Using Ecopath with Ecosim to explore nekton community responses to freshwater input from a Mississippi River diversion in Breton Sound, Louisiana

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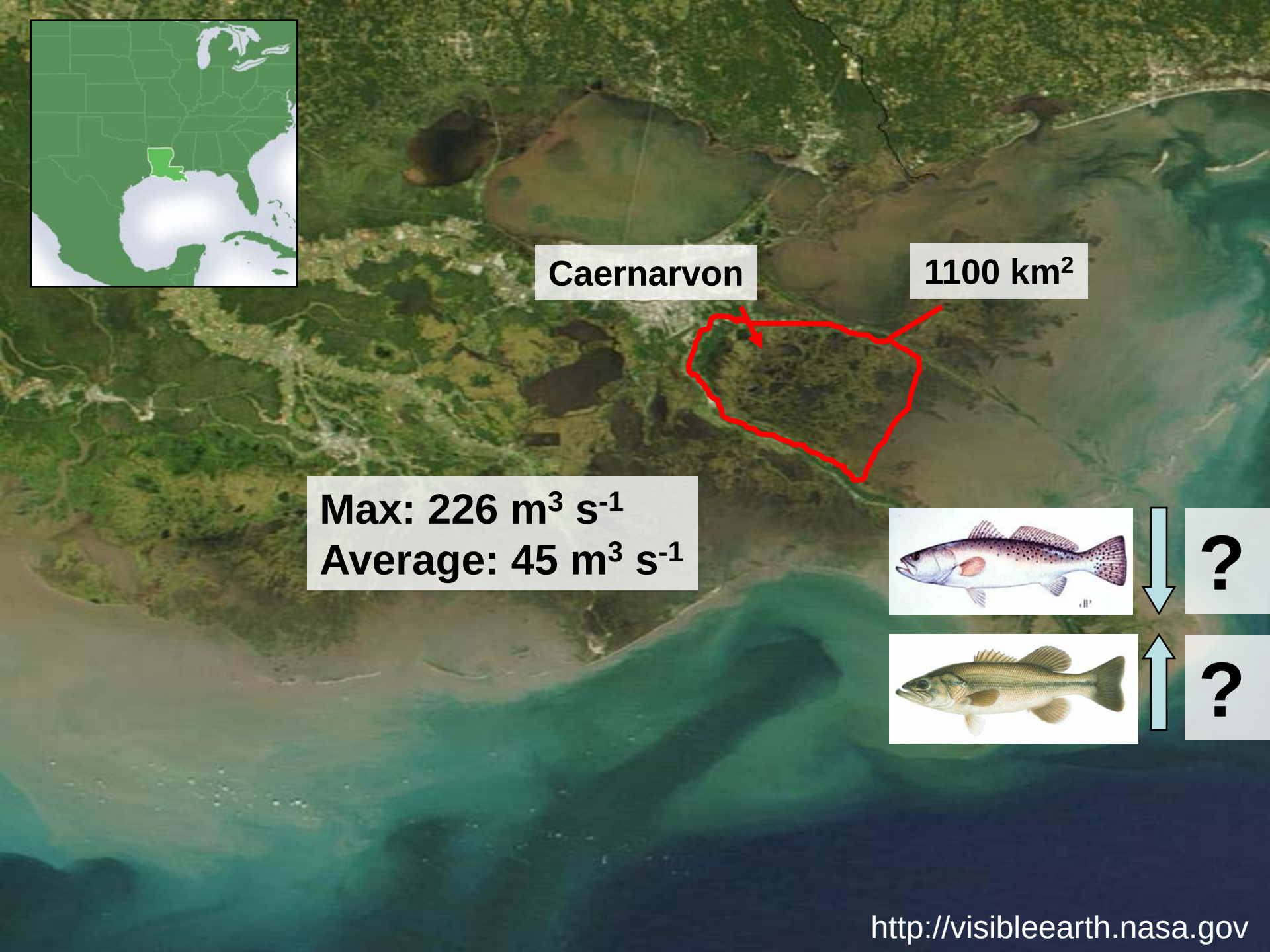

Caernarvon
1100 km²
Max: 226 m³ s⁻¹
Average: 45 m³ s⁻¹
?
?
http://visibleearth.nasa.gov

Ecopath with Ecosim (EwE)

- An ecosystem-based modeling approach, accounting for ecological interactions

- Widely used for construction of mass-balance trophic models of ecosystems

- Freeware (www.ecopath.org) and user-friendly

- Has three main components:

•Ecopath – a static snapshot of ecosystem trophic structure
•Ecosim – a time dynamic simulation module
•Ecospace – a spatial and temporal dynamic module

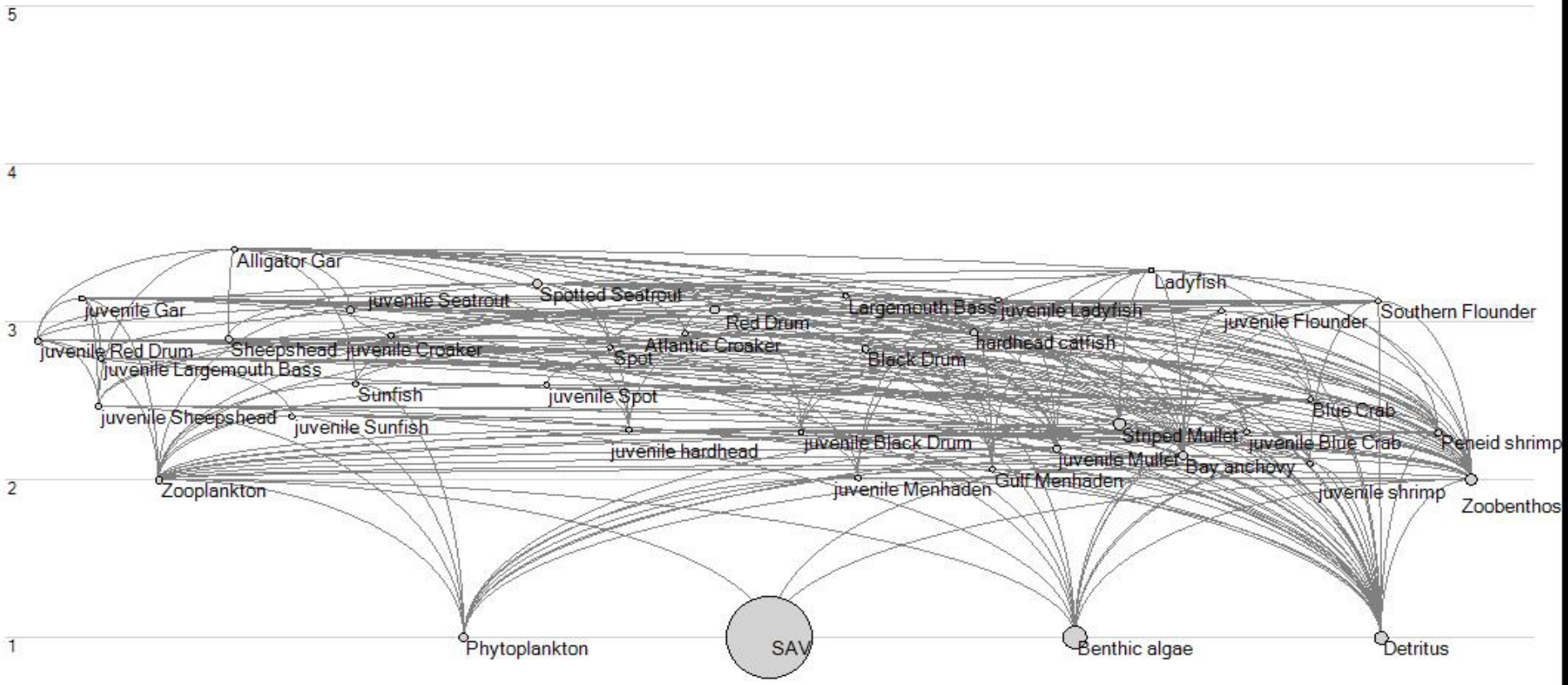
The Breton Sound Ecopath model: input

Input (39 groups)	Source
Species and biomass	Monthly surveys from 1986-1990
Multistanza (2): VBGF K	Walters (pers. comm.) or Fishbase
Juvenile biomass & Q/B	Generated by Ecopath
P/B and Q/B	GOM model (Walters et al. 2008) Weeks Bay model (Althauser, 2003) Fishbase
Diet compositions	Literature study Local stomach contents
Ecotrophic Efficiency	Generated by Ecopath

List of species/groups in the model

gar sp.	gulf menhaden
spotted seatrout	striped mullet
red drum	bay anchovy (+ small forage fish)
largemouth bass	blue crab
sheepshead	penaeid shrimp (brown,white,pink)
sunfish	zooplankton
ladyfish	zoobenthos (+ grass shrimp)
Atlantic croaker	phytoplankton
spot	macro algae/SAV
catfish sp.	benthic algae
black drum	detritus
Southern flounder	

The Breton Sound Ecopath model: output



Ecosim scenarios

Ecosim can simulate performance of species based on their specific salinity tolerances

<u>INPUT</u>

- **Breton Sound Ecopath model**
- **Forcing functions: 3 salinity time series**
- **Species-specific salinity tolerance ranges**

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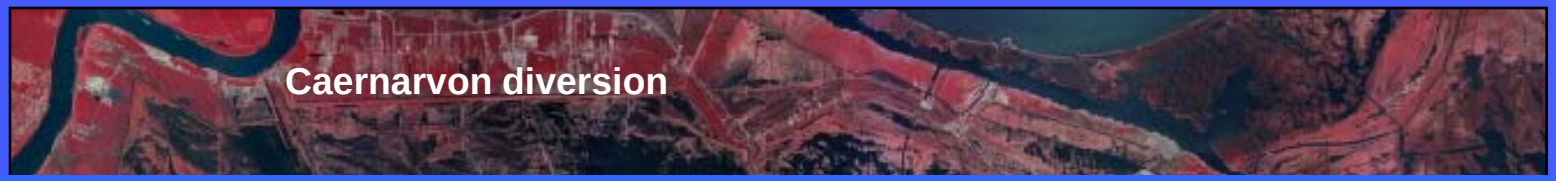
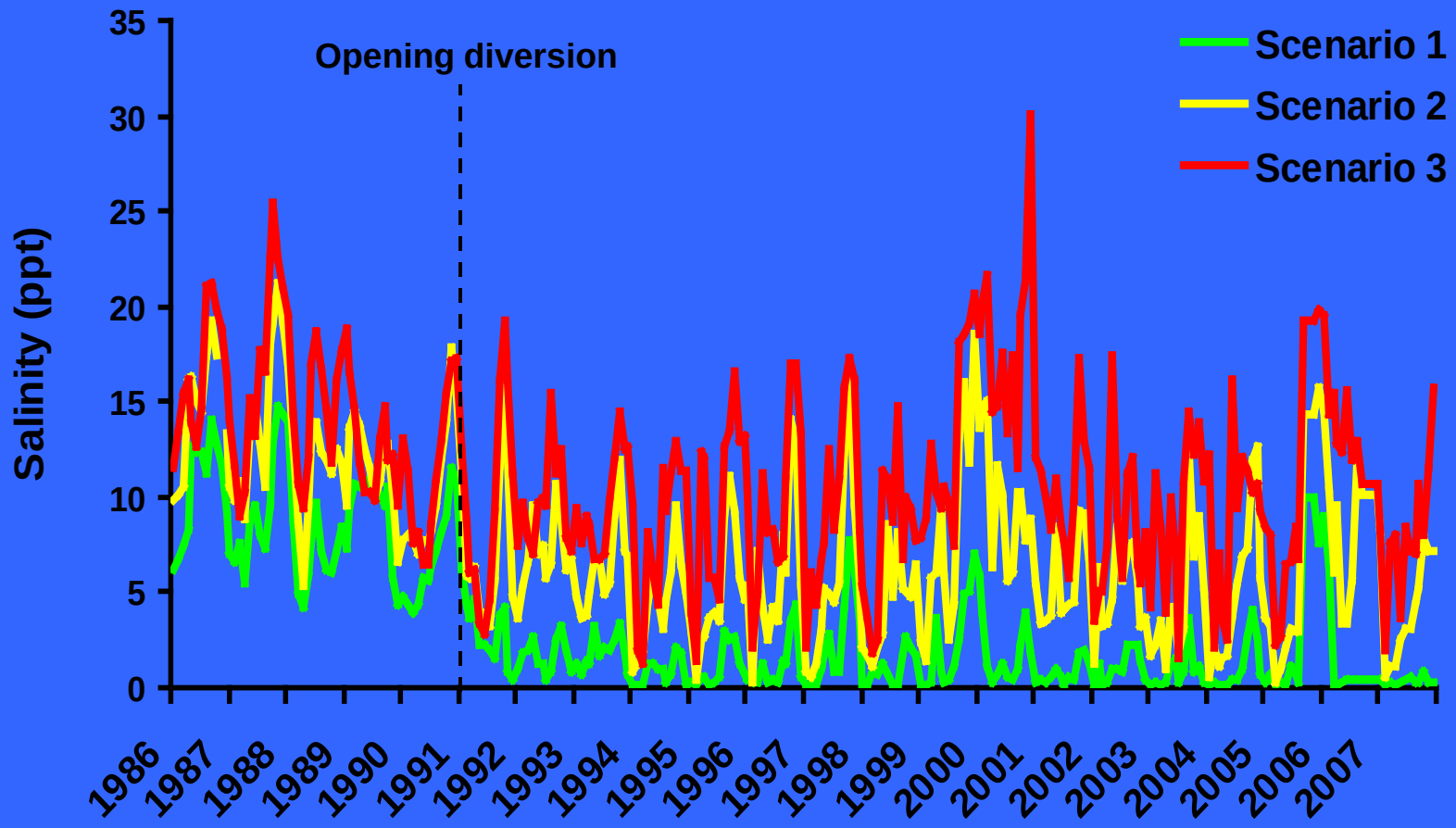
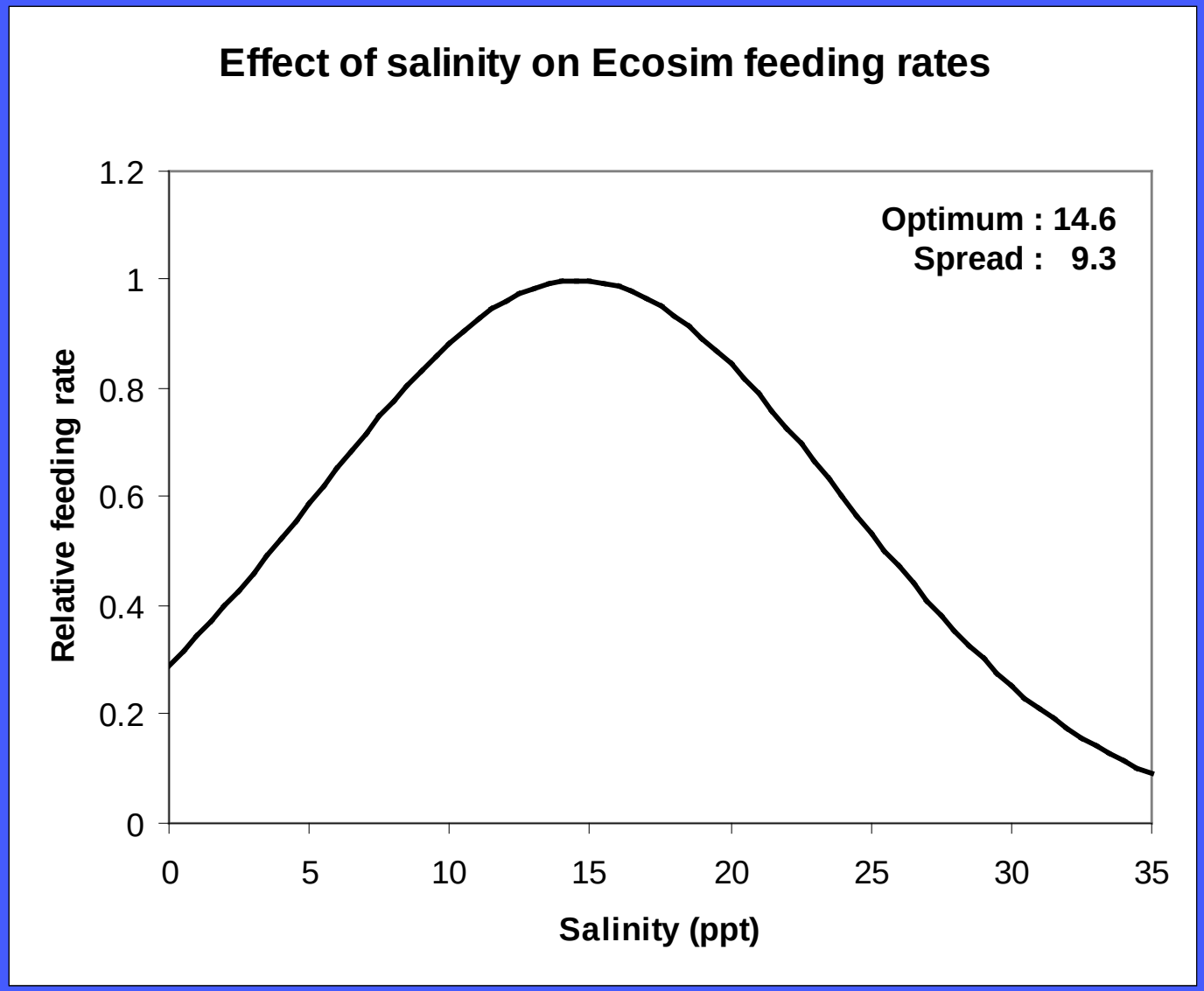

Caernarvon diversion

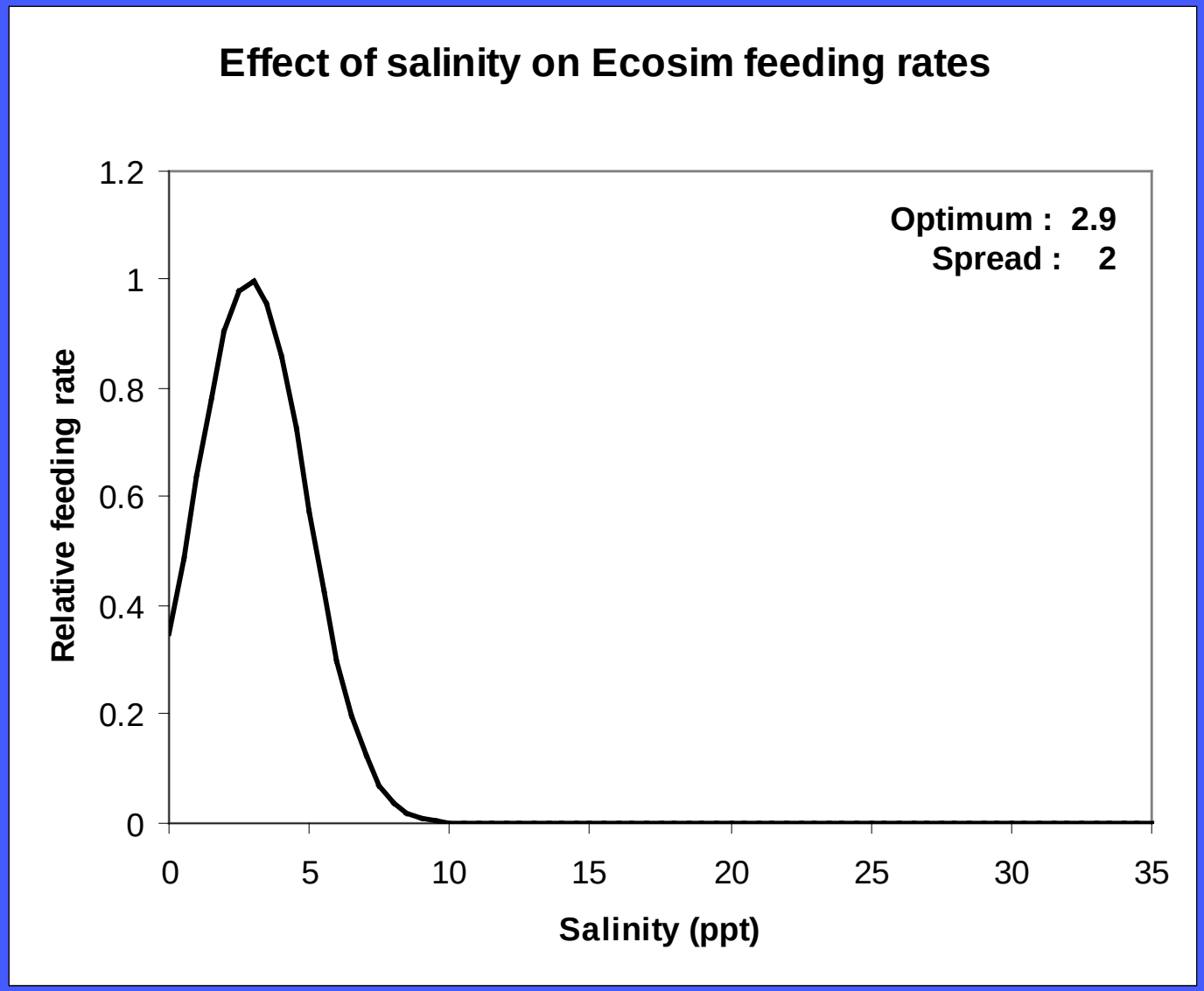

Opening diversion
Scenario 1
Scenario 2
Scenario 3
Salinity (ppt)
35
30
25
20
15
10
5
0
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007

234
253213

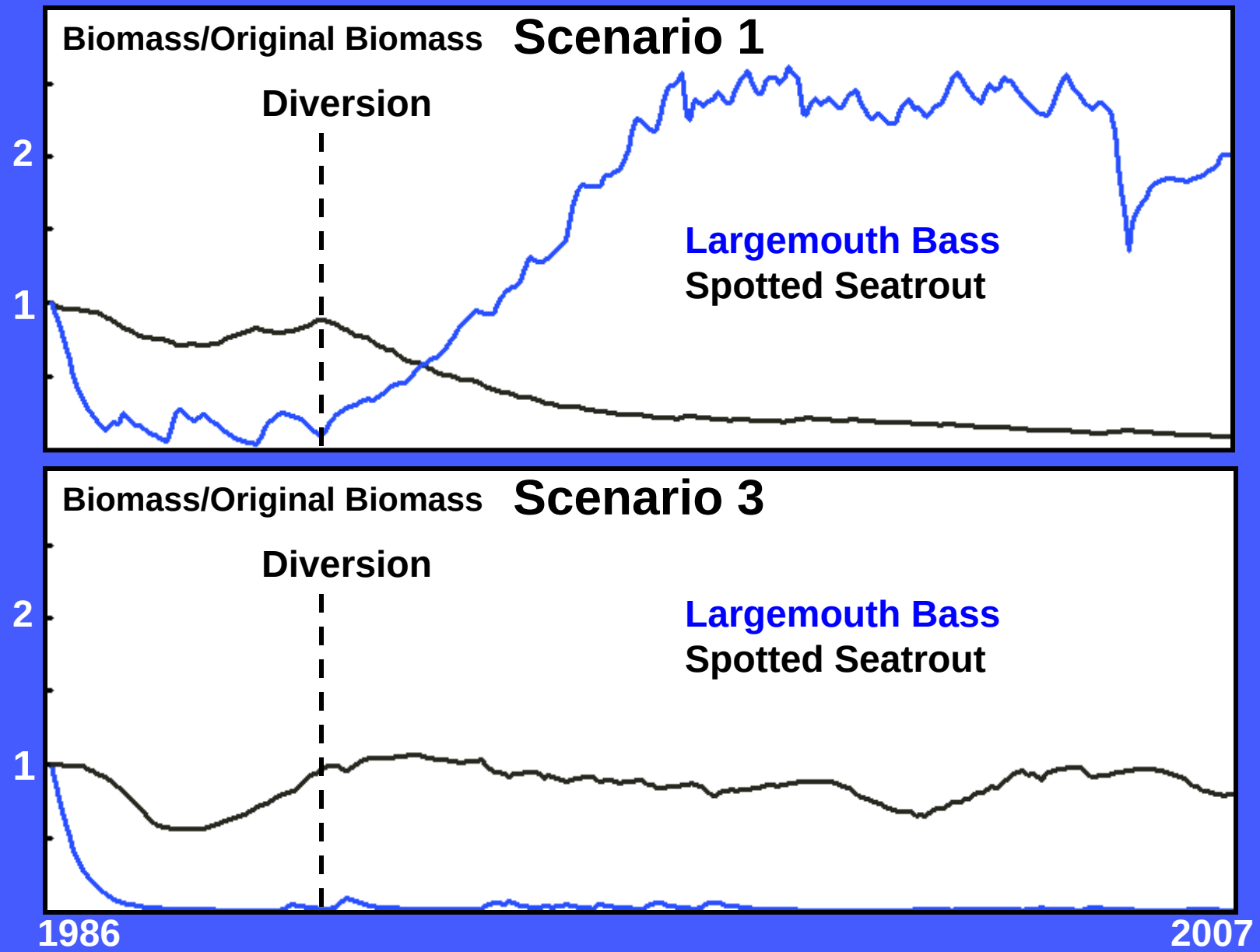
Salinity tolerances: Spotted Seatrout



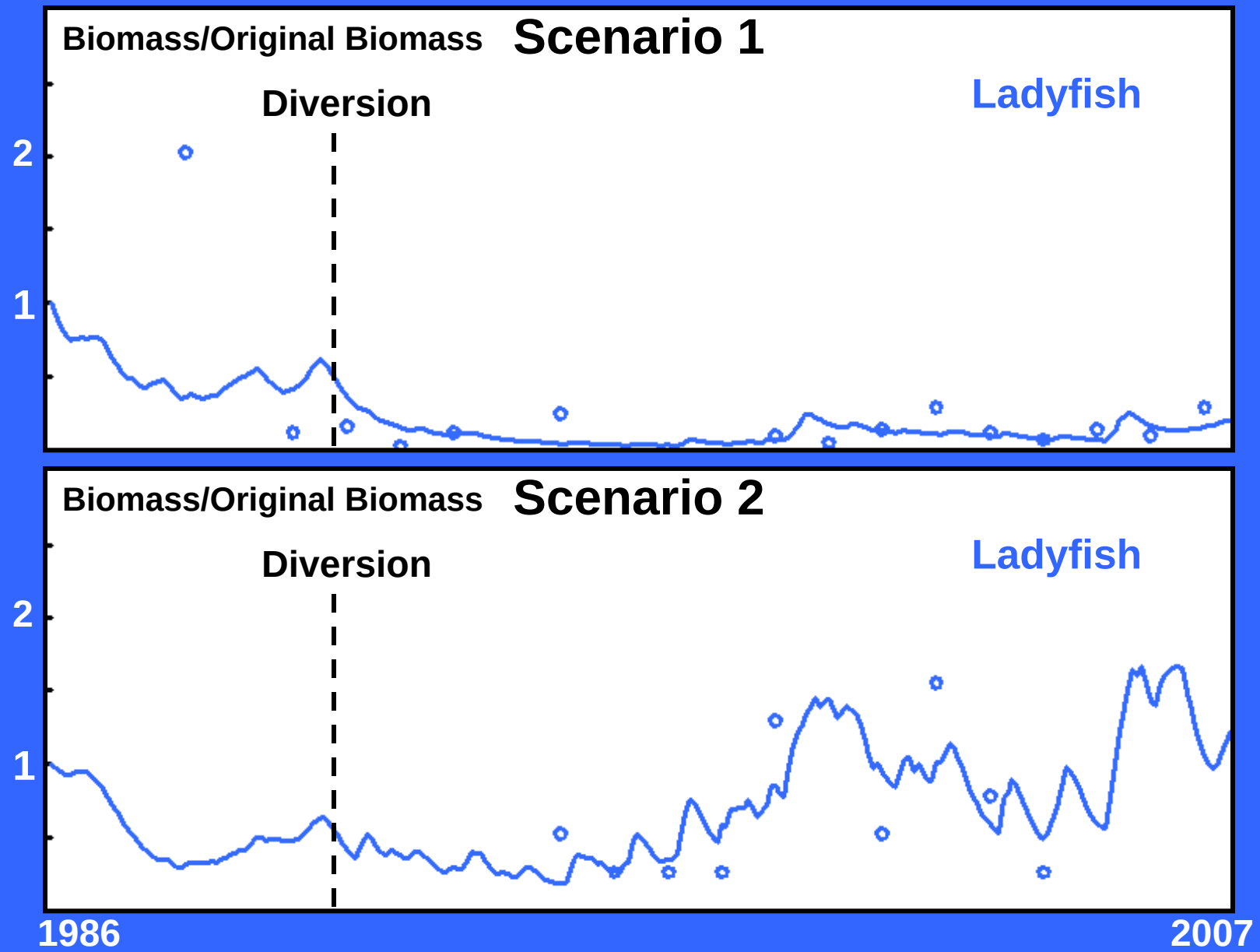
Salinity tolerances: Largemouth Bass

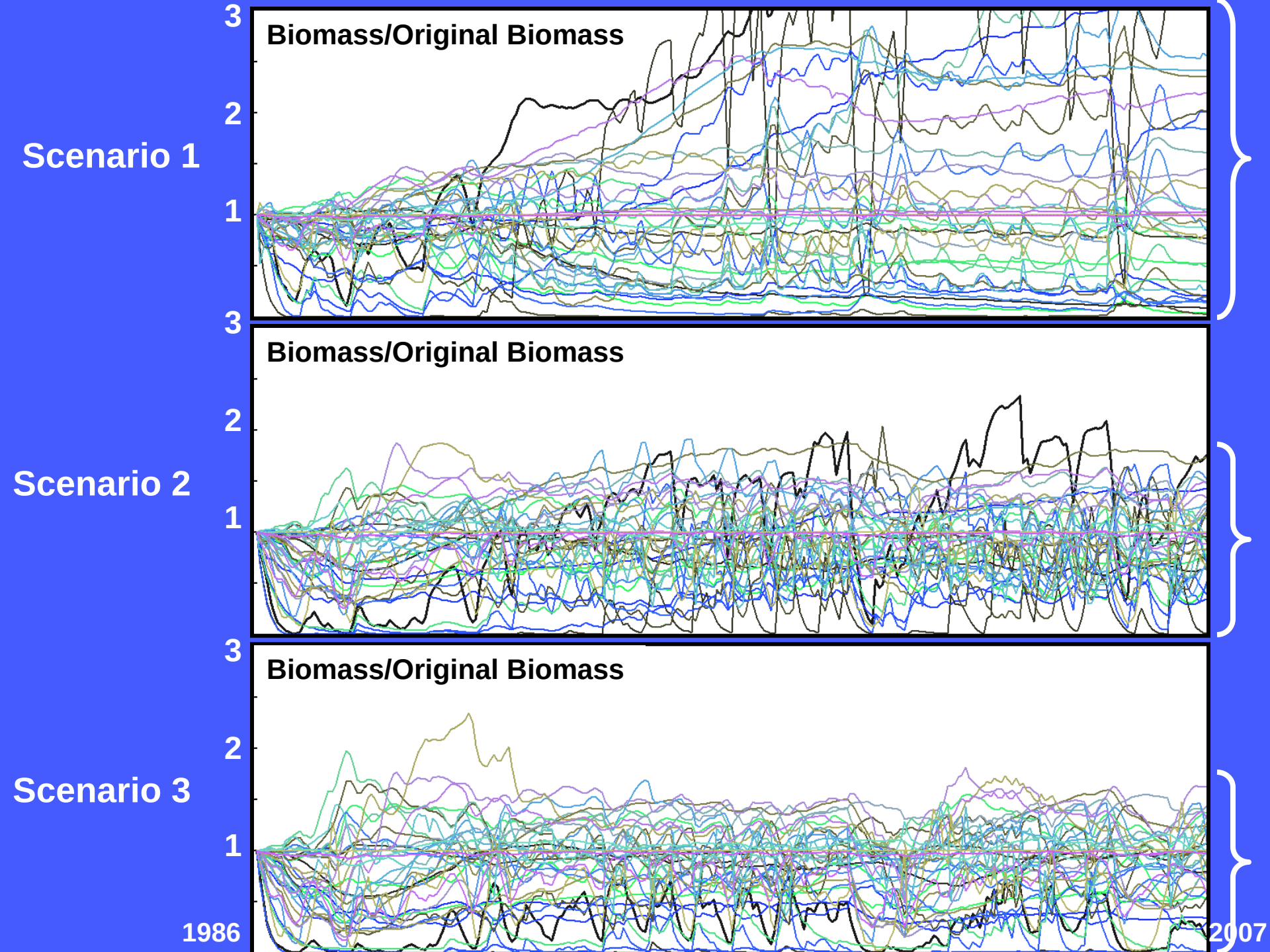


Output: Compare species per scenario

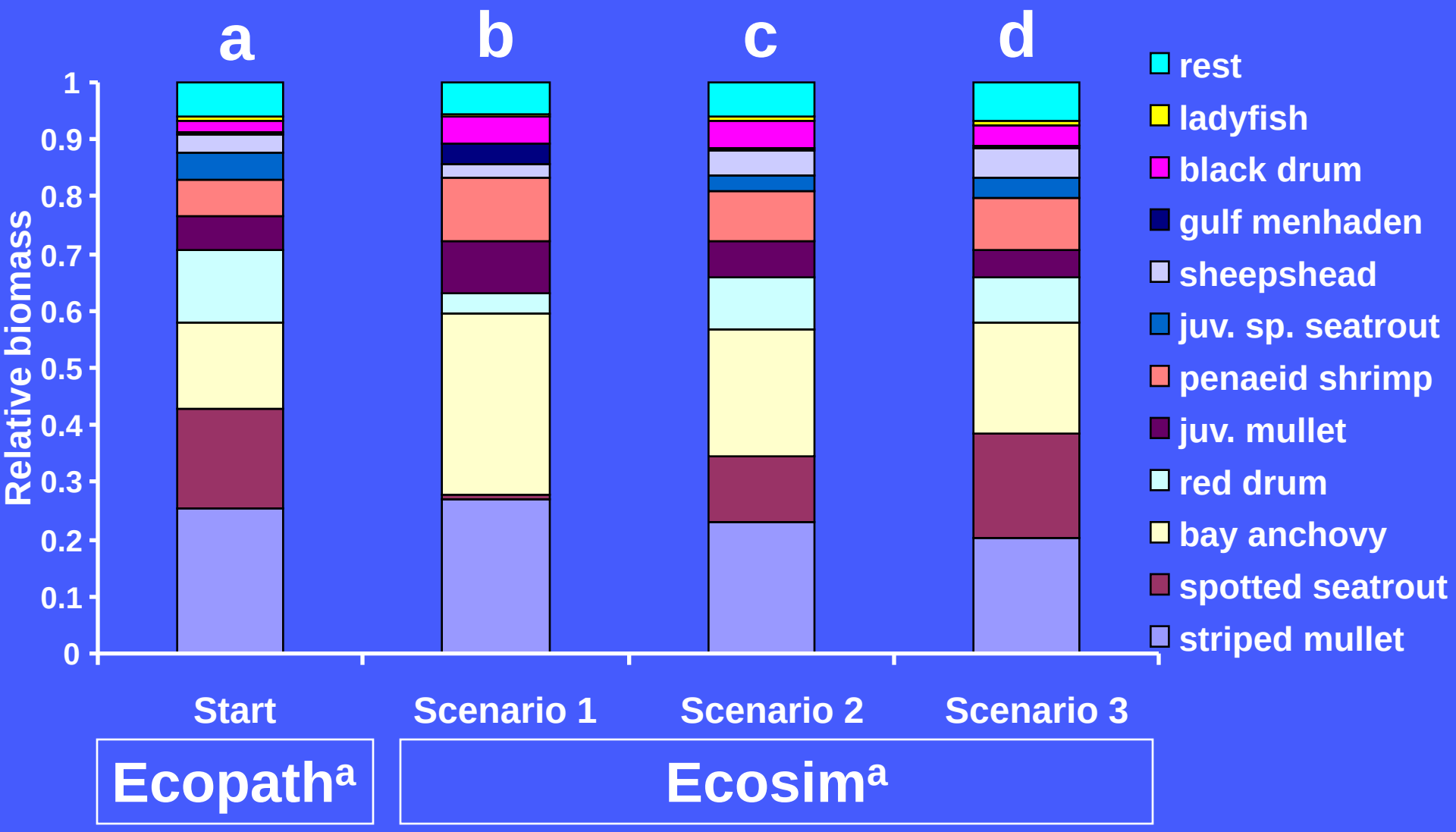


Compare Ecosim with time series data



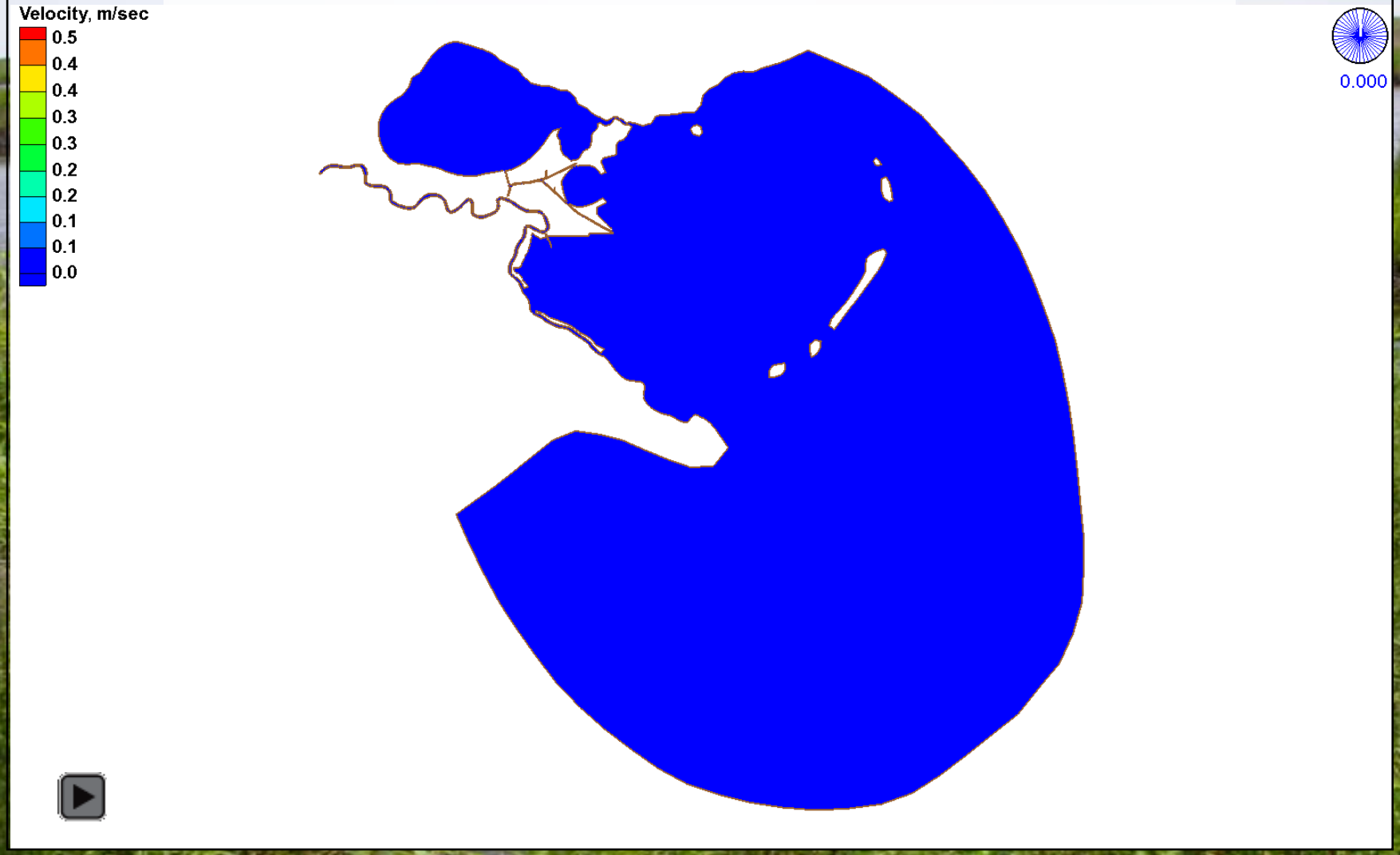

Scenario 1
Biomass/Original Biomass
3
2
1
Scenario 2
Biomass/Original Biomass
3
2
1
Scenario 3
Biomass/Original Biomass
3
2
1
1986
2007

PRIMER results ANOSIM and SIMPER analyses



Future directions

Coupling with/use output from ADH model



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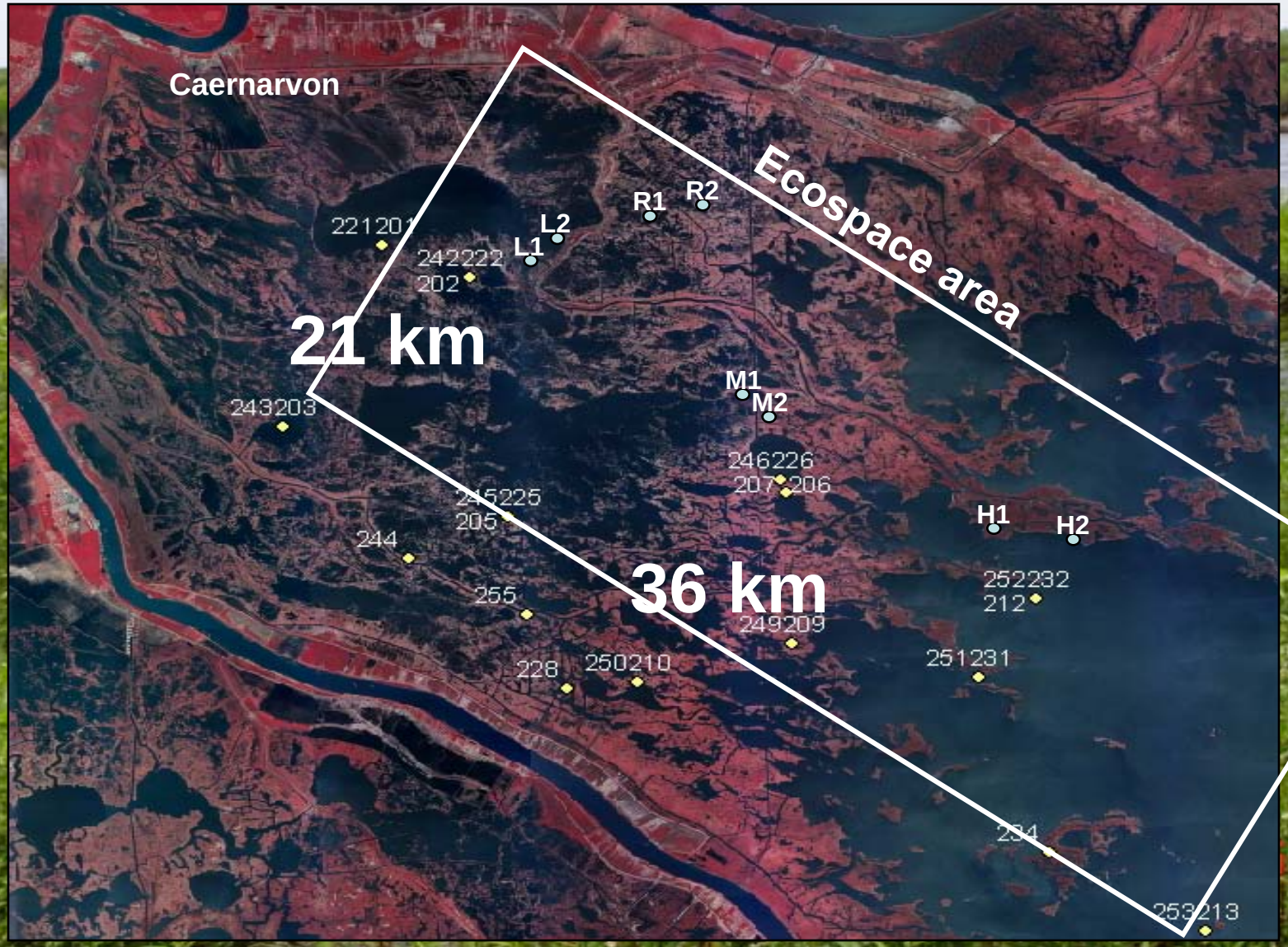
Future directions

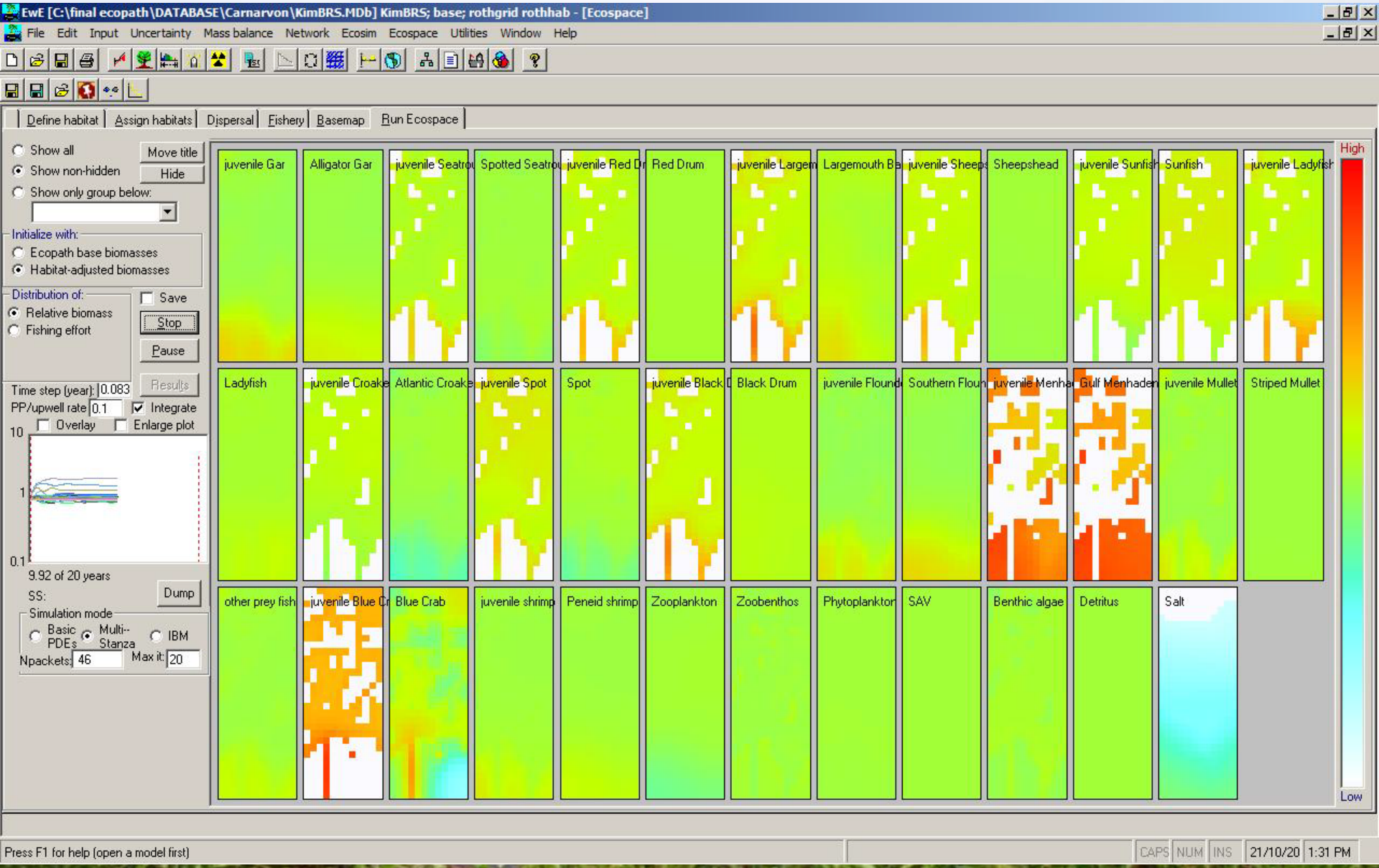
Continue Breton Sound Ecospace model

- Ecospace replicates the foodweb structure in each model grid cell
- 1x1 km cells, 21x36 km grid
- Cells have habitat ‘type’ (dense marsh, open marsh, open water), species use one or more types
- Cells have time dynamic salinity
- Nekton spatial movement dependent on cell habitat type and salinity (each species can decide to stay or move)

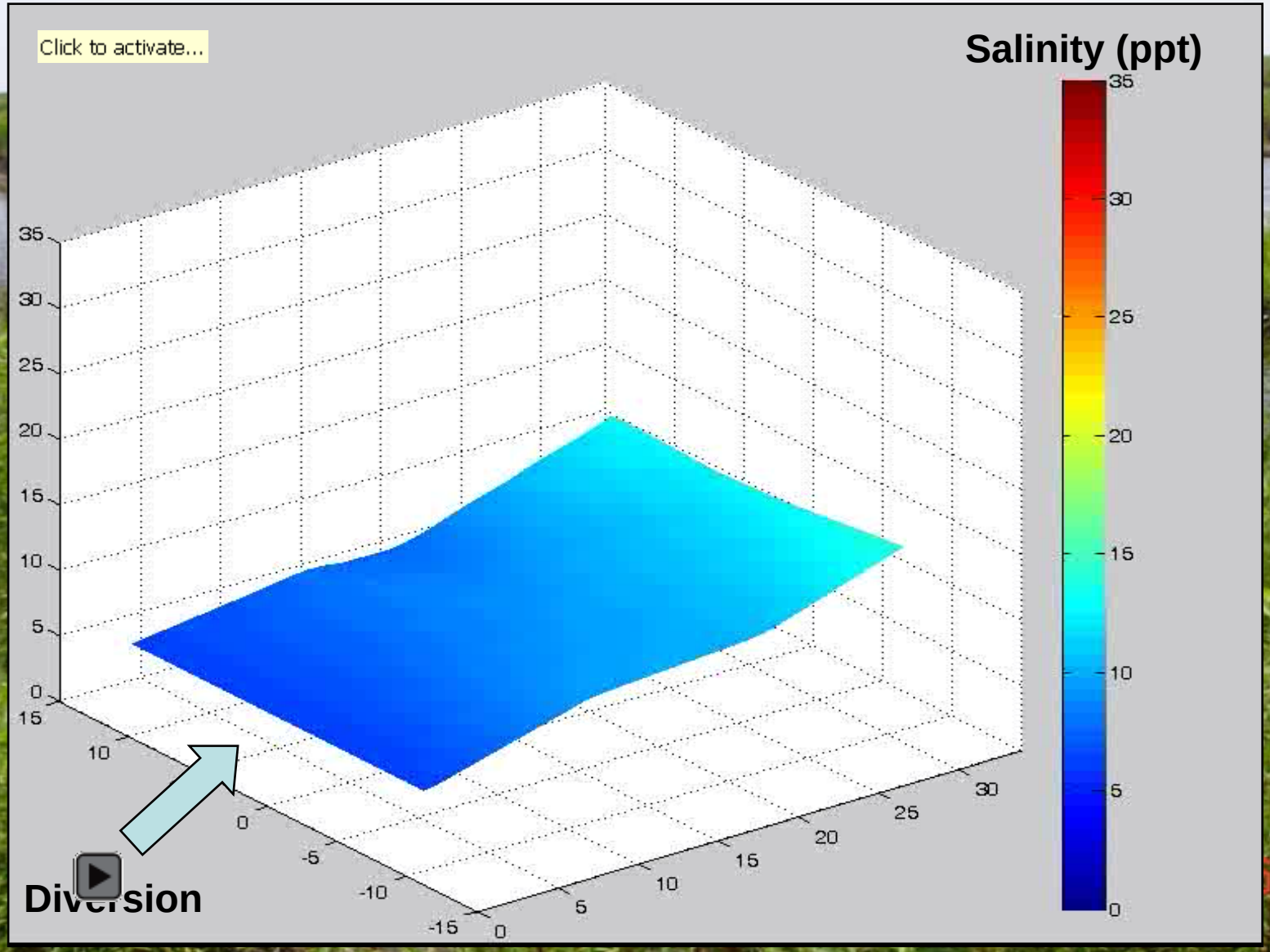
Future directions



Interface

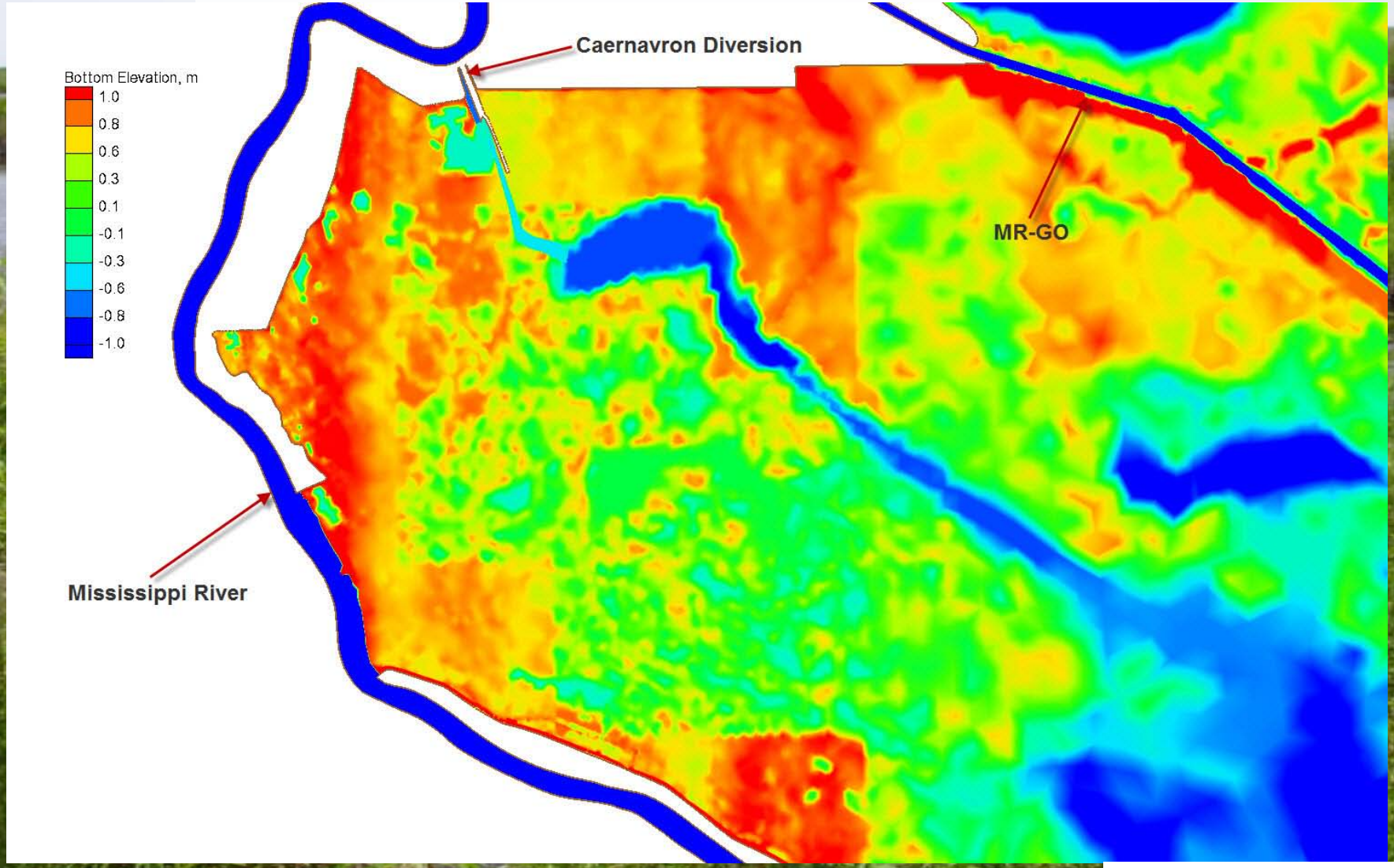

EwE [C:\final ecopath\DATABASE\Carnarvon\KimBRS.MDb] KimBRS; base; rothgrid rothhab - [Ecospace]
File Edit Input Uncertainty Mass balance Network Ecosim Ecospace Utilities Window Help
Define habitat
Assign habitats
Dispersal
Fishery
Basemap
Run Ecospace
Show all
Show non-hidden
Show only group below:
Move title
Hide
Initialize with:
Ecopath base biomasses
Habitat-adjusted biomasses
Distribution of:
Relative biomass
Fishing effort
Save
Stop
Pause
Results
Time step (year): 0.083
PP/upwell rate 0.1
Integrate
Overlay
Enlarge plot
10
1
0.1
9.92 of 20 years
SS:
Dump
Simulation mode
Basic PDEs
Multi-Stanza
IBM
Npackets: 46
Max it: 20
juvenile Gar
Alligator Gar
juvenile Seatrout
Spotted Seatrout
juvenile Red Drum
Red Drum
juvenile Largemouth Bass
Largemouth Bass
juvenile Sheepshead
Sheepshead
juvenile Sunfish
Sunfish
juvenile Ladyfish
Ladyfish
juvenile Croaker
Atlantic Croaker
juvenile Spot
Spot
juvenile Black Drum
Black Drum
juvenile Flounder
Southern Flounder
juvenile Menhaden
Gulf Menhaden
juvenile Mullet
Striped Mullet
other prey fish
juvenile Blue Crab
Blue Crab
juvenile shrimp
Peneid shrimp
Zooplankton
Zoobenthos
Phytoplankton
SAV
Benthic algae
Detritus
Salt
High
Low
Press F1 for help (open a model first)
CAPS NUM INS 21/10/20 1:31 PM

Future directions



Future directions

Improve habitat map (Bathymetry/GIS)



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Questions?

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