Département Océanographie et Dynamique des Écosystèmes
Unité Littorale
Laboratoire Environnement et Ressources
Centre Ifremer Manche Mer du Nord

Devreker David
Lefebvre Alain

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Third Application of the Comprehensive Procedure (**COMP3**) to determine eutrophication status of OSPAR marine waters.

French national report.

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Auteurs principaux	**Organisme / Direction / Service, laboratoire**
Devreker David	Ifremer/ODE/LITTORAL/LER.BL
Lefebvre Alain	Ifremer/ODE/LITTORAL/LER.BL
Contributeurs	
Ballu Sylvain	CEVA
Soudant Dominique	Ifremer/ODE/VIGIES
Lamoureux Alice	Ifremer/ODE/VIGIES
Brun Mélanie	Ifremer/ODE/VIGIES
Thieu Vincent	Paris VI/UMR 7619 METIS
Trut Gilles	Ifremer/ODE/LITTORAL/LER.AR
Le Bec Claude	Ifremer/ODE/LITTORAL/LER.BO
Menet-Nedelec Florence	Ifremer/ODE/LITTORAL/LER.N
Cochennec-Laureau Nathalie	Ifremer/ODE/LITTORAL/LER.MPL
Guesdon Stéphane	Ifremer/ODE/LITTORAL/LER.PC

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Destinataires

Ministère de l'Environnement, de l'énergie et de la mer / Direction de l'Eau et de la Biodiversité
OSPAR ICG-EUT – OSPAR HASEC

Résumé

Ce rapport est le 3ème rapport d'une série d'évaluation périodique de l'état d'eutrophisation des régions marines OSPAR (La « Procédure Commune » or COMP). Il fait suite et il est construit sur les résultats de la 1ère et 2ème application de la Procédure Commune. Il fait partie de l'évaluation globale de la qualité de la zone maritime OSPAR et de ses sous-régions qui repose sur une période d'évaluation allant de 2006 à 2014.

Abstract

This report is the third report in a series of periodic assessments of the identification of OSPAR maritime area eutrophication status (the "Common Procedure" or COMP). It follows and builds on the results of the first and second application of the Comprehensive Procedure and underpins the overall assessment of the quality of the OSPAR maritime area and its regions in 2017 based on the assessment period 2006-2014.

Mots-clés

OSPAR, Eutrophisation, évaluation, seuils, tendances, apports, azote, chlorophylle-*a*, oxygène, macrophytes, macroalgues, phytoplancton, phycotoxines.

Key words

OSPAR, Eutrophication, Assessment, threshlods, trends, riverine inputs, nitrogen, chlorophyll-*a*, macrophytes, macroalgae, phytoplankton, algal toxins.

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1. Summary

The French third application of the OSPAR comprehensive procedure is based on Water Framework Directive metrics and thresholds and OSPAR scoring aggregation methods in an effort to homogenize both approaches. Seven over the 10 criterion proposed by OSPAR were used to realized the assessment on 28 coastal areas. Results show a slightly increase in water quality compare to the precedent evaluation with trends showing an improvement of the overall situation in regard to the eutrophication status. No noticeable differences were observed between the present evaluation and evaluations made under WFD and MSFD. An effort was also done to homogenize the evaluation with those of border countries (based on COMP2 results). Solutions are proposed to assess more efficiently offshore areas in further procedures.

2. Introduction

This report is the third report in a series of periodic assessments of the identification of OSPAR maritime area eutrophication status (the “Common Procedure” or COMP) (OSPAR, 2005). It follows and builds on the results of the first (OSPAR, 2003) and second (OSPAR, 2009) application of the Comprehensive Procedure and underpins the overall assessment of the quality of the OSPAR maritime area and its regions in 2017 based on assessment period 2006-2014.

3. Description of the assessed area

In the first Procedure, the French marine area was divided into 35 sites based on 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 2007. In order to improve OSPAR and WFD programs to converge, it was decided to integrate this WFD concept of water masses into the definition of the OSPAR sites.

The lateral boundaries of OSPAR 2002 zones were revised so that each site contains coherent WFD water masses. Since OSPAR 2007 zones have lateral boundaries that coincide with a WFD water mass limit, OSPAR 2007 boundaries have been kept for the COMP3. The list of OSPAR zones, with the corresponding WFD water masses and MSFD regions is given in Table 1.

Table 1. Description of OSPAR zones.

N°	OSPAR Zones	OSPAR reporting unit involved (Lvl 4)	WFD water masse involved	MSFD Region (+ OSPAR reporting units Lvl 2)
1	Dunkirk and Calais	L4.2.2.1.22, L4.2.2.1.1	AC01, AC02	Greater North Sea (L2.2.2 + L2.2.5)
2	Boulogne, Canche, Authie and Somme	L4.2.2.1.2, L4.2.2.1.3, L4.2.2.1.4	AC03, AC04, AC05, AT01	Greater North Sea (L2.2.2)

3	Pays de Caux (Dieppe and Fécamp)	L4.2.2.1.5, L4.2.2.1.7, L4.2.2.1.25	HC18, HC17	Greater North Sea (L2.2.2)
4	Seine estuary and bay	L4.2.2.1.6, L4.2.2.1.17	HC16, HC15, HT03	Greater North Sea (L2.2.2)
5	Calvados	L4.2.2.1.18, L4.2.2.1.19, L4.2.2.1.20, L4.2.2.1.21	HC11, HC12, HC13, HC14	Greater North Sea (L2.2.2)
6	Baie des Veys and St Vaast	L4.2.2.1.23, L4.2.2.1.10, L4.2.2.1.8, L4.2.2.1.13	HC08, HC09, HC10, HT06	Greater North Sea (L2.2.2)
7	Cherbourg	L4.2.2.1.15, L4.2.2.1.16, L4.2.2.1.24, L4.2.2.1.14, L4.2.2.1.5	HC07, HC60, HC05, HC61	Greater North Sea (L2.2.2)
8	West Cotentin	L4.2.2.1.11, L4.2.2.1.12	HC04, HC03, HC01	Greater North Sea(L2.2.2)
9	Mont St Michel bay (Cancale)	L4.2.2.1.9, L4.2.2.3.21, L4.2.2.3.2	HC02, GC01, HT05	Greater North Sea (L2.2.2)
10	Rance, Arguenon and Fresnaye	L4.2.2.3.15	GC03, GT02	Greater North Sea(L2.2.2)
11	St Brieuc	L4.2.2.3.3, L4.2.2.3.4	GC05, GC06	Greater North Sea (L2.2.2)
12	Paimpol, Trieux, Jaudy	L4.2.2.3.5	GC07, GT03, GT04	Greater North Sea (L2.2.2)
13	Lannion and Morlaix	L4.2.2.3.6, L4.2.2.3.7, L4.2.2.3.8, L4.2.2.3.9, L4.2.2.3.10, L4.2.2.3.1, L4.2.2.3.16	GC08, GC09, GC10, GC11, GC12, GT06, GT07	Greater North Sea (L2.2.2)
14	Finistère abers	L4.2.2.3.11	GC13, GT08, GT09	Greater North Sea (L2.2.2)
15	Iroise	L4.3.1.5.1, L.4.2.2.3.18, part of L4.2.2.3.12	GC17, GC18	Greater North Sea – Celtic Sea (L2.2.2 + L2.3.1)
16	Brest	part of L4.2.2.3.12	GC16, GT10, GT11, GT12	Greater North Sea (L2.2.2)
17	Douarnenez	L4.2.2.3.13	GC20	Greater North Sea (L2.2.2)
18	Audierne	L4.3.3.2.41, L4.4.3.2.12, L4.2.2.3.13, L4.2.2.3.14, L4.3.1.5.3	GC24, GC26	Bay of Biscay and Iberian Coast (L2.4.1)
19	Concarneau, Aven and Belon	L4.4.3.2.14, L4.4.3.2.13	GC28, GC29, GT14, GT15, GT16, GT17	Bay of Biscay and Iberian Coast (L2.4.1)
20	Laïta, Lorient, Groix and Etel	L4.4.3.2.15, L4.4.3.2.16, L4.4.3.2.17, L4.4.3.2.18, L.4.3.2.20	GC32, GC33, GC34, GC35, GC37, GT18, GT19, GT20, GT21	Bay of Biscay and Iberian Coast (L2.4.1)
21	Bay of Quiberon and Belle Ile	L4.4.3.2.19, L4.4.3.2.21, L4.4.3.2.23	GC36, GC38, GC42, GT22	Bay of Biscay and Iberian Coast (L2.4.1)
22	Gulf of Morbihan	L4.4.3.2.22	GC39, GT23, GT24, GT25	Bay of Biscay and Iberian Coast (L2.4.1)
23	Vilaine	L4.4.3.2.20, L4.4.3.2.24, L4.4.3.2.25	GC44, GC45, GT26, GT27	Bay of Biscay and Iberian Coast (L2.4.1)
24	Loire and Bourgneuf	L4.4.3.2.26, L4.4.3.2.39, L4.4.3.2.2	GC46, GC48, GT28	Bay of Biscay and Iberian Coast (L2.4.1)
25	Vendée, Pertuis and Marennes	L4.4.3.2.27, L4.4.3.2.29, L4.4.3.2.30, L4.4.3.2.31, L4.4.3.2.32, L4.4.3.2.33, L4.4.3.2.38, L4.4.3.2.32, L4.4.3.2.34, L4.4.3.2.37, L4.4.3.2.11, L4.4.3.2.2	GC47, GC49, GC50, GC51, GC53, GC52, GC54, FC01, FC02, GT30, GT31	Bay of Biscay and Iberian Coast (L2.4.1)
26	Gironde	L4.4.3.2.10, L4.4.3.2.9	FC03, FC04, FT05, FT04, FT09	Bay of Biscay and Iberian Coast (L2.4.1)
27	Arcachon and Landes	L4.4.3.2.3, L4.4.3.2.7, L4.4.3.2.4, L4.4.3.2.6	FC05, FC06, FC07, FC08, FC09	Bay of Biscay and Iberian Coast (L2.4.1)
28	Pays Basque	L4.4.3.2.5, L4.4.3.2.8	FC10, FC11	Bay of Biscay and Iberian Coast (L2.4.1)

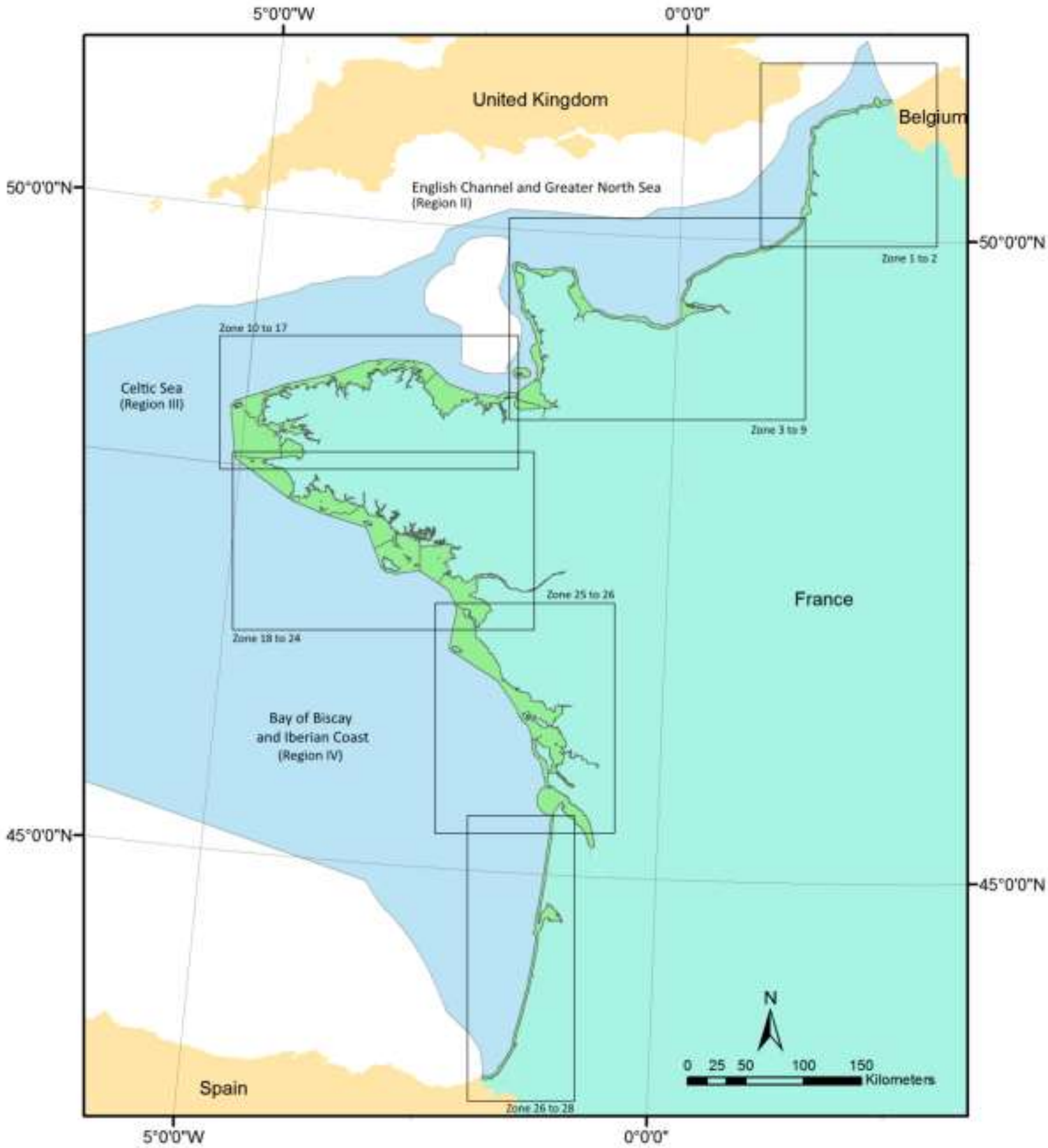

Figure 1. General overview of the main French assessments areas used for COMP3.

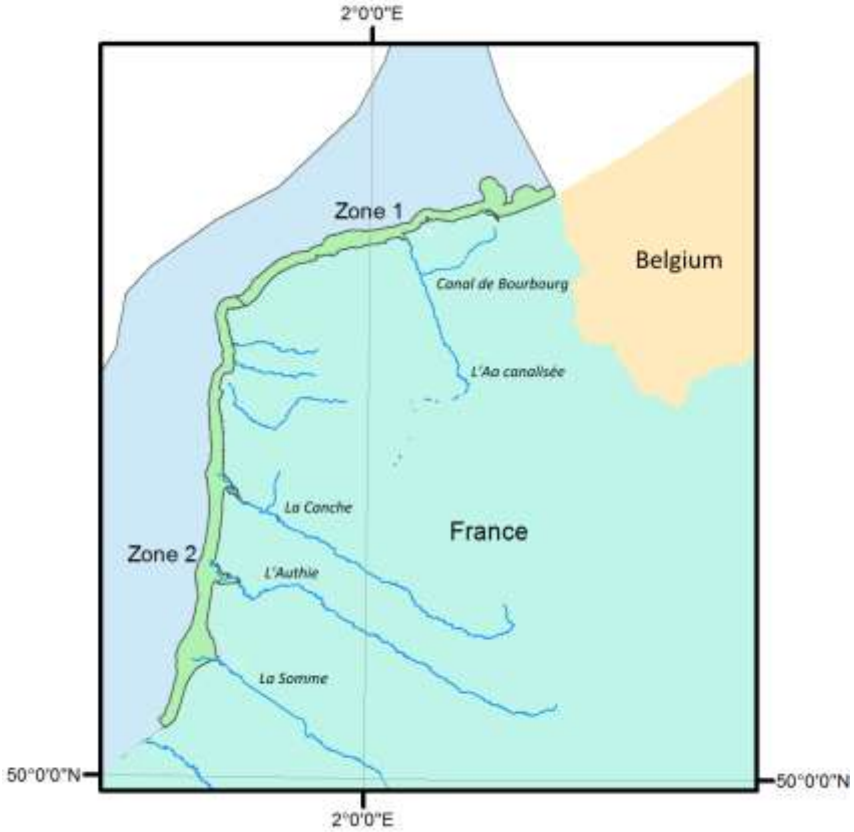

Figure 2. Detail of assessment areas (Zones 1 and 2) used for COMP3 in the eastern English Channel.

3.1 Dunkirk and Calais (Zone 1)

The Dunkirk and Calais site is the French southern shore of the North Sea (Figure 1 and 2). It is a low dune 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 of 520 km²; main rivers mean annual flow rate of 4.6 $m^3.s^{-1}$; Population of coastal towns and villages: 231 090 inhabitants.

3.2 Boulogne, Canche, Authie and Somme (Zone 2)

From Boulogne to the Canche (Figure 1 and 2), 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 of 8948 km²; main rivers mean annual flow rate of 90 $m^3.s^{-1}$; Population of coastal towns and villages: 141 968 inhabitants.

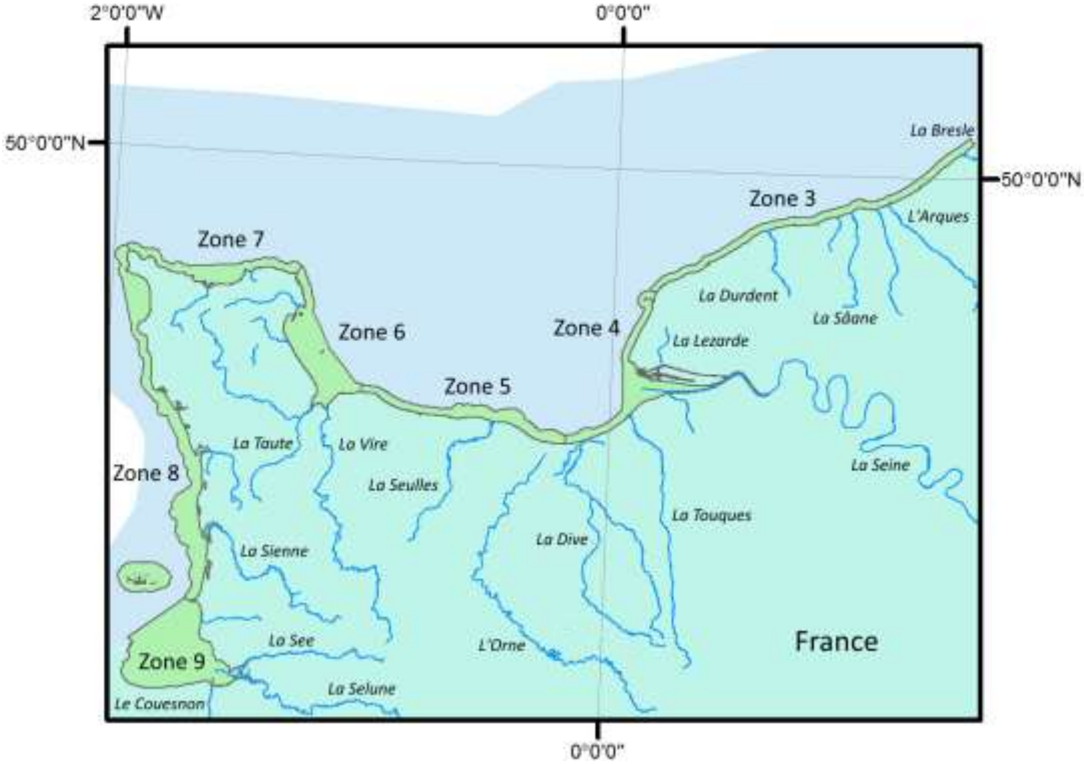

Figure 3. Detail of assessment areas (Zones 3 to 9) used for COMP3 in the eastern English Channel.

3.3 Pays de Caux (Zone 3)

The Dieppe and Fécamp site (Figure 2 and 3) is bordered by high cretaceous limestone cliffs (30 to 80 m) that are mostly in the process of erosion. 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 offshore. This site is mainly influenced by inputs from the Seine to the west.
Catchment area of 3 820 km²; main rivers mean annual flow rate of 29 $m^3.s^{-1}$ (Bresle and Arques); Population of coastal towns and villages: 95 205 inhabitants.

3.4 Seine estuary and bay (Zone 4)

The Seine estuary and bay site (Figure 1 and 3) is situated at the mouth of a catchment area under much pressure from farming, industries 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 Seine waters, and by the small coastal rivers Touques and Risle. The Seine plume orientation is driven by wind direction.
Catchment area of 82 318 km²; main rivers mean annual flow rate of 502 $m^3.s^{-1}$; population of coastal towns and villages: 262 336 inhabitants.

3.5 Calvados (Zone 5)

The Calvados site (Figure 1 and 3) 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 in north-eastern winds condition.
Catchment area of 5 371 km²; main rivers mean annual flow rate of 33,5 $m^3.s^{-1}$; population of coastal towns and villages: 41 373 inhabitants.

3.6 Baie des Veys and St Vaast (Zone 6)

The Baie des Veys and St Vaast site (Figure 1 and 3) 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. Under strong north-eastern winds condition, this site is also under the Seine plume influence.
Catchment area of 3 857 km²; main rivers mean annual flow rate of 40 $m^3.s^{-1}$; Population of coastal towns and villages: 9 723 inhabitants.

3.7 Cherbourg (Zone 7)

Rocky coast, macrotidal regime, deep substratum with mixed sediment (Figure 1 and 3). This site present very strong westward tide currents promoting the homogenization of waters. The embankments around the Cherbourg harbor create a confined zone with complex currents. The Cap Lévy act as a current barrier between the east and west part of the site.

3.8 West Cotentin (Zone 8)

Rocky coast, macrotidal regime, deep substratum with mixed sediment to the north of Cap Carteret, the south of the site present large intertidal sandy areas (Figure 1 and 3). The salinity is influenced by waters from eight natural havens spread along the coast. This site is under the pressure of shellfish farming (oysters and mussels) and farming in the catchment. The Chausey archipelago is not under the influence of terrigenous inputs, and currents tend to circulate around the archipelago giving a relatively confined characteristic to the water body.

3.9 Mont St Michel Bay (Zone 9)

This site is characterized by a large intertidal coastal area (~ 50 %) with muddy dominance (Figure 1 and 3). The salinity is influenced by the waters of the coastal rivers Couesnon, Sée and Sélune whose outlets surround the Mont St Michel. The catchment is mainly under pressure of farming and tourism, and the site is used for shellfish farming (oysters and mussels).

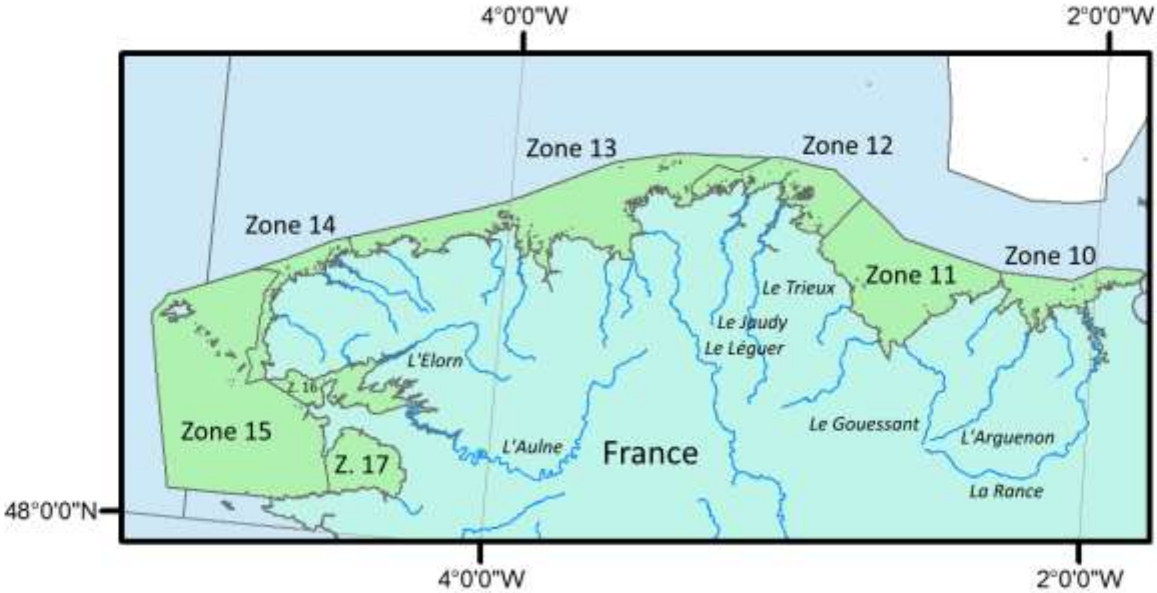

Figure 4. Detail of assessment areas (Zones 10 to 17) used for COMP3 in the western English Channel.

3.10 Rance, Arguenon and Fresnaye (Zone 10)

The Rance, Arguenon and Fresnaye site (Figure 1 and 4) 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 of 2 055 km²; main rivers mean annual flow rate of 4 $m^3.s^{-1}$ (Rance: 2.57 Arguenon: 0.82 Fremur: 0.23); Population of coastal towns and villages: 106 275 inhabitants.

3.11 St Brieuc (Zone 11)

The St Brieuc site (Figure 1 and 4) 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 of 1 212 km²; main rivers mean annual flow rate of 3.9 $m^3.s^{-1}$; (Le Gouessant: 1.44, Le Gouet: 1.67); Population of coastal towns and villages: 101 134 inhabitants.

3.12 Paimpol, Trieux, Jaudy (Zone 12)

The Paimpol, Trieux and Jaudy site (Figure 1 and 4) is a wide granite coast rocky flat extended out to sea by multiple reefs and islets with two deep estuaries, those of Trieux and Jaudy. The waters are extremely mixed by the tide but include some areas of low renewal. The medium-size Rivers drain an intensive agriculture activity.

Catchment area of 1 434 km²; main rivers mean annual flow rate of 9.5 $m^3.s^{-1}$ (Jaudy: 1.73, Trieux: 5.39); Population of coastal towns: 31 051 inhabitants.

3.13 Lannion and Morlaix (Zone 13)

The Lannion and Morlaix site (Figure 1 and 4) 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 of 1 770 km²; main rivers mean annual flow rate of 8 $m^3.s^{-1}$; (Léguer: 6.41, Yar: 0.8, Horn: 0.71); Population of coastal towns and villages: 114 968 inhabitants.

3.14 Finistère abers (Zone 14)

The Finistère abers site (Figure 1 and 4) 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 of 811 km²; main rivers mean annual flow rate of 2.4 $m^3.s^{-1}$ (Aber Wrac'h: 0.45, Aber Benoit: 0.48, Aber Ildut: 1.47); Population of coastal towns and villages: 38 872 inhabitants.

3.15 Iroise (Zone 15)

The Iroise site (Figure 1 and 4) covers the Iroise Sea area except the “Chausssée du sein”, attached to the Audierne site. It is a dangerous maritime area, traditional hydrographic feature between the Atlantic Ocean and the Bay of Brest and Douarnenez Bay. The morphology of the Molène Archipelago and Ouessant Island is similar to the northern Finistère Pointe which it constitutes an extension (see the site of Finistère Abers). The population of the Ouessant and Molene islands is 1 196 inhabitants.

3.16 Brest (Zone 16)

The Brest site (Figure 1 and 4) 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 of 2 631 km²; main rivers mean annual flow rate of 38 $m^3.s^{-1}$; (Elorn: 5.62, Aulne: 32); Population of coastal towns and villages: 242 163 inhabitants.

3.17 Douarnenez (Zone 17)

The Douarnenez site (Figure 1 and 4) 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 of 370 km²; main rivers mean annual flow rate of 1.5 $m^3.s^{-1}$; Population of coastal towns and villages: 33 340.

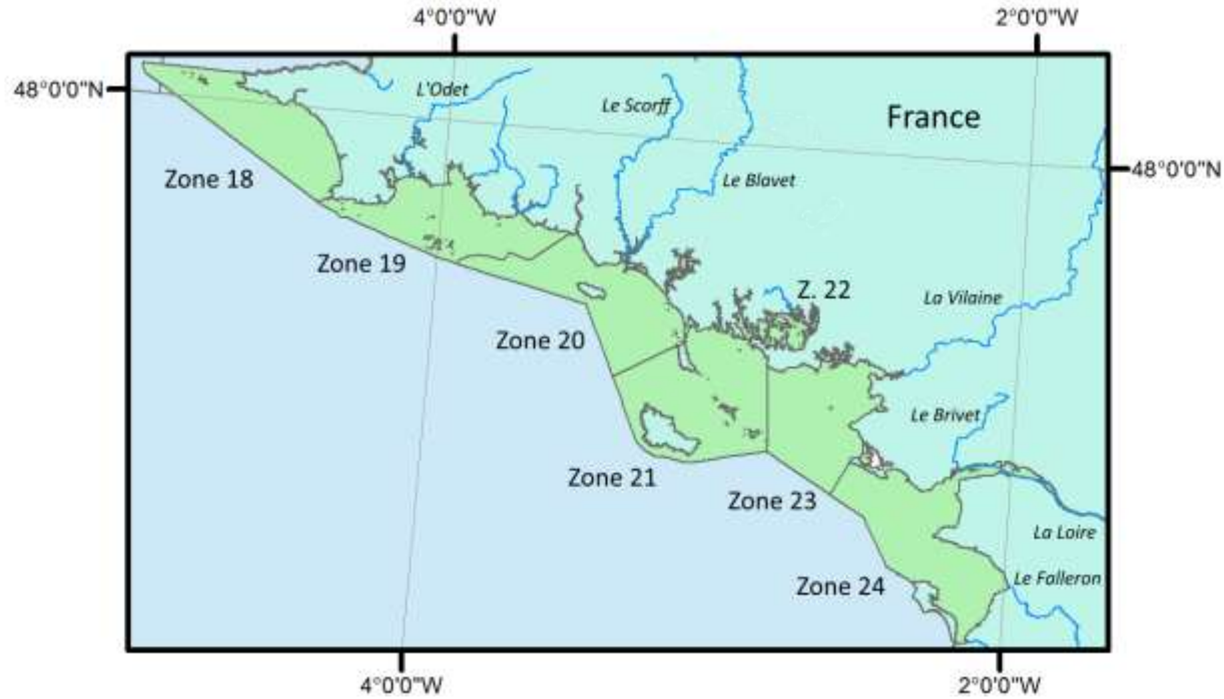

Figure 5. Detail of assessment areas (Zones 18 to 24) used for COMP3 in the Bay of Biscay.

3.18 Audierne (Zone18)

The Audierne site (Figure 1 and 5) 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 of 351 km²; main rivers mean annual flow rate of 1.5 $m^3.s^{-1}$ (Goyen: 1.41); Population of coastal towns and villages: 29 519 inhabitants.

3.19 Concarneau, Aven and Belon (Zone 19)

The Concarneau, Aven, Belon site (Figure 1 and 5) 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 of 1 380 km²; main rivers mean annual flow rate of 12 $m^3.s^{-1}$ (Odet: 7.87, Aven: 3.76); Population of coastal towns and villages: 78 969 inhabitants.

3.20 Laïta, Lorient, Groix and Etel (Zone 20)

The Lorient site (Figure 1 and 5) has a steep or mixed rocky coast to the west Laita ria, creating sandbars. Lorient harbour is the opening of the Blavet and Scorff ria in the Atlantic Ocean. Groix Island is located at 3 nautical miles from the coast. It consists

essentially of numerous valleys and bordered by steep cliffs. At the east, Etel ria is draining an area of intensive farming.
Catchment area of 3 773 km²; main rivers mean annual flow rate of 56.3 $m^3.s^{-1}$ (Laïta: 13.4, Scorff: 15.0, Blavet: 26.7); Population of coastal towns and villages: 172 929 inhabitants.

3.21 Bay of Quiberon and Belle Ile (Zone 21)

The Quiberon Bay and Belle-Île site (Figure 1 and 5) is composed of several areas. The cliffs of Belle-Ile shield it from the south-westerly 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 and the Vilaine rivers). 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 of 156 km²; main rivers mean annual flow rate of about 1 $m^3.s^{-1}$; population of coastal towns and villages: 26 216 inhabitants.

3.22 Gulf of Morbihan (Zone 22)

The Gulf of Morbihan site (Figure 1 and 5) is open on the Quiberon Bay via a narrow gap. It receives water from four major rivers, Auray, Vannes, Vincin and Noyalo Rivers. 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 of 731 km²; main rivers mean annual flow rate of 1.1 $m^3.s^{-1}$; Population of coastal towns and villages: 110 428.

3.23 Vilaine (Zone 23)

The Vilaine site (Figure 1 and 5) 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 of 11 073 km²; main rivers mean annual flow rate of 27 $m^3.s^{-1}$; population of coastal towns and villages: 34 164 inhabitants.

3.24 Loire and Bourgneuf (Zone 24)

The Loire and Bourgneuf site (Figure 1 and 5) 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 Noirmoutier Island, 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 of 118 892 km²; main rivers mean annual flow rate of 910 $m^3.s^{-1}$; population of coastal towns and villages: 152 282 inhabitants.

Figure 6. Detail of assessment areas (Zones 25 and 26) used for COMP3 in the Bay of Biscay.

3.25 Vendée, Pertuis and Marennes (Zone 25)

The Vendée, Pertuis and Marennes site (Figures 1 and 6) is composed in its northern part by sandy coasts partially stratified which turn southern in a muddy coast partially exposed to the sea (east and south-east of Ile de Ré; east of Ile d'Oleron) and mesotidal shallow rocky coast (wert and south-west of Ile de Ré; north of Ile d'Oleron).

3.26 Gironde (Zone 26)

The Gironde site (Figures 1 and 6) present a sandy coast in the northern part of the zone, highly exposed to the sea. Southern is the Gironde estuary itself, a large estuary medium to highly salty with high water flow (mean annal flow rate 960 $m^3.s^{-1}$). Catchment area of 80 000 km².

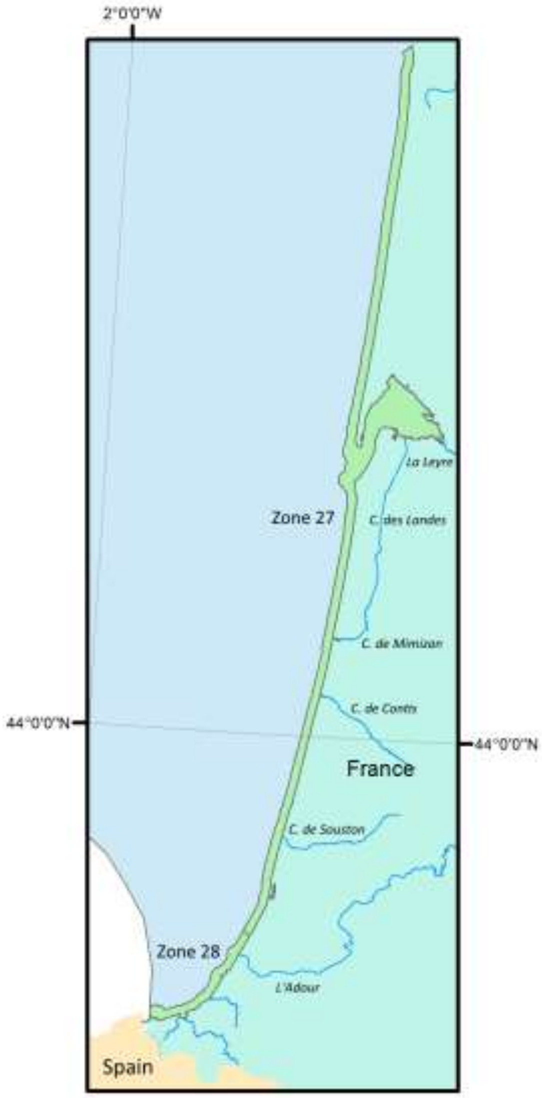

Figure 7. Detail of assessment areas (Zones 27 and 28) used for COMP3 in the Bay of Biscay.

3.27 Arcachon and Landes (Zone 27)

The Arcachon and Landes site (Figure 1 and 7) 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 of 6 350 km²; main river mean annual flow rate of the (Leyre) 22 $m^3.s^{-1}$; population of coastal towns and villages: 150 999 inhabitants.

3.28 Pays Basque (Zone 28)

The Pays Basque site (Figure 1 and 7) is composed in its northen part by a sandy coast highly exposed to the sea which continue in the southern part to a mesotidal shallow rocky coast.
Catchment area of 16 880 km²; main river mean annual flow rate of the (Adour) 350 $m^3.s^{-1}$.

4. Methods and data

The Eutrophication Committee (EUC) listed information to be included in the definition of the eutrophication status of the maritime areas (Table 2). In some cases, the criteria used for implementing the procedure in France do not completely meet the recommendations of the EUC committee, the differences from or in additions to the EUC criteria are given in italic and will be explained later.

Table 2. Harmonized assessment parameters and related elevated levels.

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)
2 Winter concentrations of dissolved inorganic nitrogen and phosphorus
Elevated levels (defined as concentrations >50% above the salinity-related or area-specific background concentrations)
DIN (normalized at salinity 33) elevated levels (>29 $\mu mol.l^{-1}$), DIP not used by France
3 Winter N/P ratio (Redfield N/P = 16)
Elevated levels (>25)
Criteria not used by 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 $cells.l^{-1}$ (unicellulars < 20µm without chain)
- large: 100 000 $cells.l^{-1}$ (colonial species < 20µm + sp. > 20µm)
Elevated levels > 40% of samples above reference abundances
3 Macrophytes, including macroalgae (region specific)
Trend from long-lived species to short-lived species (e.g. *Ulva*)
Elevated levels: depends of the green tide types and the proportion of potentially colonisable substrate

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 < $3mg.l^{-1}$
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
Criteria not used by France
3 Organic carbon/organic matter
Elevated levels (related to III.1) (concerning sedimentation areas)
Criteria not used by France

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 (include the ASP in addition to DSP/PSP)
Elevated levels: Indicator > 2

4.1 Inventory of available data

Sampling effort vary greatly as a function of the assessment parameter considered and the OSPAR zone (Table 3). The reasons are 1) some parameters are common to different monitoring network (Oxygen, Chlorophyll-*a* = Chla) with a higher measurement period and frequency and 2) some parameters as algal toxin measurement respond to specific local problems such as shellfish farming. OSPAR zones where there is no data of nitrogen fluxes are zones where no rivers have been considered for the assessment due to their too small catchment area (see 4.3.1).

Table 3. Data quantity and sampling effort by assessment parameter and OSPAR zone for the entire assessment period. Data in parenthesis (Winter DIN column) represent the number of samples take for 12 months (not only during the winter period) during the assessment period. N. of Stations is the sum of all stations used to measures the parameters WinterDIN, Chla, Phytoplankton, Oxygen and Algal Toxins

				Number of data						
N°	**OSPAR Area**	N. of Stations	Surf. area (km²)	Nfluxes (2006-**2010**)	Winter DIN (2006-2014)	Chla (2006-2014)	Phyto. Indic. (2006-2014)	MacroP. (2006-2014)	Oxygen (2006-2014)	Algal toxins (2006-2014)
1	Dunkirk and Calais	11	210	360	29 (106)	174	124	*NA*	210	12
2	Boulogne, Canche, Authie and Somme	5	295	540	102 (371)	679	683	*NA*	549	95
3	Pays de Caux (Dieppe and Fécamp)	4	233	900	18 (64)	133	192	*NA*	221	26 (21)
4	Seine estuary and bay	10	267	720	76 (362)	614	663		1 115	250
5	Calvados	6	184	360	95 (381)	673	978		1 394	95
6	Baie des Veys and St Vaast	13	281	360	127 (532)	706	894		1 411	200
7	Cherbourg	4	177	*NA*	31 (114)	119	191		208	93
8	Ouest Cotentin	8	598	180	129 (460)	699	932		1 373	77
9	Mont St Michel bay (Cancale)	11	526	540	47 (126)	382	420		554	17
10	Rance, Arguenon and Fresnaye	11	255	360	27 (81)	509	971		455	49
11	St Brieuc	4	796	180	21 (29)	139	322		255	16
12	Paimpol, Trieux, Jaudy	23	373	360	29 (58)	396	330	70200 (total of surfaces or "polygons" studied by years from aerial photography)	596	8
13	Lannion and Morlaix	16	981	180	84 (170)	646	709		646	263
14	Finistère abers	15	186	*NA*	20 (40)	120	269		110	50
15	Iroise	3	1 694	*NA*	*NA*	230	354		17	350
16	Brest	47	218	360	20 (28)	646	451		679	719
17	Douarnenez	2	243	*NA*	21 (29)	225	239		170	390
18	Audierne	2	715	*NA*	*NA*	163	220		7	188
19	Concarneau, Aven and Belon	23	699	180	111 (293)	558	463		909	1 260
20	Laïta, Lorient, Groix and Etel	32	759	540	112 (351)	521	741		1 130	755
21	Bay of Quiberon and Belle Ile	9	934	*NA*	80 (228)	352	511		587	669
22	Gulf of Morbihan	17	104	*NA*	44 (151)	237	207		326	22

23	Vilaine	21	682	180	86 (275)	729	1421		1 634	1 314
24	Loire and Bourgneuf	15	765	900	51 (118)	645	981		1 125	124
25	Vendée, Pertuis and Marennes	15	2 594	1 440	97 (135)	2 498	2709		1 756	548
26	Gironde	2	581	900	*NA*	270	129		287	49
27	Arcachon and Landes	10	638	1 080	271 (813)	3 389	1861	*NA*	5 599	1 276
28	Pays Basque	1	74	180	24 (65)	92	94	*NA*	174	*NA*

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 zones in their offshore range. This spatial coverage represents 17% of the French Greater North Sea sub-marine region and 5% of the French Bay of Biscay – Iberian Coast sub-region (Table 3) and is also due to the French monitoring networks role that is devoted to observation/monitoring of shellfish farming area. The offshore boundaries of the 2002 sites were the boundaries of the territorial waters (baseline + 12 nautical miles).

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 WFD water masses of the sites from Dunkirk and Calais to the Somme present strong phytoplankton biomass with input of nutrient due to local rivers and to the Seine estuary.
- The eutrophication status around Brittany being mainly due to green tides, a very coastal phenomenon, the status of the area between the 1nm and 12 nm can be considered to non-problematic.
- More generally area supporting strong coastal phytoplanktonic biomass (Figure 8) and/or area with strong turbidity (large estuaries) where the nutrient input can induce eutrophication beyond the maximum turbidity zone can present a decreasing gradient of eutrophication from inshore to offshore of unknown intensity. Therefore thearea between the 1 nm and 12 nm can be considered as potential-problem area.

However reflections on the possibility of extension of the French networks to offshore areas have been already engaged in relation to the Marine Strategy Framework Directive implementation; particularly in areas identified by satellite observation that sustain a strong development of phytoplankton biomass (Figure 8).

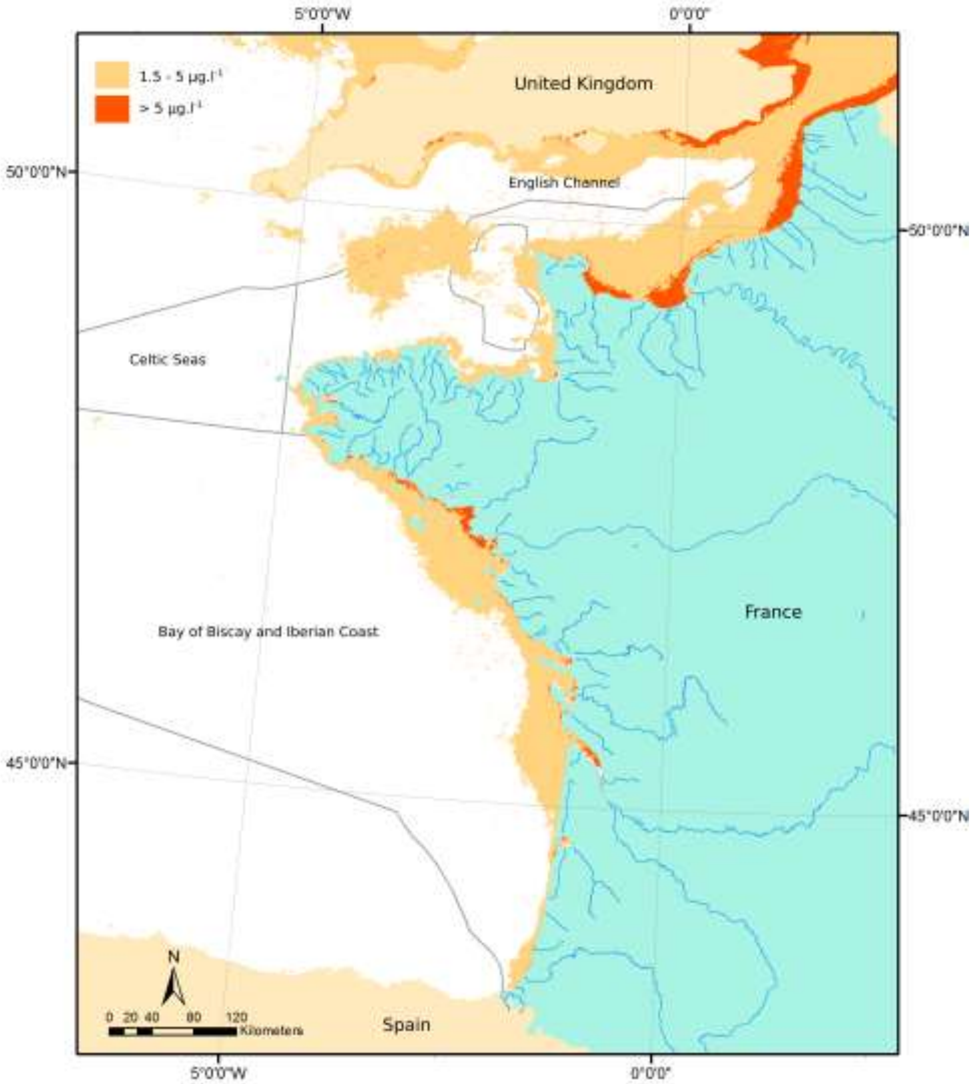

Figure 8. Map of high phytoplanktonic biomass areas (chla in µg.l^{-1}) (climatology from 2003 - 2010) derived from MODIS Chlorophyll-*a* Pigment Concentration product.

4.2 Calculation and quality of time series

4.2.1 Data from Quadrige²

Field collected and/or laboratory analyzed data are captured into the Quadrige² database through the application of the same name (Figure 9). Data **Control** is under the responsibility of people in charge of data input and/or people with access to field records and laboratory sheets. They make a data output (results and metadata) and check their consistency with the field sheets.

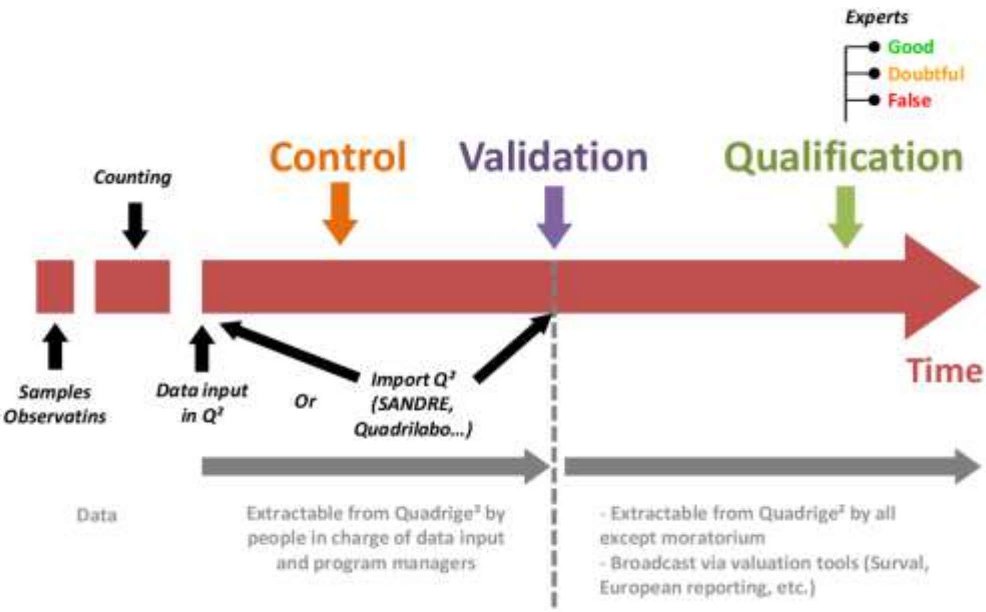

Figure 9. Schema of the Quadrige² data qualification processes (from Le Moigne and Gauthier, 2015).

Once the control and corrections have been done, **data are validated** by these same operators:

1. Confirmation of the **technical validity** of the data (correspondence with the result of the analysis)
2. Data are **locked** (it cannot be changed, even by people in charge of data input)
3. **Dissemination** of the data: validated data are downloadable by all Q² users with access to the database, and disseminated via Surval (unless the data is protected by a moratorium).

Qualification is realized after that first data verification process. Qualification involves:

• Research of doubtful data or outliers from a scientific point of view,
• Correction of data when possible,
• Attribution of a qualification level to the data. This level is:

o **good** : data make sense, their analysis will be relevant,
o **doubtful:** data may be wrong : they may bias the analysis that will be made,
o **false:** data are aberrant or had a known problem (e.g. bad analytical series and impossibility to remake). They will not be integrated with data analysis.

Qualification level corresponds to the confidence level in the data. Only data qualified "good" and "doubtful" are disseminated via Surval.
Qualification is divided into two main steps: an **"automatic" qualification** and **"expert" qualification**.

➔ **"Automatic" qualification**

Obvious or easily identifiable errors are detected (e.g.: parameter or analytical support error, error in the samples: 100°C instead of 10°C) or inconsistencies (e.g.: data entered on the level "surface" with a depth of 20m). These errors can be detected by computer by defining simple control rules (e.g. immersion < 2m). Automatic qualification involves awarding a level of quality data possibly temporary (good, doubtful or false). Only good or doubtful qualified data are used for expert qualification.

➔ **“Expert” qualification**

The responsible for this qualification are thematic experts who have the scientific knowledge needed to interpret data. It consists to highlight the statistical outliers via appropriate methods (time series, statistical tests ...).

4.2.2 Data from Water Agencies and DREAL (riverine inputs)

The nitrogen (Nitrate + Ammonium + Nitrite = NO_3 + NH_4 + NO_2) flow data come from the modeling performed in the framework of the EMoSEM project (Ecosystem Models as Support to Eutrophication Management In the North Atlantic Ocean, EMoSEM, 2015). Raw data of water discharge come from the HYDRO data bank (DREAL) and water quality data from regional Water Agencies (from northern to southern : AEAP, AESN, AELB, AEAG). These agencies used their own data qualification and validation processes.

4.2.3 Data from CEVA (macrophytes)

Data used to assess macrophytes (green tides) are qualified and validated by experts of the CEVA prior to their banking in a multi-annual database.

4.3 Methods of consideration of environmental factors in the assessment

4.3.1 Riverine inputs

Based on the CCM2 base (Catchment Characterisation and Modelling, Vogt et al., 2007), 174 basins over 300 km² were identified between the Rhine and Guadalquivir, 60 basins were kept for the French OSPAR coastal area. For a good seasonal resolution, 10 years simulations (2000-2010) were performed at the decadal time step (10 days) using the PyNuts-Riverstrahler modeling platform developed under the project. These simulations are performed at constant anthropogenic pressures, which correspond to a contemporary situation (land use 2006, 2010 sanitation etc.) combined with chronic hydrology from 2000-2009.

Kinetics and parameters of Riverstrahler model were estimated from experimental works or obtained from literature reviews. The Riverstrahler model does not require any calibration and could be applied to any river system.

Nitrogen fluxes of rivers from the same OSPAR zone (Table 1) were added by decades: only the period 2006-2010 was considered. Therefore, the temporal trend was analyzed with the Mann-Kendall test by using the R tool TTAinterface (Devreker and Lefebvre, 2014). If the trend is significantly positive, the score is “+” otherwise the score is “-“. In case of significant trend, the percentage of decreasing nitrogen fluxes per year was reported: this is the Sen’s slope. Confidence rate is the p.value given by the statistical test.

4.3.2 Winter DIN

Winter DIN (NO_3 + NO_2 + NH_4) COMP3 score calculation was derived from the DIN WFD EQR calculation for the period 2006-2014. The WFD boundary between moderate and good is the OSPAR boundary between + and -. Therefore OOAO aggregation rule was used to aggregate WFD water masses EQR in OSPAR zone, the most declassified (from worst to best : +, ?, -) water masses give the OSPAR Zone score. DIN WFD EQR was calculated as followed.

<u>DIN metric</u>

DIN metric index is the normalized concentration at salinities 33 of all measurements in a WFD water masses on the entire 9 years evaluation period (nutrient sampling are performed from November to February at 1meter under the surface of the sea near the high tide (HT ± 2h)). Thus annual assessments were not available and score were given for WFD water masses that constitute an OSPAR zone. If less than 18 measurements are available, no evaluation was performed (Daniel and Soudant, 2010) giving "?" COMP3 score. The same is applied if less than 6 measurements are associated with salinities over 20. To determine a DIN threshold value, we had to rely on historical data acquired as part of Ifremer monitoring networks (the WFD monitoring programme started in autumn 2007).
The three ecotypes with a series of consistent data for the period 2003 - 2008 are: the Seine estuary (Seine Est), the estuary of the Loire and the Arcachon basin. Then the first step in the search for DIN thresholds was to draw the dilution line DIN = f (salinity) for each of these three "control" ecotypes. Using the slope of these lines of dilution, the DIN concentration of each of the 3 "control" ecotypes was normalized to salinity of 33.

<u>DIN thresholds</u>

To calculate the DIN threshold the normalized concentration of DIN at salinity 33 was put into perspective with a primary symptom of eutrophication: chla. The normalized concentrations of DIN of the 3 "control" ecotypes were associated with percentiles 90 chla normalized as EQR (Figure 10) (chla EQR is calculated from all chla values of each of the 3 ecotypes measured between March and October for 6 years). The line resulting from the 3 "control" ecotypes allow to link the EQR chla "good / moderate condition" (= 0.33) with a DIN concentration arbitrarily defined as "thresholds" between these two states: equal to 29µmol.l^{-1} (Figure 11). Thus, this method allows calculating a threshold but not a reference value for DIN.

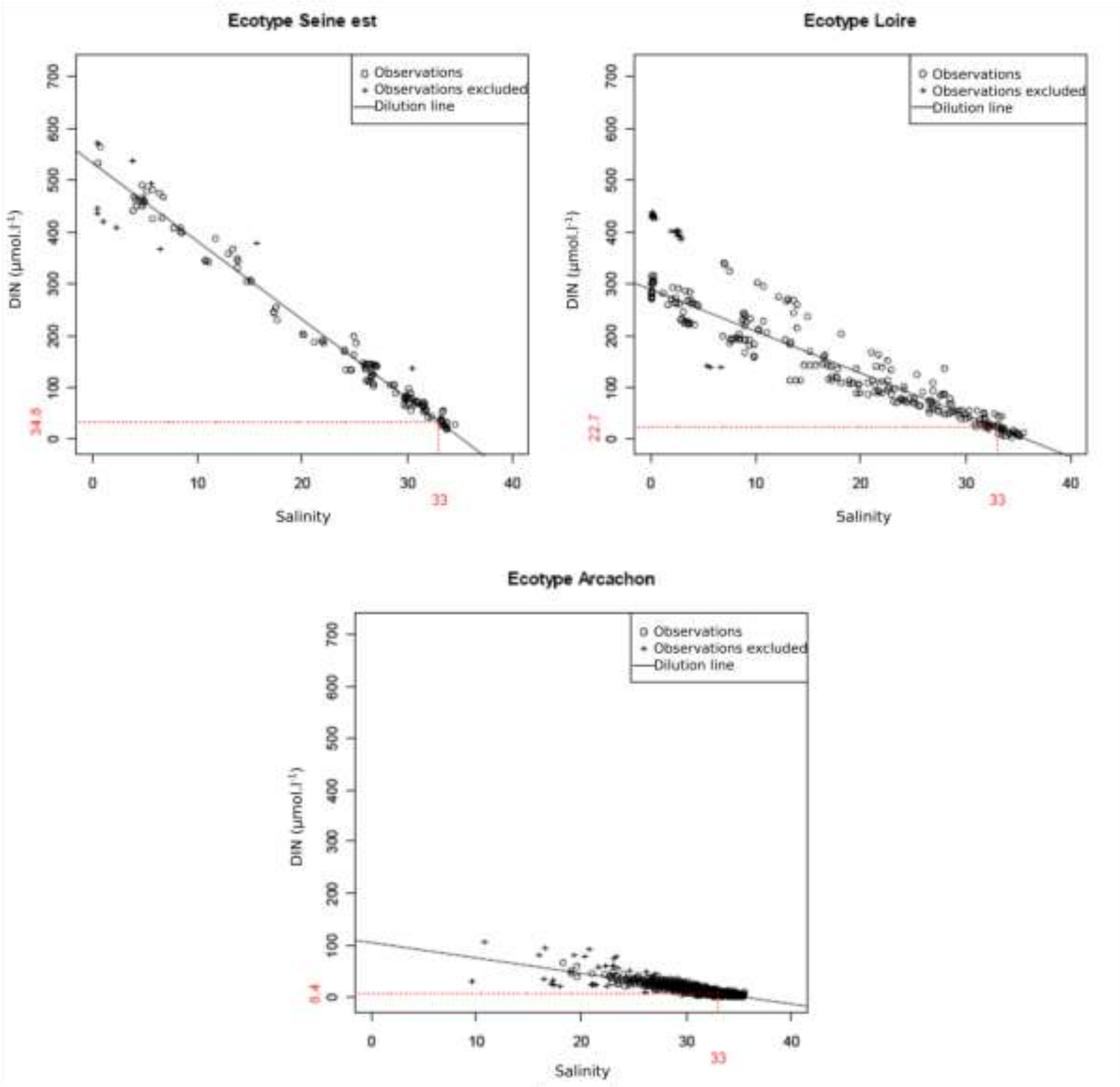

Figure 10: Distribution Winter DIN (NO_3 + NO_2 + NH_4) surface concentration measured between 2003 and 2008 in the 3 "control" ecotypes (Arcachon, Loire, Seine Est) against salinity and normalization of NID concentration at salinity 33 with the dilution line. Figure from Daniel and Soudant (2010).

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 environment), REPHY (Réseau de surveillance du phytoplancton et des phycotoxines – Network for monitoring phytoplankton and phycotoxins), SRN (Suivi des nutriments sur le littoral du Nord Pas de Calais et Picardie – Nutrient monitoring along the Nord Pas de Calais and Picardie coast), RHLN (Réseau Hydrologique Littoral Normand – Hydrological network along the Normandy coast), and the ARCHYD network (monitoring nutrients in the Arcachon basin). The data were extracted from the Quadrige2 database.

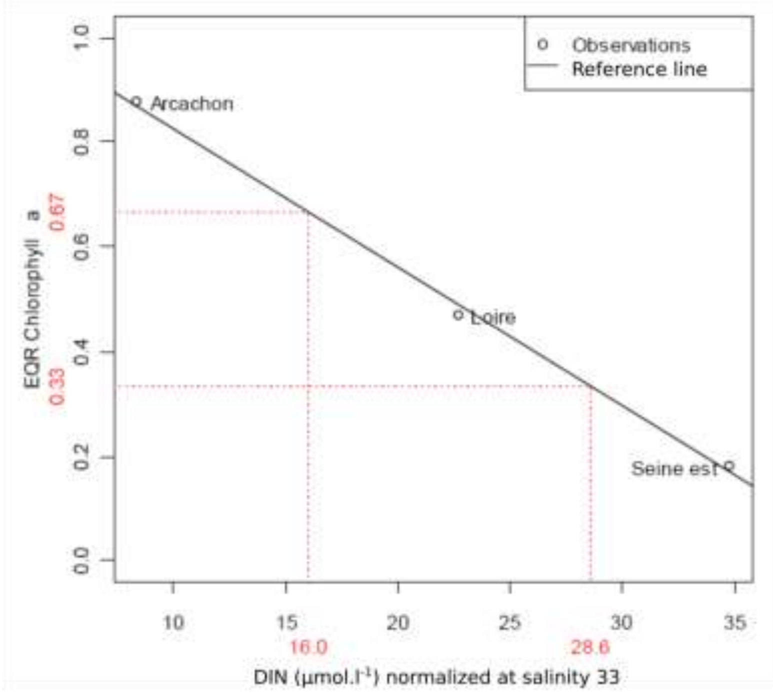

Figure 11: Distribution of DIN value normalized at salinity 33 of the 3 "control" ecotypes against their chla EQR. Determining of the two DIN threshold values that correspond to the "high/good" chla EQR and to the "good/moderate" chla EQR. Figure from Daniel and Soudant (2010).

4.3.3 Chlorophyll a

To calculate the Chla COMP3 scores the percentile 90 of chla concentration (monthly sampled from March to October near the high tide (HT ± 2h)) per OSPAR Zone (Table 1) per year was compare to chla thresholds. There are 2 different thresholds that correspond to 4 different ecotypes: North Sea coastal and transition water masses (15µg/l – in agreement with reference value from the WFD Ecotype North Sea 1/26b) and English Channel-Atlantic coastal and transition water masses (10µg/l – in agreement with reference value from the WFD Ecotype English Channel Atlantic 1/26a)). As the reference values have been set to 6.66 and 3.33µg.l^{-1} respectively in the WFD assessment, the thresholds are higher than the 50% over background conditions recommended by the OSPAR approach. Then the OOAO aggregation rule was used to aggregate annual scores, the most declassified (from worst to best: "+", "?", "-") year giving the OSPAR zone score.

Data come from the same monitoring networks and database as winter DIN.

4.3.4 Phytoplankton indicator species

Following the same process as for chla, a phytoplankton bloom was noted "+" when 40 % of the samples from an OSPAR Zone (Table 1, monthly sampled from January to December) exceed 100 000cell.l^{-1} for large cells (colonial species < 20µm + sp. >

20µm) and 250 000 cell.l^{-1} for small cells (unicellular species < 20µm without chain). The taxa list present on the French coast (OSPAR zones) is given in Annex 2.

Data come from the same monitoring networks and database as winter DIN.

4.3.5 Macrophytes

Macrophytes data (mainly aerial photography and *in situ* identifications) and indices evaluation come from the CEVA (Centre d'Etude et de Valorisation des Algues – Centre for the Study and Use of Algae) who annually publish results of the proliferation of green algae along the Brittany coast on the CEVA website (http://www.ceva.fr/fre/MAREES-VERTES/Programme-de-Lutte/Origine-et-enjeux-rapports-a-telecharger/Programme-des-annees-anterieures-et-documents-a-telecharger). Macrophytes COMP3 score are calculated using WFD EQR for 3 different types of green tide:

- Type 1 defines the green tides of *Ulva* with massive developments taking place in the large sandy bays. These green tides are formed from drifting *Ulva* vegetatively propagated. They are single-species which mean that a single species of *Ulva* is at the origin of the bloom. Algae are present both on the beach field but also floating at the bottom of the water, forming a curtain.
  The metrics used to calculate the EQR are the maximum percentage of colonized area potentially covered by green algae; the average percentage of colonized area potentially covered by green algae and the frequency of green algae deposits whose area exceeds 1.5% of the area potentially available for colonization.
- Type 2 green tides also named grubbing green tides are also found on sandy substrate. The main difference with type 1 green tides is that they have a development phase fixed on rocky reef prior to stranding on beach. This type of tide is mainly found south of the Loire and in Normandy.
  The metrics used to calculate the EQR are the percentage of spring deposition of *Ulva* (May) relative to the bedrock surface; the average percentage of summer deposition of *Ulva* (July to September) compared to the bedrock surface and the maximum percentage of soft substrate affected by stranding of *Ulva*.
- Types 3 green tides are found on muddy substrates. They consist of both blade green algae and filamentous green algae. Unlike the other two types of green tides, algae are, in this case, very mobile.
  The metrics used to calculate the EQR are the maximum percentage of potentially colonized area covered by green algae and the area affected by deposits of green algae (ha).

Therefore the boundary between WFD good and moderate is the boundary for COMP3 "-"/"+" score. Aggregations of the score of WFD water masses that constitute an

OSPAR zone (Table 1) are done using the one out all out rule (OOAO); if one water masses has a “+” or “?” score therefore the OSPAR zone is “+” or “?” for macrophytes.

4.3.6 Oxygen

Oxygen COMP3 score calculation is derived from the Oxygen WFD EQR calculation per year from 2008 to 2014 for each OSPAR zone (table 1). The WFD boundary between moderate and good is the OSPAR boundary between “+” and “-“, for oxygen concentration it correspond to 3 $mg.l^{-1}$ which differ from OSPAR recommendations (Table 2) but remains in the “deficiency” range. The score is calculated for each year and for each OSPAR Zone. Then the OOAO aggregation rule is used to aggregate annual scores, the most declassified (from worst to best: “+”, “?”, “-“) year give the OSPAR zone score. Oxygen score is calculated using the metric percentile 10 of oxygen concentration measured near the bottom (maximum of 3 m above the bottom of the water column, depending on weather conditions during sampling) from June to September, at least 4 times per year, between 2006 and 2014. As the reference value has been set to $8.33mg.l^{-1}$ in the WFD assessment, the threshold is lower than the 50% over background conditions recommended by the OSPAR approach.

Even if the entire dataset of oxygen concentration measured during the assessment period has been used for the classification, we suspected a problem in data quality for the period 2006-2007. We have to keep in mind this potential problem for the final classification.

Data come from the same monitoring networks and database as winter DIN.

4.3.7 Algal toxins

Following the same process as for oxygen and phytoplankton indicator species, the score “+” was given for a year if the toxicity measured exceeds a threshold during at least two months for an OSPAR zone. Different toxins were measured in molluscs and different threshold were applied for each of these toxins.
For DSP (Diarrheic Shellfish Poison) the threshold was $1440\mu g.kg^{-1}$; for PSP (Paralytic Shellfish Poisoning) $80\mu g.kg^{-1}$ and for ASP (Amnesic Shellfish Poison) $20\mu g.kg^{-1}$.

The ASP measurement is an addition to the OSPAR recommendations (table 2).

The data used come from national monitoring network REPHY (Réseau de surveillance du phytoplancton et des phycotoxines – Network for monitoring phytoplankton and phycotoxins). The data were extracted from the Quadrige2 database.

Even if algal toxins are part of the OSPAR COMP, ICES advices that for many coastal regions attempts to relate trends in the occurrence of HABs to nutrient enrichment are confounded by increased monitoring effort and reporting of HABs, the effects of climate change and the introduction and transfer of HAB species (ICES, 2015). Thus the occurrence and abundance of HAB species should not be used to diagnose eutrophication unless a link to anthropogenic nutrient enrichment can be demonstrated for a specific area. Therefore we have to be careful on the impact of Cat IV parameter to the classification (particularly if it is the only declassified parameter), and take into account the ICES advice to perform the final classification. Moreover as French assessment protocol also take into account the ASP, it could drive to a worse score compare to classification without ASP.

4.3.8 Confidence rating calculation

Confidences rating of riverine inputs are the p.value calculated with the Mann-Kendall trend test (Devreker and Lefebvre, 2014). Significant p.values appears in bold in the tables of section 5.2.

Due to the metric used to calculate macrophytes scores, confidence rating cannot be calculated.

A method of confidence rating calculation concerning data from the Ifremer Quardige² database applied by France to the WFD evaluation can be adapt to the OSPAR COMP evaluation but is still under discussion. The method is based on percentile calculation of the bootstrap distribution apply one the raw data and is detail thereafter:

The confidence rating calculation concerning data from the Ifremer Quadrige² database is based on bootstrap distribution method. From a sample, an estimation of a selected parameter is calculated (Davison and Hinkley, 1997) and a new sample of the same size (as the observed sample) is created. To do this, random selection is performed with replacement. The resampling step is performed many times. From each newly created sample an estimation of the parameter is calculated. All these results can appreciate the distribution of the parameter estimations. An advantage of this method is to evaluate the variability of a parameter from its single definition. A number of 1000 random resampling (n samples x 1000) is considered as good for an accuracy of 5% of the confidence rating.

The confidence rating is then calculated using the “percentile method” (modification of the R package “boot”): percentiles of the bootstrap distribution are calculated; for 5% confidences there are percentile 2.5% and 97.5%.

4.4 Meta-data and reporting of monitoring to the ICES database

France was not able to report data to ICES in due time for an overall data extraction supporting COMP3. That’s why French national report was mainly based on data from Quadige2, CEVA and EMoSEM Project. Nevertheless, France is now engaged in a reporting data process to ICES. In order to optimize routine operation France did a first data submission trial in 2015 to report hydro-biological data for the eastern English Channel and for the period 1997-2002. Data up to 2014 should be reported before the end of the year 2016. Data from other coastal areas (at the whole English Channel and Atlantic scale) should also be reported in 2016.

In addition, France reported *Phaeocystis* data for the eastern English Channel and for the period 1992-2014 in order to help other contracting parties for the common indicator assessment. Note that France has an opt-out for *Phaeocystis* common indicator.

5. Eutrophication assessment

5.1 Data analysis and presentation

Summary statistics have been performed on data for assessment parameters (except for macrophytes and toxins parameters) and for a given OSPAR zone for the entire assessment period (2006-2014). Temporal trend analyses have also been performed for the OSPAR zone close to main estuaries and at the French/Belgium boundaries (not for riverine input because it is already part of the assessment).

Table 4a. Summary statistics for nitrogen fluxes (kgN.day^{-1}) for each OSPAR zones. Significant trends in nitrogen fluxes are already given in the detailed assessment (see 5.2).

	Nitrogen Fluxes (kgN.day^{-1})*						
	Min.	**1st Qu.**	**Median**	**Mean**	**3rd Qu.**	**Max.**	**n**
Zone 01	2401	3458	5472	7453	10360	39920	360
Zone 02	2876	5153	7835	9340	11790	25970	540
Zone 03	777.9	2137.0	3191.0	4061.0	4533.0	34130.0	900
Zone 04	324.8	1771.0	3069.0	102000.0	52970.0	1099000.0	720
Zone 05	219.0	887.1	2594.0	6594.0	6484.0	57390.0	360
Zone 06	614.3	1759.0	4137.0	6724.0	9923.0	36890.0	360
Zone 07	-	-	-	-	-	-	
Zone 08	477.1	1548.0	2863.0	4716.0	6587.0	25320.0	180
Zone 09	413.1	1672.0	3806.0	6889.0	9179.0	57620.0	540
Zone 10	277.8	1036.0	3903.0	9022.0	12610.0	105600.0	360
Zone 11	411.1	584.4	1645.0	3487.0	4885.0	37330.0	180
Zone 12	869.3	1986.0	6167.0	9547.0	13340.0	63650.0	360
Zone 13	466.9	1096.0	4205.0	6909.0	10190.0	40080.0	180
Zone 14	-	-	-	-	-	-	
Zone 15	-	-	-	-	-	-	
Zone 16	718.6	2369.0	6670.0	18380.0	17890.0	187700.0	360
Zone 17	-	-	-	-	-	-	
Zone 18	-	-	-	-	-	-	
Zone 19	1759	3631	7523	13280	17880	87210	180
Zone 20	504.4	2945.0	6834.0	15950.0	18940.0	161300.0	540
Zone 21	-	-	-	-	-	-	
Zone 22	-	-	-	-	-	-	
Zone 23	5575	10370	31230	84590	113900	671300	180
Zone 24	229	613	1831	109900	16170	3165000	900
Zone 25	266.4	1141.0	4713.0	18980.0	14290.0	425000.0	1440
Zone 26	96.2	1000.0	4171.0	68590.0	70380.0	2305000.0	900
Zone 27	130.4	433.5	1074.0	2097.0	2312.0	30940.0	1080
Zone 28	18370	42160	97460	166500	215300	1404000	180

* data available from 2006 to 2010

Table 4b. Summary statistics and temporal trend for winter DIN concentration (µmol.l^{-1}) for each OSPAR zones.

	Winter DIN (µmol.l^{-1})*							
	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	n	Trend
Zone 01	0.55	9.94	21.00	19.91	25.99	54.92	29	no trend
Zone 02	0.41	16.36	27.98	27.86	38.76	66.95	102	no trend
Zone 03	9.69	25.29	30.14	30.11	35.22	50.85	18	no trend
Zone 04	11.45	33.45	47.99	53.86	62.87	145.50	76	no trend
Zone 05	14.43	26.84	32.53	35.41	40.16	114.40	95	no trend
Zone 06	11.32	22.56	27.67	29.94	35.92	109.40	127	no trend
Zone 07	9.34	11.34	13.61	14.51	15.72	42.43	31	no trend
Zone 08	0.371	9.860	14.350	16.640	21.450	54.870	129	no trend
Zone 09	10.20	19.35	28.39	32.17	40.62	91.83	47	no trend
Zone 10	6.50	11.57	13.10	13.17	14.92	17.95	27	no trend
Zone 11	7.95	10.00	11.24	11.75	13.20	18.00	21	no trend
Zone 12	8.77	10.90	13.36	49.45	19.28	419.20	29	no trend
Zone 13	7.04	10.84	21.20	51.60	63.32	508.50	84	no trend
Zone 14	35.00	52.82	68.35	103.10	106.00	424.00	20	no trend
Zone 15	-	-	-	-	-	-		
Zone 16	0.59	20.20	26.78	29.47	34.03	82.12	20	no trend
Zone 17	1.77	14.21	19.90	19.15	22.50	40.04	21	no trend
Zone 18	-	-	-	-	-	-		
Zone 19	2.92	15.84	32.00	53.66	67.91	333.60	111	no trend
Zone 20	0.44	17.52	34.49	70.57	74.06	331.60	112	17% (0,013)
Zone 21	5.55	17.66	26.32	36.14	46.67	177.00	80	no trend
Zone 22	6.17	23.59	37.36	39.86	46.95	119.70	44	no trend
Zone 23	11.93	39.24	53.82	72.50	97.38	230.00	86	no trend
Zone 24	12.21	24.72	32.46	45.98	50.24	171.40	51	no trend
Zone 25	4.87	15.50	23.30	28.87	37.05	104.50	97	no trend
Zone 26	-	-	-	-	-	-	-	
Zone 27	1.000	6.355	12.710	15.010	20.900	57.100	271	no trend
Zone 28	4.250	5.625	6.550	7.768	7.682	20.100	24	no trend

* statistics made on raw data, not on normalized ones at salinity 33

Table 4c. Summary statistics and temporal trend for chla concentration (µg.l^{-1}) for each OSPAR zones.

	Chlorophyll a (µg.l^{-1})							
	Min.	**1st Qu.**	**Median**	**Mean**	**3rd Qu.**	**Max.**	**n**	**Trend***
Zone 01	0.310	2.060	4.430	6.048	7.480	33.070	174	no trend
Zone 02	0.220	2.990	6.175	9.042	12.610	45.950	679	no trend
Zone 03	0.440	0.820	1.360	2.303	2.540	15.100	133	no trend
Zone 04	0.050	1.272	2.965	5.116	6.588	41.000	614	-2% (0,0001)
Zone 05	0.210	1.050	2.020	3.461	4.590	33.220	673	no trend
Zone 06	0.0600	0.9725	1.6350	2.3100	2.8180	21.1700	706	-2,7% (0,004)
Zone 07	0.2300	0.5750	0.8700	0.9728	1.2100	2.5300	119	no trend
Zone 08	0.050	0.760	1.140	1.590	1.775	26.500	699	no trend
Zone 09	0.0500	0.8525	1.5850	3.8710	3.2580	48.0000	382	-1,7% (0,007)
Zone 10	0.0300	0.7375	1.2750	1.9310	2.0000	37.3800	509	-2,8 (0,0005)
Zone 11	0.140	0.555	0.850	1.323	1.390	24.290	139	-4% (0,002)[1]
Zone 12	0.000	0.615	1.100	1.523	1.710	15.000	396	no trend
Zone 13	-0.070	0.500	0.805	1.354	1.618	15.700	646	no trend
Zone 14	0.220	0.500	0.500	1.226	1.200	8.900	120	no trend
Zone 15	0.100	0.690	1.040	1.476	1.557	11.270	230	no trend
Zone 16	-0.070	0.500	0.900	1.949	1.800	47.000	646	-2,7% (0,0001)[1]
Zone 17	-0.070	0.920	1.550	2.061	2.570	12.020	225	-4% (0,002)
Zone 18	0.220	0.890	1.370	2.454	2.710	22.850	163	no trend
Zone 19	0.000	1.000	1.410	2.166	2.400	33.100	558	-3.6% (0,02)[1]
Zone 20	0.280	1.000	1.750	3.006	3.180	39.000	521	no trend
Zone 21	0.220	0.890	1.450	2.101	2.652	14.000	352	no trend
Zone 22	0.330	0.830	1.330	2.125	2.710	14.090	237	-3.15% (0,009)[1]
Zone 23	0.010	1.160	2.440	4.198	5.250	32.200	729	no trend
Zone 24	0.050	1.100	2.630	4.781	5.480	49.310	645	-3% (0,01)
Zone 25	0.050	1.290	2.280	3.234	4.030	47.060	2498	2.7% (0,005)[1]
Zone 26	0.140	1.865	3.315	4.623	5.668	47.050	270	no trend
Zone 27	0.260	1.290	1.890	2.353	2.810	30.830	3389	-1,8% (0,0015)[1]
Zone 28	0.1600	0.4975	0.7200	1.2250	1.5220	6.2800	92	no trend

*Sen's slope with (p.value)
*% of unit per year
[1] no trend without years 2006 and 2007

Table 4d. Summary statistics and temporal trend for phytoplankton concentration (cell.l^{-1}) for each OSPAR zones.

	Phytoplankton (cell.l^{-1})*							
	Min.**	1st Qu.	Median	Mean	3rd Qu.	Max.	n	Trend
Zone 01	1800	205000	434300	2366000	1263000	25790000	124	no trend
Zone 02	5262	284300	772100	2719000	2306000	44400000	683	no trend
Zone 03	0	0	400	94790	3125	5847000	192	no trend
Zone 04	0	5200	44900	608100	449400	16970000	663	no trend
Zone 05	0	200	1600	171800	25850	9483000	978	-0,14% (0,005)[1]
Zone 06	0	200	2800	206400	32280	18360000	894	-1,2%(0,001)
Zone 07	0	0	200	4878	1000	586100	191	no trend
Zone 08	0	0	500	61460	7175	6755000	932	-0,4% (0,0005)[1]
Zone 09	0	0	400	70500	3500	4278000	420	no trend
Zone 10	0	100	5100	125100	82580	7182000	501	2% (0,001)[1]
Zone 11	0	0	900	177100	7075	22180000	322	no trend
Zone 12	0	725	21100	85200	78600	2506000	330	no trend
Zone 13	0	0	550	168600	11200	70140000	856	no trend
Zone 14	0	0	200	266900	1900	22130000	269	no trend
Zone 15	0	100	1600	196500	20720	17400000	354	no trend
Zone 16	0	200	7000	269200	82450	41740000	451	no trend
Zone 17	0	9450	58700	519800	377000	15760000	239	no trend
Zone 18	0	300	4850	833200	89150	36580000	220	no trend
Zone 19	0	400	13900	324700	144200	14470000	463	no trend
Zone 20	0	700	11900	312600	262800	5010000	741	no trend
Zone 21	0	4000	47300	408800	371300	5059000	511	0,8% (0,01)[1]
Zone 22	0	0	1700	235800	143800	8243000	207	no trend
Zone 23	0	3600	56500	762000	576600	34000000	1421	no trend
Zone 24	0	0	12300	408400	186800	18000000	981	no trend
Zone 25	0	100	7500	214500	86300	33520000	2709	no trend
Zone 26	0	9850	41600	168200	136800	3595000	251	no trend
Zone 27	0	160	2900	318500	199000	64490000	1861	no trend
Zone 28	0	0	450	258400	6800	7573000	94	no trend

* statistics made on samples (sum of all taxa by samples)
** 0 are due to partial flore counting
[1] no trend without years 2006 and 2007

Table 4e. Summary statistics and temporal trend for oxygen concentration ($mg.l^{-1}$) for each OSPAR zones.

	Oxygen ($mg.l^{-1}$)							
	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	n	Trend*
Zone 01	6.910	8.095	9.230	9.669	10.710	15.130	210	-2,8% (0,001)
Zone 02	1.940	8.170	9.110	9.262	10.200	14.790	549	no trend
Zone 03	5.900	8.100	9.100	9.338	10.000	16.000	221	no trend
Zone 04	3.150	7.700	8.800	8.895	9.700	21.910	1115	-0,3% (0,02)[1]
Zone 05	6.040	7.600	8.400	8.595	9.400	14.820	1394	no trend
Zone 06	4.810	8.000	8.900	8.973	9.615	16.700	1411	-1% (0,00001)[1]
Zone 07	6.700	8.085	8.695	8.799	9.400	13.000	208	no trend
Zone 08	4.310	7.900	8.600	8.782	9.400	18.500	1373	-0,7% (0,001)[1]
Zone 09	5.30	7.51	8.21	8.43	9.17	13.00	554	-1,6% (0,001)[1]
Zone 10	4.350	7.700	8.320	8.470	9.225	12.350	455	no trend
Zone 11	6.900	7.580	8.300	8.374	9.130	11.710	255	no trend
Zone 12	0.000	7.698	8.690	8.710	9.590	13.800	596	no trend
Zone 13	0.000	8.060	8.725	8.778	9.328	12.500	646	no trend
Zone 14	0.600	8.225	8.760	8.822	9.455	12.500	110	no trend
Zone 15	7.300	7.800	7.900	7.941	8.100	8.800	17	no trend
Zone 16	0.700	7.700	8.620	8.911	9.875	17.300	679	-1% (0,0009)
Zone 17	5.000	7.615	8.135	8.311	8.808	11.800	170	-2,6% (0,0001)
Zone 18	7.320	7.635	8.000	8.353	9.180	9.520	7	no trend
Zone 19	3.520	7.730	8.610	8.787	9.740	13.600	909	no trend
Zone 20	4.500	7.800	8.600	8.773	9.600	16.100	1130	no trend
Zone 21	0.40	7.50	8.00	8.11	8.60	16.40	587	no trend
Zone 22	6.20	7.40	7.90	8.09	8.80	11.90	326	no trend
Zone 23	2.00	6.90	7.70	7.79	8.70	13.70	1634	no trend
Zone 24	0.16	6.59	7.80	7.79	9.14	14.40	1125	no trend
Zone 25	0.180	7.260	7.670	7.841	8.370	14.070	1756	no trend
Zone 26	4.800	6.970	7.700	8.059	9.165	12.270	287	no trend
Zone 27	5.280	7.090	7.700	7.804	8.490	11.600	5599	+0,7% (0,0001)
Zone 28	6.210	7.342	7.770	7.817	8.255	9.340	174	no trend

*Sen's slope with (p.value)
*% of unit per year
[1] no trend without years 2006 and 2007

5.2 Parameter-related assessment based on background concentrations/levels and assessment levels

The 9 score attributed to chl*a*, phytoplankton indicator, oxygen and algal toxins are calculated for each of the 9 years between 2006 and 2014. The different score attributed to winter DIN and macrophytes are calculated for different water masses. Zones evaluated as Non-Problem Area by the screening procedure (Annexe 1) have not been re-evaluated (Zones 7, 8, 9, 25, 26, 28).

Key to the Score

+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters
- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters
? = Not enough data to perform an assessment or the data available are not fit for the purpose

5.2.1 *Dunkirk and Calais (Zone 1)*

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (-3.4% of kgN/day per year)	-	p. value of **0.001**
	Winter DIN and/or DIP concentrations	? in 2006-2014	?-	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	+ in 2006-2014	--+-++-+-	
	Area-specific phytoplankton indicator species	+ in 2006-2014	+++++++++	
	Macrophytes including macroalgae			
Indirect Effects (III)	Oxygen deficiency	- in 2006-2014	---------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	- in 2006-2014	---------	

5.2.2 *Boulogne, Canche, Authie and Somme (Zone 2)*

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (trend not significant)	-	p. value of 0.34
	Winter DIN and/or DIP concentrations	+ in 2006-2014	++?-	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	+ in 2006-2014	++++-++++	
	Area-specific phytoplankton indicator species	+ in 2006-2014	+++++++++	
	Macrophytes including macroalgae			
Indirect Effects (III)	Oxygen deficiency	? in 2006-2014	?--------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	- in 2006-2014	---------	

5.2.3 Pays de Caux (Zone 3)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (no significant trend)	-	p. value of 0.12
	Winter DIN and/or DIP concentrations	? in 2006-2014	?-	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	- in 2006-2014	---------	
	Area-specific phytoplankton indicator species	- in 2006-2014	---------	
	Macrophytes including macroalgae			
Indirect Effects (III)	Oxygen deficiency	- in 2006-2014	---------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	- in 2006-2014	---------	

5.2.4 Seine estuary and bay (Zone 4)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (-3% kgN/day per year)	-	p. value of **0.0006**
	Winter DIN and/or DIP concentrations	+ in 2006-2014	+?+	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	+ in 2006-2014	+++++-+++	
	Area-specific phytoplankton indicator species	+ in 2006-2014	---+--+--	
	Macrophytes including macroalgae	- in 2006-2014	---	
Indirect Effects (III)	Oxygen deficiency	- in 2006-2014	---------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	+ in 2006-2014	++---+-++	

5.2.5 Calvados (Zone 5)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (no significant trend)	-	p. value of 0.34
	Winter DIN and/or DIP concentrations	? in 2006-2014	-?--	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	+ in 2006-2014	-+----+--	
	Area-specific phytoplankton indicator species	- in 2006-2014	---------	
	Macrophytes including macroalgae	+ in 2006-2014	-++-	
Indirect Effects (III)	Oxygen deficiency	- in 2006-2014	---------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	+ in 2006-2014	+--------	

5.2.6 Baie des Veys and St Vaast (Zone 6)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (-2.43% kgN/day per year)	-	p. value of **0.004**
	Winter DIN and/or DIP concentrations	- in 2006-2014	----	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	- in 2006-2014	---------	
	Area-specific phytoplankton indicator species	- in 2006-2014	---------	
	Macrophytes including macroalgae	+ in 2006-2014	+---	
Indirect Effects (III)	Oxygen deficiency	- in 2006-2014	---------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	+ in 2006-2014	+++++++++	

5.2.7 Cherbourg (Zone 7) – NPA since the screening procedure

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P			
	Winter DIN and/or DIP concentrations	? in 2006-2014	??-?	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration			
	Area-specific phytoplankton indicator species			
	Macrophytes including macroalgae	- in 2006-2014	----	
Indirect Effects (III)	Oxygen deficiency			
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)			

5.2.8 West Cotentin (Zone 8) – NPA since the screening procedure

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (-5% kgN/day per year)	-	p. value of **0.0008**
	Winter DIN and/or DIP concentrations	- in 2006-2014	---	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration			
	Area-specific phytoplankton indicator species			
	Macrophytes including macroalgae	- in 2006-2014	---	
Indirect Effects (III)	Oxygen deficiency			
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)			

5.2.9 Mont St Michel Bay (Zone 9) – NPA since the screening procedure

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (-3% kgN/day per year)	-	p. value of **0.01**
	Winter DIN and/or DIP concentrations	? in 2006-2014	?--	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90^{th} percentile, maximum and mean chlorophyll *a* concentration			
	Area-specific phytoplankton indicator species			
	Macrophytes including macroalgae	- in 2006-2014	---	
Indirect Effects (III)	Oxygen deficiency			
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)			

5.2.10 Rance, Arguenon and Fresnaye (Zone 10)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (no significant trend)	-	p. value of 0.65
	Winter DIN and/or DIP concentrations	? in 2006-2014 (?=MET)	-?	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90^{th} percentile, maximum and mean chlorophyll *a* concentration	+ in 2006-2014	-+-------	
	Area-specific phytoplankton indicator species	- in 2006-2014	---------	
	Macrophytes including macroalgae	+ in 2006-2014	++	
Indirect Effects (III)	Oxygen deficiency	- in 2006-2014	---------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	- in 2006-2014	---------	

5.2.11 St Brieuc (Zone 11)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (no significant trend)	-	p. value of 0.8
	Winter DIN and/or DIP concentrations	? in 2006-2014	?-	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	- in 2006-2014	---------	
	Area-specific phytoplankton indicator species	- in 2006-2014	---------	
	Macrophytes including macroalgae	+ in 2006-2014	+-	
Indirect Effects (III)	Oxygen deficiency	? in 2006-2014	?--------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	- in 2006-2014	---------	

5.2.12 Paimpol, Trieux, Jaudy (Zone 12)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (no significant trend)	-	p. value of 0.8
	Winter DIN and/or DIP concentrations	? in 2006-2014 (?=METs)	??-	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	- in 2006-2014	---------	
	Area-specific phytoplankton indicator species	- in 2006-2014	---------	
	Macrophytes including macroalgae	+ in 2006-2014	-+-	
Indirect Effects (III)	Oxygen deficiency	- in 2006-2014	---------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	- in 2006-2014	---------	

5.2.13 Lannion and Morlaix (Zone 13)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (no significant trend)	-	p. value of 0.83
	Winter DIN and/or DIP concentrations	? in 2006-2014	-?----?	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	- in 2006-2014	---------	
	Area-specific phytoplankton indicator species	- in 2006-2014	---------	
	Macrophytes including macroalgae	+ in 2006-2014	-++++--	
Indirect Effects (III)	Oxygen deficiency	- in 2006-2014	---------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	+ in 2006-2014	+++++++++	

5.2.14 Finistère abers (Zone 14)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P			
	Winter DIN and/or DIP concentrations	? in 2006-2014	??-	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	? in 2006-2014	--??????-	
	Area-specific phytoplankton indicator species	+ in 2006-2014	+--------	
	Macrophytes including macroalgae	+ in 2006-2014	-+-	
Indirect Effects (III)	Oxygen deficiency	? in 2006-2014	--????---	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	- in 2006-2014	---------	

5.2.15 Iroise (Zone 15)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P			
	Winter DIN and/or DIP concentrations		??	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	? in 2006-2014	--------?	
	Area-specific phytoplankton indicator species	- in 2006-2014	---------	
	Macrophytes including macroalgae			
Indirect Effects (III)	Oxygen deficiency	? in 2006-2014	--???????	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	+ in 2006-2014	+++++++++	

5.2.16 Brest (Zone 16)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (no significant trend)	-	p. value of 0.3
	Winter DIN and/or DIP concentrations	? in 2006-2014 (? = METs)	???-	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	+ in 2006-2014	+--------	
	Area-specific phytoplankton indicator species	+ in 2006-2014	+--------	
	Macrophytes including macroalgae	- in 2006-2014	----	
Indirect Effects (III)	Oxygen deficiency	? in 2006-2014	-?-------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	+ in 2006-2014	+++++++++	

5.2.17 Douarnenez (Zone 17)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P			
	Winter DIN and/or DIP concentrations	- in 2006-2014	-	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	- in 2006-2014	---------	
	Area-specific phytoplankton indicator species	+ in 2006-2014	-++-+----	
	Macrophytes including macroalgae	+ in 2006-2014	+	
Indirect Effects (III)	Oxygen deficiency	? in 2006-2014	?--------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	+ in 2006-2014	+++++++++	

5.2.18 Audierne (Zone18)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P			
	Winter DIN and/or DIP concentrations	? in 2006-2014	??	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	? in 2006-2014	-------??	
	Area-specific phytoplankton indicator species	- in 2006-2014	---------	
	Macrophytes including macroalgae	- in 2006-2014	--	
Indirect Effects (III)	Oxygen deficiency	? in 2006-2014	--???????	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	+ in 2006-2014	++++++-+-	

5.2.19 Concarneau, Aven and Belon (Zone 19)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010	-	p. value of 0.29
	Winter DIN and/or DIP concentrations	? in 2006-2014 (? = GC29)	-----?	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	- in 2006-2014	---------	
	Area-specific phytoplankton indicator species	- in 2006-2014	---------	
	Macrophytes including macroalgae	+ in 2006-2014	-++---	
Indirect Effects (III)	Oxygen deficiency	? in 2006-2014	-?-------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	+ in 2006-2014	+++++++++	

5.2.20 Laïta, Lorient, Groix and Etel (Zone 20)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (no significant trend)	-	p. value of 0.51
	Winter DIN and/or DIP concentrations	? in 2006-2014	???--?---	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	+ in 2006-2014	+--------	
	Area-specific phytoplankton indicator species	+ in 2006-2014	--+-+----	
	Macrophytes including macroalgae	+ in 2006-2014	---++----	
Indirect Effects (III)	Oxygen deficiency	- in 2006-2014	---------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	+ in 2006-2014	+++++++++	

5.2.21 Bay of Quiberon and Belle Ile (Zone 21)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P			
	Winter DIN and/or DIP concentrations	? in 2006-2014	??--	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	- in 2006-2014	---------	
	Area-specific phytoplankton indicator species	+ in 2006-2014	--+-+----	
	Macrophytes including macroalgae	- in 2006-2014	----	
Indirect Effects (III)	Oxygen deficiency	? in 2006-2014	?--------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	+ in 2006-2014	+++++++++	

5.2.22 Gulf of Morbihan (Zone 22)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P			
	Winter DIN and/or DIP concentrations	? in 2006-2014 (? = METs)	???-	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	? in 2006-2014	?--------	
	Area-specific phytoplankton indicator species	- in 2006-2014	---------	
	Macrophytes including macroalgae	+ in 2006-2014	+-+-	
Indirect Effects (III)	Oxygen deficiency	? in 2006-2014	?--------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	- in 2006-2014	---------	

5.2.23 Vilaine (Zone 23)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (no significant trend)	-	p. value of 0.34
	Winter DIN and/or DIP concentrations	? in 2006-2014 (? = METs)	??--	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	+ in 2006-2014	+++---+++	
	Area-specific phytoplankton indicator species	+ in 2006-2014	-++-+----	
	Macrophytes including macroalgae	- in 2006-2014	----	
Indirect Effects (III)	Oxygen deficiency	? in 2006-2014	?--------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	+ in 2006-2014	+++++++++	

5.2.24 Loire and Bourgneuf (Zone 24)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (no significant trend)	-	p. value of 0.25
	Winter DIN and/or DIP concentrations	? in 2006-2014 (? = MET)	?--	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	+ in 2006-2014	++-+-----	
	Area-specific phytoplankton indicator species	- in 2006-2014	---------	
	Macrophytes including macroalgae	- in 2006-2014	---	
Indirect Effects (III)	Oxygen deficiency	+ in 2006-2014	+--------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP/ASP mussel infection events)	- in 2006-2014	---------	

5.2.25 Vendée, Pertuis and Marennes (Zone 25) – NPA since the screening procedure

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (no significant trend)	-	p. value of 0.21
	Winter DIN and/or DIP concentrations	? in 2006-2014	?????-----	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration			
	Area-specific phytoplankton indicator species			
	Macrophytes including macroalgae	- in 2006-2014	----------	
Indirect Effects (III)	Oxygen deficiency			
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP mussel infection events)			

5.2.26 Gironde (Zone 26) – NPA since the screening procedure

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (no significant trend)	-	p. value of 0.65
	Winter DIN and/or DIP concentrations	? in 2006-2014	????	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration			
	Area-specific phytoplankton indicator species			
	Macrophytes including macroalgae	- in 2006-2014	----	
Indirect Effects (III)	Oxygen deficiency			
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP mussel infection events)			

5.2.27 Arcachon and Landes (Zone 27)

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (no significant trend)	-	p. value of 0.09
	Winter DIN and/or DIP concentrations	? in 2006-2014	?----	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration	- in 2006-2014	---------	
	Area-specific phytoplankton indicator species	- in 2006-2014	---------	
	Macrophytes including macroalgae			
Indirect Effects (III)	Oxygen deficiency	? in 2006-2014	?--------	
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP mussel infection events)	+ in 2006-2014	+++++++++	

5.2.28 Pays Basque (Zone 28) – NPA since the screening procedure

Category	Assessment Parameters	Description of Results	Score (+ - ?)	Aggregated confidence rating
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P	- in 2006-2010 (no significant trend)	-	p. value of 0.18
	Winter DIN and/or DIP concentrations	? in 2006-2014	?-	
	Winter N/P ratio (Redfield N/P = 16)			
Direct Effects (II)	90th percentile, maximum and mean chlorophyll *a* concentration			
	Area-specific phytoplankton indicator species			
	Macrophytes including macroalgae			
Indirect Effects (III)	Oxygen deficiency			
	Changes/kills in zoobenthos and fish kills			
	Organic carbon/organic matter			
Other Possible Effects (IV)	Algal toxins (DSP/PSP mussel infection events)			

5.3 Consideration of supporting environmental factors and quality of data

Concerning supporting environmental factors, only salinity was used to normalize winter NID concentration (see 4.3.2). Salinity was measured at the same time that nutrient concentration. It shows high spatial variability (Figure 12) due to the heterogeneity of the ecotype where it was measured (coastal waters with or without influence of freshwater input, transitional waters etc.). This parameter also come from the Quadrige² database and is submit to the same quality controls as for assessment parameters (see 4.2).

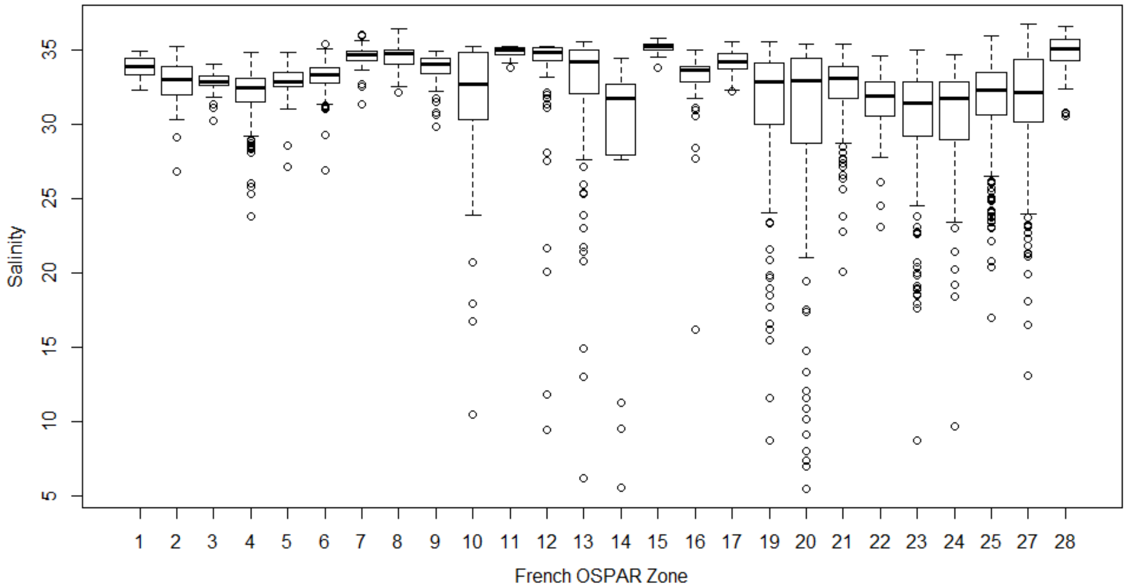

Figure 12. Boxplot of salinity (PSU) measured in the French OSPAR areas: zones 1 to 28.

No assessment was engaged concerning climate changes and alien species in the framework of eutrophication status assessment.

5.4 Overall assessment

The table and map below summarise the eutrophication status of all sites in the OSPAR area of the French coast, as defined after the 2008 revision of the Common Procedure (EUC 08/2/Info.2-E(L)).

Table 5. Overall classification of French coastal waters under the OSPAR COMP3.

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

Zone	**Cat I** Degree of nutrient enrichment		**Cat II** Direct effects		**Cat III and IV** Indirect effects / other possible effects				Initial classification	Further assessment of all other relevant information	Final classification	Evaluation period
Dunkirk and Calais (Zone 1)	NI	-	Ca	+	O_2	-	At	-	+		+	2006-2014 except for NI : 2006-2010
	DI	?	Ps	+	Ck							
	NP		Mp		Oc							
Boulogne Somme (Zone 2)	NI	-	Ca	+	O_2	?	At	-	+		+	–
	DI	+	Ps	+	Ck							
	NP		Mp		Oc							
Pays de Caux (Zone 3)	NI	-	Ca	-	O_2	-	At	-	-		-	–
	DI	?	Ps	-	Ck							
	NP		Mp		Oc							
Seine estuary and bay (Zone 4)	NI	-	Ca	+	O_2	-	At	+	+		+	–
	DI	+	Ps	+	Ck							
	NP		Mp	-	Oc							
Calvados (Zone 5)	NI	-	Ca	+	O_2	-	At	+	+		+	–
	DI	?	Ps	-	Ck							
	NP		Mp	+	Oc							
Baie des Veys and St Vaast	NI	-	Ca	-	O_2	-	At	+	+	Slightly increasing macroalgae blooms since 2008 in only one limited area. Problem with	?	–
	DI	-	Ps	-	Ck							

(Zone 6)	NP		Mp	+	Oc					algal toxins whose relationship with eutrophication is not demonstrated.		
Cherbourg (Zone 7)	NI		Ca		O_2		At		-		-	_
	DI	-	Ps		Ck							
	NP		Mp	-	Oc							
West Cotentin (Zone 8)	NI	-	Ca		O_2		At		-		-	_
	DI	-	Ps		Ck							
	NP		Mp	-	Oc							
Mont St Michel Bay (Zone 9)	NI	-	Ca		O_2		At		-	Turbidity prevents major eutrophication phenomena despite the presence of nutrients.	-	_
	DI	?	Ps		Ck							
	NP		Mp	-	Oc							
Rance, Arguenon and Fresnaye (Zone 10)	NI	-	Ca	+	O_2	-	At	-	+		+	_
	DI	?	Ps	-	Ck							
	NP		Mp	+	Oc							
St Brieuc (Zone 11)	NI	-	Ca	-	O_2	?	At	-	+		+	_
	DI	?	Ps	-	Ck							
	NP		Mp	+	Oc							
Paimpol, Trieux, Jaudy (Zone 12)	NI	-	Ca	-	O_2	-	At	-	+	Macrophyte problem restricted in one limited area.	?	_
	DI	?	Ps	-	Ck							
	NP		Mp	+	Oc							
Lannion et Morlaix (Zone 13)	NI	-	Ca	-	O_2	-	At	+	+		+	_
	DI	?	Ps	-	Ck							
	NP		Mp	+	Oc							
Finistère abers (Zone 14)	NI		Ca	?	O_2	?	At	-	+	Problem with phytoplankton species in 2006 not after. Strong mixing area (no pb chloro and oxy). Macrophyte problem restricted in one limited area (an MET) with WFD EQR close to the good boundary.	?/-	_
	DI	?	Ps	+	Ck							
	NP		Mp	+	Oc							
Brest (Zone 16)	NI	-	Ca	+	O_2	?	At	+	+	Problem with phytoplankton species and chla in 2006 not after. Therefore, only problem with algal toxins whose relationship with eutrophication is not demonstrated.	?	_
	DI	?	Ps	+	Ck							
	NP		Mp	-	Oc							
Iroise (Zone 15)	NI		Ca	?	O_2	?	At	+	+	Only problem with algal toxins whose relationship with eutrophication is not demonstrated.	?	_
	DI	?	Ps	-	Ck							
	NP		Mp		Oc							
Douarnenez (Zone 17)	NI		Ca	-	O_2	?	At	+	+		+	_
	DI	-	Ps	+	Ck							
	NP		Mp	+	Oc							
Audierne (Zone 18)	NI		Ca	?	O_2	?	At	+	+	Only problem with algal toxins whose relationship with eutrophication is not	?	_
	DI	?	Ps	-	Ck							

	NP		Mp	-	Oc					demonstrated.		
Concarneau, Aven, Belon (Zone 19)	NI	-	Ca	-	O_2	?	At	+	+	Macrophyte problem restricted in two limited area. Problem with algal toxins whose relationship with eutrophication is not demonstrated.	?	–
	DI	?	Ps	-	Ck							
	NP		Mp	+	Oc							
Lorient, Groix, Etel (Zone 20)	NI	-	Ca	+	O_2	-	At	+	+	Problem with chla in 2006 not after. Macrophyte problem restricted in two limited area. Problem with algal toxins whose relationship with eutrophication is not demonstrated.	?	–
	DI	?	Ps	+	Ck							
	NP		Mp	+	Oc							
Bay of Quiberon and Belle Ile (Zone 21)	NI		Ca	-	O_2	?	At	+	+	Only two years during the assessment period with phytoplankton species problems. Problem with algal toxins whose relationship with eutrophication is not demonstrated. Excellent water quality in regard of the WFD evaluation.	?/-	–
	DI	?	Ps	+	Ck							
	NP		Mp	-	Oc							
Gulf of Morbihan (Zone 22)	NI		Ca	?	O_2	?	At	-	+		+	–
	DI	?	Ps	-	Ck							
	NP		Mp	+	Oc							
Vilaine (Zone 23)	NI	-	Ca	+	O_2	?	At	+	+		+	–
	DI	?	Ps	+	Ck							
	NP		Mp	-	Oc							
Loire and Bourgneuf (Zone 24)	NI	-	Ca	+	O_2	+	At	-	+	Problem with oxygen in 2006 not after. Problem with chla in the first middle of the assessment period not after.	?	–
	DI	?	Ps	-	Ck							
	NP		Mp	-	Oc							
Vendée, pertuis et Marennes (Zone 25)	NI	-	Ca				At		-	NPA status confirmed but problem with algal toxins observed, not yet evaluated under the COMP3.	-	–
	DI	?	Ps									
	NP		Mp	-	Oc							
Gironde (Zone 26)	NI	-	Ca						-		-	–
	DI	?	Ps									
	NP		Mp	-								
Arcachon and Landes (Zone 27)	NI	-	Ca	-	O_2	?	At	+	+	Only problem with algal toxins whose relationship with eutrophication is not demonstrated and limited to the Bassin d'Arcachon.	?	–
	DI	?	Ps	-	Ck							
	NP		Mp		Oc							
Pays basque (Zone 28)	NI	-	Ca		O_2		At		-	NPA status confirmed but problem with algal toxins observed, not yet evaluated with the COMP3.	-	–
	DI	?	Ps		Ck							
	NP		Mp		Oc							

5.5 Comparison with preceding assessment

Results of the screening procedure, of the application of the COMP2 and of the application of the COMP3 have been compared for coastal, offshore and adjacent water.

Table 6. Comparison between assessment results of the successive Comprehensive Procedure in coastal and offshore (between 1nm and 12nm) French areas and adjacent area.

<table>
<tr><th>OSPAR Coastal Zones</th><th>Screening Procedure (French - COMP1)</th><th>OSPAR COMP2 French cosatal area (2000-2005)</th><th>OSPAR COMP3 French coastal area (2006-2014)</th><th>OSPAR COMP2 French offshore area (2000-2005)</th><th>OSPAR COMP3 French offshore area (2006-2014)</th><th>Adjacent coastal area (COMP2)</th><th>Adjacent offshore area (COMP2)</th></tr>
<tr><td>1</td><td></td><td>PPA</td><td>PA</td><td rowspan="28">NPA</td><td>PPA</td><td>PA (Belgium)</td><td>PA (Belgium)</td></tr>
<tr><td>2</td><td></td><td>PPA</td><td>PA</td><td>PPA</td><td rowspan="8">NPA (England)</td><td rowspan="8">NPA (England)</td></tr>
<tr><td>3</td><td></td><td>PPA</td><td>NPA</td><td>NPA</td></tr>
<tr><td>4</td><td></td><td>PA</td><td>PA</td><td>PPA</td></tr>
<tr><td>5</td><td></td><td>PA</td><td>PA</td><td rowspan="11">NPA</td></tr>
<tr><td>6</td><td></td><td>PA</td><td>PPA</td></tr>
<tr><td>7</td><td>NPA</td><td>NPA</td><td>NPA</td></tr>
<tr><td>8</td><td>NPA</td><td>NPA</td><td>NPA</td></tr>
<tr><td>9</td><td>NPA</td><td>NPA</td><td>NPA</td></tr>
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<tr><td>12</td><td></td><td>PPA</td><td>PPA</td></tr>
<tr><td>13</td><td></td><td>PA</td><td>PA</td></tr>
<tr><td>14</td><td></td><td>PA</td><td>NPA</td></tr>
<tr><td>15</td><td></td><td>PPA</td><td>PPA</td></tr>
<tr><td>16</td><td></td><td>PA</td><td>PPA</td><td>PPA</td></tr>
<tr><td>17</td><td></td><td>PA</td><td>PA</td><td rowspan="6">NPA</td></tr>
<tr><td>18</td><td></td><td>PA</td><td>PPA</td></tr>
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<tr><td>22</td><td></td><td>PA ???</td><td>PA</td></tr>
<tr><td>23</td><td></td><td>PA</td><td>PA</td><td>PPA</td></tr>
<tr><td>24</td><td></td><td>PA</td><td>PPA</td><td>PPA</td></tr>
<tr><td>25</td><td>NPA</td><td>NPA</td><td>NPA</td><td>NPA</td></tr>
<tr><td>26</td><td>NPA</td><td>NPA</td><td>NPA</td><td>PPA</td></tr>
<tr><td>27</td><td></td><td>NPA</td><td>PPA</td><td rowspan="2">NPA</td></tr>
<tr><td>28</td><td>NPA</td><td>NPA</td><td>NPA</td><td>NPA/PPA (Spain)</td></tr>
</table>

Assessment results comparison between the COMP2 and the COMP3 show a relative improvement in regard of the eutrophication status in French coastal waters (Table 6). Five zones classified as Problem Areas moved to Potentially Problem Areas (Zones 6, 16, 18, 19 and 24), one Potential-Problem Area and one Problem Area changed in Non-Problem Areas (Zones 3 and 14 respectively). However some water masses have decreased in quality status: Zones 1 and 2 changed from Potential-Problem area to Problem-area and Zone 27 from Non-Problem area to Potential-Problem area. The majority of offshore areas (1nm to 12 nm) are classified as non-problem areas (see 4.1) except in front of Zones 1 and 2 and in front of large estuaries (Zone 4 : Seine estuary, Zone 23 : Vilaine estuary, Zone 24 : Loire estuary and Zone 26 : Gironde estuary).

Adjacent coastal waters between France and Belgium are both classified as Problem Areas by the COMP2 linked to the same problem of high phytoplanktonic blooms. Concerning adjacent offshore waters, the Belgium evaluation has resulted in a Problematic Area in regard of eutrophication under the COMP2 application when France and England have concluded to Non-Problem Area. The French application of the COMP3 concluded in a more homogenous quality status of French and Belgium offshore water.

5.6 Voluntary parameters

5.6.1 Atmospheric inputs

Atmospheric nitrogen input is not part of the French COMP3 but can be considered for information as a pressure source for eutrophication in coastal and open seas.

Atmospheric input was not taken into account by France during the first cycle of the MSFD assessment because it was judge as a secondary source of nutrient for eutrophication processes. However the EMEP model estimated an atmospheric deposition around 12.5kt/an and 100kt/an between 1995 and 2008 with a global trend of decreasing input for the different French marine sub-region and a decreasing gradient from the coast to offshore waters. We calculated that this amounts represent approximately 20% of the total nitrogen input in the French OSPAR areas. It also showed that 50% to 67% of atmospheric N originate from agriculture activities (NHx) and contribute from 20% to 50% to the total N input at the sea. For the English-Channel and North Sea French marine sub-region, Gerrit de Leeuw et al. (2003) showed that such input can significantly impact the primary production in this area, representing 5.5% of the total new nitrogen requirement in 1999; and even if the input occur on a short period of time, the atmospheric transportation take place on long distance. One coastal monitoring station is used as data source for the functioning of the EMEP model (Porspoder: 48.30N / 4.46O) and another station is identified in the framework of OSPAR CAMP (La Hague: 49.37N / 1.50W), they will be used for further assessment of atmospheric nitrogen inputs.

5.6.2 Transboundaries transportation

Nutrients from the French river Seine largely impact the coast in the French part of the eastern English Channel then emerge mainly within the Channel jet and form up to 20% of the total N in the offshore part of the German Bight (EUC(2) 09/4/1-Add.1-E(L) part 46). Rivers freshwater contribution in the Belgium inshore area amount to 3% of the total water flow; of this 3%, 45% was from the Seine (EUC(2) 09/4/1-Add.1-E(L) part 44). In the offshore part of the Belgian maritime area, the freshwater contribution is even smaller, just 1%. Of this 1%, 69% was of French origin.

The group of Eastern French Rivers, mainly driven by the Seine River, provides a high proportion of the phytoplankton requirements in the southern half of the Eastern English Channel, in the middle part of the Southern Bight of the North Sea (EMoSEM, 2015). The group of Western French and continues to account for 25%Rivers, mainly driven by the Loire River, exerts a long range influence: it spreads over a large part of the continental shelf, enters deeply in the English Channel and contributes still more than

10% to the nitrogenous content of the phytoplankton entering the North Sea through the Straits of Dover (ECO-MARS3D, EMOSEM).

5.6.3 Toxins in molluscs

The ASPs (Amnesic Shellfish Poison) present in mussel are measured by France and can be considered as a voluntary parameter. The incriminated toxin is the domoic acid and is known to be produce by some Bacillariophyta of the genus *Pseudo-nitzschia* spp. ASPs are included in the Category IV assessment parameter, and are used together with DSP and PSP in the scoring processes.

6. Comparison and/or links with European eutrophication policies.

6.1 WFD for coastal waters

The last French WFD ecological assessment was made in 2015. Globally the assessment of coastal water quality made by France in regard of the OSPAR COMP3 for eutrophication do not differ so much from the WFD ecological evaluation in coastal waters (Table 6). The OSPAR Problem Areas coincide with WFD water masses classified as moderate or poor status considering phytoplankton or macrophytes problems. This is particularly well observed in OSPAR zone 1 to 14. The OSPAR zone 16 (West Brittany), 18 and 27 are downgraded considering OSPAR COMP3 rather than the WFD. This is mainly due to the “algae toxins” parameter that declassifies many OSPAR zones and is not taken into account in the WFD ecological assessment. At the opposite, the parameters “fish” and “subtidal macrophyte” that declassify some WFD water masses (in OSPAR Zones 25 and 26) are not used for the French OSPAR COMP3.

Atlas of WFD water masses classification can be found at these web addresses:
Zone 1 to Zone 2:

http://envlit.ifremer.fr/surveillance/directive_cadre_sur_l_eau_dce/la_dce_par_bassin/bassin_artois_picardie/fr/atlas_interactif

Zone 3 to Zone 9:

http://envlit.ifremer.fr/surveillance/directive_cadre_sur_l_eau_dce/la_dce_par_bassin/bassin_seine_normandie/fr/atlas_interactif

Zone 10 to Zone 25 (partially) :

http://envlit.ifremer.fr/surveillance/directive_cadre_sur_l_eau_dce/la_dce_par_bassin/bassin_loire_bretagne/fr/atlas_interactif

Zone 25 (partially) to Zone 28:

http://envlit.ifremer.fr/surveillance/directive_cadre_sur_l_eau_dce/la_dce_par_bassin/bassin_adour_garonne/fr/atlas_interactif

They are only available in French but they display a color based classification of water masses: Blue = High ecological quality, Green = Good ecological quality, Yellow = Moderate ecological quality, Orange = Poor ecological quality and Red = Bad ecological quality. The same color labeling will be used in table and maps thereafter.

6.2 MSFD for coastal waters

The Initial Assessment made under the first phase of the MSFD in 2012, describe different coastal target areas where there is a potential problem of eutrophication (high phytoplankton biomass and macrophytes blooms). Except for the coastal part southern to the Loire (Zone 5 to 28), the initial status reflect the same problems as the OSPAR COMP3 (Table 7).

Table 7. Comparison between assessment results of OSPAR COMP3, WFD Ecological quality status and MSFD Initial Status. In parenthesis are the declassifying parameters.

MSFD French Coastal Areas	MSFD Initial Status (Target Area 2011)	OSPAR Zones	OSPAR COMP3 Classif. (2006-2014)	WFD Areas	WFD Quality status (2006-2011)
Belgium Coast – Seine estuary	Target area in regard of Eutrophication (High Productivity)	1	PA (Chla + Phyto.)	FRAC01	Moderate (Phyto.)
				FRAC02	Moderate (Phyto.)
		2	PA (Nut.+ Chla + Phyto.)	FRAC03	Bad (Phyto + Macro. Sub.)
				FRAC04	Moderate (Phyto.)
				FRAC05	Moderate (Phyto.)
				FRAT01	Poor (Phyto.)
		3	NPA	FRHC18	Good
				FRHC17	Good
		4	PA (Nut.+ Chla + Tox.)	FRHC16	Moderate (Phyto.)
				FRHT03	Poor (Fish)
				FRHC15	Moderate (Phyto.)
Côte Fleurie - St Vaast La Hougue	Target area in regard of Eutrophication (High Productivity + Ulva blooms)	5	PA (Bloom Macro.)	FRHC14	Good
				FRHC13	Poor (Bloom Macro.)
				FRHC12	Moderate (Bloom Macro.)
				FRHC11	High
		6	PPA (Tox.)	FRHC10	Good
				FRHT06	Moderate (Fish)
				FRHC09	Good
				FRHC08	Moderate (Bloom Macro.)
Cherbourg - Mont St Michel	Not Target area in regard of Eutrophication (one secondary importance area for macrophytes blooming at Barfleur)	7	NPA	FRHC07	Good
				FRHC60	High
				FRHC61	Good
				FRHC05	High
		8	NPA	FRHC04	Good
				FRHC03	Good
				FRHC01	Good
		9	NPA	FRHC02	Good
				FRHT05	Good
				FRGC01	Good
North and West Brittany	Target area in regard of Eutrophication (multiple primary importance area for	10	PA (Bloom Macro.)	FRGT02	Moderate (Bloom Macro.)
				FRGC03	Unknown
		11	PA (Bloom Macro.)	FRGC05	Poor (Bloom Macro.)

	macrophytes blooming)			FRGC06	Good
		12	PPA (Bloom Macro.)	FRGC07	Good
				FRGT03	Moderate (Bloom Macro.)
				FRGT04	Good
		13	PA (Bloom Macro. + Tox.)	FRGC08	Good
				FRGC09	High
				FRGC10	Poor (Bloom Macro.)
				FRGC11	Good
				FRGC12	Moderate (Bloom Macro.)
				FRGT06	Moderate (Bloom Macro.)
				FRGT07	Moderate (Bloom Macro.)
		14	NPA	FRGC13	Good
				FRGT08	Good
				FRGT09	Good
		15	PPA (Tox.)	FRGC18	Good
				FRGC17	Good
		16	PPA (Tox.)	FRGC16	Good
				FRGT10	Good
				FRGT11	Good
				FRGT12	Good
		17	PA (Phyto. + Bloom Macro. + Tox.)	FRGC20	Moderate (Bloom Macro.)
South Brittany - Noirmoutier	Target area in regard of Eutrophication (High Productivity + multiple primary importance are for macrophytes blooming)	18	PPA (Tox.)	FRGC24	High
				FRGC26	Good
		19	NPA (Bloom Macro. + Tox.)	FRGC28	Good
				FRGC29	Poor (Bloom Macro.)
				FRGT14	Moderate (Bloom Macro.)
				FRGT15	Good
				FRGT16	Good
				FRGT17	Good
		20	NPA (Bloom Macro. + Tox.)	FRGT18	Moderate (Fish)
				FRGT19	Good
				FRGT20	Moderate (Bloom Macro.)
				FRGT21	Moderate (Bloom Macro.)
				FRGC32	Good
				FRGC33	Good
				FRGC34	Good
				FRGC35	Good
				FRGC37	High
		21	PPA/NPA	FRGC42	Good
				FRGC36	Good
				FRGC38	Good
				FRGT22	Good
		22	PA (Bloom Macro.)	FRGC39	Moderate (Bloom Macro.)

				FRGT23	Good
				FRGT24	Poor (Bloom Macro.)
				FRGT25	Good
		23	PA (Chla + Phyto. + Tox.)	FRGC45	Moderate (Phyto.)
				FRGC44	Poor (Macrophyte + Phyto.)
				FRGT26	Good
				FRGT27	Good
		24	PPA (Chla)	FRGC46	Moderate (Phyto.)
				FRGT28	Moderate (Fish)
				FRGC48	Moderate (Benthos + Macro)
Vendée	Not Target area in regard of Eutrophication	25	NPA	FRGC47	Good
				FRGC49	Good
				FRGC50	Poor (Macro Sub.)
				FRGC51	High
Pertuis Breton - Gironde	Target area in regard of Eutrophication (High Productivity + one primary importance area for macrophytes blooming at Ile de Ré)			FRGC52	High
				FRGC53	Moderate (Macro)
				FRGC54	Good
				FRGT30	Good
				FRGT31	Moderate (Fish)
				FRFC01	Good
				FRFC02	Good
		26	NPA	FRFC03	Good
				FRFT09	Poor (Fish)
Girondine Coast	Not Target area in regard of Eutrophication	27	PPA (Tox.)	FRFC05	Good
Arcachon	Target area in regard of Eutrophication (High Productivity)			FRFC07	Good
				FRFC06	Good
Landes	Not Target area in regard of Eutrophication			FRFC08	High
				FRFC09	Good
Pays Basque	Target area in regard of Eutrophication (High Productivity)	28	NPA	FRFC10	Good
				FRFC11	Good

6.3 Nitrate Directive.

The last classification of French vulnerable areas having regard to the Nitrate Directive (91/676/CEE) was made in 2012. They are areas where the concentration of nitrates (mainly coming from farming activities) in surface potable waters exceed, or will exceed, 50mg.l^{-1}. The Figure 13 try to highlight the coherence between these vulnerable areas definition and the eutrophication status of coastal waters made following the OSPAR COMP3. From the northern part of France to the south of Brittany, except for the Zone 3, OSPAR zones in Non-Problem or in Problem/Potential problem Areas corresponds to not vulnerable or vulnerable catchment areas, respectively. The middle part of the coastal area in the Bay of Biscay (Loire-north of the Gironde estuary) that is considered as Non-Problem Area in regard of the 2002 screening procedure is associated to a large vulnerable catchment area. The southern part of the Bay of Biscay which status is in Non-Problem Area to Potentially-problem Area is associated to non-vulnerable catchment areas except for the Arcachon Bassin.

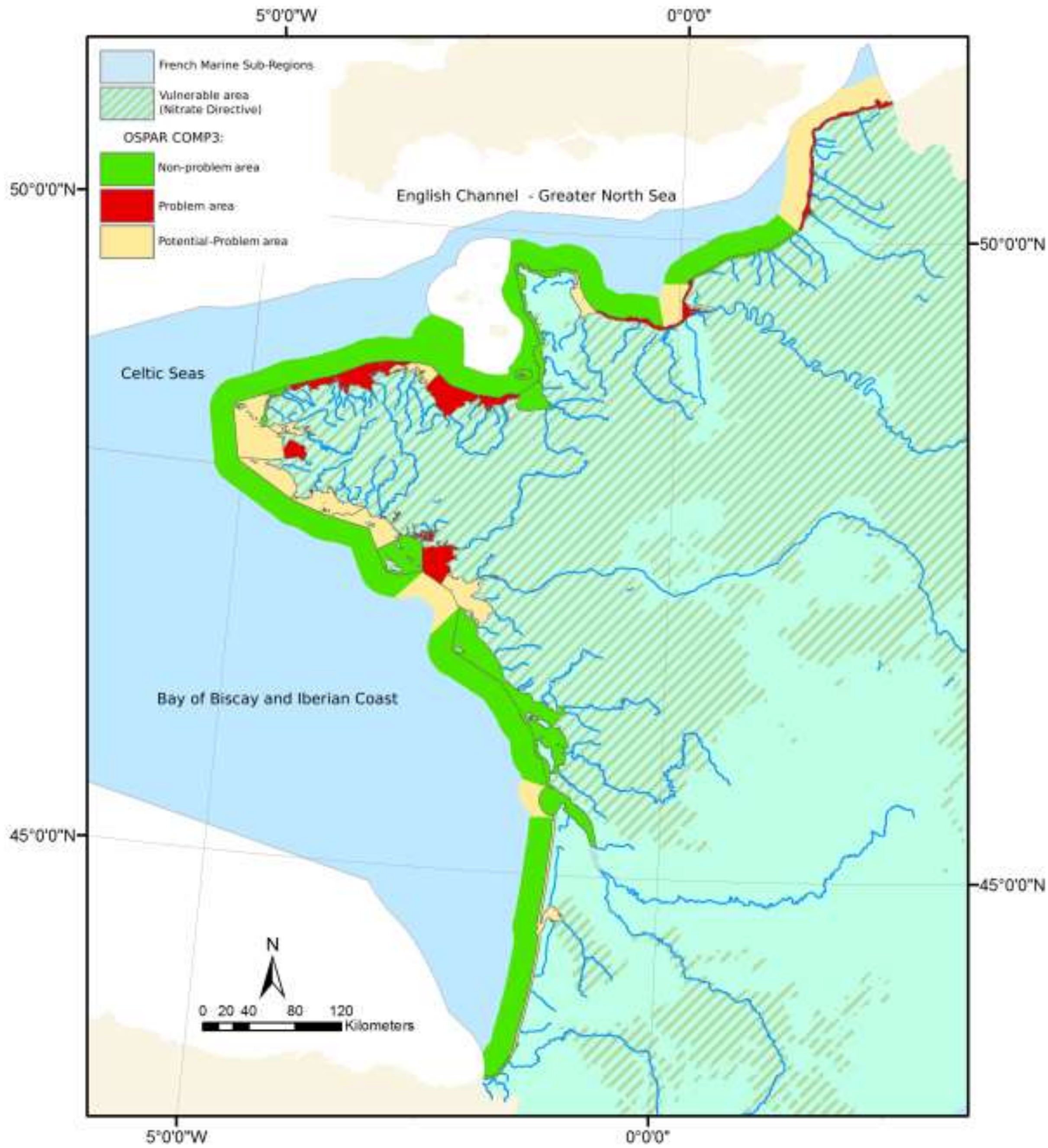

Figure 13. Overall results from the third application of the OSPAR Common Procedure (COMP3) (2006-2014) for French national marine waters (OSPAR Regions II, III and IV) (Red: Problem Areas; Green: Non Problem Areas, Yellow: Potential-Problem Areas) and status of watersheds having regard to the Nitrate Directive (green shaded areas).

6.4 Urban Waste Water Treatment Directive (UWWTD)

For the year 2013 France counted almost 20 000 wastewater treatment plants spread on its metropolitan territory, representing a global treatment capacity evaluated at 99 million population equivalents (p.e.). During the period 2006-2014 more than 300 treatment plants were render consistent with the UWWT directive (91/271/CEE) (decrease by 70-80% the nitrate concentration between in and out the treatment plants to obtain at least 1 $mg.l^{-1}$). The majority of treatment plants spread along the French Atlantic and English Channel – Greater North Sea coast are consistent with the UWW directive, only 20 coastal plants and a few plants localized in the catchment area of the Seine, Loire and Gironde were not consistent in 2014.

The maps of sensitive areas to eutrophication (Figure 14) show that coastal areas are consistent with the UWWT Directive since 2013 except for the OSPAR zone 25 and part of the 24.

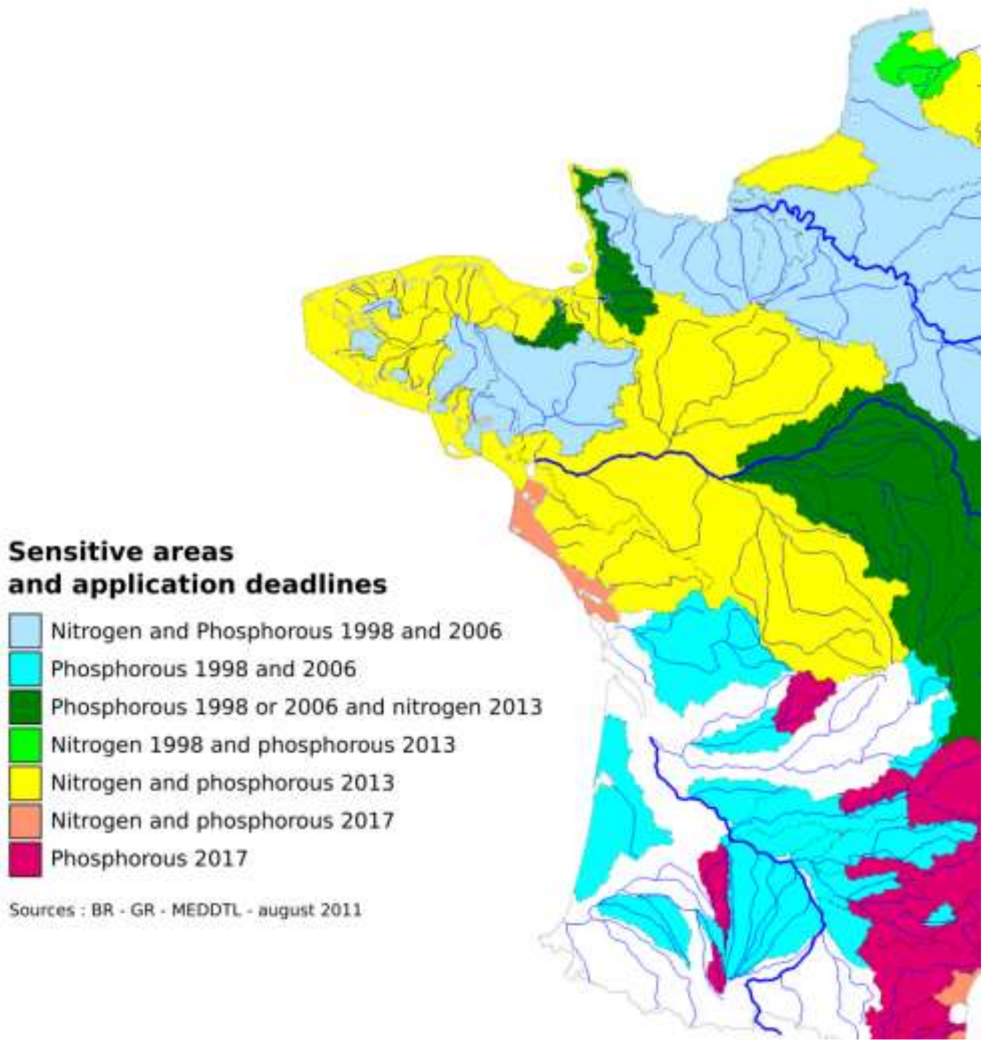

Figure 14. Sensitive areas to eutrophication identified in 2011 and deadline to be consistent with the UWW directive for treatment of phosphorous and nitrogen.

7. Link to the results of the common indicators applicable to the sub-region wherein the CP waters are assessed.

7.1 Nutrients inputs

Nutrient inputs common indicator assessment highlights that with the exception of nitrogen loads to the Iberian Seas and Bay of Biscay (Region 4) nutrient loads have significantly decreased since 1990. Decreases in loads to Region 2 (Greater North Sea) are strongly significant (i.e. decreasing trend with better than 99% confidence). A detail analyses of the data presented in the ICG-EUT report fail to show a global trend for French riverine inputs between 1990 and 2013 (ICG EUT 16/04/04). However the same data show a significant decrease of French input between 2006 and 2011 following by a strong increase. The decreasing part is also relayed by the present assessment that show significant decreasing trends or no trend in nitrogen riverine inputs (except for zone 28, see 5.4) but our assessment stop in 2010 that avoid us to relay the increase show by the annual data of the common indicator assessment.

7.2 Oxygen

Oxygen common indicator assessment showed a significant decreasing trend in the English Channel and no significant trend in the Bay of Biscay. Moreover results indicate that oxygen concentrations near the seabed in the Greater North Sea, the Celtic Seas and the English Channel were above the OSPAR threshold value of 6 $mg.l^{-1}$ for the assessment period from 2006 to 2014 (Figure 3), indicating that oxygen deficiency was not a problem in these regions during this period. These results are consistent with the present assessment: no problematic area was highlighted because of oxygen depletion (see 5.2), significant decreasing trends were observed in the English Channel (Zone 1, 16 and 17) and one significant positive trend identified in the Bay of Biscay (zone 27) for the period 2008-2014 in the same area (table 4e).

7.3 Chlorophyll-a

French data were not available in the ICES database which has been used to perform the chla common indicator assessment. However, chla common indicator assessment based on remote sensing images show decreasing trend for the assessment period in the southern bight of the North Sea, this is consistent with our results (table 4c).

8. Perspectives

8.1 Implemented and further planned measures against eutrophication

As shown in parts 6.3 and 6.4 measures to decrease water pollution by nutrients have been take in the framework of the Nitrate Directive (decreasing nitrate loads from farming activities in vulnerable catchment areas) and the UWWT Directive (decreasing nutrient loads from urban activities by using treatment plants).
More recently, specific measures took against eutrophication in marine environment by France were developed in the Program of Measures of the MSFD. Two global objectives were identified: 1) Preserved area not or poorly impacted by eutrophication and 2) Significantly reduce excessive nutrient inputs in marine area impacted by eutrophication. To reach these objectives different operational environmental objectives will be adopt by France:

- Limiting, in the catchment areas, land-based nutrient intake at source and during their transfers.
- Identify areas of eutrophication and the highest contributors' watersheds behind major nutrient inputs from the source to the outfall.
- Reduce or eliminate nutrient inputs, primarily in the most heavily contributing watersheds, acting on emissions from farms, cities and industry, and the transfer of nutrients to the marine environment.
- Reduce atmospheric nitrogen inputs (NOx) taking into account the challenges of the marine environment in the **fight against air pollution plans**, **regional plans** for air quality and **atmospheric protection plans** in the most strongly contributing regions.

Many measures, that match the goal of these objectives, have already been adopted for the application of the Nitrate Directive and the UWWT Directive. In addition to these exiting plans, measures are also developed in the SDAGE (Schémas Directeurs d'Aménagement et de Gestion des Eaux - Masterplan for Water Development and Management) concerning the WFD and SRCAE (Schémas Régionaux du Climat, de l'Air et de l'Energie – Regional Plans for Climat, Air and Enegry) concerning atmospheric pollution to reinforce action programs against eutrophication. SDAGE have been developed by catchment area (documents are only available in French):

Zone 1 to Zone 2:
http://www.eau-artois-picardie.fr/Le-SDAGE-adopte-le-16-octobre-2009.html
Zone 3 to Zone 9:
http://www.eau-seine-normandie.fr/index.php?id=1490
Zone 10 to Zone 24:
http://www.eau-loire-bretagne.fr/sdage/sdage_2010_2015
Zone 25 to Zone 28 :
http://www.eau-adour-garonne.fr/fr/quelle-politique-de-l-eau-en-adour-garonne/un-cadre-le-sdage.html

8.2 Outlook

8.2.1 Expected trends taking account of observed trends related to climate change and ocean acidification

In regards of measures took by France to reduce eutrophication and the results of the application of the COMP3 we expected the following trends:

- A continuity in the already observed decreasing trend in nitrogen inputs (phosphorus inputs being already decreased during the last decades).
- A decreasing trend of winter DIN concentration in area where there is still a problem (principally in Zone1 to Zone4)
- Globally no further trends in Oxygen concentration, the situation being actually good enough (good concentration and no strong significant trends).
- A decreasing trends in chla concentration and phytoplankton blooming in area where there is still an excessive phytoplankton biomass (principally in the Eastern English Channel and in the plume of Estuaries).
- A decreasing trend in green tides frequency and colonized surface in Brittany. These trends have already been observed by the CEVA in many OSPAR Zones of Brittany.

As no assessments have been made concerning climate change and ocean acidification, we cannot take them into account for the expected trends.

8.2.2 Improvement of assessments and monitoring

Some significant improvements have been done for the third application of the Common Procedure at the French national level (nutrient input and concentration (DIN) included in the assessment, harmonization of threshold with the WFD, new metric for macrophytes). Consequently resulting assessments are more coherent with the WFD ones and seem to be conformed to new MSFD needs. Nevertheless, the main weakness of the French assessment lies in the fact that data used are strongly linked to coastal and transitional waters. This is explained by a monitoring programme mainly devoted to shellfish surveillance then adapted to the WFD needs. Consequently as recently confirmed by the MSFD Initial Assessment (2012), offshore data are scarce, limited in time and/or space.

For OSPAR COMP and also for the MSFD, there is a clear need to considered offshore data. These could be done considering different ways: 1) extension of existing coastal monitoring programmes to offshore waters, 2) implementation of instrumented automated systems such as buoys or Ferry Box onboard research vessels or ships of opportunity, 3) use of satellite derived products (mainly chlorophyll-a concentration and turbidity), and 4) use of modeling. Because of human and financial resources limitations and/or environmental, meteorological constraints, there is no unique solution and the monitoring programme should be at the end a combination of these possibilities (optimizing their complementarity). Figures 15 to 17 are an example of proposed extension of existing coastal monitoring programmes to offshore waters in areas significantly concerned by high development of phytoplankton biomass.

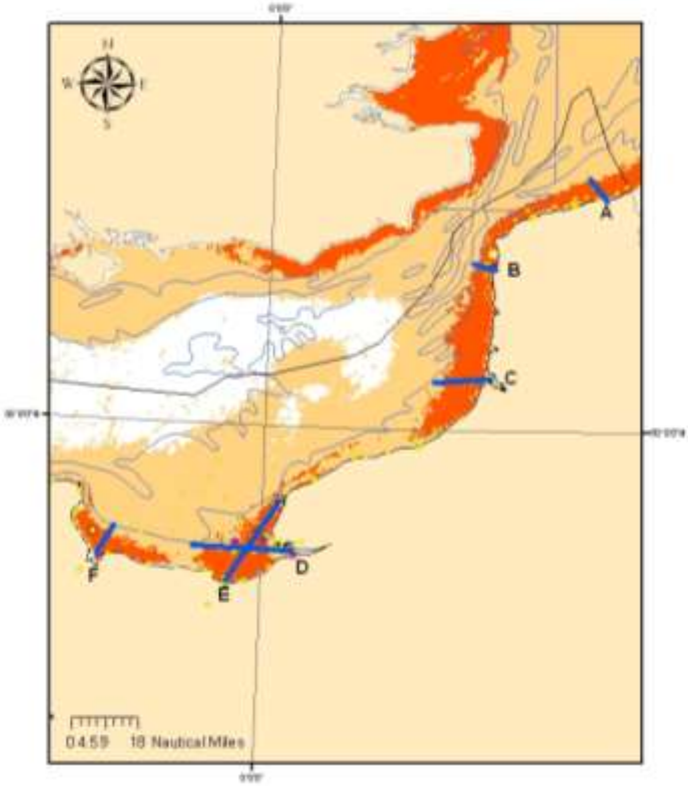

Figure 15. Proposal to complements the existing monitoring networks in the form of radial inshore-offshore in areas of highest phytoplankton biomass in the Eastern English Channel and Southern Bight of the North Sea (orange: estimation of chlorophyll-a concentration using MODIS - climatology 2003-2010 for May to July - source: F. Gohin; yellow dots: existing devices, supports for Nutrients parameter group). (A) existing Dunkirk SRN radial (B) existing SRN Boulogne-sur-Mer radial, (C) SRN Somme Bay radial to extend offshore (D) Eastern Seine Bay radial to change, (E) Ouistreham (Orne) - Antifer radial to create (F) Veys Bay radial to create.

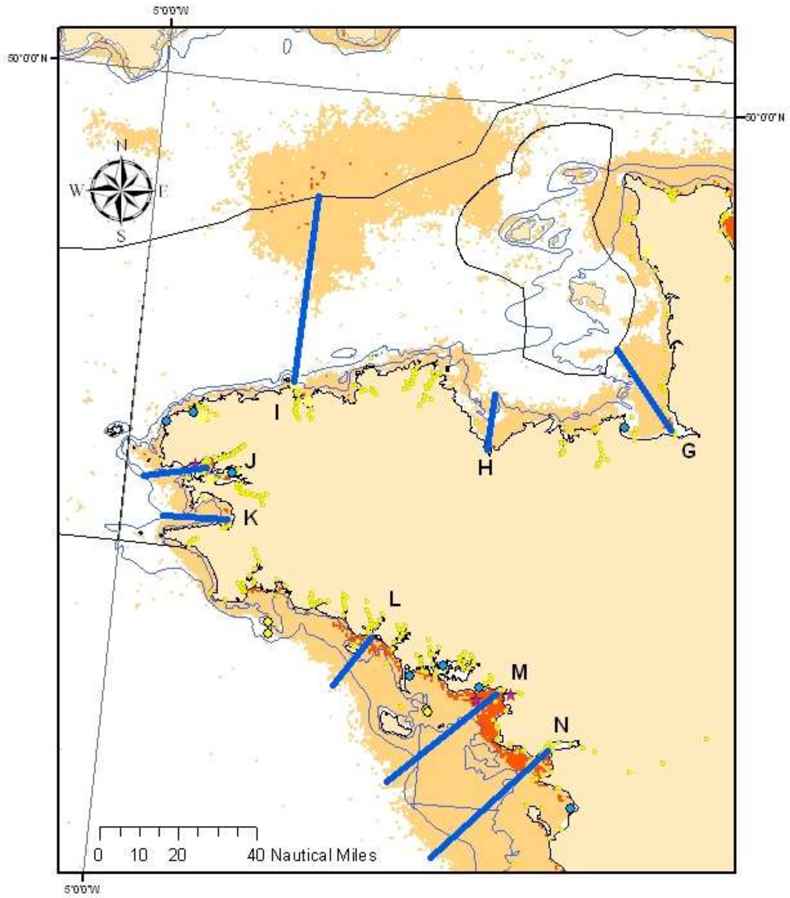

Figure 16. Proposal to complements the existing monitoring networks in the form of radial inshore-offshore in areas of highest phytoplankton biomass in the Northern part of the Bay of Biscay (orange: estimation of chlorophyll-a concentration using MODIS - climatology 2003-2010 for May to July - source: F. Gohin; yellow dots: existing devices, supports for Nutrients parameter group). (G) Mont Saint Michel Bay to offshore radial to create, (H) offshore Saint Brieuc Bay radial to create, (I) offshore Roscoff radial to create, (J) offshore Brest Harbour radial to create, (K) offshore Douarnenez Bay to create (L) offshore Lorient-Groix radial to create,(M) offshore Vilaine radial to create and (N) offshore Loire radial to create.

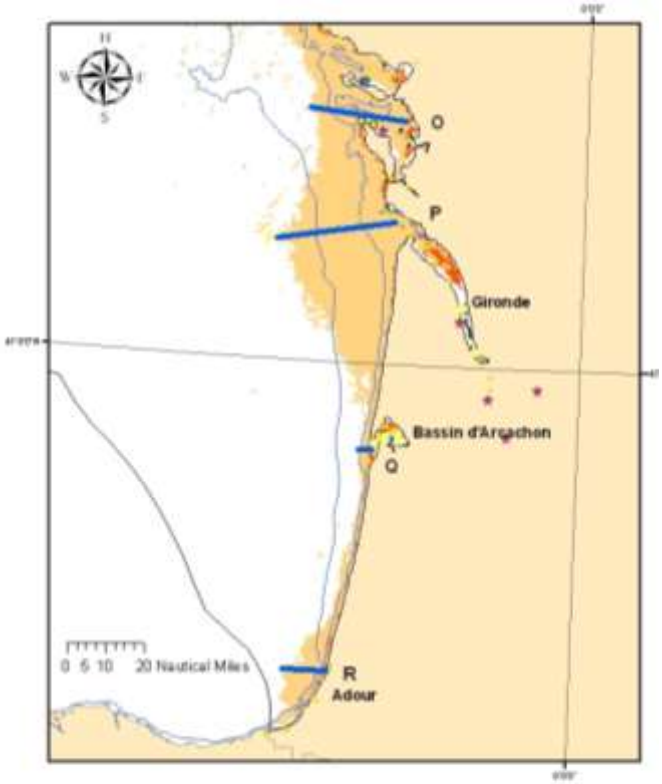

Figure 17. Proposal to complements the existing monitoring networks in the form of radial inshore-offshore in areas of highest phytoplankton biomass in the Southern part of the Bay of Biscay (orange: estimation of chlorophyll-a concentration using MODIS - climatology 2003-2010 for May to July - source: F. Gohin; yellow dots: existing devices, supports for Nutrients parameter group). (O) offshore Pertuis-Charentais radial to create, (P) offshore Gironde radial to create, (Q) offshore Arcachon Bassin to create and (R) offshore Adour radial to create.

Of course, as such an offshore oriented sampling strategy should be impossible in some areas because of too much time needed to do the works, there is a clear need to consider the added values of data supplementary to *in situ* ones. Moreover spatial coverage allowed by an *in situ*-based strategy may not be sufficient to allow an overview of water quality (mesoscale approach). So, in the near future, French assessment should be able to integrate data from satellite (MODIS) and from modeling (EcoMARS3D - as already used within OSPAR ICG-EMO (Eutrophication Modeling) Working Group) to fill the gap.

Another supplementary approach will consist in optimizing the use of data coming from High Frequency Automated Systems (HFAS) (buoys, Ferry Box). Figure 18 illustrated the existing HFAS monitoring network already operational from the English Channel to the Bay of Biscay at the French national level. Ongoing works will considerably contribute to develop and harmonize sensors, quality assurance procedures, data management and processing (example: H2020 JERICO-Next project: http://wwz.ifremer.fr/L-institut/Actualites/Reseau-europeen-d-observation-cotiere-JERICO-s-acheve-JERICO-NEXT-prend-la-releve).

Figure 18. Main locations of the French High Frequency Automated Systems (HFAS) in the English Channel and the Bay of Biscay (*Source: HOSEA – G. Charria, Ifremer*).

9. Conclusions

Concerning the French application of the OSPAR COMP, the areas identified as non-problematic during the first COMP (screening procedure, Annexe 1) areas were not re-evaluated for the second and third procedure. Compare to the second procedure macrophytes evaluation was change for a more adapted method to eutrophication assessment following expert recommendations. The problems encounter for oxygen and DIN assessment during the COMP2 (resulting in a succession of potential problem area for the majority of coastal area) was solved giving a more complete assessment of the French coastal area for the COMP3. The result is that 10 coastal areas are problematic in regard of the eutrophication assessment (13 for the COMP2), 10 have the potential problem area status (9 for the COMP2) and 8 have the non-problematic area status (6 for the COMP3).

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11. Annexes

Annexe 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 departments 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 departments 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 department 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 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 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.

Annexe 2

Main phytoplanktonic taxa identified

in the French OSPAR area

Acanthoica
Achnanthaceae
Achnanthes
Achnanthes brevipes
Actinocyclus
Actinoptychus
Actinoptychus senarius
Actinoptychus senarius + campanulifer
Adenoides
Akashiwo
Akashiwo sanguinea
Alexandrium
Alexandrium affine
Alexandrium andersonii
Alexandrium catenella
Alexandrium insuetum
Alexandrium leei
Alexandrium margalefii
Alexandrium minutum
Alexandrium ostenfeldii
Alexandrium pseudogonyaulax
Alexandrium tamarense
Alexandrium tamarense + catenella + tamutum
Alexandrium tamutum
Amphidiniopsis
Amphidinium
Amphidinium carterae
Amphidinium carterae + operculatum
Amphidinium crassum
Amphidoma
Amphidoma caudata
Amphiprora
Amphisolenia bidentata
Amphora
Amylax
Amylax triacantha
Amylax triacantha + buxus
Anabaena
Ankistrodesmus
Apedinella radians
Archaeperidinium minutum
Asterionella
Asterionella + Asterionellopsis + Asteroplanus
Asterionella formosa
Asterionellopsis
Asterionellopsis glacialis
Asterolampra marylandica
Asterolampraceae
Asteromphalus
Asteromphalus cleveanus
Asteromphalus flabellatus
Asteromphalus heptactis
Asteroplanus karianus
Attheya
Attheya armata
Aulacodiscus
Aulacoseira
Bacillaria
Bacillaria paxillifera
Bacillariaceae
Bacillariophyceae
Bacteriastrum
Bacteriastrum delicatulum
Bacteriastrum furcatum
Bacteriastrum hyalinum
Bellerochea
Biddulphia
Biddulphia rhombus
Biddulphiaceae
Bleakeleya
Bleakeleya notata
Blepharocysta
Brockmanniella
Brockmanniella brockmannii
Calciosolenia brasiliensis
Calciosolenia murrayi
Caloneis
Campylosira
Campylosira cymbelliformis
Centriques
Cerataulina
Cerataulina dentata
Cerataulina pelagica
Ceratiaceae
Ceratium
Ceratium tripos + Ceratium à cornes recourbées
Ceratocorys
Ceratocorys gourretii
Ceratoneis closterium
Ceratoperidinium yeye
Chaetoceros
Chaetoceros affinis
Chaetoceros anastomosans
Chaetoceros atlanticus
Chaetoceros borealis
Chaetoceros brevis
Chaetoceros ceratosporum var. ceratosporus
Chaetoceros coarctatus
Chaetoceros compressus
Chaetoceros convolutus
Chaetoceros curvisetus
Chaetoceros curvisetus + debilis + pseudocurvisetus
Chaetoceros dadayi
Chaetoceros danicus
Chaetoceros debilis
Chaetoceros decipiens
Chaetoceros decipiens + lorenzianus
Chaetoceros densus
Chaetoceros densus + castracanei
Chaetoceros diadema
Chaetoceros didymus
Chaetoceros didymus + protuberans
Chaetoceros diversus
Chaetoceros eibenii
Chaetoceros fragilis
Chaetoceros fragilis + wighamii
Chaetoceros furcellatus
Chaetoceros laciniosus
Chaetoceros laeve
Chaetoceros lorenzianus
Chaetoceros mitra
Chaetoceros neglectus
Chaetoceros neogracile
Chaetoceros peruvianus
Chaetoceros protuberans
Chaetoceros pseudocurvisetus
Chaetoceros rostratus
Chaetoceros saltans
Chaetoceros similis
Chaetoceros simplex
Chaetoceros socialis
Chaetoceros socialis + socialis f. radians
Chaetoceros socialis f. radians
Chaetoceros subtilis
Chaetoceros tenuissimus
Chaetoceros teres
Chaetoceros tetrastichon
Chaetoceros tortissimus
Chaetoceros wighamii
Chaetocerotaceae
Chattonella
Chlamydomonas
Chlorophyceae
Choanofila
Chrysanthemodiscus floriatus
Chrysochromulina
Chrysophyceae
Ciliophora
Climaconeis
Climacosphenia
Climacosphenia moniligera
Coccolithaceae
Coccolithus
Cocconeis
Coccosphaerales
Cochlodinium
Cochlodinium polykrikoides
Coolia
Corethron
Corethron pennatum
Corythodinium
Coscinodiscaceae
Coscinodiscophycidae
Coscinodiscus
Coscinodiscus + Stellarima
Coscinodiscus asteromphalus + oculus-iridis + perforatus
Coscinodiscus granii
Coscinodiscus oculus-iridis
Coscinodiscus radiatus
Cryptomonadales
Cryptomonas
Cryptophyceae
Cyanobacteria
Cyanophyceae
Cyclophora tenuis
Cyclotella
Cylindrotheca

Cylindrotheca gracilis
Cymatosiraceae
Cymbella
Cymbellaceae
Dactyliosolen
Dactyliosolen blavyanus
Dactyliosolen fragilissimus
Dactyliosolen phuketensis
Delphineis
Denticula
Desmodesmus communis
Detonula
Detonula pumila
Diatoma
Dictyocha
Dictyocha fibula
Dictyocha speculum
Dictyochaceae
Dictyochales
Dictyochophyceae
Dinobryon
Dinoflagellata
Dinophyceae
Dinophysiaceae
Dinophysis
Dinophysis acuminata
Dinophysis acuta
Dinophysis caudata
Dinophysis fortii
Dinophysis norvegica
Dinophysis sacculus
Dinophysis tripos
Diploneis
Diplopsalis
Diplopsalis+Diplopelta+Diplopsalopsis+Preperidinium+Oblea
Diplopsalopsis
Discosphaera
Discosphaera tubifer
Dissodinium + Pyrocystis
Ditylum
Ditylum brightwellii
Donkinia
Ebria
Ebria tripartita
Ebriaceae
Emiliania
Emiliania huxleyi
Ensiculifera
Entomoneidaceae
Entomoneis
Epithemia
Eucampia
Eucampia + Climacodium
Eucampia cornuta
Eucampia zodiacus
Euglena
Euglenaceae
Euglenoidea
Eutreptia
Eutreptiaceae
Eutreptiella
Eutreptiida
Fibrocapsa
Fibrocapsa japonica
Fragilaria
Fragilaria hyalina
Fragilariaceae
Fragilariopsis
Fragilidium
Gephyrocapsa oceanica
Gomphonema
Gomphonema + Gomphoneis
Goniodoma
Goniodoma polyedricum
Goniodomataceae
Gonyaulacaceae
Gonyaulax
Gonyaulax fusiformis
Gonyaulax kofoidii
Gonyaulax spinifera
Gonyaulax verior
Grammatophora
Grammatophora marina
Grammatophora oceanica
Grammatophora serpentina
Grammatophora undulata
Guinardia
Guinardia cylindrus
Guinardia delicatula
Guinardia flaccida
Guinardia striata
Gymnodiniaceae
Gymnodiniales
Gymnodinium
Gymnodinium + Gyrodinium
Gymnodinium catenatum
Gymnodinium heterostriatum
Gymnodinium impudicum
Gyrodinium
Gyrodinium flagellare
Gyrodinium fusus
Gyrodinium spirale
Gyrosigma
Gyrosigma fasciola
Gyrosigma lineare
Halamphora costata
Halosphaera
Hantzschia
Haptolina hirta + ericina + Chrysochromulina spinifera
Haslea
Haslea ostrearia
Haslea wawrikae
Helicostomella
Helicotheca
Helicotheca tamesis
Heliopeltaceae
Hemiaulus
Hemiaulus hauckii
Hemiaulus membranaceus
Hemiaulus sinensis
Hemidiscaceae
Hermesinum
Heterocapsa
Heterocapsa minima
Heterocapsa niei
Heterocapsa rotundata
Heterocapsa triquetra
Heterosigma
Heterosigma akashiwo
Histioneis karstenii
Hyalosira interrupta
Isthmia enervis
Isthmia minima
Karenia
Karenia brevis
Karenia brevis + papilionacea
Karenia mikimotoi
Karenia papilionacea
Karlodinium
Karlodinium veneficum
Katodinium
Katodinium glaucum
Kofoidinium velleloides
Kryptoperidinium foliaceum
Lauderia
Lauderia + Schroederella
Lauderia annulata
Lepidodinium
Lepidodinium chlorophorum
Leptocylindraceae
Leptocylindrus
Leptocylindrus danicus
Leptocylindrus danicus + curvatus
Leptocylindrus mediterraneus
Leptocylindrus minimus
Licmophora
Lingulodinium
Lingulodinium polyedrum
Lioloma
Lioloma elongatum
Lioloma pacificum
Lithodesmiaceae
Lithodesmium
Lithodesmium undulatum
Lyrella
Manguinea fusiformis
Mastogloia
Mastogloia rostratra
Mastogloia splendida
Mediopyxis helysia
Melosira
Melosira moniliformis
Melosira nummuloides
Melosiraceae
Merismopedia
Mesodinium
Mesodinium rubrum
Mesoporos
Metaphalacroma
Meuniera
Meuniera membranacea
Michaelsarsia adriaticus
Michaelsarsia elegans
Micracanthodinium
Microcystis
Minidiscus
Minutocellus
Nanoflagellés
Navicula
Navicula + Fallacia + Haslea + Lyrella + Petroneis
Navicula directa
Navicula gregaria
Navicula gregaria + cryptocephala
Navicula pelagica
Naviculaceae
Naviculales
Nematodinium
Neocalyptrella robusta
Neoceratium candelabrum
Neoceratium concilians
Neoceratium declinatum
Neoceratium euarcuatum
Neoceratium extensum
Neoceratium furca
Neoceratium fusus
Neoceratium horridum
Neoceratium kofoidii
Neoceratium lineatum
Neoceratium lineatum + minutum
Neoceratium macroceros
Neoceratium pentagonum
Neoceratium ranipes
Neoceratium symmetricum
Neoceratium teres
Neoceratium trichoceros
Neoceratium tripos
Nitzschia
Nitzschia + Hantzschia
Nitzschia bicapitata

Nitzschia fusiformis
Nitzschia longissima
Nitzschia rectilonga
Nitzschia sicula
Nitzschia sigma
Noctiluca
Noctiluca scintillans
Noctilucaceae
Noctilucales
Oblea
Octactis octonaria
Odontella
Odontella aurita
Odontella granulata
Odontella mobiliensis
Odontella regia
Odontella sinensis
Ophiaster
Ophiaster hydroideus
Ornithocercus
Ornithocercus magnificus
Oscillatoria
Ostreopsis
Ostreopsis lenticularis
Ostreopsis ovata
Oxyrrhis
Oxyrrhis marina
Oxytoxaceae
Oxytoxum
Oxytoxum + Corythodinium
Oxytoxum challengeroides
Oxytoxum globosum
Oxytoxum laticeps
Oxytoxum scolopax
Oxytoxum tesselatum
Oxytoxum variabile
Oxytoxum viride
Palaeophalacroma
Paralia
Paralia sulcata
Pediastrum
Pedinellales
Pennées
Peridinea
Peridiniaceae
Peridiniales
Peridiniella
Peridiniella catenata
Peridinium
Phaeocystis
Phaeodactylum tricornutum
Phalacroma
Phalacroma rapa
Phalacroma rotundatum
Phytoflagellés excepté dinoflagellés
Pinnularia
Plagiogramma
Plagiogrammopsis
Plagiogrammopsis vanheurckii
Plagiotropis
Plagiotropis lepidoptera
Pleurosigma
Pleurosigma + Gyrosigma
Pleurosigma aestuarii
Pleurosigma strigosum
Podocystis
Podolampas
Podolampas elegans
Podolampas palmipes
Podolampas spinifera
Podosira
Podosira + Hyalodiscus
Podosira stelligera
Polykrikaceae
Polykrikos
Polykrikos schwarzii
Pontosphaera
Pontosphaera syracusana
Porosira
Prasinophyceae
Proboscia
Proboscia alata
Proboscia indica
Pronoctiluca
Pronoctiluca pelagica
Prorocentrales
Prorocentrum
Prorocentrum balticum + cordatum
Prorocentrum cordatum
Prorocentrum dentatum
Prorocentrum gracile
Prorocentrum lima
Prorocentrum maximum
Prorocentrum mexicanum
Prorocentrum mexicanum + rhathymum
Prorocentrum micans
Prorocentrum micans + arcuatum + gibbosum
Prorocentrum rostratum
Prorocentrum scutellum
Prorocentrum triestinum
Protoceratium reticulatum
Protoceratium spinulosum
Protoctista
Protoperidinium
Protoperidinium + Peridinium
Protoperidinium bipes
Protoperidinium brevipes
Protoperidinium conicoides
Protoperidinium conicum
Protoperidinium crassipes
Protoperidinium depressum
Protoperidinium diabolum
Protoperidinium diabolum + longipes
Protoperidinium divergens
Protoperidinium granii
Protoperidinium oblongum
Protoperidinium obtusum
Protoperidinium pellucidum
Protoperidinium pentagonum + latissimum
Protoperidinium quinquecorne
Protoperidinium steinii
Protoperidinium steinii + pyriforme
Prymnesiaceae
Prymnesiales
Prymnesiophyceae
Prymnesium
Pseliodinium
Pseudanabaena
Pseudo-nitzschia
Pseudo-nitzschia americana
Pseudo-nitzschia australis
Pseudo-nitzschia delicatissima
Pseudo-nitzschia fraudulenta
Pseudo-nitzschia multistriata
Pseudo-nitzschia pseudodelicatissima
Pseudo-nitzschia seriata
Pseudo-nitzschia subpacifica
Pseudo-nitzschia turgidula
Pseudo-nitzschia, complexe americana (americana + brasiliana)
Pseudo-nitzschia, complexe delicatissima, groupe des fines (calliantha + delicatissima + pseudodelicatissima + subcurvata)
Pseudo-nitzschia, complexe seriata, groupe des effilées (multiseries + pungens)
Pseudo-nitzschia, complexe seriata, groupe des larges (australis + fraudulenta + seriata + subpacifica)
Pseudo-nitzschia, groupe des larges asymétriques (australis + seriata + subpacifica)
Pseudo-nitzschia, groupe des larges symétriques (fraudulenta)
Pseudo-nitzschia, groupe des sigmoïdes (multistriata)
Pseudosolenia calcar-avis
Pyramimonas
Pyramimonas longicauda
Pyrocystis
Pyrocystis noctiluca
Pyrodinium bahamense
Pyrophacaceae
Pyrophacus
Raphidophyceae
Raphidosphaera tenerrima
Rhabdolithes
Rhabdolithes claviger
Rhabdonema
Rhabdonema adriaticum
Rhaphoneis
Rhaphoneis + Delphineis
Rhizosolenia
Rhizosolenia acuminata
Rhizosolenia hebetata
Rhizosolenia imbricata
Rhizosolenia imbricata + styliformis
Rhizosolenia setigera
Rhizosolenia setigera + setigera f. pungens
Rhizosolenia setigera f. pungens
Rhizosolenia simplex
Rhizosolenia styliformis
Rhizosoleniaceae
Richelia intracellularis
Scenedesmus
Schroederella
Scrippsiella
Scrippsiella + Ensiculifera + Pentapharsodinium + Bysmatrum
Scyphosphaera apsteinii
Selenastrum
Seminavis
Sinophysis
Skeletonema
Skeletonema costatum
Skeletonema subsalsum
Spatulodinium
Spatulodinium pseudonoctiluca
Spiraulax kofoidii
Spirulina
Staurastrum
Stauroneis
Stephanopyxis
Stichosiphon
Striatella
Striatella interrupta
Striatella unipunctata
Surirella
Surirella recedens
Surirellaceae
Synechocystis
Synedra
Synedra + Toxarium
Synedra arcuata

Synedra fulgens
Syracosphaera
Tabellaria
Tetraselmis + Prasinocladus
Thalassionema
Thalassionema + Thalassiothrix + Lioloma
Thalassionema bacillare
Thalassionema frauenfeldii
Thalassionema javanicum
Thalassionema nitzschioides
Thalassiosira
Thalassiosira + Porosira
Thalassiosira angulata
Thalassiosira anguste-lineata
Thalassiosira antarctica
Thalassiosira gravida
Thalassiosira levanderi
Thalassiosira levanderi + minima
Thalassiosira nordenskioeldii
Thalassiosira punctigera
Thalassiosira rotula
Thalassiosira rotula + gravida
Thalassiosira subtilis
Thalassiosiraceae
Thalassiothrix
Thalassiothrix heteromorpha
Thalassiothrix longissima
Thecadinium
Tiarina
Tintinnina
Torodinium
Torodinium robustum
Torodinium teredo
Tous Dinophysis ronds avec épithèque bien visible
Toxarium hennedyanum
Toxarium undulatum
Toxonidea
Trachyneis
Triceratiaceae
Triceratium
Triceratium favus
Trichodesmium
Trigonium alternans
Tropidoneis
Umbellosphaera
Umbellosphaera irregularis
Umbilicosphaera sibogae
Vulcanodinium rugosum
Warnowia
Warnowia + Nematodinium + Nematopsides
Warnowia polyphemus
Warnowiaceae