



Heriot-Watt University
Research Gateway

Analysis of international, European and Scot's law governing marine litter and integration of policy within regional marine plans

Citation for published version:

Sheridan, H, Johnson, K & Capper, A 2020, 'Analysis of international, European and Scot's law governing marine litter and integration of policy within regional marine plans', *Ocean & Coastal Management*, vol. 187, 105119. <https://doi.org/10.1016/j.ocecoaman.2020.105119>

Digital Object Identifier (DOI):

[10.1016/j.ocecoaman.2020.105119](https://doi.org/10.1016/j.ocecoaman.2020.105119)

Link:

[Link to publication record in Heriot-Watt Research Portal](#)

Document Version:

Peer reviewed version

Published In:

Ocean & Coastal Management

General rights

Copyright for the publications made accessible via Heriot-Watt Research Portal is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

Heriot-Watt University has made every reasonable effort to ensure that the content in Heriot-Watt Research Portal complies with UK legislation. If you believe that the public display of this file breaches copyright please contact open.access@hw.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

Analysis of international, European and Scottish Law governing marine litter and integration of policy within regional marine plans

Sheridan, H¹., Johnson, K¹. and Capper, A.*¹

¹ International Centre for Island Technology, Heriot-Watt University, Franklin Road, Stromness, Orkney KW16 3AN, Scotland.

* corresponding author – email a.capper@hw.ac.uk

Declarations of interest: none.

Abstract

Within recent years, the issue of marine litter has become increasingly relevant to the citizens of Scotland. Inputs from shipping and fishing activities with additional contributions from society's throw away lifestyle has inundated healthy seas, endangered wildlife and degraded the health of the oceans. International, European and Scot's law governing the marine environment exists on a legally and non-legally binding basis, with the strictest of regulations concerning marine litter more commonly found on a non-legally binding basis. A global response is necessary to curb the issue but despite commitments to protect the marine environment, many States that have committed to reducing environmental pollution via international treaties are lagging on their promises. The introduction of marine planning to reduce conflict between users and the marine environment has the potential to address marine litter and to uphold commitments for healthy seas under the Marine Strategy Framework Directive. This paper, using a scientific literature analysis, evaluates international, European and Scottish environmental law that addresses aspects of marine litter, including inputs, types of marine litter and the outcomes of parties found guilty of contributing to the issue. Integration of these policies within regional marine plans has become the first step in tackling this ubiquitous problem as well as increasing awareness of policies and marine planning amongst the public. A survey was carried out in Scotland to establish awareness levels on these topics: awareness of marine litter (100%), marine planning (34%) and regional marine plans (33%). Raising public awareness of marine planning will aid its effectiveness in reducing the presence and impact of marine litter.

Keywords:

Marine Litter; Marine Planning; environmental law; policies; by-laws; Scotland.

1. Introduction

Pollution of the marine environment has been of global concern since the 1960s when the presence of litter waste was first recorded in the marine environment (UNEP, 2016). Plastics are abundant across every ocean and marine habitat, causing irrevocable damage to marine life leading us to question the future health of our seas. 80% of the waste found in the marine environment originates from land, with the remainder contributed by marine based activities such as shipping and fisheries (Haward, 2018). The variety of land-based litter is wide, sourced from urban litter, landfill sites, inadequate wastewater systems, production waste from the manufacturing industry and illegal dumping. These contain plastics, both recyclable and single-use, textiles, woods and synthetic fibres amongst others. Over 250 States have a coastline, and all exhibit the potential to pollute the marine environment through anthropogenic activities and mismanaged sewage and wastewater treatment plants. Currently, an estimated 4-12 million tons of plastic waste is polluting the oceans every year (Jambeck et al., 2015). With this encompassing only one element of marine litter, it is alarming to consider the overall amount of waste existing in the oceans.

Combating this global problem is particularly challenging due to the transboundary nature of marine litter wherein waste discharged in one State may pollute the coastlines of one or more other States. This is especially relevant in the North East Atlantic with several recorded incidents of debris from Atlantic Canada, Iceland, Greenland and the USA washing up on UK and Irish coastlines. A recent study demonstrated how the Gulf Stream and surface currents of the Atlantic are contributing to ever growing levels of microplastics in the Arctic Ocean where 12,000 particles of microplastics (<5 mm) were found in 1 litre of Arctic sea ice (Peeken et al., 2018). The ubiquitous nature of plastics has impacts throughout food webs with potential impacts to human health. Commercially important mesopelagic fish in the North Eastern Atlantic fishery grounds feed in surface waters making them highly susceptible to incidental ingestion of low density floating micro- and nano-plastic. Up to 73% of fish tested were found with microplastics in the gut (Alina et al., 2018).

1.1 Global Policy

It is crucial that the issue of marine pollution is dealt with at a global scale with a global response. Historically, there are several legally binding international laws and policies referring to the protection of the marine environment when concerned with pollution. The most widely accepted legislation is the United Nations Law of the Sea Convention (UNCLOS), currently ratified by 167 States and is the treaty responsible for establishing jurisdiction in the seas such as territorial seas and exclusive economic zones. Part XII of the UNCLOS concerns the protection and preservation of the marine environment, stipulating general provisions towards *“measures to prevent, reduce and control pollution of the marine environment”*. Further binding international agreements include the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 and the MARPOL 1773/78 Convention for the Prevention of Pollution from Ships. While they address the international community at large, there are several other agreements and policies binding several States together such as the environmental laws governing the European Union (EU) and the Regional Seas Programme.

1.2 European Policy

With 28 Member States and four seas (NE Atlantic, Arctic, Mediterranean and Baltic), the EU has prioritised the protection of the environment through frameworks and directives since the 1970s (Fig. 1). Additional environmental directives concern flora and fauna of the marine environment such as the Birds & Habitats Directive which assigns protected status to plants and animals deemed to be unique, endangered or at risk in a given location. At present, the 28 Member States are legally bound to these directives and are required to carry out the provisions held within them.

The Birds & Habitats Directive	The Wildlife and Countryside Act 1981
Common Fisheries Policy 1983	• Common Fisheries Policy
Water Framework Directive 2000	• Water Environment & Water Services (Scotland) Act 2003
Marine Strategy Framework Directive 2008	• Marine (Scotland) Act 2010
Urban Waste Water Treatment Directive 2009	• Urban Waste Water Treatment (Scotland) Regulations
Marine Spatial Planning Directive 2014	• Marine (Scotland) Act

Figure 1. European environmental law and its corresponding form in Scottish law.

It is customary practice for States to integrate EU policies within their own sovereign law. The Marine Strategy Framework Directive was transposed into Scot’s Law and is known as the Marine (Scotland) Act, resulting in the establishment of Marine Scotland, the governmental department responsible for policy, science, licensing and consents in the marine environment within Scotland’s territorial seas and EEZ. Following the Marine Spatial Planning Directive (MSP), Scotland initiated four pilot regional marine spatial plans, to which the Shetland Marine Spatial Plan (SMSP) was legalised and has been in operation since 2014 under the rule of Shetland Islands Council (Shetland Islands’ Council and NAFC Marine Centre, 2012). While the remaining 11 marine regions are still in the development stages, the issue of marine litter has been raised and is now recognised as a priority amongst local authorities and governmental departments alike. Utilising the adaptive planning approach to address plastic pollution of the marine environment will help to improve the health and wealth of marine biodiversity (Collie et al., 2012). This involves lengthy stakeholder consultation, discussion with relevant scientific and technical bodies and the design of policy that can respond to change. The aim of this paper is to outline the international, European and Scottish legislation concerning marine litter and discuss how marine planning may become a solution to its implementation.

2. International Legislation Concerning the Protection of the Marine Environment

There exist legally binding treaties on the marine environment and non-legally binding conventions and agreements in which States have pledged to protect the marine environment, observed as customary law in which the state has no legal obligation to undertake the provisions of a given convention but proceeds to do so out of custom.

2.1 The Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter (London Dumping Convention)

In 1972 the London (Dumping) Convention was adopted, addressing the *“deliberate disposal of wastes or other matter from vessels, aircraft, platforms or other man-made structures at sea”* and *“any deliberate disposal at sea of vessels, aircraft, platforms or other man-made structures at sea”*. It began the legislative journey to protecting the marine environment from human activities, leading to a plethora of conventions, treaties and agreements. Contracting parties are to *inter alia*:

“take all practicable steps to prevent the pollution of the sea by the dumping of waste and other matter that is liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea”

2.2 United Nations Convention on the Law of the Sea (UNCLOS)

167 States are legally bound through ratification with 14 States that have signed but not ratified the treaty (e.g. USA). Concern grew over the degradation of the marine environment and was addressed in *Part XIII: Protection and Preservation of the Marine Environment* in 1982 at UNCLOS III. This stipulated provisions on global and regional cooperation, technical assistance, monitoring and environmental assessment, types of pollution and its control, the enforcement of these regulations and safeguards. The marine environment is understood to comprise of everything from the sea surface to the seabed below including all physical, chemical and biological components. The recognition of the dangers posed by pollution from

a series of oil disasters in the 1960s and 1970s was the driving force behind implementing Part XIII. Within UNCLOS marine pollution is defined as:

“the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of the sea water and reduction of amenities”

This definition only concerns marine pollution that is deemed to be ‘*deleterious*’ rather than completely out ruling pollution of any kind to the marine environment. Scientific literature has demonstrated in the last decade that the existence of plastics, debris and litter in seas and oceans has indeed become ‘*deleterious*’ not only causing harm to marine life and impeding marine activities, but potentially causing harm to human health (Alina et al., 2018; Culin and Bielic, 2016; Rech et al., 2016). Sources of marine pollution are characterised by land-based, sea-based and from the atmosphere, but does not provide a detailed list of pollutants or substances that are prohibited nor does it stipulate any technical regulations regarding pollutants (Haward, 2018).

Each State party to the Convention is required to facilitate policies and laws to protect and preserve the marine environment from land-based sources. These policies are designed to each individual States coastline and regional features while also factoring in their current economic situation and desire for development in the future. Within the criteria for sources of land-based pollution, UNCLOS includes estuaries, river basins, pipelines and outfalls and has provided recommendations on suitable designs, measures and suggested practices to follow to prevent the release of persistent substances into the marine environment, which would include plastics and associated microplastics. Sources of marine pollution are catered for by the control of pollution by dumping at sea by vessels which are enforced by the International Maritime Organization (de La Fayette, 2001).

2.3 The Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter (MARPOL 73/78)

More commonly known as MARPOL, this act entered into force in 1988 and incorporates a revised Annex V (2013) that tackles garbage. MARPOL States:

“Harmful substance means any substance which, if introduced into the sea, is liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea, and includes substances subject to control by the present Convention”

And: “Ship means a vessel of any type whatsoever operating in the marine environment and includes hydrofoil boats, air-cushion vehicles, submersibles, floating craft and fixed or floating platforms”

This is the first international legislation that specifically mentions prohibiting the disposal of plastics in the sea. The definition of ship does not discriminate between those that are propelled (fishing and shipping vessels) and those that are fixed or floating (oil and gas platforms, marine energy extraction devices). Annex V was revised to include a variety of wastes: domestic, all plastics, fishing gear etc. but this is strictly applied to vessels and ships over a certain capacity. Therefore, the introduction of waste to receiving water bodies by means such as waste-water treatment outfalls, landfill sites, littering etc., is not controlled under MARPOL, despite it affecting the biodiversity and health of the seas.

Annex V was revised in 2011 and enforced in 2013 to prohibit the discharge of all garbage into the sea including within its scope domestic and operational waste, plastics, fishing debris (ropes, nets, garbage bags, incinerator ash) (Fig. 2). The only exception is found under Regulation 7 which stipulates the instances that they can be disposed of - if it has the potential to cause damage to the ship, its equipment, the safety of the vessel and its crew or to prevent environmental damage from the loss of fishing gear (UNEP, 2016). This revision is only applicable to ships >100 gross tonnage and ships certified to carry >15 persons. To manage the discharge of waste from larger vessels: those over 100Gt must implement a Garbage

Management Plan; those over 400Gt must carry a garbage record plan and Governments must provide suitable garbage facilities at ports that cater for such vessel sizes. Therefore, pleasure, recreational, demersal and shellfish/creel boats that are more frequently found within coastal waters do not have to comply with these provisions.

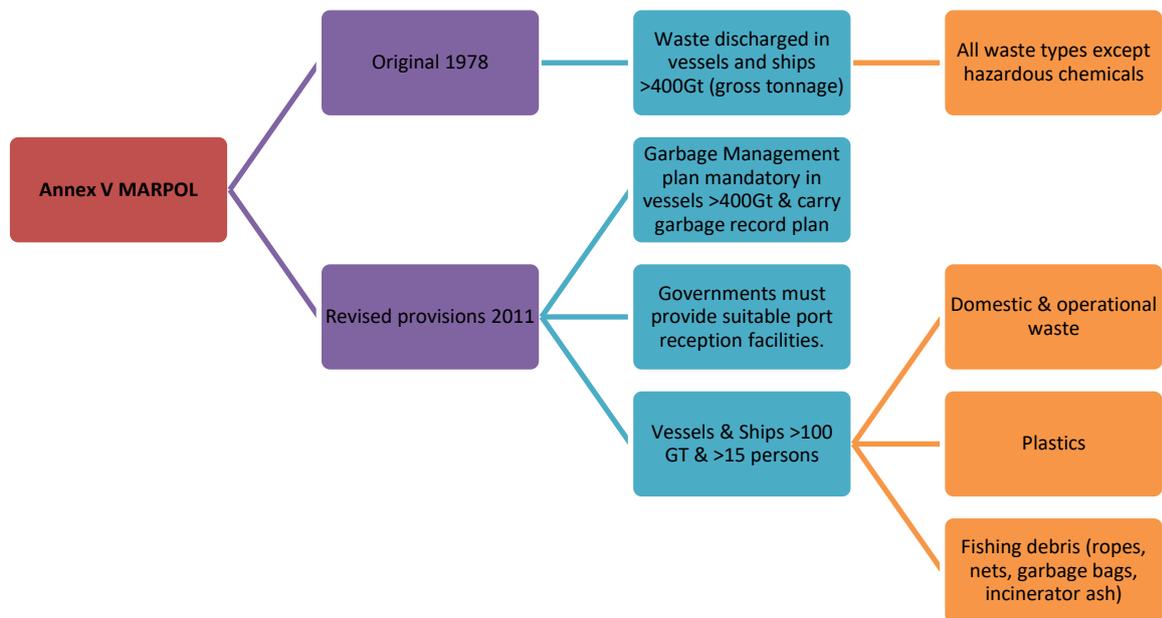


Figure 2. Original and revised Annex V provisions in relation to waste management.

Since MARPOL was enacted however, no significant decrease in the levels of marine debris has been observed in the North Sea, an active area for fishing and shipping activities (Unger and Harrison, 2016). Inadequate enforcement of regulations are likely the culprit, especially where lesser developed States do not have the facilities or resources to enforce them (Chen and Liu, 2013; Tan, 2012). Once the act of polluting has occurred, prevailing winds and currents carry waste away from the origin site, and in combination with the mobility of vessels, it is then difficult to determine the origin of pollution (Pham et al., 2014). A recent study found that the financial costs of using and providing adequate port reception facilities could potentially encourage illegal dumping of waste at sea by fisheries (Unger and Harrison, 2016). Therefore, with a low uptake and continued pollution, States may not be encouraged to provide such facilities or endeavour to enforce the regulations (Carpenter and Macgill, 2005).

It is evident that enforcement of MARPOL is an issue and should be prioritised to curb the tide of plastic that is washing ashore. Incentivising the return of waste has been promoted in the soon-to-be-introduced amended EU Ports Reception Facilities and was a key finding in a report by Chen and Liu (2013) who found participants were more motivated to abide by MARPOL regulations should the costs of waste disposal be curbed. This, however, is an EU Directive, mandated only to EU States but could potentially be a framework for international States to follow once implemented. A variety of recommendations from this report included biodegradable equipment such as nets and traps, educating fishermen on the impact of poor waste practices and a tracking program to be implemented on lost fishing gear so that it may be quantified and recovered.

2.4 The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal

The Basel Convention was adopted as a response to the dumping of toxic wastes in developing countries and the public outcry that followed it. The act aims to protect “human health and the environment against the adverse effects of hazardous wastes” with ‘hazardous wastes’ described based on origin, composition, characteristic and included two types of wastes described as ‘other wastes’ (household waste and incinerator ash). While the aims of the convention are to reduce hazardous waste generation and encourage environmentally sound management especially through transboundary movements, its remit within the scope for marine litter pollution is narrow. The convention States that:

“Based on the concept of prior informed consent, it is required that, before an export may take place, the authorities of the State of export notify the authorities of the prospective States of import and transit, providing them with detailed information on the intended movement. The movement may only proceed if and when all States concerned have given their written consent”

While this does concern the ‘movement’ of waste, it insinuates intended movement is for the purpose of disposal rather than movement in general. Prior informed consent does not incorporate the transition of marine litter from one State to another as consent for the natural

movement of water is not required, as one could argue. Is the receiving State consenting to have debris and litter from other States aggregating on their coastlines? Are they being notified? However, plastics and marine debris is not defined as a hazardous under the Basel Convention and it does not qualify as an import/export as it is not the 'intentional' movement of the wastes (UNEP, 2018)

The Parties adopted the Technical Guidelines for the Identification and Environmentally Sound Management of Plastic Wastes and for their Disposal in 2002 which included polymers and plastic types (Fig. 3). This takes into consideration the chemical make-up of plastics including any persistent pollutants, additives and polymers. Future revisions could integrate synthetic fibres, textiles and the persistent nature of plastics as a whole. These guidelines provide States with the necessary information including best practice and best techniques for managing the disposal of plastic wastes (UN Environment., 2017).

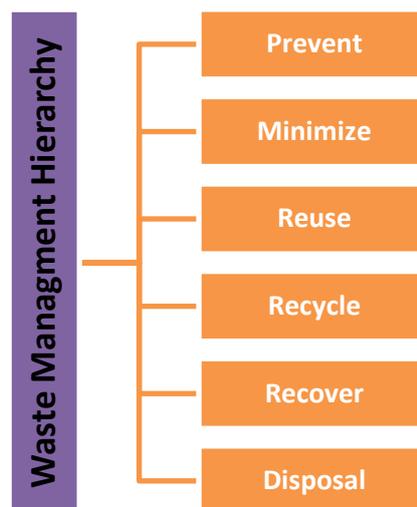


Figure 3. Waste Management Hierarchy

In 1995 the Conference of Parties (COP) aimed to introduce an amendment to prohibit the export of all hazardous wastes that are intended for final disposal, reuse, recycling and recovery from all States party to the Convention to all other countries (Raubenheimer and McIlgorm, 2018). This proposed 'Ban Amendment' failed to be established. However, with recent scientific literature relating to the hazards of marine litter to both biodiversity and human health, there is now the potential to apply a revision to the original ban amendment and incorporate plastics, synthetics, discards from fishing activities etc. Indeed, it could be

argued that any matter entering a sewage system is for final disposal and would therefore be compliant with the amendment (UN Environment., 2017). As the primary goal of the Basel Convention is to protect human health and the environment against waste, the Convention and those party to it have begun to act by coordinating at a regional level on the impacts of plastic waste, microplastics and the management of disposal and clean-up actions. The United Nations Environmental Assembly (UNEA) has recognized the relevance of the Basel Convention in relation to the issue of marine litter and has sought to apply preventative measures to waste management and disposal. Therefore, the waste hierarchy has been given utmost priority to plastics (UNEP, 2018) (Fig.3).

2.5 The Convention on Biological Diversity

196 States are party to the legally binding convention which has set targets in order to enhance biodiversity across the variety of habitats found across the world. Several of these targets relate to marine biodiversity and the influence of pollution on the seas. The Aichi Biodiversity Target 8 sets a goal of reducing pollution levels that no longer poses a detrimental threat to an environment and while it does not specifically refer to types of marine litter such as plastics and synthetics, it does stipulate that it requires, by 2020, pollution to be reduced to the stage that it no longer negatively impacts ecosystem function. Introducing an amendment to the Targets that incorporate marine debris including plastics, synthetics and abandoned, discarded and lost fishing gear would be highly beneficial. During a Conference of Parties (COP) XIII/10, State Parties agreed to adopt additional guidance documents on preventing and mitigating the effects of marine litter on the environment by encouraging the sharing of information, development of mitigation measures and policies to reduce waste at source. This waste is regarded as *“any persistent, manufactured or processed solid material in the marine and coastal environment”*. It is important to illuminate that these guidance documents are voluntary and therefore State Parties are not legally bound to the actions contained in them. However, compliance among States is silently agreed through a sense of duty and States were advised to: undertake assessments on their national policies and investigate those that cover plastics/microplastics/marine litter; establish the extent to which types of marine litter may be covered; and then aim to develop incentives that could reduce

and/or eliminate the production of microplastics (UNEP., 2016). It is important to remember that this would only be in the remit of preserving biodiversity and would not concern the manufacturing of items most commonly found in marine litter.

2.6 Non-Binding International Agreements

A larger number of 'soft law' conventions in the form of conferences, strategies and partnerships eclipse the number of legally binding treaties. These are known as Multilateral Environmental Agreements (MEAs) and are not legally binding to the States party to them. They are widely accepted and often provide evidence, guidance and goals on environmental and sustainability issues to preserve and protect the goal upon which the agreement has been set. One could argue that States are more inclined to enter into these agreements as they cannot be sanctioned for non-compliance and therefore have the ability to renege on their agreement. Several successful International agreements have been initiated by the United Nations Environment Programme, established in 1972 to prioritise environmental issues, e.g. Global Partnership on Marine Litter and the Honolulu Strategy. Goals in the Honolulu Strategy include reducing land-based sources of marine debris inclusive of solid waste and ALDFG (abandoned, lost and discarded fishing gear) across shorelines, seabed and the water column. It caters for every known marine habitat and reaffirms that the policies States introduce must address the lifecycle of plastics and not just its end point i.e. contributing to a circular economy (ten Brink et al., 2016; UNEP and NOAA, 2012). The Rio+12 Conference on Sustainable Development in 2012 introduced Goal 14 to "Conserve and sustainably use the oceans, seas and marine resources for sustainable development" to its 192 Member States, to protect the world's oceans from marine pollution and reduce the amount of floating plastic debris (Target 14.1; Indicator 14.1.1).

The Global Partnership on Marine Litter is the only global intergovernmental body that takes a holistic approach to marine litter by outlining the relationship between freshwater, terrestrial and coastal/marine ecosystems, their interactions and contributions to the problem. It is, however, a voluntary initiative which is not adopted nor implemented by all UN Member States are party to it.

There is a clear consensus amongst voluntary international agreements on marine protection:

- pollution and marine-litter reduction;
- issue of land-based pollution should be targeted at source;
- education and outreach should be promoted;
- scientific and technical knowledge should be shared, and preventative actions should be prioritised

(Grip, 2017; Haward, 2018; Houghton, 2014; Schuyler et al., 2018; UN Environment., 2017; Vince and Hardesty, 2017)

3. EU Environmental Law

Since the conception of the Economic European Community (later to be renamed the European Union), the emphasis on protecting and ensuring longevity and success for future generations has been a key priority. The Directives and Regulations passed on the marine environment currently number over 200 and are produced by specific departments of the EU such as the Directorate General of Maritime and Fisheries (DG MARE) and the Directorate-General of the Environment (DG ENV) (Bigagli, 2015). While the EU is recognised for its pioneering approach to environmental protection through legally binding policies, some are without mechanisms or instruments or lack coherency that can lead to confusion between neighbouring States (Boyes et al., 2016).

3.1 Water Framework Directive (WFD) & Marine Strategy Framework Directive (MSFD)

The Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD) have both received strong critique. One particular flaw within the legal language is the confusion over GES – Good Ecological Status in the WFD and Good Environmental Status in the MSFD. The MSFD considers a larger variety of habitats, biodiversity and human pressures than that found in the WFD even though the geographical area of these directives overlaps. Coastal waters in the WFD have precedence over the MSFD. As coastal waters are most at risk from the impacts of marine litter (Galgani et al., 2013), there can be no confusion over the criteria the area should be evaluated against. The MSFD contains an annex specifically

addressing marine litter (Descriptor 10) and taking this into consideration, it should overrule the WFD when assessing the GES of coastal waters.

3.2 Urban Waste Water Treatment Directive (UWWTD)

The Urban Waste Water Treatment Directive (UWWTD) is the legislative framework responsible for instructing Member States on appropriate treatment levels required for receiving waters, based on the population utilising the service. Many have cited that inadequate waste water services are to blame for the inundation of microplastics and litter into coastal waters via this pathway (De Falco et al., 2018; Li et al., 2018; Steensgaard et al., 2017). Storm conditions and heavy rainfall lead to inefficiency in treatment plants unable to deal with the high volumes of water. Often, the emergency response is to release untreated waste water into receiving water bodies. While this is legally acceptable as confined incidents, it can contribute to loading of macro- and microplastics (Axelsson and van Sebille, 2017). Whilst these instances are rare to frequent in many cities and towns across the EU (Aragónés et al., 2016; DLR County Council, 2015; Liberatore et al., 2015), it is imperative that national authorities re-evaluate loading capacities of sewage plants and consider the increasing frequency of heavy rainfall events associated with climate change (Miller and Hutchins, 2017).

3.3 Ports Reception Facilities Directive

Ship borne pollution and waste from fishing vessels is catered for under the Ports Reception Facilities Directive. Since its adoption in 2000, the EU has recognised loopholes and gaps in the legislation and made an amendment to the Directive to be adopted in 2019. Such discrepancies included omitting fishing vessels and recreational vessels <12 persons from notifying harbour authorities of waste to deliver. Vague language has led to inconsistencies between member States on how the directive should be delivered including how ports would be adequate to 'meet the needs of all users with respect to types and quantities of waste'. The new directive is promoting cost recovery systems to encourage ships and vessel to correctly dispose of their waste rather than contributing to waste discharges at sea. Smaller ports will also be incorporated with the aim to tackle regional marine pollution from vessels related to discarded fishing gear. This will be reinforced by initiatives such as KIMO's fishing

for litter campaign and ghost fishing activities implemented across the EU and the UK. A very important aspect of the amendment will be that all fishing vessels and recreational craft will be required to pay a fee whether they deliver waste or not, thus financing port reception facilities and ensuring their longevity. Cost recovery systems will incentivise marine users to use reception facilities. Its success, however, will depend on how Member States implement the directive and whether they address regional and local ports that far outnumber larger, more established ports.

3.4 European Strategy for Plastics

Introduced in 2018 as a response to the ubiquity of plastic found within our environment, the European Union sets out to achieve a number of goals by 2030 that will see a drastic reduction in both plastic produced and recycled within EU member States (Maes et al., 2019; Penca, 2018). Identifying the top ten single use plastics (drink bottles, caps & lids, cigarette filters, cotton bud sticks, crisp packets/sweet wrappers, sanitary applications, plastic bags, cutlery, straws & stirrers, drink cups & cup lids, balloons & balloon sticks and food containers including fast food packaging) has allowed States to target industries and consumer habits (DG ENV et al., 2018). Additionally, the strategy has set out comprehensive measures that integrate actions from both authorities and industries to work together which encourages cooperation between private and public sectors. Marine litter was high on the agenda within this strategy as actions to tackle marine litter at both source and at sea are addressed within Annex I. Coordinating with actions such as the Port Reception Facilities directive and the Marine Strategy Framework Directive will provide support to States on how to curb marine litter. However, while this strategy is thorough and impressively coordinates with other directives set out by the EU, it will ultimately be up to each individual Member State to carry out the actions set forth within each timeline. States such as the UK, France and Germany have already begun to implement the strategy via the introduction of deposit return schemes for plastic bottles and commitments to substitute single use plastic products with sustainable products (Finance, 2018; Packaging-gateway, 2018). This has yet to be introduced to States such as Ireland but has scope to be included in the national marine plan to be fully introduced and implemented in 2020.

3.5 Transboundary Impacts & Principles

A final note on European legislation regards the importance of transboundary activities and associated enforcement of policy is active across MS. Within the MSFD, criteria concerning transboundary issues states that the

" Directive shall apply to all marine waters as defined in Article 3(1) and shall take account of the transboundary effects on the quality of the marine environment of third States in the same marine region or subregion".

Much of marine litter found in surface waters, and arguably that found in the benthic region, may not originate from a State adjacent to the surface/benthic waters, but may come from several States. The proximity of States to one another has resulted in conflict in the past, most notably for fishery grounds and shipping lanes, yet the problematic issue of marine litter has not yet been addressed. Plastics are light and durable, capable of travelling hundreds of nautical miles, from one coastline to another, yet taking responsibility for this is not noted within the MSFD despite GES citing Descriptor 10 nor does the Commission address its responsibility within the 7th Environmental Action Plan (EAP).

Principles such as the Polluter Pays Principle and the Preventative Action Principle are applicable to the on-going issue of marine litter, yet whether Member States are actively enforcing these principles remains to be seen. These may be more successful in densely populated areas such as tourist sites around the Mediterranean and busy ports such as Rotterdam, Peterhead and Dublin where stricter controls and policies can be afforded by national governments. However, the number of towns and villages that are in proximity to a coastline or sit within a river catchment area may not be so strictly controlled as financing for lesser developed regions within Member States can often be reduced e.g. northwest and west coast of Ireland and the northwest of Spain. Nonetheless, marine litter itself is non-discriminatory as prevailing winds and currents decide whose shores and waterways it pollutes. Who truly pays for the pollution of these shores then? It rarely is the responsible party as the difficulty of tracing marine litter is well documented (Veiga et al., 2016).

4. Regional Conventions: OSPAR

The Oslo-Paris Convention (OSPAR) formed as the result of two conventions held during the 1970s that related to reducing pollution of the marine environment within European seas. The Conventions' primary aim is to protect the north-eastern Atlantic and its resources for the benefit of current and future generation. OSPARCOM, the Commission of the OSPAR convention, acts as a guiding body for signatory States to seek advice on best practices and available techniques that can reduce the effects of land-based pollution (Fig. 4). The issue of ubiquitous marine litter has become a priority within the Commission, to which it has responded by issuing Ecological Quality Objectives. These EcoQos are basic guidance indicators on the presence of litter material within the marine environment (Hastings and Potts, 2013). The results of these EcoQo's are published in reports by OSPAR and the 2014 report on marine litter published by the Commission stated intent to by 2020.



Figure 4. The principles that guide the OSPAR Commission's approach to managing the protection of the marine environment.

OSPAR stands at a unique position of creating both legally and non-legally binding decisions based on the reports and recommendations made to the Commission. Given the recent rise in the awareness of marine litter and the introduction of policies banning certain components of marine litter (e.g. microbead ban in the UK, plastic bag ban in Rep. of Ireland), there is the potential for the Commission to introduce a legally binding decision regarding the use of the

plastics within the North East Atlantic. Compliance to a decision can be difficult. Annex I of the Convention relates to pollution via land-based pathways and all Contracting parties must establish a monitoring and inspecting authority to assess whether levels are compliant. The Mediterranean Regional Seas programme has suffered similar problems with high levels of pollution and so adopted a legally binding compliance mechanism to deal with the problem. This could therefore become an action that the North East Atlantic Compliance could adopt. It could also provide a framework that could be replicated in other States, implementing a marine litter management strategy that is integrated into solid waste management. The success of the strategy has resulted in the reduction and closure of illegal dumping and dumpsites, fishing for litter and beach clean campaigns, port reception facilities with no special fees and also promoted the principle of best practice by establishing relationships with retailers to reduce plastic bags through taxes and incentives (Arie, 2011).

5. Scottish Law (Regional & Local Authority)

EU Directives, policies and regulations are transposed to UK law into the devolved governments of England, Wales, Scotland and Northern Ireland respectively. Transposition of EU Directives and policies within Scotland outnumbers that of Wales, England and Northern Ireland, e.g. Ross, Nash and Reid ((Ross et al., 2009) found 14 more Directives were legislated for in Scotland than in Wales.

By-laws are often implemented for governing the local and coastal marine environment and need approval by Scottish Ministers prior to introduction by the local authority. These can regulate or provide a protocol or address problems or seasonal issues within their jurisdiction, e.g., 'bathing season' in which higher levels of recreational use occurs (yachts, surfers, windsurfers, swimmers, divers, rowers) in coastal areas (Table 1). They are often poorly advertised and not understood by the public, which can lead to conflict (Hull, 2013). Most Scottish local authorities have by-laws that restrict the act of 'fly-tipping'. This is a considerable concern to the health of the marine environment as sites can be located close to riverbanks or coastal areas which contribute to a larger accumulation of waste through wind and water currents. This is treated at the end-point, i.e. local authorities have to remove all waste from the site at the cost of the tax-payer (Argyll-Bute Council). While fines can be

issued through local authorities to the offending party, the cost to the marine environment cannot be recouped through monetary gain alone. Efforts are made by local authorities to dissuade the public from illegally dumping waste and are instead encouraged to use facilities provided by local authorities.

5.1 The Marine Litter Strategy for Scotland and its implementation

Most local authorities are now using this strategy to develop aims for reducing marine litter and direct interested parties and users of the marine environment to the guidance that is available in it. This document is in accordance with descriptor 10 of the Marine Strategy Framework Directive (Marine Scotland., 2014). The removal of litter from beaches and seashores is an intensive and expensive task to undertake which is why several local authorities liaise with community groups to resolve the issue. An agreement is struck between the local authority and a national group such as Keep Scotland Beautiful or a local community movement such as 'Bag the Bruck' in the Orkney Islands. The action group conduct a beach or shore clean using materials supplied by the local authority, e.g. litter pickers, waste containers etc., the local authority then disposes of the collected litter afterwards (Argyll-Bute Council). This reduces the cost for local authorities while promoting the marine litter strategy within Scotland. The Marine Litter Strategy complies with

“Strategic Direction 2: Reduce marine and coastal based sourced of litter, in co-ordination with land sourced litter being reduced by the national litter strategy”

via the cooperation of partners with local authorities. It also encourages Strategic Direction 5 which is to

“Maintain and strengthen stakeholder co-ordination at the UK, EU and international scales”.

In some areas, local authorities are succeeding in co-operating with national organisations such as the Marine Conservation Society and associated local community groups (Marine Scotland., 2014). Each local authority is identified as the 'principal litter authority' under the Environment Protection Act 1990. Essentially this means that the council is responsible for keeping public domains clear of litter and waste, including the marine environment, i.e.

beaches, rocky shores, coastal zones, piers, jetties etc. from a variety of sources. Beaches above the mean high-water level (MHWL) and the associated amenities are to be kept clean and free of litter which involves providing suitable facilities for litter disposal. However, there is no legal requirement for councils to clean beach and seashore areas below the MHWL or to remove any marine debris from the area. As a result of tide, wave action and wind this waste can re-enter the marine environment and either move along the shore or move deeper into the sea. Voluntary groups and concerned citizens form the basis of beach cleans beyond the MHWL and while this will reduce an amount of marine litter and debris, there are no such volunteer clean-ups for the water around piers, slipways and jetties as these areas are difficult to access and clean. Specialist services, such as diving teams, would be required under the premises there is no environmental impact, however, this would be expensive and present a higher risk to those involved. Outdated outfall pipes unable to discharge sewage adequately under UUWTD guidelines can discharge at higher levels during peak times e.g. tourist season when population numbers are greater. Therefore, in the context of marine planning, a policy should be in put in place to address the impact of higher population on UWWT systems and seasonal marine litter problems.

Table 1. A selection of by-laws from various local authorities across Scotland and relevant by-laws to certain marine areas and activities.

LOCAL AUTHORITY	JURISDICTION	BY-LAW	DESCRIPTION
Argyll & Bute	Beaches & Shorelines	None	Beach cleans conducted via volunteer groups and community efforts, support supplied by Argyll & Bute Council in form of waste disposal and safety equipment (gloves and litter pickers).
Fife	Harbours	Part V: Cargoes, Ballasting, Vehicular loads and Materials brought on to harbour premises	“No person shall cause or allow any part or component of a vessel..... to fall or escape from or to be blown or to leak from a vessel or a vehicle within the harbour area.” Should such an event occur “the master of the vessel or the owner of the vehicle...shall report the incident to the harbourmaster”
Orkney Islands	Beaches & Shorelines	None	Orkney Islands Council promote ‘Pick up three pieces’ movement started by local schoolchildren
Shetland Islands	Harbour areas & development areas	Shetland Marine Plan: Clean & Safe Marine Litter	All applications for marine-related developments should, where directed by the local authority, submit a waste/litter minimisation and management plan to ensure safe disposal of waste material and debris associated with construction, operation and decommissioning stages of the development in a format to the satisfaction of the consenting authority or regulator.

			Disposal of marine waste/ litter at sea is prohibited.
South Ayrshire	Beaches	None	<p>“The Council is responsible for cleaning amenity and recreational beaches under their ownership above the mean high-water mark. Managed beaches require to be cleaned of litter in accordance with the Environmental Protection Act 1990 Code of Practice on Litter and Refuse. This code specifies that managed beaches should be cleaned to Grade B standard (some small pieces of litter evident) throughout the year and there are varying response times for returning the beach to Grade B standard depending on whether the beach is an amenity or recreational beach”</p>

5.2 Industry and links to Marine litter

Efforts to protect the environment have been well documented in Scotland both from an industry and scientific perspective. For new developments such as marine energy extraction and aquaculture farms, a strict licensing procedure exists with the requirements to conduct environmental impact assessments prior to license and planning permissions being granted. This rigid planning system is aimed at protecting seas and associated biodiversity from adverse impacts from anthropogenic activities and have been derived from the EU Directives of Environmental Impact Assessment, The Marine Strategy Framework Directive and the Water Framework Directive. Within Scot's law the scope of marine litter and vectors of marine litter pollution have been catered for under the Marine (Scotland) Act, the Offshore Marine Conservation Regulations 2007 and the Marine Works (Environmental Impact Assessment) Regulations 2017 from 0-200 nautical miles. Therefore, activities are now scrutinized from the planning stage up until the decommissioning stage. However, this does not include offshore or creel fisheries which account for a vast volume of marine litter through ADLFG especially along the north west coast and northern isles, e.g. Orkney and Shetland Isles. Discarded fishing gear is often the most visible form of marine debris along coastlines (Buckingham, 2018).

5.3 Marine Planning & Regional Marine Plans in Scotland

“A process of analysing and allocating parts of the three-dimensional marine spaces to specific uses, to achieve ecological, economic and social objectives that are usually specified through the political process; the MSP process usually results in a comprehensive plan or vision for a marine region” (Maes, 2008)

Marine planning has been introduced as a method of reducing conflict between users of the marine environment and the environment itself through a variety of methods such as hard and soft zonation of sea areas. The number of industries within the marine environment (fisheries, shipping, energy extraction, tourism, conservation, biotechnology, cabling and pipelines, military and defence and the renewable energy industry) and the concentration of activity in particular regions (e.g. the English Channel for shipping) can create several problems with regards to marine litter. The profile of marine litter as an issue has been highly

publicised through television and social media highlighting the pervasiveness of this problem (Easman et al., 2018).

For the purposes of this study, a survey analysing the public's knowledge of marine litter, marine plans and regional plans and policies was designed. Stipulated in the opening statement of the survey was that all participants must be living in Scotland to ensure that information from a Scottish-only audience was obtained. 116 individuals took part in the survey and results were analysed using SPSS software using descriptive statistics. From the survey we were able to ascertain that the Scottish public have an excellent understanding of the components and impacts of marine litter but less of an awareness of marine planning and policies. Only 32.2% of the respondents were aware that there are litter policies in place in Scotland and 95% believed that current policies in place to combat marine litter do not work. Clearly, policies and laws must be placed on a platform that all members of the public are made aware of e.g. campaigns on social media, television and through education systems. Incorporating incentives to curb marine litter was cited by 95% of individuals such as deposit return schemes. The desire for the fishing industry to have identifiable gear which would contribute to the polluter pays principle was also mentioned. Policy through marine planning could improve facilities for fishermen in conjunction with the ports reception facilities directive. Regional planning would identify ports with high-medium usage rates and can install adequate infrastructure to improve or replace conditions for fishermen. Education was popular amongst respondents, with over 98% stating that they would support the incorporation of marine litter within school curriculum at primary and secondary level. The positive impact of strategies such as these can already be seen in some schools in Scotland such as Ullapool primary school that promoted the #NaeStrawAtAw campaign (Planet Scotland, 2018). This sparked the movement towards the ban on plastic straws with the Scottish government.

Some Member States in the EU have had a marine plan in place for several years (Belgium) while others are proceeding to facilitate the planning process (Rep. of Ireland) as a response to the EU Marine Spatial Planning Directive. The Directive requires that Member States provide a national marine plan by 2021 and incorporate previous directives such as the MSFD,

WFD and Birds and Habitats Directive within it to create an adaptive management process to the marine environment. Marine planning has noted difficulty in implementation due to conflicts that often exist between policy-makers and scientists. This can often be related to time frames for decisions to be implemented: long-term solutions for scientists while policy-makers must implement short-term solutions to ensure political success with the general public (Plasman, 2008).

This has the potential for plans to 'sit on the shelf' and fail to be realised as a result of disharmony. Within Scotland however, there has been the successful roll-out of both a national marine plan and four pilot marine plans in the past decade (The Firth of Clyde, Shetland Isles, The Sound of Mull and the Berwickshire Coast). In fact, pilot marine plans were put into action several years before the EU Directive was issued and they focused on the particular characteristics of each region. Since then, the national marine plan has been adopted, sectioning Scotland's coastline into eleven marine regions. The Shetland Isles marine plan was a particularly successful pilot plan due to its bottom-up approach and close working relationship with key stakeholders such as fishermen and the oil and gas industry (Shelmerdine et al., 2014; Shucksmith et al., 2014). A local area committee has been established and islanders have taken ownership of the plan, input their own ideas, knowledge and expertise into crafting policies, enhancing the economic value of the region and protecting its shorelines from pollution. Policies in the plan are understandable and candid. Concise policies with a focussed and targeted narrative for regional marine plans could have the potential to curb the input of marine litter from anthropogenic sources. The plan is set out in an adaptive planning approach and is to be reviewed every four years.

In agreement with the objectives set forward in the EU Directive, the plan adopts the ecosystem-based approach, precautionary and polluter pays principle. An intensive list of requirements is outlined under both the national and regional marine plans to ensure that the Scottish marine regions are: (i) clean and safe; (ii) healthy and biologically diverse; (iii) productive; and (iv) maintaining ecosystem services. Plans should be adaptive in nature to allow for change that may occur on both an economic and climate related scale. The adaptive process should integrate policies that not only aim to reduce and eradicate marine litter, but

also assess the sources and sinks within each regional marine plan prior to policy development. However, each marine region is subject to different pressures. The Firth of Clyde marine region on schedule to be implemented by 2021 provides a good example.

The Firth of Clyde is historically important as a ship building region and is still heavily active with marine traffic through shipping, transport and recreational vessels. The region is embanked by several tourist towns and fishing villages such as Largs, Tarbert, and Campbelltown which see high visitor numbers between May to September (Mills et al., 2017). Seasonal pressures require adaptive management to succeed, so policy should be created to envelop both temporal and spatial scales. It has been well documented that areas with a high tourist turnover can facilitate excessive beach and seaside litter levels (Liberatore et al., 2015; Tovar-Sanchez et al., 2013). The contribution of fishing gear (nets, creel pots etc.) from creel and demersal fisheries can also be considerable as they wash up on the coastline (FAO. and UNEP., 2016). Ultimately, the impact of marine litter is not aesthetical, but also impacts local biodiversity through smothering and leaching of chemicals from plastics and associated materials (Murray and Cowie, 2011; Rochman et al., 2015; Werner et al., 2016). Informed assessments through interaction with stakeholders, scientists and policymakers, incorporating historical data and the work of NGOs such as the Marine Conservation Society and Keep Scotland Beautiful can begin to produce draft policies. By framing the problems present within individual marine regions, developing policies and objectives that holistically address each issue, a resolution to conflict can exist (Smith and Jentoft, 2017). It is vital that the wording of policies and objectives are clear, understandable and transparent so that they are non-discriminative to the public. Those drafting policy should consider hosting working groups that invite members of the public to interact with, irrelevant of their educational background, interests or occupation. As a result, the plan should be inclusive in nature and would also bestow a sense of ownership to the public in that they had a key role in creating a strategy to protect the livelihoods and biodiversity of their marine region.

6. Future Efforts to Protect the Marine Environment

Much discussion surrounds the future of marine environmental policy centres on amending existing international treaties (such as UNCLOS, The London Dumping Convention and MARPOL) rather than attempting to establish a new treaty. Treaty-making is a lengthy and time-consuming process that does not always result in a ratified agreement between States. The prime example is the 30-year process it took to ratify and adopt UNCLOS. Current projections suggest there will be approximately 33 billion tons of plastic produced by 2050 that has the potential to enter ocean environments (Rochman et al., 2013) while it is plausible that 12,000 million metric tons of plastic waste could be found across landfills and the natural environment by 2050 (Geyer et al., 2017). Amending current agreements could be the first step in aligning the environmental interests of each State and namely, its political representatives, e.g. the Basel Convention could include plastics as a 'hazardous waste' and as it exists as a legally-binding agreement, sanctions could be imposed on offending States that pollute through plastic. However, to engage the public and ensure the success of future policy, a bottom-up approach should be employed. This has been successful in regional marine plans, such as Shetland that employed the local knowledge of fishermen and islanders to identify and assess issues at a local level.

Educating people on the importance of the marine environment is vital to engaging their interest and enthusiasm for protecting the oceans, and this should be encouraged through primary, secondary and tertiary levels of education. Government could also potentially reduce the problem of marine litter by targeting audiences that have a vested interest in the quality of the seas. Recreational groups and users can encounter plastics, oils, woods and debris floating on the surface and are often the most affected by it outside of marine organisms. By providing these groups with the tools to inform their members of the potential hazards of marine litter and how their use of the marine environment can be affected by it, it could create a wave of change in the lifestyle choices. Charitable movements such as the #2minutebeachclean have been integrated into policies such as the 'Leave no Trace' scheme employed in the Republic of Ireland wherein all blue flags must now be equipped with information boards, litter pickers and bags. This was introduced on a local authority level into

seasonal bye-laws and has the scope to be integrated into the national marine plan on a temporary basis rather than during the summer season. As waste and litter levels increase in the Summer from large visitor number, litter wardens across Europe could implement the 'Leave no Trace' policy and authorised powers to impose sanctions and fine be reinforced through policy introduction via marine planning. Applying a planning system to the marine area is difficult to police and enforcing policy is not without its hurdles. While it aims to reduce and resolve conflict, it does not provide all answers for all problems (Collie *et al.*, 2012). In this respect, applying the adaptive planning approach is integral for policy-makers, planners and government to learn and provide a solution against future difficulties. Scotland have established a single governmental department to manage all marine related activities which has proven to be a success, especially when compared with neighbouring countries such as the Rep. of Ireland. The entire marine environment is governed and licensed by four separate departments in the Republic, but this hopes to be distilled into one department following the success of the Marine Scotland department.

Knowledge of the repercussions of a 'throwaway lifestyle' is lacking amongst the public (Easman *et al.*, 2018; Lotze *et al.*, 2018). This does not indicate that they do not care for the environment, but it does promote a lifestyle of convenience rather than a sustainable one. Indeed, it is stipulated within the UN Sustainable Goals that States enable their government, private sector and public, the means necessary for its citizens to live sustainably. Through education and efficient public awareness campaigns, in combination with portraying how a lifestyle of convenience can be detrimental to the marine environment, could go towards achieving some of the UN's Sustainable Development Goals. This could be implemented on a regional scale more adequately than that of a national scale, as quantifying and identifying recreational users would be more pronounced. Regional marine planning will need to interact with several groups in order to promote compliance with marine litter policy. This should begin with education of the problem, how it affects local communities by providing case studies and examples, encourage their interaction into creating policy, bestow a sense of ownership for them to solve the problem and give communities a sense of responsibility over their region.

6.1 Conclusion

In short, legally binding laws have less scope for plastics and other components of marine litter that have become widespread and hazardous to marine life in comparison to those that are non-legally binding. There is, however, an exception found in Descriptor 10 of the MSFD which is wholly dedicated to marine litter, but it must be pointed out this is only legally binding to the current states of the European Union and not the rest of the world. In order to fully deal with the issue at hand, it is imperative that governments, from State to local authority work together to streamline policies and shape them to an ever-changing climate. Policies surrounding marine litter, pollution and waste disposal need to be at the forefront of the public's consciousness to adequately combat such a prevalent issue. Transparent and accessible policies can indeed be effective in combination with marine planning, but raising awareness is the key for its success. Small to large communities need to be able to take ownership of their regional seas and the issues that occur in them, with local authorities acting to resolve them. The scope for policies will need to widen within regional areas to make accurate assessments of their catchment areas, outflows and waste disposal. True assessments in combination with future projections on population growth and demand for services can enable marine planners to adequately plan for the next 25 years for the necessary services to deal with issues that can arise from marine litter. While the ubiquitous nature of plastics and marine litter will not be resolved in the next decade, perhaps arming regions with the knowledge, ability and responsibility of taking care of their seas, we may see a reduction in the destructive nature of marine litter occurring along Scottish shores.

Acknowledgements

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

7. References

Alina, M.W., Liam, M., Peter, L.C., Allcock, A.L., Eoin, M., Olivier, S., Hannah, B., Thomas, K.D., 2018. Frequency of Microplastics in Mesopelagic Fishes from the Northwest Atlantic. *Frontiers in Marine Science* 5.

Aragonés, L., López, I., Palazón, A., López-Úbeda, R., García, C., 2016. Evaluation of the quality of coastal bathing waters in Spain through fecal bacteria *Escherichia coli* and *Enterococcus*. *Science of the Total Environment* 566-567, 288-297.

Argyll-Bute Council, Fly-Tipping, <https://www.argyll-bute.gov.uk/fly-tipping>.

Argyll-Bute Council, Marine Litter, <https://www.argyll-bute.gov.uk/marine-litter>.

Arie, T., 2011. Managing Marine Litter: Exploring the Evolving Role of International and European Law in Confronting a Persistent Environmental Problem. *Utrecht Journal of International and European Law* 27, 4-18.

Axelsson, C., van Sebille, E., 2017. Prevention through policy: Urban macroplastic leakages to the marine environment during extreme rainfall events. *Marine Pollution Bulletin* 124, 211-227.

Bigagli, E., 2015. The EU legal framework for the management of marine complex social-ecological systems. *Marine Policy* 54, 44-51.

Boyes, S.J., Elliott, M., Murillas-Maza, A., Papadopoulou, N., Uyarra, M.C., 2016. Is existing legislation fit-for-purpose to achieve Good Environmental Status in European seas? *Marine Pollution Bulletin* 111, 18-32.

Buckingham, J., 2018. Marine Debris on Orkney Beaches: A First Holistic Review. Heriot-Watt University.

Carpenter, A., Macgill, S.M., 2005. The EU Directive on port reception facilities for ship-generated waste and cargo residues: The results of a second survey on the provision and uptake of facilities in North Sea ports. *Marine Pollution Bulletin* 50, 1541-1547.

Chen, C.-L., Liu, T.-K., 2013. Fill the gap: Developing management strategies to control garbage pollution from fishing vessels.(Report). *Marine Policy* 40, 34.

Collie, J.S., Adamowicz, W.L., Beck, M.W., Craig, B., Essington, T.E., Fluharty, D., Rice, J., Sanchirico, J.N., 2012. Marine spatial planning in practice. *Estuarine, Coastal and Shelf Science*.

Culin, J., Bielic, T., 2016. Plastic Pollution from Ships. *Pomorski Zbornik* 51, 57-66.

De Falco, F., Gullo, M.P., Gentile, G., Di Pace, E., Cocca, M., Gelabert, L., Brouta-Agnésa, M., Rovira, A., Escudero, R., Villalba, R., Mossotti, R., Montarsolo, A., Gavignano, S., Tonin, C., Avella, M., 2018. Evaluation of microplastic release caused by textile washing processes of synthetic fabrics. *Environmental Pollution* 236, 916-925.

de La Fayette, L., 2001. The Marine Environment Protection Committee: The Conjunction of the Law of the Sea and International Environmental Law. *The International Journal of Marine and Coastal Law* 16, 155-238.

DG ENV, ICF, Eunomia, 2018. Assessment of measures to reduce marine litter from single use plastics: Final report and Annex, in: Environment, D.-G.f. (Ed.). European Commission, Brussels, p. 250.

DLR County Council, 2015. Bathing Water Quality at Killiney, White Rock and Seapoint, in: Council, D.L.-R.C. (Ed.).

Easman, E.S., Abernethy, K.E., Godley, B.J., 2018. Assessing public awareness of marine environmental threats and conservation efforts. *Marine Policy* 87, 234-240.

FAO., UNEP., 2016. Abandoned, Lost or Otherwise Discarded Gillnets and Trammel Nets: Methods to estimate ghost fishing mortality, and the status of regional monitoring and management, FAO Fisheries and Aquaculture Technical Paper. Food and Agriculture Organization of the United Nations, Rome, p. 96.

Finance, M.f.t.E.a., 2018. Roadmap for the circular economy: 50 measures for a 100% circular economy.

Galgani, F., Hanke, G., Werner, S., De Vrees, L., 2013. Marine litter within the European Marine Strategy Framework Directive. *ICES Journal of Marine Science* 70, 1055-1064.

Geyer, R., Jambeck, J.R., Law, K.L., 2017. Production, use, and fate of all plastics ever made. *Science advances* 3, e1700782.

Grip, K., 2017. International marine environmental governance: A review. *A Journal of the Human Environment* 46, 413-427.

Hastings, E., Potts, T., 2013. Marine litter: Progress in developing an integrated policy approach in Scotland. *Marine Policy* 42, 49-55.

Haward, M., 2018. Plastic pollution of the world's seas and oceans as a contemporary challenge in ocean governance. *Nature Communications* 9, 1-3.

Houghton, K., 2014. Identifying new pathways for ocean governance: The role of legal principles in areas beyond national jurisdiction. *Marine Policy* 49, 118-126.

Hull, A.D., 2013. Managing Competition for Marine Space Using the Tools of Planning in the UK. *Planning Practice and Research* 28, 503-526.

Jambeck, J.R., Geyer, R., Wilcox, C., Siegler, T.R., Perryman, M., Andrady, A., Narayan, R., Law, K.L., 2015. Marine pollution. Plastic waste inputs from land into the ocean. *Science (New York, N.Y.)* 347, 768.

Li, J., Green, C., Reynolds, A., Shi, H., Rotchell, J.M., 2018. Microplastics in mussels sampled from coastal waters and supermarkets in the United Kingdom. *Environmental Pollution* 241, 35-44.

Liberatore, L., Murmura, F., Scarano, A., 2015. Bathing water profile in the coastal belt of the province of Pescara (Italy, Central Adriatic Sea). *Marine Pollution Bulletin* 95, 100-106.

Lotze, H.K., Guest, H., Apos, Leary, J., Tuda, A., Wallace, D., 2018. Public perceptions of marine threats and protection from around the world. *Ocean and Coastal Management* 152, 14-22.

Maes, F., 2008. The international legal framework for marine spatial planning. *Marine Policy* 32, 797-810.

Maes, T., Perry, J., Alliji, K., Clarke, C., Birchenough, S.N.R., 2019. Shades of grey: Marine litter research developments in Europe. *Marine Pollution Bulletin* 146, 274-281.

Marine Scotland., 2014. A Marine Litter Strategy For Scotland, in: Scotland, M. (Ed.), Scottish Government, p. 34.

Miller, J.D., Hutchins, M., 2017. The impacts of urbanisation and climate change on urban flooding and urban water quality: A review of the evidence concerning the United Kingdom. *Journal of Hydrology: Regional Studies* 12, 345-362.

Mills, F., Sheridan, S., Brown, S., 2017. Clyde Marine Region Assessment. Clyde Marine Planning Partnership, p. 231.

Murray, F., Cowie, P.R., 2011. Plastic contamination in the decapod crustacean *Nephrops norvegicus* (Linnaeus, 1758). *Marine Pollution Bulletin* 62, 1207-1217.

Packaging-gateway, 2018. France launches scheme to tackle the plastic packaging mountain.

Peeken, I., Primpke, S., Beyer, B., Gütermann, J., Katlein, C., Krumpfen, T., Bergmann, M., Hehemann, L., Gerdtz, G., 2018. Arctic sea ice is an important temporal sink and means of transport for microplastic. *Nature communications* 9, 1505.

Penca, J., 2018. European Plastics Strategy: What promise for global marine litter? *Marine Policy* 97, 197-201.

Pham, C.K., Ramirez Llodra, E., Alt, C.H.S., Amaro, T., Bergmann, M., Canals, M., Company, J.B., Davies, J., Duineveld, G.C.A., Galgani, F., Howell, K.L., Huvenne, V.A.I., Isidro, E., Jones, D.O.B., Lastras, G., Morato, T., Gomes - Pereira, J.N., Purser, A., Stewart, H., Tojeira, I., Tubau, X., Van Rooij, D., Tyler, P.A., 2014. Marine litter distribution and density in European seas, from the shelves to deep basins.

Planet Scotland, 2018. Schools #naestrawataw campaign to stop plastic straws hailed by Holyrood, Planet Scotland, p. 1.

Plasman, I.C., 2008. Implementing marine spatial planning: A policy perspective. *Marine Policy* 32, 811-815.

Raubenheimer, K., McIlgorm, A., 2018. Can the Basel and Stockholm Conventions provide a global framework to reduce the impact of marine plastic litter? *Marine Policy*, <xocs:firstpage xmlns:xocs=""/>.

Rech, S., Borrell, Y., García-Vazquez, E., 2016. Marine litter as a vector for non-native species: What we need to know. *Marine Pollution Bulletin* 113, 40-43.

Rochman, C.M., Browne, M.A., Halpern, B.S., Hentschel, B.T., Hoh, E., Karapanagioti, H.K., Rios-Mendoza, L.M., Takada, H., Teh, S., Thompson, R.C., 2013. Classify plastic waste as hazardous. *Nature* 494, 169-171.

Rochman, C.M., Tahir, A., Williams, S., Baxa, D.V., Lam, R., Miller, J., Teh, F., Werorilangi, S., Teh, S.J., 2015. Anthropogenic debris in seafood: Plastic debris and fibers from textiles in fish and bivalves sold for human consumption. *Sci Rep* 5.

Ross, A., Nash, H., Reid, C.T., 2009. The Implementation of EU Environmental Law in Scotland. *Edinburgh Law Review* 13, 224-251.

Schuyler, Q., Hardesty, B.D., Lawson, T., Opie, K., Wilcox, C., 2018. Economic incentives reduce plastic inputs to the ocean. *Marine Policy*.

Shelmerdine, R.L., Stone, D., Leslie, B., Robinson, M., 2014. Implications of defining fisheries closed areas based on predicted habitats in Shetland: A proactive and precautionary approach. *Marine Policy* 43, 184-199.

Shetland Islands' Council, NAFC Marine Centre, 2012. Shetland Islands' Marine Spatial Plan, Supplementary Guidance, in: Council, S.I. (Ed.). *Monitoring and Evaluation of Spatially Managed Areas*.

Shucksmith, R., Gray, L., Kelly, C., Tweddle, J.F., 2014. Regional marine spatial planning – The data collection and mapping process. *Marine Policy* 50, 1-9.

Smith, G., Jentoft, S., 2017. Marine spatial planning in Scotland. Levelling the playing field? *Marine Policy* 84, 33-41.

Steensgaard, I.M., Syberg, K., Rist, S., Hartmann, N.B., Boldrin, A., Hansen, S.F., 2017. From macro- to microplastics - Analysis of EU regulation along the life cycle of plastic bags. *Environmental Pollution* 224, 289-299.

Tan, A.K.-J., 2012. *Vessel-Source Marine Pollution : The Law and Politics of International Regulation* / Alan Khee-Jin Tan. Cambridge : Cambridge University Press, Cambridge.

ten Brink, P., Schweitzer, J.-P., Watkins, E., Howe, M., 2016. *Plastics Marine Litter and the Circular Economy: A briefing by IEEP for the MAVA Foundation*. Institute for European Environmental Policy.

Tovar-Sanchez, A., Sanchez-Quiles, D., Basterretxea, G., Benede, J., Chisvert, A., Salvador, A., Moreno-Garrido, I., Blasco, J., 2013. Sunscreen Products as Emerging Pollutants to Coastal Waters. *PLoS ONE* 8.

UN Environment., 2017. *Combating marine plastic litter and microplastics: An assessment of the effectiveness of relevant international, regional and subregional governance strategies and approaches.*, in: UNEP (Ed.). UNEP, p. 197.

UNEP, 2016. *Marine Plastic Debris and Microplastics - Global lessons and research to inspire action and guide policy change.*, in: Programme, U.N.E. (Ed.), Nairobi.

UNEP, 2018. *Report on possible options available under the Basel Convention to further address marine plastic litter and microplastics*, in: meeting, O.-e.W.G.o.t.B.C.o.t.C.o.T.M.o.H.W.a.T.D.E. (Ed.). United Nations Environment Assembly of the United Nations Environment Programme, Nairobi,.

UNEP, NOAA, 2012. *The Honolulu Strategy: A Global Framework for Prevention and Management of Marine Debris.*, in: Programme, U.N.E., Administration, N.O.a.A. (Eds.), p. 57.

UNEP., 2016. *Decision Adopted by the Conference of the Parties to the Convention on Biological Diversity XIII/10 Addressing impacts of marine debris and anthropogenic underwater noise and coastal biodiversity*, in: Programme, U.N.E. (Ed.), Cancun, Mexico.

Unger, A., Harrison, N., 2016. Fisheries as a source of marine debris on beaches in the United Kingdom. *Marine Pollution Bulletin* 107, 52-58.

Veiga, J.M., Fleet, D., Kinsey, S., Nilsson, P., Vlachogianni, T., Werner, S., Galgani, F., Thompson, R.C., Dagevos, J., Gago, J., Sobral, P., Cronin, R., 2016. *Identifying Sources of Marine Litter.*, MSFD GES TG Marine Litter Thematic Report.

Vince, J., Hardesty, B.D., 2017. Plastic pollution challenges in marine and coastal environments: from local to global governance. *Restoration Ecology* 25, 123-128.

Werner, S., Budziak, A., van Franeker, J., Galgani, F., Hanke, G., Maes, T., Matiddi, M., Nilsson, P., Oosterbaan, L., Priestland, E., Thompson, R., Veiga, J., Vlachogianni, T., 2016. Harm Caused by Marine Litter, MSFD GES TG Marine Litter - Thematic Report.