EwE development highlights, incl. modeling food web dynamics and spatial-temporal environmental variability

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a place of mind
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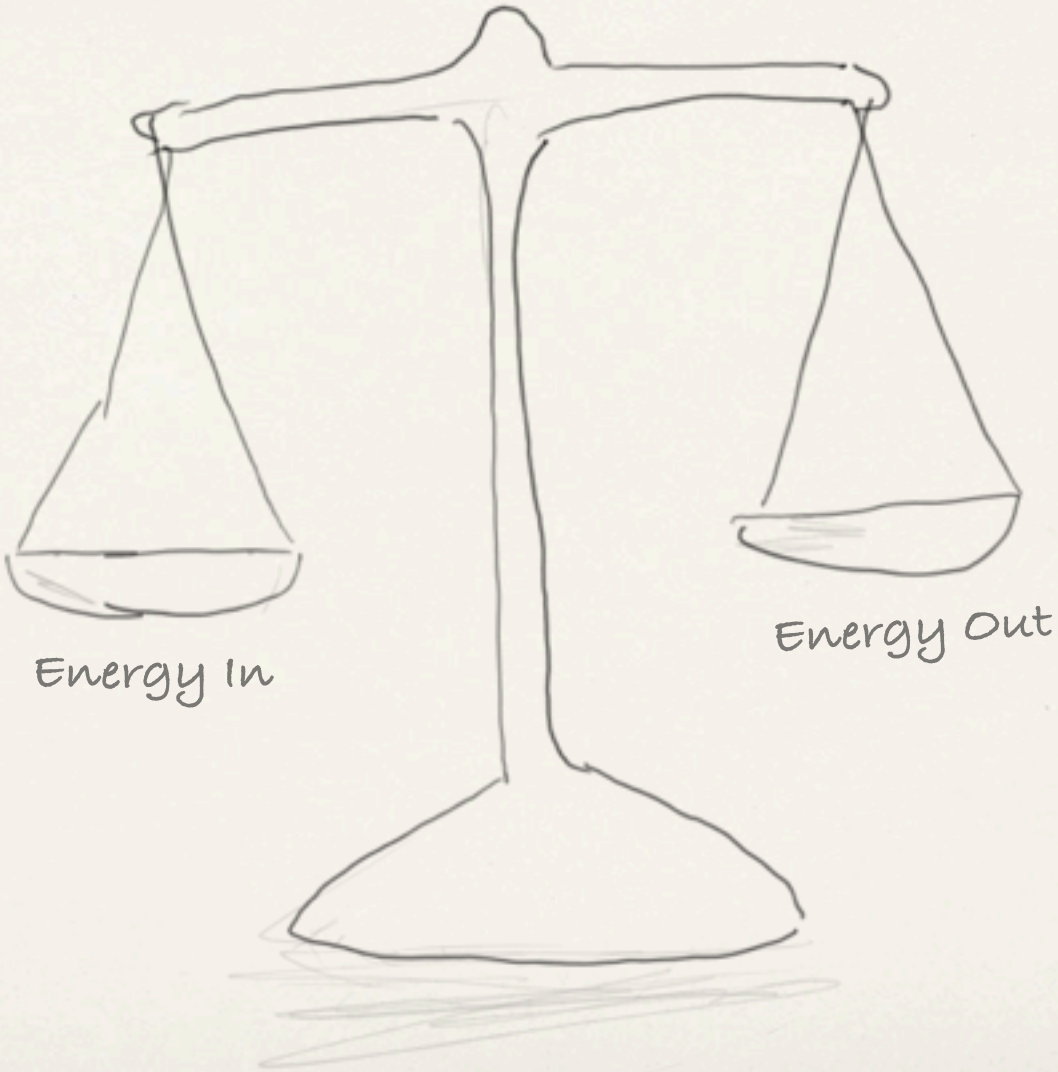
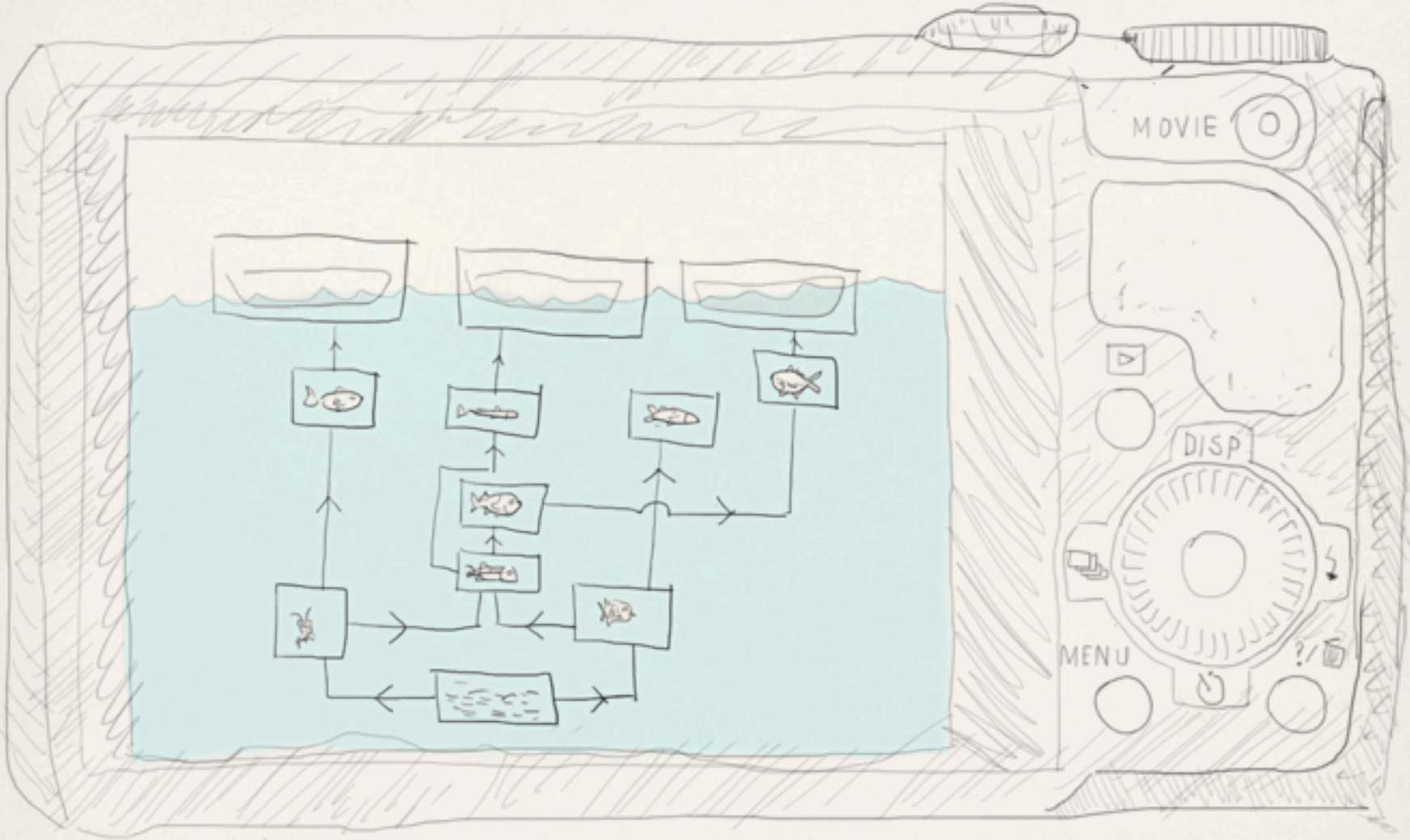
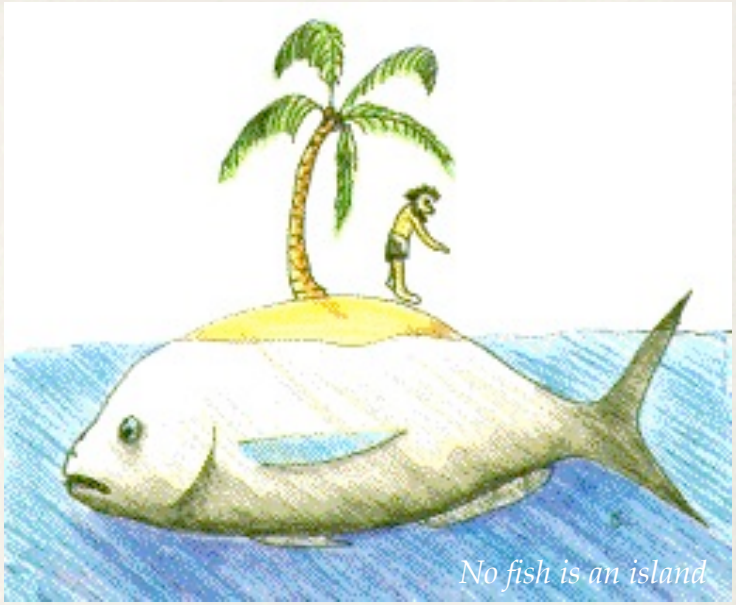

Energy In
Energy Out


MOVIE
DISP
MENU

Ecopath with Ecosim

- *Software system*
- *Open source-code (SVN access)*
- *Freely available (GNU GPL)*
- *www.ecopath.org*

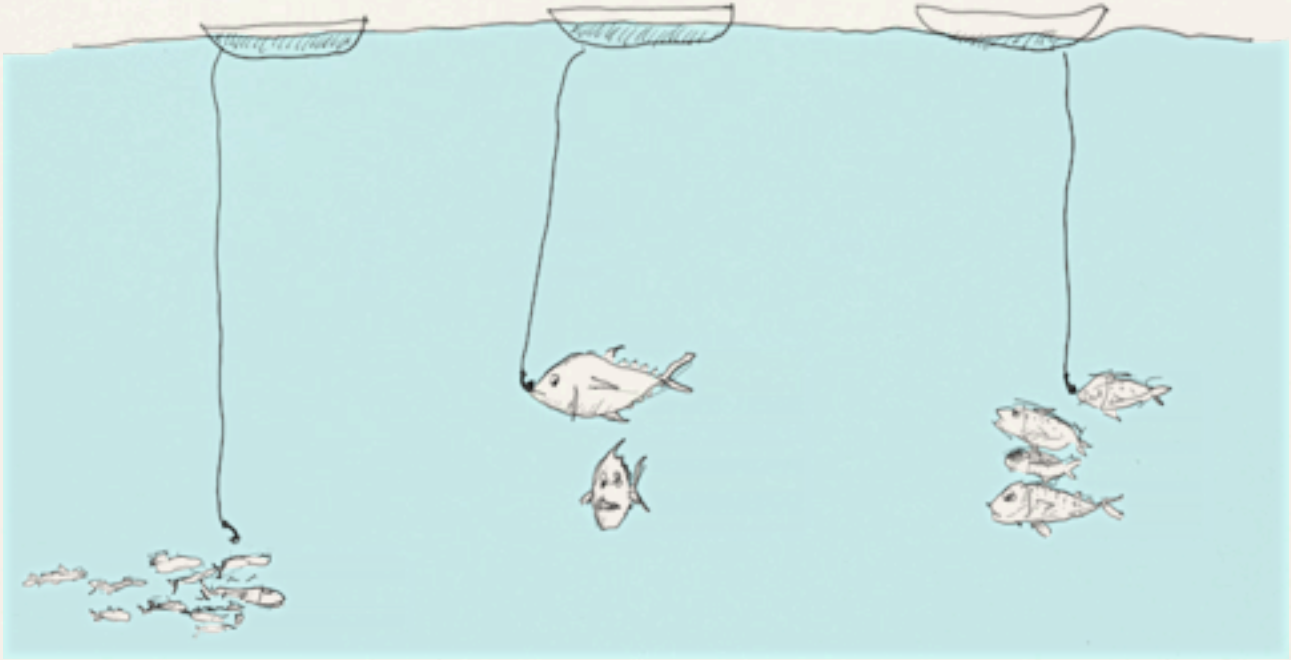


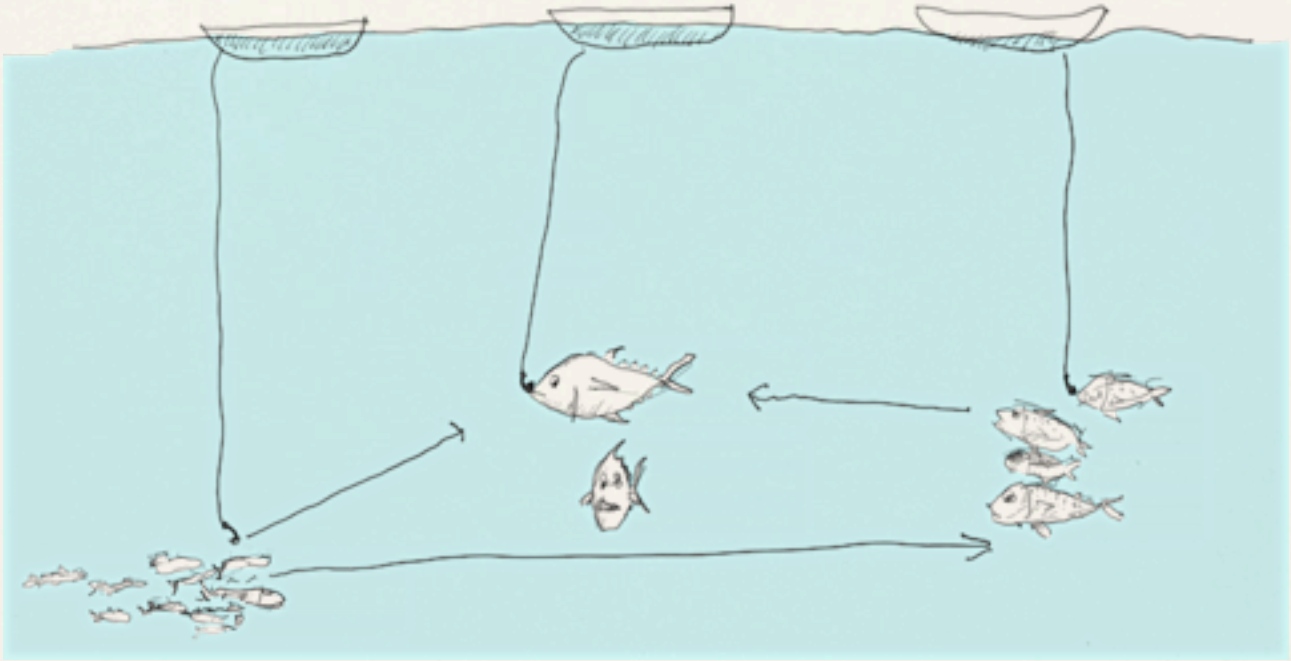
Ecopath: Mass-balance book-keeping

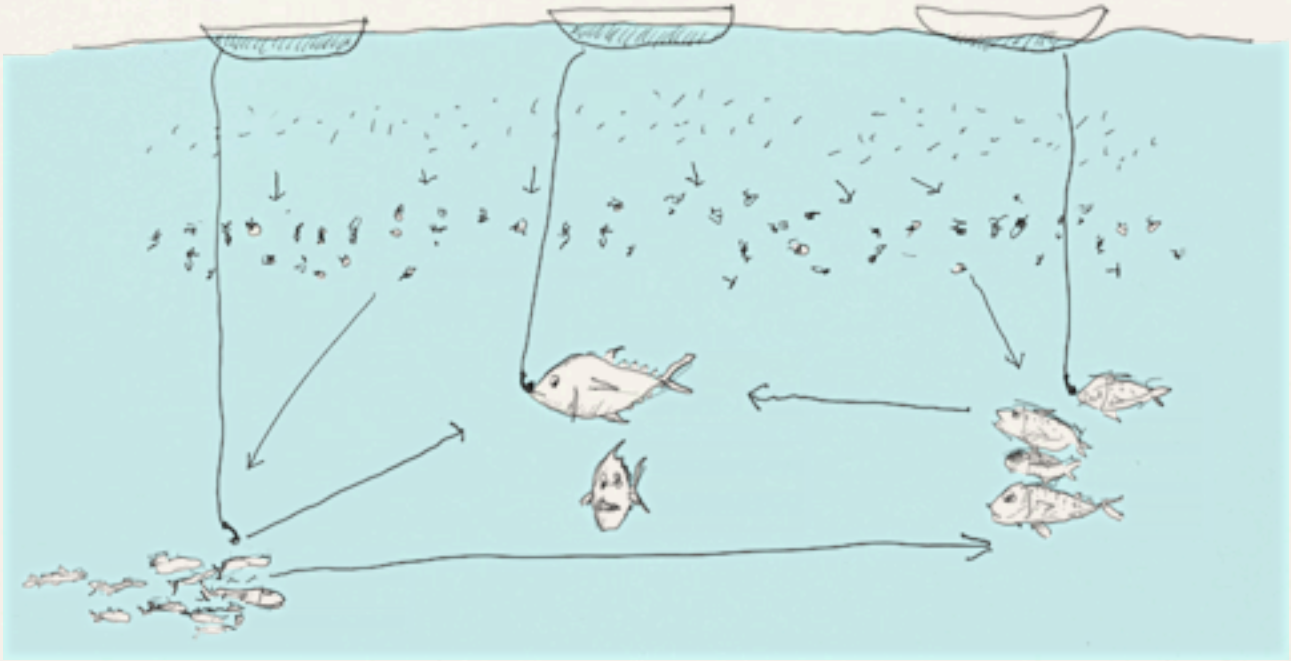
Ecosim: Time-dynamics, policy exploration, MSE, ...

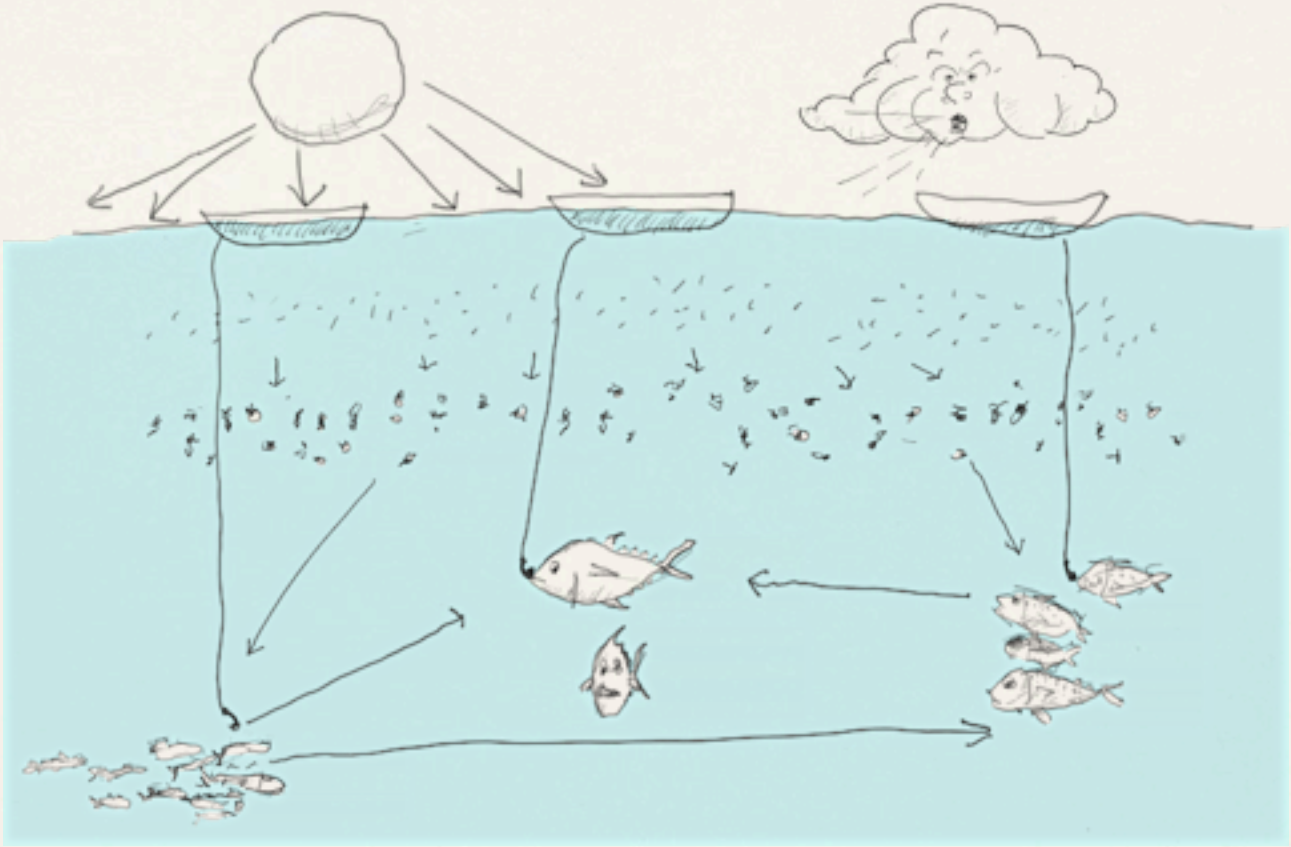
Ecospace: Spatial- and time-dynamics

Ecotracer: Tracking persistent pollutants

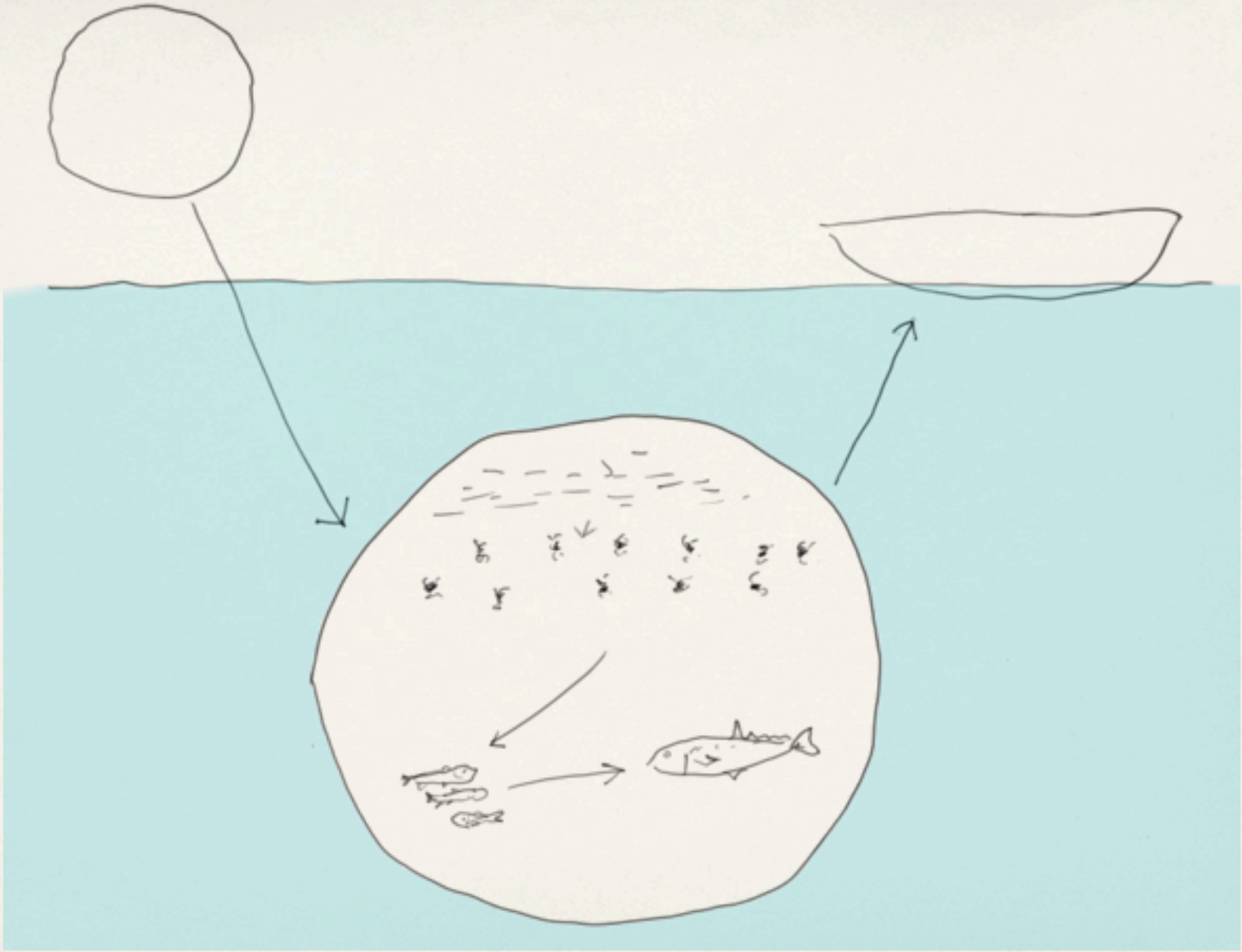




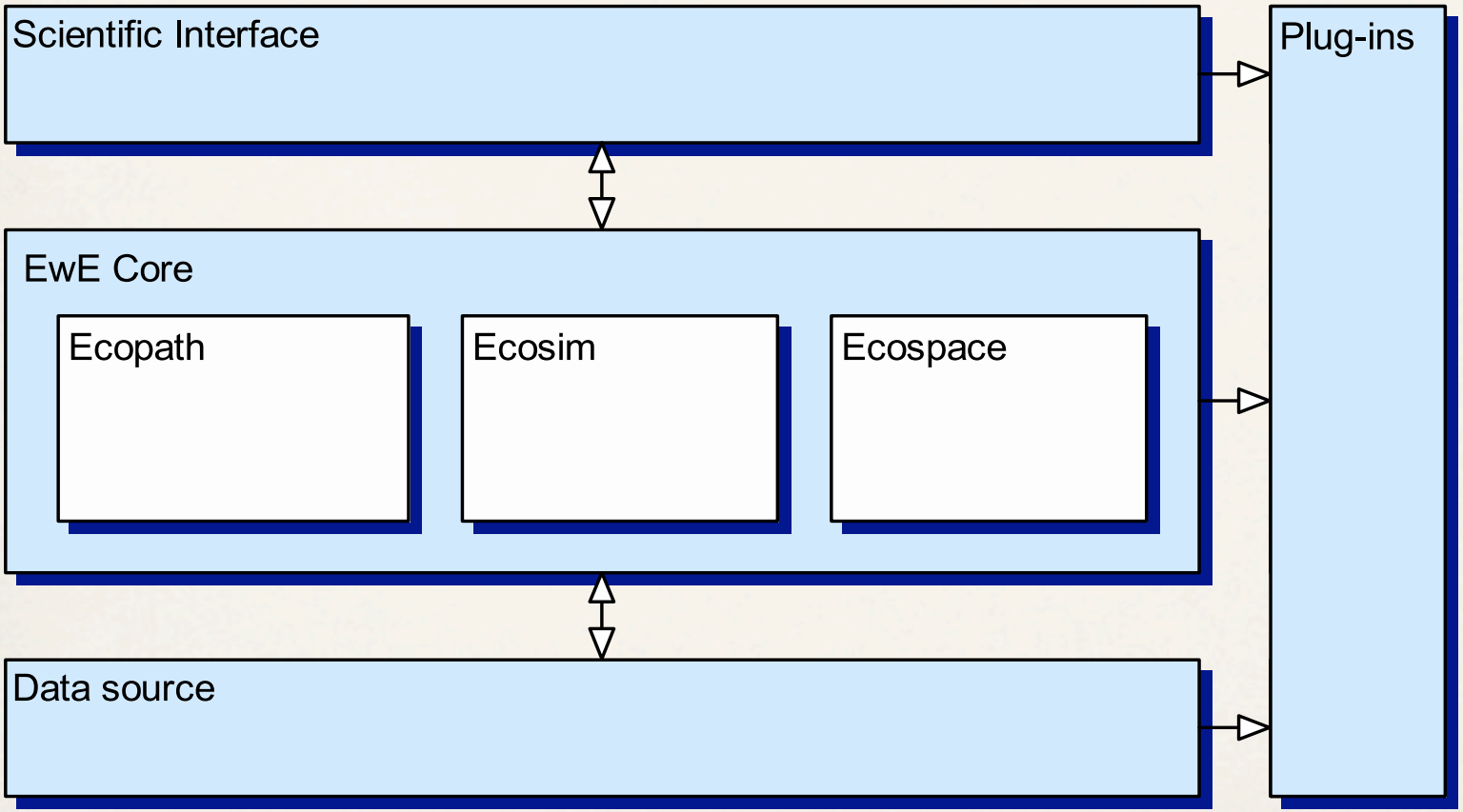




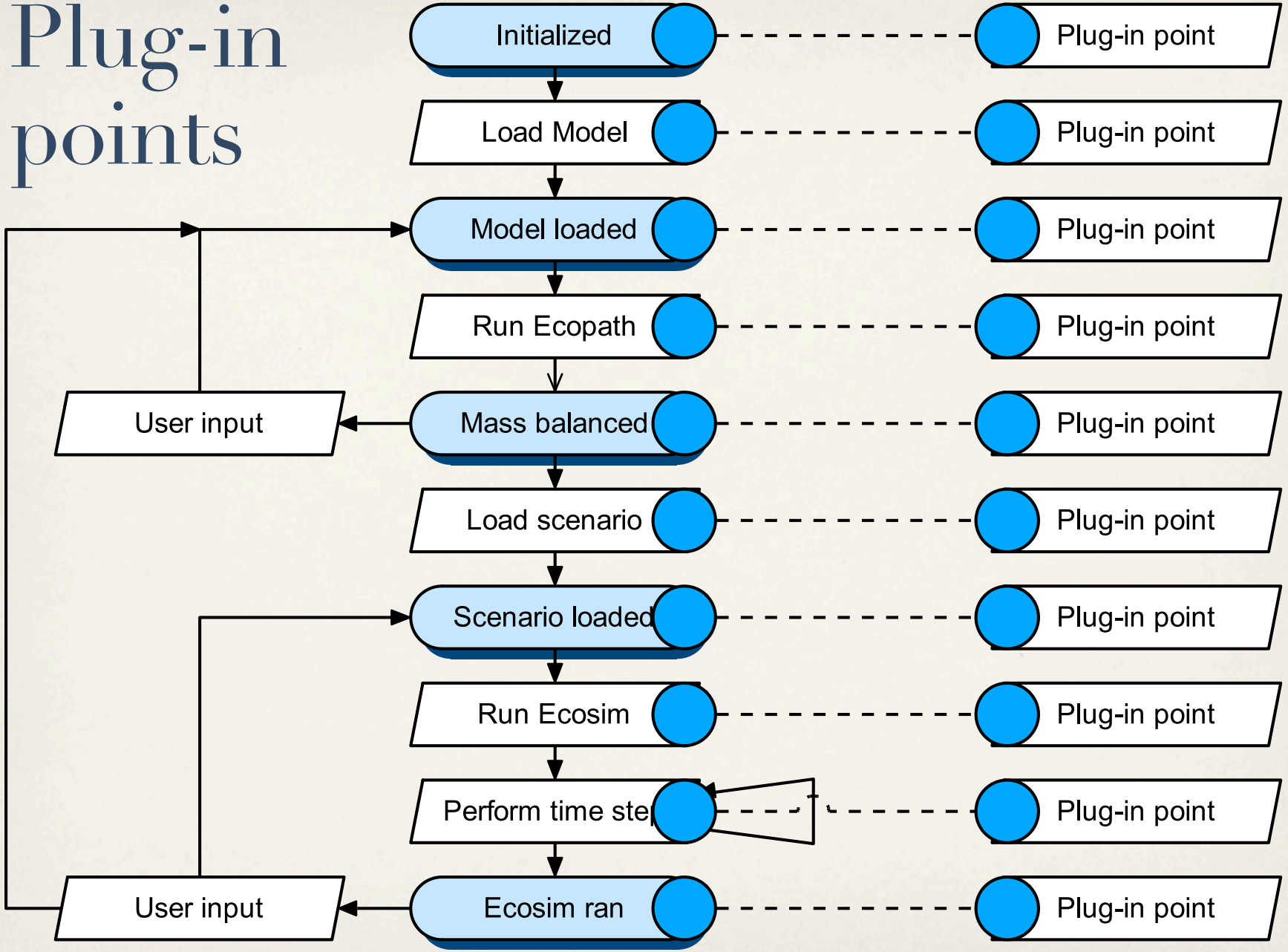
Ecopath models fitted to time series data



EwE6 overview



Plug-in points



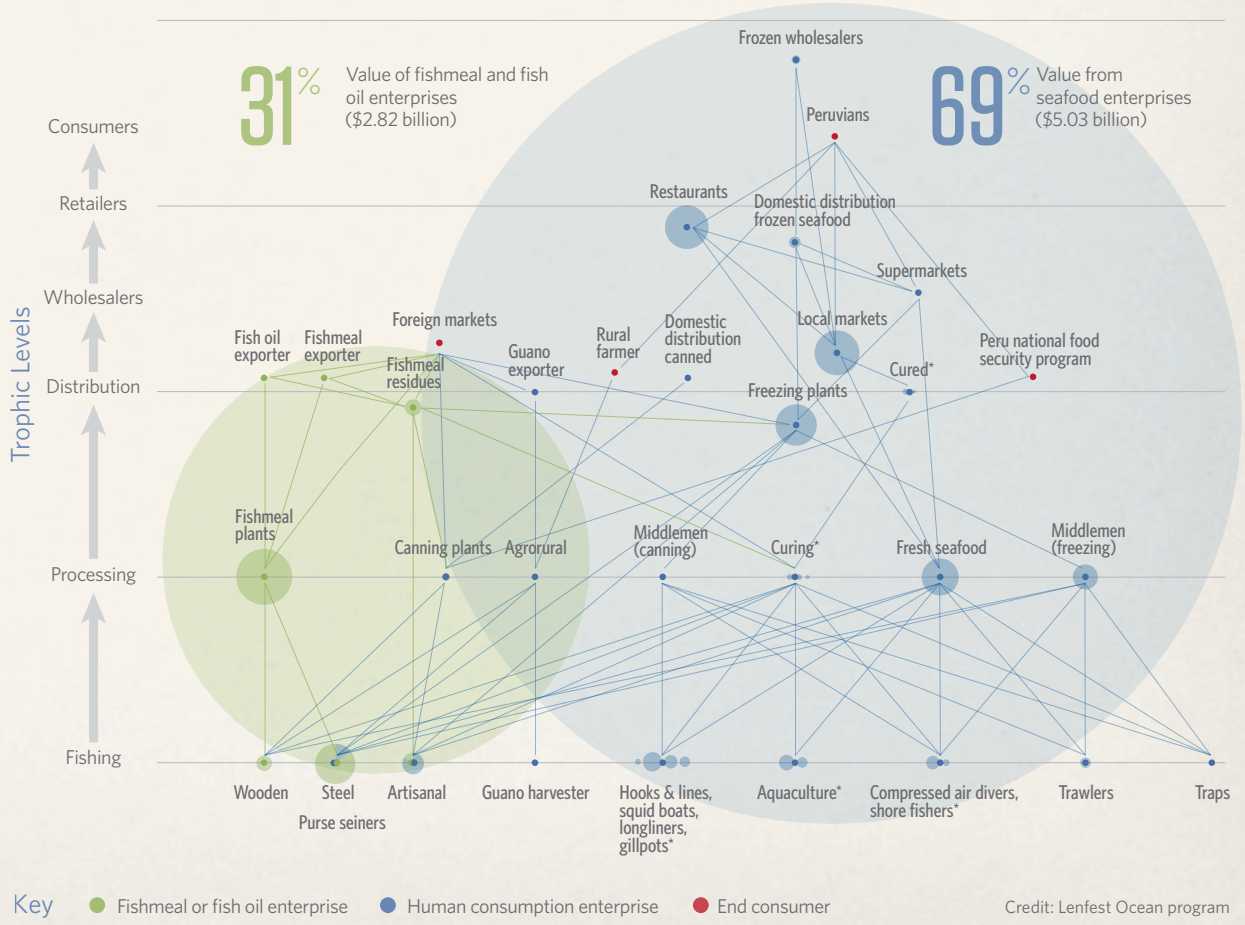
EwE modules/plug-ins

- Value chain, UBC
- Results-extractor (CEFAS)
- Management Strategy Evaluation implementation (CEFAS)
- Temporal-spatial dynamic data (UBC)
- EcoTroph (Agrocampus Ouest)
- Biodiversity indicators (CSIC-ICM)
- Network analysis, (SAMS)
- Network analysis - R (SAMS)
- Multi-Sim (DFO)
- Flow diagram (UBC)
- Ecopath model from Ecosim run (CSIC-ICM, CSIRO, DFO)
- Remarks extractor (UBC)
- Reading of GIS shape files*
- Dynamic habitat modification, (UBC)*
- FishBase taxon search*
- WoRMS taxon search*
- Sea Around Us search*
- Database-derived basemaps*
- ...

*) in progress

Value chain: Peru's fishing sector

- Bottom-up quantification
- Has world's biggest single-species fishery, for anchoveta
- But 69% of revenue and 87% of sector employment in Peru is from human consumption



Christensen et al. Marine Policy in press

EwE modeling integrates many spatial layers

Policy & awareness

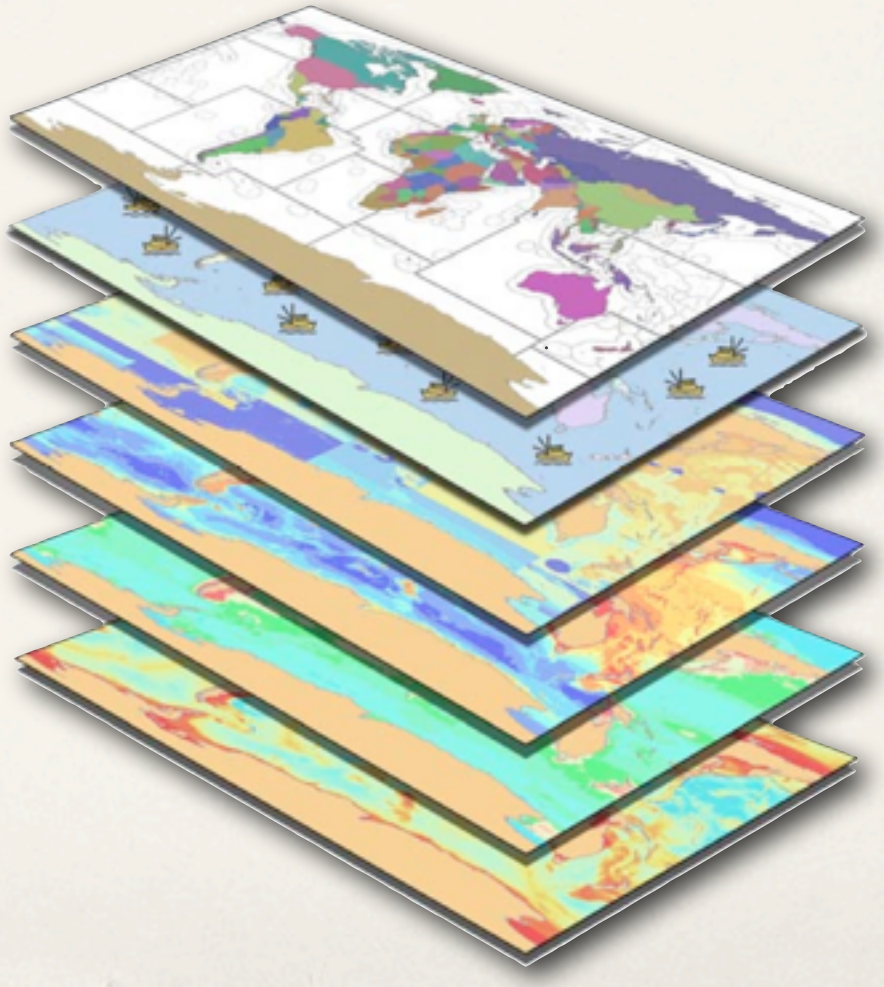
Economy & social

Seafood

Biodiversity

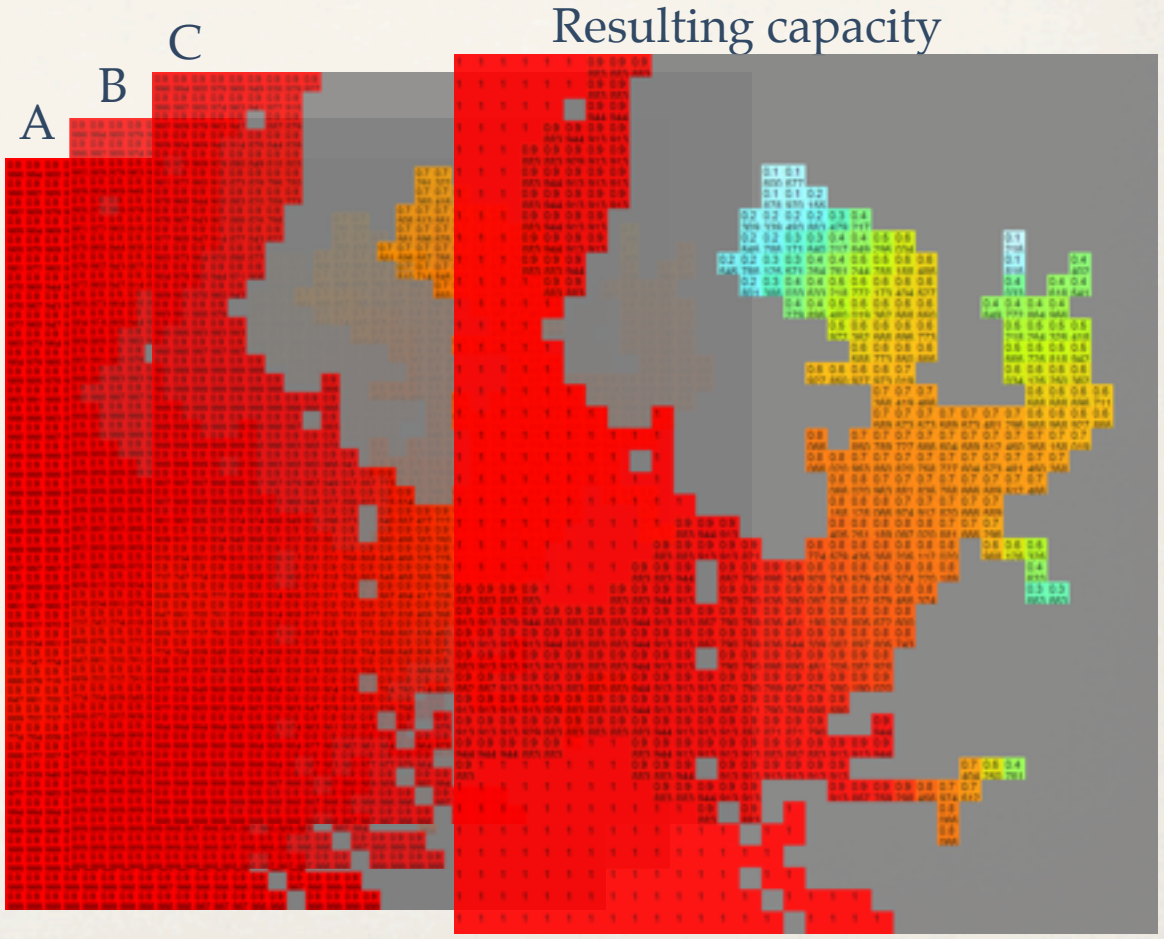
Productivity

Climate & currents



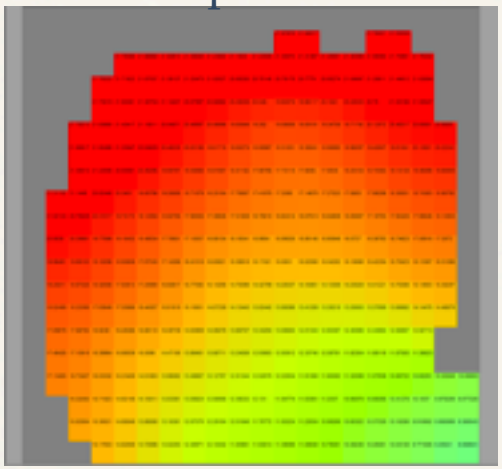
Habitat capacity modeling in EwE

- Dynamic habitat model predicts how productive individual cells are for each species
- Spatial cells have properties for different habitat types, e.g., %hard bottom

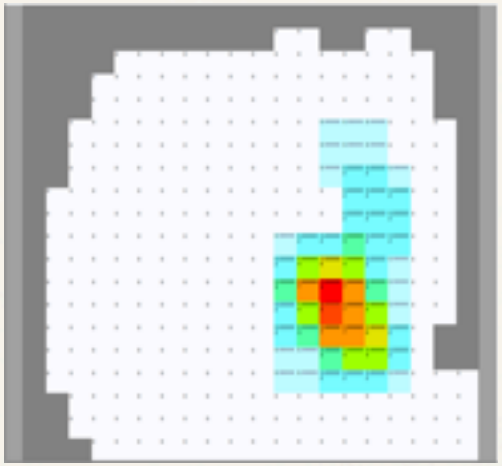


Habitat capacity: environmental maps

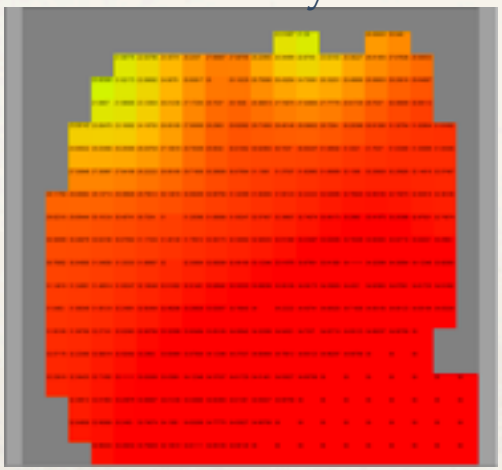
Temperature



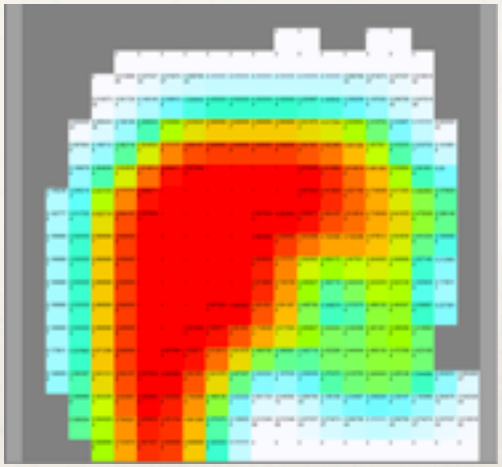
Reef area



Salinity

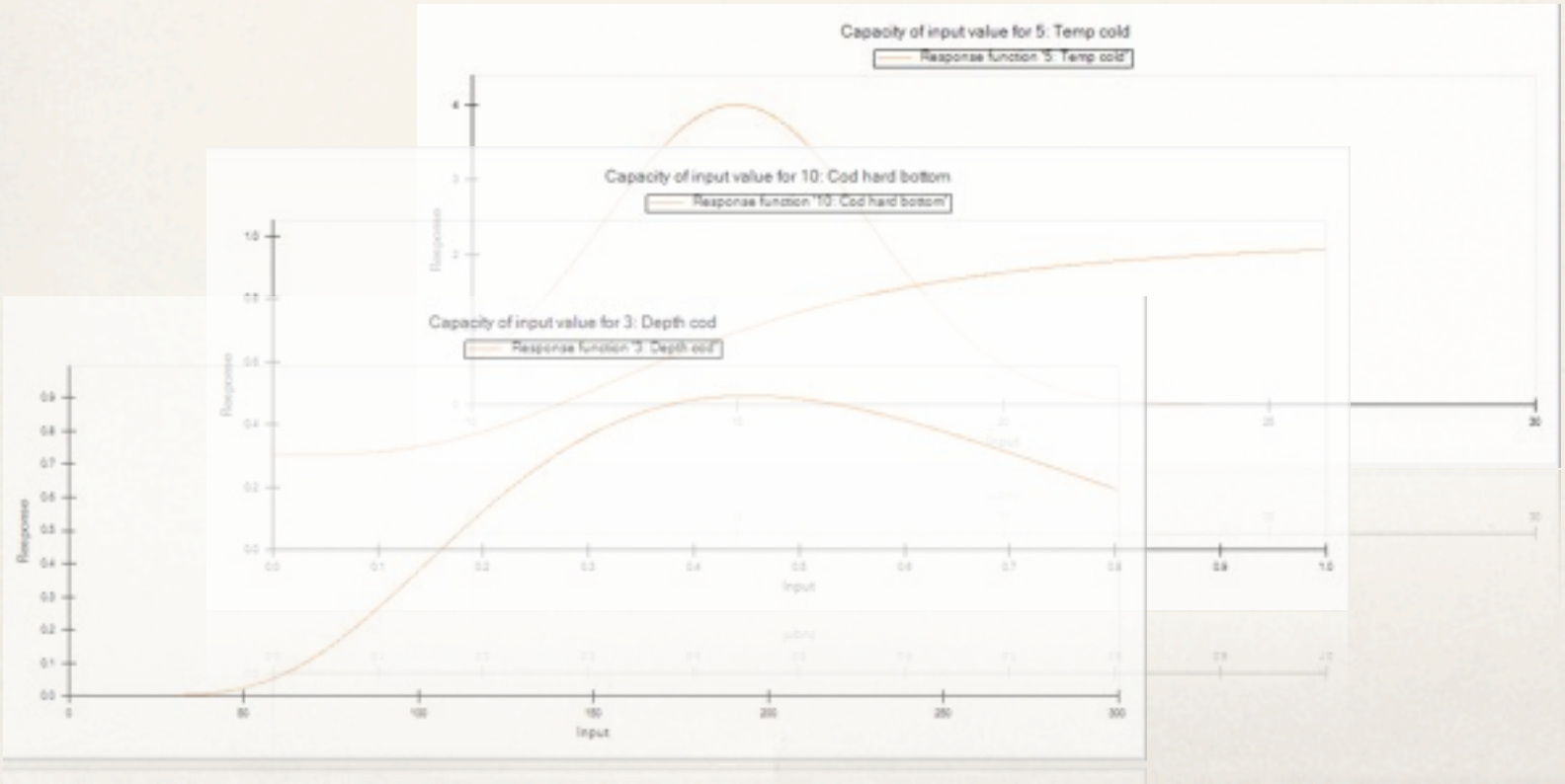


Sand bottom

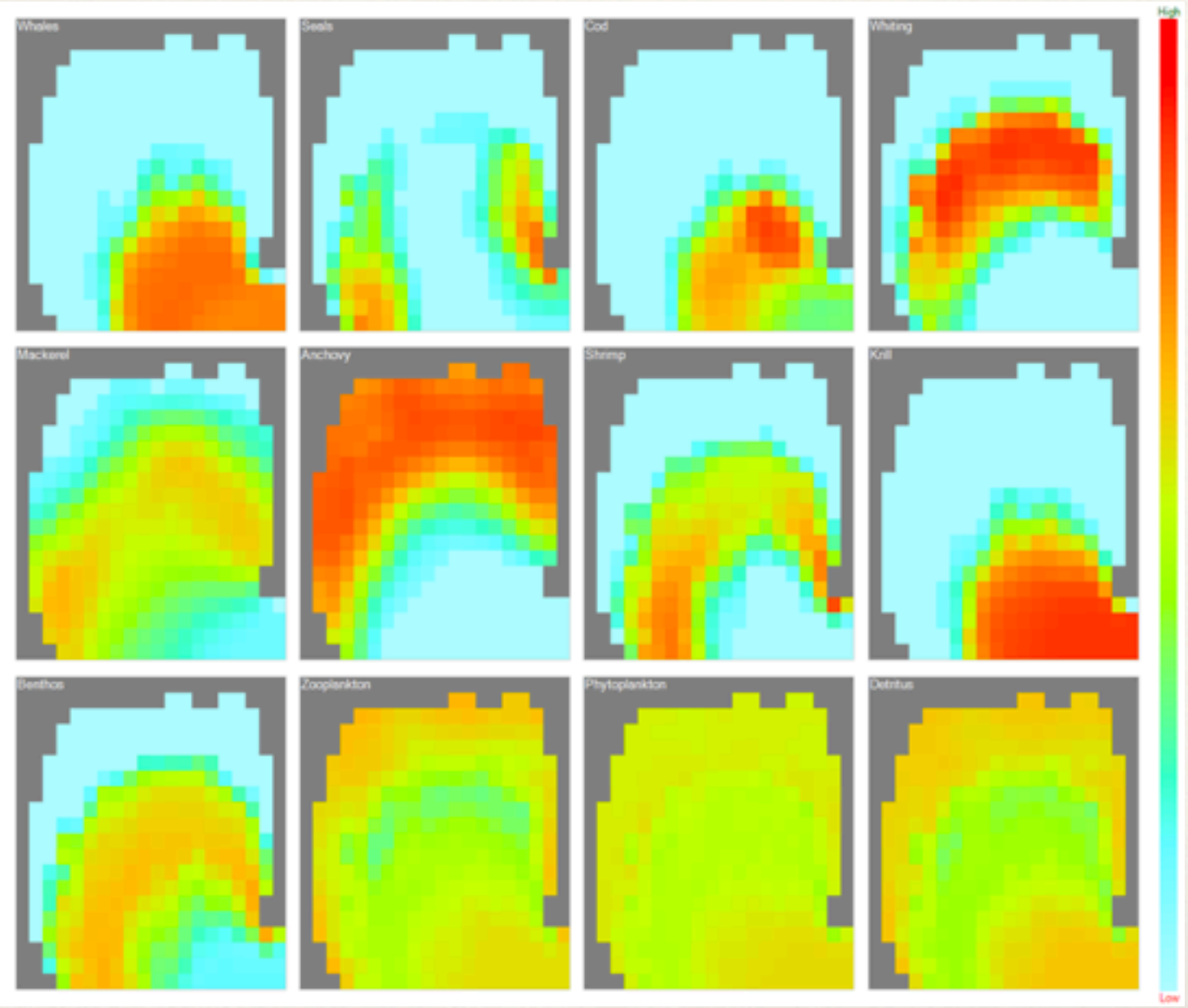


Habitat capacity modeling in EwE

- Basically asks the question: “why are the species where they are?”
- Spatial foraging arena use can be defined based on environmental factors



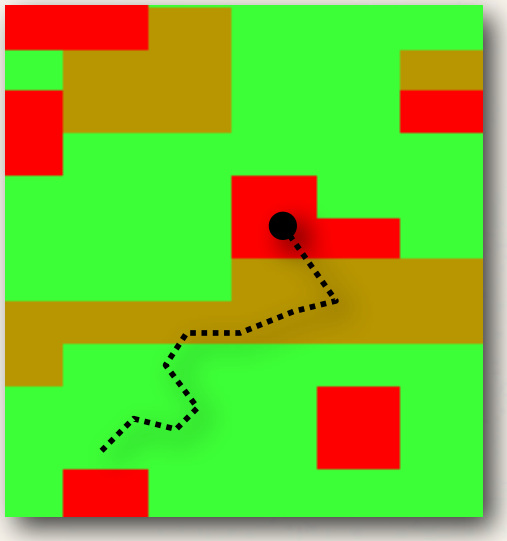
Habitat capacity: biomass maps



Ecospace IBM representation

State of each packet over time is represented by:

- X,Y position (spatial cell)
- Number of fish
- Mean body weight
- Age (stanza)



Spatial cells encountered by the packet vary in:

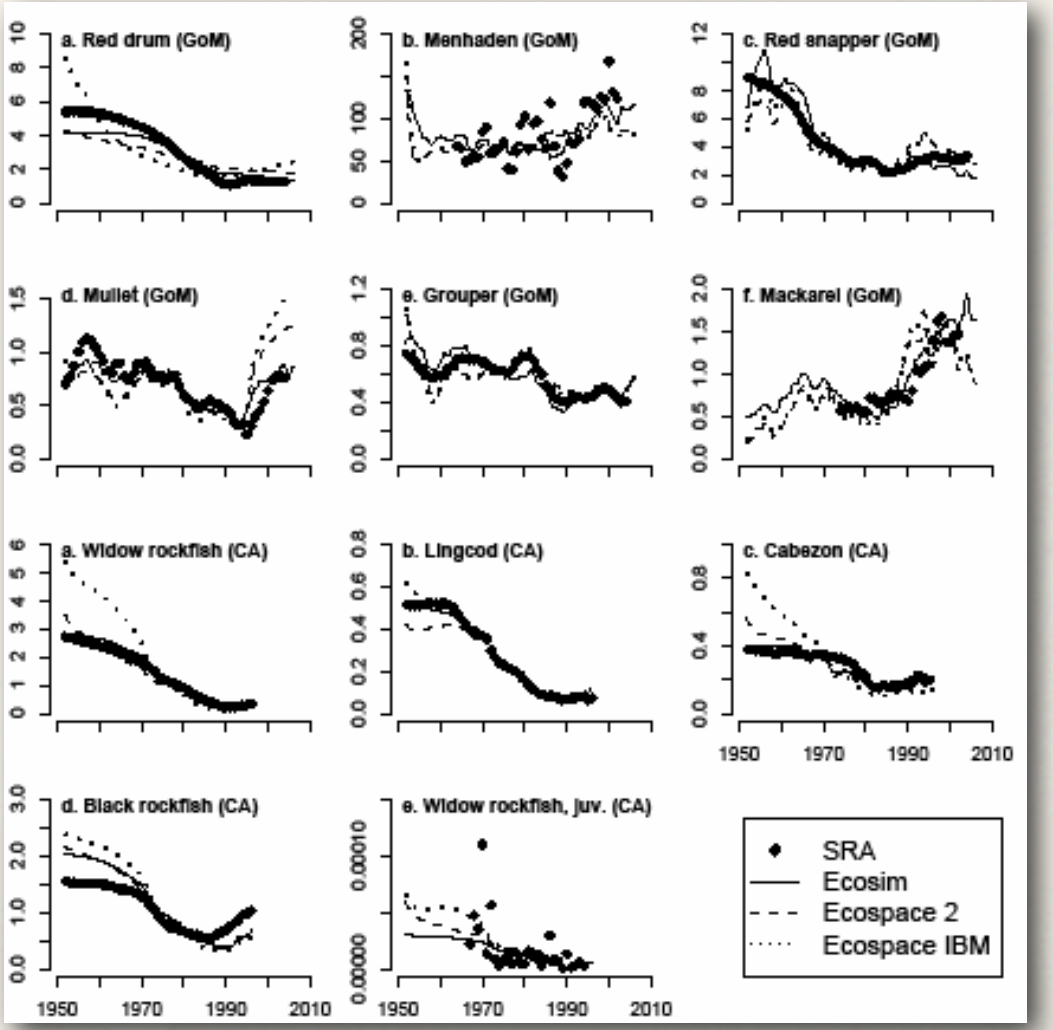
- habitat characteristics
- prey densities
- predation risk
- fishing effort

Movement rules include random direction change (diffusion), oriented seasonal migration movement, and fitness gradient moves (toward cells with higher fitness as measured by the ratio (food availability)/(predation risk)

Walters et al. Bull.Mar.Sci. 2009

SRA, Ecosim, Ecospace (& IBM) give similar time predictions and fits to

- Fits to historical stock reconstructions (SRA) and abundance trend indices for selected species, Gulf of Mexico and central California coast.

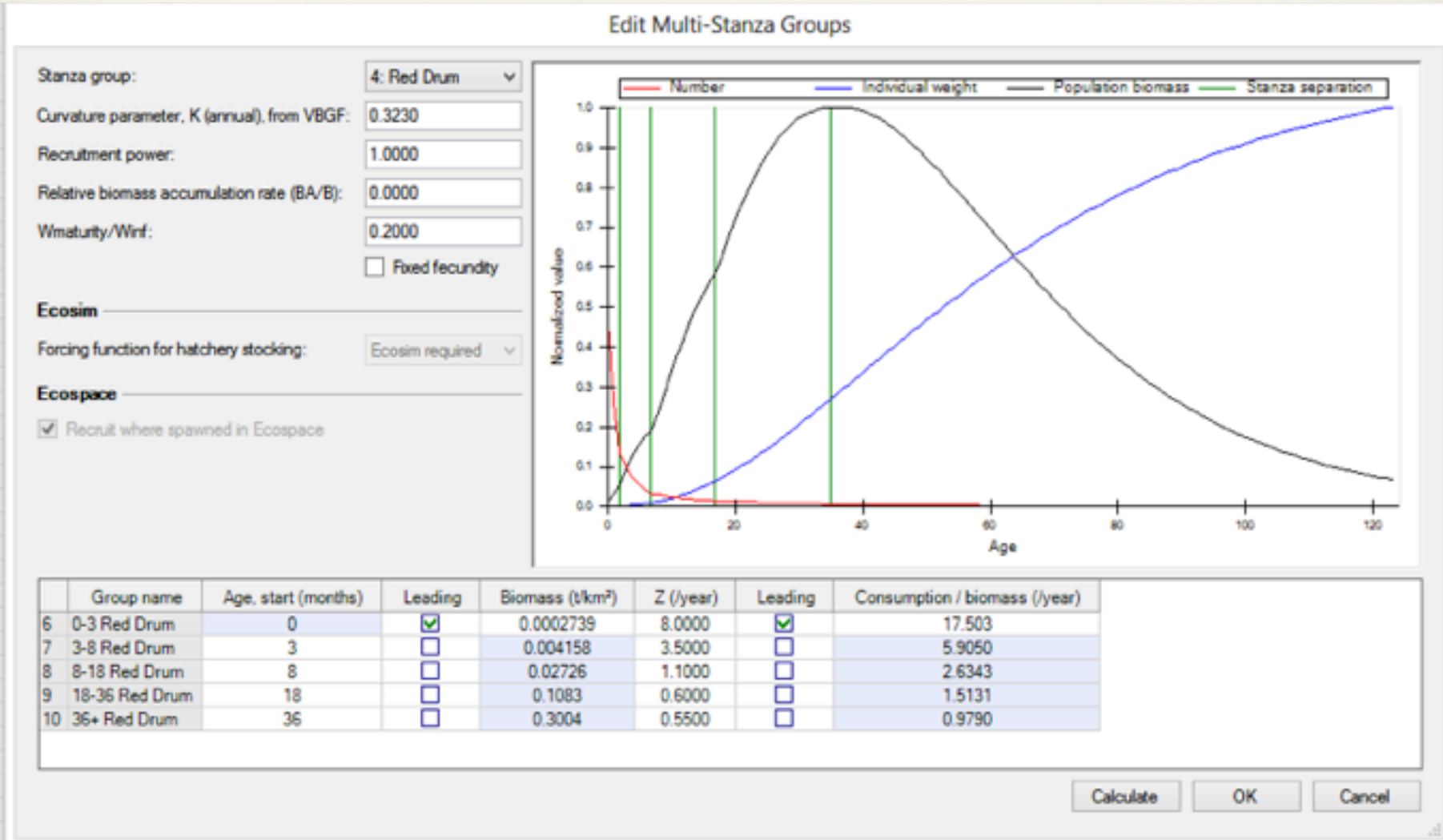


Walters et al. Bull.Mar.Sci. 2009

Modeling life history changes

- EwE uses multi-stanza formulation to model (key) groups where ontogenetic shifts are deemed important
- Has up to now been implemented using an age-based transition, but size-based is in the works

Multi-stanza groups: Size-based transitions is next



Model comparison: EwE & Size

- Size-based and trophic models use different approaches for modeling
- Also similarities, e.g. size is implicitly considered in diet compositions, (which, however, also have implicit spatial overlap considerations)
- For comparisons, common metrics are important
  - EwE can produce size spectra as a standard output, would be interesting to compare with similar output from size-based models

Gulf of Thailand size spectra

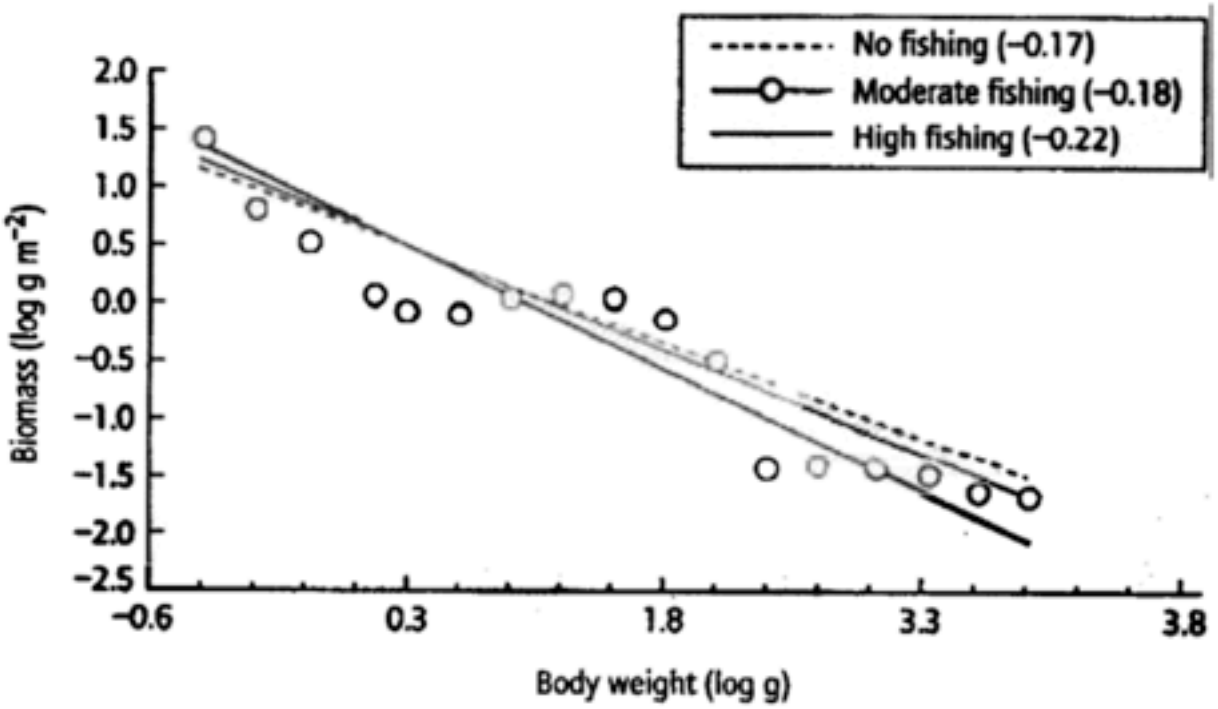


Fig. 10.2 Ecosystem-level size spectra for the Gulf of Thailand. The spectra are derived based on a trophic model with 40 ecosystem groupings (see *www.ecopath.org*). The thin line associated with 'moderate fishing' describes the 1973 situation in the Gulf, while the broken line indicates the slope of the model situation at long-term equilibrium without fishing, and the thick line indicates the 1994 situation, with resources severely depleted by over-fishing. Note that the slopes of the spectra (in brackets) increase with fishing pressure.

Pauly & Christensen 2002

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