Application of the common procedure for the identification of the eutrophication status of the OSPAR maritime areas in France.

2007 revision of the OSPAR procedure.

Synthesis report

Contents

1. Introduction

The purpose of the Common Procedure for determining the eutrophication status of marine areas of the Paris Convention (OSPAR) is to categorise the maritime area by dividing it into problem areas, potential problem areas and areas without eutrophication problems.

The Common Procedure aims to make it possible to compare the eutrophication status of the regions based on common criteria. Action required following identification of the eutrophication status of the maritime area is specified in the OSPAR Eutrophication Strategy.

The first phase of the Common Procedure was a Screening Procedure. This is a wide-ranging preliminary process, which, in theory, should be applied once in any given area in order to clearly define the areas without eutrophication problems. The aim of screening was also to identify areas which, in practice, are probably non-problem areas, but for which there is insufficient information to be able to apply the Comprehensive Procedure.

Once the Screening Procedure has been carried out, all areas which are not identified as areas without eutrophication problems are subjected to the Comprehensive Procedure and continuous monitoring must be applied in accordance with the OSPAR minimum requirements.

This procedure was implemented in 2002, and this report gives the results of the 2007 revision based on data from the interim period. In France, the application of the December 2000 European Directive led to changes in the definition of areas and parameters used in 2002, for consistency. However, care was taken to allow the best possible comparison between the 2002 and 2007 results.

2. Review of the 2002 results

In the 2002 procedure, the French coast was divided into 35 sites. After the 2002 Screening Procedure, described in Annex 1, it was shown that the following 9 sites were classified as non-problem areas, based on the available information: Cherbourg, Ouest Cotentin, Cancale, Vendée, Pertuis Breton, Pertuis d'Antioche, Marennes, Gironde, Pays Basque.

So the remaining 26 sites were subjected to the Comprehensive Procedure, and their eutrophication status was defined as follows (Table 1):

Table 1. eutrophication status of sites that underwent the Comprehensive Procedure in 2002

Problem sites	Dunkirk and Calais, Boulogne and Canche, Authie and Somme, Seine estuary and bay, Calvados, St Brieuc, Lannion, Morlaix, Douarnenez, Concarneau, Loire and Bourgneuf.
Problem site (local)	Arguenon and Fresnaye.
Potential problem site	Baie des Veys and St Vaast, Lorient.
Potential problem site (?)	Brest, Vilaine.
Non-problem site except for the problem area of the Arcachon basin	Arcachon and Landes
Non-problem site (?)	Dieppe and Fécamp, Rance, Paimpol to Perros-Guirec, Finistère abers, Aven Belon and Laïta, Etel, Bay of Quiberon and Belle Ile, Gulf of Morbihan
Non-problem site	Audierne

In Table 1, some classifications are marked "(?)".These are cases in which data is lacking for one of the essential criteria (mainly dissolved oxygen). So it was not possible to put the site in a definite category. The classification chosen is the most likely in the current state of knowledge.

3. Revision of sites for the 2007 Procedure

In the 2002 Procedure, the coast was divided into sites based on those used in the programmes monitoring environmental quality (chemicals, phytoplankton and phycotoxins, microbiology), and data management was based on the national Quadrige database. The implementation of the Water Framework Directive (WFD), creating homogeneous water masses and a new sampling plan, has led to the reorganization of all the coastal monitoring programmes. This reorganization was done when the OSPAR procedure was reviewed. In order to help OSPAR and WFD operations to converge as desired, it was decided to integrate this WFD concept of water masses into the definition of the OSPAR sites.

The lateral boundaries of OSPAR 2002 sites were revised so that each site contains a coherent WFD water mass. So each OSPAR 2007 site has lateral boundaries that coincide with a WFD water mass limit. The new list of OSPAR 2007 sites, with the corresponding WFD water masses is given in Table 2.

Table 2. Description of OSPAR 2007 sites

N°	OSPAR 2007 Area	WFD water masses involved
1	Dunkirk and Calais	AC01, AC02
2	Boulogne, Canche, Authie and Somme	AC03, AC04, AC05, AT01
3	Pays de Caux (Dieppe and Fécamp)	HC18, HC17
4	Seine estuary and bay	HC16, HC15, HT03
5	Calvados	HC11, HC12, HC13, HC14
6	Baie des Veys and St Vaast	HC08, HC09, HC10, HT06
7	Cherbourg	HC07, HC06, HC05, HC061
8	Ouest Cotentin	HC04, HC03, HC01
9	Mont St Michel bay (Cancale)	HC02, GC01, HT05
10	Rance, Arguenon and Fresnaye	GC03, GT02
11	St Brieuc	GC05, GC06
12	Paimpol, Trieux, Jaudy	GC07, GT03, GT04
13	Lannion and Morlaix	GC08, GC09, GC10, GC11, GC12, GT06, GT07
14	Finistère abers	GC13, GT08, GT09
15	Iroise	GC17, GC18
16	Brest	GC16, GT10, GT11, GT12
17	Douarnenez	GC20
18	Audierne	GC24, GC26
19	Concarneau, Aven and Belon	GC28, GC29, GT14, GT15, GT16, GT17
20	Laïta, Lorient, Groix and Etel	GC32, GC33, GC34, GC35, GC37, GT18, GT19, GT21, GT20
21	Bay of Quiberon and Belle Ile	GC36, GC38, GC42, GT22
22	Gulf of Morbihan	GC39, GT23, GT24, GT25
23	Vilaine	GC44, GC45, GT26, GT27
24	Loire and Bourgneuf	GC46, GC48, GT28
25	Vendée, Pertuis and Marennes	GC47, GC49, GC50, GC51, GC53, GC52, GC54, FC01, FC02, GT30, GT31
26	Gironde	FC03, FC04, FT05, FT04
27	Arcachon and Landes	FC05, FC06, FC07, FC08, FC09
28	Pays Basque	FC10, FC11

It should be noted that in this reorganization, the number of of sites changed from 35 to 28, after some of the 2002 sites were amalgamated. The sites are listed in Table 3:

Table 3. Amalgamation of OSPAR 2002 sites

New 2007 site	Former 2002 sites
Boulogne, Canche, Authie and Somme	Boulogne and Canche Authie and Somme
Rance, Arguenon and Fresnaye	Rance Arguenon and Fresnaye
Lannion and Morlaix	Lannion Morlaix
Concarneau, Aven and Belon	Concarneau Aven, Belon and Laïta
Laïta, Lorient, Groix and Etel	Lorient Etel
Vendée, Pertuis and Marennes	Vendée Pertuis Breton Pertuis d'Antioche Marennes

But the very coastal coverage of the WFD water masses (1 nautical mile beyond the baseline) only partially corresponds to the definition of the 2002 OSPAR sites in their offshore range. The offshore boundaries of the 2002 sites were the boundaries of the territorial waters (baseline + 12 nautical miles), given that all maritime waters beyond that boundary were considered as non-problem areas (see Annex 1, §1.1).

Thus the status of the sector between the boundary of the WFD water masses and the boundary of the territorial waters was specifically examined. The experts drew the following conclusions:

- The sector from the Pays Basque to the Vendée, and to the west of the Cotentin and Cherbourg can be considered as a non-problem area, for the same reasons as the water masses beyond the territorial waters.

- The presence of islands around Brittany (from the Loire to Mont St Michel) extends the area covered by the WFD water masses to almost all the areas potentially involved in eutrophication. Thus the sector between the boundary of the WFD water masses and the boundary of the territorial waters can be considered as a non-problem area.

- The WFD water masses of the OSPAR 2007 sites Baie des Veys and St Vaast, Calvados, and Seine estuary and bay are not fully representative of this area as far as eutrophication is concerned. The sector between the boundary of the WFD water masses and the boundary of the territorial waters will be specifically examined.

- The WFD water masses of the sites from the Pays de Caux to Dunkirk and Calais represent this area fairly accurately. Thus the sector between the boundary of the WFD water masses and the boundary of the territorial waters can be considered as a non-problem area.

4. Implementation of the Common Procedure

As mentioned above, the nine OSPAR 2002 sites classified as non-problem eutrophication areas by the 2002 procedure were reorganized into six OSPAR 2007 sites. In these sites, no new event has occurred that would change the status as a non-problem area. The remaining 19 sites (corresponding to the 26 sites that underwent the Comprehensive Procedure) had their criteria updated, and the results are given in Annex 2, in tables as specified by the EUC committee. As far as possible, the information is from a single source for all sites (national programmes). Further information was gathered from experts at a more local level.

4.1. The Common Procedure criteria

The EUC committee listed information to be included in the definition of the eutrophication status of the maritime areas. In certain cases, the criteria used for implementing the procedure in France do not completely meet the recommendations of the EUC committee, for reasons given later. The differences from or additions to the EUC criteria are given in italics in Table 4 and explained later.

Table 4: Assessment parameters of eutrophication status
Category I Causative factors; Degree of nutrient enrichment **1 Riverine Inputs of total N and P and Direct Discharges** High input and/or increasing trends (compared with previous years) *Elevated levels: over 5000-7000 T/year N; 100-200 T/year P* **2 Winter concentrations of dissolved inorganic nitrogen and phosphorus** Elevated levels (defined as concentrations >50% above the salinity-related or area-specific background concentrations) *Criteria not used in France* **3 Winter N/P ratio (Redfield N/P = 16)** Elevated levels (>25) *Criteria not used in France*
Category II Direct effects of nutrient enrichment (during growing season) **1 Maximum and mean chlorophyll a concentration** Elevated levels (defined as concentrations >50% above the offshore or historic background concentrations) *90^{th} percentile is calculated from data for March to October (inclusive)* *Values compared to a limit which depends on the type of water mass considered:* *- Atlantic and Channel coastal and transition waters: 10 mg/m3* *- North Sea coastal and transition waters: 15 mg/m3* *Elevated levels: P90 > limit* **2 Region or area-specific phytoplankton indicator species** Elevated levels (and increase in duration) *Percentage of samples with at least one bloom defined by category and taxon size:* *- small: 250.000 cells/L (unicellulars < 20 µm without chain)* *- large: 100.000 cells/L (colonial species < 20 µm + sp. > 20 µm)* *Elevated levels Percentage > 40%* **3 Macrophytes, including macroalgae (region specific)** Trend from long-lived species to short-lived species (e.g. *Ulva*) *Elevated levels: yearly occurrence of ulvae and biomass > 1000 t*
Category III Indirect effects of nutrient enrichment (during growing season) **1 Degree of oxygen deficiency** Decreased levels (< 2 mg/l: acute toxicity; 2 – 6 mg/l: deficit) *10^{th} percentile calculated from data for June to September (inclusive) for surface and sea bed samples* *Decreased levels: P10 < 3* **2 Changes and kills in zoobenthos and fish kills** Kills (related to oxygen deficit or toxic algae) Long-term changes in biomass and zoobenthos species composition **3 Organic carbon/organic matter** Elevated levels (related to III.1) (concerning sedimentation areas)
Category IV Other possible effects of nutrient enrichment (during growing season) **1 Algal toxins (DSP/PSP events)** Incidence (related to II.2) *The indicator is the number of months with toxicity* *Elevated levels: Indicator > 2* *(The toxicity is measured only when there is a risk of toxicity, the missing values are taken as absence of toxicity)*

4.2. Origin of data

4.2.1. Catchment area, flow rate and population data.

This data comes from a study done to describe the site features when defining the Quadrige monitoring sites. Obviously the catchment area data has not changed. The population data is taken from the 1999 census and is considered satisfactory for the purposes of this study.

4.2.2. Input data

The French Environment Institute (*L'Institut Français de l'Environnement*) (IFEN) has developed a model for calculating the flow of French rivers that makes it possible to calculate the input into the sea of most rivers, including small ones, as long as a discharge measuring station and certain other measurement data or emission coefficients are available. The model includes organic nitrogen and phosphorus, but only the results of inorganic nitrogen and phosphorus are presented in each sheet, because of the greater uncertainty in measuring the organic forms. The data selected for this document is the data sent to OSPAR for the RID programme. The period covered is 2000-2005.

4.2.3. Dissolved oxygen, chlorophyll and phytoplankton

The data used comes from national monitoring networks: RNO (*Réseau National d'Observation de la qualité du milieu marin* – National network for the observation of the quality of marine environement), REPHY (*Réseau de surveillance du phytoplancton et des phycotoxines* – Network for monitoring phytoplankton and phycotoxins), and SRN (*Suivi des nutriments sur le littoral du Nord Pas de Calais et Picardie* – Nutrient monitoring on the coast of Nord Pas de Calais and Picardie), the ARCHYD network (monitoring nutrients in the Arcachon basin) and the IGA programme (Monitoring the ecological impact around nuclear plants). The data was taken from the Quadrige database.

4.2.4. Macrophytes

Within the framework of the Prolittoral programme, the Loire Brittany Water Authority and the CEVA (*Centre d'Etude et de Valorisation des Algues* – Centre for the Study and Use of Algae) publishes yearly results of the proliferation of green algae along the Brittany coast on the CEVA website (http://www.ceva.fr/fr/environnement/prolitto.html). However, the details of the data required for this report had to be specially extracted from the Prolittoral database. They cover the 1999-2006 period.

4.3. Assessment

The assessment of the eutrophication status was carried out following the EUC committee guidelines as closely as possible. France's position concerning the criteria used was explained in a special report[1]. The EUC committee recommendations are not always totally applicable or exact figures are not always given. The thresholds used for the different criteria were fixed as appropriately as possible given current knowledge, to move towards the WFD requirements, without distorting OSPAR criteria.

[1] Menesguen A. (coord), 2001. L'eutrophisation des eaux marines et saumâtres en Europe, en particulier en France. (Eutrophication of seawater and brackish water in Europe, and particularly in France.) Rapport Ifremer DEL/EC/01.02. 59p.

4.3.1. Nutrients

The criterion selected for nutrient input is the *trend*, proposed by the EUC committee, i.e. an increase of over 5% in 10 years. The results given have been corrected for year to year flow rate variations, as recommended by the EUC. Given the nature of the data, the trend was assessed using a linear regression and estimated to be significant for a determination coefficient (R^2) greater than 0.3. It is apparent that even with this relatively low coefficient, few trends are significant. It is difficult to define a criterion for the *level* of inputs, because this is very dependant on the hydro-morphology of the site in question (quantity of water, rate of renewal). However, for the sites defined here, we can consider that above 5000 to 7000 T/year of inorganic nitrogen and 100 to 200 T/year of inorganic phosphorus, the input level is fairly high.

As far as nutrient concentrations are concerned, France considers that in French maritime waters, the relationship between nutrient concentrations and eutrophication is too complex to be able to define a eutrophication criterion based on nutrient concentrations or nutrient ratios.

4.3.2. Chlorophyll

The criterion selected is the chlorophyll 90^{th} percentile (P90). The P90 is calculated from the March to October data (inclusive). Values are compared to a limit which depends on the type of water mass considered:

- Atlantic and Channel coastal and transition waters: 10 mg/m3
- North Sea coastal and transition waters: 15 mg/m3

The P90 levels are considered to be elevated when they are above these limits.

4.3.3. Dissolved oxygen

The criterion selected concerns the dissolved oxygen concentration expressed in 10th percentile (P10) calculated from surface and sea bed sample data for June to September (inclusive).

P10 levels under 3 are recognized as showing eutrophication.

4.3.4. Phytoplankton

The criterion selected is the percentage of samples with at least one bloom defined by category and taxon size:

- small: 250.000 cells/L (unicellulars < 20 µm without chain)
- large: 100.000 cells/L (colonial species < 20 µm + sp. > 20 µm)

Levels are considered to be high when this percentage is over 40%.

The list of taxons present on the French coast (OSPAR area) is found in Annex 3.

4.3.5. Macrophytes

As for Ulva, the phenomenon is very widespread, and the variable and sometimes very limited areas concerned make it difficult to assess the eutrophication status of areas on the scale chosen in this report. The surface area of sites varies from 111 to 3 260 km², with a mean of 1250 km², whereas Ulva deposits usually cover areas in the order of one km². In

order to take this phenomenon into account, we have selected *permanence* (at least one listed area is affected every year), and the *size* of the nuisance (assessed biomass over 1000 tonnes).

4.3.6. Other effects

Assessment will be done case by case on the sheets. In particular, phycotoxin-related prohibition of the sale of shellfish, which is constant and affect a significant part of the site in question, has been taken into account as a criterion of the harmful effect of eutrophication. The indicator is the number of months with toxicity. (The toxicity is measured only when there is a risk of toxicity, the missing values are taken as absence of toxicity)

Levels are considered to be high when this indicator is over 2

3.4. Classification

The EUC has defined the classification procedure in a table that includes the assessment parameters by category. An assessment parameter is given a "+" score when the criterion threshold is exceeded, and a "-" score when this is not the case. When at least one of the parameters in a category has a "+" score, the category is given a "+" score. The table below defines the classification of a site.

Category I Causative factors	***Category II Direct effects***		***Categories III and IV Indirect effects or other possible effects***	***Site classification***
+	+	***and/or***	+	***Problem site***
-	+	***and/or***	+	***Problem site***
+	-		-	***Potential problem site***
-	-		-	***Non-problem site***

Important comment: in the summary sheets and the following table, some classifications are marked "(?)". These are cases in which data is lacking for one of the essential criteria (mainly dissolved oxygen). So it is not possible to classify site precisely. The classification chosen is the most likely given the current state of knowledge. Further data will be needed, either by using results previous to 1990-2000, or by creating adapted monitoring programmes. The summary sheets should be used to see the criterion involved.

5. Eutrophication status of French coastal sites

The table and map below summarise the eutrophication status of all sites in the OSPAR area of the French coast, as defined after the 2007 revision of the Common Procedure.

Key to the Table

NI Riverine inputs and Direct discharge of total N

and total P

DI Winter DIN and/or DIP concentrations

NP Increased winter ratio

Ca chlorophyll a: 90th percentile

Ps Phytoplankton indicator species

Mp Macrophytes including macroalgae

O_2 Dissolved oxygen concentration: 10th percentile

Ck Changes/kills in zoobenthos and fish kills

Oc Organic carbon/organic matter

At Algal toxins (DSP/PSP/ASP shellfish contamination events)

\+ = Increased trend, "elevated" levels, shifts or changes involving the respective assessment parameters

\- = No increased trend, "elevated" levels, shifts or changes involving the respective assessment parameters

? = Insufficient data to make the assessment or inappropriate data available

Note: categories I, II and/or III/IV are indicated by the symbol "+" when one or more of the respective parameters reveals an increased trend, "elevated" level, shifts or changes

PA: Problem Area

PPA: Potential Problem Area

NPA: Non Problem Area

Site (2002 classification)	**Category I** Nutrient enrichment		**Category II** Direct effects		**Categories III and IV** Indirect effects/ other effects				Initial classification	Further assessment of all other relevant information	Final classification
Dunkerque et Calais (PA)	NI	?	Ca	+	O_2	?	At	-	PA	Although the coastal area of Nord, Pas-de-Calais and Picardie regions be subjected to proliferations of *Phaeocystis globosa*, what has been learned in recent years do not support the conclusion about a real embarrassment for professional activities (fish and shellfish) or with important consequences on the functioning of benthic and pelagic ecosystems. In addition, nutrients inputs in the area were significantly reduced. The status of PPP is then considered more appropriate to these two areas (Dunkirk and Calais, Boulogne and Somme).	PPA
	DI		Ps	+	Ck						
	NP		Mp		Oc						
Boulogne Somme (PA)	NI	-	Ca	+	O_2	?	At	-	PA		PPA
	DI		Ps	+	Ck						
	NP		Mp		Oc						
Pays de Caux (NPA ?)	NI	?	Ca	?	O_2	?	At	-	NPA ?		
	DI		Ps	?	Ck						
	NP		Mp		Oc						

Estuaire et baie de Seine (PA)	NI	+	Ca	+	O_2	+	At	+	PA		
	DI		Ps	+	Ck						
	NP		Mp		Oc						
Calvados (PA)	NI	+	Ca	+	O_2	?	At	+	PA		
	DI		Ps	+	Ck						
	NP		Mp		Oc						
Baie des Veys et St Vaast (PPA)	NI	-	Ca	+	O_2	-	At	-	PA		
	DI		Ps	+	Ck						
	NP		Mp		Oc						
Cherbourg (NPA)										2002 Screening Procedure	NPA
Ouest Cotentin (NPA)										2002 Screening Procedure	NPA
Cancale (NPA)										2002 Screening Procedure	NPA

Rance(NPA ?), Arguenon et Fresnaye (local PA)	NI	?	Ca	-	O_2	?	At	-	PA		
	DI		Ps	-	Ck						
	NP		Mp	+	Oc						
St Brieuc (PA)	NI	?	Ca	-	O_2	?	At	-	PA		
	DI		Ps	-	Ck						
	NP		Mp	+	Oc						
Paimpol, Trieux, Jaudy, Perros-Guirec (NPA ?)	NI	?	Ca	-	O_2	?	At	-	NPA		
	DI		Ps	-	Ck						
	NP		Mp	-	Oc						
Lannion et Morlaix (PA)	NI	?	Ca	-	O_2	?	At	-	PA		
	DI		Ps	+	Ck						
	NP		Mp	+	Oc						

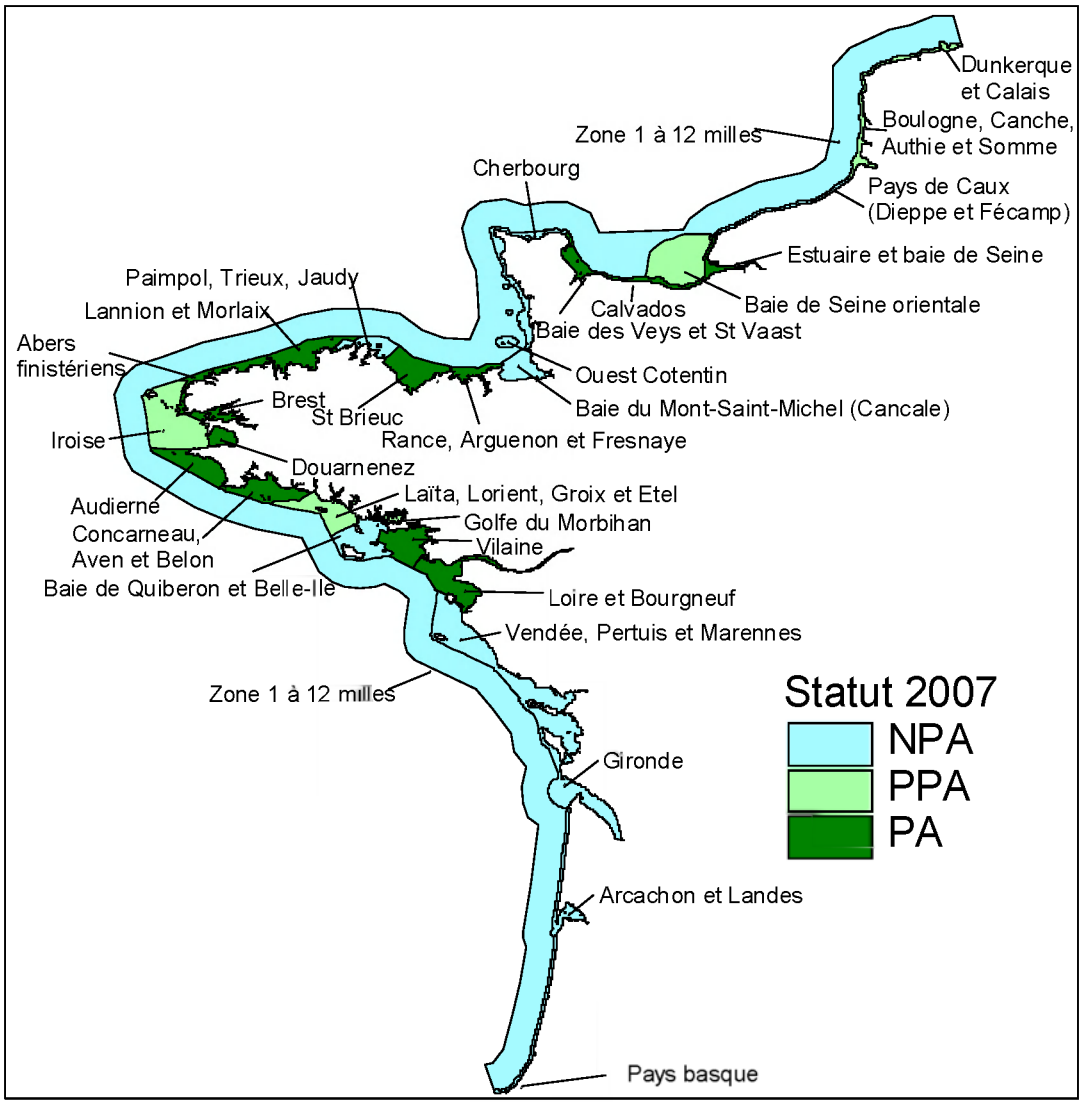
Abers finistériens (NPA ?)	NI	**?**	Ca	**?**	O_2	**?**	At	-	PA		
	DI		Ps	+	Ck						
	NP		Mp	+	Oc						
Brest (PPA ?)	NI	+	Ca	+	O_2	**?**	At	+	PA		
	DI		Ps	-	Ck						
	NP		Mp	+	Oc						
Iroise	NI	**n.a.**	Ca	**?**	O_2	**?**	At	+	PPA		
	DI		Ps	+	Ck						
	NP		Mp	-	Oc						
Douarnenez (PA)	NI	**?**	Ca	-	O_2	**?**	At	+	PA		
	DI		Ps	-	Ck						
	NP		Mp	+	Oc						

Audierne (NPA ?)	NI	?	Ca	+	O_2	?	At	+	PA		
	DI		Ps	+	Ck						
	NP		Mp	-	Oc						
Concarneau (PA), Aven, Belon (NPA ?)	NI	?	Ca	+	O_2	?	At	+	PA		
	DI		Ps	+	Ck						
	NP		Mp	+	Oc						
Laïta (NPA ?), Lorient (PPA), Groix, Etel (NPA ?)	NI	+	Ca	-	O_2	?	At	+	PPA		
	DI		Ps	-	Ck						
	NP		Mp	-	Oc						
Baie de Quiberon et Belle Ile (NPA ?)	NI	?	Ca	-	O_2	?	At	+	NPA		
	DI		Ps	-	Ck						
	NP		Mp	-	Oc						

Golfe du Morbihan (NPA ?)	NI	?	Ca	?	O_2	?	At	-	PPA		
	DI		Ps	+	Ck						
	NP		Mp	-	Oc						
Vilaine (PPA ?)	NI	+	Ca	+	O_2	?	At	+	PA		
	DI		Ps	+	Ck						
	NP		Mp		Oc						
Loire et Bourgneuf (PA)	NI	+	Ca	+	O_2	+	At	-	PA		
	DI		Ps	-	Ck						
	NP		Mp		Oc						
Vendée (NPA)										2002 Screening Procedure	NPA
Pertuis Breton (NPA)										2002 Screening Procedure 2	NPA

Pertuis d'Antioche (NPA)										2002 Screening Procedure	NPA
Marennes (NPA)										2002 Screening Procedure	NPA
Gironde (NPA)										2002 Screening Procedure	NPA
Arcachon et Landes (NPA ?)	NI	-	Ca	-	O_2	-	At	+ **?**	NPA ?	For At, mollusc toxicity has not been proved to be algal in origin (atypical toxin) The Arcachon basin remains sensitive to all increases in nitrogen input, which is currently under control	NPA
	DI		Ps	-	Ck						
	NP		Mp		Oc						
Pays basque (NPA)										2002 Screening Procedure	NPA

Etat d'eutrophisation des zones marines en France (Procédure commune OSPAR)



Annex 1
2002 Screening Procedure

Approach

It is first established that all French coastal waters beyond the territorial waters boundary are considered as areas with no eutrophication problem. This is because this boundary is so far removed from the influence of freshwater input that the water is only oceanic, from the Atlantic Ocean, with a salinity level of 35 to 35.5. In the Eastern Channel and offshore from the Loire estuary, the surface salinity beyond the territorial waters boundary can drop to between 34 and 35 during the flood season in some exceptional years. But these phenomena do not lead to a risk of eutrophication in these areas.

Moreover, it is recognized that eutrophication in a marine environment is caused by nitrogen rather than phosphorus. So the Screening Procedure only looked at nitrogen as the factor responsible for eutrophication.

Marine hydrology

Very briefly, the movement of water masses in the OSPAR areas off the French coast can be described in three ways, mainly related to tidal currents:

a. along the Channel coast, strong to very strong hydrodynamism,

b. along the south coasts of Brittany and the Pays de Loire, medium to strong hydrodynamism depending on the shape of the coast,

c. from the Vendée to the Spanish border, weak to medium hydrodynamism, with a fairly strong influence of coastal drift related to the swell along the coast of Aquitaine.

In the Eastern Channel, from the Seine Bay to Dunkirk, the waters move north-westwards along a fairly smooth coastline. The shape of the coast and the seabed accelerates the drift westward (Cap d'Antifer and Fecamp) and eastward (Straits of Pas de Calais), and slows it down in the central part (Dieppe to the Somme).

In the western Channel, from Brest to Cherbourg, despite tidal currents that can momentarily reach speeds of 4 to 5 m/s, deep coastal indentations (abers) or certain morphologies (Lannion Bay, St Brieuc Bay and Mont St Michel Bay) cause localised weak residual currents, and thus weak water renewal and areas of sediment deposition.

As in the western Channel, the very indented south coast of Brittany and the Pays de Loire have areas with small estuaries (rias) or with particular morphologies (Douarnenez Bay, Vilaine Bay, Bourgneuf Bay) that have areas of weak residual hydrodynamism and sedimentary deposits.

Along the rest of the Atlantic coast, the water is generally well renewed. The Arcachon basin is a particular case due to its shape. Complex sediment movements occur there and sedimentation occurs in the eastern part.

Demographic and economic data

Along the Channel and North Sea, the population density of the coastal *départements* and catchment areas is above the national average (100 inh./km²); industry is also more

developed, including heavy industry near the major ports. The population of the Brittany *départements* is close to the national average, but doubles in summer in the coastal resorts. The density of stock raising and related transformation industries is 3 times the French national average. The catchment areas and coastal towns and villages on the Atlantic coast to the south of Brittany are less densely populated on average. However, the population of some coastal resorts in the south of the Vendée and Charente Maritime may increase tenfold in summer. The Vendée is a *département* with a very high stock density, mainly cattle and fowl. The catchment areas of this southern part, particularly of the Loire, the Gironde and the Adour have much large-scale crop production.

Inputs to the coastal marine environment

Along the Atlantic coast, there is a mean annual freshwater input of about 3100 m3/s, 84% of which comes from the 4 rivers Seine, Loire, Gironde and Adour. The annual nitrogen input from these 4 rivers is estimated at 250 kt. This coastal load is mainly the result of farming and industry in the catchment areas of these rivers, which cover over half the surface of France. This load is particularly great in the Loire (2.5 g/m3 of nitrogen) and the Seine (6.1 g/m3 of nitrogen), where the input of nitric nitrogen has increased continuously over the last 30 years. The level from the Gironde is lower (2 g/m3 of nitrogen).

Observed effects

In the Channel, from the Seine Bay to Dunkirk, eutrophication takes the form of coloured water, from explosions of *Phaeocystis* and noctiluca plankton. This has limited[2] but real impact (fish and shellfish kills, disruption of fishing caused by clogging and choking the nets.)

The scale of these phenomena seems to have decreased over the past few years thanks to more favourable conjunctions of nutrient control, tides and winds. On the coast of Brittany, the growth of macrophytes (*Ulva sp.* and *Enteromorpha sp.*) leads to accumulations on some beaches and on the seabed in estuaries.

Abnormal levels of chlorophyll (between 30 and 70 µg/l) or dissolved oxygen (deficit or anoxia) are rarely observed, because the waters are usually well mixed, with a turbidity that limits plankton development. However, these phenomena have been observed occasionally in some estuary areas, including the Seine, Loire and Vilaine.

The appearance of toxic phytoplankton species is studied and monitored regularly.

DSP toxic events have been observed all along the coast except in Nord Pas de Calais and to the east of North Brittany, and some PSP events have occurred to the west of North Brittany. Marine animal kills have been observed in certain parts of West and South Brittany. The appearance of these toxic phytoplankton species is not always related to the anthropogenic nutrient input, and so this criterion was not taken into account for the Screening Procedure. Subsequentely, the OPSAR eutrophication committee (EUC) included this criterion in the list of Comprehensive Procedure criteria.

Overall assessment

Based on the previous considerations and the different monitoring results available, a first eutrophication status of maritime areas was established by "expert advice", taking account, depending on the case in point, of the size of the surface covered, the intensity of the

[2] See the results of the National Coastal Ecology Programme (PNEC)

phenomenon on certain very localised sites, the occurrence of the phenomenon, the impact on human activity or ecosystyems.

After this Screening Procedure, it was shown that for the following sites, the available information allowed them to be classified as non-problem areas in terms of eutrophication: Cherbourg, Ouest Cotentin, Cancale, Vendée, Pertuis Breton, Pertuis d'Antioche, Marennes, Gironde, Pays Basque.

Annex 2
Review sheets per OSPAR 2007 site

NOTE: these sheets obviously do not include sites classified as "non-problem" for eutrophication by the 2002 Screening Procedure, and which kept the same status in the 2007 Procedure (cf. Annex 1).

Key to the symbols

+ = Upward trend, "elevated" levels, substitution or modification of respective assessment parameters

- = No upward trend, no "elevated" levels, no substitution or modification of respective assessment parameters

? = Insufficient data to make the assessment or inappropriate data available

Site 1: Dunkirk and Calais

Site description

The Dunkirk and Calais site is the French southern shore of the North Sea. It is a low dunal coast (5 to 10 m) protecting very low-lying land. The extremely large foreshore is a continuation of the undersea plain, and is dotted with linear banks covered in fine sand. These banks protect the coast from the swell of the northern parts. The alternating tidal currents follow the main channels.

Catchment area 520 km²; mean annual flow rate of main rivers 4.6 m3/s; Population of coastal towns and villages 231 090

Assessment

Catégorie	Paramètres d'évaluation	Description des résultats/Notation (+ - ?)				
		2001	2002	2003	2004	2005
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Pas d'info RID				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	-	-	+	-	-
	Espèces phytoplanctoniques indicatrices	+	-	+	+	+
	Macrophytes, y compris les macroalgues					
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	-	-	-	-
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	-	-	-	-

Site 2: Boulogne Somme

Site description

From Boulogne to the Canche, the northern part of the site has various cliffs up to Boulogne, then in the southern part a low banked dunal coast indented by the small Canche estuary. The tidal currents are mainly alternating and parallel to the coast, and are stronger in the north. From the Authie to the Somme, the site has a low banked dunal coast, indented by two small estuaries, the bays of Authie and Somme. The average width of the foreshore is 500 m and the dunes are 6 to 10 m high. In the south they give way to shingle banks from the Pays d'Ault cliffs. The nearshore sea bed is covered with very marked ridges and troughs. The waters are well churned by the tides, and the overall movement is northward (coastal drift).

Catchment area 8948 km²; mean annual flow rate of main rivers 90 m3/s; Population of coastal towns and villages 141 968

Assessment

Catégorie	**Paramètres d'évaluation**	**Description des résultats/Notation** (+ - ?)				
		2001	**2002**	**2003**	**2004**	**2005**
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Niveaux en décroissance, maintenant de niveau bas : -				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	+	+	+	+	+
	Espèces phytoplanctoniques indicatrices	+	-	+	+	+
	Macrophytes, y compris les macroalgues					
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	?	?	?	?
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	-	-	-	-

Site 3: Pays de Caux

Site description

The Dieppe and Fécamp site is bordered by high cretaceous limestone cliffs (30 to 80 m) that are mostly in the process of being eroded. The hardest materials (flint pebbles) are driven northeast by the coastal drift (alternating currents parallel to the coast). The limestone is reduced to sand and mud and carried out to sea. This site is influenced by inputs from the Seine to the west.

Catchment area 3 820 km²; mean annual flow rate of main rivers 29 m3/s (Bresle and Arques); Population of coastal towns and villages 95 205.

Assessment

Catégorie	**Paramètres d'évaluation**	**Description des résultats/Notation** (+ - ?)				
		2001	**2002**	**2003**	**2004**	**2005**
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Pas de donnée RID				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	?	?	?	-	-
	Espèces phytoplanctoniques indicatrices	?	?	?	-	-
	Macrophytes, y compris les macroalgues					
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	?	?	-	-
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	-	-	-	-

Site 4: Seine estuary and bay

Site description

The Seine estuary and bay site is situated at the mouth of a catchment area under much pressure from farming and urbanisation. The depth does not exceed thirty metres or so. The tide is an important factor because it is the main cause of currents and creates a maximum fluctuation of about 7 m. The most frequent storms are from the west. The wind and swell put sediments into suspension, especially in shallow areas. The salinity is strongly influenced by the waters of the Seine, and by the small coastal rivers Touques and Risle.

Catchment area 82 318 km²; mean annual flow rate of main rivers 502 m3/s;

Population of coastal towns and villages 262 336 inhabitants.

Assessment

Catégorie	**Paramètres d'évaluation**	**Description des résultats/Notation** (+ - ?)				
		2001	**2002**	**2003**	**2004**	**2005**
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Tendance décroissante mais apports élevés : +				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	+	+	+	+	+
	Espèces phytoplanctoniques indicatrices	-	-	-	-	+
	Macrophytes, y compris les macroalgues					
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	+	-	-	-	-
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	-	+	-	-

Site 5: Calvados

Site description

The Calvados site is the central part of the wide Seine bay area. The depth does not exceed thirty metres or so. The tide is an important factor because it is the main cause of currents and creates a maximum fluctuation of about 7 m. The most frequent storms are from the west. The wind and swell put sediments into suspension, especially in shallow areas. The salinity is influenced by the waters of the coastal rivers Seulles, Orne and Dives, as well as the major influence of the Seine.

Catchment area 5 371 km²; mean annual flow rate of main rivers 33,5 m3/s;

Population of coastal towns and villages 41 373 inhabitants.

Assessment

Catégorie	**Paramètres d'évaluation**	**Description des résultats/Notation** (+ - ?)				
		2001	**2002**	**2003**	**2004**	**2005**
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Tendance n.s. et niveaux élevés : +				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	?	+	+	+	-
	Espèces phytoplanctoniques indicatrices	-	+	+	-	-
	Macrophytes, y compris les macroalgues					
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	-	-	-	-
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	-	-	-	+

Site 6: Baie des Veys and St Vaast

Site description

The Baie des Veys and St Vaast site is the western part of the wide Seine bay area. The depth does not exceed thirty metres or so. The tide is an important factor because it is the main cause of currents and creates a maximum fluctuation of about 7 m. The most frequent storms are from the west. The wind and swell put sediments into suspension, especially in shallow areas. The salinity is influenced by the waters of the coastal rivers Douve, Taute, Vire and Aure which flow into the Baie des Veys.

Catchment area 3857 km²; mean annual flow rate of main rivers 40 m3/s; Population of coastal towns and villages 9 723

Assessment

Catégorie	**Paramètres d'évaluation**	**Description des résultats/Notation** (+ - ?)				
		2001	**2002**	**2003**	**2004**	**2005**
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Tendance décroissante, niveau devenus bas -				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	+	+	-	-	-
	Espèces phytoplanctoniques indicatrices	-	-	-	-	+
	Macrophytes, y compris les macroalgues					
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	-	-	-	-	-
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	-	-	-	-

Site 10: Rance, Arguenon and Fresnaye

Site description

The Rance, Arguenon and Fresnaye site is the bay of St Malo with its steep banks and deeply indented half-closed bays. In the eastern part is the deep ria of the Rance, a small river that drains an area of intensive farming. The waters are strongly churned by the tides, except in the ria, which is closed by a tidal power station damn where sediments are deposited.

Catchment area 2 055 km²; mean annual flow rate of main rivers 4 m3/s (Rance: 2.57 Arguenon: 0.82 Fremur: 0.23); Population of coastal towns and villages 106 275 inhabitants.

Assessment

Catégorie	**Paramètres d'évaluation**	**Description des résultats/Notation** (+ - ?)				
		2001	**2002**	**2003**	**2004**	**2005**
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Pas de donnée RID				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	-	-	-	-	-
	Espèces phytoplanctoniques indicatrices	-	-	-	-	-
	Macrophytes, y compris les macroalgues	Ulves. Zones touchées chaque année, biomasse >1000 t 2 fois sur 5 +				
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	?	?	?	?
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	-	-	-	-

Site 11: St Brieuc

Site description

The St Brieuc site is a vast bay with steep sides cut into V shapes by two tertiary tectonic faults. The waters are extremely churned by the tide, but fairly poorly renewed at the back of the bay, where there is vast sandy foreshore. The rivers are not large, but drain an area of intensive farming.

Catchment area 1212 km²; mean annual flow rate of main rivers 3.9 m3/s; (Le Gouessant: 1.44, Le Gouet: 1.67); Population of coastal towns and villages 101 134 inhabitants.

Assessment

Catégorie	Paramètres d'évaluation	Description des résultats/Notation (+ - ?)				
		2001	2002	2003	2004	2005
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Pas de donnée RID				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	-	-	-	-	-
	Espèces phytoplanctoniques indicatrices	-	-	-	-	-
	Macrophytes, y compris les macroalgues	Ulves. Zones touchées chaque année, biomasse >1000 t 5 fois sur 5 +				
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	?	?	?	?
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	-	-	-	-

Site 12: Paimpol, Trieux, Jaudy, Perros-Guirec

Description du site

Le site Paimpol, Trieux, Jaudy, Perros-Guirec est un littoral granitique à larges platiers rocheux prolongés vers le large par de multiples écueils et îlots avec deux profondes rias, celles du Trieux et du Jaudy. Les eaux y sont extrêmement brassées par la marée mais comportent quelques zones de faible renouvellement. Les rivières d'importance moyenne drainent une agriculture intensive.

Bassin versant 1434 km² ; Débit moyen annuel total des principales rivières 9,5 m^3/s (Jaudy : 1.73, Trieux : 5.39) ; Population des communes littorales 31 051 habitants.

Evaluation

Catégorie	Paramètres d'évaluation	Description des résultats/Notation (+ - ?)				
		2001	2002	2003	2004	2005
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Pas de donnée RID				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	-	-	-	-	-
	Espèces phytoplanctoniques indicatrices	-	-	-	-	-
	Macrophytes, y compris les macroalgues	Ulves. Zones touchées chaque année, biomasse toujours < 1000 t -				
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	?	?	?	?
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	-	-	-	-

Site 13: Lannion and Morlaix

Site description

The Lannion and Morlaix site is a granite coast with large rocky flats to the east becoming numerous rocky reefs and islets further out. It has a wide bay (Lannion Bay) with a large sandy foreshore. There are deep rias to the west, in particular the Penzé and Morlaix rias. The waters are strongly churned by the tide but there are areas where there is poor water renewal. Several small rivers and one medium sized one, the Leguer, drain an area of intensive farming.

Catchment area 1 770 km²; mean annual flow rate of main rivers 8 m3/s; (Léguer: 6.41, Yar: 0.8, Horn: 0.71); Population of coastal towns and villages 114 968 inhabitants.

Assessment

Catégorie	**Paramètres d'évaluation**	**Description des résultats/Notation** (+ - ?)				
		2001	**2002**	**2003**	**2004**	**2005**
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Pas de donnée RID				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	-	-	-	-	-
	Espèces phytoplanctoniques indicatrices	-	-	+	-	-
	Macrophytes, y compris les macroalgues	Ulves. Zones touchées chaque année, biomasse >1000 t 5 fois sur 5 +				
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	?	?	?	?
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	-	-	-	-

Site 14: Finistère abers

Site description

The Finistère abers site is a generally low granite coast with large rocky flats becoming numerous rocky reefs and islets further out. It has deep rias (Aber Wrac'h, Aber Benoît, Aber Ildut). The waters are strongly churned by the tide and exposure to the west. The rivers are not large, but drain an area of intensive farming.

Catchment area 811 km²; mean annual flow rate of main rivers 2.4 m3/s (Aber Wrac'h: 0.45, Aber Benoit: 0.48, Aber Ildut: 1.47); Population of coastal towns and villages 38 872 inhabitants.

Assessment

Catégorie	Paramètres d'évaluation	Description des résultats/Notation (+ - ?)				
		2001	2002	2003	2004	2005
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Pas d'info RID				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	?	?	?	?	?
	Espèces phytoplanctoniques indicatrices	+	-	-	-	-
	Macrophytes, y compris les macroalgues	Ulves. Zones touchées chaque année, biomasse >1000 t 2 fois sur 5 +				
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	?	?	?	?
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	-	-	-	-

Site 15: Iroise

Description du site

Le site Iroise recouvre la zone de la mer d'Iroise, sauf la Chaussée de sein, rattachée au site Audierne. C'est une zone maritime dangereuse traditionnelle entité hydrographique entre l'océan Atlantique et la rade de Brest et la baie de Douarnenez. La morphologie de l'archipel de Molène et de l'Ile d'Ouessant est semblable à celle de la pointe du Finistère nord dont elle constitue le prolongement (cf. le site des Abers finistériens). La population des îles Molène et Ouessant est de 1 196 habitants.

Evaluation

Catégorie	Paramètres d'évaluation	Description des résultats/Notation (+ - ?)				
		2001	2002	2003	2004	2005
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Non concernée				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	?	?	-	-	-
	Espèces phytoplanctoniques indicatrices	+	-	-	-	-
	Macrophytes, y compris les macroalgues					
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	?	?	?	?
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	+	+	+	+

Site 16: Brest

Site description

The Brest site with its high, rocky and often sheer coast has a vast antechamber common to five rias. This antechamber opens out through a narrow neck into the Iroise sea, formed to the north and south by the Corsen and Raz points, which respectively continue as the Béniguet and Sein causeways. The waters are strongly churned by violent tidal currents, particularly in the narrows (up to 4 knots).

Catchment area 2 631 km²; mean annual flow rate of main rivers 38 m3/s; (Elorn: 5.62, Aulne: 32[3]); Population of coastal towns and villages 242 163 inhabitants.

Assessment

Catégorie	Paramètres d'évaluation	Description des résultats/Notation (+ - ?)				
		2001	2002	2003	2004	2005
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Tendance décroissante, mais niveaux élevés : +				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	+	+	+	-	-
	Espèces phytoplanctoniques indicatrices	-	-	-	-	-
	Macrophytes, y compris les macroalgues	Ulves. Zones touchées chaque année, biomasse >1000 t 2 fois sur 5 +				
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	?	?	?	?
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	+	+	-	+

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[3] NOTE: the RID data here give an annual flow rate of 77 m3/sec which does not seem to correspond with reality.

Site 17: Douarnenez

Site description

The Douarnenez site is a wide bay opening into the Iroise sea, bordered by cliffs to the south and north. The high, rocky coast to the north and at the back of the bay shelters a large sandy foreshore.

Catchment area 370 km²; mean annual flow rate of main rivers 1.5 m3/s; Population of coastal towns and villages 33 340.

Assessment

Catégorie	Paramètres d'évaluation	Description des résultats/Notation (+ - ?)				
		2001	2002	2003	2004	2005
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Pas de données RID				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	-	-	-	-	-
	Espèces phytoplanctoniques indicatrices	-	-	-	-	-
	Macrophytes, y compris les macroalgues	Ulves. Zones touchées chaque année, biomasse toujours >1000 t +				
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	?	?	?	?
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	+	+	+	+

Site 18: Audierne

Site description

The Audierne site is formed to the west by rocky shores as far as the Raz de Sein and in the west by a bow-shaped shingle bank that touches the Penmarc'h spur to the south. This sector has no shelter from the western swells.

Catchment area 351 km²; mean annual flow rate of main rivers 1.5 m3/s (Goyen: 1.41); Population of coastal towns and villages 29 519 inhabitants.

Assessment

Catégorie	Paramètres d'évaluation	Description des résultats/Notation (+ - ?)				
		2001	2002	2003	2004	2005
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Pas d'info RID				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	?	+	-	+	-
	Espèces phytoplanctoniques indicatrices	-	-	-	+	-
	Macrophytes, y compris les macroalgues	Ulves. Pas de zone touchée chaque année, biomasse toujours < 1000 t -				
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	?	?	?	?
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	+	-	-	-

Site 19: Concarneau, Aven, Belon

Site description

The Concarneau, Aven, Belon site has a low granitic coast with many reefs and islets. In the western part the coastline is usually steep, opening to the south in the east. But outside of these areas, the seabed drops to -50 m. The Bénodet cove and the bay of Concarneau, which are set back, are sheltered by the shallows. Sand and mud rias are present, forming bars at the entrance (Aven). The tidal currents are not very large, except in the rivers.

Catchment area 1 380 km²; mean annual flow rate of main rivers 12 m3/s (Odet: 7.87, Aven: 3.76); Population of coastal towns and villages 78 969 inhabitants.

Assessment

Catégorie	Paramètres d'évaluation	Description des résultats/Notation (+ - ?)				
		2001	2002	2003	2004	2005
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Pas de données RID				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	-	-	+	-	-
	Espèces phytoplanctoniques indicatrices	+	-	-	-	-
	Macrophytes, y compris les macroalgues	Ulves. Zones touchées chaque année, biomasse >1000 t 5 fois sur 5 +				
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	?	?	?	?
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	+	+	+	-

Site 20: Laïta, Lorient, Groix, Etel

Site description

The Lorient site has a steep or mixed rocky coast to the west, with the Laïta sand-mud ria, creating sandbars, and to the east the vast Lorient harbour, a ria common to two small rivers draining an area of intensive farming.

Catchment area 3 773 km²; mean annual flow rate of main rivers 56.3 m3/s (Laïta: 13.4, Scorff: 15.0, Blavet: 26.7); Population of coastal towns and villages 172 929 inhabitants.

Assessment

Catégorie	Paramètres d'évaluation	Description des résultats/Notation (+ - ?)				
		2001	2002	2003	2004	2005
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Tendances décroissantes, mais apports élevés : +				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	-	-	-	-	-
	Espèces phytoplanctoniques indicatrices	-	-	-	-	-
	Macrophytes, y compris les macroalgues	Ulves. Zone touchée chaque année, biomasse toujours < 1000 t -				
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	?	?	?	?
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	+	-	-	+

Site 21: Quiberon bay and Belle Ile

Site description

The Quiberon Bay and Belle-Île site is composed of several areas. The cliffs of Belle-Ile shield it from the southwesterly swell. Belle Ile and the Quiberon Houat Hoëdic line of shallows outline a navigational channel between the Loire estuary area and the west of southern Brittany. Between these shallows and the coast, Quiberon Bay is fairly isolated from offshore influences (but is subject to influences from the Loire). It forms a sort of prechamber to the gulf of Morbihan causing the waters to be powerfully sucked into the northern part of the bay.

Catchment area 156 km²; mean annual flow rate of main rivers about 1 m3/s;

Population of coastal towns and villages 26 216 inhabitants.

Assessment

Catégorie	Paramètres d'évaluation	Description des résultats/Notation (+ - ?)				
		2001	2002	2003	2004	2005
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Pas d'info RID				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	-	-	-	-	-
	Espèces phytoplanctoniques indicatrices	-	-	-	-	-
	Macrophytes, y compris les macroalgues	Ulves. Zone touchée chaque année, biomasse toujours < 1000 t -				
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	?	?	?	?
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	+	-	-	+

Site 22: Gulf of Morbihan

Site description

The Gulf of Morbihan site is composed of the ria of the Auray river and a tectonic depression connected to the sea through a narrow gap. It is complex with numerous inlets and features. Apart from an area of cliffs, the coast is low and surrounded by many shallows.

Catchment area 731 km²; mean annual flow rate of main rivers 1.1 m3/s; Population of coastal towns and villages 110 428

Assessment

Catégorie	Paramètres d'évaluation	Description des résultats/Notation (+ - ?)				
		2001	2002	2003	2004	2005
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Pas de données RID				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	?	?	?	?	?
	Espèces phytoplanctoniques indicatrices	-	+	-	-	-
	Macrophytes, y compris les macroalgues	Ulves. Zones touchées chaque année, biomasse toujours < 1000 t -				
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	?	?	?	?
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	-	-	-	-

Site 23: Vilaine

Site description

The Vilaine site is a vast shallow bay open to the southwest with the Vilaine estuary opening into it. The upstream part of this estuary is closed by a damn that regulates the flow of the Vilaine, but which causes sedimentary deposits downstream from the damn. The site is also influenced by the Loire estuary due to the general westward circulation.

Catchment area 11 073 km²; mean annual flow rate of main rivers 27 m3/s;

Population of coastal towns and villages 34 164 inhabitants.

Assessment

Catégorie	Paramètres d'évaluation	Description des résultats/Notation (+ - ?)				
		2001	2002	2003	2004	2005
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Tendances décroissantes mais apports élevés : +				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	-	-	-	+	+
	Espèces phytoplanctoniques indicatrices	-	-	-	-	+
	Macrophytes, y compris les macroalgues	Ulves. Zone touchée chaque année, biomasse toujours < 1000 t -				
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	?	?	?	?	?
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	+	-	+	+

Site 24: Loire and Bourgneuf

Site description

The Loire and Bourgneuf site is mainly composed of the wide, shallow Loire estuary. The inner estuary is a complex set of islets and marshy backwaters, crossed by a twisting navigation channel. The Bourgneuf bay, separated from the ocean by the Ile de Noirmoutier, forms an area of sedimentation with mud flats and polders, the north side of which has a large opening to the mouth of the Loire.

Catchment area 118 892 km²; mean annual flow rate of main rivers 910 m3/s;

Population of coastal towns and villages 152 282 inhabitants.

Assessment

Catégorie	**Paramètres d'évaluation**	**Description des résultats/Notation** (+ - ?)				
		2001	**2002**	**2003**	**2004**	**2005**
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	Tendances décroissantes mais apports élevés : +				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	+	+	+	+	+
	Espèces phytoplanctoniques indicatrices	-	-	-	-	-
	Macrophytes, y compris les macroalgues					
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	+	-	+	+	+
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	-	-	-	-

Site 27: Arcachon and Landes

Site description

The Arcachon and Landes site is 200 km of coastline comprised of a line of transgressive dunes, retaining the waters in the western part of the Holocene inclined plain covered with sand from the Landes. The site is mainly drained by the Arcachon basin (150 km² of water completely open to the sea).

Catchment area 6 350 km²; mean annual flow rate of the main river (Eyre) 22 m3/s;

Population of coastal towns and villages 150 999 inhabitants.

Assessment

Catégorie	Paramètres d'évaluation	Description des résultats/Notation (+ - ?)				
		2001	2002	2003	2004	2005
Degré de l'enrichissement en nutriments (I)	Apports fluviaux et rejets directs de N total et de P total	- Inputs have been reduced below the problem level, but the area remains sensitive.				
	Teneurs hivernales en DIN et/ou DIP					
	Ratio hivernal N/P ratio (N/P de Redfield = 16)					
Effets directs (II)	Chlorophylle *a* : percentile 90	-	-	-	-	-
	Espèces phytoplanctoniques indicatrices	-	-	-	-	-
	Macrophytes, y compris les macroalgues	The presence of *Monostroma obscurum* is no longer a problem for the basin.				
Effets indirects (III)	Teneur en oxygène dissous : percentile 10	-	-	-	-	
	Modifications/mortalité du zoobenthos et mortalité du poisson					
	Carbone/ matière organiques					
Autres effets éventuels (IV)	Toxines algales (épisodes de contamination de coquillages par DSP/PSP/ASP)	-	-	-	+	+

Annex 3
List of names of taxons present in the OSPAR area of the French coast

Prokaryotes (= Monera sp.)
Cyanobacteria (= Cyanophyceae)
Anabaena
Anaebaenopsis
Merismopedia
Microcystis
Nostoc
Oscillatoria
Protista
Chlorophyceae
Actinastrum
Ankistrodesmus
Closterium
Coelastrum
Cosmarium
Crucigenia
Kirchneriella
Pediastrum
Scenedesmus
Scenedesmus quadricauda
Selenastrum
Staurastrum
Chrysophyceae
Ochromonadales
Dinobryaceae
Dinobryon
Pedinellales
Pedinellaceae
Apedinella
Apedinella spinifera
Pseudopedinella
Ciliophora
Mesodinium
Mesodinium rubrum
Cryptophyceae
Cryptomonadales
Diatomophyceae
Centrales
Asterolampraceae
Asteromphalus
Biddulphiaceae
Biddulphia
Biddulphia alternans
Cerataulina
Cerataulina pelagica
Eucampia + Climacodium
Eucampia zodiacus
Eunotogramma + Anaulus + Terpsinoe
Hemiaulus
Isthmia
Chaetoceraceae
Attheya
Attheya armatus
Bacteriastrum
Chaetoceros
Campyloneis
Cocconeis
Auriculaceae
Thalassiophysa
Chaetoceros affinis
Chaetoceros compressus
Chaetoceros curvisetus + debilis + pseudocurvisetus
Chaetoceros danicus
Chaetoceros decipiens + lorenzianus
Chaetoceros densus + eibenii
Chaetoceros diadema
Chaetoceros didymus + protuberans
Chaetoceros fragilis + wighamii
Chaetoceros gracilis
Chaetoceros peruvianus
Chaetoceros perpusillus
Chaetoceros rostratus
Chaetoceros socialis + radians
Chaetoceros subtilis
Coscinodiscaceae
Coscinodiscus + Stellarima
Coscinodiscus
Coscinodiscus asteromphalus + oculus-iridis + perforatus
Coscinodiscus granii
Coscinodiscus radiatus + marginatus
Coscinodiscus wailesii
Stellarima
Stellarima stellaris
Cymatosiraceae
Arcocellulus + Minutocellus
Brockmanniella
Brockmanniella brockmannii
Campylosira
Campylosira cymbelliformis
Plagiogrammopsis
Plagiogrammopsis vanheurckii
Eupodiscaceae
Odontella
Odontella aurita
Odontella granulata
Odontella mobiliensis
Odontella regia
Odontella rhombus
Odontella sinensis
Triceratium
Triceratium favus
Heliopeltaceae
Actinoptychus
Actinoptychus senarius + campanulifer
Aulacodiscus
Hemidiscaceae
Actinocyclus
Leptocylindraceae
Corethron
Corethron criophilum
Leptocylindrus
Leptocylindrus danicus + curvatulus
Pseudo-nitzschia pungens
Pseudo-nitzschia seriata
Pseudo-nitzschia, sigmoid shape
Pseudo-nitzschia subpacifica
Leptocylindrus minimus
Lithodesmiaceae
Bellerochea
Ditylum
Ditylum brightwellii
Lithodesmium
Lithodesmium undulatum
Helicotheca
Melosiraceae
Melosira
Paralia marina
Podosira + Hyalodiscus
Podosira stelliger
Stephanopyxis
Rhizosoleniaceae
Dactyliosolen
Dactyliosolen fragilissimus
Guinardia
Guinardia flaccida
Guinardia delicatula
Guinardia striata
Proboscia
Proboscia alata var. alata
Proboscia alata var. indica
Rhizosolenia
Rhizosolenia hebetata
Rhizosolenia imbricata + styliformis
Rhizosolenia robusta
Rhizosolenia setigera + pungens
Thalassiosiraceae
Cyclotella
Detonula
Detonula pumila
Lauderia + Schroederella
Lauderia
Lauderia annulata
Schroederella
Skeletonema
Skeletonema costatum
Thalassiosira + Porosira
Porosira
Thalassiosira antarctica
Thalassiosira decipiens
Thalassiosira eccentrica
Thalassiosira levanderi + minima
Thalassiosira nordenskioeldii
Thalassiosira anguste-lineata
Thalassiosira punctigera
Thalassiosira rotula + gravida
Thalassiosira gravida
Thalassiosira rotula
Thalassiosira subtilis
Pennales
Achnanthaceae
Achnanthes
Anorthoneis
Akashiwo
Akashiwo sanguinea
Amphidinium
Amphidinium carterae + operculatum

Thalassiophysa hyalina
Cymbellaceae
Amphora
Entomoneidaceae
Entomoneis
Fragilariaceae
Asterionella + Asterionellopsis + Asteroplanus
Asterionella formosa
Asterionellopsis glacialis
Asteroplanus karianus
Climacosphenia
Dimeregramma + Glyphodesmis
Fragilaria
Grammatophora
Grammatophora serpentina
Licmophora
Plagiogramma
Podocystis
Rhabdonema
Rhaphoneis + Delphineis
Striatella
Synedra + Toxarium
Thalassionema + Thalassiothrix + Lioloma
Thalassionema nitzschioides
Naviculaceae
Berkeleya + Climaconeis
Caloneis
Diploneis
Donkinia
Gomphonema + Gomphoneis
Haslea
Haslea ostrearia
Haslea wawrikae
Mastogloia
Meuniera
Meuniera membranacea
Navicula + Fallacia + Haslea + Lyrella + Petroneis
Navicula gregaria + cryptocephala
Navicula pelagica
Pinnularia
Plagiotropis
Pleurosigma + Gyrosigma
Stauroneis
Toxonidea
Trachyneis
Nitzschiaceae
Bacillaria
Bacillaria paxillifera
Cylindrotheca
Cylindrotheca closterium
Cylindrotheca gracilis
Nitzschia + Hantzschia
Nitzschia longissima
Pseudo-nitzschia
Pseudo-nitzschia americana
Pseudo-nitzschia australis
Pseudo-nitzschia calliantha
Pseudo-nitzschia delicatissima
Ceratocorys
Cladopyxidaceae
Cladopyxis
Palaeophalacroma
Goniodomataceae
Alexandrium
Alexandrium affine
Alexandrium andersonii
Alexandrium hiranoi
Surirellaceae
Campylodiscus
Surirella
Dictyochophyceae
Dictyochales
Dictyochaceae
Dictyocha
Dictyocha fibula
Dictyocha speculum
Dinophyceae
Dinophysales
Dinophysaceae
Amphisolenia
Dinophysis
Dinophysis acuta
Dinophysis acuminata + cf. acuminata
Dinophysis caudata
Dinophysis dens
Dinophysis diegensis
Dinophysis fortii
Dinophysis hastata + odiosa
Dinophysis norvegica + cf. norvegica
Dinophysis pavillardii
tous Dinophysis ronds avec épithèque bien visible
Dinophysis sacculus + cf. sacculus
Dinophysis schroederi
Dinophysis skagii
Dinophysis tripos
Metaphalacroma
Metaphalacroma skogsbergii
Ornithocercus
Phalacroma
Phalacroma rotundatum
Phalacroma mitra + rapa
Sinophysis
Sinophysis ebriola
Oxyphysaceae
Oxyphysis
Oxyphysis oxytoxoides
Ebriales
Ebriaceae
Ebria
Ebria tripartita
Hermesinum
Gymnodiniales
Gymnodiniaceae
Pseudo-nitzschia pungens
Pseudo-nitzschia seriata
Pseudo-nitzschia, sigmoid shape
Pseudo-nitzschia subpacifica
Surirellaceae
Campylodiscus
Surirella
Dictyochophyceae
Dictyochales
Dictyochaceae
Dictyocha
Dictyocha fibula
Dictyocha speculum
Protoperidinium granii
Protoperidinium minutum
Protoperidinium obtusum
Protoperidinium pentagonum + latissimum
Protoperidinium punctulatum
Peridinium quinquecorne
Protoperidinium steinii + pyriforme
Protoperidinium venustum
Amphidinium crassum
Cochlodinium
Cochlodinium polykrikoides
Gymnodinium + Gyrodinium
Gymnodinium
Gymnodinium chlorophorum
Gymnodinium catenatum
Gymnodinium impudicum
Gymnodinium lohmanni
Gyrodinium
Gyrodinium spirale
Karenia
Karenia brevis + papilionacea
Karenia mikimotoi
Karlodinium
Karlodinium micrum
Katodinium
Katodinium glaucum
Pseliodinium
Pseliodinium vaubanii
Torodinium
Torodinium robustum
Polykrikaceae
Polykrikos
Polykrykos schwartzii
Ptychodiscaceae
Ptychodiscus
Ptychodiscus noctiluca
Warnowiaceae
Erythropsidinium
Warnowia + Nematodinium + Nematopsides
Noctilucales
Kofoidiniaceae
Kofoidinium
Kofoidinium velelloides
Spatulodinium
Spatulodinium pseudonoctiluca
Leptodiscaceae
Scaphodinium
Scaphodinium mirabile
Noctilucaceae
Noctiluca
Noctiluca scintillans
Protodiniferaceae
Pronoctiluca
Oxyrrhinales
Oxyrrhinaceae
Oxyrrhis
Oxyrrhis marina
Peridiniales
Amphidomataceae
Amphidoma
Ceratiaceae
Ceratium
Ceratium furca
Ceratium fusus
Ceratium lineatum + minutum
Ceratium ranipes
Ceratium tripos + Ceratium à cornes recourbées
Emiliania huxleyi
Hymenomonadaceae
Pleurochrysis
Pleurochrysis roscoffensis
Rhabdosphaeraceae
Acanthoica
Syracosphaeraceae
Syracosphaera + Coronosphaera + Caneosphaera

Alexandrium insuetum
Alexandrium leei
Alexandrium margalefii
Alexandrium minutum
Alexandrium ostenfeldii
Alexandrium pseudogonyaulax
Alexandrium tamarense + catenella + tamutum
Alexandrium catenella
Alexandrium tamarense
Alexandrium tamutum
Alexandrium taylorii
Goniodoma
Goniodoma polyedricum
Goniodoma sphaericum + orientale
Gonyaulacaceae
Amylax
Amylax triacantha + buxus
Gonyaulax
Gonyaulax digitale
Gonyaulax spinifera
Gonyaulax verior
Gonyaulax grindleyi
Lingulodinium
Lingulodinium polyedrum
Peridiniella
Protoceratium
Peridiniales incertae sedis
Adenoides
Fragilidium
Fragilidium subglobosum
Heterocapsa
Heterocapsa niei
Heterocapsa triquetra
Heterocapsa rotundata
Micracanthodinium
Ostreopsidaceae
Coolia
Coolia monotis
Ostreopsis
Oxytoxaceae
Amphidiniopsis
Oxytoxum + Corythodinium
Thecadinium
Thecadinium petasatum
Peridiniaceae
Diplopsalis+Diplopelta+Diplopsalopsis+Zygabikodinium+Oblea
Kryptoperidinium
Kryptoperidinium foliaceum
Protoperidinium + Peridinium
Protoperidinium bipes
Protoperidinium conicum
Protoperidinium crassipes
Protoperidinium depressum
Protoperidinium diabolum + longipes
Protoperidinium divergens
Scrippsiella + Ensiculifera + Pentapharsodinium + Bysmatrum
Bysmatrum
Bysmatrum subsalsum
Podolampadaceae
Blepharocysta
Podolampas
Pyrophacaceae
Pyrophacus
Prorocentrales
Prorocentraceae
Mesoporos
Prorocentrum
Prorocentrum compressum
Prorocentrum concavum
Prorocentrum emarginatum
Prorocentrum gracile
Prorocentrum lima + marinum
Prorocentrum mexicanum + rhathymum
Prorocentrum micans + arcuatum + gibbosum
Prorocentrum minimum + balticum + cordatum
Prorocentrum scutellum
Prorocentrum triestinum
Pyrocystales
Pyrocystaceae
Dissodinium + Pyrocystis
Euglenophyceae
Euglenales
Euglenaceae
Euglena
Phacus
Eutreptiales
Eutreptiaceae
Eutreptiella
Eutreptia
Prasinophyceae
Chlorodendrales
Chlorodendraceae
Tetraselmis + Prasinocladus
Halosphaeraceae
Halosphaera
Pachysphaera + Pterosperma
Pyramimonas
Pyramimonas longicauda
Prymnesiophyceae
Coccolithophorales
Calciosoleniaceae
Anoplosolenia
Calyptrosphaeraceae
Calyptrosphaera
Coccolithaceae
Coccolithus
Coccolithus pelagicus
Emiliania
Prymnesiales
Phaeocystaceae
Phaeocystis
Prymnesiaceae
Chrysochromulina
Chrysochromulina hirta + ericina + spinifera
Chrysochromulina parkeae + pringsheimii
Corymbellus
Corymbellus aureus
Prymnesium
Raphidophyceae
Raphidomonadales
Vacuolariaceae
Chattonella
Chattonella minima
Fibrocapsa
Fibrocapsa japonica
Heterosigma
Heterosigma akashiwo
Olisthodiscus
Phytoflagellates except dinoflagellates

Addendum
Role of nutrients in the estimates of the coastal waters quality
(22 April 2008)

If nutrients are not directly toxic for the marine environment, they can be sometimes considered as a pressure at the origin of indirect nuisances (increase of the chlorophyll biomass, change of the phytoplanctonic dominant species, massive development of macroalgae) being able to lead to the eutrophication (Figure 1). This type of phenomenon often has for origin an increase of the fluxes of nutrients poured in coastal zone because of anthropological contributions (washing out of the agricultural lands, urban or industrial discharges).

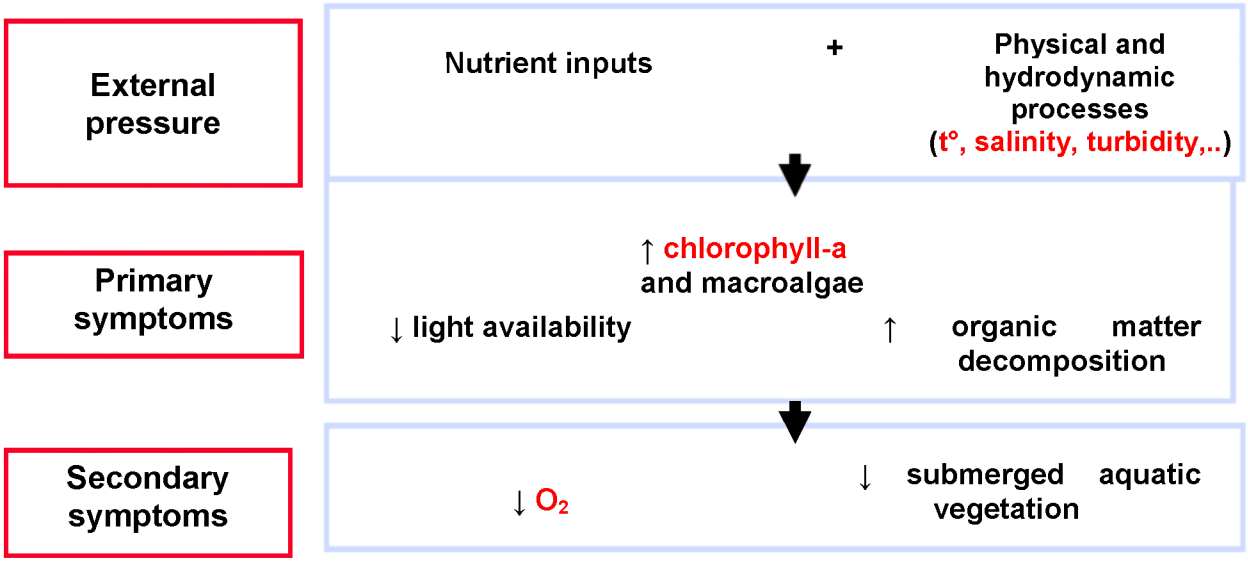

Figure 1 : Role of nutrients

However, the link between enrichment in nutrients and eutrophication of a coastal zone is very difficult to establish because of the more or less great importance of factors such as:

(1) The hydrodynamism of the zone (residual currents, tide currents, stratification of the water column, tidal range) which can lead a weak time of residence of nutrients in the coastal water body and favor an export of the river contributions towards the open sea. So, the bay of Brest and the bay of Seine, in spite of a doubling even a trebling of the nitrogen contributions in twenty years, did not present an anoxia of the bottom waters leading animal mortalities because of the intensity of the local hydrodynamism.

(2) The suspended matter which, beyond a certain concentration (> 10 mg/L), can reduce the light intensity penetrating into the water column (Hesse, 1995; Aminot and al., 1997), and thus to limit the phytoplanctonic development, even in the presence of strong concentrations of nutrients (ex: estuaries).

(3) The nature of the sediment which allows a more or less fast remineralization of the detrital organic matter.

(4) The limitation of the phytoplanctonic growth, by one or other one of the nutrients during productive period, which can favor the appearance (and the disappearance) of more or less harmful phytoplanctonic species.
(5) The salinity of the water body which, because of the generally linear relation between nutrients and salinity, implies a comparison of the concentrations in nutriments between water bodies of equivalent salinity.

Another difficulty to use the nutrients concentration as an indicator allowing to estimate the level of eutrophication of a coastal zone is due to the temporal phase shift between the maximum of chlorophyll biomass (generally in spring) and the maximal concentration of nutrients (in winter).
On the other hand, the comparison of the mean atomic ratios of the three nutrients (nitrate, phosphate, silicate) in the phytoplanctonic biomass was often used to estimate the element potentially limiting. If these ratios allow to break of the relation nutriments/salinity, they must be used with caution because they do not take into account the immediate concentrations of nutrients which evolve constantly under the influence of the multiple processes involved in the cycle of nutrients.

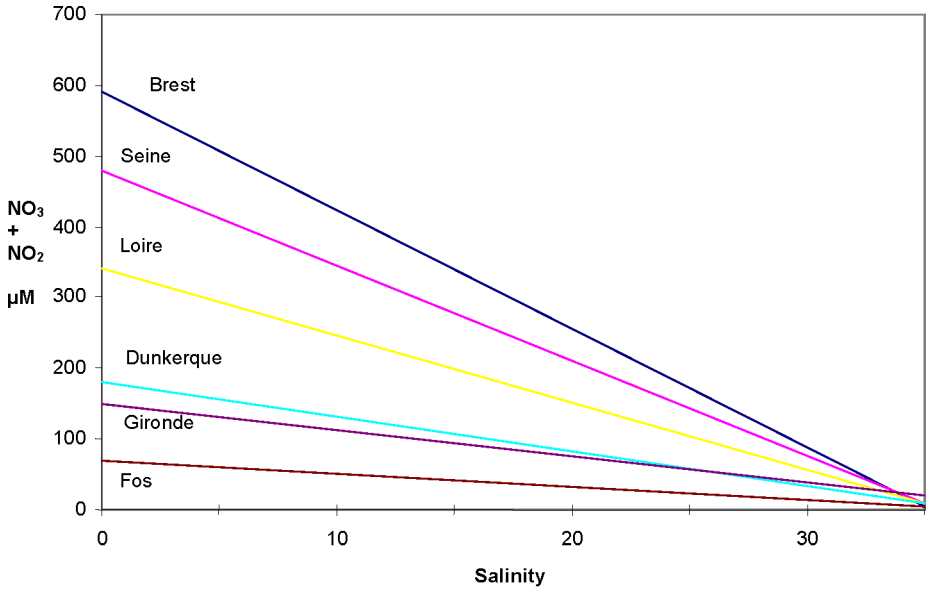

Figure 2 : Winter dilution of nitrate+nitrite on the various sites in 1995 (RNO data - Ifremer).

In estuaries and coastal zones, the mixture of sea water and continental waters is a major process of the distribution of the nutrients concentrations. Continental waters are so rich with regard to sea water as minor changes of salinity affect considerably the coastal concentrations, independently of any biological or chemical phenomenon. The salinity being a conservative parameter, it is used as reference for the other dissolved substances in estuary. So, the nutrients concentrations are diagrammatically represented by a straight line with regard to the salinity. The difference of behavior with regard to the conservative property allows to make hypotheses on involved mechanisms: an incurvation of the straight line downward can put in evidence a consumption (ex: denitrification, assimilation by the phytoplankton of the particulate phosphate,…) while an incurvation upward can put in evidence an anthropological contribution or a mineralization of the organic matter. In

this approach of the conservative property, we should not omit an essential point: the notion of constant concentration to the source during the residential time of waters in the estuary.
Given that the use of nutrients as indicator of the state of eutrophication of the coastal water bodies and estuaries water bodies can be very delicate, it seems more interesting to estimate the evolution of the "pressure" exercised by nutrients. This pressure is represented by the measure of nutrient concentrations from rivers before their mixture with the oceanic waters, that is in salinity 0 (Figure 2). This notion of pressure of nutrients can be an additional means to interpret the direct effects on the environment (chlorophyll, dissolved oxygen). It was indeed shown that the annual accumulated fluxes of nutrients by can be good indicators of the primary production of the coastal systems (Nixon, 1992).
Thus, the monitoring of nutrients within the WFD will be done only during the winter period.

REFERENCES

Aminot A, Guillaud JF, Kérouel R. (1997). La baie de Seine : hydrologie, nutriments et chlorophylle (1978-1994). Editions Ifremer, repères Océan, 14, 148 p.
Hesse KJ, Tillmann U., Brockmann U. (1995). Nutrient-phytoplankton relations in the German Wadden sea. ICES/C.M., CM1995/T:8, 13p.
Nixon SW (1992). Quantifying the relationship between nitrogen input and the productivity of marine ecosystems. Advanced Marine Technology Conference, No 5, Japan, pp. 57-83.