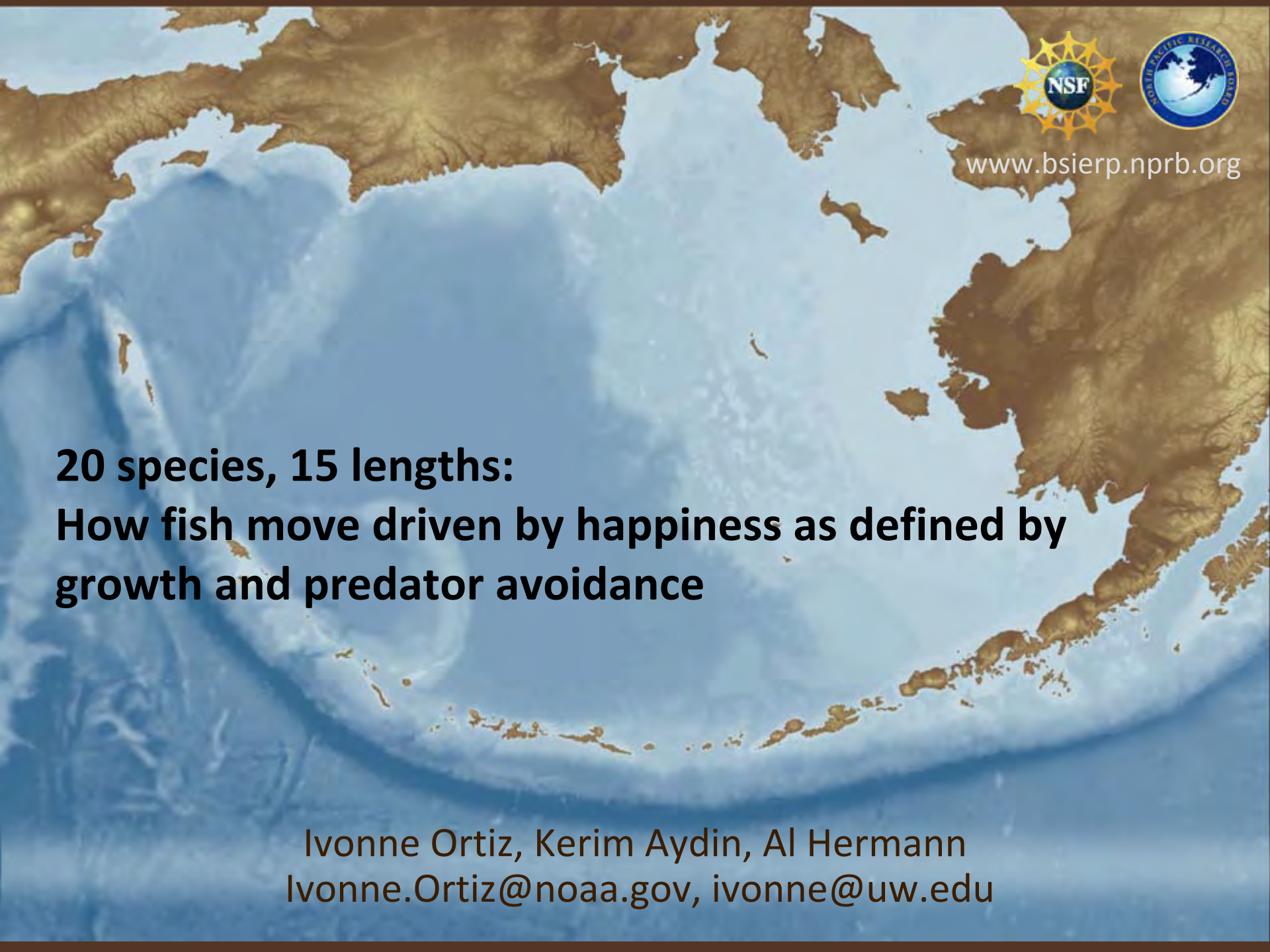

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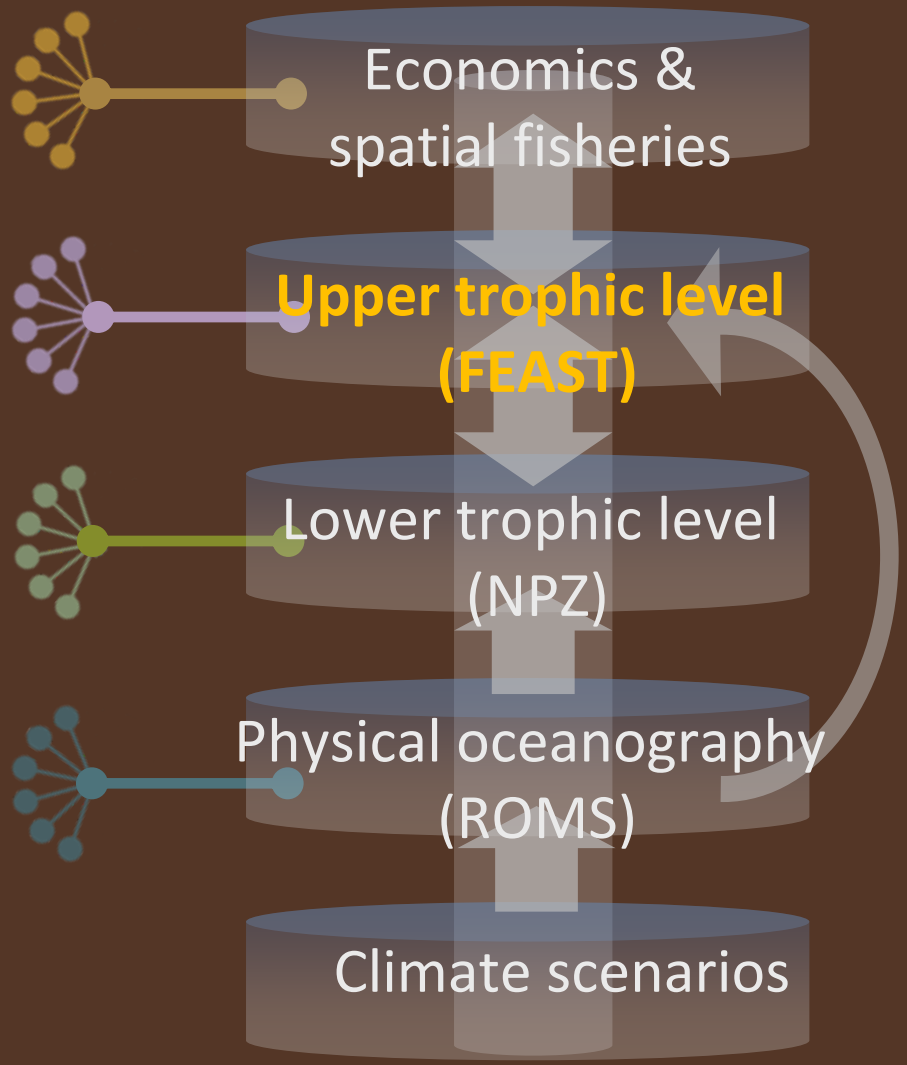
20 species, 15 lengths:
How fish move driven by happiness as defined by growth and predator avoidance

Ivonne Ortiz, Kerim Aydin, Al Hermann
Ivonne.Ortiz@noaa.gov, ivonne@uw.edu

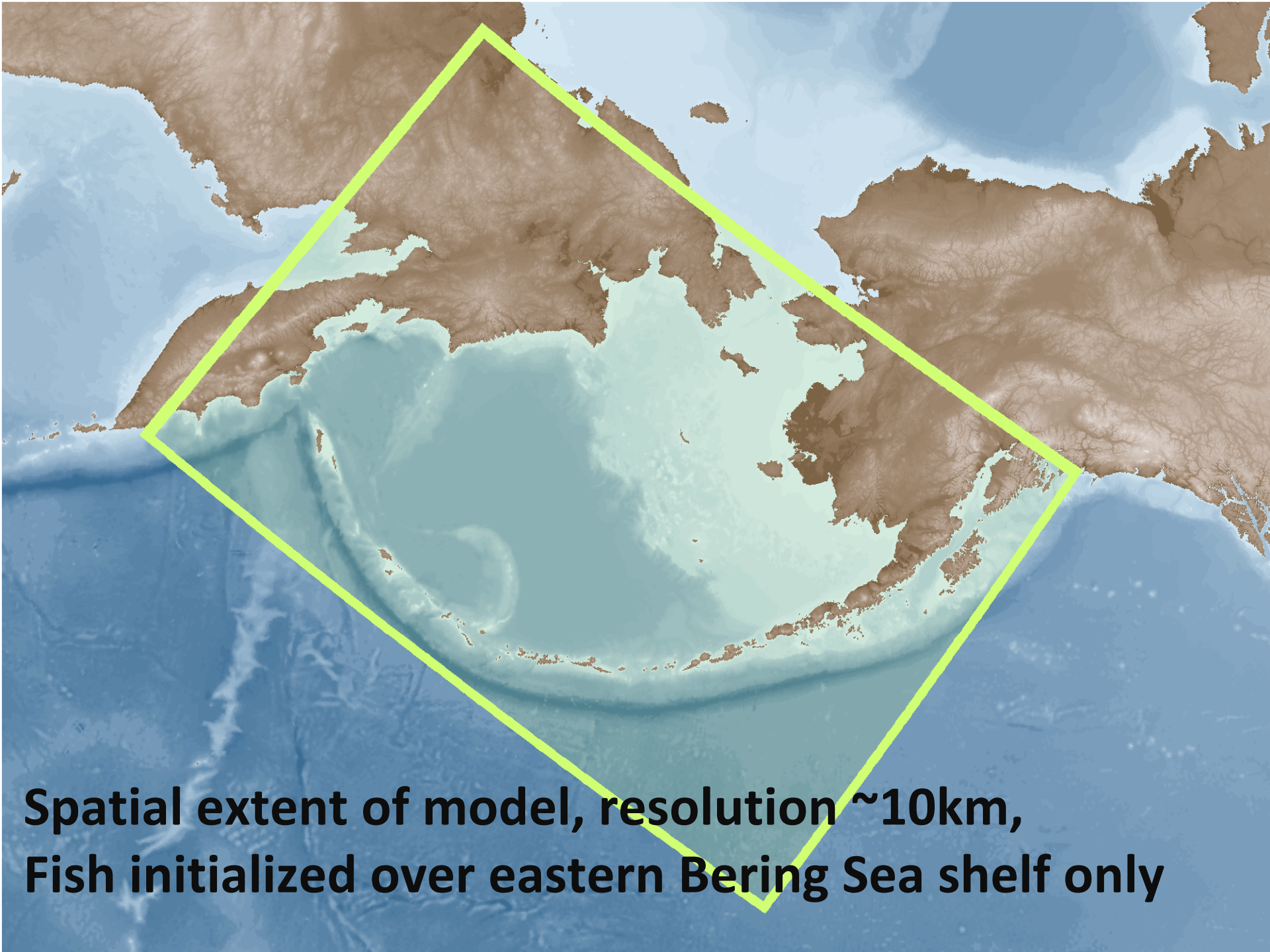
- Model framework
- FEAST setup
- Diets: differences within same species
- Movement: with and without predator avoidance
- Diet differences as a function of movement type

The Bering Sea Project

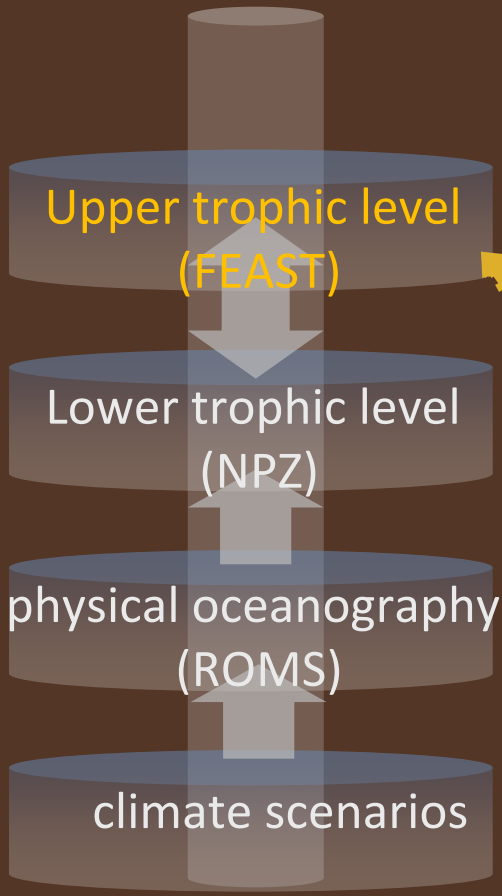
BEST/BSIERP Research Program

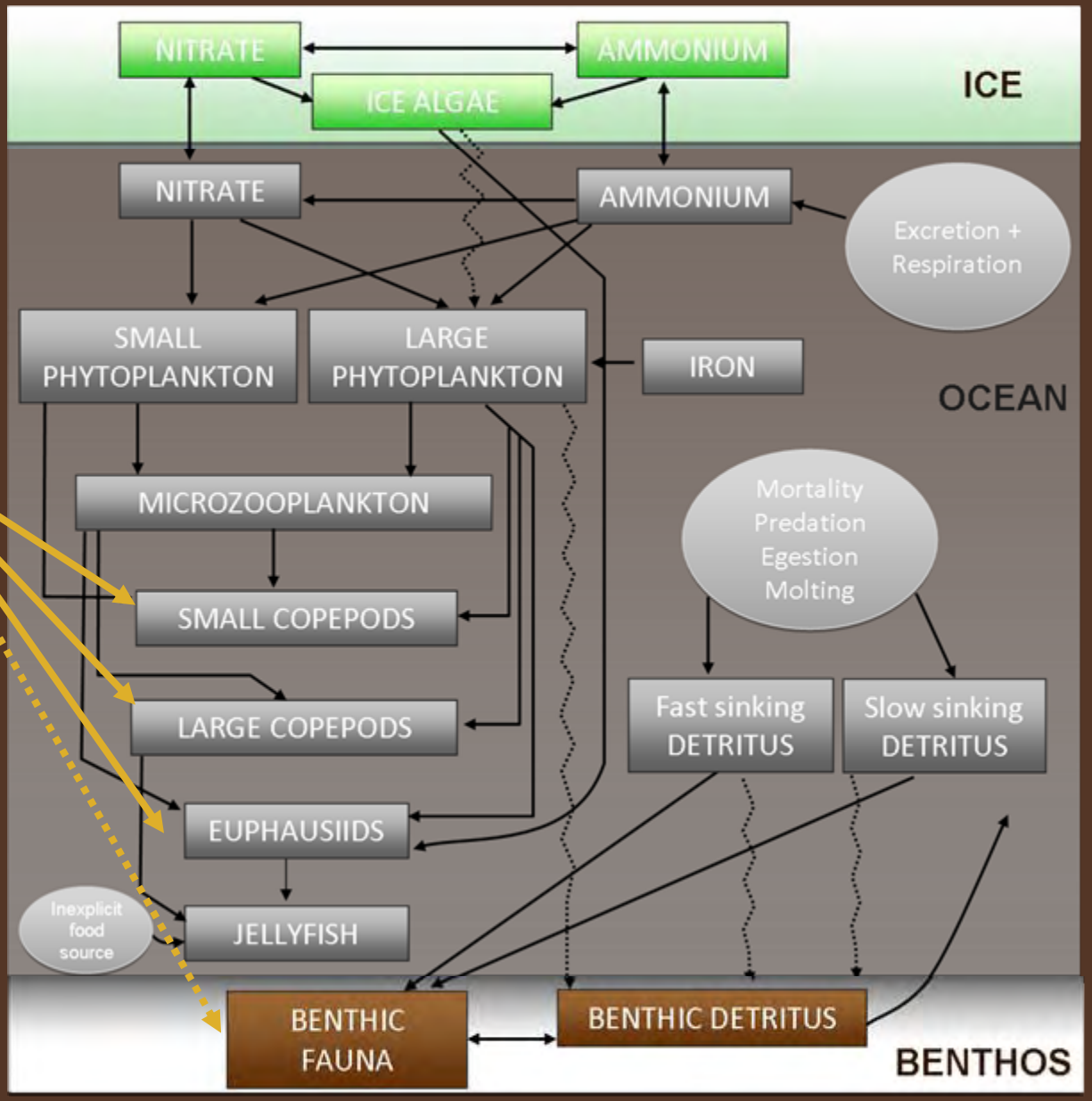


- Joint field & modeling projects
- Vertical model integrates 5 modeling & incorporates field data
- FEAST fish module


Spatial extent of model, resolution ~10km,
Fish initialized over eastern Bering Sea shelf only

Zooplankton module (NPZ-D)





FEAST – Forage-Euphausiid Abundance in Space and Time

11 ages/ 15 lengths
high detail

15 lengths
medium detail

biomass pools
low detail

NPZ

cod

arrowtooth

pollock

salmon

herring

myctophid

capelin

squids

eulachon

sandlance

crabs

shrimp

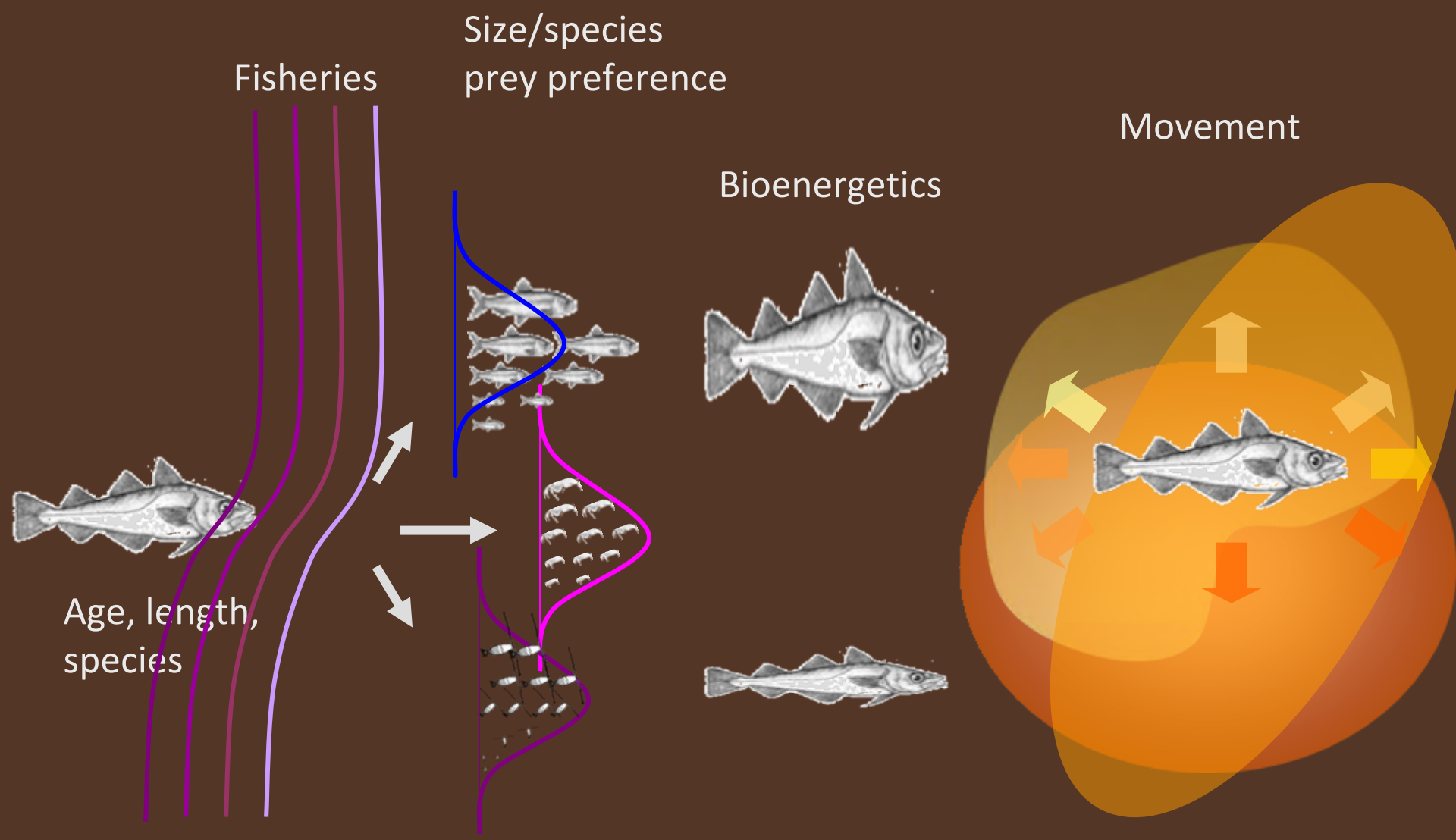
epifauna

other

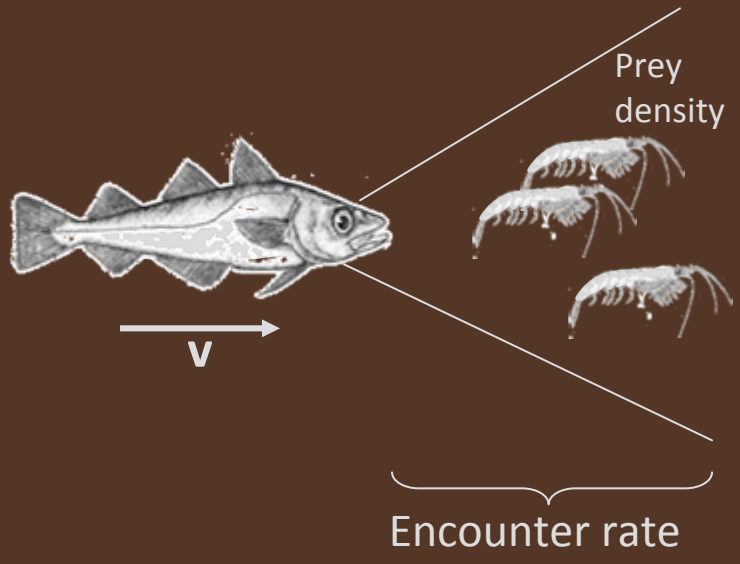
benthos

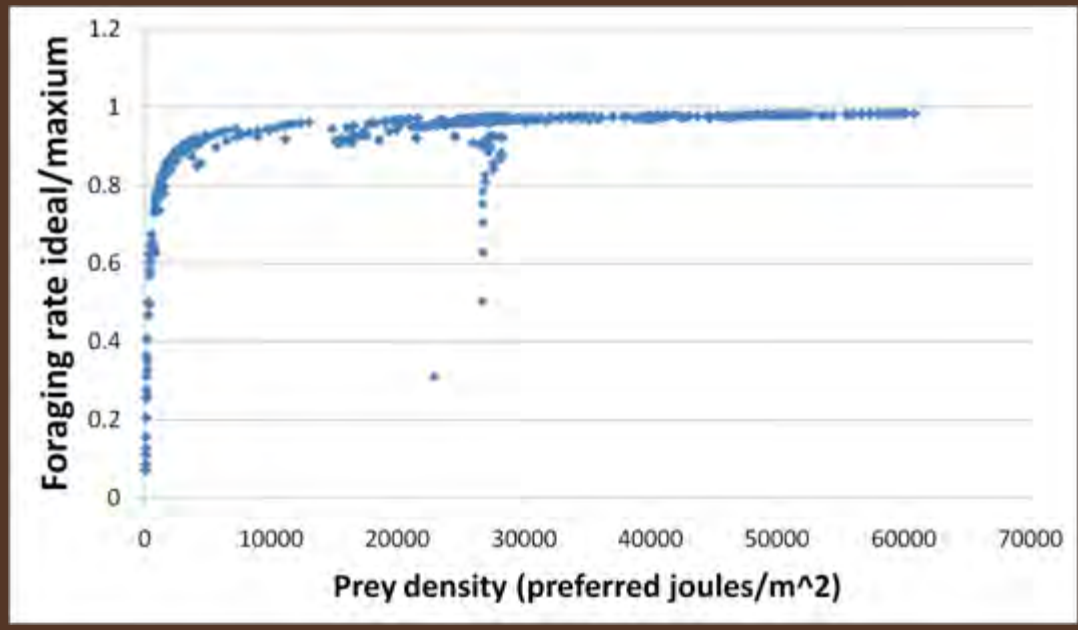
copepods &
euphausiids

FEAST


Fisheries
Size/species
prey preference
Bioenergetics
Movement
Age, length,
species

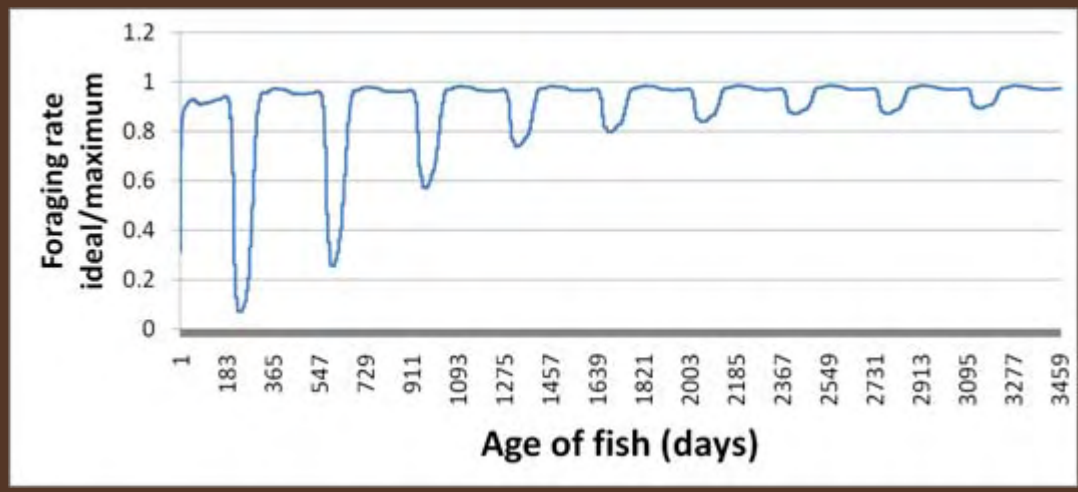
Linking foraging and bioenergetics into functional responses



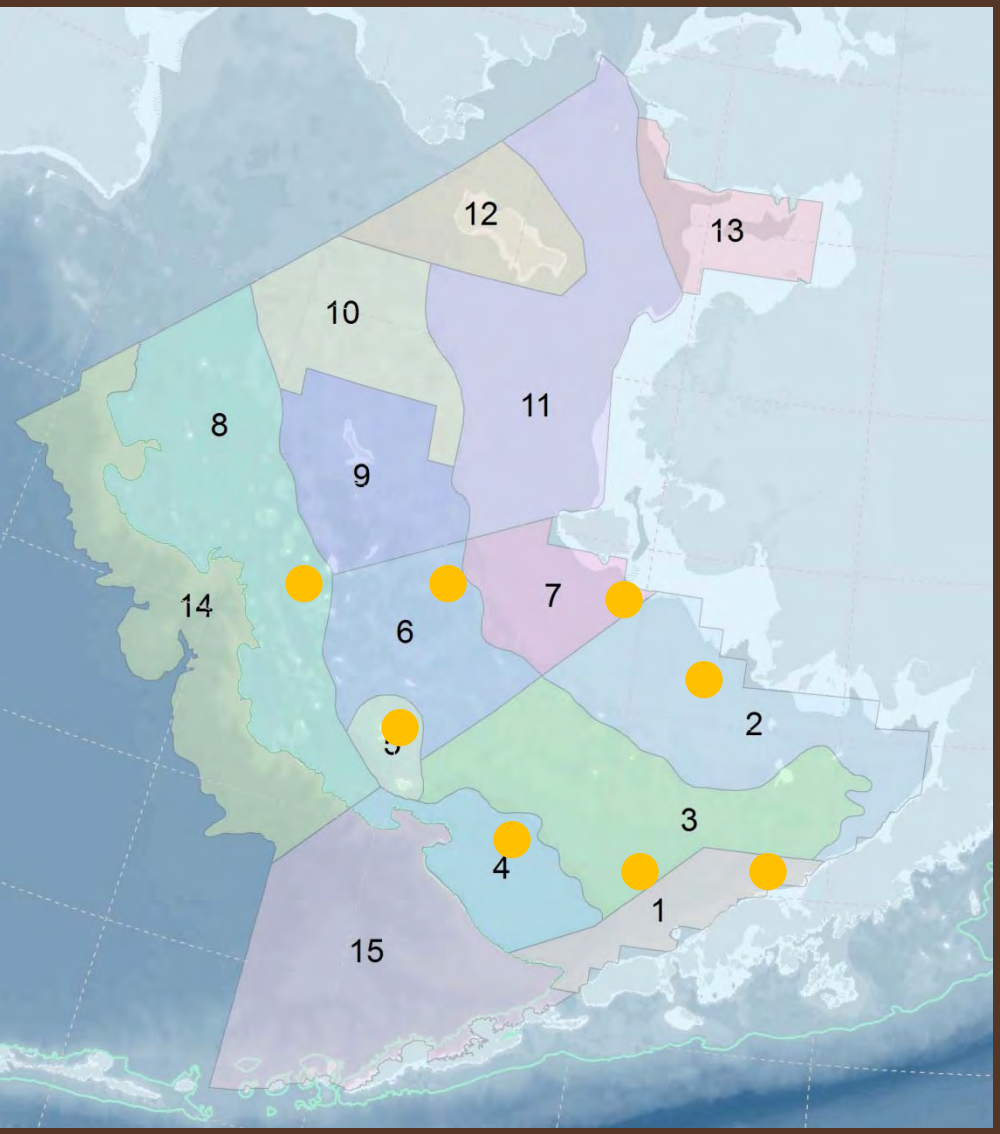


Useful consumption (joules) = **f(V,T,L)**

Respiration (joules) = $A_v \mathbf{V}^{Bv} * \mathbf{f_r(T)}$



Compared diets by pollock length and location showing selected fish prey for January 2004



Region, proportion of prey in diet 0-1

2004 month 1	POL	COD	ATF	HER	CAP	EUL
1						
2						
3						
4						
5						
6						
7						
8						

Pollock length, 1 - 80 cm

Movement: happy fish move slow, sad move fast

Type 1: individual weight gain converted to speed

(dWeight/dt)/Weight (on a -1.0 to 1.0 scale) = proportion of max movement rate (0 – 1, scaled using logistic curve)

where Weight is weight of individual fish

Type 2 = population biomass gain converted to speed

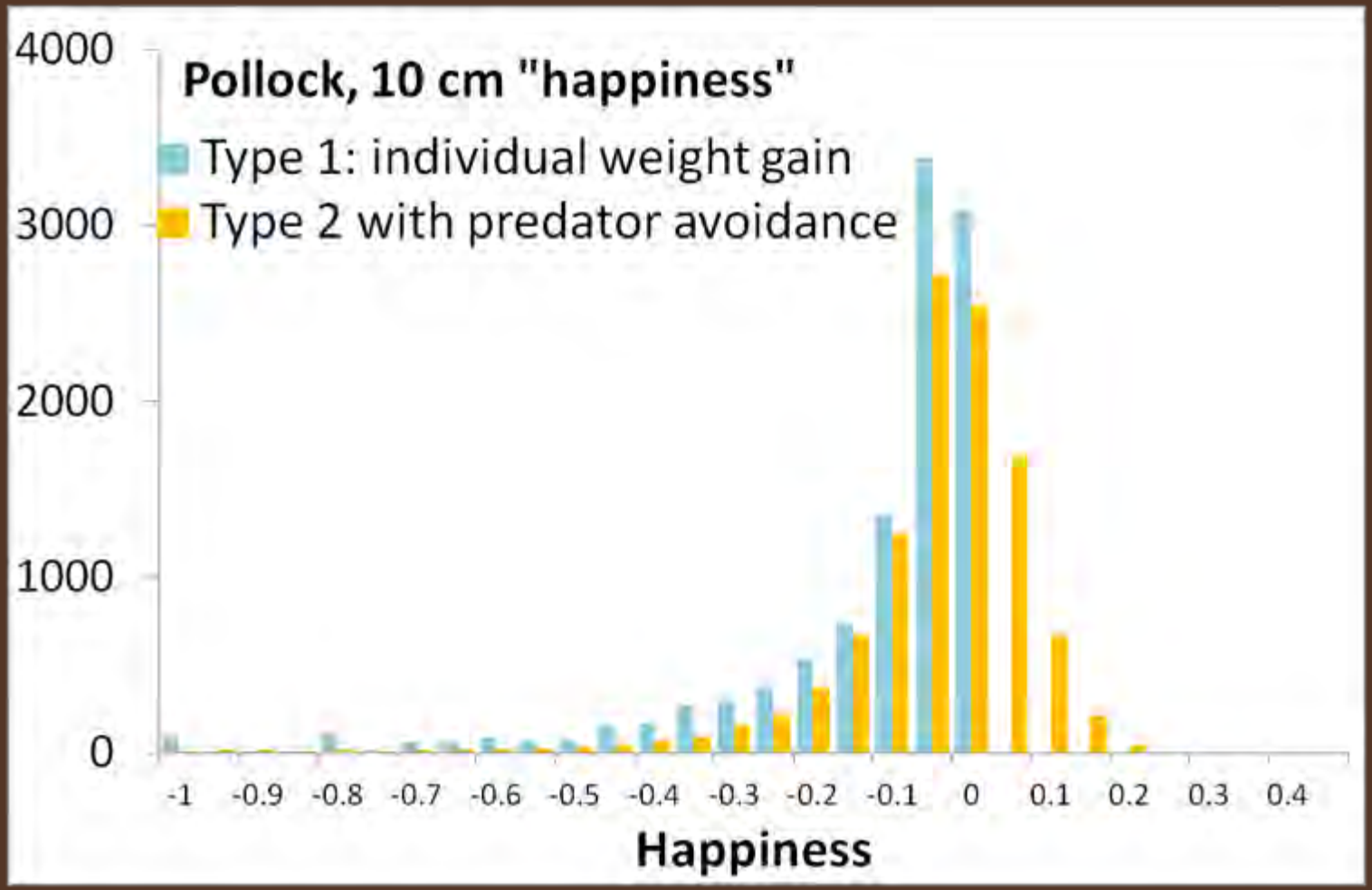
(dBiomass/dt)/Biomass

where Biomass = weight gain of individual fish * No. of fish

No. of fish is based on changes due to **predation mortality, fish will move to avoid predators**

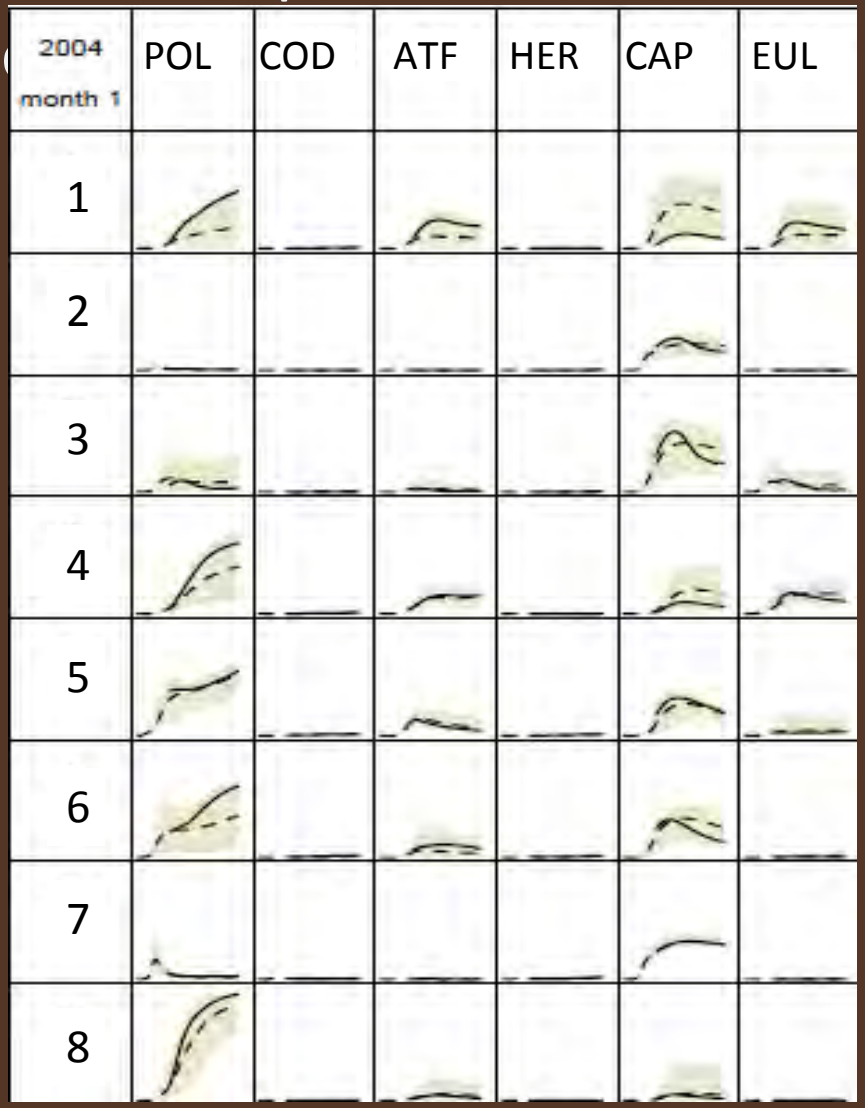
Movement: happier fish with predator avoidance

Sampled fish across 400+ stations in shelf and slope once a month in 2004

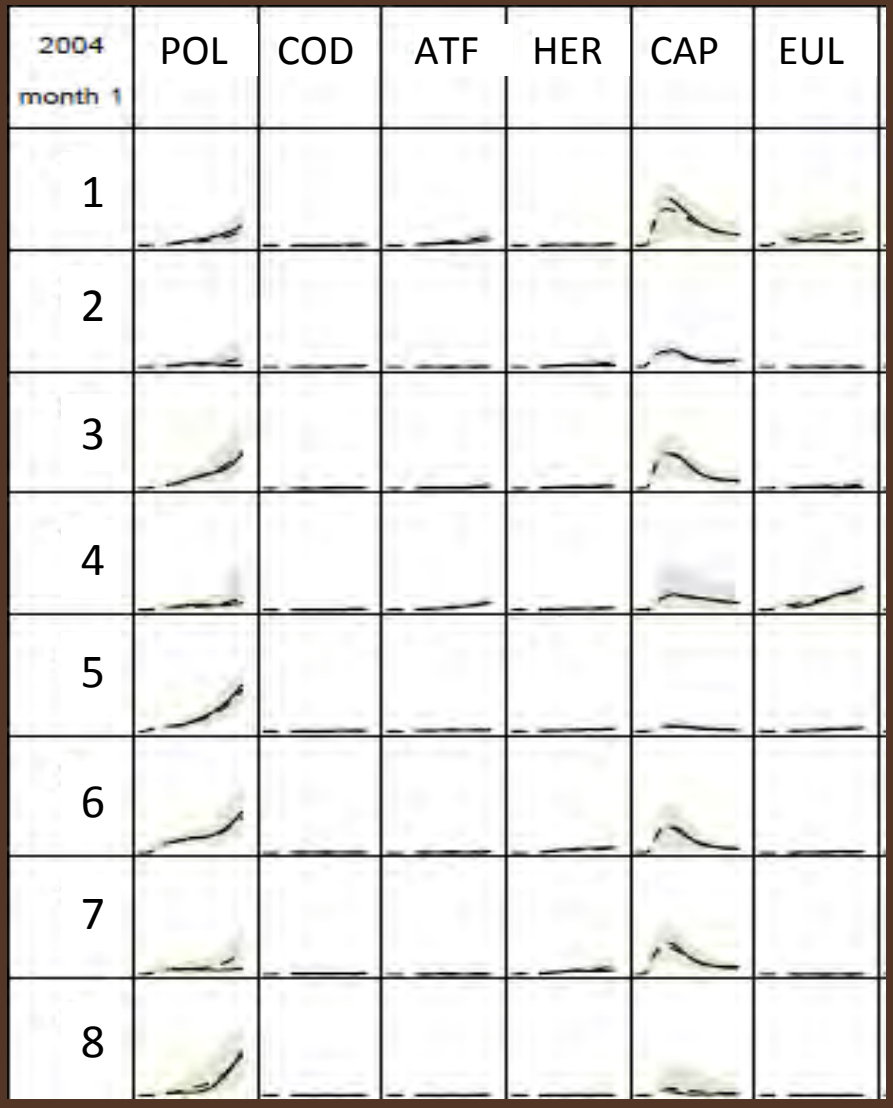


Diet differences based on movement, pollock Jan '04

TYPE 1: No predator



TYPE 2: Predator avoidance



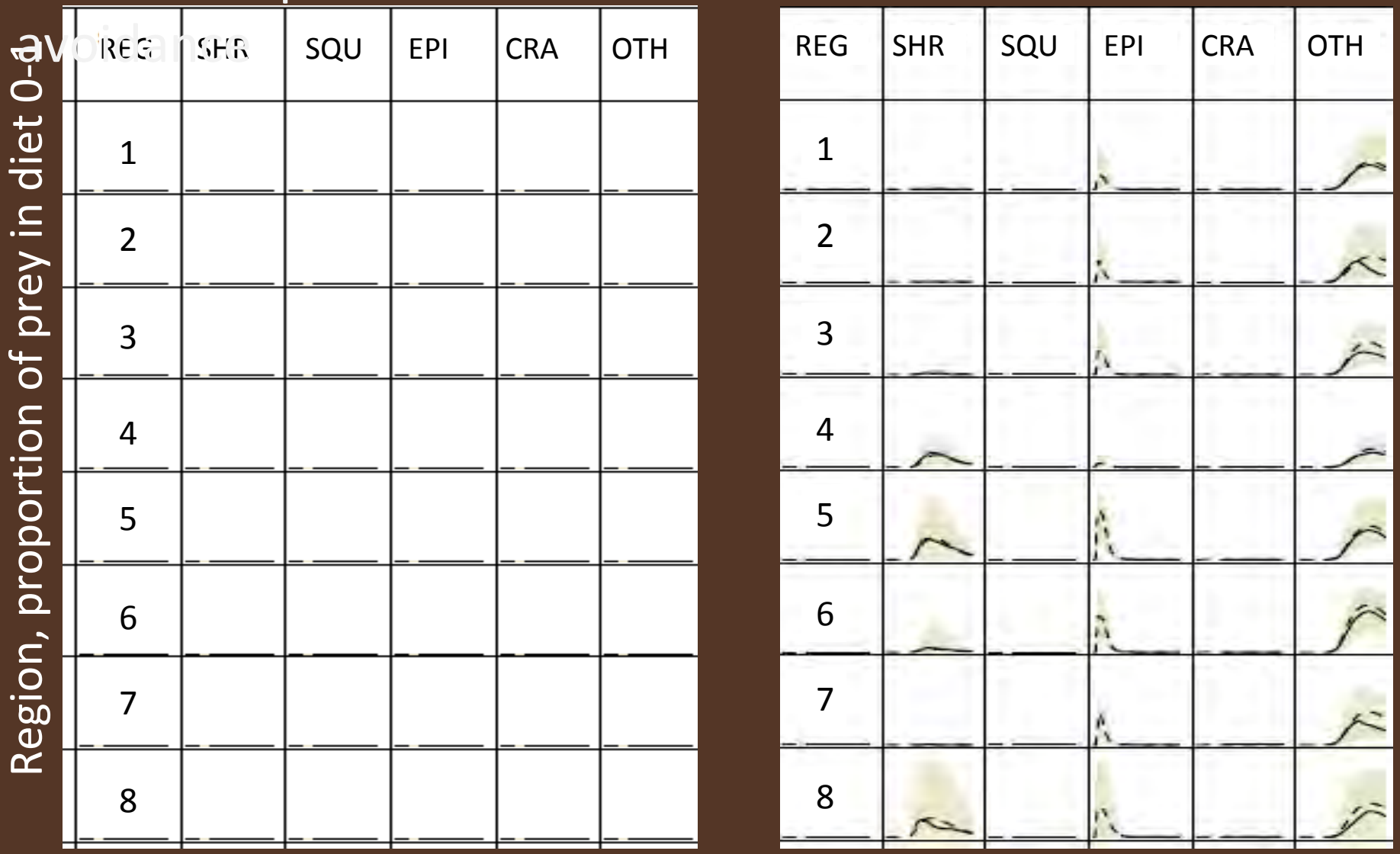
Region, proportion of prey in diet 0-1

Pollock length, 1 - 80 cm

Compared diet differences: fixed species eaten more

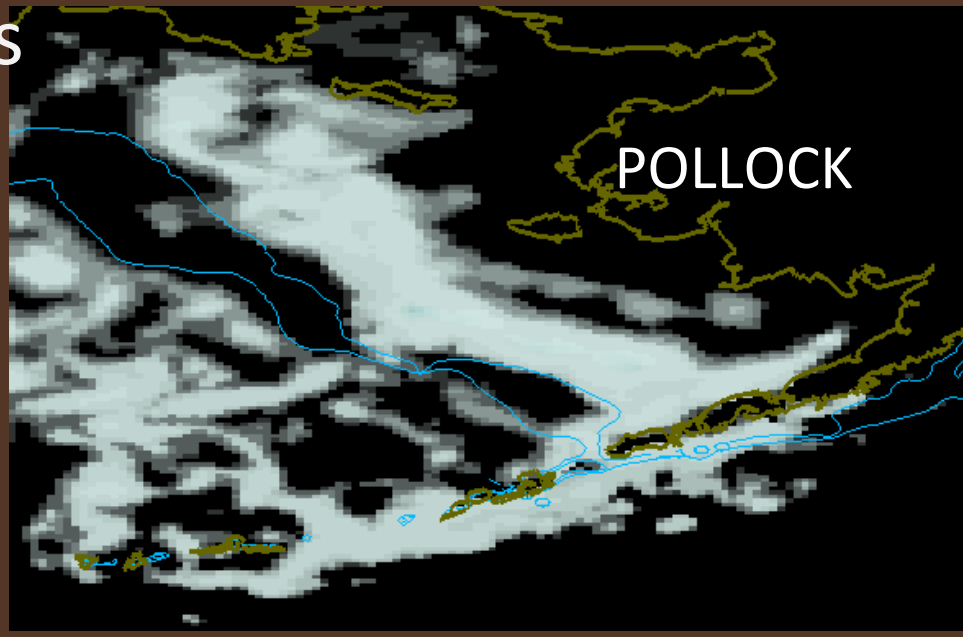
TYPE 1: No predator avoidance

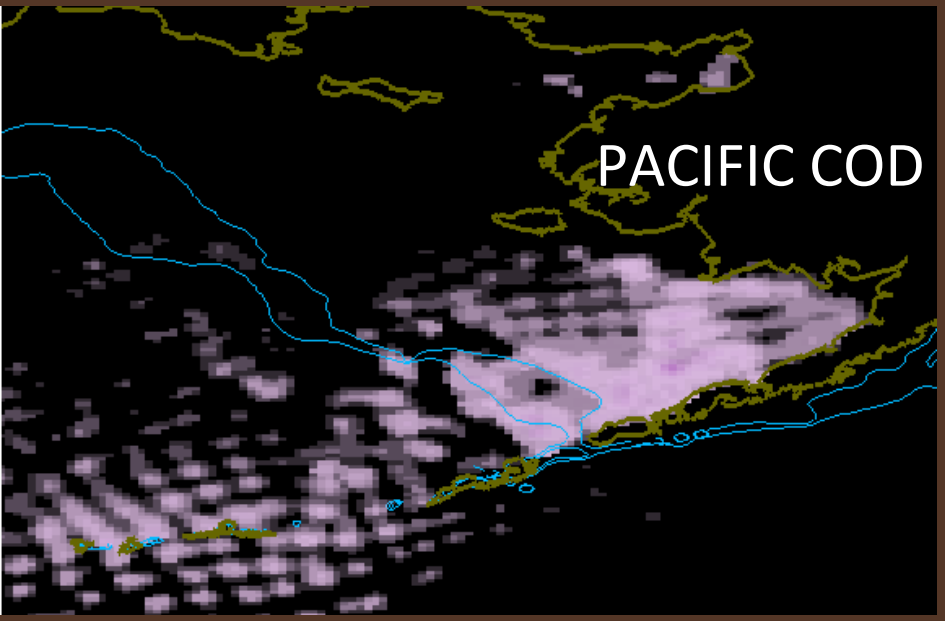
TYPE 2: Predator avoidance

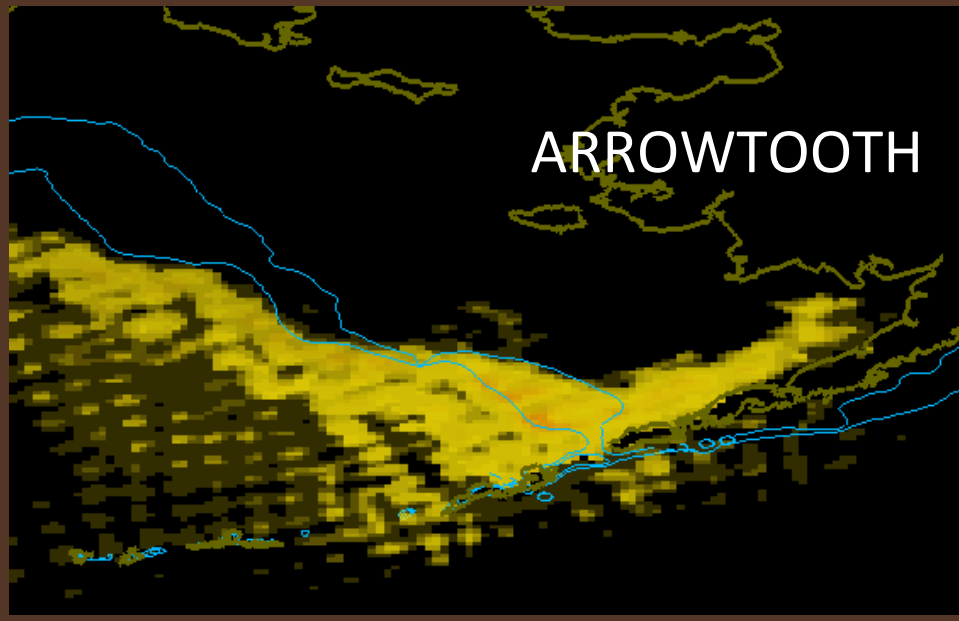


Differences in Fish Biomass Distributions

ages 1+, July 2004
three species
scales are species specific







Movie

Pollock ages 6-8 with two types of movement
Fish start where the prey are according to the spin up (jul –dec 2003) that follow prey according to the movement;
no growth or mortality in spin up.

Acknowledgements Vertical Modeling group

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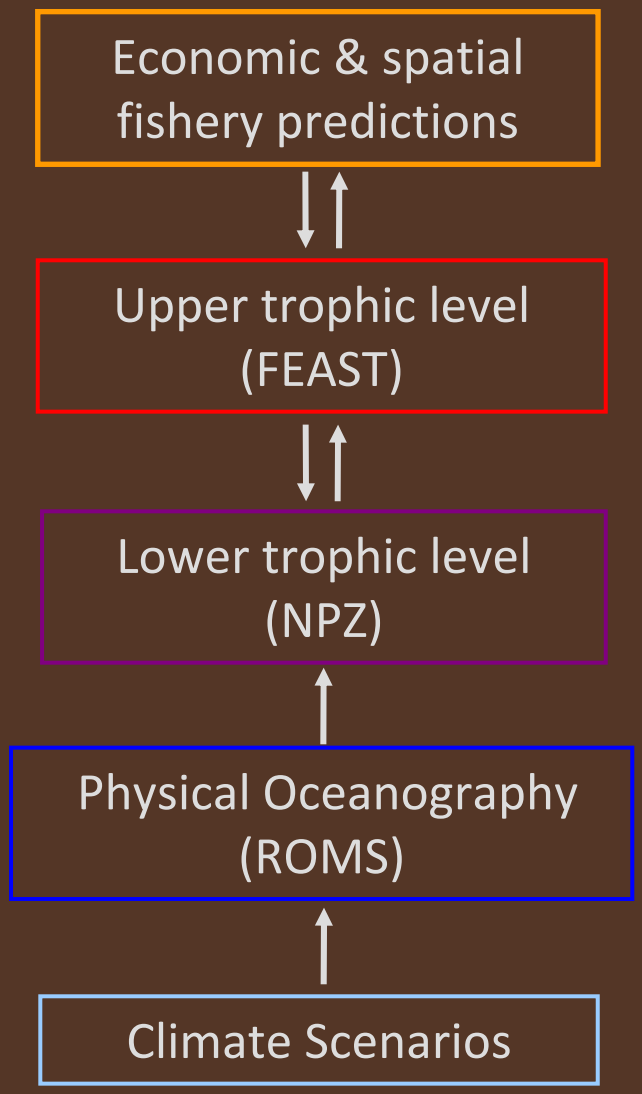

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