



JORNADA ETSIM
Madrid, 30 noviembre 2011

La respuesta a la contaminación marina en la
normativa europea: Directivas Marco del Agua y
de la Estrategia Marina

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- **Presiones** en el medio marino
- **Contaminación** y usos
- Respuestas **legales**
- **Directivas:** Marco del **A**gua (DMA) y de la **E**strategia Marina (DEME)
- El **estudio** del medio marino
 - DMA y bentos
 - DMA e integración
 - DEME y descriptores
 - DEME e integración
- **Conclusiones**

Presiones en el medio marino

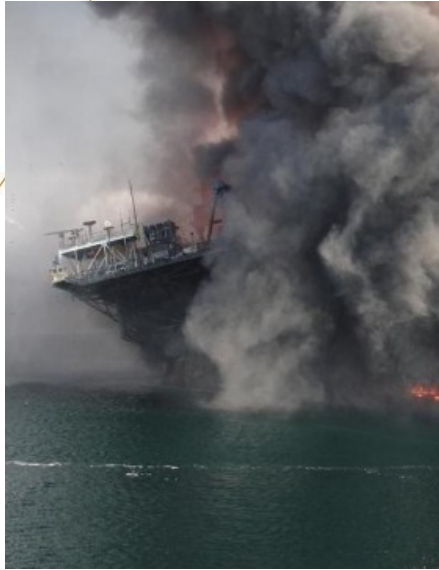
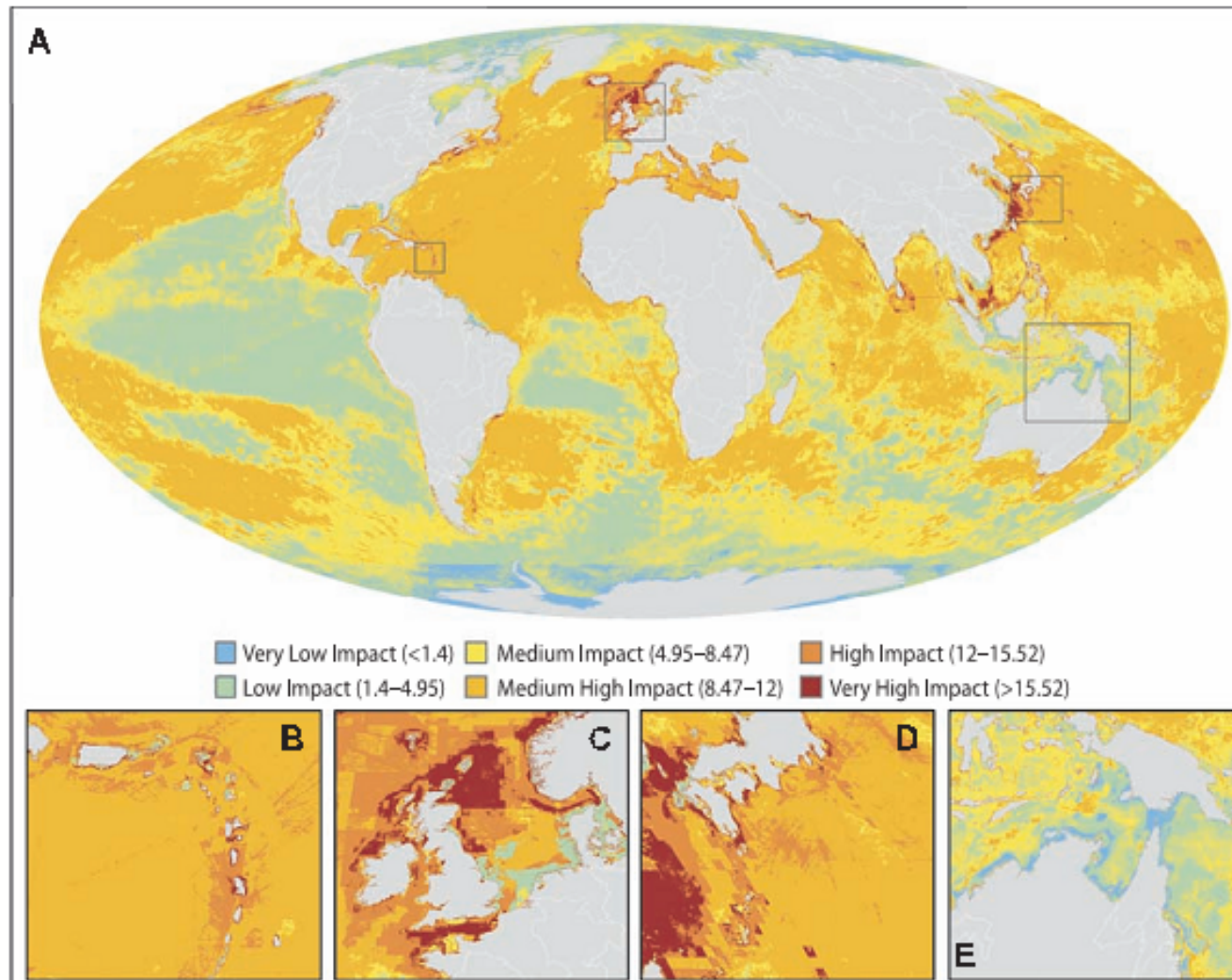
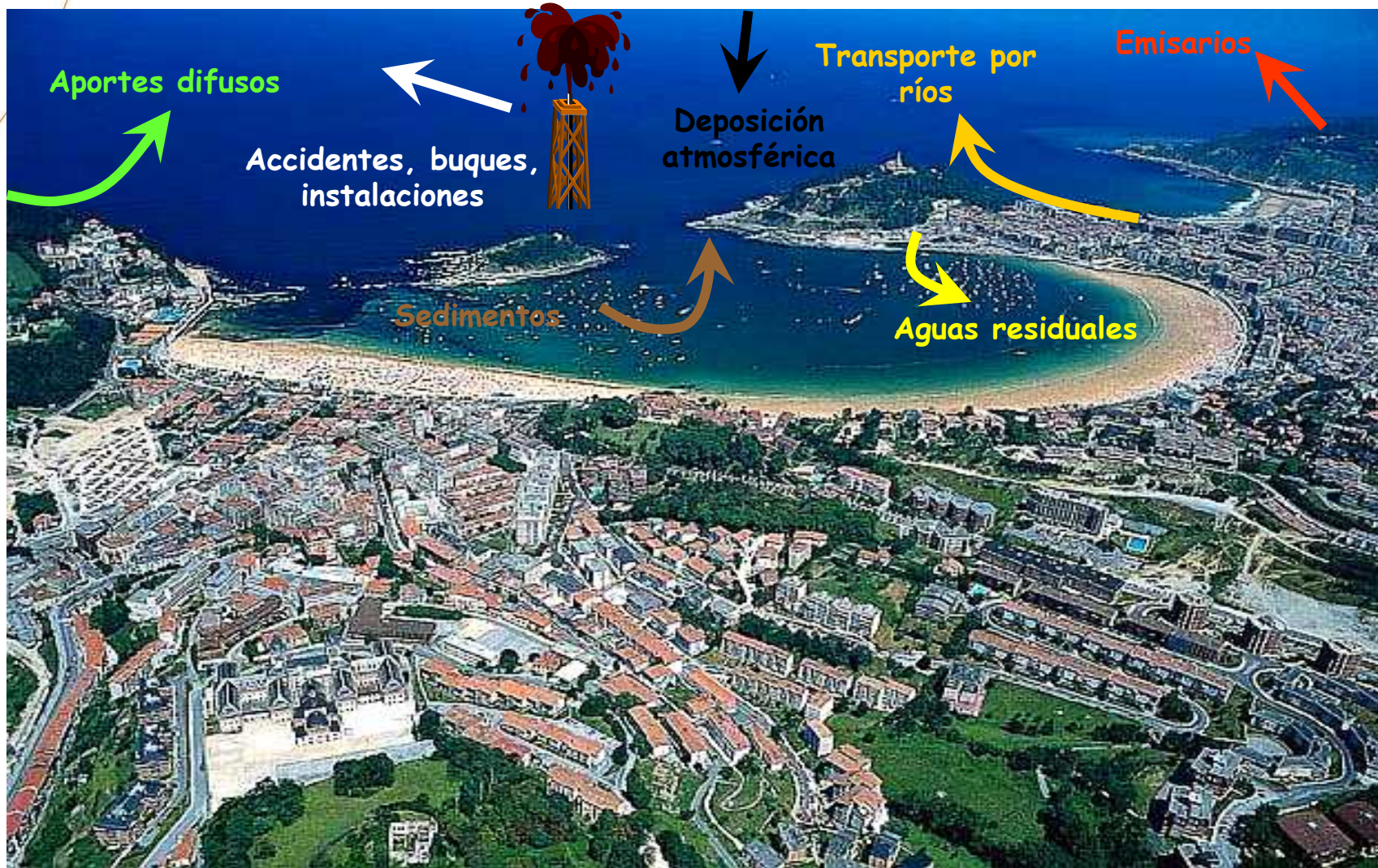


Fig. 1. Global map (A) of cumulative human impact across 20 ocean ecosystem types. (Insets) Highly impacted regions in the Eastern Caribbean (B), the North Sea (C), and the Japanese waters (D) and one of the least impacted regions, in northern Australia and the Torres Strait (E).

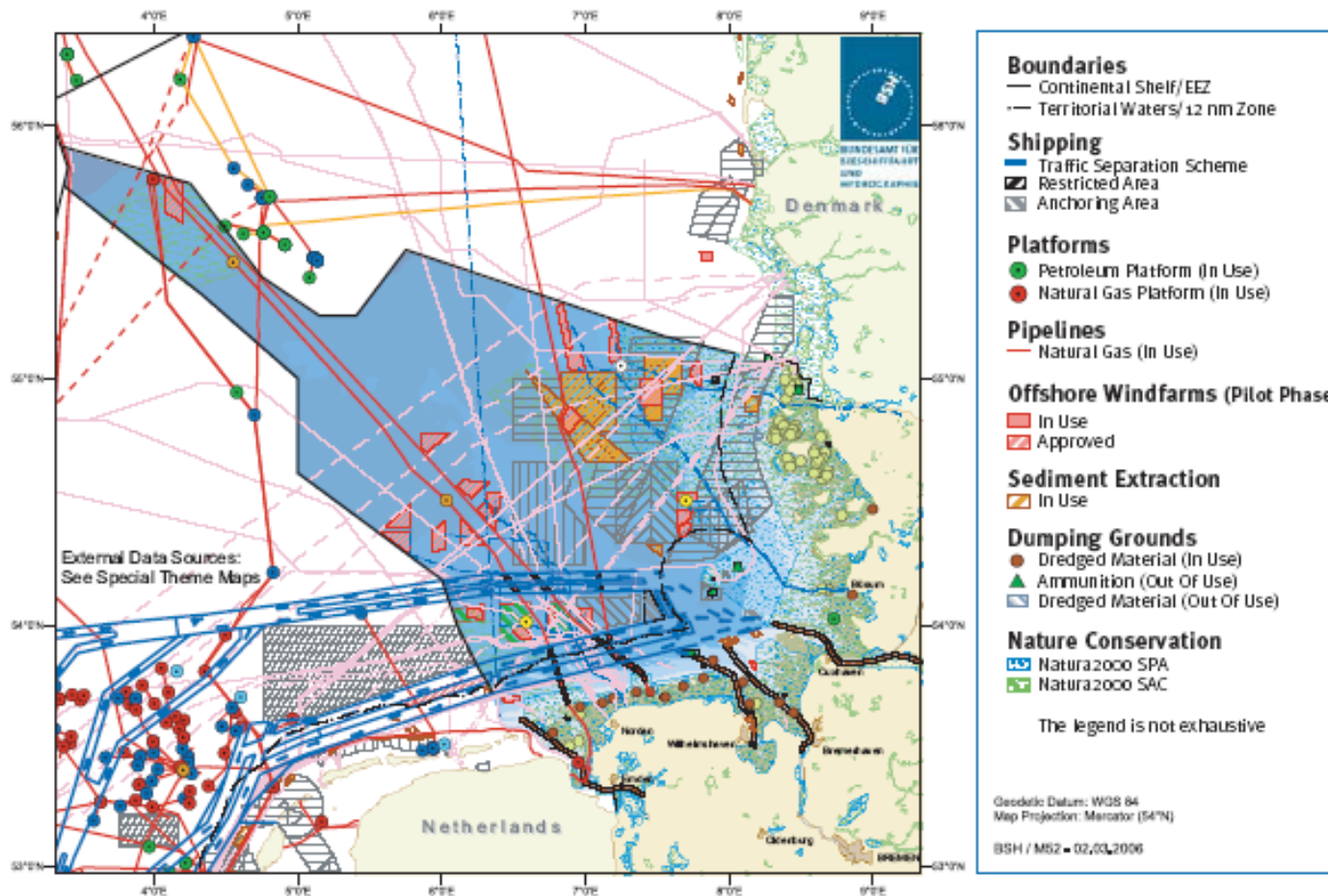


- Según **GESAMP** (Grupo de Expertos en Aspectos Científicos de la Contaminación Marina, una organización mundial dependiente de diversas organizaciones, IMO, FAO, UNESCO, WHO,...):
- Por **contaminación marina** se entiende “la **introducción por el hombre**, directa o indirectamente, de **substancias o energía** en el medio marino, provocando **efectos perjudiciales** tales como daños a los **recursos vivos**, riesgos a la **salud humana**, obstáculos a las **actividades marinas**, incluyendo la pesca, deterioro de la calidad del agua de mar para su uso y reducción de los atractivos del mar”

Contaminación y usos

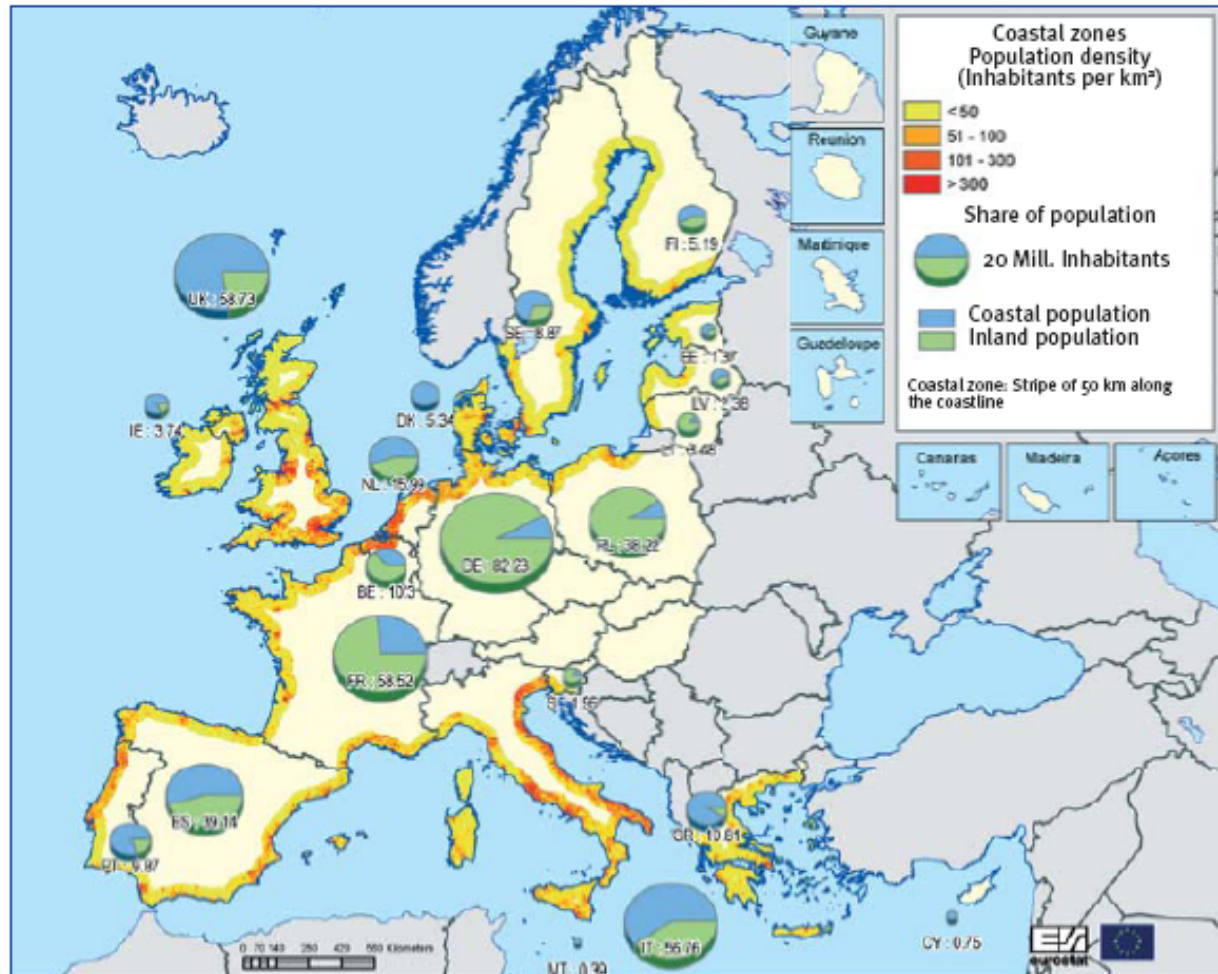


North Sea: Existing and Prospective Uses and Nature Conservation



- Usos múltiples del medio marino
- Interacción de usos

Contaminación y usos

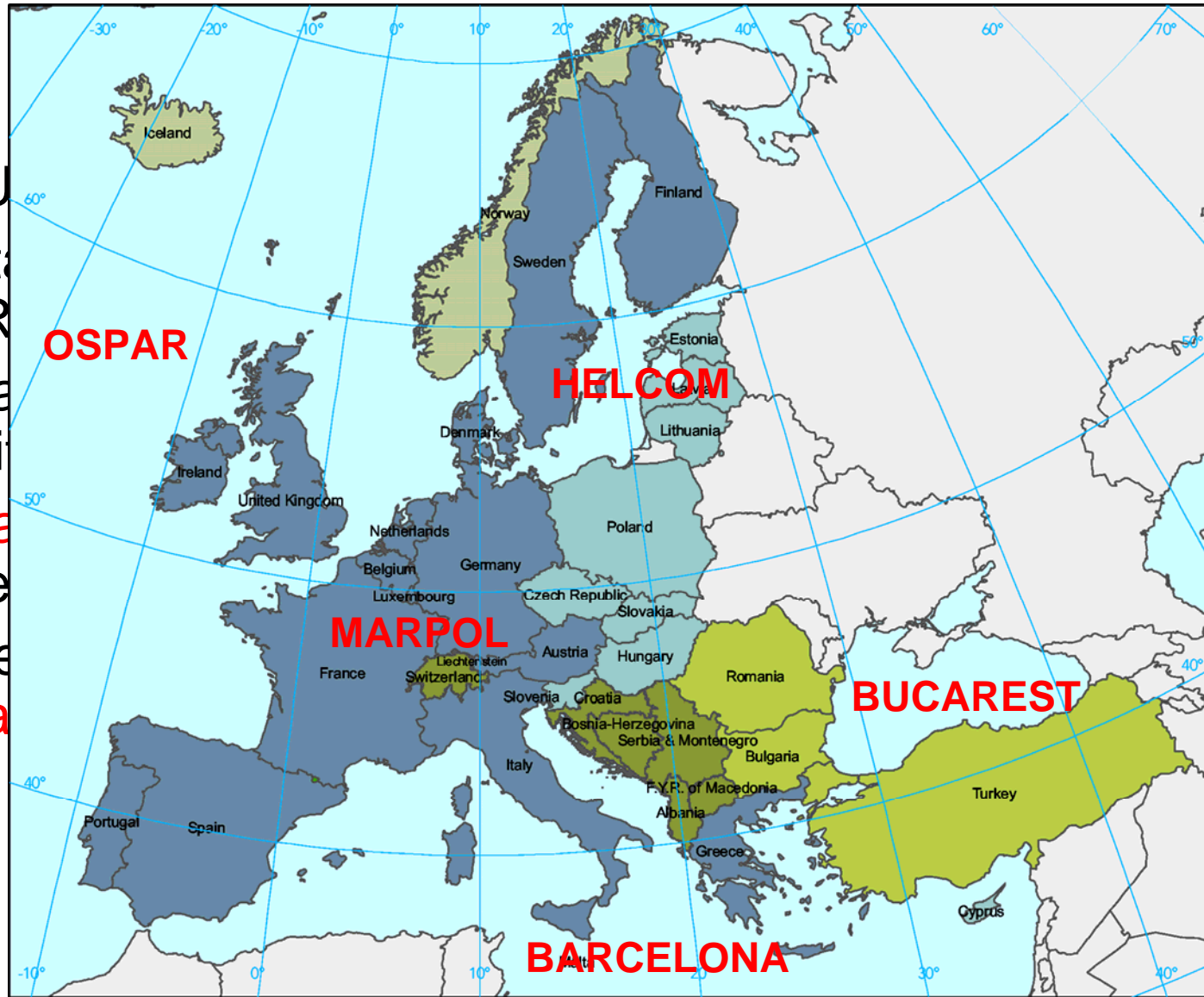


- Un importante porcentaje de la población vive en zonas costeras
- Los ingresos (PIB) de las áreas marinas son muy importantes

Statistical data: Eurostat — Database: REGIO
© EuroGeographics, for the administrative boundaries
Cartography: Eurostat — GISCO

Respuestas legales

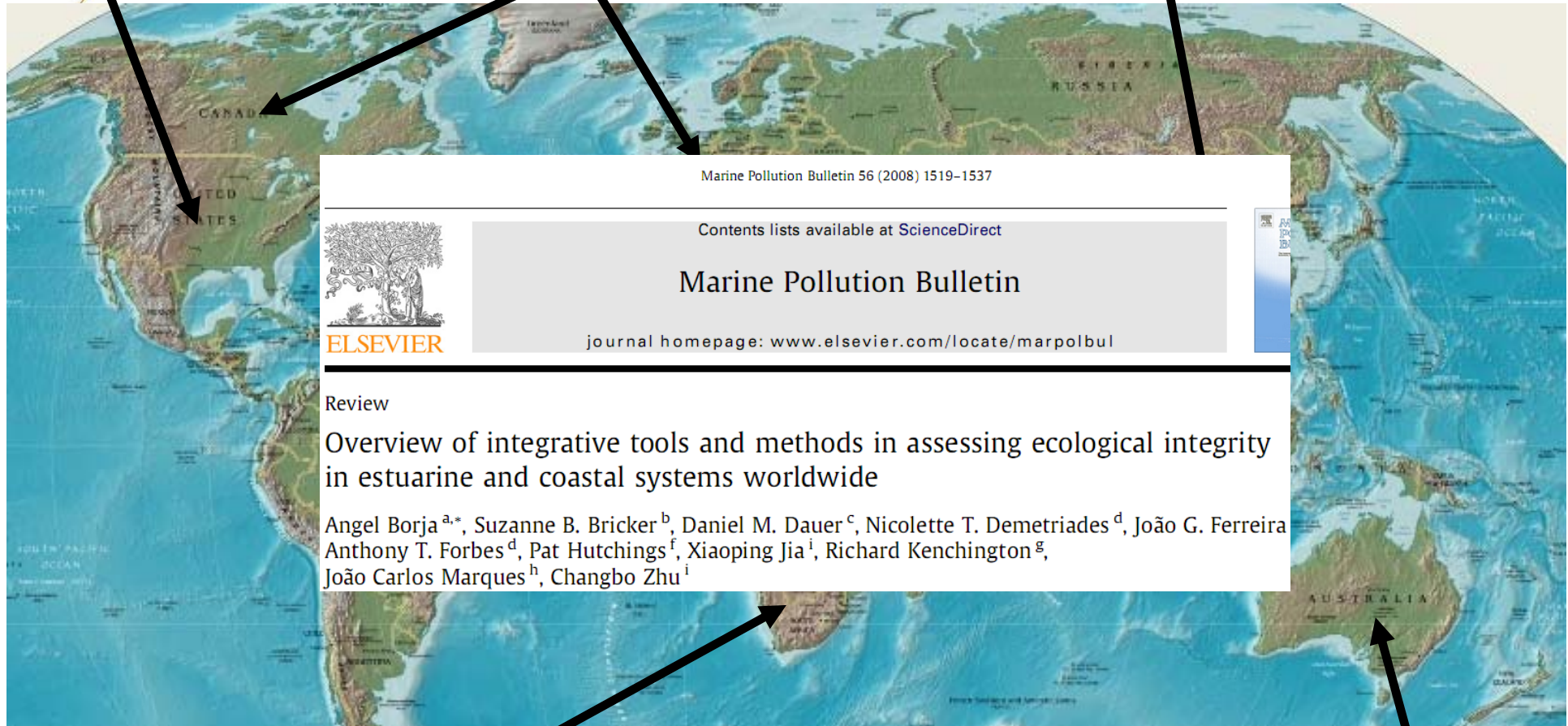
- Hay ONU
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Respuestas legales

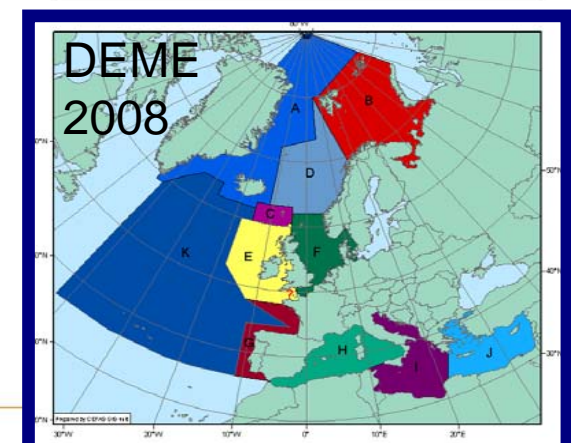
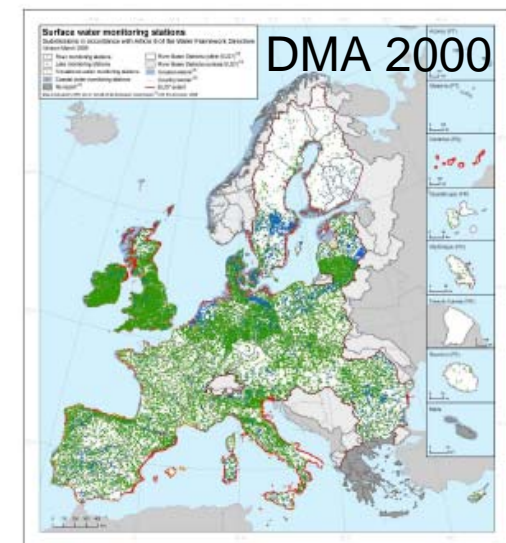
- | Directiva Marco del Agua (**DMA: 2000**)
- | Directiva Marco de la Estrategia Marina (**DEME: 2008**)
- | Clean Water Act (**1972**)
- | Oceans Act (**1997**)
- | Sea Water Quality Act (**1997**)
- | Oceans Act (**2000**)
- | Oceans Strategy (**2002**)



- | National Water Act (**1998**)
- | Oceans Policy (**1998**)
- | Coastal Management Act (**2008**)

Respuestas legales

- I Una visión global del medio marino, desde un **punto de vista ecosistémico**, proporcionando herramientas de **gestión integrada**, que tratan de mantener la **funcionalidad** de los ecosistemas junto con sus **usos**
- I **Prevenir la degradación** y proteger y **restaurar** la calidad de los ecosistemas acuáticos
- I Promover el **uso sostenible de los mares** y conservar los ecosistemas marinos.
- I Promover medidas específicas para una **progresiva reducción de los vertidos** (sustancias prioritarias)
- I **Alcanzar un Buen Estado para 2015 (DMA) y 2020 (DEME)**





Tema	Directiva Aguas	Directiva de la Estrategia Marina
Elementos y descriptores	Química Físico-química Hidromorfología Fitoplancton Macroalgas: Malo Angiospermas Macroinvertebrados Peces (sólo en aguas transición)	<ol style="list-style-type: none"> 1. Biodiversidad 2. Exóticas 3. Peces explotados 4. Redes tróficas 5. Eutrofización 6. Integridad fondos 7. Condiciones hidrográficas 8. Contaminantes 9. Contaminantes en alimentos 10. Basuras 11. Ruido y energía
Diferencias ecológicas	Integración de cada elemento ('uno fuera, todos fuera')	Integridad ecológica (método basado en los ecosistemas o 'ecosystem-based approach')

Ecosystem-based approach: Una gestión integrada de las actividades humanas basada en el mejor **conocimiento científico** disponible sobre el **ecosistema y su dinámica**, con objeto de identificar y promover acciones sobre las influencias que son críticas para la salud de los ecosistemas marinos, alcanzando así un **uso sostenible de los bienes y servicios de los ecosistemas** y el mantenimiento de la **integridad de los ecosistemas**

El estudio del medio marino

Ecological Indicators 12 (2012) 1–7



Contents lists available at ScienceDirect

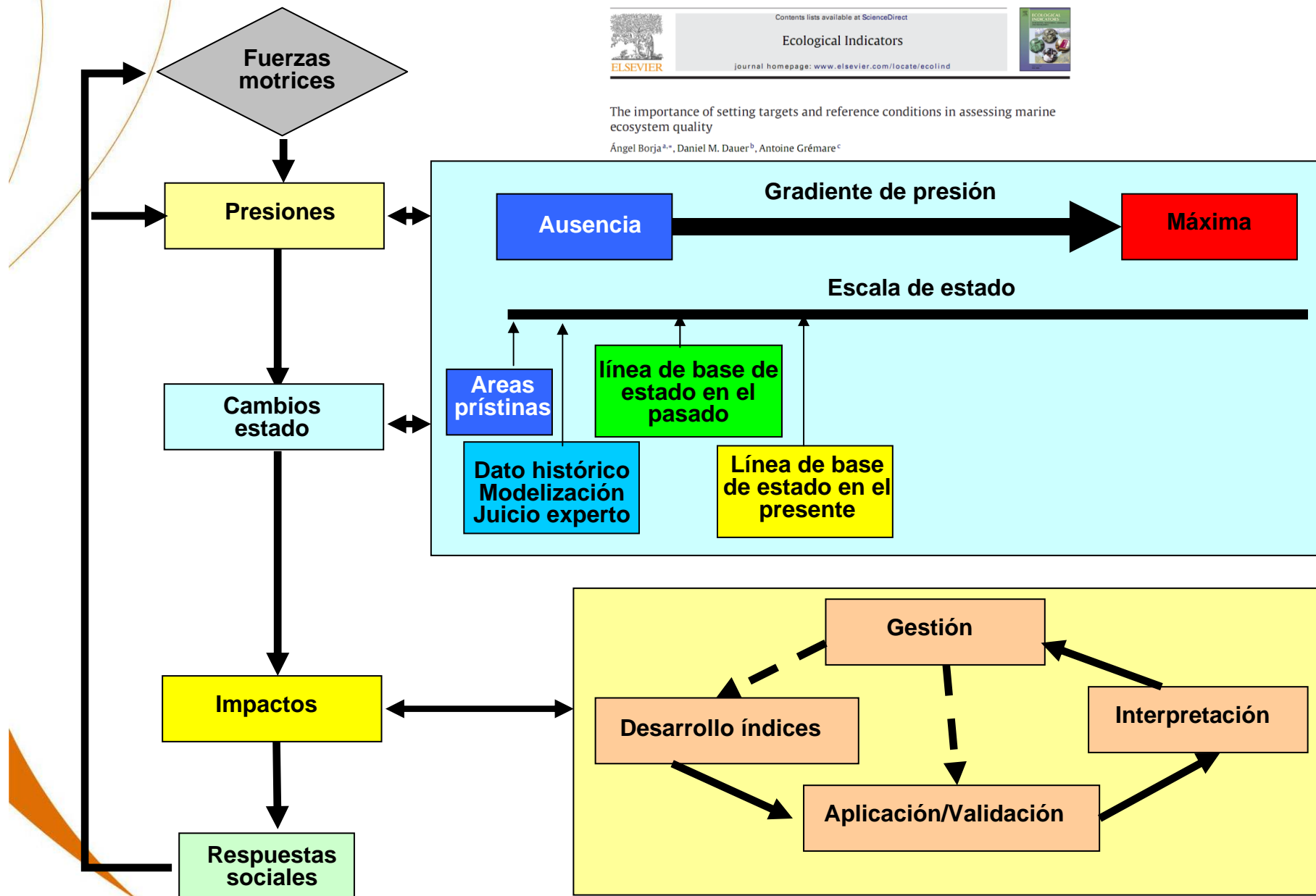
Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

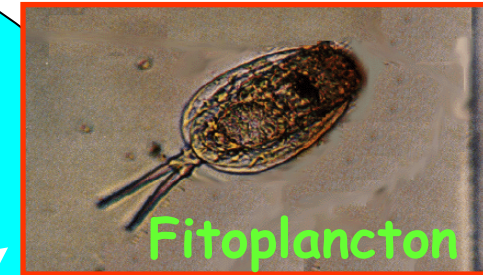


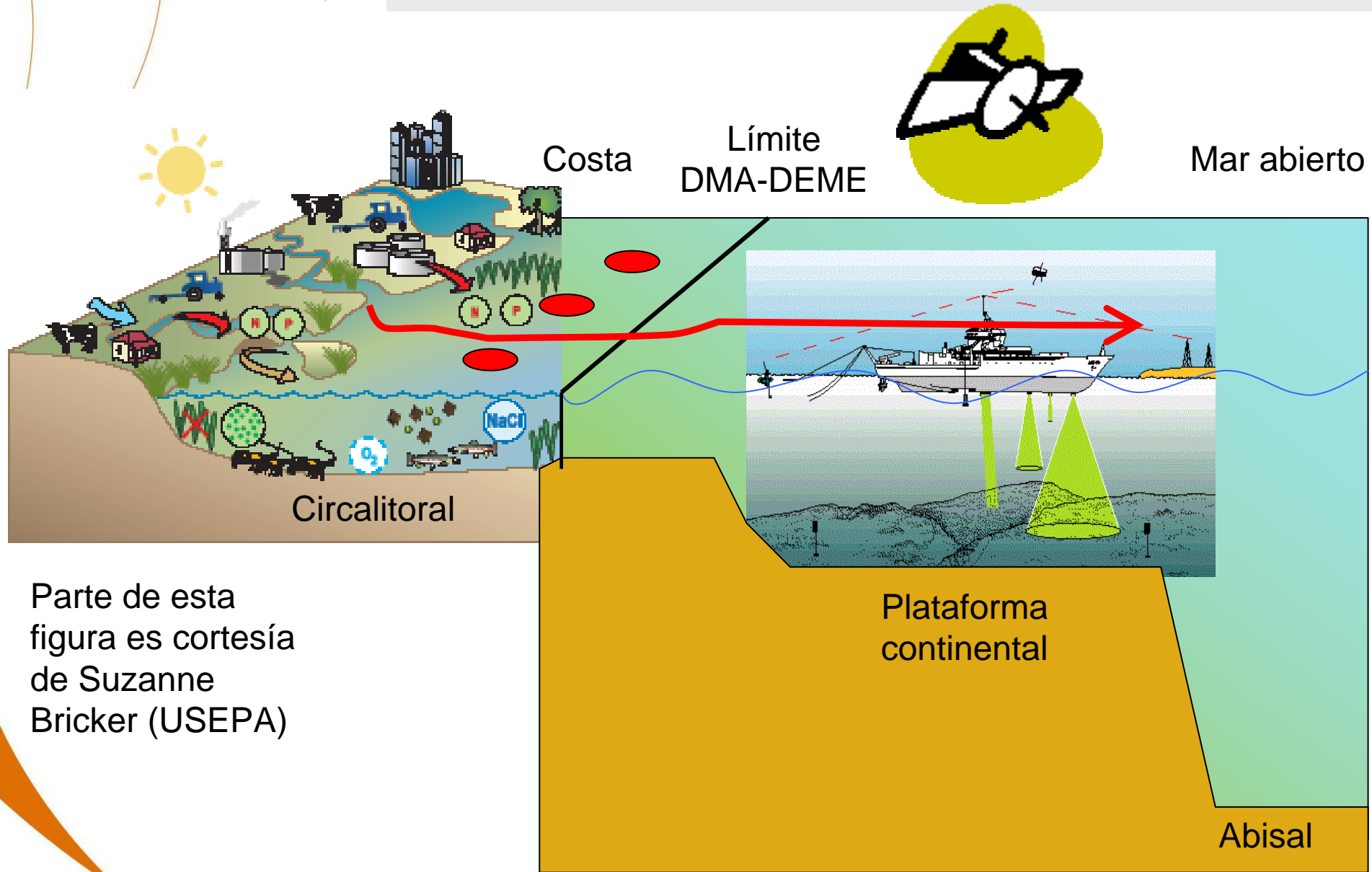
The importance of setting targets and reference conditions in assessing marine ecosystem quality

Ángel Borja^{a,*}, Daniel M. Dauer^b, Antoine Grémare^c



El estudio del medio marino





Parte de esta
figura es cortesía
de Suzanne
Bricker (USEPA)


El estudio del medio marino: DMA y bentos

$$\text{AMBI} = \{(0 \times \%GI) + (1.5 \times \%GII) + (3 \times \%GIII) + (4.5 \times \%GIV) + (6 \times \%GV)\}/100$$

<http://ambi.azti.es>

BIOTIC COEFFICIENT

0 1 2 3 4 5 6



Pergamon

Marine Pollution Bulletin Vol. 40, No. 12, pp. 1100–1114, 2000
 © 2000 Elsevier Science Ltd. All rights reserved
 Printed in Great Britain
 0025-326X/00 \$ - see front matter

PII: S0025-326X(00)00061-8

A Marine Biotic Index to Establish the Ecological Quality of Soft-Bottom Benthos Within European Estuarine and Coastal Environments

POLI A. BORJA*, J. FRANCO and V. PÉREZ

WFD

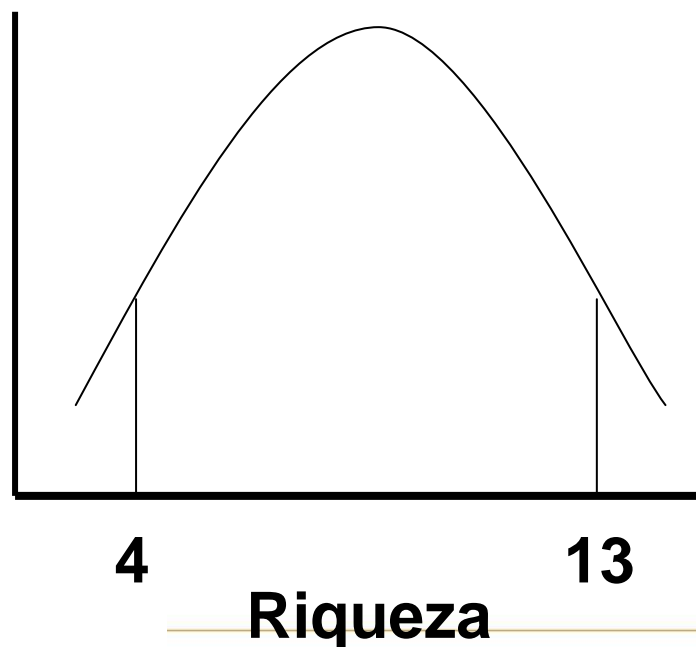
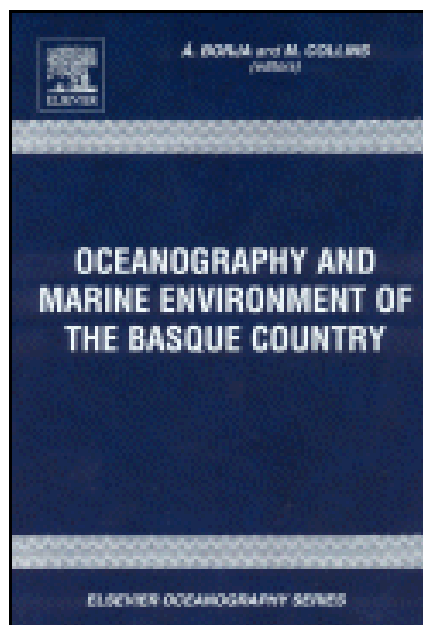
HIGH STATUS	GOOD STATUS	MODERATE STATUS	POOR STATUS	BAD STATUS
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INCREASING POLLUTION →

Condiciones de Referencia

Stretches	Type I	Type II	Type III	Type IV
Oligo/Mesohaline	C. edule-S. plana	C. edule-S. plana	C. edule-S. plana	-
Polyhaline	-	V. fasciata/P. arenarius	V. fasciata	-
Euhaline	-	A. alba/P. arenarius	A. alba	T. tenuis-V. fasciata

- Se usa diversidad, riqueza y AMBI en la determinación de la calidad biológica = M-AMBI.



El estudio del medio marino: DMA y bentos

Condiciones de Referencia

Oligo/
Polyha
Euhali



Available online at www.sciencedirect.com



Marine Pollution Bulletin 55 (2007) 16–29

MARINE
POLLUTION
BULLETIN

www.elsevier.com/locate/marpolbul

Using historical data, expert judgement and multivariate analysis in assessing reference conditions and benthic ecological status, according to the European Water Framework Directive

M

Ir	Iñigo Muxika *, Ángel Borja *, Juan Bald					ata
Richr						
Diversity (bit.ind ⁻¹)	2.5	3.8	2	3.5	4	
AMBI	2.8	2	1	2.1	1	

Mal estado: todos 0, excepto AMBI= 6

El estudio del medio marino: DMA y bentos

Factor 2

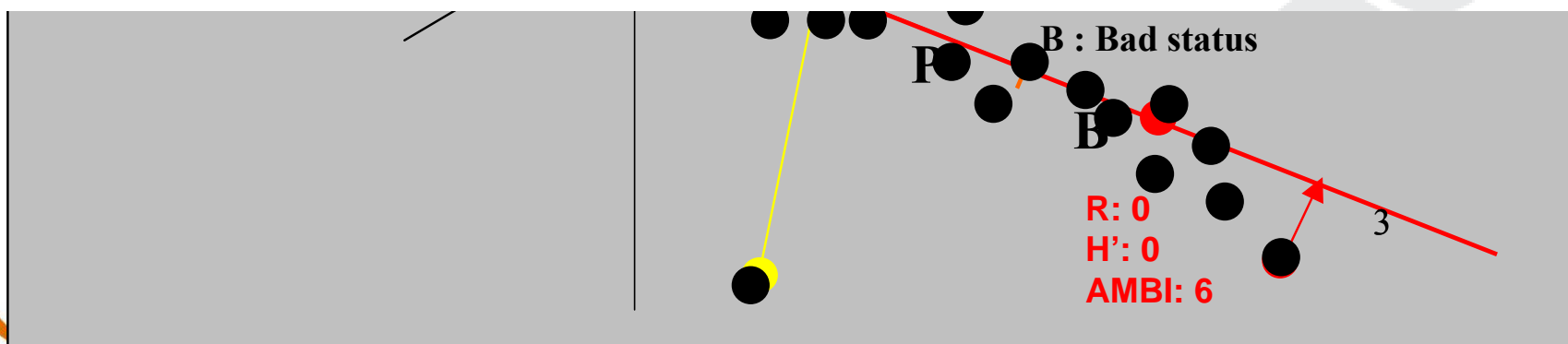
**Ecological Quality Ratio (EQR):
entre 0 y 1. Dependiendo de los
límites entre clases se determina**

Marine Ecology. ISSN 0173-9565

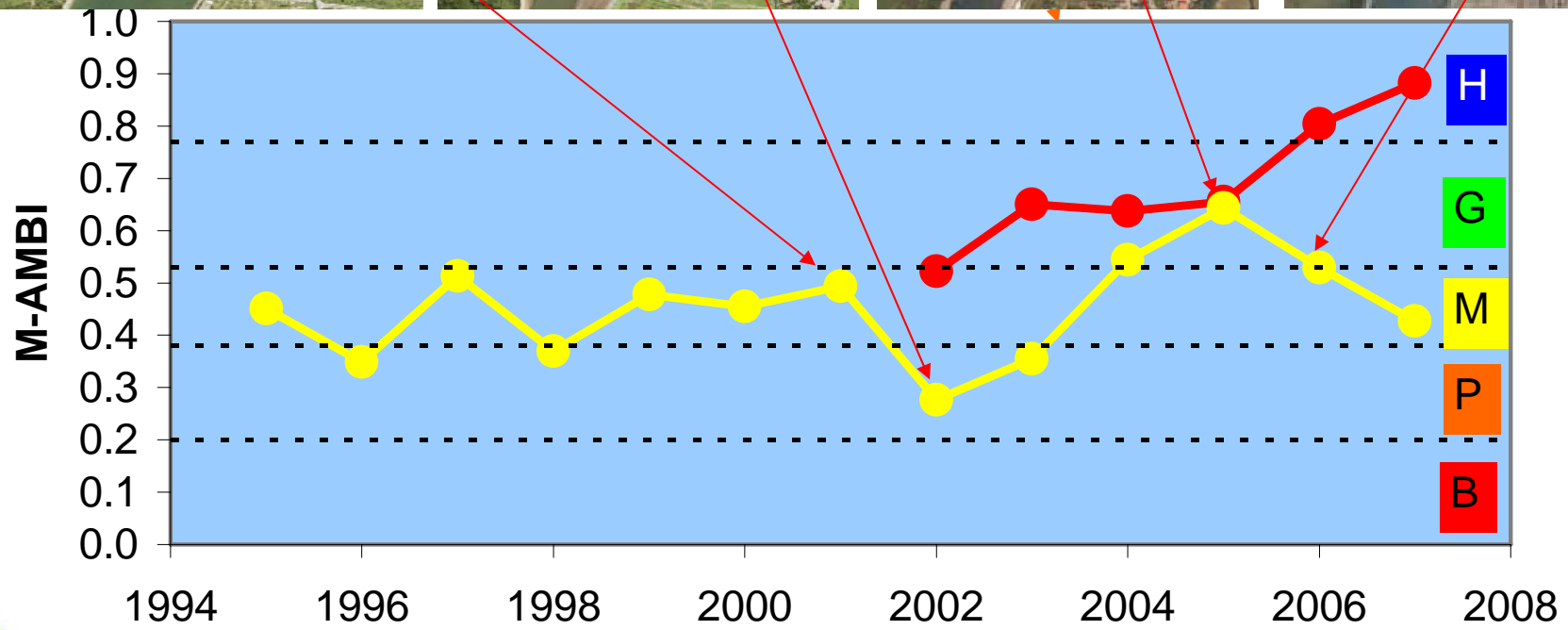
ORIGINAL ARTICLE

Paradigmatic responses of marine benthic communities to different anthropogenic pressures, using M-AMBI, within the European Water Framework Directive

Angel Borja, Iñigo Muxika & J. Germán Rodríguez

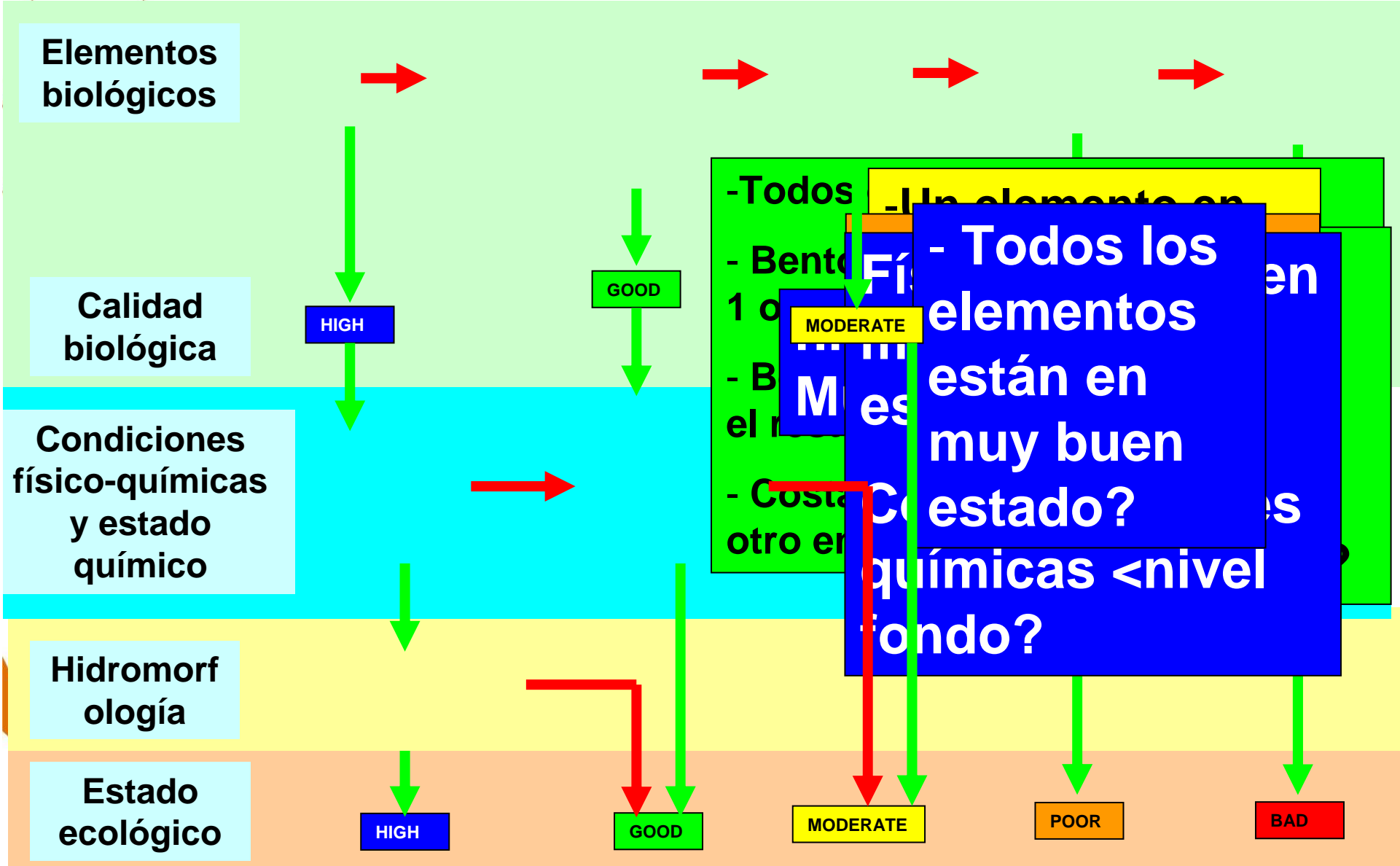


El estudio del medio marino:

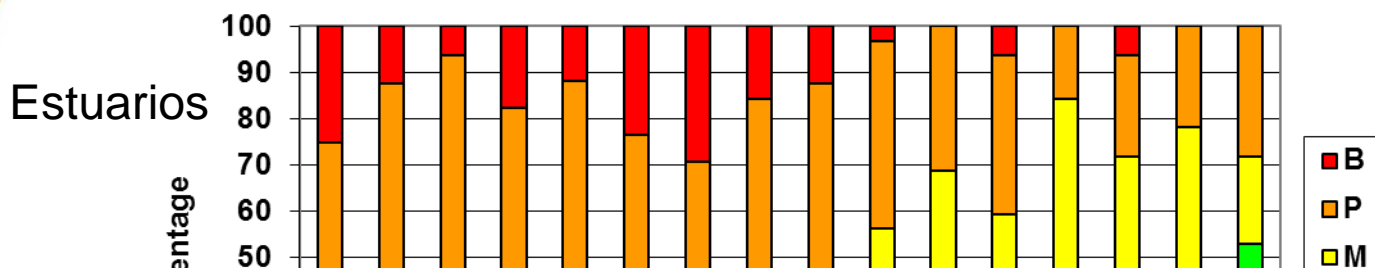


—●— E-O5 —●— E-O10

El estudio del medio marino: DMA e integración



El estudio del medio marino: DMA e integración



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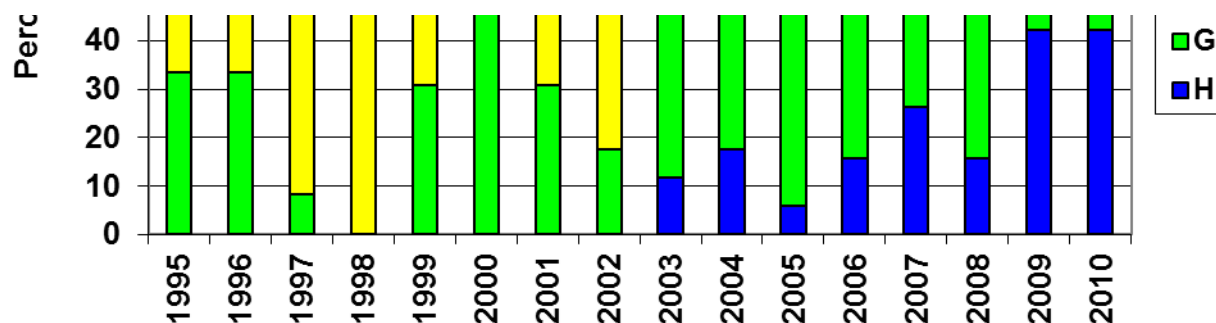
Marine Pollution Bulletin

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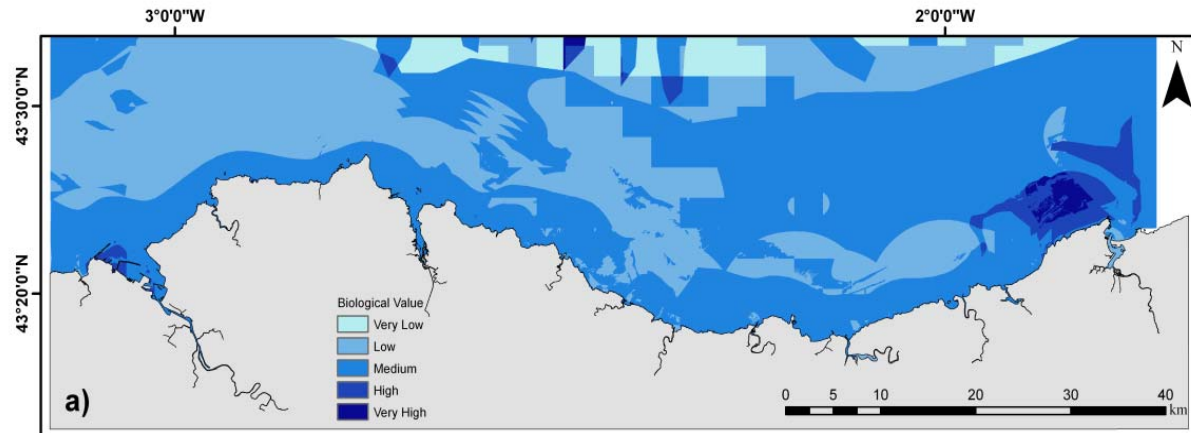
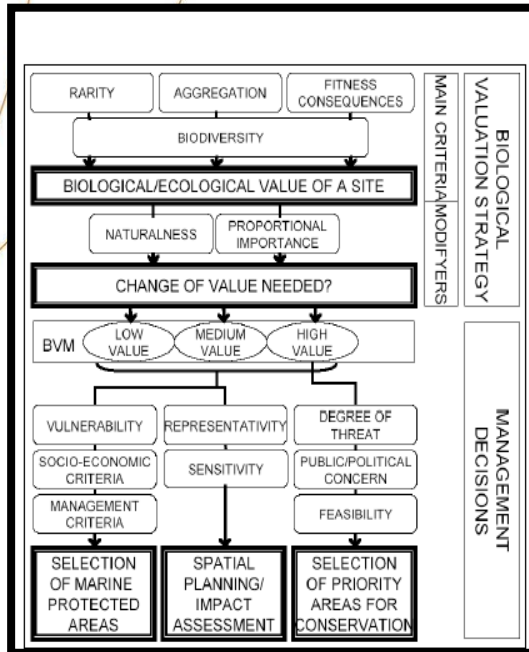


Using multiple ecosystem components, in assessing ecological status
in Spanish (Basque Country) Atlantic marine waters

Angel Borja *, Juan Bald, Javier Franco, Joana Larreta, Iñigo Muxika, Marta Revilla, J. Germán Rodríguez, Oihana Solaun, Ainhize Uriarte, Victoriano Valencia



Mari Final Biological Valuation Map onent



Contents lists available at SciVerse ScienceDirect

Estuarine, Coastal and Shelf Science

journal homepage: www.elsevier.com/locate/ecss



Marine biological valuation mapping of the Basque continental shelf (Bay of Biscay), within the context of marine spatial planning

Marta Pascual^{a,*}, Angel Borja^{a,*}, Sarah Vanden Eede^b, Klaas Deneudt^c, Magda Vincx^b, Ibon Galparsoro^a, Irati Legorburu^a

Table 5

Indicators used in the assessment of qualitative descriptor 3 (exploited fish), as described in Table 2, for 12 stocks within the southern part of the Bay of Biscay. Key: F: fishing mortality; SSB: spawning stock biomass; MSY: maximum sustainable yield; Fpa: fishing mortality for the precautionary approach; Bpa: biomass for the precautionary approach; ND: not determined; M&F: males and females; HR: high recruitment; LR: low recruitment

		<i>Engraulis encrasicolus</i>	<i>Lophius budegassa</i>	<i>Lophius pliscatorius</i>	<i>Lepidorhombus boschii</i>	<i>Lepidorhombus whiffiagonis</i>	<i>Merluccius merluccius</i>	<i>Sardina pilchardus</i>	<i>Trachurus trachurus</i>	<i>Scomber scombrus</i>	<i>Micromesistius pouassou</i>	<i>Thunnus alalunga</i>	<i>Thunnus thynnus</i>
Fishing mortality (F) (primary indicator) for all species, except for <i>E. encrasicolus</i> , which is Catch/biomass ratio (secondary indicators)	2005	0.068	0.554	0.601	0.281	0.214	0.690	0.194	0.066	0.285	0.478	0.159	0.342
	2006	0.065	0.598	0.543	0.331	0.343	0.780	0.170	0.046	0.234	0.411	0.166	0.297
	2007	0.004	0.603	0.442	0.248	0.265	0.810	0.184	0.050	0.263	0.436	0.131	0.345
	2008	-	0.352	0.424	0.226	0.206	0.750	0.267	0.065	0.236	0.476	0.129	0.311
	2009	-	0.198	0.380	0.272	0.098	0.740	0.266	0.087	0.233	0.399	0.129	0.208
	Reference F	Undefined	Fmsy = 0.44	Fmsy = 0.26	Fmsy = 0.18	Fmsy = 0.17	Fmsy = 0.26; Fpa = 0.4	Undefined	Undefined	Fmsy = 0.22; Fpa = 0.23	Fmsy = 0.18; Fpa = 0.32	Fmsy (2007) = 0.442	Fmsy = 0.09 (HR) Fmsy = 0.15 (LR)
	>F reference		3	5	5	4	5			5	5	0	5
<F reference		2	0	0	1	0			0	0	5	0	
Spawning stock biomass (SSB) (primary indicator)	2005	17110	1492	6523	4316	848	11100	369000	2356290	2290881	6210258	169151	36092
	2006	27190	1779	5707	4896	861	12700	586000	2251270	2409602	5932354	173444	39079
	2007	37080	2066	5164	5020	756	15200	566000	1955010	2540759	4631475	188885	39006
	2008	27235	2296	5436	5326	728	16000	420000	2095550	2709395	3255375	200863	34571
	2009	22000	3157	5707	4716	728	20100	316000	2276680	2978321	2097420	200806	33399
	Reference SSB	MSY & Bpa = 33000 t	MSY & Bpa = ND	MSY & Bpa = ND	MSY & Bpa = ND	MSY & Bpa = ND	MSY & Bpa = ND	MSY & Bpa = ND	MSY & Bpa = ND	MSY = 2.2 t, Bpa = 2.3 t	MSY = 2.25 t, Bpa = 2.25 t		
>SSB reference	1	-	-	-	-	-	-	-	5	4			
<SSB reference	4	-	-	-	-	-	-	-	0	1			
Proportion of fish larger than the mean size of first sexual maturation (primary indicator)	2005	100%	57%	61%	100%	32%	8%		42%	77%	100%		
	2006	100%	20%	44%	100%	40%	9%		44%	65%	-		
	2007	Fishery is closed	17%	55%	100%	44%	18%		62%	73%	100%		
	2008	Fishery is closed	75%	61%	100%	43%	19%		37%	74%	100%		
	2009	Fishery is closed	62%	57%	100%	55%	29%		34%	88%	93%		
Size at first sexual maturation (secondary indicator)		9.2 cm (range 4–12.5 cm)	M&F: 44.7 cm	M&F: 61.84 cm	17 cm	26.6 cm	M&F: 43.68 cm	14.8 cm	23.9 cm	28.6 cm	15 cm	85 cm	97–110 cm

Methods to evaluate the status of phytoplankton in coastal and estuarine water bodies (modified from Borja et al., 2012).

Method	Area using method	Biomass				Community composition	Abundance	Indicators in Overall Eutrophication Index	
		Chl a thresholds and ranges	Sample	Statistical measure	Other				

Table 6

Physico-chemical and phytoplankton variables used to assess the ecological status, within the Water Framework Directive (for methods, see Bald et al., 2005; Revilla et al., 2009), within the offshore waters of the Basque Country. The period studied extends from 2004 to 2009 at L-RF10; and from 2006 to 2009 at L-RF20 and L-RF30 (for locations, see Fig. 1). Notes: NTU: nefelometric turbidity unit.

Physico-chemical variables	L-RF10			L-RF20			L-RF30		
	Average	Std. Dev.	n	Average	Std. Dev.	n	Average	Std. Dev.	n
Salinity	34.93	0.92	24	35.20	0.31	16	35.24	0.26	16
Suspended solids (mg l ⁻¹)	4.70	4.19	24	5.66	3.30	16	5.99	3.66	16
Turbidity (NTU)	0.49	0.46	24	0.43	0.48	16	0.34	0.17	16
Oxygen saturation (%)	102.88	4.48	24	102.63	4.24	16	103.81	6.86	16
Ammonia (μmol l ⁻¹)	3.56	2.79	24	3.30	2.35	16	2.64	1.46	16
Nitrate (μmol l ⁻¹)	3.28	3.68	24	2.23	1.62	16	2.41	1.83	16
Phosphate (μmol l ⁻¹)	0.25	0.14	24	0.23	0.13	16	0.22	0.10	16
Phytoplankton	WFD-metrics	Status	n	WFD-metrics	Status	n	WFD-metrics	Status	n
Chlorophyll a (μg l ⁻¹)	1.2	High	24	1.1	High	16	0.7	High	16
Bloom frequency %	9	High	11	0	High	8	0	High	8
	Average	Minimum–maximum	n	Average	Minimum–maximum	n	Average	Minimum–maximum	n
Diatoms (10 ⁵ cells l ⁻¹)	0.4	0.0–3.4	21	0.8	0.0–3.7	14	0.5	0.0–2.4	13
Dinoflagellates (10 ⁵ cells l ⁻¹)	0.6	0.0–4.8	21	0.4	0.1–1.5	14	0.2	0.1–0.3	13
Others (10 ⁵ cells l ⁻¹)	2.6	0.0–12.4	21	2.3	0.4–5.6	14	2.2	0.6–5.9	13

Ulrich Claussen ⁿ

IFREMER ¹ (lagoons)	France	> 30 Red; 10-30 Orange; 7-10 Yellow; 5-7 Green; 0-5 Blue	annual	mean annual Chl concentration	frequency and duration	phytoplankton abundance of <2 μm, >2 μm	X	DO, nutrients, algal toxins Chl a, phytoplankton counts (<2, >2 μm), macrophytes (biomass, diversity), macrobenthos (richness, diversity), water (DO, Chl, Chl/phaeo, turbidity, SRP, TP, TN, NO ₂ , NO ₃ , NH ₄), sediment (OM, TN, TP)
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Sea

Baltic

Viewpoint

The use of benthic indicators in Europe: From the Water Framework Directive to the Marine Strategy Framework Directive

Gert Van Hoey^{a,*}, Angel Borja^b, Silvana Birchenough^c, Lene Buhl-Mortensen^h, Steven Degraer^d, Dirk Fleischer^e, Francis Kerckhof^d, Paolo Magni^{f,g}, Iñigo Muxika^b, Henning Reissⁱ, Alexander Schröder^j, Michael L. Zettler^k

Ecological Indicators 12 (2012) 174–184

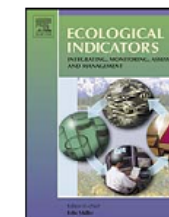


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Mediterra

Indicators for Sea-floor Integrity under the European Marine Strategy Framework Directive

Jake Rice^{a,*}, Christos Arvanitidis^b, Angel Borja^c, Chris Frid^d, Jan G. Hiddink^e, Jochen Krause^f, Pascal Lorange^g, Stefán Áki Ragnarsson^h, Mattias Sköldⁱ, Benedetta Trabucco^j, Lisette Enserink^k, Alf Norkko^l

Black Sea

El estudio del medio marino: DEME e integración

Ecosystem component	Main pressures	Relation to Qualitative Descriptors
Water & sediment chemical quality	Nutrient & oxygen levels Priority substances	Discharges, eutrofication Discharges
Plankton species	Phytoplankton Zooplankton	Discharges, eutrofication
Mobile species	Fish Sea mammals Seabirds	Removal of target species Pollutants, Plastics & Debris Pollutants, Plastics & Debris
Seafloor species	Benthic species	
	Invertebrates	Discharges, habitat loss
	Macroalgae	Discharges, removal of target species
	Angiosperms	Discharges, habitat loss
	Habitats	
	Rock & biogenic reefs	Habitat damage
Coastal sediments (0-50 m)	Habitat loss	
Shelf sediments (50-200 m)	Habitat damage, Removal of target species	
Deep-sea (>200 m)	Habitat damage	

Marine Pollution Bulletin 60 (2010) 2175–2186



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Viewpoint

Marine management – Towards an integrated implementation of the European Marine Strategy Framework and the Water Framework Directives

Ángel Borja^{a,*}, Mike Elliott^b, Jacob Carstensen^c, Anna-Stiina Heiskanen^d, Wouter van de Bund^e

El estudio del medio marino: DEME e integración

Qualitative Descriptors	Explanation of the indicators used	Reference conditions/EQS	Recent trend	Reliability (%)	Weight (%)	EQR	Final Environmental Status	Final Confidence ratio
1.- Biological diversity	integrated biological value		NA	69	15	0.51	0.08	10.35
2.- Non-indigenous species	ratio non-indigenous sp.	OSPAR	▲	80	10	0.98	0.10	8
3.- Exploited fish and shellfish			▼	100	15	0.48	0.07	15
	fishing mortality <reference			100		0.18		
	Spawning stock <reference			100		0.67		
	% large fish			100		0.59		
4.- Marine food webs			▼	70	10	0.40	0.04	7
5.- Human-induced eutrophication		WFD	▼	94	10	0.96	0.10	9.4
	Nutrients in good status			100		0.80		
	Chlorophyll in high status			100		1.00		
	Optical properties in high status			100		1.00		
	Bloom frequency in high status			70		1.00		
	Oxygen in high status			100		1.00		
6.- Seafloor integrity		WFD	▶	100	10	0.89	0.09	10
	Area not affected			100		0.87		
	% presence sensitive sp.			100		0.98		
	Mean M-AMBI value			100		0.83		
7.- Alteration of hydrographical conditions			▶	100	2	1.00	0.02	2
8.- Concentrations of contaminants	High % of samples <EQS	WFD	▼	100	9	0.80	0.07	9
	Values are 30% of the most affected in the NEA	WFD	▼	30	9	0.60	0.05	2.7
9.- Contaminants in fish and other seafood	Values are 50% of the most affected in Europe	OSPAR	▲	30	5	0.57	0.03	1.5
10.- Marine litter	Moderate ship activity	OSPAR	NA	10	5	0.70	0.04	0.5
11.- Energy & underwater noise								
Final assessment						100	0.68 Good	75.5 High

Conclusiones

- Las crecientes presiones humanas e impactos en el medio marino requieren **desarrollar acciones para reducir las**
- Se necesita una **información científica adecuada y unos métodos de evaluación** para determinar las respuestas bióticas a dichas presiones
- **Los programas de monitoreo** deben diseñarse de manera adecuada para obtener esta información
- Tenemos ya **herramientas para evaluar el estado** en la **DMA** y los **convenios internacionales**
- Estos **procesos de evaluación** deben ser lo más científicos, **simples y pragmáticos posible**
- Se debe usar **un importante apoyo científico**, en el proceso de evaluar el estado, para tener **una mejor gestión** de los ecosistemas marinos



Gracias por su atención!