Rialtas na hÉireann
Government of Ireland

Marine Strategy Framework Directive 2008/56/EC

Article 17 update to Ireland's Marine Strategy Part 1: Assessment (Article 8), Determination of Good Environmental Status (Article 9) and Environmental Targets (Article 10)

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Abbreviations

BIM	Bord Iascaigh Mhara
Cd	Cadmium
CEMP	Coordinated Environmental Monitoring Programme
CFP	Common Fisheries Policy
CICES	Common International Classification of Ecosystem Services
CSO	Central Statistics Office
DAFM	Department of Agriculture, Food and the Marine
DCCAE	Department of Communications, Climate Action and Environment
DCF	Data Collection Framework
DCHG	Department of Culture, Heritage and the Gaeltacht
DHPLG	Department of Housing, Planning and Local Government
DIN	Dissolved Inorganic Nitrogen
DIP	Dissolved Inorganic Phosphorus
DTTAS	Department of Transport, Tourism and Sport
EAC	Environmental Assessment Criteria
EC	European Commission
ED	Electoral District
EPA	Environmental Protection Agency
EQS	Environmental Quality Standards
EQSw	Environmental Quality Standards for other Surface Water
EEZ	Exclusive Economic Zone
ESA	Economic and Social Analysis
EU	European Union
FTE	Full Time Equivalent
FMSY	Fishing mortality rate that can produce Maximum Sustainable Yield
GDP	Gross Domestic Product
GES	Good Environmental Status
GVA	Gross Value Added
HD	Habitats Directive
Hg	Mercury
IBTS	International Bottom Trawl Surveys
ICES	International Council for the Exploration of the Sea
ICG ML	OSPAR Intersessional Correspondence Group on Marine Litter
IFI	Inland Fisheries Ireland
IMO	International Maritime Organisation
INFOMAR	Integrated Mapping for the Sustainable Development of Ireland's Marine Resource
INSPIRE	Infrastructure for Spatial Information in the European Community
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change

JRC	Joint Research Council
MI	Marine Institute
MPAs	Marine Protected Areas
MSFD	Marine Strategy Framework Directive
MSP	Marine Spatial Planning
MSY	Maximum Sustainable Yield
NIS	Non-Indigenous Species
NMPF	National Marine Planning Framework
NPWS	National Parks and Wildlife Service
NUTS	Nomenclature of Territorial Units for Statistics
NIUG	National University of Ireland Galway
OSPAR	Convention for the Protection of the Marine Environment of the Northeast Atlantic
PAH	Polyaromatic Hydrocarbons
Pb	Lead
PBDE	Polybrominated diphenylethers
PCB	Polychlorinated biphenyls
PCDD	Polychlorinated dibenzo-p-dioxins
PCDD/F	Polychlorinated dibenzofurans
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SAPS	Small Area Population Statistic
SEEA	System of Environmental-Economic Accounting
SEMRU	Socio-Economic Marine Research Unit
SEMS	Seafood Environmental Management System
SI	Statutory Instrument
SROCC	Special Report on the Ocean and Cryosphere in a Changing Climate
SUP	Single Use Plastic
SSB	Spawning Stock Biomass
SWAN	Sustainable Water Network
TACs	Total Allowable Catches
TBT	Tributyltin
TG	Technical Group
TGML	Technical Group on Marine Litter
UN	United Nations
VDSI	Vas Deferens Sequence Index
WFD	Water Framework Directive

This Document

This document is an update to Part 1 of Ireland's Marine Strategy: Assessment (Article 8), Determination of Good Environmental Status (Article 9) and Environmental Targets (Article 10) under the Marine Strategy Framework Directive. It contains summaries of the assessments, determination of GES and revised environmental targets for each of the 11 qualitative descriptors from Annex I of the Directive. It also contains a socio-economic assessment. The appendix to the document contains the detailed assessment sheets for the descriptors and criteria. The update has been informed by the feedback received from the public consultation held from December 2019-February 2020.

The Department of Housing, Planning and Local Government is responsible for the preparation of the Marine Strategy for MSFD and the National Marine Planning Framework (NMPF) on behalf of Government, with input from other Departments and Agencies.

Acknowledgements

This document and its assessments are the result of ongoing engagement and co-operation between the following bodies:

- Department of Housing, Planning and Local Government (DHPLG);
- Department of Agriculture, Food and Marine (DAFM);
- Department of Communications, Climate Action and Environment (DCCAE);
- Department of Culture, Heritage and the Gaeltacht - National Parks and Wildlife Service (DCHG – NPWS);
- Department of Transport, Tourism and Sport – Irish Coast Guard (DTTAS-ICG);
- Environmental Protection Agency (EPA);
- Marine Institute (MI);
- Inland Fisheries Ireland (IFI);
- Food Safety Authority of Ireland (FSAI);
- Bord Iascaigh Mhara (BIM);
- Sustainable Water Network (SWAN);
- Socio-Economic Marine Research Unit (SEMRU);
- Coastwatch.

Context

The Marine Strategy Framework Directive (MSFD) requires European Union member states, including Ireland, to achieve or maintain good environmental status (GES) in the marine environment by the year 2020 at the latest. Good environmental status in the marine environment means that the seas are clean, healthy and productive, and that human use of the marine environment is kept at a sustainable level. In this way, the achievement of GES supports the objectives of Marine Spatial Planning (MSP) and in particular, of the National Marine Planning Framework (NMPF). The assessment of the status of the marine environment and the determination of the characteristics of GES, including threshold values and environmental targets, inform decisions about how to use marine resources sustainably.

Annex I of the Directive outlines 11 qualitative descriptors for determining GES under Article 9 of the Directive. The descriptors cover a range of pressures on, and the state of, the marine environment. The details of the predominant pressures and the human activities associated with them are set out in the annexes of the Directive (as amended) and are incorporated into the assessments in this document. The descriptors and associated criteria play an important role in not only the determination of GES, but also the setting of environmental targets, monitoring programmes and the programme of measures.

Table 1: Qualitative descriptors for determining GES (from MSFD Annex I).

	Common name	MSFD Annex I
D1	Biodiversity	Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.
D2	Non-indigenous species (NIS)	Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.
D3	Commercial fish and shellfish	Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock.
D4	Food webs	All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.
D5	Eutrophication	Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters.
D6	Sea-floor integrity	Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.
D7	Hydrographical conditions	Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.
D8	Contaminants	Concentrations of contaminants are at levels not giving rise to pollution effects.
D9	Contaminants in seafood	Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards.
D10	Marine Litter	Properties and quantities of marine litter do not cause harm to the coastal and marine environment.
D11	Energy, including underwater noise	Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.

MSFD Area

The Irish Maritime Area covered by the Marine Strategy Framework Directive measures 488,762 km^2. This is the same area used for Ireland's draft National Marine Planning Framework and it incorporates the Exclusive Economic Zone (EEZ), the Territorial Sea and an area of continental shelf that extends beyond 200 nautical miles into a region abutting the Porcupine Abyssal Plain.

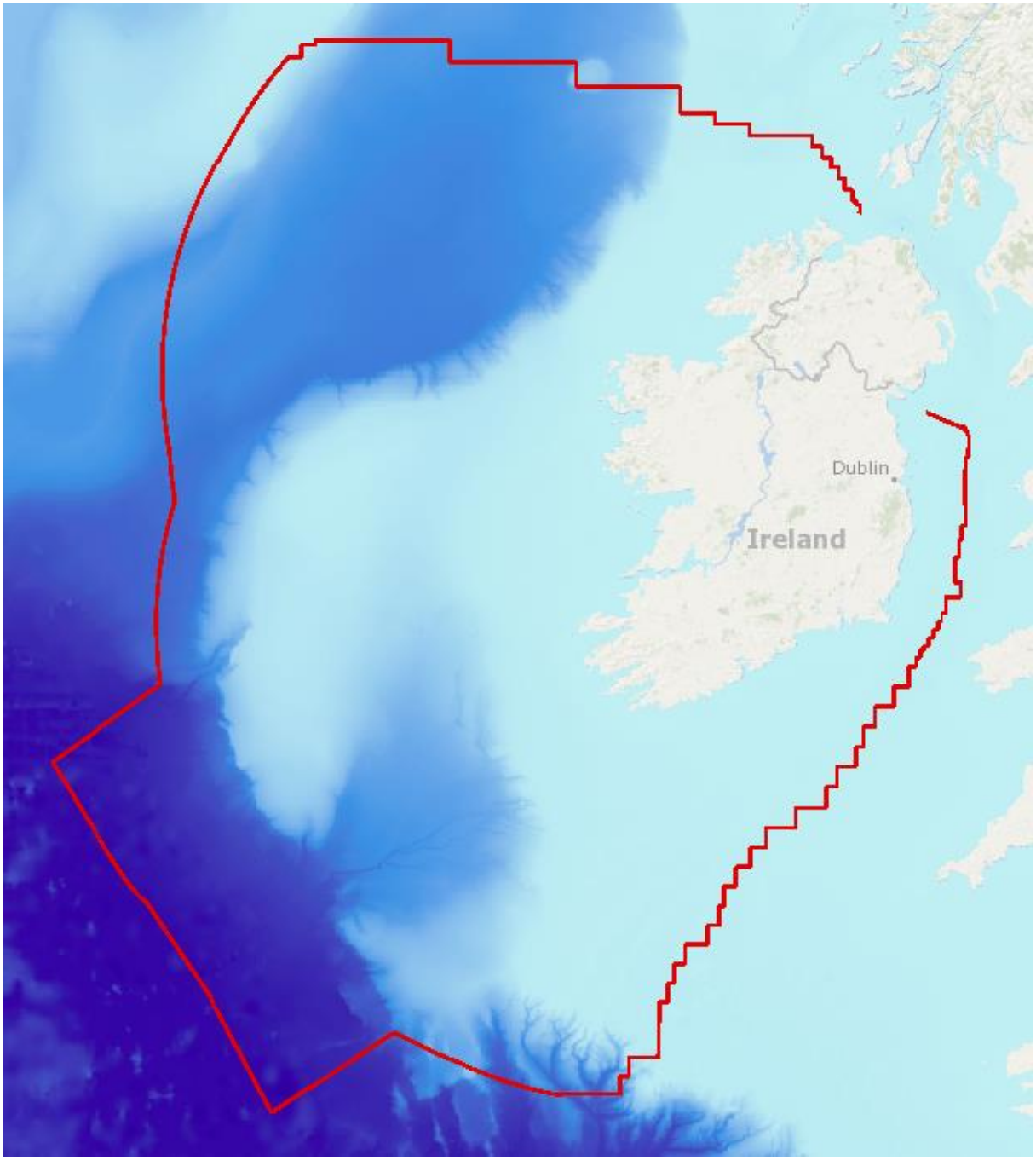

Figure 1: Maritime Area applicable for the Marine Strategy Framework Directive. (https://atlas.marine.ie/)

MSFD Timeline

The Directive is implemented in six year cycles with periodic reporting every two years.

2008
- Marine Strategy Framework Directive adopted on 17 June 2008
- Achieve or maintain good environmental status (GES) in the marine environment by the year 2020 at the latest

2011
- May 2011: Direcrtive transposed in to Irish law under S.I. 249 of 2011
- Work on cycle 1 commences: six year implementation cycle covering different stages every two years with a reporting commitment to the EU Commission. Each stage in the cycle includes a public consultation process.

2013
- April 2013: Marine Strategy Part 1: The Initial Assessment of the condition of the marine environment was completed and reported.
- This incorporated an Assessment of the Marine Environment (Article 8), Determination of Good Environmental Status (Article 9) and Establishing Environmental Targets and Indicators (Article 10)

2015
- March 2015: Marine Strategy Part 2: The Monitoring Programmes (Article 11) were developed and reported.

2016
- July 2016: Marine strategy Part 3: Programmes of Measures (Article 13) were developed and reported.
- November 2016: Agreement between member States and EU Commission on revised Commission Decision and ammending Directive (Commission Decision (EU) 2017/848 & Commission Directive (EU) 2017/845 both of 17 May 2017)

2019 -2020
- **We are here**
- April 2019: Cycle 2 work commences to update Marine Strategy Part 1: revise the 2013 Initial Assessment incorporating newly established criteria, elements and methodological standards as set out in the Commission Decision (EU) 2017/848 and the amending Commission Directive (EU) 2017/845.
- December 2019: Draft published for public consultation including new envrionmental targets and determination of Good Envrionmental Status
- June 2020: Finalisation and publication of assessment, determination of GES and new envrionmental targets.

2021
- Next steps
- Update Marine Strategy Part 2: Monitoring Programme

2022
- Next steps
- Update Marine Strategy Part 3: Programme of Measures

2023
- Next steps
- Review of the Directive by EU Commission
- Publication of OSPAR Quality Status Report to support Cycle 3 due in 2024

Commission Decision

During the implementation of the first cycle of the MSFD, it was recognised that it was necessary to improve coherence and consistency in delivery under the Directive. To this end and in cooperation with Member States the EU Commission developed a clearer, simpler set of good environmental status criteria and methodological standards to ensure coherence and consistency of implementation. The results of this work were:

- Commission Decision (EU) 2017/848 of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU. Referred to as the Commission Decision 2017/848.
- Commission Directive (EU) 2017/845 of 17 May 2017 amending Directive 2008/56/EC of the European Parliament and of the Council as regards the indicative lists of elements to be taken into account for the preparation of marine strategies.

The Commission Decision sets out a clearer framework across each of the descriptors for criteria, criterial elements, methodological standards and where appropriate, threshold values. These criteria and methodological standards are used to determine a set of characteristics for good environmental status and the extent to which good environmental status is achieved or maintained.

The Commission Decision 2017/848 divides criteria between primary and secondary criteria.

- Primary criteria are used to carry out updates of the assessments under Article 8 of the Directive. In situations where the primary criteria are not used the Member State must justify this approach.
- Secondary criteria are used to compliment the primary criteria or when the marine environment is at risk of not achieving or maintaining good environmental status for that criterion.

The Commission Decision explains different concepts to improve coherence in implementation as follows:

Criteria	Distinctive technical features that are closely linked to the qualitative descriptors.
Criteria Elements	Constituent elements of the ecosystem (species, habitats and their communities) or aspects of pressure on the marine environmental (substances, litter, Non-indigenous Species) which are assessed under each criteria.

Environmental Target	A qualitative or quantitative statement on the desired condition of the different components of, and pressures and impacts on, marine waters in respect of the marine region or subregion.
Threshold Values	A value or range of values that allows for an assessment of the quality level achieved for a particular criterion, thereby contributing to the assessment of the extent to which good environmental status is being achieved. Threshold values can form one of the characteristics of GES but are not considered in themselves to be a definition of GES.

To the greatest extent possible, Ireland has adopted the Commission Decision and amending Directive in the updating of Part 1 of its Marine Strategy.

Other EU Legislation

One of the aims of the Directive is to provide coherence and integration between EU legislative measures that have a role to play in protecting the marine environment. Where relevant, data and outputs from the following Directives, policies and regulations have been incorporated in the assessments used in this document:

- Urban Waste Water Treatment Directive 91/271/EEC
- Habitats Directive 92/43/EEC
- Water Framework Directive 2000/60/EC
- Environmental Information Directive 2003/4/EC
- Bathing Water Directive 2006/7/EC
- Infrastructure for Spatial Information in the European Community INSPIRE Directive 2007/2/EC
- Birds Directive 2009/147/EC
- Common Fisheries Policy and associated regulations
- Waste Framework Directive 2008/98/EC
- Invasive Alien Species EU Regulation 1143/2014
- Commission Regulation (EC) No 1881/2006 setting maximum levels for certain contaminants in foodstuffs
- Single Use Plastics Directive 2019/904/EU

Regional Cooperation

The Directive requires that GES is determined at the level of the marine regions or subregions, which in the case of Ireland is the Celtic Seas subregion. This subregion is shared with France and the UK and cooperation takes place through the OSPAR Commission. Where OSPAR assessments or methodologies are relevant for the descriptors evaluated in this document, these have been incorporated into the

assessments undertaken. Aspects of the work for MSFD which include OSPAR Assessments or data Ireland reports to OSPAR are outlined in Table 2.

Table 2: OSPAR related assessments and data used for the Article 17 update.

Descriptor	OSPAR Related Assessments and Data
Non Indigenous Species (Descriptor 2)	Intermediate Assessment 2017 used for comparative assessment to Ireland's MSFD assessment.
Elements of Marine Food Webs (Descriptor 4)	The assessment of plankton communities as part of this Descriptor followed methods set out for OSPAR Common Indicators PH1/FW5 and PH2. The fish assessment used the OSPAR Common Indicator methodology regarding mean maximum length of fish.
Eutrophication (Descriptor 5)	Eutrophication status assessment of the maritime area used the OSPAR Common Procedure. The most recent OSPAR assessment from 2009 to 2014 was incorporated.
Sea-floor Integrity (Descriptor 6)	The assessment of the extent of physical disturbance to benthic habitats from bottom-contact fishing activity followed the methods set out for OSPAR Common Indicator BH3.
Hydrographical Conditions (Descriptor 7)	The annual dredging assessment data reported to OSPAR and used in the Intermediate Assessment 2017 was incorporated.
Contaminants (Descriptor 8)	The data collected for the OSPAR Coordinated Environmental Monitoring Programme (CEMP), OSPAR Environmental Assessment Criteria (EAC) and OSPAR Background Assessment Criteria (BAC) were used for this assessment
Marine Litter (Descriptor 10)	The OSPAR Beach Litter survey data and methodology were used to assess the impact of litter on the coastline.
Underwater Noise (Descriptor 11)	The Irish data reported to the OSPAR Impulsive Nosie Register was used for this assessment. Comparative evaluation against data for other OSPAR Regions was also included.

Public Consultation

Public consultation plays an important role in the ongoing implementation of the Directive. Article 19 of the Directive sets out the requirements for consultation with the public and interested parties at various stages in the implementation cycle.

The Draft of this document was issued for public consultation on 20th December 2019; this consultation was open for submissions until 28th February 2020. Print advertisements were placed in the national newspapers: Irish Independent, Irish Times, Irish Examiner, The Star and An Seachtain, publicising the ongoing consultation process. Advertisements were placed on www.Afloat.ie and www.InshoreIreland.com

The consultation was hosted on the Department's website. The Department of Communications, Climate Action and Environment (DCCAE) hosted a web link to the MSFD consultation page and the Sustainable Water Network (SWAN) hosted an information page on MSFD and incorporated a link to the Department's consultation page.

During the consultation period, the Department publicised the consultation through its Facebook and Twitter accounts, while SWAN regularly tweeted about MSFD and the consultation. Face-to-face presentations on the work were also made to An Fóram Uisce (The Water Forum) and the Irish Environmental Network.

Submissions were received from:

1. An Fóram Uisce
2. Irish Offshore Operators' Association (IOOA)
3. An Taisce
4. Bord Iascaigh Mhara (BIM)
5. Sustainable Water Network (SWAN)
6. IFA Aquaculture
7. DP Energy
8. Irish Wildlife Trust (IWT)
9. Inland Fisheries Ireland (IFI)
10. Irish Whale and Dolphin Group (IWDG)
11. Galway-Mayo Institute of Technology (GMIT)
12. Department of Agriculture, Food and the Marine (DAFM)
13. Wild Ireland Defence CLG
14. Irish Wind Energy Association (IWEA)
15. Irish Water
16. Irish Environmental Network (IEN)
17. Killybegs Fishermen's Organisation
18. Irish Islands Marine Resource Organisation (IIMRO)
19. Dungarvan Shellfish Limited
20. Wild Ocean
21. Woodstown Bay Shellfish Ltd
22. Udarás na Gaeltachta
23. Private Individual

The submissions were evaluated and where relevant updates have been made to this document based on issues raised. A separate report on the public consultation will also be published.

Climate Change

Climate change is one of many pressures that have an impact on marine ecosystems. The Special Report by the Intergovernmental Panel on Climate Change (IPCC) on Ocean and Cryosphere in a Changing Climate, released in September 2019, makes it clear that further changes are ahead. Public perception equates climate change to rising sea levels, warmer and more acidic seas and the disappearance of habitats and biodiversity. The MSFD aims to manage the pressures affecting the marine environment but is currently less clear on climate change. Climate change is considered

in the preamble to the Directive and it notes that the determination of GES “may have to be adapted over time in view of climate change” amongst others.

However, climate change is not listed in the 2017 Annex III to the Directive as one of the pressures or human activities affecting, or in the marine environment required to be assessed. Although the MSFD takes existing climatic factors into account, it does not integrate climate change or explain how climate change should be tackled in marine strategies. Further work is required to consider how this pressure can be integrated into the Directive. An opportunity exists to address this in the context of the review of the Directive due by July 2023.

Within the Northeast Atlantic, the OSPAR Commission intends to address climate change as one of the draft objectives of its forthcoming North-East Atlantic Environment Strategy 2020-2030, to be adopted in 2021. The OSPAR Quality Status Report to be published in 2023 will contain assessments on ocean acidification and further work on cumulative effects.

At a global level, work on climate change has started through the IPCC Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Global Assessment Report on Biodiversity and Ecosystem Services, published in May 2019. This work will continue through the 2021 UN Climate Change Conference (UNFCCC COP 26) and other forums.

Summary

Key facts that emerge from this updated assessment under the MSFD include the following.

Good Environmental Status

1) Ireland has undertaken a more rigorous and more inclusive assessment of the state of its marine environment, building substantially on its Initial Assessment in 2013.
2) Ireland's approach to the assessment of environmental status, the establishment of clear environmental targets and the setting of threshold values has progressed significantly in the intervening period; this includes closer alignment overall with the requirements of EU decisions on MSFD implementation laid down in 2017.
3) Almost half of the 11 qualitative descriptors for determining Good Environmental Status (GES) have fully achieved GES and are highlighted in in Table 3.
4) Of the remaining six descriptors, two have fully achieved GES for the primary criteria assessed (highlighted in). Lack of data and methodologies has prevented assessment of other primary criteria. Three have also partially achieved GES (highlighted in) due to different results for key elements assessed within descriptors (e.g. variation in pressure-related impacts on individual marine habitats or species).
5) The environmental status of marine food webs in Ireland's maritime area is currently unknown (highlighted in).

A brief synopsis of the status of individual descriptors in relation to their achievement of Good Environmental Status is detailed in Table 3.

Environmental Targets

The first cycle of implementation established 24 environmental targets covering all descriptors. This update to the Irish Marine Strategy has led to 25 revised environmental targets. These revised targets now align more closely with the requirements of the Birds and Habitats Directives, the Water Framework Directive, the Common Fisheries Policy and in turn with the criteria in the Commission Decision 2017/848. This revision has resulted in 10 biodiversity targets; a move from 4 to 2 commercial fisheries targets and from 8 to 3 eutrophication targets; and an increase in targets for contaminants from 3 to 4. The revised targets are described in the summary of each descriptor below.

Table 3: Status of descriptors.

Descriptor	Common name	Achievement of Good Environmental Status (GES)
Descriptor 1	Biodiversity	Ireland has achieved GES for some elements of biological diversity within its maritime area (e.g., the majority of larger marine vertebrates assessed in 2019). For other elements (e.g. marine reptiles and 41% of non-commercial fish species assessed) the environmental status is currently unknown, while in the case of some elements (i.e. 18 of 56 non-commercial fish species assessed) GES has not been achieved.
Descriptor 2	Non-indigenous species (NIS)	Ireland has achieved GES within its maritime area for non-indigenous species. There have been three newly introduced species identified in Ireland's maritime area during the assessment period 2013-2018. While there are no established threshold values for this criterion at present, this number of introductions is considered low based on expert judgement and is comparable with the numbers of new NIS described in the OSPAR Intermediate Assessment (2017).
Descriptor 3	Commercial fish and shellfish	A total of 34 stocks (18%) have achieved GES, while the environmental status of 99 stocks (60%) is currently unknown. In the case of 44 other stocks (22%), GES has not been achieved.
Descriptor 4	Food webs	The environmental status of Ireland's marine food webs is currently unknown. There was evidence that components of the food webs are changing but it was not clear how they are affecting each other or the extent to which this is due to anthropogenic influence or associated pressures.
Descriptor 5	Eutrophication	Ireland has achieved GES for eutrophication within its maritime area, for the three primary criteria assessed; nutrients, chlorophyll a and dissolved oxygen.
Descriptor 6	Sea-floor integrity	Ireland has achieved GES for some elements of sea-floor integrity within its maritime area (e.g. under criteria for physical loss of the seabed). For other elements (i.e. criteria for physical disturbance to the seabed), the environmental status is currently unknown.
Descriptor 7	Hydrographical conditions	Ireland has achieved GES for the spatial extent and distribution of permanent hydrographical changes within its maritime area.
Descriptor 8	Contaminants	Ireland has achieved GES for concentrations of contaminants within its maritime area, for the criteria assessed which are contaminants in water and biota, acute pollution events and biological effects of contaminants. There are threshold values associated with the concentrations of contaminants and biological effects. There is no threshold value for acute pollution events.
Descriptor 9	Contaminants in seafood	Ireland has achieved GES for concentrations of contaminants in fish and seafood for human consumption within its maritime area.
Descriptor 10	Marine Litter	Ireland has achieved GES for the amount of litter on coastlines with the median number of litter items ≥2.5cm found on beaches in quarterly surveys between 2013 and 2018 decreasing from 73.5 items per 100 metres in 2013, to 46 items per 100 metres in 2018.
Descriptor 11	Energy, including underwater noise	Ireland has achieved GES for the anthropogenic impulsive sound element of underwater noise. The level of impulsive underwater noise causing activities within Ireland's maritime area were low overall during the assessment period of 2016-2018.

Biodiversity (Descriptors 1, 4 & 6)

Biological Diversity (Descriptor 1)

The 2013 Initial Assessment of Ireland's maritime area did not include several ecosystem elements within wider marine biological diversity. The current updated assessment was carried out in respect of the original Directive and newly established criteria, elements and methodological standards set out in Commission Decision (EU) 2017/848 and amending Commission Directive (EU) 2017/845.

This more comprehensive assessment under MSFD Articles 8, 9 and 10, has incorporated new assessment information and has established Environmental Targets for important representative species of marine birds, mammals, reptiles and non-commercially-exploited fish species. It has also set out Threshold Values for relevant criteria elements (e.g. species or groupings) where possible.

A key finding of the assessment is that Ireland has achieved GES for some elements of biological diversity within its maritime area (e.g., the majority of larger marine vertebrates assessed in 2019). For other elements (e.g. marine reptiles and 41% of non-commercial fish species assessed) the environmental status is currently unknown, while in the case of some elements (i.e. 18 of 56 non-commercial fish species assessed) GES has not been achieved.

Ireland has now established the following environmental targets for a set of essential faunal elements of biological diversity, namely:

a) Non-commercially-exploited species of fish;
b) Marine reptiles;
c) Marine birds;
d) Marine mammals.

Environmental Target D1T1: The mortality rate per species from incidental by-catch is below levels which threaten the species, such that its long-term viability is ensured.

Environmental Target D1T2: The population abundance of the species is not adversely affected due to anthropogenic pressures, such that its long-term viability is ensured.

Environmental Target D1T4: The species distributional range and, where relevant, pattern is in line with prevailing physiographic, geographic and climatic conditions.

Environmental Target D1T5: The habitat for the species has the necessary extent and condition to support the different stages in the life history of the species.

Elements of Marine Food Webs (Descriptor 4)

Progress towards the achievement of Good Environmental Status (GES) was assessed for elements of the marine food webs within the "Celtic Seas ecoregion", which incorporates the Irish maritime area. The assessment followed OSPAR Common Indicator methodologies and concentrated on three trophic guilds: phyto-plankton; zoo-plankton; and fish species. Due to current limitations around methods, data availability and integration models, higher trophic guilds (e.g. marine birds, mammals, other top predators) were not included in this assessment.

A key finding of the assessment was that the environmental status of Ireland's marine food webs is currently unknown. There was evidence that components of the food webs are changing but it was not clear how they are affecting each other or the extent to which this is due to anthropogenic influence or associated pressures. Marine food webs are complex systems to gather detailed information on and to interpret with scientific accuracy. This is particularly the case in Ireland's diverse and variable marine environment.

In the light of Commission Decision (EU) 2017/848 and amending Commission Directive (EU) 2017/845, Ireland has now established the following environmental targets for elements of marine food webs:

Environmental Target D4T1: The diversity (species composition and their relative abundance) of the trophic guild is not adversely affected due to anthropogenic pressures.

Environmental Target D4T2: The balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures.

There are currently no established threshold values for elements of marine food webs and the development of regional or sub-regional threshold values has not yet been undertaken.

Sea-floor Integrity (Descriptor 6)

This assessment was undertaken at the level of benthic broad habitat types listed under Commission Decision 2017/848 and occurring within Ireland's maritime area. The evaluation of the physical disturbance criterion was confined to Ireland's portion of OSPAR Region III (i.e. continental shelf area to the east, south and west of Ireland) due to limited information on benthic habitats, associated biological communities and anthropogenic pressures occurring within OSPAR Region V.

A key finding of the assessment is that Ireland has achieved GES for some elements of sea-floor integrity within its maritime area (e.g. under criteria for physical loss of the seabed). For other elements (i.e. criteria for physical disturbance to the seabed), the environmental status is currently unknown.

Permanent loss of seabed habitat across Ireland's maritime area was found to be lower than any potential threshold value at either a national or an international level. Loss of benthic habitat was calculated to be substantially less than 0.5% of the total sea-floor within Ireland's maritime area. The analysis of physical disturbance to seabed habitats, from international fishing-driven pressures quantifiable for the years 2010-2015, showed such disturbance to be widespread. It occurred in approximately 64,865 km^2 of the Irish portion of OSPAR Region III, or at least 13% of the overall maritime area.

Ireland has now established the following environmental targets for sea-floor integrity:

Environmental Target D6T1: The spatial extent and distribution of physical loss (permanent change) of the natural seabed is at a level that ensures that the structure and functions of the ecosystems, and benthic ecosystems, in particular, are not adversely affected

Environmental Target D6T2: The spatial extent and distribution of physical disturbance pressures on the seabed is at a level that ensures that the structure and functions of the ecosystems, and benthic ecosystems, in particular, are not adversely affected.

Environmental Target D6T4: The extent of loss of the habitat type, resulting from anthropogenic pressures, does not exceed a specified proportion of the natural extent of the habitat type in the assessment area.

Environmental Target D6T5: The extent of adverse effects from anthropogenic pressures on the condition of the habitat type, including alteration to its biotic and abiotic structure and its functions, does not exceed a specified proportion of the natural extent of the habitat type in the assessment area.

Although all benthic broad habitat types specified in the Decision were subject to assessment, threshold values for sea-floor integrity and for individual criteria or habitat types have yet to be developed and established. This work is taking place cooperatively at an EU and member state level through a technical working group on seabed habitats TG Seabed.

Populations of Commercial Fish and Shellfish (Descriptor 3)

In relation to populations of all commercially-exploited fish and shellfish species, the status of 177 stocks within Ireland's maritime area was assessed. The assessment also included important commercially-exploited crustacean species (e.g. prawn, shrimp and edible crab). It did not include cephalopod species or some species of coastal fish since the necessary biological information and data collection schemes to support such assessments are not currently in place.

A key finding of the assessment is that a total of 34 stocks (18%) have achieved GES, while the environmental status of 99 stocks (60%) is currently unknown. In the case of 44 other stocks (22%), GES has not been achieved.

A direct comparison with Ireland's initial assessment for the same 52 stocks considered in 2013 showed a 70% improvement in the number of stocks that have achieved GES, with an almost 70% reduction in the number of stocks whose environmental status is unknown. There has been a notable and substantial improvement in fishing mortality, assessed under criterion D3C1 set out in Commission Decision 2017/848. Of the commercially-exploited stocks that were assessed in both cycles, there was an 80% improvement in stocks meeting the requirement for the achievement of GES under this criterion.

The environmental targets from the Initial Assessment have now been replaced in light of Commission Decision (EU) 2017/848 and amending Commission Directive (EU) 2017/845. Ireland has now established the following environmental targets, based on the revised Common Fisheries Policy Regulation (EU) 1380/2013, which stipulates that "in order to reach the objective of progressively restoring and maintaining populations of fish stocks above biomass levels capable of producing maximum sustainable yield, the maximum sustainable yield exploitation rate shall be achieved by 2015 where possible and, on a progressive, incremental basis at the latest by 2020 for all stocks".

Environmental Target D3T1: The Fishing mortality rate of populations of commercially exploited species is at or below levels which can produce the maximum sustainable yield (MSY).

Environmental Target D3T2: The Spawning Stock Biomass of populations of commercially-exploited species are above biomass levels capable of producing maximum sustainable yield (MSY).

The threshold value for the proportion of stocks required to be achieving GES is 100% following the Common Fisheries Policy Regulation (EU) 1380/2013.

Non-Indigenous Species (Descriptor 2)

Ireland assessed the status of the marine environment against the primary criterion set out in the Commission Decision: the number of non-indigenous species, which are newly introduced via human activity into the wild, per assessment period, is minimised and where possible reduced to zero.

Ireland has achieved Good Environmental Status within its maritime area for non-indigenous species. There have been three newly introduced species identified in Ireland's maritime area during the assessment period 2013-2018. While there are no established threshold values for this criterion at present, this number of introductions is considered low based on expert judgement and is comparable with the numbers of new NIS described in the OSPAR Intermediate Assessment (2017).

The two secondary criteria were not assessed as Ireland is not at risk of failing to achieve or maintain GES for this descriptor.

Ireland has updated its 2013 environmental target for NIS with a new target aligned to the primary criterion for this descriptor.

Environmental target D2T1: The number of non-indigenous species which are newly introduced via human activity into the wild, per assessment period is minimised and where possible reduced to zero.

Eutrophication (Descriptor 5)

Ireland assessed the status of the marine environment against the three primary criteria set out in the Commission Decision: nutrients; chlorophyll a and dissolved oxygen, with the threshold values for these criteria based on the Water Framework Directive for inshore waters and estuaries and OSPAR for the wider MSFD area.

Ireland has achieved Good Environmental Status for eutrophication within its maritime area, for the three primary criteria assessed; nutrients; chlorophyll a and dissolved oxygen.

This assessment has shown that the areas considered at risk of eutrophication are located inshore, predominantly along the eastern, south eastern and southern coasts. The coastal and offshore areas show no indications of eutrophication and trend analysis shows no change in nutrient levels of Ireland's marine waters. Overall, the proportion of Ireland's maritime area that is classified as a problem area with regard to eutrophication is 286 km^2 or 0.05% of the maritime area and is restricted to estuarine and nearshore coastal waters. These areas fall under the remit of the WFD which has established

programmes of measures to ensure that the environmental objectives that have been set for these waters are met.

The five secondary criteria were not assessed because Ireland is not at risk of failing to achieve or maintain GES for this descriptor.

Ireland has updated its 2013 environmental targets for Eutrophication with targets aligned to the primary criteria for this descriptor.

The updated targets are:
Environmental target D5T1: Nutrient concentrations are not at levels that indicate adverse eutrophication effects.

Environmental target D5T2: Chlorophyll a concentrations are not at levels that indicate adverse effects of nutrient enrichment.

Environmental target D5T5: The concentration of dissolved oxygen is not reduced, due to nutrient enrichment.

Hydrographical Conditions (Descriptor 7)

Ireland assessed the status of the marine environment against one of the criterion set out in the Commission Decision: the spatial extent and distribution of permanent alteration of hydrographical conditions to the seabed and water column.

Ireland has achieved Good Environmental Status for the spatial extent and distribution of permanent hydrographical changes within its maritime area.

There are currently no threshold values associated with hydrographical conditions. However, the level of activities causing hydrographical changes to the seabed and water column within Irelands maritime area were very low overall during the assessment period of 2014-2018.

It is expected that further work, methodological refinement and environmentally sustainable practices will be needed to maintain this position in future MSFD cycles.

The second criterion has not been assessed because Ireland is not at risk of failing to achieve or maintain GES for this descriptor.

Ireland has updated its 2013 environmental target for Hydrographic Changes with a new target aligned to the primary criterion for this descriptor.

Environmental target D7T1: The spatial extent and distribution of permanent alteration of hydrographical conditions to the seabed and water column, is at a level that ensures that the structure and functions of the ecosystems are safeguarded and that benthic ecosystems, in particular, are not adversely affected.

Contaminants (Descriptor 8)

Ireland assessed the status of the marine environment against the two primary criteria and one of the secondary criterion set out in the Commission Decision: concentration of contaminants, acute pollution events and biological effects respectively.

Ireland has achieved Good Environmental Status for concentrations of contaminants within its maritime area, for the criteria assessed which are contaminants in water and biota, acute pollution events and biological effects of contaminants. There are threshold values associated with the concentrations of contaminants and biological effects. There is no threshold value for acute pollution events.

The assessment highlights the following:

- Concentrations of priority substances in water in coastal and transitional water bodies are typically low and compliant with Environmental Quality Standards.
- Concentrations of contaminants in shellfish are generally above OSPAR background levels however, they are not at levels where adverse effects would be expected to occur.
- Although many legacy pollutants are highly persistent in the environment, where significant temporal trends in contaminant concentrations are evident, they are typically downwards.
- There has been a marked improvement in reproductive condition in dogwhelks following the banning of TBT as a marine antifoulant.
- Monitoring indicates a low impact of acute pollution events in the maritime area.

Improved coherence of European and OSPAR assessment thresholds and new approaches to assessing risks associated with complex environmental mixtures would provide for a more robust assessment processes.

The remaining secondary criterion has not been assessed because Ireland has not had a significant acute pollution event and is not at risk of failing to achieve or maintain GES for this descriptor.

Ireland has updated its 2013 environmental targets for Concentrations of Contaminants with targets aligned to the two primary criteria and one secondary criterion assessed for this descriptor.

Environmental target D8T1a: Within coastal and territorial waters, the concentrations of contaminants do not exceed the threshold values set in accordance with Directive 2000/60/EC.

Environmental target D8T1b: Concentration of contaminants in marine matrices assessed in accordance with OSPAR Coordinated Environmental Monitoring Programme (CEMP) do not exceed OSPAR Environmental Assessment Criteria (EAC) and concentrations are not increasing.

Environmental target D8T2: The degree of biological or ecological effects that can be specifically attributed to contaminants is below the agreed OSPAR criteria. At present, this is limited to evaluation of reproductive impairment in marine gastropods associated with tributyltin (TBT).

Environmental target D8T3: Spatial extent and duration of significant acute pollution events are minimised.

Contaminants in Seafood (Descriptor 9)

Ireland assessed the status of the marine environment against the only criterion set out in the Commission Decision for this descriptor: the level of contaminants in edible tissues of seafood caught or harvested in the wild does not exceed the maximum levels laid down in Regulation (EC) No 1881/2006.

Ireland has achieved Good Environmental Status for concentrations of contaminants in fish and seafood for human consumption within its maritime area. Seafood sampled from shellfish growing waters and commercial fishing grounds around Ireland, between 2012 and 2017, shows a very high-level of compliance (99.7%) with Maximum Limits (threshold values) set in Commission Regulation 1881/2006 EC, as amended.

Ireland has updated its 2013 environmental target for Contaminants in Seafood with the target aligned to the primary criterion for this descriptor.

Environmental target D9T1: Levels of contaminants in fish and shellfish caught or harvested in Irish seas for human consumption complies with maximum limits listed in EU Regulation 1881/2006 (as amended).

Marine Litter (Descriptor 10)

Ireland assessed the status of the marine environment against its Initial Assessment 2013 target of Good Environmental Status: Reduction in the number of visible items within specific categories/types on coastlines.

Ireland has achieved Good Environmental Status within its maritime area for the amount of litter on coastlines, with the median number of litter items ≥2.5cm found on beaches in quarterly surveys between 2013 and 2018 decreasing from 73.5 items per 100 metres in 2013 to 46 items per 100 metres in 2018.

It is not possible to determine GES in relation to Commission Decision 2017/848 primary criteria for marine litter (D10C1) or micro-litter (D10C2) at this time as thresholds have not been established and currently no scientifically agreed methodologies have been developed to monitor micro-litter.

Ireland has updated its 2013 environmental target for marine litter with two new targets aligned to the primary criteria D10C1 and the EU Single Use Plastics Directive for this descriptor.

Environmental target D10T1a: The composition, amount and spatial distribution of litter in the coastline, and on the seabed, are at levels that do not cause harm to the coastal or marine environment.

Environmental target D10T1b: In accordance with the provisions of Article 5 of Directive (EU) 2019/904 by year-end 2023 eliminate beach litter caused by the items prohibited from the market under that Directive. These items are: plastic cotton bud sticks, disposable plastic cutlery and plates, plastic straws, plastic beverage stirrers, plastic balloon sticks, expandable polystyrene fast food containers and expandable polystyrene beverage containers and cups.

Underwater Noise (Descriptor 11)

Ireland assessed the status of the marine environment against the primary criterion set out in the Commission Decision: the spatial distribution, temporal extent, and levels of anthropogenic impulsive sound sources do not exceed levels that adversely affect populations of marine animals.

Ireland has achieved Good Environmental Status for the anthropogenic impulsive sound element of underwater noise within its maritime area. The level of impulsive underwater noise causing activities within Ireland's maritime area were low overall during the assessment period of 2016-2018. There are currently no threshold values proposed for underwater noise.

The second criteria on continuous low frequency sound has not been considered as work is ongoing at OSPAR and the EU to develop methodologies for the assessment of continuous noise and its impact on marine animals.

Ireland has updated its 2013 environmental target for Underwater Noise with a new target aligned to the primary criterion for this descriptor.

Environmental target D11T1: The spatial distribution, temporal extent, and levels of anthropogenic impulsive sound sources do not exceed levels that adversely affect populations of marine animals.

Economic and Social Assessment

Ireland is an Island nation and, depending on how the coast is defined, a considerable proportion of the population live at or near the coast. 94% of the population (4.47m people) live within 50km of the shoreline; 74% of the population (3.56m people) live in coastal counties and 27% of the population (1.3m people) live in shoreline Electoral Districts.

In 2018 Ireland's Ocean Economy turnover was €6.2 billion, of which €2.2 billion was direct gross value added. The Irish marine sector employs 34,132 full time equivalents. In the period overlapping the first cycle of the Directive (2012 to 2018) there has been a substantial increase in the economic contribution from the marine sector with employment increasing by 34%, turnover increasing by 31% and Gross Value Added (GVA) increasing by 78%.

There are many marine ecosystem services that generate benefit values to Irish society that go beyond the values obtained through the ocean economy industry activities. These marine ecosystems services are provided by the processes, functions and structure of the marine environment that directly or indirectly contribute to societal welfare, health and economic activities. Their contribution to welfare, health and economic activities every year can be summarised as follows:

- 96 million marine recreation trips *per annum* by Irish residents valued at €1.683 billion;
- fisheries & aquaculture worth an estimated €664 million in terms of output value from Irish waters;
- carbon absorption services are valued at €818.7 million;
- waste assimilation services valued at €316.7 million;
- scientific and educational services valued at €11.5 million;
- coastal defence services valued at €11.5 million;
- seaweed harvesting valued at €4 million; and

- aesthetic services, the added value per annum to housing stock of being close to the shore is valued at €68 million

The cost of degradation has been considered in two ways using the cost-based approach. The Environmental Transfers for the Protection and Management of the Environment and the Environmental Subsidies and Similar Transfers by Source of Funding and Administering Body have been considered. It is not possible to confirm the full cost of degradation at present. Further consideration is needed for these calculations.

Biological Diversity - Descriptor 1

Summary

The 2013 Initial Assessment of Ireland's maritime area did not include several ecosystem elements within wider marine biological diversity. The current updated assessment was carried out in respect of the original Directive and newly established criteria, elements and methodological standards set out in Commission Decision (EU) 2017/848 and amending Commission Directive (EU) 2017/845.

This more comprehensive assessment under MSFD Articles 8, 9 and 10, has incorporated new assessment information and has established Environmental Targets for important representative species of marine birds, mammals, reptiles and non-commercially-exploited fish species. It has also set out Threshold Values for relevant criteria elements (e.g. species or groupings) where possible.

A key finding of the assessment is that Ireland has achieved GES for some elements of biological diversity within its maritime area (e.g., the majority of larger marine vertebrates assessed in 2019). For other elements (e.g. marine reptiles and 41% of non-commercial fish species assessed) the environmental status is currently unknown, while in the case of some elements (i.e. 18 of 56 non-commercial fish species assessed) GES has not been achieved.

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Introduction

Ireland competed an Initial Assessment of its maritime area under the MSFD in October 2013. At the time, the assessment under biologically-orientated descriptors was largely restricted to (a) fisheries–related data for species and (b)

broad-scale mapping data for habitats. In relation to biological diversity and associated environmental targets and indicators under Descriptor 1, the 2013 assessment concluded that more work was required to develop and coordinate parameters, elements and methods that would contribute to a more effective evaluation of Ireland's marine environmental status.

Since then Ireland's approach, data collection and methods of assessment for this Descriptor under MSFD Articles 8, 9 and 10 have progressed considerably. This updated assessment considers elements of marine fauna that represent essential features and characteristics of biological diversity in Ireland's marine environment. It summarises (i) current knowledge of their environmental status, (ii) establishes new environmental targets for each faunal element that Ireland has established in order to achieve/maintain Good Environmental Status (GES) and, where possible, (iii) environmental threshold values that have been set for relevant ecosystem elements in order to secure and support the maintenance of GES in the long term. It should be noted that marine plankton species were assessed under Descriptor 4 – Elements of marine food webs and benthic habitats were assessed under Descriptor 6 - Sea-floor integrity.

The objective of this updated assessment was to meet the requirements of MSFD Articles 8, 9 and 10 concerning qualitative descriptors for determining GES, in this case specifically Descriptor 1, i.e. that "biological diversity is maintained" and that "the quality and occurrence of habitats and the distribution abundance of species are in line with physiographic, geographic and climatic conditions" (Directive 2008/56/EC).

Drivers

The principal driver of changes to biological diversity, beyond what would constitute natural change, is human economic development. Based on Commission Directive 2017/845, the predominant thematic uses and human activities currently occurring in Ireland that may introduce significant pressures and impacts on biological diversity and species' populations in the marine environment are:

- Physical restructuring of rivers, coastline or seabed (restructuring of seabed morphology)
- Extraction of non-living resources (oil & gas)
- Extraction of living resources (fish and shellfish harvesting, marine plant harvesting)

Pressures

The predominant pressures identified in Commission Directive 2017/845, that are currently of known and/or potential significance to Descriptor 1 – Biological diversity in Ireland's MSFD area, are considered to be:

- Loss of, or change to, natural biological communities due to cultivation of animal or plant species
- Disturbance of species due to human presence
- Extraction of, or mortality/injury to, wild species (by commercial fishing, and/or recreational fishing and/or other activities)
- Physical disturbance to the seabed (temporary or reversible)
- Input of nutrients (diffuse and/or point sources, atmospheric deposition)
- Input of organic matter (diffuse sources and/or point sources)
- Input of other substances (e.g. synthetic/non-synthetic substances, diffuse and/or point sources, acute events)

• Cultivation of living resources (aquaculture) • Urban & industrial uses (waste management) • Transport (shipping) • Tourism and leisure (activities) For numerous species of flora and fauna, including diadromous fish species, other human activities that are potentially important concerning the introduction of pressures on biological diversity include: - Agriculture - Forestry - Physical alteration of water bodies - Hydroelectric power - Mixed source pollution to surface and ground waters - Abstraction of water - Interspecific biological interactions due to human activity Climate change resulting from human economic practices, development and other activities, is also a significant driver with the potential to impact negatively on the marine environment. However, the evidence base that would warrant its inclusion as a known pressure source for biological diversity in Ireland's marine environment is insufficient at present. Considerable scientific research and development, and policy development at national and EU/international levels, would be required to effectively address and assess this driver in future MSFD cycles.	• Input of litter (solid waste matter, including micro-sized litter) • Input of anthropogenic sound (impulsive, continuous) Among the items listed above the most significant anthropogenic pressure on biological diversity in Ireland's maritime area is the extraction of fish and shellfish biomass (both commercial and non-commercial species) and associated disturbance introduced by human fishing activity. This occurs in the water column (e.g. pelagic trawling) and also close to or on the sea-floor (e.g. demersal trawling or set-nets, benthic dredging). It is prevalent all year round and in much of Ireland's maritime area, and is driven by a wide range of international, European Union and national fishing fleets that use diverse gear types, from jigging and long-lining to mobile nets and stationary pots. Fishing-derived pressure is, to a large extent, measurable and it is therefore supported by scientific evidence, monitoring and assessment, as well as EU and international regulation and management (e.g. through the EU Common Fisheries Policy and associated Regulations). There are also significant human pressures that can carry with them significant adverse impacts on particular species and habitats within wider biological diversity; e.g. through the disturbance or deterioration of species' breeding habitats. For diadromous fish there are a number of other pressures that are as relevant as mortality from commercial fishing. The most important of these are: Dams and other modifications of hydrological conditions; Physical alteration of water bodies; Application of fertilisers on agricultural land; Mixed source pollution to surface and ground waters; Drainage for use as agricultural land; Aquaculture, including infrastructure; Recreational angling; Increases or changes in precipitation due to climate change; Freshwater fish and shellfish harvesting; Abstraction of water; and Interspecific relations. Many of these pressures relate to land-based human activities and industries, and are covered by other policy and legal provisions designed to protect the environment, for which there are assessment

	and reporting obligations (e.g. Water Framework Directive, Nitrates Directive, Common Agricultural Policy). For larger marine vertebrate species, along with the potential pressures introduced by biomass removal, biological competition for prey resources and incidental mortality, the introduction of anthropogenic sound, disturbance of species and input of litter are considered to present the greatest secondary pressures after commercial fisheries extraction.

Environmental Targets

Ireland's Initial Assessment (2013) described the characteristics of GES for biodiversity as follows:

"Marine biodiversity is safeguarded in such a way that:

- Overall biodiversity is maintained or where appropriate restored;
- Ecosystem structure and function is not compromised;
- Abundance, distribution, extent and condition of key species and habitats (i.e. the area or environment where an organism or ecological community occurs) are in line with prevailing physiographic, geographic and climatic conditions; and
- Species and habitats identified as needing protection under national or international agreements are effectively protected or conserved through the appropriate national, regional or international mechanisms."

However environmental targets and associated indicators, to guide progress towards achieving GES in the marine environment, were under development in 2013; thus they were not established at that time. In the light of Commission Decision (EU) 2017/848 and amending Commission Directive (EU) 2017/845 Ireland has now established the following environmental targets for a set of essential faunal elements of biological diversity, namely:

a) Non-commercially-exploited species of fish
b) Marine reptiles
c) Marine birds
d) Marine mammals

Environmental Target D1T1

The mortality rate per species from incidental by-catch is below levels which threaten the species, such that its long-term viability is ensured

Environmental Target D1T2

The population abundance of the species is not adversely affected due to anthropogenic pressures, such that its long-term viability is ensured

Environmental Target D1T4

The species distributional range and, where relevant, pattern is in line with prevailing physiographic, geographic and climatic conditions

Environmental Target D1T5
The habitat for the species has the necessary extent and condition to support the different stages in the life history of the species

Threshold Values
Ireland's stated Environmental Targets for biological diversity are aligned with the requirements of Commission Directive 2017/845 and Commission Decision 2017/848. For each faunal element that was subject to assessment, at least one threshold value linked to the achievement of GES under each target was considered. This resulted in a number of threshold values being set for ongoing use in evaluating the environmental status of ecosystem/criteria elements. These threshold values are given below under Environmental Status, according to the relevant species. This process took account of ongoing EU and regional cooperative developments, existing requirements and associated timelines that relate to biological diversity under the following:
• national legislation;
• EU Directives (e.g. Habitats Directive, Birds Directive) and policies (e.g. Common Fisheries Policy);
• regional seas conventions (e.g. OSPAR Convention);
• international agreements (e.g. UN Convention on Biological Diversity).

Criteria / Criteria elements included in the Assessment
The primary criteria from Commission Decision (EU) 2017/848 that were included in the current assessment are:
D1C1 - The mortality rate per species from incidental by-catch is below levels which threaten the species, such that its long-term viability is ensured.
D1C2 - The population abundance of the species is not adversely affected due to anthropogenic pressures, such that its long-term viability is ensured.
D1C4 - The species distributional range and, where relevant, pattern is in line with prevailing physiographic, geographic and climatic conditions.
D1C5 - The habitat for the species has the necessary extent and condition to support the different stages in the life history of the species.

In all cases “criteria elements” or the essential species groups listed in a) to d) above, are evaluated against each of these primary criteria. This work was conducted using a set of species considered to be representative of each group, and for which national monitoring/assessment programmes have been established, namely;

a) Non-commercially exploited species of fish:
A total of 56 species were covered by the assessment. They included species listed in Commission Implementing Decision (EU) 2016/1251, those on the OSPAR List of Threatened and/or Declining Species & Habitats, elasmobranch species prohibited from being caught in commercial fisheries under EU Common Fisheries Policy legislation, and those listed as in danger of extinction (endangered) on the IUCN European Red List of Marine Fishes (2015). Since D1C4 and D1C5 are solely Primary Criteria for species listed under the Habitats Directive (Directive 92/43/EEC), the assessment under these criteria was confined to four fish species: Atlantic salmon *Salmo salar*, River lamprey *Lampetra fluviatilis*, Sea lamprey *Petromyzon marinus* and

Twaite shad *Alosa fallax*. In these cases, Ireland's recent Habitats Directive Art.17 reporting (2019) helped to inform the assessments undertaken.

b) Marine reptiles:

Leatherback turtle *Dermochelys coriacea*

The most frequently recorded turtle species in Irish waters and the only turtle considered to use Irish waters as part of its natural range, mainly occurring in summer-autumn. Listed in *Annex IV* of the Habitats Directive as a species in need of strict protection;

c) Marine birds:

Black-legged kittiwake *Rissa tridactyla*, Northern fulmar *Fulmarus glacialis*, Northern gannet *Morus bassanus*

Protected under the Birds Directive (Directive 2009/147/EC), all three are fully marine species that nest and breed in Ireland on islands and cliff-bound terrain that is less vulnerable to human interference and mammalian predators than the breeding habitat of other seabird species.

d) Marine mammals:

Bottlenose dolphin *Tursiops truncatus*, Harbour porpoise *Phocoena phocoena*, Grey seal *Halichoerus grypus*, Harbour seal *Phoca vitulina*

All four species occur in coastal and offshore waters of Ireland's maritime area and are listed in *Annex II* of the Habitats Directive as species whose conservation requires the designation of special areas of conservation. Both cetacean species are also listed in *Annex IV* of the Habitats Directive.

Exclusions

The criteria elements covered in this evaluation are consistent with the requirements of Commission Directive 2017/845 and Commission Decision 2017/848, and are monitored on an established national basis. Other marine biota (e.g. certain indicative species of fauna or flora, aggregated communities) that have not been included in this exercise, but that could add supplementary value to future assessments of biological diversity, may be included in the future if this is appropriate and is supported by scientific data. These could include biota that are reflected in OSPAR common indicators and associated assessments, for example.

Primary criterion D1C3 arising from Commission Decision (EU) 2017/848 [i.e. The population demographic characteristics of the species (e.g. body size or age class structure, sex ratio, fecundity, and survival rates) are indicative of a healthy population which is not adversely affected due to anthropogenic pressures] was not included in the assessment. This selection decision was based on International Council for the Exploration of the Sea (ICES, 2017) advice for a related criterion under Descriptor 3 – Populations of commercially-exploited fish and shellfish (D3C3). In this, ICES concluded that until proof-of-concept has been validated, D3C3 could not be considered operational for MSFD assessment purposes. In addition to the above exclusion, non-commercially-exploited species of cephalopods were not included as criteria elements in the current assessment due to limited scientific knowledge and data on the population biology and ecology of such species.

Primary criterion D1C6 (i.e. The condition of the habitat type, including its biotic and abiotic structure and its functions, is not adversely affected due to

anthropogenic pressures) was also not assessed with regard to pelagic broad habitat types. This was due to limited knowledge and understanding of the correct and robust scientific basis and methodologies by which pelagic habitats could be reliably assessed. Instead habitat-linked assessments carried out under Descriptor 4 – Elements of the marine food webs, Descriptor 5 – Human-induced eutrophication and Descriptor 6 – Sea-floor integrity and other Descriptors (e.g. Properties and quantities of marine litter, Introduction of energy) went a considerable way to inform the assessment of environmental status and condition of habitats in Ireland's marine area.

The OSPAR Intermediate Assessment (2017) material of relevance to biological diversity in Ireland's maritime area was evaluated but not formally included in the current assessment process under Descriptor 1. From Ireland's perspective the Intermediate Assessment (2017) had been superseded by other detailed assessment methods and more recent data which were available to this MSFD assessment process (e.g. via reporting under the Common Fisheries Policy or Ireland's 2019 reporting to the European Commission under Habitats Directive Art.17 and Birds Directive Art.12).

Impact

The parameters and characteristics specified in Commission Directive 2017/845 that are likely to be impacted upon by loss of biological diversity can be divided in to species impacts, habitat impacts and ecosystem/food-web impacts.

The species impacts are considered to operate via changes to: distribution and/or biomass; size, age and sex structure, reproductive potential, survival and mortality/injury; behaviour including movement and migration; habitat for the species (extent, suitability); and species composition within groups of species.

The main habitat impacts are considered to operate via changes to: species composition, abundance and/ or biomass (spatial and temporal variation); size and age structure of species; and physical, hydrological and chemical characteristics.

The main ecosystem impacts are considered to operate via changes to: links between habitats and species of marine birds, mammals, reptiles, fish and cephalopods; pelagic-benthic community structure; and productivity.

The effects and consequences of the predominant pressures on biological diversity during the overall assessment period (2013-2018) and prior to that, if relevant, were considered in the current assessment. For the marine vertebrates outlined above that have been included as criteria elements (i.e. eight reptile, bird and mammal species) this was primarily informed by Ireland's surveillance, assessments and reporting undertaken to meet requirements under the EU Habitats Directive and Birds Directive.

In relation to the predominant pressures identified as known and/or of potential significance in Ireland's marine area, based on scientific evidence and knowledge of current human activity there are few such pressures that were considered to operate with potential population-level effects or consequences for these species in Ireland. Among them, however, were:

- Disturbance of species due to human presence
  Certain species that avoid interaction with humans or animal predators may be highly vulnerable to human disturbance during times of the year that are critical for their populations and for survival (e.g. during migration, foraging, nesting, breeding or resting phases). Human presence may also mediate additional impacts that cause disturbance to the species' natural history, such as the introduction of problematic predators (e.g. mink at seabird breeding sites), disease or invasive species.
- Extraction of, or mortality/injury to, wild species (by commercial fishing, and/or recreational fishing and/or other activities)
  In addition to the loss of potentially significant food biomass from the marine environment through human extraction, this pressure can also have direct population consequences (e.g. via reduced survival to breeding age or impaired reproductive success) if the level of mortality or injury to wild species is not compensated for by natural factors such as productivity or immigration. [Note: Certain non-commercial fish species have been depleted by fishing in the past and are now on various lists of threatened and declining species. Although there are zero total allowable catches (TACs) or "prohibited" listings for some species, most remain vulnerable to existing fisheries. For example, some are caught as by-catch in mixed demersal trawl fisheries and gillnet fisheries, and deep-water sharks are caught in the mixed deep-water trawl fishery.]
- Physical disturbance to the seabed (temporary or reversible)
  The effect of this pressure, if it acts at a population-relevant scale, may be to deter or displace animals from their natural habitat or reduce foraging opportunities, for example, thereby influencing individual survival or reproductive performance.
- Input of other substances (e.g. synthetic/non-synthetic substances, diffuse and/or point sources, acute events)
  Several substances of industrial origin are known to be prevalent and persistent in coastal/marine environments, including being present in deposited sediments and in the tissues of prey species. Internationally, where their levels are high in the environment some synthetic organic compounds (e.g., PCBs) have been shown to impair the reproductive performance and immune function of affected individuals and, potentially, aggregations of animals (e.g. colonies, social groups).
- Input of litter (solid waste matter, including micro-sized litter)
  A number of vertebrate species appear to be vulnerable to ingestion of plastic and other litter in the marine environment. While active research into the effects of water-borne litter and its ingestion is ongoing, for species such as Leatherback turtle and other surface-feeding vertebrates, the impairment of natural nutritive physiology is a potential effect of this pressure.
- Input of anthropogenic sound (impulsive, continuous)
  Individual species (e.g. some marine mammals) and their populations may also be sensitive to certain types of underwater sound transmitted by human practices in the sea and ocean environment. This is an area under active research in relation to several anthropogenic sound sources and the individual or population-level consequences of disturbance or acoustically-driven injury.

Environment Status

Environmental status was assessed across each of the selected criteria elements as follows:

a) Non-commercially exploited species of fish

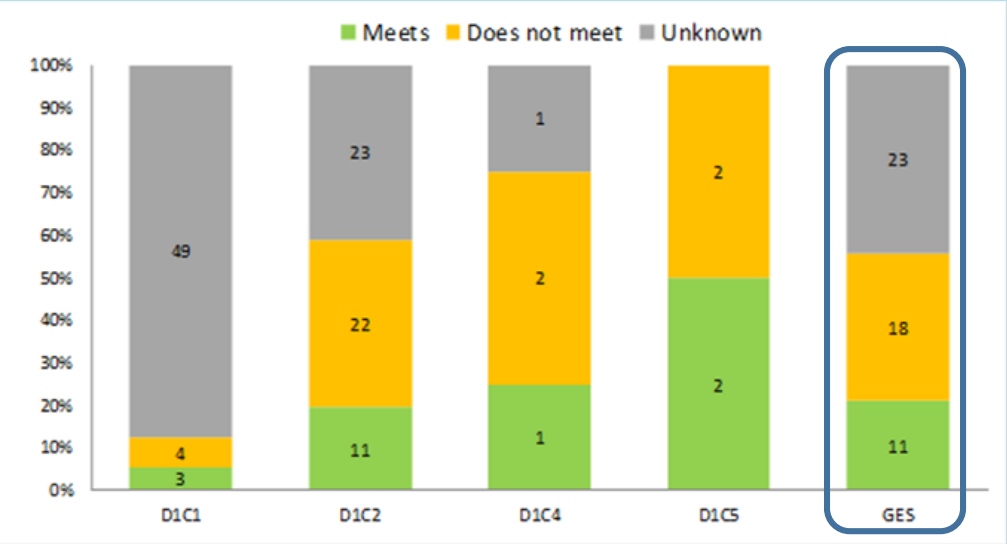
Environmental Targets: D1T1, D1T2, D1T4, D1T5

Threshold Values for GES: Not currently applicable at individual species level; Minimum of 60% of non-commercial species required to have achieved GES in order for element/group level achievement of GES (ICES 2018 advice).

Among all 56 fish species considered in the assessment the status of 33 species was considered to be known, while the status of the remaining 23 species is currently unknown. Detailed assessments against the above primary criteria concluded that eleven (11) species have achieved GES. These consist of Blue ling, Mora, Bigeye, Rabbitfish, Black dogfish, Longnose velvet dogfish, Birdbeak dogfish, Deepwater lanternshark, Blackmouth catshark, Velvetbelly lanternshark and Turbot.

The environmental status of 23 species was found to be currently unknown. These species include River lamprey (a Habitats Directive *Annex II* species), Common thresher shark, Deep sea catsharks, Norwegian skate, Knifetooth shark, Tope, Mouse catshark, Sandy ray, Starry smoothhound, Sailfin roughshark, Thornback ray, Spotted ray, Deepwater ray, Wolffish, Alfonsino, Roundnose grenadier, Snub-nose spiny eel, Straightnose rabbitfish, Spiny scorpionfish and Bluefin tuna.

Among the 18 species which were found not to have achieved GES were: Atlantic salmon, Twaite shad, Sea lamprey (all of which are *Annex II* species), European eel, Leafscale gulper shark, Portuguese dogfish, Kitefin shark, Six-gill shark, Baird's smoothhead, Blackbelly rosefish, Orange roughy, Large-eyed rabbitfish, Basking shark, Shortfin mako shark, Undulate ray, Spurdog and Cod.



Numbers and percentages of assessed non-commercial fish species meeting or not meeting Environmental Targets D1T1, D1T2, D1T4 and D1T5 under the selected primary criteria; also regarding these species' achievement of GES (right column).

In consideration of ICES advice in 2018 regarding fish species of biodiversity concern, a threshold of 60% of species conforming to GES was taken to be indicative of whether GES had been achieved overall for this criteria element. In the current assessment 11 species were found to have achieved GES, while 18 were found not to have achieved GES. The environmental status of 23 species is currently unknown. Four remaining species could not be assessed due to limited data, their critically endangered status (i.e. IUCN Red List) and associated ICES advice. Overall the proportion of non-commercially-exploited fish species that have achieved GES is 21%; this is below the lower threshold of 60% advised by ICES (2018).

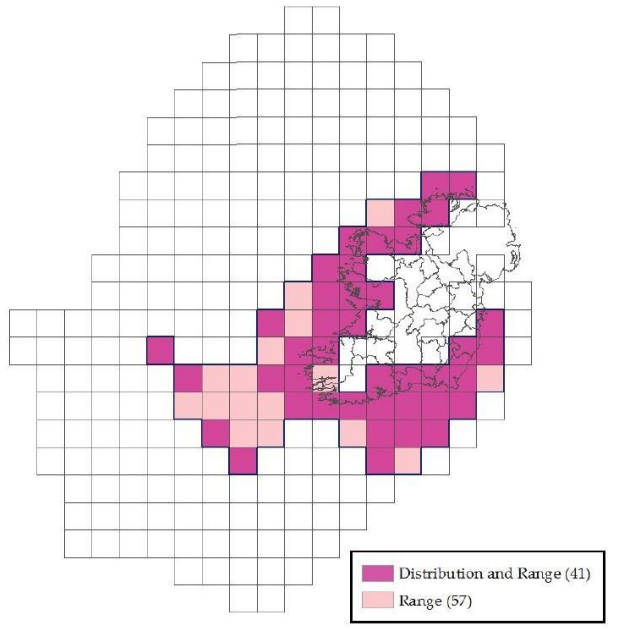
b) Marine reptiles

Environmental Targets: D1T1, D1T2, D1T4, D1T5

Threshold Values for GES: Not currently applicable at individual species level

Leatherback turtle

With regard to the primary criteria and Environmental Targets under this Descriptor, there are currently significant limitations associated with assessing and reporting on the status of this 'sea turtle' species. While some recent progress has been made in data acquisition from Ireland and adjacent waters, the species' population ecology, range, habitat use and the pressures/impacts it faces in Ireland's maritime area and the wider North-East Atlantic, are not well understood.



Observed coastal and marine Distribution and Range of Leatherback turtle in Ireland's MSFD and Habitats Directive assessment area. The map covers all known records from 2000 to 2018 (n=198) collectively displayed as coloured 50km grid cells. Source: NPWS (2019).

Leatherback turtles that migrate through Irish waters mate and breed in the tropics. In the North Atlantic, incidental by-catch in fishing gear (e.g., drift-nets, long-lines) has generally been identified as a significant conservation concern. However, the impacts of leatherback turtle interactions with commercial fishing have not been comprehensively or robustly quantified. In a regional context there is little scientific evidence of by-catch by Irish-registered vessels fishing in the open ocean. In coastal waters however, a small number of individual animals have died or been

injured as a result of entanglement in ropes associated with lobster and crab fisheries.

Providing even a rough estimate of the number of Leatherback turtles foraging within Irish waters is difficult since the area in question is very large and animal abundance in the wild could be extremely low. At present, population estimation is further complicated by inherent variability in turtle occurrence between years as a result of climate, long-term population cycles and intrinsic variation in their gelatinous zoo-plankton prey. With regard to population trends it was not possible to judge whether numbers are increasing, decreasing or stable.

Clearly targeted and collaborative international research is required on (a) the population ecology of Leatherback turtles in the North Atlantic and (b) the extent, severity and risk of impact from human activities on populations of this species. In the meantime, the overall environmental status of this species in Irish waters was assessed as currently unknown.

c) Marine birds

Environmental Targets: D1T1, D1T2, D1T4, D1T5

Threshold Values for GES: Not currently applicable at individual species level

Black-legged kittiwake

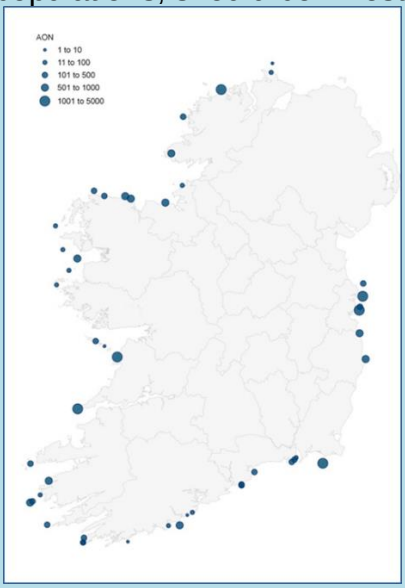
This is most numerous gull species globally and is the most oceanic in its habits, preferring to nest on vertical rocky sea-cliffs in colonies from a few pairs to several thousand pairs. In Ireland Kittiwake breeding sites are well distributed around the coast. Tracking studies in the Atlantic indicate that ca.80% of the adult population winters in waters west of the mid-Atlantic Ridge while birds from Ireland and Britain mainly occupy oceanic waters situated east of the Ridge.

Regarding the primary criteria and Environmental Targets under this Descriptor, this species was not one considered to be at a significant risk of incidental by-catch, since it feeds primarily at the sea surface on small pelagic shoaling fish and invertebrates, and appears to prefer live fish, such as sandeels, sprat or juvenile herring, to discards. Therefore, based on current scientific knowledge and available fisheries monitoring data, it was considered unlikely that the species' long-term viability is threatened by incidental mortality in commercial fisheries.

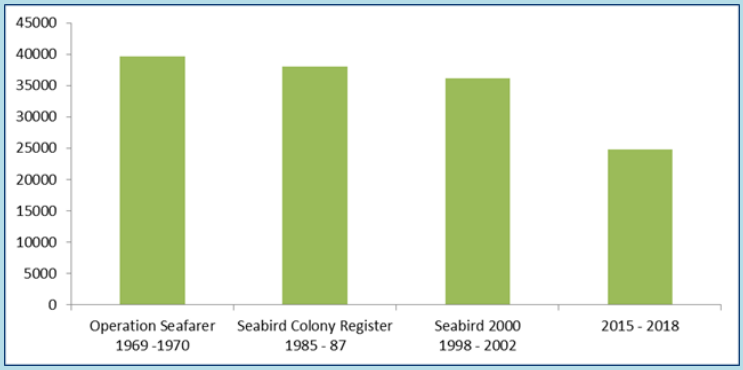
In relation to population abundance, however, there were clear indications that national figures have decreased significantly over the past 20 years (i.e. 24,728 pairs in 2015-2018, a short-term decrease of 32% from 1998/2002). This is driven by acute short-term declines at some of the most important breeding colonies in Ireland (i.e. Horn Head, Co. Donegal, Cliffs of Moher, Co. Clare and Great Saltee Island, Co. Wexford). Monitoring data collected in 2015-2018 describe a near 20% reduction in breeding population estimates at Lambay Island, Co. Dublin alone, which, owing to its relative colony size, significantly influenced the national population picture.

While there was evidence of a substantially wider distribution of breeding colonies around the coast than was known heretofore and surveys at sea describe (as expected) the species' occupancy of waters throughout Ireland's Exclusive Economic Zone (EEZ), there was nevertheless an underlying question concerning

Kittiwake reproductive success and the extent and condition of its natural habitats, given the observed breeding population decline. Causes of the decline are unclear at present and some examples of potential factors involved are changes in food availability or prey distribution, or climate-related influences. Consequently, the overall environmental status of this species in Irish waters was assessed as currently unknown, while (i) the species' population dynamics in the North-East Atlantic and (ii) the extent, severity and risk of impact from human activities on its populations, should be investigated further.



Breeding Kittiwake abundance and distribution for the period 2015–2018. Figures are based on apparently occupied nests (AONs). Source: NPWS; Cummins et al. (2019).



National breeding population estimates for Kittiwake from Operation Seafarer to the current National Seabird Monitoring Programme (2013-2018). Source: NPWS; Cummins et al. (2019).

Northern fulmar

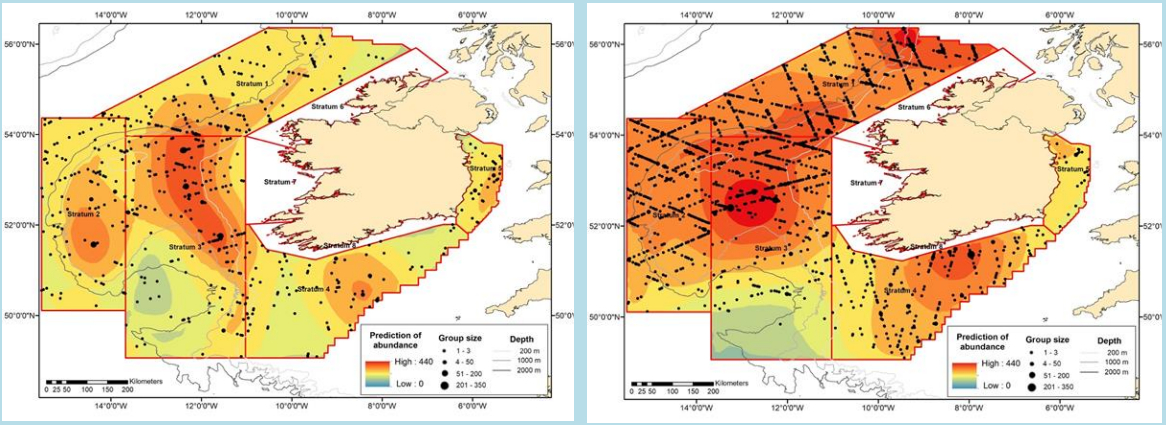
This distinctive large petrel species is a common sight around the Irish coast, particularly in the northwest, west and south of the country where it nests on steep vertical slopes and broad ledges near the top of vegetated cliffs. Fulmar breeding distribution was once mainly restricted to the Arctic but since the 1700s its range has expanded southwards from Iceland to the coasts of Britain, Ireland and France.

Although their close association with commercial fisheries and discarded offal or unwanted/incidental catches is well described, dietary studies indicate that Fulmars are very wide-ranging and feed on a wide variety of prey that occur near the sea surface including small pelagic fish, sandeels, squid, amphipods and copepods. Accidental by-catch interactions with certain fishing gears are known to occur in the North-east Atlantic (e.g. in long-lines and trawl nets). Yet the incidence of Fulmar by-catch by Irish-registered vessels would appear to be uncommon and may well be below levels that could threaten the species in the long-term. Actual

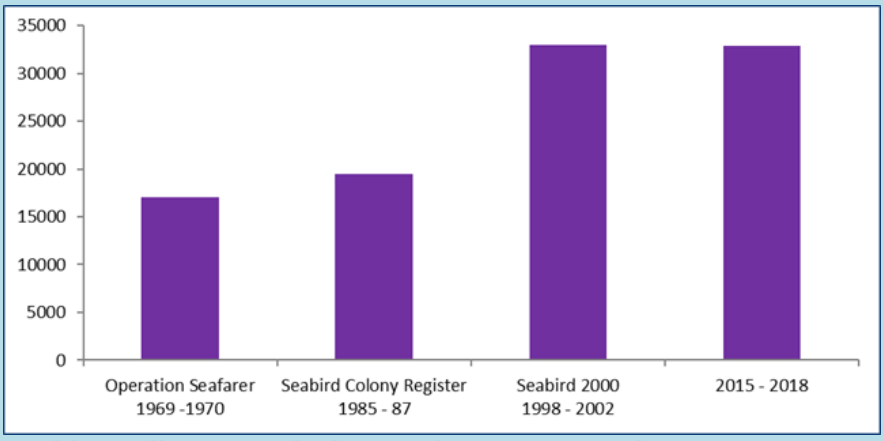
mortality rates from by-catch require active scientific research, however, since more robust conclusions are difficult to determine at present.

The population abundance of this species in Ireland appears to be relatively stable since the 1990s (ca.33,000 pairs), having increased markedly from levels recorded in periodic surveys during 1969-70 and in the 1980s. Considerable variation in population trajectories between individual breeding colonies is noted however via the National Seabird Monitoring Programme and there is a need to continue scientific monitoring, at regional and national scales on land and at sea, in order to better understand the species' population dynamics and the role/influence (if any) of human activities and impacts on Fulmar reproductive success or abundance.

In consideration of the Environmental Targets outlined above, given that the available scientific evidence from Ireland showed a low by-catch incidence, an increasing breeding distribution, an extensive distributional range at sea and stable population figures nationally, it was concluded that GES has been achieved for this species.



Predicted summer distribution (left), winter distribution (right), relative densities and observed group sizes of Fulmar in Irish waters, modelled from aerial survey data gathered in 2015 and 2016. Source: Ireland's ObSERVE Programme; Rogan et al. (2018a).



National breeding population estimates for Fulmar from Operation Seafarer to the current National Seabird Monitoring Programme (2013-2018). Figures are based on apparently occupied nests (AONs). Source: NPWS; Cummins et al. (2019).

Northern gannet

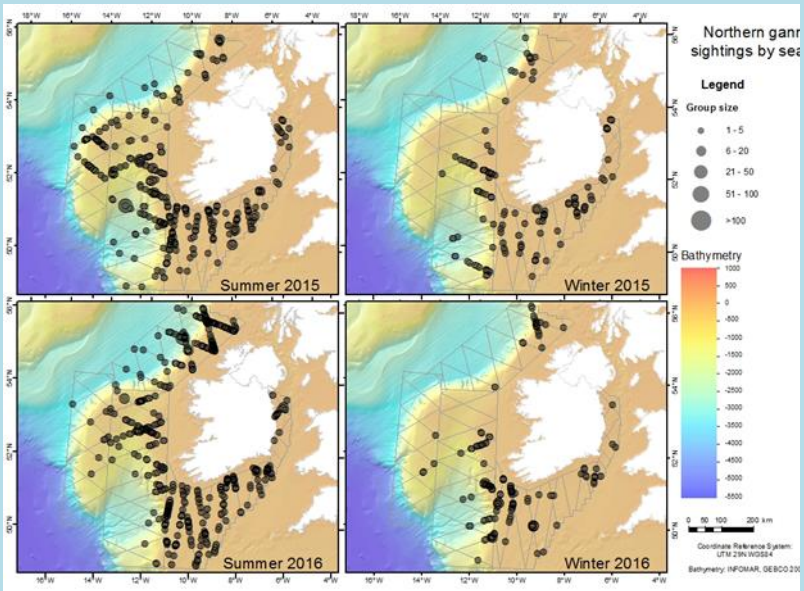
The Gannet is an iconic seabird species and the largest marine bird commonly inhabiting the North Atlantic. A wide-ranging pelagic forager, its breeding adults mainly occur in temperate waters and they are site-faithful, with most breeding colonies occupied by individual birds for decades or longer.

In a national context, Gannets breed gregariously on a few isolated sea stacks, small uninhabited islets and on occasion, inaccessible cliffs on larger islands (e.g., Ireland's Eye and Lambay Island, off Co. Dublin).

With regard to the primary criteria and Environmental Targets under this Descriptor, there was substantial evidence of this species interacting opportunistically with a wide range of commercial fisheries; for example, by feeding directly on retained catches at the surface as they are taken on board, by scavenging on discards or on drop-outs from vessels and associated gear. Gannets otherwise naturally forage at the surface and sub-surface where they mainly target small shoaling fish (e.g. sandeels, mackerel, herring and other small- to mid-sized pelagic fish).

The acquired tendency to forage around fishing operations may help to explain why the Gannet is one of the seabird species recorded as incidental by-catch in fishing operations. Data currently available from limited monitoring aboard Irish-registered vessels suggests that the rate of Gannet mortality from by-catch in Irish waters is low, however. Improved observation effort at sea (e.g. a higher % and more representative sample of fishing vessels actively monitored), particularly around higher-risk fishing methods, is required to continually validate and further support this and future assessments.

Gannet abundance and breeding distribution in Ireland for the period 2013–2014. Figures are based on apparently occupied sites (AOSs). Source: NPWS; Cummins et al. (2019).



Distribution of Gannet sightings (black circles) from aerial surveys carried out in the summer (left) and winter seasons (right), 2015 & 2016. Grey lines indicate the survey track-lines. Circles are proportional to the number of birds recorded in each sighting. Source: Ireland's ObSERVE Programme; Rogan et al. (2018a).

In relation to its abundance, the Irish breeding population of Gannets has been surveyed on five census occasions since the late 1960s, along with the population in Britain and, where possible, the wider North Atlantic. The most recent breeding season census in Ireland took place primarily during 2013 and 2014. The data generated show that the Irish population has increased by an estimated 33% over a 10-year period to reach 47,946 pairs in 2014, and that its breeding distribution has expended accordingly (up 20% since 2004, up 50% since 1984/85). Regional populations at the traditional colonies have increased across the board such that, in historical terms, the population has increased by 121% since Operation Seafarer in 1969-70.

In consideration of the Environmental Targets outlined above, given that the available scientific evidence from Ireland showed a low by-catch incidence, an increasing breeding distribution, an extensive distributional range at sea and increasing population figures over more than a decade, it was concluded that GES has been achieved for this species.

d) Marine Mammals

Environmental Targets: D1T1, D1T2, D1T4, D1T5
Threshold Values for GES: Applicable at individual species level for four species (below)

For D1T1: Not currently applicable at individual species level

For D1T2: At or greater than the current Favourable Reference Population value

For D1T4: Equivalent to the current Favourable Reference Range

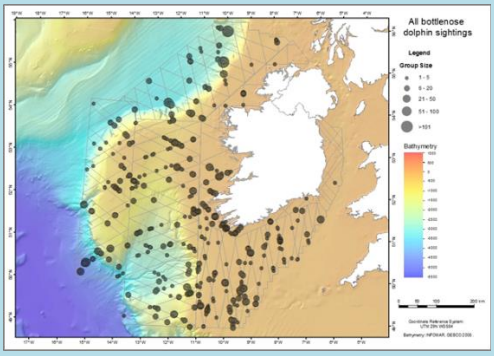
For D1T5: Equivalent to the current Favourable Reference Range

Bottlenose dolphin

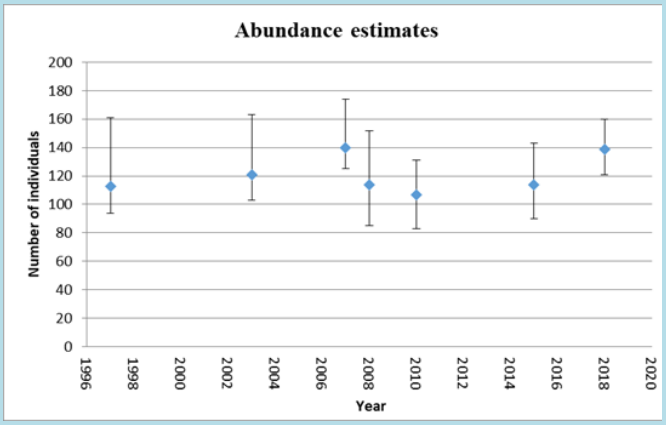
This is one of the most frequently recorded and familiar cetaceans occurring in Ireland, with contemporary sighting records showing its wide occurrence throughout Irish coastal and offshore waters, from those overlying the continental shelf and continental slope to deeper ocean basins.

Regarding incidental by-catch, the available evidence from Irish-registered fishing vessels and from coastal strandings indicates that accidental catches of this larger dolphin are uncommon in Irish commercial fisheries and are therefore unlikely to threaten the species in Irish waters. However improved observation effort at sea (e.g. a higher % and more representative sample of fishing vessels actively monitored), particularly around higher-risk fishing methods, is required to continually validate and further support this and future assessments.

Robust long-term data on Bottlenose dolphin population abundance and trends in Irish waters as a whole are not yet available. In a coastal context, high quality data collected from the Lower River Shannon, which comprises a Special Area of Conservation for this Annex II species, describe a relatively stable local population of ca.120-160 individuals. Knowledge of the species' seasonal distribution and summer abundance in western European waters has improved significantly in recent decades. There has also been improved population abundance data from a large part of Ireland's EEZ, yielding substantial new estimates numbering 68,714-147,267 individuals and exceeding all previous figures for the region.



Observed coastal and marine Distribution and Range and group sizes of Bottlenose dolphin within Ireland's EEZ, covering 482 aerial sighting records from May 2015 to March 2017 (summer and winter only). Source: Ireland's ObSERVE Programme; Rogan et al. (2018a).



Estimates of population abundance (point estimate & 95% Confidence Intervals) for Bottlenose dolphins in the Lower River Shannon SAC (i.e. Shannon Estuary), from mark-recapture photo-identification surveys conducted since 1996. Source: NPWS; Rogan et al. (2018b).

Although Bottlenose dolphins may be subject to a number of local and/or regional environmental pressures throughout their range, based on current spatial, temporal and ecological data none were considered to be of sufficient impact on the species to be causing a significant deterioration in overall range, distribution or habitat quality in Ireland from a status that is sufficient for long-term survival. In consideration of the Environmental Targets outlined above, it was therefore concluded that GES has been achieved for this species.

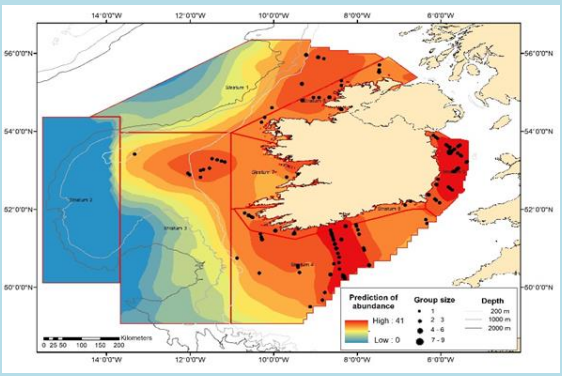
Harbour porpoise

The Harbour porpoise is the smallest cetacean species occurring in Irish waters yet is one of the most frequently recorded, though this can be more difficult offshore due to its size and inconspicuous nature.

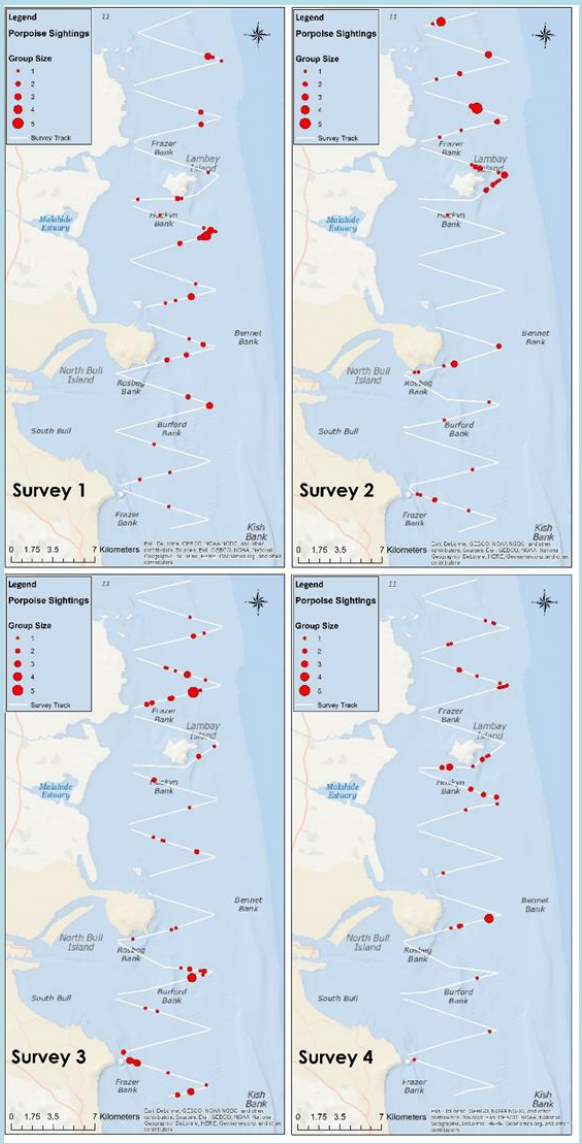
In relation to Environmental Targets under this Descriptor, available evidence from Irish and non-Irish registered fishing vessels, and from coastal strandings, indicates that accidental catches of Harbour porpoise do occur in commercial operations, particularly in set-net gears (e.g. gill-nets). This detrimental interaction is complex and variable in space and time, and is currently difficult to measure with scientific confidence. Yet it could constitute a pressure on the species, particularly in the Celtic Seas sub-region of the North-East Atlantic, which includes southern Irish waters. Significantly improved observation effort at sea (e.g. a higher % and more representative sample of fishing vessels actively monitored), particularly around higher-risk fishing methods, is required to investigate this occurrence further and to support future assessments.

Knowledge of the species' seasonal distribution and summer abundance in western European waters has improved significantly in recent decades. There has also been improved population abundance data from a large part of Ireland's EEZ,

yielding new estimates numbering 29,519-51,840 individuals and highlighting areas of apparent importance for the species (e.g. Irish Sea). In a coastal context, good quality data collected over the last decade from Ireland's three Special Area of Conservation for this Annex II species, generally describe relatively high densities during the summer months in which calving and initial nursing of young porpoises is known to occur.



Predicted summer distribution and relative density of Harbour porpoises in Irish waters in the summer of 2016, modelled from high quality aerial survey data. Source: Ireland's ObSERVE Programme; Rogan et al. (2018a).



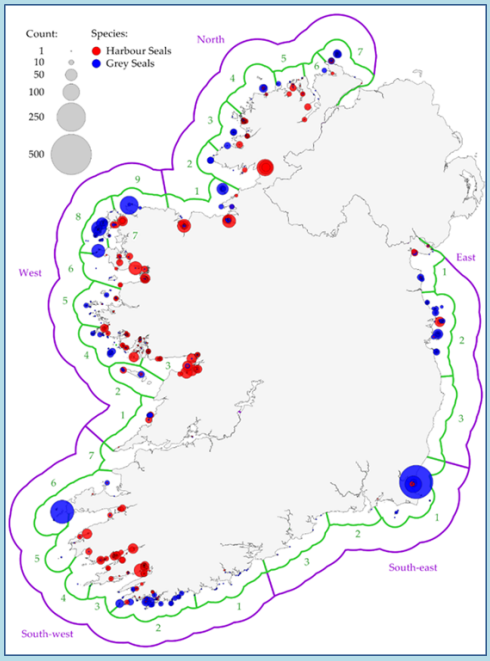
Mapped survey tracks, Harbour porpoise sighting locations and corresponding group sizes (red circles) recorded during line-transect surveys of Rockabill to Dalkey Island SAC off the Co. Dublin coast in the summer of 2016. Source: NPWS; O'Brien & Berrow (2016).

Although Harbour porpoises may be subject to a number of local and/or regional environmental pressures throughout their range, based on current spatial, temporal and ecological data none were considered to be of sufficient impact on the species to be causing a significant deterioration in overall range, distribution or habitat quality in Ireland from a status that is sufficient for long-term survival. In consideration of the Environmental Targets outlined above, it was therefore concluded that GES has been achieved for this species.

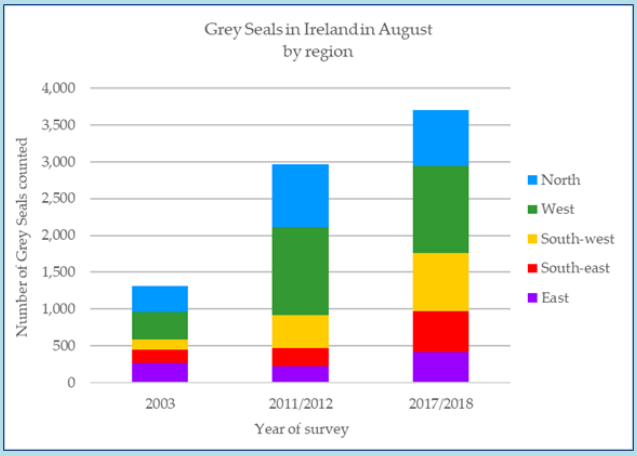
Grey seal

In Ireland the Grey seal is the most abundant and most widely distributed seal species. Generally considered part of a larger population or meta-population that also inhabits adjacent jurisdictions (i.e. the UK and France at least), the species has undergone a general expansion in its numbers and occupancy of terrestrial/inter-tidal haul-out (resting) sites in Ireland since it first gained legal protection in 1976.

Grey seals may be subject to a number of local or regional environmental pressures and threats throughout their North Atlantic range and in Irish coastal/offshore waters. Among them, accidental by-catch interactions with certain fishing métiers are known to occur, particularly with set-net gears such as tangle-nets, trammel-nets and gill-nets that are commonly used for demersal fishing in coastal and/or offshore waters. With regard to mortality rates from incidental by-catch, active scientific research into the scale, reasons for and spatial/temporal extent of interactions is ongoing at present and definitive or robust conclusions were difficult to determine in the time-frame of this assessment.



Numbers and distribution of Grey seals (blue circles) and Harbour seals (red circles) recorded within labelled sub-regions in Ireland in August 2017 & August 2018. The displayed symbol size represents the recorded group size with count guides given in the Legend (top left).



Observed increases in the number of Grey seals counted during nationwide aerial thermal imaging surveys in 2003-2018. Source: NPWS; Morris & Duck (2019).

Source: NPWS; Morris & Duck (2019).

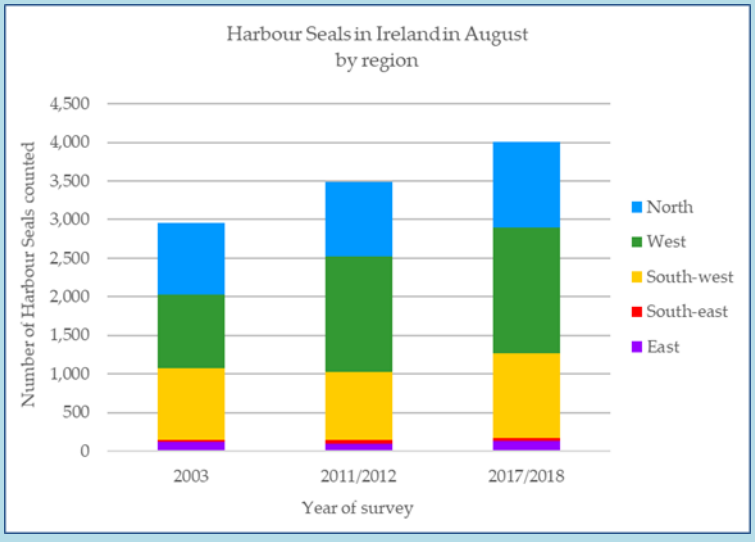
It was noteworthy, however, that evidence from surveys carried out since the mid-1990s indicates that the all-age population of Grey seals has been growing in Ireland, driven largely by increases in pup production and recruitment to the population at each of the seven main breeding colonies. In this context the estimated 7,284-9,365 seals associated with breeding in Ireland (2013) is considered to be a minimum estimate, given that more recent surveys suggest ongoing growth at the main colonies. Growing Grey seal abundance is also reflected in nationwide counts of this species in summer (August), underlining further a positive population status and trend.

Coupled with Habitats Directive assessment information (2019) which indicates that Grey seal range, distribution and habitat quality are in a favourable condition, it was concluded that GES has been achieved for this species.

Harbour seal

In Ireland Harbour seals occur in estuarine, coastal and fully marine areas and also occupy regular haul-out (resting) sites about which animals breed, moult, rest and engage in social activity, for example. In mainland Europe and the UK, substantial declines and die-offs have been recorded both historically and recently, including via viral disease. However, there has been little evidence of such occurrences on a broad regional or indeed local scale in Ireland.

Similar to Grey seals, accidental by-catch interactions of Harbour seals with certain fishing gears are known to occur. However, the incidence of Harbour seal by-catch would appear to be less common than is evident for Grey seal. With regard to seal mortality rates from by-catch, active scientific research into the scale, reasons for and spatial/temporal extent of interactions is ongoing and definitive, robust conclusions were difficult to determine in this assessment.

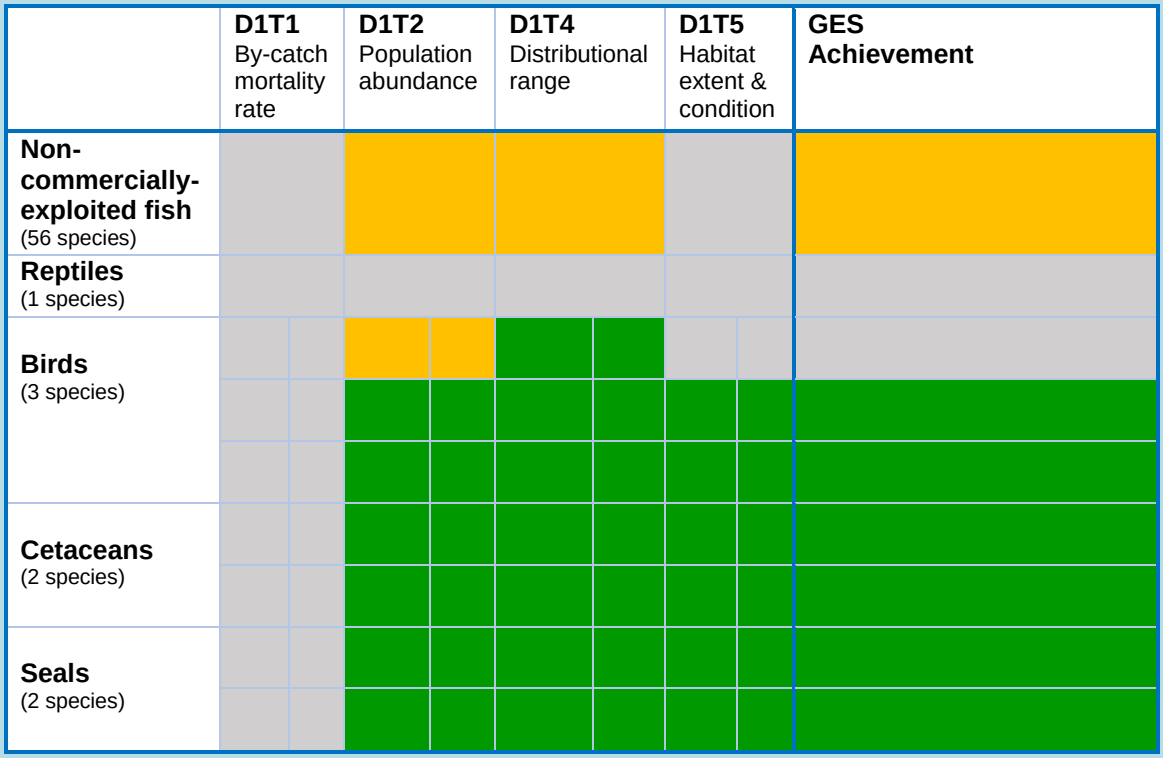


Observed increases in the number of Harbour seals counted during nationwide aerial thermal imaging surveys in 2003-2018. Source: NPWS; Morris & Duck (2019).

In relation to population numbers occurring around Ireland, the available evidence from surveys carried out since the mid-1980s indicates that the all-age population of Harbour seals has been relatively stable over the last two decades and is possibly growing gradually. There are, however, some significant gaps in the knowledge of this species' population ecology, particularly in relation to its current

breeding distribution and productivity. In this context the estimated 4,007 Harbour seals recorded in August 2017 and 2018 is a minimum estimate, being based on counts of seals at moulting haul-out sites only. It is nevertheless the highest abundance figure recorded in Ireland, suggesting both a positive population status and trend since comprehensive nationwide surveys began in 2003.

Coupled with Habitats Directive assessment information (2019) which indicates that Harbour seal range, distribution and habitat quality are in a favourable condition, it was concluded that GES has also been achieved for this species.



Synopsis of the status of selected criteria elements assessed against Environmental Targets for biological diversity D1T1, D1T2, D1T4 and D1T5; and their achievement of GES overall (right-hand-side blue bordered column).
Green shading = GES achieved;
Orange shading = GES not fully achieved;
Grey = unknown/indeterminate with respect to environmental status.

Linkages
Other primary criteria arising from Commission Decision (EU) 2017/848 that relate to and are relevant to this assessment of biological diversity are (paraphrased) as follows:

D2C1 - The number of non-indigenous species newly-introduced by human activities into the wild

D3C1 - Fishing mortality rate of populations of commercially-exploited species
D3C2 - Spawning Stock Biomass of populations of commercially-exploited species
D3C3 - Age & size distribution of individuals in populations of commercially-exploited species

D4C1 - The diversity of the trophic guild (species composition & relative abundance) is not adversely affected due to anthropogenic pressures
D4C2 - The balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures

D5C1 - Nutrient concentrations are not at levels that indicate adverse eutrophication effects
D5C2 - Chlorophyll a concentrations are not at levels that indicate adverse effects of nutrient enrichment

D6C1 - Spatial extent & distribution of physical loss (permanent change) of the natural seabed
D6C2 - Spatial extent & distribution of physical disturbance pressures on the seabed
D6C3 - Spatial extent of each habitat type which is adversely affected by physical disturbance
D6C4 - The extent of loss of the habitat type, resulting from anthropogenic pressures
D6C5 - The extent of adverse effects from anthropogenic pressures on the condition of the habitat type

D8C1 - Concentrations of contaminants in coastal & territorial waters, and beyond territorial waters
D8C3 - The spatial extent & duration of significant acute pollution events

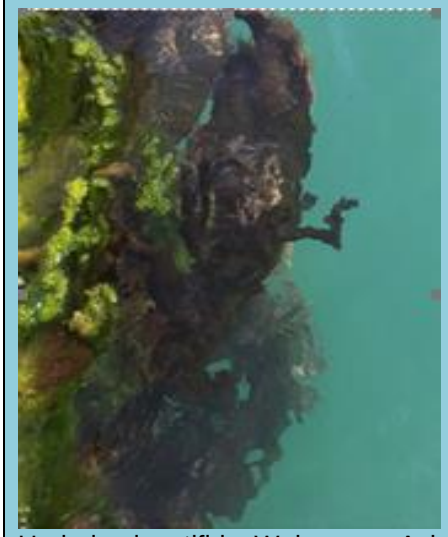
D10C1 - The composition, amount & spatial distribution of litter on the coastline, in the surface layer of the water column and on the seabed
D10C2 - The composition, amount & spatial distribution of micro-litter on the coastline, in the surface layer of the water column and in seabed sediment

D11C1 - The spatial distribution, temporal extent & levels of anthropogenic impulsive sound sources
D11C2 - The spatial distribution, temporal extent & levels of anthropogenic continuous low-frequency sound

Conclusion

Overall the assessment concluded that Ireland has achieved GES for some, but not all, assessed elements of biological diversity within its maritime area. Of seven representative higher predator species, six that consist of marine birds and mammals have achieved GES. The environmental status of one marine bird species (Black-legged kittiwake) and of Ireland's only commonly occurring marine reptile species, the Leatherback turtle, were assessed as unknown, however. Assessments undertaken for non-commercial fish species showed mixed results, with GES achieved for almost 20% of all species considered but the environmental status of a majority of species (41%) currently unknown; a further 18 out of 56 species were determined not to have achieved GES.

Non-indigenous Species - Descriptor 2



Undaria pinnatifida, Wakame or Asian kelp Photograph © Dr Stefan Kraan.

Summary

Ireland assessed the status of the marine environment against the primary criterion set out in the Commission Decision: the number of non-indigenous species which are newly introduced via human activity into the wild, per assessment period, is minimised and where possible reduced to zero.

Ireland has achieved Good Environmental Status within its maritime area for non-indigenous species. There have been three newly introduced species identified in Ireland's maritime area during the assessment period 2013-2018. While there are no established threshold values for this criterion at present, this number of introductions is considered low based on expert judgement and is comparable with the numbers of new NIS described in the OSPAR Intermediate Assessment (2017).

The two secondary criteria were not assessed as Ireland is not at risk of failing to achieve or maintain GES for this descriptor.

Introduction

In 2013 Ireland completed an Initial Assessment of its maritime area. At the time the assessment concluded that it was not possible to assess the current status of non-indigenous species (NIS) and that work was on-going on how best to improve the understanding of the presence, distribution, trends and impacts of NIS in the Irish Assessment Area.

The Commission Decision (EU) 2017/848 has led to developments in the methods of assessment for NIS.

Since the initial assessment progress has been made in the assessment of NIS through various research projects focused on quantifying the numbers of NIS in Irish marine waters.

Developments have also been made in implementing management processes aimed at minimising new introductions, including the development of a comprehensive Alien Species work programme focused on the aquaculture sector.

A broad assessment has been carried out in respect of the number of NIS which are newly introduced via human activity into the wild during the assessment period 2013 to 2018 (D2C1); this assessment shows that three new NIS introductions have been recorded during that period.

The three new introductions are:

- *Undaria pinnatifida*, Wakame or Asian kelp, encountered in Carlingford Lough, Co Louth in September 2014 and Dun Laoghaire Marina, Dun Laoghaire, Co. Dublin May 2017.
- *Schizoporella japonica*, a bryozoan, encountered in Greystones Marina, Co Wicklow in October 2015.
- *Perphora japonica*, a colonial sea squirt, encountered in Carlingford Lough, Co Louth in June 2013 and Annagh Island, Co. Mayo in August 2015.

In total 135 marine NIS have been encountered in Ireland's marine environment with records dating back as far as 1811.

Drivers

The driver for the introduction of NIS in Irish marine waters is economic development. The following activities are listed in the Commission Directive 2017/845, as drivers associated with NIS:

- Shipping;
- Tourism & Leisure;
- Fish & Shellfish Harvesting and Processing Industries.

Climate change effects may also drive NIS introductions. However, there is not enough known about climate change as a driver at this time.

Pressures

The pressures listed in the Directive associated with NIS are:

- Input or spread of non-indigenous species;
- Input of genetically modified species and translocation of native species;
- Loss of, or change to, natural biological communities due to cultivation of animal or plant species;
- Disturbance of species (e.g. where they breed, rest and feed) due to human presence.

Environmental Targets

Irelands Initial Assessment (2013) describes the characteristic of Good Environmental Status (GES) for Descriptor 2 as follows:

> "Good status is achieved when the risks and pathways from vectors which facilitate the introduction and spread of NIS as a result of human activities is significantly reduced by way of appropriate measures; and should they arrive, by applying, where feasible, practical and cost-effective means, to control or reduce their further spread".

The following targets were adopted in the 2013 Initial Assessment:

Target 1: Effect a reduction in the risk of introduction and spread of non-native species through the prioritisation of species and improved management of high risk pathways and vectors.

Target 2: The development of action plans for key high-risk marine non indigenous species by 2020.

Recognising the requirements of the Commission Decision (EU) 2017/848 and the amended Commission Directive (EU) 2017/845 the following environmental target has been established for the primary Criterion (D2C1):

Environmental Target D2T1
The number of NIS which are newly introduced via human activity into the wild, per assessment period is minimised and where possible reduced to zero.

Threshold Values
There are currently no threshold values associated with Descriptor 2. The development of regional and sub-regional threshold values for NIS have not been completed at this time.

Criteria / Criteria elements included in the Assessment
The Criterion from the Commission Decision (2017/848 EC) considered in this assessment is

- The number of NIS which are newly introduced via human activity into the wild per the assessment period (2013 to 2018), is minimised and where possible reduced to zero (D2C1).

Exclusions
There is no current evaluation under the two secondary criteria for Descriptor 2 namely:

- Criterion D2C2 (Abundance and spatial distribution of established NIS, particularly of invasive species, contributing significantly to adverse effects on particular species groups or broad habitat types) and
- Criterion D2C3 (Proportion of the species group or spatial extent of the broad habitat type which is adversely altered due to NIS, particularly invasive NIS).

Secondary criteria are used to complement the primary criteria when the marine environment is at risk of not achieving or not maintaining good environmental status for that criteria. In addition, there is currently insufficient data available on the abundance and spatial distribution of NIS in the Irish maritime area.

Impact
The impacts of NIS in Irish marine waters include:

- Loss of native biodiversity, including hybridisation and loss of genetic integrity
- Loss of recreational value
- Loss of ecosystem services, for example directly in mariculture increased time taken to clean mussel lines of Didemnum and indirectly, through the loss of potential seed sources with the banning of importing seed mussels from high risk areas.
- Transfer of diseases, including the potential for the loss to both farmed and wild stock.

Environment Status	**Linkages**
The number of NIS currently recognised in Irish marine waters is 135 based on records dating back as far as 1811. Three species are assessed as newly introduced during the period 2013-2018. Appropriate measures have been taken to control the vector risks and pathways described in the	Other Criteria and elements which relate to the D2C1 assessment are as follows: Descriptor 1 Biodiversity. Criterion 2 Population abundance.

Initial Assessment (2013), including the development of a comprehensive Alien Species work programme focused on the aquaculture sector and research projects focusing on quantifying NIS in Irish marine waters. The Ballast Water Convention has entered in-to force internationally however; the direct legal provision is not yet in-force in Ireland. Internationally ships are required to comply with its provisions and do so when entering Irish ports. The OSPAR Intermediate Assessment 2017[1] outlines the numbers of new NIS recorded in OSPAR by region. This assessment highlights that for the 6-year period 2009 to 2014 the mean member of new NIS recorder per region was as follows: • Greater North Sea (Region II) 7.67 • Celtic Seas (Regions III) 2.83 • Bay of Biscay & Iberian Coast (Region IV) 3.67 The 3 NIS newly recorded in the Irish MSFD area for the 6-year period 2013-2018 compares favourably with the OSPAR assessment figure for Region III (Celtic Seas).	Criterion 3 Population demographic characteristics. Criterion 6 Pelagic habitat condition. Descriptor 6 Sea-floor Integrity. Criterion 3 Spatial extent of habitat type. Criterion 4 Benthic habitat extent.

Conclusion

Significant progress has been made in identifying the number of NIS in Irish marine waters and three NIS have been recorded as newly introduced since 2013. Management processes aimed at minimising new introductions have been implemented.

Ireland has achieved Good Environmental Status within its maritime area for NIS. There have been three newly introduced species identified in Ireland's maritime area during the assessment period 2013-2018. While there are no established threshold values for this criterion at present, this number of introductions is considered low based on expert judgement and is comparable with the numbers of new NIS described in the OSPAR Intermediate Assessment (2017).

[1] https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/pressures-human-activities/non-indigenous/

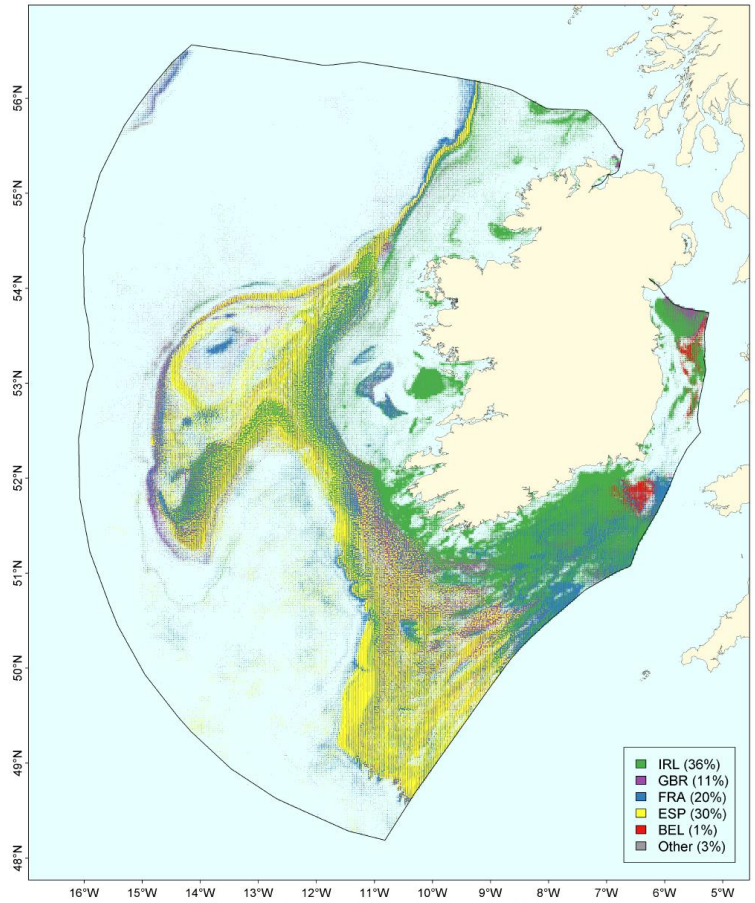
Populations of Commercial Fish and Shellfish - Descriptor 3

Summary

In relation to populations of all commercially-exploited fish and shellfish species, the status of 177 stocks within Ireland's maritime area was assessed. The assessment also included important commercially-exploited crustacean species (e.g. prawn, shrimp, edible crab). It did not include cephalopod species or some species of coastal fish since the necessary biological information and data collection schemes to support such assessments are not currently in place.

A key finding of the assessment is that a total of 34 stocks (18%) have achieved GES, while the environmental status of 99 stocks (60%) is currently unknown. In the case of 44 other stocks (22%), GES has not been achieved.

A direct comparison with Ireland's initial assessment for the same 52 stocks considered in 2013 showed a 70% improvement in the number of stocks that have achieved GES with an almost 70% reduction in the number of stocks whose environmental status is unknown. There has been a notable and substantial improvement in Fishing mortality, assessed under criterion D3C1 set out in Commission Decision 2017/848. Of the commercially-exploited stocks that were assessed in both cycles, there was an 80% improvement in stocks meeting the requirement for the achievement of GES under this criterion.



▲ The nationality of vessels ≥15m fishing in the Irish EEZ (all gears combined). IRL = Ireland; GBR = United Kingdom; FRA = France; ESP = Spain; BEL = Belgium. The percentages in the legend refer to the share of the total effort inside the EEZ for each country.

Distribution map of fishing effort within Ireland's EEZ by Irish and non-Irish registered vessels.
(Marine Institute)

Introduction

In 2013, Ireland completed an Initial Assessment of its maritime environment under the MSFD. At that time the assessment concluded that the current status of fish and shellfish stocks, in terms of their contribution to the achievement of GES, could not be fully determined because a number of stocks had not been evaluated against specific Maximum Sustainable Yield (MSY) reference points. The European Commission Decision (EU) 2017/848 has led to revisions in how commercial stocks are to be assessed, and it set out the criteria by which all stocks should be included and evaluated in the assessment. An assessment was thus carried out in respect of the criteria in this Commission Decision.

Fisheries in Ireland's maritime area are managed both under the EU's Common Fisheries Policy (CFP) and nationally for stocks not subject to the EU quota regime. This assessment covered the stocks which are fished commercially in Irish maritime waters. Many of these stocks straddle the boundary between Ireland and other jurisdictions, while some are exploited in Irish waters but not by Irish-registered vessels. The relevant criteria for inclusion of stocks in the assessment was based on Commission Decision 2017/848.

The objective of this updated assessment under MSFD Descriptor 3 was to meet the requirements of Articles 8, 9 and 10 of the Directive concerning qualitative descriptors for determining GES; this applied individually and collectively for fish and shellfish stocks being caught in Irish MSFD waters.

Drivers

In fishing stock assessment terms, Ireland's maritime area is considered a subset of the "Celtic Seas ecoregion" – as defined by the International Council for Exploration of the Sea (ICES). This ecoregion supports some of the most productive fishing grounds in Europe. At least 8 major fishing nations currently have fisheries targeting the many marine stocks within this area. The greatest volume of landings is caught by Norway, UK, Ireland, the Netherlands and France. Lesser amounts are landed by Germany, Spain and Belgium.

These fisheries target a large number of stocks. The pelagic fisheries, which account for the largest catches (by weight) in the region, are the mid-water trawl fisheries for blue whiting, mackerel, horse mackerel, herring, boarfish and sprat. The largest demersal fishery targets hake along the continental shelf edge using gill-nets and long-lines. There are also large mixed bottom-trawl fisheries targeting demersal and benthic species including *Nephrops* and gadoids. The species composition of these mixed fisheries tends to vary, depending on the area and the fishing fleets of countries involved in the fishery. In addition, there are many inshore fisheries which

Pressures

The predominant pressure exerted by commercial fishing in Irish waters was identified as extraction of or mortality/injury to wild species by commercial fishing. Such extraction of fish or shellfish from a stock leads to the fishing mortality of target species and also of non-target species (i.e. incidental by-catch).

Other pressures from commercial fishing which were identified in Irish waters were abrasion, the incidental loss of species and the introduction of marine/coastal litter.

take place within 6-12 nautical miles (nm) from the coast and which mostly use static fishing gears (i.e. gill-nets, trammel nets, tangle nets). Landings from fleets such as those registered in Ireland, Norway, the Netherlands, Germany and Denmark are dominated by pelagic species. Other EU fleets target a combination of pelagic, demersal (including *Nephrops*), deep-water and shellfish or crustacean species. France's fleet has the highest reported fishing effort. Effort levels for most countries show declining trends with the most pronounced decline seen in the effort by Spanish-registered vessels. In addition to the above, inshore fishing takes place within 12 nm of the Irish coast, while fishing from the coastal baselines out to 6 nm is limited to Republic of Ireland and Northern Ireland owned and operated vessels.	

Environmental Targets

Irelands Initial Assessment (2013) described the characteristic of Good Environmental Status (GES) for populations of commercially-exploited fish and shellfish as follows:

> Populations of commercially exploited fish and shellfish are within safe biological limits. Stocks of commercially exploited fish and shellfish species are exploited at levels which ensure long term sustainability and maintenance of sufficient reproductive capacity. Populations exhibit a healthy composition with regard to age and size distribution. Consistency to be maintained in accordance with the progressing reform of the EU Common Fisheries Policy.

The associated targets outlined in the Initial Assessment (2013) were as follows:

- Target fishing mortality to be at levels which aim to restore and maintain populations of harvested species at least at levels which can produce the maximum sustainable yield, by 2015, where possible. Where stocks are managed within an agreed management plan, which is consistent with MSY in the long term, target fishing mortality as specified by the management plan should be adhered to;
- Target fishing mortality to be at levels which aim to restore and maintain populations of harvested species at least at levels which can produce the maximum sustainable yield, by 2020, for all stocks. Where stocks are managed within an agreed management plan, which is consistent with MSY in the long term, target fishing mortality as specified by the management plan should be adhered to;
- Spawning Stock Biomass (SSB) should be within the range of biomasses which would be expected under fishing mortality equal to or below FMSY in the medium to long term, and incorporate scientific uncertainty and natural variability;

- Size and age structure, as measured by selected indicators, reflect populations which are sustainably fished in the medium to long term, and incorporate scientific uncertainty and natural variability.

The environmental targets from the Initial Assessment have now been replaced in light of Commission Decision (EU) 2017/848 and amending Commission Directive (EU) 2017/845. Ireland has now established the following environmental targets, based on the revised Common Fisheries Policy Regulation (EU) 1380/2013, which stipulates that

> "in order to reach the objective of progressively restoring and maintaining populations of fish stocks above biomass levels capable of producing maximum sustainable yield, the maximum sustainable yield exploitation rate shall be achieved by 2015 where possible and, on a progressive, incremental basis at the latest by 2020 for all stocks."

Environmental Target D3T1
The Fishing mortality rate of populations of commercially exploited species is at or below levels which can produce the maximum sustainable yield (MSY).

Environmental Target D3T2
The Spawning Stock Biomass of populations of commercially-exploited species are above biomass levels capable of producing maximum sustainable yield (MSY).

Threshold Values
The threshold value for the proportion of stocks required to be achieving GES is 100% following the Common Fisheries Policy Regulation (EU) 1380/2013.

Criteria / Criteria elements included in the Assessment
The criteria from Commission Decision 2017/848 considered in this assessment were:

D3C1 - The *Fishing mortality* rate of populations of commercially-exploited species is at or below levels which can produce the maximum sustainable yield (MSY). Appropriate scientific bodies shall be consulted in accordance with Article 26 of Regulation (EU) No 1380/2013.

D3C2 - The *Spawning Stock Biomass* of populations of commercially-exploited species are above biomass levels capable of producing maximum sustainable yield (MSY). Appropriate scientific bodies shall be consulted in accordance with Article 26 of Regulation (EU) No 1380/2013.

ICES advises that the aggregation of the assessment results for criteria D3C1 and D3C2 by stock should be done such that only if both criteria are met would GES be achieved for that stock.

Exclusions
Criterion D3C3 (i.e. the age and size distribution of individuals in the populations of commercially-exploited species is indicative of a healthy population) was not included in the assessment. This exclusion was based on ICES (2017) advice that until proof of concept has been validated, D3C3 could not be considered as operational for MSFD assessment purposes.

Impact

ICES has evaluated the main impacts of fishing on the marine environment as extraction, abrasion and smothering. Among the parameters and characteristics specified in Commission Directive 2017/845 that are likely to be impacted upon by fisheries are changes to:

- distribution and/or biomass;
- size, age and sex structure, fecundity, survival and mortality/injury;
- behaviour including movement and migration;
- habitat for the species (extent, suitability);
- species composition within groups of species.

Extraction of, or mortality/injury to, wild species by fishing and other activities impacts on food-webs, benthos, populations of fish, seabirds and mammals, for example. Such extraction of fish or shellfish from a stock through fishing activities is measured as *Fishing mortality* and is denoted the abbreviated term "*F*".

Physical disturbance (i.e. abrasion and smothering) of the seabed by fishing impacts on marine habitats in general, on benthos and on marine productivity. Abrasion is associated with bottom-contacting mobile and set-net fishing activities, in particular scallop dredging, beam trawling and otter trawling but also other activities such as anchoring and hydro-dynamic dredging. Smothering refers to an impact arising from changes in siltation on the seabed. Associated maritime activities include maintenance dredging for shipping lanes and channels, disposal or deposition of materials onto the seafloor and some bottom-contact commercial fishing, for example.

Environment Status

The assessment of Good Environmental Status (GES) for commercial fish and shellfish stocks was based on whether stocks were fished at or below a rate that is consistent with the maximum sustainable yield (MSY), and whether their spawning stock biomass was above the level that can produce MSY.

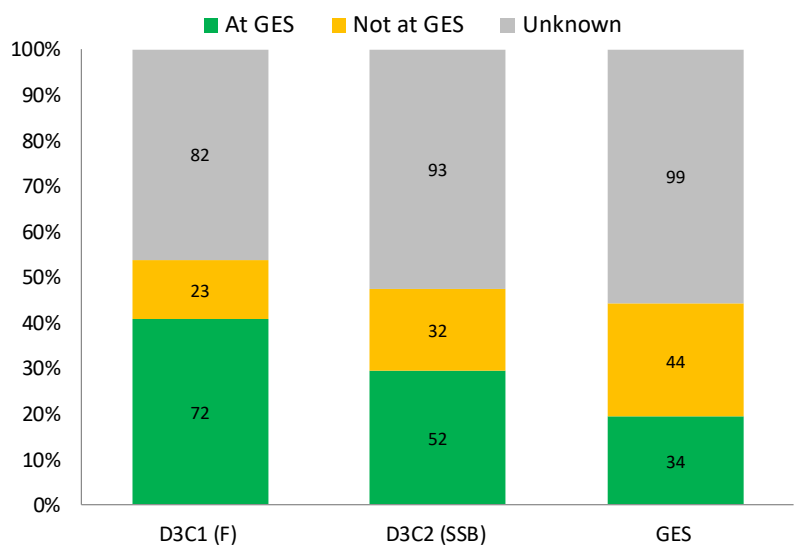
The current assessment of Descriptor 3 found that a total of 34 stocks (18%) have achieved GES, while the environmental status of 99 stocks (60%) is currently unknown. In the case of 44 other stocks (22%), GES has not been achieved.

For pelagic fish, the assessment found that three stocks have achieved GES, five stocks have not achieved GES and the environmental status of six stocks is currently unknown. For demersal fish, 10 stocks are found to have achieved GES, 18 stocks have not achieved GES and the environmental status of 18 further stocks is currently unknown.

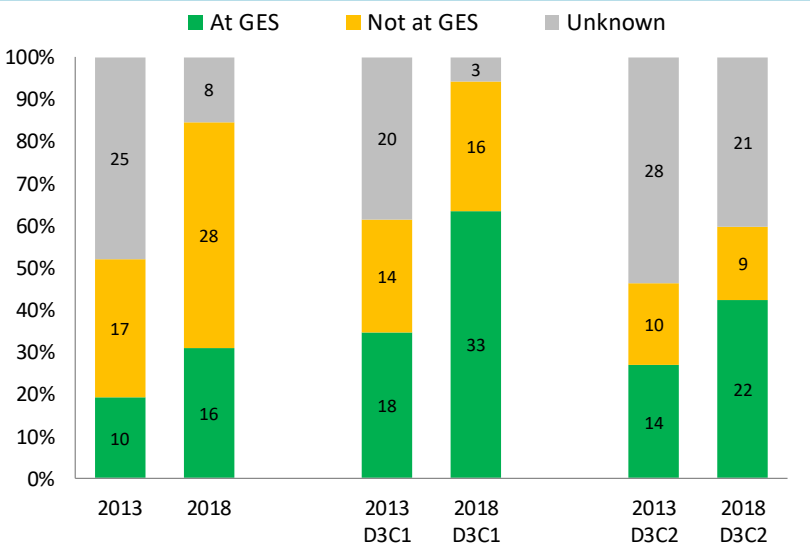
Of demersal shellfish stocks, 10 have achieved GES, four stocks have not achieved GES and the environmental status of eight stocks is currently unknown. For coastal shellfish stocks, GES has been achieved for nine stocks while 15 stocks have not achieved GES and the environmental status of 23 stocks is currently unknown.

Of the elasmobranch stocks being commercially exploited, the environmental status of most stocks (n=16) is currently unknown, one stock (i.e. Blue shark) has achieved GES, while two other stocks have not achieved GES. Among the

remaining commercially-exploited stocks in Irish waters, the environmental status of all cephalopod stocks and coastal fish is unknown. This aspect will require more work, particularly for coastal fish species that are currently targeted for commercial purposes.



The percentage and number of stocks that have conformed to criterion D3C1 (left), to criterion D3C2 (middle), and have achieved GES overall in 2018 (right). Stocks in this assessment included those managed with Total Allowable Catches (TACs) and also those not managed with TACs.



Comparison of the percentage and the number of comparable stocks that have achieved GES overall (left), have achieved the requirements of D3C1 (middle), and have achieved the requirements of D3C2 (right), based on Ireland's Initial Assessment (2013) and the current one (2018).

A direct comparison with the 2013 Initial Assessment for the same 52 stocks showed a 70% improvement in the number of stocks that have achieved GES, with an almost 70% reduction in the number of stocks whose environmental status is

unknown. Comparing between criteria, an increase was shown in both the number of stocks being exploited sustainably (i.e. meeting the requirements of criterion D3C1) and the associated stock sizes being sustainable at current fishing levels (i.e. meeting the requirements of criterion D3C2).

Linkages

Other primary criteria arising from Commission Decision (EU) 2017/848 that relate to and are relevant to this assessment of commercially-exploited fish and shellfish populations are (paraphrased) as follows:

D1C1 - The mortality rate per species from incidental by-catch is below levels which threaten the species.

D1C2 - The population abundance of the species is not adversely affected due to anthropogenic pressures.

D1C4 - The species distributional range and, where relevant, pattern is in line with prevailing physiographic, geographic and climatic conditions.

D1C5 - The habitat for the species has the necessary extent and condition to support the different stages in the life history of the species.

D4C1 – The diversity of the trophic guild (species composition & relative abundance) is not adversely affected due to anthropogenic pressures.

D4C2 – The balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures.

D6C1 – Spatial extent & distribution of physical loss (permanent change) of the natural seabed.

D6C2 – Spatial extent & distribution of physical disturbance pressures on the seabed.

D6C3 – Spatial extent of each habitat type which is adversely affected by physical disturbance.

D6C4 – The extent of loss of the habitat type, resulting from anthropogenic pressures.

D6C5 – The extent of adverse effects from anthropogenic pressures on the condition of the habitat type.

D10C1 – The composition, amount & spatial distribution of litter on the coastline, in the surface layer of the water column and on the seabed.

D11C2 - The spatial distribution, temporal extent & levels of anthropogenic continuous low-frequency sound.

Conclusion

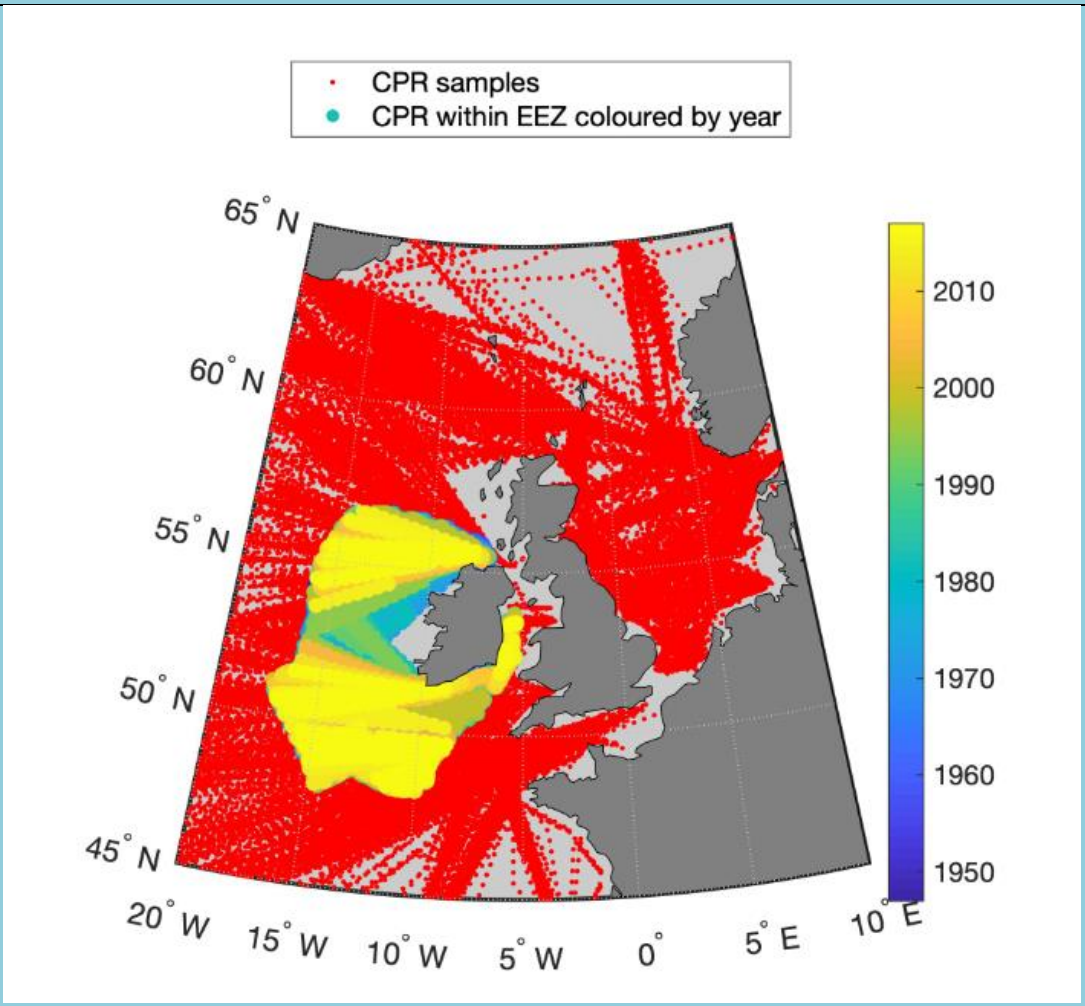
The current status of 177 commercial fish, crustacean and shellfish stocks within Ireland's maritime area was assessed. It is concluded that a total of 34 stocks have achieved GES, while the environmental status of 99 stocks is currently unknown. In the case of 44 other stocks, GES has not been achieved.

There has been a substantial improvement in the Fishing mortality metric for populations targeted by commercial fisheries, as measured under criterion D3C1. Of the commercial stocks assessed in both MSFD cycles to date, there was an 80% improvement in stocks meeting the GES requirement under this criterion.

Elements of Marine Food Webs - Descriptor 4

Summary
Progress towards the achievement of Good Environmental Status (GES) was assessed for elements of the marine food webs within the "Celtic Seas ecoregion", which incorporates the Irish maritime area. The assessment followed OSPAR Common Indicator methodologies and concentrated on three trophic guilds: for phyto-plankton, zoo-plankton and fish species. Due to current limitations around methods, data availability and integration models, higher trophic guilds (e.g. marine birds, mammals, other top predators) were not included in this assessment.

A key finding of the assessment was that the environmental status of Ireland's marine food webs is currently unknown. There was evidence that components of the food webs are changing but it was not clear how they are affecting each other or the extent to which this is due to anthropogenic influence or associated pressures. Marine food webs are complex systems to gather detailed information on and to interpret with scientific accuracy. This is particularly the case in Ireland's diverse and variable marine environment.



Continuous Plankton Recorder (CPR) survey coverage within the Irish maritime area and neighbouring waters of the North-East Atlantic, colour coded blue to yellow by year. (Marine Institute / University of Plymouth)

Introduction

In 2013 Ireland completed an Initial Assessment of its maritime area. At that time, the habitat and species assessments produced were used as a starting point from which future assessments of food web elements was planned. Commission Decision (EU) 2017/848 subsequently led to changes in the criteria for assessing GES with regard to ecosystems, including elements of the marine food webs. An assessment has now been carried out in respect of the criteria in this Commission Decision.

Marine food webs are complex and those in Irish marine waters particularly so. This is partly due to environmental and habitat variability, and changes in conditions in space and time. The relationships of all elements within marine food webs collectively form one of the most difficult descriptors of the MSFD to assess. In this regard there are currently no suitable common indicators for the food web primary criteria D4C1 and D4C2 as defined in Commission Decision 2017/848.

This updated assessment set out to evaluate Ireland's marine ecosystems, including food webs, as far as possible in the light of Commission Decision 2017/848. The objective was to meet the requirements of MSFD Articles 8, 9 and 10 concerning qualitative descriptors for determining GES, in this case specifically Descriptor 4, i.e. that "all elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity" (Directive 2008/56/EEC).

The assessment carried out for this Descriptor was conducted for the "Celtic Seas ecoregion" as a whole, as defined by the International Council for the Exploration of the Sea (ICES). This was considered to be indicative of the Irish MSFD area, which is a sub-set of the wider ecoregion within the North-East Atlantic.

Drivers

The predominant human activity driving pressures on marine food webs, based on Commission Directive 2017/845 is the extraction of living resources (fish and shellfish harvesting). At least eight major fishing nations currently have commercial fisheries operations targeting the many stocks within Ireland's diverse maritime area. Detailed descriptions of this driver are provided in the assessment undertaken for Descriptor 3 (i.e. populations of commercially-exploited fish and shellfish).

Other relevant activities acting as drivers of pressure on elements of marine food webs are the cultivation of living resources (e.g. by aquaculture, agriculture and forestry) and urban and industrial uses, such as waste treatment and disposal.

Pressures

The predominant pressure exerted on elements of marine food webs in Irish waters is the extraction of or mortality/injury to wild species by commercial fishing. This is defined as a pressure under Commission Directive 2017/845. Other relevant pressures, particularly in coastal waters, include the input of nutrients and inputs of organic matter into the marine environment.

Environmental Targets

Irelands Initial Assessment (2013) described the characteristics of Good Environmental Status (GES) for elements of marine food webs as follows:

- Abundance, distribution, extent and condition of key species is in line with prevailing physiographic, geographic and climate conditions or are indicative of sustainable exploitation;
- Age and size structure of key species is in line with prevailing physiographic, geographic and climate conditions or are indicative of sustainable exploitation;
- Vulnerable (long-lived, slowly reproducing) species populations are maintained in line with prevailing physiographic, geographic and climate conditions or are indicative of sustainable exploitation.

In the light of Commission Decision (EU) 2017/848 and amending Commission Directive (EU) 2017/845, Ireland has now established the following environmental targets for elements of marine food webs:

Environmental Target D4T1

The diversity (species composition and their relative abundance) of the trophic guild is not adversely affected due to anthropogenic pressures.

Environmental Target D4T2

The balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures.

Threshold Values

There are currently no established threshold values for elements of marine food webs and the development of regional or sub-regional threshold values has not yet been undertaken. Coordinated work will be required nationally and internationally in the future in order to support the ability to coherently and robustly assess key elements and trophic guilds against such targets.

Criteria / Criteria elements included in the Assessment

The indicators selected for this assessment were consistent with the requirements of Commission Decision 2017/848, that assessments should consider at least three trophic guilds. However, the assessment did not fully integrate across the selected guilds. The two primary criteria under Descriptor 4 that were dealt with in this assessment are follows:

D4C1 - The diversity (species composition and their relative abundance) of the trophic guild is not adversely affected due to anthropogenic pressures. [Note: This was assessed for fish species]

D4C2 - The balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures. [Note: This was assessed for phyto-plankton and zoo-plankton]

The fish assessment under criterion D4C1 used the OSPAR Common Indicator of mean maximum length of fish, which was calculated using catch data from scientific surveys for demersal and pelagic species separately.

The assessment of plankton communities followed the methodologies of the OSPAR Common Indicators PH1/FW5. The assessment of plankton biomass drew on OSPAR Common Indicator PH2. These indicators use data from Continuous Plankton Recorder (CPR) transect surveys taking place in Irish and neighbouring waters of the North-East Atlantic. The time series of these surveys spans 1958 to 2014.

Exclusions

The current assessment covered primary criteria D4C1 (fish only) and D4C2 (phyto-plankton and zoo-plankton only). This was because there are no agreed international common indicators or threshold values covering all of these elements for Irish waters, for any trophic guild. Secondary criteria D4C3 and D4C4 were not included in the assessment. In addition, the assessment did not include higher trophic guilds such as marine mammals or birds, for example. The time series for the fish assessment under criterion D4C1 was quite short because survey time series in Irish waters are relatively short thus far. Considerable work will be required in the future to develop indicators covering both primary criteria for several trophic guilds.

Impact

The parameters and characteristics specified in Commission Directive 2017/845 that are likely to be impacted upon by anthropogenic pressures can be divided into species impacts, habitat impacts and ecosystem/food web impacts.

The main species impacts are changes to:

- distribution and/or biomass;
- behaviour including movement and migration;
- habitat for the species (extent, suitability);
- species composition within groups of species.

The main habitat impacts are changes to species composition, abundance and/or biomass (spatial and temporal variation).

The main ecosystem impacts can be summarised as changes to:

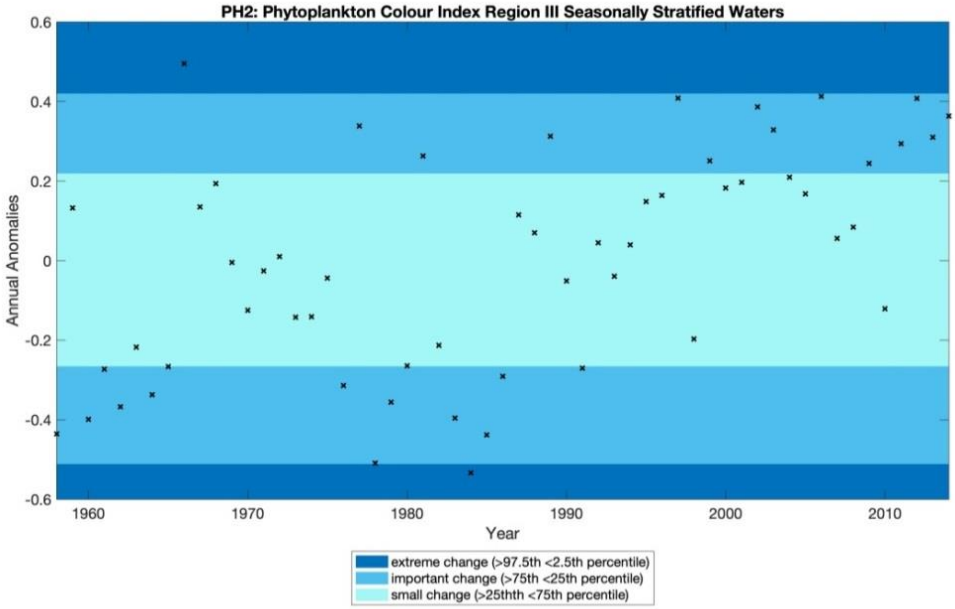
- links between habitats and species of marine birds, mammals, reptiles, fish and cephalopods;
- pelagic-benthic community structure;
- productivity.

Environment Status

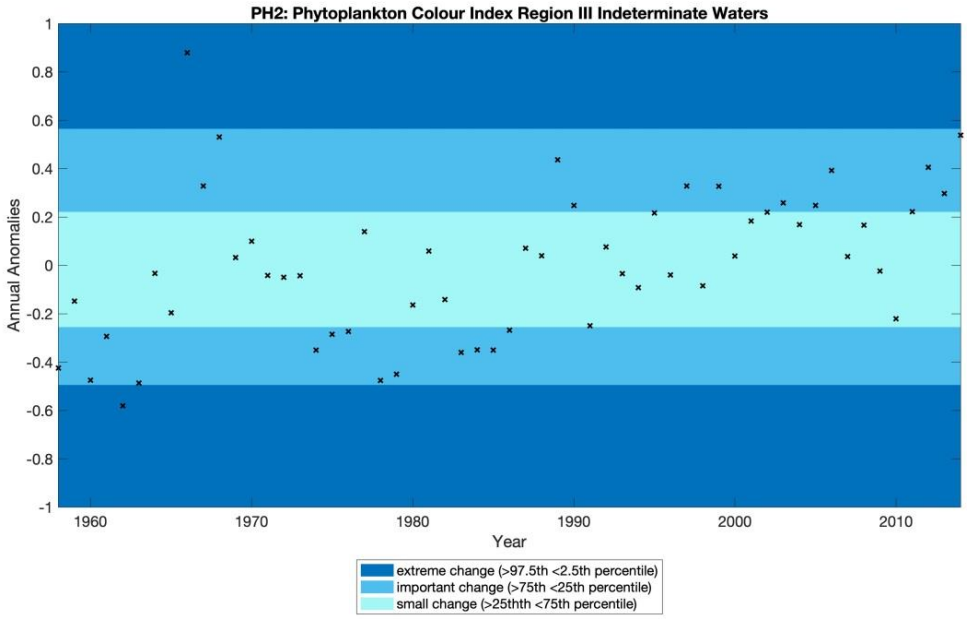
The assessment determined that there has been an increase in phyto-plankton and a decrease in zoo-plankton numbers (particularly the small copepods) in recent years compared with the 1960s. In the Celtic Seas as a whole, phyto-plankton biomass showed variability across years with an increase since the mid 1980s. In contrast, zoo-plankton biomass showed an overall decline throughout the time series, but particularly since the late 1980s. This assessment, although an initial determination under these criteria, showed that changes have occurred, highlighting potential issues or implications for the wider marine ecosystem.

Within the plankton community the assessment found that there have been significant changes in community structure and energy flows. The strongest change was observed between small and large copepods and between non-carnivorous and carnivorous zoo-plankton, indicative of food web structure and energy flow between trophic groups. The holo-plankton and mero-plankton life-form pair has also undergone significant change, suggesting changes in linkage between the benthic and pelagic components of the ecosystem. The only non-significant change was in harmful algal bloom-causing diatoms and dinoflagellates, though further work needs to be done to refine this comparison.

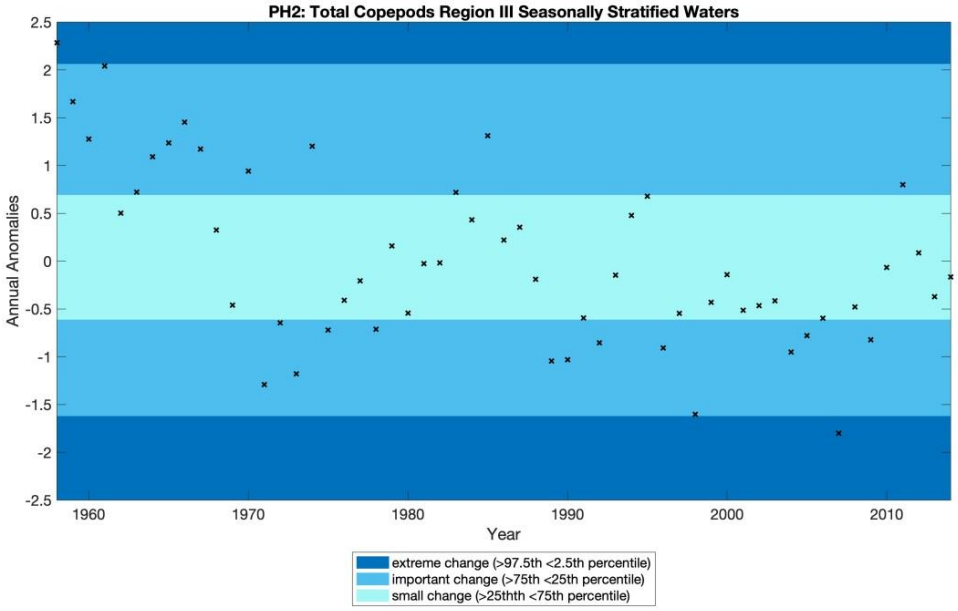
For fish under Criterion D4C1, local increases and decreases were described but for the greater part of Irish waters the situation was described as unclear. Demersal fish size was found to have decreased along the continental shelf edge waters to the west of Ireland and near some coasts, but increased to the south of Ireland. For the pelagic fish community there were increases found in the central Irish Sea and the Celtic Sea.



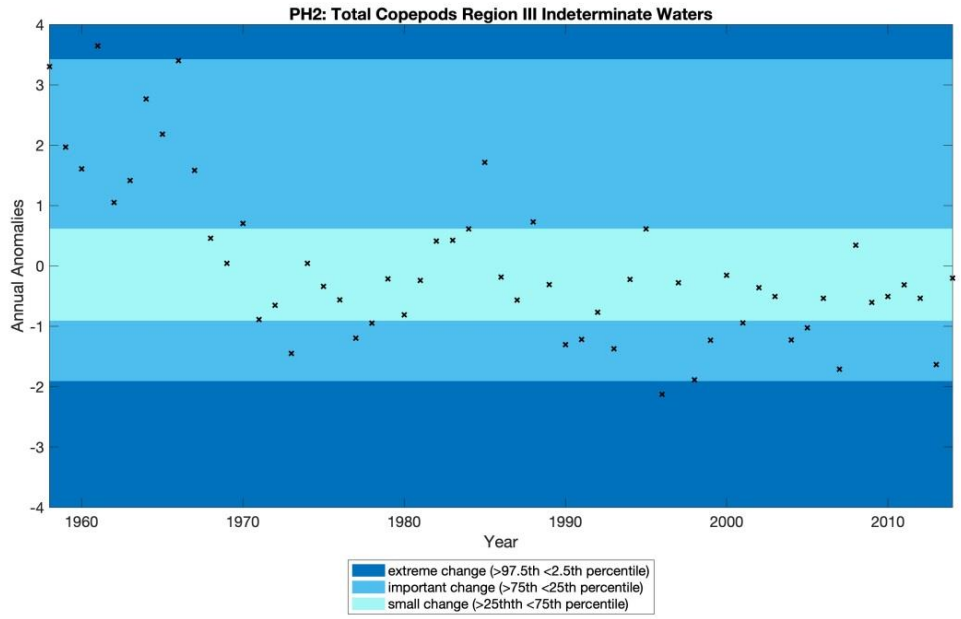
Annual anomalies for phyto-plankton colour index for the Celtic Seas, for seasonally stratified waters, over the period 1958–2017.



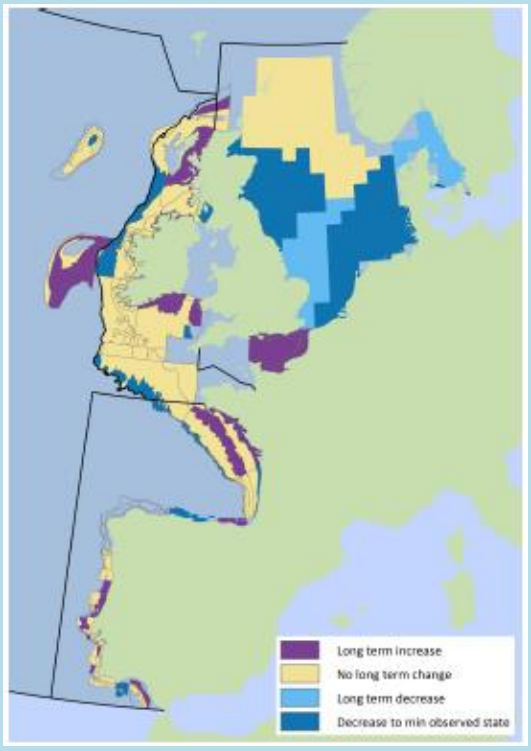
Annual anomalies for phyto-plankton colour index for the Celtic Seas, for indeterminate waters, over the period 1958–2017.

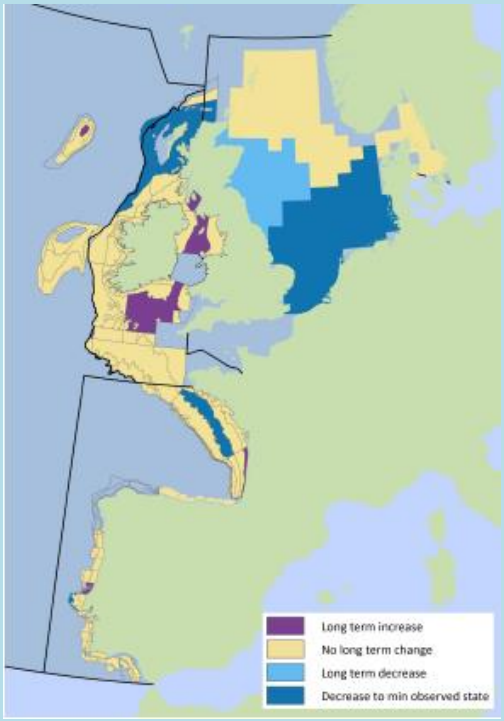


Annual anomalies for zoo-plankton abundance (total copepods) for the Celtic Seas, for seasonally stratified waters, over the period 1958–2017.



Annual anomalies for zoo-plankton abundance (total copepods) for the Celtic Seas, for indeterminate waters, over the period 1958–2017.





Spatial patterns and trends of mean maximum length of fish (left demersal fish, right pelagic fish).

Linkages

Other primary criteria arising from Commission Decision (EU) 2017/848 that relate to and are relevant to this assessment of elements of marine food webs are (paraphrased) as follows:

D1C1 - The mortality rate per species from incidental by-catch is below levels which threaten the species.

D1C2 - The population abundance of the species is not adversely affected due to anthropogenic pressures.

D1C4 - The species distributional range and, where relevant, pattern is in line with prevailing physiographic, geographic and climatic conditions.

D1C5 - The habitat for the species has the necessary extent and condition to support the different stages in the life history of the species.

D1C6 – The condition of the habitat type, including its biotic and abiotic structure and its functions.

D3C1 – Fishing mortality rate of populations of commercially-exploited species

D3C2 – Spawning Stock Biomass of populations of commercially-exploited species.

D3C3 – Age & size distribution of individuals in populations of commercially-exploited species.

D5C1 – Nutrient concentrations are not at levels that indicate adverse eutrophication effects.

D5C2 – Chlorophyll a concentrations are not at levels that indicate adverse effects of nutrient enrichment.

D6C1 – Spatial extent & distribution of physical loss (permanent change) of the natural seabed.

D6C2 – Spatial extent & distribution of physical disturbance pressures on the seabed.

D6C3 – Spatial extent of each habitat type which is adversely affected by physical disturbance.

D6C4 – The extent of loss of the habitat type, resulting from anthropogenic pressures.

D6C5 – The extent of adverse effects from anthropogenic pressures on the condition of the habitat type.

Conclusion

While there were changes evident in marine food webs, as demonstrated via plankton communities, the nature and source of environmental features or pressures that are driving changes in life-forms remain unclear. It would appear that prevailing physiographic conditions are the overall driver of change to complex systems such as marine food webs but a level of human influence cannot be discounted at this stage. For the fish trophic guild, the overall situation was unclear. The overall conclusion is that the environmental status of the marine food webs in Ireland’s maritime area is currently unknown.

Eutrophication - Descriptor 5

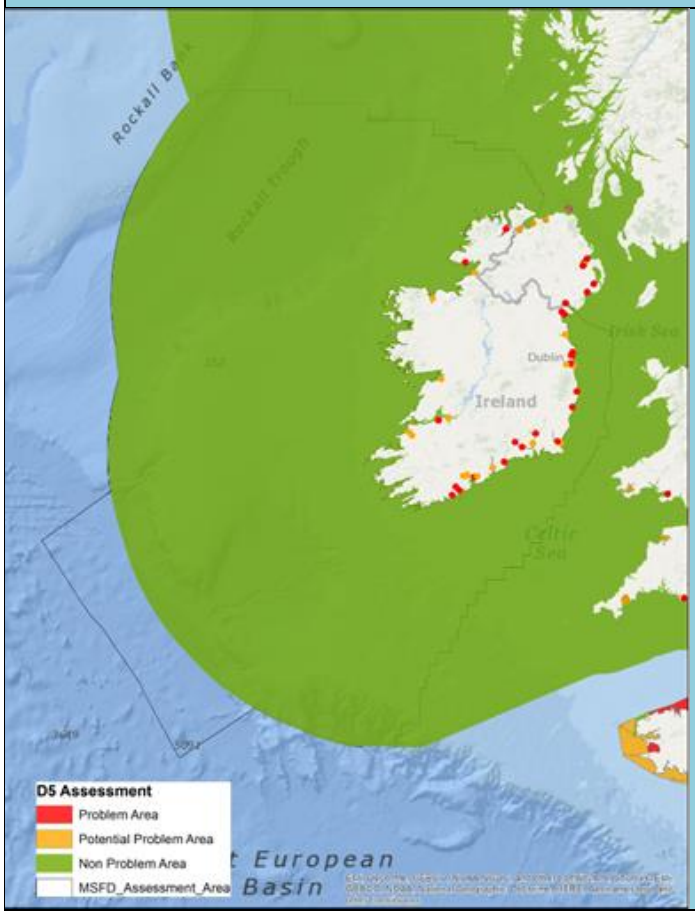
Summary

Ireland assessed the status of the marine environment against the three primary criteria set out in the Commission Decision: Nutrients, Chlorophyll a and dissolved oxygen with the threshold values for these criteria based on the Water Framework Directive for inshore waters and estuaries and OSPAR for the wider MSFD area.

Ireland has achieved Good Environmental Status for eutrophication within its maritime area, for the three primary criteria assessed; nutrients, chlorophyll a and dissolved oxygen.

This assessment has shown that the areas considered at risk of eutrophication are located inshore, predominantly along the eastern, south eastern and southern coasts. The coastal and offshore areas show no indications of eutrophication and trend analysis shows no change in nutrient levels of Ireland's marine waters. Overall, the proportion of Ireland's maritime area that is classified as a problem area with regard to eutrophication is 286 km^2 or 0.05% of the maritime area and is restricted to estuarine and nearshore coastal waters. These areas fall under the remit of the WFD which has established programmes of measures to ensure that the environmental objectives that have been set for these waters are met.

The five secondary criteria were not assessed because Ireland is not at risk of failing to achieve or maintain GES for this descriptor.



OSPAR Eutrophication Assessment result in Irish Waters (2009-2014).

Introduction

In 2013 Ireland competed an Initial Assessment of its maritime area. At that time, the assessment concluded that for Descriptor 5 it was likely that the Irish MSFD were at GES. The Commission Decision (EU 2017/848) rationalised the targets into a new set of criteria for assessing progress towards GES. These are broadly consistent with those used in the initial assessment.

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". The OSPAR Common Procedure (OSPAR, 2005) uses a set of indicators to evaluate the eutrophic status of the maritime so that OSPAR countries can define 'problem areas', 'potential problem areas' and 'non-problem areas'. For the most recent assessment (2009-2014), Ireland assessed 83 inshore areas using the full procedure and the larger offshore areas were screened to look for any indication of elevated nutrients. In nearshore and estuarine waters, assessments of nutrient and associated biological quality elements are undertaken for the WFD, the most recent of which covers the years 2013-2018 (EPA, 2019).

Drivers

The drivers of eutrophication are those which have the potential to impact on nutrient inputs into the marine environment.

Based on Commission Directive 2017/845 the human activates currently occurring in Ireland that drive the pressure causing eutrophication are:

- Cultivation of living resources (agriculture & forestry);
- Urban and industrial uses (including waste treatment and disposal).

Most of these come from land based activities and in the most recent river basin management plan the most important drivers were identified as agriculture (53%), urban waste-water (20%), domestic waste-water (11%) and urban runoff (9%). While agriculture is the most prevalent pressure identified in the plan it is also the largest land use making it a key driver of eutrophication. Across the wider MSFD area, atmospheric depositions of nitrogen must also be considered, however modelling work

Pressures

Elevated nutrient concentrations (phosphorus and nitrogen) continue to be the most widespread water-quality problem in Ireland. Monitoring of nutrient inputs from 19 major Irish rivers to estuarine and coastal waters has been ongoing since 1990. Measuring these inputs provides a useful indicator of trends in the transfer of nutrients from land-based sources. The inputs are calculated based on nutrient concentrations, which are measured 12-times a year, and river flow, which is measured continuously.

Nutrient inputs from Irish rivers have varied over the 29 years since monitoring began. Loads of total nitrogen were highest in the 1990s, then decreased until 2013. The reductions indicated the success of national measures aimed at reducing the loss of nutrients from terrestrial sources to surface waters. Since 2014 however, the trend has reversed and we are now seeing an increase in nutrient inputs to the marine environment. In recent years average total nitrogen in 2016–2018 has increased by 8,806 tonnes (16%) since

undertaken by OSPAR have shown this to be low in the Celtic seas.	2012–2014. Average total phosphorus rose by 329 tonnes (31%) over the same period undoing improvements made over previous years.

Environmental Targets

Irelands Initial Assessment (2013) describes the characteristic of Good Environmental Status (GES) for Descriptor 5 as follows:

> "Human induced eutrophication is minimised and nutrient levels do not cause an accelerated growth of algae or 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".

The environmental targets from the Initial Assessment have been updated in light of the Commission Decision (EU) 2017/848 and amending Commission Directive (EU) 2017/845, Ireland now proposes the following environmental target based on the essential elements assessed:

Environmental Target D5T1

Nutrient concentrations are not at levels that indicate adverse eutrophication effects.

> This target brings the 2013 target (Winter dissolved inorganic nitrogen and phosphorus concentration should not exceed the Environmental Quality Standard laid down in national legislation and the corresponding area specific assessment levels used by Ireland in the application of the OSPAR Common Procedure) into alignment with the Commission Decision Criterion D5C1.

Environmental Target D5T2

Chlorophyll a concentrations are not at levels that indicate adverse effects of nutrient enrichment.

> This target brings the 2013 target (Median and 90%ile chlorophyll levels in Water Framework Directive defined coastal water bodies should not exceed the Environmental Quality Standards laid down in national legislation implementing the Water Framework Directive (SI 272 of 2009)) into alignment with the Commission Decision Criterion D5C2.

Environmental Target D5T5

The concentration of dissolved oxygen is not reduced, due to nutrient enrichment.

> This target brings the 2013 target (For Water Framework Directive defined coastal water bodies, dissolved oxygen saturation should be consistent with the environmental quality standard specified in national legislation implementing the Water Framework Directive (SI 272 of 2009), except in the case of seasonally stratified waters, where the dissolved oxygen concentration (as a 5%ile) in bottom water should remain above area specific assessment levels (e.g. 5.0 to 6.0 mg/l)) into alignment with the Commission Decision Criterion D5C5.

Threshold Values

The threshold values associated with these Targets are as follows:

D5T1 Nutrient concentrations are not at levels that indicate adverse eutrophication effects
Nitrogen and Phosphorus concentrations are below the levels set for WFD assessments in inshore waters and estuaries (SI 77/2019) and those used in the OSPAR Intermediate Assessment 2017 for the wider MSFD area.

D5T2 Chlorophyll a concentrations are not at levels that indicate adverse effects of nutrient enrichment
Chlorophyll concentrations are below the levels set for WFD assessments in inshore waters and estuaries (SI 77/2019) and those used in the OSPAR Intermediate Assessment 2017 for the wider MSFD area.

D5T5 The concentration of dissolved oxygen is not reduced, due to nutrient enrichment
Oxygen concentrations are above the levels set for WFD assessments in inshore waters and estuaries (SI 77/2019) and those used in the OSPAR Intermediate Assessment 2017 for the wider MSFD area.

Criteria / Criteria Elements included in the Assessment
The assessment of Eutrophication is based on the following criteria as outlined in the Commission Decision (2017/848/ EC):

- D5C1: Nutrients in the water column: Dissolved Inorganic Nitrogen (DIN);
- D5C1: Nutrients in the water column: Dissolved Inorganic Phosphorus(DIP);
- D5C2: Chlorophyll a;
- D5C5: Dissolved oxygen in the bottom of the water column.

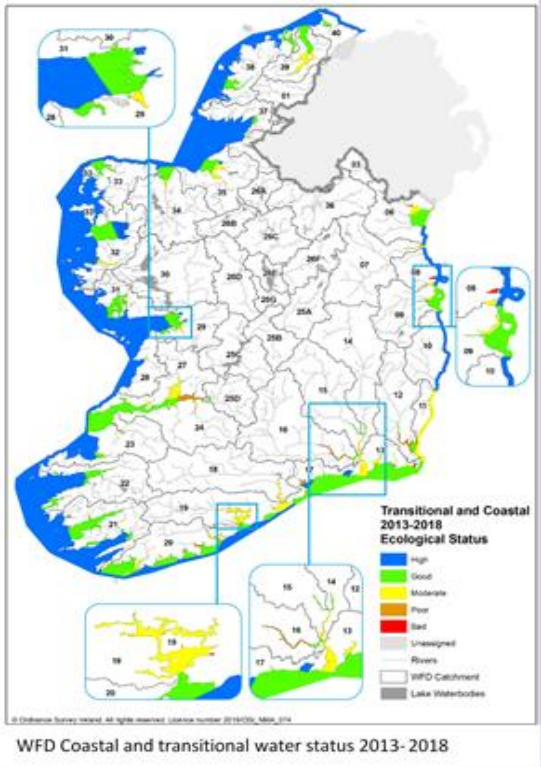
Exclusions
The 2013 initial assessment used targets which are now aligned with Secondary Criteria in the 2017 Commission Decision. The secondary criteria, listed below, are not included in this assessments as no evidence of nutrient enrichment impacts on the primary criteria were found to warrant their assessment:

- D5C3: The number, spatial extent and duration of harmful algal bloom events are not at levels that indicate adverse effects of nutrient enrichment.
- D5C4: The photic limit (transparency) of the water column is not reduced, due to increases in suspended algae, to a level that indicates adverse effects of nutrient enrichment.
- D5C6: The abundance of opportunistic macroalgae is not at levels that indicate adverse effects of nutrient enrichment.
- D5C7: The species composition and relative abundance or depth distribution of macrophyte communities achieve values that indicate there is no adverse effect due to nutrient enrichment.
- D5C8: The species composition and relative abundance of macrofaunal communities, achieve values that indicate that there is no adverse effect due to nutrient and organic enrichment. **Note:** this is a secondary criterion except when used as a substitute for D5C5.

Impact

Nutrient levels in the MSFD assessment areas are low with elevated concentrations only found in WFD transitional water areas. The current status of nitrogen and phosphorus has been determined using the environmental quality standards (EQS) specified in national legislation implementing the Water Framework Directive, and the corresponding area-specific assessment levels used in the OSPAR Common Procedure. Secondary impacts and signs of undesirable disturbance such as lowered oxygen concentration or algal blooms are not found in the MSFD areas and are restricted to inshore waters.

A risk based approach has been applied to the Descriptor 5 assessments, primarily focussing on transitional and coastal waters as the pressures are predominantly terrestrial. Where problems are not detected in these waters and unless there is a specific risk factor from offshore sources then wider assessment is not necessary.



WFD Coastal and transitional water status 2013- 2018

Figure 1: Status of Transitional and Coastal waters, assessment period 2013 to 2018 (EPA Water Quality in Ireland 2013-2018).

Note: Ecological status indicates if a water body is impacted by pollution or habitat degradation. It is assessed using Information on biology and supporting physico-chemical and hydromorphological quality elements. It includes the elements used to assess eutrophication but also other pressures that may be impacting on water bodies.

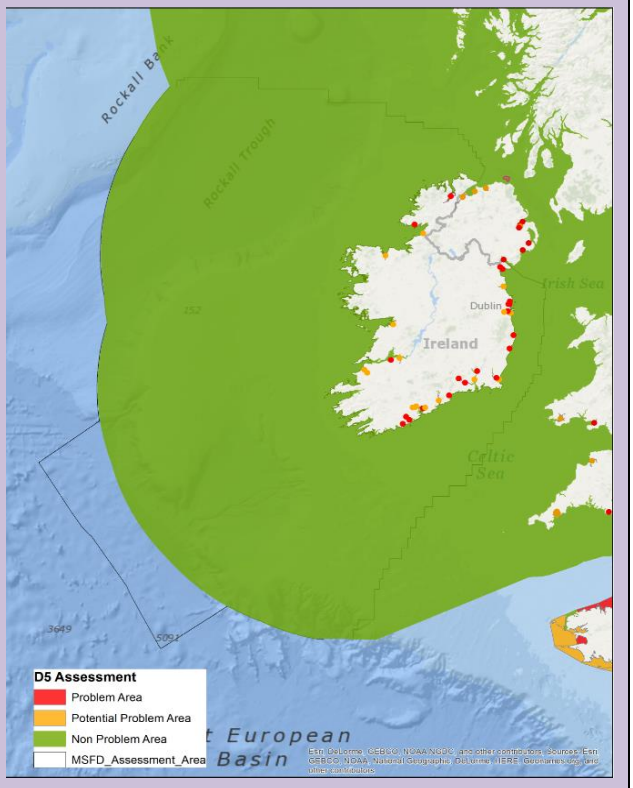


Figure 2: OSPAR eutrophication status assessment period 2009-2014 form third application of the OSPAR Common procedure.

Note: Locations of problem areas and potential problem areas are illustrated with circles, because these assessed areas are too small to be seen if their actual area extent is mapped.

Environment Status	**Linkages**
Nutrient concentration in the MSFD areas are below the OSPAR assessment thresholds. All coastal and offshore areas remain as non-problem areas and trend analysis shows no change in nutrient levels of Ireland's marine waters[2]. The WFD assessment of nearshore and estuarine waters shows that the effects of eutrophication are generally limited to estuarine waters[3]. Only 286km^2 of the WFD areas were considered as Problem or Potential Problem Areas. Ireland has achieved GES for eutrophication within its maritime area, for the primary criteria assessed; nutrients, chlorophyll a and dissolved oxygen.	Integrated Monitoring programmes are in place for this descriptor and are closely linked to monitoring for contaminants in water and shellfish. Programmes for WFD, MSFD, OSPAR and other related legislation are coordinated to optimise resources and prevent duplication. Other Criteria and elements which relate to the hydrographical conditions assessment under this assessment are as follows: Descriptor 4 Food Webs. Criterion 2: The balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures (D4C2).

Conclusion

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. The assessment highlights that 286 km^2 of the estuarine and nearshore coastal waters were assessed as eutrophic or potentially eutrophic. Overall, this represents 0.05% of the MSFD area. No offshore areas were considered as eutrophic. Estuarine and nearshore coastal waters 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] https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/pressures-human-activities/eutrophication/third-comp-summary-eutrophication/

[3] EPA 2019. Water Quality in Ireland 2013-2018 http://www.epa.ie/pubs/reports/water/waterqua/Water%20Quality%20in%20Ireland%202013-2018%20(web).pdf

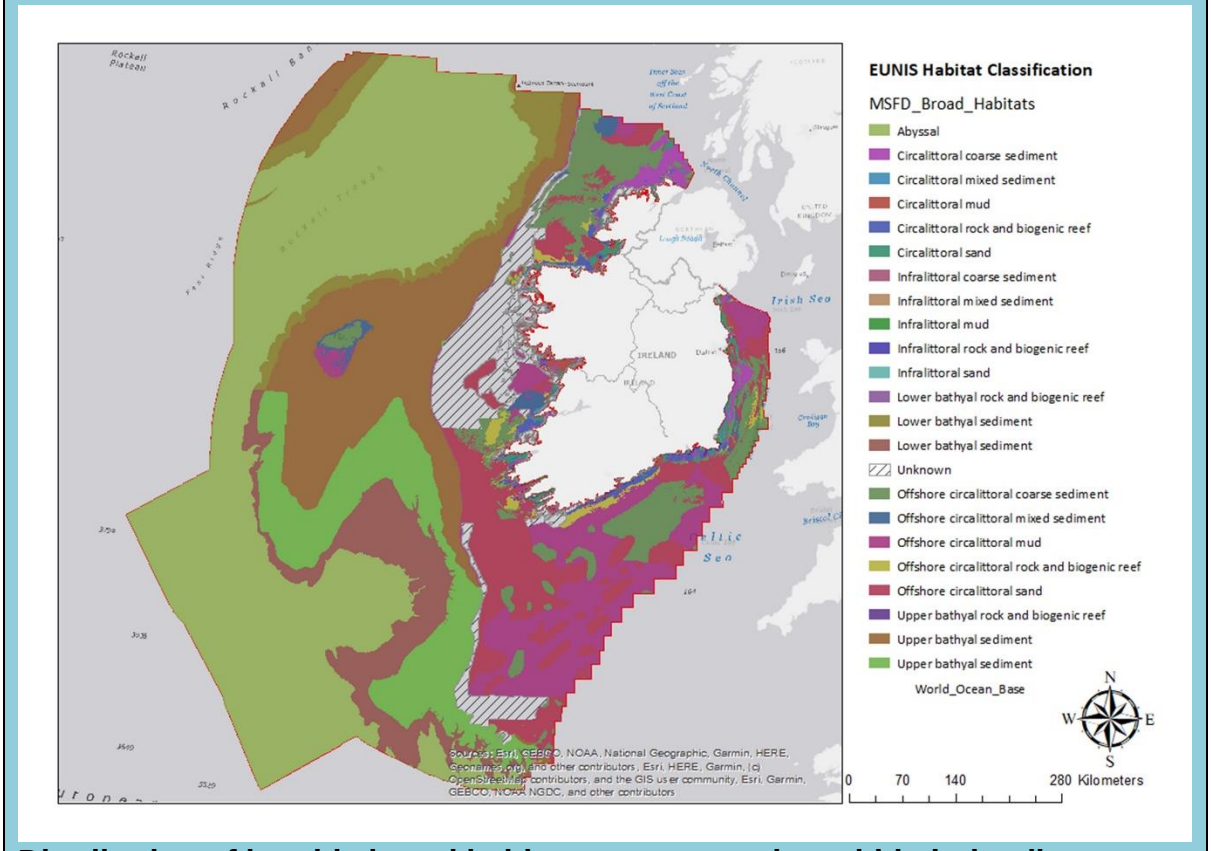
Sea-floor Integrity - Descriptor 6

Summary

This assessment was undertaken at the level of benthic broad habitat types listed under Commission Decision 2017/848 and occurring within Ireland's maritime area. The evaluation of the physical disturbance criterion was confined to Ireland's portion of OSPAR Region III (i.e. continental shelf area to the east, south and west of Ireland) due to limited information on benthic habitats, associated biological communities and anthropogenic pressures occurring within OSPAR Region V.

A key finding of the assessment is that Ireland has achieved GES for some elements of sea-floor integrity within its maritime area (e.g. under criteria for physical loss of the seabed). For other elements (i.e. criteria for physical disturbance to the seabed) the environmental status is currently unknown.

Permanent loss of seabed habitat across Ireland's maritime area was found to be lower than any potential threshold value at either a national or an international level. Loss of benthic habitat was calculated to be substantially less than 0.5% of the total sea-floor within Ireland's maritime area. The analysis of physical disturbance to seabed habitats, from international fishing-driven pressures quantifiable for the years 2010-2015, showed such disturbance to be widespread. It occurred in approximately 64,865 km^2 of the Irish portion of OSPAR Region III or at least 13% of the overall maritime area.



Distribution of benthic broad habitat types occurring within Ireland's maritime area, based on MSFD habitat classification and current data. (Marine Institute)

Introduction

In 2013 Ireland completed an Initial Assessment of its maritime area. At that time, the assessment concluded that seabed habitats in Ireland's Assessment Area were generally considered to be in a healthy condition. Since then, amended Commission Directive (EU) 2017/845 and Commission Decision (EU) 2017/848 have led to revisions in how elements of the marine environment are to be assessed to meet MSFD requirements. This has led to changes in the criteria by which Good Environmental Status must be assessed.

Sea-floor (i.e. benthic) habitats consist of physical environment features and marine organisms living on or within the sediment, on biological substrates (e.g. reef-forming organisms), or on rock. These organisms carry out essential ecological processes and functions that support healthy ecosystems. They are a key component of marine food webs, including commercial fish and shellfish species, and they provide a major source of shelter/refuge from, and food for, predators.

The nature and biological diversity of sea-floor habitats is shaped by numerous factors such as depth, light penetration and substrate type for example, which in turn determines the communities of flora and fauna that exist within them. These factors create a wide variety of habitat types, with intrinsic biological communities showing different levels of sensitivity to environmental pressures such as physical damage and physical disturbance. Some habitats are very sensitive (e.g. fragile maërl beds or coral gardens), whereas others are more robust (e.g. mobile sands and other dynamic sediments). The amending Commission Directive 2017/845 provides a list of "benthic broad habitat types" for use in the assessment and determination of GES.

The aim of this updated assessment was to evaluate this MSFD Descriptor within Ireland's maritime area, including in the light of Commission Directive 2017/845 and Commission Decision 2017/848. These set out the standardised assessment methods and specifications required in the evaluation of sea-floor integrity. In this regard, ***Physical loss*** must be understood as a permanent change to the seabed that has lasted or is expected to last for a period of two reporting cycles (12 years) or more; ***Physical disturbance*** must be understood as a change to the seabed from which it can recover if the activity causing the disturbance pressure ceases.

Drivers	**Pressures**
The main human activities driving pressures on benthic habitats, based on Commission Directive 2017/845 are: • extraction of living resources (fish and shellfish harvesting); transport; • extraction of non-living resources; • production of energy; • cultivation of living resources (marine aquaculture); • urban and industrial uses (including water treatment and disposal and industrial uses);	The relevant pressures listed in Commission Directive 2017/845 of relevance to sea-floor integrity are: ▪ physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate); ▪ physical disturbance to the seabed;

• physical restructuring of rivers, coastline or the seabed (watercourse modifications, dredging).	▪ extraction of wild species (by commercial and recreational fishing and other activities); ▪ mortality/injury to wild species (by commercial and recreational fishing and other activities); ▪ abrasion; substrate loss; ▪ changes to hydrological conditions; ▪ inputs of nutrients and/or organic matter; ▪ input and spread of non-indigenous species.

Environmental Targets

Irelands Initial Assessment (2013) described the characteristics of Good Environmental Status (GES) for sea-floor integrity as follows:

- The extent and diversity of sea-floor habitats is maintained in line with prevailing physiographic, geographic and climate conditions;
- Sea-floor habitats (physically and structurally) are sufficiently productive and extensive to support natural functionality and a healthy and sustainable ecosystem for the long term, and;
- Sea-floor habitats and their constituent species identified as needing protection under national or international agreements are effectively protected or conserved through the appropriate national, regional or international mechanisms.

However environmental targets and associated indicators to guide progress towards achievement of GES in the marine environment were under development in 2013; thus they were not established at that time. In the light of Commission Decision (EU) 2017/848 and amending Commission Directive (EU) 2017/845, Ireland has now established the following environmental targets for sea-floor integrity:

Environmental Target D6T1

The spatial extent and distribution of physical loss (permanent change) of the natural seabed is at a level that ensures that the structure and functions of the ecosystems, and benthic ecosystems, in particular, are not adversely affected.

Environmental Target D6T2

The spatial extent and distribution of physical disturbance pressures on the seabed is at a level that ensures that the structure and functions of the ecosystems, and benthic ecosystems, in particular, are not adversely affected.

Environmental Target D6T4

The extent of loss of the habitat type, resulting from anthropogenic pressures, does not exceed a specified proportion of the natural extent of the habitat type in the assessment area.

Environmental Target D6T5
The extent of adverse effects from anthropogenic pressures on the condition of the habitat type, including alteration to its biotic and abiotic structure and its functions, does not exceed a specified proportion of the natural extent of the habitat type in the assessment area.

Threshold Values
Ireland's stated Environmental Targets for sea-floor integrity are aligned with the requirements of Commission Directive 2017/845 and Commission Decision 2017/848. Although all benthic broad habitat types specified in the Decision were subject to assessment, threshold values for sea-floor integrity and for individual criteria or habitat types have yet to be developed and established. This work is taking place cooperatively at an EU and member state level through a technical working group on seabed habitats *TG Seabed*.

This process of designing and determining common threshold values and integrating assessments for sea-floor criteria is taking account of ongoing EU and regional cooperative developments, existing requirements and associated timelines that relate to sea-floor integrity under the following:
• national legislation;
• EU Directives (e.g. Habitats Directive, Birds Directive) and policies (e.g. Common Fisheries Policy);
• regional seas conventions (e.g. OSPAR Convention);
• international agreements (e.g. UN Convention on Biological Diversity).

Criteria / Criteria elements included in the Assessment
The primary criteria from Commission Decision (EU) 2017/848 that are included in the current assessment are:
D6C1 - Spatial extent and distribution of physical loss (permanent change) of the natural seabed.
D6C2 - Spatial extent and distribution of physical disturbance pressures on the seabed.
D6C4 – The extent of loss of the habitat type, resulting from anthropogenic pressures.
D6C5 - The extent of adverse effects from anthropogenic pressures on the condition of the habitat type, including alteration to its biotic and abiotic structure and its functions.

In the case of criteria D6C1 and D6C4 (i.e. physical loss) Ireland's entire maritime area was subject to assessment. In the case of criteria D6C2 and D6C5 (i.e. physical disturbance) only Irish waters occurring within OSPAR Region III was assessed.

Exclusions
This assessment did not cover criterion D6C3 (i.e. spatial extent of each habitat type which is adversely affected, through change in its biotic and abiotic structure and its functions [e.g. through changes in species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species], by physical disturbance). This was because agreed OSPAR Common Indicators or other coordinated indicators

(e.g. at EU member state level) were not available for this criterion in OSPAR Region III or Region V, which are applicable to Ireland.

In addition, due to insufficient information on disturbance effects on benthic broad habitat types within Ireland's maritime area only Habitats Directive *Annex I* listed habitats were used to represent sea-floor habitats under criterion D6C5. The assessment also did not include information gathered under the provisions of the Water Framework Directive (WFD). This is partly due to insufficient scientific knowledge and categorisation for MSFD purposes of coastal littoral habitats occurring in Ireland's maritime area.

Impact

The predominant species impacts can be identified as changes to:

- distribution and/or biomass;
- size, age and sex structure, fecundity, survival and mortality/injury;
- behaviour including movement and migration;
- habitat for the species (extent, suitability);
- species composition within groups of species.

The main habitat impacts can be identified as changes to:

- habitat distribution and extent (and volume, if appropriate);
- species composition, abundance and/ or biomass (spatial and temporal variation);
- size and age structure of species (if appropriate);
- physical, hydrological and chemical characteristics.

The ecosystem impacts can be identified as changes to:

- turbidity (silt/sediment loads);
- seabed substrate and morphology;
- pelagic-benthic community structure;
- productivity.

Environment Status

The extents of physical disturbance (D6C2, OSPAR Region III) and physical loss (D6C1/D6C4) assessed per benthic broad habitat type were estimated as follows:

- **Offshore* circalittoral mud** occupies 32,014 km^2 of sea-floor in the Irish segment of Region III, within which 73% was assessed as highly disturbed and 0% was assessed as not disturbed. Assessed physical loss was <1%.
- **Offshore circalittoral rock and biogenic reef habitat** occupies 3,381 km^2 of sea-floor in the Irish segment of Region III, within which 72% was assessed as highly disturbed and 24% was assessed as not disturbed. Assessed physical loss was <1%.
- **Offshore circalittoral** sand occupies 38,953 km^2 of sea-floor in the Irish segment of Region III, within which 67% was assessed as highly disturbed and 3% was assessed as not disturbed. Assessed physical loss was <1%.
- **Circalittoral rock and biogenic reef** occupies 3,011 km^2 of sea-floor in the Irish segment of Region III, of which 44% was assessed as highly disturbed and 47% was assessed as not disturbed. Assessed physical loss was = 1.25%.

- **Offshore circalittoral coarse sediment** occupies 27,083 km^2 of sea-floor in the Irish segment of Region III, of which 39% was assessed as highly disturbed and 29% was assessed as not disturbed. Assessed physical loss was <<1%.
- **Circalittoral mud** occupies 1,026 km^2 of sea-floor in the Irish segment of Region III, of which 30% was assessed as highly disturbed and 37% was assessed as not disturbed. Assessed physical loss was = 2.47%.
- **Circalittoral sand** occupies 2,563 km^2 of sea-floor in the Irish segment of Region III, of which 12% was assessed as highly disturbed and 45% was assessed as not disturbed. Assessed physical loss was = 1.97%.
- **Offshore circalittoral mixed sediment** occupies 1,936 km^2 of sea-floor in the Irish segment of Region III, of which 11% was assessed as highly disturbed and 24% was assessed as not disturbed. Assessed physical loss was <<1%.
- **Infralittoral rock and biogenic reef** occupies 159 km^2 of sea-floor in the Irish segment of Region III, of which 10% was assessed as highly disturbed and 62% was assessed as not disturbed. Assessed physical loss was = 1.15%.
- **Circalittoral mixed sediment** occupies 147 km^2 of sea-floor in the Irish segment of Region III, of which 7% was assessed as highly disturbed and 61% was assessed as not disturbed. Assessed physical loss was = 0.57%.
- **Circalittoral coarse sediment** occupies 4,209 km^2 of sea-floor in the Irish segment of Region III of which 5% was assessed as highly disturbed and 49% was assessed as not disturbed. Assessed physical loss was <1%.
- **Infralittoral coarse sediment** occupies 102 km^2 of sea-floor in the Irish segment of Region III, of which 3% was assessed as highly disturbed and 69% was assessed as not disturbed. Assessed physical loss was = 2.43%.
- **Infralittoral sand** occupies 236 km^2 of sea-floor in the Irish segment of Region III, of which 2% was assessed as highly disturbed and 76% was assessed as not disturbed. Assessed physical loss was = 2.49% lost.
- **Infralittoral mud** occupies 124 km^2 of sea-floor in the Irish segment of Region III, of which 1% was assessed as highly disturbed and 81% was assessed as not disturbed. Assessed physical loss was = 5.5%.
- **Infralittoral mixed sediment** occupies 20 km^2 of sea-floor in the Irish segment of Region III, of which 0% was assessed as highly disturbed and 51% was assessed as not disturbed. Assessed physical loss was = 2.73%.
- **Unknown habitat** occupies 28,333 km^2 or 19% of sea-floor in the Irish segment of Region III. Assessed physical loss was = 0.38%. A large proportion of the unknown habitat was littoral habitat.

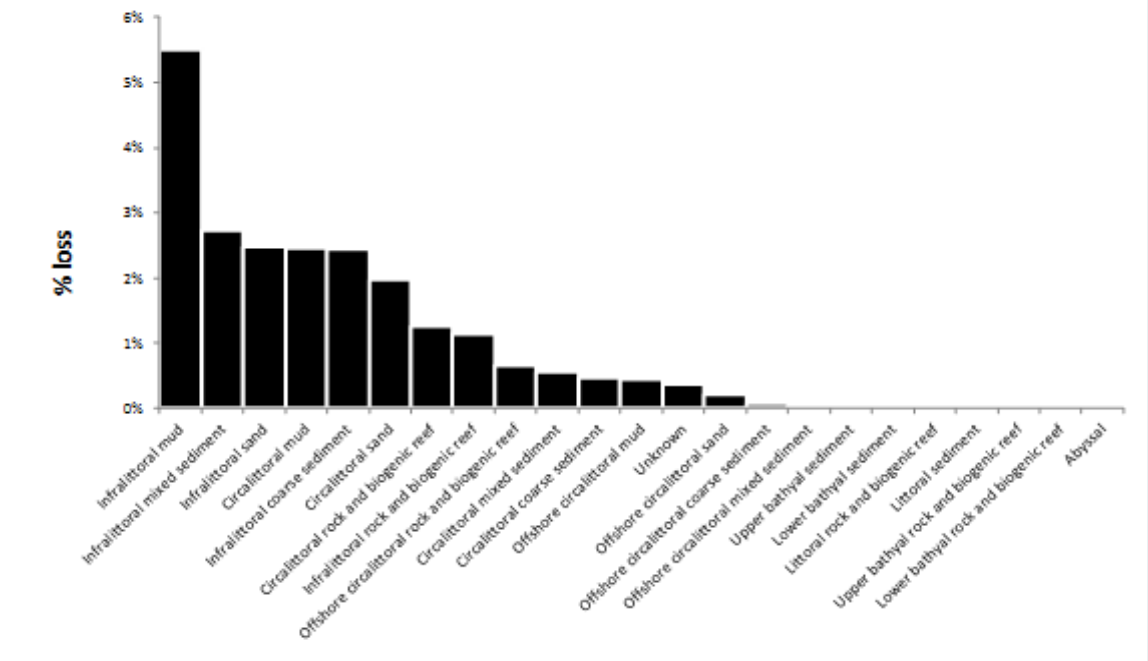
[* The term “offshore” associated with broad habitat types listed in the amending Commission Directive 2017/845 is based on the EUNIS classification system and is not linked to distance from the coast]

Of the above habitats that were assessed, none had an extent of assessed physical loss larger than any potential threshold value, either at a national or international level. Benthic habitat types recording no physical loss at all were **Littoral rock and biogenic reef; Littoral sediment; Upper bathyal rock and biogenic reef, Lower bathyal rock and biogenic reef, and Abyssal habitat**. Total physical loss (D6C1 and D6C4, sealed and unsealed) across the entire Irish maritime area was determined to be 0.12% of the total area of sea-floor, almost all

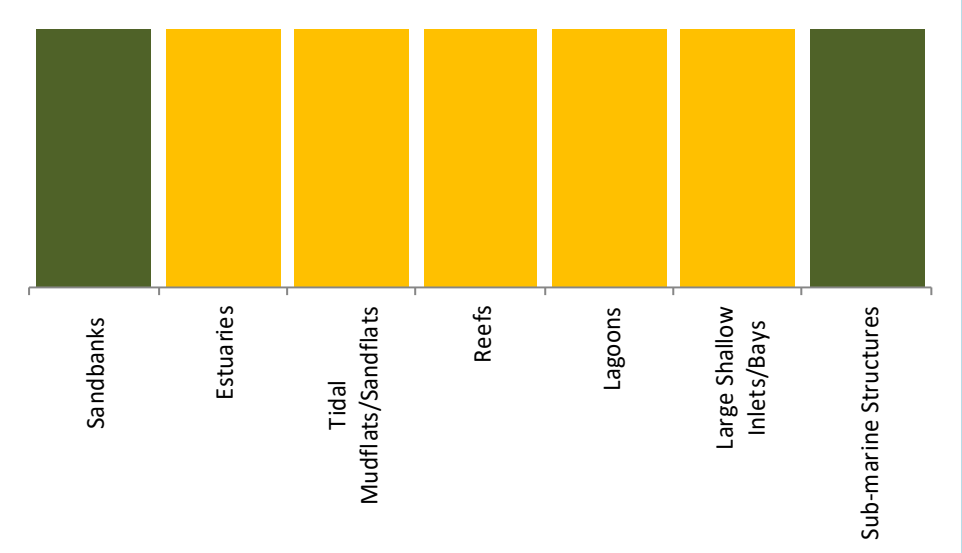
of which was categorised as sealed loss. Thus, for physical loss, all assessed habitats were evaluated to have achieved GES.

Of the same habitats occurring within OSPAR Region III, some contained physical disturbance levels that were above some hypothetical threshold values for GES. These included **offshore circalittoral mud, circalittoral sand, circalittoral rock and biogenic reef, offshore circalittoral sand, circalittoral rock and biogenic reef, offshore circalittoral coarse sediment and circalittoral mud**. Regarding the extent of adverse effects from physical disturbance on sea-floor habitat types (D6C5 – Habitats Directive *Annex I* habitats only), **sandbanks** and **submarine structures** were considered to have achieved GES, while **estuaries**, **tidal mudflats/sandflats, reefs**, **lagoons** and **large shallow inlets/bays** were found not to have achieved GES. *Annex I* habitats found to be in unknown environmental status were **maërl beds** and **sea caves**.

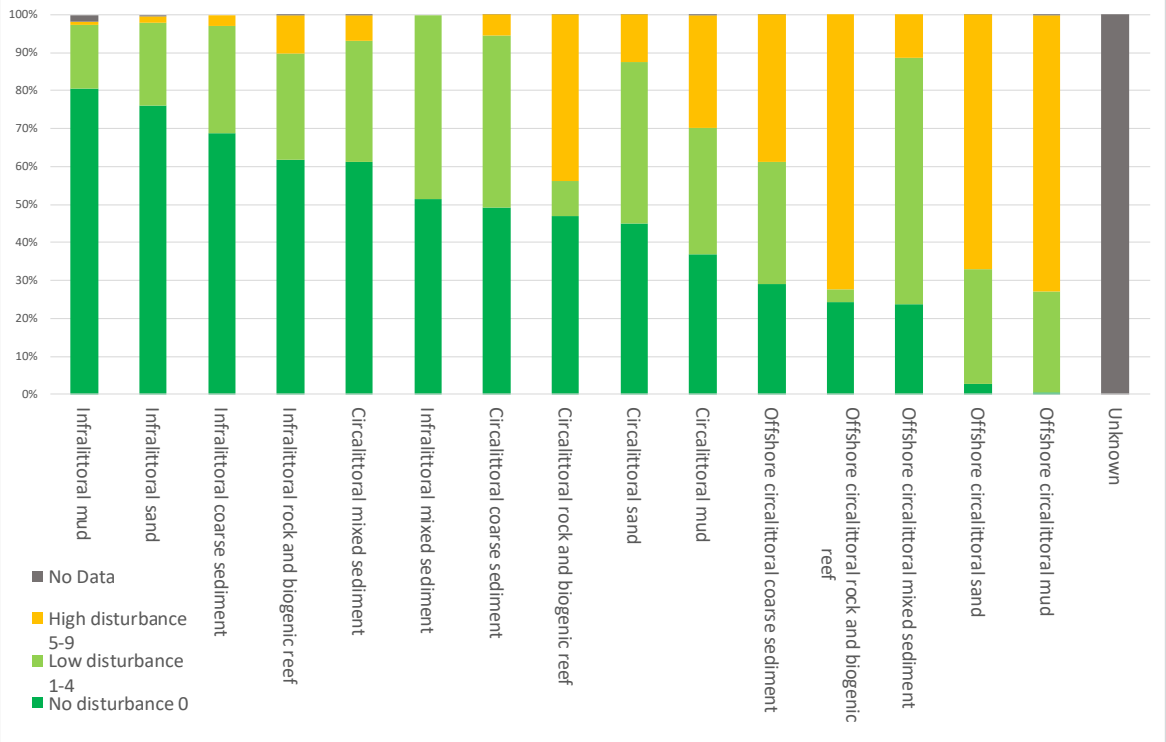
The assessment of physical disturbance criteria could not be extended to the entire Irish maritime area, however, due to limitations around data accuracy and availability. Since it was not possible to evaluate the full extent of physical disturbance and its effects on habitat types within Ireland's maritime area, the environmental status under the physical disturbance criteria (i.e. D6C2, D6C5) was evaluated as unknown.



Bar graph showing the calculated percentage area of physical loss per MSFD benthic broad habitat type within Ireland's maritime area.



Representation of the overall status of *Annex I* marine habitats as summarised in Ireland's most recent Habitats Directive assessment (NPWS, 2019). Conservation status assessments equivalent to the achievement of GES are denoted as green. Those that have not achieved GES are denoted as orange.



The extent and level of physical disturbance per MSFD benthic broad habitat type in Irish maritime waters within OSPAR Region III.

Linkages

Other primary criteria arising from Commission Decision (EU) 2017/848 that relate to and are relevant to this assessment of elements of sea-floor integrity are (paraphrased) as follows:

D1C1 - The mortality rate per species from incidental by-catch is below levels which threaten the species.
D1C2 - The population abundance of the species is not adversely affected due to anthropogenic pressures.
D1C4 - The species distributional range and, where relevant, pattern is in line with prevailing physiographic, geographic and climatic conditions.
D1C5 - The habitat for the species has the necessary extent and condition to support the different stages in the life history of the species.
D1C6 – The condition of the habitat type, including its biotic and abiotic structure and its functions.

D3C1 – Fishing mortality rate of populations of commercially-exploited species.
D3C2 – Spawning Stock Biomass of populations of commercially-exploited species.
D3C3 – Age & size distribution of individuals in populations of commercially-exploited species.

D5C1 – Nutrient concentrations are not at levels that indicate adverse eutrophication effects.
D5C2 – Chlorophyll a concentrations are not at levels that indicate adverse effects of nutrient enrichment.

D7C1 – Permanent alteration of hydrographical conditions to the seabed and water column, associated in particular with physical loss of the natural seabed.
D7C2 – Spatial extent of each benthic habitat type adversely affected due to permanent alteration of hydrographical conditions.

Conclusion

The assessment of physical loss of seabed habitat in Ireland's maritime area determined that permanent loss was lower than any potential threshold value, with overall loss calculated to be substantially less than 0.5% of the total sea-floor area. The analysis of physical disturbance to the sea-floor from fishing pressures showed it to be widespread, occurring to some degree in 64,865 km^2 within the Irish portion of OSPAR Region III. This represents at least 13% of Ireland's maritime area, although deeper waters (i.e. occurring in OSPAR Region V) were not possible to assess in this regard, due to current data limitations.

It is concluded that Ireland has achieved GES for some elements of sea-floor integrity within its maritime area (e.g. under criteria for physical loss of the seabed). For other elements (i.e. criteria for physical disturbance to the seabed) the environmental status within the Irish maritime area is currently unknown.

Alteration of Hydrographical Conditions - Descriptor 7

Summary

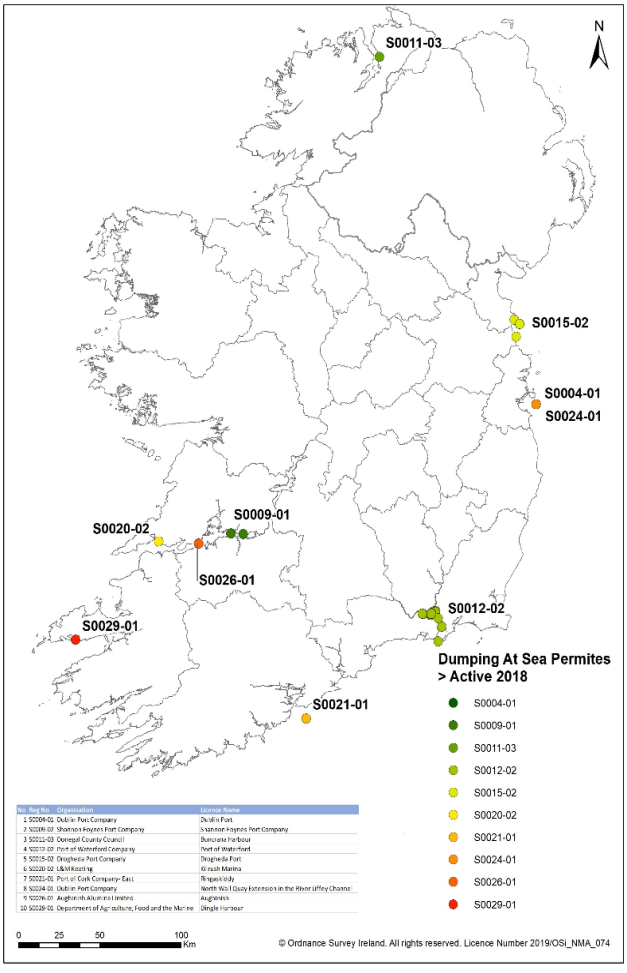
Ireland assessed the status of the marine environment against one of the criterion set out in the Commission Decision: the spatial extent and distribution of permanent alteration of hydrographical conditions to the seabed and water column.

Ireland has achieved Good Environmental Status for the spatial extent and distribution of permanent hydrographical changes within its maritime area.

There are currently no threshold values associated with hydrographical conditions however, the level of activities causing hydrographical changes to the seabed and water column within Irelands maritime area were very low overall during the assessment period of 2014-2018.

It is expected that further work, methodological refinement and environmentally sustainable practices will be needed to maintain this position in future MSFD cycles.

The second criterion has not been assessed because Ireland is not at risk of failing to achieve or maintain GES for this descriptor.



Dumping at Sea Permits Active Sites 2018 (EPA).

Introduction

In 2013, Ireland competed an Initial Assessment of its maritime area. At that time, the assessment concluded that there was insufficient data and a lack of established methods to assess whether good environmental status had been achieved for hydrographical conditions. The Commission Decision (EU 2017/848) has led to developments in the methods of assessment for hydrographical conditions. A broad assessment has been carried out in respect of the criterion, spatial extent and distribution of permanent alteration of hydrographical conditions to the seabed and water column, associated in particular with physical loss of the natural seabed (D7C1) from the EU Commission Decision 2017/848.

Since then Ireland's approach, data collection and methods of assessment for this Descriptor under MSFD Articles 8, 9 and 10 have progressed. This assessment of changes in the hydrographical conditions considers the locations where permanent changes have been made to the seabed by large scale human activates including, dredging, the disposal of dredged material and offshore structures. This updated assessment set out to evaluate the spatial extent and distribution of permanent alteration of hydrographical conditions e.g. changes in wave action, currents, salinity, temperature, both to the seabed and water column, as far as possible, in light of Commission Decision 2017/848. During the assessment period 2014 to 2018 there has been very little activity in the marine environment which impacts on hydrographical conditions.

The objective was to meet the requirements of MSFD Articles 8, 9 and 10 concerning qualitative descriptors for determining GES, in this case specifically Descriptor 7, i.e. that "permanent alterations to hydrographical conditions does not adversely affect marine ecosystems" (Directive 2008/56/EC).

Drivers

The driver of hydrographical change in the Irish MSFD area is economic development which can result in the physical restructuring of coastline or seabed. The associated human activates outlined in Directive 2017/845 which impact on Descriptor 7 are:

- dredging and deposition of material;
- energy production;
- cultivation of living resources Aquaculture;
- transport infrastructure;
- wastewater treatment & disposal;
- tourism activates and infrastructure.

These are activities that have a localised impact on hydrographical conditions but will not cause hydrographical changes over extensive areas.

Pressures

Within the Irish MSFD area the pressures relating to hydrographical changes are:

- Physical disturbance to the seabed;
- Physical loss due to permanent change of the sea bed;
- Changes of hydrological conditions.

These can result from the following activities:

- dredging and deposition of material;
- offshore energy, both hydrocarbon and renewable as a result of structures.

Environmental Targets

Irelands Initial Assessment (2013) describes the characteristic of Good Environmental Status (GES) for Descriptor 7 as follows:

"Good status is achieved when the nature and scale of any permanent changes (individual and cumulative) to the prevailing hydrographical conditions, resulting from large-scale anthropogenic activities such as coastal defence works, damming of large rivers, land reclamation projects, and structures in open and coastal sea such as wind farms, ocean energy device arrays and large scale aquaculture facilities, do not lead to significant long term impacts on marine ecosystems, in particular those biological components considered under Descriptors, 1, 4 and 6."

The environmental target from the Initial Assessment (2013) stated:

- All developments that may give rise to significant permanent changes in the hydrographical regime of currents, waves, or sediments must comply with the existing regulatory regimes and guidance should be followed to ensure that regulatory assessments are undertaken in a way that ensures the full consideration of any potential impacts, including cumulative effects at the most appropriate spatial scales, to ensure that GES is not compromised.

This target has been updated to reflect the requirements of the Commission Decision (EU) 2017/848 and amending Commission Directive (EU) 2017/845, Ireland has now established the following environmental target based on the essential elements assessed.

Environmental Target D7T1
The spatial extent and distribution of permanent alteration of hydrographical conditions to the seabed and water column, is at a level that ensures that the structure and functions of the ecosystems are safeguarded and that benthic ecosystems, in particular, are not adversely affected.

Threshold Values
There are currently no threshold values associated with hydrographical conditions. The development of regional and sub-regional threshold values for hydrographical conditions have not been undertaken at this time.

Criteria / Criteria elements included in the Assessment
The Criterion from the Commission Decision (2017/848 EC) considered in this assessment is:

- Spatial extent and distribution of permanent alteration of hydrographical conditions to the seabed and water column, associated in particular with physical loss of the natural seabed (D7C1).

Exclusions
No evaluation has been carried out for Criterion D7C2 around the spatial extent of each benthic habitat type adversely affected due to permanent alteration of hydrographical conditions due to the very small area in which hydrographical changes have been experienced during the assessment period.

Impact
During the assessment period 2014 to 2018 the levels of activity and development in the Irish Maritime area, which may cause permanent alterations of Hydrographical conditions were very limited, in both number and extent. In the context of the Irish MSFD area of **488,000** km^2 the total area where hydrographical

conditions were disturbed by human activities during the assessment period (2014-2018) is calculated at **533** km^2 resulting from dredging activities and dredged spoil disposal. In total this represents **0.109%** of the Irish MSFD area indicating the low levels of disturbance to hydrographical conditions overall. Table 1 outlines the annual quantities of dredged material disposed during the assessment period. This data is reported to OSPAR and has contributed to the OSPAR Intermediate Assessment 2017[4]. It is acknowledged that the areas where dredging and spoil disposal takes place experience localised changes in hydrographical conditions but these areas are very small relative to the overall scale of the MSFD area.

Year	Material Disposed (Dry Tonnes)
2014	680,521
2015	644,018
2016	1,072,439
2017	1,361,656
2018	1,244,196

Table 1: Quantities of Dredge Spoil disposed 2014 - 2018.

Cables pipelines and platforms can cause localised changes in hydrographic conditions these changes are not considered significant in the overall scale of the marine environment. The vast majority of development in Irish marine waters including ports harbours and jetties and their associated impact had taken place prior to the implementation of MSFD in 2008, it is not possible to evaluate the impact of these developments on hydrographical conditions.

Environment Status

This assessment has considered the activities, dredging and disposal of dredged spoil, which have caused permanent changes to the hydrographical conditions during the assessment period.
The level of pressure from these activities causing hydrographical changes to the seabed and water column within Irelands MSFD area was very low overall between 2014 and 2018, at 533 km^2 or 0.109% of Irelands MSFD area. Ireland has achieved Good Environmental Status for the spatial extent and distribution of permanent hydrographical changes within its maritime area.

Linkages

Other Criteria and elements which relate to the hydrographical conditions assessment under this assessment are as follows:

Descriptor 6: Sea-floor integrity.
Criterion 1 - Physical loss of the seabed: extent & distribution
Criterion 2 - Physical disturbance of the seabed: extent & distribution.
Criterion 3 – Disturbed habitats: spatial extents.

Conclusion

The permanent alteration of hydrographical conditions during the period 2014 to 2018 is limited to 0.109 % of the Irish Marine Strategy Framework Directive area. The impact from these alterations was localised with respect to hydrographical conditions and the short-term water quality impacts experienced during the dredging and disposal activities. The adverse impacts on the marine ecosystems are minimal from the very limited hydrographical changes which have occurred.

[4] https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/pressures-human-activities/dumping-and-placement-dredged-material/

Contaminants - Descriptor 8

Cadmium Levels in Water.
OSPAR 2019 (https://ocean.ices.dk/OHAT/)

Status (colour)
- below EQS
- above EQS

Trend (shape)
- ▼ downward trend
- ● no trend
- • status assessment only
- ○ informal status assessment
- ▲ upward trend

Summary

Ireland assessed the status of the marine environment against the two primary criteria and one of the secondary criterion set out in the Commission Decision: concentration of contaminants, acute pollution events and biological effects respectively.

Ireland has achieved Good Environmental Status for concentrations of contaminants within its maritime area, for the criteria assessed which are contaminants in water and biota, acute pollution events and biological effects of contaminants. There are threshold values associated with the concentrations of contaminants and biological effects. There is no threshold value for acute pollution events.

The assessment highlights the following:

- Concentrations of priority substances in water in coastal and transitional water bodies are typically low and compliant with Environmental Quality Standards.
- Concentrations of contaminants in shellfish are generally above OSPAR background levels however, they are not at levels where adverse effects would be expected to occur.
- Although many legacy pollutants are highly persistent in the environment, where significant temporal trends in contaminant concentrations are evident, they are typically downwards.
- There has been a marked improvement in reproductive condition in dogwhelks following the banning of TBT as a marine antifoulant.
- Monitoring indicates a low impact of acute pollution events in the maritime area.

Improved coherence of European and OSPAR assessment thresholds and new approaches to assessing risks associated with complex environmental mixtures would

	provide for a more robust assessment processes. The remaining secondary criterion has not been assessed because Ireland has not had a significant acute pollution event and is not at risk of failing to achieve or maintain GES for this descriptor.

Introduction

In 2013, Ireland competed an Initial Assessment of its maritime area. This assessment builds on that and is based on monitoring data collected under the Water Framework Directive (Dir 2000/60/EC) and OSPAR Coordinated Environmental Monitoring Programme. The objective of this updated assessment is to meet the requirements of MSFD Articles 8, 9 and 10 concerning qualitative descriptors for determining Good Environmental Status, in this case specifically Descriptor 8, that "Concentrations of contaminants are at levels not giving rise to pollution effects" (Directive 2008/56/EC).

This updated assessment is based on these same programmes, for chemical contaminants the assessment period covered is 2012 to 2015, the dogwhelk imposex assessment is based on data spanning 1993 to 2018 and acute pollution events are based on data from 2014 to 2018. The assessment addressed the criteria established in Commission Decision 2017/848.

Risk Based Monitoring

The national monitoring for hazardous substances undertaken by the Marine Institute, is risk-based and primarily focussed on coastal waters as most sources are terrestrial and marine sources are generally more concentrated in coastal waters (e.g. shipping converging around ports). If problems are not detected in inshore waters, monitoring is not widely extended beyond Irish coastal waters (which in themselves can reach near full ocean salinity) unless there is a specific risk factor, such as specific offshore sources.

Drivers	**Pressures**
The drivers of contaminants inputs to the marine environment as described in Commission Directive 2017/845 include: • Urban and industrial uses, include waste treatment and disposal; • Production of energy; • Extraction of non-living resources; • Transport.	Within the Irish MSFD area the pressures relating to Descriptor 8 come from the following activities: • Input of other substances (e.g. synthetic substances, non-synthetic substances) - diffuse sources, point sources, atmospheric depositions; • Inputs may be from land-based sources (riverine, direct discharge or atmospherically transported) or sea-based sources; • Some pollutants of concern such as many synthetic Persistent Organic Pollutants (POPs) are globally

	ubiquitous due to long-range transport.

Environmental Targets

Irelands Initial Assessment (2013) describes the characteristic of Good Environmental Status (GES) for Descriptor 8 as follows:

> "Concentrations of contaminants in the marine environment (i.e. in water, sediment and biota) are within agreed levels and adverse effects on organisms, populations, communities and biological processes do not occur."

The environmental targets from the Initial Assessment have been updated in light of the Commission Decision (EU) 2017/848 and amending Commission Directive (EU) 2017/845, Ireland has now established the following environmental target based on the essential elements assessed:

Environmental Target D8T1a

Within coastal and territorial waters, the concentrations of contaminants do not exceed the threshold values set in accordance with Directive 2000/60/EC.

Environmental Target D8T1b

Concentration of contaminants in marine matrices assessed in accordance with OSPAR Coordinated Environmental Monitoring Programme (CEMP) do not exceed OSPAR Environmental Assessment Criteria (EAC) and concentrations are not increasing.

> These targets (D8T1a & D8T1b) divided across water and biota align the 2013 target (Concentrations of selected substances identified within relevant legislation and under international obligations as relevant for the protection of the marine environment are within agreed levels at which adverse effects are unlikely to occur (e.g. are less than the Environmental Quality Standards applied within Water Framework Directive (2000/60EC) and Environmental Assessment Criteria applied within OSPAR) and concentrations are not increasing for the Assessment Area.) with the requirement of the Commission Decision Criterion D8C1.

Environmental Target D8T2

The degree of biological or ecological effects that can be specifically attributed to contaminants is below the agreed OSPAR criteria. At present, this is limited to evaluation of reproductive impairment in marine gastropods associated with tributyltin (TBT). This target remains unchanged from the 2013 target.

> This aligns with the requirements of the Commission Decision Criterion D8C2 which requires the health of species and the condition of habitats are not adversely affected due to contaminants including cumulative and synergetic effects.

Environmental Target D8T3

Spatial extent and duration of significant acute pollution events are minimised.

This target aligns the 2013 target (Occurrence and extent of significant acute pollution events (e.g. slicks resulting from spills of oil and oil products, or spills of chemicals) and the impact on biota affected by this pollution is minimised through appropriate risk-based approaches) with the Commission Decision Criterion D8C3.

Threshold Values
The threshold values applied to these targets for this assessment are as follows:

D8T1a: WFD Environmental Quality Standards for other surface waters (EQSw) established under the WFD Daughter Directive 2008/105/EC and relevant national standards for pollutants established under SI 272/2009.

D8T1b: OSPAR Environmental Assessment Criteria (EACs)[5] for contaminants in shellfish (D8C1). Where an agreed OSPAR EAC is not available for a substance, OSPAR apply alternative criteria in lieu as part of their assessments (metals and PBDEs).

D8T2: OSPAR Environmental Assessment Criteria (EACs) for imposex in dogwhelks (D8C2).

D8T3: There is no threshold value for significant pollution events.

Note1: WFD Biota EQS (Dir 2013/39/EC) sets biota limits for fish for mercury, PBDEs. These are not applied currently in OSPAR assessments and more work is required to better align EQS biota and OSPAR EACs to ensure assessments are consistent.
Note 2: OSPAR Background Assessment Criteria are used in this assessment but are not thresholds for GES.

Criteria / Criteria elements included in the Assessment
The assessment of contaminants is based on the following criteria and criteria elements from the Commission Decision 2017/848:

D8C1 concentrations of contaminants

- Concentrations of contaminants in water (Priority Substances and other relevant pollutants) in transitional and coastal water bodies (TrACs) for monitoring cycle 2011 to 2015. In compliance with EQS as laid down in Directive 2000/60/EC.
- Concentrations of contaminants in shellfish (bivalve molluscs) as assessed in accordance with the OSPAR Coordinated Environmental Monitoring Programme (CEMP). Assessments are reported for
  - Trace metals: mercury cadmium, lead, copper and zinc;
  - Polychlorinated biphenyls (PCBs);
  - Polybrominated diphenylethers (PBDEs);
  - Polyaromatic Hydrocarbons (PAH).

D8C2: Health of species and the condition of habitats are not adversely affected due to contaminants including cumulative and synergetic effects

[5] https://ocean.ices.dk/oat/trDocuments/help_ac_biota_pah_(parent).html

- Status and trends on the levels of imposex (as Vas Deferens Sequence Index -VDSI) in marine gastropods (*Nucella lapillus*).
  Note: This is a secondary criterion, it is included in this assessment as it highlights the environmental recovery after the use of the contaminant TBT was discontinued.

D8C3 The spatial extent and duration of significant acute pollution events are minimised.

Exclusions

This assessment is limited to WFD Priority Substances and Relevant Pollutants substances in water and substances for which OSPAR has developed a common indicator and for which CEMP assessments for Irish data are available.
The risk-based focus of monitoring is on coastal/inshore waters. Results do not indicate a requirement to extend current monitoring into open marine waters.

Additional data from passive sampling studies, WFD 2016-2021 cycle, including additional WFD priority substances is not included as assessments are not currently available for these elements.

An assessment has not been carried out for the secondary criterion D8C4, the adverse effects of significant acute pollution events, as there have not been any significant acute pollution events recorded under Criterion D8C3.

Impact

Contaminants in shellfish from Irish Coastal waters are predominantly within the OSPAR thresholds (EAC or alternative assessment criteria applied by OSPAR where an EAC does not exist) and concentrations of priority substances and other relevant pollutants in transitional and coastal waters comply with toxicity-based thresholds (EQSw) with few exceptions. Adverse effects on marine life would not be expected for exposure to these substances at the concentrations measured.

Levels of imposex in dogwhelks (*Nucella lapillus*) from around the Irish coast, associated with TBT contamination, have declined dramatically in recent years following the banning of TBT with few indications of significant impact remaining.

Extensive monitoring for acute pollution events has detected one oil spill from a ship in the assessment period 2014 to 2018, indicating a very low impact in the MSFD area. This monitoring was by surveillance flights and satellite imagery while there was no estimate of volume neither was there any reports of subsequent harm.

Environment Status

Ireland has achieving Good Environmental Status for concentrations of contaminants and achieved Good Environmental Status for biological effects assessed and for acute pollution events within its maritime area. Where trends are detected, they are generally downwards, most notably for cadmium and PCBs.

Better alignment of European and OSPAR assessment thresholds for biota would lead to more robust assessments in respect to substances including mercury and PBDEs.

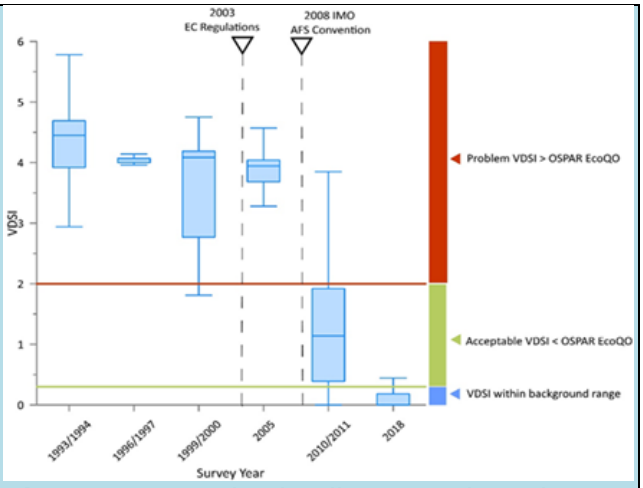


Figure 1: Box-plot (outliers not shown) of levels imposex in dogwhelk for periodic surveys undertaken since the early 1990s.

Note: Since 2005 a marked improvement in imposex status is evident. Dashed lines show timings of adoption of EC regulations and the ratification of the IMO Antifouling System Convention

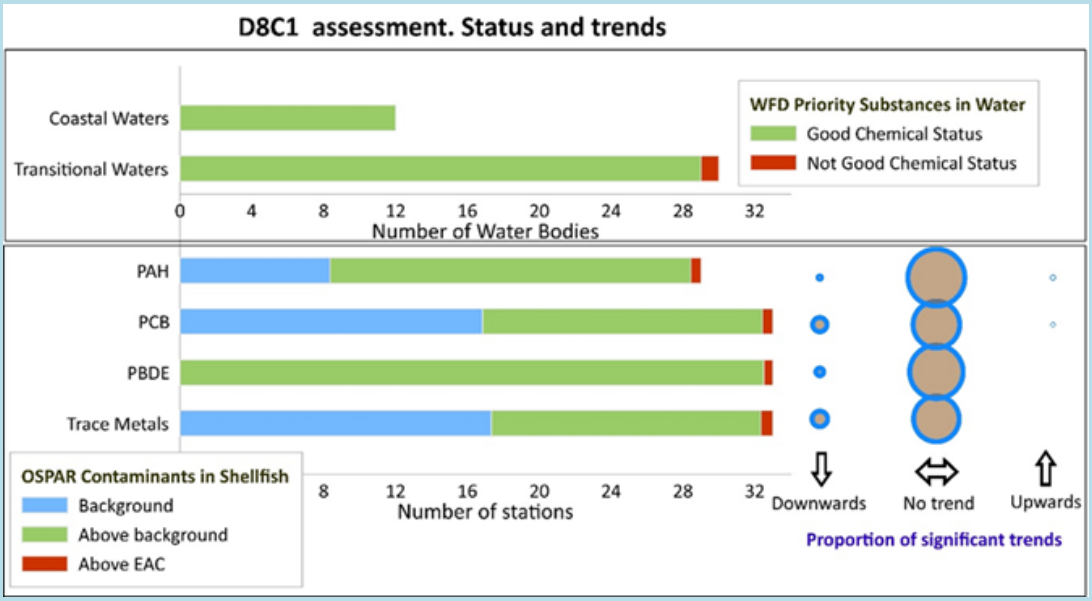


Figure 2:

Top: Stacked bar chart of Chemical Status (Priority Substances in water) for Water Framework Directive coastal and transitional water - surveillance and operational monitoring 2012-2015.

Bottom: Stacked bar chart of status assessments for contaminants in shellfish (PAH, PCBs, PBDEs and trace metals (Cd, Pb, Hg) and bubble plot showing the proportion of upward, downward and no trends observed for sites/parameters assessed.

Knowledge Gaps

Assessments are based on a limited number of substances and ecosystem components. The cumulative effect of exposure to complex combinations of contaminants are not considered in D8C1.

Linkages

Other criteria and elements which relate to the contaminants in this assessment are as follows:

Descriptor 9: Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards.

Criterion 1 - The level of contaminants in edible tissues of seafood caught or harvested in the wild (excluding fin-fish from mariculture) does not exceed levels listed in Regulation (EC) No 1881/2006.

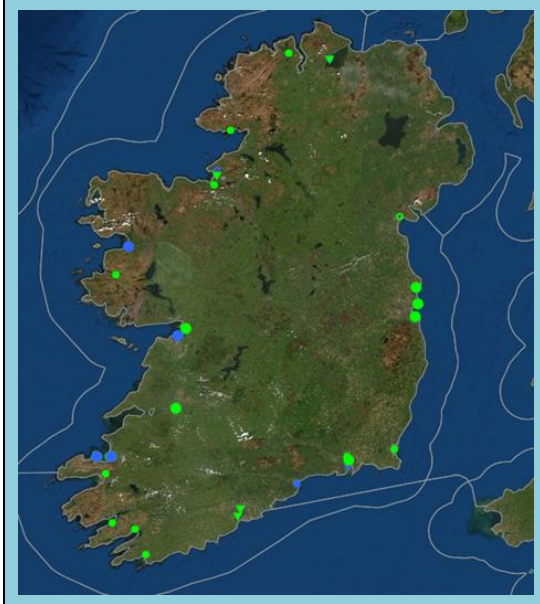
Conclusion

OSPAR assessments indicate that contaminants in shellfish from Irish Coastal waters are generally above background concentrations (OSPAR BAC) but predominantly within the OSPAR EAC thresholds. These imply adverse effects on marine life would not be expected. For the most part trends are not detected but where they do occur, they are typically in a downward direction, most notably for PCBs and cadmium. Concentrations of priority substances and other relevant pollutants in transitional and coastal waters comply with thresholds (WFD EQSw) with very few exceptions.

Levels of imposex in dogwhelks (*Nucella lapillus*), associated with TBT contamination, have decreased dramatically in recent years following the banning of TBT and are for the most part now within background range, with only very few indications of problems remaining (>OSPAR EAC).

New and improved assessment criteria and better alignment of OSPAR and EU criteria would enable more robust assessments. A number of knowledge gaps are highlighted including the challenge of assessing full ecosystem cumulative impacts of real-world combinations of contaminants.

Contaminants in Fish and Other Seafood for Human Consumption - Descriptor 9



Mercury levels in Biota (Shellfish)
OSPAR 2019.
(https://ocean.ices.dk/OHAT/)

Status (colour)
- below BAC
- below EC food limit
- above EC food limit

Trend (shape)
- ▼ downward trend
- ● no trend
- • status assessment only
- ○ informal status assessment
- ▲ upward trend

Summary

Ireland assessed the status of the marine environment against the only criterion set out in the Commission Decision for this descriptor: the level of contaminants in edible tissues of seafood caught or harvested in the wild does not exceed the maximum levels laid down in Regulation (EC) No 1881/2006.

Ireland has achieved Good Environmental Status for concentrations of contaminants in fish and seafood for human consumption within its maritime area.

Seafood sampled from shellfish growing waters and commercial fishing grounds around Ireland, between 2012 and 2017, shows a very high-level of compliance (99.7%) with Maximum Limits (threshold values) set in Commission Regulation 1881/2006 EC, as amended.

Introduction

In 2013 Ireland competed an Initial Assessment of its maritime area. An updated assessment of concentrations of contaminants in seafood and compliance with relevant regulations for consumer protection has been undertaken for the period 2012 to 2017.

Commission Regulation (EC) 1881/2006, as amended, sets maximum limits for environmental contaminants, specifically, cadmium, lead, mercury, PCBs, dioxins and certain PAH, in foodstuffs including the edible tissues of seafood. The Marine Institute (MI) measures levels of these and other contaminants in Irish seafood to assess quality of Irish seafood and compliance with this regulation. A dataset covering fish and shellfish sampled during the period 2012 – 2017 was evaluated for this assessment. This includes bivalve molluscs from designated shellfish growing waters, and fish and crustaceans landed at Irish ports or sampled on-board fisheries surveys.

The objective of the updated assessment was to meet the requirements of MSFD Articles 8, 9 and 10 concerning qualitative descriptors for determining GES, in this

case specifically Descriptor 9, “Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards” (Directive 2008/56/EC).

Drivers	**Pressures**
The drivers of contaminants inputs to the marine environment as described in Commission Directive 2017/845 include: • Urban and industrial uses, include waste treatment and disposal; • Production of energy; • Extraction of non-living resources; • Transport.	Within the Irish MSFD area the pressures relating to Descriptor 9 come from the following activities as described for Descriptor 8: • Input of other substances (e.g. synthetic substances, non-synthetic substances) - diffuse sources, point sources, atmospheric depositions. • Inputs may be from land based sources (riverine, direct discharge or atmospherically transported) or sea based sources.

Environmental Targets

Irelands Initial Assessment (2013) describes the characteristic of Good Environmental Status (GES) for Descriptor 9 as follows:
“Concentrations of contaminants in fish and other seafood caught or harvested in Irish seas for human consumption do not exceed the relevant maximum levels listed in EU regulation 1881/2006 (as amended)”.

The environmental target from the Initial Assessment (2013) stated:
Concentrations of contaminants in fish* and shellfish caught or harvested in Irish seas for human consumption show a high rate of compliance** with maximum limits listed in EU Regulation 1881/2006 (as amended).

* Excludes finfish aquaculture and also diadromous fish and other wild species or stocks that migrate beyond the Assessment Area

** Level of compliance to be defined.

This target has been reviewed to reflect the requirements of the Commission Decision (EU) 2017/848 and amending Commission Directive (EU) 2017/845, Ireland has now established the following environmental target based on the essential elements assessed.

Environmental Target D9T1

Levels of contaminants in fish* and shellfish caught or harvested in Irish seas for human consumption complies with maximum limits listed in EU Regulation 1881/2006 (as amended).
* Excludes finfish aquaculture

Note: the assessment has been carried out in accordance with the revised target and migratory/diadromous stocks were included in the assessment where data were available.

Threshold Values
The associated threshold values are the maximum limits for seafood established in Commission Regulation (EC) 1881/2006, as amended.

Criteria / Criteria elements included in the Assessment
The Criterion from the Commission Decision (2017/848 EC) considered in this assessment is (D9C1):

> The level of contaminants in edible tissues (muscle, liver, roe, flesh or other soft parts, as appropriate) of seafood (including fish, crustaceans, molluscs, echinoderms, seaweed and other marine plants) caught or harvested in the wild (excluding fin-fish from mariculture) does not exceed:
>
> - (a) for contaminants listed in Regulation (EC) No 1881/2006, the maximum levels laid down in that Regulation, which are the threshold values for the purposes of this Decision.

Exclusions
Only substances and seafood taxa for which maximum limits are established in the regulation are included in this assessment. Some seafood groups and tissues listed in the commission decision are not included as thresholds do not apply e.g. brown meat in crab.

Part b) of the criterion i.e. additional contaminants, not listed in Regulation (EC) No 1881/2006, threshold values, which Member States shall establish through regional or subregional cooperation. This is not applicable as these additional thresholds do not currently exist.

Farmed finfish are excluded from the assessment. Any source of contaminants in these fish would likely originate from feed and would not relate to marine environmental status.

Impact
The levels of contaminants in Irish seafood consistently comply with regulatory limits set in Regulation 1881/2006 as amended. Consequently, there is no impact and there is no requirement to withdraw Irish fisheries products/species from the market due to non-compliance with these limits.

Environment Status
The level of non-compliance for contaminants in seafood is extremely low and concentrations of these contaminants are generally well within the thresholds.

The current state of the Irish marine environment is evaluated as Good with respect Descriptor 9 with Good Environmental Status being achieved. An extensive monitoring program and a good dataset underpins this evaluation covering a broad range of fish and shellfish species.

	Lead	Cadmium	Mercury	Benzo(a)pyrene	Sum of 4 PAHs	Sum of ICES6 PCBs	PCDD?Fs	PCDD/Fs + DL-PCBs
Fish	134 (100%)	134 (100%)	225 (100%)			54 (100%)	22 (100%)	22 (100%)
Bivalve Mollusc	272 (100%)	272 (98%)	274 (100%)	214 (100%)	212 (100%)	272 (100%)		
Cephalopod	4 (100%)	4 (100%)	4 (100%)					
Crustacean	24 (100%)	54 (96%)	21 (100%)	1 (100%)	1 (100%)	19 (100%)	18 (100%)	18 (100%)

Table 1: Summary table of compliance with maximum limits established in Commission Regulation 1881/2006/EC as amended for seafood sampled 2012 - 2017.

Notes: the table shows the number of samples tested and the % compliance in brackets, with maximum limit. Green - 100% compliance. Amber <100% compliance

Linkages

Other Criteria and elements which relate to the Descriptor 9 are as follows:

Descriptor 8: Contaminants.
Criterion 1 - Concentrations of contaminants are at levels not giving rise to pollution effects – measured concentrations of contaminants in the marine environment.

Conclusion

Ireland has achieved Good Environmental Status for concentrations of contaminants in fish and seafood for human consumption within its maritime area Seafood sampled from shellfish growing waters and commercial fishing grounds around Ireland, between 2012 and 2017, shows a consistently very high level of compliance (99.7%) with Maximum Limits set in Commission Regulation 1881/2006 EC, as amended. This relates to the following contaminants; mercury, cadmium, lead, indicator polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/Fs – dioxins), sum of PCDD/Fs and dioxin-like PCBs, and polyaromatic hydrocarbons (PAH).

Out of 1422 individual test results for metals in all samples, an overall compliance of 99.5% was achieved. Organic substances show 100% compliance for 853 individual test results was recorded. The overall compliance rate was 99.7% for 2273 test results.

An extensive monitoring program and good dataset of results covering a broad range of fish and shellfish species underpins this assessment. On the very rare occasions of non-compliant results were detected these related to very local coastal issues or to other non-pollution related factors.

Marine Litter - Descriptor 10

Summary

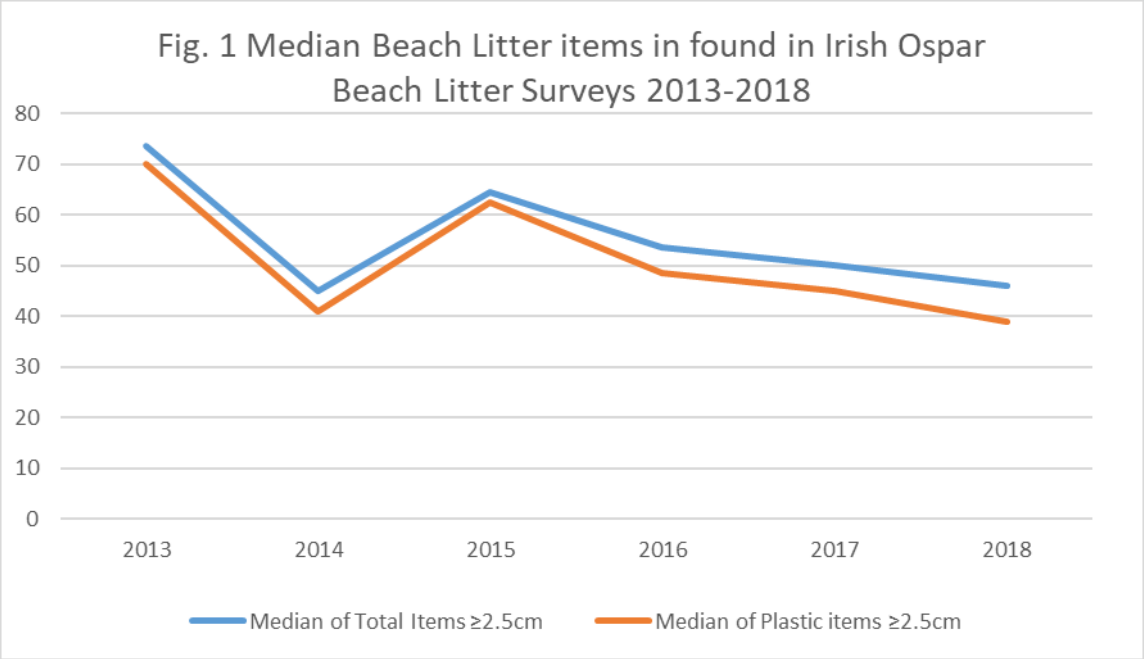
Ireland assessed the status of the marine environment against its Initial Assessment 2013 target of Good Environmental Status: Reduction in the number of visible items within specific categories/types on coastlines.

Ireland has achieved Good Environmental Status within its maritime area for the amount of litter on coastlines with the median number of litter items ≥2.5cm found on beaches in quarterly surveys between 2013 and 2018 decreasing from 73.5 items per 100 metres in 2013, to 46 items per 100 metres in 2018.

The Commission Decision 2017/848 sets out two primary criteria and two secondary criteria for the assessment of marine litter. The primary criteria are;

- the composition, amount and spatial distribution of litter (> 5mm) on the coastline, in the surface layer of the water column, and on the seabed, are at levels that do not cause harm to the coastal and marine environment, (D10C1); and
- the composition, amount and spatial distribution of micro-litter (particles of < 5mm) on the coastline, in the surface layer of the water column, and in seabed sediment, are at levels that do not cause harm to the coastal and marine environment (D10C2)

It is not to possible determine GES in relation to Commission Decision 2017/848 criteria as marine litter thresholds have not been established at this time and currently no scientifically agreed methodologies have been developed to monitor micro-litter.



Median beach Litter items - Ireland 2013-2018.

Currently no scientifically agreed methodologies have been developed to monitor micro-litter on the coastline, in seafloor sediments, nor on the surface of the water column.

Member States are required to establish threshold values for litter and micro-litter through cooperation at Union level, taking into account regional or sub-regional specificities. These threshold values are currently still under development. While monitoring and data sources exist for coastal and seabed litter (other than micro-litter), at this time gaps remain in relation to monitoring and data analysis of the surface layer of the water column.

Introduction

In 2013, Ireland completed the Initial Assessment of its maritime area under the Marine Strategy Framework Directive. At that time, the assessment concluded that there was lack of established evidence in relation to the environmental impacts of marine litter. It also concluded that insufficient survey data from beach litter surveys and seabed litter monitoring undertaken as part of International Bottom Trawl Surveys (IBTS[6]) to form a comprehensive analysis. Thus, it was not possible at that time to assess the status of the pressure and determine whether or not GES had been achieved.

The Commission Decision 2017/848 sets out comprehensive requirements for the determination of GES, these are:

- The composition, amount and spatial distribution of litter on the coastline, in the surface layer of the water column, and on the seabed, are at levels that do not cause harm to the coastal and marine environment.
- Member States shall establish threshold values for these levels through cooperation at Union level, taking into account regional or sub -regional specificities.

The Decision classifies litter for consideration under D10C1 criterion in the following categories: artificial polymer materials, rubber, cloth/textile, paper/cardboard, processed/worked wood, metal, glass/ceramics, chemicals, undefined and food waste.

D10C2 micro-litter is classified in the categories ‘artificial polymer materials’ and ‘other’.

Since 2013, Ireland’s data collection and methods of assessment in relation to coastal and seabed litter have progressed significantly. There is now consist longitudinal beach litter data available from Ireland's OSPAR beach litter surveys to indicate trends. This data may be used to meet assessment requirements as set out under MSFD Article 8. However, at this time there is no established or agreed methodology for the assessment of the surface layer of the water column.

[6] Seabed litter data gathered during groundfish surveys undertaken by the Marine Institute is uploaded to the International Council for the Exploration of the Sea (ICES) DATRAS database.

There are currently no agreed methodologies for the assessment of micro-litter although Ireland is currently working with other contracting parties to the OSPAR Convention to develop an indicator for micro-litter in sediments.

Work to develop threshold values is underway at EU Level and this is being supported by work under regional sea conventions such as OSPAR.

Drivers

The drivers of marine litter in Irish marine from those listed in the revised directive 2017/845 are as follows:

- Urban and Industrial uses including waste treatment and disposal;
- Tourism and leisure activities;
- Transport.

The primary sources of marine litter are the deliberate or accidental loss of materials into the environment through littering, mismanaged waste or accidental spillage and also in the case of micro-litter, through abrasion, wear and fragmentation. These include:

- Land based human activities generating litter in proximity to pathways to the marine environment, such as rivers, streams, drains, sewage and other wastewater outflows; or in proximity to coastal areas, in particular coastal urban conglomerations, recreational/ tourist areas, ports, harbours and marinas.
- Mismanaged municipal, industrial, service industry, agricultural or other waste or accidentally lost materials entering the environment in coastal areas or in proximity to pathways to the marine environment.
- Litter generated by maritime human activities within the Irish Exclusive Economic Zone, in particular fishing, aquaculture activities, shipping, offshore installations, or maritime recreational and tourist activities.
- Marine litter originating from landward or maritime activities beyond the national jurisdiction carried into the Irish maritime area by currents or winds.

Pressures

The 'Input of litter (solid waste matter, including micro-sized litter)' is the only pressure listed in the Commission Directive 2017/848 associated with marine litter.

Potential pressures may arise from litter deposition and accumulation in key habitats; large scale entanglements such as "ghost fishing" by lost or discarded fishing or aquaculture gear; and potential harm to species generated through large scale ingestion of plastics.

Environmental Targets

Irelands Initial Assessment (2013) described the characteristics of Good Environmental Status (GES) for marine litter as follows:

- The amount of litter, and its degradation products, on coastlines and in the marine environment is reducing over time and are at levels which do not result in harmful effects to the coastal or marine environment.

In the light of Commission Decision (EU) 2017/848 and amending Commission Directive (EU) 2017/845, Ireland has now established the following environmental targets for marine litter:

Environmental Target D10T1a
The composition, amount and spatial distribution of litter in the coastline, and on the seabed, are at levels that do not cause harm to the coastal or marine environment.

Environmental Target D10T1b
In accordance with the provisions of Article 5 of Directive (EU) 2019/904 by year end 2023 eliminate beach litter caused by the items prohibited from the market under that Directive. These items are: plastic cotton bud sticks, disposable plastic cutlery and plates, plastic straws, plastic beverage stirrers, plastic balloon sticks, expandable polystyrene fast food containers and expandable polystyrene beverage containers and cups.

Threshold Values
There are currently no established threshold values for marine litter at an EU level, as required by the Commission Decision 2017/848 with work ongoing at EU and OSPAR technical groups on marine litter. Ireland is actively engaged in all of these processes.

Criteria / Criteria elements included in the Assessment
The Criterion from the Commission Decision 2017/848 sets out for the determination of GES in relation to this descriptor is as follows:

- The composition, amount and spatial distribution of litter on the coastline, in the surface layer of the water column, and on the seabed, are at levels that do not cause harm to the coastal and marine environment.
- Member States shall establish threshold values for these levels through cooperation at Union level, taking into account regional or subregional specificities.

Litter (excluding micro-litter) is classified in the following categories: artificial polymer materials; rubber; cloth/textile; paper/cardboard; processed/worked wood; metal, glass/ceramics; chemicals; undefined; and food waste.

There is also a facility that allows for EU Member States to add their own national sub - categories. Ireland is developing subcategories based on the most common items found in Irish beach litter surveys undertaken under the OSPAR Convention.

Impact
Harm caused by marine litter
Commission Decision 2017/848 states that the primary consideration for the determination of is that the “properties and quantities of marine litter do not cause harm to the coastal and marine environment”. However, this remains challenging to determine.

The EU Joint Research Council (JRC) report Harm caused by Marine Litter states that “the monitoring of impacts on biota is challenging, but there is clear evidence

of harm to individuals and to a lesser extent assemblages of organisms and populations of some species." Evidence exists that there are harmful effects of marine litter on individual organisms of many species and some populations. Linking evidence of harm to individuals to negative effects on populations has not been possible to date for most affected species. Marine litter, in combination with other anthropogenic stressors, may present additional challenges to marine biodiversity but this has not yet been established. As with many other anthropogenic pressures, quantifying the effects of marine litter in isolation on biodiversity is very challenging. Currently, it remains necessary to rely on the precautionary principle to develop policy in relation to marine litter.

Entanglement
There is evidence of harm to individuals from entanglement, especially birds, mammals, fish and turtles. There may be a particular risk from abandoned, lost or discarded fishing gear. However, the impact on overall populations remains inconclusive.

Ingestion
There is evidence that marine species (mammals, birds, fish and invertebrates) ingest plastic litter and that, in some populations, a large number may ingest it. While there is evidence from laboratory experiments of negative physical/mechanical impacts from ingestion of plastic on individual marine organisms from lower trophic levels, quantifying the extent of this harm to populations from this is not possible at this time.

Chemical transfer
Some plastics contain potentially harmful chemical additives. Plastics may also sorb and concentrate chemicals from seawater. There is evidence that plastic can transfer chemicals contaminants to wildlife. However, there is considerable uncertainty about the relative importance of this pathway.

Marine Litter as a vector invasive species
Bacteria, algae, unicellular organisms, and invertebrates have been demonstrated to settle on floating or sea-floor debris (i.e."rafting"). Litter items have both similar and different characteristics to natural floating debris in facilitating transport, dispersion and potential colonisation. To date, it is hard to quantify the relative importance of rafting on anthropogenic versus natural debris.

Assemblages of species
The presence of marine litter can affect marine assemblages through smothering, direct physical damage, provision of a new habitats, modifying existing natural habitats, or transport chemical contaminants and invasive species. However, to date, evidence of effects comes from localised studies and cannot be extrapolated to larger spatial scales.

Prevalence

Beach Litter
The Draft Joint Research Council Technical reports *Marine Beach Litter Baselines* and *A European Beach Litter Threshold Value and Assessment Method* recommends that the median number of beach litter items of ≥ 2.5 cm

should be considered rather than the arithmetic mean for the determination of baselines and threshold values. While the actual baselines and threshold values have yet to be agreed, this method for determining them is supportable as it helps to mitigate against statistical anomalies caused by outlier events.

The table and graph below outline the mean number of beach litter items ≥2.5 cm found on Irish beaches in Ireland's OSPAR beach litter surveys undertaken since Ireland's MSFD initial assessment was undertaken in 2013.

Year	Median of Total Items ≥2.5cm	Median of Plastic items ≥2.5cm	% Plastic relative to Total items
2013	73.5	70	95.24%
2014	45	41	91.11%
2015	64.5	62.5	96.90%
2016	53.5	48.5	90.65%
2017	50	45	90.00%
2018	46	39	84.78%

Table 1. Median Beach Litter items.

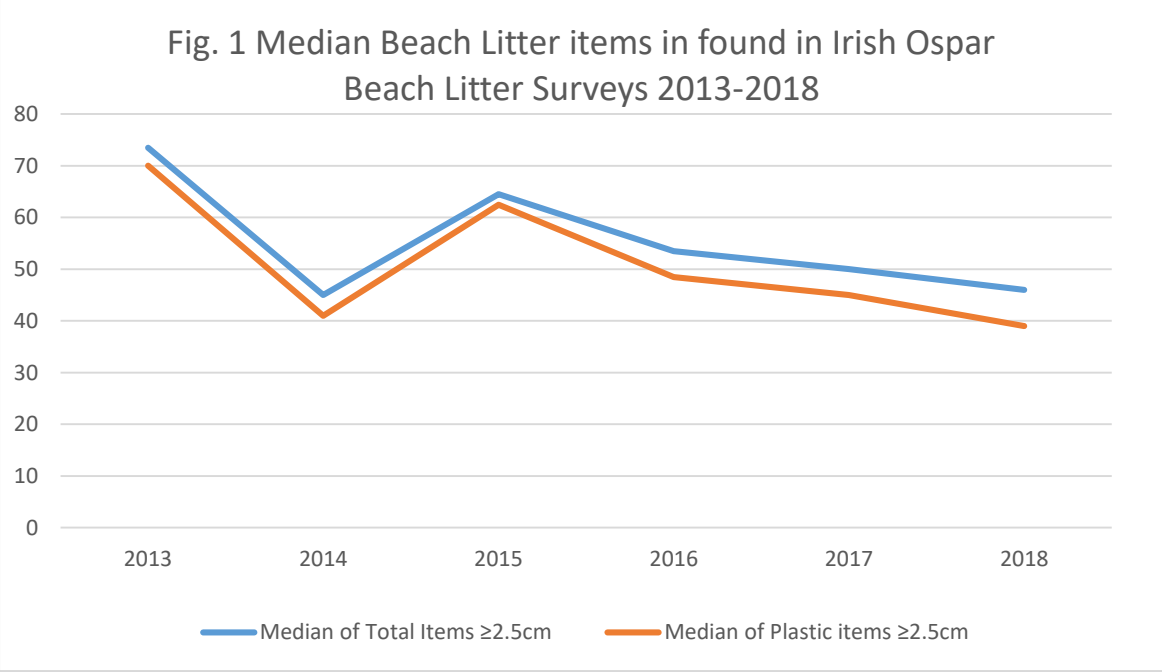


Fig. 1 Median beach Litter items - Ireland 2013-2018.

This data illustrates that there has been an overall downward trend in the total number of beach litter items (including plastic items) being found in beach litter surveys during the period 2013 to 2018.

OSPAR Reference No	SUP[7]/Non-SUP	% of Total Beach Litter 2013-2018 (includes items excluded by TG-ML Baseline Report)
Plastic: String	Non-SUP	37.54%
Plastic: Plastic small fragments	Non-SUP	11.52%
Plastic: Crisp packets	SUP	10.25%
Plastic: Rope	Non-SUP	7.70%
Plastic: Small bags	SUP	4.16%
Plastic: Bottle Caps	SUP	3.73%
Plastic: Plastic large fragments	Non-SUP	2.89%
Plastic: Drinks bottles	SUP	2.76%
Plastic: Food packaging	SUP	1.37%
Plastic: Bags	SUP	1.32%

Table 2 Top 10 items found in Beach Litter surveys 2013-2018.

The JRC Technical Report – *A European Beach Litter Threshold Value and Assessment Method*, recommends that 2015-2016 is considered as possible reference years for the when setting European baselines for beach litter found in 100 metre surveys. The report states that the overall EU-wide median number of items found in 100m beach litter surveys in these years was 165 items. The Report found that there was an overall median value of 61 items per 100 metre beach litter on Irish beaches surveyed for OSPAR in the same period. This represents 36.97% of the corresponding EU-wide median value of 165. By this measure, Ireland's maritime area has the 7th lowest country sub-region out of 29 EU sub-regions in terms of beach litter. By end 2018, there had been a further 20% decrease (from 61 to 49 items) in the median number of beach litter items found on Irish beaches in OSPAR surveys.

Seabed Litter

Seabed litter recovered during research trawls is undertaken as part of the International Bottom Trawl Surveys (IBTS). It operates at large regional scales and provides data standard protocols. This data is uploaded onto a central database hosted by ICES and is being used to develop monitoring of seabed litter for MSFD and regional seas conventions such as OSPAR. For example, OSPAR is using data from seabed litter trawls to develop a seabed litter indicator which could be used for MSFD purposes.

Year	No. of trawls
2012	172
2013	176
2014	170
2015	47
2016	172
2017	149
2018	153
Total 2012-2018	**1039**

Table 3. Number of bottom trawls surveyed for litter in Irish marine waters.

[7] SUP = Single Use Plastic

Surface of the Water Column
At this time there are no standardised methodologies established for monitoring of marine litter on the surface of the water column so data is not available to determine prevalence.

Micro-litter
There are no standardised methodologies for monitoring micro-litter in coastal areas, either on the surface of the water column or in seabed sediments. However, OSPAR Intersessional Correspondence Group on Marine Litter (ICG-ML) is working to develop sediment monitoring methodologies and develop an indicator that may be used in seabed and coastal sediment sampling. If this is successfully adopted by the OSPAR Commission, such an indicator would be offered to MSFD Technical Group on Marine Litter (TGML) as a template to inform the development of monitoring and assessment indicators under MSFD.

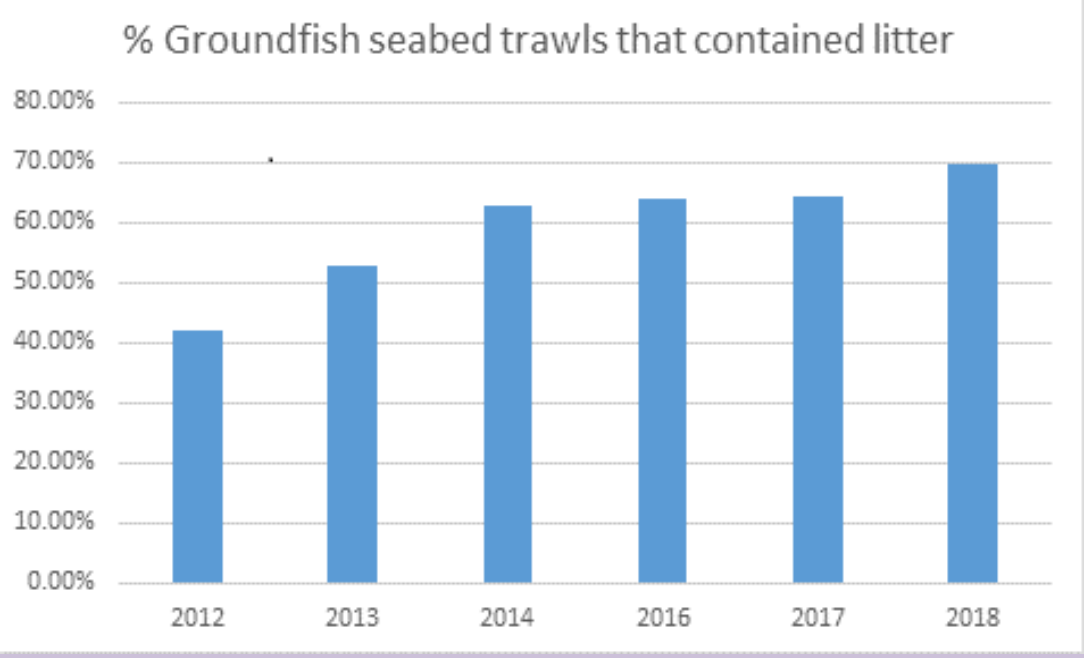


Fig. 2: Percentage of groundfish survey seabed trawls surveyed that contained litter between 2012-2018 in Irish marine waters.

Ireland has commissioned research to analyse sediment samples taken from intertidal and sub-tidal sites around the coast. It is anticipated that this will help inform the development of an OSPAR microplastics in sediment indicator.

Environment Status	**Linkages**
The characteristics of Good Environmental Status for marine litter set out in Ireland's 2013 Initial Assessment (2013), were "the amount of litter, and its degradation products, on coastlines and in the marine environment is reducing over time and are at levels which do not result in harmful effects to the coastal or marine environment".	Other Criteria and elements which relate to the marine litter assessment are as follows: Descriptor 1: Biodiversity. Criteria 2 - Population abundance.

The amount of litter on coastlines has decreased since 2013, this respect of the Initial Assessment 2013 characteristics is compatible with GES. This has been superseded by the revised criteria for Descriptor 10 as set out in Commission Decision 2017/848. Which states that the "properties and quantities of marine litter do not cause harm to the coastal and marine environment". Clear evidence of environmental harm (as opposed to harm to individual organisms or localised communities) has yet to be identified. Additional data gaps exist in relation to the litter of all types on found on the surface of the water column and micro-litter generally. Finally, threshold values have not been determined for Descriptor 10.	Criteria 3 - Population demographic characteristics. Descriptor 2: non-indigenous species. Criterion 1 - The number of non-indigenous species newly introduced via human activity. Descriptor 6: Sea-floor integrity. Criterion 2 - Physical disturbance of the seabed: extent & distribution. Criterion 3 – Disturbed habitats: spatial extent.

Conclusion

The Initial Assessment (2013) described the characterising GES as

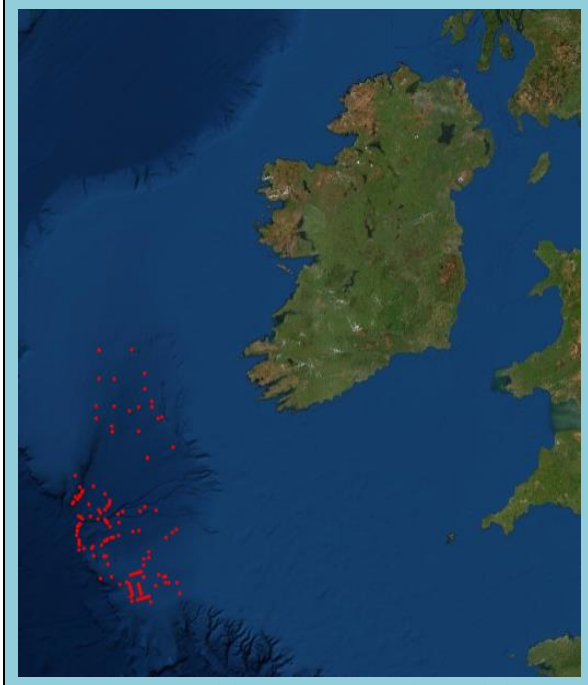
> '*The amount of litter, and its degradation products*[*]*, on coastlines and in the marine environment is reducing over time and are at levels which do not result in harmful effects to the coastal or marine environment.'*

The amount of litter on coastlines recorded through the beach litter surveys has decreased during the period 2013 to 2018, indicating Descriptor 10 is compatible with GES.

It will be necessary in the future to change these characteristics of Good Environmental Status for Marine Litter to factor in the revised criteria set out in Commission Decision 2017/848.

However, to establish whether or not GES will be achieved in the future under the Commission Decision criteria requires that agreed methodologies and threshold values need to be determined. Data gaps will need to be addressed in relation to harm caused by marine litter. Micro-litter prevalence and trends in all specified aspects of the marine environment will have to be established as will prevalence and trends for all marine litter items on the surface of the water column. This will require the development of agreed monitoring protocols and indicators. Ireland will continue to work nationally and with our EU and OSPAR Convention partners to address these knowledge gaps will inform the assessment of GES and the setting of requisite environmental targets at the earliest opportunity.

Introduction of Energy including Underwater Noise - Descriptor 11



Documented instances of impulsive noise from seismic surveys carried our under Licence during 2017.
OSPAR 2018

Summary

Ireland assessed the status of the marine environment against the primary criterion set out in the Commission Decision: the spatial distribution, temporal extent, and levels of anthropogenic impulsive sound sources do not exceed levels that adversely affect populations of marine animals.

Ireland has achieved Good Environmental Status for the anthropogenic impulsive sound element of underwater noise within its maritime area.

The level of impulsive underwater noise causing activities within Ireland's maritime area were low overall during the assessment period of 2016-2018. There are currently no threshold values proposed for underwater noise.

The second criteria on continuous low frequency sound has not been considered as work is ongoing at OSPAR and the EU to develop methodologies for the assessment of continuous noise and its impact on marine animals.

Introduction

In 2013, Ireland completed an Initial Assessment of its maritime area. At that time, the assessment concluded that there was insufficient information to determine the full extent of sound generating activities and the corresponding environmental status in Irish marine waters.

The revised Commission Decision (EU) 2017/848 has led to developments in the methods of assessment for underwater noise.

The European Commission's Technical Sub-Group Noise (TG Noise) have made substantial progress in developing methodologies for the assessment of impulsive noise, however the assessment methodologies for continuous noise are less well developed.

A registry of impulsive noise has been developed by ICES to specifically support OSPAR contracting parties in providing information for regional assessments for

MSFD descriptor 11. Ireland has reported data to this register for the years 2016, 2017 and 2018; this reporting is based on data from impulsive noise activity associated with petroleum exploration.

This assessment set out to evaluate the spatial distribution, temporal extent, and levels of anthropogenic impulsive sound sources in Irish marine waters during 2016, 2017 and 2018, as far as possible in light of Commission Decision 2017/848.

The objective was to meet the requirements of MSFD Articles 8, 9 and 10 concerning qualitative descriptors for determining GES, in this case specifically the impulsive noise criterion of Descriptor 11, that the spatial distribution, temporal extent, and levels of anthropogenic impulsive sound sources do not exceed levels that adversely affect populations of marine animals.

Drivers

The driver of underwater noise in Irish marine waters is economic development. The following activities are listed in the revised directive 2017/845 as drivers associated with underwater noise generation:

- Renewable energy generation;
- Transport infrastructure;
- The extraction of oil & gas (including petroleum exploration & production, and decommissioning);
- Transmission of electricity and communications (including laying of telecommunication cables);
- Research, survey & educational activities (including seafloor mapping);
- Military operations.

Impulsive noise generating activities which took place in Irish waters, during the assessment period 2016 to 2018, are contained within the categories:

- The extraction of oil and gas (seismic/acoustic activity associated with petroleum exploration);
- Research, survey and educational activities.

Pressures

The 'Input of anthropogenic sound' is the only pressure listed in the Directive associated with underwater noise generation. However, links to the biological pressure 'disturbance of species (e.g. where they breed, rest and feed) due to human presence' is also relevant.

Environmental Targets

Irelands Initial Assessment (2013) describes the characteristic of Good Environmental Status (GES) for Descriptor 11 as follows:
Loud, low and mid frequency impulsive sounds and continuous low frequency sounds introduced into the marine environment through human activities do not have adverse effects on marine ecosystems:

- Human activities introducing loud, low and mid-frequency impulsive sounds into the marine environment are managed to the extent that no significant long-term adverse effects are incurred at the population level, or specifically to vulnerable / threatened species and key functional groups.
- Continuous low frequency sound inputs do not pose a significant risk to marine life at the population level, or specifically to vulnerable / threatened species and key functional groups'.

The environmental target from the Initial Assessment was the 'Establishment of a register of impulsive noise to determine the current level and tends in impulsive noise in the Irish Marine Environment'. This target has been achieved, through regional co-operation, by the continuing provision of impulsive noise data to the ICES/OSPAR noise register.

To address the requirements of the revised Commission Decision (EU) 2017/848 and amending Commission Directive (EU) 2017/845, Ireland has now established the following environmental target based on the essential elements assessed for impulsive noise:

Environmental Target D11T1
The spatial distribution, temporal extent, and levels of anthropogenic impulsive sound sources do not exceed levels that adversely affect populations of marine animals.

Threshold Values
There are currently no threshold values associated with underwater noise. TG Noise aim to produce advice on regional and sub-regional threshold values in 2020 and Ireland will develop threshold values in line with this advice when it is available.

Criteria / Criteria elements included in the Assessment
The Criterion from the Commission Decision (2017/848 EC) considered in this assessment is:

- the spatial distribution, temporal extent, and levels of anthropogenic impulsive sound sources do not exceed levels that adversely affect populations of marine animals (D11C1).

Exclusions
There is no current evaluation under Criterion D11C2 (spatial distribution, temporal extent, and levels of anthropogenic continuous low-frequency sound do not exceed levels that adversely affect populations of marine animals).

Work is ongoing at a European level to develop methodologies for the assessment of continuous noise and its impact on marine animals. The current TG Noise document 'Monitoring Guidance for Underwater Noise in European Seas' states that 'current ambient sound levels in European marine waters and their impact on the ecosystem are largely unknown'.

Impact
Underwater noise can interfere with key life functions of marine animals (e.g., foraging, mating, nursing, resting, migrating) by impairing hearing sensitivity, masking acoustic signals, eliciting behavioural responses, or causing physiological stress.

There is considerable knowledge of the impacts of impulsive underwater noise on a selected number of individual marine species. These impacts can be quantifiable, like changes in behavior and/or death. Other impacts, such as

hearing sensitivity reduction or physiological stress, can be more difficult to quantify.

The potential impacts of underwater noise on animal populations and/or ecosystems have yet to be developed.

TG Noise recognise these knowledge gaps in relation to impacts. The current advice document states that underwater noise is 'a relatively new topic, and at this stage, with the knowledge and information available, Member States should not expect to have full understanding of impacts of noise on populations and ecosystems in the near future, and defining internationally agreed threshold values is therefore difficult'.

The NPWS guidance document 'Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish waters'[8] was first developed in 2007 and updated in 2014. This document provides the statutory method of mitigating lethal or sub-lethal injury of marine mammals from acoustic surveys and blasting in Irish waters. These guidelines are based on monitoring a prescribed mitigation zone around an acoustic source and are considered to be some of the most robust guidelines in Europe for the protection of marine mammals during acoustic surveys and blasting. Since these Guidelines were introduced in 2014, adherence to them has been a condition of any application for searching for petroleum with an acoustic noise element. All applications for offshore petroleum activities are submitted to the NPWS for their observations.

Environment Status

The primary anthropogenic impulsive sound source in Irish marine waters during this assessment period is associated with acoustic surveys carried out for petroleum exploration. The spatial distribution, temporal extent, and levels of seismic/acoustic survey activity in Irish marine waters during 2016, 2017 and 2018 have been assessed, using the data Ireland has reported to the OSPAR/ICES Noise Register.

Impulsive noise levels from 2016, 2017 and 2018, expressed as Pulse Block Days*, are summarised in Figure 1 from across the OSPAR Regions II, III and V. The OSPAR regions are as follows Region II - The Greater North Sea, Region III - The Celtic Seas and Region V - The Wider Atlantic. This assessment highlights that The Greater North Sea had by far the highest levels of anthropogenic impulsive noise when compared with the Celtic Seas and the Wider Atlantic. All Irish impulsive noise generating activities carried out between 2016 and 2018 occurred in the Wider Atlantic and no other parties documented impulsive noise generating activities in the Wider Atlantic during this period.

The levels of underwater noise causing adverse effect to populations of marine animals within Irelands MSFD area is generally low and low in comparison with impulsive noise generating activity levels in neighbouring OSPAR Regions.

[8] https://www.npws.ie/sites/default/files/general/Underwater%20sound%20guidance_Jan%202014.pdf

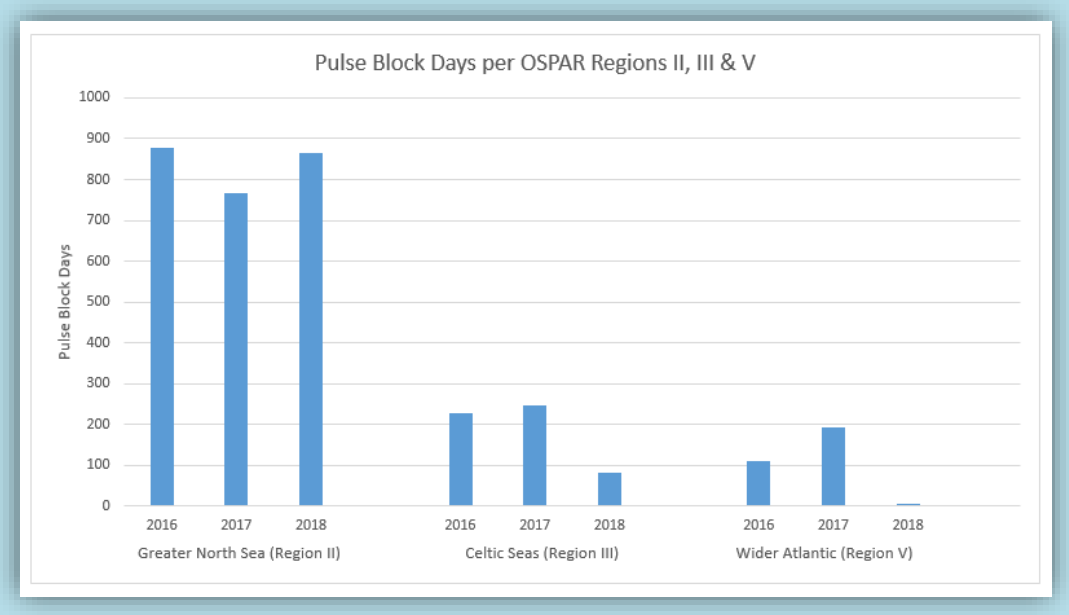


Figure 1: Impulsive noise pulse block days per OSPAR Regions II, III & V.

* Where Pulse Block Days are the number of days within a specified spatial unit in which anthropogenic impulsive sources occurred in a given calendar year.

Linkages

Other Criteria and elements which relate to the D11C1 assessment are as follows:

Descriptor 1: Biodiversity.
Criterion 2 - Population abundance.
Criterion 3 - Population demographic characteristics.
Criterion 6 - Pelagic habitat condition.

Conclusion

Impulsive noise data, from activities carried out under licence, during 2016, 2017 and 2018 has been included in the ICES/OSPAR Impulsive Noise Register.

The extent and levels of impulsive noise generating activities in Irish marine waters for 2016, 2017 and 2018 were assessed and a comparison of Pulse Block days in OSPAR Regions II, III and V was carried out. This assessment of Criterion D11C1 highlights the limited activity and low levels of impulsive noise generated in the Irelands maritime area.

Ireland has achieved Good Environmental Status for the anthropogenic impulsive sound element of underwater noise within its maritime area.

Economic and Social Assessment

1. Introduction

This chapter outlines an economic and social analysis of the use of Irish waters addressing the following:

- The economic contribution made by various marine sectors and the numbers they employ.
- A socio-economic characterisation of population living in coastal Ireland.
- A review of the ecosystem service values generated from Irish waters and
- An indicative assessment of the cost of degradation of the Irish marine environment.

2. Goods and services provided by the Irish ocean economy

The marine water accounts method of analysis was used to estimate the goods and services provided by the Irish ocean economy. The ocean economy is defined as any economic activity that directly or indirectly uses the sea as an input or produces an output for use in a sea-specific activity. The marine water accounts method consists of four stages:

1. Define the marine sectors that are part of the Irish marine or ocean economy;
2. The marine industries for which there is publically available data were identified as were those sub-sectors where no publically available data was available;
3. For those activities that are only partially marine (e.g. cargo handling, tourism) the proportion of economic activity that is marine-based was estimated; and
4. The levels of turnover, employment, value-added (GDP), was recorded for each industry identified as forming part of the marine sector.

This report draws on data from the Central Statistics Office (CSO)'s Census of Industrial Production and Annual Service Enquiry databases. Additional targeted survey data from the Socio Economic Marine Research Unit (SEMRU) in National University of Ireland Galway (NUIG) have been used to collect information on the smaller marine industries where publically available information is not available. The reference year is 2018 and this is compared to available data for 2012.

Ireland's ocean economy had a turnover of €6.2 billion in 2018, of which €2.2 billion was direct gross value added (GVA). The Irish marine sector employed 34,132 full time equivalents (FTEs). The direct GVA from marine economic activity is therefore approximately 1% of national output. The value of the ocean economy in terms of turnover and GVA is dominated by shipping and maritime transport, the seafood

industry (wild capture fisheries, aquaculture and seafood processing combined), tourism, and leisure in marine and coastal areas (Table 1). Shipping and maritime transport continues to be the largest contributor in terms of turnover and value added in 2018. Tourism and leisure in marine and coastal areas is the next largest category overall and is the largest contributor with regards to employment accounting for just over 51% of all employment in the ocean economy.

Table 1. Direct Turnover, GVA and Employment by industry, 2018.

Marine Sector	Direct Turnover € Millions	Direct GVA € Millions	Direct Employment (FTEs)
Shipping and Maritime Transport	2,288.37	697.21	5,055
Marine Tourism and Leisure	1,253.73	648.44	18,107
International Cruise Industry	51.44	20.34	…
Marine Retail Services	167.03	74.53	927
Sea Fisheries	315.39	173	2,663
Marine Aquaculture	176	100.32	1,925
Seafood Processing	563.74	161.13	2,383
Oil and Gas Exploration & Production	819	106.47	154
Marine Manufacturing, Construction & Engineering	136.78	67.89	834
Advanced Marine Technology Products & Services	96.45	41.87	683
Marine Commerce	228.15	67.7	389
Marine Biotechnology & Bio-products	76.41	29.77	545
Marine Renewable Energy	57.59	37.19	467
Total	**6,230.07**	**2,225.85**	**34,132**

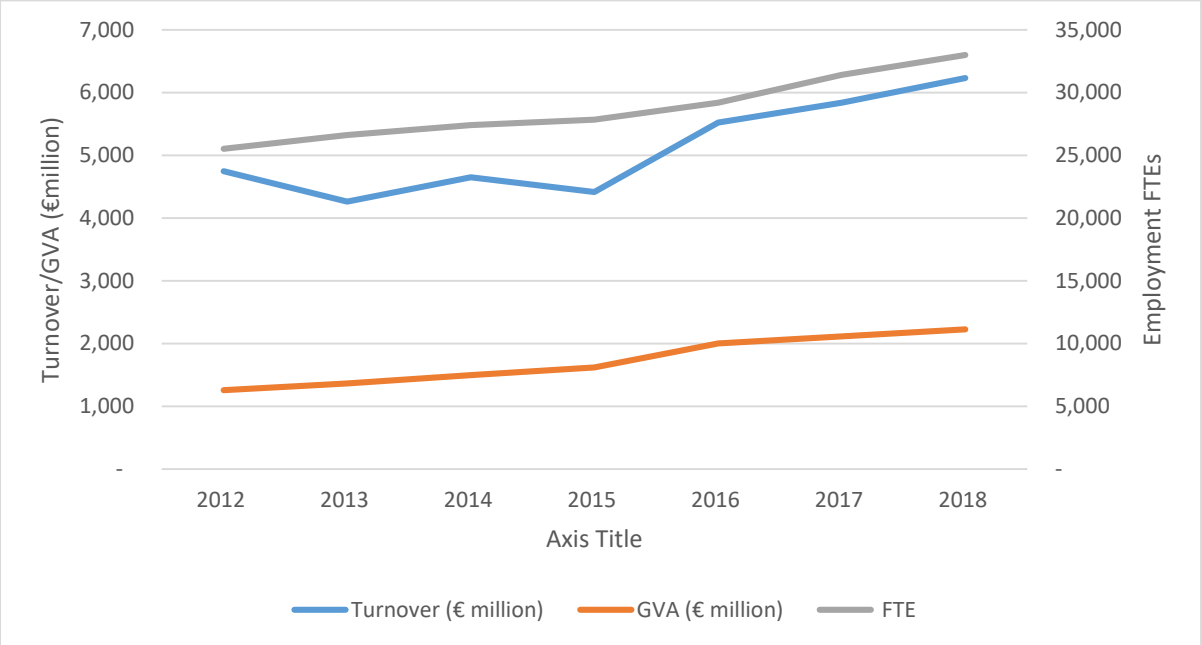


Figure 1. Direct Turnover, GVA and Employment by industry, 2012 to 2018.

Figure 1 highlights the substantial increase in the economic contribution from the various marine industries and the numbers of people they employ since 2012. Turnover has increased by 31% over the period, GVA has increased by 78% and employment has increased by 34% over this 7-year period.

The spatial distribution of enterprises and employment in Ireland's ocean economy is shown in Figures 2 and 3 respectively. While Dublin and Cork have the highest number of marine related enterprises, counties Donegal, Galway, Kerry and Wexford show the highest levels of employment along with Dublin and Cork. This indicates the importance of marine tourism in particular and also the seafood industry in employment in the ocean economy and these counties are some of the most popular tourism destinations and seafood areas in the country.

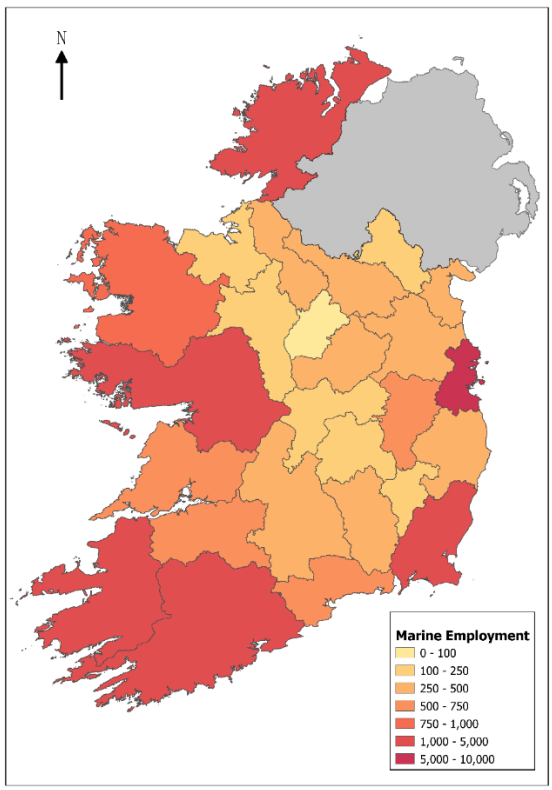


Figure 2. Spatial distribution of enterprises and employment in Ireland's Ocean Economy.

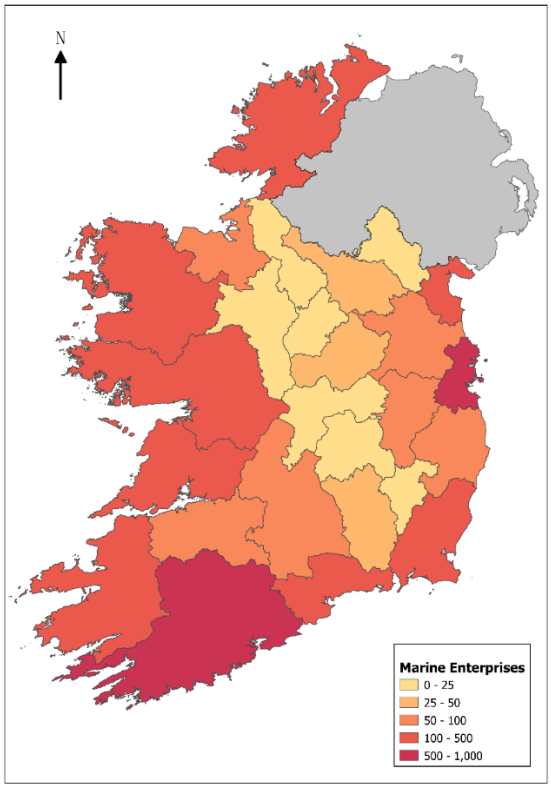


Figure 3. Spatial distribution of enterprises in Ireland's Ocean Economy.

3. Pressures and associated activities in Irish seas

Table 2 provides a summary of the main anthropogenic pressures associated with each of the marine activities listed in Table 1 and uses the relevant pressures listed in Commission Directive 2017/845. The assessment of the top pressures in each case relies on expert judgement and the work of Pedreschi et al. (2019). Table 2 is

not an exhaustive list of pressures from each activity on the Irish marine environment.

Table 2. Pressures from marine industrial activities in Irish waters.

	Key Pressure 1	Key Pressure 2	Key Pressure 3
Shipping and Maritime Transport	Input of anthropogenic sound (impulsive, continuous)	Input or spread of Non Invasive Species	Input of other substances (synthetic substances, acute events)
Marine Tourism and Leisure	Input of litter (solid waste matter, including micro-sized litter)	Disturbance of species (e.g. where they breed, rest and feed) due to human presence	Input or spread of Non Invasive Species
International Cruise Industry	Input of anthropogenic sound (impulsive, continuous)	Input of litter (solid waste matter, including micro-sized litter)	Input of other substances (synthetic substances, acute events)
Marine Retail Services	Secondary service to other marine industries so minimum direct pressure on marine environment		
Sea Fisheries	Extraction of, or mortality/injury to, wild species of fish and mammals (by commercial and recreational fishing and other activities)	Input of litter (solid waste matter, including micro-sized litter)	Disturbance of species (e.g. where they breed, rest and feed) due to human presence
Marine Aquaculture	Input of nutrients and input of organic material causing eutrophication (in particular from finfish aquaculture).	Input of litter (solid waste matter, including micro-sized litter)	Input or spread of Non Invasive Species
Seafood Processing	Input of nutrients and input of organic material	Input of other substances – point sources and acute events.	Input of litter (solid waste matter, including micro-sized litter)
Oil and Gas Exploration and Production	Physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate and physical disturbance to sea bed impacting benthic habitats	Input of other substances (synthetic substances, acute events	Input of anthropogenic sound (impulsive, continuous)
Marine Manufacturing, Construction and Engineering	Input of anthropogenic sound (impulsive, continuous)	Physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate and physical disturbance to sea bed impacting benthic habitats	Disturbance of species (e.g. where they breed, rest and feed) due to human presence
Advanced Marine Technology	Input of anthropogenic sound (impulsive, continuous)	Input of other forms of energy (including electromagnetic fields,	Disturbance of species (e.g. where they breed,

	Key Pressure 1	Key Pressure 2	Key Pressure 3
Products and Services		light and heat affecting hydrographical conditions	rest and feed) due to human presence
Marine Commerce	Secondary service to Shipping and Maritime Transport so minimum direct pressure on marine environment		
Marine Biotechnology and Bio-products	Extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities)	Physical disturbance to sea bed impacting benthic habitats	Disturbance of species (e.g. where they breed, rest and feed) due to human presence
Marine Renewable Energy	Disturbance of species (e.g. where they breed, rest and feed) due to human presence	Physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate	Input of other forms of energy (including electromagnetic fields, light and heat affecting hydrographical conditions
Marine Research	Physical disturbance to sea bed impacting benthic habitats	Disturbance of species (e.g. where they breed, rest and feed) due to human presence	Input of anthropogenic sound (impulsive, continuous)
Naval Defence	Input of anthropogenic sound (impulsive, continuous)	Disturbance of species (e.g. where they breed, rest and feed) due to human presence	Input of other forms of energy (including electromagnetic fields, light and heat affecting hydrographical conditions
Wastewater agglomerations and associated discharges	Input of nutrients – diffuse sources, point sources, atmospheric deposition causing eutrophication	Input of nutrients – diffuse sources, point sources, atmospheric deposition impacting mammals, fish and benthic habitats	Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides)

Different levels of intensity in the marine activities outlined in Table 2 will generate different levels of pressures on the marine environment. The precise level of impact will vary according to scale and management approach combined with the local and regional landscape, hydrodynamics and chemical characteristics.

For example, the European Environmental Agency (EEA, 2019), note that major impacts may result from high-input / high-output intensive aquaculture systems, the effects of which “include the discharge of suspended solids; the nutrient and organic enrichment of recipient waters resulting in the build-up of anoxic sediments; changes in benthic communities and eutrophication; the release of antibiotics and pharmaceuticals; the introduction of diseases and escapees to the ecosystem, affecting biodiversity; the introduction (deliberate or accidental) of alien species; and impacts on wild fauna. The development of aquaculture also has a direct impact on capture fisheries”. With less intensive systems and shellfish aquaculture in particular the impacts should be much lower.

4. A socio-economic characterisation of Irish coastal population

Socio-economic data was obtained from existing national and European statistical portals. The marine social and economic indicators identified for the assessment are listed in Table 3 and a social analysis to supplement the economic analysis was also carried out as part of the Economic and Social Assessment (ESA). This involved examining the socio-demographic profile of the Irish population living in coastal regions.

Small Area Population Statistics (SAPS) from Irish Census of Population were used to define what is referred to as the 'coastal economy'. SEMRU have previously defined such coastal regions that make up the coastal economy as:

Shoreline Electoral Districts: establishments or population located in an electoral district (ED) that is immediately adjacent to an ocean or sea, included estuaries and bays. Of the 3400 EDs in the country, 670 are Shoreline Electoral Districts;

Coastal County: establishments or population located in a county that has a shoreline of any length adjacent to an ocean or sea, included estuaries and bays. 15 of the 26 counties in the Republic of Ireland are Coastal Counties.

European NUTS III Coastal Region: standard statistical regions (EU NUTS level 3), where at least half of the population is within 50 km of the shoreline. This is the Eurostat definition of a coastal region and for Irish case this includes 7 of the 8 NUTS 3 regions in Ireland, the Border, the West, Dublin, the Mid-East, the Mid-West, the South East and the South West. Only the four counties of the Midlands NUT 3 region are excluded from this definition.

The above definitions for coastal regions were outlined as such because a lot of data is collected in Ireland based on these different administrative and political jurisdictions.

Table 3 Average socio-economic characteristics of Irish coastal communities based on the 2016 Irish population census.

	Coastal EDs	**Coastal Counties**	**NUTS III Coastal**
Population	1,302,144	3,557,125	4,469,564
Population Change 2011-2016	2.77%	2.67%	2.52%
Female Unemployment Rate (%)	11.92	10.77	10.84
Female Unemployment Change 2011-2016 (Percentage Points)	-3.18	-3.06	-3
Male Unemployment Rate (%)	14.8	13.22	13.09

	Coastal EDs	Coastal Counties	NUTS III Coastal
Male Unemployment Change 2011-2016 (Percentage Points)	-0.3	-0.61	-0.75
Third Level Education (%)	33.83	31.98	31.24
Primary Level Education Only (%)	15.68	15.61	15.64
Semi- and Unskilled Manual Workers (%)	18.7	18.29	18.27
Higher and Lower Professionals (%)	35.57	35.8	35.53
Pobal Relative Affluent Index Score (%)	-1.04	-0.78	-1

Table 3 highlights that 1.3 million individuals live in coastal EDs, 3.56 million live in coastal counties and 4.47 million live in the Coastal NUTS3 (EU Coast) area. These represent 27%, 74% and 94% of the total population of the country for each coastal spatial scale respectively. The population in coastal EDs increased by 2.77% between 2011 and 2016. This increases the likely pressures from anthropogenic sources on the marine environment. Coastal EDs have a slightly higher unemployment rate (13.44%) than the national average (12.07%). Male unemployment rates are higher than female unemployment in coastal EDs. Female unemployment also saw a larger relative decrease between the census years 2011 and 2016.

Figure 4 also shows the distribution of male and female unemployment rates at the Coastal ED, County, and NUTS3 spatial scales.

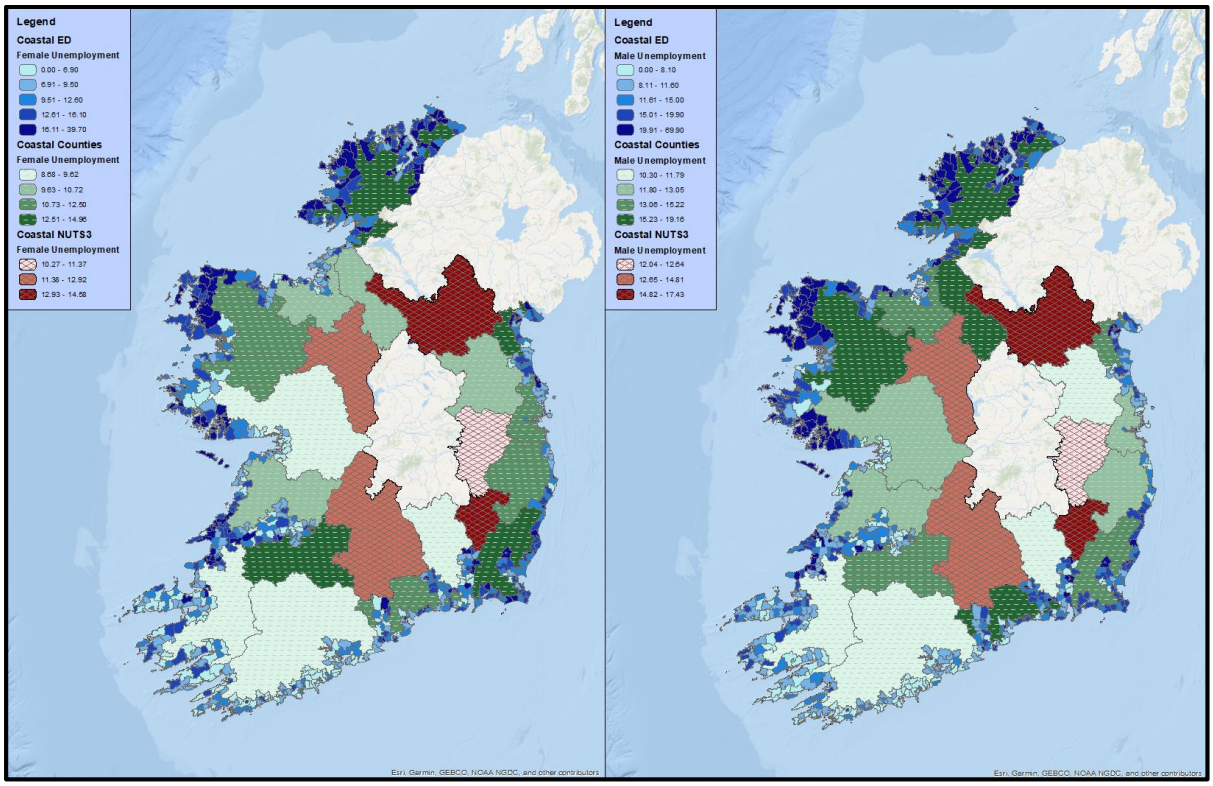


Figure 4. Male and Female Unemployment Rates at the Coastal ED, County, and NUTS3 spatial scales.

Just over 33% of those living in coastal EDs have a third level education. In terms of social class, 18.7% of those living in coastal EDs are categorised as being semi- and unskilled manual workers and 35.6% are categorised as higher and lower professionals. Observing the Relative Affluent Index Scores, the average coastal ED has a score of -1.04, putting it "marginally below average" in terms of affluence.[9]

Further information on the marine industry activities reviewed above and the coastal economy statistics, along with a detailed discussion of the methodologies used in each case, are available in the supporting report: Ireland's Ocean Economy Report.

5. An Assessment of marine ecosystem service values in Irish waters

There are many marine ecosystem services that generate benefit values to Irish society that go beyond the values obtained through the ocean economy industry activities reviewed in the previous section. These marine ecosystems services are "provided by the processes, functions and structure of the marine environment that directly or indirectly contribute to societal welfare, health and economic activities". Research was carried out to determine the ecosystem service values from Irish marine waters.

In 2018 SEMRU published a study (Norton et al. 2018) that examined the ecosystem service benefits that society receives from Ireland's marine environment. The study used a framework called the UN Common International Classification of Ecosystem Services (CICES). This ecosystem service assessment is based on CICES version 4.3. While there is an accompanying classification of abiotic (non-living) outputs from natural systems, CICES mainly focuses on biotic (living) elements rather than abiotic elements of nature. The use of water as a medium for transportation of goods (shipping), is not classed as an ecosystem service. Oil and gas have biological origin from the accumulated remains of marine organisms and have through time and geological processes become abiotic mineral resources. Thus both shipping and oil and gas are valuable marine services, but not ecosystem services and are reported on in the assessment under the Marine Accounts section.

This approach provides a profile of the marine ecosystem services derived from Ireland's coastal, marine and estuarine natural resources and estimates the value to society of these marine ecosystem services. Table 4 outlines these ecosystem services and their associated value. It is important to note the following:

- Not all of the ecosystem services provided by the marine environment could be monetarized, the value of those that could was substantial;

[9] A full description of the Relative Affluent Index Score is available in Haase and Pratschke (2008).

- Due to the different methods used to estimate the service benefit values, value estimates shown in Table 4 may not be directly comparable and should not be aggregated.

More research is needed to examine how Irish coastal and marine ecosystems provide these services and to examine how exactly Irish society value these services.

Table 4. Values of Irish Coastal and Marine Ecosystem Service Benefits.

Ecosystem Service	CICES Classification	Quantity of ES per annum	Estimate of the Value of ES per annum
Provisioning ecosystem service			
Off shore capture fisheries	Wild Animals	469,735 tonnes	€472,542,000
Inshore capture fisheries	Wild Animals	14,421 tonnes	€42,113,000
Aquaculture	Animals - Aquaculture	39,725 tonnes	€148,769,000
Algae/ Seaweed harvesting	Wild Plants & Algae/ Plants & Algae from Aquaculture	29,500 tonnes	€3,914,000
Genetic materials	Genetic materials from biota	Not quantified	Not valued
Water for non-drinking purposes	Surface water for non-drinking purposes	1,189,493,326 m^3 of seawater used for cooling	Not valued
Regulating and maintenance ecosystem services			
Waste services	Mediation of waste, toxics and other nuisances	9,350,642 kg organic waste 6,834,783 kg nitrogen 1,118,739 kg phosphorous	€316,767,000
Coastal defence	Mediation of flows	179 km of coastline protected by saltmarsh	€11,500,000
Lifecycle & habitat services	Lifecycle maintenance, habitat & gene pool protection	773,333 ha protected through SAC's	Not valued
Pest & disease control	Pest & disease control	Not quantified	Not valued
Climate regulation	Atmospheric composition & climate regulation	42,647,000 tonnes CO_2 absorbed	€818,700,000
Cultural services			
Recreational services	Physical & experiential interactions	96 million marine recreation trips per year	€1,683,590,000
Scientific & educational services	Scientific & educational	Marine education and training fees	€11,500,000

Ecosystem Service	CICES Classification	Quantity of ES per annum	Estimate of the Value of ES per annum
Marine heritage, culture & entertainment	Heritage, cultural & entertainment	Not quantified	Not valued
Aesthetic services	Aesthetic	Flow value of coastal location of housing	€68,000,000
Spiritual & emblematic values	Spiritual &/or emblematic	Not quantified	Not valued
Non-use values	Existence & bequest values	Not quantified	Not valued

In relation to cultural ecosystem services, information about use of the coastal and marine ecosystems by users is not captured routinely and is dependent on one off reports which use different methods. Valuation of these services is a developing area where research may be needed to demonstrate how to incorporate these values into decision making. The significant contribution that provisioning, regulation and maintenance, and cultural marine ecosystem services make to the welfare and economic activity of Ireland. On an annual basis, recreational services interacting with coastal, marine and estuarine ecosystems result in approximately 96 million marine recreation trips per year by Irish residents with an estimated annual value of €1.7 billion. Fisheries and aquaculture are estimated to be worth €664 million in terms of output value from Irish waters, carbon absorption services are valued at €819 million, waste assimilation services €317 million, scientific and educational services €11.5 million, coastal defence services of €11.5 million, seaweed harvesting €4 million and the added value per annum to housing stock of being close to the shore (aesthetic services) is valued at €68 million. Even though not all of the ecosystem services provided by the marine environment can be monetized, this research indicates that the value of those that can is substantial.

The full supporting report on “Valuing Ireland’s Blue Ecosystem Services” provides a detailed breakdown of the ecosystem service benefits analysed and discusses the alternative valuation methods used in generating the values reported in Table 4. The full supporting report is available to download here.

6. Analysis of the indicative costs of degradation

There is no single methodological approach used in assessing costs of marine environmental degradation. The EU working group on Economic and Social Assessment (ESA) has facilitated taking stock of the various existing approaches in order to deal with this issue as effectively as possible. This assessment considers the costs incurred by society in avoiding degradation of the marine environment.

This analysis of the costs of degradation is carried out by studying the accounting costs, the costs associated with the various existing monitoring, prevention,

avoidance and mitigation measures, taking into account the objectives of preserving the good environmental status of the marine waters concerned in a set of public policies, including the MSFD.

This approach has been used because of data availability, reliability and repeatability. The costs of avoiding degradation are considered and the calculation of such costs considers only the costs of measures aimed at preventing further degradation to the marine environment. The estimated costs are then used to infer how much the current state of the marine environment is valued by Irish society.

CSO has, through the implementation of the UN System of Environmental-Economic Accounting (SEEA), established a series of environmental accounts modules for Ireland. The SEEA is a statistical system that brings together economic and environmental information into a common framework to measure the condition of the environment, the contribution of the environment to the economy, and the impact of the economy on the environment.

The CSO have been generating accounts that examine the environmental subsidies and similar transfers paid by the Irish government to all sectors of the Irish economy and to international organisations, and environmental transfers paid by the EU to all sectors of the Irish economy. Annual figures are available from 2000-2016.

Where a programme has more than one objective and is not wholly aimed at environmental protection or resource management then the CSO only include a share of the programme funding based on available information on the amount of expenditure relating to the environmental objective under the programme.

While many of these transfers are at a high level of aggregation discussions with the governing bodies allow us to estimate the approximate share of the relevant transfers that are aimed at protecting the marine environment and that therefore constitute costs aimed at avoiding degradation. These costs are shown in Table 5 for the review period 2012 to 2017. Note the figures shown in Table 5 are the total costs of the programmes while the final column indicates the estimated share of the total programme costs that are aimed at the protection and management of the marine environment in particular.

Table 5. Environmental Transfers for the Protection and Management of the Environment, 2012 - 2017 (€'000) (Source: CSO Environmental Accounts).

	2012	2013	2014	2015	2016	2017	Marine Protection / Management %
Programme for the Management of Wild Flora & Fauna							
Lobster V-Notching Scheme	71	86	253	320	336	342	100%
Marine Environment Protection Scheme	178	141	315	296	-	-	100%
Salmon Conservation Fund	641	195	595	267	557	252	100%
Sea Fisheries Protection Authority (fisheries conservation)	221	735	630	375	194	500	100%
Seafood Environmental Management Part A	34	51	9	16	-	-	100%
Seafood Environmental Management Part B	117	-	-	-	-	-	100%
Sustainable Fisheries Scheme	-	-	-	-	515	444	100%
Programme for Other Environmental Protection Activities							
UN Environment Fund	361	361	358	507	508	478	5-10%
Programme for the Protection of Biodiversity & Landscapes							
Marine Biodiversity Scheme	496	333	330	559	427	1,780	100%
Programme for Wastewater Management							
Wastewater Treatment Facilities (Irish Water and Local Authorities)	5,040	5,377	7,855	2,935	235	767	65-75%
Water Services Investment Programme (Wastewater)	150,363	124,396	-	-	-	-	65-75%
Capital Investment Plan (Wastewater)	-	-	150,000	168,000	199,000	229,000	65-75%
Rural Wastewater Plan (Capital)	5,304	6,307	777	1,146	212	199	65-75%
Totals	**162,824**	**137,981**	**161,122**	**174,421**	**201,984**	**233,762**	

Note: A dash indicates programme not in operation or no payments made.

The programmes presented in Table 5 do not cover all the costs associated with the protection of the marine environment as there will be other activities that have a broader remit with some element aimed at the marine environment. To get this full information a detailed analysis would be needed of the accounts of all the relevant bodies that are responsible for the prevention of degradation of the marine environment and this is a recommended area for further research.

An alternative approach to examining the costs of implementing programmes and measures to prevent degradation of the marine environment is to examine the expenditure of those institutes that have responsibility for such management and protection activities. The CSO Environmental Accounts series, breaks down environmental subsidies and similar transfers by source of funding and administering body. Table 6 summarised these figures for the institutions that have a role in marine environment protection. The final column gives an indication of the share of the total figures that goes to marine rather than terrestrial environment protection and

management. Some of these are unknown at this time and require further research to determine them.

Table 6. Environmental Subsidies and Similar Transfers by Source of Funding and Administering Body, 2012-2017 (€'000) (Source: CSO Environmental Accounts).

Source of Funding	Program Admin	2012	2013	2014	2015	2016	2017	Marine %*
DAFM	BIM	218	139	289	316	425	391	100
	DAFM	109,125	96,038	60,640	40,611	63,531	101,847	3-5*
	IFI	641	195	595	267	557	252	5-10*
	MI	248	167	165	280	2,220	2,762	100
DCCAE	DCCAE	3,500	8,798	8,073	4,506	10,118	7,997	?*
	EPA	11,735	10,629	9,595	7,539	9,569	9,598	15-20*
	SEAI	49,621	30,358	34,618	37,830	39,770	57,836	2-3*
DCHG	DCHG	3,497	3,982	4,173	4,022	4,390	4,251	?*
	HC	739	911	896	933	1,209	1,130	?*
	NPWS	4,765	4,026	3,096	2,070	811	596	?*
DHPLG	DHPLG	1,314	965	472	110	723	715	100**
Env. Fund	DCCAE	8,467	4,419	4,153	4,234	1,922	1,990	?
EU	BIM	182	139	289	316	425	396	100
	DAFM	152,103	122,485	150,548	95,792	87,755	126,267	10-15*
	EU	1,193	1,230	2,071	2,941	3,392	4,082	?
	MI	248	167	165	280	3,352	3,870	100

Notes:

*indicates best available estimate of share.

** refers to the Department's expenditure on the marine related issues. Source Office of the Comptroller and Auditor General Appropriation Accounts 2018. Prior to 2016 this department was the Department of Environment, Community and Local Government.

? The Marine % Share is unknown at this time; further research is required.

7. Key Outputs

The key outputs from this Economic and Social Assessment of Irelands marine environment are as follows:

- Ocean Economy turnover in 2018 was €6.2 billion, of which €2.2 billion was direct gross value added.
- Employment in the marine sector in Ireland was 34,132 full time equivalents
- Between 2012 and 2018 there has been a substantial increase in the economic contribution from the marine sector:
    - Turnover has increased by 31% over the period
    - GVA has increased by 78%
    - Employment has increased by 34%

- There is an extensive list of pressures from human activities in the marine environment
- Depending on how the coast is defined a considerable proportion of the population live at or near the coast:
    - 1.3 million live in shoreline Electoral Districts, 27 % of the population
    - 3.56 million live in coastal counties, 74 % of the population
    - 4.47 million live within 50km of the shoreline, 94 % of the population
- Marine ecosystem services make a substantial contribution to welfare, health and economic activities every year:
    - 96 million marine recreation trips per annum by Irish residents valued at €1.683 billion
    - Fisheries & aquaculture worth an estimated €664 million in terms of output value from Irish waters
    - Carbon absorption services are valued at €818.7 million
    - Waste assimilation services valued at €316.7 million
    - Scientific and educational services valued at €11.5 million
    - Coastal defence services valued at €11.5 million
    - Seaweed harvesting valued at €4 million
    - Aesthetic services, the added value per annum to housing stock of being close to the shore is valued at €68 million
- The cost of degradation has been considered in two ways using the cost based approach;
    - Environmental Transfers for the Protection and Management of the Environment
    - Environmental Subsidies and Similar Transfers by Source of Funding and Administering Body

  Further consideration is needed for the cost of degradation calculations.

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