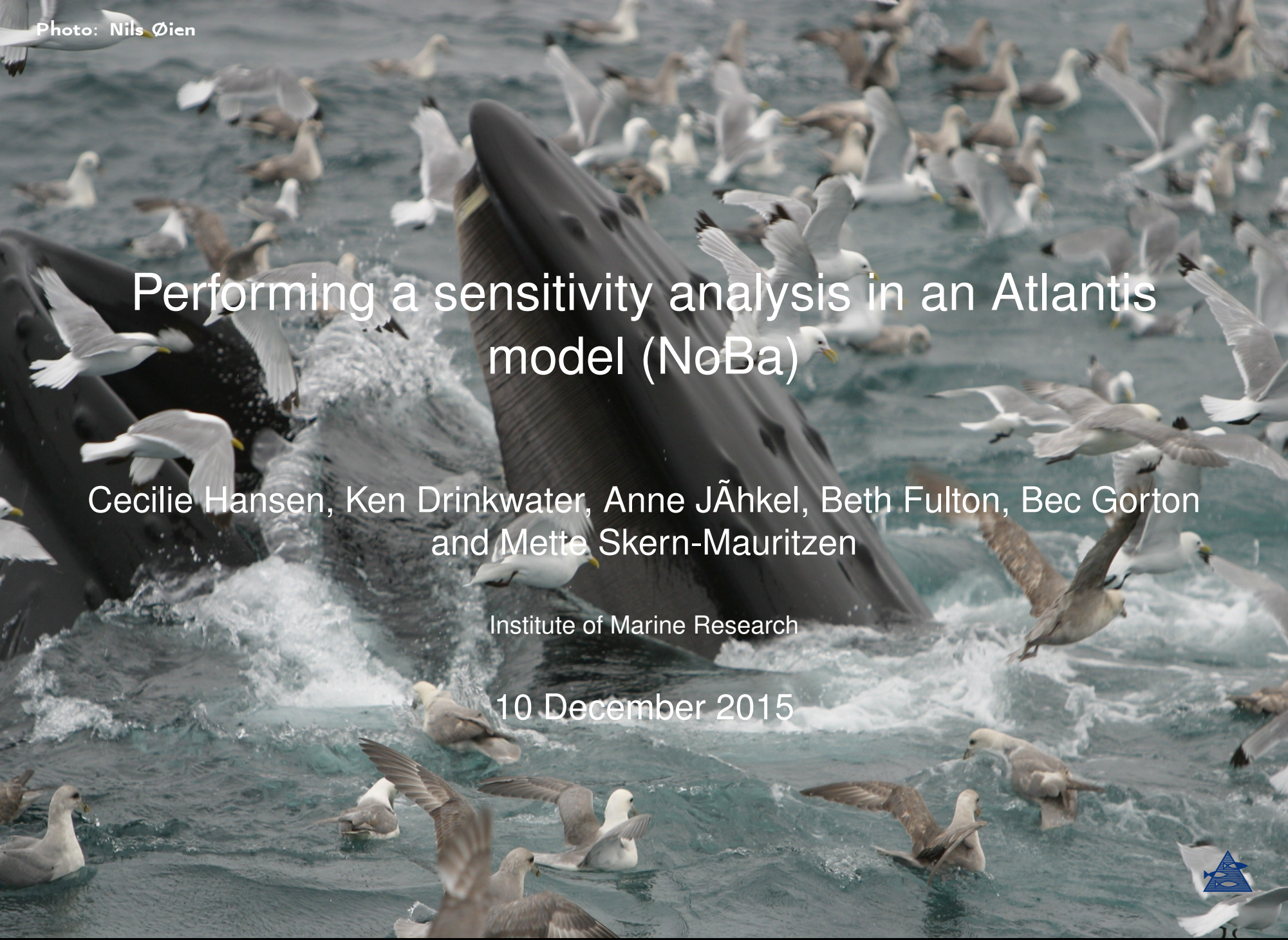


Performing a sensitivity analysis in an Atlantis model (NoBa)

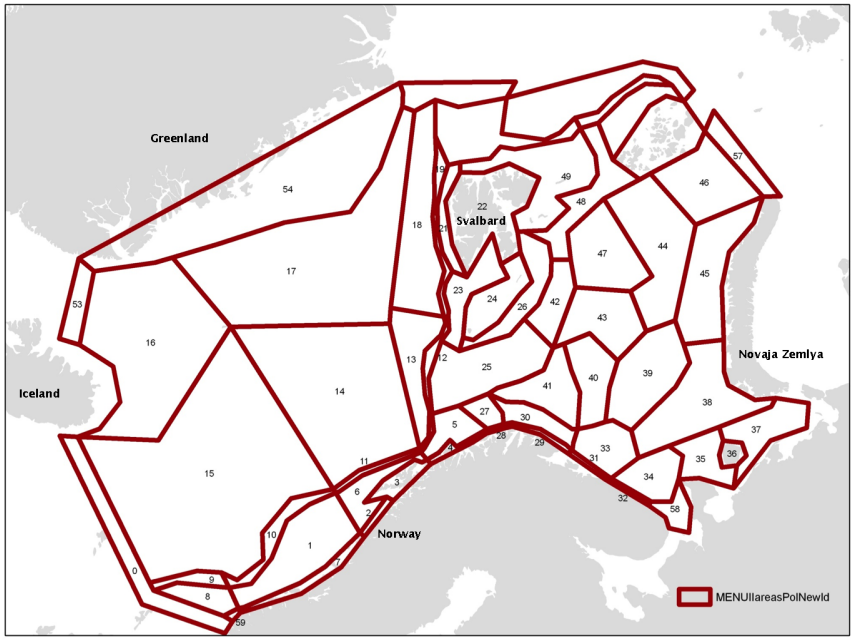
Cecilie Hansen, Ken Drinkwater, Anne JÃhkel, Beth Fulton, Bec Gorton and Mette Skern-Mauritzen

Institute of Marine Research

10 December 2015

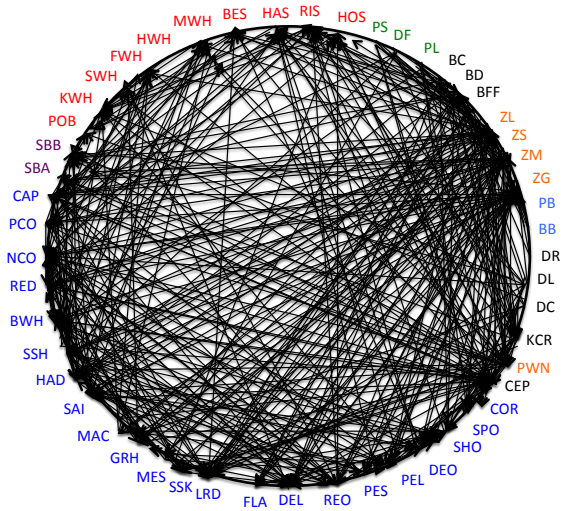
Nordic and Barents Seas Atlantis

- High-latitude system
- 4 million km^2 covered by 60 polygons, higher resolution in the Barents Sea
- Physical forcing from ROMS (1981-2001 + 2046-2065)
- 7 depth layers + 1 sediment layer



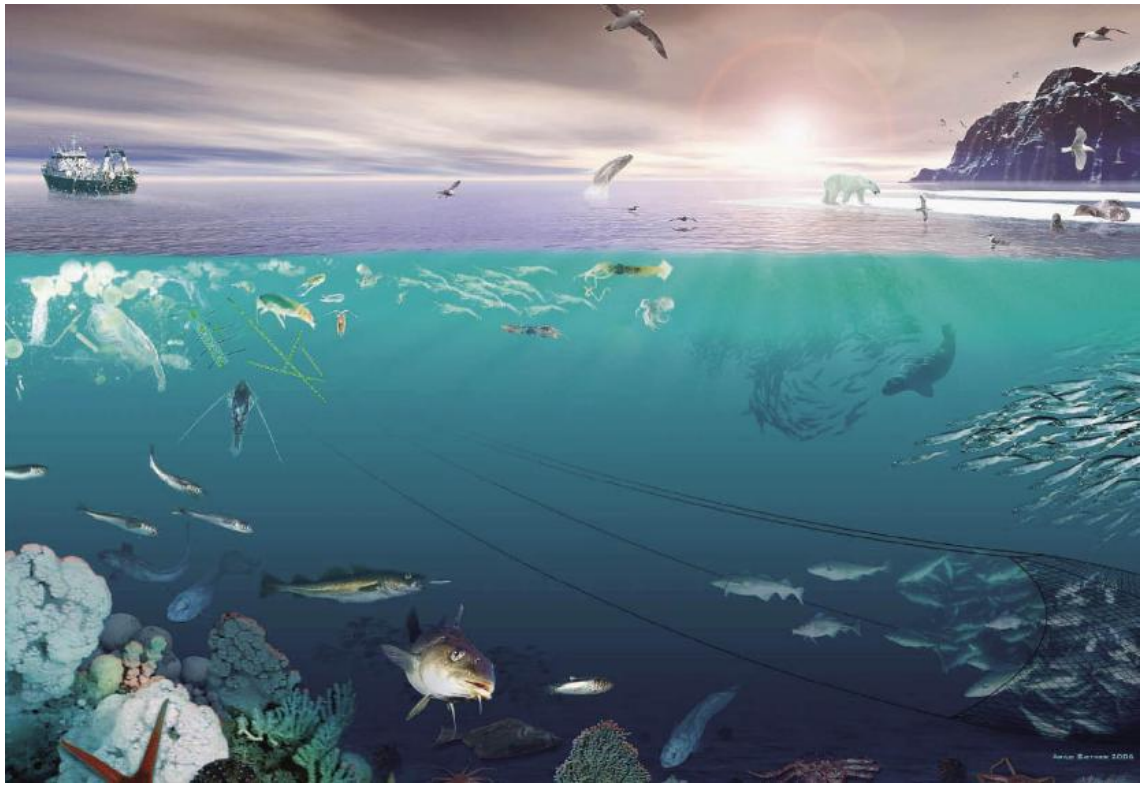
NoBa - biology

- 53 components, where some 'more important' species have their own group. The components include:
  - 10 marine mammals
  - 2 seabird functional groups
  - 20 fish components, 7 functional groups, 13 single-species
  - Shrimps and squid
  - Red king crab and snow crab
  - 5 benthic components
  - 4 zooplankton components
  - 3 phytoplankton components
  - 2 bacteria components
  - 3 detritus components



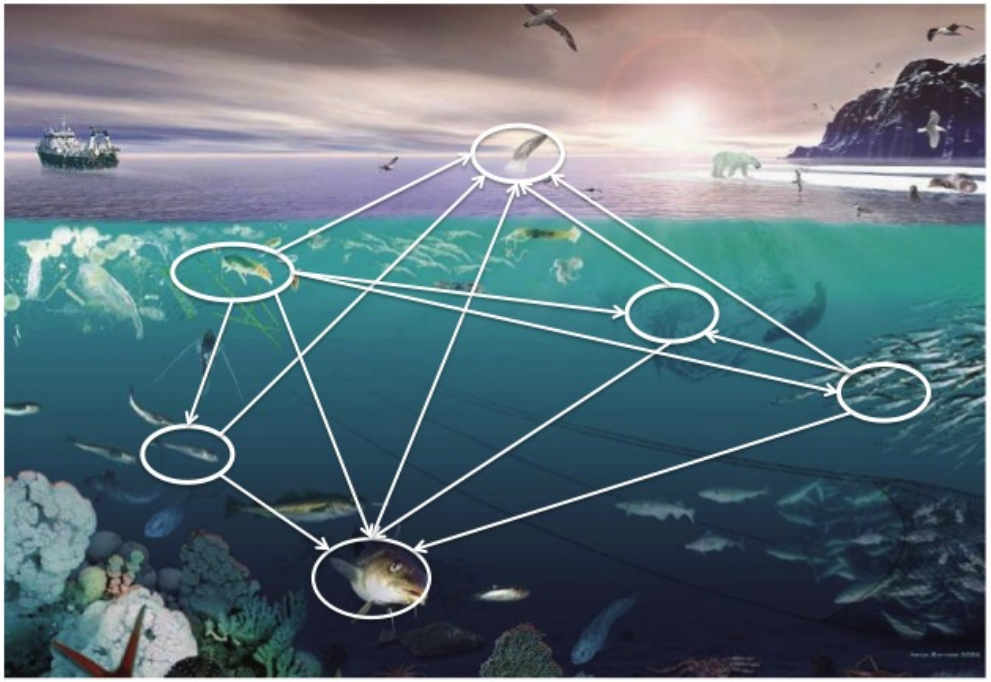
Objective for the sensitivity study

- How will the model respond to pertubations of the key life history parameters (mortality, growth, consumption, recruitment and prey availability) of five chose species - are the ecosystem more vulnerable to any of these?
- Does it respond to 'known' perturbations in a similar way to that seen in literature?



Too complex for a full sensitivity analysis, hence ...

- 5 key species: Minke whales, cod, herring, capelin, polar cod
- 5 key parameters: Mortality, growth, consumption, recruitment and availability of prey

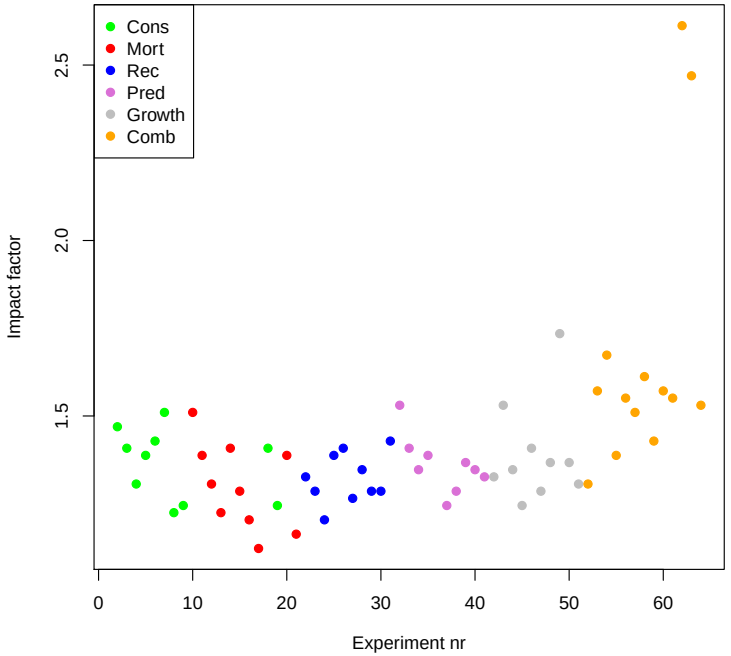


Forcing and set-up

- Physical forcing (temperature, salinity, volume fluxes) from one year only - 1998
- All simulations are 55 years long, 25 years burn-in time included
- Biomass estimates are averages over the last 10 years of the simulations
- Only the Barents Sea boxes are included in the biomass estimates that will be discussed
- Code-base: becdev (for this particular study)
- All parameters was changed (positive and negative) with 25%
- One-at-a-time approach for the first 50 simulations
- Based on the response in the ecosystem, a set of combination runs was performed

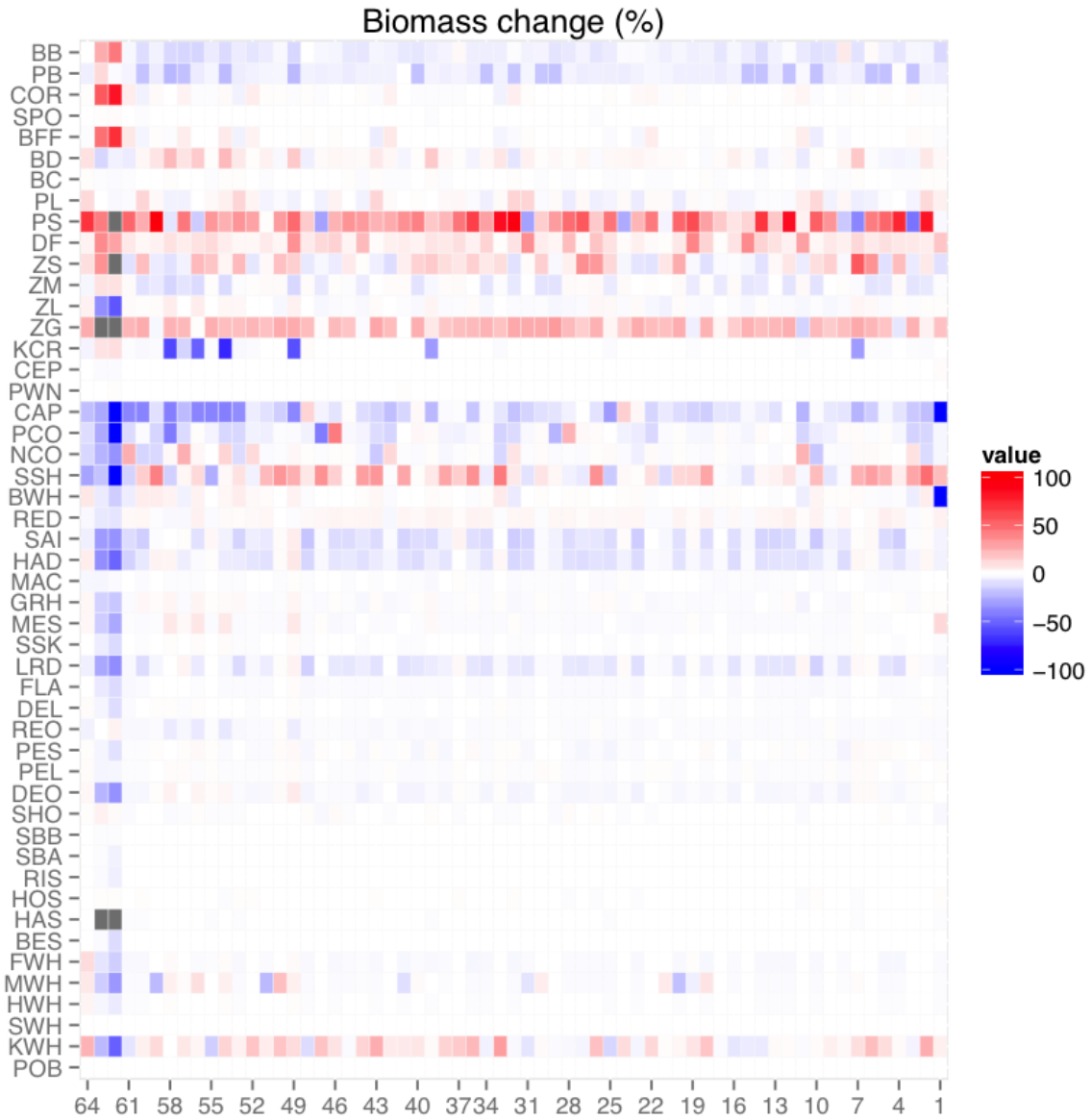
Results

- An 'impact factor' was calcuated, based on the magnitude of the impact on the biomass of all components included in the model
- Weights accordingly to change in biomass > 20% => w=4, 10-20% => w=3, 5-10% => w=2 and <5% => w=1
- The impact factor was then the average of the weights for all components in the model



The response of the ecosystem to perturbing key life history parameters - consumption (cons), mortality (mort), recruitment (rec), predation (pred), growth rates (Growth) and combinations of these (Comb)

Results


Biomass change (%)
BB
PB
COR
SPO
BFF
BD
BC
PL
PS
DF
ZS
ZM
ZL
ZG
KCR
CEP
PWN
CAP
PCO
NCO
SSH
BWH
RED
SAI
HAD
MAC
GRH
MES
SSK
LRD
FLA
DEL
REO
PES
PEL
DEO
SHO
SBB
SBA
RIS
HOS
HAS
BES
FWH
MWH
HWH
SWH
KWH
POB
64 61 58 55 52 49 46 43 40 37 34 31 28 25 22 19 16 13 10 7 4 1
value
100
50
0
−50
−100

Conclusions

- Perturbation of pelagic fish (herring, capelin and polar cod) parameters resulted in most high-level impact runs
- The combined runs had the largest impact on the ecosystem, followed by growth rate, prey availability and consumption
- Roughly 50% of the combined runs are additive, 14 % are synergistic, 38% are antagonistic
- There is a large buffering capacity in the system, this is also supported by the literature
- Top predators are less affected by the perturbations than mid-trophic level species
- Significant changes was also seen on lower trophic levels - particularly the jellyfish (ZG), small phytoplankton (PS), dinoflagellates (DF) and small zooplankton (ZG)