



REST-COAST H2020

Technical field trip, lagoon of Venice - Tuesday, 18th October 2022

LIFE LAGOON REFRESH

“Coastal lagoon habitat (1150*) and species recovery in Venice Lagoon by increasing the freshwater input and restoring the salt gradient”

Rossella Boscolo Brusà

ISPRA- Institute for Environmental Protection and Research, Italy

Alessandra Feola, Federica Cacciatore, Emanuele Ponis, Adriano Sfriso, Piero Franzoi, Matteo Lizier, Paolo Peretti, Bruno Matticchio, Nicola Baccetti, Valerio Volpe, Luigi Maniero, Federica Oselladore, Alvisè Luchetta, Michele Cornello, Andrea Bonometto

rossella.boscolo@isprambiente.it lagoonrefresh@isprambiente.it

www.lifelagoonrefresh.eu





LIFE LAGOON REFRESH: general information

Coastal lagoon habitat (1150) and species recovery by restoring the salt gradient increasing fresh water input*

Budget info

Total amount: 3'315'130 Euro
% EC Co-funding: 74,13%

Duration

Start: 01/09/2017
End: 31/08/2022

Location

Venice Lagoon
ITALY

Coordinator *ISPRA – Italian National Institute for Environmental Protection and Research*

Project leader *Rossella Boscolo Brusà (ISPRA)*

Partners

Veneto Region - Environmental Protection Department

Interregional Superintendency for Public Works in Veneto, Trentino Alto Adige, Friuli Venezia Giulia

University Cà Foscari of Venice

IPROS Environmental Engineering s.r.l





LIFE LAGOON REFRESH: project background

**RIVERS DIVERSION
(from 1500 to 1800)**

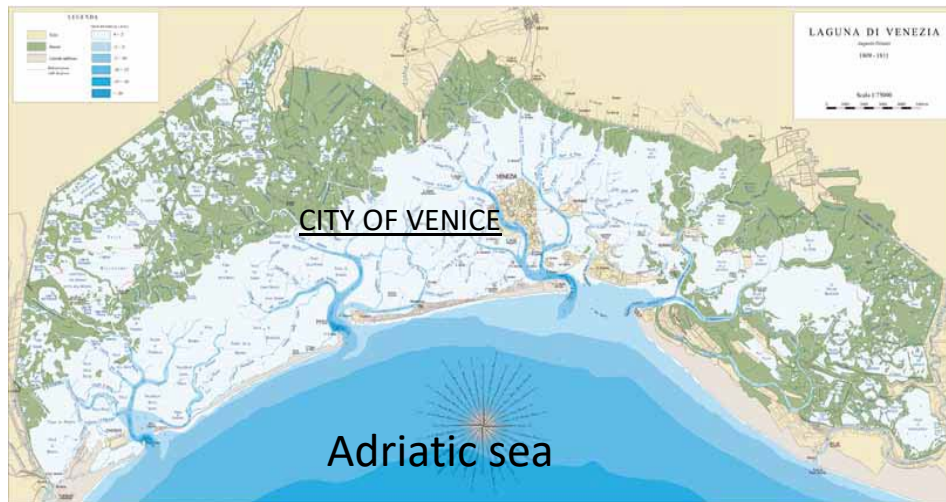


**Decrease of fresh water input;
Decrease of sediment input**



**INCREASE OF THE SALINITY
REED BED REDUCTION**

D'Alpaos, 2010. Morphological evolution of the Venice Lagoon through historical and hydrographic maps



First modern hydrographic map based on surveys of 1809 and 1811

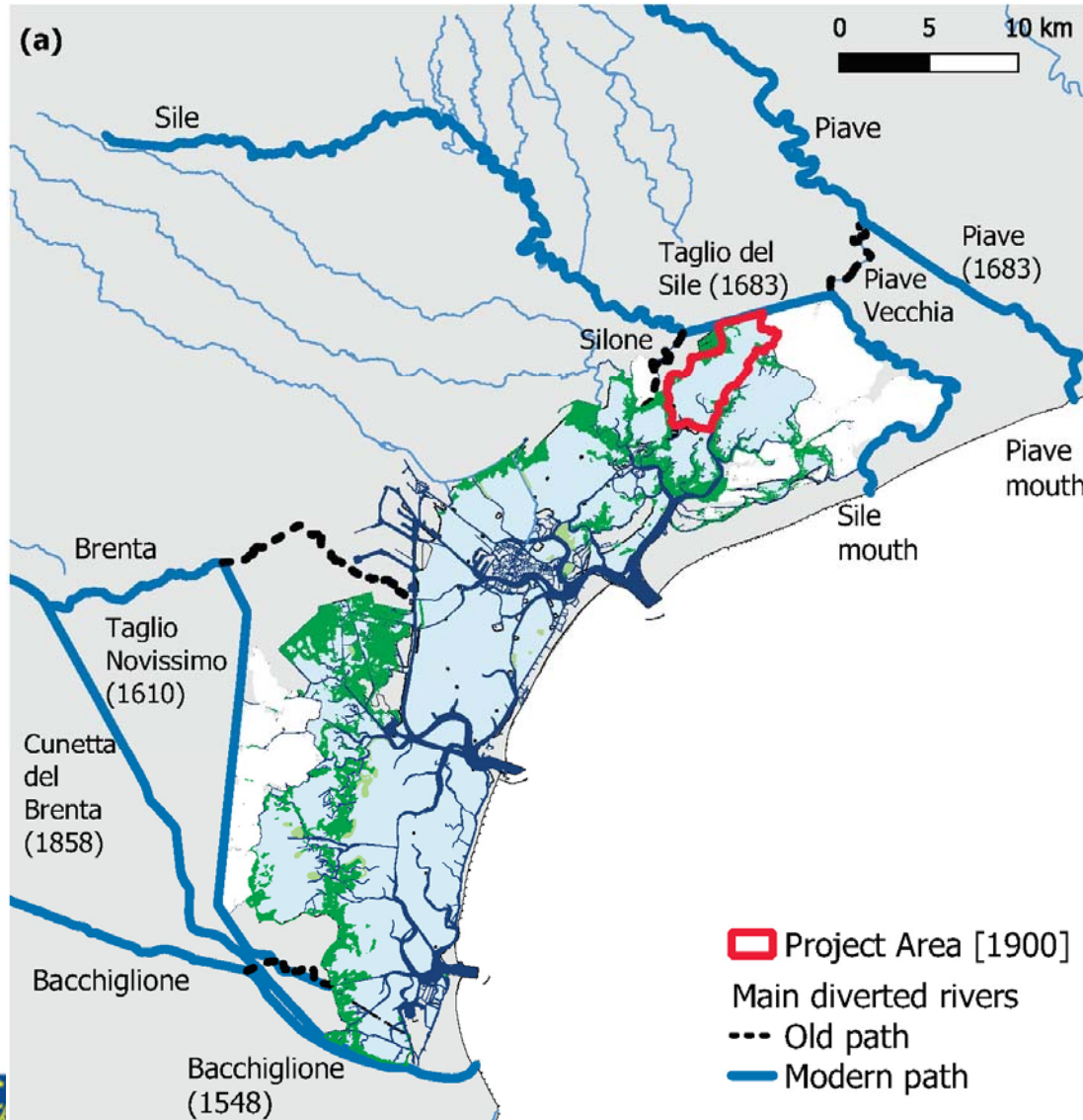


Hydrographic map based on surveys of 2000

**SEVERE REDUCTION OF THE ECOTONAL ZONE BETWEEN LAND AND LAGOON,
CHARACTERIZED BY A MARKED SALINE GRADIENT**

SALT MARSHES SURFACE DECERASED from 170 Km² (1901) to 43 km² (2003)

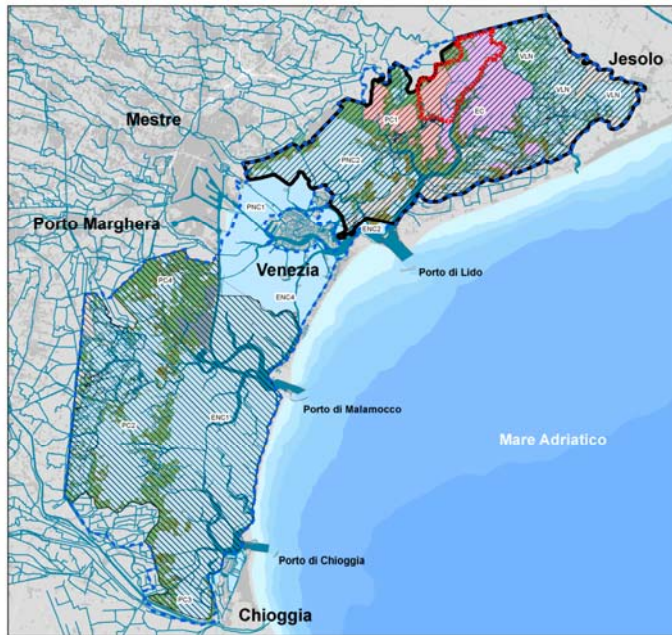
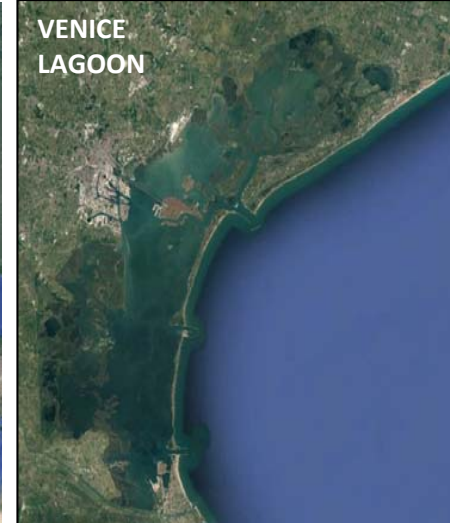




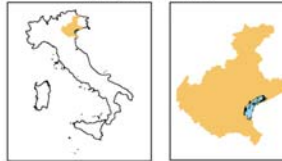
A map of the Venice Lagoon with the main rivers diverted during historical human environmental modifications (Bacchiglione and Brenta in the south, Sile and Piave in the north).



LIFE LAGOON REFRESH: project area



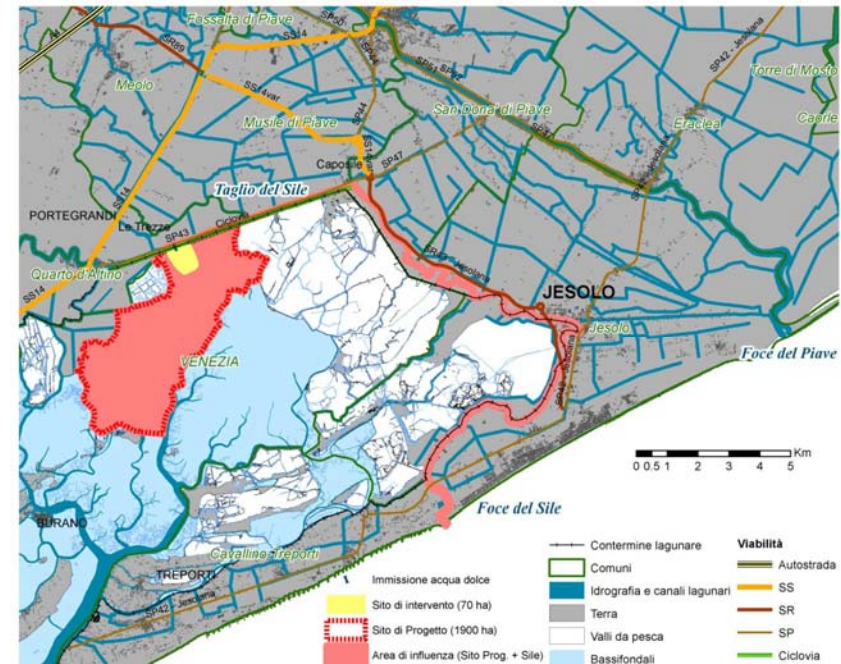
Aree protette (SIC E ZPS) e Corpi idrici definiti ai sensi della Direttiva 2000/60/CE in Laguna di Venezia



- Project Site
- Natura 2000**
- Project Area - SIC IT3250031 - LAG. SUPERIORE
- SIC IT3250030 - LAG. MEDIO - INFERIORE
- ZPS IT325046 - LAGUNA DI VENEZIA

- Corpi Idrici 2000/60/CE**
- EC - Palude maggiore
- PC1 - Dese
- Altri corpi idrici

- Idrografia e canali lagunari
- Barene
- Velme



- Contermine lagunare
- Comuni
- Idrografia e canali lagunari
- Terra
- Valli da pesca
- Bassifondali
- Viabilità**
- Autostrada
- SS
- SR
- SP
- Ciclovía



Project area before interventions of Life Lagoon refresh



The project area is shallow water with some residual salt marshes





Project area before interventions of Life Lagoon refresh



The Sile river flows parallel to the lagoon and a bike lane runs between river and lagoon



A spillway was built after the extreme event of 1966 to protect the town of Jesolo, located downstream, from the risk of flooding. During significant overflow events, a considerable volume of fresh water enters the lagoon through this spillway, with peaks of flow rates of tens of m^3/s .

The water that currently spills from the Sile river arrives directly in the lagoon without finding a buffer zone.



Human activities in the area:
«cavane» for small boats

Project area before interventions of Life Lagoon refresh





LIFE LAGOON REFRESH: project main objectives

THE PRINCIPAL GOAL OF THE PROJECT IS TO RECREATE THE TYPICAL OLIGO-MESOHALINE ENVIRONMENTS OF ESTUARINE TYPE AND THEIR SERVICES

- to recover the salinity gradient lost and to restore reed bed
- to improve the **Degree of Conservation of Habitat 1150** * - Coastal lagoons in the Northern Lagoon of Venice, SCI IT3250031
- to reduce the **degree of eutrophication**, thanks to reed phytoremediation function;
- to improve the **status of bird species** included in annex I of Dir. 2009/147/EC, that use the reed environment during the winter period and /or for breeding, foraging or nesting (*Phalacrocorax pygmeus**, *Botaurus stellaris**, *Ardea purpurea*, *Ixobrychus minutus*, *Circus aeruginosus*, *C. cyaneus*, *Alcedo atthis*);
- to increase the **presence of fish species** attracted by the presence of low-salinity environments;





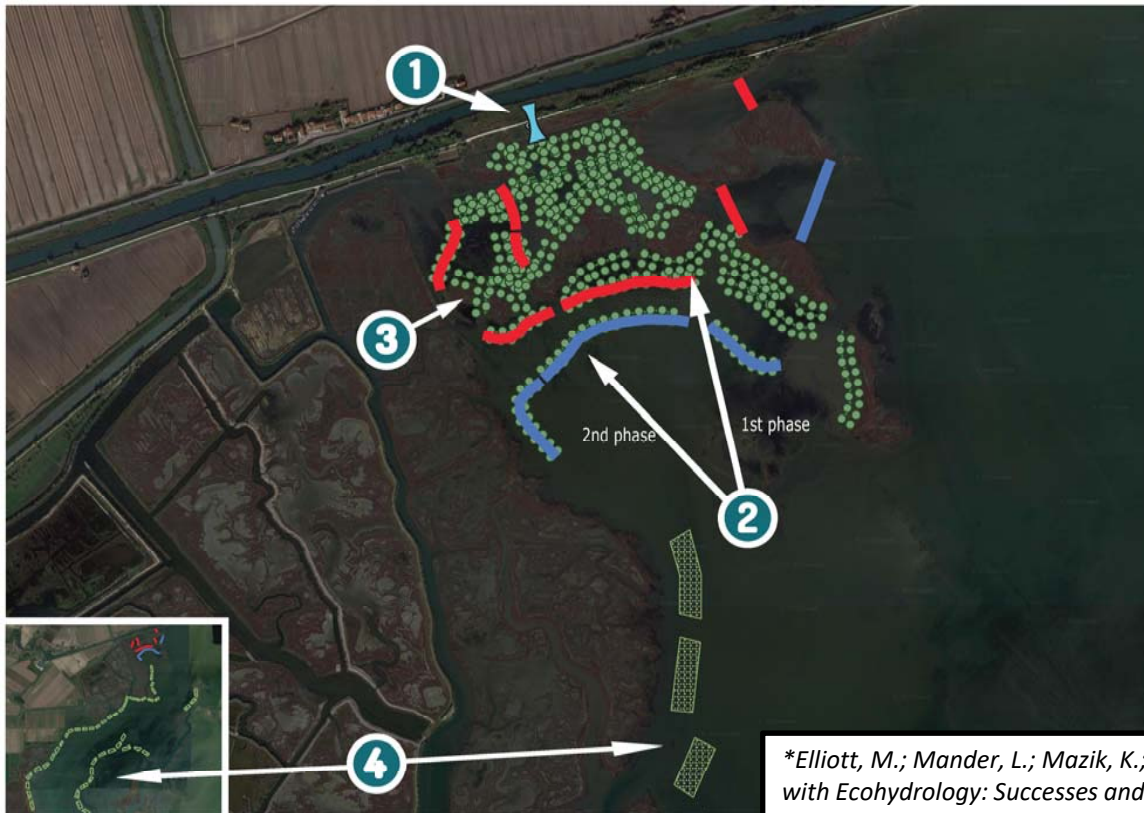
LIFE LAGOON REFRESH: project key actions, conservation actions

TYPE A Approach:
restoring the hydrological processes and physico-chemical conditions

- 1) diversion of a **freshwater flow** (1.000 l/s) from the Sile river into the lagoon;
- 2) restoration of the **intertidal morphology** to sustain the reed development;

*Ecoengineering according to Elliot et al 2016**

TYPE B Approach: direct intervention on biota with transplanting actions



- 3) planting of *Phragmites australis*;
- 4) Transplantation of *Ruppia cirrhosa*, *Zostera marina*, *Zostera noltei*;

+ MANAGEMENT APPROACH

- 5) Reduction of hunting and fishing pressure in the area

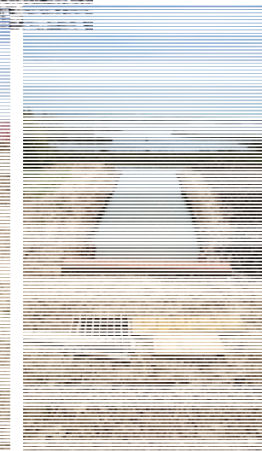
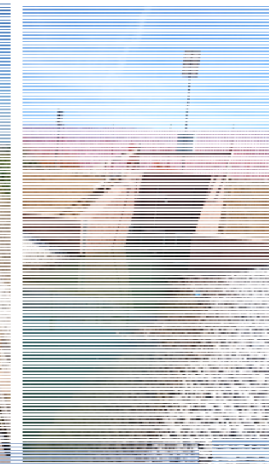
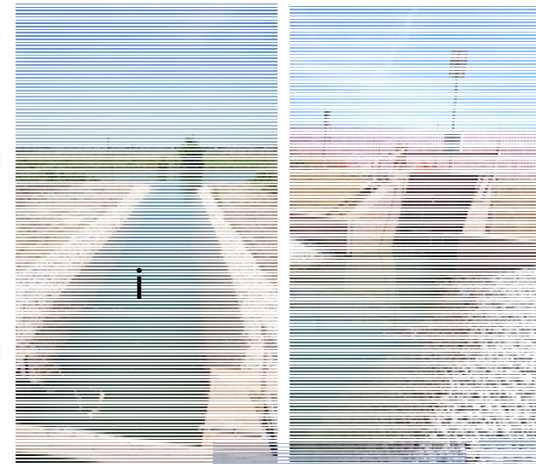
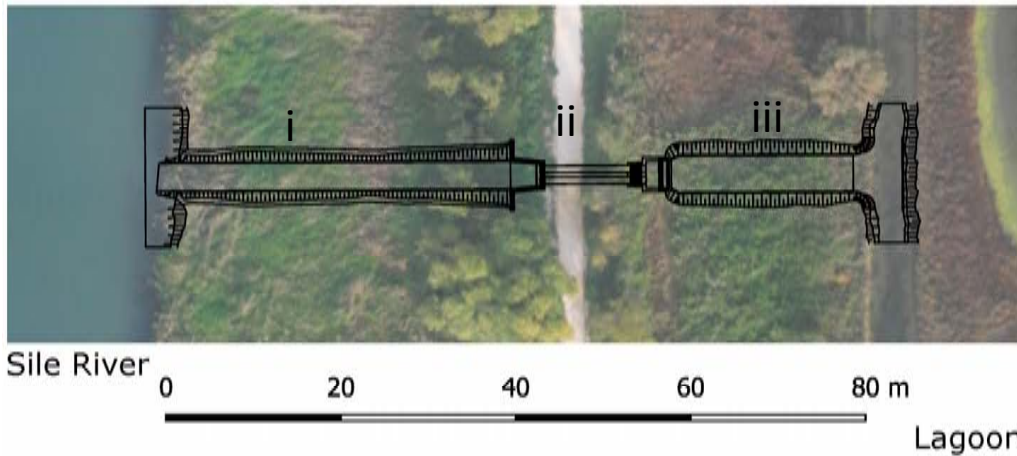
*Elliott, M.; Mander, L.; Mazik, K.; Simenstad, C.; Valesini, F.; Whitfield, A.; Wolanski, E. Ecoengineering with Ecohydrology: Successes and failures in estuarine restoration. *Estuar. Coast.* 2016, 176(5) 12-35



LIFE LAGOON REFRESH: project key actions, conservation actions

1 HYDRAULIC WORKS

Consists of two pipelines crossing the right embankment of the Sile river. The hydraulic works included three elements: (i) a linear channel for intake from the Sile river with a length of 40 m and width of 3 m; (ii) a crossing of the embankment, made by two parallel pipes with a diameter of 0.8 m; (iii) an inflow channel in the lagoon with a length of 20 m, a width of 4 m, and two non-return valves at the beginning of the channel.



The diversion of a freshwater flow from the Sile river into the Lagoon is gradually increased starting from 300 l/s to approximately 1000 l/s.

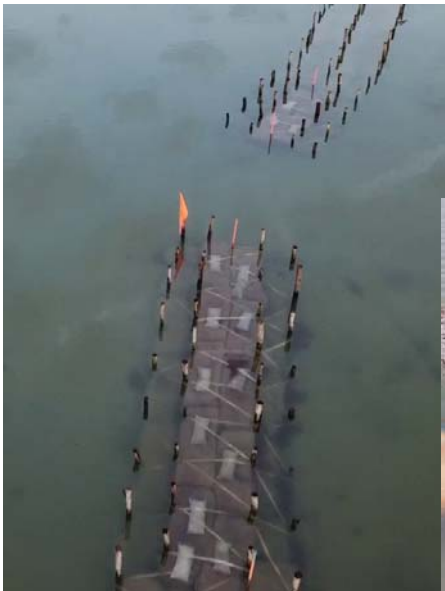
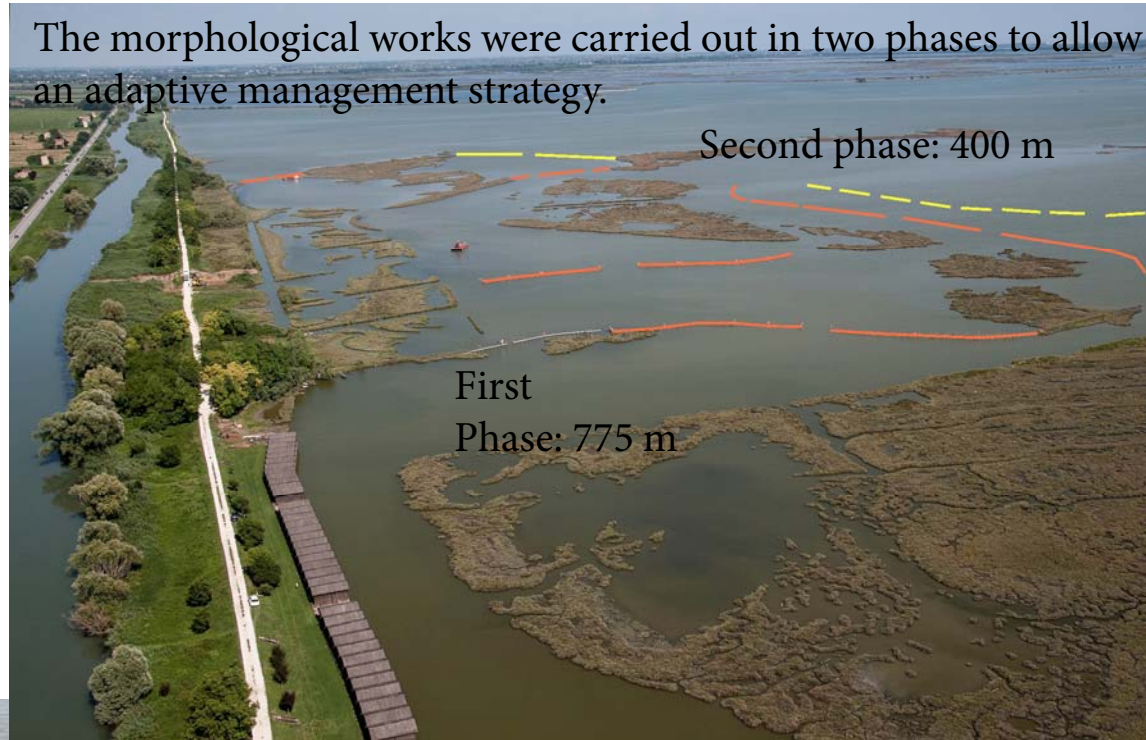
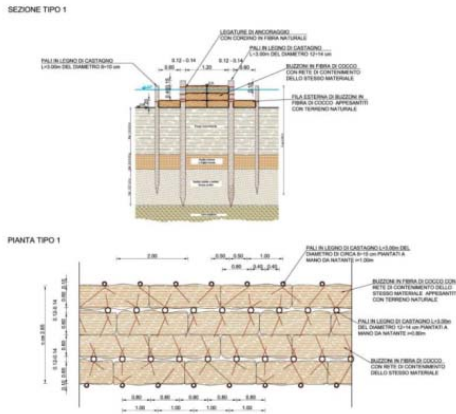


LIFE LAGOON REFRESH: project key actions, conservation actions

2 MORPHOLOGICAL STRUCTURES

Two lines of modular biodegradable elements, were placed on the lagoon shallow area in front of the freshwater intake area to slow dispersion of freshwater

The morphological works were carried out in two phases to allow an adaptive management strategy.



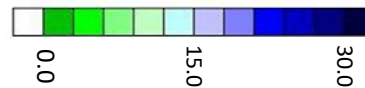
We use modular bags light and biodegradable (coconut fibers and jute), placed manually from small boats, without the need to dredge channels

NUMERICAL MODEL WAS USED TO EVALUATE DISCHARGE VARIATION IN TERMS OF SALINITY DIFFUSION

With a inflow nil (pre-intervention) the salinity is about 30



Salinity



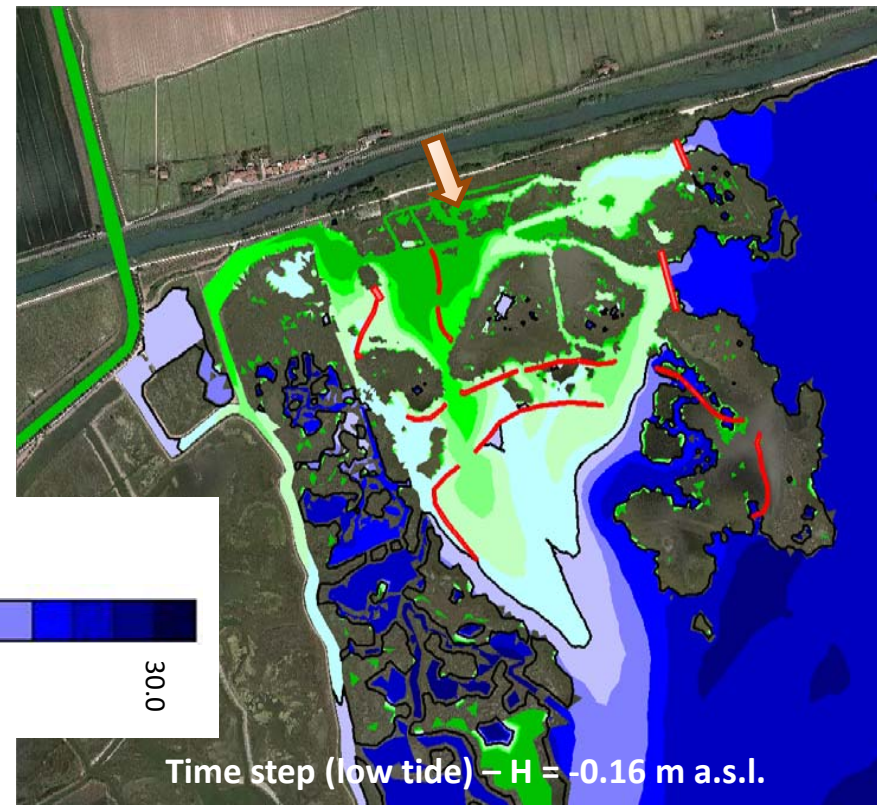
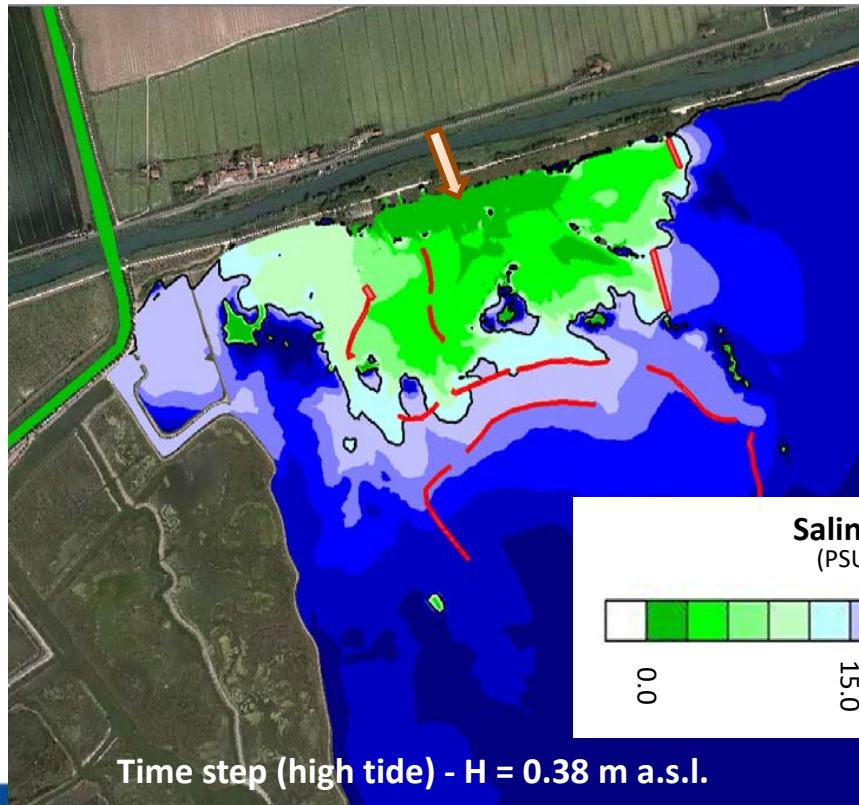
Recovery of the salinity gradient

NUMERICAL MODEL IS USED TO EVALUATE DISCHARGE VARIATION IN TERMS OF SALINITY DIFFUSION

With a inflow of 1000 l/s we obtain the expected results in terms of recovery salinity gradient

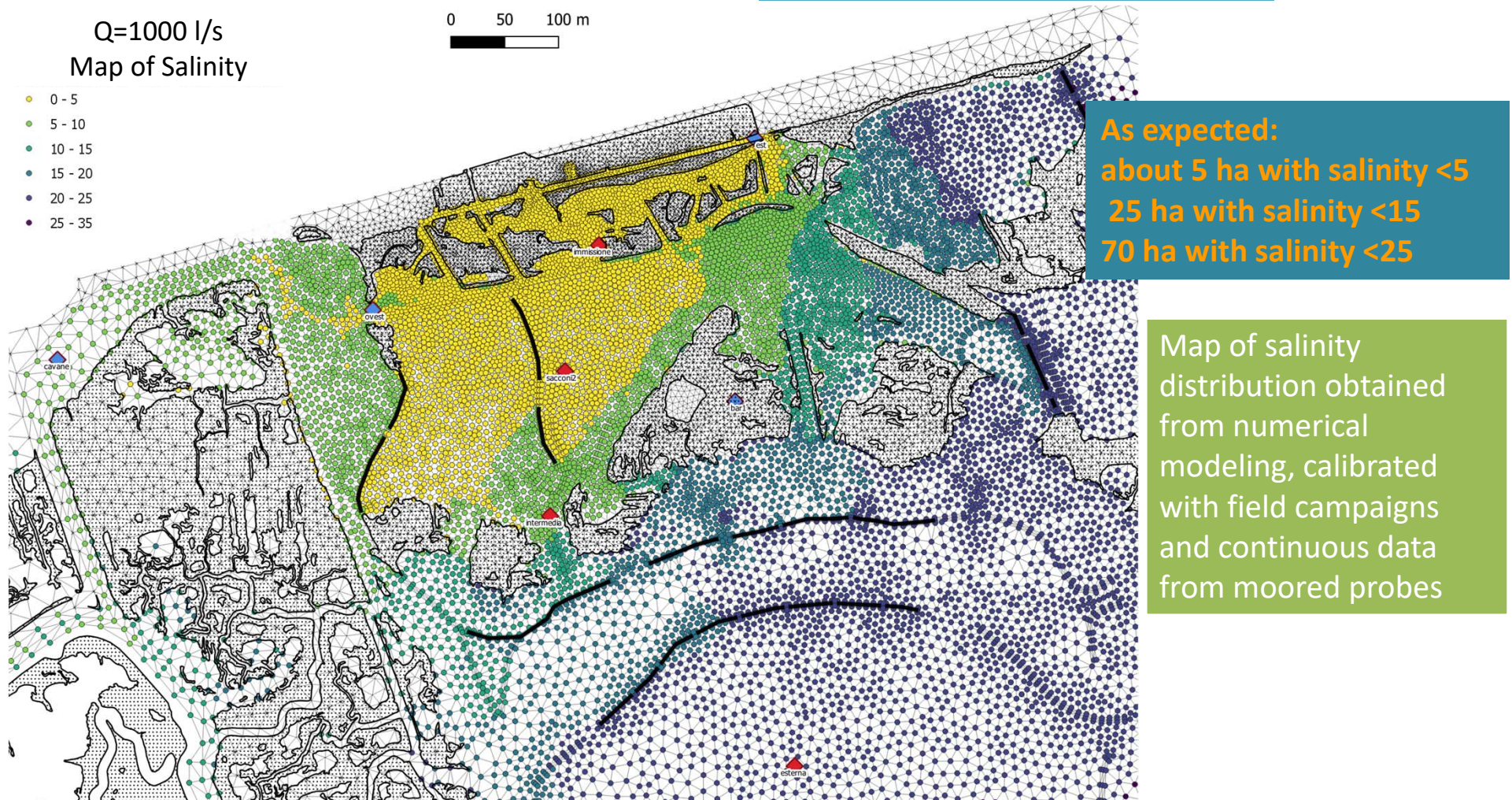
EXPECTED RESULTS:

- WATER SALINITY: FROM >30 (ANNUAL MEAN) TO <5 (5 ha); <15 (25 ha); <25 (70 ha);



The sluice gates were opened at 1000 l/s on February 2021

The salt gradient met the target



Reedbed: trasplantation and Results

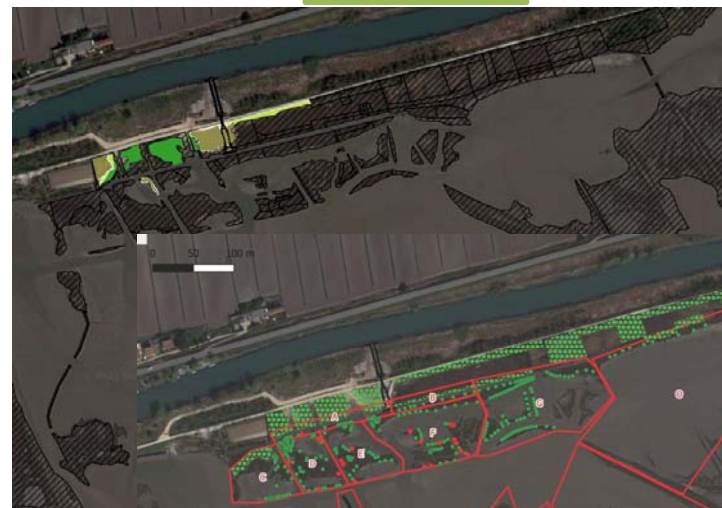
FISHERMEN, HUNTERS, STAKEHOLDERS WERE INVOLVED IN THE REED AND SEAGRASS TRANSPLANT ACTIONS AFTER A TRAINING COURSE

3 REEDBED TRANSPLANTATION

Results

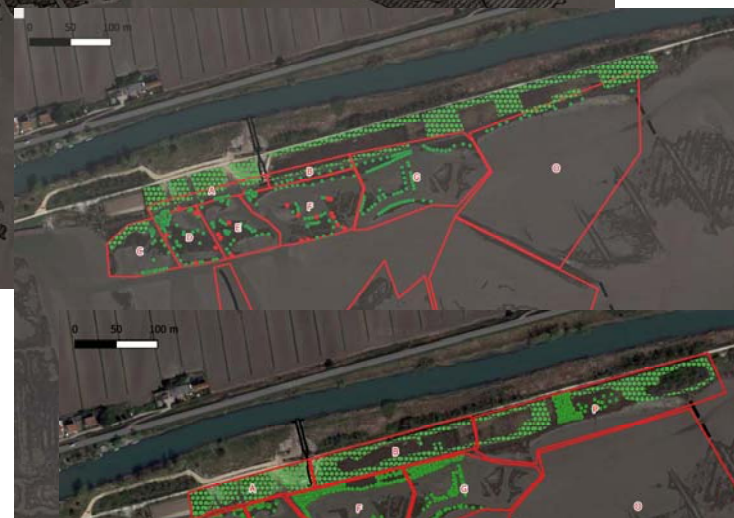


Planting of clumps (ca. 2500 of 10-15 cm in diameter) and rhizomes of *P. australis*



2018
ante
operam

2021
post
operam

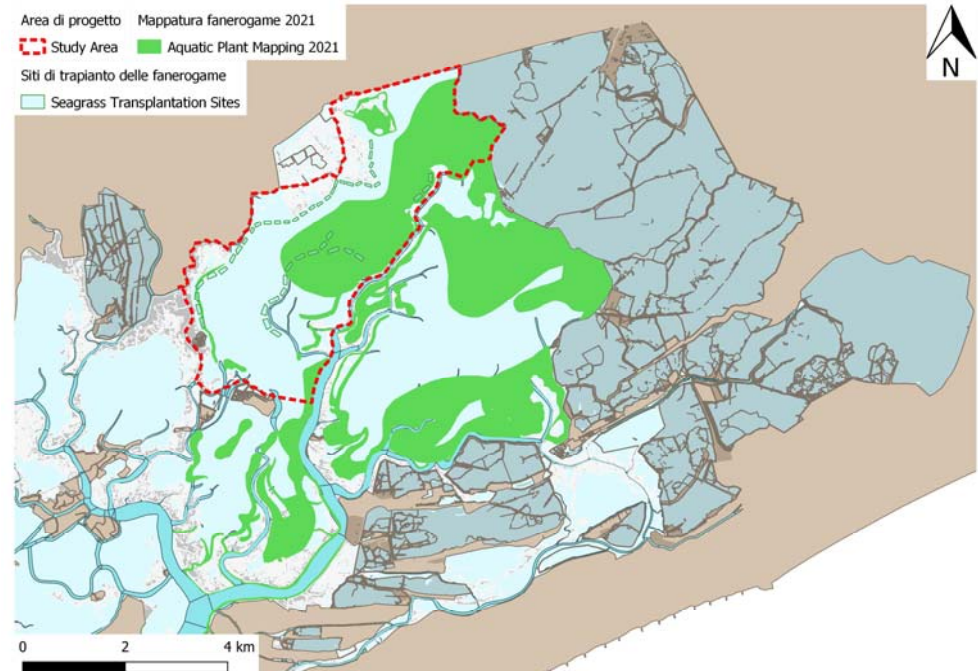


2022
post
operam



4 AQUATIC ANGIOSPERMS TRANSPLANTATION

Results

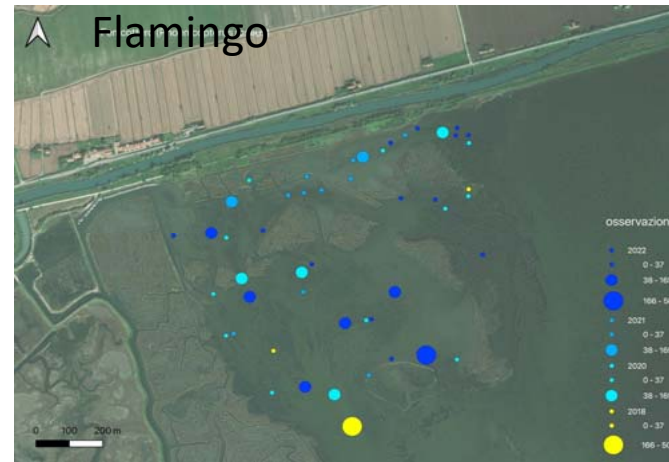
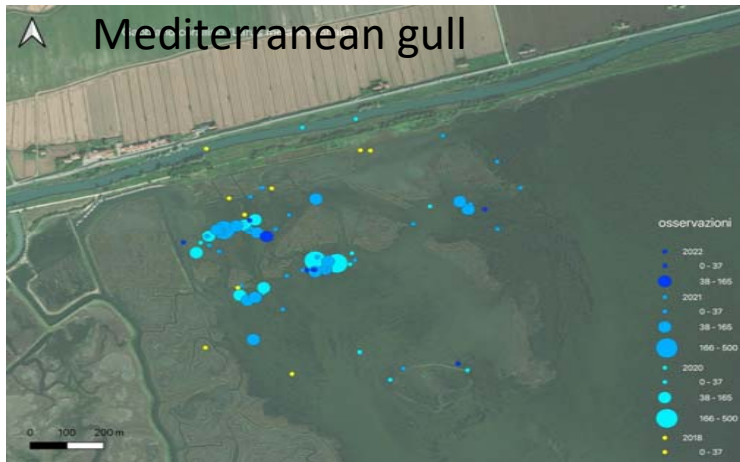


A development of aquatic angiosperm beds was observed in area of transplantation

Transplantation of small clumps and rhizomes (approximately 2500) of *Ruppia cirrhosa*, *Zostera noltei* and *Zostera marina*, aquatic angiosperms species.

Birdlife Results

The bird community immediately changed with the freshwater input. For example an increase of the abundance of Mediterranean gull, Flamingo, Little Tern was monitored

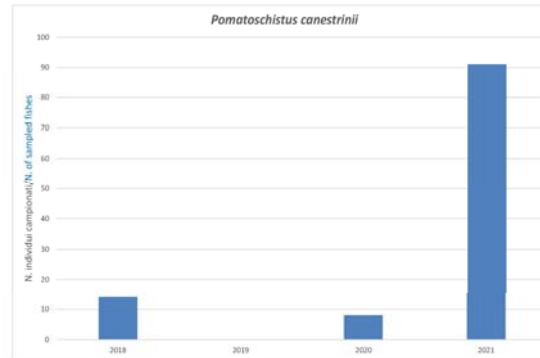


For the rest of the community it is necessary giving the reedbeds time to grow and develop as Botaurus stellaris, Locustella luscinioides Panurus biarmicus

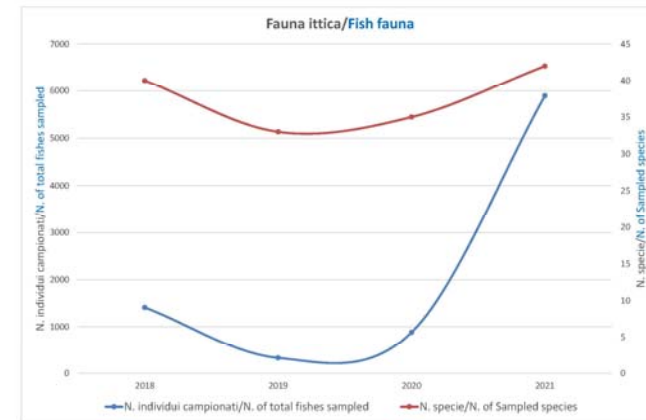


Fishes Results

Fish Fauna monitoring showed an increase of target species *Pomatoschistus canestrinii*



And an increase in abundance of migratory species' juveniles of commercial interest





Involvement of stakeholders

STAKEHOLDERS CAN MAKE OR BREAK A PROJECT!

*Gann et al. (2019)**


Involvement of stakeholders

	National and local authorities as:	People attending Venice Lagoon as:
Who?	<ul style="list-style-type: none">• Municipality, Regional Offices• Reclamation Consortia• District Authority	<ul style="list-style-type: none">• Fishermen• Hunter• Lagoon enthusiasts
When?	<ul style="list-style-type: none">• Before writing the proposal• During the project permission phases• In After Life	<ul style="list-style-type: none">• Before writing the proposal• During the project permission phase to share the restrictions• During the project
How?	<ul style="list-style-type: none">• Organizing several meeting• Requesting official permissions• Requesting modification of hunting and fishing regulations	<ul style="list-style-type: none">• Organizing several meeting• Organizing training course• With active participation in transplantation activities



*Gann, G.D.; McDonald, T., Walder, B.; Aronson, J.; Nelson, C.R.; Jonson, J.; Hallett, J.G., Eisenberg, C.; Guariguata, M.R., Liu, J.; Hua, F., Echeverría, C.; Gonzales, E.; Shaw, N.; Decler, K.; Dixon, K.W. *International principles and standards for the practice of ecological restoration, 2nd ed.*; Society for Ecological Restoration, Washington, D.C. U.S.A., 2019

Life Lagoon Refresh is a multidisciplinary project to restore coastal lagoon habitats. The strategy of the project covered a combination of different aspects and tools:

- strong involvement of stakeholders: national and local authorities, fishermen's and hunters' organization
- an ecological engineering approach with four concrete actions
 - the diversion of a freshwater flow from the Sile River into the lagoon
 - the restoration of intertidal morphology, through biodegradable structures
 - the reed and aquatic angiosperm transplantations with the involvement of local fishermen and hunters
- a management approach with a reduction of hunting and fishing pressure
- Use of numerical models as supporting tools for planning, testing the results and managing conservation actions
- environmental monitoring, performed before and after the conservation actions
-  Communications tools: website, social media, newsletter, scientific paper, meetings with citizens, students dissemination activities



Conclusions

If you want to know more.....

 **frontiers** | Frontiers in Ecology and Evolution

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EDITED BY
Guangxuan Han,
Yantai Institute of Coastal Zone
Research (CAS), China

REVIEWED BY
Maria Flavia Gravina,
University of Rome "Tor Vergata," Italy
Zhenguo Niu,
Aerospace Information Research
Institute (CAS), China

*CORRESPONDENCE
Rossella Boscolo Brusà
rossella.boscolo@isprambiente.it
Federica Cacciatore
federica.cacciatore@isprambiente.it

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Conservation actions for restoring the coastal lagoon habitats: Strategy and multidisciplinary approach of LIFE Lagoon Refresh

Rossella Boscolo Brusà^{1*}, Alessandra Feola¹,
Federica Cacciatore^{1*}, Emanuele Ponis¹, Adriano Sfriso²,
Piero Franzoi², Matteo Lizier³, Paolo Peretti⁴,
Bruno Matticchio⁴, Nicola Baccetti⁵, Valerio Volpe⁶,
Luigi Maniero⁶ and Andrea Bonometto¹





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Thank you

Contact:

Rossella Boscolo Brusà

Italian Institute for Environmental Protection and Research, ISPRA

Email rossella.boscolo@isprambiente.it

lagoonrefresh@isprambiente.it

Website www.lifelagoonrefresh.eu