Chesapeake Bay Fisheries Ecosystem Model (CBFEM): ASMFC Menhaden Runs

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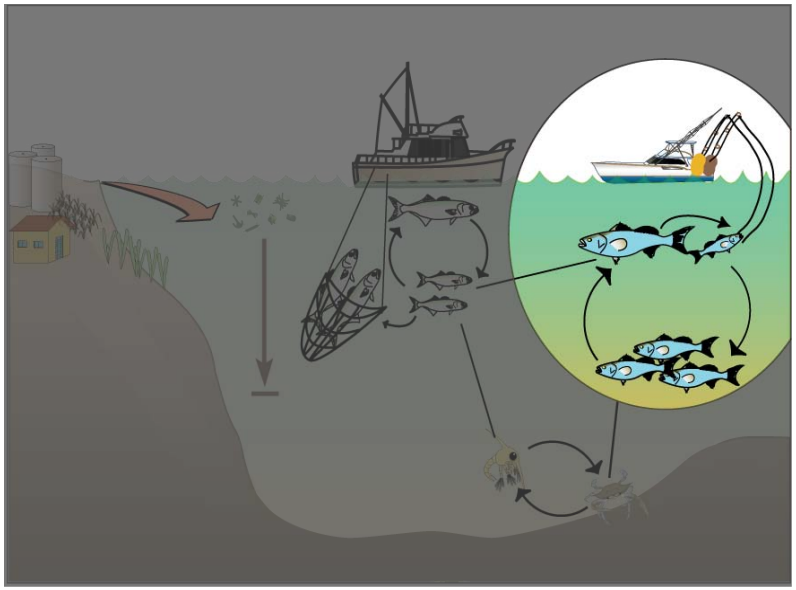
October 15, 2010

Objective

- These model scenarios are presented to gain insight into the possible responses of menhaden, its predators and the Chesapeake Bay ecosystem to the potential fishery management actions, using the Chesapeake Bay Fisheries Ecosystem Model (CBFEM), based on the Ecopath with Ecosim software.

- Specifically the Atlantic States Marine Fisheries Commission (ASMFC) – Atlantic Menhaden Management Board ask that the Multispecies Technical Committee (MSTC) use tools and data already available “to consider options for SPR reference points at the current estimated level (10%) as well as at 15%, 25%, and 40% MSP”. The goal is for the Board to be able to consider the potential trade-offs between menhaden harvest and predator population dynamics if they adopt any of the different addendum options

Changing View of Fisheries Management

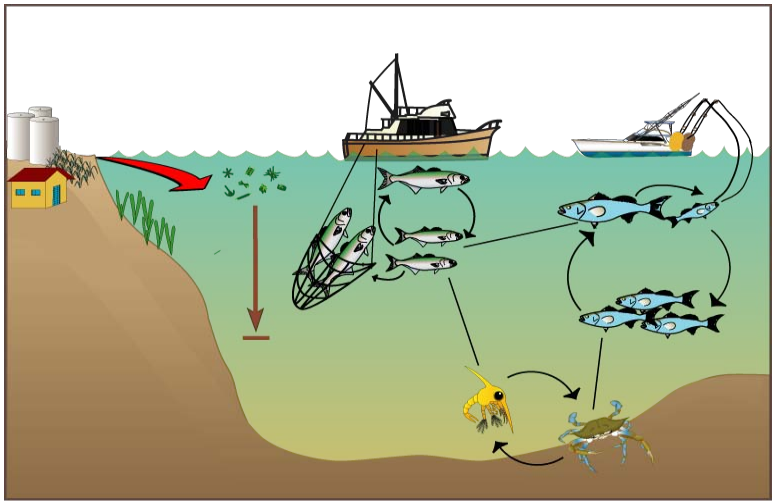


Single-species/sector management

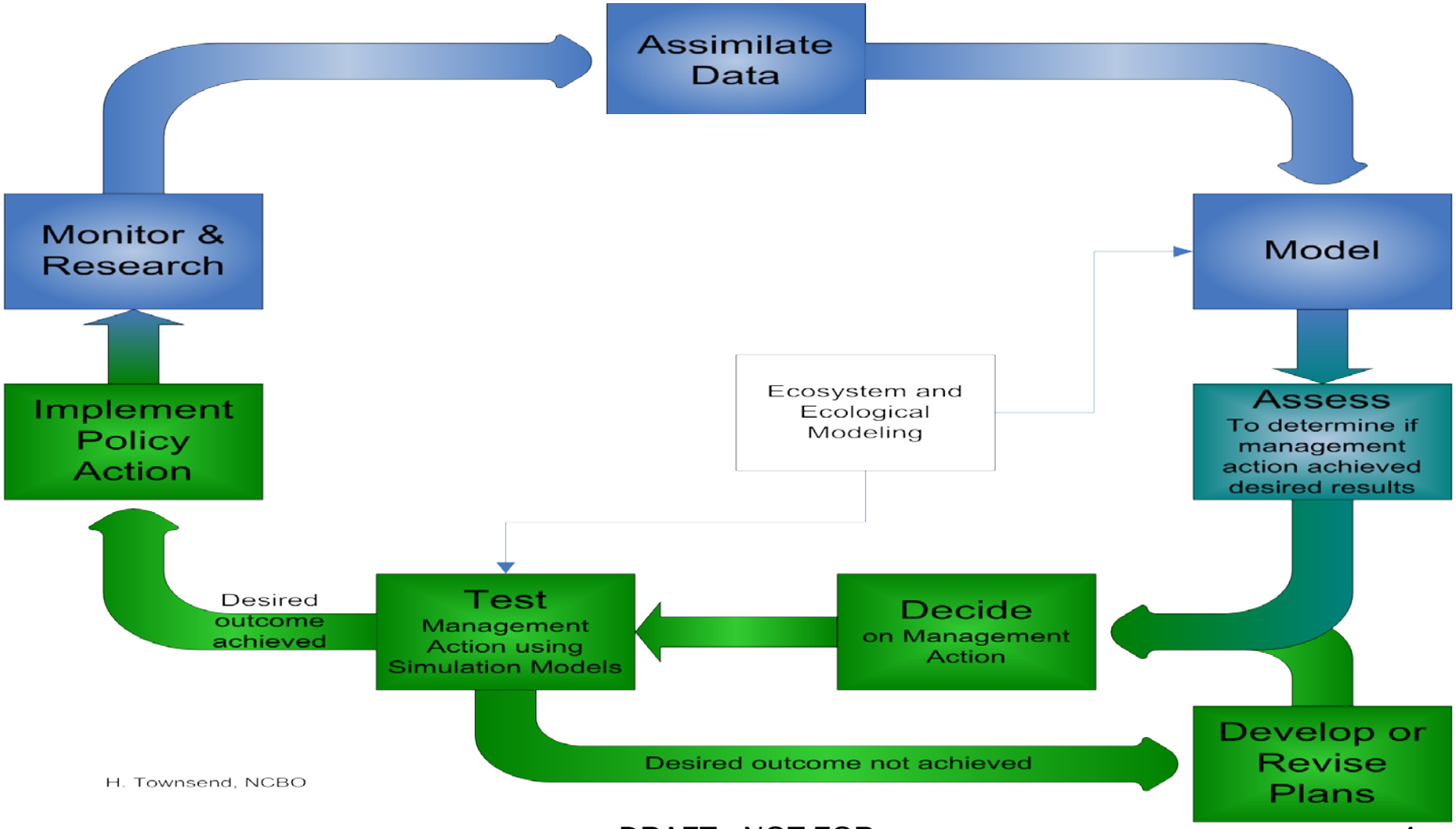
- Simplified view of system
- Tactical decision-making
- Manage by reference points and benchmarks

Ecosystem/Multi-species management

- Complex view of system
- Strategic decision-making
- Manage by considering alternative scenarios



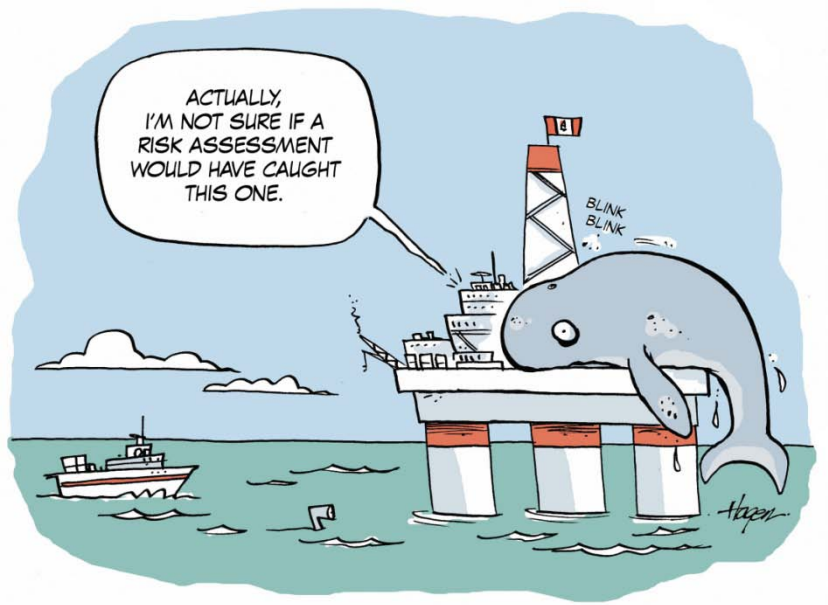
Adaptive Resource Management Approach



Role of Ecosystem Models in EBFM

Indicator Development

Management Strategy Evaluation



Risk Analysis

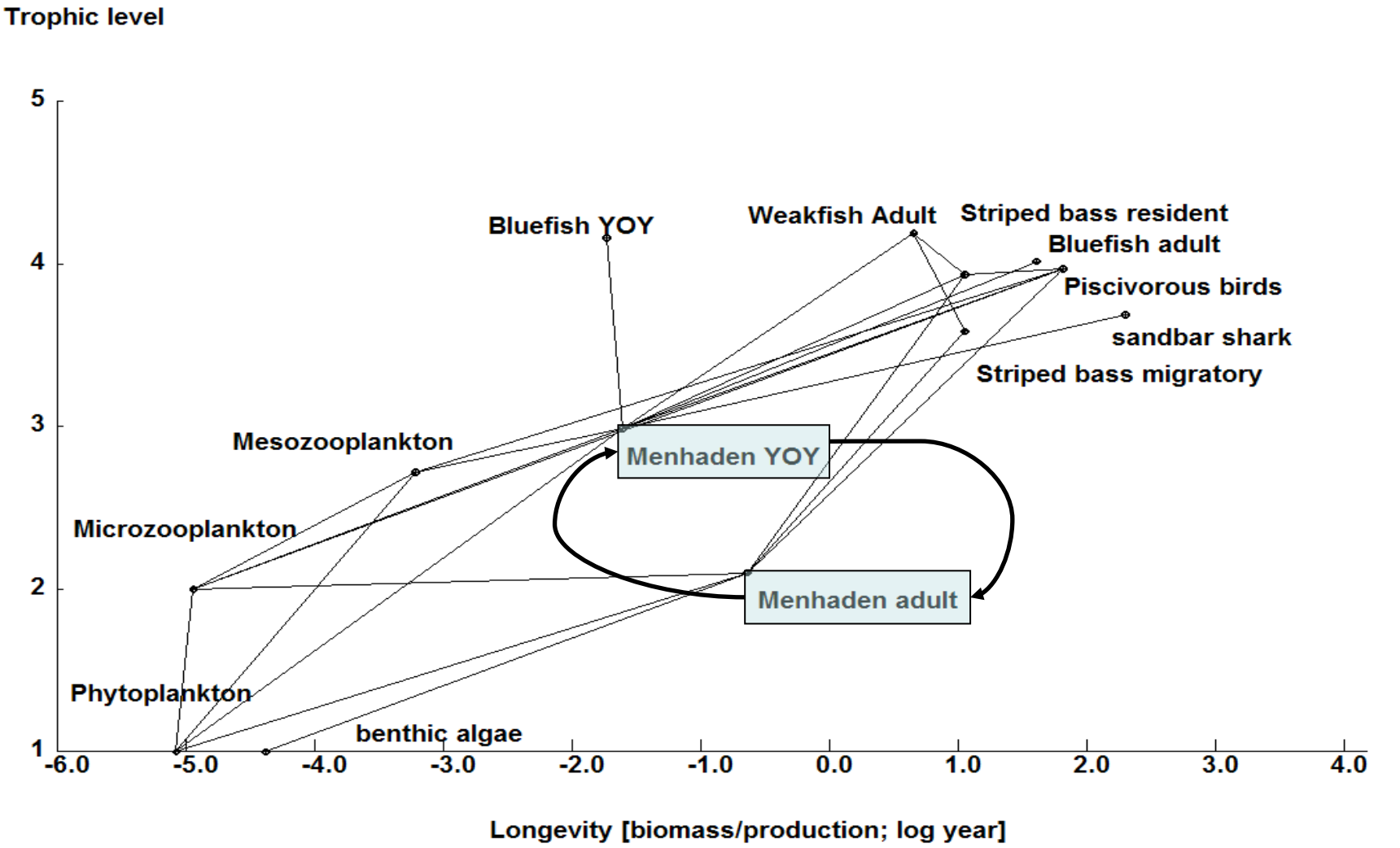
Implicitly consider trade-offs in goods and services provided by the ecosystem

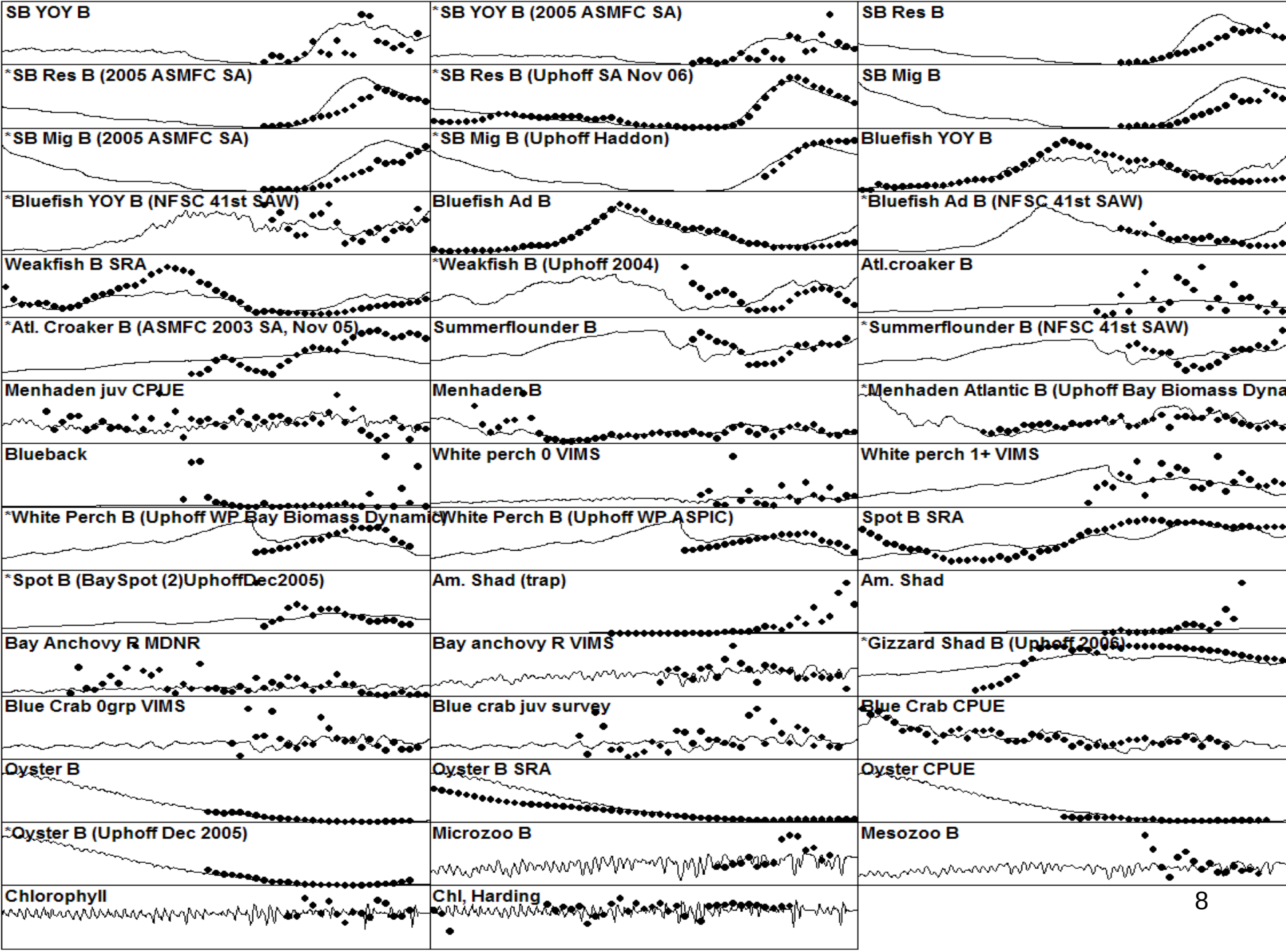
IEAs – Levin et al 2009

Status of Chesapeake Bay Fisheries Ecosystem Model: Overview

- **Ecopath** module has been completed.
  - 45 trophic groups
  - 218 diet links
  - 1950 model gives a snapshot of what the Chesapeake was like 50 yrs ago
- **Ecosim** module
  - “Tuned” to some time series data; ~100 data sets and assessments
  - 50 yr simulations with a nutrient loading forcing functions, attempts to replicate the current status and dynamics of the Chesapeake
  - Simulations can be run to explore policy options (i.e., fisheries management plans) and familiarize people with ecosystem approaches.
- **Technical Report** (200+ pages) is complete
  - Data reviewed by Ecosystem Modeling Technical Advisory Panel (EMTAP) and Bay Program Scientists

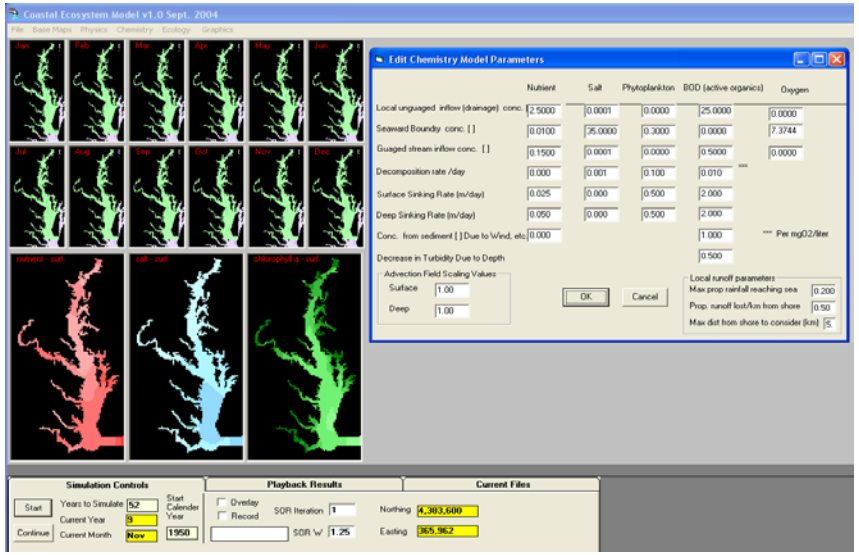
Age/Stage Structure

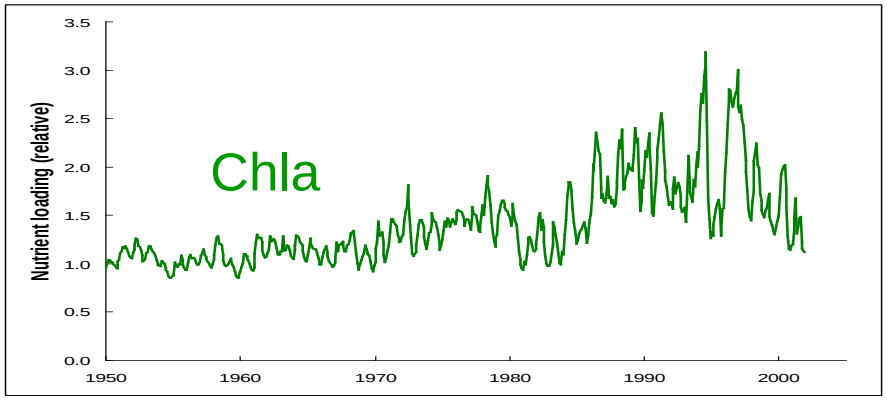



SB YOY B
*SB YOY B (2005 ASMFC SA)
SB Res B
*SB Res B (2005 ASMFC SA)
*SB Res B (Uphoff SA Nov 06)
SB Mig B
*SB Mig B (2005 ASMFC SA)
*SB Mig B (Uphoff Haddon)
Bluefish YOY B
*Bluefish YOY B (NFSC 41st SAW)
Bluefish Ad B
*Bluefish Ad B (NFSC 41st SAW)
Weakfish B SRA
*Weakfish B (Uphoff 2004)
Atl.croaker B
*Atl. Croaker B (ASMFC 2003 SA, Nov 05)
Summerflounder B
*Summerflounder B (NFSC 41st SAW)
Menhaden juv CPUE
Menhaden B
*Menhaden Atlantic B (Uphoff Bay Biomass Dyna
Blueback
White perch 0 VIMS
White perch 1+ VIMS
*White Perch B (Uphoff WP Bay Biomass Dynamic)
*White Perch B (Uphoff WP ASPIC)
Spot B SRA
*Spot B (BaySpot (2)UphoffDec2005)
Am. Shad (trap)
Am. Shad
Bay Anchovy R MDNR
Bay anchovy R VIMS
*Gizzard Shad B (Uphoff 2006)
Blue Crab 0grp VIMS
Blue crab juv survey
Blue Crab CPUE
Oyster B
Oyster B SRA
Oyster CPUE
*Oyster B (Uphoff Dec 2005)
Microzoo B
Mesozoo B
Chlorophyll
Chl, Harding
1950
1962
1974
1986
1950
1962
1974
1986
1950
1962
1974
1986

Chesapeake Bay Regional Estuarine Ecology Model (CBREEM)

- A simple hydrodynamic model with 1-month time step and simulation period of 50+ years.
- Used to create primary production forcing function to drive CBFEM

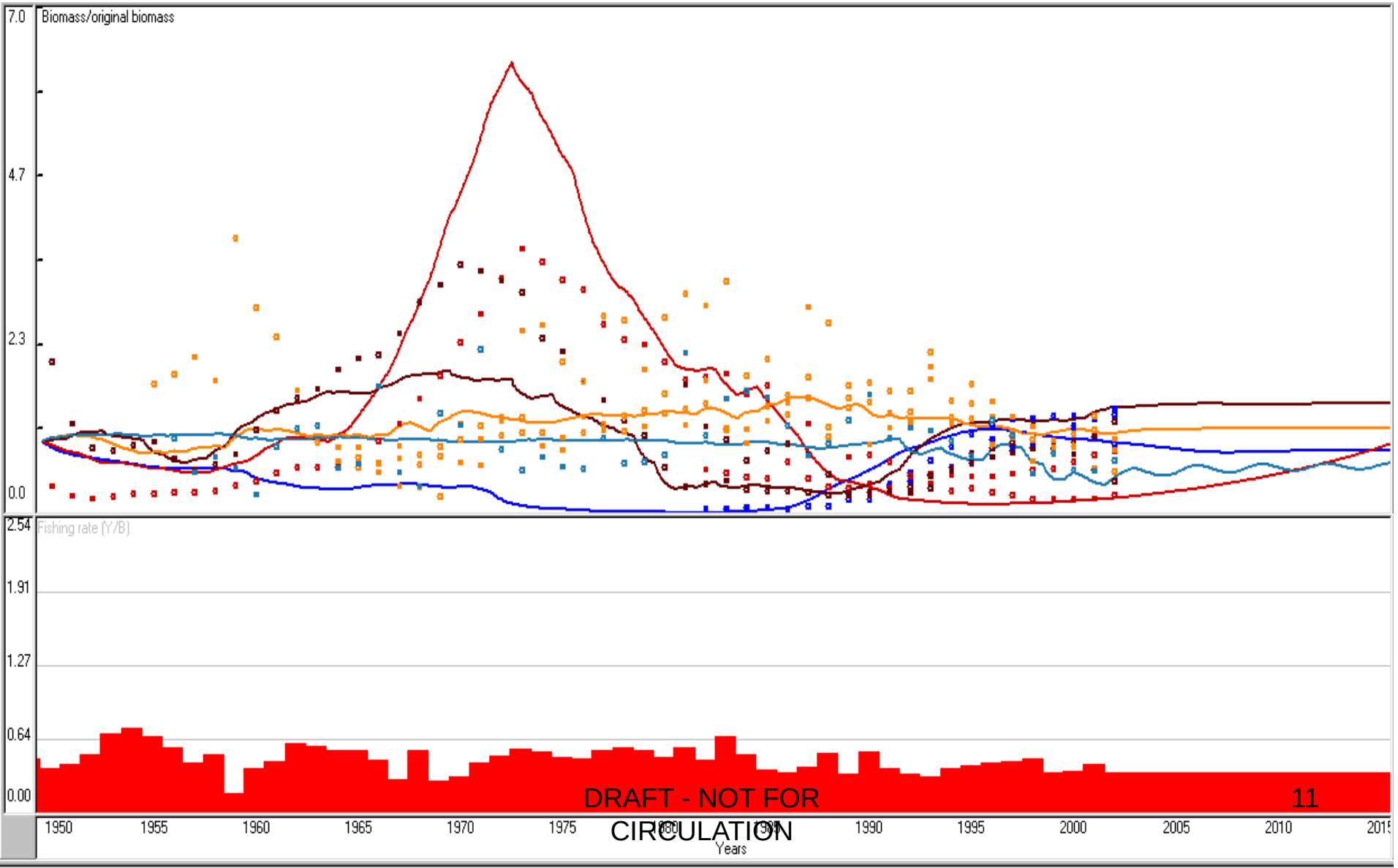




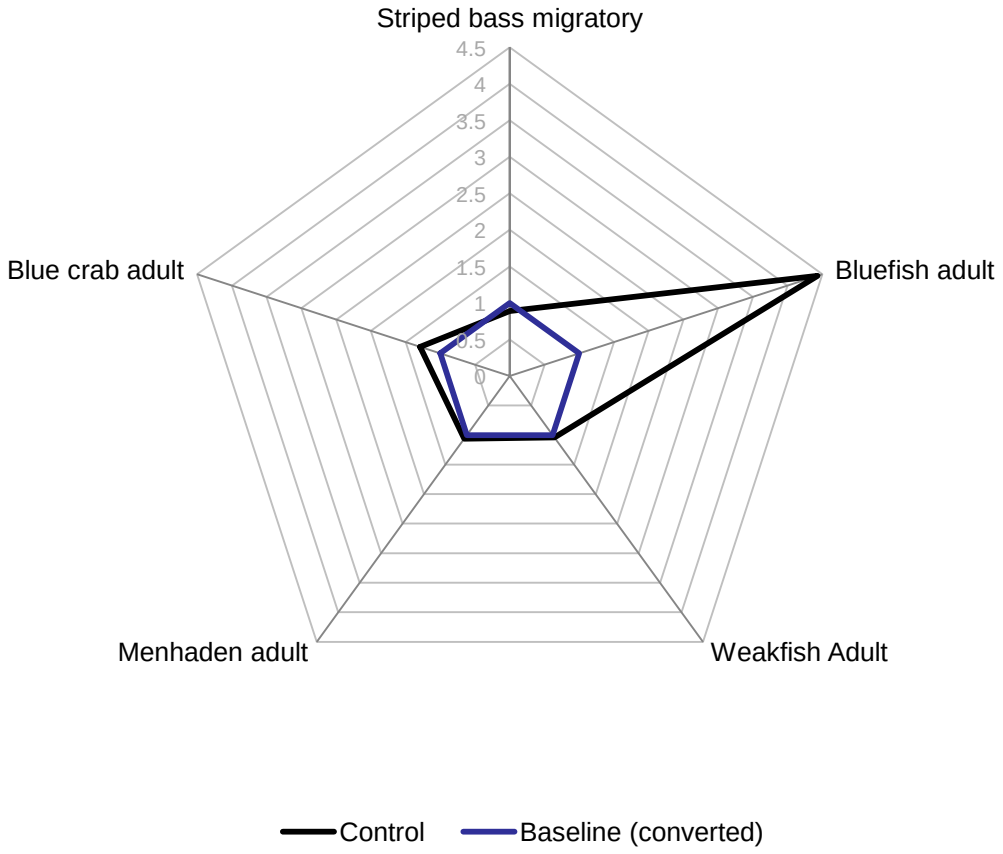
Methods – Menhaden Runs

- Baseline Scenario – Model run from 1950-2002. No changes in F for Menhaden or in recruitment forcing function. Time series fit shown in Figure 1
- 'Control' projection – Ecosim projected to 2015. The drivers (Fishing Mortality and Catch) for the baseline scenario are just extended based on the 2002 value.
- 'Experimental' Scenarios – Ecosim projected to 2015. The fishing mortality for Menhaden is varied. For other focal species, the drivers (Fishing Mortality and Catch) for the baseline scenario are just extended based on the 2002 value. Recruitment is varied using EwE forcing functions.
  - *10%MSP (F=0.87)
  - 15% MSP (F=0.66)
  - 25% MSP (F=0.44)
  - 40%MSP (F=0.27)
  - *Note the current CBFEM has F at 0.34 in 2002. This indicates that the CBFEM needs to be updated with more recent assessment data.

Results

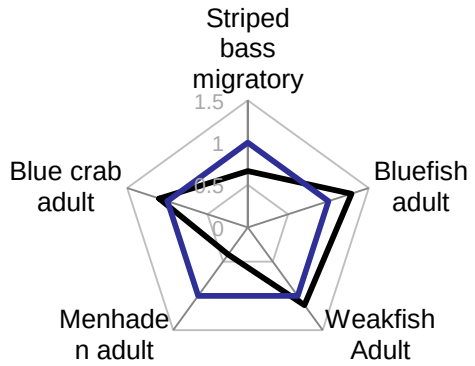


Results – Control

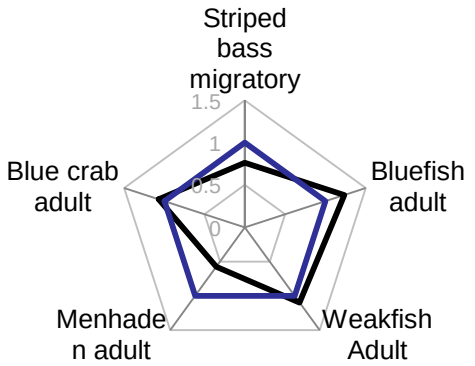


$$\Delta B_{sp} = \frac{B_{Scenario,2015} - B_{Scenario,2002}}{B_{Control,2015} - B_{Control,2002}}$$

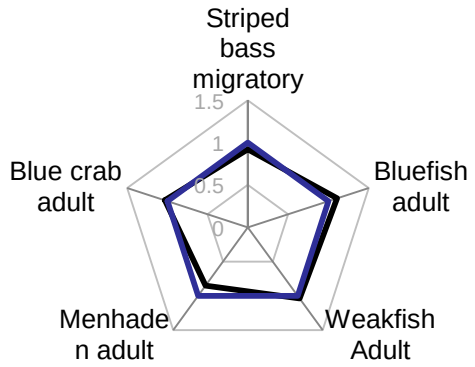
Results – “Experiment”



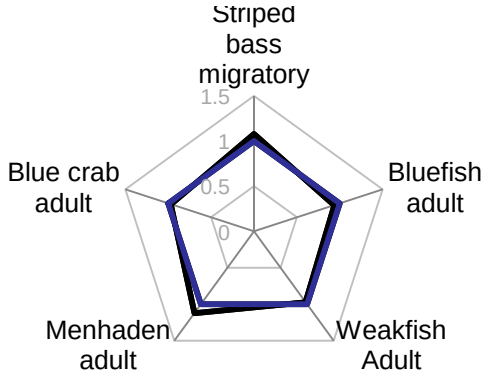
10%MSP(F=0.87)



15%MSP(F=0.66)



25%MSP(F=0.44)

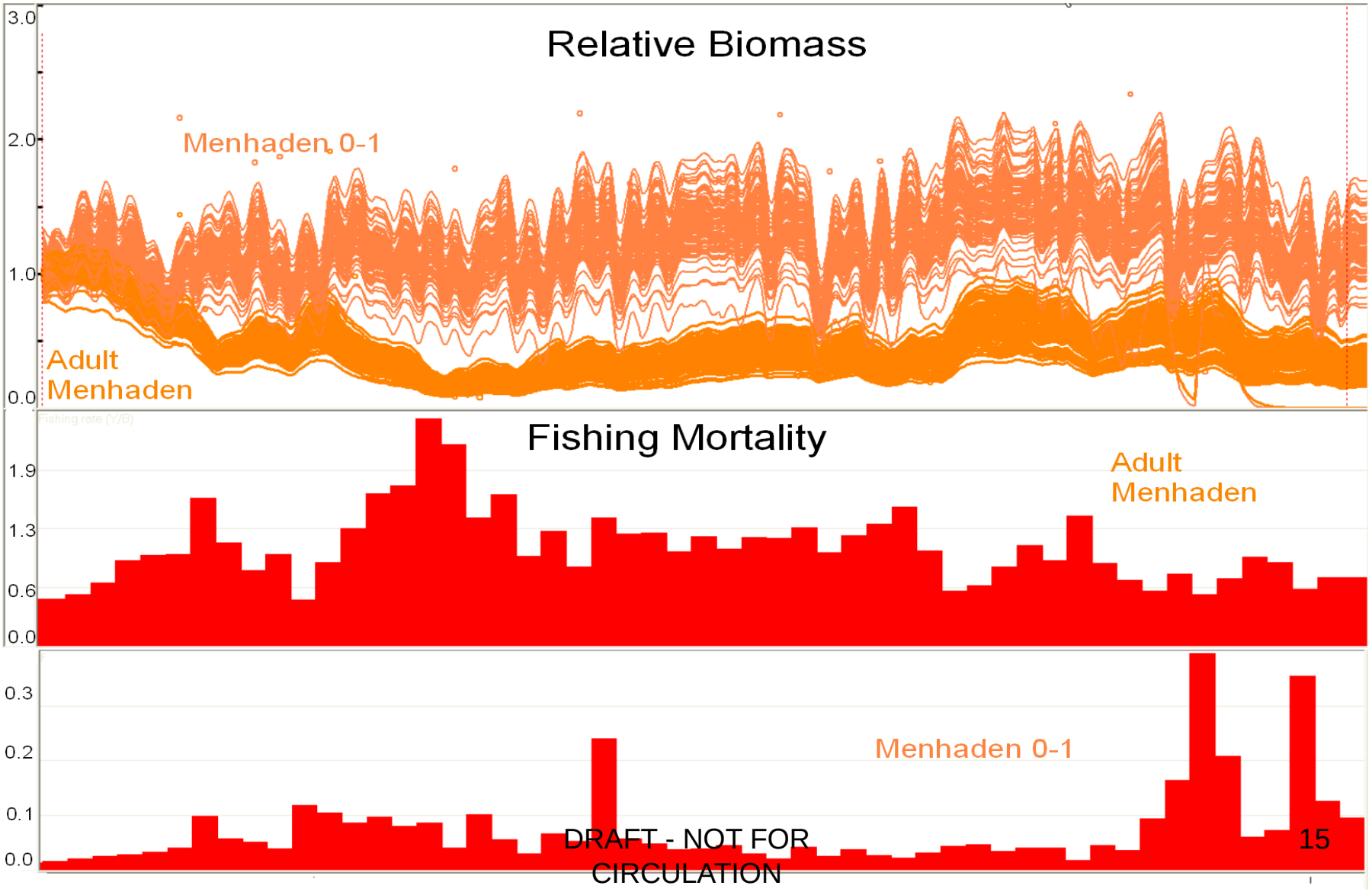


40%MSP(F=0.27)

Conclusions

- Need to update the model. The model was built using much of the data from stock assessments for around 2002. Modifications to those stock assessments have not been incorporated. The CBFEM has values for Menhaden and Blue Fish fishing mortality that are lower than estimated in current stock assessments for those species. As a result, bluefish populations go off the charts and menhaden using the F levels suggested in Menhaden SPR analysis don't match up well
- Before any of this model is used to inform a management decision we will need to update the model and do some uncertainty analysis. Making this model more suitable for risk analysis and management scenario evaluation is doable within a year.

Conclusions



Conclusions

- Other analyses/ reference points
  - Management scenario exploration using various levels of Z as a reference point
  - Potentially could use MSVPA inputs to create an ASMFC EwE Model that covers the same species as the MSVPA..

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Turning science into quantitative info for ebfm

- Requires “iterative two-way flow” of information, a conversation
  - Managers’ priorities ↔ possibilities/scenarios from modelers