Using the end-to-end model Atlantis to test the performance of EwE

Erla Sturludottir and Gunnar Stefansson
University of Iceland

ICES WGSAM 2017

MareFrame

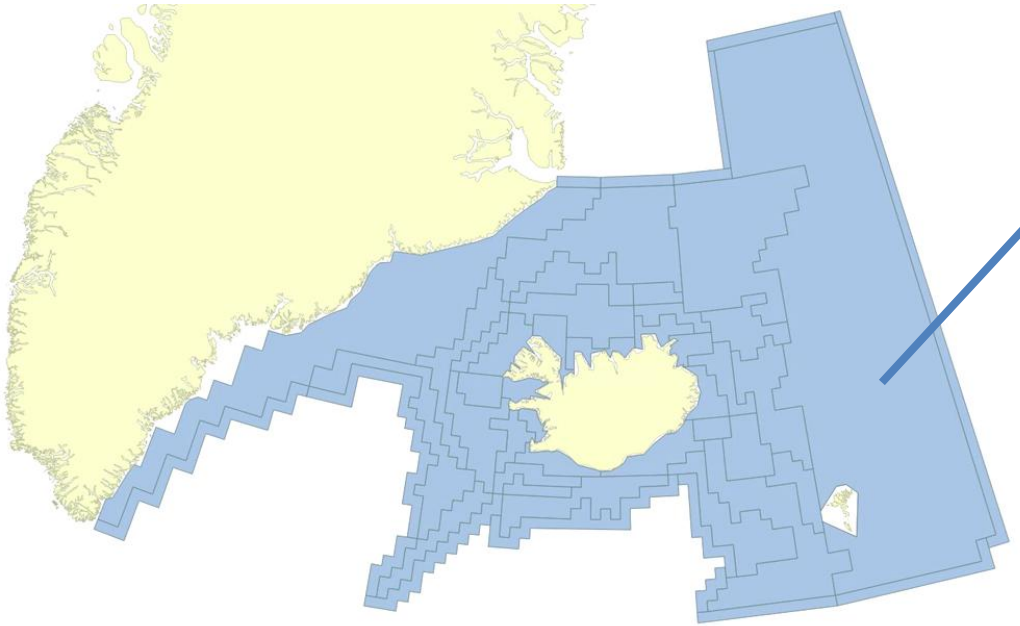
MINOUW

Introduction

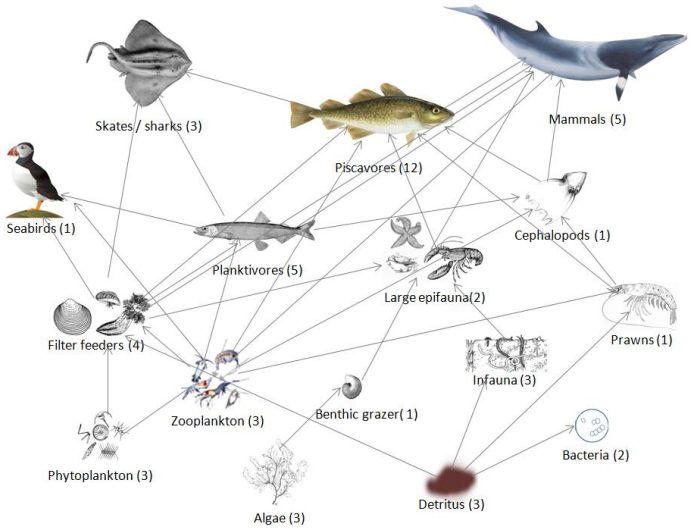
- Atlantis model has been constructed for Icelandic waters.
- Atlantis used as an operating model to test the performance of EwE.
- Difficult to test the performence of ecosystem models.

The Icelandic Atlantis model

- 52 spatial boxes
- 7 layers



- 52 functional groups

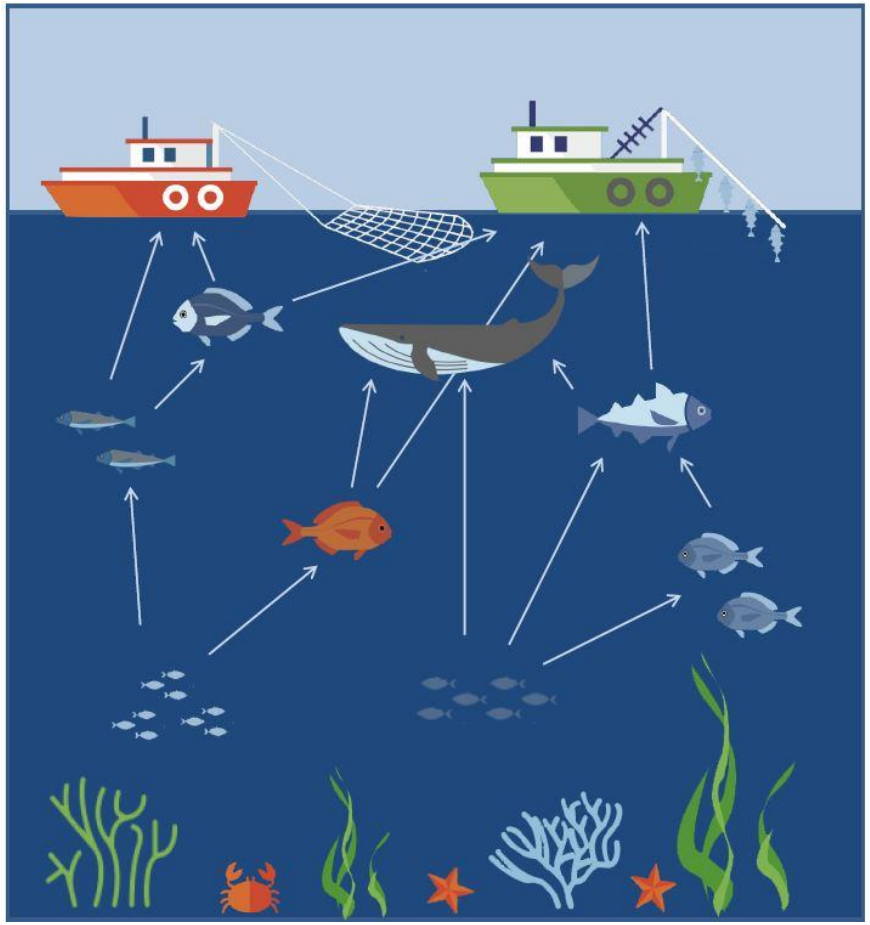


- Time step 12 hours

- 10 Ageclasses
- SSB-Recruitment
- Feeding curve
- Selectivity

Ecopath with Ecosim (EwE)

- **Ecopath: mass-balanced snapshot of the system.**
- **Ecosim: a time dynamic simulation module.**



The Ecopath part

- **The Ecopath equations**

$$P_i = Y_i + M2 + E_i + BA_i + MO_i$$

$$M2_i = \sum_{j=1}^{n} Q_j * DC_{ij} \qquad M0_i = P_i(1 - EE_i)$$

- **Parameters in Ecopath: B, P/B, Q/B, EE and DC**

The Ecosim part

- **Balanced Ecopath model is the start**

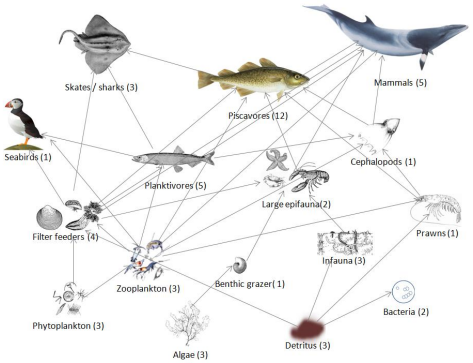
- **The growth rate in Ecosim is defined as:**

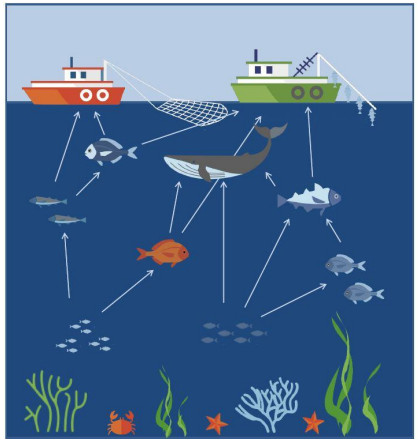
$$\frac{\partial B_i}{\partial t} = g_i \sum_j^n c_{ji} - \sum_j^n c_{ij} + E_i - (M0_i + F_i)B_i$$

$$c_{ij} = Q_{ij} * \frac{V_{ij} * Y_j}{V_{ij} - 1 + Y_j} * \frac{D_{ij} * Y_i}{D_{ij} - 1 + Y_i}$$

Can EwE mimic the Atlantis ecosystem?

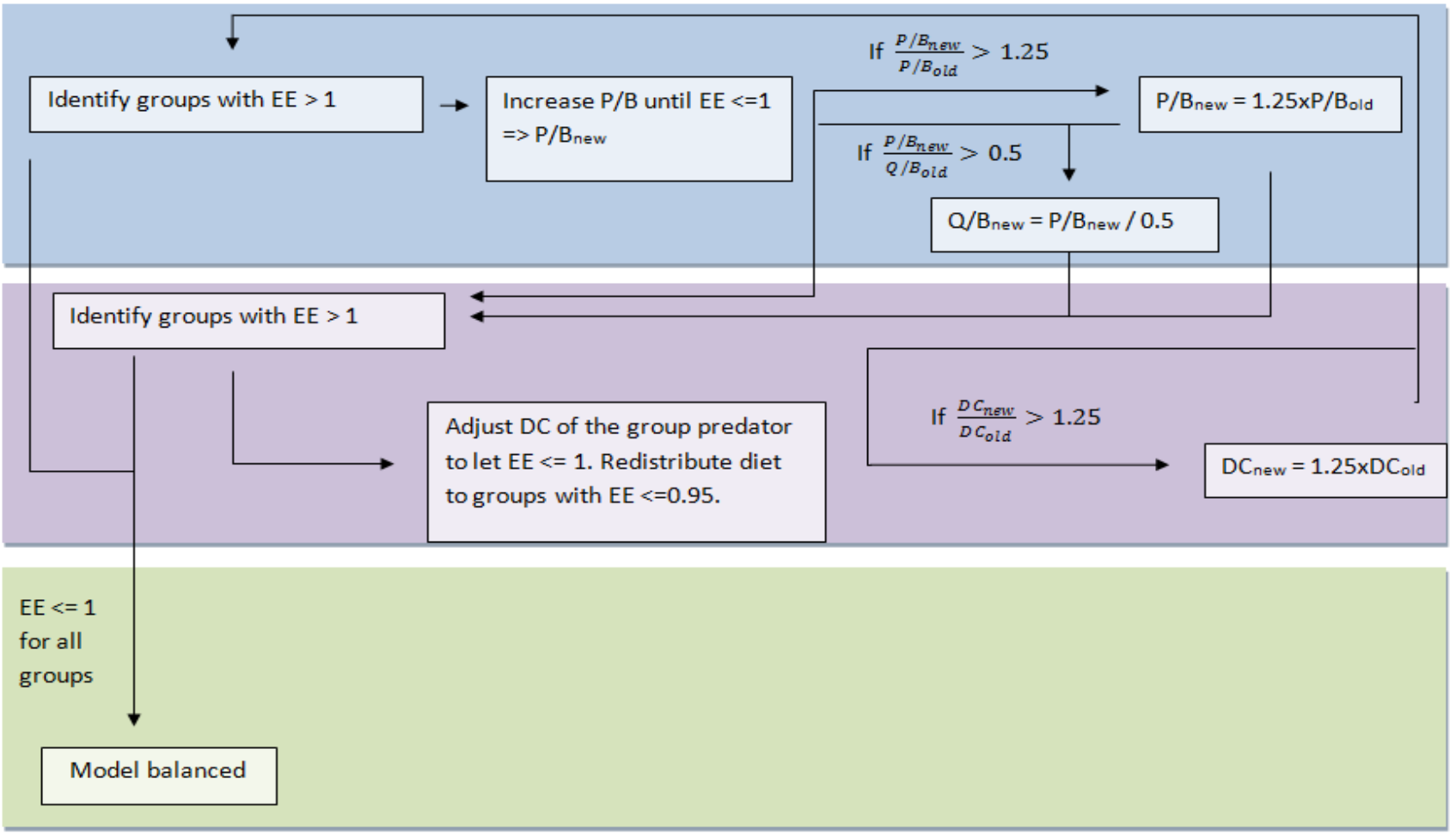
- **Information from Atlantis imported into EwE (Rpath)**
  - **Biomass**
  - **Total mortality**
  - **Consumption**





- **Ecopath not in balance!**

Automatic balancing process

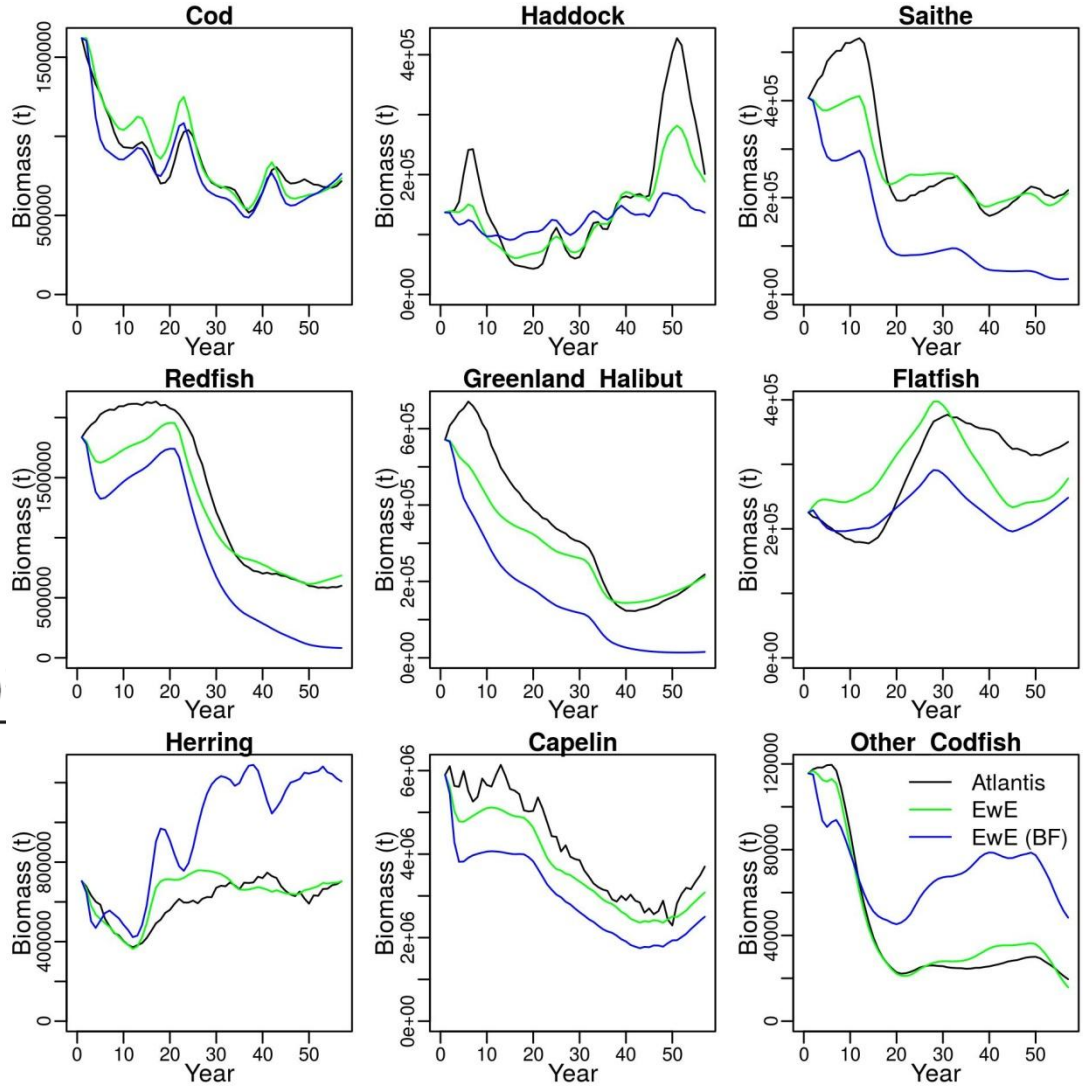


Fitting the Ecosim model

- **Harvest rates calculated from Atlantis.**
- **Fitted to time-series of biomass and catches.**
- **Vulnerability parameters in predator-prey interactions estimated.**

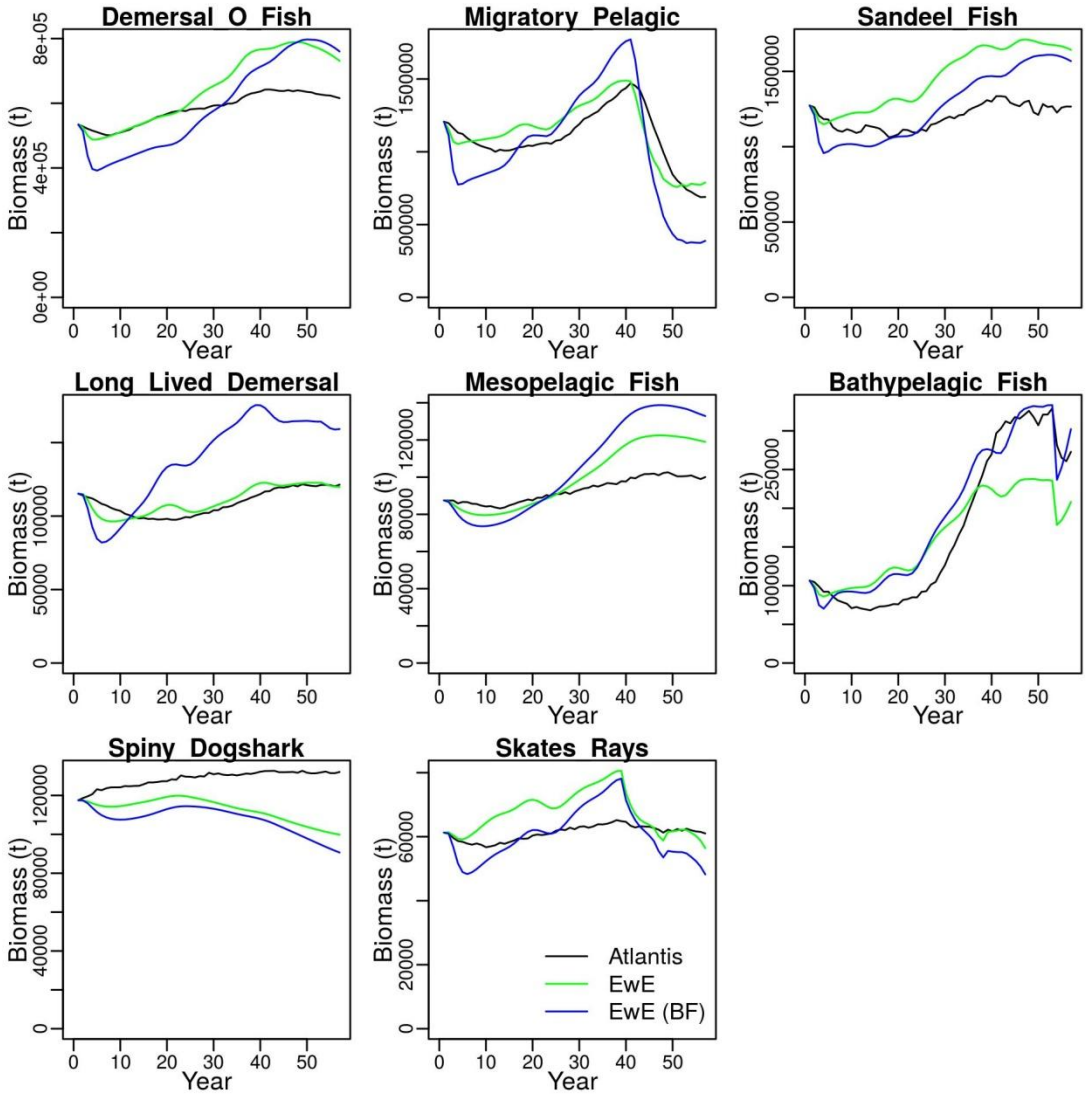
Performance when hindcasting

Metric	Average
r	0.85 → 0.90
RI	2.15 → 1.18
MEF	-1.78 → 0.71



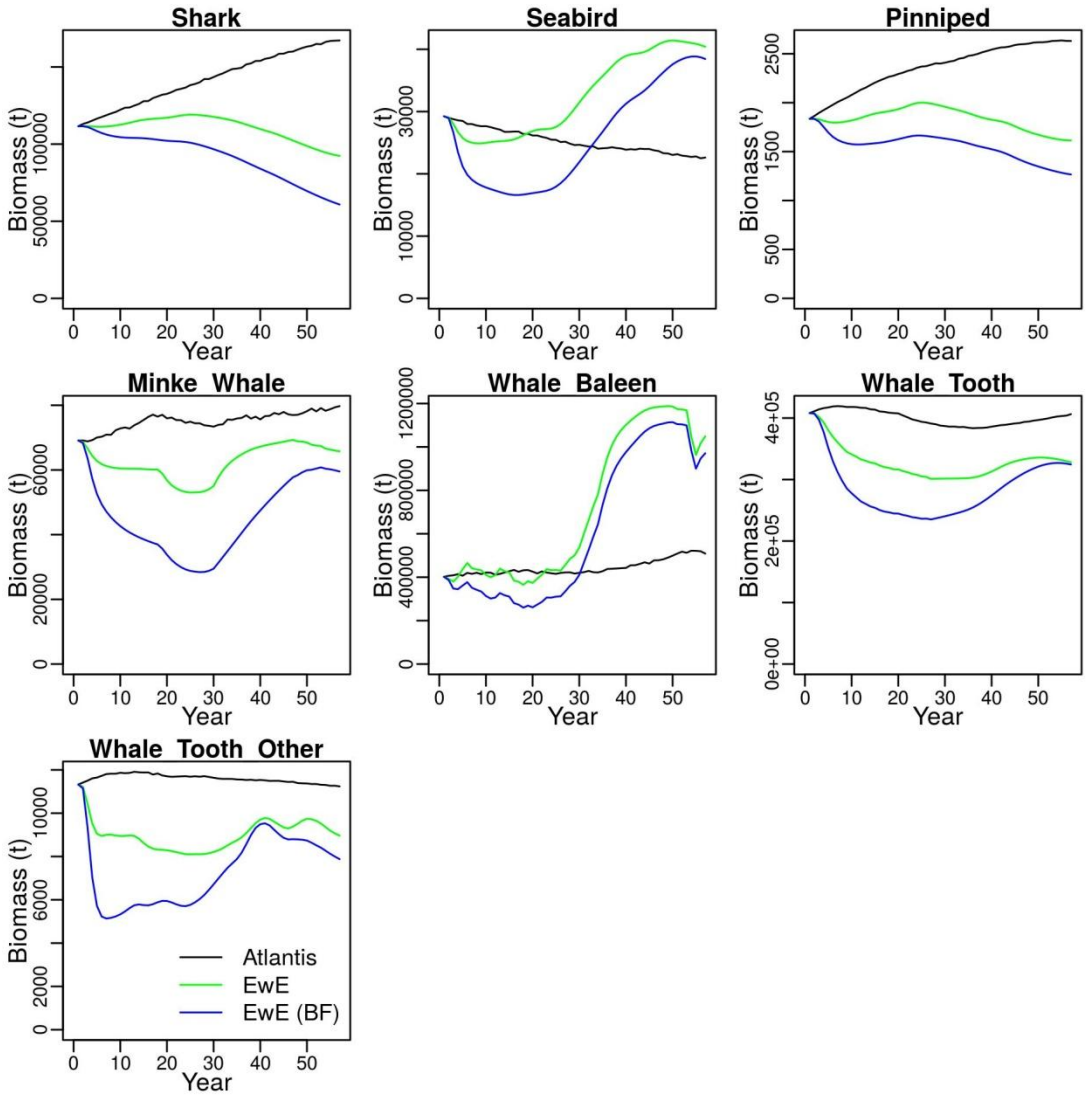
Performance when hindcasting

Metric	Average
r	0.68 → 0.67
RI	1.24 → 1.17
MEF	-9.94 → -6.16



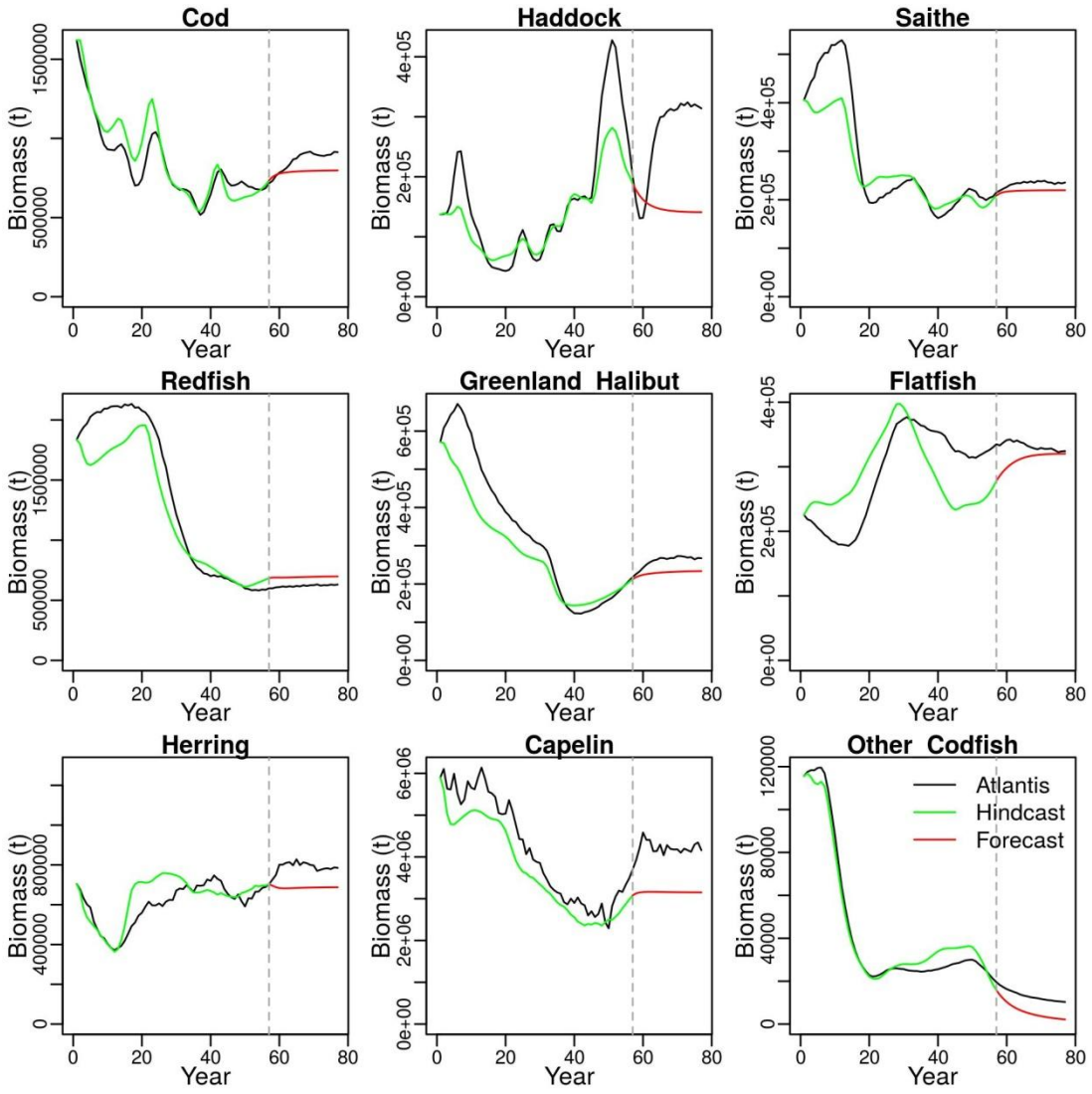
Performance when hindcasting

Metric	Average
r	-0.29 → -0.11
RI	1.63 → 1.37
MEF	-144 → -65



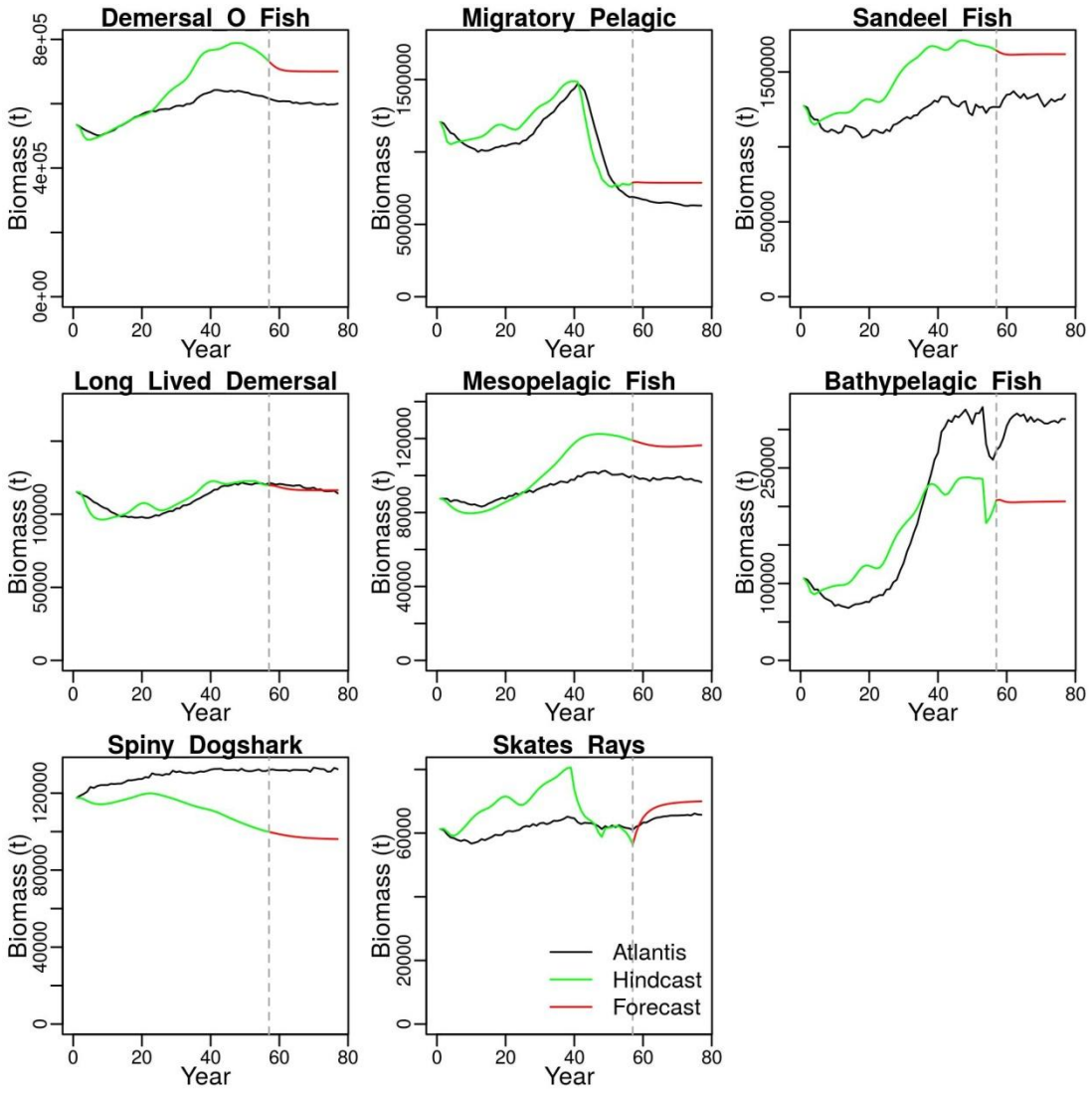
Performance when forecasting

Metric	Average
r	0.90 → 0.35
RI	1.18 → 1.41
MEF	0.70 → -16.4



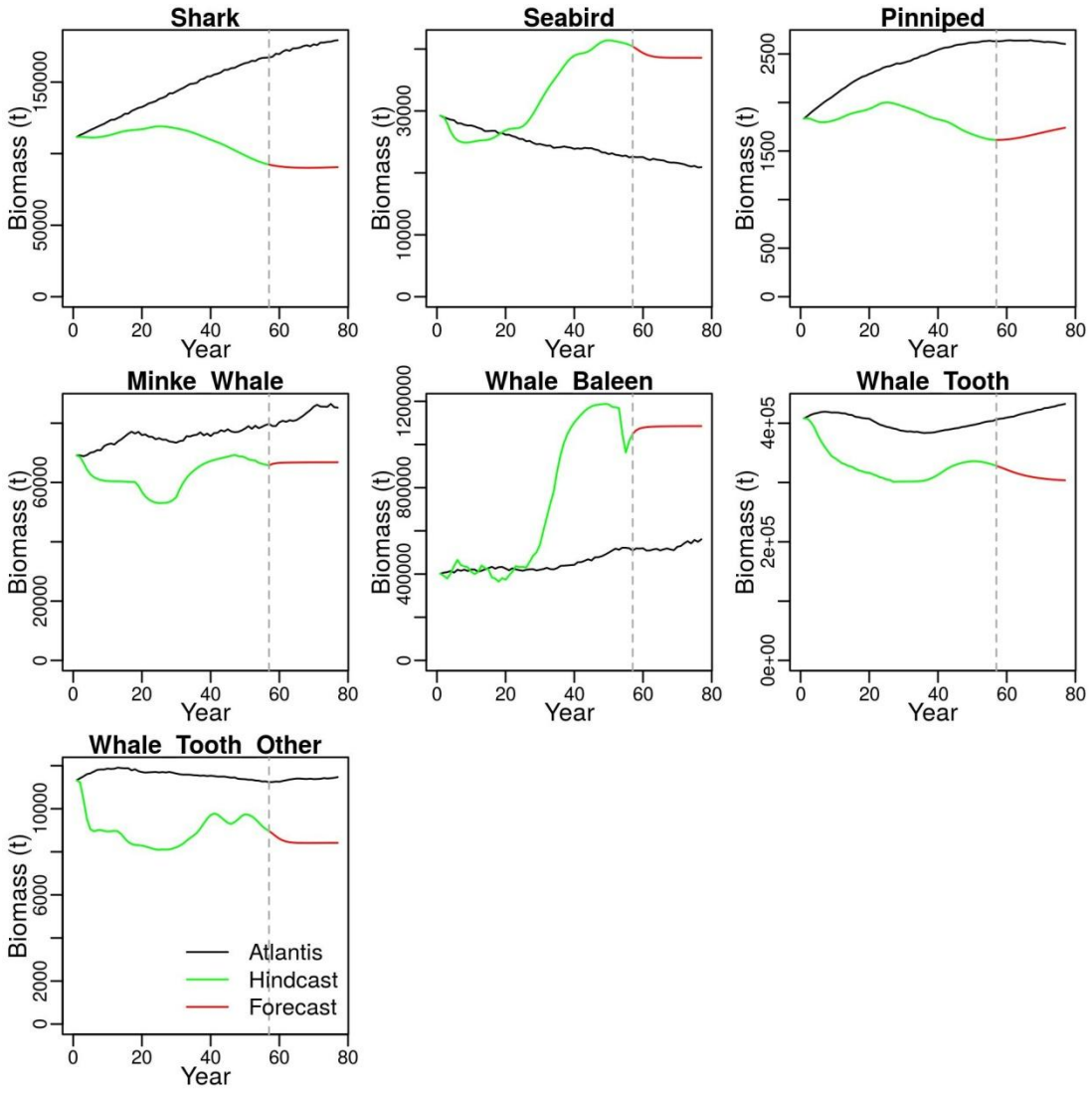
Performance when forecasting

Metric	Average
r	0.67 → 0.25
RI	1.17 → 1.22
MEF	-6.16 → -619

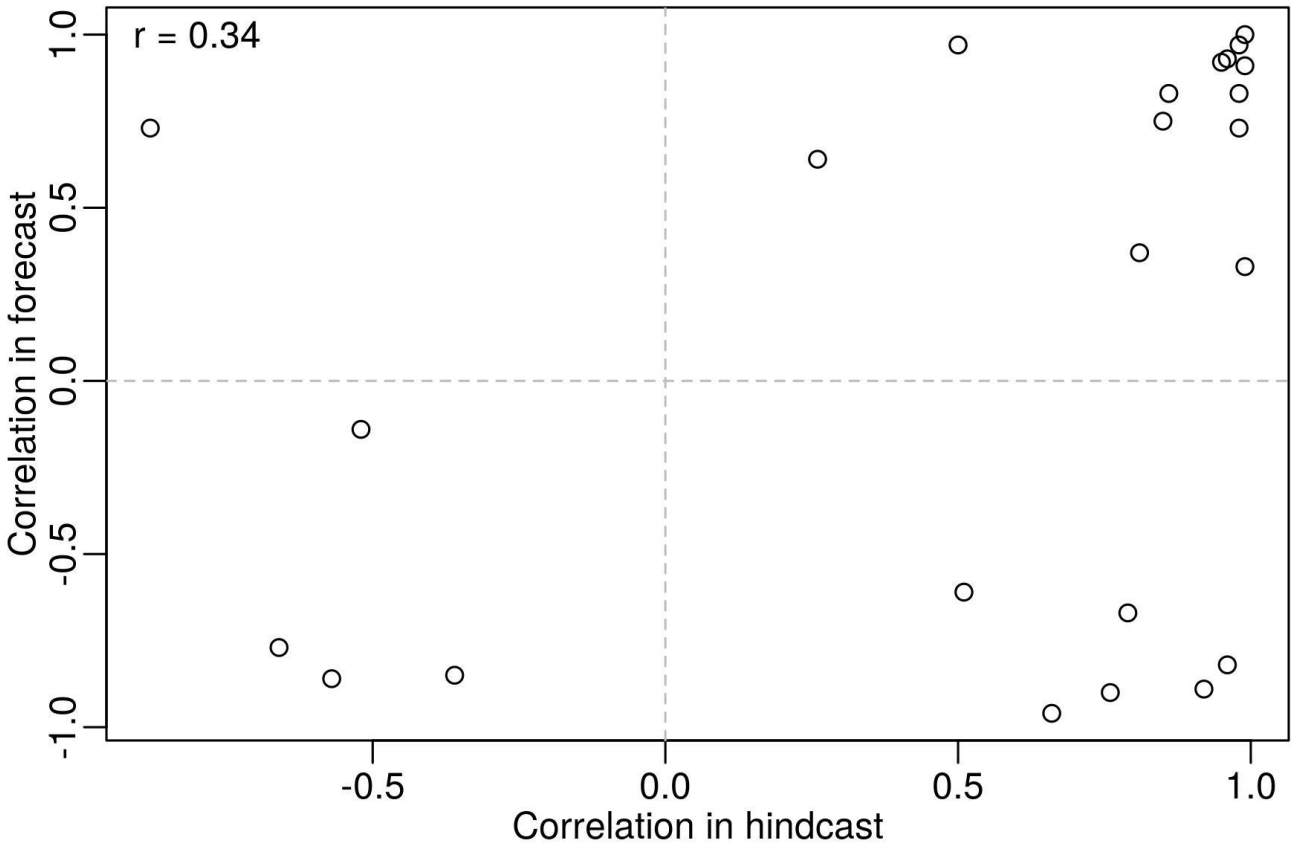


Performance when forecasting

Metric	Average
r	-0.11 → -0.24
RI	1.37 → 1.61
MEF	-65 → -1819

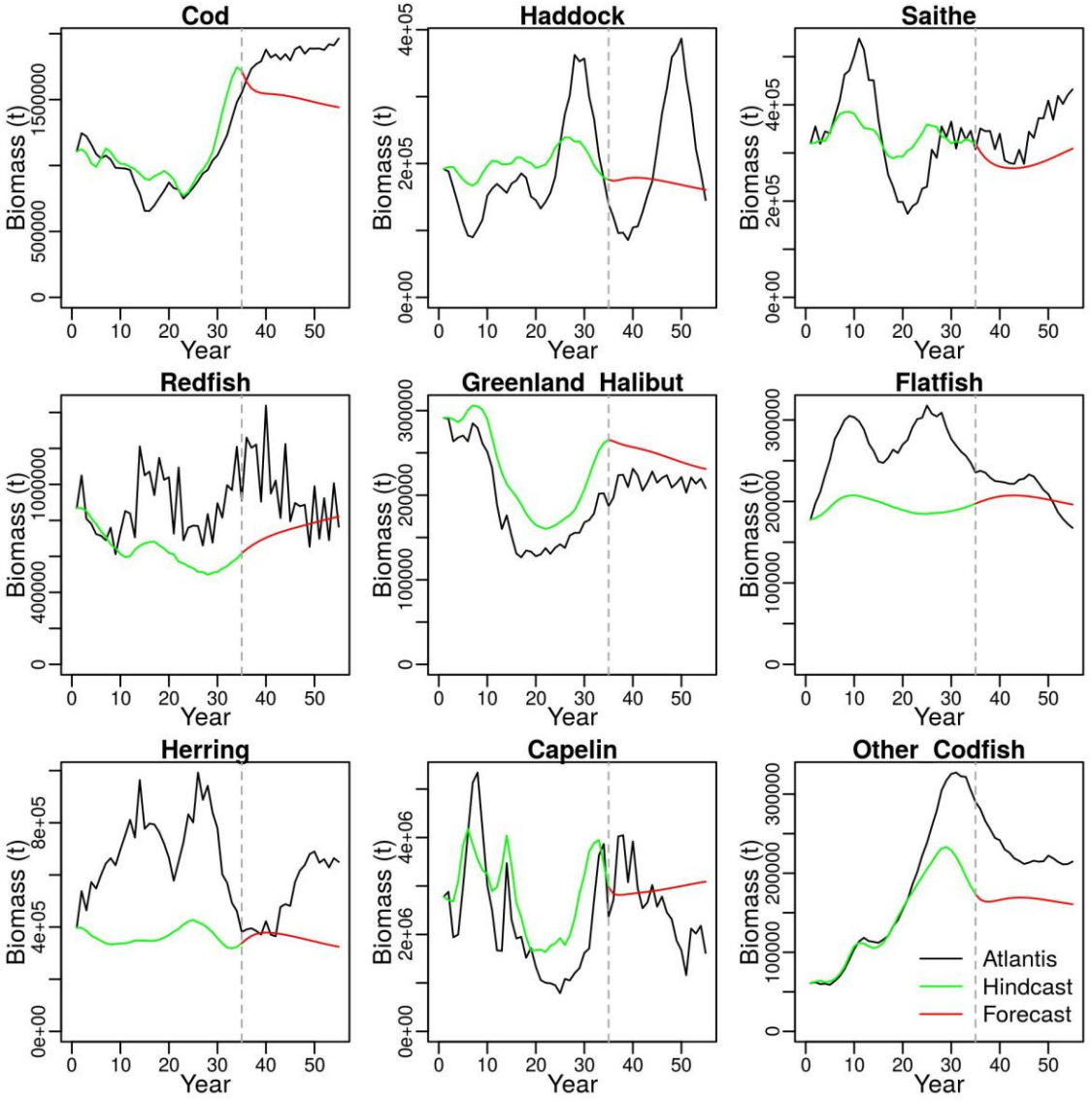


What does hindcast say about the forecast?

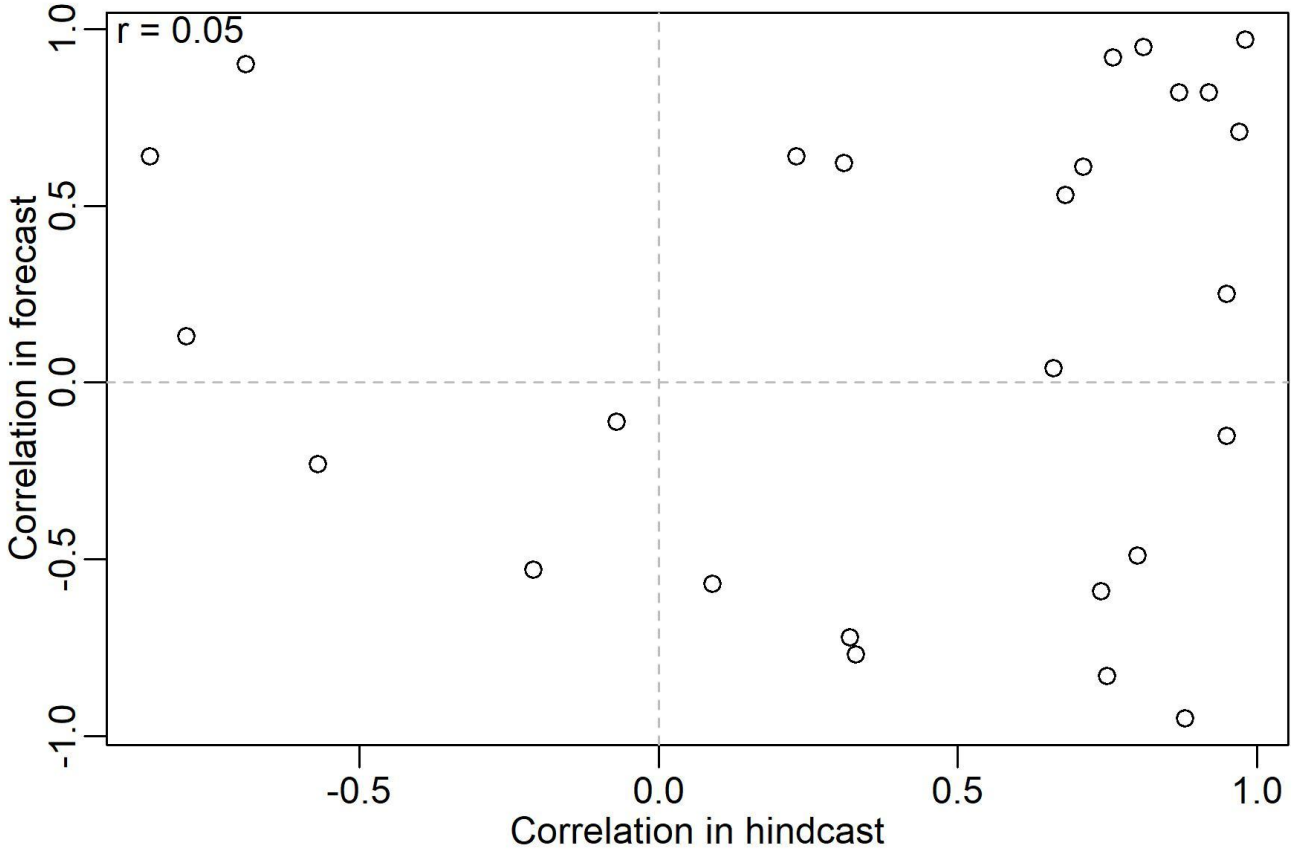


Performance when forecasting (Version 2)

Metric	Average
r	0.64 → -0.25
RI	1.41 → 1.36
MEF	-1.07 → -4.1



Hindcast does not say much about the forecast!



Conclusion

- It was possible to make a simple EwE model that fitted the Atlantis ecosystem.
- The forecasting ability of the model was however not reliable.
- Next: How is the performance when it comes to ranking management strategies?

Acknowledgement

This project has received funding from the European Union's Seventh Framework Programme for research, technological developement 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)

MARINE RESEARCH INSTITUTE

MareFrame

SIGILLUM UNIVERSITATIS ISLANDIAE

MINOUW