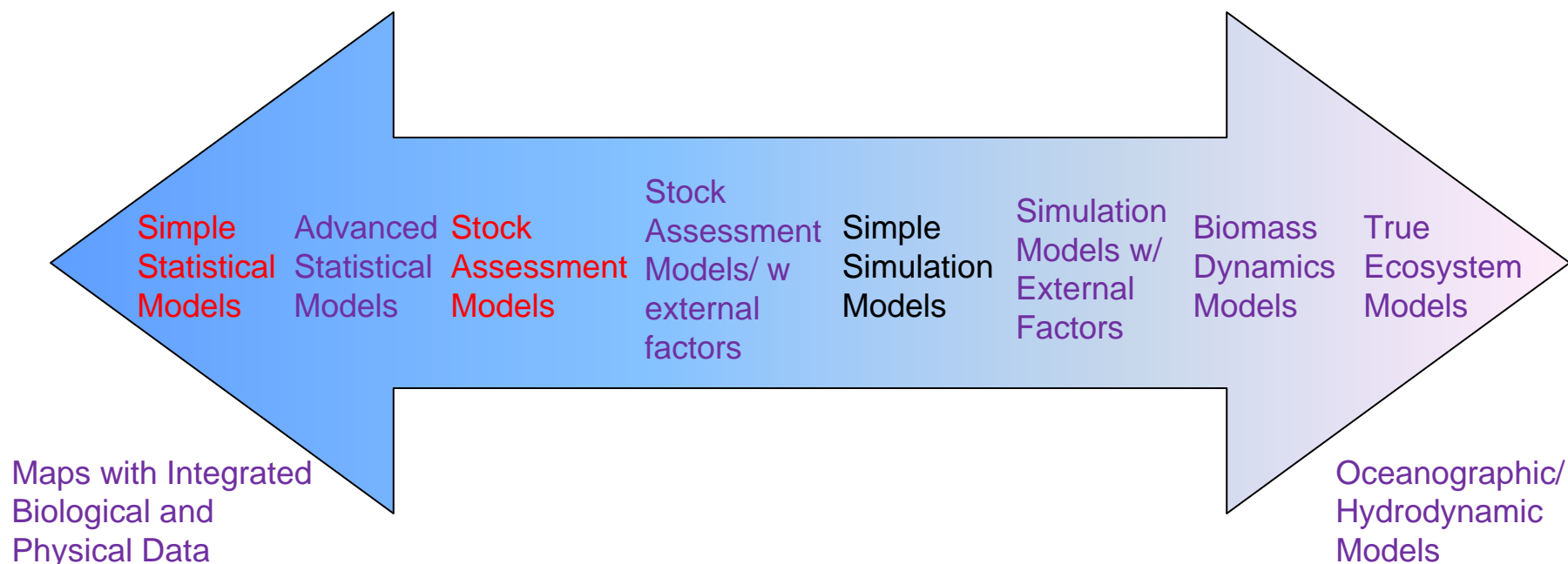


# Chesapeake Atlantis Model (CAM)

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# Spectrum of Modeling For Living Resource Management



\* Red text denotes models most conventionally used in Living resource management

\* Purple text denotes models in use and being developed by NCBO Ecosystem Modeling Team

# The Chesapeake Atlantis Model (CAM)

## A True Ecosystem Model

### *Incorporating:*

#### Biological environment

- ✓ Primary production
- ✓ Trophic interactions
- ✓ Recruitment relationships
- ✓ Age structure
- ✓ Size structure
- ✓ Life History

#### Fisheries

- ✓ Multiple sectors
- ✓ Gears
- ✓ Seasons
- ✓ Spatially explicit

#### Physical environment

- ✓ Geology
- ✓ Chemistry
- ✓ Circulation & currents
- ✓ Temperature
- ✓ Salinity
- ✓ Water clarity
- ✓ Climate variability

#### Nutrient Inputs

- ✓ Currency is Nitrogen

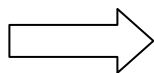
#### Industry

# Atlantis

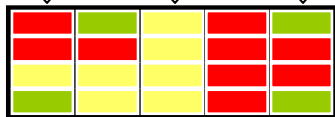
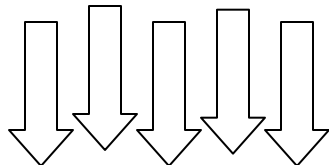
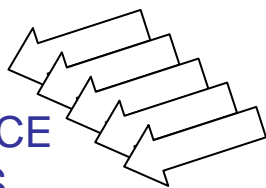
## Management Strategy Evaluation (MSE)

### Manager Roles

DEFINE OBJECTIVES



PERFORMANCE MEASURES



### Simulation Cycle



Biophysical



Industry



Implementation



Management

Monitoring



Assessment

# Implementations

- ❖ MPA planning in E.S. context
- ❖ ITQ's/ "catch shares"
- ❖ Evaluate ecological indicators

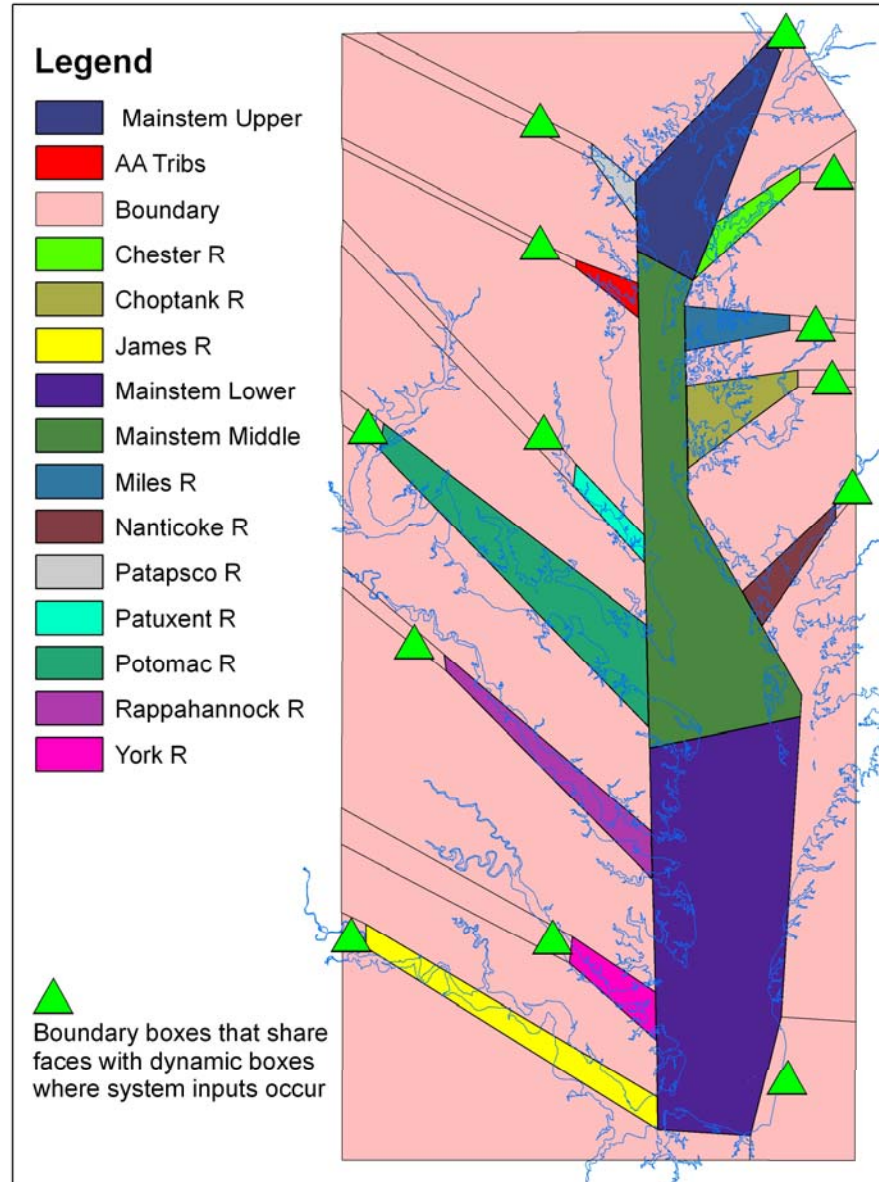


Sustainability of fisheries in context of climate change:

- ❖ Evaluate economic pressures
- ❖ Effort allocation
- ❖ Gear choice

- ❖ Eutrophication most critical
- ❖ A few key species capture the major ecosystem impacts
- ❖ Ecosystem models identify impacts single-species models miss

# Chesapeake Atlantis Model (CAM)



# Ecological Groups in CAM

## Finfish

- Alosines (Amer.Shad, Alewife & Herring)
- Bay anchovy
- Black drum
- Bluefish
- Butterfish, harvestfish (“Jellivores”)
- Catfish
- Croaker, Atlantic
- Gizzard shad
- Littoral forage fish (Euryhaline: Spot (18), silver perch (25a), FW to 10ppt: yellow perch, redbreast sunfish, pumpkinseed, smallmouth & largemouth bass)
- Menhaden
- Striped bass
- Summer flounder
- Other flatfish (hogchoker, tonguefish, window pane, winter flounder)
- Pelagic forage fish (small) - striped + rainwater killifish (mummichogs), silversides
- Reef assoc. fish (spadefish, blennies, gobies, Tautog, black seabass, toadfish)
- Spotted hake, lizard fish, northern searobin
- Weakfish Adult
- White perch adult

## Elasmobranchs

- Cownose ray
- Dogfish, smooth
- Dogfish, spiny
- Sandbar shark

## Birds

- Predatory birds (osprey, green heron, laughing gull, seaducks)
- Herbivorous seabirds (mallard, geese & swans)

## Mammals

- Bottlenose dolphin
- Muskrat/nutria/beaver

## Reptiles

- Seaturtles

## Invertebrates

- Benthic deposit feeders (sea slugs; echinoderms; amphipods; isopods; small crustaceans; snails [herbivorous]; ghost [& other demersal] shrimp, annelids, flatworms, sediment amphipods) & other filter feeders (Hard clams/bivalves/ arcs/ ribbed mussels/ filter feeding polychaetes/ burrowing anemones/ barnacles)
- Blue crab YOY
- Blue crab adult
- Brief squid
- Oyster YOY
- Oyster 1+
- Soft clam

## Primary Producers

- Benthic microalgae
- “Grasses:”
  - Marsh grasses (emergent)
  - SAV – type varies with salinity
- Phytoplankton - Large (diatoms)
- Phytoplankton - Small
- Dinoflagellates

## ZooPlankton

- Ctenophores
- Sea nettles
- Microzooplankton (.02-.2mm): rotifers, ciliates, copepod nauplii
- Mesozooplankton (.2-20mm): copepods, etc.

## Detritus

- Carrion
- Carrion (sediment)
- Labile
- Labile (sediment)
- Refractory
- Refractory (sediment)

## Bacteria (.2-2 um [.002 mm] - feed microzooplankton food chain)

- Benthic Bacteria (sediment)
- Plankton-Bacteria: blue-green algae

*Thanks to:*



**Marine and Atmospheric Research**

**Northeast Fisheries Science Center**



*Northwest Fisheries Science Center*

*NOAA Fisheries Service*



**NOAA Chesapeake Bay Office**

