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Integrating sediments in the European Water Framework Directive

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Introduction

- 2000, Publication of the Water Framework Directive to assess the Ecological Status of European transitional and coastal waters.
- Terminologies, concepts, tools… have been developed.
- Mostly waters (for the physico-chemical status).
- Role of sediments in the ecosystems.
- Debate on integrating or not integrate sediments.
- We propose a methodology to include sediments in the integrative assessment of the Ecological Status of the marine environment.

Objective

- To develop a methodology that considers sediments, waters and biota in an integrative approach for the assessment of the physico-chemical and ecological status of the marine system.

The steps within the WFD

- Water bodies are classified into several categories (rivers, lakes, transitional, etc.)
- For each of the categories some typologies should be determined (following Systems A and B)
- Reference conditions
- Identification of pressures and impacts
- Environmental monitoring
- Ecological Quality Ratio derivation
- Ecological Status assessment
- Intercalibration

Determining typologies

- **Salinity (System A):**
- **Tide Range (System A)**
- **Wave Exposition (System B)**
- **Water depth (System B)**
- **Mixing (System B)**
- **Intertidal Proportion (System B)**
- **Residence Time (System B)**
- **Substrate (System B)**
- **Current Velocity (System B)**

4 typologies have been defined for the water masses along the Basque Coast (3 for transitional waters and 1 for coastal waters).

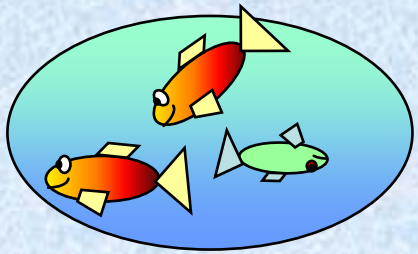
18 water masses have been distinguished along the Basque Coast: 14 estuarine and 4 littoral type.

Determining reference conditions

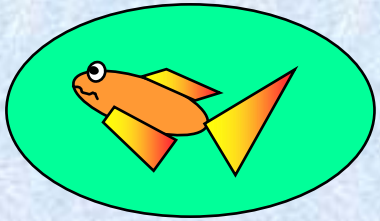
Reference Variation

Ecological Status

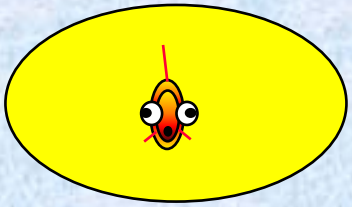
None or small



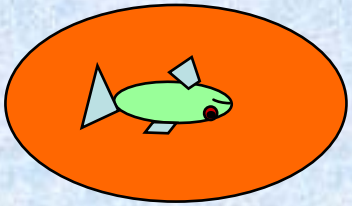
Slight



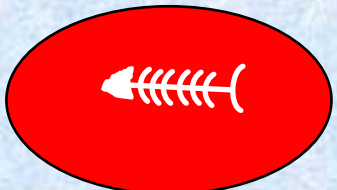
Moderate



Important



Strong



High

Good

Moderate

Poor

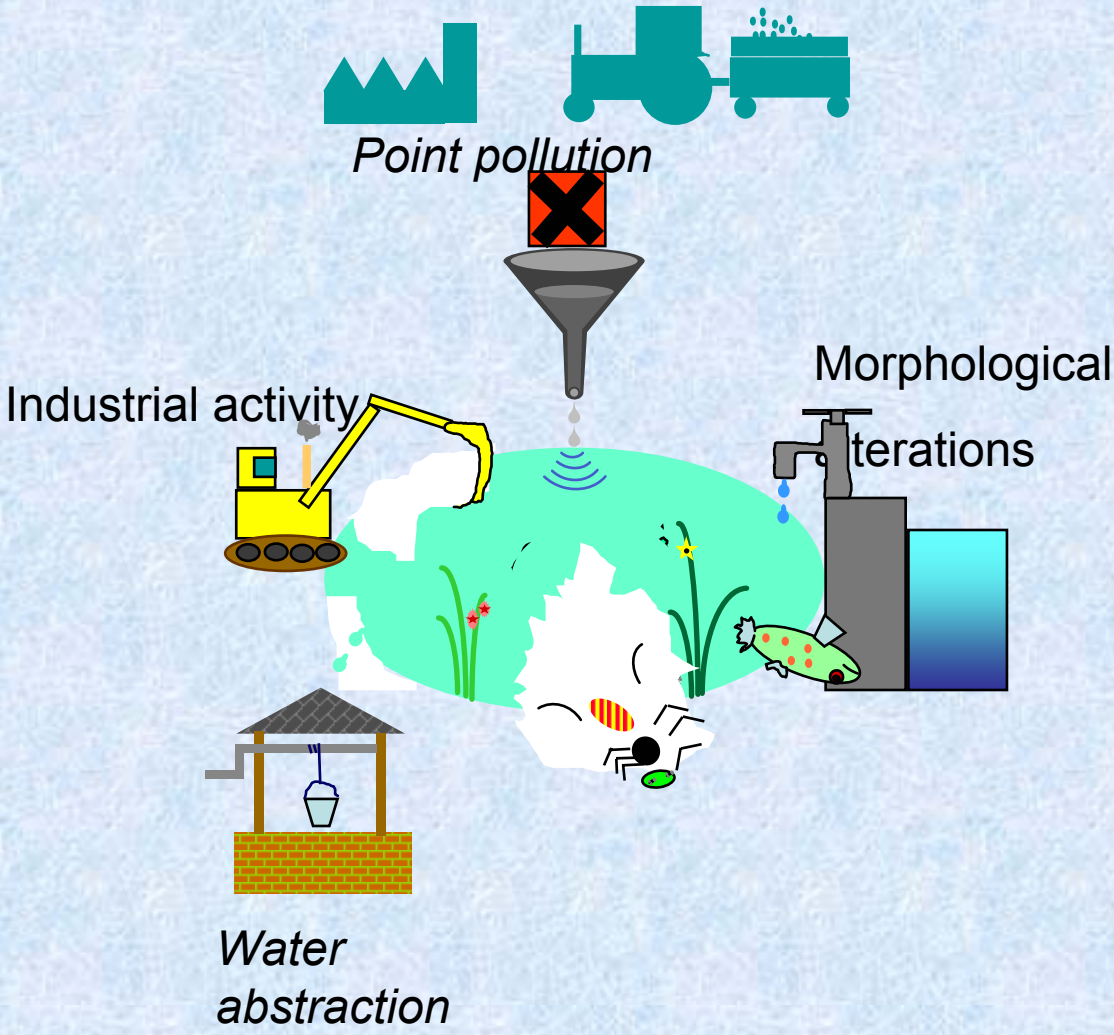
Bad

Prevent degradation

Restore

Pressures in transitional and coastal waters

- Nutrients (diffuse and point sources)
- Organic enrichment
- Hazardous Substances (diffuse and point sources)
- Water abstraction
- Morphological alterations (linear, surface)
- Commercial fishing
- Industrial water use
- Aquaculture
- Alien species
- etc



Pressures in transitional and coastal waters (the most significant by water body)

MASA	Aguas	Sedimentos	Agua	Sedimentos		Pérdida	Amarres	Especies alóctonas
Barbadun							No hay	No hay
Nerbioi							Alta	Alta
Butroi							Moderada	No hay
Oka							Moderada	Baja
Lea							Baja	No hay
Artibai							Moderada	No hay
Deba							Baja	Baja
Urola							Alta	No hay
Oria							Baja	No hay
Urumea							No hay	No hay
Oiartzun							Alta	Alta
Bidasoa							Alta	Moderada
Cantabria-M							No hay	Baja
Matxitxako-							Alta	Baja
Getaria-Frar							Alta	Baja

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Estuarine, Coastal and Shelf Science 66 (2006) 84–96
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The European Water Framework Directive and the DPSIR, a methodological approach to assess the risk of failing to achieve good ecological status

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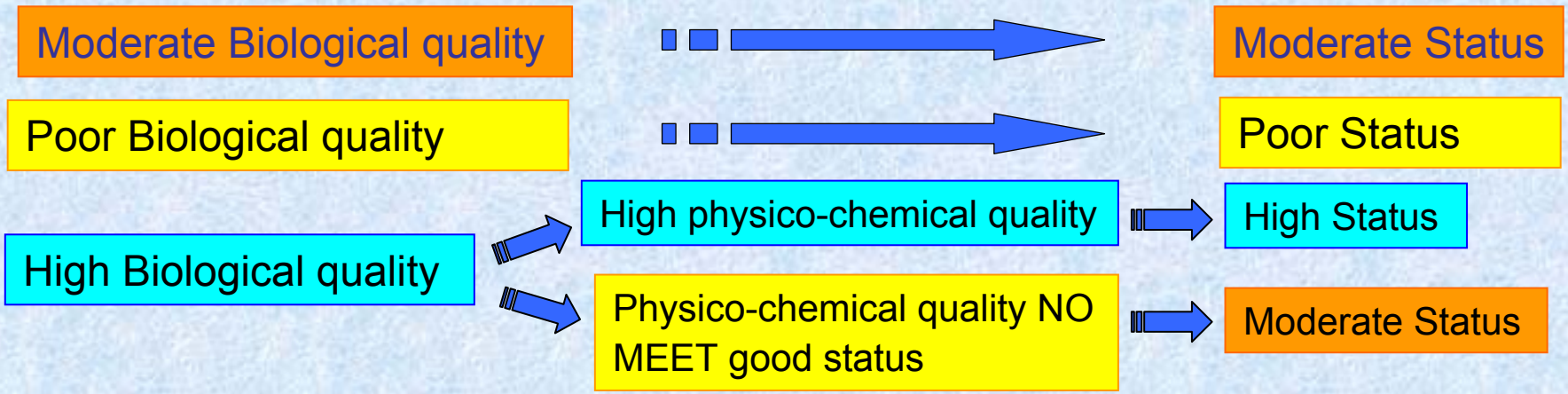
Environmental monitoring in the Basque Country (sampling stations)

- **Sampling period 1995-2005**
- **18 water bodies**
- **Estuaries: 32 sampling stations**

Environmental monitoring in the Basque Country (elements)

Assessing the ecological status

- Following the scheme proposed by the WFD, the assessment of the ecological status integrates:
  - **Physico-chemistry** quality in waters: typologies, impacts, chemistry.
  - **Biological elements**: phytoplankton, fishes, benthos, and macroalgae.



Our proposal: summary

- To assess the chemical status integrating contaminants in waters, sediments and biota: a decision-tree is used to assess the meet / do not meet chemical quality.
- We have used quality objective levels for metals and organic compounds published in European and Spanish legislations for waters, sediments and biota.
- Since the publication of the new Directive on 2006, new quality objectives for waters will be used.
- We have developed Quality Objective levels for sediments: background levels define the high chemical status.

Chemical status (water, sediment, biota)

VARIABLE	QUALITY OBJECTIVES	LEGISLATION
Cadmium	1	83/513/CEE
Copper	5	R.D. 995/2000
Nickel	50	R.D. 995/2000
Lead	50	R.D. 995/2000
Zinc	30	R.D. 995/2000
Chromium (hexavalent)	50	R.D. 995/2000
Chromium (trivalent)	50	R.D. 995/2000
Arsenic	50	R.D. 995/2000
Selenium	1	R.D. 995/2000
Mercury	1	80/778/CEE
Cyanide	40	R.D. 995/2000
PCBs	0,03	EPA (2002)
DDTs	25	86/280/CEE
Hexachlorociclohexane	0,02	84/491/CEE
Pentachlorofenol	2	86/280/CEE
Aldrin	0,01	86/280/CEE
Dieldrin	0,01	86/280/CEE
Endrin, Isodrin	0,005	86/280/CEE
Trichloromethane	12	86/280/CEE
1,2-Dichloroethane	10	86/280/CEE
Tetrachloroetilene	10	86/280/CEE
Tetrachloromethane	12	86/280/CEE
Trichloroetilene	10	86/280/CEE
1,1,1-Trichloroethane	100	R.D. 995/2000
Hexachlorobutadiene	0,01	86/280/CEE

WATER

SEDIMENT

VARIABLE	LIMIT
Cadmium	9.6 mg/kg
Copper	270 mg/kg
Nickel	52 mg/kg
Lead	220 mg/kg
Zinc	410 mg/kg
Chromium	370 mg/kg
Arsenic	70 mg/kg
Mercury	0.71 mg/kg
PAHs	45000 µg/kg
PCBs	180 µg/kg
DDTs	46 µg/kg
DDE	27 µg/kg
Aldrin, Dieldrin	5 µg/kg

BIOTA

Variable	Units	Limit	
Cd	(mg kg^{-1} PF)	1	Orden 2-8-91 (BOE 195)
Cu	(mg kg^{-1} PF)	20 (60)	Orden 2-8-91 (BOE 195
Ni	(mg kg^{-1} PF)	1,5	ICES
Pb	(mg kg^{-1} PF)	5	Orden 2-8-91 (BOE 195
Zn	(mg kg^{-1} PF)	1000	Orden 2-8-91 (BOE 195
Hg	(mg kg^{-1} PF)	0.5	Orden 2-8-91 (BOE 195
As	(mg kg^{-1} PF)	4	Orden 2-8-91 (BOE 195
Cr	(mg kg^{-1} PF)	1.8	Orden 2-8-91 (BOE 195
ΣPAHs	(µg kg^{-1} PF)	200	AESA, XUGA
ΣPCBs	(µg kg^{-1} PF)	2000	Nauen, 1983
ΣDDTs	(µg kg^{-1} PF)	2000	Nauen, 1983
HCB	(µg kg^{-1} PF)	200	Nauen, 1983
δ-HCH	(µg kg^{-1} PF)	200	Nauen, 1983

(annual mean, or selected period, over or under limits)

Chemical status (integration)

WATER	SEDIMENT	BIOMONITORS	ASSESSMENT
All variables meet	All variables meet		Meet Chemical Status
	1 variable not meet		
	>=2 not meet		Not Meet Chemical Status
1 variable not meet	All variables meet		Meet Chemical Status
	1 variable not meet	All variables meet	
		No data	
		>=1 not meet	Not Meet Chemical Status
	>=2 not meet		
>=2 not meet			

	AGUAS				SEDIMENTOS							
ESTACIONES	PCB	Cadmio	Selenio	Zinc	DDT	Aldrín	Dieldrín	Mercurio	Níquel	Plomo	Zinc	Valoración
E-M5	0.018	0.35	1.00	37.6	3.75	0.30	0.34	0.26	27.10	49.28	243.52	Cumple
E-M10	0.017	0.55	1.00	20.6	7.73	0.30	0.30	0.14	29.71	57.68	242.99	Cumple
E-N10	0.020	0.36	1.00	15.5	3.18	0.51	0.30	0.21	63.65	96.62	267.81	Cumple
E-N15	0.028	0.74	3.05	28.0	4.56	1.01	0.72	1.74	36.86	144.85	441.68	No cumple
E-N17	0.043	2.43	1.30	30.6	205.65	6.34	32.34	2.11	35.13	232.93	567.38	No cumple
E-N20	0.024	0.73	1.00	15.3	3.02	0.30	0.39	2.17	31.92	182.39	499.85	No cumple
E-N30	0.017	1.10	1.00	12.9	3.03	0.30	0.30	0.78	30.17	57.06	238.63	Cumple
L-N10	0.292	0.30	1.00	7.8	3.40	0.30	0.64	0.27	12.97	36.10	85.88	Cumple
L-N20	0.017	9.03	1.00	14.5	3.05	0.30	0.30	0.58	43.53	123.96	518.92	Cumple
E-B5	0.020	0.69	1.00	26.9	3.51	0.30	0.30	0.36	22.59	33.19	146.48	Cumple
E-B7	0.016	1.58	1.00	25.3	3.00	0.30	0.30	0.41	24.86	37.91	141.15	Cumple
E-B10	0.018	0.90	1.00	12.5	3.00	0.30	0.30	0.21	17.68	51.14	112.37	Cumple
L-B10	0.018	0.28	1.00	10.0	3.00	0.30	0.30	0.68	17.57	44.67	199.02	Cumple
L-B15	0.020	0.43		8.8								Cumple

Quality objective levels for sediments

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Science of the Total Environment

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Maximum likelihood mixture estimation to determine metal background values in estuarine and coastal sediments within the European Water Framework Directive

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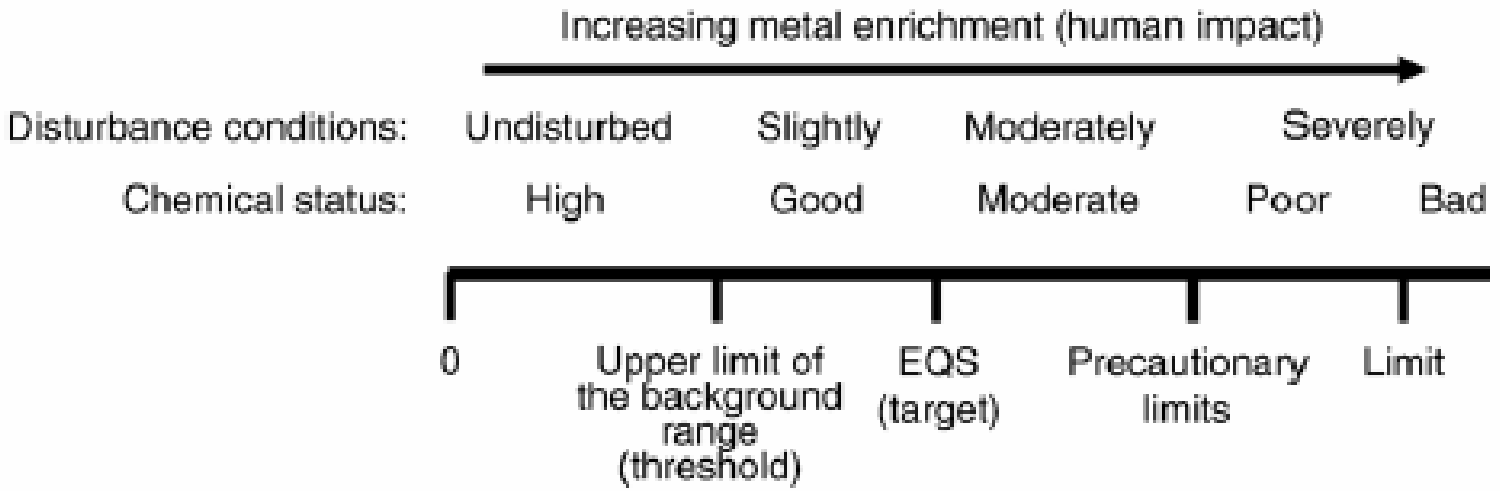

Assessing the ecological status

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Viewpoint

Implementation of the European water framework directive from the Basque country (northern Spain): a methodological approach

Ángel Borja *, Javier Franco, Victoriano Valencia, Juan Bald, Iñigo Muxika, María Jesús Belzunce, Oihana Solaun

Assessing the ecological status

	BIOLOGICAL ELEMENTS				BIOLOGICAL STATUS	Physico-chemical elements	CHEMISTRY		Morphological elements	ECOLOGICAL STATUS	WATER BODY ECOLOGICAL STATUS
	Phytopl.	Macroalg.	Benthos	Fishes			>DL	>QO			
E-M5	M	P	M	M	P	H	Yes	No	H	P	
E-M10	G	P	M	G	P	H	Yes	No	H	P	Poor
E-N10	G	P	M	P	P	H	Yes	No	P	P	
E-N15	M	P	M	G	P	G	Yes	Yes	P	P	Poor
E-N17	M	P	H	G	M	H	Yes	Yes	P	M	
E-N20	M	M	H	G	G	H	Yes	Yes	P	M	
E-N30	M	M	G	H	G	H	Yes	No	P	G	Good
E-B5	H	G	G	M	G	H	Yes	No	H	G	
E-B7	H	G	G	G	G	H	Yes	No	H	G	Good
E-B10	H	M	G	G	G	H	Yes	No	G	G	

Without impact

Significant impact

HIGH | GOOD | MODERATE | POOR | BAD

Conclusions

- **There are suitable (appropriate) tools for the assessment of the ecological status.**
- **The results obtained from the integral analysis are consistent with the knowledge and experience we have from our systems.**
- **The principle 'one out, all out' is not real, and it must be discussed.**
- **It is more appropriate to combine several parameters than to use one simple index.**
- **One of the most important tasks is the selection of adequate reference conditions for each typology (the salinity gradient must be taken into account).**
- **Our methodology has been intercalibrated obtaining very good results according with the Directive purposes.**
- **The methodologies for ecosystem management must be based on science and on the expert judgment. But complex methodologies are not suitable for management as we need to be practical and pragmatic.**

http://www.ingurumena.ejgv.euskadi.net/r49-564/es/contenidos/informacion/aguas_y_litoral/es_955/indice_c.html

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Thanks for your attention

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