Anadromous Fish Spawning and Habitat Assessment

Corsica River

Final Report, 2007

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Intro

Anadromous fish, including striped bass, American shad, hickory shad, alewife herring, blueback herring, white perch and yellow perch, have historically supported economically important commercial and recreational fisheries in the Bay. These species live in estuarine or marine systems as adults and migrate into the tidal fresh and freshwater reaches of the Bay to spawn. Larval and juvenile life stages feed and grow in the confined tidal freshwater areas of the Bay's headwater and tributaries. While these species are generally wide-ranging, their early life stage and adult habitats may be confined to small areas vulnerable to landscape-related pressures (high nutrients, contaminants, disrupted hydrology). In the Bay, impaired habitat has been identified as a major threat to anadromous species, particularly yellow perch (Uphoff, et al. 2005), alewife and blueback herring (Klauda et a. 1991).

Habitat requirements for spawning and larval habitat for alewife and blueback herring and yellow perch have been described (Funderburk et al. 1991). Historical assessments of spawning and larval habitat indicate that yellow perch, white perch, alewife and blueback herring utilized the Corsica River for spawning and larval habitat (O'Dell et al. 1980). However, the watershed is under urbanization pressure, which has been shown to threaten anadromous fish habitat (Limburg and Schmidt 1990; Uphoff et al. 2005). Urbanization contributes significantly to contaminant loads, eutrophication, and physical degradation of coastal areas (Pearce 1991; Beach 2002). Research in freshwater streams has revealed a strong relationship between impervious cover and degradation of stream quality (Capiella and Brown 2001). As little as 10% watershed impervious cover can result in degraded stream conditions such as altered hydrology, elevated temperatures, eutrophication, and increased contaminants (Capiella and Brown 2001). Limburg and Schmidt (1990) noted a negative relationship and a significant threshold for declining anadromous fish spawning success in Hudson River, New York, watersheds in response to urbanization. Habitat degradation in the best recruitment areas of the Baltic Sea due to human activities (agriculture, forestry, industry, and settlement) has been implicated in the decline of estuarine populations of European perch *Perca fluviatilis* (Ljunggren et al. 2003).

Two significant habitat quality issues related to urbanization that potentially impacted yellow perch population dynamics were described in a recent study of Severn River–salinity intrusion into the upper tidal spawning area and larval nurseries due to landscape changes, and poor summer dissolved oxygen throughout juvenile and adult habitat (Uphoff et al. 2005). Depressed egg and larval viability appear to be critical factors suppressing Severn River yellow perch. PCB levels in white perch fillets in 14 tributaries were closely related to impervious surface in the watershed (King et al. 2004). Anthropogenic chemicals such PCBs disrupt endocrine function associated with reproduction and are associated with depressed survival, malformation, and abnormal chromosome division of eggs and larvae (Longwell et al. 1992; Longwell et al 1996; Colborn and Thayer 2000; Rudolph et al. 2003).

A TMDL for nutrients has been developed for the Corsica River, and stream restoration efforts to achieve needed nutrient reductions are in the planning stage. The three major tributaries to the Corsica River are also listed as biologically impaired. The restoration efforts need to consider anadromous and resident fish habitat needs in addition to nutrient reduction in order to realize the full benefit of habitat restoration.

To date, we have completed two years of anadromous fish early life stage sampling in the Corsica River. In 2006, we conducted adult sampling in the three stream reaches that documented historical spawning. We also conducted yellow perch larval fish sampling in the tidal area to determine the presence absence of yellow perch. This information has proven to be useful in determining larval habitat quality in tributaries known to support yellow perch spawning. In 2007, we conducted adult and early life stage sampling in the three stream reaches and repeated the yellow perch larval sampling in the tidal area. Additionally, under another funding initiative, we conducted summer juvenile and adult sampling in the upper tidal areas of the Corsica River proper.

Methods

Stream Spawning Survey

Volunteers set wire traps as a single site in three streams, Gravel Run, Mill Stream and Three Bridges Branch. Sites were located at the historical sampling sites (O’Dell et al. 1977).

Traps were constructed of 2.54 mm mesh chicken wire formed into cylinders 1.22 m long and 0.46 m wide. One end was crimped and secured with heavy single strand wire leaving an approximately 102 mm opening to retrieve any captured fish. The small opening was secured shut with a hook also constructed of single strand wire. The other end of the wire cylinder was left open. A funnel, also constructed of 2.54 mm wire mesh, was fitted into the open end and tapered from 457 mm at the mouth to 102 mm over a 0.61m distance.

Volunteers deployed traps with the open end facing down stream in chutes or other sites of constricted flow so that migrating fish would be likely to encounter them and were left to soak for 24 hours. They were not anchored but were secured to bank structures by a heavy cord to prevent loss during high flow from storm events. The traps were not baited. After 24 hours, volunteers retrieved the traps and any fish captured were identified to species. Any anadromous fish that were captured were measured and sex was identified. Water temperature and conductivity was taken at each site at the time of retrieval.

Samples were collected using stream drift nets. The nets were made of 360-micron mesh. They were attached to a square frame with a 300 X 460 mm opening. The frame was connected to a wood handle so that the net could be held in place. A threaded collar was placed on the end of the net so that a mason jar could be connected to the net to collect the sample. Nets were placed in the stream with the opening facing upstream for five minutes. The nets were then retrieved and rinsed in the stream, by repeatedly dipping the lower part of the net and splashing water on the outside of the net to avoid sample contamination. The mason jar was then removed from the net. A sample label describing, site, date, time and collectors was placed in the jar. The jar was sealed and placed in a cooler for transport. After a team finished sampling for the day, they would turn their samples over to the coordinator, who would then fix them with 10% buffered formalin and 2 ml rose Bengal to stain the protein.

Water quality measures including, temperature, pH, conductivity and dissolved oxygen were recorded for each site. Water quality parameters were taken using a hand held YSI model 55. The meters were calibrated for dissolved oxygen according to the manual.

All data were recorded on standard field data forms and verified at the site and also by the volunteer coordinator.

Samples were sorted in the laboratory. All samples were rinsed with water to remove the formalin. Samples were then placed into a white sorting pan. The samples were sorted systematically (from one end of the pan to another) under a 10x bench magnifier. All larvae and eggs were removed from the sample and identified under a microscope. Eggs and larvae were retained in small vials and fixed with formaldehyde for verification. Ten percent of the samples were placed back into the jar after they were sorted in order to assess sorting efficiency.

Yellow Perch Larval Presence-absence

Conical plankton nets were used to collect larvae at 10 sites per system 2-3 days each week in the upper estuaries. These sites were sampled with little or no spacing between tows because the larval nurseries were small. The extent of the area to be sampled was determined from larval presence in surveys conducted during the 1970s and 1980s (O'Dell 1987). Nets were 0.5-m in diameter, 1.0-m long, and had 0.5 mm mesh. Plankton nets were towed for two min at about 2.8 km per hour during nine dates between March 27 and April 27, 2006.

Each sample was emptied into a glass jar and checked for larvae. If a jar contained enough detritus to obscure examination, it was emptied into a pan with a dark background and observed through a magnifying lens. Detritus was moved with a probe or forceps to free larvae for observation. On a few occasions, detritus loads or wave action prevented thorough examination, so samples were preserved and brought back to the lab for sorting.

Larval yellow perch relative abundance was assessed as presence–absence (Mangel and Smith 1990) rather than using counts because high numbers of zero catches were expected and encountered. The proportion of tows with yellow perch larvae (L_p) was determined annually for dates spanning the first catch through the last date that larvae were consistently present. Confidence intervals (95%) were constructed using the normal distribution to approximate the binomial distribution (Uphoff 1997).

Yellow perch larval presence-absence in the tidal Corsica was compared to a record of L_p developed from historic data collected in the tidal Nanticoke (1965-1971) and Choptank rivers (1986-1990 and 1998-2003), collections in the Nanticoke river during 2004-2006 and Severn River during 2001-2005. Severn River collections during 2004-2005 used identical methods employed in 2006; a composite estimate for 2001-2003 (plotted as 2002) was formulated because annual sampling was inadequate during these years (Uphoff et al. 2005). Choptank and Nanticoke River collections made prior to 1991were considered an historic reference and their mean L_p (0.66) was used as an estimate of central tendency. Historic collections in the Choptank and Nanticoke rivers targeted striped bass eggs and larvae (Uphoff 1997), but yellow perch were also common. Larval presence-absence was calculated from data sheets prior to 1998. After 1998, L_p in the Choptank River was determined directly in the field in the same manner used for striped bass eggs (Uphoff 1997). All tows were made for two minutes. Standard 0.5 m diameter nets were used in the Nanticoke River during 1965-1971 (1.0 • 0.5 mm mesh) and after 1998 in the Choptank River (0.5 mm mesh). Trawls with 0.5 m nets (0.5 mm mesh) mounted in the cod-end were used in the Choptank River during 1986-1990 (Uphoff et al. 2005). Survey designs for Choptank and Nanticoke rivers are described in Uphoff (1997).

Salinity (ppt) and temperature data (°C) collected during 2006 were compared to requirements of yellow perch larvae (Piavis 1991) to determine the extent and duration of suitable habitat. A negative impact was inferred from any measurement not meeting the habitat requirements and the suitability of each parameter was indicated by the percentage of measurements not meeting the requirement. Temperatures > 20 °C and salinity > 2 $^{o}/_{oo}$ were considered detrimental. Means and standard errors (SE) of all temperature and salinity measurements (all dates and sites) were estimated for each system.

Summer Juvenile and Adult Sampling

Each fixed site was sampled once a visit and there were two visits a month during July-September. All sites on one river were sampled on the same day, except Mattawoman and Piscataway rivers which were sampled the same day to reduce mileage and travel time. Sites were numbered from upstream (site 1) to downstream. The crew leader flipped a coin each day to determine whether to start upstream or downstream. This coin-flip somewhat randomized potential effects of location and time of day on catches and dissolved oxygen concentrations. However, sites located in the middle would likely not be influenced by the random start location as much as sites on the extremes because of the bus-route nature of the sampling design. If certain sites needed to be sampled on a given tide then the crew leader deviated from the sample route to accommodate this need. Trawl sites were generally in the channel, adjacent to seine sites. At some sites, seine hauls could not be made because of permanent obstructions or lack of beaches. The latitude and longitude of the trawl sites was taken in the middle of the trawl area, while seine latitude and longitude were taken at the exact seining location.

Water quality parameters were recorded at all sites. Temperature (ºC), dissolved oxygen (mg/L), conductivity (μmho), salinity (ppt) and pH (units) were recorded for the surface, middle and bottom of the water column at the trawl sites and at the surface of the seine site. Mid-depth measurements were omitted at shallow sites with less than 1.0 m difference between surface and bottom. Secchi depth, to the nearest 0.1 m, was taken at each trawl site. Weather, tide state (flood, ebb, high or low slack), date and start time were recorded for all sites.

Trawling and seining were used to sample fish populations. Gear specifications and techniques were selected to be compatible with other Fisheries Service surveys.

A 4.9 m (16ft) semi-balloon otter trawl was used to sample fishes in mid-channel bottom habitat. The trawl was constructed of treated nylon mesh netting measuring 38.1 mm (1½ inch) stretch in the body and 33 mm (1¼ inch) stretch in the codend, with an untreated 12 mm (½ inch) stretch knotless mesh liner. The headrope was equipped with floats and the footrope was equipped with a 3.2 mm (1/8 inch) chain. The net used 0.61 m (24 inch) long by 0.30 m (12 inch) high trawl doors attached to a 6.1 m (20 ft) bridle leading to a 24.4 m (80 ft) towrope. Trawling was in the same direction as the tide. The trawl was set up tide of the actual site location far enough to pass the site halfway through the tow. This allowed the same general area to be trawled regardless of tide direction. A single tow was made for six minutes at 3.2 km/hr (2.0 miles/hr) at a site on each visit. The contents of the trawl were emptied into a tub for processing.

An untreated 30.5 m • 1.2 m (100 ft • 4 ft) bagless knotted 6.4 mm (¼ inch) stretch mesh beach seine, the standard gear for Bay inshore fish surveys (Carmichael et al. 1992; Durell 2004), was used to sample inshore habitat. The float-line was rigged with 38.1 mm • 66 mm (1½ • 2½ inch) floats spaced at 0.61 m (24 inch) intervals and the lead-line had 57 gm (2 ounce) lead weights spaced evenly at 0.55 m (18 inch) intervals. One end of the seine was held on shore, while the other was stretched perpendicular to shore as far as depth permitted and then pulled with the tide in a quarter arc. The open end of the net was moved towards shore once the net was stretched to its maximum. Once both ends of the net were on shore, the net was retrieved by hand in a diminishing arc until the net was entirely pursed. The section of the net containing the fish was then placed in a washtub for processing. The distance the net was stretched from shore, the maximum depth of the seine area, primary and secondary bottom type, and percent of seine area containing aquatic plants were recorded.

All fish captured were identified to species and counted. Striped bass and yellow perch were separated into juveniles and adults. White perch were separated into three categories (juvenile, small and harvestable size) based on size and life stage. The small white perch category consisted of age 1+ white perch smaller than 200 mm. White perch greater than 199 mm were considered to be of harvestable size and all captured were measured to the nearest millimeter.

Results:

Stream Spawning Survey

We surveyed three streams in the Corsica River to determine if anadromous fish were using them as spawning grounds. Both Old Mill Stream Branch and Three Bridges Branch supported anadromous fish spawning when they were surveyed in the late 1970’s, whereas Gravel Run did not show evidence that anadromous fish were present during spawning season (O’Dell et al, 1980). We examined the proportion of samples with fish present in our trap and ichthyoplankton samples (Figures1 and 2). Results show that the Old Mill Stream Branch and Three Bridges Branch are still functioning as they did in the 1970’s as spawning and nursery habitat for yellow perch and white perch, as evidenced by presence of both ripe adults and eggs and larvae. We did observe one male white perch in spawning condition, in Gravel Run, however, we did not find evidence of successful spawning in ichthyoplankton samples (no eggs or larvae were observed). These data represent 10 samples taken in 2006 and 7 samples in 2007.

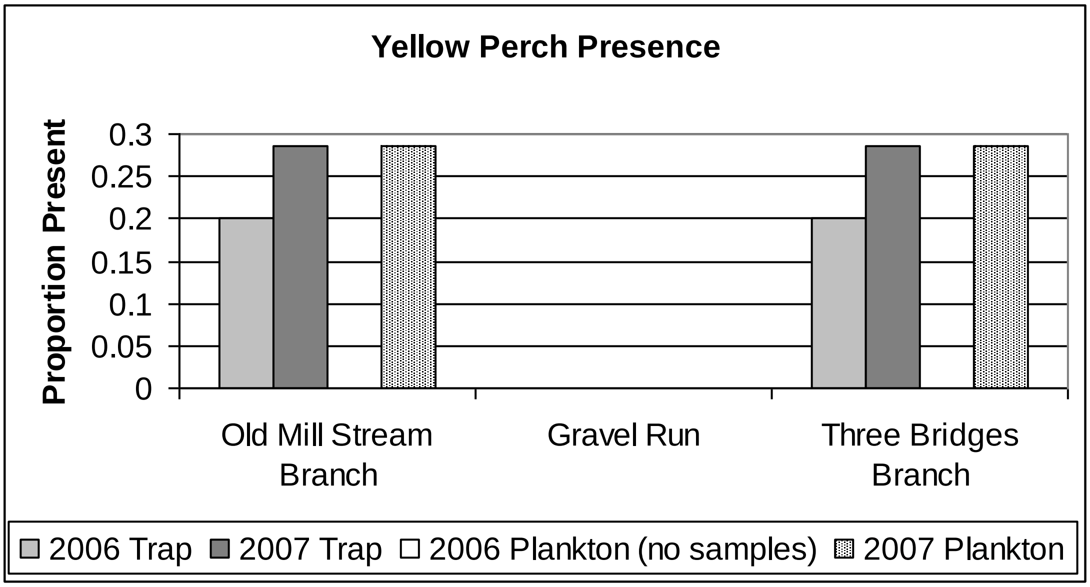

Figure 1. Proportion of samples with adult yellow perch and eggs or larvae present.

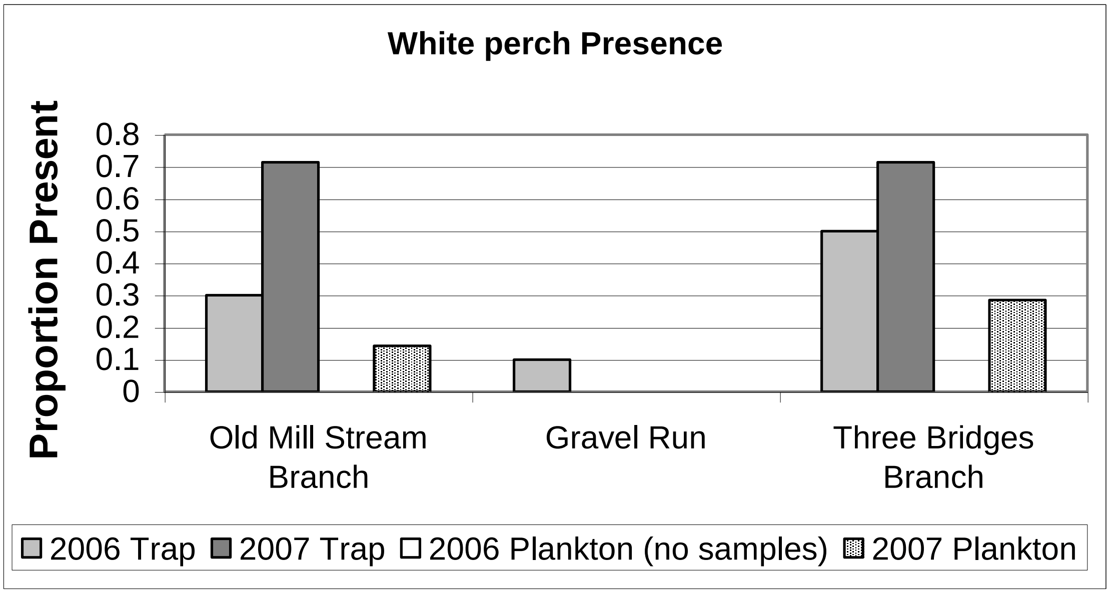

Figure 2. Proportion of samples with adult yellow perch and eggs or larvae present.

Yellow Perch Larval Presence-absence

In 2006, the proportion of positive tows in the Corsica River (0.5) was below the historical median of 0.65, however, it was within the range of the Choptank River, which has an active

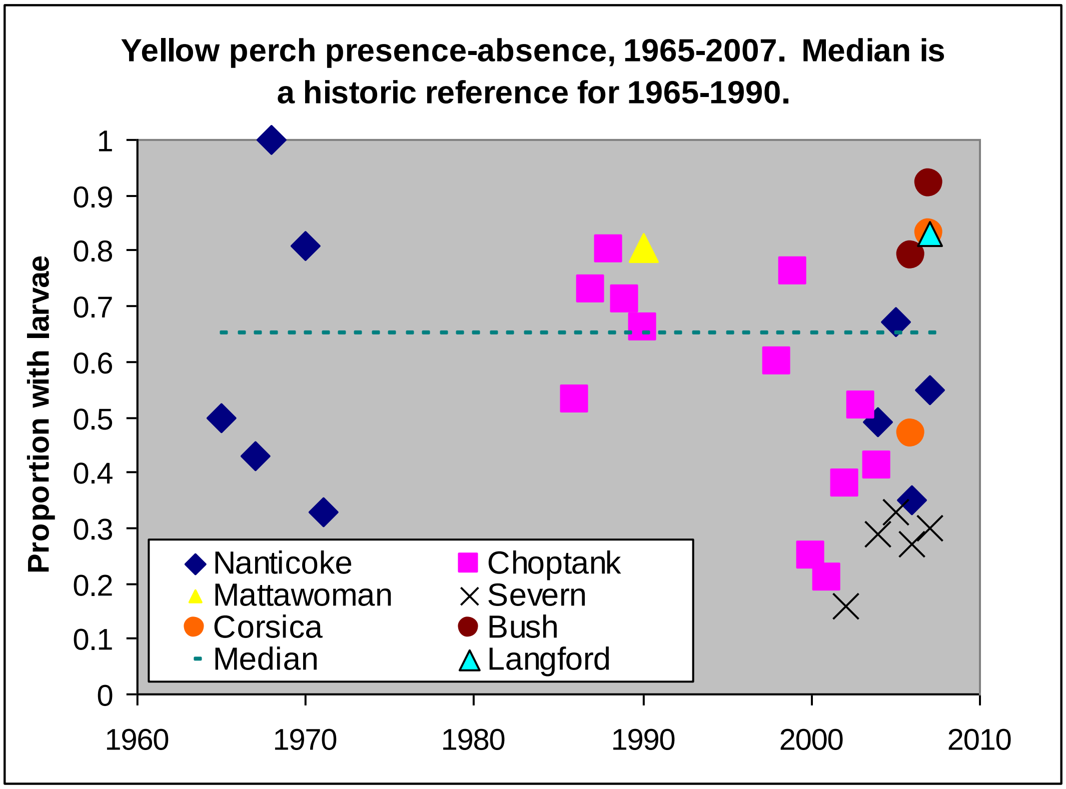

Figure 3. Yellow perch larval presence for systems sampled from 1960 to present.

fishery, which remains productive (Piavis et al. 1999). It was also within the range of the Nanticoke River, which has been closed to fishing for over two decades but still supports a viable yellow perch population (Piavis et al. 1999). Because it was below the median proportion, we sampled Langford Creek in 2007as a comparison to the Corsica. We found that the Corsica River and Langford Creek had very similar presence of yellow perch larvae in 2007, and they were both above the median presence with 80% of the samples showing presence of yellow perch. This suggests to us that reproduction is successful and barring any unforeseen mortality events, the population should remain viable if the present state of the watershed is maintained. We are concerned however, that if the watershed undergoes substantial urban development, we will begin to see a decline in yellow perch reproduction, like we have seen in our study of the Severn River (Uphoff et al, 2005).

Summer Juvenile and Adult Sampling

A total of 75,550 fish representing 33 species were captured in seines and trawls in the Corsica River between 2003 and 2006. We caught 33,519 fish representing 23 species in trawls. White perch was the dominate species, comprising 69% of the total catch. Atlantic silversides dominated the seine catch and made up 42% of the total catch. We captured 42,031 fish representing 28 species. Four species (American eel, Atlantic croaker, hogchoker, and white catfish) were captured in the trawl, which were not observed in the seine. Nine species occurred in the seine, which were not observed in the trawl. These included Atlantic needlefish, banded killifish, bluefish, Northern pipefish, rainwater killifish, silvery minnow, striped anchovy, striped killifish, and tessellated darter.

River	Year	Total Fish Captured	Catch per Effort	Number of Species Observed	Species Comprising 90% of the Catch
Corsica	2003	16,792	600	16	White perch Bay anchovy
Corsica	2004	6,409	267	16	White perch Striped bass Bay anchovy
Corsica	2005	3,998	167	18	White perch Spot
Corsica	2006	6,320	263	12	White perch
Langford	2006	7,003	292	13	White perch

Table 1. Fish summary information from the trawl.

Tables 1 and 2 show the total catch by year for the Corsica River. Number of species, total catch and effort adjusted catch declined in the trawl and the seine over the sampling period. However, we examined the 2006 data from Langford Creek as a comparison and found that the 2006 catch data from the Corsica River were similar to 2006 catch data for Langford Creek. Baywide seine data from the Maryland Striped Bass Juvenile Index Survey show that white perch abundance has declined over the same time frame (http://www.dnr.state.md.us/fisheries/juvindex/index.html). This decline coupled with the similarity between Langford Catch and Corsica catch in 2006 suggest that this decline was not triggered by some internal change in habitat, but instead reflects similar patterns that are being observed from a baywide perspective. However, we will continue to monitor the summer fish assemblage this year to determine if this declining trend continues in the Corsica River.

River	Year	Total Fish Captured	Catch per Effort	Number of Species Observed	Species Comprising 90% of the Catch
Corsica	2003	19,149	1197	23	Atlantic silverside Blueback herring White perch Striped killifish Striped bass
Corsica	2004	11,582	681	20	Atlantic silverside Mummichog Striped killifish Spottail shiner White perch
Corsica	2005	8,627	479	21	Mummichog White perch Atlantic silverside Spottail shiner Banded killifish Striped killifish
Corsica	2006	2,673	148	19	White perch Mummichog Bay anchovy Atlantic menhaden Striped killifish Atlantic silverside
Langford	2006	1446	69	21	White perch Atlantic silverside Striped killifish Bay anchovy Atlantic menhaden Mummichog Gizzard shad Inland silverside Striped bass Spottail shiner Pumpkinseed Spot Bluegill Bluefish Yellow perch

Table 2. Fish summary information from the seine.

We examined water quality conditions in the near-shore seine area and the offshore trawl area. Table 3 shows the mean and range of data observed by station. Median temperature and salinity fluctuated over the years. This reflects natural variation that is inherent in these systems. However, interestingly, median dissolved oxygen remained fairly constant over the years. The

River	Year	Median Temperature (°T)	Range Temperature (°T)	Median Dissolved Oxygen (m/L)	Range Dissolved Oxygen (mg/L)	Median Salinity (ppt)	Range Salinity (ppt)
Corsica	2003	26.65	19.5-29.8	5.6	1.4-10.7	4.4	1.3-9.0
Corsica	2004	27.35	23.0-29.5	5.35	2.2-9.7	6.5	3.6-7.5
Corsica	2005	28.5	25.4-32.5	5.05	0.0-11.6	7.7	4.4-11.0
Corsica	2006	27.3	22.7-33.0	5.25	1.5-16.8	7.3	4.6-10.2
Langford	2006	27.3	21.0-30.7	6.65	3.4-9.9	6.35	5.5-10.6

Table 3. Median temperature, dissolved oxygen and salinity for all stations and areas sampled in Corsica River and Langford Creek.

range in dissolved oxygen was greatest in 2006 with the maximum dissolved oxygen concentration reaching 16.8 mg/L. This high concentration was likely driven by the persistent algal bloom that was documented by DNR see (http://mddnr.chesapeakebay.net/newmontech/contmon/archived_results_quick_fullyear_graph.cfm?param=chlorophyll&year=2006&shortname=corsicariver&tablename=corsicariver2006 which shows the concentration of chlorophyll a at Sycamore Point.)

River	Year	Percent time below 5.0 mg/L dissolved oxygen	Percent time below 3.0 mg/L dissolved oxygen
Corsica	2003	54	7
Corsica	2004	54	4
Corsica	2005	83	33
Corsica	2006	75	25
Langford	2007	33	0

Table 4. Percentage of time dissolved oxygen was below the 5.0 and 3.0 mg/L standard for dissolved oxygen.

We also examined bottom dissolved oxygen in the offshore channel area to determine how often it was below the 5.0 mg/L concentration that is a commonly accepted standard for fish. Table 4 shows these results. Data show Corsica water dissolved oxygen concentrations in the bottom water fail to meet the 5.0 mg/L criterion at least half the time. This varied by year, but in 2006 when we sampled Langford Creek, violations in the Corsica were double what we observed in Langford Creek. These data represent six measurements at four stations per year during the summer sampling season when water quality conditions are most taxing on fish. Other work that we have done suggests that a dissolved oxygen threshold of 3.0 mg/L results in reduced presence of key game and sport fish (Uphoff et al. 2007). We applied this threshold and observed an increasing trend of oxygen concentrations below this threshold as well. In 2006, Langford Creek did not have any violations of this lower threshold, where Corsica had violations 25% of the time. We presume that this increase in violations is related to the prolonged sewage spill that was abated in 2004 (??), which added a large organic load in a system that is poorly flushed. However, based on our comparisons in fish catch, we did not see an obvious response in the fish community. Comparisons between Corsica and Langford were similar, even while water quality was better in Langford Creek.

Discussion:

Our evaluation of fish data in the Corsica River suggest that it is still a viable spawning habitat for the semi-anadromous, Chesapeake Bay resident species, white perch and yellow perch. Comparisons to historic records show that areas that served as spawning and nursery habitat are still supporting this function today. This is what was expected, given the watershed is still minimally urbanized. In a similar study in the Bush River, we found that increases in impervious cover (4% - 8.5%) can result in loss of stream spawning habitat for these species (Uphoff et al. 2007). Yellow perch larval presence/absence sampling revealed that larval survival is as good as other river systems that have known viable yellow perch populations. IN a case study conducted on the Severn River, where impervious cover exceeds 15% of the watershed, we documented that yellow perch reproduction is impaired. We observed spawning adults, but eggs collected from this river system showed poor hatch rate and larval survival was very low. This suggests that there a factor that is complicating reproduction. When we compare the Severn River with watersheds with a more rural landscape, similar to the Corsica, we find increased survival and stable populations (Uphoff et al. 2005). Given this potential loss in spawning habitat and population stability, we caution the Implementer’s Team to consider the impact of future development in the watershed and work to curb growth as much as possible.

Tidal fish community data showed a decline in abundance and also species over the four year sampling record. However, recent comparisons to Langford Creek did not show that the

Corsica was drastically different in fish community abundance and composition. Declines that were seen in the Corsica were reflected in baywide declines observed in the Maryland Juvenile Index Study. However, bottom dissolved oxygen conditions in the Corsica appear to be getting worse. The violations of the 3.0 mg/L criteria increased over the four years, probably in response to the organic load related to past sewage spills. Evidence from our impervious cover work shows that increases in deep water low oxygen can be expected in systems that are urbanizing. In watersheds where impervious cover was greater than 10%, dissolved oxygen in the bottom water rarely exceeded 3.0 mg/L and almost never reached the 5.0 mg/L mark. This effect leads to a habitat squeeze phenomenon, where fish in the offshore are move near-shore to find viable habitat. This causes crowding, which can lead to increased predator prey interactions and increased disease incident. Loss of bottom habitat also reduces food availability for bottom feeding fishes like white perch. Research still needs to be conducted to determine how damaging this can be to a white perch population. (Uphoff et al. 2007).

Conclusion

Our present assessment indicates that the Corsica River is still supporting viable and crucial spawning and nursery habitat for the semi-anadromous white perch and yellow perch. We recommend a cautious approach to development that limits impervious cover to no more than 8% of the watershed. Percentages higher than this have been associated with loss in spawning and nursery habitat for these species. Dissolved oxygen concentrations are declining, further development in the watershed could exacerbate this effect.

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