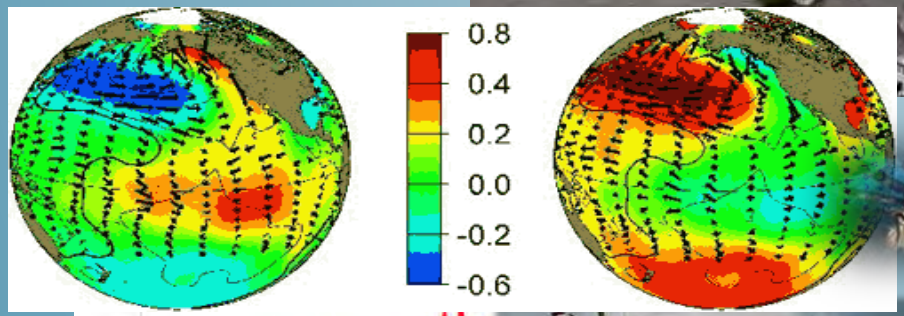
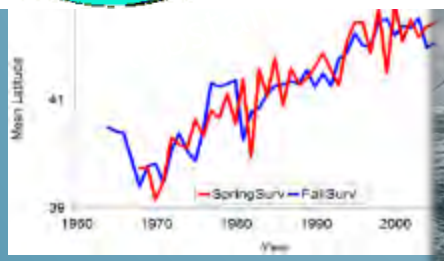
# ECOSYSTEM/HABITAT RESTORATION AND FISHERIES MANAGEMENT

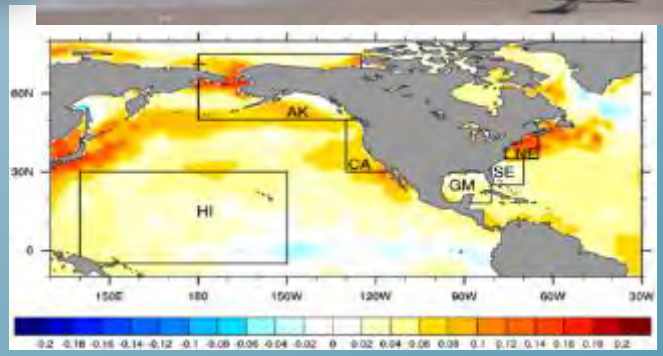
Howard Townsend
NOAA/NMFS/HC/CBPO

GoM Hypoxia/Diversions Workshop
July 14-16, 2014 – Stennis Space Ctr

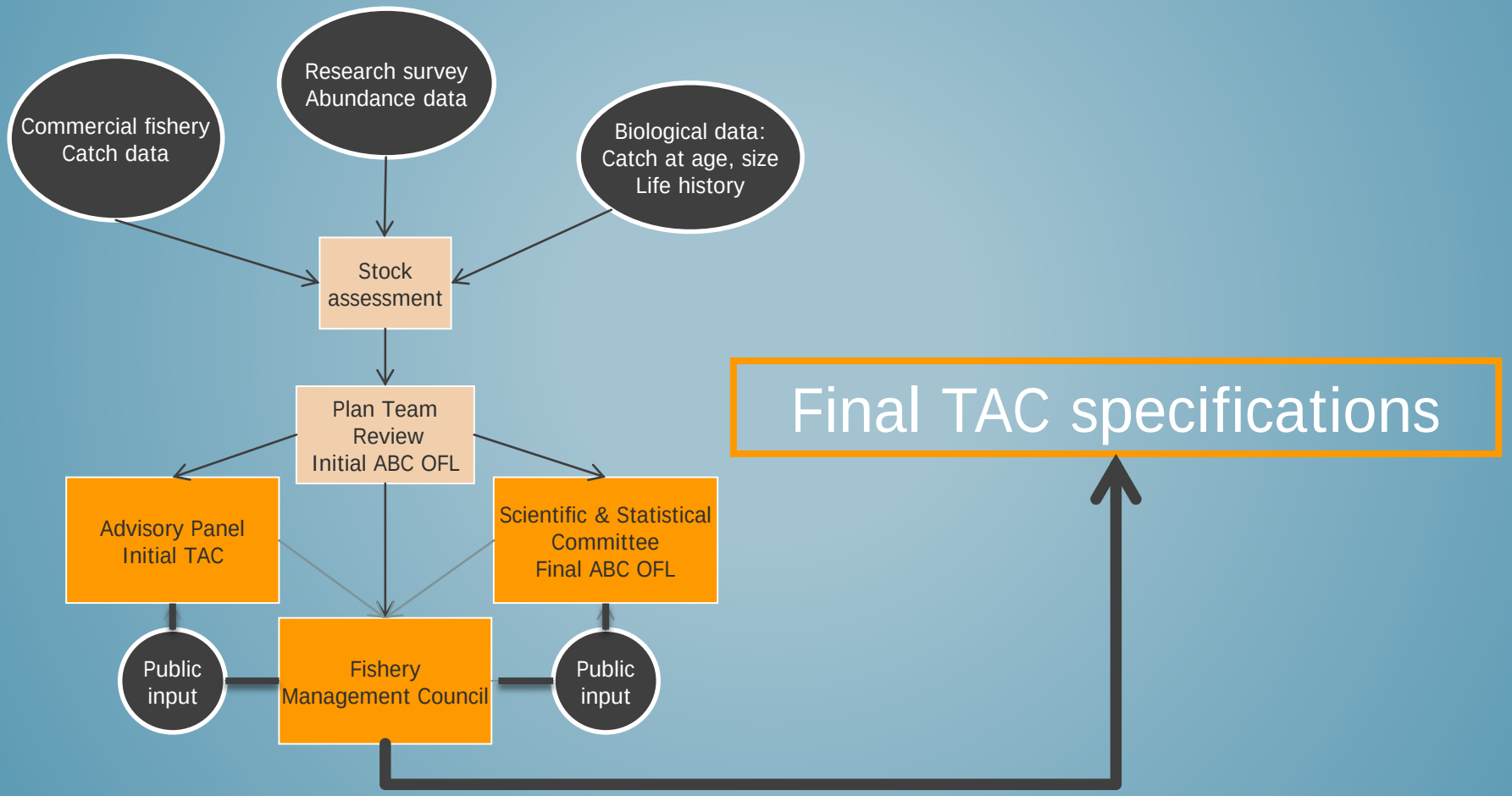
# *Marine Ecosystems Face Many Pressures*



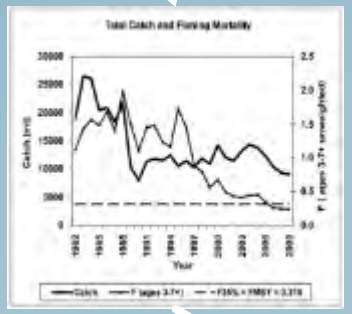




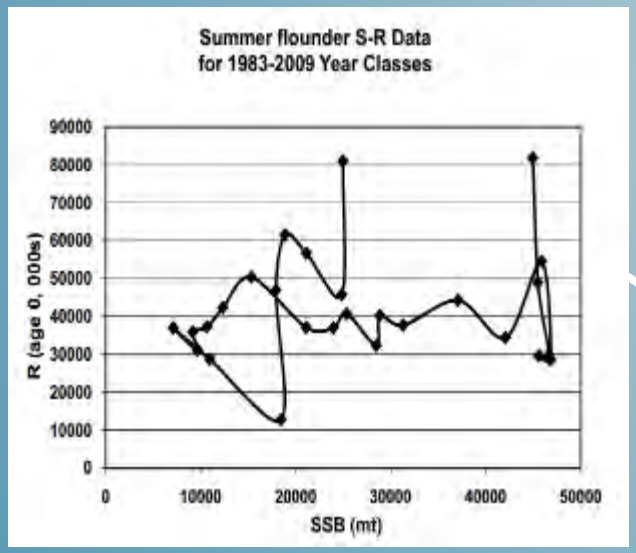
# *Fisheries Management process*

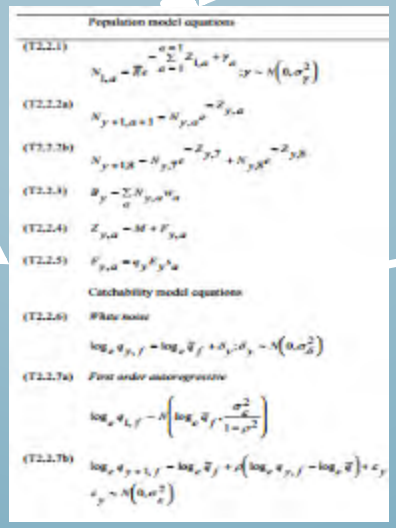


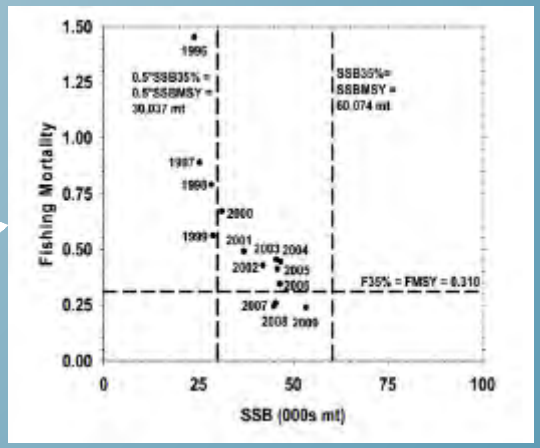
# $Z = F + M$


Total Catch and Fishing Mortality
Catch (mt)
F (ages 3-7) unweighted
Year

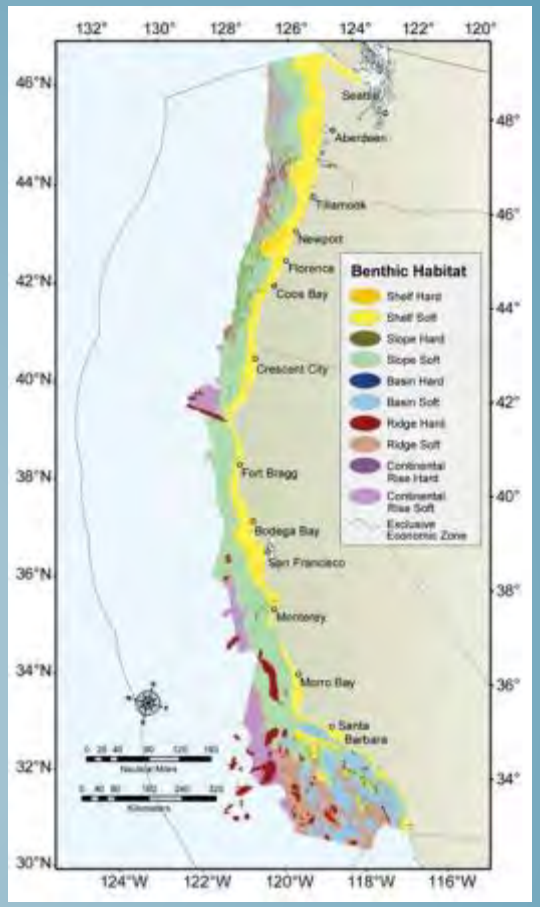
M=0.2


Summer flounder S-R Data
for 1983-2009 Year Classes
R (age 0, 000s)
SSB (mt)


Population model equations
Catchability model equations
White noise
First order autoregressive

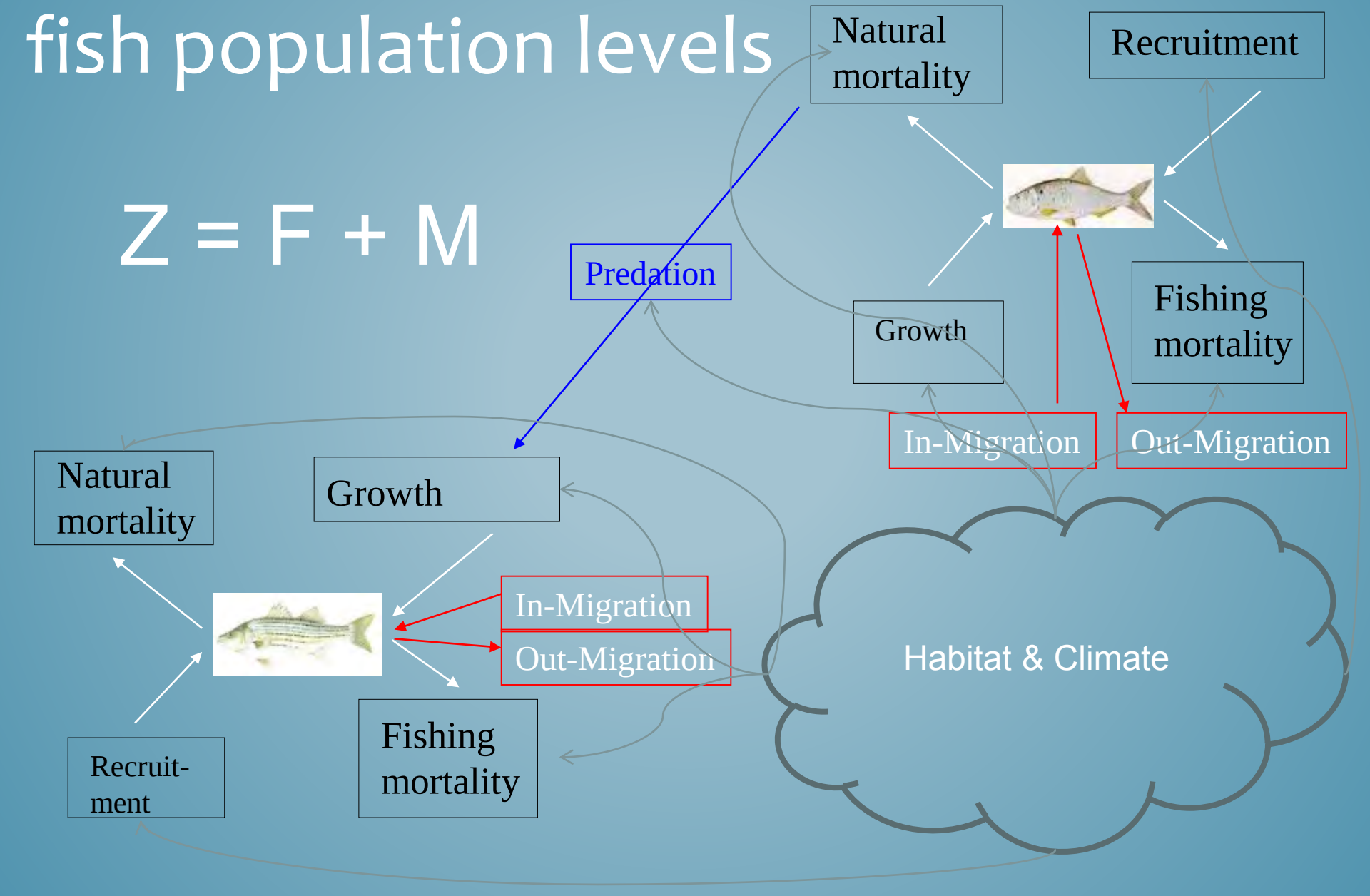

Fishing Mortality
SSB (000s mt)
0.5*SSB35% = 0.5*SSBMSY = 30,037 mt
SSB35%= SSBMSY = 60,074 mt
F35% = FMSY = 0.310

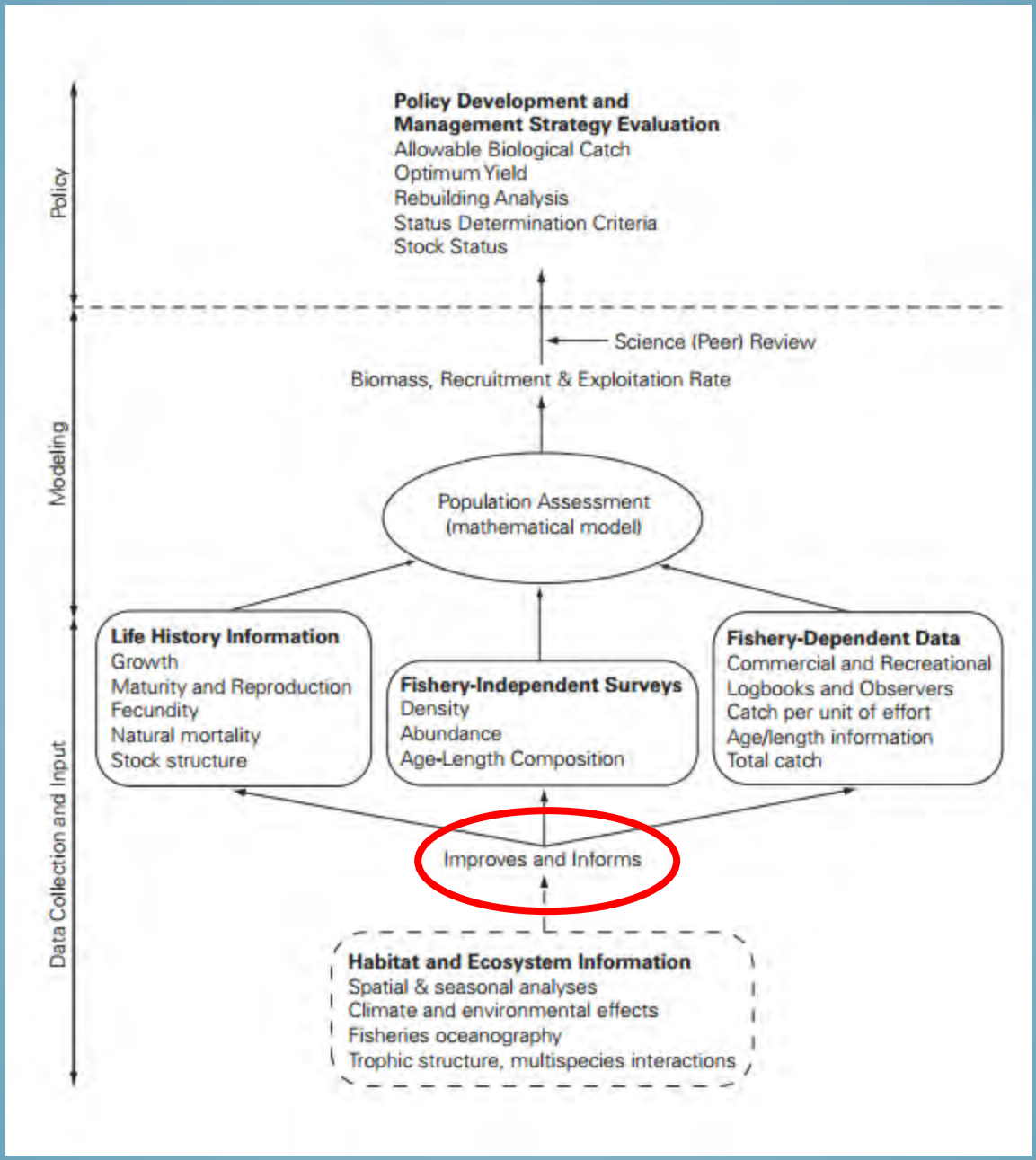
Habitat includes the physical, chemical, biological, and geological components of both benthic and pelagic realms.

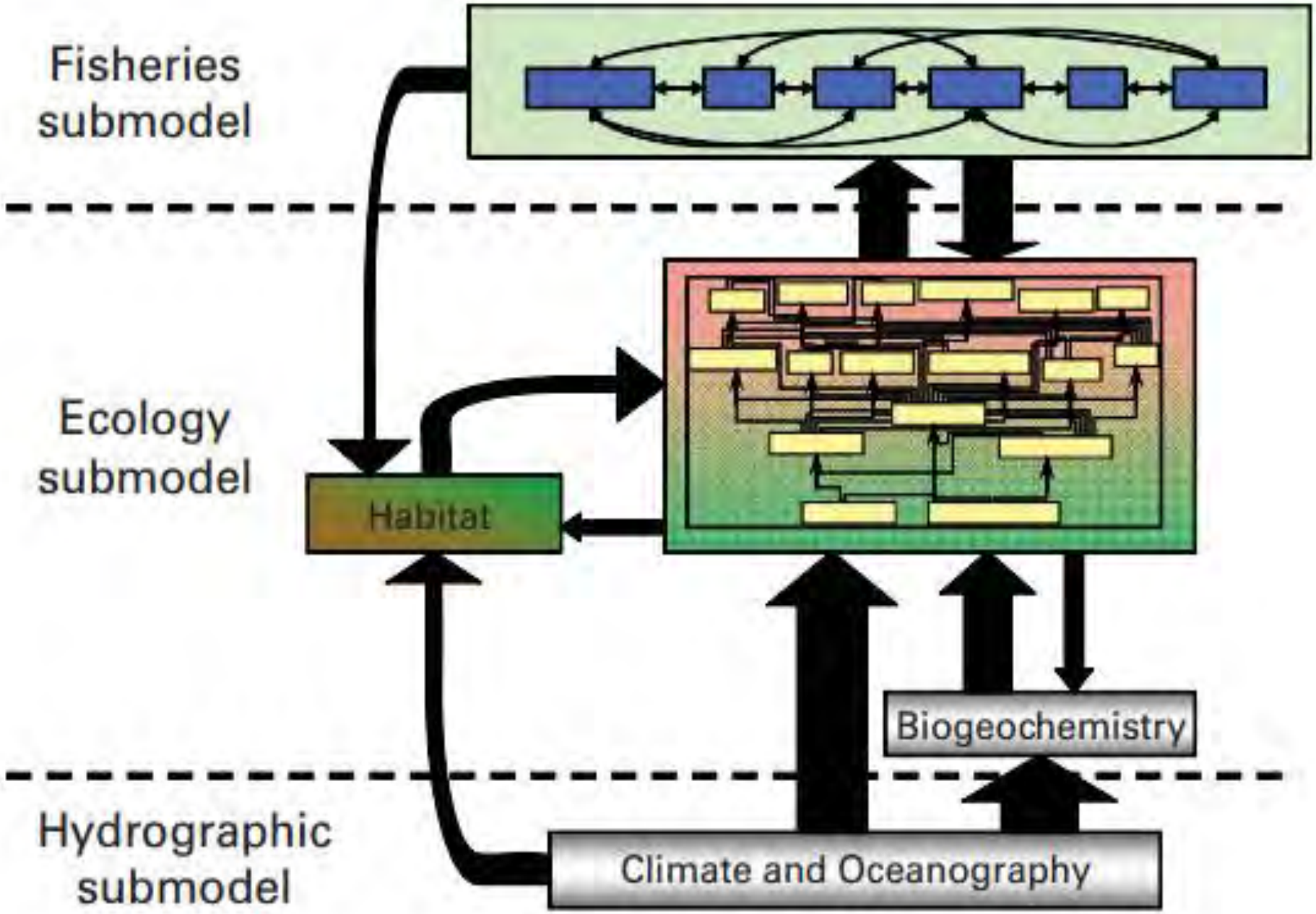


# Processes that control fish population levels

$$Z = F + M$$




Policy
Modeling
Data Collection and Input
Policy Development and
Management Strategy Evaluation
Allowable Biological Catch
Optimum Yield
Rebuilding Analysis
Status Determination Criteria
Stock Status
Science (Peer) Review
Biomass, Recruitment & Exploitation Rate
Population Assessment
(mathematical model)
Life History Information
Growth
Maturity and Reproduction
Fecundity
Natural mortality
Stock structure
Fishery-Independent Surveys
Density
Abundance
Age-Length Composition
Fishery-Dependent Data
Commercial and Recreational
Logbooks and Observers
Catch per unit of effort
Age/length information
Total catch
Improves and Informs
Habitat and Ecosystem Information
Spatial & seasonal analyses
Climate and environmental effects
Fisheries oceanography
Trophic structure, multispecies interactions


Fisheries submodel
Ecology submodel
Habitat
Biogeochemistry
Hydrographic submodel
Climate and Oceanography

# *Levels of Marine Ecosystem Management (Fisheries)*

1) ***Ecosystem-Based Management (EBM)***

   *multiple ocean use sectors are discussed and strategic decisions made as to various tradeoffs among sectors*

2) ***Ecosystem-Based Fisheries Management (EBFM)***

   *has facets of both strategic & tactical decisions solely within the fisheries sector*

3) ***Ecosystem Approach to Fisheries (EAF)***

   *adds ecosystem factors into fisheries stock assessments for tactical management decisions*

Based on: Ihde & Townsend. 2013. Interview with Jason Link. Fisheries 38(8) 363-369.Z

# *Levels Of Ecological Model Use To Inform LMR Management*

*Heuristic*

- *Understanding Ecosystem Functioning*
- *Relative Importance of Different Processes*
- *Advancing Scientific Theory*

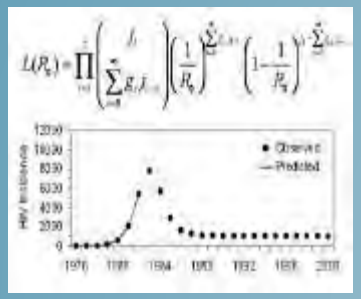
*Strategic*

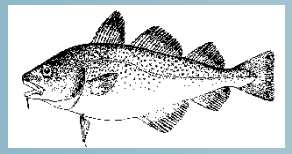
- *Assessing Biomass Tradeoffs*
- *System Level Emergent Properties & RPs*
- *Evaluating Alternate Stable States*
- *Cumulative Impacts on Non-Target Species, Habitat*
- *General "What If" Scenarios and Gaming, Long Term Trends*
- *Time-scale: Decades*

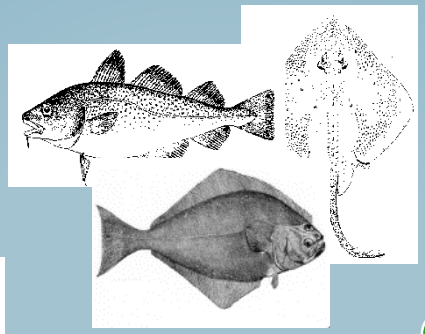
*Tactical*

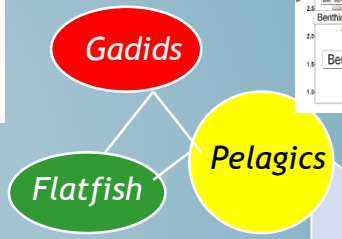
- *Revised Stock Assessments*
- *Yield Adjustments*
- *Altered Biological Reference Points, etc.*
- *Specific Impacts on Non-Target Species, Habitat*
- *Specific "What If" Scenarios and Gaming*
- *Time-scale: 1-5 years*

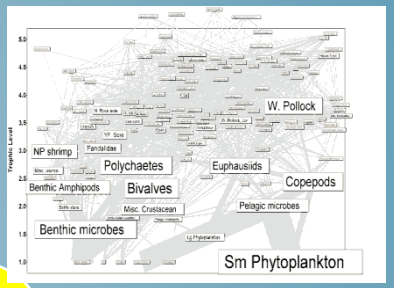
# Spectrum of Modeling For LMR Mgmt Process










Simple Statistical Models

Advanced Statistical Models

Stock Assessment Models

Stock Assessment Models/ w external factors

Multi-species Models

MS Models w/ External Factors

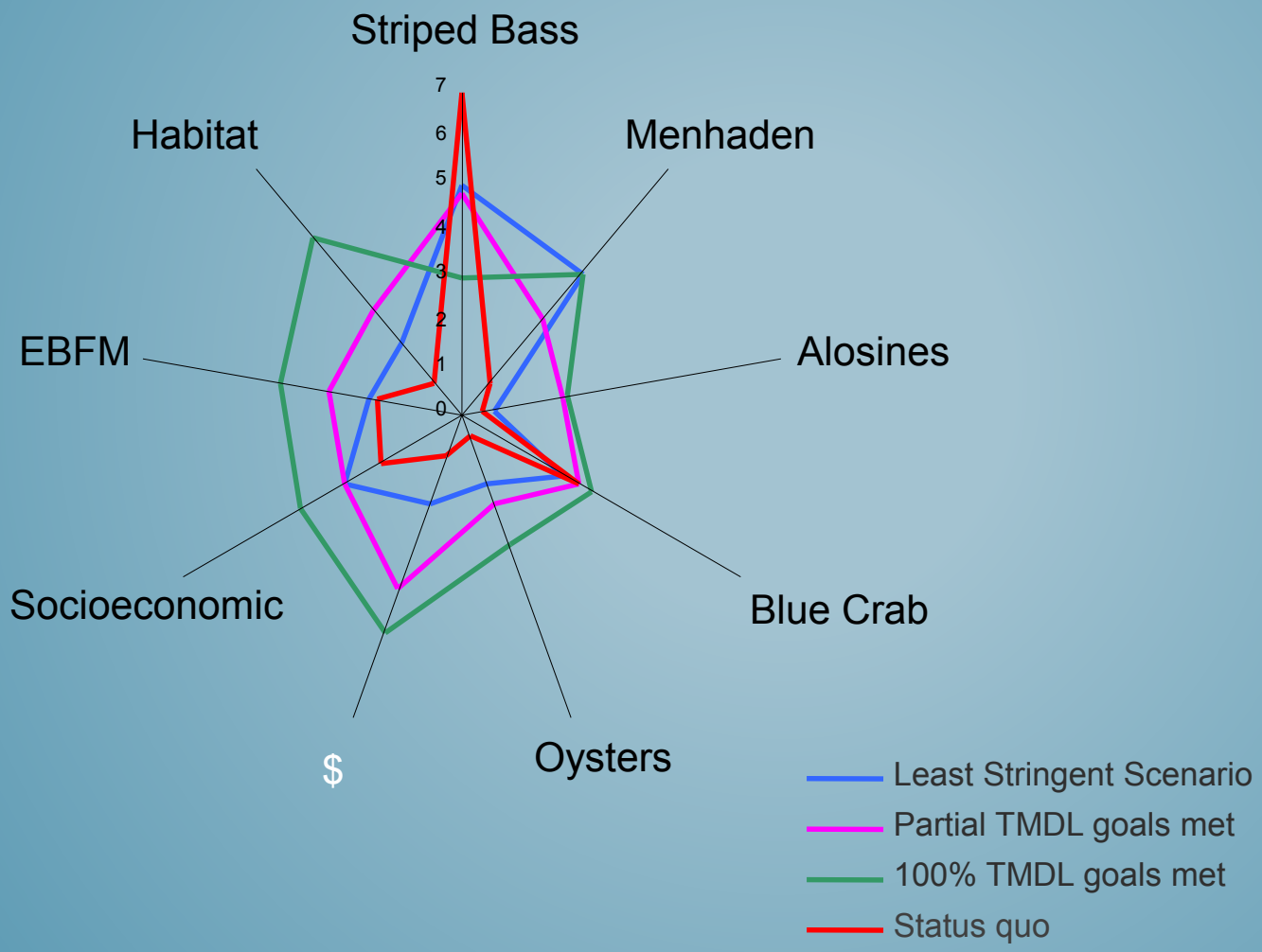
Biomass Dynamics Models

True Ecosystem Models

Maps with Integrated Biological and Physical Data

Oceanographic/ Hydrodynamic Models

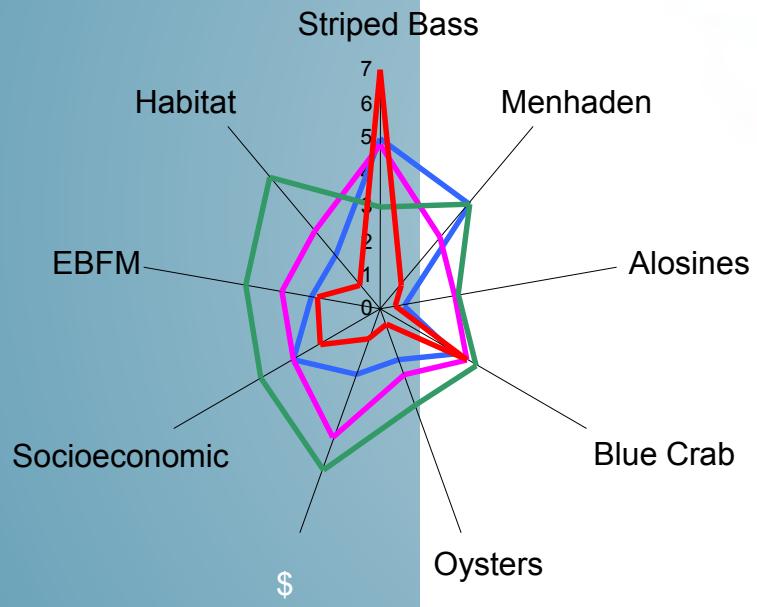
# Tradeoffs

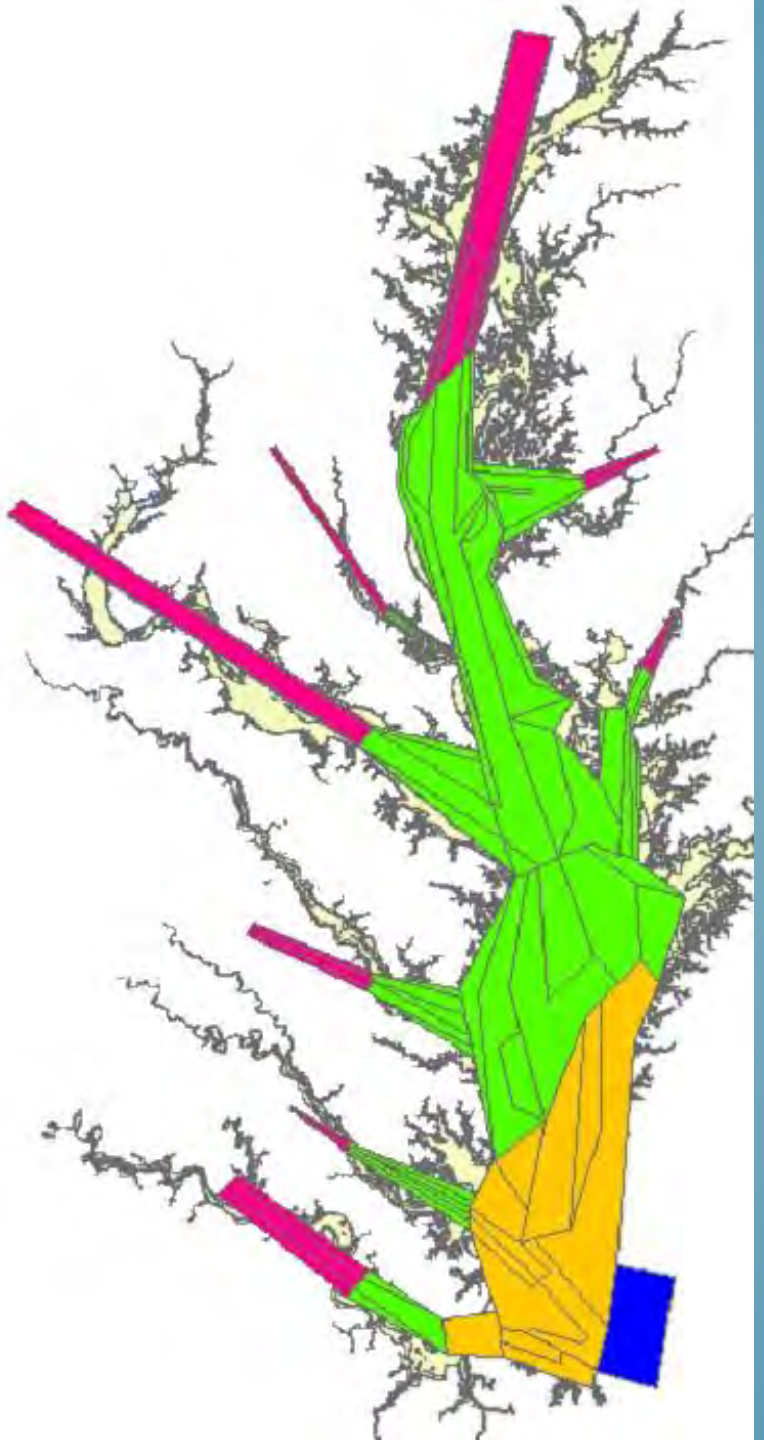



For Illustrative Purposes Only -- Not Based on Actual Modeling Results

# EXTRA SLIDES

# Chesapeake A



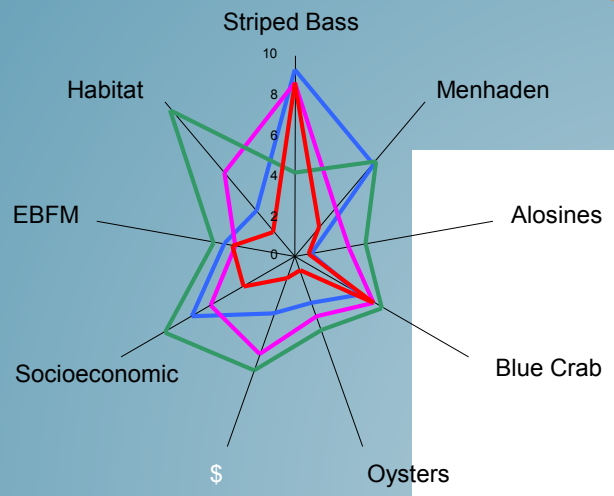



# Tradeoffs

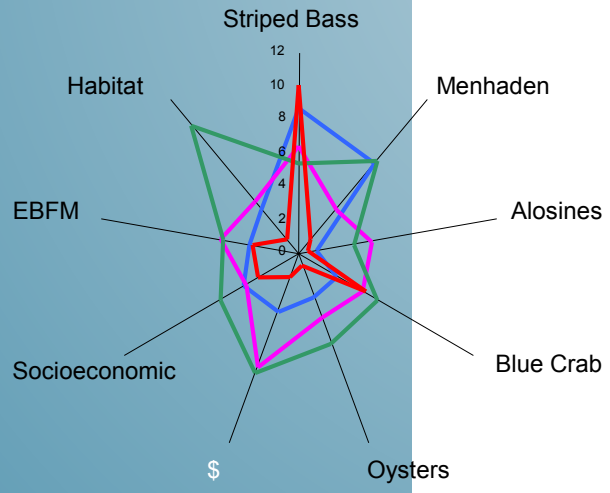
## CAM Output

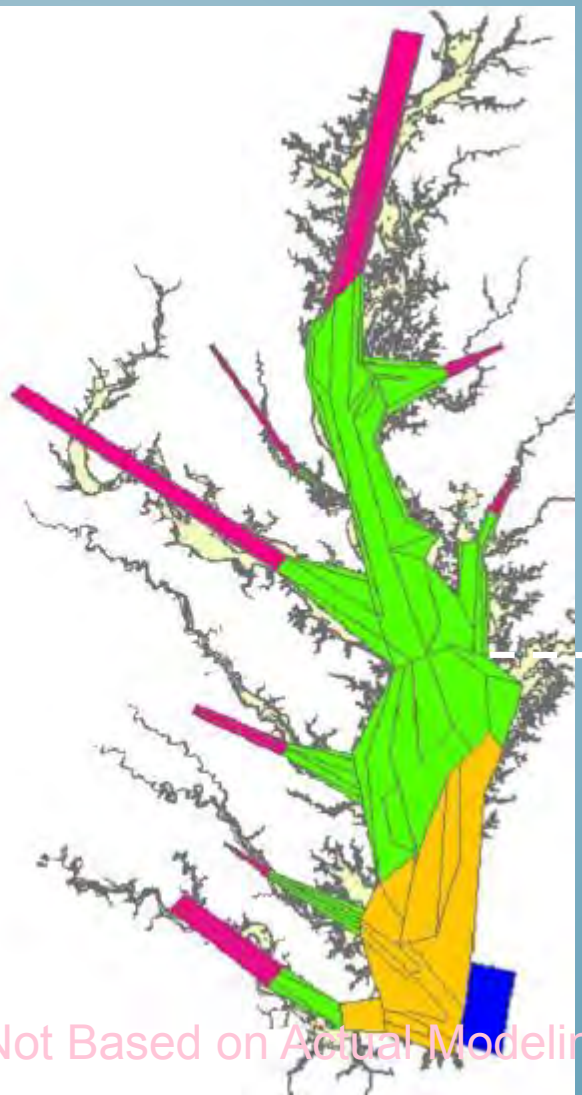
20 year Simulation

MD




VA



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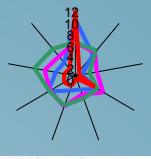
# Tradeoffs

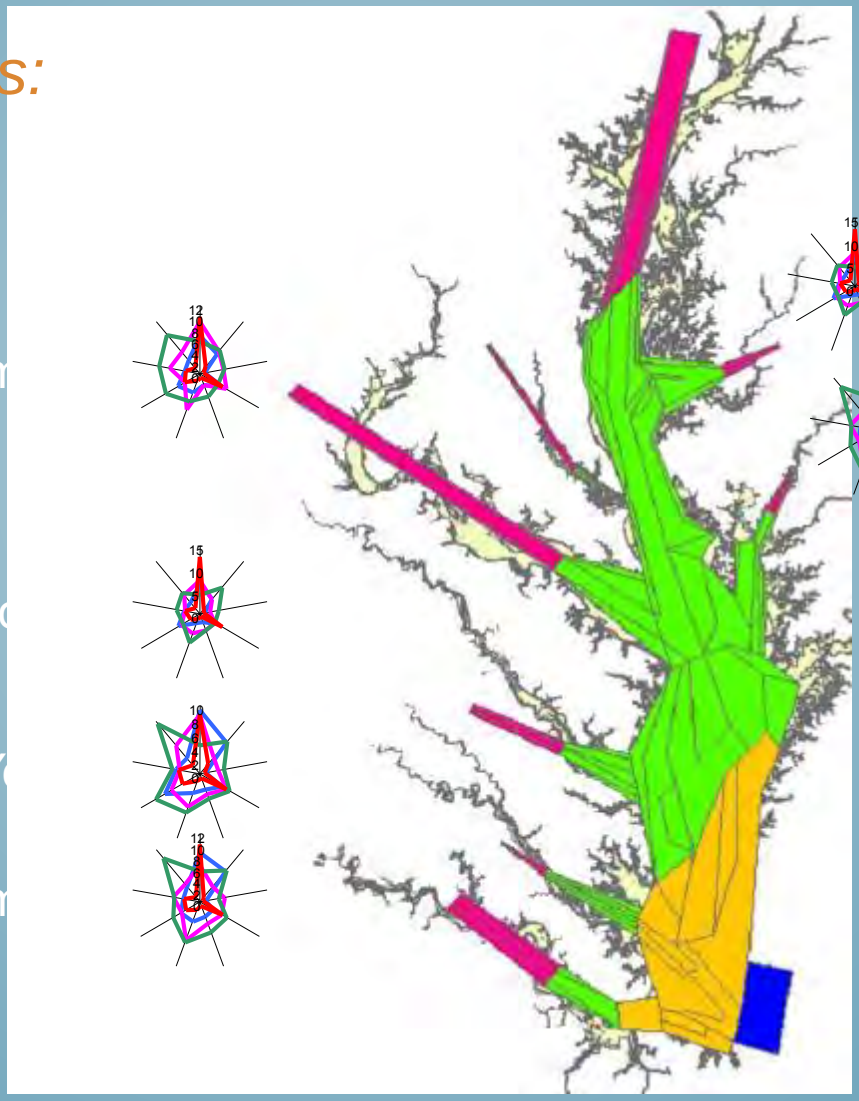
CAM Output

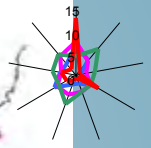
20 year Simulation



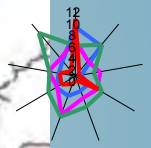
Susquehanna/
Upper-Bay

*Focus areas:*





Choptank

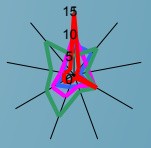


Nanticoke

Potom



Mid-Bay



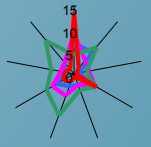
Rappahanno



Y



Lower-Bay



Jam



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# Atlantis

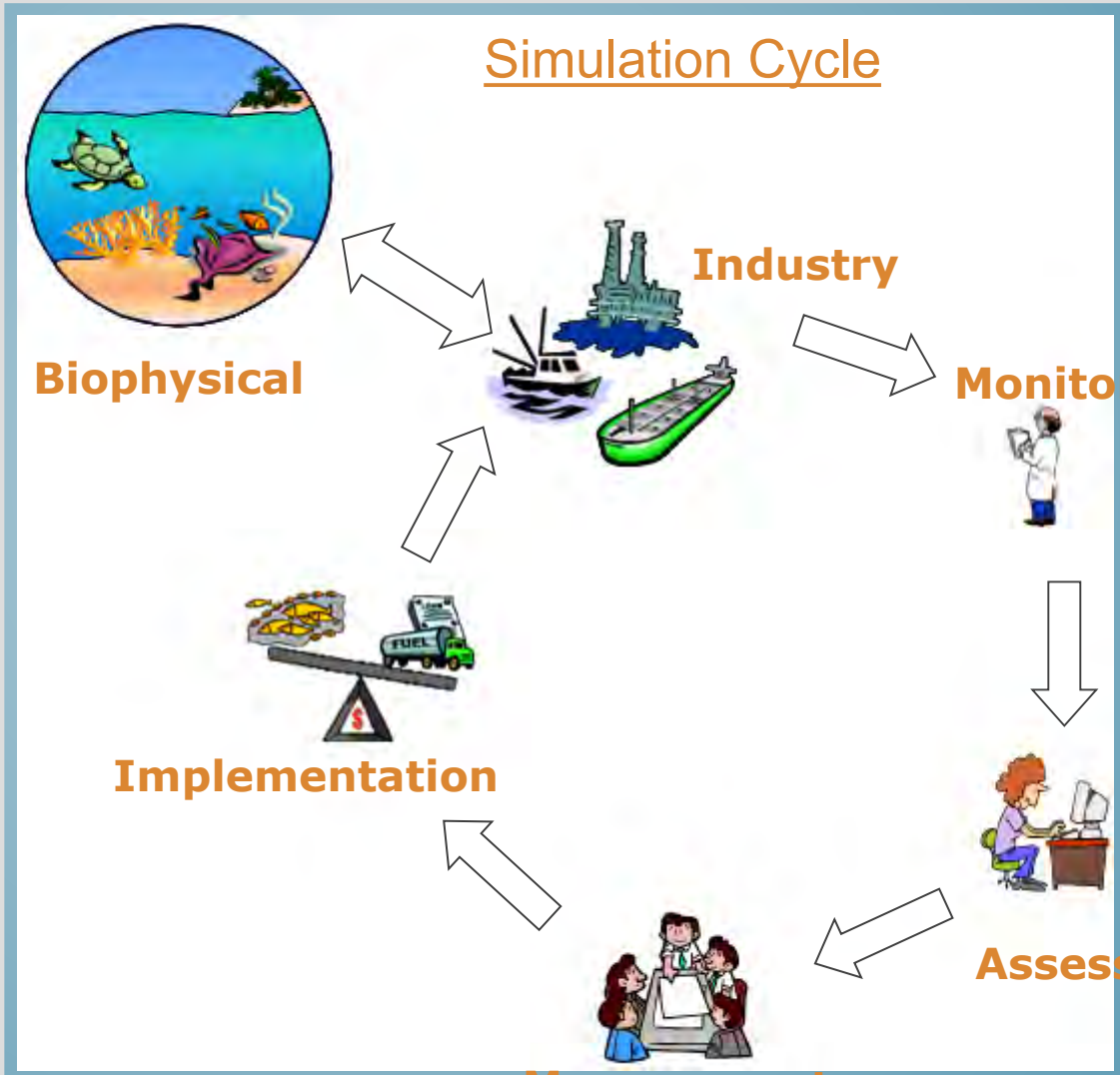
## Management Strategy Evaluation (MSE)

### Manager Roles

DEFINE OBJECTIVES

PERFORMANCE MEASURES

### Simulation Cycle




Modified from E. Fulton

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### Manager Roles

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PERFORMANCE MEASURES

### Simulation Cycle

Biophysical

Industry

Monitoring

Implementation

Assessment

Management

Modified from E. Fulton

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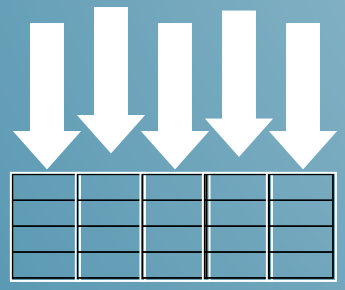
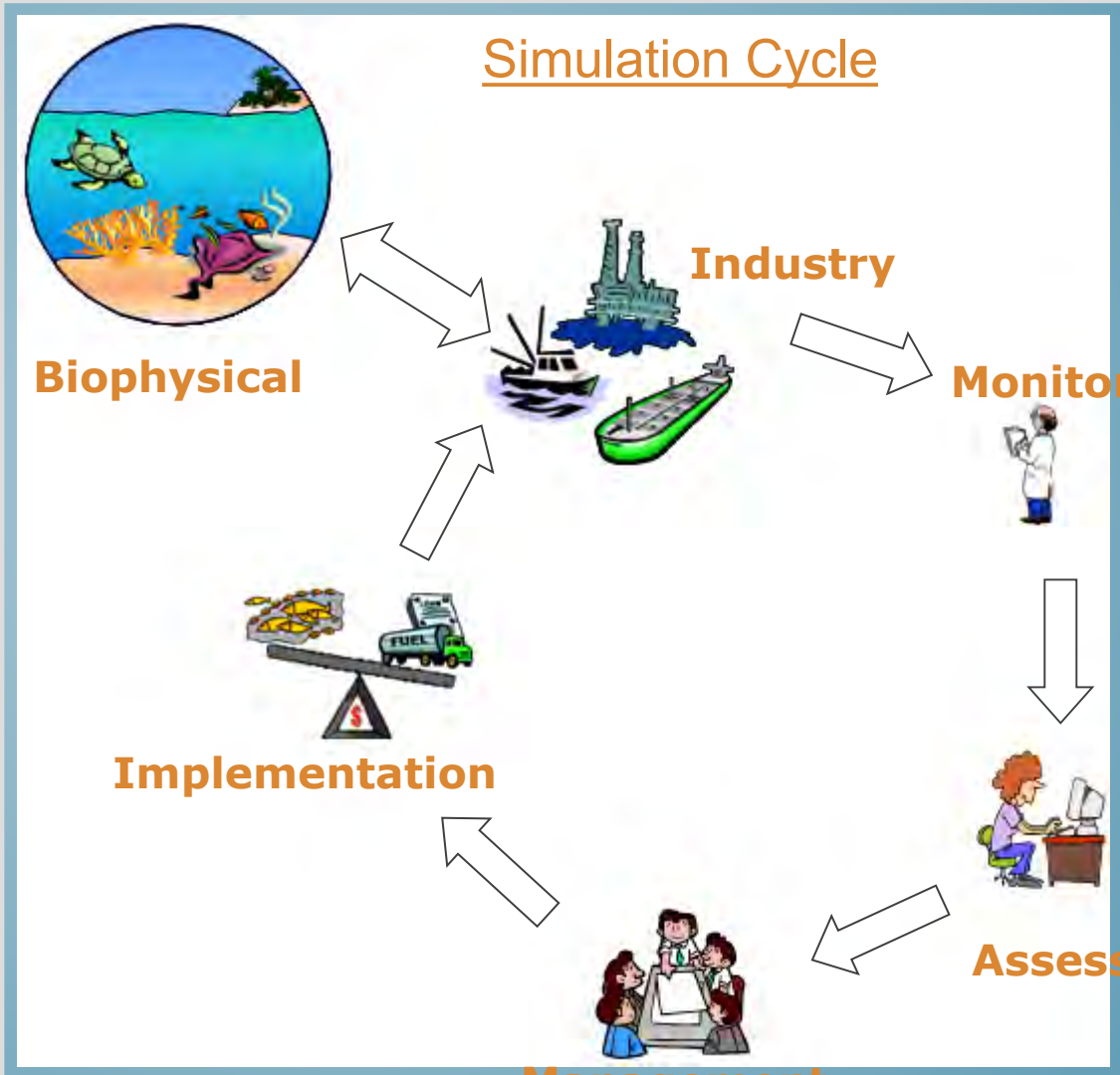


### Simulation Cycle

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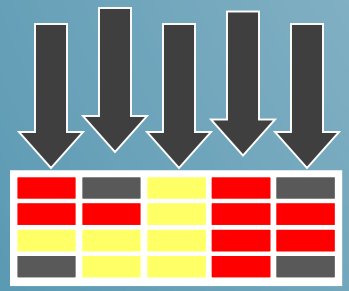

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