Climate change projections of commercial fish distributions around north western Europe

Elena Couce, Bryony Townhill, Jon Tinker, Susan Kay and John K. Pinnegar

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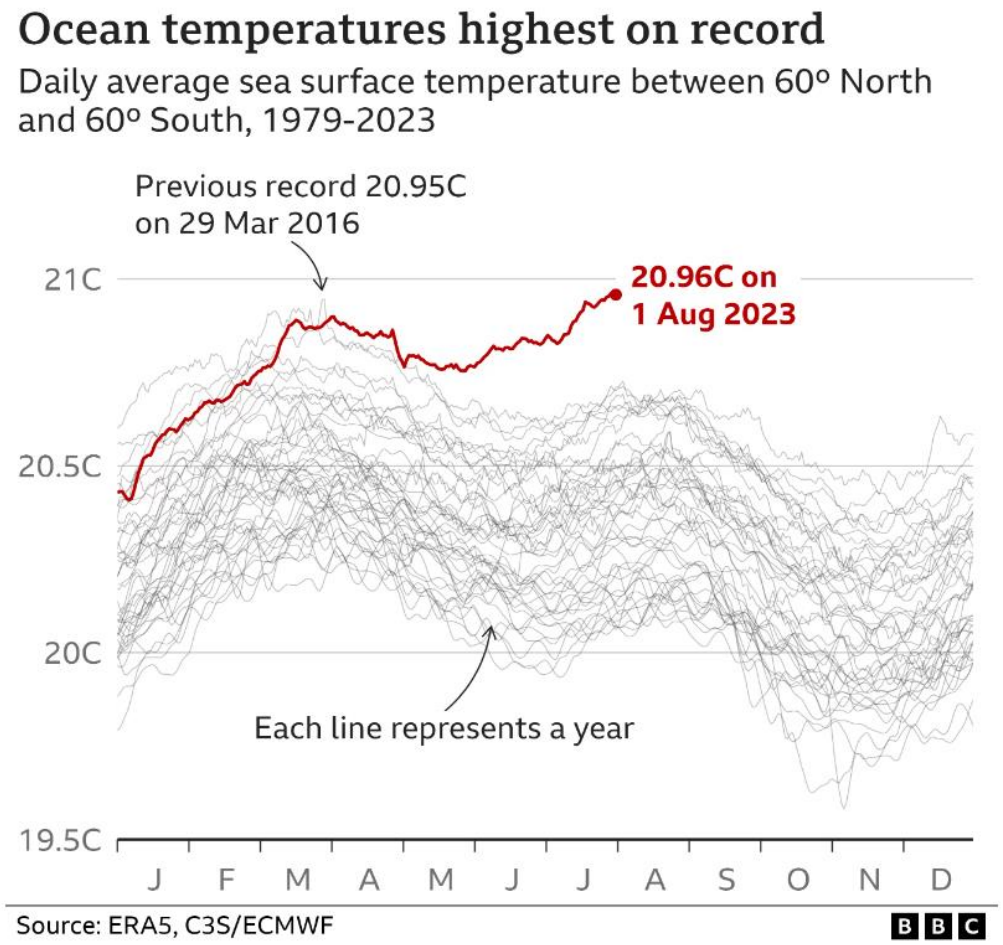
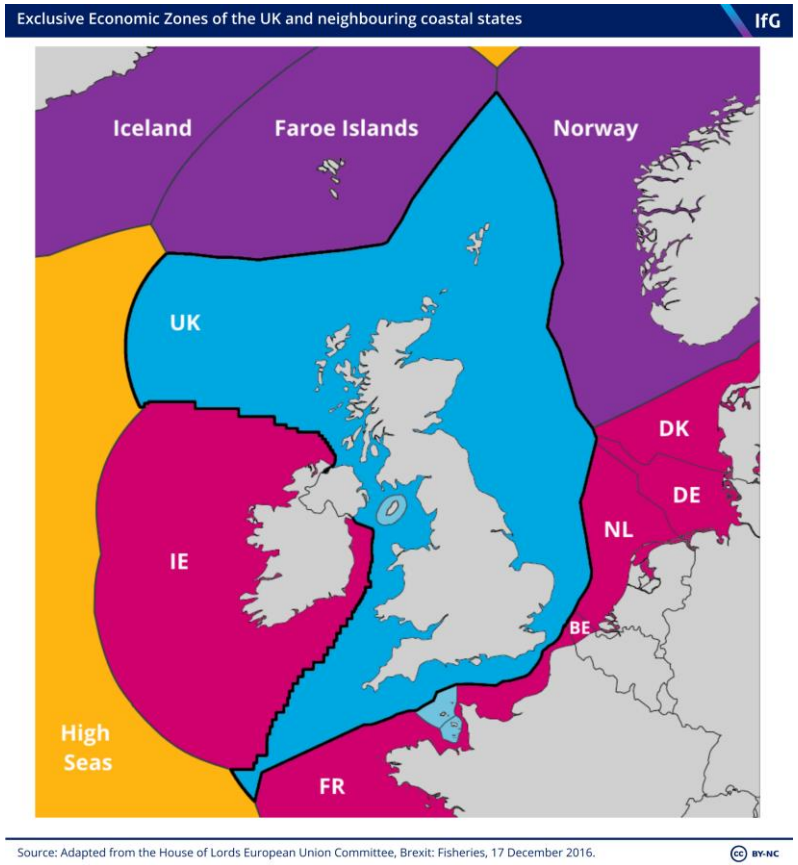
Climate change

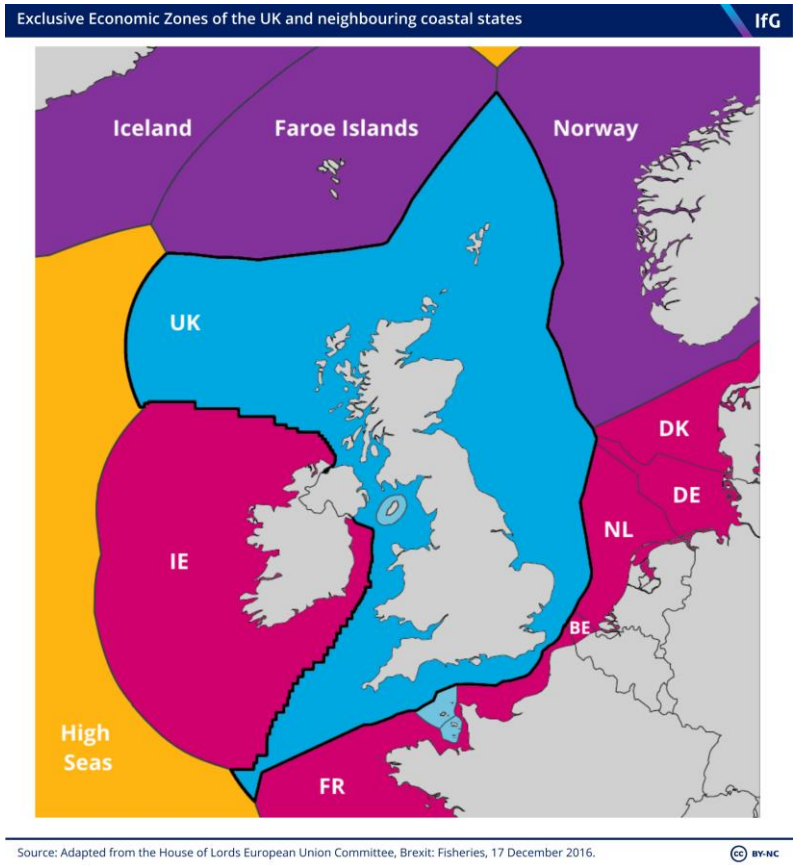


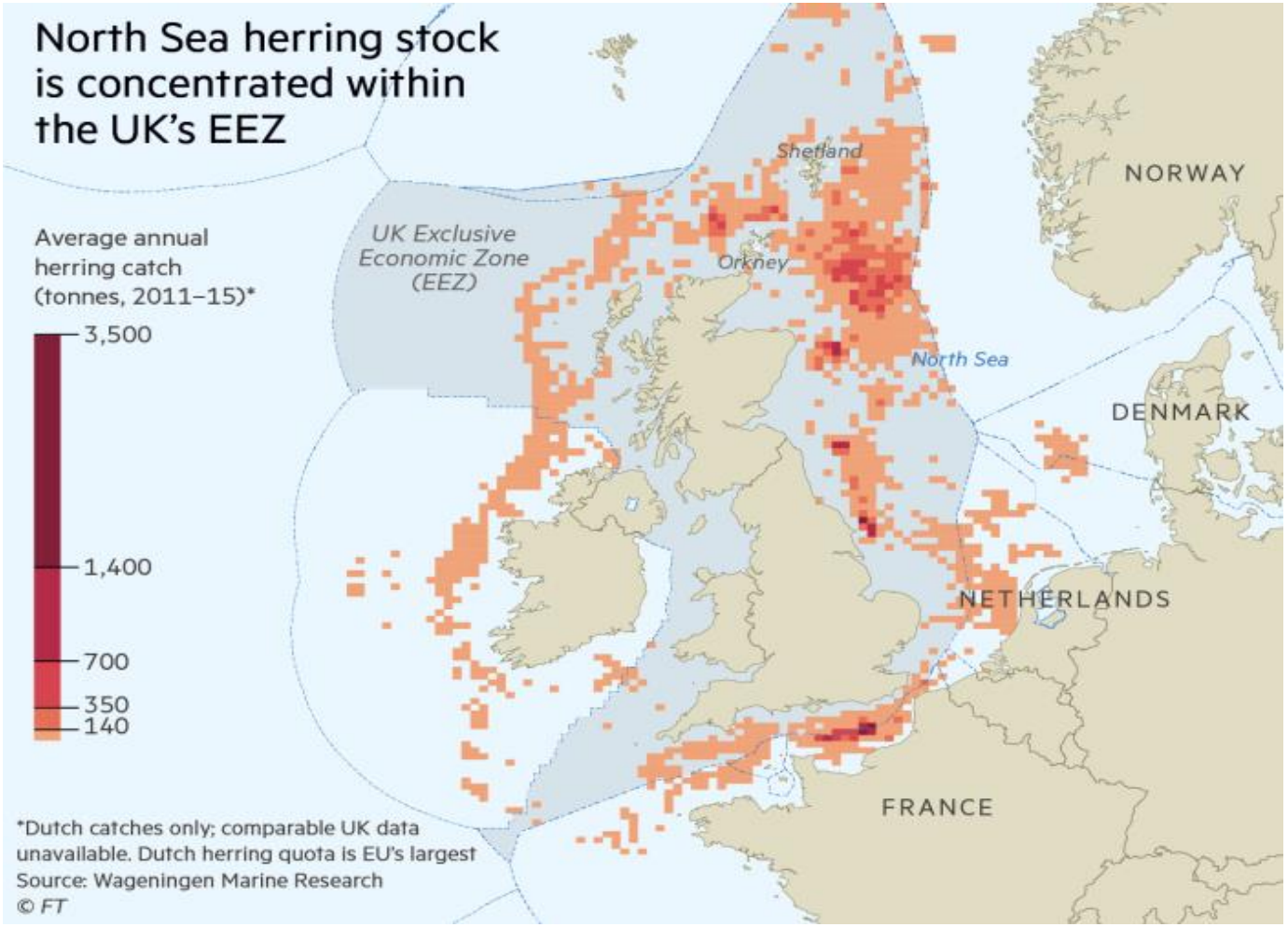
The Challenge of managing stocks across international borders



- In December 2020 **the UK left the EU Common Fisheries Policy (CFP)**
- The CFP allows **common access** to all EU waters, but **quotas are set according to 'relative stability'**
- For each stock, quotas are **allocated to each country according to a fixed percentage (in perpetuity)** known as a 'relative stability' key.
- 'Relative Stability' allocations are based on the nations' **'track record' (and the situation in the 1970s)**
- There is **no recognition that fish distributions can change**
- In the EU-UK Trade and Cooperation Agreement, the UK made the case that **allocation should be based on 'zonal attachment'**

The Challenge of managing stocks across international borders





The recent ‘Mackerel War’…

- In recent years there has been the apparent **westward and north-westward spread of mackerel** into Icelandic and Faroese waters.
- During 2007 - 2016 the mackerel **distribution range increased three-fold and the centre-of-gravity shifted westward by 1650 km and northward by 400 km.**
- Whether shift was due to **natural stock fluctuations or warming sea temperatures** became a serious point of contention.
- During the summers of 2020-2021 fishers have witnessed a substantial **eastward retreat** in mackerel concentrations


Daily Record AND SUNDAY MAIL

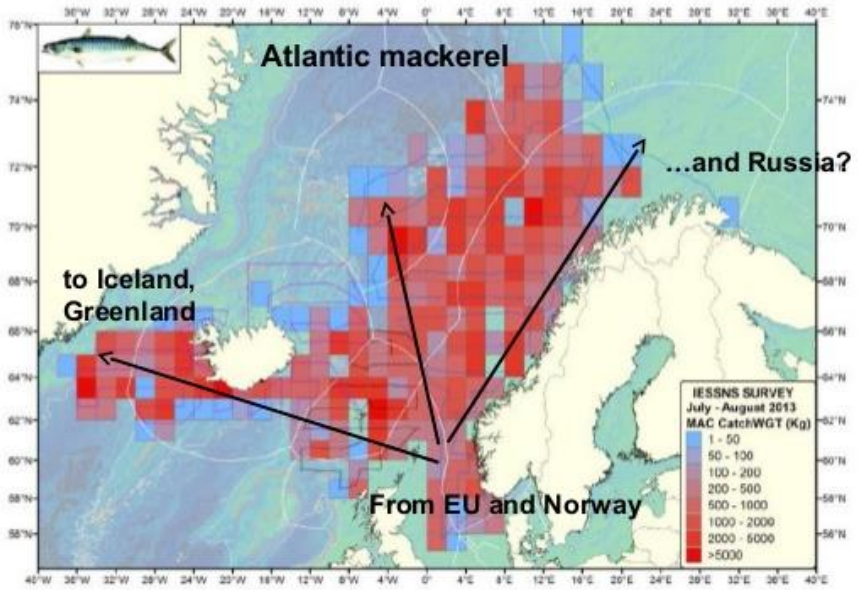
By Jack Mathieson 8 Jan 2013 00:01

Cod War II: Scotland's fishermen call for sanctions against Iceland over mackerel dispute

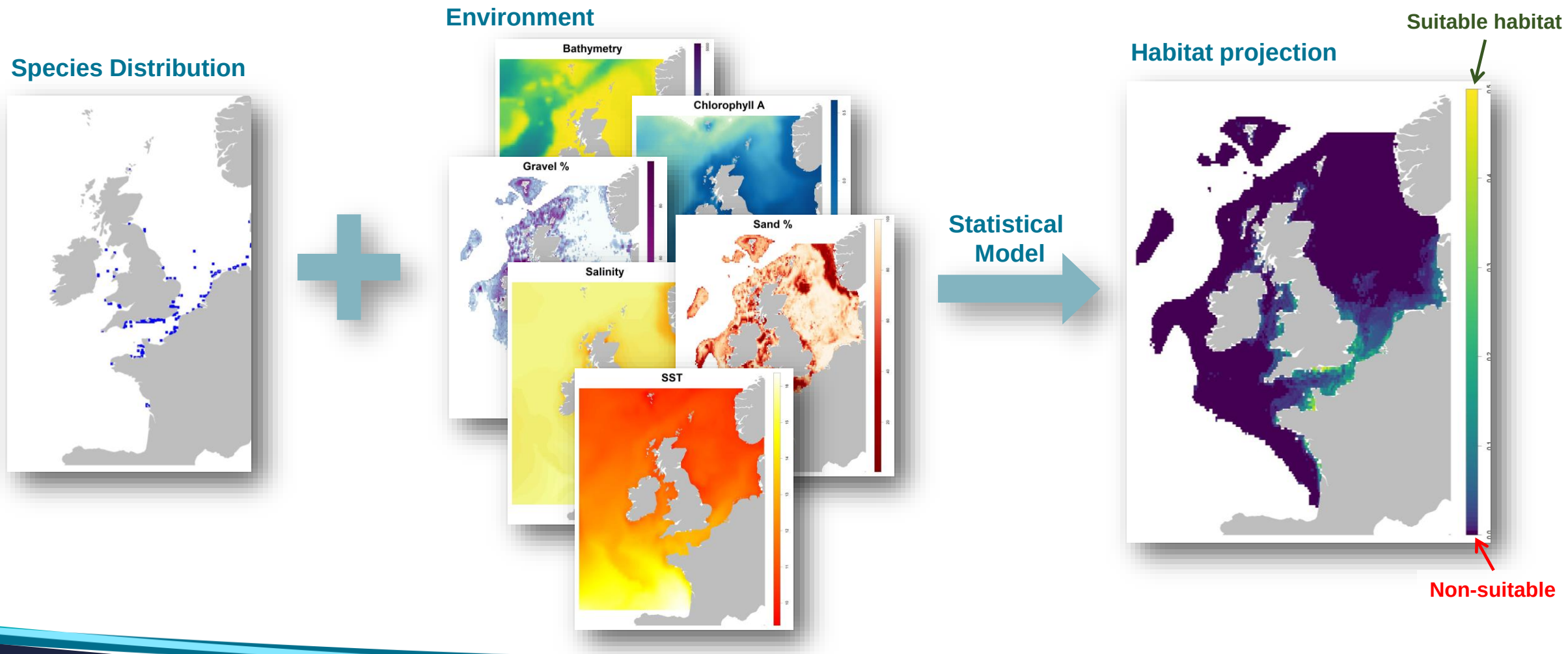
ICELAND stands accused by Scots fishermen of acting in a criminal manner over the way they fish mackerel.

Scotland's fishermen are furious at Iceland's attitude

Maurice McDonald/PA

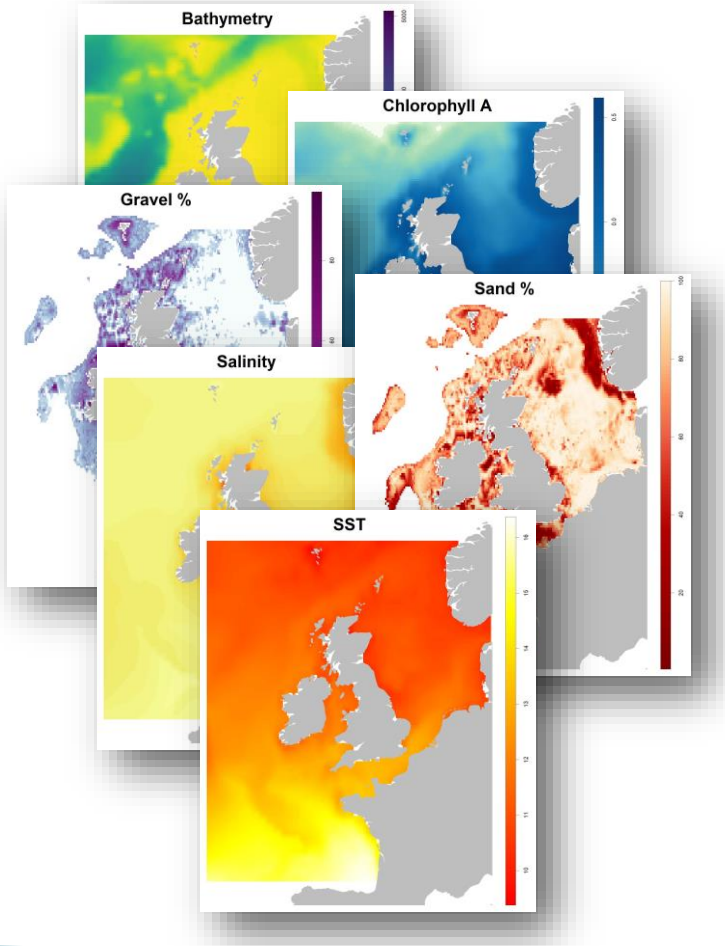


Species Distribution Models (SDMs)



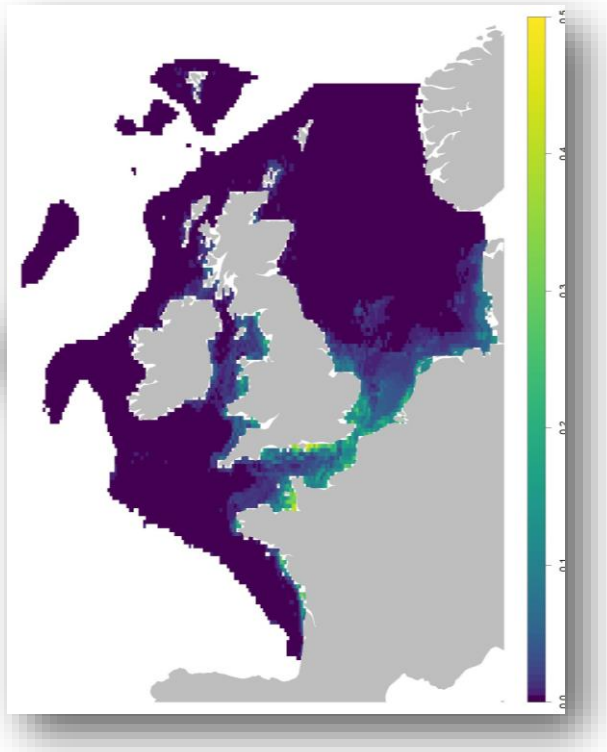
Species Distribution Models (SDMs)

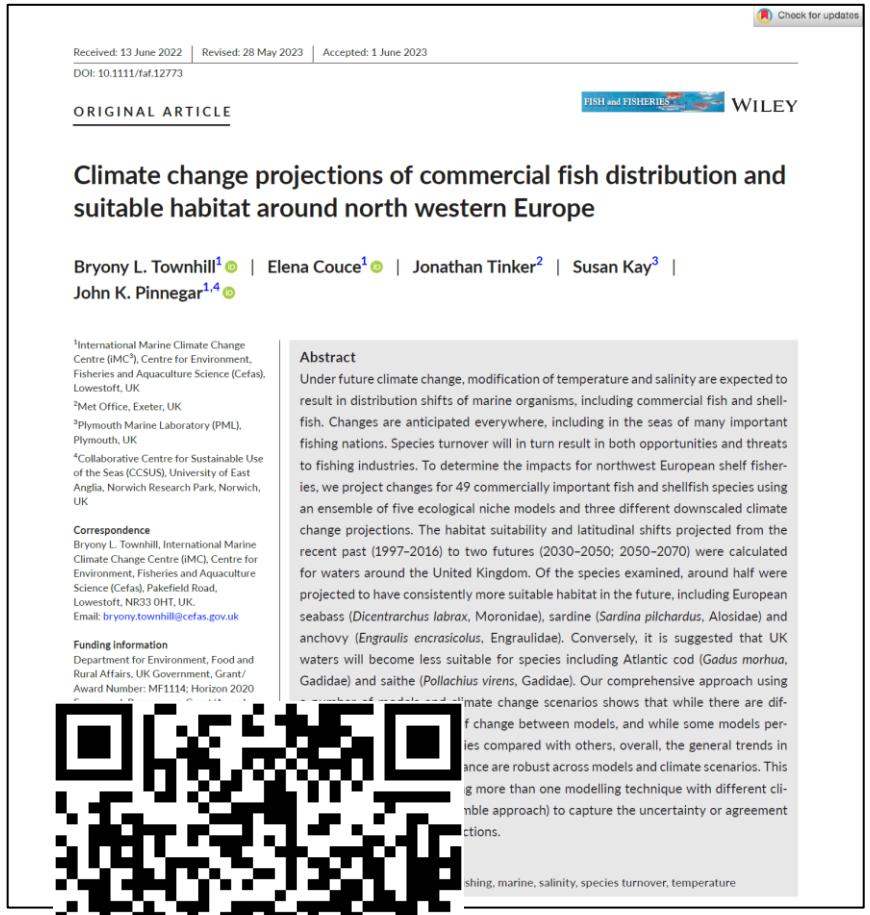
Future environment



Statistical Model

Future habitat projection





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ORIGINAL ARTICLE

FISH and FISHERIES WILEY

Climate change projections of commercial fish distribution and suitable habitat around north western Europe

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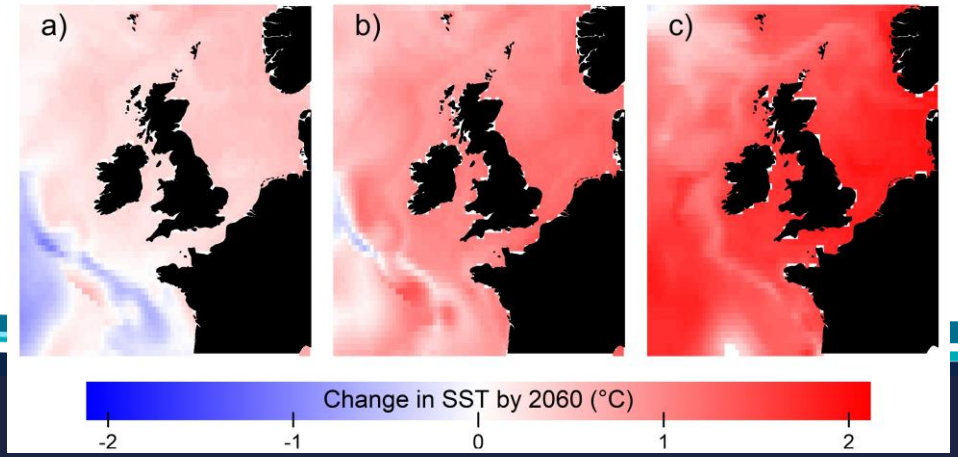
Abstract

Under future climate change, modification of temperature and salinity are expected to result in distribution shifts of marine organisms, including commercial fish and shellfish. Changes are anticipated everywhere, including in the seas of many important fishing nations. Species turnover will in turn result in both opportunities and threats to fishing industries. To determine the impacts for northwest European shelf fisheries, we project changes for 49 commercially important fish and shellfish species using an ensemble of five ecological niche models and three different downscaled climate change projections. The habitat suitability and latitudinal shifts projected from the recent past (1997–2016) to two futures (2030–2050; 2050–2070) were calculated for waters around the United Kingdom. Of the species examined, around half were projected to have consistently more suitable habitat in the future, including European seabass (*Dicentrarchus labrax*, Moronidae), sardine (*Sardina pilchardus*, Alosidae) and anchovy (*Engraulis encrasicolus*, Engraulidae). Conversely, it is suggested that UK waters will become less suitable for species including Atlantic cod (*Gadus morhua*, Gadidae) and saithe (*Pollachius virens*, Gadidae). Our comprehensive approach using
mate change scenarios shows that while there are dif-
f change between models, and while some models per-
ies compared with others, overall, the general trends in
ance are robust across models and climate scenarios. This
g more than one modelling technique with different cli-
mble approach) to capture the uncertainty or agreement
ctions.

shing, marine, salinity, species turnover, temperature

- **Future projections of habitat suitability for 49 commercial fish species.**
- Employed an **ensemble of 5 SDM:** Maxent, BIOCLIM, Generalised Linear Models (GLMs), Random Forest and Support Vector Machines (SVM)
- **Three carbon emission scenarios** (RCP 4.5, RCP 8.5, and A1B – 11 variants)
- Environmental variables: **depth, temperature and salinity (surface, near-bed and difference).**
- **Spatial resolution of 12 km** (1/9° latitude by 1/6° longitude)



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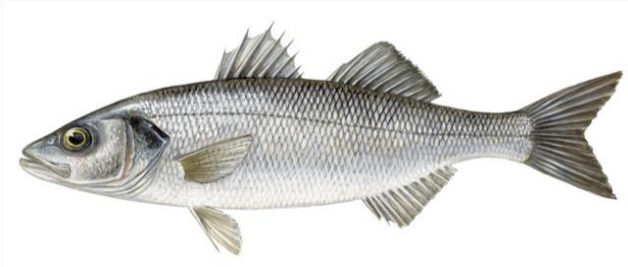
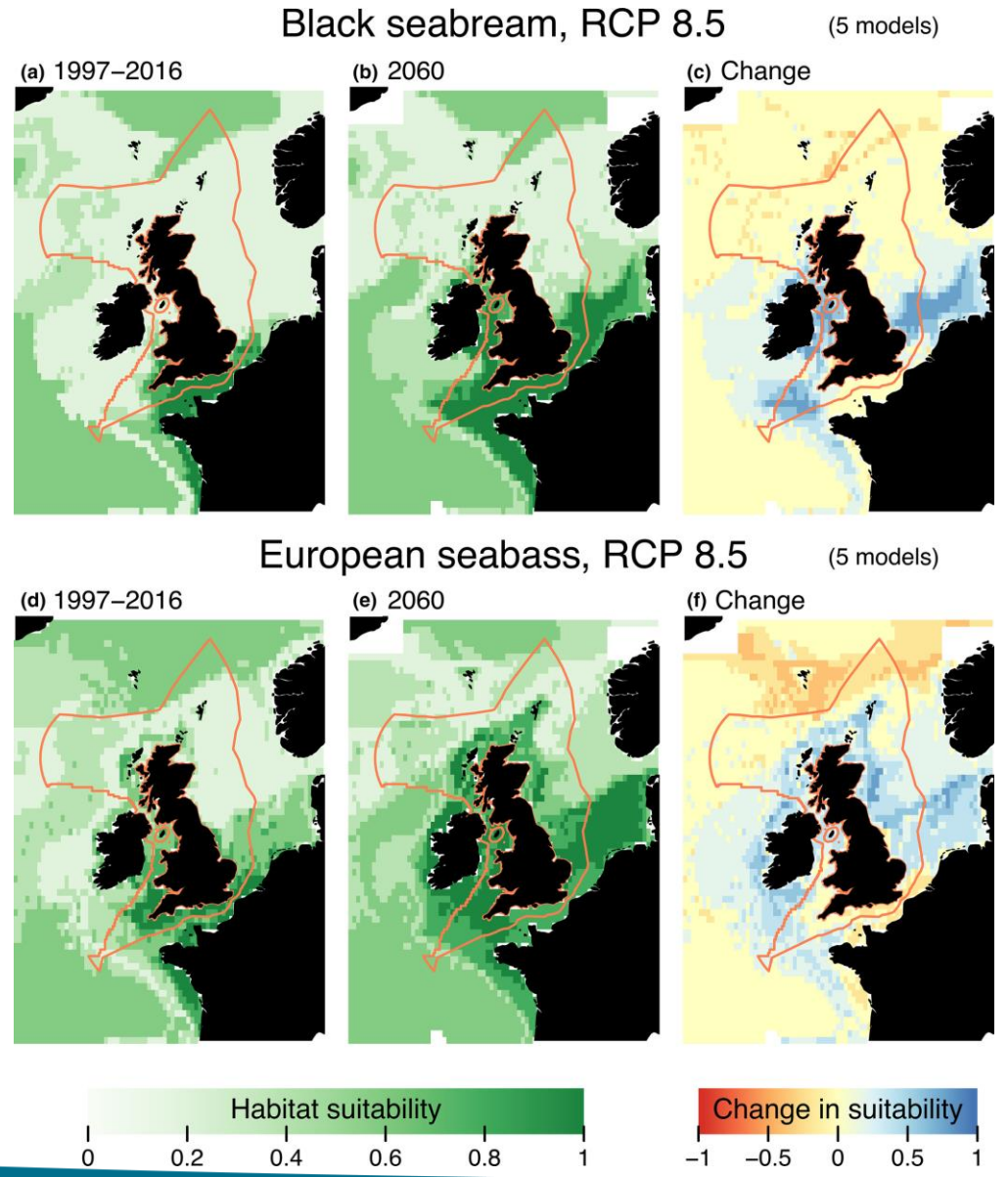
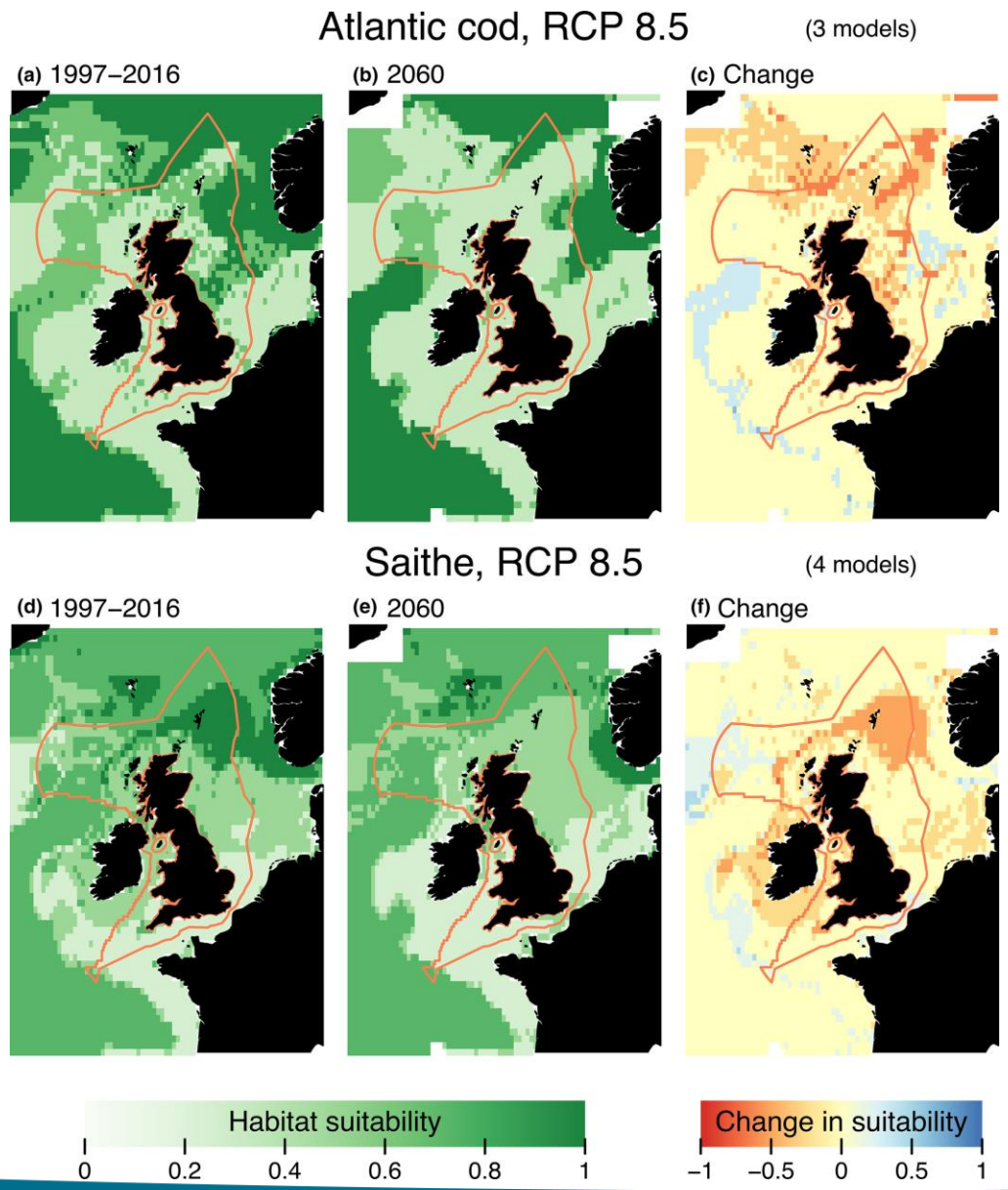



Black seabream, RCP 8.5
(5 models)
(a) 1997–2016
(b) 2060
(c) Change
European seabass, RCP 8.5
(5 models)
(d) 1997–2016
(e) 2060
(f) Change
Habitat suitability
0
0.2
0.4
0.6
0.8
1
Change in suitability
−1
−0.5
0
0.5
1



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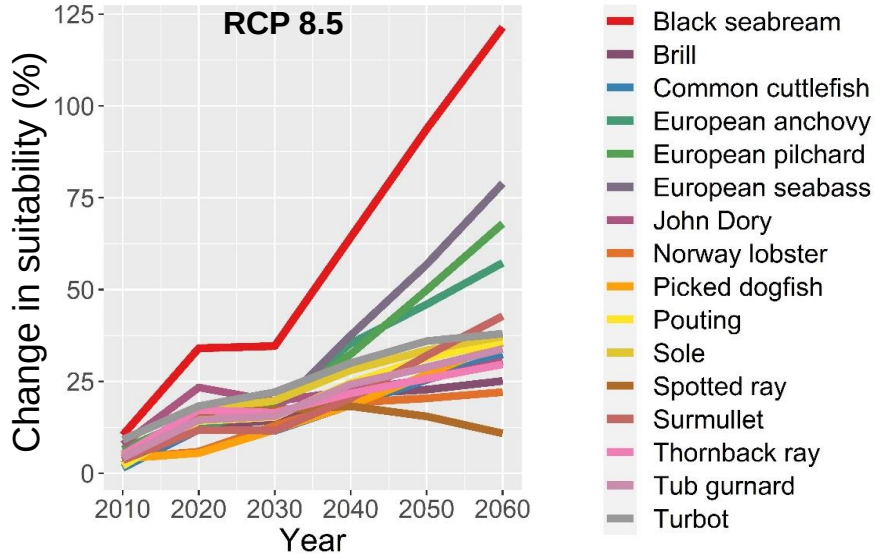
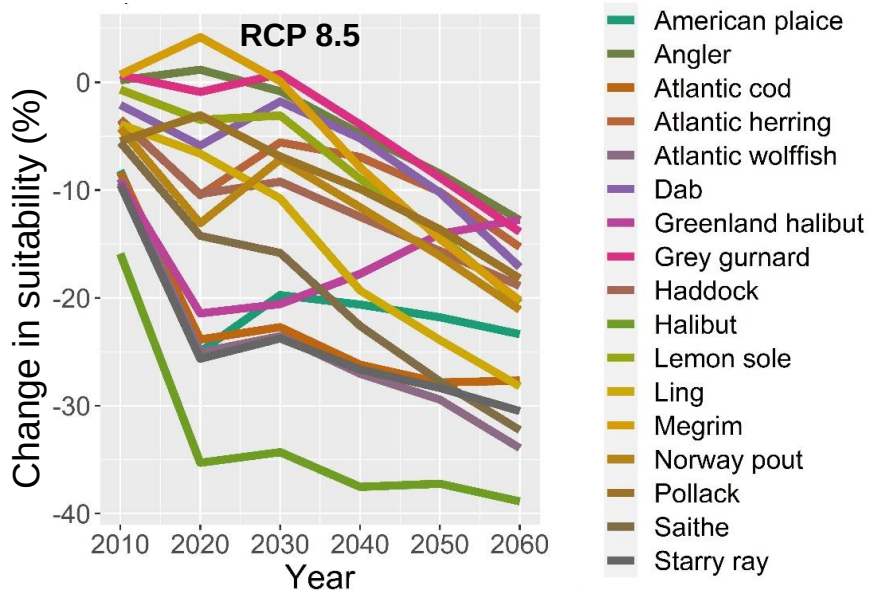
Winners

Stocks where the UK Exclusive Economic Zone (EEZ) is predicted to become more suitable in the future include:

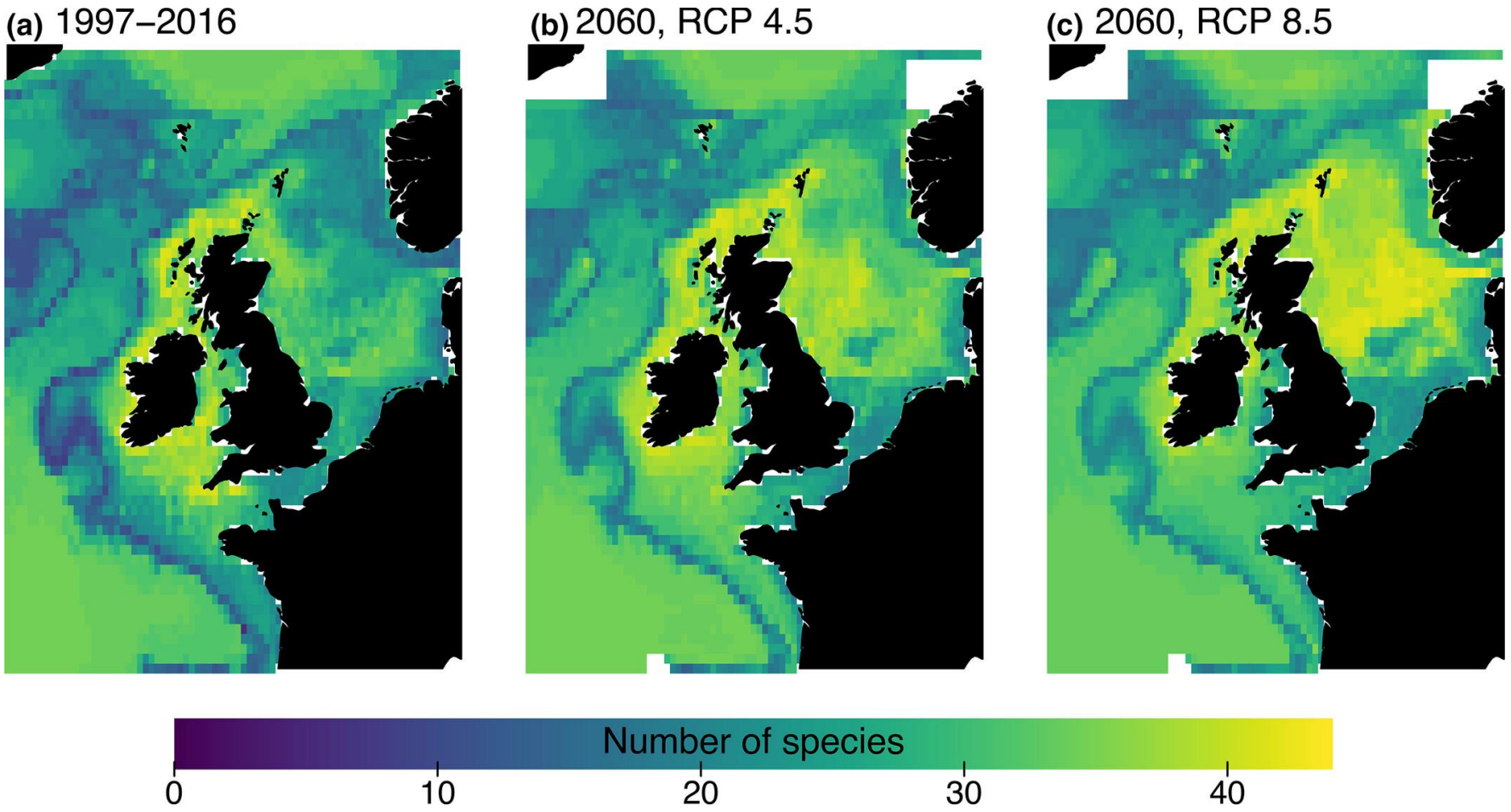


Losers

The UK EEZ will become less suitable for:



Changes in species richness



- Number of species projected to have suitable habitat by at least half of the species distribution models
- **The North Sea becomes more suitable** for many species
- **The Celtic Sea becomes less suitable** for many species

Conclusions:

- Climate change is likely to have implications for many (if not all) commercial fish around the northwest of Europe and the UK, with **substantial turnover of species**
- Of the species examined, around **half were projected to benefit** from more suitable habitat in the UK EEZ and **half were expected to lose out**
- Many of the **'incoming' species are not currently covered by EU quota restrictions**
- Many of our **traditional target species will decline**
- There can be a **big differences between individual models**, so an 'ensemble' is useful to determine if patterns are robust.

Thank you for listening

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