

BENTHIC INDEXES APPLIED TO INTERTIDAL AND INFRA-LITTORAL ROCKY BOTTOMS IN RELATION TO THE WFD AND MSFD: ASSESSING METRICS

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Abstract

Currently used benthic indexes for the assessment of Good Ecological Status (GEcS) and Good Environmental Status (GenS) according to European legislations (WFD and MSFD) are reviewed. A total of 16 indexes have been found. The most targeted biocenosis are macroalgal communities. A catalogue of indexes with targeted biocenosis and applied metrics is presented.

Keywords: *Mediterranean Sea, Biodiversity, Algae, Bio-indicators*

An overview of the currently used benthic indexes for the evaluation of the Good Ecological Status (GEcS) of rocky bottoms according to the WFD, and the Good Environmental Status (GenS) according to the MSFD for European seas, is presented (acronyms used sensu [1]). A bibliographical search was done using online available databases, as well the references from articles. The search included articles published between 2001 and 2016. A total of 16 indexes have been found, which have been developed by different European countries, as well for different water bodies (mainly NE Atlantic and Mediterranean). Intercalibration exercises have been done among countries. Although rocky habitats are exposed to several pressures and impacts, only few evaluations have been done.

The indexes found are (acronyms in alphabetical order): ALEX – Alien Biotic Index; CAI – Coralligenous Assemblages Index; CARLIT-EQR – Cartography of Littoral Rocky Shore Communities; CCO – Cover, Characteristic Species, Opportunistic Species; CFR – Calidad de Fondos Rocosos (Quality of rocky bottoms); COARSE – Coralligenous Assessment by Reefscape Estimation; EEI – Ecological Evaluation Index; ESCA – Ecological Status of Coralligenous Assemblages; HPI – Helgoland Phytobenthic Index; ICS – Index of Community Structure; MarMAT – Marine Macroalgal Assessment Tool; MFCI – Marine Fish Community Index; PAN-EQ-MAT – General Ecological Quality Macroalgal Assessment Tool; QISubMac – Quality Index of Subtidal Macroalgae; RICQI – Rocky Intertidal Community Quality Index; RSL – Reduced Species List.

These indexes target several biocenoses: Macroalgal communities, Coralligenous assemblages, Fish communities and, Intertidal communities. Being Macroalgal communities the most studied with 58.33% of the revised indexes, followed by Intertidal communities with 25%, Coralligenous assemblages with 12.5% and Fish communities with 4.17%. These indexes are usually composed by several metrics, these metrics are combined to result in a number that indicates the status of the water body that is being assessed [2]. A relation of the indexes and their metrics can be found in Table 1.

In this overview we aim to present a catalogue of the different indexes developed for WFD and MSFD, in order to allow other researchers to have a simple but effective comparison of these indexes, mainly for rocky bottom habitats. This review condenses the wide array of benthic indexes that are currently being applied, allowing a comparison of metrics at rocky shores, both intertidal and subtidal, indicating the need of a more reductionist approach to assess Good Ecological Status (GEcS) and Good Environmental Status (GenS) according to the European legislations.

Tab. 1. Benthic indexes developed for rocky bottoms, intertidal and infra-littoral, in relation to targeted biocenosis and applied metrics. Index acronyms see text, WFD – Water Framework Directive, MSFD – Marine Strategy Framework Directive.

Biocenosis	Index	Policy	Regional Sea	Metrics
Coralligenous assemblages	CAI	WFD	NW Mediterranean	Sludge percent cover Percent cover of builders Percent cover of bryozoans
	COARSE	MSFD	NW Mediterranean	Benthic categories percent cover Thickness and consistency of calcareous layer Borer marks Species richness Erect calcified organisms Sensitivity of bryozoans Total cover of species Maximum height Necrosis
	ESCA	WFD & MSFD	NW Mediterranean	Presence/absence and abundance of sensitive taxa/groups Diversity of assemblages Heterogeneity of assemblages
Fish communities	MFCI	MSFD	NE Atlantic	Diversity and composition Abundance Nursery function Trophic integrity
Intertidal communities	CCO	WFD	Atlantic - French Channel	Global cover of macroalgal communities Number of characteristic species per topographic/level community Cover of opportunistic species
	ICS	WFD & MSFD	Atlantic - French Channel	Stratification sub-index Organization sub-index Taxonomic sub-index
	MarMAT-EQR	WFD	NE Atlantic	Species richness Proportion of Chlorophyta Number of Rhodophyta Number of opportunists/ESG1 Proportion of opportunists Shore description Coverage of opportunists Species richness Total abundance/cover
	PAN-EQ-MAT	WFD	NE Atlantic	Opportunistic species abundance/cover Indicator species
Macroalgal assemblages	RICQI	WFD	NE Atlantic	Morphologically complex algae Species richness Faunal cover
	ALEX	MSFD	NW Mediterranean	Abundance of native species Abundance of alien species Abundance of established alien species Abundance of invasive alien species
	CARLIT-EQR	WFD	NW Mediterranean	Presence and abundance of communities
	CFR	WFD	NE Atlantic	Coverage of characteristic macroalgae Fraction of opportunistic species Richness of characteristic macroalgae
	EEI	WFD	E Mediterranean	Abundance of ESG I Abundance of ESG II
	HPI	WFD	North Sea	Species richness Green algae Fucetum Depth limit
	QISubMac	WFD	Atlantic - French channel	Presence/absence of sensitive perennial macroalgae Maximum depth extension Mean density of structuring species Number of characteristic species Mean density of opportunistic species Total number of identified taxa Mean <i>Laminaria hyperborea</i> stipe length Mean quantity of epibionts on <i>Laminaria hyperborea</i> stipes
RSL	WFD	NE Atlantic	Species richness Proportion of Chlorophyta Proportion of Rhodophyta Proportion of opportunistic species ESG ratio Physical type of shore	

References

- 1 - Borja, A., Elliott, M., Andersen, J. H., Cardoso, A. C., Carstensen, J., Ferreira, J. G., Heiskanen, A-S., Marques, J.C., Neto, J.M., Teixeira, H. Uusitalo, L. Uyarra, M.C, Zampoukas, N. 2013. Good Environmental Status of marine ecosystems: what is it and how do we know when we have attained it? *Marine Pollution Bulletin*, 76(1-2): 16-27
- 2 - Green, R. and Chapman, P. M. 2011. The problem with indices. *Marine Pollution Bulletin*, 62(7): 1377-1380