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## **CIGESMED: CORALLIGENOUS BASED INDICATORS TO EVALUATE AND MONITOR THE "GOOD ENVIRONMENTAL STATUS" OF THE MEDITERRANEAN COASTAL WATERS, A SEASERA PROJECT (WWW.CIGESMED.EU)**

### **Abstract**

*Coralligenous is one the main shallow Mediterranean milieu generating structural complexity and biodiversity. It produces goods and services for several sectors. Pollution, anchors and trawling may cause its degradation, whilst traditional fishing as well as angling mainly affect target species. Diver frequentation is another cause of degradation. Coralligenous may also be susceptible to invasive alien species. These habitats, which are of great ecological, socio-economic and patrimonial importance, are also under the pressures caused by the global warming.*

*CIGESMED's (2013-2016) goal is to understand the links and consequences of natural and anthropogenic pressures to the functioning of these habitats and to define and maintain their Good Environmental Status (GES) in the Mediterranean Sea. Indexes, specific to coralligenous habitat, will be co-constructed and collectively tested by scientists, marine natural parks and reserves, through the implementation of a "citizen science" network. Among other methods, trees of knowledge will be experimented as tools to sort, organize and illustrate very large heterogeneous sets of data. CIGESMED outcome will be an integrative assessment of the GES within the Marine Strategy Framework Directive.*

*CIGESMED gathers scientists from France, Greece and Turkey, making it possible to access to sites and to work on the same issues in both the northwestern Mediterranean basin and the Aegean-Levantine one. Ten trained (scientific diving and ROV) laboratories of marine ecology are involved. A Committee of External Advisors (scientists, stakeholders and policy-makers), meeting at an annual basis, and aiming at providing advice on all aspects of the execution of the project is helping the scientific steering committee and is ensuring CIGESMED to meet its objectives.*

**Key-words:** citizen science, coralligenous habitat; EraNet; indexes; large ecological data sets; Marine Strategy Framework Directive; monitoring; observable biodiversity; protocol; scientific diving; species list.

### **Framework**

*CIGESMED is a SeasEra project (EUF7ERA-NET) Towards Integrated Marine Research Strategy and Programmes supported by the E.C. under Seasera's theme 3: Development of indicators and science support and management tools for the determination of Good Environmental Status in the Mediterranean Sea.*

*CIGESMED is a 3 years project launched on 3 different dates, depending on the national funding agencies: Greece, January 2013, 1<sup>st</sup> (GSRT), Turkey, February 2013, 1<sup>st</sup> (TÜBİTAK), France, March 2013, 1<sup>st</sup> (ANR).*

In spite it was already coined by Lamarck (1801), the term “coralligenous”, was firstly used [in its ecological meaning] by Marion (1883) to describe the so-called *broundo* along the coasts of Provence. He hypothesized that *Corallium rubrum* was indivisible from these hard biogenic bottoms. Presently, this term sets off debate, because the presence of red coral on this type of bottom is neither inevitable, nor exclusive. Because its physiognomic meaning, Boudouresque (1973) recommended to avoid it. Ballesteros (2006) suggested the use the term “coralligenous habitats” that best describes the different types of habitats covered by this umbrella term. This is the very meaning used in CIGESMED’s framework.

In the current European context, coralligenous habitats are considered as habitats of “community interest” (Habitats Directive 92/43/CEE, code: 1170-14) and shortly promised to be promoted as “priority habitat”. They are also considered as “high-value ecological zone” since the Barcelona Convention, which proposed, in 2008, a management plan for the coralligenous habitats. However, to-date there is no regulatory instrument for their protection.

In spite of this situation, the EU Marine Strategy Framework Directive (MSFD) requires that each state develops a strategy and an action plan in order to reach and maintain a “Good Environmental Status” [GES] for its marine habitats, assessed and monitored by means of 11 descriptors.

Many studies on coralligenous habitats have been published such as theses or reviews by Laubier (1966), Hong (1980), Ballesteros (2006) or Kružić (2014). The first symposium dedicated to coralligenous habitats took place quite recently (UNEP–MAP–RAC/SPA, 2009), to extend the Action Plan for the Conservation of Marine Vegetation did start (adopted in 1999 by the Barcelona Convention).

Coralligenous habitats are assemblages of complex habitats with very low dynamic of construction that is not well documented. These habitats are not only “hotspots” of biodiversity, but furthermore they represent socio-economic stakes. Activities such as small-scale fishing and scuba diving highly depend on them. Fishermen look for species of high commercial value such as red coral, crustaceans, rock fishes, and other kind of seafood. Divers look for the landscapes beauty, offered by coloured and erect species such as gorgonian corals, algae and bryozoans. Beyond these interests, other services provided by coralligenous habitats are suspected such as CO<sub>2</sub> sequestration (Martins et al., 2013, Noisette, 2013). They are threatened by the global change and anthropogenic pressures. Only a GES may guarantee the maintenance of all the services provided by coralligenous habitats.

### **CIGESMED’s objectives**

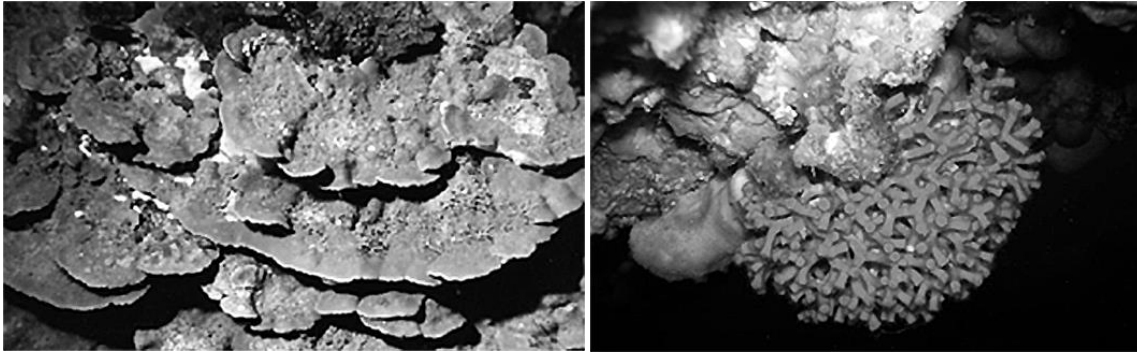
There are pretty few programs and networks for the monitoring of coralligenous habitats. CIGESMED is one of them. It implies three countries<sup>1</sup> (France, Greece and Turkey) from 2013 to 2016. CIGESMED objectives are:

(1) to fulfil the key gaps in the current scientific knowledge of the coralligenous habitats that make it difficult to make recommendations for their protection, by developing barcoding to enhance reliable identification for conservation and protection purposes

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<sup>1</sup> Only these 3 Mediterranean countries were eligible in the SeasEra’s framework. This is the reason why no Italian, Spanish or any other partners were allowed to directly contribute to the project. However, distinguished members of these states do participate to the Committee of External Advisors, established by the project.

(engineer-, invasive- and cryptic- species), and by studying genetic structuring and effective dispersal potential of keystone/habitat species,  
The main targets are algal builders (coralline algae and organisms such as bryozoans), eroders (mollusks, sponges ...) and erect species (sponges, gorgonians...) [seascape makers]



***Coralligenous “builders” from Marseilles vicinity: the Rhodophyte Lithophyllum cabiochae (left) and the bryozoan Myriapora truncata (right)***

(2) to enhance the knowledge on coralligenous populations by deciding on reference states, acquiring long temporal sets of observations/data, and setting up a network of Mediterranean experts (long term series).

To do so, CIGESMED was working to establish a list of species relevant to monitor different coralligenous habitat types (*cf. the article by Çinar et al., this volume*). The project also developed a protocol based on photoquadrats which will be validated in the different Mediterranean basins (*cf. the article by David et al., this volume*).

(3) to monitor networks, locally managed and to coordinate them on a regional scale, standardizing protocols that could be applied to the entire Mediterranean and testing indices and indicators, specific to coralligenous.

Assessment of the conservation state is done using IndexCor. It is made of 3 metrics based on (i) the number of sensitive species vs. number of indifferent species<sup>2</sup>, (ii) the observable species richness, and (iii) a structural complexity index (*cf. article by Sartoretto et al., this volume*).

Other indices will be tested and compared (Checci & Piazzzi 2010, Checci *et al.*, 2014, Deter *et al.*, 2012) as well as rapid visual assessment methods (Gatti *et al.*, 2012, Gatti & Sartoretto 2013, Kipson *et al.*, 2012).

(4) to test population genetic criteria as tools to monitor the GES of the coastal Mediterranean Sea. Target species are chosen among the builder species (coralline algae and the bryozoan *Myriapora*) as well as the seascape makers (*Paramuricea clavata* – see photo on the left).

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<sup>2</sup> The terms “sensitive” and “indifferent” refer to a classification of species sensitivity to 4 impact types, assessed by experts: organic matter rate, hyper-sedimentation, physical deterioration and temperatures alteration.



(5) to implement a “citizen science” network to increase the number and frequency of observations, but also to allow observation networks created in the framework of CIGESMED to last and run beyond the end of the project, which is a difficult issue (Arvanitidis *et al.*, 2011).

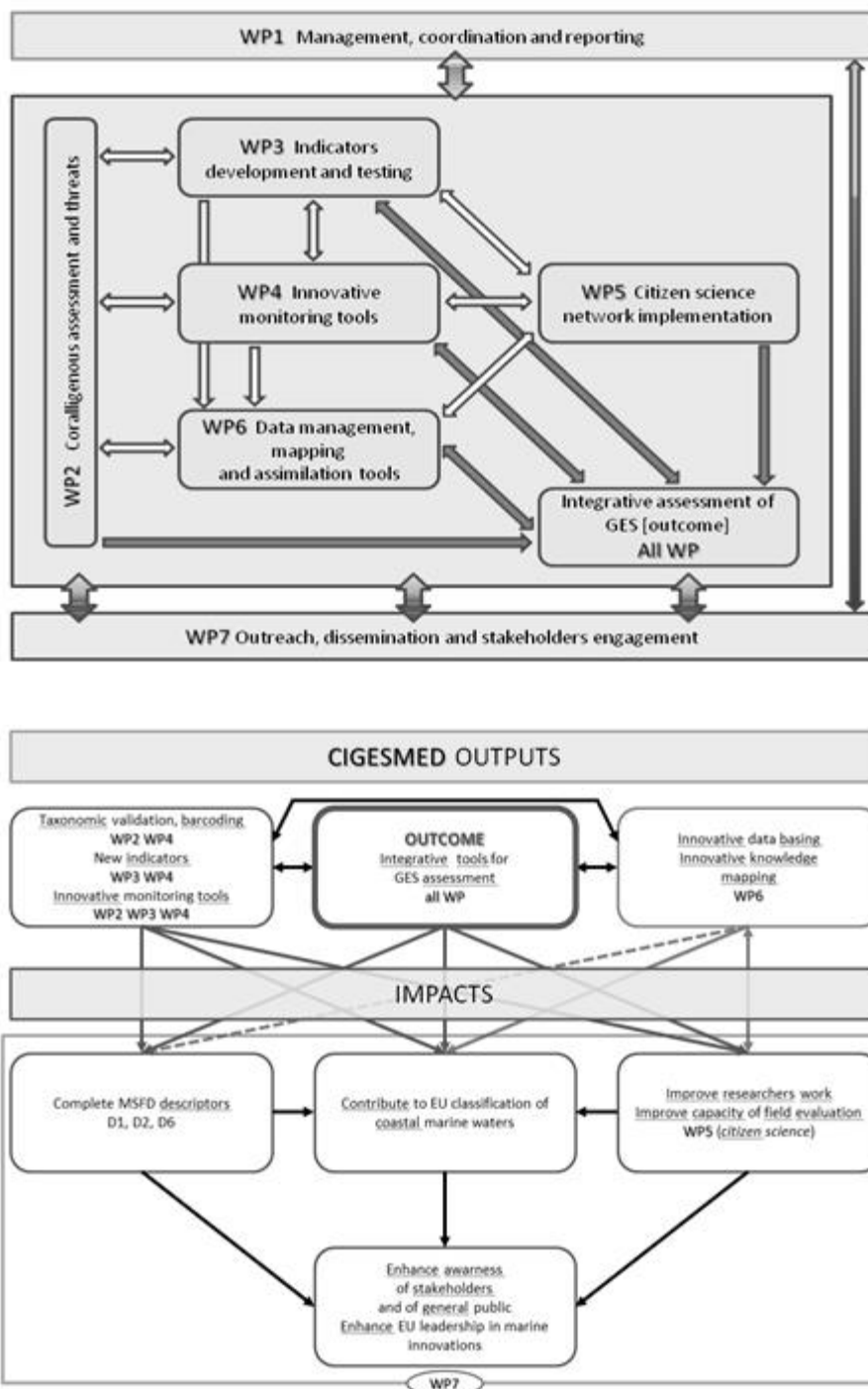
Citizen science will use open source plugin able of self-automatic installation on web site of members. The objective is not only to permit the qualibration of citizen data and include them in the CIGESMED information system, but also to improve methods and tools of implications of citizens allowing long-term observations and analyses. The interfaces are being developed in France (IMBE) and in Greece (HCMR).

and (6) to create a data systems making data reusable and scalable with other observatory networks. The primary principle of CIGESMED data organisation is to adopt all accessible formats, and requirements (i) to use open access, open data, and open source software, (ii) to increase exchanges between national scientific communities about coralligenous studies, and (iii) to make sure that surveys and protocols are reusable (cost effective, security in dive and analytics methods, knowledge of managers). Indexations servers and programs are responsible to build graphs, and specific ontologies will permit to densify the links between the different objects describing habitats. The objective is to build representations of data, used to find correlation between discrete and non-ordinate values, and not only systems of metrics, usable by every stakeholders to build indicators. Among the different methods of representation CIGESMED is presently in testing the knowledge trees (Authier et Lévi 1992) as tools to sort, organize and illustrate the large heterogeneous sets of produced data and as a tool of dissemination towards scientists, decision makers, environmental managers and general public.

### **CIGESMED’s structure and organization**

CIGESMED outcome will be an integrative assessment of the GES within the Marine Strategy Framework Directive.

To make it possible, CIGESMED gathers scientists from France, Greece and Turkey, making it possible to access to sites and to work on the same issues in both the north-western Mediterranean basin and the Aegean-Levantine one. Ten laboratories of marine ecology are involved.



The Steering Committee consisting of the representatives of the parties (WP leaders) and the coordinator are responsible for all practical decision making, strategic planning and implementation.

A Committee of External Advisors (scientists, stake-holders and policy-makers) will meet at an annual basis, and aims at providing advice on all aspects of the execution of the project to ensure CIGESMED to meet its objectives.

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