CHESAPEAKE BAY COMMISSION

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Land Conservation = Fish Conservation

New Science Brings New Meaning

New science is emerging that paints a clearer picture of the relationship between land use, water quality and fisheries health. Up until now, while intuitively obvious, the science behind the linkage has been oblique. What we do on the land can play a profound role on the health of our fisheries. Below are two case studies – one positive and one negative – linking land use to fisheries health.

Agricultural Lands

The Chesapeake Bay supplies most of the striped bass (or rockfish) for the Atlantic coast. Reproductive success underwent a severe decline in the 1970s. Overfishing and habitat deterioration had been implicated as possible causes. Strong conservation measures that reduced harvest, including moratoriums in Bay waters, were followed by a dramatic recovery of the population. However, it is possible that agricultural conservation measures enhanced recovery as well.

From 1980 to 1990, the Maryland Department of Natural Resources' Fisheries Service studied the survival of striped bass eggs and larvae in Choptank River to better understand why rockfish had declined. The Choptank River is an important striped bass nursery area. This study found that survival rates of larvae increased at the development stage where they shifted from feeding on their egg yolk to being able to feed on their own (see Figure 1).

Agricultural pesticides and fertilizers were thought to be potential sources of toxic metals implicated in the sharp decline of striped bass. In 1994, the Caroline County Soil Conservation Service District Conservationist (Mr. James Luzader) supplied records of implementation of nine major agricultural best management practices (BMPs) during the 1980-1990 period (other counties did not have comparable records). Caroline County borders a major portion of the Choptank River and the records should indicate BMP trends in the watershed. Increased larval survival coincided with increased adoption of agricultural BMPs designed to conserve soil, reduce contaminated runoff and reduce pesticide and fertilizer use (see also Figure 1). As many as four BMPs were positively correlated with survival and two measures that accounted for the greatest acreage -- conservation tillage and cover crops -- were most strongly correlated.

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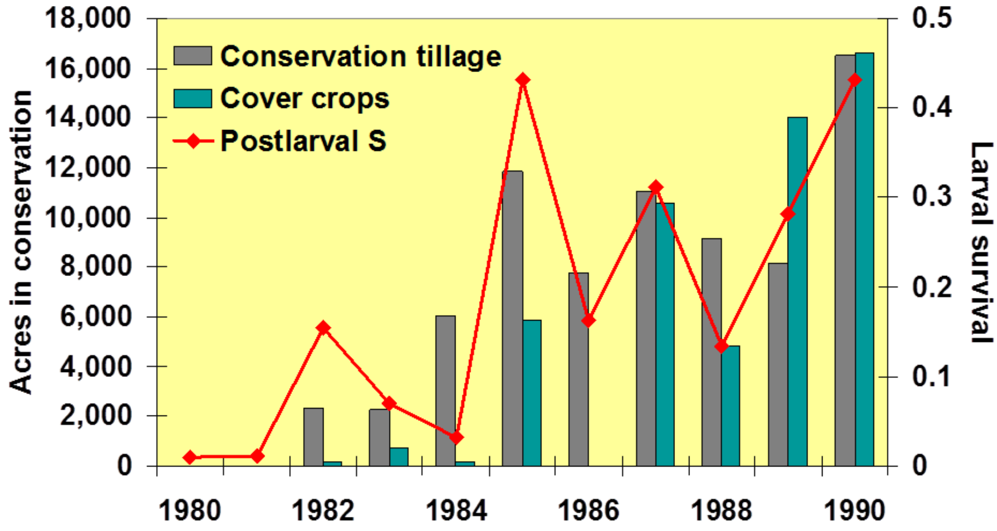
Figure 1. Choptank River postlarval survival follows Caroline County BMPs that minimized erosion, and use of pesticides and fertilizer. Caroline County, MD, borders most of the nursery and had very good records.



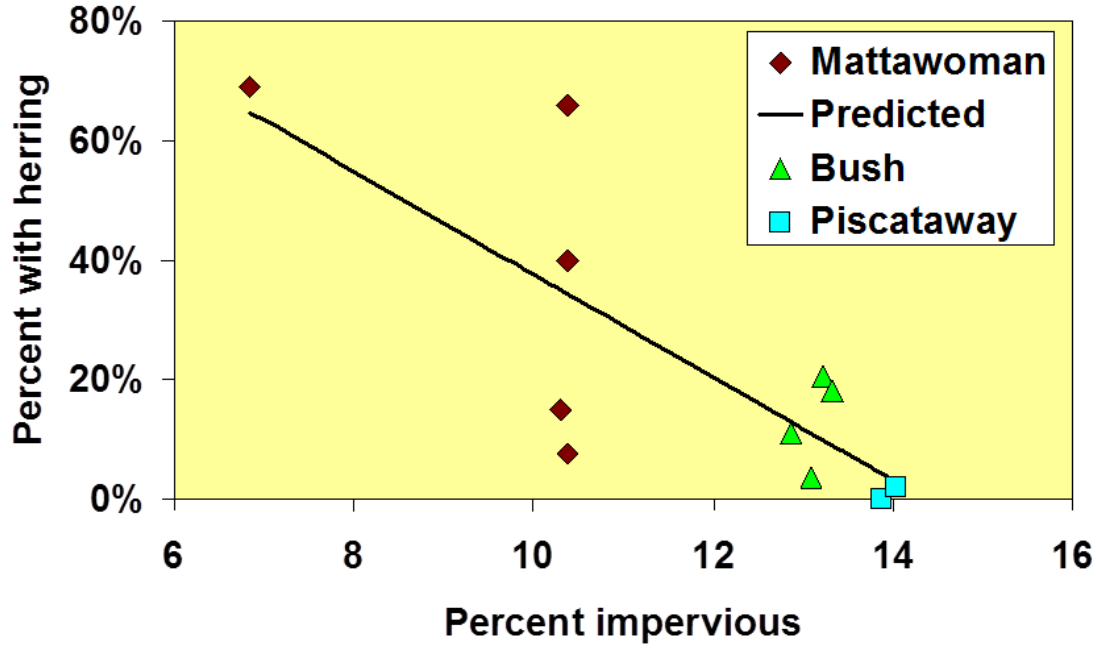
Developed Lands

Development affects water quality and quantity needed for good fish habitat.   Development converts natural areas into paved surfaces, rooftops, and compacted soils which results in less infiltration to groundwater and greater volumes of surface water. Local streams experience lower flows between rainfall events and extreme flows during storms, resulting in more flooding, stream channel erosion, and downstream sedimentation.

As trees are replaced by impervious surfaces, runoff temperature increases. Excess nutrients washed from developed lands can cause algae blooms that deplete oxygen. Expanding road networks require more salt to melt winter's ice which then pollutes streams and threatens freshwater organisms, including fish. Other pollutants such as toxic metals (lead, cadmium, etc.) and organic pollutants (oil, grease, and pesticides) enter waterways in urban runoff and wastewater. These compounds may reduce success of fish spawning and make fish less safe to eat. As the percentage of impervious surfaces in a watershed increases, fish diversity declines and desirable species can become less abundant. .

A Maryland DNR's Fisheries Service study indicates that stream spawning of herring, both alewife and blueback herring, diminishes with increasing development (indicated by the amount of impervious surface in the watershed). The percentage of streams sampled that had one or more herring egg or larvae (see Figure 2) was about 70 percent when impervious surfaces occupied 7 percent of a watershed (a rural watershed in transition to a suburban one). The percentage of streams with eggs or larvae declined steadily as the transition to a suburban watershed (10 percent or more impervious surface) was complete (see also Figure 2).

Figure 2. Percent of stream samples with herring eggs or larvae versus impervious surface for three Maryland watersheds.



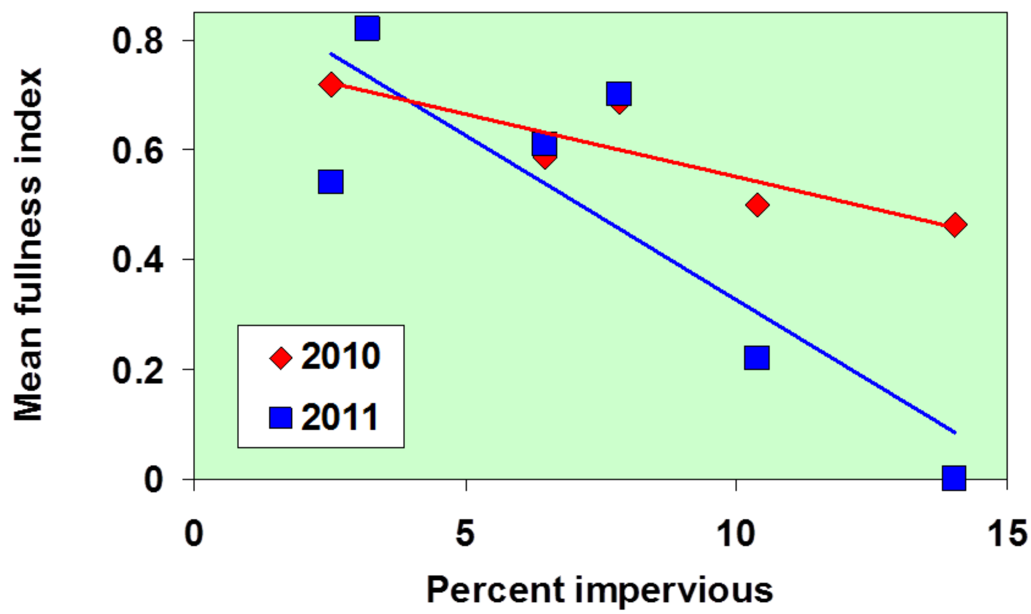
The percentage of sampled streams with herring eggs or larvae was predicted to fall to near zero as the watershed developed further to 14 percent impervious surface. An earlier study in Hudson River tributaries in New York State also found that alewife egg and larval densities declined strongly with increasing development. Herring stocks along the Atlantic coast have declined dramatically for a variety of reasons and destruction of stream spawning habitat because of development appears to be a contributing factor.

The importance of adequate zooplankton supply on feeding success of Chesapeake Bay striped bass and American shad larvae has also been well documented. Low feeding success can lead to starvation and failure of a year-class. Yellow perch larvae occupy the same habitat and are believed to mirror the survival characteristics of striped bass. A recent study of yellow perch larval feeding success in Chesapeake Bay sub-estuaries during 2010 and 2011 by Maryland DNR's Fisheries Service has found that feeding success declined as impervious surface increased (Figure 3).

Years of high spring flow favor anadromous fish recruitment in Chesapeake Bay and may represent favorable episodes that deliver accumulated organic matter from the watershed to the estuary. This organic matter fuels higher production of zooplankton that fish larvae feed on. Land-based organic matter largely supported one of the most successful year-classes of American shad in Virginia's York River, while less successful year-classes were associated with low flows that delivered less organic matter resulting in less phytoplankton and zooplankton production. Differences in annual feeding success were much more extreme in suburban tributaries (10 percent or more impervious surface) and it was likely that larvae starved in 2011 in the most developed tributary.

The amount of organic matter present during 2011 yellow perch sampling declined as the percent development increased. This decline suggests that urbanization may affect the quality, quantity and timing of the delivery of organic matter in streams as riparian zones and floodplains become disconnected from stream networks by stormwater management and the burial of small streams into culverts, pipes, and pavement.

Figure 3. Feeding success of yellow perch larvae on zooplankton in 2010 and 2011 declined with development.



Conclusion

As agricultural operations intensify and urbanized land uses increase, it becomes more important than ever to understand their potential impacts on fish and shellfish populations. The case studies presented above provide scientific confirmation that decisions about land use have a direct bearing on the health of fish populations, both good and bad. Policies to improve land management and land conservation must be more closely aligned with policies to manage our fisheries if we are to succeed in accommodating both our growing populations and the resources we need to survive. In other words, sound land conservation really can improve fisheries management.

CREDITS:
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