Development of habitat-based reference points for recreationally important Chesapeake Bay fishes of special concern: development targets and thresholds: 2013 report at http://dnr.maryland.gov/fisheries/fhep/pdf/2013_FHEP_Annual_Report.pdf

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Job 1 Introduction

Creating reference points that indicate safe and unsafe watershed stress from development involves determining functional relationships between an indicator of watershed development and habitat quality (water quality, physical structure, etc) or a species response (habitat occupation, abundance, distribution, mortality, recruitment success, growth, fish condition, etc). Quantitative, habitat-based reference points are envisioned as a basis for strategies for managing fisheries in increasingly urbanizing coastal watersheds and for communicating the limits of fisheries resources to withstand development-related habitat changes to stakeholders and agencies involved in land-use planning.

Executive Summary

Stream Ichthyoplankton - Proportion of samples with Herring (Blueback Herring, Alewife, American Shad, and Hickory Shad) eggs and-or larvae (P_{herr}) provided a reasonably precise estimate of relative abundance based on encounter rate. Magnitude of P_{herr} may indicate how much habitat is available or how attractive it is from year to year more-so than abundance of spawners. In developed watersheds, a combination of urban and natural stream processes may create varying amounts of ephemeral spawning habitat annually and dampen spawning migrations through increased conductivity (primarily from road salt). Regression analyses indicated significant and logical relationships among $P_{herr,}$ level of development (structures per hectare or C / ha), and conductivity (a measure of dissolved salts in water) consistent with the hypothesis that urbanization was detrimental to stream spawning. An unavoidable assumption of these analyses was that watersheds at different levels of development could substitute for time-series.

In Mattawoman Creek, we obtained adequate sample sizes by pooling data across years to estimate proportions of samples with White Perch eggs and larvae or Yellow Perch larvae. This allowed us to compare for 1989-1991 collections (C / ha = 0.43–0.47) with 2008-2013 (C / ha = 0.87-0.91) at the same combinations of downstream sites. These estimates did not detect a loss in stream spawning for Yellow Perch. A decline in White Perch stream spawning was likely.

Estuarine Yellow Perch Larval Sampling - Estimates of the proportion of plankton net tows with Yellow Perch larvae, L_p, declined perceptibly once watershed development exceeded the threshold (0.83 structures per hectare, C / ha, equivalent to 10% impervious surface, IS). A forest cover classification in a watershed was associated with higher L_p (median L_p = 0.79) than agriculture (median L_p = 0.51) or development (median L_p = 0.30). Interpretation of the influence of salinity class or primary land cover on L_p needs to consider that our survey design was limited to existing patterns of development. All estimates of L_p at or below target levels of development (0.27 C / ha or 5% IS; rural forested and agricultural watersheds) or at and beyond high levels of development (1.59 C / ha or 15% IS; suburban and urban watersheds) were from brackish

subestuaries; estimates of L_p for development between these levels were from fresh-tidal subestuaries with forested watersheds.

There appears to be some potential for development to influence organic matter (OM) and larval Yellow Perch feeding dynamics. However, OM may not matter much if there is not a match in the timing of copepod abundance and early feeding stages of Yellow Perch larvae. We did not interpret RNA/DNA ratios as rejecting or supporting the OM hypothesis since there was little indication of a match of zooplankton and Yellow Perch larvae in 2012 (primarily upper Bay subestuaries) or 2013 (primarily Potomac River subestuaries). A contrasting year of high overall feeding success would greatly aid interpretation of RNA/DNA ratios. Our RNA/DNA sampling indicated that most Yellow Perch larvae collected were in the starved category in both years (55 of 91 larvae in 2012 and 2013 (137 of 170).

Estuarine Fish Community Sampling - Plots of species richness (number of species encountered) against our indicator of watershed development (structures per hectare or C / ha) in 4.9 m trawl collections did not suggest relationships for either tidal-fresh or oligohaline (low salinity) subestuaries. Plots did suggest that number of species declined when development went beyond the threshold in watersheds of mesohaline (mid-strength salinity) subestuaries. In general these exploratory analyses of species richness and development supported trends found in analyses of development and DO. Bottom DO was not negatively influenced by development in tidal-fresh or oligohaline subestuaries, but was in mesohaline subestuaries. Depletion of DO in bottom waters of mesohaline subestuaries to hypoxic or anoxic levels represented a direct loss of habitat. Availability of White Perch at a size of interest to anglers ($\geq$ 200 mm TL) were more likely to be high in mesohaline subestuaries with rural or transition watersheds, and least likely to be found in subestuaries with suburban-urban watersheds independent of salinity class.

We continued to track bottom dissolved oxygen (DO), submerged aquatic vegetation (SAV), finfish abundance and number of finfish species collected in 3.1 m and 4.9 m trawl samples from Mattawoman Creek and compared them to changes in C / ha. For this report, we obtained measurements of total ammonia nitrogen (TAN; NH_3 plus NH_4) from a Chesapeake Bay Program (CBP) monitoring site located in the channel adjacent to a continuous monitor within dense SAV bed.

The level of development in Mattawoman Creek's watershed more than doubled between 1989 (0.43 C / ha) and 2011 (0.91 C / ha) and reached the suburban threshold in 2006. A downward shift of bottom DO after 2000 corresponded to changes in Mattawoman Creek's subestuary chlorophyll a from high to low and shift in SAV acreage from low (coverage of ~10% or less of water area) to high (coverage of > 30%). Median TAN was low and stable through 2000 and then began a rapid rise to a spike in 2002. Median TAN dropped after 2002, but was elevated beyond that seen prior to 2001; during 2007-2009, median TAN was consistently elevated beyond this period's baseline.

We developed a hypothesis that water quality dynamics in Mattawoman Creek's extensive SAV beds (low DO, high pH, and high organic matter) may be creating episodes of ammonia toxicity for fish. Mattawoman Creek's finfish abundance appeared to be susceptible to boom and bust dynamics after 2001. "Busts" were concurrent with spikes (2002) or plateaus (2007-2009) of TAN. Collapses of the magnitude exhibited during 2002 and 2008-2009 were not detected previously.

MD DNR – Habitat-based reference points for recreationally important species (Jim Uphoff)	Fisheries GIT Member Update

Update on Status: ongoing.

Connection to GIT: FYI.