



Tools for the transition to the spatial management of coastal resources:  
The stalked barnacle fishery in SW Europe

# PERCEBES

José Luis Acuña (Coordinator, University of Oviedo, Spain)

Funded projects final conference, 12-13 November 2019, Brussels

BiodivERsA COFUND Call (2015-2016)

« Understanding and managing biodiversity dynamics to improve ecosystem functioning and delivery of ecosystem services in a global change context: the cases of soils and sediments, and land- river and sea-scapes »

# CONSORTIUM DESCRIPTION

***Field work, community changes, population recovery, bioeconomic modelling, documentary, dissemination, outreach & interaction with stakeholders.***



Universidad de Oviedo  
Universidá d'Uviéu  
University of Oviedo

**Partner 1 (Coordinator):** José Luis Acuña, University Oviedo, Spain, Funded by Ministry of Science, Innovation and Universities (MICINN).

Universidade de Vigo

**Partner 2:** Elsa Vázquez, University Vigo, Spain, Funded by Ministry of Science, Innovation and Universities (MICINN).

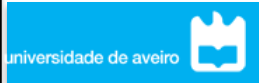


**Partner 3.** Teresa Cruz, University Evora, Portugal, Funded by Foundation for Science and Technology (FCT).



**Partner 4.** Dominique Davoult, University Sorbonne, France, Funded by Agence Nationale de la Recherche.

## ***Biophysical modelling & outreach***



**Partner 5.** Jesus Dubert, University Aveiro, Portugal, Funded by Foundation for Science and Technology (FCT). **Tasks:** biophysical modelling.

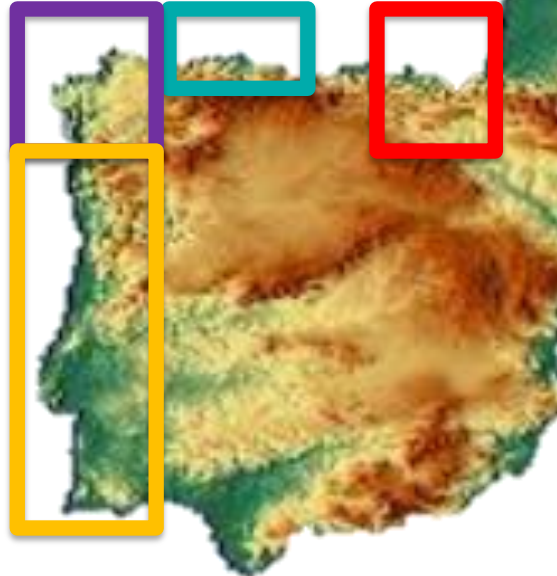


**Partner 6.** Amandine Nicolle, Graduate and Postgraduate Engineering School and Research Institute, France, Funded by Agence Nationale de la Recherche.

# PROJECT DESCRIPTION

- Stalked barnacles: an expensive delicacy generating a **significant economy**.
- Distribution range **from Brittany to Senegal**.
- Populations are connected by **drifting pelagic larvae**:
- **Atlantic Arc** contains a **wide range of spatial management tools**:

- **FRANCE**: open, **MPAs**, low exploitation.
- **SPAIN-BASQUE COUNTRY**: open, passive management.
- **SPAIN-ASTURIAS**: co-managed **TURF**, micromanagement, intense exploitation.
- **SPAIN-GALICIA**: co-managed **TURF**, rotation, **MPAs**, intense exploitation.
- **PORTUGAL**: open, **MPAs**, moderate to intense exploitation.





# PROJECT DESCRIPTION

## OBJECTIVE OF PROJECT PERCEBES

Demonstrate the effects of Stalked Barnacle harvesting on the biodiversity, productivity and connectivity of SB stands both at local and landscape level.

## METHODOLOGICAL APPROACH

**1-A continental-scale, Human Exclusion Experiment (HEE).** We will use steel cages to simulate the effects of 1 and 2 year harvest halts and open plots as controls where harvest continues unimpeded. The HEE will test the effect of those treatments on the biodiversity, productivity and economic value of SB stands and on their potential to produce larvae.

**2-Construction of regional, spatially explicit Bioeconomic Models (BM).** We will build biophysical larval dispersal models to visualize the seeding effects of fallow or protected areas on other regions and the patterns of connectivity among managed or co-managed units. These models will be validated by direct measurement of recruitment distributed in time and space and used as base for the bioeconomic models.



# SCIENTIFIC OUTPUTS

## HUMAN EXCLUSION EXPERIMENT



- End of experiment in July 2019
- Sample analysis completed end October 2019
- Data analysis underway



open access

Co-managed  
TURF

Co-managed  
TURF



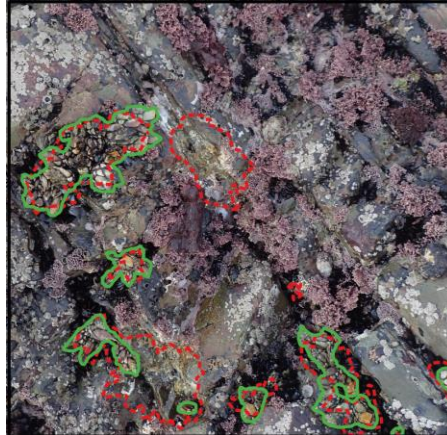
Universidade de Vigo

Open Access

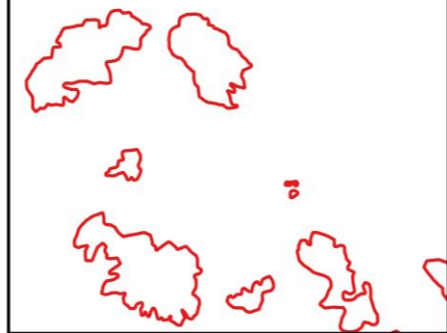




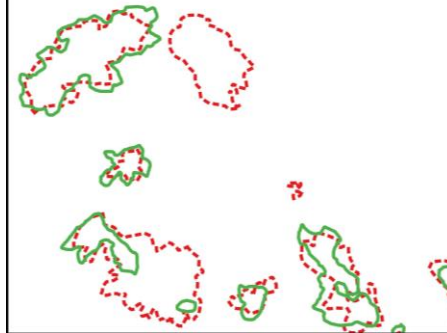
# SCIENTIFIC OUTPUTS



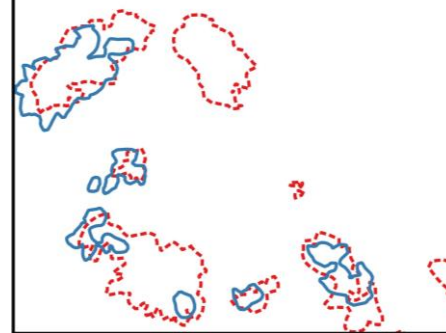
July 2017



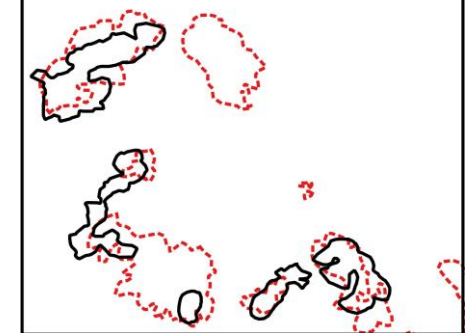
December 2017



July 2018



July 2019



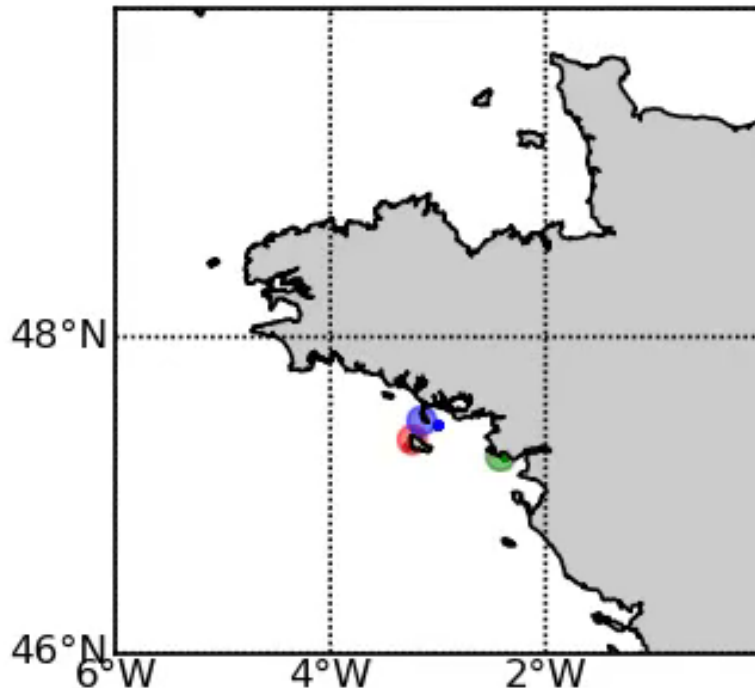
- Preliminary inspection of the plots suggests that recovery is very slow.
- If confirmed, this may have a profound influence on management

# SCIENTIFIC OUTPUTS

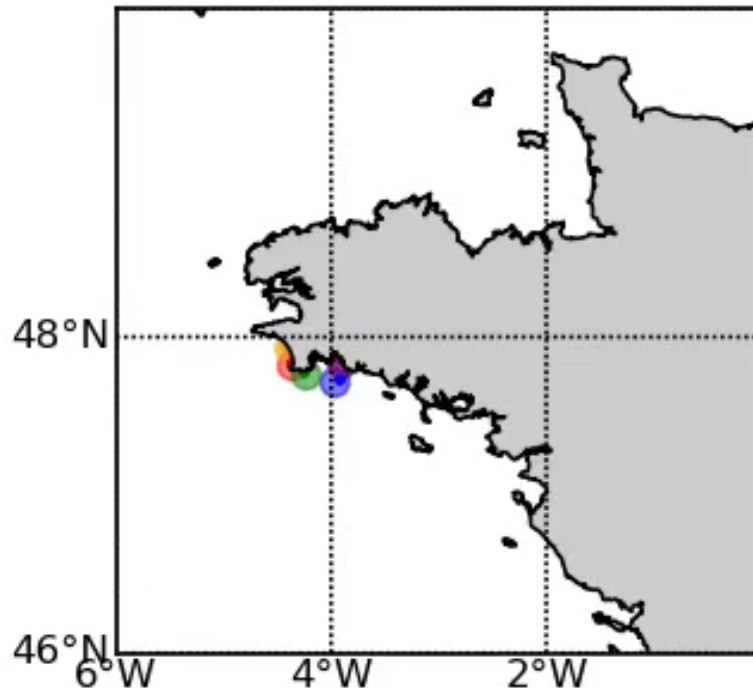
## LARVAL TRANSPORT MODELS

- Larval transport models are the foundation for the bioeconomic models.
- Models based on the best available knowledge of stalked barnacle biology are ready.
- These are two model runs of the Brittany coast model.

1.3 days since 15 of April

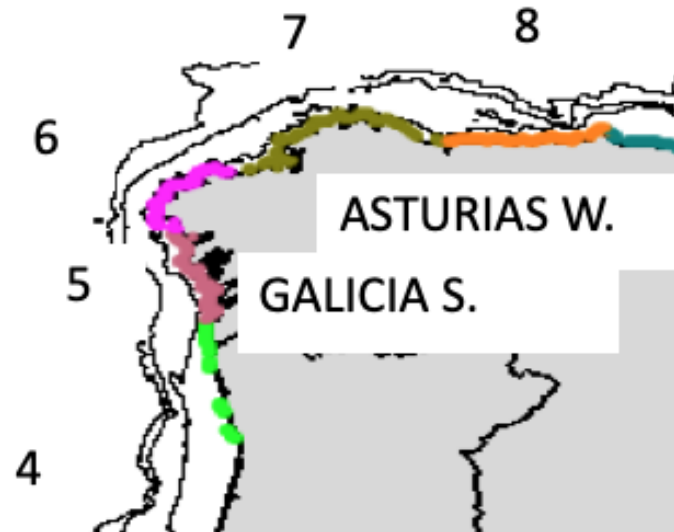
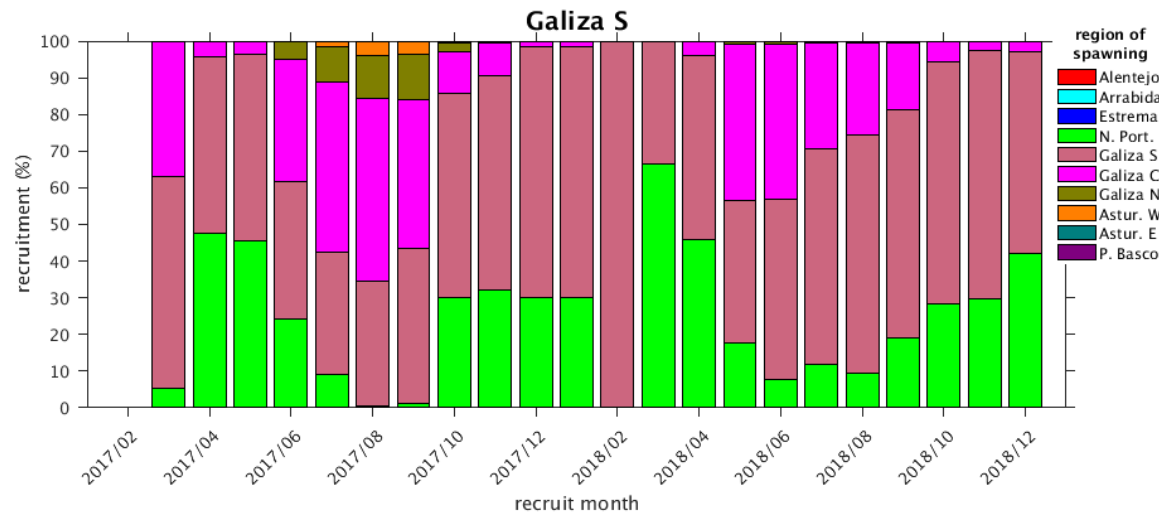


1.2 days since 15 of May



# SCIENTIFIC OUTPUTS

## LARVAL TRANSPORT MODELS



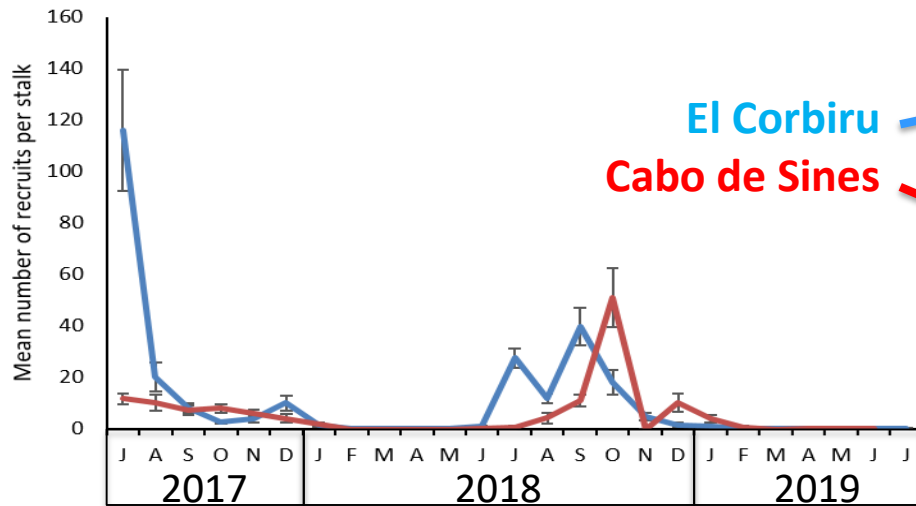
- The models can be used to estimate larval transport among regions of the Atlantic Arc.
- This example is from the Iberian Peninsula model.
- The histogram represents the percentage of larvae recruiting to the Southern Galicia region from the surrounding regions.



# SCIENTIFIC OUTPUTS

## LARVAL RECRUITMENT SERIES

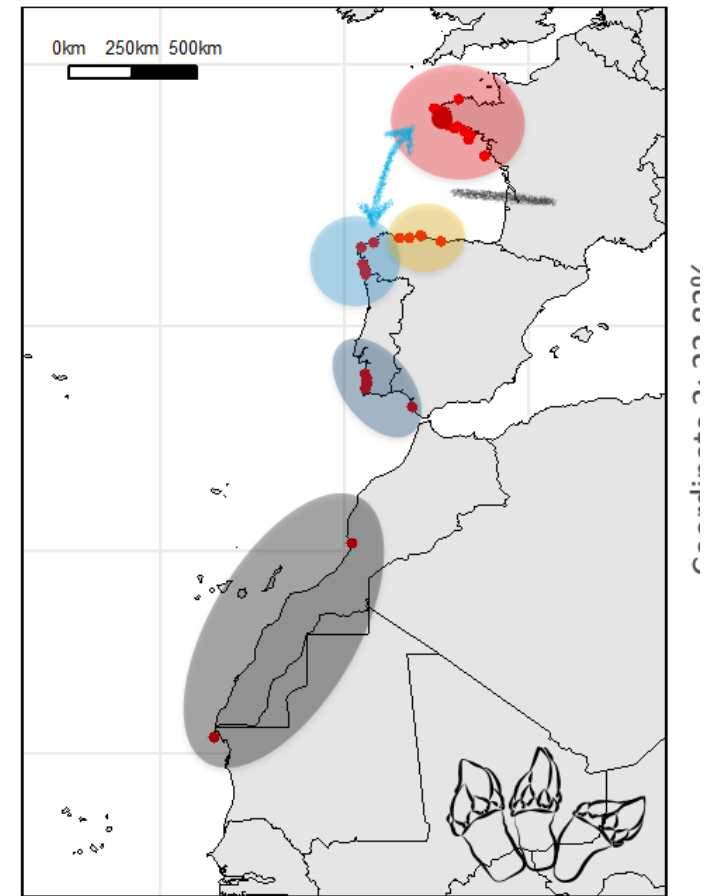
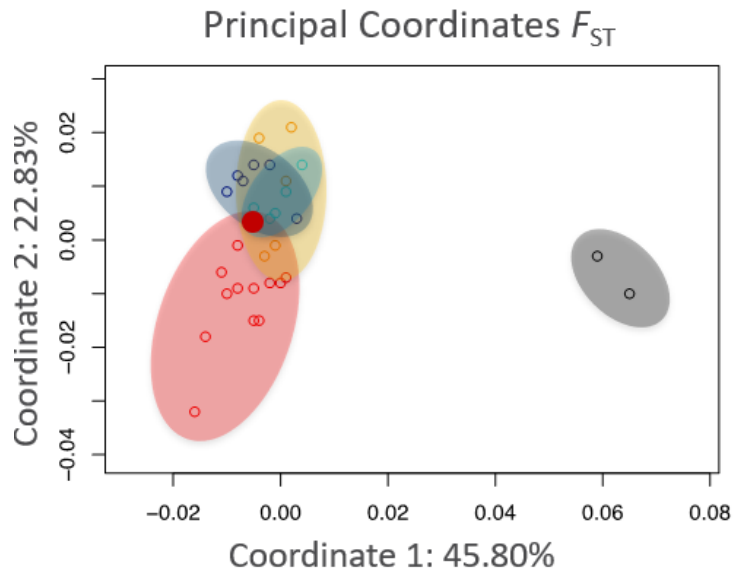
- Larval transport models are validated with recruitment data.
- Larvae recruit on the stalks of adults.
- Aided by harvesters, we collected adults in 20 sites across the Atlantic Arc during 2 years.
- Sample analysis finished October 31st.
- Data analysis still preliminary.
- Summer is a critical period



# SCIENTIFIC OUTPUTS

## GENETIC STRUCTURE OF THE POPULATION

- Attempts to use 15 microsatellites previously developed were unsuccessful.
- We had to develop 20 new microsatellite markers in 5 diff. multiplex PCRs. Analysis is now underway.
- We will compare genetic connectivity against model-generated connectivities, adding a further validation step.



Preliminary analysis based on 7  $\mu$ sat markers



## SCIENTIFIC OUTPUTS

### ARTICLES PUBLISHED

Höfer, J., Muñiz, C., Weidberg, N., García-Flórez, L., & Acuña, J. L. (2016). High densities of stalked barnacle larvae (*Pollicipes pollicipes*) inside a river plume. *Journal of Plankton Research*, 39(2), 316-329.

Rivera, A., Gelcich, S., García-Flórez, L., & Acuña, J. L. (2017). Heterogeneous management and conservation perceptions within the gooseneck barnacle co-management system in Asturias (N. Spain). *Marine Policy*, 81, 229-235.

Rivera, A., Gelcich, S., García-Flórez, L., & Acuña, J. L. (2019). Social attributes can drive or deter the sustainability of bottom-up management systems. *Science of The Total Environment*, 690, 760-767.





## SCIENTIFIC OUTPUTS

### ARTICLES IN PREPARATION

- 1) Human Exclusion Experiment: community analysis (lead Univ. Oviedo)
- 2) Human Exclusion Experiment: *P. pollicipes* population recovery (lead Univ. Evora)
- 3) Recruitment and maturity, an analysis of large scale patterns (lead Univ. Vigo)
- 4) Pollicipes growth (lead Univ. Evora).
- 5) Larval transport model in Brittany (Univ. Sorbonne)
- 6) Larval transport model in Iberian Peninsula (lead Univ. Aveiro)
- 7) Genetic structure of the population (lead Univ. Oviedo/Vigo)
- 8) Management regimes (lead Univ. Vigo)
- 9) Bioeconomic model for Asturias (lead Univ. Oviedo)
- 10) Bioeconomic model for Galicia (lead Univ. Vigo)
- 11) General Bioeconomic model (lead Univ. Oviedo).

# SOCIETAL / POLICY OUTPUTS

**INTENSE INTERACTION WITH STAKEHOLDERS AND AMONG PARTNERS**



# SOCIETAL / POLICY OUTPUTS

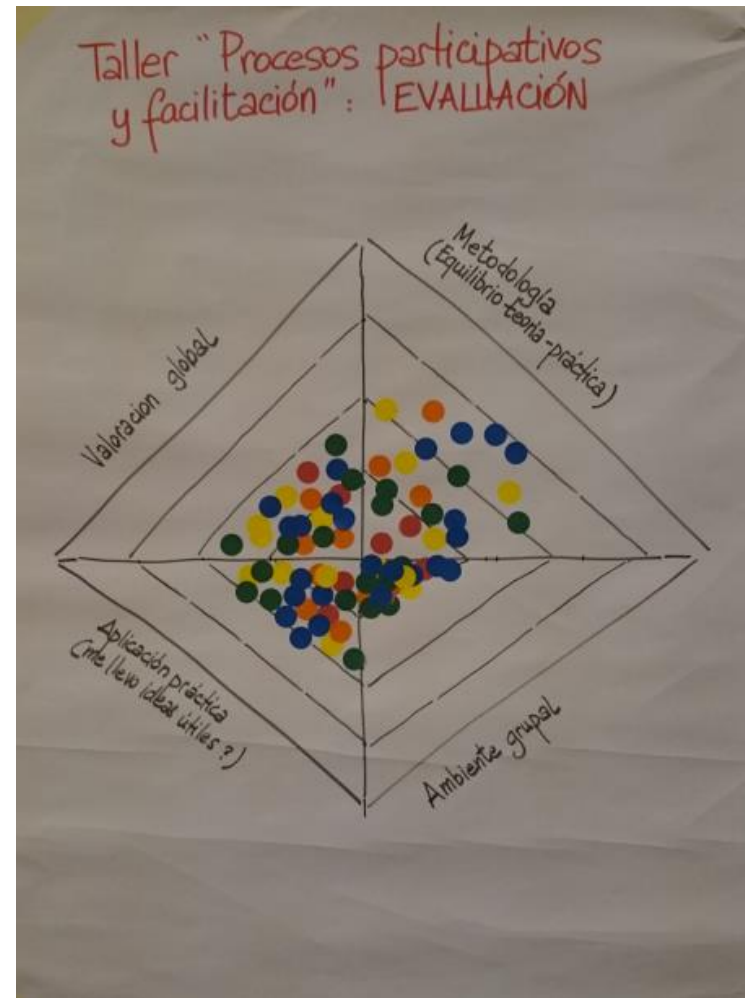
## THE PERCEBES COLLABORATIVE WORKSHOP

- Date:** 23-25 January 2020.
- Place:** Cudillero, Asturias, N Spain
- Attendees:** barnacle harvesters, administration personnel (manager, guard and/or technician/barefoot biologist) and scientists from all four regions. NGO (WWF, Ecologistas en Acción). Facilitated by WWF.

### -Objectives:

- 1) Disseminate **project results** among stakeholders.
- 2) Explore the potential for **crossbreeding of good management practices** among regions.
- 3) Facilitate **interaction** across sectors and regions.

- Workshop will be followed by a **dissemination campaign**







# SOCIETAL / POLICY OUTPUTS

## POLICY BRIEF

- **SUGGESTED BY:** BIODIVERSA projects RESERVE BENEFIT and PERCEBES
- **TITLE:** *Guidelines for the spatial management of European marine living resources*
- **BACKGROUND:** spatial management tools of marine resources (i.e MPAs, TURFS) are gaining momentum, yet their design remains a challenge. The combination of spatially-explicit biophysical and bioeconomic models and of population genetics may guide the design process with high benefits for everyone.
- **SUGGESTED RECOMMENDATIONS:**
  - 1) **There is a continuum of spatial management** tools from open access to marine reserves, with a **vast intermediate territory** of which Policy makers should be aware. There are examples in the EU where to seek inspiration.
  - 2) **Biophysical/bioeconomic models** and population genetics can give insight into **optimal size, spacing and effort allocation** within networks of spatial resource management units.
  - 3) Development of optimal local solutions requires that the **fishers are embed at all levels of the design process, from the science up to the decision-making**. Co-management has shown great potential to promote this kind of solutions.



# SOCIETAL / POLICY OUTPUTS

## VIDEO DOCUMENTARY

- The activities of the project have been recorded at the four field sites.
- Scientists, harvesters and administrations have been interviewed *in situ*.
- Beyond the epics of the fishery, the documentary will focus on the role of collaboration between fishers and scientists to achieve sustainable use of the resource.
- Some of the recorded scenes have been regularly published at the percebes site as micro clips illustrating the aims of the project:

<https://www.unioviedo.es/percebes/>

- Some examples of the clips produced to date:

*Modelling larval transport:* <https://vimeo.com/338675794>

*Harvesting barnacles in La Erbosa (Asturias, N Spain):* <https://vimeo.com/310794198>

*Building cages for the Human Exclusion Experiment:* <https://vimeo.com/323184233>

*Setting up the Human Exclusion Experiment in Alentejo:* <https://vimeo.com/226791355>

*Setting up the Human Exclusion Experiment in Asturias:* <https://vimeo.com/226507823>

# ACKNOWLEDGEMENTS

## OFFICIAL FUNDING AGENCIES



# FCT

Fundação para a Ciência e a Tecnologia  
MINISTÉRIO DA EDUCAÇÃO E CIÊNCIA

AGENCE NATIONALE DE LA RECHERCHE  
**ANR**



Asturian  
Network  
of fishers and  
scientists

redapesca



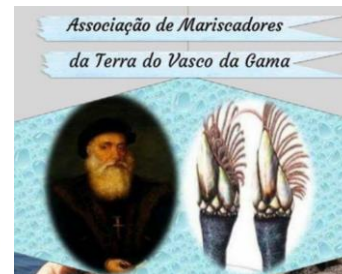
**altekio**  
INICIATIVAS HACIA  
LA SOSTENIBILIDAD

AGENCE FRANÇAISE  
POUR LA BIODIVERSITÉ  
ÉTABLISSEMENT PUBLIC DE L'ÉTAT

**DGRM360°**



*La Anunciada*  
COFRADIA DE PESCADORES | BAIONA



Associação dos  
Marisqueiros da Vila  
do Bispo

**Sines**  
MUNICÍPIO







**THANK YOU!!**