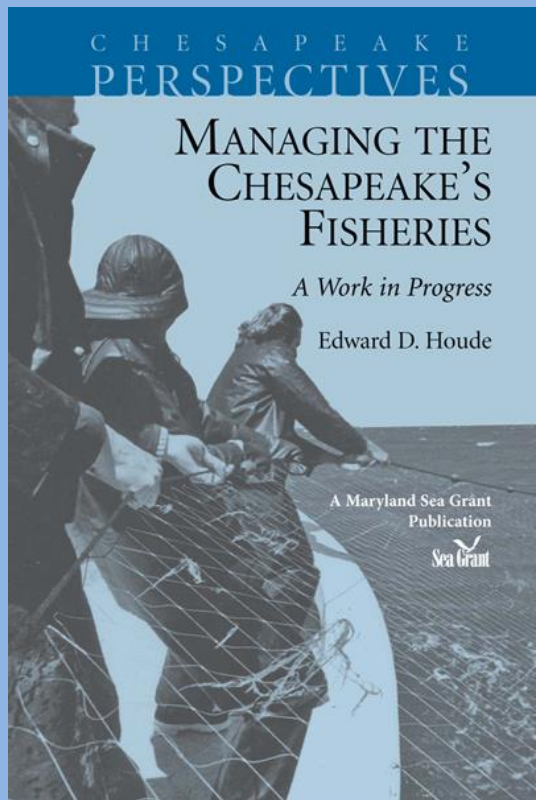
Chesapeake Bay Fisheries 101

Edward Houde
Chesapeake Bay Commission
Annapolis, MD
7 January 2016



University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE
CHESAPEAKE BIOLOGICAL LABORATORY

Content of This Presentation

- Synopsis of Status of Key Fisheries
- Status of Science Supporting Management and Science Needs
- Stresses and Concerns
- Bay Program Initiatives
- Emerging Topics of Policy, Management, and Governance

Chesapeake Bay: Timeline of Events and Trends

1607: Jamestown Colony

Deforestation

Agriculture

1600

1700

1775: Human No. = 700,000

Agriculture, Deforestation, Sedimentation, Dams

Substantial Fisheries Develop: Shad, River herring

1850: Human No. = 1.8 million

Agriculture, Deforestation, Sedimentation

Dams; Industrial-Scale Fishing: Oysters, Menhaden

1800

1900

1930: Human No. = 5 million

Industrial Agriculture, Reforestation, Nutrient Loading,

More Dams, Oyster and Shad collapse, Heavy Fishing on Striped Bass and Blue Crab, Loss of SAV, Eutrophication, Hypoxia, Menhaden issues

1984:Chesapeake Bay Program

2002: Human No. = 15 million

Climate Change?

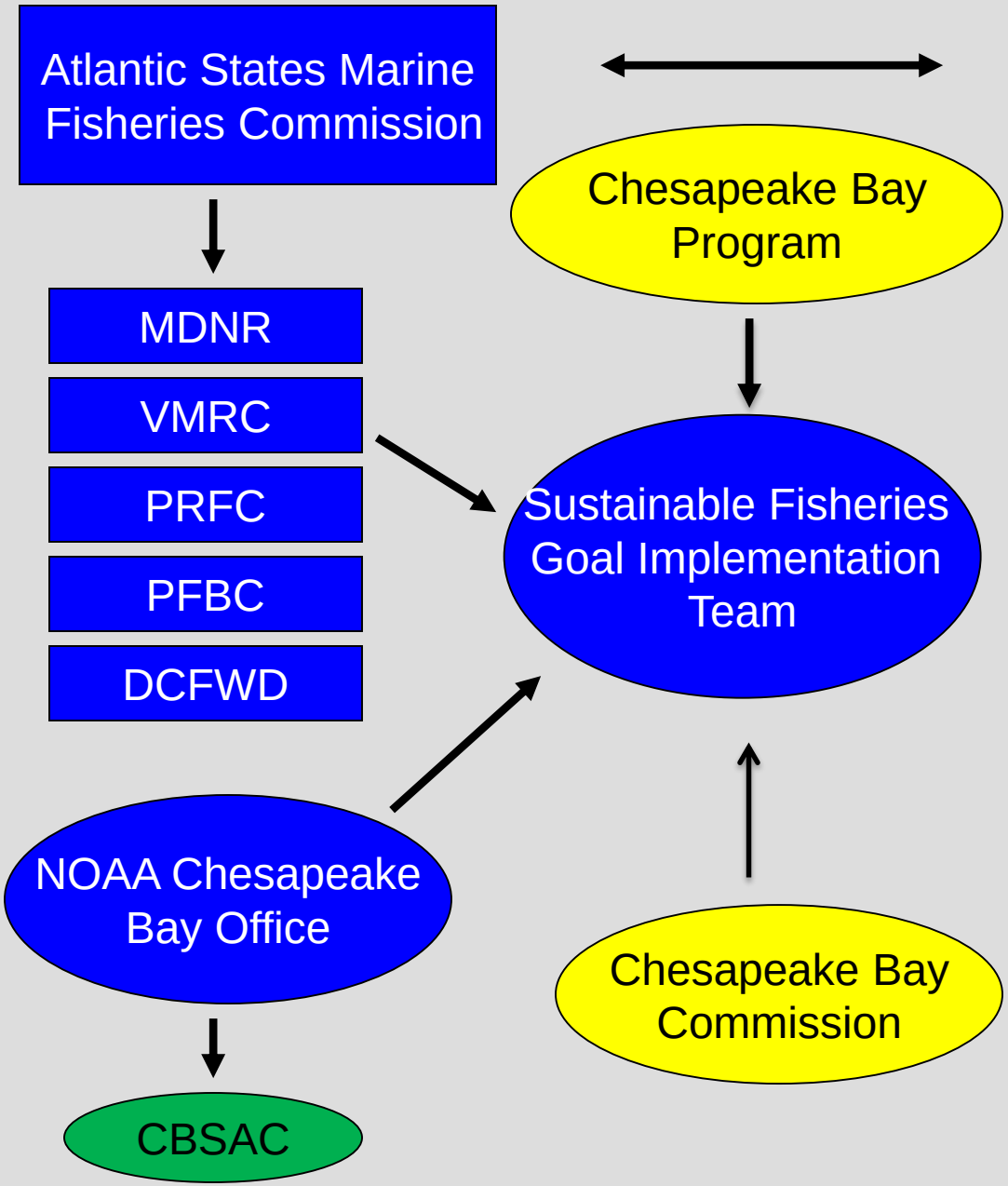
Stressed Ecosystem, Heavy Fishing

Ecosystem-Based Mgt; Excess Nutrient Problem Unsolved

2000

2100

Fisheries Management in Chesapeake Bay

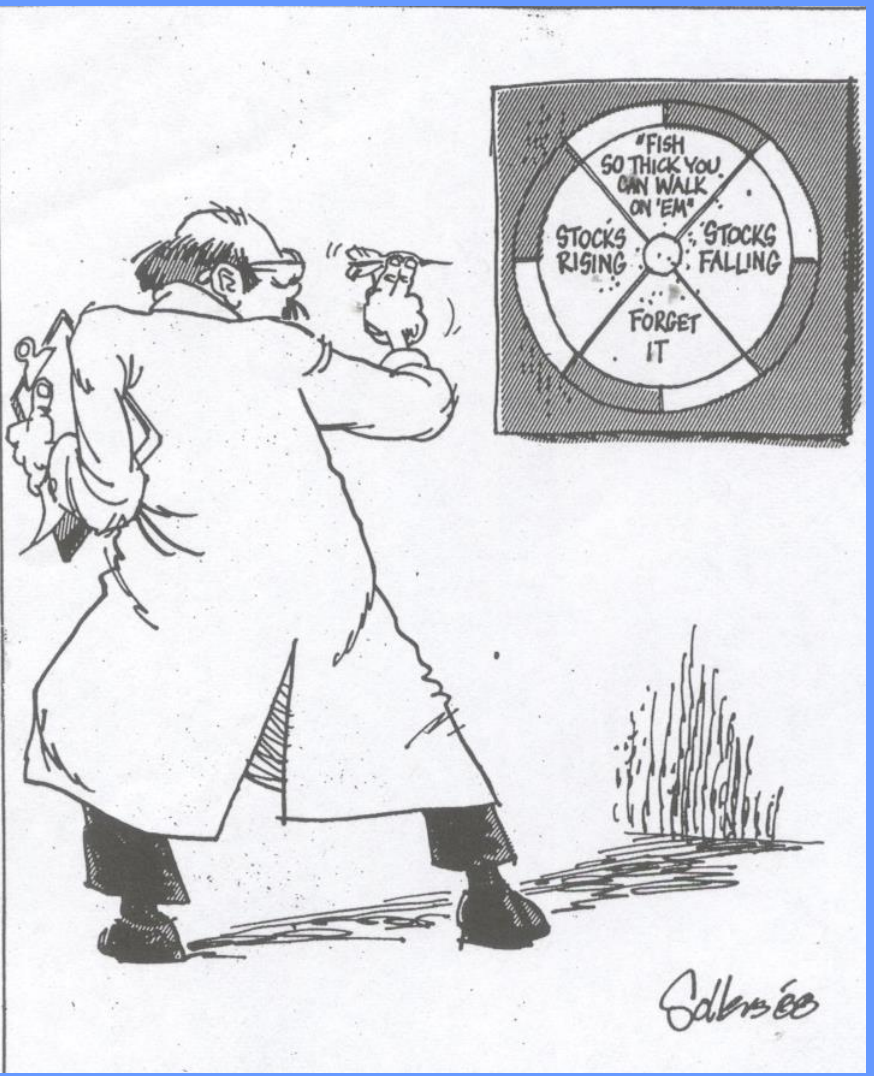


Multi-Jurisdictional Management

It's complex and complicated

Do we have appropriate fishing policies?

Is management reliable?



How good are stock assessments?

Is the science sufficient?

Is the science reliable?

Observations

Data

Models

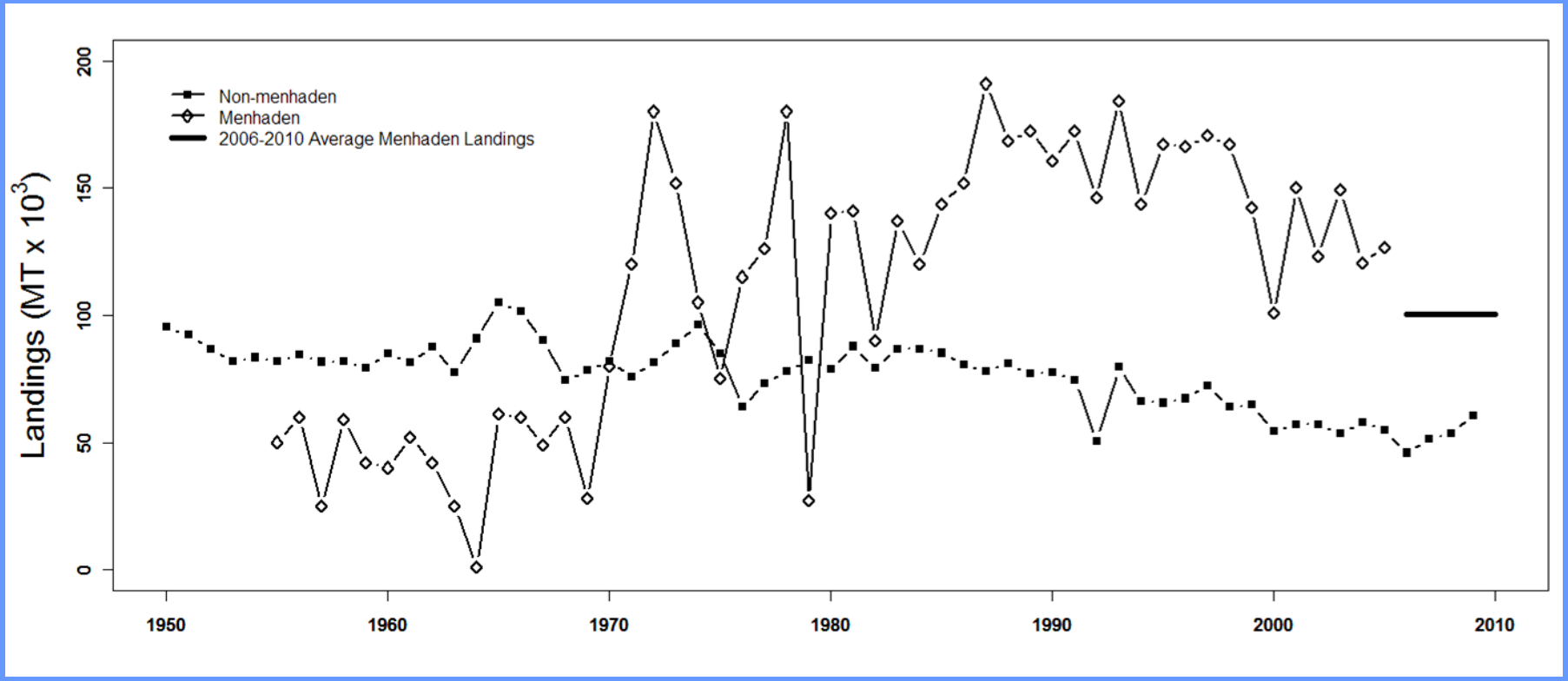
Uncertainty

Risk

Combined field and modeling programs

Conducting Science and Training Fishery Scientists

Commercial Fisheries Landings, Chesapeake Bay



- Menhaden fishery now accounts for >60% of Bay commercial landings
- Menhaden fishery was capped at 109,020 tons in 2006 and now at 87,000 tons beginning in 2014
- Total commercial catches reached >250,000 tons in 1970s and 80s
- Blue crab is second largest fishery, >30,000 tons

Was 250,000 tons sustainable?

Chesapeake Bay Icons, Issues and Concerns

- Eastern Brook Trout
- Eastern Oyster
- Striped Bass
- Blue Crab
- Atlantic Menhaden

Hopeful Surprises

- Atlantic Sturgeon

Problem Children

- Shads and River Herrings
- American Eel
- Softshell Clam

Concerns

- Habitat Loss
- Water Quality
- Climate Change
- Forage Species
- Invasive Species
- Endocrine Disruptors
- Diseases

Chesapeake Watershed Agreement

16 June 2014

Sustainable Fisheries Goal: Protect, restore and enhance finfish, shellfish and other living resources, their habitats and ecological relationships to sustain all fisheries and provide for a balanced ecosystem in the watershed and Bay.

Vital Habitats Goal: Restore, enhance and protect a network of land and water habitats to support fish and wildlife and to afford other public benefits, including water quality, recreational uses and scenic value across the watershed.

Watershed Agreement: The Goals

Brook Trout: Restore and sustain naturally reproducing brook trout populations in Chesapeake headwater streams with an eight percent increase in occupied habitat by 2025.

Fish Passage: By 2025, restore historical fish migratory routes by opening 1,000 additional stream miles, with restoration success indicated by the consistent presence of alewife, blueback herring, American shad, hickory shad, American eel and brook trout.

Blue Crab: Maintain a sustainable blue crab population based on the current 2012 target of 215 million adult females. By 2018, evaluate a Bay-wide, jurisdiction-based, allocation management framework .

Oyster: Restore native oyster habitat and populations in 10 tributaries by 2025 and ensure their protection.

Forage Fishes: By 2016, develop a strategy for assessing the forage fish base available as food for predatory species in the Chesapeake Bay.

Fish Habitats: Use existing and new tools to integrate information and conduct assessments to inform restoration and conservation efforts.

Brook Trout, Status, Issues, Prognosis

Habitat
Pavement, Impervious Surfaces
Habitat Restoration and Recovery
Changing Climate

In 2011, there were an estimated 2.69 million acres of available brook trout habitat in the Chesapeake Bay watershed. Based on this estimate, an 8 percent increase would require an additional 215,200 acres of habitat to be occupied by brook trout by 2025.

Threats:

- Dams
- Roads
- People
- Invasive Species
- Land use
- Genetic integrity
- Climate Change

Prognosis: Careful Optimism

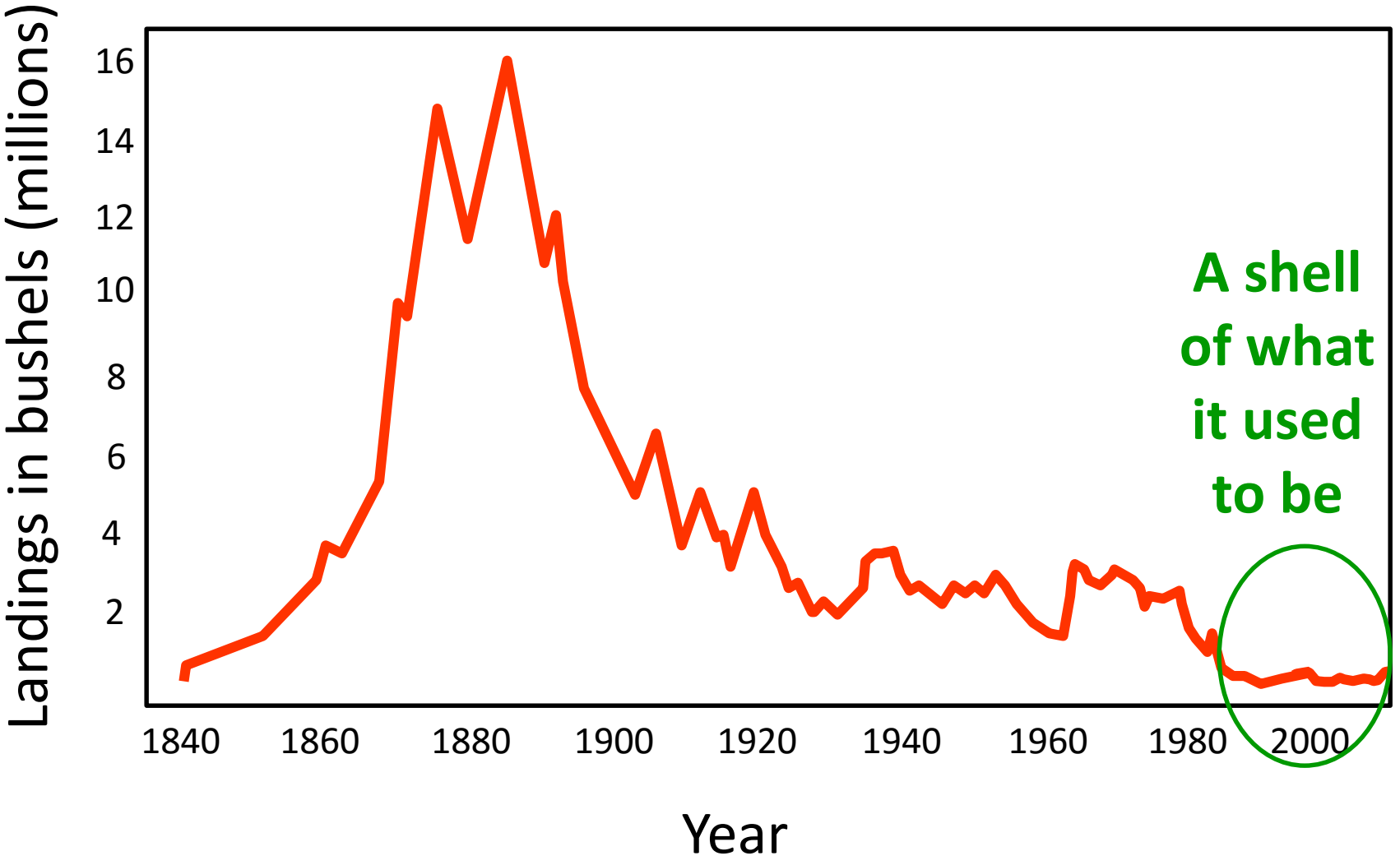
Brook Trout

Oyster, Status, Issues, Prognosis

Landings
Stock Assessments
Reference Points
Diseases
Controlling Effort
Spatial Management
Sanctuaries
Aquaculture

Long-Term Prognosis: ?? Hopeful, But Many Obstacles

Over a century of decline in landings in Maryland



North 2015

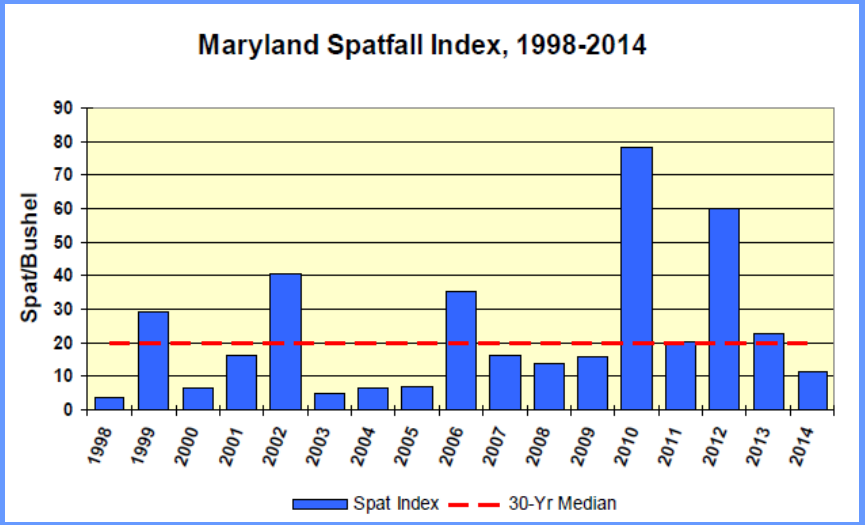
Oysters covered by sediment

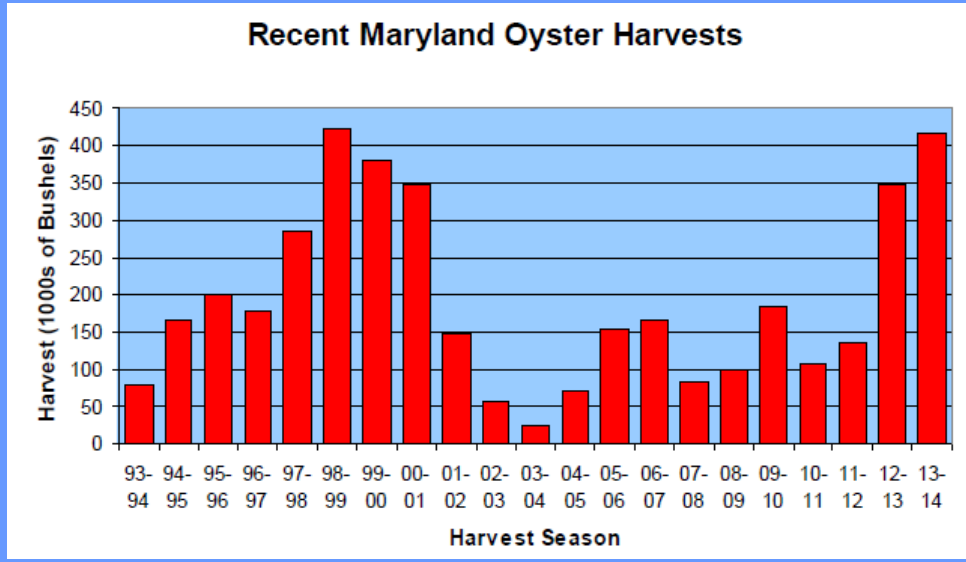
The Chesapeake's oysters need help

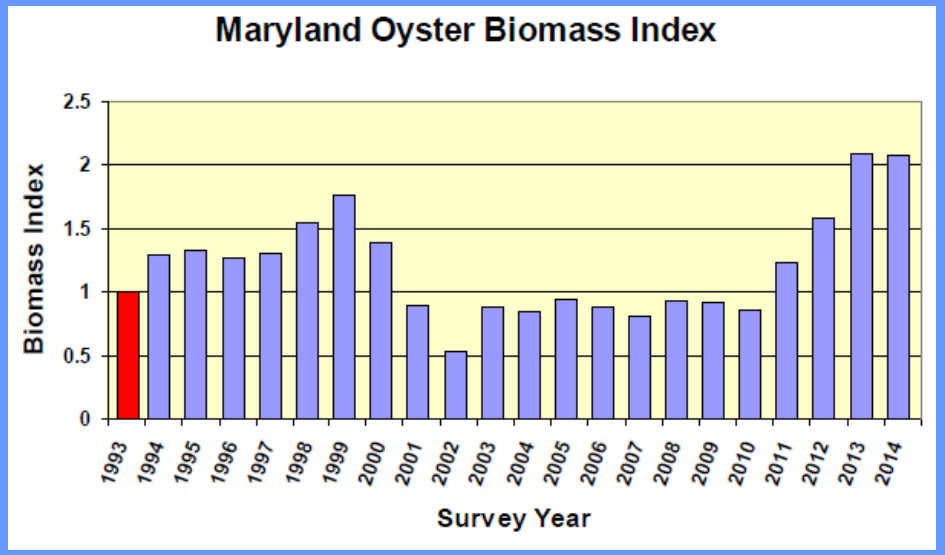
Overharvest
Habitat Loss

One year's worth of shell from one shucking house

Oyster Harvests and Abundance







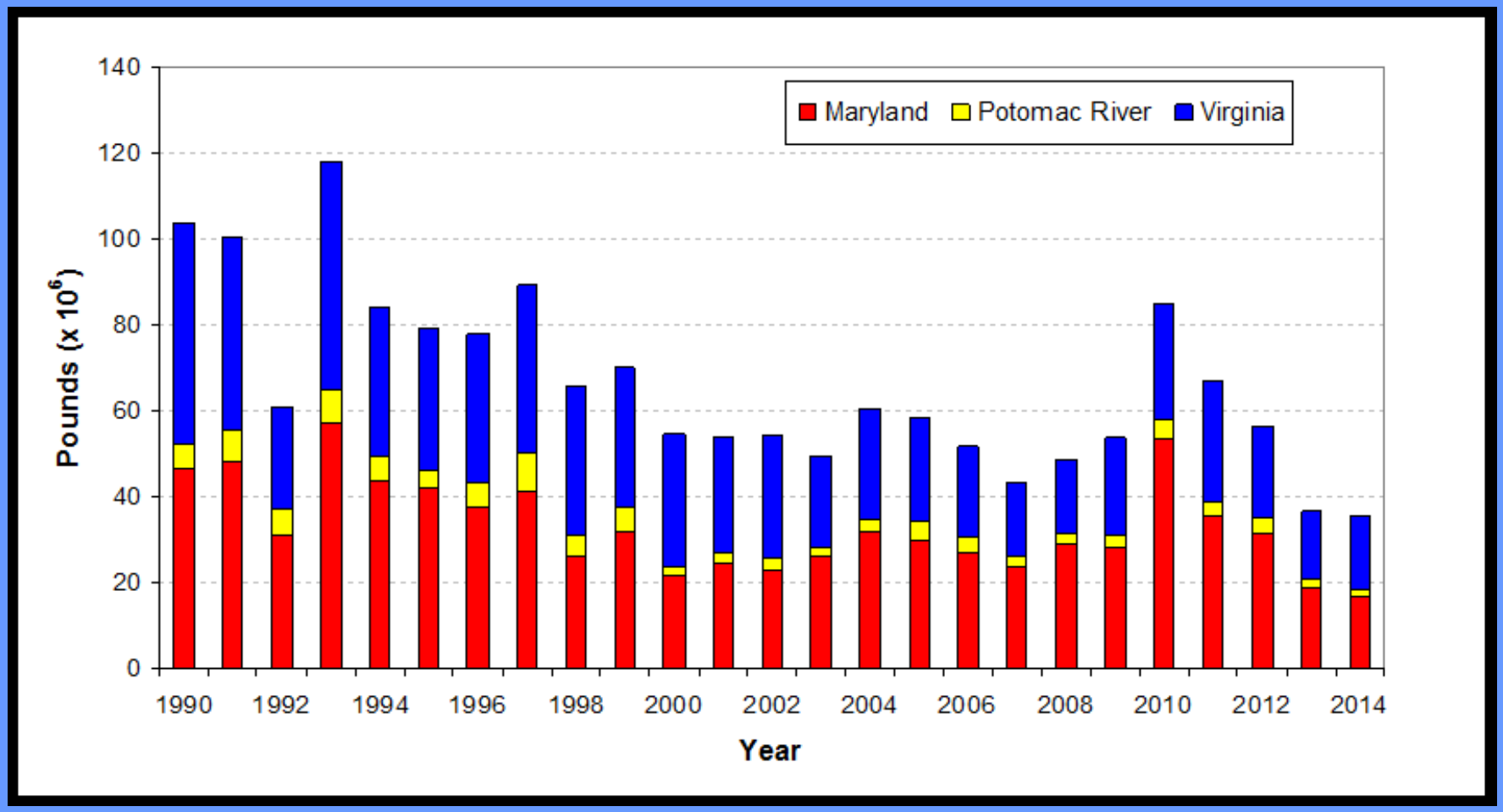
MD DNR 2015

Blue Crab: Status, Issues, Prognosis

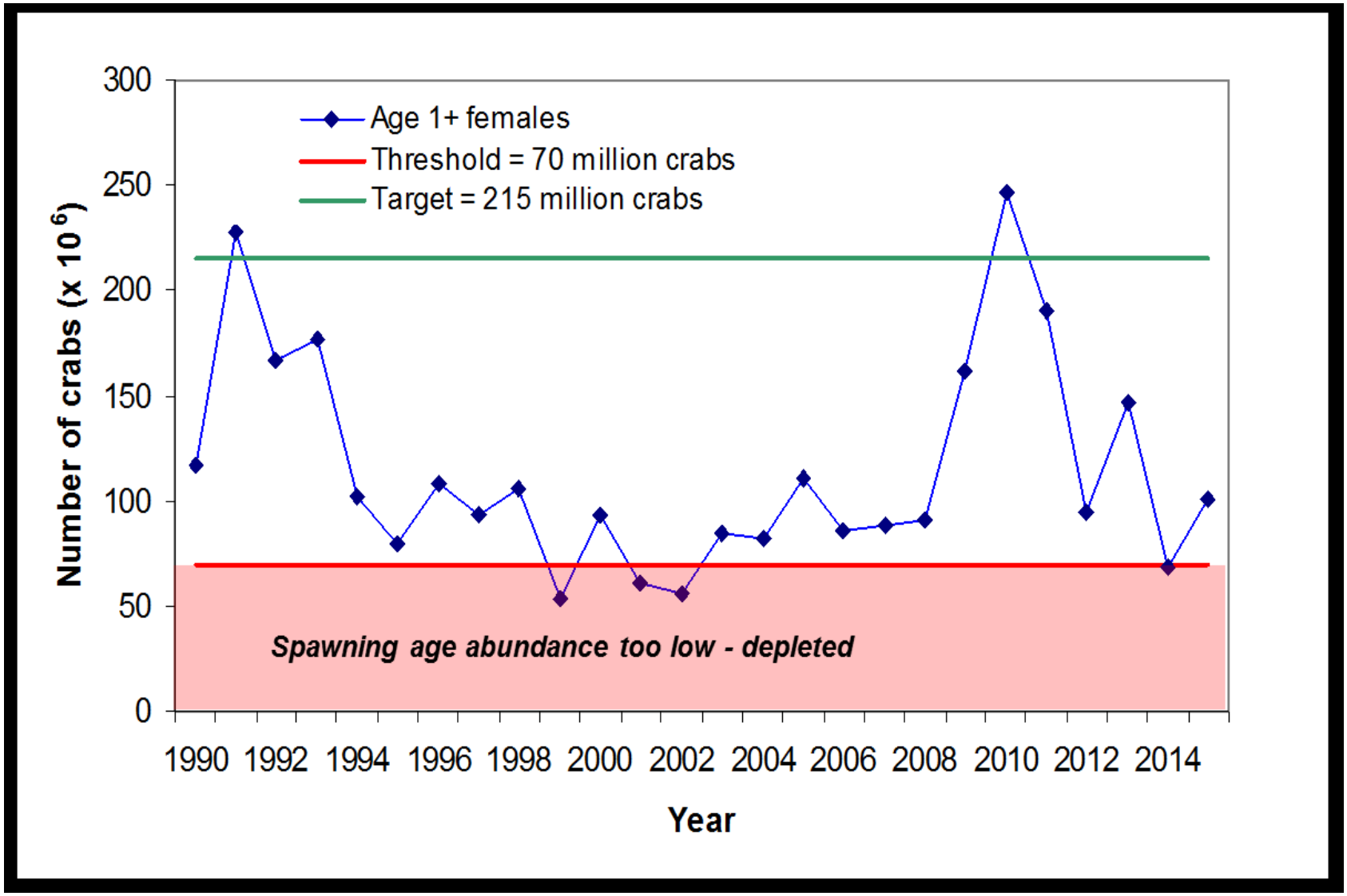
Landings
Stock Assessment: Female abundance, age-0 recruitments
Controlling Effort
Reference Points
Winter Weather
Long-Term Climate Change

Long-Term Prognosis: Good

Total commercial blue crab landings (all market categories) in Chesapeake Bay, 1990-2014.

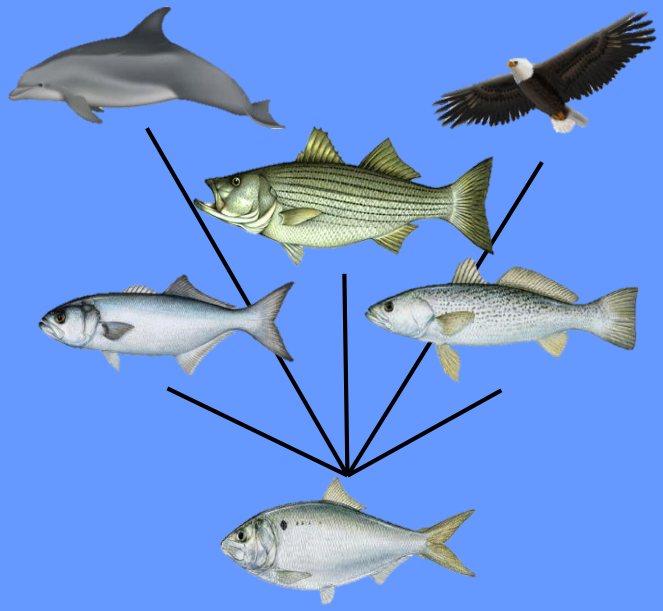


Blue Crab Management: Hitting the Target



Menhaden Status, Issues, Prognosis

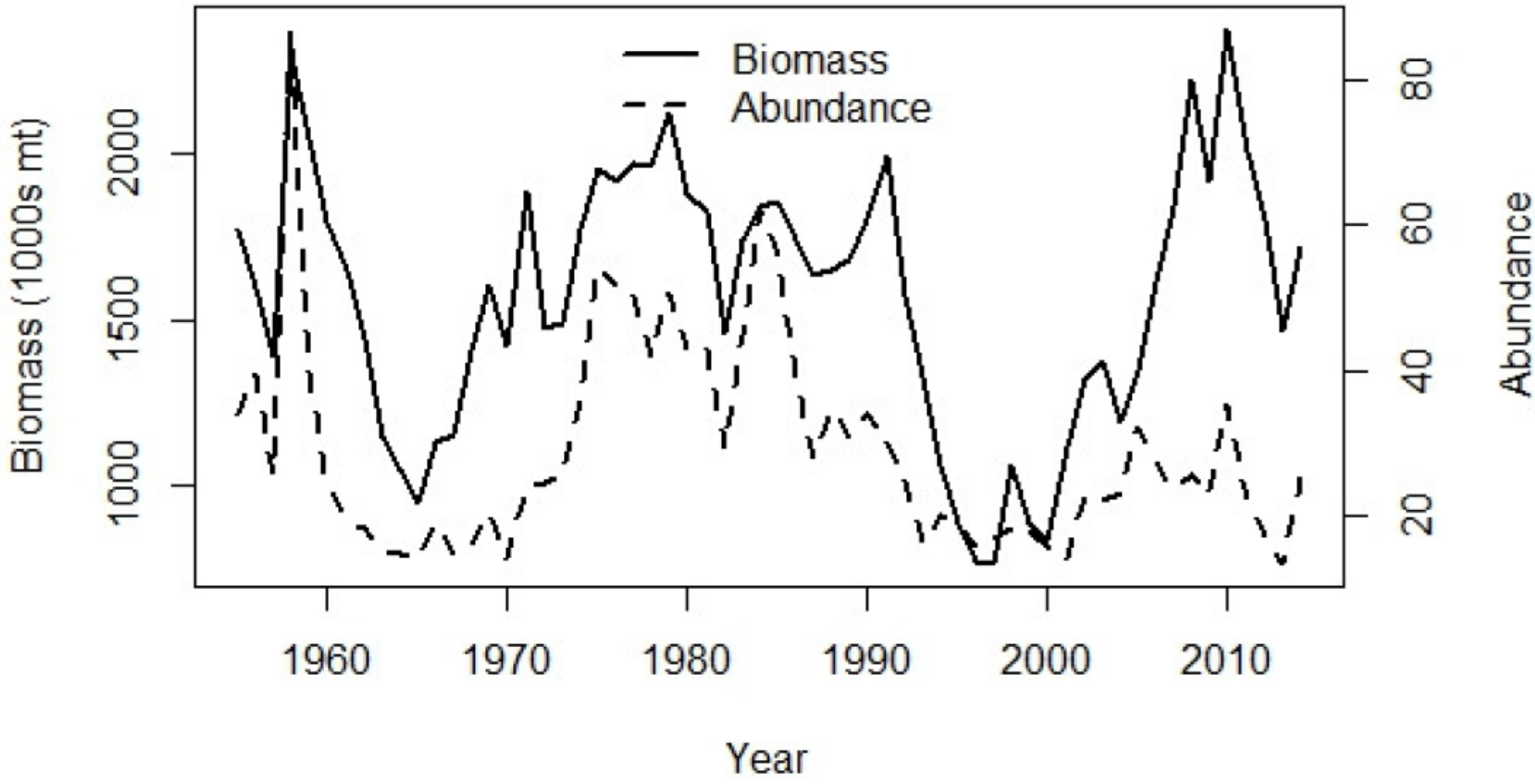
Biggest Fishery in Chesapeake Bay
Important Forage Species
Landings
Localized Depletion
SEDAR 40, Stock Assessment
Chesapeake Bay Nursery
Disease



Managed by ASMFC

<u>Prognosis</u>: Good, But Care Needed to Manage Appropriately and Account for Ecosystem Needs

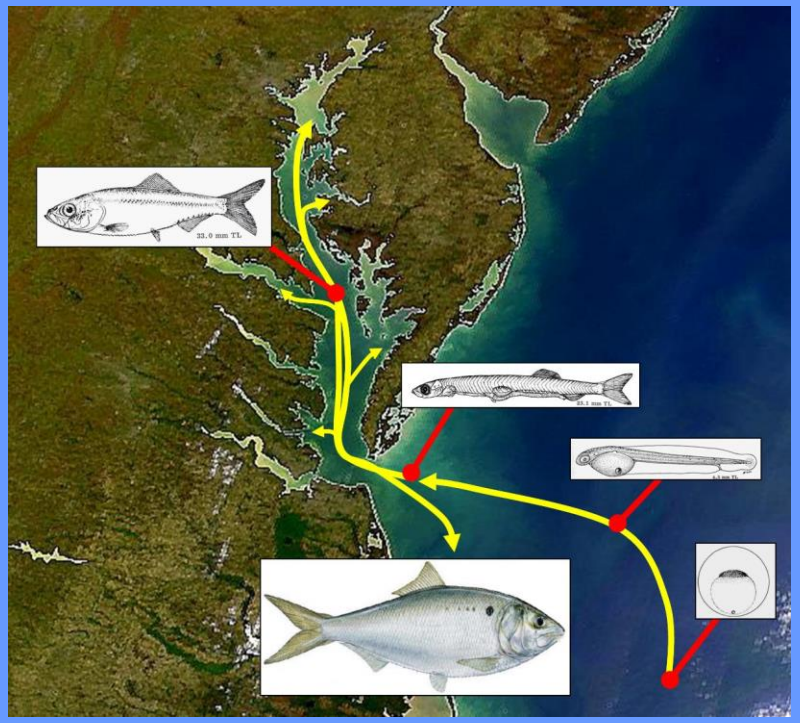
Atlantic Menhaden Abundance and Biomass

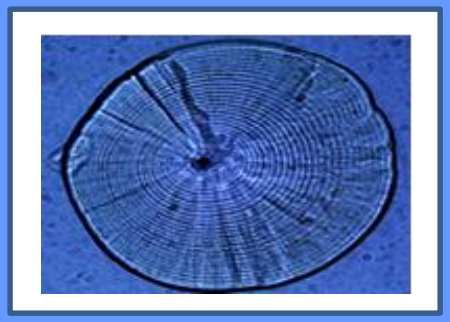


Biomass is presently high but Abundance is at low level

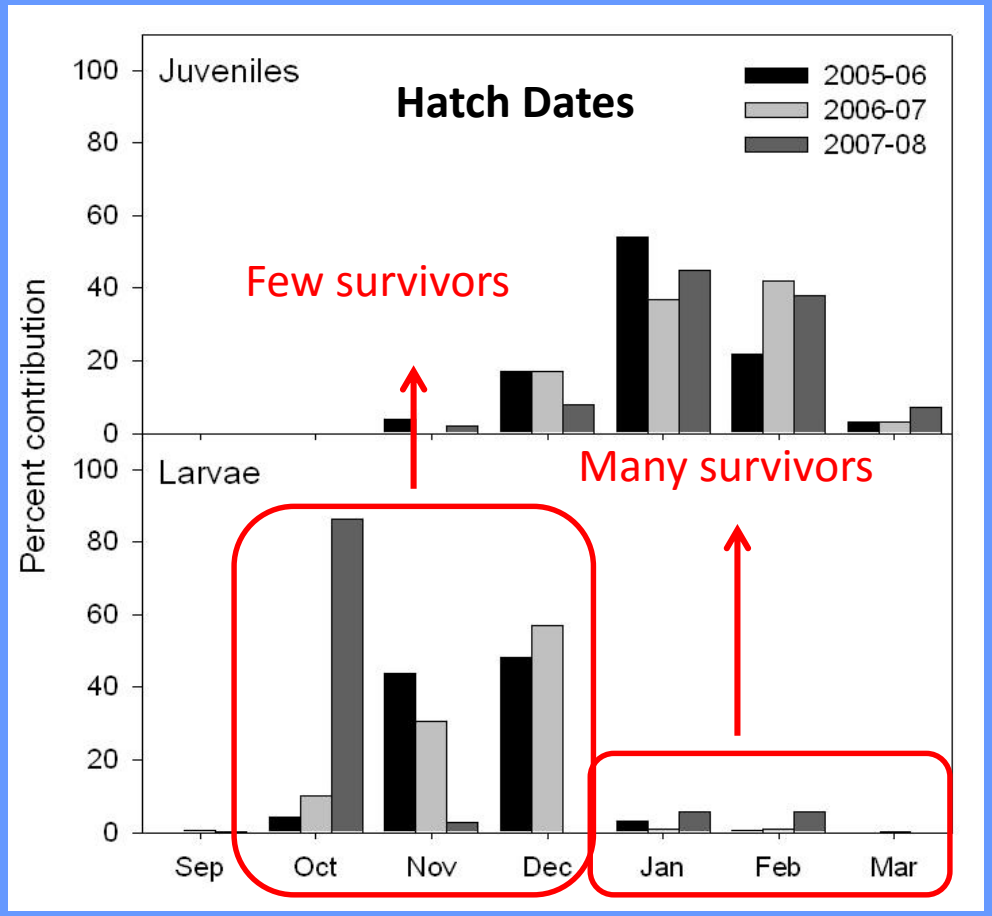
SEDAR 40. 2015

Linking what happens in the Chesapeake to offshore spawning





Otolith of larval menhaden
Showing ~50 daily rings



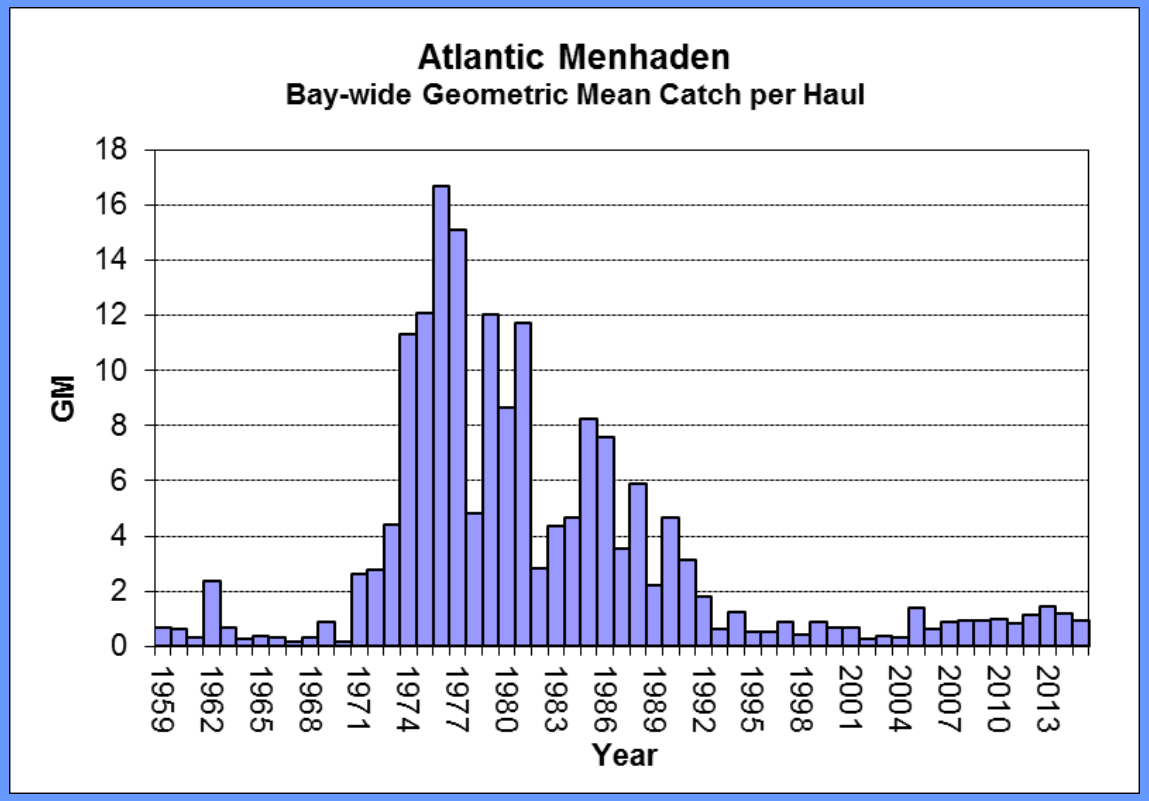
Most Chesapeake juveniles originated Jan – Feb each year

Most Chesapeake larvae originated Oct-Dec each year

Inference: Winter mortality of larvae entering during fall and early winter months.

Recruitment Trends

Atlantic Menhaden



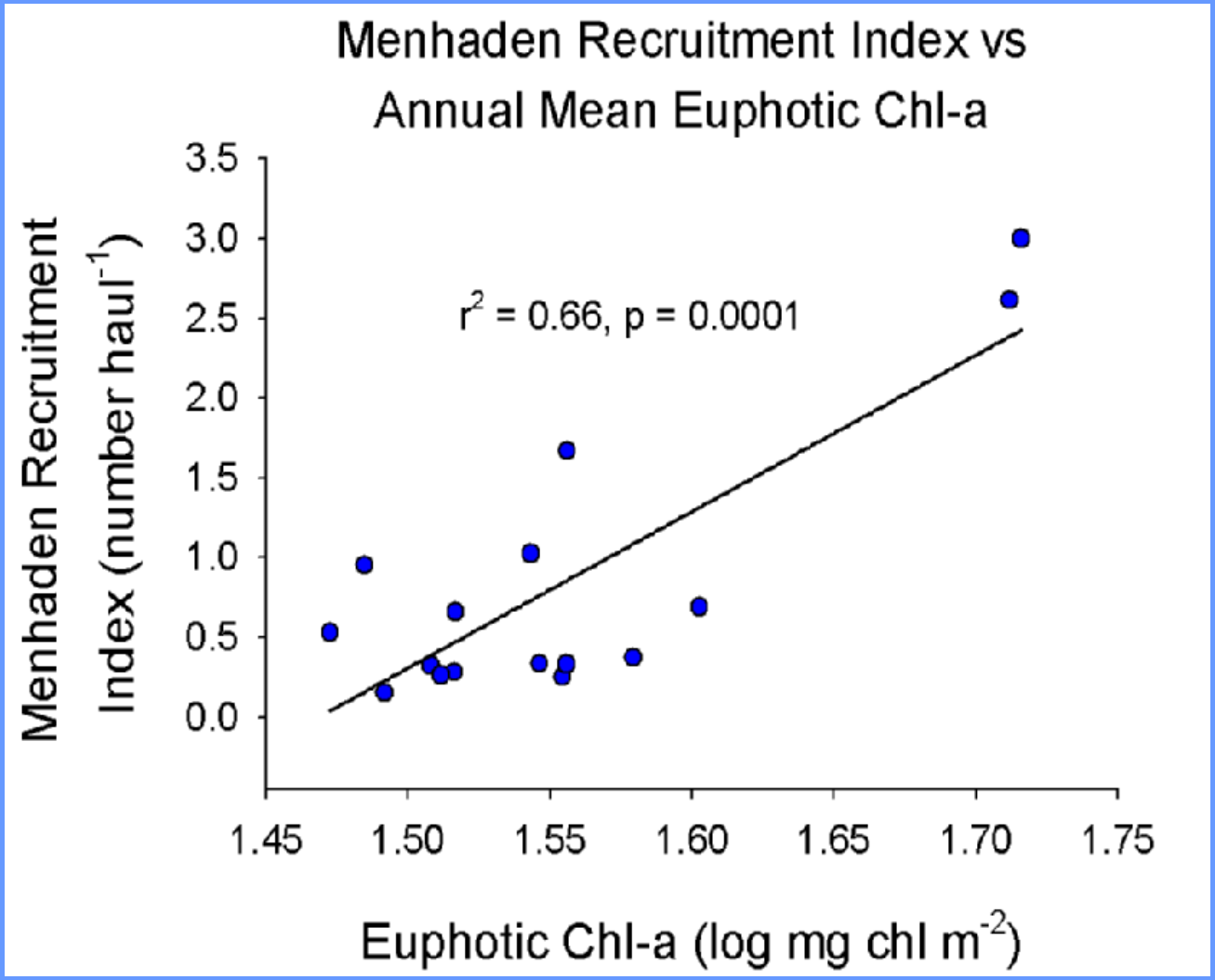
Chesapeake Bay Young-of-the-Year Juvenile Index

Historically, > 65% of coastwide recruitment came from the Chesapeake Bay

Despite declining or low recruitment coastwide and in Chesapeake Bay, coastwide abundance of menhaden had held at a reasonably high level because fishing mortality also had been trending downward.

from MD DNR juvenile seine survey

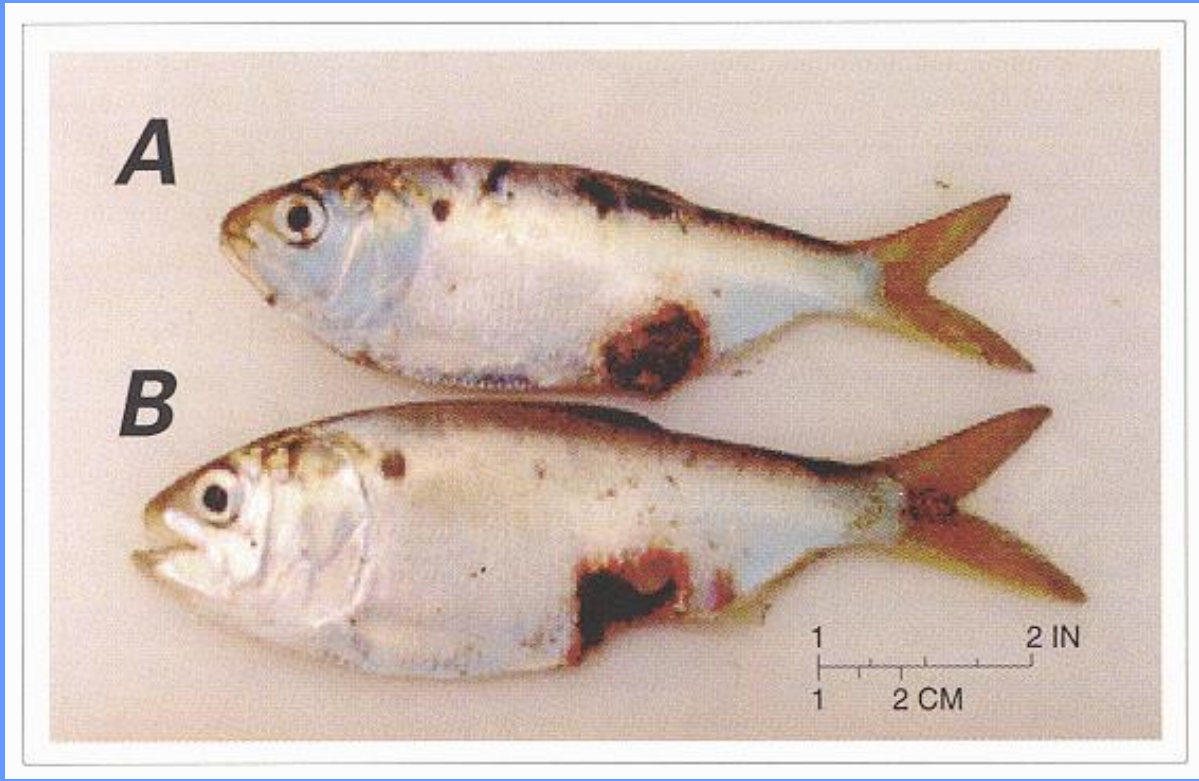
Recruitment and Primary Production



Relationship between abundance of young (age 0) Atlantic menhaden (recruitment) and phytoplankton food in Chesapeake Bay for years 1989-2004.

From Houde et al. 2011

What about Disease?



Ulcerative Lesions on Atlantic menhaden. Causative agent is *Aphanomyces invadans*

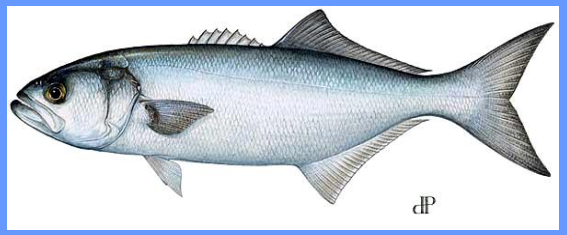
These ulcers were thought initially to be from *Pfiesteria* attacks. the *Aphanomyces* organism is a fungus. Some menhaden survive the infection. Consequences of this disease to menhaden recruitment and abundance are not known.

From Blazer et al. 2013

Menhaden: Allocation and EBFM

Commercial Fishery

Bluefish



Predators/Piscivores

Striped Bass

Weakfish

Osprey

Recreational Striped Bass Fishing

What is a “Fair” **Allocation** Plan?

Can Humans Cause
“Localized Depletion?”

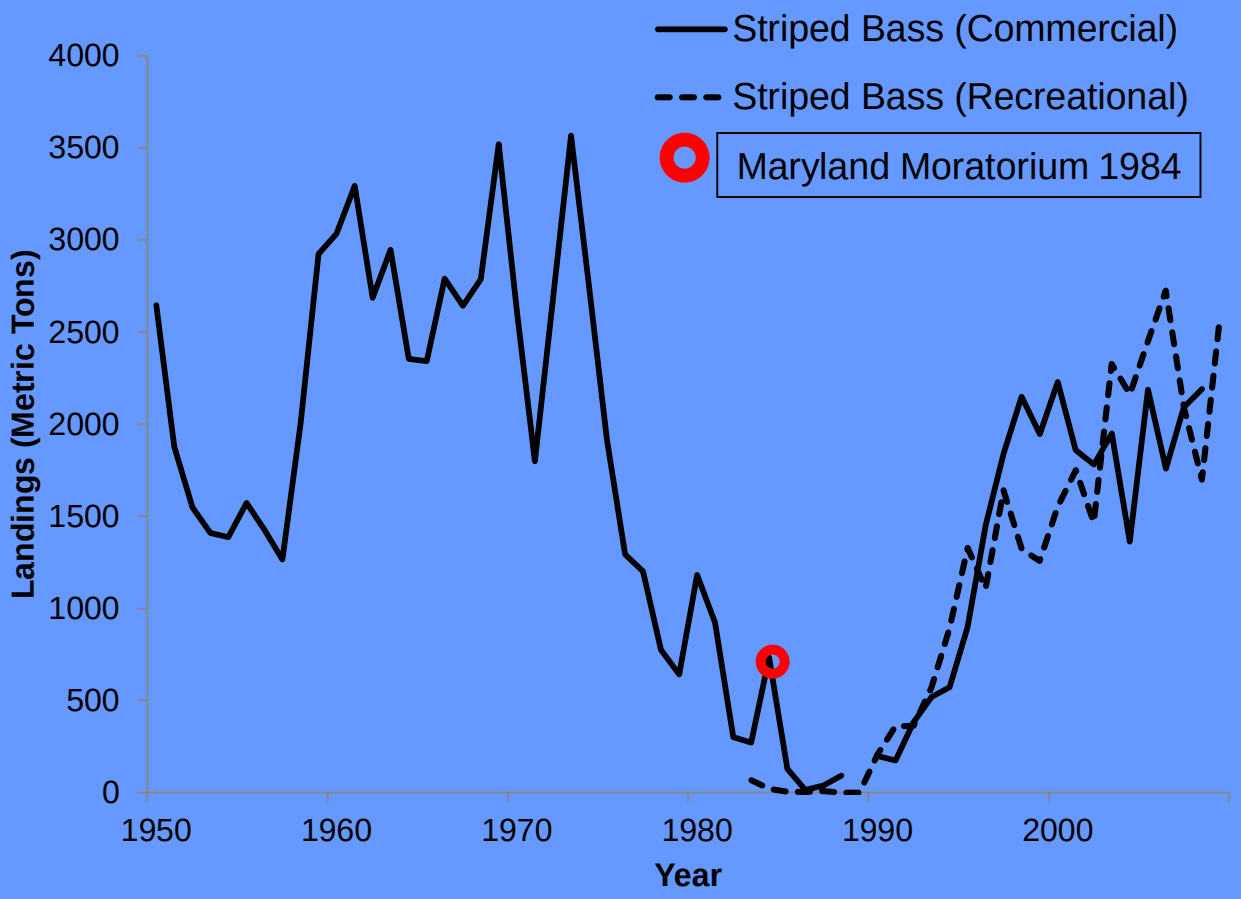
Striped Bass Status, Issues, Prognosis

Stock status
Chesapeake Bay Landings
Controlling Fishing Mortality
Recruitment success
Spawning areas and Habitats
Disease
Forage Issues
Chesapeake a Critical Nursery

Managed by ASMFC

Prognosis: Good +

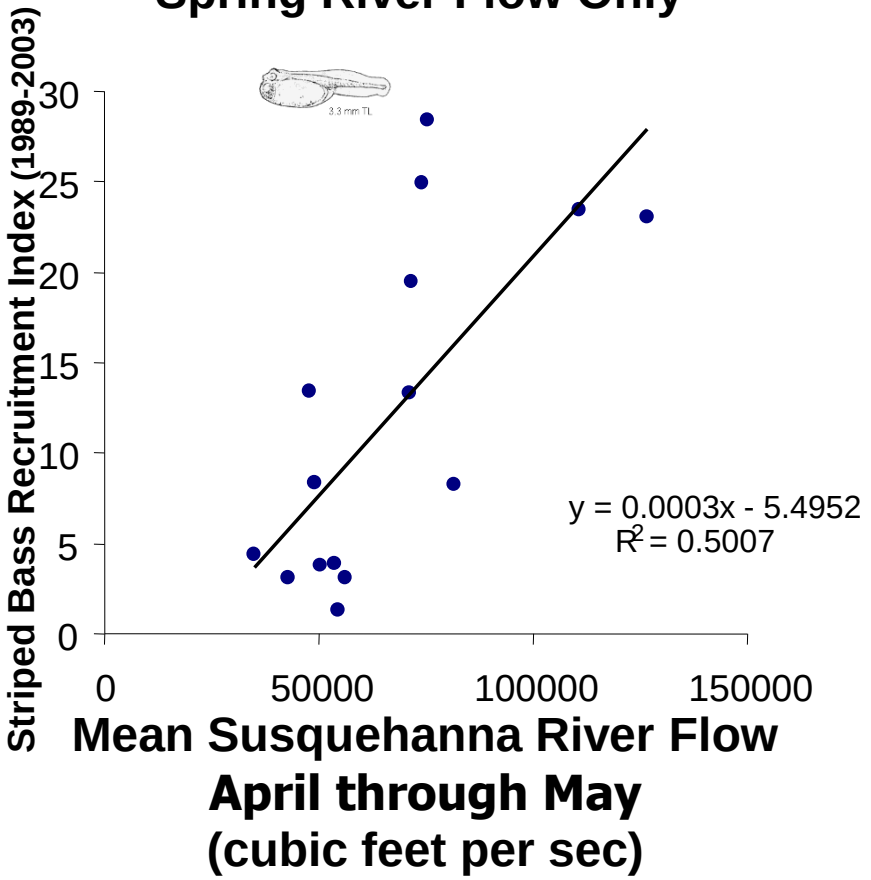
Striped Bass Landings: Commercial and Recreational Chesapeake Bay



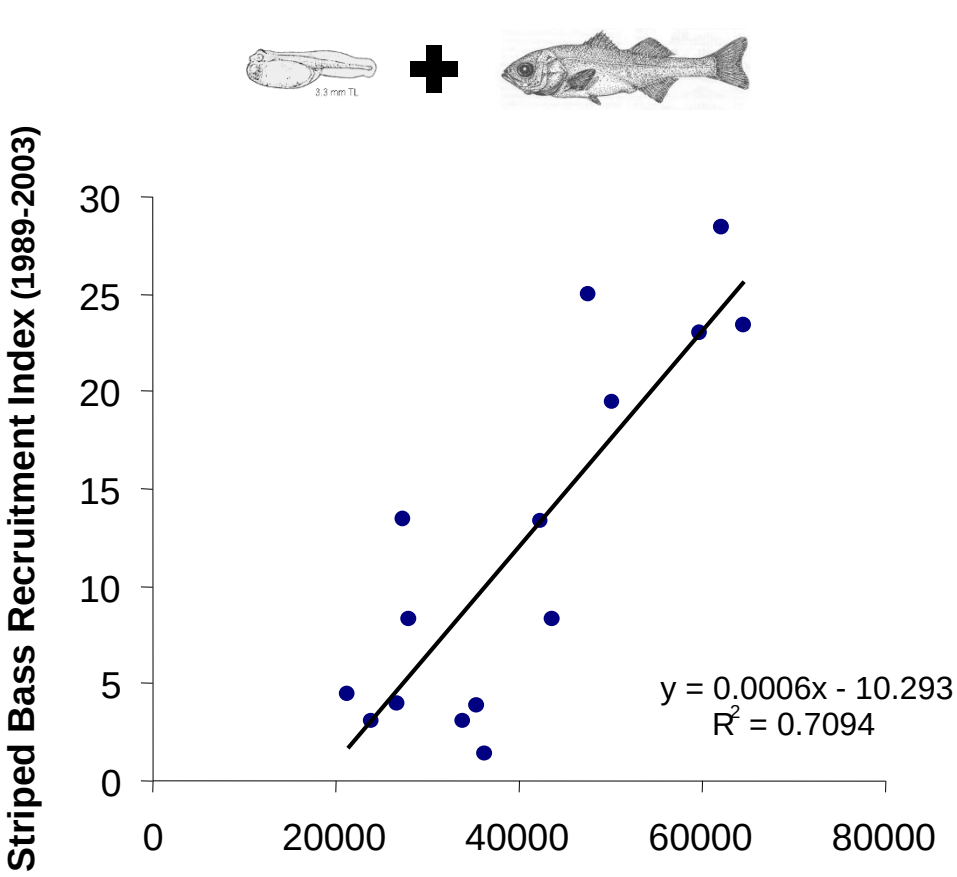
A case of management success

Striped Bass
YOY Recruitment Index: Upper Chesapeake Bay, 1989-2003

Spring River Flow Only



Spring and Summer River Flow

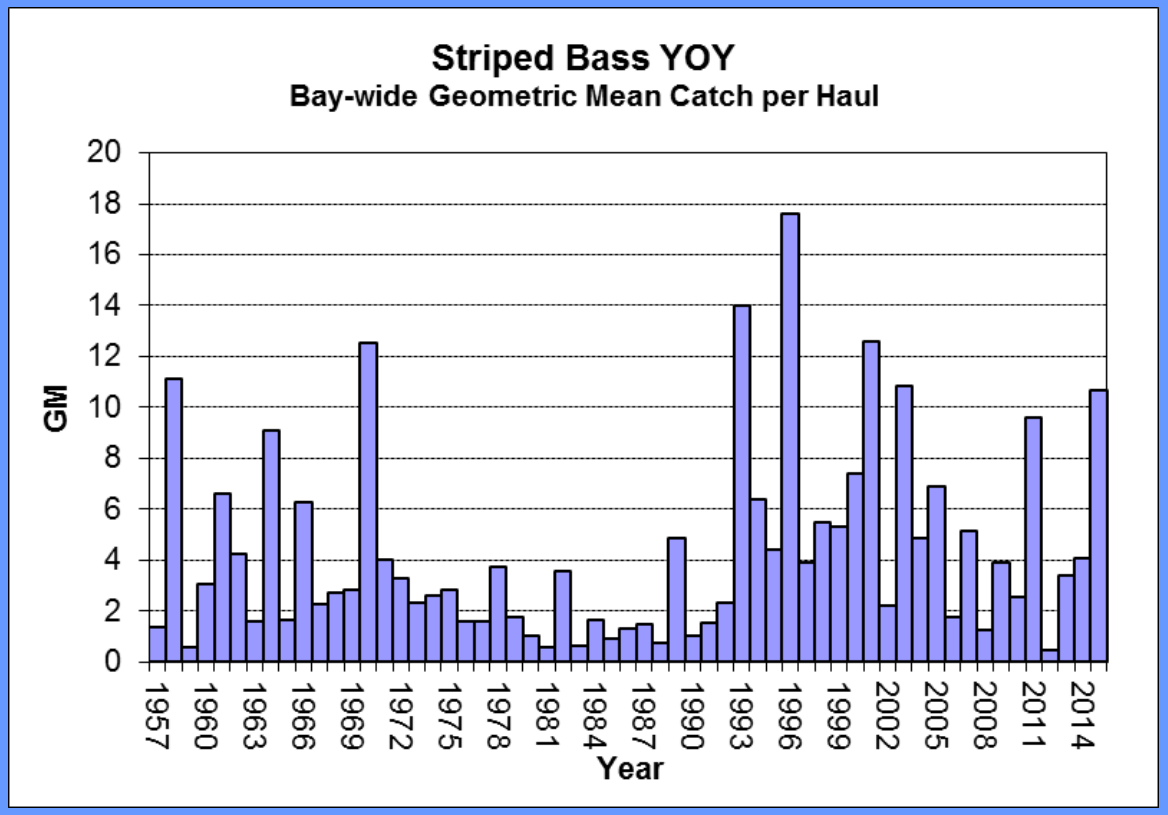


Y Axis: MD DNR YOY recruitment index data

Martino and Houde 2010

Recruitment Variability: Young-of-the-year Striped Bass, Chesapeake Bay

Geometric Mean Number



Periodic high recruitment success is the rule. We understand factors that contribute to recruitment variability. Cold, wet, late winter-early spring weather correlates with successful recruitments.

From MD DNR Juvenile Index site

Mycobacteriosis in Chesapeake Bay Striped Bass

Mycobacterium shottsii,

The disease can be acute or chronic. Acute disease Is lethal. Chronic disease may ultimately kill long-lived striped bass.

In 2008, > 50% of adult striped Bass may have harbored the disease.

http://www.vims.edu/bayinfo/faqs/mycobacteriosis.php

Chesapeake Bay Forage

Factors Affecting Forage Abundance (Chesapeake Forage Workshop 2014)

Habitat (amount and quality)

Predation

Water quality

Land use and watershed development

Fishing and catch removals

Climate change

Food for forage species

Ihde et al. 2015

Economic Value of Forage Fish

Direct value of commercial catch = $5.6 billion

Supportive commercial value = $11.3 billion

Total global commercial value = $16.9 billion

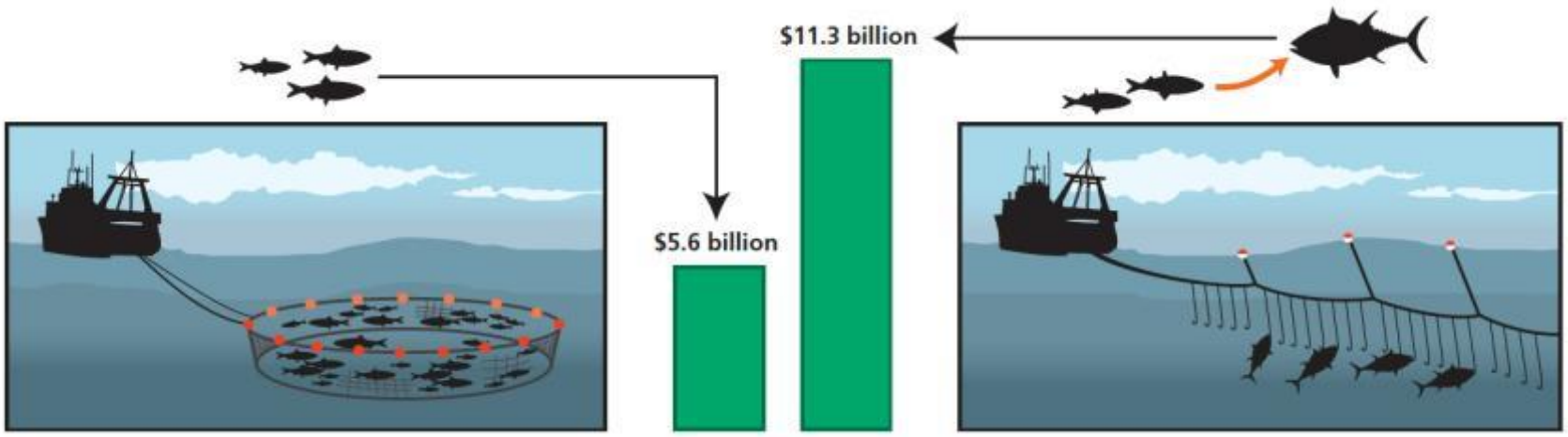
Value in 2006 dollars

FORAGE FISH DIRECT VALUE

The commercial catch of forage fish was $5.6 billion.

FORAGE FISH SUPPORTIVE VALUE

Forage fish added $11.3 billion in value to commercial catch of predators.



Chesapeake Bay Forage Fishes

- Not all forage fishes are harvested, e.g., bay anchovy, the most abundant fish in Chesapeake Bay. (10 – 200 billion)

- Atlantic menhaden: Is it “the most important fish in the sea?”

Forage Workshop: Identified Important Forage Taxa and Groups

Key Forage Groups

Bay Anchovy
Polychaetes
Mysids
Amphipods and Isopods
Mantis Shrimp
Spot
Weakfish
Sand Shrimp
Atlantic Croaker
Razor Clams
Menhaden

Blue = Invertebrates

Additional Important Forage Groups

American Shad and River Herrings
Atlantic Rock Crab
Atlantic Silverside
Blackcheek Tongueish
Blue Crab
Flounders
Gizzard Shad
Kingfish
Lady Crab
Macoma Clams
Mud Crab
Mummichog & Killifishes
Small Bivalves

Chesapeake Bay Program 2015
Forage Fish Outcome Management Strategy

Ecosystem-Based Approaches to Fisheries Management

Precautionary Approach

Risk-Averse Management

Conserve the Structure, Quality, and Productive Capacity of the Ecosystem

Primary Considerations:

- Habitat, Water Quality
- Predator-Prey Relationships
- Stakeholder Participation

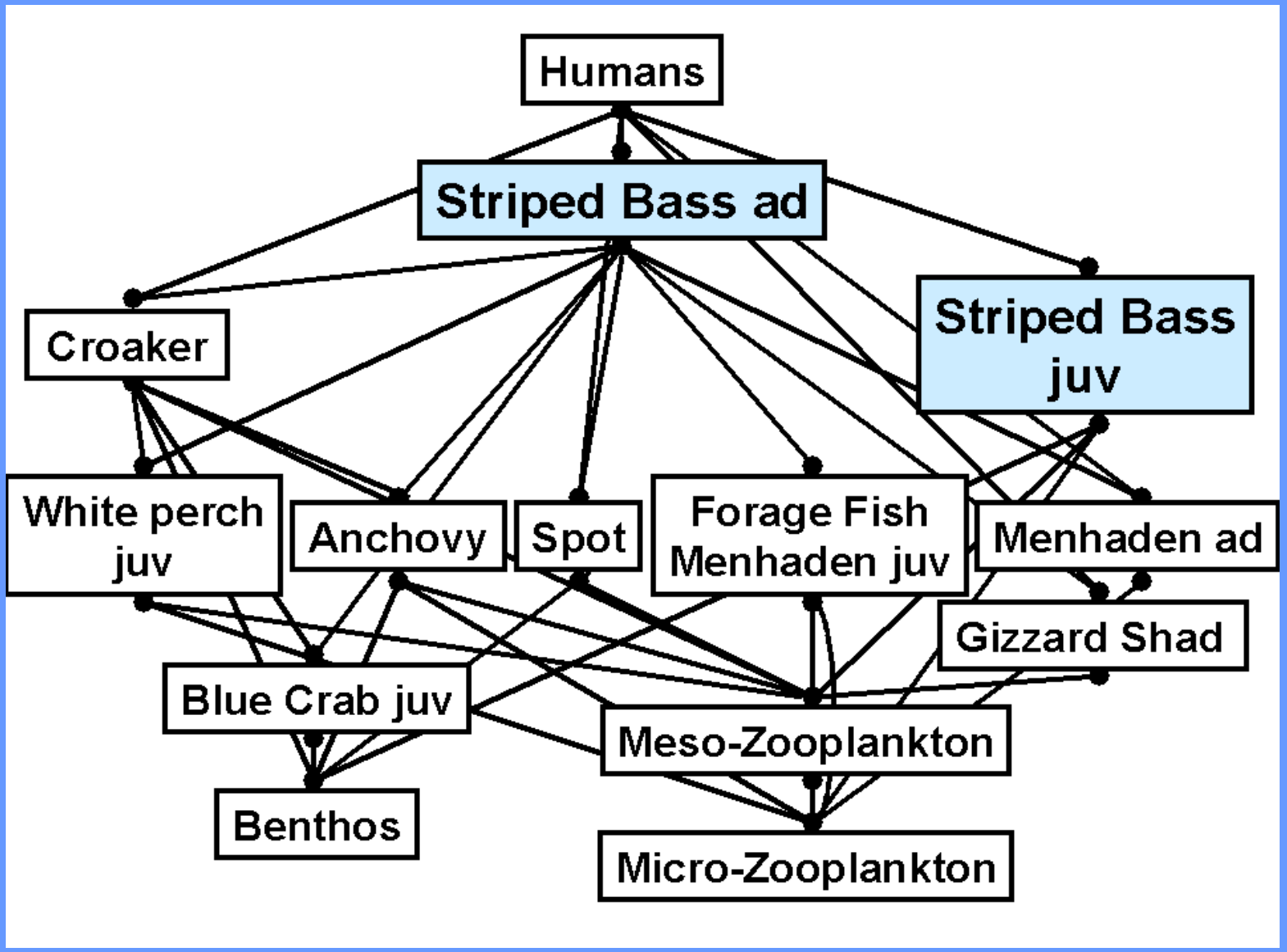
Immediate, Near-Term and Far-Term Actions to Implement EBFM

Adaptive Management

Consider alternative management scenarios; e.g., how to manage if oysters don't recover, or we don't have SAV, or shads/river herrings are extirpated.

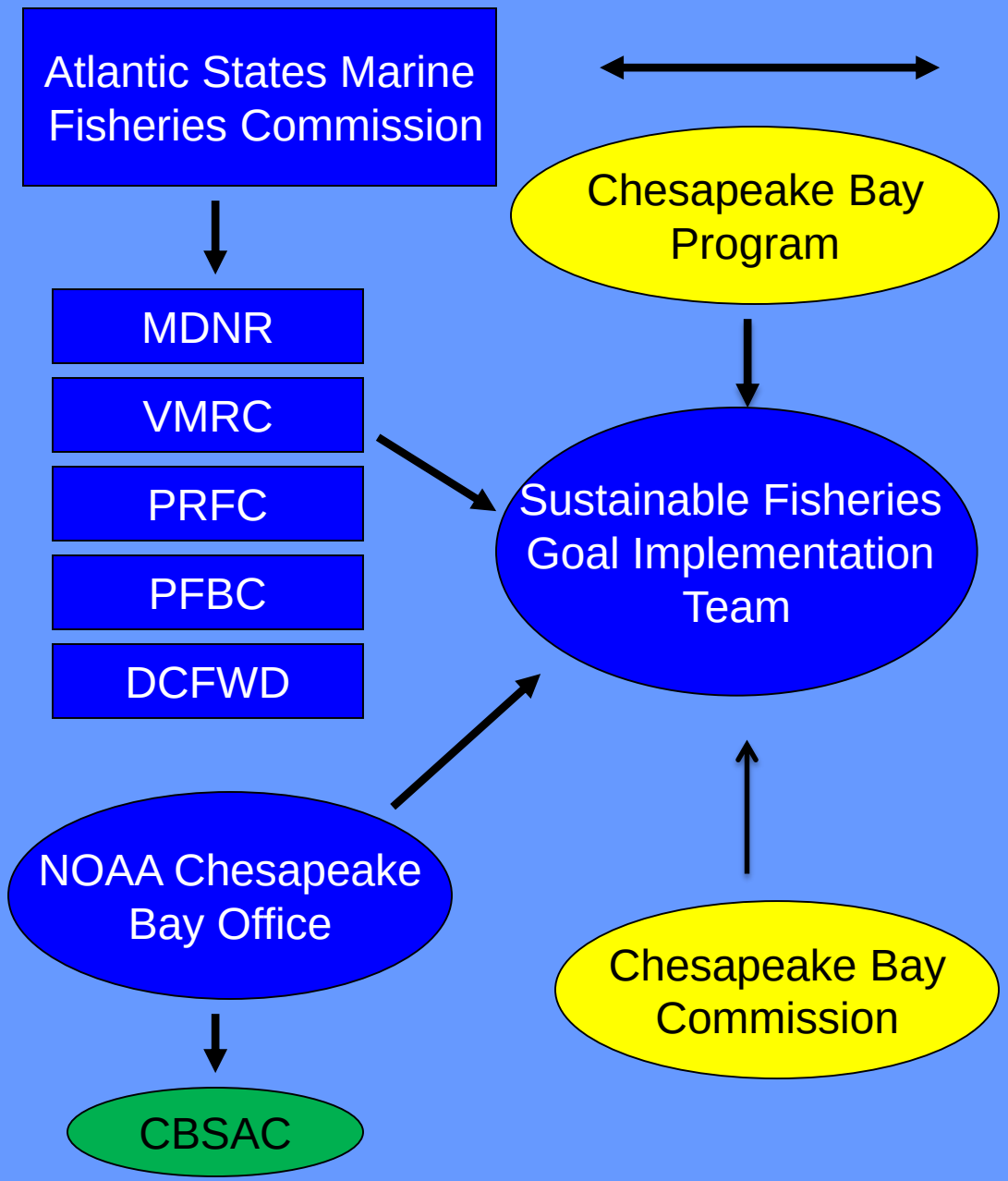
Foodweb of striped bass:

Can we quantify the links?



From Fisheries Ecosystem Plan: Chesapeake Bay, CBFEAP 2006

Fisheries Management in Chesapeake Bay



It's already complex. But, are the structures and processes adequate to manage fisheries with an ecosystem approach in mind?

Interactions with other management agencies?

Are new institutions needed?

Fish Passage

Background

The fish passage workgroup is part of the Habitat Goal Implementation Team.

Fish Passage Outcome: During the period of 2011-2025, restore historical fish migratory routes by opening 1,000 additional stream miles, with restoration success indicated by the presence of blueback herring, alewife, American shad, Hickory shad, Brook Trout and/or American eel

Prognosis: Goal is achievable. Outcome is hopeful

Need we be concerned about INVASIVE SPECIES?

"Fish the James River all year round and encounter huge blue catfish in excess of 100 lbs."

Why is this invasive species a problem?

A management dilemma: High value to recreational anglers; high cost to the ecosystem; Big, invasive predators have high consumption demand—especially on forage fishes.

Endocrine Disruptors

Intersex Fish; Feminization
Susquehanna and Potomac/Shenandoah Rivers Watersheds
Susquehanna higher incidence than Ohio and Delaware Rivers in PA
Agricultural Chemicals herbicides (e.g., atrazine), estrogenic additives to animal feeds, and Human Sewage Effluent (wastewater)
Natural and Synthetic Estrogenic Compounds
Smallmouth Bass
Human Health (?): Fetal development, male sperm counts; weakened immune systems
Problem known for more than two decades, especially in Europe

USGS, USFWS. Blazer, Ivanowicz, Pinkney et al.

Prognosis

- Oyster: Outlook uncertain for a sustainable fishery on wild oysters; aquaculture potential high. Outcomes since 2012 hopeful. Sanctuaries are important. Restoration also important.

- Blue Crab: Outlook favorable for a sustainable fishery; resilient and tolerant. Good example of coordinated, collaborative management across jurisdictions. What is best allocation strategy and plan?

- Striped Bass: Outlook very favorable for sustainable fishing; competent across-sector, regional management; need to be on guard to control fishing mortality.

Prognosis (cont.)

Menhaden: Outlook favorable for a sustainable fishery. Need to consider conserving its ecosystem services. Management should aim to maintain a relatively high biomass. Ecosystem reference points are being developed.

Shads and River Herrings: No sustainable fishery is possible under present conditions. Steep declines coastwide and in the Bay. Multiple factors likely responsible. Restoration of fish passage is important.

Threatened Species: American eel, Atlantic sturgeon, shortnose sturgeon. Outlook is not good for any of them, but there is hope. Some positive signs for Atlantic sturgeon.