

3D Printed Artificial Reef deployment in the Atlantic coast: project overview, monitoring and results

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Background: Coastal Infrastructure

‘Ocean Sprawl’

New infrastructure is rapidly increasing in the marine environment

Typically minimal structural complexity: smooth streamlined designs and few of the habitat features that you find in natural reefs (e.g. texture, holes, tunnels, overhangs)



Background: 'greening the grey'



Background: Artificial Reefs in the NE Atlantic

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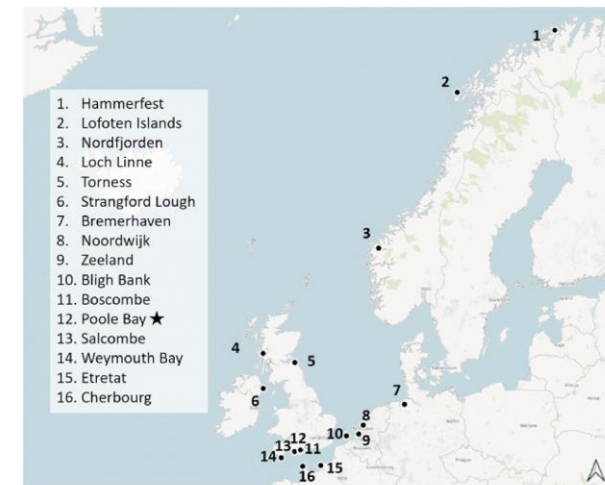
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Artificial reefs in the North –East Atlantic area: Present situation, knowledge gaps and future perspectives

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→ Lack of knowledge on which design and specific features of Artificial Reefs are important for attracting different organisms



Reis et al. 2021

Introduction to the 3DPARE project

Main aim: design, deploy and monitor 3D printed concrete reef units, suitable for high wave-intensity Atlantic coastal conditions, and test a variety of design features to determine their contribution to biodiversity

→ Inform environmental managers/engineers on specific features to be incorporated in coastal infrastructure projects

Funding: Interreg Europe

Duration: 2017 - June 2023



3D Printing process



3D Printed Reef Units + Control block



Small overhangs



Big overhangs

CUBIC



Small overhangs



Big overhangs

RANDOM



Control

Reef Unit Deployment

Deployed in Spring/Summer 2020

UK - Poole Bay

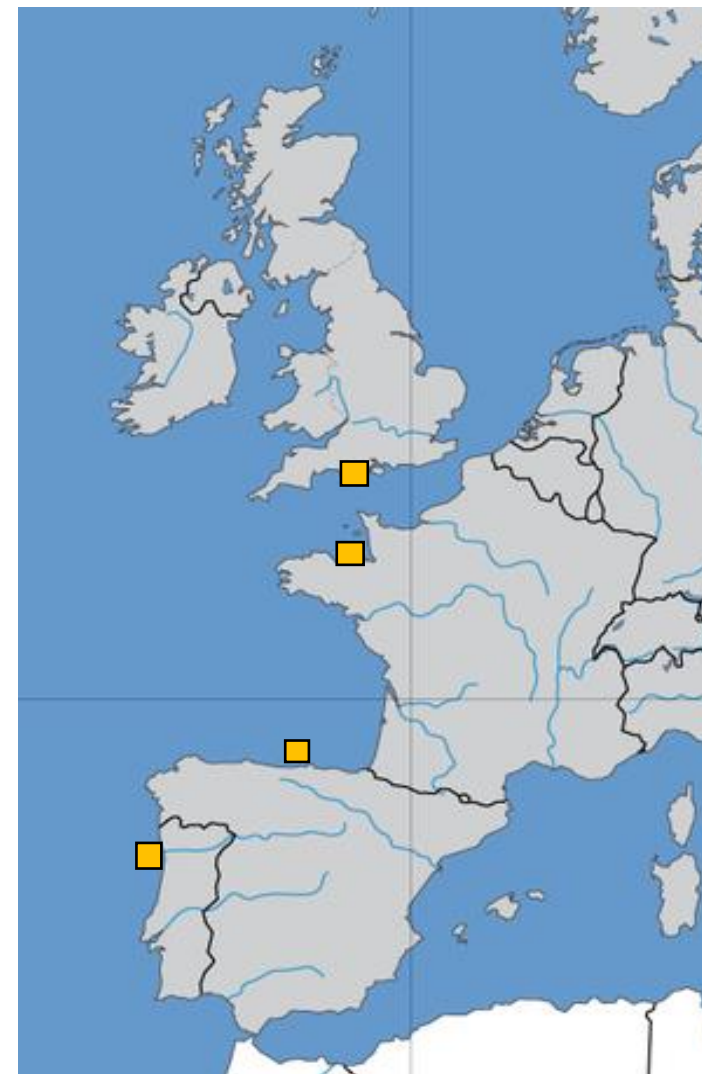
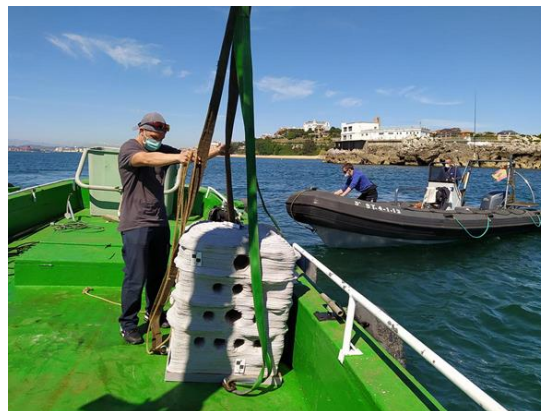
France - Saint-Malo Bay

Spain - Santander

Portugal – Matosinhos Bay

Sandy seafloor next to
existing infrastructure

Ave. Depth: 4 - 15m



Biological Monitoring

Where:

Artificial Reef Units, adjacent Artificial Structure and Natural Reef

→ number or % cover of marine flora & fauna within each habitat feature

Survey methods:

- SCUBA Underwater Visual Census
- Remote Underwater Video
- Photogrammetry
- Environmental dataloggers (Temp, light, current)



Results

Already one day
after deployment...



Results

After ~ 1 year....

Visual differences
between countries

Spain



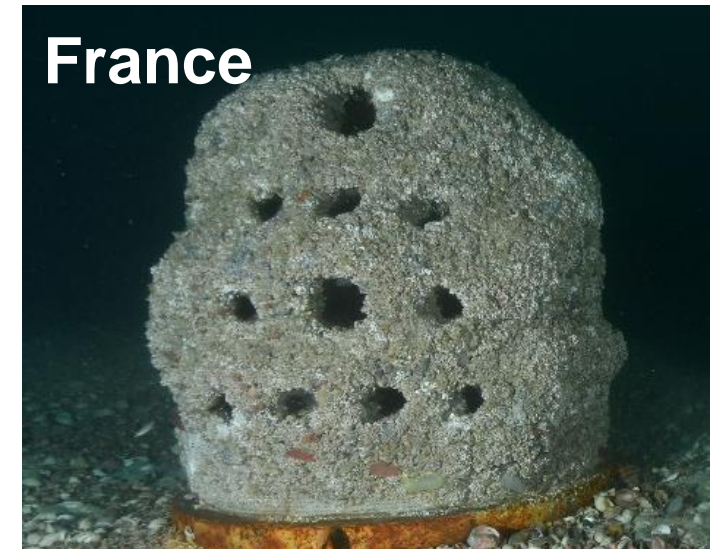
Portugal



UK



France



Results

Community variation between Reef Types in each country

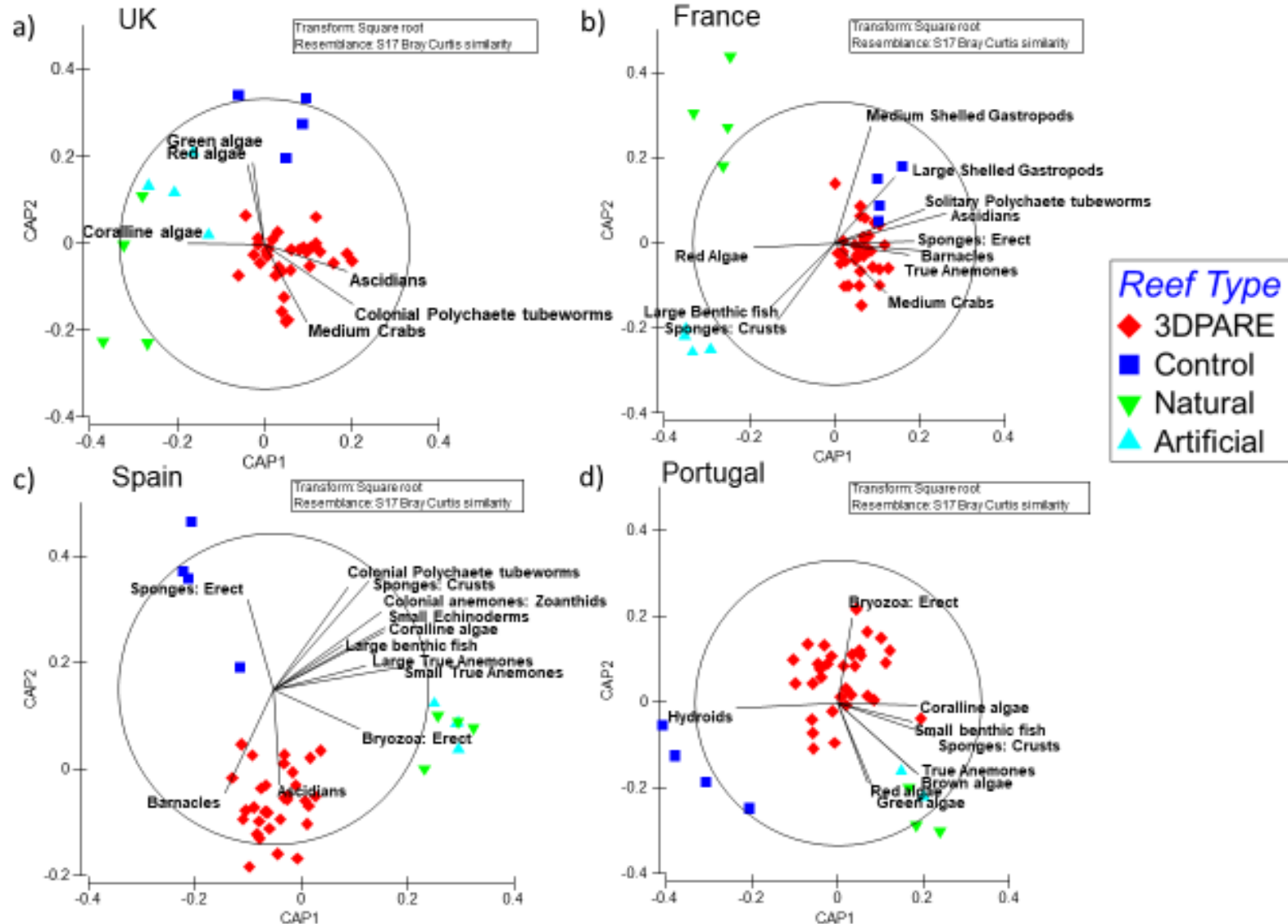
→ Distinct communities of the 3D printed Reef Units versus the other Reef Types

3DPARE Reef Units:

UK: Ascidians, Tube Worms & Crabs

FR & SP: Barnacles & Ascidians

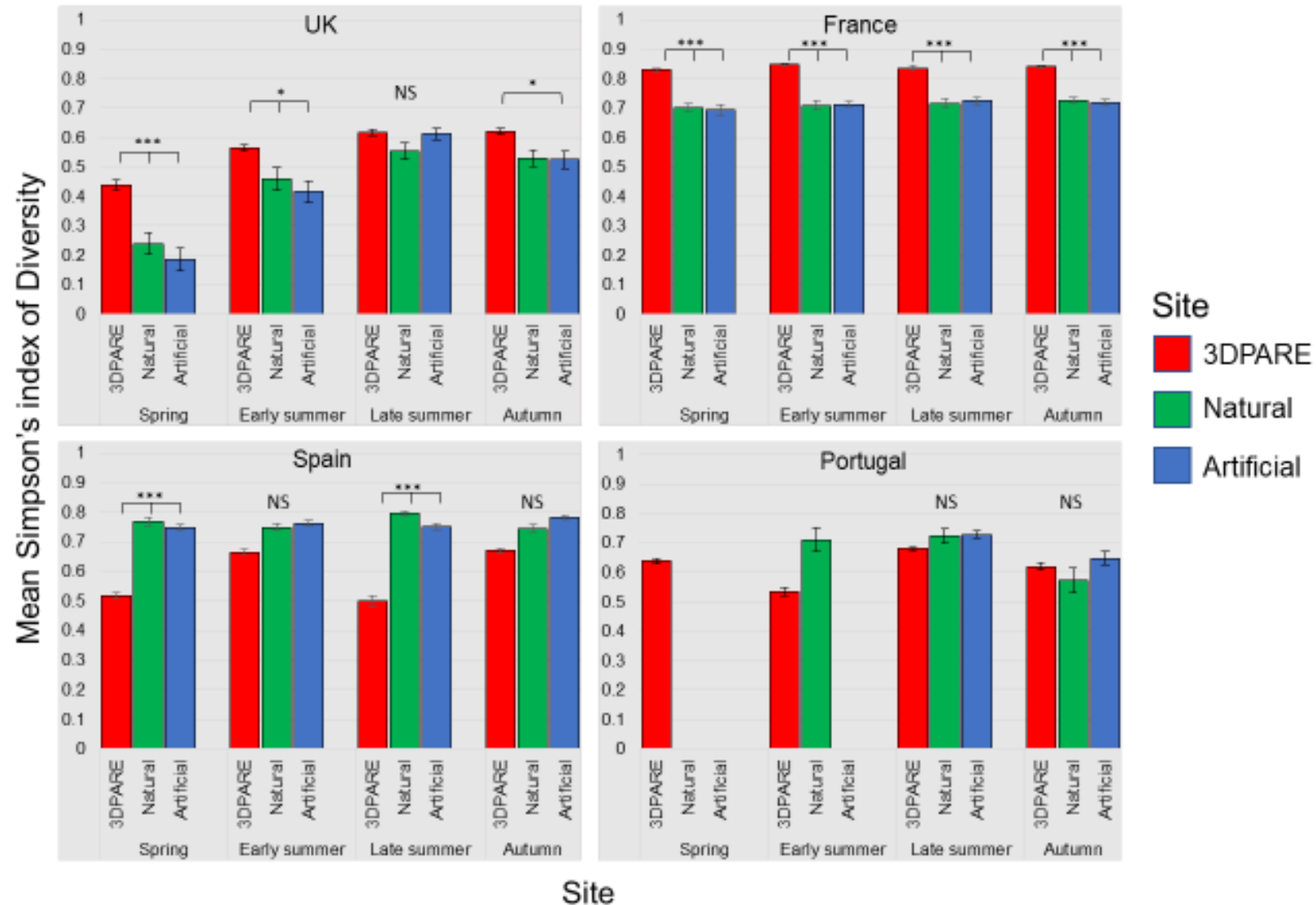
PT: Bryozoans & Hydroids



Results

Flora & Fauna Diversity for each Site in each Country

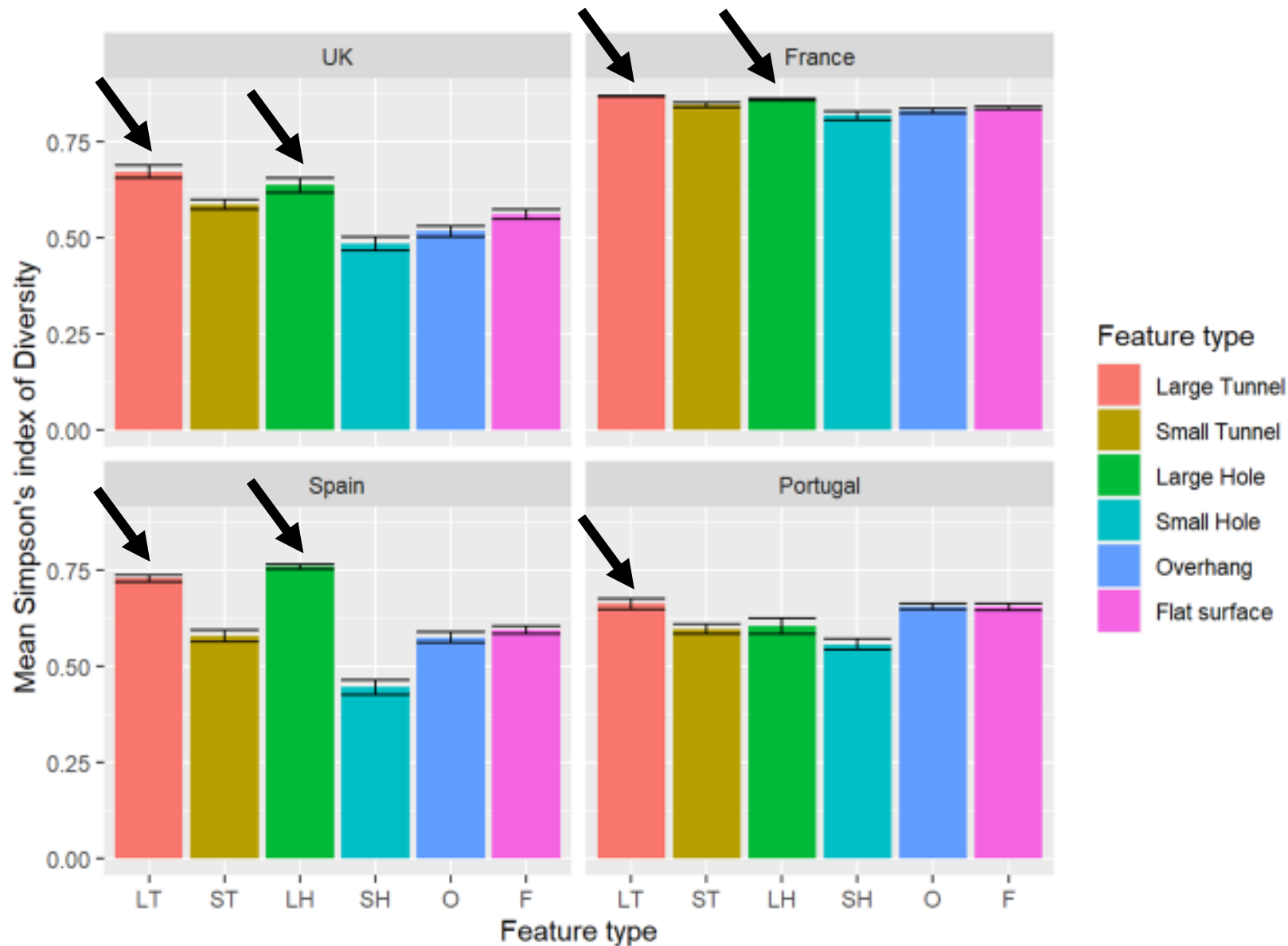
→ Biodiversity using the 3D-printed reef units can be the same as, or higher, than at natural rocky reefs



Results

Diversity by Feature type In each Country

→ Generally highest in Large Tunnel and Large Hole



Results: Mobile fauna per Feature type

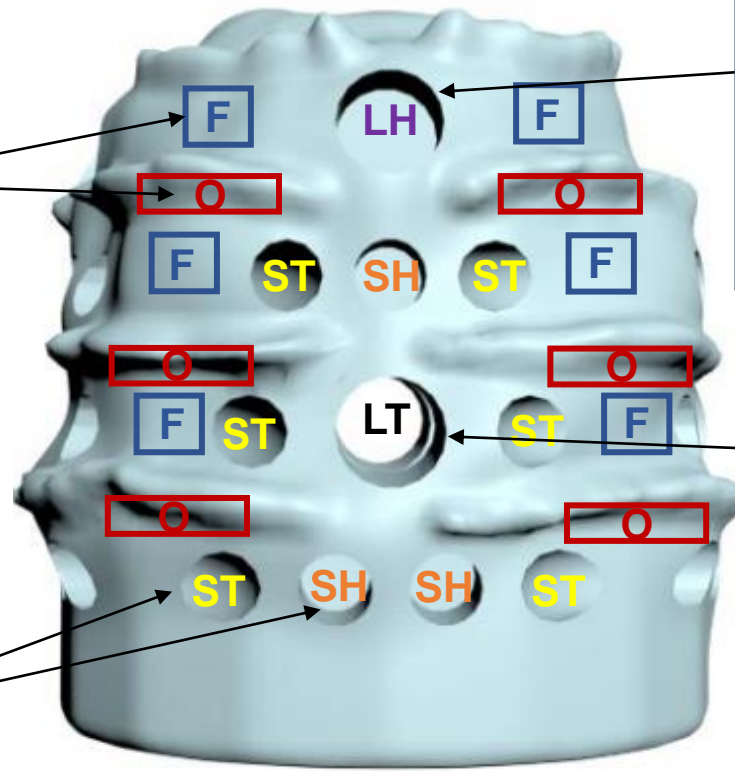


Flat Surfaces & Overhangs

- Shelled gastropods (UK)
- Seastars (ES, PT)
- Flatworms (ES)

Small Holes & Tunnels

- Crabs (UK, FR)
- Shrimps
- Small fish < 15cm
- Shelled gastropods (FR, PT, ES)

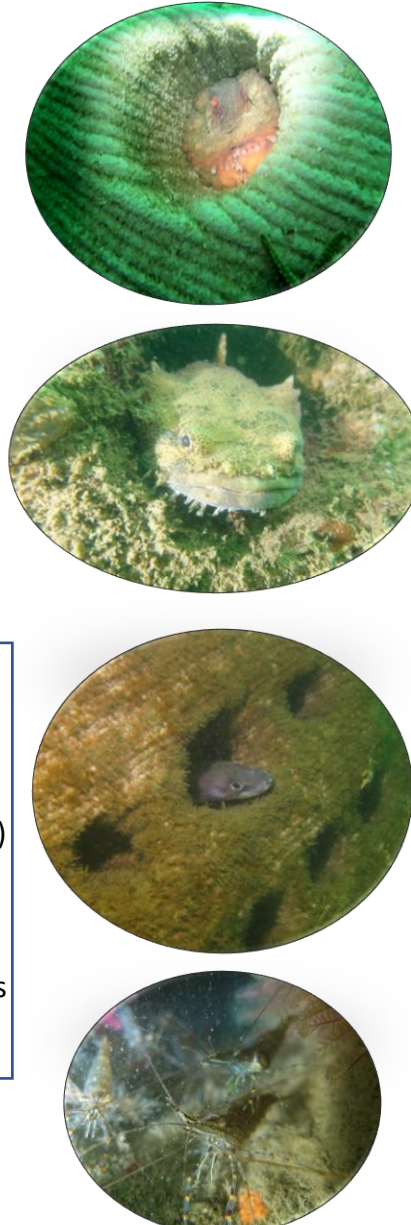


Large Holes

- Octopus (PT)
- Crabs (UK, FR)
- Large fish (> 15cm)
- Shelled gastropods (FR, PT, ES)

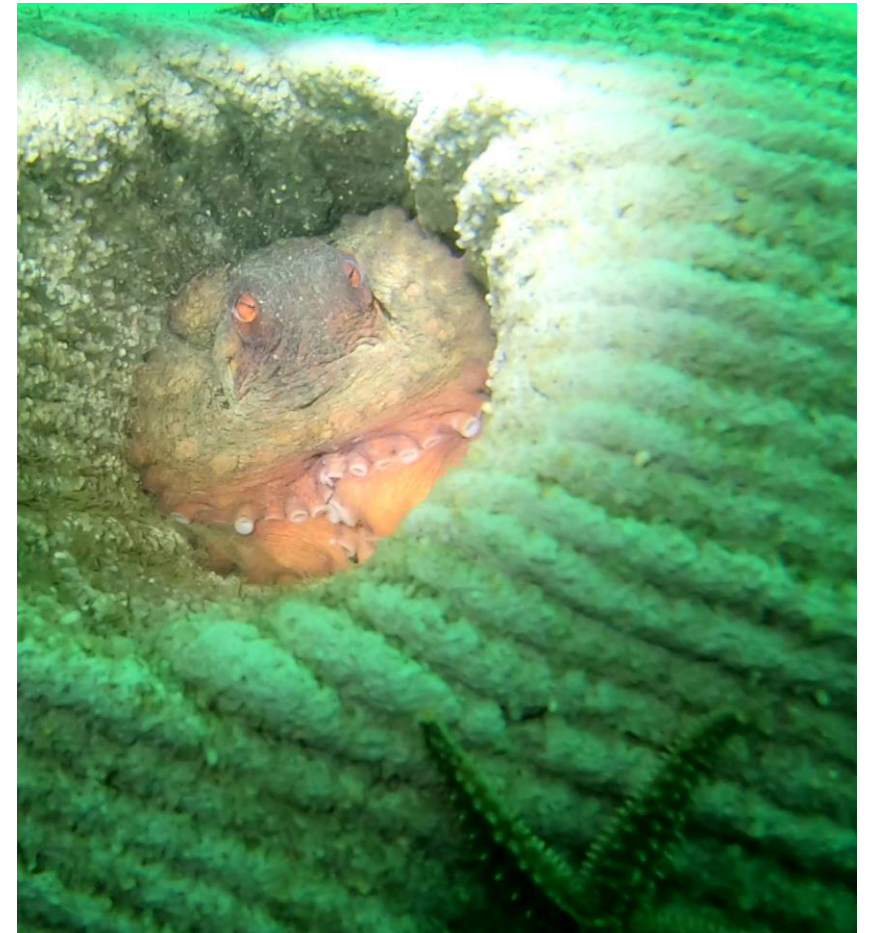
Large Tunnels

- Crabs (UK, FR)
- Large fish (> 15cm)
- Shrimps
- Shelled gastropods (FR, PT, ES)



Most important conclusions so far (after 18 months immersion)

- The diversity of marine life using the 3D-printed reef units can be the same as, or higher than, at natural rocky reefs.
- The incorporation of different habitat features is very important to include a broad community of marine life. A variety of habitat features of different sizes is recommended, to provide habitat and refuge for a range of species and increase overall diversity.



Thank you!



All people involved, especially
Sam Greenhill (BU)



more info 3DPARE project here:

