

Shifts in the North Sea ecosystem and fisheries implications



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RESEARCH ARTICLE

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ECOLOGICAL
SOCIETY

Shifts in North Sea forage fish productivity and potential fisheries yield

Lotte W. Clausen^{1,2} | Anna Rindorf² | Mikael van Deurs²  | Mark Dickey-Collas^{1,2} |
Niels T. Hintzen³

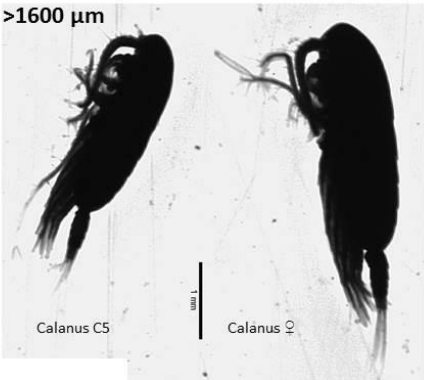
Forage fishes in the North Sea



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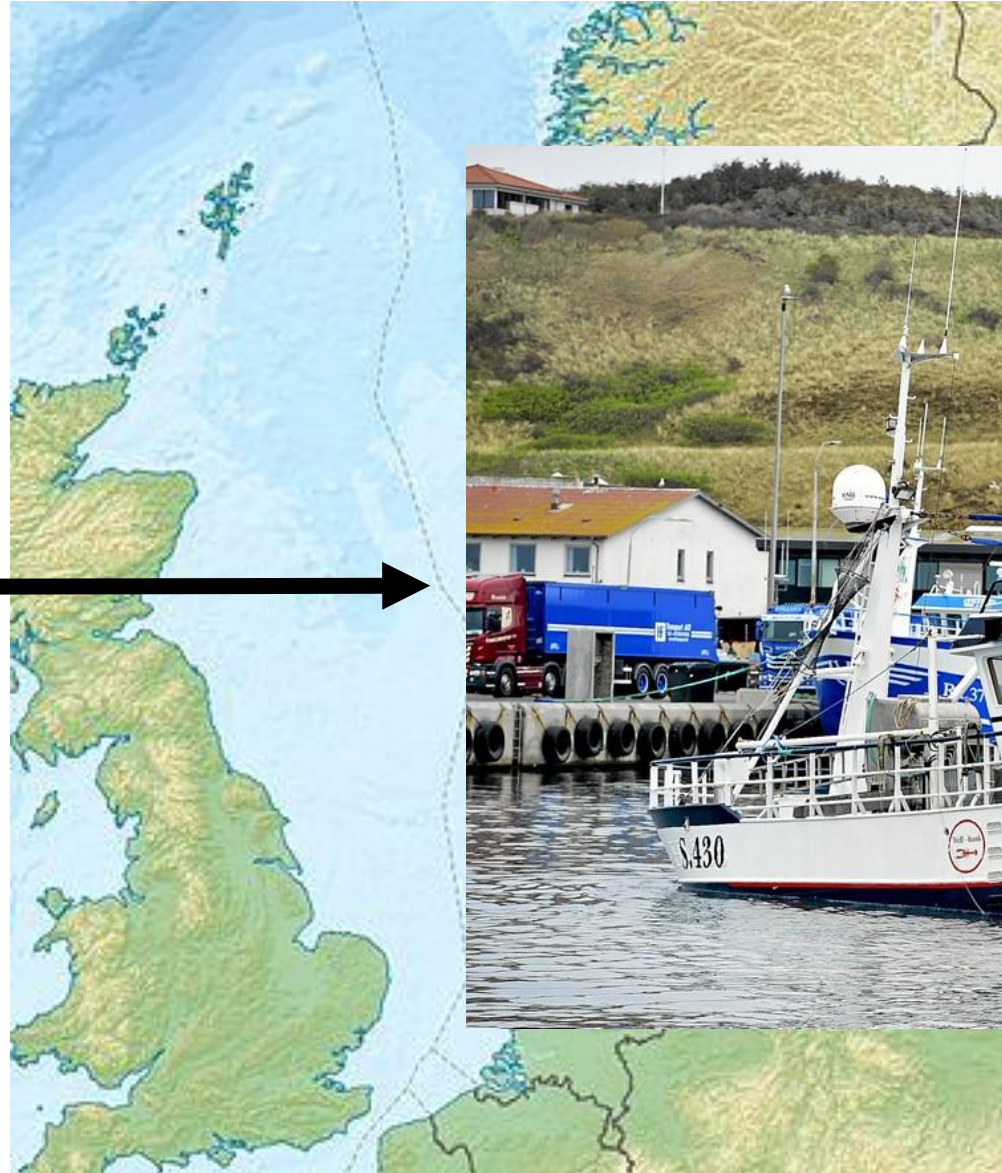
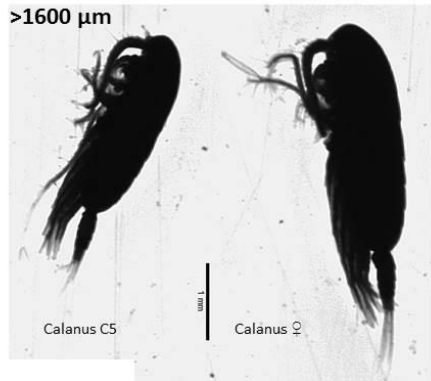
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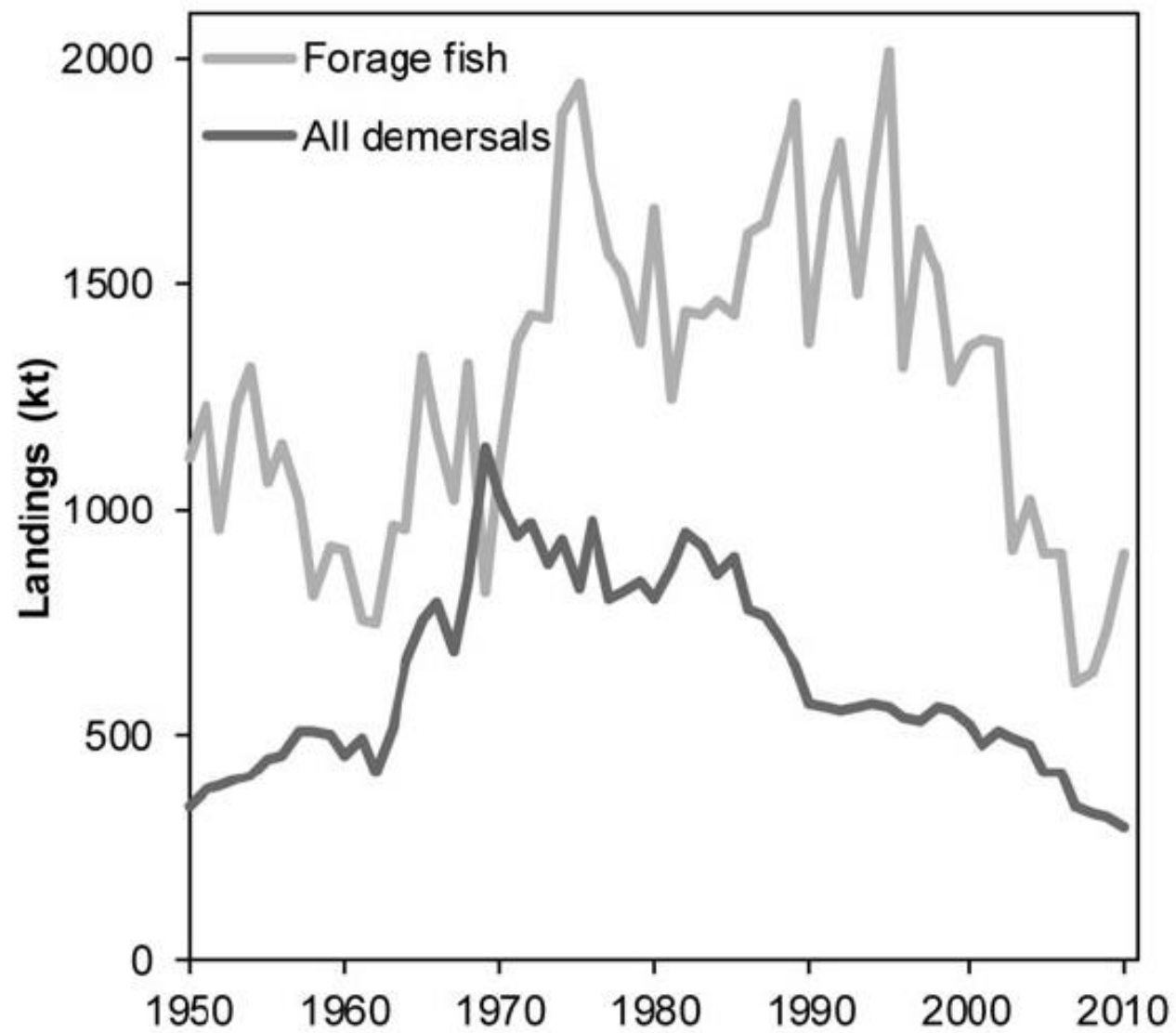


Forage fishes in the North Sea



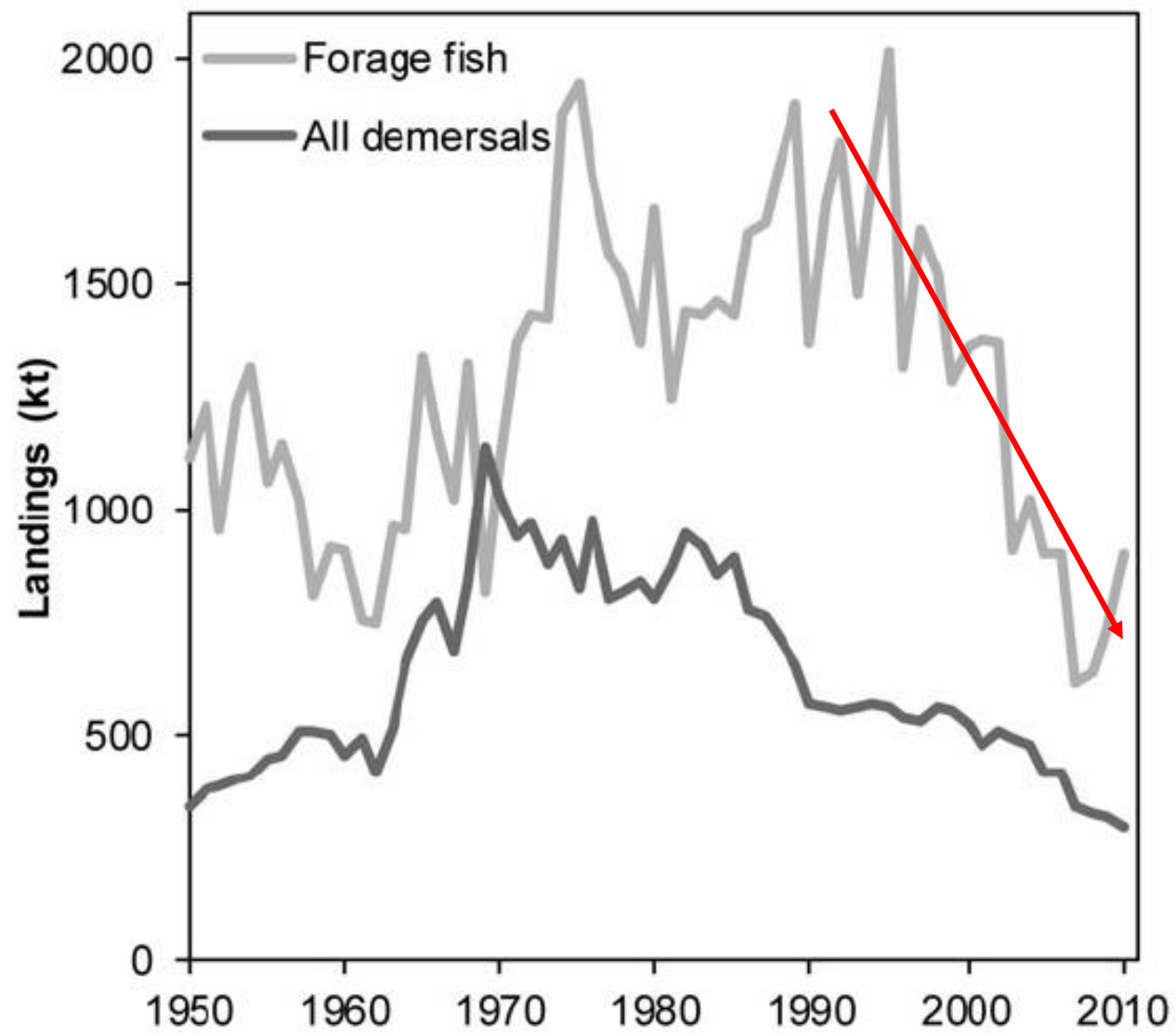
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Forage fish, their fisheries, and their predators: who drives whom?

Georg H. Engelhard^{1*}, Myron A. Peck², Anna Rindorf³, Sophie C. Smout⁴, Mikael van Deurs³, Kristina Raab^{5,6}, Ken H. Andersen³, Stefan Garthe⁷, Rebecca A.M. Lauerburg², Finlay Scott^{1,8}, Thomas Brunel⁵, Geert Aarts⁵, Tobias van Kooten⁵, and Mark Dickey-Collas^{5,9}



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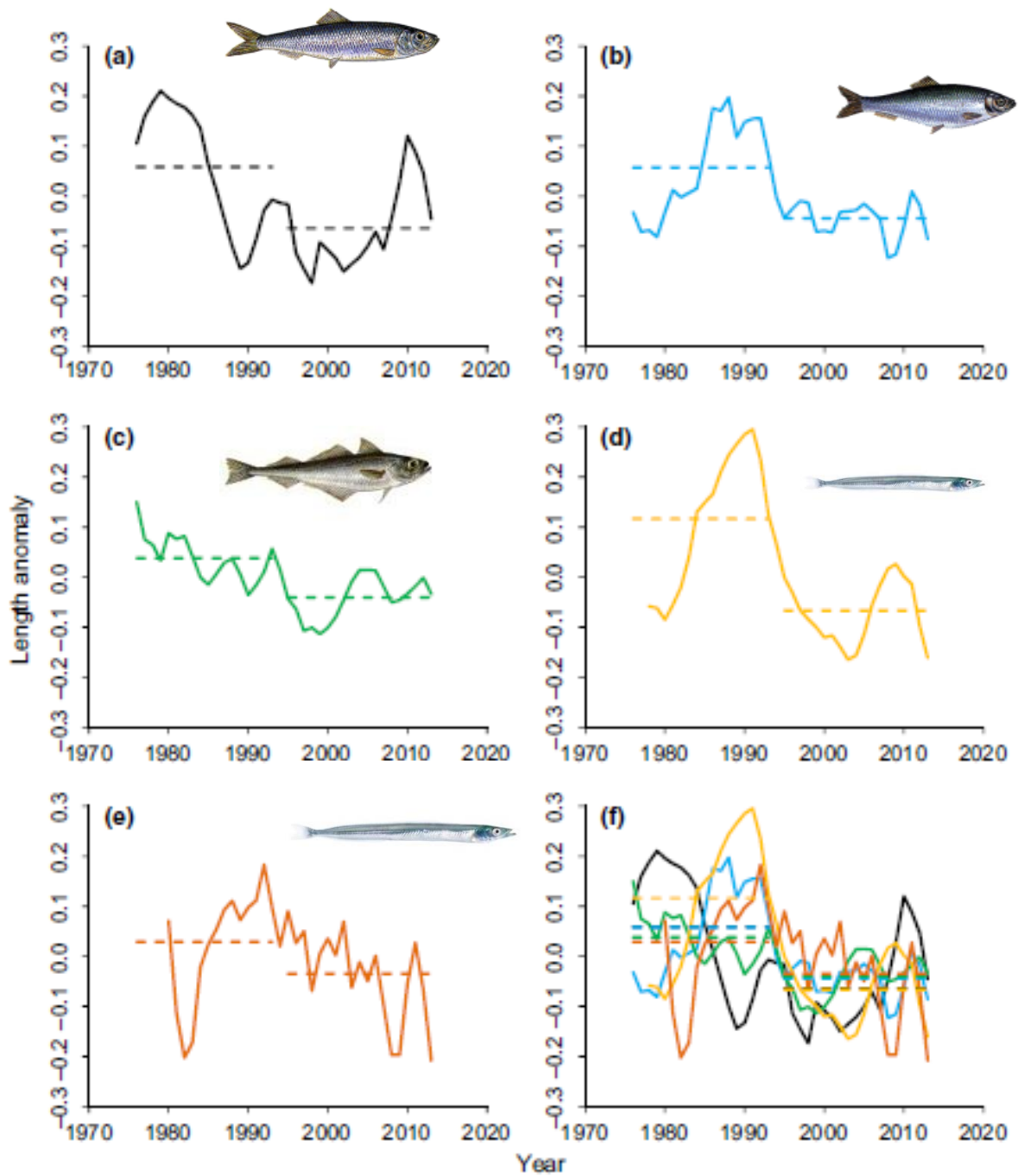
Why have catches declined?

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BIOLOGICAL PRODUCTION



Length at age from scientific surveys



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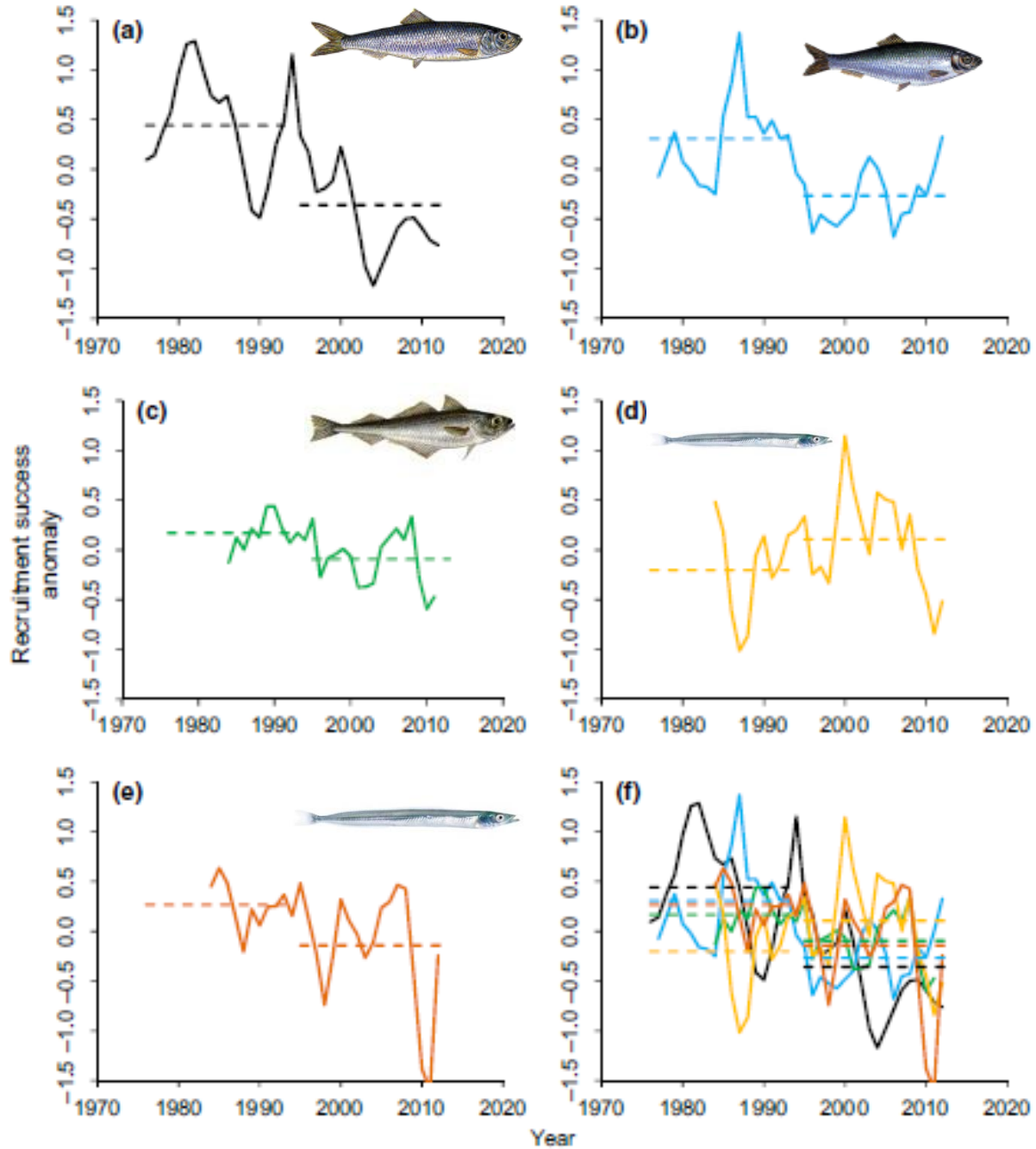
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Recruitment success from assessment models (Recruits per spawner biomass)



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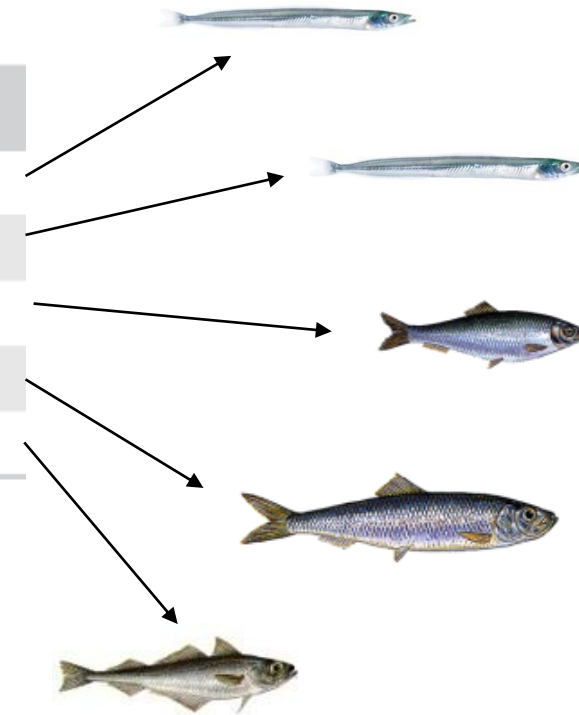


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Weight at age from commercial catches and recruitment from assessment models

Stock	Weight at age (%)	Recruitment (%)
Sandeel (southern)	-26	-23
Sandeel (northern)	-24	-52
Sprat	-6	-9
Herring	-3	-27
Norway pout	-8	-29



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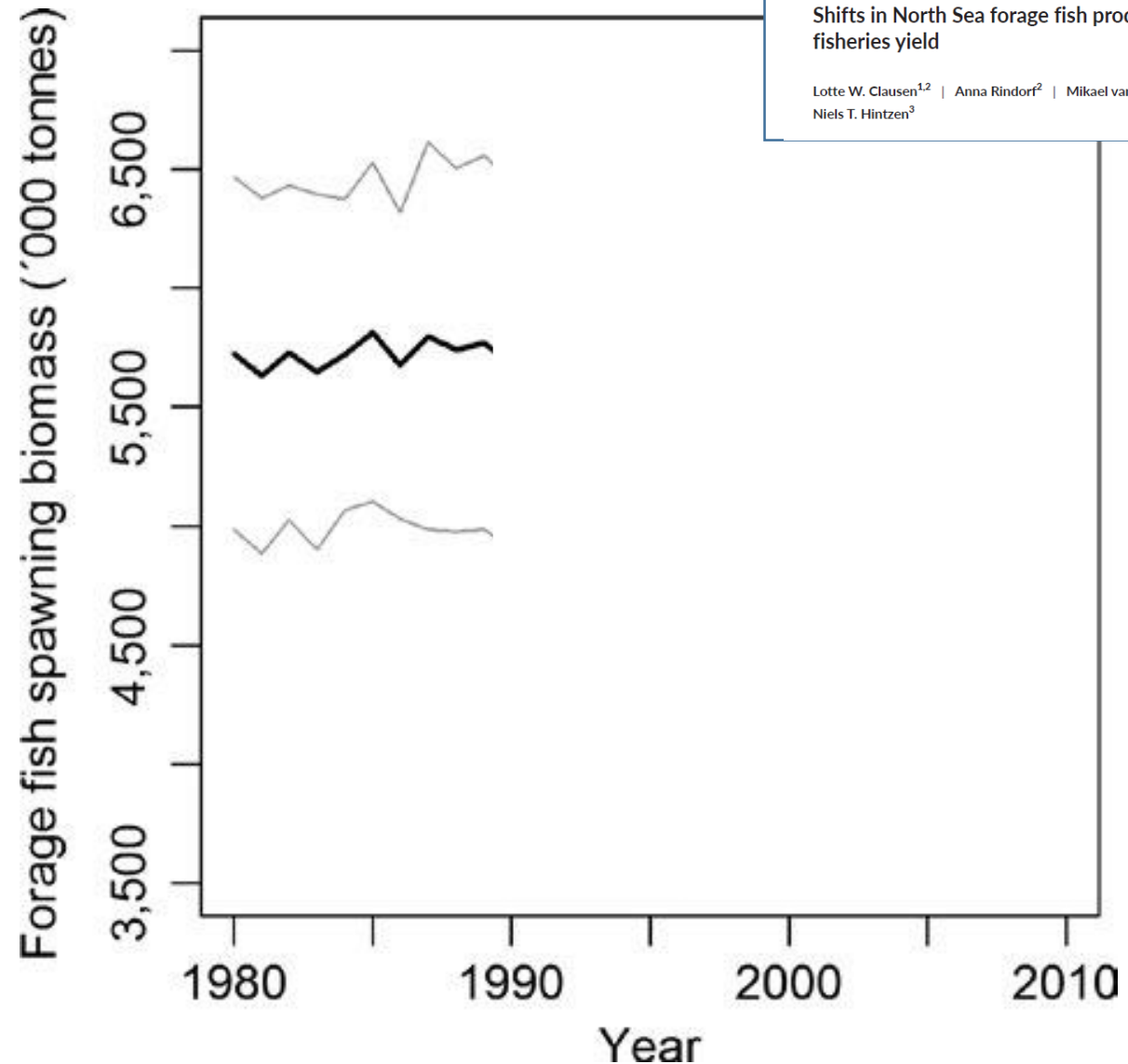
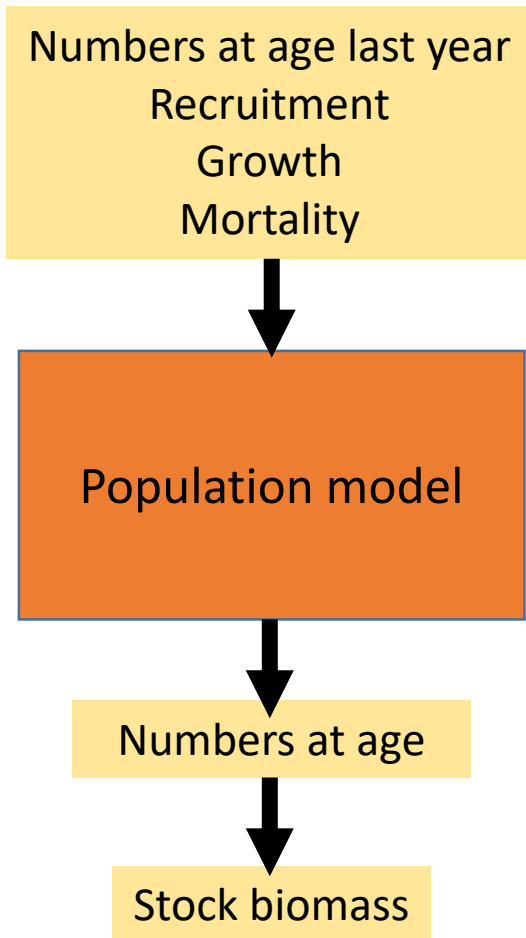
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Let's consider a hypothetical scenario in the past with no fishing



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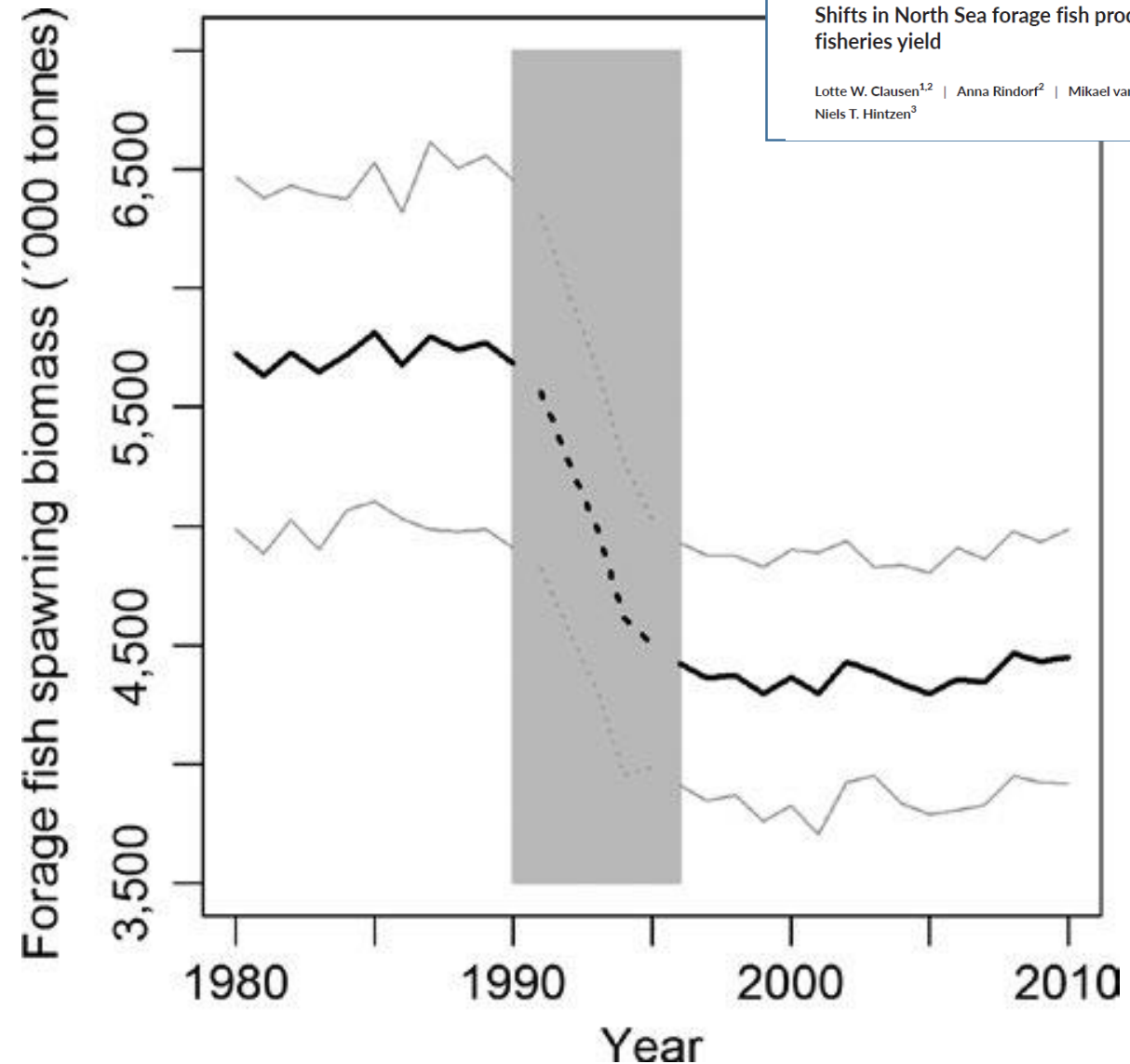
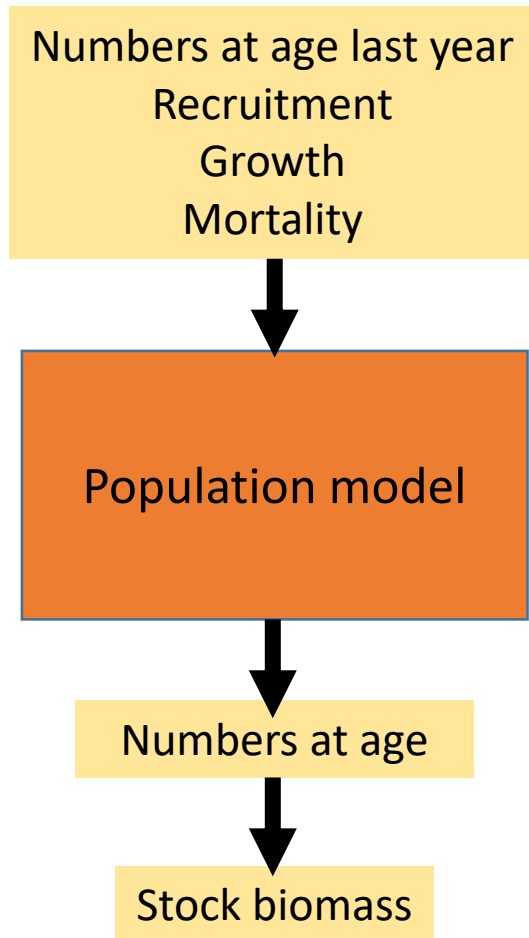
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And now consider a hypothetical scenario in recent time with no fishing



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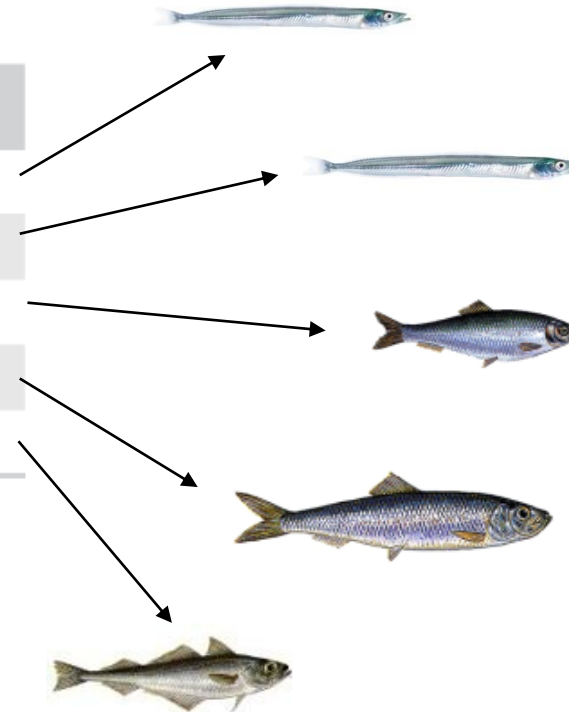
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Then consider a scenario, where we fished the past productive stock and the recent in-productive stock according to Fmsy principles

Stock	MSY (%)	F_{msy} (%)
Sandeel (southern)	-56	-50
Sandeel (northern)	-68	-64
Sprat	-34	-48
Herring	-33	-26
Norway pout	-45	-41



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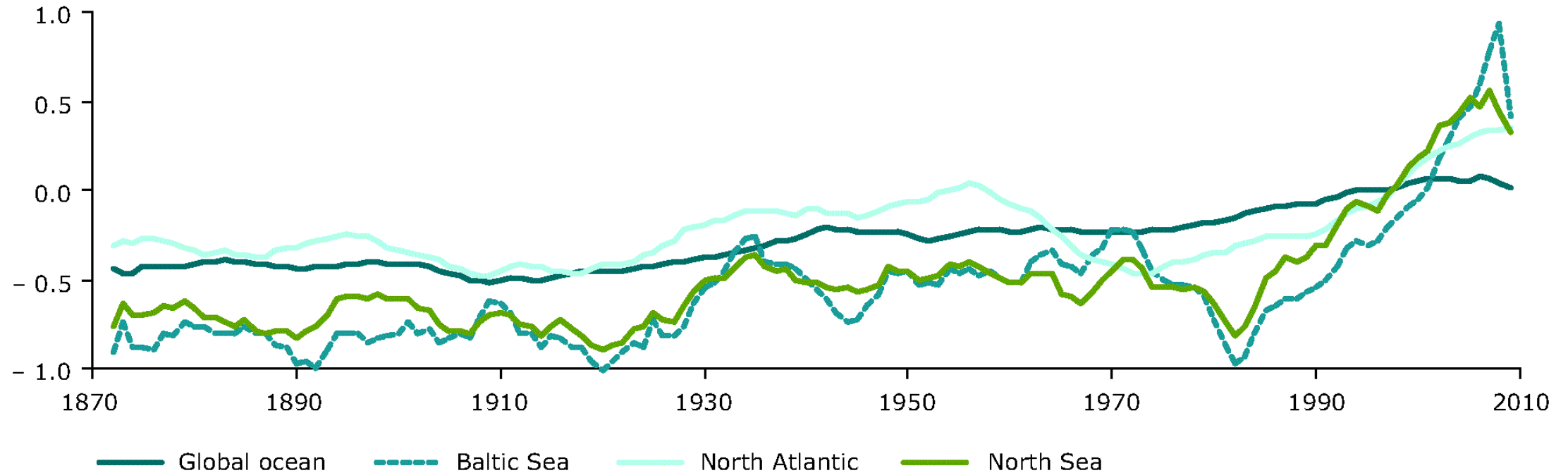
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**All evidence point to a shift in forage fish productivity
with fisheries implications**

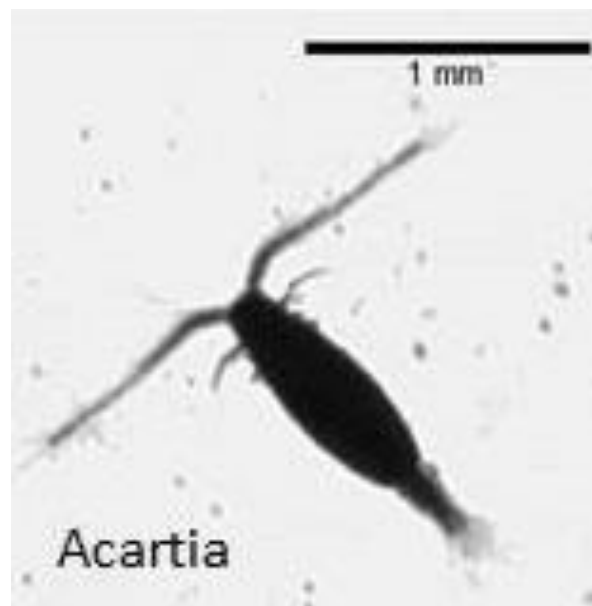
But why?

Long term change in Sea Surface Temperature

SST anomaly (Deg)



Source: European Environmental Agency

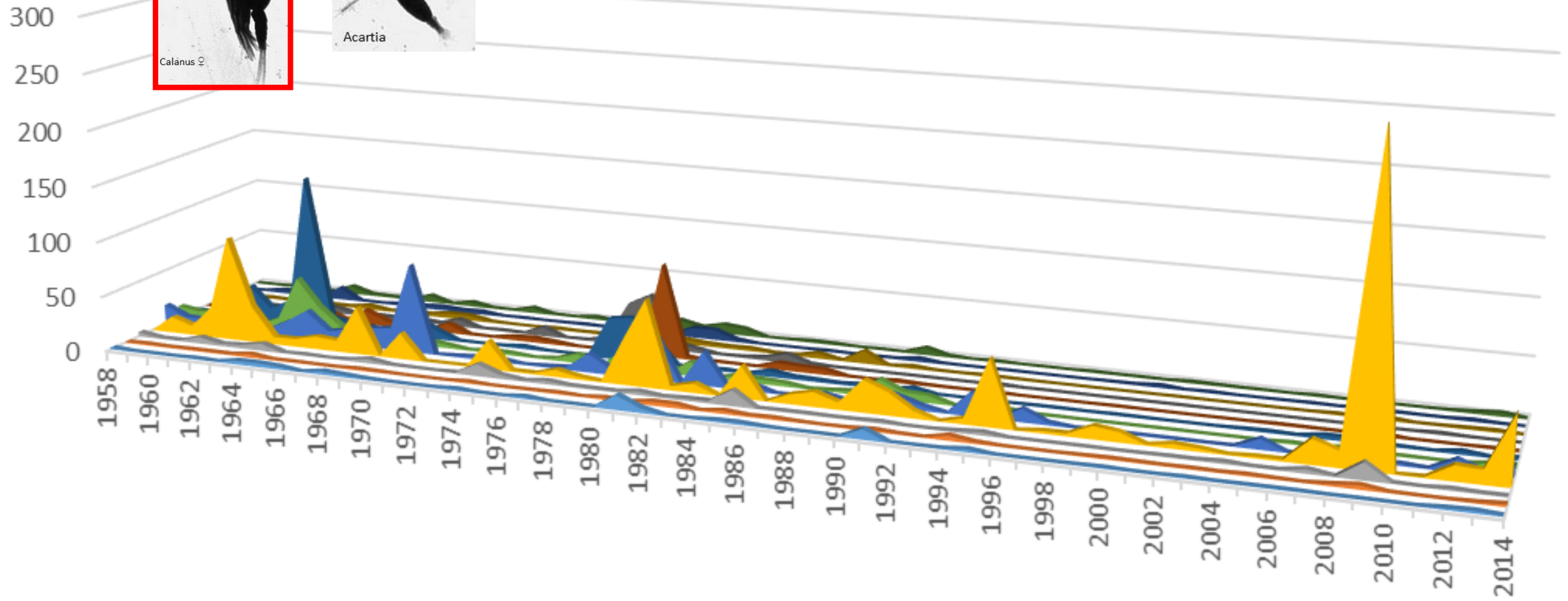
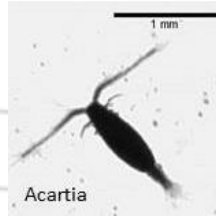




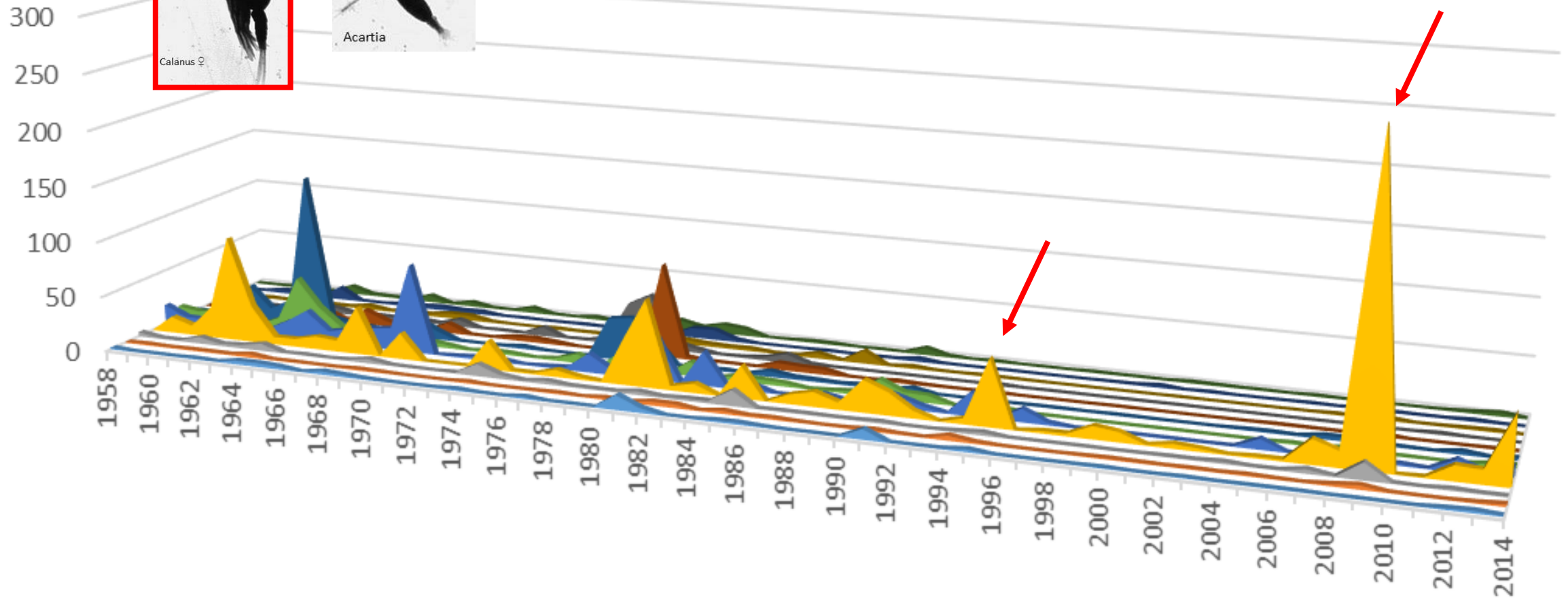
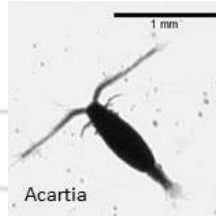
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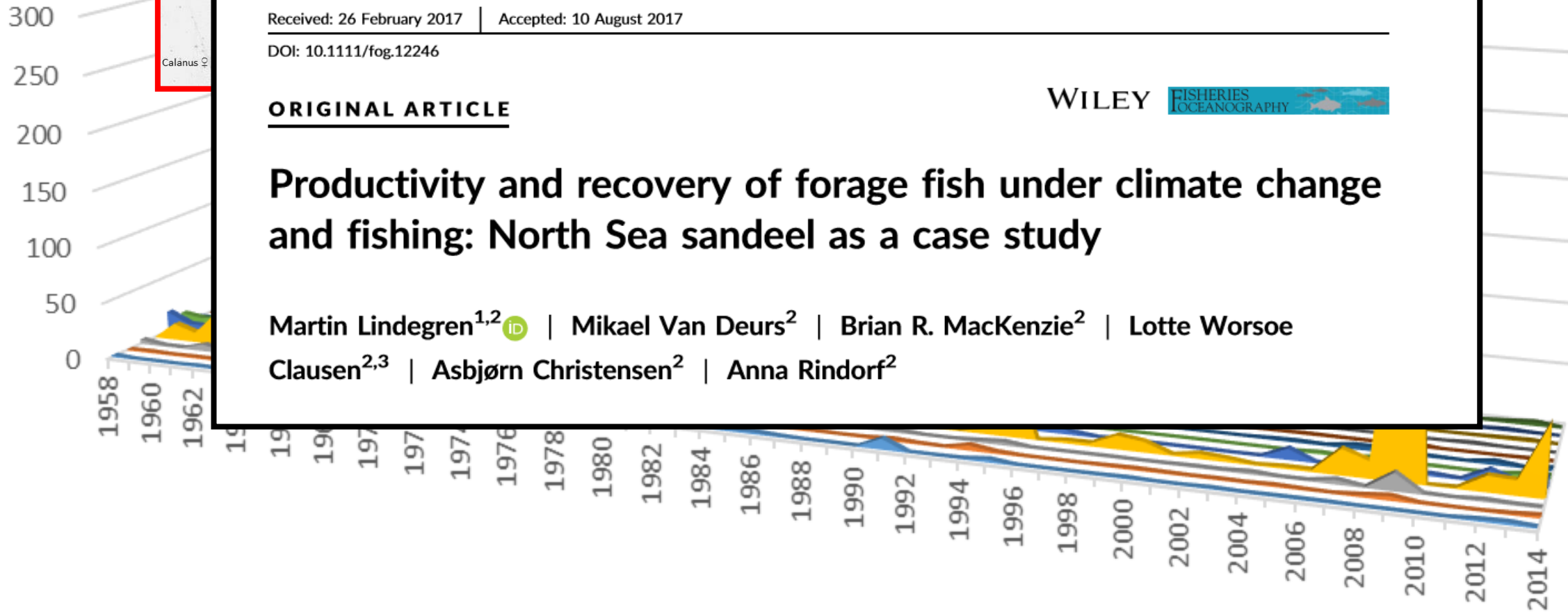
C. finmarchicus



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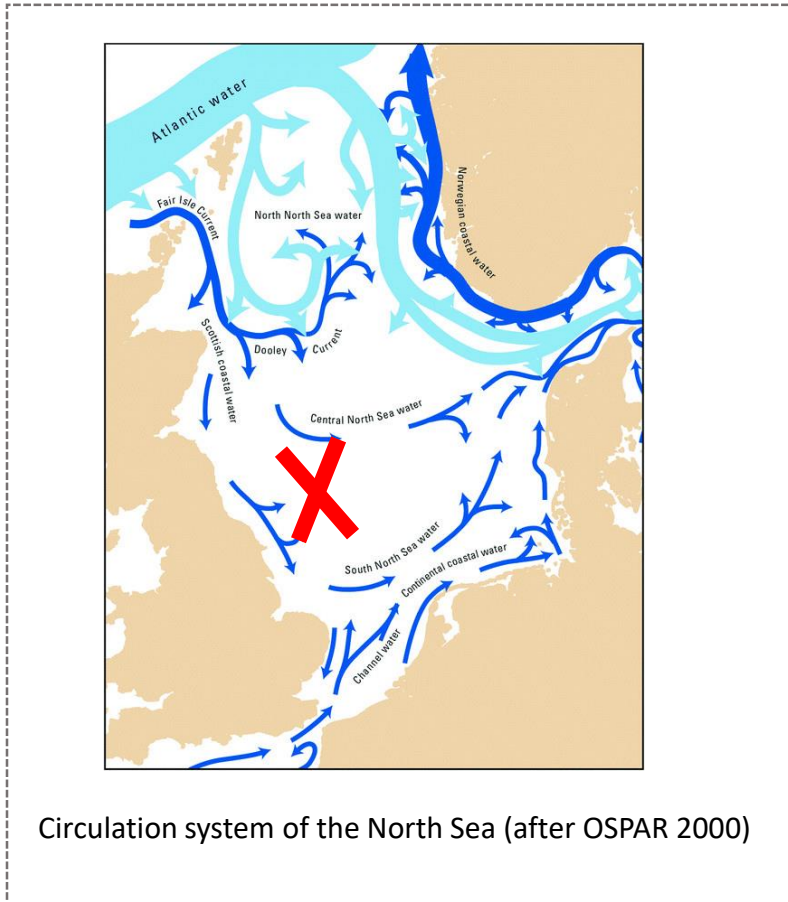
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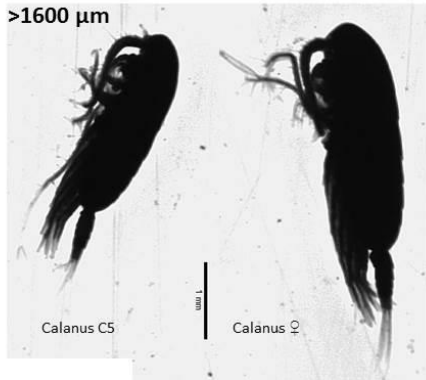
WILEY **FISHERIES OCEANOGRAPHY**

Productivity and recovery of forage fish under climate change and fishing: North Sea sandeel as a case study

Martin Lindegren^{1,2}  | Mikael Van Deurs² | Brian R. MacKenzie² | Lotte Worsoe Clausen^{2,3} | Asbjørn Christensen² | Anna Rindorf²

ONGOING WORK:





- Today's North Sea is different from past time North Sea
- This is why total forage fish catches have reduced over time
- Data suggest that it has to do with climate induced bottom-up effects, but the exact mechanisms are not clear to us yet

Many more studies on regime-shifts in the North Sea can be found in the scientific literature, see for example:



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Progress in Oceanography 60 (2004) 245–262

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Fisheries Research 50 (2001) 163–171

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The North Sea regime shift: evidence, causes, mechanisms
and consequences

Grégory Beaugrand *

CNRS, UMR 8013 ELICO, Université des Sciences et Technologies de Lille 1, 28, avenue Fosh BP 80 62930 Wimereux, France

A regime shift in the North Sea circa 1988 linked to
changes in the North Sea horse mackerel fishery

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^b*Instituto de Investigação das Pescas e do Mar, Avenida de Brasília, 1400 Lisboa, Portugal*

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