A catalogue of indicators/indices on Biodiversity Descriptors for MSFD and future developments



Working Session: Marine Biodiversity & Ecosystem Functioning Rome, 29 May 2019 *Kalliopi Pagou & Elena Stanca*



The story:

Within the frame of MSFD implementation in the Southern European Seas and the scientific support offered to the Competent Authorities and stakeholders, a series of DG ENV funded projects have been collaborating with the LIFEWATCH infrastructure regarding the Biodiversity Descriptors on constructing, maintenance and sustainability of resources and outcomes/products developed:



INTEGRATED REGIONAL MONITORING IMPLEMENTATION STRATEGY IN THE SOUTH EUROPEAN SEAS (2013-2015, www.iris-ses.eu)



ACTION PLANS FOR INTEGRATED REGIONAL MONITORING PROGRAMMES, COORDINATED PROGRAMMES OF MEASURES AND ADDRESSING DATA AND KNOWLEDGE GAPS IN MEDITERRANEAN SEA (2015-2017, www.actionmed.eu)



SUPPORT MEDITERRANEAN MEMBER STATES TOWARDS COHERENT AND COORDINATED IMPLEMENTATION OF THE SECOND PHASE OF THE MSFD (2017-2019, www.medcis.eu)



SUPPORT <u>MED</u>ITERRANEAN MEMBER STATES TOWARDS IMPLEMENTATION OF THE MARINE STRATEGY FRAMEWORK DIRECTIVE NEW GES DECISION AND PROGRAMMES OF MEASURES AND CONTRIBUTE TO REGIONAL /SUBREGIONAL COOPERATION (2019-2021, www.medregion.eu)



www.ins-ses.eu



Pilot Project - New Knowledge for an integrated management of human activities in the sea

Activity Nr 2

POPs IN THE NW BLACK SEA ECOSYSTEM

VALENTINA COATU



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developed an effective, open-access and open-resource, long lasting, continuously updated e-Learning platform with MSFD descriptors related short interviews and power-point lectures available on the IRIS-SES website, through the use of the Lifewatch EU project (also on LifeWatch Service Centre e-Learning area).

Aiming to offer to the MSFD stakeholder community (including students) a platform, with training tools available for the dissemination of the importance of monitoring the ecological/environmental status of our seas, as well as the relevance and characteristics of MSFD descriptors.







In IRIS-SES training material, were included:

- morpho-functional diversity as body size diversity (D1),
- zooplankton diversity and pelagic food web dynamics in Adriatic (D1, D4),
- alien species to marine Mediterranean ecosystems (D2),
- nutrient & phytoplankton dynamics and HABs in the Black Sea (D5),
- smart monitoring for phytoplankton blooms remote sensing (D1, D5),
- bioturbation and sea bed integrity (D6),
- interactions of biotic and abiotic components of the sea bed ecosystem (D6),
- problems raising from nano-particle contaminants and critical pressures from POPs in marine ecosystems and organism responses and contaminant bio-magnification (D8),
- the ecological impact of marine litter (D10).





- Within ActionMed we performed a review on how EU MSs deal with biodiversity indicators in their IAs, identifying the commonalities and differences between nationally selected indicators, by considering important information sources with respect to biodiversity descriptors/indicators, GES, and targets, such as EU research projects (i.e. PERSEUS, DEVOTES, EMBOS etc.).
- Best practices of biodiversity tools of other regional approaches (i.e. OSPAR biodiversity assessment, HELCOM Biodiversity Assessment Tool (BEAT); MARMONI Marine Biodiversity Assessment Tool etc) were also considered, in order to categorize indicators and produce an indicator inventory.
- The **produced inventory of biodiversity descriptors**, being a freely available e-catalogue, has been published for open consultation on the ActionMed webportal (http://actionmed.eu/explore-the-electronic-catalogue-on-biodiversity-descriptor/).
- Advanced functions of the catalogue, linking descriptors/indicator to metrics for computational purposes were available by the end of the project on the LifeWatch-ITA webportal, with application to case studies.





- Also we collected information to build study cases in the biodiversity databases of marine LifeWatch Virtual Research Environments (VREs), to be made available as in kind contributions by LifeWatch-ITALY and LifeWatch-GREECE, in order to develop experimental tests of uncertainty associated to biodiversity indicators currently used by MSs or scientific networks.
- The case studies have been applied on an idealised <u>transect from inland brackish water to the</u> <u>open sea</u>, to take also into account the natural gradient of nutrients, with decreasing concentrations along increasing distance from the coastal source of freshwater/anthropogenic effluents and nutrient input.
- Finally, <u>a GIS tool related to Biodiversity (D1) and Seafloor Integrity (D6) descriptors</u> developed as a toolbox, in order to assess the degree of vulnerability of the benthic habitats to human stressors. The design of the GIS tool has been based on the outcomes of the UNEP/MAP Biodiversity online working group, the HELCOM Baltic Sea Impact (2010) and the OSPAR BH3 indicator addressing the pressures causing physical damage to the seafloor habitats. Thus, the main concept of the GIS tool is to relate the sensitivity of Mediterranean priority habitats to the pressure type and intensity.



Some examples





Figure 2. The workflow of the Benthic Habitat Risk Assessment tool







Figure 10. Assessment of the physical damage of the meadows regarding the bottom trawlers activity (step 6).





Within the Proposals for the Mid- & Long-term Action Plans:

Availability, accessibility and visualization (possibly via GIS Tools) of large datasets is crucial to define monitoring strategies and interpret their output.

Pivotal role of data portal and virtual research environment (e.g. EMODnet, LifeWatch-ERIC).

Integration of European Research Infrastructures in the implementation of European Directives, can reinforce the EU policy towards a wise and efficient process of ensuring ecosystem health at the EU scale

Electronic catalogue on Biodiversity Descriptor

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	Index name	Element	Descriptor
		Phytoplankton	D1
	to (year):	Author name	Туроlоду
	2015 -		

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Index	Element	Title	Authors	Year	Published.on	Typology	Associated.descriptors	
Abundance of phytoplankton	Phytoplankton	ESTRATEGIA MARINA DEMARCACION MARINA CANARIA PARTE IV. DESCRIPTORES DEL BUEN ESTADO AMBIENTAL DESCRIPTOR 1: BIODIVERSIDAD EVALUACION INICIAL Y BUEN ESTADO AMBIENTAL	de Armas D, Bellas J	2012	AZTI-JGR - D1 - Canarias Spanish Ministry of Agriculture, Food and Environment	Report	D1-D4-D5	
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Abundance of selected phytoplankton species and taxa groups	Phytoplankton	ESTRATEGIA MARINA DEMARCACION MARINA NORATLANTICA PARTE IV. DESCRIPTORES DEL BUEN ESTADO AMBIENTAL DESCRIPTOR 1: BIODIVERSIDAD	de Armas D, Bellas J	2012	AZTI-JGR - D1 - Noratlantica Spanish Ministry of Agriculture, Food and Environment	Report	D1-D3-D4-D5	







As additional deliverable to the case studies task of ActionMed, a webtool for phytoplankton dataset has been produced and available on the ActionMed website (http://actionmed.eu/).

The webtool is able to calculate a large number of phytoplankton community indicators and provides support for correlation, similarity and time series analysis.

The webtool allows:

- 1) the analysis of the datasets described in a study case;
- 2) the upload of phytoplankton datasets organized according to the LIFEWATCH standards



Pelagic Habitats as Biodiversity component included in the COMMISSION DECISION (EU) 2017/848

Theme

Pelagic habitats (relating to Descriptor 1)

Criteria, including criteria elements, and methodological standards

Criteria elements	Criteria	Methodological standards					
Criteria elements Pelagic broad habitat types (variable sali- nity (¹), coastal, shelf and oceanic/beyond shelf), if present in the region or subregion, and other habitat types as defined in the second paragraph. Member States may select, through regional or subregional cooperation, addit- ional habitat types according to the criteria laid down under 'specifications for the	Criteria D1C6 — Primary: The condition of the habitat type, includ- ing its biotic and abiotic structure and its functions (e.g. its typical species composi- tion and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), is not adversely af- fected due to anthropogenic pressures.	Methodological standards Scale of assessment: Subdivision of region or subregion as used for assessments of benthic broad habitat types, reflecting biogeographic differences in species composition of the habitat type. Use of criteria: The extent to which good environmental status has been achieved shall be expressed					
selection of species and habitats'.	Member States shall establish threshold values for the condition of each habitat type, ensuring compatibility with related values set under Descriptors 2, 5 and 8, through regional or subregional co- operation.	 for each area assessed as: (a) an estimate of the proportion and extent of each habitat type assessed that has achieved the threshold value set; (b) a list of broad habitat types in the assessment area that were not assessed. 					

(1) Retained for situations where estuarine plumes extend beyond waters designated as Transitional Waters under Directive 2000/60/EC.





Issues identified: According to the latest revision of the GES definitions, all 8 Mediterranean MSs have defined GES at the Biodiversity Descriptor 1 level,

However, not all of them in relation to pelagic habitats and plankton communities

The level of coherence among them is still low for pelagic habitats

MEDCIS contribution:

Issues to be addressed & resources to be used as the e-catalogue on Biodiversity descriptor developed in ActionMed

Review the use of existing diversity indicators for different plankton groups in the Mediterranean
Compare existing approaches of GES definitions for D1
Practices in other European seas

Focus on plankton indicators for phytoplankton, zooplankton and prokaryotes

Data resources

For the phytoplankton case study



Data Portal

In this section you will access the catalogue of resources provided by LifeWatch.

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		Cryptophyce	ae				Cryptophyceae	cone+half sphere	Unique	flagella	11	
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Computation





- Index_Workflow, on Phytoplankton Virtual Research Environment, provided by LifeWatch Italy (<u>www.lifewatchitaly.eu</u>)
- 8 different indices commonly used in phytoplankton ecology were calculated

Taxonomic richness

Margalef's diversity

 $M' = \frac{R' - 1}{\log N}$

 $E' = \frac{H'}{\log R'}$

Pielou's evenness

Sheldon's evenness

BergerParker's dominance

Shannon - Wiener's diversity

$$BP' = \frac{n_1}{N}$$

 $Sh' = \frac{e^{H'}}{R'}$

 $H' = -\sum p_i \times \ln p_i$

Simpson's diversity $S' = \sum p_i^2$ McNaughton's dominance

$$McN' = \frac{n_1 + n_2}{N}$$





WORKFLOW ORCHESTRATOR



Computation



Index workflow output

country	locality	parenteventi me	onth year	depth H	Shannon_H	Shannon_H_Simpso	n_U M	lenhinick_U Margal	et_U	Gleason_U Mo	Inthosh_P Hurlb	ert_PIE Pielou_	J	Sheldon_J	LudwReyn_J	BergerParke I	McNaughton h	ulburt
ITALY	Alimini-Otranto	MC_FA01	10 201	3 0 33	2,139	8,493	0,814	0,208	3,159	3,257	1,422	0,84	0,612	0,257	0,234	0,295	0,55	54,98
ITALY	Alimini-Otranto	MC EA01	10 201	4 0 35	2.179	8.837	0.8	0.109	2.945	3.032	1443	0.824	0.613	0.252	0.23	0.327	0.612	61,241
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HALY	Alimini-Utranto	MC_FAU1	12 201	5 0 24	2,006	7,434	0,81	0,138	2,228	2,325	1,428	0,845	0,631	0,31	0,28	0,287	0,544	54,404
ITALY	Alimini-Otranto	MC_FA01	12 201	6 0 17	7 1,186	3,274	0,548	0,044	1,341	1,425	1,668	0,583	0,419	0,193	0,142	0,648	0,778	77,755
ITALY	Alimini-Otranto	MC_FA01	2 201	4 0 17	7 2,172	8,777	0,845	0,145	1,68	1,784	1,382	0,898 (0,767	0,516	0,486	0,28	0,475	47,522
ITALY	Alimini-Otranto	MC_FA01	2 201	5 0 43	3 1,861	6,432	0,745	0,066	3,24	3,317	1,502	0,763 0	0,495	0,15	0,129	0,427	0,626	62,622
ITALY	Alimini-Otranto	MC FA01	3 201	3 0 2	1 1.495	4,458	0.647	0.126	1.954	2.052	1.585	0.679	0.491	0.212	0.173	0.522	0.794	79.44
ITALY	Alimini-Otranto	MC_FA01	3 201	4 0 2	1 1.833	6.253	0.783	0.029	1.516	1.592	1.464	0.822 (3.602	0.298	0.263	0.331	0.614	61.45
ITALY	Alimini-Otranto	MC EA01	3 201	6 0 27	0.479	1.614	0 184	0.091	2 284	2 372	1897	0 191	0 145	0.06	0.024	0.902	0.95	95.026
ITALY	AliminiaOtranto	MC EA01	4 201	4 0 24	0.689	1 991	0.326	0.075	1995	2.082	1.815	0.341	0.217	0.083	0.043	0.811	0.911	91.12
ITALY	Alimini-Oranto	MC EAO1	4 201	5 0 2	1 1522	4 624	0.701	0.013	1,619	1699	1543	0.736 (0,211	0,003	0.192	0,011	0,31	72 669
ITALL	Alimini-Octanico	MC_FAO1	4 201	0 2	1 1,000	4,034	0,101	0,044	1,010	1,000	1,343	0,100 0	3,304	0,221	0,102	0,434	0,131	70,000
TALL	Alimini-Otranto	MC_FAUL	5 201	2 0 20	1,331	4,041	0,043	0,015	1,103	1,132	1,300	0,003 0	3,400	0,202	0,10	0,507	0,131	73,034
TIALY	Alimini-Utranto	MC_FA01	5 201	3 0 20	1,375	3,355	0,614	0,065	1,659	1,746	1,616	0,646 (J,459	0,198	0,155	0,578	0,771	77,106
HALY	Alimini-Utranto	MC_FAU1	5 201	6 U 46	5 2,604	13,521	0,904	0,06	3,384	3,459	1,309	0,924	0,68	0,294	0,278	0,215	0,333	33,324
ITALY	Alimini-Utranto	MC_FA01	6 201	4 0 25	9 1,175	3,239	0,501	0,072	2,332	2,415	1,702	0,519 0	J,349	0,112	0,08	0,694	0,77	77,043
ITALY	Alimini-Otranto	MC_FA01	6 201	5 0 43	3 1,845	6,327	0,782	0,038	2,986	3,057	1,466	0,8	0,49	0,147	0,127	0,368	0,593	59,346
ITALY	Alimini-Otranto	MC_FA01	6 201	6 0 40	2,033 2	7,638	0,753	0,261	3,875	3,975	1,487	0,772	0,551	0,191	0,17	0,456	0,592	59,217
ITALY	Alimini-Otranto	MC_FA01	7 201	2 0 18	3 1.8	6.052	0.784	0.072	1.54	1.63	1,459	0.83 (0.623	0.336	0.297	0.306	0.58	57,985
ITALY	Alimini-Otranto	MC FA01	7 201	3 0 18	1.618	5.045	0.727	0.107	1.66	1,757	1.513	0.77	0.56	0.28	0.238	0.388	0.699	69.88
ITALY	Alimini-Otranto	MC_EA01	8 201	4 0 22	2 266	9.64	0.82	0.212	2 261	2,369	141	0.86 (1 733	0.438	0.411	0.378	0 474	47 407
ITALY	Alimini-Otranto	MC EA01	8 201	5 0 23	0.926	2 5 2 5	0.343	0.108	2.053	2 146	1802	0.359 (295	0.11	0.069	0.806	0.863	86 274
ITALY	Alimini-Otranto	MC EAO1	9 201	2 0 13	1722	5 599	0.753	0.066	1 127	1232	1.499	0.916 (1672	0.431	0,393	0.405	0,639	63 929
ITALY	Alimini Oranio	MC FAO1	9 201	2 0 22	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	10 799	0,100	0.221	2 226	2 226	1.997	0.96	0.60	0.227	0,000	0.246	0,000	49 550
ITALL	Alimini-Ottanto	MC_FA01	0 201	0 33	2,313	10,130	0,034	0,231	3,220	3,320	1,001	0,00	0,00	0,321	0,300	0,340	0,430	43,330
TALY	Alimini-Utranto	MC_FAUL	3 201	0 43	2,334	13,10	0,333	0,107	3,323	4,010	1,200	0,354 (J, 1 10	0,420	0,413	0,101	0,234	25,425
THALY	AMP Torre Guaceto	MC_1601	10 201	2 0 28	3,003	20,27	0,335	0,122	2,485	2,575	1,243	0,37 0	1,303	0,724	0,714	0,133	0,255	25,455
ITALY	AMP Torre Guaceto	MC_TG01	10 201	4 0 26	5 2,609	13,585	0,884	0,053	2,018	2,098	1,338	0,919	0,801	0,522	0,503	0,256	0,393	39,252
ITALY	AMP Torre Guaceto	MC_TG01	10 201	5 0 19	0,384	1,468	0,134	0,037	1,445	1,525	1,927	0,142	0,13	0,077	0,026	0,93	0,955	95,483
ITALY	AMP Torre Guaceto	MC_TG 01	1 201	3 0 30) 3,123	22,715	0,942	0,092	2,507	2,593	1,237	0,974	0,918	0,757	0,749	0,145	0,229	22,895
ITALY	AMP Torre Guaceto	MC_TG01	1 201	4 0 27	7 2,848	17,259	0,919	0,062	2,142	2,224	1,282	0,954 (0,864	0,639	0,625	0,183	0,302	30,24
ITALY	AMP Torre Guaceto	MC_TG01	12 201	3 0 4	1 3,082	21,808	0,938	0.064	3,096	3,173	1,246	0,962	0,83	0,532	0,52	0,132	0,225	22,494
ITALY	AMP Torre Guaceto	MC TG01	12 201	4 0 23	2.425	11.303	0.873	0.055	1.82	1.903	1.353	0.913 (0.773	0.491	0.468	0.253	0.395	39,512
TALY	AMP Torre Guaceto	MC_TG01	2 201	4 0 2	2 695	14,801	0.915	0.061	171	1796	1287	0.961 0	1885	0.705	0.69	0.143	0.287	28.66
ITALY	AMP Torre Guaceto	MC TG01	2 201	5 0 32	2 472	11.851	0.876	0.073	2 551	2,633	1349	0.905	0 713	0.37	0.35	0.246	0 384	38 437
ITALY	AMP Torre Guadeto	MC TG 01	3 201	3 0 38	3 212	24.824	0.948	0.097	3.1	3 184	1,225	0,973 (1 883	0.653	0.644	0.11	0.217	21668
ITALY	AMD Tassa Conserva	MC_TC01	4 201	4 0 30	2,409	11 110	0.000	0.001	2 250	0,104	1.220	0,010	0,000	0,000	0,044	0.276	0,422	42,000
TALL	AMP Torre Guaceto	MC_TG01	4 201	4 U 22	2,400	10,710	0,005	0,211	2,203	2,307	1,004	0,306 0	3,113	0,505	0,402	0,210	0,423	42,213
TALY	AMP Torre Guaceto	MC_TOUT	4 201	5 0 23	2,312	10,716	0,073	0,204	2,321	2,433	1,345	0,312 1	J, (50	0,466	0,442	0,204	0,357	30,011
TIALY	AMP Torre Guaceto	MC_1601	5 201	2 0 26	3,028	20,665	0,942	0,084	2,18	2,268	1,237	0,979	0,93	0,795	0,787	0,114	0,211	21,141
HALY	AMP Torre Guaceto	MC_TG01	5 201	3 0 25	3,1	22,198	0,947	0,067	2,305	2,387	1,227	0,981	0,921	0,765	0,757	0,098	0,175	17,504
ITALY	AMP Torre Guaceto	MC_TG01	6 201	4 0 28	3 2,84	17,121	0,929	0,064	2,222	2,305	1,263	0,964 (J,852	0,611	0,597	0,133	0,228	22,82
ITALY	AMP Torre Guaceto	MC_TG01	6 201	5 0 20) 2,167	8,735	0,802	0,151	1,945	2,047	1,434	0,844 (0,723	0,437	0,407	0,4	0,51	51,002
ITALY	AMP Torre Guaceto	MC_TG 01	7 201	2 0 32	2 3,131	22,892	0,946	0,1	2,688	2,775	1,228	0,977 (0,903	0,715	0,706	0,103	0,194	19,436
ITALY	AMP Torre Guaceto	MC_TG01	8 201	3 0 23	3 2.512	12.332	0.872	0.039	1.726	1.804	1.356	0.911	0.801	0.536	0,515	0.238	0.45	44,951
ITALY	AMP Torre Guaceto	MC TG01	8 201	4 0 26	2.397	10,995	0.868	0.073	2.128	2.214	1.359	0.903 (0.736	0.423	0.4	0.248	0.417	41.712
ITALY	AMP Torre Guaceto	MC_TG01	8 201	5 0 2	1 2 132	8.435	0.805	0.054	1676	176	1438	0.845	0.7	0.402	0 372	0.31	0.602	60 197
ITALY	AMP Torre Guaceto	MC TG01	9 201	2 0 30	295	19 107	0.932	0.088	2 485	2.57	1257	0.964 0	1867	0.637	0.624	0.115	0,002	22 404
ITALY	AMP Torre Guadeto	MC TG01	9 201	3 0 22	2 / 79	11 912	0.877	0.052	1734	1.817	1348	0.918 0	1 802	0,001	0,024	0,113	0,224	40 422
ITALY	Anna Marian Destative Trans Conserve	MC_TC01	10 201	C 0 22	2,410	0 500	0.471	0.02	1/104	1,017	1,340	0,00 0	3,002	0,341	0,32	0,231	0,404	77 222
TALY	Area Marina Protetta Torre Guaceto	MC_TC01	10 201		1,253	3,322	0,971	0,00	1,403	1,577	1,121	0,433 0	0,430	0,136	0,140	0,721	0,773	11,002
TALY	Area Marina Protetta Torre Guaceto	MC_TG01	11 201	0 26	1,884	6,573	0,703	0,077	2,148	2,234	1,541	0,731 1	1,578	0,253	0,223	0,517	0,645	64,546
HALY	Area Marina Protetta Torre Guaceto	MC_1G01	1 201	r U 31	2,218	9,184	0,838	0,067	2,851	2,93	1,399	0,862	0,614	U,248	0,227	0,261	0,514	51,4
HALY	Area Marina Protetta Torre Guaceto	MC_TG01	6 201	6 020	J 2,027	7,591	0,811	0,067	1,667	1,755	1,43	0,853 (J,677	0,38	0,347	0,353	0,494	49,427
ITALY	Area Marina Protetta Torre Guaceto	MC_TG01	7 201	6 0 19	2,608	13,571	0,912	0,108	1,742	1,838	1,29	0,962 0	D,886	0,714	0,698	0,156	0,294	29,351
ITALY	Bari-S. Vito (Polignano)	MC_BA01	10 201	4 0 37	7 1,47	4,348	0,511	0,211	3,484	3,581	1,69	0,525 (0,407	0,118	0,093	0,69	0,79	79,032
ITALY	Bari-S.Vito (Polignano)	MC_BA01	10 201	5 0 56	1,515	4,55	0,63	0,214	4,941	5,031	1,602	0,641 0	0,376	0,081	0,065	0,496	0,846	84,611





We processed

• more than 4000 samples and 85,500 data entries

The 8 different indices common in phytoplankton ecology tested vs.

- **oeutrophication levels**
- \circ seasonality
- **ospatial axes (latitude and longitude)**
- **osub-regional scale**
- \circ depth
- $\odot \mbox{distance}$ from the coast



Output analysis

• Distribution of indices across anthropogenic impact levels

-1

3

N

1 0

8

0





Margalef's diversity

Pielou's evenness

3

1

3



Sheldon's evenness







McNaughton's dominance



Life Output analysis

• Distribution of indices along spatial axes





non-impacted sites (0, 1, 2)

impacted sites (3)



Conclusions and recommendations from the phytoplankton case studies in the Med:



 biodiversity indices (as the combination of Shannon's/Simpson's diversity and Sheldon's evenness indices) can discriminate the level of eutrophication impact on plankton communities across different coastal environments in the Med

• space-specific thresholds are needed due to the strong variation of biodiversity indices along longitudinal and latitudinal gradients

 sampling across the whole water column is quite imperative because taxonomic indices appear to be more constant across different depths and distances from the coast

• high sampling frequency is very crucial since many indices have bad performances in discriminating impacted sites in summer (July – August)

• more testing of existing plankton biodiversity indicators with good performances is needed in order to construct solid thresholds for the Med.



Ecological Indicators 82 (2017) 558-573



Original Articles

Sensitivity of phytoplankton metrics to sample-size: A case study on a large transitional water dataset (WISER)

CrossMark

F. Cozzoli^{a,*}, E. Stanca^a, G.B. Selmeczy^a, J. Francé^b, I. Varkitzi^c, A. Basset^a

Ecological Indicators 95 (2018) 203-218



Review



Pelagic habitats in the Mediterranean Sea: A review of Good Environmental Status (GES) determination for plankton components and identification of gaps and priority needs to improve coherence for the MSFD implementation



I. Varkitzi^{a,*}, J. Francé^b, A. Basset^c, F. Cozzoli^c, E. Stanca^c, S. Zervoudaki^a, A. Giannakourou^a, G. Assimakopoulou^a, A. Venetsanopoulou^a, P. Mozetič^b, T. Tinta^{b,d}, S. Skejic^e, O. Vidjak^e, J-F. Cadiou^f, K. Pagou^a





The work will continue in MEDREGION. Among the objectives are:

- Selection of indicators (for D1, D4, D6) based upon criteria established in the Commission Decision (EC, 2017).
- Set reference conditions and thresholds (i.e. boundary between good and moderate status.
- Integration of multiple indicators, criteria, ecosystem components, and descriptors in multiple temporal and spatial scales.
- Perform a gap analysis about pollution pressures on biodiversity in the Mediterranean









Thank you!