COASTWATCH AUTUMN 2016 SURVEY RESULTS

All Ireland - Part 1

Coast Character, Biodiversity and Water Quality

Coastwatch

Coastwatch Coordination, Department of Civil, Structural and Environmental Engineering,
Museum Building, Trinity College Dublin, Dublin 2, www.coastwatch.org

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Karin Dubsky, Angel Duarte and Florence Lamouline

Compiled from Coastwatch volunteer survey reports

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Museum Building, Trinity College Dublin, Dublin 2, www.coastwatch.org

Printed by Snap Dame Street

Autumn 2016 Coastwatch Survey Results
Island of Ireland

Compiled from Coastwatch volunteer survey reports by
Karin Dubsky, international and national Coastwatch coordinator, Ángel Duarte Campos, technology and GIS coordination, with contributions and follow up work by David Wall, Paddy Houlihan, Florence Lamouline, Bettina Wimmer, Romain Peiffer, Michael Walsh and Roselyn Shaw.

The survey was supported by the Department of Housing and Local Government, Water Services Section.

Coastwatch Coordination

hosted by

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Coastwatch

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Surveyors, regional and national coordinators worked gratis or integrated the survey into their official work load. We would like to thank all for their citizen science contributions in the autumn 2016 survey and indeed in follow up work since then. A special thanks to those who organised and lead training meetings and particularly Niamh Ni Cholmain and all in Dublin city and Dublin Biosphere for hosting the all-Ireland kick off exhibition and workshop and printing sea shell posters.

Thank you for the over 900 photos which were also submitted, to be shown at result events and invaluable to help confirm identity of features and species. Names of regional coordinators and surveyors/team leaders for those who indicated names could be published are listed on following pages.

Our gratitude also to Trinity College Dublin for hosting Coastwatch and my colleagues for their support especially Prof Brian Broderick as head of department for his interest and encouragement and Dr Trevor Orr as well as Patrick Veale for solving surveyor engineering questions and identifying strange objects.

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Social Media: Rana Rassouli (Facebook) and Conor Pyle (Website)

Technical coordination and Data Handling: Angel Duarte including Island digitising, design of new survey question input form, result analyses, survey map update progress and result analyses with GIS mapping.

Report: Karin Dubsky and Angel Duarte, with Florence Lamouline (Chapter 3), edits and contributions from Roselyn Shaw, Michael Walsh, Michael Gunn, Romain Peiffer and Paddy Houlihan.

Cover design and front page by Bettina Wimmer.

Photo Credits:

Front Cover

Cork Surveyor training with familiar figure; by regional coordinator Bernie Connolly.
An inflow- too small to test officially, too big to ignore if it enters a Shellfish Water
Baby Blue Rayed Limpets on sea spaghetti; by Karin Dubsky
Edible Crab Waterford estuary; by Paddy Houlihan
Honeycomb Sabellaria reef covered in green seaweed; by Paddy Houlihan

Inside Front Cover

Coastwatchers at the Preliminary Results Launch in Trinity College Dublin; by Love your Lough Team NI.

All other photos are named beside image except where surveyor preferred to have name withheld.

COASTWATCH SURVEYORS MAIN CONTACT 2016 AUTUMN SURVEY

Names are only included, where the completed survey form confirmed permission to publish. Due to input form space limitations, normally only one name represents groups and schools.

29 Killanin Cubs Group
Adam Butler
Adventure Tourism Mgmt. ITTralee
Aidan Faughey
Aine Walsh
Andrew Cox
Anna Aherne
Anne Laird
Annie Getchell
Anthony Brogan
Anto Dillon
Ardmore Tidy Towns
Ardscoil Ris
Barry Flynn
Ben OShea
Bernie Connolly
Billy Harty
Breda Enright
Brenda Burke
Brenda Murphy
Brendan Allard
Brendan Griffin
Brendan O'Kane
Brian MacSuibhne
Brían MacSuibhne
Carmel Mackey
Cathal Divine
Cathal Diviney
Catherine Seale
Cathleen Ní Chonghaile
Chelsie Shaff
Christine Laughlin
Cian GIll
Ciara Conboy-Fischer
Cilian Roden
Claire Lewis
Clare Murray
Clashmore & Kinsalebeg Cmty. Counc.
Cleas
Cobh Tidy Towns
Conor Brownlee
Conor Mc Mahon
Cora Harding
Cordula Maguire
Darach Ó Murchú
Darragh Oneill
Dave Wall
Declan Collins
Deirdre Ryan
Des Farrell
Diane and
Diane Orr
Dion Deacon
D J Hemming
Donncha O Muirthile
Douglas Taylor
Dublin City Council Biodiversity
Eilís Sheehy
Eimear Manning
Eiméar Savage
Eleanor Carlton
Elizabeth Donnelly
Elizabeth O Brien
Emer Mc Loughlin
Emilie Massard
Eva Hennessy
Foyle Ambassadors
Frank O'Reilly
Frederick Boal
Frieda McGovern
Geoffrey Jones
Geoff Warke
Gerry Moore
Ger Scollard
Gina Kyriazopoulou
Glenarm Wildlife Group
Gráinne Cronin O'Reilly
Harm Deenen
James Rainey
Jayne, Marie, Anto
Jennifer Lynch
Jenny Suddaby
Jill Crosher
Jim Crowley
Jim Hurley
Joe Keatinge
John J
John Johanson
Jonathan Mason
Karen Dowling
Karin Dubsky
Katharine Duff
Kevin Lynch
Kimberly Harris Group
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Linda O'Dwyer
Love Your Lough
Maggie Gavin
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Margaret Somers
Mark Daly
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Paula Farrell
Paul and Karin
Paul Dubsky
PCA
Peta Taaffe
Peter Craven
Peter Mellor
Peter Pearson
Polly Dolan
Rasmus Sloth Pedersen
Regina Classen
Richard Torney
Robert Anthony
Rory Keatinge
Roslyn Nicholson
Ruairí Moore
Ruth Ennis
Sabine Springer
Sally Hennessy
Sam
Sara Dominguez
Sarah Gavin
Scoil Ard Ris, Transition Year
Scoil Chaitlin Naofa
Sea Life Bray
Seal Rescue Ireland
Shay Daly
Siobhan Tanner
Skerries Community College
S.N. na Naomh Uile an Cloigeann Stack
St Declan's National School
Stephane Merceron
Stephanie Linehan
Tara McMahon
Tempe Pearson
The Brodies
The Maguires
The Robert's family
The Thompson family
The Wendy House
Training Event Cobh
TCD, Zoology Department
Trevor Orr
Trish Murphy
Trish ODonohhue
Victor Fusco
Wild Bunch

REGIONAL AND NATIONAL SURVEY COORDINATORS

Regional Coordinators in Clockwise Order, from County Louth.

REGION	COORDINATOR
REPUBLIC OF IRELAND	
Louth	**Brendan McSherry** *Heritage Officer, Louth coco*
Meath	**Frank O Reilly** *Coastwatch Meath*
Dublin - Fingal	**Michael Walsh** *Coastwatch Dublin N*
Dublin City	**Niamh Ni Cholmain** *Biodiversity Unit Dublin City Co*
Dun Laoghaire	**Rory Keatinge** *Coastwatch*
Wicklow	**Annie Falomo** *National SeaLife Centre Bray* **Roselyn Shaw** *Coastwatch*
Wexford	**Karin Dubsky** *Coastwatch*
Waterford	**Alan Walshe** *Coastwatch and IWT*
Cork	**Bernie Connolly** *Cork Environmental Forum* **Karen Loxton** *Cork Nature Forum*
Kerry	**Dr. David McCormick** *Tralee Bay Wetlands Centre*
Galway	**Dr. Elaine O 'Riordan** *Galway Coco Bidi Project*
Galway City	**Dr. Kevin Lynch** *Geography NUIG*
Mayo	**Anthony Brogan** *Ceide Fields Visitor Centre & Coastwatch*
Donegal East	**Dr. Trish Murphy** **Lucy White** *Coastwatch & Celebrate Water*
NORTHERN IRELAND	
NORTHERN IRELAND	**Dave Wall** *Ulster Wildlife*

CONTENTS

HISTORY OF COASTWATCH AND NETWORK AIMS

The Coastwatch Europe (CWE) survey was first designed and tried in Ireland in 1987 by the International Co-ordinator, in cooperation with the Irish Times (national newspaper), With EC aid the survey method was then disseminated to eight European countries in 1988. The first large scale survey was carried out in 1989 in six countries: Norway, Denmark, Ireland, Netherlands, Portugal and the UK, and on a pilot scale in four more: Iceland, Germany, Belgium and Italy. Participation grew in 1990 with Latvia, Spain and Sweden joining. In 1991 the survey area was further increased with the inclusion of Greece, Estonia, Lithuania and Poland. In 1992 France, Bulgaria, Ukraine and a corner of Finland were added and in 1993 Russia joined. In the same year, Japan brought 50 volunteers for training and then tried the project at home. In 1996 Romania joined. It was the year in which international coordination handed out analyses programmes to national teams to start reporting results at home and focus on follow up work to improve matters on the ground – provide the coastal public with information and deal with democracy issues – public participation in coastal zone management, planning and access to information. Several post graduate including PhD projects developed including f. streptococci water pollution test kits. Coastwatch was supported internationally by EC project funding to do joint training, data gathering and problem solving follow up work. Depending on country and time, coordination is in the hands of solely volunteer, to fully waged teams.

The survey is the common base project shared by the Coastwatch Europe network members. General network aims put the role of the survey into context:

1. Training and education of volunteers and students in fieldwork, basic reporting methods and relevance of shore quality and problem results obtained to policy and legislation (from local to national, EU and international conventions).
2. Gathering baseline data about the European coast for use by local communities, authorities, governments, research organisations and NGO's.
3. Raising awareness of our coastal zone as a driver of European commons and as valuable shared resource, for which we have responsibility.
4. Giving back up and expertise to members of the public, wanting to participate actively in coastal zone management (CZM), protective and remedial action.

With time the focus broadened from waste to natural environment and to linked social and human rights issues. Lawyers joined national teams in several countries, so free legal and scientific aid could be provided and significant development, specific waste law and product changes were achieved. As follow up work grew, more extra national questions were added to the international survey questionnaire. The network went through a local and national focus period. Coastwatch international coordination hosted by Trinity College sought research funding and became partner in 'Citclops' EC FP7 funded research project which brought a whole new perspective of interpretation water colour and transparency, algal blooms and use of apps to record water colour with time and location on the web – the 2015 launched Eyeonwater app. The Google Earth, GIS based and social media survey approach designed by our Spanish volunteer researcher in Ireland proved successful and is now being used in Portugal, Spain, UK and Ireland with pilot areas in other countries.

EXECUTIVE SUMMARY

The autumn 2016 survey undertaken by Coastwatch volunteers around the island of Ireland ran from the 15th Sept to 15th October. Another week of 'injury time' was granted to facilitate those who postponed their booked survey due to jellyfish and some other issues. A month later, over 500 coastal site audits were inputted and analysed to present preliminary marine litter, biodiversity and water quality findings at a results workshop in Trinity College Dublin. After surveyor feedback on the draft report, cross checks and adding of some late survey forms, this is Part I of the final report. The November 2016 event also provided an opportunity to flag key findings for use in current marine policy and law discussions and to plan follow up action.

Results for the island of Ireland Coastwatch 2016 shore survey are based on shore audits by ~ 2000 volunteers reporting on nearly 600 survey units (where 1 s.u. is ~ 500m shore length). After removal of inaccessible sites and duplicates, data from 525 distinct survey units was analysed - 45 sites from NI and 480 from the Republic. This represents ~ 3.5% of our 7900 km of island of Ireland coast.

Survey Method: Volunteers from all walks of life chose and booked their survey areas online, or through regional coordinators. They carried out a snapshot audit of their s.u. from hinterland down to low water once between Sept 18th and Oct. 22nd, completing survey questions and water tests while on the shore. Support materials were available to download from the Coastwatch website including seashell, seaweed and jellyfish ID aids. Additionally a Coastwatch pilot micro litter app was introduced in autumn 2016 for download and surveyors were encouraged to check waste reception facilities if their chosen survey area contained a harbour. Data was returned online or by post for input, cleaning and analysis. Select results were mapped using GIS. The preliminary results were presented for comment together with local case studies on Nov 23rd 2016 in Trinity College Dublin and also posted on the Coastwatch website. After edits based on surveyor and regional coordinator comments this is Part I of the final report. Results are illustrated with maps and graphics, some comparing findings over several years. Part I is about biodiversity, water quality and surveyor concerns. Part II to be launched in late May focusses on waste and litter.

BIODIVERSITY

The survey form contained general habitat and biota questions shared by all Coastwatch countries and more detailed extra questions for select biota prioritised for Ireland and the UK. In contrast to early surveys, where only litter data was considered reliable, now with government grant aided support materials and training, the number of surveyors attempting the extra nature questions has risen to 85% and quality of information when cross checked for verification is generally high.

Jellyfish were reported on 15% of survey sites. Additionally Portuguese-man-of-war was mentioned as a species rarely reported before in 11 sites. The 'jellyfish present' figure is higher than in other years and would be even higher if stretches of booked sites had been surveyed as planned. Calls from surveyors on several West Cork, Kerry and Galway shores noted the presence of Lion's mane and Mauve stinger jellyfish and Portuguese-man-of -War occurrence as reason to postpone and then abandon surveys, citing serious sting threat and school health and safety rules.

Other Animals in occurrence frequency rank order:

Birds were the most widespread (84% of su) and numerous animals, with a count of 14252 live birds and 47 dead birds recorded. Most dead birds were on the Meath and Fingal coast.

Empty seashells were reported on 73% and live shellfish on 50% of shores. The Coastwatch seashell poster for the Dublin area, printed by Dublin City Council or downloaded by surveyors, was used to add species lists. After alerting surveyors to our special interest in the unusual blue-rayed limpet which lives on Kelp and Sea Spaghetti, a new blue-rayed limpet site was reported from Dalkey, Dun Laoghaire, augmenting another recent Coastwatcher record from nearby Sandycove. Prior to that there was no Dublin area record.

Empty oyster shells are still widespread as it once was a common shellfish. Today the range is restricted and remaining sites are under threat. For the first time, two live native oysters *Ostrea edulis* were found by a school group in Dublin Bay on an old oyster bed. The bay was thought to contain no live stock for decades. In Carlingford Lough more were found. Surveyor photos and accounts show the Lough to have biodiversity hotspots with areas teeming with tunicates, peacock worms, molluscs and seagrass with flocks of shorebirds feasting on them. On the downside surveyors noted further intensification of bottom mussel aquaculture activity and associated seafloor damage and litter.

Live fish were reported from 14% of survey sites and dead fish in 3% sites. In extra background knowledge questions for surveyors who know their area well, 11% of sites were thought to host juvenile fish or a fish nursery.

More dead seals were spotted than the previous year and less live seals. Seventy two live seals were recorded dotted around 34 survey sites and 9 dead ones found in 5 sites; one in Carn Annagh, Co Mayo contained 4 decomposing dead seals. One large dead seal in Donegal was found totally entangled in ropes. Just after the survey several more dead seals were reported and the Courtown Seal Sanctuary had over 80 rescue seals, a record number that they were looking after.

Seven live cetaceans were spotted over 3 survey sites and 5 dead ones in 5 sites. The reports of dead ones included a large female fin whale which had been swept up with many cuts. It was buried on the shore by Dun Laoghaire County Council. A baleen found a kilometre from the fin whale was thought to belong to another whale but was not counted as dead cetaecean.

Other dead animals included a Leather-backed turtle in Ferriters Cove, Co Kerry. Given that this endangered (red listed) turtle only passes through our waters, the annual Coastwatch survey record of one or two of these dead animals per year in just 3.5% of our coast seems high.

The 2016 survey included 35 survey units where Honeycomb worm *Sabellaria* reefs were observed. This biogenic reef is highlighted in training and surveyor updates. There was particularly good surveyor cover of the Hook Head to Youghal coast which may also have the highest honeycomb worm density on this island. While surveyor photos showed some prime quality honeycomb reef, there were green opportunistic algae overgrowing some and here reef quality deterioration was noted. Biogenic reef is classed as priority habitat under the EU habitat directive and is vulnerable to trampling, bottom dredging, sediment changes and eutrophication. In Northern Ireland surveyors covered part of the well-developed and protected Mourne coast honeycomb reef and also found a few reef hummocks in Carlingford lough at Ross Trevor, which was a new site.

Some sites with Invasive Alien Species (IAS) were recorded including Sea Buckthorn, Giant Hogweed and Japanese Knotweed on land, Spartina Grass in the splashzone and intertidal, and Zebra mussels in the Dublin Grand Canal Basin. The demand for surveyor IAS identification training and information on action if found was only covered in County Galway, so under reporting of these species is likely. The zebra mussel find in the Grand Canal basin, Dublin and follow up work are provided as example.

WATER QUALITY

Sewage: 42% of waters in survey sites were thought to be reliably sewage free and 39% rarely effected. Occasional sewage pollution was thought to affect 13% of s.u. and in 6% it was considered frequent or usual.

Inflows: There were 491 streams, drains, piped discharges recorded in the 525 survey sites. This is less than the typical 1 – 1.2 inflows/s.u. due to dry weather which dominated in autumn 2016.

Good Signs: In a quick visual check, surveyors found animal life in 10% and live fish in 4% of inflows.

Bad and potentially bad signs: Discoloured scum and froth were reported on 7% of inflows (as against 12% last year), a bad smell was noted for 6%. Dumped waste was recorded in 4% of inflows and visual signs of sewage or sewage fungus in 2%. Dead fish were seen in 3 sites (0.6%) Oil pollution was not a problem, with

only 2 cases of oil in inflows reported – one in the North and one in the South. The one in the South was resolved by the time the site was checked in follow up action.

Nitrate tests were carried out on 177 (36%) of the inflows. First detection by Merck field test method is 10 mg/l -NO_3, about double the concentration expected in most pristine waters. Only 'available' nitrates are detected, not nutrients already taken up by biota. Results were good for 53% of the inflows as nitrate levels were below detection. In a further 21% concentrations were between 10 and 24mg/l NO_3. But a quarter of tested inflows were suffering serious nitrate enrichment: 17% had nitrate concentrations between 25 and 49mg/lNO_3 and 9 % breached the legal nitrate limit of 50mg/l NO_3. An apparent improvement in number of 'clean' inflows when compared to the previous 2 years was attributed to more west coast survey reports where water is lower in nitrates and the fine weather. Looking back, 9-10% of inflows breached the Nitrate Directive maximum limit every year over the past 5 annual surveys.

Green algae biomass is used as an official indicator of nutrient status of bays and estuaries suitable for their growth. Coastwatchers reported green algae patches and thin lines washed up on just over half of the survey units (52 %) in keeping with previous few years, while large algal mats were recorded in 18% of shores, suggesting nutrient enrichment. Surveyors also noted extensive *Ectocarpus* carpets in Dublin Bay. This brown seaweed has a similar niche to the green *Ulva* seaweeds – fast growing fuelled by high nutrient levels, sunshine and warmth and breaking down to a mush carpet which covers the intertidal and may emit dangerous gases. In 2016 this decaying mass was so large that several sites were abandoned by surveyors.

Nitrate results obtained by Coastwatch surveyors were mapped and for the first time they were set into context of official coastal and transitional water data found on www.catchment.ie. Direct comparisons are hampered as official data available is a few years old and most inflows tested by citizens appear not to be tested officially. We were able to conclude that inflows which tested low in nitrates on the west coast generally flowed into waters officially classed as 'Good' and 'High' quality status; while transitional and coastal waters already classed as eutrophic in 2012 and 15 (latest published EPA data sets) appear to still receive nutrient top ups from the small inflows tested by Coastwatchers. Here citizen science can be complementary to official large inflow monitoring data and point to areas where nutrient management would need to be stepped up if Ireland is to comply with EU water law and most importantly have healthy transitional and coastal waters, which support the widest and quality demanding uses. This goes especially for shellfish and bathing waters, as well as Natura 2000 sites.

BACKGROUND INFORMATION AND SURVEYOR CONCERNS

Surveyors who reported threats to the shore mentioned erosion most frequently. The threat of erosion was reported in 153 sites (29.1% of su). It was higher than any other year, although the weather was mainly calm and fine during our survey period, with no storm which typically raises extra erosion concern. Hard erosion control measures were noticed in 224 sites, a figure which is steadily growing.

For the first time, recreational abuse ranked second (12.2% of su), pushing water pollution into third place (9%). As the 2016 survey included more west coast, this may have influenced threat ranking and further analyses of threat by county over time would be required. Flooding was considered a threat in 6.3% of shores. A mix of other threats included sea weed harvesting, aquaculture, planning issues and invasive alien species were recorded. The threat of construction in the coastal zone is still well down from peak Celtic Tiger days.

Recommendations to address problems identified in the Survey, support the gathering of extra information and citizen participation in coastal zone protection and management are provided at the end of each chapter. Some examples of follow up work already undertaken are provided.

CHAPTER 1: INTRODUCTION AND METHODS

1.1. INTRODUCTION

The 2016 Coastwatch survey marks 29 years since the survey was designed and run first with the Irish Times (1987). While the basic surveying – a set area around low tide – has remained the same, today's technology with online maps for survey site mapping and choice, Facebook as information channel and the online survey data input option have dramatically changed how we engage in this citizen science project. It has created opportunities for comparing and contributing valuable extra information to official monitoring schemes and results display.

The All Ireland survey ran from Sept 15th to Oct 15th, with further reports accepted until the end of the month. Preliminary results were produced for participant comment 6 weeks later. Final results covering 525 survey sites was launched on April 9th by HE Dr Thomas Nader, Austrian Ambassador to Ireland at the Waterford estuary Honeycomb reef.

The survey carried out by volunteers assesses the coast in 500 m survey units, with information gathered then pooled and mapped. Apart from factual reports on various animals, plants, types of litter, there are also personal views sought about the coast surveyed.

One highpoint in support was with the 'Spirit of Oysterhaven.

Picture 1. 1 The vessel before departing from Kinsale by Darragh Murphy.

This sail training vessel carried out several citizen science initiatives with Coastwatch during the year and took survey materials on board before sailing south like the swallows from Kinsale to Spain, Portugal and onward south to reach the most southerly land in Europe – the Selvagen islands. With marine biologists among the crew, they carried out scientific work on route and used the Coastwatch marine litter app and 'eyeonwater' app to track litter, water transparency and colour as their journey progressed south. Select findings from that journey will be published with international Coastwatch results.

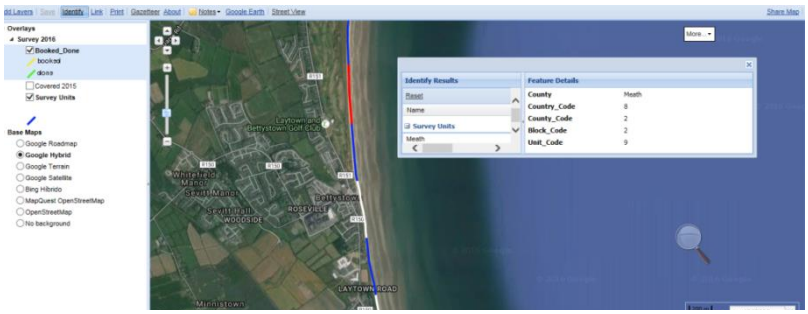
1.2. METHODS

The Coastwatch Survey is carried out by members of the public. It involves walking a chosen piece of coast once around low tide. The surveyors are asked to fill in a questionnaire for each survey site, designed to give an overview of the state of the coast – see www.coastwatch.org

Picture 1. 2 Survey area. Photo by Alan Deacon.

A survey site or survey unit (**s.u.**) is a stretch of shore approximately 500m long as measured along mean high tide mark. The width covers the sea shore from start of the hinterland down to the edge of shallow water at low tide. Five years ago the coastline which was being divided into 500 metre units by hand on paper maps was digitised using GIS, improving the accuracy. As in previous years each coastal unit was given a unique code based on the EC NUTCODE system, with counties numbered in clockwise direction, and with further numerical codes for the 5 km blocks within each county and finally the 10 units within each block. Smaller islands around Ireland have been digitised on request.

Surveyors go online bit.do/cwsurveyunits to bring up the digitised Coastwatch survey map and zoom in on a potential survey area. The shore is hugged by a line with marked blue and white increments which denote a 500m s.u. - see example in screen shot below. Volunteers click on a chosen blue or white segment which then turns it red and brings up the unique survey unit identification code. This is copied onto the survey questionnaire and is notified to Coastwatch to update the bookings map.



Picture 1. 3 Coastwatch Survey Map

To avoid duplication, booked sites are manually marked yellow and once data is returned, they are changed to green.

Volunteers are advised to photograph their map as there may be no internet connection on the shore. They can then refer to the map photo on their phone to zoom in and out and 'geolocate' features while doing fieldwork. It is useful to photograph a view with several s.u. just in case the surveyor wants to continue surveying the next s.u. and needs to identify the next s.u. end point.

Those who did not have online facilities were helped by regional or national coordinators, who provided hard copies of survey forms and a map of an area to survey after discussing their preferred lcations over the phone or in a training session where a larger area may be divided up between surveyors.

Materials

The materials for the Coastwatch Survey 2016 were available online, or distributed through the regional coordinators by post on request. They comprised of:

- Survey questionnaire 2016: (online and hard copy) Most questions remain the same every year. Where there is a change it is flagged. In 2016 live fish were introduced as extra inflow question.
- Survey Guide notes: (online and hard copy), with detailed explanatory notes from preparatory, over survey to return of data and how to share photos and videos.
- Water N test kits: The Merck Quant colorimetric field test for nitrite and nitrate in fresh water as single test strips and packed in Coastwatch HQ with colour charts and instructions. The packs were distributed by regional coordinators and posted to surveyors on request.
- ID Posters: A one page species ID poster focussing on the survey questions is included in the survey questionnaire. Additionally a 'Jellyfish and Relations' poster with 'stingometer' was produced due to demand as jellyfish swarms arrived. Dublin city council reprinted the Coastwatch Dublin seashell poster.

EXTRA MATERIALS (Data generated is not presented here, but for waste and litter in Results Part II)

- A Seaweed Module: citizen science pilot pack provided information and invited surveyors to test it.
- A Harbour Waste Management Questionnaire was updated and surveyors encouraged to complete it if their s.u. was in a harbour, marina or included a working pier.
- A pilot Micro-litter App: to collect information about visible micro-litter (location, type, source…) and to make people aware of its existence.

Coordination and communication

Regional coordinators: got the word out to invite participants. They also answered surveyor questions in 'their county', allocated survey sites to those who were unable to go online and distributed materials. Some also carried out training for new surveyors and did extensive survey work themselves. Surveyors were targeted through the existing network from previous surveys, media and social media. Where possible training sessions were provided to groups and individual surveyors.

Data compilation and analysis

Surveyors could either return the completed questionnaires for input by volunteers in HQ or enter their data directly online via an input form on the Coastwatch website. The second option was chosen by most. After the data was inputted it was transformed into a spreadsheet to be checked and analysed. If there were questionnaires with missing information, or any doubt about the data the surveyors were contacted.

Verification

Special information like new Seagrass bed locations, beaching of large animals or unusually low / high litter counts was also followed up and photos sought. Where possible the special finds were also verified by an experienced Coastwatcher and advice given on who else to contact or any follow up work advised.

CHAPTER 2: COAST SURVEYED AND ITS CHARACTER

2.1. SURVEYING AND COAST SURVEYED

Participants were asked to state the date on which they carried out their Coastwatch shore audit. As figure 2.1 below shows, the first audits took place just before the official survey start date of Sept 15th. After the 15th of September, an average of 12 units/day were surveyed until the end of October when the extended survey period was closed. There were three peaks of >30 survey sites/day of which one on October 15th counted 40 s.u. Peaks are linked to spring tides which offer best survey conditions and weekends when most surveyors who take on several survey units have time.

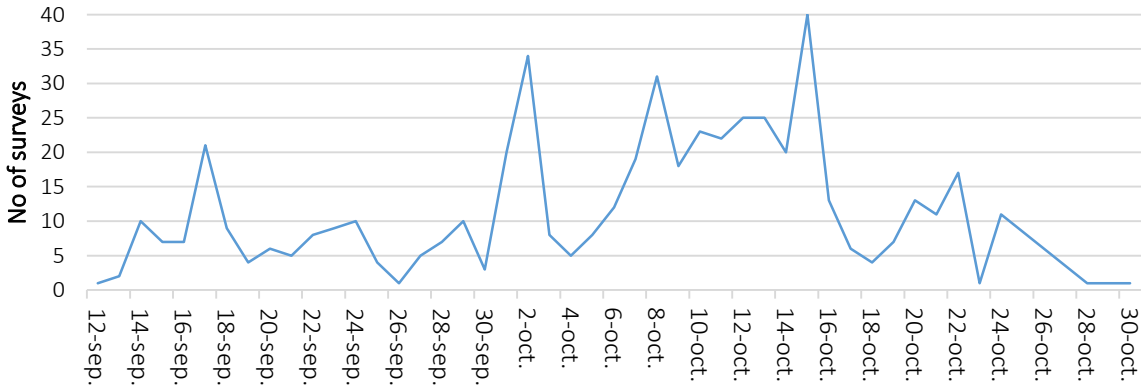


Figure 2. 1 Survey fieldwork over time expressed as number of survey units done per day (Coastwatch survey 2016)

The total number of units surveyed included in this report is 525 (45 in Northern Ireland and 480 in the Republic of Ireland). Of these, 18 were surveyed twice by different people (giving us a total of 543 units received through the input form within the deadline). This amounts to 262.5 km of the shoreline of the island of Ireland, or 3.3% of the coastline mapped by Coastwatch.

Another 21 surveys were received after result mapping started and are stored, but not included, though some photos were used and another 30 or so Donegal forms were lost as hard copy. A short report was made by the coordinator though of aquaculture shore use and photos supplied. Figure 2.2 and enlarged report back cover show the location of survey units used in this report.

Figure 2. 2 Coast surveyed in the Autumn Survey of 2016

Figure 2.3 bar chart (below) provides an overview of survey return by county. The largest survey area covered in any county was in Fingal (N. Dublin) where 73 s.u. were returned. This was followed by Wexford (66) and Cork (58). In Northern Ireland the county with the most surveys was County Down (29). Survey participation in Northern Ireland and County Donegal was unusually low. In NI the survey sponsorship hoped for did not materialise affecting publicity and results.

When expressed as percentage of coast surveyed – see figure 2.4 below - Meath gets the first place with 21 out of its 36 s.u. covered, while the Dublin region had the highest coverage, with Dun Laoghaire in 1st place with more than half of the coast covered.

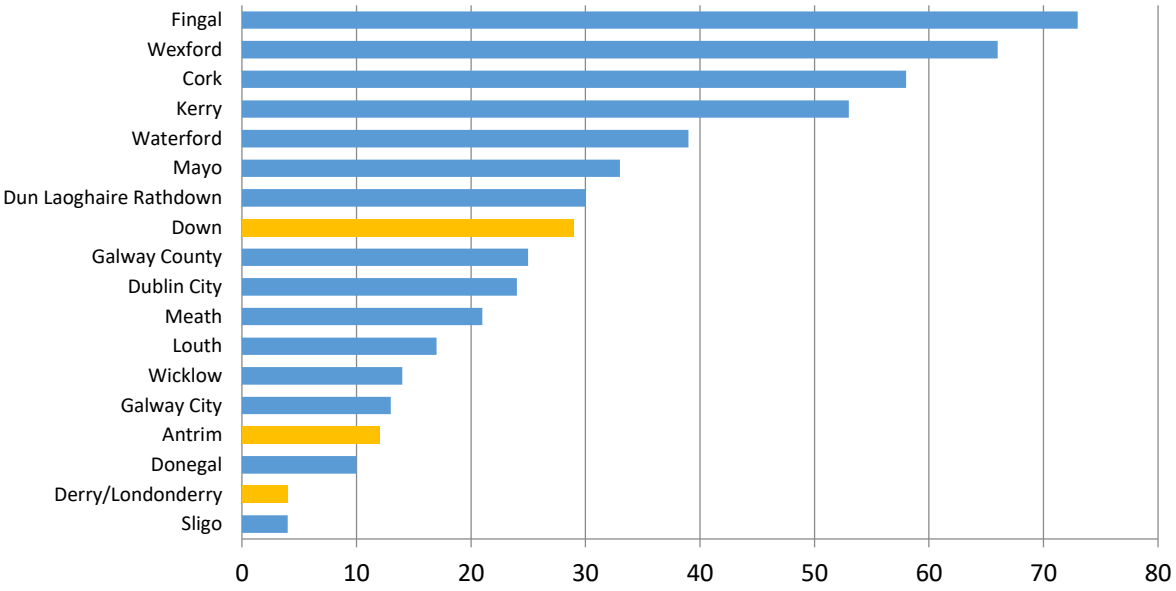


Figure 2. 3 Number of s.u. per county used in this report

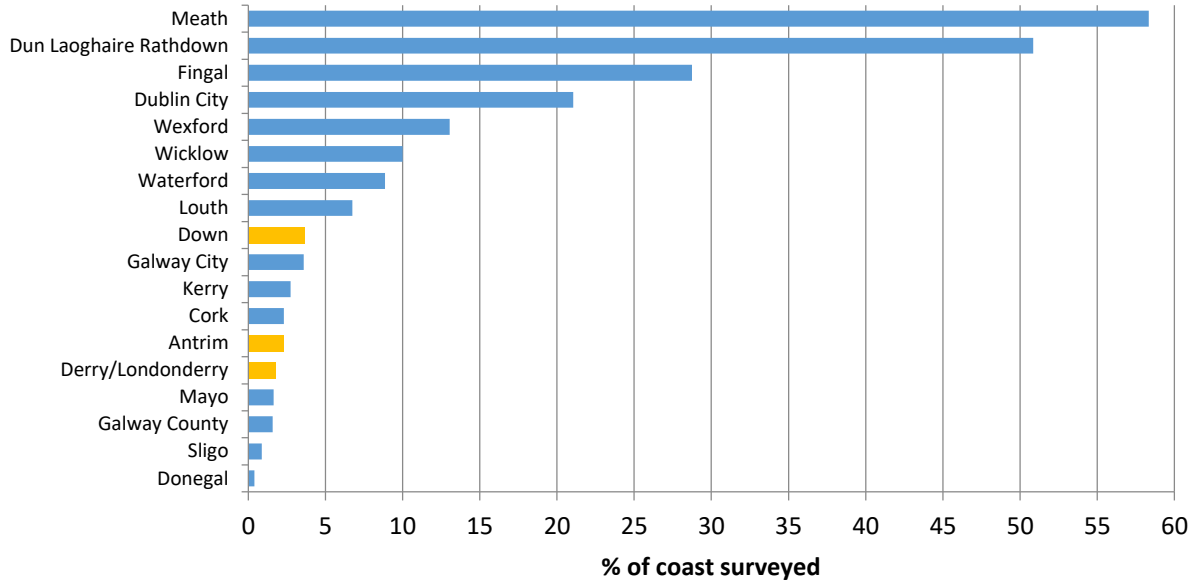


Figure 2. 4 Percentage of county coast covered

Looking back, over the last 4 autumn surveys (2013 to 2016), Coastwatchers have covered 1470 individual sites around the island of Ireland (~9.3% of the coast) at least once and every coastal county is included North and South.

Of these 1470 sites, 56 (mapped in figure 2.5 (i)) below have been surveyed in all 4 years and in the case of some in Dublin and Donegal most of the past 29 years. They are our reference sites. About half are urban, clustered around the Dublin area, while the other half is distributed over 6 counties: Wicklow, Wexford, Waterford, Kerry, Galway and Donegal. Additionally 89 units have been surveyed in 3 of the 4 years with an island wide spread.

Figure 2. 5 Coastwatch survey reach: (i) Reference survey units covered every year 2013/14/15/16 in the autumn Coastwatch survey (N=56) and (ii) survey units covered at least once over the last four years (N=1470).

2.2. Shore Access

Most shores surveyed were accessible by foot (91%). For 31% access was also possible by vehicle. In 12% it was difficult to access the chosen site directly from the hinterland and surveyors had to approach via an adjacent survey unit. In 1 site the access was marked as 'prohibited'.

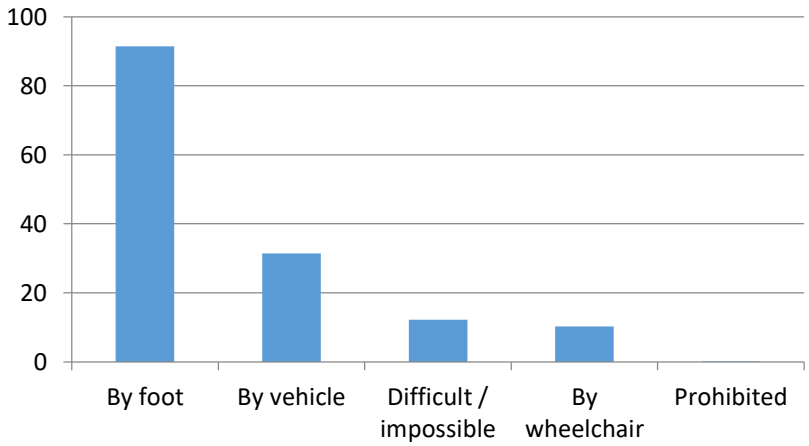


Figure 2. 6 Shore Access Island of Ireland 2016 (N=525)

Wheelchair access right down to high water mark was indicated as possible in 12% of sites. But this may well be an over estimate as according to wheelchair users which whom we discussed this question, many wheelchairs do not have wheels suitable for traversing a

sandy splashzone, even if it they could master the intertidal where the people are seen walking in picture 2.1 below.

As we were also made aware that accurate wheelchair access information is missing for almost all of our coast, a rephrasing of this question and guidelines written by wheelchair users is being considered for autumn 2017.

From surveyor comments there are a few recurring shore and water access issues: The first are around physical access to the shore. In some urban and resort areas shore access becomes a challenge as walled or fenced off by properties along the shore, while in rural areas erosion of rights of way and paths running along the shore can cut off previously accessible areas.

At the same time new often private access routes are built as developments spread out around beaches and recently around aquaculture operations. Although these access routes require planning permission, they may 'appear' without obvious owner and there is no one to close it off if land ownership is unclear in the road or lane to sea interphase where the new access branches off.

Traffic on the shore is another matter. Intertidal aquaculture operations - like Gigas oysters on trestles – normally depend on tractor access to plots, which can be highly damaging to sensitive mudflat habitats like sandmasons, or seagrass beds, but may have far less impact on a firm sand bank. In Lough Foyle surveyors noted deeper tractor marks and new shore access points due to rapid expansion of intertidal aquaculture spreading into the lough. None is licensed due to unsettled ownership matters.

Right around Ireland, shore access is a sensitive, sometimes complicated matter, which due to on-going erosion and shore changes will continue to bring up new access issues. Land/seashore ownership and user rights are often unclear and so is who should enforce legislation.

Picture 2. 1(i) Groomsport; Fingal. Photo by Geoff Jones. (ii) Intertidal damage from oyster farming.

2.3. HINTERLAND

The immediate hinterland is described (for this survey purposes) as the first ~500m of land, immediately above the splashzone of that s.u. But the exact shore limits are not always clear. As the Foreshore Act is about to be amended and new marine protected area legislation added to it, a short note of definitions is included in box below.

SHORE DEFINITIONS IN THE FORESHORE ACTS 1933 - 2005

The word "**foreshore**" means the bed and shore, below the line of high water of ordinary or medium tides, of the sea and of every tidal river and tidal estuary and of every channel, creek and bay of the sea or of any such river or estuary (NB - In the Coastwatch survey that is referred to as the intertidal and sub-littoral.)

The word "**seashore**" means the foreshore and additionally every beach bank, and cliff contiguous thereto and includes all sands and rocks contiguous to the foreshore (in the Coastwatch survey that means extending landwards to the upper limit of the splashzone). However in the Irish translation of the act, the landward end of the seashore is defined by where marram grass (if present) ends. Marram grass can extend inland beyond the fore dunes. The Foreshore Act 'seashore' is normally equivalent to a Coastwatch 'splashzone', except where fixed dune with marram grass is found (when Coastwatch would define it as 'hinterland').

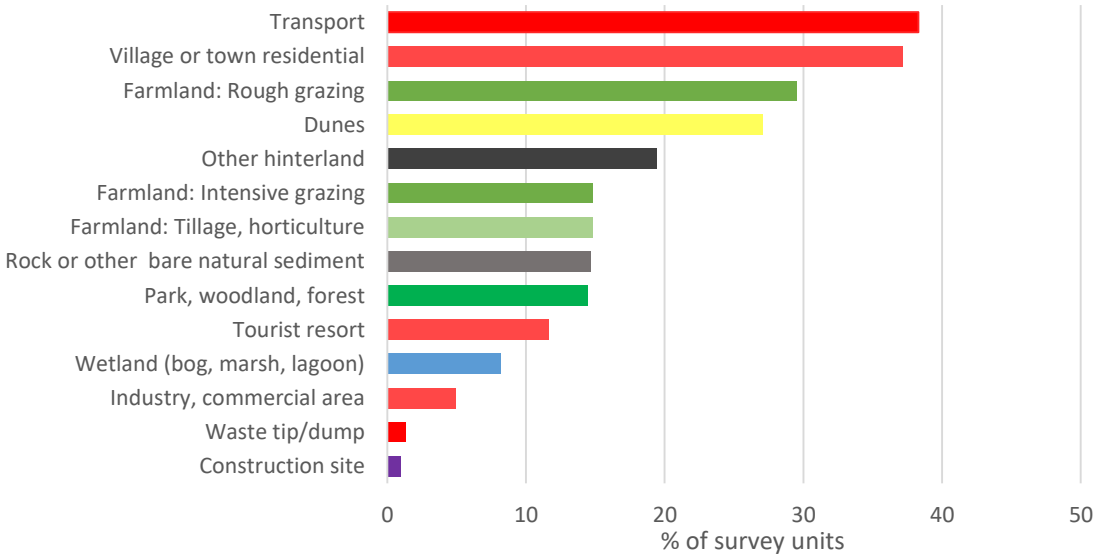


Figure 2. 7 Percentage of immediate hinterland of surveyed areas devoted to a given land use. (N=525)

Results for the 2016 survey graphed in figure 2.7 above shows that Transport (road, train, port…)' was found above the survey units in 38.3%. 'Village or town residential' in 37.1%. These two and 'tourist resort', 'industry' and 'waste tip' would all include much sealed ground where run off water needs to be dealt with and are marked in red in figure 2.7 above. About half of the hinterland just above the survey area was farm land, marked in shades of green with 'rough grazing' reported most frequently (29.5% s.u.), followed by tillage and intensive grazing which were seen on immediate hinterland of 14.8 % s.u. each. The 8% wetland hinterland is of particular interest as it has the potential to act as sponge and nutrient buffer between land and sea.

The ranking is similar to 2015 but over the years there is a shift towards more transport and urban settlements in our survey data, which would require further analyses to distinguish between new access roads and surveyor choice of surveys closer to housing and roads.

Picture 2. 2 Coliemore harbour. Old sea wall as hard *erosion control. Photo Karen Downing*

Picture 2. 3 Natural hinterland and very little shore use, rural Donegal. Photo Anne Getchell

2.4. Splashzone Sediments and Erosion Control

In Question D3 surveyors were asked to note which of the splash zone sediments and habitats listed they saw in their 500m s.u. Most surveyors reported that there were several types present, with **sand/gravel/stone** most frequent (70% su) see figure 2.7. **Hard erosion control** was recorded in 43% of survey units – see figure 2.8 below. This may be a reflection of survey area choice, with volunteers tending towards areas with roads, ports and other transport infrastructure which needs to be reliably protected from erosion. However there is also a gradual increase in hard erosion control around our shores, which was commented upon by several surveyors.

Picture 2. 4 Looking down a rough boulder sea wall, which also acts as marine litter tra.p Photo by Eiméar Manning.

Natural rock was the third most common splashzone coast type recorded and found in 34% of survey units. That response includes shores with rocky outcrops on sandy shores and true rocky coasts.

Dunes and **cliffs, 'other'** types of splashzone, ranked 6th, describing at least part of 15.2% of survey sites. That includes the natural boulder clay sea banks of the SE and S coast which slip and slump when their base is undermined by the sea as well as the faces of old Bray and Ringsend dumps.

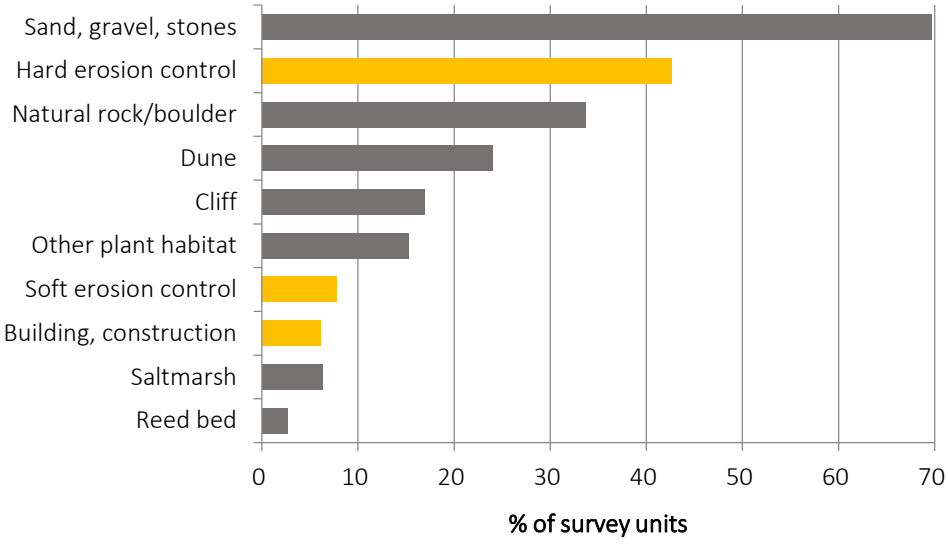


Figure 2. 8 Spashzone habitats in part or all of a s.u, (N=525)

Soft erosion control like earth banks were noted in only 7.8% of surveyed sites. From training sessions we suspect that grassed manmade dykes and embankments are often recorded as 'other' rather than as manmade soft erosion control. **Buildings and construction** which had another function rather than erosion control - usually a pier, harbour or slipway were present in 6.1% of survey sites. Areas where hard and soft erosion control were present are mapped in figure 2.9 and show that they are scattered around all coasts.

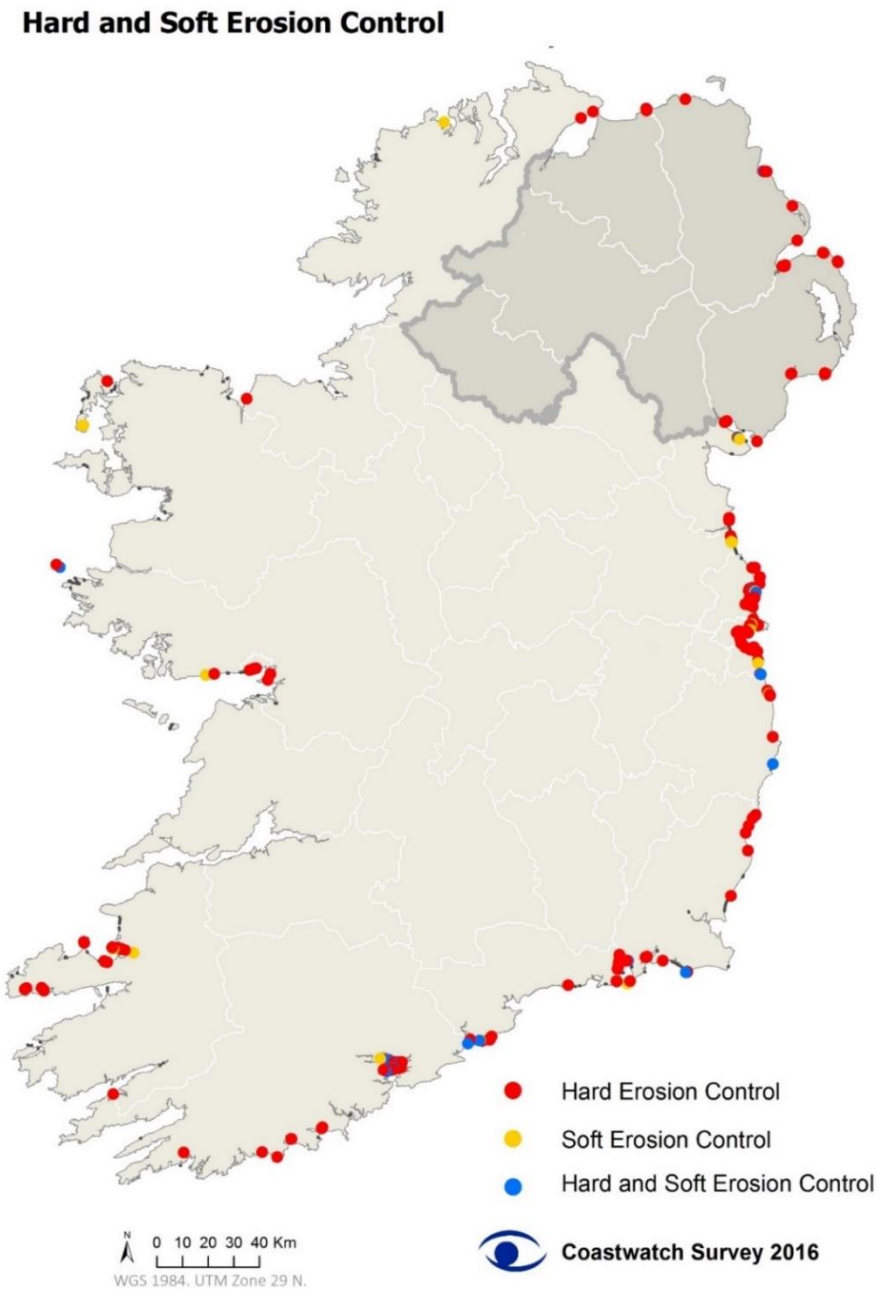


Figure 2. 9 Sites where surveyors reported seeing hard and/or soft erosion control (where 'hard' was defined as wall, rock armour, or gabions and 'soft' as earth banks, marram grass planting, or similar)

2.5. RECOMMENDATIONS

1. An erosion management policy should be drafted by government

2. A databank of erosion control measures should be set up and run alongside flood maps by the OPW.

3. Set a standard audit condition into all grant aided schemes, so that erosion control, flood and managed retreat schemes get checked independently every 3 years and after major storms, to assess their condition. The audit is published as well as upkeep work if needed. This would help us learn from the schemes put in place and make more informed choices when deciding on new schemes.

4. Shore Access and travel across the shore rights and obligations need to be clarified – eg as a Foreshore guidance on this subject. Recent new access to the shore which is unauthorised needs to be closed off and the habitat restored where possible by authorities themselves if the user cannot be identified.

CHAPTER 3: BIODIVERSITY

3.1. INTRODUCTION

The 2015 European Environment - state and outlook report http://www.eea.europa.eu/soer concludes that biodiversity loss and the degradation of ecosystem services in the EU have continued since the EU 2010 biodiversity baseline report. This holds particularly true for the coastal zone, where apart from man's direct impacts of fishing, development, recreation, water pollution etc. we have to deal with the challenges of more storms, heavier downpours of water and sea level rise.

There is lots of life on the shores and in shallow waters around the island of Ireland. Some is obvious, like big brown seaweeds and the Chinese hat like limpets stuck tightly onto rocks, or flocks of wintering seabirds arriving in our bays looking for food and shelter. We also note a seal's head popping up and occasional sightings of whale and dolphins. Most of our sea life though – even life we walk across when the tide is out – goes unnoticed. If presence is not known, how can absence be missed? And if people do not know how fragile and complex our shore life is, how can they manage activities which may cause damage in one location or in a particular season, but be harmless in another area of shore or a month later? If we want to halt the loss of biodiversity (which is also a UN Biodiversity Convention target) then public and decision maker awareness and specific site knowledge need to improve.

Aim 1 of the Coastwatch biodiversity questions is to raise awareness, open eyes and train people where to look for shore life, as well as how to avoid damage and disturbance. The photo below of rock pool beauty is an example.

Picture 3. 1 Looking into a rock poll by Brenda Murphy

Aim 2 is to contribute to scientific knowledge. With a marine area almost 10 times that of land and over 7000 km of All Ireland shore, our few official marine scientist's and equipment can only monitor so much, then make assumptions based models and other data like satellites about the rest. There are highly productively inshore nursery and spawning grounds which we know surprisingly little about. On the shore the least studied appears to be strip exposed at spring low tide which is too shallow for most marine research vessel work and too deep for intertidal surveys except at spring low tide and the remote bay and estuarine shores with splash zone retreats - tidal channels, saltmarshes and reed beds which are awkward to access and away from coastal roads.

Coastwatch survey data for these areas is of particular value as it augments official data and has included locating new or previously unrecorded dunes, sea grass beds and honeycomb reefs. In that context we particularly welcome the increase in surveyors from fishing communities, traditional seaweed harvesters and recreational users with boats.

Other important surveyor records are unusual, fleeting finds - a beached sea turtle, mass death of organisms or an algal bloom.

Aim 3 is to support active citizen engagement in informed decision making. That may be a personal decision not to drive over an intertidal seagrass bed once you know that it's there; or a rethink of a dog walk to stop your dog chasing wintering birds. Coastwatchers may also make an informed contribution to teaching or commenting on a planning application, or providing input into consultations like the Programme of Measures to bring our seas to Good Environmental Status (GES) under the Marine Strategy Framework Directive (MSFD). While the first example above just requires knowledge of something fragile and valuable to inform personal behaviour, the other examples also require some understanding of technical and legal language and the planning context. A workshop on this MSFD topic was organised in January 2016, hosted by Dublin city council and supported by the Department of Housing water section. It generated over 60 comments from surveyors on the draft Programme of Measures, which were then collated by Coastwatch coordination and submitted.

The survey form contains general habitat and species questions shared by all Coastwatch countries and more detailed extra questions for select biota prioritised for Ireland and the UK. In contrast to early surveys, where only litter data was considered reliable, now with government grant aided support materials and field training, the number of surveyors attempting these extra nature questions has risen to 85% and quality of information when cross checked for verification is generally high. The identification is kept simple, but photos of shore biota sometimes added as here tease to find out more.

3.2. HABITATS AND SELECT PLANTS

As the survey is aimed at the general public, the international survey form only includes a selection of habitats, groups of algae, plants and animals (see appendix 1 Section C and D of the survey form). Optional extra species and local harvesting knowledge being sought on the back page are specific to the Irish and UK survey forms. This adds valuable local information and is aimed at more informed surveyors.

3.2.1. Dunes and soft coast Habitat complexes

Dunes and associated wetlands form our important soft coast fringes. Often they are interwoven - e.g. a dune with a stream meandering through, which lagoons supporting reed beds and saltmarshes, or temporary splashzone and intertidal lagoons which children love playing in.

Dune/wetland habitat complexes are important for biodiversity as fish nursery ground, nesting habitats for birds like kingfisher and also form trampoline-like erosion mitigation, carbon stores and water filters. Most of these (except reed beds) are habitats listed for protection in the EU Habitats Directive and stock as well as health audits are undertaken and reported on every 7 years in so called 'Article 17' reports.

3.2.2. Dunes

Dunes are divided into 8 different habitat types in the habitats directives, from young fore dune to old grey dune, with the latter offered special protection as most vulnerable to damage and slow to recover. - According to the last RoI Article 17 report (2013), the status of 6 of the 8 dune types was "Inadequate" and for two the status was considered "Bad".

In the 2016 Coastwatch survey, some dune habitat was spotted in 27% of survey units as mapped in figure 3.2. This includes extensive dune systems and small marram grass covered fringe dune.

Dunes were the focus of the 2015 Coastwatch survey follow up work. For the first time, detailed maps of volunteer reports were overlaid on official dune habitat records. Where surveyors reported dune habitat and official records did not, further satellite image checks were undertaken and photos requested or sites visited. This confirmed that surveyors found 'extra' dunes including old grey dune habitat in several remote west coast areas which were not in the official record. The work is still ongoing, but the reader is referred to initial findings in http://coastwatch.org/europe/wp-content/uploads/2017/04/CW_Report_2015.pdf

Surveyors in several areas noted a further increase in hard erosion control measures facing eroding dunes. Some brought examples of such hard erosion control measures failing in pictures, as the rock armour was washed out and flattened, with high tide water running over the rocks and continuing the erosion of the sand dune behind it. Loose geotextile was seen in photos both around these rocks and washed up as marine litter.

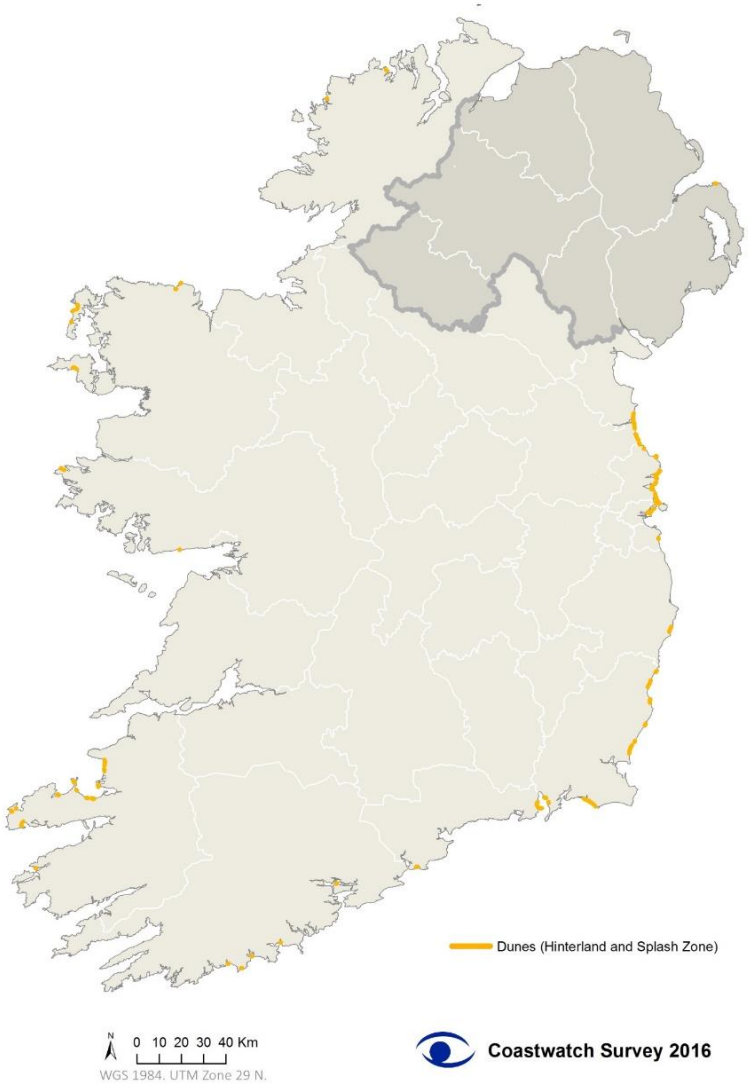


Figure 3. 1 Dunes found during the Coastwatch Survey 2016

Some comments:

Outstanding: the view of fresh marram grass on a long new sand spit which has grown out from Bannow island, Co Wexford. This new feature is presumed to have been created by sand from the > 500 ha of sand spit which used to jut out from the opposite (Fethard) side of the Bannow Bay opening, but was eroded over a few years by sea and wind.

Dilemma 'Should she stay or should she go?': Sand spits around Ireland go through natural reconfiguration stages. Some stages stay stable for decades or longer and then suddenly change. What do you do if a spit is about to change but its present form is seen as particularly valuable - like the Fenit spit, Co Kerry where a huge *Zostera noltii* seagrass bed has developed in its shelter? This sea grass bed will be lost if the spit, which is now only a few meters wide, breaks. Should nature take its course, or should erosion control measures 'save'

the dune and current habitat mix? This question has an extra twist as the site is a Special Area of Conservation (SAC) under the Habitats Directive.

Dune management: '*Dunes need management and we have no management plans'*, one Kerry surveyor told us. 'It starts with machine removal of tide line debris on bathing beaches and ends with too little farm guidance, no walks to show off best practise in dune management or examples of good ecological status.

3.2.3. Coastal Wetlands

Three coastal wetland types logged by surveyors as occurring in their survey unit were mapped: **reed beds, saltmarsh and glasswort.** All three were recorded in 11% of survey units and unsurprising there was considerable overlap between these when mapped, as they thrive under similar shelter and sediment conditions in that band between land and sea, salt and fresh water. – see maps 3.2 below. All three are of high biodiversity value, act as buffers, taking up nutrient run off from the hinterland, act as climate change buffers and have other specific ecosystem services.

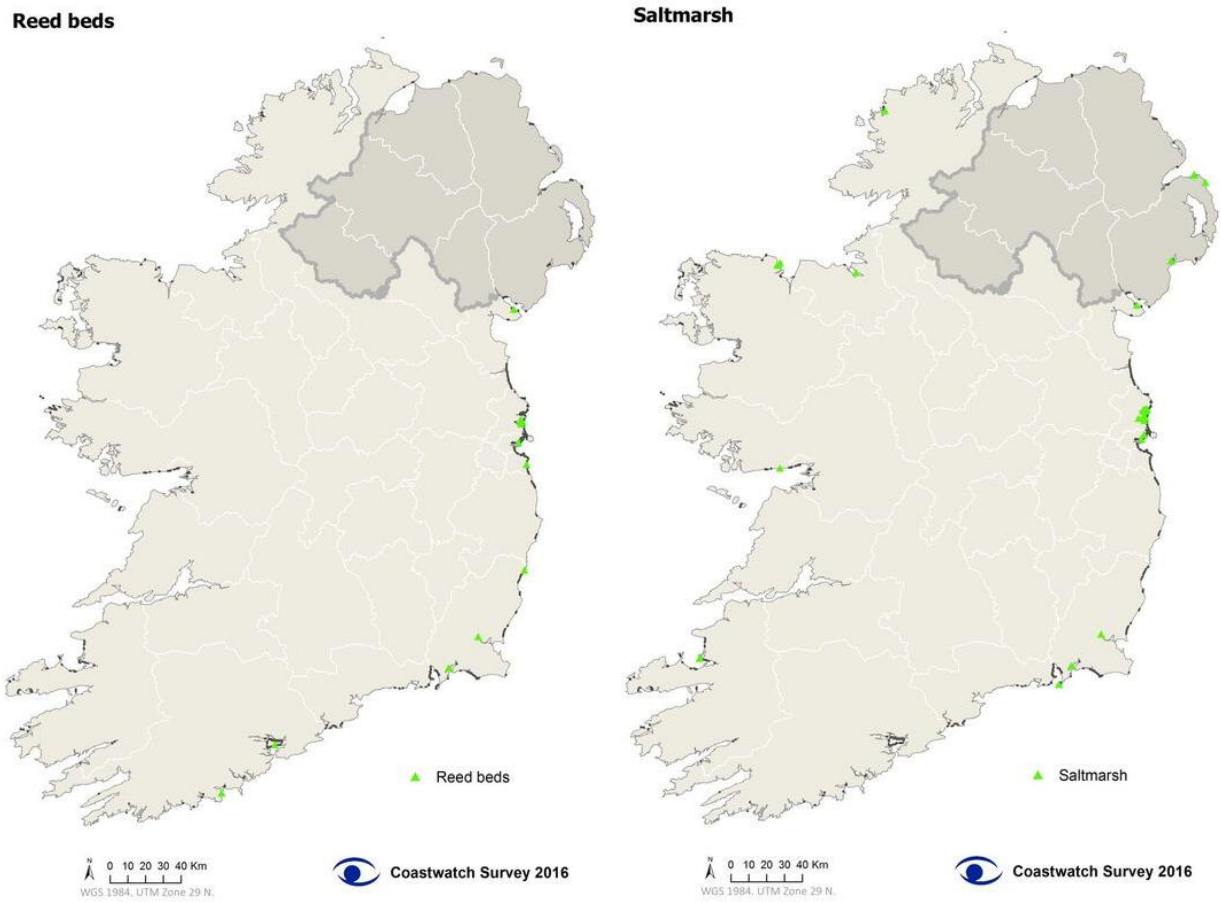


Figure 3. 2 Autumn 2016 Coastwatch survey location records for two wetland habitats (i) Reedbed, (ii) Saltmarsh.

An extra note on Salicornia flats, as the least known of these wetlands and probably still underreported in our survey, although with training more and more surveyors can identify this little plant.

Salicornia is little waxy green shore plant, which may grow mixed in with saltmarsh grasses in the splashzone, or as dense swards of several Salicornia spp. on hard mud, usually in front of saltmarsh see picture 3.2 overleaf.

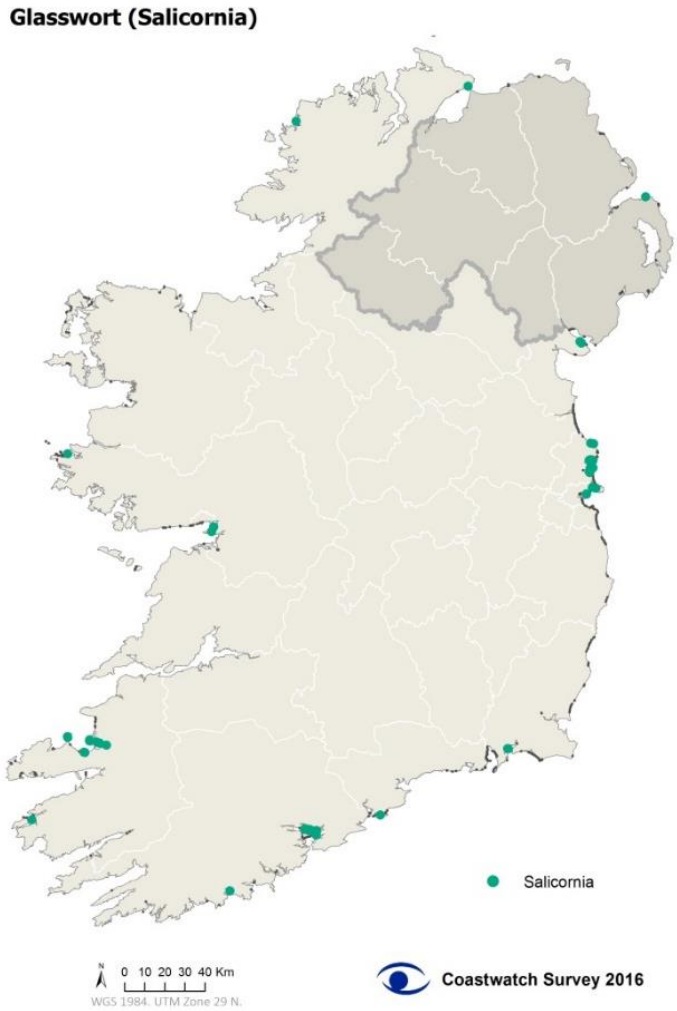


Figure 3. 3 Records of a third wetland habitat, Salicornia sward.

Picture 3. 2 Salicornia. 1st photo by Catherine Seale.

There are several species and some are highly prized edible plants, if they come from a clean water area.

The dense sward is also considered to be habitat (Habitat code: 1310 in the Habitats Directive). As sward forming *Salicornias* around Ireland are annual and only die off in late autumn, the Coastwatch survey is a good time to record this habitat which is highly susceptible to erosion and can also be damaged by driving on the shore for field access, aquaculture and recreational pursuits.

Locations where surveyors found *Salicornia* in autumn 2016 are mapped in figure 3.3. Note that the location map says nothing about the amount found.

FOLLOW UP WORK

Over the years most Salicornia sward on mud sites which are being followed in reference sites have produce a new sward annually or almost every year. One can still see the old 'dead Christmas tree look' plants when the new ones pop up in between the following year. Exceptions are when whole shore changed - for example with breach of a sand spit. From follow up work in one bay, the amount which germinates in a location varies greatly though from year to year. Also we are finding more Salicornia in saltmarsh now, especially along the South coast, where sea level rise appears to have the most noticeable effect. At least some Salicornia species can withstand very high nutrient levels and have been seen to push through thick *Ulva* seaweed carpets in south Dublin Bay.

3.3. SEAWEED

There are over 500 seaweed species around Ireland (see this link for seaweed ID algaebase.org). They are organized into 3 broad groups – brown, red and green seaweeds. Most are hand high or smaller and with a few exceptions are only known by their Latin name, but at the other end we have a few species which can underwater forests. Typically these are up to 2 m high Eggwrack 'Asco' *Ascophyllum nodosum* forests from mid shore down into shallow sublittoral, where the longer kelp forests take over, with a few other species mixed in. Snorkeling just above the kelp blades as shown in photo below, gives an impression of these underwater forests and the life darting in and out of them. Once in the forest a whole world of other seaweeds and sponges attached to the kelp, and growing along the forest floor opens out.

As we are lucky in Ireland to have good tidal ranges, we get daily access to the intertidal to see this seaweed wealth attached to hard surfaces in a pattern governed by hours of exposure, sunlight or shade and other factors.

Picture 3. 3 (i) Kelp forest in Bantry Bay, with sprinkling of other species peeping out of the canopy. Photo by Ecoeye divers. (ii) Example of the sometimes strikingly red young Red Rags Dilsea carnosa. Photo Karin Dubsky.

RESULTS:

Surveyors reported brown and/or red seaweeds growing on 66% of shores and green seaweeds on 70%. There was no extra part in the survey questionnaire to identify species, but for the first time many surveyors added notes or wrote separate emails on seaweed. In the WFD seaweed diversity is one of the ecological quality indicators monitored. In Ireland that is done by the EPA.

Problems arises when there is too much nutrient in the coastal system and opportunistic green algae take over with mass decay as thick mush layer which quickly becomes anaerobic and kills life underneath. The survey question on green seaweeds seeks to capture this. Patches or thin bands of green seaweeds as associated with fresh water inflows were found in 52% of survey units, while thick green seaweed carpets, taken as indicators of nutrient enrichment, were recorded on 18% of shores. Results are mapped and the issue is expanded upon in Chapter 4.2.

3.3.1. Coastwatch Seaweed Module

A Citizen Science Seaweed module was drafted in 2016 coastwatch.org/europe/seaweed/ to provide basic info and vocabulary for those curious about seaweeds and to help protect this wealth of species and habitats.

It was posted on line as pilot module to be used and tested. Several teachers and a Queens University field course group tried it. Based on their encouraging feedback, a second version will be produced with online data input forms to make analyses easy and share results.

First surveyor finds include:

Over 2.1 m long egg wrack reported with photos, which puts them well above the 1.5 m typical length described in seashore books and many kelp measurements. Rare and protected floating rafts of egg wrack (*Ascophyllum nodosum ecad. mackaii* beds) in several sheltered Connemara bays and estuaries. While on notable but of concern the Invasive alien Sargassum seaweed was also found and in new sites - see IAS section 3.

Picture 3. 4 (i) Ascophyllum nodosum ecad. mackaii *(Photo Robert Wilkes) (ii)* ***Coastwatchers testing the new seaweed module in Cork, (Photo Ecoeye) (iii) Regional Coordinator checking kelp length in Shanganagh***

3.3.2. Swept-up seaweed

Surveyors reported dislodged decaying seaweeds of any kind in 68.3% of survey units. This is part of a natural food web and cycle of nutrients. Swept up seaweeds are vital food and shelter for animals such as sand hoppers which are in turn eaten by flat fish and birds. They also provide the nutrient base for marram grass and other dune builders. Seaweed nutrients help fore dunes grow and/or wash back into the coastal ecosystem to nourish the seaweed and seagrass standing crop.

Removal of swept up seaweed by beach cleaning machines which clear whole tidelines and remove the base for dune formation is an issue on many bathing beaches. In autumn 2016 surveyor Paddy Houlihan noticed a school class clearing brown seaweeds cast up on the tideline. When asked they explained they had come to 'clean the beach'. He was able to curtail their activity by telling them about the wonders of seaweed on the spot. In this report we encourage others to spread the word.

3.3.3. Seaweed Concern and Follow-up action

Concern about a significant change in our rocky shore intertidal and shallow water if seaweed is damaged or removed largescale was expressed by some surveyors. During the summer there were reports of heat/sun around Australia killing 100s of miles of kelp in 2014-15 with no recovery so far. Large scale harvesting licenses are in the process of being applied for in Ireland and one is already granted. The

importance of these seaweeds is well documented. They represent a habitat and food supply for other marine animals, juvenile fish including important commercial species like cod and for birds feeding on them. They work as carbon storage, helping to reduce a driver of climate change.

While in the past most people visiting the seashore were satisfied when they saw seaweed growing in the intertidal and complained if they saw too much dislodged seaweed - especially if it was a smelly Ulva mush, now seaweeds are a talking point. The economic value of this resource has risen rapidly. Discovery of new attributes and uses in food, health and cosmetic industries have mushroomed. The international demand for kitchen use has shot up. Most of the 15 species of high priced 'sea vegetables' are harvested in the intertidal. The risk of overharvesting wild food accessible to all is clearly there - even when harvested by hand.

There are many challenges for citizens and government which discovers it is rich in a natural resource. It is urgent that we have an informed discussion and take action to ensure that:-

- sufficient high status high seaweed diversity sites remain and are protected.

- harvesting of seaweeds is sustainable for the marine ecosystems which depend on them.

It requires a lot more information, especially about our brown seaweed forests and the smaller red seaweeds which cling to them, as well as the biota which lives here or visits for feeding or breeding. Which is why the EU organic label law (Council Regulation (EC) No 834/2007 on organic production and labelling of organic products) is helpful, specifying requirements of both high or good quality status water where wild seaweeds are harvested (or are cultured) and an onerous management plan to avoid ecosystem damage and overharvest.

Apart from the risk of ecosystem damage, there are issues with protection of traditional hand harvester rights. In the past traditional harvesters were not encouraged to seek foreshore licenses for their small patches. Today they can register their traditional rights, but the application process but there is no user friendly information how and legal fees may be putting this out of reach for people with limited means.

3.3.4. Seagrass *(Zostera* species around Ireland)

Seagrass is a grass - like our grass fields on land, which lives in the sea. Its presence, health and abundance are used to indicate a traditional or coastal water body's classification as being at good or higher status. Around Ireland and other N European countries it is generally Zostera spp.

Picture 3. 5 A rather thin Seagrass Zostera noltii lawn on intertidal mudflats. Photo by Karin Dubsky

Picture 3. 6 Swept up Seagrass. Photo by Jim Hurley.

Seagrass (*Zostera* spp) was reported from 59 sites (11.2% of all survey units). In 39 of these it was found growing, and in 32 it was found swept up, giving an overlap of 12 sites where it was found both growing and swept up – see pi chart Figure 3.4 below. As soon as all new sites where seagrass was reported as growing have been verified, the map will be published on line together with seagrass species and any local information.

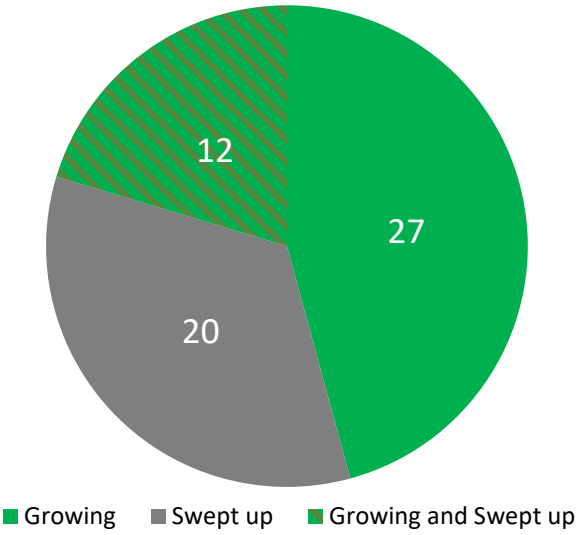


Figure 3. 4 Seagrass Zostera records during the Coastwatch Survey (growing and swept up). Expressed as number of s.u. where found.

New finds already verified include in front of Zetland pier, Bantry Bay. The long sublittoral *Zostera marina* had been reported swept up near here in the 2015 survey, which gave rise to a search of possible source in 2016 aided by local fishermen. Bantry Bay is not listed among the 19 bays and estuaries which are known to support *Z marina* beds.

Protection

Zostera noltii, the 'uncut wet lawn' look seagrass is used as good status indicator in the implementation of the water framework directive and well monitored in most transitional and coastal waters by the EPA' s seagrass expert Dr Robert Wilkes who has produced distribution maps like the one copied here – figure 3.5. *Zostera marina* though, the very long, highly productive sublittoral marine habitat is only strictly protected when listed in Natura 2000 sites at present. The distribution outside SACs is not fully known.

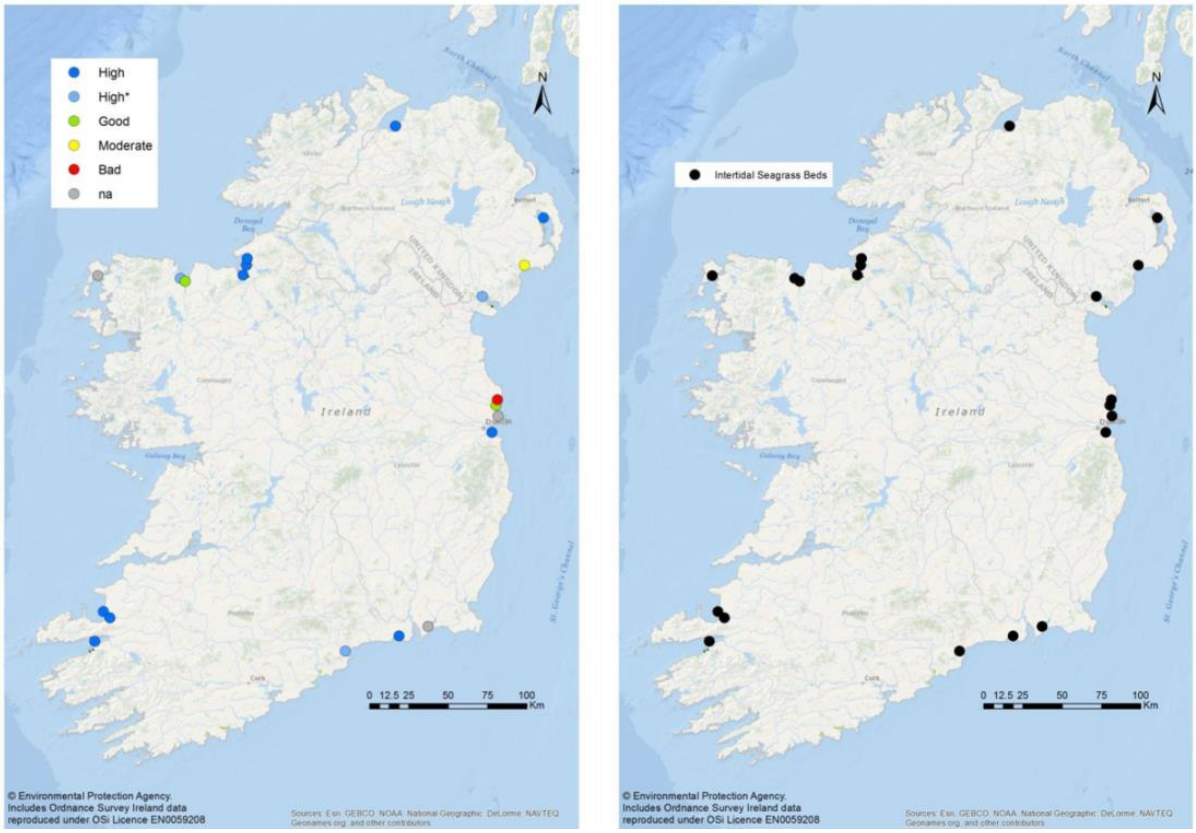


Figure 3. 5 Intertidal Seagrass Zostera Noltii record. Sourece: EPA

Sea grass damage avoidance

Whenever you see chunks of whole *Z marina* grass swept up and there has not been an obvious storm event, possible causes should be investigated.

In 2015 unusual quantities of this sea grass was reported washing in on tide lines in Blacksod Bay and this was attributed to boats entering the bay for scallop dredging and working around the seagrass beds. The Coastwatcher evidence was used by government and the local RIFF to review scallop dredging and first halt it as by our urgent request, then reintroduce limited dredging with management measures to avoid the sea grass beds.

Citizen science efforts finding seagrass and new beds in in the 2016 survey is a priority for verification.

3.4. Animals - Overview

Animals were reported as present/absent from a tick list of main groups and are shown in frequency rank order in figure 3.6.

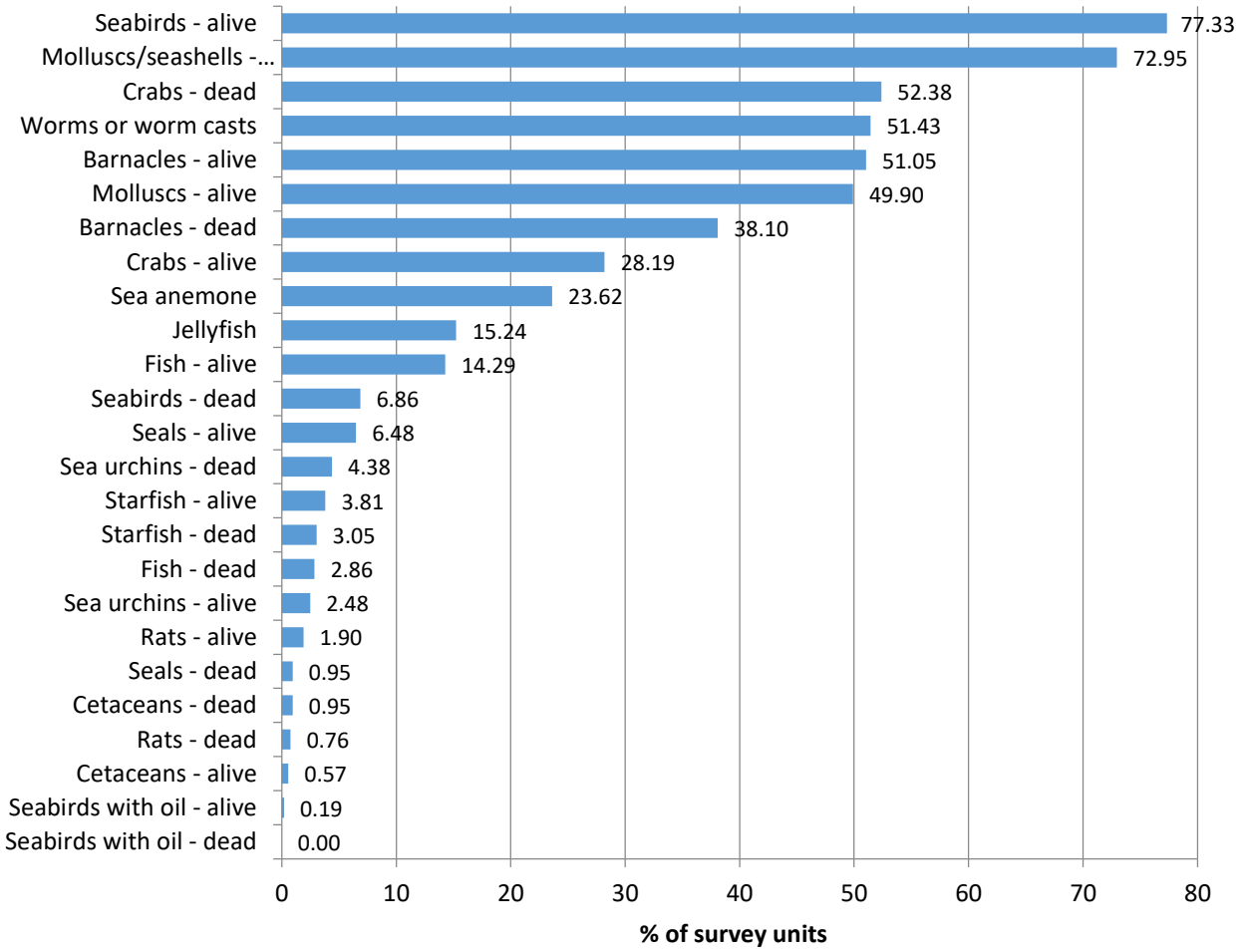


Figure 3. 6 Animals present on the Coastwatch Survey 2016.

3.4.1. Jellyfish

Jellyfish were reported on 15% of survey sites, but as they - together with Portuguese-men-of-war - had made it to Irish shores in such unusually high numbers, that it caused over 20 surveys to be abandoned, the real jellyfish presence during the autumn survey was greater than on 15% of shores.

Picture 3. 7 Jellyfish carpeting the intertidal Galway - Photo Brian McSuibne

Picture 3. 8 Portuguese Man o War, Kilmore shore – Photo Jim Hurley

Some shores were just carpeted by stranded jellyfish and surveyors were uneasy walking over their bodies. Our survey data includes 11 sites with one or more Portuguese man of war and 79 with jellyfish. Calls from surveyors on several West Cork, Kerry and Galway shores noted the presence of Lion's mane, Mauve stinger jellyfish and Portuguese-man-of -War as reason to postpone and then abandon surveys. Serious sting threat and school health and safety rules were the most common reasons. Coastwatch had produced a jellyfish poster with 'stingometer' to respond to calls for advice and to warn that some can cause nasty stings even when stranded and dead.

3.4.2. Birds

Birds were the most widespread (84% of su) and numerous animals, with a count of 1 4252 live birds and 47 dead birds recorded. No oiled birds were reported. Most dead birds were on the Meath and Fingal coast. Some dead cetaceans were also found in this area.

We do not know cause of death and few surveyors identify dead birds or note in comments whether they were divers (which are more likely to be caught in a net). Often they were part eaten or decomposed – in one case a surveyor found just a beak – see photo 3.8. We do not know of any autopsies carried out on any dead animal found during the survey, except for targeted bird stomach litter content work carried out in Sligo RT, which will be reported on in the separate waste and marine litter Part II report.

Picture 3. 9 Duck beak; photo by Karen Downing

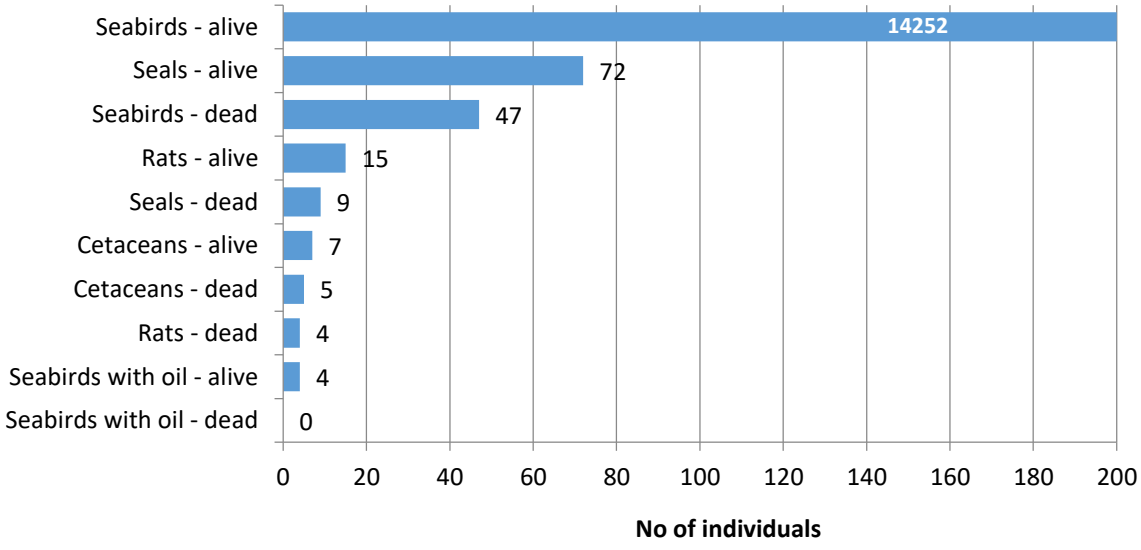


Figure 3. 7 Animal counts total for all survey units (N = 525), autumn 2016 survey.

3.4.3. Molluscs -Seashells

After birds, empty seashells were the most common marine biota; reported on 73% and live molluscs on 50% of shores. The Coastwatch seashell poster for the Dublin area, printed by Dublin City Council or downloaded by surveyors, was used widely and contributed to surveyors submitting species lists.

SPECIAL FINDS AND ONES WHICH ARE WORTH LOOKING FOR

After alerting surveyors to our interest in the Blue-rayed Limpet, *Patella pellucida* which lives mainly on kelp and as juvenile on sea spaghetti, a blue-rayed limpet site was reported from Dalkey, (Dun Laoghaire), augmenting a recent Coastwatcher record of one from nearby Sandycove kelp in rock pools. Prior to that we had not come across any blue rayed limpet record in the Dublin biosphere, but would love to know if anyone else has seen it in another biosphere site, or indeed anywhere on the Wicklow or North Wexford coast. Our next record south is on the SE coast from Hook head onward.

Picture 3. 10 Young Blue raused limpets on sea spaghetti.

Two live Native Oysters *Ostrea edulis* were found in Dublin Bay on an old oyster bed. The bay's native oysters were thought to have been lost decades ago. The find by Ardscoil Ris transition year pupils follows the discovery of one very old specimen earlier last year by another Coastwatcher Dave Tilly.

In Carlingford Lough several surveyors found live native oysters of different size classes and in some areas the density was sufficient to be described officially as 'oyster bed'. It suggests that we may be seeing the recovery of old oyster beds on the Northern Irish side of the lough. Surveyors noted Gigas oyster cultivation in parts of the lough as a threat, with operations overlapping onto native oyster beds and as the cultivated Gigas Oyster is beginning to reproduce here and can take over intertidal areas when it becomes invasive. In 2016 Coastwatchers reported the first Gigas oysters cemented onto intertidal boulders on the RoI shore at Carlingford village. The Lough has biodiversity hotspots - areas teeming with tunicates, peacock worms, sea pens and a range of molluscs and seagrass with flocks of shorebirds feasting on them. Surveyors also noted bottom mussel aquaculture activity, some of it involving removal of old intertidal mussel beds at 'The Narrows' with associated seafloor damage.

Picture 3. 11 Gigas Oyster shells. Photo by Darach Ó Murchú

Apart from a few life native oyster finds, empty shells were widespread, as this was once a common shellfish and the shells are hard wearing unless eaten by boring sponges. Today the range of live oysters is restricted with at most 10 sites around the island with commercial beds. In the Republic the Native oyster isn't specially protected as a species outside commercial oyster beds where oyster fishing orders are in place and Gigas oysters as well as bottom mussel culture are practised in the same broad areas – e.g. in Lough Swilly and Lough Foyle. However the Native oyster is protected in the OSPAR convention and in

Northern Ireland, where Gigas oyster growing licenses are not granted in bays and estuaries with native oyster beds. This policy was introduced to reduce risk of exposing native wild stocks to disease which may be brought in on cultured Gigas stock and also as c Gigas oyster larvae have been found to successfully settled on or near native oyster ground (see invasive alien species section 3. below). This NI policy is not enforced or enforceable in the two Cross border loughs though.

Many other shellfish were noted and photographed. Among them periwinkle aggregations, mussel beds and shellfish eggs, most commonly whelk egg balls and the typical Dogwhelk *Nucellus* 'skittles'.

Picture 3. 12 Some commercially harvested shellfish which the MSFD requires us to manage and report on.
(i) Periwinkle aggregation on rocks Kerry shore. Photo Darach Ó Murchú
(ii) Mussel seed on rocks, Waterford coast. Photo Anto Mc Fly

3.4.4. Marine Mammals

There were more large dead marine animals this year than usual. Sad headlines were:

SEALS

Seventy two live seals were recorded dotted around 34 sites, with 5 in NI – see map in figure 3.8. Nine dead seals were found in 5 sites - all in the RoI. One site in Carn Annagh, Co Mayo contained 4 decomposing dead seals. One large dead seal in Donegal was found totally entangled in ropes. Most seals were reported along the east coast. After the survey was over more dead seals were reported and the Courtown Seal Sanctuary, Co Wexford held record numbers of rescue seals in autumn 2016. There were more dead seals than in the 2015 survey and less live seals reported, although the weather was better in autumn 2016.

CETACEANS

Seven live cetaceans were spotted over 3 survey sites and 5 dead ones in 5 sites. One of these was 'smell spotted' on Shankill beach, county Dublin. It was a large fin whale which had been swept up with many cuts and was later buried on the shore by Dun Laoghaire County Council. A giant brush like baleen - see picture 3.13 – was swept up a mile north and possibly from a second fin whale, as several people had reported spotting 2 whales around the Wicklow coast 2 days previously. (It was not counted though).

Picture 3. 13 Dead Fin Whale above and separate baleen Killiney and Shankhill Photos by Robert Nicholson

A notable 'other' was a dead Leather-backed turtle in Ferriters Cove, Co Kerry. Given that this turtle only passes our waters and is critically endangered, the annual Coastwatch survey record of one or two of such dead animals in just 3.5% of our coast seems high enough to be of concern.

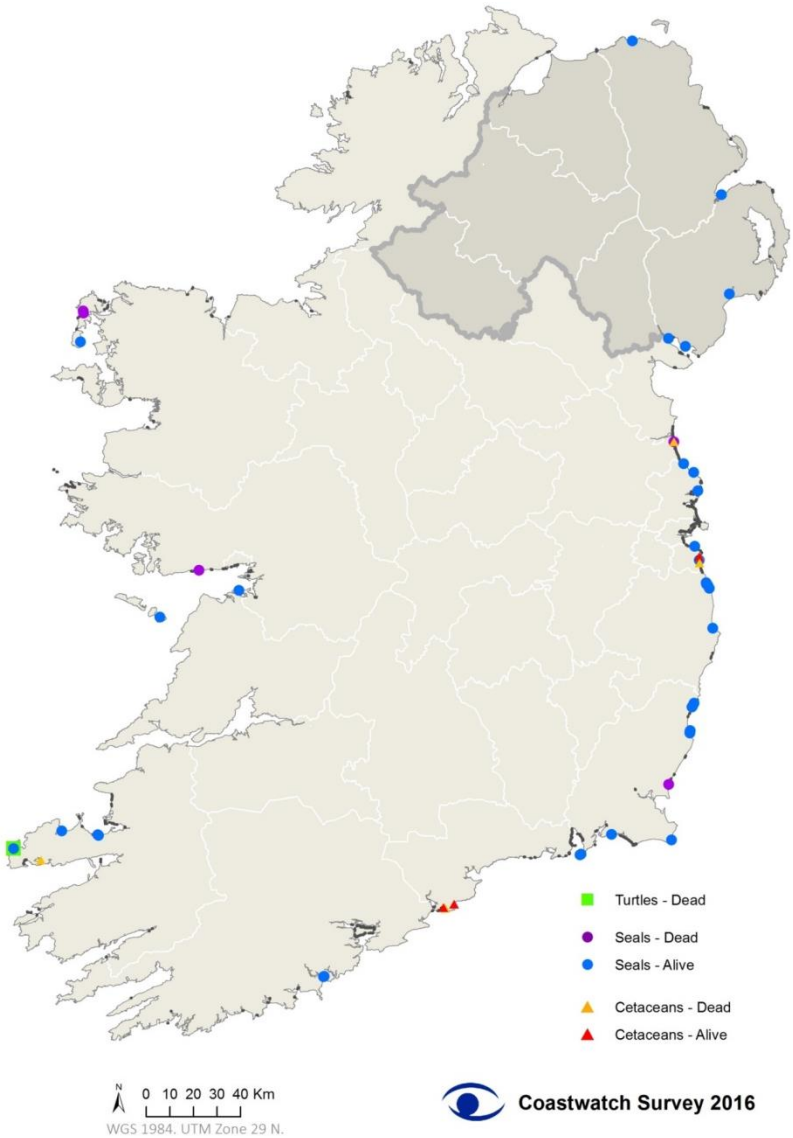


Figure 3. 8 Large Sea Creatures on the Coastwatch Survey 2016

3.5. Worms

3.5.1. Lugworm and Sand Mason

Surveyors found Lug worm in 251 s.u. (48%) and Sand Mason in 62 s.u. (12%). See figure 3.9. These worms love the warms muds and sandy muds of our estuaries and sheltered bays and are absent along the fast currents of the open East coast.

Lugworm are high value food for birds and inshore fish such as flounder. That is why they are of interest to anglers and dug for bait. In several areas of Dublin, Wexford and Cork surveyors expressed concern about intensity of digging and damage to the intertidal seafloor.

Some sites have changed from stable 'lugworm heaven', where old worms form sizable midshore hummock fields & nursery stock lies higher up on the shore as little squiggles. Today they are undulating turned mudscapes with obvious damage, which is slow to repair.

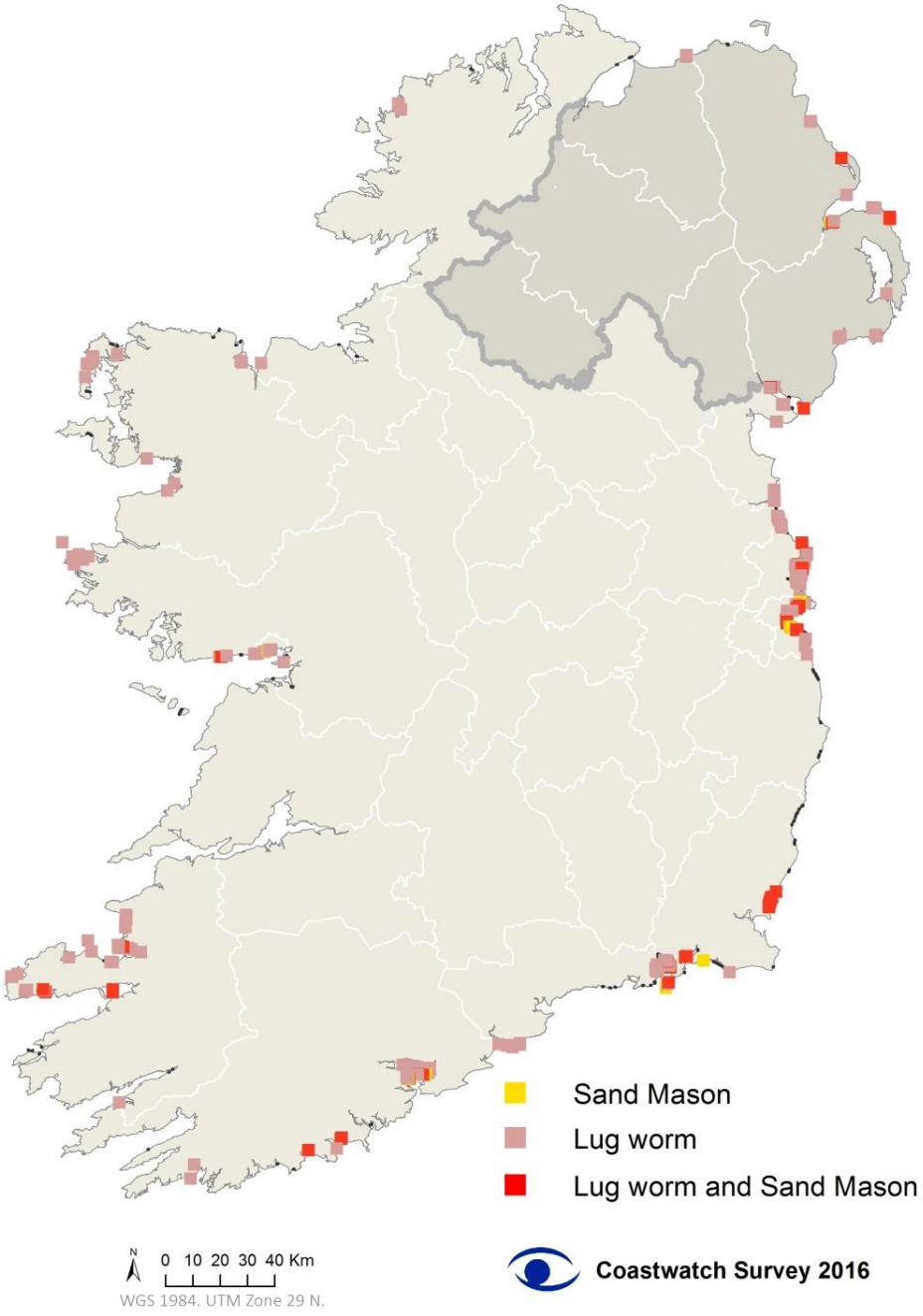


Figure 3. 9 Lugworm and Sand Mason during the Coastwatch Survey 2016

At least in Natura 2000 sites we need a review of this activity to manage it with bait digger permit and best practise enforceable guide-lines and no take zones. Lugworm aquaculture is practised in the UK as both income and to reduce pressure on the shore.

Picture 3. 14 Sand Mason. Photo by Anne Laird.

Picture 3. 15 Lugworms. Photo by Ann Getchell.

3.5.2. Honeycomb worm reef

The reef building worm *Sabellaria alveolata* can create amazing biogenic architecture in the intertidal and shallow sublittoral. Biogenic reef is classed as priority habitat under the EU habitat directive. As it is just made from sand glued together it is delicate and breaks when you stand on it. Apart from being vulnerable to trampling, bottom dredging, anchoring, sediment changes and burying are known pressures. In the Coastwatch survey 2016 smothering by green algae settling on the reef appeared widespread.

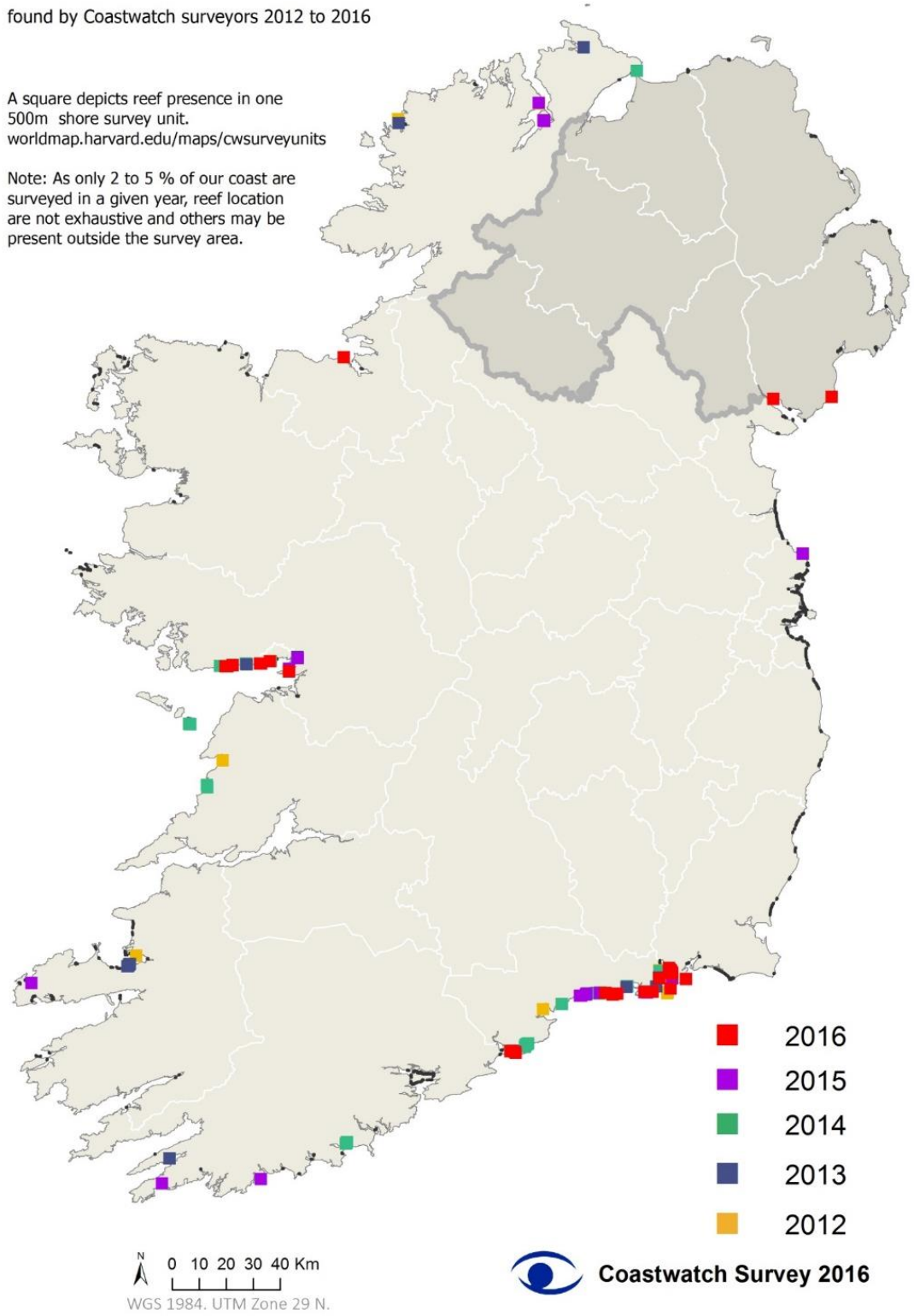


Figure 3. 10 Honeycomb Sabellaria reef around the Island of Ireland as recorded in Coastwatch autumn surveys 2012 to 2016

Results

The 2016 Coastwatch survey results included 35 survey units where Honeycomb worm *Sabellaria* reef was observed. In NI *Sabellaria* was reported from one surveyed site in the known well-developed and well protected Mourne coast honeycomb reef. A second one consisting of small reef patches in a boulder rock platform was found at Rostrevor, in Carlingford lough. This had not been noticed here or recorded before. In the RoI the two biggest clusters were found in Waterford Harbour (Barrow, Nore Suir estuary) continuing along west to Annestown, Co Waterford. The second cluster was in the Salthill area of Co Galway. Further reef was found in Kerry and Sligo, where the extent may be much larger but only one survey unit was checked. Many sites where *Sabellaria* had been found previously (outside the Waterford estuary and Galway Salthill area), were not resurveyed in 2016. The map (Fig 2.4) of the distribution found over 5 years shows reef present around the South, West and North coast, but no East coast occurrence in the republic, except for a small thin patch in Ballbriggan in 2015 which had disappeared in 2016.

The Waterford estuary area was well covered over several years and we can say with confidence that it is the largest honeycomb worm reef cluster we have come across or know of on this island and possibly in Europe – although at present the French reefs at Bay of Mont-Saint-Michel are taken as the largest.

Reef health

The worm reef health varied, as the photos submitted by surveyors show. When worms are tightly packed with sharp edges to the entrance and there is a crisp colour hue, the reef was deemed healthy. Signs of poor health were abraded tops, silt layers on the reef, toppled over worm hummocks, reef receding from rocks which were previously occupied.

Some prime quality as seen in the picture below was found in most survey units in lower shore sites. On the shores from Booley Bay Co Wexford North for 2.5 kilometre it could almost be described as luxurious carpets interspersed by hummocks. There were also good tightly packed patches at Ballyvooney, Co Waterford. There were bare stone patches and mud patches too which tell a story. In photo 3.16(iii) below for example, the large circular limpet scars in limestone rock indicate that there was a time when limpets could grow old on these rocks. It is not known, if reef worms entrapped the limpets which then died and later the reef died, or if some other cause like large sediment loads buried both reef and limpets as the estuary's sands and muds do move. Recolonization of this rock by reef worms was observed in March '17.

Picture 3. 16 (i) Dense healthy honeycomb reef 8_8_38_4_ Photo Anto McFly. (ii) Large disarray honeycomb worm holes emerging in spring 2017 after the green seaweed cover has washed away. (iii) Bare limestone left in some areas, where the circular limpet scars tell that there was once a time when limpets could grow old on this rock. Photos Karin Dubsky.

Green seaweed as pressure: for the first time reports and photos came in that reef surfaces were under a blanket of green opportunistic Ulva algae. Reports came from South Hook head and Kilfarrassy in

Waterford Harbour, and also from Galway bay at Salthill. *Ulva* carpet is not mentioned as a pressure in the literature. However reef quality deterioration under full green seaweed cover was stark and noted independently by several surveyors. At least in some sites, the green algae coincided with high nutrient input from small inflows – see chapter 4. It is hoped to investigate the nitrate sources further and also check for phosphates and stream ecology as part of a follow up project planned jointly with Wexford county council and LAWCO.

Figure 3. 11 Green algae on Honeycomb Reef. Photo by Paddy Houlihan

These biogenic reefs may be naturally in a state of flux. We have observed some reef in Booley bay grow to over a meter high, getting more complex, with caves and passages as it grew. When the worms are actively reef building, they incorporate whatever is in the way into their structure. Surveyors found a child's shoe, a can, plastic sheeting and a glove in reef, and more commonly trapped brown seaweeds where only the top protruded. A fortnight later, though the same reef could be falling apart, hummocks falling over, leaving just patches of mud behind. Or part of a reef cracks open in the centre, exposing a cross section with parallel worm tubes, as seen on photo 3.17 below.

While this author has seen reefs being build, the break down process and causes are unclear. Are there environmental and/or human pressure conditions which interfere with the worm population's build and repair work, or is the structure inherently unstable when it reaches a certain size and shape – too top heavy in case of hummocks?

Picture 3. 17 Reef in break down phase. Alan Walshe, Waterford Regional Coordinator is touching a fishing glove incorporated by the worms during reef formation.

Reef Protection

Follow up work was done on the Waterford Harbour reef by mapping it onto the designated Special Areas of Conservation (SACs) in the area and checking whether the Sabellaria is mentioned in site information. Sabellaria reef is listed as a qualifying interest for the SAC.

The results are tabulated overleaf, where the reef is divided into 6 zones and each is considered in light of its location and present protection status.

The exercise shows that the area of reef marked on the official R. Barrow, R Nore SAC 2162 map is much smaller than the actual reef. The other Waterford Harbour reef areas are either outside protected sites altogether, or in an SAC, but not mentioned and hence unlikely to be well protected.

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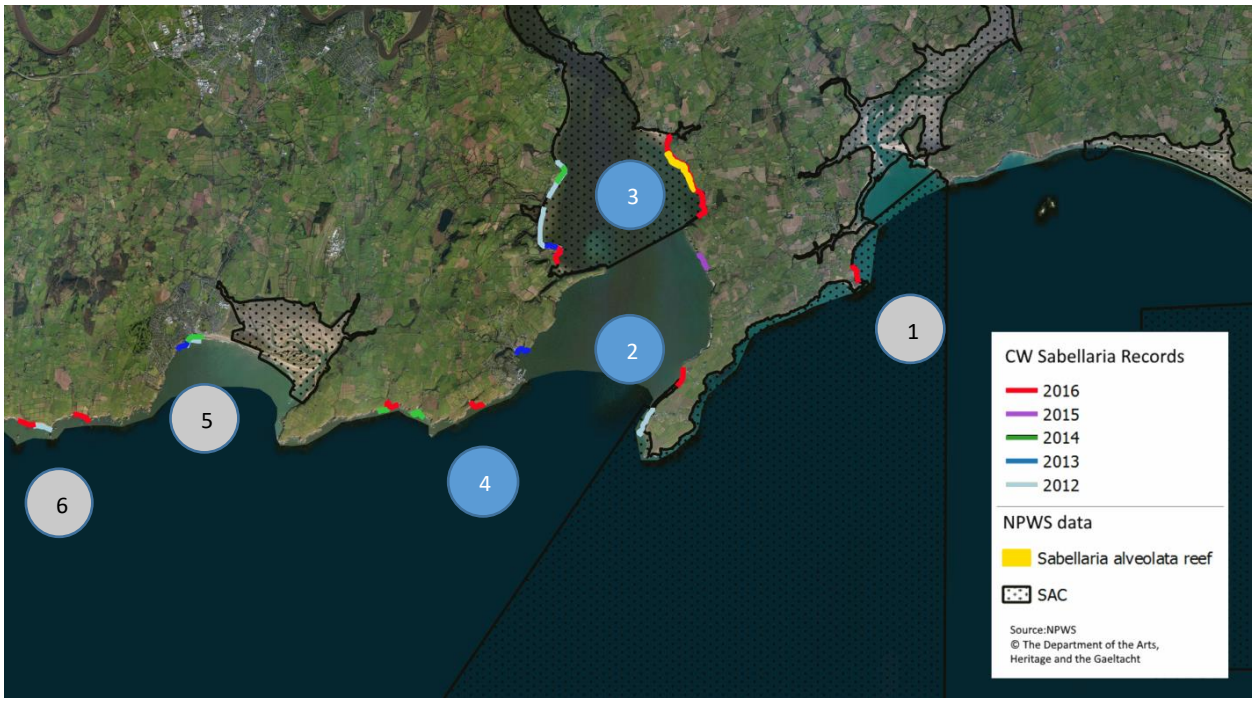


Figure 3. 12 Sabellaria Reef found in Coastwatch surveys 2012 – 16 in and around Waterford harbour. Colour determined by the year it was last found in a survey. Yellow highlight shows the reef as marked on the National Parks and Wildlife Service habitat map for SAC 2162. Numbered area information is summarised in table below. Numbers in blue circles denote inner estuary and grey outer estuary/coastal waters using Coastwatcher fieldwork data and NPWS protected site 2162 map.

Sabellaria Reef Location	Designation	WFD water T Transitional C Coastal	Comment: size/special	Coastwatch Recommendation
1. Baginbun Hd	Hook Head SAC 764 but not listed in conser objectives	C	A small reef marking the most easterly *Sabellaria* location of the S coast.	Add to Hook Head SAC reef habitat as qualifying interest and set conservation obj.
2. Just S of Loftus Hall shore to S tip of Dollar Bay	Small part in Hook Hd SAC 764, most not in SAC.	C but outer Waterford estuary	Reef has shrunk. Threat of eutrophication and in spots visitor trampling and anchoring	Add as above Protect as part of a greater Waterford estuary MPA.
3. Inner estuary S of Duncannon/ Woodstown	R. Barrow, R Nore SAC 2162 Sabellaria reef is mentioned in C. obj	T	Biggest reef. occurs both sides of estuary. NPWS map reef smaller & on the Wexford side only.	Update NPWS 2010 map to incl. both sides. Develop core reef management plan with local stakeholders.
4. Dunmore E to Ballymacaw	No	C Tucked away & Open coast	Small healthy area of reef seen most years, 2016 green algae	Protect as part of a greater Waterford estuary MPA
5. Tramore Ladys slipway	No	C tucked away	Excellent reef all years size varies. IAS Japanese seaweed here	Protect as part of a greater Waterford estuary MPA Or protect in Copper Coast Geopark
6. Garris, Kilfarracy Annestown Boatstrand	SPA coast designation not relevant to reef	C Open	Discrete reef sheets extends further West Eutrophication signs in 2016 noticeable 1st time	Explore protection as part of the Waterford estuary MPA outer zone - like Dub Bay biosphere, or as part of the Copper coast Geopark.

3.6. FISH

Fish are used as biological indicators in both the Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD). An abundance and diversity of fish is a good sign. In EU Marine Law MSFD one of the 11 Descriptors is focused on commercially important fish and shellfish. The goal the EU member states agreed on *(as Descriptor 3)* was:

'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.'
http://www.housing.gov.ie/sites/default/files/publicconsultation/files/marine_strategy_framework_directive_programme_of_measures_november_2015.pdf

In the 2016 Coastwatch Survey live fish were found in 75 of the 525 survey units - see graph below. In 15 survey units dead fish were recorded. Additionally 16 inflows with live fish were found and 3 with dead fish. No surveyor comments of actual fish kills were flagged. The previous two years surveyors had noted lines of dead sprat washed up on the tideline, but not in 2016.

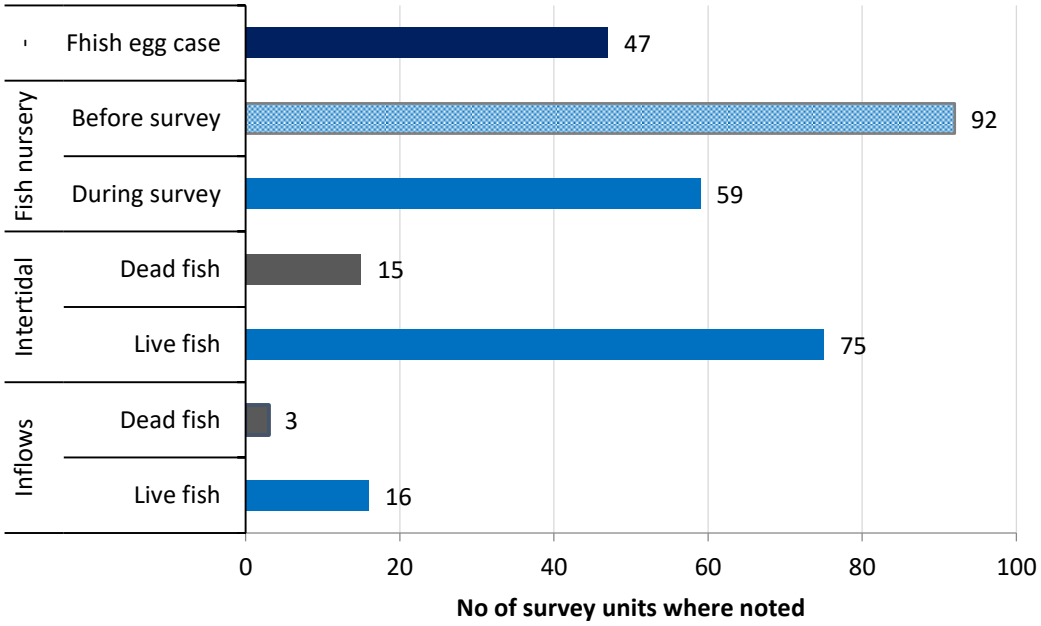
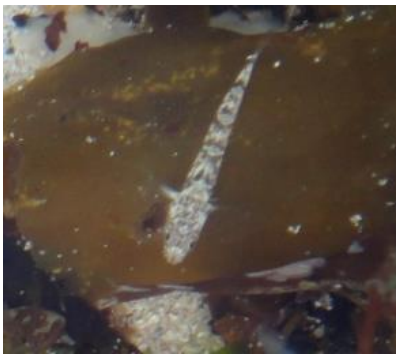


Figure 3. 13 Number of survey units with information on live and dead fish, fish nurseries, juveniles and fish egg cases

At present surveyors are not supplied with a fish ID guide and are only given basic search hints, which cover rock pools with their own resident fish population, boulders in the intertidal which species like butterfish hide under, estuarine stony areas and river banks where eels might be found under stones or by poking into silty sediment at the mouth of streams. Streams which form temporary lagoons on the shore and estuarine mudflat and sandflat puddles are 'homes' for some juvenile flat fish. Occasionally 1 to 2 year old plaice may be seen here in their hundreds of thousands, but these records are rare and none were reported in the 2016 survey.



Picture 3. 18 Fish swimming in shallow water. Photo by Polly Dollan

Picture 3. 19 Well camouflaged fish at Red Strand (County Cork) Photos by Bernie Connolly

Surveyor responses to the question '***Where*** *did you see fish'* show that fish was found mostly in rock pools (51%) followed by shallow water/sea and rivers/streams. Other locations mentioned were saltmarsh channels and under rocks.

Volunteers were asked to estimate **how many** fish they saw. Over 990 fish were reported in 40 survey units (averaging 25 per s.u.) with estimates for shoal fish.

What fish? While most did not specify species seen, but indicated type as 'flat fish', or 'shoal of fish', there were several species lists which included: blennies, gobies, rocklings and sea bass; sand eels, butterfish, shanny, clingfish, smelt, mullet, stingray, pollock, wrasse, 'baby ling, trigger fish, garfish and sea trout.

In the Biodiversity Extra Question page surveyors entered data regarding **juvenile fish and fish nurseries.** Surveyors reported knowing of fish nurseries from 90 sites (just over 17% of s.u.) with stream mouth and water just below the survey unit included. In 59 of these sites, surveyors also saw fish during their survey.

Picture 3. 20 (i) Trigger Fish. Kilmore Quay, Photo Jim Hurley, (ii) Young plaice caught in lagooning Inch river. Photo Cathy Lee

As spotting fish in our survey relies on seeing them unaided by nets or other equipment and as surveyors vary from keen fishermen who know where to look and novices, the present results yield only a fraction of what fish might be milling around and a 'no fish seen' result does not indicate that fish were absent.

Fish Egg cases:

Surveyors were asked to look out for fish egg cases in Extra Questions and give an estimated count. Surveyors counted over 324 egg cases in 47 s.u. (more than 7 per s.u. in 10% of the coast). Regarding species, dogfish was the most common as they tend to come tied in a bundle, while skates and rays wash up as single cases.

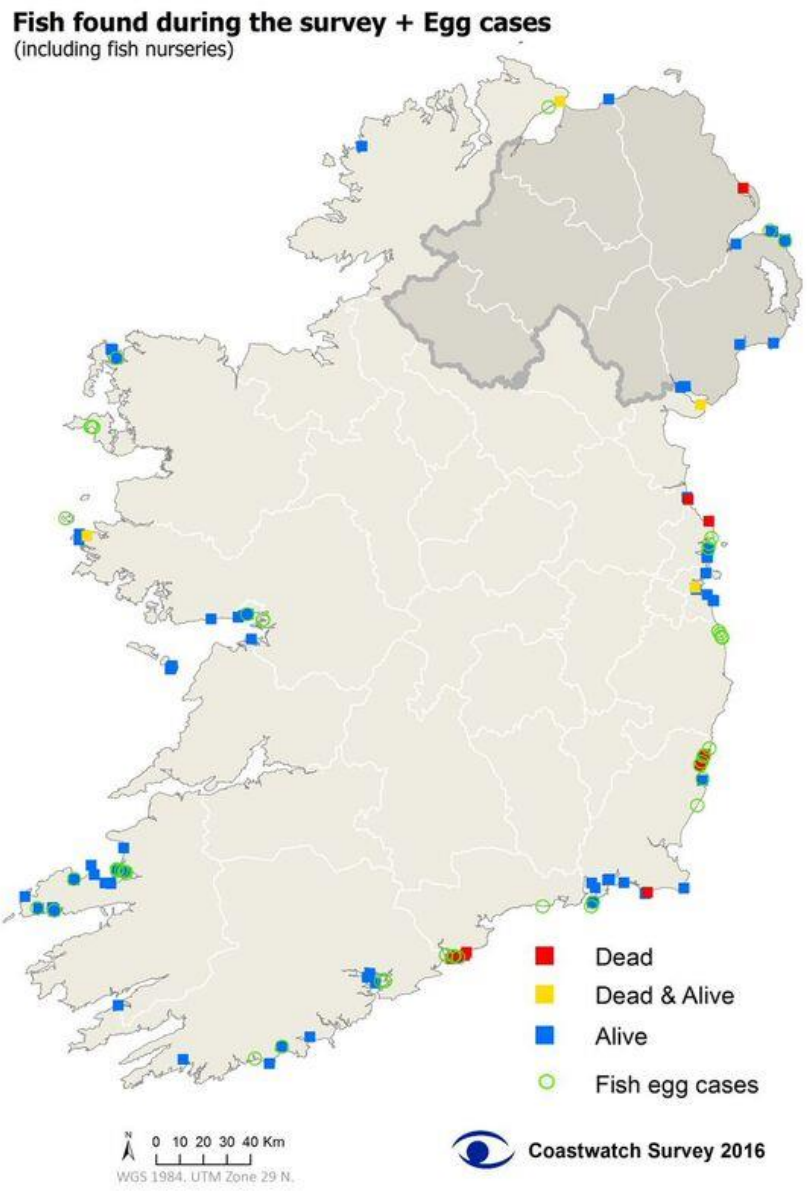


Figure 3. 14 Fish and fish egg cases found during the Coastwatch Survey (including fish nurseries).

When mapped – see Figure 3.14 - the 47 survey units were scattered right around the coast from Dublin, Wicklow, Wexford, Waterford, Cork, Kerry, Galway Mayo and Donegal with hot spots in the Dublin and N Wexford area, around Tramore bay Tralee Bay an Galway bay. In NI some were found in Co Down. Surveyors had not been asked to identify the egg cases, but in some areas surveyors noted that they found eggs of several ray and/or skate species.

Some experienced surveyors who knew their area well noted that they found only few egg cases at time of survey, but expected the main load to wash up later around Christmas or early in the year.

The autumn 2016 fish egg case distribution was compared with published year round mermaid's purse search citizen science data for Ireland as presented on maps for blonde ray, common skate, cuckoo ray, greater and lesser spotted dogfish, small eyed/ painted ray, spotted ray, thorn-back ray, undulate ray and white skate produced by Dr. Sarah Varian and published in the North West Waters Atlas http://oar.marine.ie/handle/10793/1075. In both maps egg case findings were broadly similar, with most sightings along the east coast and clusters in Tralee Bay and Galway Bay.

To conclude, the Coastwatch survey results may not contribute directly to the fish descriptor monitoring, but fish egg case observations of commercially important species may become useful, especially if we can better support surveyors with guides and fieldwork training for:

- species like eels and plaice which spend part of their life cycle in rivers or streams.
- shoaling species like sprats and sand eels which other fish hunt for food and surveyors notice due to the sheer numbers swimming in shallow water, or swept up if beached while pursued.
- egg cases of commercially important fish.

The fish section is still being developed and comments from readers for future use would be very welcome. Some spring and summer follow up work with inshore fishermen in the Waterford estuary has been planned to include eel search and mapping.

3.7. Invasive Alien Species

Invasive Alien Species (IAS) are animals or plants that are introduced intentionally or accidentally into a natural environment where they are not naturally found, and where they spread with serious negative consequences for their new environment. http://ec.europa.eu/environment/nature/invasivealien/index_en.htm

Some IAS are well-known for decades in Ireland, like the problem of rhododendron in Killarney National Park and more recently giant rhubarb on Achill Island and curly waterweed & zebra mussels in Lough Corrib grabbing the attention of the national media.

Coastwatch started reporting IAS as a separate data entry in the 2013 survey as IAS had started to appear in surveyor notes.

On the island of Ireland governments set up a formal joint approach from 2007 when they launched "Invasive Species Ireland" funded by the Northern Ireland Environment Agency and several agencies in the RoI. to protect native biodiversity and ecosystem services, as well as to minimize and mitigate the human health or economic impacts that these species can have.

However this joint venture to tackle IAS was discontinued in 2015. Ironically on 1st January 2015 EU law Regulation 1143/2014 on invasive alien species entered into force. It sets out how to tackle IAS by: prevention, early detection and rapid eradication, and management. One other key element is a list of 'invasive alien species of Union concern' which will have EU wide rules applying. It was adopted with a first batch listed in 2016 but will be added to.

While the Invasive Species Ireland project is still an important source of information for identification etc. and a place for reporting sightings, the backup needed to focus on this area in the survey was missing. So Coastwatch training and prioritization plans for this section were deferred to 2017 in the hope that there would be a vibrant new Invasive Species Ireland team which could support surveyors, or a direct EU link.

Results

Given the limitations in training and information materials IAS reports were collated from several sections of the Coastwatch survey form:

Question B2 Inflows – IAS (on the water or on banks around the inflow).
- D3 Intertidal:– where Cord Grass (Spartina) was listed and pictures included
- D4 Intertidal: - Any new or recent species of animal, plant, or seaweed?
- F 4 General Observations - Evidence of Serious Risk – IAS is one tick opion
- The Extra Questions on Biodiversity also had Gigas Oyster and Slipper Limpet options

Invasives recorded in the 2016 autumn survey are listed below, going from land and river bank into water:

On land and in the splash zone New Zealand Flax (Phormium tenax and P. colensoi), Sea Buckthorn (Hippophae), Giant hogweed (Heracleum mantegazzianum) and Japanese Knotweed (Fallopia japonica) were seen. In the splashzone and high intertidal Cord grass (Spartina). Lower in the intertidal Gigas (Pacific) oyster *Crassostrea* in several sites and Zebra mussels found in one - the Dublin Grand Canal Basin. More work is planned on this and there is a high demand for ID training for surveyors and action to 'tackle the invaders'.

Invasive Alien Species in more detail. Land based stretching into the splashzone:

Japanese Knotweed (*Fallopia japonica*) – an established Invasive and a detriment to both marine and terrestrial habitats. It can vigorously outcompete native plants, damage hard surfaces including foundations, and can block up rivers and outflows causing flooding and sedimentation impacts. Japanese knotweed can spread through even tiny fragments of its rhizome or small segments of stem, meaning it is

often spread by mistake. Rhizome and stems that are washed downstream in water can also recolonize, meaning watercourses are a clear pathway for its spread. Japanese Knotweed was mentioned in 6 s.u.

New Zealand Flax (Phormium tenax) – long established in Ireland, this was planted as a wind break along the coast at least as far back as the mid-19th century. It is found mainly on the south, south-west and west coasts, as well as in gardens throughout the country. Due to its size it is used in gardens for privacy and shelter. Unfortunately its high tolerance to exposed conditions and ability to grow in many soil types means once it escapes the garden it can thrive in the wild. Here it may outcompete other native plants on sea banks. Nothing grows under an established New Zealand flax thicket and in North Wexford it is spreading and needs to be closely monitored and eradication trials undertaken. I was mentioned in 7 s.u.

Giant Rhubarb (Gunnera tinctoria) – another established Invasive, Gunnera has escaped from gardens where it was planted for its architectural features. It is a large plant that can outcompete other natives, literally putting them in the shade! It grows vigorously through its rhizomes, which like Japanese knotweed can spread if even a tiny portion is disturbed. Both plants also can lie dormant in the rhizome for anything up to 20 years, before resurfacing as new growth. It has caused significant problems on the west coast where it seems to thrive in the harsh, salty environment of the Atlantic coast. Achill Island in particular has had a terrible time trying to eradicate Gunnera which has threatened to take over much of the landscape there.

Pampas Grass was not mentioned as an IAS, but and it can be seen to spread in areas like the Dublin Booterstown marsh islands where it was accidentally introduced with spoil. In Cork photo below pampas grass was planted in a line just above the splahzone. In case of erosion, material would be carried by the tide to new sites. It was mentioned in one survey unit.

Cord grass (Spartina anglica) – an established Invasive plant that can spread over mudflats in sheltered coastal areas. Spartina grass was recorded in 57 or 11% of all s.u.. It was originally planted in Ireland to help stabilize the coast and gain land due to its deep root structures and gradual silting of ground around it. Unfortunately it is often found in the same area as Salicornia flats and seagrass beds, where it can be detrimental to the survival of the native species. It is therefore designated a significant invasive on the Most Unwanted list (www.invasivespeciesireland.com/most-unwanted-species) and all sightings should be reported on this website. On the other hand, it canm be a valuable habitat with tuft seaweed understory and a perfect place for shore crabs to molt.

Picture 3. 21 (i) Pampas grass; photo by Gerry Moore (ii) Giant Rhubarb; photo by by Rory Keatinge.

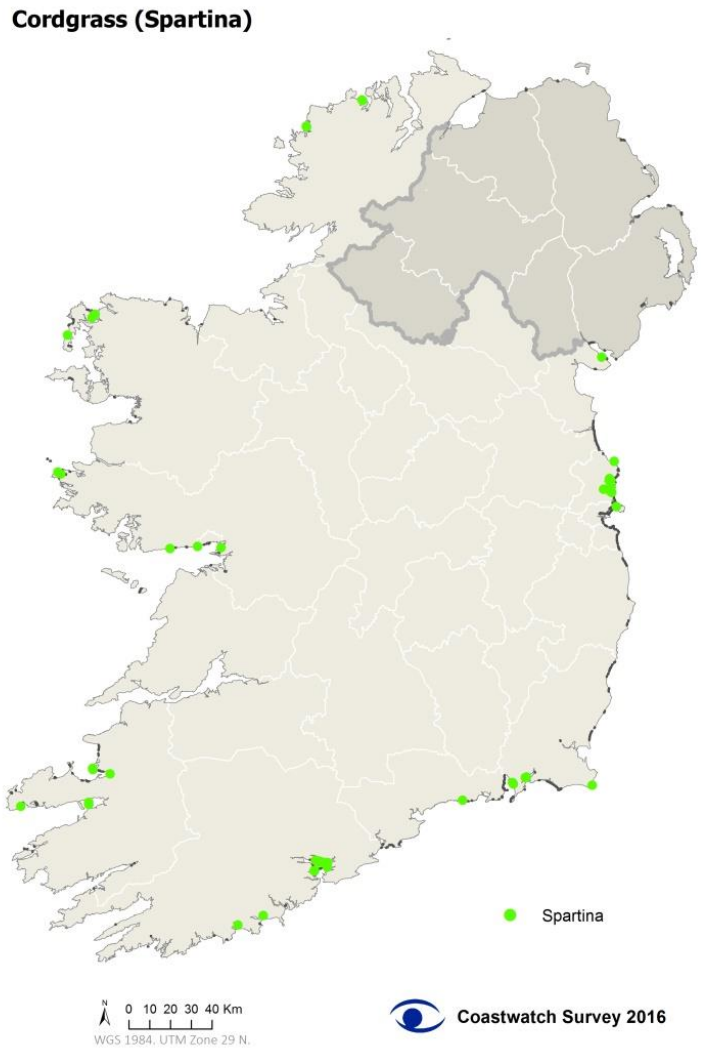


Figure 3. 15 Cordgrass Spartina records during the Coastwatch Survey 2016

Lower in the intertidal and swept up finds by surveyors were queried as to possible IAS , especially if the surveyor noted them for the first time on a shore they knew well. Some of these were easy to identify - like Japanese seaweed *Sargassum muticum* (pic 3.22) that was reported from several known sites including Tramore Bay and Bulloch Harbour in Dublin. A new site was identified in Bantry bay on the Sheep head peninsula, where this survey represented the first report.

In autumn 2016 David Tilly notified Coastwatch and IFI of zebra mussels he noticed in the Grand Canal basin locks just beside the River Dodder mouth as it flows into the Liffey estuary. He heard no more.

In April 2017 Coastwatchers went out to the site as part of follow up work. Romain Pfeiffer one of the group sent this note now included in final report.

More photos or specimens would confirm identity in other cases, two of which are shown in picture 3.23 overleaf.

Picture 3. 22 Light sea spaghetti in the forfront with dense cover of invasive Japanese seaweed Sargassum behind it.Photo by Bantry Bay diver.

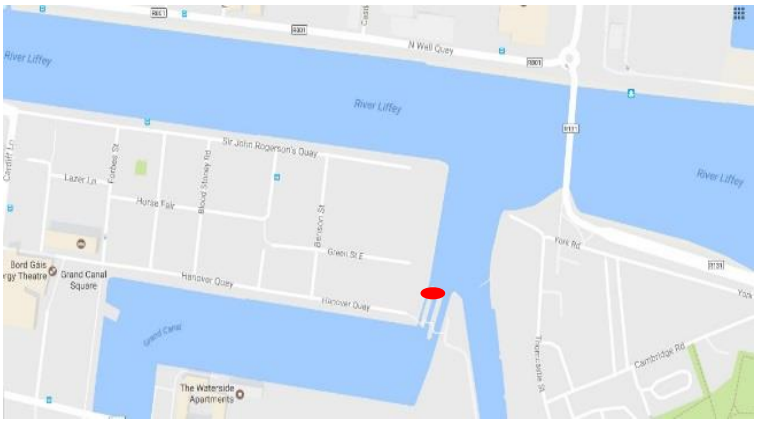
Picture 3. 23 (i) Marlogue Strand. Photo by PJ O Brian. (ii) Jelly around sea beard Photo Anne Laird.

FOLLOW UP WORK – BY ROMAIN PFEIIFER, RORY KEATINGE AND BETTINA WIMMER

Zebra Mussel (*Dreissena polymorpha*)

After Dave Tilly found Zebra mussels during his Coastwatch survey and reported same to IFI, we wanted to see whether the mollusc was still present and if any action had been taken.

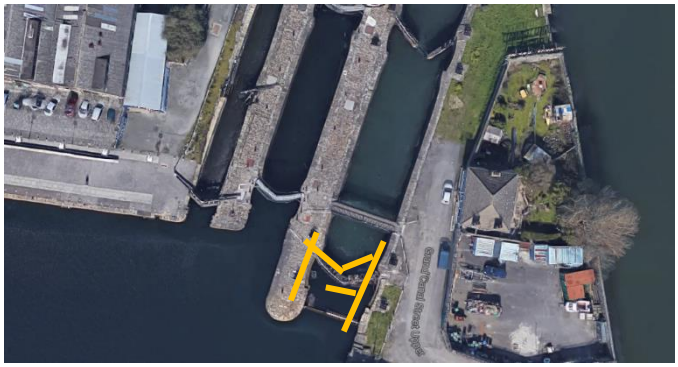
Area: We checked the Grand Canal from its confluence with the Dodder to R802 bridge on several fieldtrips in April 207. Zebra mussels were found in the last lock as the canal enters Grand Canal basin. They were recorded as dense stands on lock gates and the walls between those gates (see map and aerial photo), patches covered ~ 31 m^2 (walls and gates combined). The lock gates may be defunct. From initial search no zebra mussel was found outside of this area, but there was too much turbidity in the Dodder to see the bottom of the river estuary. Pictures i and ii overleaf show zebra mussel patches. Initially we tried to contact IFI and Dublin City Council but did not find anyone who seemed responsible to address the issue. However Dublin City Council advised to contact Inland Waters Ireland.



Map of the Dodder Grand Canal confluence. Red point is where the zebra mussels were found.

A call and email to Inland Waters Ireland yielded a positive response. A representative was aware of zebra mussels higher up in the Grand canal and was open to examining the site and planning an eradication event at next suitable low spring tide. He thought they may be best scraped off into a boat which would also be used as work platform. Joint planning is underway. It is hoped to have the eagle eyed Dodder

Action group members checking their river at low tide for zebra mussels.



↑*Aerial picture of the locks gates and walls where zebra mussels were found (patches in yellow)*

Picture (i) and (ii) Zebra Mussel patch on the old Grand Canal lock gate: left picture is the downstream gate of the area, right picture is the upstream gate of the area (Pictures taken by Rory Keatinge) →

3.8. BIODIVERSITY SECTION RECOMMENDATIONS

GENERAL: A final set of recommendations will be published in June after further consultation around the coast with Coastwatch groups during biodiversity week.

Some points are included here:

1. Create the coherent network of MPAs - joint up around the island of Ireland.
2. Create X-border MPAs in the two loughs and a coherent management And protection plan which starts with a formal agreement to set aside any land/seabed claims but just focus on achieving the protection, restoration and sustainable use goals.
3. Create a linked network of physical coastal citizen observatories, with existing ecology, wetland centres and new ones where gaps exist. Ideally each has a special expertise to lead on. One gap identified is no East coast RoI urban centre. A site with good range of habitats possibly on abandoned infrastructure and easy to breach for citizens would be ideal – e.g. Dun Laoghaire old sea bath
4. To achieve the top three recommendations we need baseline data which enables action. We lack public and sectoral information, guidance and advice how to protect and restore coastal

nature/biodiversity in both jurisdictions. To address that a review of coastal Natura 2000 site awareness, public information and protection attitude and how to improve it to benefit nature and man would be valuable. This baseline work could be carried out on the shore this summer – either restricted to the 2 loughs or ideally island wide.

5. Species/Habitat specific recommendations are being drawn up. One which is complete is set out here for biogenic reefs:

   5.1. An effective management and where needed restoration policy focusing on the conservation status of biogenic reef structures especially mussel beds and honeycomb reefs should be developed.

   5.2. Online guidance is needed on reef functions, distribution, management and restoration, so the ecosystem services are realised and protected. Where relevant this is put into local authority biodiversity action plans and bylaws to ensure adequate reef protection.

   5.3. A Honeycomb Sabellaria worm reef range and quality island wide should be undertaken, along with review of reef pressures and protection. Citizen science research should be included.

6. RoI: on MPAs

   6.1. MPA legislation should be enacted as a high priority to enable government to designate new MPAs as required under the MSFD.

   6.2. A new designation process where the selection criteria are clear and reasoned site proposals are put forward and considered whether they come from NGOs, local coalitions or inshore fishermen, rather than following the old government and consultants route which was used for Natura 2000 site selection. This proven successful NI model should be initiated now, to be ready when new legislation is passed.

7. An end to limbo aquaculture: Aquaculture concern were stronger in our last survey and continued with steady flow of mails into 2017. There has been an awfully long time to adjust to the Birds Case ECJ.

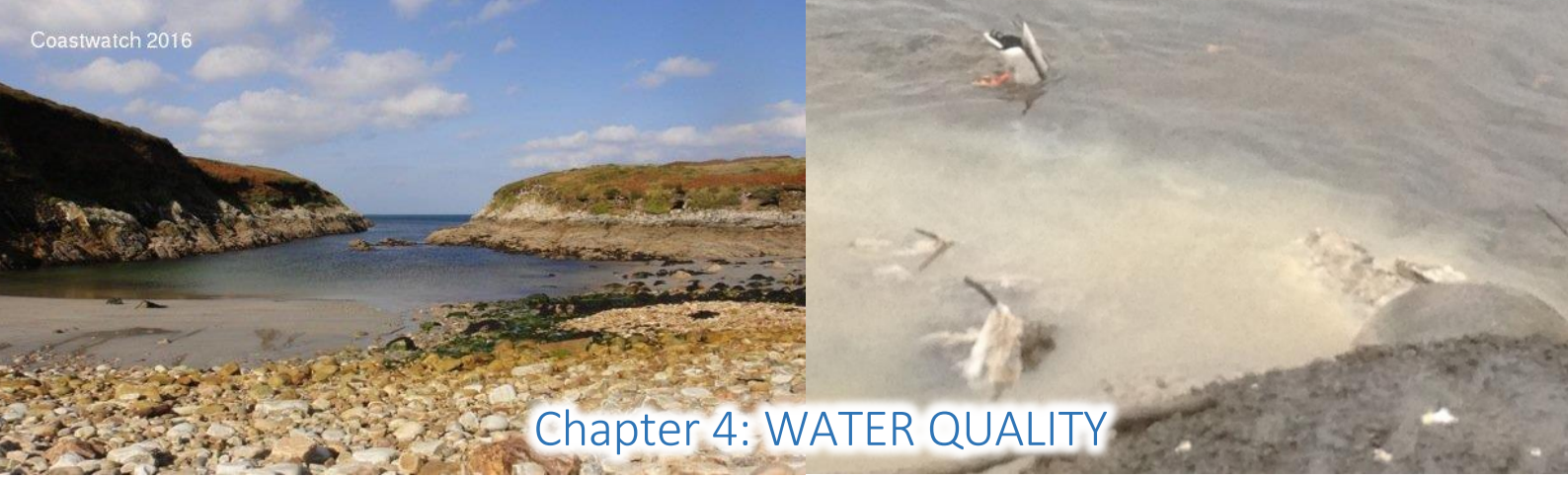
   7.1. Time scale: Publish a policy statement and assign resources to ensure that by end of 2017 all aquaculture operations are running with a license. A published map and conditions and annual monitoring reports should start from 2018.

   7.2. Review impact of inshore aquaculture and examples of best practise for all designated shellfish waters this summer/autumn and publish the results to inform new license conditions and enforcement protocols. Employ more staff to accomplish this vital work.

8. Seaweed: Ten recommendations on seaweed were adopted in Coastwatch led workshops in 2016 and are available on www.coastwatch.org in the seaweed module. These need to be addressed.

   Among these a core ask is for a seaweed protection and resource management policy which should be drafted for adoption in 2017 to put a frame and guidance around resource protection and use.

   A background paper on seaweed ecosystem values, stocks and health, impacts of best and poor practice harvesting should be collated from published information abroad and our own dispersed data with identification of information gaps.



Chapter 4: WATER QUALITY

Water quality features in several sections of the annual Coastwatch survey. Water pollution (Survey question F4) was returned as second highest threat – after erosion - by surveyors in the 2016 autumn survey. The water quality and indicator results for 2016 are presented in the following order in this chapter:

4.1. Sewage pollution incidents Background knowledge and opinion of those who know their area well.
4.2. Presence of opportunistic green seaweeds alive or decaying on the day of survey.
4.3. Inflows: a description of fresh water entering the survey unit, a check for good and bad signs and nitrate tests.
4.4. Threat (risk) of sea water pollution.
4.5. Some comparisons of Coastwatch results with official monitoring results and water quality status.

4.1. Sewage Pollution Incidents

Question B3 of the Coastwatch questionnaire asked surveyors who know their area well to indicate the frequency of sewage pollution incidents in their area. Results for 374 su, presented in figure 4.1 below show that 42% of waters were deemed reliably sewage free and 39% rarely effected. Occasional sewage pollution was reported in 13% of sites. In 4% it was considered frequent and 2% usual. Seasonal pollution was recorded in only 3 sites (0.3%), in keeping with the last 5 years where it has remained below 1%.

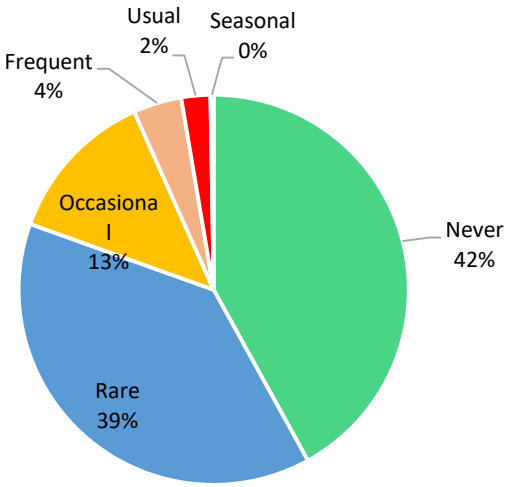


Figure 4. 1 *Frequency of sewage pollution incidents. Surveyor background knowledge. N=374 s.u.*

Looking back over the last twenty years we can see that in the first decade of surveys, sewage pollution was risk was 3 and 4 times as high. Sewage indicators were common on Dublin beaches where the largest number of bathers congregated on hot days. In the 2000 survey, sewage free shores were reported from only 17% of shores. However over the last 5 years, the sewage pollution incident results have stayed the same.

Both raw sewage discharges and the overloading or maintenance issues in areas with sewage treatment. Need to be addressed. Towns like Arklow and Moville are still awaiting their first sewage treatment plant and are 'dis-serviced' by short outfalls as shown in photo above right. At least treatment plants are planned or under construction. Elsewhere the sewerage system bypasses clusters of houses (e.g. on Doldrom Bay Howth head, Fingal County Council where raw sewage discharges into designated waters) and there are still single houses where a pipe brings sewage directly from toilet to seashore. Regarding sewerage infrastructure maintenance, several complaints of overactive storm water overflows may be linked to use of 'flushable' wipes forming ropes in treatment plants. (See Coastwatch Waste and Litter results 2016 for more on this.)

4.2. Green Seaweeds Alive or Decaying

Introduction

There are several species of green seaweeds which can form large carpets in the intertidal. Most now fall under one genus name *Ulva* and are structured like green translucent sheets of 'sea lettuce' (*Ulva lactuse and Ulva rigida)* or long stringy tubes of 'gut weed' (which used to be called *Enteromorpha*). Typically these Ulva seaweeds thrive (or bloom) in sheltered warm nutrient rich lagoons, estuarine and coastal areas. They behave like nettles on land, virtually disappearing in winter, popping up in spring with longer hours of sunshine and rapid summer growth. Years like 2016 with lots of calm warm weather extending into the autumn provide ideal growing conditions. If then you have sufficient N and P nutrient inputs, from agriculture, horticulture, sewage, traffic - and increasingly activities in the coastal zone itself including aquaculture - the green seaweed carpet or bloom can continue to build up over months. Green seaweed carpets die back in autumn and are dislodged in storms with decaying algae forming mush layers, causing anaerobic conditions and potentially dangerous gas emissions.

The assessment of ecological health of the marine environment is governed by two primary pieces of EU legislation, the Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD). Both use green seaweeds as indicators of eutrophication. In Ireland the EPA is doing monitoring work on this- see http://www.epa.ie/pubs/reports/water/other/wfd/ [1] Monitoring takes into account how big the seaweed carpet is (spatial cover), how thick (biomass) and for how long the green carpet lasts (persistence relative to undisturbed conditions)[2]. Opportunistic macro algae 'blooms' are used for assessment of transitional and lagoon waters in Ireland for WFD reporting, while suitable sheltered coastal waters are checked to inform compliance with the MSFD eutrophication descriptor. Only about 40% of the ~300 transitional and coastal water bodies are monitored directly (Robert Wilkes personal communication)

Coastwatch survey question D3

Surveyors were asked to indicate whether green seaweeds were present and if so whether as patches/thin band or as carpet cover/thick mat. Surveyors are not asked to identify species or estimate size or thickness of carpets. It is explained in guide notes that the former simply indicates the species is present - typically where fresh water enters the shore. The latter is an indicator of nutrient enrichment or eutrophication.

Results:

Green algae patches were reported from just over half of the survey units (52 %), while larger algal mats were recorded in 18.3% of shores as mapped in Figure 4.2. Both occurrences are higher than in recent years. Green seaweed carpets are familiar on mudflats in shallow warm nutrient rich areas like Rodgerstown estuary, Malahide estuary, Dublin Bay, Bannow Bay, Clonakilty Courtmacksherry and Tralee bay. In NI surveyors in Belfast Lough, Carlingford and Lough Foyle reported seeing green seaweed carpets.

***Picture 4. 1** Green algae on Sabelleria reef Photo Karin Dubsky*

Impacts

Surveyors in Waterford Harbour, on both Waterford and Wexford sites commented on unusual green algae blankets on the *Sabellaria* reefs. They observed that the reef was in poor silty condition or possibly abandoned, where so covered. In one area of Hook Head, the reef was totally blanketed in *Ulva* and *Sabellaria* only found underneath, as it was

[1] Wan AHL, Wilkes RJ, Heesch S, Bermejo R, Johnson MP, Morrison L (2017) Assessment and Characterisation of Ireland's Green Tides (*Ulva* Species). PLoS ONE 12(1): e0169049. doi:10.1371/journal.pone.0169049

[2] Scanlan C. M., Foden J., Wells E. and Best M. A. The monitoring of opportunistic macroalgal blooms for the water framework directive. Mar. Pollut. Bull. 2007;55(1–6):162–171. Available: http://dx.doi.org/10.1016/j.marpolbul.2006.09.017 Accessed 7 December 2015. doi: 10.1016/j.marpolbul.2006.09.017. pmid:17070853 (quoted in Wan et al)

carefully searched for where recorded previously. Surveyor Paddy Houlihan who has been checking his reef at Kilfarassy, Co Waterford regularly for at least 4 years noted, that he had never seen such extensive green algal cover. Drain and stream nitrate levels were checked and were raised to high (25 to 50 mg/l NO_3) in these areas.

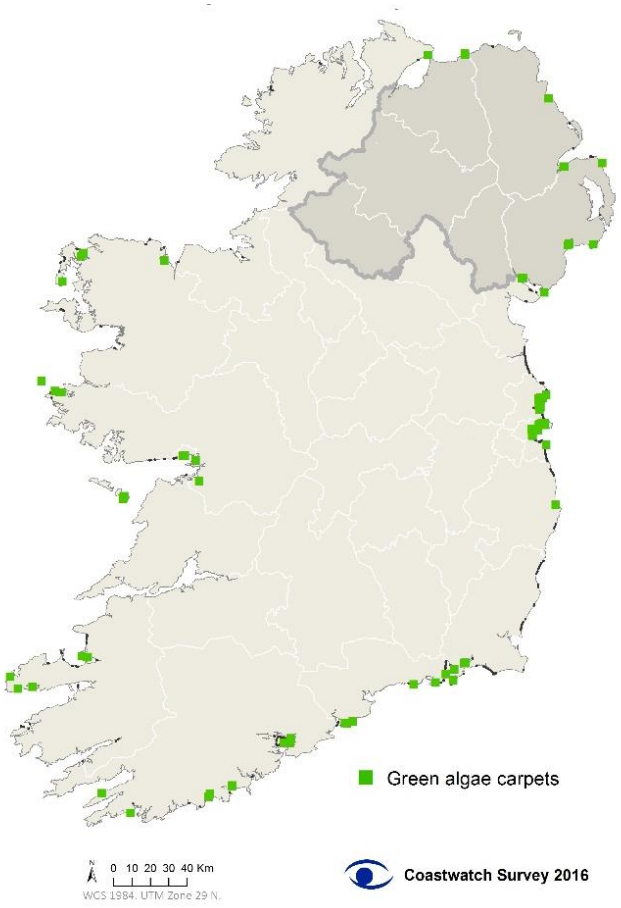


Figure 4. 2 Location where green algae carpets were reported (in 18% of 374 s.u).

***Picture 4. 2** (i) Ectocarpus carpet decaying S Dublin Bay and (ii) Ectocarpus bloom decaying on Booterstown shores. Photo Rory Keatinge*

In Dublin Bay surveyors noted extensive *Ectocarpus* bloom in 2016. This thin sheet-like brown seaweed is an opportunistic nutrient enrichment indicator like the *Ulva* seaweeds, but tends to grow in the low intertidal and shallow sublittoral. It is also fast growing and forms mush carpets when dislodged – see picture 4.2.

The swept up *Ectocarpus* biomass was so high in autumn 2016 that volunteers abandoned the survey in several Dublin Bay sites

The unusual warm dry weather is likely to have contributed to this problem which was hardly mentioned in the autumn survey of the previous 3 years.

Looking back

Urban: Twenty years ago, a wave of complaints about sulphur smells around Dublin Bay used to signal that the green seaweed carpets had started to rot in Dublin Bay. The carpet would be rolled up by the incoming tide and winds. Seaweed mush, mixed with sewage indicator sanitary waste, used to decay feet thick around Merrion Gates and Ringsend in South Dublin Bay. Between noxious gases and occasional mass death of macroinvertebrates trapped underneath, the shore would become a temporary no-go area in late summer. In the last decade the green carpet was thinning with less nutrients entering the system. Dumping of sewage sludge at sea had long halted and more sewage treatment reduced the nutrient load entering enclosed bays like Belfast Lough and Dublin Bay. This and local authority seaweed removal efforts saw a drastic drop off in public complaints, until *Ectocarpus* a brown opportunistic sea weed became prevalent around Bull Island.

Rural: Most public complaints of green seaweed carpets came from Courtmacsherry where huge Ulva specimens were growing. Consistent green algal carpet reports but with less public attention were reported from the Boyne Estuary, Rodgerstown estuary, Bannow Bay, Tramore Back Strand and Tralee bay. Here a mix of nutrient sources between agriculture, resorts, and landfill were contributing to the green macro algal blooms. The most recent 2016 survey reports of green algal carpets on Honeycomb reef priority habitat in the Waterford estuary directly below high nitrate field discharges is new and of concern.

4.3. INFLOWS

4.3.1. Characterisation of inflows discharging from land into the coastal environment

In the autumn 2016 Coastwatch survey, volunteers reported coming across 491 inflows as they walked 525 survey units. Autumn 2016 was drier than normal and this is likely to account for a slightly lower number of inflows per survey unit compared to the previous 4 years. The typical Irish ~ 1 inflow per survey unit count is much higher than that in most other European countries.

As shown in figure 4.3 over a third of the inflows (36%) were described as 'pipes' when entering the shore. From surveyor comments, this category includes some culverted streams though, as these enter the shore after passing under a road or lane. Stream bridges at the shore are vulnerable to erosion damage and may then be replaced simply by a concrete pipe. The next most frequent inflow category was water seeping in from land (22.6%) Seepage may enter above the shore such as a cliff face, or bubble up the splashzone or in the intertidal. Streams and rivers (which the surveyors had to cross rather than walk up along) made up 21.4% of the inflows and drains 20%.

To get a rough impression of size, surveyors were asked to class the inflow as small, medium or large. In all categories 'small' was the most common or joint most common inflow description.

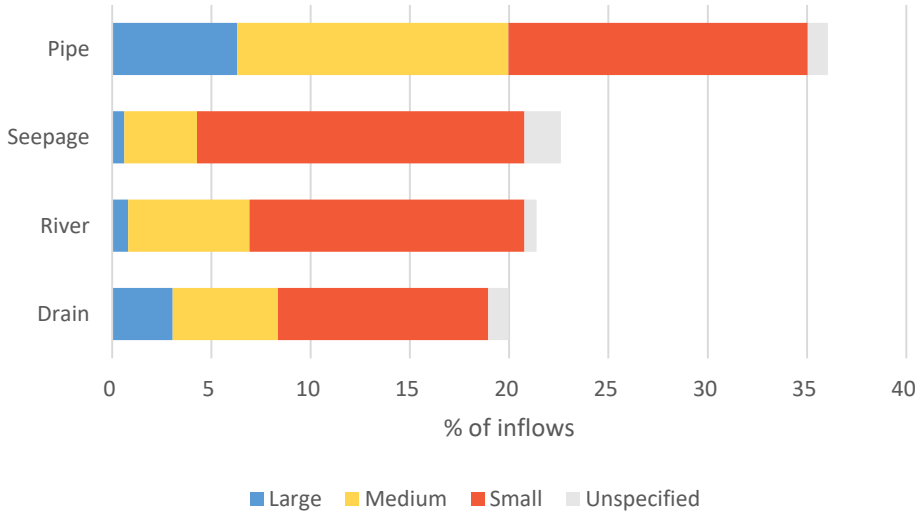


Figure 4. 3 *Percentage of inflows by type and by size in Republic of Ireland and Northern Ireland. N=491 inflows.*

Picture 4. 3 *(1) Pipe; by Ruth Ring (2) Seepage; by Alan Deacon (3) Stream/river; by Polly Dollan (4) Drain; by Brian Mac Suibhne*

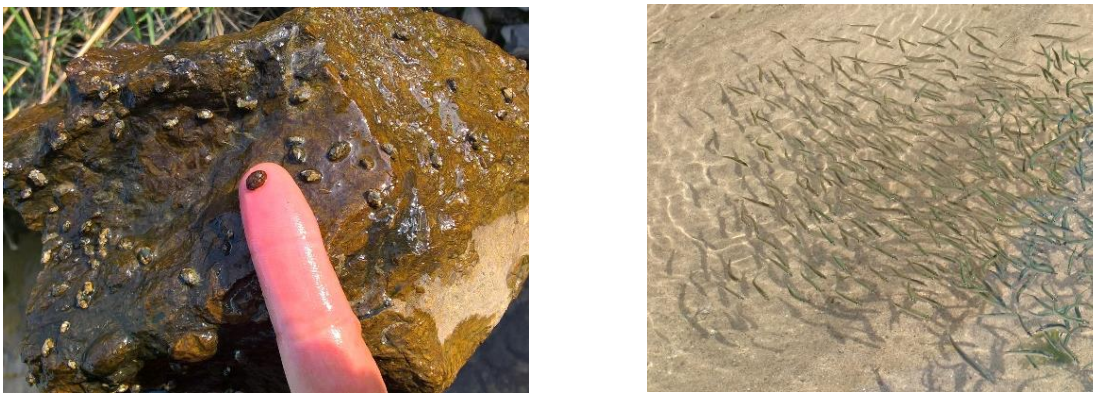
4.3.2. Inflow health and pollution signs

Surveyors undertook a visual and olfactory check of the inflows they encountered, looking for water quality indicators animal life, bad smell, discoloration, dead fish, dumped waste, sewage, oil and invasive alien species. Figure 4.4 below shows these good and bad quality indicators from most to least frequently reported.

Good Quality Signs

Animal life was the most frequent quality indicator reported (46 inflows). It may seem surprising that animal life was seen in only 10 % of inflows, but it must be remembered that surveyors only do a quick visual check of each inflow as it emerged from the hinterland or runs over the shore. It did not include kick sampling, netting or a targeted search for life as this would take too much time in a very full shore audit which is tide dependent.

Live fish were reported from 11 streams, 2 drains and 3 pipes, which are assumed to be drains or streams which were culverted as they entered the shore. For 2 inflows the type was not specified.



Picture 4. 4 *(i) Macro invertebrates on stone in drain; by Florence Lamouline. (ii) Shoal of sandeels in stream; by Alan Walshe.*

While this is valuable information, it is likely that a much higher animal life and fish presence would be recorded in a more focussed inflow survey. Such work has already started in Donegal where the Bredagh River Trust was formed headed by the Donegal regional coordinator Dr Trish Murphy. Subject to funding some exciting stream follow up action is planned for spring/summer 2017.

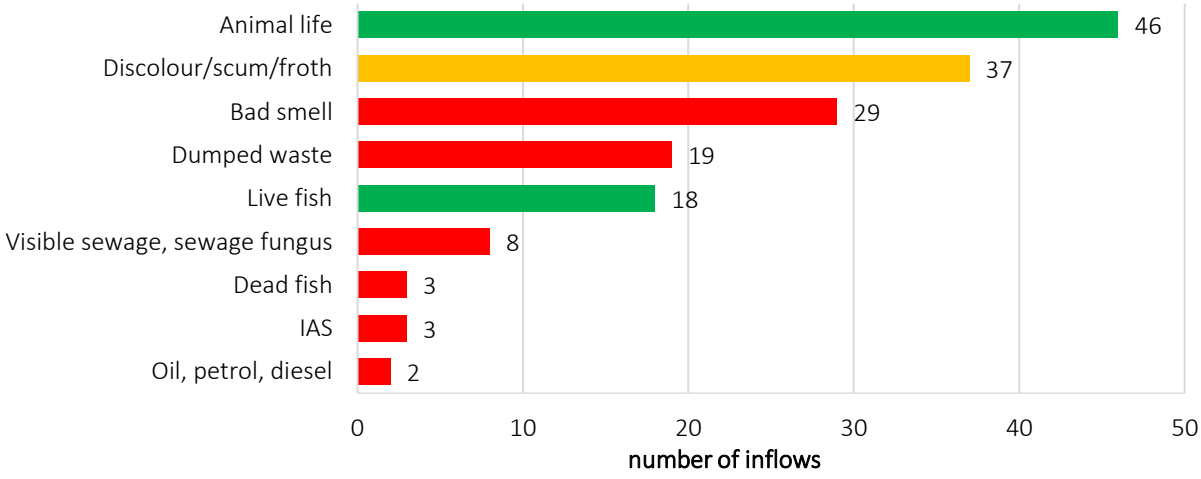


Figure 4. 4 *Number of inflows where a given quality indicator was reported (2016 Autumn Survey All Ireland; N=491 inflows)*

Bad and 'Of Concern' - Visual Signs and Smell

The most frequent potential pollution indicator noticed in 2016 was discolouration &/or scum/ froth reported from 37 (8%) of inflows (Fig 4.4) - mainly piped and stream discharges. This indicator also ranked first and in similar 7-10% of inflows over the last 5 annual surveys.

Picture 4. 5 *Plastic sheeting in a 'manky' rural stream*

Not all discoloration/scum/froth is recorded as a bad sign by local surveyors. If stream discoloration is put down to natural conditions e.g. transparent water with brown humic acid discoloration, as seen in the satellite image (4.7) it may not be reported as 'bad sign'. The same goes for temporary discolouration after a heavy shower. Where surveyors don't know the area or they also see foam or peaty materials in the stream bed, the scum and discoloration are reported more readily. Given that 2016 was a survey with more dry weather than usual, few of the 8% discolouration recorded are likely to be weather related. For several streams, photos were submitted but the surveyor name is withheld. For example, picture 4.5 taken in a remote area below a farm. The surveyor noted that there was natural discolouration, but the stream bed was scummy and littered; both where seaweed had been lodged by the tides and inland above that.

Picture 4. 6 *Humic acid rich discoloured river water visible from Google©*

Twenty nine (6%) of inflows were reported to have a bad smell. In 8 (1.8%) of those, surveyors noted visible sewage or sewage fungus. Again piped inflows were most frequently affected. Darach Ó Murchú's description of one in Kerry: 'the pipe was for sewage or grey water. It was blocked and broken and was intermittently spewing out discoloured water'.

Things have improved significantly - the 2000 survey results had sewage or sewage fungus report from 8% of RoI inflows and 3% of NI.

Picture 4. 7 *Broken pipe discharge; Darach Ó Murchú*

Dumped debris was reported from 19 (3.8%) of inflows. Five sources were mentioned in notes: -

1. Windblown, lost or abandoned waste entering streams and drip feeding into the coast.
2. A storm water overflow or sewage pipe provides a predictable source location for sewage waste - usually as an intermittent waste discharge. Wet wipe strings caught on sticks were mentioned for the first time - see photo front in chapter banner heading.
3. Waste washed out of riparian dumps from individual house, farm or landfill sites.
4. Waste dumped from bridges, piers and sea walls and lodged in inflows. In several areas especially Kerry this was mentioned as getting worse.
5. Marine litter from further afield washed up into a stream mouth in storms or spring tides as shown on picture 4.8.

Picture 4. 8 Marine litter washed up; photo by Florence Lamouline

Looking back, in the 2000 survey, dumping was the most frequent problem reported of all bad signs. Otherwise the rank order of bad signs stayed the same as in the previous 4 years.

Dead fish were reported from 3 inflows but with no comment. In one case it was later confirmed to be a single dogfish fish (marine origin) washed into the inflow as it made its way across the beach. The early silage making fish kills are over, but several surveyors have mentioned not seeing dead fish on the day, but being concerned about lack of fish when they knew the stream to be teeming with fish in the past.

Invasive alien species:

Survey reports of IAS included those seen on banks of inflows and in the water. Japanese Knotweed as seen in picture 4.9 (i) of the Ballymoney stream, Co Wexford has it growing right down to the water's edge. In Donegal, Trish Murphy noted: 'Japanese Knotweed is spreading down the Bredagh and the Redcastle Rivers'. The Global Invasive Species Programme categorises Japanese knotweed as one of the world's 100 worst invasive alien species.

Picture 4. 9 *(i) left: Invasive Japanese Knotweed on left bank of Ballymoney Stream. Co Wexford. Photo Paul Dubsky. (ii) below:, Zebra mussels in lock gate Grand Canal basin Dublin. Photo Rory Keatinge*

In autumn 2016 Zebra mussels were found and reported to IFI by Dave Tilly in the Dublin Grand Canal basin. The site was revisited as part of follow up work in March 2017 and zebra mussels were still present (see picture 4.9 ii). This area is right at the Dodder river mouth. Removal and a check to ascertain whether it has spread up that river was advocated by Coastwatch (See case study box on pages 40 and 41)

Oil pollution Oil was seen on 2 inflows – one ditch in the RoI and one small inflow with oily surface in NI. Both inflows were revisited with view to identifying the cause and addressing it. The RoI inflow from a farm still looked unpleasant with much silage wrap around the stream mouth, but on resurvey but there was no sign of oil pollution. This is an excellent result to celebrate.

Picture 4. 10 *Oil like shine, but cracking of surface shows this is not oil pollution but iron bacteria at work. Photo by Ellis Sheehy.*

In the past up to 4 % of inflows were reported to suffer from oil pollution. While some reports may have been false positives, where the natural iron oil bacteria - see picture 4.10 - were mistaken for oil pollution, there were certainly inflows carrying oil from garages, burst heating oil tanks and other sources. To weed out false positives, a special effort was made in 2016 training and guide notes to help surveyors to differentiate between oil/diesel/petrol which has a distinct smell and has oil swirling on water and the natural iron bacteria oil like film sometimes seen on seepage and pools, which cracks when disturbed by drawing a stick through it.

4.3.3. Nitrate concentrations in Inflows

Surveyors tested water for nitrite and nitrate concentrations in 177 (36%) of all 497 inflows they encountered in the 2016. No elevated nitrite levels were recorded, as expected. Nitrite quickly changes to nitrate once out in air and it is highly unusual at shore discharge points.

Figure 4.5 below shows nitrate concentrations in bands as read off the test kit chart. Nitrate level < 10mg/l are 'below detection' in the Merck Quantum test used and make up just over half of the water's tested. Another 10% reported a slight change of colour of the white NO_3 pad on their sampling stick. So taking the 2 first categories – 'below detection' and up to 10 mg/l NO_3 together, we see almost three quarters (74%) of all inflow waters tested were clean to moderately polluted.

However 17% had significant nitrate pollution of 25mg/l up to 49 mg/l NO_3. Another 9% were in breach of the nitrates directive's 50mg/l NO_3 limit and can be described as grossly enriched at time of survey.

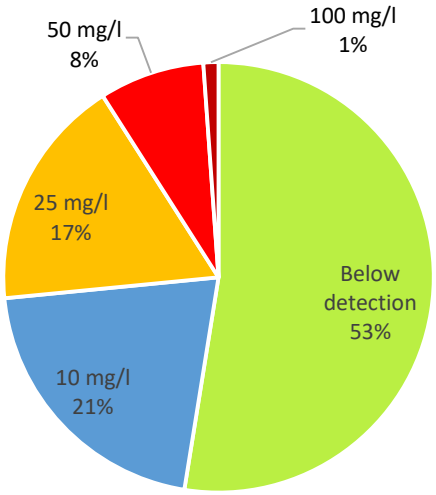


Figure 4. 5 *Nitrate level in inflows reported (2016 Autumn Survey All Ireland; N=177 inflows tested)*

Comparing inflow quality over the last 5 years, (figure 4.6 below) shows that the very high (>50 and even 100mg/lNO_3) records have made up 9 to 11% of inflows every year. Much larger annual variations were recorded in the 'below detection' and 'marginally polluted' inflow categories. The 2016 results include more clean streams than 2014 and 2015, but the results are not as good as 2012.

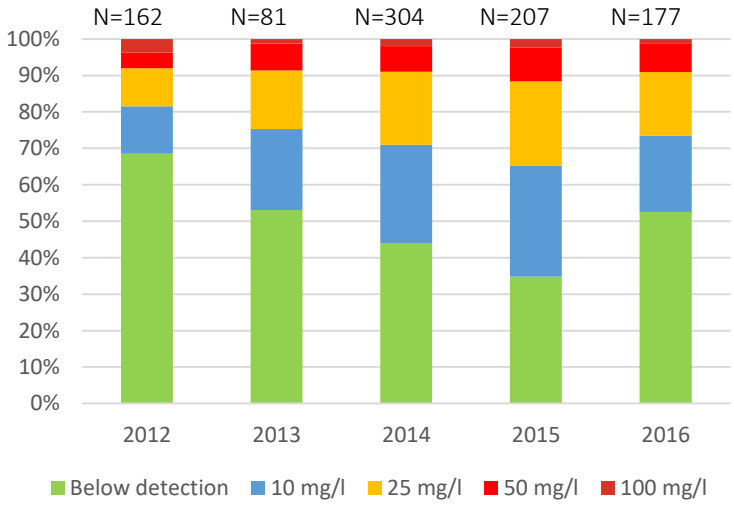


Figure 4. 6 *Nitrate level in inflows tested 2012-16. (Coastwatch Autumn Survey; N=number of inflows tested)*

Picture 4. 11 *Surveyors testing nitrates in seepage water from a broken drain in Carlingford Lough.*

In Fig. 4.7 overleaf, the nitrate levels recorded at the mouth of their inflows are mapped. The results show that nitrate pollution is not spread evenly, but that it is worst along the south coast. Further analyses would be needed to determine the contribution from land and farm and yard discharges and how many from urban, individual house and industrial discharges. Urban Dublin inflows tested had low-medium NO3 pollution. Horticulture hinterland N Dublin inflows didn't breach 50mg/l NO3 for the first time in 4 years.

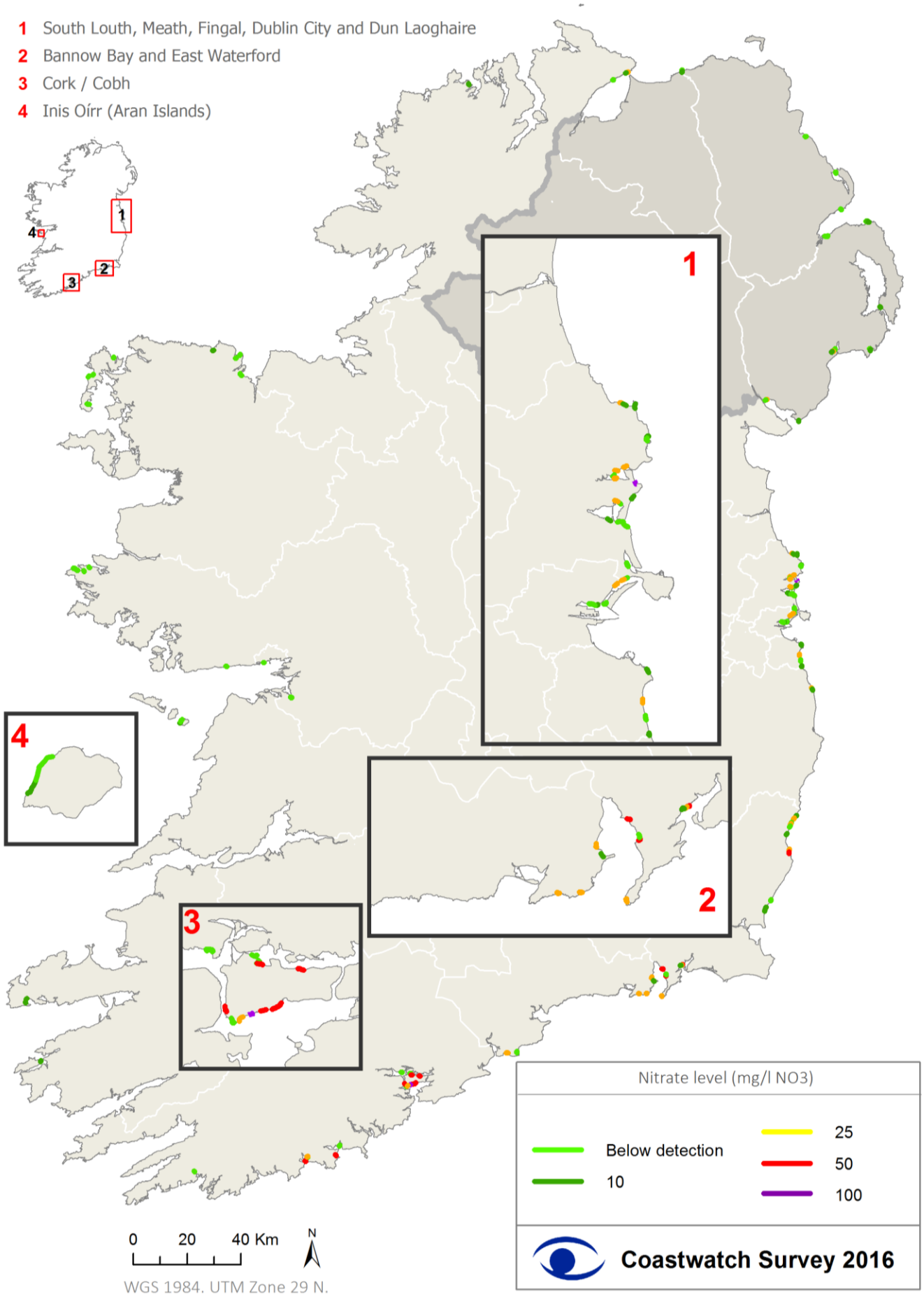


Figure 4. 7 *Nitrate Levels in inflows tested in the autumn 2016 Coastwatch survey (N-177)). Where several inflows were tested in one survey unit, and results were different, (in 2 cases) the worst result determines the colour shown.*

In Map (Figure 4.8) below test results are summarised in three pie charts, comparing the nitrate levels of east, south and west coast inflows. Comparisons show the 'below detection' or 'marginally raised' nutrient content in almost all west coast inflows, contrasts with the worrying enrichment levels in over half of the south coast and 30% of east coast inflows tested.

Picture 4. 12 *Cattle on sloping field in Co Cork .Name withheld*

Picture 4. 13 *Stream discoloration can be caused by natural humic acid and has nothing to do with nitrate levels Photo by Polly Dollan*

While this is a small sample size and it represents only an autumn snap shot check of inflow water nitrate levels as they enter transitional or coastal waters, these results are similar to those obtained in autumn inflow tests carried out by Coastwatch surveyors over the past five years, especially as to percentage of inflows with high nutrient levels. The period covers most of the third Nitrate Action Programme to control pollution from agriculture and our surveys include both dairy, tillage and horticulture areas.

From Coastwatch survey data of nearly 1000 small inflows into transitional and coastal waters on the island of Ireland over the last 5 years we can conclude that the west coast continues to be of high quality but along the south coast and pockets of the east coast, nitrate inputs are consistently too high.

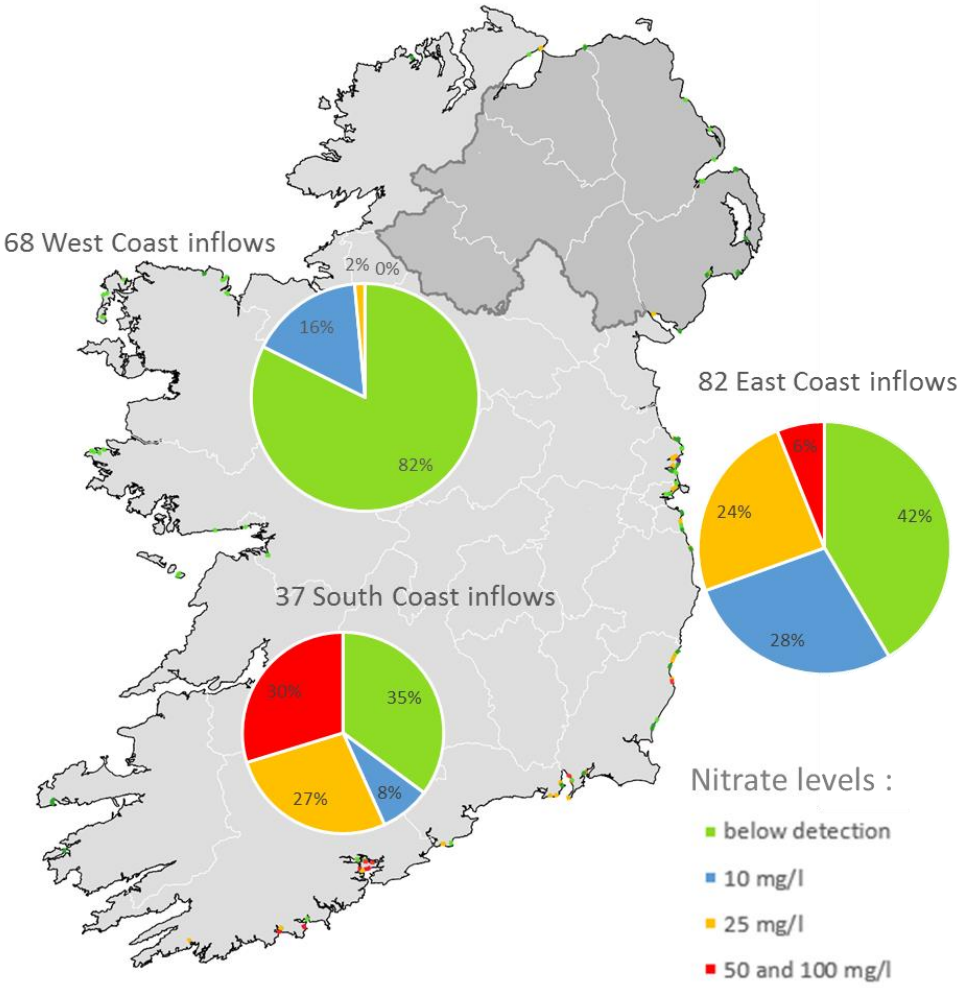


Figure 4. 8 *Inflow nitrate levels pooled by region where they were taken.*

4.4. Risk/Threat of Water Pollution

In question F4 surveyors are asked to consider whether there is any serious risk or imminent planned change for the worse to their survey unit. A tick list of risks and threats are provided as well as an 'other' option. The list is based on the threats surveyors first noted when this question was phrased as an open invitation to write your own list 20 years ago and is updated occasionally. Water pollution can be ticked as general risk, or by type of pollution with 4 options: sewage, oil, agricultural, and industrial pollution.

Figure 4.9(i) shows water pollution as the third most frequent threat mentioned. Eight percent of survey units were returned with this threat. When a pie chart is drawn to see the relative threat of different types of water pollution – see Figure 9.4(ii), sewage is still the most frequently cited type of water pollution, with 52% of surveyors who mentioned water pollution naming it. This was followed by agricultural pollution, chosen by 36% of surveyors with a water pollution problem. Most of the 6% of survey units where citizens had reported sewage pollution incidents as being 'frequent' or 'usual' (Figure 4.1 above) also indicated that water pollution was a serious risk to their waters. The 4 % who mention oil as a threat would have considered the pollution source to come from the sea or inflow.

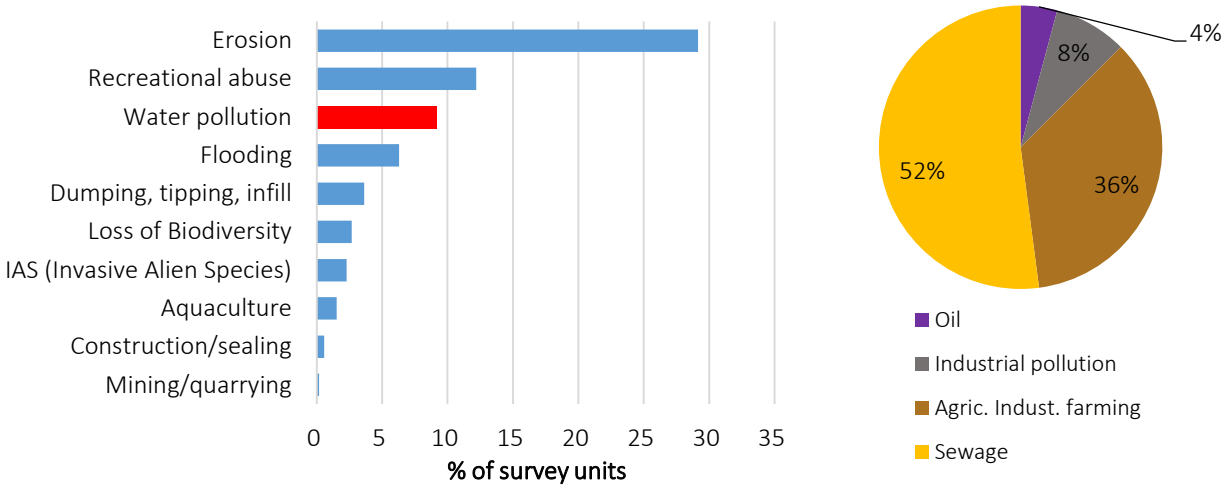


Figure 4. 9 *(i) Threats to the shore perceive by surveyors* *(ii) The threat of water pollution by type*

Results for 2016 in the context of the previous 4 years are presented in Figure 4.10 below. It suggests that the risk of water pollution is perceived by surveyors to be declining. The water pollution threat was reported for less survey units in 2016 than in any of the last 5 years.

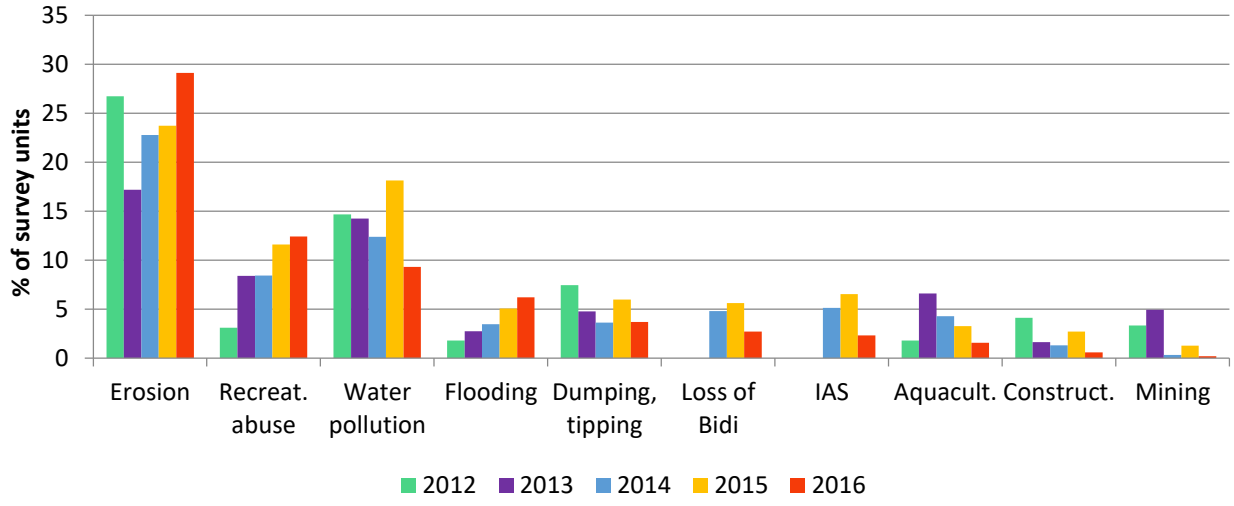


Figure 4. 10 *Surveyor opinions on what are serious threats or imminent risks to their coast, Coastwatch survey 2012 to 2016.*

4.5. COMPARISON OF COASTWATCH INFLOW DATA AND OFFICIAL COASTAL AND TRANSITIONAL WATER DATA

INTRODUCTION

While in NI the implementation of the second river basin management plan (rbmp) has commenced, the draft 2nd cycle for the republic and the cross border plan have just been published (March 2017) -see http://www.housing.gov.ie/sites/default/files/public-consultation/files/draft_river_basin_management_plan_1.pdf for public consultation. Coastwatch coordination would like to support readers to participate in the consultation. To this end extra effort is being made to compare Coastwatch results with official data this year. After a steady flow of queries, on how to access official information, to compare local Coastwatch inflow quality data with relevant official quality information, a Coastwatch access and understanding of official data hand out sheet has been prepared (see www.coastwatch.org).

The question readers should consider is whether a proposed measure as set out in the draft river basin management plan (rbmp) will be adequate to bring their area to 'Good' or 'High' quality status. Or, if of 'High' quality status now, to keep it there. If surveyors doubt that the proposed measures are adequate, it would be useful to set out what else is needed. The consultation is open until end of August 2017.

There is a wealth of information on water quality on the government water website in the draft plan and on www.catchments.ie. But two issues need to be highlighted before embarking on any comparisons: The first is timescales. The online nutrient and ecological quality information is based on sampling carried out 5 to 10 years ago. This contrasts to speed at which bathing water quality information is made available – i.e. within 2 weeks of determination. The second issue is sampling point locations. When citizens search the catchments maps to find out what is known about water quality in their area, or they want to check their own data against published data, they realise that the small inflows they have tested are often not tested or even shown on official maps.

As example, figure 4.11 below sets out the official Cork harbour water quality status and shows where discharge licenses have been granted as star symbols. But the map does not show any data corresponding to the 13 inflows our surveyors found and tested in Cork harbour. As the nitrate concentrations in 6 of those Coastwatcher surveyed inflows were breaching nitrate directive 50mg/l NO_3 limits, this is of concern.

Figure 4. 11 *(i) Official Cork Harbour ecological water quality (where green is good and yellow is moderate and (ii) Coastwatch surveyor inflows tested for nitrates with red and purple breaching the 50mg/l NO_3 limit.*

4.5.1. Nutrient flow: Coastwatch inflow data and receiving water quality

How much do small inflows contribute to nutrient enrichment of transitional or enclosed coastal waters? We simply don't know. Where many small inflows discharge into a shallow bay or estuary with habitats suitable for development of nutrient hungry opportunistic algae, the role may be significant, for example on *Zostera* sea grass health or even survival, as eluded to in chapter 3.

Some exploratory work linking inflow quality, as determined in the Coastwatch survey, with receiving water quality is presented below.

The online EPA water quality status map (Figure 4.12) below, depicts latest information on coastal water nutrient status and is based on the EPA's 2010-2012 assessment cycle. The 4 point quality scale used is: 'unpolluted – intermediate – potentially eutrophic – eutrophic', leaving some remaining areas as 'unassigned'. As one can see, unpolluted (blue) waters form an outer open coastal water quality band, while any high nutrient levels (reds and oranges) are dotted around inshore enclosed water bodies, where most human activity is concentrated and rivers discharge. Numbered rings were added to the EPA map to compare their coastal water quality to clusters of Coastwatch surveyor inflow nitrate test data.

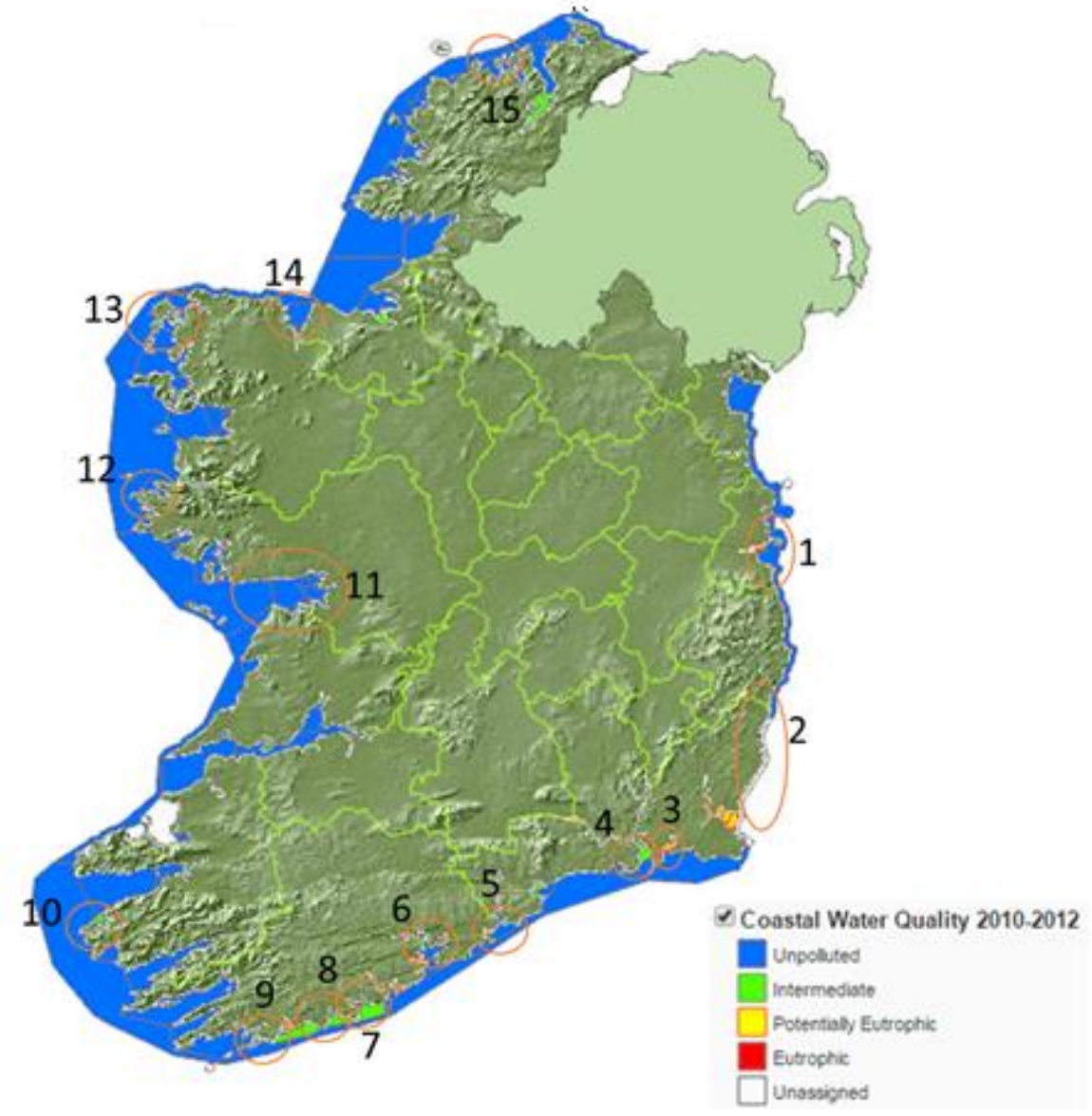


Figure 4. 12 *EPA Water Quality -nutrient status of transitional and coastal waters (Source: gis.epa.ie/Envision) with 15 added Coastwatch inflow NO_3 test clusters (autumn 2016 survey).*

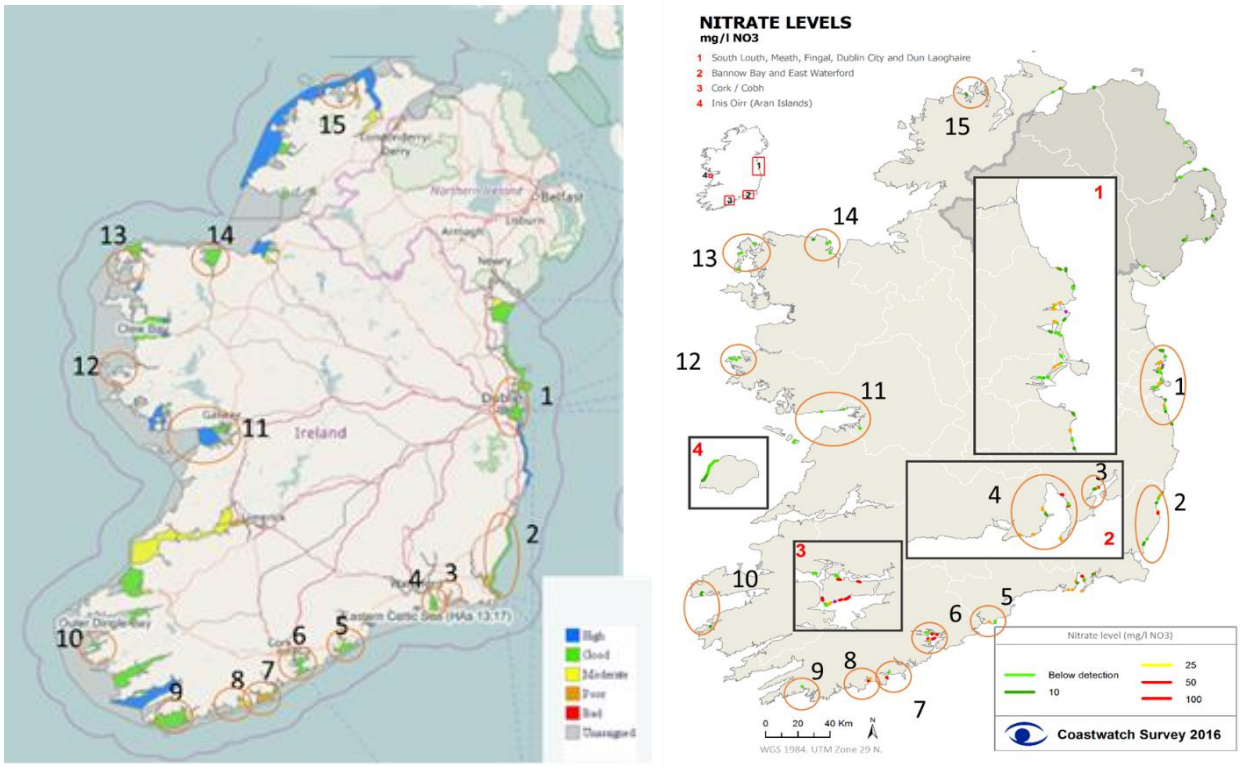


Figure 4. 13 *(i) EPA Ecological Water Quality of transitional and coastal waters (Source: www.catchments.ie/maps/) and (ii) Coastwatch inflow NO3 sampling results in 15 clusters (autumn 2016 survey)*

Figure 4.13 (i) above left shows another EPA quality map, this time the coastal and transitional water ecological status, based on official monitoring 2010 - 2015. Apart from using a 5 rather than 4 point scale (high, good, moderate, poor and bad) this assessment takes a larger range of parameters into account than the nutrient map. In keeping with WFD requirements, if one parameter is below standard, it pulls the whole water body ecological quality classification down. The map shows that our transitional and coastal ecological quality status (2015) is not as good as the earlier (Figure 4.12) nutrient quality map.

Figure 4.13 (ii) shows the Coastwatch nitrate test results again to facilitate comparisons of the 15 survey cluster areas, where Coastwatcher tested inflows.

In figure 4.14 (table overleaf), we look at each of the 15 Coastwatch sampling clusters in more detail, setting out receiving water nutrient status (2012) and ecological quality (2015).

Results:

All Irish Sea and south coast clusters included some inflows where Coastwatchers reported high nitrate levels. These inflows were entering receiving waters of mixed quality status. In contrast west coast clusters from Valentia to Sheephaven had low nitrate concentration in inflows and these inflows entered transitional and coastal waters which were officially deemed to be of high status. It suggests that things just haven't changed. High quality coastal receiving waters are not being compromised by increased nutrient load, but areas which needed to be improved are still being fed with high nitrate water in 2016. As word of caution regarding high quality, green algae carpets were recorded on the west coast too. A Coastwatch summer 2014 survey of >200 inflows in the SE revealed high nutrient levels in inflows around bathing resorts. The levels dropped at the end of the tourist season.

It would be useful to carry out a summer follow up nitrate test sweep around all areas where green seaweed carpets were reported and recheck inflows with 'bad signs' including IAS while there. In terms of the tourism offer, a special 'Wild Atlantic Way High Water Quality Status' attribute could be highlighted, with the few raw sewage discharge problems and bathing waters of poor quality clearly set as exceptions.

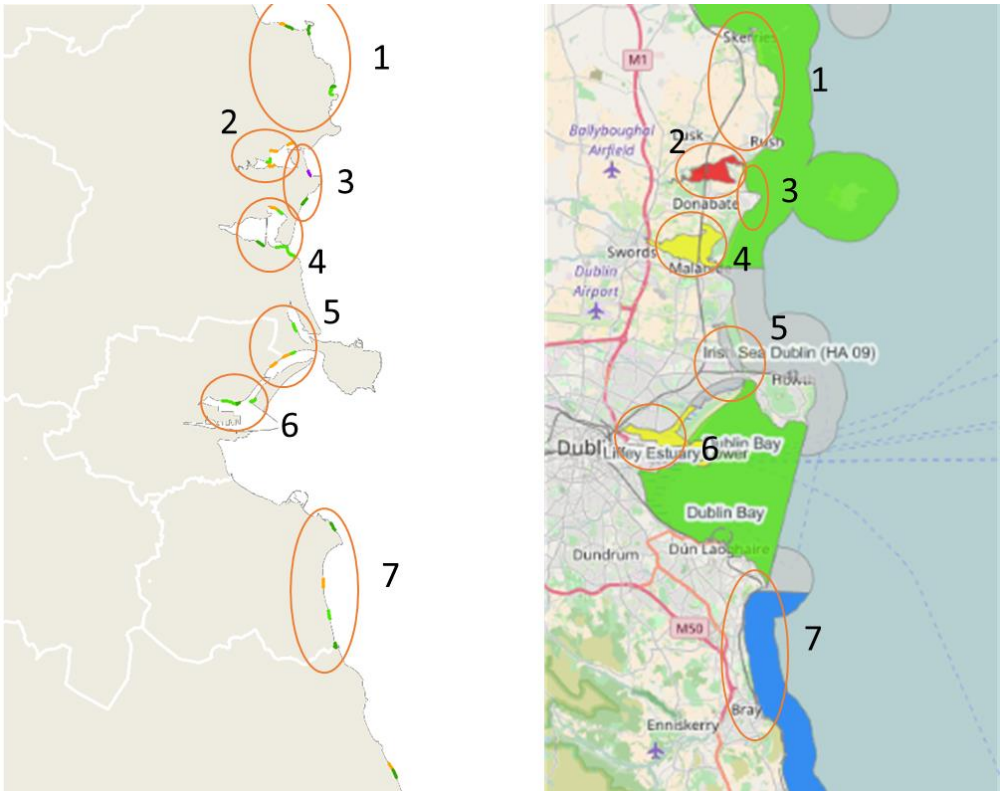
COASTWATCH INFLOW TEST CLUSTERS	Nutrient status map 2012	Ecological quality catchment state 2015	Coastwatch inflow nitrate (NO_3) concentration 2016	Comment
1. Greater Dublin, mainly biosphere coast.	Several status divisions from unpolluted to eutrophic	Good and High	Mix below detection to 1 highest 100mg/l see map 4.13 below	Coastwatch mirrors official nutrient status. Opportunistic alga blooms. Prioritise N2000 & Biosphere
2. N. Wexford coastal waters	Unassigned	Good	Mix from below detection to > 50 mg/l	Strong currents but local pollution concerns: Bad sign inflows into bathing waters
3. Bannow Bay	Potentially eutrophic	Unassigned	Mix from 10 mg/l to > 50 mg/l	Prioritize for further work as shellfish w and N2000 site with many small inflows
4. Waterford Harbour	Intermediate	Good	Mix from 10 mg/l to > 50 mg/l	Localized action required. Surveyors noted Sabellaria reef in poor status where covered in green algae
5. Youghal Bay	Unpolluted	Good	Below detection [1], 25 mg/l [1]	Inflow and good status match, but some raised N.
6. Cork Harbour Different areas	Unpolluted and Intermediate	Good	Mix with serious pollution (see more detailed figure 4.15 below)	Some serious inflow pollution into what had been unpolluted waters. Research into sources urgent.
7. Courtmacsherry Bay	Intermediate	Poor	Mix from below detection to > 50 mg/l	Requires better nutrient management! Small inflows contributing to load
8. Clonakilty Bay	Eutrophic and Intermediate	Moderate	Mix from below detection to > 50 mg/l	Requires better nutrient management! Small inflows contributing to load
9. Roaring Water Bay	Unpolluted	Good	25 mg/l [2]	Concern so recheck. One of few west coast inflows with raised nitrate levels
10. Valencia Harbour	Unpolluted and Intermediate	Good	10 mg/l [3]	Inflow N levels mirror official status, where assigned Areas which have inflow N below detection and are officially unpolluted/high quality should be celebrated and protected
11. Galway Bay	Unpolluted	Good and High	Below detection [5], 10 mg/l [1]	
12. Ballynakill Bay	Unpolluted	Unassigned	Below detection [4]	
13.	Unpolluted	Good	Below detection [4]	
14. Killala Bay	Unpolluted	Good	Below detection [3], 10 mg/l [1]	
15. Sheephaven Bay	Unpolluted	Unassigned	10 mg/l [2]	

Figure 4. 14 *Table of surveyed coastal areas with official nutrient status (EPA 2010-12 data), ecological water quality status (2010-2015 data) and inflow nitrate levels (Coastwatch 2016 data).*

A closer look at the maps for the Greater Dublin area (Figure 4.15) and Cork (Figure 4.16) shows that ironically inner estuary inflows discharging into enclosed coastal waters tended to be more polluted than those at the open coast where it didn't matter as much, as the dilution would be greater.

The officially unassigned quality area of Bull Island lagoon north, which also suffered from large green algal blooms as in previous years, had several raised nitrate inflow test results. The cumulative impact of many small inflows discharging into enclosed areas like Bull island lagoon, is unknown. This urban area also receives aerial inputs of nitrogen oxides from car exhausts, which may also be a significant contribution.

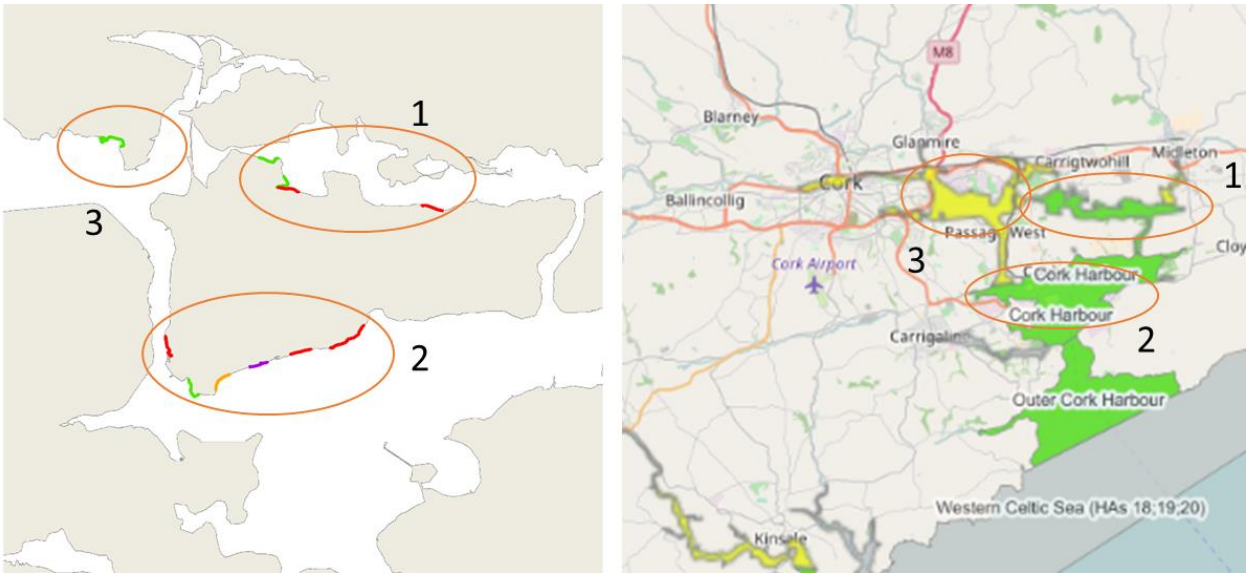
In the case of Rogerstown, the estuary was already classified as eutrophic and at risk in 2015 based on 2010-2015 data. Since then we have seen a loss of large areas of mussel beds which would have filtered out nutrients and no evidence of a reduction in inflow nutrient levels.



	Low						High
MAP AREA	1	2	3	4	5	6	7
Coastwatch N tests 2016							
Ecological status EPA 2015	Good	Bad	Good	Moderate	Unassigned	Moderate	High
Nutrient status EPA 2012	Unpolluted	Eutrophic	Unpolluted	Intermediate	Eutrophic /unassigned	Potentially eutrophic	Unpolluted

Figure 4. 15 *Comparison of Greater Dublin Area Coastwatcher nitrate test results autumn 2016 on map and pie charts for 7 sub areas, with official EPA ecological status and nutrient status (2012) maps.*

Zooming in on the Cork data (figure 4.16 below), a more worrying picture than for Dublin emerges, for nitrate inputs into Cork harbour North shore in particular. With the receiving water deemed of good ecological quality, but surveyors recording a mix of nitrates from below detection to > 100mg/l NO_3 and green seaweed carpets on mudflats in several areas. The string of inflows tested in cluster 2 in map 4.16 below had more breaches of the nitrates directive 50mg/l NO_3 than recorded anywhere else. This area should be prioritised for further study to see if this was an unusual peak – such as first rain after a dry spell washing in high nitrate concentrations, or whether it is a more persistent problem.



MAP AREA	1	2	3
Coastwatch nitrate 2016			
Ecological status EPA 2015	Good	Good	Moderate
Nutrient levels EPA 2012	Intermediate	Unpolluted and intermediate	Intermediate

Figure 4. 16 *Comparison of Cork Harbour Coastwatcher nitrate test results autumn 2016 with official EPA ecological status and nutrient status (2012) maps for the same area. The table shows Coastwatch results summarised into pie charts for 3 sub areas.*

4.5.2. Designated Shellfish area

Designated shellfish areas are to ensure good quality waters for shellfish aquaculture and harvesting from the wild. 'A' quality waters authorise harvesters to sales of bivalve shellfish for direct consumption, while 'B' requires some purification and 'C' significant pre-treatment. Government - in our case the Marine Institute - test shellfish in these areas for phytoplankton and E coli faecal bacteria indicators before they can be put up for sale.

Filter feeding shellfish harvested commercially, like mussels, require nutrients and may benefit from some enrichment. But eutrophic waters cause problems with green algae fouling surfaces and bottom sediments may become anaerobic. So nutrient inputs need to be watched and controlled. Additionally raised nutrient inputs may signal other problems, like insufficient sewage treatment, slurry or land spreading of manures with microbe and micro litter issues which could be critical for shellfish farmers.

In the Republic of Ireland, 64 areas are currently designated as shellfish waters (S.I. No. 268 of 2006, S.I. No. 55 of 2009, S.I. 464 of 2009). In this section, we look at nitrate inflow test data in 4 of the designated shellfish areas as mapped (Figure 4.17 below).The four areas are Bannow Bay, Waterford Harbour, Cork Harbour and Roaringwater Bay.

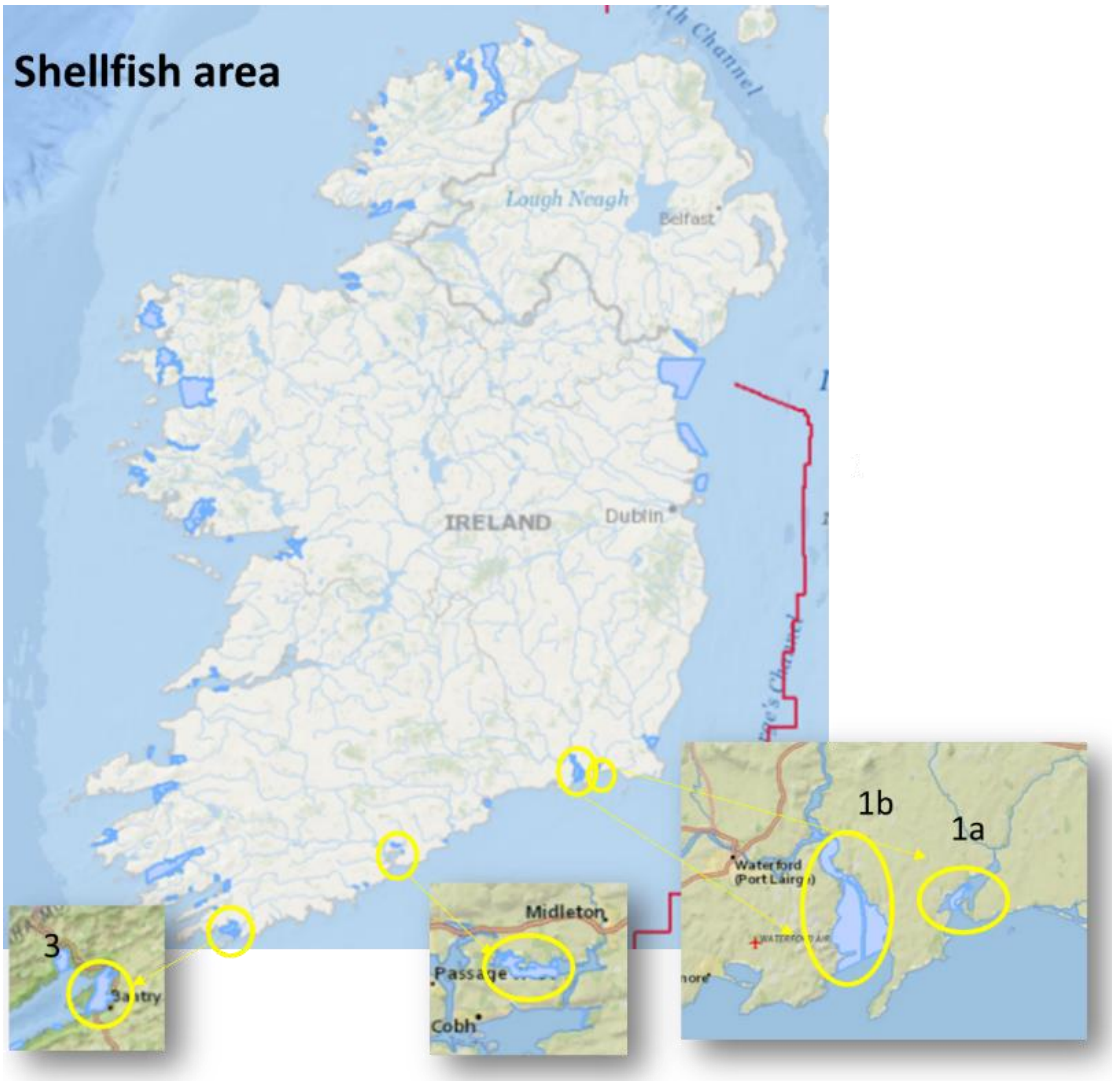


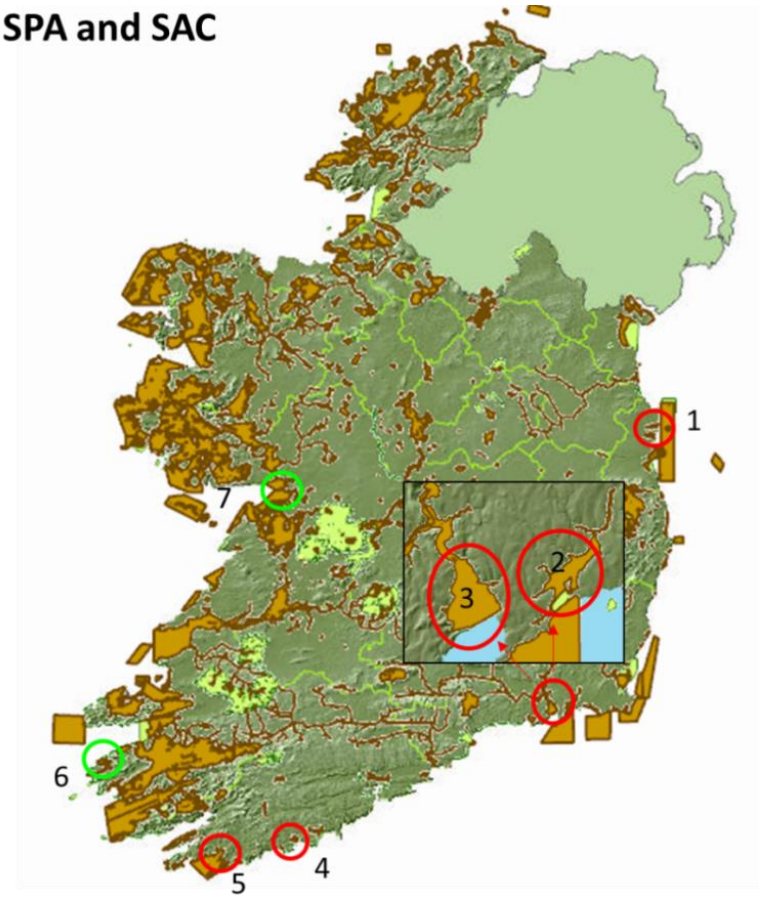
Figure 4. 17 *Shellfish Areas Republic of Ireland http://atlas.marine.ie/ and highlighted the 4 areas where Coastwatchers tested a number of inflows entering the shellfish water. In all some raised nitrate levels were reported, with levels breaching the nitrates directive 50 mg/l limit in Bannow Bay, Waterford Harbour and Cork Harbour.*

In all 4 at least one inflow tested had nitrate levels 25mg/l NO_3 or higher. Two of these - Bannow Bay and Cork North Channel - stood out as having several inflows with high nitrate levels. They are also among the 10 shellfish waters which did not meet the E coli guide value on several occasions between 2009 and 2015. Nutrient levels were also high in some of officially monitored inflows into these waters. For further information on shellfish waters see the Irish Marine Atlas http://atlas.marine.ie/

At present it appears that there is no official inflow surveillance for inshore shellfish waters in Ireland and that the equivalent to the bathing water risk profile is not required or produced voluntarily by aquaculture or wild harvest operators. It would seem useful to introduce such a system and to prioritise areas which are known to have problems.

4.5.3. Designated Natura 2000 areas

Marine Protected Areas, especially designated Natura 2000 sites (SPA and SAC), are to achieve high or good status water quality, depending on the features for which they are designated. Mapping Coastwatch inflow nitrate levels obtained in autumn 2016 shows 5 Natura 2000 sites which were subjected to high nitrate inputs of 25mg/l or more NO_3 as shown in red on figure 4.18 below.



	Natura 2000 Site included in Coastwatch survey, with raised nitrate levels in inflows	Nitrate in inflows mg/l NO_3 BD=Below detection
1	Rogerstown Estuary (SAC, SPA)	From 25 to 100
2	Bannow Bay (SPA, SAC)	From 10 to 50
3	River Barrow and River Nore (SAC)	From BD to 50
4	Clonakilty Bay (SPA, SAC)	From BD to 50
5	Roaringwater Bay and Islands (SAC)	25

Figure 4. 18 *Designated Nature protection SACs and SPAs; Source: http://gis.epa.ie/Envision with numbered red circles showing areas where surveyors detected high nitrate levels in inflows and green circles where inflows into Natura 2000 sites were not polluted; autumn 2016 Coastwatch survey.*

Discussion and Conclusion

Ireland is rich in rain and wetlands. There are more fresh water inflows coming from land into the sea as seepage, ditches and streams than in most other countries. These waters add to the diversity of coastal habitats and many of them are fish spawning and nursery areas and form otter highways. They add to our coastal beauty and attractiveness. Most of our designated bathing and shellfish waters sport one of more of these inflows. Children are attracted to these features and parents are known to place small children into lagoons formed by streams on summer beaches as the waters are calm and warm.

Coastwatch survey results highlight that water quality cannot be taken for granted. While animal life and fish were reported from almost one in ten inflows there were more inflow problems including sewage and other 'bad signs' especially litter and waste. Year after year around half of the inflows tested in our Coastwatch survey return elevated nitrate levels. When that is broken down by region, the west and north coast waters consistently produce the best results, while the occurrence of raised nitrate levels on the east and south coast is not improving. On mapping our results we see the reason why nationally Coastwatch nitrate results in 2016 appear marginally better than in the previous 4 years, is due to more testing of west coast inflows.

The 2016 EPA State of the Environment report summed up our water quality status as follows:

'Preliminary results indicate that there has been no overall improvement in water quality over the first river basin cycle (2009-2015). The target of a 13.6% improvement in the ecological status of surface waters (from the 2009 baseline) by 2015 was not achieved. Water quality improvements are required at approximately 50% of rivers, lakes and estuaries that are impacted by pollution or other pressures. The two main suspected causes of pollution in rivers are agriculture and municipal sources, accounting for 53% and 34% of cases, respectively.' (Page 12 in http://www.epa.ie/media/ExecutiveSummary.pdf)

When we compared maps of latest available EPA nutrient status and ecological quality data (for rivers, transitional and coastal waters) with our small inflow data, they generally match. The exception is Cork harbour where our test results flag very high nitrate levels which were not seen in the earlier EPA data.

There are shellfish aquaculture areas and Natura 2000 sites around Ireland N and S with a wide intertidal zone and steeply sloping coastal land, drained by short streams. If these are loaded with nutrients, it is a recipe for receiving water problems. Carpets of intertidal opportunistic seaweeds on less competitive species like sea grass (*Zostera*) are an issue; as is fouled aquaculture gear. When the opportunistic macro algae bloom is over, the die off phase produces toxic gases which can stress or kill marine organisms and the nutrients released back from decaying algae into the sediments will not make for good or high status waters. This automatically excludes some high end coastal uses like organic (EC organic standard) seaweed aquaculture.

Animals stocked on coastal land produce not only nutrients but also faecal matter, which can pose a contamination risk for bathing and shellfish waters. So hinterland and waters need to be monitored and managed to minimise that risk. Since autumn 2016 we have noticed a surge of effort by authorities to join forces and to inform and involve stakeholders. This goes particularly for the EPA and the Local Authority Waters and Communities Office (Lawco) which are spearheading public engagement. There is also an official outreach and acknowledgement of the value of citizen science, with the EPA catchment newsletter recently devoting an issue to it. The new draft National Biodiversity Plan lists citizen science monitoring support as an action and a first European Marine Board citizen science opinion is about to be published.

Weaknesses remain. Timely access to water data is assured for bathing waters, but a wealth of other water data is on local authority websites, but password protected and not available to the public. It still requires stamina to extract discharge license information from some local authorities and Irish Water!

A first attempt of putting Coastwatch inflow nitrate test results into context of official receiving water quality data this year was limited to using official data which was a few years out of date. However this first comparison still yielded valuable information and can be expanded upon - e.g. to focus on bathing waters.

Given the length of our coast and number of officials tasked with monitoring and enforcement, we argue that informed active citizen scientists are an essential complement to the work authorities do. Inflow and coastal water quality monitoring by citizens can flag problems which can inform own and local behaviour, can raise official attention, augment official monitoring and give some security to those who require dependable quality while harvesting from the wild, running a recreational or marine food business.

RECOMMENDATIONS

Water Recommendation 1: REDUCE NUTRIENT INPUTS INTO OUR ESTUARINE AND COASTAL WATERS

Coastwatch results showed an increase in opportunistic algae and the N load coming down inflows, especially on the E and S coast is too high. Food Harvest 2020 targets is further increasing cattle stocking density. More intensive use of farmland to provide enough fodder for these cattle, is adding more nutrients to estuarine and coastal waters which are already in trouble. At the same time continued loss of reed bed and willow thickets on stream banks, is reducing the natural nutrient sinks and buffers. While agriculture and is not the only source of nutrients, it is one which is increasing as cattle numbers increase. A review of this policy is urgently needed as well as opportunity for farmers to co-design a suit of measures in a given catchment to reduce the nutrient load and monitor whether the measures are effective.

Water Recommendation 2: RESOLVE SEWAGE AND INDUSTRIAL POLLUTION PROBLEMS FASTER.

The Irish Water time table for getting sewage treatment under way for the 36 estuarine and coastal locations where raw sewage is still discharging, appear too slow when one compares it with some standard treatment plant building schemes on the continent – e.g. Netherlands.

License applications for industrial discharges should follow set time scales like planning applications to avoid applications hanging in 'applied limbo' for several years, while the discharge is merrily entering our waters.

Water Recommendation 3: PUBLIC ACCESS TO INFORMATION AND REPORTING

Citizens should have access to the water data which is now password protected on official websites (with exceptions provided for as set out in the Aarhus Convention). If citizens comes across a suspect quality inflow, they should be able to check official data on line using www.catchments.ie to see:

- whether there is official monitoring of the inflow and if yes the quality from monitoring data.
- whether there is/are water pollution license discharges into that inflow and detail of same, no matter whether it is an IPC license, (where this information is already available on line), or a local authority or Irish water license, which at present has to be requested formally.
- who to contact and who shall and who could act to protect, license, enforce, monitor and lead pollution incident control, enforcement action and restoration – a 'WHO IS WHO IN THE COASTAL ZONE'

Water Recommendation 4: TRAINING TO USE ASSESSMENT AND REPORTING TOOLS

Coastal citizens could be credible partners helping to protect and restore water quality, getting and sharing data and making/sharing speedy alerts when water pollution problems arise. This requires recommendations 2 and 3 to be implemented and speedy upskilling of citizens. A skills exchange and support for stream and river bank restoration, as well as wetland construction to intercept sloping field run off should be introduced for land owners and Tidy Towns groups.

The EPA /local authority small stream assessment scheme should be extended to interested citizens. Fieldwork training for citizens in stream ecology sampling, ID of indicator and invasive organisms,

monitoring and reporting should be made widely available. For farmers in the hinterland of shellfish waters, bathing waters and Natura 2000 sites such training should be a funded course option.

Water Recommendation 5: DESIGNATED WATER QUALITY ASSURANCE

We should be able to expect Shellfish and Bathing waters, including the streams entering them, to be of good or high quality unless advised otherwise. To live up to that expectation we recommend:

5.1. Regulations to control activities in the watershed and immediate area of shellfish and bathing waters should be drafted similar to those for drinking water, where strict controls apply around water abstraction points. These legally binding conditions should include no spreading of septic tank or sewage treatment plant sludge and detailed control of invasive alien species. The Bathing water 'profile' model should be applied to Shellfish waters, to be aware of and control potentially polluting activities in the watershed.

5.2. Inflow monitoring schemes should be drafted for designated areas, by combination of citizen scientist and trained scientific staff, informed by the designated area profile. Water quality data is then published in a timely fashion using the bathing water EPA publication model.

5.3. Community alert systems to deal with water pollution and problems quickly and efficiently should be set up and supported. This needs to be tailored to the specific designed waters and watersheds and link those who depend on quality to those who hold a discharge license and to authorities. Any discharge license holder should be legally obliged to participate and to report problems, to avoid or minimise risk to human health or environment.

Water recommendation 6: QUALITY AWARD AND RECOGNITION

6.1. Where a coastal watershed reaches/maintains 'high' or 'good' quality, land and water way managers should be given recognition. Farmers should be rewarded with extra farm payments and eligibility for model area status as marketing support.

6.2. Recognition should also be given to citizens regularly assessing the quality of shores and inflows and contributing that data. Two ideas Coastwatchers would like to discuss to progress this are:

- extension of RoI 'Water Keeper' model which is already legally established, to citizen scientists;
- an All-Ireland coast and stream award certificate and lapel pin for those who are trained up as citizen scientists in this area and actively engaging in rbmp. They should also have access to free test kits and support, as well as an annual meeting to exchange information, extra training opportunities and celebrate water quality achievements.

A Background information on the 500 m survey unit & surveyor(s)

office use

A1 Country code | County code | Block code | Unit code

http://worldmap.harvard.edu/maps/cwsurveyunits

Scan me with your phone to see Coastwatch map

A2 **Name of survey unit or area**

Map name | Local name if different or landmark

A3 **Name and address of surveyor(s)/school/group**

Name (Please write ***very*** clearly!)

Address

Telephone | Email Please write ***very*** clearly!

A4 **Date of survey**

Day | Month | Year

For your privacy:
Would you like to be named as surveyor and results contributor?
☐ Yes ☐ No

A5 **How well do you know this site?**

☐ Well ☐ A little ☐ Here on 1st or 2nd visit

A6 **From present knowledge - is this unit (or part of) an officially designated area?**

☐ Yes ☐ No ☐ Don't know

A7 **If yes, tick which nature &/or human use designations/permits apply:**

- ☐ (UNESCO) Biosphere Reserve
- ☐ Ramsar Site
- ☐ Natura 2000 site (SPA &/or SAC)
- ☐ National Park
- ☐ Other Nature designation.....
- ☐ 'Bathing Water'
- ☐ Shellfish areas (aquaculture or wild harvesting)
- ☐ Access for vehicles (e.g. shore route to fields)
- ☐ Other use designation or permit including boat mooring .....

Any comment on shore use (specially traditional uses? .....

.....

A8 **Is there direct access to your coastal unit from land down to high water?**

☐ by vehicle ☐ by foot ☐ by wheelchair **Also please tick if:-**

☐ Access is prohibited* ☐ Access is difficult or impossible going direct from hinterland to shore*

** If access is prohibited or difficult, but you managed anyway, add a note in F6*

B Land and Inflows

B1 **What is the immediate hinterland mainly devoted to?**
(Tick up to five boxes if necessary)

- ☐ **Farmland**: Intensive grazing
- ☐ **Farmland**: Tillage, horticulture
- ☐ **Farmland**: Rough grazing
- ☐ Park, woodland, forest
- ☐ Dunes
- ☐ Wetland (bog, marsh, lagoon)
- ☐ Rock or other bare natural sediment
- ☐ Village or town residential
- ☐ Tourist resort
- ☐ Waste tip/dump (official and unofficial)
- ☐ **Industry, commercial** area, or power station
- ☐ **Transport**-> tick: ☐road ☐train ☐carpark ☐harbour.
- ☐ Construction site
- ☐ Other: please state: (e.g. golf course) .....

NB - Extra Coastwatch harbour Qs available

B2 **Please count all inflows into your s.u. as you walk. Give details of up to 4 inflows in the order encountered. If there are more than 4, choose the most important in terms of potential pollution impact.**

Information on inflows as encountered – or important ones:	Inflow 1	Inflow 2	Inflow 3	Inflow 4
Type: **'P'** for **P**ipe, **'S'** for **Seepage**, **'D'** for **D**rain, storm drain or irrigation canal, **'R'** for **R**iver, stream or lagoon exit.				
Size: S **S**mall, M **M**edium, or L **L**arge				
✓ **Tick if you observe (add comments in F6):**				
Animal life in/on inflow water (**add F if you see live Fish**)				
A bad smell from the inflow				
Discolour/scum/froth (possibly from pollution)				
Dead Fish				
Dumped waste				
Visible sewage &/or sewage fungus &/or sewage/sanitary litter				
Oil, petrol or diesel				
Invasive Alien Species - **'W'** for water or **'B'** for banks around the inflow (see Coastwatch IAS poster)				

If you have access to test kits please complete for those tests you managed to carry out on an inflow:

Inflow water:	Inflow 1	Inflow 2	Inflow 3	Inflow 4
Did you detect **Nitrite**? NO_2	+ or -	+ or -	+ or -	+ or -
What **Nitrate** (mg/l NO_3) levels did you find?				
What is the Inflow Water **temperature** (C)				
How acidic or basic is the water? The **pH** is:				

The Total Number of Inflows counted in the survey unit was: ☐
(Include active and intermittently active inflows like storm drains)

B3 **If you know the survey unit well, please estimate frequency of sewage pollution incidents**
(This is focussing on water of your survey unit. Think of advice if a visitor was to swim or eat shellfish)

☐ Never ☐ Rare ☐ Occasional ☐ Frequent ☐ Usual ☐ Seasonal

Comment?.....

C SPLASH ZONE (The shoreline from mean high water up to land- spring high watermark)

C1 **Indicate the approximate width of splash zone.** (Tick several widths if area is not uniform)

☐ 0-1m ☐ 1-5m ☐ 5-50m ☐ 50-250m ☐ > 250m (estimate with big steps)

C2 **What is your splash zone covered in?** (Tick up to five boxes)

☐ Salt Marsh ☐ Sand, Gravel, Stones ☐ Building Construction (**not** erosion control)

☐ Reed Bed ☐ Natural Rock/boulder ☐ Hard erosion control (walls, rock armour)

☐ Dune ☐ Cliff ☐ Soft erosion control (man-made e.g. bank)

☐ Other plant cover habitat (e.g. bog or field) .....

D INTERTIDAL (From low to high water) *+ see Extra Questions end page*

D1 **Estimate the average width of the intertidal area at low tide.** (If width varies, tick all that apply)

☐ < 5m ☐ 5-50m ☐ 50-250m ☐ > 250m

D2 **What is the intertidal surface composed of:** (Tick max. four boxes)

☐ Solid rock ☐ Sand

☐ Boulders (>20cm ø) ☐ Silt or mud

☐ Gravel (0.2 – 20cm ø) ☐ Other (e.g. walls, infill, road)

D3 **Which of the plants and seaweeds did you find in the intertidal&/or splashzone?**

Check ID notes, extra pilot questions page available for Ireland + UK see web.

☐ Glasswort (*Salicornia*) ☐ Brown and/or red seaweed growing

☐ Cord grass (*Spartina*) ☐ Green seaweed: patches or thin band

📷 ☐ Sea grass (*Zostera*) ☐ *growing* ☐ *swept up* ☐ Green seaweed: carpet cover or thick mats

☐ Other of note:..... ☐ Dislodged decaying seaweeds of any kind

D4 **Any new or recent species of animal, plant, or seaweed which appeared or spread in this area?**

☐ Yes ☐ No ☐ Don't know Note?.....

If yes it could be climate change related southern species extending North, or an invasive alien species (IAS)

D5 **Indicate which of the animals listed below you found alive or dead –** see ID notes

Animal	Alive	Dead
Jellyfish		
Sea anemone		
Worms + casts		
Molluscs/seashells (empty shells = dead)		
Barnacles		
Crabs		
Sea urchins		
Starfish		
Fish		

Animal	Alive	Count (or estimate)	Dead	Count
Seabirds				
Seabirds with oil				
Seals				
Dolphins or Whales				
Rats				

Noteworthy good and bad - e.g. unusual amount of dead animals swept up?

E LITTER, WASTE AND POLLUTION (at all shore levels)

If near a harbour, see harbour survey form

E1 **Tick major item(s) found on your survey unit anywhere from start of hinterland to water**

Give any extra information in F6, take pictures if possible and note location if this requires follow up work.

☐	Landfill Materials (e.g. concrete, rubble, debris from sea defences, demolition…)
☐	Abandoned Vehicles, Girders, Machines
☐	Household furnishings (e.g. beds, carpets, pieces of furniture etc.)
☐	Dumped household refuse in bags or piles of rubbish
☐	Ship wreck, or parts of ship wreckage
☐	Tyres. Please count if more than 1 → ☐ ☐
☐	Aquaculture trestles and other large abandoned aquaculture gear
☐	Other. Please Specify:

E2 **LITTER count: Drinks containers and other items found anywhere on the shore.**

ALERT! Coastwatch count changes. You can count **the first 100m** of your survey unit or the **full 500m.**

See why in guide notes. **If numbers are too large, just estimate. If a category is not counted mark NC.**

Drinks Containers:	Count	Other select Litter	Count
Plastic Bottles		Bottle Lids	
Metal cans		Plastic Shopping Bags	
Glass Bottles		Lighters	
Cartons/Tetrapack		Other:	

Please tick: The litter count above is for: the whole 500m s.u. ☐ **just first 100m** (from s.u. start or end) ☐

E3 **Tick which of the following items of general litter or pollution you found on your unit.**

☐ Fishing or aquaculture gear; tick source(s) → ☐ Traps ☐ Nets ☐ Aquaculture ☐ Angling

☐ Rope and String

☐ Hard Plastic containers like crates, buckets

☐ Foamed Polystyrene

☐ Sanitary waste, cotton buds, condoms, nappies

☐ Medical Waste - **syringes, plasters …**

☐ Container(s) of hazardous but not medical substance (e.g. chemical drums empty or full)

☐ Other plastics (not any of above, e.g. crisps)

☐ Tar, oil, petrol. If found, add note in **F6.** If serious, contact authorities & Coastwatch.

☐ Textiles, shoes, gloves and clothing

☐ Paper, cardboard and worked wood

☐ Food, fish waste and bones

☐ Faeces - mammal (e.g. dog, human)

☐ Glass (**not drinks**), including light bulbs

☐ Cans (**not drinks**), including sprays,

☐ Other (e.g. wax, dog poo in plastic bag): .....

.....

E4 **Meso & Micro litter pilot:** Is there an area where you see **tiny litter** threads, bits, beads?

☐ Yes ☐ No **If yes**, could you try to use our **pilot micro litter app**? www.coastwatch.org/europe/microlitter

E5 Looking back, **which area was most littered?** If several, tick more than one.

☐ Splash zone ☐ Tide mark ☐ Intertidal ☐ Sea

Was that litter: ☐ accumulating in area(s) or ☐ was it spread more or less evenly?

THANK YOU!!! All the nasty litter stuff done. Onward to the last page of the main questionnaire …

F GENERAL OBSERVATIONS

F1 **Has recent weather made the appearance of your coastal unit change?**

☐ Yes, looks cleaner than usual ☐ No, recent weather is insignificant

☐ Yes, looks worse than usual ☐ Don't know

If there are other reasons for changed appearance, please note space at F6 below.

F2 **Has the shore been cleaned within the last week?**

☐ Yes ☐ No ☐ Don't know

F3 **Is there any planned change of character (positive or negative) which is imminent for this coastal unit?** (If 'yes' describe in F6)

☐ Yes ☐ No ☐ Don't know

F4 ***Tick* if you have evidence of a serious risk and/or imminent planned change for the worse from any of the threats/activities listed below to your s.u. or adjacent sea/land.**
If there are any other threats please note in F6.
ACTION: In case of threat which requires immediate action, call relevant authority or Coastwatch

☐ Erosion
☐ Flooding
☐ Mining/quarrying
☐ Construction/sealing
☐ Dumping, tipping, infill
☐ Water pollution by → ☐ Sewage; ☐ Oil; ☐ Agricultural or industrial farming; ☐ Industrial pollution
☐ Recreational abuse
☐ Aquaculture
☐ IAS (Invasive Alien Species)
☐ Loss of Biodiversity
☐ Other .....

F5 **Is there something or things you really like or love about this survey unit? Tell us:**

F6 **Comments or observations:** If adding an extra page, please include your survey area code.

Thank you so much for all your work!
There are some **EXTRAS**. It would be great if you could answer these too where relevant:
1. Extra questions on select worms, seashells, fish, harvesting from the sea and shore changes (overleaf)
2. A separate page on Harbour waste management for anyone who is surveying a harbour (coastwatch.org)

Please submit data as soon as possible and no later than October 22nd.

Go to www.coastwatch.org for data input. Any please see front page for contacts.

EXTRA QUESTIONS Ireland and UK Take lots of photos

Biodiversity – just a few important members of 3 groups which may be found on your shore:

I. Worms: did you find any evidence of colonial worms, or large patches with lots of:

Worms	Found?	Comment (Amounts/ noteworthy)
Lug worm (*Arenicola*) casts (at all shore levels)		
Honeycomb (*Sabellaria*) reef (Mid- shore levels)		
Sand mason (*Lanice*) bed &/or casts (low shore pools)		

II. Sea shells: A small selection to focus on - see new Coastwatch Seashell poster for ID these and more.

Sea shells and eggs	Alive	Dead (empty shell)	Describe your find. (e.g. mussel bed, or Gigas oyster stuck to rocks, or shellfish eggs attached) 'Other' is special or query.	Photo or speciment for ID?
Mussel				
Native oyster				
Gigas oyster				
Cockle				
Razor shell				
Limpet				
Slipper limpet				
Dogwhelk				
Shellfish eggs				
Other:				

III. Fish nursery: (area where fish hatch, and/or juveniles stay)

Did you see **fish** or **fish nurseries**? No ☐ Yes ☐

If Yes, where? ..... Estimate how many .....

What type or species and any juveniles? .....

Did you see fish here before? No ☐ Yes ☐

Did you find any **fish egg case(s)**? No ☐ Yes ☐ if yes please estimate count: ☐ Take photo of species

Harvesting from the sea

Do you see or know of aquaculture, collecting for home use or commercial harvesting? (Add if other)

	Aquaculture	Harvesting	Commercial Harvesting	Comment
Seaweed				
Mussel				
Oyster				
Periwinkle				
Crab				
Lobster				
Fish				
Other:.....				

Shore Changes - Nature, erosion, water or use changes of note to shore, wildlife, or use?

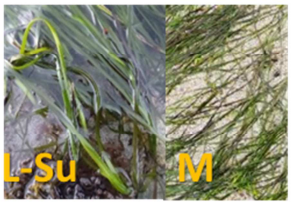
BIODIVERSITY GUIDE COASTWATCH SURVEY 2016 ©

See more on www.coastwatch.org

Section D. Intertidal and shallow water

Glasswort (*Salicornia*)
Green waxy or red to orange in autumn

Cordgrass (*Spartina*)
Forms dense upright clumps or fields IAS



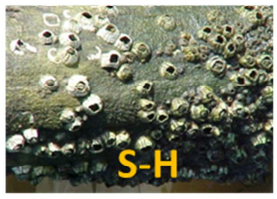
Sea grass (*Zostera*)
Z marina (L) long blades
Z noltii (R) on mudflats like lawn.

Green seaweed (*Ulvas*)
Tissue, tube or thread-like.
Attached but no roots.

Brown & red seaweeds
Many forms on rocks and other seaweeds

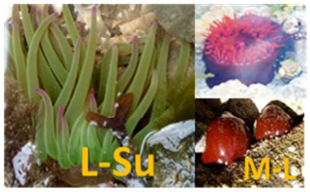
Jellyfish
Many species
Barrel (L) – Compass (R)

Crab (Crustaceans)
Here Common Shore crab
Hides in cool moist areas



Barnacles
Crustacean where adults are permanently attached.

Sea urchins or echinoids
Common and Sea potato



Sea Anemones
Snakelock (L) – Beadlet(R)

Starfish
Common starfish

Shellfish swept up
see CW Shell poster

Extra Questions

Lug worm (*Arenicola*) casts
Worms live in sand + mudflat
Smallest at highest shore levels.

Honeycomb (*Sabellaria*)
Worms build sand reefs, usually stuck to boulders.

Sand Mason (*Lanice*)
Worm buried in shell/sand tube with stiff top fringe.

Mussels (*Mytilus*)
Beard threads hold onto rock or others in 'beds.'

Native Oyster
On and half buried in sandy-mud

Gigas Oyster (cultured + IAS)
Shape changes: Looks like native oyster if growing on rocks.

Razor Shell
3 species - 1 of these is our Longest shell

Cockle
In sand & mud
Several species

Limpet
Chinese hats on rocks,
Several species.

Slipper limpet *Crepidula*
IAS on stones, on top of each other and other shellfish.

Dog whelk & Periwinkle
Whelk opening with siphon canal. Winkle opening round.

Common Whelk Egg ball (L)
Dogwhelk 'skittles' (R)

Fish egg cases
Dogfish (top) often in clumps
skate/ray (below) individual cases.

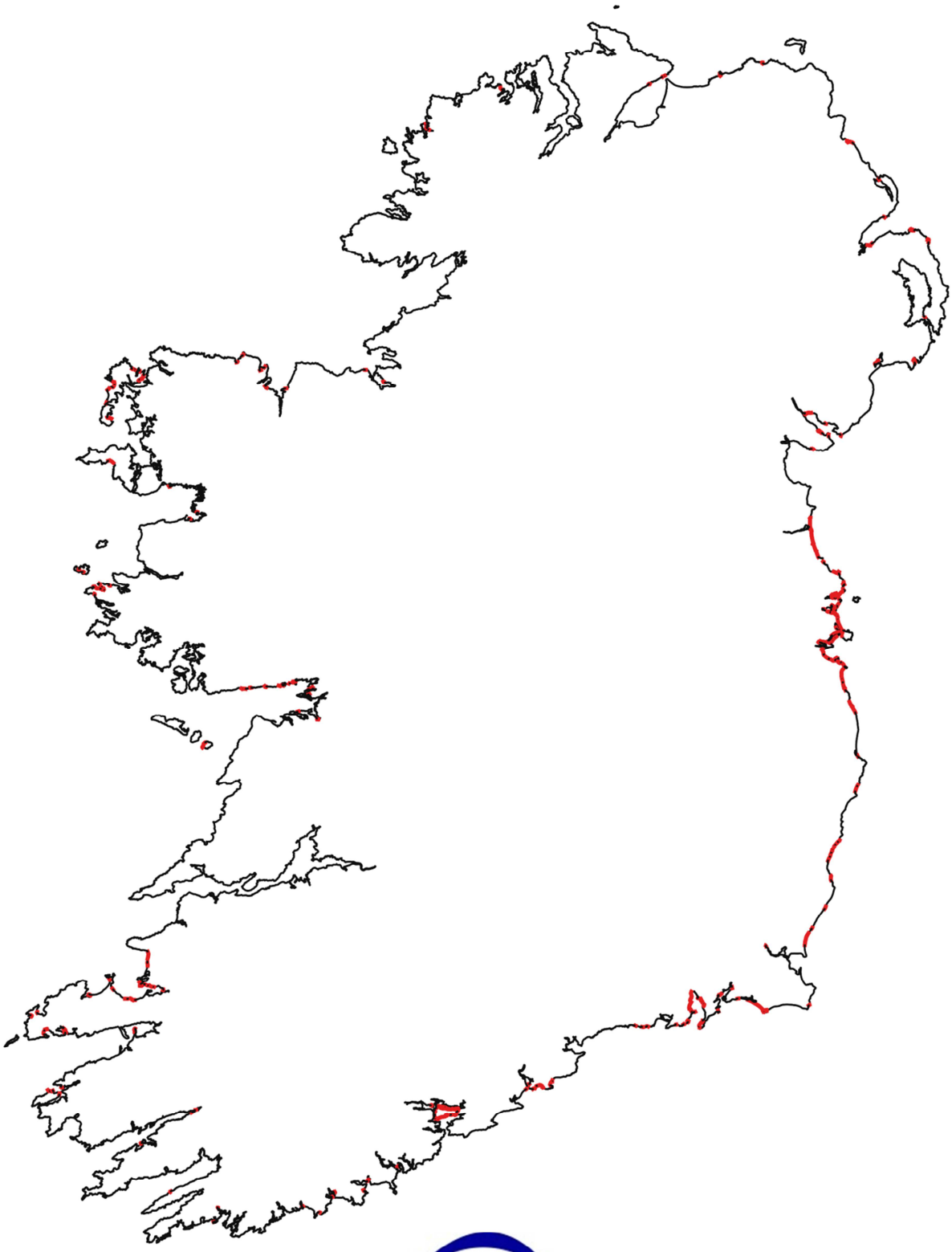
Key to Shore Level

S Splash-zone
H High
M Mid
L Low
Su sub-Littoral

Biodiversity Poster as used in Coastwatch Survey to help volunteers ID animals and plants.

Design and text – Karin Dubsky and Ángel Duarte.

ISLAND OF IRELAND COAST COVERED IN THE COASTWATCH SURVEY 2016



Coastwatch

Started in Ireland in Autumn 1987