

Integrated ecosystem model of Icelandic waters

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ICES Annual Science Conference 2016



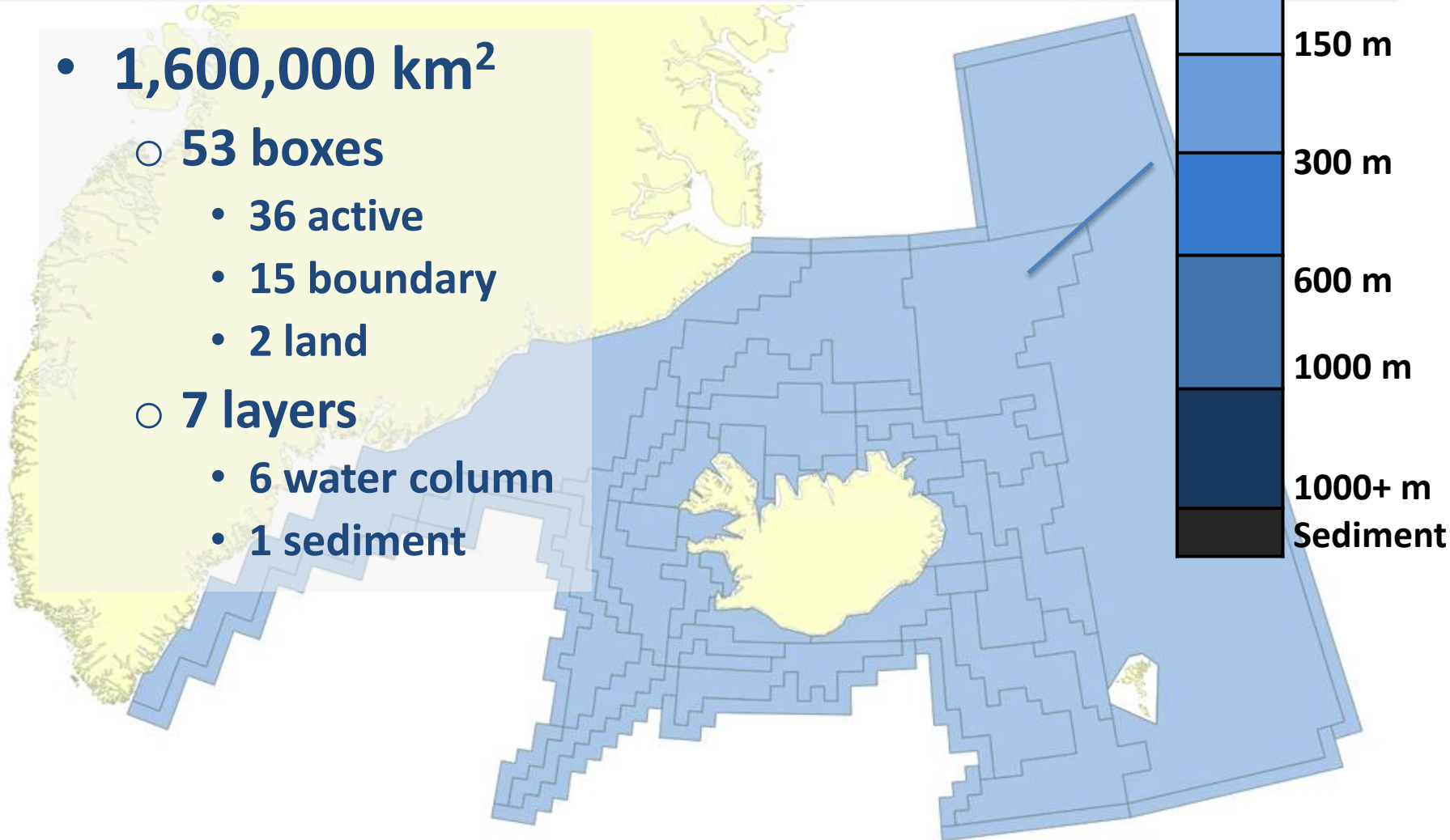
Atlantis

- Simulates the entire ecosystem.
- Ecosystem model
- Fisheries model
- Sampling and assessment model
- Management model
- Socio-economic model

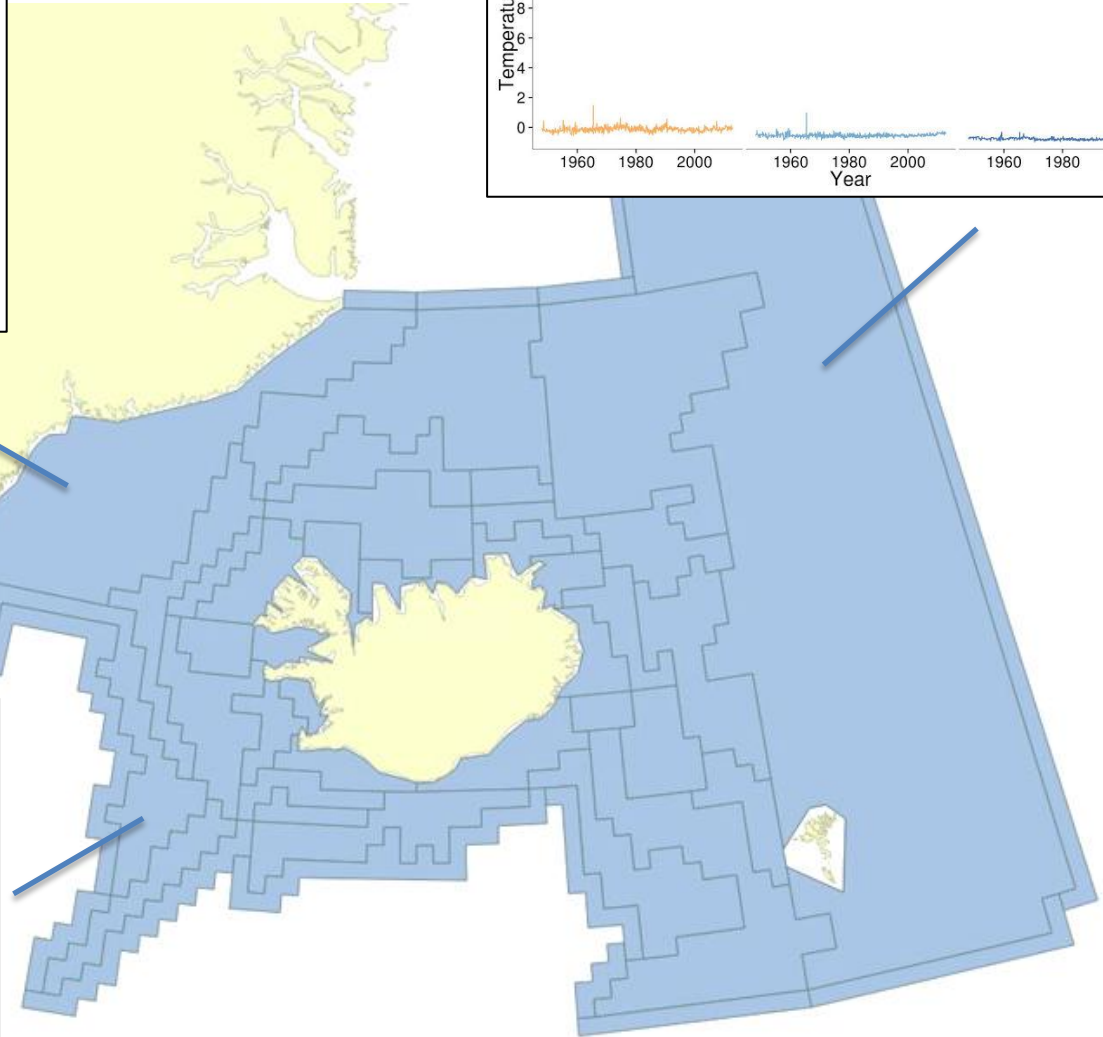
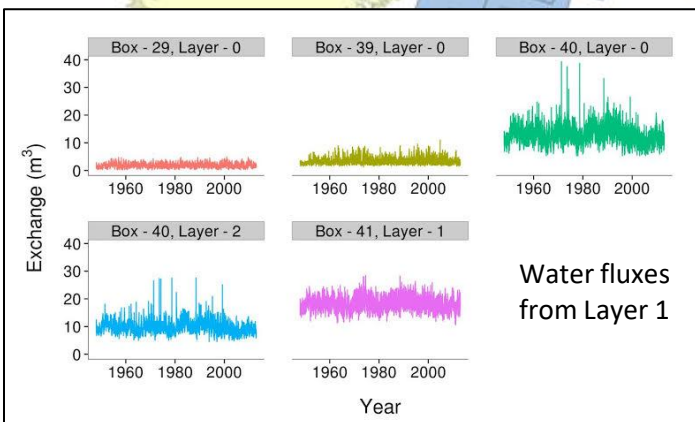
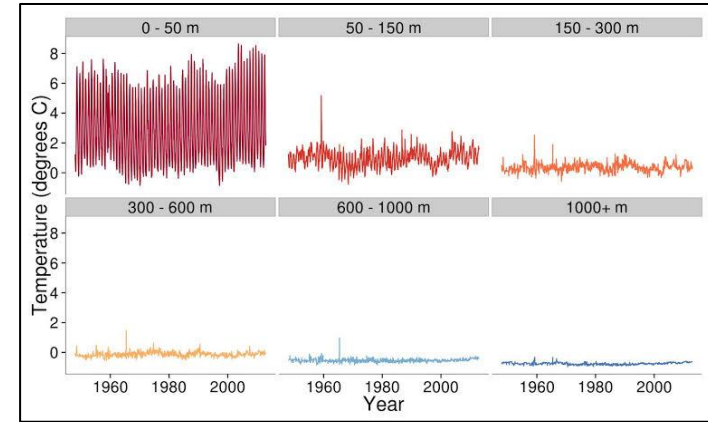
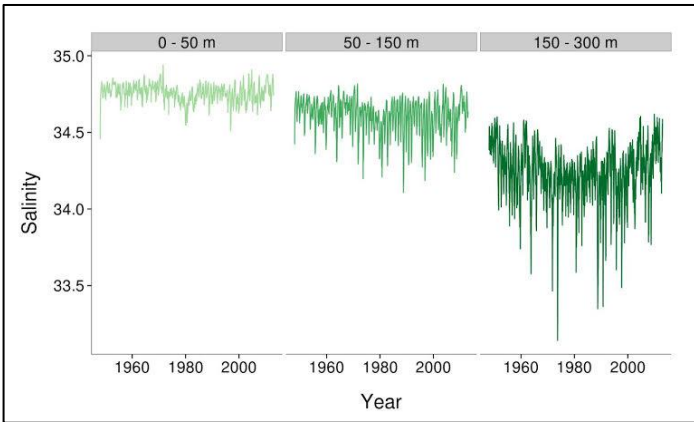


The model geometry

- **1,600,000 km²**
 - **53 boxes**
 - 36 active
 - 15 boundary
 - 2 land
 - **7 layers**
 - 6 water column
 - 1 sediment



The oceanography model



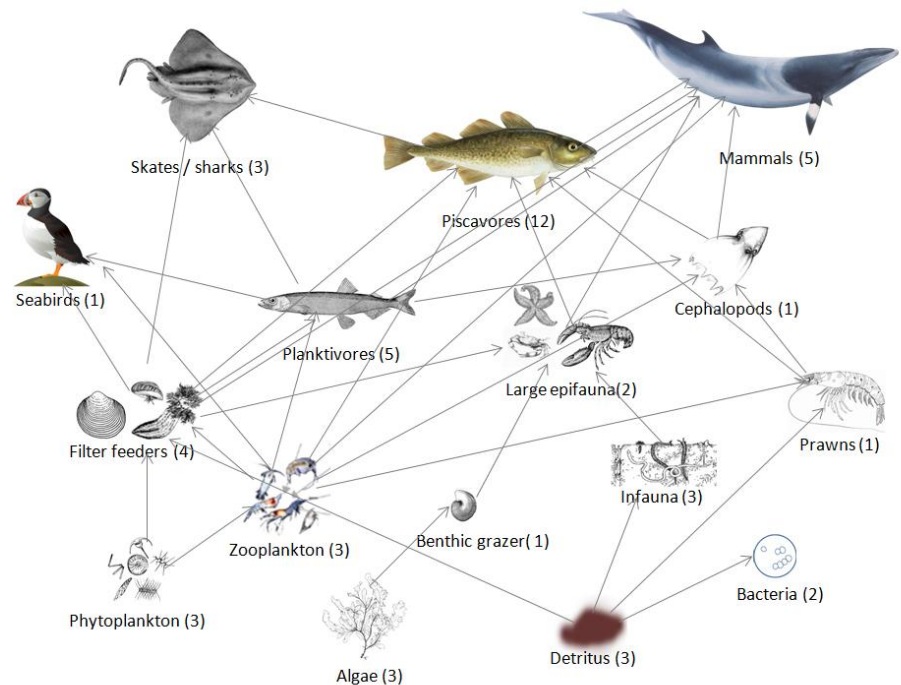
The biology model

- **Functional groups**
- **Consumption**
- **Predation**
- **Growth**
- **Reproduction**
- **Movement**
- **Migration**



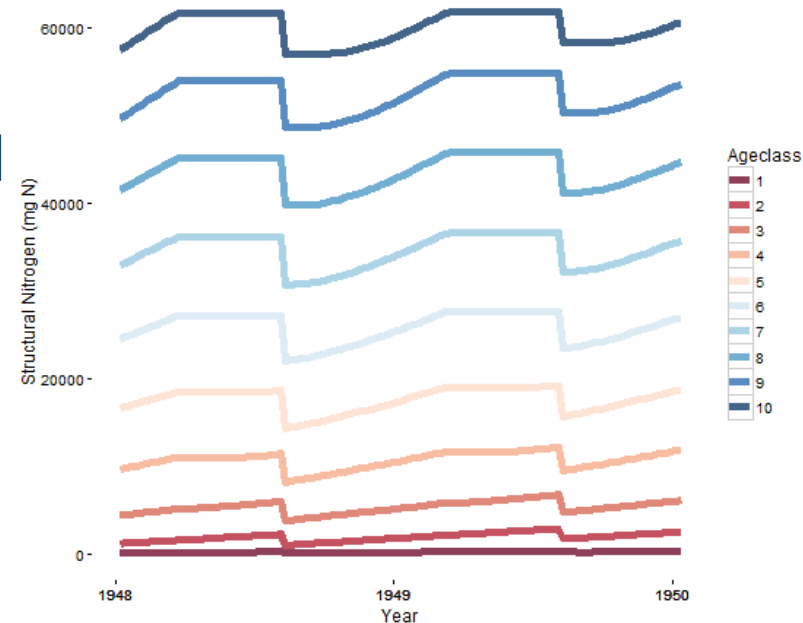
The functional groups

- **52 functional group**
 - **25 vertebrates**
 - 16 fish
 - 3 shark/skates
 - 5 mammal
 - 1 seabird
 - **16 invertebrate groups**
 - **6 primary producers**
 - **2 bacteria**
 - **3 detritus**



The biology model

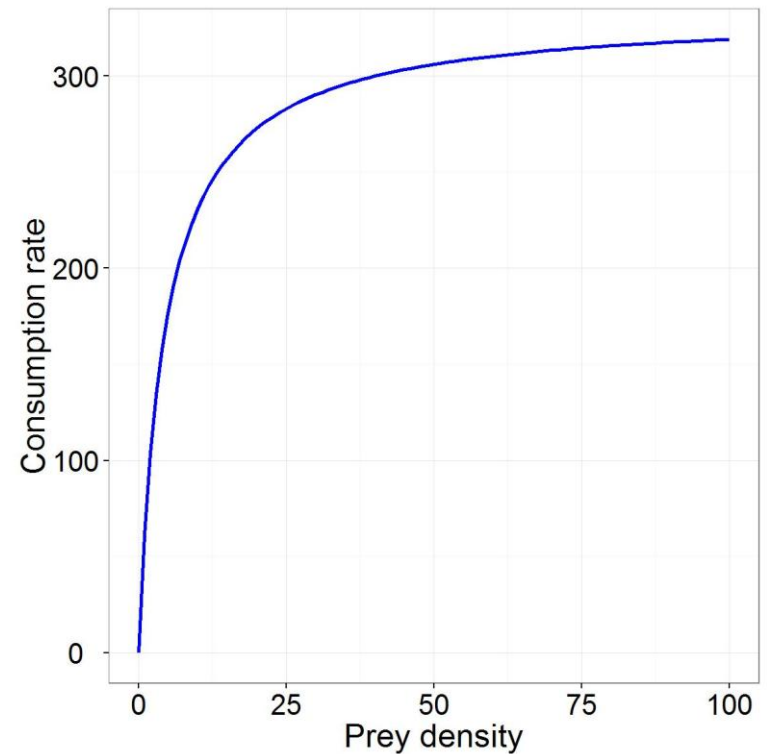
- **Vertebrates**
 - **10 age classes**
 - Numbers per age within ageclass
 - **Weight in mg N per individual**
 - Reserved weight
 - Structural weight
- **Invertebrates**
 - **2 ageclasses**
 - **Biomass pools mg N m⁻³**



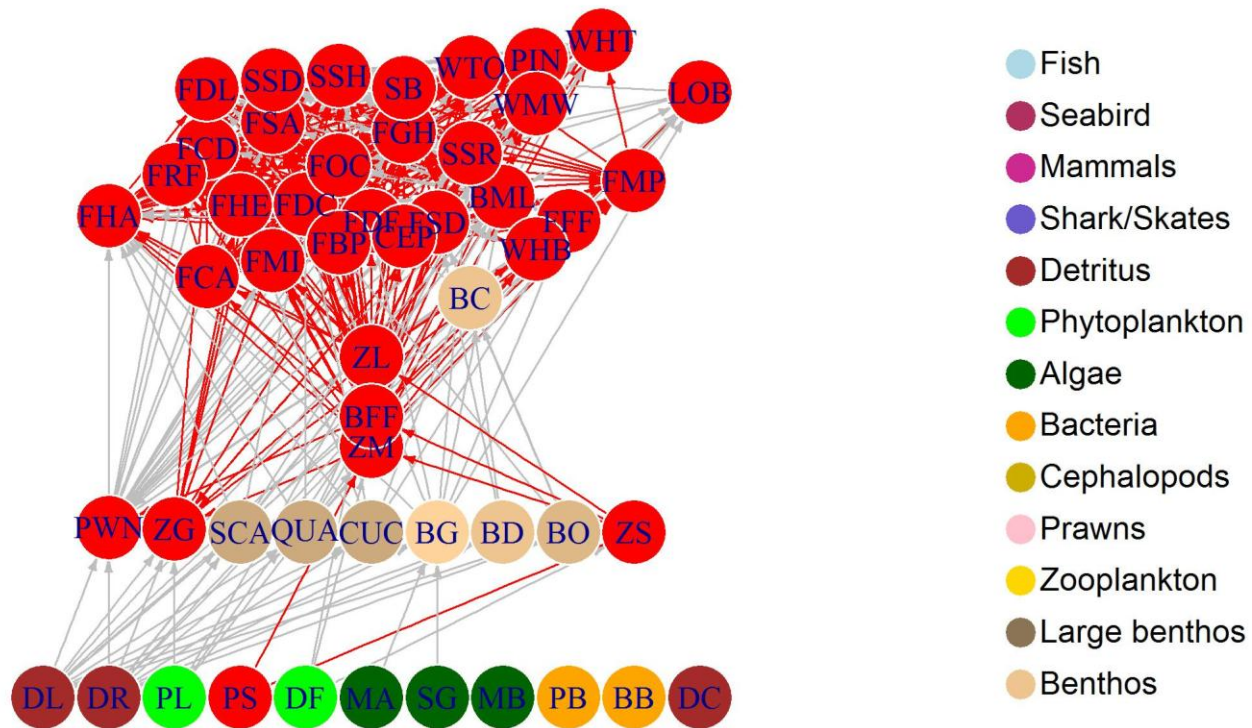
Consumption

- Holling type II
- Gape limitation
- Prey availability

$$Q_{ij} = \frac{a_{ij} \cdot Prey_i \cdot C_j}{1 + \frac{C_j}{\mu_j} \sum_k Prey_k \cdot \epsilon_{ij} \cdot a_{ij}}$$



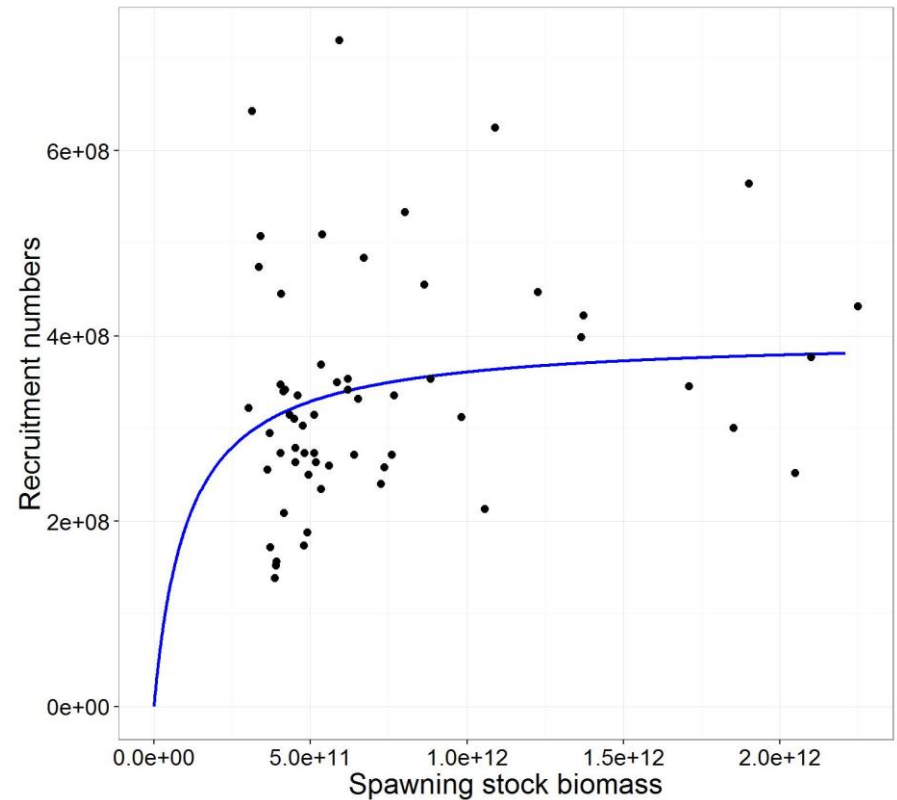
Food web from the Atlantis model



Reproduction

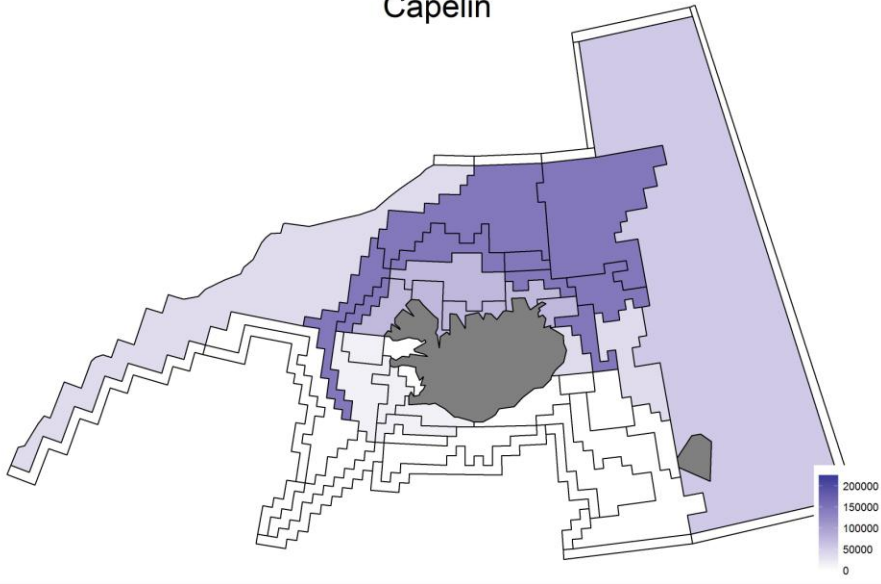
- Beverton – Holt
- Fixed number per adult

$$N_{\text{Rec}} = \frac{SSB \cdot \alpha}{\beta + SSB}$$

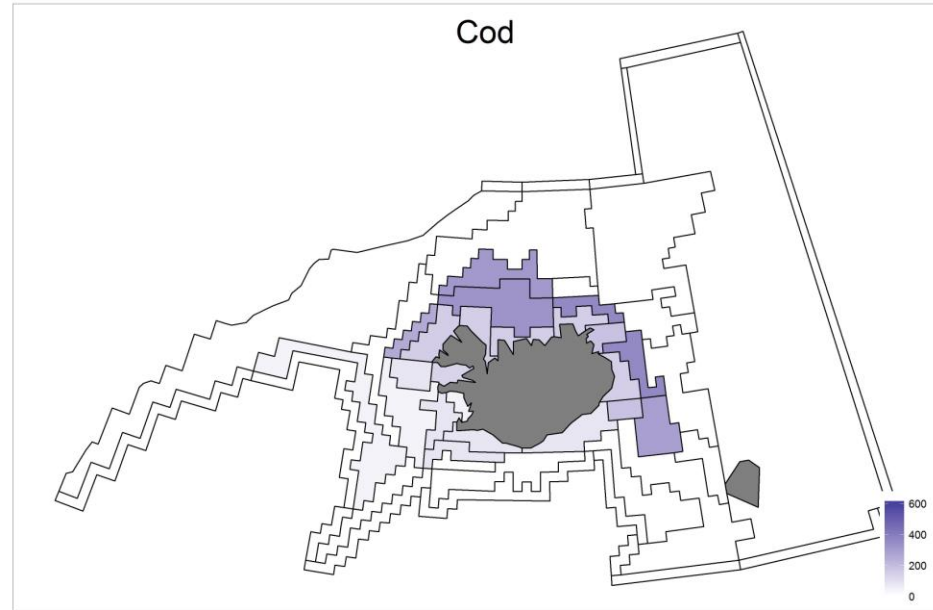


Spatial distribution

Capelin

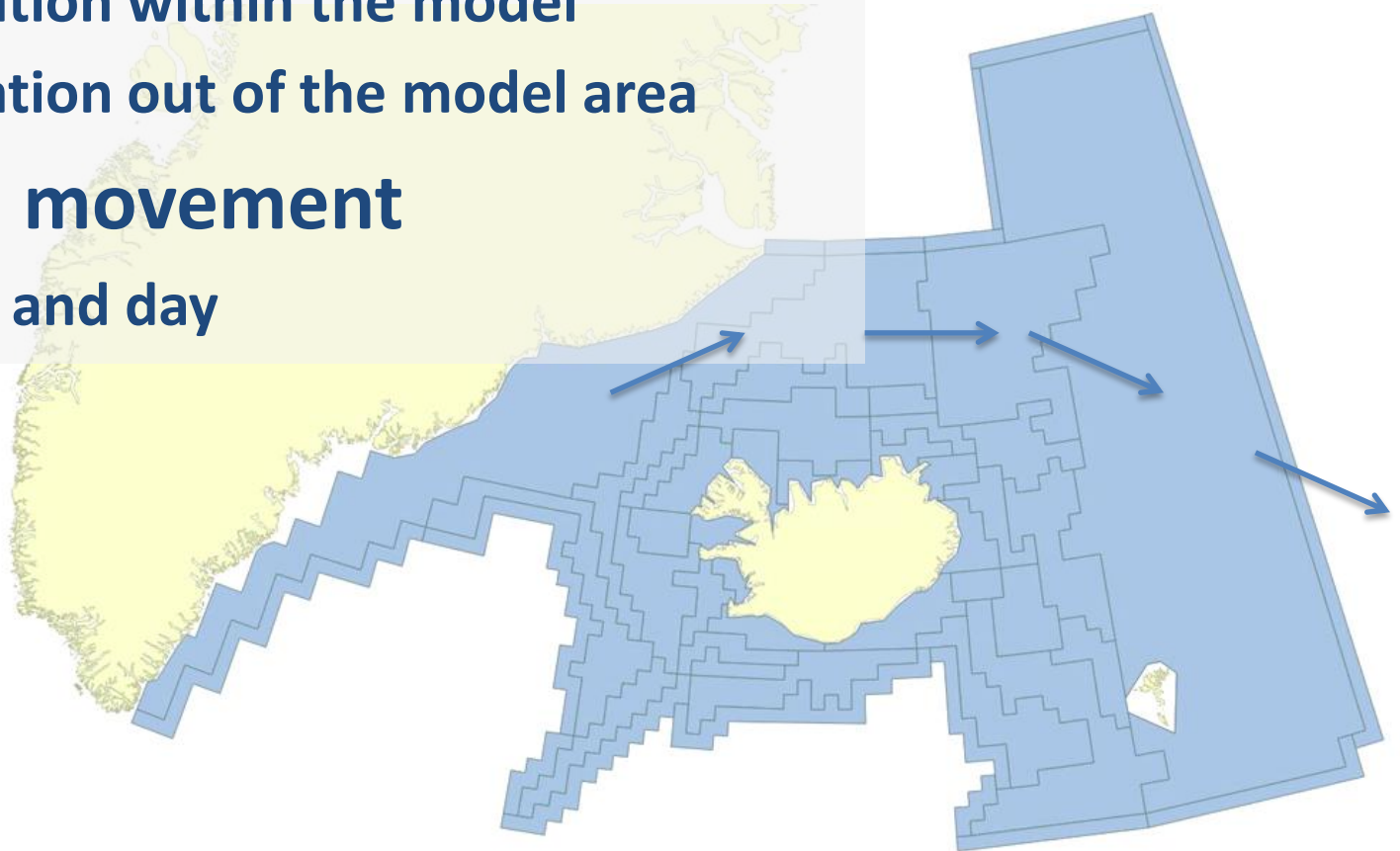


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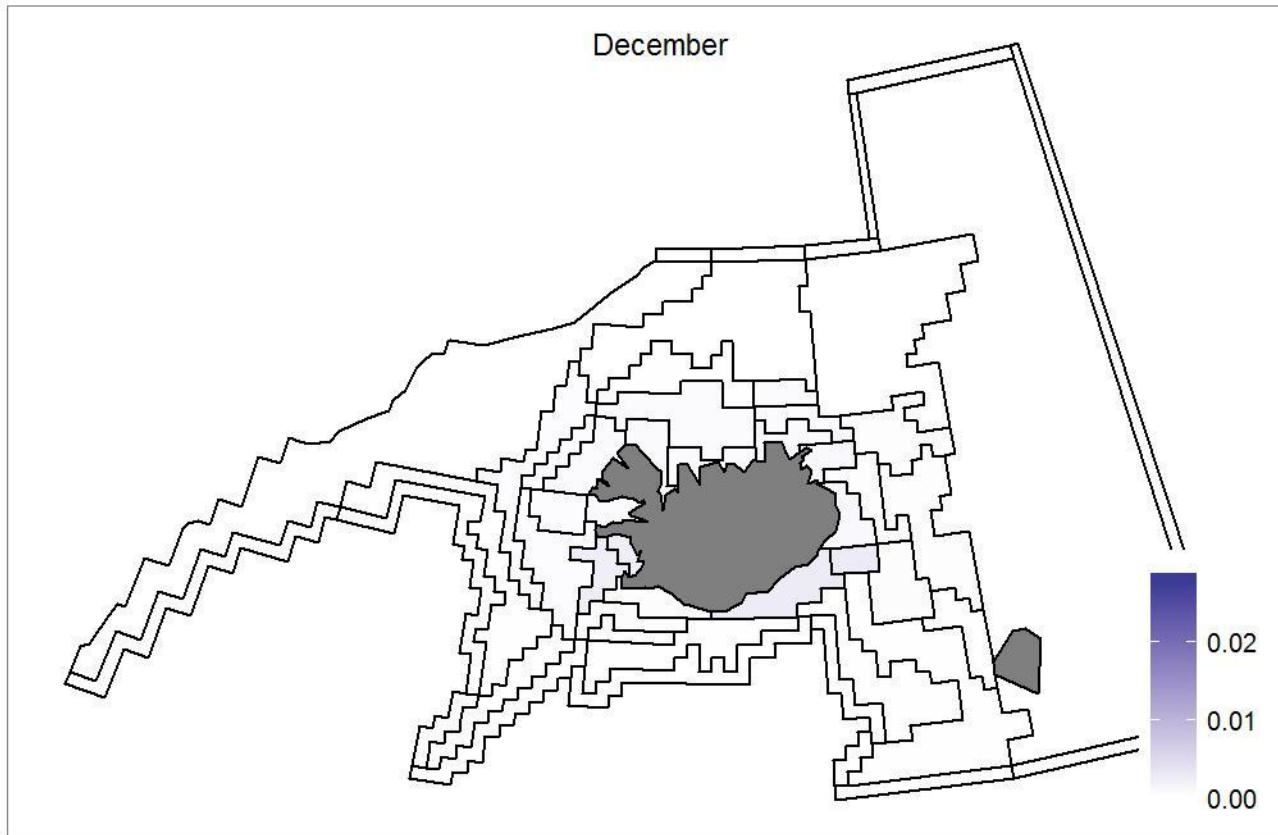


Migration and movement

- **Horizontal movement**
 - Migration within the model
 - Migration out of the model area
- **Vertical movement**
 - Night and day



Migration of Minke Whale



The fisheries model

- Fisheries
 - Multiple fleets
 - Gear
 - Target
 - Selectivity



Photo: Sigurður Bergþórsson



Photo: Magnús Jónsson



Photo Vinnslustöðin

Fishing fleets

- Longline
- Gillnet
- Handline
- Purse seine
- Danish seine
- Midwater trawl
- Bottom trawl
- Shrimp trawl
- Lobster traps
- Dredge
- Whaling



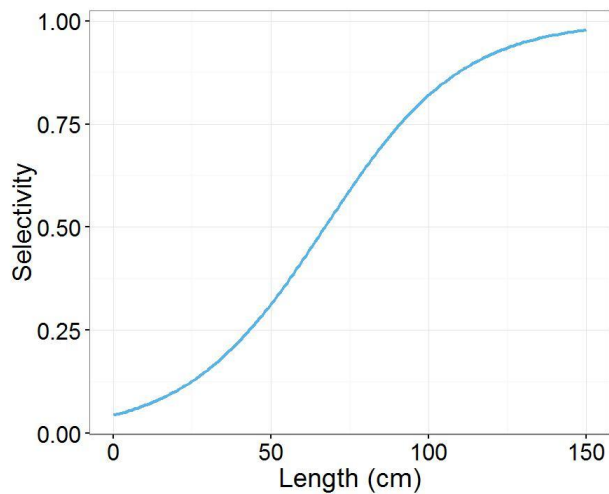
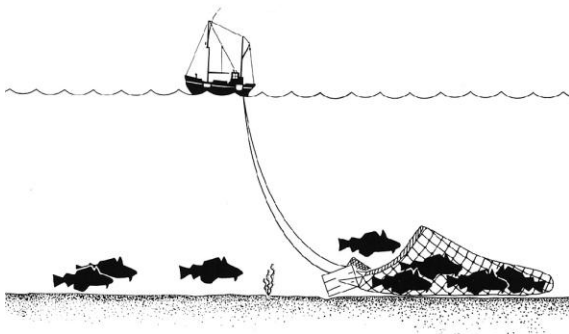
Fishing

Fishing
gear

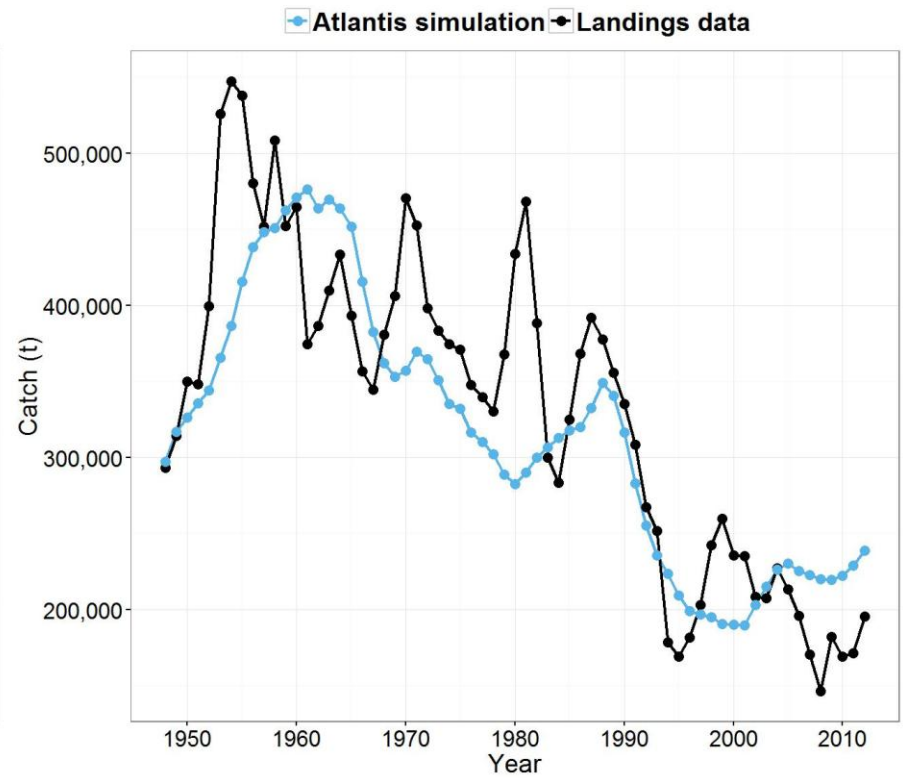
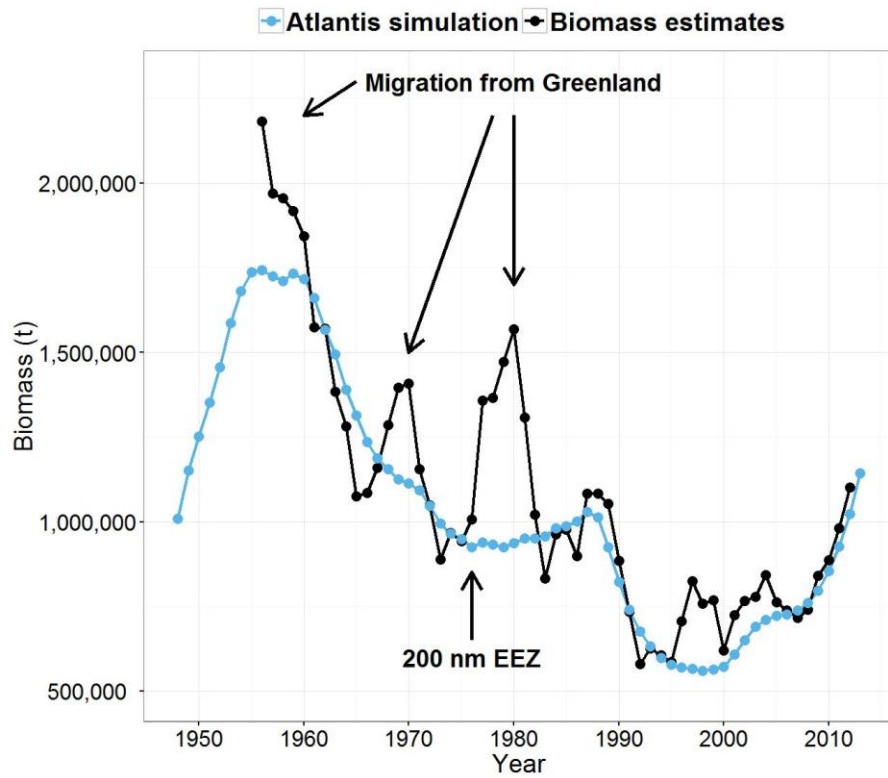
Selectivity

Harvest
rate

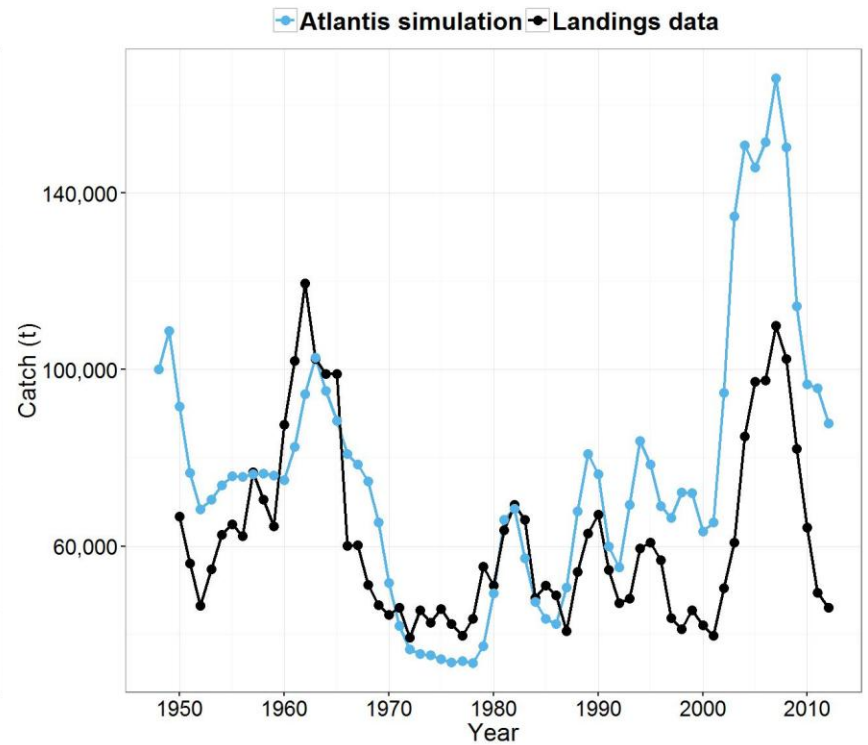
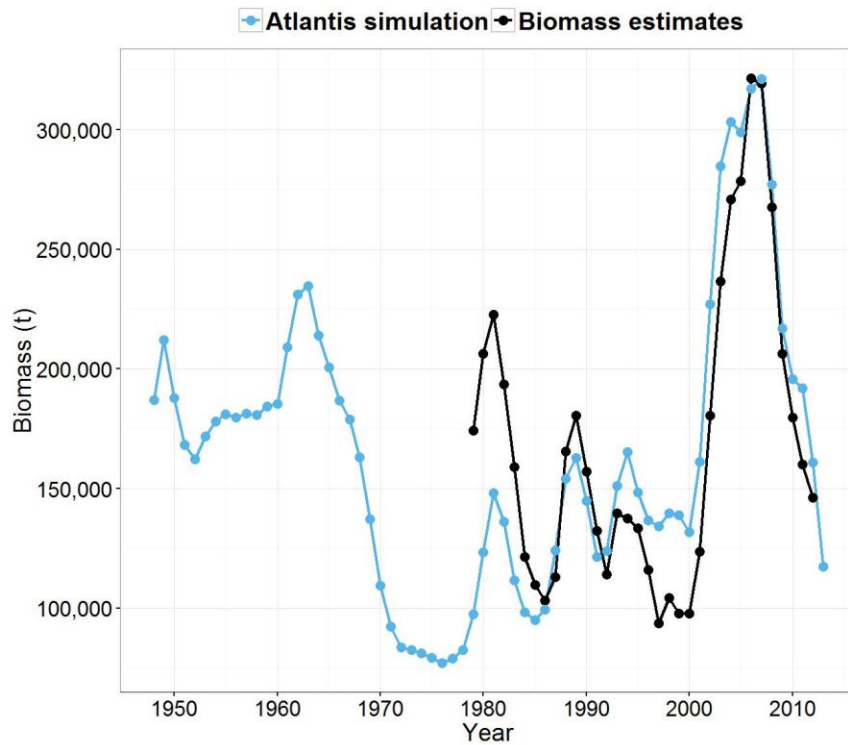
Catch
biomass



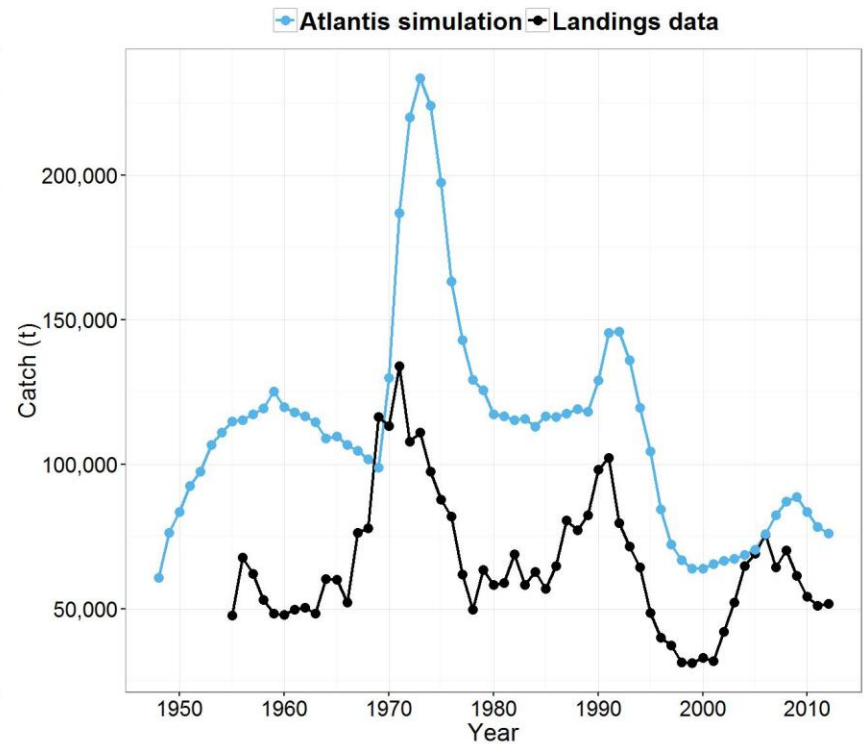
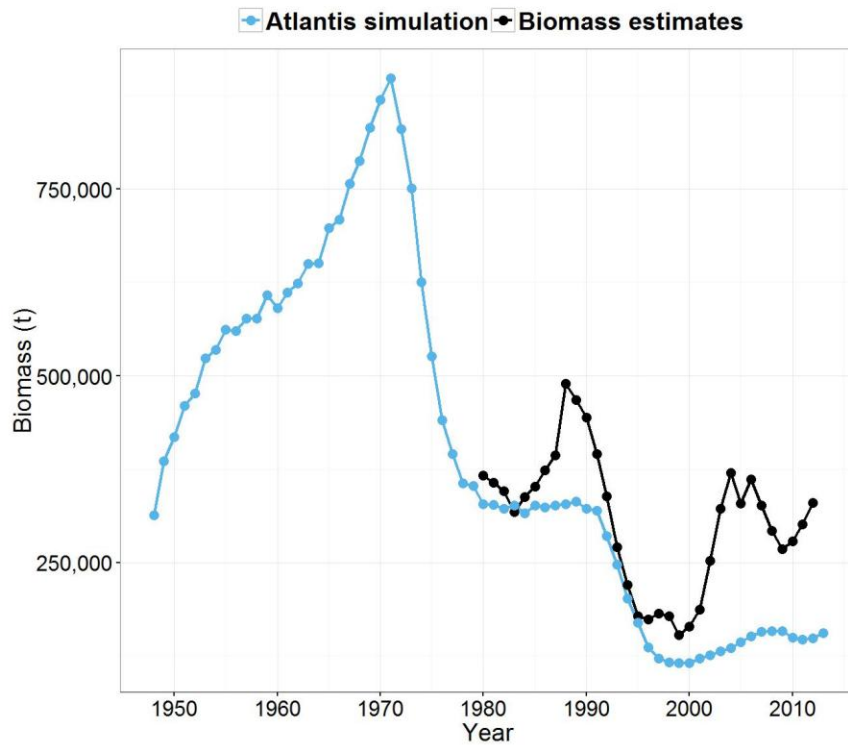
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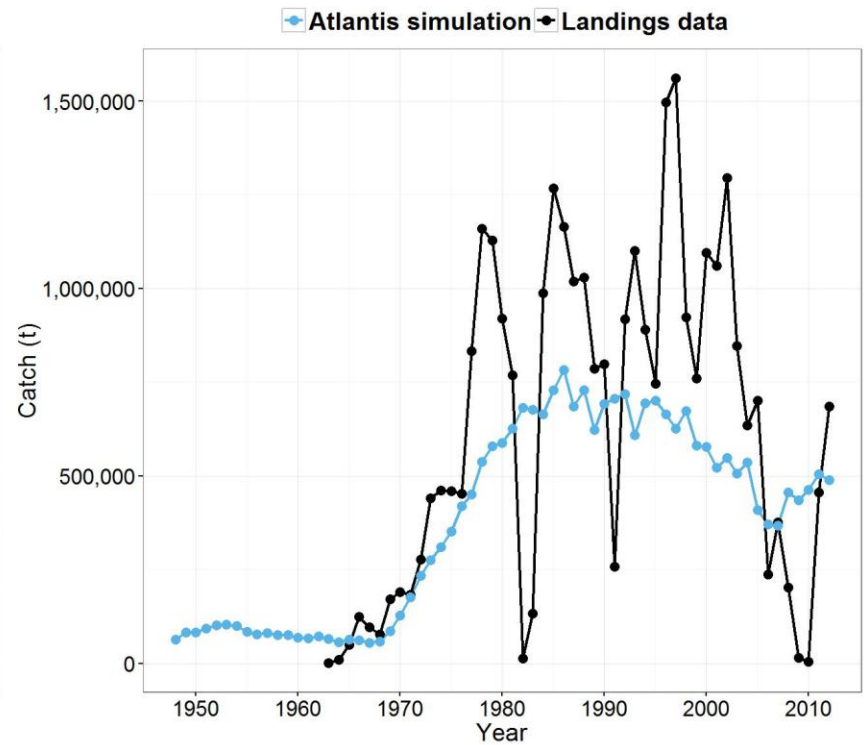
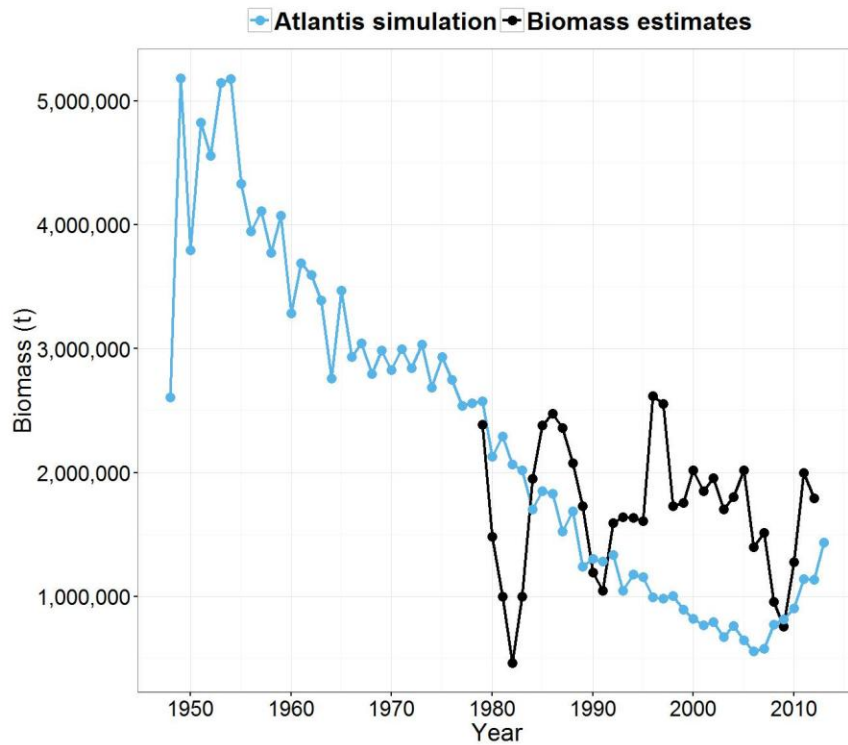
Haddock



Saithe



Capelin



Discards

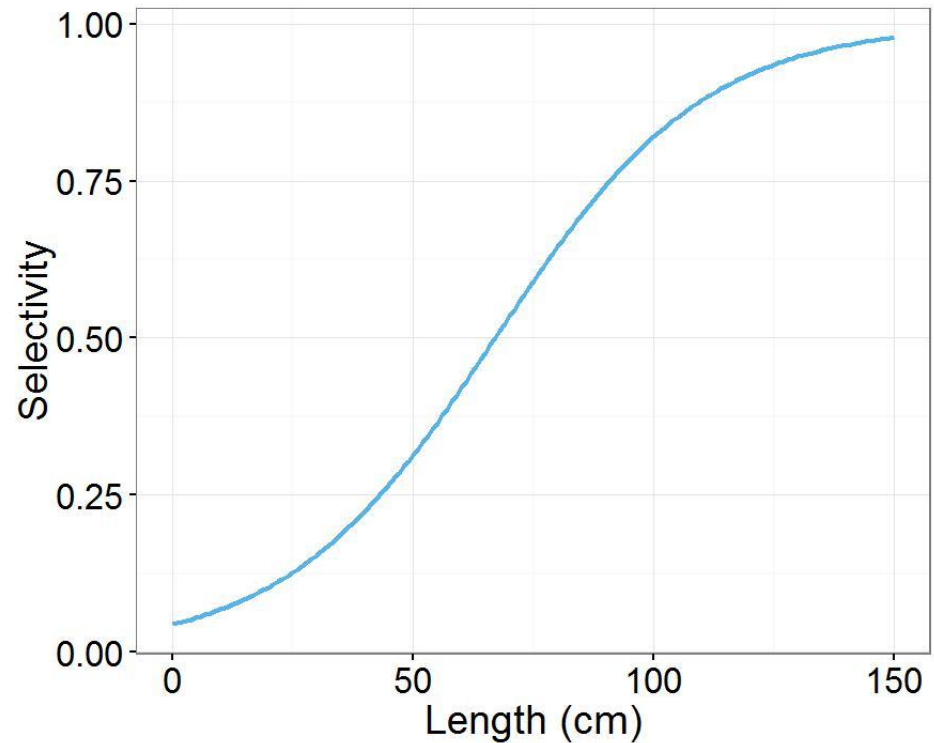
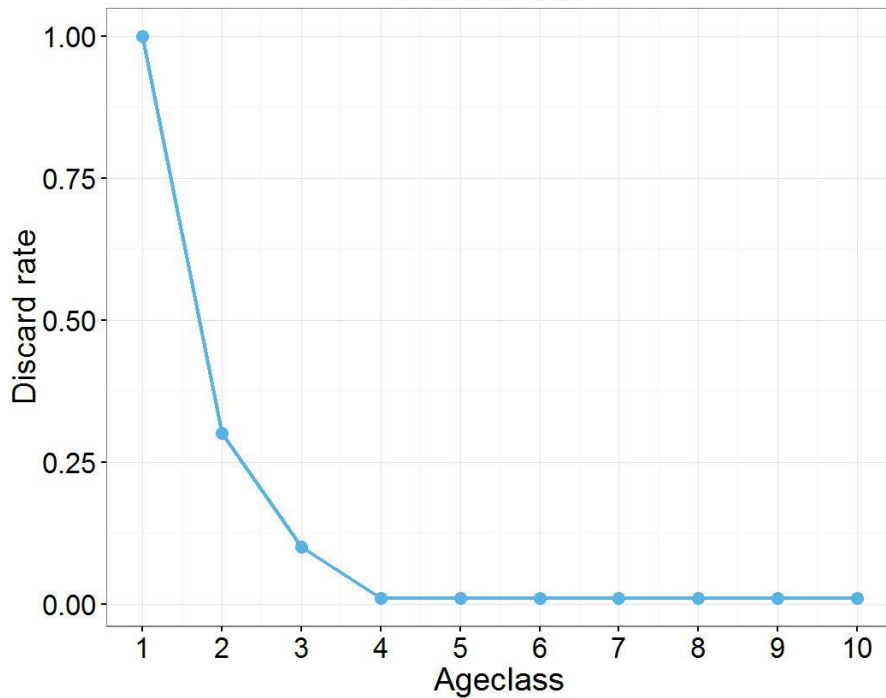
- Constant
- Constant per age class
- Size based
- Discard survival
- Discarded waste



Discards

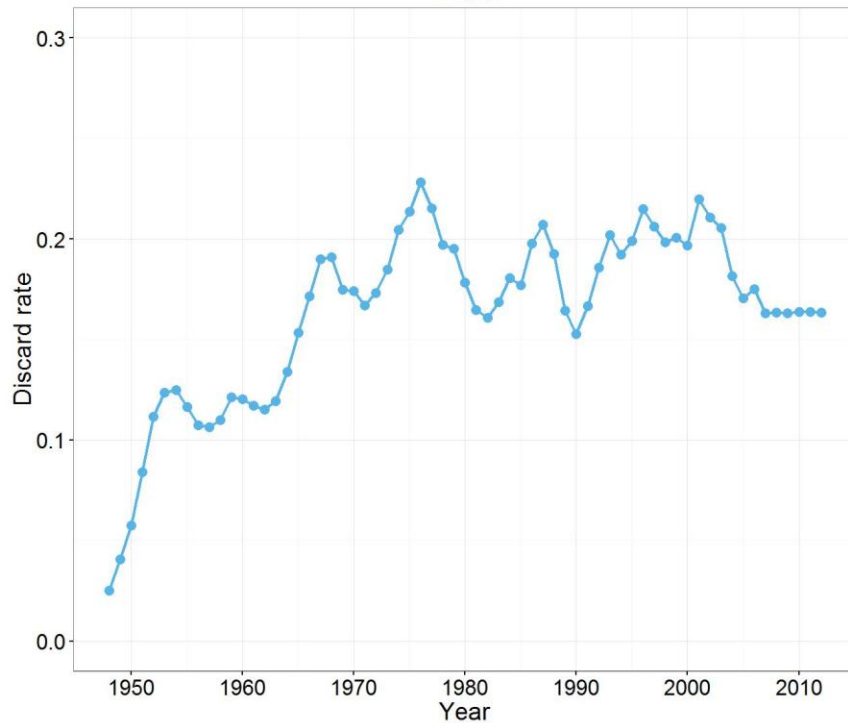
- Constant per cohort

Haddock

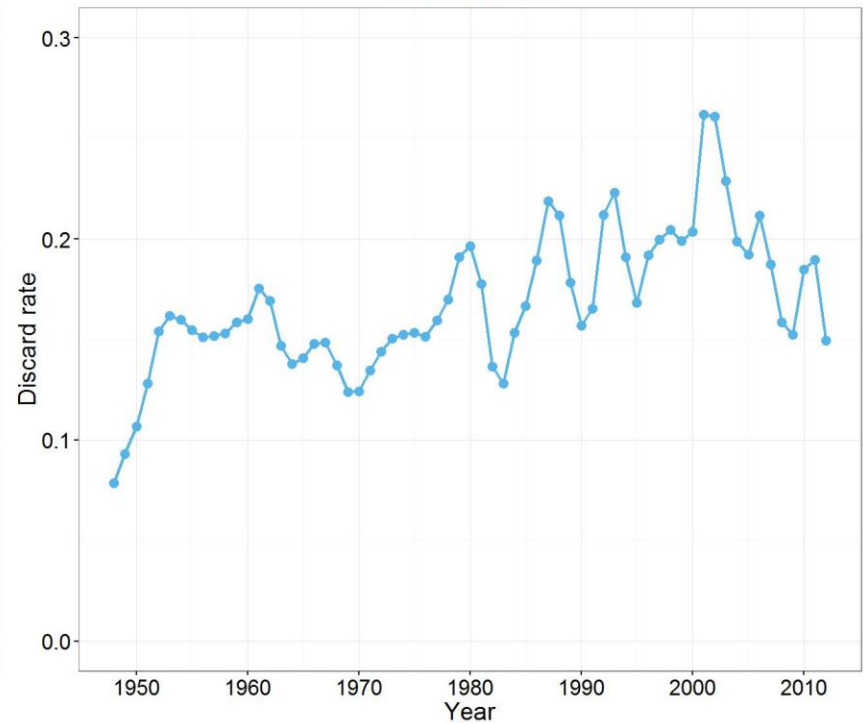


Simulated Discards

Cod



Haddock



Use of Atlantis

- **Operating model**
- **Scenarios**
 - **Fishing pressure**
 - **Effect of discards**
- **Management strategy evaluation**

Acknowledgement



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no. 613571 and from the European Commission's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 634495 for the project Science, Technology, and Society Initiative to minimize Unwanted Catches in European Fisheries (MINOUW)



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