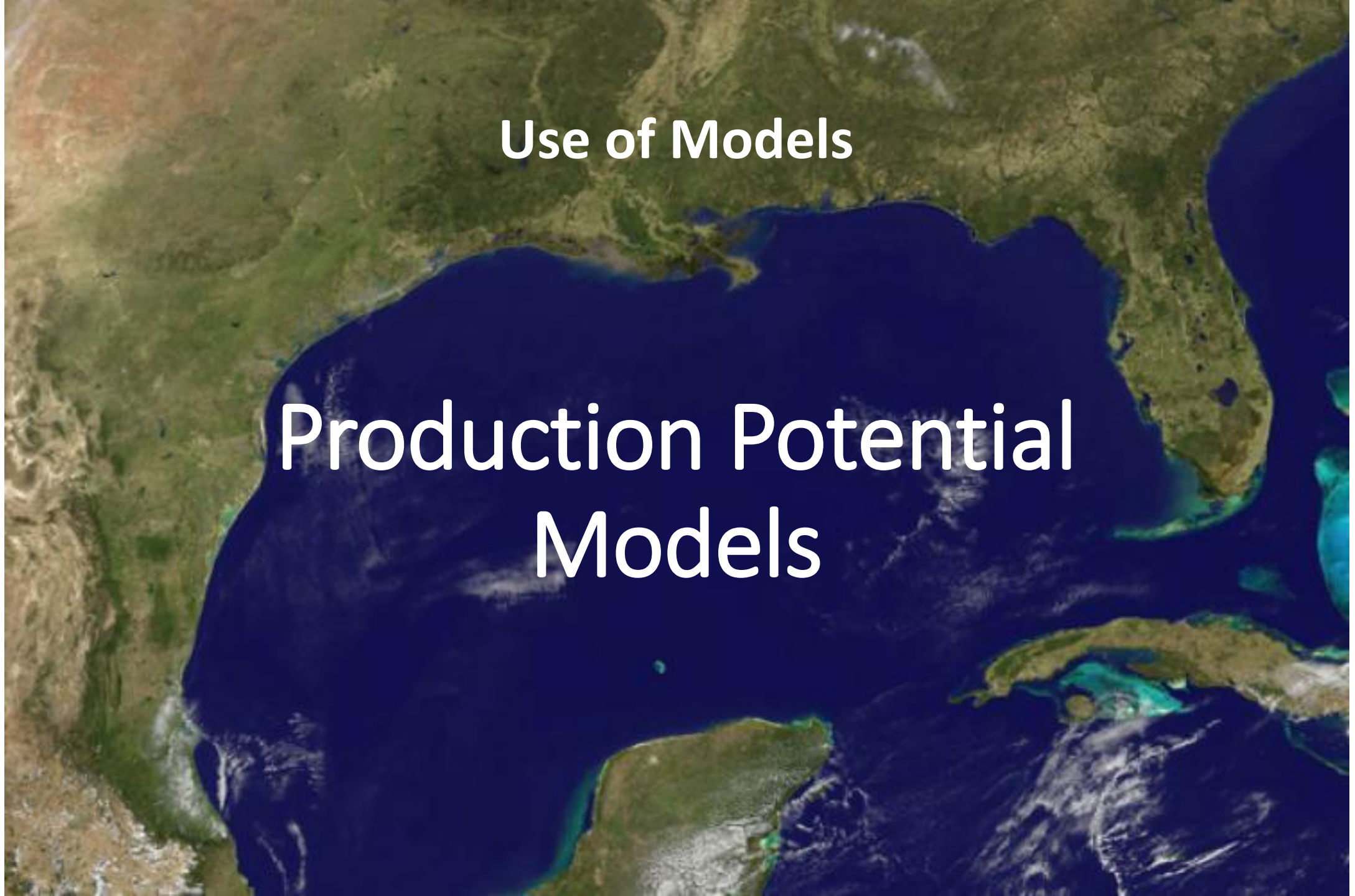
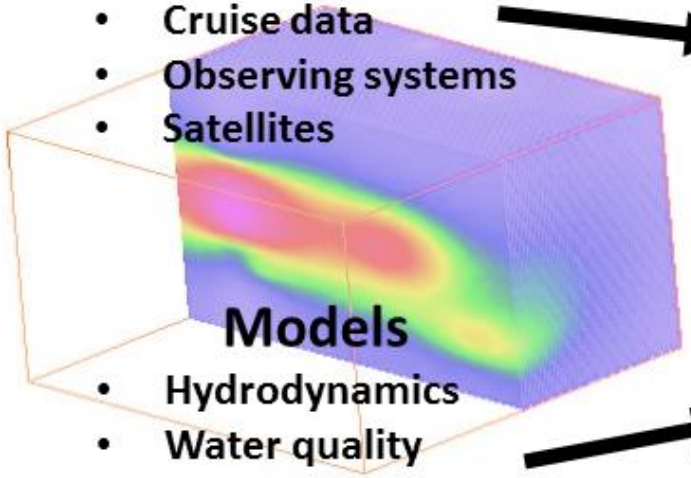

Use of Models
Production Potential Models

Drivers

Observations

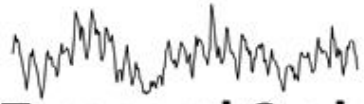
- Cruise data
- Observing systems
- Satellites



Models

- Hydrodynamics
- Water quality
- Food web

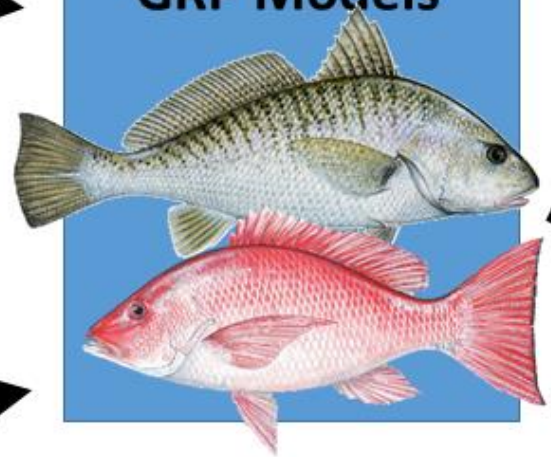
Products

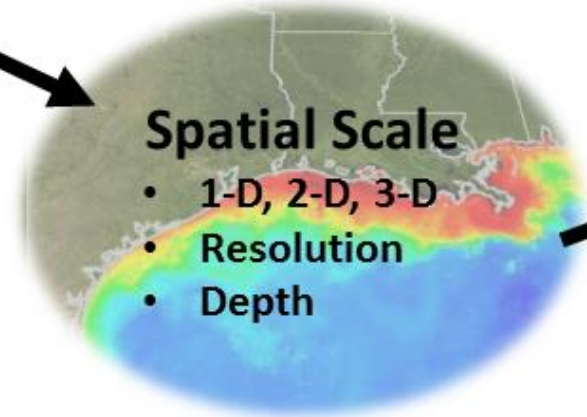


Temporal Scale

- Daily
- Seasonal
- Yearly

GRP Models



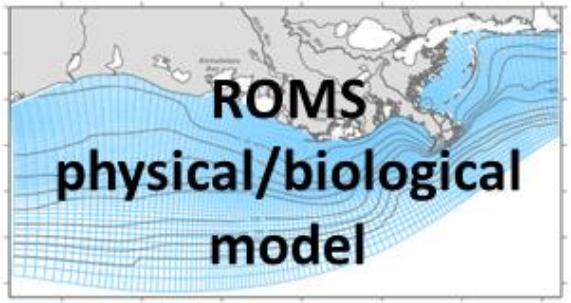


Spatial Scale

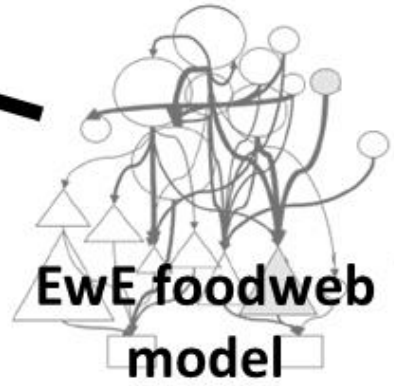
- 1-D, 2-D, 3-D
- Resolution
- Depth

Habitat Quality Indices

- Mean/max
- % change
- Volume/area

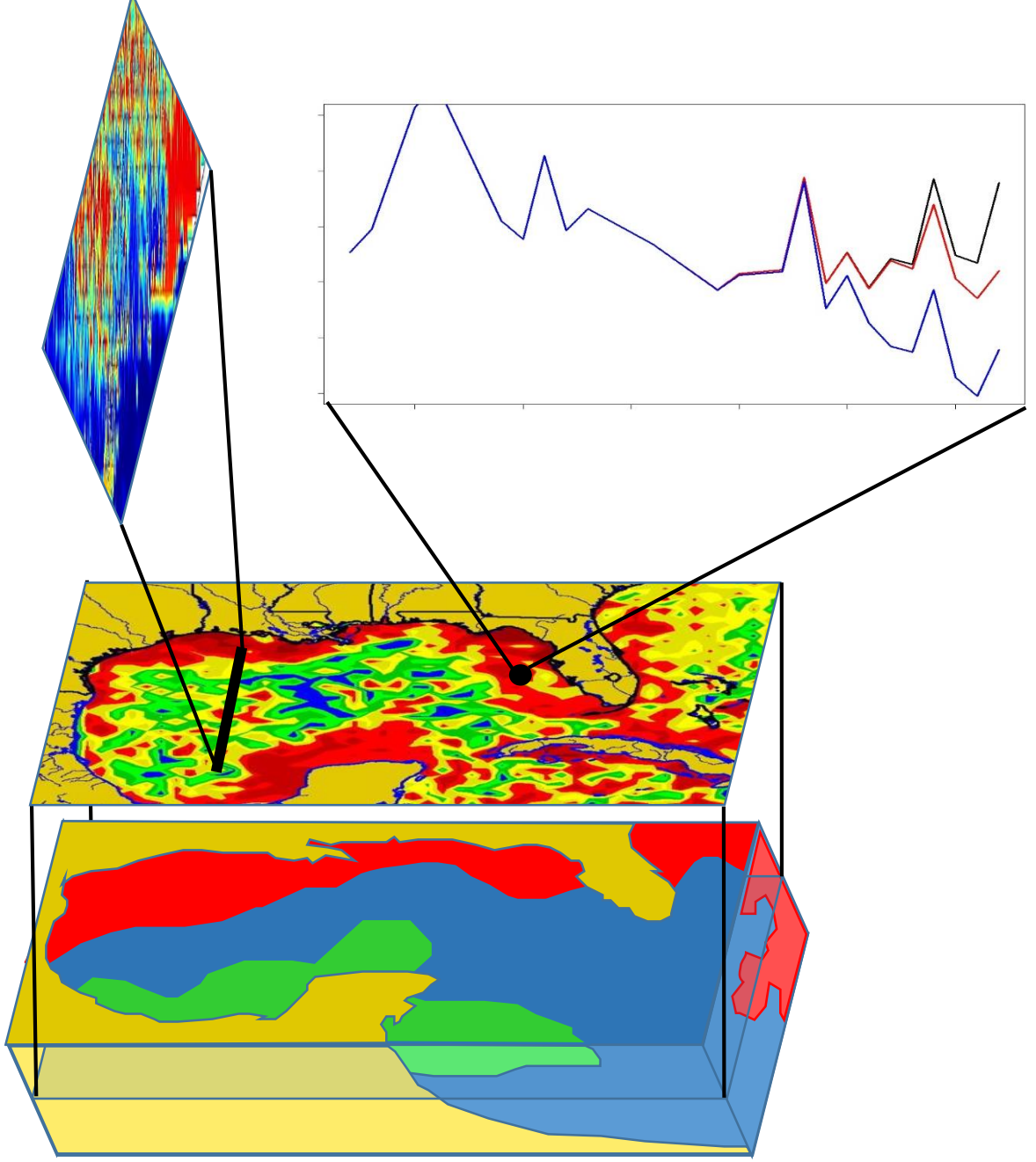


ROMS physical/biological model



EwE foodweb model

Fish size & production
Habitat suitability



Tools & Products

- Parameterized and validated habitat models for ~ 6 -10 species
- Quantitative habitat maps and annual production potential
  - Data Driven
  - Model driven with Nutrient loading scenarios
- Spatial/temporal indices of fish habitat quality and production

- Model Development
- Data Drivers
- Linkage of models
- Tools

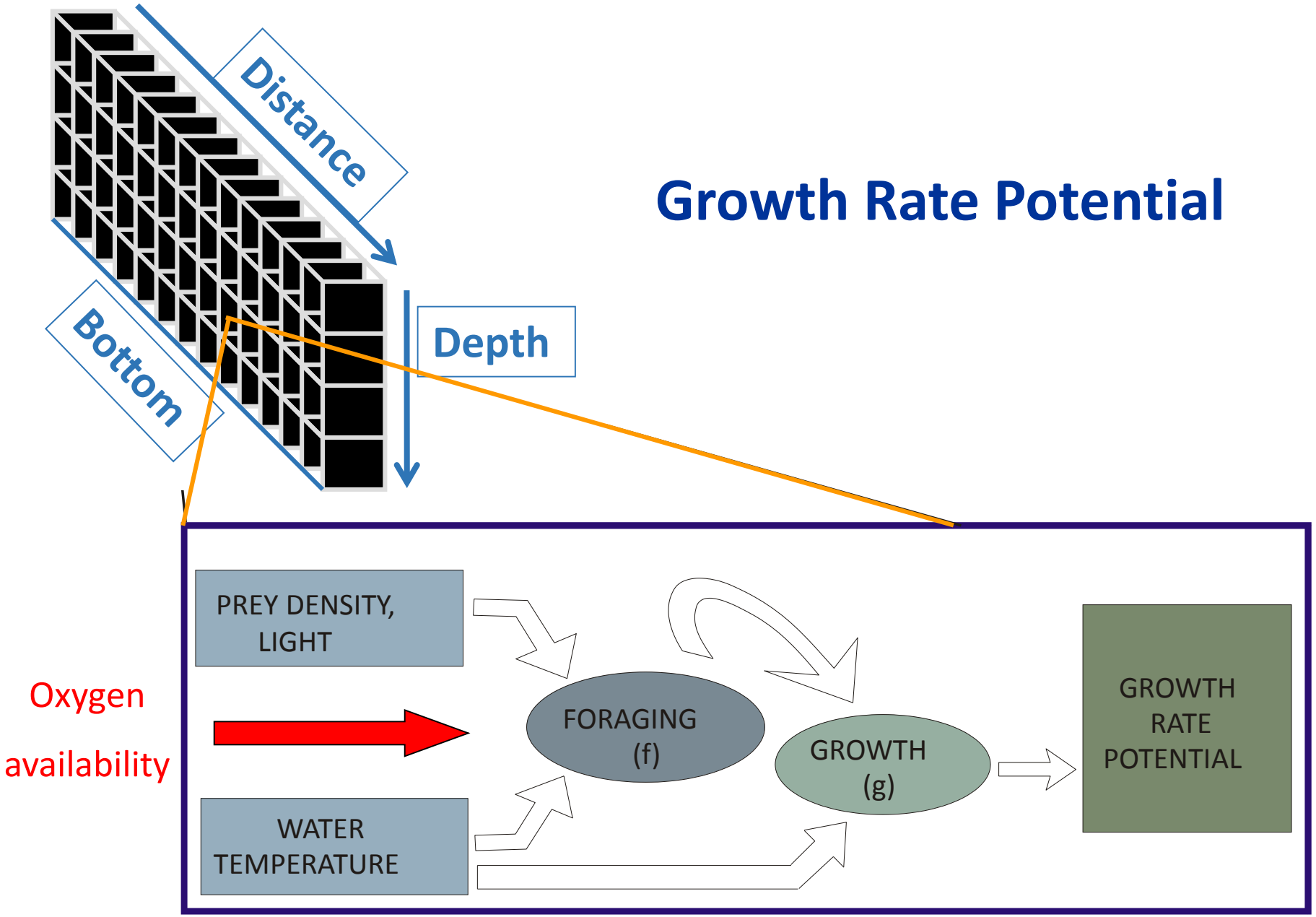
Cynthia Sellinger

Cassie Glaspie

Habitat Quality = Growth Rate Potential

- Expected daily growth rate of a fish if placed in a volume of water with known conditions such as prey size and density, temperature, oxygen and light

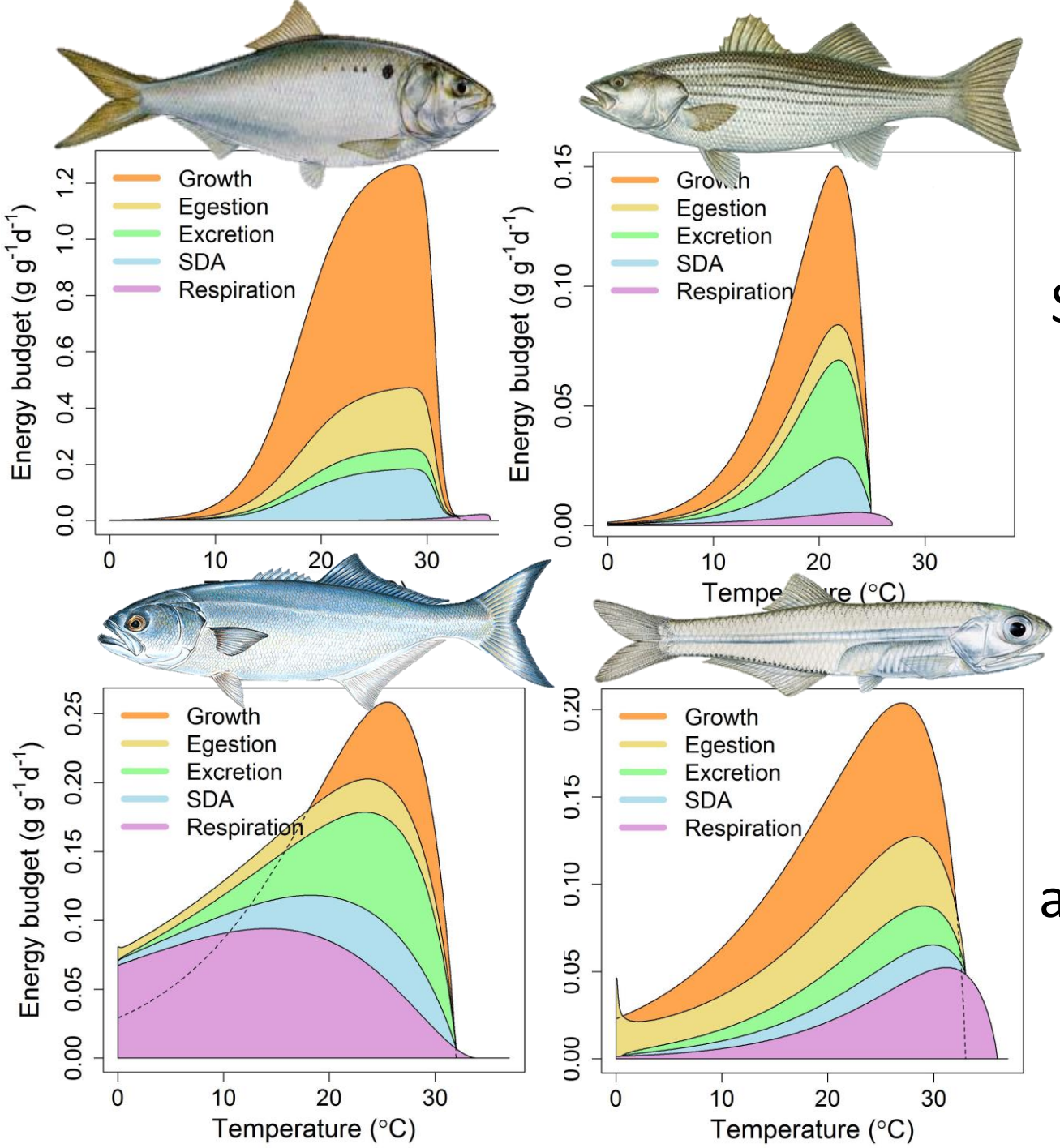
Growth Rate Potential



- Bioenergetics for ~10 species
  - 4 previously created
  - ~6 new for this project
- GRP on observations
  - CTD, XBT, and PFL casts between 1922 and 2015
  - Yearly or monthly
- GRP on ROMS model output
  - Daily, for each cell

Prior GRP models

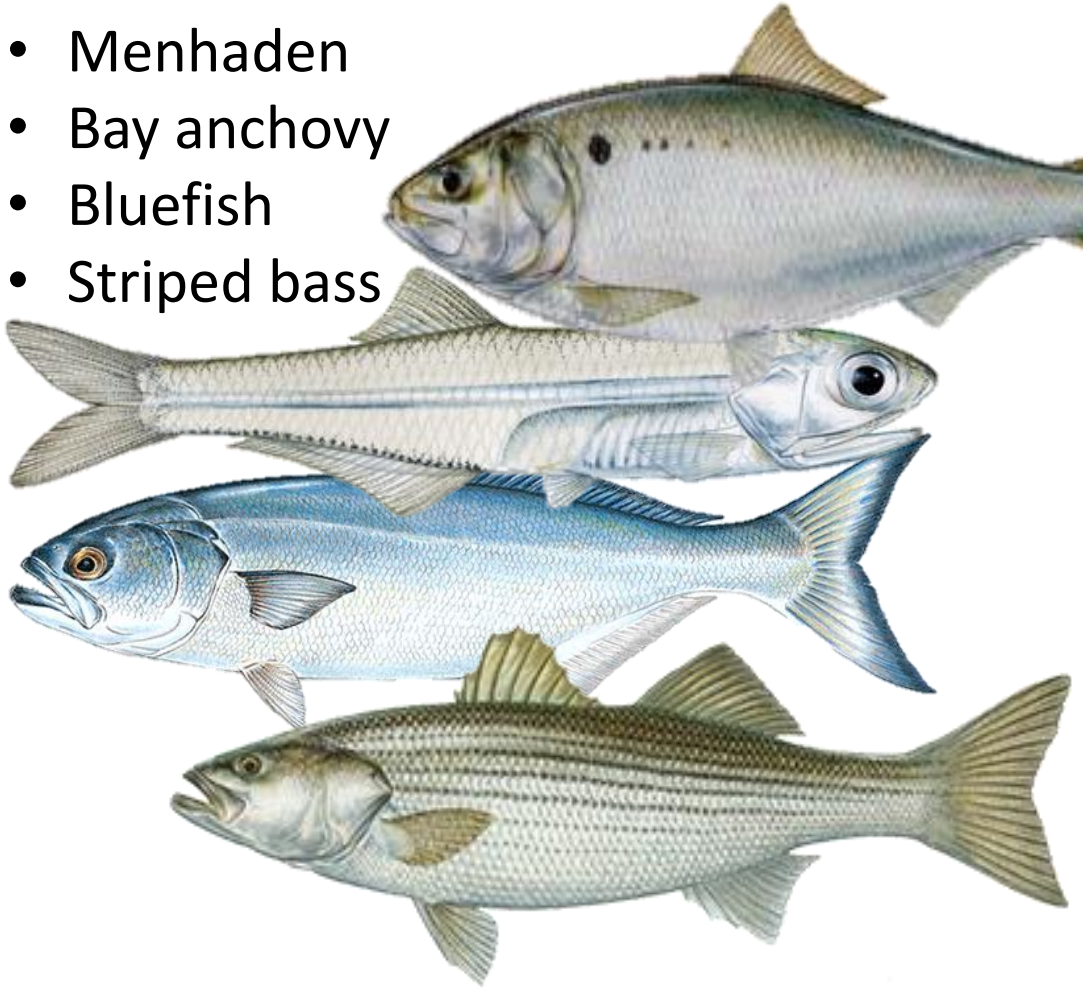
- Models tested and published
- Consumption also varies with DO



Next Steps: Better Coverage of the Food Web

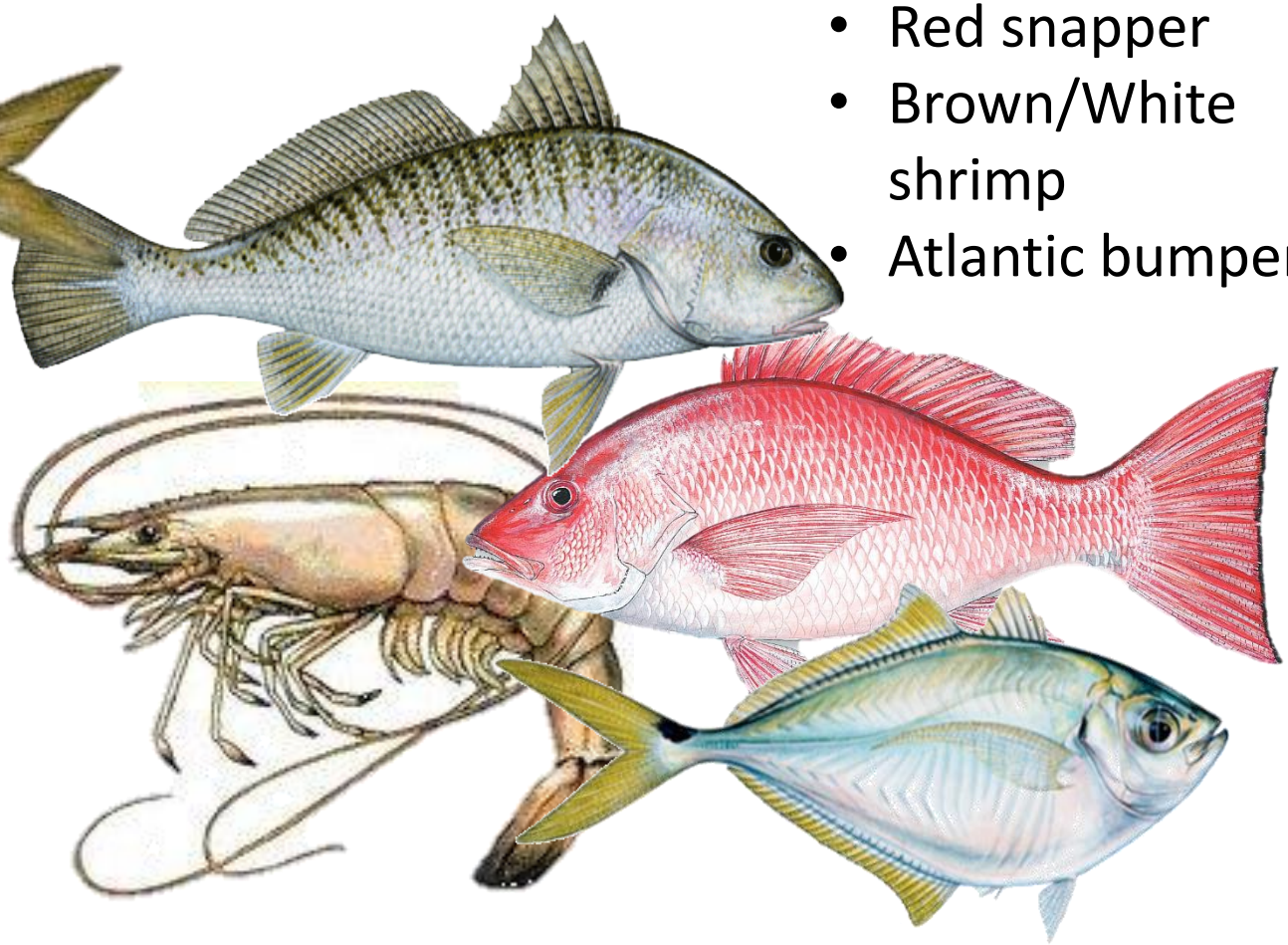
Current models

- Menhaden
- Bay anchovy
- Bluefish
- Striped bass



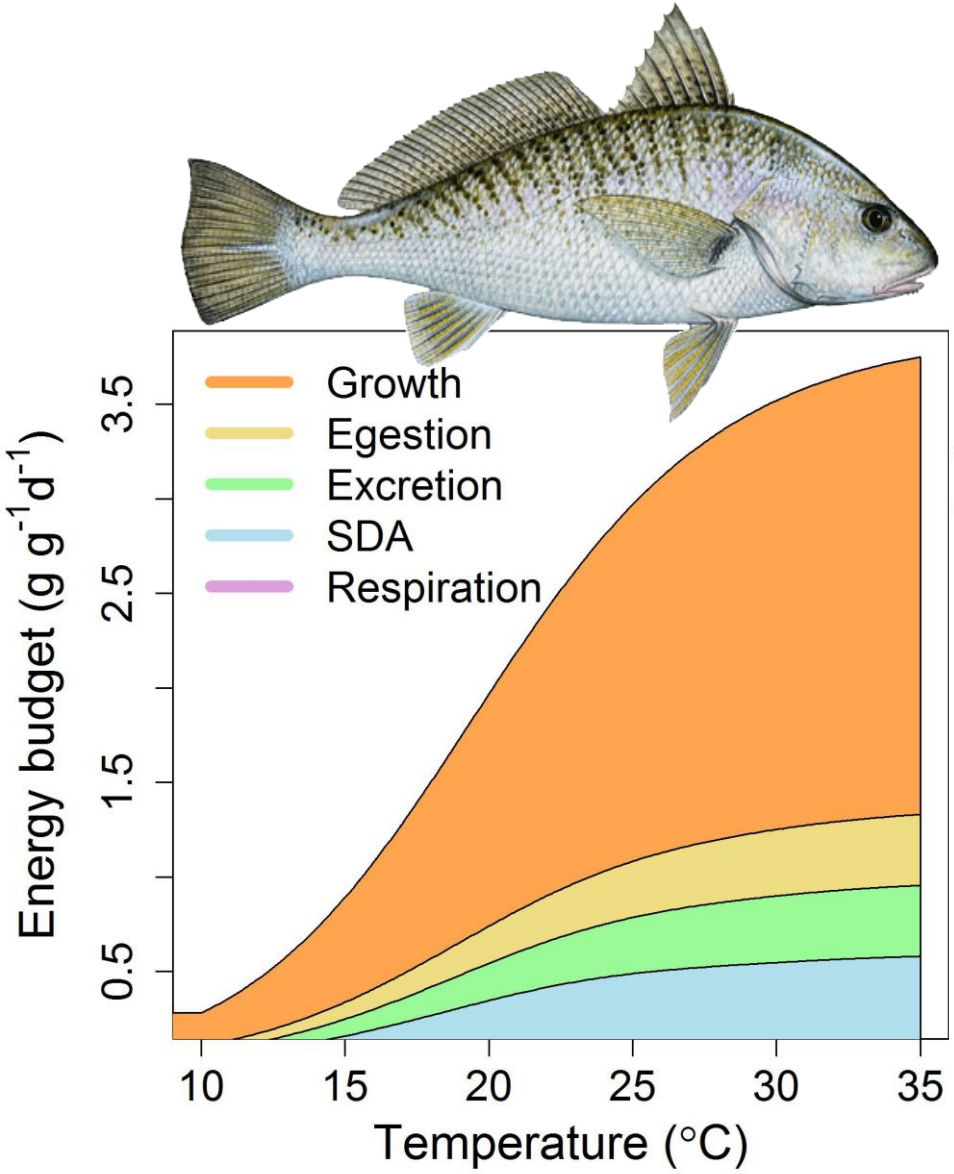
Potential new species

- Atlantic croaker
- Red snapper
- Brown/White shrimp
- Atlantic bumper

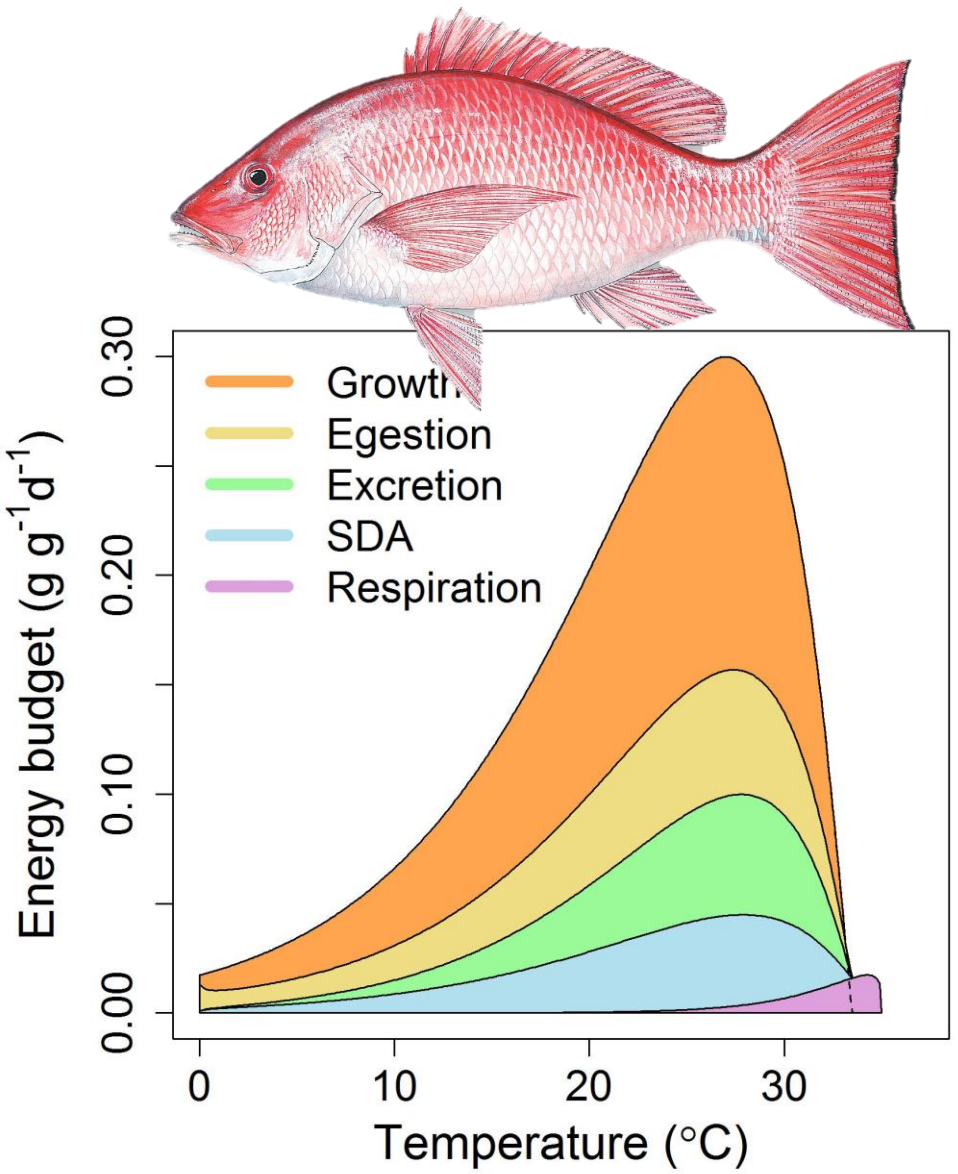


New GRP models

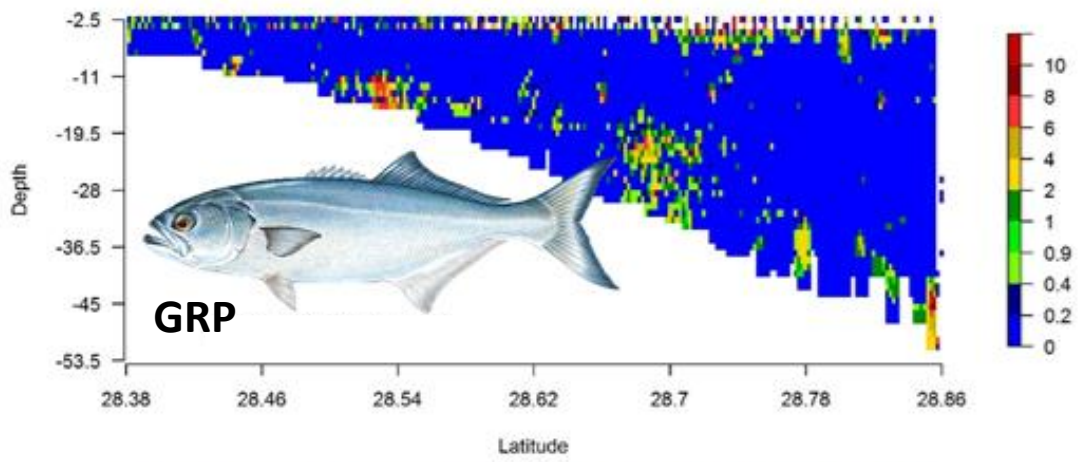
- Collaborated with Kenny Rose to create croaker model
  - Will allow comparisons between model approaches

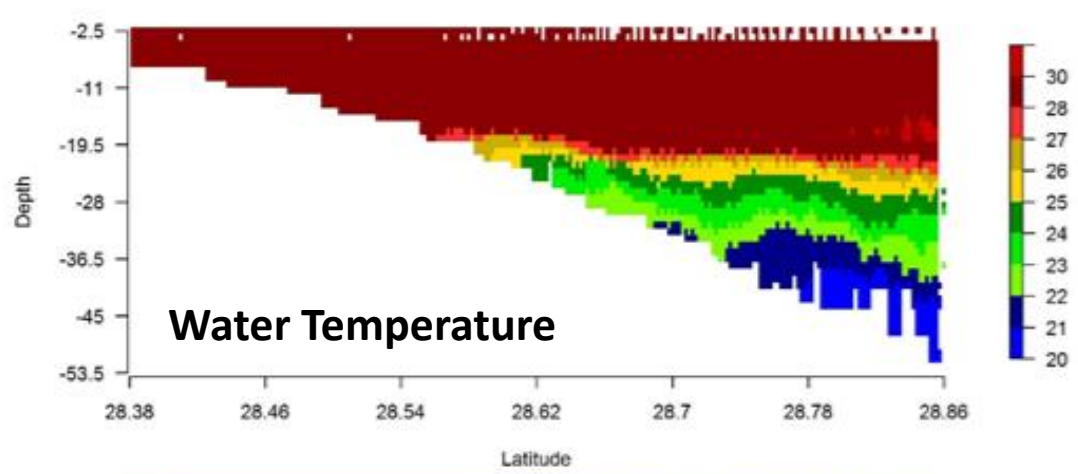


Atlantic croaker



Red snapper


GRP
Depth
Latitude
-2.5
-11
-19.5
-28
-36.5
-45
-53.5
28.38
28.46
28.54
28.62
28.7
28.78
28.86
10
8
6
4
2
1
0.9
0.4
0.2
0


Water Temperature
Depth
Latitude
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-11
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-28
-36.5
-45
-53.5
28.38
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28.54
28.62
28.7
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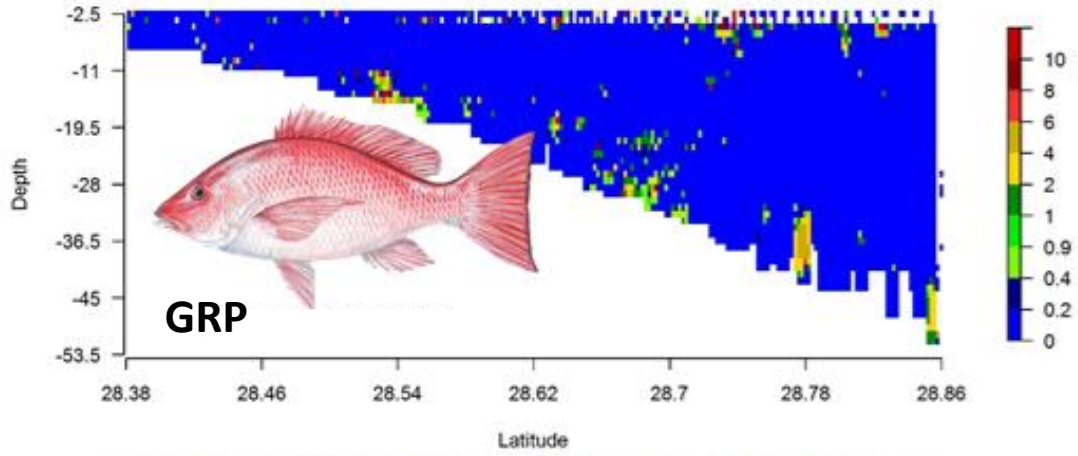
28.86
30
28
27
26
25
24
23
22
21
20


GRP
Depth
Latitude
-2.5
-11
-19.5
-28
-36.5
-45
-53.5
28.38
28.46
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28.62
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10
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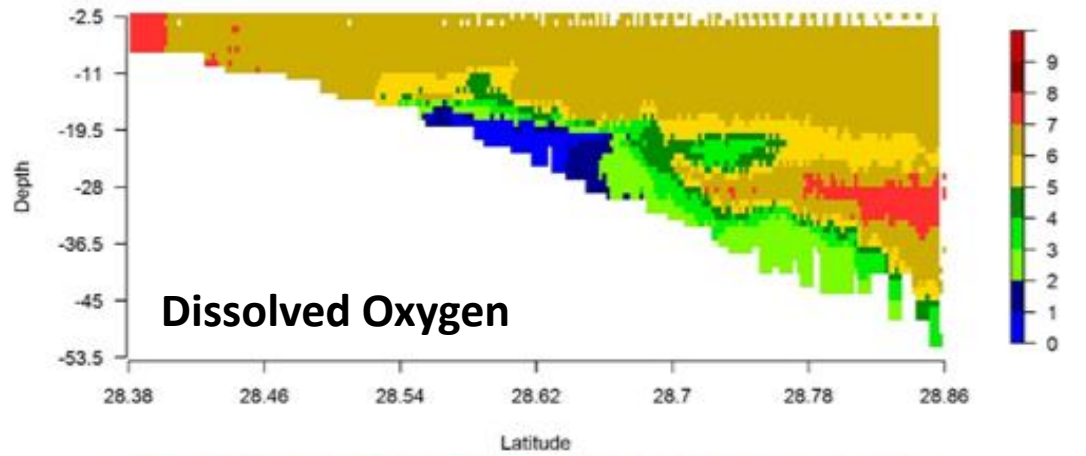
Dissolved Oxygen
Depth
Latitude
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-11
-19.5
-28
-36.5
-45
-53.5
28.38
28.46
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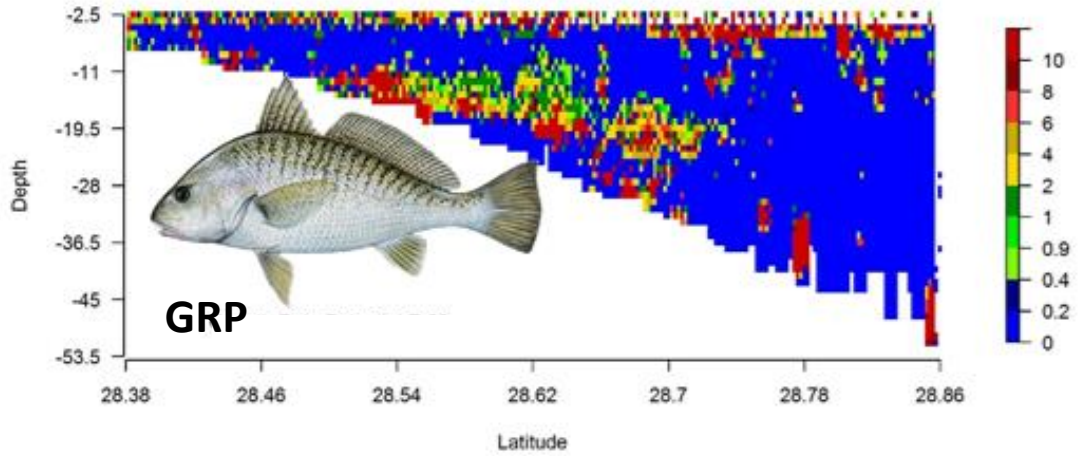
28.7
28.78
28.86
9
8
7
6
5
4
3
2
1
0


GRP
Depth
Latitude
-2.5
-11
-19.5
-28
-36.5
-45
-53.5
28.38
28.46
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28.7
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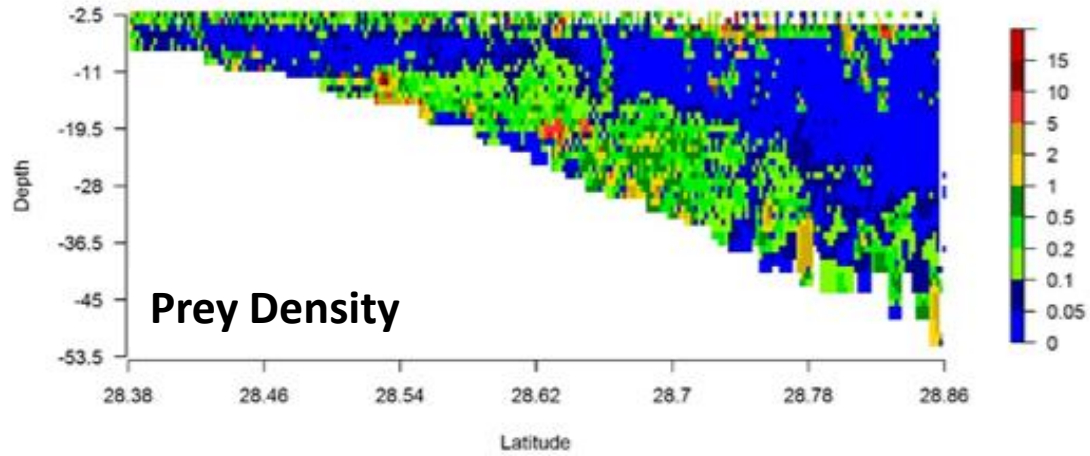
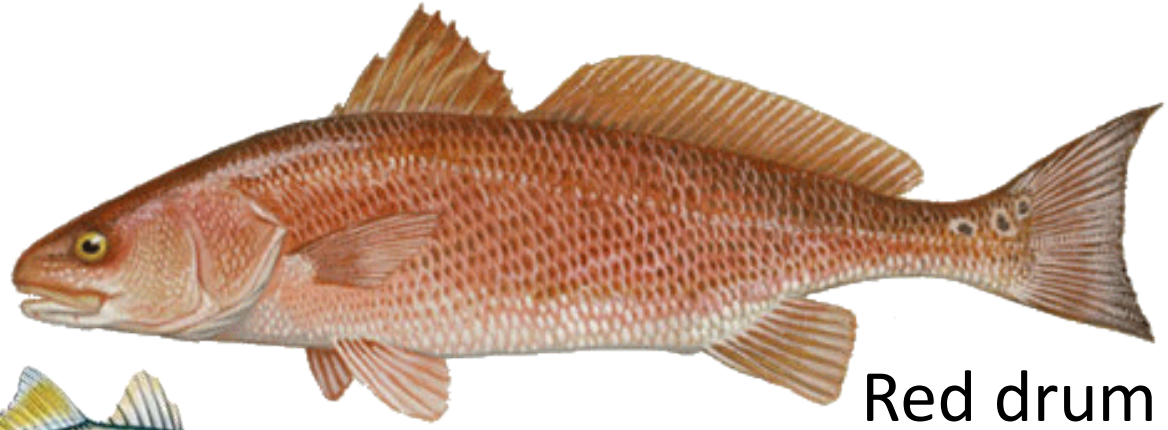
6
4
2
1
0.9
0.4
0.2
0


Prey Density
Depth
Latitude
-2.5
-11
-19.5
-28
-36.5
-45
-53.5
28.38
28.46
28.54
28.62
28.7
28.78
28.86
15
10
5
2
1
0.5
0.2
0.1
0.05
0

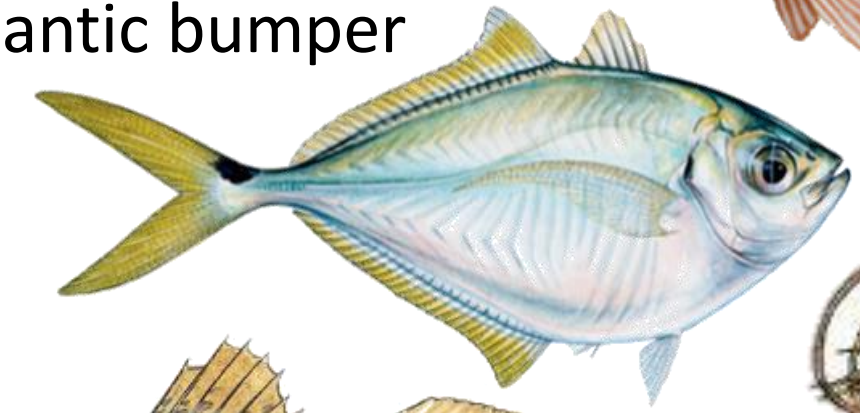
Future models?

- Focus on key species of the region
- Bumper, seatrout, and drum were recommendations from worshop participants

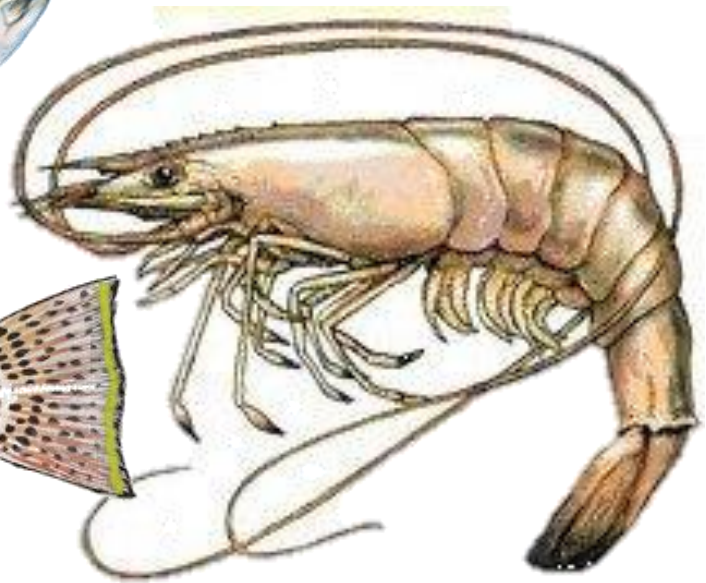


Red drum

Atlantic bumper



Spotted seatrout

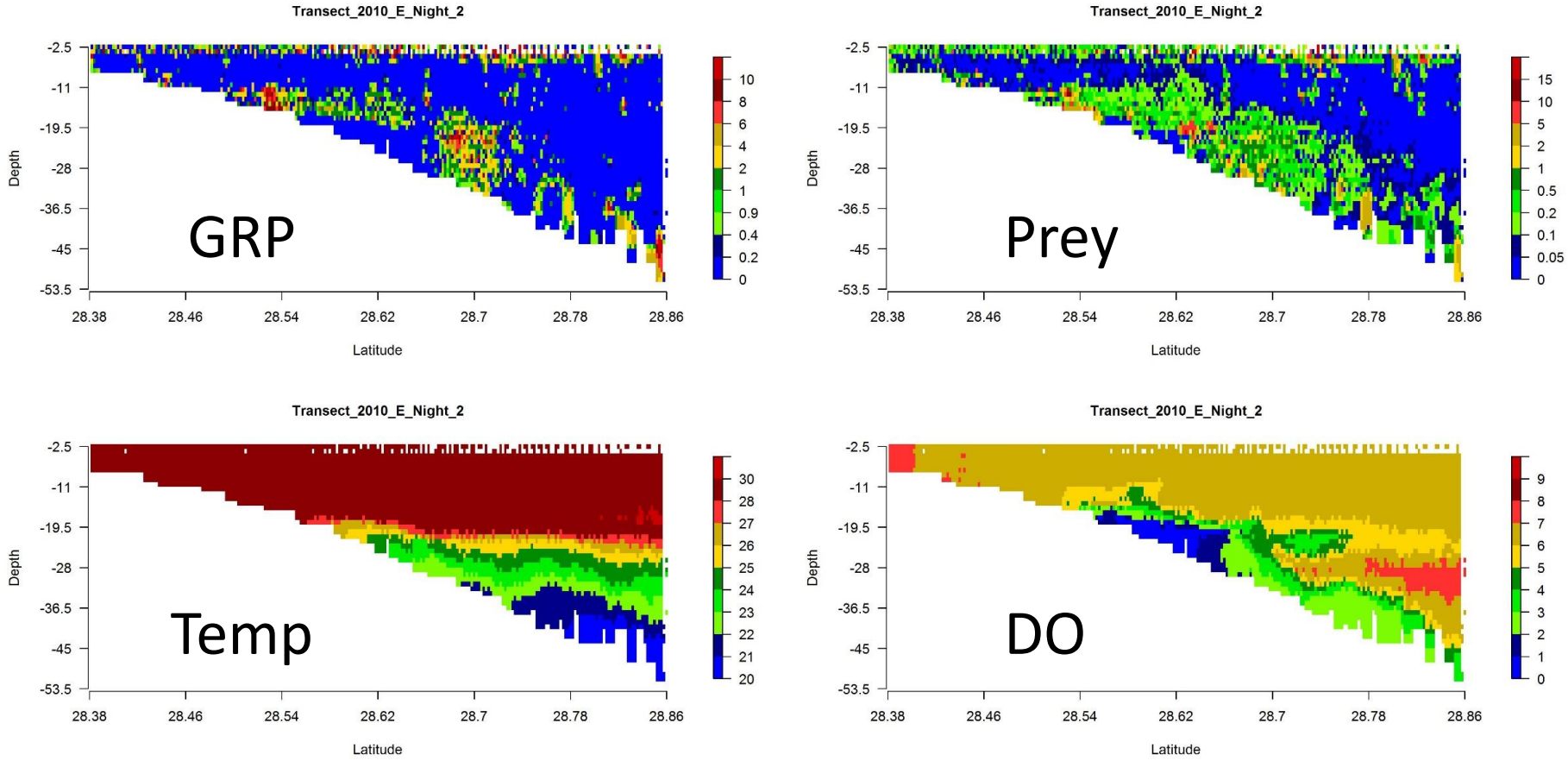


Brown shrimp

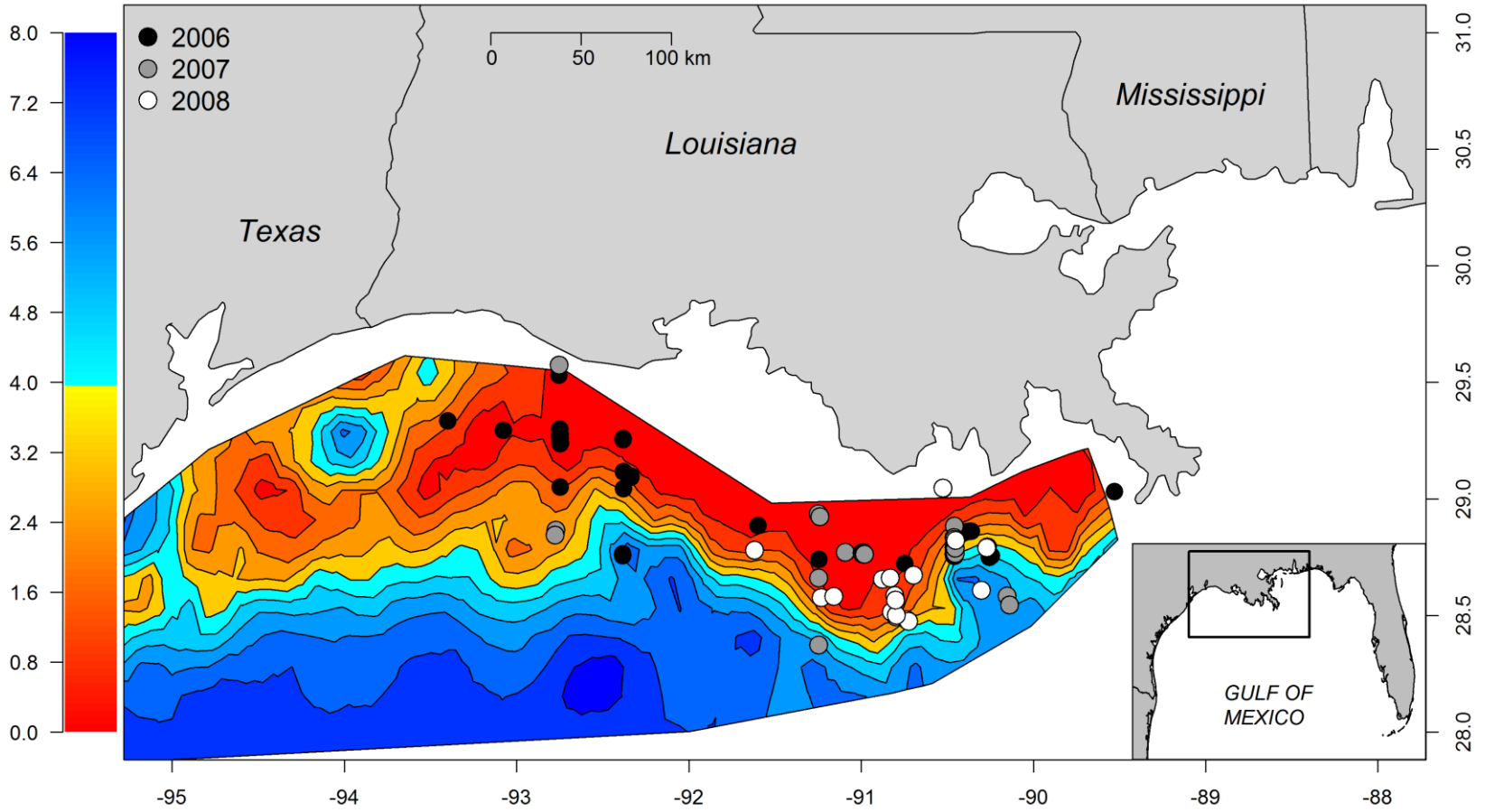
Open source GRP

- Open source version of the GRP model in R
- Anticipated product: R package
- Freely shared
- Adapted to interface with observing systems

Sample output for vertical transects



Improving food web models: fish diet

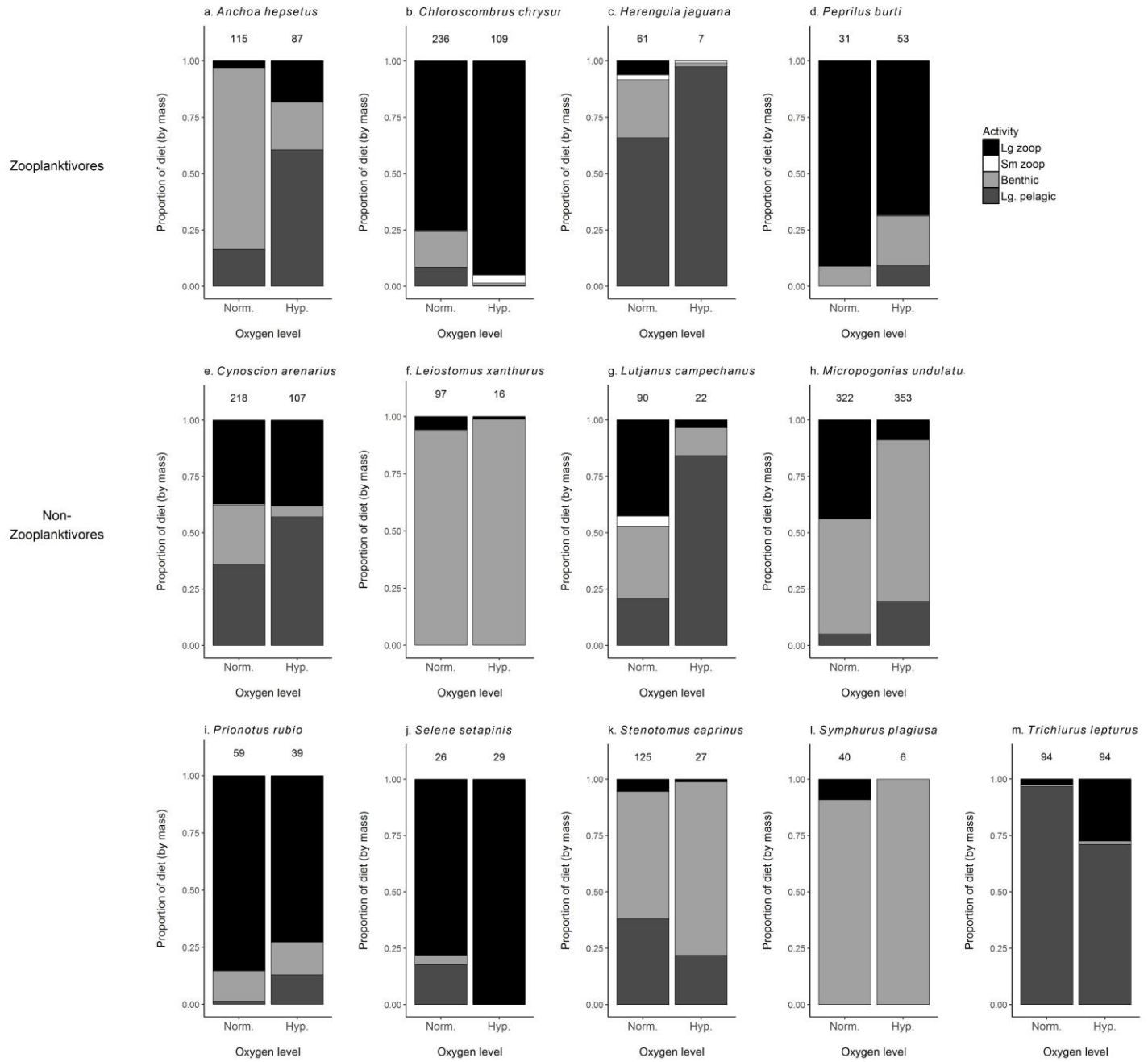


- Location of trawl samples 2006-2008
- Species-specific diet under hypoxic and normoxic conditions

Oxygen contours (mg L^{-1}) for 2008 from SEAMAP

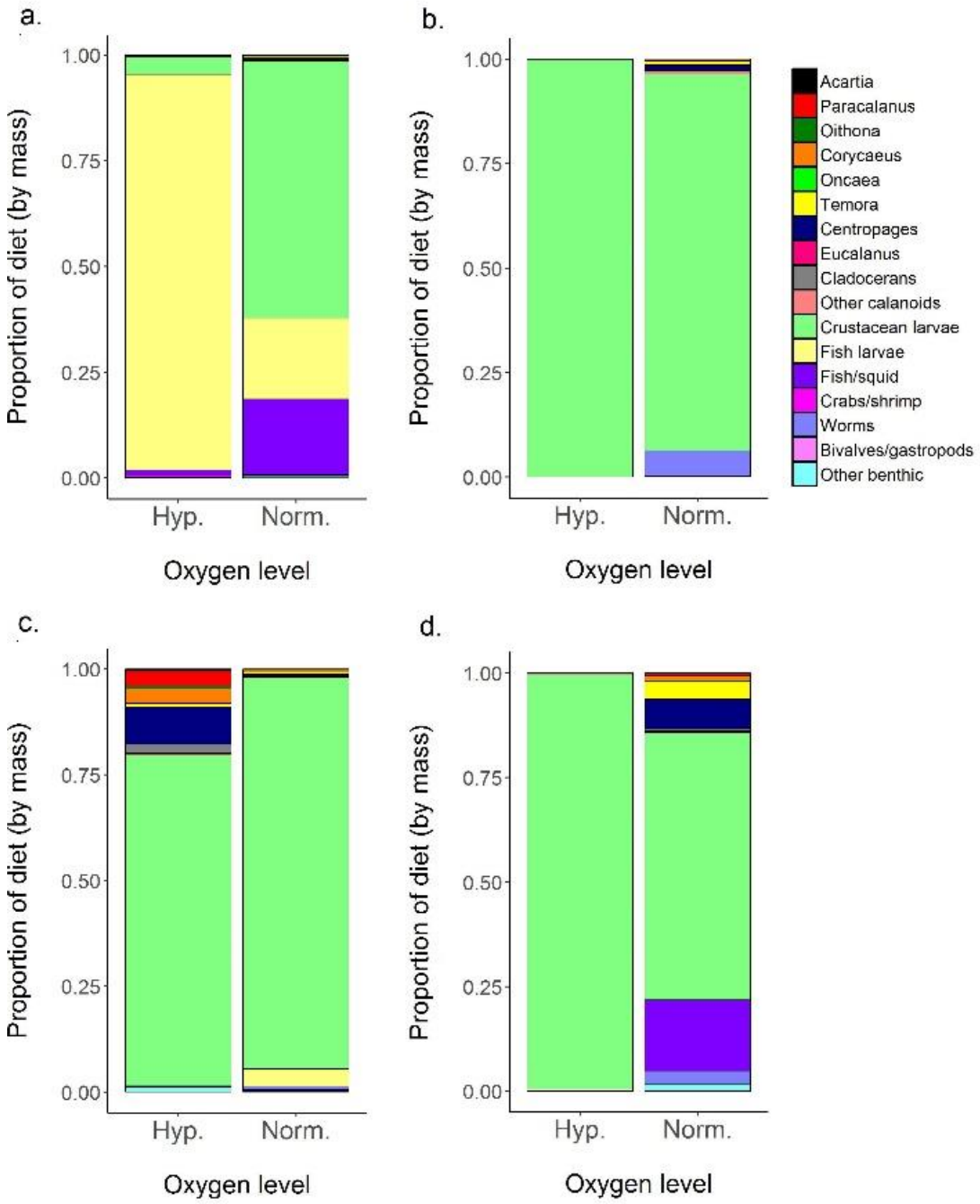
Improving food web models: fish diet

- Diets of fish from hypoxic regions significantly different from diets of fish from normoxic regions
- Fish in hypoxic areas generally consumed more fish and less benthic organisms
- Diet information (n=4,810, 36 species) will facilitate the creation of new GRP models



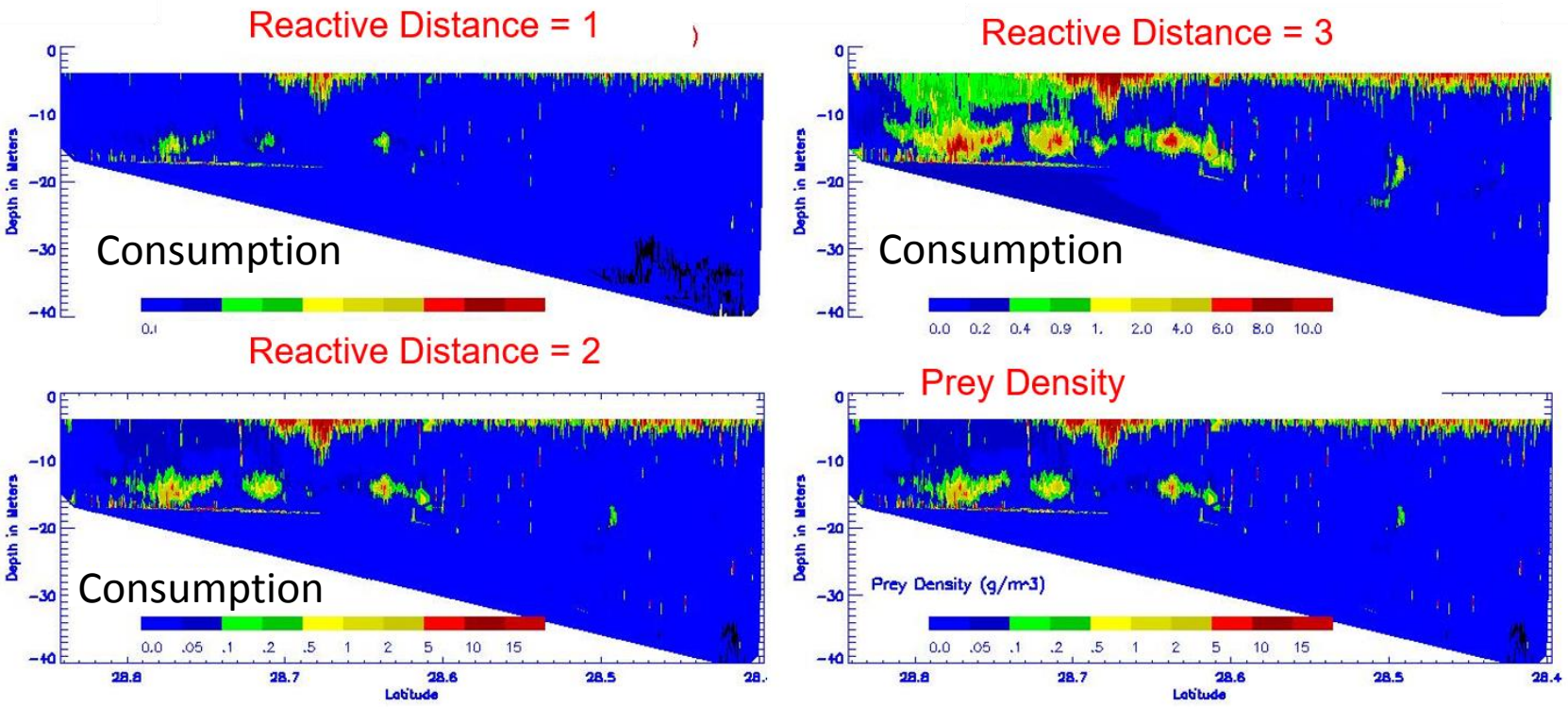
Atlantic bumper diet

- Diet information (n=610) for Atlantic bumper lacking
- Crustacean larvae made up the largest component of diets by mass
- Bumper in hypoxic areas consumed less fish, squid, and worms
- Diet information will be incorporated into bumper GRP model

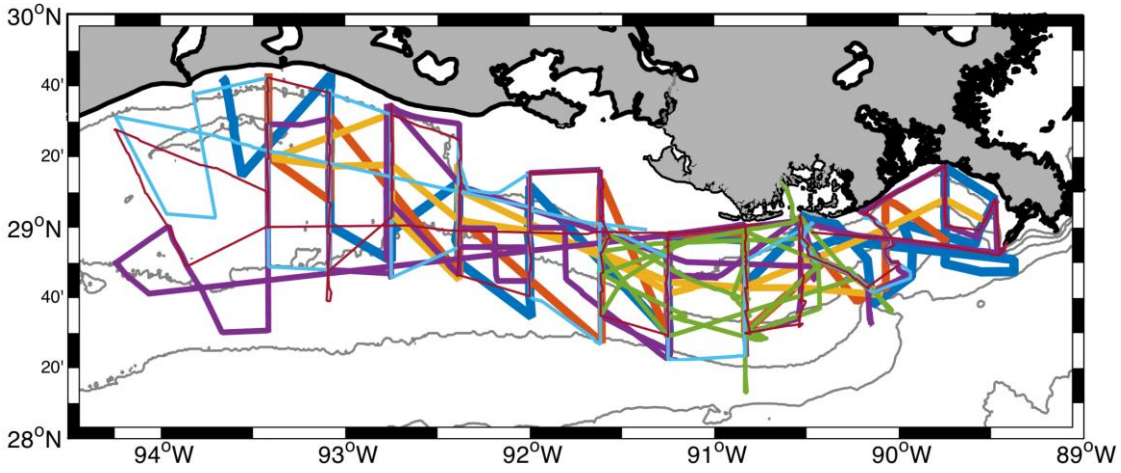


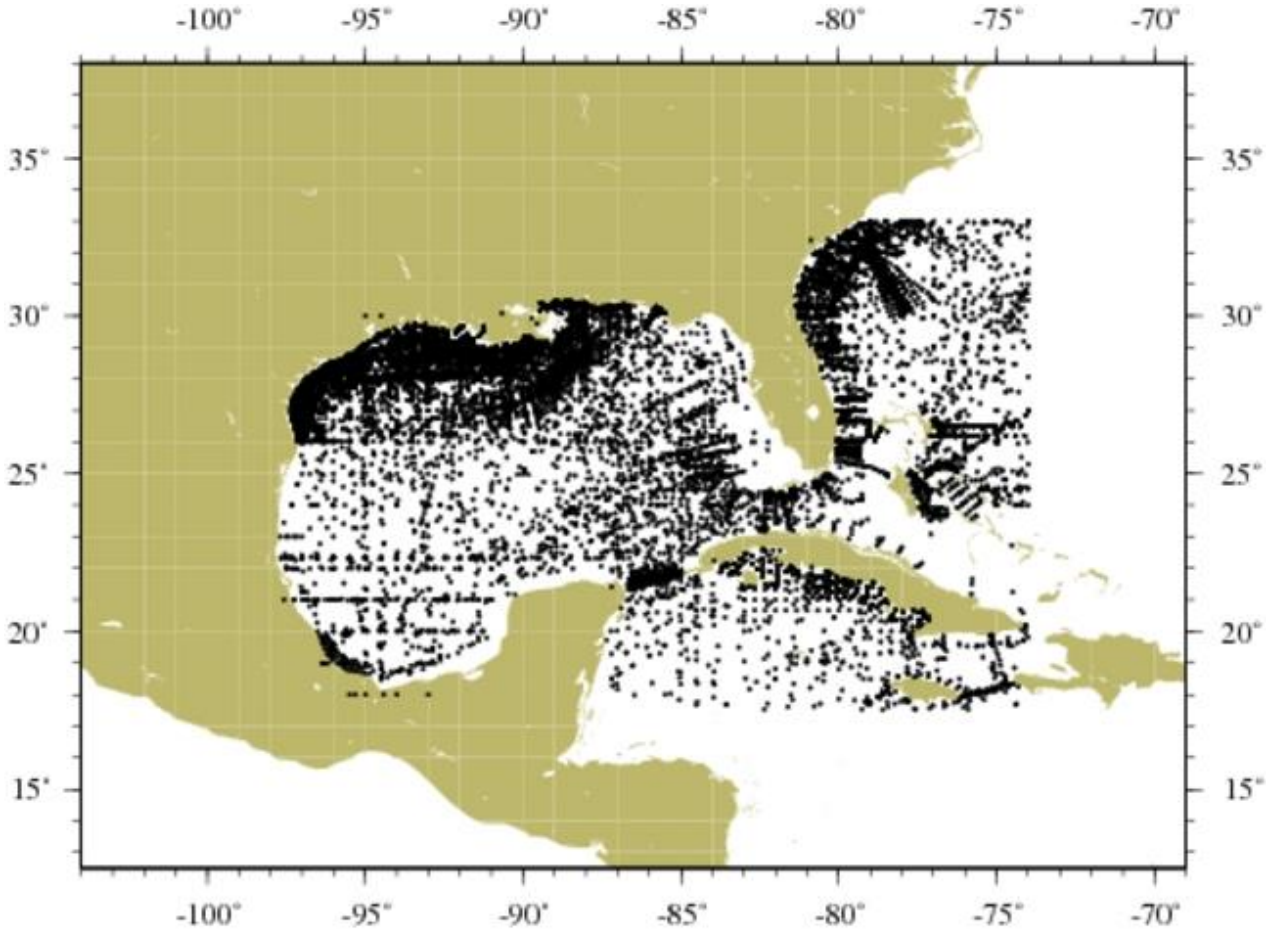
Minimum data needs

- Focused on sensitivity of foraging model
- Reactive distance and swimming speed hard to find
- Low swimming speed = low sensitivity when when prey biomass is very high or low
- Low reactive distance = much lower consumption rates that would result in under-use of prey hotspots



GRP using historical data

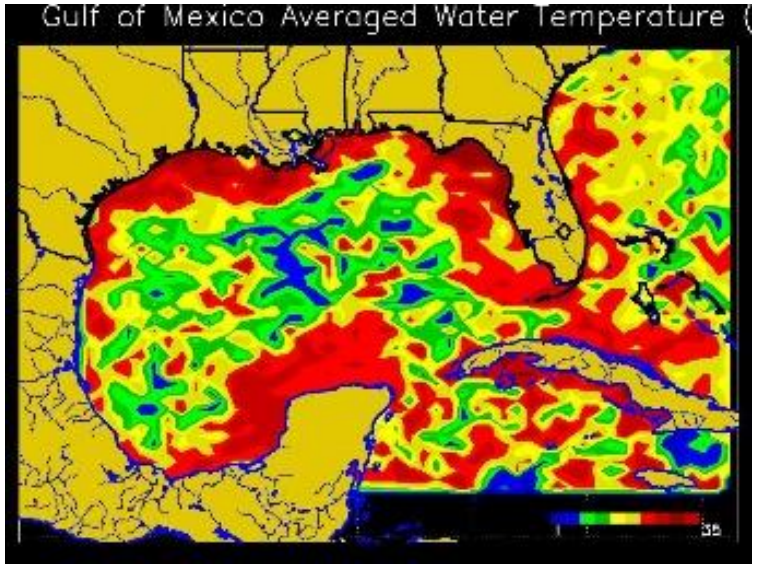


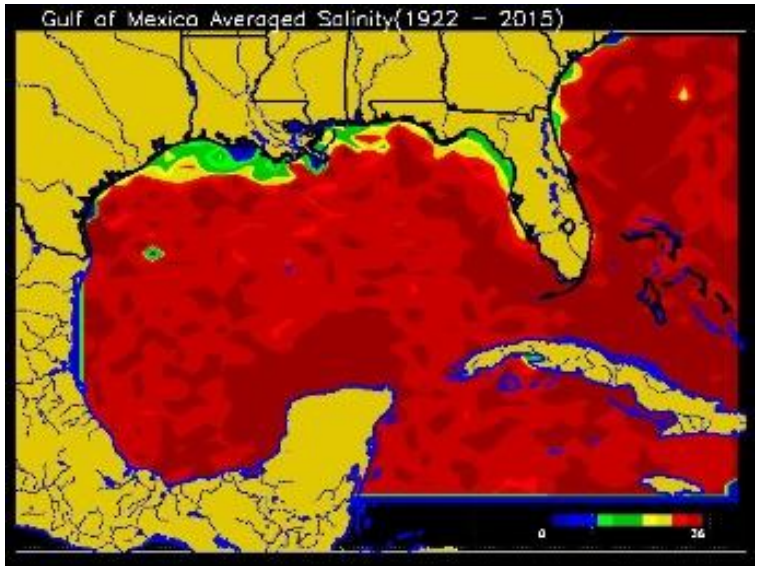


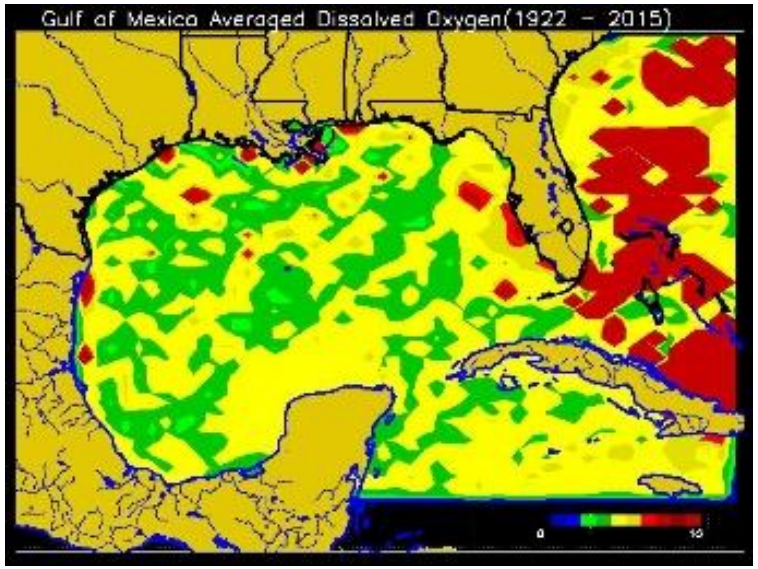
- Seven cruises conducted between 2003 and 2011
- 20,776 CTD, XBT, and PFL casts between 1922 and 2015 (NOAA NODC)

Historical data: CTD, XBT, and PFL casts

- Shown: averages over all depths and across all years (1922-2015)
- Salinity and dissolved oxygen vary considerably in nearshore areas
- Temperature and dissolved oxygen vary in offshore waters
- A few regions exhibited average dissolved oxygen of 3 mg L^{-1}, including coastal Louisiana



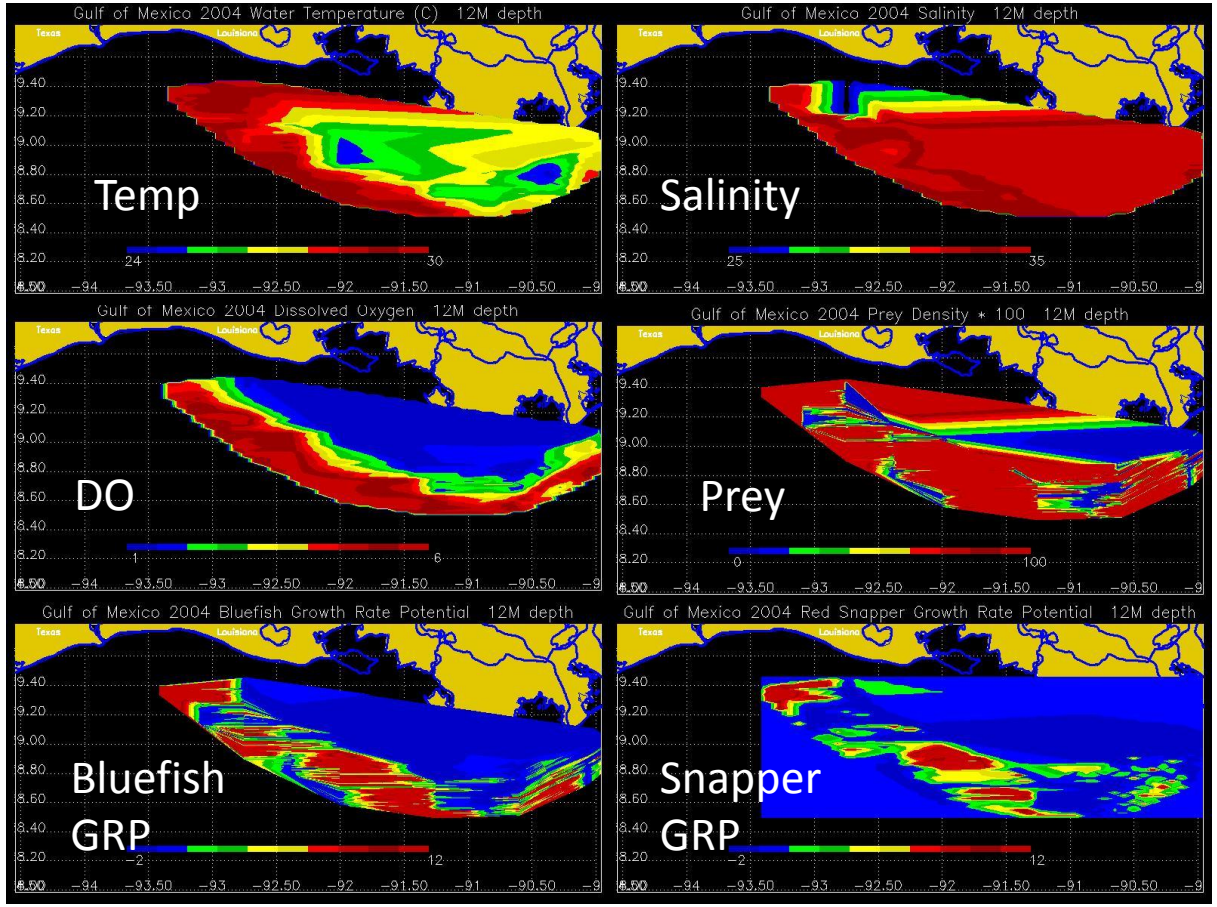




Historical data: Field transects

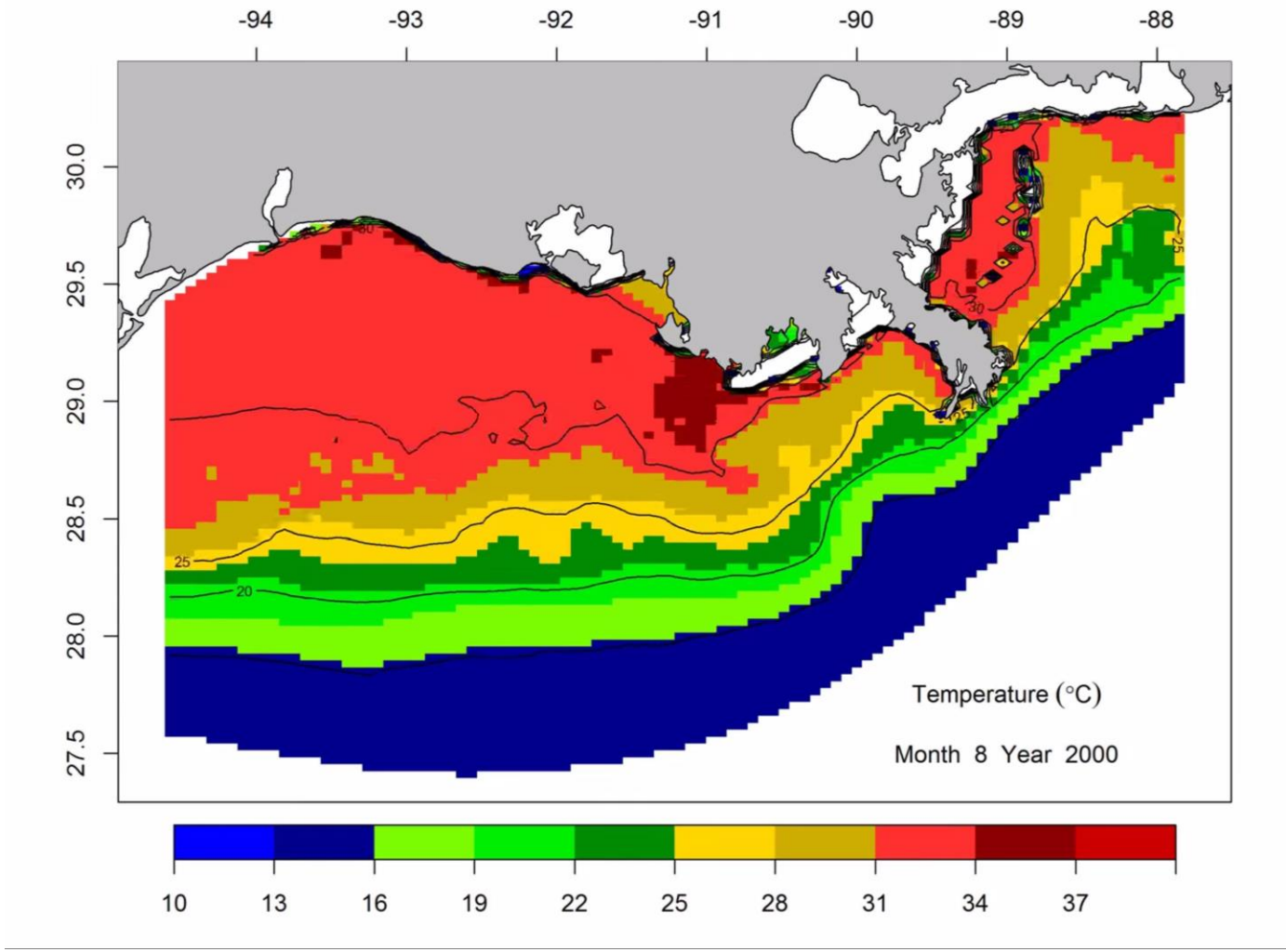
- Research cruises (2003, 2004, 2006, 2007, 2008, 2009 & 2010)
- Plotted DO, temperature and salinity for depths ranging from 0 – 29
- Plotted prey densities from acoustic profiles
- All transects processed to remove noise caused by non-biological sources, and have undergone an extensive QA/QC process
- Constructed horizontal and vertical transects of growth rate potential for both bluefish and red snapper (1,827 plots)
- Future work
  - GRP for remaining species
  - Validation of ROMS model

12 m depth horizons

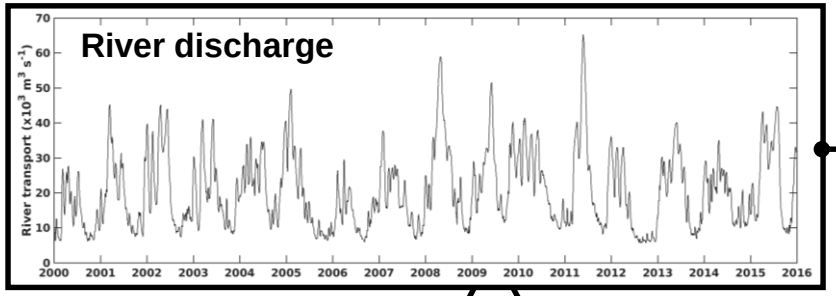


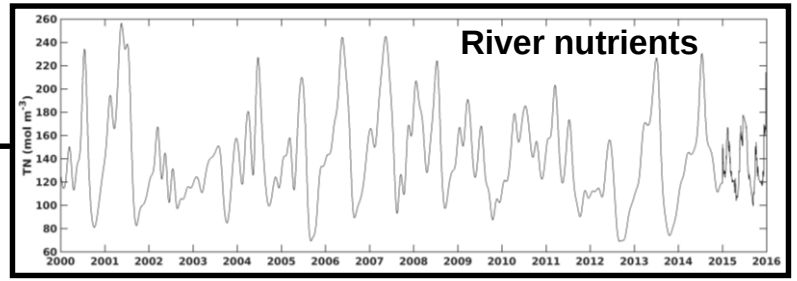
ROMS N and P scenarios

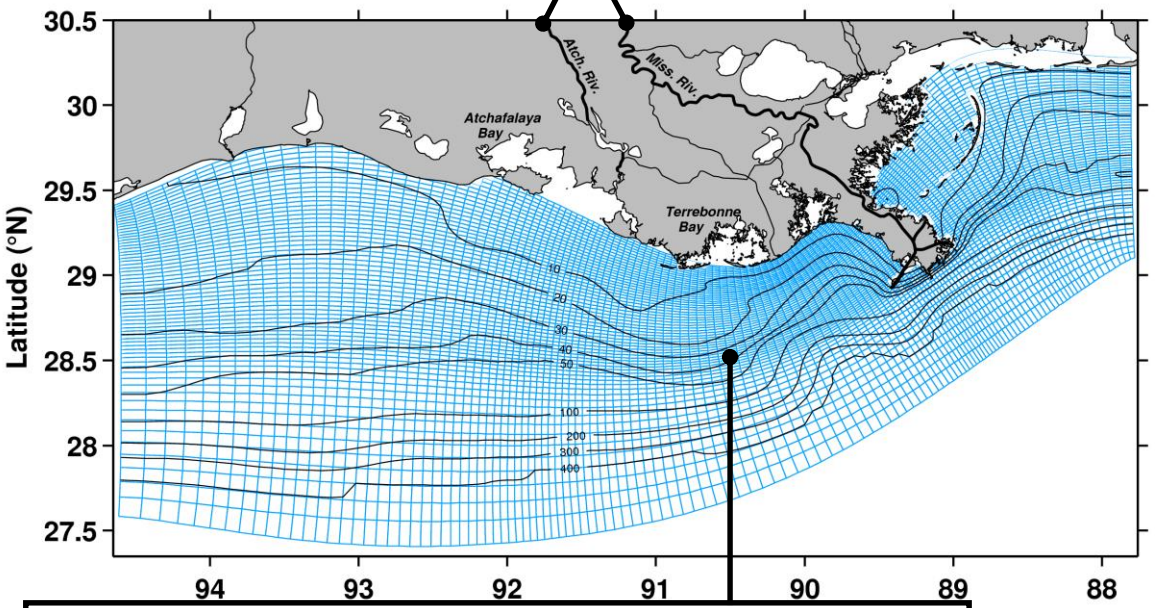
- Obtained (from A. Laurent) and processed N100P100, N90P80, and N60P60 scenarios
- Horizontal maps of temperature, dissolved oxygen, salinity, phytoplankton, and zooplankton for 20 depth layers
- Daily 1/1/2000-1/1/2017
- Next steps, GRP

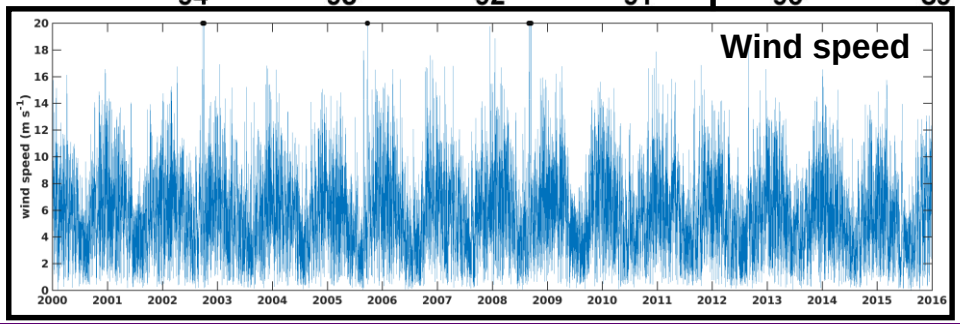


Circulation Model (ROMS)









Resolution: 3-5 km in horizontal (8,192 cell)
20 vertical layers

Total = 163,840 cells

Forcing: 3-hourly winds (spatially-resolved);
climatological surface heat and freshwater fluxes

River inputs: daily freshwater input (U.S. Army Corps of Engineers);
monthly nutrient and particulate matter loads (USGS)

Simulation period: 2000 – 2016

Output: Daily 3D field of state variables
(T, S, currents + biological variables)

Menhaden

N100P100 Bottom layer

N100P100 Surface layer

CONFERENCES – AFS SESSIONS

Brandt, S. B., and Mason, D. 2017. "**Pelagic fish seascapes: Integration of new technology and modeling**.", American Fisheries Society Meeting, 20 – 24 August, Tampa, FL.

Glaspie, C.N., Brandt, S. B. 2017. "**Response of fishes to extreme climate events**." American Fisheries Society Meeting, 20-24 August, 2017, Tampa, FL.

PRESENTATIONS

AFS

Glaspie, C.N., Brandt, S. B. and Sellinger, C. E. 2017. "Hypoxia impacts on small pelagic fishes: Insights from high-frequency acoustic sensing." American Fisheries Society Meeting, 20 – 24 August, Tampa, FL.

Glaspie, C.N., Brandt, S. B. and Sellinger, C. E. 2017. "North Pacific Salmon habitat quality in response to climate regime shifts." American Fisheries Society Meeting, 20 – 24 August, Tampa, FL.

ESA

Glaspie, C.N., Brandt, S. B. and C. S. Sellinger. 2017. Defining energy seascapes to predict distribution and production of fish. Annual Meeting of Ecological Society of America, 6 – 11 August, Portland OR.

Future directions: GRP as an Index for Production

- Use framework developed for Chinook salmon
  - Incorporate indices of habitat quality in population models
- Conversion of growth to production through body size-fecundity-recruitment relationships


Questions?