



Implementing marine forests restoration: new insights and future challenges

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AFRIMED Consortium

21st April 2021



Algal forests restoration in Mediterranean Sea - AFRIMED



AFRIMED is an EU project on the restoration of degraded *Cystoseira s.l.* macroalgal forests in the Mediterranean Sea.

AFRIMED involves 8 EU and not-EU countries and 11 partners.

Funded by the Executive Agency for Small and Medium Enterprise (EASME) and European Maritime and Fisheries fund (EMFF).

Started in 2019 – will finish in 2022.

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AFRIMED IS AN EUROPEAN PROJECT ON THE RESTORATION OF THE DEGRADED MACROALGAL FOREST (*Cystoseira*)

This project has received funding from the Executive Agency for Small and Medium Enterprise (EASME) and European Maritime and Fisheries fund (EMFF) under grant agreement No 789059

AFRIMED NEWS ABOUT AFRIMED

The Problem



Habitat loss

- Deterioration of coastal ecosystems can alter the key areas of many marine mammals, sea turtles and seabirds.
- Major evidence of habitat loss in tropical coastal systems.
- But also in coastal Mediterranean habitats.



Collapse of the Natural Capital



Sustainable development: integrating natural capital into economic and financial systems

By 2030 the value of natural capital must be integrated into the instruments of economic and financial planning of the public administration (National Committee for Natural Capital)

Habitat	Area	Natural capital	Loss %	Natural Capitale Loss
	(ha)	Euro/ha/yr		(Mln Euro)
<i>Cystoseira s.l.</i>	9600	287.4	84	1,509
Seagrass	337611	10107.9	25	3,369
Coralligenous	96700	35268.2	25	11,756

Impact of marine algal forests loss

Impact of date mussel fishery

Cost of the environmental damage for 1,060 linear m of the MPA Punta Campanella:
11.401.248 euro

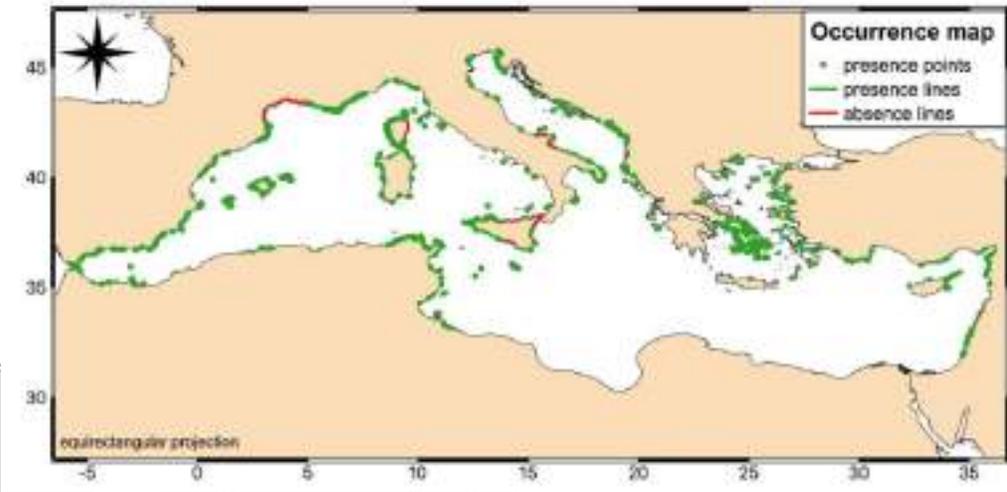
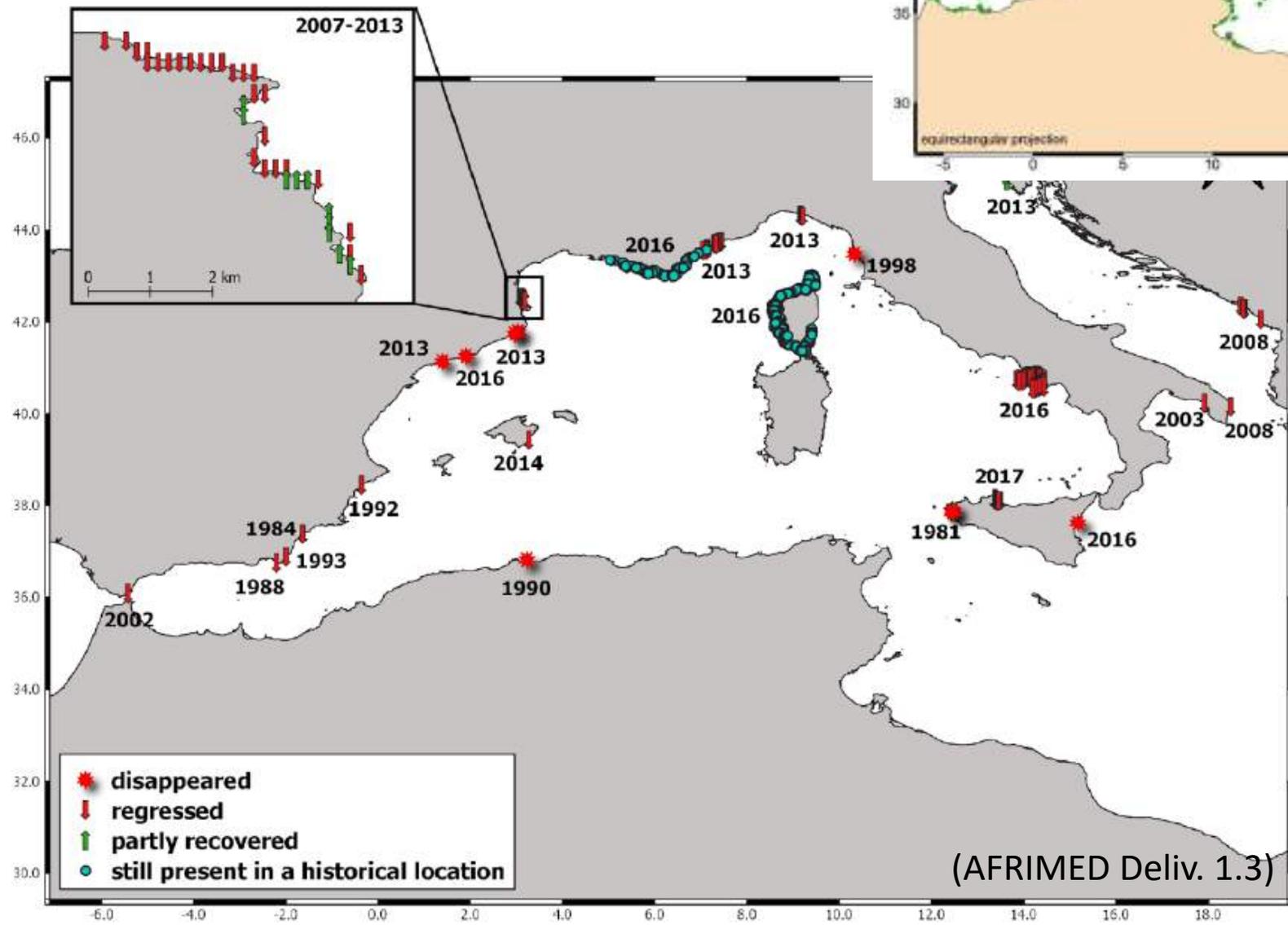


Environmental damage in Salento:
540-860 millions €

Damage of ecosystem services:
10-34 millions € per year



The regression of *Cystoseria* s.l.



(AFRIMED Deliv. 1.3)

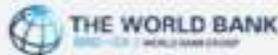
EU Green Deal Biodiversity Strategy 2030



GOAL 14 - CONSERVE AND SUSTAINABLY USE THE OCEANS, SEAS AND MARINE RESOURCES FOR SUSTAINABLE DEVELOPMENT

GOAL 15 - PROTECT, RESTORE AND PROMOTE SUSTAINABLE USE OF TERRESTRIAL ECOSYSTEMS, SUSTAINABLY MANAGE FORESTS, COMBAT DESERTIFICATION AND HALT AND REVERSE LAND DEGRADATION AND HALT BIODIVERSITY LOSS

“...it is essential to increase the value given to protecting and restoring natural ecosystems, to the sustainable use of resources and to improving human health.” (EU green Deal)



Best protocols and techniques available

More than 20 protocols available for marine ecosystems restoration, validated in MERCES in the last 5 years.

Comprising protocols and techniques for *Cystoseira s.l.* forests.

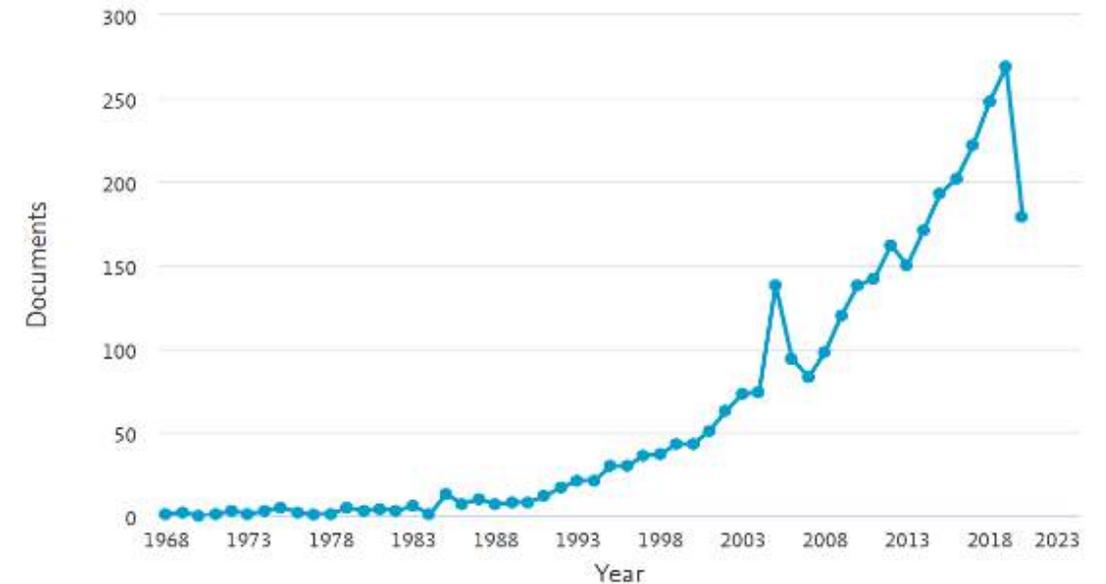
Need to scale up!
Need to cross EU borders



The need transnational cooperation to restore marine ecosystems



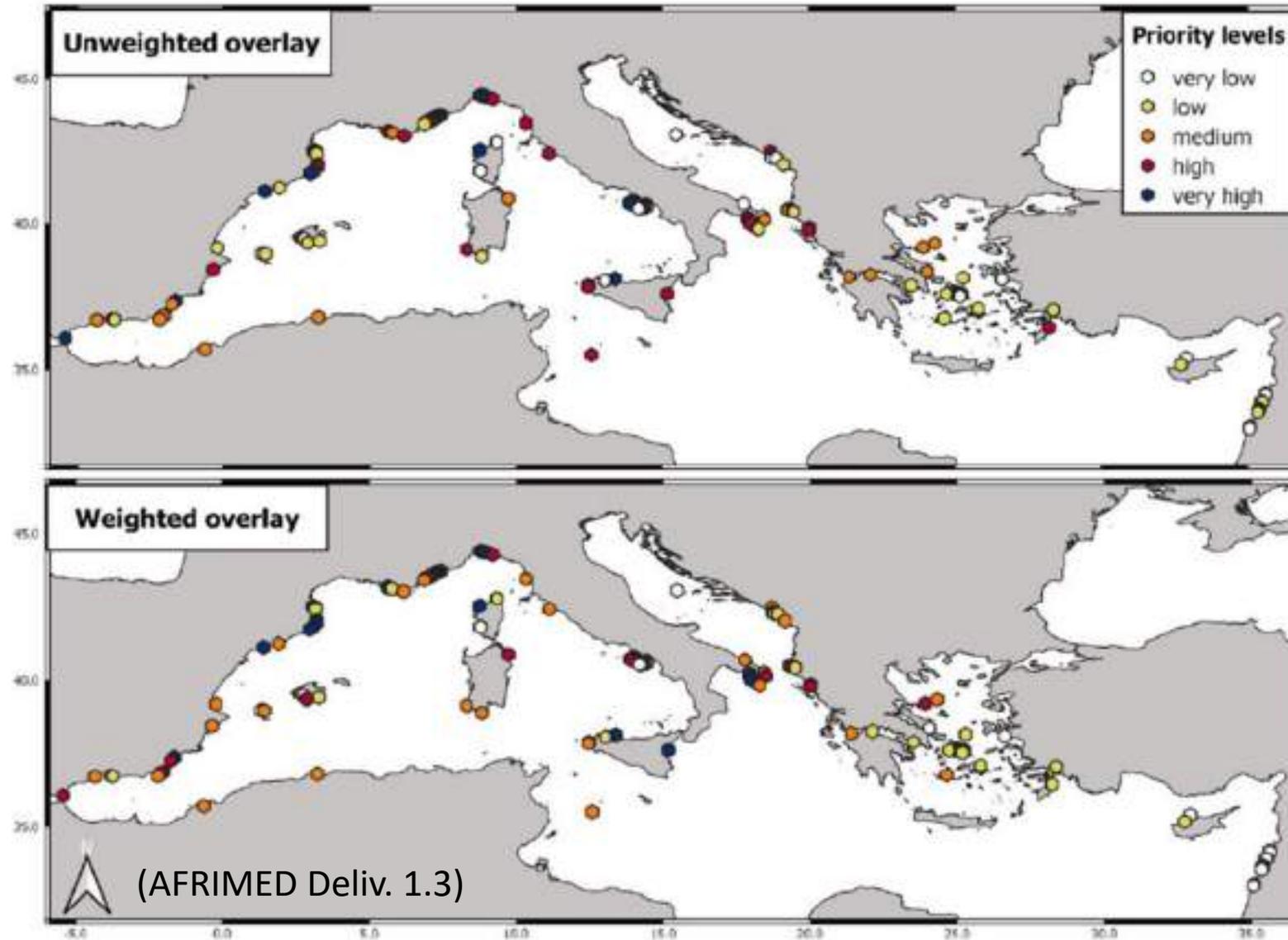
Documents by year



A sustainable management strategy for the ocean should establish **science-based conservation goals**, develop a **global framework** for defining baseline conditions, and establish monitoring requirements.



Marine Ecosystem Restoration
in Changing European Seas



Priority areas for the restoration of *Cystoseira s.l.* forests across the Mediterranean Sea

OECD: Building the industry of Marine Ecosystems restoration

Biodiversity: Finance and the Economic and Business Case for Action



Welcome to the MERCES Business Club

Home > Business club > Case Studies of Best Practice

Case Studies of Best Practice

The following links take you to case studies on marine ecosystem restoration grouped by subject area.

- Soft bottom ecosystems** – including seagrass meadows, salt marshes and mangroves
- Hard bottom ecosystems** – including corals, macroalgae and colonisation of man-made structures
- Ecosystem services** – including the benefits from restoring marine ecosystems
- Deep-sea ecosystems** – including deep-sea mining, deep-water corals, Gulf of Mexico



Marine Ecosystem Restoration in Changing European Seas

The need of Marine Restoration Governance Arrangements (MRAG)

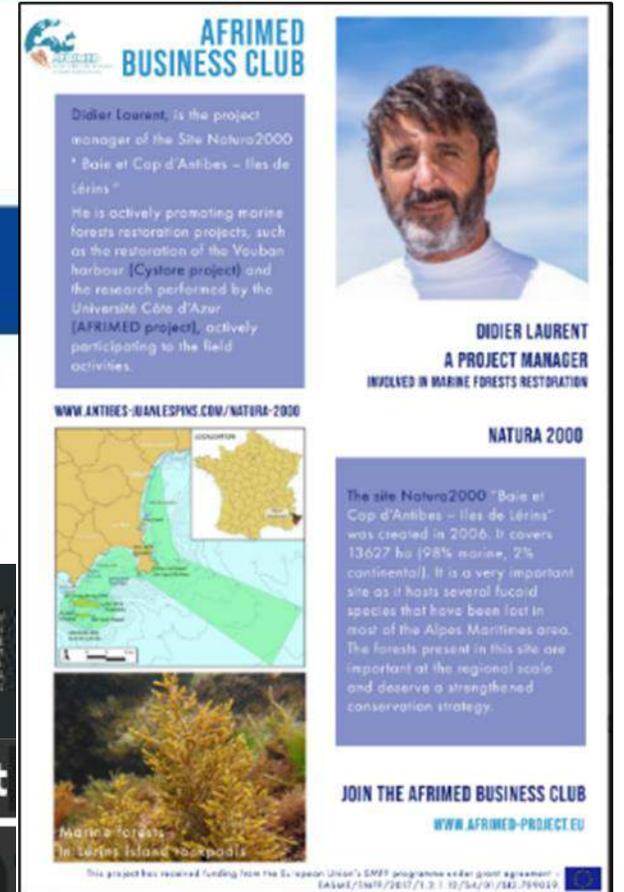
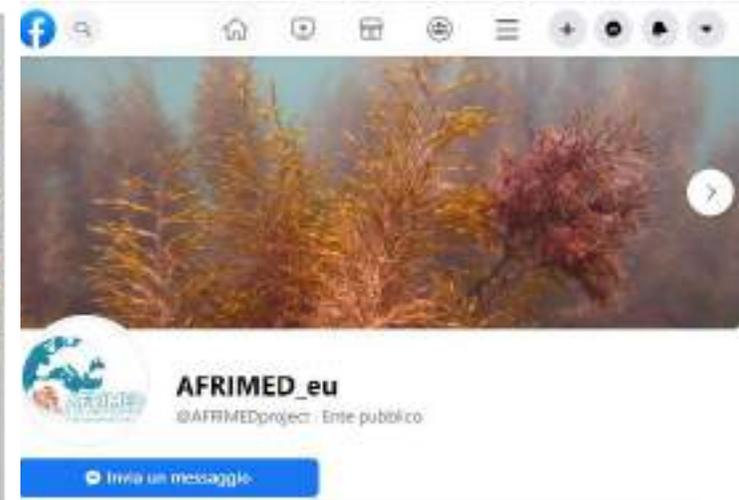


“A linkage between the top-down and the bottom-up restoration governance arrangements is lacking.

*To fill this implementation gap, a **process of institutionalization of restoration governance arrangements at different levels** needs to take place”*

Raise awareness in the Society

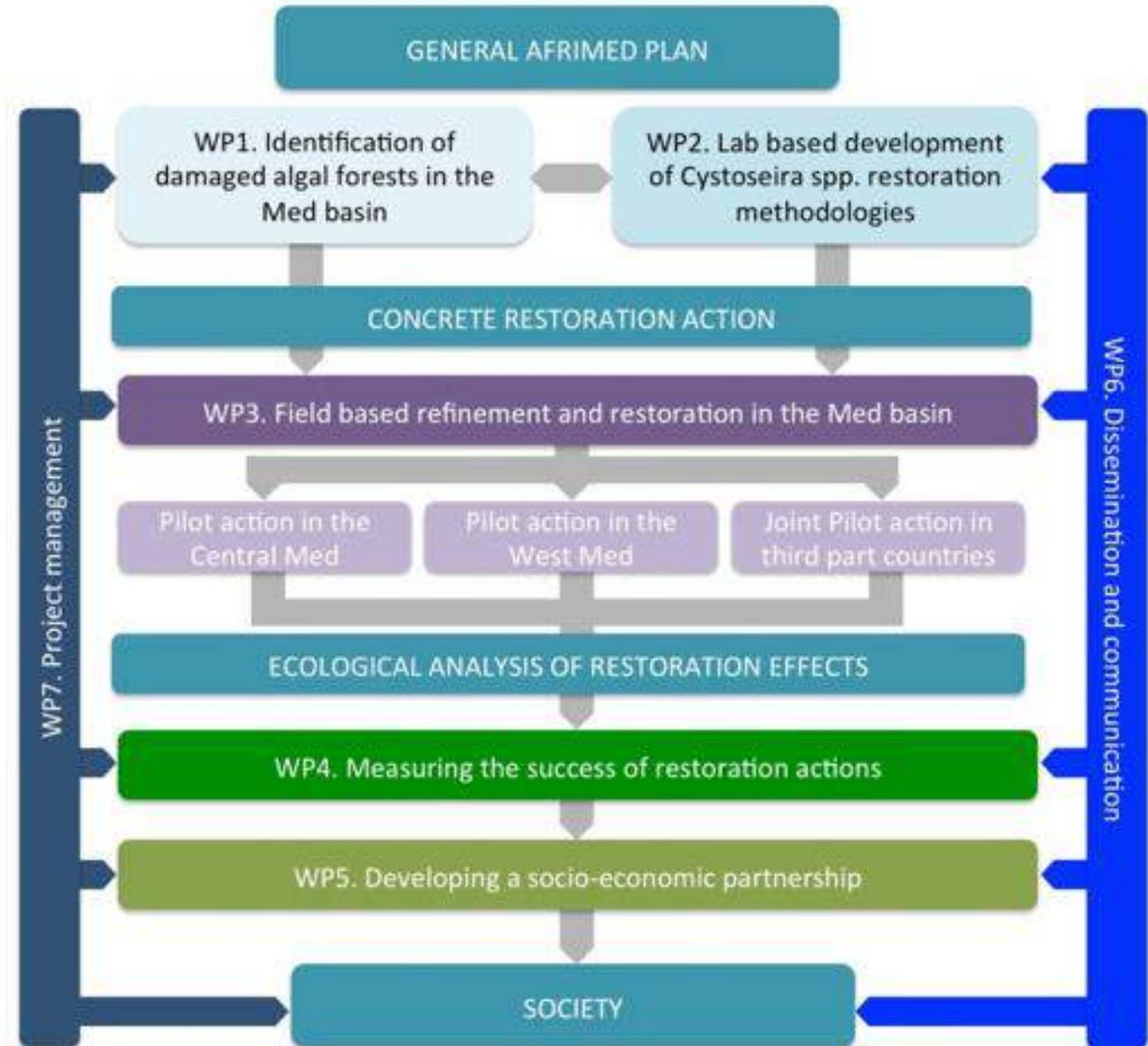
- 2 symposia at World and EU SER Congress
- scientific papers
- e-material
- newsletter and factsheet
- documentary on youtube
- social networks
- involvement of young students
- international students exchange
- local events for citizens
- dialogue with EMFF



AFRIMED framework

The pillars:

- Science
- Society
- Blue economy
- Policy



AFRIMED objectives:



- Map the **distribution and status of macroalgal forests**;
- Map the **drivers that compromise** the health and restoration potential;
- Conduct **laboratory and field-based experiments**;
- **Improve the efficiency** and success rate of restoration;
- **Develop indicators**, targets and monitoring frameworks;
- **Promote the replicability and transferability** of know-how through coordinated pilot joint actions;
- Engage with relevant **stakeholders**.

The Consortium & Participants



1. **UNIVPM (Coordinator)**
2. **SZN** - Stazione Zoologica
3. **UCA** - Université Cote d'Azur
4. **UdG** - University of Girona
5. **HCMR** - Hellenic Centre for Marine Research
6. **HAO-DEMETER** Hellenic Agric Org
7. **WCMC** - UN Env World Conservation Monitoring Centre
8. **ECOREACH**
9. **UV** - University of Vlora
10. **FSB** - University of Carthage
11. **UCD** - University Chouaib Doukkali

11 beneficiaries
8 countries

6 Academia
3 Research institutes
1 NGO
1 SME



JOIN THE AFRIMED COMMUNITY



www.afrimed-project.eu



AFRIMED_eu



AFRIMED_eu



Afrimed Project



AFRIMED (community)



Algal Forest Restoration In the MEDiterranean Sea
(AFRIMED)
Grant agreement n.
EASME/EMFF/2017/1.2.1.12/S4/01/SI2.789059



<http://www.afrimed-project.eu>

AFRIMED project has received funding from the European Union's EMFF programme under grant agreement – EASME/EMFF/2017/1.2.1.12/S4/01/SI2.789059

This output reflects only the author's view and the European Union cannot be held responsible for any use that may be made of the information contained therein.

Advances in marine forests restoration under the EU project AFRIMED and stakeholder involvement



Stazione Zoologica Anton Dohrn Napoli



Marine restoration under the biodiversity strategy

Simonetta Fraschetti

Università di Napoli Federico II - Stazione Zoologica di Napoli



Marine Ecosystem Restoration in Changing European Seas



Is it possible to reverse present trajectories of changes?

before

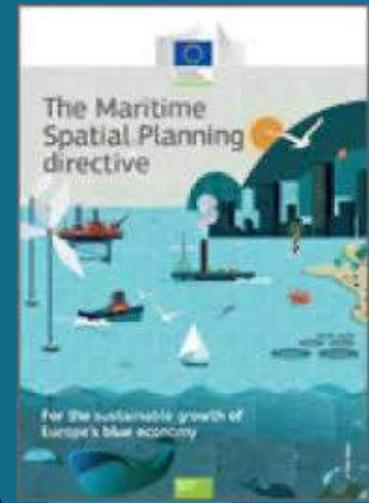
after ?



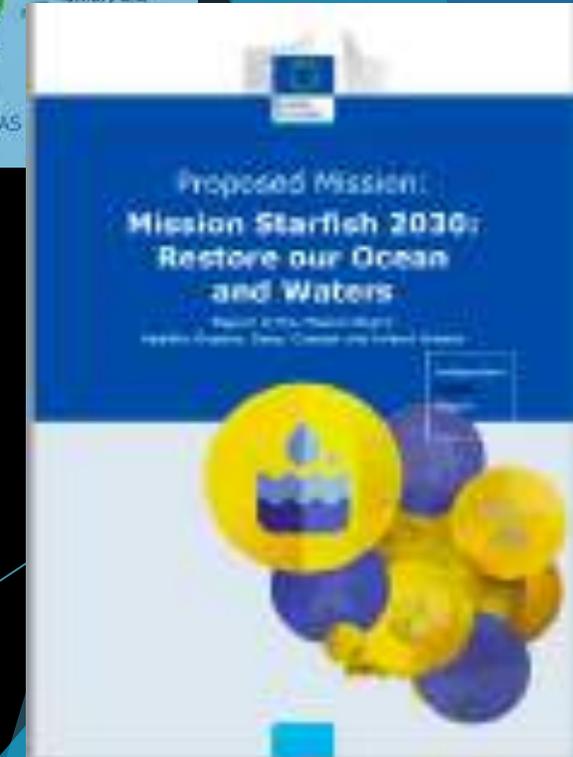
Restoration: when changes in resource management and natural processes are not in the position to recover a degraded ecosystem in a reasonable timeframe

Strategies, Directives and Legislations

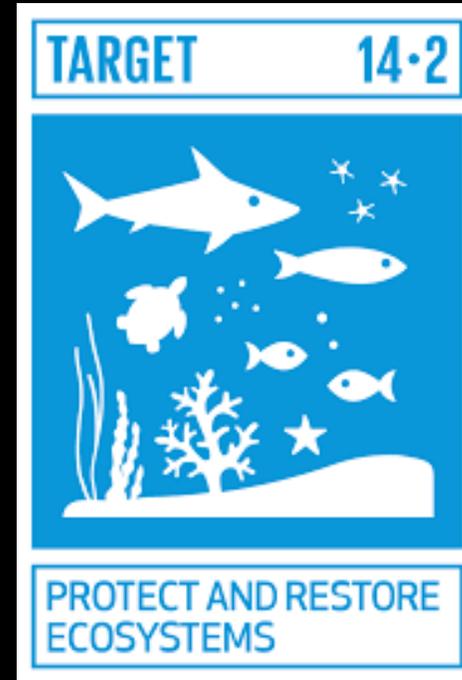
MSPD



MSFD



SDGs - Agenda 2030



2050 vision of the EU Biodiversity Strategy “European Union biodiversity and the ecosystem services it provides - its natural capital - are protected, valued and appropriately restored for biodiversity's intrinsic value and for their essential contribution to human wellbeing and economic prosperity

UN Decade of “Ecosystem Restoration” and UN Decade of Ocean Science for Sustainable Development



- ▶ SER is the leading international organization working on the science, practice, and policy of ecological restoration
- ▶ Ecological restoration must be integrated with conservation and sustainable production
- ▶ Restoration investment be based on a strong, defensible, and understandable scientific foundation

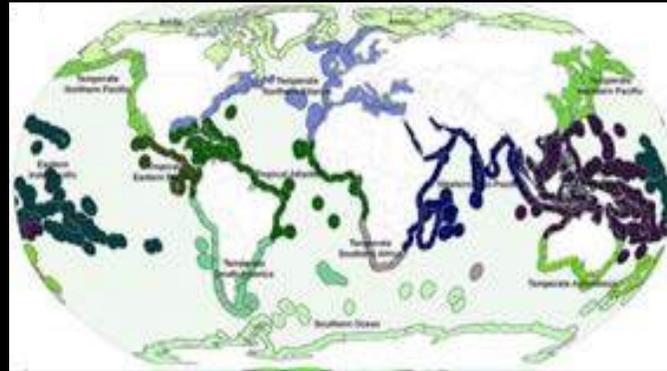
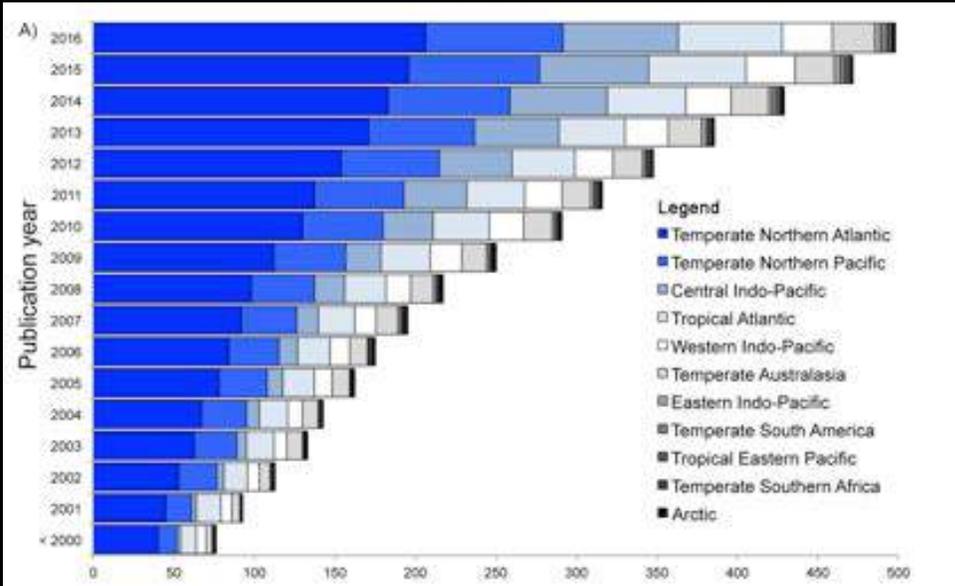


But the marine systems....

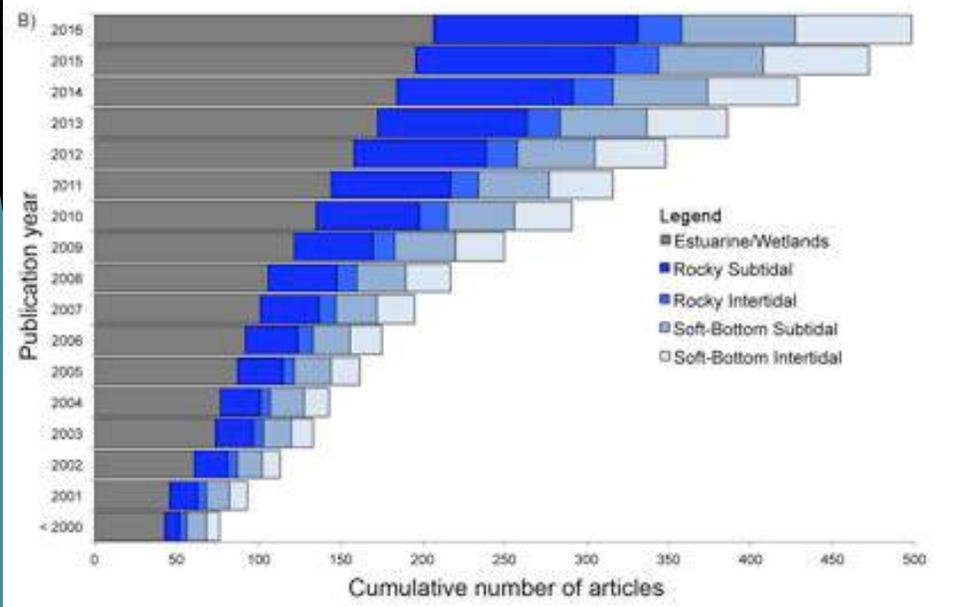
► What do we know about MARINE restoration?



Where?

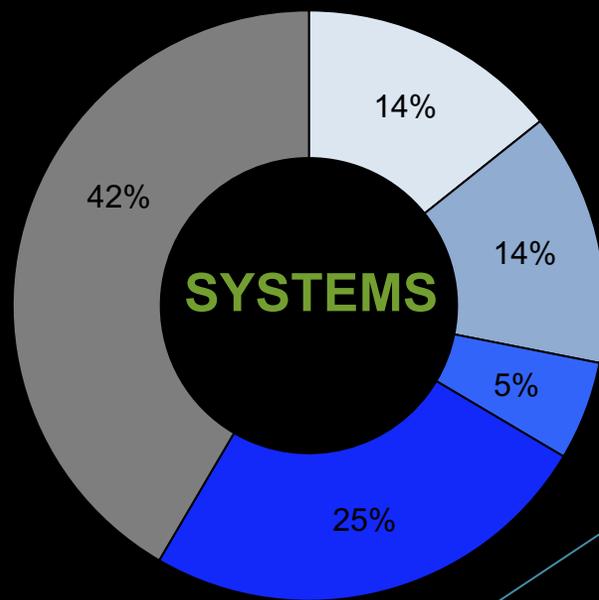


1 Most of the efforts have been concentrated in the northern part of the globe

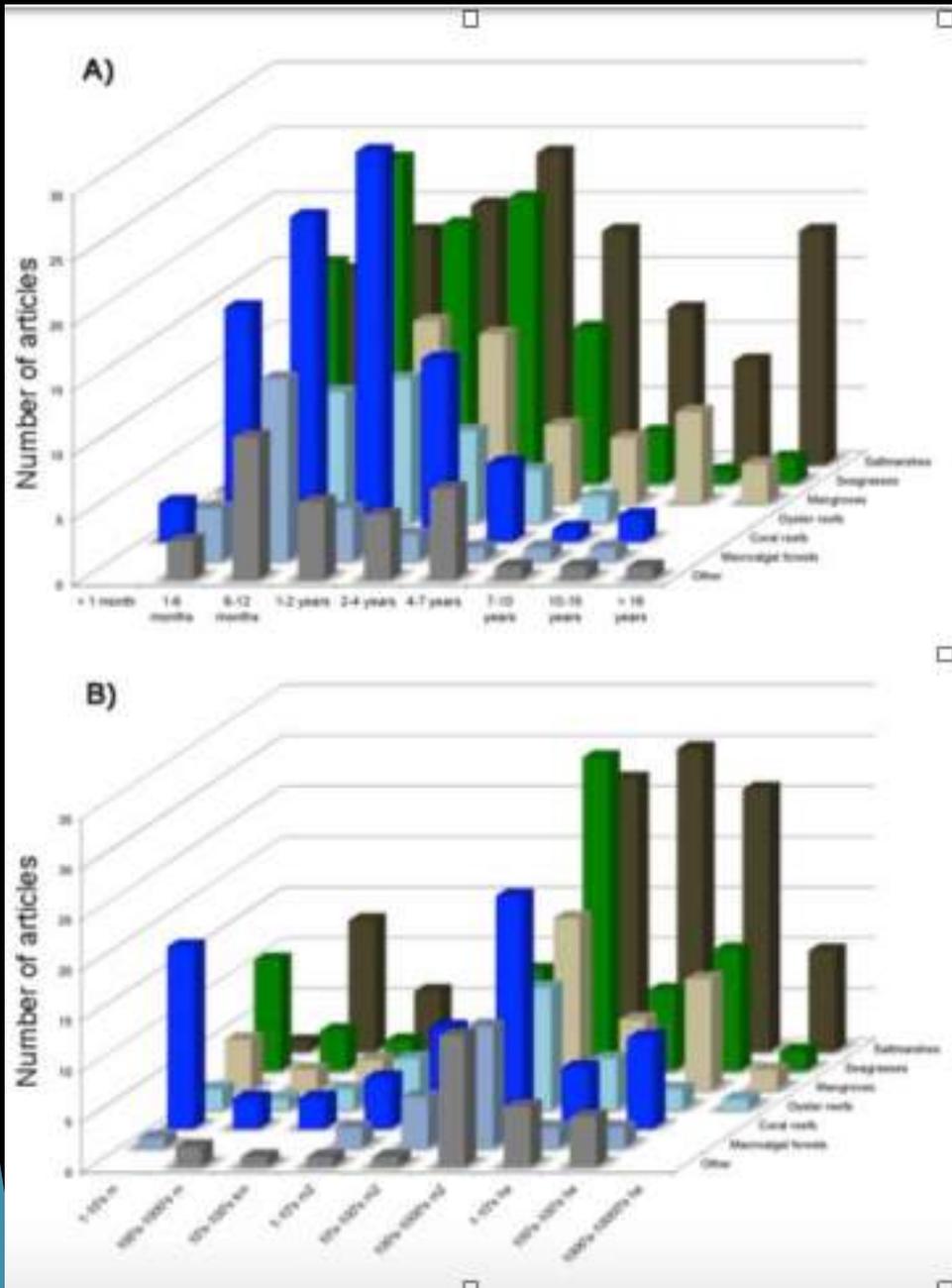


2 The highest number of studies has been recorded in estuarine/wetlands system

3 The most targeted habitat of restoration actions is represented by:



Extent and duration



- 12 With the exception of wetlands, most restoration projects cover too small areas (< 1 ha) to address the scale of human disturbance
- 13 Generally, most of the effort in the implementation of active restoration actions covered a temporal interval of few years (i.e. 1-2 years). Exception to this trend are: Saltmarsh, mangrove and seagrass habitats





First Conclusions

- Restoration efforts across marine habitats are increasing but focused on few habitats and **rarely approached at ecosystem level.**
- The **knowledge** across habitats is **still heterogeneous** and, for some habitats, we are still in the **explorative phase.**
- The outcomes of even the best-trained restoration methodology can still be highly uncertain
- The measure of “**success**” across studies is heterogeneous and sometimes also vaguely reported



Marine Ecosystem Restoration in Changing European Seas

merces@h2020ph8.eu Partners' Area

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Help
Keep the
ecosystem

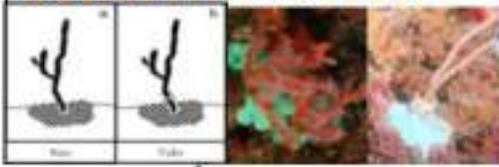
Presenting MERCES project - Restoring European Seas



Identify key processes for restoration success



Define protocols for restoration action



Scale-up pilot actions

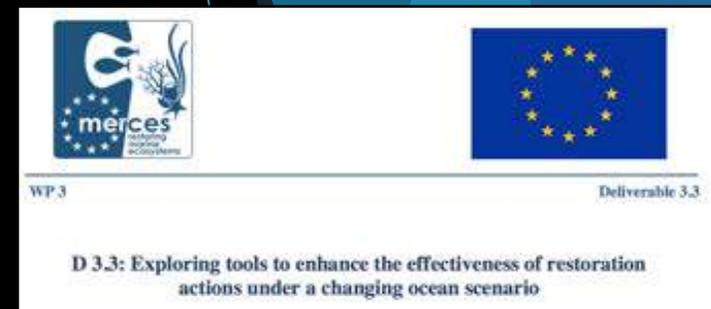


Perspectives

Restoration in a changing ocean



Combination of Lab & Field experiments

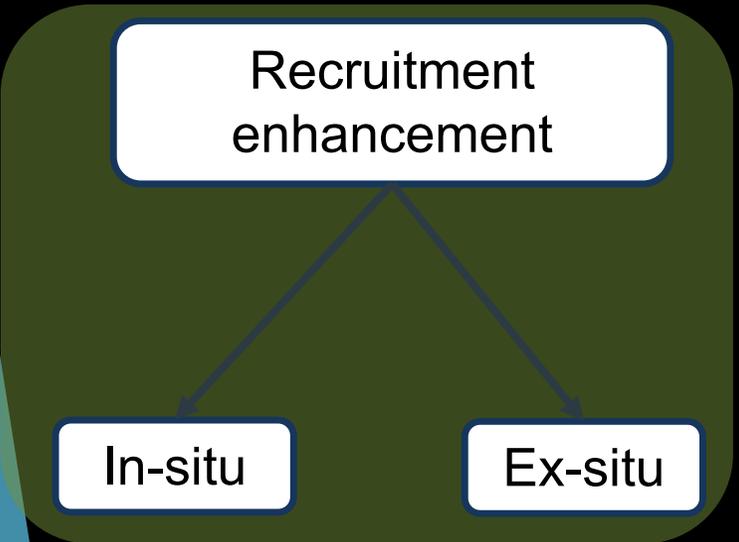


Working in different ecological contexts with same approaches to infer general patterns

+ 20 protocols
+ 60 scientific publication



1 Time 1 Action Big success



2011 Restoration action 4 sites * 5 m²

2014 Monitoring * 50 m²

2017 Monitoring * 100 m²

2019 Restoration success

High density of recruits

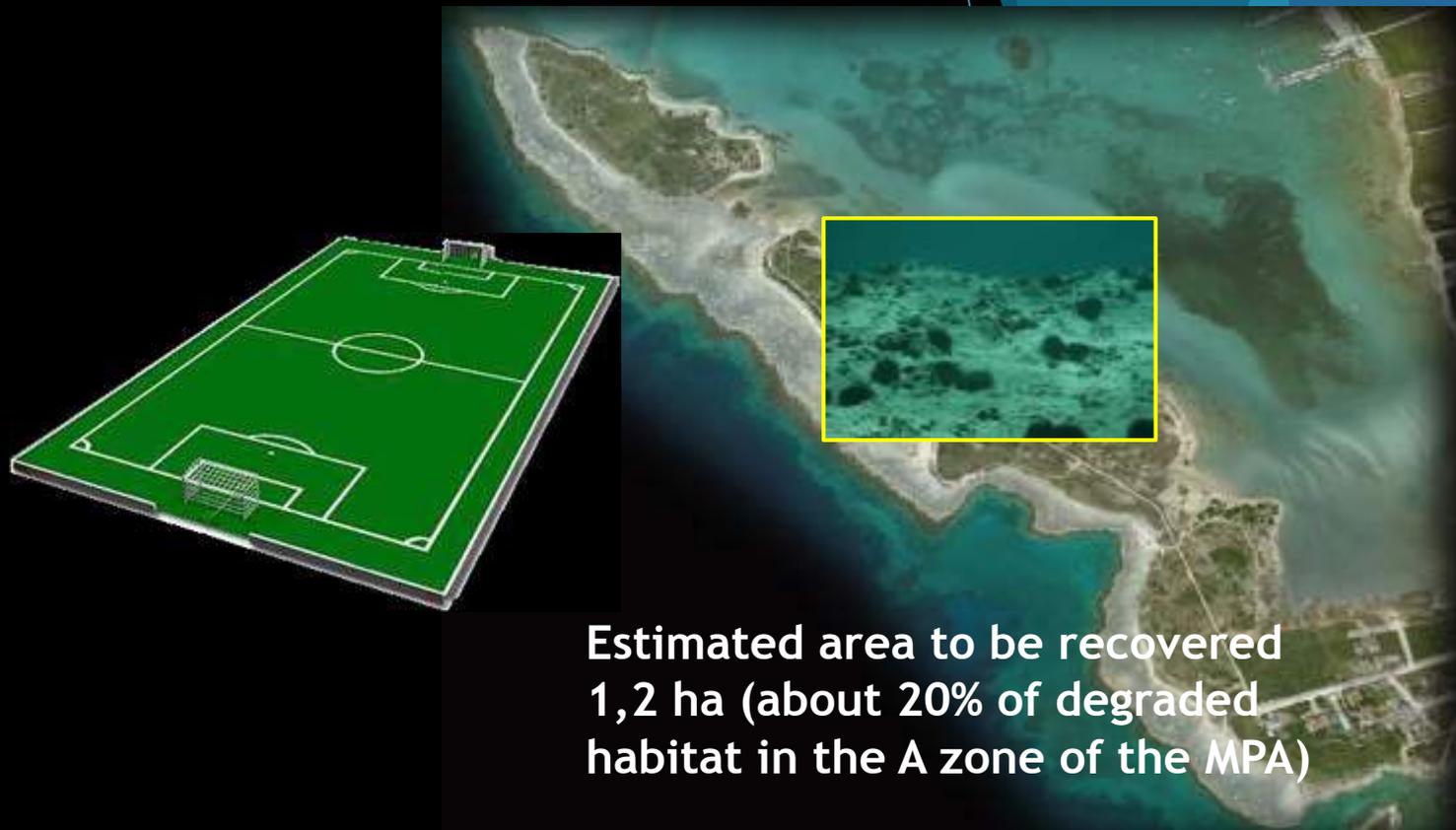
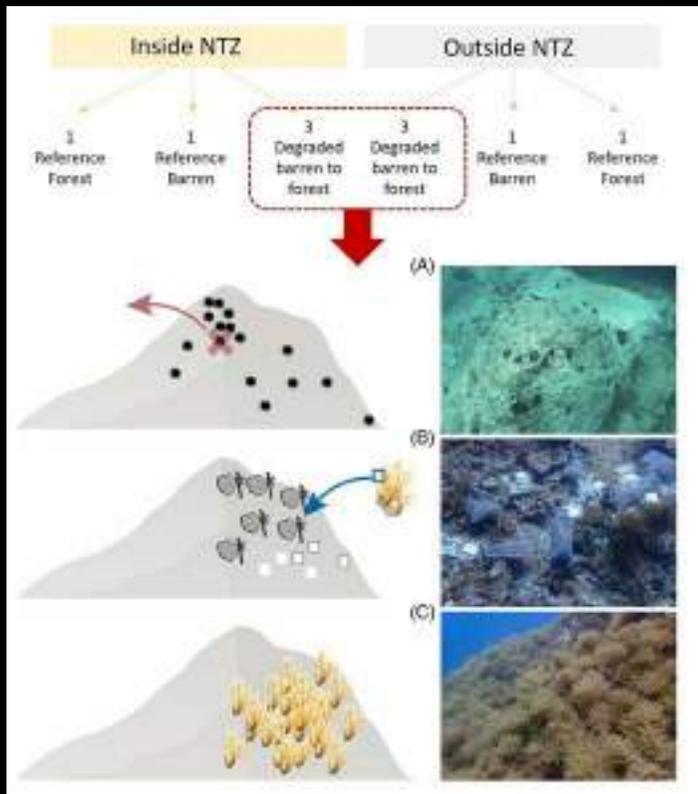
Similar density of individuals
 Presence of fertile individuals
 Area increase

100 m² of restored area
 Size structure comparable to donor and control populations
 Mature individuals: self-maintaining population

increased the 20% of the natural area of a priority habitat!



Synergistic interactions to support success interventions



Revegetation success was assessed 1 year later in the six barren grounds, but was only achieved after combining active with passive restoration strategies

RESTORATION ECOLOGY
The Journal of the Society for Ecological Restoration

RESEARCH ARTICLE [Full Access](#)

From marine deserts to algal beds: *Treptacantha elegans* revegetation to reverse stable degraded ecosystems inside and outside a No-Take marine reserve.

Alba Medrano, Bernat Hereu, Maria Clementson, Maria Pagés-Escobá, Graciela Rovira, Jordi Solà, CRISTINA LINARES

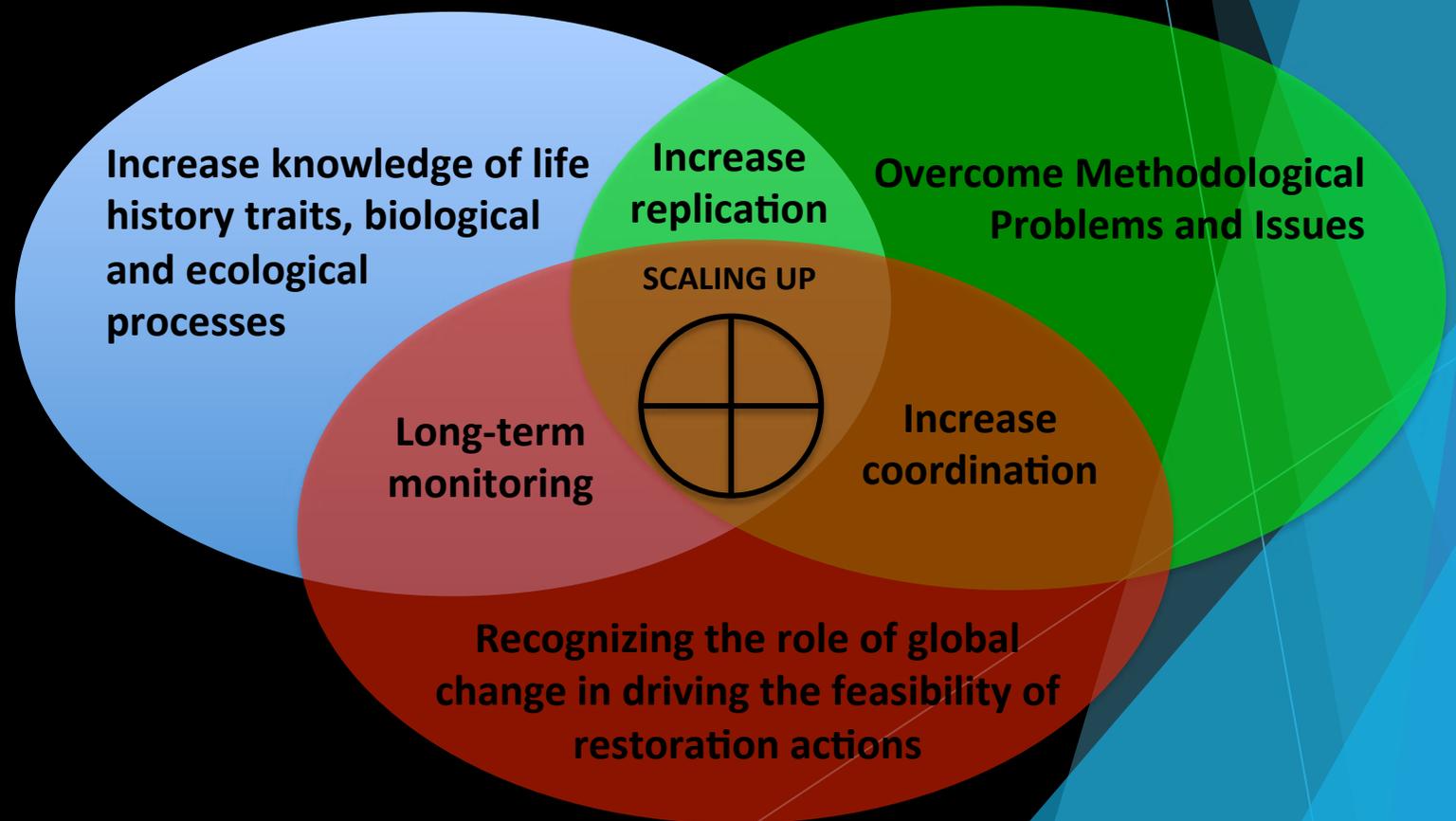
Large-Scale Sea Urchin Culling Drives the Reduction of Subtidal Barren Grounds in the Mediterranean Sea

Manuel Domínguez, Mónica Rodríguez, Ana Espino, José Martínez, and Mónica Espinosa

Conclusions from MERCES

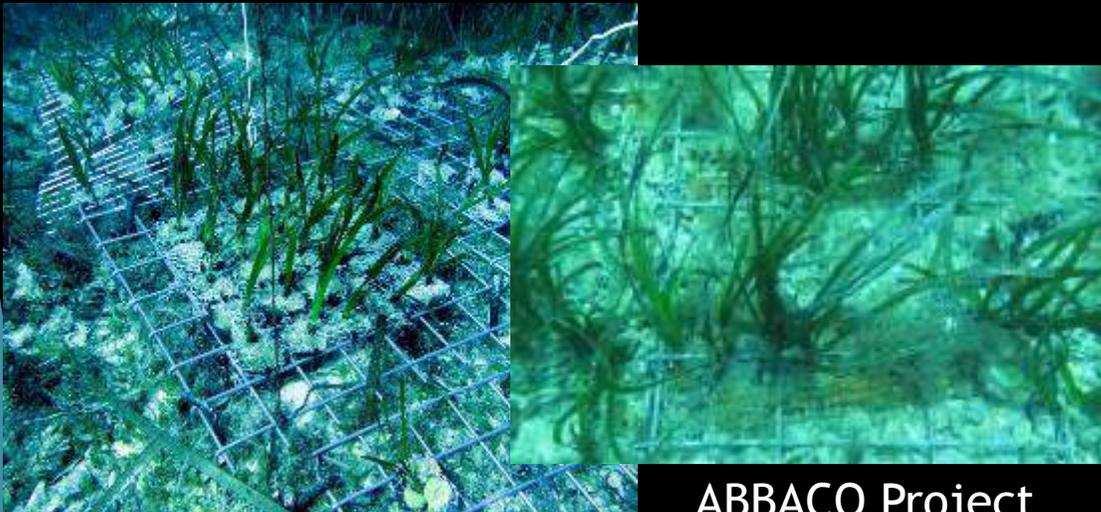


Scaling up is challenging. Knowledge about key processes and methodological issues have to be carefully considered to support large scale restoration interventions.



More success stories

Seagrasses



ABBACO Project



300 hectares of intertidal salt marsh, together with 70 hectares of transitional brackish habitat and over 100 hectares of coastal grazing marsh and freshwater habitat

Oyster reefs: hectares of habitat recovered



Human capitalization

UNIVERSITÀ
POLITECNICA
TRIEVE MARCHE

**The first training course on marine restoration
in the Mediterranean**



Trivase Porto (Lecce, Italy) 2-7 September 2018



new jobs in a framework of environmental sustainability.....

New investments from the EU



Afrimed Project



Restoring biodiversity and ecosystem services

TOPIC ID: LC-GD-7-1-2020

Grant



BiodivRestore Call Announcement

Upscaling
Restoration prioritisation informed by social, economic and ecological conditions
Setting baselines, goals and a monitoring framework
Supportive and robust management practices

- 1) fine scale mapping of degraded marine habitats at EU scale for setting restoration baselines and targets and providing a roadmap to prioritize areas and activities according to their urgency for upscaling coastal and deep-sea restoration efforts;
- 2) identifying and monitoring indicators and thresholds to measure large-scale restoration efficiency and success in terms of benefits and trade-off;
- 3) capitalizing restoration efforts from prior research experience to assess the restoration effects on marine biodiversity and ecosystem services;
- 4) applying the best technological, non-technological and social solutions (stakeholder participation) for sustaining and monitoring restoration success to assess the restoration effects on marine biodiversity and ecosystem services in different habitats from coastal areas to the deep sea;
- 5) provisioning a cost-benefit analysis of the effects and sustainability of the up-scaled restoration actions;
- 6) identifying public-private partnerships, cross-sectoral collaborations and forms of participation in marine restoration governance arrangements;
- 7) development innovative co-funding and crowdfunding of marine ecosystem restoration to accelerate investments in and promotion of marine coastal restoration.

Marine restoration projects are undervalued

Coral reefs, mangroves, and seagrass beds support the livelihoods of many millions of people worldwide. These ecosystems are rapidly degrading, leading governments and foundations to dedicate billions of dollars to their active restoration. Such initiatives are often criticized for being too small in scope and too expensive to combat the extent of anthropogenic threats driving habitat loss [e.g., (1, 2)]. However, this criticism undervalues key attributes of restoration projects that are not contingent on spatial scale.

Restoration accelerates the recovery of biological communities at local scales. Although restored habitats remain vulnerable to subsequent disturbance events, their biodiversity has the potential to increase ecosystem resilience of larger areas by providing seed material for recovery (3). Restoration can also counter the economic, socio-cultural, and psychological impacts of habitat degradation for local communities (4), even if techniques are too expensive to upscale globally. The pessimistic view of marine restoration as a fruitless exercise differs from attitudes about the rehabilitation of forest habitats that suffer equivalent large-scale degradation. Generally, socio-economic, ecological, and cultural values

INSIGHTS | LETTERS

are appreciated in tree planting, whether it involves a few saplings or millions (5, 6).

Political agreements for global reductions in atmospheric carbon have been slow to emerge. Relying on their implementation as the only solution to the degradation of tropical habitats is a major gamble. In the meantime, restoration projects could help maintain species survival and ecosystem services, ultimately providing humanity with the breathing space to stabilize the climate.

Timothy A. C. Gordon^{1,2*}, Andrew N. Radford³,
Stephen D. Simpson¹, Mark G. Meekan²

¹University of Exeter, Exeter EX4 4PS, UK.

²Australian Institute of Marine Science, Perth, WA 6009, Australia. ³University of Bristol, Bristol BS8 1TQ, UK.

*Corresponding author. Email: tg333@exeter.ac.uk





Advances in marine forests restoration under the EU project AFRIMED and stakeholder involvement

Save the date



Is it possible to recover an extinct marine forest?

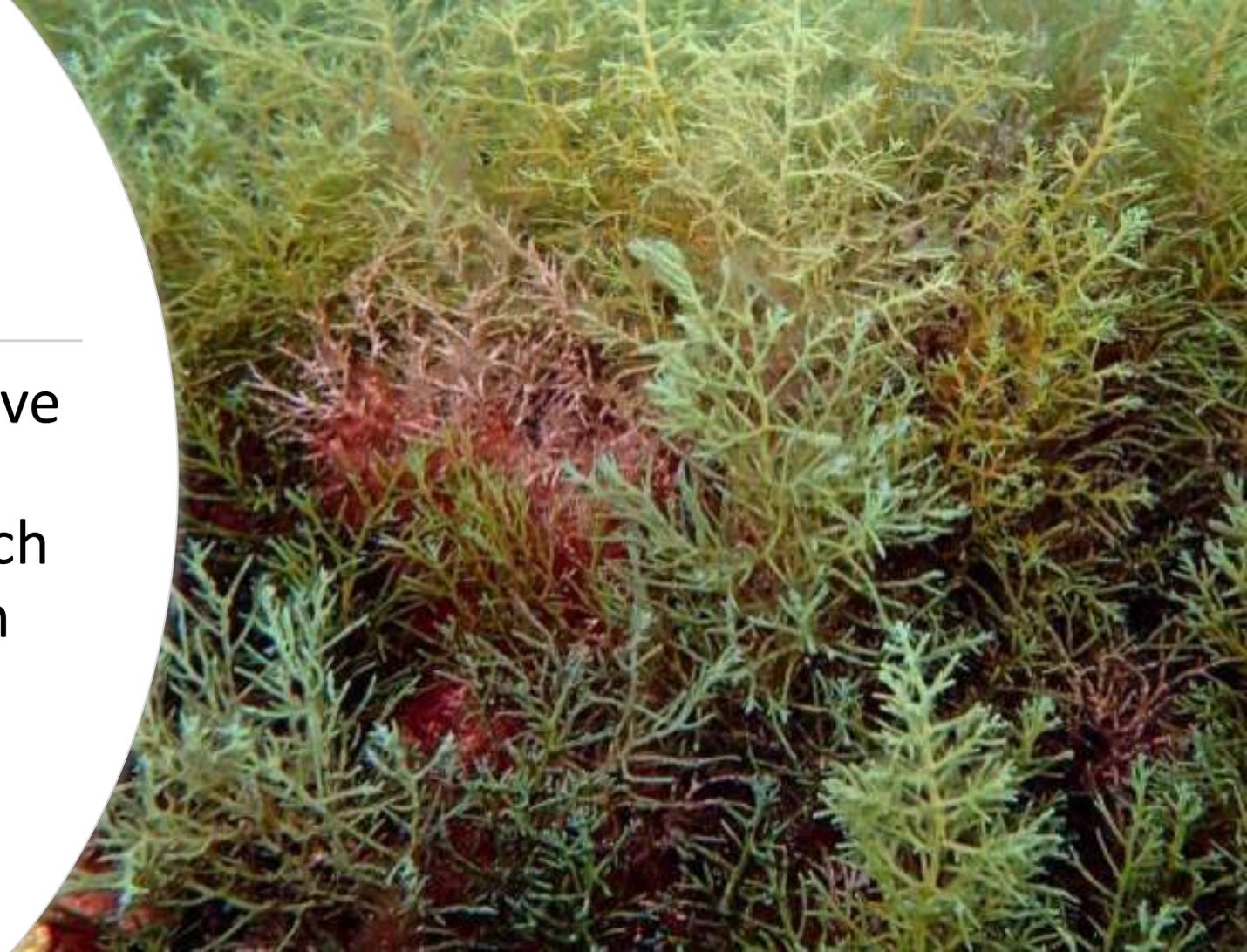
Dra. Emma Cebrian







Most productive
and
biodiversity-rich
ecosystems on
Earth.





Marine Forests

The importance of conservation

Enter

Conservation

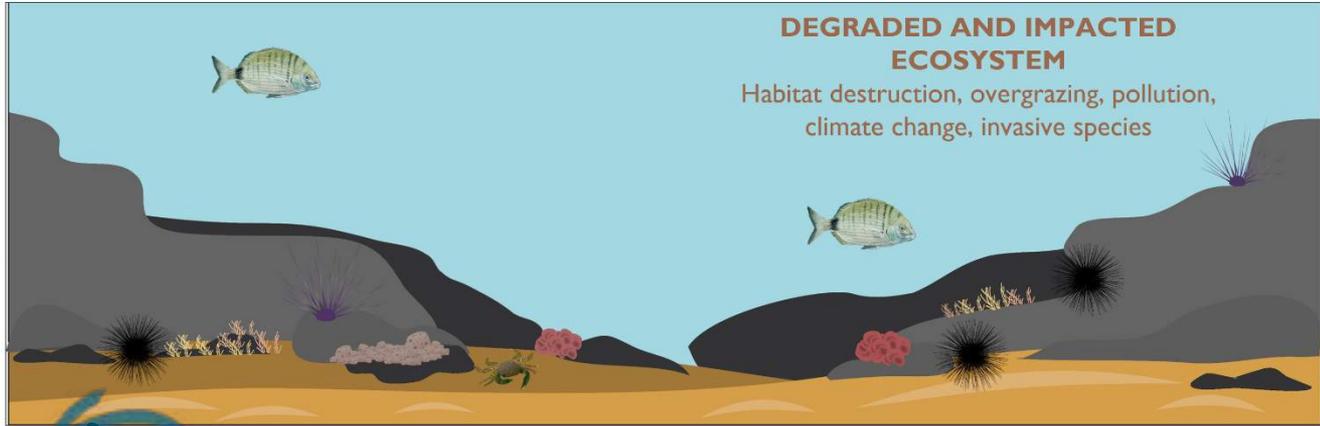




Cystoseira forest



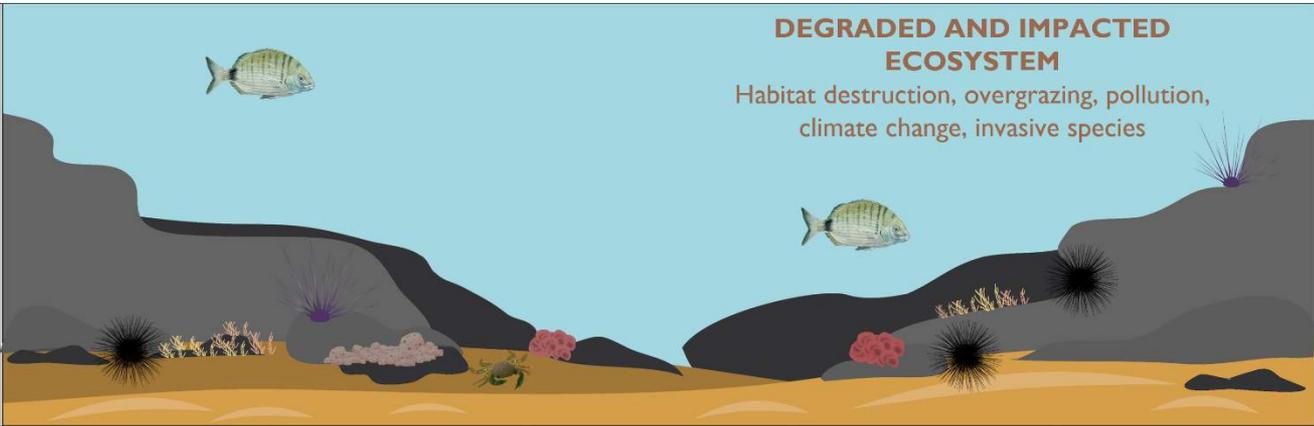
Solution...



1st Impact mitigation



Solution...
?
?
?



Degraded and impacted ecosystem



Juvenile cultivation



Transport to the field



Population restoration



Marine forest





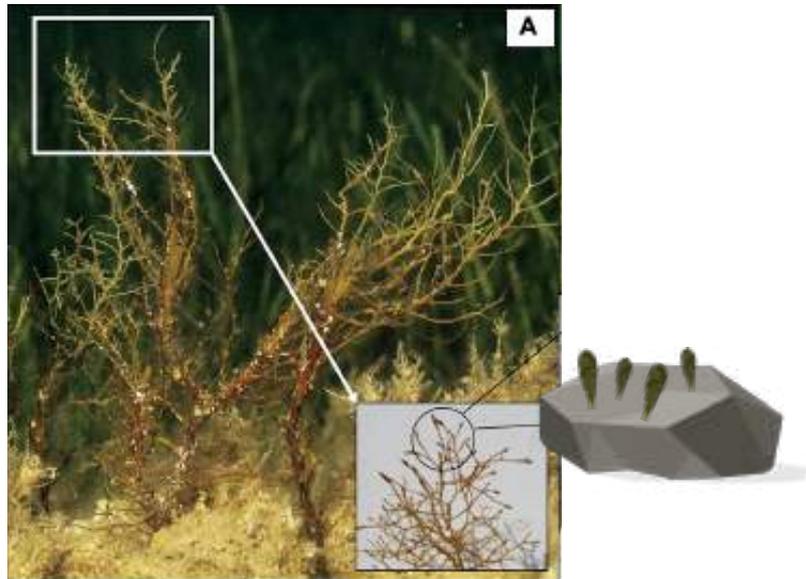
Adults
transplantation

WARNING

Critical
conservation
status

Recruitment
enhancement

Non destructive methods
with less adult manipulation

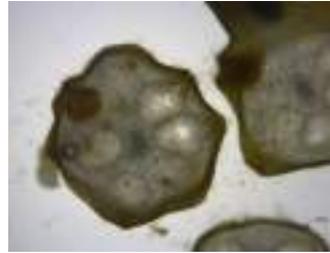


Recruitment
enhancement

Non destructive methods
with less adult manipulation

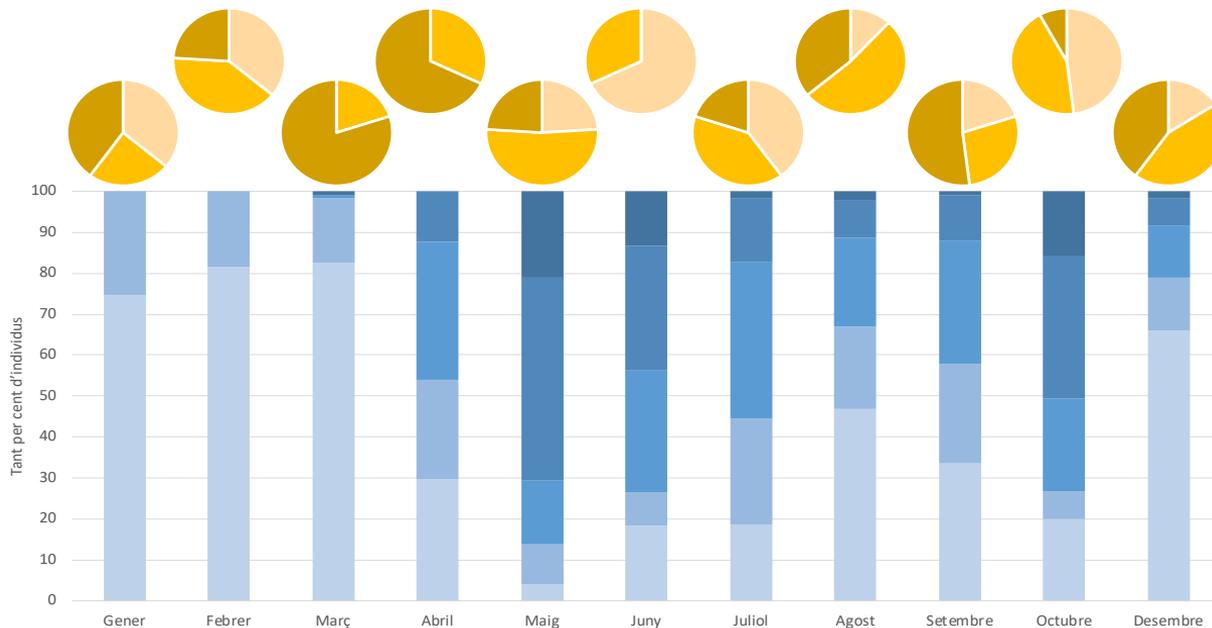
What do we need to know?

1. Phenology



What do we need to know?

1. Phenology

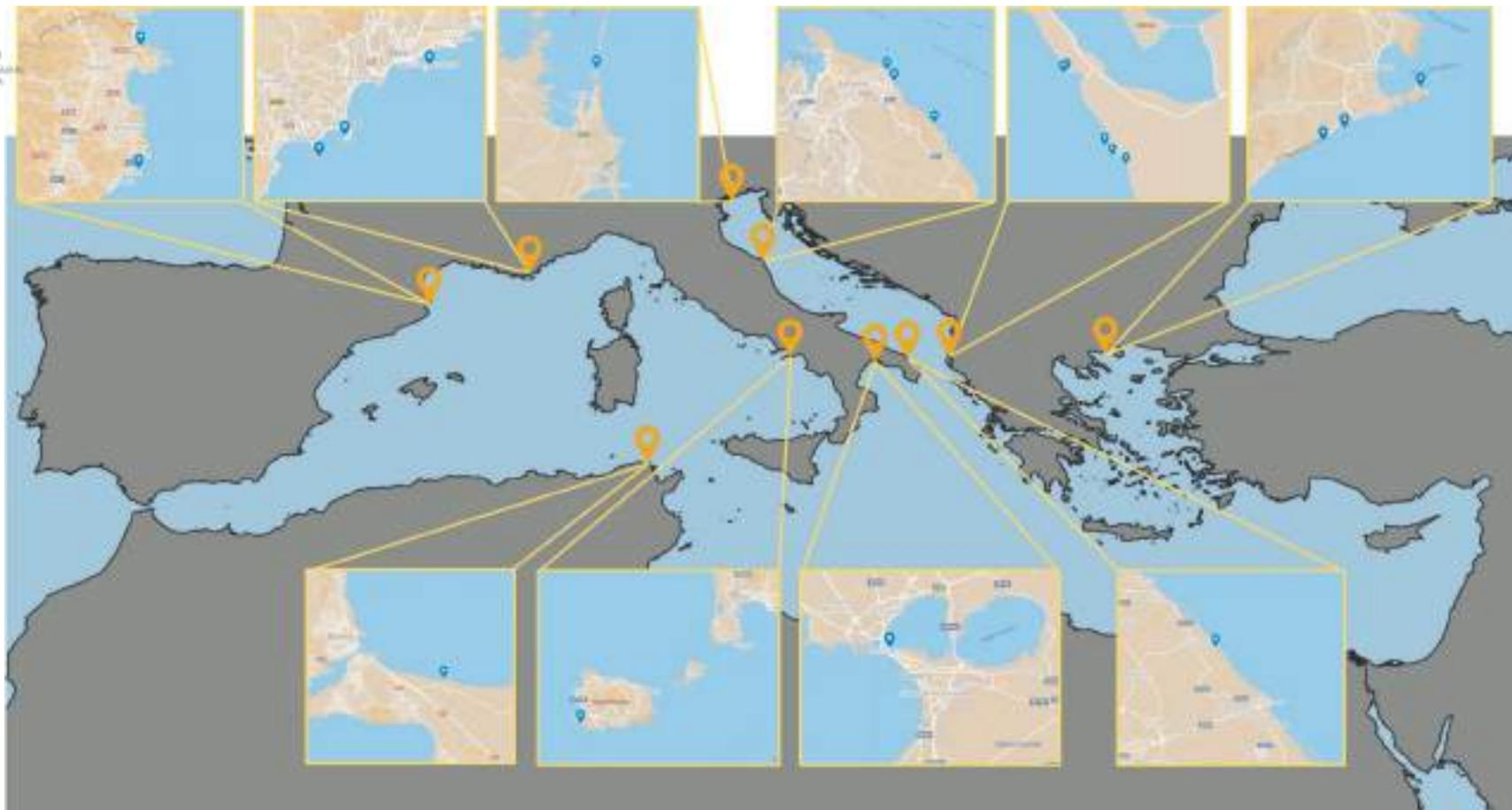


Stage of receptacles:

- Mature
- Immature
- Not fertile

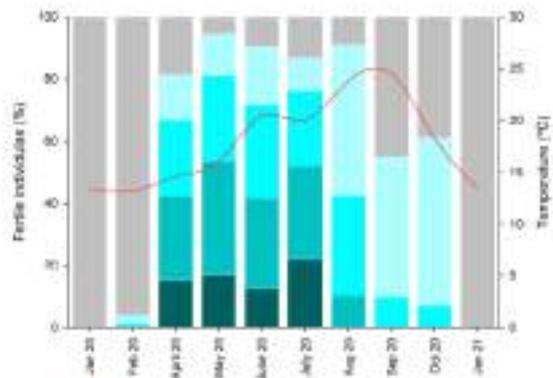
Presence of fertile branches:

- 75-100%
- 50-75%
- 25-50%
- 1-25%
- 0%

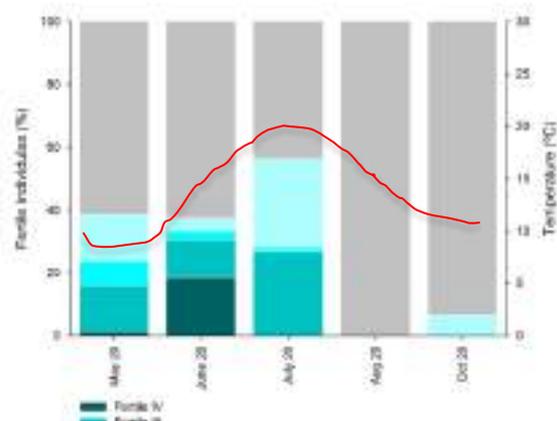


Phenological studies

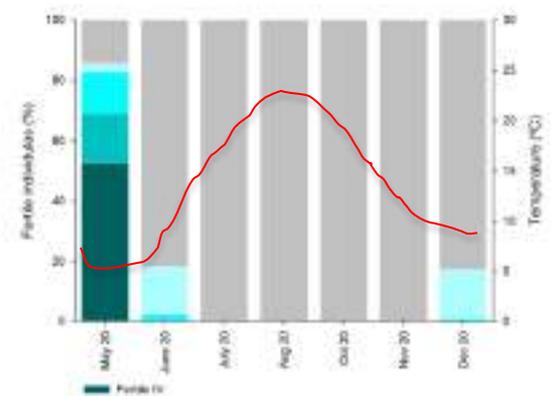
E. crinita - Cala Estreta



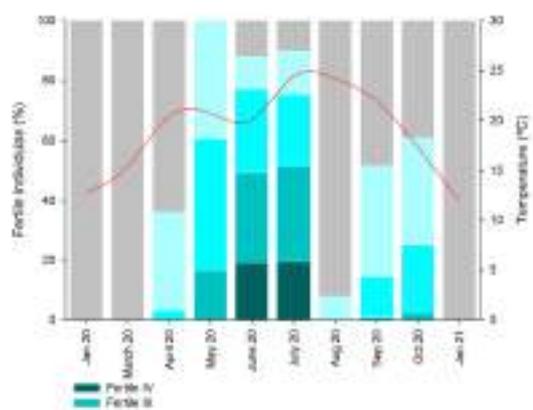
E. crinita - Sta. Margherita



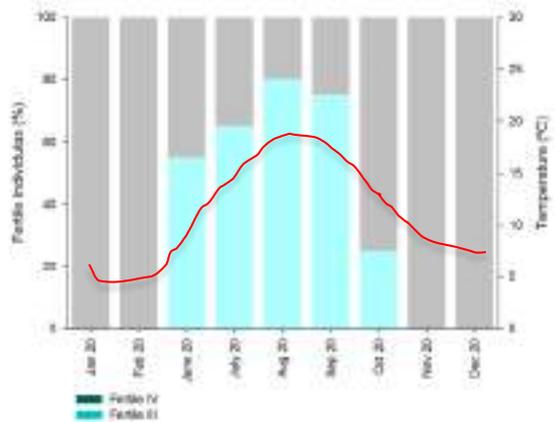
E. crinita - Ischia



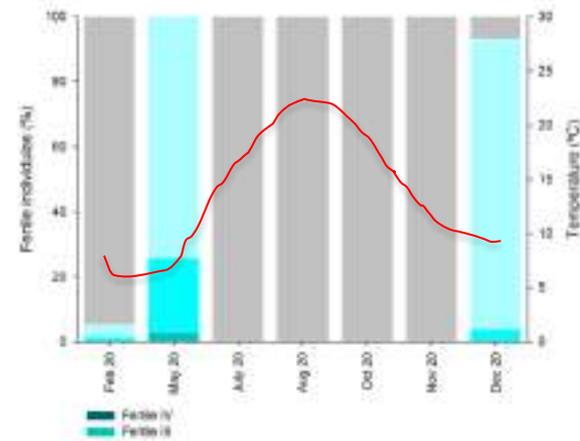
E. crinita - Port de la Solva



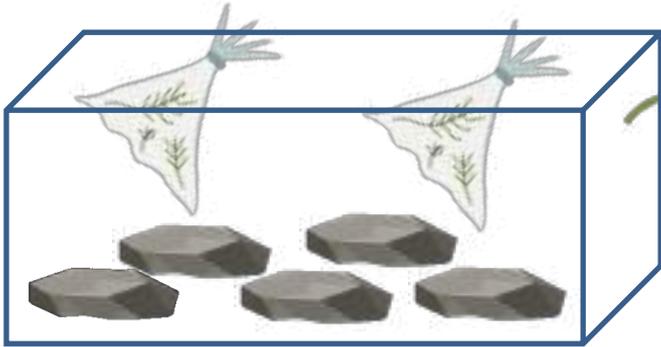
E. crinita - Bizerka



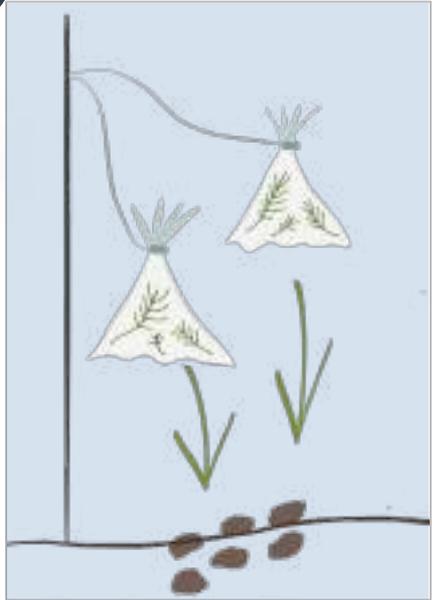
E. crinita - Frigole



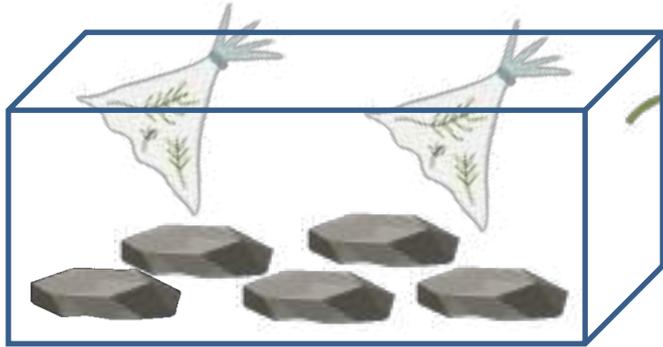
Ex-situ



In-situ



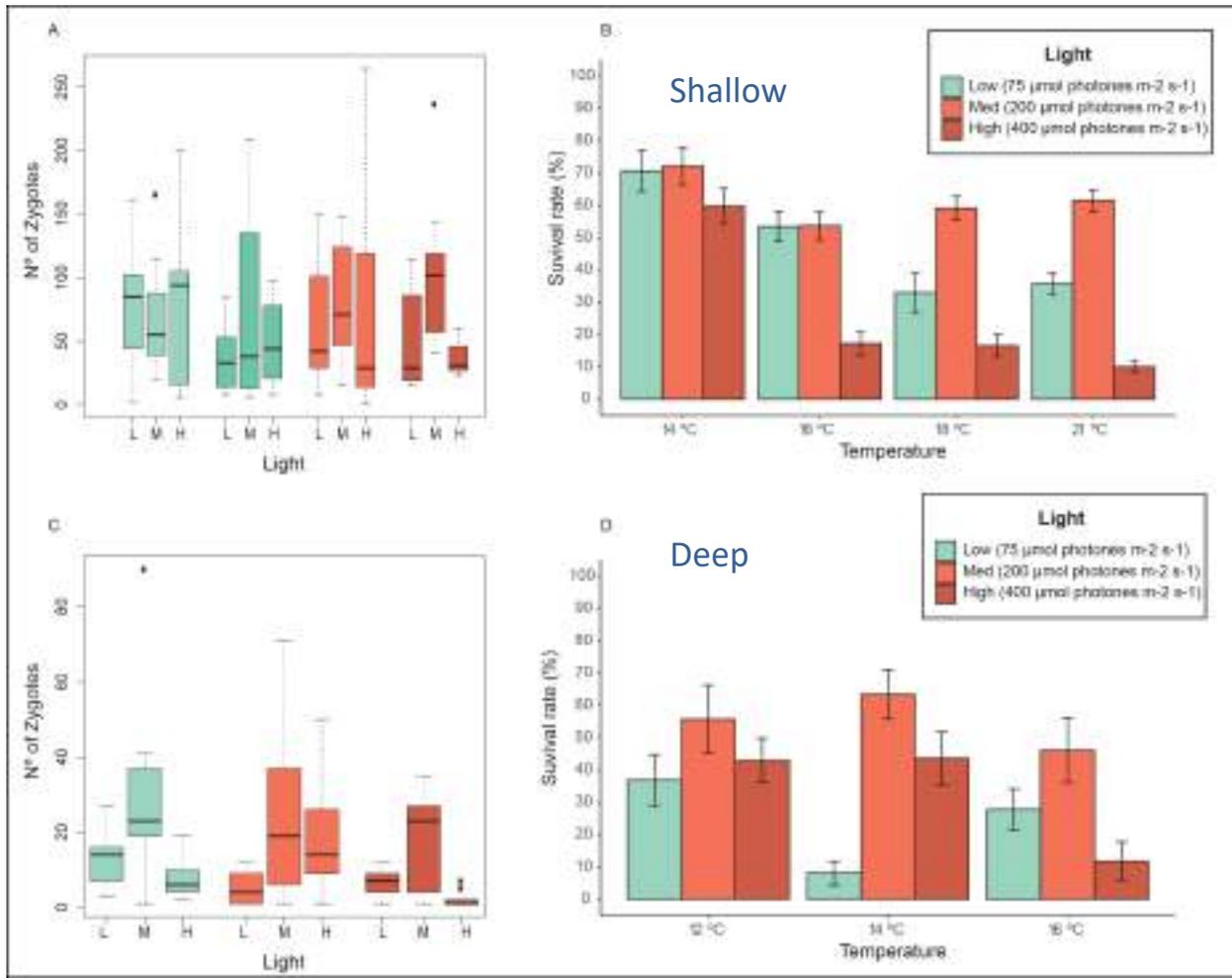
Ex-situ



Environmental conditions

- Irradiance
- Temperature





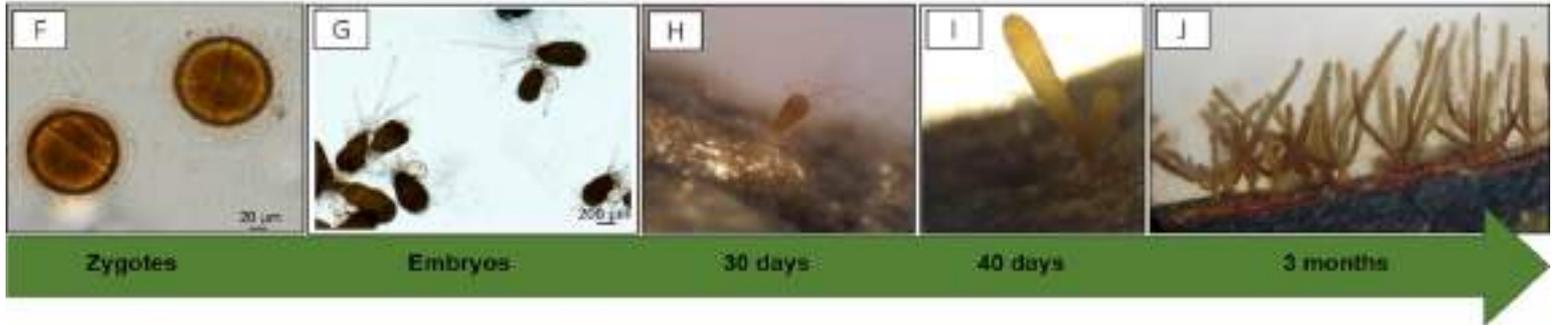
Environmental conditions



- Irradiance
- Temperature

Ex-situ

In-situ



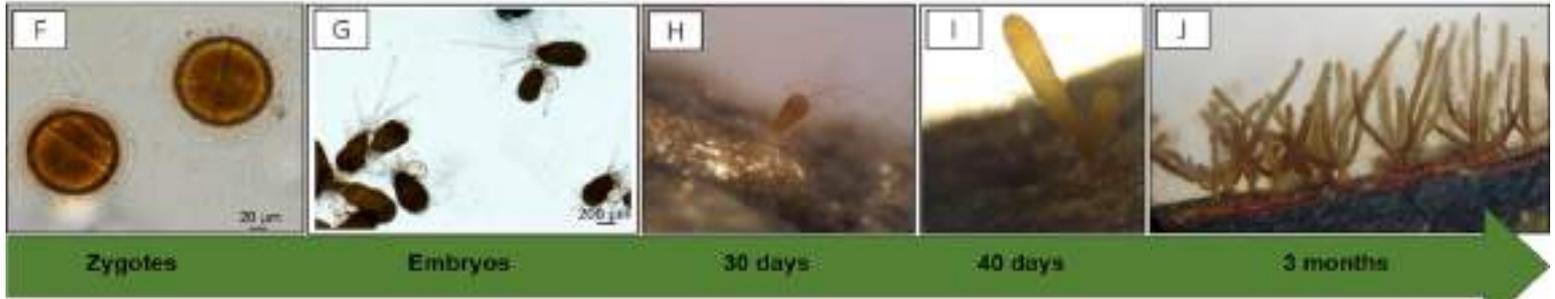


Is it possible
to recover an
extinct marine
forest?



Ex-situ

In-situ



How many substrates with recruits do we need?

How many times?

How much does it coast?



1 Time 1 Action Big success

2011

Restoration action 4 sites * 5 m²

2014

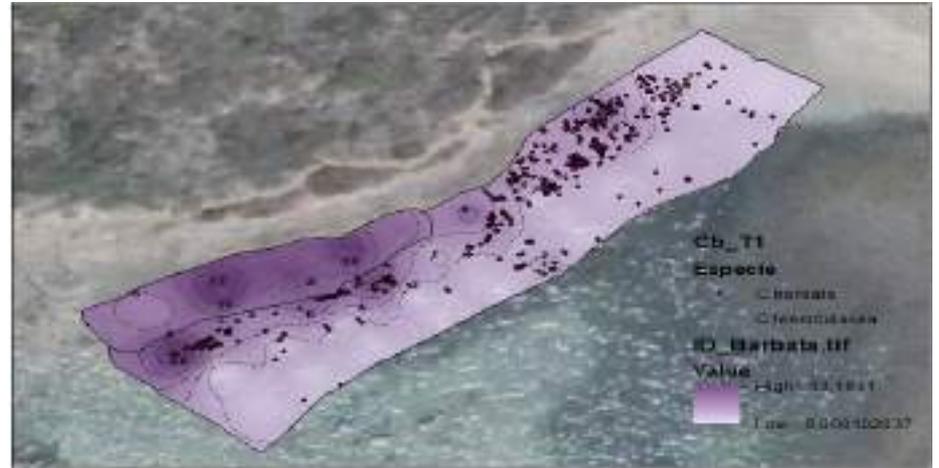
Monitoring * 50 m²

2017

Monitoring * 100 m²

2019

Restoration success • 965 m²

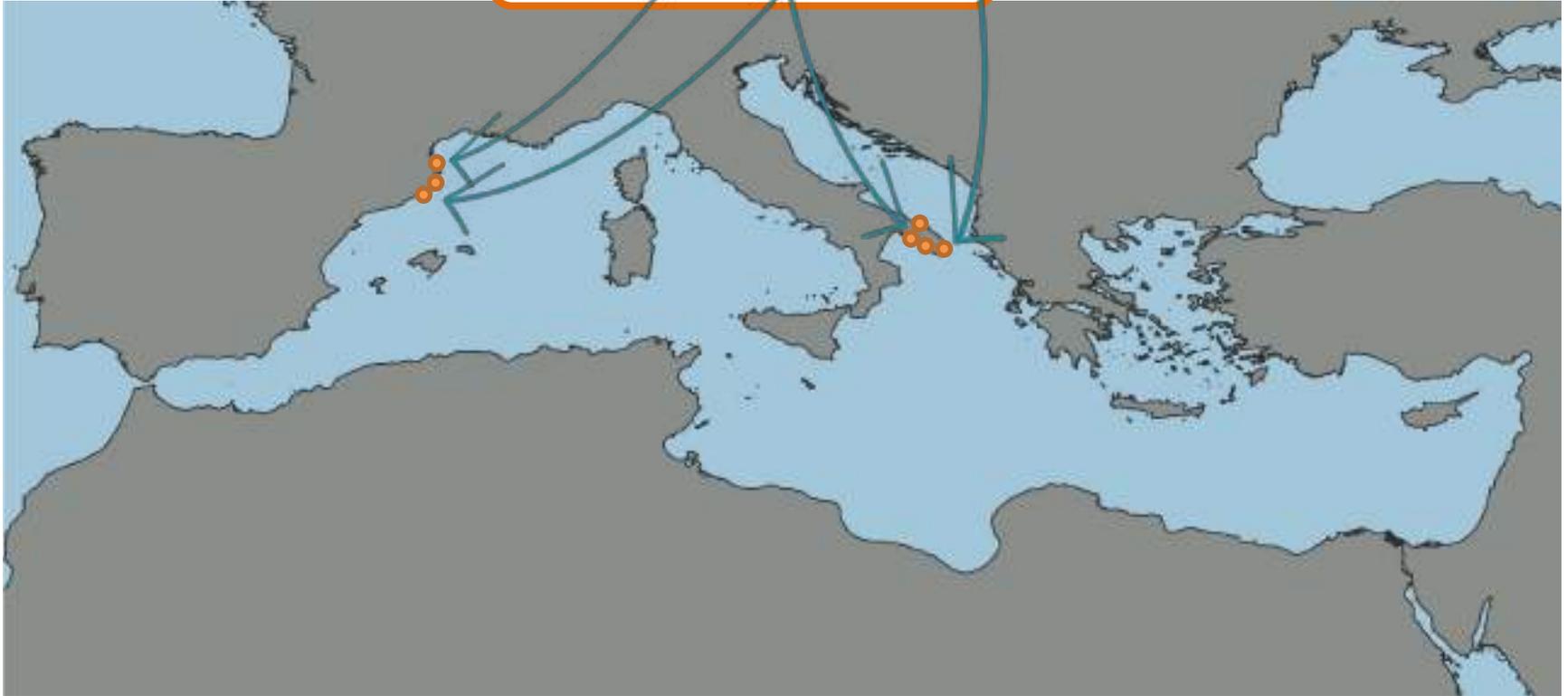




Happy end

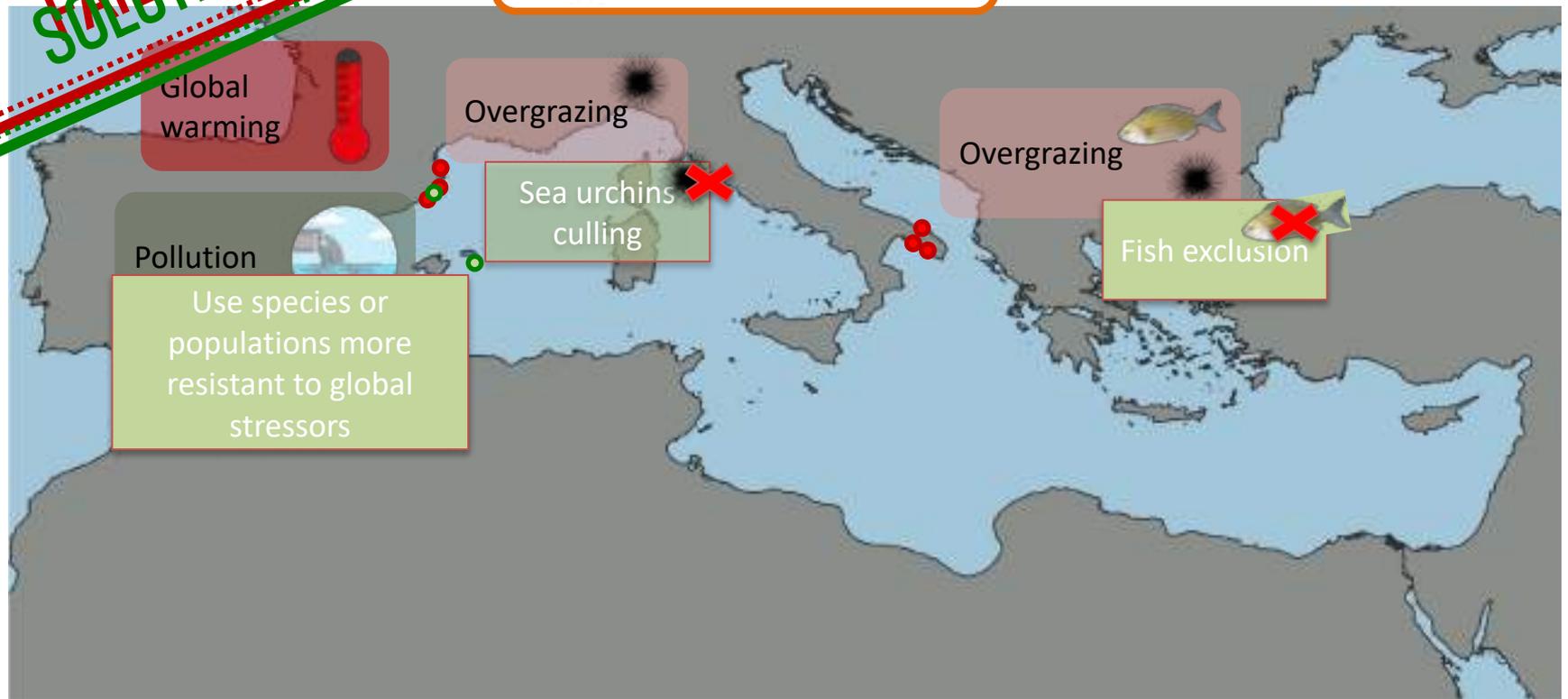


Restoration Actions



FAILURE
SOLUTION

 Restoration Actions





How much does it cost?

	METHOD		Complementary techniques		
	In Situ	Ex situ	Sea urchins culling	Herb. exclusion (cages)	Substrate provision
Needed /previous knowledge					
Implementation activities					
Maintenance activities after planting					

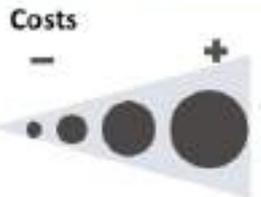
Concepts

- Personnel
- Material
- Facilities

Personnel costs:
 Field work
 Lab work
 Culture maintenance
 Population monitoring
 Bibliographic resources

Material:
 Dive material
 Culture equipment and sensors
 Sampling material
 Epoxy, plastic bags, dispersal bags, cages.

Facilities
 Culture labs
 Microscope

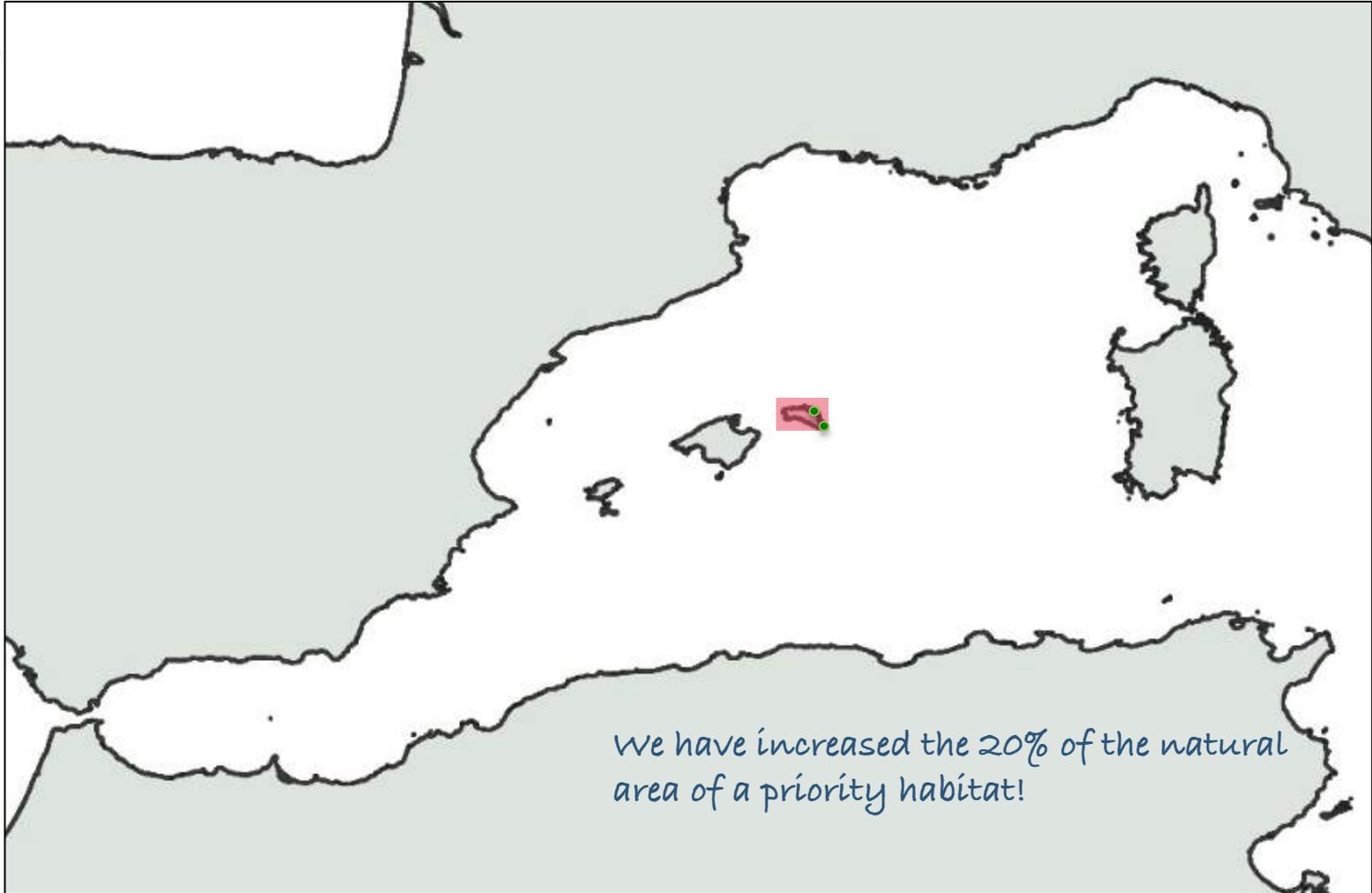


Is it a lot?





Balearic Islands



We have increased the 20% of the natural area of a priority habitat!

- UPSCALING? Yes, we can!
- Let's enroll new actors and share techniques!
- Use species or populations more resistant to global stressors





www.afrimed-project.eu



 AFRIMED_eu

 AFRIMED_eu



Afrimed Project



AFRIMED (community)

Advances in marine forests restoration under the EU project Afrimed

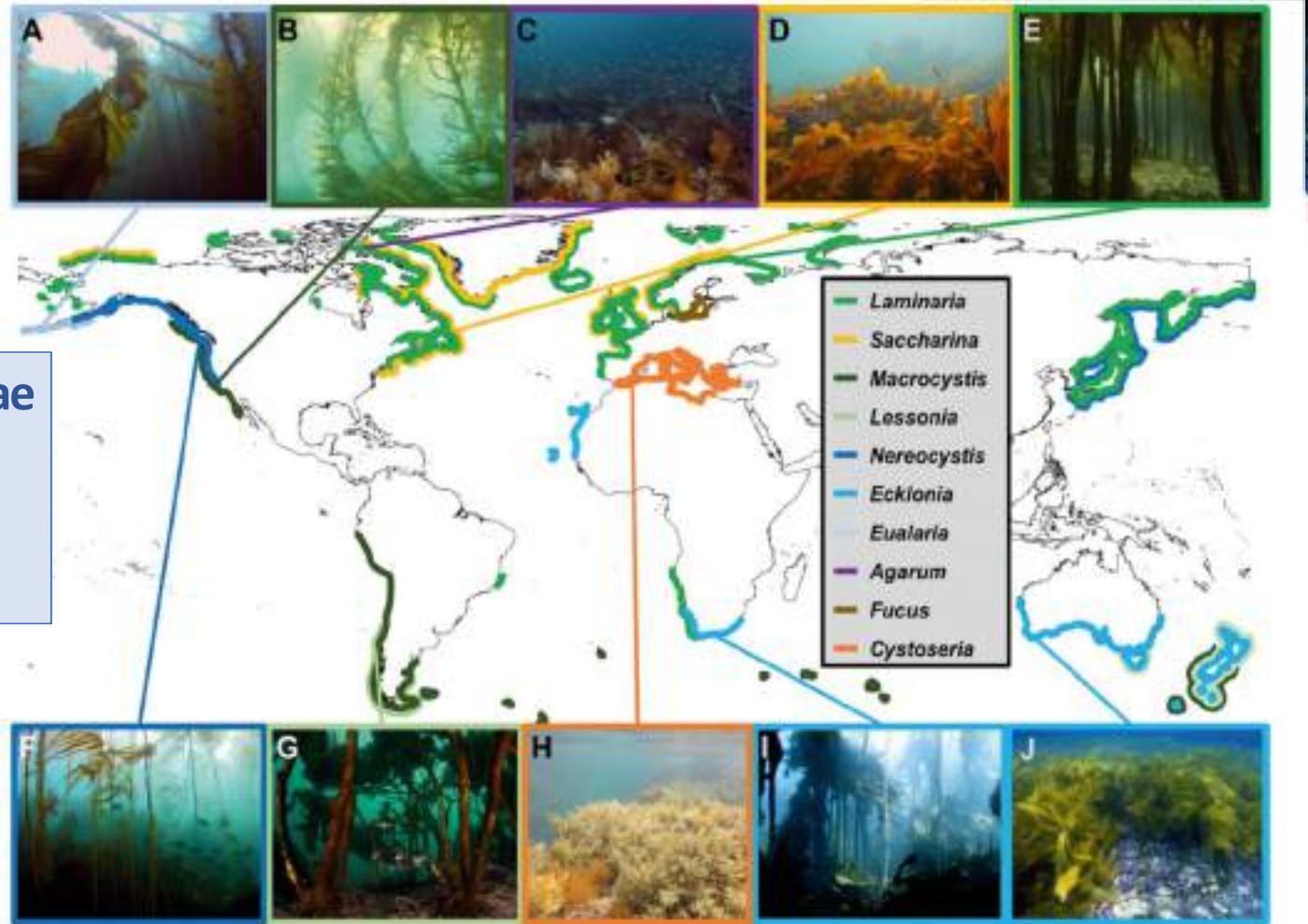
Context-dependent restoration actions : case studies

L. Passeron Mangialajo



Advances in marine forests restoration under the EU project Afrimed

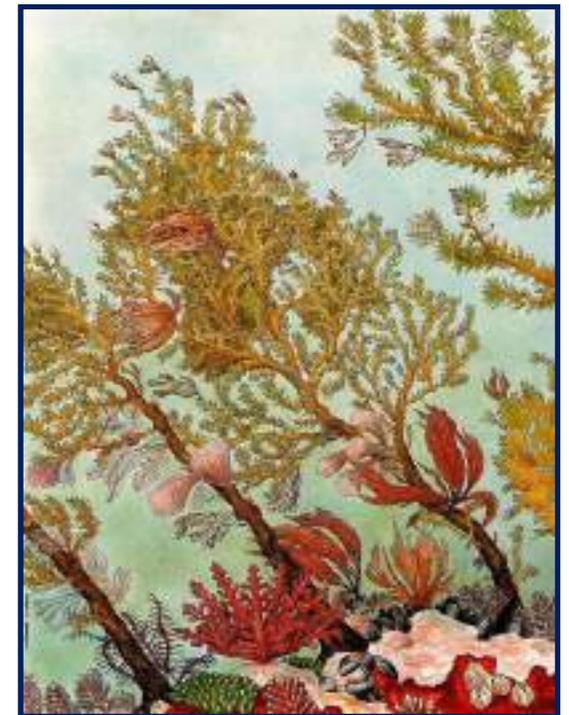
Marine forests of large brown algae worldwide, mostly composed by Laminariales (kelps) and Fucales (fucoids)



Thomas Wernberg T., Filbee-Dexter K., 2019

In the Mediterranean Sea: mostly fucalean species of the genus *Cystoseira sensu lato* (now *Cystoseira*, *Ericaria* and *Gongolaria*¹) and *Sargassum* (but also few Laminariales).

- **More than 30 species, most of them endemic of Mediterranean Sea** (tricky identification, rare historical data and poorly known actual distribution)
- **Long-living (several dozens of years²)**
- **Short dispersal³**



¹ Orellana et al., 2019; Molinari and Guiry, 2020

² Ballesteros et al., 2009

³ Mangialajo et al., 2012, Verdura et al., 2018

Shallow forests (exposed)



Ericaria amentacea
(but also *E. mediterranea*,
E. selaginoides, *C.*
compressa...)

Shallow forests (sheltered/rockpools)



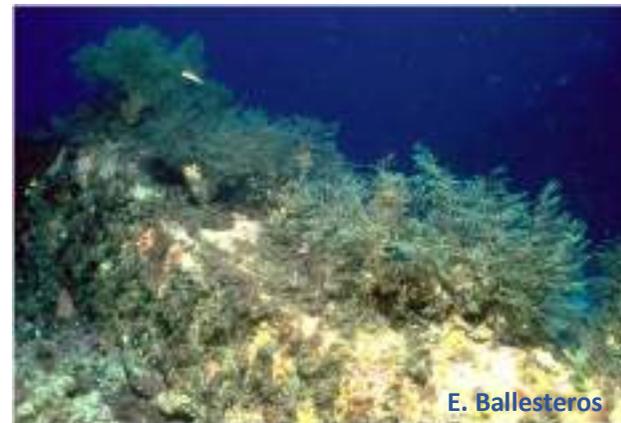
Gongolaria barbata
(but also *G. squarrosa*,
E. barbatula, *E. crinita*,
C. foeniculacea...)

Infralittoral forests



Ericaria brachycarpa
(but also *C. corniculata*,
G. sauvgeauana,
G. elegnas, *G.*
montagnei...)

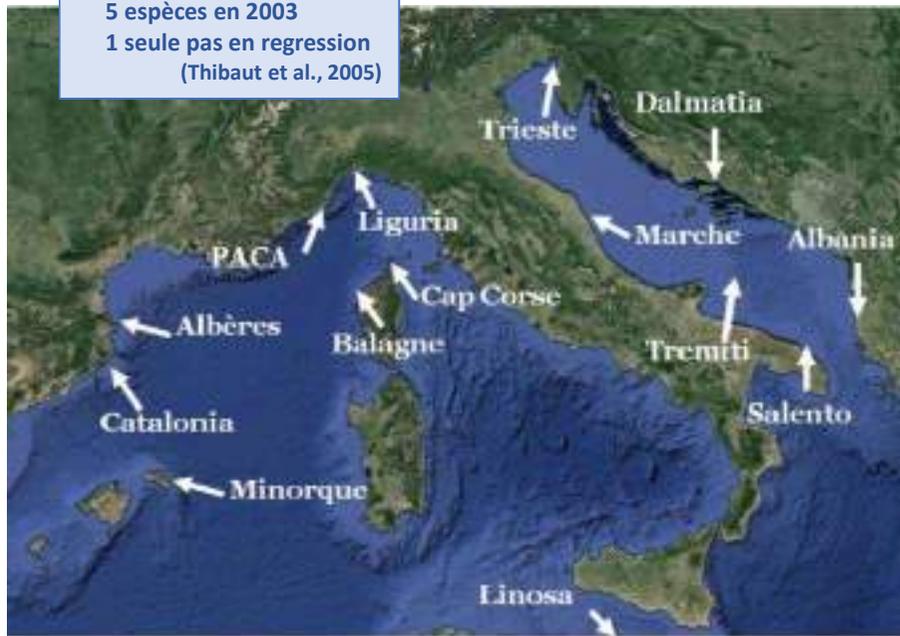
Deep forests



Ericaria zosterooides
(but also *E. funkii*,
C. montagnei v.
compressa...)

Drivers of loss :

Côte des Albères
 14 espèces en 1912
 9 espèces en 1978
 5 espèces en 2003
 1 seule pas en regression
 (Thibaut et al., 2005)



- Vukovik 1982
- Hoffman *et al.* 1988
- Airoldi 1998
- Cormaci & Furnari 1999
- Thibaut *et al.* 2005
- Guidetti 2006
- Serio et al. 2006
- Mangialajo *et al.* 2008
- Perkol-Finkel & Airoldi 2010
- Sales & Ballesteros, 2010
- Fraschetti *et al.* 2011
- Navarro et al., 2011
- Sales et al., 2011
- Cardona *et al.* 2013
- Robvieux 2013
- Bianchi et al., 2014
- Thibaut et al., 2015
- Orlando et al., 2021



- **Habitat destruction (especially in shallow forests)**
 - **Decrease in water quality (pollutants, turbidity)**
 - **Physical damage (anchoring, fishing, trampling)**
 - **Biotic factors (herbivory, competition, invasions)**
 - **Climate change**
- (and they are often interacting)

Efforts have been made in recent decades in order to reduce such drivers



Biotic factors

Herbivory - a threat to marine forests



Sea urchins are considered the most effective herbivores in temperate areas

A DELICATE BALANCE KELP FORESTS, SEA URCHINS, AND SEA OTTERS

Kelp forests are highly productive ecosystems. In addition to supporting ocean life, they absorb carbon dioxide from the atmosphere—a critical function when humans are increasing the amount of atmospheric carbon dioxide through fossil fuel emissions.

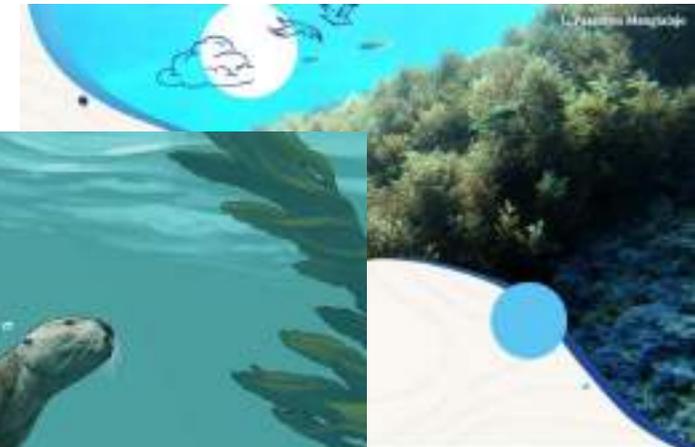
Warming ocean waters have brought a new threat to **GIANT KELP** (*Macrocystis pyrifera*) and **BULL KELP** (*Nereocystis luetkeana*) forests, such as those off the coast of California: sea urchins. The warmer waters off California slowed kelp growth just as one of the urchin's main predators, the **SUNFLOWER SEA STAR** (*Pycnopodia helianthoides*), declined in numbers, leading to an explosion in the population of **PURPLE SEA URCHINS** (*Strongylocentrotus purpuratus*)—an estimated 60- to 100-fold increase.

The voracious urchins eat through the stalks of kelp at their anchor points on the seafloor, killing off the stalks and leaving behind swaths of "urchin barrens." Between 2006 and 2017, over 90 percent of the kelp in the waters off Northern California were wiped out by a booming population of purple sea urchins. Once urchins have rendered an area barren, it's almost impossible for kelp forests to return.

One of the most important species living in the kelp forests of the Pacific is the **SEA OTTER** (*Enhydra lutris*). Considered a keystone species of the kelp forests, sea otters are responsible for maintaining balance in the ecosystem.

Sea otters prey on sea urchins, which can keep the urchin population from growing out of control and destroying kelp forests. However, along the Pacific coast, humans hunted the sea otter population nearly to extinction by the early 20th century. According to the International Union for Conservation of Nature (IUCN), the sea otter remains an endangered species. In an effort to preserve kelp forest ecosystems, conservationists have reintroduced sea otters to some areas where the population has been depleted.

NATIONAL GEOGRAPHIC



(Pacific ocean)

Desertification in the Mediterranean Sea



Sparid overfishing

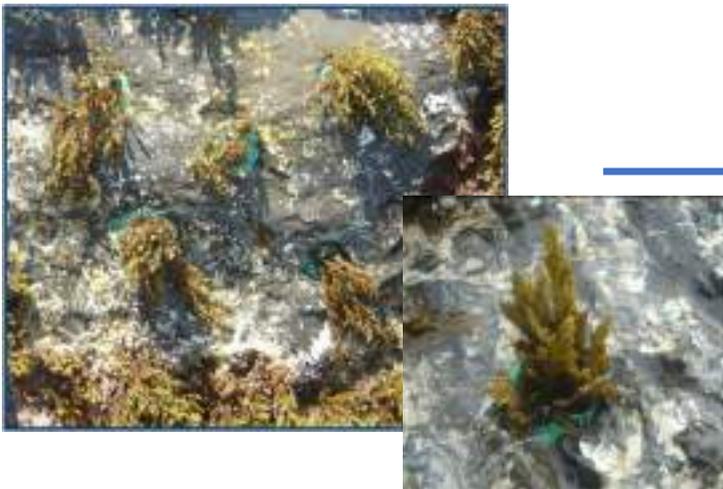


Date mussel illegal fishery

Infralittoral forests



Some experiments in shallow forests in exposed shores highlighted a high grazing pressure, in absence of sea urchins



E. amentacea and *C. compressa*
(Susini et al., 2007; Mangialajo et al., 2012)



(Gianni et al., 2018)

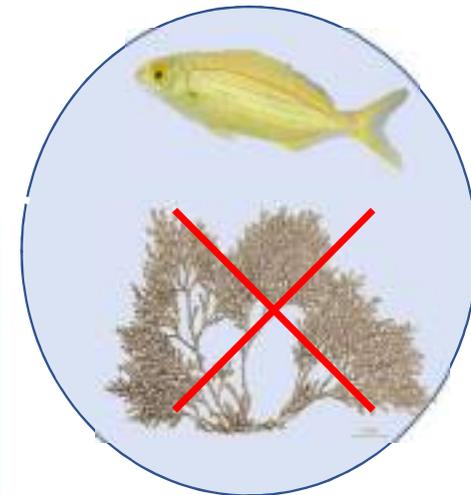
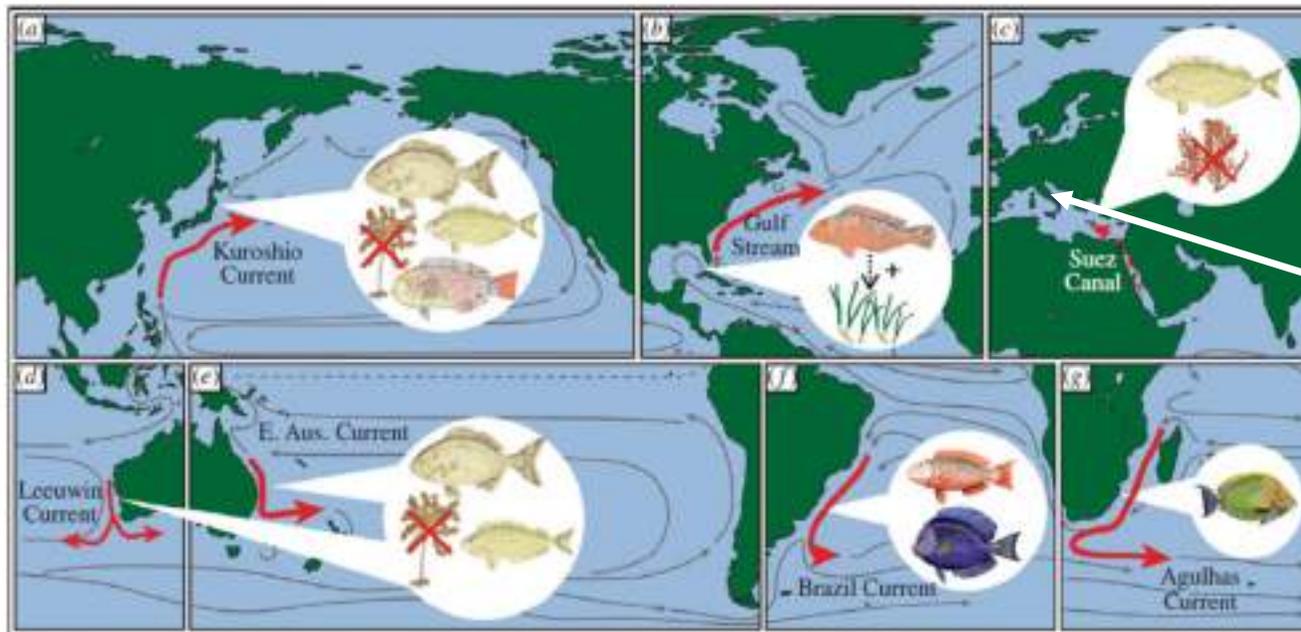
Caging experiments proved that salemas can be the most efficient grazer in shallow exposed shores



Fish herbivory in temperate areas has been considered negligible in the past compared to sea urchins grazing pressure



In recent decades tropical herbivorous fish expanding their range / invading temperate areas have caused impressive regime shifts around the world



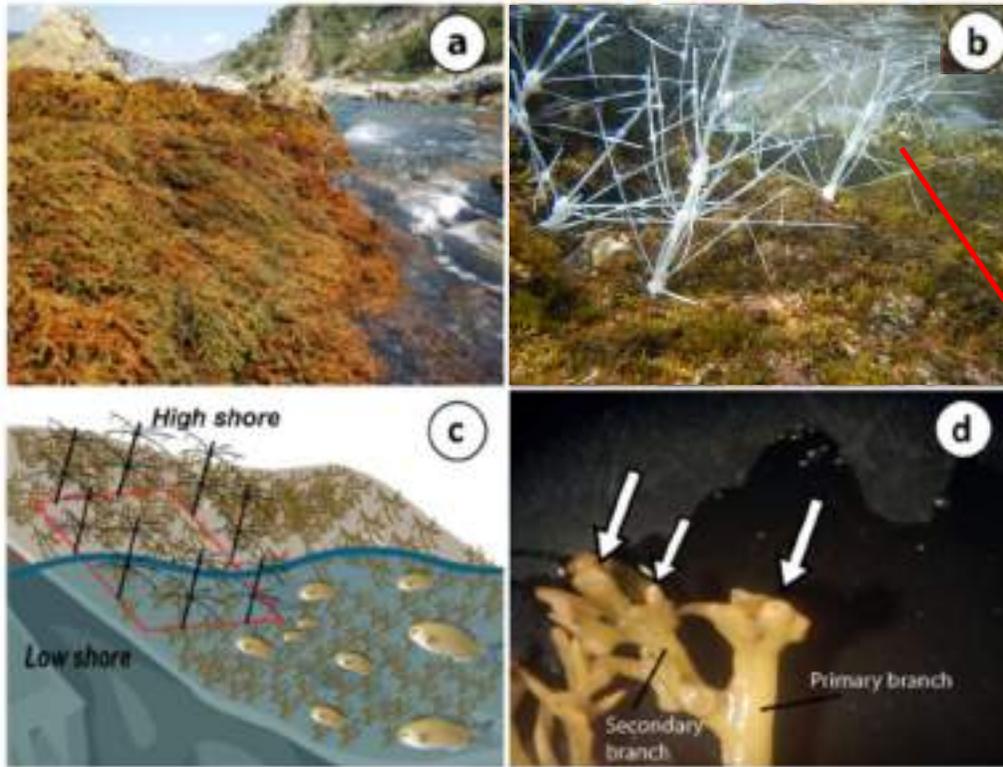
(Vergès et al., 2014)



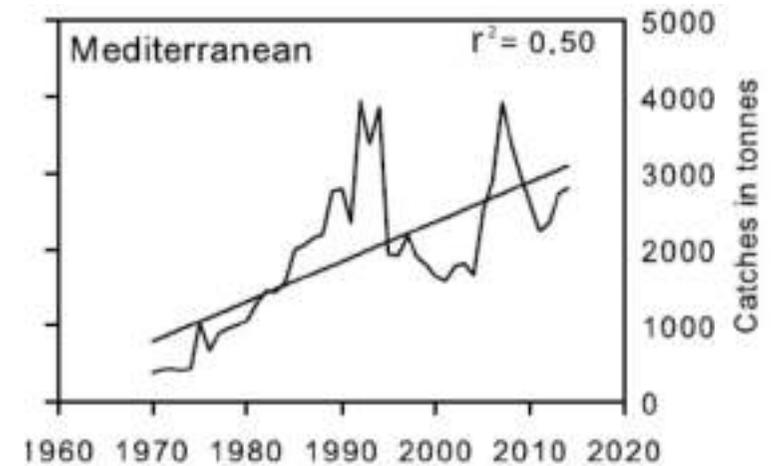
A further study performed in natural forests showed that salema grazing can reduce *Cystoseira* s.l. biomass by up to **86%** and reproductive potential by up to **97%**.

OPEN Threats to large brown algal forests in temperate seas: the overlooked role of native herbivorous fish

Fabrizio Gianni^{1,2}, Fabrizio Bartolini², Alexis Pey¹, Mathieu Laurent¹, Gustavo M. Martins³, Laura Airoldi² & Luisa Mangialajo^{1,4}



(Gianni et al., 2017)



DeFish: Herbivorous fish deterrent device

(Gianni et al., 2020)

In the context of ecological restoration : similar observations in forestation actions on harbour dikes



Projets :

- CYSTORE-GIREL (2011-2015)
(port of Marseille Fos),
- ReCYST (2015-2018)
(Marseille, Calanques national Park)
- CYSTORE-VAUBAN (2016-2020)
(Antibes, port Vauban)



As a result of these studies, high densities of recruits are observed a few months after the restoration, proving the effectiveness of the technique. But the survival, development and fertility are highly affected by grazing.

Courtesy F. Javel  SUEZ and T. Thibaut 



Shallow forests (sheltered/rockpools)

In absence of sea urchins and salemas, consumptive (grazing) and non-consumptive disturbances on restoration actions have been observed from several other organisms (Perkol-Finkel et al., 2012; Ferrario et al., 2016; Gianni et al., 2018)

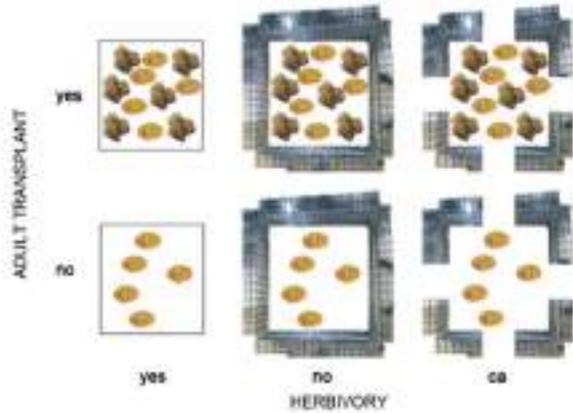


Little is known about mesograzers effects on restoration actions



Several recent restoration actions deal with the grazing pressure (in particular in the phases of setup)

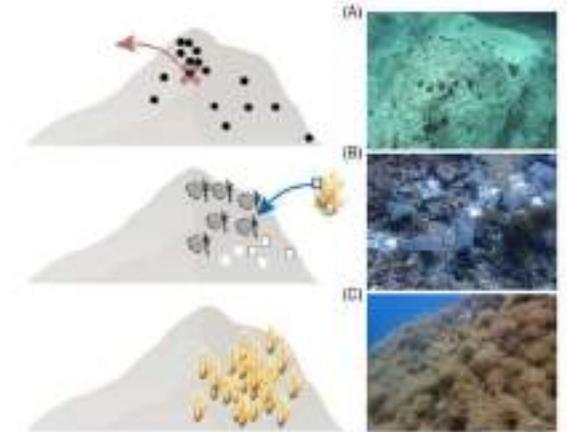
Tamburello et al., 2019 (*E. amentacea*)



Orlando et al., 2021 (*G. barbata*)



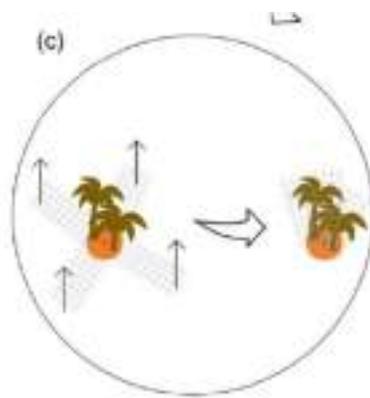
Medrano et al., 2020 (*G. elegans*)



Mangialajo et al., unpublished (*C. compressa*)



Savonitto et al., 2021 (*G. barbata*)



Javel et al., in progress (artificial rockpools)



Montserrat et al., in progress (*C. compressa*)



Marine forests restoration in Côte d'Azur

Mediterranean Marine Science
Indexed in WoS (Web of Science, ISI Thomson) and SCOPUS
The journal is available on line at <http://www.medit-mar-sc.net>
DOI: <http://dx.doi.org/10.12681/mms.1032>

Research Article

Decline and local extinction of Fucales in the French Riviera: the harbinger of future extinctions?

T. THIBAUT^{1,2}, A. BLANFUNE^{1,2}, C.F. BOUDOURESQUE¹ and M. VERLAQUE¹

An important loss in the area, but donor populations are still present



Cap Ferrat

Baie et Cap d'Antibes – Iles de Lérins

Collaboration with the Natura2000 sites « Baie et Cap d'Antibes – Iles de Lérins » and « Cap Ferrat » managers (Metropole NCA and Ville d'Antibes), associated partners of Afrimed project.

Thank to Didier Laurent, Coralie Meinesz and Adrien Lyonnet for their contribution, to the ECOSEAS team participating to this huge work (Benoit, Cécile, Fabrice, Gilbers, Guillaume, Jean-Mi, Marga) and to all Afrimed partners.

Conclusion

Mediterranean marine forests are formed by several species.

Multiple drivers of change act in synergy at different scales, with species-specific effects.

Priorities for restoration actions : fine mapping, considering species ecology and driver effects, including biotic drivers in the context of climate change.

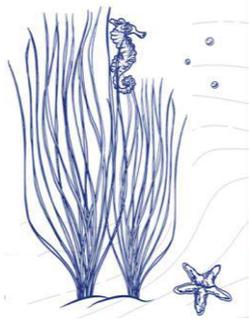
A case-by-case approach is preferable to implement restoration actions, taking into account the specific context.

Added value from collaborations among different stakeholders (policy, management, research, innovation, NGOs...)



THANK YOU FOR YOUR ATTENTION





Membre de UNIVERSITÉ CÔTE D'AZUR

Stakeholder involvement in restoration: Stronger together

Nadia Papadopoulou, Luisa Passeron Mangialajo, Chris Smith and collaborators

Hellenic Centre for Marine Research (HCMR), Greece
Nice Sophia Antipolis University (UNS), France



ICO-solutions initiative and AFRIMED webinar
«Advances in marine forests restoration under the EU
project AFRIMED and stakeholder involvement»

21 April 2021



Our Objective

To raise the awareness of different stakeholders to the loss of Mediterranean Marine forests.

Three Specific tasks:

- Create a Business Club;
- Organise 2 Stakeholder Meetings;
- Compile *Best Practices*



Stronger together- Creation of a Business Club

Involving-bringing together relevant **public and private** stakeholders who share an interest in coastal ecosystem conservation and restoration.

4 aims/tasks:

- 1. Compile a list of relevant geographically representative stakeholders/institutions to be contacted.**
- 2. Create a business club page where updates on restoration issues or case study outcomes will be showcased.**
- 3. Regular updates in the Project's newsletters, with stakeholder/business related articles**
- 4. Short online questionnaire on expectations from AFRIMED! Please fill in the survey in the chat.**



Stronger together - Creation of a Business Club

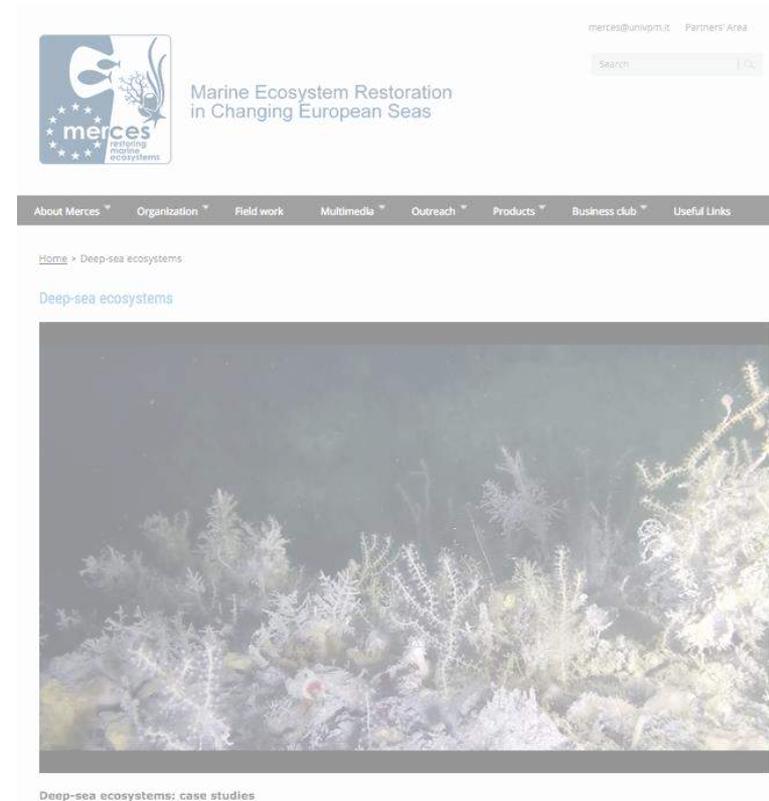
- Building on the successful MERCES BC! with dedicated Webinars and Business Newsletters
- <http://www.merces-project.eu/>
- Webinar examples:

- "Moving to Industrial-Scale Coral Habitat Restoration":

- Jesper Elzinga (Van Oord Dredging and Marine Contractors (Van Oord), the Netherlands) "The Recovery of Reefs Using Industrial Techniques for Slick Harvesting and Release (RECRUIT)"

- "Building a Business Case for Marine Ecosystem Restoration"

- "*Private Finance in Marine Ecosystem Restoration*"



<http://www.merces-project.eu/?q=content/welcome-merces-business-club-5>

Stronger together- Creation of a Business Club

- Building on the successful MERCES Business Club

- Newsletter

articles

examples



The BESE-elements have been developed by Bureau Waardenburg, together with the Radboud University of Nijmegen, Enexio and Rodenburg Biopolymers.

www.bese-elements.com

MaRESTORATION - news from marine restoration applications

Restoring coastal fisheries using artificial habitats – Lecaillon G.	6
Coral reef restoration - The 'Coral Engine': the way for local communities to manage the long term and large-scale supply of genetically diverse corals for reef rehabilitation – ter Hofstede R.	10
Collaborative restoration of deep-sea corals between fishermen and scientists – Carreiro Silva M., Morato T., Bilan M.	13
Working with recreational diving businesses for marine ecosystem restoration: a promising partnership and business opportunity – Garrabou J., Gómez-Gras D., López-Sanz A., Milanese M., Linares C., Montero I., Medrano A., Pagès M., Cerrano C.	17
Rescuing seagrass beds - Project Indre Viksfjord (Norway) – Trondsen I.E., Rinde E.	20
Restoration of marine ecosystems using natural biodegradable materials – Didderen K., Lengkeek, W.	24
Kelp restoration – the seeded gravel approach – Steen H., Fredriksen S., Moy F.	29

MERCES Reviews in the spotlight

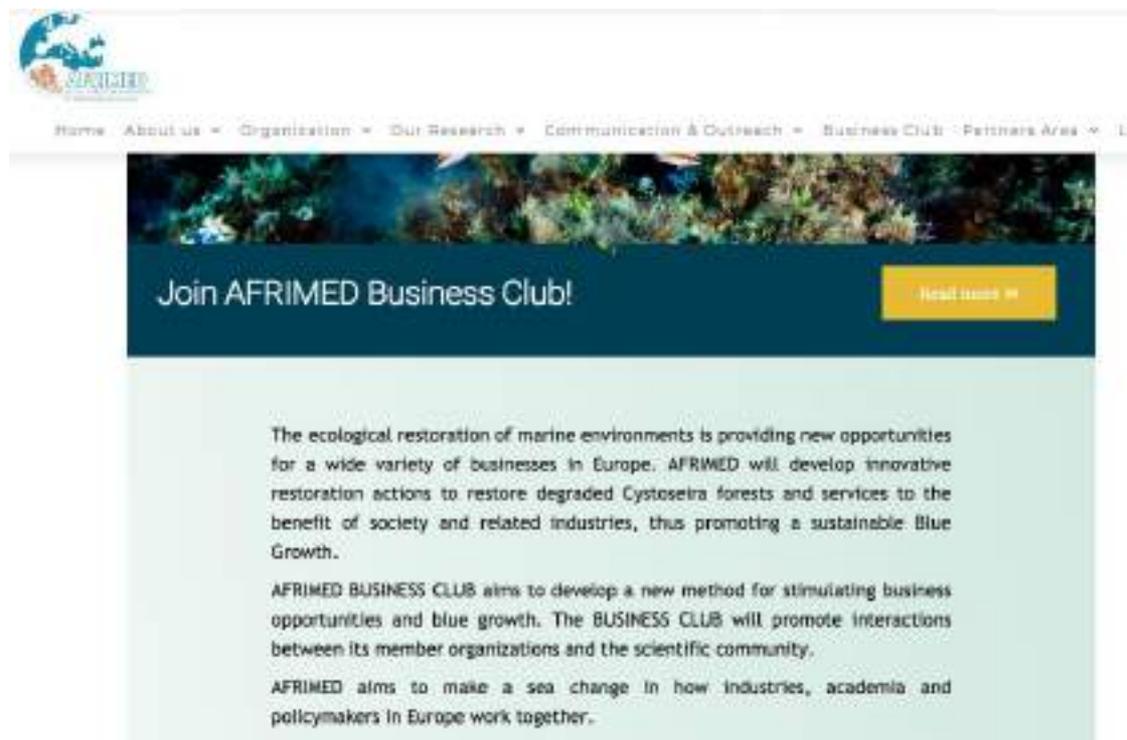
Review of best practice and economic costs of marine ecosystem restoration – Papadopoulou N.	32
Review of international governance structures and legal frameworks – Ojaveer, H.	37
Review of stakeholder perceptions on marine restoration – Papadopoulou N.	39

NEWSLETTER

Stronger together- Creation of a Business Club

A forum for the restoration community!

- The AFRIMED BC webpage will allow access to documents, reports and publications, both from the project, but also from external experiences from stakeholders



Stronger together- Creation of a Business Club

We will share **Factsheets/Examples** on interested stakeholders/ Positive and Negative experiences, and new **tools!** to capitalize on knowledge, experiences and lessons learnt, and to build the decision tree/best practices work.

So far various examples in various stages and working and hoping for more following this event 😊

STRONGER TOGETHER!



AFRIMED Business Club: EXAMPLE 1

Site Natura2000 Baie Cap d'Antibes – Iles de Lérins



Example of a stakeholder project manager of the Site Natura2000 "Baie et Cap d'Antibes – Iles de Lérins" who is actively promoting marine forests restoration projects, such as the restoration of the Vauban harbour (Cystoseira project) and the research performed by the Université Côte d'Azur (AFRIMED project), actively participating to the field activities.

WWW.ANTIBES-JUANLESPINS.COM/NATURA-2000

AFRIMED BUSINESS CLUB

Didier Laurent, is the project manager of the Site Natura2000 "Baie et Cap d'Antibes – Iles de Lérins". He is actively promoting marine forests restoration projects, such as the restoration of the Vauban harbour (Cystoseira project) and the research performed by the Université Côte d'Azur (AFRIMED project), actively participating to the field activities.

DIDIER LAURENT
A PROJECT MANAGER INVOLVED IN MARINE FORESTS RESTORATION

NATURA 2000

The site Natura2000 "Baie et Cap d'Antibes – Iles de Lérins" was created in 2006. It covers 13427 ha (98% marine, 2% continental). It is a very important site as it hosts several faunal species that have been lost in most of the Alpes-Maritimes area. The forests present in this site are important at the regional scale and deserve a strengthened conservation strategy.

JOIN THE AFRIMED BUSINESS CLUB
WWW.AFRIMED-PROJECT.EU

Mazzeella forests in Lérins island (Antibes)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 845841/845841/2017/7.3.1-02/04/21/212.784654

AFRIMED Business Club: EXAMPLE 2

Site Natura2000 'Cap Ferrat'

Example of a stakeholder – MPA manager joining forces with a University team to field actions and supporting management actions & plans

AFRIMED BUSINESS CLUB

Natura 2000 FR 93
CAP FERRAT

The site Natura2000 "Cap Ferrat" was created in 2009. It is completely marine and covers nearly 9000 ha. It is in a very attractive zone and different activities are present. Marine forests prevail on the site and are regularly surveyed, in collaboration with Ecossea Laboratory of the Université Côte d'Azur.

NATURA 2000 CAP FERRAT SITE
METROPOLE NICE CÔTE D'AZUR

A PROJECT MANAGER INVOLVED IN MARINE FORESTS RESTORATION

The Natura2000 Cap Ferrat site is managed by the Métropole Nice Côte d'Azur, Carole Malnes is the project manager.

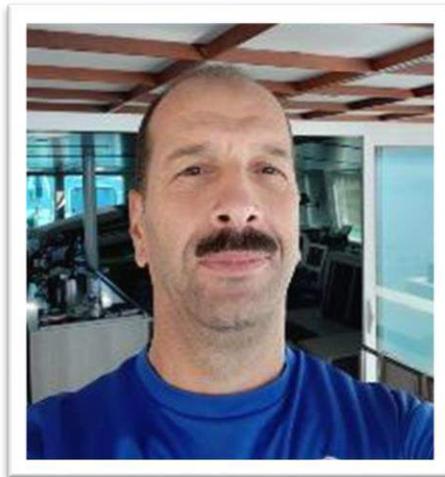
The presence of historical data shows that some populations have been lost in the past, due to causes that have subsequently been mitigated. Cap Ferrat is therefore a perfect site for marine forests restoration experiments. Restoration of natural habitats has been included in the management measures of the site.

WWW.NICECOTEDAZUR.ORG/ENVIRONNEMENT/NATURA-2000/NATURA-2000-CAP-FERRAT

JOIN THE AFRIMED BUSINESS CLUB
WWW.AFRIMED-PROJECT.EU

AFRIMED Business Club: EXAMPLE 3

Example: diving club in Tunisia



Jebalia Fathi

Director of association of underwater sports and the environment Bizerte
 Leading projects in bioprospecting and biodiversity monitoring



Localisation of Bizerte



AFRIMED Business Club: EXAMPLE 4

Example: MPA & Laboratory in Albania



Research group
“Ismail Qemali”



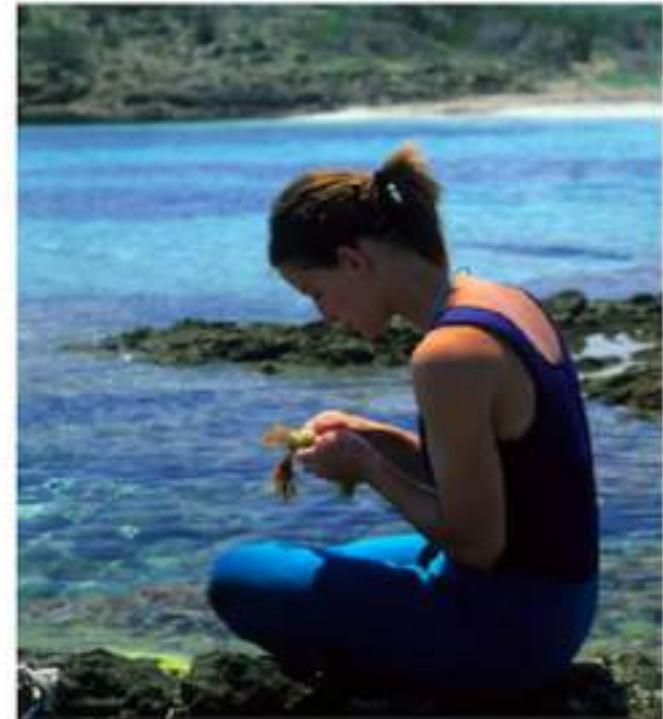
AFRIMED Business Club: EXAMPLE 5

Menorca Biosphere reserve in Spain, restoration actions



AFRIMED BUSINESS CLUB

Marta Sales is a marine biologist specialised in the conservation of macroalgal forests. She designed and applied the first recruitment enhancement restoration actions that have successfully lead to a well-established *Cystoseira* forest in Teulera (case study of AFRIMED project). In close collaboration with OBSAM (socio-environmental observatory of Menorca), Marta Sales works for the maintenance and promotion of macroalgal marine forests conservation in Menorca Island.



MARTA SALES

OBSAM'S COLLABORATOR

SPECIALISED IN THE CONSERVATION OF MACROALGAL FORESTS

MENORCA BIOSPHERE RESERVE



AFRIMED Business Club: EXAMPLE 6

Example: new tools for restoration actions

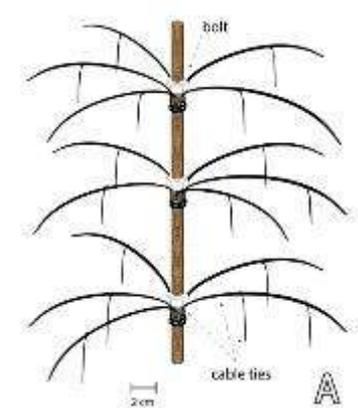
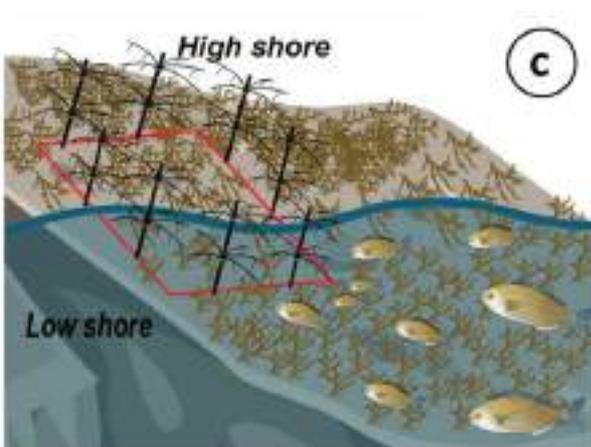


PRACTICAL ARTICLE

Optimizing canopy-forming algae conservation and restoration with a new herbivorous fish deterrent device

Fabrizio Gianni^{1,2,3}, Vesna Mačić⁴, Fabrizio Bartolini¹, Alexis Pey¹, Mathieu Laurent¹, Luisa Mangialajo^{1,5}

DeFish:
herbivorous fish
deterrent device



We aim to organise Two Stakeholder Meetings

Provide forum to exchange ideas, thoughts and concerns, from several diverse points of view. To foster knowledge transfer and drive Blue Growth – a two-way street.

Meeting 1, linkages to AFRIMED **case studies**



Meeting 2, issues related to **up-scaling restoration**

- Meetings are framed around structured surveys to provide insights on useful outcomes, preferences, dislikes, success factors and challenges.
- They are also feed-back devices on issues, case studies and decision-making tools



Final Goal: Compilation of Best Practices

Identification of **Best Practices for reforestation in the Mediterranean Sea**: again, stronger together, project teams, involving and getting feedback from stakeholders.

A flow chart will be produced as a decision tool publicly available to allow all the involved stakeholders to know:

- **when** a reforestation action is worth considering and
- **which** preconditions should be met/implemented to aid restoration success (reduction of pressures, monitoring, etc.)



Before we close, we put the spotlight on France 😊 where there is a very constructive dynamic on restoration, that represents an example could be replicated in several countries.

An example of cooperation among researchers, technicians, managers decision makers, consultants, business, highly supported by the French Water Agency (Agence de l'eau Rhône-Méditerranée-Corse)

It started a dozen of years ago: with the idea to restore the nursery function in shallow coastal ecosystems (Sublimo Life project). The Driver approach is supported by the French Water Agency and includes a large amount of stakeholders.



La démarche DRIVER

- Coopération : chercheurs, techniciens, gestionnaires, institutions, entreprises et partenaires financiers.
- Dynamique de montage de projets, de partage et de valorisation des résultats
 - Contribution à la définition des politiques de restauration écologique des petits fonds côtiers.



The Water Agency supported the Driver approach since the beginning, **accelerated the process, fostering interactions, project building and valorisation of results.** Several **types of restoration actions have been implemented** in this framework, in harbours (green), modified environments (light blue), mooring zones (blue) and waste waters affected zones (purple).

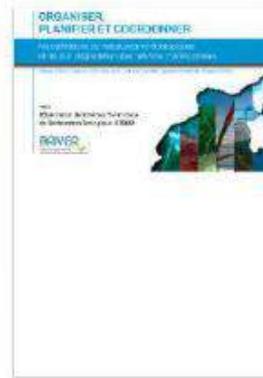
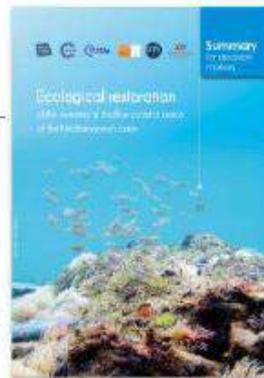
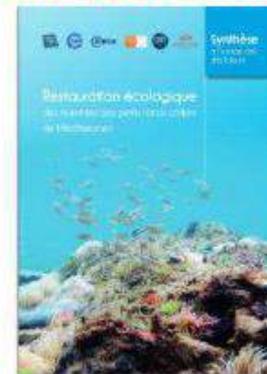
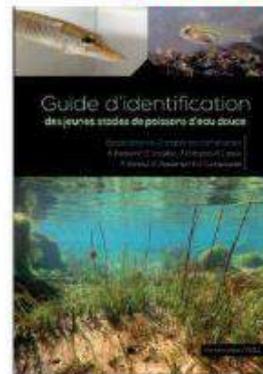
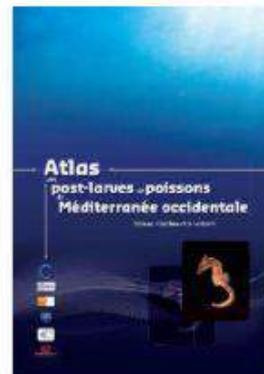


Several publications have been realized in this context, contributing to the definition of policies of shallow coastal ecosystem restoration, available from the website

www.restoration-ecologique.com

www.ecocean.fr

Livrables et articles scientifiques



A Few Examples of actions implemented

Replenishment of fish assemblages

Exemple : CASCIOUAR (2015-2025)



CASCIOUAR (2015-2025) = Repeuplement de poissons côtiers à partir de la technique de PCC

- ⇒ 3 étapes validées scientifiquement par un projet européen LIFE+ SUBLIMO
- ⇒ un projet du programme Nature 2050
- ⇒ 2 phases, 10 ans... dans le cadre du contrat de baie de la Métropole Aix-Marseille



Posidonia meadow restoration in mooring zones

Exemple : REPIC (2019-2022)



REPIC (2019-2022) = Repliquage des herbiers de Posidonie dans une zone impactée par le mouillage

- ⇒ Expérimenter la capacité de restauration des herbiers de posidonie dégradés par le mouillage sur un site atelier impacté par le mouillage mais intéressant aux engins à moteur
- ⇒ Replanter 1000 m² de posidonie



Mais aussi un projet de restauration de posidonies en 2018

Artificial fish nursery biohut

Exemple : Biohut



Biohut = Hutte de biodiversité, Nurserie artificielle

- ⇒ 2 fonctions combinées : un substrat naturel (source de nourriture) et un abri contre les prédateurs
- ⇒ Matériaux recyclables et recyclés
- ⇒ Validé par un projet de recherche (2013-2014) et plusieurs thèses



En Méditerranée :
Poissons : 62 espèces / 40 000 observations
Faune vagile : 265 espèces / 50 000 observations
Faune & flore fixées : 63 espèces / 2 500 observations

Gardening harbour dikes with Cystoseira forests

Exemple : CYSTORE – Port Vauban (2019-2022)



CYSTORE (2017-2019) = Projet pilote de restauration écologique en milieu artificiel

- ⇒ Cystoseira amentacea est une algue brune dite ingénieure et endémique de Méditerranée



Installation de bouquets fertiles sur la digue du Port Vauban

Julie P., François D., 2020, CYSTORE: Pilote de restauration écologique en milieu artificiel. Sous-Titre: Suivi scientifique de l'implantation de Cystoseira amentacea. Cahier n° 1409/2020 (consultable publit, p. 39 p.)

If you are interested in the activities performed in the Driver context, **see the replay of this recent ICO webinar!**

Webinaire - La restauration écologique, qu'est-ce que c'est ?

8 Avril 2021
9h30 - 12h30 (UTC+1)



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Thank you! Questions?



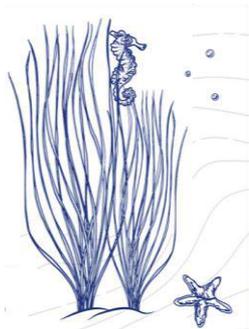
Algal Forest Restoration In the MEDiterranean Sea
(AFRIMED)

Grant agreement n.

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<http://www.afrimed-project.eu>



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