NOAA Chesapeake Bay Office

Funding for Fisheries Research in Virginia

$1,000,000 in Awards

Roger Mann (VIMS), Carnegie, Wesson, Naylor, Tarnowski, Dungan, Paynter and Townsend: A Bay-wide approach to oyster stock assessment.

Ryan Carnegie (VIMS) and Dungan: A Bay-Wide Integration of Oyster Disease Analyses.

Ryan Carnegie (VIMS): Oyster reef elevation and oyster health.

P.G. Ross (VIMS): The effects of oyster density on nitrogen removal and biodiversity.

Rochelle Seitz (VIMS): Population decline and restoration of soft-shell clams in Chesapeake Bay.

Mary Fabrizio (VIMS): Hypoxia, temperature, and mycobacteriosis and striped bass.

Mary Fabrizio (VIMS): Estimating Population Size and Survival Rates of Blue Catfish in Chesapeake Bay Tributaries.

Rob Latour (VIMS): Characterizing blue catfish growth in Chesapeake Bay

Greg Garman (Virginia Commonwealth University): Predation by blue catfish on native fishery resources in Bay waters.

Rob Hale (VIMS): Expansion of the blue catfish fishery as a population control strategy and the influence of ecological factors on contaminants in the fish.

Roger Mann (VIMS): Measures to reduce the loss of oyster restoration projects to cownose ray predation.

Bob Fisher (VIMS): Assessment of cownose ray stock using DNA markers

John McConaugha and Shannon Wells (Old Dominion University): The effects of changing population density on blue crab reproduction

A Bay-Wide Approach to Oyster Stock Assessment, Estimates of Vital Rates and Disease Status

Roger Mann[1], Ryan Carnegie[1], James Wesson[2], Mike Naylor[3], Mitch Tarnowski[3], Chris Dungan[3], Kennedy Paynter[4], and Howard Townsend[5]

[1]Virginia Institute of Marine Science, [2]Virginia Marine Resources Commission,
[3]Maryland Department of Natural Resources, [4]University of Maryland, [5]NOAA NCBO

Objective:

Design and implement a bay wide oyster stock assessment, develop estimates of growth rate and disease status, natural and harvest mortalities (M, F), and shell budgets.

Progress to date:

(i) Field work complete– 1600 stations, 175 reefs, 8300 acres (VA), 399 stations, 260 bars (MD).

(ii) Sample collection for disease assay - 30 locations in VA, 43 in MD, and 3 size classes.

(iii) Selected station sample collection for oyster condition (30 total).

Planned activity:

(i) Comparison of sampling gear in a single location.

(ii) Retrospective analysis of long term data set using post stratification approaches.

(iii) Estimation of year class structure, vital rates for both live oyster and shell budgets.

(iv) Development of reference points for management.

VIMS | William & Mary
Virginia Institute of Marine Science

Virginia Marine Resources Commission

Maryland Department of Natural Resources

MEES Marine Estuarine Environmental Sciences Graduate Program

Cooperative Oxford Laboratory

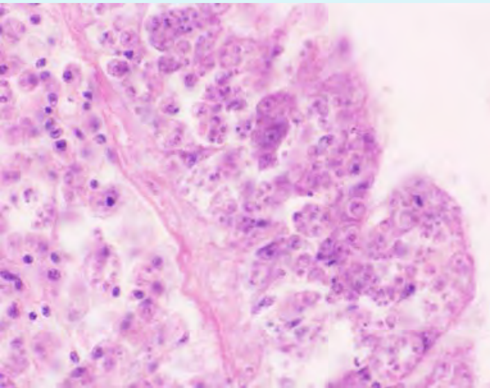
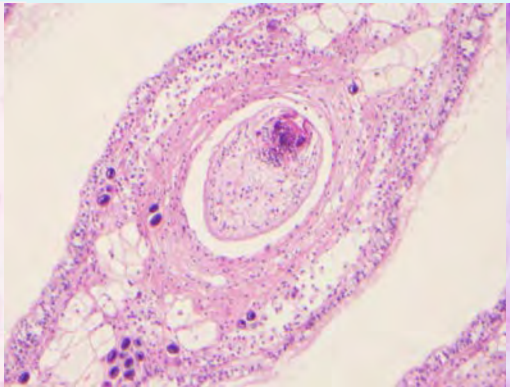
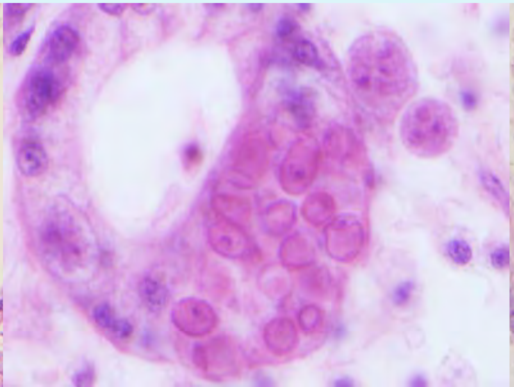
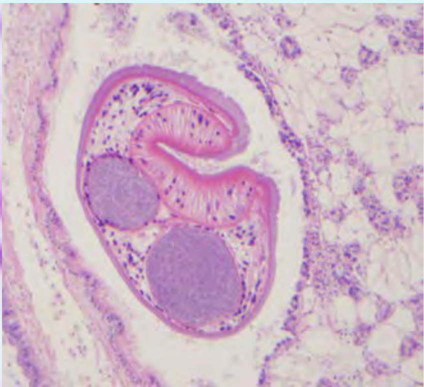
A Bay-Wide Integration of Oyster Disease Analyses

Ryan B. Carnegie[1] and Christopher F. Dungan[2]

[1]Virginia Institute of Marine Science, Gloucester Point, Virginia
[2]Maryland Department of Natural Resources, Cooperative Oxford Laboratory, Oxford, Maryland

Background and Rationale – Virginia and Maryland have long maintained separate and incompatible datasets on oyster disease. Integrating these analyses – developing unified rating systems for the diseases, and applying them to present samples but also retrospectively – will yield a dynamic bay-wide portrait of oyster disease. It will allow incorporation not only of the oyster but of the pathogens as well into ecosystem models of Chesapeake Bay.

In addition to the core monitoring and analyses, evaluation of size-specific disease levels in oysters ranging from small sub-markets (< 50 mm) to large survivors (> 100 mm) will provide insight into the development and distribution of disease resistance among oysters in Virginia and Maryland.

Influence of Oyster Reef Elevation on the Health of *Crassostrea virginica*: Can We Engineer a Solution to Disease in Oyster Restoration?

Ryan B. Carnegie[1] and Kennedy T. Paynter[2]

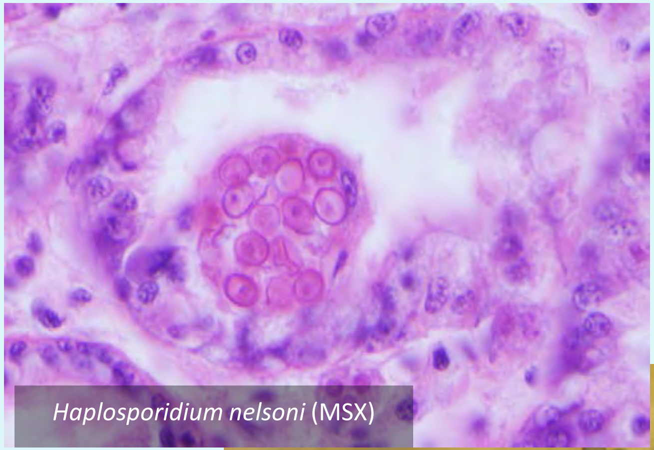
[1]Virginia Institute of Marine Science, Gloucester Point, Virginia
[2]University of Maryland, College Park, Maryland

Background

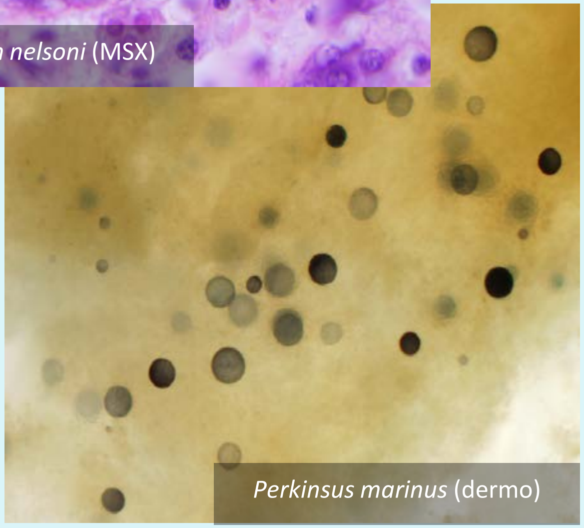
Parasitic diseases continue to adversely affect Chesapeake Bay oyster populations. It has recently been argued that engineering of reefs with significant vertical relief will promote better oyster health and serve to mitigate these diseases in restoration, yet evidence for this is lacking. Evaluating whether oysters higher on three-dimensional reefs are indeed healthier than those at low elevations is the focus of our work.

Project Objective

To determine the influence of position (*base* versus *crest*) on the prevalence and intensity of dermo, MSX, and other oyster diseases at two high-relief reefs in disease-intense waters of Chesapeake Bay.



Haplosporidium nelsoni (MSX)



Perkinsus marinus (dermo)

VIMS | William & Mary
Virginia Institute of Marine Science

MEES
Marine Estuarine Environmental Sciences Graduate Program

Study Sites

Bland Point Reef in the Piankatank River
--Oysters distributed over 5 vertical feet, from 4 to 9 ft depth

Shell Bar Reef in the Great Wicomico River
--Oysters distributed over 5-8 vertical feet, from 3 to 8-11 ft depth

Study Design

Two sampling periods
--September 2011 (peak dermo disease—COMPLETED)
--April 2012 (peak MSX)

Collections by divers along crest, base transects

Disease diagnostics using standard methods

Progress to Date

Results for dermo disease completed, with disease levels similar at both elevations at each reef (POSTER)

No indication yet that elevation significantly influences oyster health

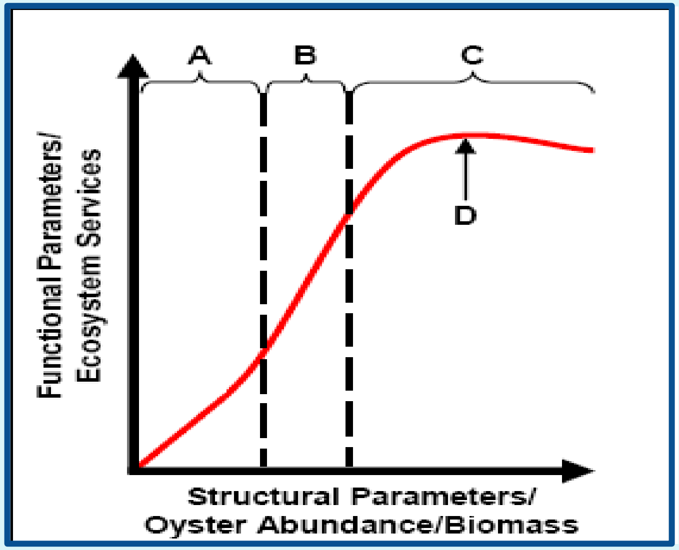
Scaling Ecosystem Services to Reef Development: Effects of Oyster Density on Nitrogen Removal and Biodiversity

M. Lisa Kellogg[1], M. W. Luckenbach[1], J. C. Cornwell[2], T. Leggett[3] and P. G. Ross[1]

[1]Virginia Institute of Marine Science, Eastern Shore Laboratory, Wachapreague, VA
[2]University of Maryland Center for Environmental Science, Horn Point, MD
[3]Chesapeake Bay Foundation, Norfolk, VA

Background

Quantifying the ecosystem services provided by restored (or conserved) oyster reefs is impeded by the lack of a clear relationship between oyster reef structural characteristics and ecological functions.



Project Objectives

1. Develop an experimental oyster reef system with varying oyster densities that can serve as a platform for measuring relationships between oyster abundance (and biomass) and ecosystem services.

2. Utilize these experimental reefs to determine quantitative relationships between oyster abundance (and biomass) and (*i*) sediment characteristics, (*ii*) reef community structure, (*iii*) nitrogen sequestration, and (*iv*) biogeochemical fluxes, including denitrification rates.

Experiment Reef System

Oyster density treatments: 0, 10, 25, 50, 100 and 250 oysters/m^2

Experimental reefs: 16 m^2 each, 3 replicate reefs per treatment

288 bushels of shell for reef bases

20,880 oysters added to the experimental reefs

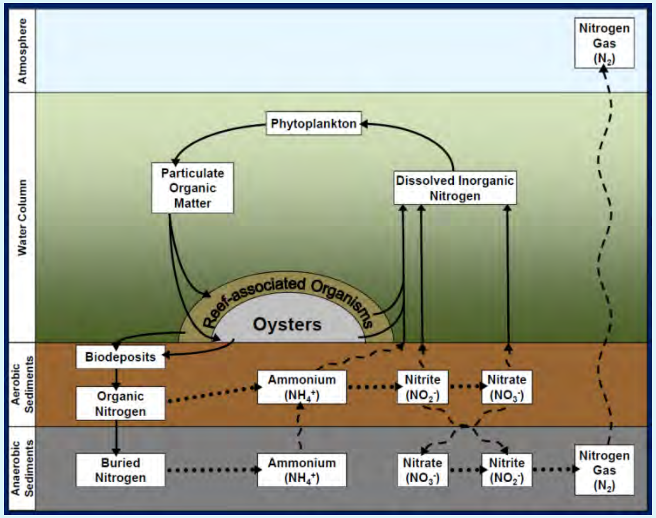
BACI Experimental Design

Prior to reef construction, incubation chambers were used to measure biogeochemical fluxes from natural bottom sediments from the study site.

Water samples collected from the chambers were analyzed to determine net fluxes of O_2, P, N_2, NH_4+, and combined NO_3+NO_2.

Benthic community composition was determined from samples taken at the study site.

These values will be compared to those from oyster reefs of varying densities in samples collected during 2012.



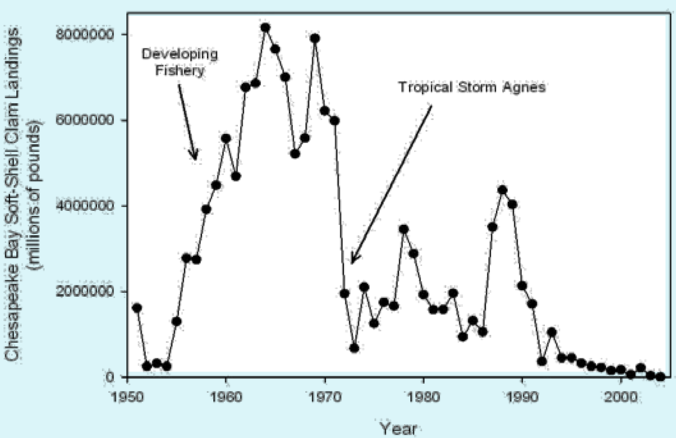
Population Decline and Restoration of Soft-shell Clams in Chesapeake Bay: Role of Predation, Habitat, Disease, & Environmental Factors

Rochelle D. Seitz[1]*, Anson H. Hines[2], Chris F. Dungan[3]

[1]Virginia Institute of Marine Science, College of William & Mary, Gloucester Point, VA
[2]Smithsonian Environmental Research Center, Edgewater, MD
[3]MD Department of Natural Resources, Cooperative Oxford Laboratory, Oxford, MD

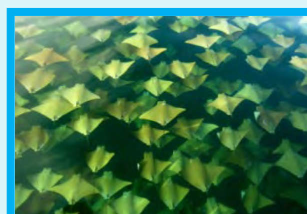
Introduction: Why study *Mya*?

- Biomass dominants
- Prey for predators: crabs, rays, & fish
- Clams ~50% of blue crab diet
- Filtering capacity higher than that of oysters
- Important fishery species: Maryland, New England, and elsewhere
- Wide geographic range:
  - North Atlantic
  - North Pacific



Objectives

- Determine what caused *Mya* population decline
  - Examine MANY Potential Factors
    - Predation
    - Habitat structure
    - Climate change (near southern limit)
    - Storm activity
    - Disease (*Perkinsus* sp.)
      - MD DNR long-term sampling comparison
- Concurrently examine other bivalves
- Concurrently examine other predators
  - Blue crabs & Cownose rays



VIMS | WILLIAM & MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE

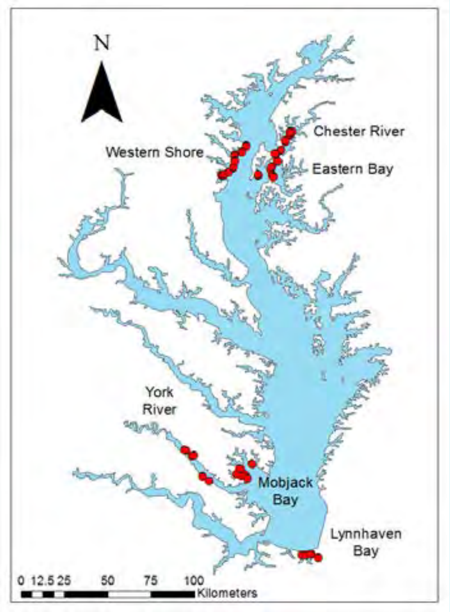
Smithsonian Environmental Research Center

Cooperative Oxford Laboratory

Methods

- Soft-shell clam sampling approach
  - Broad-scale bivalve study (suction sampling & dredging)
  - Structural refuge study
  - Manipulative caging experiments
  - Mesocosm experiments
  - Disease determination
- Suction sampling
  - Large sampling ring: 0.33-m^2 surface area
  - Measure physical variables
- Watermen dredging
- Predator exclusion (crabs, rays)
- Structural refuge study (sand, mud, SAV, shell, woody debris)
- Mesocosm study (examine effects of temperature & salinity)

Sampling sites



Fall sampling summary

Watermen dredging

- Variable *Mya*
- 10 times more *Tagelus*
- Most bivalves in "shelly" habitat
- Disease present

Bivalve species in suctions

- *Tagelus plebeius*
- *Mercenaria mercenaria*
- *Aligena elevata*

Quantifying the Interactive Effects of Hypoxia, Temperature, and Mycobacteriosis on Striped Bass, and their Impact on the Energetics and Ecology of these Fish

Dominique Lapointe[1], Mary C. Fabrizio[1], Wolfgang Vogelbein[1], David Gauthier[2] and Richard Brill[3]

[1] Virginia Institute of Marine Science; [2] Old Dominion University and [3] NOAA - National Marine Fisheries Service

Background

- During summer, low oxygen levels in the deeper portions of the bay may force adult striped bass out of their thermal refuges and into warmer, sub-optimal habitats
- Mycobacteriosis, a bacterial disease, is now common in Chesapeake Bay striped bass. However, the interactions between the disease and environmental factors remain unexplored

Healthy (left) and diseased (right) adult striped bass

Objective

- Quantify the influence of temperature and hypoxia on the metabolism of healthy and diseased striped bass at normal (20°C) and elevated (28°C) temperatures, and under hypoxic conditions

Experimental setup used for determination of fish metabolism

Temperature-controlled aquaria containing the respirometers

Respirometer (acrylic tube), pumps, chiller and heaters in an empty aquarium

Striped bass placed into a respirometer for determining metabolic rate

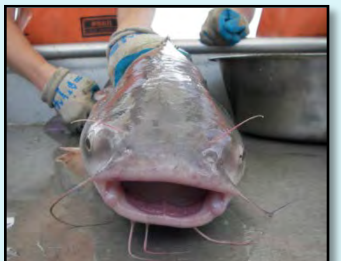
Preliminary Results

When exposed to elevated temperatures the metabolic scope of fish is reduced, suggesting that when trapped in warm waters, striped bass may

- Experience fatigue more rapidly
- Be restricted in their ability to elude predators or secure prey
- Exhibit lower growth rates

Estimating Population Size and Survival Rates of Blue Catfish in Chesapeake Bay Tributaries

Mary C. Fabrizio[1], Troy D. Tuckey[1], Robert J. Latour[1], Greg Garman[2], Bob Greenlee[3], and Mary Groves[4]



[1]Virginia Institute of Marine Science
[2]Virginia Commonwealth University
[3]VA Dept of Game & Inland Fisheries
[4]MD Dept of Natural Resources

Background

Blue catfish, a freshwater species, were first introduced in VA tidal rivers and are now well established in many tributaries of Chesapeake Bay

Basic information on the population biology of this invasive species is lacking, but such information is crucial to ecosystem models that aim to explore the effects of blue catfish on native aquatic fauna

Objectives

Estimate population abundance and survival rates of blue catfish in the James River

Measure movement rates of adult fish between the freshwater and estuarine reaches of the James and Potomac rivers

Characterizing Blue Catfish Growth in Chesapeake Bay

R.J. Latour[1], M.C. Fabrizio[1], T.D. Tuckey[1], C.L. Gervasi[1], Greg Garman[2], Bob Greenlee[3], and Mary Groves[4]

[1]Virginia Institute of Marine Science; [2]Virginia Commonwealth University;
[3]VA Dept of Game & Inland Fisheries; [4]MD Dept of Natural Resources

Background

Populations of the invasive blue catfish (*Ictalurus furcatus*) are thriving in the primary tributaries of Chesapeake Bay. Achieving desired management objectives for these populations requires fundamental blue catfish population dynamics information. Understanding growth is key to estimating population-specific biomasses.

Project Objectives

1. Develop a 'master' database of existing and newly collected data on the growth of blue catfish in the James, York, Rappahannock, and Potomac rivers.
2. Analyze existing and newly collected data to formally describe the growth patterns and dynamics of blue catfish in the primary tributaries of Chesapeake Bay.

Platforms for data collection

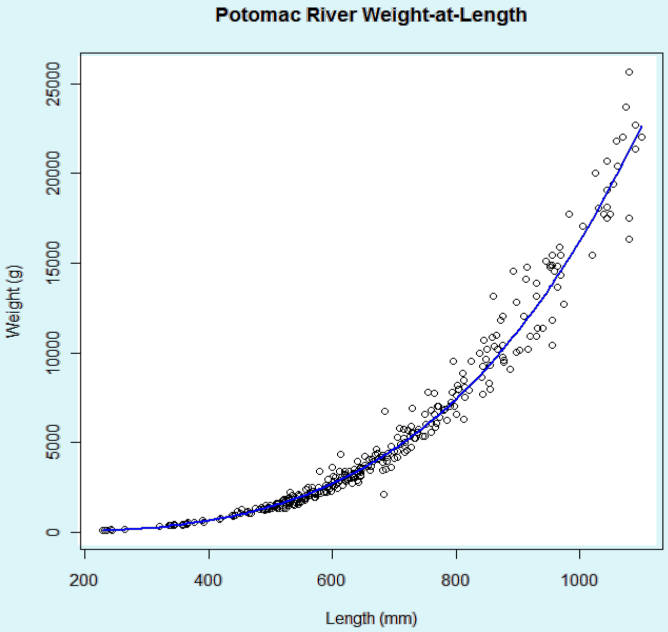
- Synthesize existing data, identify and fill data gaps
- VIMS Trawl & Seine: York, James, Rappahannock
- Electrofishing: Potomac, James, Rappahannock

Data analysis

- Length-at-age, weight-at-age, weight-at-length relationships
- Investigate significance of sex, temporal, spatial covariates

Preliminary results

- Potomac River, weight-at-length
- Electrofishing, each fall, 2008-2010
- Allometric growth function, multiplicative error structure provided best fit
- No statistical significance detected for sex covariate on weight-at-length relationship



Tools for More Effective Management of Invasive Catfish Predators in Chesapeake Bay Waters

Greg Garman[1], Steve McIninch[1], Bob Greenlee[2], Mary Groves[3] and Mary Fabrizio[4]

[1]Virginia Commonwealth University—VCU Rice Center (ggarman@vcu.edu)
[2]Virginia Department of Game and Inland Fisheries
[3]Maryland Department of Natural Resources
[4]Virginia Institute of Marine Science

Background

Blue catfish and flathead catfish were introduced to Virginia tidal waters over 30 years ago. Populations have since expanded into a substantial portion of Chesapeake Bay and are numerically dominant in many river systems. Decision-support tools are needed to more effectively manage these novel and invasive predators and—possibly—to help limit expansion into new habitats.

Project Objectives

1. Conduct an assessment of blue catfish and flathead catfish predation effects on key fishery resources in Chesapeake Bay and its tributaries.
2. Develop and evaluate likely expansion scenarios and field protocols for effective surveillance and targeted control.

Preliminary results (Fall, 2011) from a rapid examination of n=258 predators >200 mm TL in several Virginia rivers suggest that a substantial proportion (up to 63%) of blue and flathead catfish prey on economically-significant or recovering fishery resources, including blue crab, white perch, American shad, and blueback herring. For example, 39% of blue catfish from the lower James River had consumed anadromous clupeids (*Alosa* spp.); 59% of flathead catfish from the Rappahannock River had consumed white perch. Expanded estimates of predation mortality for *Alosa* spp. will be developed for Virginia and Maryland rivers in 2012.

Allocation of Effort for Surveillance and Targeted Control Programs

Resource value \ Risk of establishment	Low	High
Low	minimal	moderate
High	moderate	intensive

We will develop spatially explicit (i.e., GIS-based), forecasting models to identify areas of likely expansion by invasive catfishes and to prioritize threats to selected fishery resources. Model outputs will allow management agencies to focus surveillance and targeted control efforts on the most vulnerable high-value resources.

In Spring, 2012, at least two tidal creek systems will be selected for experimental predator control studies using semi-permeable, instream barriers to exclude predatory catfishes.

Influence of ecological factors on contaminant burdens in Chesapeake watershed blue catfish

Rob Hale, Troy Tuckey, Mary Fabrizio, Mark La Guardia & Drew Luellen

Virginia Institute of Marine Science, hale@vims.edu

Project duration: September 2011 – August 2012

Background

- Expanding blue catfish populations threaten native species
- Fishing may exert downward pressure on populations
- Fish consumption has benefits, but pollutants present undefined risks
- Direct analysis of fish fillets is best approach for determining human exposure

However, state budget for fish contaminant monitoring has been slashed

Objectives

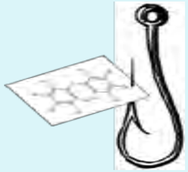
- Obtain blue catfish from the Chesapeake Bay tributaries
- Evaluate legacy & emerging pollutants in fillets
- Develop a predictive model relating contaminant burdens to fish size, sex & trophic position

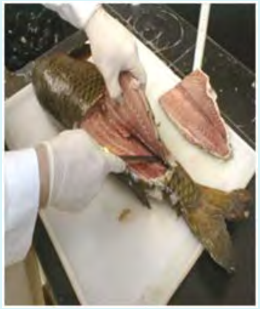
Risk Benefit

VIMS | William & Mary
Virginia Institute of Marine Science

Blue catfish sampling in process, leveraging existing collection programs in MD & VA

- James, Rappahannock & Potomac Rivers





Fillets to be analyzed using state-of-the-art methods

- Historical, persistent pollutants

  Mercury, PCBs, organochlorine pesticides

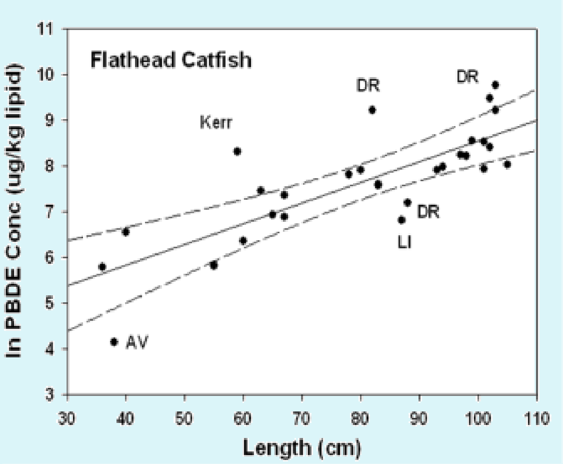
- Emerging contaminants

  Ultra-performance liquid chromatography + mass spectrometry to determine an expanded suite of brominated flame retardants

- C & N stable isotopes determined to evaluate fish trophic level

Construct predictive models relating levels of individual pollutants in fish to ecologically-relevant factors

- Collection site
- Duration of pollutant exposure (fish size/age)
- Reproductive status (egg production may sequester some pollutants



Oyster Planting Protocols to Deter Losses to Cowanose Ray Predation

Roger Mann[1], Robert Fisher[1], James Wesson[2], A.J. Erskine[3], Tommy Leggett[4], and Bill Goldsborough[4]

[1]Virginia Institute of Marine Science, [2]Virginia Marine Resources Commission,
[3]Cowart Seafood and Bevans Oyster Company, [4]Chesapeake Bay Foundation

Background

Oysters subject to predation loss by cownose rays (*Rhinoptera bonasus*). Rays are opportunistic and locally very destructive. A directed fishery for rays may reduce numbers local impact on predation will be small. A local control strategy is needed.

Overall Project Objectives

Identify predator deterrence options..

Component Objectives

Examine for each of spat on shell and natural seed sources:

(i) pre-planting preparation of the target area (be this a lease or reserve);
(ii) planting density of seed and substrate;
(iii) overplanting with additional shell post seed planting (this will increase subsequent harvest costs);
(iv) varying harvest strategies with time post planting.

Progress to date

Planning is in hand for an industry scale (acres per treatment) field experiment to begin in Spring 2012 in regions of known high and low historical ray predation.

The Role of Predation in Blue Crab Reproductive Effort

John R. McConaugha, Shannon L. Wells

Old Dominion University

- Inter- and intra-annual differences have been detected since 2002 for the following parameters:
  - Eggs produced per brood
  - Egg diameter
  - Female carapace width
  - Energy allocated per egg
- Larval survival is positively impacted by the amount of energy allocated per egg.
- Increases observed in the blue crab population abundance in the last few years have been accompanied by increasing female size, egg number per brood, and egg energy.
- Population abundance, and therefore predation (harvesting), seem to play a significantly positive role in female reproduction, and the amount of effort expended on reproduction.