



BEST PRACTICE FRAMEWORK

**FOR THE MANAGEMENT
OF FISHING GEAR**



CONTENTS

DOCUMENT INFORMATION

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Citation: Global Ghost Gear Initiative (2021) Best Practice Framework for the Management of Fishing Gear: June 2021 Update. Prepared by Huntington, T. of Poseidon Aquatic Resources Management Ltd. 94 pp plus appendices.

ABOUT THE GLOBAL GHOST GEAR INITIATIVE

The **Global Ghost Gear Initiative**® (GGGI) is the world’s largest cross-sectoral alliance committed to driving solutions to the problem of abandoned, lost or discarded fishing gear (ALDFG or “ghost gear”) worldwide. The GGGI aims to improve the health of aquatic ecosystems, protect aquatic life from harm, and safeguard human health and livelihoods.

Founded on the best available science and technology, the GGGI is the first and only initiative dedicated to tackling the problem of ghost fishing gear on a global scale. The GGGI’s strength lies in the diversity of its 120+ members including the fishing industry, the private sector, academia, governments, intergovernmental and nongovernmental organizations. Every participant has a critical role to play to mitigate ghost gear locally, regionally and globally.

Founded by World Animal Protection in 2015 and hosted by Ocean Conservancy® as part of its Trash Free Seas® program since 2019, further information on the GGGI can be found at www.ghostgear.org.

The GGGI Best Practice Framework for the Management of Fishing Gear is a tool developed by the GGGI for stakeholder groups across the seafood supply chain to apply in order to prevent, mitigate and remediate ghost gear.

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ACRONYMS USED

ALDFG	Abandoned, lost or discarded fishing gear	GT	Gross tonnage
API	Application programming interface	HDPE	High density polyethylene (plastic)
BIM	Bord Iascaigh Mhara or BIM (Irish Sea Fisheries Board)	IMO	International Maritime Organisation
CPC	Commission Contracting Party (e.g., of RFMOs)	IOTC	Indian Ocean Tuna Commission
DFO	Fisheries and Oceans Canada (Department of Fisheries and Oceans)	IUU	Illegal, unreported and unregulated (fishing)
EC	European Commission	KIMO	Kommunenenes Internasjonale Miljøorganisasjon (Danish Local Authorities' Environmental Organization)
EMFF	European Maritime and Fisheries Fund	NOAA	National Oceanic and Atmospheric Administration
EPR	Extended producer responsibility	OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic (the OSPAR Convention)
ETP	Endangered, threatened or protected	PA	Polyamide (Nylon)
EU	European Union	PHA	Polyhydroxyalkanoate
EEZ	Exclusive economic zone	PRF	Port reception facility/facilities
FAD	Fish aggregating device	RFMO	Regional fisheries management organization
FANTARED	Ghost net (in Spanish)	ROV	Remotely operated vehicle
FAO	Food and Agriculture Organization of the United Nations	RFVS	Responsible Fishing Vessel Standard
FIP	Fisheries improvement project	SSS	Side scan sonar
GESAMP	Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection	SUP	Single use plastic
GGGI	Global Ghost Gear Initiative (known as the “triple GI”)	UAV	Unmanned aerial vehicle
GISIS	IMO Global Integrated Ship Information System	VIMS	Virginia Institute of Marine Science
GPS	Global positioning system	WAP	World Animal Protection



1 BACKGROUND AND NEED FOR A BEST PRACTICE FRAMEWORK

1.1 BACKGROUND

Over the last decade, academia, NGOs and the fishing industry have called considerable attention to abandoned, lost or discarded fishing gear (ALDFG)—also called “ghost gear”—and its impacts on the aquatic environment through ghost fishing, entanglement and habitat damage (Macfadyen *et al*, 2009; Richardson *et al*, 2019). This attention has been revitalized in recent years by the growing realization of the scale and potentially catastrophic impact of plastic pollution and its accumulation in the aquatic ecosystem, and the contribution of ALDFG to this global problem. In response, in 2017 the GGGI took a major step forward by producing the Best Practice Framework for the Management of Fishing Gear¹ for wild capture fisheries (C-BPF).

Following an intensive, six-month global consultation process, the C-BPF was formally launched at the Seattle SeaWeb Seafood Summit in June 2017. Since then, the C-BPF has become an important resource for a wide range of stakeholders, from fishers to seafood buyers. For instance, multiple leading retailers such as Nomad Foods, Sainsbury’s and Waitrose are GGGI members who have committed to addressing ALDFG; Thai Union, one of the world’s largest vertically integrated fishing and processing businesses, is also committed to implementing the C-BPF within its

operations. In addition, the GGGI and FAO have held a number of regional workshops on implementing the C-BPF to reduce ALDFG through national fisheries and marine plastic policies (see FAO, 2020a)².

Over the intervening three years since the C-BPF was launched in 2017, there has been significant experience gained from its application and further developments made in areas such as fishing gear marking, gear tracking technology and recycling. In order to incorporate these new developments in the C-BPF, and to celebrate the GGGI’s fifth anniversary, the GGGI decided to update the C-BPF in September 2020 and to launch this revised version in 2021.

It is intended that the C-BPF will continue to be updated and refreshed on a regular basis in the future to ensure it both remains relevant and promotes the latest best practices as they develop.

1.2 THE NEED FOR A REVISED BEST PRACTICE FRAMEWORK

The C-BPF is intended for use by a broad spectrum of stakeholders, including gear manufacturers, fishers in both commercial and artisanal fisheries, port authorities, fisheries management authorities, seafood companies and other interested parties. As the interest in ALDFG as a global issue continues to develop, and as

lessons are learned from case studies around the world, there is a need to incorporate the latest technologies, methodologies and studies into the C-BPF to ensure it remains up to date and relevant. The process by which the C-BPF has been updated has been two-fold:

1. A literature review (see [Appendix A](#) for full bibliography) to assemble the main events and research outputs since the original version was written in 2017. These include but are not limited to:
 - Recent release of the State of World Fisheries and Aquaculture 2020 (FAO, 2020a)
 - Finalization of the “Voluntary guidelines on the marking of fishing gear” (FAO, 2019)
 - The emerging outputs from the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection’s (GESAMP) Working Group 43 on sea-based sources of marine litter (GESAMP, 2020b)
 - Various documents on fish aggregating device (FAD) best management by the International

Seafood Sustainability Foundation (ISSF) (Restrepo *et al*, 2019 & 2020)

- Work done by The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) Commission 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 NE Atlantic (OSPAR, 2020)
 - Various meta-analyses by Richardson *et al* on global fishing gear loss rates (Richardson *et al*, 2018 & 2019)
2. A detailed and systematic review of the original 2017 C-BPF by GGGI to compile the lessons learned from the past three years of implementation. Our sincere thanks to the organizations that provided expert feedback to these revisions, specifically [Archipelago Marine Research](#), [International Seafood Sustainability Foundation](#), [Natural Resources Consultants](#), and the [University of California, Davis](#).



¹ See <https://www.ghostgear.org/resources>
² See <http://www.fao.org/documents/card/en/c/ca9348en>

2 UNDERSTANDING GLOBAL FISHING GEAR USE

2.1.1 GLOBAL FISHING TRENDS

The capture of fish and other aquatic life from the wild has been practiced for millennia and, despite the relatively recent rise of aquaculture, is still an important source of sustenance, income and economic reward for millions of people. The most recent version of FAO's "The State of Fisheries and Aquaculture (SOFIA) 2020" (FAO, 2020b) states that the total global capture production of 96.4 million metric tons in 2018 is the highest ever, well above the 93.8 million metric tons of 1996. It also estimates that 39 million people were engaged in the primary sector of capture fisheries in 2018. Around 85% of fishers were in Asia, with the remainder in Africa (9%), the Americas (5%), Oceania (0.8%), and Europe (0.3%)

Global fishing capacity has risen steeply since the 1970s, though the trend appears to be reaching a plateau. This has occurred due to a considerable reduction in Europe over the past decade, with more recent reductions occurring in North America and Africa, and a slowing in the rate of increase in other regions. The fishing capacity of developed nations as a whole had decreased by 37% in 2012 from peak levels in 1991. Conversely, the fishing capacity of developing nations dramatically

increased over the last 30 years but has decreased by 2.8% since 2016, mainly due to a 20% reduction in the Chinese fleet (FAO, 2020b).

2.1.2 ESTIMATING GEAR USE BY TYPE

While there are good estimates of wild catches by species, geographic areas and fisher type (e.g., via FAO's FishStat J online database³, OECD⁴, Eurostat⁵, Sea Around Us⁶ and others), there is no recurrent quantification of catches by fishing gear. As a result, there are only a few global estimates of this, mainly by FAO in their most recent estimation of global discards by fishery (Pérez Roda *et al*, 2019) and by Sea Around Us (Pauly *et al*, 2020).

Zeller and Pauly (2015) have attempted to reconstruct marine fisheries catches and to map these with fishing gear by using the FAO-derived Seas Around Us catch database (with data up through 2014) focusing on seven different gear types to assess their relative importance. Their research was based primarily on commercial gear. Artisanal gear types were recorded when the artisanal fishery provided the bulk of the reference information for a species in a given family. The results from Pauly *et al*, 2020 are shown in Figure 1 overleaf.

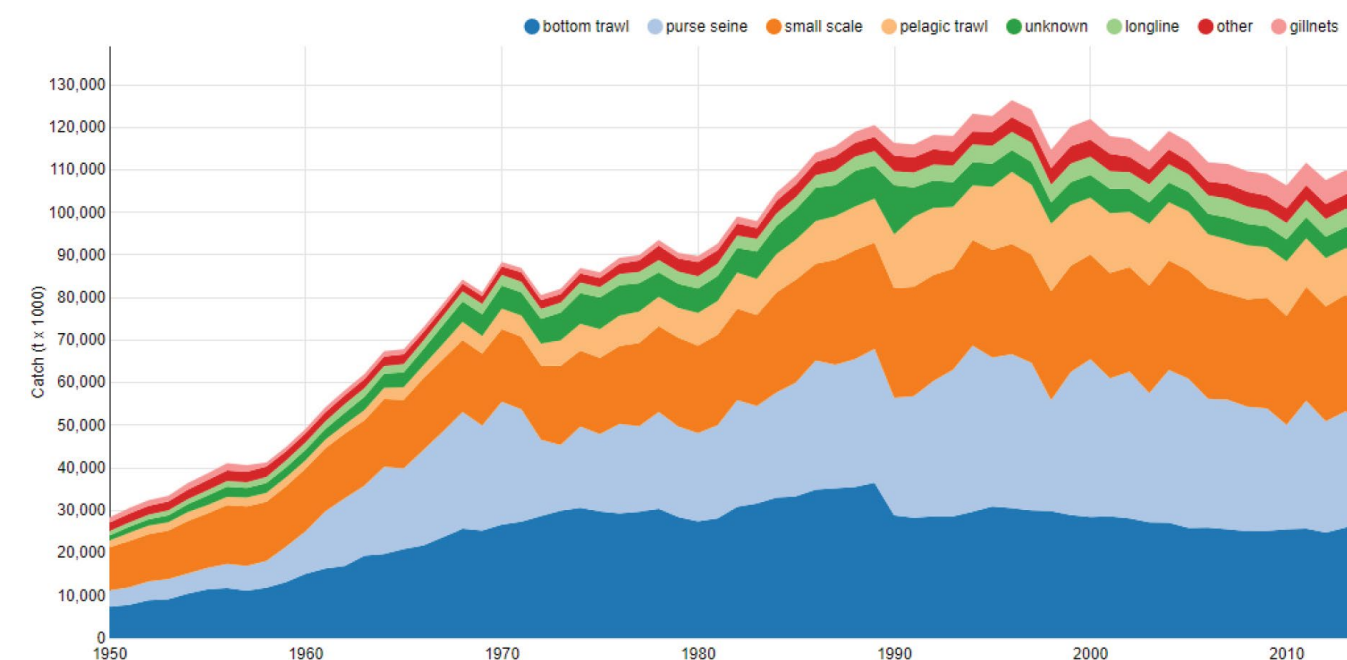
³ <http://www.fao.org/fishery/statistics/software/FishStatJ/en>

⁴ https://www.oecd-ilibrary.org/agriculture-and-food/oecd-review-of-fisheries-country-statistics_rev_fish_stat

⁵ <https://ec.europa.eu/eurostat/web/fisheries/overview>

⁶ <http://www.seaaroundus.org/data/#/eez>

FIGURE 1: CATCH BY GENERAL FISHING GEARS OVER THE PERIOD 1950–2014



Source: Pauly D., Zeller D., Palomares M.L.D. (Editors), 2020

Figure 1 shows the trend in global gear usage in terms of contribution to global catch over 1950–2014. This indicates that bottom trawl represented 26%, seine nets (e.g., purse seines and other forms of ring nets) account for around 21% of global catch in 2014, with pelagic trawls accounting for around 12%. Gillnets and long lines were both 4% each, with the remainder either unknown (5%) or small-scale (26%). The small-scale fisheries will be a mixture of handlines, gillnets and traps. Looking at the trends, with the exception of a period over the 1960s when seine net use expanded to nearly 45% (mainly at the expense of mid-water trawls), the proportion of catch by each gear has remained surprisingly consistent.

In the 1950s, the catches by major countries were dominated by those taken by gillnet, seine and bottom trawl. By the 1970s, the catch of these major fishing countries by gillnet gear decreased, while their use of midwater trawl gear increased. This trend, however, was not well reflected in the balance of catch taken by "other" countries whose relative gear use remained constant. By the 1990s,



the importance of midwater trawl had decreased for most countries, with the exception of the nations comprising the former Soviet Union, where relative catch associated with midwater trawl actually increased. Seine gear (especially purse seine), continued to be important in the 1990s and 2000s.

Based on the above, the following gear classes are included in the Framework:

Gear class	Examples of gear types
Gillnets	Includes fixed, drifting and other tangling nets, including trammel nets
Fish aggregating devices	Anchored and drifting FADs
Traps and pots	All traps, pots and other static fish traps
Longlines	Includes drifting, bottom and pelagic set longlines
Bottom trawls	Single, pair, twin and beam trawls for finfish and shrimp; also includes Danish, Scottish and other fly seines
Hooks and lines	Includes hand lines, pole and line, trolling and jigging (both mechanized and by hand)
Mid-water trawls	Single or pair mid-water trawls, mainly targeting small pelagic species
Seine nets	Includes purse seines, ring nets and beach seines

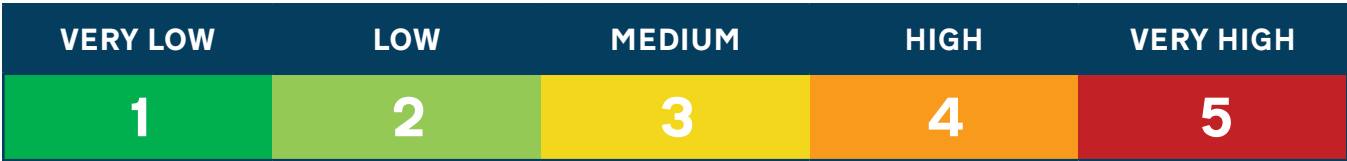
It should be noted that we have also included fish aggregating devices (FADs) in this analysis. FADs are gear used to aggregate fishes and increase catch per unit effort. They are always used in conjunction with another gear type (e.g., seine nets or hooks and lines) and are often lost or abandoned at sea (more details on this can be found in the FAD section starting on [page 13](#) of this document). Excluded are dredges and other large mechanical devices, as these are not easily lost, are readily recovered and not considered to be involved in ghost fishing. The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) Working Group on sea-based sources of marine litter (WG 43) is building an understanding of sea-based sources of marine litter, in particular from the shipping and fishing sectors, including the relative contribution of different sources, analysis of plastic use and management within both industries and the range and extent of impacts from sea-based sources of marine litter. In developing the C-BPF, the risk analysis evaluated dominant fishing gears based on (i) the likelihood of being abandoned,

lost or discarded and (ii) the impact on aquatic life and habitats if lost.

2.2 RISK ANALYSIS OF ALDFG BY GEAR TYPE

To develop best practices, it’s important to understand which types of gear are most likely to become ALDFG, and what their potential impacts are in the environment. We evaluated all the main gear types and assigned subjective risk scores based on the best available information currently available. The two attributes are:

- 1. **Likelihood of loss:** Considers the likelihood of each gear type being abandoned, lost or discarded in the first place.
- 2. **Impact once lost:** Considers the impact of abandoned, lost or discarded gear on aquatic life and the environment more generally. This includes likelihood of ghost fishing, the risk of entanglement with aquatic mammals, reptiles



and birds as well as possible habitat damage. It also considers where the disintegration and abrasion of plastic elements of the gear might lead to microplastic production.

The risk element is scored out of 5, and both likelihood and impact are color-coded as shown above.

The ranking applied to each gear type indicates a sense of the relative risk (likelihood and impact) from these different gear types. The process by which these risks are assigned are empirical, based on an extensive literature review (see [Appendix A](#) for full bibliography),

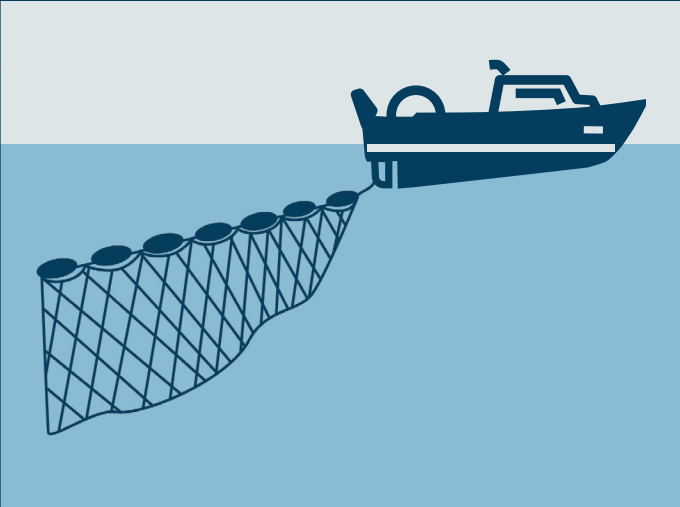
as well as expert knowledge. However, it is fully appreciated that both the likelihood of ALDFG—and the impacts these may have—are highly context specific, potentially varying significantly by fishery, fisheries management practices, geography, etc. This guide is intended as a starting point for establishing best practices to deal with the relative risks of each gear type based on the analysis of each below.

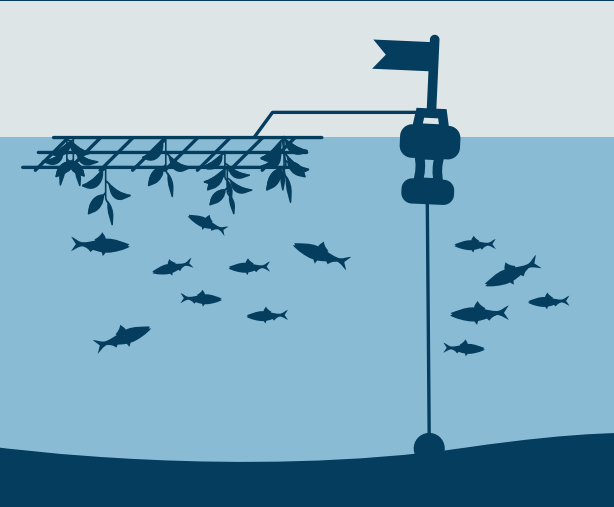
For more information on assessing the risk and impact of ALDFG, and in particular its contribution to marine plastics and microplastics, see GESAMP (2020)⁷ and Gilman *et al*, 2021.

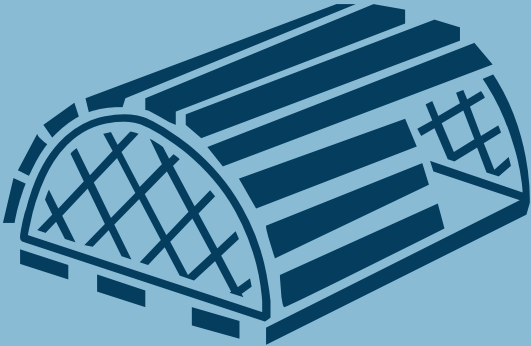
⁷ Proceedings of the GESAMP International Workshop on Assessing the Risks associated with Plastics and Microplastics in the Marine Environment (see [Appendix A](#) for full citation and link).



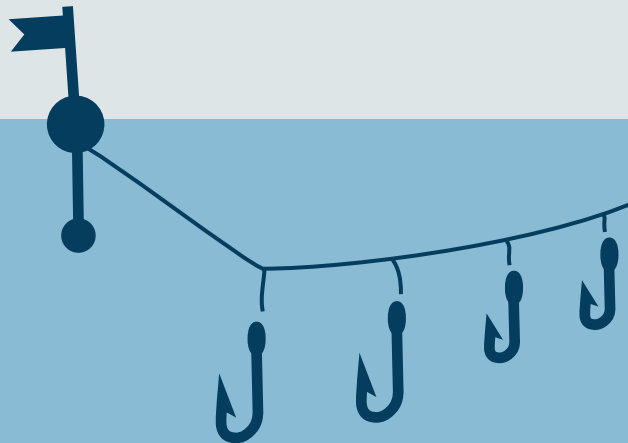
Photo credit: Eleanor Church—Lark Rise Pictures

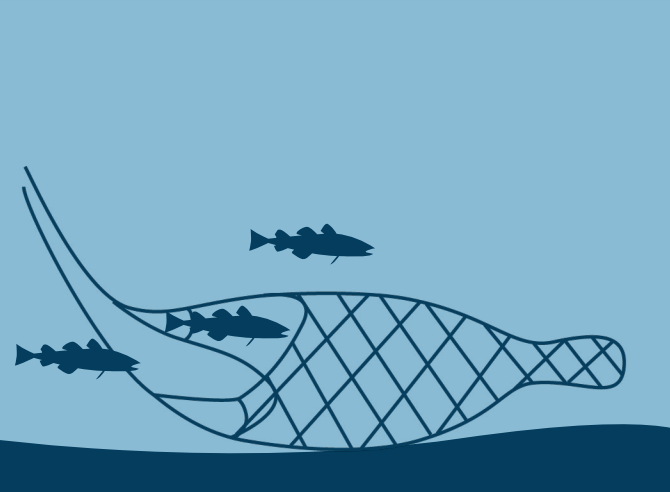
2.2.1 GILLNETS	
	DESCRIPTION
	<p><i>Gillnets</i> are single walls of netting which can either be fixed or allowed to drift (pictured). They catch fish by enmeshing or entangling them usually around their gill covers. <i>Trammel nets</i> are a variant of gillnets that consist of three parallel panels of nets with different mesh sizes which can be used to catch a much wider variety of species. <i>Entangling nets</i> are usually set on the seabed and have large meshes to capture shellfish and large whitefish such as monk, ray and turbot (also known as ray nets).</p>
TYPICAL FISHERIES IN WHICH GEAR IS USED	GEOGRAPHIC DISTRIBUTION OF USE
<p>Gillnets are widely used in both artisanal and small-scale commercial fisheries worldwide. It is an effective fishing method, suited to a wide range of waters, and gillnets are generally cheap and easy to buy and repair. Gillnets mainly target demersal and epipelagic finfish but are also used for small pelagic species and tuna. They can be set on the surface, midwater or on the bottom.</p>	<p>Gillnets are widely used in both temperate and tropical waters. They are particularly popular in NE European waters, much of Africa and the Middle East and south-east Asia. They are also a common gear for use in estuarine, river or lake fisheries worldwide.</p>
CONTRIBUTION TO ALDFG AND GHOST FISHING	
<p>Susceptibility to loss: Gillnets can have high rates of loss, particularly in mixed fisheries areas where gear conflicts (especially with mobile gear) are more likely. In Northern Australia’s EEZ, Indonesian and Australian fishers identified the snagging of nets (78%) and gear conflicts (19%) as the main causes of gear loss (Richardson <i>et al</i>, 2018). Many gillnets are set in areas with strong tidal or other currents and are thus susceptible to accidental loss. As gillnet panels are relatively cheap, there is less incentive to recover lost or abandoned gear, and their deliberate discarding at sea (either due to lack of storage space or heavy damage) is not infrequent.</p> <p>Impact of ALDFG: Abandoned, lost or discarded gillnets can continue to fish before the net breaks down and buoyancy is lost. As they are often made of light material, e.g., monofilament netting, they are not easily seen by fish and other aquatic animals and will often re-suspend in different current conditions. With a wide range of mesh sizes and structures, the risk of entanglement with aquatic animals and seabirds is high. Gillnets will eventually accrete to the substrate. While this may reduce entanglement and subsequent mortality of aquatic life, it does not eliminate species impacts. Nets on the seafloor can continue to ghost fish for the life of the material’s structural viability; however, the species that are impacted may be different than those that were impacted when the net was buoyant and suspended in the water column (i.e., a shift from impacts on pelagic to benthic species).</p>	
LIKELIHOOD (OF 5): 5	IMPACT (OF 5): 5

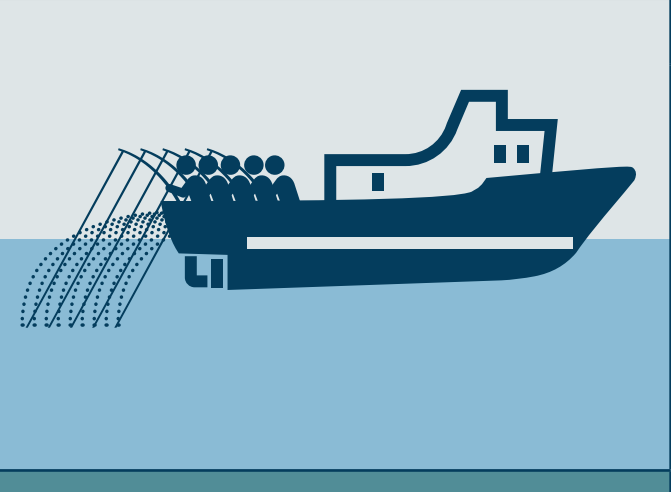
2.2.2 FISH AGGREGATING DEVICES (FADS)	
	DESCRIPTION
	<p>A fish aggregating device (FAD) is a man-made object used to attract fish. They are then fished using purse seines or, in coastal waters, hand lines. They are either anchored to a fixed location (aFADs) or drifting (dFADs) and are tracked by locator beacons. FADs use a combination of natural, e.g., palm fronds, and artificial, e.g., netting materials, to extend their presence. aFADs are anchored to a fixed location and have an underwater structure of a mooring line and “streamers” typically made from rope or shade cloth that attract fish. The surface end of the mooring line is attached to buoys of various configurations to provide buoyancy.</p>
TYPICAL FISHERIES IN WHICH GEAR IS USED	GEOGRAPHIC DISTRIBUTION OF USE
<p>The main users of dFADs are the tropical tuna fisheries targeting pelagic tuna such as yellowfin, bigeye and skipjack tuna. Coastal aFADs are often used to encourage smaller-scale fishers to move outside the reefs, and will mostly target neritic tunas, jacks and mahi mahi.</p>	<p>FADs are mainly found in tropical regions. dFADs are used extensively in the Atlantic, Indian and Pacific Ocean pelagic tuna fisheries. Coastal aFADs are used by many small island and archipelagic states in particular, but are also used in other tropical coastal waters, usually in a depth between 50 to 1,000 meters, although some may be deeper.</p>
CONTRIBUTION TO ALDFG AND GHOST FISHING	
<p>Susceptibility to loss: FAD loss has become an increasingly important issue. While drifting FADs represent a considerable investment, losses can occur due to dFADs sinking, locator beacon failure or deliberate abandonment when they drift beyond a cost-effective distance from main fishing areas (Richardson <i>et al</i>, 2017). Anchored FADs are also prone to loss, mainly due to mooring failure, and are less easy to recover as they are not generally equipped with location equipment.</p> <p>Impact of ALDFG: The main impact for abandoned, lost or discarded FADs (and indeed some FADs still under the control of fishers) is from entanglement with FAD netting, with sharks and, to a lesser extent, aquatic turtles which are particularly vulnerable (Filmlalter <i>et al</i>, 2013). Non-entangling netting under dFADs has been proposed as a solution, but this netting can become entangling when it is damaged during beaching or colliding with a reef. Until 100% biodegradable and non-entangling designs are available (ISSF, 2019) and broadly applied by purse seine fisheries, abandoned, lost or discarded FADs will continue to pose a large ghost fishing risk, significantly contribute to aquatic pollution, and continue to cause significant damage to sensitive aquatic environments such as coral reefs when they drift ashore. It should be noted that many tuna purse seine fleets are now being required by RFMOs to switch to non-entangling FADs.</p> <p>aFADs typically pose a reduced risk of entanglement and pollution than dFADs. This is largely because the lengths of purse seine netting that are typically attached to dFADs would cause too much drag in currents and strain the mooring lines used by aFADs. As a result, aFADs typically use “streamers” made of rope and strips or relatively small panels of small mesh shade cloth as aggregators.</p>	
LIKELIHOOD (OF 5): 5	IMPACT (OF 5): 4

2.2.3 TRAPS AND POTS	
	DESCRIPTION
	<p>Traps and pots¹ are a collective term for structures into which fish or shellfish are guided or enticed through funnels that encourage entry but limit escape. These include pots, creels, cuttlefish pots, fish traps, etc. For the purpose of this report, they also include fixed gears such as fyke and stake nets. Pots can be made of natural materials like bamboo, as well as plastic and metal.</p> <p>Traps are normally laid in strings connected by ropes and marked with buoys at each end of the string.</p>
TYPICAL FISHERIES IN WHICH GEAR IS USED	GEOGRAPHIC DISTRIBUTION OF USE
<p>Traps and pots are used in a wide variety of crustacean and finfish fisheries. For crustacean fisheries, traps or parlour type pots are particularly popular to catch lobster, crab and nephrops. Traps can also be used to catch finfish, e.g., the Seychelles <i>cordonnier</i> (rabbitfish) fishery. Most pots are baited.</p>	<p>Traps and pots are usually used in shallow coastal waters, as well as in the margins of rivers and lakes. The use of pots in temperate waters is mainly targeted at crustacean fisheries, while warmer waters tend to have a more mixed crustacean (e.g., spiny lobster/swimming crab) or finfish use.</p>
CONTRIBUTION TO ALDFG AND GHOST FISHING	
<p>Susceptibility to loss: Like gillnets, the loss of traps and pots is often linked to conflict with towed gears, as well as with other inshore water vessels and even large aquatic mammals. They are also particularly susceptible to theft and accidental loss through storms and other events. The increased use of GPS and other navigational devices, even by smaller vessels, has reduced the incidence of accidental trap loss. Longer pot strings may be easier to recover, while individual pots may be less so.</p> <p>Impact of ALDFG: Pots and traps also tend to pass through a progressive process of ghost fishing. As they are usually baited when they are set, if the pot is lost, over time the bait or lost catch attracts scavengers. These scavengers may become entrapped and subsequently die, forming new bait for other scavengers. Entrapped animals may escape over time. Animals captured in abandoned, lost or discarded traps die from starvation, cannibalism, infection, disease, or prolonged exposure to poor water quality (i.e., low dissolved oxygen). A key point is that catching efficiency depends on gear design, species behavior and seasonality. A second key risk of this gear is entanglement of large aquatic mammals with connecting ropes and lines, which can occur both when the gear is under control or is abandoned, lost or discarded.</p>	
LIKELIHOOD (OF 5): 4	IMPACT (OF 5): 4

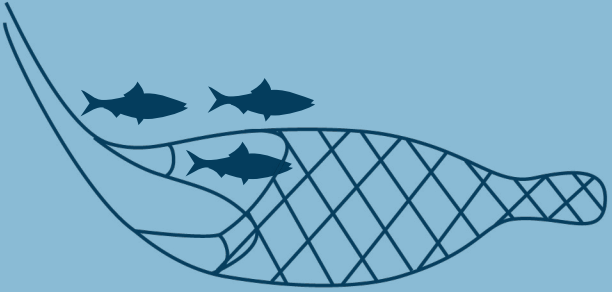
¹ There does not seem to be any definitive difference between “pots” and “traps” and the two terms are used interchangeably in most literature.

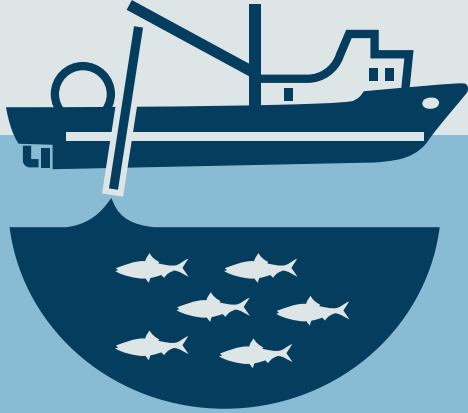
2.2.4 LONGLINES	
	DESCRIPTION
	<p>Longlining can be used to target both pelagic and demersal fish with the lines being rigged and set at a position in the water column to suit the particular species. A basic longline consists of a long length of line made of light rope or, more commonly, heavy nylon monofilament; this “main line” can be many miles in length depending on the fishery. To this main line, multiple branch lines with baited hooks (snoods) are attached at regular intervals. This rig is set either on the seabed (demersal) or in midwater (pelagic) with a buoy at either end and allowed to fish for a set period.</p>
TYPICAL FISHERIES IN WHICH GEAR IS USED	GEOGRAPHIC DISTRIBUTION OF USE
<p>Longlines are used extensively, both on the surface (usually targeting large pelagic species such as tunas and billfish) and on the bottom, targeting high value demersal species.</p>	<p>Longlines are used in a wide variety of locations. Their use in temperate waters tends to be focused on demersal fish such as cod but can also be used in the water column for species such as halibut. In tropical waters longlines are commonly used to catch tuna, as well as bottom species like snappers and groupers.</p>
CONTRIBUTION TO ALDFG AND GHOST FISHING	
<p>Susceptibility to loss: One of the main problems with longlines is how easily they can snag on the seabed and break away from the vessel. The extensive use of longlines, their often extremely long-set configuration, and relatively low cost means that the overall quantity of longlines lost is likely to be high. But figures to substantiate this are few and far between. There could be some deliberate gear discarding when tangled or damaged, particularly if there is not adequate space on the vessel to return the damaged gear for disposal.</p> <p>Impact of ALDFG: The mortality rate from lost demersal longlines is usually low, as is associated habitat damage (Pham <i>et al</i>, 2014). Such lost gear may persist in the environment, however, when it is constructed of monofilament. Ghost fishing mortality is a function of the gear type, the operation and the location in regard to active ocean features and elements. Lost longline gear may continue to catch fish as long as bait exists on the hooks. Fish caught on the hooks may themselves become a form of bait for subsequent fish, both target and non-target, and longlines will not stop fishing until all of the hooks are bare. Baited hooks may also pose an ingestion risk to aquatic mammals, birds, turtles and other animals and the lines themselves pose an entanglement risk.</p>	
LIKELIHOOD (OF 5): 3	IMPACT (OF 5): 3

2.2.5 BOTTOM TRAWLS	
	DESCRIPTION
	<p>A bottom (or demersal) trawl with a wide tapering net ending with a cod-end where trapped fish collect. The net is predominately made from HDPE netting in various thicknesses. During construction the netting is lashed to the frame ropes (headline, footrope and wing lines) usually with a nylon (PA) twine.</p> <p>Towed by a powered vessel using trawl warps, they often use doors or a heavy beam to maintain the net opening. Mainly used to capture demersal finfish or shrimp.</p>
TYPICAL FISHERIES IN WHICH GEAR IS USED	GEOGRAPHIC DISTRIBUTION OF USE
Widely used by commercial whitefish, shrimp and nephrops fisheries in temperate waters. More associated with shrimp fisheries in tropical waters. Due to the need for powerful vessels, is generally conducted by commercial fisheries operating on the continental shelf.	Mainly the eastern seaboard of North America, shallow coastal waters of NE Europe, the NE and SE coasts of South America, West Africa, most coastal waters of SE Asia and Australia.
CONTRIBUTION TO ALDFG AND GHOST FISHING	
<p>Susceptibility to loss: Apart from the Norwegian, FANTARED and some Irish and United Kingdom surveys, there is little other reference in literature to the levels of loss of trawl nets and other mobile gear. Anecdotal information suggests that considerable effort is put into the immediate recovery of lost gears due to their high value, combined with improvements in navigation and gear marking technologies. However, it is apparent that some trawl nets are lost, possibly even in considerable volume. For example, three-quarters of fishing debris found on beaches on Cape York, Australia consists of trawl nets, and the majority (around 79%) of fishing debris is of southeast Asian manufacture. It is also likely that trawl warps are sometimes discarded at sea (Macfadyen <i>et al</i>, 2009).</p> <p>Impact of ALDFG: The larger diameter synthetic multifilament twine common to trawl nets is the key factor that reduces ghost fishing mortality in lost trawl gear as it tends to weigh the net down, speeding the substrate aggregation process. However, this can increase the likelihood of entanglement with aquatic mammals, reptiles or birds. In dynamic areas such as tidal streams or even oceanic current gyres, abandoned, lost or discarded trawl nets may not accrete to the seabed and may cause more damage as they move around. In this case they may represent a potential navigation hazard or cause physical abrasion to the benthic substrate.</p>	
LIKELIHOOD (OF 5): 2	IMPACT (OF 5): 3

2.2.6 HOOKS AND LINES	
	DESCRIPTION
	<p>Handlines may be used with or without a pole or rod. For fishing in deep waters, the lines are usually operated using reels or frames on which to store the long length of line. The bait may be artificial or natural. Pole and line fishing (pictured) involves a number of crew equipped with a bamboo or fiberglass pole with a short, unbaited hook. This gear type includes jigging with lines, operated by hand and used in small boats. Trolling is a method of towing artificial lures to attract fish.</p>
TYPICAL FISHERIES IN WHICH GEAR IS USED	GEOGRAPHIC DISTRIBUTION OF USE
Handlines are used to catch tunas as well as demersal species and are a common recreational fishing gear. Pole and line fishing (pictured) is commonly used for skipjack and other tunas. Jigging is used to catch both finfish and cephalopods, often in combination with lights.	Hooks and lines are used in a wide variety of locations. Their use in temperate waters tends to be focused on demersal fish such as cod but can also be used in the water column for species such as halibut. In tropical waters hand lines are commonly used to catch tuna, as well as bottom species like snappers and groupers.
CONTRIBUTION TO ALDFG AND GHOST FISHING	
<p>Susceptibility to loss: Hooks and sections of line can be lost through snagging with the bottom, the age-related brittleness of monofilament line, and when they are broken by large fish or other animals. Although abandoned, lost or discarded hooks and lines are generally small in size, their extensive use by both commercial and recreational fishers in often rocky and complex benthic environments means that the cumulative volume is likely to be considerable. A recent analysis found that 29%¹ of fishing lines used globally are lost (Richardson <i>et al</i>, 2019).</p> <p>Impact of ALDFG: Hooks can become embedded in fish or other animal jaws, inhibiting feeding and causing local trauma that can lead to eventual mortality. Lines can become wrapped around both aquatic flora and fauna with subsequent entanglement. Both baited and unbaited hooks may also pose an ingestion risk to aquatic mammals, birds, turtles and other animals. Foraging birds—both seabirds and water birds such as swans—are at particular risk from both engorging hooks and becoming entangled in line.</p> <p>This said, the potential for ghost fishing from lost hooks and lines is usually low. Such lost gear may persist in the environment as it usually consists of a monofilament line that will gradually break up and contribute to the microplastic load (Lusher <i>et al</i>, 2017).</p>	
LIKELIHOOD (OF 5): 3	IMPACT (OF 5): 2

¹ The overall loss was 29%. The predicted percentages of gear loss across the subcategories were 23% for handlines, 65% for pole-lines, and 20% for longlines. However the authors acknowledge that the available data and studies geographically over-represent North America and Europe from commercial fisheries.

2.2.7 MID-WATER TRAWLS	
	DESCRIPTION
	A mid-water (or pelagic) trawl towed by one or two vessels using a set of midwater doors to open the net horizontally. The position within the water column is controlled by the speed of the vessel and the amount of weight on the wing ends.
TYPICAL FISHERIES IN WHICH GEAR IS USED	GEOGRAPHIC DISTRIBUTION OF USE
Mid-water trawls are usually used to target large schools of mainly small pelagic species such as anchovy, sardines, herring, mackerel, capelin, rock fish and Antarctic krill. Like bottom trawls they usually require powerful vessels and the large catch volumes require considerable on-board handling and storage space. As such they are mainly restricted to larger commercial operations.	Used extensively to target large volumes of small pelagic fish, either for direct human consumption or for reduction into fishmeal. They are used extensively around the world in polar, temperate and tropical waters.
CONTRIBUTION TO ALDFG AND GHOST FISHING	
<p>Susceptibility to loss: As they are fished mid-water they seldom have contact with the bottom and thus gear loss is relatively infrequent. Usually being large and expensive sets of equipment, if lost, attempts will be made to recover the gear. Given the size of the gear, and the sophistication of the vessels involved, this is usually successful.</p> <p>Impact of ALDFG: With a smaller mesh size than bottom trawls, these small pelagic fish targeting nets may capture fish, but being large and heavy are more likely to quickly accrete to the seabed. With a small mesh they are less likely to entangle aquatic animals, although other elements of the gear such as the warps and head/foot ropes may be problematic. They may cause damage to sensitive habitats if moved by currents, although will tend to be lost in deeper, possibly less biodiverse seabed areas.</p>	
LIKELIHOOD (OF 5): 1	IMPACT (OF 5): 2

2.2.8 SEINE NETS	
	DESCRIPTION
	A purse seine (pictured) is large, surface-set net used to surround a shoal of pelagic fish, the bottom of which is then drawn together to enclose them. A ring net works in a similar manner and is usually operated by surrounding a shoal of pelagic fish with a wall of netting, often operated by two boats. Beach seines are used to encircle fish in shallow water, with the net being drawn together by fishers on a beach.
TYPICAL FISHERIES IN WHICH GEAR IS USED	GEOGRAPHIC DISTRIBUTION OF USE
Purse seines are used to capture both large and small pelagic fish. They are an important gear for fishing tuna (around 65% of tuna is caught this way ¹), often in association with FADs. These gears are also used for capturing small pelagic species such as anchovy and mackerel. Ring nets are typically used in shallower waters than purse seine nets, and they tend to capture smaller fish such as anchovy and chub mackerel.	Purse seines are commonly used for tuna fisheries in the Atlantic, Indian and Pacific Oceans. They are also an important gear for the large forage fisheries in the Pacific Ocean off South America. Ring nets are a common gear in coastal and archipelagic tropical waters, especially for neritic tunas and small pelagic species.
CONTRIBUTION TO ALDFG AND GHOST FISHING	
<p>Susceptibility to loss: As they are fished on the surface, purse seines and ring nets seldom have impact with the bottom and thus complete gear loss is highly unusual. Usually being large and expensive sets of equipment, if lost, attempts will be made to recover the gear. Given the size of the gear, the fact that it is floating, and the sophistication of the vessels involved, this is usually successful. There is potential for the loss of floats from purse seines, and while these are normally retrieved or washed up, their breakup may contribute to the microplastic load. For FADs, see page 13.</p> <p>Impact of ALDFG: With a smaller mesh size than bottom trawls, those purses seines targeting small pelagic fish may capture fish but being large and heavy are more likely to quickly accrete to the seabed. With a small mesh they are less likely to entangle aquatic animals. They may cause damage to sensitive habitats if moved by currents, although will tend to be lost in deeper, possibly less biodiverse seabed areas. However, as mentioned above, abandoned, lost or discarded purse seines are very rare.</p>	
LIKELIHOOD (OF 5): 1	IMPACT (OF 5): 2

¹ Unpublished Poseidon analysis of tuna RFMO data in 2018

2.2.9 SYNOPSIS

The analysis of fishing gear usage has examined two key elements: (i) the *extent of their global use*; and (ii) the *overall risk they pose* in terms of ghost fishing and other ALDFG impacts.

The review of global fishing gear use indicates that midwater and bottom trawls and seine nets account for the majority of fish catches by volume. When calculated by effort, the results are similar: trawls (both bottom and mid-water) are ranked highest, but hook and line (including longlines) and gillnets also rank highly. Traps and pots are relatively less used, but still globally significant, especially—but not exclusively—in small-scale fisheries. When considering the risk of ghost fishing, gillnets pose the highest risk, with FADs second, and traps and pots third.

The conclusion of this combined analysis is that it is worth considering all these gear types in the Best Practice Framework. Although seine nets and trawls have the lower risk of ghost fishing, the fact that they account for the highest volume of global catches means they need to be considered, especially as losses can be concentrated in relatively small areas. Conversely, while traps and pots and FADs account for lower volumes of fish capture, they have a relatively higher risk of ghost fishing, and therefore must also be considered.

The above analysis also shows that gear loss and consequential ghost fishing is a global phenomenon, and this must be reflected in the framework. Both gillnets and traps and pots—the two main fishing gears with a high risk of ghost fishing—are used both in temperate and tropical waters, although there will be an emphasis on shallower coastal waters where they are mainly deployed. Mid-water trawls and purse/ring seines are more often deployed in deeper pelagic waters, mainly by larger-scale fisheries, and this again needs consideration.

Using the likelihood and impact scoring multiplied together to produce a rudimentary risk assessment, gillnets pose the most risk of ghost fishing, FADs second, and traps and pots third. Hooks and lines, longlines, bottom and mid-water trawls and seine nets pose a relatively lower risk for ghost fishing, despite their extensive use worldwide.

GEAR CLASS	LIKELIHOOD	IMPACT	TOTAL RISK
Gillnets	5	5	25
Fish aggregating devices	5	4	20
Traps and pots	4	4	16
Longlines	3	3	9
Bottom trawls	2	3	6
Hooks and lines	3	2	6
Mid-water trawls	1	2	2
Seine nets	1	2	2

3MANAGEMENT OPTIONS AND MECHANISMS FOR RESPONSIBLE FISHING GEAR USE

3.1 OPTIONS FOR PREVENTING, MITIGATING AND REMEDIATING ALDFG3.1.1 PREVENTATIVE MEASURES

Preventative measures are the default preferred approach, in that they prevent ALDFG from getting into the aquatic environment in the first place.

SPATIAL AND/OR TEMPORAL MEASURES

The use of spatial and or temporal restrictions on fishing have considerable potential to reduce gear conflicts and to ensure that fishers reduce the risk of their gear interacting with vulnerable aquatic habitats or species. With the widespread use of GPS mapping, this is a practical and targeted approach. However, like most forms of management, the involvement of fishing practitioners and other stakeholders is critical in designating areas and identifying gear/time restrictions to both ensure that their professional and expert knowledge is included, and that the resulting measures are acceptable and that implementation is possible.

Marine spatial management is not a new concept but is gathering increasing acceptance worldwide. Maritime Spatial Planning (MSP) is an important component of the revised EU Common Fisheries Policy (CFP), as it enables a more strategic approach to fisheries management by providing opportunities to manage fishing effort and increase capture efficiency and the eventual value of seafood

products. Spatial management provides the following benefits related to the use of fishing gear:

- Reduces the potential for gear conflict, especially between mobile and static fishing gear, and thus maximizing the economic potential of individual fisheries;
- Can provide protection of vulnerable aquatic habitats, where appropriate, with the designation of core and buffer areas;
- With a temporal element, can protect vulnerable seabirds and aquatic animals at periods when the potential for interaction is particularly high, e.g., parent seabirds foraging during the nesting season, spawning aggregations, and juvenile fish nursing periods; and,
- Provides opportunities for, and reduces the potential for conflict with, other sea uses, including recreational fishing, sailing and other marine-related activities.

As discussed above, local maritime spatial planning is necessarily a participatory process to improve both effectiveness and compliance levels. It can also be used to reduce gear conflicts and improve operational tenure, especially between commercial and small-scale fishing operations in coastal areas. While such approaches are generally part of a wider fisheries management regime, voluntary designations of spatial-temporal zoning measures are not uncommon.

For instance, the Scottish Fishermen’s Federation, the Scottish Creel Fishermen’s Federation, and the Western Isles Fishermen’s Association, in conjunction with Marine Scotland, implemented voluntary measures for three newly designated marine protected areas in Scotland that will be replaced by statutory provisions as part of the management implementation program.

GEAR DESIGN TO REDUCE WHOLE OR PARTIAL LOSS OF FISHING GEAR AND ITS COMPONENTS

Some degree of gear loss is inevitable given the hostile conditions of aquatic (especially marine) environments. Fishers understand this and will use their knowledge and experience to maintain control over fishing gear, as losing gear has associated cost and time implications. There is also some scope to further reduce the risk of gear loss through better design. It also has to be acknowledged that much of the gear used by small-scale fishers, especially at the artisanal level, tends to be either homemade or cheap and thus prone to breakage or loss. It is also important to understand that the loss of a whole gear assembly is unusual—generally segments of the gear may be lost, e.g., a net panel or cod-end lost through contact with the bottom, or a number of pots lost from a string. Gear loss can also be considered at an even smaller level, with ropes shedding fibers as they abrade under normal wear and tear.

With the recent focus on the impact of ALDFG, gear manufacturers have turned to different ways to reduce the potential for entanglement with fishing gear, especially from ropes used to mark and haul pots and traps. These include technologies such as “ropeless” gear, “weak” ropes, sleeves and time tension line cutters (TTLC).

- **Ropeless gear:** Ropeless gear essentially consists of a container or bag of rope and buoys that is attached to the bottom gear, combined with a release

mechanism that is activated by an acoustic signal from a surface-based transmitter. One such system, the Ropeless Lobster Raft by GGGI member SMELTS⁸ is essentially the same as what lobster fishers currently use. However, all lines and buoys have been replaced with an inflatable lift bag technology built into the lobster/crab traps themselves as single unit. This technology relies on buoyant force—widely used in marine salvage operations—as a reliable and efficient way to recover traps. Activating an acoustic trigger or timer control brings the gear to the surface with no vertical lines in the water. Once at the surface, the gear is easy to locate via a blinking LED light on the bag and highly reflective SOLAS tape. A radar reflector, GPS, and radio tracker are also all built into the inflation module to assist in tracking the location of the gear.

Desert Star System’s Ropeless Fisher™ has an associated smart phone app that allows fishers to log trap and trawl present gear locations with GPS, as well as use acoustic gear marking to monitor and share gear locations⁹. As recently noted by DFO in Canada¹⁰ there have been some successes with ropeless gear to date (most notably in the Acadian crab fishery), as well as real challenges (specifically, in the offshore lobster fishery in SW Nova Scotia). It is evident that while there is much to learn about the application of this new and relatively expensive technology to different types and scales of fisheries, this approach has considerable potential for further development and application.

- **Weak or whale release ropes:** The use of ropes with a breaking strength of 7,536 Newtons (1,700 lb/ft) or less have been advocated for pot/trap fisheries that have the potential to entangle North Atlantic right whales. Historical records show that the incidence and severity of whale entanglements correlates with an increase in the breaking strength of ropes used in northwest Atlantic pot fishing¹¹.

An analysis of specific whale entanglement cases showed that North Atlantic right whales were more likely to be found entangled in ropes of higher breaking strengths and that reducing the breaking strength to 7,536 Newtons or less would lead to fewer and less severe whale entanglements (Knowlton *et al*, 2016).

- **Sleeves:** In a variation to the weak rope concept described above, the braided sleeve design (a design from the South Shore Lobster Fishermen’s Association and developed by rope manufacturer NovaBraid) is 0.5–1 meter hollow braided sleeve that can be integrated into typical three-strand fishing ropes. This is achieved by cutting the three-strand rope and inserting the bitter ends into each end of the sleeve at a side-cut until they meet in the middle. A small length of the sleeve is tucked into the rope at both ends to help ensure the rope will not pull out of the sleeve. In lab tests, the sleeves break on average at 7,117 Newtons (1,600 lb/ft) (see Footnote 12). An expert consultation organized by DFO Canada suggested that weak ropes and sleeves can present retrieval challenges in depths greater than 300 feet (100 meters), that the durability of rope is also a factor, including challenges during hauling, and there are usage differences according to species (crab/lobster), location (near/offshore) and ocean conditions (tides and time of year).
- **Time tension line cutters (TTLC):** A TTLC uses a cutting blade to cut a line when a load is applied over an extended period. The time period is dictated by the size of a double-chambered hydraulic cylinder, the diameter of a hole between the two chambers, and how long it takes for fluid to transfer between the two under pressure. If a fisher hauls a pot this will be within the time window and the current will not be triggered, but if this time threshold is exceeded, e.g., in the case of a protracted whale entanglement, the cutter will engage and cut the line (Pickett, 2007).
- There are now a number of initiatives looking to develop fishing gear that has biodegradable

components and is more easily recyclable. One such initiative is the EU-funded INdIGO (Innovative Fishing Gear for Ocean) project, which launched in late 2020. This crossborder France-UK project has four work packages, including: (i) a situational analysis, (ii) new fishing gear development, (iii) a study of marine aging and the environmental impact of new materials, and (iv) a “psycho-ergonomic approach” to integrate the end users at each stage of the development of the new fishing gear. This four-year project aims to reduce the amount of plastic in the English Channel area of the UK and France by 3% through the development of biodegradable fishing equipment.

REDESIGNING FISHING VESSELS AND OTHER APPROACHES TO REDUCE GEAR LOSS

While the focus is usually on gear design and materials, there are also other practical approaches to reducing gear loss and aquatic littering. One particular issue is on-board storage facilities. Most fishing vessels maximize catch storage and working space, often at the expense of storage areas. For example, a deep-water gillnet fishery involving 50 vessels off the UK continental shelf in the 1990s discarded all their net panels, bringing back only headline and foot ropes, with up to 30 kilometers of gear routinely discarded per vessel per trip, which in deep-water locations are known to continue ghost fishing for two to three years after loss (Hareide, 2005). Improved gear retrieval, packing and storage solutions therefore need to be considered when designing fishing vessels for single or multiple fisheries. One particular issue is the storage of bait box packaging and waste, which is often difficult to control on windy days when crew are in a hurry to get traps baited and into the water.

It is acknowledged, however, that most fishing vessels are designed around the deployment of very specific gear types with most available space being used in one way or another for harvesting operations and/or safety features, making redesign/retrofit options for gear loss either impractical or prohibitively expensive, particularly for smaller vessels (~15m or below). However, some newer vessels, such as the F/V “Ocean

⁸ <https://www.smelts.org/>
⁹ See <https://www.desertstar.com/ropeless-fishing> for more information
¹⁰ <https://www.dfo-mpo.gc.ca/fisheries-peches/management-gestion/ghostgear-equipementfantome/summit-sommet-2020-eng.html>
¹¹ See <https://www.bycatch.org/sites/default/files/Whale-release%20rope%20overview%202020.pdf>

Azul” of *Pesquera Azul*¹²—a newly launched vessel in 2020—incorporate ALDFG prevention/mitigation/remediation measures into their design. The Ocean Azul incorporates numerous environmental and sustainable technologies, including their “Ghost Gear Cleaner” system, consisting of a specialized container onboard the vessel to store gear they retrieve while at sea and bring it back to shore for proper disposal. Similar to vessels in *Austral Fisheries*¹³ fleet, they hope to recover more ghost gear than they lose in the course of normal longlining fishing operations.

BETTER MARKING AND IDENTIFICATION OF FISHING GEAR

As recognized by the FAO Expert Consultation on the Marking of Fishing Gear (FAO, 2016), “adequately and systematically marked fishing gears can facilitate reducing:

- i. the abandonment and discarding of fishing gears in the aquatic environment;
- ii. the unintended catch of endangered, threatened and protected species of fish and other animals;
- iii. the level of illegal, unreported and unregulated (IUU) fishing;
- iv. dangers to navigation and accidents at sea associated with unattended fishing gear, as well as ALDFG;
- v. the accumulation of ALDFG in the aquatic environment;
- vi. damage to vulnerable and sensitive aquatic habitats; and
- vii. economic losses to fishers resulting from ghost fishing and degradation of fishing grounds.”

The marking of fishing gear encompasses two main aspects: (i) surface markers or other devices that indicate the position, nature and extent of the fishing gear; and, (ii) identifiers that allow the relevant

authority to identify the party ultimately responsible for the deployment of the fishing gear. These are briefly examined below.

Marking the position, nature and extent of fishing gear: The Convention on Conduct of Fishing Operations in the North Atlantic (the Atlantic Convention) was adopted in June 1967 following a conference involving the major fishing nations in Europe and North America (UK Government, 1967). The requirements covered signals for different fishing activities (e.g., lighting combinations for use when trawling) and the marking of the ends of nets, lines and other gear with flags, buoys and radar reflectors. This has been updated by a number of other initiatives, including FAO (1993) and FAO (2016 & 2019). In particular the FAO (2019) Voluntary Guidelines on the Marking of Fishing Gear took the results of the 2016 Expert Consultation on the marking of fishing gear and through a Technical Consultation in February 2018 further developed the text for adoption by the UN FAO Committee on Fisheries (COFI) in July 2018. One of the main advances in these voluntary guidelines since the Expert Consultation reported in the 2017 C-BPF is the ongoing development of a risk-based approach to assist relevant authorities in determining the need for and requirements of a system for marking of fishing gear.

Bord Iascaigh Mhara (BIM) in Ireland conducted a useful review of gear marking standards and the identification of issues that may cause difficulties in their implementation (Robson *et al*, 2006 and BIM, 2009). Recent developments and technical innovations have seen an adoption of low cost, low power demand marine lighting systems, power provision at sea (e.g., solar photo-voltaic power and more efficient battery systems), the fitting of radio/satellite buoys for pelagic loglines, and FADs.

Identifiers that allow the relevant authority to identify the party ultimately responsible for the deployment of the fishing gear: The loss of all or part of fishing gear is both a financial loss for the

vessels concerned, as well as a potential safety and environmental hazard. While most vessels do try to retrieve lost gear with variable levels of success (see Macfadyen *et al*, 2009; and Brown *et al*, 2005), considerable amounts of ALDFG—both mobile and static—remain in the aquatic environment. The majority is eventually bound up in the substrate, although some is brought to the surface by other fishing boats or is washed ashore. Having gear adequately marked helps inform where the gear was lost and by whom, thus facilitating the return of gear to the fisher if found in working condition. Additionally, having information on the gear owner and source fishery provides critical data to estimate the scale and nature of gear loss or, in the rarer cases of deliberate gear discarding from illegal fisheries or regions in which there are no viable disposal options for end-of-life gear, to assist in providing evidence to control authorities and to inform regional waste management plans.

The government of Taiwan has taken significant steps to promote gear marking in regional fisheries, in particular with their demersal gillnet fishery (see *Box 1*).

The biggest challenge to allowing the identification of ALDFG is that often only certain parts, usually the marker buoys, are provided with written identification or identification tags. As a result, the majority of lost gear is unidentifiable. Various new technologies have been developed to address this, including radio and other forms of tags:

- **Electronic tagging:** Electronic tagging, such as the use of Radio Frequency Identification (RFID) tags can be produced relatively cheaply and be embedded with considerable amounts of user-definable information. RFID tags are already being used in some fisheries, such as in SW England where fishers who have been allocated



¹² <https://pazul.no/vessel>
¹³ <https://www.australfisheries.com>

BOX 1: REQUIREMENTS FOR THE MARKING OF GILLNETS IN TAIWAN



Photo credit: Joel Baziuk

The government of Taiwan has taken significant steps to promote gear marking in local fisheries, in particular with their demersal gillnet fishery, which makes up the majority of fishing in Taiwanese waters with 10,186 (7,662 full-time and 2,524 part-time) of the 21,908 registered fishing vessels in the country using various types of gillnets.

In various countries around the world, surface gillnets are marked with the vessel's name, an associated fishing registration number marked on the surface floats or end buoys to facilitate identification of deployed gear by local authorities. However, typically not all floats are marked, and often only the buoy at either end of a net is marked. As a result, if such a net gets snagged and breaks, it is less likely that the section of net that snagged will be marked, which often makes it impossible to trace to the source fishery.

In Taiwan, the National Fisheries Agency has proposed a requirement that the gillnets be marked with the vessel registration number on the marker buoys, on the demersal floats that hold the gillnet aloft in the water, as well as the weights that affix the bottom of the net to the seabed (for demersal gillnets). This additional set of marking guidelines means that if a net or piece of net snags or is otherwise lost during fishing operations, there is a high likelihood that it will still be able to be identified and traced back to the source fishery. In the past, there was no collection/recycling channel for fishing nets, which were typically sent for incineration. To tackle this issue, the Taiwan National Fisheries Agency has designated storage sites in every port for fishers to deposit their end-of-life gear. Additionally, the Ocean Conservation Administration has developed a system to collect this end-of-life gear and recycle it locally, creating a viable recycling solution for this waste material.

Taiwan's fisheries management is divided into local and national regulations, leading to some confusion over which set of rules applies in which area. Four local governments requested that there be a single set of regulations, as it was difficult for fishers to follow different sets of regulations which vary by region. In response, the Taiwan National Fisheries Agency has developed a single national regulation for gear marking and reporting of lost gillnets. These new national regulations will come into effect in 2021, following a 6-month period, allowing fishers to adapt to the new set of regulations. Fishers that willingly report gear loss as per the regulations are not penalized, but they must still report any lost gear as a condition of license. As such, this additional marking system is extremely important for data gathering and identifying IUU gear, as well as for identifying which fisher has lost the net, as any fisher who does not either properly mark their gear, or who does not report lost gear willingly can be subject to fines of up to 150,000 TWD (US\$ 5,000). Due to the high volume of artisanal gillnet fishers in Taiwan, it is anticipated that enforcement will still likely be a challenge, but this is a significant step by the Taiwan National Fisheries Agency to develop solutions to this issue.

a potting permit will now be supplied with RFID tags that are secured to each pot. Marine enforcement officers are then able to scan each pot using a hand-held RFID reader to ensure that only those fishers with permits are operational within their jurisdiction. Any pots without a tag will be removed from the water. One limitation is that the reading distance is only about one meter, which means gear will effectively have to be hauled in order to access RFID data, which is usually avoided by control agencies. The cost and logistical requirements might also be seen to outweigh the benefits. This is especially so, given that potentially non-compliant vessels using illegal gear or fishing in closed areas are unlikely to adopt this technology.

- **Other forms of tags:** Coded wire tags can be implanted into netting and scanned for identifying data when required. Alternatively, rogue yarn (a yarn of different twist or color from the rest) can be inserted into multi-strand twines. This has been used in Japan and Canada to distinguish gear from fishers based in specific management areas (Macfadyen *et al*, 2009). Hand-held laser read bar coding is also easy and cheap to produce and print onto plastic tags.

BEST PRACTICES FOR PREVENTION, MITIGATION AND REMEDIATION OF GEAR LOSS

3.1.2 PREVENTION

Prevention measures are those which aim to prevent gear from getting lost in the first place and are considered the most effective measures for addressing gear loss at scale.

The most obvious preventative approach is through diligence and good practice on the behalf of the fisher, ideally having been made aware of best practice measures most applicable for their fishery and region, supported by regulation by the relevant fisheries management authority, and having access to adequate port reception facilities for end-of-life gear. While many fishers already employ best

practices to prevent gear loss where possible to avoid replacement costs and lost fishing time, access to training for fishers and vessel operators is also critical. Where possible/relevant, preventative practices might include:

- Gear use limits, e.g., limited lengths of gillnet fleets, trap strings, etc., to increase control of fishing gear and reduce the risk of damage or loss.
- Soak time limits for static gear such as gillnets and traps. Longer soak times increase the risk of gear loss, so fishers will aim at a balance of achieving a catch and retrieving gear quickly.
- Use of alternative gears as dictated by prevailing weather and other conditions.
- Rigging options that minimize gear loss, even if it compromises catch levels.
- Good communication with other fishers, especially with different segments, e.g., between static and mobile operators in common fishing grounds.
- Use and sharing of seabed and local current mapping data to reduce snagging and subsequent gear loss.

IMPROVED END-OF-LIFE FISHING GEAR DISPOSAL FACILITIES

One key driver for the responsible disposal of old or damaged fishing gear is the convenient access to low-cost disposal opportunities. MARPOL Annex V and its amendments, the latest entering into force in 2018 (see IMO, 2017), (i) requires that every ship of above 100 gross register tonnage should follow a written garbage management plan and (ii) prohibits the "discharge into the sea of synthetic fishing net and line scraps" and provides a methodology for determining the nature and adequacy of port reception facilities for garbage that is based on the "number and types of ship that will call at the port." This latter requirement suggests that fishing ports should have adequate gear reception facilities that reflect the scale and nature of their fisheries. This is relatively straightforward for larger fishing ports but can become problematic for

small coastal ports which have limited quayside space or logistical issues with the subsequent responsible disposal of this waste.

Within this general area of gear disposal, there are a number of best practices and management options available:

- **Involvement of gear manufacturers:** With the adequacy of corporate environmental responsibilities and tools such as life cycle analysis, gear manufacturers have a degree of responsibility in facilitating the responsible use and disposal of their products. This should be through a number of different ways, including (i) buy-back of old gear for reconditioning or recycling into new fishing gear (possibly allied to deposit schemes for returned gear) and (ii) sponsorship and/or implementation of responsible gear disposal schemes.
- **Recycling and reuse of end-of-life fishing gear:** Ideally some degree of recovery of the costs of responsible disposal could be gained through recycling and reuse of fishing gear and its materials. This might require some level of local pre-processing of fishing gear into its constituent components, e.g., rope, net panels, buoys, fastenings, etc., to assist and identify prospective buyers. This approach, when combined with a wider collection system, could also build up sufficient quantities of gear components to make them further attractive to buyers. This could also be allied with some form of certification or labelling scheme to identify products as recycled fishing gear and thus gain a higher value (see [Box 2](#)).
- **Alternative uses of end-of-life fishing gear:** In Australia, rangers in northeast Arnhem Land use abandoned, lost or discarded fishing nets found on the coast to harden coastal tracks for vehicles (Kiessling, 2003), while in some countries old nets are recycled at household level into chicken and stock fencing, soccer goals, etc.

EDUCATION, AWARENESS AND INFORMATION ON GHOST FISHING

Most fishers are aware of their responsibilities towards maintaining the aquatic environment and the resource base on which they depend for their livelihoods. They are also fully aware of the need to minimize risk to their gear, and to make every effort to recover lost or abandoned gear where possible. This said, there are always opportunities for further education and awareness building, both to expand fishers’ mindfulness of the consequences of ALDFG in general and ghost fishing in particular, as well as provide additional information on best practice, risk-reduction strategies and new approaches to gear recovery. Various options exist including:

- **Development of education and awareness-building material:** A number of awareness campaigns—often associated with the wider issue of aquatic litter—already exist such as the NOAA/ Ocean Conservancy Council “Keep the Coast Clear Campaign” in the USA, the MCS “Marine Litter Action Framework,” and of course GGGI itself. With the notable exception of GGGI, the majority of these current awareness-building initiatives are aimed at the public in general, thus developing consumer awareness of the issue, but not influencing the sector directly. There are several programs working directly with fishers, with many of these focused on gear removal, e.g., the Marine Debris Location and Removal Program in Virginia and the [Northwest Straits Initiative’s Derelict Fishing Gear Program](#)¹⁴ in Puget Sound, both in the USA. However, there are relatively few that focus on the priority approach of working with fishers to prevent fishing gear being lost in the first place. Such education efforts should focus on practical, high risk areas which, while needing to be defined through a participatory approach, might include such issues as bait box litter management, avoiding gear conflict, reporting of abandoned gear, etc. There is also a good case to extend education and awareness to include policy

¹⁴ <https://nwstraitsfoundation.org/derelict-gear/>

BOX 2: MINI CASE STUDIES ON RECYCLING OF FISHING GEAR

USA: A public-private partnership was established with a recycler in Washington State. The Washington ports, located within an hour or so from the recycler, benefited from providing a service to their fishers and from the free hauling and pickup they received when a recycling container was full (reducing their extremely high waste disposal costs). In Alaska, communities which were dealing with quickly filling landfills, heavy equipment entanglement problems and difficulties in burying nets, benefited from the removal of this bulky, troublesome material. Some communities sent baled nets or well-cleaned containers of well-compacted loose net, which could generate revenue or be used for other commodities (such as baled cardboard or metals), to help defray the costs of transport or had the transport donated mainly by freight companies hauling empty barges southward at the end of the fishing season. From an average collection volume of 46 metric tons between 1991 and 1999, collected volumes have been halved as funds for coordination and promotion of the program have been reduced (Recht and Hendrickson, 2004). From Macfadyen *et al*, 2009.

Philippines and Cameroon: Global synthetic fiber manufacturer Aquafil Group, global carpet tile manufacturer Interface Inc., and the Zoological Society of London (ZSL) have partnered to form [Net-Works](#) to establish local supply chains for collecting end-of-life fishing gear and recycling it into new yarn for carpet tile production.

Canada: For many years old fishing nets collected at Steveston Harbour just south of Vancouver, British Columbia, were sent to be buried in a landfill with no other viable disposal option. Inspired by the Net-Works project mentioned above, in 2014 Steveston Harbour Authority worked on a pilot project with Aquafil to send nylon6 fishing nets for recycling. After proving the system was viable, and after a successful operation with GGGI in 2016 to recover an older purse net off the coast of Pender Island, they did a short [feasibility study](#) to see what it would take to clean recovered ghost gear sufficiently for recycling. See [Section 4.6.3](#) for a more detailed case study.

See [Section 4.5.3](#) to see Case Study on GGGI’s work in Indonesia on fishing gear collection and recycling.

makers, port authorities, and fishery managers (NOAA Marine Debris Program, 2015).

- **Information availability:** As also noted by NOAA (NOAA Marine Debris Program, 2015), one major gap in this area is the lack of web-accessible data products regarding ghost fishing information, studies, and projects. Some databases already exist such as GGGI’s data portal (see [Section 3.2.4](#) for more information) StrandNet, an Oracle database that summarizes all records of sick, injured, or dead aquatic wildlife reported to the Department of Environment and Heritage Protection in Queensland, Australia (Department of Environment

and Heritage Protection, 2014). This is a powerful tool that centralizes data from known mortalities as compiled by five different agencies across Australia, including those from derelict fishing gear. Having a centralized location with one or more searchable databases would be a significant advancement for educational and outreach purposes, not just locally but globally. There would be a need to have mechanisms in place to oversee management, verification, and distribution of such data.

Suggestions for data to include are:

- Spatial zoning of fishing gear regulations searchable by state/region/nation/fishery

- Mortality of organisms searchable by species/region found
- Location of found ALDFG with data provided by fishers, scientists, and general public
- List of initiatives from both governmental and nongovernmental organizations to promote collaborations and reduce duplicative research efforts
- Published literature, including government reports, conference summaries, and links to peer reviewed literature

IMPROVED FISHERIES MANAGEMENT

While ghost fishing can be best prevented through the specific measures discussed above, there are elements of the wider fisheries management regime that might affect the risk of fishing gear being abandoned, lost or discarded and thus indirectly lead to ghost fishing.

Some fisheries are managed on a *limited effort basis*, e.g., through restricting the timing and duration of the fishing season, the number of days at sea, or the number of licenses issued to fish a certain stock. However, these can have unintended consequences, such as encouraging a race to fish, which in turn may lead to spatial conflicts, shortcuts in gear rigging and deployment, and possibly higher rates of gear abandonment when time pressures are involved. The use of an alternate *output control* management system, e.g., the allocation of quotas that can be fished at leisure, may solve some of these issues but can also lead to other problems such as discarding (especially in mixed fisheries) and high grading (especially in small pelagic fisheries).

In summary, fisheries policy, management and regulatory authorities should be encouraged to consider the implications of fisheries management strategies on fishing gear use and loss, possibly through inclusion in any ex-ante evaluation or impact assessment that might be undertaken.

3.1.3 MITIGATION

Mitigation measures are those put in place to minimize the damage caused by fishing gear if and when it does become ALDFG.

GEAR DESIGN TO REDUCE THE INCIDENCE AND DURATION OF GHOST FISHING

For most gear types, e.g., gillnets, there have been very few approaches to reduce ghost fishing potential once the gear is lost. The two exceptions are traps/pots and fish aggregating devices, both of which are examined in more detail below.

This has been the focus of a number of initiatives to prevent lost gear from ghost fishing once control is lost. For example, Florida’s spiny lobster fishery has had a requirement for escape mechanisms since 1982 (Matthews and Donahue, 1996). The fisheries management plan for king and tanner crab in the Bering Sea states that “*an escape mechanism is required on all pots; this mechanism will terminate a pot’s catching and holding ability in case the pot is lost.*” Biodegradable escape cords (rot cords) can be effective at disabling derelict traps, although this depends on the design involved (Natural Resources Consultants, Inc., 2015). Despite these requirements, trap recovery programs have identified that significant proportions of the traps recovered do not have the requisite rot cord for reducing catching capacity if lost. Forty percent of commercial traps recovered in Port Susan in Washington State did not have rot cords (Natural Resources Consultants, Inc., 2007). This highlights the importance of monitoring and enforcement to support any mitigation measures that are implemented.

Bilkovik *et al* (2012) tested in a blue crab (*Callinectes sapidus*) trap fishery a fully biodegradable panel with a cull or escape ring designed for placement on the sides of a crab pot that completely degrades into environmentally neutral constituents after approximately one year. The authors noted that their solution was more effective than the aforementioned rot cords, as biodegradable cull panels create

entrance-sized holes for escape in the upper chamber. They also note that newer biodegradable polymers (see [Box 3](#)) are far more effective than biodegradable plastics produced in the past. Further, they note that lost pots can become habitat for aquatic organisms if modified to become ineffective at trapping. The potential for using modern biodegradable materials is not restricted to trap fisheries as they can be used for mussel socks as well as the multitude of other plastics used on board boats, such as bait box packaging material.

One recent innovation is [Resqunit](#)¹⁵. Resqunit is a combination escape hatch and emergency buoy for lobster and crab pots. The Resqunit is mounted over an escape hatch on a crab or lobster pot with biodegradable (usually cotton) rot cord. If the trap

becomes separated from its rope/buoy for any reason, the rot cord will biodegrade after a set amount of time (depending on the unit—the newer 2021 units now have electric timed-release mechanisms) and the Resqunit buoy is released and floats to the surface. A strong rope is attached to Resqunit and the fishing gear, allowing the trap to be identified and retrieved.

Other fishing gear with a high potential for improved design for reducing both the potential for ghost fishing as well as habitat interactions are fish aggregating devices (FADs). It is estimated that FADs are now used for over 40% of world tropical tuna catches, making this technique a major phenomenon for high seas fisheries worldwide, and one that has experienced great expansion over the past three decades (Taquet, 2013). In 2013, Pew estimated that between 47,000

¹⁵ <https://www.resqunit.com/en/>.

BOX 3: USE OF BIODEGRADABLE PLASTICS IN FISHERIES

Polyhydroxyalkanoates (PHAs) are a family of naturally occurring biopolyesters that are produced by bacteria and are completely biodegradable by microbes typically found in the aquatic environment. PHA meets the American Society of Testing and Materials certification as well as European Standards for biodegradation in the aquatic environment (Chanprateep, 2010). PHA has physical characteristics similar to non-degradable plastics and can be formulated for extrusion into molded forms. The rate of biodegradation can be controlled by adjusting the thickness of the polymer.

Researchers at the Virginia Institute of Marine Science (VIMS) tested PHA as the material of choice for use in developing escape panels for crab, lobster, and fish traps (VIMS, undated). Earlier methods of providing escape vents for animals captured in lost traps were prone to failure either by degrading too quickly or not at all. PHA is consumed by bacteria and panels constructed of PHA have a high level of certainty of dissolving and providing an avenue for escape. Since PHA is consumed by bacteria naturally occurring in water, PHA biopanel have an added benefit of lasting longer if regularly fished. This is because microbes feeding on the PHA have inhibited or delayed growth when exposed to UV light during trap retrieval requiring constant regrowth of bacteria on biopanel of active traps. Lost traps, however, remain on the bottom out of UV light exposure and populations of bacteria can proliferate and more quickly consume the PHA.

A South Korean company, ANKOR Bioplastics Co., is currently working on biodegradable resins such as PBS (Polybutylene succinate) and PBAT (Polybutylene adipate-co-terephthalate) for twines used in fishing nets and ropes. See <http://en.an-korbio.co.kr/>.

and 105,000 drifting FADs were being deployed each year in 2011 (Baske *et al*, 2013), and this was updated to 81,000 to 121,000 in 2013, a 14% increase (Gershwin *et al*, 2015). French and Spanish purse seine fleets are attempting to develop “ecological FADs,” which are biodegradable and therefore are not conducive to ghost fishing. ISSF published revised guidelines for the construction of non-entangling FADs (ISSF, 2015), which left specific, on-the-water designs to the fishing industry, comparing designs that varied from traditional, high entanglement risk designs to low-risk, non-entangling FAD designs that incorporated cloth attractors rather than mesh panels and all biodegradable materials. In 2019 they published a best practice manual for FAD management, including the use only of non-entangling FADs (Restrepo *et al*, 2019; Restrepo *et al*, 2020) as well as design for non-entangling and biodegradable FADs (ISSF, 2019).

Restrepo *et al* (2020) advise that fishers should test biodegradable FADs using local material if possible, suggesting, for example:

- **Raft:** Rafts should be constructed using bamboo, balsa wood or other natural materials that degrade without polluting the aquatic environment. For FAD flotation, the use of plastic buoys and containers should be reduced as much as possible (e.g., reducing the weight and volume of the FAD structure would require less flotation).
- **Tail:** Only natural and/or biodegradable materials (cotton ropes and canvas, manila hemp, sisal, coconut fiber, etc.) should be used, so that they degrade without causing impact on the ecosystem.

Self-destructing FADs are also being tested in the EPO (IATTC, 2008) but have so far not been implemented in that region or elsewhere. In 2019, the Indian Ocean Tuna Commission (IOTC), like a number of other RFMOs, adopted a resolution that requires CPCs to use non-entangling designs and encourages the use of biodegradable material in the construction of FADs (IOTC, 2019).

3.1.4 REMEDIATION

Remedial measures are those taken to report and assist the recovery of ALDFG. It is recognized that gear recovery can often be an expensive exercise, and is thus less of a focus than prevention, but may be appropriate in some circumstances, particularly in critically sensitive habitats or when gear is interacting with endangered, threatened or protected (ETP) species.

LOST, ABANDONED AND FOUND FISHING GEAR REPORTING

One important management tool that has been often suggested, but is still rarely enacted, is the reporting of lost or abandoned fishing gear (it is presumed that deliberately discarded fishing gear will not be reported for obvious reasons). As noted above, reporting of the “loss or discharge” of fishing gear is specifically required by MARPOL Annex V, but this (i) excludes fishing gear that is released into the water for later retrieval (e.g., FADs, traps and static gear) and (ii) only applies to vessels >400 gross register tonnage, which are required to carry garbage management plans, thus excepting the majority of coastal fishing vessels. The FAO Expert Consultation on fishing gear marking (FAO, 2016) noted that “the effectiveness of gear marking systems would be significantly enhanced when incentives exist to: (i) encourage the uptake of gear marking systems, (ii) the reporting of lost or abandoned fishing gears, and (iii) the safe retrieval and responsible disposal of ALDFG” and urged relevant authorities to (i) establish appropriate reporting regimes, (ii) develop and maintain a record/register of fishing gear reported as being found, lost, abandoned, or disposed of¹⁶, and (iii) make information about ALDFG available to relevant RFMO/As, other relevant organizations and entities, including stakeholders, as appropriate. Further guidance on these elements were provided in the final Voluntary Guidelines on the Marking of Fishing Gear (VGMFG) produced in 2019 (FAO, 2019).

Although currently very few national maritime administrations make the reporting of lost or discarded

fishing gear mandatory, there are a few exceptions. In 2018, the Canadian Department of Fisheries and Oceans (DFO) made the reporting of lost commercial fishing gear mandatory, including the location and details of the gear/components lost¹⁷. Iceland provides guidelines to fishing vessels and keeps a record book on fishing gear reported lost at sea or incinerated. Malaysia also has established a national inventory of net types and other fishing gear. ISSF notes that “Longline fisheries are unlikely to have substantial habitat impacts. Nevertheless, the fishery should collect and report data on abandoned, lost and discarded fishing gear, and provide information on location of sets” (Restrepo *et al*, 2020). One of the factors holding

back reporting is the lack of standardization of fishing gear units, reporting methods and data requirements, database/register structures, and the difficulty in monitoring the actual retrieval rates of fishing gear.

There are other approaches to estimating the volume and nature of ALDFG including the monitoring and tracking of gear use and loss via initiatives such as a “check out—check in” tactic whereby vessels are routinely required to account for their fishing gear inventory and balance purchases and sales/loss/disposal. However, this can impose a considerable burden on both regulatory authorities, as well as the fishers themselves. One area where this approach might work is with FADs, where RFMOs

¹⁷ See <https://www.dfo-mpo.gc.ca/fisheries-peches/reports-rapports/fixe-atl-fixe/index-eng.html>



Photo credit: Global Ghost Gear Initiative

¹⁶ Includes fishing gear sold or put ashore and destroyed.

might require vessels to account for all FAD use and disposal, possibly in association with a third-party certification scheme. FADs can also be managed by a combination of electronic tracking, restrictions on the total number of active FADs followed by any one vessel (as in IOTC waters), or by establishing FAD registration and tracking systems as currently being trialed by the PNA in the Western Central Pacific.

ALDFG LOCATION AND IDENTIFICATION

While the position and identity of ALDFG may be reported by the owner of the gear, or by another vessel, locating and identifying fishing gear on the water is a considerable challenge. Sea-based surveys can be used to locate lost fishing gear that may still be ghost fishing or damaging habitats. Where no accurate information on location of gear is available, the use of modeling techniques, local knowledge and anecdotal information to identify potential hotspots is essential in order to better target a survey intended for gear retrieval (Macfadyen *et al*, 2009; NOAA, 2010). Towed-diver surveys of the north-western Hawaiian Islands, for example, identified high entanglement risk zones by recognizing oceanographic conditions leading to the likely collation of aquatic debris combined with high densities of sensitive species—in this instance, monk seal nursery areas (Donohue *et al*, 2001).

Side scan sonar (SSS) is a sea-bed mapping technology that has become more accurate and more affordable in recent years, with increased use of artificial intelligence (AI) to automate data analysis and improvements to reduce its acoustic impact on sensitive marine mammals, such as with the [Open Sidescan](https://cidco.ca/en) project by CIDCO¹⁸. SSS is likely to be applicable where relatively large or readily distinguishable items such as pots or traps are located, although it can also be used for gillnets and other ALDFG. The NOAA Gulf of Mexico Marine Debris Project has used SSS from survey vessels in its retrieval of large aquatic debris, assisted by an autonomous survey vessel (ASV), and derelict blue

crab traps were mapped using SSS in the Virginia portion of Chesapeake Bay by VIMS (Havens *et al*, undated). In mid-2020, the Canadian federal government announced CAD 8.3 million for a Sustainable Fisheries Solutions and Retrieval Support Contribution Program for 22 projects in Canada, including SSS mapping to identify hotspots in the estimated 1.8 billion items of marine debris on the Bay of Fundy sea floor. The GGGI itself has been involved in a number of projects using SSS to map out ALDFG debris fields, including one resulting from an illegal gillnet fishery in the Gulf of California in Mexico.

The use of Remotely Operated Vehicles (ROVs) has received mixed results as the maneuverability of ROVs can be hampered by currents. However, Melli *et al* (2016) reported on the successful use of ROV imaging to investigate aquatic litter abundance in the north-west Adriatic Sea and, more recently, ROVs were successfully used by GGGI in Myanmar where they were useful in giving recovery divers a preview of the condition of lost nets. This enables them to make a plan prior to diving for the actual recovery, which was found to increase both recovery efficiency and safety. Unmanned Aerial Vehicles (UAVs) have also been tested by the GGGI in Myanmar to locate lost gear in near-shore coastal environments with a depth of ~10 meters and have been found to be very effective for plotting lost gear on geospatial maps and giving an indication of lost gear densities, provided surface conditions are ideal and turbidity is low. The GGGI is also working on piloting an AI routine in 2021 to identify gear in aerial photos to reduce the cost and time required to sort through images from similar surveys, potentially drastically cutting down on the cost of doing similar surveys in other areas in the future.

A more recent innovation is the use of transponder technology that can be attached to fishing gear to assist locating it if lost. For instance, Norwegian [Ocean Space Acoustics \(OSAC\)](https://www.osac.no)'s [PingMe](https://www.pingme.no) device is a relatively cheap, passive device that responds to sonar pings by reflecting a unique identity that can



Photo credit: Blue Ocean Gear

be interpreted by software and its location fixed. This can be used by fisheries authorities to locate, map and possibly retrieve lost gear, and by fishers to set and retrieve their gear.

[Blue Ocean Gear](https://blueoceangear.com/)¹⁹, a start-up out of San Francisco, California, is also taking a high-tech approach to gear monitoring. Their Smart Buoy systems are GPS enabled buoys about the size of a grapefruit which can be attached to deployed gear and provide real-time location information to the gear's owner via a mobile and desktop app. The buoys are pressure-sealed, have a battery that lasts for six months, and can immediately alert the gear owner if the gear moves from its deployed location, providing real-time location data so both it and the gear can be quickly and efficiently recovered. Using onboard sensors, they can also detect whether the gear comes into contact with a large mammal, such as a

whale, and could be used to inform marine mammal rescue agencies of a tangled animal's exact location.

ALDFG RECOVERY

Gear recovery normally takes place in the first instance through the use of "creeps," which are grapnels fabricated specifically for retrieving lost fishing gear. They are a useful, effective and low-cost solution for situations when gear is recently lost or abandoned, the location of the gear is known, and where the benthic environment is suitable for grappling (i.e., sandy bottoms with no risk of snagging or harming sensitive habitats). Grapnels can take a number of forms, from single grapnels (suitable for lost trawls or large net sheets) to beams, such as Roger's Grapnel (see the Fundy North Fisherman's Association Ghost Gear Retrieval Manual (2016) and associated YouTube video²⁰) that snags both ropes and traps. In addition to post-lost recovery, there have been a number

¹⁸ <https://cidco.ca/en>

¹⁹ <https://blueoceangear.com/>

²⁰ See https://www.youtube.com/watch?v=0uH5g0UEp0c&feature=em-share_video_user

of historical derelict gear clean-up operations. The Norwegian Directorate of Fisheries has organized retrieval surveys annually since 1980 and over the period of 1980 to 2003, removed 9,689 gillnets of 30 meters standard length (approximately 290 kilometers) from Norwegian fishing grounds at a cost of around NOK 1.5 million (US\$ 181,000). As mentioned above, Fisheries and Oceans Canada has recently launched its CAD 8.3 million (US\$ 6.6 million) Sustainable Fisheries Solutions and Retrieval Support Contribution Program for 26 projects both in Canada and internationally.

In relatively shallow (30–40m) coastal waters it is possible to survey and retrieve ALDFG through the use of SCUBA and surface-supplied air diver surveys. This approach is particularly useful on complex 3-D habitats such as coral reefs and wrecks where traditional creeping is impossible. Such ventures can include local dive clubs but can be extended to engage the entire coastal community, such as in Australia’s Carpentaria Ghost Net Programme where community groups have formed a network to clean up beaches and establish a coordinated information recording process to build a picture of the quantities, impacts and likely origins of ghost nets across northern Australian waters. The Gulf of Maine Lobster Foundation Gear Grab initiative encourages fishers to volunteer their time and vessels to grapple for lost traps. Recovered gear is brought to a central wharf for sorting and processing, salvageable traps are returned to their owners, and unusable traps are disposed of and the steel is recycled. Information about each recovered trap is recorded and given to scientists to assess the impact on aquatic habitat²¹. Ghost Diving Foundation²² (formerly Ghost Fishing Foundation) is an international charity organization conducting gear recovery in multiple locations around the world.

²¹ See <http://www.geargrab.org/>.
²² See <https://www.ghostdiving.org/>.
²³ See <https://www.kimointernational.org/>.

In addition to targeted surveys or initiatives, some states operate a continual system for gear recovery. In the Sea of Japan, fisheries patrol vessels from the national agency bring any ALDFG identified to shore, as do fishing vessels chartered by fisheries organizations and the local government, which are funded by central government subsidy (Inoue and Yoshioka, 2004). However, gear recovery programs in many jurisdictions may face certain legal constraints and challenges. As noted by the NRC, *“in the United States, recovery of DFG [derelict fishing gear] may be inhibited by prohibitions against tampering with abandoned gear, the application of cabotage laws and burdensome certification requirements for vessels that transport DFG, and fishery regulations that prohibit vessels from carrying gear that is not a gear type permitted under their license endorsement”* (NRC, 2008).

In the EU there is a [Fishing for Litter](#) scheme that encourages fishers to land any aquatic litter, whatever its origin, if caught during normal fishing operations. Largely funded through the EU’s European Maritime Fisheries Fund (EMFF) public finance scheme, this is coordinated by KIMO²³ (Local Authorities International Environmental Organisation), an association of coastal local authorities whose goal is to eliminate pollution from the Northern Seas.

3.2 IMPLEMENTING MECHANISMS FOR FISHING GEAR MANAGEMENT

Having looked at the different management approaches and measures for preventing, mitigating and remediating ghost fishing, this section examines how these have been applied in practice. The purpose is to help identify how best practice might best be applied, e.g., through (i) voluntary actions, possibly via a code of conduct, (ii) third party certification, (iii) mandatory legislation, and/or (iv) better awareness and information (see [Table 1](#)).

TABLE 1: ALLOCATION OF IMPLEMENTATION MECHANISMS TO MEASURES TO PREVENT GHOST FISHING

Approach	Measure	Implementation Mechanisms			
		Voluntary guidance	3rd party certified	Regulatory	Awareness and information
Prevention	Spatial and/or temporal measures	✓		✓	
	Gear design to reduce whole or partial loss of the fishing gear	✓		✓	
	Vessel design to reduce gear and other aquatic litter discarding	✓		✓	
	Better marking and identification of fishing gear	✓	✓	✓	
	Improved end-of-life fishing gear disposal facilities	✓	✓	✓	
	Education and awareness				✓
	Improved fisheries management regime			✓	
	Good practice for avoidance, mitigation and response.	✓	✓		
Mitigation	Design to reduce the incidence and duration of ghost fishing	✓	✓	✓	
Remediation	Lost gear reporting, location and recovery initiatives	✓	✓	✓	✓

3.2.1 VOLUNTARY ACTIONS AND GUIDANCE

According to Table 3, the majority of measures investigated in [Section 3.2.2](#) can be implemented through voluntary means. This rather broad category can include the following approaches:

Codes of Conduct: Codes of Conduct (CoC), often used interchangeably with Codes of Practice (CoP), are sets of rules, usually established by a representative or

umbrella body in order to harmonize and improve the conduct of its members. CoC are widely used in the fishing industry to develop and formalize a collective best practice approach, sometimes as support to a third-party certification initiative.

A study for OSPAR (CEFAS, 2017) found that five out of 12 countries (Iceland, Ireland, the Netherlands, Spain and the UK) in the Northeast Atlantic have a national code of practice or

BOX 4: CODE OF GOOD PRACTICE TO MINIMIZE GEAR CONFLICT AND GEAR LOSS IN GILLNET FISHERIES

THE FANTARED 2¹ project included the development of a netting code of good practice to minimize gear conflict and gear loss and to agree on measures to mitigate the impact of lost gear on commercially important stocks. Agreed between the gillnet fishing fleets of the UK, Spain, Portugal, France, Sweden and Norway, the main points of the agreement were:

- Only setting the amount of gear that can be handled regularly and efficiently;
- Marking gear properly, including the identity of the vessel;
- Paying close attention to weather patterns and not setting gear when poor weather is expected;
- Ensuring that gear is set in such a way as to avoid conflict with other users, and taking appropriate precautions when fishing in areas of high marine traffic;
- Always carrying net retrieval gear aboard; and
- Always attempting to retrieve lost gear and reporting its loss where possible.

Regional additions include using radar reflectors, using certain surface buoy combinations for strong current conditions, tagging nets and specifying minimum standards for gear construction.

From Brown *et al*, 2005

¹ *Redes Fantasma* (ghost nets in Spanish)

guidance that delivers the FAO Code of Conduct for Responsible Fisheries and/or a voluntary agreement with the fishing sector.

- In **Iceland**, there is a voluntary agreement where fishers can deliver nets and dolly ropes to waste receptions facilities free of charge. The voluntary agreement between the fishers and the Icelandic Recycling Fund (a state-owned agency) aims to recover and recycle fishing nets made from plastic.
- In **Ireland**, the Bord Iascaigh Mhara (BIM) provides a Responsibly Sourced Standard by issuing a Certification of Best Practice for wild caught Irish seafood (BIM, undated). This certification involves a commitment to environmental responsibility, which includes waste management. It includes

sections on fishing gear management, recovery of lost fishing gear and aquatic litter management.

- In the **Netherlands**, there is a voluntary agreement called the Green Deal Fishery for a Clean Sea, in which the fishing sector, fishing harbors, waste organizations, NGOs and the ministry, work together to decrease the amount of aquatic litter from the fishing sector and to increase the recycling of the fishing waste collected.
- In **Portugal**, there is voluntary cooperation from fishers resulting from the Docapesca project Fishing for Sea No Trash.
- **Spain** has a national code of practice but did not provide further details.

- In the **UK and now globally**, the Responsible Fishing Vessel Standard (RFVS) is a voluntary scheme which supports a responsible fishing industry by ensuring best practice²⁴. GGGI was part of the technical advisory group that saw ALDFG referenced more strongly in the revised standard in 2020 which includes requirements for (i) procedures to be in place for the management and recording of lost, “end of life” or recovered (third-party) fishing gear and (ii) that “Inorganic/ non biological waste produced from vessel operations, including gear repair activities and waste matter that is recovered from the marine environment, shall be brought ashore to be disposed of in a manner that will not have a detrimental impact on the environment.”

Voluntary agreements: Another voluntary approach is the establishment of agreements between different parties to improve coordination and reduce the potential for misunderstanding and conflict. A typical example might be communication between different fleet segments operating over a joint fishing ground, where agreements might be reached in terms of access, priority, communication, vessel and gear marking and contingency plans in case of incidents taking place. One example of such an agreement is the Inshore Potting Agreement (IPA) in SW England which is a zoned fishery management scheme that has operated since 1978 over an area of approximately 500 square kilometers to reduce conflict between different sectors of the fishing industry. It includes areas for the exclusive use of static gear (principally crab pots) and areas for seasonal static gear use. Towed-gear fishing is allowed in seasonal areas during periods when they are free from static gears. This scheme has worked successfully for nearly 40 years and has proven to have both reduced gear conflict risk as well as shown that it is possible to allow some sectors of the fishing industry to retain access to specific fishery resources while protecting aquatic benthic species and habitats (Blyth *et al*, 2004).

²⁴ See <http://www.seafoodassurances.org/ProgramStandards/RFVS>

Good and responsible design: A third approach, and one rather different from those preceding, is encouraging good and responsible design. This covers a number of different areas, including gear, gear constituents (e.g., ropes and ironmongery), as well as vessel design.

- **Fishing gear design:** As discussed in the previous section, the particular design of a fishing gear assemblage can dictate its vulnerability to both loss and the gear’s ability to ghost fish after control is lost.
- **Fishing gear components:** The design of the constituent components of fishing gear are as important as the design of the whole assemblage. For instance, the use of specific materials (e.g., biodegradable), ropes that do not shed fibers, the integration of identification tags, integration of on-board power, lighting and communication equipment, robust materials that prevent gear failure in the event of storm, or other induced stresses can all contribute to the overall robustness of fishing gear, as well as its behavior when control is lost.
- **Vessel design and facilities:** A number of issues associated with ghost fishing, such as the discarding of gear due to insufficient storage space or insufficient control and stowage of other aquatic litter (e.g., bait packaging), can be mitigated through better vessel design. Therefore, the development of innovative and convenient forms of gear and waste storage need to be considered in vessel design and manufacture. Some more progressive fishing operations include container storage onboard to specifically store any ALDFG they generate or recover.

A recent report by the [Blue Circular Economy Project](#) (Charter *et al*, 2020) provides some useful ideas on the opportunities for circular business models and circular design related to fishing gear.

3.2.2 THIRD-PARTY FISHERIES CERTIFICATION

The last two decades has seen a rise of seafood-related ecolabels, mainly Type I²⁵ voluntary, multiple criteria-based schemes such as the Marine Stewardship Council (MSC) responsible fishing scheme. Ecolabeling in fisheries emerged in response to a public and industry perception that public mechanisms (i.e., policy and regulation) had failed to adequately manage the sustainability of aquatic resources. Ecolabeling is seen to provide incentives which drive improvements in fisheries management by rewarding best practice. These rewards are said to include market access, price premiums and consumer satisfaction. As such, ecolabeling is seen as a tool with which to place pressure on governments to address shortfalls in fisheries and aquaculture policy, regulation and management (MRAG *et al*, 2015). MRAG *et al* (2015) mapped over 100 seafood ecolabeling schemes and mapped 73 in detail. Of these, only 16 covered capture fisheries and a further 27 covered both capture fisheries and aquaculture. While we have not done a definitive appraisal of all these capture fisheries-related ecolabeling schemes, there is currently limited explicit reference assessing and including the potential for ghost fishing in assessments.

The original (Version 1.1) of the MSC Fishery Standard (Principles and Criteria for Sustainable Fishing) specifically included scoring criteria on (i) the loss of fishing gear during fishing operations and (ii) information on the extent and significance of ghost fishing. However, in an attempt to simplify the standard in 2004, a new fisheries certification methodology was introduced in 2006 that removed the specific references to lost gear and the potential for ghost fishing. However, it is still implicit in the current standard (FCR v2.1) in that the MSC

Principles and Criteria for Sustainable Fishing include criteria that relate to ghost fishing and gear loss, including that the fishing operation shall (see Box GSA7 in MSC, 2018) (i) make use of fishing gear and practices designed to avoid the capture of non-target species and non-target size, age, and/or sex of the target species; minimize mortality of this catch where it cannot be avoided, and reduce discards of what cannot be released alive; (ii) implement appropriate fishing methods designed to minimize adverse impacts on habitat, especially in critical or sensitive zones such as spawning and nursery areas; and (iii) minimize operational waste such as lost fishing gear, oil spills, on-board spoilage of catch, etc. In summary, unobserved fishing mortality on primary and secondary species²⁶ and endangered, threatened and protected (ETP) species is still included in MSC's Principle 2, but not explicitly so.

MSC does seem to be making some difference in driving better practices—for instance the companies involved in longline fishing of Alaska cod requested a federal government grant of US\$ 500,000 towards research on the impacts of lost longline gear, as recommended by the MSC certification process of that fishery (Washington & Abalouch, 2011). However, MSC acknowledges that overall the consideration of ALDFG within fishery assessments was found to be inconsistent, absent or incorrect with very little “on the water” change (MSC, 2020). As a result, ALDFG is subject to a specific assessment as part of a wider review of the Fisheries Standard, to which the GGGI has been an important contributor. This is examining ways in which (i) the consideration of ALDFG impact needs to be explicit in MSC fishery assessments and (ii) promoting the implementation of gear loss avoidance strategies and mitigation actions in certified fisheries. The revised MSC Fisheries Standard should be applied to new fisheries entering assessment in late 2022.

²⁵ ISO, 2012, Environmental labels and declarations: how ISO standards help. Available at: <http://www.iso.org/iso/environmental-labelling.pdf>
²⁶ MSC segregate those species not included in the unit of certification as primary (e.g., managed) and secondary (e.g., unmanaged) catch elements.



In 2017, the original C-BPF reported that relatively few certification standards focused on aquatic litter (including lost gear and other litter directly attributable to fishing activities) issues, with only three of the 16 sustainability programs assessed for WWF International in 2009 including waste in their standards: The UK's **Responsible Fishing Vessel Scheme** considers lost fishing gear recovery, vessel discharges and aquatic litter recovery; (ii) the **Clean Green** of the Southern Rock Lobster fishery that supports removing environmentally unfriendly practices, such as the use of plastic bait box straps, and managing responsible disposal and recycling of aquatic wastes—oil, plastics and cardboard; and (iii) **Carrefour's Pêche Responsable** promotes “responsible production methods and reducing waste” (Accenture Development Partners, 2009).

Since then, the **FairTrade USA** Capture Fisheries Standard (v. 1.1.0, November 2017) now includes compliance criteria where (i) a strategy has been developed and its implementation has begun to minimize, and where physically possible, recover derelict fishing gear, and (ii) if derelict fishing gear

is generated by the Registered Fishers, the strategy has been fully implemented to minimize and, where physically possible, recover fishing gear lost at sea (FairTrade USA, 2017). With the assistance of GGGI, the new version of the **Friend of the Sea** has also been updated to specifically cover the issue of ghost fishing and ALDFG, including requirements on rapidly locating and retrieving lost fishing gear, recording and reporting lost gear to the authorities, including the use of the GGGI Ghost Gear Reporter App (Friend of the Sea, 2020).

The **KRAV** capture fisheries standard does not specifically mention ghost fishing or lost gear but does include the need for “degradable meshes and degradable panels or equivalent equipment in all cages and traps” and a requirement to “clearly mark all equipment so it is possible to trace the equipment to you” (KRAV, 2019).

While not an ecolabel per se, the Monterey Bay Aquarium's **Seafood Watch** program includes a Standard for Fisheries that specifically covers fisheries-related mortality associated with ghost

fishing, whether there is significant likelihood of ghost fishing and if so whether there is a comprehensive strategy to limit/avoid ghost fishing that includes the following: (i) measures to assess, minimize, and mitigate the impacts of derelict gear from the fishery (e.g., gear modifications, gear-tending procedures, etc.); or (ii) a time-sensitive requirement for reporting gear loss and location. Fisheries must also collect data on lost gear or otherwise demonstrate a method to include ghost fishing impacts in the assessment of fishing mortality (Seafood Watch® Standard for Fisheries, 2016).

3.2.3 MANDATORY LEGISLATION

Beyond the voluntary approaches of self-determination and third-party certification described above, the third main implementation approach to the management of fishing gear is mandatory legislation. This option is the primary means of managing authorities to influence fisher behavior, both in terms of better managing gear to ensure it remains under control, as well as their response to losing gear and its recovery. The advantage of legislative measures is that they can be required of all fishers and compliance can be reinforced through punitive measures. However, a legal approach is often expensive to implement and control, and poorly designed legislation can be both difficult to enforce and, in some cases, counterproductive.

The main area where a legislative approach has been adopted is in gear marking. This has largely stemmed from international fisheries instruments such as the *United Nations Agreement for the Implementation of Certain Provisions of the Convention on the Law of the Sea* of December 1982 relating to the *Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks* (Fish Stocks Agreement), the *FAO Code of Conduct for Responsible Fisheries* (the CCRF), and the *Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas* (Compliance Agreement). These have then been translated into regional management,

such as through IOTC's active FAD limits and Inter-American Tropical Tuna Commission (IATTC)'s ban of supply vessels or through regional blocks such as the European Union, as well as into national law.

Hodgson has considered a regulatory toolbox of possible approaches to ALDFG (Stephen Hodgson, personal communication), including the following:

1. **Command and control regulation:** Regulation involves the setting of legally binding rules, either directly in legislation, or as conditions in licences, the “command” part, and the enforcement of such rules through the use of civil and/or criminal penalties to sanction non-compliance, the “control part.” A simple ban on a given activity, such as the deliberate disposal of fishing gear at sea, is one kind of command-and-control rule that can be imposed. There would be little point in legislating against accidental or unintentional loss of gear. Command and control legislation can also be used to require certain actions in specified circumstances. For example, legislation could require anyone losing fishing gear to report this loss to the relevant authorities and make every effort to recover gear where possible. Alternatively, “no-fault” reporting systems can be used where reporting gear loss is mandated by law but there is no penalty associated with accidental loss of gear. This is the case in Washington State in the USA and in Canada. Penalties are applied, however, if gear is not reported lost and is later found/recovered by someone else.
2. **Liability regimes:** Liability regimes seek to impose civil liability upon those who cause harm to the environment and/or natural resources through, for example, causing pollution. The amount or quantum of financial damages that must be paid is usually calculated by reference to the costs of remedying the environmental harm. Specific liability regimes have been developed in a number of countries with regard to particularly environmentally harmful activities or those using hazardous substances. As to the fisheries sector

in general, and ALDFG in particular, it is difficult to see how an “ordinary” liability regime could be particularly relevant. In particular, it is difficult to quantify the harm caused by overfishing or the effects of ALDFG that could give rise to a damages claim. Nevertheless, the recovery of ALDFG does have an economic cost. There may be scope for seeking to recover some or part of that cost if certain requirements are not met in terms, for example, of reporting lost gear.

3. **Impact assessment:** Environmental impact assessments (EIAs) and strategic environment assessments (SEAs) are decision-making tools intended to ensure that the potential environmental impacts of specific proposed activities are considered, including the introduction of new fishing techniques and the impacts of a fisheries management policy or plan.
4. **Data and information systems:** Data is absolutely essential to fisheries management. Modern fisheries legislation typically provides the basis for a range of legal rules relating to data starting from the collection and collation of fisheries catch and effort data, through storage and information management, and in appropriate cases public access to such data taking into account confidentiality issues. Two main issues are pertinent when applying data collection to ALDFG. First of all, there is a shortage of global data about the scope and scale of ALDFG. The GGGI has established its Build Evidence Working Group to address this issue, as well as developing its Ghost Gear Reporter App to gather data and further populate their global data portal (see [Section 3.2.4](#)). Second, and more specifically if ALDFG is ever to be recovered from the sea, information about its location will be essential. Rules on the reporting of ALDFG either by those

who actually lose gear or who come across it may potentially have a role to play.

With increasing public concern over plastic in the aquatic environment, there has been a flurry of legislation aimed at reducing aquatic litter, including from fishing. In the EU, the Single Use Plastics Directive (SUP Directive)²⁷ and Port Reception Facilities Directive (PRF Directive)²⁸ were both adopted in 2019, requiring their implementation by 2021. The SUP Directive targets the 10 single-use plastic products most often found on Europe's beaches and seas as well as ALDFG which accounts for 27% of all beach litter in the EU and amounts to around 11,000 metric tons per year entering European seas²⁹. In the PRF Directive, sea-based sources of aquatic litter will be addressed more effectively by improving the availability and use of facilities in ports.

The SUP and PRF Directives complement each other, in particular through the application of extended producer responsibility (EPR) schemes for the financing of waste from fishing gear, foreseen under the SUP Directive. Under the EPR schemes, manufacturers and producers of fishing gear and their assembling elements (e.g., ropes, twines) will be responsible for the organization and costs of the separate collection of waste gear from ports and for their subsequent transport and appropriate treatment. These measures are coupled with the obligation to conduct awareness raising measures on fishing gear. The EPR schemes will financially support the indirect fee system for garbage from ships foreseen under the PRF Directive thus helping to avoid any potential increase on the fee vessels will have to pay for bringing waste to ports. Studies have recently been completed to develop reporting mechanisms for both the SUP and PRF Directives.

²⁷ Directive (EU) 2019/904 on the reduction of the impact of certain plastic products on the environment

²⁸ Directive (EU) 2019/883 on port reception facilities for the delivery of waste from ships, amending Directive 2010/65/EU and repealing Directive 2000/59/EC

²⁹ Based on the impact assessment supporting the SUP Directive.

3.2.4 IMPROVED AWARENESS, INFORMATION AND OTHER INITIATIVES

The final set of implementation approaches mainly revolve around greater stakeholder awareness of the issue and how it can be provided, the provision of more information to assess and combat ALDFG and its consequences, and possible manufacturer-related initiatives to limit gear loss and its impacts.

BEST PRACTICE GUIDELINES

Codes of conduct or good practice as agreed and applied by specific stakeholder groups have been discussed earlier in this document. A similar, but less targeted approach is the development of wider guidelines for best practice that might be fairly generic, serving to address and inform the wider fishing community.

One example of this approach is the FAO VGMFG. Following the considerations of an ad hoc Working Group on a standardized system for the marking of fishing gear, an FAO expert consultation prepared guidelines for the marking of fishing gear in 1991 (FAO, 1993) and, subsequently, a proposed system for marking fishing gear was included in the 1996 FAO Technical Guidelines for Fisheries (FAO, 1996). Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) also includes requirements for the utilization of fishing gear identification systems, which were last updated in 2018. Concern was expressed at COFI 31 (July 2014) over ghost fishing by ALDFG that paved the way for a new expert consultation on gear marking in 2016, resulting in the publication of new draft guidelines for the marking and identification of fishing gear (FAO, 2016). Following a Technical Consultation in February 2018, the VGMFG were adopted by COFI in July 2018 (FAO, 2019).

INFORMATION PROVISION

The issue of ALDFG and ghost fishing is increasingly well-known. In particular, it has attracted the attention of a number of large organizations in recent years, which has resulted in a number of regional and global

syntheses, such as Brown *et al* (2005), Macfadyen *et al* (2009) and, more recently, Richardson *et al* (2019). However, there is a significant lack of data available, particularly quantitative data, regarding ALDFG. Gilman (2015) looked at ALDFG data collection provisions among the 19 main global and regional fisheries management bodies and found that only four organizations were explicitly mandated by their convention or agreement text to monitor and control ALDFG and ghost fishing, and suggested that modifying mandates of the other organizations might augment members’ political will to monitor, prevent and remediate ALDFG and ghost fishing. Gilman also found that 10 organizations collected logbook or observer data on ALDFG and considered that harmonizing data collection protocols where they are in place, and filling gaps where they are lacking, would improve regional monitoring of ALDFG.

The GGGI Ghost Gear Reporter App (see photo of home page, right), which is freely available to download for [Android](#) and [Apple](#) mobile operating systems, allows users to report lost gear, including photographs and spatial information to GGGI’s data portal.

The [GGGI global data portal](#) is the world’s largest collection of ALDFG records and data, housing detailed datasets from dozens of data contributors from all over the world. The data portal currently has over 300,000 individual records and is continually growing as new data are submitted. Data can be submitted either via direct upload of large datasets through the online data portal interface, or via single records submitted through the Ghost Gear Reporter App, which is available in 13 languages as of the time of this publication: Chinese, Danish, Dutch, English, Finnish, French, Italian, German, Portuguese, Norwegian, Spanish, Swedish and Thai.

The GGGI data portal is the central global hub for all things related to ALDFG data including the amalgamated data set itself and a series of tools to interact with that data based on data agreements from contributors. Current functionality includes:

- Accessing top line data (position and gear type) for research purposes;

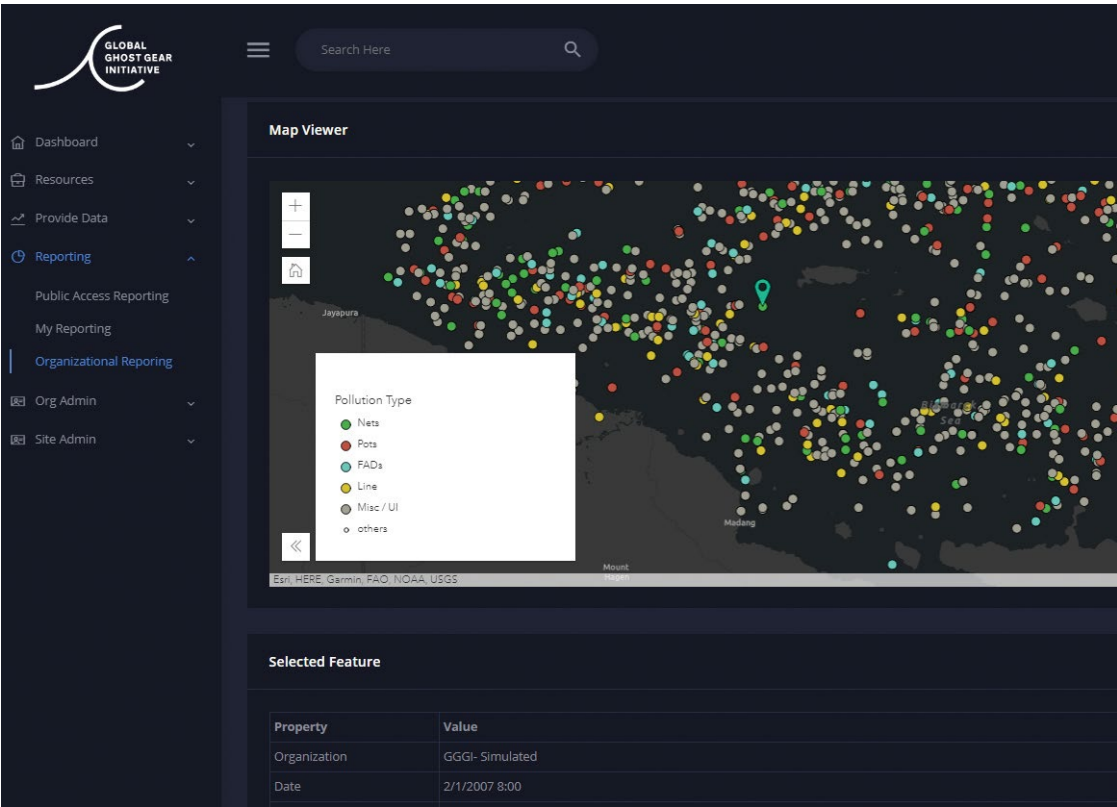
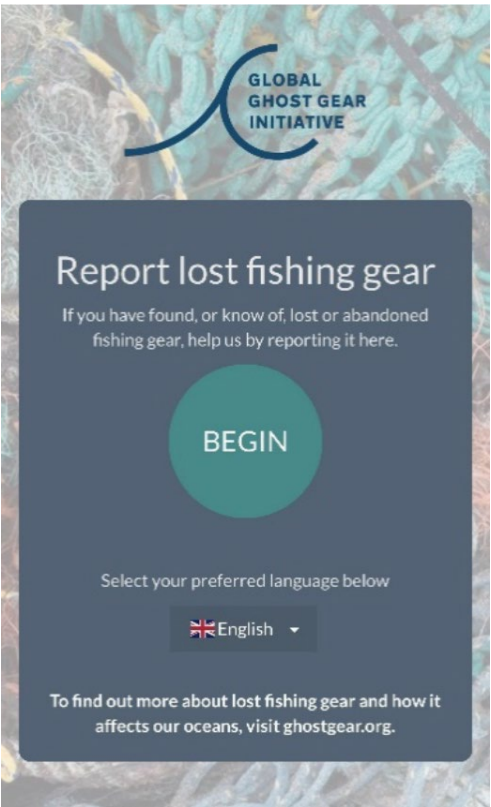
- Viewing an interactive global map of all plotted data points using ArcGIS;
- Application Programming Interface (API) functionality to communicate with other databases;
- A data card on how to collect and submit ideal ALDFG data sets;
- Broader reporting tools including geo selection, data filtering, graphs and charts;
- User management for projects or organizations submitting data; and
- A resource library of links to/downloads of relevant ALDFG literature.

MANUFACTURER INITIATIVES

With the increasing adoption of life cycle analyses by manufacturers and their incorporation into corporate and social responsibility initiatives, there is considerable potential for manufacturers to

become more involved in facilitating the responsible use of their products. As suggested above, this could include initiatives such as

- **Gear buy-back schemes/discounted new gear:** One simple approach might be for manufacturers to buy-back old gear (for refurbishment or recycling) and discount this value against the purchase of near gear. While seemingly simple, there are considerable complications, such as the sorting and collection of old gear and its valuation.
- **Deposit scheme for some gear:** Some discrete gear components, such as plastic pots and buoys, could attract an end-of-life refund when returned to the manufacturer or their agent.
- **Traceability:** Manufacturers should be encouraged to build in traceability to their products by marking them with manufacturer name, year of manufacture, type of product and production batch



4 THE BEST PRACTICE FRAMEWORK

4.1 PURPOSE AND PRINCIPLES

The purpose of the Best Practice Framework is to provide clear guidance to a range of relevant stakeholders including seafood businesses, the fishing industry, certification bodies and local and national authorities/governments on how to effectively address the issue of ALDFG.

The basic principles of the Best Practice Framework are as follow:

- Appropriate management responses are likely to be variable for different fisheries, as are the research gaps, but generally *prevention* (e.g., Codes of practice, improved communication between active and passive gear users) and *mitigation* (e.g., the use of biodegradable material to reduce ghost fishing potential) are almost certainly more effective than *remediation* (retrieval programs) over the long term. Therefore, the framework will focus on prevention and mitigation in particular.
- Although, as noted above, appropriate management responses will likely be specific to different fisheries, this framework is generic in approach.
- The framework is aimed at a wide range of stakeholders, both large and small, private and public, nongovernmental and governmental.

- The framework will allow GGGI to engage stakeholders in an informed and structured fashion, allowing the development of strategies for facilitating change in the use and nature of fishing gear so that the impact of ALDFG is minimized in the future.

The best practices for the management of fishing gear are broadly categorized between measures that **prevent** (avoiding the occurrence of ALDFG in the environment); **mitigate** (reducing the impact of ALDFG in the environment); and, **remediate** (removing ALDFG from the environment).

In recognition of the diverse roles and responsibilities different stakeholders (see overleaf for more details) have in managing fishing gear, the framework attempts to identify best practice approaches for individual stakeholder types. In each case the same structure is used:

- **Principles of Best Practice:** Includes a brief statement about the role of the stakeholder in gear and ALDFG management and provides a brief set of basic principles of best practice.
- **Key Best Practice Actions and Approaches:** Advocates as set of best practices against the principles and identified main collaborating partners.
- **Case Study:** A brief case study to illustrate current best practice in this stakeholder group.

1. Spatial and/or temporal measures	
2. Gear design to reduce whole or partial loss of the fishing gear	
3. Vessel design to reduce gear and other aquatic litter discarding	
4. Better marking and identification of fishing gear	
5. Improved end-of-life fishing gear disposal facilities	
6. Education and awareness	
7. Improved fisheries management regimes	
8. Good practice for avoidance, mitigation and response	
9. Gear design to reduce the incidence and duration of ghost fishing	
10. Lost gear reporting, location and recovery initiatives	

• Prevention

• Mitigation

• Remediation



4.2 STAKEHOLDERS ADDRESSED BY THESE GUIDELINES

Key stakeholder groups were identified through a literature review (see Appendix A).

Stakeholder group	Role	Best practice areas
Gear designers and manufacturers	Design, production and sale of fishing gear	Embedded traceability; research into, and use of/ integration of biodegradable materials for use in the aquatic environment; incentives to return end-of-life/used gear.
Fishers	Individuals and crew catching seafood at sea	Reduced soak times, gear use limits in high-risk areas and during high-risk times; marking and identification of fishing gear, responsible storage of gear; reporting of lost gear, guidance on lost/abandoned gear location and retrieval.
Fleet operators and fisheries organizations	Non-statutory organizations representing fishers	Code of Practices specific to fisheries and/or fishing fleets; spatio-temporal agreements with other metiers; monitoring of fishing gear losses, communication protocols.
Port operators	Bodies operating and managing fishing ports	Accessible, low-cost gear and litter disposal facilities; integration into recycling initiatives; better awareness of responsible disposal opportunities; implement “check out-check in” gear inventories where appropriate.
Fisheries managers and regulators	Management bodies setting policy, plans and regulations for fishing activities	Designation of spatio-temporal restrictions in high-risk areas; development of appropriate gear marking and identification regulations; development of technical regulations to reduced ghost fishing potential in high-risk areas; conduct impact assessment to gauge unintended consequences of management actions on gear loss and ghost fishing.
Fisheries control agencies	Body or agency responsible for enforcing fisheries regulations	Establish registry and database of lost/abandoned gear; enforcement of gear marking and identification regulations.
Fisheries and aquatic environment research	Research and development	Development of biodegradable materials that are acceptable to fishers, but effective at reducing gear catching ability after control is lost.
Seafood ecolabel standard and certificate holders	Setting and maintaining standards for responsible sourcing of seafood	Gear loss and its consequences (e.g., ghost fishing) needs to be included in all seafood sustainability standards, with supporting guidance provide where necessary.

Stakeholder group	Role	Best practice areas
Post-harvest seafood companies	Processors, wholesalers and retailers	Encouraged to ensure that their seafood sourcing avoids high risk fisheries and that they participate in relevant initiatives, e.g., gear recycling (see case study in Section 4.6.3), where possible.
NGOs	Advocates for sustainability and good practices	Coordination of advocacy, actions and information gathering; contribute to a centralized ALDFG/ghost fishing information hub/forums; organizing ALDFG recovery in vulnerable areas.
International development and funding agencies	Grant or credit-based development agencies investing in responsible fisheries	Encouraging high-level (e.g., national and regional) investment into combatting ALDFG and encouraging the responsible use of, and end of use disposal of, fishing gear.
Municipality councils and authorities	Local authorities providing governance and laws	Raising awareness, supporting port reception and retrieval/recycling programs where appropriate, encouraging extreme weather preparedness and reporting of lost gear.



Photo credit: Joel Baziuk

4.3 GEAR DESIGNERS, MANUFACTURERS AND RETAILERS

4.3.1 PRINCIPLES OF BEST PRACTICE

<p>As recognized by some of the more responsible gear manufacturers, there is an important role to be played at the beginning of the fishing gear life cycle to ensure that gear is well designed and sensitive to its potential impact if lost, and that there is a degree of gear traceability built into the materials and gear components that allows the potential for the cost-effective identification of gear origin and ownership at different points in the life cycle.</p> <p>With the advent of corporate environmental responsibilities and tools such as life cycle analysis, gear manufacturers have a degree of responsibility in facilitating the responsible use and disposal of their products. This should be through a number of different ways, including (i) buy-back of old gear for reconditioning or recycling into new fishing gear (possibly allied to deposit schemes for returned gear) and (ii) sponsorship and/or implementation of responsible gear recalling and disposal/recycling schemes.</p>	Approach	Principles
	Prevention	<ul style="list-style-type: none">• Gear components should have built-in traceability where practical, based on an industry-wide code of practice.• These gear traceability systems should be linked to standard record-keeping practices of commercial transactions.• Retailers of fishing gear, if different from the manufacturer, should include these batch numbers in their record keeping.• Facilitate and promote fishing gear recycling and responsible disposal.
	Mitigation	<ul style="list-style-type: none">• Research and development of both materials and gear design to disable fishing gear after control is lost. These should retain the catching effectiveness of traditional equipment and be both practical and cost effective.• Collaboration with fishers, fishery organizations and researchers to test and improve gear design and materials.
	Remediation	<ul style="list-style-type: none">• Collaboration with management authorities to assist in tracing the origin and ownership of recovered fishing gear.



Photo credit: Joel Baziuk

4.3.2 KEY BEST PRACTICE ACTIONS AND APPROACHES: GEAR DESIGNERS, MANUFACTURERS AND RETAILERS

Approach and Principle		Best Practice	Other participants
Prevention	Gear components should have built-in traceability where practical, based on an industry-wide code of practice.	<ul style="list-style-type: none">• Development and promotion of low cost and durable means of identifying the manufacturer name, year of manufacture, type of product and production batch of key gear components, e.g., ropes, net panels, traps etc.	<ul style="list-style-type: none">• Fishing industry• Research and development
	Gear traceability systems linked to record-keeping practices of commercial transactions. Retailers of fishing gear, if different from the manufacturer, should include these batch numbers in their record keeping.	<ul style="list-style-type: none">• Implementation of a traceability system that allows the recording of ownership transfer at the main transaction points in the supply chain.	<ul style="list-style-type: none">• Fishing gear sales• Fishing industry
	Facilitate and promote fishing gear recycling and responsible disposal.	<ul style="list-style-type: none">• Facilitate the buy-back of old gear for reconditioning or recycling into new fishing gear.• Support the implementation of responsible gear disposal schemes.	<ul style="list-style-type: none">• Fishing industry• Port operators• Recycling companies (e.g., Aquafil)
Mitigation	Research and development of both materials and gear design to disable fishing gear after control is lost. These should retain the catching effectiveness of traditional equipment and be both practical and cost effective.	<ul style="list-style-type: none">• Reduced use of persistent materials, e.g., mixed polymer materials in fishing gear• Research into biodegradable materials that have predictable and controllable rates of degradation.• Application of new biodegradable material technologies to different fishing gears and accessories, e.g., bait bands.	<ul style="list-style-type: none">• Research and development• Bait producers
	Collaboration with fishers and fishery organizations to test and improve gear design and materials.	<ul style="list-style-type: none">• Testing of biodegradable materials and designs with fishers to improve their effectiveness and acceptability.	<ul style="list-style-type: none">• Research and development• Fishing industry
Remediation	Collaboration with management authorities to assist in tracing the origin and ownership of recovered fishing gear and to locate lost gear for recovery/retrieval.	<ul style="list-style-type: none">• Industry-wide agreement of data embedding, coding and other practices.• Recording of fishing gear/component production and transaction points to be made available to management authorities upon request.	<ul style="list-style-type: none">• Fisheries management authorities• Fishing industry

4.3.3 CASE STUDY: GEAR DESIGNERS, MANUFACTURERS AND RETAILERS



Fiskevegn A.S., a major Norwegian fishing gear manufacturer, was contacted by the Department of Parks and Wildlife, Nature Protection Branch, Western Australia in late March 2016 to try to trace the origin of abandoned fishing gears that had caused the death of humpback whales.

They reported that “Whilst we have made significant progress with mitigation measures with the Western Australian Fishing Industry jointly with WA Fisheries, cases of very compromised entangled humpbacks have slowly been increasing and we needed to identify who/what/when/where and why we were having to deal with such challenging cases”.

During the 2015 humpback migrations, nine cases of entangled whales were observed by their agency, and the same types of ropes have been involved repeatedly in some cases. Images from the field were sent to Fiskevegn for review (all images courtesy Dept. of Parks and Wildlife) (see two images, top left).

A close-up of the ropes involved in these cases is shown on the bottom right-hand side. This is a Danline rope (PP fishing rope) made from a mix of polyethylene and polypropylene. Some 7,450 suppliers of such ropes are listed on Alibaba.com. While Fiskevegn has reasonable grounds to make assumptions about the origin of the ropes in this particular case based on the physical characteristics, on a legal level the trails went cold here.

This is a relevant example of environmental risk that could be managed better through the use of industry-driven product traceability. Using identification marking tape, the manufacturer, product, year of manufacture and batch number, could have been conclusively identified in an instant. With that information at hand, investigators could move to understand the supply chain to the IUU vessels.

Source: Fiskevegn (courtesy of Trond-Inge Kvernevik)



4.4 FISHERS AND VESSEL OPERATORS

4.4.1 PRINCIPLES OF BEST PRACTICE

Approach	Principles
<p>Prevention</p> <p>Fishers are the key stakeholders in these guidelines. No fisher wants to lose expensive fishing gear, but sea conditions, equipment failure, the actions of others and safety considerations can all lead to the loss or abandonment of gear.</p> <p>As with many aspects of life, fishers need to take a risk-based approach to gear loss, by both reducing the likelihood of initial loss as well as reduce the impact of gear losses should they occur, through a mixture of good practice in locating, rigging and setting fishing gear, investment in gear marking and a responsible approach to fishing and overall marine stewardship.</p> <p>In addition to being proportional to the risks and consequences of gear loss, it is recognized that the actions and best practice demanded of fishers should be simple, pragmatic and affordable.</p>	<ul style="list-style-type: none"> • Reduce risk of gear loss or abandonment through the avoidance of high-risk areas/situations, the use of well-maintained and set fishing gear, and minimizing the amount of gear set. • Adjust fishing methods to prevailing conditions to reduce the risk of gear loss, e.g., shorter soak time, etc. • Training and awareness-building of crew in good practice and responsible fishing. • The clear marking and identification of fishing gear and its main components. • The responsible disposal of end-of-life fishing gear and other potential aquatic litter.
<p>Mitigation</p>	<ul style="list-style-type: none"> • Use of fishing gear designed to stop fishing after control is irretrievably lost, e.g., through the use of biodegradable materials. • Reporting of lost or abandoned fishing gear.
<p>Remediation</p>	<ul style="list-style-type: none"> • Recovery and subsequent reporting of ALDFG, its transport to shore and its subsequent responsible disposal. • Best practical recovery of fishing gear after it has been lost or abandoned.



Photo credit: Joel Baziuk

4.4.2 KEY BEST PRACTICE ACTIONS AND APPROACHES: FISHERS

Approach and Principle	Best Practice	Other participants
Prevention	Reduce risk of gear loss or abandonment through the avoidance of high-risk areas/situations and the use of well-maintained fishing gear.	<ul style="list-style-type: none"> • Fisheries organizations • Fisheries management authorities • Fisheries control authorities
	Adjusting fishing methods to prevailing conditions to reduce the risk of gear loss, e.g., shorter soak time, etc.	<ul style="list-style-type: none"> • Fisheries organizations • Fisheries research organizations
	Training and awareness-building of crew in good practice and responsible fishing.	<ul style="list-style-type: none"> • Fisheries organizations • Fisheries managers and regulators • NGOs

Approach and Principle	Best Practice	Other participants
Prevention (continued)	The clear marking and identification of fishing gear and its main components.	<ul style="list-style-type: none"> • Fisheries organizations • Maritime management authorities • Fisheries control authorities
	The responsible disposal of redundant fishing gear and other potential aquatic litter.	<ul style="list-style-type: none"> • Port authorities • Fisher organizations

³⁰ Mandatory for all vessels >100 gross register tonnage (MARPOL, Annex V)

Approach and Principle		Best Practice	Other participants
Mitigation	Use of fishing gear designed to stop fishing after control is irretrievably lost.	<ul style="list-style-type: none">Fishers are encouraged to trial and, where appropriate, adopt gear incorporating escape mechanisms, biodegradable components and other technologies that disable gear after control is lost.In the case of FADs, the use of non-entangling materials (e.g., canvas) and the use of biodegradable materials where possible.	<ul style="list-style-type: none">Gear manufacturersResearch organizations
	Reporting of lost or abandoned fishing gear.	<ul style="list-style-type: none">In the event of any major loss or abandonment of fishing gear, the nature, last known time, date and position should be reported in a timely fashion to the relevant authorities (see Fisheries managers and regulators).Where FADs are used, the last known time, date and position of lost or abandoned FADs should be reported in a timely fashion to the relevant authorities.	<ul style="list-style-type: none">Fisher organizationsFisheries management authorities
Remediation	Recovery and subsequent reporting of ALDFG, its transport to shore and responsible disposal.	<ul style="list-style-type: none">In the event of gear conflict, every effort should be made to report details of the incident to the relevant authorities.If the damaged gear represents a significant navigation, environmental or animal welfare risk, efforts should be made to recover the damaged gear and return it to shore for the attention of the relevant authorities.Fishers should be encouraged to report gear loss without fear of recrimination.	<ul style="list-style-type: none">Maritime management authorities

Approach and Principle		Best Practice	Other participants
Remediation (continued)		<p>Best practical recovery of fishing gear after it has been lost or abandoned.</p> <ul style="list-style-type: none">Fishing operators should be incentivized, prepared and equipped to recover their gear if lost or abandoned. Preparations may include the carrying of retrieval tools and advance training of crew of their use.If gear is lost or abandoned, every reasonable effort should be made to recover the gear either immediately or at a later date. Priority should be given to gear that represents a navigation hazard or one that presents a real threat to the aquatic environment.The recovery of lost, abandoned or discarded fishing gears should be undertaken with due regard to human safety and the subsequent damage such retrieval may have on the aquatic environment and habitat.In the event of failure of recovery, it should be reported through the agreed channels to the relevant authority giving details of the gear and its last known position. The relevant authority should use the most effective means to give a general warning to other vessels, especially if it presents a specific navigation risk and, if necessary, dispatch a trained removal team.	<ul style="list-style-type: none">Maritime management authoritiesNGOs

4.4.3 CASE STUDY: FISHERS



Crew of the *Island Safari* remove crabs from a recovered lost trap in MacIntyre Bay, British Columbia, 2017 (Photo credit: Natural Resources Consultants)

The Dungeness crab (*Cancer magister*) fishery is an important economic driver in British Columbia, representing 31% of the value of the province’s wild shellfish products. The Area A commercial fishery is the largest in British Columbia, generally landing over one-third of the commercially allocated Dungeness crabs in the province. Approximately 60% of the Area A commercial crab fishers are members of the Area A Crab Association, which represents them in a variety of forums.

Lost crab traps are a recognized problem for the Area A crab fishery. Data from 2003 through 2013 indicates that between 6% and 10% of traps are lost each year. In 2013, 2,533 traps were reported lost.¹ Trap loss is generally due to severe weather and sea conditions, and traps are usually lost when they are moved away from the location of deployment after which the fisher cannot relocate them. The buoys of these lost traps can be visible on the water surface or they might be submerged, with lines still attached. In addition to safety, liability, economic, and environmental impacts, lost traps in Area A cause conflicts with other fisheries, in particular with salmon trollers in the northern part of the area and with groundfish trawlers in the south eastern part of the area.

To address the problems associated with lost traps in Area A, the Area A Crab Association had paid for annual, post-season sweeps of lost crab traps since 2000. A commercial crab vessel is typically chartered each year to conduct three to five days of stray trap removal work in conjunction with softshell crab surveys also conducted annually. Traps are located through visual surveys in areas where fishers have reported losing gear. In 2015, the chartered vessel removed about 190 traps. In other years as many as 500 traps have been removed.

¹ Data provided by Shellfish Data Unit, Aquatic Resources Research and Assessment Division, Pacific Biological Station, Fisheries and Oceans Canada

4.5 FISHERIES ORGANIZATIONS

4.5.1 PRINCIPLES OF BEST PRACTICE

While many actions can be effectively taken at the individual vessel level, fishing organizations that represent certain fisheries, fleets or geographic areas have the potential to both address common issues across their members, as well as leverage cooperation and assistance from other parts of the sector. In particular, fisheries organizations can work on behalf of their members to ensure that their knowledge and concerns are incorporated into both voluntary and mandatory management measures.	Approach	Principles
	Prevention	<ul style="list-style-type: none">• Development of codes of practice on behalf of their members to facilitate and encourage responsible fishing.• Development of means and mechanisms to comply with MARPOL Annex V, in conjunction with regulatory bodies and fisheries managers where appropriate.• Work on behalf of their members to liaise with the fishing and other competent authorities in establishing marine spatial planning tools to minimize gear conflict.• Where fishing organizations procure goods or services on behalf of their members, they should require their suppliers to conform with best practice where applicable (e.g., codes of practice).• Liaise with third party seafood certification bodies to address management and information requirements for reducing ghost fishing and the impacts of ALDFG on aquatic fauna, flora and habitats.
	Mitigation	<ul style="list-style-type: none">• Development of lost and abandoned fishing gear reporting protocols, procedures and avenues on behalf of their members.
	Remediation	<ul style="list-style-type: none">• Identification and clearance of lost gear hotspots that represent either an operation or navigation hazard to their members, or a significant economic loss through the ghost fishing and subsequent mortality of their member’ target species or a risk of entangling aquatic mammals, birds or turtles occupying the region.



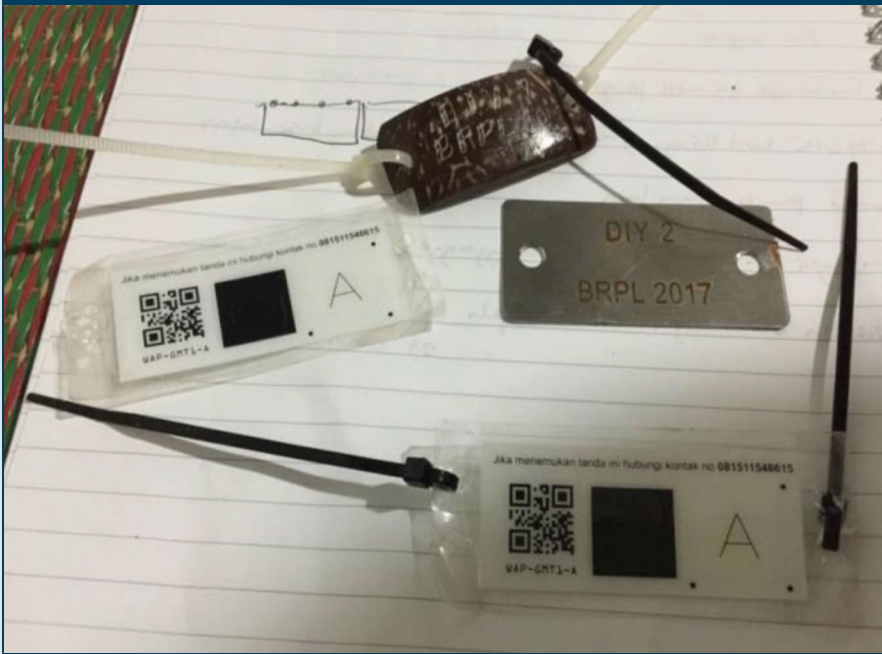
4.5.2 KEY BEST PRACTICE ACTIONS AND APPROACHES: FISHER ORGANIZATIONS

Approach and Principle		Best Practice	Other participants
Prevention	Development of codes of practice/good conduct on behalf of their members to facilitate and encourage responsible fishing.	<ul style="list-style-type: none">• Identification of common issues and management needs across the membership (and with other similar organizations where appropriate) and decide whether a Code of Practice might provide a set of standards and best practices to address these.• Participatory development of a Code of Practice, identifying minimum, good and best practice levels.• Agree how these might be implemented, e.g., voluntary, self-certification by the fisheries organization, or third party certified.	<ul style="list-style-type: none">• Fishers
	Development of means and mechanisms to comply with MARPOL Annex V.	<ul style="list-style-type: none">• Fisher organizations should encourage their members to comply with MARPOL Annex V regulations on waste management at sea. If necessary (and as recognized by Art 6.4.1 in Annex V), assistance might be sought from government in “developing resolutions, bylaws and other internal mechanisms” (IMO, 2012).	<ul style="list-style-type: none">• Fisheries management authorities
	Work on behalf of their members to liaise with the fishing and other competent authorities in establishing marine spatial planning tools to minimize gear conflict.	<ul style="list-style-type: none">• Work with members to review the advantages, disadvantages and mitigatory options of marine spatial planning approaches (e.g., gear zoning) to the membership.• Work with the statutory authorities involved in marine spatial planning to develop optimal working solutions that minimize potential gear conflict.	<ul style="list-style-type: none">• Fisheries management authorities
	Where fishing organizations procure goods or services on behalf of their members, they should require their suppliers to conform with Best Practice where applicable.	<ul style="list-style-type: none">• Fisher organizations involved in procurement on behalf of their members consider developing a responsible procurement strategy that requires suppliers to conform to certain standards in terms of design, quality and traceability. This strategy could be aimed at fulfilling this gear management best practice framework, but could also be expanded to include other considerations, such as social and ethical procurement.	<ul style="list-style-type: none">• Gear manufacturers• Certification bodies

Approach and Principle	Best Practice	Other participants
Prevention (continued)	<p>Liaise with third party seafood certification bodies to address management and information requirements for reducing ghost fishing and the impacts of ALDFG on aquatic fauna, flora and habitats.</p> <ul style="list-style-type: none"> • Related to the other preventative measures mentioned above, fisher organizations might work with Fisheries Improvement Project (FIPs) and third-party certification bodies to ensure their members adhere to benchmarks and standards to which they are party. • A key focus will be the operational management and information requirements for best practice in ecosystem management, e.g., bycatch, endangered, threatened and protected (ETP) interactions and habitat impacts. 	<ul style="list-style-type: none"> • Fishers • Certification bodies
Mitigation	<p>Development of lost and abandoned fishing gear reporting protocols, procedures and avenues on behalf of their members.</p> <ul style="list-style-type: none"> • Through liaison with the relevant fisheries management and control authorities, development of protocols and procedures for the reporting of the loss or abandonment of fishing gear. The nature and scope of this reporting system would reflect both the scale of fishing involved, as well as the specific circumstances of the member vessel operations, e.g., the gear used, etc. 	<ul style="list-style-type: none"> • Fisheries management and control authorities
Remediation	<p>Identification and clearance of lost gear hotspots that represent (i) an operation or navigation hazard to their members, (ii) a significant economic loss through the ghost fishing and subsequent mortality of their member' target species, or (iii) a risk of entangling aquatic mammals, birds or turtles occupying the region.</p> <ul style="list-style-type: none"> • Fisher organizations should periodically consult their members to understand whether ALDFG represents either an operational or safety hazard to their members, or alternately might be affecting their target stocks through ghost fishing. • If yes, fisher organizations would engage with the public, private and NGO sectors to investigate cost-effective methods of recovering ALDFG (and other aquatic litter, if appropriate). 	<ul style="list-style-type: none"> • Maritime management authorities • Research organizations • NGOs

4.5.3 CASE STUDY: FISHER ORGANIZATIONS

Gear Marking Pilot Study in Indonesian Small-Scale Gillnet Fisheries



Tags tested during fishing gear marking experiment. Metal, bamboo and Septillion tags are shown here with cable tie attachments.

At their 32nd Session in 2016, FAO’s Committee on Fisheries (COFI) encouraged FAO to conduct pilot projects related to ALDFG and gear marking in developing countries. The purpose of this project was to test means and methods of marking gillnets in accordance with FAO’s then Draft Guidelines on the Marking of Fishing Gear (now finalized as the *Voluntary Guidelines on the Marking of Fishing Gear*) and explore the scope for a retrieval and recycling scheme.

A pilot study was conducted in Indonesia. The project was led by the Indonesian Ministry of Marine Affairs and Fisheries together with World Animal Protection and supported by FAO and the Dutch Government. The study found that the availability of environmentally friendly materials for markers and fisher safety when operating gear with physical markers were both key issues. The study also found that gear marking must be implemented in the context of broader measures for managing fishing gear and wider fisheries management measures as gear marking alone is unlikely to solve the ALDFG and ghost fishing issues that are apparent in Indonesian small scale-scale and probably other similar fisheries, particularly in developing countries. Such measures could include fisher education and awareness raising, capacity building in general, spatial management of fishing effort and a circular economy approach to managing end-of-life gear.

The study concluded that, in general, small-scale fishers were cooperative and supportive of gear marking initiatives. However, there is a need for greater understanding of the benefits of gear marking. Further work should be done on related issues, particularly the ability to retrieve the gear when it becomes lost.

The study produced a large number of recommendations, which included that for successful implementation of gear marking there needs to be a clear implementation plan which takes into consideration the need for capacity building and education to build understanding and acceptance of the objectives for marking fishing gear and the process for enforcement.

Source: Dixon et al, 2018. See <http://www.fao.org/3/BU654en/bu654en.pdf>

4.6 PORT OPERATORS

4.6.1 PRINCIPLES OF BEST PRACTICE

Approach	Principles
Prevention	<ul style="list-style-type: none">• Provision of adequate port reception facilities for the disposal of fishing gear in accordance with MARPOL Annex V.• Inclusion of end-of-life fishing gear into Port Waste Management Plans where appropriate.• Development of agreements with both local gear manufacturers and recycling businesses to maximize opportunities for the cost-effective and environmentally responsible disposal of landed waste.• Information exchange with IMO’s Port Reception Facility (PRF) database to ensure that specialist reception facilities are easily located.
Mitigation	<ul style="list-style-type: none">• Not applicable.
Remediation	<ul style="list-style-type: none">• Providing a common forum (e.g., notice boards, web fora, other communication) for port users on (i) prevention and mitigation approaches and (ii) relaying gear loss reports to other mariners.

It is important that it is convenient, safe and relatively inexpensive to dispose of end-of-life fishing gear and aquatic litter in port. Ports, and in particular Port Reception Facilities (PRFs), should work with fishing operators and organizations to ensure that adequate facilities are provided.

Given the relationships ports have with local government, businesses and other local interests, they have a potential role in catalyzing the development of the downstream recycling and disposal of received material in a responsible and cost-effective fashion.



Photo credit: Joel Baziuk

4.6.2 KEY BEST PRACTICE ACTIONS AND APPROACHES: PORT OPERATORS

Approach and Principle	Best Practice	Other participants
Prevention	Provision of adequate port reception facilities for the disposal of fishing gear in accordance with MARPOL Annex V.	<ul style="list-style-type: none"> Waste recycling companies
	Inclusion of end-of-life fishing gear into Port Waste Management Plans where appropriate.	<ul style="list-style-type: none"> Fisher organizations
	Development of agreements with both local gear manufacturers and recycling businesses to maximize opportunities for the cost-effective and environmental responsible disposal of landed waste.	<ul style="list-style-type: none"> Fisher organizations Local government Seafood businesses
	Information exchange with IMO's Port Reception Facility (PRF) database to ensure that specialist reception facilities are easily located.	<ul style="list-style-type: none"> Port authorities
Remediation	<ul style="list-style-type: none"> Fishing harbor managers provide facilities for displaying and promoting information on the management and responsible disposal of fishing gear and other aquatic litter. Harbor masters develop a system to compile and exchange information on lost fishing gear and other potential navigation hazards with all maritime traffic. 	<ul style="list-style-type: none"> Fisher organizations

4.6.3 CASE STUDY: PORT OPERATORS

Steveston Harbour Authority Net Recycling Initiative in British Columbia, Canada



Prior to 2014, Steveston Harbour Authority had to resort to burying end-of-life nets in landfill; but, in 2014, they developed a recycling solution for these end-of-life nets that saw 100% of the nylon6 net material recycled at no cost to the fishers or the Harbour Authority.

The project was inspired by the Interface and Aquafil collaboration Net-Works™ project, where fishing communities in the Danajon Bank in the Philippines recover discarded fishing nets, which are then shipped to Aquafil's ECONYL® plant in Slovenia to be regenerated into nylon6 fiber. This fiber is then used by Interface in their Net-Effect® line of carpet tiles. Steveston Harbour Authority reached out to Aquafil and established a pilot program in 2014 to send their waste nylon6 nets to Aquafil to be recycled. The project employs local fishers in the offseason to strip and bag the nets for transport to recycling facilities, and has seen over 200,000 kilograms of nets recycled since its inception in 2014.

The pilot project provided invaluable insight into the logistical and financial challenges associated with collecting, preparing and shipping nets, and how to streamline the process to make it efficient and sustainable for everyone, including fishers, the Harbour Authority and the recycling partners. Lessons learned include how much nylon6 can be recovered from a full seine net; how much labor is required to strip the net from its other parts (cork line, bunt, lead line); and how to efficiently load a container to maximize the amount of net that can be sent to a recycler in a single trip.

Prior to 2017, only nylon6 material could be recycled as part of the program, but in 2018, this expanded to include collection and recycling of both polyethylene and polypropylene by PLASTIX Global and Save Our Planet Recycling, which has a local collection facility, negating the need to send material overseas to be recycled. Another local recycling facility being created by [Ocean Legacy Foundation](https://oceanlegacy.ca/)³¹ will launch in 2021, which will see polyethylene and polypropylene material recycled locally. Other materials such as lead line, cork line and unrecyclable ropes are placed in bins freely accessible to local fishers for reuse in building and mending other nets.

Source: <https://stevestonharbour.com/british-columbia-commercial-net-recycling-program/> Photo credit: Joost Van Der Graaf

³¹ <https://oceanlegacy.ca/>

4.7 FISHERIES MANAGERS AND REGULATORS

4.7.1 PRINCIPLES OF BEST PRACTICE

<p>The emphasis of these best practice guidelines is on voluntary mechanisms, possibly allied with third-party certification initiatives.</p> <p>This said, fisheries management authorities and other statutory regulators have a distinct role to play in managing fishing practices at regional³², national and local levels. This may be in terms of establishing minimum standards and requirements through legislative means, or in assisting fishers' organizations and other business groups in maintaining voluntary best practices.</p>	Approach	Principles
	Prevention	<ul style="list-style-type: none"> Policy, management and regulatory authorities should, using the 2019 FAO VGMFG³³, consider the need, scope, implementation and coordination procedures for a fishing gear marking system in waters under their jurisdiction. Constraints to the effective implementation of a system for gear marking should be identified. Adequate education, training and other forms of capacity-development should be provided to fishers, relevant authorities and other interested parties to facilitate the implementation of the gear marking system.
	Mitigation	<ul style="list-style-type: none"> Relevant authorities should establish appropriate reporting regimes, such as those stipulated by MARPOL and the London Convention³⁴.
	Remediation	<ul style="list-style-type: none"> Policy, management and regulatory authorities should partner or collaborate with appropriate organizations, NGOs, commercial entities or other national governments in order to fully avail of the benefits of the system of gear marking, including the monitoring and retrieving of ALDFG.

³² Includes Regional Fisheries Management Organizations (RFMOs)

³³ FAO (2019). Voluntary guidelines on the marking of fishing gear. Rome. 88 pp. Licence: CC BY-NC-SA 3.0 IGO. <http://www.fao.org/3/ca3546t/ca3546t.pdf>

³⁴ London Convention: "Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972". See <http://www.imo.org/en/OurWork/Environment/LCLP/Pages/default.aspx> for more details.



Photo credit: Joel Baziuk

4.7.2 KEY BEST PRACTICE ACTIONS AND APPROACHES: FISHERIES MANAGERS AND REGULATORS

Approach and Principle	Best Practice	Other participants
Prevention	<p>Policy, management and regulatory authorities should consider the need, scope, implementation and coordination procedures for a fishing gear marking system in waters under their jurisdiction.</p> <ul style="list-style-type: none"> Systems and minimum standards for the marking and identification of fishing gear should be developed at relevant levels, e.g., regional, national and local. The relevant policy-making authorities, with the participation of interested parties, should decide: <ul style="list-style-type: none"> a. On the use of a system, if applicable, for the marking of fishing gear; b. The fisheries, fishing gears, vessels or areas to which the system applies to, and conditions for implementation, or the grant of exemptions from, the agreed system; and c. The reporting procedures, data storage, retrieval and information exchange. These systems should reflect the recently published Voluntary Guidelines for the Marking of Fishing Gear (FAO, 2019). Where appropriate, policy, management and regulatory authorities should consider the use of a risk assessment process to identify the priorities and scope of such systems to ensure that they are both necessary and practical in the context of different fisheries under their jurisdiction. 	<ul style="list-style-type: none"> Fishers Fisher organizations Gear manufacturers Fisheries control authorities NGOs
	<p>Constraints to the effective implementation of a system for gear marking should be identified. Adequate education, training and other forms of capacity-development should be provided to fishers, relevant authorities and other interested parties to facilitate the implementation of the gear marking system.</p> <ul style="list-style-type: none"> Policy, management and regulatory authorities should raise awareness of the problems caused by ALDFG and provide relevant stakeholders and the general public a clear purpose and rationale why it is necessary and beneficial to properly mark fishing gear. Policy, management and regulatory authorities and other interested parties should cooperate to identify and share best practices, collate and share information, as well as coordinate effective communication and training. 	<ul style="list-style-type: none"> Fishers Fisher organizations Gear manufacturers Fisheries control authorities

Approach and Principle	Best Practice	Other participants
Mitigation	<p>Relevant authorities should establish appropriate reporting regimes.</p> <ul style="list-style-type: none"> Policy, management and regulatory authorities should ensure that there is a practical and robust lost and abandoned fishing gear reporting system in place that is consistent with the context of different fisheries under their jurisdiction. Reporting protocols and pathways should be developed and implemented in cooperation with gear manufacturers, vessel operators, fishing companies and fishing organizations, as well as with other fisheries administrations. A record/register of fishing gear reported as being found, lost, abandoned, or disposed of should be maintained by the relevant authority. This record/register should include details of: <ul style="list-style-type: none"> a. Type and characteristics of the fishing gear; b. Any fishing gear mark(s) and other identifiers; c. Date, time, position of loss or retrieval, depth of water, etc.; d. Reason for loss (if known); e. Weather conditions; and f. Any other relevant information including entrapment of endangered, threatened or protected species. Registers of gear loss should be harmonized and connected where possible with other registers at regional, RFMO and other levels. Overtime, such registers could be merged where appropriate. 	<ul style="list-style-type: none"> Fishers Fisher organizations Gear manufacturers Fisheries control authorities

Approach and Principle	Best Practice	Other participants
Remediation	<p>Policy, management and regulatory authorities should partner or collaborate with appropriate organizations, NGOs, commercial entities or other national governments in order to fully avail of the benefits of the system of gear marking, including the monitoring and retrieving of ALDFG.</p> <ul style="list-style-type: none"> States are encouraged to develop communication frameworks to enable the recording and sharing of information on fishing gear loss, where necessary, in order to reduce loss and facilitate recovery of fishing gear. States are further encouraged to develop frameworks to assist fishing vessels in reporting the loss of gear to the flag state, and where appropriate, to the coastal state in whose jurisdiction the loss of the fishing gear occurred. Such frameworks should take into consideration implementation challenges in small scale and artisanal fisheries and recreational operations. The relevant authority and the fishing industry should encourage owners of the fishing gear to have adequate equipment and training available to facilitate the recovery of ALDFG. Where possible, the owner and the relevant authority should collaborate to enhance recovery efforts. Owners (national or foreign) should be informed of gear recovered (where appropriately marked) so that they can collect the recovered gear for reuse or safe disposal. 	<ul style="list-style-type: none"> Fishers Fisher organizations Gear manufacturers Fisheries control authorities NGOs

4.7.3 CASE STUDY: FISHERIES MANAGERS AND REGULATORS

Statutory guidance on the marking of fishing gear, retrieval and notification of lost gear

The FAO’s *Voluntary Guidelines on the Marking of Fishing Gear* are a culmination of a globally coordinated effort to formulate a comprehensive set of generic guidelines to combat, minimize and eliminate ALDFG and to facilitate the identification and recovery of such gear.

The UK’s Marine Management Organisation (MMO) shows how this generic guidance can be used at national level, requiring how different types of fishing gear must be marked, what must be done if fishing gear is lost, and how to report lost fishing gear. This is summarized briefly here:

Gear type	Marking	Distance from shore (nautical miles)		
		0–12 nm	6–12 nm	12–200 nm
Beam trawl	PLN	Yes		Yes
Set nets: Gillnets, entangling nets, trammel nets and trap nets	Label	Yes		Yes
Drift nets: Drifting gillnets and drifting trammel nets	Marker buoy	Recommended		Yes
Lines and pots: Long lines, lines, pots and traps.	Contact IFCA	Yes		

MARKING OF FISHING GEAR

You must mark passive gear and beam trawls with the port letters and numbers (PLN) of your vessel. This applies to the gear in use and gear you are carrying on board your vessel.

Labels

In all EU waters, passive gear that is used or carried on board must have a permanent label showing the vessel PLN. Each label must be: (i) at least 75 millimeters x 65 millimeters in size, (ii) made of durable material and (iii) securely fixed to the gear and not removable.

Retrieval of lost gear

The guidance states: “If you lose all or part of your fishing gear you must attempt to retrieve it as soon as possible. You must carry equipment on board your vessel to retrieve lost gear unless you operate exclusively within the territorial waters (12 nautical mile limit), or you never spend more than 24 hours at sea from departing to returning to port”.

Notification of lost gear

If lost gear cannot be retrieved, the fisher must inform the UK fisheries authorities within 24 hours of the following.

- PLN and name of the fishing vessel
- Type of gear lost
- Time when the gear was lost
- Position where the gear was lost
- Measures taken to retrieve the gear

If an electronic logbook is used, lost gear can be reported using the lost gear declaration (GLS) when submitting the daily fishing activity report (FAR). If the vessel does not have an electronic logbook, the fisher must report lost gear to the UK Fisheries Monitoring Centre (UKFMC).

Source: MMO (<https://www.gov.uk/guidance/markings-of-fishing-gear-retrieval-and-notification-of-lost-gear>).

4.8 FISHERIES CONTROL AGENCIES

4.8.1 PRINCIPLES OF BEST PRACTICE

Fisheseries control agencies are those mandated with the monitoring, control and surveillance (MCS) of fishing activities. MCS functions are normally a combination of aerial (including drone and satellite) surveillance, at-sea inspections and port inspections.

The main function of MCS is to prevent and deter illegal, unreported and unregulated (IUU) fishing. Gear marking is an important mechanism for assisting regulating fisheries. If gear is well marked and has sufficient identification so it can be linked to vessels or gear registers, this is evidently a useful tool for enforcement agencies checking on gear set in certain areas. Conversely, if, say, a fisheries patrol picks up unidentified fishing gear in a location where all gear must be marked and linked to a vessel/ gear registry, it is a reasonable assumption it is being illegally operated and appropriate action can then be taken.

Approach	Principles
Prevention	<ul style="list-style-type: none"> • Where the marking of fishing gear is necessary or required, it should be a condition of any authorization to fish. • Fisheries management bodies should ensure that control and enforcement of a system for the marking of fishing gear is an integral part of arrangements for the monitoring, control and surveillance of fisheries. • Inspections should be carried out by the relevant authority to verify that owners and operators mark their fishing gear as required and take action as necessary. • The relevant authority should consider fair and reasonable penalties or sanctions for non-compliance with the various requirements of fishing gear marking and identification systems.
Mitigation	<ul style="list-style-type: none"> • Not applicable.
Remediation	<ul style="list-style-type: none"> • A combination of intelligence-based information and risk assessment should be used to identify IUU fishing hotspots and to predict where illegally-placed gear and gear lost through resulting gear conflict might occur. This can be used for both anti-IUU fishing operations as well as focused ALDFG clean-up operations.



Photo credit: World Animal Protection

4.8.2 KEY BEST PRACTICE ACTIONS AND APPROACHES: FISHERIES CONTROL AGENCIES

Approach and Principle		Best Practice	Other participants
Prevention	Where the marking of fishing gear is required, it should be a condition of any authorization to fish.	<ul style="list-style-type: none"> Fish licensing conditions should explicitly include the prevailing requirements to mark and identify fishing gear as a condition to fish, including reporting and other management requirements. 	<ul style="list-style-type: none"> Fisheries management authorities
	Fisheries management bodies should ensure that control and enforcement of a system for the marking of fishing gear is an integral part of arrangements for the monitoring, control and surveillance of fisheries	<ul style="list-style-type: none"> The marking of fishing gear, together with other aspects of fishing gear management that is required by law, e.g., spatial or temporal gear zones, should be included in MCS planning and operations, including in risk-based prioritization processes. 	<ul style="list-style-type: none"> Fisheries management authorities Fisher organizations
	Inspections should be carried out by the relevant authority to verify that owners and operators mark their fishing gear as required and take action as necessary.	<ul style="list-style-type: none"> Inspections should be conducted, both at sea and at port, to ensure that gear marking and other requirements are being complied with. During inspections at sea, due consideration for the health and safety of both inspection and fishing industry personnel should be paramount. In particular, care must be taken not to become entangled with fishing gear, especially in poor sea conditions. Deployed gear that is found without required marks should be reported to the relevant authority. Port State inspection of fishing gear should be conducted in accordance with the procedures set out in Annex B, paragraph e) of the FAO Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing, including conditions in relation to marking of the fishing gear. 	<ul style="list-style-type: none"> Fisheries management authorities Fisher organizations

Approach and Principle		Best Practice	Other participants
Prevention (continued)	The relevant authority should consider fair and reasonable penalties or sanctions for non-compliance with the various requirements of fishing gear marking and identification systems.	<ul style="list-style-type: none"> An appropriate penalty or other sanction framework should be developed to prevent and deter non-compliance with fishing gear marking and other regulations relevant to this framework. It is important that these penalties or sanctions are proportionate to the non-compliance involved and that these are clearly communicated to the fishing industry, and appropriate consultation and appeal systems put in place. 	<ul style="list-style-type: none"> Fisheries management authorities Fisher organizations
	A combination of intelligence-based information and risk assessment should be used to identify IUU fishing hotspots and to predict where illegally-placed gear and gear lost through resulting great conflict might occur. This can be used for both anti-IUU fishing operations as well as focused ALDFG clean-up operations.	<ul style="list-style-type: none"> Port States and Regional Fishery Management Organizations/Bodies should be made aware of the linkage between illegal, unreported and unregulated (IUU) fishing and ALDFG, and leverage monitoring, control and surveillance (MCS) technologies and resources against IUU fishing for the reduction of ALDFG MCS authorities, working with both other maritime surveillance agencies as well as the fishing industry, should be encouraged to identify IUU hotspots, with accompanying information on diurnal/seasonal patterns, gear types involved and the scale and nature of the IUU fishing taking place. This data could be shared with cooperating agencies to allow (i) illegally-placed fishing gear to be located, retrieved and where possible the owners traced for further action and (ii) to assist gear recovery programs target locations with a high likelihood of finding ALDFG. 	<ul style="list-style-type: none"> Fisheries management authorities Fisher organizations

4.8.3 CASE STUDY: FISHERIES CONTROL AGENCIES

Consideration of Health and Safety Issues When Retrieving Lost or Abandoned Fishing Gear	
<p><i>Mandatory reporting requirements for lost gear in Canada (Canada ALDFG Program)</i></p> <p>Canada signed onto the GGGI in 2018 and is acting on its commitment to address ghost gear through regulatory and operational measures, as well as by providing funding opportunities for innovative solutions both within Canada and internationally. An early action in 2018 was awarding funding through its <i>Innovative Solutions Canada</i> program to five small businesses for development of gear technologies to reduce ghost fishing and develop/improve ghost gear removal technologies.</p> <p>As a first step to the regulatory program, Canada has expanded mandatory reporting requirements for lost gear to additional commercial fisheries in 2019. Additionally, a new requirement to report any retrieved gear previously reported lost has been introduced in commercial fisheries, which will allow for targeted retrieval efforts and a robust analysis of the ghost gear issue in Canada.</p> <p>In July 2019, Canada’s Department of Fisheries, Oceans, and the Canadian Coast Guard (DFO) also carried out a three-day ghost gear removal project in the Gulf of St. Lawrence, removing over 100 crab pots, more than 9 kilometers 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.</p> <p>Going forward, the Government of Canada is working with stakeholders through its <i>Sustainable Fisheries Solutions and Retrieval Support Contribution Program</i> or “<i>Ghost Gear Fund</i>”. The 8.3 million CAD (US\$ 6.7 million) program launched in 2019 assists indigenous groups, fish harvesters, the aquaculture industry, non-profits, and communities to take concrete actions to support ghost gear across four main pillars: prevention, retrieval, responsible disposal and international leadership. A critical component of this program is supporting harvester-led gear retrieval efforts and supporting fish harvesters to test and acquire new gear technologies to reduce gear loss. Canada also hosted the first-ever Gear Innovation Summit in Halifax in February 2020, with the focus being on bringing fishers, technology companies, gear manufacturers, and government representatives together to discuss technological solutions to mitigate ghost gear.</p> <p>Source: Effective Ghost Gear Solutions; Learning from what works (GGGI, 2020) For more information: www.dfo-mpo.gc.ca/species-especes/mammals-mammiferes/ghostgear-equipementfantome/index-eng.html</p>	<p>SUCCESSFUL STRATEGIES</p> <ul style="list-style-type: none">• Taking a comprehensive and strategic approach to addressing ghost gear at the national fisheries management level• Showing leadership by dedicating funding to gear prevention and removal efforts both domestically and internationally• Learning from other areas and adopting successful strategies to the local and regional context• Building capacity in the fisheries sector to address ghost gear• Tying actions together with the Canada-wide strategy on zero-plastic waste

4.9 FISHERIES AND AQUATIC ENVIRONMENT RESEARCH

4.9.1 PRINCIPLES OF BEST PRACTICE

Approach	Principles
	<p>Prevention</p> <ul style="list-style-type: none">• Research and development of low-cost gear marking, identification and traceability technologies.• Development of improved low carbon power generation technologies and energy efficient lighting and communication solutions for fishing gear and gear marking systems.• Provision of better information on the drivers, extent, impact and costs of ALDFG.
	<p>Mitigation</p> <ul style="list-style-type: none">• Further development of (i) biodegradable materials for use in the aquatic environment and (ii) fishing gear disabling systems.• Research and evaluation of ghost fishing efficiency and mortality rates of different fishing gear designs.
	<p>Remediation</p> <ul style="list-style-type: none">• Development of standard definitions and methodologies for ALDFG data collection.• Research into the cost-effectiveness of different gear location and retrieval methods.• Gear recovery programs should take into account the scale and nature of the fishery, as gear recovery strategies will differ markedly between small-scale fisheries and commercial operations.

The concept of integrated “blue growth” is resulting in a more collaborative institutional environment for aquatic research, with diverse areas such as fisheries, ecosystem monitoring, robotics and remote sensing all exploring common opportunities.

This suggests that with advances in material science, information technology and maritime engineering there are real opportunities to improve fishing gear management, prevent its loss, disable lost gear and aid its recovery through innovative research and development.



Photo credit: Blue Ocean Gear

4.9.2 KEY BEST PRACTICE ACTIONS AND APPROACHES: FISHERIES AND AQUATIC ENVIRONMENT RESEARCH

Approach and Principle		Best Practice	Other participants
Prevention	Research and development of improved gear marking, identification and traceability technologies.	<ul style="list-style-type: none">The development of innovative solutions to fishing gear marking, identification and traceability, including the integration of identification tags and other markers to key gear components.A key consideration of such research should be the cost-effectiveness, practicality and acceptability of such systems to ensure their subsequent adoption by gear manufacturers and the fishing industry.	<ul style="list-style-type: none">Government (funding)Gear manufacturersFishing industry
	Development of improved low carbon power generation technologies and energy efficient lighting and communication solutions for fishing gear and gear marking systems.	<ul style="list-style-type: none">Further investigation into low carbon power independent power provision at sea, including photovoltaic, wind and wave-powered electrical generation, as well as improved power storage through improved power cell storage solutions.Application of LED and other low-draw lighting systems for fishing gear.Development of remote communication and locator beacon systems that improves both the control of fishing gear and will aid its recovery if lost.	<ul style="list-style-type: none">Government (funding)Fishing industry (e.g., piloting and/or adopting new technologies)
	Provision of better information on the drivers, extent, impact and costs of ALDFG.	<ul style="list-style-type: none">Provision of information to policy makers, industry and other interested stakeholders on why fishing gear is lost, its overall contribution to aquatic litter, the impact on the aquatic environment and the quantifiable and non-quantifiable costs of ALDFG.	<ul style="list-style-type: none">GovernmentGear manufacturersFishing industry
Mitigation	Further development of biodegradable materials and fishing gear disabling systems.	<ul style="list-style-type: none">Build on recent advances in biodegradable material science and applying this to practical, cost-effective and acceptable solutions for disabling ALDFG.Investigation into new materials for fishing gear that have a lower environmental cost.	<ul style="list-style-type: none">Gear manufacturersFishing industry

Approach and Principle		Best Practice	Other participants
Mitigation (continued)	Research and evaluation of ghost fishing efficiency and mortality rates of different fishing gear designs.	<ul style="list-style-type: none">Researchers should collaborate with gear manufacturers and the fishing industry to develop and test different fishing gear technologies to assess ghost fishing efficiency, mortality and other elements (e.g., longevity of ghost fishing, environmental variables and the subsequent fate of ALDFG) in order to contribute to improved gear design and more effective disabling systems.	<ul style="list-style-type: none">Gear manufacturersFishing industry
	Development of standard definitions and methodologies for ALDFG data collection.	<ul style="list-style-type: none">Information on the nature, location and scale of ALDFG is key for both preventing it in the first place and also for targeting gear recovery programs. Researchers work with fisheries managers to develop practical and effective data collection programs compiling gear loss reporting with other forms of information, e.g., IUU fishing risk assessments and hotspot analyses.	<ul style="list-style-type: none">Fisheries managers and regulatorsFisheries control agencies
Remediation	Research into the cost effectiveness of different gear location and retrieval methods.	<ul style="list-style-type: none">Assist the development of cost-effective ALDFG survey systems that can locate and quantify the amount of lost gear of different types in order to assess the likely threat—and cost—to both anthropogenic activities (e.g., navigation, fishing, etc.) and the aquatic environment.Assist the development of cost-effective ALDFG recovery techniques that can be subsequently adopted by industry, the government and NGOs.	<ul style="list-style-type: none">GovernmentFishing industryFisheries organizationsNGOs
	Gear recovery programs should take into account the scale and nature of the fishery, as gear recovery strategies will differ markedly between small-scale fisheries and commercial operations.	<ul style="list-style-type: none">It is recognized that the nature of gear recovery operations will depend very much on the scale of the fishery. Small-scale artisanal fisheries, which often use large numbers of affordable static gear such as gillnets and traps (thus giving rise to low but persistent abandonment) are very different to commercial operations where large pieces of gear might be abandoned or lost, but efforts are made to either report the loss or recover it at a later date.	<ul style="list-style-type: none">Fisheries organizations

4.9.3 CASE STUDY: FISHERIES AND AQUATIC ENVIRONMENT RESEARCH

Please see case study on polyhydroxyalkanoate (PHA) use as a biodegradable plastic in PHA biodegradable escape panel for blue crab trap fisheries in [Section 3.1.3](#) on page 31.

4.10 SEAFOOD ECOLABEL STANDARD AND CERTIFICATE HOLDERS

4.10.1 PRINCIPLES OF BEST PRACTICE

<p>The ecolabeling of seafood, mainly though the third-party certification and assessments of individual fisheries and vessel units, is an important market driver for responsible fishing.</p> <p>Good management and information in terms of reducing bycatch, preventing the loss of gear and subsequent habitat damage and unaccountable fishing mortality, as well as impacts on endangered, threatened and protected (ETP) species are all potentially covered by such ecolabels. However, there is currently limited explicit reference to assessing and including the potential for ghost fishing in certification assessments.</p>	Approach	Principles
	Prevention	<ul style="list-style-type: none">Assessing the degree to which fisheries manage and prevent, through measures, strategies or other means, the abandonment, loss and discard of fishing gear.
	Mitigation	<ul style="list-style-type: none">Specific recognition of, and guidance on, recognizing and managing the consequences of ALDFG on the status of the aquatic environment.Assessing the degree to which fisheries have sufficient information on which both assess and manage the consequences of ALDFG on the status of the aquatic environment.
	Remediation	<ul style="list-style-type: none">Recognition of best practice by fisheries that recover fishing gear that is lost or abandoned by the fleet under assessment.Recognition of fisheries that participate in programs that recover ALDFG and other aquatic litter.




Photo credit: Shin Arunrugstichai

4.10.2 KEY BEST PRACTICE ACTIONS AND APPROACHES: SEAFOOD ECOLABEL STANDARD AND CERTIFICATE HOLDERS

Approach and Principle		Best Practice	Other participants
Prevention	Assessing the degree to which fisheries manage and prevent, through measures, strategies or other means, the abandonment, loss and discard of fishing gear.	<ul style="list-style-type: none">Inclusion of benchmarks, scoring guidelines or scoring guidance that implicitly recognizes best practice in terms of the preventative measures, strategies or other means to reduce the risk of the loss or abandonment of fishing gear including such aspects as spatial/temporal segregation, lower-risk fishing methods, training and awareness of skippers and crew, gear marking systems deployed, and the responsible disposal of end-of-life fishing gear (see Section 4.4.3).	<ul style="list-style-type: none">Fisheries under assessment or in a Fisheries Improvement ProjectNGOs
Mitigation	Specific recognition of, and guidance on, recognizing and managing the consequences of ALDFG on the status of the aquatic environment.	<ul style="list-style-type: none">Inclusion of benchmarks, scoring guidelines or scoring guidance that implicitly recognizes best practice in terms of the preventative measures, strategies or other means to reduce the risk of unaccounted fishing mortality of target and non-target species, impacts on the status of habitats and aquatic communities and impacts on the status of ETP species.	<ul style="list-style-type: none">Fisheries under assessment or in a Fisheries Improvement ProjectNGOs
	Assessing the degree to which fisheries have sufficient information to both assess and manage the consequences of ALDFG on the status of the aquatic environment.	<ul style="list-style-type: none">Inclusion of benchmarks, scoring guidelines or scoring guidance that implicitly assess the degree to which fisheries have sufficient information on which to (i) assess the impact of, and (ii) base measures, strategies or other means to reduce the likelihood of unaccounted fishing mortality of target and non-target species, impacts on habitats and aquatic communities and impacts on the status of ETP species resulting from ALDFG.	<ul style="list-style-type: none">Fisheries under assessment or in a Fisheries Improvement ProjectResearchers
Remediation	Recognition of best practice by fisheries that recover fishing gear that is lost or abandoned by the fleet under assessment.	<ul style="list-style-type: none">Inclusion of benchmarks, scoring guidelines or scoring guidance that recognize and acknowledge best practice, in terms of measures, strategies or other means, of fisheries to recover where possible and safe to do so, fishing gear that is lost or abandoned by the fleet under assessment.	<ul style="list-style-type: none">Fisheries under assessment or in a Fisheries Improvement Project
	Recognition of fisheries that participate in programs that recover ALDFG and other aquatic litter.	<ul style="list-style-type: none">Inclusion of benchmarks, scoring guidelines or scoring guidance that recognize and acknowledge best practice in fisheries that participate in programs that recover ALDFG and other aquatic litter.	<ul style="list-style-type: none">Fisheries under assessment or in a Fisheries Improvement Project

4.10.3 CASE STUDY: SEAFOOD ECOLABEL STANDARD AND CERTIFICATE HOLDERS

MSC Intent: “Ghost Fishing” and Impacts from Gear Loss	Friend of the Sea
<p>The MSC Principles and Criteria for Sustainable Fishing currently includes criteria that relate to ghost fishing and gear loss.</p> <p>In the MSC Fisheries Certification Requirements (Version 2.1, August 2015), assessment teams are required to consider whether fisheries review measures to minimize mortality of unwanted catch. This also includes consideration of unobserved mortality, such as that caused by ghost fishing. The impacts of gear loss on habitats are considered under the Habitats components. In particular, there is Guidance on the Habitats Management Performance Indicator (PI) (2.4.2) that indicates that in order for a fishery to score a 100, a management strategy should be in place even for gears that do not regularly contact benthic habitats since gear loss or unexpected seafloor impacts could occur. In addition, in the Ecosystem PIs, the team need to consider how the fishery impacts the wider ecosystem structure and function. Indirect effects of lost gear and other operational waste that are not considered directly under the primary, secondary and ETP PIs are considered here.</p> <p>However, MSC acknowledges that overall the consideration of ALDFG within fishery assessments was found to be inconsistent, absent or incorrect with very little “on the water” change (MSC, 2020). As a result, ghost gear is subject to a specific assessment as part of a wider review of the Fisheries Standard and will examine ways in which (i) consideration of ghost gear impact needs to be explicit in MSC fishery assessments and (ii) promoting the implementation of gear loss avoidance strategies and mitigation actions in certified fisheries. The revised MSC Fisheries Standard should be applied to new fisheries entering assessment in late 2022.</p> <p>Source: MSC Fisheries Certification Requirements Version 2.01 (August 31, 2018)</p>	<div><div><div>®</div><div>The Friend of the Sea Wild Sustainable Fishing Requirements Standard (Ver. 4, March 2020) has a strong focus on preventing or mitigating the loss of fishing gear in the Fishery Management section of their standard.</div></div></div> <p>Essential elements include:</p> <ul style="list-style-type: none">• The fleet is equipped with measures that guarantee a quick retrieval of lost fishing gear to avoid ghost fishing.<ul style="list-style-type: none">– Reporting of lost FADs with date, time and last known position to relevant authorities. <p>Important elements include:</p> <ul style="list-style-type: none">• Vessels shall have appropriate equipment on board to assist in the safe recovery of lost fishing gear.• When retrieval is not possible, the vessel must record the last known position of lost gear and report to the relevant authorities. If fishing authorities do not have the means to collect information on lost fishing gear, an alternative option is to report the details to the GGGI via the Ghost Gear Reporter App.• Vessels shall be prepared and commit to the recovery and salvage of fishing gear lost by other vessel operators and to recycle damaged or found fishing gear, where appropriate and practically possible.• The unit of certification undertakes an annual assessment of the lost gear records (amount and reasons for loss) and, in high-risk areas or during high-risk times, implement mitigation measures to address, where appropriate and practically possible. <p>Source: https://friendofthesea.org/wp-content/uploads/FOS-Wild-Standard-v.4.pdf</p>

4.11 SEAFOOD BUSINESSES

4.11.1 PRINCIPLES OF BEST PRACTICE

Seafood businesses, e.g., those companies involved in the purchase, processing and value adding, distribution and sale of seafood, have a considerable role in ensuring that their raw material is procured from responsible and well-managed fisheries that minimize the potential for—and consequences of—ALDFG.	Approach	Principles
	Prevention	<ul style="list-style-type: none">• Seafood businesses should require their suppliers to conform with best practice as promoted through these guidelines or applicable local legislation to the same effect.• Businesses should where possible provide an alternate, less costly means of end-of-life fishing gear disposal to actively incentivize the retrieval of lost nets and their proper disposal (e.g., by supporting harbors/ports by providing disposal facilities, buy-back schemes or reuse/recycling initiatives through their supply chain).
	Mitigation	<ul style="list-style-type: none">• Likewise, seafood businesses whose strategy is to source from third-party certified fisheries should ensure that these recognize the impacts of ALDFG on the aquatic environment and ensure that these are managed effectively (see Best Practice guidelines for third-party certification in Section 4.10).
	Remediation	<ul style="list-style-type: none">• Likewise, seafood businesses whose strategy is to source from third-party certified fisheries should ensure that these recognize the efforts of fisheries to recover their gear if lost or abandoned. Where they have their own sustainable sourcing guidelines, they should favor those fisheries that participate in recovery programs for fishing gear (see Best Practice guidelines for third-party certification in Section 4.10).



Photo credit: Joel Baziuk

4.11.2 KEY BEST PRACTICE ACTIONS AND APPROACHES: SEAFOOD BUSINESSES

Approach and Principle		Best Practice	Other participants
Prevention	Seafood businesses should require their suppliers to confirm with best practice as promoted through these guidelines or applicable local legislation to the same effect.	<ul style="list-style-type: none">• To this end, seafood businesses should ensure that these recognize the risks of fishing gear loss and ensure that these are managed effectively, either through sourcing raw material from certified fisheries (see Best Practice guidelines for third-party certification in Section 4.10) or developing specific procurement guidelines and audit/verification systems.• Seafood retailers in particular should consider measures to reduce sourcing from high-risk fisheries that, directly or indirectly, may lead to gear loss or disposal at sea.	<ul style="list-style-type: none">• Certification Bodies• Fisheries Improvement Projects
	Liaise with third party seafood certification bodies to address management and information requirements for reducing ghost fishing and the impacts of ALDFG on aquatic fauna, flora and habitats.	<ul style="list-style-type: none">• Related to the other preventative measures mentioned above, seafood businesses might work with Fisheries Improvement Project (FIPs) and third-party certification bodies to ensure their raw material supply chain avoids fisheries with unacceptable levels of ghost fishing.	<ul style="list-style-type: none">• Fishers• Certification bodies
Mitigation	As above.	<ul style="list-style-type: none">• Likewise, seafood businesses should ensure that these recognize the impacts of ALDFG on the aquatic environment and ensure that these are managed effectively (see Best Practice guidelines for third-party certification in Section 4.10).	<ul style="list-style-type: none">• Certification Bodies• Fisheries Improvement Projects
Remediation	As above.	<ul style="list-style-type: none">• Likewise, seafood businesses should ensure that these recognize the efforts of fisheries to recover their gear if lost or abandoned, and that participate in recovery programs for fishing gear rather than their own (see Best Practice guidelines for third-party certification in Section 4.10).	<ul style="list-style-type: none">• Certification Bodies• Fisheries Improvement Projects

4.11.3 CASE STUDY: SEAFOOD BUSINESSES

The Thai Union Ghost Gear Work Plan (2018–2020)



Ghost Gear Dive in June 2019 in Thailand (Photo credit: Thai Union)

Thai Union, one of the world’s largest seafood processors, joined the GGGI in 2018 in a drive to help reduce the growing problem of ghost gear worldwide. Healthy living and healthy oceans are integral to Thai Union’s business. The company’s global sustainability strategy, SeaChange®, includes a responsible sourcing program under which Thai Union has made a commitment to ensure safer, cleaner oceans by driving economically viable and sustainable solutions to the problem of ghost fishing gear and marine litter globally. This commitment drives Thai Union’s work with the GGGI, which in 2019 saw the company be the first to publish a dedicated work plan to achieve its goals with the GGGI.

Since joining the GGGI in March 2018, Thai Union has worked with the GGGI to identify projects that will support efforts to address the problem of abandoned, lost and discarded fishing gear, and set objectives for more efficiently managing the issue. Among others, Thai Union has committed to:

1. Support Fishery Improvement Projects (FIPs) for purse seine tuna in the eastern Atlantic Ocean and Indian Ocean to ensure that these are in line with the GGGI Best Practice Framework and the FAO Voluntary Guidelines on the Marking of Fishing Gear. The activities in the FIP action plans include improved management of fish aggregating devices (FADs), the use of non-entangling FADs and understanding the impact of FADs on the ecosystem.
2. Increase the number of vessels involved in the FAD Watch program in the Indian Ocean and to increase their capacity to remove lost FADs.
3. Improve management practices for ghost gear in Thailand to reduce and prevent pollution into the marine environment. The goal is to develop and implement best practices for the fishing industry in Thailand to prevent fishing gear from becoming ghost gear by applying best practices from the GGGI Best Practice Framework.

Main source: <https://www.thaiunion.com/files/download/sustainability/policy/Thai-Union-and-the-Global-Ghost-Gear-Initiative-Work-Plan-2018-2020-Overview.pdf>

4.12 NONGOVERNMENTAL ORGANIZATIONS

4.12.1 PRINCIPLES OF BEST PRACTICE

<p>Nongovernmental organizations (NGOs) have proved to be key advocates of good practice and responsible fishing and participate in a wide variety of activities ranging from research and managing Fisheries Improvement Projects to providing seafood consumers and other stakeholders with valuable information and advice.</p> <p>With regard to fishing gear management and addressing the consequences of ALDFG, NGOs have a particular role in capacity-building, research, developing codes of practice and awareness-raising.</p>	Approach	Principles
	Prevention	<ul style="list-style-type: none"> Advocates for change, being able to focus on a wide range of actors, including policymakers, seafood businesses and fishers. Acting as catalytic partners with a particular focus on small-scale fishers, developing and facilitating local groupings, assisting with consensus-building and program planning. Providing direct capacity-building and training, again mainly to small-scale fishers, to improve practical skills and ensuring both environmental and financially sustainable businesses. Raising public awareness in emerging or under-reported issues related to the loss of fishing gear and the subsequent impact on the aquatic environment. Acting as an independent intermediary and auditor.
	Mitigation	<ul style="list-style-type: none"> Providing research and survey support to mitigatory actions that either reduce the ability of ghost fishing gear to continue to fish or to directly address the impacts on aquatic animals and birds, habitats and other key components of the aquatic ecosystem.
	Remediation	<ul style="list-style-type: none"> Identify, catalyze funding for and where appropriate manage and implement remediation projects for end-of-life fishing gear removal and fisheries-related aquatic litter recycling.



Photo credit: Joel Baziuk

4.12.2 KEY BEST PRACTICE ACTIONS AND APPROACHES: NONGOVERNMENTAL ORGANIZATIONS

	Approach and Principle	Best Practice	Other participants
Prevention	Advocates for change, being able to focus on a wide range of actors, including policymakers, seafood producers and fishers.	<ul style="list-style-type: none"> Through objective, evidence-based analysis, NGOs should identify opportunities for reducing levels of ALDFG and mitigating their impacts. This will then inform the development of carefully defined advocacy campaigns targeted at the relevant actors throughout the supply chain and governance framework. 	<ul style="list-style-type: none"> Interaction with all other stakeholders
	Acting as catalytic partners, possibly with a particular focus on small-scale fishers, developing and facilitating local groupings, assisting with consensus-building and program planning.	<ul style="list-style-type: none"> Many small-scale fisheries or less-well represented fisher groups lack the ability to mobilize their resources or gain sufficient consensus to join forces. NGOs can therefore provide a pivotal role in developing local groupings and building consensus over common issues of concern. NGOs can then assist the united grouping to develop a coordinated approach to addressing common problems, be it through a unified code of practice or a memorandum of understanding, and other approach as appropriate. 	<ul style="list-style-type: none"> Small-scale fisher communities and potential groupings
	Providing direct capacity-building and training, again probably mainly to small-scale fishers, to improve practical skills and ensuring both environmental and financially sustainable businesses.	<ul style="list-style-type: none"> Contribute to skills development through a combination of direct training, group training workshops, mentoring or e-learning to address skill gaps in fisheries or related business management, especially when related to the use of low-impact fishing gears and fishing techniques. Particular roles can include training needs analysis, curriculum development and the provision of training as required. 	<ul style="list-style-type: none"> Small-scale fisher communities and other established groupings
	Raising public awareness in emerging or under-reported issues related to the loss of fishing gear and the subsequent impact on the aquatic environment.	<ul style="list-style-type: none"> Identification of issues relevant to ghost fishing and its impacts that could benefit from increased public (and other stakeholder) awareness. Development of targeted awareness-building resources and the preparation and making available of supporting information. 	<ul style="list-style-type: none"> Other relevant stakeholders

Approach and Principle	Best Practice	Other participants
Prevention (<i>continued</i>)	Acting as an independent intermediary and auditor. <ul style="list-style-type: none">• Address gaps in the commercial third-party certification industry through the provision of inspection or other auditing services to provide independent evidence of compliance levels in fishing gear-related management frameworks.	<ul style="list-style-type: none">• Fisher organizations• Port operators
Mitigation	Providing research and survey support to mitigatory actions that either reduce the ability of ghost fishing gear to continue to fish or to directly address the impacts on aquatic animals and birds, habitats and other key components of the aquatic ecosystem. <ul style="list-style-type: none">• NGOs potentially have a role in supporting research and other actions to reduce the impact of ALDFG in the aquatic environment. This can include developing survey methodologies to identify ALDFG hotspots, especially in coastal waters, and conducting research to estimate the economic value of the ecosystem benefits resulting from ALDFG removal/reduction. In particular they can assess the cost of ghost fishing on target and non-target species, together with the impacts on ETP species and vulnerable aquatic ecosystems.	<ul style="list-style-type: none">• Research organizations
Remediation	Identify, catalyze funding for and where appropriate manage and implement remediation projects for end-of-life fishing gear removal and fisheries-related aquatic litter recycling. <ul style="list-style-type: none">• Some NGOs specialize in organizing and coordinating practical responses to aquatic environmental issues, such as removing end-of-life ALDFG in coastal waters.• Such NGOs can assist local stakeholders in identifying ALDFG impact hotspots, developing and assessing gear removal options, raising funding and organizing gear removal and responsible disposal.	<ul style="list-style-type: none">• Maritime management authorities• Fishing organizations• Port authorities

4.12.3 CASE STUDY: NONGOVERNMENTAL ORGANIZATIONS

Northern Prawn Fishery—Cleaning up Ghost Nets in Northern Australia



The Gulf of Carpentaria in northern Australia has been identified as a global hotspot for ghost nets, with over 2,400 metric tons drifting from SE Asia into Australian waters each year. This is higher than any other area in Oceania and Southeast Asia. These nets vary in size from a football field, a big rig truck (6 metric tons or 6 kilometers long), to 20 kilometers long. Sea turtles make up 80% of the aquatic life found entangled in these nets and many of these are dead or dying (Wilcox *et al*). Between 2004 and 2016, GhostNets Australia, working with indigenous

rangers, removed more than 300 entangled turtles from 13,000 ghost nets. The estimated number of turtles caught by a sample of 8,690 ghost nets was between 4,866 and 14,600 turtles, assuming nets drift for one year. Net identification work indicates that less than 4% of ghost nets are coming from Australian fisheries.

The Northern Prawn Fishery (NPF)³⁵ is a large trawl fishery operating across northern Australia. The NPF has been a willing partner and leader of many significant initiatives to improve prawn stocks, reduce bycatch and foster research to improve their overall sustainability. The NPF is considered the gold standard of trawl fisheries globally by the FAO and is MSC certified. NPF fishers encounter ghost nets from time to time, mainly when they become entangled in their propellers or active nets. NPF operators are not contributors to this problem and do everything they can to avoid losing gear while fishing. They also actively retrieve ghost nets where possible.

The NPF and World Animal Protection worked in partnership to reduce ghost nets found in the NPF, in particular in the Gulf of Carpentaria. This partnership contributed to existing clean-up efforts in the Gulf, specifically by GhostNets Australia working with indigenous rangers. This is an excellent example of different sectors collaborating to address a global ghost gear hotspot. In 2015, the NPF formally included ghost gear management, retrieval and data collection within their operations manual to encourage operators to assist with mitigating the ghost net problem. Fishers voluntarily helped to remove ghost nets by:

- (i) Removal, e.g., retrieving ghost nets from the water where feasible. Raptis, a key operator in the industry provides disposal facilities at their Karumba site for vessels to offload ghost nets retrieved. Where collection is not possible, for example during peak fishing times, nets are buoyed to enable coordination of a later retrieval; and
- (ii) Reporting, e.g., fishers log the position of ghost nets encountered and provide information and a photo of the net(s) to World Animal Protection. The project is self-funded by the industry. The NPF is considering clean-up days at locations that are difficult to access without a boat, working with GhostNets Australia and World Animal Protection.

The lessons: The NPF has been actively involved in working with indigenous groups and NGOs to reduce the impacts of ghost nets for many years. This important partnership with World Animal Protection is another step in the NPF’s journey towards sustainability and an example of how success can be achieved through collaboration across sectors.

Source: <http://www.ghostgear.org/solutions/northern-prawn-fishery-industry-cleaning-ghost-nets>

³⁵ <http://npfindustry.com.au/the-northern-prawn-fishery/>

4.13 INTERNATIONAL DEVELOPMENT AND FUNDING AGENCIES

4.13.1 PRINCIPLES OF BEST PRACTICE

<p>International development agencies include both multilateral agencies (such as the World Bank, the Asian Development Bank, the African Development Bank and the United Nations Development Programme (UNEP)) and bilateral agencies (such as Australia’s Department of Foreign Affairs and Trade (Development Cooperation Division), France’s Agence Française de Développement (AFD) and the Japan International Cooperation Agency (JICA)) have all funded large fisheries development projects in the past.</p> <p>With the growing alarm and awareness of ALDFG’s contribution to aquatic litter, many of these organizations are now taking an interest in helping nations address these issues through financial grants or loans, often accompanied by technical assistance packages.</p> <p>This stakeholder group also includes philanthropic organizations involved in marine fisheries conservation such as the Pew Charitable Trust, the Walton Foundation and the Packard Foundation.</p>	Approach	Principles
	Prevention	<ul style="list-style-type: none">• Recipient countries are enabled to recognize the scale and nature of ALDFG in their waters.• Evidence-based management and regulation of fisheries to prevent ALDFG.• Support is aimed at providing practical and economically-viable solutions to ALDFG.• Support and proposed actions are embedded in a coherent policy and action framework with an agreed roadmap.
	Mitigation	<ul style="list-style-type: none">• Develop and promote best practice and proven technologies that reduce the incidence and impact of ALDFG.
	Remediation	<ul style="list-style-type: none">• Recipient countries are supported in developing ALDFG information systems.• Recipient countries and authorities are enabled to design and conduct targeted ALDFG retrieval programs.



4.13.2 KEY BEST PRACTICE ACTIONS AND APPROACHES: INTERNATIONAL DEVELOPMENT AND FUNDING AGENCIES

Approach and Principle		Best Practice	Other participants
Prevention	Recipient countries are enabled to recognize the scale and nature of ALDFG in their waters.	<ul style="list-style-type: none">• Develop and promote methodologies for estimating baseline ALDFG volumes and replenishment rates, the identification of key actors and pathways.	<ul style="list-style-type: none">• Fisheries managers and regulators• Fisheries control agencies• Fisheries and aquatic environment research
	Evidence-based management and regulation of fisheries to prevent ALDFG.	<ul style="list-style-type: none">• Support studies that identify the drivers for ALDFG and assist development of regulatory and other management tools to address these drivers.• Support to ALDFG risk assessments and regulatory/management gaps analyses at sub-national, national and regional levels.	<ul style="list-style-type: none">• Fisheries managers and regulators• Fisheries control agencies• Regional fisheries organizations
	Support is aimed at providing practical and economically-viable solutions to ALDFG.	<ul style="list-style-type: none">• Conduct feasibility studies into the technical and economic viability of end-of-life and abandoned, lost or discarded fishing gear collection, repurposing, recycling or responsible disposal.	<ul style="list-style-type: none">• Fisheries managers and regulators• Port operators
	Support and proposed actions are embedded in a coherent policy and action framework with an agreed roadmap.	<ul style="list-style-type: none">• Assist recipient countries prepare an ALDFG and aquatic litter action plan with recommended investments, policy actions and a suggested implementation roadmap.• Assist to integrate ALDFG-specific recommendations into policy documents, fisheries management plans and legislative frameworks.• Awareness raising programs on ALDFG should be supported and integrated at regional, national and community levels, including integration into existing aquatic debris awareness programs, maritime training and observer programs.	<ul style="list-style-type: none">• Fisheries managers and regulators• Environment agencies

Approach and Principle		Best Practice	Other participants
Mitigation	Develop and promote best practice and proven technologies that reduce the incidence and impact of ALDFG.	<ul style="list-style-type: none"> Conduct pilot projects to introduce proven and cost-effective technologies that reduce the potential for gear to ghost fish. Where appropriate, these pilot projects could be developed to further adapt the technology to local circumstances and then to demonstrate and replicate these at a wider level. 	<ul style="list-style-type: none"> Research organizations
	Recipient countries are supported in developing ALDFG information systems.	<ul style="list-style-type: none"> Design of lost or abandoned gear reporting systems. 	<ul style="list-style-type: none"> Fisheries managers and regulators Fisheries control agencies
Remediation	Recipient countries and authorities are enabled to design and conduct targeted ALDFG retrieval programs.	<ul style="list-style-type: none"> Design and funding of targeted lost or abandoned fishing gear recovery programs. Development of public-private partnerships and civil society collaborations that explore and support the creation of economic incentives and solutions to reduce and eliminate ALDFG, including ALDFG recovery and retrieval programs, and to help implement practical solutions and technologies for cost effectiveness and efficiency. 	<ul style="list-style-type: none"> Fisheries managers and regulators Fleet operators and Fisheries organizations

4.13.3 CASE STUDY: INTERNATIONAL DEVELOPMENT AND FUNDING AGENCIES

Pre-Feasibility Study on Management, Retrieval and Recycling of Used and Abandoned, Lost and Discarded Fishing Gear, and Inventory of Plastic Use and Loss from Aquaculture in Indonesia

The problem: In 2017, the Government of Indonesia (GoI) announced its National Plan of Action on Marine Plastic Debris (2017–2025), which has the ambitious aim to reduce plastic marine debris by 70% by 2025. In Indonesia, sea-based leakage is estimated to contribute to at least 20% of waste leaked into Indonesia’s marine environment. One of the five pillars of this Plan is to “reduce sea-based leakage,” highlighting the significance of this source. Sea-based leakage can include pollution from maritime activities and ships, fisheries, and debris transported through ocean flows. The “greening” of ports is necessary, including investments to develop efficient waste collection facilities at harbors and ports as well as incentive systems for the collection of waste at these sites. Development, implementation and enforcement of good practices are equally important to ensure that the waste can enter the collection systems.

The solution: The World Bank is currently planning a US\$ 200 million project in partnership with Indonesia’s Ministry of Marine Affairs (MMAF) and Fisheries and Ministry of National Development Planning (BAPPENAS). Called Oceans for Prosperity (LAUTRA) Phase 1, its objective is to improve management of fisheries and coastal ecosystems in target fisheries management areas and to improve the livelihoods of target coastal communities. In support of this, they are funding a US\$ 150,000 pre-feasibility study on management, retrieval and recycling of used and ALDFG, and inventory of plastic use and loss from aquaculture in Indonesia. This pre-feasibility has the following seven tasks:

1. Analysis of ongoing net recycling pilot in Pekalongan, Java
2. Baseline of ALDFG volumes and replenishment rates, key actors and systems
3. Techno-Economic pre-feasibility study for a used and ghost gear repair, retrieval and recycling value chain
4. Inventory on plastic use in aquaculture, including seaweed culture
5. Development of an ALDFG and Aquaculture Plastic Action Plan
6. Extrapolate the results of the ALDFG analysis and the plastic use in aquaculture to a national scale
7. Determination of an indicator and implementation of a protocol to measure decrease in sea-based plastic aquatic debris

The lessons: This project, which will be conducted over 2020–2021, shows how a holistic, integrated approach to including the ALDFG into both fisheries and plastic waste management can be identified with a relatively low budget.

Source: World Bank Terms of Reference

4.14 MUNICIPALITY COUNCILS AND AUTHORITIES

4.14.1 PRINCIPLES OF BEST PRACTICE

<p>Although cities and municipalities are relatively new to the ALDFG discussion, there are significant ways for them to engage, particularly in coastal communities with local fishing fleets. Depending on the country/region, fishing fleets are often intimately intertwined with the cities, towns and municipalities in which they are located.</p> <p>Primary engagement opportunities will vary by region, but include awareness raising and education (both for local fishers and the public), support for local port reception facilities and/or retrieval/recycling initiatives, and encouraging preparedness for extreme weather (i.e., retrieving deployed gear ahead of extreme weather events).</p>	Approach	Principles
	Prevention	<ul style="list-style-type: none">Local fishers and members of the public are educated about the ghost gear issue.Support access to end-of-life retrieval and recycling systems at local fishing ports where appropriate/feasible.Liaise with local fishing ports to promote gear retrieval ahead of extreme weather events.
	Mitigation	<ul style="list-style-type: none">Promote reporting of ALDFG by local fishers and the community via the GGGI Ghost Gear Reporter App.
	Remediation	<ul style="list-style-type: none">Support fisher-led gear/debris retrieval programs in accordance with local laws, such as Fishing for Litter.



Photo credit: Shin Arunrugstichai

4.14.2

Approach and Principle		Best Practice	Other participants
Prevention	Local fishers and community members are aware of the ALDFG issue, how it affects their community, and how local fishers can and/or are helping with the issue. Community members feel empowered to do something about the issue in their community.	<ul style="list-style-type: none">Develop ALDFG education/ awareness campaigns in concert with local fishers and community groups, focusing on local solutions.Education campaigns should focus on the ALDFG issue as a whole, as well as local solutions that may also be in place (e.g., other actions in line with the practices outlined in this section).	<ul style="list-style-type: none">Fisheries managers and regulatorsFisheries and aquatic environment researchEnvironment agenciesFisher organizationsPort operatorsSmall-scale fisher communities and other established groupingsFishersNGOs
	Fishers have a viable end-of-life solution for their gear, ideally at no cost to them where feasible. Sufficient port side receptacles for gear exist and a transport system is operational to get the gear from the port to a local recycler or waste disposal facility.	<ul style="list-style-type: none">Support end-of-life gear disposal programs at local fishing ports, potentially providing space for gear to be stored on municipal property if port upland storage is limited or non-existent.Support transportation logistics for local end-of-life gear programs, either to local recyclers (if feasible) or landfill (if not).	<ul style="list-style-type: none">Fisheries managers and regulatorsPort operatorsFisher organizationsSmall-scale fisher communities and other established groupingsFishersLocal waste management
	Fishers are encouraged to retrieve set gear ahead of major weather events to prevent economic losses to them, and environmental harm caused by lost gear.	<ul style="list-style-type: none">Liaise with local fishers and fishing ports to promote retrieval of deployed gear ahead of major weather events to decrease potential gear loss.	<ul style="list-style-type: none">Port operatorsFisher organizationsSmall-scale fisher communities and other established groupingsFishers
Mitigation	Fishers and community members feel empowered to contribute actively to solutions and play a part in gathering and submitting valuable data on the issue.	<ul style="list-style-type: none">Promote reporting of gear loss to the GGGI global data portal to contribute to global data on the issue and inform future solution work.Reporting should be encouraged by both fishers at the time of loss (this can be done anonymously via the Ghost Gear Reporter App) and local community members or clean up organizations, should they come across lost gear either on the shoreline or while on the water.	<ul style="list-style-type: none">Research organizationsFisher organizationsSmall-scale fisher communities and other established groupingsFishersLocal community members and clean up organizationsNGOs

Approach and Principle		Best Practice	Other participants
Remediation	Fishers have a way to dispose of gear/debris they may incidentally bring up their gear and are able to dispose of it at port without incurring cost.	<ul style="list-style-type: none">• Cities can support programs such as Fishing for Litter, which encourages fishers to collect and bring back any debris that they bring up in their gear.• Municipal authorities can raise awareness, provide funding, and help create facilities at ports where collected waste can be properly disposed.	<ul style="list-style-type: none">• Fisheries managers and regulators• Port operators• Fishers• Fisher organizations

Photo credit: Eleanor Church—Lark Rise Pictures



APPENDIX A

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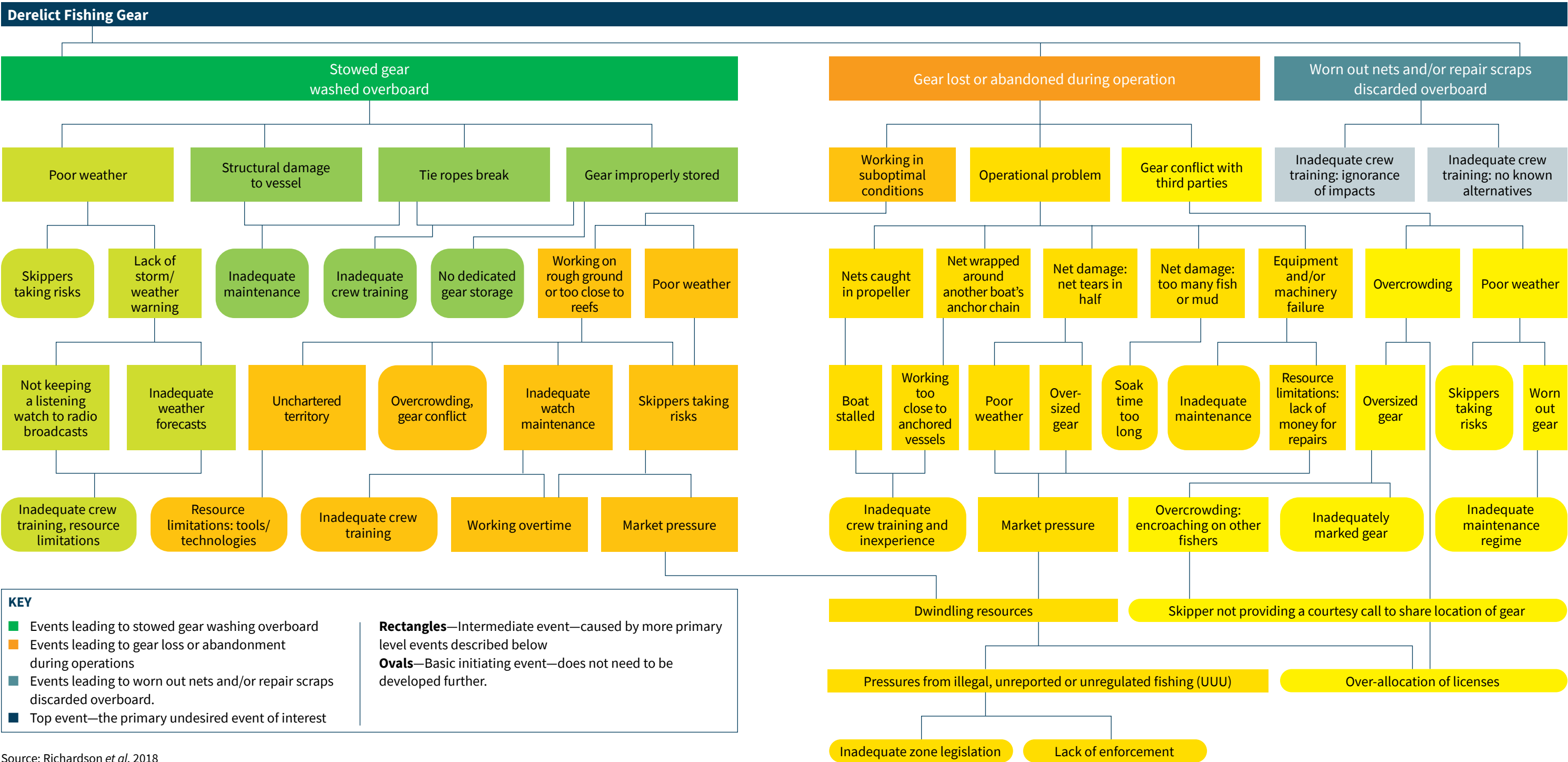
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APPENDIX B

ANALYSIS IDENTIFYING THE CAUSES OF DERELICT FISHING GEAR FROM TRAWL, GILLNET AND PURSE SEINE VESSELS



Source: Richardson *et al*, 2018

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The Global Ghost Gear Initiative is the world's
only cross-sectoral alliance dedicated to
driving solutions to abandoned, lost and
discarded fishing gear globally.

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