



Applying Forage Fish Science to Fisheries Management

Sustainable Fisheries Goal Implementation Team
Solomons, Maryland
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Examples in Fisheries Management



Atlantic menhaden

- Multispecies modeling for coast wide menhaden assessment
 - Top down MSVPA defining menhaden M_2
- Ecological reference points (in development)
 - Bottom up modeling defining menhaden needed to support predators
- Recent management action to conserve more menhaden as forage

ASMFC's weakfish prey trends analysis and FMP section

NEFMC and MAFMC FMP forage fish sections

- river herring and sea herring interactions

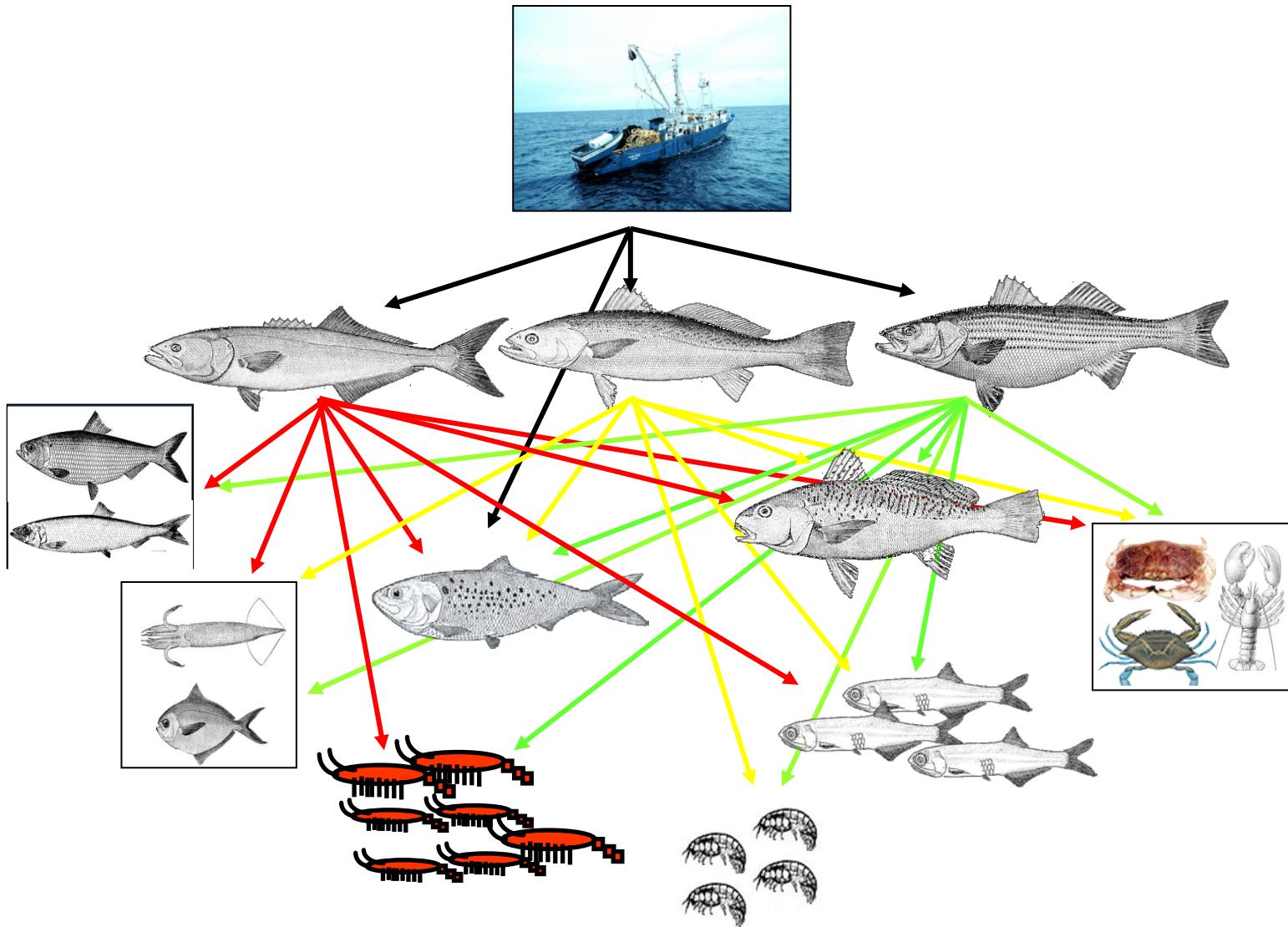
Washington and Alaska's forage fish FMPs



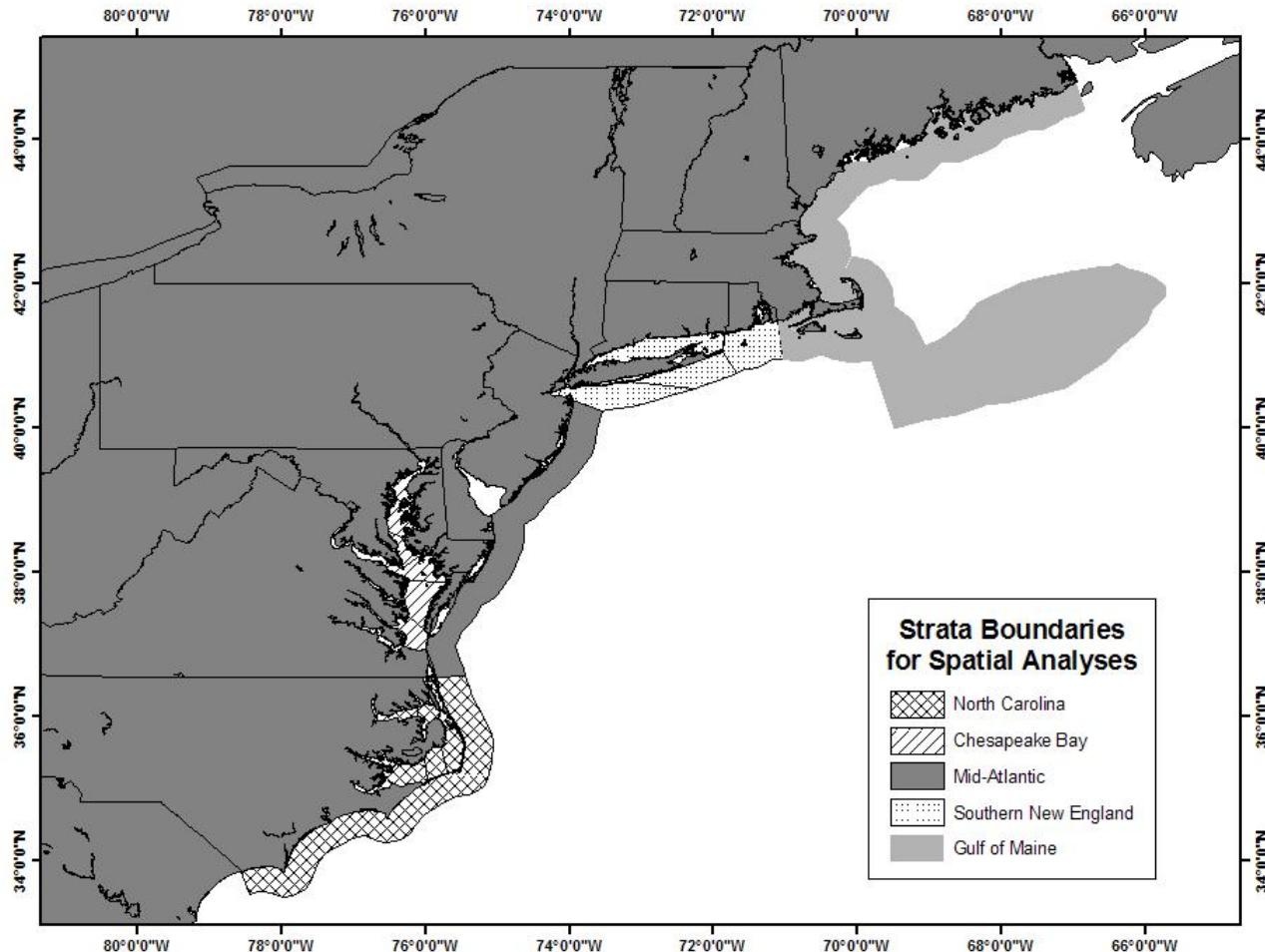
The MSVPA-X

- A series of single species predator stock assessment models that trophically “links” predators to their prey (i.e. predators consume menhaden and other prey)
- Estimates of predation mortality (M_2) on menhaden used in the single species assessment of menhaden

MSVPA-X: modeling a slice of the food web



Five Regions





The MSVPA-X

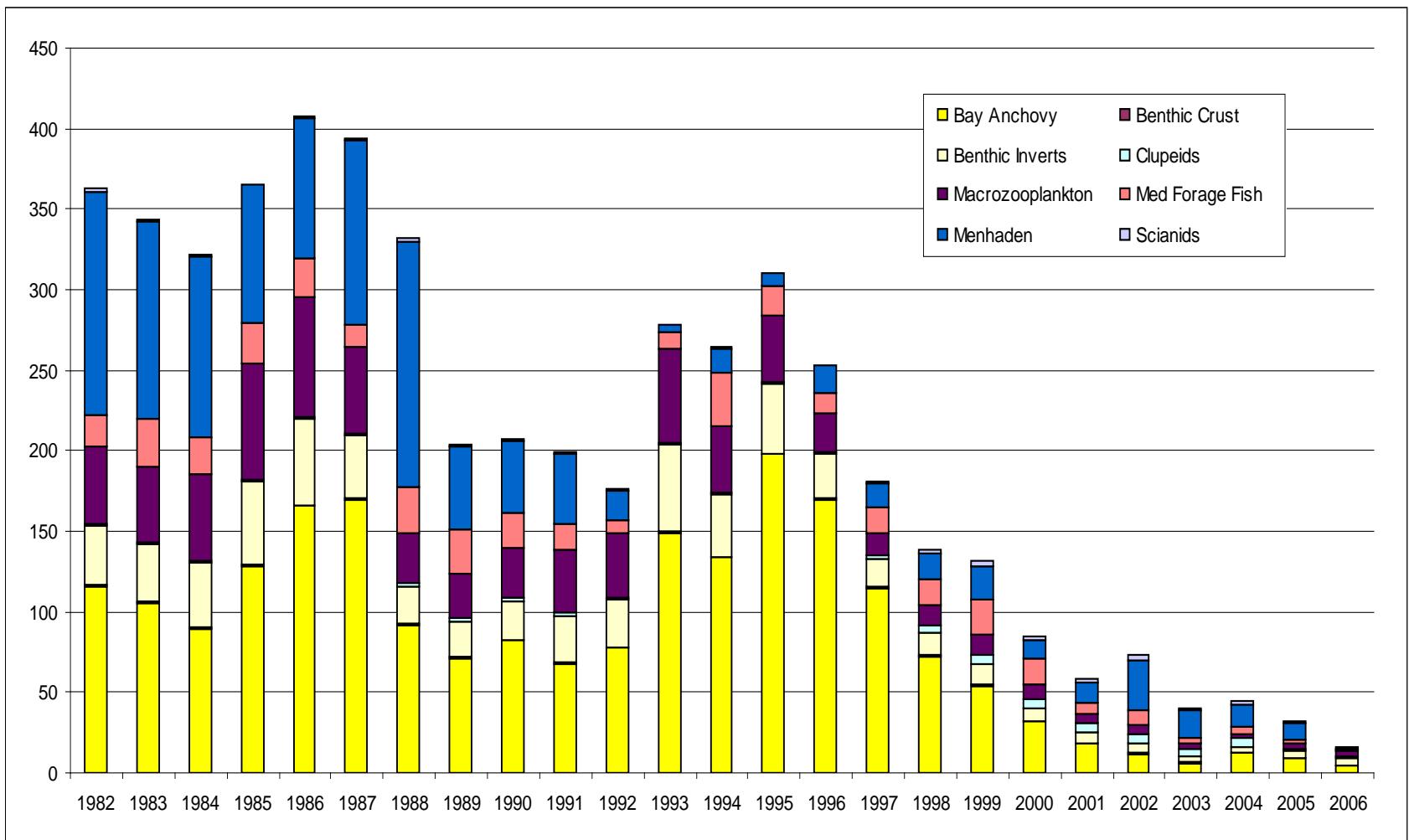
- Predators modeled with a VPA:
 - Striped bass
 - Weakfish
- Predator biomass trends entered in model:
 - Bluefish
- Prey modeled with a VPA : Menhaden
- Prey biomass trends entered in model (a.k.a. “Other prey”):
 - Bay Anchovy
 - Other clupeids (Atlantic herring, thread herring, scads,...)
 - Benthic Invertebrates
 - Sciaenids (spot and Atlantic croaker)
 - Macrozooplankton
 - Benthic Invertebrates (blue crab, rock crab, Jonah crab, American lobster)
 - Squids and Butterfish

ASMFC weakfish forage analysis



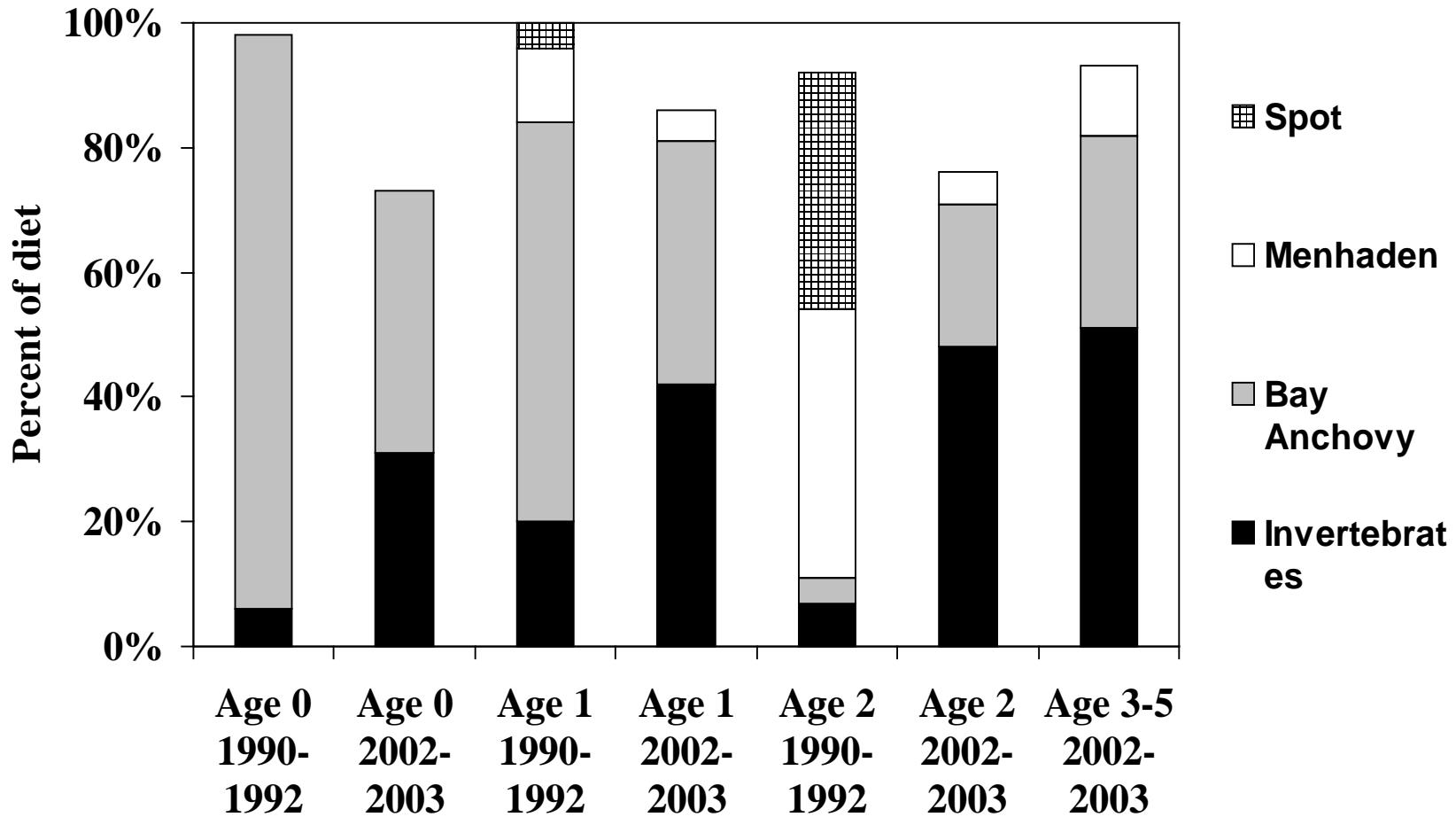
Life Stage	Major Prey	Location
Larvae	Mysid shrimp; copepod/isopod/amphipods	Chesapeake Bay
Juveniles, Age-0	Bay anchovy <i>Anchoa mitchilli</i> , Mysid shrimp <i>Neomysis spp.</i>	Northeast
<100mm	Mysid shrimp <i>Neomysis spp.</i> , Bay anchovy <i>Anchoa mitchilli</i>	Chesapeake Bay
Adults, Age-1,-2	Bay anchovy <i>Anchoa mitchilli</i> , Mysid shrimp <i>Neomysis spp.</i>	Northeast
Small-medium (100-374mm)	Bay anchovy <i>Anchoa mitchilli</i> , Mysid shrimp <i>Neomysis spp.</i> ; to a lesser extent - spotted hake <i>Urophycis regia</i> , YOY weakfish	Chesapeake Bay
Large-medium (374mm-474mm)	spot <i>Leiostomus xanthurus</i> , Atlantic menhaden <i>Brevoortia tyrannus</i>	Chesapeake Bay

ASMFC weakfish forage analysis



from ASMFC multispecies model update report (2008)

ASMFC weakfish forage analysis



from Hartman and Brandt (1995) and Latour (2003)



Regional Examples

New England FMC's FMP forage sections

- Describe key prey for each Council species; no binding management actions; implemented in 2007

NEFMC and MAFMC

- River herring bycatch caps & area closures in Atlantic herring and squid, mackerel, butterfish FMPs; implemented in 2012-13

Alaska's Forage Fish Management Plan (FFMP)

- Recognizes importance of forage to sustainable stocks of salmon, halibut, groundfish; implemented in 2006
- Species: capelin, smelts, sand lance, krill, others
- 2% forage bycatch limit in groundfish fishery



Regional Examples

Washington's forage fish management plan

- Recognizes forage as a key component of the marine ecosystem; implemented in 1998
- Species: herring, smelt, anchovies, sardine
- Primary objective = conserving forage for salmon, other fish, marine birds and marine mammals; potential catch of forage stocks foregone if needed for predators
- <http://wdfw.wa.gov/publications/pub.php?id=00195>

Forage Fish Management Plan

A plan for managing the forage fish resources and fisheries of Washington

by
Greg Bargmann

Adopted by the
Washington Fish and Wildlife Commission
on January 24, 1998

Washington Department of Fish and Wildlife
600 Capitol Way N.
Olympia Washington 98501

September 1998

- *What species comprise the Chesapeake Bay forage base?*
- *Strengths and gaps in forage fish monitoring and research?*
- *Options for incorporating forage fish more formally in the Bay Program's New Agreement?*
- *Options for incorporating forage fish more formally in state and regional fisheries management?*
- *Habitat management and forage fish production?*

Chesapeake Bay Forage Species



Bay Anchovy
Menhaden
Shad and river herring
Silversides
Sciaenids (spot, croaker)
Macrozooplankton
Benthic Invertebrates (blue crab)
...