Towards G7 Action to Combat Ghost Fishing Gear

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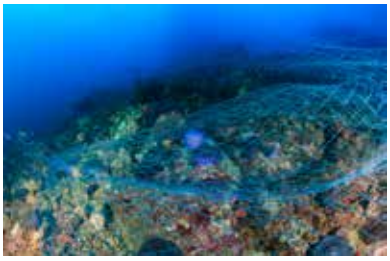

Towards G7 Action to Combat Ghost Fishing Gear

This Policy Paper provides in-depth analysis of the drivers, impacts and best practices to address ghost fishing gear. It places the issues of abandoned, lost, or otherwise discarded fishing gear within the larger context of marine plastic pollution. Ghost gear is particularly harmful because it negatively affects fisheries, non-target species (e.g. entanglement of wildlife), habitats, navigational safety, and coastal tourism. As a significant source of marine pollution, ghost fishing gear contributes to environmental and health risks of plastic pollution. The report identifies good practices and policies to prevent gear loss, reduce its impacts, and to recover lost gear. It reviews current policy efforts at the international level and in G7 countries and recommends a comprehensive policy response through international co-operation and circular economy approaches.

This Policy Paper was prepared as a background document for G7 Climate and Environment Ministers under the G7 Presidency of the United Kingdom

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A background report prepared for the
2021 G7 Presidency of the United Kingdom

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Foreword

The OECD is pleased to produce this background report at the request of the United Kingdom Department for Environment, Food and Rural Affairs (Defra) for the UK's 2021 G7 Presidency. The 2021 Climate and Environment Track, jointly led by Defra and the Department for Business, Energy and Industrial Strategy, will focus on six policy priorities including ocean action.

The OECD is privileged to conduct this work in consultation with the Food and Agriculture Organization of the United Nations (FAO) and the Global Ghost Gear Initiative (GGGI), both of which have conducted extensive work to advance policy and awareness around ghost fishing gear. This report is intended to inform G7 discussions around ghost gear, exploring the following issues in its subsequent chapters:

- **Chapter 1** situates the issue of ghost gear into the broader story of marine plastic pollution and the ocean economy. It explores the societal benefits plastic has provided, as well as its exponential proliferation over the last 70 years, including in fishing gear. The chapter explores multilateral, national and private sector initiatives to combat ghost gear. Finally, it identifies some of the key information gaps that should be filled in order to most effectively take action on ghost gear.
- **Chapter 2** identifies some of the most common causes for gear loss, including features of the natural environment, inclement weather, gear conflict and intentional disposal. It explores the literature on scope and extent of economic and environmental losses due to fishing gear loss.
- **Chapter 3** identifies some of the key good practices that have the potential to prevent, mitigate or remove ghost gear. Examples from G7 countries in particular are highlighted in this chapter to showcase and provide inspiration for action at a broader scale.
- **Chapter 4** concludes this background report. Based on desktop research, expert interviews and expertise in the areas of environmental policy, fisheries policy, resource efficiency and circular economy, it outlines possible key priority actions that G7 members can take in order to most effectively combat ghost fishing gear.

Acronyms and Abbreviations

ALDFG	Abandoned, Lost or otherwise Discarded Fishing Gear
ADF	Advanced Disposal Fee
BPF	GGGI Best Practice Framework for the Management of Fishing Gear
DRS	Deposit Return Scheme
EoL	End of Life
EPR	Extended Producer Responsibility
FAO	Food and Agriculture Organization of the United Nations
GGGI	Global Ghost Gear Initiative
IMO	International Maritime Organization
IUU	Illegal, Unreported and Unregulated
MARPOL	International Convention for the Prevention of Pollution from Ships
MCS	Monitoring Control and Surveillance
MSP	Marine Spatial Planning
RMFO	Regional Fisheries Management Organisations
RFBs	Regional Fisheries Bodies
RSP	Regional Seas Programmes
SDG	Sustainable Development Goal
UNEA	United Nations Environment Assembly
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization

Executive Summary

Ghost fishing gear is a particularly harmful form of marine pollution because the lost gear continues to entangle and capture wildlife. The economic impacts of ghost gear include the forgone catch of target fisheries, risks to navigational safety, delays to shipping and impacts on coastal tourism. Not only does ghost fishing gear continue to capture target species, but it can capture threatened and endangered species too, as well as destroy habitats.

Modern fishing gear is mainly made of synthetic materials, in particular plastic. As such, ghost gear contributes to microplastic pollution and the spread of invasive species that can be transported over long distances.

This background paper examines the state of knowledge of the drivers and impacts of ghost gear, good practice to prevent and mitigate impacts, and sets the policy issue within the G7's ongoing work to address marine plastic pollution.

Key Findings:

- Ghost gear contributes significantly to the flow of plastic pollution into the ocean and the plastic material present in the ocean. Estimates of an exact contribution vary by model and estimation techniques employed, so that there is not one widely-accepted figure.
- Gear loss differs significantly by gear type. An estimated 5.7% of nets, 8.6% of traps, and 29% of lines in use are lost each year. The impacts of ghost gear also vary by gear type. Gillnets, traps and pots are associated with high levels of damage compared with mid-water trawls and seine nets.
- Gear loss can be caused by natural drivers such as the physical environment and weather conditions, as well as gear conflict, user error or malfunction, and intentional disposal.
- Policy action to address ghost gear is happening at several governance levels. At the international level, the G7 has ongoing commitments to address marine plastic litter, including the G7 Action Plan to Combat Marine Litter. Several organisations under the auspices of the UN research ghost gear and host ongoing dialogue between countries. All G7 countries have adopted some national and subnational measures to address ghost gear, but there are opportunities to improve and expand these.
- Good practice to address ghost gear includes measures to avoid gear loss, to mitigate the impact of lost gear, and to locate and retrieve lost gear.
    - Gear marking promotes responsible ownership, helps to reduce gear conflict, facilitates monitoring and identification measures to address similar loss, and assists in recovering and returning lost gear.
    - Provision of adequate disposal facilities helps reduce purposeful abandonment of gear, improves collection of end of life gear and prepares the material for recycling or for other environmentally sound waste management.
    - Marine spatial management can help prevent gear loss and limit its impact by reducing gear conflict.

- Gear design requirements, incentives, and support for further research for gear innovation can help to improve marking technology and to address ghost fishing of lost gear.
- Education and awareness efforts help to address unintentional gear loss by user error and to raise awareness of the damage caused by intentionally abandoned gear.
- Extended Producer Responsibility internalises the costs of end of life gear to the design choices made by producers. It can also incentivise investment in collection facilities and improve data collection and sharing about gear purchases and loss. The success of current EPR programs in recycling collected material suggests that most end of life gear is recyclable.

Key Recommendations:

- The direct impacts of ghost gear and its contribution to marine plastic pollution can be addressed by actions across two policy pillars:
  - Pillar 1: Leverage international co-operation and national frameworks
    - At the international level, the G7 can adopt commitments specific to ghost gear, co-ordinate research efforts, and join cross-stakeholder initiatives, such as the Global Ghost Gear Initiative, to engage NGOs and the private sector (including fish harvesters).
    - At the national level, national risk assessments, marine spatial and temporal planning, and a national system of collaboration between stakeholders are needed.
  - Pillar 2: Implement circular economy or similar principles throughout the lifecycle of gear
    - At the design stage, policy is needed to require gear marking (such as identifying the vessel the gear belongs to) and to incentivise the manufacture of repairable and recyclable fishing gear.
    - At the use stage, policy can set requirements or incentives for the reporting of lost gear and the support of efforts to retrieve and return lost gear.
    - At the end of life stage, policy needs to ensure provision of adequate disposal facilities, address the economic barriers to recycling, and encourage or establish extended producer responsibility schemes for gear.

1 Introducing ghost fishing gear within the broader context of marine plastic debris

The ocean plays a vital role in planetary well-being

Human activities place increasing pressure on the world's ocean through accelerating climate change, overfishing and pollution including marine plastics, of which abandoned, lost or otherwise discarded fishing gear (ALDFG) causes the most harm. This report situates ghost gear within the broader context of action to combat marine plastic debris. It identifies key information gaps, causes and impacts of ghost gear and highlights a series of good practices used to combat ghost gear. Finally, the report proposes a series of priority actions that G7 countries can take to combat ghost fishing gear.

Note that for the purposes of this report, the term ghost gear will be prioritised and will be used to encompass all forms of ALDFG.[1] As well, the report will focus primarily on ghost gear from capture fisheries, rather than aquaculture.

The ocean regulates climate, provides life-giving oxygen and is home to rich biodiversity. It has absorbed more than 90% of excess atmospheric heat since 1970, likely shielding the earth from some of the worst effects of climate change (IPCC, 2019[1]). The ocean is also vital for economic prosperity. It is a source of jobs and employment, having provided an estimated USD 1.5 trillion in economic activity and 31 million direct jobs in 2010 (OECD, 2016[2]). The ocean also provides an essential source of food for much of the population, with fish being a unique source of animal protein and essential nutrients, especially for coastal communities in developing economies (FAO, 2020[3]).

The ocean economy and G7 countries

The G7 countries are particularly reliant on the ocean for fundamental elements of their culture, economies and environment, which makes addressing issues like marine plastic litter and ghost gear of paramount importance. On average, nearly a quarter of G7 populations live within 10km of the coast, with this figure going up to nearly half for Japan (OECD, 2021[4]). Further, G7 countries have responsibility for over 40 million square kilometres of maritime areas.

[1] "Ghost gear" and "ghost fishing gear" are often used interchangeably with ALDFG. Ghost gear is sometimes referred to as a subset of ALDFG, which has the capability to continue "ghost" fishing after it has been abandoned, lost or otherwise discarded. For the purposes of this report, the authors will be using the term ghost gear interchangeably with ALDFG.

G7 countries play a major role in fisheries, accounting for over USD 21 billion in landings in 2018 and representing over half of the value from the 37 OECD member countries (OECD, 2021[4]). In terms of marine capture, G7 countries account for 12% by weight globally (FAO, 2020[5]). G7 countries exported nearly USD 21 billion in fish in 2018, accounting for about 13% of the global total. They are major global importers, importing over USD 65 billion in fish in 2018, which accounts for 43% of the global total (OECD, 2021[6]).

Given the central role that the ocean plays in economic prosperity and human well-being, it is in the best interest of all nations to take immediate and urgent action to address these very real existential threats facing the ocean, marine biodiversity and ocean economy. They also play a central role in international fisheries policy, notably as central members of Regional Fisheries Management Organizations (RFMOs).

Through the G7 and G20 fora, member countries have acknowledged the impacts of marine plastic litter, identified needs to address these impacts, and made commitments to policy action. To date, communiqués and commitments have primarily focused on land-based sources of marine plastic litter. Germany's 2017 G20 Presidency adopted the Action Plan on Marine Litter, while Canada's 2018 G7 Presidency commissioned several reports on plastics management and adopted an Ocean Plastics Charter. In its 2019 Presidency, Japan adopted the G20 Implementation Framework for Actions on Marine Plastic Litter and the Osaka Blue Ocean Vision. Positively, G7 and G20 member countries have made significant progress in aligning around a shared appreciation of the issue, and acknowledgement that an objective and a set of actions will be required. [2]

The 2021 UK G7 Presidency prioritises continuing action on marine plastic pollution, with a further focus on the problem of ghost gear. A G7 objective and further commitment to actions to address sea-based contributions to marine plastic, in particular ghost gear, would build upon the existing G7 legacy.

Plastic brings many societal benefits, but its proliferation has adverse impacts

Plastics are found in nearly every ocean basin in the world, from the high Arctic to the most remote islands. An estimated 4.8 to 12.7 million metric tons of plastic entered the ocean in 2010, with no signs of abating (Jambeck et al., 2015[7]).[3] In the marine environment, roughly 5% of plastic litter is found on beaches, 1% on the ocean surface, and 94% on the sea floor (Eunomia, 2016[8]). Plastics pollution and ghost gear pose ecological risks including entanglement, habitat destruction, and ingestion. Risks to human health include the degradation of plastic material into microplastics that are present in seafood and sea salt.

The production of plastic has grown exponentially over the past seventy years, from close to zero production to over 400 million tons per year (Figure 1.1). The material has a strong strength-to-weight ratio, is impermeable to liquids, and highly resistant to degradation. As well, plastic is relatively inexpensive. Due to these desirable properties, manufacturers have substituted plastics for other inputs (e.g. concrete, glass, wood, and natural fibres) in many sectors, including fisheries. Substitution of alternative materials with plastic has some benefits for society and the environment, such as its high strength-to-weight ratio, which

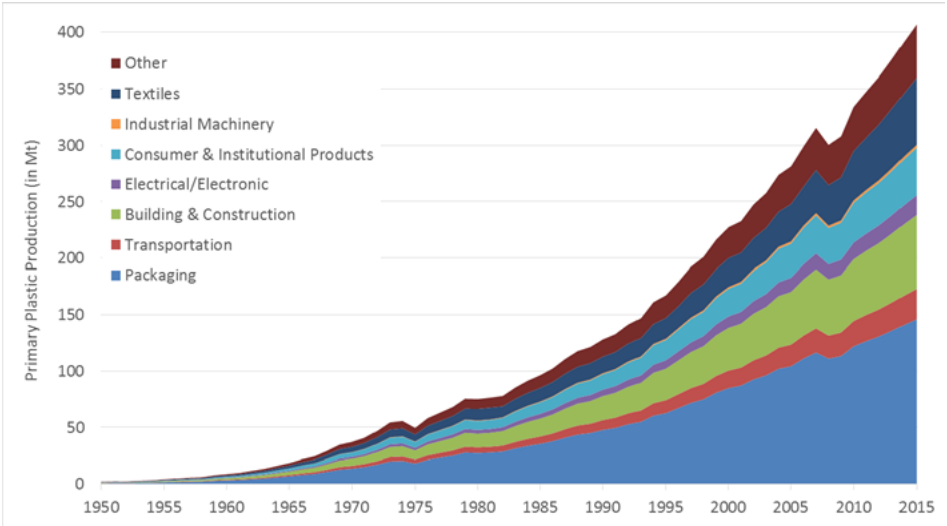
[2] A full list of G7 and G20 communiqués and commitments related to addressing marine plastic pollution and ghost gear is available in the Annex 1. Timeline of G7 and G20 communiqués and commitments related to marine plastic pollution.

[3] Estimates of plastic waste generation differ depending on modelling method used. For example, Lebreton and Andrady estimate 181 million tonnes of plastic waste was generated in 2015 using per-capita municipal solid waste estimates (2019[136]). Borrelle et al model of marine plastic pollution is based on population, waste generation and composition, proportions of mismanaged waste and geography. The approach is applied globally, not just coastal regions. The model estimates that between 19 and 23 million metric tons of plastic waste entered the ocean in 2016 (Borrelle et al., 2020[147]).

has allowed for light weighting of products. In turn, this reduces fuel use and greenhouse gas emissions in transportation (Andrady and Neal, 2009[9]).

Figure 1.1. Global plastics production has grown exponentially over the past seventy years

Global plastics production: 1950 to 2015



Source: (Geyer, Jambeck and Law, 2017[10])

Fishing equipment is now predominantly made with synthetic or semi-synthetic materials, due to their durability, strength, and weight relative to natural alternatives. In fisheries, plastic material is used in boat construction and maintenance, gear, avoidance devices, fish hold insulation and crates (Lusher, Hollman and Mandoza-Hill, 2017[11]). Plastics are a fundamental input to many common types of gear. For instance, plastics make up trawl and dredge net floats and netting; they make up the netting wall, floats and synthetic rope of gill and seine nets. In traps and pots, they make up the net, synthetic lines, piping frames and coating, and make up fishing lines and buoys as well (Lusher, Hollman and Mandoza-Hill, 2017[11]).[4]

The current seascape of ghost gear

While fishing gear has been lost and left at sea since time immemorial, the extent of ghost gear and its associated impacts have increased in tandem with increasing fishing effort and capacity, and increased durability of fishing gear (MacFadyen, Huntington and Cappell, 2009[12]). The exact amount of ghost fishing gear released into the ocean on an annual basis is unknown, though Working Group 43 of the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP 43) will soon issue its first technical report that will summarize the global state of knowledge on all sea-based sources of marine litter, including fishing as a source of ghost gear.[5] Lebreton et al. estimate that globally 17.9% of marine

[4] Polyamide, polyethylene, and polypropylene are the main plastic polymers used in most fishing gear.

[5] Previous crude estimates of the amount of ghost gear entering the ocean each year at a global level vary. Necessarily, global estimates require assumptions and are based on imperfect or limited data. Rough estimates by MacFadyen suggests that ghost gear makes up around 10% of plastics entering the ocean each year (2009[12]), while a meta-study on material flows by Eunomia places that estimate at around 9% (2016[8]). However, the composition of fishing gear in several cited retrieval projects and beach litter surveys much larger than 9-10%. A more thoroughly-vetted global rate of fishing gear in the composition of marine plastic pollution is a remaining research gap.

plastic pollution is derived from fishing (2017[13]), with nearly half of the material recovered from the Great Pacific Garbage Patch (Box 1.1) being ghost gear (2018[14]).

Box 1.1. Nearly half of the Great Pacific Garbage Patch is made up of fishing nets

Of the 1.15 to 2.41 million tonnes of plastic entering the ocean each year, over half is less dense than water and therefore can be transported over extended distances by global ocean currents (Lebreton et al., 2017[13]). Garbage patches are large areas of the ocean where this marine debris collects, brought together by rotating ocean currents called "gyres" (NOAA, n.d.[15]).

The Great Pacific Garbage Patch (GPGP), located between California and Hawaii, is the largest of the five plastic accumulation zones in the ocean (The Ocean Cleanup, n.d.[16]). The GPGP is estimated to contain at least 79 thousand tonnes of plastic and cover an area of 1.6 million square kilometres (Lebreton et al., 2018[17]), equivalent to around three times the size of France.

Over 46% of the GPGP floating plastic mass is comprised of fishing nets (Lebreton et al., 2018[17]), which can result in entanglement of marine species and ghost fishing. Other harmful impacts of marine debris include ingestion of plastic by marine organisms, which can have harmful health impacts to the animal itself as well as accumulate in the food chain. Finally, marine debris can transport non-native species long distances, potentially spreading disease and impacting native species.

Among G7 countries, more specific detail can be found concerning the share of fishing gear in the stock of marine plastic observed by researchers. Approximately 90% of items identified in beach litter surveys conducted by OSPAR from 2009 to 2018 were plastic, of which fishing activities were noted as a main source of litter (OSPAR[18]).[6] In Canada, at least 56% of marine debris collected between August and September, 2020, as part of a marine debris retrieval program for the outer shoreline of British Columbia, was composed of derelict fishing gear (Markel and Smith, 2020[19]).

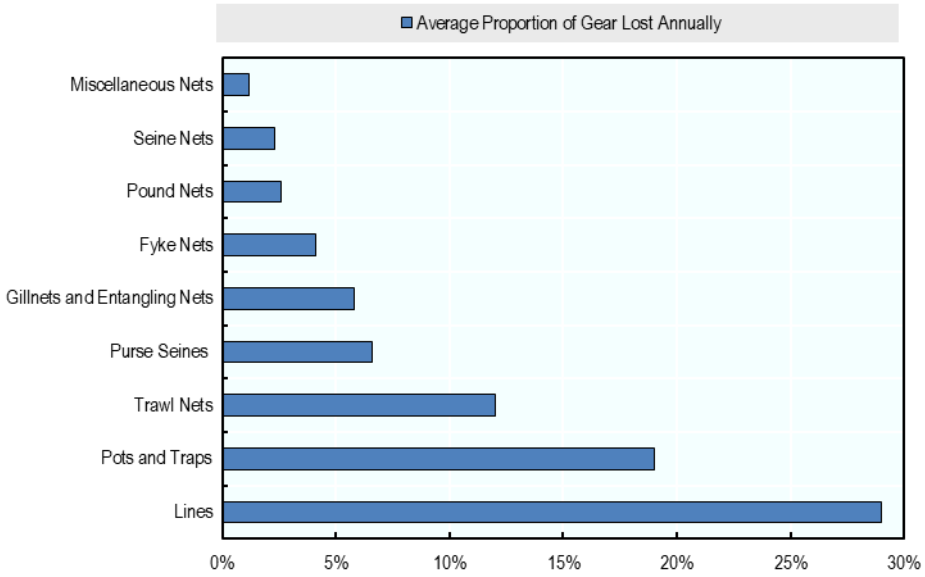
Notably, the share varies significantly depending on the geographic region and physical features of the ocean environment. For example, in Japan, fishing gear is estimated to make up 30% by weight of artificial material washed ashore along Japan's coast (Plastic Waste Management Institute, 2019[20]). In a survey of the deep sea floor in Italian regions in the Tyrrhenian Sea, fishing gear made up 89% of marine debris (Angiolillo et al., 2015[21]).

Gear loss differs significantly by type of gear. Richardson et al. extrapolated regional and fishery studies to arrive at global estimates of the annual share of gear lost by gear type (**Error! Reference source not found.**). Their estimates suggest that nets are typically less frequently lost compared to traps and line equipment.[7]

[6] OSPAR is the regional sea convention for the North-East Atlantic with membership composed of Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

[7] The impacts of ghost gear also vary by gear type. Gillnets, traps and pots are associated with high levels of damage compared with mid-water trawls and seine nets. Therefore, the larger loss rate does not necessarily mean that the gear type is more harmful as ghost gear (see Table 2.1. Not all gear types have the same risk of ghost fishing). Despite limitations in available data by region, the Richardson et al study provides rough estimates of the proportion of gear loss.

Figure 1.2. Rate of gear loss differs by gear type



Note: "Lines" includes a range of different equipment from hand lines to long lines.
Source: (Richardson, Hardesty and Wilcox, 2019[22]).

Fishing gear can have particularly harmful impacts (see more in Causes and consequences of ghost fishing gear). For instance, marine animals are most at risk of entanglement from ghost fishing gear relative to other types of marine plastic litter. Ghost gear can also reduce potential catch and populations of non-target species by continuing to fish for years even after it is lost.

Information gaps on the scope and impacts of ghost gear

As the preceding sections demonstrate, impacts from ghost gear are significant and must be urgently addressed. However, key information gaps remain in fully understanding the scope of the problem:

- First, there are significant geographic disparities in availability of information to study the scope and extent of ghost gear. Even among high-income G7 countries, there appears to be a dearth of research in particular fisheries and regions. These data disparities are further pronounced in regions of the world that are not as well studied, such as swaths of Africa, Asia, South America and Antarctica (GESAMP Working Group 43, 2020[23]).
- Second, there is missing consensus on the scope and magnitude of ghost gear at a global scale (GESAMP Working Group 43, 2020[23]). This stems from a lack of definitions and universally agreed methods as to how gear is counted, and in turn how to track the loss of gear (Gilman, 2015[24]).
- Third, there is an uneven understanding of the impacts of ghost gear. Particular fisheries (see Box 1.2), non-target species, gear types and ecosystems have been well researched while others have not been studied thoroughly at all (GESAMP Working Group 43, 2020[23]).

Action to address information gaps in the economic research of ghost gear will help inform evidence-based policymaking. For example, additional information on the effectiveness of policies, including a robust understanding of cost-benefit of available policy options, would greatly assist policy selection and evaluation. Some estimates of cost-benefit of solutions have been conducted (see Costs to fisheries from lost gear and ghost fishing of target species), but these need to be expanded to develop a systematic

understanding of how best to address ghost gear. Cost-benefit analyses should include consideration of the vast ecosystem services provided by marine species and ecosystems.

Box 1.2. Aquaculture's role in gear loss calls for future study

Plastic is used as a material for aquaculture equipment, including sea cage collars and cage nets. However, aquaculture remains a significant information gap in ghost gear [8] (Huntington, 2019[25]). Efforts are underway by the Global Ghost Gear Initiative (GGGI) and others to better understand its pathways, impacts and potential solutions. With aquaculture production growing globally and now accounting for nearly half of seafood production worldwide (FAO, 2020[3]), understanding the contribution of this sector to ghost fishing gear is of critical importance for future studies. Some G7 countries are major producers and importers of aquaculture. For example, Japan, United Kingdom and Canada are major producers of finfish in marine and coastal aquaculture; and Japan, United States of America, France, Italy and Canada are major producers of molluscs (FAO, 2020[3]).

Several governance levels co-ordinate action to combat ghost gear

Policy interventions have occurred at various levels of governance (international, national, regional, and non-governmental organisations) to research, prevent and mitigate ghost gear. However, policy gaps remain, signalling the possibility for action by the G7 to facilitate international co-ordination and the adoption of further effective measures. This section reviews the current policy framework and gaps and outlines a possible framework for G7 action.

Multilateral fora set international policy and co-ordinate the state of knowledge

In addition to action by the G7 and G20 (see The ocean economy and G7 countries), the General Assembly and specialised agencies of the United Nations have hosted multilateral dialogue and co-ordination of policy on ghost gear. The UN General Assembly has recognised this issue on several occasions, including as part of the broader issue of marine litter (MacFadyen, Huntington and Cappell, 2009[12]). Ghost fishing and its impacts are also relevant to meeting the Sustainable Development Goals (Box 1.3).

Box 1.3. Combatting ghost gear can help countries achieve their Sustainable Development Goals

The UN Sustainable Development Goals, adopted by all UN Member States in 2015 as part of the 2030 Agenda for Sustainable Development, represent a call to action across 17 goals to "end poverty, protect the planet and improve the lives and prospects of everyone, everywhere". Combatting marine plastic litter and ghost gear has benefits across many of the SDGs. Explicitly, marine litter is recognised under SDG 14.1 Life Below Water, to prevent and significantly reduce marine pollution of all kinds by 2025.

More broadly, ghost gear adversely impacts potential catch, thereby potentially affecting people's livelihoods (SDG 1 No Poverty) and food security (SDG 2 Zero Hunger). This could be of increasing concern as fish consumption has increased globally overall, largely in developing and least developed

[8] Plastic is also used as a material for pearl culture as cage nets for pearl oysters. While some research has started to analyse its environmental impact as ghost gear, (CRIOBE[145]), further analysis is needed.

countries. SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action) will become increasingly relevant along due to the significant greenhouse gas emissions resulting from virgin plastics production and end of life recycling processes.

Source: (United Nations, n.d.[26])

The Food and Agriculture Organization (FAO) of the United Nations first recognised ghost gear in its proceedings in the 1980s, and has since conducted dedicated work on the issue. For example, FAO has developed Voluntary Guidelines for the Marking of Fishing Gear (FAO, 2019[27]) and has held a series of regional workshops in partnership with GGGI to identify best practices (FAO, 2019[28]). Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL), administered by the International Maritime Organization (IMO) includes fishing gear as pollution, but recognises that some accidental loss of fishing gear may occur and requires fishing vessel operators to "report the accidental loss or discharge of fishing gear which poses a significant threat to the marine environment and navigation" (International Maritime Organization, 2017[29]).

The Joint Group of Group of Experts on the Scientific Aspects of Marine Environment Protection (GESAMP) is an advisory body to the United Nations on marine protection. Within the GESAMP framework, a working group on sea-based sources of marine litter was established in 2019. The group is actively researching the contributions of sea-based sources of marine pollution and the extent of impacts in preparation of a forthcoming final report (GESAMP, 2020[30]).

Regional Sea Conventions and action plans are regional governance fora for coordination of common marine priorities, policy development, and project implementation. Presently eighteen different maritime regions have a convention or action plan in place, administered independently, within a larger regional framework, or within the auspices of UNEP. These help member countries to address threats to the marine and coastal environment, including plastics pollution and ghost gear (UNEP, 2021[31]). The Regional Seas Strategic Direction (2017-2020) sets forth a thematic strategy to reduce marine pollution, to which conventions and action plans are to enhance data and increase visibility of the issue (UNEP, 2016[32]).

National policy to address causes and impacts of ghost gear

All G7 governments have, to some extent, adopted national and subnational policy measures to address the causes and mitigate the impacts of ghost gear (see Annex 2. National policy action by G7 states to address). The public sector has facilitated voluntary efforts of the private sector, implemented policy interventions, and provided financial and technical assistance for emerging economies. These policies can improve plastics waste management, raise awareness, increase removal, and facilitate research on ghost gear. However, each country has potential to add measures to its existing policy mix to extend the geographic coverage of good practices (see Chapter 3). As well, monitoring and enforcement of measures is needed to ensure implementation.

Non-governmental organisations facilitate commitments and research

Private initiatives and NGOs co-ordinate voluntary commitments to address plastic pollution by promoting environmentally sound waste management, awareness campaigns, and removal activities. For example, the Global Ghost Gear Initiative (GGGI), launched in 2015, is a cross-sectoral alliance with 140 members including 50 from the private sector, 62 NGOs, 8 from academia, 2 intergovernmental organisations and 18 governments, with the aim of driving solutions to ghost gear. Amongst the G7, Canada, the United Kingdom and the United States are members. The GGGI Best Practice Framework for the Management of Fishing Gear (BPF) focuses on the most commonly-used gear types across the gear use lifecycle and

provides best practice recommendations to all actors in the seafood supply chain across prevention, mitigation and remediation strategies (Huntington, 2017[33]) (Huntington, 2017[34]).[9]

Remaining gaps in co-ordinating action

There are gaps in international law for the governance of marine plastic waste. MARPOL, adopted by the IMO in 1988, is the only global international treaty to address marine debris (Parker, 2019[35]). MARPOL bans dumping of plastic waste by ships into the ocean. However, no international governance instrument is in place to comprehensively address challenges of marine debris, plastics and microplastics (UN Report of the Secretary-General, 2018[36]). Remaining gaps in governance of marine plastic litter include: specifically dedicated policy instruments[10]; geographic coverage of RFMOs; fragmentation of national legislation on ocean affairs; missing inter-sectoral co-ordination, incomplete assessment of implementation; and formal multilateral compliance committees (UN Report of the Secretary-General, 2018[36]).

The UNEP hosts several non-binding initiatives including the Global Partnership on Marine Litter (GPML) and the Clean Seas Pact. The GPML was launched at the UN Conference on Sustainable Development (Rio+20) in June 2012. GPML is a platform for co-operation and sharing of best practices on instruments to address marine plastic pollution. The UN Environment Programme provides secretariat services (GPML, 2018[37]). The Clean Seas campaign began in 2017, after the UN endorsement of the Clean Seas Pact. The campaign includes 57 countries that have pledged to reduce pollution from single use plastics, protect national waters and encourage recycling (UNEP, 2019[38]). As a result of the fifth international marine debris conference, the Honolulu strategy set a global framework, recommended strategies and potential actions to reduce the amount and impacts of plastic litter (NOAA and UNEP, 2012[39]). However, the strategy is non-binding and does not prescribe specific targets or actions.

Researchers and civil society have recently called for further international co-operation to address marine plastic litter. In 2017, for example, seven scientists actively researching the environmental and health impacts of plastic pollution published a call for a binding international agreement to set waste reduction targets, set incentives for resource efficiency and circular economy, and establish a funding source for waste management infrastructure development in emerging economies (Borrelle et al.[40]). The International Union for Conservation of Nature (IUCN) has adopted a resolution to ask the international community to adopt a global agreement for actions to prevent and reduce marine plastic pollution (IUCN, 2020[41]). In a jointly-produced business case, the Ellen MacArthur Foundation, the World Wildlife Fund, and the Boston Consulting Group called for a global agreement on plastics with binding targets, tied to national action plans, and with harmonised measurements (Duncan et al., 2020[42]). In 2021, the Editorial Board of Nature called for a global agreement to advance the current non-binding commitments by UNEP and the private sector (Nature Editorial Board, 2021[43]).

Discussion on further instruments to address marine plastic pollution, including the possibility of a global agreement, are ongoing within the auspices of the UN Environment Assembly (UNEA). An Ad Hoc Open Ended Expert Group was established under UNEA in 2017 and held four high level events to consider the international governance needs to address marine plastic litter and microplastics, completing its mandate in 2020 (IUCN, n.d.[44]) (AHEG, 2020[45]). Prioritisation of policy interventions is a likely barrier to an agreement. For example, some states have sought to prioritise waste management infrastructure development while others sought plastic design requirements or bans be a part of such an agreement (Parker, 2019[35]). The fifth session of the UNEA will resume in Nairobi in 2022 and will further progress on resolutions on marine litter and microplastics (UNEA, 2021[46]).

[9] The BPF was first released in 2017. An updated BPF will be released in 2021.

[10] With the exception of some regional action plans on marine litter.

G7 leadership can elevate global action on ghost gear

This background paper describes the drivers, impacts and best practices to address ghost fishing gear. Chapter 2 describes the causes of loss of fishing gear, both intentional and unintentional, and analyses its economic and environmental consequences. Chapter 3 reviews the good practices available to prevent and mitigate its impacts, with examples and some early results of implementation of the good practices by G7 countries. Based on the preceding analysis, this report proposes priority actions which G7 governments can take to demonstrate global leadership on the urgent issue of combatting ghost fishing gear, and continuing the legacy of strong G7 action on marine plastic debris: (see Table 4.1. Key actions to address ghost gearTable 4.1.). Specifically, the G7 can take action to leverage international co-operation and national frameworks and to further implementation of circular economy or similar principles throughout the lifecycle of fishing gear. Examples of priority actions include coordination of research efforts, and development of risk assessments to help policymakers better understand the issue and the effectiveness of actions; marking of fishing gear to facilitate reporting, retrieval, and traceability; and gear collection infrastructure to ensure recycling and other environmentally sound waste management of gear.

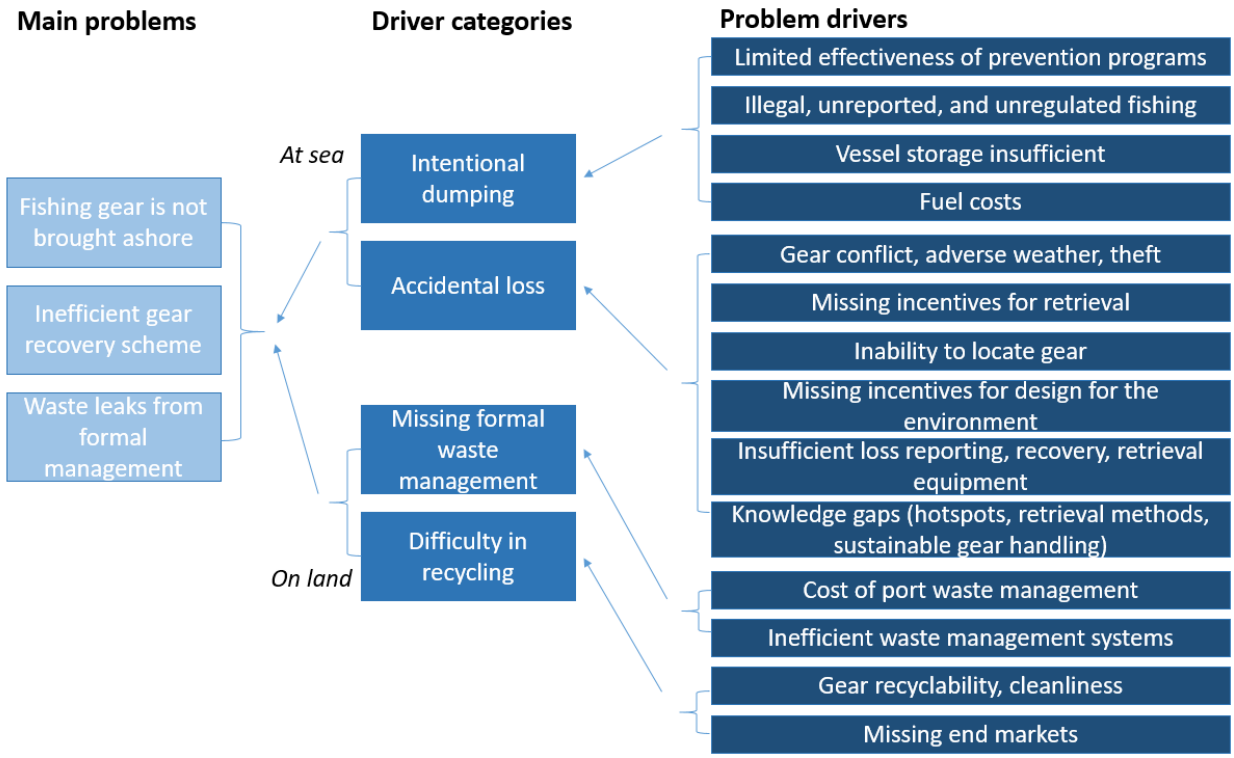
2 Causes and consequences of ghost fishing gear

Fishing gear is lost for a number of reasons, both intentional and unintentional

Natural environment

Physical features of the natural environment, such as reefs, rocks or other structures on the seafloor can snag or otherwise interfere with gear. Some gear, in particularly gear that is designed to touch the seafloor, can be particularly susceptible to loss this way (see Table 2.1). Gear loss can also be exacerbated by strong tides, currents, or winds. For example, gear can be carried away from its deployed location by weather forces. Further, once lost, inclement weather conditions can make it difficult, costly or dangerous for fishers to attempt retrieval of lost gear, and may also damage gear making it less valuable to retrieve. Once damaged, there may also be some incentive to intentionally discard gear rather than wasting valuable fishing time at sea (Macfadyen, Huntington and Cappell, 2009[47]).

Figure 2.1. Ghost gear is a complex issue with multiple causes



Source: Adapted from (Viool et al., 2018[48])

Gear conflict

Fishing gear can also be lost through entanglement with other fishers' gear or through damage from non-fishing vessels (see also **Error! Reference source not found.**). The most commonly reported cause of gear conflict is by mobile gear (for example, trawling) passing through areas where static gear is deployed (Macfadyen, Huntington and Cappell, 2009[47]). Gear can also come into conflict in areas where multiple gear types (e.g. pots, nets and lines) are deployed in the same area at the same time, increasing the chances of them becoming entangled with one another. However, these conflicts are considered less serious and generally the gear is more easily retrievable as it does not travel great distances (Macfadyen, Huntington and Cappell, 2009[47]).

User error or gear malfunction

Gear can also be lost if used inappropriately or in conditions to which it may not be suited (Hareide et al., 2005[49]). For example, if too many nets or other gear are deployed, the fisher may not be able to recoup all nets at the appropriate time. Long soak times can also compromise gear integrity and increase the likelihood of gear being dislodged, while resulting in a higher proportion of catch being unsuitable for consumption[11] (Hareide et al., 2005[49]). Gear can further be lost when tracking systems, which would be used to trace the location of lost gear, malfunction (Gilman, 2015[50]).

Intentional disposal of fishing gear

Fishers may discard unwanted components of gear at sea when deemed more practical or economical to disposal onshore, especially when port reception facilities are unavailable. The lack of convenient harbour-side collection facilities can result in fishers having to dispose of unwanted gear in municipal waste facilities. This can involve both time (with associated costs) and charges imposed for disposal, if indeed such disposal is permitted at all. Therefore, incentives may be strong to deliberately discard gear at sea or to illegally dump it at other land-based locations (Macfadyen, Huntington and Cappell, 2009[47]). Setting excessive gear can also result in discarding gear. For instance, there may be insufficient room on board for all of the gear, such as when the space used to store nets when starting a trip are subsequently used as the fish hold (Gilman, 2015[50]).

Loss or abandonment of fishing gear by illegal, unreported and unregulated (IUU) fishers is also suspected of contributing considerable amounts of ghost gear, as illegal fishers often abandon or discard fishing gear to conceal their activities. While the link between IUU fishing and ghost gear is difficult to prove and quantify, some examples provide corroborating evidence of the phenomenon. In 2015, The Thunder, an illegally fishing vessel that was issued an Interpol Purple notice for suspected poaching of tootfish, abandoned 72km of illegal gillnet at sea while fleeing from inspections. While this happened in Mauritius, the Thunder, as many other illegal vessels, had travelled and poached in many different areas of the world and provides a clear example of how illegally fishing vessels voluntarily dump fishing gear at sea when fleeing from inspections. Another known example of the link between IUU fishing and ghost gear happens in the Gulf of California where nylon gillnets used to illegally catch totoaba, an endangered species highly prized in China for its use in traditional medicine, are abandoned at sea. These abandoned illegal nets often entangle and pose threat to vaquitas, a critically endangered small porpoise. In 2017, GGGI, World Animal Protection and WWF Mexico organized a retrieval project that removed 5,700 square meters of illegally set gillnets that were lost and abandoned in the Gulf of California (GGGI, 2018[51]).

[11] The quality of fish reduces with length of soak time, particularly for gill netting.

Table 2.1. Not all gear types have the same risk of ghost fishing

Relative risk of ghost fishing according to gear class

Gear Class	Susceptibility to loss	Impact of ghost gear	Risk of ghost fishing
Gillnets	Very high High rate of loss, particularly in mixed fisheries where gear conflict is more likely. Many gillnets are set in areas with strong currents, making accidental loss more likely. As gillnets are relatively cheap, there is less incentive to recover and deliberate discarding at sea (for reasons including damage or lack of storage space) can be common.	Very high As they are light gear, they are likely to continue fishing if lost, and can be difficult for animals to see and avoid. They have a wide range of mesh sizes making them dangerous to multiple types of organism. Even once they reach the substrate, they will continue to ghost fish organisms on the ocean floor until the material breaks down.	**Very high**
Traps and pots	High High rate of loss, particularly in mixed fisheries where gear conflict is more likely. They are also more susceptible to theft and accidental loss through storms. Individual pots are more difficult to recover than longer pot strings.	High Bait in traps and pots can continue fishing, with animals eating the bait in turn becoming further bait. The gear also poses an entanglement risk if connecting with ropes and lines.	**High**
Fish Aggregating Devices (FADs)	High FADs can be lost through locator beam failure or deliberate abandonment, for example if damaged. Loss of anchored FADs may be more likely mainly due to mooring failure and as they are not equipped with location equipment.	Medium The main impacts of FADs are from entanglement in the netting, with marine turtles and sharks especially susceptible. They can also wash towards shore and in the process damage vulnerable coral reef systems.	**High**
Hooks and lines	High The extensive use of longlines, their long-set configuration and low cost make them a high likelihood for loss.	Medium Longlines can continue fishing as long as bait exists on the hooks, and fish caught on hooks can in turn become bait. The hooks pose risk of being ingested and lines pose an entanglement risk.	**Medium**
Bottom trawls	Low The high value of the gear and improvements in navigation and marking technologies means there is effort put into recovery of bottom trawls if lost. However, there is mixed evidence of loss.	Medium The larger diameter synthetic multifilament twine common to trawl nets make it less likely to ghost fish, but can make it more dangerous to entanglement of marine mammals, reptiles or birds.	**Medium**
Mid-water trawls	Very low Mid-water trawls seldom have contact with the ocean floor, making gear loss infrequent. The large size of gear, in addition to replacement expense, means recovery is usually attempted and successful.	Low The smaller mesh size means mid-water trawls may capture small pelagic fish, but less risk of entanglement to marine animals. As they are large and heavy, they are likely to quickly fall to the seabed, and may cause damage to sensitive habitats.	**Low**
Seine nets	Very low Seine nets are fished at the surface, and with limited impact on the ocean floor complete gear loss is unusual. As they are large, expensive and floating gear, recovery attempts are often made and are successful.	Low The smaller mesh size means mid-water trawls may capture small pelagic fish, but less risk of entanglement to marine animals. As they are large and heavy, they are likely to quickly fall to the seabed, and may cause damage to sensitive habitats.	**Low**

Note: The risk of ghost fishing gear is a function of the likelihood of gear loss and the impact of gear if lost. Where the risk falls between two categories of risk, the risk is rounded up.
Source: Adapted from (Huntington, 2017[33]).

Ghost gear and aquaculture

The contribution of aquaculture to ghost gear is less well documented than that resulting from capture fisheries, but in some cases has been known to result in such debris (Sandra et al., 2020[52]). Plastics are widely used in aquaculture production, as flotation, filament, and structural or containment components (Huntington, 2019[25]). The pathways of ghost gear entering the environment are different for aquaculture relative to capture fisheries (please refer to Chapter 2 for a discussion on causes related to capture fisheries). Extreme weather and its catastrophic impact on facilities are likely to be a main driver of marine litter from aquaculture. Some low-level leakage of plastics may also occur from inter-tidal and sub-tidal installations from working in a highly dynamic natural environment (Huntington, 2019[25]).[12]

Environmental impacts of marine plastics and ghost gear are widespread and harmful

The ubiquitous use of plastic material has drawbacks for the environment. Plastic waste has several possible outcomes at end of life. These include formal waste management processes like landfilling, incineration and recycling. However, some plastic instead leaks to the natural environment, such as when fishing gear is abandoned, lost or discarded. The waste generated can have harmful impacts on the environment and human health, as well as economic costs.

As fishing gear is largely comprised of plastic material, many of these environmental challenges are highly relevant in a broader policy discussion of ghost gear. However, ghost gear in particular, given its specific design function is to capture marine animals, can have environmental impacts that go beyond other forms of marine plastic debris.

Greenhouse gas emissions

Greenhouse gas emissions are produced during plastics production, as well as at their end of life. Primary plastics production typically transforms petroleum or natural gas into constituent monomers. This process is highly energy-intensive, with Zheng and Suh estimating that plastics production generated 1.7 Gt of CO_2 equivalent, which corresponds to roughly 3.5% of global emissions, in 2015 (2019[53]). Fossil fuel feedstock used in plastics production also accounts for 4-8% of global oil and gas production and this share could increase further in the future as plastics production is expected to grow (Hopewell, Dvorak and Kosior, 2009[54]).

At the end of life of plastics, incineration of plastic waste generates hazardous pollutants such as polyaromatic hydrocarbons, persistent organic pollutants, as well as climate-warming carbon dioxide (Ilyas et al., 2018[55]). Reusing or mechanically recycling plastic maintains a higher value of material and reduces environmental impacts compared with other forms of waste management and virgin plastics production.

Entanglement

Entanglement is believed to be the most deadly of impacts from marine plastic debris, with direct harm or death resulting in 79% of cases of entanglement (Gall and Thompson, 2015[56]) and most entanglement caused by fishing gear. In marine animals – in particular, cetaceans (such as whales and dolphins), seals, birds, sea turtles and elasmobranchs (such as sharks and rays) – entanglement can result in immobility leading to inability to feed, or drowning. All seven known sea turtle species have been recorded as entangled, 45% of marine mammals species and 25% of seabird species (Gall and Thompson, 2015[56]).

[12] The GGGI is currently developing a Best Practice Framework for the Management of Aquaculture Gear, to be released in 2021.

Just 0.39% of fish species have entanglement records, though entanglement in gear can create a positive feedback loop, with target and non-target fish species acting as bait that continues to fish (Gilardi et al., 2010[57]) (read more in section Ghost fishing gear has significant costs to fishers, coastal communities and the broader economy).

In an assessment of the most common forms of marine debris, fishing gear is expected to have four times more impact on marine life – including marine mammals, sea turtles and seabirds – through entanglement than the other forms of marine debris combined (Wilcox et al., 2016[58]). Another study suggested that over two-thirds of entanglement incidents were caused by fishing gear including plastic ropes and netting (Gall and Thompson, 2015[56]). One review suggests that of the 1000 turtles (acknowledged by the authors as likely a profound underestimate) killed annually, the majority are killed from entanglement with fishing gear including ghost gear (Duncan et al., 2017[59]). Although recent population-level studies are limited, one study suggests entanglement contributes significantly to declining numbers of the Northern fur seal observed in the 1980s in the Pribilof Islands off the coast of Alaska, United States (Fowler, 1987[60]).

While the economic costs of these impacts are difficult to quantify, they are no doubt significant when taking into account the invaluable ecosystem services organisms provide. For example, economists from the International Monetary Fund estimate the average value of a great whale to be USD 2 million – including its carbon sequestration and other ecosystem services it provides – with the total stock of great whales valued at over USD 1 trillion globally (Chami et al., 2019[61]).

Ingestion and degradation to microplastics

The impacts of macro-plastic ingestion are widespread, highly irreversible, and can be lethal for marine populations of mammals, birds, turtles, and fish (Beaumont et al., 2019[62]). Ingestion of marine plastic can have immediate impact on the animal itself, by choking or disrupting digestion. Six of the 7 sea turtle species, 39% of seabird species and 26% of marine mammals have ingestion records (Gall and Thompson, 2015[56]). While ingestion inflicts less immediate damage than entanglement – resulting in direct harm of death in an estimated 4% of cases (Gall and Thompson, 2015[56]) – ingestion can have sinister and far-reaching impacts throughout the food chain. Ingested plastics and microplastics become incorporated into the organism, which are in turn ingested into higher trophic levels and eventually humans.

Field and laboratory studies have detected ingestion of microplastics by commercially fished species. However, adverse impacts of ingestion are only noted in laboratory studies with relatively high concentration levels (Lusher, Hollman and Mandoza-Hill, 2017[11]). Microplastics from fishing gear have also been detected digested in coral reefs (Hall et al., 2015[63]).

Habitat destruction

Impacts on habitat have been significant in certain contexts. In particular, ghost gear can be destructive to certain benthic habitats – that is, to the seafloor and its associated biodiversity. The mechanism of this interaction can occur through abrasion, smothering and translocation of organisms (MacFadyen, Huntington and Cappell, 2009[12]).

Coral reefs are also highly susceptible to damage from ghost gear. One study of the Florida Keys coral reef system in the United States, which supports multimillion-dollar commercial and recreational fisheries, found that 84% of visible impacts to sponges and benthic cnidarians (including coral) was caused by lost hook-and-line fishing gear (Chiappone et al., 2005[64]).

Derelict gear washed ashore can also disrupt nesting areas for breeding seabirds. In the Maine Coastal Islands National Wildlife Refuge Complex, including nationally-significant nesting islands that support endangered and threatened species, the United States Fish and Wildlife Service reported collecting 19,200 pounds (8,709 kg) of marine debris, including lobster traps, from a one-kilometre stretch of shoreline (Guertin, 2019[65]).

Introduction of alien species

Invasion of alien species is identified as one of the five direct drivers of change in nature, including to the marine environment, in the last 50 years and the rate of introduction of invasive species is higher than ever before (IPBES, 2019[66]). This can have large-scale consequences, with one estimate proposing that global marine species diversity may decrease by as much as 58% with worldwide biotic mixing (Mckinney, 1998[67]).

Alien species, including encrusting organisms such as bacteria, diatoms, algae, barnacles, hydroids and tunicates, can be transported on floating ghost gear and other forms of marine debris that are picked up in one location and transported by ocean currents to other locations (Beaumont et al., 2019[62]; Derraik, 2002[68]; Barnes, 2002[69]) (Gilman et al., 2021[70]). Potentially disruptive consequences to native biota include a sudden decline in abundance (Galil, 2007[71]; Gilman, 2015[24]) and disease spread (Lamb et al., 2018[72]). While this loss of abundance may not result in immediate eradication of the local species, it may have impacts such as reduction in genetic diversity to that species and changes in habitat structure. One estimate suggests that anthropogenic marine debris – including plastic and ghost gear – roughly doubles the risk of alien species dispersal in the subtropics, and more than triples this risk at latitudes greater than 50 degrees (Barnes, 2002[69]). Other evidence points to plastic waste entanglement associated with an increased risk of disease among coral reefs (Lamb et al., 2018[72]).

Ghost fishing gear has significant costs to fishers, coastal communities and the broader economy

Costs to fisheries from lost gear and ghost fishing of target species

Costs to fishers from ghost gear come primarily from lost potential catches due to continued ghost fishing of target species and from the cost of losing gear. Richardson et al. estimate that, on an annual basis, 5.7% of fishing nets, 8.6% of traps and 29% of fishing lines are lost globally (Richardson, Hardesty and Wilcox, 2019[73]). This represents a tremendous cost to fishers in terms of gear replacement, as well as the opportunity-cost of lost fishing potential. Cost estimates vary significantly based on type of fishery, gear and location, suggesting considerable variation in the experience of individual fishers (Jeffrey et al., 2016[74]).

While estimates of costs and losses incurred from ghost fishing are largely specific to certain fisheries and geographic locations, this section covers some of the limited research conducted to date. Multiple studies have shown that depending on the type of gear and the fishery, ghost fishing can continue for long periods of time. One study showed that while the catch efficiency of lost nets decreased rapidly within the first three months of loss by around 80%, the catch efficiency stabilised at around 5-6% of the initial catch efficiency and was expected to persist for several years (Tschernij and Larsson, 2003[75]).

This associated loss of target species can be significant. While no global studies to estimate costs from ghost fishing have been conducted, there are several examples of regional or fishery-specific studies that demonstrate significant loss in potential catch. Another study that examined monk fish landings in the Cantabrian Sea (Spain and France) suggests that an estimated 18.1 tonnes of monkfish are captured annually by abandoned nets, representing 1.46% of the commercial landings of these species in the region (Sancho et al., 2003[76]). In the Washington waters of the Salish Sea, an estimated 4.5% of the value of Dungeness crab harvest is lost annually to ghost fishing (Antonelis et al., 2011[77]).

Efforts to recover pots can have positive impacts on the fishery in question. A study in Chesapeake Bay, United States, showed the potential value of removing 34,408 derelict pots led to a 27% increase in harvest, valued at USD 21.3 million. The authors extrapolate their findings to suggest that removing even less than 10% of derelict pots and traps in major crustacean fisheries could result in USD 831 million in

recovered annual landings globally (Scheld, Bilkovic and Havens, 2016[78]). Sullivan et al. suggest that fishing gear recovery has the potential to add more than 24,000 mature blue crabs back into the Mullica River-Great Bay Estuary in New Jersey, United States (2019[79]).

However, further work is needed to ascertain the cost-benefit of recovering fishing gear. A study from Washington, United States, suggests that the value of saved crabs ranged from USD 36.96-61.04 per removed trap, which is below the estimated cost of trap removal of USD 92.66-193.00 per trap (Antonelis et al., 2011[77]). Another study, examining Dungeness crab fishery in Puget Sound, Washington, estimated the cost benefit to be significantly more favourable towards gear recovery: with the loss to the commercial fishery estimated at over USD 19,656 and the cost of gillnet removal at USD 1,358 (Gilardi et al., 2010[57]). It is important to note that these cost-benefit analyses do not necessarily take into account the broader ecosystem and social benefits of gear removal, and therefore can be expected to underestimate the true benefit.

Impacts on shipping

Marine plastics and ghost gear can impact shipping, in particular interfering with navigational safety and delays. For example, entanglement of vessel propellers, anchors or deployed equipment can adversely impact manoeuvrability and stability (MacFadyen, Huntington and Cappell, 2009[12]). Attempts to clear the debris by divers can be dangerous work, particularly in adverse weather conditions, and can cause delays to shipping. A six-year study of the impact on ghost gear on Korea's navy ships showed that propeller entanglement occurred multiple times per ship and throughout all local seas, with the incidence increasing over time in some cases (Hong, Lee and Lim, 2017[80]). One case of fishing gear damage reported to the International Marine Contractors Association refers to vessel repair costs of "hundreds of thousands of dollars" and the vessel not able to be used for nearly 90 days (2018[81]).

Impacts on human health

Ghost fishing gear, like other types of marine plastic litter, breaks down into microplastics in the environment. These microplastics are in turn consumed by marine organisms, being incorporated into higher and higher trophic levels and ultimately poses risks for human health.[13]

The presence of plastic in fish and shellfish food sources has led to concerns about health risk of human food consumption. Of particular concern, some plastic additives are persistent, bio-accumulative, and toxic substances (PBTs) (Lusher, Hollman and Mandoza-Hill, 2017[11]). As well, additives can leach out of polymers into the environment or body tissues (Galloway, 2015[82]). Human consumption of plastic from seafood is likely dependent on the fishery in question. Vandermeersch et al. estimate 1 particle per day consumption (2015[83]), but greater concentrations (4 particles per gram of tissue) have been reported in bivalves, such as mussels, in China (Li et al., 2015[84]). However, removal of the gastrointestinal track can greatly reduce exposure risk from human consumption for some species. Presently, consumption likely only negligibly increases exposure to PBTs (Lusher, Hollman and Mandoza-Hill, 2017[11]). Plastics are also more directly entering the food chain, for instance plastics have been discovered in drinking water and sea salt (Kosuth, Mason and Wattenberg, 2018[85]).

The empirical evidence of the impacts from plastic pollution to the environment and human health is currently limited, but expanding. As such, there is uncertainty about the magnitude of the damages. Current levels of plastic introduced into the natural environment are significant, but a relatively recent phenomenon. Full impacts will only emerge in the longer term, but some effects are already clearly visible. Anticipated

[13] Some polymers are made of monomers that are carcinogenic, mutagenic, or both. However chemical safety data is a limitation in policymakers current ability to predict risks from plastics-associated chemicals (Galloway, 2015[82]).

growth in plastic production and waste generation suggest higher concentrations and thus impacts may be forthcoming.

Impacts to tourism

Adverse economic consequences of plastic pollution, including ghost gear, may in particular affect coastal communities relying on tourism. First, the reputation of tourist destinations can be harmed from having an image of marine and coastal litter associated with a holiday destination. For example, one study suggests that beachgoers would avoid a beach visit in a high-litter scenario, resulting in local tourism losses of up to 40% (Krelling, Williams and Turra, 2017[86]).

Second, communities and local tourism operators can bear the clean-up costs, for example of beaches. These costs – while not all caused by ghost gear – can be significant. In the UK, a beach being a "popular tourist area" was the most frequently cited reason for why municipalities undertake beach clean ups, and is estimated to cost municipalities GBP 17.9 million annually (equivalent to approximately USD 21.4 million) annually (Mouat, Lozano and Bateson, 2010[87]).

3 Good practices to prevent, mitigate impacts of and retrieve ghost gear

Given the different causes and types of ghost gear, a multi-dimensional approach covering a range of possible solutions and collaboration among different stakeholders is required. This section explores good practices that are being implemented around the world, building on the framework provided by the GGGI BPF (Huntington, 2017[33]) (Huntington, 2017[34]). These examples help to identify possible solutions that can be adopted on a wider scale.

The GGGI BPF categorises measures aimed at addressing ghost gear into three categories depending on their objective and the stage of intervention. Measures are categorised into:

- **Prevention** measures aimed at avoiding gear loss, discard or abandonment;
- **Mitigation** measures aimed at reducing the impact of the gear once it has been lost, discarded or abandoned; and
- **Remediation** measures aimed at locating and retrieving ghost fishing gear.

In practice, many of the measures identified as useful and effective in the GGGI BPF act at several stages of intervention and a comprehensive plan of action would require a combination of measures (Table 3.1). For example, implementing a system for the marking of fishing gear can help to prevent gear loss or discard but can also address the adverse impacts of ghost gear by helping to locate and recover it faster when it is lost. From an environmental point of view and on the basis of the few cost-benefit policy impact analyses available (MacFadyen, Huntington and Cappell, 2009[12]), prevention measures are likely to be preferable to remediation measures. However, even in highly regulated environments, where prevention measures are in place, some loss of fishing gear is likely inevitable, and mitigation and remediation measures are therefore needed to reduce its impact.

Table 3.1. Good practices addressing ghost gear are implemented across G7 countries

Type and example of policy measure by category (prevention, mitigation and remediation)

Policy measure	Prevention	Mitigation	Remediation	Examples
Marking of fishing gear	X		X	• Canada, France, Germany, Italy and UK: ownership details must appear on gear. • U.S.: Washington state requires ownership details on gear.
Vessel design	X		X	• France, Germany, and Italy: a ship's indirect fee for port waste management can be reduced for those vessels designed, equipped or operated to minimise waste.
Disposal facilities	X			• All: MARPOL Annex V Regulation 7. • France, Germany, Italy: EU Directive on Port Reception Facilities. • U.S.: public-private partnership with Healthy Oceans.
Spatial or temporal planning	X			• All: spatial planning for Marine protected areas. • Canada: Pacific North Coast Integrated Management Area. • France, Germany, Italy: EU Common Fisheries Policy.

				• Japan: marine cadastre includes gear conflict awareness. • U.K: national marine plans. • U.S.: four states have marine spatial plans.
Gear design	X	X		• US: biodegradable escaping panels or cords in Florida and Washington state.
Education and awareness	X			• France, Germany, and Italy: Marine LitterWatch offers tools for data collection and sharing. • Japan: National Action Plan for Marine Plastic Litter awareness raising. • U.S.: Marine Debris Program (NOAA) supports outreach and behaviour change projects.
Reporting and retrieval of ghost gear			X	• All: MARPOL Annex V requires reporting of lost gear. • Canada: lost gear must be reported within 24 hours. Ghost Gear Fund supports retrieval projects. • France, Germany, and Italy: Vessels must have retrieval gear, 24 hour reporting requirement. Germany's fishing for litter program implements funding from the European Maritime Fisheries Fund (EMFF). • Japan: subsidised patrol vessels collect lost gear • U.K.: Requires retrieval and notification of lost gear • U.S.: Newly Lost Net Reporting, Response, and Retrieval Program in the Puget Sound requires 24 hour gear loss reporting.
Extended Producer Responsibility	X			• France, Germany, and Italy: to introduce before 2025 EPR schemes for fishing gear and fishing gear components made with plastic. • The UK are reviewing and consulting on an EPR scheme for end-of-life fishing gear by 2022.

Note: Examples are not an exhaustive list.
Source: Authors' assessment and (Huntington, 2017[34]).

The marking of fishing gear helps prevent gear loss and assists in recovery if lost

A system for the marking of fishing gear is a key good practice to prevent and retrieve ghost fishing gear. Using surface markers, such as buoys, helps to locate the position of gear thus reduce losses and prevent conflict between different types of gears. Location trackers, such as satellite buoys, assist in finding and recovering gear when it is lost. Finally, marking gear to its owner(s), including underwater marking, helps to identify recovered ghost gear and acts as a deterrent to IUU fishing. Identification allows better quantification of the problem of ghost gear and its sources and for penalties in the case of infraction of the law. For example, when inspections at ports identify unmarked fishing gear that cannot be linked to its ownership, or permission to fish in a specific area, this can indicate IUU fishing operations and helps sanction against them.

Voluntary Guidelines for the Marking of Fishing Gear

The FAO Voluntary Guidelines for the Marking of Fishing Gear (VGMFG) (2019[27]), endorsed by its Committee on Fisheries in July 2018, is the key international instrument to assist States and regional fisheries bodies (RFBs), including regional fisheries management organizations and arrangements (RFMO/As) in developing and applying a system for the marking of fishing gear and related measures to address ghost gear. The Guidelines provide general recommendations reminding regulators that a correct marking system should take into consideration local and fisheries needs and be elaborated in collaboration with all relevant stakeholders. The Guidelines encourage FAO Member States and RFBs to collaborate in the development and implementation of harmonised marking systems. They promote a simple, pragmatic

marking system allowing the owner and the position of fishing gear to be identified, and linking the gear to the person or entity responsible for fishing operations. For this purpose, the Guidelines suggest the use of a unique mark that matches vessel registration details whenever possible and otherwise a company common mark followed by individual gear identifier. The document also suggests that when gear marking is implemented by relevant authorities it should, as appropriate, be a condition of any new fishing authorization.

The Guidelines stress the importance of a preventive risk assessment associated with ghost gear to target those fisheries that need gear marking in priority and thus effectively reduce the likelihood and impact of gear loss. In doing so, the Guidelines provide a set of possible risks and items that need to be considered when making the assessment such as risks regarding the ecology, the economic aspect, the technological aspect, safety and navigation, cultural interactions. They also stress that an effective risk assessment should consider the availability of information and the possible beneficial synergies to be derived from harmonising gear marking systems.

Once a system for the marking of fishing gear has been designed, the Guidelines recommend that its enforcement be an integral part of fisheries monitoring, control and surveillance (MCS) arrangements (including thorough inspections) and that appropriate penalties be applied when the requirements of the gear marking system are not fulfilled. Unmarked or wrongly marked fishing gear may indicate IUU fishing operations and should be reported to appropriate authorities for inspections. Gear marking would in this way help prevent, detect and fight IUU fishing.[14]

Gear marking schemes in G7 countries

At the national level, several examples of mandatory gear marking exist. Canada requires fishing gear to be marked to the vessel registration number or with the name of the person who owns the gear (Government of Canada, Justice Laws Website[88]). In 2019, The Department of Fisheries and Ocean Canada announced a mandatory gear marking program in Eastern Canada consisting of specific colours that must be used to correctly identify fishing ropes in different fisheries, regions and sub-regions in Canada (Fisheries and Oceans Canada[89]). Each rope consists of colour schemes braided into the rope; one colour signifying the region, another the species, and a third identifying individual fishing areas within the region. The EU Common Fisheries Policy Control Regulation (European Commission[90]) also contains the requirement to mark fishing gear. Article 8 of Regulation (EC) no. 1224/2009 (EU Lex, 2009[91]) states that fishing gear has to be marked allowing the identification of the gear owner. UK legislation also requires fishing gear to be marked (UK legislation, 2006[92]; UK Government, 2016[93]).[15]

[14] The Guidelines also stress the importance of the associated components of an effective gear marking system, including the improvement of gear marking technologies (see Gear design changes can reduce gear loss and its impacts) and reporting, recovery and disposal of ALDFG (see Reporting and retrieval policies help to address unavoidable gear loss) .

[15] Mandatory gear marking schemes are also implemented at the local level in some G7 countries. For instance, Washington State (U.S.) requires every shellfish pot, ring net, or star trap left unattended in Washington waters to have its own buoy line and a separate buoy that is permanently and legibly marked with the operator's first name, last name, and permanent address (telephone number is voluntary). Buoys must be constructed of durable material and must be visible on the surface at all times except during extreme tidal conditions (Washington Department of Fish&Wildlife[140]).

Improved vessel design and fishing gear disposal facilities can help reduce intentional discard of fishing gear

Disposal facilities at ports can help to address purposeful discarding of damaged fishing gear at sea by providing gear users with an avenue for disposal of end of life gear. Disposal facilities can also improve collection of gear and facilitate the preparation of gear for reuse or recycling. MARPOL Annex V Regulation 7 requires that "the Government of each Party to the Convention undertakes to ensure the provision of facilities at ports and terminals for the reception of garbage, without causing undue delay to ships, and according to the needs of the ships using them" (International Maritime Organization, 2017[29]). However, scale and capacity issues have led to under provision of adequate port reception facilities (Macfadyen, Huntington and Cappell, 2009[47]). Discharge of unwanted gear at sea linked to a lack of capacity for ports to accept ghost gear, is still a relevant phenomenon (Richardson et al., 2016[94]).

The EU 2019 Directive on Port Reception Facilities provides a recent example of regulation aimed at improving port waste management and protecting marine environments against the negative effects from discharges of waste at sea. It requires EU Member States to ensure that appropriate waste reception is in place, including for ghost gear, and has been implemented for each port. This follows ongoing consultations with all the relevant parties, such as port users or their representatives, local competent authorities, port reception facility operators and representatives of civil society.

In addition, the regulation mandates that the right level of incentives be in place to encourage the delivery of waste to port reception facilities. The EU directive suggests a cost recovery system which requires the application of an indirect fee that should be due irrespective of the delivery of waste and should give the right to deliver the waste without any additional direct charges. The Directive also calls for both on-board waste segregation, which would separate derelict fishing gear from other waste produced on the vessel, and for separate collection at port. This would enable derelict fishing gear to be prepared for reuse or recycling in the downstream waste management chain (EU Lex, 2019[95]).

Fishing vessels often try to maximize the efficiency of the little space they have on-board. Sometimes the space used to store nets can be filled at the end of a trip with catch fish (Gilman, 2015[50]), leading fishers to abandon or discard used nets at sea in order to save space. Ensuring adequate space on-board to stow gear and emergency retrieval tools is therefore a key preventive practice. To incentivize this practice, the EU Directive on Port Reception (EU Lex, 2019[95]) states that a ship's indirect fee for port waste management can be reduced for those vessels designed, equipped or operated to minimise waste. Reduction and efficient recycling of waste can be primarily achieved through effective on-board waste segregation.

Spatial or temporal planning measures can help prevent gear conflicts

Spatial management is key to prevent gear conflict, especially conflict between static and mobile gear.[16] This objective can be achieved either by actively segregating users of different types of gear or by ensuring that all fishers are aware of the presence of other users' gear in the water (Macfadyen, Huntington and Cappell, 2009[47]). Designating core and buffer areas, through for example Marine Protected Areas (MPA), can reduce ghost fishing impact by avoiding fishing activities in vulnerable marine habitats. Temporal elements in the marine spatial planning, such as seasonal closures, can prevent overlapping fisheries who wish to use the same geographic area. Finally, spatial management helps reducing possible conflicts with sea uses different from commercial fishing, such as marine transport, sailing or recreational fishing.

[16] Spatial management is the analysis and organisation of human activities in marine areas to achieve ecological, economic and social objectives.

Marine spatial planning and zoning started mostly as voluntary agreements between fishers to avoid gear conflict. An example of a voluntary agreement running since 1978 is the Inshore Potting Agreement in Devon, England, UK. Fishers using static gear (trap or net) and towed gear (trawl and dredge) reduced their gear conflict by designing areas for the exclusive use of static gear, and areas for seasonal static gear use. Towed-gear fishing is allowed in seasonal areas during periods when they are free from static gears (Blyth et al., 2004[96]). Another example is in the Area A crab fishery in British Columbia, Canada, where salmon trawlers and crab fishers have an informal agreement designing separate fishing areas for trawlers and crabbers (GGGI, 2020[97]). In Washington State (U.S.), crab fishers and vessel captains voluntarily follow designated traffic lanes to avoid gear conflict (GGGI, 2020[97]). Marine spatial planning or MPAs are currently being designed and implemented in all G7 countries. Early initiatives in this domain have started mostly at the state level in the U.S.[17] Canada started action in this domain in 1996 with legislation for Ocean management, the *Oceans Act*, followed by 2005-2007 Canadian Ocean Action Plan identifying four pillars, including integrated ocean management (Ehler, 2020[98]). Marine spatial planning is an important component of the revised EU Common Fisheries Policy (European Commission[99]) and member States will establish it by 2021. The four countries of the United Kingdom all have national plans completed or near completion (Ehler, 2020[98]).[18] Japan as well is currently discussing the possibility of implementing MSP (Sasakawa Peace Foundation, 2020[100]).[19]

Gear design changes can reduce gear loss and its impacts

Changes to the design of fishing gear can reduce the likelihood of gear loss and its impacts. Three particular areas for gear improvement include: marking and tracking technologies, escape cords and panels and excluder devices (mechanisms that prevent entanglement).

Gear marking is an essential best practice to reduce ghost gear (see The marking of fishing gear helps prevent gear loss and assists in recovery if lost). FAO and GGGI workshops on implementing best practices (FAO, 2019[28]) identified new technologies for marking fishing gear that are cost-effective, easily accessible and environmentally friendly as a necessary tool for expanding and improving the implementation of gear marking systems. Examples might include new types of gear labels that do not get lost at sea or cost-effective GPS systems to track the fishing gear.

Escape cords and panels can help to stop ghost fishing from lost traps and pots in particular. Biodegradable materials and gear modifications to facilitate mammals' self-release after entanglement may reduce the impacts of gear loss. For example, in crab or shellfish fisheries biodegradable cords can be designed to effectively disable derelict traps (Huntington, 2017[33]). Another possibility is a biodegradable panel with an

[17] Oregon has adopted a Territorial Sea Plan in 1994 and in 2008 the governor of Massachusetts signed the *Ocean Act*, the first comprehensive ocean planning legislation in the U.S. Alaska Fish and Game Department designs specific spatial areas for trawlers or crab fishers so as to protect crab nursery areas and prevent gear conflict (GGGI, 2020[97]). In 2019, four of 35 coastal Unit states and territories of the United States have approved marine spatial plans (Ehler, 2020[98]).

[18] A UK Marine Policy Statement released in 2011 provided the framework for preparing the marine plans. As of today, six Marine Plans have already been implemented and four more are expected to be completed by 2021 (UK Government[141]; UK Marine Management Organization, 2013[138]).

[19] While a complete MSP is still under discussion, MPAs have been designated in Japan; in 2010, more than 30% of the individual MPAs in Japan were established by self-imposed instruments agreed by members of fishery co-management organizations (Yagi et al., 2010[137]). Japan also recently implemented a "Marine Cadastre" to promote understanding, proper use and conservation of the Ocean, helping reducing gear conflict (Japan Coast Guard[143]; Tsunoda, 2019[142]).

escape ring could reduce ghost fishing of lost crab pots.[20] A number of shellfish fisheries are required to use degradable escape panels in traps (Macfadyen, Huntington and Cappell, 2009[47]).

Bio-degradable plastics have some limitations (see Box 3.1). Therefore, their application for a specific purpose, such as to reduce ghost fishing in a particular fishery, is likely more appropriate for avoiding unintended consequences than a uniform endorsement in all instances.

Box 3.1. Biodegradable plastics can complicate recyclability

Biodegradation is the deterioration of material by living organisms (e.g. bacteria, fungi, and algae). In a two-stage process, plastics biodegrade by first breaking down into smaller fractions through either biotic or abiotic processes, and then the resultant fragments are bio-assimilated by organisms, ultimately ending in mineralisation (Napper and Thompson, 2019[101]).

Some stakeholders have argued for the design and adoption of plastic material in fishing gear that is marketed as biodegradable (FAO, 2020[102]). *Force majeure* causes of ghost gear (see Fishing gear is lost for a number of reasons, both intentional and unintentional) make this option appealing for policymakers because the causes suggest some inevitable gear loss.

However, the rate and process of degradation depends on physical and environmental conditions such as exposure to light, heat, mechanical abrasion, moisture, and chemical conditions. For example, one study found little change in the chemical structure of different plastic carrier bags exposed to varying environments (including saltwater) after 27 months (Napper and Thompson, 2019[101]). Biodegradable plastics also generate microplastics, as do conventional plastics (Kubowicz and Booth, 2017[103]). As such, there is currently a lack of evidence that degradable plastics have an environmental advantage compared with conventional plastics (Napper and Thompson, 2019[101]).

Biodegradable plastics are an undesired contaminate in recycling streams because their inclusion in recyclate impacts the strength and durability of the resultant material. As well, biodegradable plastics are difficult to isolate and contain with currently deployed recycling sorting technologies (Kubowicz and Booth, 2017[103]). There is also concern that the moniker of biodegradability may misconstrue true performance and lead to littering (OECD, 2018[104]).

These trade-offs in accelerated degradation and potentially adverse impacts to recycling systems may compromise any real benefits gained from the use of biodegradable materials. Therefore awareness of the limitations of degradability performance and selection of material with consideration of end of life processes can help to reduce unintended consequences of material selection.

Physical modifications of gear can help to reduce entanglement. Examples include excluder devices, the use of weak ropes or hooks, tie-downs and nets with lower profile, rope-less fishing or entrance barriers (FAO, 2021[105]). Some of these measures have been tested and others are used but not adequately studied. Therefore, additional analysis of these modifications, their positive effect in reducing entanglement and their possible risks of increasing lost rate is needed.

Policies, including regulation and economic incentives can stimulate the design of better gear and its adoption. Regulations can require manufacturers and gear owners to adopt best available technology or to meet minimum requirements. For example, Florida's spiny lobster fishery has had a requirement to use degradable escape panels in traps since 1982 (Matthews and Donahue, 1996[106]). Tools to instigate

[20] Panels can degrade in about a year, are relatively inexpensive and there is no evidence that they adversely affect active catch (Bilkovic et al., 2012[139]).

research and development can also help to encourage innovation. Economic incentives and extended producer responsibility schemes (See section on Extended Producer Responsibility) provide incentives to design for the environment by internalising the end of life costs of design choices to gear producers.

Box 3.2. Gear design choices impact the end of life phase

Gear design should enable and ease repair, re-use, and recycling. Stakeholder engagement, including manufacturers, gear users, port collection facilities managers, and policymakers, is likely needed to move design towards meeting both performance and environmental considerations. Possibilities include design for reparability and the use of fewer polymers per individual gear. Economic as well as technical barriers inhibit circularity of gear. Preparation, collection, and separation can enable recycling of technically difficult to recycle materials. For example, recyclers and gear manufacturers have recently developed rope material sourced from post-use maritime ropes (Plastix, 2021[107]).

Enhancing education and awareness of ghost gear impacts and measures may help to influence behavioural changes amongst fishers and consumers

Awareness of the harm caused by ghost fishing gear both at the environmental and at the economic level might change fishers' perception of the issue and influence their behaviour. In some cases, fishers may be unaware of both the environmental damage caused by their lost gear and the possible economic losses caused by a decline in stock due to ghost fishing. Campaigns raising awareness of the consequences and of the magnitude of the issue of ghost gear such as pilot removals or workshops with fishers might therefore influence fishers' behaviour and increase their compliance with voluntary measures. Awareness campaigns should be complemented with technical training about how to avoid losing gear and how to best retrieve it when it is lost.

Campaigns raising general public awareness of the issue of ghost gear and its negative impacts can raise the demand for both regulatory interventions and market measures such as third-party certification schemes including gear loss prevention as a requirement for their evaluation. The Marine Stewardship Council, for example, includes criteria that relate to ghost fishing and gear loss in the standards they use to certify fisheries. In particular, certified fishing operators are required to minimise their impact on habitats and reduce their operational waste such as ghost gear (Huntington, 2017[33]; Marine Stewardship Council[108]).

Awareness campaigns can be run either through reports and media articles describing the problem and impacts of ghost gear or by showing citizens the magnitude of the problem, with projects involving citizens into the collection and measurement of waste from the beach or underwater. This type of citizen-science programs have many benefits: they remove litter from the beach or the ocean, they help build an extensive database of the problem of marine litter, and help increase citizens' awareness of the problem. An example of this approach is the project Marine LitterWatch developed by the European Environment Agency. Marine LitterWatch offers tools – a mobile app, a web portal and a public database – to collect and share comparable data on marine litter on beaches. It is helping to build a harmonized EU database of marine litter and it increases citizens' awareness of the issue. Other similar programs, such as the Diving against Debris Program, involve recreational divers into the collection and reporting of marine debris (European Environment Agency, 2015[109]; Project Aware[110]).

Reporting and retrieval policies help to address unavoidable gear loss

Sometimes gear loss is unavoidable due to bad weather or accidents. Immediate retrieval is the best solution to prevent all types of harm and requires training and on-board equipment. The FAO VGMFG (FAO, 2019[27]) suggest Member States should encourage fish operators to expend every reasonable effort to immediately recover lost gear and have adequate equipment and training to do so. When immediate retrieval is not possible, due for example to adverse weather conditions that could threaten human safety, obligations to report lost gear might help in its relocation, avoidance of other vessels' entanglement and later recovery.

MARPOL Annex V (International Maritime Organization, 2017[29]) requires the mandatory reporting of discarded, abandoned or lost fishing gear and this is further stressed in FAO VGMFG (FAO, 2019[27])and GGGI BPF (Huntington, 2017[33]) (Huntington, 2017[34]). Further, incentives and regulation to report and recover ghost gear found while at sea and not belonging to the fisher should be established (Huntington, 2017[34]). FAO VGMFG (FAO, 2019[27]) encourages responsible authorities to include reporting obligations when setting a system for gear marking. It suggests for example that reporting of ghost gear to relevant authorities might be a requirement for fishing operators to obtain fishing authorization or licence. Pilot or end-of-season retrieval programs, preferably run in collaboration with fishing communities and associations, are also effective at reducing the impact of ghost gear and increase awareness.

Examples of lost gear reporting requirements

Canada makes reporting of lost fishing gear mandatory for everyone within 24 hours after loss with the inclusion of information such as name of fishing operator and licence number, fishing area, position, description of the gear that was lost, estimation of its length or number of units. The EU Council Regulation No 1224/2009 (EU Lex, 2009[91])requires Union fishing vessels to have the equipment on board to retrieve lost gear. In cases where gear is lost, the master of the vessel has to retrieve it as soon as possible. If the lost gear cannot be retrieved, the master of the fishing vessel is to inform the authorities of its flag Member State within 24 hours. The flag Member State has then to inform the competent authority of the coastal Member State. The information includes the external identification number and the name of the fishing vessel, the type and the position of lost gear as well as the measures that were undertaken to retrieve it. Fishing vessels below 12 metres can be exempted.

Under the proposal for a Regulation of the European Parliament and of the Council amending Council Regulation (EC) No 1224/2009, the reporting by the fishing vessel is to be done in an electronic logbook, and Member States are required to collect and record the information concerning lost gear and provide it to the Commission upon request. The information collected and available in the waste delivery receipts on passively fished waste in line with this Directive could also be reported in this way.

Compulsory requirements for reporting loss of fishing gear are key both to estimate the magnitude of the issue and to retrieve ghost gear in the shortest time possible. However, the requirement to report lost gear within 24 hours from loss might also have the shortfall of preventing fishers to search and find their lost gear. Anecdotal evidence suggests that in certain weather conditions, fishers may retrieve their lost gear even a few days later. Therefore, ensuring that the report can be easily cancelled if gear is thereafter found is key to ensuring compliance and avoiding inaccurate reports of lost gear.

Examples of collection and retrieval of ghost gear

The collection and retrieval of marine litter and ghost gear is a key remediation practice that is crucial to implement both at the local level and national level with incentives for fishers to bring back litter and gear. Particularly successful examples of local gear removal are the ones involving all stakeholders such as the Puget Sound Derelict Fishing Gear Program in Washington State (USA). The Newly Lost Net Reporting,

Response, and Retrieval Program in the Puget Sound includes a real-time telephone and online reporting system for lost fishing nets. Fishers are required to report lost nets within 24 hours. Reports to the system are responded to within hours and response teams are mobilized to find and retrieve verified newly lost fishing nets. The program has removed over 70 newly lost gillnets since the program's inception in 2012 (GGGI, 2020[97]).

Some countries have national or regional retrieval programs in place. In 2019, Canada's Department of Fisheries, Oceans, and the Canadian Coast Guard (DFO) carried out a three-day ghost gear removal project in the Gulf of St. Lawrence in 2019, removing over 100 crab pots, more than 9 kilometres of rope, and releasing over 10,000 pounds of live crab back to the water for the benefit of the fishery and endangered North Atlantic right whales in the area (GGGI, 2020[97]). Canada recently established the Sustainable Fisheries Solutions & Retrieval Support Contribution Program, or Ghost Gear Fund, (Fisheries and Oceans Canada[111]) encouraging Canadians to take actions to reduce plastic in the marine environment. In the biennium 2020-2022 the fund will support 26 projects around the world falling under 4 main themes: ghost gear retrieval, responsible disposal, acquisition and piloting of available technology, international leadership.

The European Maritime and Fisheries Fund (EMFF) Article 40 and 43 explicitly mention that the fund can be used to support the collection of waste by fishers from the sea such as the removal of lost fishing gear and marine litter or investments in facilities for waste and marine litter collection (European Commission; Directorate-General for Maritime Affairs and Fisheries, FAME SU, 2017[112]). Some EU G7 members have used EMFF for projects aimed at collecting marine litter and ghost gear such as Germany Fishing for Litter program (Marlisco[113]).In the UK, KIMO, a network of local governments, has a Fishing For Litter program providing participating vessels with bags to collect marine litter that is caught in their nets during fishing activities and covers all waste costs (Fishing For Litter[114]). In Japan, patrol vessels operated by Japanese Fisheries Agency and fisheries organizations subsidised by the government regularly collect ALDFG and dispose it on land (Inoue and Yoshioka, 2002[115]).

Extended Producer Responsibility can have benefits for the design and end of life outcomes for ghost gear

Extended Producer Responsibility (EPR)[21] for fishing gear could have several benefits for the design and end of life outcomes for fishing gear. Data collection and reporting in fulfilment of EPR obligations can help to improve transparency of the manufacture, collection, disposal, and recycling of fishing gear. The costs of EPR schemes can be partially offset by the revenue generated from recycling. EPR for fishing gear manufacturers can help to shift the cost burdens of waste management from small ports and fishing operators. As well, an EPR approach can provide incentives for manufacturers to design gear that is less vulnerable to loss during use and more recyclable or repairable (see Gear design changes can reduce gear loss and its impacts) (Charter, Sherry and O'Connor, 2020[116]) (Jauke van Nijen, 2021[117]). The UK are reviewing and consulting on an EPR scheme for end-of-life fishing gear by 2022.[22] As well, the EU has recently adopted a directive for its Member States to implement EPR for gear manufacturers (see Box 3.3).

[21] EPR is an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of the product's life-cycle. EPR has been an effective policy tool for shifting financial responsibility of waste management from the public sector to producers, and its implementation has coincided with increased recycling rates. An EPR approach can be implemented with one or a combination of various policies, including product take-back requirements, advanced disposal fees (ADFs), and standards, and information-based instruments (OECD, 2016[144]).

[22] The UK's waste and resources strategy states support for the EU's requirement of Member States to implement EPR for fishing gear and an expectation that the UK will review and consult on its own EPR scheme (DEFRA, 2018[146]).

Box 3.3. Single use plastic directive includes EPR for fishing gear in the EU

EU Directive 2019/904 requires Member States (including G7 members France, Germany, and Italy) to introduce before 2025 EPR schemes for fishing gear and fishing gear components made with plastic. The intent is to ensure separate collection of fishing gear and to finance recycling and other environmentally sound waste management. Producers are defined as the entity that places the fishing gear on the market or sells directly to the private household. Fishers and artisanal gear makers are excluded from the definition of a producer and EPR obligations. Indicating the potential incentive gap for fisherman, the directive states that EPR should be supplemented with further incentives for fishers to bring back waste gear.

EPR schemes will need to cover the costs of separate collection (adequate port reception facilities or other equivalent facilities), transport and treatment, and measures to raise awareness on good practices for waste management, including the impact of littering and improper waste disposal.

Member States with marine waters will need to set national minimum annual collection rates of waste fishing gear containing plastic for recycling. In the long term (by 2027), the EU intends to set binding collection targets informed by the national level reporting. As well, standardisation organisations are required to develop standards for circular design (reuse and recyclability) of gear (EU Lex, 2019[118]).

Several design choices will determine the incentives for actors impacted by the policy approach. These include:

- The definition of the "producer" impacts which actors are responsible for the physical and economic obligations of EPR. Manufacturers and or the gear users can be defined as producers. Placing EPR obligations solely with the gear manufacturer risks insufficient incentives for the gear user to minimise the risk of gear loss, but can bolster incentives for manufacturers to design for recycling.
- The scope of responsibility determines the extent of the producer's obligations. Policymakers will need to determine if gear retrieval is included in the EPR scheme. Inclusion helps to internalise the cost of gear loss, increase incentives for gear design that facilitates retrieval, and raise awareness, but can increase costs of EPR fulfilment.
- The policy tools selected determine the strength of the incentives. Collection targets alone are likely insufficient. Financial instruments, including ADFs and deposit return schemes (DRS) strengthen incentives for proper disposal at end of life and create a financial base for producers to fulfil obligations.[23]

Cost distribution and design trade-offs faced by producers are likely drawbacks to an EPR system for fishing gear. Despite the definition of producer, the incidence of the costs for implementing EPR can be split between the manufacturers, the fisherman, and customers. It is possible that the costs would disproportionally impact small and medium size enterprises (Jauke van Nijen, 2021[117]). Exclusion of such groups from EPR obligations, however, could favour these groups with an advantage. As well, EPR aims to provide designers of products with the incentives to design for the environment. The design of the EPR system and the ways in which fees are set by design type can send a signalling function to producers. In the case of fishing gear, there are potentially competing design choices, such as design for recyclability

[23] The EC commissioned an impact assessment of EPR options to reduce ghost gear. It estimated that the economic benefits of an EPR scheme with DRS would outweigh the costs of the system. However, these benefits and costs were not evenly distributed amongst stakeholders (manufacturers, fishers, recyclers, and governments). The costs and benefits of an EPR system without DRS would be roughly equal (not including social and environmental impacts) (Viool et al., 2018[48]).

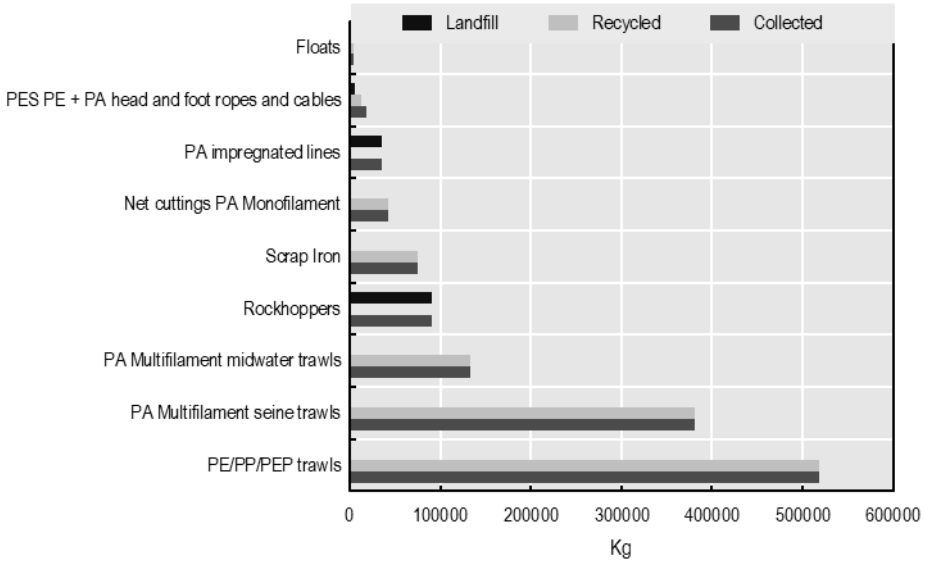
versus bio-degradability. As well, fishing gear is typically made of several parts and can be combined, repaired and reused, complicating accounting for DRS and collection requirements by producers (Jauke van Nijen, 2021[117]).

Collection infrastructure and transportation of end of life gear are further considerations. Fisheries vary in geographic spread and port infrastructure. As well, some gear can be quite heavy (e.g. 9,000 kg) or very long (e.g. several kilometres). Therefore, collection and transportation are likely to be significant drivers of cost for meeting EPR obligations.

Voluntary EPR schemes for fishing gear have developed where economic and policy conditions have made such options viable. Nofir is an EPR system based in Norway, but that also conducts work in the U.K. and is looking to expand operations to Canada, which collects end of life gear for recycling for free. The revenue generated by recycling pays for the operation costs. Collection occurs at port facilities and by requested collections. In Iceland, the federation of Icelandic fishing vessel owners and fish processing plants (SFS) has established an EPR system in place of enforcement of the country's ADF policy. Vessel owners pay, clean and prepare gear, and pay for transportation costs to a collection centre. The costs (roughly 85-110 euros/tonne) are equivalent to disposal fees for landfill or incineration (Jauke van Nijen, 2021[117]). Indicating the recyclability of gear that is separately collected, operators estimate that roughly 90% of collected gear was recycled in 2016 (Figure 3.1).

Figure 3.1. Fisheries Iceland estimate that 90% of collected gear was recycled in 2016

End of life gear outcomes estimated by Fisheries Iceland in 2016



Source: (Fisheries Iceland, 2017[119]).

These early adoption examples suggest that separately collected gear is generally technically recyclable, recycling can generate revenue that partially offsets the costs of program implementation, and that accessible and affordable collection provides some incentives for vessel owners to participate in schemes. However, both Iceland and Norway have geographically concentrated ports that allow for relatively affordable collection schemes and transportation that facilitates trade with recyclers (Box 3.4). As well, neither system has included manufacturers in responsibility and fulfilment of EPR. The full extent of implications for an EPR system as will be introduced in the EU (see Box 3.3) remain to be determined.

Box 3.4. Trade and end of life fishing gear

Trade enables efficient allocation of end of life material such as fishing gear by facilitating the movement of material to markets with a comparative advantage in waste processing. For example, fishing gear collected in Iceland and Norway is typically shipped to continental Europe for recycling and for other environmentally sound waste management (Jauke van Nijen, 2021[117]). However, differences in the stringency of environmental regulation can also facilitate trade with environmental impacts (Yamaguchi, 2018[120]). Requirements for trade implemented by traditional importers (e.g. China) and recent amendments to the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal* and the *OECD Decision of the Council on the Control of Transboundary Movements of Wastes Destined for Recovery Options* aim to reduce trade in difficult to recycle plastics and to improve quality of traded plastic waste. The changes have added complexity and some uncertainty for some recyclers and waste shippers. Governments can continue to work towards reducing friction in trade regimes to encourage desirable trade (OECD, forthcoming[121]). Particularly as recyclability is emphasised by manufacturers, trade in waste of fishing gear can help to efficiently produce secondary material.

4 Towards G7 action to address ghost gear

This report highlights the significant costs and impacts of abandoned, lost or otherwise discarded fishing gear, and the urgency with which it must be addressed on a global scale. G7 countries in particular, given their global influence and leadership role, have the potential to build on existing commitments made in G7 and G20 fora to turn the tide on this global, multi-dimensional challenge. As demonstrated time and again, global leadership is required to make a real difference on such a complex issue as ghost gear.

Building on the priority areas identified throughout the report, and the good practices identified in the previous chapter, this final concluding section proposes a series of priority actions that G7 countries could take in order to lead the way in addressing the ghost gear challenge.

The proposed actions will by necessity take a multi-faceted approach: there is no one silver bullet nor one-size-fits-all solution that will solve ghost gear and its impacts. Nor will the same approach and priority actions necessarily be the same across G7 members. As this report endeavours to illustrate, there is significant variation in causes and impacts of ghost gear even within countries, depending on features as diverse as the natural environment, type of fishery and gear used, and the jurisdictional responsibilities between levels of government. A multi-pronged approach by G7 members at the national and international level is therefore required.

This report proposes a series of 14 key actions across 2 pillars that G7 countries could take to lead on the ghost fishing gear issue (Table 4.1.). Indeed, these priority actions could be adopted by all countries seeking to reduce ghost fishing gear. The two pillars focus on leveraging international co-operation and national planning frameworks, and on implementing circular economy or similar principles throughout the lifecycle of fishing gear.

Coordination of research efforts (key action 2) is a priority for the development of risk assessments (key action 4) at the global, regional, national, and local scale. These assessments will help policymakers to better understand the issue and the actions that will be most effective to address impacts of ghost gear by the context of the fishery. Policies for gear marking (key action 8) are important across the lifecycle and facilitate further opportunities for traceability, reporting, retrieval, and incentive-based mechanisms to prevent and reduce gear loss. At the end of life stage, the provision of a gear collection infrastructure (key action 12) is critical to ensuring recycling and other environmentally sound waste management of gear. Extended Producer Responsibility and incentive based polices can help to support and finance separate collection and recycling of end of life gear.

Table 4.1. Key actions to address ghost gear

Pillar	Sub-pillar	Key action
Leverage international co-operation and	*International*	1. Re-enforce G7 commitments to address marine plastic litter, including taking explicit measures to addressing ghost fishing gear. Leverage G7 global influence and leadership to support developing countries to develop and implement practices that reduce gear loss.

national frameworks		2. Co-ordinate a research agenda, in collaboration with existing efforts*, to address information gaps that persist in understanding the scope, impact and potential solutions to address ghost fishing gear. The research agenda can include particular attention to the contributions of aquaculture to ghost fishing gear, and the costs and relative benefits of potential solutions along the ghost gear lifecycle. As well, data collection and sharing on gear loss can help to revise global estimates of gear loss.
		3. Join initiatives such as the Global Ghost Gear Initiatives (GGGI), a cross-stakeholder alliance of fishing industry, private sector, corporates, NGOs, academia and governments focused on addressing ghost gear worldwide, in order to learn from and share experiences in combatting ghost gear.**
		4. Strengthen multilateral agreements on policy efforts to address marine plastics pollution through the Regional Seas Conventions and continued negotiations within the UNEA for a global agreement.
	National	5. Conduct national risk assessments to identify priority areas where there may be a higher amount of ghost fishing gear due to fishing practices or weather conditions, or impacts to particularly sensitive habitats, incorporating cost-benefit analysis in order to help focus interventions and identify information gaps.
		6. Harness the potential for marine spatial and temporal planning to reduce ghost gear, in particular through avoidance of gear conflict.
		7. Ensure a transparent and inclusive system at the national level for collaboration to combat ghost fishing gear that includes relevant stakeholders across ministries, levels of government, port authorities, fishery associations and gear manufacturers and recyclers. This network can assist in identifying roles and responsibilities, and existing governance gaps, to address ghost gear. They can also serve as mechanisms to build education and awareness of, and share good practices to address, the economic, environmental and social costs of ghost gear.
Implement circular economy or similar principles throughout the lifecycle	*Design*	8. Develop, implement, and enforce standards for gear marking, building on the FAO Voluntary Guidelines for the Marking of Fishing Gear, to promote identification of ownership, location, and material composition. Promote the harmonisation of gear marking systems within RFMOs.
		9. Incentivise design in the manufacture of fishing gear that be easily repaired and fit for re-use, and is technically recyclable with the waste infrastructure in the market to which the gear is placed. Improving the design of gear can promote resource efficiency and increasing the marketability of end of life gear.
	Use	10. Set requirements for gear users and vessel owners to report lost gear. Central storage of this data can inform fisheries management policies.
		11. Set requirements or incentives (including conditioning fisheries support) for vessel owners to retrieve lost gear (and net scraps) and maintain on board space for retrieved gear. Support return or reuse of retrieved gear, potentially with no fault for the retriever to promote reclaim and reuse. Regulations that limit gear removal to the gear owner can hinder well-intentioned removal efforts.
	End of life	12. Ensure the physical and policy context for environmentally sound waste management of fishing gear. This includes provision of sufficient port reception facilities to ease collection and transport of end of life gear, and policy measures to facilitate and encourage reuse and recycling.
		13. Address economic barriers to recycling of ghost gear by internalising the external costs of landfilling and incineration, for example through economic incentives (e.g. taxes) or EPR policy.
		14. Encourage extended producer responsibility to internalise the costs of end of life gear management. EPR can incentivise design for the environment, including increased transparency throughout the lifecycle. Deposit return schemes can incentivise efforts to mitigate gear loss and to return end of life gear to collection points.***

Note: *Existing efforts include GESAMP Working Group 43 and FAO's ALDFG surveys; **The IMO-FAO GloLitter Partnership project is another such example; ***Cost-benefit analyses should be used to inform the selection of policy measures given geographic and market conditions.

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Annex 1. Timeline of G7 and G20 communiqués and commitments related to marine plastic pollution

Table A.1. G7 and G20 have hosted initiatives to address plastic pollution and ghost gear

	G7 Communiqués	G7 Commitments	G20 Communiqués and commitments
2015	Elmau Summit: acknowledged plastic marine litter is a global challenge that affects ecosystems and potentially human health (G7 Leader's Declaration, 2015[122]).	Action Plan to Combat Marine Litter: to address sources (both on-land and marine-based), remove plastic waste from the ocean, increase awareness of the issue, and support additional research (G7 Leader's Declaration, 2015[122]). Actions include maximising the proportion of marine-based waste that is delivered to port reception facilities (in accordance with MARPOL), and identifying options to address waste from fishing and aquaculture industries, including pilot projects of deposit refund schemes. (G7 Leaders' Declaration, 2015[123]).	
2016	Ise-Shima declaration acknowledged the role of the 3Rs (reduce, reuse, recycle) in preventing and reducing marine plastic litter. Identified a need to support scientific research on conservation and management of marine resources (G7 Leaders' Declaration, 2016[124]).	Toyama Environment Ministers' Meeting committed countries to promote: financing opportunities for environmentally sound waste management and wastewater treatment and sharing best practices; reducing marine litter, particularly removal actions; international collaboration through UNEP, IMO, and FAO; outreach and education activities leading to individual behaviour change; standardizing monitoring methodologies; and research activities (G7 Leaders' Declaration, 2016[125]).	
2017	Bologna Environment Ministers' Meeting: called for an increase in international co-ordination, particularly at the regional level through the Regional Seas Programmes (RSPs) and the RMFOs. Calls for initiatives to harmonise indicators and methodologies for monitoring, create databases, identify and disseminate best practices, develop capacity, reduce use of single use plastics (SUPs), and implement policy measures (e.g. extended producer responsibility and development of waste management infrastructure) (G7 Leaders' Declaration, 2017[126]).	Bologna roadmap: announced next steps for actions by countries as part of the G7 Alliance on Resource Efficiency. The roadmap identified a need for the assessment of the economic benefits and opportunities for improved product design and to address barriers to recycling and reuse of plastics (G7 Leaders' Declaration, 2017[126]).	Hamburg summit: launched the Marine Litter Action Plan and the Global Network of the Committed as platforms to address marine litter (G20 Leaders´ Declaration, 2017[127]). The action plan identified priority areas of concern for potential policy measures: the socio-economic benefits of preventing marine litter; waste prevention and resource efficiency; sustainable waste management; waste water treatment and storm water management; awareness, education and research; removal and remediation action; engagement of stakeholders (G20 Leaders' Declaration, 2017[128]).
2018	Charlevoix: endorsed the Charlevoix Blueprint for Healthy Oceans, Seas and Resilient Coastal Communities and the G7 Ocean Plastics Charter (G7 Leaders' Declaration, 2018[129])	• Charlevoix blueprint: a commitment to take a lifecycle approach to plastics stewardship, move towards resource efficiency of plastics, and promote harmonisation of monitoring methodologies for marine litter (G7 Leaders' Declaration, 2018[129]). • Ocean Plastics Charter: endorsers* committed to policy goals to: sustainable design, production, and after-use markets including 100% re-useable, recyclable, or recoverable plastics by 2030 and at	

		least 50% recycled content by 2030; collection, management, and waste system infrastructure; recycle and reuse 55% of packaging by 2030 and recover all plastics by 2040; sustainable lifestyles and education; research, innovation, and technology; coastal and shoreline action (G7 Leaders' Declaration, 2018[129]). • Innovation Challenge to Address Marine Plastic Litter (2018), member countries committed to undertake initiatives to promote innovation in addressing marine plastic pollution by managing plastics more sustainably throughout the life-cycle (G7 Leaders' Declaration, 2018[130]). The challenge seeks to incentivise innovation, including clean-up measures to address ghost gear and fishing gear waste (G7 Leaders' Declaration, 2018[130]).	
2019	Biarritz Chair's Summary on Climate, Biodiversity and Ocean, welcomed the adoption of the Osaka G20 Blue Ocean Vision and Implementation Framework for Actions on Marine Plastic Litter (G7 Leaders' Declaration, n.d.[131]).	G7 Future of the Seas and Oceans Working Group called for an ocean observing system and a data-sharing infrastructure. The working group established a coordination centre for ocean observation platforms to interface with the Global Ocean Observing System (GOOS) (G7 Leaders' Declaration, 2019[132]).	• Osaka Blue Ocean Vision to reduce additional pollution by marine plastic litter to zero by 2050 (G20 Leaders' Declaration, 2019[133]). • Framework for Actions on Marine Plastic Litter**:** facilitates the implementation of the Marine Litter Action Plan (G20 Leaders' Declaration, 2019[134]).

Note: *The Ocean Plastics Charter was endorsed by Canada, France, Germany, Italy, the United Kingdom and the European Union.

Annex 2. National policy action by G7 states to address marine plastic pollution and ghost gear

Table A.2. G7 countries have adopted a range of measures to facilitate public efforts, private sector co-ordination, and development assistance to combat marine plastics

Policy measures adapted from Communiqué of the G7 Toyama Environment Ministers

Policy measures and efforts	Co-ordination of Voluntary Efforts	Domestic Public Efforts	Development Assistance
Environmentally sound waste management	• France: "National Pact on plastic packaging" and the European Plastics Pact. • Japan: Clean Ocean Material Alliance (CLOMA). • U.K.: Operation clean sweep (pre-production pellets) and UK Plastics Pact (packaging sector). Supports the Global Plastic Action Partnership (GPAP) a public private partnership for funding CE solutions. • U.S.: WRAP Program: an MOU to improve recycling of flexible packaging in partnership with the American Chemistry Council.	• Canada: Action Plan on Zero Plastic Waste: harmonising of EPR, roadmap on single use products EoL; green public procurement, support for recycling infrastructure. • EU: From 2021, EU 2019/883 Directive on port reception facilities for delivery of waste from ships. Article 8 of Regulation (EC) no. 1224/2009 on fishing gear. • Italy: Article 13 of the MSFD: management of litter generated by fishing and aquaculture activities, including discarded equipment. • Japan: National Action Plan for Marine Plastic Litter on waste management, litter prevention (e.g. Plastics smart campaign), land based collection (e.g. UMIGOMI Zero week). • U.S.: America Recycles program: summit, information sharing program. Supported a National Framework for Advancing Recycling System.	• Canada: 100 million CAD ESM waste management, Ghost Gear Fund • Germany: PREVENT Waste Alliance to develop and pilot waste approaches with technical and financial support. • Japan: financial assistance and action plans, ASEAN+3 and. MARINE initiatives. • U.K.: UK Aid, Small Charities Challenge Fund and UK Aid match. Commonwealth Clean Ocean Alliance, including the Blue Charter. Environmental Pollution programme (SMEP): pollution reduction in developing states. Blue Plant Fund. • U.S.: Municipal Waste Recycling Program (MWRP), Clean Cities Blue Oceans (CCBO).
Outreach and education activities	• U.S.: "Trash Free Waters" partnership with communities for projects, outreach, capture, reduction, and research.	• France: Awareness campaign "I sail, I sort" • Italy: Article 13 of the MSFD training and awareness measures. • Japan: National Action Plan for Marine Plastic Litter awareness raising. • U.K.: National Litter Strategy (2017): awareness, enforcement, access. • U.S.: Marine Debris Program (NOAA) developed 11 sub-national action plans and a national strategic plan. Supports projects outreach and behaviour change.	• U.K.: Commonwealth Litter Programme (CLiP) awareness raising and training.
Reducing marine litter,	• Italy: Public-private agreement on collection and management of waste found on seabed at select	• Canada: Canada Shipping Act and the Canadian Environmental Protection Act: prohibits litter in	• Canada: international funding as part of the Sustainable Fisheries Solutions and Retrieval Support

particularly removal	ports. Tuscany-Fishing for Litter Agreement (2018) a pilot project to compensate fishers for plastic waste collection. Article 13 of the MSFD collection and disposal chain for litter accidentally collected by fishers. • Japan: Demonstration project (2020) for financially supporting voluntary collection by fishers. • U.S.: WasteWise Project: public-private partnership for waste reduction, including incorporation of sustainable materials management into business models.	waters. Fisheries act prohibits littering in domestic waters used for fishing. Sustainable Fisheries Solutions and Retrieval Support Contribution Program: a CAD 8.3 million (2020-2022) investment in prevention, retrieval, and purchase of new gear technology. Operation Ghost (2019): retrieval in the Gulf of St. Lawrence. • Germany: IMO Action Plan on Marine Plastic Litter from Ships. • Italy: Il Po d'Amare project, an automated plastic collection device in the river Po. • Japan: National Action Plan for Marine Plastic Litter removal from the ocean. Deployment of marine environment improvement vessels at ports and at sea. Financial support for local governments to implement the Act on Promoting the Treatment of Marine Debris Affecting the Conservation of Good Coastal Landscapes and Environments to Protect Natural Beauty and Variety. • U.K.: A contracting party to OSPAR Convention for the protection of the North-East Atlantic. Supports the regional action plan.	Contribution Program. • U.S.: Marine Debris Grants funded projects in Peru, and in the Caribbean.
Research	• France: Citizen science platform (Remed Zero Plastique) • Japan: Support for development of fishing gear alternatives: marine biodegradable plastic and recyclable plastics. • U.S.: Marine Debris Monitoring and Assessment Program: citizen science partnership for shoreline surveys.	• U.K.: supports research on impacts and innovation (over 100 million GPB). Called for evidence (2019) on bio-based and bio-degradable plastics.	• U.K.: Commonwealth Litter Programme (CLiP) research support.

Source: Adapted from (Ministry of the Environment Japan, 2020[135]).

Table A.3. All G7 countries have adopted some measures to combat ghost gear

Country	Examples of action to combat ghost gear
Canada	• Joined GGGI in 2018 • Sustainable Fisheries Solutions and Retrieval Support Contribution Program: a CAD 8.3 million (2020-2022) investment in prevention, retrieval, and purchase of new gear technology. • Operation Ghost (2019): a 3-day retrieval expedition in the Gulf of St. Lawrence. • Mandatory gear loss reporting requirements (most fisheries as of 2018)
France	• Awareness campaign: "I sail, I sort" • Outreach program for good practices to fishers and mussel harvesters • EU Legislation (Article 8 of Regulation (EC) no. 1224/2009): fishing gear has to be marked allowing the identification of the gear owner, vessels need to have on board the necessary equipment to recover gear, and vessels are obliged to attempt to retrieve gear, or in some cases to inform their flag state authorities within 24 hours.
Germany	• EU Legislation (Article 8 of Regulation (EC) no. 1224/2009): fishing gear has to be marked allowing the identification of the gear owner, vessels need to have on board the necessary equipment to recover gear, and vessels are obliged to attempt to retrieve gear, or in some cases to inform their flag state authorities within 24 hours.
Italy	• Programme of measures according to Article 13 of the MSFD (D.P.C.M. 10/10/2017) i. Design and implementation of measures to improve the management of litter generated by fishing and aquaculture activities, including discarded equipment, favouring, where possible, its reuse, recycling and recovery. ii. Study, design and creation of a collection and disposal chain for litter accidentally collected by fishers. iii. Implementation of training and awareness measures to increase knowledge and promote the education of the public and economic operators to prevent and combat marine litter. • Tuscany-Fishing for Litter Agreement (2018): pilot project to compensate fishers for plastic waste collection. • EU Legislation (Article 8 of Regulation (EC) no. 1224/2009): fishing gear has to be marked allowing the identification of the gear owner, vessels need to have on board the necessary equipment to recover gear, and vessels are obliged to attempt to retrieve gear, or in some cases to inform their flag state authorities within 24 hours.
Japan	• Patrol activities aimed at stopping littering, dumping, and leakage of waste. • Supports local governments to implement the Act on Promoting the Treatment of Marine Debris Affecting the Conservation of Good Coastal Landscapes and Environments to Protect Natural Beauty and Variety (FY 2020 budget of JPY 2,999 million). • Demonstration project (2020) for financially supporting voluntary collection by fishers • Deployment of marine environment improvement vessels at ports and at sea. • Support for development of fishing gear alternatives: marine biodegradable plastic and recyclable plastics.
United Kingdom	• Joined GGGI in 2017 • Funds GGGI interventions, workshops, and trainings • 25 Year Action plan: calls for network of marine protected areas • Blue Planet Fund • UK is a Contracting Party to the OSPAR convention, implementing national and collective actions to tackle ghost gear as part of the Regional Action Plan on Marine Litter including preparing a scoping study on best practices for the design and recycling of fishing gear as a means to reduce quantities of fishing gear found as marine litter in the North-East Atlantic. • The UK has committed to review and consult on measures such as EPR on end-of-life fishing gear by 2022 as described in the 2018 Resources and Waste Strategy. • UK has two Fishing For Litter schemes, for South-West England and Scotland, with over 300 participating vessels collecting litter that is caught in fishing activities and disposing of it appropriately on return to ports and harbours.
United States	• Joined the GGGI in YEAR • Promoted GGGI voluntary gear marking guidelines • Marine Debris Grants: funded projects in Peru, and in the Caribbean. • Prevention grants supported engagement with industry on loss of fishing gear and derelict vessels

Note: Not an exhaustive list of actions taken by G7 countries.

Towards G7 Action to Combat Ghost Fishing Gear

This Policy Paper provides in-depth analysis of the drivers, impacts and best practices to address ghost fishing gear. It places the issues of abandoned, lost, or otherwise discarded fishing gear within the larger context of marine plastic pollution. Ghost gear is particularly harmful because it negatively affects fisheries, non-target species (e.g. entanglement of wildlife), habitats, navigational safety, and coastal tourism. As a significant source of marine pollution, ghost fishing gear contributes to environmental and health risks of plastic pollution. The report identifies good practices and policies to prevent gear loss, reduce its impacts, and to recover lost gear. It reviews current policy efforts at the international level and in G7 countries and recommends a comprehensive policy response through international co-operation and circular economy approaches.

This Policy Paper was prepared as a background document for G7 Climate and Environment Ministers under the G7 Presidency of the United Kingdom

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