



How food security can be linked to the ecological and economical status of the coralligenous habitats of the Mediterranean Sea

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Coralligenous habitats

They are endemic Mediterranean habitats mainly made of sciaphilous coralline algae of **complex structure** which enable the development of several types of communities including gorgonians or red coral [10] [11].

Ecosystem services (ESs)

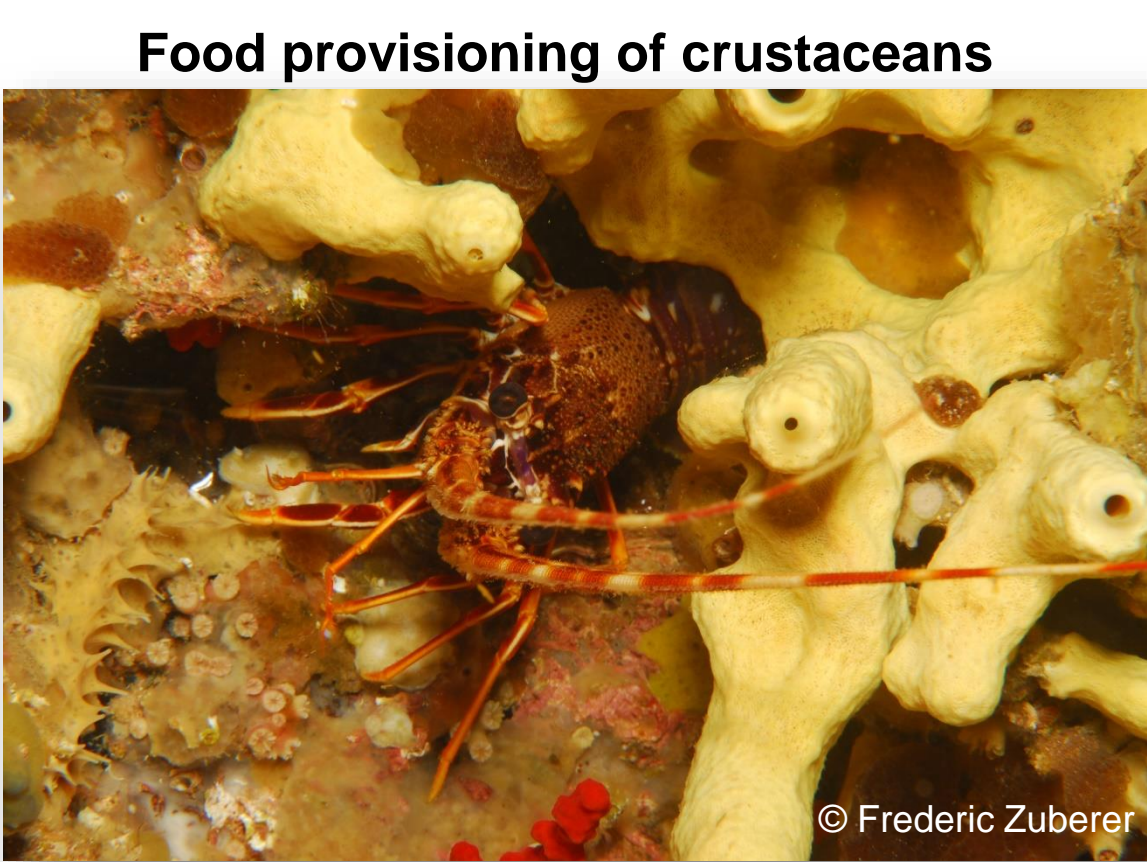
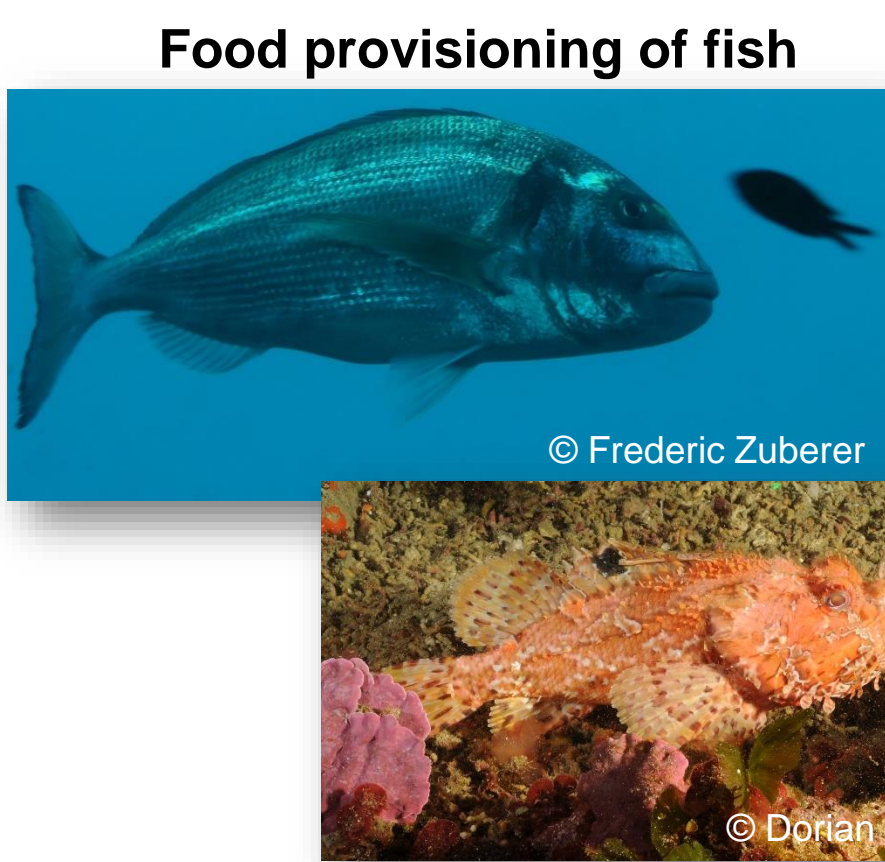
The concept of ecosystem service (ES) refers to the natural **functions and products** that **benefit to human activities and well-being** [4]. It implies that natural ecosystems should be evaluated not only in term of ecological functioning, but also in terms of **economics and social supplies**. Moreover they should be conserved in a state in which they may support human well-being [3]. The Millenium Ecosystem Assessment was the first to classify ESs into **four main categories** : provisioning, regulating, supporting, and cultural services [12] .

Seafood in human diet

In 1992 about 67% of the global population lived within 60 km of the coast [8]. The same year, the « **Mediterranean diet** » was promoted as one of the healthiest : it is characterised by relative **high intake of seafood**, and poor intake of meat [6].



Coralligenous habitats supplies



Ecosystem services

Coralligenous habitats provide goods and services in their natural functioning, that are commonly called ecosystem services. Resources are considered to be **provided directly** when collected in the habitat, such as **rockfishes, crustaceans, sea urchins, red coral**. But coralligenous also provide **indirectly resources**. First they provide sheltered areas for fish juveniles, essential to maintain adult fish stocks. Second, their aesthetic landscapes are so attractive that coralligenous habitats support great scuba-diving activities, in Marseilles and many other spots in the Mediterranean Sea. Thus two main activities of a town such as Marseilles rely on coralligenous habitats : **recreational diving and fishing** (recreational and small-scale professional).

Food provisioning

About 8500 species of macroscopic organisms should live in the Mediterranean Sea [2] . And in 2006, Ballesteros [1] counted more than 1600 species constituting the coralligenous structure or directly depending on it. Thus, **18% of the Mediterranean species are related to coralligenous habitats** which are recognized to be the 2nd « hot spot » of Mediterranean biodiversity. Otherwise, **artisanal fishing fleet is estimated to be 80% of the Mediterranean fleets** [5] [7] . Small-scale coastal fisheries mainly operate on the continental shelf (0-200 m deep) where precisely the coralligenous habitats can be present. From those habitats, fishermen exploit teleost fishes (sea bream, scorpion fish, red mullet, sea bass), crustaceans (spiny lobster), echinoderms (rock and et violet sea-urchins) and cephalopods (common *Octopus*). Because of their nursery function for fish populations, coralligenous habitats play an essential role in the maintaining of fish stocks on the coast. Moreover they are **providers of high-value species** such as: the gilthead sea bream, the striped red mullet, and the sea bass [9].

Since they are hotspot of biodiversity, « nursery » habitats and also direct producers of seafood, coralligenous habitats are essential to seafood provisioning

Table 1: Putative functions, services and goods of coralligenous habitats (adapted to coralligenous species from Heip *et al.* 1998 and Duarte, 2000)

Ecosystem functions	Suspected coralligenous species implicated
Primary production	Structural species
Carbon storage	Structural species
Ecosystem services	Suspected coralligenous species implicated
Gas and climate regulation	To complete
Disturbance regulation	Structural species
Erosion and sedimentation control	Structural species
Remineralisation	Structural species
Recreation (scuba-diving) tourism and education	Aesthetism of these landscapes and fish related
Habitats and refuge (« nursery »)	Structural species
Ecosystem goods	Suspected coralligenous species implicated
Food resources and gastronomy	Fish, crustaceans, echinoderms, cephalopods
Raw material for jewellery	Red coral
Genetic resources	All species
Natural heritage	All species
Material for medicine	To complete

Table 2: Main fishing activities of the French Mediterranean coast related to coralligenous habitats in 2011 (adapted from IFREMER) One boat can practice several fishing activities

Fishing activity	Number of boats	Total amount of months of activity	Average number of months dedicated to this activity/boat
Small-mesh fishing nets	569 (52%)	4 105	7,2
Small-mesh sea breams nets	399 (37%)	2 227	5,6
Crustaceans nets	137 (13%)	609	4,4
Cephalopods nets	92 (8%)	289	3,1
Urchins and echinoderms fishing by scuba-diving	89 (8%)	494	5,6
Sea breams longlines	83 (8%)	520	6,3
Fish longlines	81 (7%)	463	5,7
Angling	74 (7%)	314	4,2
Fish and octopus traps	61 (6%)	481	7,9

Table 3: Species related to the coralligenous habitats that are part of the ten top high-valuated species of the French Mediterranean Sea in 2011 (extracted from the IFREMER's synthesis)

Species found in coralligenous habitats	Tonnage (T)	Total Value (€)	Mean price calculated (€/Kg)
Gilthead sea bream (<i>Sparus aurata</i>)	339 (3%)	2 396 022 (7%)	7,06
Octopus (<i>Octopus vulgaris</i>)	822 (8%)	1 982 455 (6%)	2,41
Sea bass (<i>Dicentrarchus labrax</i>)	95 (1%)	1 548 171 (4%)	16,21
Striped red mullet (<i>Mullus surmuletus</i>)	174 (2%)	1 187 769 (32%)	6,81
TOTAL	9 705 (100%)	35 895 251 (100%)	3,70

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