LIFE TRANSFER

SEAGRASS TRANSPLANTATION FOR TRANSITIONAL ECOSYSTEM RECOVERY

Seagrass transplantation for transitional Ecosystem Recovery

LIFE TRANSFER

Layman's Report

Contribution, data, picture and information: all the project's beneficiaries
Istituto Delta Ecologia Applicata s.r.l. text: Graziano Caramori; graphic: Mattia Maggiore

Co-finanziato dall'Unione Europea
Costo totale: € 4.214.120, contributo finanziario UE: € 3.160.590
Data inizio: 01/12/2020 Data termine: 30/11/2025

Beneficiari di progetto

Università di Ferrara

Natural Environment and Climate Change Agency

Comunidad Autonóma de la Región de Murcia - Consejería de Agua, Agricultura, Ganadería, Pesca y Medio Ambiente – Dirección General de Mar Menor

Asociación Empresarial Centro Tecnológico de la Energía y del Medio Ambiente de la Región de Murcia

Dipartimento di Scienze Ambientali, Informatica e Statistica, Università Ca' Foscari Venezia

Ente di Gestione per i Parchi e la Biodiversità-Delta del Po

Hellenic Centre for Marine Research

Istituto Delta Ecologia Applicata srl

Universidad de Murcia

Ente Parco Regionale Veneto del Delta del Po

Table of contents

Seagrass meadows and coastal lagoons

Seagrasses are flowering plants that live completely submerged in marine and brackish waters. These species are plants, not seaweed.

Coastal lagoons represent one of Europe's most ecologically valuable yet threatened environments. These shallow water bodies, partially separated from the sea by sand barriers, create unique conditions of brackish water where rivers meet the sea, supporting exceptional biodiversity.
Despite occurring along only 13% of the coastlines of all continents, they deliver disproportionately high ecosystem services, including fish production, water purification, and carbon sequestration.

LIFE TRANSFER addresses seagrass meadows in coastal lagoons, that are among Europe's most valuable yet threatened habitats, recognized as priority habitat coded as 1150* under the EU Habitats Directive.

The heart of these ecosystems — the underwater seagrass meadows — has suffered severe regression over recent decades due to pollution, altered water circulation, and human activities.

The environmental problem

Seagrasses represent true "ecosystem engineers," capable of profoundly modifying the environment in which they live, improving water quality, increasing biodiversity, and stabilizing sediments.

At the heart of healthy lagoon ecosystems are underwater seagrass meadows.

A healthy seagrass meadow can harbour more biodiversity than areas without vegetation.

These plants create the foundation for the entire ecosystem, yet they have suffered a dramatic decline. In the Mediterranean alone, we have lost approximately 33,000 km² (about 18%) of seagrass meadows in recent decades, retreating at an alarming rate.

Several interconnected factors drive this decline. **Eutrophication**: excess of nutrients from agricultural runoff and urban wastewater stimulates blooms of fast-growing algae that block sunlight from reaching seagrasses and consume oxygen when they decompose. This process affects most coastal lagoons. **Invasive Species**: in Mar Menor, the alien alga *Caulerpa prolifera* has spread along most of the lagoon bottom, changing sediment characteristics and negatively affecting seagrass species. **Climate Events**: increasingly frequent extreme weather events, such as the severe floods that affected Mar Menor in 2019, can cause the stratification of the water column, loss of transparency and of light radiation and sudden changes in salinity and sedimentation that damage seagrass communities.

A Cascading Effect on Ecosystems

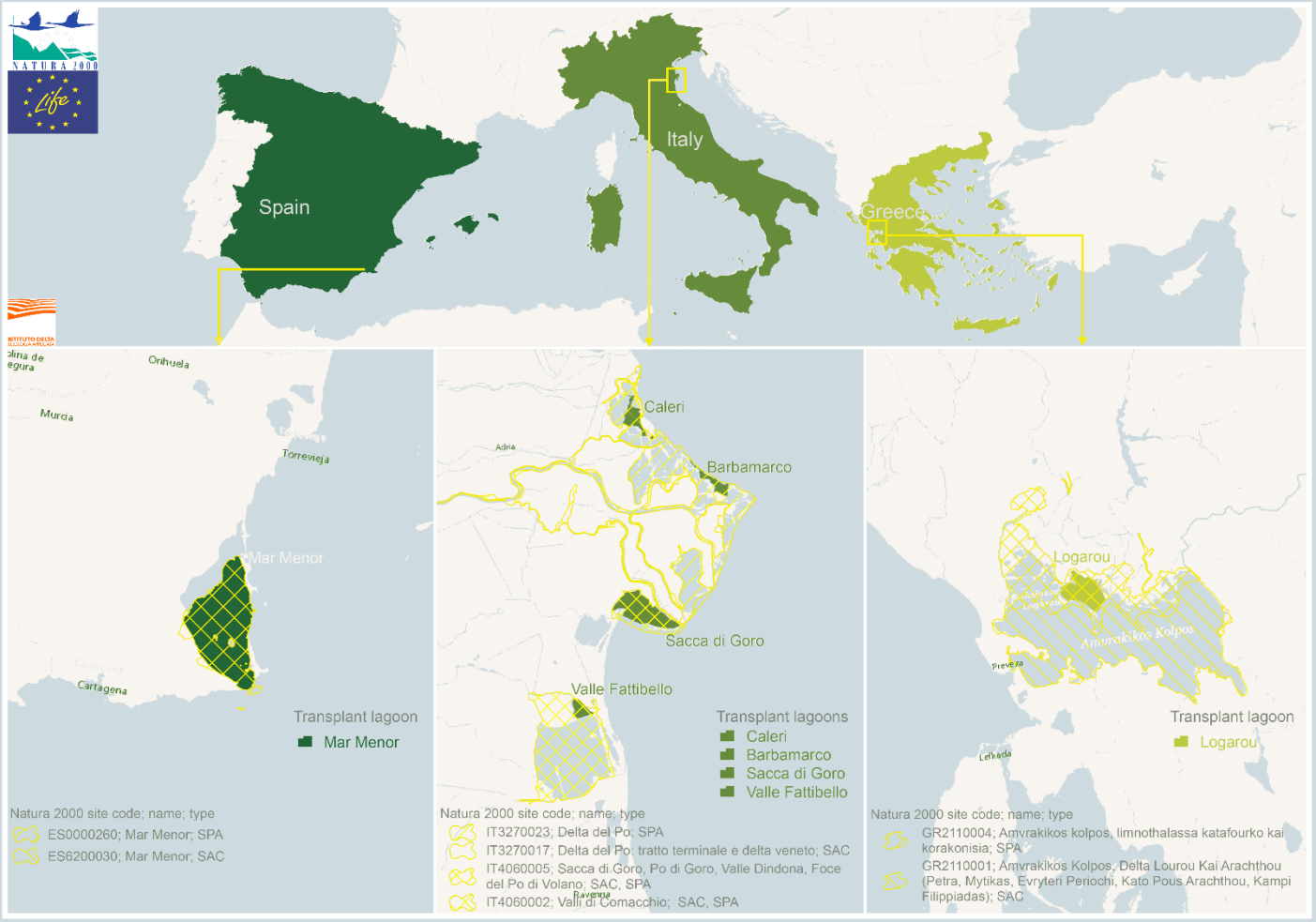
The loss of seagrass meadows triggers a cascade of ecological consequences: **Biodiversity Loss:** areas without seagrasses have fewer species and lower abundance of benthic organisms; **Reduced Water Quality**: without seagrasses filtering water and stabilizing sediments, turbidity increases; **Fish nursery areas** disappear, affecting both protected species and commercially important fish stocks; **Carbon Release**: instead of sequestering carbon, degraded seagrass beds can become sources of greenhouse gas emissions.

Even when environmental regulations have reduced the primary causes of degradation in recent years, the natural recovery of seagrass meadows remains extremely poor or non-existent. This is especially true when seed banks are depleted and remnant meadows are too sparse and isolated to naturally recolonize the lagoon—precisely the situation LIFE TRANSFER aims to address.

The project targeted 4 species occurring on seagrass meadows: *Cymodocea nodosa*, *Zostera marina*, *Zostera noltei and Ruppia cirrhosa*. Each species was selected to match the specific ecological conditions of the different lagoon.

The conservation actions

LIFE TRANSFER has implemented concrete actions to improve the conservation of the priority habitat 1150* Coastal lagoons, through the transplantation of submerged aquatic seagrasses in six coastal lagoons located in Spain, Italy and Greece.



Building on the successful methodology developed by LIFE SeResto, our project implemented a network of small-scale transplants that served as nuclei for natural recolonization.

The transplantation was carried out using a simple but effective method: small sods approximately 15 cm in diameter are taken from donor sites, where the plants are abundant, and transplanted into the target lagoons.

For larger species such as *Z. marina* it is possible to transplant the single rhizomes.

By reconnecting these fragmented underwater landscapes, LIFE TRANSFER aims to significantly improve the conservation status of coastal lagoons, enhance biodiversity, and strengthen the resilience of these ecosystems against climate change all while supporting the communities that have relied on these waters for generations.


It is as simple as transplanting any other plant.

What makes our approach unique is the direct involvement of local fishermen in the transplantation process, creating a powerful synergy between conservation goals and local communities whose livelihoods depend on healthy lagoon ecosystems. Local fishermen were specifically trained for this purpose, under the supervision of scientific staff. This direct involvement has further raised awareness among the local community about the importance of seagrass meadows.

Testimonial from a fisherman of Preveza Fisheries Cooperative: “It's a good thing that scientists approached us because science and fishermen exchange each other’s knowledge and this way we get better results.”

Results achieved

After five years of dedicated conservation work across three Mediterranean countries, LIFE TRANSFER has achieved significant ecological improvements in the targeted coastal lagoons. Our results demonstrate how targeted interventions can revitalize these valuable ecosystems and enhance their ecological functions.

The project has successfully triggered the process of seagrass recolonization, with varying success rates across different lagoons and species:

Mar Menor (Spain): *C. nodosa* transplants demonstrated an over 80% survival rate with substantial growth, while *R. cirrhosa* showed approximately a 65% survival. This different success provides valuable insights for future restoration efforts.

Caleri Lagoon (Italy): *Z. noltei* has shown exceptional growth, with transplanted sods expanding from 15cm to over 1m in diameter within a single growing season. By 2025, these patches have merged to create continuous meadows, transforming the previously bare substrate. In the other Italian Lagoons, transplant was not totally successful in particular with *R. cirrhosa*, highlighting the importance of adaptive management in restoration. In the **Barbamarco Lagoon** located in the Po River delta, in addition to seagrass transplantation, dredging of a sub-lagoonal channel was carried out to improve water circulation. This action was fundamental to restore optimal hydrodynamic conditions for seagrass growth and to prevent anoxic phenomena that can occur due to poor water circulation. This intervention improved the conservation status of about 600 hectares of lagoon habitat.

Logarou Lagoon (Greece): the survival rate of transplanted sods appears dependent on the type of methodology used. With the updated tools designed by HCMR the 6-month survival rate ranged from 38-46 %, whilst the 12-month survival rate ranged from 28-46 % during the project. Seagrass restoration has triggered a cascade of positive effects on water quality.

Biodiversity Enhancement

The ecological benefits of seagrass restoration have been quantified through multiple scientific indicators.

The Macrophyte Quality Index (MaQI) iImproved from "Poor" (0.25) to Moderate" (0.55) in Caleri lagoon, demonstrating enhanced plant community structure

The Benthic Macroinvertebrate Index (M-AMBI) in transplant sites consistently showed higher values compared to control sites, with Caleri and Barbamarco reaching "Good" status.

The Habitat Fish Bio-Indicator (HFBI) in transplant areas showed increased values (0.35 in Caleri versus 0.21 in control sites), indicating improved habitat quality for fish. Restoration areas now support a richer fish community.

These combined results demonstrate that the approach of small-scale, strategically placed transplants can effectively initiate large-scale habitat recovery.

The differences in success rates between species and locations provide valuable lessons for future restoration efforts in Mediterranean coastal lagoons and beyond.

Benefit and impact

Overall, the LIFE TRANSFER project has demonstrated significant conservation benefits for the targeted Natura 2000 sites across Italy, Spain, and Greece, focusing on priority habitat 1150* Coastal lagoons. Through the transplantation of native seagrass species, the project has initiated a process of ecosystem recovery that extends beyond simply restoring vegetation cover.

The restoration of seagrass meadows is providing critical ecosystem structure that supports benthic communities and fish fauna. The project is effectively demonstrating how active restoration measures can improve the conservation status of priority habitat 1150* by reestablishing its characteristic vegetation.

Adapting to different environments

One of the key transferable innovations of LIFE TRANSFER is our adaptation of techniques to different environmental conditions:

In turbid waters: HCMR (Hellenic Centre for Marine Research) developed a specialized tool for planting sods in the highly turbid waters of Logarou Lagoon (Greece), where low visibility makes traditional transplantation methods challenging.

Species-specific approaches: we've documented different success rates and methodologies for various seagrass species (*Z. marina*, *Z. noltei*, *R. cirrhosa*, and *C. nodosa*), providing valuable insights on which species work best under specific conditions.

Small-scale, low-impact methodology: the refined technique uses small sods -15 cm diameter - making transportation easier and reducing impact on donor sites while maintaining effectiveness.

Policy Implications

LIFE TRANSFER offers several important policy implications relevant to European legislation, particularly the Nature Restoration Law.

✓**Evidence-based restoration techniques**: the project provides tested methodologies for active restoration of coastal lagoons through seagrass transplantation, as practical example of restoration measure listed in Annex VII of the Nature Restoration Law. The varying success rates between species (e.g. *C. nodosa* performing better than *R. cirrhosa*) provide valuable insight for developing species-specific restoration protocols.

✓ **Stakeholder engagement model**: the successful involvement of local fishermen in restoration activities demonstrates a practical approach to the socio-economic considerations embedded in the Nature Restoration Law. This participatory model helps build local ownership of restoration efforts and aligns conservation with livelihoods, addressing one of the main concerns about implementation feasibility.

✓ **Socio-economic impact:** the project's evaluation of the socio-economic impact established a clear link between lagoon ecosystems and local economies (49-93% in the Italian context) providing economic justification for restoration investments and supporting the monitoring and reporting requirements anticipated in the Nature Restoration Law.

✓ **Multiple-benefit approach**: LIFE TRANSFER demonstrates how habitat restoration simultaneously delivers multiple policy objectives - biodiversity conservation (Habitats Directive), improved water quality (Water Framework Directive), and carbon sequestration (Climate Change mitigation). This aligns with the integrated approach promoted in the EU Biodiversity Strategy for 2030.

✓ **Adaptive management**: the varying success across lagoons illustrates the importance of site-specific approaches and adaptive management in restoration projects - a key consideration for the practical implementation of restoration targets at national and local levels.

Transferability of project results

Spreading the Seagrass Solution

The LIFE TRANSFER project has developed a highly effective and replicable methodology for restoring seagrass meadows in coastal lagoons.

Training the Trainers

At the heart of our transferability strategy is the "training of the trainers" approach.

The project has implemented specific knowledge transfer events targeting site managers and technicians from other Natura 2000 sites.

One event was dedicated to Member States outside our project consortium, with 17 site managers and technicians participating from 6 countries: Portugal, France, the Netherlands, Belgium, Bulgaria, and Germany. Three additional events were implemented in Spain, Italy, and Greece, training 21 local site managers and technicians. In total, 38 people were trained across all events.

These events included both theoretical training and practical field demonstrations, allowing participants to witness first-hand the results of successful transplantations and learn directly from our experienced team. During the events a comprehensive handbook detailing all aspects of the methodology was distributed to participants, ensuring wide accessibility to the methodology. The handbook is also available for download from the website.

Real-World Application

The transferability of our approach has already been demonstrated through its adoption by the LIFE FOR POMORIE LAGOON project in Bulgaria. After networking events and sharing our executive project, the Bulgarian team successfully implemented our methodology in their coastal lagoon restoration efforts.

Additionally, our techniques have been incorporated into regional Prioritized Action Frameworks and Strategic Nature Projects, such as LIFE NatConnect 2030, ensuring institutional support for wider implementation

The Path Forward

The transferability of LIFE TRANSFER goes beyond methodology – it represents a paradigm shift in approaching seagrass restoration. By emphasizing community involvement, particularly fishermen who understand the lagoons intimately, LIFE TRANSFER created a model that is not only technically effective but also socially sustainable. As climate change and human pressures continue to threaten coastal ecosystems across Europe, the techniques developed and shared through LIFE TRANSFER provide a proven, adaptable approach to restoring these vital habitats and the ecosystem services they deliver.

Online information

Further information is available on the official project's website and dedicated social media. To ensure the longevity of the project knowledge transfer, a comprehensive handbook is provided detailing all aspects of the methodology, including extraction, transportation, and transplantation techniques for different species, besides a list of other seagrass transplant experiences.

Project's website		www.lifetransfer.eu
Facebook page		www.facebook.com/share/1Bqo8em8q6
Videoclip of the project		www.youtube.com/watch?v=fP_1IKoP9pY
Videoclip of Spanish lagoon		www.youtube.com/watch?v=fJ8oVFXxvfs
Videoclip of Italian lagoons		www.youtube.com/watch?v=mCRcwzlAWps
Videoclip of Greek lagoon		www.youtube.com/watch?v=nXMTowfHAkU
Handbook for Natura 2000 managers and technicians		www.lifetransfer.eu/wp-content/uploads/2024/07/HANDBOOK-OF-SEAGRASS-TRASPLANTS-Rev10-images.pdf

LIFE TRANSFER

SEAGRASS TRANSPLANTATION FOR TRANSITIONAL ECOSYSTEM RECOVERY