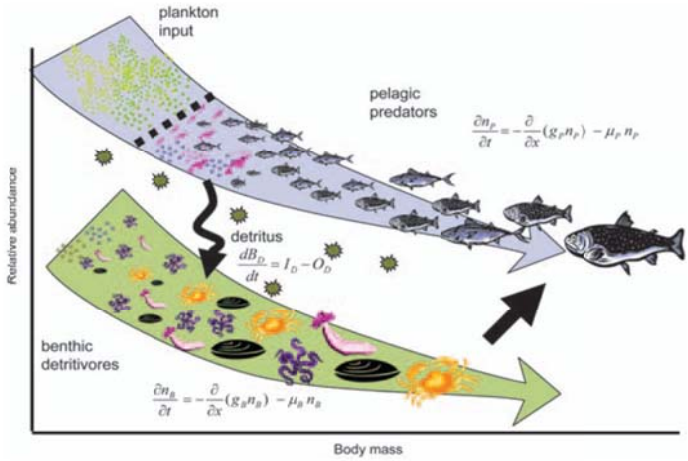
Coupled Community Size-Spectrum Model (CCSSM)



Model type: The CCSSM models the structure and dynamics of two interacting size structured communities. The "pelagic" community consists of predators feeding on other predators and on "benthic" prey that share and compete for detritus[1]. Species are not represented explicitly and phytoplankton dynamics are not modelled explicitly. This non-spatial model provides predictions of the abundance of organisms in each size-structured food chain at size, based on growth and mortality that arise from organisms encountering and eating available and suitable food. In various applications, outputs of size and abundance in each food chain can be used to predict changes in the size spectrum in response to fishing, temperature and primary production and predicting fishery yields.

Existing Models for UK shelf seas:
Predictions of size-spectrum slopes were validated in the North Sea by comparing model predictions with empirical data on the size structure of pelagic predator and benthic detritivore communities. Fish production estimates from an application to 78 EEZs using physical–biogeochemical model inputs for 1992–2001 showed reasonable correspondence with national catch statistics from the United Nations Food and Agriculture Organisation (FAO) database. Modelled relative growth rates have been compared with empirical growth rates for species from the North Sea and elsewhere and fall within reasonable bounds given that the coupled size-spectrum model treats growth as a continuous process and does not represent species.

Existing uses:
- Assessment of fishing impacts on community size structure and abundance in the North Sea[1].
- Exploration of the effects of coupling between pelagic and benthic food webs on responses to fishing[2].
- Prediction of the effects of climate change on fish production at regional and global scales[3].
- An extension of the model to has been applied to coral reefs to investigate the consequences of habitat complexity loss on fisheries[4].

Potential new uses:
- Inferring fishing mortalities across regions by fitting the model to landings data from 85 different regions globally and with quantifiable uncertainty measures to assist policy makers.
- As part of a multi-model ensemble to address climate effects on fisheries.

Key modelling issues:
- Empirical research on the links between benthic and pelagic components of the model would provide better validation for future application.
- Care should be taken when setting up the time and size resolution of the model as these can result in instabilities.

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[1] Blanchard et al. (2009). Journal of Animal Ecology 78, 270-280.
[2] Blanchard et al. (2011). Theoretical Ecology 4, 289-300.
[3] Blanchard et al. (2012). Philosophical Transactions of the Royal Society of London: Biological Sciences 367, 2979-2989.
[4] Rogers et al. (2014). Current Biolopgy 24, 1000–1005.