

# The sensitivity of cold-water corals\* to environmental change

*\*here: framework-forming stony corals*



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ATLAS investigates **interconnections** between **physical parameters** such as ocean circulation together **with the biogeochemistry and biodiversity of Atlantic ecosystems**.

ATLAS examines **how sensitive deep-water ecosystems** (e.g. sponges and cold-water corals) **are** coupled to surface production, and how management can adapt as human use and oceans change.

How sensitive are these ecosystems?

Which are the critical physical parameters?

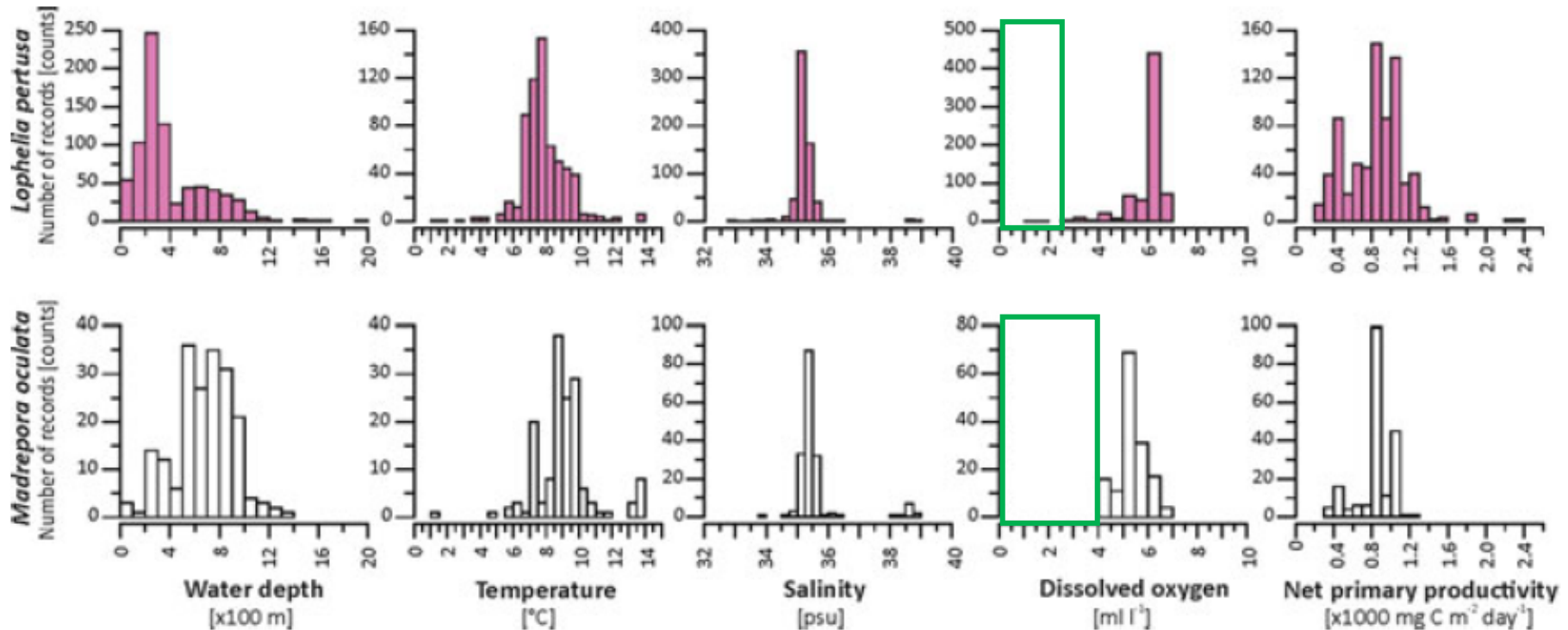
What are their critical levels?

[www.eu-atlas.org](http://www.eu-atlas.org)

## Ecological preferences of *Lophelia pertusa* & *Madrepora oculata*:

There is a wealth of information with respect to e.g.,  
temperature, pH, oxygen, productivity, etc.

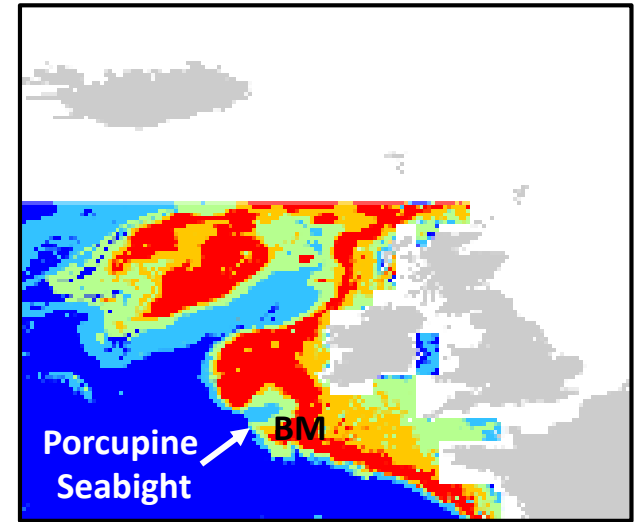
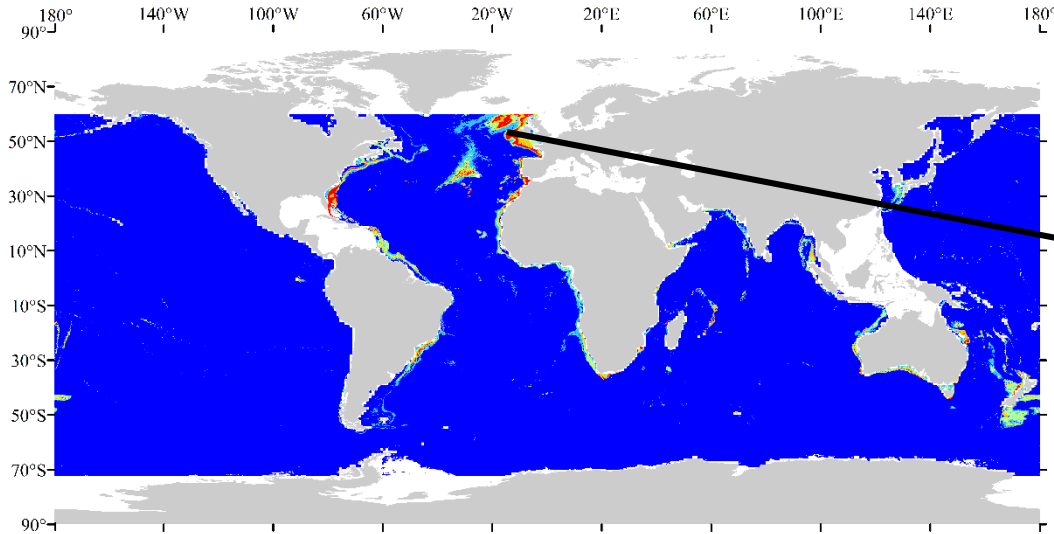
that is largely based on observations & lab experiments.



**Fig. 2 Oceanographic boundary conditions.** Oceanographic boundary conditions (water depth, temperature, salinity, dissolved oxygen concentrations, net primary production) for living occurrences of *Lophelia pertusa* and *Madrepora oculata* in the North Atlantic (data sources: UNEP-WCMC see Freiwald et al. 2005; WOA World Ocean Atlas 2013 see Boyer et al. 2013)

compiled by Wienberg & Titschack, 2017

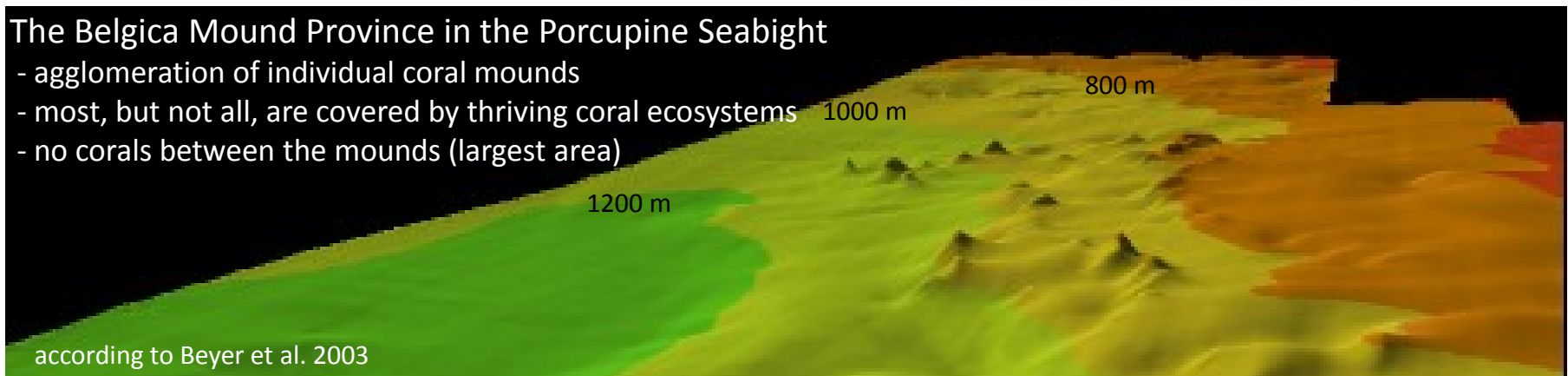
# Habitat suitability map for *Lophelia pertusa* (Davies & Guinotte, 2011)



- Habitat suitability maps indicate habitable regions
- Such regions are not always/entirely inhabited
- We still do not understand why corals grow at one specific spot but not next door ...

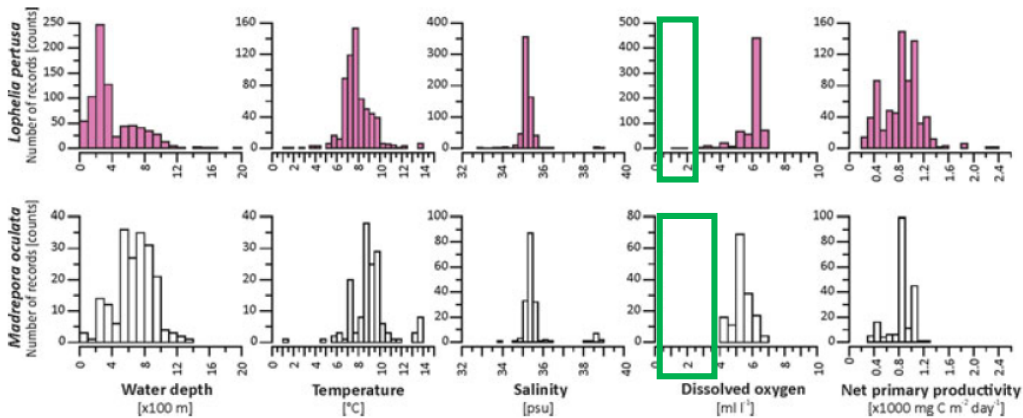
## The Belgica Mound Province in the Porcupine Seabight

- agglomeration of individual coral mounds
- most, but not all, are covered by thriving coral ecosystems
- no corals between the mounds (largest area)



according to Beyer et al. 2003

## REPORTED Ecological preferences of *L. pertusa* & *M. oculata*:

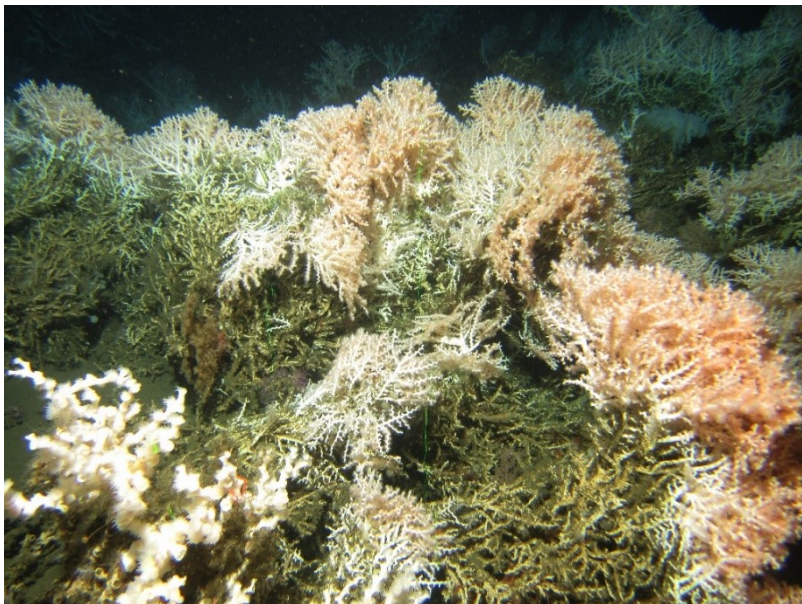


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Thus, the lower limit of tolerable oxygen concentrations is described for *L. pertusa* from 1.5 ml/l to 3 ml/l and for *M. oculata* around 4 ml/l.

Consequently, assumed future decreases in oxygen concentrations below these levels (resulting e.g., from global change) might be interpreted to regionally form a risk for these corals.



The Angolan continental margin: thriving *L. pertusa* and *M. oculata* reefs with oxygen concentrations <0.8 ml/l.

We still have much to learn about the ecological preferences of *L. pertusa* and *M. oculata* (and other marine species)!  
... and also about their geographical distribution

# Factors controlling the distribution/fate of cold-water corals



To answer these questions:

How sensitive are these ecosystems?

Which are the critical physical parameters?

What are their critical levels?

we follow a different approach:

The long-term development of cold-water corals (and the associated ecosystems) is often marked by temporal declines/extinctions.

We investigate past on/offsets of coral vitality (e.g., in coral mound records) and link them to environmental parameters to detect critical properties.

Here: increasing bottom current energy fostering the food supply

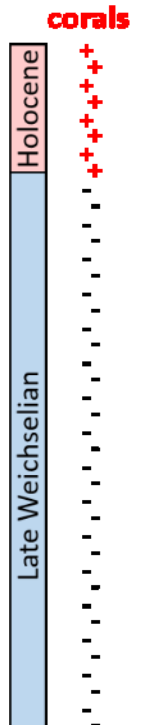
Advantages:

- critical parameters

Disadvantages:

- hardly any real quantitative data  
(semi-quantitative ...)

Cold-water coral development along the Irish margin



# Matrix of changing environmental parameters vs. changing coral vitality (*temperature, productivity, oxygen, bottom currents, ...*)



- comparing on/offsets of coral growth in various settings around the North Atlantic with environmental parameters
- qualitative detection of critical environmental parameters
- lack of numbers (i.e. distinct thresholds) a problem?  
**Yes and No!**



	Angola	Mingulay, Scotland
oxygen	<0.8 ml/l	>3 ml/l
		Laboratory experiments by Dodds et al. 2007 original environment: ~ 6ml/l

**→ regional sensitivities!**  
*+ the combined effect  
of multiple stressors*

## Conclusion



- we still have to learn quite a lot about the environmental preferences/tolerances of cold-water corals in order to understand their present-day distribution

- looking into the past allows to detect critical environmental changes (i.e. parameters) affecting cold-water corals

- in any forward-looking approach we have to consider regional differences in their sensitivity to environmental changes

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