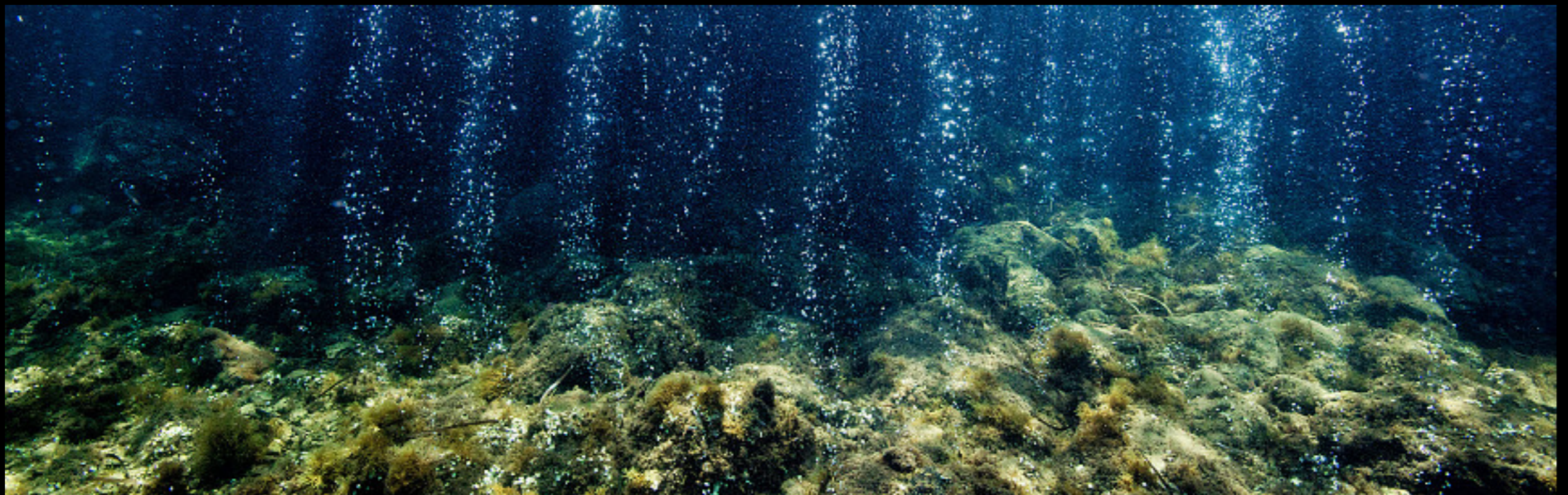


Study case: Preliminary results from a meta-analysis using natural analogs

Jérémy Carlot

Post-doctoral Fellow

Institut de la Mer de Villefranche-sur-Mer (IMEV), France



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

What does “functioning” mean ?

Functional Ecology  BRITISH
ECOLOGICAL
SOCIETY

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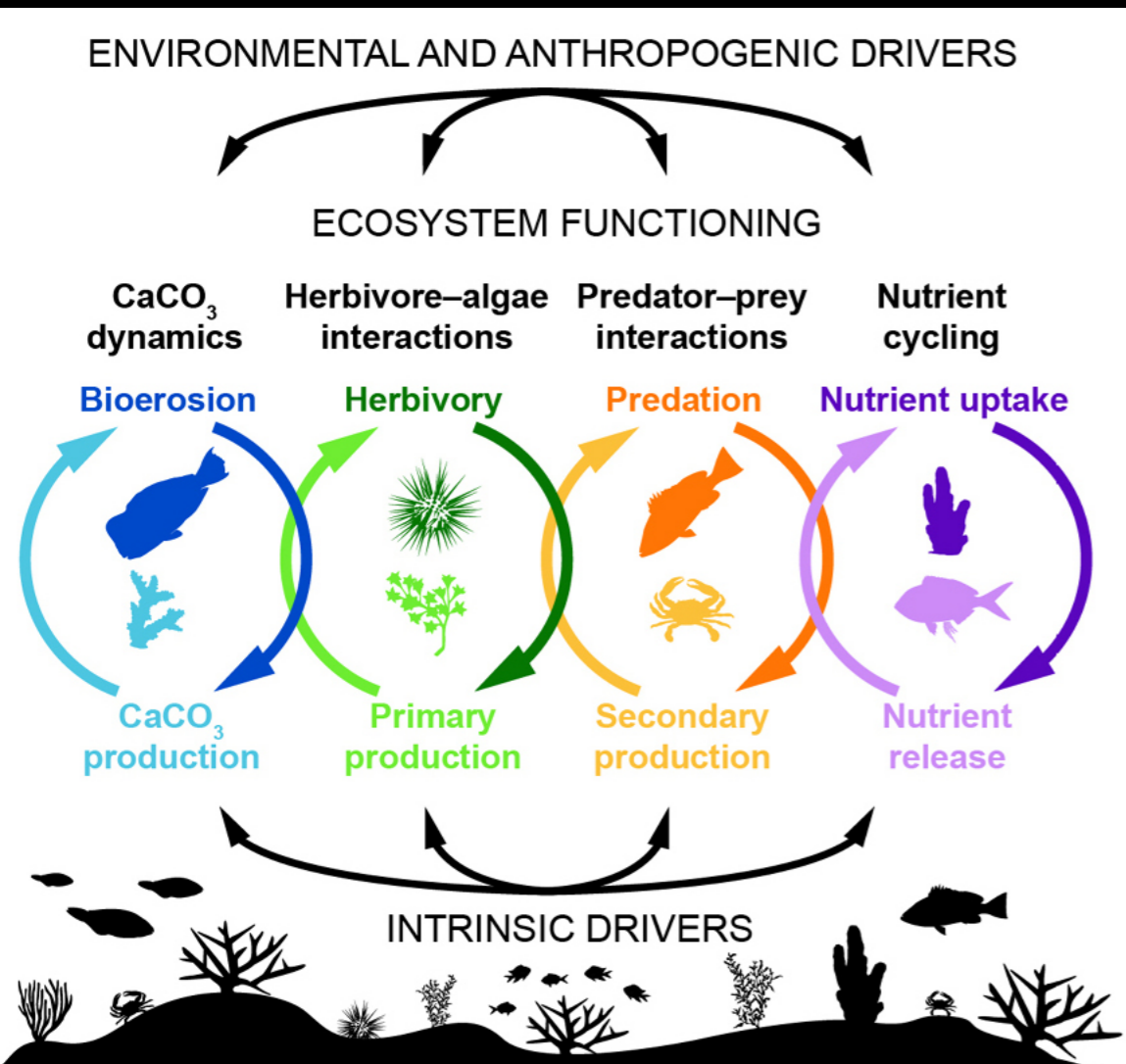
The meaning of the term ‘function’ in ecology: A coral reef perspective

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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

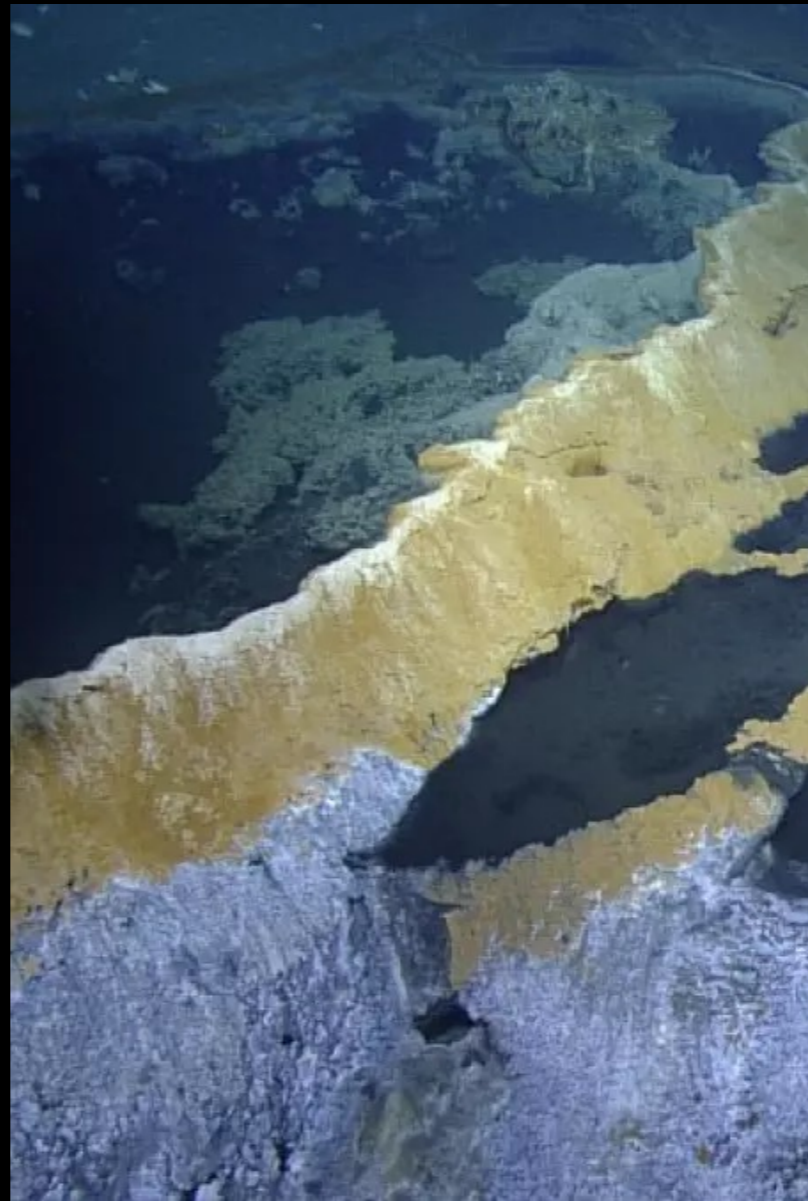
David Mouillot^{1,2} , Nicholas A.J. Graham², Sébastien Villéger^{1,3}, Norman W.H. Mason⁴,
David R. Bellwood^{2,5}

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

nature

[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



Fully-reproducible

PECO = Population, Exposure, Comparator, and Outcomes

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\")"

Geographic_Population = "(\"Dominica\" OR \"Greece\" OR \"Italy\" OR \"Japan\" OR \"Mexico\" OR \"New Zealand\" OR \"Northern Mariana Island\$\" OR \"Palau\" OR \"Papua New*Guinea\" OR \"Portugal\" OR \"Russia\" OR \"Spain\" OR \"Taiwan\" OR \"Mediterranean\" OR \"natural analog*\" OR \"CO2 vent*\" OR \"CO2 seep\$*\" OR \"natural CO2\" OR \"vent*\" OR \"naturally acidified ecosystem\$\" OR \"natural lab*\" OR \"Caribbean\" OR \"model ecosystem\")"



Fully-reproducible

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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



Fully-
reproducible

Hall-Spencer et al. (2008)

Agostini et al. (2010)

Kroeker et al. (2011)

Fabricius et al. (2011)

Jonhson et al. (2012)

Uthicke & Fabricius (2012)

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Crook et al. (2013)

Inoue et al. (2013)

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Linares et al. (2015)

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Vogel et al. (2015)

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Vizzini et al. (2017)

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Teixido et al. (2018)

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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%!"
```

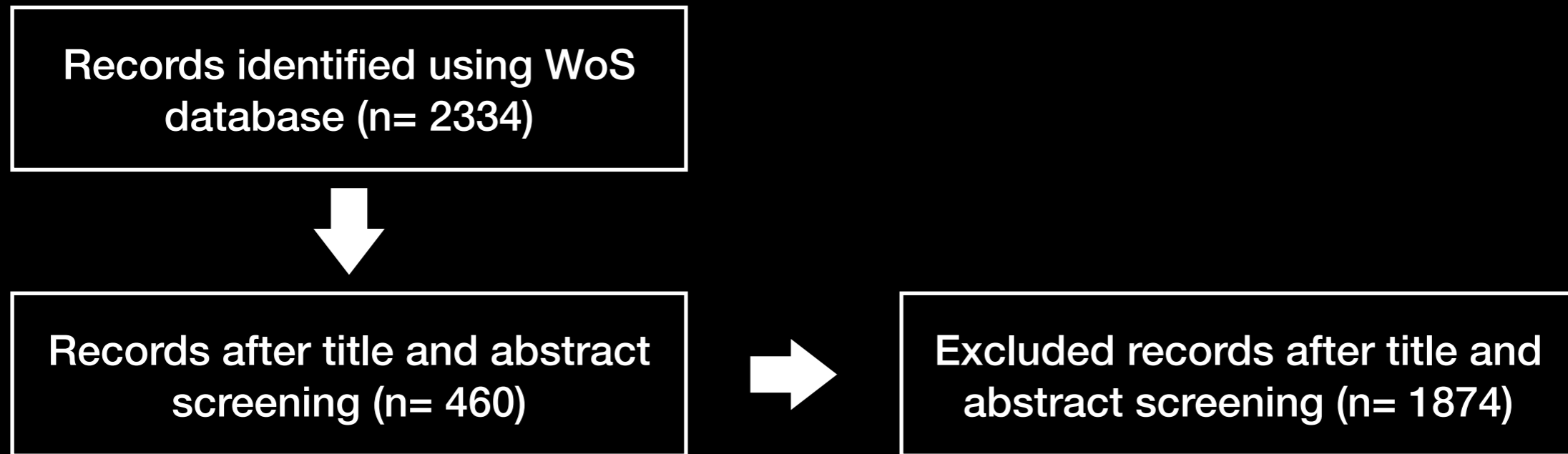
Records identified using WoS
database (n= 2334)

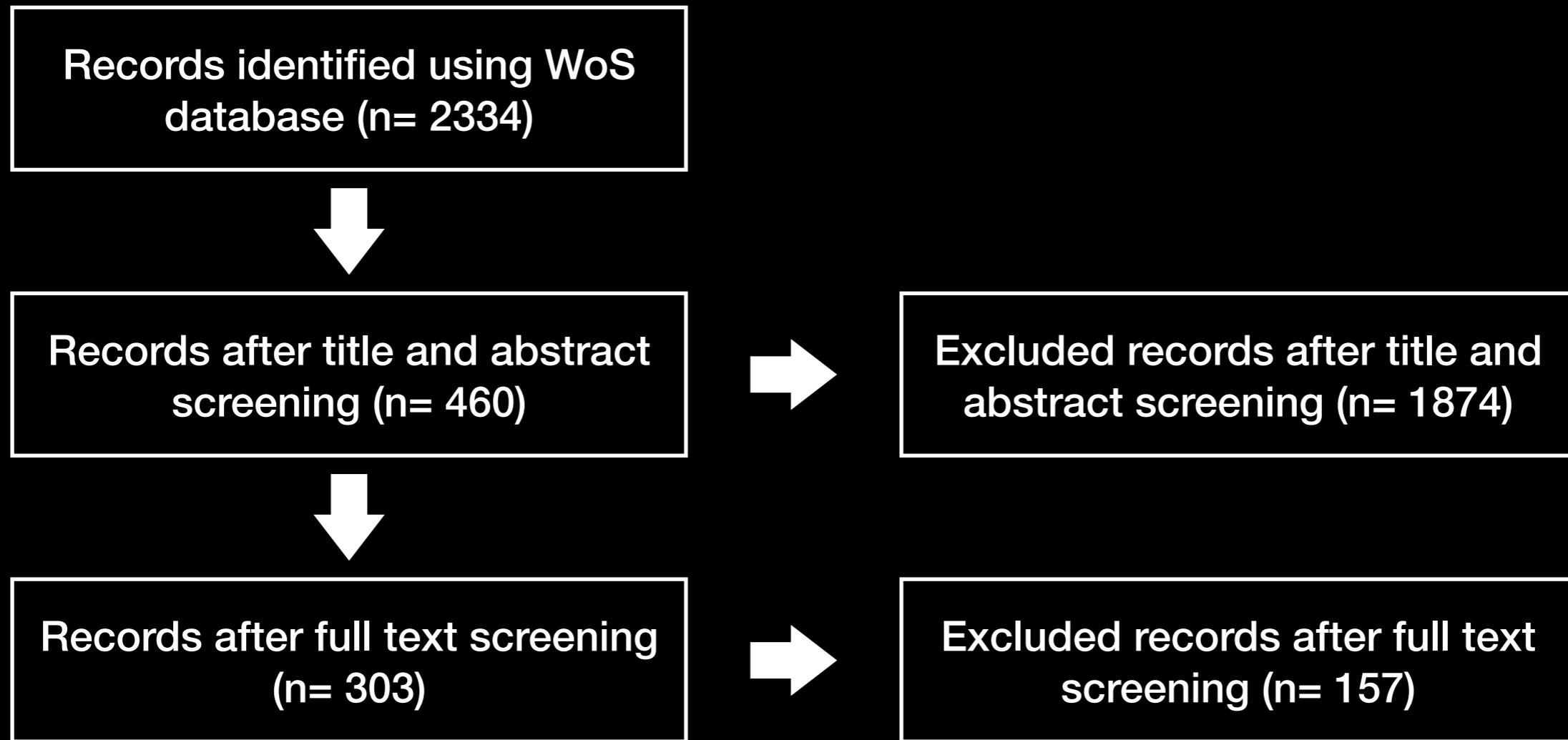


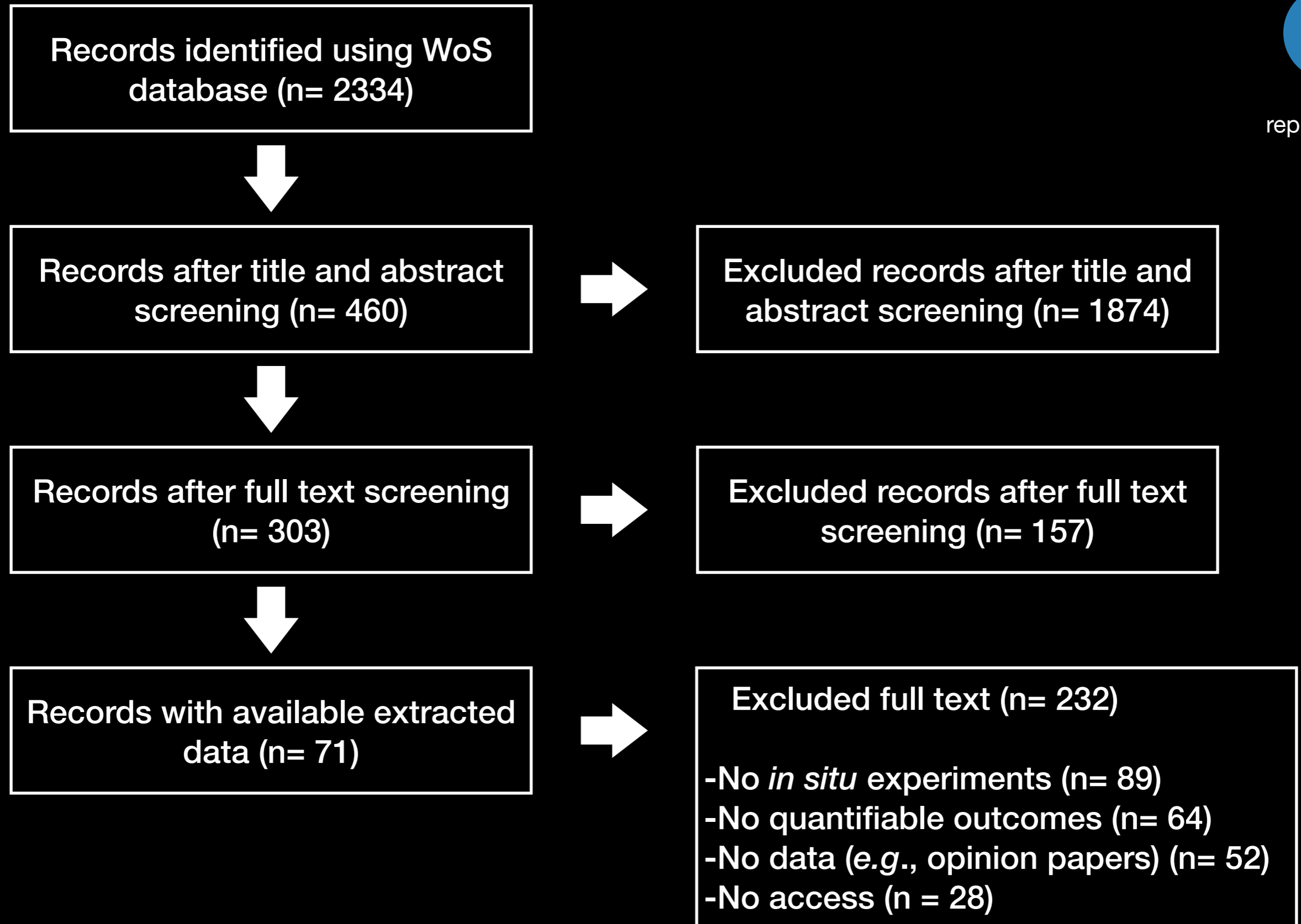
Fully-
reproducible



Fully-reproducible









Fully-reproducible



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



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





Fully-reproducible



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



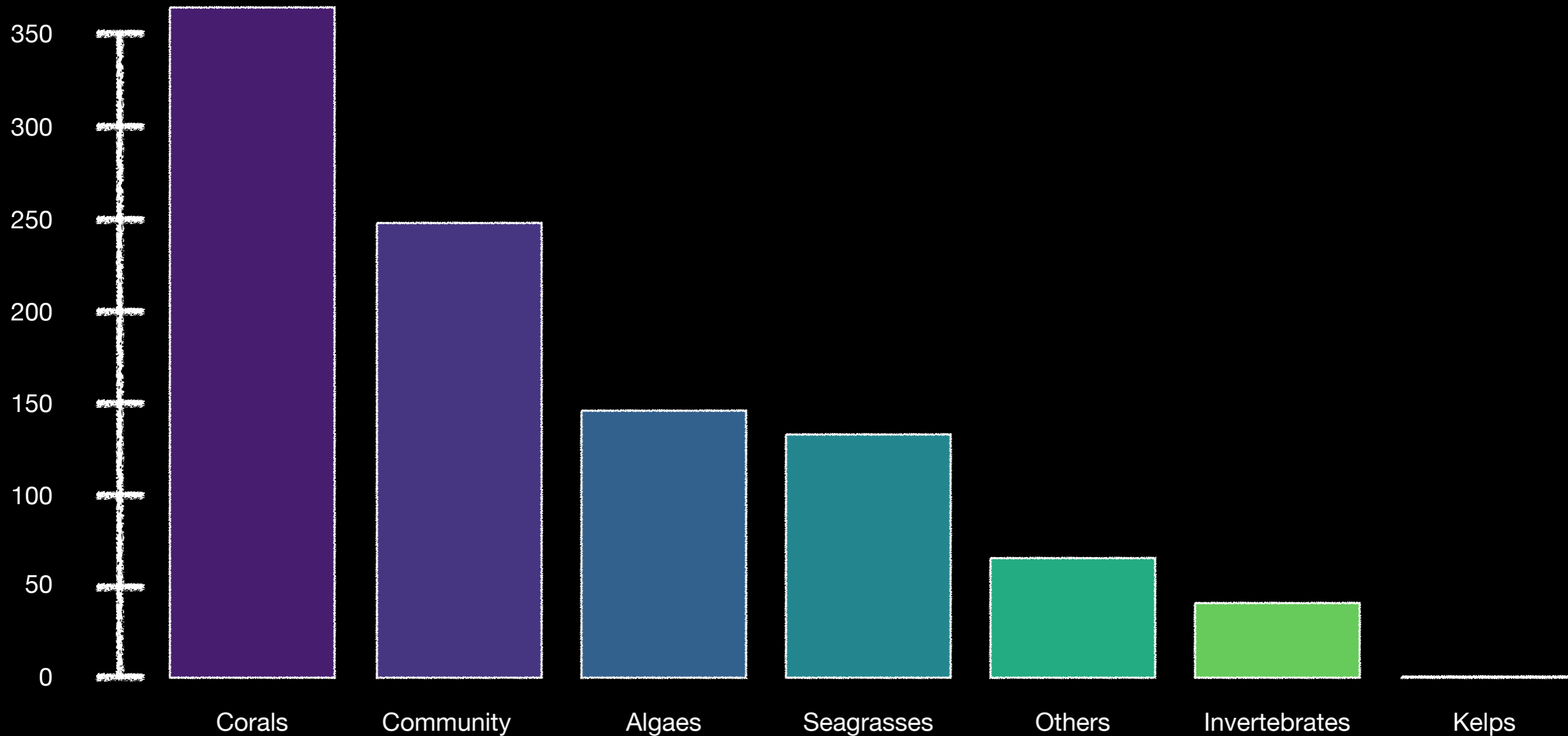
extracting data
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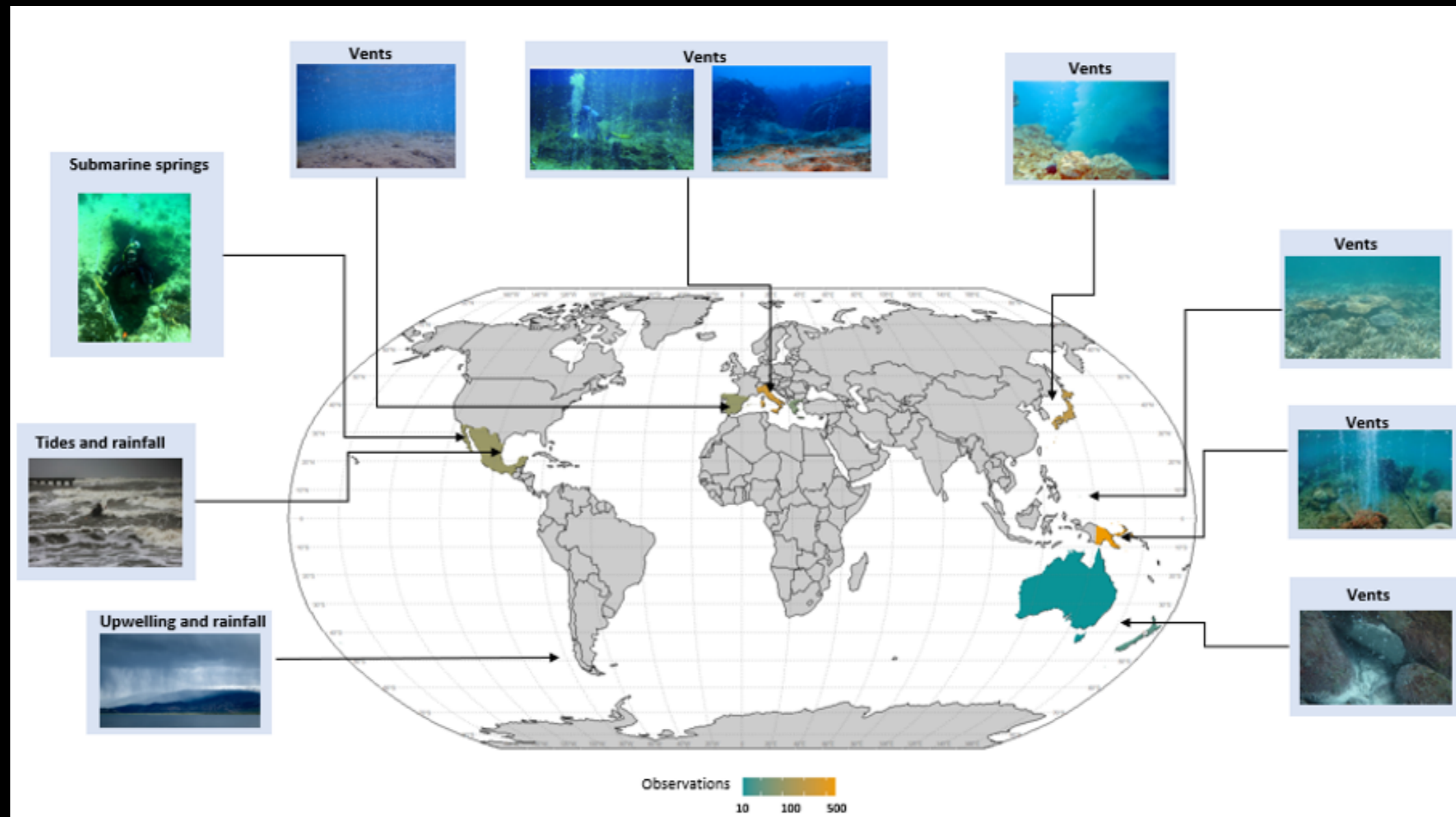
Final dataset

- 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



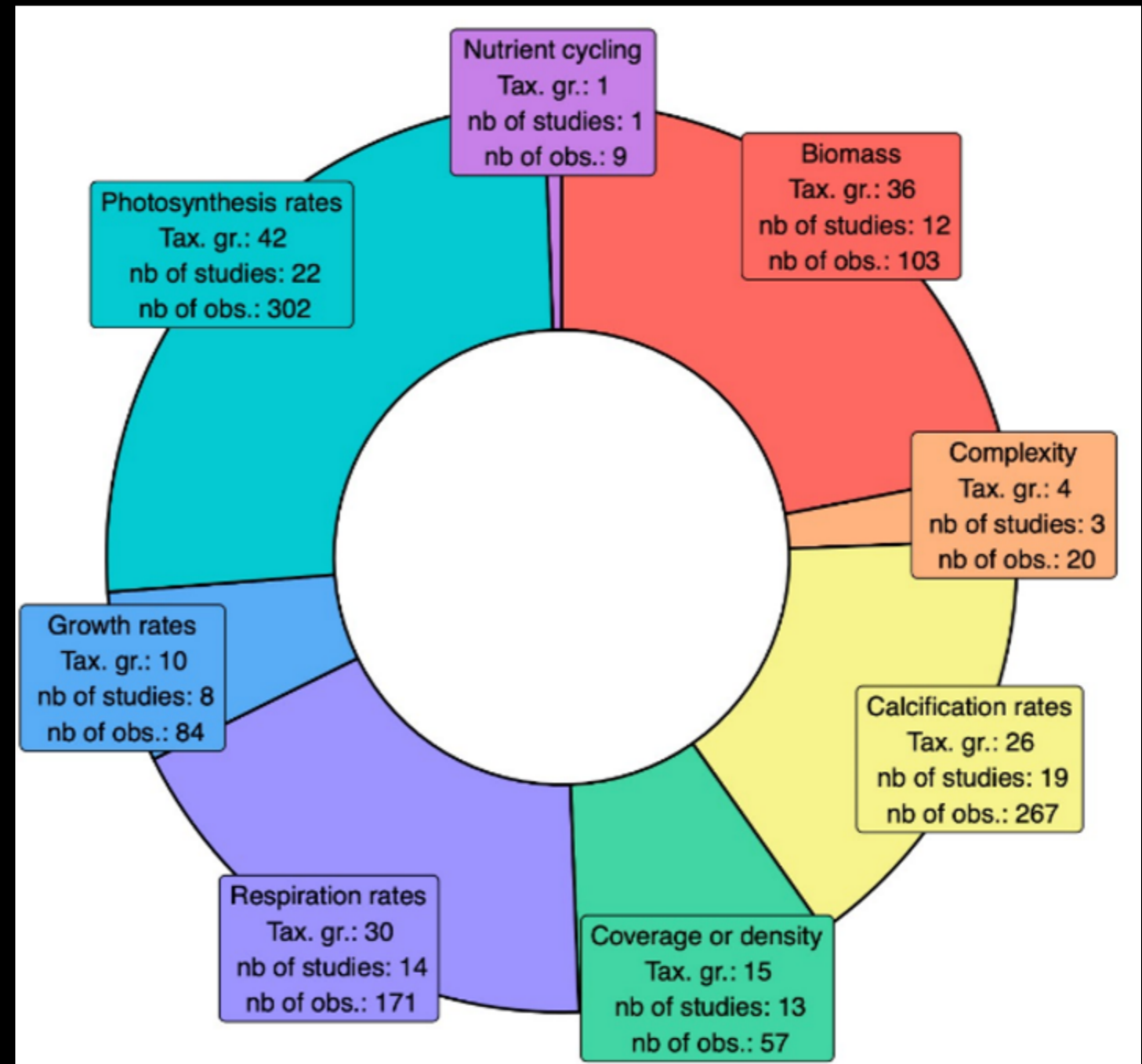
Systematic map



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 Torchy
Master student



Núria Teixidó
Sr. Research Scientist





**SORBONNE
UNIVERSITÉ**



Thank you for your attention!

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