



# HIPPO-REF – Seahorse Refuges for Marine Biodiversity Restoration in the Port of Vigo

## IAPH AWARDS 2026



Environmental Care

## Context

HIPPO-REF is a joint initiative between the Institute of Marine Research (IIM-CSIC) and the Port Authority of Vigo, developed to demonstrate that port infrastructure can become a space for ecological restoration capable of hosting marine biodiversity of high value.

The project's starting point is Hippo-DEC, a project funded by the Spanish Ministry for Ecological Transition (MITECO) and also led by IIM-CSIC. Over recent years, Hippo-DEC detected recurring seahorse presence in different areas of the Port of Vigo, revealing that the port environment, despite its intense maritime activity, retains environmental conditions that allow sensitive species such as seahorses to settle. This finding opened the opportunity to design a pilot project integrating marine science, ecological engineering and port management to favour the recovery of degraded habitats through nature-based solutions.

The inspiration for the project comes from international experiences such as the Seahorse Hotels developed in Sydney by the University of New South Wales (UNSW), where artificial structures have allowed the recovery of seahorse populations in urbanised areas. HIPPO-REF adapts this concept to the Atlantic, port context of Vigo, integrating it into the port's environmental strategy and aligning it with European policies on sustainability, biodiversity and coastal resilience. The project is conceived as a demonstrative pilot with the capacity for scaling and replication in other European ports, aspiring to become a reference in the integration of biodiversity into maritime infrastructure.



## The Challenge

Seahorses are species of great ecological sensitivity and excellent bioindicators of environmental quality. They require complex structures to anchor themselves with their prehensile tail, low-current areas in which to feed, and environments with good water quality and marine vegetation nearby. The loss of seagrass meadows and the alteration of the coastline have reduced the habitats available to these species, leaving few refuges for them in urbanised and industrialised waterfronts.

The challenge HIPPO-REF set out to address was therefore twofold. The first was technical and ecological: to determine whether appropriately designed artificial structures could actually replace the natural habitat that a species this demanding depends on, acting as equivalent refuges. The second was strategic: to do so within an active commercial port, an environment generally assumed to be incompatible with the presence of sensitive marine species, and to show that this assumption does not have to hold.

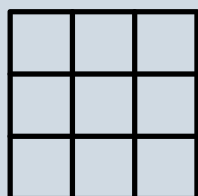
This second dimension matters beyond Vigo. European ports are increasingly called upon to play an active role in the ecological transition, integrating nature-based solutions into their infrastructure and contributing to the restoration of marine ecosystems. HIPPO-REF gives the Port of Vigo a concrete, evidence-based way of showing that port activity can coexist with marine conservation and generate tangible environmental benefits.



# Project Description

## 3.1 Objectives

The general objective of HIPPO-REF is to restore and enhance marine biodiversity in the Port of Vigo through the installation of artificial refuges that function as microhabitats for seahorses and other associated species. This general objective is developed through a set of specific goals:



Evaluate the ecological and technical feasibility of installing artificial refuges for seahorses in the port environment.



Monitor the colonisation and behaviour of *Hippocampus spp.* in structures specifically designed for their settlement.

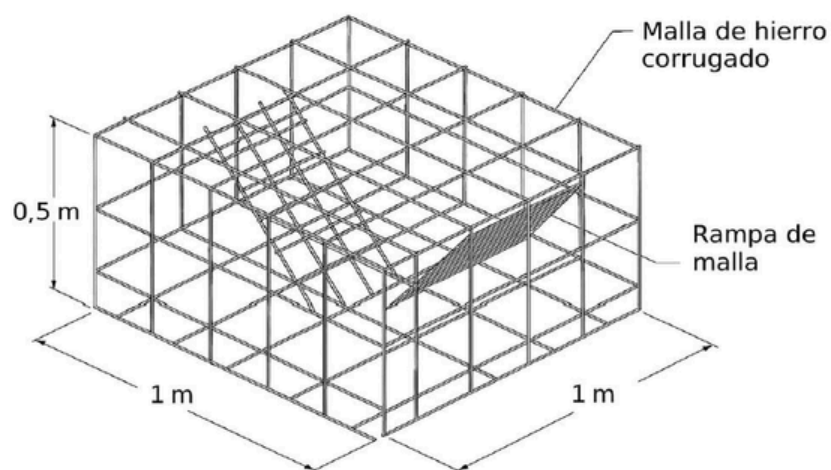


Contribute to the development of innovative nature-based solutions for the environmental improvement of the Port of Vigo.

### 3.2 Methodology

Two locations were selected for the pilot on the basis of their ecological potential and accessibility: the A Laxe underwater viewpoint (Nautilus) and Peiraos do Solpor, in Bouzas. A Laxe offers sheltered waters, low current and vertical and horizontal structures that favour settlement, together with excellent accessibility for monitoring and outreach. Bouzas offers good water quality, nearby marine vegetation, moderate currents and complex port structures that generate microhabitats suited to syngnathids and other species.

The structures themselves are four artificial reef-type refuges, two different models installed at each location, built from corrugated iron mesh modules approximately 1 × 1 × 0.5 metres, incorporating a mesh ramp. The design is intended to provide anchoring points and generate cavities and shaded areas that reproduce, as far as possible, the structural complexity of the natural habitats seahorses and other benthic species use. Sites were evaluated beforehand for current, turbidity, presence of marine vegetation and substrate availability.



Following deployment by scientific diving teams in February 2026, the structures were left for a maturation period of approximately one month, during which they were colonised by biofilm, algae, sponges, molluscs and small invertebrates, building up a structural complexity similar to that of natural habitats.

Monitoring combines two complementary techniques. Monthly dives by a scientific diving team record visual observations, photographs, video and behavioural data. In parallel, an IIM-CSIC ROV is used to obtain high-resolution imagery without direct diver intervention, documenting the ecological maturation of the structures, benthic colonisation and the presence of fauna while minimising disturbance to the seahorses and their environment.

### 3.3 Activities and timeline

- February–March 2026: Initial evaluation of the two zones through exploratory dives characterising the habitat and local biodiversity, and recording basic physico-chemical parameters (temperature, salinity, turbidity). Design and fabrication of the four refuge structures.
- March 2026: Deployment of the structures at their definitive locations, followed by a one-month maturation period allowing natural colonisation by benthic organisms.
- March–September 2026: Monthly monitoring through scientific diving (four-person team) and ROV surveys, recording the presence and behaviour of seahorses and associated species.
- October 2026: Final assessment and technical report, including a comparative analysis between locations and structure types, and recommendations for future action, including possible extensions of the project.

### 3.4 Results

Monitoring carried out over the first four months following deployment (March to June 2026) confirmed ten sightings of *Hippocampus guttulatus* using the structures, with individuals displaying natural anchoring, feeding and camouflage behaviour. The prolonged presence of some individuals in the same refuges points to site fidelity and confirms that the structures are fulfilling their ecological function.

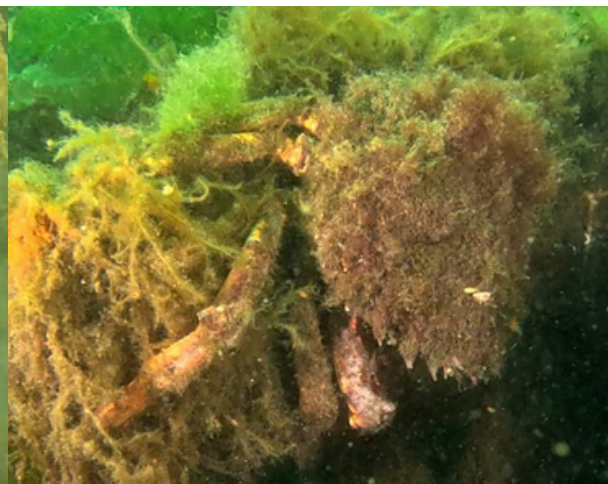
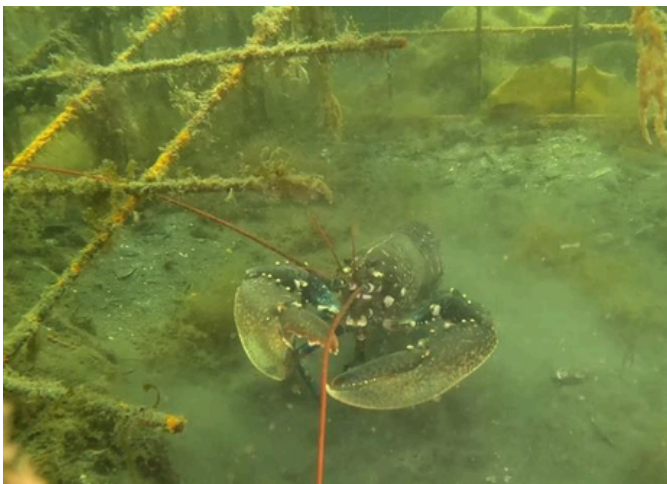
One of the most significant findings was the detection of a juvenile seahorse during a monitoring dive. Juveniles do not travel far from their birth site, so their presence is one of the strongest indicators of ecological success: it confirms active reproduction within the port environment and shows that the refuges support early-life settlement, not only adult individuals.



Beyond seahorses, the structures have also attracted pipefish (family *Syngnathidae*), which share the ecology of seahorses and confirm that the refuges generate functional microhabitats capable of sustaining whole communities of sensitive species. Monitoring also recorded female cuttlefish (*Sepia officinalis*) inside the structures, together with egg clutches attached to the internal bars — evidence that the refuges support reproductive processes for species of high ecological and commercial value.



Adult spider crabs and lobsters have also been observed sheltering and feeding inside the structures, confirming that the refuges suit larger benthic species as well. The benthic colonisation recorded on the structures, including biofilm, algae, sponges, bryozoans, molluscs and echinoderms, shows a growing structural complexity that reinforces the function of the refuges as multi-purpose artificial reefs.

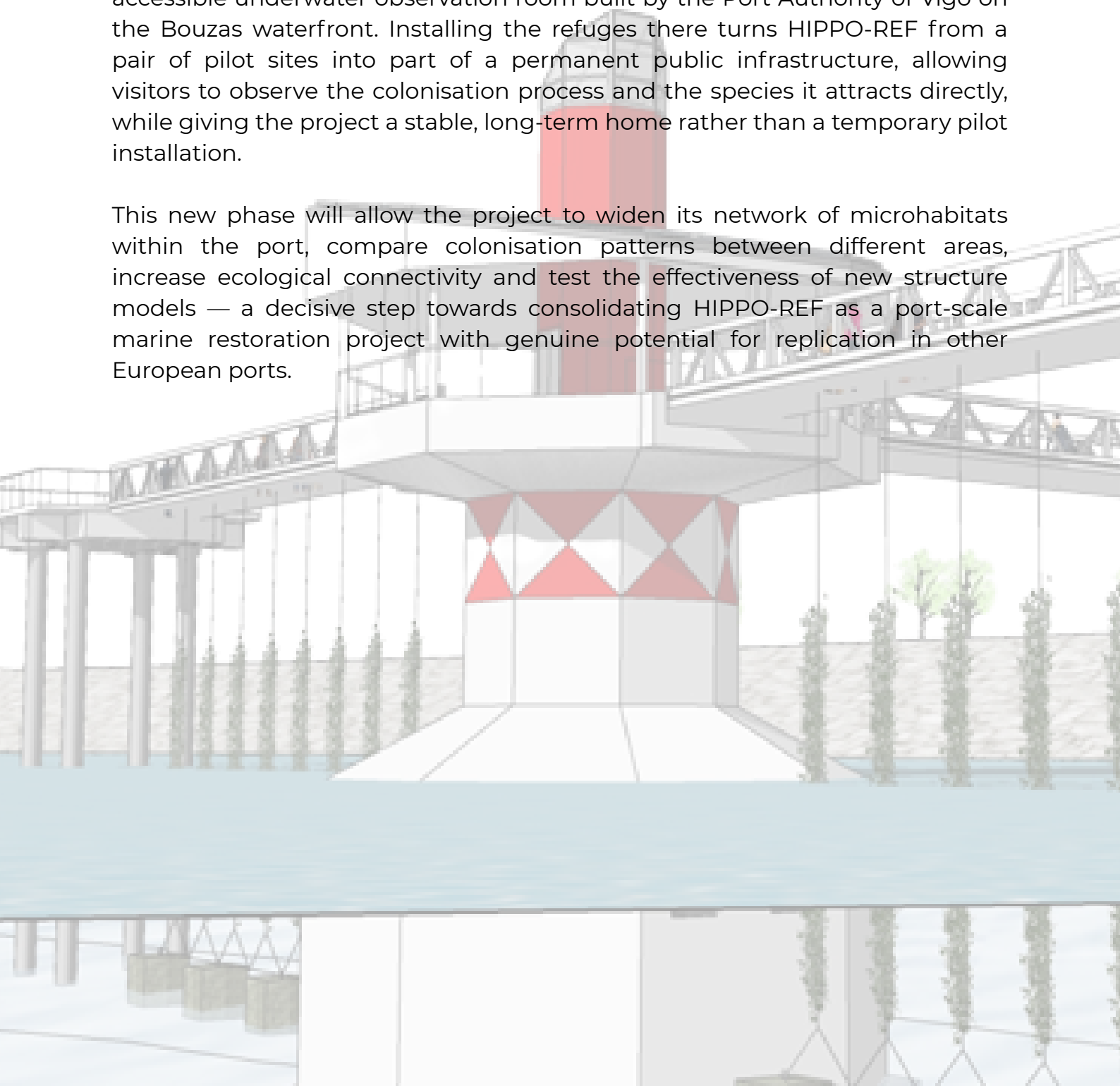


### 3.5 New phase: installation at the Peiraos do Solpor Underwater Observatory

The next phase of HIPPO-REF extends the network with two additional refuges at Peiraos do Solpor, in Bouzas. This location has shown a significant improvement in water quality in recent years and hosts complex port structures that generate microhabitats suited to syngnathids, cephalopods and crustaceans; the proximity of marine vegetation (*Zostera* spp.) and the prior presence of seahorses reinforce its suitability for the project's expansion.

Crucially, these new refuges are being installed at the underwater observatory that forms the centrepiece of Peiraos do Solpor — a permanent, publicly accessible underwater observation room built by the Port Authority of Vigo on the Bouzas waterfront. Installing the refuges there turns HIPPO-REF from a pair of pilot sites into part of a permanent public infrastructure, allowing visitors to observe the colonisation process and the species it attracts directly, while giving the project a stable, long-term home rather than a temporary pilot installation.

This new phase will allow the project to widen its network of microhabitats within the port, compare colonisation patterns between different areas, increase ecological connectivity and test the effectiveness of new structure models — a decisive step towards consolidating HIPPO-REF as a port-scale marine restoration project with genuine potential for replication in other European ports.



#### 4. Innovative character

HIPPO-REF's innovation operates on several distinct layers, rather than a single novel feature.

- Conceptual adaptation: the project takes the Seahorse Hotel model pioneered by UNSW in Sydney and adapts it, for the first time in this context, to an Atlantic commercial port, applying it to a different species assemblage and set of environmental conditions.
- Operational setting: rather than restoring habitat in a protected or non-industrial coastal area, HIPPO-REF deploys its solution inside a working commercial port, directly testing — and countering — the assumption that port infrastructure and sensitive marine biodiversity cannot coexist.
- Monitoring approach: the combination of monthly scientific diving with ROV-based, non-invasive imaging allows detailed, high-resolution documentation of colonisation and behaviour while minimising disturbance to the seahorses and their environment.
- Ecological reach: the refuges function as multi-species, multi-purpose artificial reefs rather than single-species solutions, supporting seahorses, pipefish, cuttlefish, spider crabs, lobsters and a diverse benthic community within the same structures.
- Design economy: the modular, low-cost structures keep the solution simple to fabricate, deploy and replicate, without requiring complex or expensive engineering.

Taken together, these layers give HIPPO-REF measurable results and strong visual evidence of real impact, showing that ports can become spaces of ecological restoration capable of hosting marine biodiversity of high value. The project aligns with the European Green Deal, the EU Biodiversity Strategy 2030 and the Mission on Restoring our Ocean and Waters, and complements existing initiatives such as Living Ports and NaturPorts, positioning the Port of Vigo as a reference in integrating nature-based solutions into port infrastructure.

## **5. Replicability and transferability**

HIPPO-REF was conceived from the outset as a demonstrative pilot with capacity for scaling and replication in other European ports. Its potential for growth is broad: installing networks of refuges across multiple areas of the Port of Vigo, integrating biodegradable or 3D-printed structures, and developing citizen science programmes that involve the community in monitoring marine biodiversity. More broadly, HIPPO-REF can become a replicable model for other European ports, contributing to a network of biodiverse ports that integrate nature-based solutions into their infrastructure.

As part of IIM-CSIC's commitment to continuous improvement of the project and to international knowledge exchange in marine restoration, a team of researchers from the institute will travel to the University of New South Wales (UNSW) in Sydney, Australia. The aim of this visit is to learn directly about the Seahorse Hotels project that UNSW runs in the port of Sydney, a pioneering initiative that has demonstrated the effectiveness of artificial structures in supporting the settlement and recovery of seahorse populations in urban environments. The stay will allow the team to examine in detail the methods, designs and protocols applied in Australia, build synergies between both teams, and explore avenues of scientific collaboration to strengthen and extend the reach of HIPPO-REF in the Port of Vigo.

## **6. Governance, port cooperation and stakeholder engagement**

The project is developed within the framework of the Blue Growth Vigo strategy. This strategy, launched by the Port Authority of Vigo in 2016 and inspired by the European Commission's Blue Growth approach, is based on a collaborative model that brings together stakeholders from the quadruple helix: public institutions, academia, industry, and civil society. HIPPO-REF arises as a concrete and innovative response to the strategic goals of sustainable development, environmental restoration, and climate resilience in the port-maritime context.

The project is also building international cooperation, through the planned research stay of the IIM-CSIC team at the University of New South Wales in Sydney, aimed at exchanging methods and protocols with the team behind the Seahorse Hotels initiative and exploring further scientific collaboration.

Within the Port of Vigo, HIPPO-REF does not stand alone: it is one strand of a broader restoration strategy that also includes Living Ports and NaturPorts, and its stakeholder base extends across the scientific, institutional and port-management actors involved in that wider strategy, described in the following section.

## 7. Contribution to the UN Sustainable Development Goals

HIPPO-REF's contribution to the 2030 Agenda follows directly from what the project actually does: restoring habitat inside a working port, building it through inter-institutional and international cooperation, and using it to bring marine biodiversity into a public, urban setting.



Ocean literacy, environmental education and knowledge transfer for schools and the public

Unprecedented maritime engineering infrastructure in Spain; innovative integration of nature-based solutions

New model of port-city integration based on sustainability and valorisation of natural heritage

Long-lasting, durable infrastructure designed to deliver sustained value rather than a temporary or disposable intervention

Adaptation to climate change; reinforcing resilience of coastal ecosystems

Restoration of marine ecosystems; increased marine biodiversity; improved ecological quality of the Vigo Bay

Partnership between a public research institute (IIM-CSIC) and a port authority. Extending internationally through the planned research exchange with the University of New South Wales in Sydney.