



Biodiversity, Ecosystem Services and Natural Capital: the study case of NATURA 2000 Site of Aquatina of Frigole

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Deliverable T3.2.1

**IMPRECO e-learning platform, realized by
PP3 - University of Salento, for the protected area of Aquatina di Frigole**

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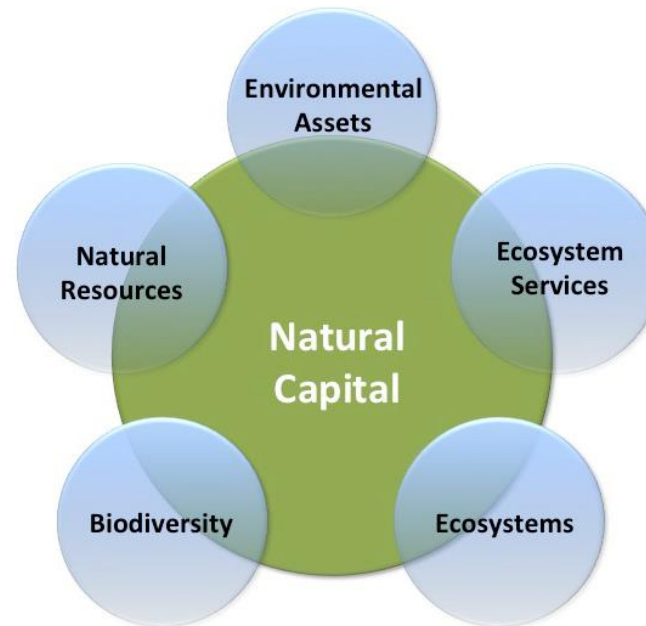
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Outline

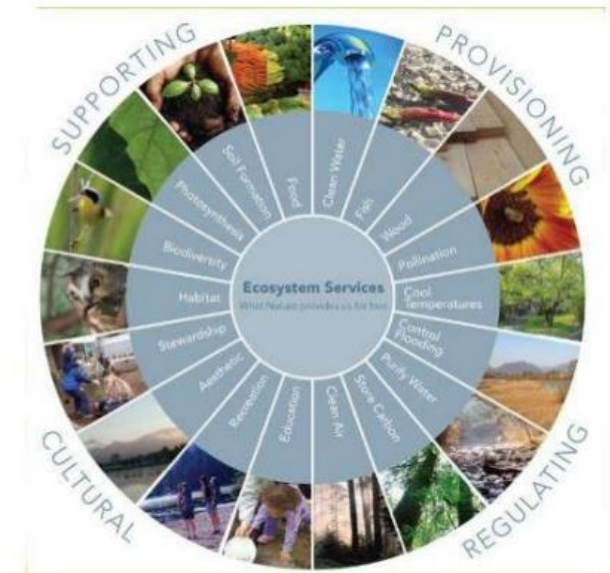
- 1. Natural Capital and Economic Capital;*
- 2. NATURA 2000 network;*
- 3. Biodiversity in the NATURA 2000 site of Aquatina di Frigole;*
- 4. Ecosystem services in the NATURA 2000 site of Aquatina di Frigole;*
- 5. Environmental threats in the protected area of Aquatina di Frigole;*
- 6. Valorization of the protected area of Aquatina di Frigole.*

Natural and Economic Capital

- The set of living organisms, natural resources, goods and services ecosystems, processes and ecological functions constitutes the natural capital;
- “Natural capital is defined as the world’s stocks of natural assets which include geology, soil, air, water and all living organisms that provide valuable goods and benefits, direct and indirect to humans, and which are necessary for the survival of the environment itself from which they are generated (UK Natural Capital Committee)”.

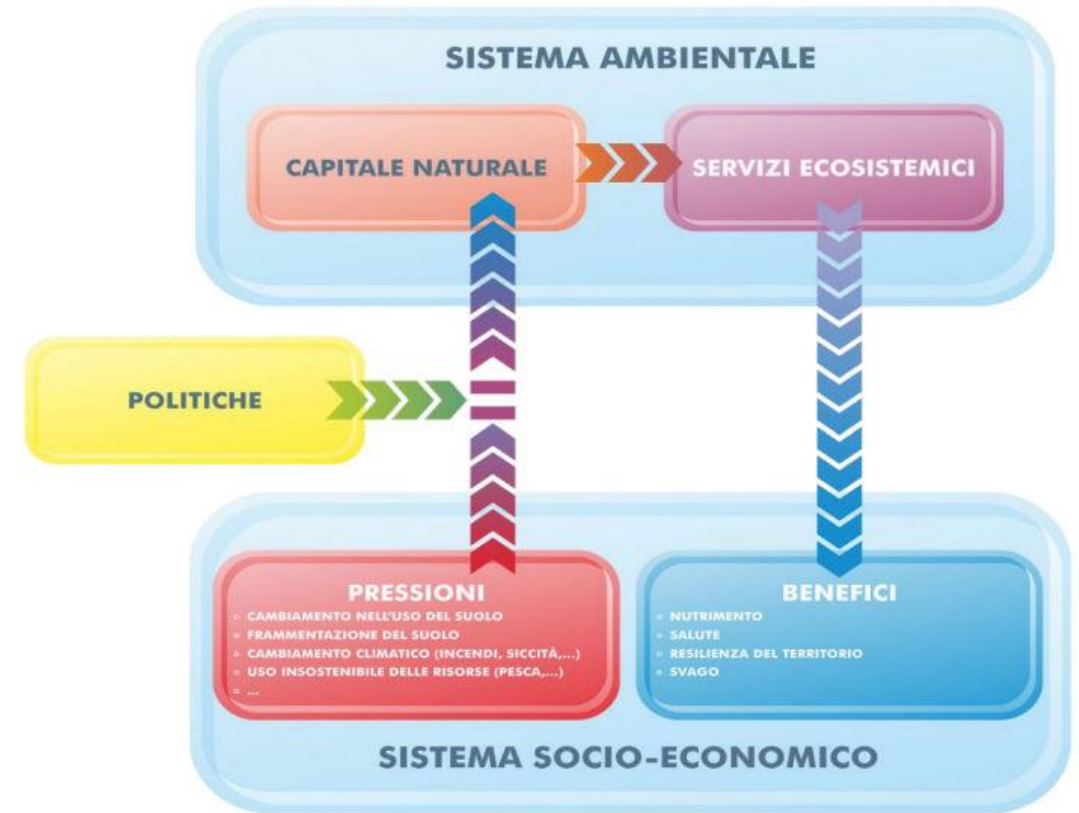
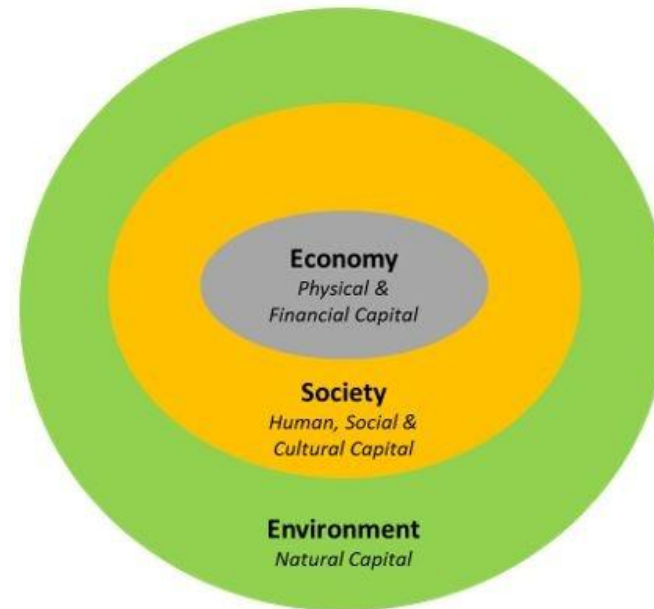


What is Natural Capital?



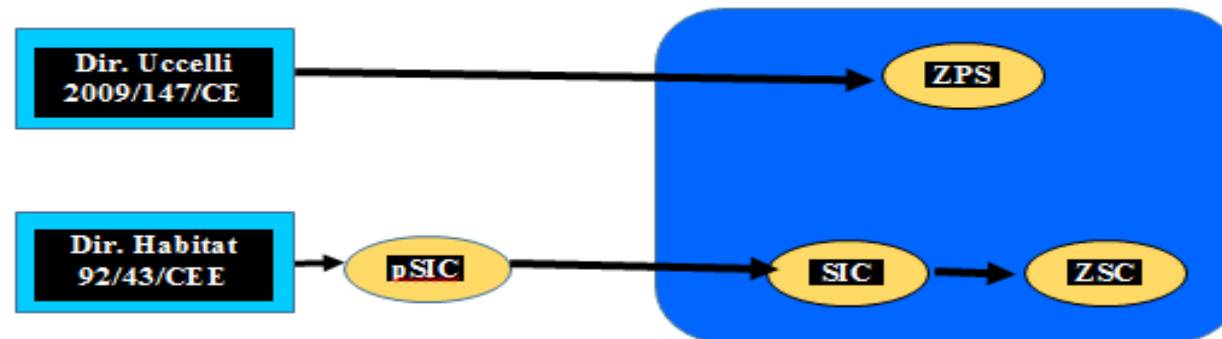
Natural and Economic Capital

- Human activities, population growth and the race for "western-style well-being" impact on natural capital, putting it constantly at risk;
- Economic capital is based on natural capital (technologies and fishing)
- It is necessary to preserve the natural capital and to protect biodiversity, ecosystems through a sustainable management of natural resources.



NATURA 2000 network

- **NATURA 2000** is a network of nature protection areas in the territory of the European Union. It is made up of Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Sites of Community Importance (SCI) to protect the most valuable and threatened habitats and species across Europe.
- *Safeguarding the biodiversity of the European territory with measures aimed at "ensuring the maintenance or restoration, in a satisfactory state of conservation, of natural habitats and species of fauna and flora of community interest" (Art.2)*



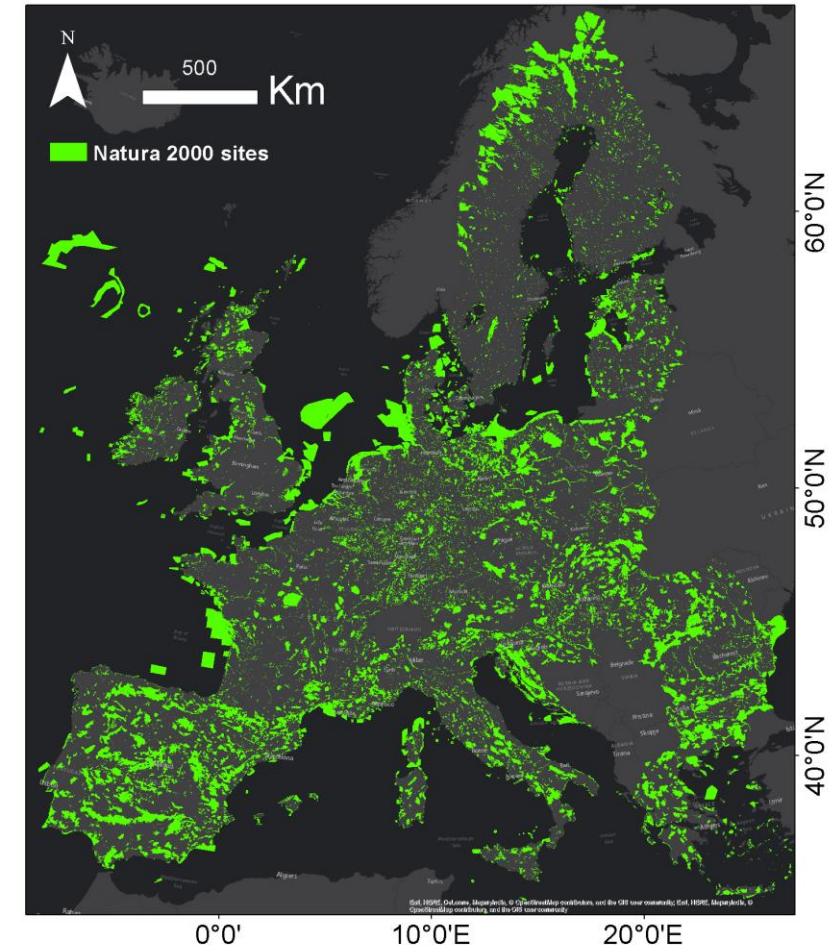
NATURA 2000 network

Distribution and extension of the NATURA 2000 sites in Europe

- Over **27,000** NATURA 2000 sites
- Over **100,000,000** hectares of protected surface (Europe surface about 445,000,000 hectares).

Distribution and extension of the NATURA 2000 sites in Italy

- In Italy, **2,574** NATURA 2000 sites have been identified and divided in the three biogeographical regions (Alpine, Continental and Mediterranean);
- In Italy NATURA 2000 sites **cover about 19% of the terrestrial national territory and 4% of the marine territory.**



The NATURA 2000 site of Aquatina di Frigole

- NATURA 2000 site «Aquatina di Frigole» id. code: IT9150003;
- Total area: 3163 ha, of which 95% marine area (3004 ha);
- Terrestrial area: 159 ha, of which 45 ha are covered by the lagoon.



Satellite view of Aquatina di Frigole



- Special Protection Area (SPA) and Sites of Community Importance (SCI)
- Area: 3163 ha
- Marine area 95 %



Aquatina di Frigole

- Aquatina di Frigole is a **Site of Community Importance (SCI)** and a **Special Protection Area (SPA)** belonging to the **NATURA 2000 network**

NATURA 2000 is an ecological network spread throughout the European Union that guarantees the long-term maintenance of natural habitats and of threatened or rare species of flora and fauna at a community level, based on the Habitats and Birds Directives.



Recently, specimens of the mollusc bivalve ***Cozza pinna (Pinna nobilis)***, have been found in the lagoon. It is an endemic species of the Mediterranean sea, and protected by European Union.



Biodiversity and nature conservation

The two pillars of biodiversity protection in the European Union are:

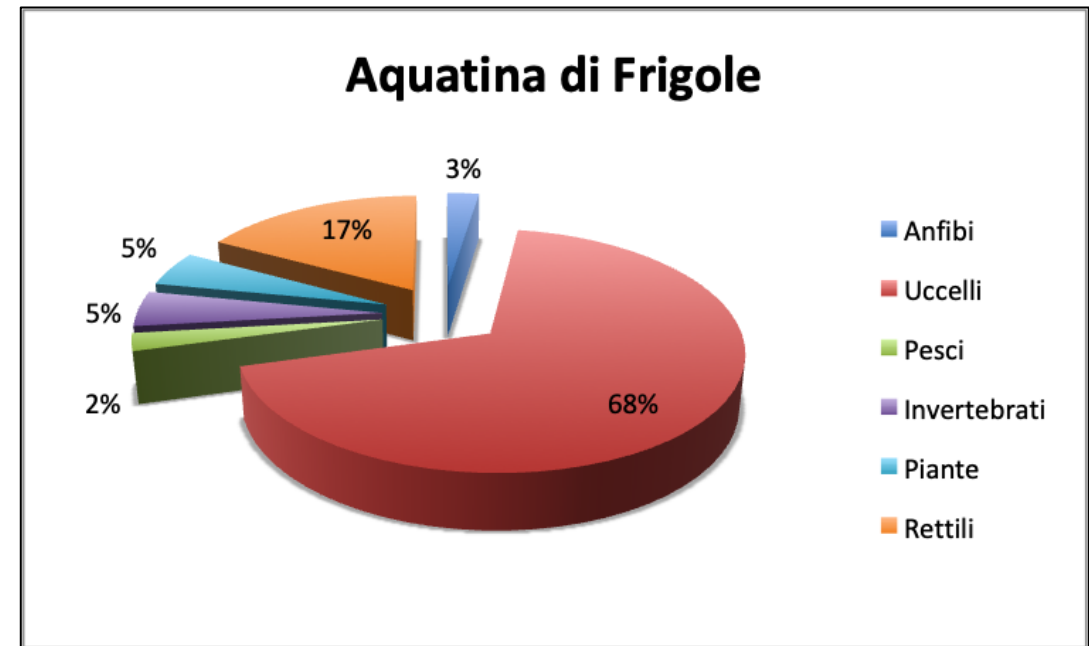
- **Bird Directive** (2009/147/CE) for the conservation of the wild birds
- **Habitat Directive** (43/92/CEE) concerning the conservation of natural and semi-natural habitats and wild flora and fauna*



***Art. 2 - Safeguard the biodiversity of the European territory with measures aimed at "ensuring the maintenance or restoration, in a satisfactory state of conservation, of natural habitats and species of wild fauna and flora of community interest"**

Species of community interest under NATURA 2000 directives in Aquatina di Frigole (SDF, 2015)

Habitats	Amphibians	Birds	Fish	Invertebrates	Plants	Reptiles	Total
Aquatic vegetation				2			2
Coastal lagoon		5					5
Coastal lagoon, Land		4					4
Freshwaters		1					1
Freshwaters, Land	1	1					2
Coastal lagoon, Marine		1					1
Land		7			2	7	16
Marine		4	1				5
Land, Marine		2					2
Coastal lagoon, Pond		1					1
Wetland		2					2
Total	1	28	1	2	2	7	41



Some species of community interest under NATURA 2000 directives



Other 31 species relevant for the management and conservation of the protected area of Aquatina di Frigole

Species included in the two Directives “Habitat” and “Birds” (NATURA 2000) but missing in the most recent «Natura 2000 standard form» for the protected area of Aquatina di Frigole

Habitats	Fish	Invertebrates	Plants	Total
Coastal lagoon, Freshwaters, Marine	1			1
Coastal lagoon, Marine	15		1	16
Marine	9	1		10
Freshwaters, Marine	4			4
Total	29	1	1	31



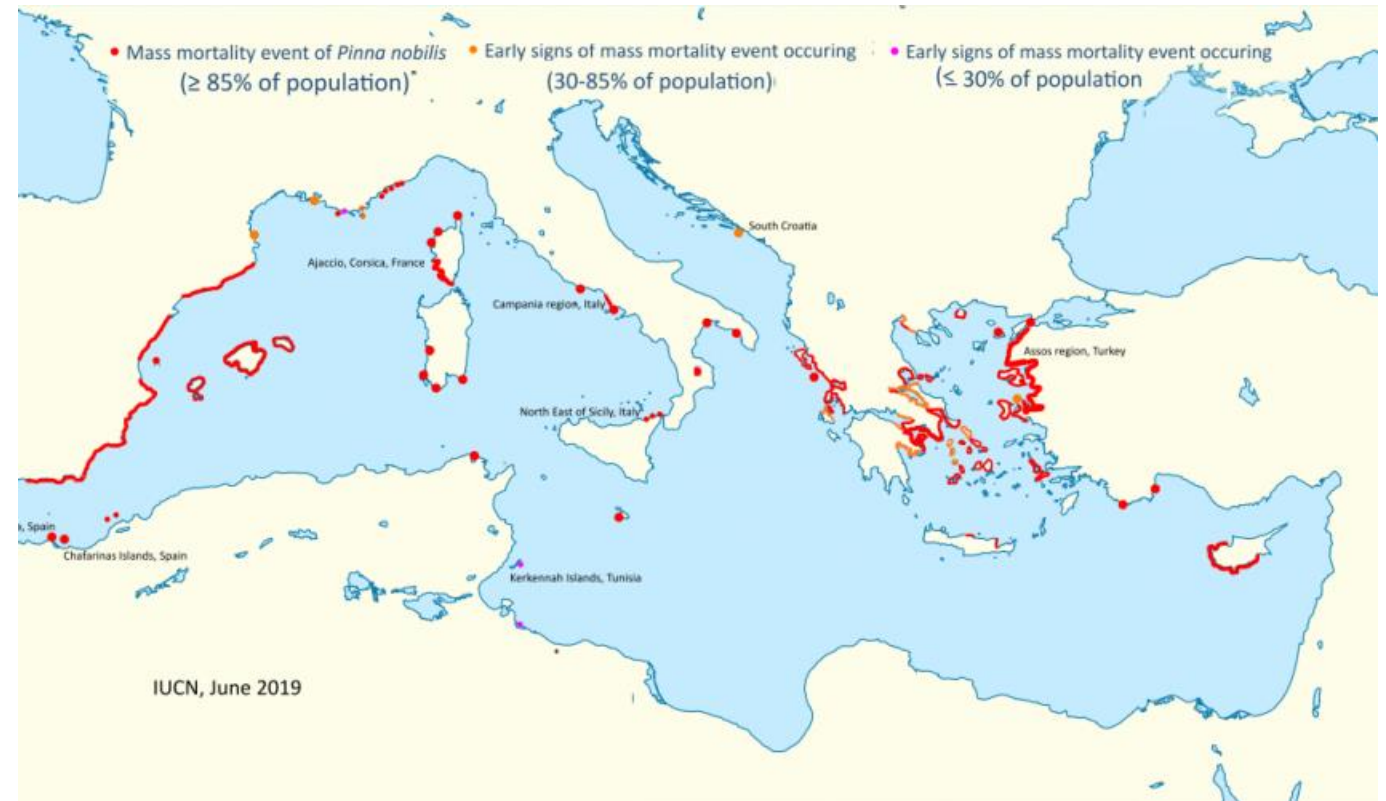
Other species of community interest in Aquatina di Frigole

First census of *Pinna nobilis* inside the protected area of Aquatina di Frigole
(January 2018)



Pinna nobilis L. in Aquatina di Frigole

- **Species features:** 1. Endemic of the Mediterranean sea; 2. Filter feeder species; 3. Contribute to the increase in local biodiversity and provides food availability to the crustacean and larvae living inside the valves; 4. Species heavily threatened by massive deaths, by illegal fishing, by anchoring boats.



Atlas of species of community interest in Aquatina di Frigole



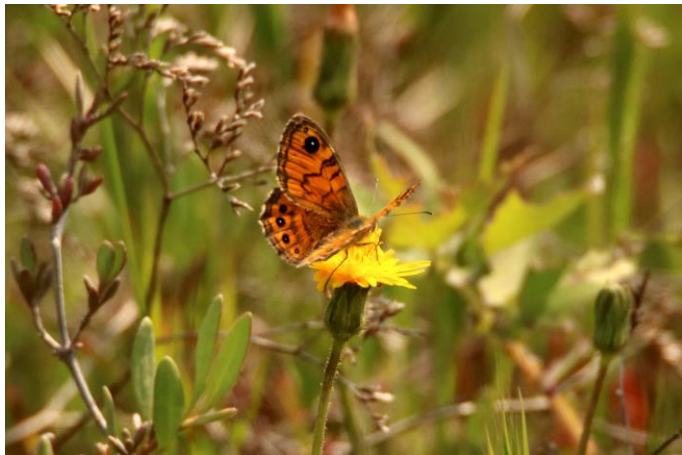
Taxonomic groups	No	Name of species	
Bird	1	<i>Anas acuta</i>	
	2	<i>Anas crecca</i>	
	3	<i>Anas penelope</i>	
	4	<i>Anas platyrhynchos</i>	
	5	<i>Spatula querquedula</i>	
	6	<i>Ardea purpurea</i>	
	7	<i>Ardeola ralloides</i>	
	8	<i>Aythya nyroca</i>	
	9	<i>Botaurus stellaris</i>	
	10	<i>Chlidonias hybridus</i>	
	11	<i>Chlidonias niger</i>	
	12	<i>Circus aeruginosus</i>	
	13	<i>Circus cyaneus</i>	
	14	<i>Circus pygargus</i>	
	15	<i>Ardea alba</i>	
	16	<i>Egretta garzetta</i>	
	17	<i>Fulica atra</i>	
	18	<i>Gallinago gallinago</i>	
	19	<i>Gallinula chloropus</i>	
	20	<i>Himantopus himantopus</i>	
	21	<i>Ixobrychus minutus</i>	
	22	<i>Nycticorax nycticorax</i>	
	23	<i>Platalea leucorodia</i>	
	24	<i>Plegadis falcinellus</i>	
	25	<i>Porzana porzana</i>	
	26	<i>Recurvirostra avosetta</i>	
	27	<i>Sternula albifrons</i>	
	28	<i>Thalasseus sandvicensis</i>	
	Fish	29	<i>Aphanius fasciatus</i>
	Invertebrate	30	<i>Coenagrion mercuriale</i>
	Reptile	31	<i>Elaphe quatuorlineata</i>
		32	<i>Zamenis situla</i>
		33	<i>Emys orbicularis</i>

Other species identified in the protected area of Aquatina di Frigole

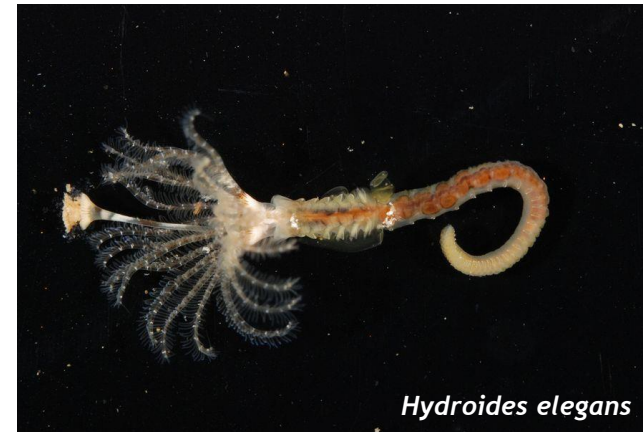
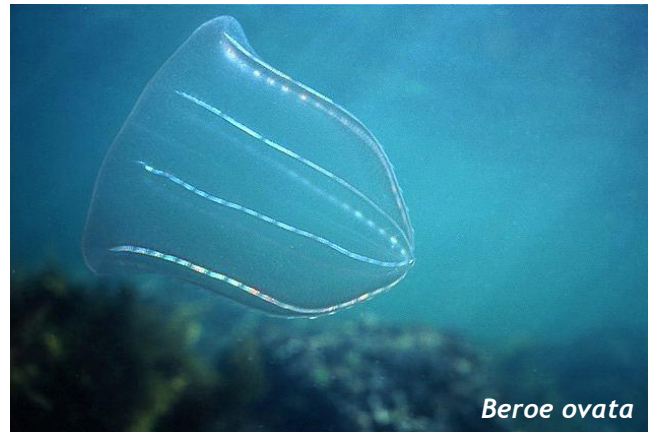
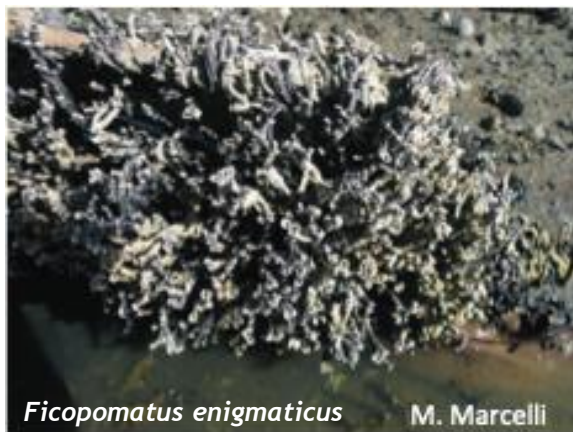
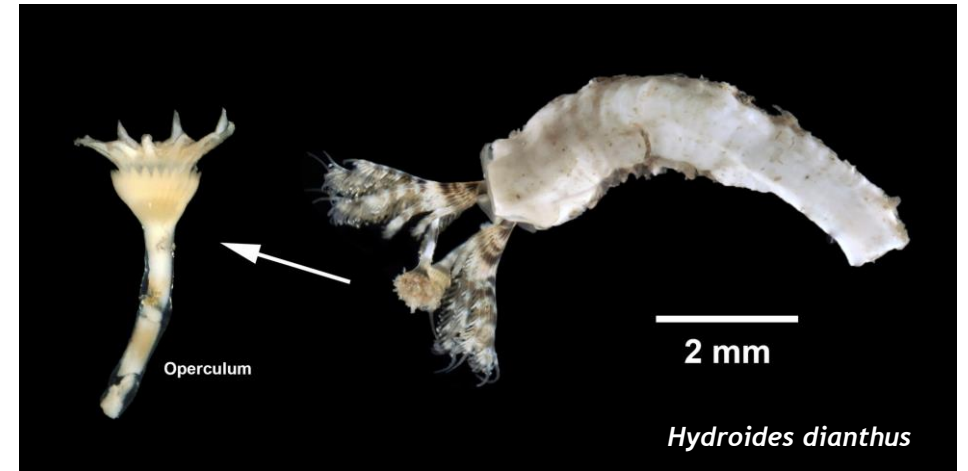
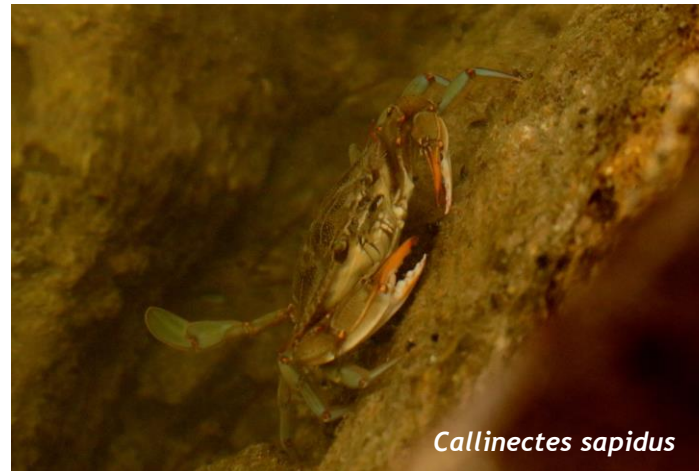
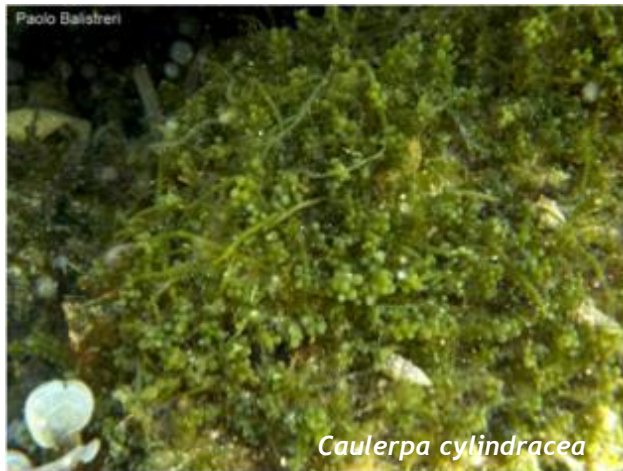
Habitats	Algae	Fish	Invertebrates	Plants	Total
Coastal lagoon				5	5
Coastal lagoon, Freshwaters				1	1
Coastal lagoon, Marine	26	4	78	2	110
Land				20	20
Marine		7	30		37
Freshwaters, Marine	1			1	2
Coastal lagoon, Freshwaters, Marine	1				1
Coastal lagoon, Land, Marine				1	1
Total	28	11	108	30	177

Species found in the protected area of Aquatina di Frigole but not protected under the NATURA 2000 Directives "Habitat" and "Bird"

Some species not protected under NATURA 2000



Some alien species reported in the protected area of Aquatina di Frigole



Habitats of community importance in Aquatina di Frigole

Habitat N2k	Denominazione	Area (ha)
1120*	Posidonia beds (<i>Posidonia oceanica</i>)	2214.10
1150*	Coastal lagoons	52.40
1210	Annual vegetation of drift lines	158.15
1310	Salt pioneer swards	0.40
1420	Mediterranean and thermo-Atlantic halophilous scrubs	158.15
2120	Shifting dunes along the shoreline with <i>Ammophila arenaria</i>	63.26
2250*	Coastal dunes with <i>Juniperus</i> spp.	11.10
2260	Cisto-Lavenduletalia dune sclerophyllous scrubs	11.10



1420 - Vegetation with *Halocnemum strobilaceum*



1420 - Succulent suffruticose plants on salted soils



1210 – Formation in *Cakile maritima*

Ecosystem services in the protected area of Aquatina di Frigole

Ecosystems provide to the human society many essential **goods and ecosystem services** that support human well being.

Goods include food, water, fuel and woods; **the services** include instead the water supply and air purification, natural waste recycling, soil formation, pollination and many other natural regulatory mechanisms.



Example: pollination

- Over a third of human foods - from fruits to seeds to vegetables would be lost if there were no pollinators (bees, wasps, butterflies, flies, but also birds and bats), which, visiting the flowers, carry the pollen of the male anthers on the stigma of the female organ, giving rise to fertilization.



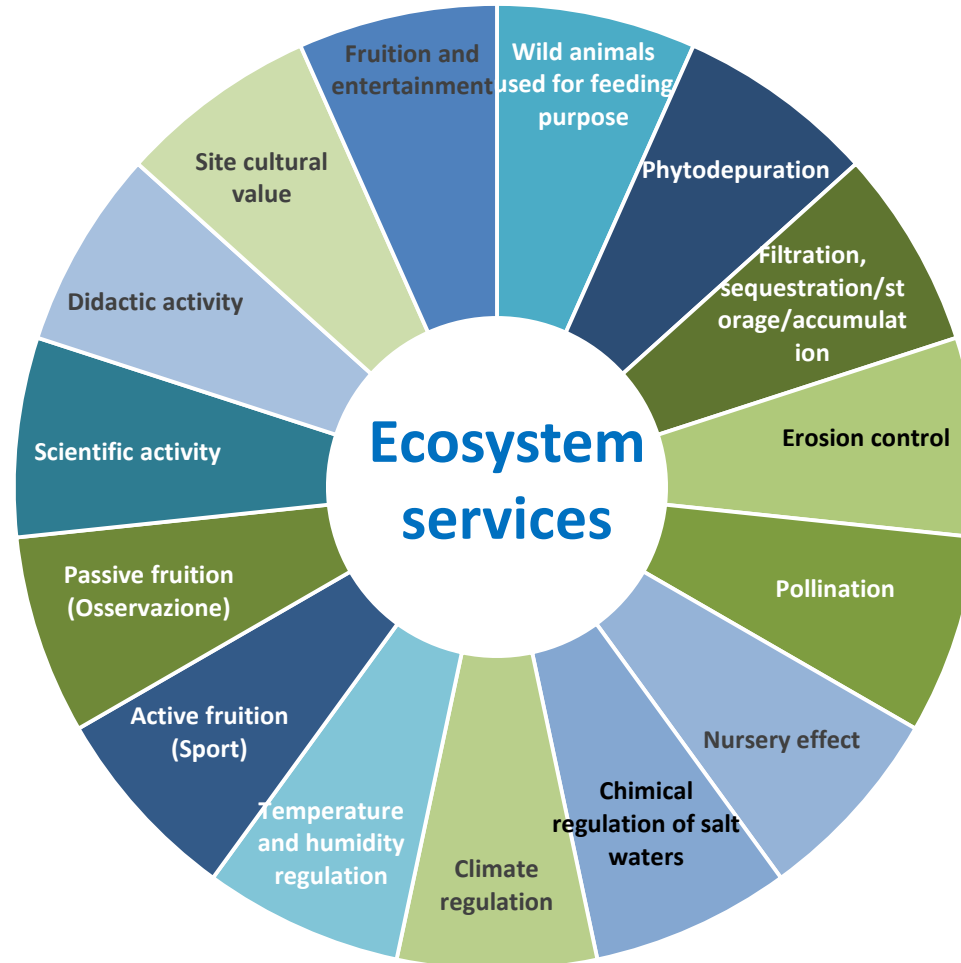
Ecosystem services classification (Millenium Ecosystem Assessment)

Ecosystem services are grouped in four categories:

1. **supporting services** (example soil formation, nutrient cycle)
2. **provisioning services** (example food, water, oxygen, raw material)
1. **regulating services** (example erosion prevent, pollination, waste-water treatments)
2. **cultural services** (example spiritual experience and sense of place, tourism and recreation).



Ecosystem services in Aquatina di Frigole



Threats to ecosystem services

- Habitat loss and fragmentation
- Pollution and climate change
- Over-exploitation of natural resources



Threats to biodiversity and conservation

- Invasive **alien species**

The **alien species** (or allochthonous) are those organisms (animal and plants) introduced by man, voluntarily or accidentally, outside of their natural geographic range and in which they are able to reproduce

When alien species introduction represents a serious threat to biodiversity and thus to ecosystem services we speak of invasive species (e.g., *Callinectes sapidus*, *Procambarus clarkii*, *Caulerpa taxifolia*)



Threats to biodiversity and conservation

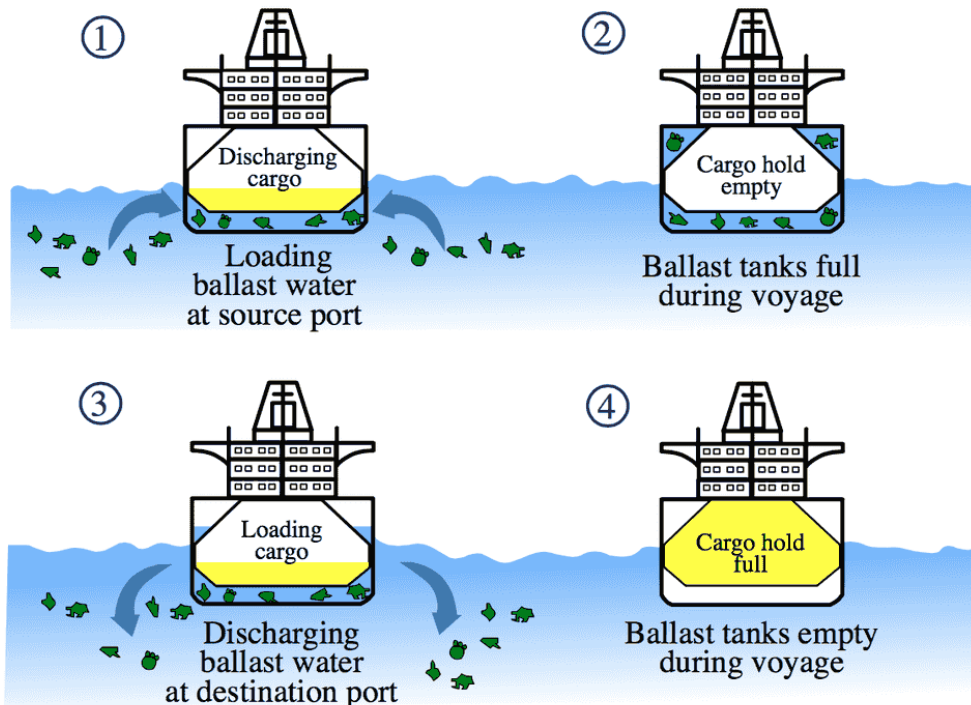
Consequences of the introduction of invasive alien species

- ✓ *Replacement of the native (or indigenous) species;*
- ✓ *Decrease of the biodiversity (biological diversity);*
- ✓ *Structural and functional damage to the ecosystem in which they settle;*
- ✓ *Loss of genetic integrity due to hybridization phenomena;*
- ✓ *Negative effects on ecosystem services.*

Threats to biodiversity and conservation

Pathways

- A. *Transport (ballast water);*
- B. *Fouling;*
- C. *Artificial channels, the opening of the Suez Canal (1869), through which many species entered the Mediterranean, defined as "lessepsian species" from the name of the engineer Ferdinand Marie de Lesseps.*

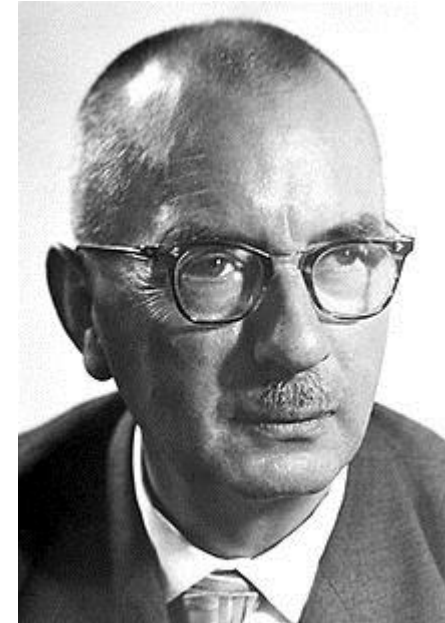


Threats to biodiversity and conservation

Plastics and microplastics



Giulio Natta



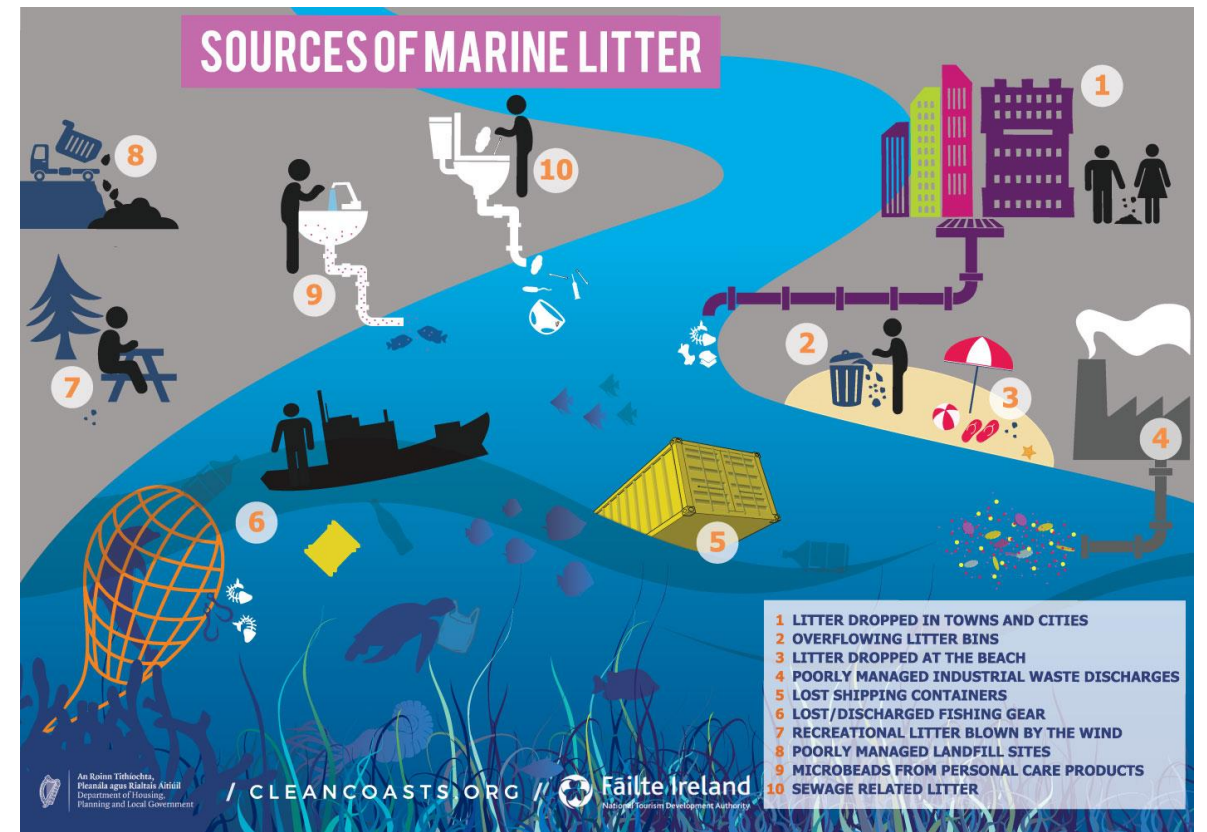
Karl Ziegler

Nobel Prize for Chemistry in 1963

Threats to biodiversity and conservation

Plastics and microplastics in the environment

- **Solid waste** can enter in the marine environment directly or reach it indirectly through rivers, discharges and under the action of the winds;
- The waste can accumulate near the source, or it is released on the coasts and return offshore if not picked up;
- Resistant to degradation, they undergo the process of photo-decomposition which determine the fragmentation of ever smaller particle materials, giving rise to **microplastics**.



Threats to biodiversity and conservation

The plastic pollution impact

Microplastics are all those particles of anthropogenic origin with dimensions between 5 and 0.33 mm

1. Ingestion by filter feeders and detritivores entering the food chain;
2. Entrapment in an entanglement of fishing nets (ghost nets);
3. Accumulation of toxic substances present in microplastics.



Plastic debris and microplastics in the protected area of Aquatina di Frigole



Plastiche e microplastiche abbandonate lungo la
banchina della laguna e nell'area protetta di
Aquatina di Frigole

Valorisation of the protected area of Aquatina di Frigole

Scientific research on biodiversity, aquaculture and fishing

1. 261 records in GOOGLE SCHOLAR;
2. 78 articles in SCOPUS refer to “Acquatina” and **22 articles concern research activities carried out directly in the lagoon.**

Networking

1. Long-Term Ecosystem Research in Europe;
2. INTERREG ADRION 2014 – 2020;
3. Project funded by Apulia region;
4. Interaction with territory.

Valorisation of the protected area of Aquatina di Frigole

Didactic activity, dissemination, promotion of sustainable sports and tourism





Valorisation of the protected area of Aquatina di Frigole

Involvement in international projects



INTER-ASIA



INTERREG-BIG



Common strategies and best practices to
IMprove the transnational PROtection of
ECOsystem integrity and services - IMPRECO



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Thank you!



Project's media