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GUIDELINES FOR DEVELOPING PLANS OF ACTION ON MANAGING ABANDONED, LOST AND DISCARDED FISHING GEAR






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Cover photographs
Top row, left to right: sperm whale entangled in a drift gillnet (Alberto Romero, Marine Photobank); artisanal pot mangrove fishing vessel (copyright Eric Gilman, Fisheries Conservation Research Group); decomposed trevally caught in a ghost net (Sijmon de Waal, Marine Photobank). Bottom row, left to right: diver removes tangled fishing net from coral reef (US NOAA Fisheries); derelict gillnet (Frank Baersch, Marine Photobank); derelict lobster pot (US NOAA Fisheries).

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Summary

The adverse ecological and socioeconomic effects from at-sea abandoned, lost and discarded fishing gear (ALDFG)[1] have become increasingly problematic over recent decades. Adverse impacts include: ghost fishing; marine wildlife ingestion; distribution and transfer of toxins and microplastics into marine food webs; and altered distributions and behavior of species that raft on or aggregate beneath floating ALDFG and fishing aids, including the transport of invasive non-native species and distribution of microalgae that cause harmful algal blooms. ALDFG also causes habitat degradation; obstruction and damage to maritime sectors such as from fouling marine vessels and damaging submarine cables and in-use fishing gear; reduction of socioeconomic values of coastal areas, and costs for ALDFG disablement or removal.

The fishery-specific causes of ALDFG occurrence, adverse effects, and robustness of the contemporary management framework determine suitable management strategies. Unintentional and intentional causes for ALDFG production vary between fisheries, and by gear type, region, and scale of fishery. Some causes are globally prevalent, such as the practicality of abandoning and discarding under rudimentary fisheries management systems, and loss during inclement weather. Other causes of ALDFG include severed buoy lines, abrasion of strands of dolly ropes, gear moving position, and theft. ALDFG management strategies can apply a sequential mitigation hierarchy of avoid, minimize, remediate and offset unavoidable ALDFG production and adverse impacts. Management measures include input controls on effort, output controls on catch, measures that reduce ALDFG production rates, methods to reduce ALDFG's adverse impacts, methods that disable or remove ALDFG, and enabling measures that incentivize the employment of ALDFG mitigation methods. The latter includes government- as well as market-based mechanisms, such as certification against the Marine Stewardship Council fisheries standard.

These guidelines provide stakeholders with recommendations on the development of plans of action (POA) on managing the occurrence and adverse effects of abandonment, loss and discarding of fishing gear and aids. POA-ALDFG can contribute to ameliorating this particularly damaging component of marine debris. POA-ALDFG can have local fishery-specific, national-level, to broad regional-level scales. ALDFG Action Plans can assist fishery stakeholders to prepare to meet the more rigorous requirements on ALDFG and ghost fishing under the Marine Stewardship Council's fisheries standard.

These guidelines define criteria on when adoption of an POA-ALDFG is warranted. They review the complementary role and benefits of regional ALDFG plans and summarize intergovernmental organizations' guidance and measures on ALDFG. The guidelines define prescribed contents of a POA-ALDFG. This includes assessments of the enabling environment; compliance with ALDFG monitoring and management measures; causes and underlying drivers of ALDFG production; rates and magnitudes of ALDFG production; and the fate, composition, and impacts of ALDFG. POAs can include a summary of findings from any performance assessments of the ALDFG management

[1] See section 1.4 for a discussion on excluding *Otherwise* from the term abandoned, lost and discarded fishing gear.

strategy. The guidelines' suggested contents for POA-ALDFG include defining the plan's scope, and specific, measurable and timebound objectives, activities and milestones. The guidelines also recommend that POA-ALDFG include recommended activities on: fisheries management framework improvements, assessing ALDFG production rates and levels that employ approaches with the highest possible strength of evidence, identifying the causes of ALDFG production and adverse impacts, evaluating alternative ALDFG management strategies, and scheduling performance assessments and adaptation of the POA-ALDFG. These guidelines include annexes that enable the discovery of ALDFG management approaches that address specific causes for ALDFG production and adverse impacts, describe approaches to estimate ALDFG production rates and magnitudes, and that define priority inputs for evaluating alternative ALDFG management strategies.

These guidelines are designed for application across data-limited to data-rich fisheries, from small-scale to industrial and large-scale fisheries, across gear types, and across the various forms of fisheries management systems.

Acronyms

ABNJ	Areas Beyond National Jurisdiction
AIS	Automatic Identification System
ALDFG	Abandoned, lost and discarded fishing gear
COFI	Committee on Fisheries
EEZ	Exclusive Economic Zone
EPR	Extended Producer Responsibility
FAD	Fish Aggregating Device
FAO	Food and Agriculture Organization of the United Nations
GPS	Global Positioning System
IMO	International Maritime Organization
IUU	Illegal, Unreported and Unregulated (fishing)
MARPOL	International Convention for the Prevention of Pollution from Ships
MSE	Management Strategy Evaluation
NPOA	National Plan of Action
POA	Plan of Action
RFMO	Regional Fisheries Management Organization
RFMA	Regional Fisheries Management Arrangements
RPOA	Regional Plan of Action
UNGA	United Nations General Assembly

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1. Introduction

The adverse ecological and socioeconomic effects from abandoned, lost and discarded fishing gear (ALDFG)[2] have become increasingly problematic over recent decades. This is partly due to the expansion of the global capacity, effort and footprint of marine capture fisheries and the shift to using readily available synthetic, lighter and more durable materials for fishing gear and fishing aids. There is growing recognition of the need for improved understanding and evidence-informed management of ALDFG. The adoption and implementation of effective Plans of Action on managing ALDFG (POA-ALDFG) by stakeholders can contribute to ameliorating this particularly damaging component of marine debris.

ALDFG's components, when leakage occurs from fishing and support vessels at sea, can be defined as follows (adapted from Gilman et al. 2023[3], GESAMP 2021[4] and FAO, 2019[5]):

- **Abandoned**: Fishing gear that has been deployed at sea for fishing over which an operator or owner has control and could retrieve, but deliberately leaves at sea.
- **Lost**: Fishing gear over which an operator or owner has accidentally lost the ability to locate or lacks the capability to recover, and does not recover.
- **Discarded**: Fishing gear that fishers deliberately release into the sea without any attempt for further control or recovery, and do not recover.

1.1. Causes of ALDFG

There are various unintentional as well as intentional causes for fishing gear and aids from marine capture fisheries to be abandoned, lost or discarded at sea. These causes can vary substantially between fisheries, and by gear type, region, and scale of fishery. Some causes are globally prevalent, such as the practicality of abandoning and discarding under rudimentary fisheries management systems, and loss during inclement conditions. Other causes are applicable to only static (passive) or to only mobile (active) gear types, such as severed buoy lines and abrasion of strands of dolly ropes, respectively. Other causes apply only to untended[6] (i.e., gear that the vessel deploys and then leaves the area for a time before returning to retrieve the gear) and passive fishing gear, such as gear moving position and theft.

An understanding of both direct causes and underlying drivers of fishing gear to be abandoned, lost or discarded is critical for identifying effective management strategies. For example, fishing

[2] See section 1.4 for a discussion on excluding *Otherwise* from the term abandoned, lost and discarded fishing gear.
[3] Gilman et al. 2023. Matching fishery-specific drivers of abandoned, lost and discarded fishing gear to relevant interventions. *Marine Policy* 155: 105738
[4] GESAMP. 2021. Sea-based Sources of Marine Litter. GESAMP Working Group 43. International Maritime Organization, London.
[5] FAO. 2019. *Voluntary Guidelines on the Marking of Fishing Gear*. Food and Agriculture Organization of the United Nations, Rome.
[6] Untended gear refers to fishing gear or a fishing aid (such as a drifting fish aggregating device or FAD) that is deployed by a fishing or support vessel and then the vessel leaves the area for a period of time and the gear is left unsupervised by the vessel before the vessel returns to retrieve the gear

during sever weather conditions may be an important direct cause of ALDFG production. Poor access to weather and oceanographic forecasts, adverse economic conditions and a race to fish in derby fisheries are examples of indirect, underlying drivers that explain fishers' decisions to fish during inclement conditions, which can result in their losing or needing to abandon their gear, or cause vessels to sink. Deficits in one or more component of fisheries management frameworks can be important indirect drivers of ALDFG production. The low cost for new netting in some gillnet fisheries can reduce the incentive for fishers to mitigate their ALDFG production. Government subsidies for new gear may reduce incentives to repair or use worn components to repair damaged gear, resulting in gear abandonment and discarding and a reduced incentive to locate gear when it becomes lost. The cost for fuel can affect fishers' decisions on the distance they will travel to retrieve drifting gear. In fisheries where new gear components are expensive, fishers may continue to use worn gear longer, increasing the risk of loss.

1.2. ALDFG Impacts

ALDFG is an especially problematic component of marine debris. The magnitude, fate and composition of ALDFG determine the type and severity of ecological and socioeconomic impacts. Fate refers to where derelict gear occurs during its lifetime, which is determined by whether it initially floats or sinks and whether it moves, which determines which habitat types are impacted. The fate of ALDFG depends on physical properties of the derelict gear and environmental conditions including wind, waves and currents. ALDFG may oscillate in the water column, sinking when biofouling increases in density, then rising after biofouling decreases at depth. ALDFG can be distributed by biota after entangling in or ingesting the debris. Wind and hydrographic features can disperse floating marine debris over vast distances, some of which strands on sensitive coastal and nearshore habitats, and can cause floating debris to concentrate into vast garbage patches within oceanic gyres. ALDFG distribution and fate are affected by changes in ocean circulation, wind strength and direction, formation and persistence of eddies, and storm intensity and frequency in response to climate change. The composition of ALDFG influences the types and degree of impacts. For example, the composition of ALDFG determines whether the debris initially floats or sinks, determining its fate, and many components of gear used in most fisheries are now predominantly made of plastic, which can transfer toxins, metals and microplastics into marine food webs (discussed below).

Adverse ecological and socioeconomic impacts caused by ALDFG, some of which are summarized in Figure 1, include:

- Ghost fishing, where, under certain conditions, derelict gear can catch and kill organisms for years, including commercial and threatened species;
- Distribution and transfer of toxins and nano- and micro-plastics into marine food webs at various trophic levels, from zooplankton to large pelagic fishes, and ingestion of nano- to macro-plastic and other ALDFG components by marine wildlife;
- Altered distributions and behavior of species that raft or aggregate beneath floating ALDFG, potentially causing broad community- and ecosystem-level changes. This includes floating ALDFG transport of invasive alien species and distribution of microalgae that may cause harmful algal blooms;

- Alteration and degradation of coastal and marine habitats;
- Interference with in-use fishing gear and with other maritime sectors including aquaculture, marine mining, submarine cables, and marine vessels such as when lost fishing lines tangle in vessel propellers, creating safety risks at sea;
- Time and expense required to replace lost and abandoned gear that was not yet ready for retirement or repair;
- Reduction of the socioeconomic value of coastal and nearshore areas; and
- Economic costs for remediation, including ALDFG detection, disablement or removal.

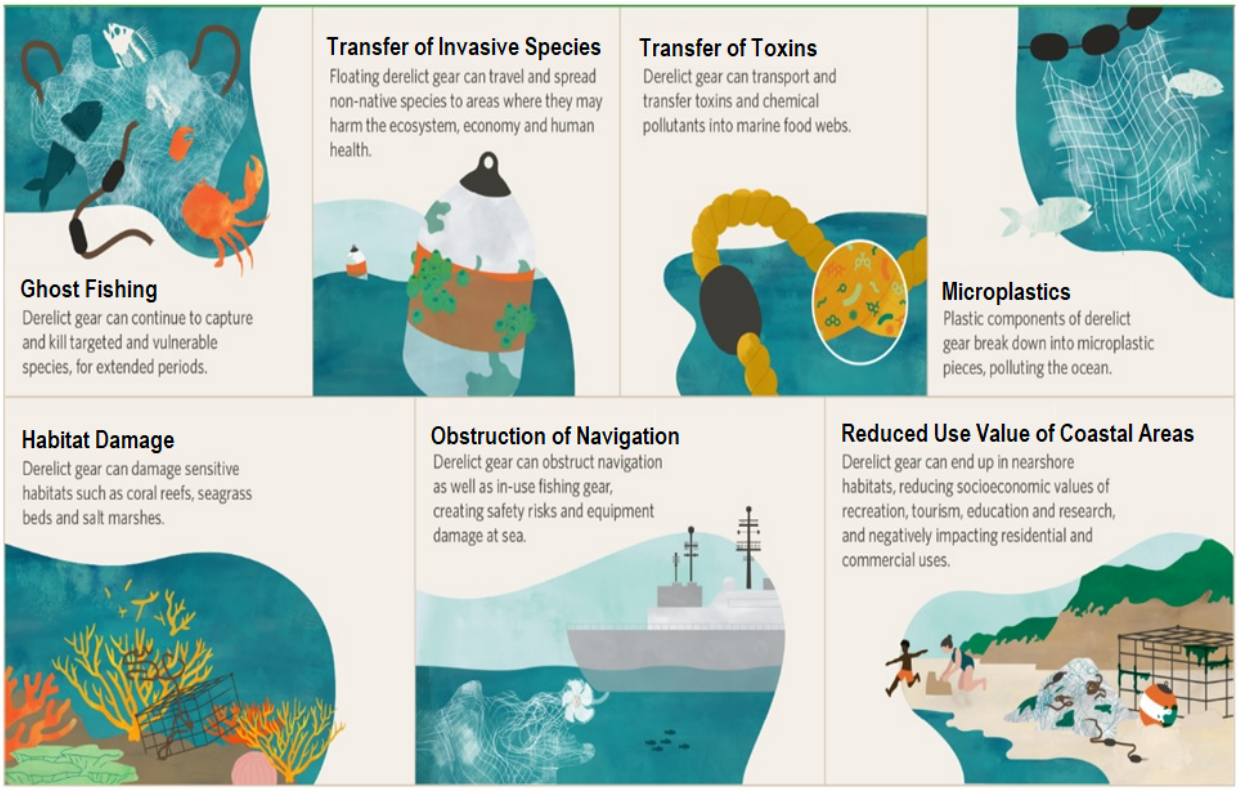

Figure 1. Ecological and socioeconomic adverse impacts caused by ALDFG (figure adapted from Gilman et al.[7] and courtesy of The Nature Conservancy).

ALDFG can also have beneficial impacts. For instance, ALDFG can provide artificial habitat, may provide a meeting point to form and restructure fish schools, and can be repurposed for various applications.

1.3. ALDFG Management Interventions

There are numerous management interventions (i.e., strategies, approaches, methods) to avoid, minimize, remediate and offset ALDFG production and adverse impacts. ALDFG management

[7] Gilman et al. 2023. Introduction to the Marine Policy special issue on abandoned, lost and discarded fishing gear: Causes, magnitude, impacts, mitigation methods and priorities for monitoring and evidence-informed management. *Marine Policy* 155: 105738

measures can be placed into five high-level categories (see Annex 1 for a detailed list of ALDFG management measures):[8]

- Input controls that limit effort and output controls that limit catch that reduce fishing effort will also eliminate or reduce ALDFG production;
- Measures that reduce ALDFG production rates;
- Methods that reduce the adverse effects of ALDFG;
- Methods that disable or remove ALDFG; and
- Enabling measures that incentivize the employment of ALDFG mitigation methods. These can be market-based, such as fisheries certification programs, and government-based, including from command-and-control frameworks of large-scale industrial fisheries and community-based self-governance and co-management frameworks of small-scale fisheries.

1.4. Addressing Common ALDFG-related Misconceptions

Otherwise: The Food and Agriculture Organization of the United Nations (FAO) refers to ALDFG as abandoned, lost or otherwise discarded fishing gear. Here we intentionally exclude the word otherwise. Including otherwise might incorrectly suggest that the terms abandoned and lost are types of discarded gear. Furthermore, the term otherwise might incorrectly be interpreted to mean that fishing gear that is abandoned, lost and discarded at sea are the only three possible sources of derelict fishing gear, which is also not the case, discussed below (e.g., derelict gear leaked from coastal landfills).

Gear marking: Gear marking is frequently prescribed as a 'silver bullet' solution to ALDFG. Fishing gear marking can be a solution in some fisheries.[9] When combined with a robust fisheries management framework, gear marking to identify the owner or last user of ALDFG can reduce ALDFG production. Gear marking to identify ownership can disincentivize deliberate abandonment and discarding, incentivize the retrieval of temporarily lost gear, may make it more difficult to steal gear, and may create an incentive to comply with prescribed report protocols when gear is lost or abandoned. It may also deter illegal fishing, which can be a driver for ALDFG production. Gear marking can also enable supply chain traceability, facilitating Extended Producer Responsibility schemes for fishing gear. Gear marking to improve visibility can reduce accidental loss such as from mobile fishing gear contact with static gear. However, discussed below, the fishery-specific causes of ALDFG production and adverse effects, as well as the robustness of the fisheries and ALDFG management framework need to be considered when evaluating alternative ALDFG management strategies. Gear marking to increase the visibility of passive gear may conflict with some approaches to reduce gear theft and vandalism, including using

[8] GESAMP. 2021. *Sea-based Sources of Marine Litter*. GESAMP Working Group 43. International Maritime Organization, London.
GESAMP. 2022. Legal Aspects of Abandoned, Lost or Otherwise Discarded Fishing Gear. Food and Agriculture Organization of the United Nations, Rome and International Maritime Organization, London.
Gilman et al. 2022. Matching fishery-specific drivers of abandoned, lost and discarded fishing gear to relevant interventions. *Marine Policy* 141: 105097
Ocean Conservancy. 2021. *Best Practice Framework for the Management of Fishing Gear*. Global Ghost Gear Initiative, Ocean Conservancy.

[9] Ibid

submerged buoys and floatlines.[10] In fisheries with rudimentary management systems, gear marking in isolation is unlikely to control ALDFG production.

Fisher ALDFG surveys: Fisher surveys are commonly recommended to estimate causes, rates, and the composition of ALDFG production. Discussed in detail in Annex 3, the relative strength of evidence of alternative methods for producing these estimates should be considered. Due to the unavailability of robust data from independent at-sea fisheries observer and electronic monitoring programs, surveys of fishers and other experts have been the predominant approach to estimate ALDFG production rates and other information. Expert surveys can be a rapid and low-cost approach that for many fisheries may be the only source available of information on ALDFG, including production rates but also causes for leakage and details on the gear components that become abandoned, lost and discarded. However, expert surveys have a relatively high risk of bias and can have both low internal and external validity. Surveys can produce biased data if ALDFG is a highly sensitive issue due to regulatory measures and penalties, reputation risks, and due to several additional sources of bias. There is also a risk that the data collected from survey respondents are not representative of the underlying population that was sampled, such as if there is undercoverage or nonresponse bias, or if the questionnaire design or the way the questionnaire was administered caused biased responses. Structured expert elicitation approaches can improve on simple expert judgement approaches to reduce some of these sources of bias. When possible, more robust, independent approaches, such as at-sea observer and electronic monitoring, should be used.

1.5. Overview of Guidelines for the Preparation of POA-ALDFG

These guidelines provide stakeholders with criteria on when adoption of a POA-ALDFG is warranted. The guidelines review the roles and benefits of regional plans of action on ALDFG, which complement but do not replace national plans. They summarize intergovernmental guidance and measures on ALDFG, including recommendations on gear marking produced by the Food and Agriculture Organization of the United Nations (FAO) and ALDFG recommendations adopted by regional fisheries management organizations (RFMOs).

The guidelines define prescribed contents of a POA-ALDFG. This includes content related to an assessment of the current enabling environment, and identification of deficits and priority improvements. Assessments are suggested to benchmark the contemporary ALDFG management framework components (monitoring, control, surveillance, enforcement, and outcomes of enforcement actions); compliance with ALDFG monitoring and management measures; causes and underlying drivers of ALDFG production; rates and magnitudes of production; and the fate, composition, and ecological and socioeconomic adverse impacts of ALDFG. The contents of POAs can also include a summary of findings from any performance assessments of the ALDFG management strategy. The national plans can include a summary of identified deficits and improvement priorities.

[10] Gilman et al. 2022. Matching fishery-specific drivers of abandoned, lost and discarded fishing gear to relevant interventions. *Marine Policy* 141: 105097

The guidelines provide suggested contents of the POA-ALDFG related to the scope, defining specific and measurable process and outcome objectives; and including specific, measurable and timebound activities and milestones, and identifying the lead and budget for each activity. Suggested contents also include activities on improving fisheries management framework components (monitoring, control, surveillance, enforcement, and outcomes of enforcement actions), activities on assessing ALDFG production rates and levels that employ approaches with the highest possible strength of evidence, activities related to identifying the causes and underlying drivers of ALDFG production and adverse effects, activities to evaluate alternative ALDFG management strategies, and scheduling regular performance assessments of the POA-ALDFG and adaptation of the plan based on the outcomes of the performance assessments.

The guidelines are designed to address shortcomings identified with the design and implementation of the International Plan of Action for the Conservation and Management of Sharks and the International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries.[11] This is accomplished by defining criteria to determine whether a national plan is needed; prescribing the inclusion of specific, measurable and timebound objectives and activities; including outcome objectives when feasible; conducting regular performance assessments and adapting national action plans based on the findings; and clarifying how regional plans of action complement and do not replace the benefits of national plans of action.

These guidelines were informed by a Senegal NPOA-ALDFG prepared through funding from FAO,[12] guidelines for assessments and for developing national plans of action on sea-based, marine, plastic litter developed by the International Maritime Organization (IMO) and FAO,[13] national plans on marine litter developing by applying the aforementioned guidelines,[14] a decision support tool for bycatch management strategy evaluation,[15] publications in the journal Marine Policy[16] and a report by the International Seafood Sustainability Foundation on inputs fisheries multispecies bycatch management strategy evaluation.[17]

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[11] Good S et al. 2020. National Plans of Action (NPOAs) for reducing seabird bycatch: Developing best practice for assessing and managing fisheries impacts. *Biological Conservation*, 247: 108592

Gilman E et al. 2023. Global governance guard rails for sharks: Progress towards implementing the United Nations international plan of action. *Fish and Fisheries* 25: 1-17.

[12] MFME. 2022. *National Action Plan to Compat Abandoned, Lost and Discarded Fishing Gear, Lost or Discarded at Sea*. Ministry of Fisheries and Maritime Economy, Republic of Senegal.

[13] IMO and FAO. 2023. *Guidance Document on the Country Status Assessment on Sea-Based Marine Plastic Litter*. Prepared by E. Kleverlaan. GloLitter Partnerships. International Maritime Organization, London, and Food and Agriculture Organization of the United Nations, Rome.

IMO and FAO. 2023. *Guidance Document on Developing a National Action Plan on Sea-Based Marine Plastic Litter*. Prepared by E. Kleverlaan. GloLitter Partnerships. International Maritime Organization, London, and Food and Agriculture Organization of the United Nations, Rome.

[14] Available from the GloLitter Partnerships' (a project of the Government of Norway, IMO and FAO aiming to reduce marine litter) online library: https://glolitter.imo.org/resources.

[15] Gilman E et al. 2022. A decision support tool for integrated fisheries bycatch management. *Reviews in Fish Biology and Fisheries* 32: 441-472.

[16] *Marine Policy* special issue on abandoned, list and discarded fishing gear: https://www.sciencedirect.com/special-issue/10FBTP152M7.

Gilman E et al. 2022. Matching fishery-specific drivers of abandoned, lost and discarded fishing gear to relevant interventions. *Mar Policy* 141: DOI: 10.1016/j.marpol.2022.105097

[17] ISSF. *Inputs for Multispecies Bycatch Management Strategy Evaluation*. ISSF Report 2024-04. International Seafood Sustainability Foundation, Pittsburgh, PA, USA.

The guidelines include six annexes. These summarize ALDFG management approaches in Annex 1, direct causes and underlying drivers for ALDFG production and adverse effects in Annex 2, and Annex 3 describes approaches to estimate ALDFG production rates and magnitudes and the relative strength of evidence of alternative approaches. Annex 4 summarizes key inputs for evaluating alternative ALDFG management strategies. There are four criteria related to the fishery-specific context, and there are nine criteria for evaluating individual ALDFG management interventions. Annex 5 contains a template national plan of action on marine plastic litter included in the IMO and FAO guidelines. Finally, Annex 6 summarizes intergovernmental organizations' guidance and recommendations on ALDFG.

The scope of the guidelines includes ALDFG from marine capture fisheries, including ash from onboard incineration of unwanted/end-of-life fishing gear, as well as abandoned, lost and discarded fishing aides, such as derelict satellite and radio buoys, and derelict anchored and drifting fish aggregating devices (FADs).[18] The scope excludes: (1) derelict fishing gear that enters oceans from sources other than fishing and support vessels, such as from fishing harbors, seaports, and coastal landfills; (2) non-gear marine debris and liquid wastes leaked from fishing vessels into the sea; (3) marine debris derived from aquaculture and ranching sectors; and (4) other forms of marine pollution from fishing and other vessels, including light and noise pollution.

These guidelines can be adapted to be applied at a narrow scale for fishery-specific ALDFG management, at a national-level (i.e., NPOA-ALDFG), and at a nested-scale for regional ALDFG management. The guidelines are designed for application across data-limited to data-rich fisheries, from artisanal/small-scale to industrial/large scale fisheries, and across gear types. And, the guidelines are designed for use across the various forms of fisheries management systems, ranging from government command-and-control frameworks with input and output controls typical of data-rich, large-scale fisheries, to informal community-based self-governance and co-management frameworks with territorial use rights and indicator-based rules typical of data-limited, small-scale fisheries.

[18] FAO. 2018. *Stakeholder Views on Methods to Identify Ownership and Track the Position of Drifting Fish Aggregating Devices Used by Tuna Purse Seine Fisheries with Reference to FAO's Draft Guidelines on the Marking of Fishing Gear*. FAO Fisheries Circular 1163. By: Gilman E, Bigler B, Muller B, et al. Food and Agriculture Organization of the United Nations, Rome. https://www.fao.org/3/BU653en/bu653en.pdf
FAO. 2019. *Voluntary Guidelines on the Marking of Fishing Gear*. ISBN 978-92-5-131312-1. Food and Agriculture Organization of the United Nations, Rome.

2. Criteria Warranting Preparation of a POA-ALDFG

2.1. Assessments and Criteria for POA-ALDFG Adoption

Criteria are provided to enable stakeholders to determine whether preparation of a POA-ALDFG is warranted. To obtain the minimum information needed to evaluate these criteria, it is recommended that stakeholders conduct assessments to determine:

- Rates and magnitudes of ALDFG production;
- The fate and composition of ALDFG;
- The ecological and socioeconomic adverse impacts of ALDFG;
- Direct causes and underlying drivers of ALDFG production and adverse impacts; and
- The robustness of each component of the ALDFG governance framework, including whether there is systematic non-compliance with ALDFG monitoring and management measures.

If a stakeholder prepares a national plan, these assessments are also recommended to produce the evidence needed to inform how stakeholder's design their POA-ALDFG, summarized in Section 3.1.

Table 1 summarizes the suite of criteria to support stakeholders in determining whether preparation of a POA-ALDFG is warranted. The suite includes criteria that are suitable across the continuum of data-limited to data-rich fisheries. The first two criteria in Table 1 can be applied for fisheries lacking information from the assessments suggested above, where stakeholders can base decisions on preparing a POA-ALDFG employing a precautionary approach based on gear-specific relative risks and, if available, augmented with information on whether problematic ALDFG is systematically leaked by a fishery. The third criterion is suitable for fisheries with direct information on the rates and amount of leaked ALDFG, and the fate and composition of ALDFG, but that lacks direct evidence of adverse impacts. The final two criteria are for data-rich fisheries with direct information on the degree of adverse ecological and socioeconomic impacts caused by ALDFG, and with evidence from assessments on the performance of the ALDFG management framework.

The criteria do not attempt to define quantitative, measurable thresholds of limit or target reference points of the effects of ALDFG. In some cases, target and limit thresholds for unacceptable impacts may be defined. For example, stocks with comprehensive harvest strategies aim to maintain a stock's biomass above a biological limit reference point and near a target threshold, where the latter might be defined based on achieving an agreed balance of biological and socioeconomic objectives. Similarly, limits of accepted impact have been defined for marine megafauna based on demographic parameters with a range of data requirements and concomitant range in certainty in outcomes And, thresholds have been defined for impacts to vulnerable marine ecosystems. However, for most ALDFG adverse impacts, explicit, quantitative

cutoffs have not been defined and will require assessments to determine whether impacts warrant the production of a POA-ALDFG.

Findings from semi-quantitative and more robust, model-based, quantitative ecological risk assessments that estimate relative and absolute impacts, respectively, can be helpful for impacts of ALDFG lacking defined thresholds.

Table 1. Criteria to support stakeholders to determine whether preparation of a POA-ALDFG is warranted, suitable across the continuum of data-limited to data-rich fisheries.

Criterion	Description
A high-risk gear type is used	One or more fishery employs a gear type that is predicted to have a high relative risk of causing adverse ecological or socioeconomic impacts.
A high-risk gear type is used that systematically leaks problematic ALDFG	A gear type with a high relative risk of causing adverse impacts is used in one or more fishery and there is evidence that the production of ALDFG regularly occurs and causes adverse ecological or socioeconomic impacts.
There is evidence of a large magnitude of ALDFG production with problematic fate and composition	Lacking direct information on the impacts of ALDFG, monitoring systems produce estimates of the rate of production, fate and composition of ALDFG that indicate that there is a high risk of causing one or more adverse ecological or socioeconomic impact.
Evidence of adverse impacts from ALDFG	There is evidence that ALDFG from one or more fishery causes unacceptable levels of ecological or socioeconomic impacts.
Findings from a performance assessment indicate that the ALDFG management framework has not met objectives on acceptable levels of risks or impacts from ALDFG	An assessment of the ALDFG management framework determined that objectives have not been met, including process objectives related to the risk of adverse impacts from ALDFG or, if defined and adopted, outcome objectives on limit reference points for unacceptable impacts from ALDFG.

For data-deficient fisheries, stakeholders can conduct assessments against the following criterion: Do fisheries employ one or more gear type predicted to have a high relative risk of causing adverse ecological or socioeconomic impacts? Gilman et al. (2021)[19] assessed global gear-specific relative risks from ALDFG resulting in a rank-order of fishing gear types based on each gear type's ALDFG production rate, magnitude of the gear that is in use globally estimated from indicators of catch weight and fishing grounds area, and adverse consequences. On a global scale, the five highest-risk gear types with scores in the 75% quantile and above (RR > 0.70) were, from highest risk: set and fixed gillnet and trammel net, drift gillnet, tuna purse seine using drifting and anchored FADs, bottom trawl and pole-and-line using anchored FADs. The five least-concern, lowest-risk gear types on a global scale, with scores in the 25% quantile and below (RR < 0.43) were: beach seine, demersal longline, troll, non-tuna purse seine, and miscellaneous (hand dredge, harpoon, etc.). As a precautionary approach, lacking information on the rates, levels, fate, composition and adverse impacts of ALDFG leaked by a fishery, when a high relative risk gear type is used, a POA can implement actions to fill these information deficits as well as

[19] Gilman E et al. 2021. Highest risk abandoned, lost and discarded fishing gear. *Scientific Reports* doi: 10.1038/s41598-021-86123-3

identify causes of ALDFG leakage and adverse impacts and establish or augment the ALDFG management framework to mitigate these causes.

A more robust approach for data-limited fisheries to estimate the local risk from ALDFG can be made if quantitative or qualitative information is available on whether problematic ALDFG is systematically leaked by a fishery. For example, evidence that a proportion of anchored FADs break from their moorings and strand in sensitive coastal habitats each year would be qualitative evidence to inform a decision on preparing a POA.

2.2. Roles of Regional Plans of Action on ALDFG

Regional Plans of Action (RPOAs) on ALDFG can complement but do not replace the need for national-level ALDFG plans. RPOAs can assist States to plan, coordinate and harmonize regional-level ALDFG assessment and management activities. The FAO International Plans of Action on sharks and seabirds have been criticized for not providing guidance on the role of RPOAs, where the existence of a regional plan might influence States to decide not to consider developing an NPOA.[20]

For example, none of the countries covered by the European Union's RPOA-sharks have NPOA-sharks. Some RPOA-sharks explicitly state that they do not eliminate the need for national plans. For instance, the Pacific Islands RPOA-sharks states that, "The development of an RPOA…does not remove the necessity for the PICTs [Pacific Island countries and territories] to undertake national assessments of their…fisheries as a basis for deciding whether…an NPOA should be developed."[21] The Mediterranean Sea RPOA-sharks similarly encourages individual States to adopt NPOAs.[22]

[20] Good S et al. 2020. National Plans of Action (NPOAs) for reducing seabird bycatch: Developing best practice for assessing and managing fisheries impacts. *Biological Conservation*, 247: 108592;
Gilman E et al. 2023. Global governance guard rails for sharks: Progress towards implementing the United Nations international plan of action. *Fish and Fisheries* 25: 1-17.

[21] Lack M, Meere F. 2009. *Pacific islands regional plan of action for sharks: Guidance for Pacific island countries and territories on the conservation and management of sharks*. Pacific Islands Forum Fisheries Agency, Secretariat of the Pacific Community, and Secretariat of the Pacific Regional Environment Programme.

[22] UNEP. 2003. *Action plan for the conservation of cartilaginous fishes (Chondrichthyans) in the Mediterranean Sea*. Regional Activity Center for Specially Protected Areas, United Nations Environment Programme.

3. Contents of POA-ALDFG

3.1. Outline of a Suggested POA-ALDFG

Template outlines for the recommended contents of a 'Background Assessment' and POA-ALDFG follow. Sections 3.2 and 3.3 contain details for the prescribed contents.

1. Background Assessment
   1.1. Criteria that were assessed and assessment results that informed stakeholders whether an POA-ALDFG was warranted
   1.2. Description of fisheries included in the scope of the plan
   1.3. Causes, rates, levels, fate, composition and ecological and socioeconomic impacts of ALDFG from individual fisheries
   1.4. ALDFG management framework: frameworks for monitoring, control (laws, regulations, policies, and fishing license terms), surveillance, enforcement, and outcomes of enforcement actions (i.e., penalties applied by the government in response to identified infractions)
   1.5. Market-based mechanisms that incentivize voluntary industry implementation of ALDFG management measures
   1.6. Evidence on compliance with ALDFG monitoring requirements and ALDFG management measures
   1.7. Outcome of ALDFG Management Strategy Evaluation (if conducted): Short-list of ALDFG management interventions, ranked by stakeholders based on the: (i) predicted efficacy in addressing the causes of ALDFG production, (ii) likelihood of compliance given the enabling environment and the effect of fisher behavior on efficacy, and (iii) acceptable level of economic and practicality costs, and any costs to crew safety.

2. POA-ALDFG
   2.1. Scope: subset of marine litter, covered fisheries
   2.2. Specific, measurable objectives, including process, impact and outcome objectives
   2.3. ALDFG management strategy evaluation – if not already conducted
   2.4. ALDFG management measures: ALDFG management measures selected for inclusion in the action plan, based on the outcomes of an ALDFG management strategy evaluation process
   2.5. Specific, measurable and timebound activities and milestones designed to achieve the objectives. For each activity define the lead, budget, source of funding and tactical details (the process for implementation). Categories of activities that might be included follow:
      2.5.1. Activities to address identified deficits with the fisheries management framework – including: monitoring, control (including ALDFG management measures – including avoidance, minimization and remediation mitigation methods – that were selected from the management strategy evaluation process), surveillance, enforcement and outcomes of enforcement actions

2.5.2. Activities to produce robust estimates of rates and levels of ALDFG, and the composition of ALDFG
2.5.3. Activities to identify causes and underlying drivers of ALDFG occurrence
2.5.4. Activities to determine the fate (where the derelict gear ends up and for how long) and ecological and socioeconomic impacts of ALDFG
2.5.5. Capacity-building, outreach, and other research areas
2.5.6. Identify strategies to reduce potential risks and obstacles to implementation
2.5.7. Independent performance assessments and adaptive management

3.2. Assessment, Identification of Deficits and Priority Improvements

POA-ALDFGs should include a background section that describes the covered marine capture fisheries, the enabling environment for ALDFG management, and a summary of the current state of known ALDFG causes, rates, levels, fate, composition and impacts. This includes descriptions of:

- Information on each fishery that is within the POA scope, including: the recent number of active vessels and the number of fishers, vessel and equipment characteristics, characteristics of the fishing community, identification of local to intergovernmental management authorities, the number and distribution of landing sites, gear designs, fishing methods including the spatiotemporal distribution of effort, recent annual effort, recent annual magnitude of retained and discarded catch, catch composition, principal market species and seafood products, main end markets, and economic annual ex-vessel yield;
- Causes and underlying drivers of ALDFG production and adverse effects;
- Rates and magnitudes of production of ALDFG;
- The fate and composition of leaked ALDFG;
- Ecological and socioeconomic adverse impacts of ALDFG;
- The contemporary ALDFG monitoring, legal, regulatory, policy, surveillance and enforcement frameworks, including community-based self-governance and co-management frameworks and government command-and-control frameworks;
- Market-based mechanisms with a nexus to fishery practices that affect ALDFG production, adverse effects and management; and
- Compliance with ALDFG monitoring requirements and ALDFG management measures.

The fisheries that are within the POA's scope should be defined in the background section. For example, the scope of an NPOA-ALDFG should include fisheries that occur within the State's exclusive economic zone (EEZ), which might include fishing vessels flagged to the State as well as flagged to foreign nations. The scope of covered fisheries of an NPOA could also include fisheries with vessels flagged to the State that fish in areas beyond national jurisdiction (ABNJ - i.e., the high seas). The NPOA scope might also be defined to include vessels flagged to the State that fish in other States' EEZs, especially if those foreign EEZs are not covered by an NPOA-ALDFG of the coastal State.

The contents of POAs can also include a summary of findings from any performance assessments of the ALDFG management strategy. This suggested background section of POAs can also include a summary of the identified deficits, including information gaps, and improvement priorities.

If the stakeholders conducted ALDFG management strategy evaluation (MSE) prior to developing the action plan, then the background section of the POA-ALDFG should describe the employed MSE process. Alternatively, if stakeholders have not conducted an MSE process, then an ALDFG MSE process should be included as a future planned activity as part of the action plan. Annex 4 defines key inputs for an ALDFG MSE process. MSE simulates the likely performance as well as tradeoffs of alternative ALDFG management strategies against a POA's agreed objectives, and can be designed to account for the effects of uncertainty. The MSE process can help clarify ALDFG management objectives because objectives might become clearer as stakeholders identify tradeoffs through the MSE simulation process. The MSE process includes ongoing, continual discussions with stakeholders on the scope, objectives and management measures and adaptation over time.

3.3. Scope, Objectives, Activities, Milestones, Performance Assessments, Adaptation

3.3.1. POA Scope

The POA-ALDFG should define the scope of the plan. This includes the definition of the subset of marine debris covered by the scope of POAs as suggested in the introduction of covering ALDFG from marine capture fisheries, including ash from onboard incineration of unwanted/end-of-life fishing gear, as well as abandoned, lost and discarded fishing aides.

NPOA-ALDFG can have a scope of ALDFG leaked from fisheries under the State's jurisdiction, and might also include ALDFG that is leaked from foreign fisheries operating outside of the State's EEZ and that subsequently drift into the State's EEZ. The definition of the plan's scope should also specify whether ALDFG leaked from foreign flagged vessels that illegally fish within the State's EEZ are included, although it might be challenging to identify the illegal source fisheries that produced the ALDFG.

These guidelines can be adapted to be applied at a narrow scale for fishery-specific ALDFG management (i.e., a fishery plan of action), for all national fisheries (i.e., an NPOA-ALDFG), and at a broad, nested-scale to manage ALDFG by regional fisheries (i.e., a regional plan of action or RPOA-ALDFG).

3.3.2. Objectives

POA-ALDFG should define specific, measurable and timebound process, impact and outcome objectives. Table 2 defines these three categories of objectives and provides illustrative examples. The approach to assess and select objectives for the action plan can be implemented

as part of the MSE process (Annex 4). Objectives should have specific, measurable and timebound definitions. For example, a process objective of having all vessels of a pot fishery employ biodegradable escape panels by a specified date is specific, measurable and would support a performance assessment. Objectives such as employing gear marking to identify ownership, increasing awareness of the adverse effects of ALDFG, and reducing ALDFG production lack specificity and are not measurable as they are subject to variable interpretations and do not define quantitative outcome, and are not timebound.

The POA-ALDFG objectives can define the desired balance between economic, practicality and safety costs and the ecological and socioeconomic benefits derived from avoiding, minimizing and remediating ALDFG production and adverse effects from implementation of the selected ALDFG management strategy. Participatory tools can assist stakeholders to balance competing objectives of managing ALDFG, where different interest groups place disparate importance on economic, social and ecological objectives (i.e., the triple-bottom-line). For example, conjoint analysis and choice-based survey approaches, used predominantly in marketing and business, assess consumer preferences among alternative products, services or features by having respondents rank them according to their trade-offs. These approaches have been employed in fisheries applications to understand fisher behavior and to weight objectives. Multi-Criterion Decision Analysis is a similar approach that has been used to rank alternative bycatch policy interventions.

Table 2. Definitions of three categories of objectives and ALDFG-relevant examples.

Objective category	Definition	Examples
Process	Identify an activity, process or program that does not have a direct nexus to causing a change in conservation status.	Establish a program by a specified date that retrieves derelict gear at sea before it strands on sensitive coastal habitats. Convene a meeting by a specified date to discuss alternative ALDFG management approaches. Develop a training program by a specified date for fisheries observers to improve their recording of ALDFG leakage events. Conduct research by a specified date to identify the habitat impacts of stranded ALDFG. Require all fishing gear to be marked to identify the owner by a specified date.
Impact	Specify a process or performance of an ALDFG management strategy that is indirectly related to an end-result outcome on conservation status.	Reduce the magnitude of ghost fishing mortalities of an endangered species by a specified percent from a baseline level by a specified date. Reduce the number of lost pots in a fishery by a specified percent from a baseline level by a specified date.
Outcome	Define a response from an ALDFG management strategy on the conservation status of a population, stock, species, multispecies, habitat or ecosystem.	Achieving the aims of a stock-level harvest strategy to maintain a stock's biomass above a biological limit reference point and near a target threshold, or similarly to achieve objectives of multispecies- or ecosystem-level harvest strategies.

What is considered an acceptable effect of ALDFG management measures on economic viability (i.e., the effect on the ability to remain financially sound) will vary substantially between fisheries. In general, small-scale fisheries may have limited or no economic surplus to accommodate increased economic costs. For these fisheries, if the catch sector is expected to cover costs for ALDFG management activities, then this will constrain options, as well reduce the likelihood of adoption and uptake. If other stakeholders are to cover initial and ongoing economic costs, then a wider range of options becomes feasible.

3.3.3. Activities and Milestones

POA-ALDFG are recommended to include specific, measurable and timebound activities and milestones. The plan also recommends identifying the lead, budget and source of funding for each activity. The plan should also explain how each activity will contribute to achieving an objective.

POAs are recommended to include activities that:

- Improve components of the fisheries management framework, including monitoring, control, surveillance, enforcement and outcomes of enforcement actions.
- Strengthen market-based mechanisms for ALDFG monitoring and management.
- Assess production rates and levels that employ approaches with the highest possible strength of evidence – including assessments that are conducted to ascertain the certainty and validate qualitative estimates derived from approaches such as expert elicitation surveys.
- Identify causes and underlying drivers of ALDFG production and adverse effects.
- Identify the fate, composition and adverse ecological and socioeconomic impacts of ALDFG.

An ALDFG MSE process (see Annex 4) could be conducted as part of the assessment phase to develop the plan, or otherwise could be included as an activity in the POA. The POA should also have a tactical component that details the process for implementing the actions. The POA might also include activities that are broadly applicable to fisheries management improvements that also address ALDFG deficits. This includes, for example, activities on capacity-building, outreach, research, monitoring, legal and regulatory frameworks, surveillance and enforcement.

3.3.4. Strategies to Overcome Potential Obstacles to Plan Implementation

The POA-ALDFG can identify potential risks and obstacles to successful implementation, and identify strategies that will be implemented to reduce these risks and to attempt to overcome these obstacles.

3.3.5. Performance Assessments and Adaptive Management

POA-ALDFG are recommended to include regularly scheduled, independent (third or otherwise second-party) performance assessments and ongoing adaptation of the ALDFG management strategy based on findings from the performance assessments. The POAs should document the process for these independent performance assessments. The performance assessments should be conducted against the specific, measurable and timebound objectives, activities and milestones. The assessments should identify challenges in POA implementation and recommend how the ALDFG management strategy be adapted to overcome those identified challenges.

The POA-ALDFG should also be periodically amended when there are, for example, changes in fisheries that affect causes of ALDFG production and adverse effects, new information from monitoring and research programs, development of new technologies for ALDFG mitigation, and the adoption of new national or regional ALDFG management measures. Stakeholders may also change their overarching objectives for ALDFG management and for balancing tradeoffs, warranting adaptation to the POA-ALDFG and ALDFG management strategy.

Annex 1. ALDFG Management Measures

Table A1.1 identifies categories of methods for mitigating at-sea abandoned, lost and discarded fishing gear (ALDFG) and enabling measures that provide incentives to implement ALDFG mitigation methods, illustrative theoretical and empirical (observed, real-world) examples, and in some cases provides details on the definition of the method.

Table A1.1. ALDFG mitigation and enabling interventions and illustrative empirical and theoretical examples. Methods with an asterisk are approaches that would be used specifically for ALDFG management, while other approaches could be employed for broader applications. Some examples include footnotes with references; see [23] for a full list of references.

Mitigation and Enabling Methods	Examples
Area-based fisheries management tools - static and dynamic time-area restrictions	* Zoning to spatially or temporally separate gear types to avoid gear conflicts (e.g., passive gear being towed away by mobile gear) that result in gear loss. For example, in Devon, UK, a voluntary Inshore Potting Agreement designates areas for exclusive use by static or towed gear use, and for seasonal separation of static and towed gear use. * Zoning to avoid marine vessels from towing away fishing gear, severing marker buoys and buoy lines, etc. (and to minimize in-use and derelict fishing gear from obstructing navigation). * Closed fishing areas where there is high risk of gear snagging on seabed features, debris and infrastructure (e.g., offshore oil and gas pipelines and wellheads, and submarine cables). * Closed areas for anchored FADs determined to be a high risk of loss due to unsuitable oceanographic conditions. * Closed areas for deployment of drifting FADs identified as hotspots for grounding and abandonment (via deactivation of attached satellite buoys).[24] * Restrictions on fishing depths of fleets of gillnets and pots to reduce risk of loss and increase likelihood of recovery if temporarily lost. * Restrictions on fishing during inclement weather (threshold current, sea state, presence of sea ice).

[23] Gilman et al. 2022. Matching fishery-specific drivers of abandoned, lost and discarded fishing gear to relevant interventions. *Marine Policy* 141: doi: 10.1016/j.marpol.2022.105097
GESAMP. 2021. *Sea-based Sources of Marine Litter*. GESAMP Working Group 43. International Maritime Organization, London.
GESAMP. 2022. Legal Aspects of Abandoned, Lost or Otherwise Discarded Fishing Gear. Food and Agriculture Organization of the United Nations, Rome and International Maritime Organization, London.

[24] Imzilen T, et al. 2021, Spatial management can significantly reduce dFAD beachings in Indian and Atlantic Ocean tropical tuna purse seine fisheries. *Biological Conservation* 254: 108939.
Escalle L, et al. 2021. *Report on Analyses of the 2016/2021 PNA FAD Tracking Programme*. WCPFC-SC17–2021/MI-IP-04. Western and Central Pacific Fisheries Commission, Kolonia, Federated States of Micronesia.

Mitigation and Enabling Methods	Examples
	* Dissemination of accurate weather forecasts - inform fishery participants of when and where sea conditions pose a risk of gear loss or abandonment, as well as fishing vessel safety.
*Communication within and between fishing fleets on the location of their gear	* Formal or informal systems for fishing fleets operating at the same time and fishing grounds to communicate to enable avoiding gear conflicts that result in gear loss. For instance, in the Netherlands, a phone app allows gillnet fishers to provide trawlers with the location of their gear. * Communication between tuna purse seine fleets on the position of their FADs would increase the ability to retrieve FADs and reduce the risk of loss.[25]
*Limit amount of gear allowed onboard	* Restrict the volume of fishing gear a vessel can possess based on available storage space, including when the fish hold is full * Restrict the amount of fishing gear per vessel based on the amount that can typically be practically retrieved
*Controls on at-sea disposal of debris and infrastructure installation and decommissioning practices	* Prohibitions on the disposal of debris, including from decommissioned oil and gas infrastructure, in areas with a high risk of snagging by demersal fishing gear * Implementation of installation and decommissioning practices for infrastructure, such as for offshore oil and gas, that avoids and minimizes the risk of snagging by demersal, mobile fishing gear, including: (i) burial of pipelines and clearing of clay berms in fishing grounds of demersal mobile gear, and (ii) the removal of small diameter, exposed oil and gas pipelines when decommissioned
Incinerators and compactors	Reduce the onboard storage space required for garbage, including unwanted fishing gear, by using a compactor, as described in Section 2.10 of the MARPOL Annex V implementation guidelines, and by using an incinerator, as described in Section 2.11of the MARPOL Annex V implementation guidelines, and following regulation 16 of MARPOL Annex VI on air pollution criteria. (Note, MARPOL Annex V prohibits the discharge into the sea of ash from shipboard incinerators).
Input and output controls	Restrictions on fishing effort and on catch levels cap the amount and duration of fishing effort, which in turn caps ALDFG risk. * Input controls on the amount of gear that is deployed (e.g., area of gillnet, length of longline, number of FADs) and on soak duration of static gear can reduce the risk that gear becomes lost, especially for unattended passive gear. * Input controls on the duration of fishing trips might reduce the risk that the volume of accumulated worn gear exceeds storage capacity. * Buyback programs reduce or eliminate fishing capacity * Vessel-based limit on the number of drifting FADs with activated satellite buoys, limit on the number of FAD deployments, or limit on the number of FAD tracking buoys purchased annually per vessel. * Catch limits (trip and seasonal, individual and fleet-wide). If exceeding a fleetwide quota triggers a fishery closure, this would eliminate ALDFG while the closure remains in effect.

[25] Moreno G, et al. 2024. *First International Workshop on the Recovery of Fish Aggregating Devices*. *Ad-Hoc* permanent working group on FADs. Inter-American Tropical Tuna Commission, La Jolla, USA.

Mitigation and Enabling Methods	Examples
	* Individual transferable quotas or catch shares can eliminate a race for fish and associated risk-taking behavior that can result in gear loss and abandonment, as well as unsafe conditions. * Required removal of gear, including drifting and anchored FADs, during off seasons and closed periods can reduce the risk of gear abandonment and loss.
Periodic or continual attendance of passive gear	Requiring passive gear to be under frequent or continual observation reduces or avoids loss from the gear moving position, theft, vandalism, vessel strikes, and conflicts with mobile fishing gear.
Change in gear type or fishing strategy	* Change from a gear type with a high ALDFG production rate to one with a low rate, such as from pelagic longline to troll or buoy gear * Change from a gear type whose ALDFG has relatively high adverse ecological and socioeconomic consequences to one with low adverse consequences, such as such as from pots with high ghost fishing efficiency to demersal longlines with low ghost fishing efficiency. * Some fishery bodies have banned the use of gillnets and trammel nets to avoid ghost fishing. * Change from sharing FADs by vessels of a single company to sharing them more broadly, to reduce the risk of producing derelict FADs.[26]
Continuous maintenance of gear and vessel equipment to replace and repair worn gear components and damaged equipment	* Regularly inspect and replace fishing lines when worn to reduce the risk of catch severing the line and escaping with terminal tackle attached * Regularly inspect and repair or replace anchored FAD moorings when worn * Repair and recover damaged drifting FADs that a vessel sets on or otherwise encounters at sea * Regularly inspect and repair or replace malfunctioning vessel equipment, including haulers and gear tracking systems
Deterrence of illegal, unreported and unregulated (IUU) fishing	* Effective IUU deterrents may reduce incentives for abandoning gear in response to the risk of detection. * If unmarked gear is found in areas where it is required to be marked, then authorities can confiscate or disable the IUU gear (e.g., North East Atlantic Fisheries Commission). * Legal, policy, institutional and operational responsibilities of national fisheries management authorities, including coastal, flag and port States, to combat IUU fishing have been defined by binding and voluntary international instruments.
*Gear designs and materials that reduce gear loss	* Knowledge of fishing depth and current speed, and employ appropriate gear designs (e.g., buoy line length) for the environmental conditions * Designs for anchored FAD anchors, moorings and surface buoys have been developed to reduce the risk of loss. * Weak links in some gear designs minimize the proportion of gear that is lost. For example, in bottom trawls, weak links can be incorporated so that lower panels or fragments of the lower panels of the trawl break away when the trawl snags on a bottom feature (on rough seabed or debris) instead of losing the entire trawl net. Weak links can reduce gear loss when large organisms entangle in gear, such as by incorporating a weak link into the float lines of pot and gillnet gear, so that just the floatline is lost instead of an entangled organism moving an entire string of pots or gillnet panels.

[26] ISSF. 2023. *ISSF Workshop on Different Approaches to Limit the Number of FADs in the Oceans*. ISSF Technical Report 2023-03. International Seafood Sustainability Foundation, Pittsburgh

Mitigation and Enabling Methods	Examples
	* Submerged buoys and floatlines reduce the risk of loss from vessel strikes, as well as from theft and vandalism. * Minimizing the number and length of vertical lines in the water column of fixed gear, such as pots and gillnets, reduces whale entanglement risk and concomitant rate of lost gear. * Ropeless traps (eliminate vertical buoy lines) eliminate risk of gear loss from whale entanglement in the buoy lines (improvements in the technology may be needed to increase reliability for retrieval – current ropeless gear technology could exacerbate gear loss, as well as increase costs). * Design drifting FADs to reduce the drift velocity, reducing the risk of drifting outside of fishing grounds.
Gear marking to enable supply chain traceability	Individual gear components have built-in traceability, such as by embedding tracers into ropes or twine, or using color-coded lines, that enables identifying the manufacturer, year of production, type of gear component, etc. This enables retrieved ALDFG to be traced back through the supply chain, which might incentivize manufacturers to use materials that reduce the risk of loss and that reduce ghost fishing efficiency (see record for Extended Producer Responsibility schemes), and might incentivize fishers to not abandoned or discard and comply with requirements to report lost gear.
Gear marking to identify ownership	* Gear marking to identify the owner or last user of ALDFG can create a disincentive for deliberate abandonment and discarding, incentive to retrieve lost gear, may make it more difficult to steal gear, and may create an incentive to report when gear is lost or abandoned. * May deter illegal fishing, which can be a driver for the production of ALDFG. * Marking techniques include: physical marks, color coded lines and twines, coloring with paint, tags, coded wire tags, radio frequency identification tags, Automatic Identification Systems, radio buoys and satellite buoys.
Gear marking to increase passive gear visibility	* Making passive gear visible reduces navigational risks to vessel operators, which can reduce the risk of gear loss from damage by passing vessels and in-use gear. * FAO adopted *Voluntary Guidelines on the Marking of Fishing Gear* in 2019. * Marking techniques include radar reflectors, AIS beacons, high-flyer buoys, flags and lights.
Gear repair systems	* Frydendahl, a Danish net manufacturer, collects damaged nets at seaports, and if repairable, returns the refurbished nets. * Gear manufacturer Cosmos Trawl repairs trawl, seine and other gear types in port.
Gear supply chain traceability system and Extended Producer Responsibility schemes for fishing gear	* Companies in the supply chain of gear components provide for chain-of-custody traceability, documenting the transfer of ownership through the supply chain from manufacturer and assemblers to final point of sale. Retrieved ALDFG can be traced to the fishing vessel that last owned the gear who may have been required to report when it became derelict (but if the gear was subsequently used for fishing by another vessel, such as salvaging the gear after it was properly disposed of on land, derelict gear that was retrieved, or gear that was stolen, then it would not be feasible to identify the last fishing vessel that abandoned, lost or discarded it). * Before 2025, France, Germany and Italy plan to introduce requirements for Extended Producer Responsibility (EPR) schemes for fishing gear components made of plastic. A similar scheme is under consideration in the UK.
Gear technology that increases ghost fishing selectivity of ALDFG from passive gear	* Reducing anchored gillnet mesh size, profile and eliminating or increasing the length of tiedowns reduces marine turtle ghost fishing rates. * Using anchored gillnets with increased net tension might reduce the ghost fishing risk of large marine organisms.

Mitigation and Enabling Methods	Examples
	* Modifying trap entrances (e.g., use of collars, reduced size of the opening) can reduce the risk of entry and capture of threatened species (e.g., pinnipeds, sea otters, terrapins). * Using less- and non-entangling designs of fish aggregating devices may reduce ghost fishing mortalities of sharks, marine turtles and other species.[27]
Gear technology that reduces habitat impacts of ALDFG	Changes in gear designs and materials that reduce habitat damage from ALDFG. * Measures restricting the depth of the appendage, weight or size of drifting FADs can reduce impacts on sensitive coastal habitats when derelict FADs run aground. For example, the Indian Ocean Tuna Commission restricts FAD appendage lengths to 50 m.[28] * Restricting the weight and volume of FADs would reduce the amount per FAD that becomes ALDFG and might reduce habitat impacts
*Management of waste produced when: (1) repairing and making up new gear onboard vessels at sea; (2) preparing gear for storage; and (3) processing offal, spent bait and discards prior to discarding overboard	Manage these 3 sources of waste so that fishing gear does not accidentally get swept or intentionally discarded overboard. * Include procedures in a MARPOL Garbage Management Plan to manage waste produced when repairing and making up new gear * Make receptacles available and conveniently located for practical disposal when crew make up new gear and repair damaged gear * Conduct routine deck cleaning and proper disposal of waste following making up new and repairing old gear * Inspect new gear prior to first use to remove and properly dispose of any loose fragments * Remove all gear from dead catch, offal and spent bait prior to discarding
More durable gear components	While less durable and biodegradable gear may be an appropriate solution to reducing the production and adverse effects of ALDFG in some fisheries and gear types, in other cases more durable gear components might be appropriate (however noting that some more durable fishing gear components may have a longer duration of ghost fishing efficiency). For example: * Materials that reduce rates of breaking moorings, such as for anchored FADs * More durable buoys and floatlines to reduce the risk of loss from vessel strikes * Reduce the risk of gear loss from catch escaping with gear attached (resulting in increased catch rates of those species) such as using wire and multifilament for branchline leaders to reduce bite-off rates
Prohibitions on the use of hazardous materials (e.g., lead, copper coating and other antifouling agents) in fishing gear components	Banning the use of hazardous materials in fishing gear to reduce the dispersal and transfer of toxins derived from ALDFG into marine food webs, and risk of ingestion of toxic components of ALDFG. * Danish Statutory Order no. 856 (2009) prohibits the import and sale of products containing lead, including for commercial and recreational fishing gear and equipment.
Secure stowing of gear onboard	Stow gear onboard in a manner that reduces risks of being swept overboard during rough conditions

[27] ISSF. 2019, ISSF Guide to Non-entangling FADs. International Seafood Sustainability Foundation, Washington, D.C., USA.
[28] IOTC. 2024. *Resolution 24/02 on Management of Drifting Fish Aggregating Devices (FADs) in the IOTC Area of Competence*. Indian Ocean Tuna Commission, Mahe, Seychelles.

Mitigation and Enabling Methods	Examples
Reduce health risks from stowed gear with biofouling	Find safe methods for storing fishing gear with biofouling, including ALDFG retrieved at sea, to reduce health risks to crew, in order to reduce a cause for abandoning gear and a reason for not retrieving ALDFG
Technology to reduce unwanted gear contact with the seabed	Use of Global Positioning System (GPS), seabed mapping and other technology reduces the likelihood of gear loss from contact with the seabed.
Technology to track gear position	* Active pingers (transponders) and passive reflectors are the two main types of acoustic technology to locate fishing gear. * Marking static gear with Automatic Identification System (AIS) beacons, in addition to tracking the position of the gear and relocating temporarily lost gear, allows fishers to detect when other vessels are approaching their gear so that they can attempt to avoid collision with their gear * Satellite buoys attached by fishers to drifting FADs enable real-time tracking of position * Small geo-locating buoys attached to drifting FADs provide positional data, even after fishers deactivate an attached satellite buoy * Radio buoys attached to pelagic longlines enable real-time tracking of position * Buoys enable visual tracking of passive gear position. Submerged buoys reduce the risk of loss from passing vessels and towed gear, and from theft.
Training, outreach and education for new entrants and periodic refreshers	Providing training, education and outreach opportunities for new entrants to fisheries, and periodic refresher training, can increase or develop a conservation ethic, incentivizing fishers' use of best practice ALDFG mitigation methods that increase fishers' capacity to employ current best practice mitigation methods, augment their ability to recover gear when temporarily lost or abandoned, and use gear designs and methods that avoid and reduce adverse consequences of ALDFG. * More experienced Indian gillnet and trammel net fishers had lower rates of gear loss and abandonment. * Fishers have identified training crew in gear management practices as a priority for ALDFG prevention.
Degradable and less durable gear	* Biodegradable components for gear types that are made of synthetic materials, including traps, drifting and anchored FADs and gillnet netting, are under research and development * Biodegradable drifting FADs will reduce the durability of at-sea ALDFG as well as reduce marine plastic pollution * Escape panels and cords using untreated twine and rings and galvanic timed releases can be used to reduce ghost fishing duration by traps * Corrodible hooks can reduce the risk of ghost fishing mortalities by hook-and-line fisheries. * Biodegradable floats and biodegradable links in floatlines could reduce the ghost fishing duration of derelict anchored nets. * Using less-durable materials for relevant gear components (e.g., thinner net twine diameter and weaker material, 'weak' hooks with narrower wire diameter) to produce a breaking strength that allows large organisms to break free of the gear and escape might reduce the risk of ghost fishing and risk of mortality following escapement from ALDFG.

Mitigation and Enabling Methods	Examples
*Disablement of ghost fishing efficiency of reported/detected ALDFG	* Derelict gear detection methods include: satellite buoy data, aerial surveillance, boat surveys, acoustic sonar, remotely operated vehicles, diver and snorkeler surveys, and surveys of fishers and other experts. * Programs may sweep fishing grounds with a trawl or other gear to disable derelict gear, reducing or possibly eliminating its ghost fishing efficiency.
*Port reception and recycling facilities for ALDFG, convenient and affordable	* Provide a convenient and affordable method for vessels to properly dispose of their retired gear and ALDFG that they encounter and retrieve at sea. * MARPOL Annex V Regulation 8 obligates governments to provide adequate port reception facilities for garbage from ships and to facilitate and promote their use. * The International Maritime Organization (IMO) maintains a *Port Reception Facility Database* * The fishing gear manufacturing company Cosmos Trawl collects end-of-life nets, dismantles them, and sends recyclable components to recycling facilities. * Fisheries Iceland collects retired and discarded synthetic net fragments from purse seine and trawl vessels, of which about 90% is shipped to Lithuania for recycling, for subsequent use in electrical and automotive industries in Germany.
Materials for gear components that are recyclable	This may result in a market for retired gear, incentivizing proper disposal.
*Removal of reported/detected ALDFG	Remove ALDFG that is detected inadvertently or by programs that search for ALDFG. Removal can be conducting by: normal gear hauling (e.g., for lost pots that retain surface buoys); sweeping with grapples or arrays of hooks, trawls, and other gear; vessel winches; remotely operated vehicles; divers, snorkelers and hookah; inflatable lift bags. * Removal of ALDFG and other marine debris was correlated with a reduction in entanglement rates of the Hawaiian monk seal (*Neomonachus schauinslandi*). * Programs in the Seychelles, Palmyra Atoll and Galapagos that track satellite buoy data to intercept derelict drifting FADs before they run aground have reduced FAD standings. * A program in the Puget Sound, Washington, locates derelict shellfish pots using sidescan sonar with a differential global positioning system, which are subsequently removed * The Norwegian Directorate of Fisheries implements a lost gillnet detection and recovery program. Detection is conducted using fishing vessel VMS data, reports of lost gear, fisher surveys and boat surveys. The derelict gear is retrieved by sweeping with anchors attached to a trawl. * The Republic of Korea pays fishers to retrieve derelict gear and other debris from coastal fishing grounds and deliver it to port reception facilities. * One-off efforts, such as for research studies, have conducted ALDFG retrieval from fishing grounds.
*Requirement for fisher reporting of gear that they lost, abandoned or discarded (such as required under MARPOL Annex V[4])	* Under MARPOL Annex V, fishing vessel operators are required to record discarded and lost fishing gear in a garbage record book or ship's log, and to report to relevant authorities when it, "poses a significant threat to the marine environment and navigation," as determined by member States. * Some regional fishery bodies and agreements require fishers to report lost gear that could not be retrieved. For example, the Indian Ocean Tuna Commission adopted a drifting FAD Register that requires reporting of FAD and

Mitigation and Enabling Methods	Examples
	satellite buoy deployment, activation, deactivation, and whether a deactivated satellite buoy was retrieved or otherwise was lost or abandoned.[29] * Mechanisms for fishers to report their ALDFG or that they encounter at sea, including "no fault" reporting that eliminates penalties for losing gear that would present a disincentive for reporting, can lead to quick identification and retrieval of ALDFG, if derelict gear retrieval programs exist.
*Requirements for fishers to: (1) possess equipment to retrieve ALDFG, (2) obtain training on how to safely retrieve ALDFG, (3) attempt to retrieve ALDFG that they produced or that they encounter at sea, when safe, and (4) participate in initiatives where fishers are engaged in identifying ALDFG mitigation solutions.	* Some fishery bodies require fishing vessels to possess specified equipment for ALDFG retrieval, require vessels to attempt to retrieve their derelict gear, and to attempt to retrieve derelict gear that they encounter at sea. * Eliminating barriers to fisher collection of ALDFG that they encounter at sea, such as license agreements that prohibit possession of additional or unmarked gear. * Eliminating barriers to fisher retrieval of gear that drifts into restricted areas (e.g., drifting FADs used by tuna purse seine vessels enter an exclusive economic zone of a country where they are not licensed to fish) can reduce gear abandonment. * Initiatives such as workshops for fishers can catalyze fisher engagement in identifying solutions for ALDFG mitigation.[30]
*Technology to detect temporarily lost and abandoned gear	* Technology can provide an alert when anchored gear moves position, so that the temporarily lost gear can be located and recovered. * Sidescan sonar may enable locating lost pots and nets. * Pingers and pinger detectors can locate lost gear. * Creeping (sweeping) with grapples, anchors or other gear around the area where gear, such as a string of pots, was lost.
*ALDFG rate or magnitude limit, fleet- or vessel-based, where the latter could be individual transferable ALDFG quotas	A performance standard measure for managing ALDFG, ALDFG quotas could be instituted through individual vessel non-transferable quotas, individual transferable quotas similar to individual transferable quotas or catch shares for target species, or fleetwide thresholds. Rewards, penalties, and a combination of these approaches can be used as a consequence of exceeding the quota, such as requiring more stringent monitoring or mitigation methods. By leaving it up to fishers to determine how they avoid exceeding a limit, this allows for flexibility for individual participants in a fishery to select approaches that they prefer, and might incentivize fishers' innovation of more effective and commercially viable ALDFG mitigation methods.

[29] IOTC. 2024. *Resolution 24/02 on Management of Drifting Fish Aggregating Devices in the IOTC Area of Competence*. Resolution 24/02. Indian Ocean Tuna Commission, Mahe, Seychelles.

[30] Moreno G, et al. 2018. *Workshop for the Reduction of the Impact of Fish Aggregating Devices' Structure on the Ecosystem*. ISSF Technical Report 2018-19A. International Seafood Sustainability Foundation, Washington, D.C., USA.

Mitigation and Enabling Methods	Examples
*Negative incentives - penalties	* Mandatory deposit on new gear is not reimbursed if retired gear is not returned * Government owns gear and lease to fishing company, fined if not returned * No subsidies on new gear * Higher tax on new gear if old/retired gear is not returned * In combination with or in place of 'Rewards', individual vessels or a fishery could be assessed a levy (tax) per unit of ALDFG produced per year, or could be assessed a penalty if an ALDFG production limit (quota) is exceeded or if they do not comply with required ALDFG monitoring or mitigation measures. Other options for penalties include: reducing or withholding subsidies, reducing the allocation of effort or catch quotas for fisheries with effort or catch limits, reducing access to certain fishing grounds or seasons, increasing permit or license fees, and increasing export or other taxes. Negative market reputation risk is an additional cost.
*Positive incentives - rewards	* Retired (old, damaged) gear buyback programs (e.g., trawl fishers of the island of Texel in the Netherlands are paid for nylon dolly ropes collected at sea) * Fee/reward for retrieving ALDFG encountered at sea * Ecolabeling, including certification against ecological sustainability standards that include robust criteria for monitoring and managing ALDFG (e.g., Marine Stewardship Council, Monterey Bay Seafood Watch Program) * Subsidy or discount on new gear when old/retired gear is returned * In combination with or in place of 'Penalties', individual vessels or a fishery could receive a reward if an ALDFG production limit is met, or if they participate in voluntary ALDFG research or implement optional ALDFG monitoring or mitigation measures. Options for rewards include: providing or increasing subsidies, increasing the allocation of effort or catch quotas for fisheries with effort or catch limits, access to fishing grounds or seasons that would otherwise be unavailable, reducing permit or license fees, and reducing export or other taxes. Positive market branding is an additional incentive.
*Robust ALDFG management framework control, surveillance, enforcement and outcomes of enforcement actions, including implementation of MARPOL Annex V ban on abandonment and discarding of fishing gear[5]	* National frameworks to implement the international prohibition on intentional abandonment and discarding of fishing gear at sea under MARPOL Annex V can be effective deterrents given robust monitoring, control, surveillance and enforcement systems that deter noncompliance. * Several regional bodies (e.g., Commission for the Conservation of Antarctic Marine Living Resources, International Commission for the Conservation of Atlantic Tunas, Northwest Atlantic Fisheries Organization, Western and Central Pacific Fisheries Commission) have adopted binding measures that reiterate or expand on MARPOL Annex V prohibitions (see Annex 6). * The fisheries management framework could eliminate perverse incentives for non-compliance with ALDFG mitigation methods, such as subsidies on new gear

[1] This table is adapted from a review by Gilman et al. (2022) *Marine* Policy doi: 10.1016/j.marpol.2022.105097

[2] The *2017 Guidelines for the Implementation of MARPOL Annex V* clarify that Party's governments should determine if accidentally lost and discarded fishing gear is required to be reported under Annex V Regulation 10.6 by considering factors including: (i) the amount of lost and discarded gear; (ii) the conditions of the marine environment where it was lost or discarded; (iii) the characteristics of the lost gear, including types, weight and/or length, quantity, material, and buoyancy; and (iv) the vulnerability of habitat and protected species to gear interactions in the location where the gear was lost/discarded. The IMO guidelines use the example of "whole or nearly whole large fishing gear or other large

portions of gear" as derelict fishing gear that could be considered to meet the Annex V Regulation 10.6 definition of posing "a significant threat to the marine environment and navigation."

[3] The International Convention for the Prevention of Pollution from Ships (MARPOL) Annex V generally prohibits the discharge of all garbage into the sea. Regulation 3 prohibits the disposal of all plastics, including fishing gear, into the sea in all locations. Regulation 7 defines exceptions to the prohibitions during emergency and non-routine situations, and additional exceptions are provided in regulations 4, 5, and 6 of the Annex, which are related to food waste, cargo residues, cleaning agents and additives and animal carcasses. The MARPOL Annex V implementation guidelines clarify that, "Fishing gear that is released into the water with the intention of later retrieval, such as FADs, traps and static nets, should not be considered garbage or accidental loss." This clause is likely intended to apply to all untended in-use fishing gear, but not to untended gear that fishers set but do not retrieve either due to accidental loss or intentional abandonment, and that fishers intentionally discard at sea.

Annex 2: ALDFG Direct Causes of Production and Adverse Impacts

Table A2.1. Direct causes of the production and adverse consequences of ALDFG[1], categorized as resulting in abandoned (A), lost (L) or discarded (D) fishing gear.[31]

ALDFG causes	ALDFG component
Lack of incentives to implement ALDFG mitigation methods due to deficits with one or more component of the management framework	A, L, D
Limited awareness or low concern of fishers over the adverse consequences of ALDFG	A, L, D
No program in place to retrieve or disable gear reported as ALD; legal framework prohibits retrieving and disabling others' gear	A, L, D
Economic instruments (e.g., subsidies for new gear, insurance for lost gear, fishers are not responsible for covering costs for new gear) make it inexpensive for fishers to replace gear. This reduces the incentive for fishers to repair and maintain gear and vessel equipment, to not abandon and discard unwanted gear, to avoid risks of gear loss, and to attempt to retrieve temporarily lost and abandoned gear	A, L, D
Bad weather, strong currents or sea ice sever, move or submerge surface marker buoys or float lines; move the gear so that it cannot be relocated or cause the gear to snag on bottom features; break moorings; and sweep improperly stored gear overboard	A, L
Impractical, including insufficient time, or economically inefficient to retrieve gear or to attempt to locate and retrieve temporarily lost or abandoned gear (e.g., it is impractical or not economically viable for a vessel to recover a drifting FAD that drifts far from outside of the fishing grounds)	A, L
Static gear (gillnets, pots) is set too deep, increasing risk of loss and impracticality for retrieval, and reducing the likelihood of recovery if temporarily lost	A, L
Risk of detection of illegal fishing or illegal gear (e.g., crew spot a patrol vessel while illegally fishing in a closed area, and flee, abandoning their gear, in order to attempt to avoid detection)	A, D
Use of biodegradable gear creates a disincentive for fishers to responsibly dispose of end-of-life gear	A, D
Worn/damaged gear components, including ash from onboard incineration of unwanted/end-of-life fishing gear, are perceived to be most convenient to discard or abandon at sea	A, D
Insufficient storage room onboard for all gear that was set (e.g., when the space used to store gear when starting a trip is subsequently used as the fish hold)	A, D
Malfunction of vessel equipment other than gear tracking system (e.g., hauler)	A
Unsafe to retrieve gear (e.g., snagged on submerged feature, inclement weather)	A

[31] Gilman et al. 2022. Matching fishery-specific drivers of abandoned, lost and discarded fishing gear to relevant interventions. *Marine Policy* 141: doi: 10.1016/j.marpol.2022.105097
GESAMP. 2021. *Sea-based Sources of Marine Litter*. GESAMP Working Group 43. International Maritime Organization, London.
GESAMP. 2022. *Legal Aspects of Abandoned, Lost or Otherwise Discarded Fishing Gear*. Food and Agriculture Organization of the United Nations, Rome and International Maritime Organization, London.

ALDFG causes	ALDFG component
Untended gear drifts out of fishing grounds into areas where the fishing vessel is prohibited, preventing the vessel from recovering the gear (e.g., a drifting FAD drifts into an EEZ where the vessel is not authorized to fish)	A, L
When repairing and making up new gear onboard vessels at sea, used and new gear components (crimps, chafing gear, net clippings, fragments of line, strands of dolly rope, etc.) may be inadvertently swept or intentionally discarded overboard	L, D
Catch escapes with gear remaining attached (e.g., hook biteoffs of terminal tackle of hook-and-line gear, baleen whale entanglement in floatlines and groundlines of active, in-use pots and gillnets)	L
During use of the gear, due to regular wear and from the use of bottom gear that contacts the seabed, fragments of gear components can detach, such as small pieces of foam from floats and buoys, and strands or pieces of strands from dolly ropes	L
Fishing vessel sinks with gear onboard or set	L
Gear conflicts, both between (e.g., passive gear is accidentally or intentionally towed away or marker buoy and buoy lines are cut by mobile fishing gears such as trawlers and dredgers) and within gear types (e.g., in congested fishing grounds, gear is set on top of each other).	L
Improper gear designs and materials increase loss rates (e.g., improperly designed mooring for an anchored FAD)	L
Inadequate maintenance/replacement of worn gear components, including components used to track gear position, result in loss	L
Malfunction of tracking systems of passive gear	L
Marine organism moves gear (e.g., baleen whale entangles in float or groundline of fixed gear, and drags the gear away)	L
Marine traffic - commercial ships and recreational vessels anchor on static gear, pull up and cause the loss of the gear	L
Marine traffic - passing vessel runs over the gear, towing away gear, cutting marker buoys and buoy lines, etc.	L
New gear may contain loose fragments that can be lost at sea when first used	L
Operator error, including by new entrants/inexperienced fishers (e.g., fish at grounds with high risk of gear loss, use fishing gear designs or materials that result in loss, gear is set too deep for buoy line)[2]	L
Snag on wrecks, other debris, infrastructure (cables, oil and gas pipelines and wellheads), and natural submerged features	L
Surface marker buoy lines and float lines sever due to wear, causing loss of the main portion of the gear, including the sinking of drifting FADs	L
Theft of passive gear, including removing a satellite buoy from a drifting FAD	L
Untended passive gear is misplaced (e.g., untended gear with no tracking system drifts away and is lost)	L
Untended passive, static gear is left in place in between fishing seasons to retain possession of fishing grounds, increasing risk of loss	L
Vandalism, including cutting buoy lines, removing marker buoys, intentionally running over the gear (e.g., due to conflicts within and between gear types, due to gear located in shipping channel)	L
Crew release live catch or discard dead catch with gear remaining attached (e.g., following prescribed handling and release practices for deeply hooked ETP species)	D
Discarded offal and bait may contain terminal tackle (e.g., bait with hook)	D

ALDFG causes	ALDFG component
Insufficient storage space onboard for worn/damaged gear components that were replaced during the trip	D

[1] The table is adapted mainly from the review published by Gilman et al. (2022) *Marine* Policy doi: 10.1016/j.marpol.2022.105097.

[2] May be more appropriately categorized as an underlying, indirect driver of ALDFG production – discussed in the Introduction.

Annex 3: Methods to Estimate ALDFG Production Rates and Magnitudes

Accurate estimates of rates and levels of ALDFG production contribute to understanding the resulting ecological and socioeconomic impacts, enable performance assessments of efforts to reduce ALDFG, and provide evidence to inform management responses to focus on fisheries and gear type posing the highest risk.[32] An assessment of the rate and quantity of ALDFG might be undertaken by a stakeholder prior to preparing a POA-ALDFG – where for a data-rich fishery or nation, the action plan can therefore focus on actions to address known ALDFG problems, or otherwise if there is uncertain or no information available on ALDFG rates and levels, then such as assessment can be included as an activity in the POA.

The enormity and diversity of global fisheries and data limitations has made it challenging to produce certain, comprehensive and contemporary global, regional and fishery-specific estimates of rates and amounts of ALDFG. There are about 38 million fishers participating in marine capture fisheries with 4.1 million fishing vessels, using a wide range of gear types with tremendous variability between fisheries in the causes and underlying environment that explain ALDFG production and its adverse impacts. Studies have estimated ALDFG production rates, with large uncertainty, for a small proportion of global fishing gear types and regions. Estimates of the amount (in weight or volume) of ALDFG production are also highly uncertain. For over a decade the literature has extensively referenced an extremely coarse and dated estimate of ALDFG production, where a 2009 report presented a rough approximation that ALDFG is <10% of the volume of total marine litter and that 640,000 t of ALDFG is produced annually, based on a 1975 estimate that 6.36 million t of marine litter is generated annually. More recent estimates of the quantity of global ALDFG are also highly uncertain due to data constrains and the need to make large assumptions. More robust estimates are of ALDFG production rates and levels are needed to guide management interventions and assess their performance.

It is important to consider the relative degree of risk of error and bias and strength of evidence of alternative methods for estimating ALDFG rates and magnitude.[33] Meta-analytic syntheses such as meta-analyses can produce the most robust and generalizable findings that are optimal for guiding regional- and global-level policy. Meta-analytic based studies can estimate gear-specific ALDFG production rates from a mix of context-specific fisheries so that the overall pooled estimate is relevant over the globally diverse fisheries using that gear type. Harmonizing the units used for ALDFG production rate studies will enable pooling in meta-analytic synthesis studies. Conclusive meta-analytic syntheses require substantially larger sample sizes of individual ALDFG studies for all gear types and regions.

[32] Gilman et al. 2023. *Marine Policy* 155: 105738
Richardson et al., 2021. *Marine Policy* 129: 104522
[33] Gilman E, Chaloupka M. 2023. *Reviews in Fish Biology and Fisheries* 33: 137-146

For individual fisheries, robust ALDFG production data can be obtained from independent observer and electronic monitoring programs when these monitoring program designs include relevant data fields and use robust data collection protocols, and are designed to overcome sources of statistical sampling bias (e.g., sampling rate, balanced sampling across strata, observer effect, observer displacement effect, coercion and corruption, and crew concealing catch from observers and EM systems). However, there is limited independent monitoring of global marine fisheries. For example, regional fisheries bodies have no observer coverage for about 69% of their managed fisheries. Furthermore, less than a third of international fisheries management bodies collect data on ALDFG production, and those few observer programs that do collect information on ALDFG production record qualitative records that do not support robust quantitative assessments.

Due to the unavailability of robust data from independent at-sea fisheries observer and electronic monitoring programs, surveys of fishers and other experts have been the predominant approach to estimate ALDFG production rates. Expert surveys can be a rapid and low-cost approach that for many fisheries may be the only source available of information on ALDFG, including production rates but also causes for leakage and details on the gear components that become abandoned, lost and discarded. However, expert surveys have a relatively high risk of bias and can have both low internal and external validity. Surveys can produce biased data if ALDFG is a highly sensitive issue due to regulatory measures and penalties, reputation risks, and due to several additional sources of bias such as retrospective, anchoring, availability, prevailing paradigm, dominance, groupthink and overconfidence. Furthermore, there is a risk that the data collected from survey respondents are not generalizable and are unrepresentative of the underlying population that was sampled, such as if there is undercoverage or nonresponse bias, or if the questionnaire design or the way the questionnaire was administered caused biased responses. Structured expert elicitation approaches can improve on simple expert judgement approaches to reduce some of these sources of bias and improve the accuracy of estimates.

ALDFG data collected from expert surveys could subsequently be validated through more certain approaches. For example, a baseline, index-level of limited independent monitoring data from observers or an electronic monitoring system, or a mass-balance assessment (measure all inputs onto and outputs off of a vessel), could complement and validate ALDFG expert surveys.

The reporting and retrieval of ALDFG at sea and stranded on coastlines are additional approaches to estimating ALDFG production. Estimates can also be obtained from surveys of fishing grounds, including through: in situ observations by divers; sonar, video and still photography obtained from marine vessels, manned submersibles, underwater remotely operated vehicles, and above and underwater drones; and retrieved debris from trawling and towing grappling devices. For drifting FADs, analyses of satellite buoy tracking data have supported estimates of ALDFG production rates.

Estimates of ALDFG leakage would be more robust if they are able to account for both legal and IUU fisheries. Rates of ALDFG generated from IUU fishing may be substantially different from

estimates obtained from legal fisheries if a main cause of ALDFG by the IUU fishers is abandonment of gear when operating illegally and a risk of detection occurs.

Annex 4: Inputs for ALDFG Management Strategy Evaluation

There are several key criteria that stakeholders, including fisheries management authorities and the fishing industry, should account for when evaluating and selecting amongst alternative ALDFG management strategies. These key criteria are summarized in Table A4.1, and are divided into categories of criteria related to the fishery-specific enabling environment and criteria related to characteristics of ALDFG management measures.

Deficits in one or more component of a fisheries management framework, including monitoring, control, surveillance, enforcement and outcomes of enforcement actions, are especially problematic when the efficacy of an ALDFG control measure is affected by crew behavior and the ALDFG measure creates large costs to economic viability, practicality or crew safety. For instance, gear marking to identify ownership will be an effective deterrent of intentional discarding and abandonment of fishing gear only if there is a robust fisheries management framework (e.g., a pilot project in Indonesia to mark gillnets to identify ownership did not reduce gillnet ALDFG production rates in part due to fisheries management framework deficits).[34] Gear marking will be an ineffective deterrent in fisheries lacking relevant regulations, with deficits in surveillance or enforcement, or where outcomes of enforcement actions are insufficient to deter noncompliance.

Alternative ALDFG management methods can be assessed based on the enabling conditions of the fisheries management framework that are needed to deter noncompliance. An initial consideration is whether fishers would be expected to voluntarily employ the method — including whether it causes high or low costs to commercial viability (economic viability, practicality, and crew safety), and whether the method constitutes a major change from conventional practices. Another key consideration is whether efficacy relies on crew behavior. And a third consideration is whether the method is suitable given the capacity of the management system to conduct robust compliance monitoring, and that has adequate consequences (penalties and/or rewards) to incentivize compliance. This accounts for what approaches effectively enable compliance monitoring, the state of the fisheries' surveillance program, the robustness of the enforcement framework and outcomes of enforcement actions in response to an identified infraction. These main considerations for compliance likelihood of alternative ALDFG management approaches are summarized as follows:

- Is voluntary compliance expected?
    - Costs to components of commercial viability
    - Degree of change from conventional practices
- Does the method's efficacy rely on crew behavior?

[34] GGGI. 2017. *Gear Marking in Indonesian Small-Scale Fisheries: A Pilot Project Case Study*. Global Ghost Gear Initiative, Ocean Conservancy, Washington, D.C.
FAO. 2018. *Gear Marking Pilot Study in Indonesia Small-scale Gillnet Fisheries with Reference to FAO's Draft Guidelines on the Marking of Fishing Gear*. COFI/2018/SBD.18. United Nations Committee on Fisheries. Food and Agriculture Organization of the United Nations, Rome.

- Are the fishery's monitoring, control, surveillance and enforcement frameworks adequate?
    - What methods enable robust compliance monitoring (dockside vessel inspection audits, port sampling of landed catch, satellite-based vessel monitoring systems, at-sea human observers / fisheries electronic monitoring, etc.) — and does the fishery have the needed monitoring and surveillance systems?
    - Does the fishery have robust legal and regulatory frameworks, and are outcomes of enforcement actions adequate incentives for compliance?

For fisheries with limited monitoring and surveillance, and/or weak enforcement frameworks, ALDFG management methods whose performance is strongly affected by crew behavior and which are not convenient for crew to employ, may be unsuitable. Methods whose efficacy does not rely on crew behavior during fishing, such as methods for which compliance can be determined through dockside inspections or satellite-based vessel monitoring systems, have high promise for compliance. And methods that are affected by crew behavior but can be confirmed without observers and fisheries electronic monitoring systems — such as static area-based management tools to prevent fishing in areas with a high risk of gear loss, which can be monitored with a satellite-based vessel monitoring system — may also have high promise for compliance.

Table A4.1. Criteria for ALDFG management strategy evaluation to identify effective interventions due to the fishery-specific context and to aspects of individual management measures.

Evaluation Criteria	Description
Criteria on the fishery-specific enabling environment	
Causes	What is the relative importance of each direct and indirect cause of ALDFG production. For example, a fishery where ALDFG is produced mainly from fishing during inclement weather will have different solutions than a fishery where gear is abandoned when it drifts out of range.
Impacts defined by magnitude, composition and fate	How much ALDFG a fishery produces, what the ALDFG is made of, where the ALDFG ends up and how long it persists determine what ecological and social impacts are caused and the severity of each impact.
Governance enabling environment	The robustness of each component of the ALDFG fisheries management framework of monitoring, control, surveillance, enforcement, and outcomes of enforcement actions.
Market-based enabling environment	Are there market-based mechanisms that incentivize voluntary industry implementation of ALDFG management measures.
Criteria on aspects of individual management measures	
Costs to commercial viability	The costs that the ALDFG management measure has on economic viability (including direct costs for requisite gear and equipment and effects on catch rates and value), practicality and crew safety.

Evaluation Criteria	Description
Effect size	ALDFG management strategies can be assessed based on the predicted magnitude of their effect on ALFG's adverse impacts, based on the effect of the strategy on ALDFG production rates, magnitude, fate and composition, and hence how they contribute to meeting ALDFG management outcome objectives.
Degree of deviation from conventional practices	Does the ALDFG management measure entail a large deviation from conventional fishing methods or gear designs?
Effect of fisher behavior on efficacy	Does efficacy of the measure rely on crew behavior, such as communication with other vessels on the position of their gear to reduce gear conflicts and maintenance of gear and vessel equipment to reduce gear loss - or is the ALDFG management measure's efficacy not affected by fishers' behavior, such as regulations on gear designs (e.g., weak links, escape panels and chords), area-based management tools and derelict gear retrieval programs.
Compliance monitoring requirements	Resources required for effective compliance monitoring: (1) What surveillance approaches can feasibly detect non-compliance, such as dockside vessel inspections, at-sea boarding, onboard observers, electronic monitoring, satellite-based Vessel Monitoring Systems and Automatic Identification System, and electronic tracking of the position of drifting, untended gear. (2) What level of surveillance is needed, accounting for whether efficacy relies on crew behavior and how likely is fisher compliance with the intervention given an intervention's costs to commercial viability. For example, in fisheries lacking at-sea independent monitoring, ALDFG management methods that are affected by crew behavior but can be confirmed without observers and electronic monitoring– such as spatiotemporal management to reduce the risk of gear conflicts – which can be monitored with a satellite-based vessel monitoring system, may be effective.
Compliance likelihood	The likelihood that fishers will comply with an ALDFG management measure is based on four of the above criteria of: (i) robustness of the ALDFG management framework, (ii) costs to commercial viability, (iii) how different the method is from conventional practice, (iv) whether the efficacy of the method is affected by crew behavior, and (v) compliance monitoring requirements.
Strength of evidence	Policy decisions should be guided by the relative strength of evidence of the efficacy of alternative measures at mitigating derelict gear production rates and impacts. Evidence from studies employing quantitative synthesis approaches including meta-analyses have the lowest risks of error and bias and are more generalizable and thus suitable for broad regional- and global-scale policy.
Evidence of efficacy in practice	It is important to validate that the efficacy of an ALDFG management measure when used under controlled conditions is of similar effectiveness when employed in real-world conditions through "pragmatic" studies that rely on robust independent monitoring. The efficacy of some ALDFG management measures is strongly affected by crew behavior. This can cause substantial differences in the efficacy of these methods between estimates from experiments, where researchers implemented the measure, versus from analyses of observer or electronic monitoring data, where fishers implemented the method during commercial operations. Therefore, for ALDFG management methods whose efficacy is affected by crew behavior, analyses of observer and electronic monitoring data may provide a more certain estimate of responses during commercial fishing operations than experiments.
Sequential ALDFG mitigation hierarchy	Methods that avoid and minimize ALDFG production and adverse consequences should be considered before potentially less effective and more expensive interventions for remediation and offsets.

Annex 5: Excerpt from IMO and FAO Guidelines — Template for National Action Plans on Sea-based, Marine, Plastic Litter

The following Template for National Action Plans on Sea-based Marine Plastic Litter is an excerpt from an IMO and FAO report, Guidance Document on Developing a National Action Plan on Sea-Based Marine Plastic Litter.[35]

Introduction
Describe the sea-based marine plastic litter issues in the country with the focus on the findings of the Country Status Assessment.

Objectives of the National Action Plan
Describe the overarching objectives of the National Action Plan, that is to prevent and reduce sea-based sources of marine plastic litter.

Country context including geographical scope and current state of knowledge on sea-based marine plastic litter at national and local levels
Information such as population and description of the country in terms of coastline and adjacent seas, its geographical situation, and an overview of the current state of knowledge at a country level, regarding production of marine plastic litter from maritime and fisheries activities, scale and impacts.

Principles and approaches that should frame the implementation
List the primary overarching principles such as the precautionary approach; the polluter pays principle; the ecosystem approach; public and private participation; sustainable consumption and production and best available knowledge and practices.

Specific actions, responsible authorities/agencies/institutions, and timelines
Various ranges of actions should be identified and set out in a table. In this section the actions should be described, including why each action is necessary, who do you plan to engage and what is the expected outcome. Actions should respond to priorities and gaps identified in the Country Status Assessment. The Country Status Assessment should also provide information on the relevant stakeholders and institutions that should be engaged in the implementation of the NAP.

Monitoring progress
Describe how, by whom and when the progress will be measured.

[35] IMO. 2023. *Guidance Document on Developing a National Action Plan on Sea-Based Marine Plastic Litter.* GloLitter Project Coordination Unit, International Maritime Organization, London.

Annex 6: Intergovernmental Organizations' ALDFG Guidance and Measures

A summary follows of guidance and measures on ALDFG that have been adopted by intergovernmental organizations.[36]

- Annex V of the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78), the Guidelines for the Implementation of Annex V in relation to reducing impacts of lost fishing gear, and the International Maritime Organization's Action Plan on Reducing Marine Litter from Ships include ALDFG-related requirements. Regulation 3 of MARPOL Annex V prohibits the disposal of all plastics, including fishing gear plastic components, into the sea. Regulation 7 defines exceptions to the prohibitions during emergency and non-routine situations, and additional exceptions are provided in regulations 4, 5, and 6 of the Annex, which are related to food waste, cargo residues, cleaning agents and additives and animal carcasses. The MARPOL Annex V implementation guidelines (Section 1.7.8) clarify that untended but in-use fishing gear, and fishing aids such as FADs, are not considered garbage or accidental loss. Annex V requires fishing vessel operators to record discarded and lost fishing gear in a garbage record book or ship's log, and to report to relevant authorities when lost gear poses a significant threat, as clarified by the 2017 guidelines.

- The United Nations Environment Programme's Regional Seas Programme, established in 1974, provides a coordination mechanism for neighboring countries to address marine and coastal conservation issues. Many of the 18 regional seas programs have developed regional action plans to address marine litter, including mitigating the production of ALDFG (e.g., see PAME, 2021[37]).

- The FAO 1995 Code of Conduct for Responsible Fisheries includes recommendations for States to prevent the loss of fishing gear, reduce ALDFG and implement the MARPOL Convention.

- United Nations General Assembly (UNGA) resolutions related to ALDFG, including the earliest of Resolution 60/31 of 2005, which called upon States and relevant intergovernmental bodies to take action to address ALDFG and most recently adopted Resolution 78/68 in 2023, which calls upon States to adopt effective ALDFG management measures and for States and regional fisheries management organizations and arrangements (RFMO/As) to take action to reduce ALDFG.

[36] For detailed reviews of the legal aspects of ALDFG, see:
GloLitter. 2022. *Legal Aspects of Abandoned, Lost or Otherwise Discarded Fishing Gear*. FAO and IMO, Rome and London.
GESAMP. 2021. *Sea-based Sources of Marine Litter*. GESAMP Working Group 43. International Maritime Organization, London

[37] PAME. 2021. *Regional Action Plan on Marine Litter in the Arctic*. Protection of the Arctic Marine Environment Secretariat, Akureyri, Iceland.

- The International Guidelines on Bycatch Management and Reduction of Discards, which the Committee on Fisheries (COFI) endorsed at its 29th session in 2011, calls upon States and Regional Fisheries Management Organizations and Arrangements to consider the impacts on living aquatic resources from ghost fishing by ALDFG.

- FAO produced Voluntary Guidelines on the Marking of Fishing Gear, which were endorsed by COFI at its 33rd session in 2018. The guidelines explain that marking gear provides a means to identify fishing gear presence and ownership and identify monitoring, control and surveillance frameworks necessary for effective gear marking requirements; include advice on conducting a risk-based approach to implement gear marking systems; provide suggestions for management measures on reporting and recovering ALDFG; and advocate for measures requiring the traceability of fishing gear throughout the supply chain. FAO also published in 2023 a Supplement that provides technical advice for marking fishing gear.[38]

- Measures have been adopted by RFMO/As and other regional bodies, including measures specifically on monitoring and managing ALDFG, as well as other measures that are implemented to address a range of fisheries management objectives but contribute to avoiding, minimizing and remediating ALDFG, including on gear marking, deterring illegal, unreported and unregulated (IUU) fishing, constant or periodic attendance of static gear, and gear technology that increases ghost fishing selectivity or reduces the rate of gear loss. A sample of examples of measures directly related to ALDFG monitoring and management follow:
    - The Commission for the Conservation of Antarctic Marine Living Resources has adopted measures that require removing hooks from offal prior to discharge by demersal longline vessels, prohibit discharging plastics (as defined by MARPOL Annex V) into the sea, ban discharging incinerator ash in designated areas, and task regional observers with recording information on lost and discarded gear for specified gear types.[39]
    - The Inter-American Tropical Tuna Commission, Indian Ocean Tuna Commission (IOTC) and the International Commission for the Conservation of Atlantic Tunas (ICCAT) adopted binding measures, and Western and Central Pacific Fisheries Commission (WCPFC) a non-binding measure on transitioning to the use of only biodegradable drifting FADs by tuna purse seine fisheries.[40]

[38] FAO. 2023. *Voluntary Guidelines on the Marking of Fishing Gear. Manual for the Marking of Fishing Gear*. Suppl. 2. Food and Agriculture Organization of the United Nations, Rome.

[39] CCAMLR Measures 25-02, 26-01, and Scientific Observer Logbook, CCAMLR Scheme of International Scientific Observation, Commission for the Conservation of Antarctic Marine Living Resources, Hobart.

[40] IATTC. 2023. Resolution C 23-0 on the Design and Biodegradability of Drifting Fish Aggregating Devices (DFADS) in the IATTC Area of Competence. Resolution C 23-04. Inter-American Tropical Tuna Commission, La Jolla, USA.
IOTC. 2024. *Resolution 24/02 on Management of Drifting Fish Aggregating Devices in the IOTC Area of Competence*. Resolution 24/02. Indian Ocean Tuna Commission, Mahe, Seychelles.
ICCAT. 2024. Recommendation by ICCAT Replacing Recommendation 22-01 on a Multi-Annual Conservation and Management Programme for Tropical Tunas. Rec 24-01. International Commission for the Conservation of Atlantic Tunas, Madrid.

- IOTC encourages Parties to implement actions to monitor and mitigate ALDFG; and tasks onboard observers with recording information on hook loss by pole-and-line fisheries.[41]
- ICCAT adopted the Recommendation by ICCAT on Abandoned, Lost or Otherwise Discarded Fishing Gear.[42] The measure requires Parties to prohibit their fishing vessels from abandoning and discarding fishing gear except for safety reasons, and require vessels to: possess equipment to retrieve lost fishing gear, attempt to retrieve lost fishing gear, and report lost gear that was retrieved or otherwise that could not be retrieved. The measure does not apply to longline gear.
- WCPFC adopted the Conservation and Management Measure on Marine Pollution.[43] The measure requires parties from discharging any plastics other than fishing gear when operating within the WCPFC convention area, and encourages parties to prohibit their vessels from discharging into the sea oil or fuel products or oily residue, and garbage, including fishing gear and incinerator ash. The measure clarifies that fishing gear that are released into the water with the intention of subsequent retrieval such as FADs, traps and static nets, are not considered garbage. The measure requires parties to encourages their vessels to retrieve and retain ALDFG for discharge at port reception facilities, or if not possible to retrieve, then to report the location and characteristics of the encountered ALDFG. The measure requests parties to provide adequate port reception facilities to receive waste from fishing vessels.

WCPFC. 2023. Conservation and Management Measure for Bigeye, Yellowfin and Skipjack Tuna in the Western and Central Pacific Ocean. CMM 2023-01. Western and Central Pacific Fisheries Commission, Kolonia, Federated States of Micronesia.

[41] IOTC. 2024. *Recommendation 24/11 on Marine Pollution*. Recommendation 24.11. Indian Ocean Tuna Commission, Mahe, Seychelles.
IOTC Regional Observe Scheme – Observer Trip Report.

[42] ICCAT. 2019. *Recommendation by ICCAT on Abandoned, Lost or Otherwise Discarded Fishing Gear*. Recommendation 19-11. International Commission for the Conservation of Atlantic Tunas, Madrid.

[43] WCPFC. 2017. *Conservation and Management Measure on Marine Pollution*. CMM 2017-04. Western and Central Pacific Fisheries Commission, Kolonia, Federated States of Micronesia.

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