



## Reproductive health of yellow perch *Perca flavescens* in selected tributaries of the Chesapeake Bay

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### HIGHLIGHTS

- ▶ Reduced recruitment of yellow perch has occurred in urban tributaries of Chesapeake Bay.
- ▶ We compared reproductive health biomarkers in perch from two urban, one developing, two less developed watersheds.
- ▶ Lack of final maturation, abnormal yolk and zona pellucida were noted in females.
- ▶ Leydig cell proliferation was noted in males.

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### ABSTRACT

Reduced recruitment of yellow perch has been noted for a number of years in certain urbanized watersheds (South and Severn Rivers) of the Chesapeake Bay. Other rapidly developing watersheds such as Mattawoman Creek are more recently showing evidence of reduced recruitment of anadromous fishes. In this study, we used a battery of biomarkers to better document the reproductive health of adult yellow perch collected during spring spawning in 2007–2009. Perch were collected in the South and Severn Rivers, Mattawoman Creek and the less developed Choptank and Allen's Fresh watersheds for comparison. Gonadosomatic indices, plasma reproductive hormone concentrations, plasma vitellogenin concentrations and gonad histology were evaluated in mature perch of both sexes. In addition, sperm quantity (cell counts) and quality (total and progressive motility, spermatogenic stage and DNA integrity), were measured in male perch. Many of these biomarkers varied annually and spatially, with some interesting statistical results and trends. Male perch from the Choptank and Allen's Fresh had generally higher sperm counts. In 2008 counts were significantly lower in the perch from the Severn when compared to other sites. The major microscopic gonadal abnormality in males was the proliferation of putative Leydig cells, observed in testes from Severn and less commonly, Mattawoman Creek perch. Observations that could significantly impact egg viability were an apparent lack of final maturation, abnormal yolk and thin, irregular zona pellucida. These were observed primarily in ovaries from Severn, South and less commonly Mattawoman Creek perch. The potential association of these observations with urbanization, impervious surface and chemical contaminants is discussed.

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### 1. Introduction

The native range of yellow perch (YP) *Perca flavescens* includes much of Canada, from central Canada east and southeast through the Great Lakes–St. Lawrence and the upper Mississippi basins and

on the Atlantic slope from Maine to Georgia (Grzybowski et al., 2010). Historically, YP populations in Chesapeake Bay and the Great Lakes supported major recreational and commercial fisheries (Piavis, 1991; Wells, 1977). However, at selected sites or tributaries in both geographic regions, major population declines and a lack of recruitment have occurred (Yellow Perch Work Group, 2002; Clapp and Dettmers, 2004; Wilberg et al., 2005).

In the Chesapeake Bay (Fig. 1), commercial YP harvest began to decline during the mid-1960s and reached its nadir during 1976–1982 (Yellow Perch Work Group, 2002). Declines in YP recreational fishing participation in the urbanizing subestuaries within the Baltimore–Washington corridor became evident in the 1980s (O'Dell 1987) and

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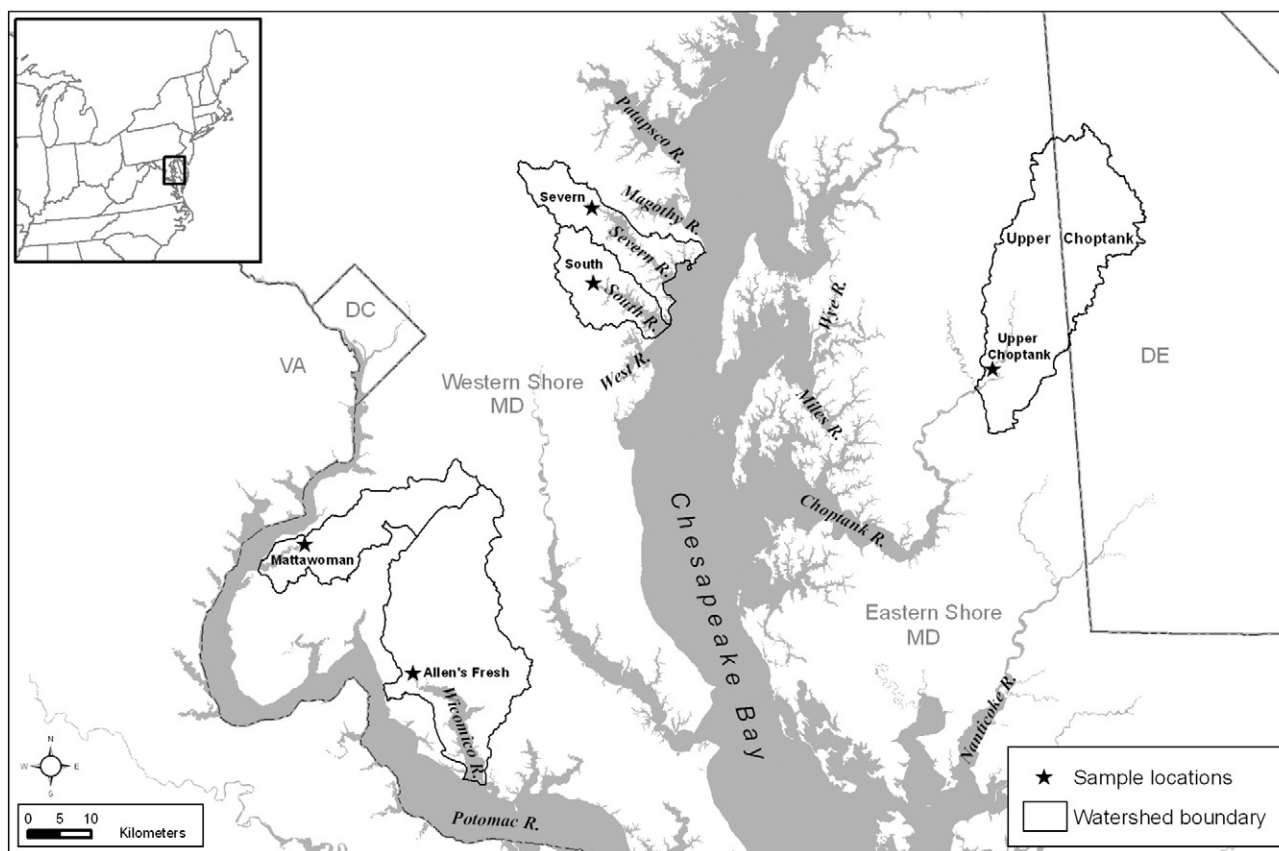


Fig. 1. Watersheds and sampling locations for collections of yellow perch in Chesapeake Bay tributaries 2007 through 2009.

these declines were attributed to habitat degradation by urban/suburban development (Yellow Perch Work Group, 2002; Uphoff et al., 2005). Subestuaries, including the Severn and South Rivers, closed to YP fishing for nearly 20 years, were reopened for recreational fishing in 2009. The rationale (for the Severn, South and West Rivers) being that these watersheds are extremely degraded habitat, reproductive output is low, while the adult population appears stable and therefore recreational harvest would not impact the total reproductive capacity (Maryland Fisheries Service, 2012).

Yellow perch are semi-anadromous in the Chesapeake Bay watershed and adults remain in their natal tributaries. As a result, they are exposed to chemical mixtures and stressors typical of their respective tributaries. Upstream spawning migration of adults and the subsequent downstream dispersal of juveniles are their primary movements (Muncy, 1962; Piavis, 1991). The adults migrate from the lower parts of the tributaries to the upper regions in search of suitable spawning habitat in late February–early March. Males tend to reach the freshwater spawning areas first and do not migrate downstream until the females leave. In the 1950s studies in the Severn River indicated YP first appeared when water temperatures were 3.9–6.7 °C and peak spawning occurred at water temperatures of 5.6–7.2 °C (Mansueti, 1964). Later studies indicated peak spawning occurs when water temperatures reach sustained levels of 8.5 to 11 °C (Hardy, 1978). Peak spawn is usually fewer than five days and in some years two to three days (S. Minkinen, personal observation).

During spawning females extrude distinctive, long, accordion-like strands of eggs, which have a thick gelatinous egg membrane (Mansueti, 1964). Two indicators that have been used to assess reproductive success and year class strength in selected tributaries are egg mass surveys and larval abundance. The Coastal Conservation Association of Maryland conducts egg mass surveys in YP spawning reaches. These surveys are performed by volunteers making counts or semi-quantitative estimated counts (i.e. >100 or >300 egg

masses per 50 m of shoreline) by walking along the shore or on the water by kayak or other watercrafts. These data are not consistently collected annually for all tributaries; however, they provide useful comparative observations suggestive of differential spawning success. For instance, counts from survey data in 2005–2009 were consistently high in the Choptank (>200) and Mattawoman (>100 except 82 in 2008). Counts in Allen's Fresh (a tributary of the Wicomico River on the western shore of the Chesapeake Bay) varied annually from 350 in 2006 to 40 in 2009. Counts have been consistently low (<100 and often <50) in the South and Severn with none observed in the South in 2009 and only seven in the Severn in 2006 (Coastal Conservation Association Maryland, Ken Hastings, personal communication).

Larval presence,  $L_p$ , is defined as the proportion of 0.5 m plankton tows with larvae during the peak weeks from late March through early May, and is used as an indicator of year class strength. The  $L_p$  index integrates egg production, egg hatching success, and survival of first-feeding larvae. Brackish systems with small watersheds and high levels of development (South, Severn and Magothy Rivers) have exhibited a persistent depression in  $L_p$ , below a reference minimum since 2002. Regression analyses indicated that development (percent of impervious surface in the watershed, i.e. pavement, rooftops and compacted soils) was negatively related to  $L_p$ . Other systems may exhibit wide variation in larval presence, but the low levels similar to those seen in these urbanized subestuaries are not common. However, since 2008 spawning site loss for anadromous fishes is evident in the developing Mattawoman Creek (Uphoff et al., 2010, 2011).

Neither excessive adult mortality nor reduced growth has been observed in Severn River YP. Additionally, Severn River broodstock induced to spawn in the hatchery produced visually abnormal egg chains and too few viable eggs to support hatchery production. Hence, the depressed egg and larval survival are hypothesized to be critical factors suppressing resident YP populations in western shore

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