

# West Scotland demersal fishery Implementation Case Study

**2020 International Forum on the Effects of Climate Change on Fisheries & Aquaculture**  
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ClimeFish



This project has received funding from the European Union's Horizon 2020 research and innovation action under grant agreement no. 677039

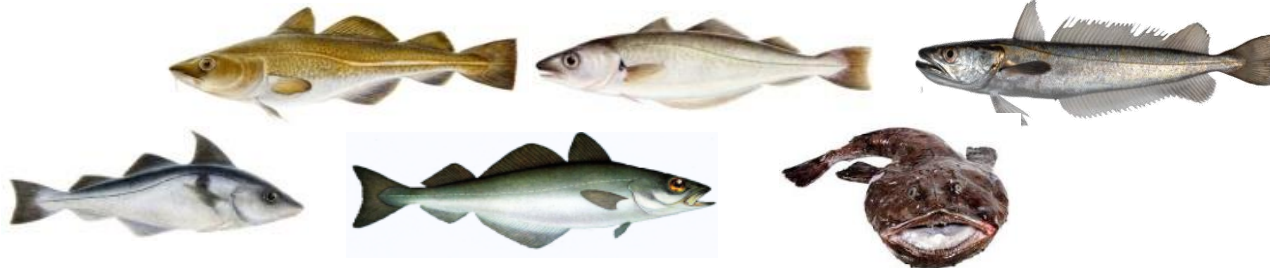


# A mixed fishery targeting multiple species

Cold-water species



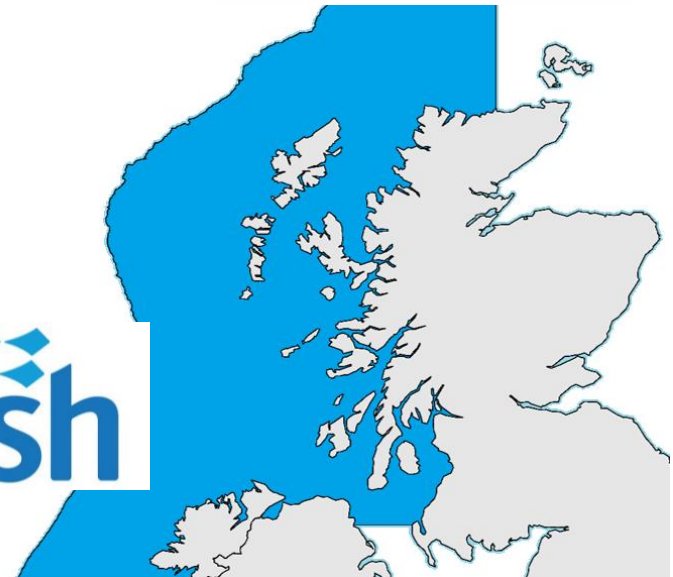
Warm-water species



❑ Main stakeholders



seafish



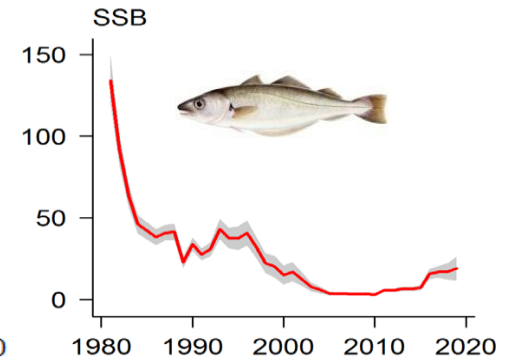
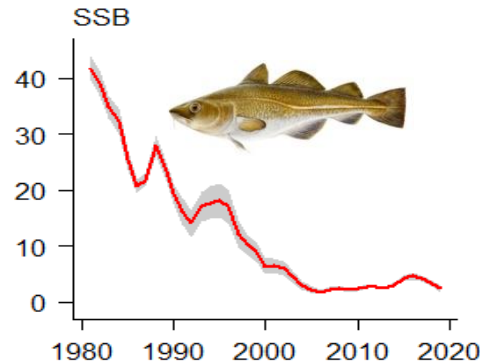
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# A fishery already facing numerous challenges

❑ Depleted stocks of cod and whiting

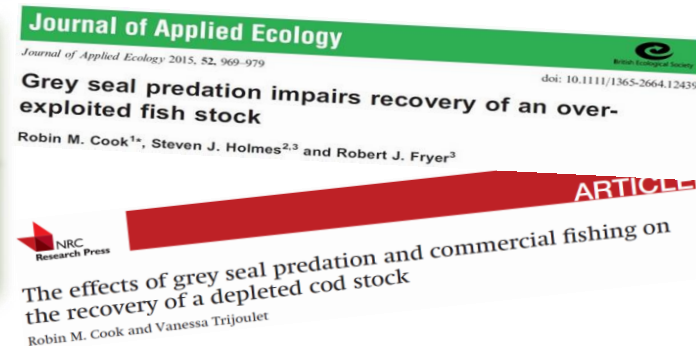


❑ Bycatch by Nephrops fishery



ICES WGCSE  
REPORT 2018  
ICES ADVISORY COMMITTEE  
ICES CM 2018/ACOM:13

❑ Predation from grey seals on cod



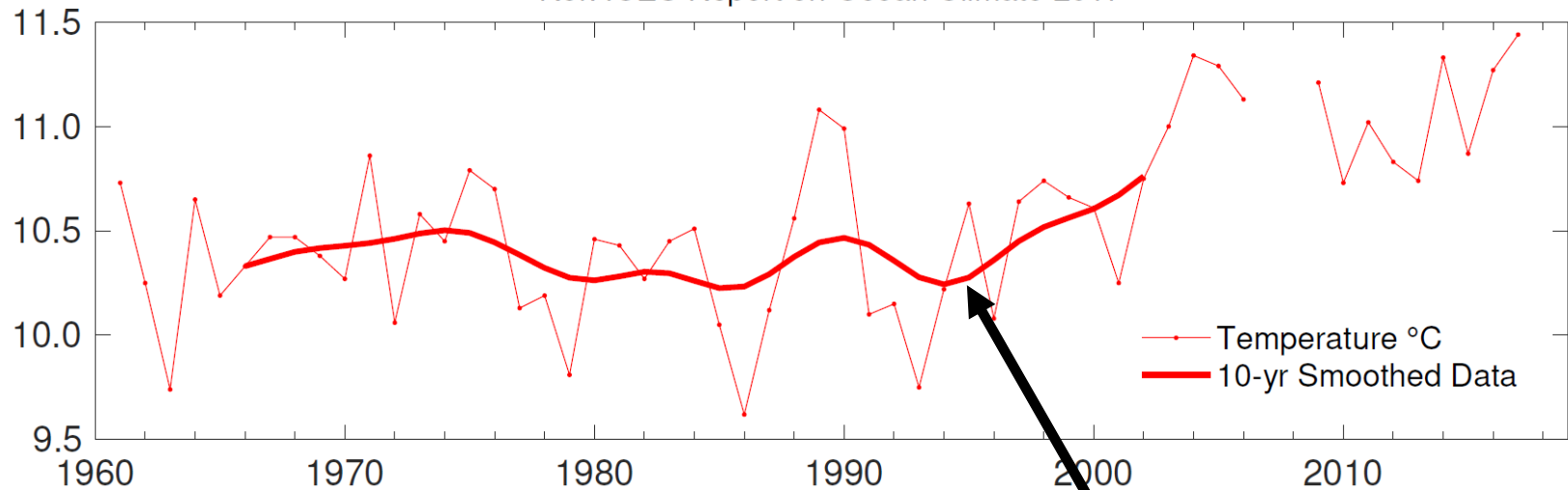
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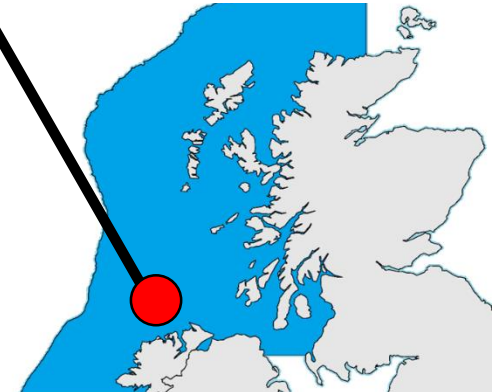


# West Scotland waters are warming

Data Provider: Marine Institute/Met Eireann - Ireland  
Ref: ICES Report on Ocean Climate 2017



González-Pola et *al.*, 2018



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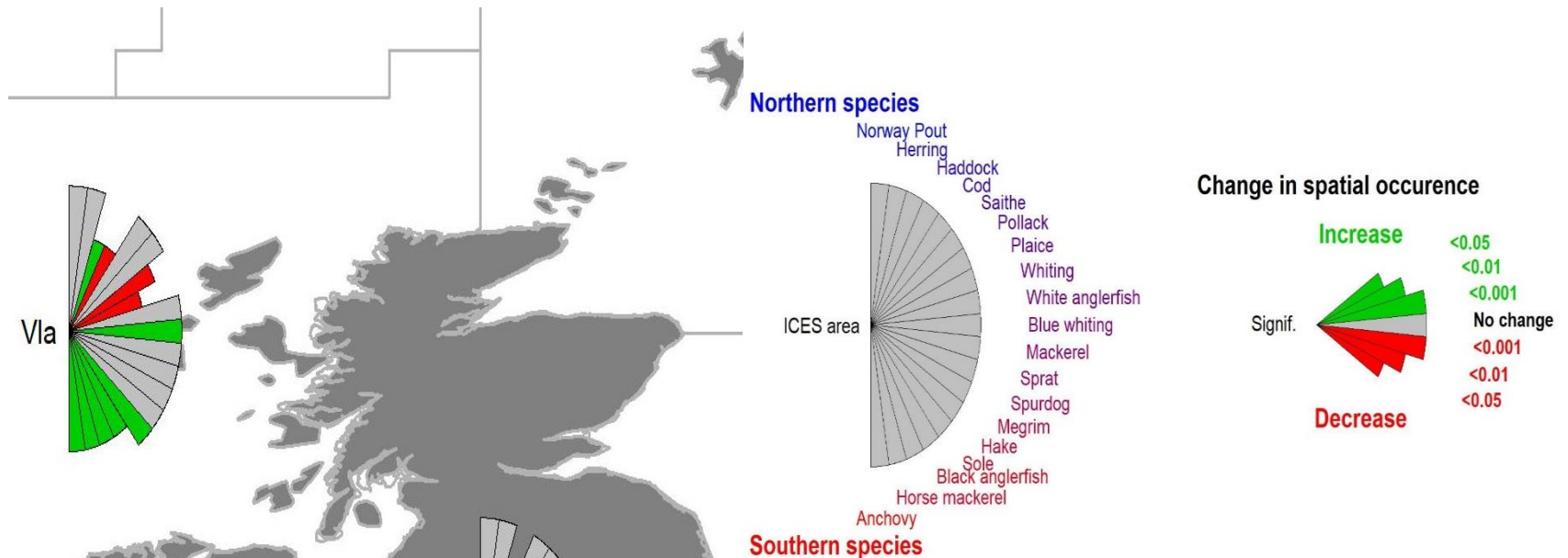


# Warming is causing fish distributions to change

## Changing fish distributions challenge the effective management of European fisheries

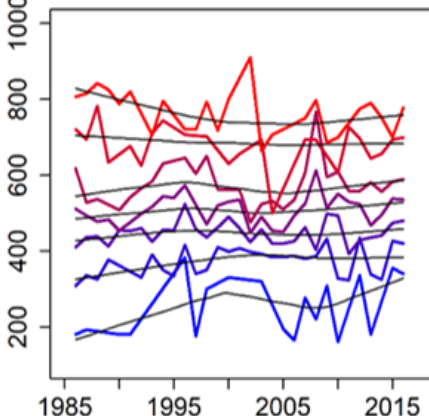
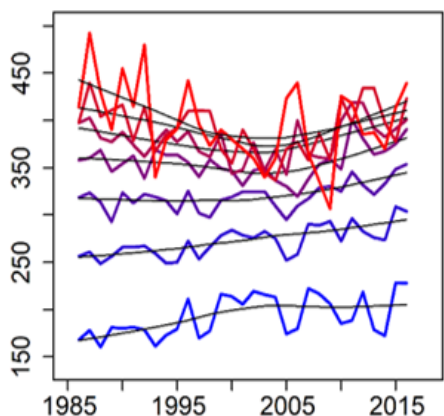
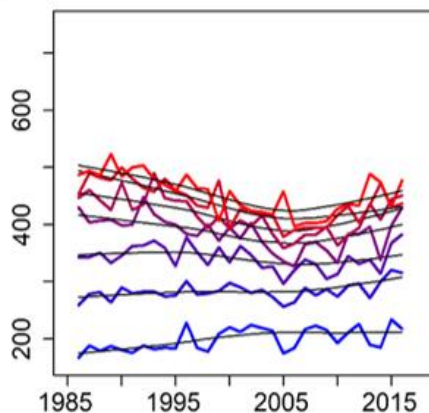
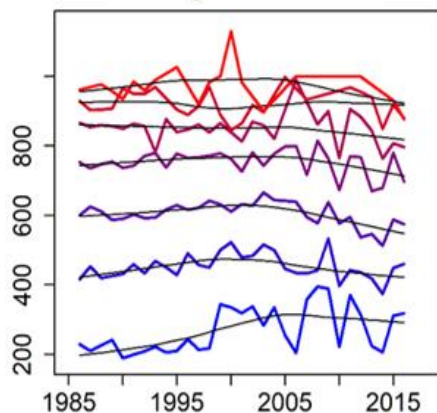
Alan Ronan Baudron, Thomas Brunel, Marie-Anne Blanchet, Manuel Hidalgo, Guillem Chust, Elliot John Brown, Kristin M. Kleisner, Colin Millar, Brian R. MacKenzie, Nikolaos Nikolioudakis, Jose A. Fernandes and Paul G. Fernandes

## Expansion/contraction in area occupied





# Warming is affecting fish body sizes



## Change in mean length-at-age

☐ Increase in juvenile length

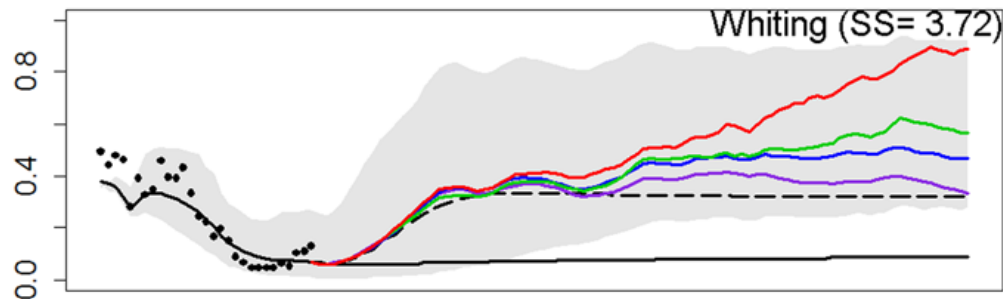
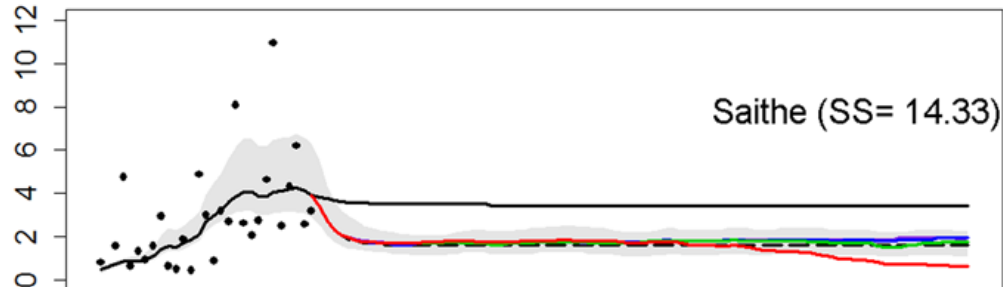
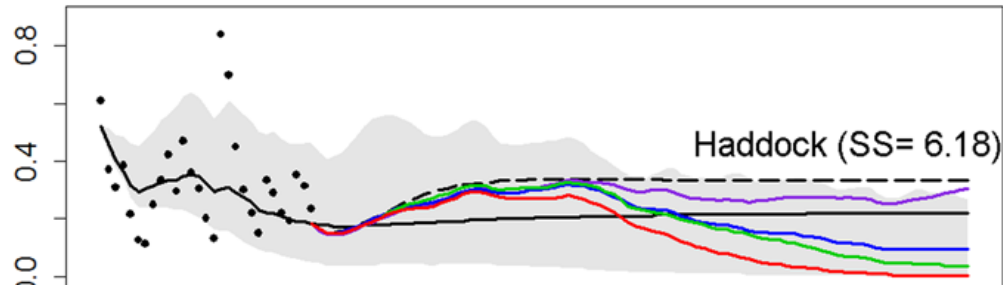
☐ Decrease in adult length

☐ Concomitant with temperature increase

☐ Consistent with Temperature-Size Rule



# Warming will likely affect species composition



## Impact of ocean warming on sustainable fisheries management informs the Ecosystem Approach to Fisheries

N. Serpetti<sup>1</sup>, A. R. Baudron<sup>2</sup>, M. T. Burrows<sup>1</sup>, B. L. Payne<sup>1</sup>, P. Helaouët<sup>3</sup>, P. G. Fernandes<sup>2</sup> & J. J. Heymans<sup>1</sup>

❑ Decline in biomass of cold-water species

❑ Increase in biomass of warm-water species



# Can we mitigate the impact of warming?

## Stakeholders' objectives:

- ☐ Recover cod



- ☐ Maximise landings of emerging species



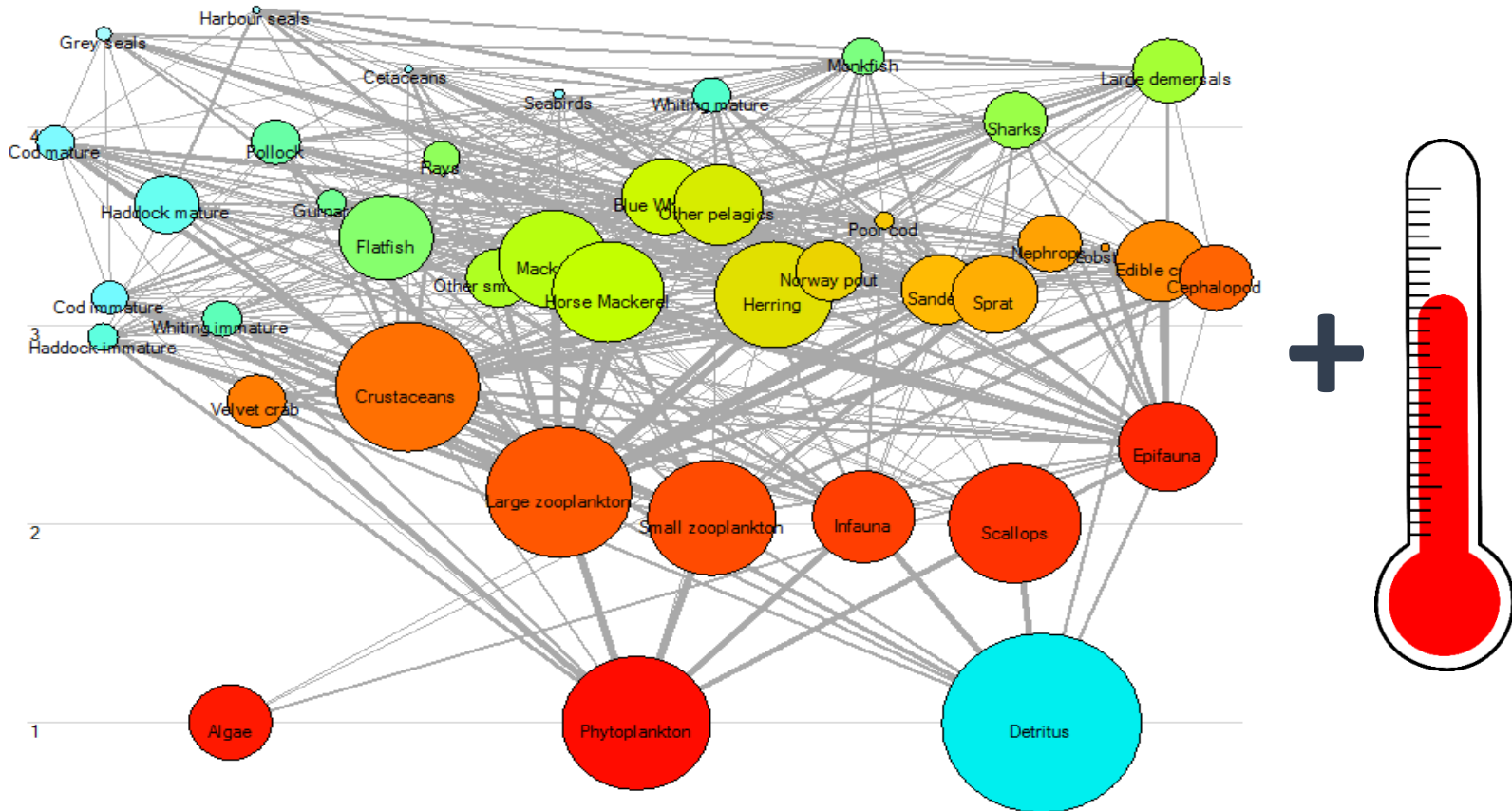
- ☐ Maximise landings of whiting post-recovery





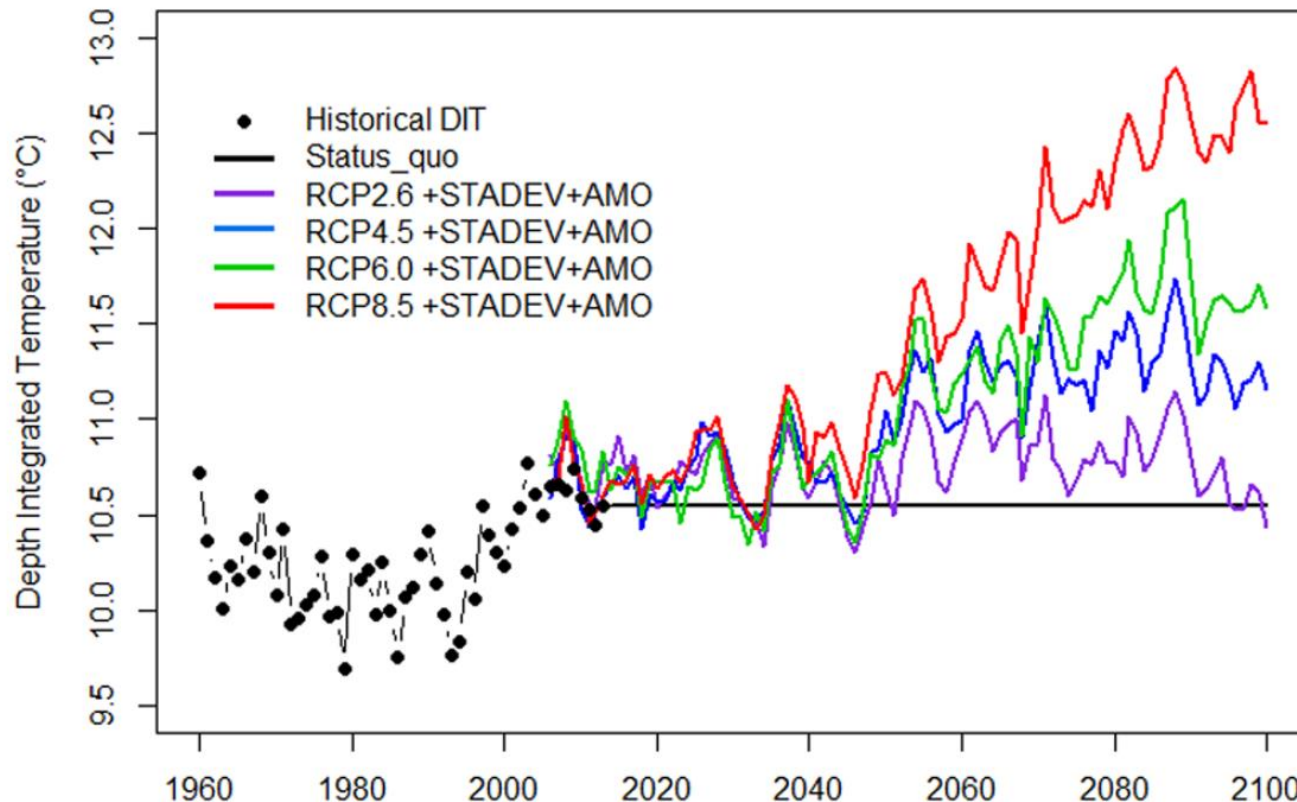
# Biological forecasting

- ❑ Explore alternative fishing strategies under climate change
- ❑ Food web ecosystem model, temperature included



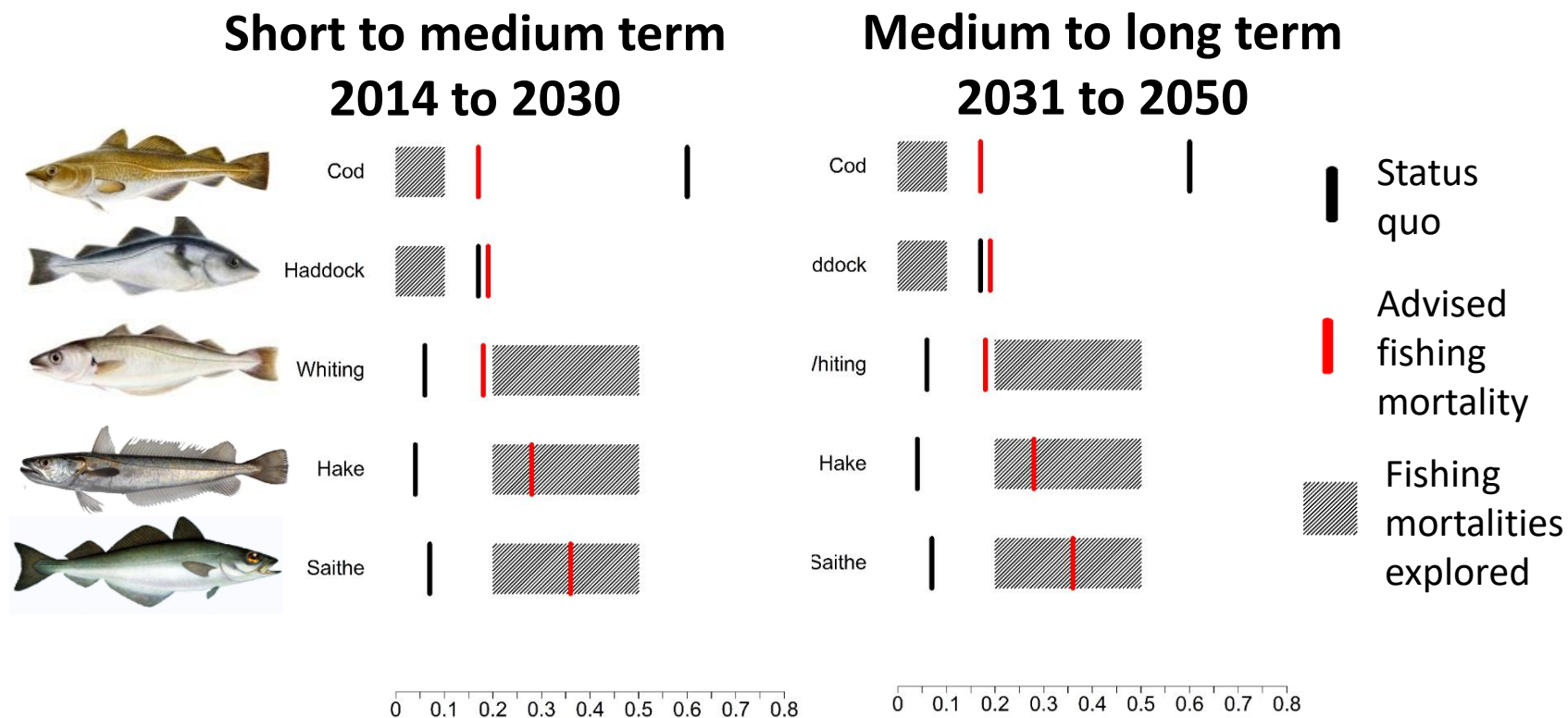
# Biological forecasting: methods

- Forward simulations under medium (4.5) and severe (8.5) warming



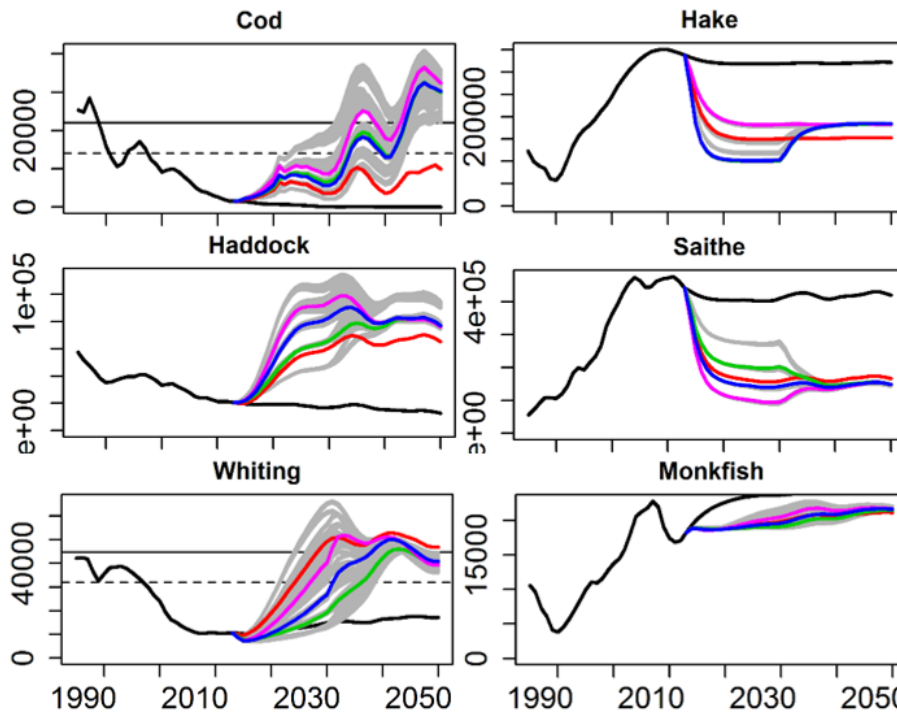
# Biological forecasting: methods

- ❑ Simulations from 2014 to 2050
- ❑ Alternative fishing mortalities at medium and long term



# Biological forecasting: results

## ☐ Medium warming (IPCC 4.5) – Biomass



## Fishing mortalities



Medium term

0 0.1 0.2 0.3 0.4 0.5 0.6



Long term

0 0.1 0.2 0.3 0.4 0.5 0.6

■ Status quo

■ Advised fishing mortality

Max landings

■ Emerging species

■ Whiting

■ Emerging species & whiting



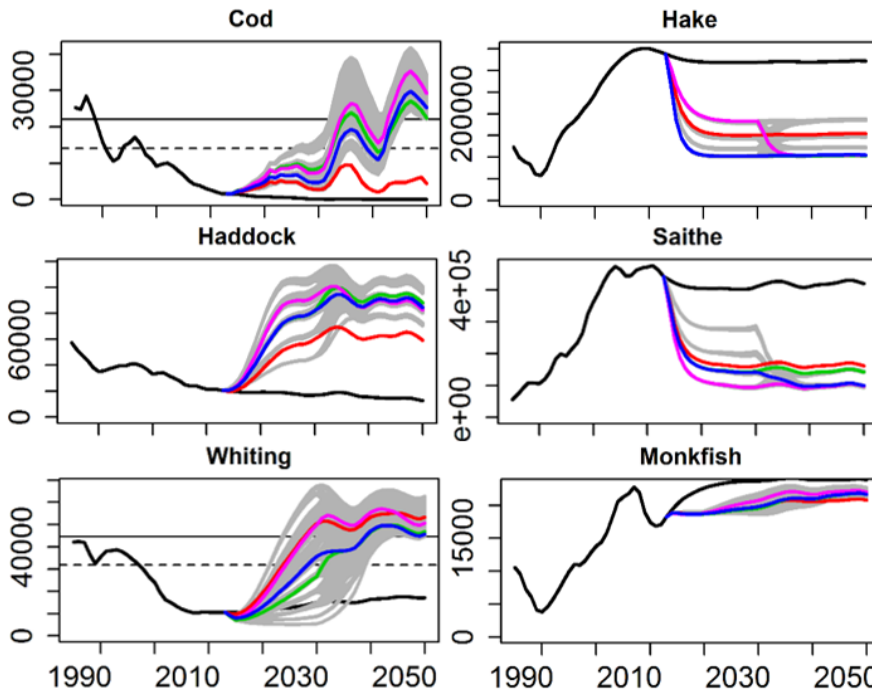
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# Biological forecasting: results

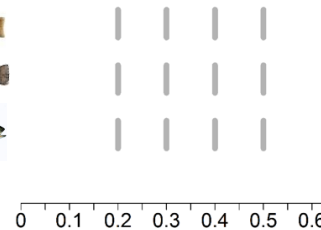
## Severe warming (IPCC 8.5) – Biomass



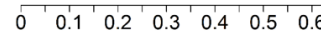
## Fishing mortalities



Medium term



Long term



Status quo

Advised fishing mortality

Max landings

Emerging species

Whiting

Emerging species & whiting



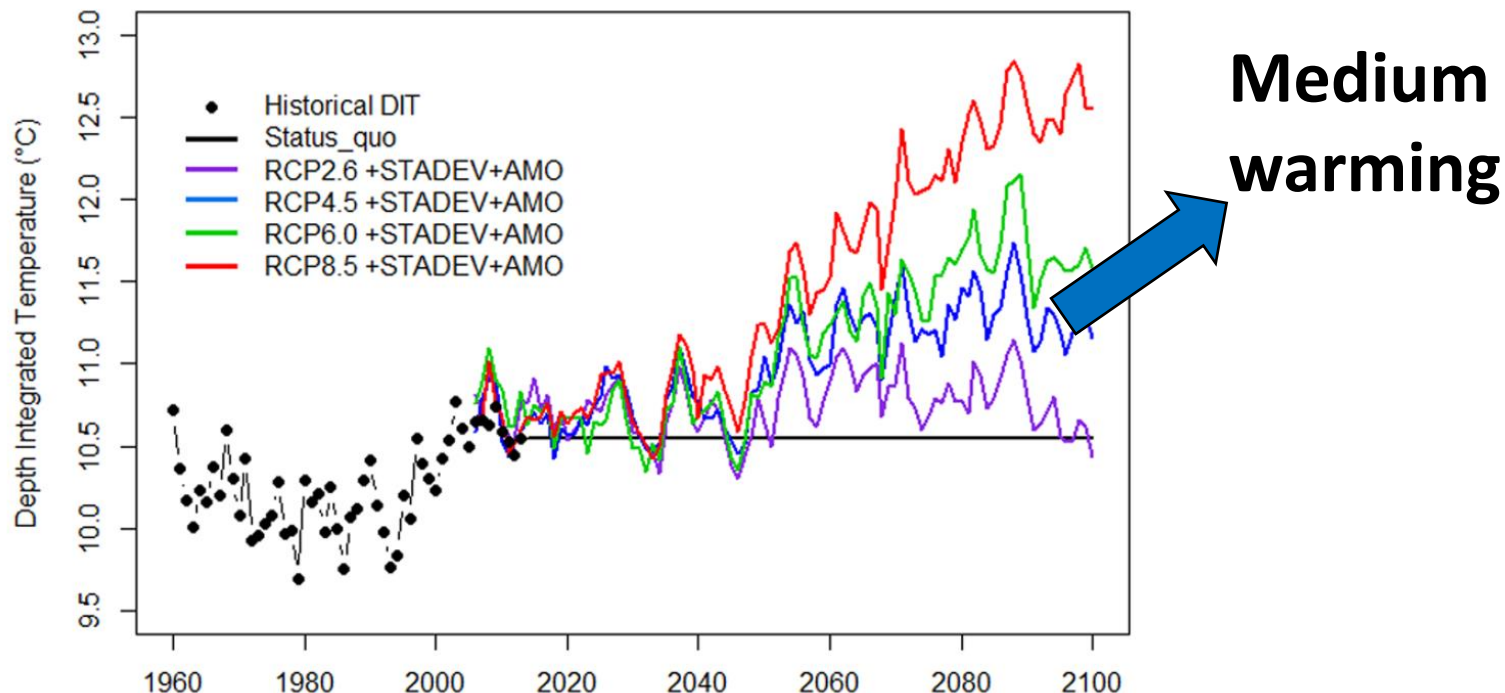
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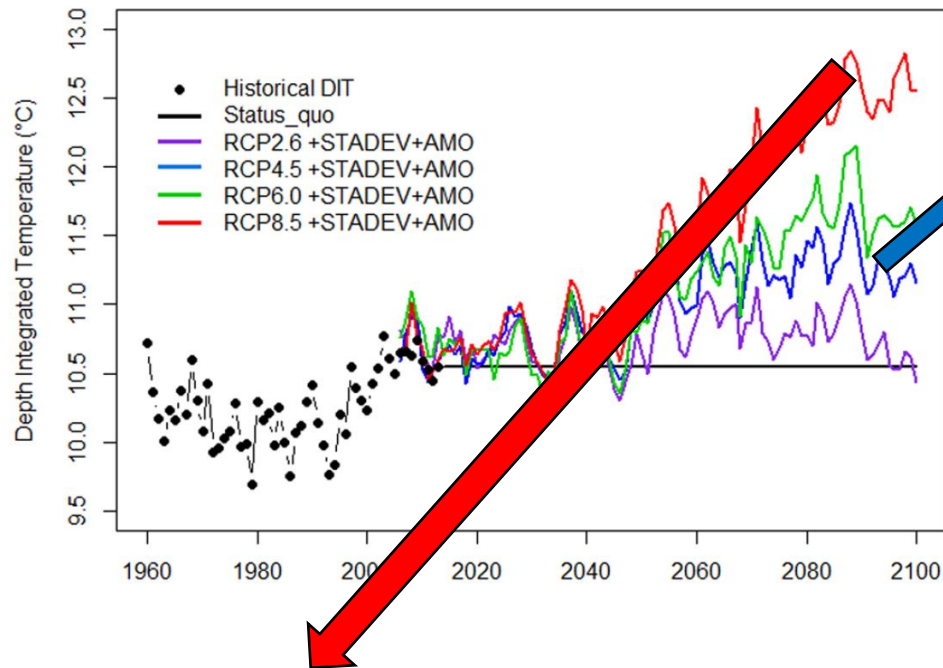
# Biological forecasting: main findings



- ☐ Recovery of cod, and whiting to some extent, possible
- ☐ Cod could possibly sustain low fishing mortality



# Biological forecasting: main findings



## Medium warming

- ☐ Recovery of cod, and whiting to some extent, possible
- ☐ Cod could possibly sustain low fishing mortality

## Severe warming

- ☐ Recovery of cod only possible with no fishing on long term
- ☐ Whiting could possibly sustain higher fishing mortalities



# Risk Assessment: some threats...

## Information from literature, analyses & stakeholders input

- ☐ Extreme weather = poor working conditions
- ☐ Recruitment = collapse of cold water species
- ☐ Distribution changes = reduction in cold water species biomass
- ☐ Changes in catch composition = lack of quotas



4	EXTREME	Greatly affects/damages the industry
3	HIGH	Major damages to the industry
2	MODERATE	Challenges for the industry
1	MINOR	Small/reparable damage to the industry



# Risk Assessment: & some opportunities!

## Information from literature, analyses & stakeholders input

- ❑ Shift in species' distribution = increase in warm-water species biomass
- ❑ Higher biomass for some species = new catch potential
- ❑ Rise in emerging species biomass = access to new markets



1	MINOR	Limited improvement to present conditions
2	MODERATE	Favourable change for the industry
3	MAJOR	Significant improvements to present conditions
4	EXTREME TRANSFORMATIVE	Transformative benefits to the industry



# Mitigate risks and utilise opportunities?

## 15 climate adaptation measures identified



### *Industry level (8)*

- ☐ Avoid cod bycatch
- ☐ Target emerging species
- ☐ Improve safety

### *Policy level (7)*

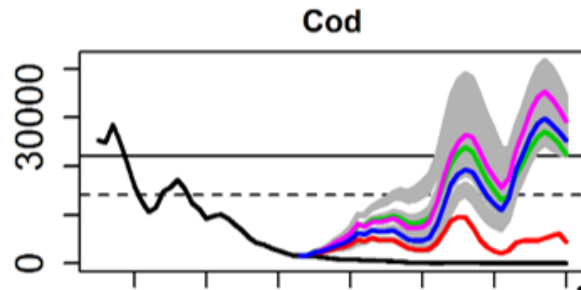
- ☐ Access to quotas & markets for emerging species
- ☐ Flexible management to account for changes
- ☐ Improve monitoring & infrastructure



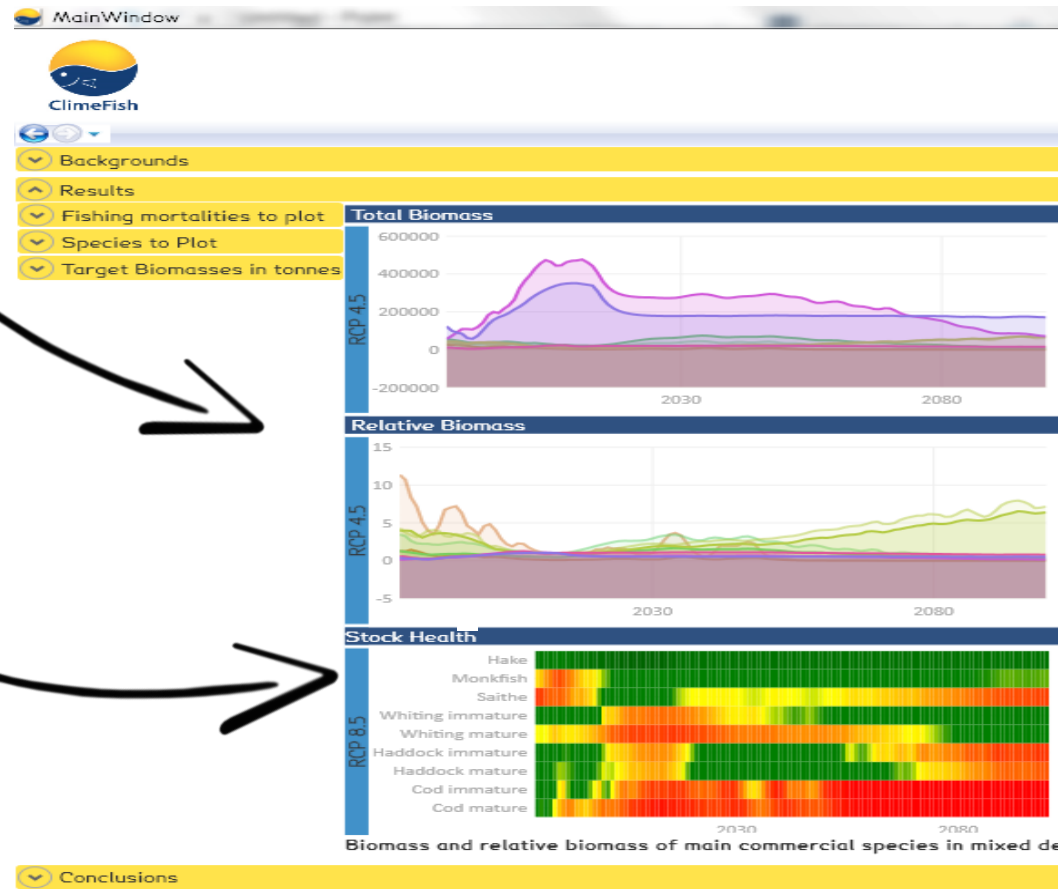


# Helping West Scotland stakeholders decide

## Model simulations



## Decision Support Software



## Climate Risk Assessment



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# A few key points

- ❑ Climate change is impacting the West Scotland demersal fishery in numerous ways, and likely to keep on doing so
- ❑ Some threats (e.g., storms) but also some opportunities (e.g., emerging species)
- ❑ Some obstacles in adapting? E.g., lack of flexible management to keep pace with changes
- ❑ Climate change still perceived as 'low priority' relative to more pressing issues (e.g., depleted stocks & discards)



# Thank you

## ClimeFish publications:

- ❑ Audzijonyte, A, Barneche, DR, Baudron, AR, Belmaker, J, Clark, TD, Marshall, CT, Morrongiello, JR et al. 2018. **Is oxygen limitation in warming waters a valid mechanism to explain decreased body sizes in aquatic ectotherms?** Global Ecology and Biogeography 28:64–77. <https://doi.org/10.1111/geb.12847>
- ❑ Baudron, AR, Brunel, T, Blanchet, M-A, Hidalgo, M, Chust, G, Brown, E, Kleisner, KM, Millar, C, MacKenzie, BR, Nikolioudakis, N, Fernandes, J & Fernandes, PG. 2020. **Changing fish distributions challenge the effective management of European fisheries.** Ecography 42: 1–12. <https://doi.org/10.1111/ecog.04864>
- ❑ Baudron, AR, Pecl, G, Gardner, C, Fernandes, PG & Audzijonyte, A. 2019. **Ontogenetic deepening of Northeast Atlantic fish stocks is not driven by fishing exploitation.** Proceedings of the National Academy of Sciences, 116, 2390– 2392. <https://doi.org/10.1073/pnas.1817295116>
- ❑ Ikpewe, IE, Baudron, AR, Ponchon, A & Fernandes, PG. **Changes in size at age of commercial fish species provide additional evidence of the effects of global warming.** In review
- ❑ Serpetti, N, Baudron, AR, Burrows, MT et al. 2017. **Impact of ocean warming on sustainable fisheries management informs the Ecosystem Approach to Fisheries.** Sci Rep 7, 13438. <https://doi.org/10.1038/s41598-017-13220-7>

