

RugOBSS project

Rugulopteryx okamurae Observing Beachcast System from Space



14 Octubre 2026

Mar Roca Mora, CSIC; Maria J. Lima, CIMA-UAlg; Bede Ffinian Rowe Davies, IFREMER



ICAN  CSIC

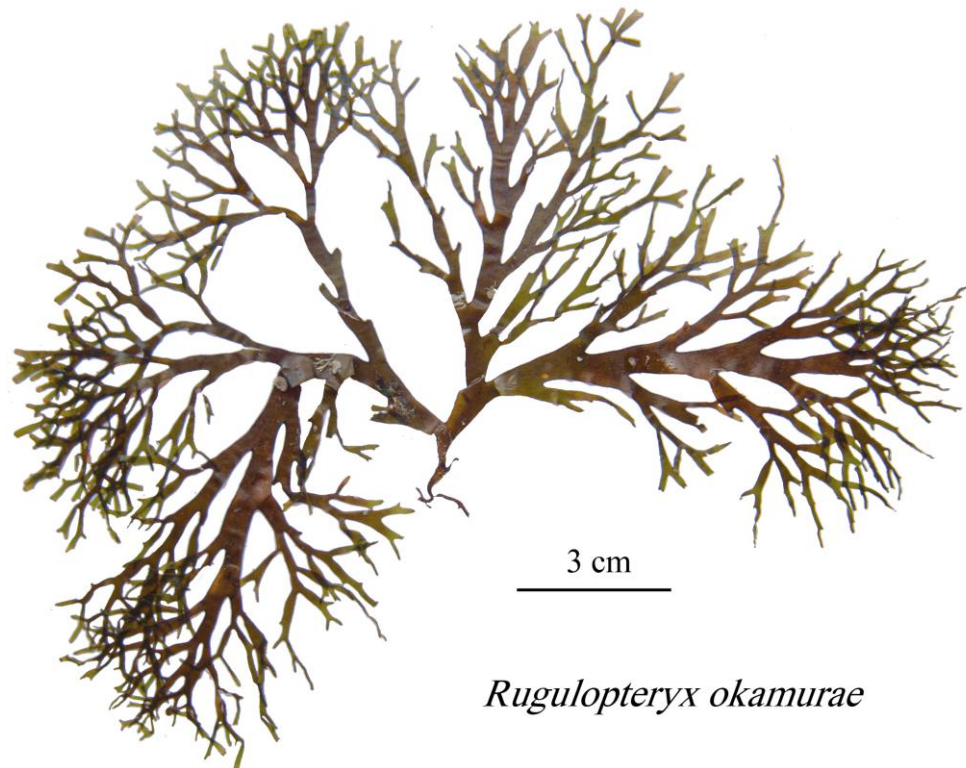
 **UAlg**
UNIVERSIDADE DO ALGARVE

 **Ifremer**

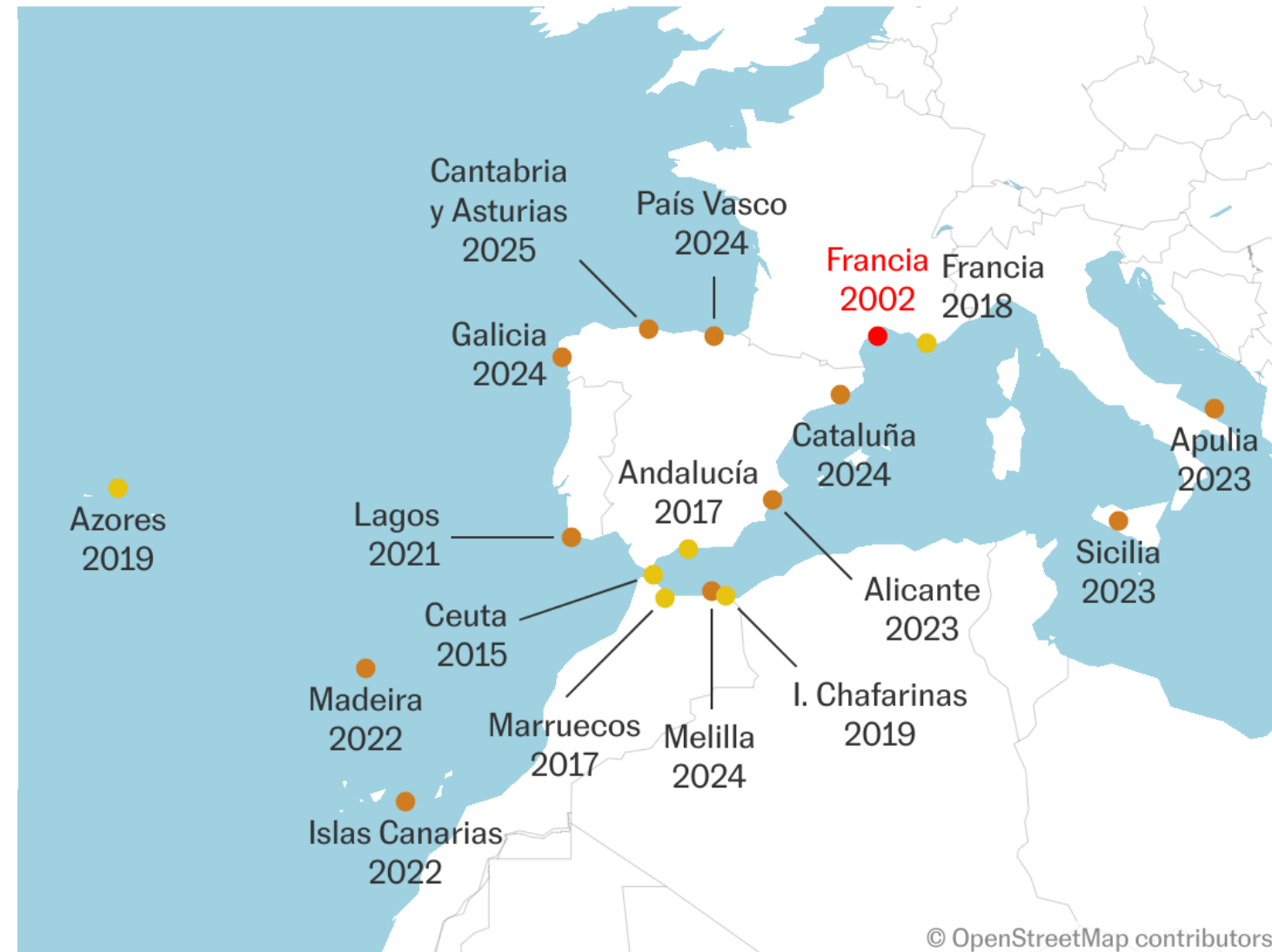


Evolución de la distribución del alga '*R. okamurae*'

Inicio (2002) 2015-2019 2020-2025



Rugulopteryx okamurae







Biodiversity loss

*90-100% cover
(rocky bottoms)*



Fisheries

*>50% of captures losses
Fishing nets damage*

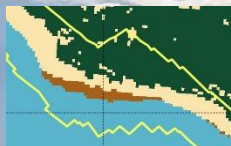


Tourism

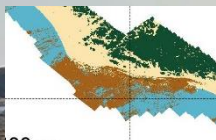
*Disgusting smell
'Floating' biomass*

~200.000€/beach
Summer 2025
BIOMASS REMOVAL

Satélite



Dron



Radiómetro

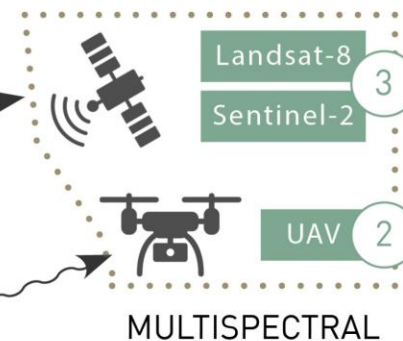
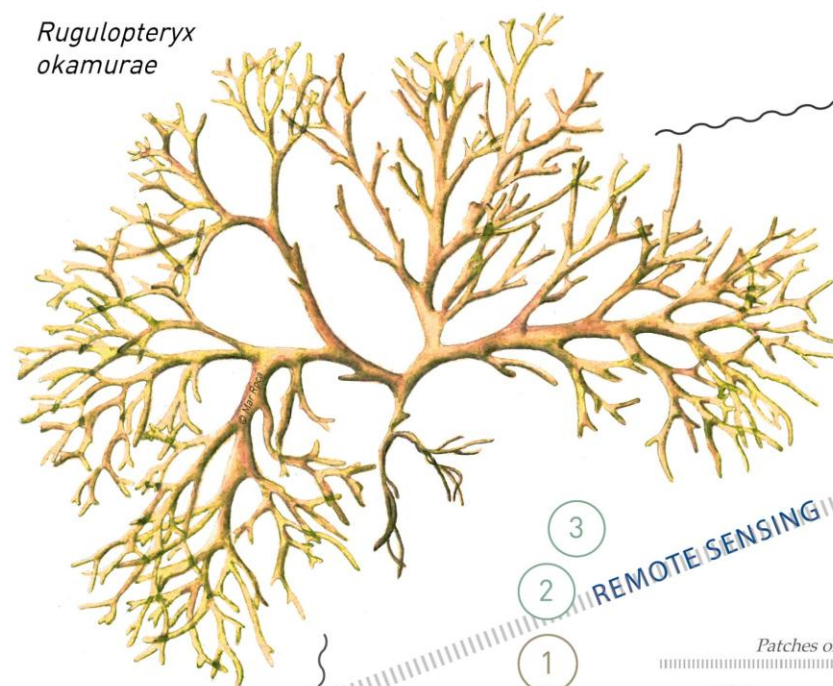


Roca et al., 2022

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*Rugulopteryx
okamurae*



Cadiz (Spain)



Supervised classification

Accuracy
study

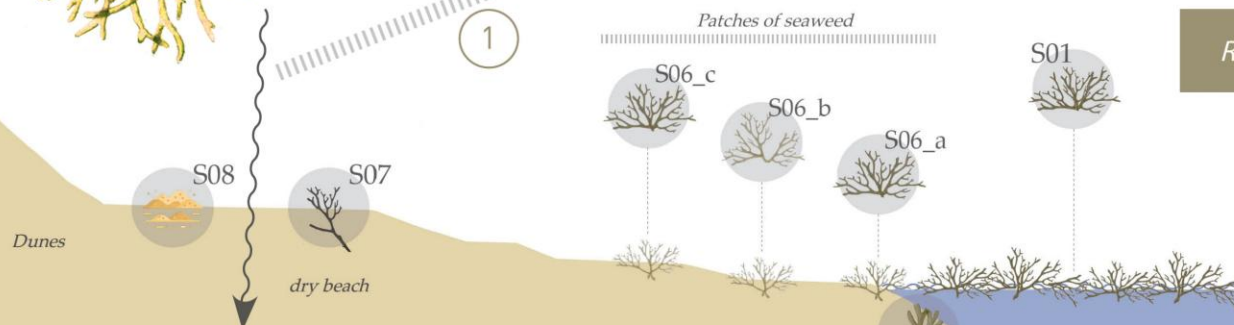
Beached, in-water and submerged
(up to 5 m depth) cartography

R. okamurae monitoring



early-warning system
before reaching the beach

3
2
1
REMOTE SENSING



1
Field radiometer
in-situ
measurements

HYPERSPECTRAL

A transboundary project run by Early Career Researchers

 **RugOBSS**

Invasive Macroalgae
Observing System



Mar Roca Mora
(Cadiz, Spain)
Team Leader



Bede Ffinian Rowe Davies
(Montpellier, France)



Maria João Borlido Oliveira Lima
(Faro, Portugal)



Focus area



2026

Funding (18.000€)



RugOBSS – Invasive Macroalgae Observing Beachcast System – Hackathon 2025

In the European Union, 40% of marine invasive alien species are macroalgae. *Rugulopteryx okamurae*, a brown macroalgae first detected in 2015 in the Strait of Gibraltar, has been causing biodiversity degradation, ecosystem disruption and economic losses in tourism, aquaculture and fisheries. Since its introduction, it has rapidly expanded through both the Mediterranean Sea and the Atlantic Ocean, creating frequent high biomass accumulations on beaches.

Top 10

RugOBSS

Mar Roca Mora



Blue-Cloud2026

A federated European FAIR and Open Research Ecosystem for oceans, seas, coastal and inland waters

European Award
(Brussels)
Among 2000 people



Premio Economía Azul –Emprendimiento



Scope

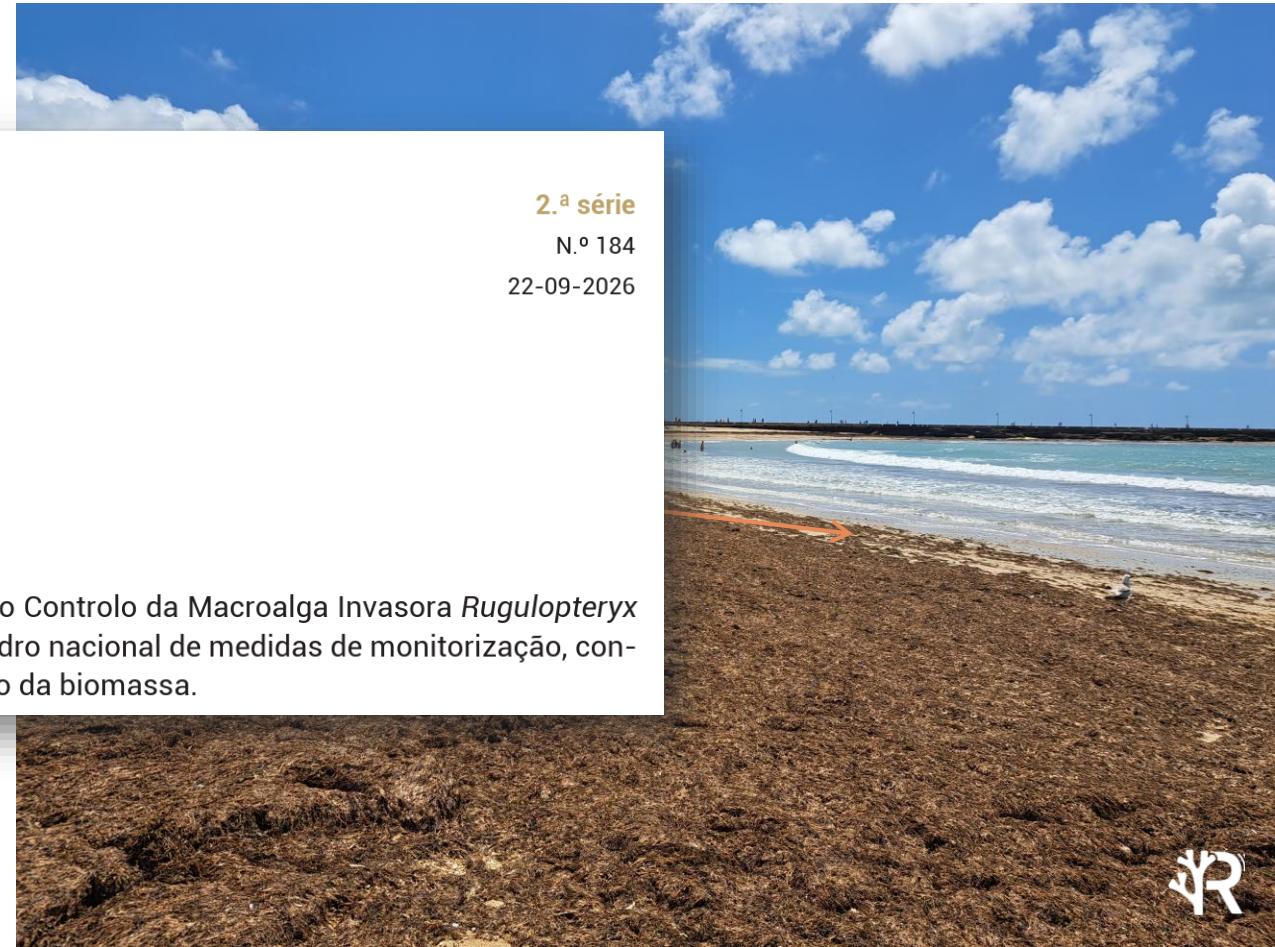
Beached and detached (in water) biomass

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Algarve, Portugal

Cadiz, Spain



DIÁRIO
DA REPÚBLICA

2.^a série

N.º 184

22-09-2026

AMBIENTE E ENERGIA

Gabinete da Ministra do Ambiente e Energia

Despacho n.º 11629/2026

Sumário: Aprova o Programa de Ação Nacional para o Controlo da Macroalga Invasora *Rugulopteryx okamurae* 2026-2030, estabelecendo o quadro nacional de medidas de monitorização, contenção, mitigação de impactes e valorização da biomassa.





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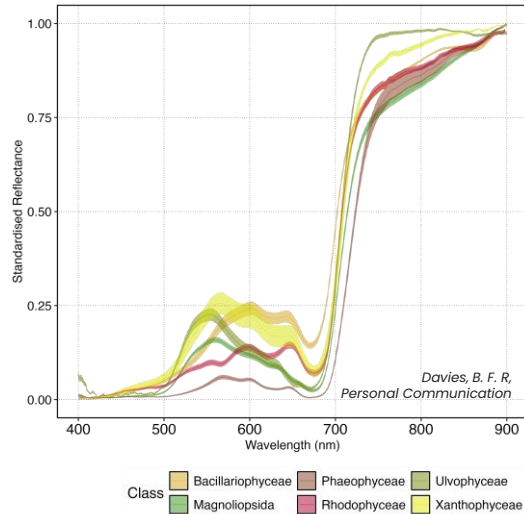
Portuguese Strategy, 2026–2030

1. **Monitor** and better understand the spread and dynamics of the species throughout the country (*Development of a National Georeferenced Database (WebGIS)*)
2. Ensure a rapid, **coordinated** and environmentally sustainable response to invasions in the short, medium and long-term; (*report sightings, also fishermen*)
3. **Mitigate negative impacts** on biodiversity and socio-economic activities by fostering shared responsibility (*including fisheries*);
4. **Add value** to the **collected biomass** through circular and innovative solutions;

For the fisheries and aquaculture sectors, the plan promotes biosafety measures, **gear and vessel decontamination, biofouling management**, surveillance of aquaculture facilities, **stakeholder training**, and potential support mechanisms to mitigate impacts and losses

Our integrative approach

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ALGAS na
PRAIA



Observadores
del Mar

Ground-truth data

Satellite analytics

Citizen science



- Sentinel-2 (2015–2026)
- Machine learning
- Cloud computing
- Ad-hoc algorithm





RugOBSS objectives

1

Creating the **first ground truth database** of *R. okamurae* beachcasts aligned with satellite imagery

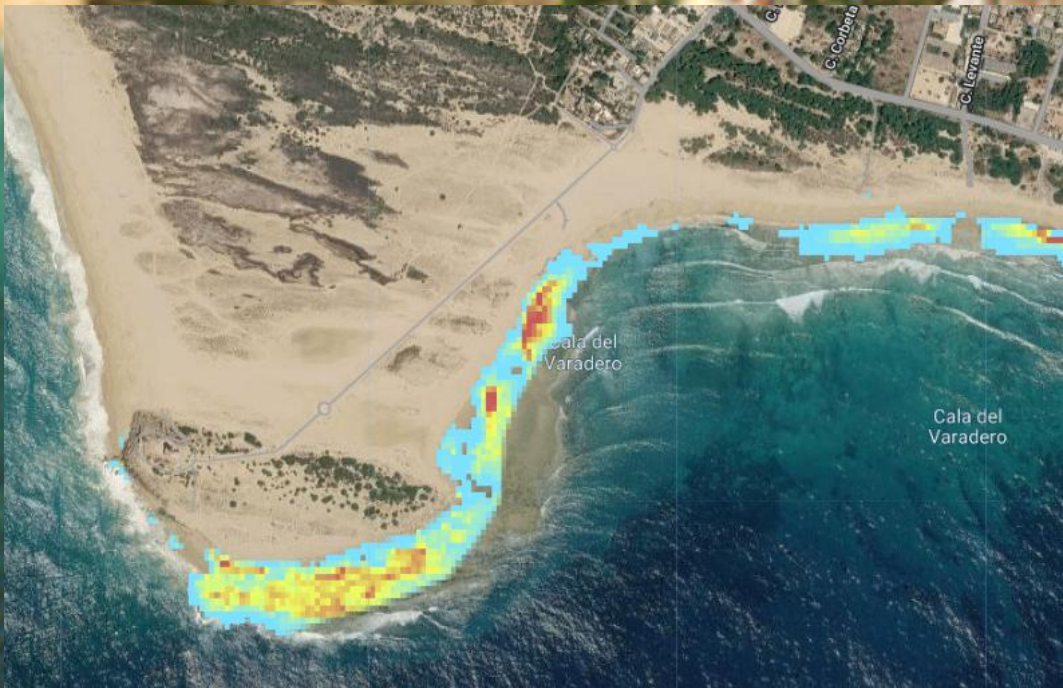
2

Analyzing **10 years** of **satellite imagery** to understand beachcast spatio-temporal trends and cumulative impacts

3

Developing and validating the open source **RugOBSS machine learning model** for Sentinel-2 imagery, accessible through a web-based platform

Identify potential beachcast from satellite imagery



Affection level



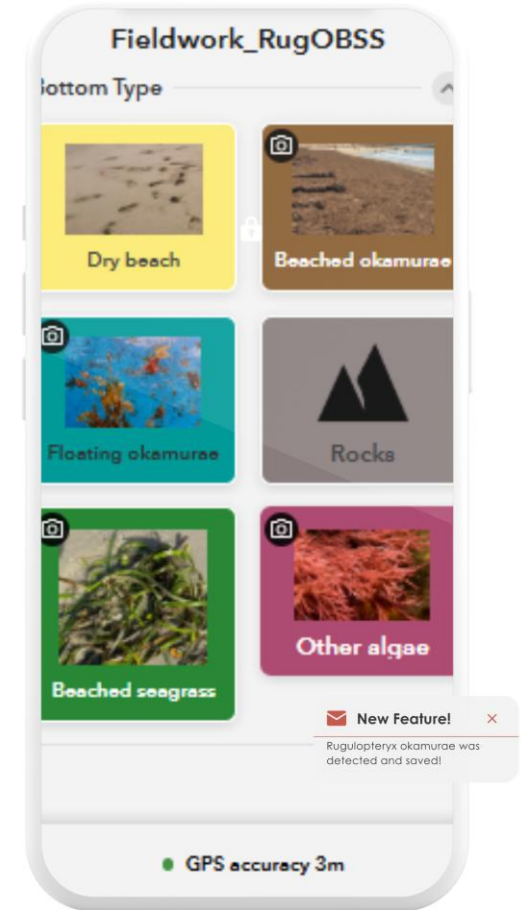
Ground-truth data

Biomass

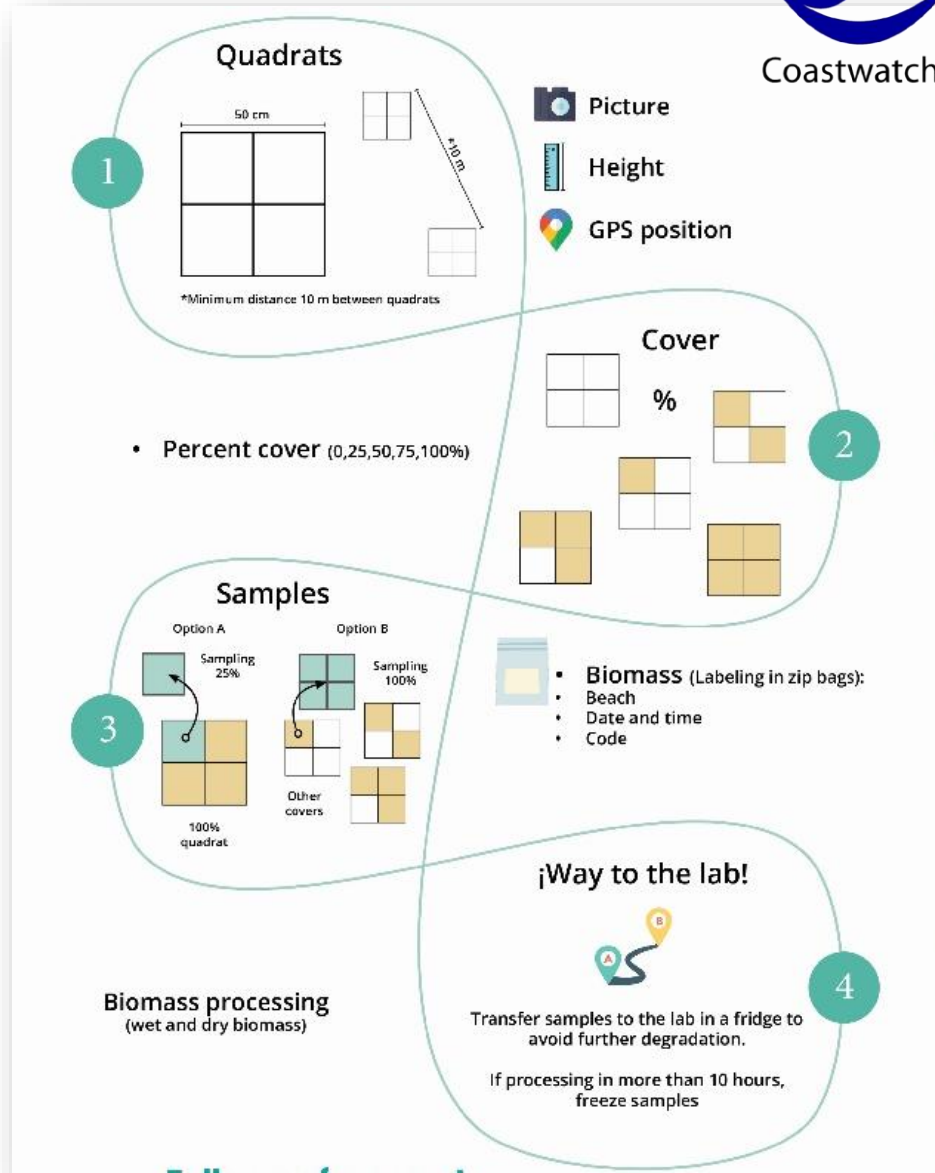
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Sentinel-2 acquisition plan



GARMIN



Presence, cover and biomass quantification

Volunteer & be part of the **CoastWatch Europe** community

Estimate cover & height



Sample & process biomass



Be an active part of the solution!



1

Presence and scientific validation

Asymmetric bifurcations

Green/brown colour

Flat, without relief

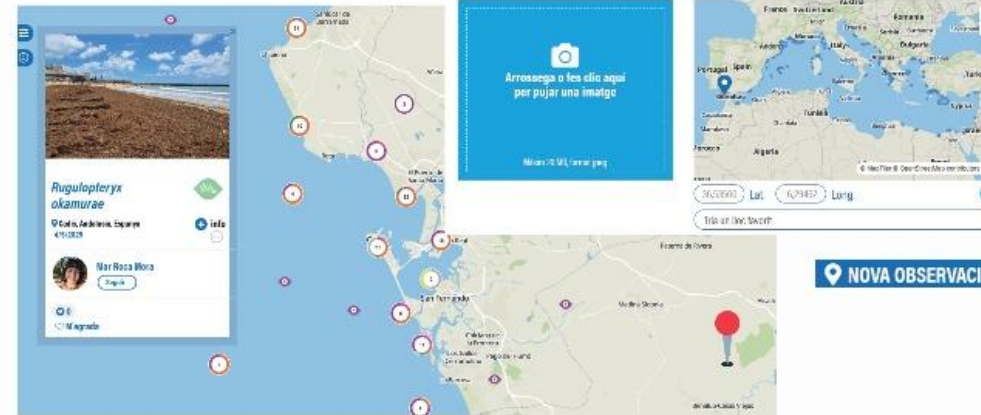
13-15 cm



Your observations help track the invasion and validate the **RugOBSS** satellite-derived model of *R. okamurae* beachcasts



Observadores del Mar



Invasive species project

👉 If you see this on the beach:

- 📷 Take a picture
- 📍 Geolocate it
- 📱 Upload it to Observadores del Mar!

Beached



Floating



In detail





**How to design a Sentinel-2 algorithm
to specifically detect *Rugulopteryx
okamurae*?**

Challenge

Zostera noltii



Rugulopteryx okamurae



Arribazones mixtos – *Posidonia oceanica*



Mar Mediterráneo



Almería (April 2026)



Time beached?

Degraded

Fresh

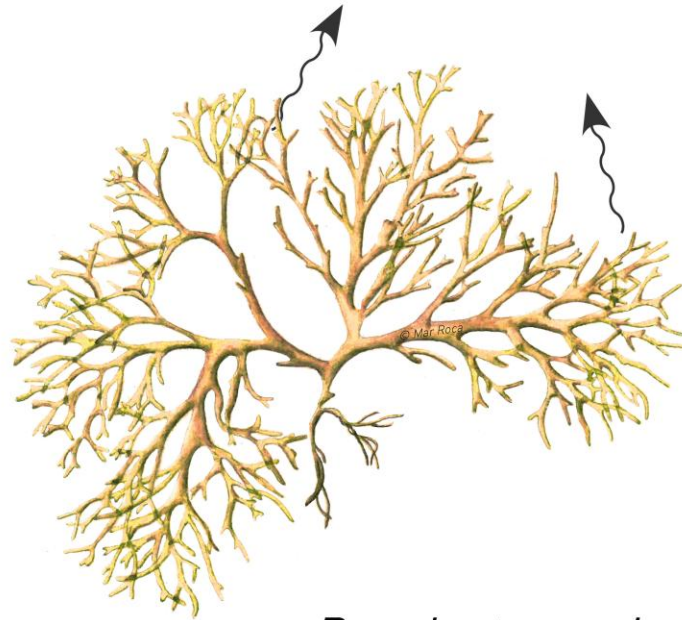
Detached
floating

in situ spectral change analysis

in situ degradation

photooxidation

HYPER SPECTRAL
GAMs



Rugulopteryx okamurae

Scalable biomass degradation insights from Earth Observation

3 Drying experiment



Fresh samples

2

PlanetScope

Sentinel-2

MULTISPECTRAL
suitability analysis

1

Field radiometry



Zostera noltii

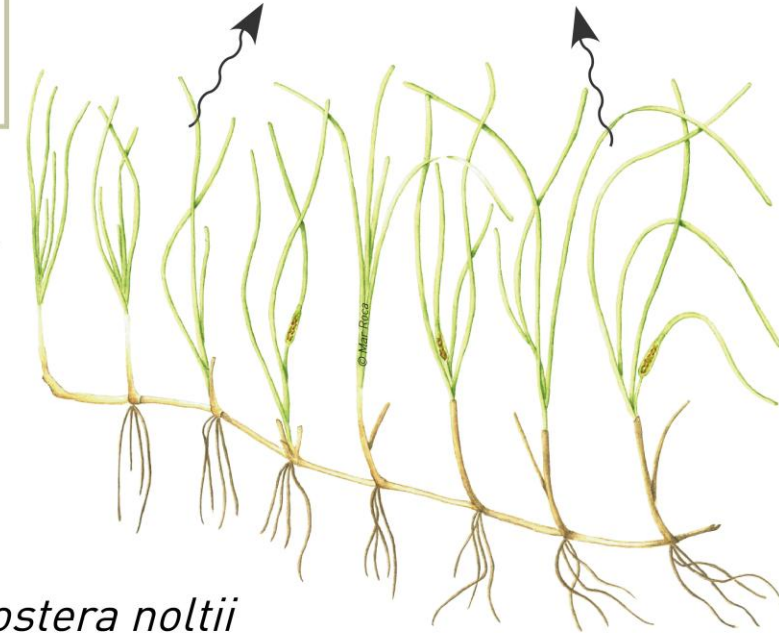
Gradual water content loss analysis

HYPER SPECTRAL
GAMs



desiccation

spectral shape



Beached + floating



Beached + intertidal

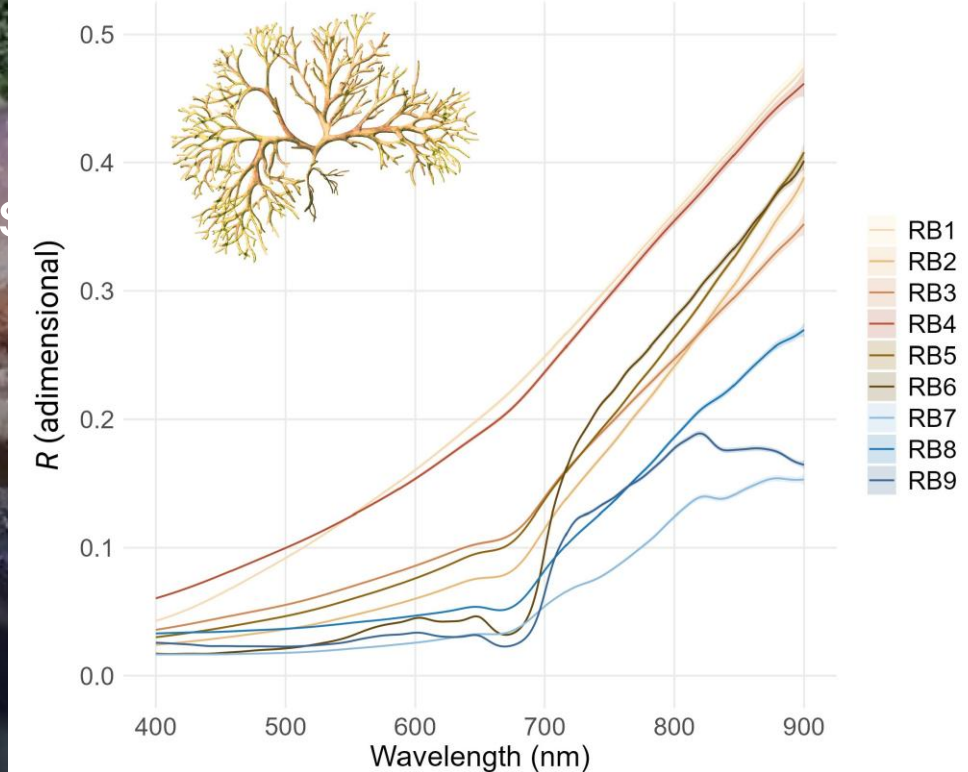
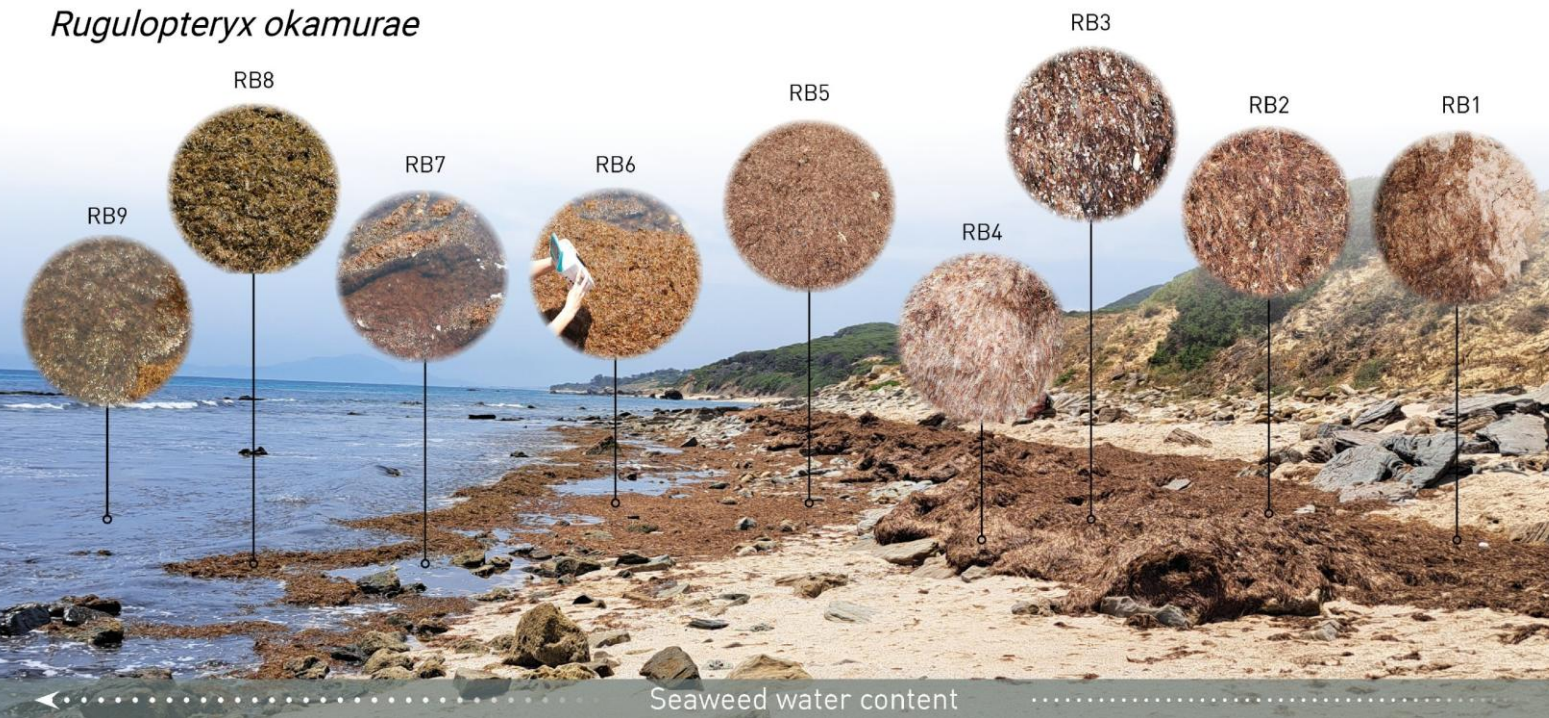


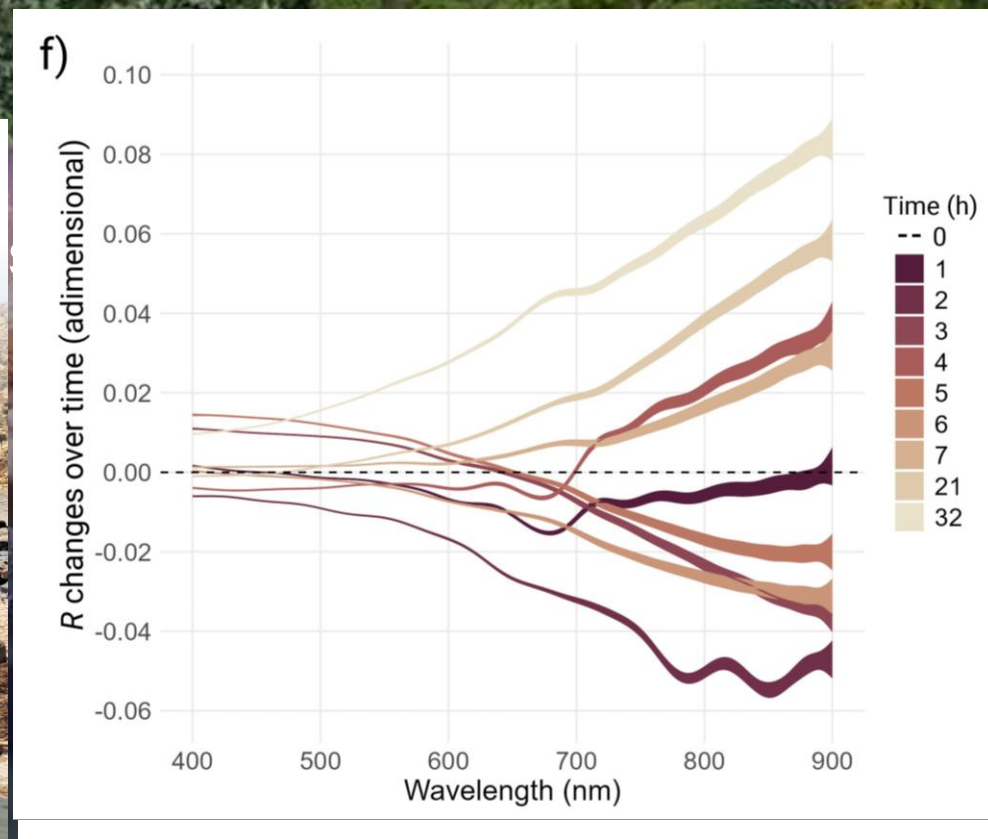
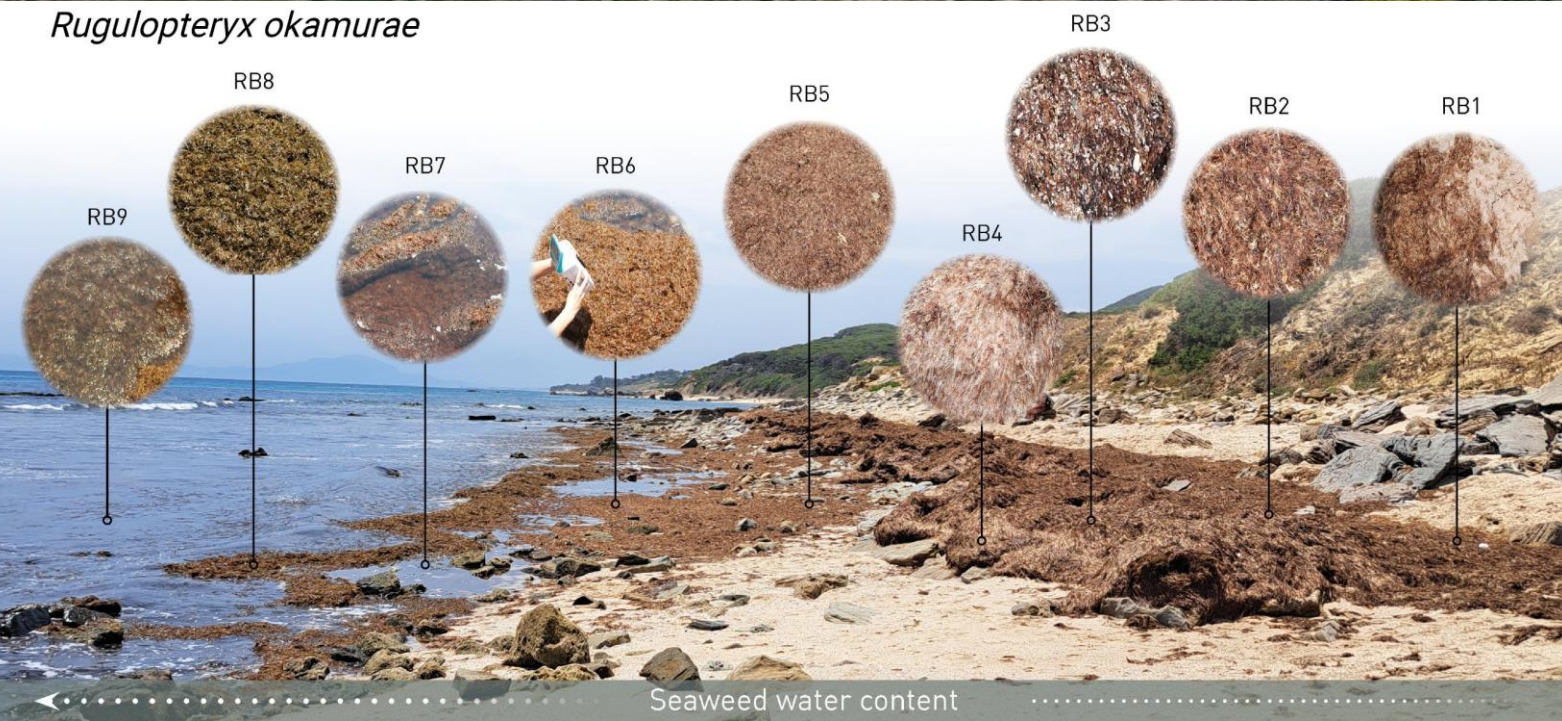
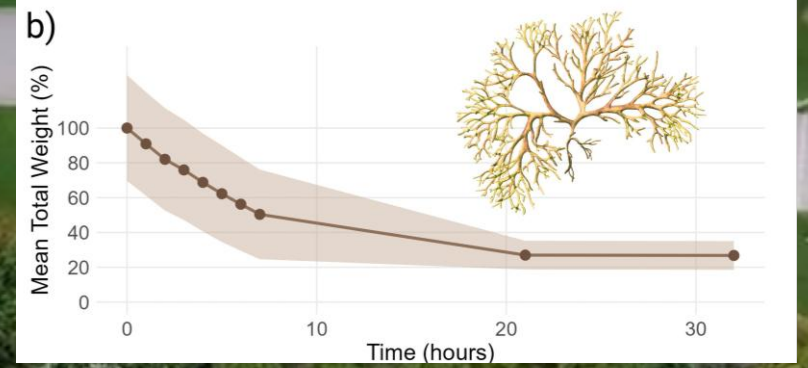
Beachcast degradation stages of *Rugulopteryx okamurae* and *Zostera noltii*: towards a scalable remote-sensing monitoring platform

Mar Roca-Mora^{a,*}, Bede Ffinian Rowe Davies^{b,c}, Pierre Gernez^b, Maria Laura Zoffoli^d, Laurent Barillé^{b,e}

Time beached?

Rugulopteryx okamurae





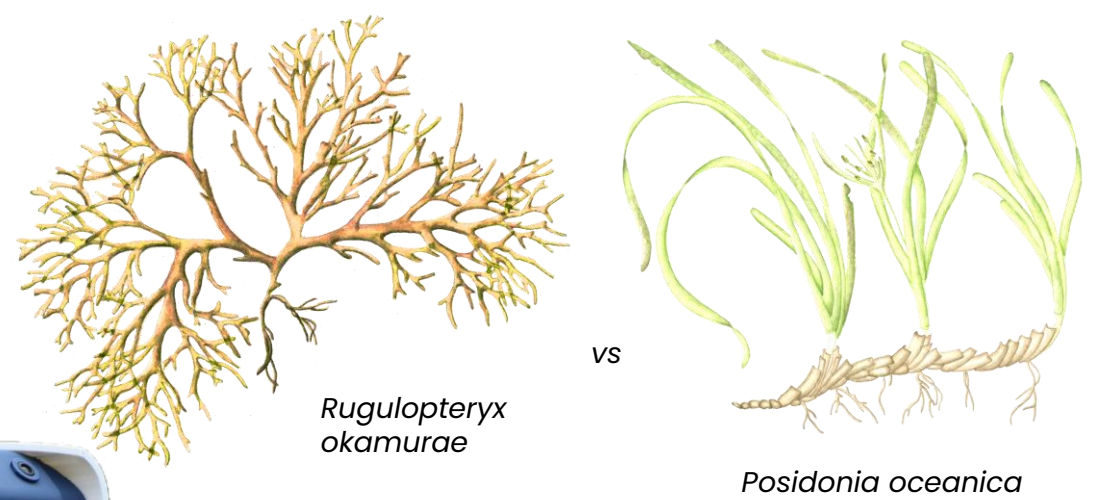
Hyperspectral signal



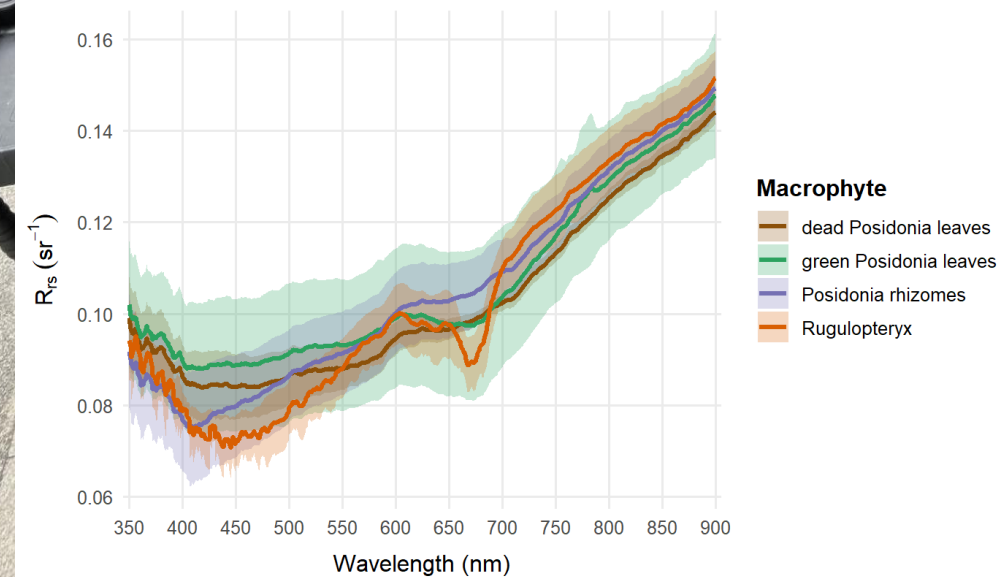
Posidonia oceanica



Objective
Detection of beached
P. oceanica in the
Mediterranean



Rugulopteryx vs. Posidonia (t=0)





Which are the spatio-temporal dynamics of
beached ***Rugulopteryx okamurae***?

Rugulopteryx okamurae
cumulative impacts
Ceuta (2015-2026)

Biomass frequency



~ 1 km²



Recurrence

Area

Cover

Biomass

Temporal
trends

1. Benzú

2. Calamocarro

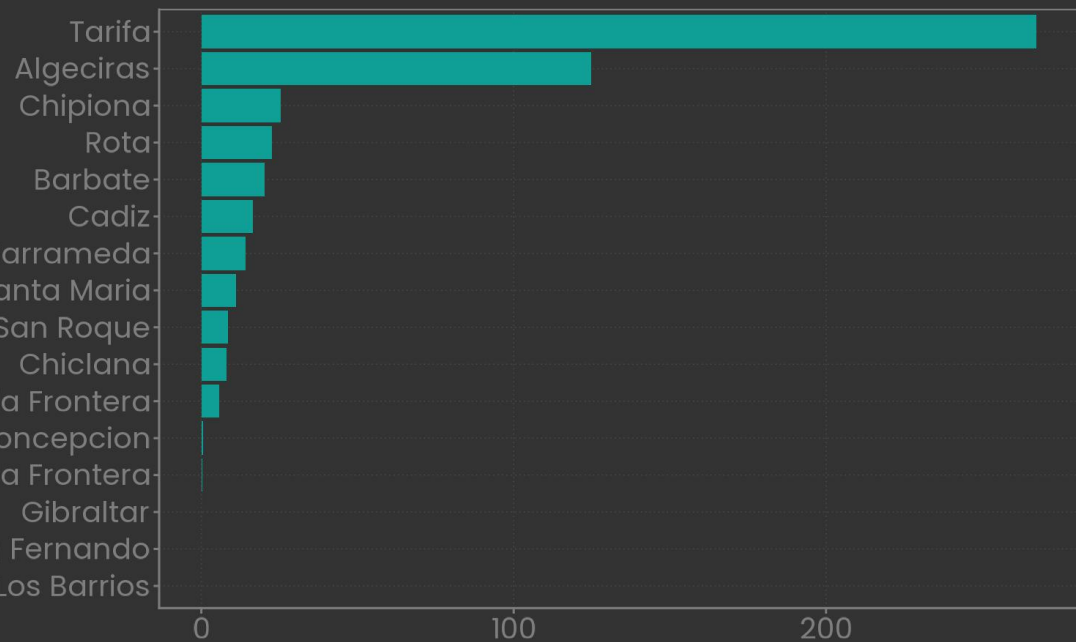
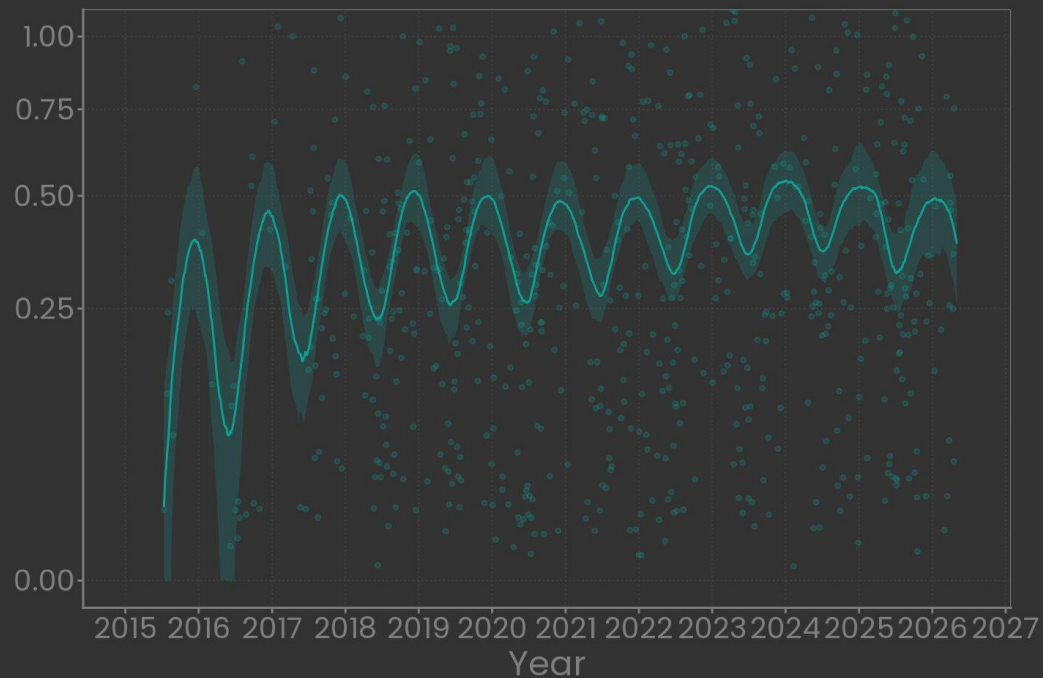
3. Benitez

4. La Bolera

5. Sarchal

6. Miramar



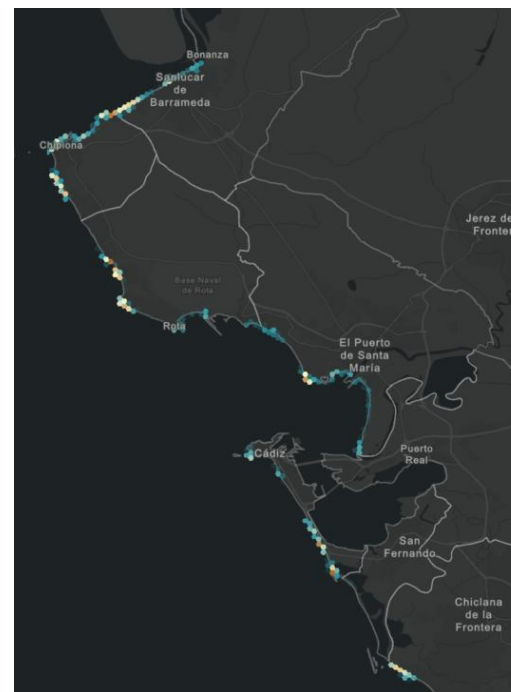
Cumulative Area Classified as Biomass in km²

Cadiz

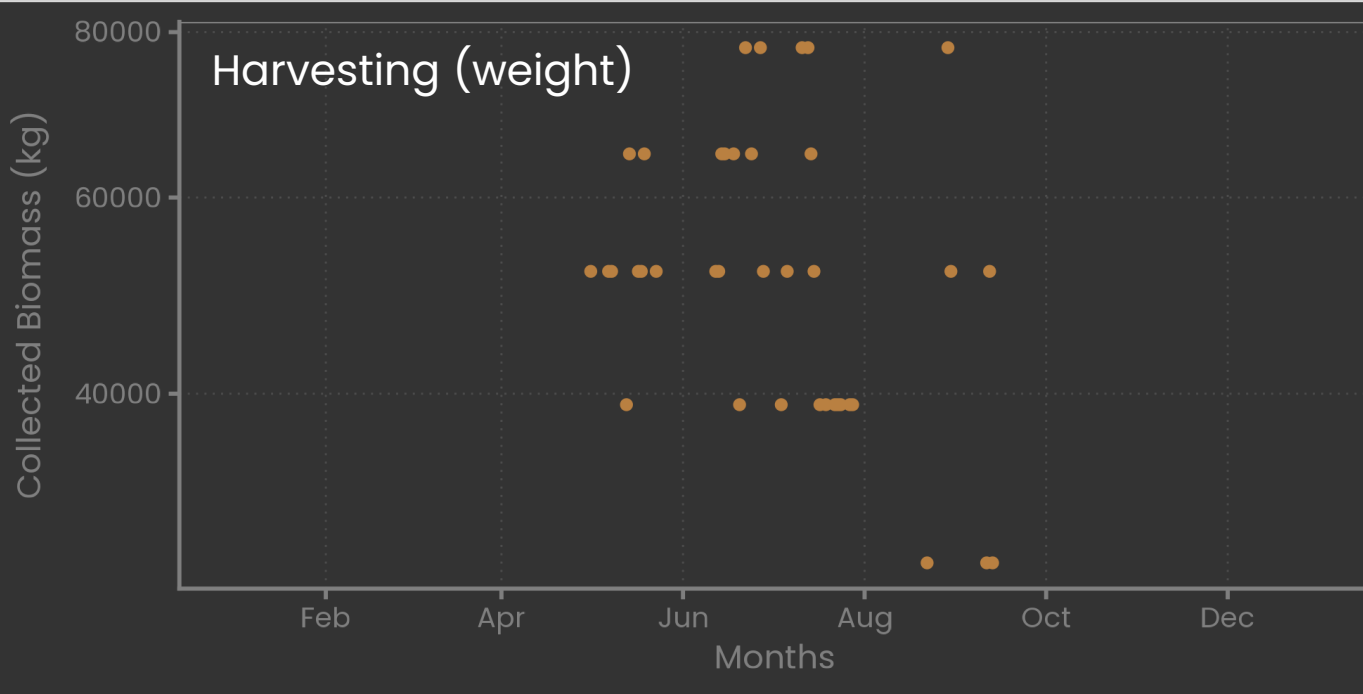
2015-2026

Rugulopteryx okamurae
cumulative impacts

Biomass frequency



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Local meetings (Cadiz)

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November 2025



June 2026



Need to know the **cumulative impact** in each municipality to **plan mitigation budget for biomass harvesting**

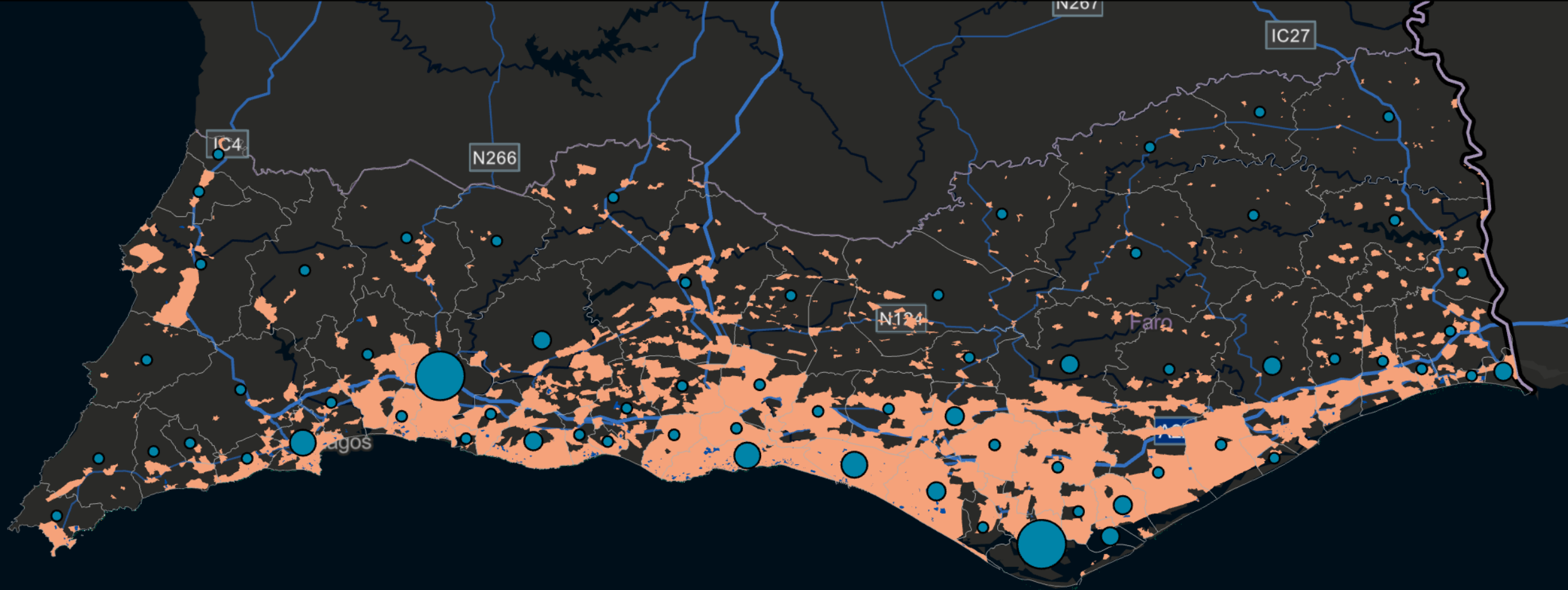


PROGRAMA DE COOPERACIÓN PARA PALIAR LOS EFECTOS DEL ALGA INVASORA *RUGULOPTERYX OKAMURAE* EN EL LITORAL GADITANO

Ayudas económicas concedidas a los municipios litorales para paliar los efectos de la invasión

Municipio	2022	2023	2024	Concesiones 2025	Concesiones 2026
ROTA	0,00 €	0,00 €	0,00 €	5.000,00 €	30.165,30 €
EL PUERTO DE S.M.	0,00 €	0,00 €	0,00 €	0,00 €	37.500,00 €
CÁDIZ	0,00 €	0,00 €	0,00 €	0,00 €	37.500,00 €
CONIL	0,00 €	0,00 €	18.000,00 €	18.000,00 €	30.295,00 €
BARBATE	18.000,00 €	60.000,00 €	92.000,00 €	137.500,00 €	137.500,00 €
TARIFA	65.000,00 €	103.000,00 €	140.000,00 €	150.000,00 €	150.000,00 €
ALGECIRAS	22.627,53 €	19.336,26 €	20.000,00 €	30.000,00 €	30.000,00 €
LA LÍNEA	36.772,31 €	72.090,99 €	70.000,00 €	90.000,00 €	90.000,00 €
SAN ROQUE	0,00 €	0,00 €	0,00 €	62.500,00 €	62.500,00 €
TOTAL	142.399,84 €	254.427,25 €	340.000,00 €	493.000,00 €	605.460,30 €

TOTAL ACUMULATIVO	142.399,84 €	396.827,09 €	736.827,09 €	1.229.827,09 €	1.835.287,39 €
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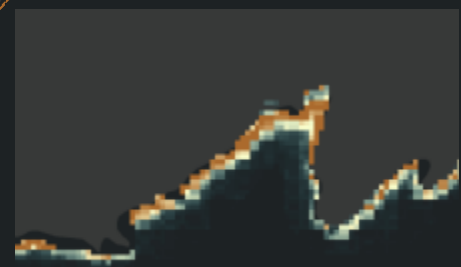
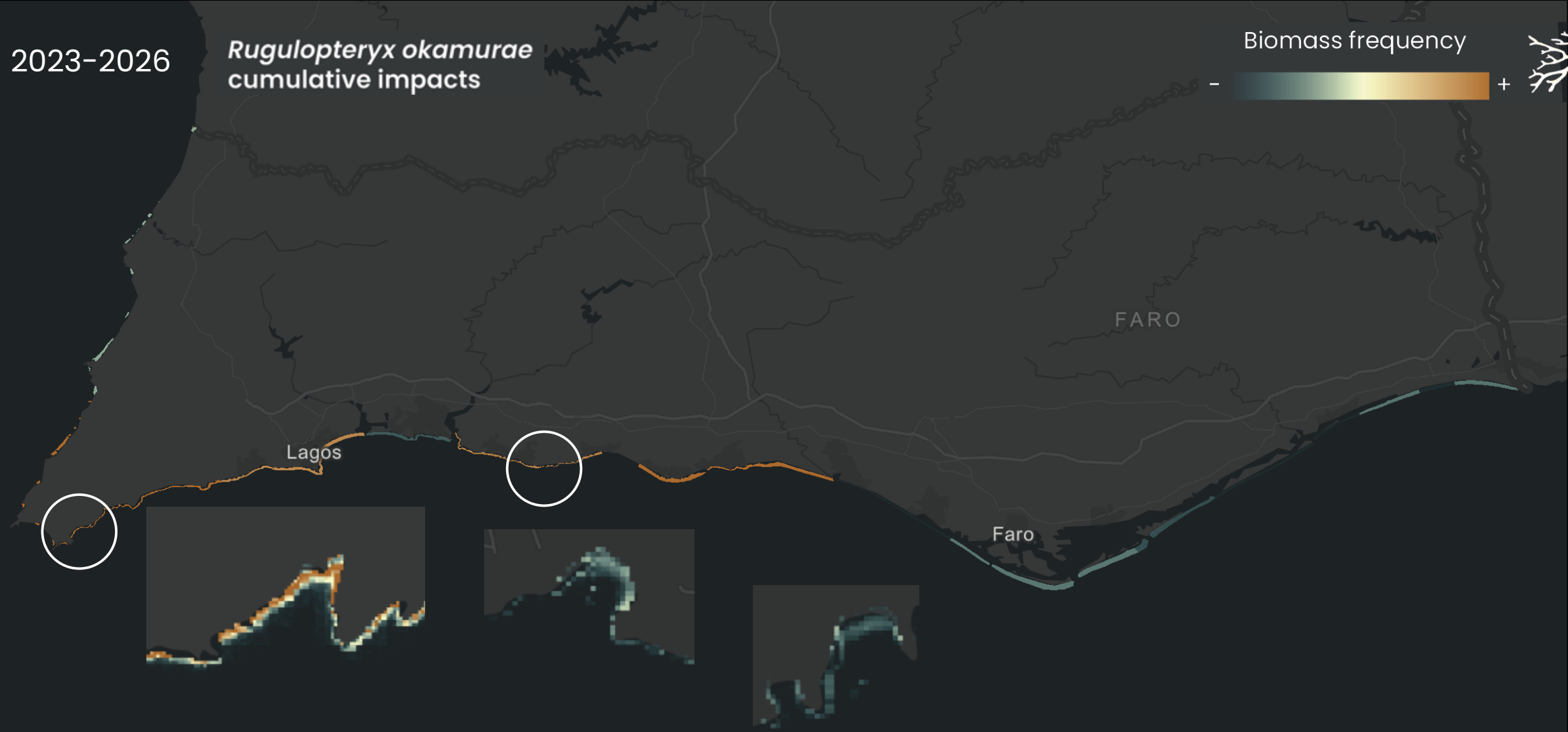
What has been the
impact in the Algarve?

R. okamurae first
detection in **2023**

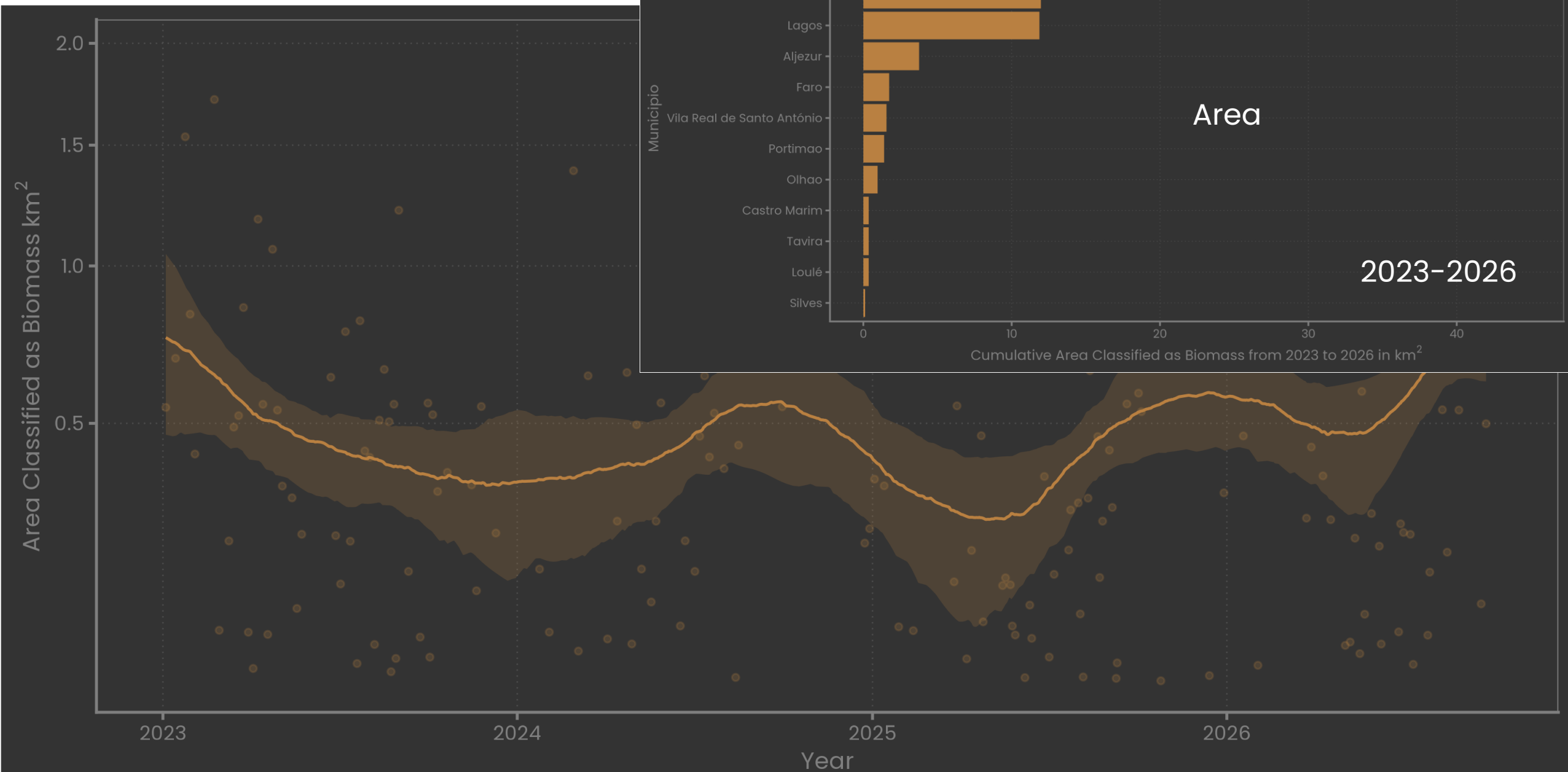
2023-2026

Rugulopteryx okamurae
cumulative impacts

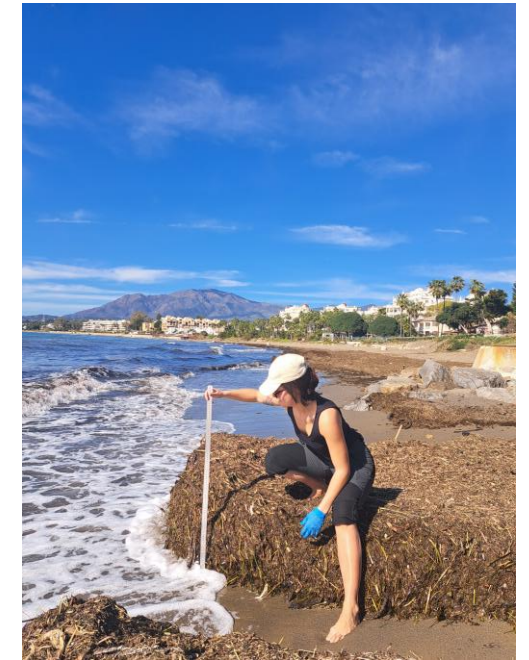
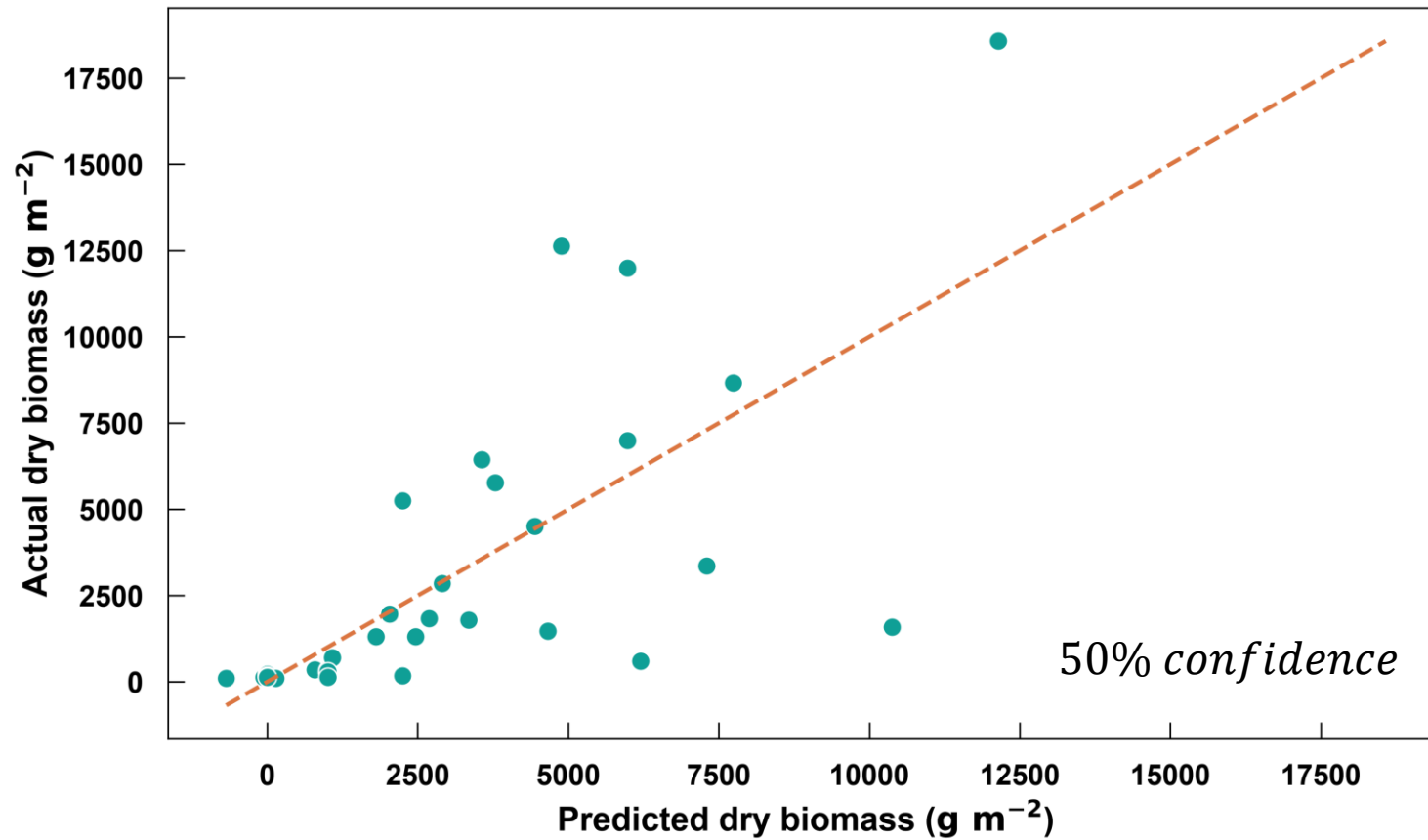
Biomass frequency



Algarve beaching trends



Satellite-derived biomass



$$\text{Total biomass (g/m}^2\text{)} = 3190.72 + 485.32 (\text{Coverage}) - 2724.91 (\text{Height}) + 5423.38 (\text{Coverage} \times \text{Height})$$

The background of the slide is a vibrant underwater photograph. It shows a dense field of seaweed in various shades of brown, orange, and red, growing from a rocky seabed. The water is a clear, deep blue, and sunlight filters down from the surface, creating a dappled light effect on the seaweed.

Can we predict the
biomass arrival?

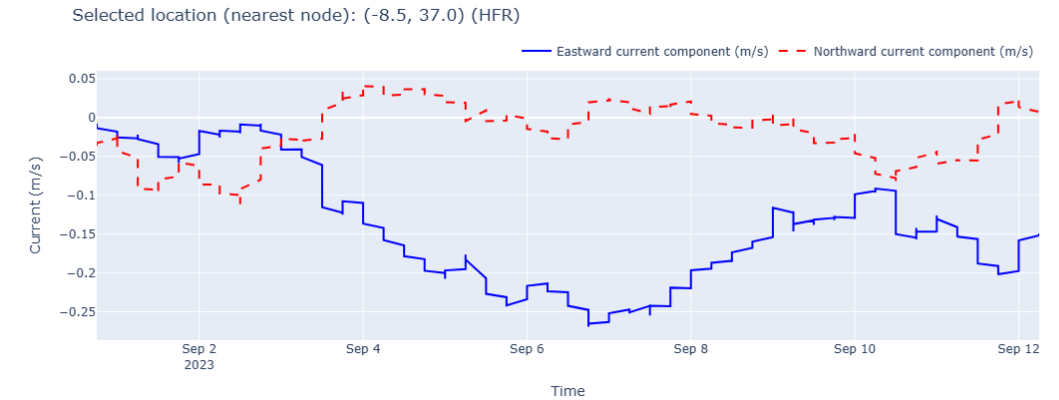
Biomass hindcast

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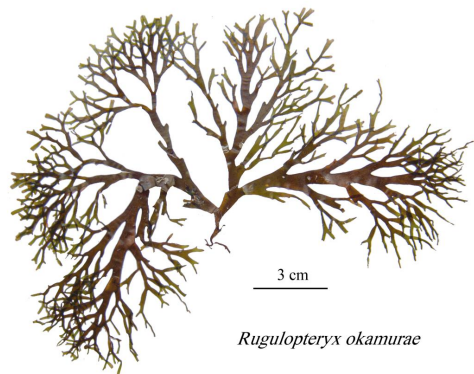
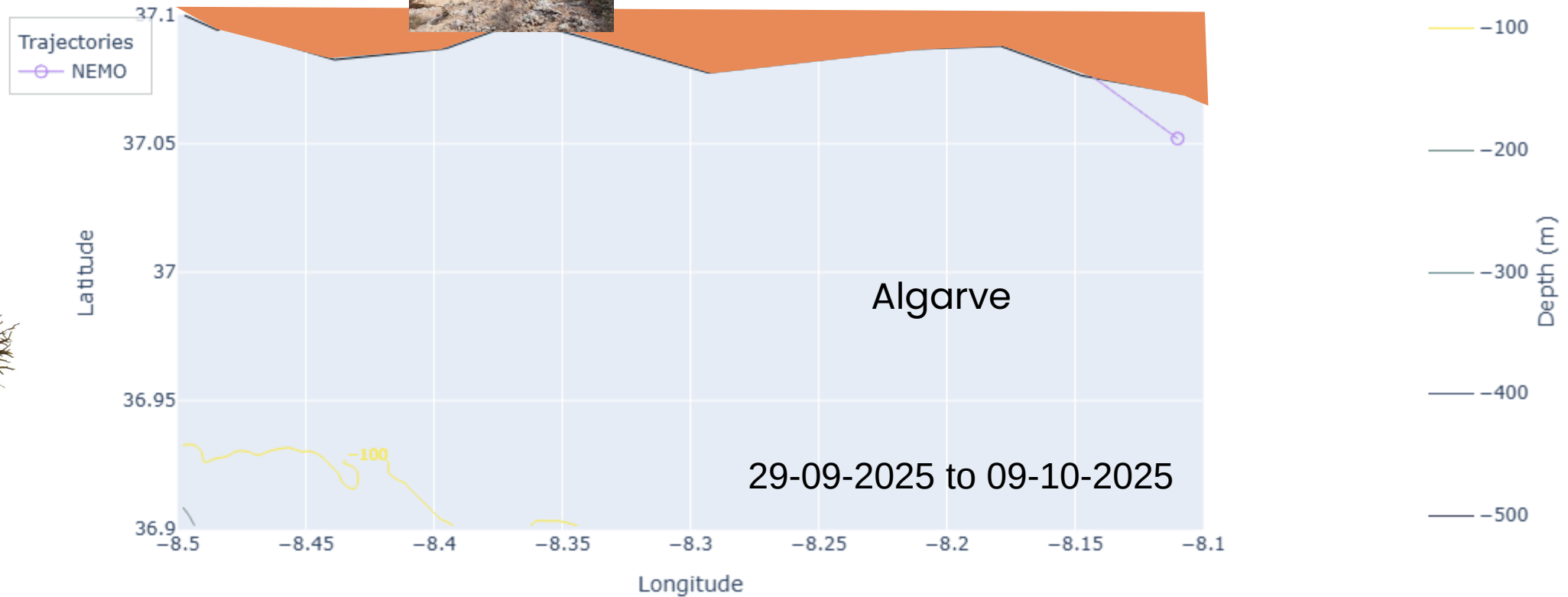


Parameter	System	HF radars	Multiparametric buoys	Wave buoys	Tide Gauges	Gliders	Remote sensing	Models
Surface Currents								

detection of **no-go-zones** for fishermen



Pathway trajectories



Source?

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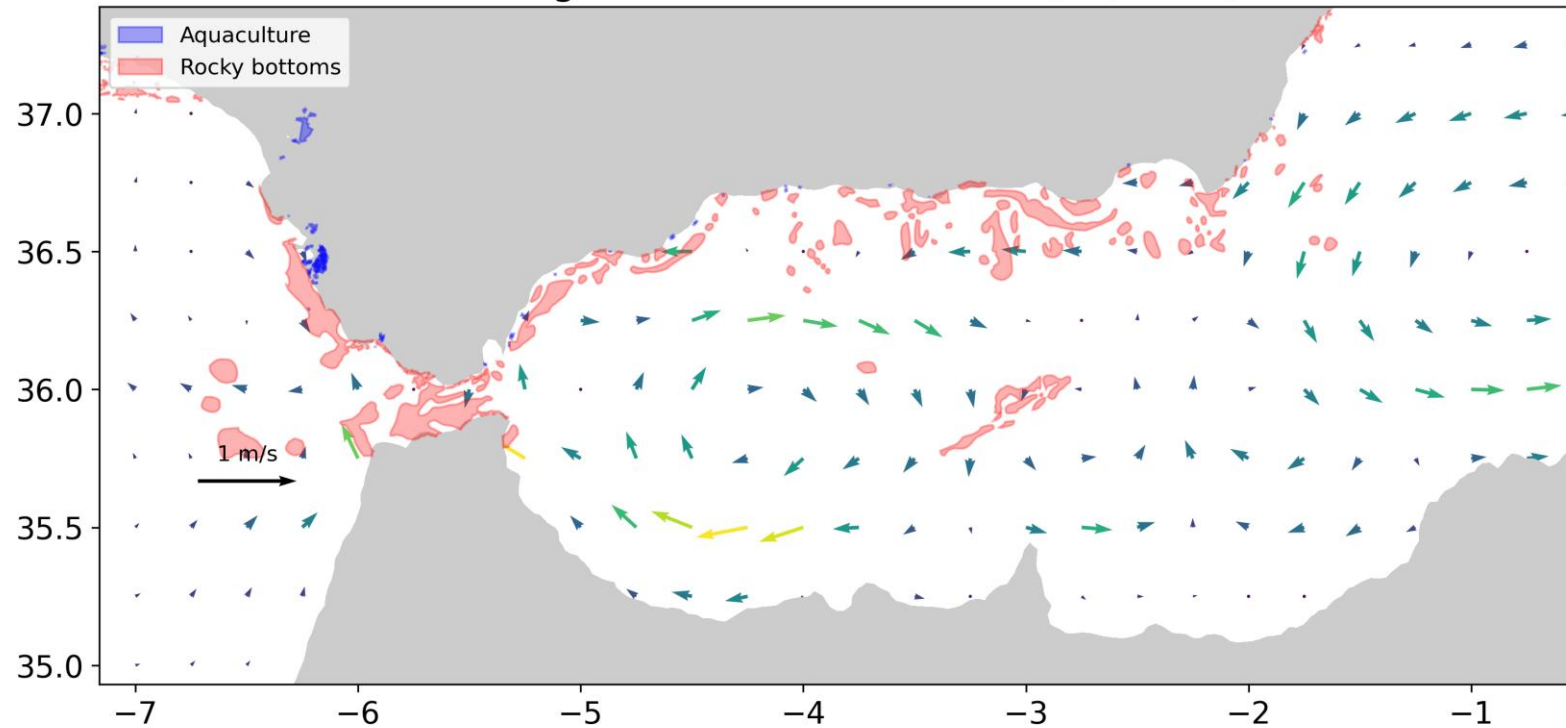


Rocky bottoms

Work in progress

Sinked detached biomass

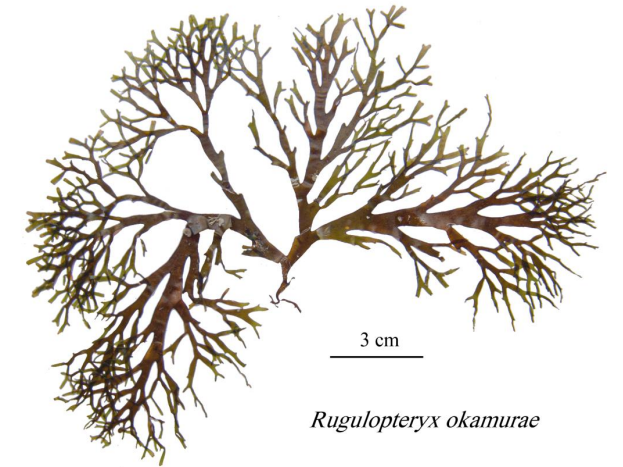
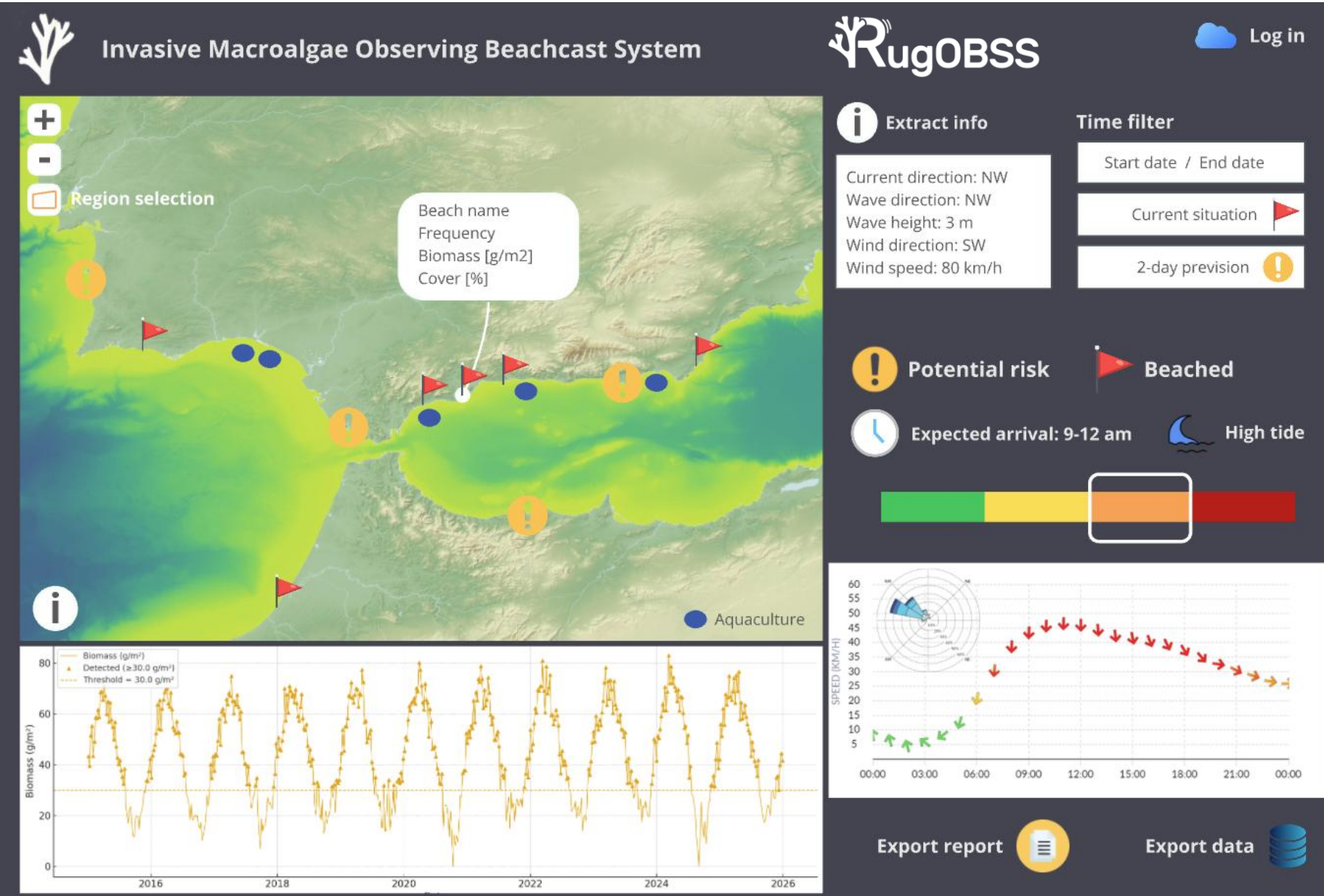
Average near-surface currents (10/2021)



The future platform

Work in progress

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Rugulopteryx okamurae

- FAIR and **VALIDATED** RugOBSS algorithm



- Needed tool to monitor the invasion at scale

- TECH TRANSFER FOR MANAGEMENT**

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ifremer

RugOBSS
Invasive Macroalgae
Observing System



Grab your
sticker!



@rugobss



14 Octubre 2026



¡Gracias!
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Maria Lima
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Bede Davies
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