Implementing marine forests restoration: new insights and future challenges

Silvia Bianchelli and Roberto Danovaro
AFRIMED Consortium

21st April 2021
AFRIMED is an EU project on the restoration of degraded *Cystoseria 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.
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)

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

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 Cystosera s.l.
EU Green Deal
Biodiversity Strategy 2030

"...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
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.
Priority areas for the restoration of Cystoseira s.l. forests across the Mediterranean Sea
OECD: Building the industry of Marine Ecosystems restoration

Welcome to the MERCES Business Club

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
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

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Afrimed Project
AFRIMED (community)
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.
Marine restoration under the biodiversity strategy

Simonetta Fraschetti
Università di Napoli Federico II - Stazione Zoologica di Napoli
Is it possible to reverse present trajectories of changes?

Restoration: when changes in resource management and natural processes are not in the position to recover a degraded ecosystem in a reasonable timeframe.
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?
Most of the efforts have been concentrated in the northern part of the globe.

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

The most targeted habitat of restoration actions is represented by:
- saltmarshes
- seagrasses
- coral reefs
With the exception of wetlands, most restoration projects cover too small areas (< 1 ha) to address the scale of human disturbance.

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.
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
Recruitment enhancement

In-situ  Ex-situ

1 Time  1 Action  Big success

2011  Restoration action 4 sites * 5 m²  High density of recruits
2014  Monitoring * 50 m²  Similar density of individuals
  Presence of fertile individuals
  Area increase
2017  Monitoring * 100 m²  100 m² of restored area
  Size structure comparable to donor and control populations
  Mature individuals: self-maintaining population
2019  Restoration success  increased the 20% of the natural area of a priority habitat!
Synergistic interactions to support success interventions

Estimated area to be recovered 1.2 ha (about 20% of degraded habitat in the A zone of the MPA)

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

- Increase knowledge of life history traits, biological and ecological processes
- Increase replication
- Overcome Methodological Problems and Issues
- Long-term monitoring
- Increase coordination
- Recognizing the role of global change in driving the feasibility of restoration actions
More success stories

Seagrasses

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

ABBACO Project
Human capitalization

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

Water JPI
Water challenges for a changing world

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 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.

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Is it possible to recover an extinct marine forest?
Most productive and biodiversity-rich ecosystems on Earth.
Marine forests
The importance of conservation

Conservation
Cystoseira forest
Impact mitigation

DEGRADED AND IMPACTED ECOSYSTEM
Habitat destruction, overgrazing, pollution, climate change, invasive species

HIGHLY DIVERSE MARINE MACROALGAL FOREST
DEGRADED AND IMPACTED ECOSYSTEM
Habitat destruction, overgrazing, pollution, climate change, invasive species

Solution...

Degraded and impacted ecosystem  Juvenile cultivation  Transport to the field  Population restoration  Marine forest

HIGHLY DIVERSE MARINE MACROALGAL FOREST

© Jana Verdura & Cristina Galobart
Threatened populations

Adults transplantation

WARNING

Critical conservation status

Recruitment enhancement

Non destructive methods with less adult manipulation

Threatened populations

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
Ex-situ

Environmental conditions
- Irradiance
- Temperature
Environmental conditions

- Irradiance
- Temperature
In-situ

Ex-situ

Zygotes
Embryos
30 days
40 days
3 months
Is it possible to recover an extinct marine forest?
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

Cefali et al. 2019
Happy end
Global warming

Pollution

Overgrazing

Sea urchins culling

Fish exclusion

Restoration Actions

Use species or populations more resistant to global stressors

References:
Tamburello et al. 2019; Medrano et al. 2020; Guarnieri et al. 2020; De Caralt et al. 2020, Verdura et al. submitted
How much does it cost?

Verdura et al. 2018, Tamburello et al. 2019

<table>
<thead>
<tr>
<th>Needed /previous knowledge</th>
<th>In Situ</th>
<th>Ex situ</th>
<th>Complementary techniques</th>
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<td>Sea urchins culling</td>
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<td>Herb. exclusion (cages)</td>
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<th>In Situ</th>
<th>Ex situ</th>
<th>Complementary techniques</th>
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<tr>
<th>Maintenance activities after planting</th>
<th>In Situ</th>
<th>Ex situ</th>
<th>Complementary techniques</th>
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<tr>
<td>Herb. exclusion (cages)</td>
<td><img src="chart15.png" alt="Chart" /></td>
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<tr>
<td>Substrate provision</td>
<td><img src="chart17.png" alt="Chart" /></td>
<td><img src="chart18.png" alt="Chart" /></td>
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</tbody>
</table>

**Concepts**
- 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.
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AFRIMED (community)
Advances in marine forests restoration under the EU project Afrimed

Context-dependent restoration actions: case studies

L. Passeron Mangialajo
Marine forests of large brown algae worldwide, mostly composed by Laminariales (kelps) and Fucales (fucoids)
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 years\(^2\))**
- **Short dispersal\(^3\)**

\(^1\) 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)

*Gongoloria 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 zostерoides*

*(but also *E. funkii*, *C. montagnei v. compressa...)*
Drivers of loss:

- 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.

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
Biotic factors

Herbivory - a threat to marine forests
Sea urchins are considered the most effective herbivores in temperate areas.
Some experiments in shallow forests in exposed shores highlighted a high grazing pressure, in absence of sea urchins (Susini et al., 2007; Mangialajo et al., 2012).

Caging experiments proved that salemas can be the most efficient grazer in shallow exposed shores (Gianni et al., 2018).

*E. amentacea* and *C. compressa* (Susini et al., 2007; Mangialajo et al., 2012)
In recent decades tropical herbivorous fish expanding their range / invading temperate areas have caused impressive regime shifts around the world.

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

(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%.

DeFish: Herbivorous fish deterrent device

(Gianni et al., 2020)

(Gianni et al., 2017)
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.
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)
Marine forests restoration in Côte d’Azur

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

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
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/](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](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 Rodenburgh Biopolymers.

www.bese-elements.com

http://www.merces-project.eu/?q=content/welcome-merces-business-club-5
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 – MPA manager joining forces with a University team to field actions
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: 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
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

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.
AFRIMED Business Club: EXAMPLE 6

Example: new tools for restoration actions

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.)
Updating and building new connections 😊

JOIN US

Your expectations:
- Restoration of degraded European habitats (e.g. through pilot restoration actions in MPAs)
- Networking, creating a forum linking research, conservation, public and private sectors
- Linking restoration and Blue growth
- Restoration implementation
- Policy implementation
- New knowledge on methods
- Promoting restoration and sustainably using our ocean

stk expectations online survey

stakeholder list (150+ contacts)

Conference presentations (SER, SERE, EMD 2021, +) & events
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.

Courtesy Philippe Lenfant, Université de Perpignan
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.
A Few Examples of actions implemented

Replenishment of fish assemblages

Exemple: CASCIOMAR (2015-2025)

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

Artificial fish nursery biohut

Exemple: Biohut

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

Posidonia meadow restoration in mooring zones

Exemple: REPIC (2019-2022)

- Répétition des herbes de Posidonia dans une zone impactée par le mouillage
- Expérimenter la capacité de restauration des herbes de posidonia dégradées par le mouillage sur un site-terrain impacté par le mouillage mais interdit aux engins à moteur
- Replanter 1000 m² de posidonia

Gardening harbour dikes with Cystoseira forests

Exemple: CYSTORE – Port Vauban (2019-2022)

- CVSTORE (2017-2019) – Projet pilote de restauration écologique en milieu artificiel
- Cystoseira amestacea est une algue brune dite ingénieuse et endémique de Méditerranée

Courtesy Anais Gudefin, ECOCEAN
If you are interested in the activities performed in the Driver context, see the replay of this recent ICO webinar!

https://ico-solutions.eu/fr/workshops/webinaire-la-restauration-ecologique-quest-ce-que-cest/
Thank you! Questions?

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