OSPAR CONVENTION FOR THE PROTECTION OF THE MARINE ENVIRONMENT OF THE NORTH-EAST ATLANTIC

National Eutrophication Assessment Report under the Common Procedure

Ireland

Report on the Third Application of the Comprehensive Procedure

2016

Compiled by the Environmental Protection Agency and the Marine Institute

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1. Summary

This report contains the outcome of the third application of the OSPAR Comprehensive Procedure by Ireland and is primarily based on data collected between 2006 and 2014. A total of 83 water bodies (estuarine and nearshore coastal waters) have been included in the assessment along with 7 coastal and offshore areas.

In this third assessment, 20 areas (24%) have been classified as Problem areas, 16 (19%) as potential problem areas and 47 (57%) as non-problem areas. All coastal and offshore areas remain classified as non-problem areas.

In the second application, 26 (41%) were classed as problem areas, 5 (8%) were classified as potential problem areas and 32 (51%) were classified as non-problem areas. The coastal and offshore waters, which were divided into 7 separate assessment zones for screening, were all classified as non-problem areas.

The assessment has shown that the largest number of problem areas, are located inshore, and predominantly along the eastern, south eastern and southern coasts of Ireland. In general, this distribution reflects the greater impacts that arise from pressures associated with higher human population densities and more intense agricultural activities in these regions.

All coastal and offshore areas remain as non-problem areas and trend analysis shows little change in nutrient levels of Ireland's marine waters.

Overall, in terms of extent, the proportion of Ireland's maritime area that is classified as a problem area with regard to eutrophication is small and restricted to estuarine and nearshore coastal waters. These areas fall under the regime of the EU Water Framework Directive, which has established programmes of measures to ensure that the environmental objectives that have been set for these waters are met.

2. Introduction

Under the OSPAR convention, eutrophication is defined as:

> *The enrichment of water by nutrients causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned, and therefore refers to the undesirable effects resulting from anthropogenic enrichment by nutrients.*

A key element of the OSPAR Strategy to Combat Eutrophication is the Comprehensive Procedure for the Identification of the Eutrophication Status of the Maritime Area. This Procedure, adopted by OSPAR in 1997, sets the framework within which it is the responsibility of individual OSPAR Contracting Parties to assess the eutrophication status of their parts of the OSPAR maritime area.

This report contains the results of Ireland's third application of the Comprehensive Procedure and follows the first application of the Comprehensive Procedure in 2003 and second application in 2007.

3. Description of the assessed area

A map of the assessment area including the location of individual sub-areas and the general sampling area of estuarine, near-shore coastal and offshore waters is shown in Figures 1 and 2.

Delineation of estuarine and nearshore coastal water bodies

The boundaries of the estuarine and nearshore waters included in this assessment are those that have been developed for the Water Framework Directive and those that had been previously identified for the purposes of the Urban Waste Water Treatment and Nitrates directives. The landward boundary of a transitional water body (estuarine) was defined as the upper tidal (either freshwater or saltwater) limit, with the outer boundary, in the majority of cases, being defined by a surface salinity value of 30.0 PSU (Practical salinity Unit). Some large transitional waters were further sub-divided into practical management units based on existing information on the impact from known pressures. The inshore boundary of coastal stretches and bays was defined by the outer limit of the adjacent transitional water, with the outer limits of these waters being drawn according to the most prominent enclosing headlands or other significant physical features as appropriate. The outer limit of more offshore coastal water bodies was demarcated by the baseline plus 1-nautical mile seaward boundary of the WFD.

Delineation of coastal and offshore water bodies for winter nutrient assessment

The boundary of the offshore waters in this assessment includes Ireland's Exclusive Economic Zone (EEZ) boundary, MSFD areas and extends out to surface waters of the Rockall trough, as indicative of background off-shelf nutrient levels. Irish coastal and offshore waters were separated into 7 areas, broadly based on salinity regime, hydrographic characteristics and other features such as riverine inputs (Table 1). Assessments of nutrient status vs areas-specific criteria and temporal trends for these areas were carried out for water of salinity >33.

Table 1. Irish coastal and offshore marine areas for the purpose of the nutrient trend assessment.

	Area	Description	Main riverine inputs and other features
1	NE Irish Sea	Carlingford to South Dublin	Main riverine inputs are the R. Liffey and R. Boyne
2	SE Irish Sea	South Dublin to Waterford Harbour, including St. George's Channel	Main riverine inputs are the R. Avoca, R. Slaney and the Barrow, Nore and Suir rivers (into Waterford Harbour). Also some influence from the Severn/Wye (trans-boundary UK)
3	Celtic Sea	Waterford Harbour to Mizen Head	Main riverine inputs are the Rivers Blackwater and Lee
4	SW Coastal Waters	Mizen Head to Galway Bay	Main riverine inputs are the Rivers Shannon and Corrib
5	NW Coastal Waters	Galway Bay to Lough Foyle	Main riverine inputs are the Rivers Corrib, Erne and Foyle
6	Western Shelf	Across the shelf until the shelf break	No direct riverine inputs
7	Rockall Trough*	Across Rockall Trough	No riverine inputs. Deep winter mixing regenerates nutrients to surface.

*note area mostly outside the Irish EEZ

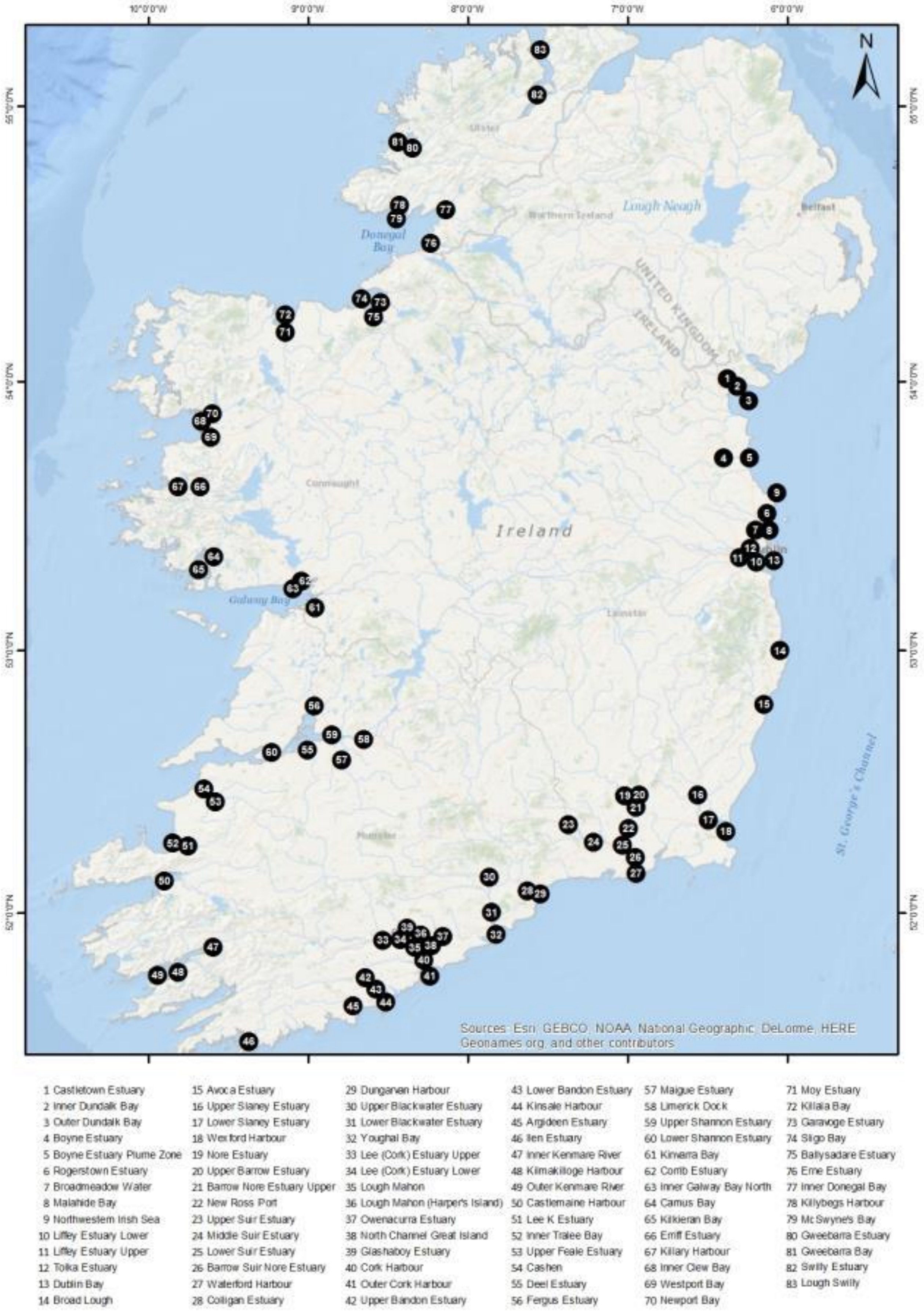

Figure 1. Location of estuarine and nearshore coastal water areas for the third assessment

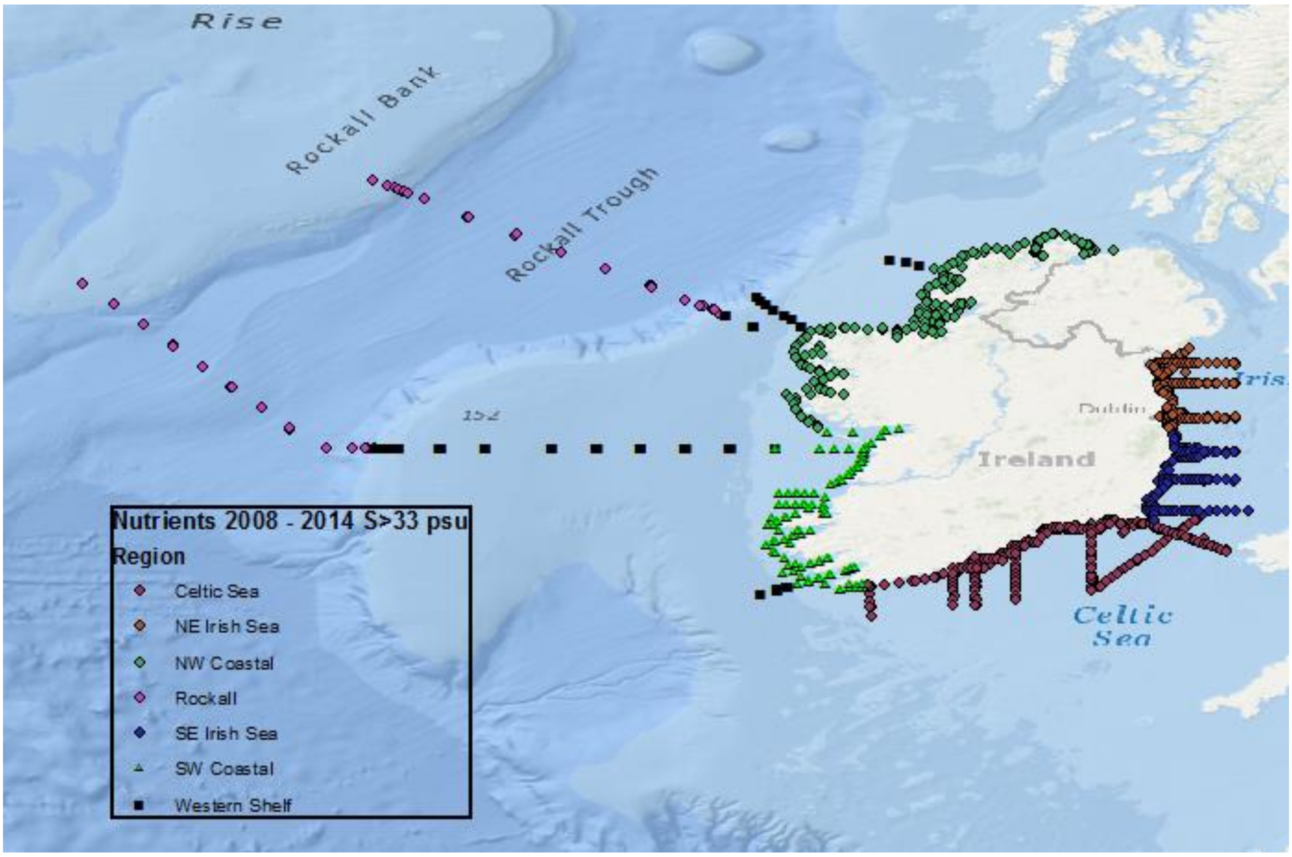

Figure 2. Stations with salinity >=33 psu, sampled for winter surface dissolved inorganic nutrients during shipboard environmental and oceanographic surveys between 2008 - 2014

4. Methods and data

The main source of data used in this assessment is derived from the Environmental Protection Agency's national estuarine and nearshore coastal waters monitoring programme and the Marine Institute's annual winter monitoring programme of coastal and offshore Irish waters. The winter component of the both the EPA and Marine Institute programmes are carried out between the months of November to March inclusive, with the summer component of the EPA programme being undertaken between the months of May to September inclusive.

Environmental Protection Agency – sampling and analytical methods

Monitoring is undertaken four times per annum, once in winter and three times over the summer months (May- September) in estuarine and coastal areas around Ireland. Winter monitoring is carried out to assess trends and maximum concentrations in inorganic nutrients in the absence of biologically induced variability, whereas summer monitoring is designed to detect the direct and indirect effects of nutrient enrichment such as accelerated plant growth and impacts on oxygenation conditions.

Sampling is carried out at multiple locations throughout the water body, and at multiple depths and is undertaken, where practicable, as close to low and high water to capture tidally driven variability.

Field measurements include temperature, salinity, dissolved oxygen (percent saturation), secchi depth. The water samples, which are collected using Ruttner sampling bottles, are analysed for pH, ammonia (NH3), total oxidised nitrogen (NO_2 + NO_3), ortho-phosphate ($PO_{4,}$ - Molybdate Reactive Phosphorus), biochemical oxygen demand (BOD) and chlorophyll A variety of techniques are used to analyse the samples such as flow-injection colorimetry for nutrients and UV spectrometry for chlorophyll, which is extracted using the hot methanol technique.

Field instruments used to measure salinity are calibrated against KCL standards of known conductance and chlorophyll fluorescence readings are calibrated against discrete water samples whose chlorophyll a content has been determined in the laboratory. Analytical techniques are validated through intercalibration and intercomparison exercises carried out between the different EPA laboratories.

Marine Institute – sampling and analytical methods

Annual winter nutrient sampling is carried out in January/February on board the *RV Celtic Voyager* for coastal surveys and on the *RV Celtic Explorer* for surveys across the shelf and the Rockall Trough (station positions of each year Annex 2b). Over the last two decades the sampling programme has evolved with coverage initially focusing on Western Irish Sea but subsequently extending into the Celtic Sea. The current winter environmental programme on board the *Celtic Voyager* includes sampling for dissolved inorganic nutrients around the entire Irish coast (coastal water focus) biennially, along with a number of offshore transects completed. Nutrients samples are also collected during Celtic Voyager hydrographic surveys along 53N (shelf) and across the Rockall Trough. Actual winter sampling is highly weather dependent and annex 2b shows the sampling completed on a year by year basis. Given the weather dependence and evolution of sampling approaches, caution must be exercised in comparing summary results from year to year for given areas.

The assessment includes surface waters only, collected from each station at a depth of 2 to 3 metres using either the on-board peristaltic pumping system or using Niskin bottles on the conductivity, temperature and depth (CTD) rosette. All seawater samples for nutrient analysis were filtered using acid-cleaned polycarbonate filters and preserved by freezing. A sub-sample was collected for each sample for accurate salinity analysis.

Total oxidized nitrogen (TOxN), ortho-phosphate (ortho-P), nitrite and silicate were analysed using segmented flow analysers. Discrete salinity samples were analysed using Guildline benchtop salinometers. Vertical profiles of conductivity and temperature were recorded using a Seabird SBE - 911 CTD system. A rigorous quality assurance scheme underpins analysis, including accreditation to ISO 17025 for both nutrient and salinity analysis and participation in QUASIMEME proficiency testing exercises. A detailed description of sample collection, analysis and quality control is outlined in McGrath et al. (McGrath *et al.* 2013).

A relatively simple approach was used to assess temporal trends in surface winter dissolved inorganic nutrient concentrations using non-parametric Mann-Kendall tests using the R platform and the TTA trend analysis package(Devreker and Lefebvre 2014).

Coastal waters with salinity > 33 and offshore waters are compared directly with the OSPAR area-specific assessment criteria for elevated TOxN (15µM for off-shelf waters and 12µM for the Irish Sea) and ortho-phosphate (0.8µM). Although assessment parameters are related to dissolved inorganic nitrogen (DIN), ammonia was not determined so TOxN are reported. N:P ratios are assessed for offshore waters using OSPAR assessment criterion of 24 (50% above Redfield Ratio).

National Assessment Scheme and the OSPAR Comprehensive Procedure

The parameters included in Ireland's national trophic status assessment scheme (TSAS), along with their units, assessment levels and statistics are summarised in Table 2. As can be seen from the cause-relationship structure of the scheme, the approach used to assess the trophic status of Irish water bodies is similar to the OSPAR Comprehensive Procedure. Importantly the values for each of these parameters is scaled to take into account the influence of salinity, which is an important factor in determining the water quality characteristics of estuarine and nearshore coastal waters. A full description of the national method can be found in (Toner *et al.* 2005). To summarise, both dissolved inorganic nitrogen (DIN) and ortho-phosphate (MRP) levels are assessed in summer and winter, chlorophyll data is assessed using a median and 90 percentile approach and oxygen conditions are assessed both in respect of deoxygenation and supersaturation.

As indicated by Ireland in the previous application of the Comprehensive Procedure the use of N:P ratios, while applied in the current assessment to offshore and coastal waters, was not applied to estuarine and nearshore coastal waters that are influenced by freshwater input. Previous examination of over 1000 freshwater sites has shown that the N:P ratio can on average be as high as 75:1.

In addition to water-column monitoring information is also included on the abundance and composition of macroalgae from certain transitional areas. This uses the WFD assessment for opportunistic macroalgal blooms which has been used in Ireland since the implementation of the WFD monitoring programme in 2007. This scheme is comprised of 5 metrics that describe the biomass and coverage of green opportunistic algae in a water body.

Table 2. Parameters and assessment levels for Irish estuaries, bays and nearshore coastal waters used in the TSAS scheme (Toner *et al.* 2005). Assessment criteria are adjusted on a sliding scale from 0-34.5 psu.

Parameter	Numeric Criterion	Statistic	Period to which Criterion Applies
Category A (Nutrient Enrichment)			
Dissolved Inorganic Nitrogen	mg/l (≈ µM)		
Tidal Fresh Waters (0 psu)	>2.6 (185)	Median	Winter or Summer
Intermediate Waters (1- 17)	>1.4 (100)	Median	Winter or Summer
Full salinity Water (>34.5)	>0.25 (18)	Median	Winter or Summer
Ortho-phosphate (MRP)	µg/l (≈ µM)		
Tidal Fresh Waters (0 psu)	>60 (2.0)	Median	Winter or Summer
Intermediate Waters (1- 17)	>60 (2.0)	Median	Winter or Summer
Full salinity Water (>34.5)	>40 (1.25)	Median	Winter or Summer
Category B (Accelerated growth)			
Chlorophyll	(µg/l)		
Tidal Fresh Waters (0 psu)	>15 (median) or >30 (90 percentile)		Summer
Intermediate Waters (1- 17)	>15 (median) or >30 (90 percentile)		Summer
Full salinity Water (>34.5)	>10 (median) or >20 (90 percentile)		Summer
Category C (Undesirable disturbance)			
Tidal Fresh Waters (0 psu)	<70 (5 percentile) or >130 (95 percentile)		Summer
Intermediate Waters (1- 17)	<70 (5 percentile) or >130 (95 percentile)		Summer
Full salinity Water (>34.5)	<80 (5 percentile) or >120 (95 percentile)		Summer

5. Eutrophication assessment

5.1 Summary of data

This section provides a summary of the data that have been used in the second application of the Comprehensive Procedure for each of the sub-areas and Irish coastal and offshore waters of the western Irish Sea and eastern Celtic Sea.

5.1.1 Estuarine and nearshore coastal waters

Winter DIN and DIP Concentrations
The assessment of the data from 2006-2014 have been undertaken using a series of rolling-aggregations. These assessments consist of other eutrophication assessments undertaken for national and international requirements (e.g. UWWTD, nitrates directive, WFD etc.). The periods assessed are 2006-2008, 2007-2009, 2009-2011, 2010-2012, 2010-2014. These assessments combine all the data across each period which allows for greater confidence in the assessment.

The level of exceedance above or compliance below an assessment parameter is presented as a percentage deviation from the respective assessment level (based on salinity related thresholds detailed in table 2). The use of percentages to represent breaches or compliance with each of assessment parameters provides a means of summarizing the results of the monitoring programme. The percentage exceedance above or compliance below the assessment levels for a winter DIN and MRP (ortho-phosphate) for the first 2006-2008 assessment and the most recent 2012-2014 assessment are shown in Figure 3. This information is summarized in the assessment tables in Annex XX and results of the initial and final classification are given in section 5 below.

A statistical measure of confidence has been calculated based on the methodology proposed by Norway (Molvaer *et al.* 1997, Molvaer *et al.* 2008)

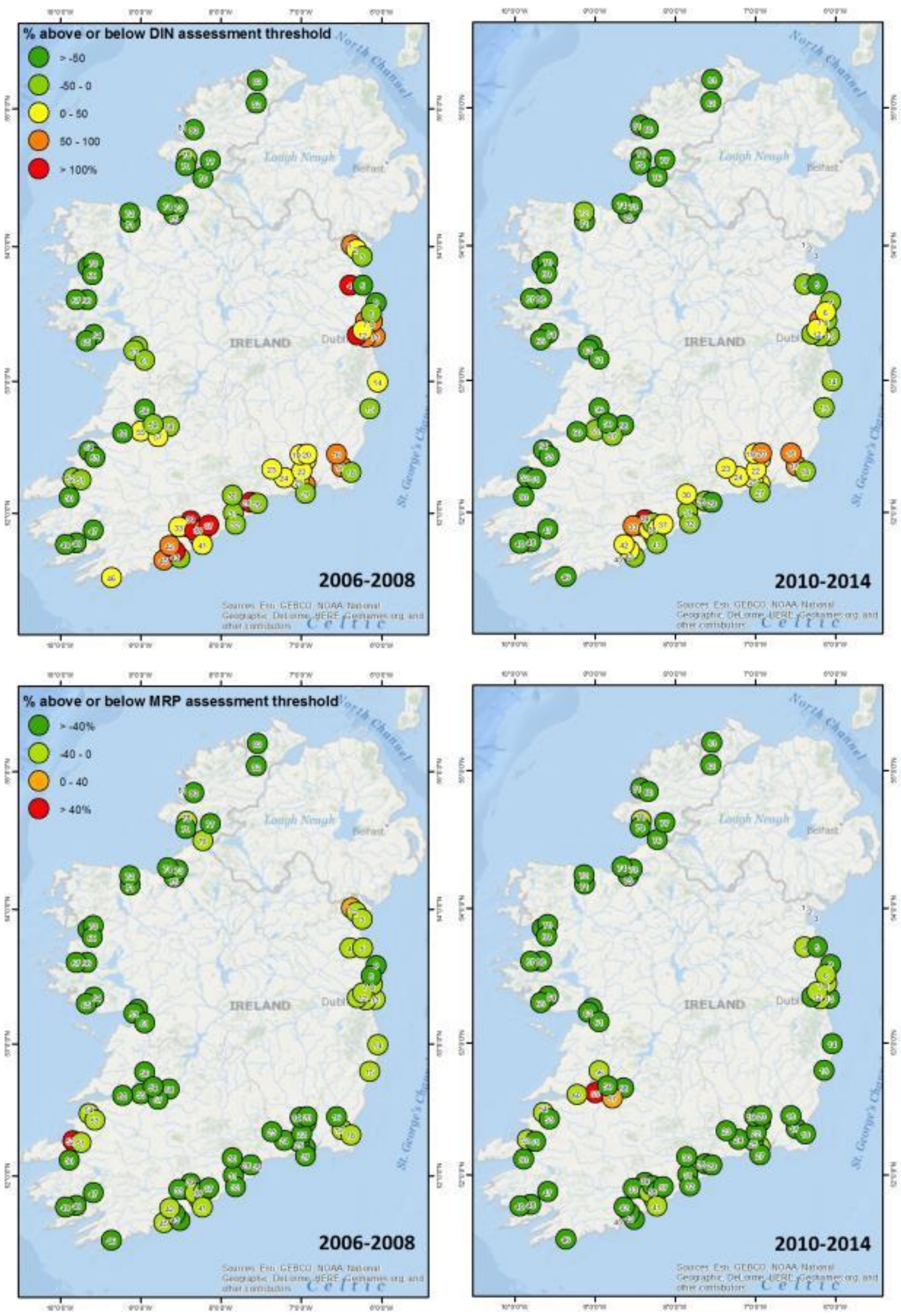

Figure 3. Percentage below or above the assessment levels for winter DIN (top) and MRP (bottom) in 2006-2008 and 2010-2014.

Riverine inputs and direct discharges of total N and total P

Data from the OSPAR riverine inputs programme has been used to assess the levels of inputs of N and P into the marine environment and also to look at trends from 2006-2014. Trends analysis was undertaken using the TTA interface in R using a Mann Kendall trend test with sens estimator. An analysis of total P, total N, MRP, TON and NH3 was undertaken and for all areas assessed there were no upward trends. Significant downward trends in total P were seen in the Deel, Maigue, Erne, Nore and Liffey inputs. Significant declines in total N were seen in 40% of the areas assessed (Figure 4). A summary table is included in the annexes.

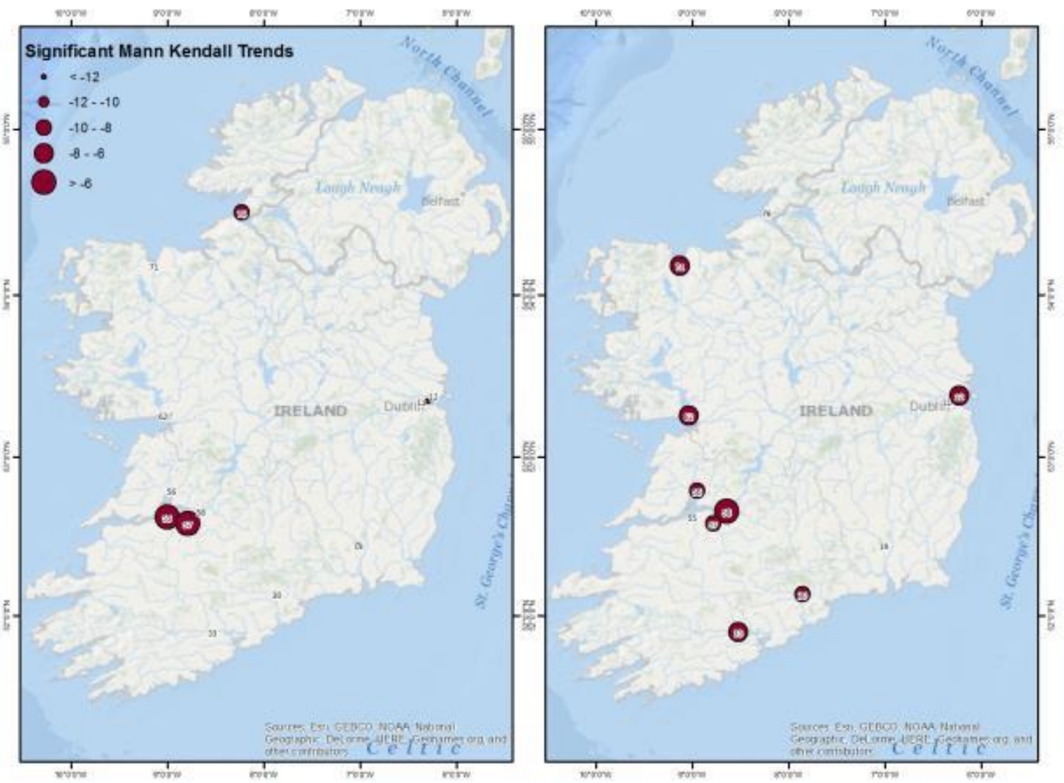

Figure 4. Mann Kendall trend analysis on TP (left) and TN (right) inputs from 2006-2013. Only significant trends are plotted.

Winter N:P ratios

As in previous applications of the Comprehensive Procedure, the use of N:P ratios was not applied to estuarine and nearshore coastal waters that are influenced by freshwater input. Previous examination of over 1000 freshwater sites has shown that the N:P ratio can on average be as high as 75:1 and often higher. While in many of the higher salinity nearshore water bodies the N:P was between 16 and 24, in the majority of areas this criteria was not used.

Area-specific phytoplankton indicator species

The assessment of direct effects of nutrient enrichment on the phytoplankton community was obtained from information gathered as part of the WFD monitoring programme. The Irish WFD assessment tool calculates two Ecological Quality Ratios for the assessment of phytoplankton- one based on the Chlorophyll concentration and a second metric looking at abundance of individual taxa above an assessment threshold. WFD assessments of moderate status or worse were considered as indictors of possible direct effects of nutrient enrichment. An analysis of the data from 2007-2012 was used for this assessment, to tie in with WFD assessments.

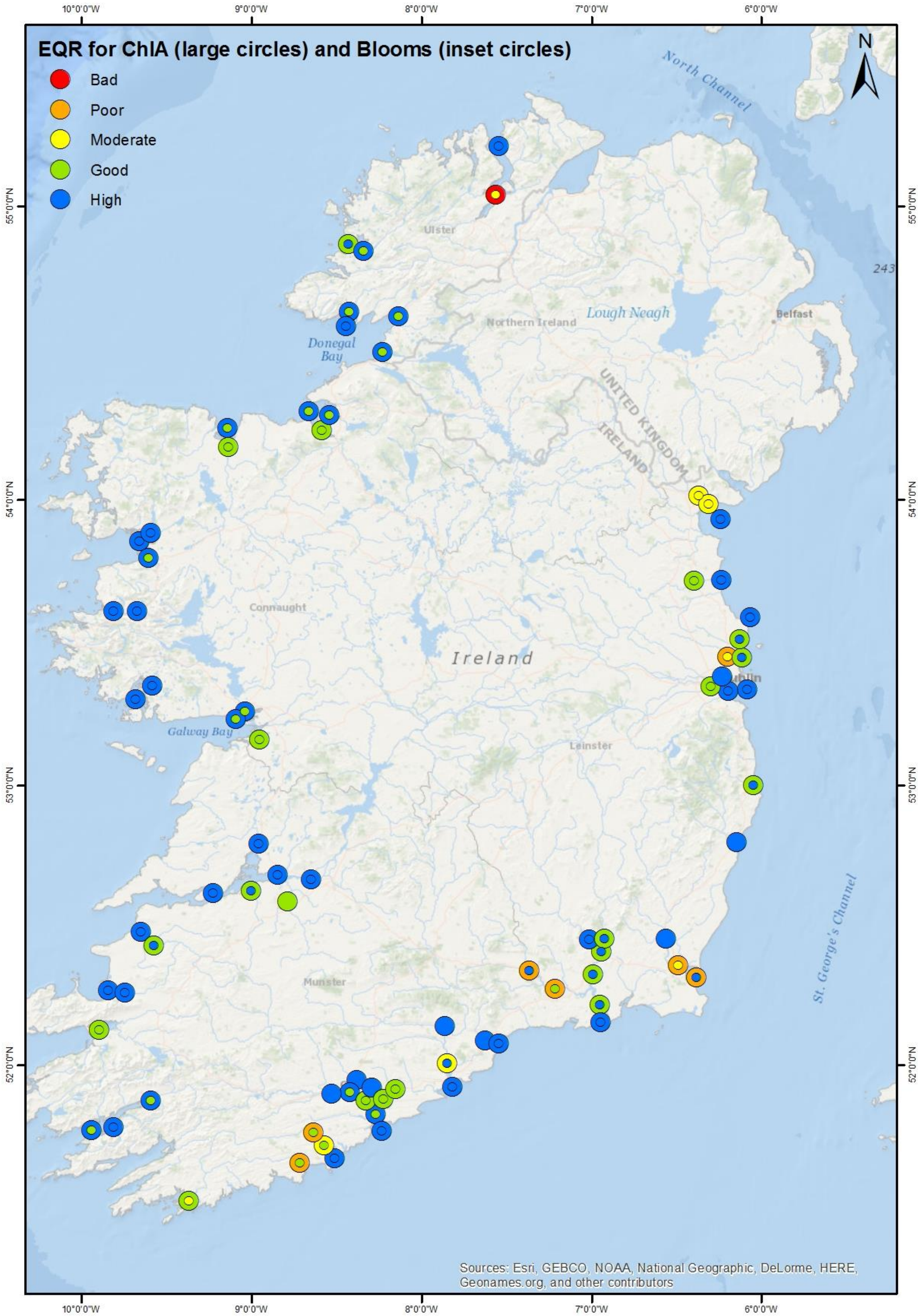

Figure 5. WFD assessment of elevated Chlorophyll (large circles) and elevated individual taxa counts (inset circles) using the WFD assessment tool (2007-2012).

Elevated growths of opportunistic macroalgae.
Elevated macroalgal growth due to the effects of nutrient enrichment are also assessed using the WFD monitoring tool. This tool is primarily used in estuarine water bodies but is also applied in some coastal areas. 17 areas were assessed- 9 (53%) were high or good status, 5 (29%) were moderate status indicted a degree of direct effects of enrichment and 3 (18%) were of poor status.

Indirect effects
Oxygen deficiency was found at 17% of the estuarine and nearshore coastal waters assessed. The lowest level of deficiency was a saturation of 38% in the Feale estuary following the collapse of a phytoplankton bloom. Other areas with persistent low O_2 levels include the upper Liffey estuary and the Lee estuary in Cork. Some areas in the North west of the country have shown depressed O_2 levels following a series of large phytoplankton blooms of *Karenia* sp. (O'Boyle *et al.* 2016).

Organic carbon/organic matter
Insufficient data was available for a full assessment of organic carbon. The WFD set a BOD value of 4mg/l (95%ile) for transitional waters. This EQS has been breached in 14 areas and is generally related to die off of phytoplankton blooms in the water column.

5.1.2 Coastal and offshore waters: Winter nutrients assessment

A trend assessment of dissolved inorganic nutrient data collected by the Marine Institute in winter between 2006 and 2014, and also between 1997 and 2014 is shown below in Table 3 and 4, respectively, with box plots for each region in Annex 2a.
There are no trends in nutrient concentrations in offshore waters along the western shelf and Rockall Trough between 2006 and 2014. These offshore datasets provide information on background or oceanic nutrient concentrations and support an assessment of the natural variability of nutrient concentrations in seawater.
The more enclosed Irish Sea is subject to greater freshwater influences and the potential for anthropogenic nutrient inputs. No significant trends in nutrient concentrations were observed in the of western Irish Sea areas (at salinities > 33) between 2006 and 2014. Individual transects were examined where greater year to year consistency of sampling was achieved (Figure 6). There is an increase in N:P ratio in the NE Irish Sea over the same period, with an upward trend in both TOxN and N:P ratio along the Liffey transect (within the NE Irish Sea region). There are very small negative trends in phosphate and silicate along the Boyne transect, coinciding with a small positive increase in salinity may be an artefact of the evolving sampling regime. Similarly, there is a small negative trend in salinity in both the NE and SE Irish Sea, with a positive trend in phosphate between 1997 and 2014 may also be an artefact of sampling.
In summary, while there are some significant trends in the data depending on the timescale, these are small and should be treated with caution. There are no major trends in surface nutrient concentrations in coastal (salinity > 33) and offshore waters.

The annual median nutrient concentrations between 2008 and 2014 for each area were plotted against salinity in Figure 7. Median TOxN and ortho-phosphate were lower than the OSPAR criteria (50% above background) in all regions over this period. Most N:P ratios were close to the Redfield Ratio of 16, however N:P ratios were lower in the Irish Sea (12-14) in all years, presumably due to denitrification leading to naturally lower concentrations of TOxN in the Irish Sea compared to the shelf break (Hydes *et al.* 2004). Overall while concentrations of TOxN, P are higher into the Irish Sea and eastern Celtic Sea the concentrations offshore are within the OSPAR criteria which are In conclusion, there are no indications of elevated nutrient concentrations in Irish coastal (salinity >33) and offshore waters relative to the OSPAR assessment criteria.

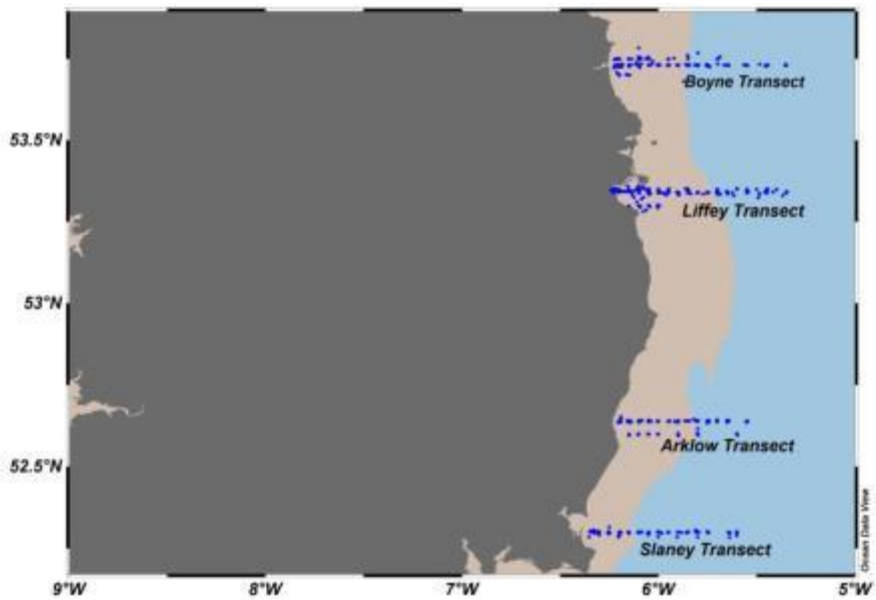

Figure 6. Spatial coverage of the stations where salinity>33 within the major regions of Irish coastal, shelf and offshore waters between 1997 and 2014. 2b Station positions of the separate transects in the Irish Sea where trends were assessed. Station plots of individual years are in Figure 1 in the Appendix.

Table 3. Trend results for median nutrient and salinity concentrations (at salinity > 33) for the different regions in Figure 1 from 2006-2014. Significant P-values (<0.05) are highlighted.

	Sal >33	Trend (uM/yr)	Trend (%/yr)	P-value	Units
NE Irish Sea 2006-2014	PO4	-0.02	-2.68	0.12	µM
	TOxN	0.04	0.48	0.47	µM
	Silicate	0.00	0.05	1.00	µM
	Salinity	0.01	0.03	0.60	
	N:P	0.44	3.19	0.03	
SE Irish Sea 2006-2014	PO4	0.00	0.07	1.00	µM
	TOxN	0.04	0.47	0.75	µM
	Silicate	0.04	0.68	0.75	µM
	Salinity	-0.02	-0.05	0.60	
	N:P	0.05	0.31	0.92	
Celtic Sea 2006-2014	PO4	0.01	2.05	0.76	µM
	TOxN	0.07	0.77	1.00	µM
	Silicate	0.08	1.65	0.76	µM
	Salinity	-0.01	-0.02	1.00	
	N:P	-0.13	-0.76	0.37	
SW Coastal 2006-2014	PO4	0.00	-0.25	0.83	µM
	TOxN	0.25	2.57	0.25	µM
	Silicate	0.06	1.20	0.60	µM
	Salinity	-0.07	-0.21	0.35	
	N:P	0.17	0.99	0.35	
Western Shelf 2006-2014	PO4	-0.01	-0.93	0.37	µM
	TOxN	-0.22	-2.37	0.37	µM
	Silicate	-0.02	-0.78	0.77	µM
	Salinity	-0.01	-0.02	1.00	
	N:P	-0.11	-0.64	0.76	
Rockall 2006-2014	PO4	-0.01	-2.16	0.09	µM
	TOxN	-0.24	-2.24	0.46	µM
	Silicate	-0.28	-8.27	0.09	µM

	Salinity	-0.02	-0.05	0.22	
	N:P	-0.04	-0.21	1.00	
Liffey Transect 2006-2014	PO4	-0.01	-2.11	0.35	µM
	TOxN	0.21	2.67	0.03	µM
	Silicate	0.09	1.46	0.92	µM
	Salinity	0.00	0.01	0.92	
	N:P	0.56	4.39	0.03	
Boyne Transect 2006-2014	PO4	-0.02	-3.71	0.02	µM
	TOxN	-0.26	-3.44	0.12	µM
	Silicate	-0.21	-3.19	0.03	µM
	Salinity	0.07	0.22	0.03	
	N:P	0.01	0.05	1.00	
Arklow Transect 2006-2014	PO4	-0.01	-1.16	1.00	µM
	TOxN	0.30	3.21	0.55	µM
	Silicate	0.08	1.42	0.55	µM
	Salinity	-0.03	-0.09	0.37	
	N:P	0.26	1.66	0.76	
Slaney Transect 2006-2014	PO4	0.02	3.08	0.65	µM
	TOxN	0.20	2.00	0.55	µM
	Silicate	0.21	3.44	0.55	µM
	Salinity	-0.01	-0.03	1.00	
	N:P	0.23	1.28	0.37	

Table 4. Trend results for median nutrient and salinity concentrations (at salinity > 33) for the different regions in Figure 1 for the full length of the time series. Significant P-values (<0.05) are highlighted.

	Sal>33	**Trend (unit/yr)**	**Trend (%/yr)**	**P-value**	**Units**
NE Irish Sea 1997-2014	PO4	0.00	0.61	0.36	µM
	TOxN	0.00	-0.02	1.00	µM
	Silicate	0.11	1.68	0.07	µM
	Salinity	-0.02	-0.06	0.01	
	NP	-0.07	-0.45	0.65	
SE Irish Sea 1997-2014	PO4	0.01	1.16	0.01	µM
	TOxN	0.02	0.18	0.79	µM
	Silicate	0.05	0.94	0.13	µM
	Salinity	-0.02	-0.05	0.02	
	NP	-0.19	-1.08	0.06	
Celtic Sea 2003-2014	PO4	0.02	2.74	0.21	µM
	TOxN	0.11	1.20	0.72	µM
	Silicate	0.03	0.57	0.86	µM
	Salinity	0.00	0.00	1.00	
	NP	-0.34	-1.98	0.05	
Liffey Transect 1997-2014	PO4	0.00	-0.01	0.94	µM
	TOxN	-0.14	-1.65	0.40	µM
	Silicate	0.07	1.18	0.26	µM
	Salinity	-0.01	-0.02	0.47	
	NP	-0.20	-1.43	0.40	
Boyne Transect 1997-2014	PO4	0.00	-0.03	0.94	µM
	TOxN	-0.09	-1.19	0.05	µM
	Silicate	-0.01	-0.12	0.91	µM
	Salinity	-0.01	-0.02	0.50	
	NP	-0.08	-0.64	0.23	
Arklow Transect 1997-2014	PO4	0.01	1.44	0.03	µM
	TOxN	0.00	-0.05	1.00	µM
	Silicate	0.12	2.20	0.12	µM
	Salinity	-0.03	-0.09	0.01	

	NP	-0.29	-1.68	0.14	
Slaney Transect 1997-2014	PO4	0.01	2.52	0.03	µM
	TOxN	0.04	0.44	0.52	µM
	Silicate	0.03	0.55	0.62	µM
	Salinity	-0.01	-0.03	0.30	
	NP	-0.23	-1.25	0.17	

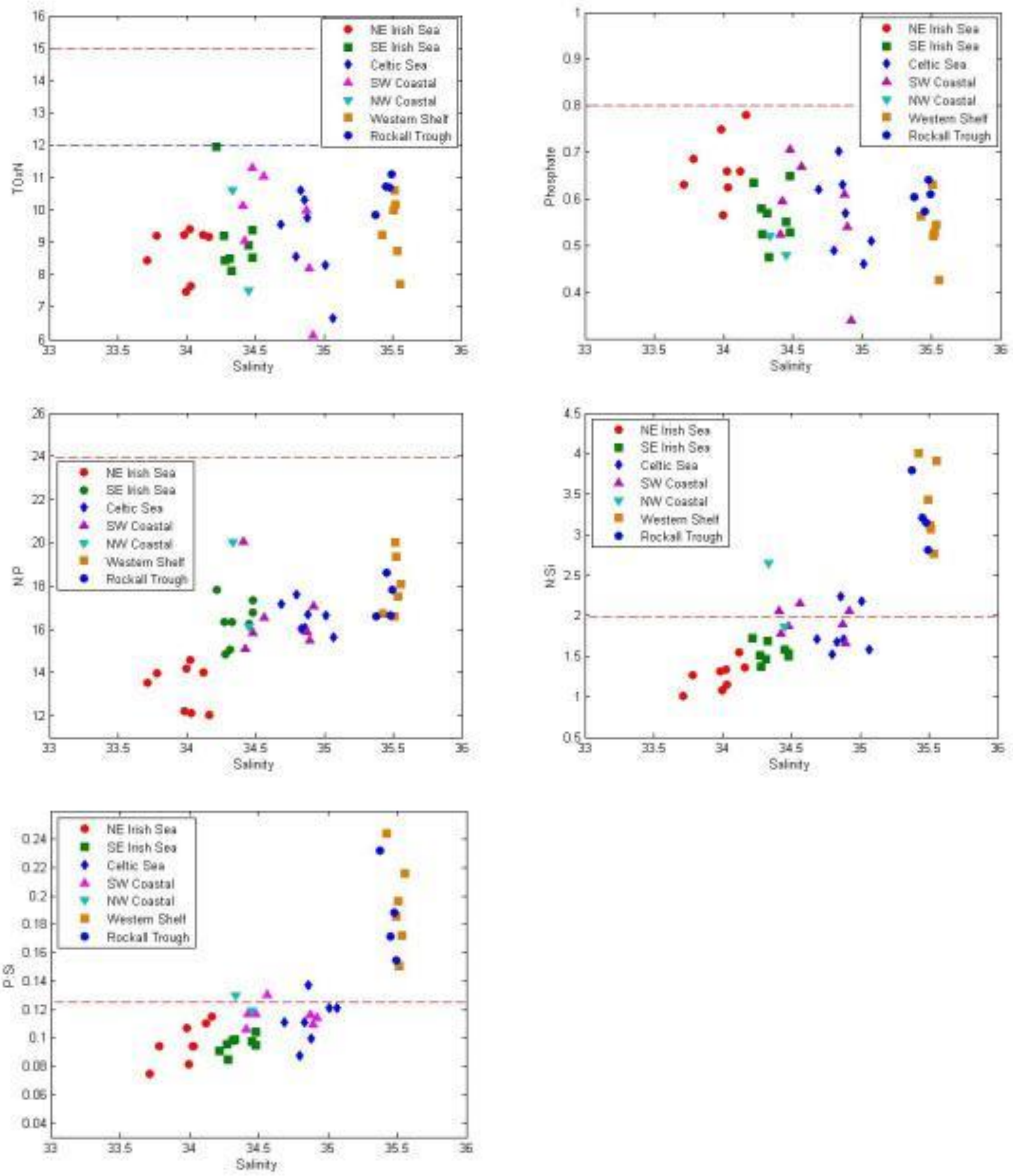

Figure 7. Annual Median winter concentrations of TOxN, Phosphate, N:P, N:Si and P:Si ratios per area between 2006 and 2014 in all regions. OSPAR nutrient assessment criteria are also shown (50% above background e.g. 12µM ToxN for the Irish Sea and 15µM ToxN for other coastal and offshore waters).

5.2 Parameter-related assessment

5.2.1 Estuarine and nearshore coastal waters (sub-areas)

Of the 83 areas included in the initial classification, 27 (32%) were classified as problem areas, 24 (29%) were classified as potential problem areas and 32 (39%) were classified as non-problem areas. In the final classification, 20 (24%) were classified as problem areas, 16 (19%) were classified as potential problem areas and 47 (57%) were classified as non-problem areas.

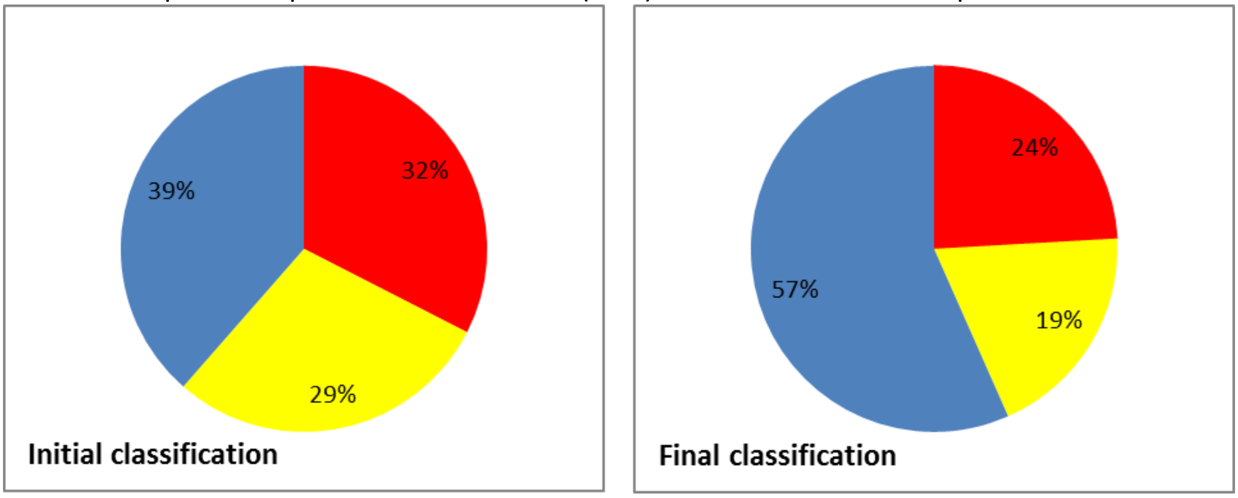

Figure 8. Initial classification of estuarine and nearshore coastal waters and Final classification.

5.2.1 Coastal and offshore waters

Winter dissolved nutrient concentrations are consistently below area-specific OSPAR thresholds for offshore and coastal areas assessed. Nutrient ratios for offshore waters are below OSPAR thresholds. The confidence in this assessment is high as the dataset is substantial with good coverage of the areas assessed.

5.4 Overall assessment

The outcome of the final classification, following appraisal of all relevant information, is shown in Figure 9. In the final classification, 20 (24%) were classified as problem areas, 16 (19%) were classified as potential problem areas and 47 (57%) were classified as non-problem areas.

Figure 9 clearly shows the contrast between the regions with the largest number of problem areas being located along the eastern and south eastern coasts and the majority of non-problem areas being located along the western and north western coasts. In general, this distribution reflects the difference in the magnitude of nutrient inputs from agricultural and municipal wastewater treatment sources that are much greater along the eastern, south eastern and southern coasts.

It is also apparent from Figure 8 that the occurrence of eutrophication is mainly restricted to inshore estuarine waters and rarely extends out to the adjacent more open coastal areas.

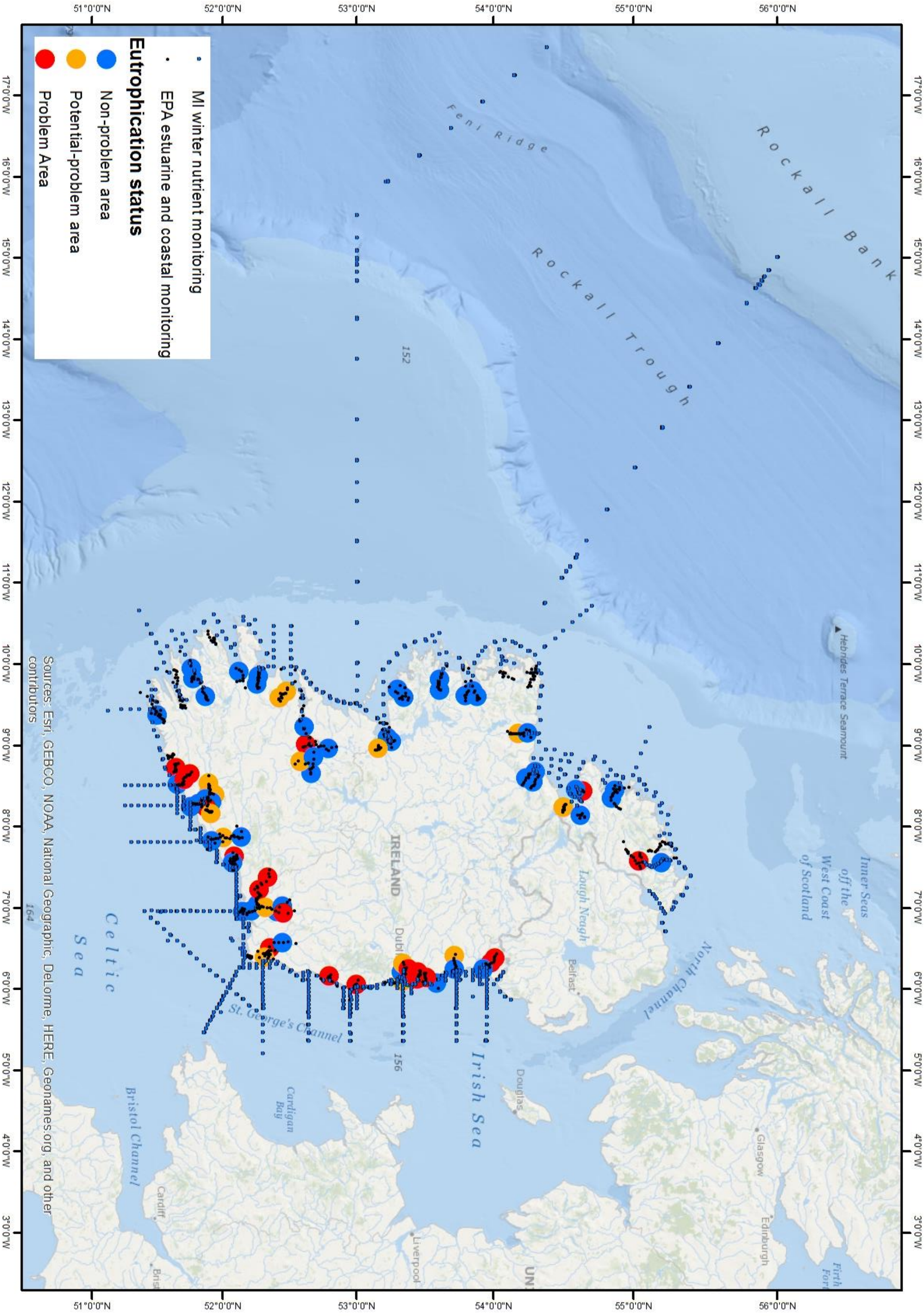

Figure 9. Overall classification for the Third Application of the OSPAR Comprehensive Procedure

5.5 Comparison with preceding assessment

In the 3rd application of the OSPAR common procedure, 24% of transitional and coastal waters assessed were identified as Problem areas, 19% as potential problem areas and 57% as non-problem areas. This is an improvement from the 2nd application where 41% were identified as problem areas and in increase from 51% in areas identified as non-problem (Figure 10). As in the previous assessments, offshore waters do not show elevated nutrient concentrations.

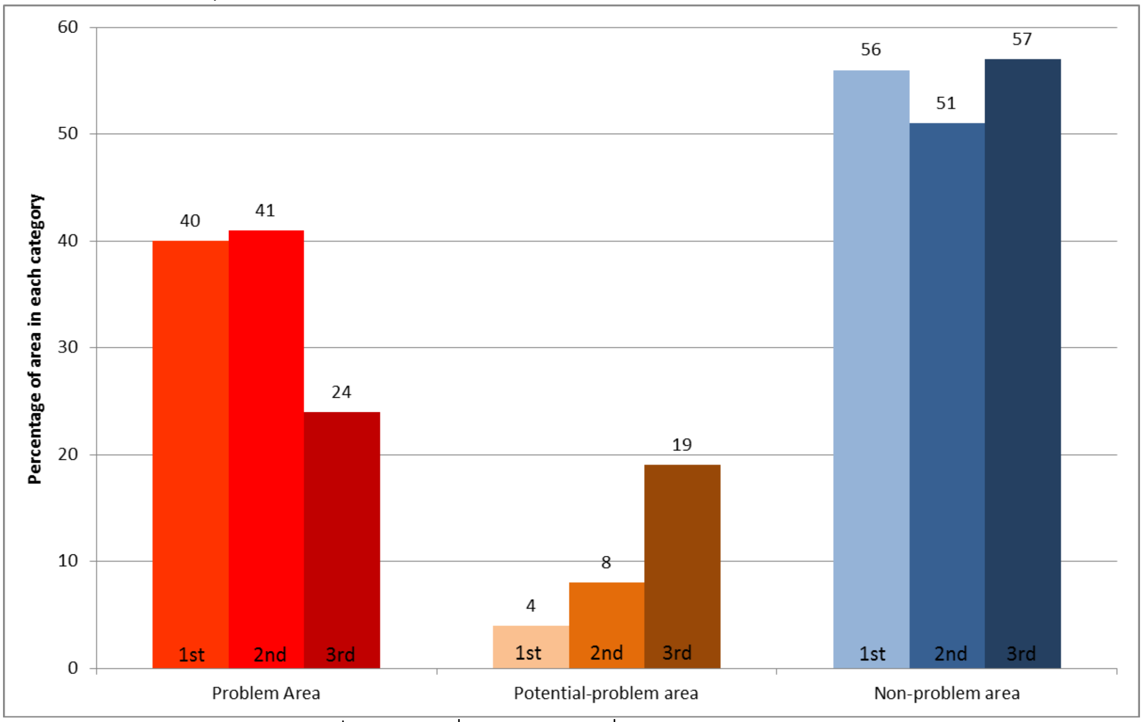

Figure 10. Comparison between 1st 2003, 2nd 2007 and 3rd 2015 application of the comp

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

Urban Waste Water treatment

In 2014, a total of 12 (7%) large urban areas did not meet the Urban Waste Water Treatment Directive requirement to provide secondary (biological) treatment (EPA, 2015a). Seven large urban areas did not comply with the Directive's requirement to provide infrastructure to reduce nutrients and discharged effluent that did not meet nutrient quality standards. Untreated sewage was discharged into 45 areas, mostly estuaries or coastal areas. Just 24% of the waste water load discharged into sensitive areas from large towns and cities complied with mandatory EU nutrient quality standards, up from 17.5% in 2013. This is well below the EU average of 88% compliance for nutrients (EC 2016).

The Nitrates Directive and the Nitrates Action Programme

The Nitrates Directive which was adopted in 1991 has the objective of reducing water pollution caused or induced by nitrates from agricultural sources and preventing further such pollution, with the primary emphasis being on the management of livestock manures and other fertilisers. Ireland's national Nitrates Action Programme (NAP) was given statutory effect by the European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2006 which were made on 19 July 2006. The purpose of the Nitrates Action Programme is to provide a set of rules relating to the use and application of Livestock manure and artificial fertilizers. The National Action Programme under the Nitrates Directive is due to be reviewed again in 2017. This will provide an opportunity to evaluate the need to amend existing farm management measures under the programme.

Water Framework Directive

Feedback from the first cycle of WFD implementation highlighted that better governance arrangements were needed for subsequent cycles of River Basin Management. Ireland has attempted to remedy this by the development of a new three-tier governance structure (www.catchments.ie). Underpinning the new water governance arrangements for managing water is the integrated catchment management approach, which complements the river basin planning process. It approaches sustainable resource management from a catchment perspective, in contrast to a piecemeal approach that artificially separates land management from water management.

8. Perspectives

Eutrophication from nutrient enrichment continues to be the main issue impacting on Irish WFD surface waters. 48% of transitional waters and 22% of coastal water are at less than good WFD ecological status (Bradley et al. 2015). The two most important sources of nutrient pressure remain agriculture and municipal discharges. While downward trends in nutrient inputs(Ní Longphuirt *et al.* 2015) have been observed, particularly from the agricultural sector, these pressures need to be managed to ensure modest improvements seen so far are maintained and improved.

9. Overall summary and conclusions from the national report

This report contains the outcome of the Third Application of the OSPAR Comprehensive Procedure by Ireland. It is primarily based on data collected between 2006-2014, and some data from outside this period has also been used. A total of 83 areas (estuarine and nearshore coastal waters) as well as the coastal and offshore waters have been included in the assessment.

The assessment is mainly based on data collected by the Environmental Protection Agency's national estuarine and nearshore coastal waters monitoring programme and the Marine Institute's annual winter monitoring programme of coastal and offshore waters. The winter component of the both the EPA and Marine Institute programmes are carried out between the months of November to March inclusive, with the summer component of the EPA programme being undertaken between the months of May to September inclusive.

Information on winter and summer concentrations of DIN and DIP together with summer levels of chlorophyll and oxygen undersaturation and super-saturation were used in the assessment. Information was also included on the abundance and composition of macroalgae from certain transitional areas. While information on shellfish biotoxins and potential toxic phytoplankton species was taken into account in the initial assessment it was not considered in the overall assessment as there is little evidence that the occurrence of these blooms, or associated toxicity in shellfish, in Irish waters, is related to nutrient enrichment or other forms of anthropogenic pollution.

Of the 83 areas included in the initial classification, 27 (32%) were classified as problem areas, 24 (29%) were classified as potential problem areas and 32 (39%) were classified as non-problem areas. In the final classification, 20 (24%) were classified as problem areas, 16 (19%) were classified as potential problem areas and 47 (57%) were classified as non-problem areas.

The assessment has shown that the largest number of problem areas are located inshore and predominantly along the eastern, southeastern and southern coasts of Ireland. In general, this distribution reflects the greater impacts that arise from pressures associated with higher human population densities and more intense agricultural activities in these regions.

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11. Annexes

Annex 1: IRELAND – Third Application of the Comprehensive Procedure ([1]Upper Transitional waters, [2]Lower transitional waters, [3]nearshore Coastal waters)

Area	**Category I** Degree of nutrient enrichment	**Category II** Direct effects	**Category III and IV** Indirect effects/ other possible effects		Initial classification	Appraisal of all relevant information (concerning the harmonised assessment criteria, their respective assessment levels and the supporting environmental factors)	Final classification
Castletown Estuary, Inner and Outer Dundalk Bay							
(1) Castletown Estuary[1]	NI DI + NP	Ca + Ps + Mp	O_2 + Ck Oc -	At	Problem area	Elevated winter nutrients and direct effects present.	Problem area
(2) Inner Dundalk Bay[2]	NI DI + NP	Ca + Ps + Mp +	O_2 - Ck Oc -	At	Problem area	Elevated winter nutrients and direct and indirect effects present. Elevated levels of chlorophyll, phytoplankton bloom frequency and opportunistic green algae present. Change in benthic invertebrate community structure indicative of organic enrichment.	Problem area
(3) Outer Dundalk Bay[3]	NI DI - NP -	Ca - Ps - Mp	O_2 - Ck Oc -	At	Non-problem area		Non-problem area
Boyne Estuary and Plume Zone							
(4) Boyne Estuary[2]	NI - DI + NP	Ca - Ps + Mp -	O_2 - Ck Oc +	At	Problem area	Elevated winter nutrients, dissolved inorganic nitrogen and elevated phytoplankton bloom frequency. This latter indicator, in the absence of elevated biomass, is not sufficient to confirm a direct effect so the area is classed as a potential problem area. In the last assessment this area was classified as a potential-problem area due to the presence of opportunistic macroalgae, but levels of this indicator have decreased in the current assessment period. Decrease in riverine inputs of total phosphorus (TP) and total ammonia (NH^4).	Potential-problem area
(5) Boyne Estuary Plume Zone[3]	NI DI - NP -	Ca - Ps - Mp	O_2 - Ck Oc -	At	Non-problem area		Non-problem area
Rogerstown Estuary, Broadmeadow, Malahide Bay and Northwestern Irish Sea							
(6) Rogerstown[2]	NI DI + NP	Ca - Ps - Mp +	O_2 - Ck Oc -	At	Problem area	Elevated levels of green opportunistic affecting seagrass beds in the inner part of estuary.	Problem area
(7)Broadmeadow [2]	NI DI +	Ca + Ps +	O_2 + Ck	At	Problem area	Elevated levels of winter nitrogen and phosphorus and summer phosphorus. Elevated summer chlorophyll and very high levels	Problem area

	NP		Mp		Oc	+				of dissolved oxygen supersaturation indicating excessive photosynthetic activity.	
(8) Malahide Bay[3]	NI		Ca	-	O_2	-	At		Problem area	Elevated levels of winter nitrogen and elevated levels of green opportunistic macroalgae in summer. Elevated winter N:P ratio	Problem area
	DI	+	Ps	-	Ck						
	NP	+	Mp	+	Oc	-					
(9) Northwestern Irish Sea (HA08)[3]	NI		Ca	-	O_2	-	At		Non-problem area		Non-problem area
	DI	-	Ps	-	Ck						
	NP	-	Mp		Oc	-					
Liffey Estuary, Tolka Estuary, Dublin Bay and Southwestern Irish Sea											
(10) Liffey Estuary Lower[1]	NI	-	Ca	-	O_2	-	At		Potential-problem area	No direct or indirect effects arising and decrease in riverine inputs of total phosphorus (TP) and total ammonia (NH^4).	Non-problem area
	DI	+	Ps	-	Ck						
	NP		Mp		Oc	-					
(11) Liffey Estuary Upper[2]	NI	-	Ca	-	O_2	+	At		Problem area	Decrease in riverine inputs of total phosphorus (TP) and total ammonia (NH^4). Degree of nutrient enrichment has decreased in the current assessment. Depressed dissolved oxygen levels in upper estuary may be due to historically-enriched sediment.	Potential-problem area
	DI	+	Ps	-	Ck						
	NP		Mp		Oc	-					
(12) Tolka Estuary[2]	NI	-	Ca	-	O_2	-	At		Problem area	Elevated levels of winter nitrogen and phosphorus and in summer excessive levels of green opportunistic macroalgae.	Problem area
	DI	+	Ps		Ck						
	NP		Mp	+	Oc	-					
(13) Dublin Bay[3]	NI		Ca	-	O_2	-	At		Potential-problem area	Elevated levels of brown opportunistic algae (*Ectocarpus* sp.) are seasonally present and occasionally wash-up on shore in nuisance quantities. Change in benthic invertebrate community structure indicative of organic enrichment.	Potential-problem area
	DI	-	Ps		Ck						
	NP	-	Mp	?	Oc	-					
Broad Lough											
(14) Broad Lough[2]	NI		Ca	-	O_2	+	At		Problem area	Depressed dissolved oxygen levels in summer. Elevated winter nutrients	Problem area
	DI	+	Ps		Ck						
	NP		Mp		Oc	-					
Avoca Estuary											
(15) Avoca Estuary[2]	NI	-	Ca	-	O_2	-	At		Potential-problem area	Significant reduction in riverine inputs of total nitrogen (TN), total ammonia (NH^4) and total phosphorus (TP). Previously a Problem area	Problem area
	DI	-	Ps		Ck						
	NP		Mp		Oc	-					

Slaney Estuary and Wexford Harbour											
(16) Upper Slaney Estuary[1]	NI	-	Ca	-	O_2	-	At		Problem area	Decrease in riverine inputs of total phosphorus (TP) and total ammonia (NH^4), but excessive levels of nitrogen in summer and winter. No direct effects observed. Direct effects may be inhibited due to high flushing rate.	Non-problem area
	DI	+	Ps		Ck						
	NP	+	Mp		Oc	-					
(17) Lower Slaney Estuary[2]	NI	-	Ca	+	O_2	-	At		Problem area	Excessive levels of winter and summer nitrogen and elevated levels of chlorophyll and dissolved oxygen supersaturation. Lack of suitable substrate may inhibit opportunistic algal growth.	Problem area
	DI	+	Ps	+	Ck						
	NP	+	Mp	-	Oc	+					
(18) Wexford Harbour[3]	NI		Ca	+	O_2	-	At		Problem area	Elevated winter N:P ratio, but no direct effects arising. Change in benthic invertebrate community structure indicative of organic enrichment. Low levels of DSP and *Dinophysis* sp. detected in this area.	Potential-problem area
	DI	+	Ps		Ck						
	NP	+	Mp		Oc						
Barrow-Nore-Suir Estuaries											
(19) Nore Estuary[1]	NI	-	Ca	-	O_2	-	At		Problem area	Elevated levels of winter and summer nitrogen and summer phosphorus. No direct or indirect effects arising. Decrease in riverine inputs of total phosphorus (TP) and total ammonia (NH^4).	Non-problem area
	DI	+	Ps		Ck						
	NP		Mp		Oc	-					
(20) Upper Barrow Estuary[1]	NI	-	Ca	+	O_2	-	At		Problem area	Excessive levels of winter and summer nitrogen and direct and indirect effects arising but decrease in riverine inputs of total phosphorus (TP) and total ammonia (NH^4).	Problem area
	DI	+	Ps		Ck						
	NP	+	Mp		Oc	-					
(21) Barrow Nore Estuary Upper [1]	NI		Ca	-	O_2	-	At		Problem area	Excessive levels of winter and summer nitrogen but primary production likely to be limited by light availability.	Non-problem area
	DI	+	Ps		Ck						
	NP	+	Mp		Oc	-					
(22) New Ross Port[1]	NI		Ca	-	O_2	-	At		Potential-problem area	Excessive levels of winter and summer nitrogen but primary production likely to be limited by light availability. Change in benthic invertebrate community structure indicative of organic enrichment.	Potential-problem area
	DI	+	Ps		Ck						
	NP		Mp		Oc	-					
(23) Upper Suir Estuary [1]	NI	+	Ca	+	O_2	-	At		Problem area	Increase in riverine inputs of total nitrogen (TN) (although not statistically significant) but decrease in total phosphorus (TP) and total ammonia (NH^4). Elevated levels of winter and summer nitrogen and summer chlorophyll.	Problem area
	DI	+	Ps		Ck						
	NP	+	Mp		Oc	+					
(24) Middle Suir Estuary[1]	NI	+	Ca	+	O_2	-	At		Problem area	Increase in riverine inputs of total nitrogen (TN) (although not statistically significant) but decrease in total phosphorus (TP) and total ammonia (NH^4). Elevated levels of winter and summer nitrogen and elevated summer chlorophyll and dissolved oxygen superstauration.	Problem area
	DI	+	Ps		Ck						
	NP	+	Mp		Oc	-					

(25) Lower Suir Estuary[2]	NI	+	Ca		O_2	-	At		Problem area	Elevated levels of winter and summer nitrogen but primary production likely to be limited by light availability.	Non-problem area
	DI	+	Ps		Ck						
	NP	+	Mp		Oc	-					
(26) Barrow Suir Nore Estuary[2]	NI		Ca	-	O_2	-	At		Potential-problem area	Elevated winter nitrogen but no direct or indirect effects arising.	Non-problem area
	DI	+	Ps		Ck						
	NP		Mp		Oc	-					
(27) Waterford Habour[3]	NI		Ca	-	O_2	-	At		Non-problem area	Elevated N:P ratio, but no direct or indirect effects arising. DSP algal toxins and intermittent episodes of *Dinophysis* above assessment level but at levels considered not to be indicative of eutrophication.	Non-problem area
	DI	-	Ps		Ck						
	NP	-	Mp		Oc	-					
Colligan Estuary and Dungarvan Harbour											
(28) Colligan Estuary[2]	NI		Ca	-	O_2	-	At		Problem area	Elevated winter nitrogen and elevated green opportunistic macroalgae in summer.	Problem area
	DI	+	Ps		Ck						
	NP		Mp	+	Oc	-					
(29) Dungarvan Harbour[3]	NI		Ca	-	O_2	-	At		Non-problem area		Potential-problem area
	DI	-	Ps		Ck						
	NP	-	Mp		Oc	-					
Blackwater Estuary and Youghal Bay											
(30) Upper Blackwater Estuary[1]	NI	-	Ca	-	O_2	-	At		Potential-problem area	Elevated winter and summer nitrogen but no direct or indirect effects arising. Direct effects may be inhibited due to high flushing rate. Notable decrease in riverine inputs of total nitrogen (TN), total ammonia (NH^4) and total phosphorus (TP).	Non-problem area
	DI	+	Ps		Ck						
	NP		Mp		Oc	-					
(31) Lower Blackwater Estuary[2]	NI	-	Ca	+	O_2	-	At		Potential-problem area	Direct effects present; elevated chlorophyll and opportunistic green macroalgae.	Problem area
	DI	-	Ps	-	Ck						
	NP		Mp	-	Oc	-					
(32) Youghal Bay[3]	NI		Ca	-	O_2	-	At	-	Potential-problem area	Elevated N:P ratio but no direct or indirect effects arising. Intermittent accumulations of green opportunistic algae, but levels not indicative of problem area status.	Non-problem area
	DI	-	Ps		Ck						
	NP	+	Mp	-	Oc	-					
Lee Estuary, Lough Mahon, Harper's Island, Owenacurra Estuary and North Channel Great Island											
(33) Lee (Cork) Estuary Upper[1]	NI	+	Ca	-	O_2	+	At		Problem area	Increase in riverine inputs of total phosphorus but decrease in total nitrogen. Elevated winter nitrogen and depressed dissolved oxygen levels in summer which may be linked to historically enriched-sediments.	Potential-problem area
	DI	+	Ps		Ck						
	NP		Mp		Oc	+					
(34) Lee (Cork) Estuary Lower[2]	NI	+	Ca	-	O_2	+	At		Problem area	Increase in riverine inputs of total phosphorus (although not statistically significant) but decrease in total nitrogen. Elevated winter nitrogen and depressed dissolved oxygen levels in summer which may be linked to historically enriched-sediments.	Potential-problem area
	DI	+	Ps	-	Ck						
	NP		Mp		Oc	-					
(35) Lough Mahon[2]	NI		Ca	-	O_2	-	At		Potential-problem area	Elevated winter nitrogen but no direct or indirect effects arising. Opportunistic algal growth may be inhibited due to absence of suitable substrate.	Non-problem area
	DI	+	Ps	-	Ck						
	NP		Mp		Oc	-					

(36) Harper's Island[2]	NI		Ca	-	O_2	+	At		Potential-problem area		Non-problem area
	DI	+	Ps	-	Ck						
	NP		Mp		Oc	-					
(37) Owenacurra Estuary[2]	NI		Ca	-	O_2	-	At	-	Potential-problem area	Excessive winter nitrogen but no direct or indirect effects arising. PSP and DSP toxins detected sporadically and presence of *Alexandrium and Dinophysis* above respective assessment levels but no elevated trend detected.	Non-problem area
	DI	+	Ps		Ck						
	NP		Mp		Oc	+					
(38) North Channel Great Island[2]	NI		Ca	-	O_2	+	At		Potential-problem area	Elevated winter nitrogen and elevated summer dissolved oxygen supersaturation. PSP and DSP toxins detected sporadically and presence of *Alexandrium* and *Dinophysis* above respective assessment levels but no elevated trend detected.	Problem area
	DI	+	Ps	-	Ck						
	NP		Mp		Oc	-					
Glashaboy Estuary and Cork Harbour											
(39) Glashaboy Estuary[2]	NI		Ca	-	O_2	-	At		Potential-problem area	Excessive winter and summer nitrogen but no direct or indirect effects arising. High flushing rate may inhibit phytoplankton growth.	Non-problem area
	DI	+	Ps		Ck						
	NP		Mp		Oc	+					
(40) Cork Harbour[3]	NI		Ca	-	O_2	-	At		Problem area	Elevated winter nitrogen and elevated phytoplankton bloom frequency. In the absence of elevated phytoplankton biomass, elevated bloom frequency on its own is not sufficient to indicate a direct effect. Classified as potential problem area.	Potential-problem area
	DI	+	Ps	+	Ck						
	NP	+	Mp		Oc	-					
(41) Outer Cork Harbour[3]	NI		Ca	-	O_2	-	At		Problem area	Elevated winter nitrogen, winter N:P ratio and elevated phytoplankton bloom frequency. In the absence of elevated phytoplankton biomass, elevated bloom frequency on its own is not sufficient to indicate a direct effect. Elevated cover of green opportunistic algae on rocky shores requires further investigation and assessment. Classified as potential problem area.	Potential-problem area
	DI	+	Ps	+	Ck						
	NP	+	Mp	?	Oc	-					
Bandon Estuary and Kinsale Harbour											
(42) Upper Bandon Estuary[1]	NI	-	Ca	+	O_2	+	At		Problem area	Elevated levels of winter nitrogen and elevated levels of chlorophyll, bloom frequency and DO supersaturation indicating excessive levels of photosynthesis. Elevated levels of organic enrichment in summer.	Problem area
	DI	+	Ps	-	Ck						
	NP		Mp		Oc	+					
(43) Lower Bandon Estuary[2]	NI	-	Ca	+	O_2	+	At		Problem area	Elevated levels of winter nitrogen and elevated levels of chlorophyll, bloom frequency and DO supersaturation indicating excessive levels of photosynthesis. Elevated levels of organic enrichment in summer.	Problem area
	DI	+	Ps	-	Ck						
	NP		Mp		Oc	+					
(44) Kinsale Harbour[3]	NI		Ca	+	O_2	-	At	-	Non-problem area	Low levels ASP and DSP toxins present – no elevated trend detected.	Non-problem area
	DI		Ps		Ck						
	NP	-	Mp		Oc	-					

Argideen Estuary											
(45) Argideen Estuary[2]	NI		Ca	+	O_2	+	At		Problem area	Elevated levels of winter and summer nitrogen. Excessive levels of green opportunistic macroalgae present in summer and elevated levels of chlorophyll also present in summer. Elevated levels of organic enrichment in summer.	Problem area
	DI	+	Ps		Ck						
	NP		Mp	+	Oc	+					
Ilen Estuary											
(46) Ilen Estuary[2]	NI		Ca	-	O_2	-	At		Potential-problem area	Elevated phytoplankton bloom frequency, but in the absence of elevated biomass, insufficient to indicate a direct effect.	Non-problem area
	DI	+	Ps	+	Ck						
	NP		Mp		Oc	-					
Kenmare River and Kilmakilloge Harbour											
(47) Inner Kenmare River[2]	NI		Ca	-	O_2	-	At		Non-problem area	Elevated levels of organic enrichment.	Problem area
	DI	-	Ps	-	Ck						
	NP		Mp		Oc	-					
(48) Kilmakilloge Harbour[2]	NI		Ca	-	O_2	-	At		Non-problem area	Presence of DO undersaturation due to natural seasonal stratification and not anthropogenic nutrient enrichment.	Non-problem area
	DI	-	Ps	-	Ck						
	NP		Mp		Oc	-					
(49) Outer Kenmare River[3]	NI		Ca	-	O_2	+	At		Non-problem area	Presence of DO undersaturation due to natural seasonal stratification and not anthropogenic nutrient enrichment.	Non-problem area
	DI	-	Ps	-	Ck						
	NP	-	Mp		Oc	-					
Castlemaine and Cromane											
(50) Castlemaine Harbour[2]	NI		Ca	-	O_2	-	At		Non-problem area		Non-problem area
	DI	-	Ps		Ck						
	NP		Mp		Oc	-					
(51) Cromane[2]	NI		Ca	-	O_2	-	At		Non-problem area		Non-problem area
	DI	-	Ps		Ck						
	NP		Mp		Oc	-					
Lee (Kerry) Estuary and Tralee Bay											
(52) Lee (Kerry) Estuary[1]	NI		Ca	-	O_2	-	At		Potential-problem area	Elevated winter phosphorus but no direct or indirect effects arising.	Non-problem area
	DI	-	Ps		Ck						
	NP		Mp		Oc	-					
(53) Inner Tralee Bay[2]	NI		Ca	-	O_2	-	At		Non-problem area		Non-problem area
	DI	-	Ps		Ck						
	NP	-	Mp		Oc	-					
Feale Estuary and Cashen											
(54) Upper Feale Estuary[1]	NI		Ca	-	O_2	+	At		Potential Problem area		Non-problem area
	DI	-	Ps		Ck						
	NP		Mp		Oc	+					
(55) Cashen[2]	NI		Ca	-	O_2	-	At		Potential Problem area	Elevated organic enrichment: source unknown.	Potential Problem area
	DI	-	Ps		Ck						

	NP		Mp		Oc	+				

Shannon Estuary											
(56) Deel Estuary[1]	NI	-	Ca	-	O_2	-	At		Problem area	Elevated summer phosphorus and summer BOD.	Problem area
	DI	+	Ps		Ck						
	NP		Mp		Oc	+					
(57) Fergus Estuary [1]	NI	-	Ca	-	O_2	+	At		Non-problem area		Non-problem area
	DI	-	Ps		Ck						
	NP		Mp		Oc	-					
(58) Maigue Estuary[1]	NI	-	Ca	-	O_2	+	At		Potential-problem area	Elevated winter phosphorus and nitrogen but no direct or indirect effects arising.	Non-problem area
	DI	+	Ps		Ck						
	NP		Mp		Oc	-					
(59) Limerick Dock [1]	NI		Ca	-	O_2	-	At		Non-problem area		Non-problem area
	DI	-	Ps		Ck						
	NP		Mp		Oc	-					
(60) Upper Shannon Estuary[1]	NI	-	Ca	-	O_2	-	At		Non-problem area		Non-problem area
	DI	-	Ps		Ck						
	NP		Mp		Oc	-					
(61) Lower Shannon Estuary[2]	NI	-	Ca	-	O_2	-	At	-	Non-problem area	Low levels of DSP and *Dinophysis*; above assessment level but not considered at levels indicative of eutrophication.	Non-problem area
	DI	-	Ps		Ck						
	NP		Mp		Oc	-					
Kinvarra Bay, Corrib Estuary and Inner Galway Bay											
(62) Kinvarra Bay[3]	NI		Ca	-	O_2	-	At		Potential-problem area	Some evidence that groundwater inputs of nutrients may be causing nutrient enrichment. Elevated phytoplankton bloom frequency. Classed as potential problem area because elevated bloom frequency on its own insufficient to indicate a direct effect and uncertainty about magnitude of groundwater inputs.	Potential Problem area
	DI	-	Ps	-	Ck						
	NP		Mp		Oc	+					
(63) Corrib Estuary[2]	NI		Ca	-	O_2	-	At	-	Non-problem area		Non-problem area
	DI	-	Ps	-	Ck						
	NP		Mp		Oc	-					
(64) Inner Galway Bay[3]	NI		Ca	-	O_2	-	At	-	Non-problem area	Intermittent low levels of DSP, and *Dinophysis* above assessment level but not considered at levels indicative of eutrophication.	Non-problem area
	DI	-	Ps	-	Ck						
	NP		Mp		Oc	-					
Camus Bay and Kilkieran Bay											
(65) Camus Bay[2]	NI		Ca	-	O_2	-	At		Non-problem area		Non-problem area
	DI	-	Ps		Ck						
	NP		Mp		Oc	-					
(66) Kilkieran Bay[3]	NI		Ca	-	O_2	-	At		Non-problem area	Change in benthic invertebrate community structure indicative of organic enrichment, but may be linked to collapse of large *Karenia mikimotoi* bloom in summer 2005. These blooms are known to originate offshore and are not thought to be linked to inshore nutrient enrichment.	Non-problem area
	DI	-	Ps	-	Ck						
	NP		Mp		Oc	-					

Erriff Estuary and Killary Harbour											
(67) Erriff Estuary[2]	NI		Ca	-	O_2	-	At		Non-problem area		Non-problem area
	DI	-	Ps		Ck						
	NP		Mp		Oc	-					
(68) Killary Harbour[3]	NI		Ca	-	O_2	-	At		Non-problem area		Non-problem area
	DI	-	Ps	-	Ck						
	NP	-	Mp		Oc	-					
Inner Clew Bay, Westport Bay and Newport Bay											
(69) Inner Clew Bay[2]	NI		Ca	-	O_2	-	At		Non-problem area		Non-problem area
	DI	-	Ps	-	Ck						
	NP	-	Mp		Oc	-					
(70) Westport Bay[2]	NI		Ca	-	O_2	-	At		Non-problem area		Non-problem area
	DI	-	Ps	-	Ck						
	NP	-	Mp	-	Oc	-					
(71) Newport Bay[2]	NI		Ca	-	O_2	-	At		Non-problem area		Non-problem area
	DI	-	Ps	-	Ck						
	NP	-	Mp		Oc	-					
Moy Estuary and Killala Bay											
(72) Moy Estuary[2]	NI		Ca	-	O_2	-	At		Potential Problem area	Elevated levels of green opportunistic macroalgae and phytoplankton bloom frequency.	Problem area
	DI	-	Ps	-	Ck						
	NP		Mp	+	Oc	-					
(73) Killala Bay[3]	NI		Ca	-	O_2	+	At	-	Potential Problem area	Single elevated BOD measurement – insufficient to classify as potential problem area. AZP and low levels of DSP and *Dinophysis*.	Non-problem area
	DI	-	Ps		Ck						
	NP	-	Mp		Oc	-					
Garavogue Estuary and Sligo Bay											
(74) Garavogue Estuary[2]	NI		Ca	-	O_2	-	At		Non-problem area	Elevated phytoplankton bloom frequency, but insufficient on its own to indicate a direct effect in the absence of elevated biomass.	Non-problem area
	DI	-	Ps	-	Ck						
	NP		Mp		Oc	-					
(75) Sligo Bay[3]	NI		Ca	-	O_2	-	At	-	Non-problem area	Low levels of DSP, and *Dinophysis* above assessment level but not considered at levels indicative of eutrophication.	Non-problem area
	DI	-	Ps	-	Ck						
	NP	-	Mp		Oc	-					

Ballysadare											
(76) Ballysadare Estuary[2]	NI		Ca	-	O_2	-	At		Non-problem area	Elevated phytoplankton bloom frequency and DO supersaturation.	Potential Problem area
	DI	-	Ps	-	Ck						
	NP		Mp		Oc	-					
Erne Estuary, Inner Donegal Bay, Killybegs Harbour, McSwynes Bay											
(77) Erne Estuary[2]	NI	+	Ca	-	O_2	-	At		Potential Problem area	Elevated riverine inputs of total phosphorus (although not statistically significant) and elevated phytoplankton bloom frequency.	Potential Problem area
	DI	-	Ps	-	Ck						
	NP		Mp		Oc	-					
(78) Inner Donegal Bay[2]	NI		Ca	-	O_2	-	At		Non-problem area		Non-problem area
	DI	-	Ps		Ck						
	NP		Mp		Oc	-					
(79) Killybegs Harbour[3]	NI		Ca	-	O_2	+	At		Problem area	Depressed DO levels and elevated brown opportunistic algae in inner part of Harbour.	Problem area
	DI	+	Ps		Ck						
	NP	-	Mp	+	Oc	-					
(80) McSwyne's Bay[3]	NI		Ca	-	O_2	+	At		Non-problem area	Significant DO undersaturation in summer. Donegal Bay is an area of slack residual flow and water column stratification can occur close to the coast. Oxygen undersaturation in the bottom layer of this water body is likely to be due to the presence of seasonal water column stratification. Persistant and high levels of AZP, low levels of DSP toxins and low levels of *Dinophysis*.	Non-problem area
	DI	-	Ps	-	Ck						
	NP	-	Mp		Oc	-					
Gweebarra Estuary and Bay											
(81) Gweebarra Estuary[2]	NI		Ca	-	O_2	-	At		Non-problem area		Non-problem area
	DI	-	Ps		Ck						
	NP		Mp		Oc	-					
(82) Gweebarra Bay[3]	NI		Ca	-	O_2	+	At		Non-problem area		Non-problem area
	DI	-	Ps		Ck						
	NP	-	Mp		Oc	-					
Swilly Estuary and Lough Swilly											
(83) Swilly Estuary[2]	NI		Ca	+	O_2	+	At		Problem area	Direct effects arising; excessive phytoplankton blooms may be linked to organic enrichment and elevated levels of dissolved organic matter (DOM).	Problem area
	DI	-	Ps	+	Ck						
	NP		Mp		Oc	+					
(84) Lough Swilly[3]	NI		Ca	-	O_2	-	At		Non-problem area		Non-problem area
	DI	-	Ps	-	Ck						
	NP	-	Mp		Oc	-					

[1] For example, caused by transboundary transport of (toxic) algae and/or organic matter arising from adjacent/remote areas.
[2] The increased degree of nutrient enrichment in these areas may contribute to eutrophication problems elsewhere.

Key to the table

NI	Riverine inputs and direct discharges of total N and total P
DI	Winter DIN and/or DIP concentrations (exceedance above or below salinity adjusted threshold)
NP	Increased winter N/P ratio
Ca	Maximum and mean chlorophyll *a* concentration (µg/l)
Ps	Increased bloom frequency
Mp	Macrophytes including macroalgae (WFD EQR for Opportunistic macroalgae)
O_2	Oxygen deficiency (% saturation)
Ck	Changes/kills in zoobenthos and fish kills
Oc	BOD mg/l
At	Algal toxins (DSP/PSP mussel infection events)

+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters

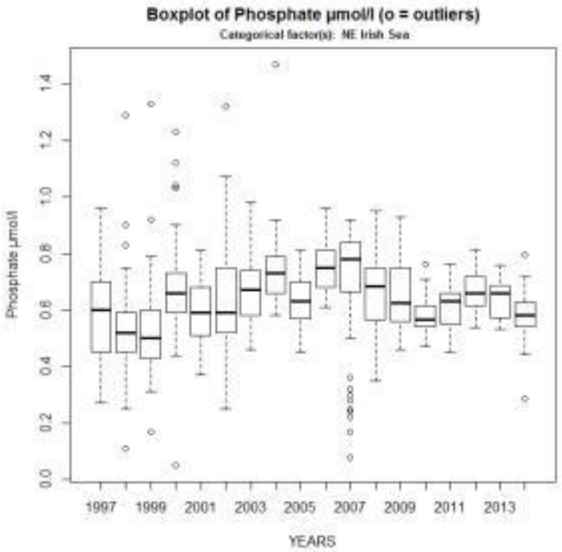
- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters

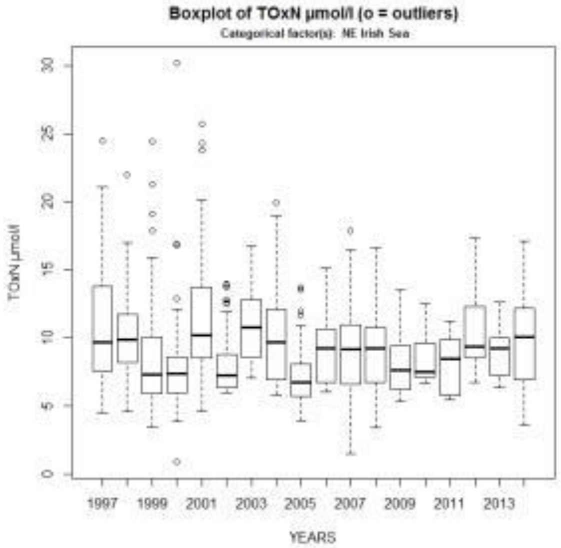
? = Not enough data to perform an assessment or the data available is not fit for the purpose

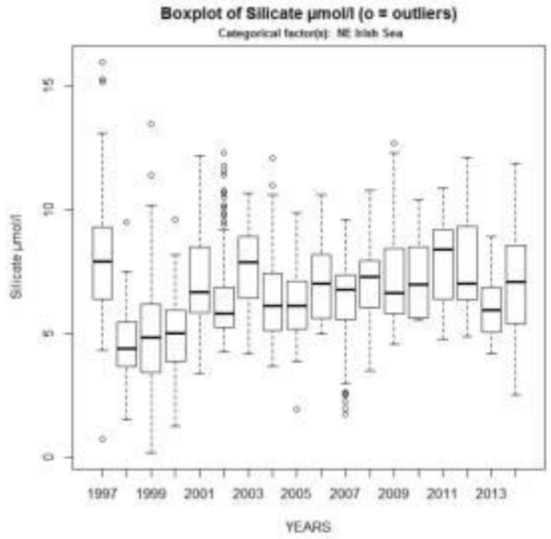
Note: Categories I, II and/or III/IV are scored '+' in cases where one or more of its respective assessment parameters is showing an increased trend, elevated levels, shifts or changes.

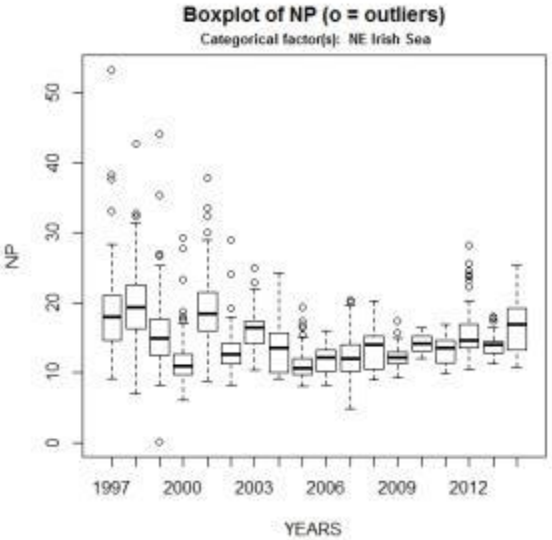
I

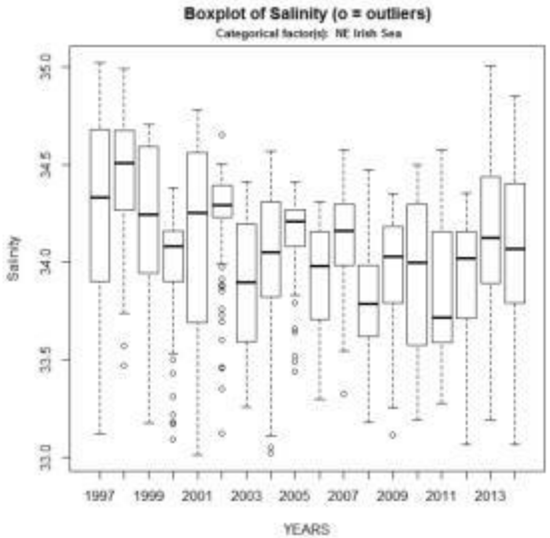
Annex 2a Boxplots of TOxN, Phosphate, Silicate, N:P ratios and salinity for each region highlighted in Figure 2a and each transect in Figure 2b.

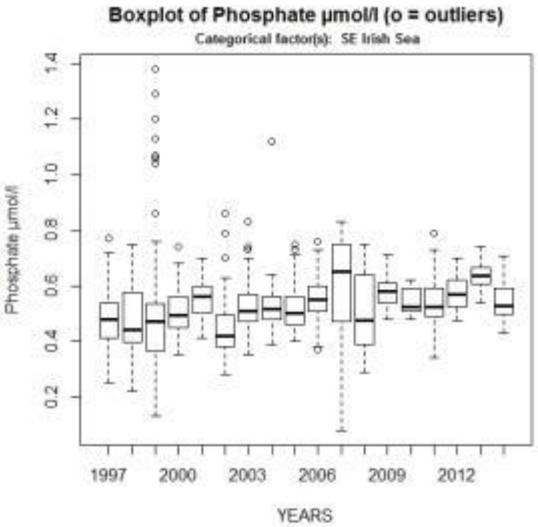


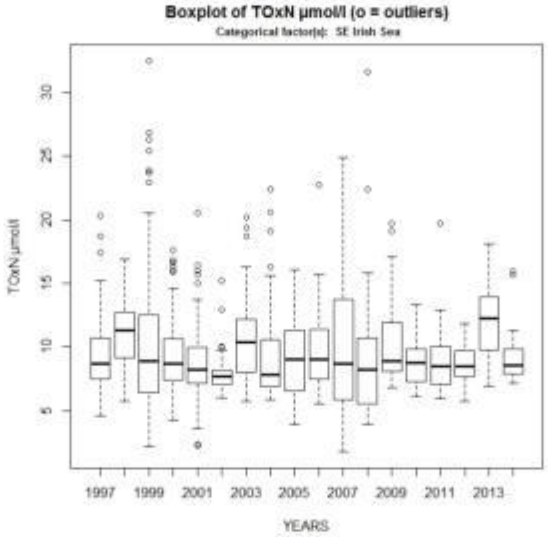


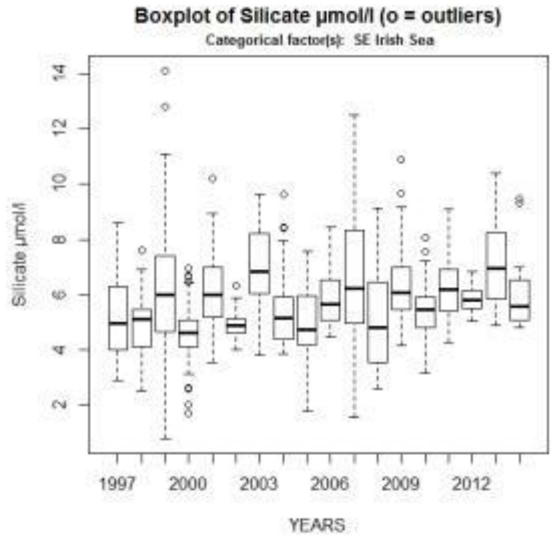


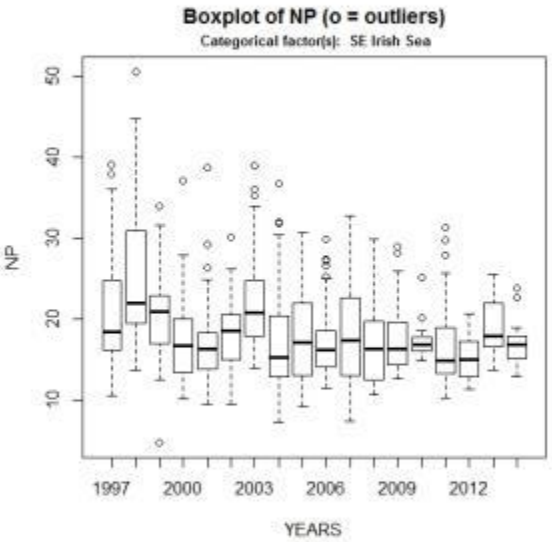


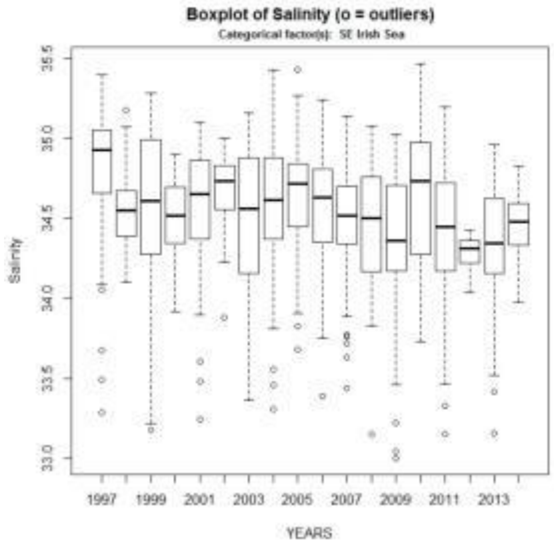


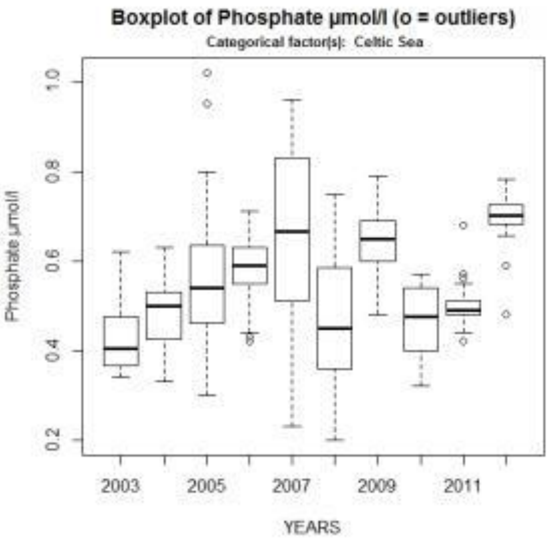

Boxplot of Phosphate µmol/l (o = outliers)
Categorical factor(s): SE Irish Sea
Phosphate µmol/l
0.2 0.4 0.6 0.8 1.0 1.2 1.4
1997 2000 2003 2006 2009 2012
YEARS

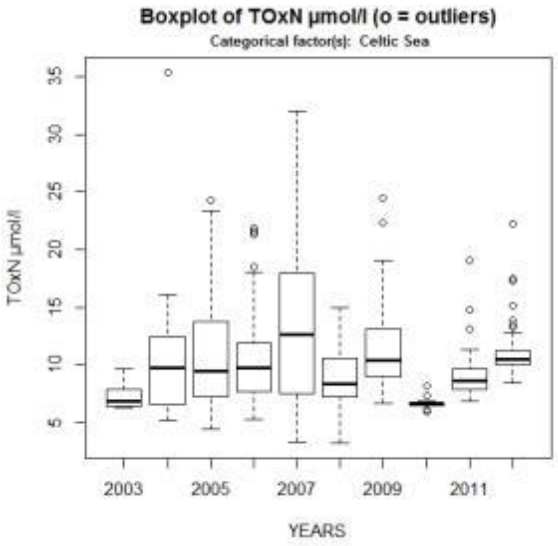

Boxplot of TOxN µmol/l (o = outliers)
Categorical factor(s): SE Irish Sea
TOxN µmol/l
5 10 15 20 25 30
1997 1999 2001 2003 2005 2007 2009 2011 2013
YEARS

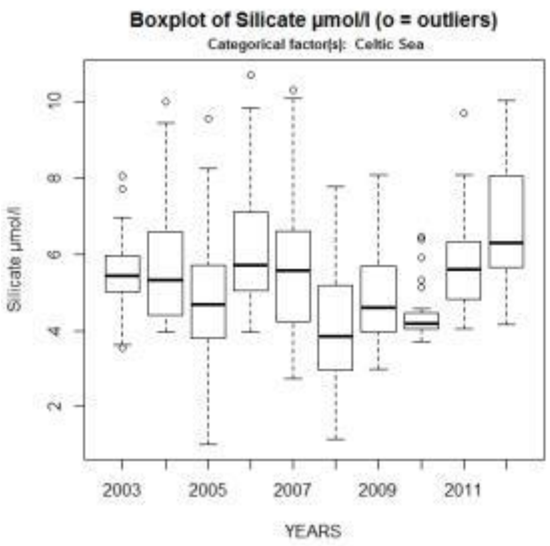

Boxplot of Silicate µmol/l (o = outliers)
Categorical factor(s): SE Irish Sea
Silicate µmol/l
2 4 6 8 10 12 14
1997 2000 2003 2006 2009 2012
YEARS


Boxplot of NP (o = outliers)
Categorical factor(s): SE Irish Sea
NP
10 20 30 40 50
1997 2000 2003 2006 2009 2012
YEARS


Boxplot of Salinity (o = outliers)
Categorical factor(s): SE Irish Sea
Salinity
33.0 33.5 34.0 34.5 35.0 35.5
1997 1999 2001 2003 2005 2007 2009 2011 2013
YEARS


Boxplot of Phosphate µmol/l (o = outliers)
Categorical factor(s): Celtic Sea
Phosphate µmol/l
YEARS
2003
2005
2007
2009
2011


Boxplot of TOxN µmol/l (o = outliers)
Categorical factor(s): Celtic Sea
TOxN µmol/l
YEARS
2003
2005
2007
2009
2011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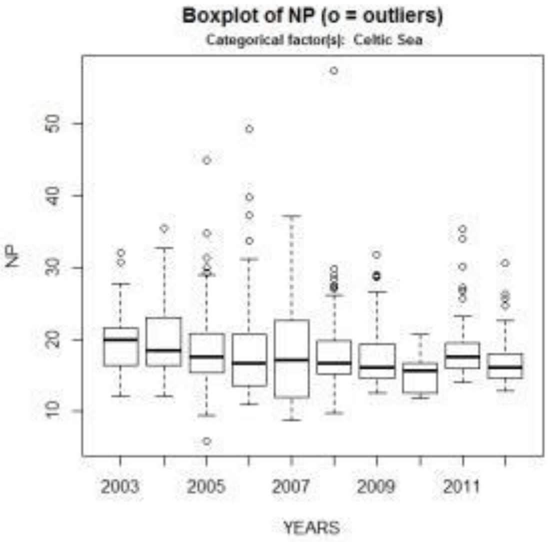
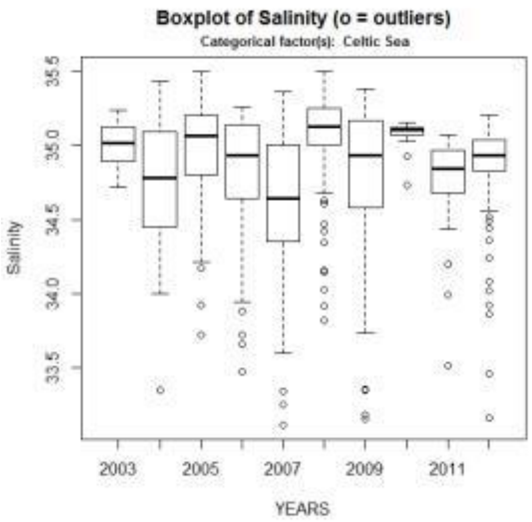
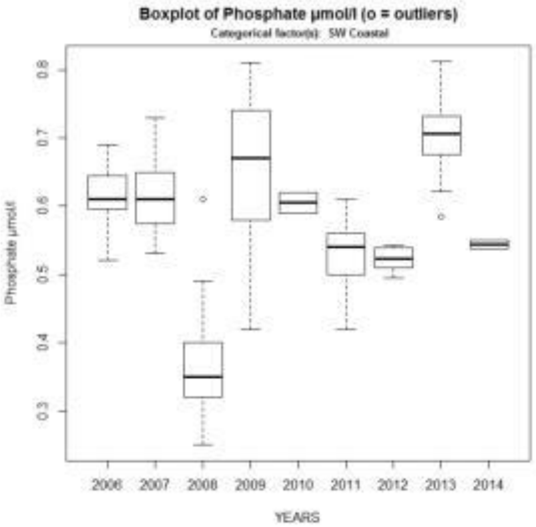
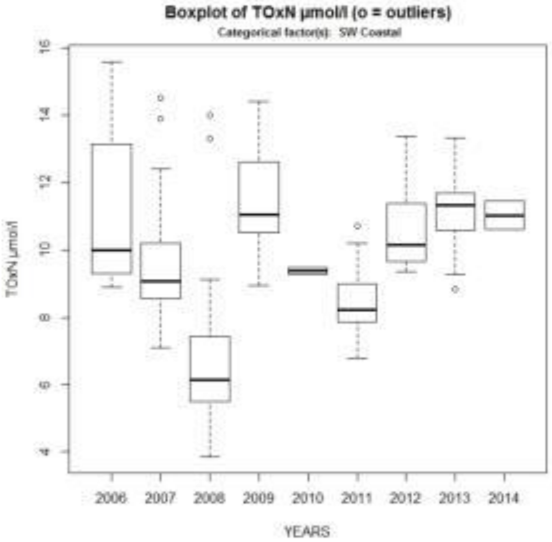
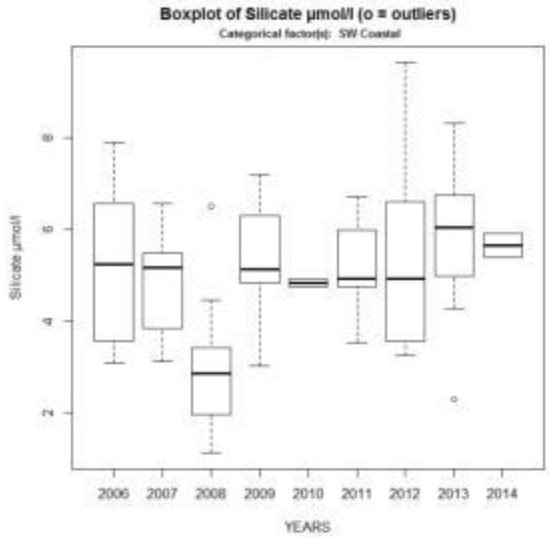
Categorical factor(s): Celtic Sea
Silicate µmol/l
YEARS
2003
2005
2007
2009
2011


Boxplot of NP (o = outliers)
Categorical factor(s): Celtic Sea
NP
YEARS
2003
2005
2007
2009
2011


Boxplot of Salinity (o = outliers)
Categorical factor(s): Celtic Sea
Salinity
YEARS
2003
2005
2007
2009
2011


Boxplot of Phosphate µmol/l (o = outliers)
Categorical factor(s): SW Coastal
Phosphate µmol/l
0.3 0.4 0.5 0.6 0.7 0.8
2006 2007 2008 2009 2010 2011 2012 2013 2014
YEARS


Boxplot of TOxN µmol/l (o = outliers)
Categorical factor(s): SW Coastal
TOxN µmol/l
4 6 8 10 12 14 16
2006 2007 2008 2009 2010 2011 2012 2013 2014
YEARS


Boxplot of Silicate µmol/l (o = outliers)
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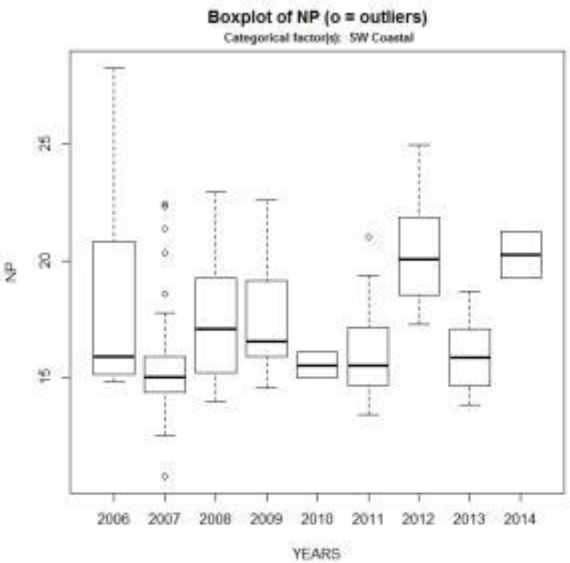
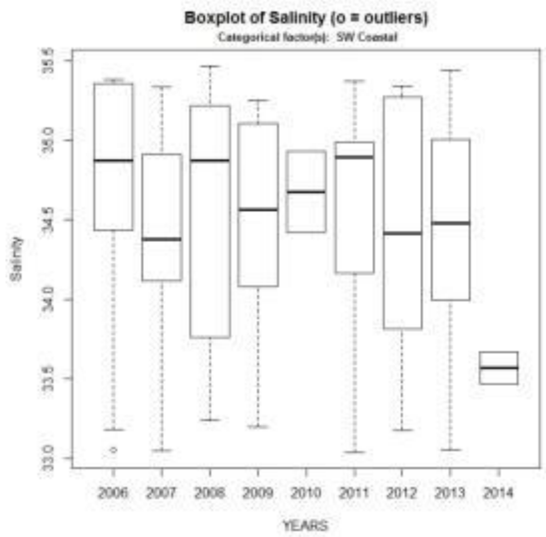
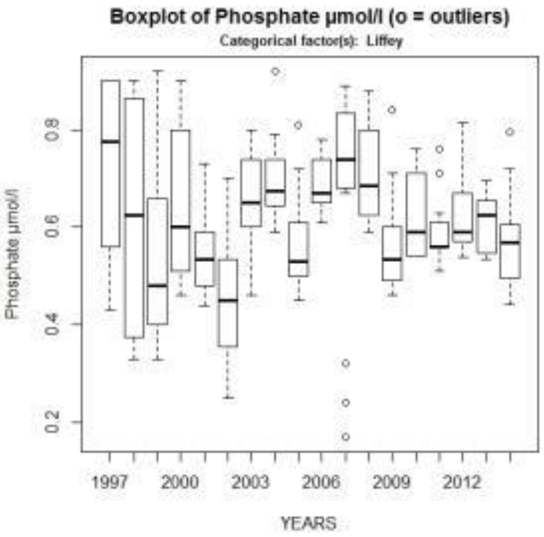
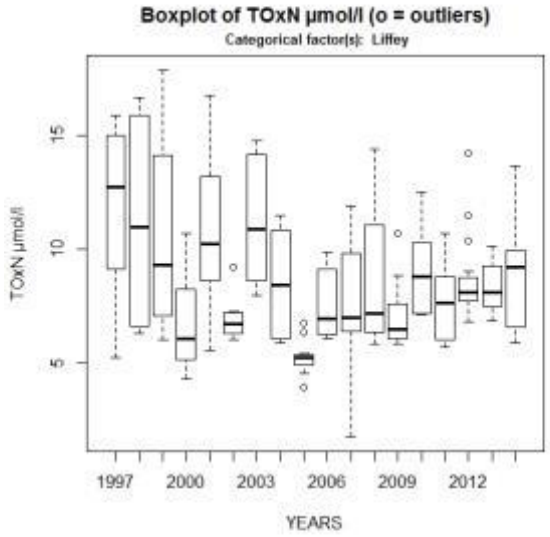
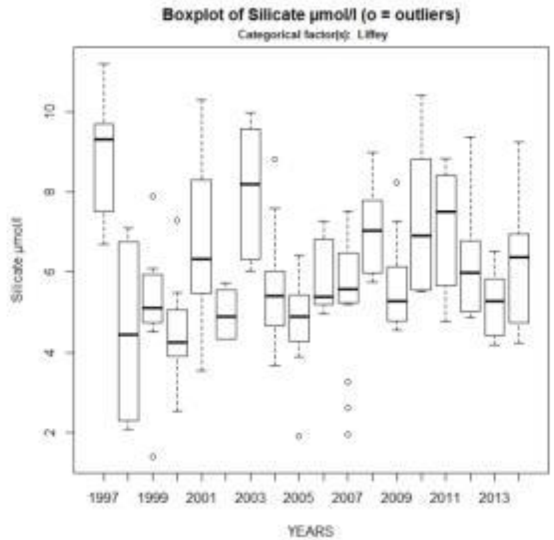
Silicate µmol/l
2 4 6 8
2006 2007 2008 2009 2010 2011 2012 2013 2014
YEARS

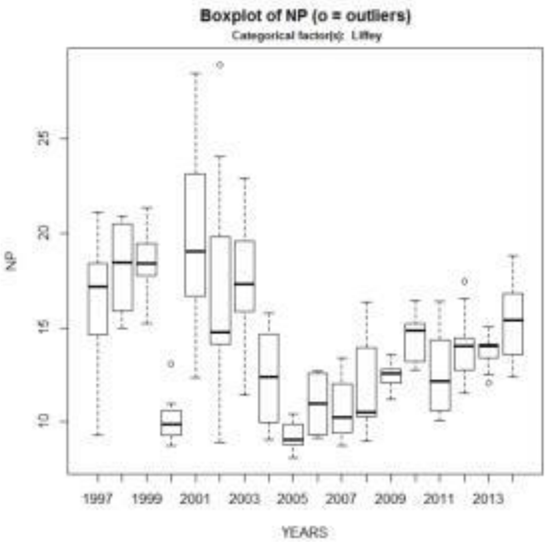

Boxplot of NP (o = outliers)
Categorical factor(s): SW Coastal
NP
15 20 25
2006 2007 2008 2009 2010 2011 2012 2013 2014
YEARS

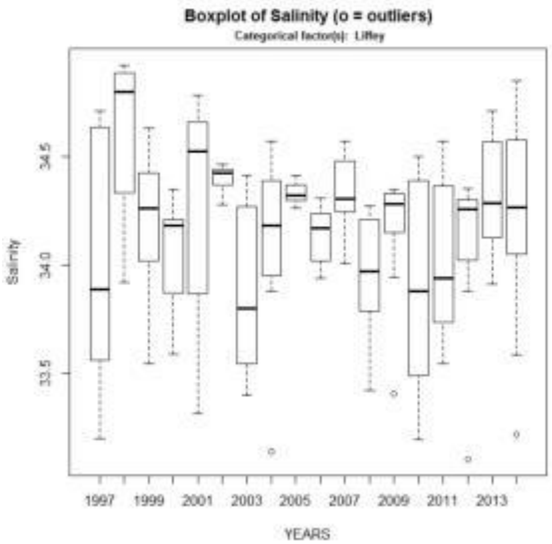

Boxplot of Salinity (o = outliers)
Categorical factor(s): SW Coastal
Salinity
33.0 33.5 34.0 34.5 35.0 35.5
2006 2007 2008 2009 2010 2011 2012 2013 2014
YEARS

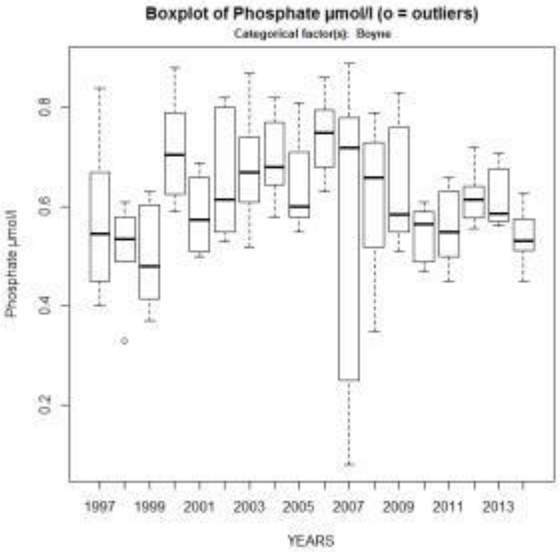

Boxplot of Phosphate µmol/l (o = outliers)
Categorical factor(s): Liffey
Phosphate µmol/l
0.2
0.4
0.6
0.8
1997
2000
2003
2006
2009
2012
YEARS

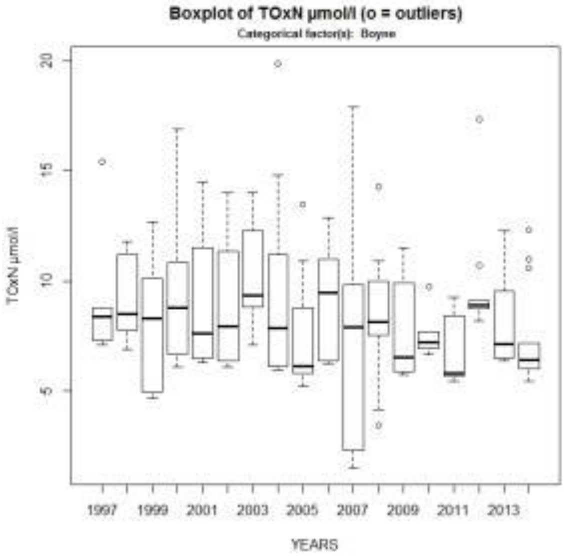

Boxplot of TOxN µmol/l (o = outliers)
Categorical factor(s): Liffey
TOxN µmol/l
5
10
15
1997
2000
2003
2006
2009
2012
YEARS

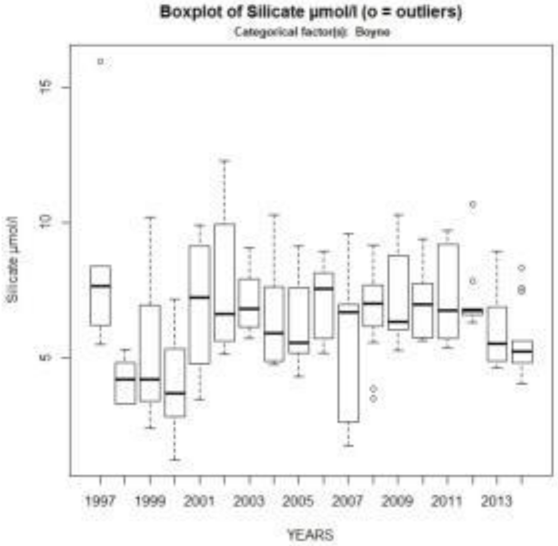

Boxplot of Silicate µmol/l (o = outliers)
Categorical factor(s): Liffey
Silicate µmol/l
2
4
6
8
10
1997
1999
2001
2003
2005
2007
2009
2011
2013
YEARS

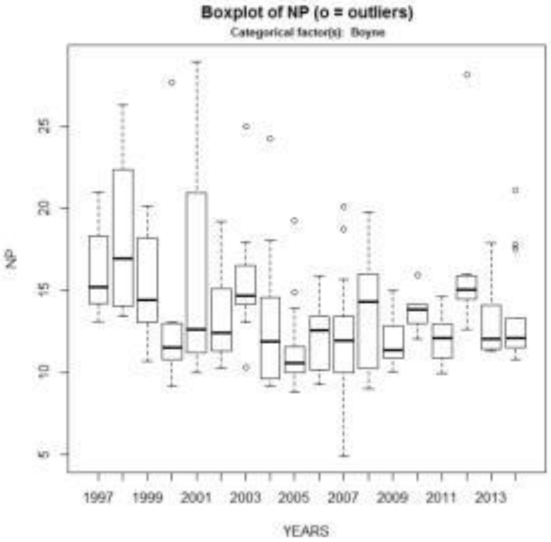

Boxplot of NP (o = outliers)
Categorical factor(s): Liffey
NP
10
15
20
25
1997
1999
2001
2003
2005
2007
2009
2011
2013
YEARS

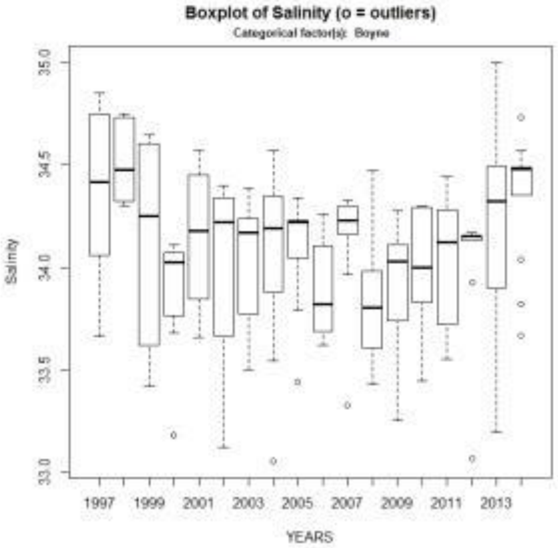

Boxplot of Salinity (o = outliers)
Categorical factor(s): Liffey
Salinity
33.5
34.0
34.5
1997
1999
2001
2003
2005
2007
2009
2011
2013
YEARS

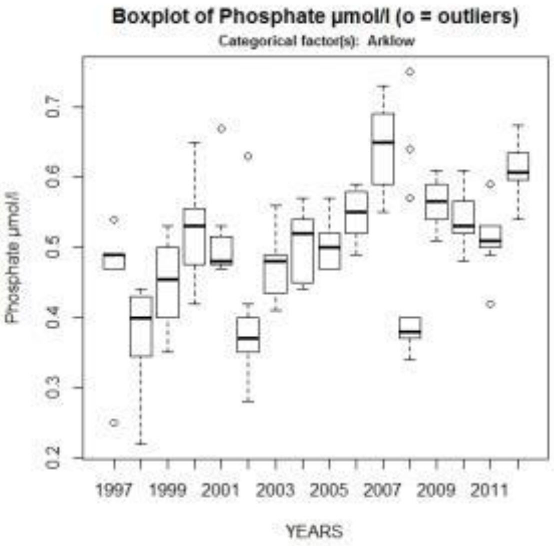

Boxplot of Phosphate µmol/l (o = outliers)
Categorical factor(s): Boyne
Phosphate µmol/l
0.2
0.4
0.6
0.8
1997
1999
2001
2003
2005
2007
2009
2011
2013
YEARS

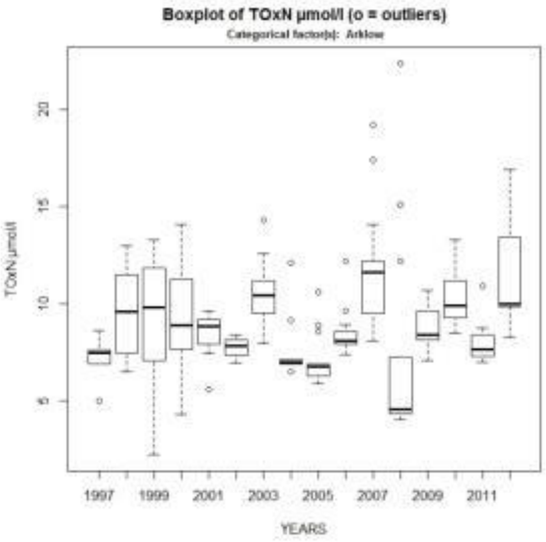

Boxplot of TOxN µmol/l (o = outliers)
Categorical factor(s): Boyne
TOxN µmol/l
5
10
15
20
1997
1999
2001
2003
2005
2007
2009
2011
2013
YEARS

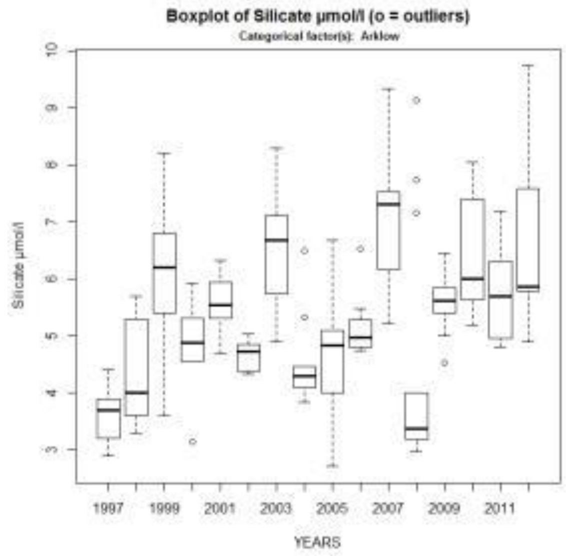

Boxplot of Silicate µmol/l (o = outliers)
Categorical factor(s): Boyne
Silicate µmol/l
5
10
15
1997
1999
2001
2003
2005
2007
2009
2011
2013
YEARS

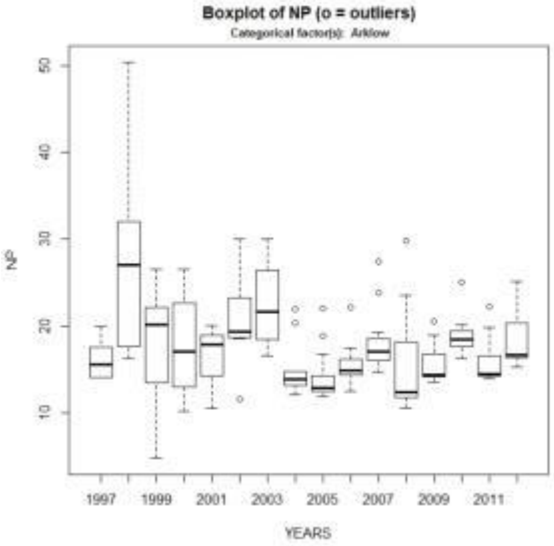

Boxplot of NP (o = outliers)
Categorical factor(s): Boyne
NP
5
10
15
20
25
1997
1999
2001
2003
2005
2007
2009
2011
2013
YEARS

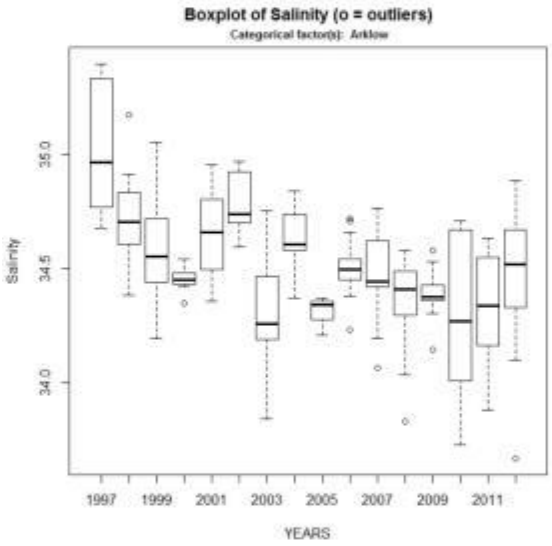

Boxplot of Salinity (o = outliers)
Categorical factor(s): Boyne
Salinity
33.0
33.5
34.0
34.5
35.0
1997
1999
2001
2003
2005
2007
2009
2011
2013
YEARS

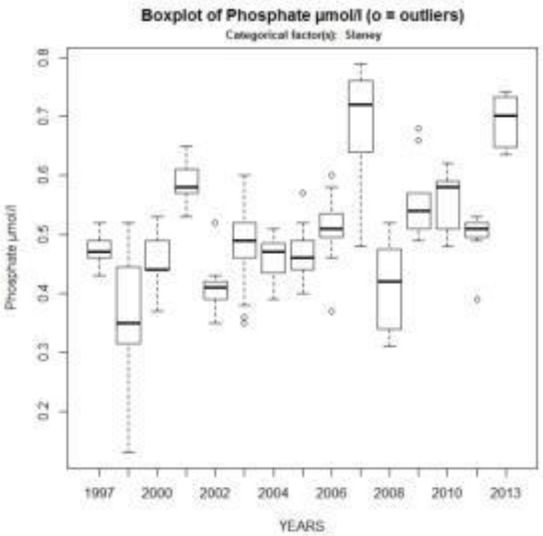

Boxplot of Phosphate µmol/l (o = outliers)
Categorical factor(s): Arklow
Phosphate µmol/l
YEARS

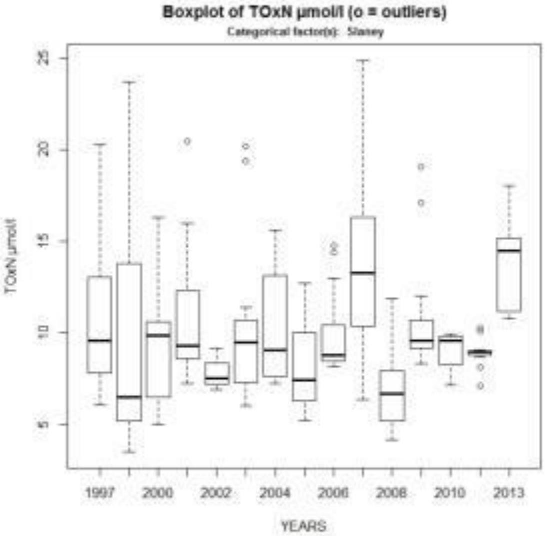

Boxplot of TOxN µmol/l (o = outliers)
Categorical factor(s): Arklow
TOxN µmol/l
YEARS

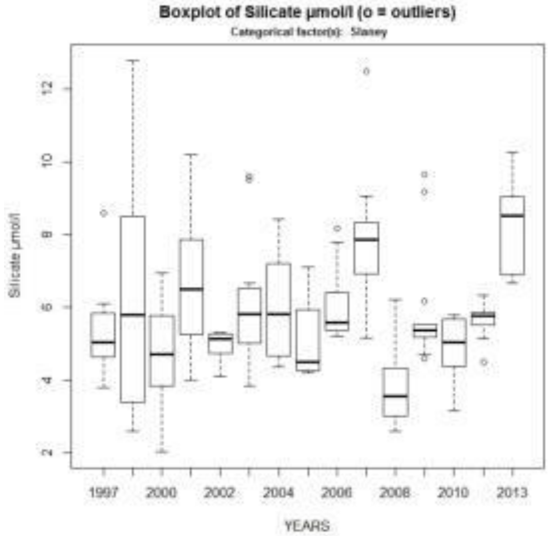

Boxplot of Silicate µmol/l (o = outliers)
Categorical factor(s): Arklow
Silicate µmol/l
YEARS

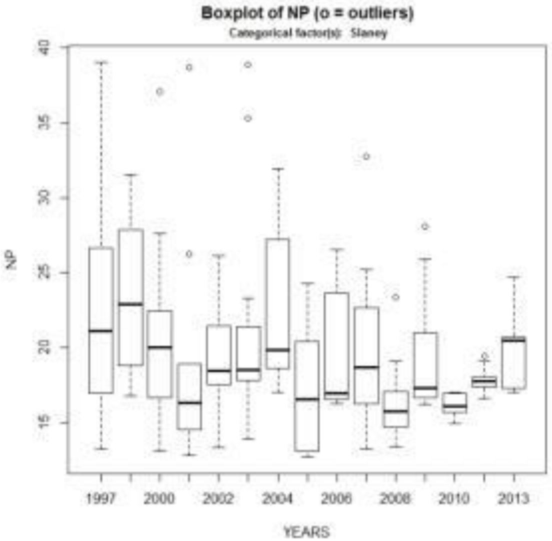

Boxplot of NP (o = outliers)
Categorical factor(s): Arklow
NP
YEARS

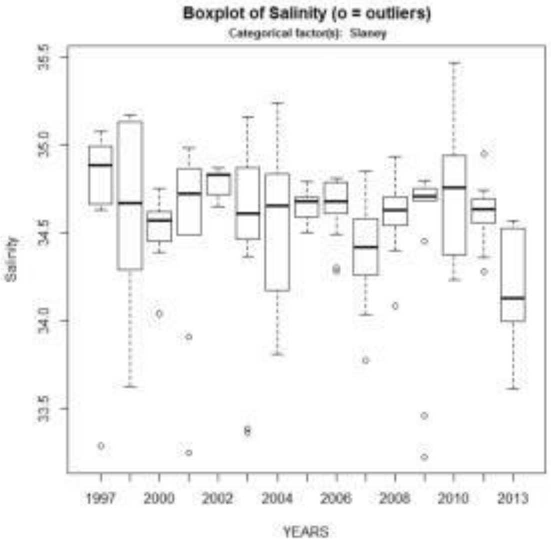

Boxplot of Salinity (o = outliers)
Categorical factor(s): Arklow
Salinity
YEARS


Boxplot of Phosphate µmol/l (o = outliers)
Categorical factor(s): Slaney
Phosphate µmol/l
YEARS
1997 2000 2002 2004 2006 2008 2010 2013

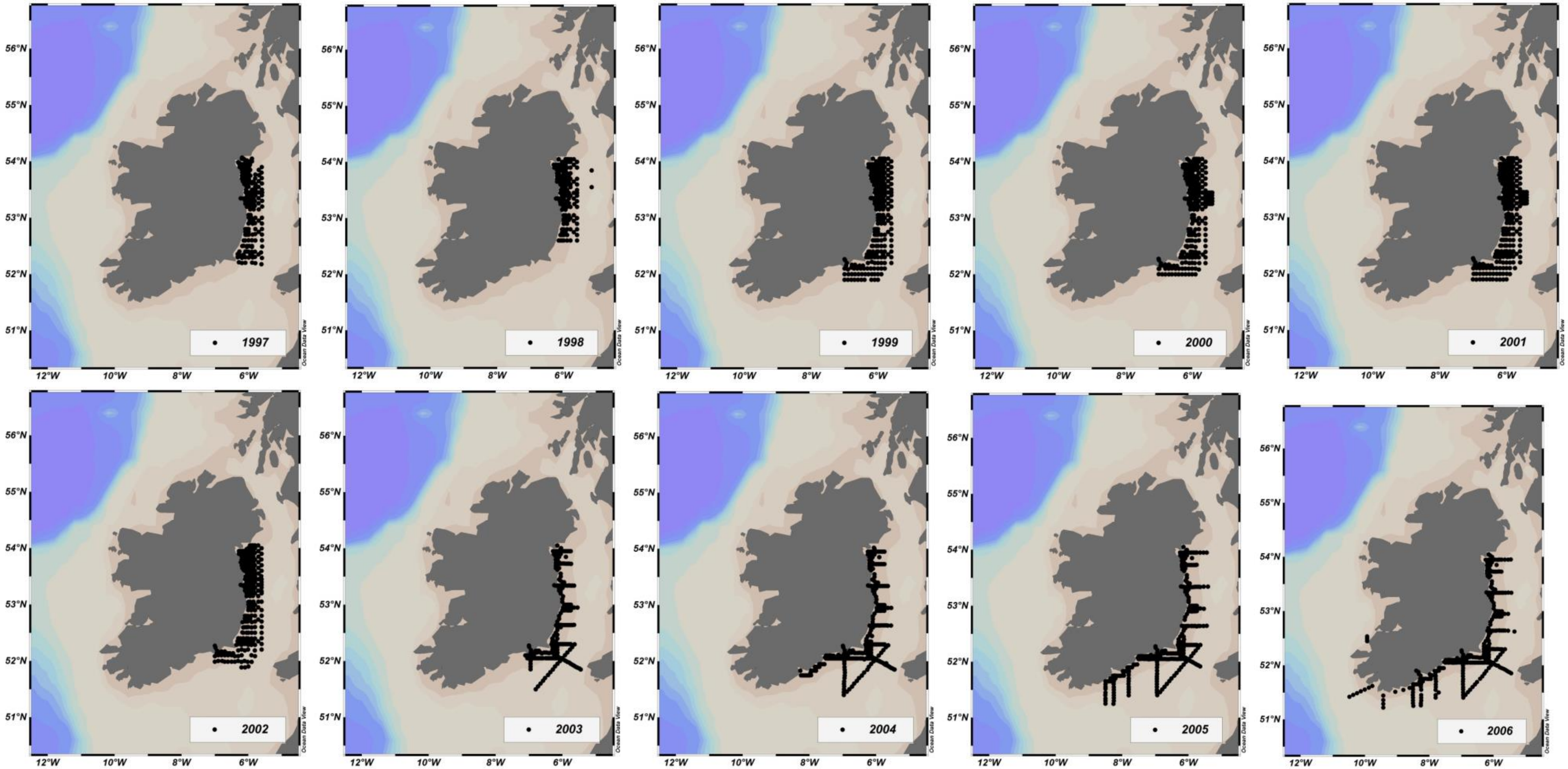

Boxplot of TOxN µmol/l (o = outliers)
Categorical factor(s): Slaney
TOxN µmol/l
YEARS
1997 2000 2002 2004 2006 2008 2010 2013

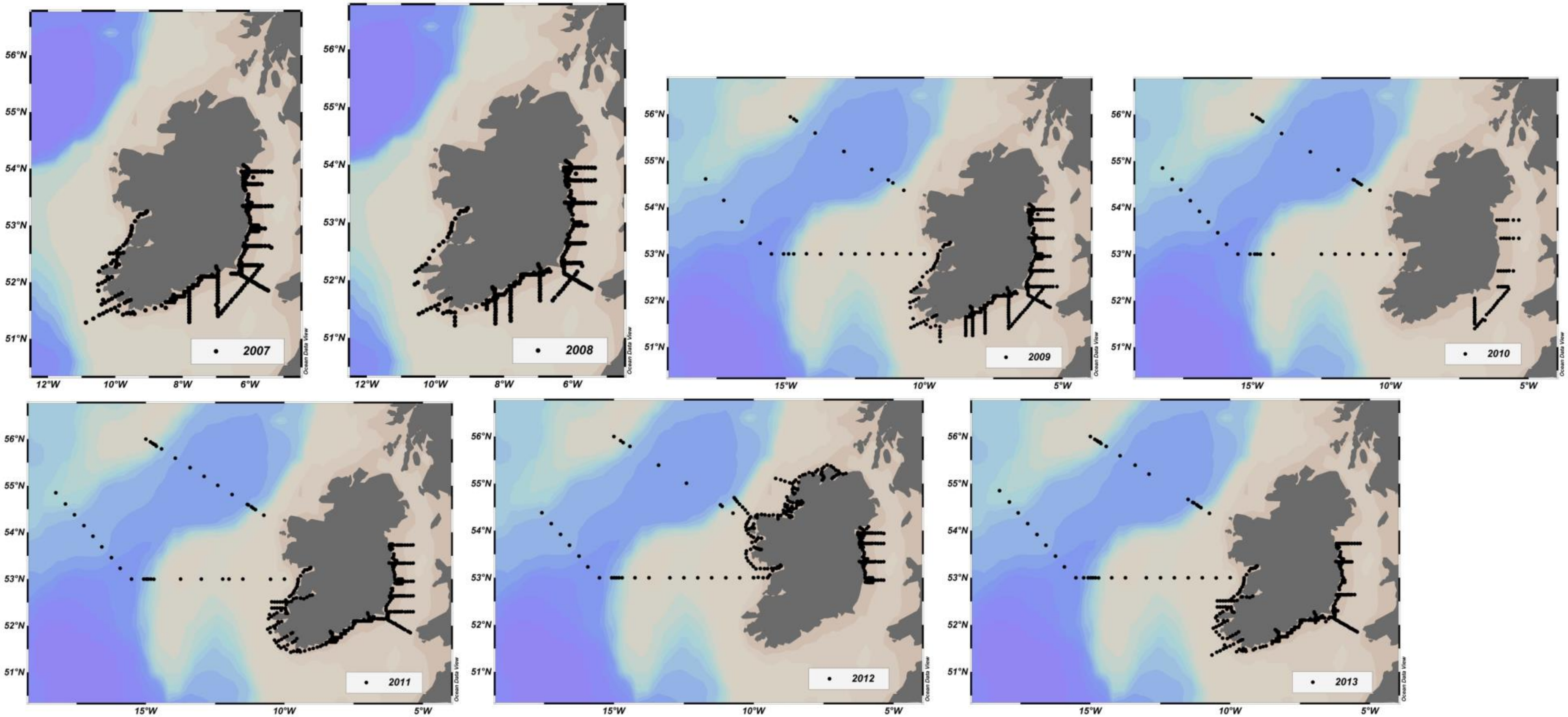

Boxplot of Silicate µmol/l (o = outliers)
Categorical factor(s): Slaney
Silicate µmol/l
YEARS
1997 2000 2002 2004 2006 2008 2010 2013


Boxplot of NP (o = outliers)
Categorical factor(s): Slaney
NP
YEARS
1997 2000 2002 2004 2006 2008 2010 2013


Boxplot of Salinity (o = outliers)
Categorical factor(s): Slaney
Salinity
YEARS
1997 2000 2002 2004 2006 2008 2010 2013

Annex 2b: Station positions of surface winter nutrient samples for each individual year included in the assessment




2007
2008
2009
2010
2011
2012
2013

Annex 2c. Coastal and offshore waters summary statistics and nutrient salinity regressions 2008 - 2014

1 Summary statistics dissolved inorganic nutrients for coastal and offshore waters of salinity >33psu 2008 – 2014

	TOxN							PO4					
	Celtic Sea	NE Irish Sea*	NW Coastal	Rockall	SE Irish Sea	SW Coastal	Western Shelf	Celtic Sea	NE Irish Sea*	NW Coastal	Rockall	SE Irish Sea	SW C
Mean	9.85	9.15	9.30	10.32	9.54	9.68	9.83	0.56	0.63	0.50	0.60	0.56	
Median	9.39	9.03	9.43	10.47	9.00	9.83	9.97	0.55	0.63	0.51	0.61	0.56	
Std Dev	3.24	2.65	1.70	0.97	2.87	2.19	1.40	0.13	0.10	0.06	0.06	0.10	
Min	3.21	3.43	6.10	7.98	3.89	3.85	4.21	0.20	0.29	0.29	0.37	0.29	
Max	31.60	17.33	13.37	12.20	22.40	14.40	12.80	0.98	0.95	0.61	0.75	0.79	
25%ile	7.70	6.95	7.69	9.68	7.82	8.06	9.20	0.48	0.56	0.48	0.56	0.51	
75%ile	11.20	10.80	10.84	10.90	10.80	11.33	10.51	0.67	0.70	0.54	0.64	0.62	
90%ile	13.64	12.51	11.29	11.55	13.38	12.46	11.15	0.73	0.76	0.56	0.67	0.68	
Number	**465**	**385**	**192**	**96**	**305**	**200**	**66**	**464**	**386**	**192**	**95**	**305**	

	N:P							Salinity					
	Celtic Sea	NE Irish Sea*	NW Coastal	Rockall	SE Irish Sea	SW Coastal	Western Shelf	Celtic Sea	NE Irish Sea*	NW Coastal	Rockall	SE Irish Sea	SW Co
Mean	17.50	14.41	18.66	17.38	17.08	16.84	17.84	34.79	33.95	34.30	35.44	34.29	
Median	16.58	13.97	18.66	17.13	16.55	16.32	17.47	34.90	33.98	34.40	35.46	34.32	
Std Dev	4.25	3.27	2.78	1.44	3.95	2.38	1.86	0.42	0.36	0.51	0.12	0.35	
Min	9.71	8.97	13.38	15.07	10.23	13.41	14.49	33.15	33.06	33.02	34.46	33.00	
Max	57.45	28.18	26.59	23.67	31.28	24.96	22.65	35.56	35.00	35.03	35.59	35.47	
25%ile	14.82	12.14	16.26	16.33	14.14	15.04	16.57	34.60	33.70	33.98	35.43	34.12	
75%ile	19.17	15.88	20.65	17.97	19.09	18.03	19.04	35.08	34.21	34.70	35.49	34.53	
90%ile	22.57	18.92	22.33	19.21	22.81	20.41	20.80	35.20	34.40	34.85	35.53	34.71	
Number	**464**	**385**	**192**	**95**	**305**	**198**	**66**	**470**	**387**	**194**	**99**	**307**	

***Note 52% of NE Irish Sea stations in this table have a salinity >33 and <34psu**

Annex 3: link to assessment table

No.	Name	Riverine inputs and direct discharges of total N and total P		Input trends 2006-2013								Degree of Nutrient Enrichment (I): Winter DIN and/or DIP concentrations														overall		
		P inputs (kt/a)	N inputs (kt/a)	Total P	sens estimator	P	Trend	Total N	sens estimator	P	Trend	2006-2008 DIN	2007-2009 DIN	2009-2011 DIN	2010-2012 DIN	2012-2014 DIN	DIN SCORE	CONFIDENCE	2006-2008 MRP	2007-2009 MRP	2009-2011 MRP	2010-2012 MRP	2012-2014 MRP	MRP SCORE	CONFIDENCE	overall	minimum conf	
1	Castletown Estuary											58	54	54	53		++++	100	2	3	-14	-15		++--	100	+	100	conf on previous
2	Inner Dundalk Bay											36	36	-19	-30		++--	100	-38	-27	-35	-24		----	100	+	100	conf on previous
3	Outer Dundalk Bay											-45	-48				--	100	-31	-35				--	100	-	100	conf on previous
4	Boyne Estuary	6.32	0.12	No Trend	-3.19	0.54	-4.62	No Trend	-366.06	0.06	-8.67	116	76	8	25	-6	++++-	60	-33	-33	-33	-38	-36	-----	100	+	60	
5	Boyne Estuary Plume Zone											-60	-59	-29	-52	-73	-----	100	-40	-52	-30	-37	-50	-----	100	-	100	
6	Rogerstown Estuary											-33	-34	-56		17	--- +	50	-54	-27	-33		-39	--- -	100	+	50	low sample num
7	Broadmeadow Water											72	67	30		84	+++ +									+	0	low sample num
8	Malahide Bay											98	2	-50	-42	0	++---	66	-40	-35	-42	-67	-33	-----	100	+	66	low sample num
9	Northwestern Irish Sea (HA 08)											-62	-56	-42	-44	-43	-----	100	-44	-46	-48	-49	-45	-----	100	-	100	
10	Liffey Estuary Lower											56	-10	-1	-52	-9	+----	67	-15	-23	-23	-37	-14	-----	100	+	67	
11	Liffey Estuary Upper	1.94	0.04	**Sig decline**	**-4.82**	**0.02**	**-13.6**	No Trend	-27.49	0.17	-1.95	194	-35	-21	-16	-17	+----	99	-26	-33	-51	-51	-53	-----	100	+	99	
12	Tolka Estuary			No Trend	-0.17	0.71	4.31	**Sig decline**	**-10.85**	**0.02**	**-7.65**	32	1	7	-5	17	+++-+	58	-6	2	4	-2	-24	-++--	100	+	58	
13	Dublin Bay											53	-61	-39	-54	-46	+----	100	-19	-40	-38	-45	-40	-----	100	?	100	
14	Broad Lough											18	-57	224		-14	++ -	61	-20	-45	-37		-68	--- -	100	+	61	near threshold
15	Avoca Estuary			No Trend	-2.035	0.27	-11.8	No Trend	-51.39	0.11	-4.76	-32	-11	-13	-53	-28	-----	100	-35	-82	-84	-79	-90	-----	100	-	100	
16	Upper Slaney Estuary			No Trend	-12.43	0.11	-19.2	No Trend	-8.31	0.9	-0.15	95	112	97	99	78	+++++	99	-44	-38	-42	-70	-63	-----	100	+	99	
17	Lower Slaney Estuary											99	119	76	72	55	+++++	91	-8	-81	-47	-61	-57	-----	100	+	91	
18	Wexford Harbour											-45		-36	24	-26	- -+-	91	-33		-63	-54	-53	- ---	100	?	91	
19	Nore Estuary			**Sig decline**	**-12.42**	**0.04**	**-13.9**	No Trend	-305.03	0.11	-6.88	23	39	17	19	32	+++++	68	-67	-42	-23	-36	-44	-----	100	+	68	
20	Upper Barrow Estuary			No Trend	-7.43	0.11	-7.91	No Trend	-110.83	0.27	-1.75	45	90	47	47	62	+++++	98	-74	-33	-18	-63	-73	-----	100	+	98	
21	Barrow Nore Estuary Upper											34	41	69	72	44	+++++	100	-73	-50	-13	-57	-65	-----	100	+	100	
22	New Ross Port											23	62	10	20	23	+++++	65	-73	-18	-17	-37	-60	-----	100	+	65	near threshold
23	Upper Suir Estuary			No Trend	-8	0.11	-8.53	No Trend	-306.46	0.11	-4.51	28	28	28	28	20	+++++	100	-67	-53	-33	-65	-68	-----	100	+	100	
24	Middle Suir Estuary											29	44	17	23	23	+++++	93	-58	-50	-33	-50	-57	-----	100	+	93	
25	Lower Suir Estuary (Little Island - Cheekpoint)											38	26	10	27	24	+++++	100	-58	-43	-45	-40	-40	-----	100	+	100	
26	Barrow Suir Nore Estuary											70	25	10	48	10	+++++	72	-46	-45	-42	-31	-29	-----	100	+	72	
27	Waterford Harbour											-34	-25	-31	-51	-49	-----	100	-63	-53	-48	-54	-55	-----	100	-	100	
28	Colligan Estuary											173	111	-35	-33	-13	++---	67	-68	-60	-59	-59	-65	-----	100	+	67	
29	Dungarvan Harbour											-12	-19	-60	-60	-60	-----	100		-52	-61	-61	-68	----	98	-	98	
30	Upper Blackwater M Estuary			No Trend	-14.47	0.17	-8.33	**Sig decline**	**-744.24**	**0.01**	**-9.4**	-34	1	42	45	14	-++++	66	-42	-40	-72	-73	-63	-----	100	+	66	
31	Lower Blackwater M Estuary / Youghal Harbour											-23	-24	42	-5	-9	--+--	98	-45	-42	-72	-64	-48	-----	100	?	98	
32	Youghal Bay											-29	-36	-37	-37	-19	-----	81	-54	-50	-88	-88	-44	-----	100	-	81	
33	Lee (Cork) Estuary Upper			No Trend	-7.17	0.06	-10.5	**Sig decline**	**-209.69**	**0.04**	**-7.08**	39	5	25	46	50	+++++	99	-47	-47	-53	-59	-59	-----	100	+	99	
34	Lee (Cork) Estuary Lower											85	67	88	118	58	+++++	97	-32	-29	-30	-37	-15	-----	100	+	97	
35	Lough Mahon											102	70	15	-10	22	+++-+	89	-22	-27	-48	-48	-24	-----	100	+	89	
36	Lough Mahon (Harper's Island)												73	50	-2	-30	++--	low		10	-23	-42	-45	+--	100	+	100	low sample num
37	Owenacurra Estuary											134	84	78	17	2	+++++	35	-45	-48	-66	-67	-62	-----	100	+	35	low sample num
38	North Channel Great Island											85	71	11	1	2	+++++	100	-29	-28	-57	-55	-43	-----	100	+	50	low sample num
39	Glashaboy Estuary											182	157	121	139	143	+++++	94	-43	-44	-52	-58	-57	-----	100	+	94	
40	Cork Harbour											41	17	-11	-7	-13	++---	91	-36	-42	-57	-52	-37	-----	100	+	91	
41	Outer Cork Harbour											13	12	-38	-35	-36	++---	94	-40	-42	-59	-58	-39	-----	100	+	94	
42	Upper Bandon Estuary			No Trend	-11.02	0.27	-5.07	No Trend	-99	-4.7	0.27	91	6	17	20	25	+++++	100	-35	-50	-57	-58	-42	-----	100	+	100	
43	Lower Bandon Estuary											149	22	11	20	10	+++++	61	-49	-54	-54	-56	-48	-----	100	+	61	sample near bo
44	Kinsale Harbour											-34	-36	-45	-49	-42	-----	98	-51	-50	-88	-71	-60	-----	100	-	98	
45	Argideen Estuary											60	88	55	97		++++		-38	-43	-55	-53		----		+	0	
46	Ilen Estuary											12	-6	-6	-5		+---	100	-60	-49	-59	-55	-62	-----	100	?	100	
47	Inner Kenmare River											-81	-81	-70	-70	-81	-----	100	-83	-83	-73	-73	-75	-----	100	-	100	
48	Kilmakilloge Harbour											-85	-84	-55	-57	-76	-----	100	-79	-91	-60	-60	-70	-----	100	-	100	
49	Outer Kenmare River											-78	-85	-50	-57	-65	-----	100	-77	-72	-51	-51	-61	-----	100	-	100	
50	Castlemaine Harbour											-72	-69			-83	-- -	100	-69	-70			-62	-- -	100	-	100	
51	Lee K Estuary											-42	-30			-74	-- -	99	-20	8			-55	-+ -	100	?	99	
52	Inner Tralee Bay											-9	-48			-56	-- -	100	43	-42			-35	+- -	100	?	100	
53	Upper Feale Estuary											-60	-60	-60	-60	-73	-----	100	-39	-45	-45	-45	-50	-----	100	-	100	
54	Cashen											-52	-50	-50	-50	-71	-----	100	-2	-38	-38	-38	-33	-----	100	-	100	
55	Deel Estuary			**Sig decline**	**1.18**	**0.04**	**-5.03**	No Trend	-57.21	0.06	-9.96	5	-11	-27	-49	-39	+----	100	-58	-58	-65	50	50	---++	99	+	99	
56	Fergus Estuary			No Trend	-3.23	0.11	-11.7	**Sig decline**	**-55.49**	**0.02**	**-8.09**	-60	-53	-54	-52	-72	-----	100	-63	-58	-57	-5	-17	-----	81	-	81	
57	Maigue Estuary			**Sig decline**	**-3.35**	**0.02**	**-5.88**	**Sig decline**	**-124.08**	**0.04**	**-9.7**	12	2	-24	-11	-13	++---	100	-68	-60	-52	17	17	---++	97	+	97	
58	Limerick Dock			No Trend	-14.8225	0.17	-9.22	**Sig decline**	**-454.46**	**0.04**	**-5.84**	-45	-49	-53	-50	-61	-----	100	-78	-76	-78	-73	-67	-----	100	-	100	
59	Upper Shannon Estuary			No Trend	-14.8225	0.17	-9.22	**Sig decline**	**-454.46**	**0.04**	**-5.84**	-44	-52	-53	-51	-69	-----	100	-67	-76	-78	-53	-50	-----	100	-	100	
60	Lower Shannon Estuary											-51	-54	-51	-49	-61	-----	100	-45	-53	-65	-57	-7	-----	71	-	71	
61	Kinvarra Bay											-35	-44	-55	-55	-63	-----	100	-54	-56	-63	-58	-61	-----	100	-	100	
62	Corrib Estuary			No Trend	-4.75	0.71	-6.91	**Sig decline**	**-278.41**	**0.02**	**-7.73**	-47	-62	-62	-46	-71	-----	100	-60	-62	-54	-54	-81	-----	100	-	100	
63	Inner Galway Bay North											-42	-53	-62	-45	-56	-----	100	-56	-56	-57	-57	-79	-----	100	-	100	
64	Camus Bay											-91	-92	-92	-92	-90	-----	100	-79	-88	-88	-90	-90	-----	100	-	100	
65	Kilkieran Bay											-80	-82	-82	-82	-81	-----	100	-72	-70	-70	-88	-88	-----	100	-	100	
66	Erriff Estuary											-86	-91	-95	-92	-93	-----	100	-73	-73	-72	-74	-83	-----	100	-	100	
67	Killary Harbour											-74	-76	-68	-52	-62	-----	100	-71	-66	-52	-52	-53	-----	100	-	100	
68	Inner Clew Bay											-74	-76	-56	-48	-68	-----	100	-56	-58	-60	-52	-52	-----	100	-	100	
69	Westport Bay											-77	-87	-43	-51	-81	-----	100	-59	-59	-62	-55	-52	-----	100	-	100	
70	Newport Bay											-92	-93	-80	-64	-69	-----	100	-68	-65	-64	-57	-53	-----	100	-	100	
71	Moy Estuary			No Trend	-2.91	0.27	-4.45	**Sig decline**	**-164.38**	**0.04**	**-6.93**	-66	-72	-80	-80	-80	-----	100	-52	-50	-53	-58	-83	-----	100	-	100	
72	Killala Bay											-64	-58	-68	-49	-44	-----	100	-50	-46	-48	-51	-51	-----	100	-	100	
73	Garavoge Estuary											-71	-73	-73	-76	-76	-----	100	-50	-48	-49	-57	-64	-----	100	-	100	
74	Sligo Bay											-70	-70	-63	-63	-62	-----	100	-57	-55	-44	-51	-56	-----	100	-	100	
75	Ballysadare Estuary											-70	-69	-78	-72	-80	-----	100	-51	-49	-44	-58	-83	-----	100	-	100	
76	Erne Estuary			**Sig decline**	**-12.87**	**0.04**	**-8.05**	No Trend	-146.96	0.11	-4.63	-68	-68	-79	-77	-82	-----	100	-33	-50	-25	-33.3333	-50	-----	100	-	100	
77	Inner Donegal Bay											-80	-80	-81	-81	-87	-----	100	-80	-81	-63	-62	-81	-----	100	-	100	
78	Killybegs Harbour											-43	-30	15	-11	-54	--+--	100	-30	-7	40	-7	-13	--+--	84	+	84	
79	McSwyne's Bay											-60	-56	-36	-47	-75	-----	100	-52	-52	-51	-70	-77	-----	100	-	100	
80	Gweebarra Estuary											-92	-91	-92	-96	-97	-----	low	-83	-82	-83	-83	-83	-----	100	-	100	low sample num
81	Gweebarra Bay												-68		-55	-74	- --	100		-76		-51	-52	- --	100	-	100	low sample num
82	Swilly Estuary											-53	-57	-57	-56	-63	-----	100	-57	-57	-57	-57	-57	-----	100	-	100	
83	Lough Swilly											-58	-58	-52	-59	-75	-----	100	-53	-53	-52	-53	-53	-----	100	-	100	

No.	Name	Winter N/P ratio (Redfield N/P = 16)				Direct Effects (II): Maximum and mean chlorophyll a concentration	Area-specific phytoplankton indicator species			Macrophytes including macroalgae	Indirect Effects (III): Oxygen deficiency	o2 Conf	o2 comments	~~Changes/kills in zoobenthos and fish kills~~	Organic carbon/organic matter	Other Possible Effects (IV): Algal toxins (DSP/PSP mussel infection events)		
		0709	1214	Score, 'Trend'		2007-2012	2007-2012	Phyto Confidence	Comments						BOD		Initial Classification	Final Classification
1	Castletown Estuary	63.9		+ v		0.436	0.418	100% mod or worse	Blooms caused mainly by the diatom Asterionellopsis glacialis		FAIL	97	mod 72%				Problem Area	Problem Area
2	Inner Dundalk Bay	49.5		+ v		0.476	0.4	100% mod or worse	Blooms caused mainly by the diatom species especially Asterionellopsis	mod	High	100					Problem Area	Problem Area
3	Outer Dundalk Bay	15.8		- v	-	0.869	1	98.2% Good or better			Good	100					Non-problem area	Non-problem area
4	Boyne Estuary	105.9	41.3	++ v		0.72	0.6	83.3% good or bette	Blooms caused by diatoms species mainly Skeletonema spp.	mod	Good	100	fail for high DO		5.43 Fail		Problem Area	Potential-problem are
5	Boyne Estuary Plume Zone	15.8	11.9	-- v		0.93	0.8	99.5% good or better			High	100	fail for high DO				Non-problem area	Non-problem area
6	Rogerstown Estuary	29.1	48.5	++ ^		0.637	1	81.7% good or better		poor	Good	100	fail for high DO				Problem Area	Problem Area
7	Broadmeadow Water	45.7	86.0	++ ^		0.24	0.4	99.9% mod or worse	Blooms caused by Skeletonema and Chaetoceros spp.		FAIL	100	72% and fail high 160%		6.02 Fail		Problem Area	Problem Area
8	Malahide Bay	34.4	34.8	++ ^	+	0.659	1	83.5% good or better		mod	High	100					Problem Area	Problem Area
9	Northwestern Irish Sea (HA 08)	16.7	20.6	-- ^		1	1	100% good or better			High	100					Non-problem area	Non-problem area
10	Liffey Estuary Lower	68.1	18.5	+- v		1	1	100% good or better			Good	100					Potential-problem ar	Non-problem area
11	Liffey Estuary Upper	24.0	165.6	++ ^		0.77	0.6	82.7% good or bette	Fails due to blooms of Euglenophyceae group and		FAIL	100	66%				Problem Area	Potential-problem are
12	Tolka Estuary	23.1	35.0	-+ ^		1				poor	Good	100	fail for high DO				Problem Area	Problem Area
13	Dublin Bay	15.0	16.7	-- ^		1	1	100% good or better		good	High	100					Potential-problem ar	Potential-problem are
14	Broad Lough	55.2	211.5	++ ^		0.732	0.8	100% good or better			High	100	fail for high DO				Problem Area	Problem Area
15	Avoca Estuary	380.3	748.9	++ ^		1					Good	100	73%				Potential-problem ar	Problem Area
16	Upper Slaney Estuary	318.1	444.4	++ ^		1					High	100					Problem Area	Non-problem area
17	Lower Slaney Estuary	188.0	243.6	++ ^		0.393	0.4	100% moderate or w	Fails due to blooms of both diatoms (Chaetoceros spp. C. closterium) or		High	100	fail for high DO		6 Fail		Problem Area	Problem Area
18	Wexford Harbour	57.4	36.5	++ v	+	0.385	1	61.1% good or better			High	100					Problem Area	Potential-problem are
19	Nore Estuary	221.4	118.8	++ v		0.904	1	99.3% Good or better			High	100					Problem Area	Non-problem area
20	Upper Barrow Estuary	273.9	569.1	++ ^		0.704	1	87.4% good or better			High	100					Problem Area	Problem Area
21	Barrow Nore Estuary Upper	263.5	390.0	++ ^		0.686	1	85.9% good or better			High	100					Problem Area	Non-problem area
22	New Ross Port	241.7	294	++ ^		0.679	1	85.3% good or better			High	100					Potential-problem ar	Potential-problem are
23	Upper Suir Estuary	297.7	400.8	++ ^		0.246	0.8	61.1% moderate or worse			High	100	fail for high DO		4.35 Fail		Problem Area	Problem Area
24	Middle Suir Estuary	259.0	213.3	++ v		0.25	0.6	83.8% moderate or v	Fails due to blooms of Coscinodiscus spp. (20-50um)		Good	98	fail for high DO				Problem Area	Problem Area
25	Lower Suir Estuary (Little Island - Cheekpoint)	162.1	169.5	++ ^							High	100					Problem Area	Non-problem area
26	Barrow Suir Nore Estuary	113.7	77.9	++ v		0.694	1	86.6% good or better			High	100					Potential-problem ar	Non-problem area
27	Waterford Harbour	58.9	23.3	+- v		1	1	100% good or better			High	100	some high values				Non-problem area	Non-problem area
28	Colligan Estuary	178.2	51.8	++ v		0.849				mod	High	100					Problem Area	Problem Area
29	Dungarvan Harbour	32.2	19.4	+- v		1	8	94.7% good or better		good	High	100					Non-problem area	Non-problem area
30	Upper Blackwater M Estuary	252.2	306.9	++ ^		0.829					High	100					Potential-problem ar	Non-problem area
31	Lower Blackwater M Estuary / Youghal Harbour	113.5	143.7	++ ^		0.447	0.8	55.3% good or better		good	High	100					Potential-problem ar	Potential-problem are
32	Youghal Bay	25.4	29.1	++ ^		1	0.8	94.7% good or better		good	High	100					Non-problem area	Non-problem area
33	Lee (Cork) Estuary Upper	201.2	360.3	++ ^		0.852					FAIL	100	48%		7.10545 Fail		Problem Area	Potential-problem are
34	Lee (Cork) Estuary Lower	91.5	67.3	++ v		0.83	0.6	81.9% good or better			FAIL	98	55%				Problem Area	Potential-problem are
35	Lough Mahon	95.7	79.3	++ v		0.702	0.6	83.4% good or better			Good	91					Potential-problem ar	Non-problem area
36	Lough Mahon (Harper's Island)	101.7	79.3	++ v		0.815					FAIL	low	63%, low sample nos				Potential-problem ar	Non-problem area
37	Owenacurra Estuary	291.9	175.6	++ v		0.633	0.6	83.9% good or better			High	100			5.5 Fail		Potential-problem ar	Potential-problem are
38	North Channel Great Island	86.7	49.6	++ v		0.66	0.6	83.8% good or better			Good	100					Potential-problem ar	Problem Area
39	Glashaboy Estuary	377.1	459.1	++ ^		0.851					Good	100			7.111 Fail		Potential-problem ar	Potential-problem are
40	Cork Harbour	73.6	29.5	++ v		0.806	0.6	82.2% good or better	Fails due to diatom blooms		High	100					Non-problem area	Non-problem area
41	Outer Cork Harbour	43.1	22.3	+- v	-	1	0.8	94.7% good or better			High	100					Potential-problem ar	Non-problem area
42	Upper Bandon Estuary	196.6	209.3	++ ^		0.303	0.6	84.1% moderate or w	Fails due to blooms of diatoms and Heterocapsa triquetra blooms		High	100	fail for high DO		7.435 Fail		Problem Area	Problem Area
43	Lower Bandon Estuary	145.3	131.1	++ ^		0.418	0.6	84.5% moderate or w	Fails due to blooms of diatoms and Heterocapsa triquetra blooms		High	100	fail for high DO		5 Fail		Problem Area	Problem Area
44	Kinsale Harbour	21.9	19.6	-- v		1	1	100% good or better			Good	100					Non-problem area	Non-problem area
45	Argideen Estuary	115.2				0.323	0.6	84.2% moderate or worse		poor							Problem Area	Problem Area
46	Ilen Estuary	67.9	43.2	++ v		0.71	0.4	61.6% moderate or w	Fails due to blooms of Skeletonema, Glenodinium, Heterocapsa and		High	99.9					Potential-problem ar	Non-problem area
47	Inner Kenmare River	109.4	37.4	++ v		0.855	0.6	81.5% good or better			High	98					Non-problem area	Non-problem area
48	Kilmakilloge Harbour	48.5	17.9	+- v		1	1	100% good or better			High	100					Non-problem area	Non-problem area
49	Outer Kenmare River	23.9	17.2	-- v		1	0.6	78.4% good or bette	Fails due to diatoms blooms		FAIL	100	probably due to stratification				Non-problem area	Non-problem area
50	Castlemaine Harbour	75.3	16.6	+- v		0.659	0.6	83.8% good or better		high	High	100					Non-problem area	Non-problem area
51	Lee K Estuary	47.4	14.4	+- v		0.851	0.8	100% Good or better			Good	100			4.5 Fail		Potential-problem ar	Non-problem area
52	Inner Tralee Bay	19.7	21.0	-- ^		1	1	100% Good or better		high	High	100					Non-problem area	Non-problem area
53	Upper Feale Estuary	78.2	51.2	++ v		0.746	1	90.8% good or better			FAIL	100	38%		7 Fail		Potential-problem ar	Potential-problem are
54	Cashen	52.2	29.9	++ v		0.945	0.8	99.0% Good or better			Good	100	fail for high DO		5.84 Fail		Potential-problem ar	Potential-problem are
55	Deel Estuary	201.4	46.7	++ v		0.739	1	90.3% good or better			Good	100	fail for high DO				Problem Area	Problem Area
56	Fergus Estuary	85.3	19.4	+- v		1	1	100% good or better			FAIL	100	69%				Potential-problem ar	Non-problem area
57	Maigue Estuary	274.0	71.1	++ v		0.66					FAIL	100	67% also fail high DO				Potential-problem ar	Potential-problem are
58	Limerick Dock	239.8	136.0	++ v		1	1	100% good or better			High	100					Non-problem area	Non-problem area
59	Upper Shannon Estuary	201.2	74.1	++ v		1	1	100% good or better			High	100					Non-problem area	Non-problem area
60	Lower Shannon Estuary	48.9	21.0	+- v		1	1	100% good or better			High	100					Non-problem area	Non-problem area
61	Kinvarra Bay	45.6	40.9	++ v		0.711	0.6	83.3% good or bette	Fails due to diatom and dinoflagellate blooms		High	100			5.63 Fail		Potential-problem ar	Potential-problem are
62	Corrib Estuary	40.6	61.9	++ ^		1	0.6	78.4% good or bette	Fails due to mainly Chaetoceros spp. Blooms		High	100					Non-problem area	Non-problem area
63	Inner Galway Bay North	41.3	50.9	++ ^		1	0.6	78.4% good or bette	Fails due to mainly Chaetoceros spp. Blooms		Good	100					Non-problem area	Non-problem area
64	Camus Bay	24.0	26.5	-+ ^		1	1	100% good or better			High	100					Non-problem area	Non-problem area
65	Kilkieran Bay	18.0	22.1	-- ^		1	1	100% good or better			High	100					Non-problem area	Non-problem area
66	Erriff Estuary	28.0	26.5	++ v		1	1	100% good or better			High	100					Non-problem area	Non-problem area
67	Killary Harbour	14.9	22.1	-- ^		0.927	0.8	99.6% good or better			Good	100					Non-problem area	Non-problem area
68	Inner Clew Bay	8.9	13.5	-- ^		1	1	100% good or better			High	100					Non-problem area	Non-problem area
69	Westport Bay	8.8	7.7	-- v		1	0.6	78.4% good or better			High	100					Non-problem area	Non-problem area
70	Newport Bay	10.3	14.9	-- ^		1	0.8	94.7% good or better			High	100					Non-problem area	Non-problem area
71	Moy Estuary	45.4	112.8	++ ^		0.716	0.6	83.3% good or better		mod	High	100					Potential-problem ar	Potential-problem are
72	Killala Bay	31.1	19.4	+- v		1	0.6	78.4% good or better			FAIL	100	72%				Potential-problem ar	Non-problem area
73	Garavoge Estuary	16.9	31.1	-+ ^		0.902	0.6	80.7% good or better			High	100					Non-problem area	Non-problem area
74	Sligo Bay	14.0	18.8	-- ^		1	0.6	78.4% good or better		good	High	100					Non-problem area	Non-problem area
75	Ballysadare Estuary	29.0	70.8	++ ^		0.671	0.6	83.7% good or better		good	High	100					Non-problem area	Non-problem area
76	Erne Estuary	47.3	34.6	++ v		1	0.6	78.4% good or better			High	100					Potential-problem ar	Potential-problem are
77	Inner Donegal Bay	37.6	28.8	++ v		1	0.6	78.4% good or better			High	98.7					Non-problem area	Non-problem area
78	Killybegs Harbour	14.4	13.3	-- v		0.927	0.6	80.1% good or better			FAIL	100	60%				Problem Area	Problem Area
79	McSwyne's Bay	17.7	24.3	-+ ^		0.915	1	99.5% good or better			FAIL	100	62%, natural stratifictaion				Non-problem area	Non-problem area
80	Gweebarra Estuary	11.0	15.5	-- ^		1	0.6	78.4% good or better		high							Non-problem area	Non-problem area
81	Gweebarra Bay	22.1	13.8	-- v		0.775	1	92.9% good or better			FAIL	98.8	73%				Non-problem area	Non-problem area
82	Swilly Estuary	35.4	20.1	+- v		0.167	0.4	99.0% moderate or v	Fails due to diatoms blooms and Heterocapse triquetra blooms		High	100	fail on high DO		5 Fail		Problem Area	Problem Area
83	Lough Swilly	19.9	12.2	-- v		0.93	0.8	99.5% good or better			High	100					Non-problem area	Non-problem area

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