

Nurseries in Ports and Marinas for Biodiversity and Biomass Restoration

Promoting understanding, fostering a sense of responsibility, driving behavioural change

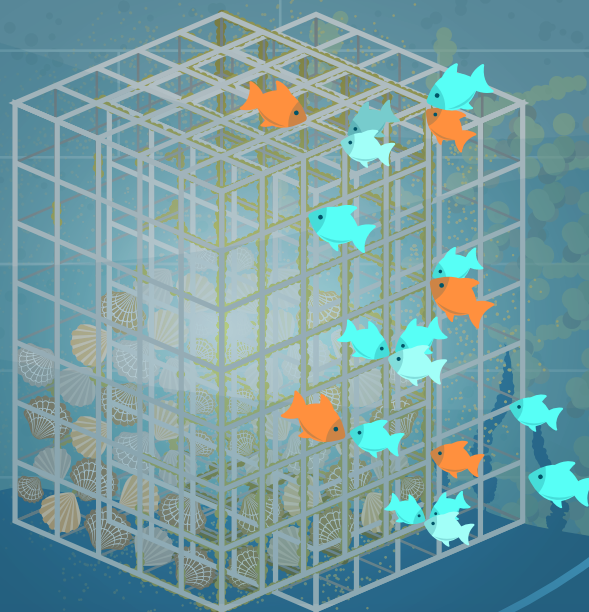
Modular underwater habitats

Natural reefs replica

Self-sustaining

Biological Deserts

- ✗ Concrete coastlines
- ✗ Lack of underwater roughness
- ✗ Inadequate surface area for larval settlement



The spillover effect

- ✓ Fish repopulation
- ✓ Diverse Marine life
- ✓ 2030 restoration objectives



Key Message

- Small infrastructure that revitalizes the ecosystem in significantly artificialized underwater areas.
- Small initial investment and no maintenance required.
- Infrastructure for scientific underwater colonization studies and educational/communication activities.
- Focal point for early detection of invasive species.

Policy Relevance

- **EU Nature Restoration Law**, which entered into force in August 2024, mandates binding targets to restore at least 20% of the EU's land and sea areas by 2030, and all degraded ecosystems by 2050.
- **The Marine Strategy Framework Directive (MSFD)**, the main environmental pillar of the EU's maritime policy. Its focus is on the overall health status of marine waters.
- **Plano Nacional de Restauro da Natureza (PNRN)**, aligned with the EU regulation, with the objective of rearing at least 20% of marine areas until 2030.
- **The Climate Basic Law (Lei de Bases do Clima)** is currently the most forward-looking legislation regarding “active restoration”. This Portuguese law explicitly links the ocean to climate resilience.



What is the Challenge

About a quarter of all European coastlines have been modified because of human activities. Intense anthropomorphization of coastal areas has destroyed natural habitats, leading to a significant loss of biodiversity, while unbalancing existing ecosystems. Artificially increasing the rugosity of the underwater landscape in Ports and Marinas lays down much-needed substrate for restoring the coastal underwater ecosystem.

An Innovative Solution

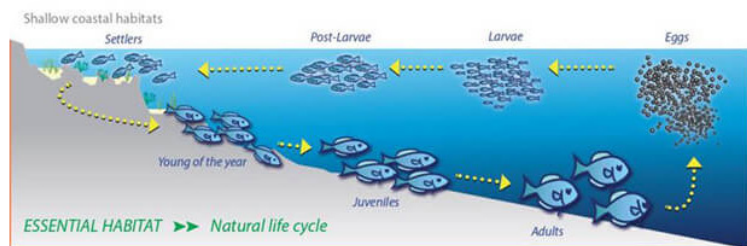
Deploying Artificial Fish Nurseries (AFNs) in Ports and Marinas provides a home for local benthic species to settle on, while providing shelter and food for young fish. Meanwhile, active acoustic recruitment may boost initial colonization of the Artificial Fish Nurseries. From this healthy, diverse and protected environment, local fish communities are supported to thrive and repopulate the impacted coastal areas.

Artificial Fish Nurseries may also be the focus of marine biodiversity restoration activities/events/initiatives, serving to help promote awareness and understanding of the ocean in coastal communities.



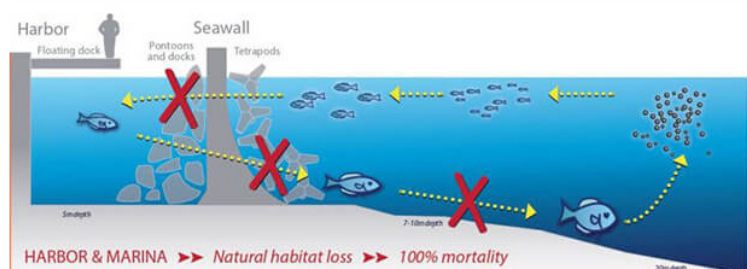
The Benefits the solution produces

- Restoration of underwater ecosystems in heavily artificialized coastal areas.
- Increased biodiversity and biomass for more resilient coastal underwater ecosystems.
- Increased community engagement with Marine biodiversity restoration activities/events/initiatives.
- Promotion of ocean literacy in these coastal.
- Marine restoration through behavioural change and empowerment of people to adopt pro-environmental behaviours.



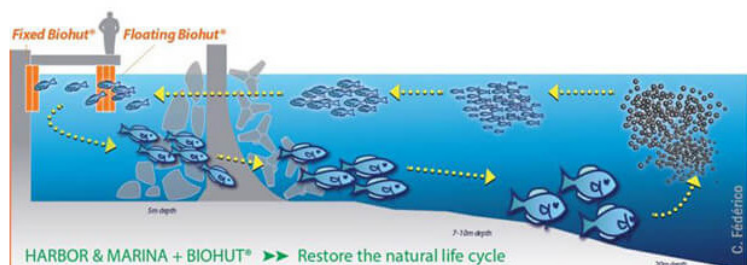
NATURALLY

In a natural environment, fish depend on suitable habitats during their different stages of development. The shallow waters near the shore are essential in this cycle.



YESTERDAY

Coastal developments impact the nursery function of shallow waters, by profoundly modifying the essential habitat of the larvae. This pressure leads to a decline in adult populations.



TODAY, with Biohut®

Biohut® replaces the role of nursery subtracted by the man and allows to restore the natural cycle. This eco-service contributes to the recovery of the ecosystem.

How developed is the solution

The Artificial Fish Nurseries are ready for large scale production and deployment. They have been shown to locally strengthen underwater ecosystems by increasing the rugosity of the environment and thus increasing available food and shelter. However their larger scale impact on the broader ecosystem and fish stocks are yet to be validated (SRL-7 on the scale of Social Readiness Levels). The use active acoustic recruitment and its impact on the rate of attraction of the various species has been verified in controlled environments (SRL-5) but still needs validation in relevant operational environments.

Where could also be applied to?

This solution particularly applicable to heavily modified coastlines, where hard infrastructure predominates (e.g. port areas), habitat texture has been severely reduced/simplified, and where ecosystems need texturized (more complex) surfaces and seascapes to promote benthic fauna development.

Area characteristics

Intention for applying this solution

Heavily modified (simplified with hard infrastructure) coastal areas such as ports and marinas

Artificialization reduced the texture of underwater surfaces, and the number of habitat niches. The AFNs act to restore this more complex texture and lay the foundations for diversifying ecosystem restoration.

Underwater areas protected from the harsh ocean/sea/river environments

Strong storms, waves, tides and currents may damage the AFNs or pull them from the mooring, so it is important they are sheltered from extremes.

Water ways degraded by industrial activity

Responsible industries/companies may see Artificial Fish Nurseries as an opportunity compensate or mitigate their negative impact.

Areas for tourism-related diving activities

Artificial Fish Nurseries can be hotspots of underwater biodiversity and will have positive impact on mobile underwater fauna, increasing the interest for diving activities.

Areas where fishing is not allowed

The undisturbed evolution of the ecosystem will significantly increase the number of fish, which will subsequently spillover to the surrounding areas.



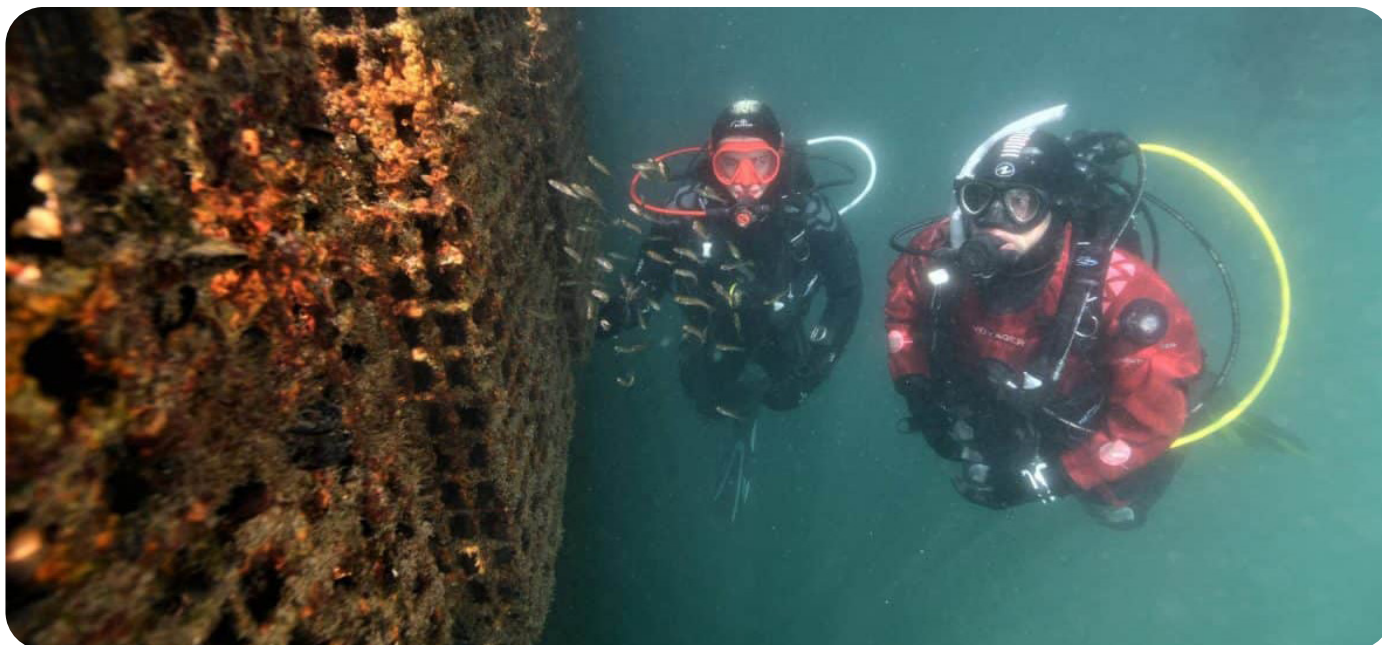


Who is this relevant to?

- Local authorities, Port authorities and Marina's owners/managers;
- Local fishing groups;
- Dive Clubs .

What do you need to have in place:

- Underwater location protected from adverse sea conditions, with infrastructure with means for anchoring the Artificial Fish Nurseries, typically ports or marinas.
- Authorization and support of local community and/or authorities, to ensure care for the deployed Fish Nurseries and avoid theft or damage.
- Electric power source for acoustically enhanced solution.
- Optional: Experienced diver(s) to support the installation and perform monitoring and maintenance activities.
- Access by general population to promote marine biodiversity restoration activities/events/initiatives.



Key components of implementation:

The most important components are:

Someone who funds the initiative. They must acknowledge the benefits and know how to “profit” or benefit from it. Usually, local companies promoting their environmental conscience and impact on local communities. Public funding schemes are now becoming available for restoration activities.

Authority that authorizes the deployment of the Artificial Fish Nurseries. The best approach is to bring local associations that can speak of the benefits for the local community.

Identify

- Environmental organization to promote coastal ecosystem restoration.
- Local port, marina or coastal authority you who will need to authorize the deployment of the Artificial Fish Nurseries.
- Funding institution or programme to support the acquisition of the Artificial Fish Nurseries.

Acquire

- Artificial Fish Nurseries.
- Acoustic emission hardware.
- Monitoring equipment.

Deploy

- Assemble the Artificial Fish Nurseries near your deployment location.
- Deploy your Artificial Fish Nurseries, with support from two experienced divers.

Monitor

- Monitor the mechanical state of the Artificial Fish Nurseries.
- Monitor the impact on the biodiversity.
- Promote community engagement and communication activities around the Artificial Fish Nurseries.

Monitoring your success

It is very important to monitor your AFNs and the impact they have on the local environment and citizens perspectives/awareness. Here is a list of the main things you should think about monitoring:

- 1. AFN integrity:** Ensure the installed Artificial Fish Nurseries are not damaged by weather factors like waves and currents nor by local activities.
- 2. Ecological Succession progress:** Here, you can observe and record information on:
 - Colonization, by fast-growing opportunistic species like barnacles, bryozoans, sponges, polychaetes.
 - Growth and Succession, by slower-growing but more competitive species like massive sponges, large macroalgae, and corals.
 - Attraction of Mobile Fauna like fish, crustaceans, molluscs, and other mobile species that are attracted by shelter and food.
- 3. Presence of unwanted/invasive species:** Often your local species may need a helping hand to get established, and benefit from some early assistance by keeping the space available for them. Monitor invasive or unwanted species and remove them to promote a healthy ecosystem with local species.
- 4. Community engagement:** Monitor promote local community engagement with the installed Artificial Fish Nurseries, through communication and educational activities.

Ecological monitoring should be performed in 3 or 6-monthly intervals, consisting of:

- Underwater visual census.
- eDNA analysis.
- Acoustic analysis.

This is a highly damaging monitoring activity and should be performed in Autumn when the ecosystem is still vibrant and right before the severe winter conditions.

Costs and Timeframes

	Approximate cost	Cost range*	Approximate timeframe	Timeframe ranges
Identify location and get authorization	660€	[0€:1000€]	1 month	[1 : 3] months
Identify funding institution or programme	3.100€	[0€:5000€]	2 months	[1 : 12] months
Acquire equipment	43.000€	[30.000€:50.000€]	1 month	[1 : 3] months
Assemble and deploy the cages	4.200€	[3.000€ : 5.000€]	1 month (plan and install)	[1 : 3] months
Monitor the ecological impact	1.800€	[500€:2500€]	1 month (plan and execute)	[1 : 3] months

**Cost ranges are relative to each other within this blueprint document, and have been developed by looking at the demonstration sites the activities were undertaken in. Please contact the authors for more information on how they could translate in your region.*



The challenges you may encounter

List two challenges per activity area that people may encounter implementing the solution elements.

Activity	Challenge 1	Challenge 2	Catalysts
Identify environmental organization	Environmental organization		An established organization may have contacts with institutions that may resolve the blocking points ahead
Identify Port authority or Marina	Authority must be willing to provide the necessary authorizations	Must provide access to the installation location. And electric power if an acoustic solution will be used	Cooperant port authority with running environmental protection programmes
Identify funding institution or programme	Very difficult to present attractive benefits that justify the investment	Demonstrate that the continuous communication benefits that the implementation with allow	Company with environmental responsibility projects running. Or a funding programme directed at environment restoration actions
Acquire equipment	Have the available funds		STRIX has a list with all required equipment
Assemble and deploy the cages	Assemble the cages and the acoustic system very close to the installation location		STRIX provides support for the installation
Monitor the ecological impact	Define the monitoring protocol aligned with the expected local colonization sequences		Cooperation with a local marine research institution interested in the restoration results



Key Contact who to talk to about your application idea

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Further information (reading/resources box)

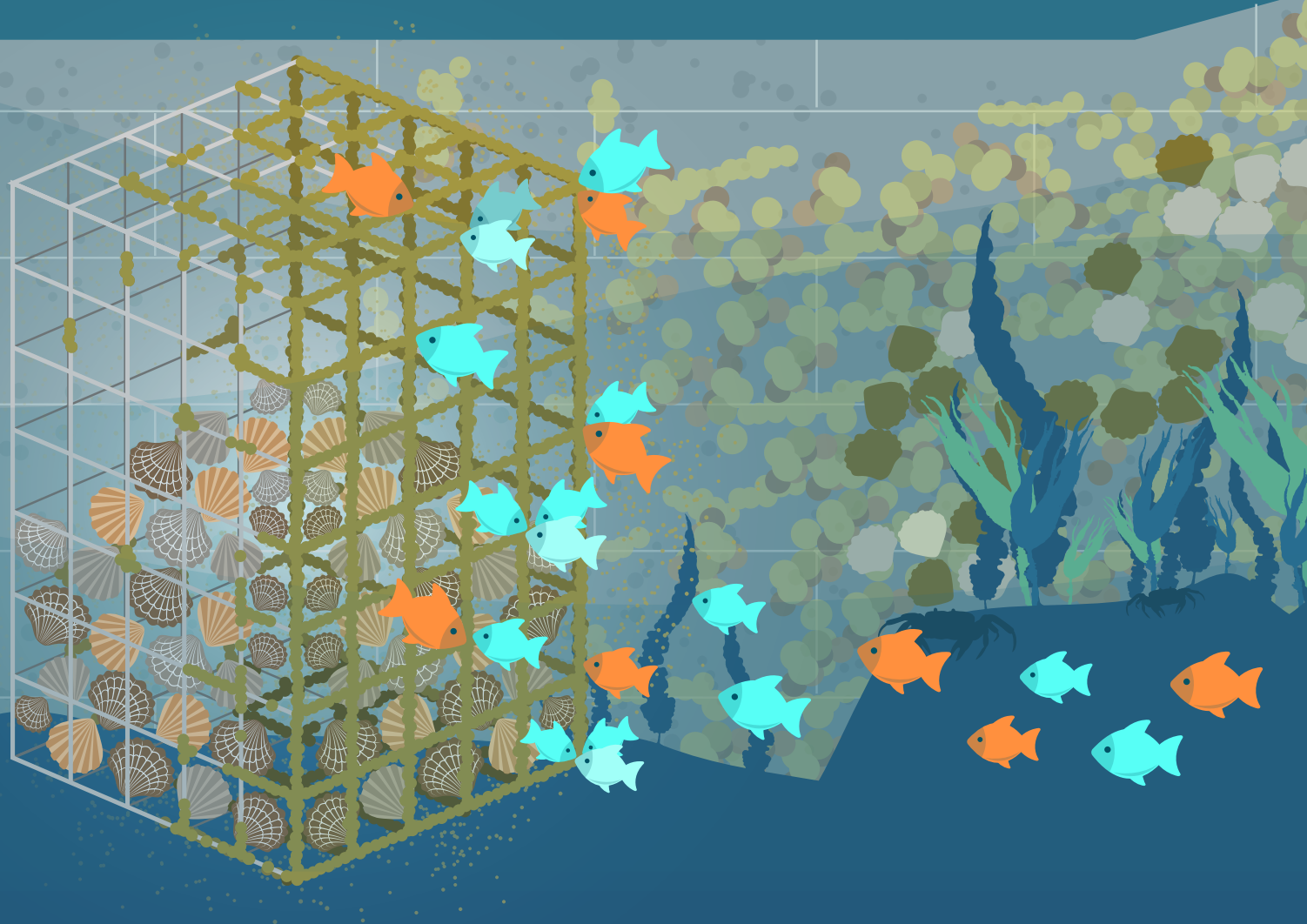
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Blueprint

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a-aagora.eu



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