Amendment 1
to the 2002 Maryland Tidewater Yellow Perch Fishery Management Plan
April 2017

Introduction

Yellow perch (*Perca flavescens*) are found throughout most of the freshwater areas in Maryland and have adapted to estuarine habitats within the Chesapeake Bay. Adult yellow perch have a "semi-anadromous" life history strategy. Adults migrate into tidal and non-tidal freshwater to spawn, then move downstream to estuarine waters to complete their life history. Yellow perch are important for both the commercial and recreational fisheries in Maryland. They provide the first angling opportunity for recreational fishermen during the late winter/early spring spawning runs and are an important regional commercial fishery. A Maryland fishery management plan (FMP) was adopted in 2002. Since then, there have been changes in the yellow perch management approach.

Statement of the Problem

A Maryland Department of Natural Resources Fisheries Service Plan Review team (FS PRT) met in 2013 to assess the goals, objectives, strategies, and actions in the 2002 Maryland Tidewater Yellow Perch Fishery Management Plan (Maryland YP FMP) and to discuss their application to current practices and future needs of tidewater yellow perch management. The Fisheries Allocation Review Policy (2012) was also used during the review process. The draft yellow perch review report was presented to the Tidal Fisheries and Sport Fisheries Advisory Commissions for their input as part of the review process. The PRT also reviewed comments submitted by other stakeholders. The full PRT concluded that the FMP goal is still appropriate to the overall tidewater yellow perch management framework. However, since changes in yellow perch management occurred in 2008 and 2009, some objectives, strategies and actions need to be updated. As a result, the PRT recommended the development of an amendment to the Maryland YP FMP. Amendment 1 to the 2002 Maryland YP FMP revises the management plan objectives, incorporates the status of the stock and presents the current management approach.

Management Background

The 2002 Maryland YP FMP was developed by the Yellow Perch Workgroup comprised of representatives from DNR, sport fishing groups, commercial fishermen and local watershed conservation organizations. The DNR team drafted the biological background and fishery information sections and the workgroup participated in management discussions. Once the management section was drafted, additional input was provided by Maryland's Sport Fisheries Advisory Commission (SFAC) and Tidal

Fisheries Advisory Commission (TFAC). Comments on the draft plan were compiled in a public tracking table and changes were made to the draft as appropriate. After the plan was signed by the Secretary of Maryland DNR, it was incorporated by reference into the Annotated Code of Maryland in October, 2003. Under Natural Resources Article Section 4-215, a fishery management plan gives the Department additional authority to manage a resource and develop regulations as necessary.

Yellow perch stakeholder meetings were conducted in 2006 to discuss the state of the fisheries and to identify key topic issues. The results of the meetings were documented in "Recommendations of the Maryland Yellow Perch Stakeholder Committee on the Management of Yellow Perch in Maryland" (2006). Recreational fishermen were concerned about the commercial yellow perch harvest impacting the availability of fish for the recreational fishery. In 2007, Maryland Senate Bill 702 directed the Department to manage yellow perch in consultation with the stakeholders. Specifically, the Department was required to "(1) provide a management strategy for yellow perch that enables yellow perch to migrate to historical spawning rivers and streams before spawning; and (2) equitably allocate harvests of yellow perch between recreational and commercial harvesters."

Stakeholders were asked to help define the recreational and commercial fishery objectives and stakeholder meetings resumed in the summer of 2008. Stakeholders agreed on the following objectives:

For the recreational fishery:

1. Improve angler satisfaction.
2. Improve catch rates.
3. Minimize recreational and commercial conflicts.
4. Establish biomass and mortality targets and thresholds that are conservative and would buffer against externalities (such as habitat change, predation, and climate).

For the commercial yellow perch fishery:

1. Maintain a viable and sustainable commercial fishery.
2. Expand seasonal opportunities for the commercial fishery.
3. Develop strategies to enhance economic value of the commercial fishery.
4. Minimize commercial and recreational conflicts.

Yellow perch management changed substantially after the public stakeholder meetings in 2008. The updated stock assessment and monitoring results were presented to the stakeholders. Management options were discussed to meet the objectives and to address the requirements of Senate Bill 702: specifically, consult with the SFAC and TFAC. Recreational creel limits were increased from 5 to 10 fish/person/day and closed areas were opened. Additional measures (tagging and enhanced daily reporting) were implemented to improve accountability within the commercial fishery. Management measures to ensure accountability continue to be refined. As a result, the FMP strategies and actions have been annually updated since 2007 and periodically reviewed. The SFAC and TFAC members are regularly informed on the status of the yellow perch resource and

fisheries. The management framework of this amendment captures the approach that began with the 2009 fishing season.

Stock Status

Based on the most recent stock assessment update, overfishing is not occurring. The yellow perch resource is assessed from the upper Chesapeake Bay which includes the Bay and tributaries north of the Chesapeake Bay Bridge except the Chester River. The estimated average biomass (all ages) from the upper Chesapeake Bay (1998-2016) was 202,500 kg (445,600 lbs.). Biomass reached a low in 2012 at 150,200 kg (330,500 lbs.), but was at or above average in 2013, 2014, and 2016 (Figure 1). Since 2001, yellow perch abundance estimates (all ages) in the upper Bay have varied between approximately 1.2 and 3.0 million fish (Figure 2) (unpublished update to Piavis & Webb 2016).

Young-of-year (YOY) relative abundance indices for yellow perch from the Estuarine Juvenile Finfish Survey Head-of-Bay have varied significantly over time (Figure 3). During the mid-1990s and early 2000s, YOY indices were well above average. Since 2007, seven out of ten years have been below the average index. A winter trawl survey was initiated in winter 2000 to sample resident species in the upper Bay region. Age 1 catch-per-unit-effort (CPUE) indicated below average recruitment in five of the last ten years. The years of below average recruitment were decidedly below average (Figure 3a).

Estimated recruitment, the abundance of age 1 yellow perch in the upper Chesapeake Bay derived from the population model, has ranged between a time series low of 21,400 fish in 2004 to 1.13 million fish in 2012 (Figure 4). The time series average recruitment of age 1 fish is 441,300 fish (1998-2016). Yellow perch biomass and numbers are expected to remain fairly stable, as poor year classes were produced in 2012 and 2013, but above average year classes were produced in 2014 and 2015. The reasons for poor year-classes are not entirely understood, but some areas have experienced poor survivorship of early life stages.

Goal and Objectives

Amendment 1 to the 2002 Maryland Tidewater Yellow Perch Fishery Management Plan formally updates the yellow perch management framework in Maryland. The goal of the plan is to:

> *"Protect and maintain a viable spawning population that supports the ecological role of yellow perch in the Chesapeake Bay while generating optimum long-term social and economic benefits from their recreational and commercial utilization over time."*

"Viable spawning population" is defined as the ability of the population to replace itself. The spawning potential is a measure of the reproductive output a population needs to produce in order to compensate for fishing mortality.

The following objectives meet the goal and replace the objectives in the 2002 Maryland Tidewater Yellow Perch Fishery Management Plan:

1. Develop and incorporate an ecosystem-based framework for assessing and managing the yellow perch resource throughout Maryland Tidewater tributaries and the upper Chesapeake Bay.
2. Apply habitat requirements for yellow perch and work with institutions, associations, communities, and individual landholders to restore priority habitat areas for yellow perch where feasible.
3. Define geographic management units and implement conservative management strategies with accountability measures.
4. Calculate biological reference points for the yellow perch resource and determine appropriate targets and thresholds. Use the targets and thresholds to guide management decisions.
5. Monitor stock status and develop additional indicators of stock status for management regions outside of the current assessment area when information is available.
6. Continue efforts to enhance accountability in the commercial and recreational fisheries.
7. Implement and periodically re-evaluate the recreational and commercial fishery stakeholder objectives.
8. Increase access to the yellow perch resource for fishermen where possible and within the established targets and thresholds.
9. Develop institutional pathways that ensure yellow perch are considered in Chesapeake Bay restoration efforts such as toxic contaminant and nutrient reductions, best agricultural management practices, restoration of stream buffers, restoration of submerged aquatic vegetation (SAV), and initiatives to reduce the impact of development in watersheds that contain presently viable, self-sustaining yellow perch spawning and nursery areas.

Ecosystem Management Considerations

Important ecosystem considerations for yellow perch are land/habitat conservation, multi-species interactions and climate change. In order to safeguard spawning areas and larval/juvenile nursery areas, emphasis should be placed on the conservation and protection of existing high quality habitat. Conserving agricultural land and natural areas such as forests, wetlands and stream corridor buffers is a proactive approach and recommended for protecting fish aquatic habitats. These land features have a natural capacity to provide ecological services such as protecting water quality, providing habitat, mitigating stormwater run-off and floodwaters, and filtering pollutants.

A major land/habitat concern is the increase in residential development. Negative habitat effects of residential development have been cited for the decline of the yellow perch stock (Jensen 1993; Yellow Perch Workgroup 2002; Uphoff et al. 2005). Increased development has also been linked to the declining use of streams for yellow perch spawning and reduced egg and larval viability (Uphoff et al. 2005: Blazer et al. 2013, Uphoff et al. 2015; 2016). However, juvenile and adult yellow perch survival (with the exception of episodic fish kills) and growth do not appear to be particularly affected by development (Uphoff et al. 2005). Yellow perch stocks may appear to persist in well-developed subestuaries as a result of juveniles migrating from productive spawning areas; but are not self-sustaining because of low egg and larval viability (Uphoff et al. 2005; Uphoff et al. 2015).

Impervious surface (paved surfaces, buildings, and compacted soils) can be used as a general indicator of residential development. Impervious surfaces increase runoff volume and intensity, erosion, sedimentation, temperature, contaminant loads (metals and organic compounds that may be directly toxic or disrupt endocrine function), and nutrient loads (Wheeler et al. 2005; NRC 2009). Although impervious surface can be used to infer how aquatic habitats respond to residential development, there are additional stressors such as the discharge and withdrawal of groundwater or surface water that also contribute to the negative effects of development on aquatic habitat. These stressors are difficult to isolate (Breitburg et al. 1998; Folt et al. 1999).

Impervious surface guidelines (Uphoff et al. 2011; Maryland Department of Natural Resources 2012) provide an overview of watershed conditions and watershed and fisheries management strategies applicable to yellow perch under various levels of development (Table 1). The only sound way to buffer against biological losses is to conserve natural areas and farms (Maryland Department of Natural Resources 2012). In order to develop a more proactive approach for conserving fish habitat, DNR units need to coordinate with county, state and federal government agents and stakeholders to influence county comprehensive growth plans and zoning options to conserve aquatic habitat, especially for fishery resources.

Table 1. Impervious Surface Guidelines and Management Considerations

% Impervious Surface	Aquatic Condition	Management Considerations
<2	Highest aquatic biodiversity; Healthy fisheries.	1) Protect areas from development; a) Essential for sensitive species such as brook trout; b) Guards against impacts to aquatic diversity and fishery resources.
2 – 5		1) Manage harvest or reintroduce yellow perch (if

	Generally high aquatic biodiversity; Healthy fisheries.	needed); 2) Conserve natural/rural (forests, wetlands, farms, etc.) features; 3) Support ecological revitalization projects.
5 – 10	Declining biodiversity & fisheries.	1) Conserve remaining rural land (high priority); 2) Restrict harvest & stock (may compensate for reduced egg and larval viability); 3) Ecological revitalization may help maintain fisheries.
10 – 25	Impaired biodiversity & fisheries (unlikely to reach former levels).	1) Utilize reconstruction projects with caution, may help mitigate hydrologic impacts; 2) Remediation is unlikely to eliminate habitat stress; 3) Harvest management & stocking ineffective for maintaining a sustainable fishery.
>25	Significantly impaired biodiversity & fisheries.	1) Limited improvement from ecological reconstruction; 2) Fisheries often beyond managing.

Biotic interactions or "multi-species" relationships especially trophic dynamics are another important ecosystem consideration. The availability of prey items, like zooplankton, is essential for larval and early juvenile survival. If prey items are not available in an area, it would help explain the lack of yellow perch abundance and possibly suggest solutions. Chesapeake Bay Program zooplankton monitoring in the tidal-fresh portion of the upper Bay during 1985-2001 (funding and monitoring ended in 2001) indicated that zooplankton availability to yellow perch larvae was persistently low during 1985-1992 and typically higher afterward (Uphoff et al. 2012). An upward shift in the upper Bay yellow perch juvenile index after 1992 corresponded to a similar general shift in zooplankton, although year-to-year variation was not particularly well matched (Uphoff et al. 2012).

Adult yellow perch are known to eat insect larvae, crustaceans and small fish (Murdy et al. 1997). In the Chesapeake Bay, documented prey items include anchovies, killifish and silversides (Hildebrand 1929). Differences in diet, i.e. types of prey items, vary by area and probably reflect differences in food availability. Diets of yellow perch, white perch, and channel catfish in the Susquehanna River during the summer-fall season overlapped considerably based on benthic invertebrates. This overlap indicates a potential for competition (Weisberg and Janicki 1990). Yellow perch are prey to other organisms including larger piscivorous fish and birds. These include predators such as striped bass, largemouth bass, chain pickerel, catfish, white perch, bluefish, ospreys, bald eagles, gulls, terns, herons and egrets. Competition and predation by invasive species is another multi-species concern. Although it is not currently clear how invasive catfish species or snakeheads directly or indirectly impact yellow perch, their potential impacts are a concern especially since their habitat use overlaps.

Widespread climate factors may influence the survival of yellow perch egg and larvae in Chesapeake Bay subestuaries. Long-term (1965-2012) regression analysis indicated that yellow perch egg and larval viability (indicated by the proportion of plankton tows with larvae) may reflect a combination of March air temperatures (negative influence) and March precipitation (positive influence) (Uphoff et al. 2012). Average air temperatures in March 2012 were higher than any other years and viability was abnormally low in the southerly subestuaries (Nanjemoy and Nanticoke rivers) when compared to the Head-of-Bay region. It provides some evidence that climate factors may influence yellow perch egg and larval survival. Average annual air temperature in Chesapeake Bay is projected to increase by $1.0 – 1.5^{0}$C by 2030 and even more by 2095. Poor survival of yellow perch eggs and larvae may become more common as temperatures rise (Uphoff et al. 2012).

Strategy 1.
Ecosystem guidelines will continue to be refined for all phases of yellow perch management with habitat and invasive species interactions as the primary ecosystem management focus.

Action 1.1.
Adopt the use of the IS reference points in watershed planning and fisheries management. Educate citizens and county government officials about the ecological and economic importance of aquatic health, identification of prime habitat and aquatic resources, and encourage them to implement land management decisions for aquatic resource protection.

1. Work with county staff when developing their comprehensive plans to conserve priority habitats.
2. Work with local government, counties, DNR and state agencies to keep farming and forestry viable, and manage development.
3. Work with the Fisheries Habitat Workgroup and stakeholders to conserve habitat.

Action 1.2.
Partner with other DNR units especially the Project Review Division and the interdisciplinary teams such as the Invasive Species Matrix team to assess watersheds and establish priority habitat areas for protecting yellow perch spawning and nursery areas.

Action 1.3.
Participate in relevant forums, especially through the Chesapeake Bay Program, to improve the effectiveness of fish habitat conservation and restoration efforts, and implement baywide climate change strategies.

Action 1.4.
Utilize the environmental review process to prevent the destruction of designated high quality habitat both in the short-term and the long-term. Emphasis should be placed on preserving habitat in more pristine areas.

Action 1.5
Promote/support zooplankton monitoring with the ultimate goal of understanding the relationship between zooplankton abundance and larval/early juvenile fish survival.

Action 1.6.
Consider the role and potential impacts of invasive species on all life stages of yellow perch and mitigate the ecological impacts where feasible.

Action 1.7.
Consider climate change in yellow perch management planning to the extent that information is available.

Stock Assessment

The status of the yellow perch stock is determined by periodic stock assessments with special emphasis on the upper Chesapeake Bay (tidewater areas north of the Bay Bridge and all tributaries except the Chester River). Methodologies for stock assessments can change over time. In the 2002 Maryland YP FMP, yellow perch were assessed using a spawning stock biomass per recruit model to set conservative fishing mortality levels and monitor fishing mortality through biological sampling. However, that method of estimating fishing mortality (F) produced a generational history of F, not a true annual F (Piavis and Uphoff 1999). There could be years of overfishing before the monitoring survey could detect it. Since then, more data have been collected and the stock assessment process has been refined using a statistical catch-at-age (CCA) model and a spawning stock biomass per recruit (SSB/R) model.

The SSB/R model is utilized to determine overfishing status, i.e., to set the biological reference point (BRP) for fishing mortality (F). Management measures for

yellow perch are based on achieving a F rate that produces a 35% maximum spawning potential (MSP). The MSP is the spawning stock biomass per recruit (SSB/R) when F is zero. The degree to which fishing reduces the SSB/R is expressed as a percentage of MSP. For yellow perch, $F_{35\%}$ and $F_{25\%}$ are the target and threshold reference points, respectively, and are consistent with the 2002 Maryland YP FMP. The selection of this target and threshold is considered a risk-averse strategy. Overfishing is deemed to occur when an annual F exceeds $F_{35\%}$ MSP. Reference points for yellow perch were calculated in 2010 and updated in 2014. For the commercial fishery slot limit, F target = $F_{35\%}$ = 0.53 and F threshold (limit) = $F_{25\%}$ = 0.85. For the recreational fishery 9" minimum size limit, F target = $F_{35\%}$ = 0.50 and F threshold (limit) = $F_{25\%}$ = 0.80.

The CAA model estimates population abundance at age, annual fishing mortality, recruitment, catchability and selectivity of the fishery (Piavis and Webb 2011). Since recreational harvest data are unavailable before 2008 and creel surveys have been limited in number and scope, recreational removals have not been considered in the stock assessment models. The most recent stock assessment used data from 1998-2015. Instantaneous fishing mortality (F) has remained below the target level (0.53) since 2002 (Figure 5). Fishing mortality was calculated at 0.16 for 2013, 0.11 in 2014, 0.13 in 2015, and 0.21 in 2016. In contrast, F peaked in 2002 at 1.09 when overfishing was occurring.

Strategy 2.
The status of the yellow perch stock will be evaluated through periodic stock assessments using monitoring data, best available scientific methodology, and ecosystem considerations to guide yellow perch fishery management.

Action 2.1.
Continue fishery dependent and fishery independent monitoring for yellow perch and collect biological data to inform stock assessments. Utilize supplemental data, when available, such as the upper Bay trawl survey, to provide additional information for managing the stocks.

Action 2.2.
Conduct a stock assessment annually and periodically review the stock assessment methodology to make improvements/adjustments as needed.

Action 2.3.
Utilize biological reference points (BRPs) to assess the status of the yellow perch stock and update the BRPs as necessary to account for conservation needs and measures of uncertainty in the models.

Commercial Fishery

Yellow perch commercial harvest has varied over time. In the mid 1990's, the commercial harvest of yellow perch rose to levels not observed since 1967. Increased

landings resulted from increased fishing effort, market changes and increased recruitment. During that time period, yield-per-recruit models were used to suggest the appropriate size at entry to the fishery and the juvenile index was used as a predictor of future abundance. In 1999, concern over increased effort and its consequences to rebuilding yellow perch populations resulted in expanded monitoring and additional assessment of yellow perch populations, especially in the upper Bay. Biological reference points (BRPs) based on maximum spawning potential were developed. Previously, yellow perch regulations were based on limited, river-specific data which required close attention to open and closed areas and changing regulations. Management strategies intended to better control fishing mortality were implemented in 2000.

Fishery statistics for yellow perch have been influenced by changes in regulations and fishing effort, especially over the last decade and a half. After considerable stakeholder input between 2006 and 2008, and the completion of a stock assessment in 2008, a total allowable catch (TAC) was developed in 2009. The TAC is allocated 50:50 between the commercial fishery and the recreational fishery. It is calculated annually based upon the stock assessment to achieve the target fishing mortality rate (F=0.53). Retrospective analysis of the assessment model demonstrated that the population size is often underestimated, resulting in a conservative and risk-averse TAC calculation. The upper Bay TAC is calculated using the most recent upper Bay stock assessment data. The TAC for the Chester River is based on the historical proportion of river landings to upper Bay landings. The TAC for the Patuxent River is based on historical landings. If commercial harvest exceeds the TAC, all or a portion of the overage is subtracted from the TAC of the next fishing year (Table 2). In order to minimize the possibility of going over the TAC, regulations were changed in 2011 to allow the Department to close the fishery with 24 hours notice if the TAC is projected to be met.

The commercial fishery has a slot limit of 8.5 to 11 inches with several closed areas (see Appendix 1 for an account of regulations). Fyke nets account for the majority of the commercial catch (over 95%) which generally occurs between February and March. The commercial fishery is closed by public notice once the harvest is projected to reach the TAC.

Licensed commercial fishermen are required to have a special permit to harvest yellow perch and are required to report their catch on a daily basis. In 2009, the Department implemented a commercial yellow perch tagging requirement. Each individual yellow perch must be tagged with tags supplied by the Department prior to off-loading from the boat. Fishermen must call the Yellow Perch Call Center and report the weight and number of fish caught each day. If a fisherman did not fish that day, he is still required to call in and report that he did not fish. In the case of the live market fishery, fishermen are required to have a representative from the Department witness the loading of yellow perch onto trucks to verify the weight and number of fish harvested.

Although the individual tagging system is currently in place, a pilot program began in 2016 to give fishermen another option on how they can report their yellow perch harvest. Fishermen can choose to either continue with the current tagging protocol

(tagging individual fish and calling in everyday whether they fish or not) or they can choose to report electronically using the Fishing Activity & Catch Tracking System (FACTS™): an online harvest reporting system that has been customized to meet the needs of Maryland commercial watermen. Fishermen that choose to report electronically are required to attend an hour-long training session on how to access the FACTS system using a smart phone, iPad, or computer and how to submit an electronic harvest report. Once a fisherman is trained to use the FACTS system, he is issued box tags. Box tags are used to tag containers of fish rather than individual fish and significantly reduces labor. The box tags must be filled out as required prior to landing the yellow perch. Fishermen that sell fish for the live market fishery are no longer required to buy tags, however, all other requirements pertaining to selling live yellow perch remain. Evaluation of the pilot program will include how well the fishermen report when hailing out and hailing in; how well they return their used/unused box tags as required on a monthly basis, and how the tags match up to what was reported. There are currently 62 licensed commercial fishermen with yellow perch permits and approximately 40% were enrolled in the pilot project.

Strategy 3.
Utilize a conservative and risk-averse approach to the calculation of an annual Total Allowable Catch (TAC) as the primary method to control fishing mortality and incorporate ecosystem considerations when feasible.

Action 3.1.
Calculate fishing mortality (F) annually as part of the stock assessment.

Action 3.2.
Maintain the 8.5 to 11.0 inch slot limit for the commercial fishery in all open areas. Adjust size limits if stock assessments indicate adjustments are necessary, with input from stakeholders.

Action 3.3.
Maintain geographic management units for the commercial fishery, based on the stock assessments. Currently, the management units are: upper Bay, Chester River and Patuxent River. Consider expanding areas if data becomes available.

Action 3.4.
Implement a harvest reporting system that ensures accountability and update total harvest on a daily basis. When the TAC is projected to be reached before the season end date, close the commercial fishery.

Action 3.5.
Identify commercially harvested yellow perch using a tagging system as an additional method of ensuring accountability.

Action 3.6
Promote the use of electronic reporting to improve the timely and accurate collection of harvest data.

Action 3.7.
Continue to enforce yellow perch regulations and laws. Utilize the penalty workgroup to establish a point system that includes violations of commercial and recreational yellow perch regulations that may include both temporary suspensions and loss of participation in the fishery.

Recreational Fishery

Yellow perch offer one of the earliest fishing opportunities for recreational fishermen each year. The recreational fishery is mostly a shore-based activity so access to fishing locations is important. In 2009, Maryland DNR developed new regulations to improve the yellow perch fishing experience. The creel limit was increased from 5 fish per day to 10 fish per day. The regulations also opened tidal areas that were previously closed to recreational fishing including the Patapsco, Magothy, Severn, South, West and Nanticoke rivers.

Recreational estimates of yellow perch catch and effort are available through the Marine Recreational Information Program (MRIP, formerly the Marine Recreational Fisheries Statistics Survey or MRFSS), but most annual estimates are too imprecise to be useful for management. Federal efforts to monitor recreational fishing in Maryland's tidal tributaries early in the year are not adequate to provide good coverage and, therefore, do not provide reliable estimates. Few Maryland state recreational surveys have been conducted. However, Wilberg and Humphrey (2008, 2009) conducted recreational surveys in the Chester, Bush, Northeast, Patuxent, South, Magothy and Potomac tributaries (Mattawoman, Nanjemoy, and Wicomico Creeks). Estimated harvest for the part of the season that they conducted creel surveys (estimates were not extrapolated to the entire yellow perch season) were minimal with approximately 3,000 fish (2008) and 8,000 fish (2009) harvested. However, estimated total catch was much higher with 58,000 fish (2008) and 56,000 fish (2009). In addition to estimating harvest and catch, angler's attitudes were surveyed. Generally, angler's perceived their fishing success as poor but rated the quality of their fishing trip as moderate to high.

A voluntary online creel survey was initiated by the MD DNR Fisheries Service in 2008 (http://dnr.maryland.gov/fisheries/survey/yperch/2012.pdf). The survey includes information about catch, harvest, fish length, fishing success, perceptions of success and quality of a fishing trip. The last summary report (2016) noted a 73% drop in the number of anglers responding to the survey since 2008. Over the years, catch per angler hour has been between 1.5 (2008) and 6.2 fish (preliminary results, 2016). Currently, the tidal yellow perch recreational fishery is open year round, has no closed areas, a minimum size limit of 9 inches, and a creel limit of 10.

Strategy 4.
Continue to provide opportunities for the yellow perch recreational fishery.

Action 4.1.
Explore ways to increase recreational harvest accountability and fishing opportunities.
Action 4.2
Continue to promote participation in the DNR on-line angler survey.

Action 4.3.
Adjust size limits and creel limits as needed to meet established targets and consider stakeholder input when changing regulations.

Action 4.4.
Establish and periodically review penalties for violations of size and creel limits in the recreational yellow perch fishery.

Action 4.5.
Estimate catch and effort from the recreational fishery when data, funding and personnel are available.

Reduce user conflicts

Recreational fishermen were concerned about commercial gear, especially fyke nets, in the vicinity of recreational fishing locations. Maryland DNR implemented commercial gear restrictions including placement, timing, and harvest limits. Gear restricted areas for setting fyke nets became effective in February 2009 for the upper Bay, Chester River, and Patuxent River. All other areas are closed to commercial fishing for yellow perch and maps showing restriction lines can be found on the DNR website. Limiting where the commercial fishery is allowed has been successful at decreasing user conflicts.

Besides conflicts between recreational and commercial fisheries on fishing areas, there have been discussions on allocating the TAC: each sector of the fishery requesting a larger allocation. Since the commercial fishery is managed under a quota system, harvest is constrained from year to year. As part of the 2013 review of the YP FMP, the review team considered the Fisheries Allocation Policy and associated data through 2012. The team did not recommend any changes to the yellow perch allocation.

Fisheries Service has two advisory commissions that were created in 1973: the Tidal Fisheries Advisory Commission (TFAC) and the Sport Fisheries Advisory Commission (SFAC). Provisions for both groups are provided for in Natural Resources Article, §4-204 Annotated Code of Maryland. The TFAC is charged with providing advice on commercial fisheries matters and the SFAC is charged with providing advice

on recreational fisheries issues. These commissions are the pathway for discussing issues related to yellow perch.

Strategy 5.
Respond to user conflicts by providing a forum for discussion and the transparent development of actions, when necessary.

Action 5.1.
Continue to review and respond to possible user conflicts through the SFAC and TFAC stakeholder meetings and briefings. Establish ad hoc groups as necessary to address specific issues when they occur.

Chesapeake Watershed Agreement

The Chesapeake Watershed Agreement (2014) reflects the Chesapeake Bay partnership's commitment to restore and protect the Chesapeake Bay watershed and its living resources. Since the regional partnership began more than 30 years ago, it has improved water quality, restored habitats and implemented environmental policies. The 2014 Agreement recognizes the need for local public involvement to successfully implement actions in the Bay watershed. Although the Agreement is based on an ecosystem approach, by necessity, it is laid out by goals and outcomes. These goals and outcomes include sustainable fisheries, vital habitats, water quality, toxic contaminants, healthy watersheds, stewardship, land conservation, public access, environmental literacy and climate resiliency. Under the vision for sustainable fisheries, the fish habitat outcome is important to yellow perch. The fish habitat outcome will "continually improve effectiveness of fish habitat conservation and restoration efforts by identifying and characterizing critical spawning, nursery and forage areas within the Bay and tributaries for important fish and shellfish, and use existing and new tools to integrate information and conduct assessments to inform restoration and conservation efforts."

Strategy 6.
Continue to partner with the Chesapeake Bay Program to protect and conserve living resources of the Chesapeake Bay.

Action 6.1.
Coordinate with the Chesapeake Bay Program partners to address habitat and living resource issues, especially actions that impact yellow perch.

References

Arnold, C.L. Jr. and C.J.Gibbons. 1996. Impervious surface coverage: the emergence of a key environmental indicator. Journal of the American Planning Association Spring 1996;

62(2):243-258. http://www.esf.edu/cue/documents/Arnold-Gibbons_ImperviousSurfaceCoverage_1996.pdf

Blazer, V.S. and coauthors. 2013. Reproductive health of yellow perch *Perca flavescens* in selected tributaries of the Chesapeake Bay. Science of the total environment 447:198-209.

Breitburg, D.L. and coauthors. 1998. Understanding effects of multiple stressors: ideas and challenges. Pages 416-431 *in* M.L. Pace and P.M. Groffman, editors.

Folt, C.L., C.Y. Chen, M.V. Moore, and J. Burnaford. 1999. Synergism and antagonism among multiple stressors. Limnology and oceanography 44(3):864-877.

Interagency Mattawoman Ecosystem Management Task Force. 2012. The case for protection of the watershed resources of Mattawoman Creek: recommendations and management initiatives to protect the Mattawoman ecosystem. 213p. http://www.dnr.state.md.us/ccp/pdfs/MEPR_Dec2011.pdf

Jensen, P. 1993. The effects of fishing moratoria. Fisheries 18:22-24

Kane, A. 2013. Managing coastal watersheds to address climate change: vulnerability assessment and adaptation options for the Middle Patuxent Subwatershed of the Chesapeake Bay. 103p. http://www.nwf.org/What-We-Do/Energy-and-Climate/Climate-Smart-Conservation/Adaptation-Reports.aspx

Maryland Department of Natural Resources. 2012. The case for protection of Mattawoman Creek: recommendations and management initiatives to protect the Mattawoman ecosystem. http://www.dnr.state.md.us/ccp/pdfs/MEPR_Dec2011.pdf

McGinty, M.M. and J.H. Uphoff. 2011. Applying impervious thresholds to develop management priorities. Presented at Dec. 19-20 meeting of the Chesapeake Bay Program Sustainable Fisheries Goal Implementation Team, Making the connection: land, water quality & fisheries.

Murdy, E.O., R.S. Birdsong, and J.A. Musick. 1997. Fishes of Chesapeake Bay. Smithsonian Institution Press, Washington, DC. 324p.

National Research Council (NRC). 2009. Urban stormwater management in the United States. National Academies Press, Washington, D.C.

Piavis, P. and J. Uphoff. 1999. Status of yellow perch in Maryland's portion of the Chesapeake Bay during 1998. Fisheries Technical Report Series Number 25, Maryland Department of Natural Resources, Annapolis, Maryland.

Piavis, P. and E. Webb, III. 2011. Assessment of upper Chesapeake Bay yellow perch stocks with a statistical catch-at-age model. Fisheries Technical Report Series. Maryland Department of Natural Resources, Fisheries Service. Annapolis, Maryland.

Piavis, P.G. and E. Webb, III. 2012. Population and vital rates of resident finfish in selected tidal areas of Maryland's Chesapeake Bay. Maryland Department of Natural Resources, Federal Aid Annual Report, F-61-R, Annapolis, Maryland.

Piavis, P.G. and E. Webb. 2015. Population assessment of yellow perch in Maryland with special emphasis on head-of-bay stocks. Maryland Department of Natural Resources, Federal Aid Annual Report, F-61-R-10, Annapolis, Maryland.

Uphoff, J.H. and coauthors. 2005. Interim assessment of yellow perch Perca flavescens habitat and population dynamics in Severn River, a suburbanized Chesapeake Bay sub-estuary. Fisheries Service Technical Report Series Number 46. Maryland Department of Natural Resources, Stevensville, Maryland.

Uphoff, J.H., M. McGinty, R. Lukacovic, J. Mowrer and B. Pyle. 2009. Impervious surface target and reference points for Chesapeake Bay subestuaries based on summer dissolved oxygen and fish distribution. Fisheries Technical Report Series Number 55. Maryland Department of Natural Resources, Annapolis, MD 21401.

Uphoff, J.H. and M.M. McGinty. 2011. Managing Chesapeake Bay's land use, fish habitat, and fisheries: positive and negative case studies. Presented at Dec. 19-20 meeting of the Chesapeake Bay Program Sustainable Fisheries Goal Implementation Team, Making the Connection: Land, Water Quality & Fisheries.

Uphoff, J.H. and coauthors. 2012. Marine and estuarine finfish ecological and habitat investigations. Performance Report for Federal Aid Grant F-63-R, Segment 2, 2012. Maryland Department of Natural Resources, Annapolis, Maryland.

Uphoff, J.H. and coauthors. 2015. Marine and estuarine finfish ecological and habitat investigations. Performance Report for Federal Aid Grant F-63-R, Segment 4, 2014. Maryland Department of Natural Resources, Annapolis, Maryland.

Uphoff, J.H. and coauthors. 2016. Marine and estuarine finfish ecological and habitat investigations. Performance Report for Federal Aid Grant F-63_R, Sement5, 2015. Maryland Department of Natural Resources, Annapolis, Maryland.

USDA National Water Program. 2013.
http://www.usawaterquality.org/themes/watershed/research/modeling.html

Wheeler, A.P., P.L. Angermeier, and A,E. Rosenberger. 2005. Impacts of new highways and subsequent landscape urbanization on stream habitat and biota. Reviews in fisheries Science 13:141-164.

Weisberg, S.B. and A.J. Janicki. 1990. Summer feeding patterns of white perch, channel catfish, and yellow perch in the Susquehanna River, Maryland. Journal of Freshwater Ecology Vol.5, Issue 4:391-405.

Wilberg, M. and J. Humphrey. 2008. A creel survey for early spring fisheries of Maryland's Chesapeake Bay tributaries. Progress Report to Maryland Department of Natural Resources 8-1-2008. Ref. No. (UMCES) CBL 08-085. 17p.

Wilberg, M. and J. Humphrey. 2009. A Creel Survey for Early Spring Fisheries of Maryland's Chesapeake Bay Tributaries. Final Report to Maryland Department of Natural Resources. Ref. No. (UMCES) CBL 10-096. 20p.

Yellow Perch Workgroup. 2002. Maryland Tidewater Yellow Perch Fishery Management Plan. Maryland Department of Natural Resources, Annapolis, Maryland.

Figure 1. Estimated biomass of yellow perch (all ages) from the Upper Chesapeake Bay.*

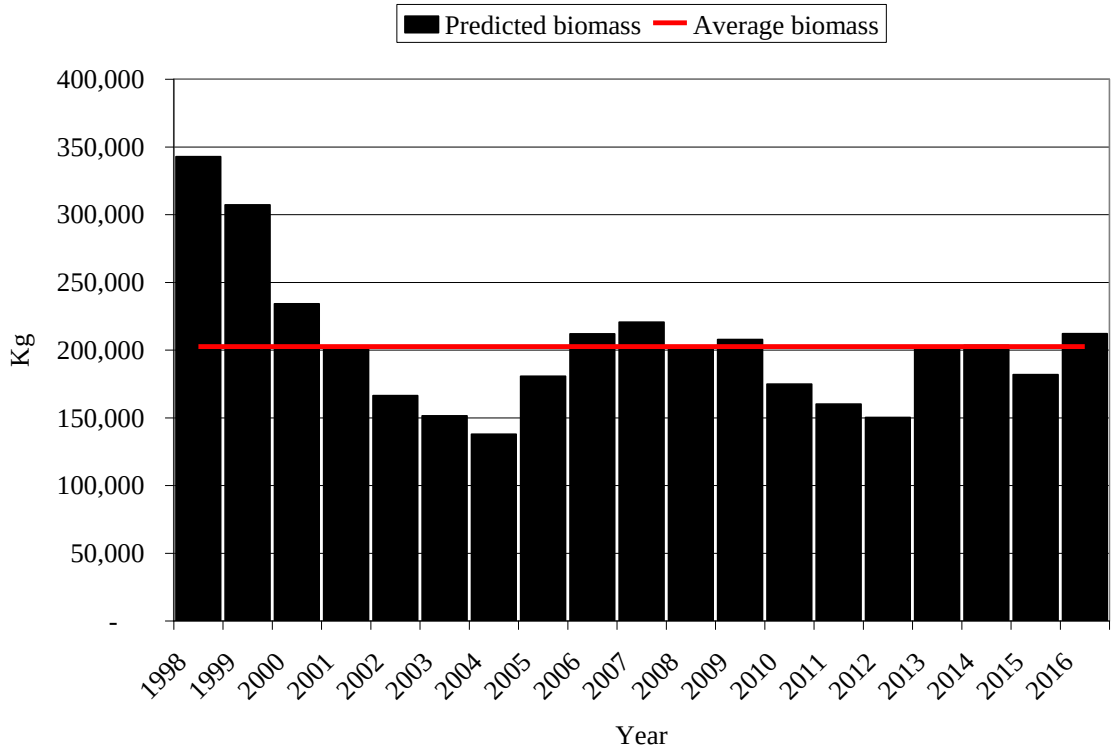


Figure 2. Estimated abundance of yellow perch (all ages) from the Upper Chesapeake Bay.*

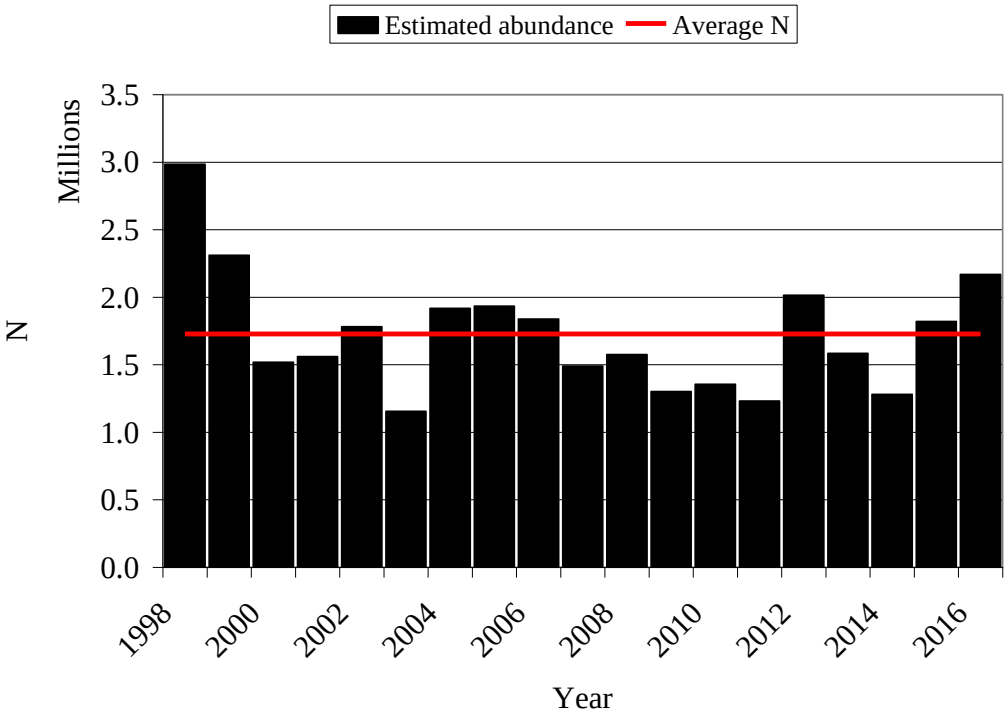


Figure 3. Head-of-Bay young-of-year relative abundance index for yellow perch, 1979 – 2016, based on Estuarine Juvenile Finfish Survey data. Horizontal line=time series average. Error bars indicate 95% confidence interval.*

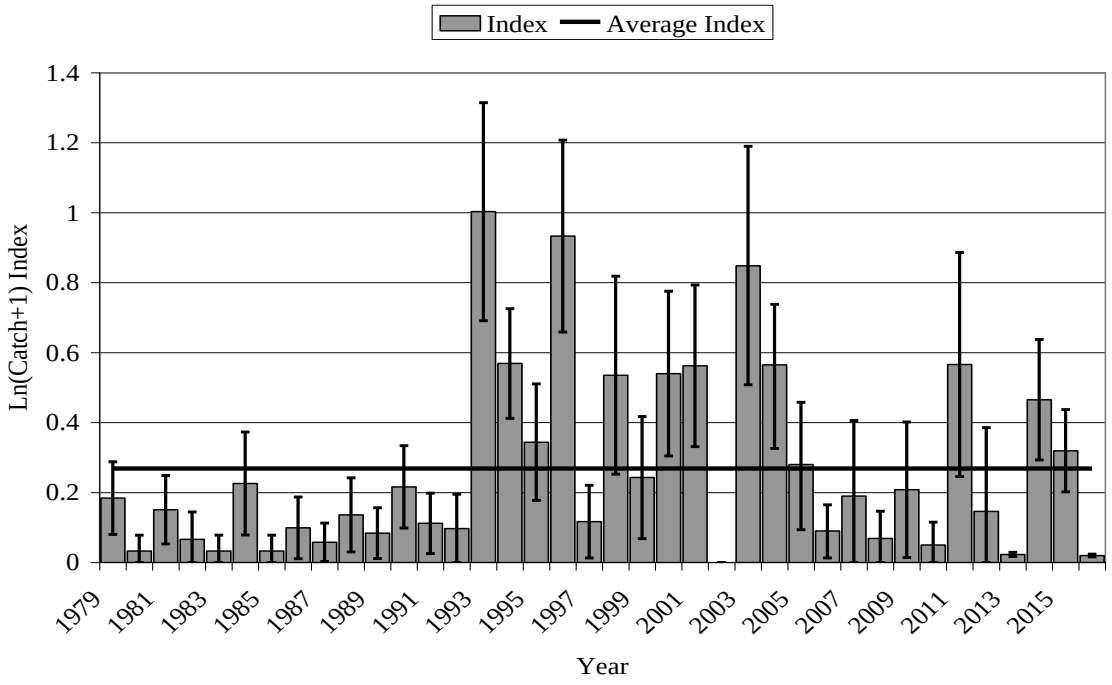


Figure 3a. Age 1 yellow perch relative abundance from upper Bay trawl survey, 2000 – 2016. 2004 not sampled, 2003 and 2005 have low sample sizes.*

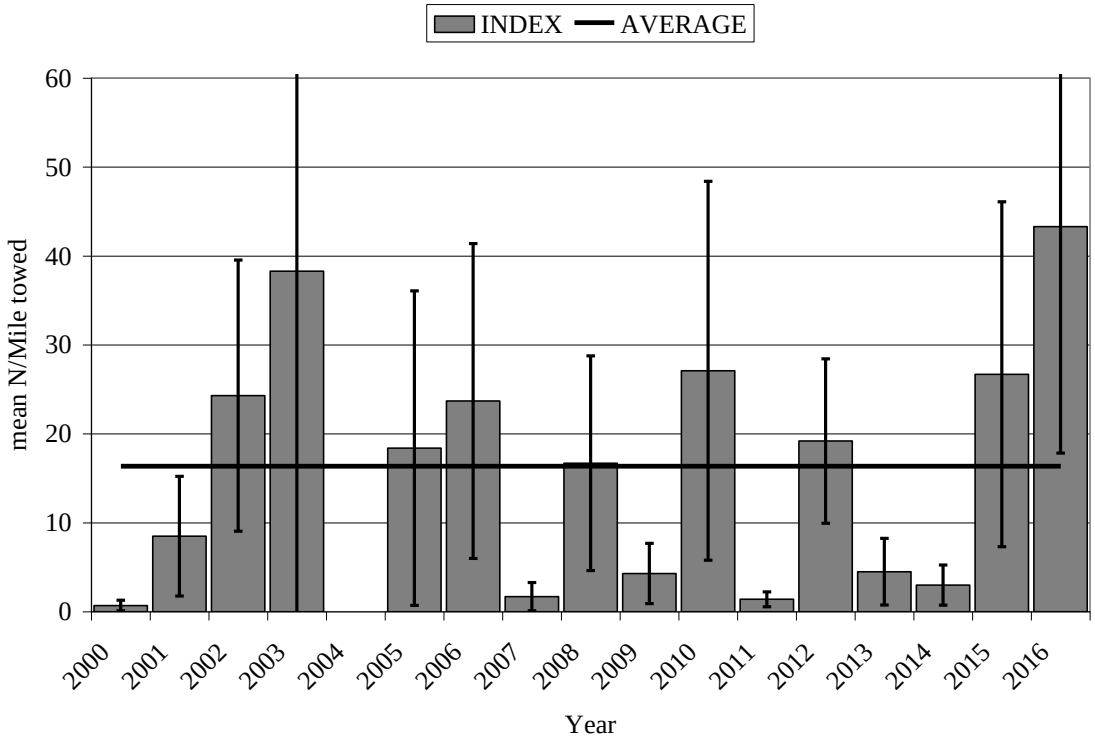


Figure 4. Estimated recruitment (numbers of age 1 fish) of yellow perch in the Upper Chesapeake.

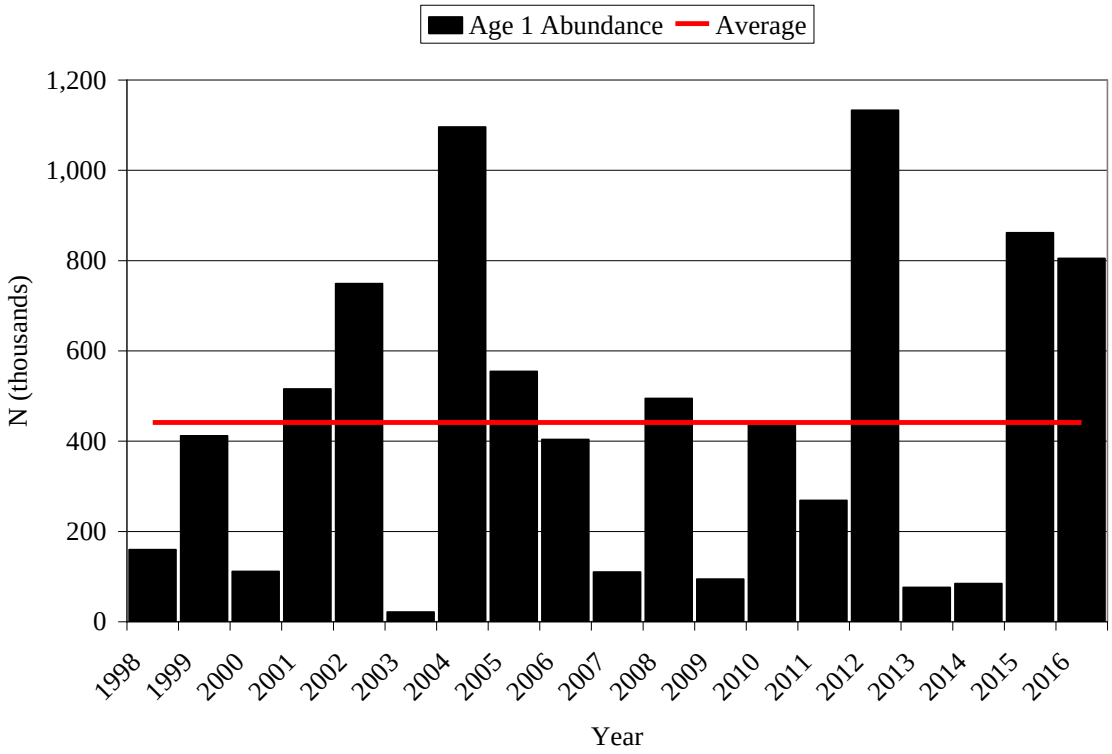
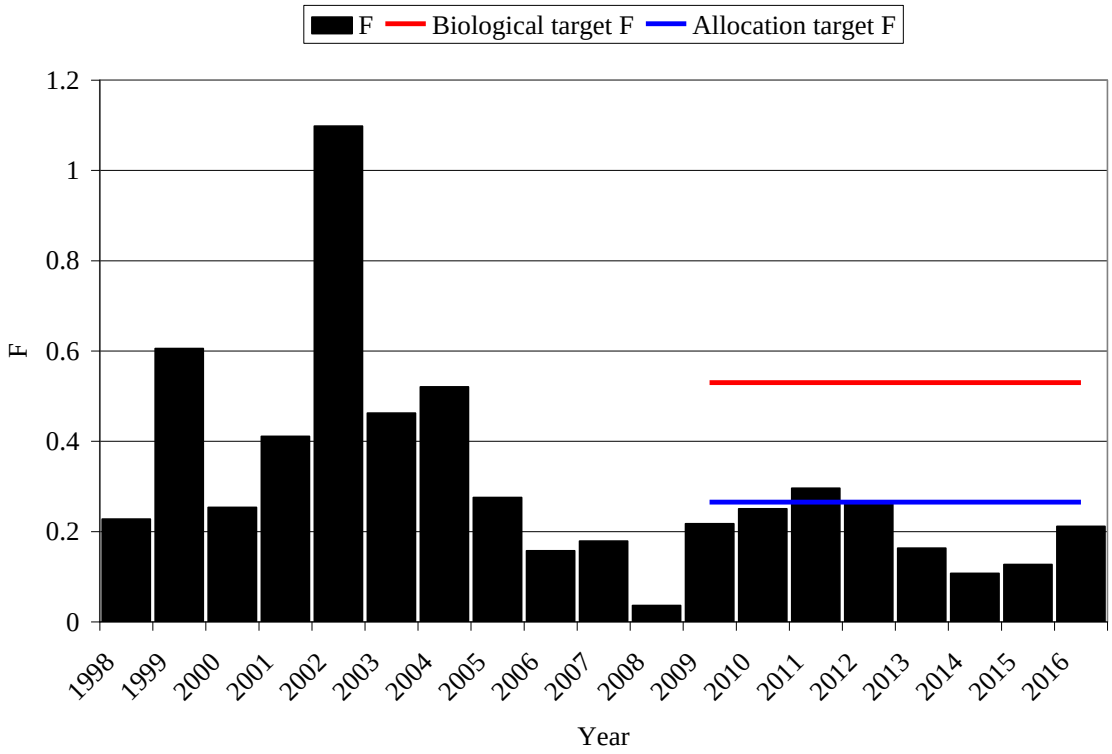


Figure 5. Estimated yellow perch fishing mortality from the upper Chesapeake Bay.*



*Data from Piavis & Webb (pers. Comm)

Table 2. Total Allowable Catch (TAC) and harvest in pounds by area for the yellow perch commercial fishery, 2009-2017.

UPPER BAY				
Year	TAC Computed	TAC Adjusted	Harvest	Difference
2009	38,000		42,951	4,951
2010	44,900	39,949	49,629	9,680
2011	47,200	37,520	37,543	23
2012	38,973	38,950	36,975	-1,975
2013	29,800	29,800	19,352	-10,448
2014	27,200	27,200	19,305	-7,895
2015	30,489	30,489	34,478	3,989
2016	46,098	42,109	56,501	14,392
2017	52,992	45,976	44,426	-1,550

CHESTER RIVER				
Year	TAC Computed	TAC Adjusted	Harvest	Difference
2009	6,600	6,600	4,598	-2,002
2010	7,800	7,800	8,748	948
2011	8,200	7,252	3,258	-3,294
2012	6,770	6,770	5,518	-1,252
2013	5,175	5,175	4,737	-438
2014	4,725	4,725	4,675	-50
2015	5,305	5,305	5,332	27
2016	9,221	9,194	8,077	83
2017	10,600	10,558	6,381	-4,177

PATUXENT RIVER				
Year	TAC Computed	TAC Adjusted	Harvest	Difference
2009	2,500	2,500	1,149	-1,351
2010	2,500	2,500	1,455	-1,045
2011	2,500	2,500	1,613	-887
2012	2,500	2,500	1,287	-1,213
2013	2,500	2,500	1,075	-1,425
2014	2,500	2,500	1,113	-1,387
2015	2,500	2,500	1,111	-1,389
2016	2,500	2,500	330	-2,170
2017	2,500	2,500	-	-2,500