Fish – Habitat Connections

Land use, shoreline, hypoxia & acidification

…a focus on the shallows

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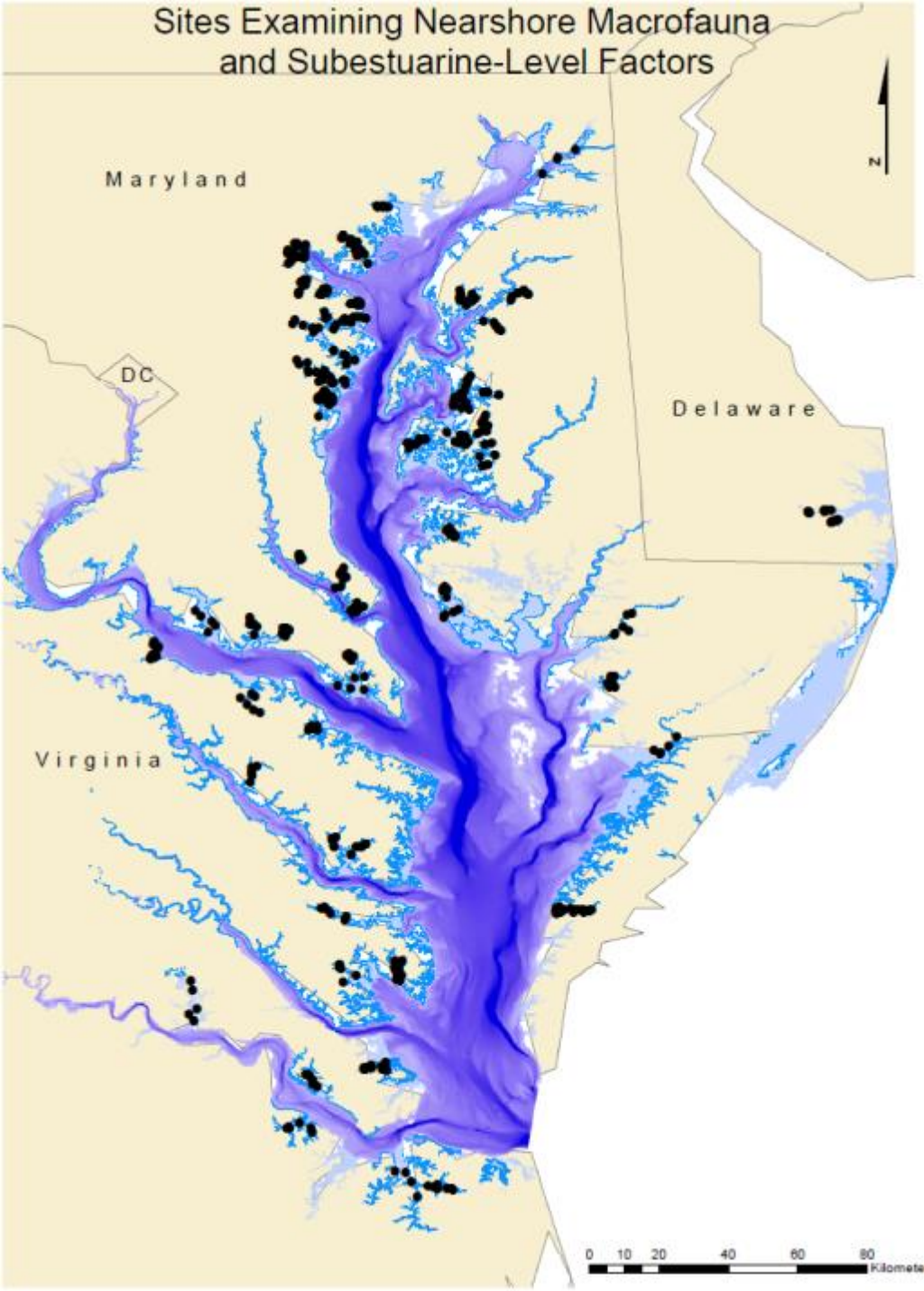
- Field sampling & meta-analysis – land use and shoreline hardening (nearshore finfish, blue crabs & grass shrimp)
- *Phragmites* vs native vegetation (mummichogs)
- Acidification & hypoxia (silversides)

Local scale effects

Land Cover

Shoreline hardening & alteration



Scope of Study

- Meta-analysis of fisheries data spanning 39 subestuaries and 587 sites (Kornis *et al*. in review)
- > 600,000 individuals
- Subset examining direct use of wetland, beach, bulkhead and riprap (64 sites each)

Data Contributors

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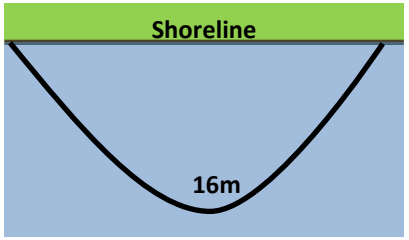
Donna Bilkovic (VIMS)
Richard Balouskus/Tim Targett (U-Delaware)
Ryan King (Baylor U, formerly of SERC)
Jim Uphoff (Maryland DNR)
Steve Giordano & David Bruce (NOAA CBO)
John Jacobs (NOAA Oxford Lab)

Bulkhead and riprap shorelines leave small-bodied fishes between a rock and a hard place



Smaller bodied species tend to be more abundant at natural shorelines; larger bodied species tend to be more abundant at hardened shorelines

Subestuary-Scale Effects

Significant Predictors for 12 of 16 species

Positive Relationship	Negative Relationship

% Cropland – 6
Blue Crab
Atlantic Croaker
Spot
Mummichog
Atlantic Menhaden
Centrarchidae

Negative for Benthivores
Positive for Planktivores

% Hardened Shoreline – 10
Blue Crab
Atlantic Croaker
Spot
Silver Perch
Bay Anchovy
Hogchoker
Menidia spp.
Atlantic Menhaden
Grass Shrimp
Centrarchidae

Mostly Negative

% Riparian Wetland – 14
Blue Crab
Atlantic Croaker
Spot
Silver Perch
Bay Anchovy
Hogchoker
Atlantic Menhaden
Centrarchidae
Menidia spp.
Grass Shrimp
Hogchoker
Gizzard Shad
Mummichog
Striped Killifish
Striped Bass

Mostly Positive

Blue Crab

Spot

Atlantic Croaker

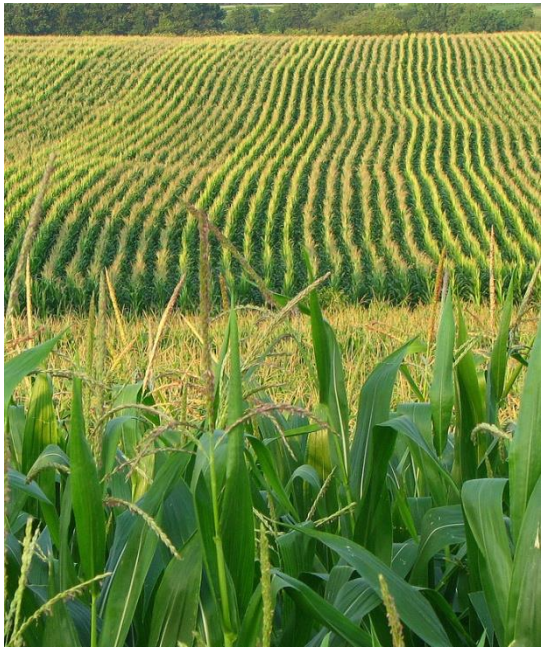
The proportion of land within 100 m of the shoreline that is wetland is positively related to the abundance of blue crab, spot, and Atlantic Croaker

Blue Crab

Spot

Atlantic Croaker

The proportion of the watershed land use comprised of agriculture is negatively related to nearshore abundances of blue crab, spot and Atlantic croaker



High cropland

↓

High nitrogen

↙ ↘

Low oxygen Low SAV

Chris Patrick et al., submitted

Blue Crab

Spot

Atlantic Croaker

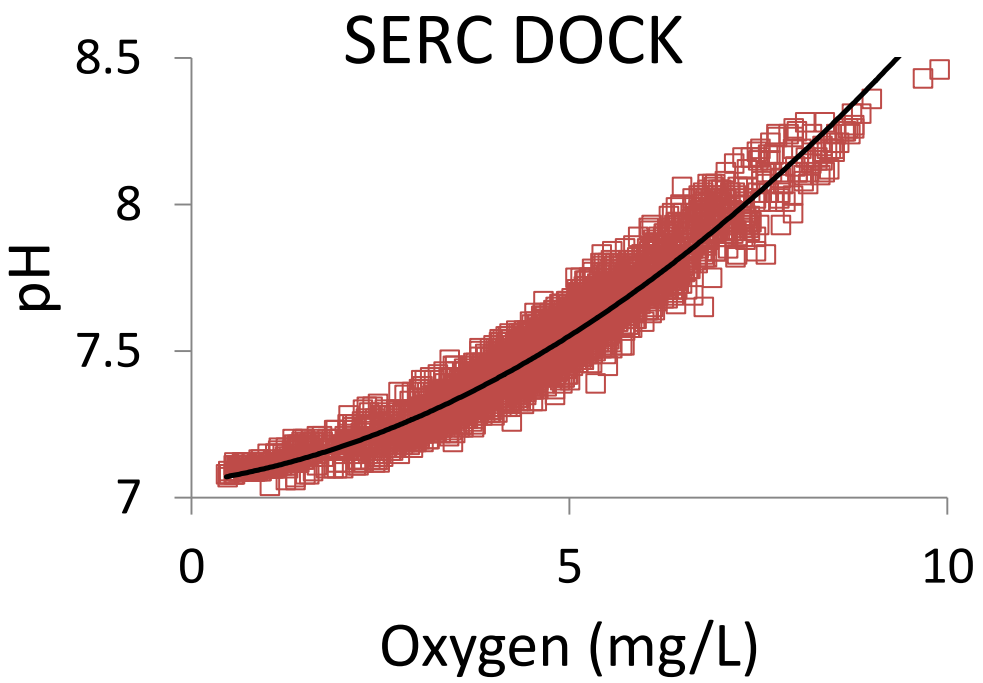
The proportion of shoreline that is hardened within a subestuary is negatively related to nearshore abundances of blue crab, spot and Atlantic croaker

Wetlands with more tidal inundation had significantly greater nekton abundance, predation activity and predator density

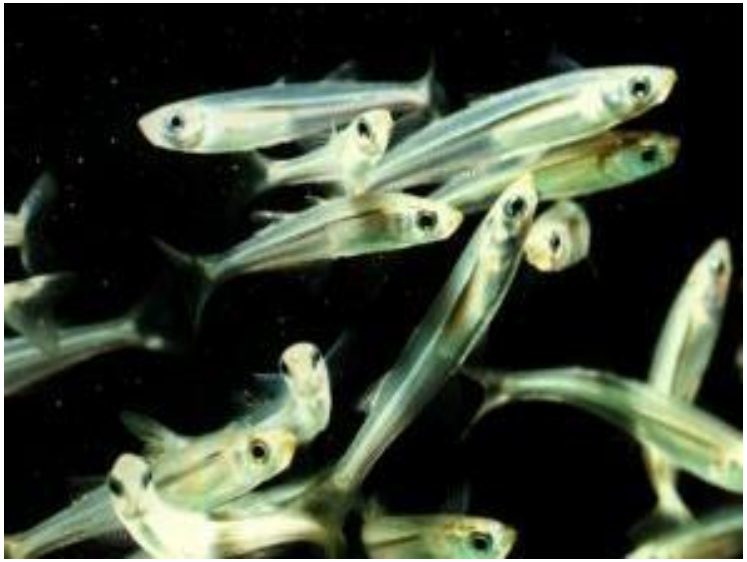
Effects of diel-cycling DO & ph on fish growth & behavior

….local variation & adaptation

Part of larger Breitburg et al project with Tim Targett, Kenny Rose, Bruce Michael & Howard Townsend



Low pH increases sensitivity to hypoxia



Diel-cycling hypoxia

- reduces growth of juvenile fishes
- alters anti-predator behavior
- may alter trophic pathways

Low pH increases sensitivity to hypoxia

Local variation in sensitivity to diel-cycling hypoxia