

Study case: Preliminary results from a meta-analysis using natural analogs

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What are the effects of Ocean acidification (OA) on benthic communities **functioning using natural analogs** ?

What does “functioning” mean ?

Functional Ecology



CORAL REEF FUNCTIONAL ECOLOGY IN THE ANTHROPOCENE |  [Free Access](#)

The meaning of the term ‘function’ in ecology: A coral reef perspective

David R. Bellwood , Robert P. Streit, Simon J. Brandl, Sterling B. Tebbett

First published: 16 December 2018 | <https://doi.org/10.1111/1365-2435.13265> |
Citations: 168

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Functional Ecology



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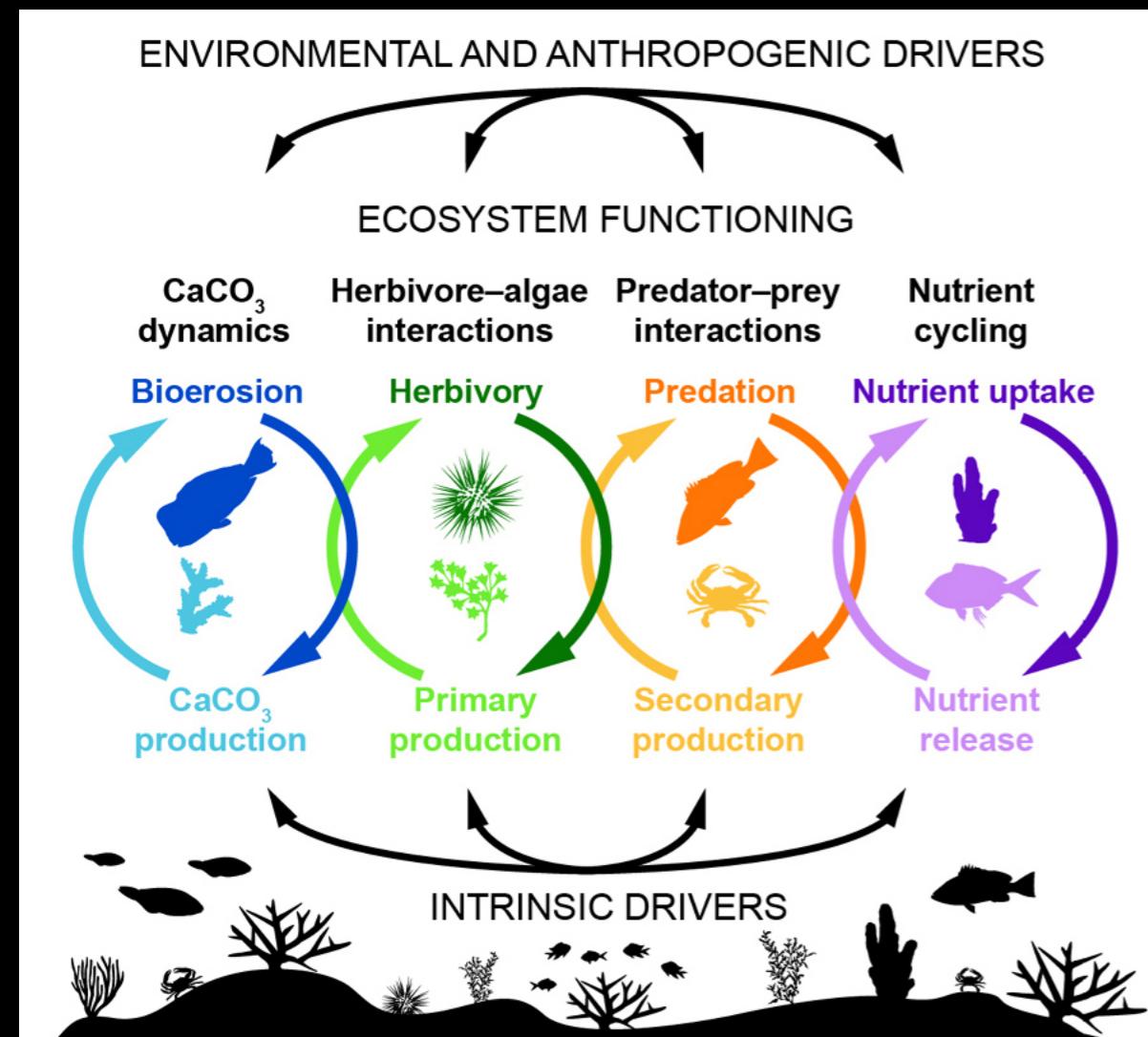
The meaning of the term ‘function’ in ecology: A coral reef perspective

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“Function refers to the **flow of energy or material** within an **ecosystem**, and therefore, functioning of a complex system of interactions can be defined as the sum of processes or functions that sustain the system (Jax 2005).”

Which functions did we target ?



- CaCO₃ production, Growth, biomass changes
 - Photosynthesis and Respiration activities
 - Nutrient cycling
- Complexity (indirect driver)
- Coverage (indirect driver)

Trends in Ecology & Evolution



Volume 28, Issue 3, March 2013, Pages 167-177

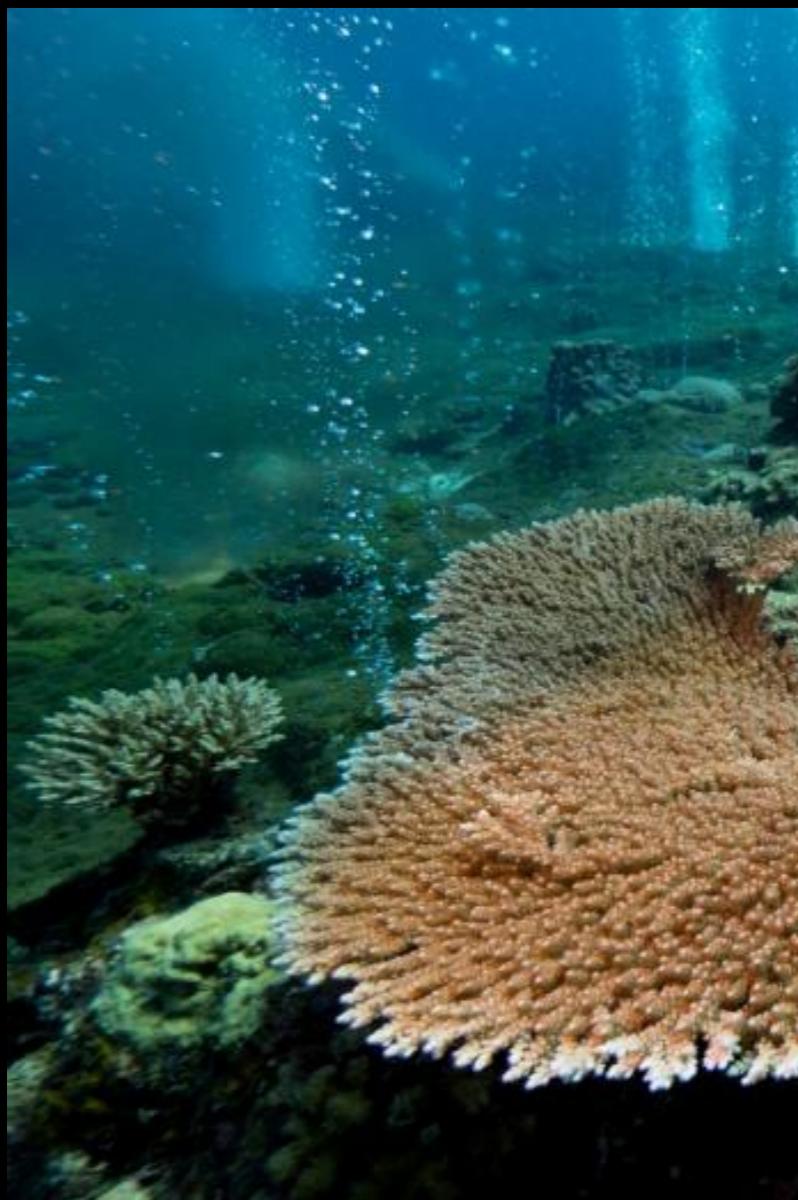
Review

A functional approach reveals community responses to disturbances

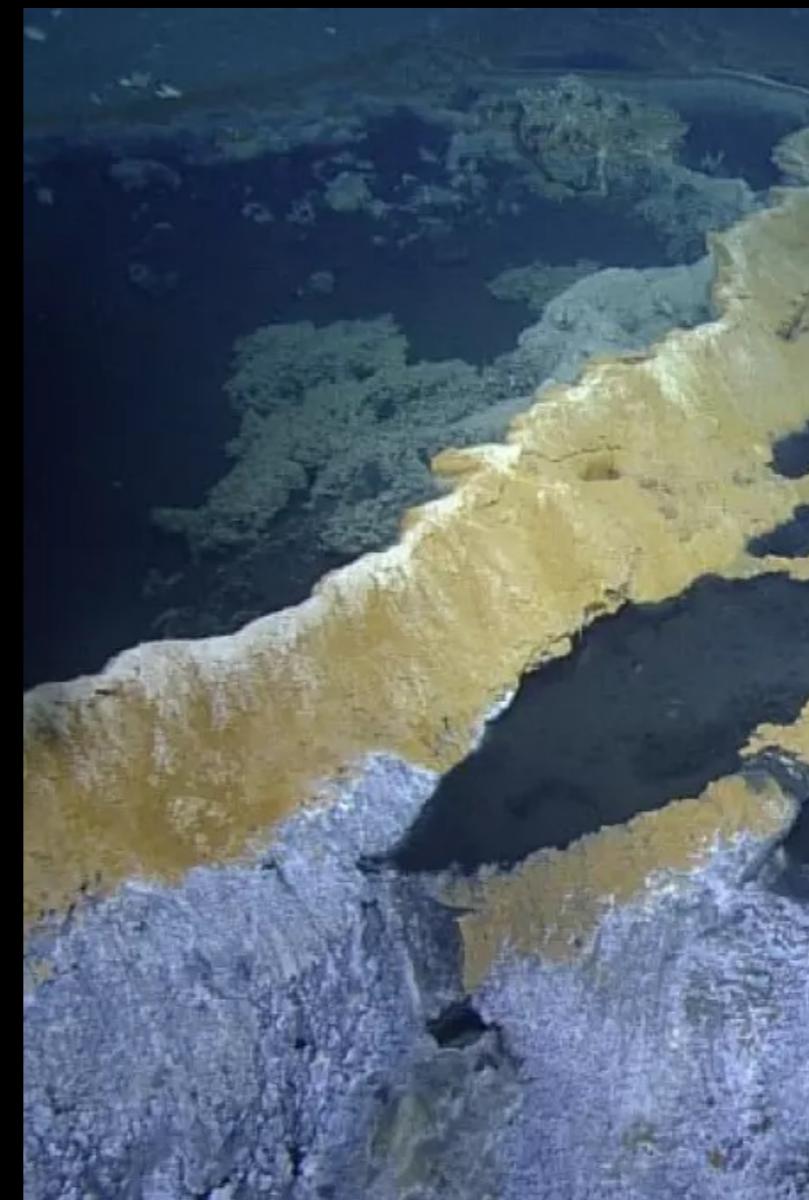
David Mouillot^{1 2}  , Nicholas A.J. Graham², Sébastien Villéger^{1 3}, Norman W.H. Mason⁴,
David R. Bellwood^{2 5}

1st study looking at functioning in the marine systems
It was in **2013!**

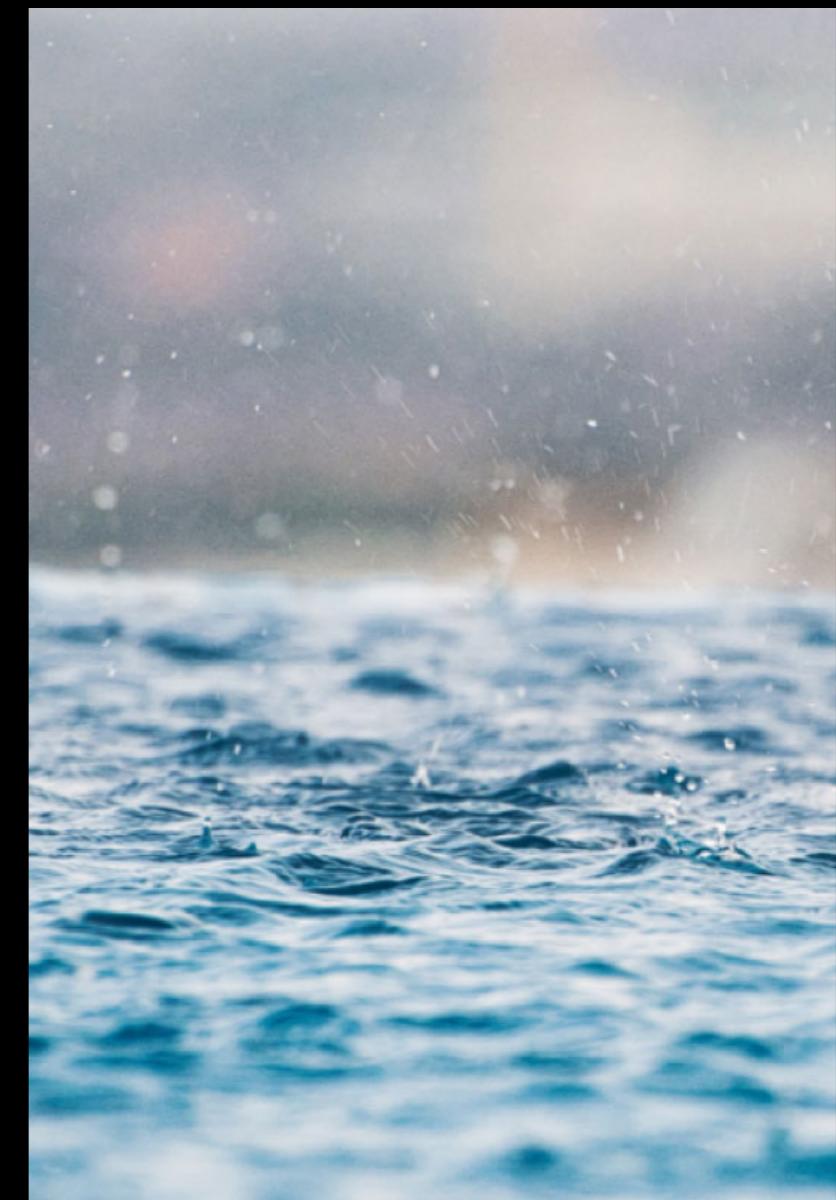
“An environment that shows the same characteristics as the future environment”



CO₂ vents



Tides



Rainfall events

“An environment that shows the same characteristics as the future environment”

It is also a very powerful way to study the effect of OA:

- At the ecosystem level, and *in situ*
- With a long term exposure (100 years or more)
- And to determine species winners
- And to look for potential adaptation

Published: 08 June 2008

Volcanic carbon dioxide vents show ecosystem effects of ocean acidification

[Jason M. Hall-Spencer](#) , [Riccardo Rodolfo-Metalpa](#), [Sophie Martin](#), [Emma Ransome](#), [Maoz Fine](#), [Suzanne M. Turner](#), [Sonia J. Rowley](#), [Dario Tedesco](#) & [Maria-Cristina Buia](#)

[Nature](#) 454, 96–99 (2008) | [Cite this article](#)

16k Accesses | 1025 Citations | 62 Altmetric | [Metrics](#)

1st study using natural analogs to study OA
It was in **2008!**

What are the effects of Ocean acidification (OA) on benthic communities functioning using natural analogs ?

PECO = Population, Exposure,
Comparator, and Outcomes



Fully-
reproducible

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Domain_where_focusing = "TS=(

Population_of_interest = "(\"benthos\" OR \"benthic communit*\" OR \"benthic organism\$\" OR \"invertebrate\$\" OR \"kelp\$\" OR \"alga*\" OR \"reef\" OR \"calcified alga*\" OR \"fleshy alga*\" OR \"coralline alga*\" OR \"turf alga*\" OR \"macroalga*\" OR \"nematode\$\" OR \"seagrass\" OR \"Posidonia\" OR \"echinoderm\$*\" OR \"calcifying species\" OR \"calcareous\" OR \"bivalve\$\" OR \"annelid\$\" OR \"mollus*\" OR \"coral\$\" OR \"polychaete\$\" OR \"gastropod*\" OR \"seaweed\$\" OR \"calcareous species\")"

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Functional_Outcomes = "(\"function*\" OR \"habitat-forming\" OR \"photosynthesis\" OR \"calcification\" OR \"respiration\" OR \"nutrient uptake\$\" OR \"nutrient absorption\" OR \"carbon stockage\" OR \"growth\" OR \"biomass\" OR \"filtration\" OR \"complexity\" OR \"predation\" OR \"hebivor*\" OR \"autotrophy\" OR \"heterotrophy\" OR \"primary produc*\" OR \"secondary produc*\" OR \"accretion\" OR \"nutrient cycling\" OR \"reproduction\" OR \"productivity\")"

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query <- paste(Domain_where_focusing, Population_of_interest, " AND ", Geographic_Population, " AND ", Exposure, " AND ", Functional_Outcomes, ")", sep = "")



24 studies

Hall-Spencer et al. (2008)
Agostini et al. (2010)
Kroeker et al. (2011)
Fabricius et al. (2011)
Jonhson et al. (2012)
Uthicke & Fabricius (2012)
Kroeker et al. (2012)
Kroeker et al. (2013)

Crook et al. (2013)
Inoue et al. (2013)
Russel et al. (2013)
Apostolaki et al. (2014)
Linares et al. (2015)
Echons et al. (2015)
Vogel et al. (2015)
Harvey et al. (2016)

Kamenos et al. (2016)
Vizzini et al. (2017)
Sunday et al. (2017)
Agostini et al. (2018)
Connell et al. (2018)
Teixido et al. (2018)
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Teixido et al. (2018)
Milazzo et al. (2019)
Harvey et al. (2021)

```
> # Print test-list score
> print(paste("My recovering rate equals ", round(Hit_score, 2), "%!", sep = ""))
[1] "My recovering rate equals 87.5%!"
```

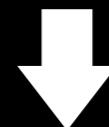
Records identified using WoS
database (n= 2334)



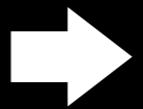
Fully-
reproducible

Flow diagram

Records identified using WoS database (n= 2334)



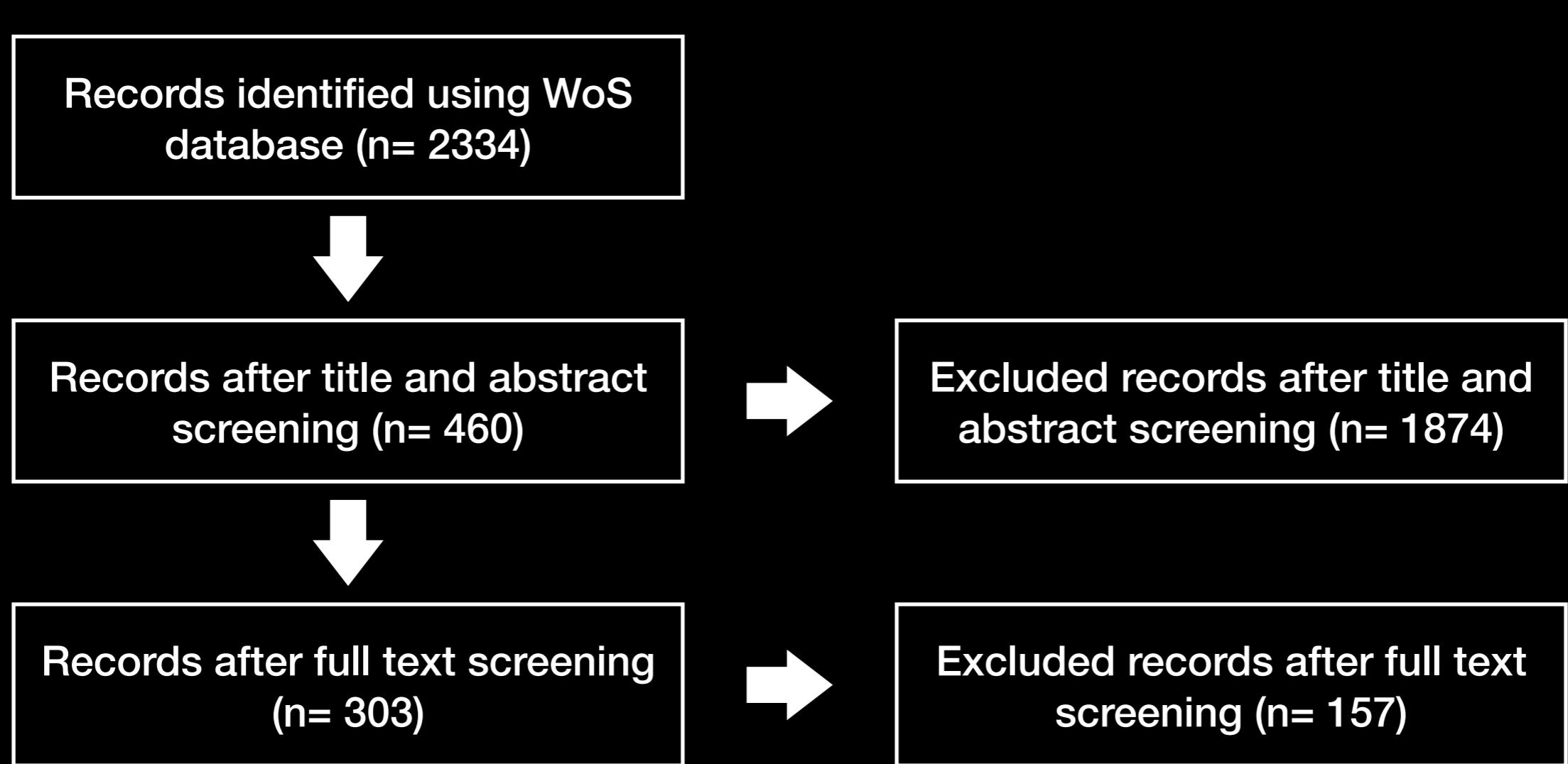
Records after title and abstract screening (n= 460)



Excluded records after title and abstract screening (n= 1874)



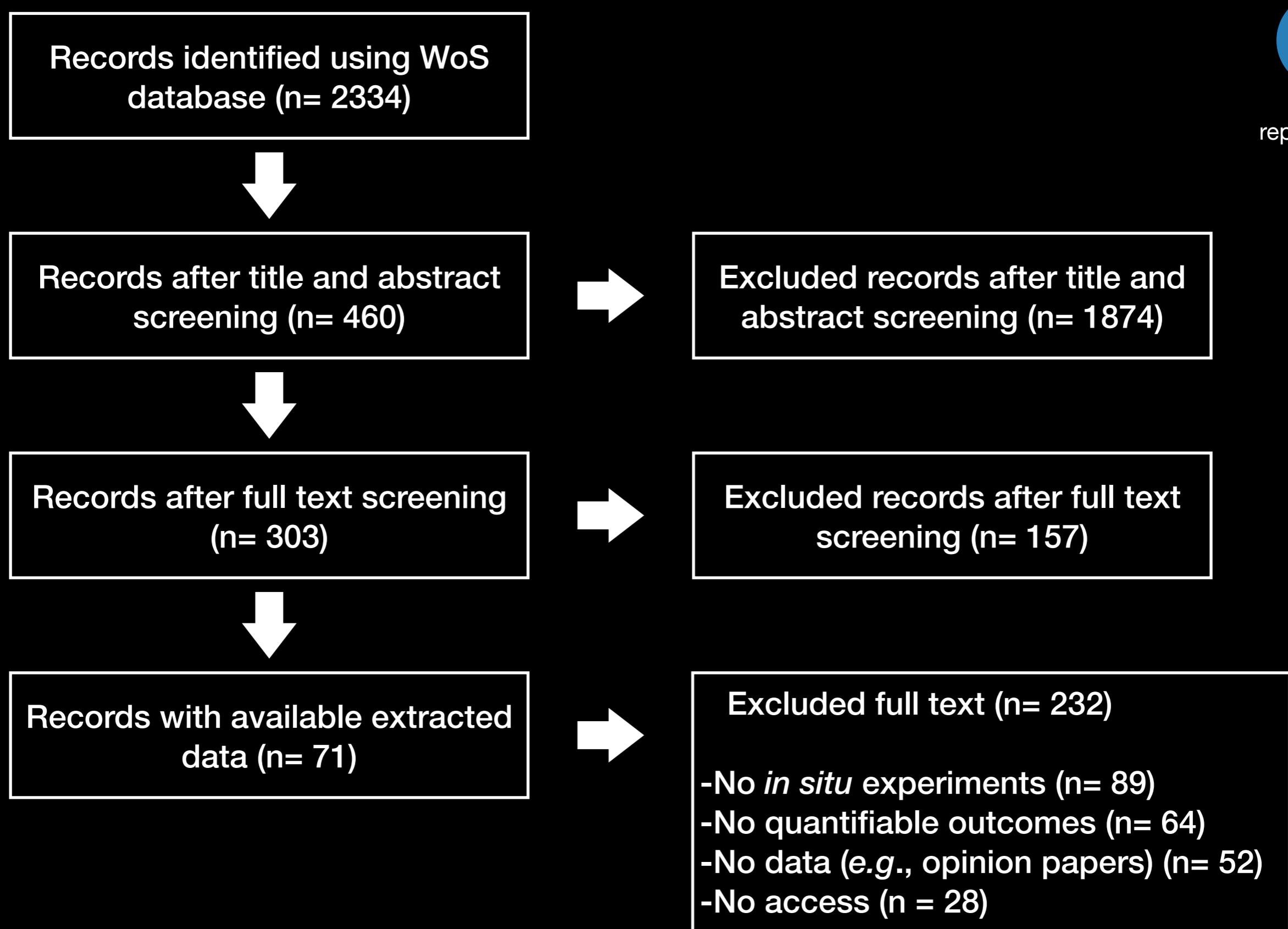
Flow diagram



Flow diagram



Fully-
reproducible





<https://youtu.be/tiL-gZgN9Qk?t=180>



Fully-
reproducible



extracting data
from images with
the **juicr** package
for R



<https://youtu.be/tiL-gZgN9Qk?t=180>



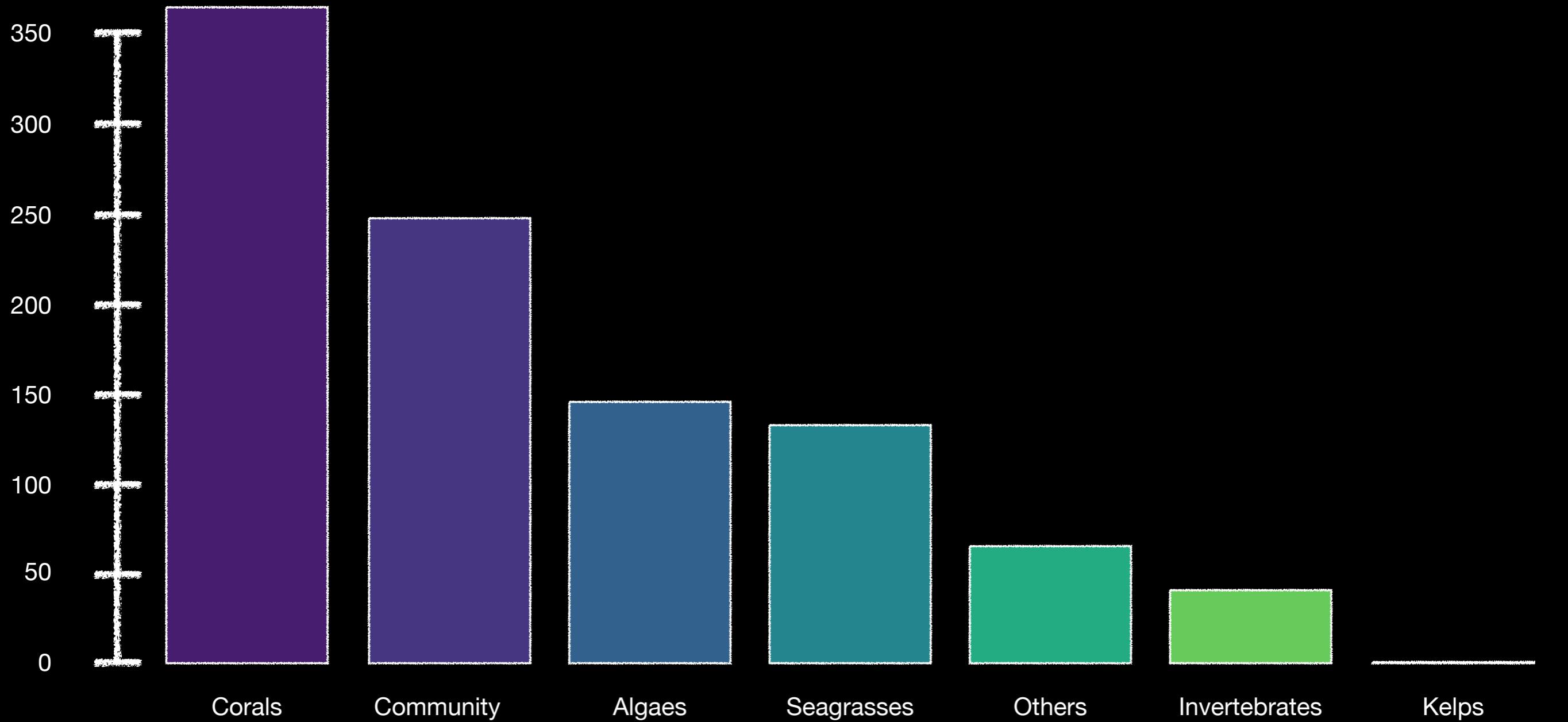
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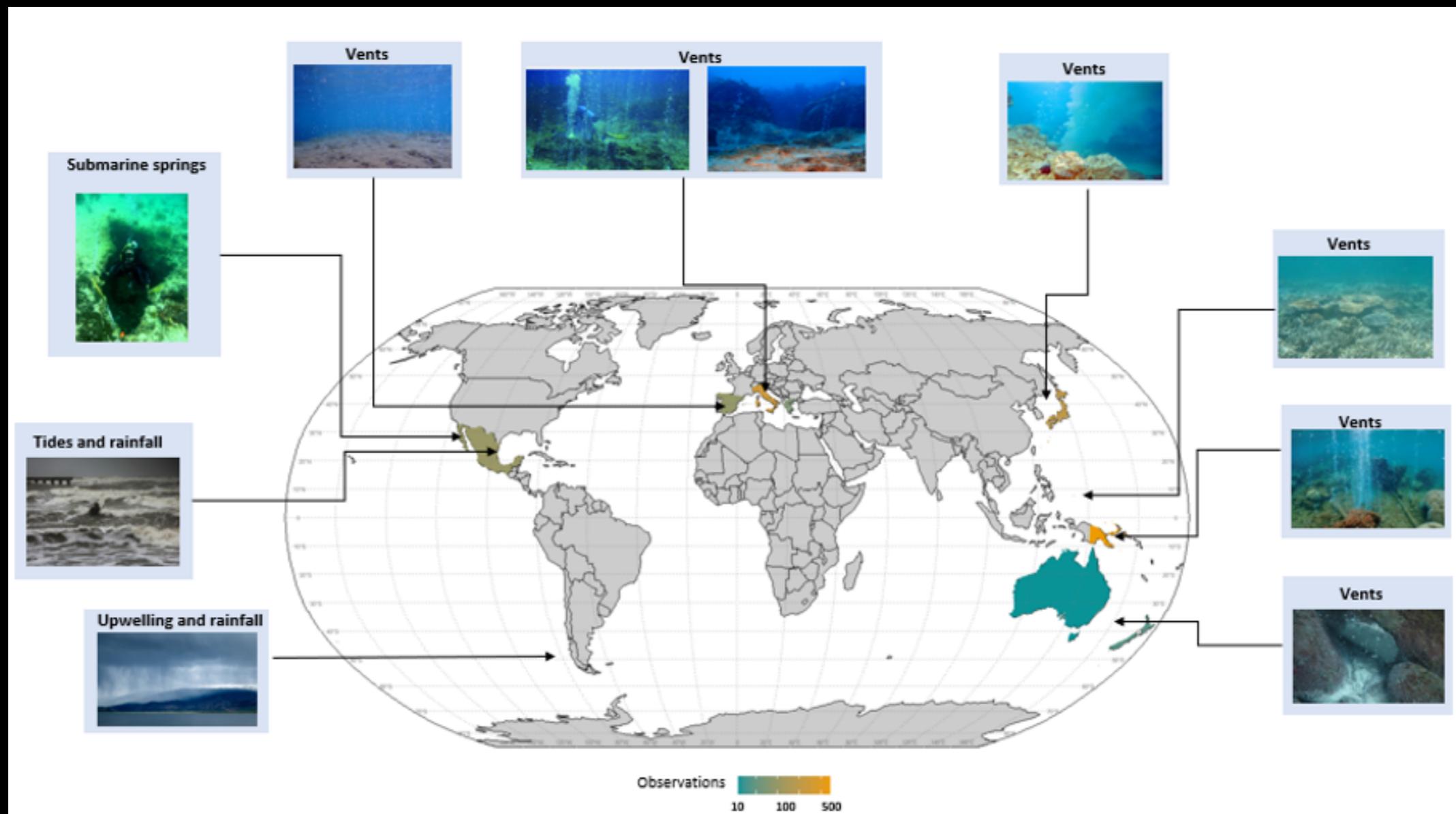
Final dataset

- 1013 observations
- 15 countries
- > 73 species
- CaCO₃ information collection
- 5 mains natural analogs (i.e., CO₂ vents, rainfall, submarine springs, tides, upwellings)
- > 5 processes (i.e., respiration, photosynthesis, calcification, growth, nutrient cycling)

Organisms



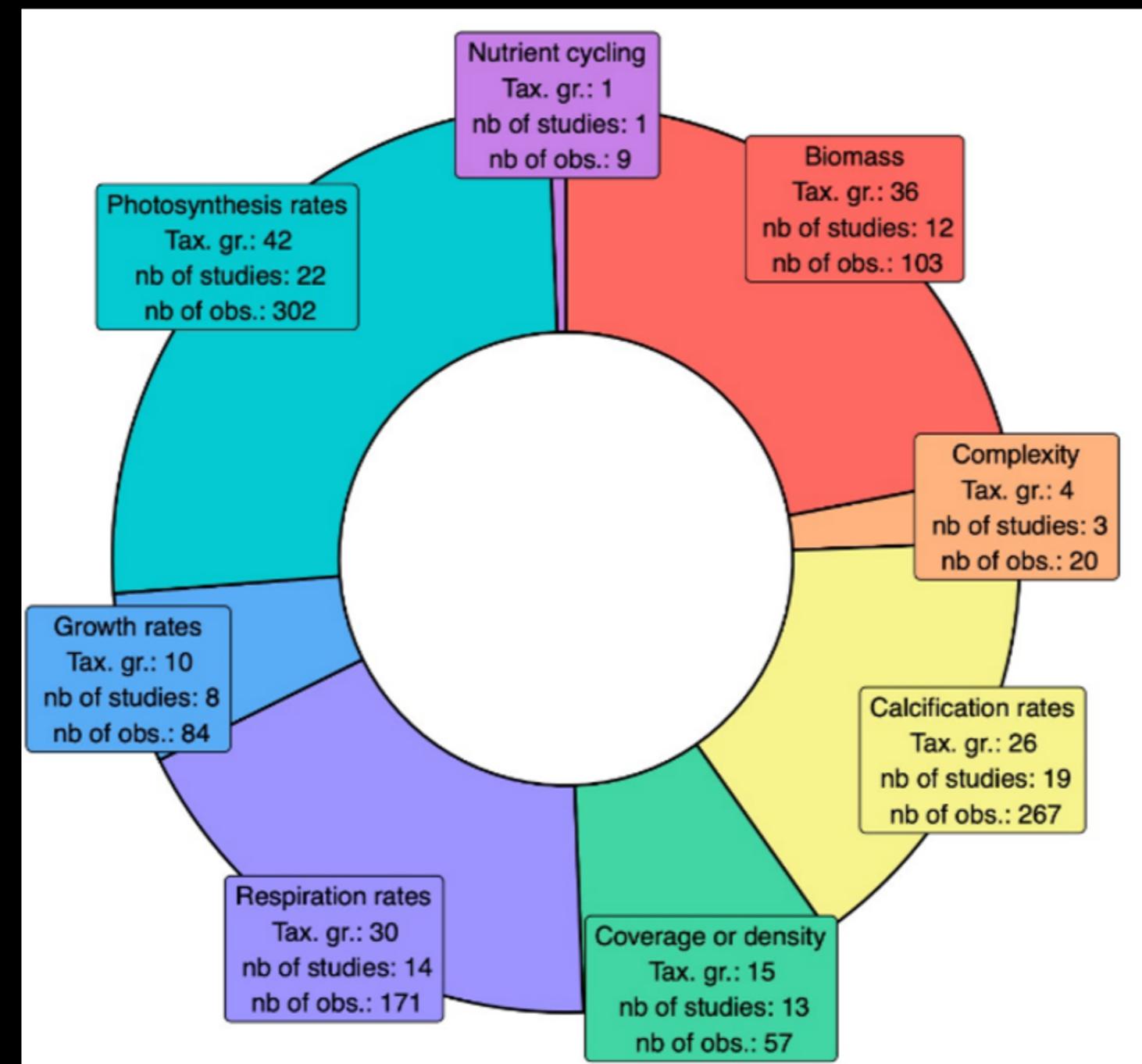
Systematic map



Most of the studies are located in Japan,
New-Papua and Italy

Functions

Most of the studies focus on photosynthesis & respiration rates, calcification rates and biomass



- Unit homogenization
- Meta-analysis (Forest plots)
- Look for potential trends according to the natural analogs, or to the studied taxon

Team mates working on this project



Romane Torchay
Master student



Núria Teixidó
Sr. Research Scientist





A split-level image showing an underwater landscape. The top half is a rocky coastline with green algae growing on the rocks. The bottom half is a clear, greenish-blue sea floor covered in green algae. The water is shallow, allowing a clear view of the seabed.

Thank you for your attention!

Jérémy Carlot
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