

Marine Ecosystem Climate Services

How can we develop climate-services
in knowledge-poor systems?

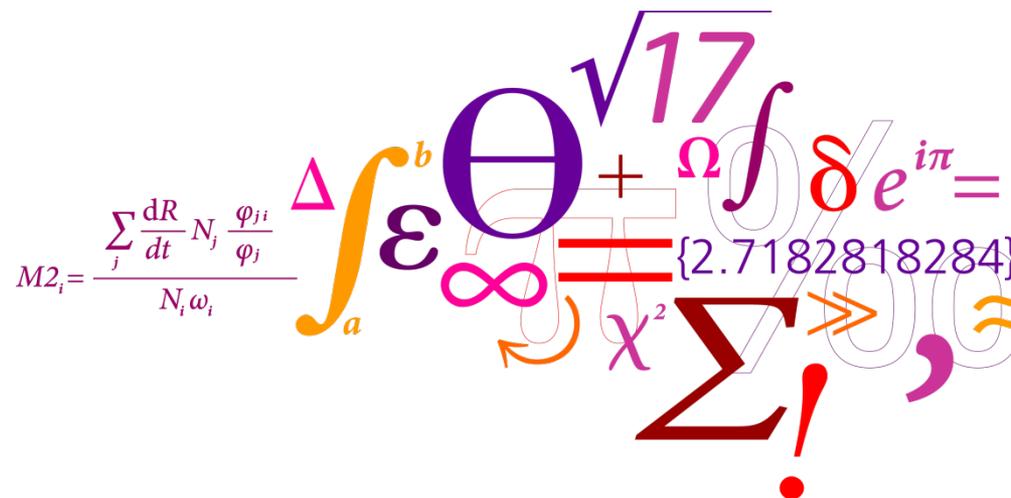
Mark R Payne

mpay@aqua.dtu.dk

 @MarkPayneAtWork

DTU Aqua

National Institute of Aquatic Resources



Decadal-scale forecasting of the ocean is a reality

Multiyear Prediction of Monthly Meridional Overturning Circulation at 26.5°N

Daniela Matej,^{1*} Johanna Baehr,² Johann H. Jungclauss,¹ Helmuth Haak,¹ Wolfgang A. Müller,¹ Jochem Marotzke^{2*}

Attempts to predict changes in Atlantic Meridional Overturning Circulation (AMOC) have yielded little success to date. Here, we demonstrate predictability for monthly mean AMOC strength at 26.5°N for up to 4 years in advance. This AMOC predictive skill arises predominantly from the wind-driven upper-mid-ocean geostrophic transport, which in turn can be predicted because we will in predicting the upper-ocean zonal density difference. Ensemble forecasts initialized in January 2008 and January 2011 indicate a stable AMOC at 26.5°N until at least 2014, brief wind-induced weakening in 2010. Because AMOC influences many aspects of AMOC as an important potential carrier of climate predictability. AMOC is further affected northward ocean heat transport and therefore European and North Atlantic climate (1–3). Through its influence on sea surface temperature (SST), AMOC is further

SCIENCE www.sciencemag.org

Initialized decadal predictions of the rapid warming of the North Atlantic Ocean in the mid 1990s

Johns, R. T. Sutton,¹ and D. M. Smith²

2012; revised 5 September 2012; accepted 6 September 2012; published 10 October 2012

the North Atlantic subpolar gyre (SPG) SPG heat surface temperatures (SST) H... years. By examining initi... Office D...



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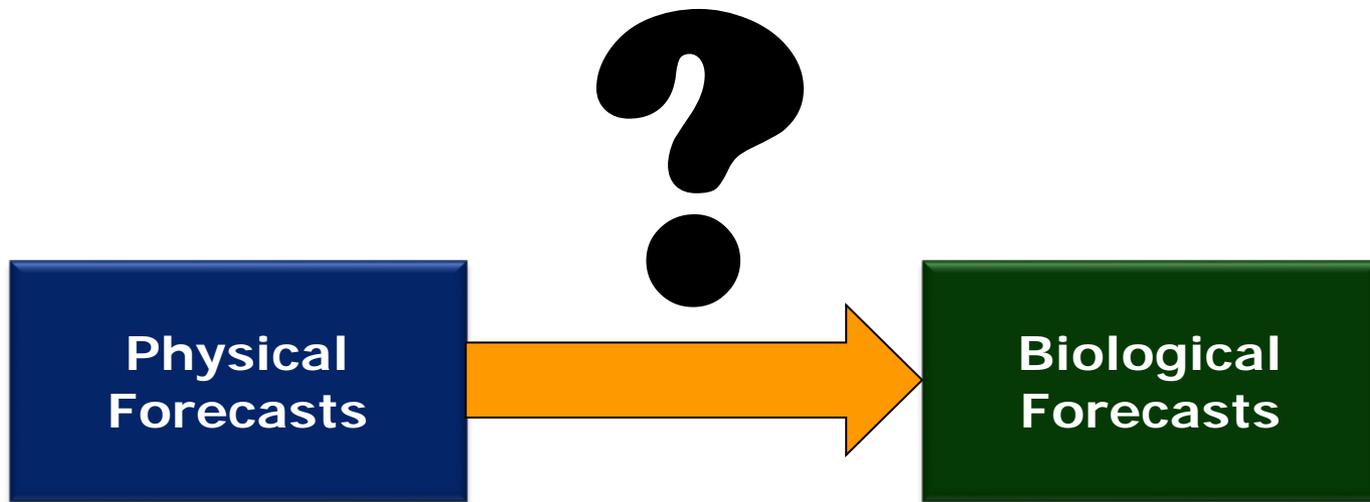
Decadal predictions of the North Atlantic CO₂ uptake

Hongmei Li¹, Tatiana Ilyina¹, Wolfgang A. Müller¹ & Frank Sienz¹

As a major CO₂ sink, the North Atlantic, especially its subpolar gyre region, is essential for the global carbon cycle. Decadal fluctuations of CO₂ uptake in the North Atlantic subpolar gyre region are associated with the evolution of the North Atlantic Oscillation, the Atlantic meridional overturning circulation, ocean mixing and sea surface temperature anomalies. While the physical state of the ocean can be predicted several years in advance by system models, predictability of CO₂ uptake has remained unexplored. We find large multi-year variability in oceanic CO₂ uptake skill in the western subpolar gyre region is up to... winter and is attributed to the improv...

DOI: 10.1038/ncomms11076

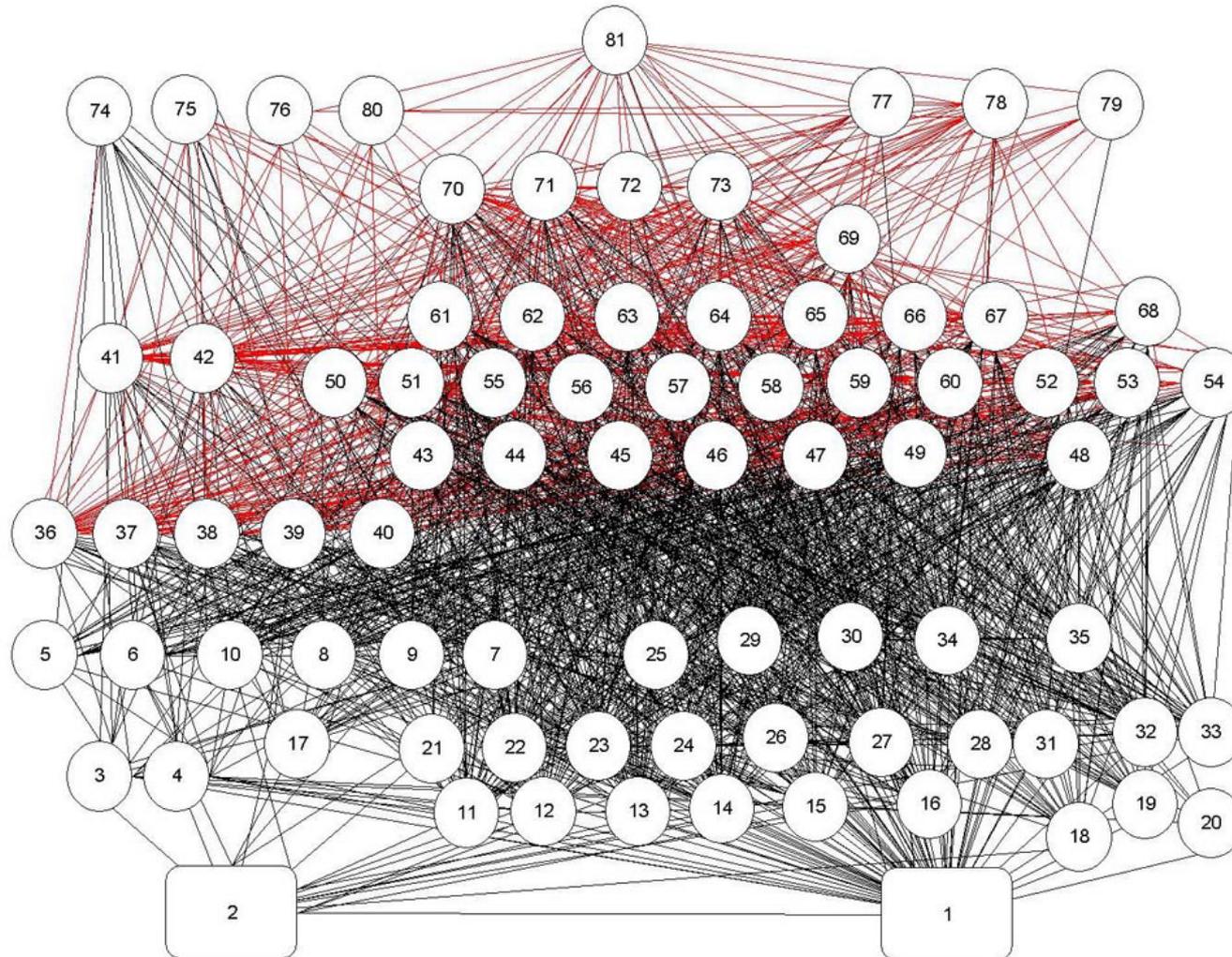
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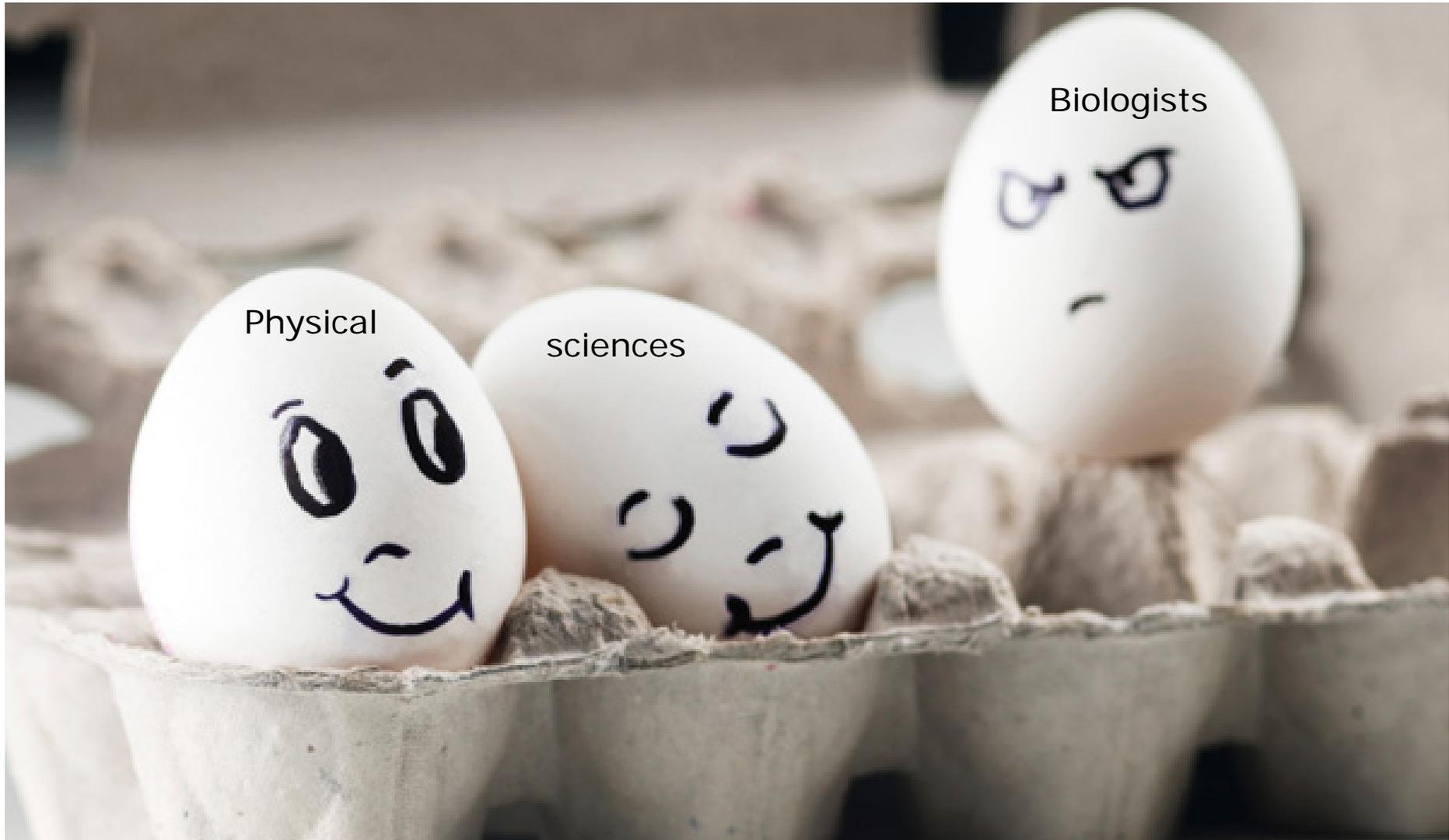
Can we translate physical predictions into biological predictions?

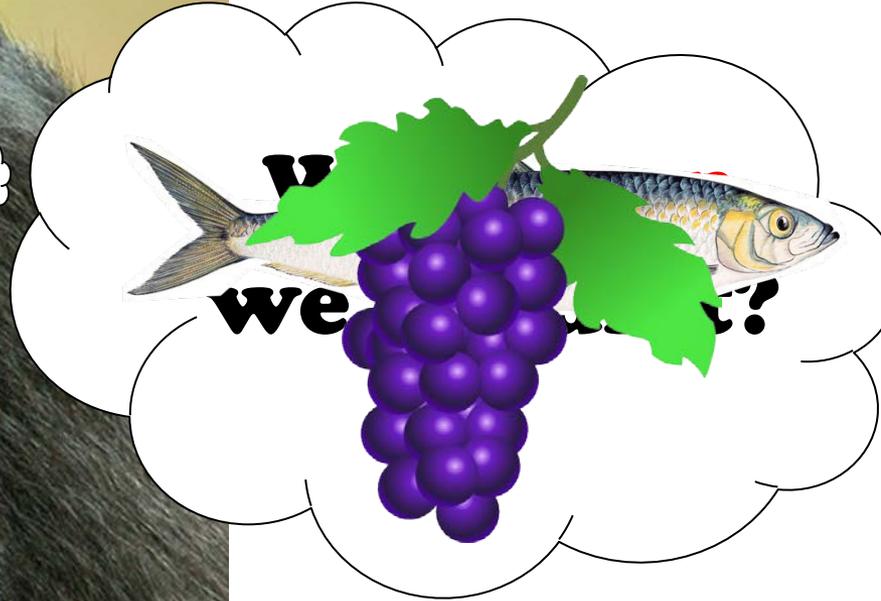
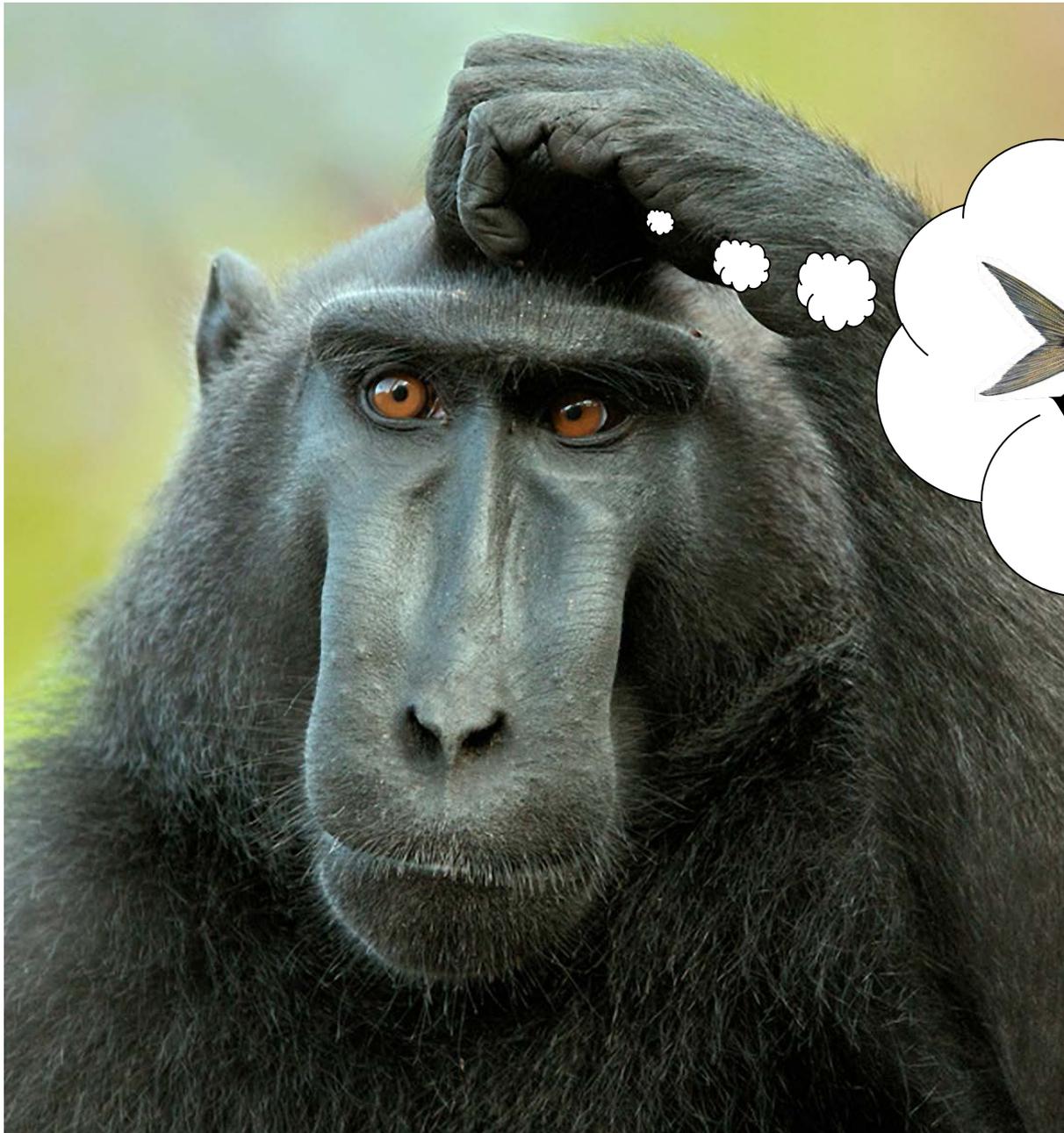
But biology is complex....

Food Web of the Northeast US Continental Shelf*

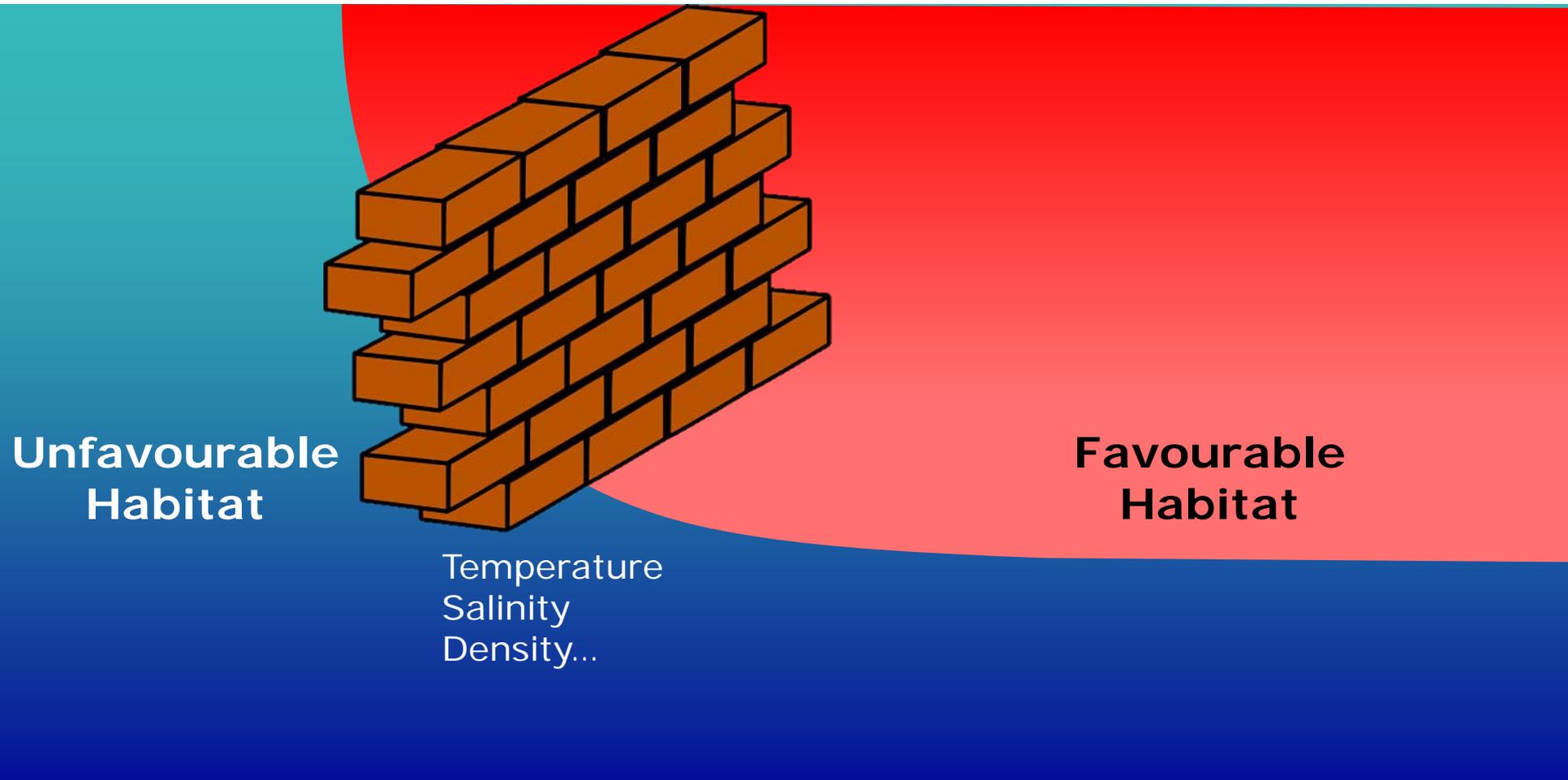


Prediction envy...





Physiological constraints in the ocean



Case Study 1 - Bluefin Tuna



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<http://dx.doi.org/10.2305/IUCN.UK.2011-2.RLTS.T21860A9331546.en> [Download supplement](#)

NOT EVALUATED	DATA DEFICIENT	LEAST CONCERN	NEAR THREATENED	VULNERABLE	< ENDANGERED >	CRITICALLY ENDANGERED	EXTINCT IN THE WILD
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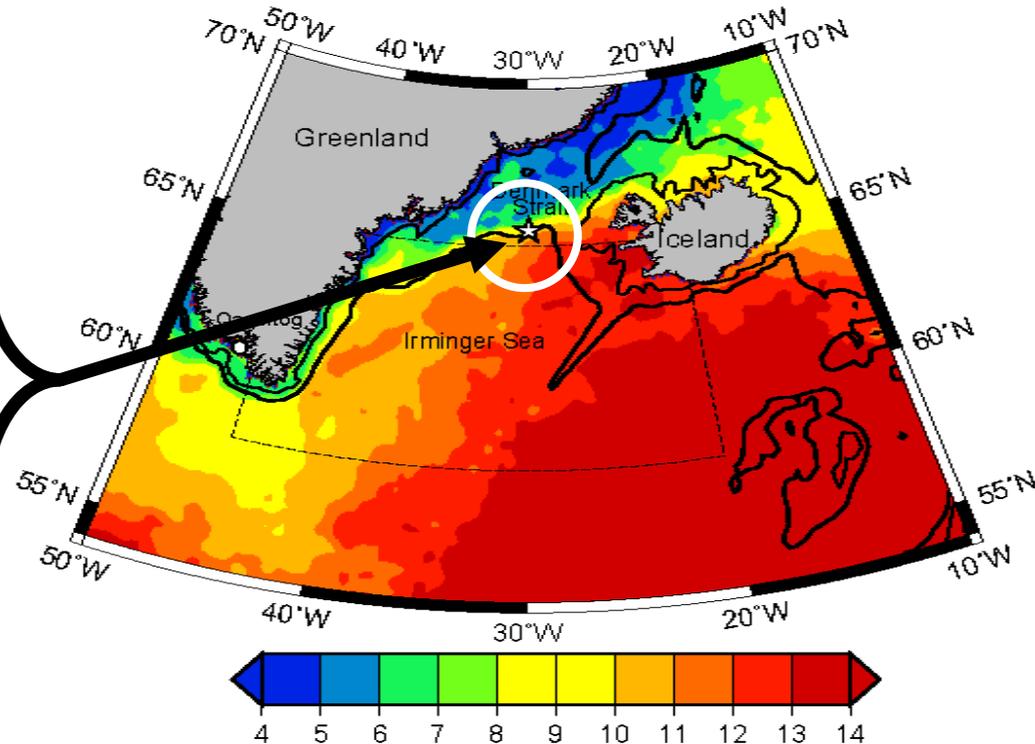
Catches of Bluefin Tuna in Denmark Strait and Irminger Sea



Aug 2012

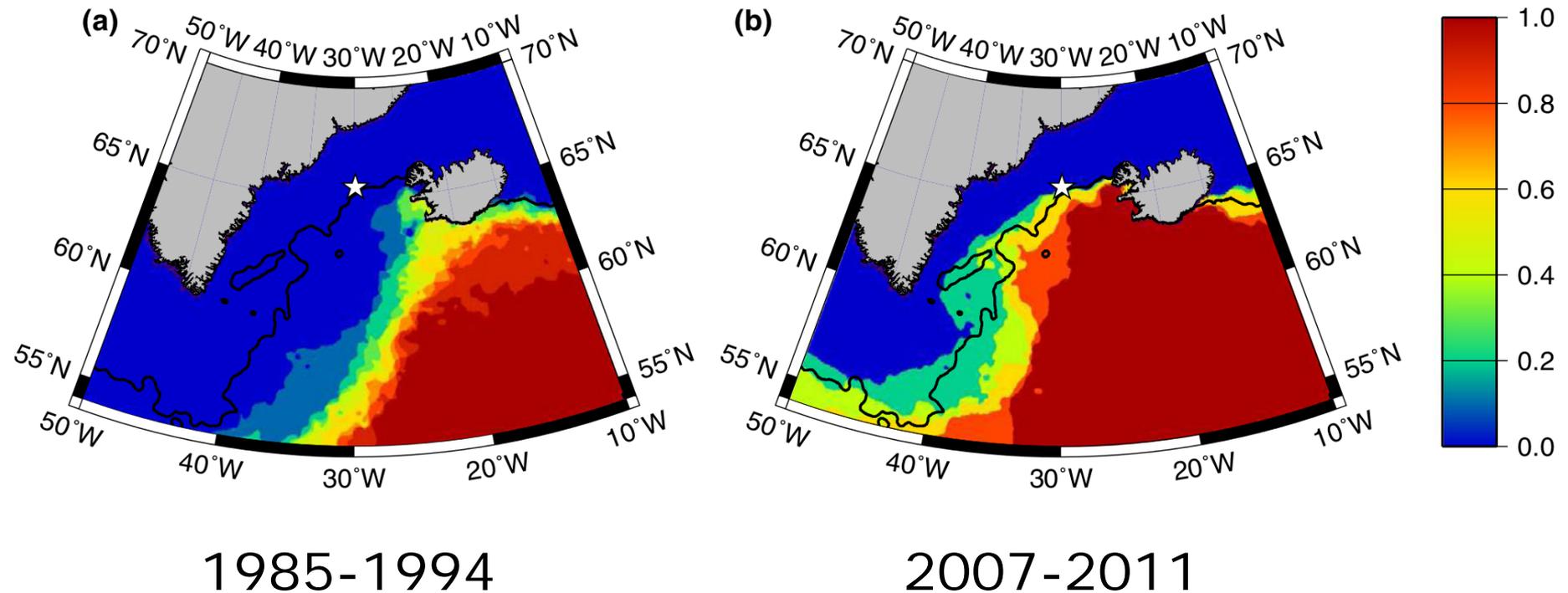


Aug 2014



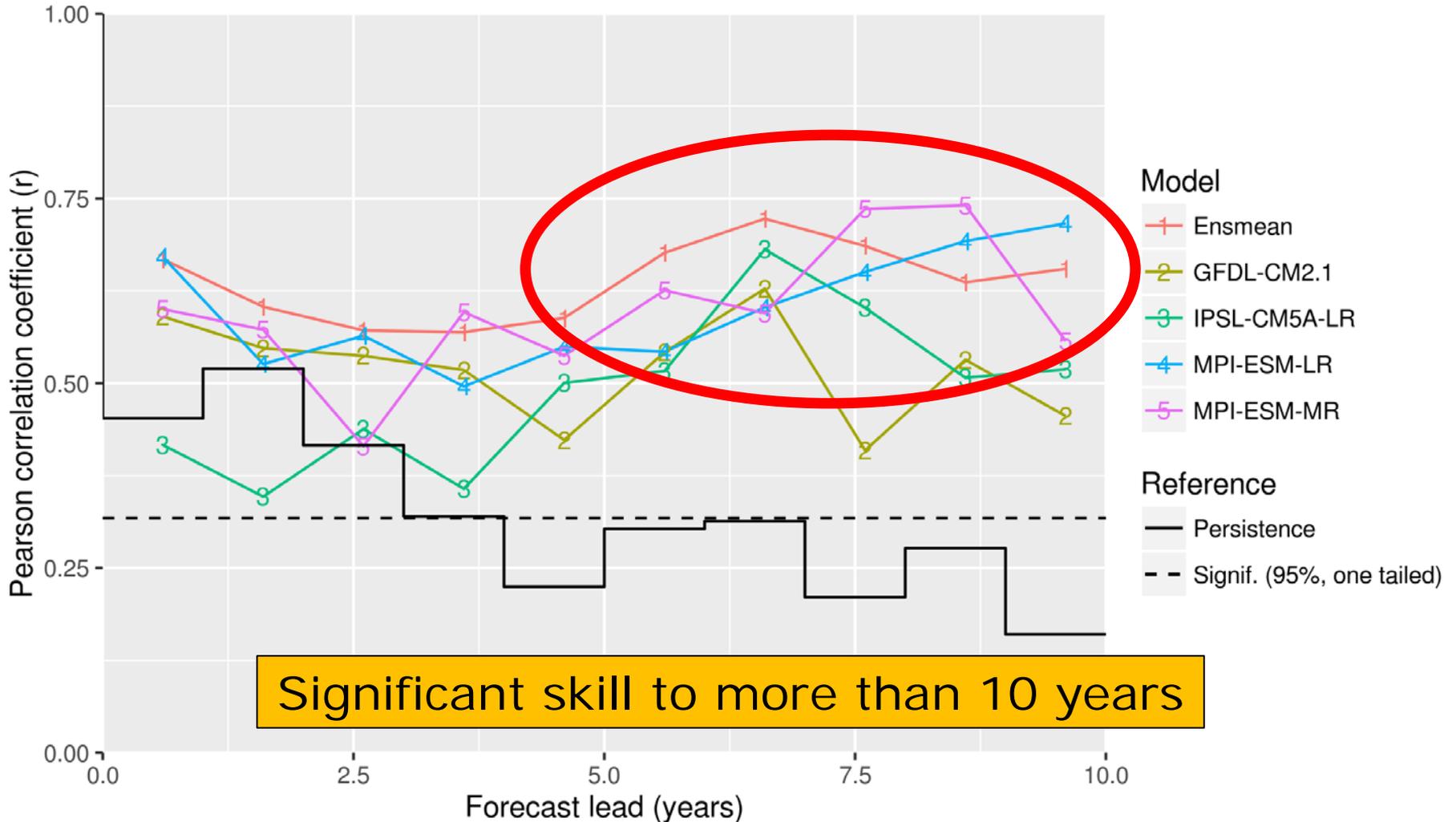
First report of tuna in this area in at least 370 years

Proportion of years with suitable habitat

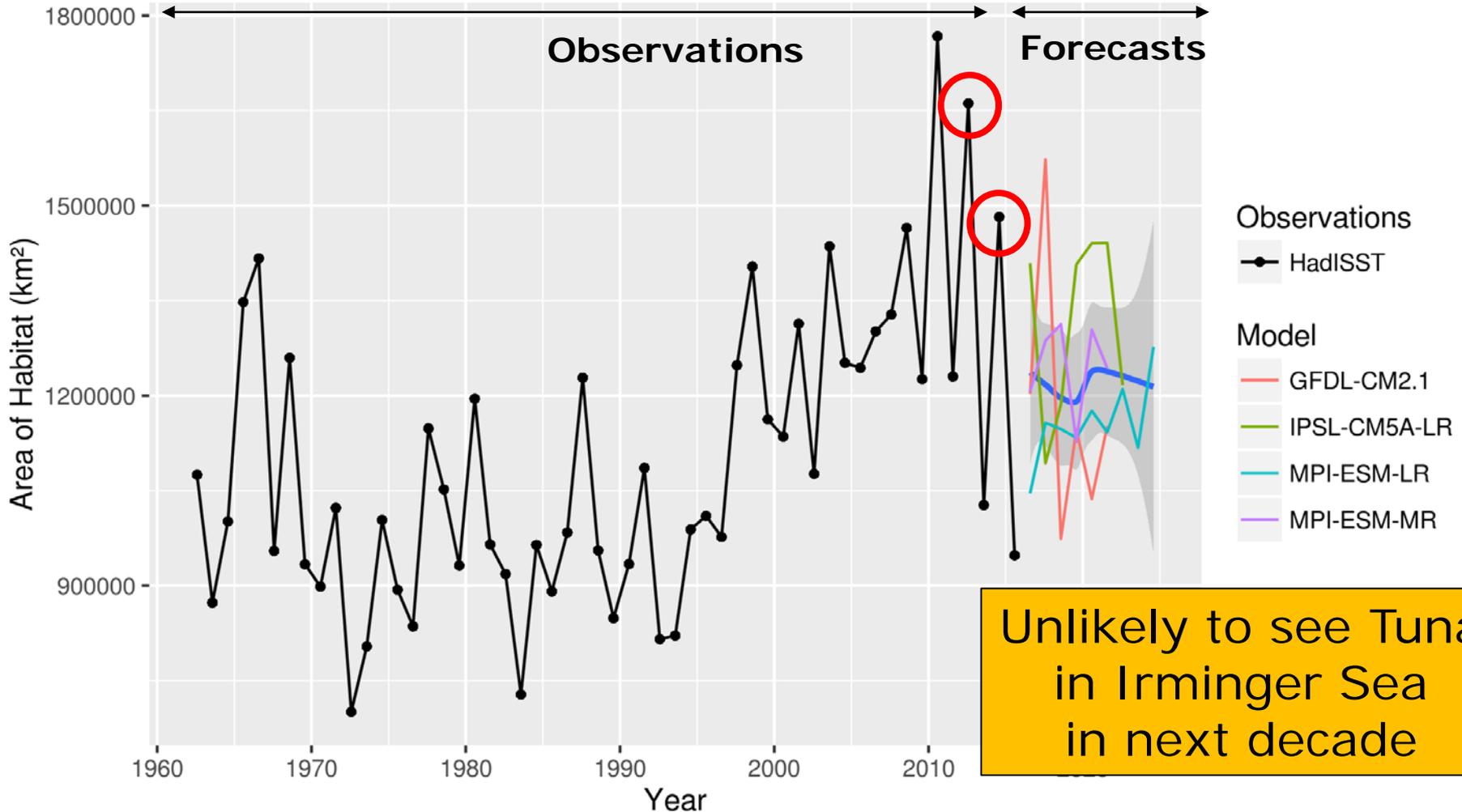


Can we forecast habitat?

Retrospective Forecast (Hindcast) Skill - Area of Potential Bluefin Tuna Habitat



Bluefin Tuna Habitat Forecasts



Case Study 2 - Blue whiting



Spawning region

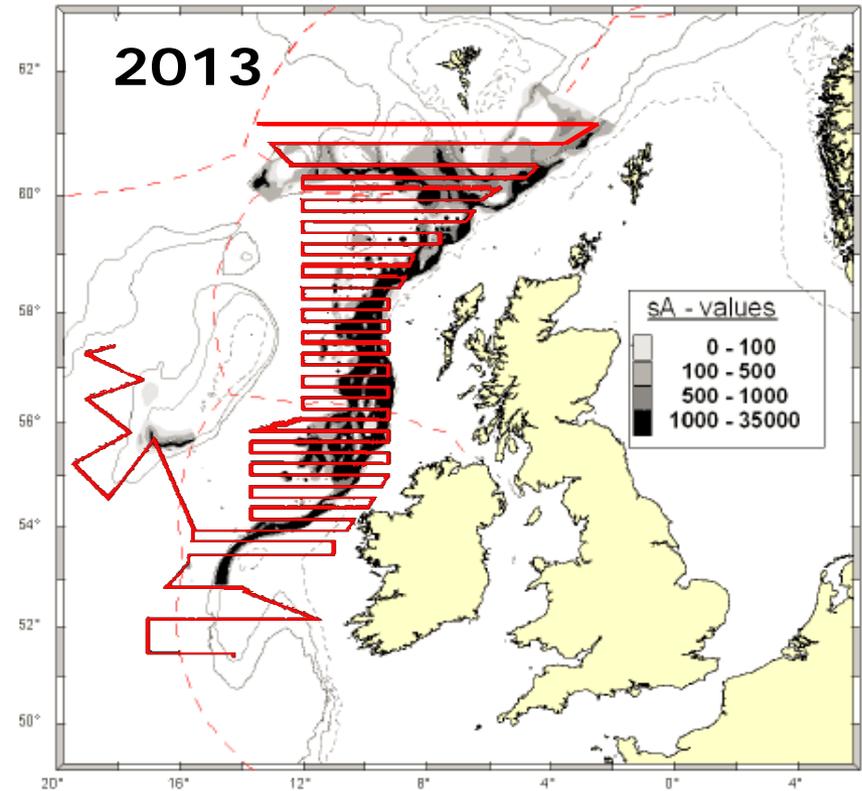
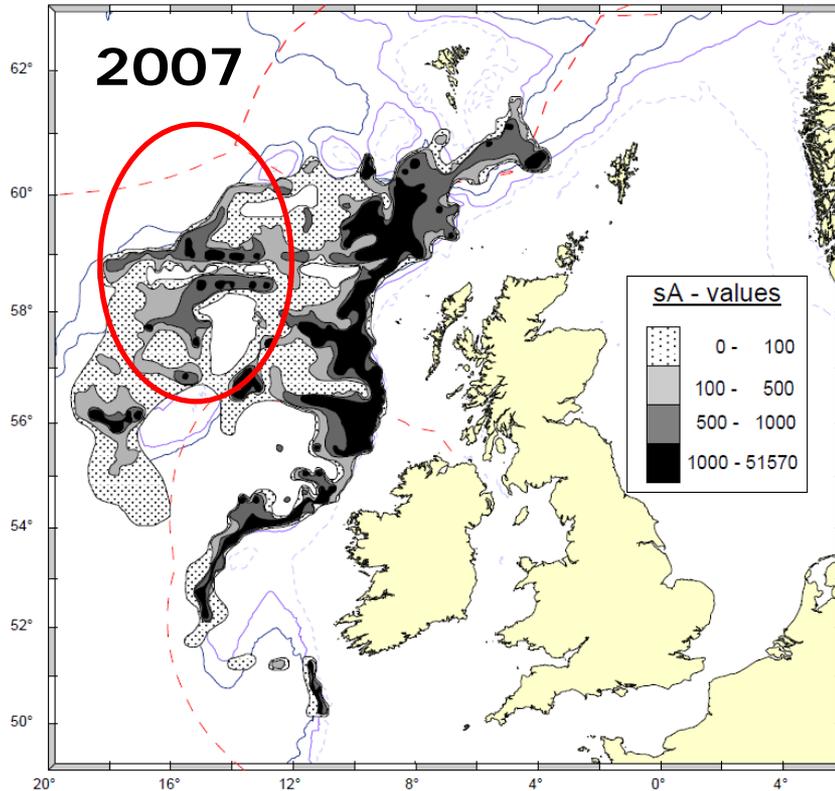


- Important feed for aquaculture
- Third largest fishery in the world in 2004.

Observed distribution of blue whiting

Expanded distribution

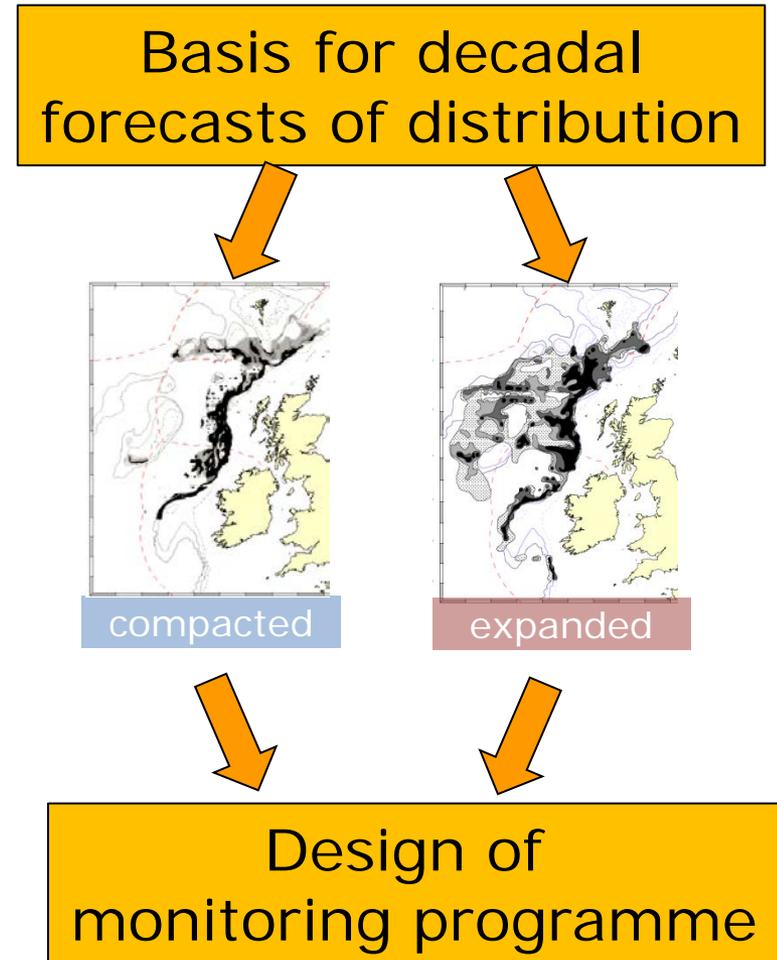
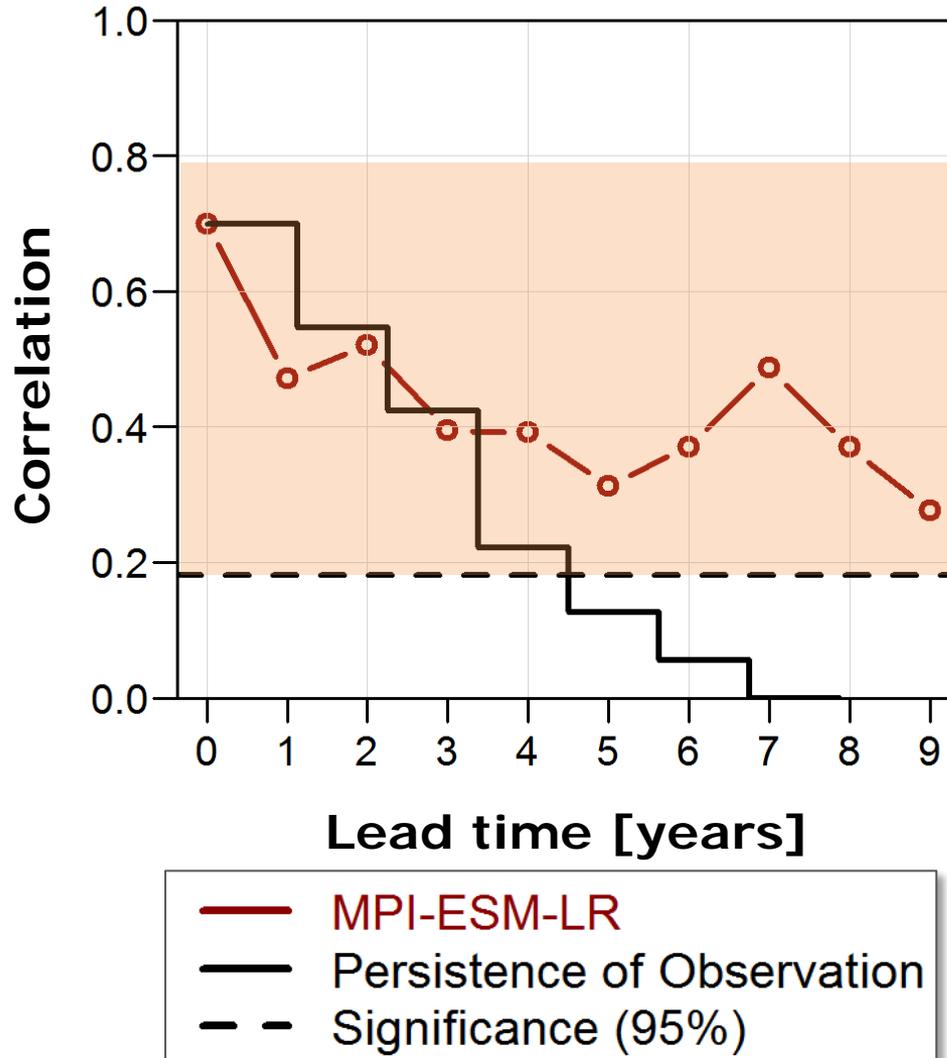
Compacted distribution



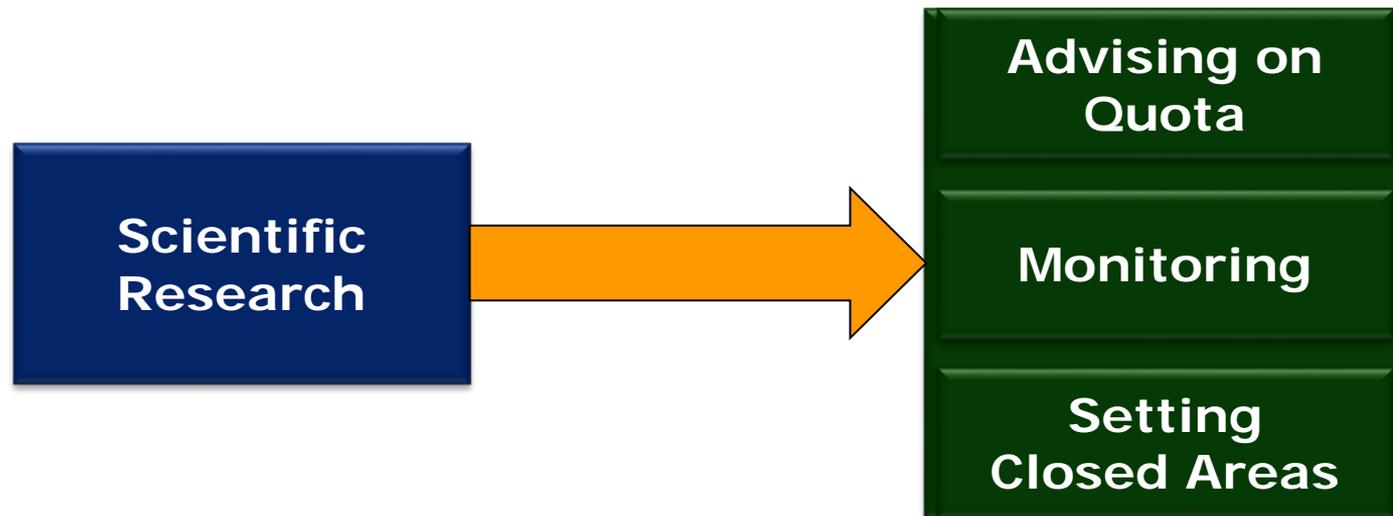
Warm & Saline

Cold & Fresh

Blue Whiting habitat forecast system



Who are the end-users?



End-users are our scientific peers

Marine Ecosystem Climate Services

Ask not "how do I predict <my pet thing>?"

Ask "what can I predict?"

Decadal prediction of marine ecosystems is possible

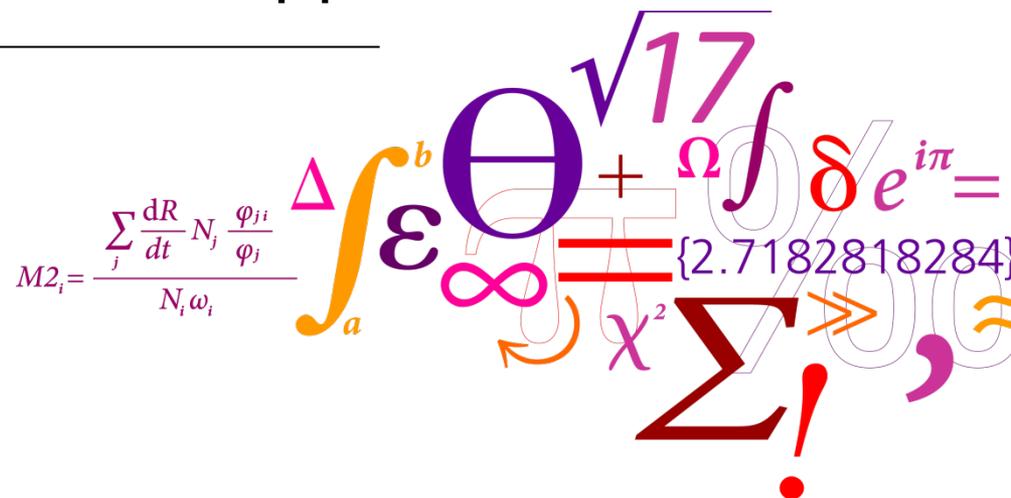
Direct route to management applications

Mark R Payne

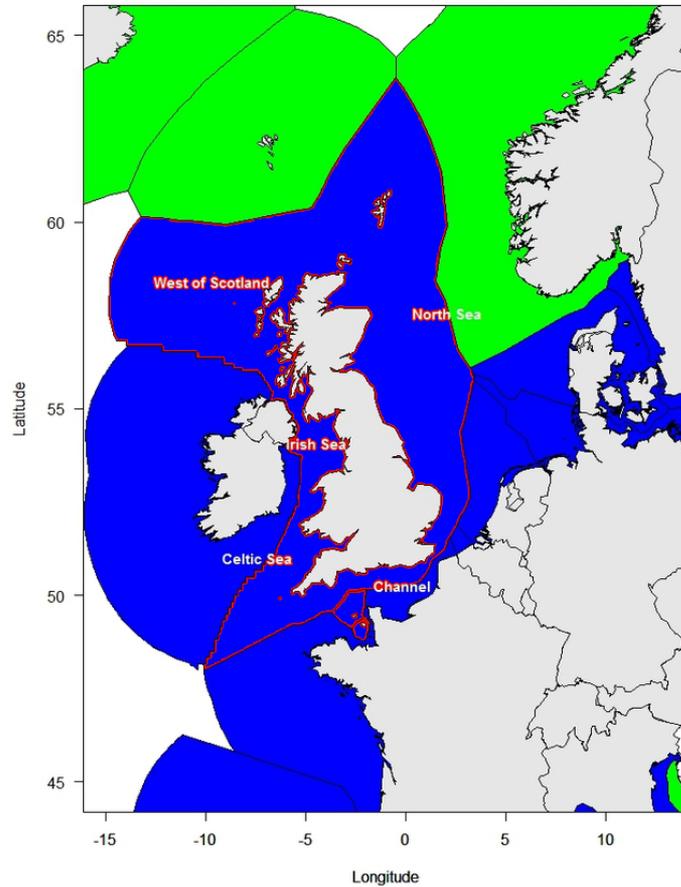
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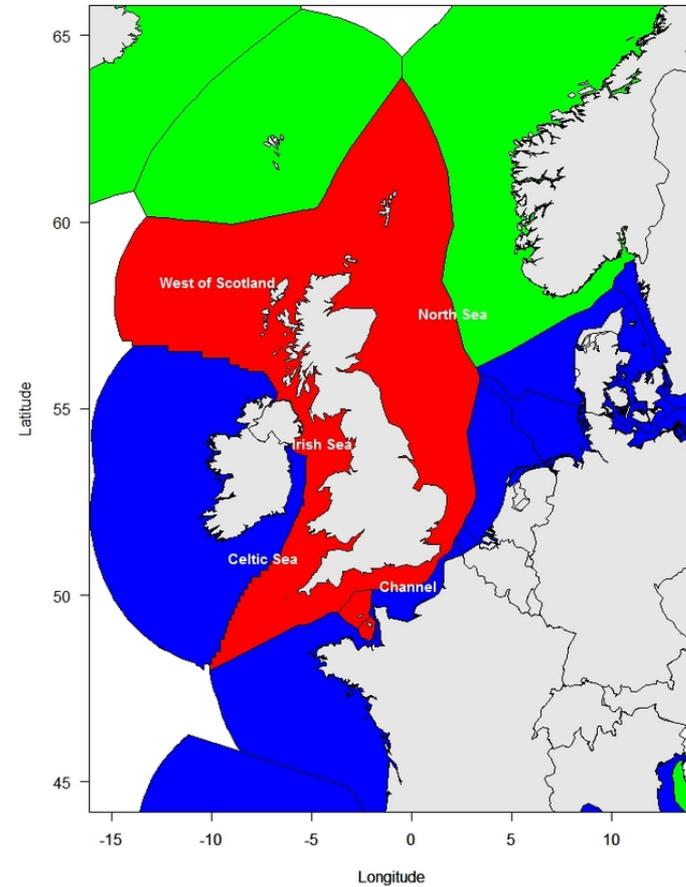


The New North Sea Landscape



Now

Marine Ecosystem Climate Services



2020

Mark R Payne (mpay@aqua.dtu.dk)