# EBFM in Chesapeake Bay

E. D. Houde

Workshop on Ecosystem-Based Fisheries Management

New England Fisheries Management Council

Newport, RI

27 August 2009

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE
CHESAPEAKE BIOLOGICAL LABORATORY

# 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

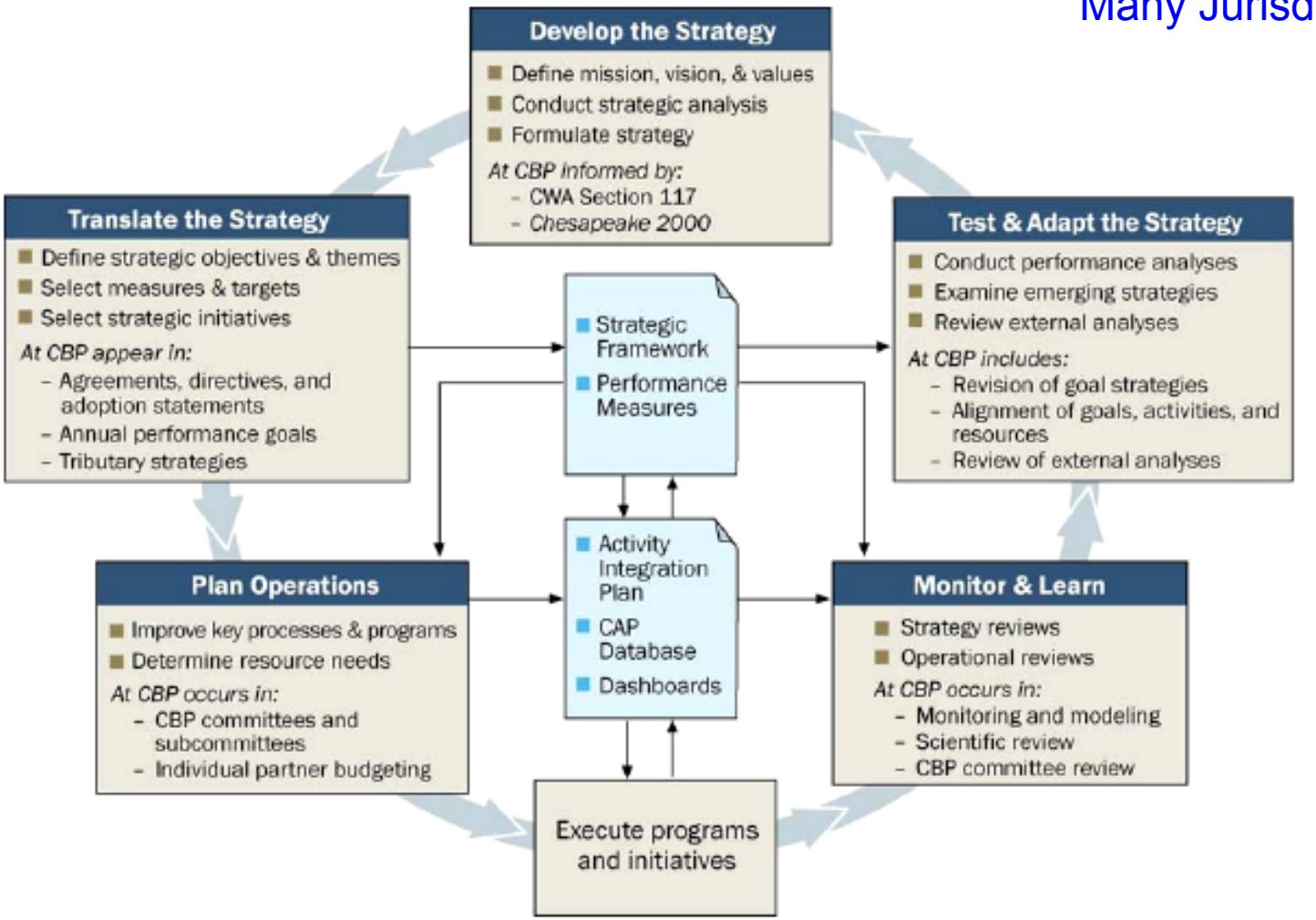
2100

# Chesapeake Bay Program: Chesapeake Action Plan

## EPA Lead and Coordinating Agency

Big. Complex.
Many Facets.
Many Jurisdictions

Figure 10. *Chesapeake Bay Program Management System*



# Many Life Histories are Represented

Management is Complex

Most Species Are Not Permanent Bay Residents

Moves Toward Multi-species and Ecosystem-Based Management Will Require Broader Multi-Agency Involvement

Anadromous Fishes
- Striped Bass
- Shads, River Herrings

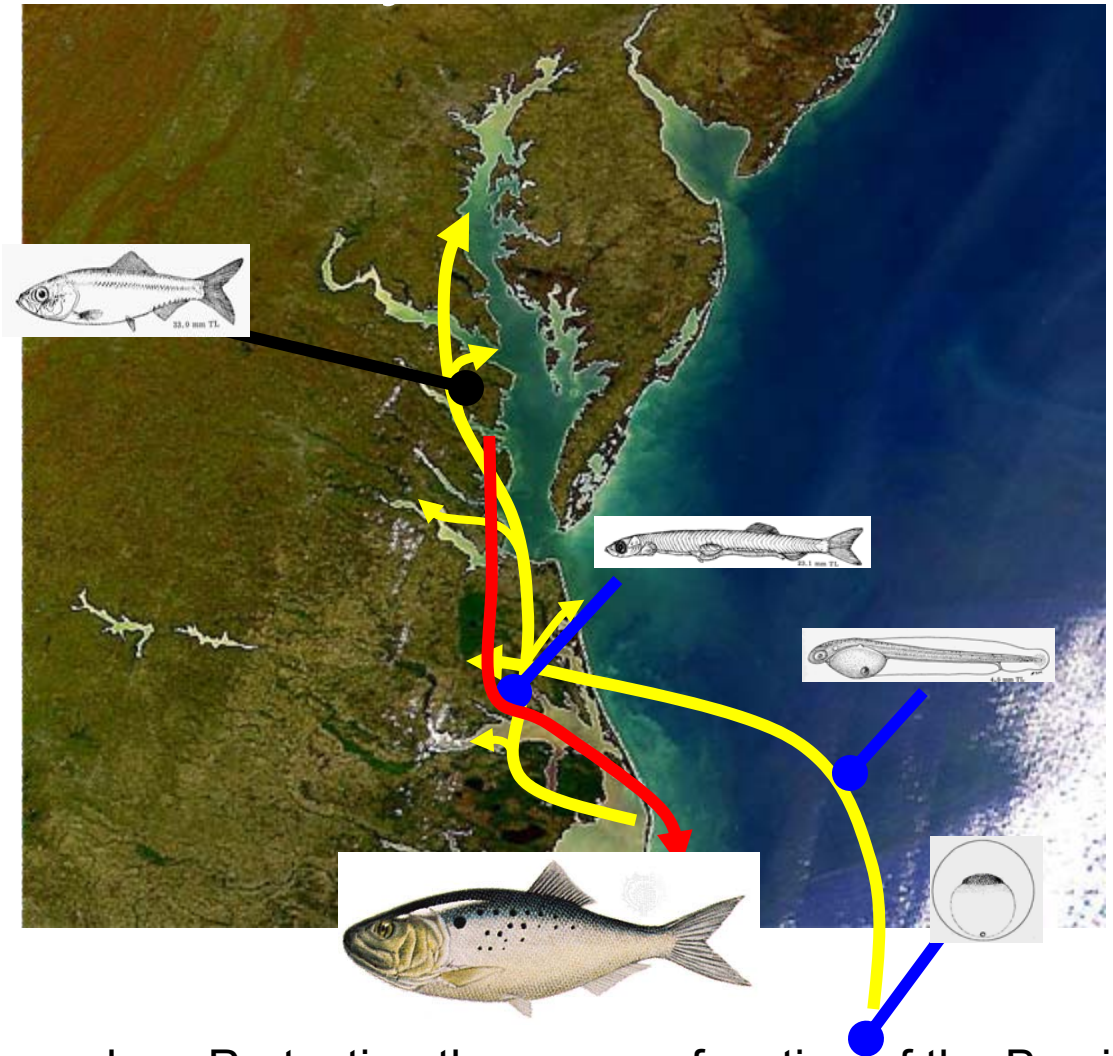
Bay Residents
- Blue Crab
- Eastern Oyster
- Bay Anchovy

Coastal Migrants
- Weakfish
- Atlantic croaker
- Atlantic menhaden

FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION / DIANE ROME PEEBLES

**24 Species are managed in the Bay. Most are not lifetime Bay residents.**

# Atlantic Menhaden:  Life Cycle



Life cycles are complex.  Protecting the nursery function of the Bay is important.

The ecosystem's "boundaries" are not obvious

Chesapeake Bay Commercial Catch

Total Removals?

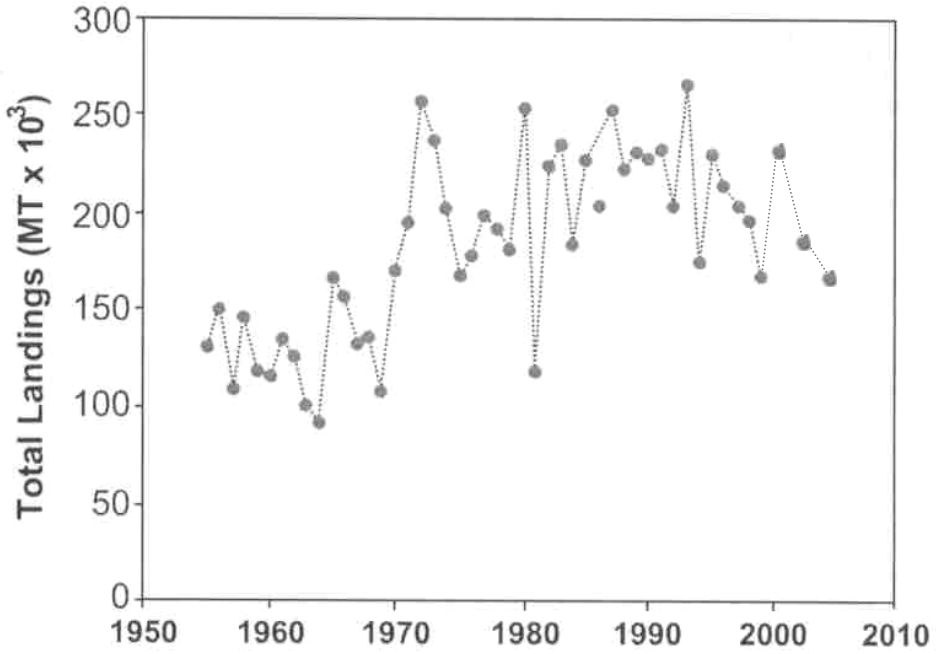
Carrying Capacity?

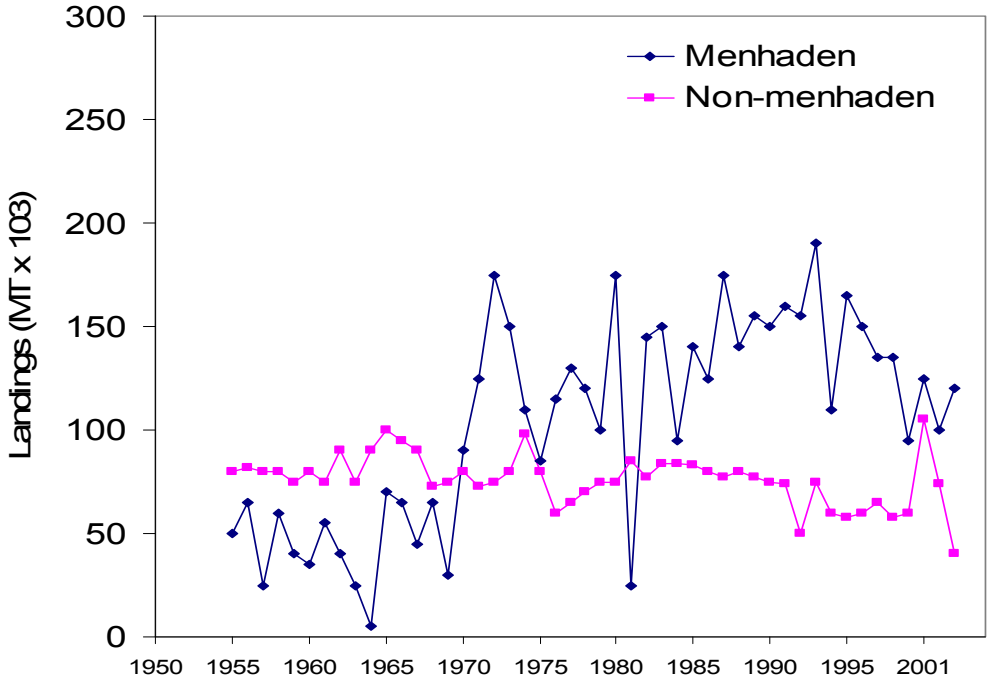
The Bay historically may have supported landings (removals) exceeding 300,000 tons (>250 kg/ha).

Was that level sustainable?

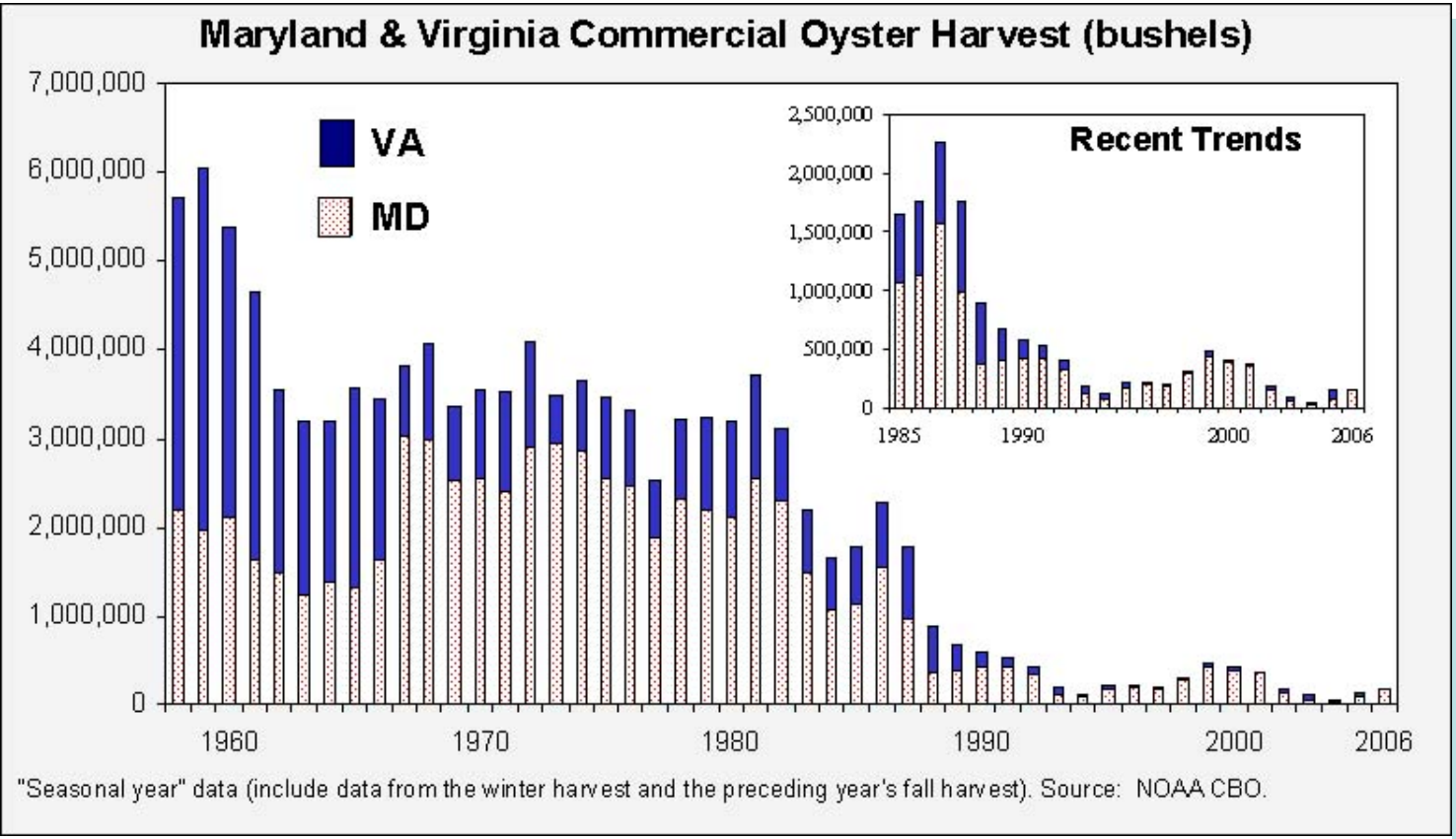
What is the carrying capacity and level of landings that can be taken now? How should landings be allocated among trophic levels?

From Chesapeake Bay Fisheries Ecosystem Plan



# The Oysters are Gone Folks. This is a Big Deal!



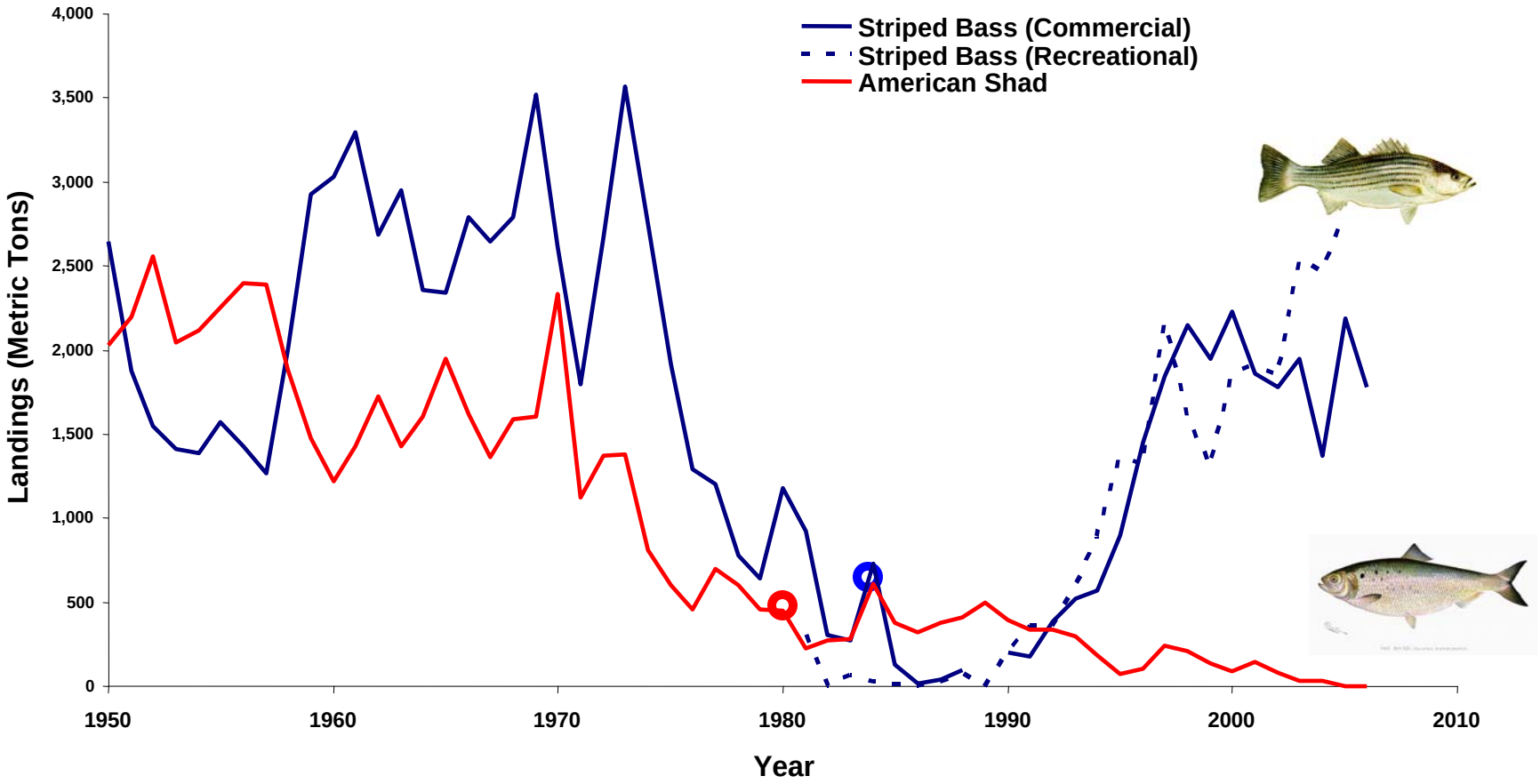

**Oyster harvests have declined due to overharvesting, disease, pollution and loss of oyster reef habitat.**

**Two protozoan parasites, discovered in the 1950s, MSX and Dermo, have been a major cause of the oyster's decline during recent times.**

Total Bay Landings now are only ~0.1% of the peak which occurred in the late 19th century

Recent annual landings (2003-2005) were valued at $3.2 million

# Chesapeake Bay: Striped Bass and American Shad Commercial Landings




The Chesapeake ecosystem is still very capable of supporting striped bass reproduction.

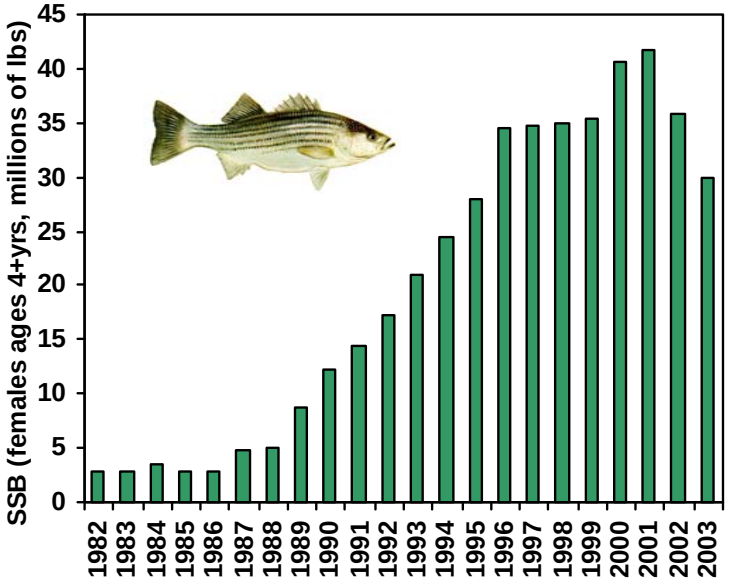
Maryland Moratorium 1980

Maryland Moratorium 1984

NMFS Landings Statistics

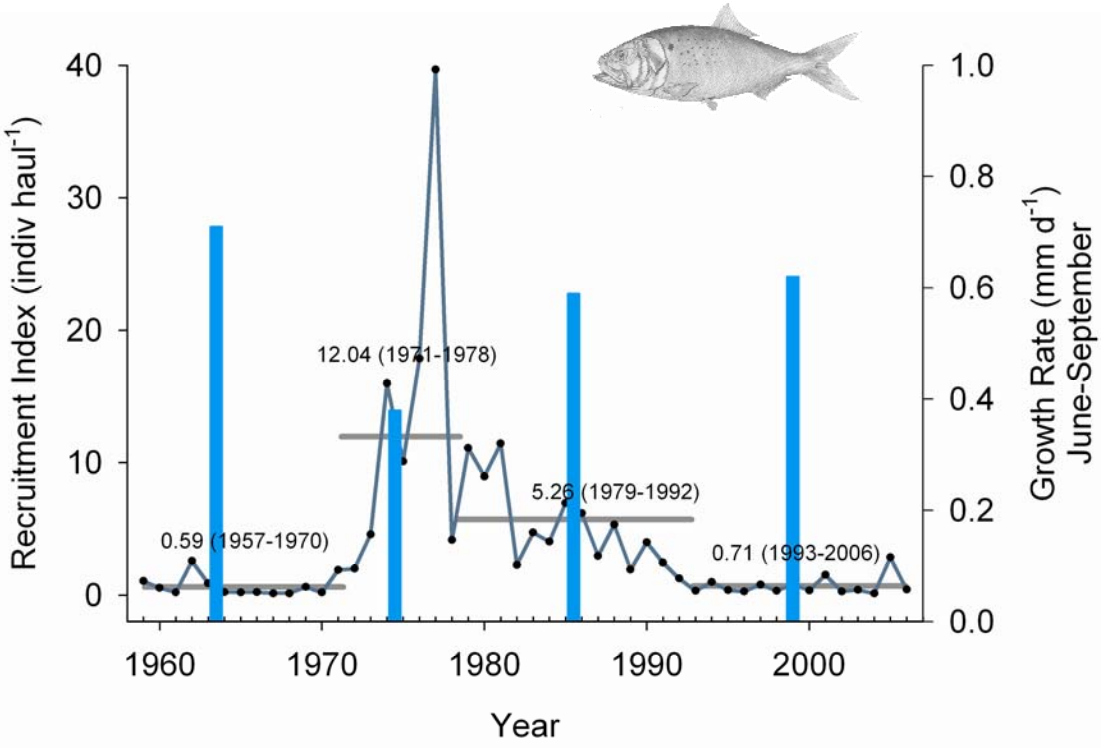
# Menhaden recruitments are down: WHAT DOES IT MEAN?

## Striped Bass Stock Biomass




Menhaden recruitments began to decline before recovery of striped bass

## YOY Menhaden Recruitment Index

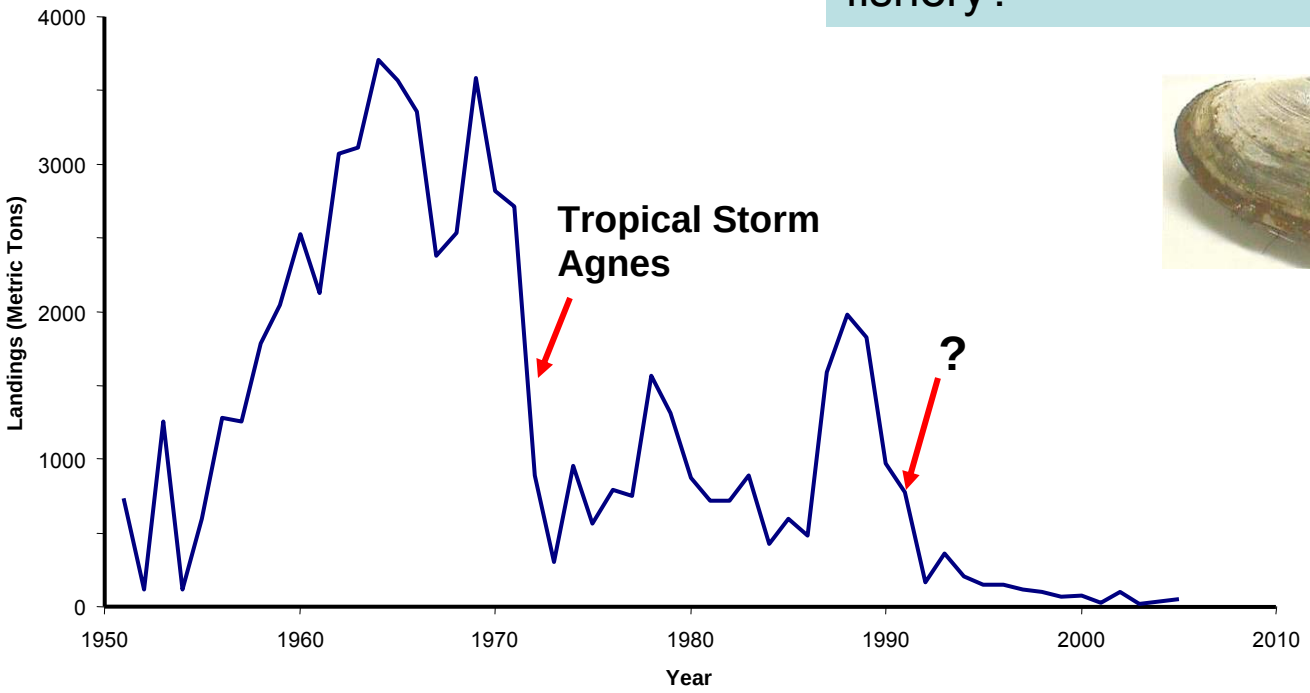



*** Menhaden recruitment index: Combined MD and VA seine survey data, area weighted by tributary areas.**

**** Mean growth rates for periods based on modal analysis of VIMS trawl survey data**

# Chesapeake Bay: Soft Clam: Commercial Landings

What were stressors that led to collapse of the population and fishery?



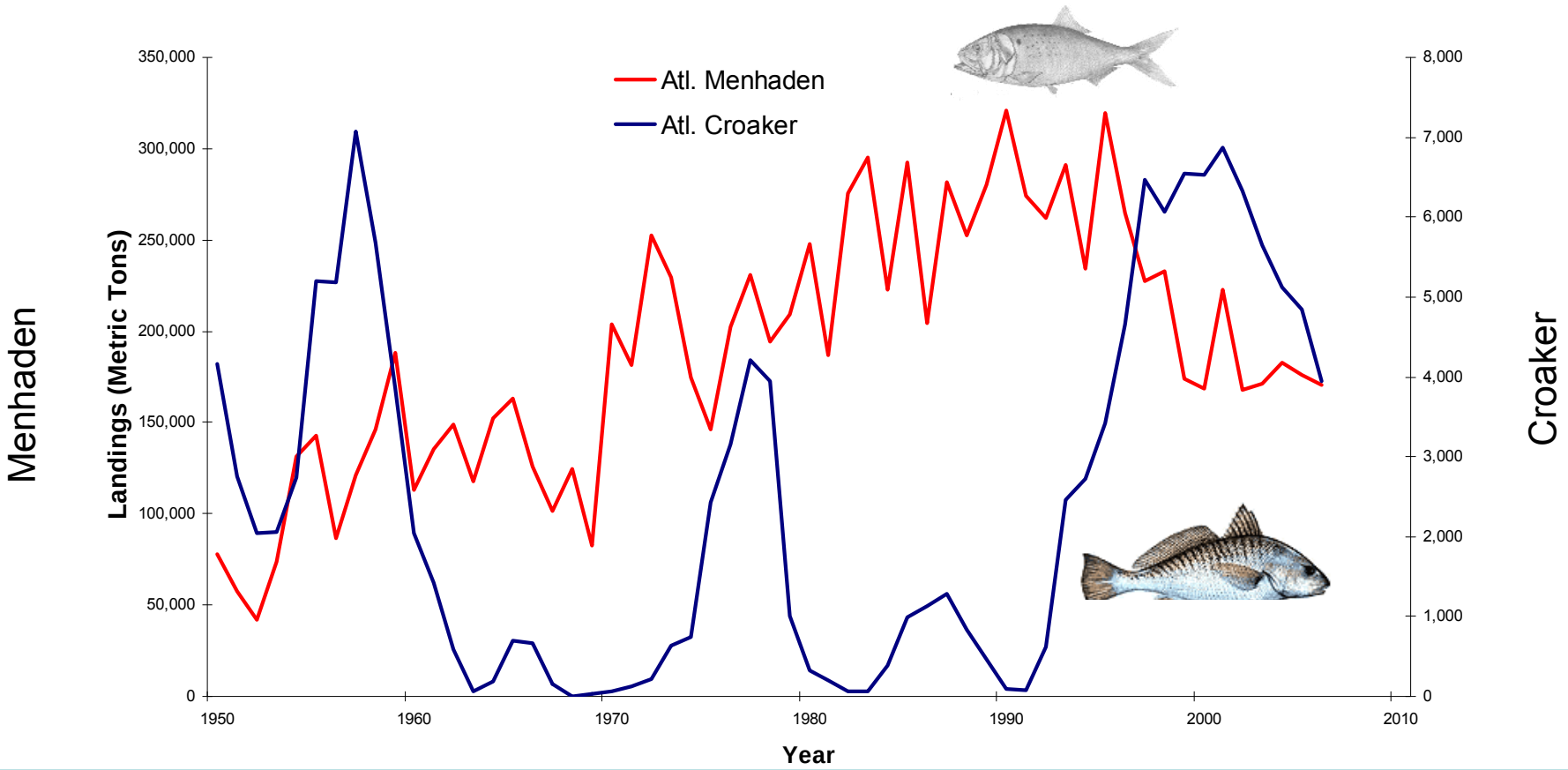

Soft clam Landings crashed after Tropical Storm Agnes, 1972

Landings partially recovered, but to a lower level than before Agnes

Landings essentially disappeared in early 1990s.

NMFS Landing Statistics

# Commercial Landings
## Coastwide Atlantic Menhaden Landings
## Chesapeake Bay: Atlantic Croaker

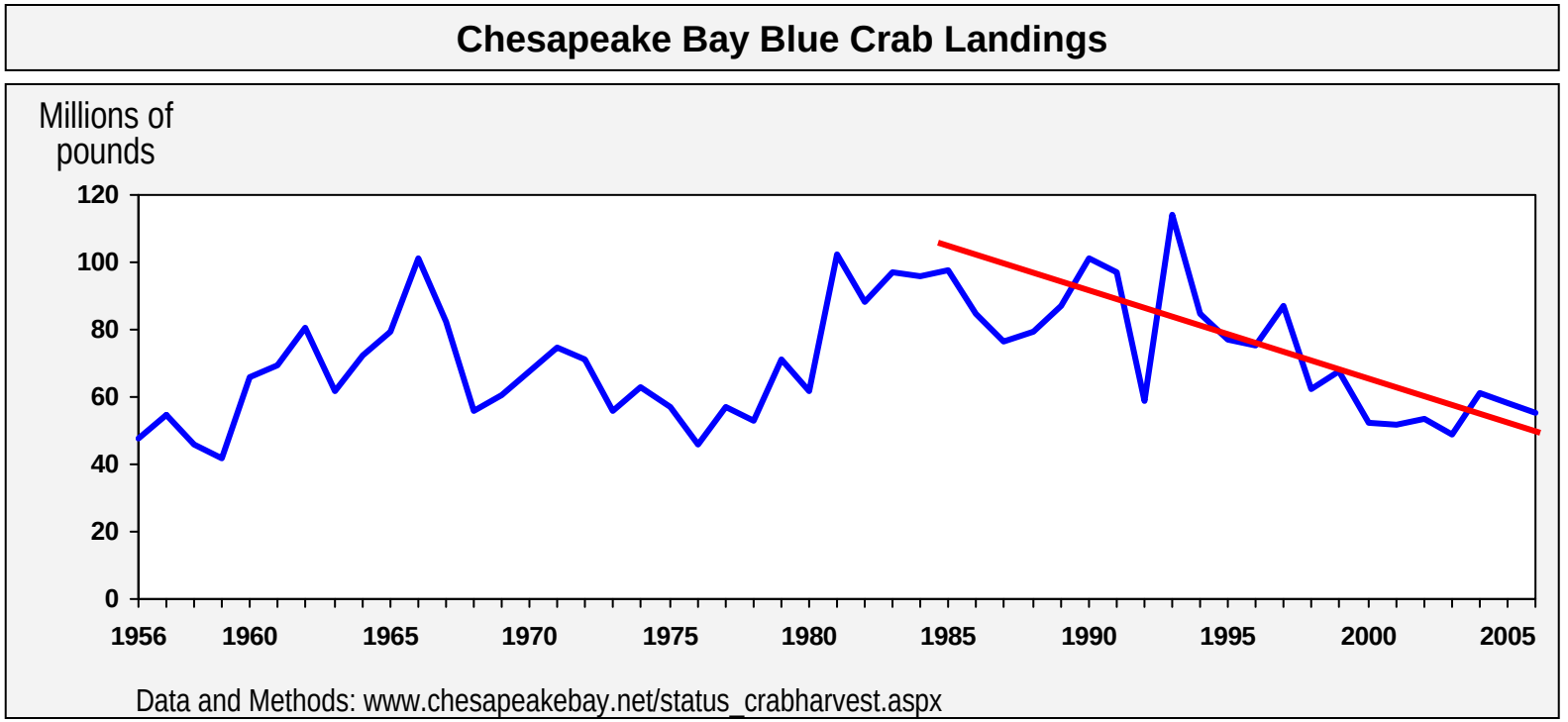



60-70% of the menhaden landings come from Chesapeake Bay. Localized Depletion? Menhaden purse-seine fishery in Chesapeake Bay now capped at 109,020 tons.

Croaker landings show periodic shifts. Warm winters support high abundance.

NMFS Landings Statistics

# Chesapeake Bay: Blue Crab: Commercial Harvest




Blue crab landings declined from ~40,000 tons annually To ~25,000 tons.

Chesapeake Bay's most valuable commercial fishery.

# Incentives to Develop Ecosystem-Based Fisheries Management in Chesapeake Bay

**Rio Conference 1992 (United Nations)**

**Precautionary Approach- -Fisheries, 1995 (United Nations, Lysesil)**

**Reauthorization of the MSFCMA, 1996**

****EPAP Recommendations (NMFS), 1999**

**NAS/NRC Report, "Sustaining Marine Fisheries," 1999**

**"C2K", Chesapeake Bay Program, 2000**

**Reykjavik Declaration, 2001 (FAO, United Nations)**

**Pew Report, 2003; USCOP Report, 2004**

**Reauthorization of MSFCMA, 2006**

**Chesapeake Bay Fisheries Ecosystem Plan, 2006**

**Maryland Sea Grant: Fisheries Ecosystem Management Planning, 2008**

## The FEP is Published: http://chesapeakebay.noaa.gov/docs/FEP_FINAL.pdf

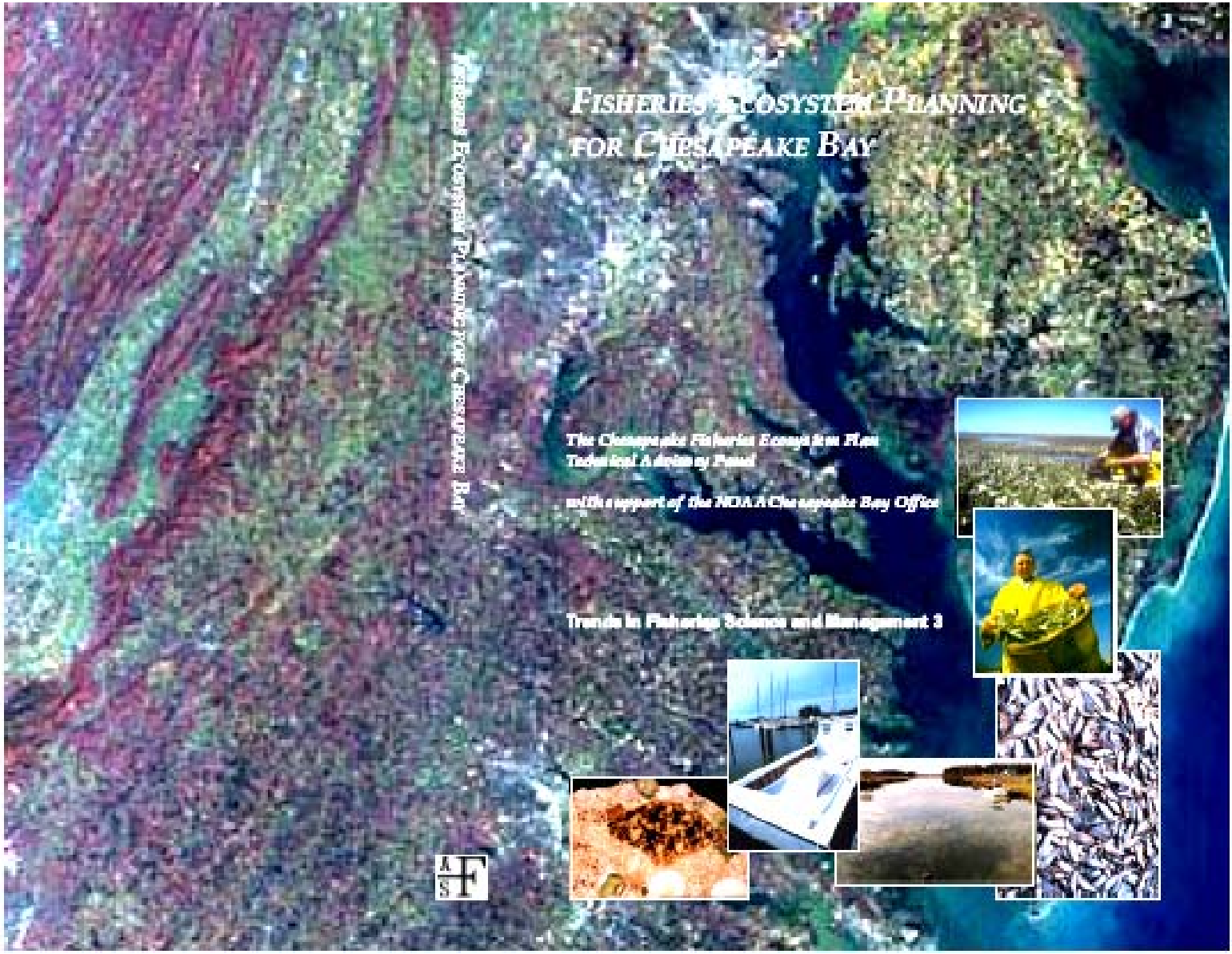
***FISHERIES ECOSYSTEM PLANNING***

***FOR CHESAPEAKE BAY***

***The Chesapeake Fisheries Ecosystem Plan***

***Technical Advisory Panel***

***with support of the NOAA Chesapeake Bay Office***




**American Fisheries Society, Trends in Fisheries Science and Management 3. 450 pp.**

# Pathways to Implementation

- **Obtain endorsement of the FEP as guiding framework for Chesapeake Bay fisheries management**
  - **Chesapeake Bay Program**
  - **Other Bay resource management institutions with regulatory authority (e.g., MDNR, VMRC, MDE, DCDH, VDEQ)**
  - **Regional fisheries management institutions (e.g., ASMFC, MAFMC, SAFMC)**

**Chesapeake Bay Program Executive Council adopted the FEP as its Guide for development of EBFMs (Dec. 2005).**

- **Develop first generation pilot FMPs as 'proof of concept' for ecosystem-based fisheries management (Oysters, blue crab, menhaden, striped bass, shad/river herrings)**

- **Build a cooperative ecosystem approach to Bay resource management between State and Federal partners with jurisdiction over coastal and estuarine areas.**

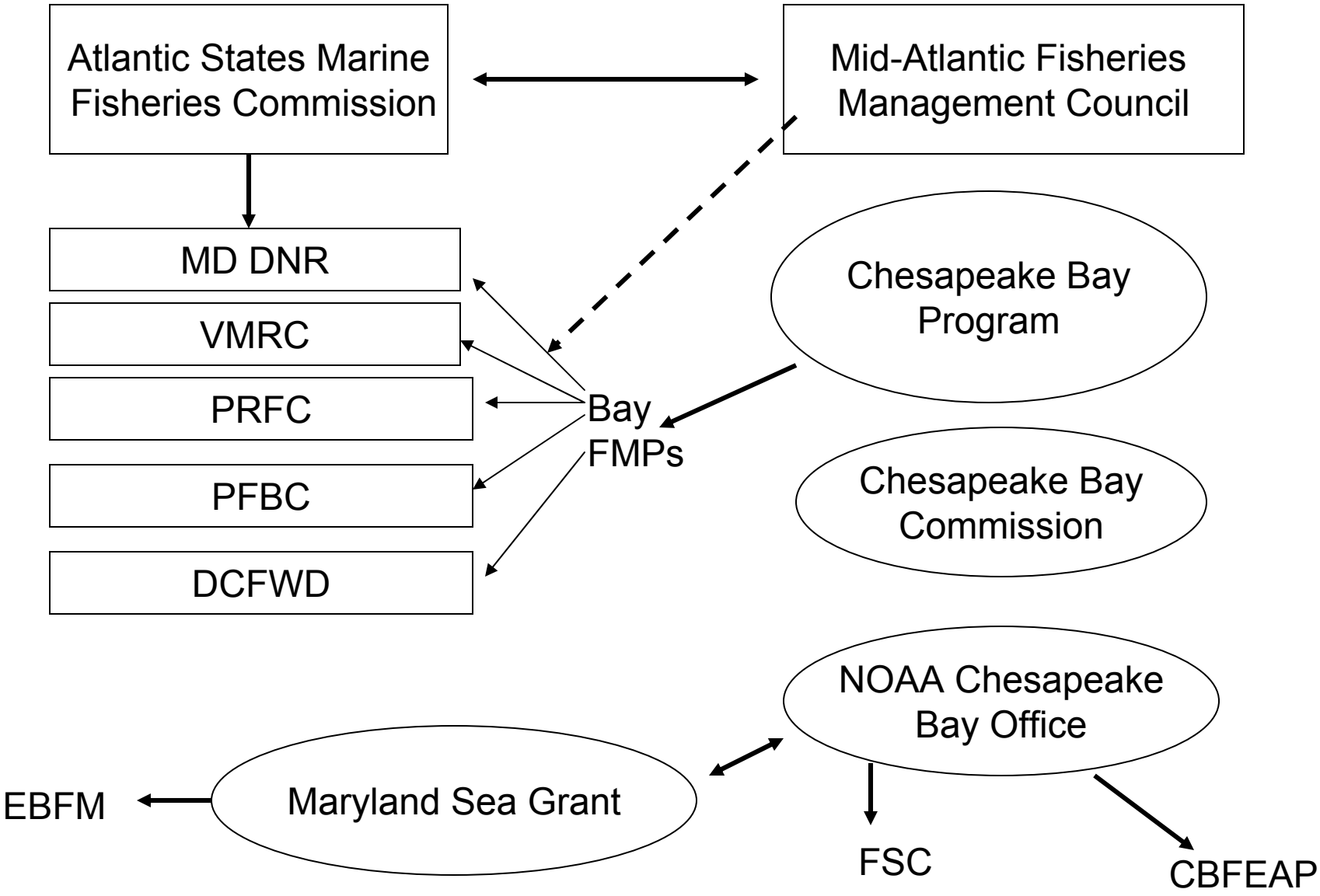
# Management, Jurisdictions, and Institutions

**Is There**

**1) a Need for New Institutions to Accommodate Ecosystem-Based Fisheries Management?**

**2) a Need to Create Institutions that Include Agencies Other than Fisheries Management Agencies?**

# Fisheries Management in Chesapeake Bay



# What Will EBFM Look Like When Implemented in Chesapeake Bay?

- Single-Species Plans Imbedded in a Chesapeake Bay Ecosystem Plan

- Habitat-Sensitive
- Key Species Emphasized
- Predator-Prey, Food Webs
- Precautionary
- Recognizes Externalities
- New Reference Points
- New Institutions?

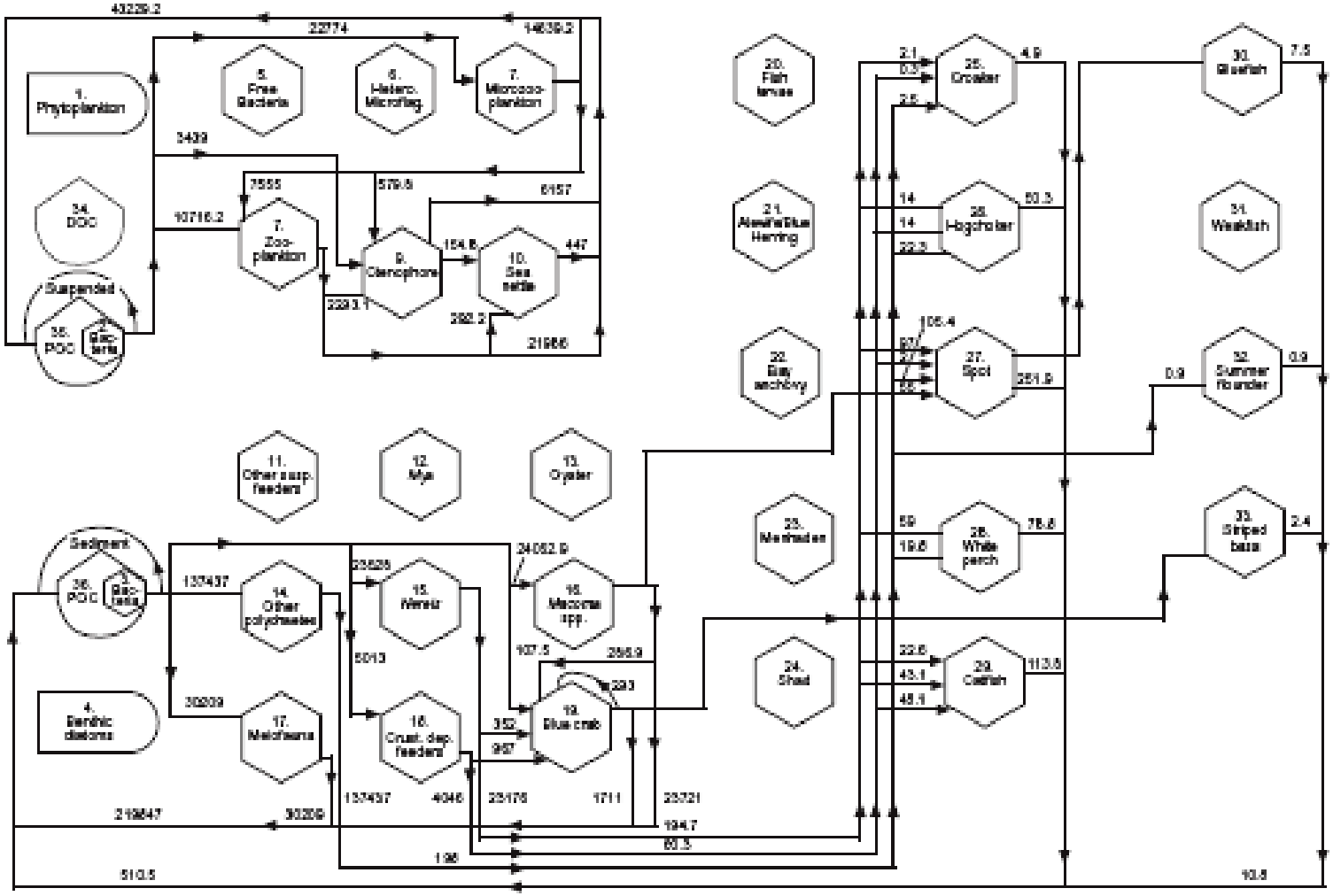
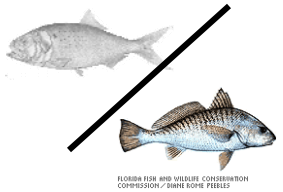
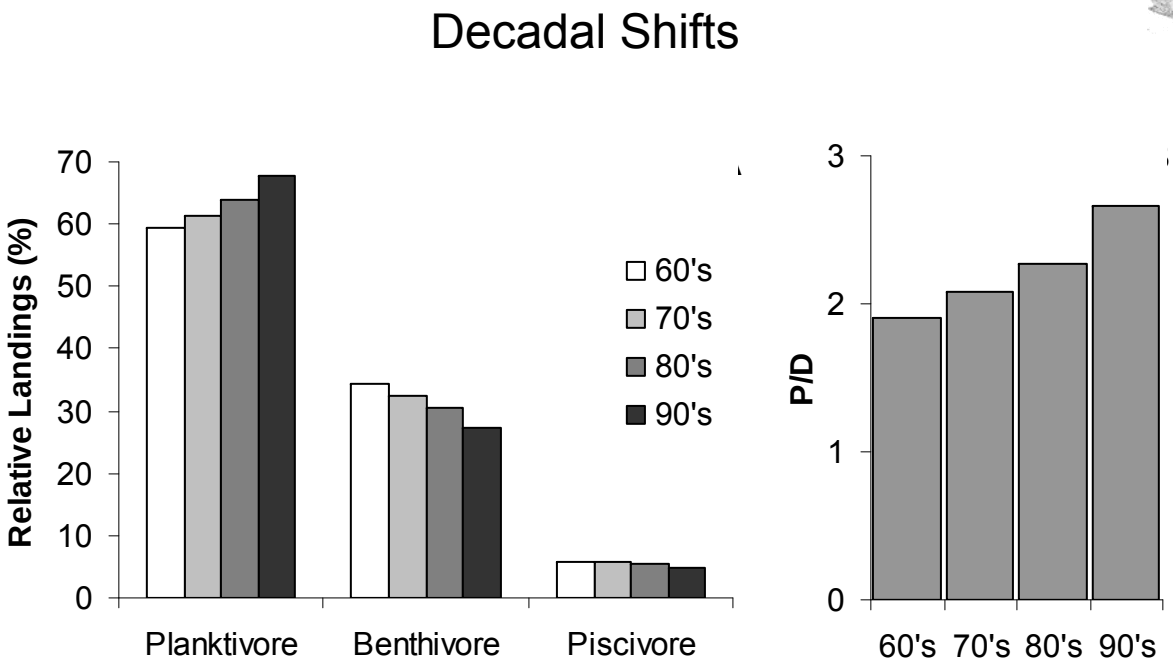



Figure 2. Food web components of middle (mesohaline) Chesapeake Bay, indicating composite cycling of carbon. This web is generally representative of the major food web components used in previous network (energy flow) analyses of the Chesapeake food web (Baird and Ulanowicz 1989; Monaco and Ulanowicz 1997; Hagy 2002) (adapted from Baird and Ulanowicz 1989).

Food-Web Modeling and Network Analysis, e.g., Baird and Ulanowicz 1989

# Chesapeake Bay
# Feeding Guilds Represented in Commercial Landings



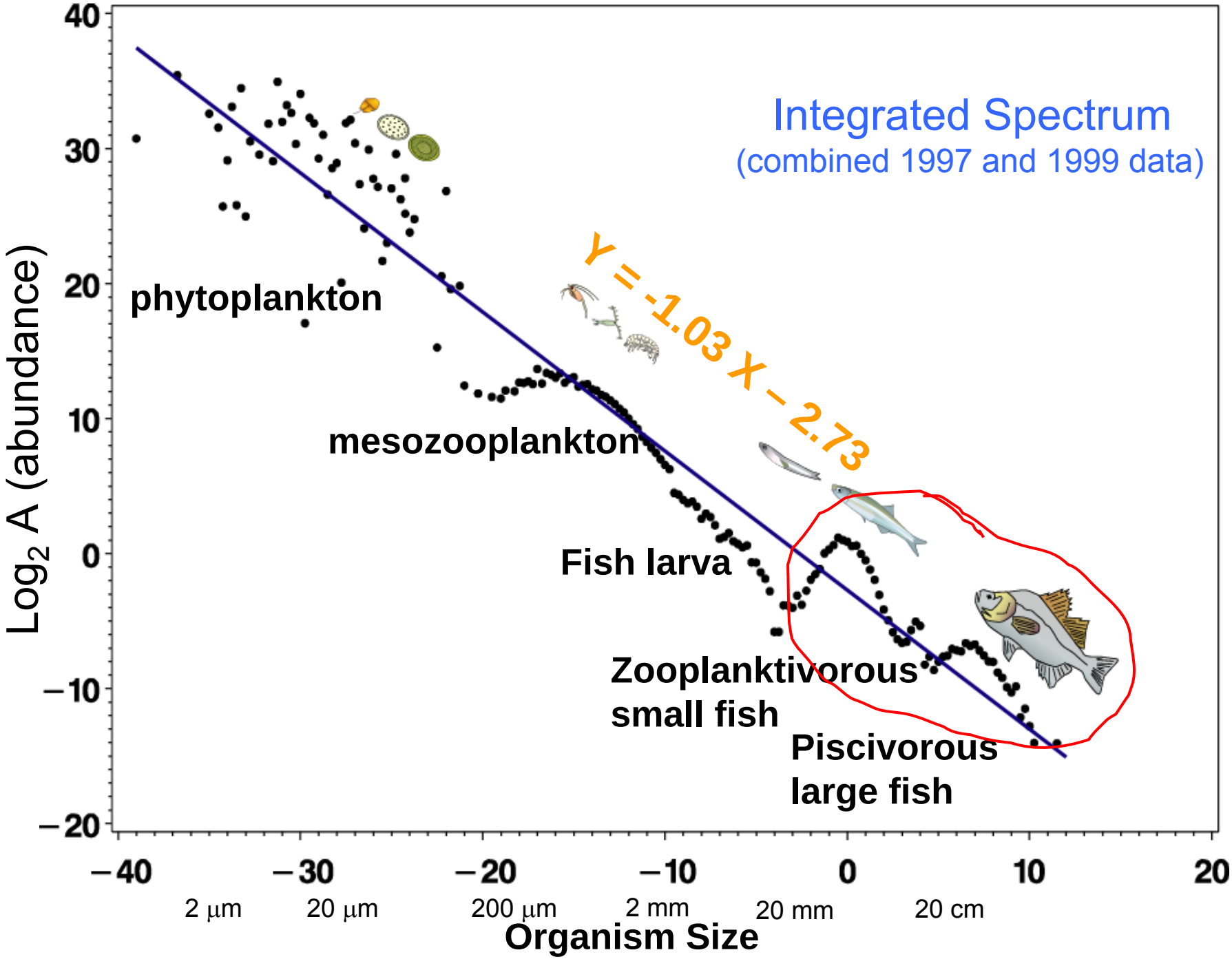



**P = Planktivores D = Demersal (Benthivore)**

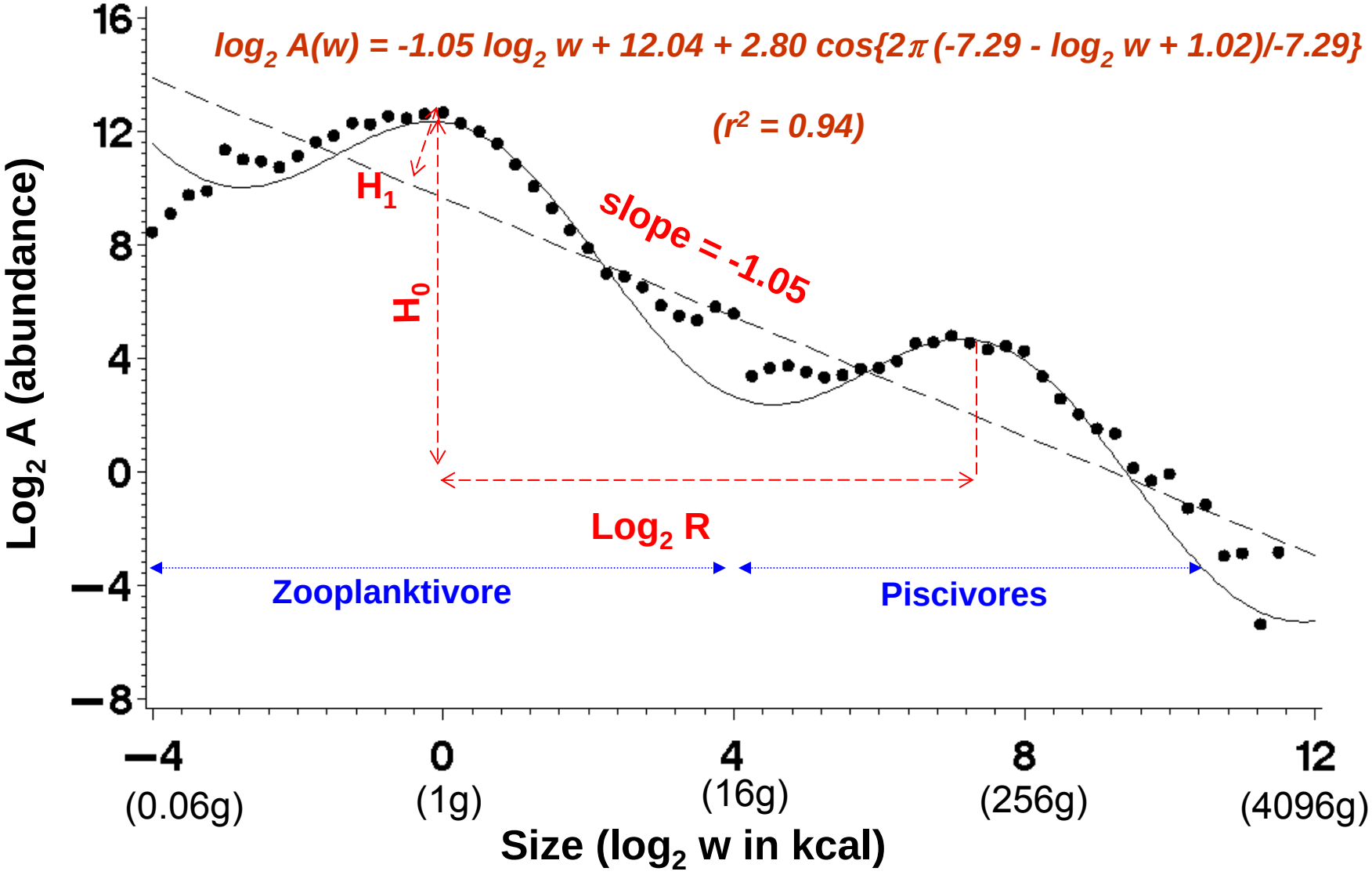
**Relative increase in planktivorous fishes in landings since 1960**

**Response to eutrophication?**

**Response to fishing?**


Integrated Spectrum
(combined 1997 and 1999 data)
Y = -1.03 X - 2.73
phytoplankton
mesozooplankton
Fish larva
Zooplanktivorous
small fish
Piscivorous
large fish
Log2 A (abundance)
40
30
20
10
0
−10
−20
−40
−30
−20
−10
0
10
20
2 μm
20 μm
200 μm
2 mm
20 mm
20 cm
Organism Size

$$\log_2 A(w) = -a \log_2 w + H0 + H1 \cos\{2\pi(\log_2 R - \log_2 w + \log_2 w_{i0})/\log_2 R\}$$




**Normalized Biomass Size Spectra for Zooplanktivorous Fish and Piscivores: Chesapeake Bay (1995-2000)**

# Atlantic Menhaden

Climate and Weather

Ocean Physics and Biology

Estuarine Water Quality and "Habitat"

Predation

Fishing

YOY Menhaden

Age 1-2 Menhaden

Age 3+ Menhaden

Disease (?)

## Ecosystem Services

Filtering

Food for Predators

Products and Profits

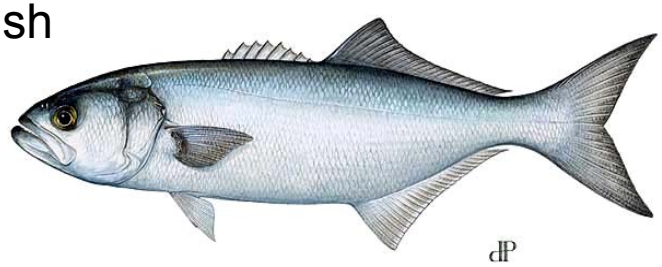
Human Interests

E. Houde

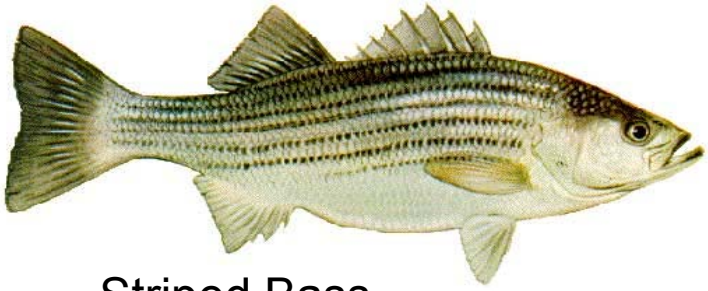
# Menhaden: Allocation and EBFM

Commercial Fishery

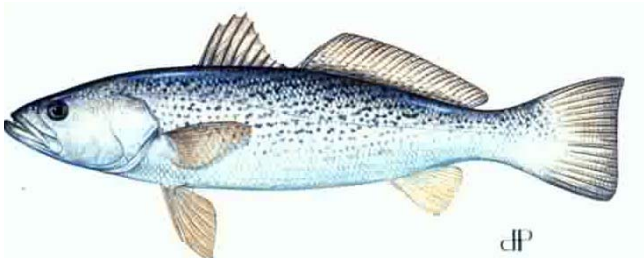
Bluefish



## Predators/Piscivores



Striped Bass



Weakfish

Osprey

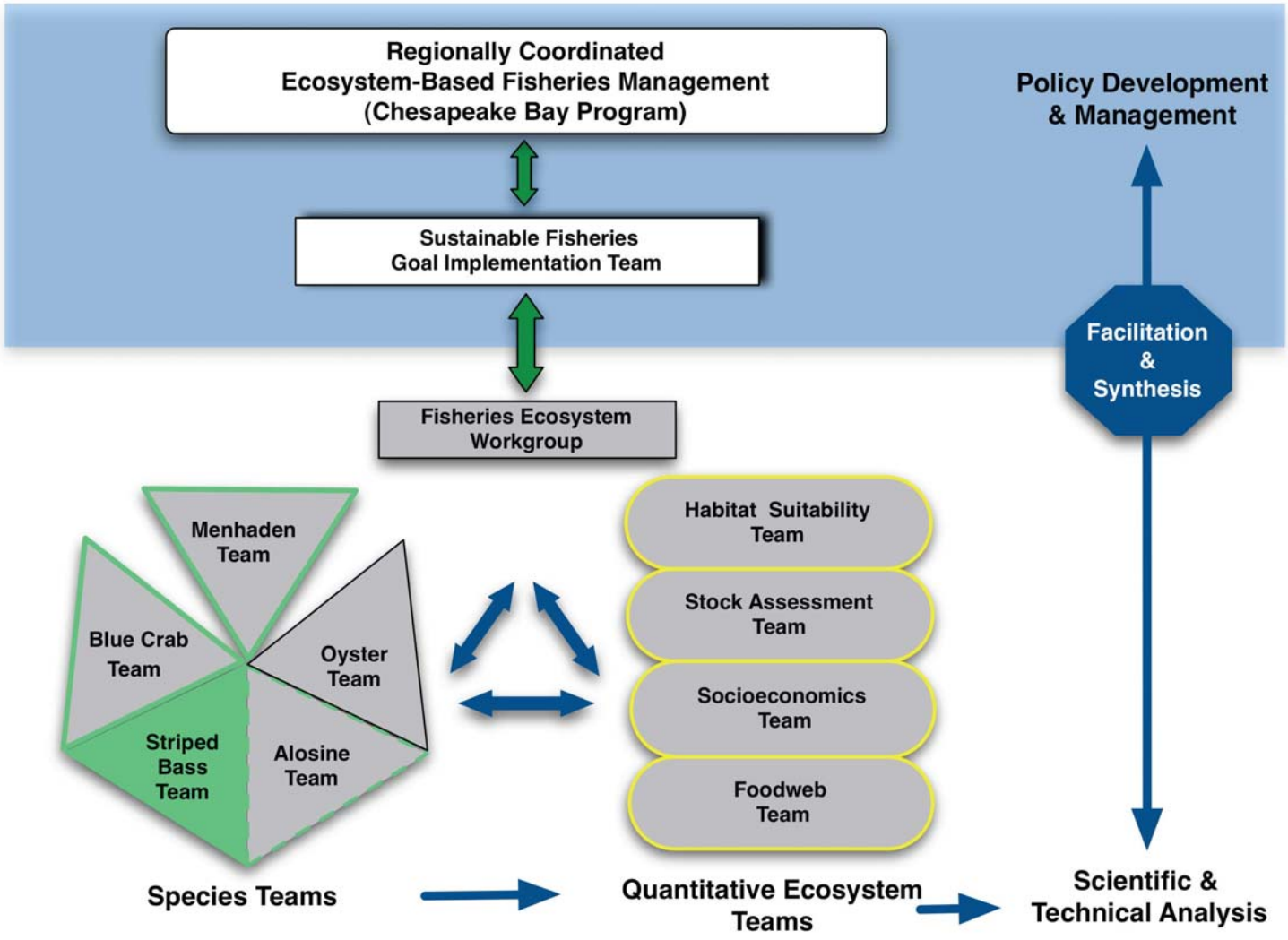

Recreational Striped Bass Fishing

What is a "Fair" **Allocation** Plan?

Can Humans Cause
"Localized Depletion?"

# Maryland Sea Grant
# Ecosystem-Based Fisheries Management Planning

http://www.mdsg.umd.edu/programs/policy/ebfm/



# Need for New Indicators and Reference Points in EBFM

- 1. Indicators of Trophic State of the system relative to the target species (predator and prey balance)
- 2. Biomass and Production Measures of Target Species Relative to its Prey and Predators (productive status of the ecosystem)
- 3. Diversity measures (richness of the ecosystem)
- 4. Size spectra measures (state of the ecosystem; predator and prey balance)
- 5. Some indicators/reference points will be compound and complex (ordination, multivariate)
- 6. Habitat and Water Quality Indicators keyed to status of the target resource (habitat suitability)

# Additional Thoughts

- Suites of Single-Species F and B reference points, set conservatively to assure retention of ecosystem services. Build on existing single-species plans. Some reference points are appropriate, but need to be more precautionary, spatially-explicit, and ecosystem-sensitive (striped bass)

- For Forage Species: F≤M. Manage for Z, not F, to account for predator numbers variability (menhaden)

- Be wary of introducing exotic species (oysters)

- Think strategically and long-term. Recognize externalities, e.g., climate effects. Prepare for major changes or perturbations (oysters, soft clam)

- EBFM ideally will be evolutionary, not revolutionary (this doesn't mean we should delay implementation)

# What Immediate Steps Can Be Taken to Implement EBFM in Chesapeake Bay?

- Continue Risk-Averse, Single-Species Fisheries Management.

  ---Set Target Fishing Mortality Levels Below Those that Yield MSY

  ---Maintain Adequate Spawning Stock Biomass and Fecundity

- Regulate or Deny Use of Gears that Are Destructive of Key Habitats or which Result in Unwanted Bycatch.

- Reduce or Eliminate Bycatch.

  ---Young and Small Individuals of Targeted Species

  ---Untargeted Species, Including Threatened and Endangered Species

- Rigorously Enforce Fisheries and Environmental Regulations.

# What Intermediate-Term Steps Are Needed for Implementation of EBFM in Chesapeake Bay?

- Explicitly Account for Predator-Prey Interactions.
  ---Recognize Critical Predator-Prey Interactions and Allocate Accordingly
  ---Develop and Incorporate Multispecies Modeling into Assessments
  ---Develop Appropriate Reference Points

- Expand Use of Spatially-Explicit Management Approaches.

- Increase Stakeholder Involvement in the Management Process.
  ---Further Democratize and Include Stakeholder Inputs
  ---Recognize the Diverse Stakeholder Interests (Including, but Above and Beyond, Fisheries)

# What Are the Long-Term Actions Needed for Implementation of EBFM in Chesapeake Bay?

- Improve Water Quality
- Restore Habitats
- Manage to Conserve Food-Web Structure.
  ---Develop and Incorporate Ecosystem Modeling into Assessments
- Adopt and Implement “Managed Areas” Approaches.
  ---Apply Zoning and Networking for EBFM and Broader Ecosystem Management Goals
- Develop New Governance Structures that Support EBFM.
  ---Develop Inter-Agency Collaboration and Cooperation Protocols
  ---New Institutions (?)

# Moreover,

- **Recognize the externalities that affect ecosystems and fisheries production/performance**

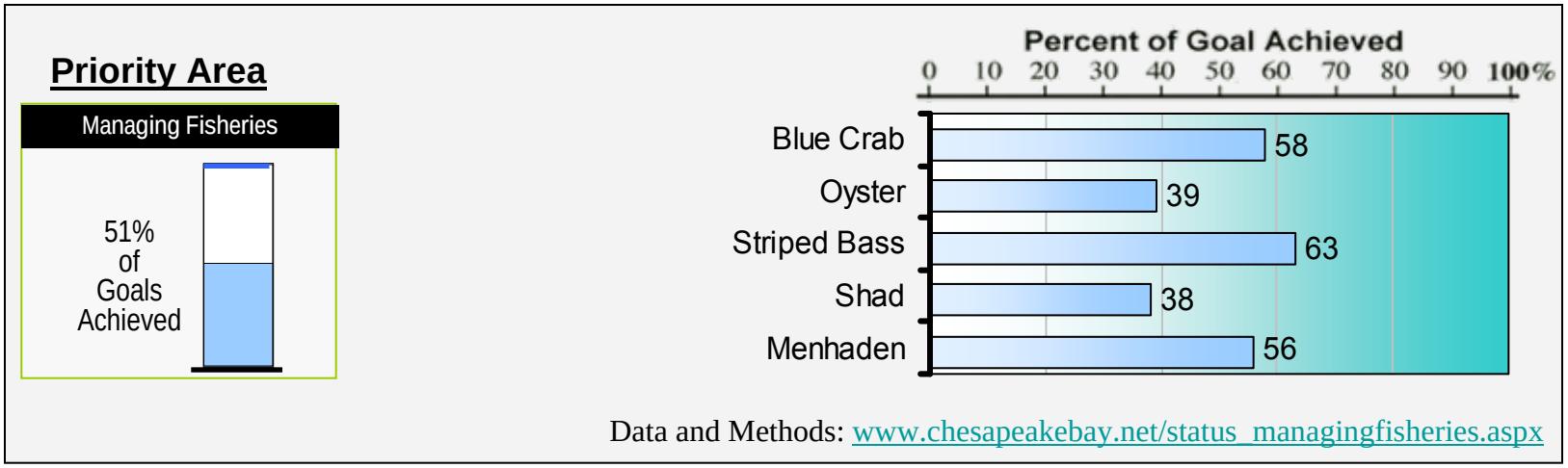
- **Develop management strategies or plans that conserve the resiliency of the Bay ecosystem**

- **Review historical performance of present single-species management plans before developing new EBFMPs**

- **Develop EBFMPs that don't close out options. Effective EBFMPs must be flexible, adaptive plans.**

# Chesapeake Bay Program

## Fishery Management Planning




This graphic documents efforts and activities, not success

Ecosystem-Based Plans Under Development

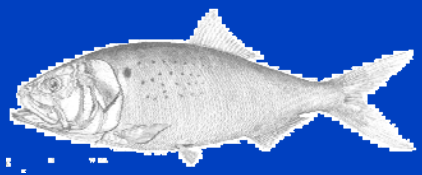
# Atlantic Menhaden: “Localized Depletion”

**This is the primary issue driving the move to ecosystem-based approaches to management of menhaden.**

**How can we evaluate the role of menhaden in localized predator-prey dynamics? (Models? Foraging, Spatial, Behavioral. )**

**Can precautionary set-asides or regulations be instituted as an ecosystem-based measure in the absence of specific knowledge of ‘localized depletion’ or its consequences?**

**Do we have a clear objective for management with respect to localized depletion?**



# Policy and Management

Policy: A Decision on how to use (or not use) a resource

To Fish or not?
If Yes to Fish, under what Guidelines?
Broad and specific statement of benefits from adopting a particular policy

Management: The Measures enacted to carry out a policy

If Fishing is allowed, what specific rules and allocation?
If No Fishing, how do we evaluate ecosystem benefits?