods of capture, and expanding incentives for harvest;
5. Minimize negative ecological impacts caused by invasive catfish by prioritizing control of those species;
6. Support and build Maryland's traditional fishing economy;
7. Grow new seafood export opportunities for fisheries in Maryland.

Section 3. Objectives of Management Plan

1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species occurring in targeted rivers of Maryland's Chesapeake Bay.
2. Promote fishing for tidal populations of catfish in the Chesapeake Bay using available tools for disseminating information.
3. Create a framework for routinely soliciting public input when reviewing progress toward the goal of this plan.
4. Implement adaptive management strategies that are compatible with the management objectives of this plan and are periodically reviewed to ensure their effectiveness at achieving the goal of this plan.

Section 4. Introduction

Section 4.1. Species

Catfish in the Chesapeake Bay watershed are animals belonging to the Vertebrata and Actinopterygii, or ray-finned fishes. They have been further classified in the Order Siluriformes. Two families of Siluriformes occur in North America, the Ictaluridae and the Ariidae. Of these, only the Ictaluridae are common and year-round residents in Maryland waters; therefore, they are the focus of this fishery management plan. Genetic work to describe relationships among the Ictaluridae has been accomplished by Arce et al. (2016). While clinal variation in population traits existed for widespread ictalurids, extensive introductions have muddied the genetic patterns.

The Ictaluridae have been grouped by common name into catfish, bullheads, madtoms, stonecats, and blindcats. All of these species lack scales, possess an adipose fin, possess three sharp stiff spines at the forward end of dorsal and each pectoral fin, and possess eight distinct barbels with taste buds; one long barbel from each corner of the mouth, a shorter pair near the nostrils, and four under the chin. In most ictalurid catfish, the integumentary sheaths that cover the spines have cells that produce toxins, which constitute a non-lethal and mild venom that can cause redness and mild pain if it penetrates human skin. The most virulent stings from spines, similar to bee stings, are credited to madtoms (Birkhead 1972).

There are 24 species of Ictaluridae in the United States and Canada. It is the largest freshwater family of fishes entirely indigenous to North America. The tidewater of the Chesapeake Bay watershed contains four genera and eight species of catfish, two of which are considered invasive species. A regional Invasive Catfish Management Strategy to specifically address invasive catfish was adopted by the Chesapeake Bay Program in 2020. The species of Ictaluridae in the Chesapeake Bay include: white catfish (*Ameiurus catus* Linnaeus 1758), brown bullhead (*Ameiurus nebulosus* Lesueur 1819), yellow bullhead (*Ameiurus natalis* Lesueur 1819), channel catfish (*Ictalurus punctatus* Rafinesque 1818), margined madtom (*Noturus insignis* Richardson 1836), tadpole madtom (*Noturus gyrinus* Mitchill 1817), blue catfish (invasive)(*Ictalurus furcatus* Lesueur 1840), and flathead catfish (invasive)(*Pylodictis olivaris* Rafinesque 1818).

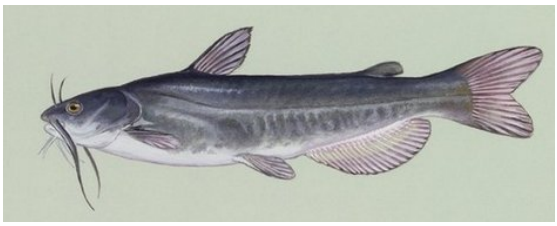
Genera can be distinguished generally by morphology of fins and tooth patches. The *Ictalurus* or large catfish have deeply forked caudal fins whereas other catfish tend to have truncated or only slightly emarginate caudal fins. The members of *Ameiurus* can be distinguished from *Ictalurus* by its lack of a deeply forked caudal fin. Only the genus *Noturus* has an adipose fin that is fused (though sometimes notched) with the caudal fin. The genus *Pylodictis* is distinguished by its flat or depressed head, but also the lateral posterior extensions of its premaxillary band of teeth.

Section 4.1.1. Native or Non-native, Non-invasive

Yellow Bullhead (*Ameiurus natalis*)

Brown Bullhead (*Ameiurus nebulosus*)

White Catfish (*Ameiurus catus*)



Tadpole Madtom (*Noturus gyrinus*)

Margined Madtom (*Noturus insignis*)

Channel Catfish (*Ictalurus punctatus*)

Section 4.1.2. Invasive

Blue Catfish (*Ictalurus furcatus*)

Flathead Catfish (*Pylodictis olivaris*)

Section 4.2. Range and Distribution

Species of Ictaluridae are natively distributed from the Rocky Mountains in North America and eastward, extending south into Mexico, northern Guatemala and Belize, and northward into Canada. None of the Ictaluridae are native to the Pacific slopes north of Mexico. Species were introduced west of the Rocky Mountains in the 1800s and have become abundant in California.

Catfish are generally considered to be nocturnal and occupy submerged crevices, logs, or woody material, and/or deep pools during the day and swim into shallow waters for feeding at night. Catfish have adapted to forage in poor visibility, such as at night. Their taste buds are spread among the barbels and over most of their body. Catfish also use chemical senses much more than sight to find prey. Their sense of smell is so acute, in fact, some catfish recognize each other via chemical cues in their slime (Todd 1968; Atema et al. 1969). The chemical cues and communication system has resulted in a complex social structure including pecking orders for bullheads (Todd 1971).

Most catfish are warmwater fishes. Catfish can tolerate warmwater temperatures, up to 35.3 degrees Celsius (95.5 degrees Fahrenheit)(for white catfish), but preferences for different habitat conditions vary among species. Catfish generally occupy sluggish rivers, creeks, ponds, and lakes. However, some catfish, such as flathead catfish and stonecats, can occupy cooler rivers and coexist with trout species (*Salmoniformes*) in clear, rock-bottomed streams of higher elevations and/or latitudes. Several species of catfish tolerate various degrees of pollution and oxygen depletion. Suitable dissolved oxygen levels for reproduction is 5 parts per million, but catfish can tolerate lower levels. Lethal dissolved oxygen concentrations for channel catfish were observed between 0.8 parts per million and 1.0 parts per million, depending on water temperature (25 degrees Celsius (77 degrees Fahrenheit) to 35 degrees Celsius)(95 degrees Fahrenheit)(Kendall and Schwartz 1968; Jones et al. 1978).

Ictaluridae is a family of freshwater catfish, not known to spawn in brackish water, though some do thrive in brackish estuaries and tidal rivers. No ictalurids are anadromous, so their life cycles are largely confined to freshwater or estuaries. Catfish of the Chesapeake Bay are euryhaline and tolerant of a wide range of salinities (0 parts per thousand to 15 parts per thousand). Both channel catfish and blue catfish can notably inhabit streams when salinities are greater than 10 parts per thousand (Lippson et al. 1979; Jenkins and Burkhead 1994). Other species of catfish, such as flathead catfish and brown bullhead, are not commonly found in habitats with such high levels of salinity.

Section 4.2.1. Native or Non-native, Non-invasive

<u>Yellow Bullhead</u>
Yellow bullheads are endemic to the eastern and central United States. Yellow bullheads can be found in all major rivers of the Chesapeake Bay, particularly in shallow, vegetated, slow-flowing streams, but also ponds and lakes, backwaters, and sluggish current habitats. The availability of submerged vegetation is an important predictor of distribution and abundance of yellow bullhead (Trautman 1981). The species is rarely found when salinities exceed 5 parts per thousand and is

not a common estuarine resident (Jenkins and Burkhead 1994). The species is, however, tolerant of high acidity habitats such as cypress swamps (Jenkins and Burkhead 1993).

Brown Bullhead

Brown bullheads are native throughout the eastern United States and southern Canada. They can also be found in some western drainages of California because of human introductions. Brown bullheads are found in all major rivers of the Chesapeake Bay, as well as in freshwater ponds and lakes of the Chesapeake Bay watershed, particularly freshwater marshes and streams that can range between shallow and silty, to deep and clear. Because the species tolerates greater salinities (up to 20 parts per thousand), it is more widely encountered than yellow bullhead in tidewater. The species also tolerates low dissolved oxygen, water temperatures up to 31.6 degrees Celsius (89.0 degrees Fahrenheit), and domestic and industrial pollution (Page and Burr 2011).

White Catfish

White catfish are native to the Atlantic coastal states from Florida to New York, including the Chesapeake Bay watershed. In the Chesapeake Bay, the species is commonly collected in brackish waters ranging between 5 parts per thousand and 16 parts per thousand, but also freshwater. The species is not commonly found in densely vegetated areas, but like other bullheads, is found in slow-moving streams, major rivers, river backwaters, reservoirs, and ponds. Additionally, like brown bullhead, white catfish live over silty bottoms and prefer slow moving water (Trautman 1981).

Tadpole Madtom

Tadpole madtoms are distributed along the gulf slope from Texas to Florida, along the Atlantic coastal plain to New York, and throughout the Mississippi and Missouri River valleys. They have been introduced to some locations but remain noticeably absent from the Appalachian highland from Alabama to New York. In Maryland the species can be found in the coastal plains of Chesapeake Bay watershed and is common in backwaters of creeks and rivers, ponds, oxbows and sloughs (Douglas 1974).

Margined Madtom

Margined madtoms are distributed from southeastern Lake Ontario and south on the Atlantic slope from New York to Georgia. The species has been introduced in New Hampshire and Michigan. In Maryland, the species can be found throughout the piedmont and upper Chesapeake Bay, as well as in streams of western Maryland in the Appalachian mountain range.

Channel Catfish

Channel catfish are native to the Mississippi and Gulf Coast drainages of the United States and southern Canada and were introduced to the Chesapeake Bay. The species was extensively introduced along the Atlantic coast and elsewhere and now occurs throughout much of the United States and northern Mexico, though the species is limited west of the Rocky Mountains. The species has been collected in freshwater and brackish water up to 18 parts per thousand, and commonly in waters with salinities greater than 5 parts per thousand. The species is found in lakes and ponds, but more commonly in streams and rivers of the Chesapeake Bay. Juveniles live

in shallow water whereas adults tend to occupy deep water areas with submerged structure, such as logs or other cover, and possibly over sand or gravel bottoms (Sternberg 1987).

Section 4.2.2. Invasive

Blue Catfish

Blue catfish, native to the Mississippi, Ohio, and Missouri Rivers, were introduced to Virginia waters in the 1970s. Adults successfully reproduced and spread into Maryland's portion of the Chesapeake Bay watershed. The species thrives in both fresh and brackish water (less than 12 parts per thousand), principally living in major river channels and backwaters of large rivers of Maryland (Figure 1). Blue catfish prefer clear, swift water with firm bottoms in their native range (Sternberg 1987; Etnier and Starnes 1993). The species can be found in deep channels of several major rivers of the Chesapeake Bay, including ones with silted bottoms. During winter, individuals retreat to deeper water and during spring, move into sloughs and backwaters (Jenkins and Burkhead 1994).

Flathead Catfish

Flathead catfish were originally distributed from large rivers of the Mississippi, Missouri, and Ohio River basins, and south into Mexico. The species is not commonly introduced outside of its native range, but has been introduced into Virginia and Pennsylvania waters, from where the species has spread into Maryland's portion of Chesapeake Bay. In Maryland's major rivers of the Chesapeake Bay, flathead catfish are abundant in freshwater sections of the two largest freshwater ranges of the Bay - the Susquehanna River and the non-tidal reaches of the Potomac River (Figure 1). They occupy deep pools and channels of the major rivers, which may be either clear or turbid water. Typically, fish live over hard substrate and may be associated with submerged structure, such as logs or channel ledges; juveniles are often found in riffles of rivers and frequently under rocks.

Section 4.3. Life History

Section 4.3.1. Native or Non-native, Non-invasive

Yellow Bullhead

Yellow bullheads (*Ameiurus natalis* Lesueur 1819) are warmwater, omnivorous fish that feed on macroinvertebrates and fishes. Sexual maturity is reached at age two and fish live approximately six years (maximum length = 600 millimeters (23.6 inches); maximum weight = 1.9 kilograms (4.2 pounds)). The spawning season lasts from spring to mid-summer and April to June in Virginia (Jenkins and Burkhead 1993). Adults build shallow, circular nests that may be associated with submerged structure, or may occur in slow-moving water with open spaces. Males maintain and guard nests and eggs.

Brown Bullhead

Brown Bullheads (*Ameiurus nebulosus* Lesueur 1819) are warmwater, omnivorous fish with young that consume macroinvertebrates and adults that consume algae, invertebrates, and fish. Sexual maturity is reached at age 3 and fish live approximately nine years (maximum length =

550 millimeters (21.6 inches); maximum weight = 2.7 kilograms (5.9 pounds)). The spawning season extends from April into late summer in southerly states when water temperatures reportedly range between 14 and 29 degrees (57.2 and 84.2 degrees Fahrenheit)(Jenkins and Burkhead 1993). Nests are built by one or both parents by clearing the substrate of silt under logs and in wooden cavities, and in some cases, pollution such as aluminum cans. Once eggs are released to the nest, one or both parents may maintain and guard the eggs. Approximately 1500-2600 mature ova can be spawned in a single clutch, resulting in broods of approximately 600-700 (Jenkins and Burkhead 1993).

White Catfish

White catfish (*Ameiurus catus*) exhibit in-system spawning migrations to fresh or near-fresh waters in rivers or larger tributaries. Spawning begins when water temperatures approach 25 degrees Celsius (77 degrees Fahrenheit). In the Chesapeake Bay region, this generally corresponds to a mid-May through June spawning season. Males excavate nests in depressions over gravel or silted channel edges. Fecundity estimates can range from 1,000 to 3,000 eggs per female. Either parent guards the nest with males clearing the eggs of silt by fin-fanning or collecting the eggs in their mouth and expelling them back into the nest. White catfish egg diameters range from four to five millimeters (0.1 – 0.2 inches) and are demersal, double walled, gelatinous and slightly adhesive. Incubation occurs in two to five days. Yolk sac larvae are approximately 9 millimeters (0.3 inches) at hatching. The pre-juvenile stage lasts for approximately 2.5 months. All fin rays, fin folds and pigmentation are developed by 25 millimeters (1 inch) total length (Mansuetti and Hardy 1967). Pre-juvenile white catfish remain in aggregations until they reach the juvenile stage when they disperse.

Tadpole Madtom

Tadpole madtoms (*Noturus gyrinus* Mitchill 1817) and the margined madtoms (*Noturus insignis* Richardson 1836) (see below) occur in different regions of the tidal Chesapeake Bay watershed, but have similar appearances and natural histories (Rhode et al. 1994). Tadpole madtoms consume dipteran larvae and isopods throughout their life, which usually lasts up to three years. Sexual maturity can be reached within the first year, but mostly by the second (Whiteside and Burr 1986). They can be distinguished physically. Tadpole madtoms range in size between one and five inches with a chubby, uniformly colored body, though there is a faint dark line along the side.

Margined Madtom

Margined madtoms (*Noturus insignis* Richardson 1836) range between 50 and 150 millimeters (2 – 6 inches) and the body is uniformly yellow or gray with a well-defined black edge on the median fins. Madtoms feed on small crustaceans, insects, and small fishes. They spawn from May to August when clumps of eggs are deposited in shelters, such as the streambed, below boulders or rocks, below boards or in artificial structures, such as tin cans. One of the parents guards the eggs. The number of eggs produced by a female margined madtom was observed to be 107, but the number varies with size of the fish. Growth rates were reported to be 57.2 millimeters (2.2 inches) by the end of the first year and most species of madtom can reach sexual maturity in their first year. They rarely live longer than four years.

Channel Catfish

Channel catfish (*Ictalurus punctatus)* live in different warmwater habitats. Adult channel catfish may be found in large rivers or medium-sized streams or impoundments, and are routinely stocked in ponds of various sizes. Adults can tolerate moderate salinity levels. Although channel catfish tolerate salinity concentrations of 11 parts per thousand for extended periods, successful reproduction can only occur below 8 practical salinity units and maximum salinity for larvae is less than 9 parts per thousand. Seasonal migration is common in channel catfish populations where summer home ranges are established with a general downstream fall migration. Channel catfish over-winter in deeper pools. The spawning migration pattern is similar to white catfish where an upstream movement to suitable spawning habitat occurs in the spring. Spawning activity includes nest building (excavation of nest depressions in sandy channel edges) by both the male and female. Once fertilization is complete, the male tends and guards the nest. The male also fans the eggs with its fins to reduce siltation. Spawning occurs around 27 degrees Celsius (80.6 degrees Fahrenheit), or generally early June in the Chesapeake Bay region. Fecundity estimates range from 1,000 to 70,000 eggs per female, depending on parent body size. The diameter of the fertilized egg is around 3.5 millimeters (0.1 inches), and hatching occurs in seven to ten days. Yolk sac larvae range from 12 millimeters (0.5 inches) to 15 millimeters (0.6 inches) and yolk resorption occurs three to five days post-hatch. Pre-juvenile channel catfish remain in aggregations until they reach the juvenile stage when they disperse. Developing channel catfish have all fin rays, fin folds and pigmentation by 32 millimeters (1.2 inches) total length and are classified as juveniles (Mansuetti and Hardy 1967).

Section 4.3.2. Invasive

Blue Catfish

Blue catfish (*Ictalurus furcatus*) inhabit deep warmwater impoundments and channels of medium to large rivers. Fish prefer clear, strongly flowing waters and can be found over mud, sand or gravel bottoms during the day, moving into the shallows or upper water column at night to feed. Common prey items include aquatic invertebrates, clams and fishes (Figure 2). In the Chesapeake Bay, studies of prey fishes and invertebrates have shown predation on gizzard shad (*Dorosoma cepedianum*), white perch (*Morone americana*), blue crabs (*Callinectes sapidus*) and clams (*Corbicula fluminea*). Reproduction occurs during late spring and early summer. Females deposit eggs under logs, brush or riverbanks of pools or backwaters in nests built by males. It is the largest catfish species in North America and lives up to 20 years (1650 millimeters (65 inches), 68 kilograms (150 pounds)).

Flathead Catfish

Flathead catfish (*Pylodictus olivaris*) live in freshwater (up to salinity of 5) pools with logs and woody debris in low-gradient to moderate-gradient, small to large rivers, lakes, and impoundments. Adults prey upon crayfish, clams, and fishes. In the Chesapeake Bay watershed, adults specifically consume American shad (*Alosa sapidissima*) and other alosids, gizzard shad, white perch, and American eel (*Anguilla rostrata*). Reproduction occurs in rocky and sandy runs and riffles in June and July by males building and defending nests near submerged woody materials. Sexual maturity is reached between ages 3 and 5 (400 millimeters (16 inches) to 600 millimeters (24 inches)(Grabowski et al. 2004). An adult can grow up to 1550 millimeters (61

inches) and 56 kilograms (123.4 pounds) making it the second largest catfish species in North America.

Section 4.4. Habitat

In the Chesapeake Bay watershed, catfish are found primarily in freshwater, though some species (e.g., blue catfish) can be caught in brackish waters. Spawning is generally limited to freshwater or water with a salinity of less than 2 practical salinity units (Perry 1973). Both river and lake waters are utilized by catfish and some species live in both. For the purpose of this fishery management plan, only tidally influenced rivers of the Chesapeake Bay watershed will be characterized as inhabited by catfish.

The Chesapeake Bay is the largest estuary in the contiguous United States and is bounded by the Atlantic Ocean. More than 150 major rivers make up the 16,575,924 hectares of the Chesapeake Bay watershed. The bay is a saltwater habitat influenced by freshwater runoff that creates an oligohaline zone in the upper tidally influenced rivers, a mesohaline zone near the mouths of rivers and in the mainstem of the bay, and a polyhaline zone that occurs closer to the mouth of the Chesapeake Bay. The two largest freshwater drainages that dilute the saltwater of the Chesapeake Bay include the Susquehanna River to the north and the Potomac River to the west of the mainstem. They reach into the neighboring states of the Mid-Atlantic Region, including Virginia, West Virginia, Pennsylvania, New York, and the District of Columbia. Some major rivers of the eastern side of Chesapeake Bay are shared with Delaware. The Mid-Atlantic states share jurisdiction of the Chesapeake Bay watershed and often jointly manage its resources. One example is with blue catfish, whose management is guided by the Chesapeake Bay Program's Invasive Catfish Management Strategy that was developed by multiple agencies within the Mid-Atlantic region.

Catfish of the Chesapeake Bay watershed can be found in larger river systems or small tidal creeks, depending on genus or specific preferences, age-specific preferences, seasonal changes in water temperature, and diurnal changes in light. Species of the genus *Ictalurus* (blue catfish, channel catfish) tend to be large-river species, and are abundant in deep swift channels, as well as sloughs and backwaters in spring. The *Amerius* catfish, on the other hand, may be more common in slower moving water year-round. The margined madtom of the genus *Noturus* prefers slower moving waters and sloughs. Catfish move seasonally along the river gradient in response to changing water temperature. Blue catfish exhibit seasonal movements within large rivers and move greater distances during the pre-spawning or spawning seasons and into the summer (Garrett 2010). Such movements can be associated with different habitat types. Flathead catfish use submerged structure during the spring, but pools during the fall, resulting in large-scale, spatiotemporal movements between these seasons, as well as restricted movement during winter or summer (Daugherty and Sutton 2004).

At smaller temporal scales, catfish may also occupy different spatial habitats. Submerged structure is preferred during daylight by some catfish. Margined madtom, for example, is found near substrates and under cover during daylight, but in open water streams at night (Jenkins and Burkhead 1994). Structure can include many types of hardened materials, such as woody logs or

root wads, small or large boulders, deep water boat docks and marinas, and concrete debris. Both submerged structure and deep water habitat afford protection from sight-feeding predators during daylight hours (Allouche 2002) and protect nests during the spawning season. Blue catfish can leave deepwater bottom habitats at night and swim into the water column, presumably chasing prey, in the rivers of the Chesapeake Bay.

Large and small spatiotemporal patterns of habitat association can differ for an individual catfish as it ages. Young flathead catfish tend to prefer stream riffles throughout the day and night, while older and larger fish prefer moderate to deep pools during the day and move to shallow riffles at night for foraging (Trautman 1981). This suggests that larger and older fish move greater distances diurnally than smaller and younger ones.

Section 4.5. Description of Fisheries

Maryland's portion of the Chesapeake Bay and its tidal tributaries (hereafter, Chesapeake Bay) provide an extensive recreational and commercial catfish fishery. Native bullhead and white catfish, naturalized channel catfish, and invasive blue and flathead catfish offer anglers numerous harvest and trophy fishing opportunities in Chesapeake Bay. Currently there are no creel or length restrictions on any catfish species in Maryland's tidal basin of Chesapeake Bay.

Catfish are the fifth most popular target by recreational anglers according to the Maryland National Creel Census in 2011, with approximately 46,000 (20 percent) of all resident and nonresident anglers spending 731,000 days fishing for them (U.S. Fish and Wildlife Service 2014). In a 1990 creel survey, catfish had the second highest harvest rate behind white perch. It was second only to largemouth bass as the most sought-after fish (MDDNR 1991). Although many historical records grouped all catfish species together, channel catfish were the primary fish targeted by most catfish anglers. Results from a 2017 Maryland tidal creel survey indicated that blue and channel catfish, combined, were second to largemouth bass as the most targeted species in the tidal Potomac River and upper Chesapeake Bay. Results from the 2017 creel survey also indicated that the growth of the blue catfish population in the Potomac River and upper Chesapeake Bay has resulted in a 10-fold increase in harvest rates of catfish since the 1997 creel survey. There has also been a 10-fold increase in the number of guides reporting catfish harvest in the Chesapeake Bay going from four in 2000 to now 40. Harvest rates for recreational anglers ranged from 29.6 percent in the upper bay to 53.4 percent in the Potomac River in 2017 (unpublished data, Maryland Department of Natural Resources).

The commercial catfish fishery is an important fishery in Maryland, with 861,825 kilograms (950 U.S. tons) of catfish landed from Chesapeake Bay in 2018. Commercial fishermen harvest catfish primarily with five different gear. Haul seines and finfish trotlines are predominately utilized in the blue catfish fishery, whereas pound nets, fyke nets, and fish pots harvest the bulk of the other catfish species. Pound nets and fyke nets are opportunistic, multi-species fishing gear that entrap various marketable fishes. Fish pots are cylindrical hoop nets that are usually rigged in a series of several fish pots attached to a single line. These nets are baited with clams or various meal bags and specifically target catfish species. Five catfish species are commercially harvested in Maryland's tidewater.

Table 1. Proportion of catfish species accounting for all catfish landings.

	Channel Catfish	Blue Catfish	White Catfish	Brown Bullhead	Flathead Catfish
2014 - 2018	84.1 percent	13.4 percent	0.7 percent	1.7 percent	0.1 percent
2011 - 2013	89.3 percent	7.4 percent	2.0 percent	0.1 percent	1.0 percent

Section 4.5.1. Native or Non-native, Non-invasive

Yellow Bullhead and Brown Bullhead

Yellow and brown bullheads can be found throughout the Chesapeake Bay. However, brown bullhead tends to be more abundant because they can tolerate greater salinities, up to 20 parts per thousand, than yellow bullhead can tolerate (Murdy et al. 1997). Limited catch data exists to properly quantify the recreational fishery status of bullheads (Murdy et al. 1997). However, a creel survey conducted on the Susquehanna River documented a total harvest estimate of 3,724 brown bullheads in 1980 (Weinrich et al. 1981). More recently, a creel survey on the tidal Potomac River by the Virginia Department of Game and Inland Fisheries reported a total catch of only 16 brown bullheads, which made up less than one tenth of one percent of the total catch. No bullheads were reportedly harvested during the survey. Maximum size for bullhead is around 500 millimeters (19.6 inches)(brown bullhead) and 600 millimeters (23.6 inches)(yellow bullhead), but the typical size is less than 300 millimeters (11.8 inches)(Murdy et al. 1997). The current state record for Maryland is 2.2 kilograms (4.8 pounds) caught in the Big Gunpowder River. Bullheads can be easily caught using worms, chicken livers, cut bait, artificial, or live fish in slow moving pools and backwater areas.

Bullheads are reported in commercial catfish landings, but generically as “other catfish” and possibly comprise a by-catch fishery (Sauls et al. 1998). Brown bullheads are captured as a by-catch, but local market demand can at times provide for directed fisheries at smaller scales. Peak landings of “other catfish” occurred in 1997 (71,617 kilograms (78.9 U.S. tons)) and averaged 14,107 kilograms (15.5 U.S. tons), 1987 to 2018. The brown bullhead commercial harvest fishery occurs mostly in spring. Fish pot harvest accounted for 89 percent of the harvest, 2009 to 2018.

White Catfish

White catfish caught during recreational fishing could approach 600 millimeters (23.6 inches) but the typical size is around 300 or 330 millimeters (11.8 or 13.0 inches)(Murdy et al. 1997), or approximately 0.25 kilograms (0.5 pounds) (Schwartz and Jachowski 1965). The state record was caught in the Elk River and is currently 4.3 kilograms (9.5 pounds)(2018). White catfish can be caught with hook-and-line using similar methods as bullheads, and are commonly found in streams, rivers, and estuarine waters with salinities ranging from 5 and 16 parts per thousand (Murdy et al. 1997).

The species is commercially harvested, though it is a least preferred target because its large head presents difficulty during processing. White catfish are caught commercially using fish pots, fyke nets, pound nets, haul seines, gill nets, and hook and line. Reporting of white catfish in commercial landings was made mandatory in 1996. Peak annual landings occurred in 2014 at 52,262 kilograms (45.6 U.S. tons) and landings averaged 25,163 kilograms (27.7 U.S. tons) per year (1996 - 2018). Since 2000, white catfish have comprised approximately ten percent of total catfish landings by weight. The commercial landings have declined precipitously since 2015 and were below 45 kilograms (99.2 pounds) in 2018. The commercial fishery for white catfish occurs mainly during spring. White catfish Landings from March through June accounted for 62 percent of the landings, and the period September through November accounted for just 27 percent of the total landings. White catfish were mostly harvested from pound nets (57 percent) over a ten-year period (2009 – 2018) and followed by fyke nets (42 percent). The previous ten-year period had fyke nets (52 percent) as the predominant gear followed by pound nets (34 percent) and fish pots (12 percent).

Tadpole Madtom and Margined Madtom

Madtoms are not targets of recreational or commercial fisheries. Madtoms are pursued locally for bait by recreational anglers to catch other river species.

Channel Catfish

Nonnative channel catfish were introduced to the Potomac River from 1889 to 1905 by the U.S. Fish Commission. By the 1950s, channel catfish could be found throughout the Chesapeake Bay and formed the basis of a major recreational and commercial fishery (Sauls et al. 1998). Prior to the blue catfish introduction, channel catfish were the most popular recreational and commercial fishery but still remain popular today. Considered a freshwater fish in its native range (Mississippi River drainage), channel catfish in the Chesapeake Bay can be found in salinities from five to nine parts per thousand (Murdy et al. 1997). The current state record is 13 kilograms (28.7 pounds) caught in Mattowoman Creek. The Virginia Department of Game and Inland Fisheries 2015 creel survey on the tidal Potomac River documented a total catch of 4,614 and harvest of 961, for a harvest of 20.8 percent. The typical size range for channel catfish is 400 to 600 millimeters (23.6 inches) with a maximum size of just around 800 millimeters (31.5 inches).

Commercial landings for channel catfish peaked in the mid-1980s (Piavis et al. 2010) and since 2011, channel catfish were more than 80 percent of total catfish landings by weight (Figure 3). Landings reached a time series high in 2012 at 1,088,622 kilograms (1200 U.S. tons). However, channel catfish landings have slowly declined since 2015 while blue catfish landings have steadily increased. The 2018 commercial harvest was 635,029 kilograms (700 U.S. tons), which was below the time series average of 680,388 kilograms (750 U.S. tons).

The commercial fishery is fairly seasonal, exhibiting a bi-modal monthly harvest that can be categorized as a spring fishery and fall fishery. Harvest during March-May accounted for 30 percent of the time series landings, and the fall fishery (October - December) accounted for 36 percent of the time series landings. The summer months of July and August had the least harvest of five percent and four percent, respectively. Harvest by gear type remained fairly consistent over the last 20 years. Fish pot harvest accounted for 60 percent of the channel catfish harvest

during 1999 - 2008; pound nets and fyke nets accounted for 22 percent and 15 percent of the channel catfish harvest, respectively. The most recent 10-year period indicated the same, with fish pots accounting for 58 percent of the total harvest and pound nets and fyke nets accounting for 29 percent and 10 percent of the channel catfish harvest, respectively (Figure 4).

Section 4.5.2. Invasive

Blue Catfish

Blue catfish spread rapidly throughout the Chesapeake Bay during the late 1990s and 2000s. Stocked as an additional recreational fish in Virginia rivers by the Virginia Department of Game and Inland Fisheries in the 1970s, blue catfish were later found in the Potomac River. Following the initial discovery of the Potomac River blue catfish population, blue catfish capture and harvest numbers increased rapidly. Their range also increased with blue catfish expanding into the Patuxent River in the mid-2000s.

Catfish are targeted by hand fishing along ledges or under logs, in addition to hook-and-line, because of their affinity for structure during the day. Hand fishing is not as common in the mid-Atlantic region as it is across the native range of blue catfish. Blue catfish adults were prized as a food fish for their large size, and great taste (Murdy et al. 1997). The Virginia Department of Game and Inland Fisheries Potomac River creel survey in 2015 estimated 12,856 blue catfish were caught with 2,641 being harvested, resulting in 20.5 percent harvest. Blue catfish were the second most caught species behind largemouth bass. Because of their large size, anglers also enjoy an opportunity to catch a big fish. Blue catfish in the Potomac River routinely reach weights exceeding 23 kilograms (51 pounds), with the current state record in Maryland at 38 kilograms (84 pounds) caught at Fort Washington.

Commercial blue catfish landings increased from 56,699 kilograms (62.5 U.S. tons) to 107,955 kilograms (119 U.S. tons) annually between 2011 and 2016 in Maryland waters (Figure 5). Reported landings of blue catfish were required beginning in 2011. Landings increased rapidly in 2017 and 2018 to 228,157 kilograms (251.5 U.S. tons) and 219,992 kilograms (242.5 U.S. tons), respectively. Including the mainstem of Potomac River that is managed by the Potomac River Fisheries Commission, the total harvest of blue catfish in 2018 was over 1.3 million kilograms (1433 U.S. tons). The commercial fishery is fairly seasonal, exhibiting a bi-modal monthly harvest that can be categorized as a spring fishery and fall fishery. Harvests between February and April accounted for 45 percent of the time series landings, and the fall fishery (September - November) accounted for 30 percent of the time series landings (Figure 6).

Haul seines account for the majority of blue catfish commercial landings (Figure 7). Haul seines accounted for 73 percent of the landings, followed by finfish trotlines (12 percent). Trotlines have only been a legal commercial gear since March 2017. Commercial finfish trotline regulations were first adopted with a sunset clause on March 27, 2017 under an authority from the General Assembly and have now been adopted without sunset as legal gear. In 2018, haul seines accounted for 60 percent of total blue catfish landings and trotlines accounted for 20 percent of total blue catfish landings. Trotline harvests increased from 22,233 kilograms (24.5 U.S. tons) in 2017 to 48,552 kilograms (53.5 U.S. tons) in 2018.

The Maryland Department of Natural Resources and the Maryland Department of Agriculture's Seafood Marketing Program work together to increase demand for blue catfish by bringing awareness to the quality of the fillet and expanding market opportunities, with the hope to increase harvest rates and control the population. Based on density estimates from Virginia tidewater and recent commercial landings in Maryland, the blue catfish fishery harvest levels are well under levels necessary to effectively reduce the population size.

Flathead Catfish

Flathead catfish were introduced to the Chesapeake Bay Watershed in the 1970s and have since made their way to portions of the tidal rivers in the Chesapeake Bay. Flathead catfish tend to be less tolerant of salinity but are occasionally found in low salinity stretches of tidal rivers. Flathead catfish, as large agile predators, are often targeted by recreational anglers. Live sunfish are the preferred bait among anglers to catch flathead catfish. Like blue catfish, flathead catfish are also sought as food. Flathead catfish can reach lengths up to 1200 to 1300 millimeters (47.2 or 51.2 inches). Flathead catfish fishing tournaments are common where the species is abundant on the non-tidal Potomac River and in some locations of the Susquehanna River. There is currently no state record for flathead catfish in Maryland. Commercial landings for flathead catfish have averaged 12,973 kilograms (14.3 U.S. tons) and ranged from 7,348 kilograms (8.1 U.S. tons) in 2011 to 17,139 kilograms (18.9 U.S. tons) in 2017. Average landings are approximately one percent of total catfish landings. This low percentage could be owed to the relatively low abundance of flathead catfish in Maryland, as well as the inaccessibility of non-tidal habitats to commercial harvest. The majority of the flathead catfish commercial harvest occurred in April and May (50.3 percent). June through September harvest varied between five percent and ten percent of the annual harvest. While commercial harvesters used baited trotlines to catch flathead catfish, fish pots were the only gear accounting for an appreciable amount of flathead catfish landings (96 percent of landings).

Section 4.6. Description of Fishery-Dependent Monitoring

Commercial Harvest

Commercial harvest from Maryland waters is reported in weight to Maryland Department of Natural Resources. Commercial fishermen are required to keep a daily log that documents landings, gear, fishing effort, and location. The daily logs are submitted monthly. Commercial fishermen also have the option to electronically submit their daily fishing activities while still on the water. The mainstem of the Potomac River is managed by the Potomac River Fisheries Commission, which also receives commercial landings reports. Commercial reporting requirements have changed throughout the years to better account for species-specific harvest. Prior to 1987, commercial landings were reported as catfish, which at that time included white catfish, channel catfish, and brown bullhead. Brown bullhead were separated out in 1987 and channel catfish and white catfish were similarly added in 1996. Blue catfish and flathead catfish were added in 2011. Since reporting requirements changed in 2011, channel catfish landings declined from nearly 90 percent to 84 percent, and the proportion of blue catfish rose from 7.4 percent to 13.4 percent. Prior to 2011, commercial landings for blue catfish and flathead catfish were reported in the non-specific catfish category.

Angler Creel Surveys

Several creel surveys report catches and preferred targets of anglers who fish the tidal freshwater of the Chesapeake Bay. Catfish are a highly popular target among these anglers. Maryland Department of Natural Resources conducted creel surveys in the fresh upper Chesapeake Bay (1987; 2017), Choptank River (1988), and Potomac River (1990; 2017). These data are available in the appropriate federal aid reports that are publicly available upon request (e-mail: customerservice.dnr@maryland.gov). The National Survey of Fishing, Hunting, and Wildlife-associated Recreation surveys were sponsored by the U.S. Fish and Wildlife Service in 2006, 2011, and 2016. These surveys report angling efforts directed at particular species in freshwater and saltwater environments for the nation. For 2006 and 2011, specific reports for Maryland are also available. These reports can be downloaded from:

https://www.census.gov/programs-surveys/fhwar/library/publications.html

The National Oceanographic and Atmospheric Administration conducts an Access Point Angler Intercept Survey (APAIS). This in-person intercept survey collects information from anglers as they complete their fishing trips. The survey is conducted at marinas, boat ramps, beaches, fishing piers, and other publicly accessible fishing sites. Trained samplers interview anglers and collect information about the length, weight, and species of fish caught, the number and species of fish released, and information about the fishing trip, including the duration and mode (i.e., shore, private boat, charter boat, or head boat). While these surveys support management of species typically important for interstate commerce, other species such as catfish may also be reported. More information on this survey is located here:

https://www.fisheries.noaa.gov/recreational-fishing-data/types-recreational-fishing-surveys

Angler's Log

Maryland Department of Natural Resources maintains a website and database of photos and reports submitted by anglers who have caught fish. In 2019, there were 372 posted reports by anglers. This is a voluntary submission system whereby anglers report their name, hometown, photos, location information, and any additional content via email to

fishingreports.dnr@maryland.gov

All photos are also made available on Fisheries Service Flickr Page. The Angler's Log can be accessed here:

https://dnr.maryland.gov/fisheries/pages/recreational/anglers_log.aspx

Volunteer Angler Survey

Maryland Department of Natural Resources hosts eight Volunteer Angler Surveys and one of these is the Freshwater Multi-Species Survey. Anglers who are fishing recreationally are encouraged to report their catches using this on-line survey. Data has been collected since 2013 with approximately 100 reports per year. Reporting is incentivized by a raffling of quarterly prizes to participants. Data support management objectives to monitor catch rates for targeted

species. The data also provide some information on species targets and economic investment by anglers. Catfish species such as blue catfish and bullheads are species targets reported by recreational anglers. The Freshwater Multi-Species Survey can be accessed here:

https://dnr.maryland.gov/Fisheries/Pages/survey/index.aspx

Section 4.7. Description of Fishery-Independent Monitoring

Tidal Bass Survey

The Freshwater Fisheries Program's Tidal Bass Survey is managed by the Tidal Bass Program to collect biological data used to manage largemouth bass fisheries in tidewater. As part of this survey, biologists collect information on the presence of other fish species that include catfish. This is a daytime fall survey that operates between September and October in several targeted tidal freshwater areas of rivers within the watershed. Fishes are collected using boat electrofishing as described in the Tidal Bass Survey's Standard Operating Procedure, which is available on-line.

https://dnr.maryland.gov/fisheries/Documents/Tidal_Bass_Survey_SOP.pdf

Approximately 140 shoreline sites are surveyed each year. In addition to the occurrence of catfish species, the Tidal Bass Survey also records data regarding habitat conditions. These habitat conditions include measurements of salinity, water clarity, submerged vegetation, submerged woody materials, and shoreline characteristics.

Striped Bass Seine Survey

The juvenile striped bass survey documents annual year-class success for young-of-the-year striped bass (*Morone saxatilis*) and the relative abundance of many other fish species in the Chesapeake Bay. Over 100 fish species have been collected since 1954. Annual indices of relative abundance provide an early indicator of future adult stock recruitment, and document annual variation and long-term trends in abundance and distribution. Juvenile indices are derived annually from sampling at 22 fixed stations within Maryland's portion of the Chesapeake Bay. Stations have been sampled continuously since 1954, with changes in some station locations. They are divided among four of the major spawning and nursery areas: seven each in the Potomac River and Head of Bay areas and four each in the Nanticoke and Choptank rivers. Sampling is monthly, with rounds (sampling excursions) occurring during July, August, and September. Replicate seine hauls, a minimum of thirty minutes apart, are taken at each site on each sample round. This produces a total of 132 samples from which bay-wide means are calculated. Auxiliary stations have been sampled on an inconsistent basis and are not included in survey indices. The data enhances geographical coverage in rivers with permanent stations or provides information from other river systems. More information for this survey is available at:

https://dnr.maryland.gov/fisheries/Pages/striped-bass/juvenile-index.aspx

Blue Crab Summer Trawl Survey

The Maryland blue crab trawl survey is a department of Natural Resources sampling program conducted from May through October. The trawl survey began in 1977 with data collected from six river systems in Maryland's Chesapeake Bay region. The summer trawl survey produces information on trends in blue crab abundance, carapace width, and weight. Other species such as catfish are also collected and enumerated. Samples are collected once a month, May through October. There are a total of 37 sites in six different river systems - Chester River, Patuxent River, Choptank River, Eastern Bay, Tangier Sound, and Pocomoke Sound. Each of the 37 sites are sampled monthly. In 2002, auxiliary sites in three additional rivers were added. These include eight sites in the Little Choptank River and four sites each in Fishing Bay and the Nanticoke River. A 4.9 meter (16 feet) semi-balloon otter trawl is used for sampling. The net is towed once at each site for six minutes at a speed of three knots. After the sample is removed from the trawl, the crabs are sorted out of the sample and counted.

Striped Bass Spawning Stock Survey

The Striped Bass Program is responsible for monitoring and characterizing Maryland's portion of the Chesapeake Bay's spawning stock of striped bass. Since 1985, biologists at Maryland Department of Natural Resources have been conducting the survey in historic striped bass spawning locations on the Upper Chesapeake Bay and the Potomac River. During the spawning stock survey, multiple fish species are sampled along with striped bass to help assess the health of the bay. Blue catfish was detected in the Potomac River in 1996 and in the upper Chesapeake Bay in 2005. The upper Chesapeake Bay portion of the survey is an integral part of the triennial channel catfish population assessment. The survey is conducted up to six days a week from late March to mid-May. Surveys are conducted using experimental drift gill nets in the Upper Chesapeake Bay and Potomac River. The experimental drift gill nets are a series of differently sized mesh, nylon multifilament panels (3, 3.75, 4.5, 5.25, 6, 6.5, 7, 8, 9, and 10-inch stretch-mesh). Details of the spawning stock survey may be found at:

Striped Bass Spawning Stock Biomass Survey

Upper Bay Winter Trawl Survey

The winter trawl survey was initiated in 2000, and spans sites in the Chesapeake Bay from one mile below Tolchester, Maryland to Turkey Point at the mouth of the Elk River (10 total sites). Three river systems are also surveyed including the Elk River (4 sites), the Sassafras River (3 sites), and the Chester River (6 sites). The winter trawl survey comprises six rounds with all sites sampled in each round. The survey samples these sites from early January through mid-February with a 9.1 meter (29.8 feet) bottom trawl. Prior to 2020, blue catfish catches were minimal, but the 2020 sampling season produced over 2,000 blue catfish of various size-classes. Channel catfish have always been represented in the trawl survey, and annual relative abundance indices are produced for age 1 channel catfish and the full population.

Choptank River Fyke Net Survey

The Choptank River fyke net survey was initiated in 1986. Channel catfish, white catfish and brown bullhead are the target species in this multi-species survey. Six unbaited fyke nets are

fished from mid-February through early April. Fyke nets are fished two or three times per week depending on catch rates. Channel catfish data from the fyke net survey are the main data stream for a triennial Choptank River channel catfish assessment. Relative abundance indices of white catfish and brown bullhead are also available. Utility of the Choptank River fyke net data for assessing blue catfish populations is unresolved.

Atlantic Sturgeon Juvenile Survey

A juvenile trawl survey is conducted in the Marshyhope Creek and the upper Nanticoke River to evaluate successful spawning and larval survival of Atlantic Sturgeon. Ten trips are taken in late fall and early spring to sample once per week. Trawl sampling is conducted in Marshyhope Creek and a large portion of the Nanticoke mainstem in Maryland, as well as the upper Nanticoke in Delaware and its tributaries. A 7.6 meter (24.9 feet) semi-balloon otter trawl is used. It is made with knotless netting in the body and the cod end, which allows for the easy removal of catfish, which is commonly caught as bycatch.

Section 5. Plan Goal

The goal of Maryland's Catfish Fishery Management Plan is to ensure recreational and commercial harvests that support fishing and seafood industries, while also ensuring the sustainability of native and non-native, non-invasive catfish populations, maintaining the ecological integrity of Chesapeake Bay ecosystems, and depleting invasive catfish populations.

Section 6. Management Objectives, Strategies, and Actions

Section 6.1. Management Objectives

1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species occurring in targeted rivers of Maryland's Chesapeake Bay.
2. Promote fishing for tidal populations of catfish in the Chesapeake Bay, using available tools for disseminating information.
3. Create a framework for routinely soliciting public input when reviewing progress toward the goal of this plan.
4. Implement adaptive management strategies that are compatible with the management objectives of this plan, and are periodically reviewed to ensure their effectiveness at achieving the goal of this plan.

Section 6.2. Management Strategies and Actions (*pertains only to invasive catfish)

Objective 1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species occurring in targeted tidal rivers of Maryland's Chesapeake Bay.

Strategy 1.1. Establish data streams from targeted tidal rivers of Maryland's Chesapeake Bay.

Action 1.1.1
Identify existing catfish monitoring programs that monitor trends in abundance of tidal populations of catfish across years, within targeted rivers of Chesapeake Bay. Use existing fishery-independent surveys from tidewater areas (e.g., Atlantic Sturgeon Juvenile Trawl Survey; Tidal Bass Survey; Large River Assessments; Marine Recreational Information Program creel surveys; Virginia Department of Game and Inland Fisheries, Virginia Institute of Marine Science) to archive data more comprehensively on relative abundance and distribution of native or non-native, non-invasive catfish and invasive catfish.

Action 1.1.2
Determine sampling gear with high capture efficiencies for different species of catfish and salinities.

Action 1.1.3
When Maryland Department of Natural Resources determines survey needs, create scientifically defensible, fishery independent standard operating procedures to establish a sampling program that generates indices for measuring trends in abundance of tidal populations of catfish across years, within targeted rivers of Chesapeake Bay.

Action 1.1.4
Ensure accurate annual commercial harvest data for all tidal populations of different species of catfish are reported. Use existing fishery-dependent surveys, such as the Alosine survey which includes commercial and charter boat catches, and the Volunteer Angler Survey, to examine trends in harvest.

Action 1.1.5
Create scientifically valid recreational surveys to document catches, harvest, and assess attitudes toward harvest for tidal populations of different species of catfish. Surveys can include public opinion and consumer surveys, as well as angler intercept surveys to estimate angler effort aimed at the trophy fishery and the harvest fishery.

Action 1.1.6*
Create an annual survey to quantify the number of blue catfish and flathead catfish in targeted areas, and compare densities with long-established populations from Virginia (e.g., tagging study).

Action 1.1.7*
Develop monitoring program to assess predatory and other antagonistic interactions of invasive catfish through analysis of existing data and modeling.

Action 1.1.8*
Track number of blue catfish fish processors and their commercial sales to vendors.

Action 1.1.9*
Track the number of research projects focused on blue catfish and flathead catfish in tidewater.

Strategy 1.2. Use scientifically obtained data to create management strategies for tidal populations of catfish.

Action 1.2.1*
For invasive catfish, generate a research plan that includes management objectives, a review of published studies and empirical and/or theoretical research, and a plan to reduce the number of invasive catfish in targeted locations.

Action 1.2.2*
For invasive catfish, refine existing tools or create tools for disseminating information on the ecological and health value of consuming invasive, wild-caught catfish to the general public, vendors, and/or to watermen who directly sell fish.

Action 1.2.3*
Determine the water bodies at risk of colonization by blue catfish or flathead catfish.

Action 1.2.4
Develop simple population models to determine if levels of harvest are expected to result in recruitment overfishing or changes in size structure.

Action 1.2.5
Identify the conservation needs of native and non-native, non-invasive catfish species.

Action 1.2.6
For native and non-native, non-invasive catfish, implement actions that protect or restore populations.

Strategy 1.3. Use departmental authority to conduct pilot projects to harvest invasive catfish.

Action 1.3.1*
Support development of pilot projects that use new technologies for harvesting invasive catfish.

Action 1.3.2*
Utilize data from pilot projects to achieve objectives of this Plan.

Objective 2. Promote fishing for tidal populations of catfish in the Chesapeake Bay using available tools for disseminating information.

Strategy 2.1. Encourage consumptive and non-consumptive uses of invasive catfish.

Action 2.1.1*
Identify incentives and remove regulatory barriers for harvest and processing of invasive catfish.

Action 2.1.2*
Create invasive catfish derbies or tournaments, or work with existing tournaments.

Action 2.1.3*
Include blue catfish and flathead catfish in public awareness campaigns targeting invasive species, including efforts to prevent new introductions and instead, encourage harvest.

Action 2.1.4*
Conduct collaborative research with partner agencies to identify non-consumptive, ecologically beneficial uses of invasive catfish, such as protein sources for livestock or fertilizer for agriculture.

Action 2.1.5
Create or support the creation of more fish processing plants.

Action 2.1.6*
Use data from surveys of diet preference for invasive catfish to promote ecological consequences of invasive species.

Objective 3. Create a framework for routinely soliciting public input when reviewing progress toward the goal of this plan.

Strategy 3.1. Routinely update management plan with most current available science.

Action 3.1.1
Collate and disseminate science reports and research updates to a list of stakeholders (e.g., biologists, recreational and commercial sectors, non-profit organizations, managers) who agree to meet regularly and agree to review progress on the plan.

Action 3.1.2
Collate and disseminate science reports and research updates to the general public using social media and other digital communications.

Objective 4. Implement adaptive management strategies that are compatible with the management objectives of this plan and are periodically reviewed to ensure their effectiveness.

Strategy 4.1. Develop effective regulations that sustain native and non-native, non-invasive catfish, and facilitate harvest of invasive catfish.

Action 4.1.1
Review existing regulations that pertain to catfish in tidewater for compatibility with management strategies for the species.

Action 4.1.2
Consider and/or propose new enforceable regulations that support the management strategies of this plan.

Action 4.1.3
Propose regulations or regulatory changes that facilitate harvest of invasive catfish, allow dockside sale of commercial catch and improve access of fisheries by commercial harvesters.

Action 4.1.4*
Consider proposals that authorize the department to issue permits for harvesting invasive catfish statewide (tidal and non-tidal waters).

Strategy 4.2. Implement effective fishery management strategies for targeted populations and species of catfish.

Action 4.2.1
With refereed science available, implement population specific management strategies within the scope of this plan's objectives for targeted populations, and species of catfish using a combination of outreach, enforceable regulation or laws, and/or angler incentives.

Action 4.2.2
With stakeholder group meetings, review observed outcomes of specific management strategies for targeted populations and species of catfish, and compare with expected outcomes to determine if strategy modification is necessary.

Section 7. Plan Development

Initial stages of plan development began with internal meetings within Maryland Department of Natural Resources and meetings with stakeholders in the blue catfish fishery (Appendix 1). The first draft of this plan was written by a small workgroup of departmental staff between October 2019 and May 2019. The workgroup was composed of Mary Groves, Joseph Love, Dan Goetz, and Paul Piavis.

Section 8. Plan Revision

The implementation table will be reviewed annually to ensure actions are being taken to implement the plan. Progress toward taking these actions will be reported in annual updates. As information becomes available to sufficiently alter the content of this plan, it will be updated following a similar process as described in "Section 7. Plan Development."

Section 9. Implementation Table (*pertains only to invasive catfish)

Objective	Strategy	Action
1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species occurring in targeted tidal rivers of Maryland's Chesapeake Bay.	1.1. Establish data streams from targeted tidal rivers of Maryland's Chesapeake Bay.	1.1.1. Identify existing catfish monitoring programs that monitor trends in abundance of tidal populations of catfish across years, within targeted rivers of Chesapeake Bay. Use existing fishery-independent surveys from tidewater (e.g., Atlantic Sturgeon Juvenile Trawl Survey, Tidal Bass Survey, Large River Assessments, Marine Recreational Information Program creel surveys, Virginia Department of Game and Inland Fisheries, Virginia Institute of Marine Science) to archive data more comprehensively on relative abundance and distribution of native or non-invasive catfish and invasive catfish.
1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species occurring in targeted tidal rivers of Maryland's Chesapeake Bay.	1.1. Establish data streams from targeted tidal rivers of Maryland's Chesapeake Bay.	1.1.2. Determine sampling gear with high capture efficiencies for different species of catfish and salinities.
1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species occurring in targeted tidal rivers of Maryland's Chesapeake Bay.	1.1. Establish data streams from targeted tidal rivers of Maryland's Chesapeake Bay.	1.1.3. When DNR determines survey needs, create scientifically defensible, fishery independent standard operating procedures to establish a sampling program that generates indices for measuring trends in abundance of tidal populations of catfish across years within targeted rivers of Chesapeake Bay.

1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species occurring in targeted tidal rivers of Maryland's Chesapeake Bay.	1.1. Establish data streams from targeted tidal rivers of Maryland's Chesapeake Bay.	1.1.4. Ensure accurate annual commercial harvest data for all tidal populations of different species of catfish are reported. Use existing fishery-dependent surveys (e.g., Alosine survey, which includes both commercial catches; charter boat catches, Volunteer Angler Survey) to examine trends in harvest.
1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species occurring in targeted tidal rivers of Maryland's Chesapeake Bay.	1.1. Establish data streams from targeted tidal rivers of Maryland's Chesapeake Bay.	1.1.5. Create scientifically valid recreational surveys to document catches, harvest, and assess attitudes toward harvest for tidal populations of different species of catfish. Surveys can include public opinion and consumer surveys and angler intercept surveys to estimate angler effort aimed at the trophy fishery and the harvest fishery.
1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species occurring in targeted tidal rivers of Maryland's Chesapeake Bay.	1.1. Establish data streams from targeted tidal rivers of Maryland's Chesapeake Bay.	1.1.6.* Create an annual survey to quantify the number of blue catfish and flathead catfish in targeted areas and compare densities with long-established populations from Virginia (e.g., tagging study).
1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species	1.1. Establish data streams from targeted tidal rivers of Maryland's Chesapeake Bay.	1.1.7.* Develop a monitoring program to assess predatory and other antagonistic interactions of invasive catfish through analysis of existing data and modeling.

occurring in targeted tidal rivers of Maryland's Chesapeake Bay.		
1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species occurring in targeted tidal rivers of Maryland's Chesapeake Bay.	1.1. Establish data streams from targeted tidal rivers of Maryland's Chesapeake Bay.	1.1.8.* Track number of blue catfish fish processors and their commercial sales to vendors.
1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species occurring in targeted tidal rivers of Maryland's Chesapeake Bay.	1.1. Establish data streams from targeted tidal rivers of Maryland's Chesapeake Bay.	1.1.9.* Track the number of research projects focused on blue catfish and flathead catfish in tidewater.
1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species occurring in targeted tidal rivers of Maryland's Chesapeake Bay.	1.2. Use scientifically obtained data to create management strategies for tidal populations of catfish.	1.2.1.* For invasive catfish, generate a research plan that includes management objectives, a review of published studies and empirical and/or theoretical research, and a plan to reduce the number of invasive catfish in targeted locations.
1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native,	1.2. Use scientifically obtained data to create management strategies	1.2.2.* For invasive catfish, refine existing tools or create tools for disseminating information on the ecological and health benefits of consuming invasive, wild-caught catfish to the general public, vendors, and/or to watermen who directly sell fish.

non-invasive catfish species and two invasive catfish species occurring in targeted tidal rivers of Maryland's Chesapeake Bay.	for tidal populations of catfish.	
1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species occurring in targeted tidal rivers of Maryland's Chesapeake Bay.	1.2. Use scientifically obtained data to create management strategies for tidal populations of catfish.	1.2.3.* Determine the water bodies at risk of colonization by blue catfish or flathead catfish.
1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species occurring in targeted tidal rivers of Maryland's Chesapeake Bay.	1.2. Use scientifically obtained data to create management strategies for tidal populations of catfish.	1.2.4. Develop simple population models to determine if levels of harvest are expected to result in recruitment overfishing or changes in size structure.
1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species occurring in targeted tidal rivers of Maryland's Chesapeake Bay.	1.2. Use scientifically obtained data to create management strategies for tidal populations of catfish.	1.2.5. Identify the conservation needs of native and non-native, non-invasive catfish species.
1. Develop scientifically defensible data streams that can be used to	1.2. Use scientifically obtained data to create	1.2.6. For native or non-native, non-invasive catfish, implement actions that protect or restore populations.

assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species occurring in targeted tidal rivers of Maryland's Chesapeake Bay.	management strategies for tidal populations of catfish.	
1. Develop scientifically defensible data streams that can be used to assess management strategies for four native or non-native, non-invasive catfish species and two invasive catfish species occurring in targeted tidal rivers of Maryland's Chesapeake Bay.	1.3. Use departmental authority to conduct pilot projects to harvest invasive catfish.	1.3.1. Support development of pilot projects that use new technologies for harvesting invasive catfish.
2. Promote fishing for tidal populations of catfish in Chesapeake Bay using available tools for disseminating information.	2.1. Encourage consumptive and non-consumptive uses of invasive catfish.	2.1.1.* Identify incentives for harvest of invasive catfish.
2. Promote fishing for tidal populations of catfish in Chesapeake Bay using available tools for disseminating information.	2.1. Encourage consumptive and non-consumptive uses of invasive catfish.	2.1.2.* Create invasive catfish derbies or tournaments, or work with existing tournaments.
2. Promote fishing for tidal populations of catfish in Chesapeake Bay using available tools for disseminating information.	2.1. Encourage consumptive and non-consumptive uses of invasive catfish.	2.1.3.* Include blue catfish and flathead catfish in public awareness campaigns targeting invasive species, including efforts to prevent new introductions and instead, encourage harvest.
2. Promote fishing for tidal populations of catfish in	2.1. Encourage consumptive and	2.1.4.* Conduct collaborative research with partner agencies to identify non-consumptive, ecologically beneficial uses of invasive

Chesapeake Bay using available tools for disseminating information.	non-consumptive uses of invasive catfish.	catfish, such as protein sources for livestock or fertilizer for agriculture.
2. Promote fishing for tidal populations of catfish in the Chesapeake Bay using available tools for disseminating information.	2.1. Encourage consumptive and non-consumptive uses of invasive catfish.	2.1.5. Create or support creation of fish processing plants.
2. Promote fishing for tidal populations of catfish in the Chesapeake Bay using available tools for disseminating information.	2.1. Encourage consumptive and non-consumptive uses of invasive catfish.	2.1.6.* Use data from surveys of diet preference for invasive fishes to promote ecological consequences of invasive species.
3. Create a framework for routinely soliciting public input when reviewing progress toward the goal of this plan.	3.1. Routinely update management plan with most current available science.	3.1.1. Collate and disseminate science reports and research updates to a list of stakeholders (e.g., biologists, recreational and commercial sectors, non-profit organizations, managers) who agree to meet regularly and agree to review progress on the plan.
3. Create a framework for routinely soliciting public input when reviewing progress toward the goal of this plan.	3.1. Routinely update management plan with most current available science.	3.1.2. Collate and disseminate science reports and research updates to the general public using social media and world wide web.
4. Implement adaptive management strategies that are compatible with the management objectives of this plan, and are periodically reviewed to ensure their effectiveness at achieving the goal of this plan.	4.1. Develop effective regulations that sustain native and non-native, non-invasive catfish, and facilitate harvest of invasive catfish.	4.1.1. Review existing regulations that pertain to catfish in tidewater for compatibility with management strategies for the species.
4. Implement adaptive management strategies that are compatible with the management objectives of this plan, and are periodically reviewed	4.1. Develop effective regulations that sustain native and non-native, non-invasive catfish, and	4.1.2. Consider and/or propose new enforceable regulations that support the management strategies of this plan.

to ensure their effectiveness at achieving the goal of this plan.	facilitate harvest of invasive catfish.	
4. Implement adaptive management strategies that are compatible with the management objectives of this plan, and are periodically reviewed to ensure their effectiveness at achieving the goal of this plan.	4.1. Develop effective regulations that sustain native and non-native, non-invasive catfish, and facilitate harvest of invasive catfish.	4.1.3. Support regulations that allow dockside sales of commercial catch, and improve access of fisheries by commercial harvesters (e.g., commercial invasive catfish and snakehead harvesting permits).
4. Implement adaptive management strategies that are compatible with the management objectives of this plan and are periodically reviewed to ensure their effectiveness at achieving the goal of this plan.	4.1. Develop effective regulations that sustain native and non-native, non-invasive catfish, and facilitate harvest of invasive catfish.	4.1.4.* Consider proposals that authorize the department to issue permits for harvesting invasive catfish statewide (tidal and non-tidal waters).
4. Implement adaptive management strategies that are compatible with the management objectives of this plan, and are periodically reviewed to ensure their effectiveness at achieving the goal of this plan.	4.2. Implement effective fishery management strategies for targeted populations and species of catfish.	4.2.1. With refereed science available, implement population specific management strategies within scope of this plan's objectives for targeted populations and species of catfish using a combination of outreach, enforceable regulation or laws, and/or angler incentives.
4. Implement adaptive management strategies that are compatible with the management objectives of this plan, and are periodically reviewed to ensure their effectiveness at achieving the goal of this plan.	4.2. Implement effective fishery management strategies for targeted populations and species of catfish.	4.2.2. With stakeholder group meetings, review observed outcomes of specific management strategies for targeted populations and species of catfish, and compare with expected outcomes to determine if strategy modification is necessary.

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Figures

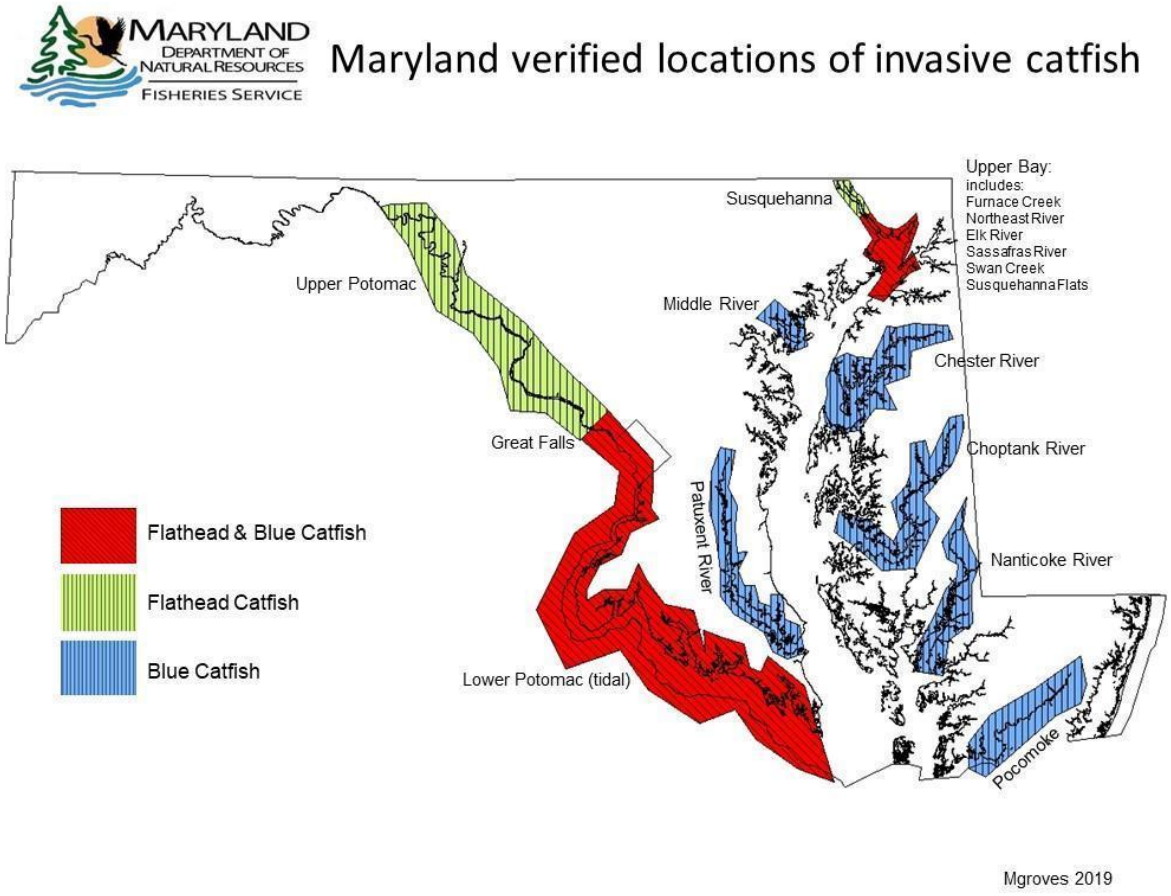


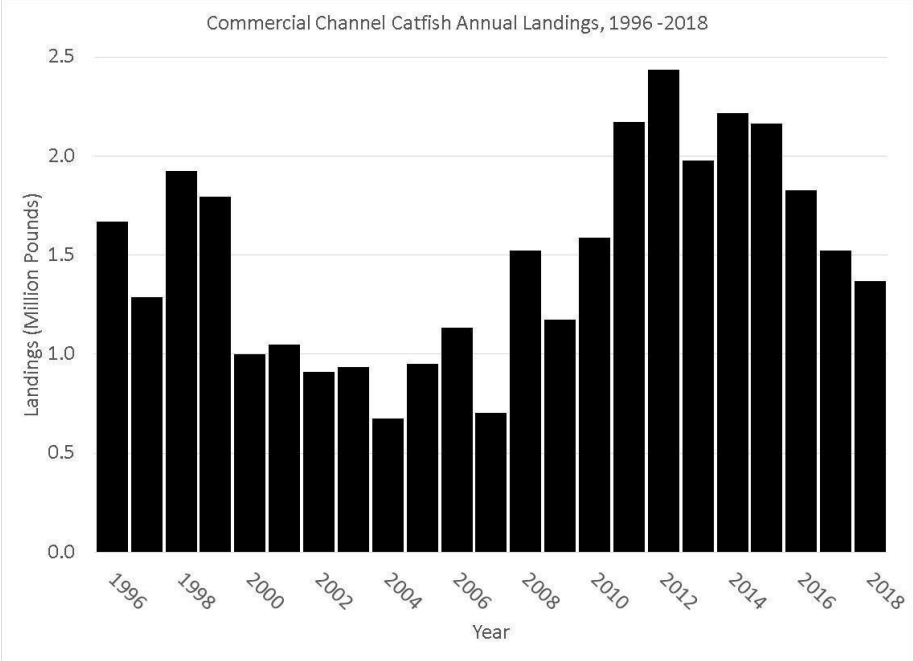
Figure 1. Map of Chesapeake Bay watershed in Maryland depicting locations where blue catfish (*Ictalurus furcatus*) and flathead catfish (*Pylodictus olivaris*) are currently found. Locations where flathead catfish alone are found (green) occur in non-tidal waters and are not the subject of this fishery management plan. Data from Maryland Department of Natural Resources.

1 Other (≤ 4% of fish)- Blue crab, Rusty crayfish, Killifish, Goldfish, Hog choker, Sea lamprey, Catfish ssp., Yellow perch, Detritus, Rock, Amphipod, Algae, Minnow ssp., White perch.

2 Other (≤ 4% of fish)- Unidentified minnow, Catfish ssp., Freshwater mollusks, Corbicula, Detritus, Blue Catfish, Blueback herring, American eel, Gizzard shad, Northern snakehead, Submerged Aquatic Vegetation, Dragonfly, Crayfish ssp., Redhorse sucker.

3 All unidentified fish remains were preserved and sent to a lab for DNA identification. Results pending.

Figure 2. Diets of blue catfish (*Ictalurus furcatus*) from Patuxent River (Chesapeake Bay watershed) collected during winter (2019/2020) and spring (2020). Data were collected by gastric lavage, inspection of guts, and DNA analysis of digested tissue.



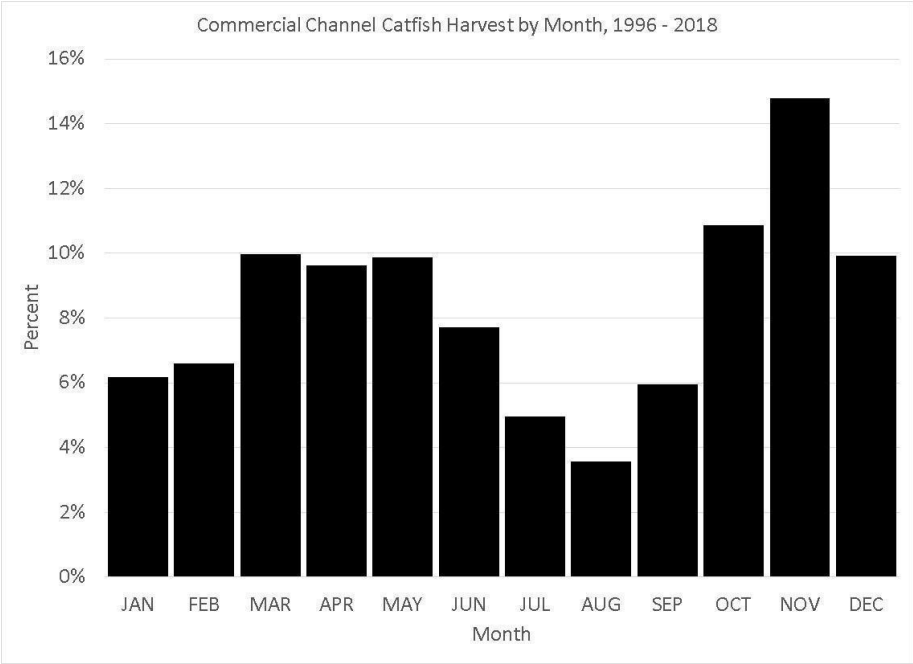
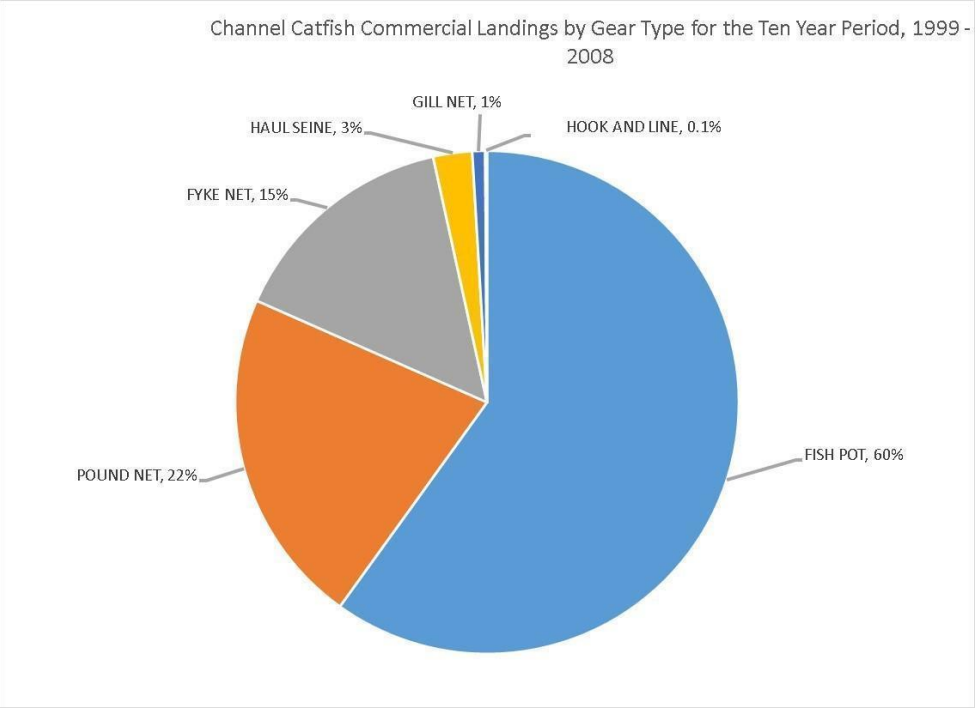


Figure 3. Commercial landings of channel catfish (*Ictalurus punctatus*) in Maryland's tidewater of Chesapeake Bay (1996 - 2018). Total biomass (in pounds) landed per year (upper figure) and percentage of total biomass landed by month (lower figure). Data from Maryland Department of Natural Resources.



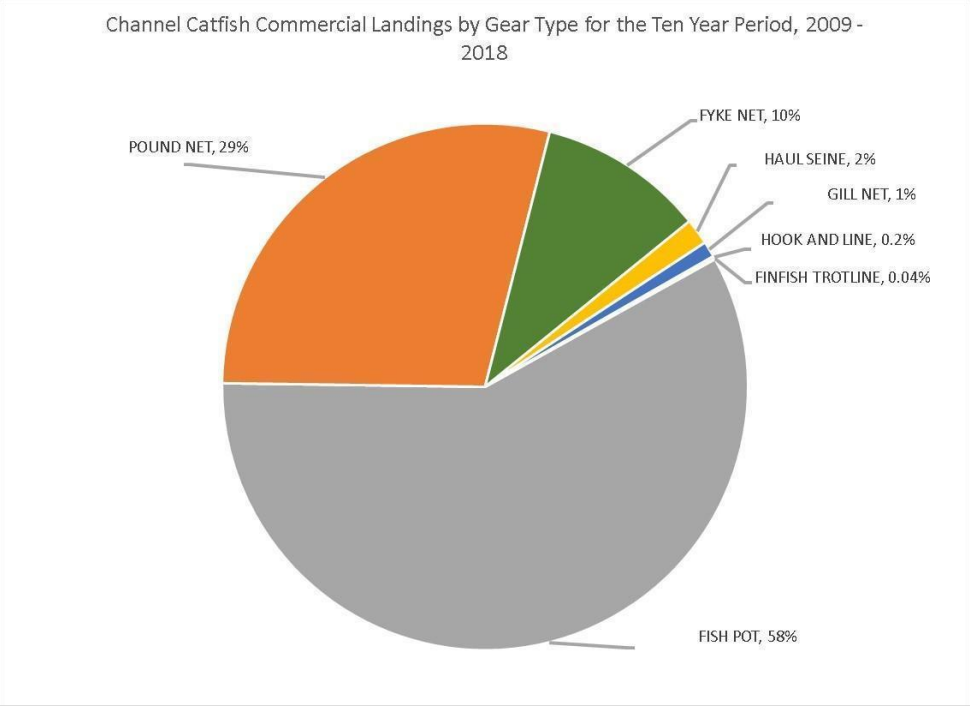


Figure 4. Gears used by commercial watermen to harvest channel catfish (*Ictalurus punctatus*) (1999 - 2008, upper figure; 2009 - 2018, lower figure) in Maryland's tidewater of Chesapeake Bay. Relative percentages reflect the percent by weight of channel catfish landed with each gear type. Data from Maryland Department of Natural Resources.

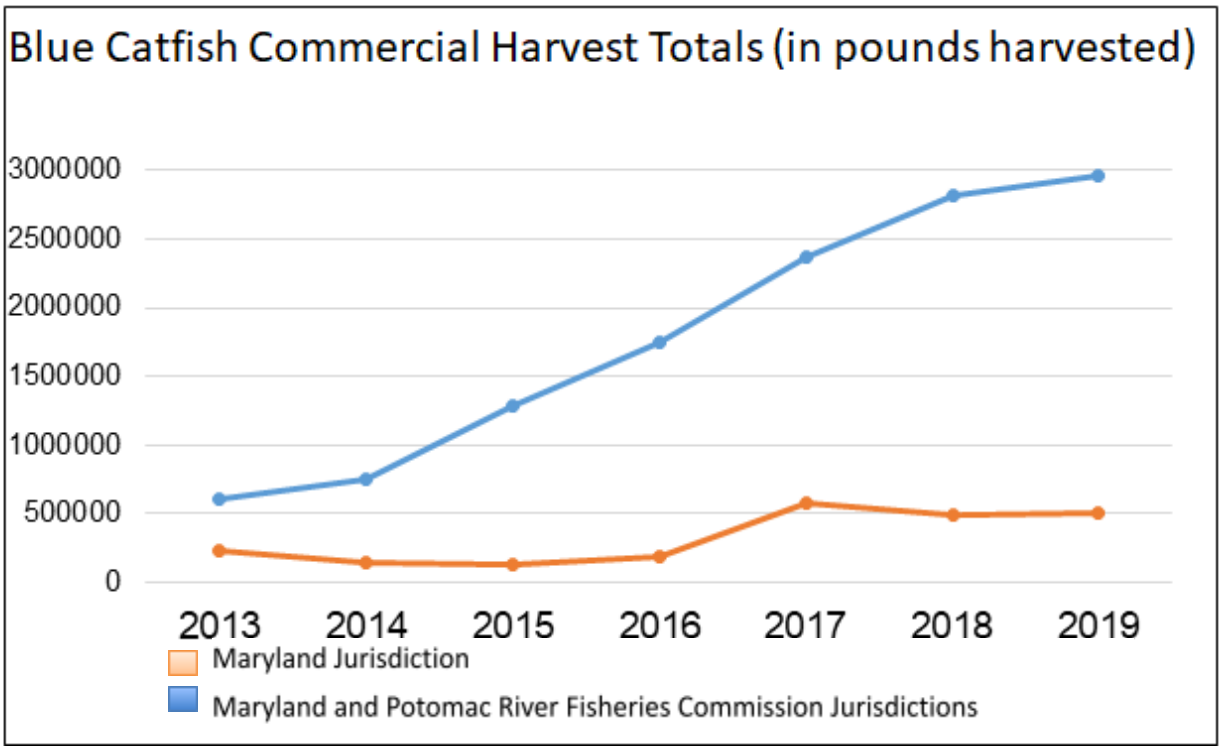
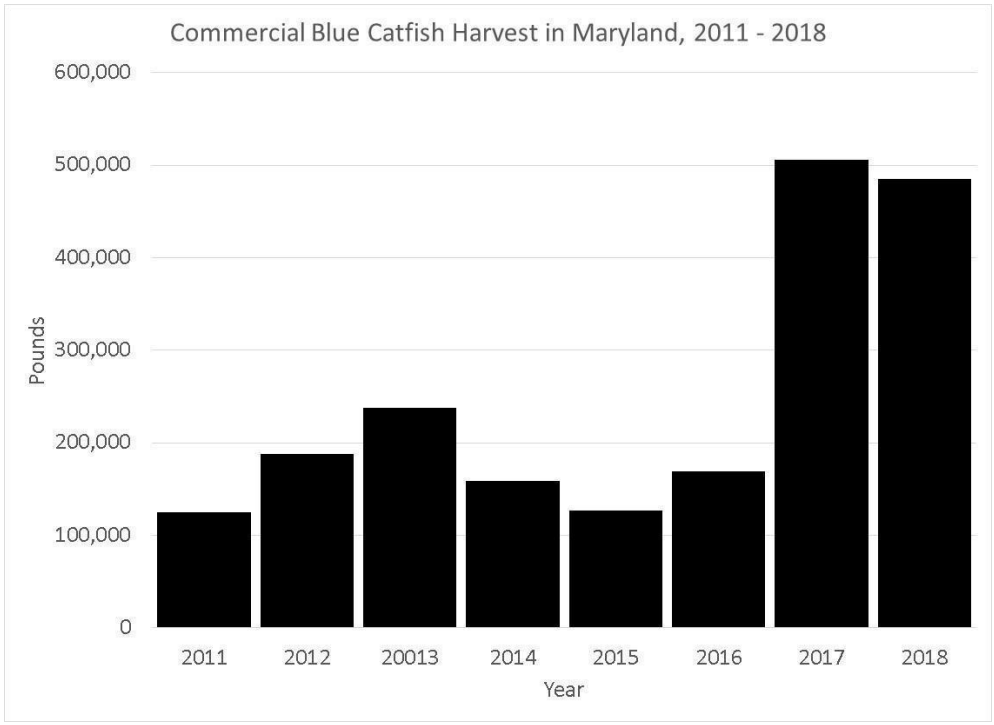


Figure 5. Commercial landings of blue catfish (Ictalurus furcatus) in Maryland's tidewater of Chesapeake Bay (2013-2018). Total biomass (in pounds; lbs) landed per year and reported to both Maryland Department of Natural Resources and the Potomac River Fisheries Commission (blue line), and just Maryland Department of Natural Resources (orange line).



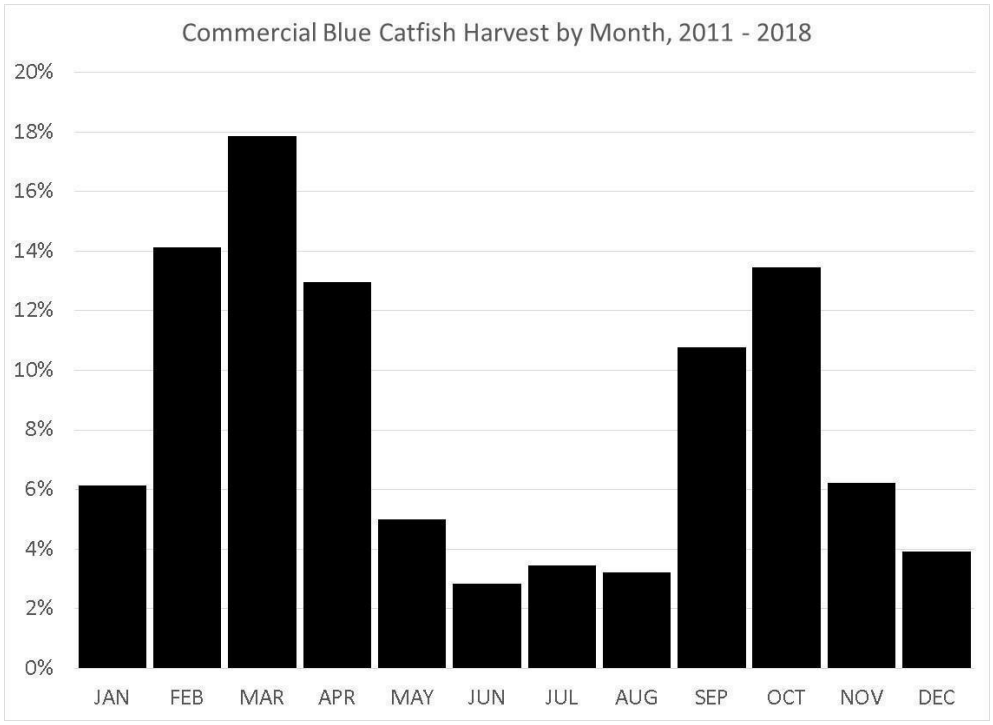


Figure 6. Commercial landings of blue catfish (*Ictalurus furcatus*) in Maryland's tidewater of Chesapeake Bay (2011-2018). Total biomass (in pounds) landed per year (upper figure) and percentage of total biomass landed by month (lower figure). Data from Maryland Department of Natural Resources.

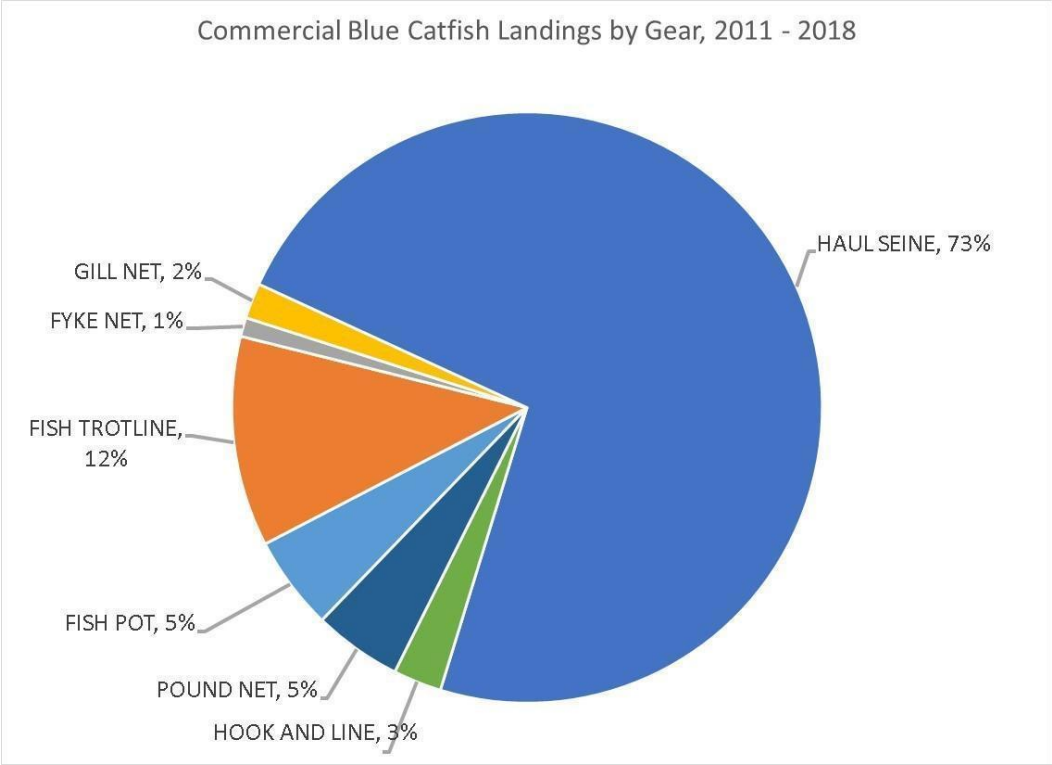


Figure 7. Gears used by commercial watermen to harvest blue catfish (*Ictalurus furcatus*) (2011 - 2018) in Maryland's tidewater of Chesapeake Bay. Relative percentages reflect the percent by weight of blue catfish landed with each gear type. Data from Maryland Department of Natural Resources.

Appendix 1. Correspondence Related to Development of the Fishery Management Plan

MEMORANDUM

Date: March 8, 2019

To: Tony Prochaska, Director of Freshwater Fisheries Program

From: Invasive Fish Workgroup

RE: Managing invasive fish and fisheries in Maryland

cc: David Blazer, Director of Fishing and Boating Services

Invasive Fishes Workgroup Notes

A meeting was held between 10:00 am – 11:10 am on March 4, C1-B Tawes, to discuss a collaborative approach toward managing invasive fishes and fisheries in Maryland. The meeting was attended mostly by employees of Maryland Department of Natural Resources: Joe Love, Mary Groves, Brett Coakley, Michael Kashiwagi, Eric Wilson, Connie Lewis, Paul Piavis, Jonathan McKnight (Chair, Invasive Species Matrix Team), Jay Killian, and Ron Bulkhalt (Maryland Department of Agriculture, by phone).

The group considered priority objectives for fish and fisheries management. Consensus was reached with the following objectives:

1. *Fish Management Objective*: Determine the population size, distribution, and ecological impacts of invasive fishes in Maryland.

2. *Fishery Management Objective*: Create and support management actions that reduce the number of invasive fishes in any location where the species is proliferating.

The workgroup discussed data or actions necessary to achieve these objectives.

1. Fish Management Objective

1.a. Use existing fishery-independent surveys (e.g., Tidal Bass Survey; Non-tidal Potomac Seine Survey; Large River Assessments; Marine Recreational Information Program creel surveys; Virginia Department of Game and Inland Fisheries, Virginia Institute of Marine Science) to continue obtaining data on relative abundance and distribution of invasive fishes and relative abundance of other species in the ecosystem.

1.b. Create an annual survey to quantify the number of blue catfish and flathead catfish in targeted areas and compare densities with long-established populations from Virginia (e.g., tagging study).

1.c. Develop an annual survey of diet preference for invasive fishes.

2. Fishery Management Objective

2.a. Support regulations that allow dockside sale of commercial catch and improve access of fisheries by commercial harvesters (e.g., commercial invasive catfish and snakehead harvesting permits).

2.b. Use existing fishery-dependent surveys (e.g., Alosine survey; commercial catches; charter boat catches, Volunteer Angler Survey) to examine trends in harvest.

2.c. Disseminate information on the ecological and health value of consuming invasive fish to vendors supplied by wholesalers and/or to watermen who directly sell fish.

2.d. Create new creel surveys to document catches and assess attitudes toward harvest.

2.e. Develop invasive fish derbies or tournaments, or work with existing tournaments, and use outreach to encourage harvest in targeted locations.

2.f. Create or support creation of fish processing plants.

The workgroup then briefly discussed funding opportunities via Federal Aid. There are two sources of federal funds that can be used to continue or create data or actions to achieve the objectives. Within the next year, funds will be requested to fund actions: 1.b, 1.c, 2.c, 2.d, and 2.e.

DATE: August 28, 2019
TO: Bill Anderson (Assistant Secretary, Aquatic Resources)
FROM: Joseph Love (Program Manager, Freshwater Fisheries)
Tony Prochaska (Director, Freshwater Fisheries Program)
RE: Minutes, Expanding Opportunities for Blue Catfish Sales
C.C.: Michael Luisi (Division Director, Monitoring and Assessment)
Mary Groves (Southern Region Manager, Freshwater Fisheries Program)
James McKitrick (Legislative and Constituent Services Director)
George O'Donnell (Customer Relations Manager)
Stone Slade (Seafood Marketing Director, Maryland Department of Agriculture)

The Maryland Department of Natural Resources hosted a meeting on 20 August 2019 to discuss expanding opportunities for blue catfish sales (see appended Agenda). Attendees included staff (Tony Prochaska, George O'Donnell, James McKitrick, Mary Groves, Joe Love), Maryland Department of Agriculture (Mark Powell, Stone Slade, Cassie Shirk), legislative representatives (Mike Arntz), watermen (William Rice, William "Rocky" Rice, Jr., John Milligan), fish processor representatives (Stephanie Pazzaglia), and University of Maryland Agriculture Extension Services (Cathy Liu).

The purpose of the meeting was to answer a series of questions (see agenda, and below). While minutes are detailed on page 2, a consensus of responses was summarized for each question below as well. We also identified actions that could help expand opportunities for blue catfish sales.

Question: Are we at maximum harvest or is product returned to the water? **Consensus: Harvest does not appear to be maximal, populations are growing, but there are some significant barriers to improving sales. Due to barriers (discussed below), commercial watermen are returning product to the water. For example, a commercial waterman from the upper bay targets channel catfish and returns blue catfish to the water because they aren't in demand or profitable.**

Question: What are the problems in getting more wild caught blue catfish on the dinner table? Are the current USDA inspection rules barriers in assuring market supply via certification? **Consensus: Both processing opportunities and profits to watermen are barriers and problems to getting more catfish on the dinner table. And yes, the USDA ruling has made it at best inconvenient, or at worst, impossible, to maximize production.**

Question: How can the state do a better job connecting watermen with wholesalers or vendors, and wholesalers with vendors? **Consensus: The state has done a good job but should continue lines of communication, such as this meeting and open conversations with its staff (e.g., George O'Donnell), and creating a platform to advertise and promote blue catfish events and vendors across the state. Additionally, there are no processors on the lower eastern shore and the state should explore ways to provide other opportunities to watermen in this area.**

Question: What information does Maryland Department of Agriculture need to improve marketability? **Consensus: Marketing should focus on increasing the number of vendors, and will be supported by advertising Chesapeake Bay Blue Catfish is not a bottom feeder, is sustainable, and is an ecofriendly, healthy product to consume. Because diets are similar between blue catfish and striped bass, the flavor profile of blue catfish is very different and better than that of other catfish.**

Future Actions

Create a common messaging for marketing blue catfish and work toward increasing the number of vendors selling or serving blue catfish.

Create a website for advertising the messaging and statewide initiatives and/or vendors for sharing education and promoting consumption, which could help increase the number of vendors that sell blue catfish.

The state should determine if an inspector must be employed by FDA, or could be certified by FDA. If the latter is true, a waterman could become certified and help jump start a processing location on the lower shore.

The state should support and/or begin creation of a fish processing operation center on the eastern shore.

The state should determine if it is reasonably possible for a commercial waterman, who cleans blue catfish aboard their boat, to sell the fillets from their boat in bulk wholesale; and if not, determine how to change that aspect of the rule to allow bulk in-state wholesale.

The state should support the removal of the USDA's inspection of fish processing operations in Maryland.

John Milligan may reach out to Stephanie Pazzaglia to explore fish processing opportunities.

John Milligan may seek more information from the Maryland Department of Natural Resources on selling blue catfish as a wholesale operation in spite of the USDA ruling.

Mary Groves will provide James McKitrick data on growth rates of blue catfish and other data that supports department policy.

Schedule another, larger meeting in the future to foster continued communication among all stakeholders.

Detailed Minutes

Are we at maximum harvest or is product returned to the water? Bill Rice noted that if this fish is not sustainable, then he doesn't know what will be. Mary Groves noted that there is evidence that individual growth rates have not declined, a sign that the population is expanding and has not reached its carrying capacity in Potomac River. Joe Love noted the population has expanded in the Chesapeake Bay watershed significantly, particularly on eastern shore and upper Chesapeake Bay. He provided data that showed the increase in commercially landing blue catfish on Patuxent River, Susquehanna River, and Wicomico River, though biomass is much lower currently than that harvested from Potomac River. Bill Rice noted that from March through May, the market can be flooded with catch. Stephanie Pazzaglia noted that product can sit in storage, but is sold. On eastern shore, storage and transportation remains a problem, as noted by John Milligan. There is no fish processing plant on the eastern shore. Product has been returned to the water, noted by Rocky Rice, because of current inspection rules and the increased cost of inspectors during holidays.

What are the problems in getting more wild caught blue catfish on the dinner table? John Milligan discussed the USDA ruling as a significant problem because inspectors work a set schedule. He mentioned that the general public can contact local governments to express their frustration with the federal government interfering with state fishing operations. Stephanie Pazzaglia added that processing and inspections occur between 7:30 am and 3:30 pm, which may not be when fish are brought to the processing house. John Milligan noted that there is no processing plant on the eastern shore, further limiting options for those watermen. He discussed an option in Vienna that would cost $300 a month to operate a processing house. Rocky Rice noted that product has been abandoned. James McKitrick provided a summary of observations from

watermen on the ruling and noted that the Maryland Department of Natural Resources policy is to do away with the ruling as it currently affects Maryland fisheries. Bill Rice noted that consumers have received no benefit owed to the ruling. Bill Rice noted that the ruling is inconvenient and George O'Donnell added, unnecessary, though Rice added some standards are useful because no one wants tainted meat.

George O'Donnell discussed the cost of inspection and its problem with smaller processing houses. The cost of inspection was nominal for J.J. McDonnell, as noted by Stephanie Pazzaglia. While there is increased demand for blue catfish and northern snakehead (another invasive fish in Maryland), the price paid to watermen remains low compared to retail price (~ $9.00/lb). John Milligan and Rocky Rice noted that if they cannot get at least $0.50/lb, then it is not worth it to harvest blue catfish. An average of $0.60/lb over the year would be reasonable and Milligan said, $1.00/lb would make the operation profitable.

How can the state do a better job connecting watermen and wholesales or vendors, or wholesalers and vendors? James McKitrick suggested a larger meeting in the near future to help achieve continued communication. Such meetings help to connect people, such as Stephanie Pazzaglia who may be able to facilitate sales of some eastern shore blue catfish from John Milligan. John Milligan valued his conversations with George O'Donnell on concerns he has had over the USDA ruling and its deterrent to commercial sales. Stone Slade and Joe Love discussed a collaborative website platform for listing promotional events and vendors that sell blue catfish. John Milligan mentioned the Troy Hill event in Cambridge on November 16, which is a harvester's event. Vendors such as Wholefoods had sold blue catfish fillets, but did not this past year, and George O'Donnell suggested that Cracker Barrel would be an ideal vendor for selling Chesapeake Bay Blue Catfish to its patrons.

What information does Maryland Department of Agriculture need to Improve Marketability? Stephanie Pazzaglia mentioned that J.J. McDonnell heavily promotes the meat as ecofriendly and spends a lot of time educating their patrons on blue catfish. Cathy Liu discussed the health benefits of eating blue catfish and how that message should be included into education. She provided some examples of that outreach to the meeting participants. Stephanie Pazzaglia discussed the problems with marketing the species as just a "catfish" because of the public perception that the fish is a bottom eating fish. John Milligan and Mary Groves discussed their data that support blue catfish are not bottom feeders and in fact, eat gizzard shad and other fishes. Mark Powell also noted the need to make the fish more appealing in the marketplace for more vendors to sell the species. Stephanie Pazzaglia noted that the taste of Chesapeake Bay Blue Catfish

tastes different and better than other catfish. She indicated that having a diversity of vendors would increase vendor competition and lower prices to the consumer, possibly increasing demand and ultimately offering a fairer price to watermen. Stephanie Pazzaglia further suggested a name change, though not formal as Joe Love discussed problems with that. Both Stephanie Pazzaglia and Mark Powell highlighted the name, Chesapeake Bay Blue Catfish as a good name to draw distinction to the species.

Date: January 19, 2021 and January 21, 2021
RE: Meetings of Sport Fisheries Advisory Commission and Tidal Fisheries Advisory Commission. The following comments were received and responded to by the Maryland Department of Natural Resources.

Comment	DNR Response	Change to Draft (Y/N)	Page of Draft	Original Draft Text	New Revised Text
Why couldn't the state of MD recognize a recreational fishing license (reciprocity) from the border states (VA, DE, WV and PA) when targeting an invasive species such as blue catfish?	The department shares reciprocity with Virginia in tidal waters. There is a cheap commercial license ($15) to harvest invasive catfish, though this license is not a reciprocal one. Strategy 4.1 includes actions that develop effective regulations for facilitating harvest of invasive catfish, including a review of existing regulations (Action 4.1.1) and consideration or proposal of new regulations that support management strategies of this plan (Action 4.1.2), with a specific interest in proposals that authorize the department to issue permits for harvesting invasive catfish statewide (Action 4.1.4).	N	N/A	N/A	N/A

Can blue catfish or flathead catfish be marketed to Omega as proteins for their products, or how else can these species be marketed?	The FMP could further collaboration with Maryland Department of Agriculture in pursuing other marketing options beyond restaurants and seafood dealers; this broadens existing actions regarding such measures in the FMP	Y	Pages 28, 37	2.1.4.* Conduct research to identify non-consumptive, ecologically beneficial uses of invasive catfish	2.1.4.* Conduct collaborative research with partner agencies to identify non-consumptive, ecologically beneficial uses of invasive catfish, such as protein sources for livestock or fertilizer for agriculture.
If DNR expects the avg american to understand any fishery issue, why are we reporting in the "Metric " System...The US is not using the METRIC system.....Suggest Changing!	Conversions for grams, meters, and degrees Celsius were provided in parentheses at each mention.	Y	Pages 10, 12, 13, 14, 15, 17, 18, 19, 20, 21	Several Locations: e.g., 35.3 degrees Celsius; 25 degrees Celsius; (maximum length = 600 millimeters, maximum weight = 1.9 kilograms);(maximum length = 550 millimeters; maximum weight = 2.7 kilograms).	Several locations: e.g., 35.3 degrees Celsius (95.5 degrees Fahrenheit); 25 degrees Celsius (77 degrees Fahrenheit); (maximum length = 600 millimeters (23.6 inches); maximum weight = 1.9 kilograms (4.2 pounds)); (maximum length = 550 millimeters (21.6 inches); maximum weight = 2.7 kilograms (5.9 pounds)).
Can DNR respond to what has been done ref meetings of Mar 8, 2019 and Aug 28, 2019	As stated on page 29, these early meeting were the initial stages of FMP development	N	N/A	N/A	N/A
Correct Mansuetti with "A.J." reference in literature cited	Corrected as recommended in Literature Cited	Y	Page 42	Mansuetti, A	Mansuetti, A.J.
Left justify all of the subheads	All subheadings were left justified, as suggested	Y	Pages 10-15, 19-24, 25-29	Left Justified subheadings	Removed Left Justification in subheadings

Use of metric system is a chore and required conversion	Conversions for grams, meters, and degrees Celsius were provided in parentheses at each mention.	Y	Pages 10, 12, 13, 14, 15, 17, 18, 19, 20, 21	Several Locations: e.g., 35.3 degrees Celsius; 25 degrees Celsius; (maximum length = 600 millimeters, maximum weight = 1.9 kilograms);(maximum length = 550 millimeters; maximum weight = 2.7 kilograms).	Several locations: e.g., 35.3 degrees Celsius (95.5 degrees Fahrenheit); 25 degrees Celsius (77 degrees Fahrenheit); (maximum length = 600 millimeters (23.6 inches); maximum weight = 1.9 kilograms (4.2 pounds)); (maximum length = 550 millimeters (21.6 inches); maximum weight = 2.7 kilograms (5.9 pounds)).

Adoption Statement

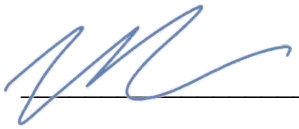
We, the undersigned, adopt the Fishery Management Plan for Tidewater Catfish (December 2021) as a guide to managing catfish in Maryland's tidewater. The Fishery Management Plan for Tidewater Catfish (December 2021) provides a framework for conserving and wisely using the catfish resource. It adopts management strategies based on the best available science.

The Maryland Department of Natural Resources will update the plan as needed and report on progress made in achieving the management plan's goals and objectives.

Date: 1/12/2022

Jeannie Haddaway-Riccio

Secretary, Maryland Department of Natural Resources



Date: 1/12/2022

Matthew Fleming

Acting Assistant Secretary, Maryland Department of Natural Resources