

Douglas C. Speirs, Michael R. Heath,
Angus Cameron & Chris McCaig

WP5 TASK 5.2.2 (Quantify the impact by Atlanto Scandic herring and associated pelagic fish such as blue whiting and mackerel exert on mid trophic levels) and **5.3.2** (Develop quantitative and qualitative models with herring, blue whiting as the focal species for predicting the expected impacts of changes in fishing and climate)

- Deliverable 5.2 (Progress report on trophic control mechanisms for key species)

WP8 TASK 8.2 (Comparative analysis of North Atlantic marine food web structure and function) work towards the following deliverables:

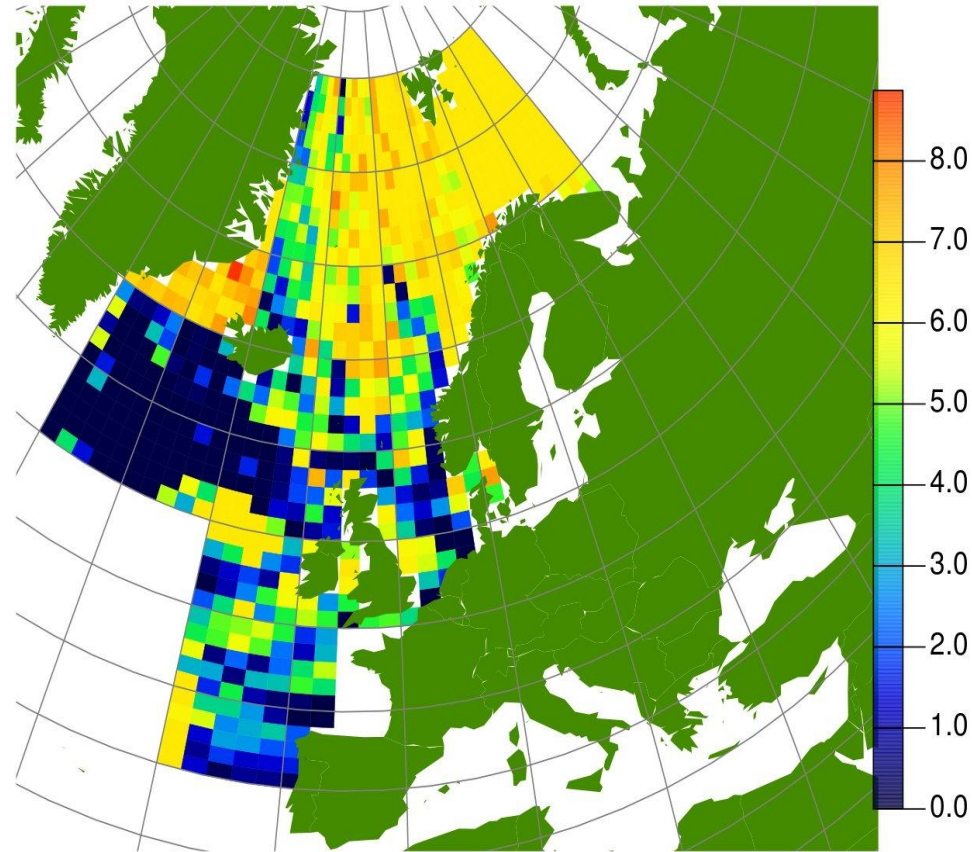
- Extension of Deliverable 8.3 (compilation of input data for each region in which the StrathE2E model will be applied)
- Deliverable 8.4 (Report on final tuned food web & key species analyses for each region)
- Deliverable 8.5 (Report on the pressures and processes causing structural ecosystem changes and key species dynamics),
- Deliverable 8.9 (Evaluate indicators identified within the MSFD, or alternative indicators, to characterise GES).

WP5 Spatial modelling of blue whiting

- Produce spatial and temporal maps of blue whiting predation on mid-trophic levels
- We have developed an Eulerian model of blue whiting, with explicit length structured life cycle and fine spatial resolution
- Our model must explain large changes in blue whiting recruitment

Personnel

D. Speirs, M. Heath,
C. M^cCaig – 50% PDRA since July 2012



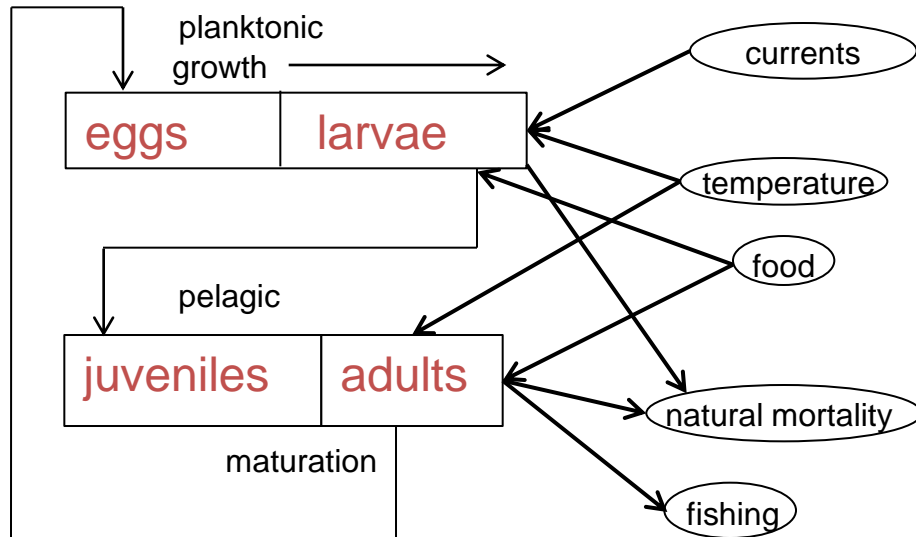
Map of blue whiting spawning stock biomass 25/12/2006

Preliminary model results

Model elements

Model of blue whiting life cycle

Drivers from NOCS NEMO-MEDUSA model



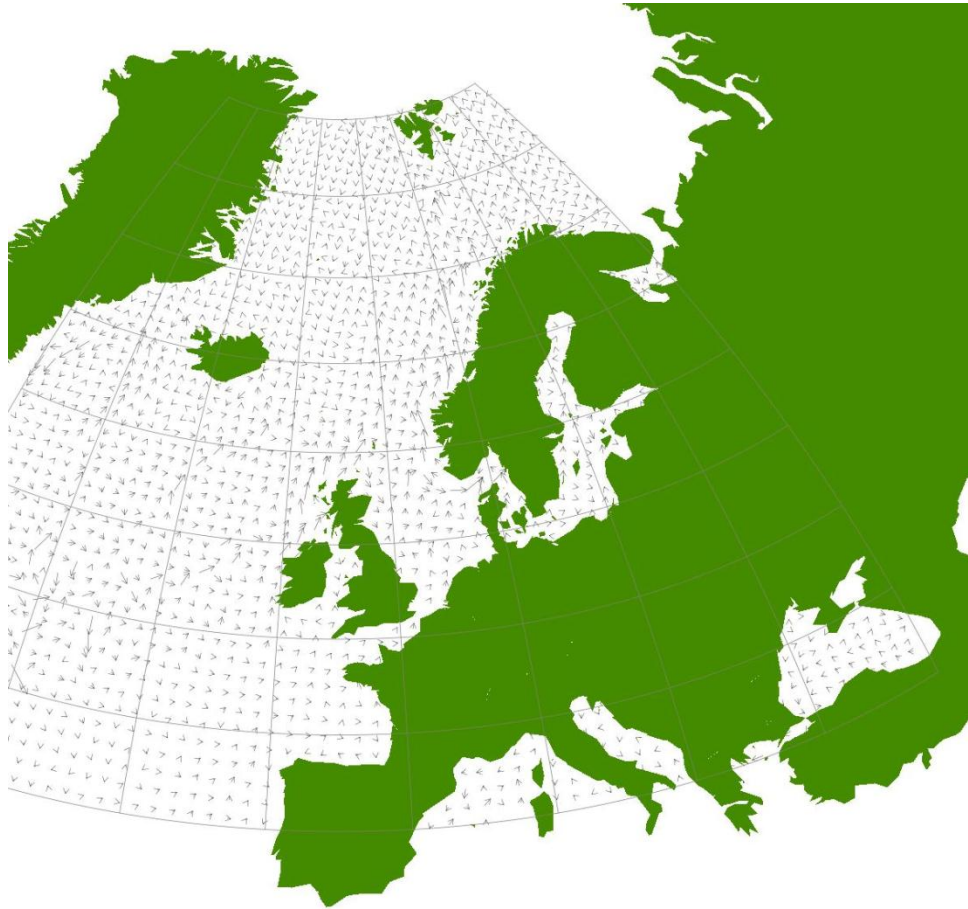
outputs

Biomass;
length
distributions;
temporal and
spatial map of
predation on
zooplankton

Model outputs to
be validated by
comparison to
stock
assessments and
survey length
distributions

- Model captures progression of numbers of individuals through development classes of juveniles and adults
- Rate of progression is a function of food and temperature
- Predation is determined by growth and development of juveniles and adults
- Spatial domain is 40° - 80° N, 40° W- 40° E (omitting Mediterranean & Baltic seas) with grid cells 2° E x 1° N
- Present results are preliminary as full climate/food drivers are not satisfactorily implemented

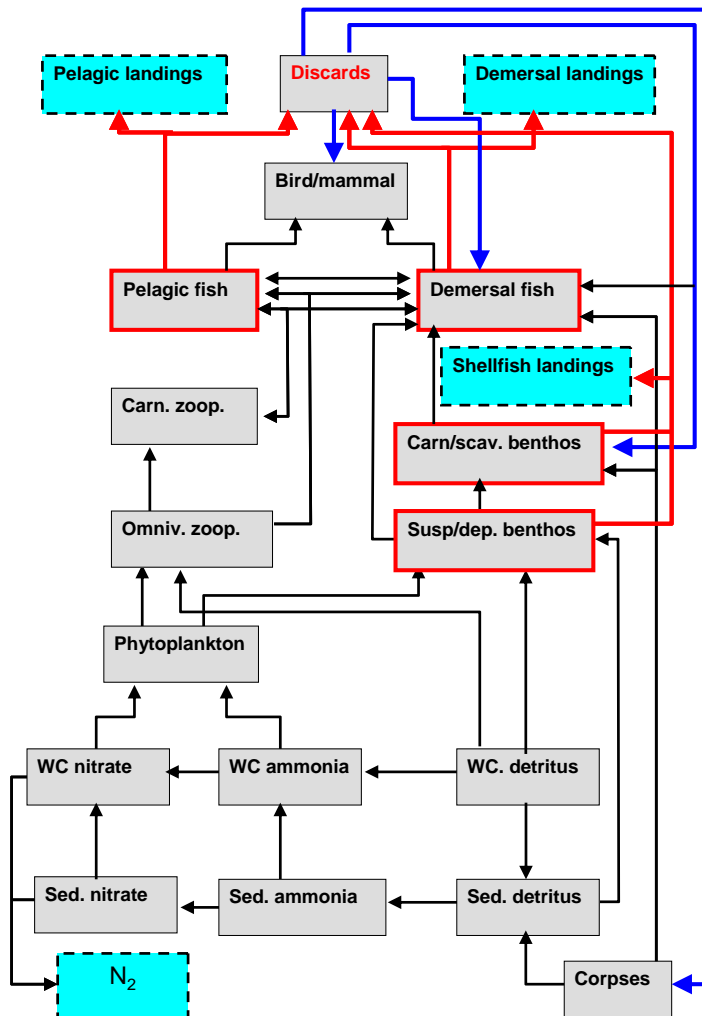
Ongoing development



Current field 21/3/1990
from NEMO-MEDUSA model of NOCS

- Growth and spatial transport of individuals as a function of currents, temperature (using model outputs from WP6) and zooplankton food availability (using model outputs from WP4) to be implemented
- Forward run to be performed – when driving data is available
- Predation impact on zooplankton to be calculated for different scenarios
- Calculating predation impacts will be particularly challenging as blue whiting do not feed consistently over year

WP8 Shelf seas E2E regional models



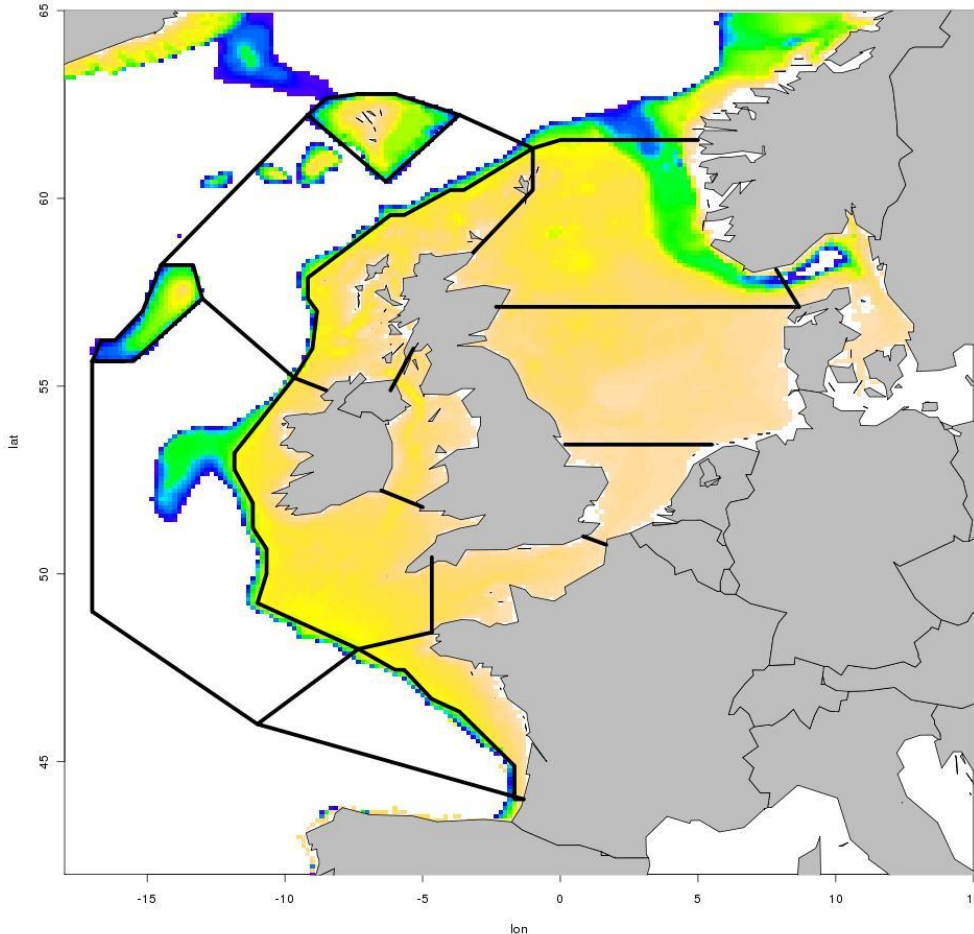
Extension of Deliverable 8.3

The configuration and driving variables required to run the StrathE2E model :

- Model layer volumes and thicknesses (*Completed*)
- Monthly hydrodynamic volume fluxes, and (WP6 *delivery delayed*)
- Monthly temperature and vertical layer exchange rates (WP6 *delivery delayed*)
- Monthly suspended sediment (*Completed*)
- Monthly freshwater nitrate and ammonia inputs to each region, and river nitrate and ammonia concentrations (*Completed*)
- Monthly averaged atmospheric deposition rates of nitrate and ammonia (*Completed*)
- Regional seabed sediment porosity (*Completed*)
- Annual of fishery harvest ratios (proportion (*Completed*))

The StrathE2E model available as a C-object for running in the R Statistical Environment, and is being developed as a web application - see www.mathstat.strath.ac.uk/outreach/e2e/

WP8 Shelf seas E2E regional models



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Outputs

Deliverable 8.4 (Report on final tuned food web & key species analyses for each region):

• **Identifying key parameters affecting North Sea fisheries: Global sensitivity analysis of a marine end-to-end ecosystem model.** David J. Morris, Douglas C. Speirs, Angus I. Cameron, Michael R. Heath

Submitted: *Ecological Modelling* – currently being revised following referee comments

• **Dynamic food webs in a changing world: A trait-based modelling approach for describing shifting species composition within functional groups in response to changing temperatures.** Angus I. Cameron, David Morris, Douglas C. Speirs and Michael R. Heath

Manuscript close to submission. MASTS Annual Science Conference abstract, August 2013

Deliverable 8.5 (Report on the pressures and processes causing structural ecosystem changes and key species dynamics):

• **Understanding patterns and processes in models of trophic cascades.** Michael R. Heath, Douglas C. Speirs, John Steele

In press *Ecology Letters*. MASTS Annual Science Conference abstract, August 2013.

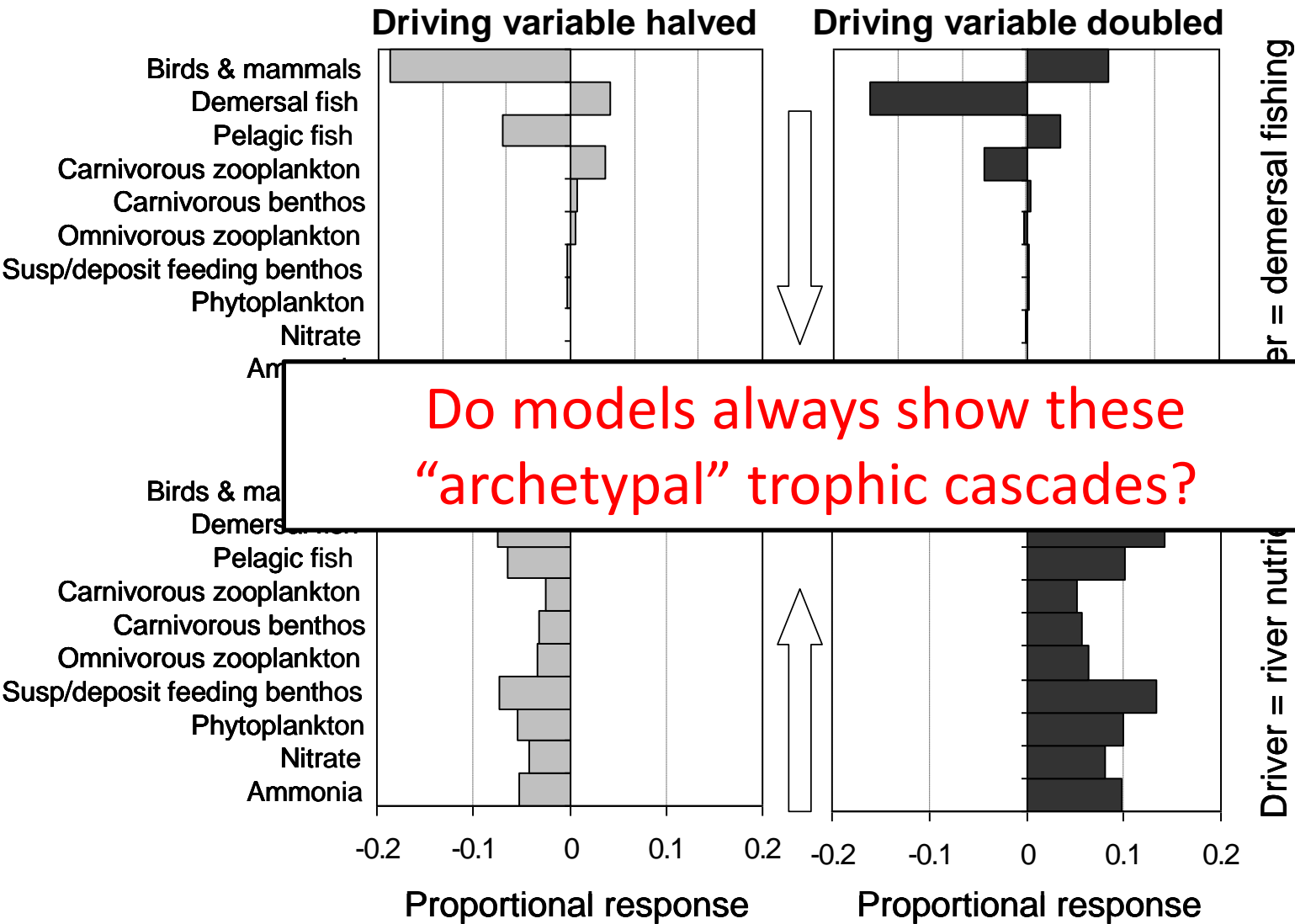
• **Ecosystem consequences of a ban on fishery discards.** Michael Heath, Robin Cook, Angus Cameron, David Morris and Douglas Speirs. MASTS Annual Science Conference abstract, August 2013.

Deliverable 8.9 (Evaluate indicators identified within the MSFD (or alternative indicators) to characterise GES):

• Using a partial ecosystem model to define strategies to achieve fish community size composition targets under an ecosystem approach to marine management. **Douglas C. Speirs, Simon P.R. Greenstreet, Chris McCaig.**

Manuscript to be submitted to *Journal of Applied Ecology*.

Trophic cascades in StrathE2E





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