

PROGRESS ON THE SOUTH ATLANTIC REGION ECOPATH MODELLING

Towards an *integrative* Ecopath / Ecosim / Ecospace model

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SAFMC Habitat Protection & Ecosystem-Based Mgmt AP Meeting

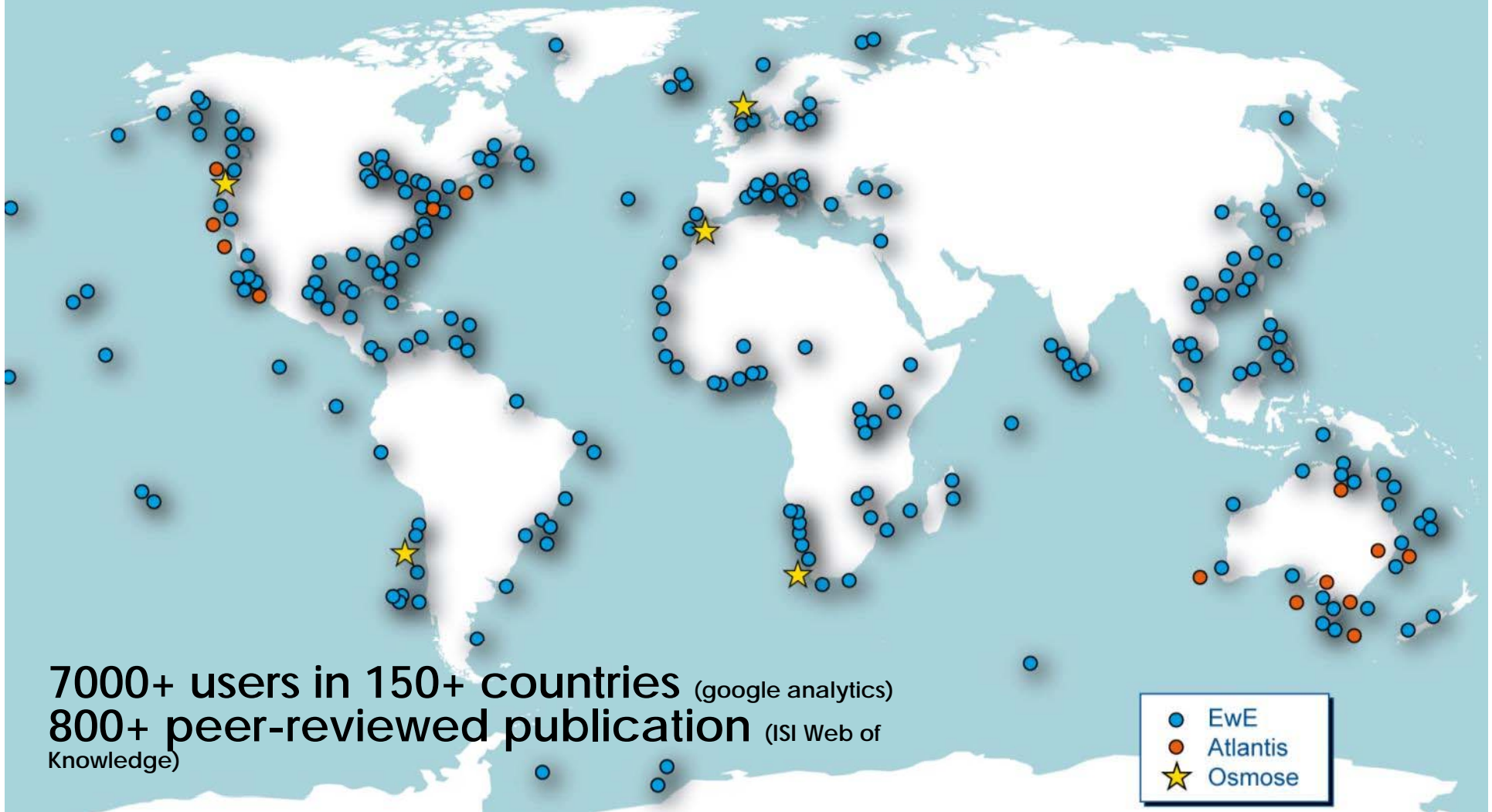
May 17th, 2017

ECOPATH WITH ECOSIM



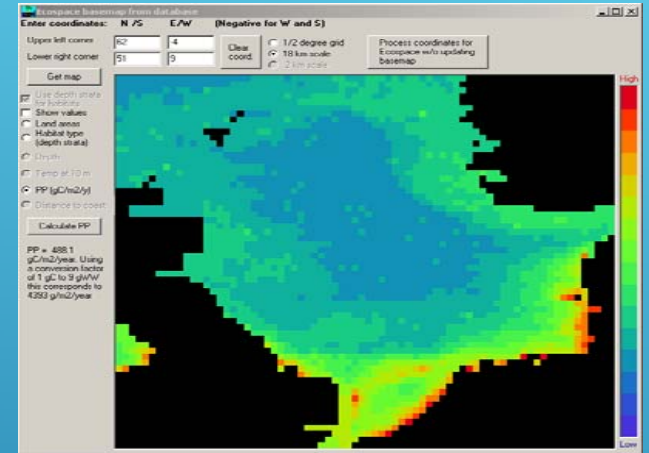
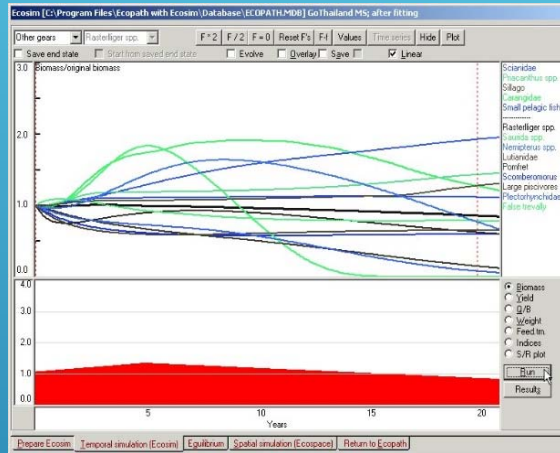
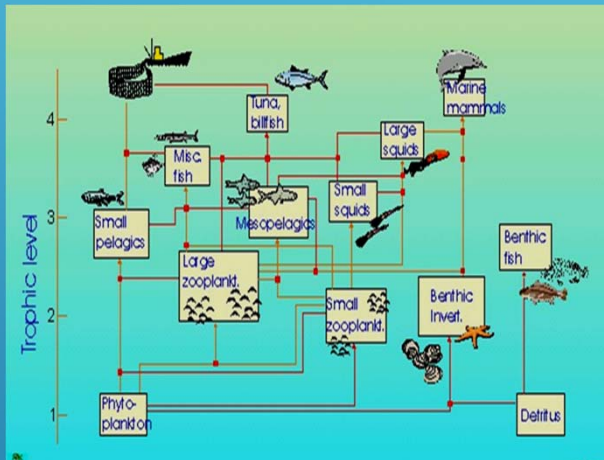
No fish is an island

ECOPATH WITH ECOSIM



7000+ users in 150+ countries (google analytics)
800+ peer-reviewed publication (ISI Web of Knowledge)

ECOPATH / ECOSIM / ECOSPACE



SOUTH ATLANTIC BIGHT FOOD WEB

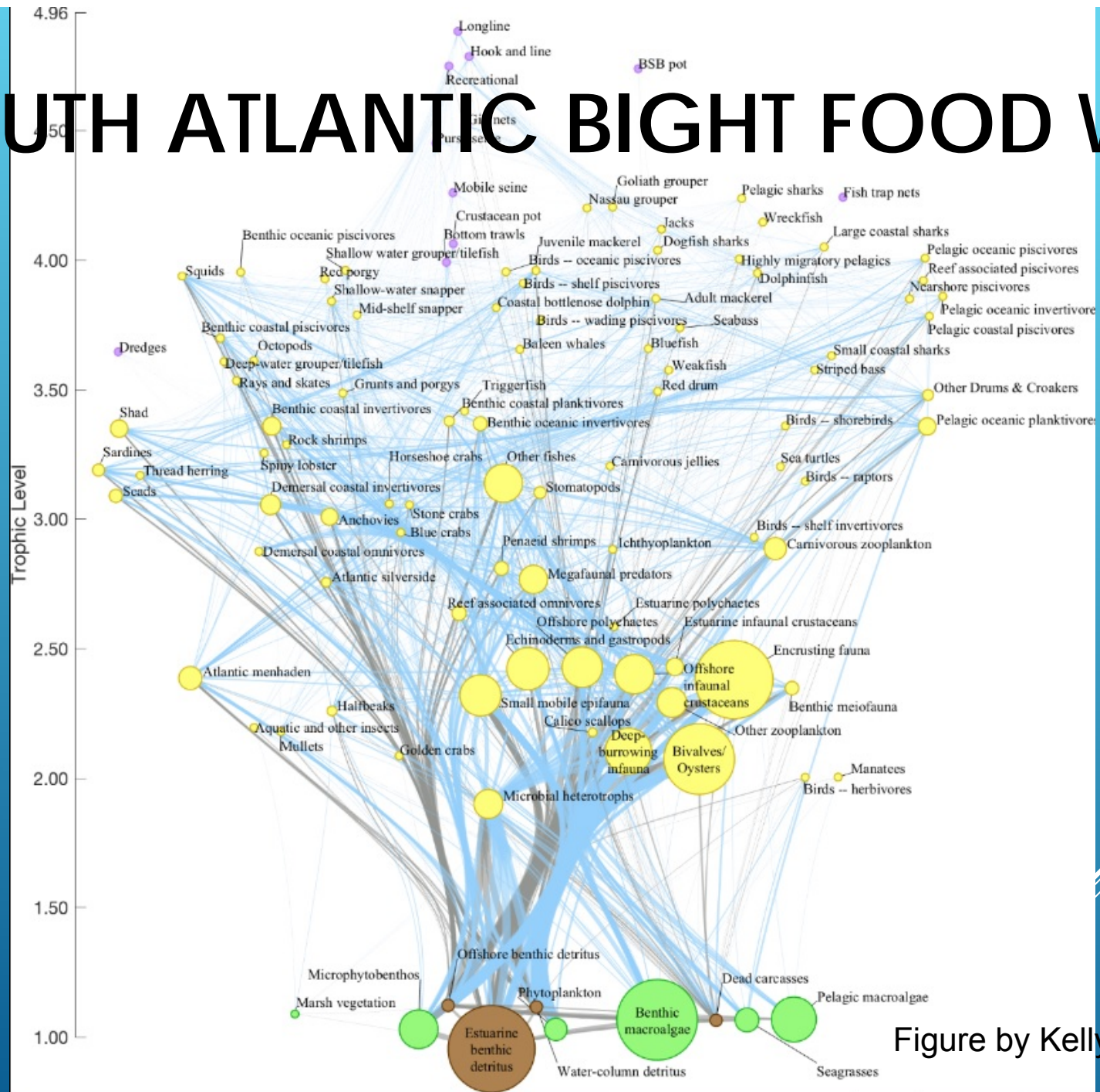



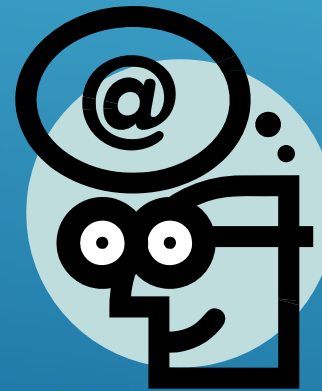
Figure by Kelly Kearney

HISTORY OF THE SAB MODEL

- ▶ 2001 - Strawman 48-box model constructed
 - ▶ 2004 - Preliminary 98-box model developed
 - ▶ 2013 - Model refined to address forage fish questions
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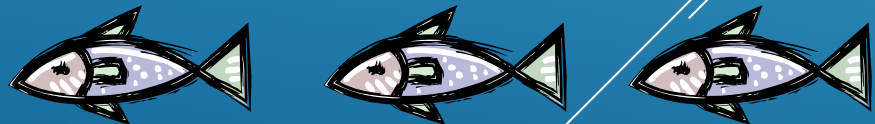
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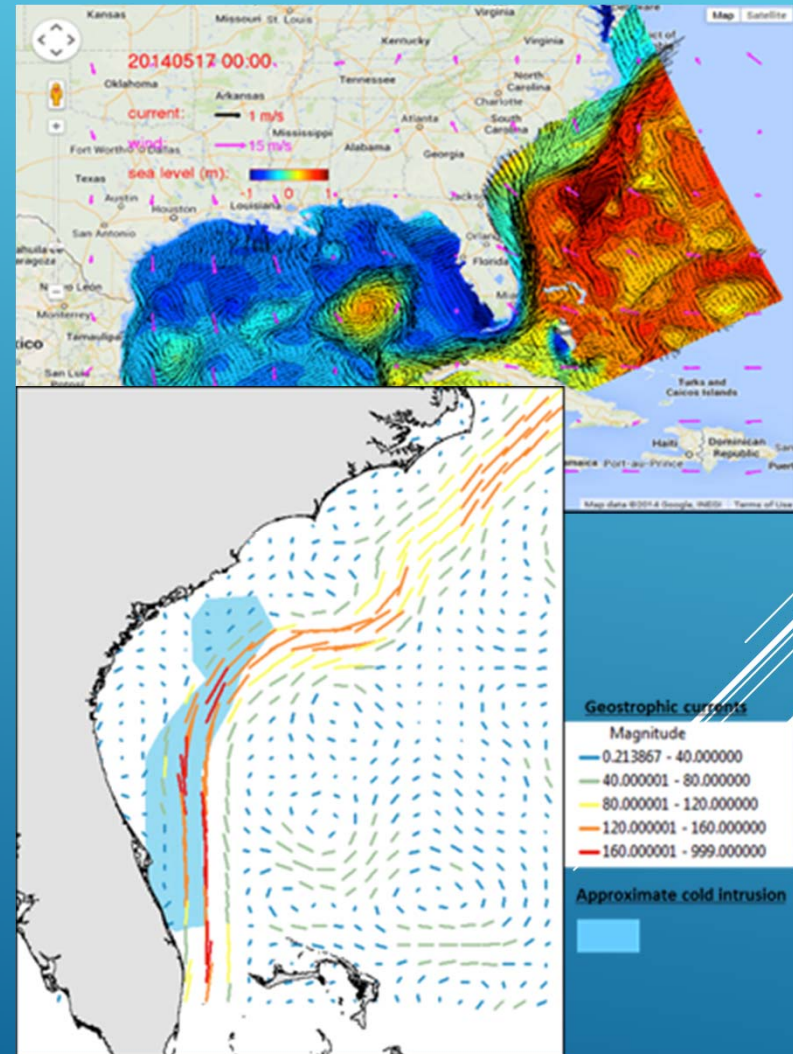
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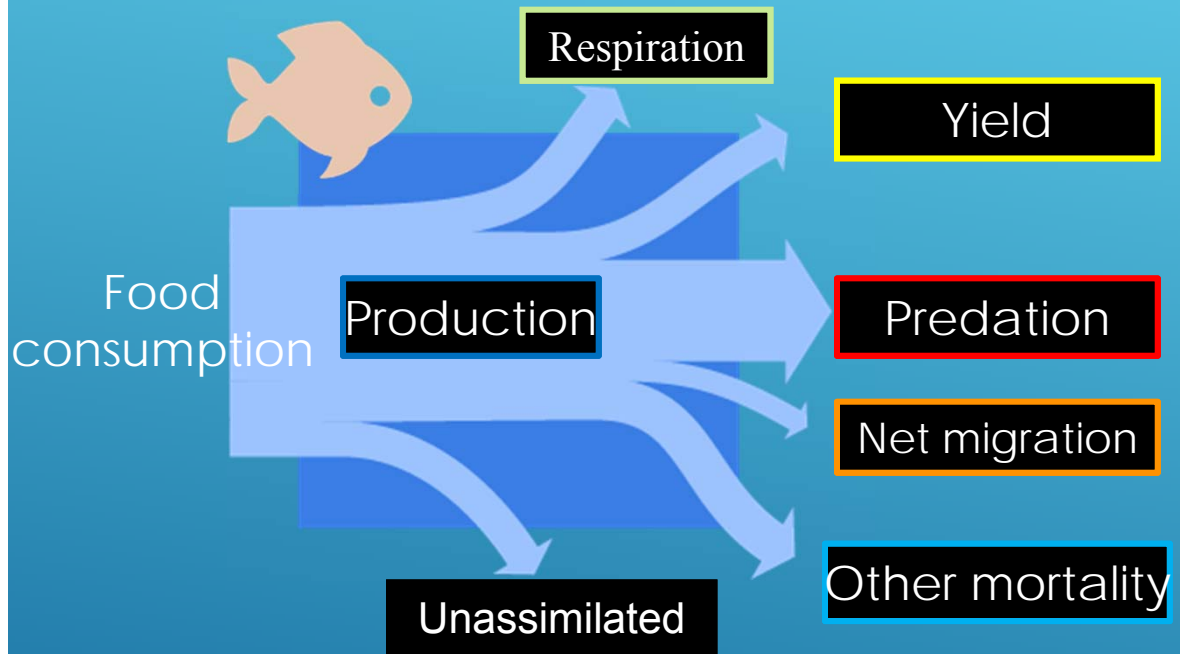
THE MODELS WILL:

- ▶ Advance and refine the LCC conservation blueprint
- ▶ Support the SA Fishery Management Council's move to ecosystem-based management
- ▶ Link to hydrodynamic oceanographic models and satellite data
- ▶ Provide more realistic predictions about spatial policy options
- ▶ Predict impacts of episodic events that are limited in space (oil spills, red tides, upwelling)
- ▶ Meet the immediate needs of the SSC and the South Atlantic Council





ECOPATH



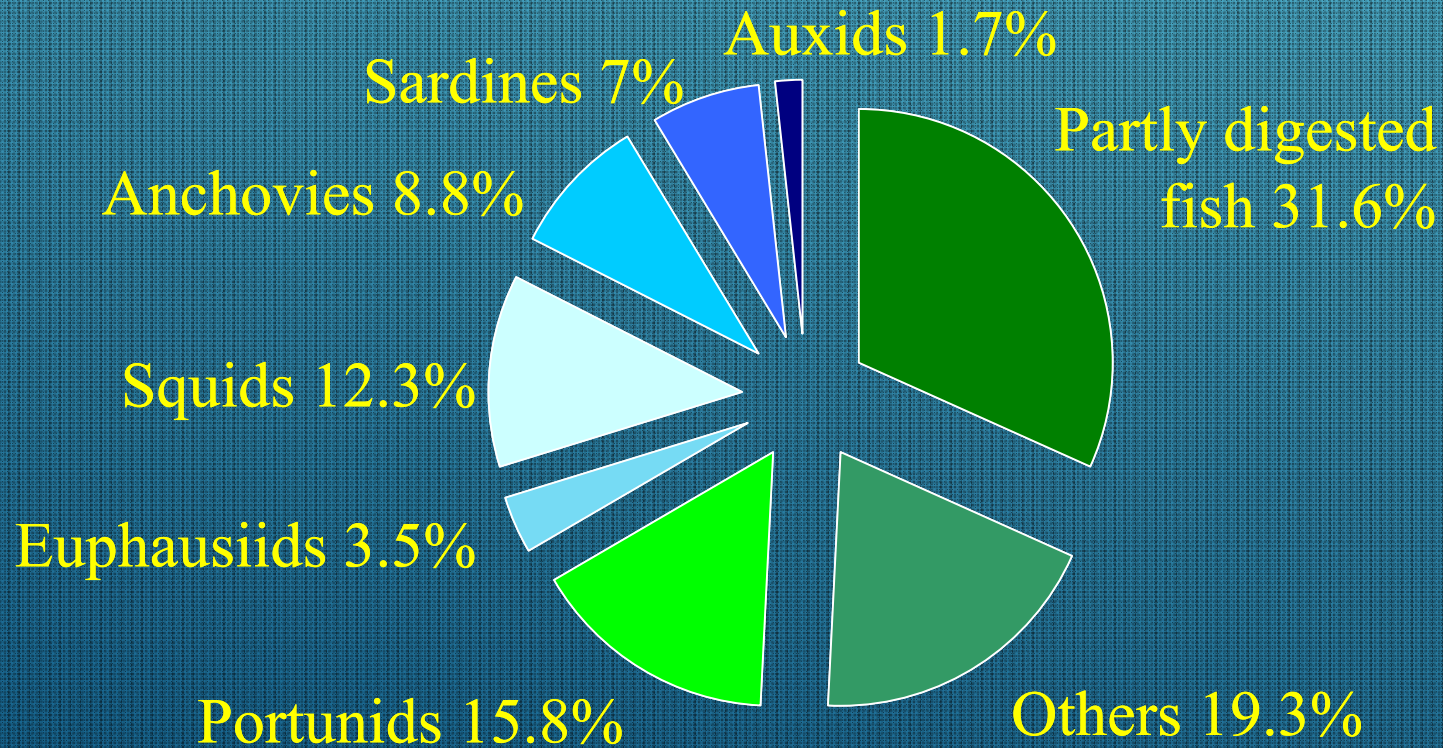
B_i	Biomass
P_i/B_i	Production
Q_i/B_i	Specific consumption
DC_{ij}	Fraction of prey i in diet of predator j
$B_i A_i$	Biomass accumulation
EE_i	Production used in the system
$1-EE_i$	Unexplained mortality

$$1. \left(\frac{Q}{B}\right)_i \cdot B_i = \left(\frac{P}{B}\right)_i \cdot B_i + R_i + UN_i$$

$$2. \left(\frac{P}{B}\right)_i \cdot B_i = \sum_{Pred,j=1}^n \left(\frac{Q}{B}\right)_j \cdot B_j \cdot DC_{ij} + E_i + Y_i + BA_i + \left(\frac{P}{B}\right)_i \cdot B_i \cdot (1 - EE_i)$$

Diet composition

e.g., for a tuna



Use volume or weight!

Articulated forage groups in the 2014 99-box South Atlantic Bight *EwE* model

Anchovies

Atlantic menhaden

Atlantic silverside

Halfbeaks

Mulletts

Sardines

Scads

Shad

Thread herring

Pelagic oceanic planktivores

Squids

Shrimps



Species / Groups in SAB 99-box model

Coastal bottlenose dolphin	Thread herring	Seabass	Estuarine infaunal crustaceans
Manatees	Shad	Wreckfish	Estuarine polychaetes
Large coastal sharks	Anchovies	Other fishes	Bivalves/Oysters
Small coastal sharks	Atlantic silverside	Sea turtles	Offshore infaunal crustaceans
Baleen whales	Halfbeaks	Carnivorous jellies	Offshore polychaetes
Pelagic sharks	Pelagic oceanic invertivores	Birds -- oceanic piscivores	Small mobile epifauna
Rays and skates	Demersal coastal invertivores	Birds -- shorebirds	Calico scallops
Dogfish sharks	Demersal coastal omnivores	Birds -- shelf piscivores	Benthic meiofauna
Adult mackerel	Benthic oceanic piscivores	Birds -- herbivores	Deep-burrowing infauna
Juvenile mackerel	Benthic oceanic invertivores	Birds -- wading piscivores	Carnivorous zooplankton
Bluefish	Benthic coastal piscivores	Birds -- shelf invertivores	Aquatic and other insects
Weakfish	Benthic coastal invertivores	Birds -- raptors	Other zooplankton
Red drum	Benthic coastal planktivores	Encrusting fauna	Ichthyoplankton
Atlantic menhaden	Reef associated piscivores	Squids	Microbial heterotrophs
Mullets	Reef associated omnivores	Stomatopods	Phytoplankton
Other Drums & Croakers	Triggerfish	Octopods	Microphytobenthos
Striped bass	Shallow water grouper/tilefish	Blue crabs	Benthic macroalgae
Highly migratory pelagics	Goliath grouper	Horseshoe crabs	Pelagic macroalgae
Dolphinfish	Nassau grouper	Golden crabs	Seagrasses
Pelagic oceanic piscivores	Deep-water grouper/tilefish	Stone crabs	Marsh vegetation
Pelagic coastal piscivores	Shallow-water snapper	Spiny lobster	Estuarine benthic detritus
Nearshore piscivores	Mid-shelf snapper	Rock shrimps	Offshore benthic detritus
Pelagic oceanic planktivores	Jacks	Penaeid shrimps	Water-column detritus
Sardines	Red porgy	Megafaunal predators	Dead carcasses
Scads	Grunts and porgys	Echinoderms and gastropods	

Focused on predatory fish of particular value in the SAB ecosystem model

Spanish/king mackerels

Vermillion snapper

Gag grouper

Dolphinfish

Black seabass

Greater amberjack

Cobia

Red snapper

Newly Articulated Species / Groups in the 2017 SAB 128-box model

Adult king mackerel	Snowy grouper	Red snapper
Juvenile king mackerel	Yellowedge grouper	Other mid-shelf snapper
Spanish Mackerel	Other deep grouper	Greater amberjack
Cobia	Blueline tilefish	Almaco jack
Atlantic Spadefish	Golden tilefish	Bar Jack
Hogfish	Yellowtail snapper	Banded rudderfish
Ocean triggerfish	Mutton snapper	Blue runner
Gray triggerfish	Gray snapper	Other jacks
Gag grouper	Lane snapper	Other porgys
Red grouper	Cubera snapper	White grunt
Black grouper	Other shallow snapper	Other grunts
Scamp grouper	Vermilion snapper	Black Seabass
Other shallow grouper/tilefish	Silk snapper	Bank/Rock seabass