Managing Development and Chesapeake Bay’s Estuarine Fish Habitat and Fisheries

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Maryland Fisheries Service has been looking at development and fish habitat dynamics in Chesapeake Bay.

Ecosystem-based management approach

• **Goals:**
  – Fish management strategies that reflect development’s impact
  – Guidance for planning agencies
MD subestuaries studied 2001-2011

Spring spawning & larval habitat: egg-larval collections.

Summer habitat: Juvenile-adult & DO
Focus is on "iconic" managed species
Presence-absence (P-A) is main measure of fish response to development

- Ecologically meaningful
- Statistically robust
- Understandable
- Cost-effective
- Larval collections designed for P-A
- Convert juvenile-adult counts for each species to P-A (frequent 0’s, clumped distributions)
- Use counts for total N & species richness
Impervious surface measures intensity of development

- Baltimore
- Magothy
- Severn
- South
- Miles
- St. Clements
- Corsica

Impervious %

City
Suburb
Rural
Volunteers conducted anadromous fish stream surveys during 2005-2010 to explore development’s effect.

Three watersheds were sampled.
Proportion of stream samples with herring eggs or larvae versus impervious surface

![Graph showing the proportion of stream samples with herring eggs or larvae versus impervious surface. The graph includes data points for Mattawoman, Bush, and Piscataway, with a regression line indicating a correlation coefficient of $r^2 = 0.77$. The 1991 sampling point is also marked.](image)

$1991$ sampling

$r^2 = 0.77$
Proportion of samples (95% CI) with anadromous fish eggs or larvae in developed and undeveloped portions of watershed
Estuarine yellow perch larvae were sampled with plankton nets towed from boats.
Proportion of tows with yellow perch larvae declines with development in tidal-fresh and brackish subestuaries (fresh and brackish as categories in regression)

\[ R^2 = 0.61 \]
Early larvae feeding success on zooplankton in 2010 was negatively related to development in 5 subestuaries.

\[ r^2 = 0.77 \]

**Graph:**
- **Y-axis:** Mean fullness index (Range = 0 to 1)
  - Index = 0, no food
  - Index = 1, completely full
- **X-axis:** Percent impervious
  - 0 to 15%

The graph shows a linear relationship between percent impervious and mean fullness index, with a high coefficient of determination, indicating a strong negative correlation.
Summer habitat: habitat occupation and dissolved oxygen
Mean summer bottom DO and percent impervious for fresh and brackish tributaries.

![Graph showing the relationship between percent impervious surface and mean bottom DO for fresh and brackish tributaries. The graph includes linear regression lines for each type with the following coefficients:

- Fresh: $r^2 = 0.66, P < 0.0001$
- Brackish: $r^2 = 0.47, P = 0.014$]
Proportion of bottom trawls with adult white perch degrades by 15% impervious in fresh-tidal or brackish, but how you get there differs.

\[ r^2 = 0.35, P = 0.0006 \]
\[ r^2 = 0.91, P = 0.0001 \]
Severn River yellow perch fishery & development, 1950-2009

- Egg hatch > 80%
- Egg hatch < 10%
- Lethal salinity
- Hypoxia
- PCB’s?

Fishery closed.
Fishery reopened.

% Impervious Surface

Reopened - egg hatching too low for recovery

- Maryland threshold SSB per recruit = 25%; target = 35%
- Current / past egg hatch = current SSB per recruit at F=0
- Best case = 12%
- Threshold can't be reached
- Occasional recolonization from outside provides fishery
Perch encounter multiple development-related stressors

Watershed
- Road salt
- Sediment
- Flow change

Streams
- Tidal-fresh estuary

Salinity
Zooplankton
Contaminants

Estuary
- Low DO / high nutrients
- Altered food web?

Contaminants
Nutrients
Detritus

Low DO / high nutrients
Altered food web?
Endocrine disruptors?
Harvest

Watershed

Estuary

Tidal-fresh estuary

Salinity
Zooplankton
Contaminants

Low DO / high nutrients
Altered food web?
Impervious surface reference points

- < 5% impervious - harvest restrictions & stocking; preserve watershed
- 5-10% - option to decrease harvest & stocking to compensate. Preserve & fix watershed
- >10% - preserve & fix watershed.
  Managing harvest & stocking not sustainable strategies.
- >15% - watershed & fishery solutions limited
Planning and zoning is fisheries management!!!

- Development is the source of stressors too extensive for fisheries managers to “go it alone”
- Local development plans are a proactive approach to managing land use and fish habitat
- New DNR effort – state natural resource managers work with local planners to protect fish habitat