Addressing ALDFG in Africa: A best practice guide

Book · February 2024

CITATIONS
0

READS
85

3 authors, including:

Peter John Randall
Centre for Environment, Fisheries and Aquaculture Science
13 PUBLICATIONS **124** CITATIONS
SEE PROFILE

Danica Marlin
Sustainable Seas Trust
22 PUBLICATIONS **219** CITATIONS
SEE PROFILE

ADDRESSING ALDFG IN AFRICA:
A best practice guide

Edited by Tayla Gifford, Peter Randall and Danica Marlin




SST
Norwegian Embassy
Pretoria

Published by African Marine Network, Sustainable Seas Trust, Gqeberha, South Africa.
Visit the website: www.sst.org.za. For any queries, email info@sst.org.za

Editors:
Tayla Gifford, Research Officer (Sea-Based Sources of Waste Coordinator), Sustainable Seas Trust, South Africa
Peter Randall, Marine Litter Scientist (ALDFG specialist), Centre for Environment, Fisheries and Aquaculture Science, United Kingdom
Danica Marlin, Head of Research, Development and Monitoring, Sustainable Seas Trust, South Africa

Authors:
Tayla Gifford, Sustainable Seas Trust, South Africa
Peter Randall, Centre for Environment, Fisheries and Aquaculture Science, United Kingdom
Danica Marlin, Sustainable Seas Trust, South Africa
Joshua Nathaniel, Stand Out for the Environment (SOFER) Initiative, Nigeria

Case study authors:
Anthony Appiah, Fisheries Scientific Survey Division, Fisheries Commission, Ghana
Terry Achieng, Catchgreen Biodegradable Fishing Nets, South Africa
Emma Algotsson, Catchgreen Biodegradable Fishing Nets, South Africa
Tayla Gifford, Sustainable Seas Trust, South Africa
David Kaplan, Marine Biodiversity, Exploration and Conservation, University of Montpellier, France
Danica Marlin, Sustainable Seas Trust, South Africa
Joshua Nathaniel, Stand Out for the Environment (SOFER), Nigeria
Emmanuel Sofa, Stand Out for the Environment (SOFER), Nigeria

Layout:
Anje Kaber from Designs by Anje

Citation:
Gifford T, Randall P, Marlin D and Nathaniel J. 2024. Addressing ALDFG in Africa: a best practice guide. (Gifford T, Randall P and Marlin D. Eds) African Marine Waste Network, Sustainable Seas Trust, Gqeberha, South Africa.

Acknowledgement:
Sustainable Seas Trust is grateful to the Norwegian Ministry of Foreign Affairs, Norway, for core funding to the African Marine Network programme. Crown Copyright images have been used with kind permission of Cefas. We also thank the fisheries managers, fishers and workshop attendees who shared their knowledge and experiences which were incorporated into this guide and thereby assisted in its creation.

Table of Contents

List of tables and figures

Figure 12: FAO's guide to voluntary marking of fishing gear.

Figure 13: Seaweed farmers in Kibuyuni village in Kenya are testing Biodolomer®Ocean ropes.

Figure 14: End-of-Life fishing nets and ropes at a collection point in Nigeria, as part of the Fishing Net Gains project run by the SOFER Initiative. The nets and ropes have components made from different materials e.g. metal, ropes composed of different plastic polymers, making them difficult to recycle but not necessarily difficult to repurpose.

Figure 15: Repurposing of end-of-life fishing nets to make hammocks, Kenya.

Figure 16: Skips for hazardous waste provided as part of port waste reception facilities at the Port of Port Elizabeth, Gqeberha, South Africa.

Figure 17: A repurposed fishing net being used to protect a thatched roof in a village in Nigeria.

Figure 18: SOFER Initiative team with community members at a fishing nets recovery facility in Limbe, Nigeria.

Figure 19: South African trawler en route to land at Cape Town. Conditions in African countries need to be considered carefully when developing best practices for ALDFG.

Foreword

Abandoned, lost or otherwise discarded fishing gear (ALDFG) is considered harmful not only because it may lead to ghost fishing, but because fishing gear makes up a significant proportion of macrolitter in the world's oceans. Not only does ALDFG have the potential to continue fishing long after it has been lost, and hence it is in direct competition with fisheries, but it also contributes to marine plastics and all the associated harmful impacts that plastics have on the environment (smothering, microplastics, etc). There is a paucity of information about ALDFG, especially in Africa. Many international organisations, research institutes and NGOs have developed excellent guides for best practices towards mitigating ALDFG. However, these guides are either broad in scope or based on information from developed countries, and therefore contain guidance that is not applicable to African conditions. Consequently, this guide arose from the urgent need to gather data on ALDFG in Africa, and to simultaneously begin to develop best practices, that are useful for regional and/or local conditions within Africa.

The guide was developed through a collaborative process, consisting of both in-person and virtual workshops, meetings and interviews with stakeholders who understand ALDFG within an African setting. In this guide we discuss what and how data on ALDFG should be collected, who is responsible for this data collection and who is responsible for the reporting of ALDFG. Within this guide, the marking of fishing gear and fishing gear modification, including the use of biodegradable fishing gear, are discussed to see what measures are feasible to African fishers. Case studies are included to showcase the work already taking place in African countries towards gathering ALDFG data, working with communities to raise awareness, and creating innovative solutions for end-of-life fishing gear. The guide is a working document and serves as a starting point to develop best practices for ALDFG for African fisheries, so that we may collectively work towards a future where the people of Africa and her seas flourish together.

Dr Stacey Webb
Head of Marine and Coastal Impact Programmes of Sustainable Seas Trust

About Sustainable Seas Trust

Sustainable Seas Trust (SST) is a science-based organisation working to protect Africa's seas for the benefit of all those who live on the continent through research, education, economic upliftment and collaboration.

Acronyms and abbreviations

ALDFG	Abandoned, Lost or otherwise Discarded Fishing Gear
DFFE	Department of Forestry, Fisheries and Environment
EEZ	Exclusive Economic Zone
EPR	Extended Producer Responsibility
FAD	Fish Aggregating Device
FAO	Food and Agriculture Organisation
EIA	Environmental Investigation Agency
EOL	End-of-Life
EOLFG	End-of-Life Fishing Gear
GESAMP	Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection
GGGI	Global Ghost Gear Initiative
IATTC	Inter-American Tropical Tuna Commission
IMO	International Maritime Organisation
IUU	Illegal, Unreported and Unregulated (fishing)
ISSCFG	International Standard Statistical Classification of Fishing Gear
KMFRI	Kenya Marine and Fisheries Research Institute
MARPOL	The International Convention for the Prevention of Pollution from Ships
MSC	Marine Stewardship Council
NOAA	National Oceanic and Atmospheric Administration
RFMO	Regional Fisheries Management Organisation
SAMSA	South African Maritime Safety Authority
SINTEF	Stiftelsen for industriell og teknisk forskning
TNPA	Transnet National Ports Authority
UNEP	United Nations Environment Programme

Glossary of key terms

The definitions below refer to the use of terms in this guide only and care should be taken when applying them in other contexts.

Abandoned, lost or otherwise discarded fishing gear (ALDFG)	Fishing gear that has been relinquished, misplaced or dumped in the aquatic environment (e.g. sea, river, lake) and is no longer in the control of an owner/operator.
Active fishing gear	Fishing gear that is towed through the water column (e.g. seine nets, mid-water trawl) or towed across the seabed (e.g. bottom trawls) by a vessel to catch fish and other animals.
Artisanal fisher	These are fishers that use low level technology, such as small canoes, or vessels with no or low-powered engines, and use traditional fishing gear e.g. spears or hand reels. Artisanal fishers make short fishing trips close to shore and catch is mainly for private consumption.
Baseline	The starting point against which future comparisons can be made, as in the initial estimate of the amount and type of ALDFG in a given area.
Biodegradable	Materials that can be broken-down by naturally occurring micro-organisms such as bacteria and fungi – into water, biomass, and gases such as carbon dioxide and methane.
Biofouling (of an object)	A buildup of biological material and its attachment on a surface of a stationery material or instrument that is under water e.g. barnacles, algae, seaweeds etc.
Commercial fisher	An individual who practices the harvesting of marine or freshwater resources (e.g. organisms), for commercial sale.
Creeping	A method of fishing gear recovery by the towing of a grapnel along the seabed to hook and recover lost fishing gear in areas where the towing would not cause environmental damage.
Exclusive Economic Zone (EEZ)	An area of the ocean that extends 200 nautical miles beyond a nation's territorial sea and within which that nation has jurisdiction over living (e.g. fish) and non-living (e.g. oil) resources.
Extended Producer Responsibility (EPR)	A concept where manufacturers, producers and importers of products bear a significant degree of responsibility for the environmental impacts of their products throughout the product life cycle.
Fish Aggregating Device (FAD)	A fish aggregating device (FAD) is a permanent, semi-permanent or temporary structure, which is deployed and/or tracked, and used to aggregate fish for subsequent capture. A FAD can be either an anchored FAD (aFAD) which is often deployed within a nation's EEZ, or a drifting FAD (dFAD), which is often deployed in the high seas.
Fishing Gear	Any physical device or a combination of items that are placed on or in water, or on the seafloor, to capture, control (for subsequent capture) or harvest, marine organisms.
Flag state	This is the country under which a commercial or merchant vessel is registered, and the vessel must follow the laws enforced by that country.

Garbage (under MARPOL Annex V)	According to MARPOL Annex V, garbage includes all kinds of food, domestic and operational waste, all plastics, cargo residues, incinerator ashes, cooking oil, fishing gear, and animal carcasses generated during the normal operation of the ship and liable to be disposed of continuously or periodically. Garbage does not include fresh fish and parts thereof generated as a result of fishing activities undertaken during the voyage, or as a result of aquaculture activities.
Gear conflict	When active fishing gear, such as trawls, is pulled through an area that has passive gear, such as lobster pots, and the gears become tangled resulting in one or both gear types becoming damaged. **Note** that the gear may be in use (i.e. purposefully fishing) or it may not be in use (i.e. it is at sea as ALDFG).
Ghost fishing	The destructive cycle of continued catching and killing of marine animals by abandoned, lost or otherwise discarded fishing gear.
Harmonised monitoring methods	Methods that are conducted in the same way in different areas or countries so that data collected to detect trends and report on progress in meeting national and international obligations are reliable and comparable.
Illegal, Unreported and Unregulated (IUU) fishing	IUU fishing includes all fishing that breaks fisheries laws or occurs outside the reach of fisheries laws and regulations. IUU fishing includes such actions as fishing without a permit or license, fishing in a closed area, fishing with prohibited gear, fishing over a quota, or the fishing of prohibited species.
Marine litter	Any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environments as a result of human activity.
Marine pollution	A combination of chemicals and litter, most of which comes from land sources and is washed or blown into the ocean. This pollution results in damage to the environment, to the health of all organisms, and to economic structures worldwide.
Maritime	Human activities that occur at sea, including shipping, naval matters, navigation, seaborne trade etc.
Passive fishing gear	Fishing gear that is left out at sea for a period of time before it is retrieved, and which relies on an animal's movement or interaction with the gear to catch or trap it. Bait may be used to attract the animal (e.g. longlines, traps and pots), the tide may be used to drift the gear or the gear waits passively for the animal to swims into it (e.g. gill nets).
Polymer	A substance which is made up of many similar units bonded together.
Port Reception Facilities (PRF)	These facilities may be fixed, floating or mobile that receive and collect waste from ships, including cargo residues, garbage, oily water and sewage, from the port's regular vessel traffic.
Recycle	Transform a product or component into its basic materials or substances and reprocess them into new materials and products.
Regional Fisheries Management Organisation (RFMO)	An international organisation that regulates regional fishing activities in the high seas.
Sea-based sources of waste (also called 'sea-based marine pollution')	Sea-based marine pollution includes, abandoned, lost or otherwise discarded fishing gear (ALDFG), pollution from aquaculture, and pollution from sea-based activities such as shipping and tourism that threaten marine and coastal ecosystems.

Spatial/Temporal closures	Spatial closures ban or restrict fishing within all or a subset of a particular fishing zone, either permanently or for a defined period (temporal closure). Spatial and temporal measures aim to avoid or minimise bycatch by either temporarily or permanently moving fishing out of an area or requiring that particular mitigation techniques be adopted in an area.
Stakeholder	Any party that may be affected by, take an interest in or have influence over activities or decision-making (e.g. fishers, businesses, government, citizens) in relation to ALDFG data collection.
Warp tension meter	An instrument on a winch for measuring the load on the warp to a deployed fishing gear (e.g. trawl).

The definitions in this table were sourced from the following: European Cetacean Bycatch Campaign (ECBC); The European Commission; European Maritime Safety Agency (EMSA); Food and Agriculture Organization of the United Nations (FAO); He *et al*. 2021; International Maritime Organization (IMO); Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP); MARPOL Annex V; Mehdi *et al*. 2021; Maritime Institute of Technology and Graduate Studies (MITAGS); National Geographic; National Oceanic and Atmospheric Association (NOAA); Olive Ridley Project; Randall 2020; Organization for Economic Co-operation and Development (OECD); Save Our Seas Foundation; The Pew Charitable Trust; United Nations Environment Programme (UNEP).

CHAPTER 1: INTRODUCTION

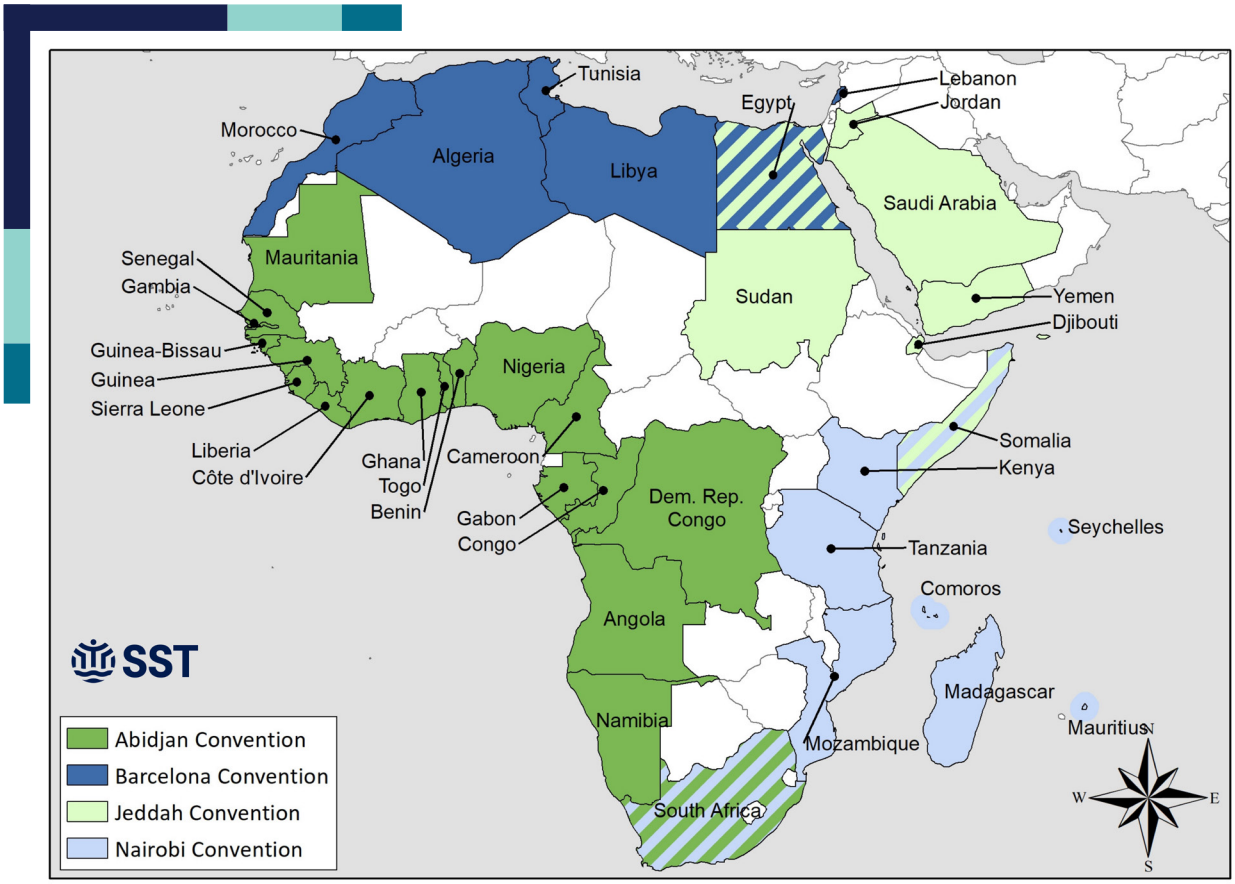

Figure 1: *African countries that have ratified the four regional conventions which exist to protect Africa's coasts and seas.*

1.1. Marine Litter

Marine litter, and specifically plastic marine litter, has received increasing attention in recent years and is a well-recognised global issue (GESAMP 2021). As such, several conventions exist to address marine litter and establish international standards for environmental protection (see **Appendix 1**). The most important international convention regarding sea-based sources of waste is the International Convention for the Prevention of Pollution from Ships (MARPOL). In addition to MARPOL, many African countries are signatories to regional conventions for the protection of the marine and coastal environments of Africa (**Figure 1**; see **Appendix 2**).

Plastic litter is a persistent problem (Tiller *et al.* 2019) due to not only its design which leads to it remaining in the marine environment for decades (Kühn *et al.* 2015), but also the sheer volume of litter entering the oceans annually. It is estimated that by 2040, there will be 23 – 37 million tonnes of plastic entering the oceans annually if appropriate interventions to prevent plastic pollution are not implemented soon (Pew 2020). While most of the plastic entering the ocean is thought to be from land-based activities and sources, the commonly cited 80:20 ratio of land-based and sea-based sources of waste in the oceans is not based on scientific work (GESAMP 2021). It is now believed that sea-based sources of waste contribute more to

marine litter than previously thought, and become more abundant further away from urban centres, for example in remote areas, open sea and on islands (Ryan *et al.* 2019). Sea-based sources of waste which have been reviewed (GESAMP 2021) include fishing and aquaculture activities, maritime activities such as shipping, oil and gas extraction and tourism, and other activities such as research. Additional sources may include military activities, the energy industry and dumping.

A census in 2022 estimated that globally, 4.1 million commercial fishing vessels are operating, with Africa contributing the second largest fleet of 23.5% of that total, equating to approximately 963 500 vessels (FAO 2022a). In African countries, as is the case in many developing countries, artisanal or small-scale fishers are key stakeholders in the fishing sector. Globally, artisanal fisheries support approximately 113 million people, with the African continent contributing the second largest work force of 12% of that total, equating to approximately 13.56 million subsistence fishers (FAO 2023). However, there is often little or no regulation of, or legislation for, the artisanal fishery sector which can lead to a limited understanding of the artisanal fisher's contributions to sea-based sources of waste (GESAMP 2016). While Africa's role in global aquaculture production remains low (Adeleke *et al.* 2020), production in multiple countries has grown in recent years (FAO 2022a) and the contribution of aquaculture to ALDFG is not well quantified (GESAMP 2021). As Africa has the second largest commercial fishing fleet globally, and currently an unquantifiable contribution of ALDFG by the artisanal fisheries and aquaculture, Africa needs to better understand its contributions to ALDFG and prioritise the implementation of best practices to prevent, mitigate and remediate fishing gear waste, as well as non-gear marine debris from fishing vessels, such as net repair needles, bait boxes etc.

1.2. Abandoned, lost or otherwise discarded fishing gear (ALDFG)

Most ALDFG is made of plastic (Macfadyen *et al.* 2009) and can include items, as classified by the International Standard Statistical Classification of Fishing Gear (ISSCFG) such as nets, pots, traps, ropes, fishing lines, floats, buoys and lures and non-plastic items may include hooks, sinkers and anchors (**Figure 2**). An estimated 46-86% of plastic, by mass, floating in the ocean is in the form of fishing nets (Lebreton *et*

***Figure 2**: A variety of abandoned, lost or otherwise discarded fishing gear (ALDFG) found along the coast of South Africa: (A) a buoy, (B) a jig, (C) bundle of fishing line, (D) lobster pot, (E) net, and (F) rope (note that rope may or may not be from fishing activities).*

al. 2018; Lebreton *et al.* 2022). ALDFG can enter the marine environment as a result of environmental (e.g. storms or rough sea), operational (e.g. spatial or temporal mismanagement) or enforcement (e.g. illegal fishing activities) drivers (Macfadyen *et al.* 2009; GESAMP 2021). The difference in terms as to whether gear is 'abandoned', 'lost' or 'discarded' is based on whether the owner/operator using the gear is or is not in control of it, and the owner/operator's intent (see **Box 1** for details).

Box 1: Definitions of ALDFG

Fishing gear may be left at sea for reasons such as gear conflict, bad weather or conflict with marine traffic.

Abandoned fishing gear: the owner/operator has control of the gear and could retrieve it but intentionally leaves it at sea due to bad weather or an unforeseen situation.

Lost fishing gear: the owner/operator does not have control over the gear and cannot locate and/or retrieve it.

Discarded fishing gear: the owner/operator has intentionally released the gear at sea and will not try to gain control of it or retrieve it.

Modified from GESAMP (2021) and Randall (2020)

***Figure 3**: A cat shark caught by hook and entangled in fishing line at Cape Recife, Gqeberha, South Africa (left), and an African sacred ibis entangled in fishing line at Kommetjie Beach, Cape Town, South Africa (right).*

ALDFG has a number of negative environmental and socio-economic impacts including seafloor damage (Consoli *et al.* 2020), entanglement (Jepsen and de Bruyn 2019; **Figure 3**), ghost fishing (NOAA Marine Debris Program 2015), gear conflict, loss of costly gear (Scheld *et al.* 2016), damage of property such as boats (Vlachogianni 2017), costs involved in clean-up efforts (UNEP 2017), reduced tourism value of

coastal areas (Qiang *et al.* 2020), and provides a habitat for, and assists in spreading, invasive species (García-Gómez *et al.* 2021; Miralles *et al.* 2018). Additionally, marine litter in the ocean, including ALDFG, can break up into smaller fragments to become microplastics which may be a potential source of toxic chemicals that may be harmful to marine life (GESAMP 2016). Due to the increasing understanding of ALDFG's impacts, several Best Practice Guides have been developed in recent years to prevent, mitigate and remediate ALDFG (see section 1.3.2).

1.3. Best Practices for ALDFG

1.3.1. Background

Previous best practice guides have developed clear yet broad measures to prevent, mitigate or remediate ALDFG, which are applicable globally for stakeholders including fishers, fishery management, port management and others. While most measures were developed to be applied worldwide, there is a need for the measures to be considered at a more localised level. Africa has a lack of resources and capacity with varying socio-economic and political landscapes (UNEP 2017). Furthermore, African fisheries are affected by piracy leading to gear being abandoned. Therefore, the globally developed guides for ALDFG are not always easily applied in the African context. This guide aims to consider the existing global best practice measures along with a guide specific to South Africa (Randall 2020) and apply and analyse them within the African context. By considering the measures in Africa, it is possible to share insights into how various African countries can take appropriate and manageable steps and actions to implement globally accepted best practice measures.

1.3.2. Literature

The widely known and accepted guides (**Figure 4**) which exist and were applied to the African context include:

- Environmental Investigation Agency. 2020. Nothing fishy about it: Meaningful measures on fishing gear at IMO. Available at: https://eia-international.org/wpcontent/uploads/EIA-report-Nothing-Fishy-About-It-IMO-Briefing-spreads.pdf.
- GESAMP. 2021. Sea-based sources of marine litter. (Gilardi K., ed.) (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP/ISA Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). Rep. Stud. GESAMP No. 108, 109 p. Available at: www.gesamp.org.
- Global Ghost Gear Initiative. 2021. Best Practice Framework for the Management of Fishing Gear: June 2021 Update. Prepared by Huntington T. of Poseidon Aquatic Resources Management Ltd. Available at: www.ghostgear.org/resources
- Giskes I, Baziuk J, Pragnell-Raasch H and Perez Roda A. 2022. Report on good practices to prevent and reduce marine plastic litter from fishing activities. Rome and London, FAO and IMO. Available at: https://www.fao.org/responsible-fishing/resources/detail/en/c/1480462/
- Hodgson S. 2022. Legal aspects of abandoned, lost or otherwise discarded fishing gear. Rome: FAO. Availaible at: https://www.fao.org/responsible-fishing/resources/detail/en/c/1469915/
- Macfadyen G, Huntington T, and Cappell R. 2009. Abandoned, lost or otherwise discarded fishing gear. UNEP Regional Seas Reports and Studies, No. 185; FAO Fisheries and Aquaculture Technical Paper, No. 523. Rome, UNEP/FAO. 2009. 115p. Available at: https://www.fao.org/3/i0620e/i0620e.pdf
- Randall P. 2020. South African Marine Fisheries and Abandoned, Lost and Discarded Fishing Gear. Cefas (Centre for Environment, Fisheries and Aquaculture Science). Commonwealth Litter Programme, South Africa. doi:10.13140/RG.2.2.30135.96162.
- WIOMSA 2022. Gap analysis report and developed guidelines on regulatory frameworks on marine litter in Africa [Unpublished report].

Figure 4: Best practice guides for ALDFG considered in this report.

A summary of the suggested best practice measures discussed in the eight publications can be found in **Table 1**. Noted in recent publications is that several of the suggested measures (for example, reduced soak times of gear) do not directly focus on ALDFG. Rather, the measures may indirectly assist in preventing, reducing or mitigating ALDFG (Drinkwin 2022).

***Table 1**: Globally suggested best practices for abandoned, lost or otherwise discarded fishing gear (ALDFG).*

Suggested action	Details
ALDFG data collection and monitoring	• Baseline data collection should be conducted. • Long-term monitoring should be conducted to assess trends in levels of ALDFG (Macfadyen *et al.* 2009), and can be a tool for awareness-raising and influencing policy. • Data collection should be harmonised for comparability of data.
Awareness campaigns	• Provide training, publications, workshops (Macfadyen *et al.* 2009) and awareness campaigns to fishers, fishery managers, port authorities, policy makers (GGGI 2021), tourists and the general population (GESAMP 2021; Giskes *et al.* 2022).
Fishery techniques and management	• New fishing techniques and fishery management policies or plans should be assessed by the relevant authorities for their potential environmental impacts. • Decision-making tools such as environmental impact assessments or strategic environment assessments can be used when assessing new techniques or policies (GGGI 2021).
Funding support	• Engage with private companies to support projects to prevent or reduce ALDFG. **Note**: Financial support for ALDFG projects tends to be difficult to secure, especially in less-developed countries. Private-public partnerships can help with seed money or continued support of a project (Giskes *et al.* 2022).
Gear design and modifications	Mitigation measures through the following modifications: • A longline's time tension line cutter (TTLC) uses a cutting blade that is triggered to cut the line when the line has been under continuous tension for a specified amount or once lines are under

	a determined amount of tension. Ropes may be weakened to allow marine life to break free (GGGI 2021). • Biodegradable gear (whole or partial): Some fishing gear, such as traps or FADs can be composed (either partially or as a whole) of biodegradable and non-entangling material, or gear may make use of rot cords (Randall 2020; GESAMP 2021; GGGI 2021). • To reduce occurrence of entanglements and ghost fishing, add components such as pingers, lights, reflectors, streamer lines or weak points (Macfadyen *et al.* 2009; Randall 2020).
Gear marking	• Gear can be marked by using transponders, marker buoys or Dahn floats, Dahn flags and/or radar reflectors (Macfadyen *et al.* 2009; GESAMP 2021). • Surface marking can be used for location purposes, and owner/operator marking for responsibility of gear (GGGI 2021). Marking can also be used to improve gear visibility (EIA 2020). • Gear marking may be costly and therefore be limited to large-scale fisheries or those with larger, more expensive gear (Macfadyen *et al.* 2009). Various tagging types, including coded wire tags (Macfadyen *et al.* 2009; GGGI 2021) or colour-coded wire (GGGI 2021) could be used instead. • There are a limited number of mandatory implementations, with most gear marking regulations currently voluntary (Randall 2020). **Note**: in some cases, fishers purposefully do not use marking due to the risk of theft (Lovell *et al.* 2023). It is uncertain whether this would be an issue in Africa.
Gear recovery	• To recover gear, conduct beach surveys, at-sea surveys (including those using videos and cameras to detect gear), diving surveys (Macfadyen *et al.* 2009; GESAMP 2021), clean-ups (Giskes *et al.* 2022) and creeping (Randall 2020; GESAMP 2021). • At-sea surveys can make use of modelling and local knowledge to find hotspots (GGGI 2021). Use trained recovery teams to remove ALDFG (Giskes *et al.* 2022).
Gear traceability	• Record ownership across the supply chain: marking manufacturer name, year of manufacture, batch number (if retailer is different to manufacturer, should include details in their records) (GGGI 2021). • The marking of FADs for traceability purposes needs to consider, for example, the following: - the use of FADs should only be allowed if they are marked. - FADs should have a unique physical identification mark and dFADs used for large-scale offshore operations could use satellite buoys to facilitate fisheries management. - the operator/owner of the FAD must be clearly defined since satellite buoys attached to FADs are often exchanged. - the relevant authorities should be notified by the FAD's operator/owner of the last know position of a FAD that is lost or abandoned. • For more details on marking of FADs, please see the FAO's *Voluntary Guidelines on the Marking of Fishing Gear* (2019).
Gillnet usage limitations	• Prohibited use of gillnets in deep-water due to increased risk of loss (Macfadyen *et al.* 2009). • Vessel required to remain in vicinity of fishing gear.
Navigational aids (e.g. GPS and sea-bed mapping)	• Use instrumentation to prevent gear from coming into contact with the seabed or other obstacles (reduced snagging and loss) (Macfadyen *et al.* 2009). • Ensure fishers are trained in correct use of navigational aids.

Partnerships and support	• Engage with large global partnerships such as GGGI and GloLitter Partnerships Programme to foster connections between similar organisations or potential funders (Giskes *et al.* 2022). • Learn from ALDFG campaigns elsewhere.
Port reception facilities (PRF)	• Improving fishing gear waste disposal at ports (Randall 2020; GESAMP 2021; GGGI 2021) can help prevent fishers from discarding gear at sea (see MARPOL Annex V Reg 7) (Macfadyen *et al.* 2009). PRF for either disposal or recycling, should link recyclers with port management; especially when recyclers are not near to the port. • PRF should involve gear manufacturers who buy discarded gear for repurposing and/or recycling. In addition to gear disposal, ports should include facilities for general waste disposal (Giskes *et al.* 2022). Port waste reception facilities should be assessed by relevant authorities to determine if they are suitable. Small ports and harbours have limited space and capacity which can create inadequate or absent waste facilities (Macfadyen *et al.* 2009). Adequate port waste facilities need to factor in the number and type of vessels using the port – fishing ports need to supply EOLFG reception facilities (GGGI 2021). To reduce concerns over cost to vessels it is best to include cost of port waste disposal into port fees rather than a standalone fee (Macfadyen *et al.* 2009; Randall 2020; GESAMP 2021).
Port waste management plan (PWMP)	• A PWMP should be used to improve the availability, adequacy and use of reception facilities by all vessels calling the port. PWMP must be regularly reviewed and updated (GloLitter 2022). • All ports and harbours should have a port waste management plan for various waste types, as per MARPOL requirements. A PWMP should also comply with international, national and local regulations regarding waste management.
Record ALDFG quantities	• Determine ALDFG quantities through surveys, clean-ups, interviews with fishermen and share the data (GESAMP 2021; Giskes *et al.* 2022)
Reduce fishing effort	• Limit time spent fishing or reduce amount of fishing gear active per vessel, or reduce soak time of passive gear as this can indirectly reduce ALDFG (Randall 2020; GESAMP 2021).
Reporting fishing gear loss	• Gear type and location should be reported in a timely manner by the gear owner/operator. • Integrate gear loss reporting into catch reporting logbooks or observer programmes, and amend MARPOL to include reporting of losses (Macfadyen *et al.* 2009; Randall 2020; GESAMP 2021). • For recording data, standardise the units for how gear loss is reported, as units will differ depending on gear type (GGGI 2021). Make use of check in-check out systems for fishing gear i.e. use a gear inventory (GGGI 2021) with a no-fault, no-penalty policy (GESAMP 2021; Giskes *et al.* 2022). • Develop a global data repository for gear loss reporting (EIA 2020).
Responsibility costs, extended producer responsibility (EPR)	• Through EPR schemes, claim back for partial or full cost of ALDFG recovery/clean-ups. • EPR could cover the costs of fishing gear waste collection at ports, transport, and treatment, as well as educational/awareness raising. EPR could support port costs, preventing increased port costs for improved waste facilities being felt by vessel operators and owners (GGGI 2021). • Gear recovery is costly, and it is difficult to place the responsibility

	on a particular party, but the cost of gear recovery (full cost or partial) could be supported through EPR.
Reward or deposit scheme	• Reward for the return of ALDFG to port by fishers (Macfadyen *et al.* 2009; GESAMP 2021; GGGI 2021). • Use of returned EOLFG as a deposit for new gear (GGGI 2021).
Spatial and/or temporal management (zoning)	• Zoning can be used to reduce gear conflicts and interactions with wildlife or habitats and other marine activities (Randall 2020; GESAMP 2021; GGGI 2021).
Third-party fishery certification (such as Marine Stewardship Council)	• Third-party certification should include gear loss and likelihood of ghost fishing into their scoring system.
Use of Remotely Operated Vehicles (ROVs)	• Make use of ROVs to obtain visual and real-time ALDFG litter abundance, to give gear recovery teams a preview of gear condition and density. **Note**: Use of ROVs requires suitable sea conditions (GGGI 2021).
Use of side scan sonar: sea-bed mapping technology	• Side scan sonar can be useful for locating large and easy to identify gear types, such as traps and pots (Macfadyen *et al.* 2009) and gillnets (GGGI 2021) and can identify possible sea-bed features which could cause gear damage or loss (Randall 2020).
Use of transponder technology	• Transponder technology could be used to determine location of gear by tracking it in the water (Randall 2020). **Note**: This technology is costly and therefore limited to large scale fisheries or those with larger, more expensive gear (Macfadyen *et al.* 2009). Passive devices attached to gear can be used, which bounce back sonar pings or sounds for the targeted ALDFG gear (GGGI 2021) so that lost gear can be located and recovered in real time (EIA 2020).
Use of Unmanned Aerial Vehicles (UAVs)	• UAVs can be used to assist in locating and plotting of lost gear in near-shore coastal areas within a depth of approximately 10 metres (hotspots). • UAVs can also map areas of high snag-risk (Macfadyen *et al.* 2009). In addition, there is potential for Artificial Intelligence (AI) to identify gear and estimate amounts from aerial imagery, saving manual processing time following aerial surveys (GESAMP 2021). **Note**: teaching AI to identify various types of waste, especially in water, may require a lot of resources (e.g. strong hardware and time; Edström 2022).
Vessel design - adequate storage	• Have sufficient on-board storage facilities for gear, bait boxes and waste as well as for catch. • Fishing vessels focus on catch storage and working space, rather than storage areas. Improvements to aid packing and storage solutions on-board vessels should be factored into vessel design (GESAMP 2021; GGGI 2021).
Vessel inspections at port	• Inspections may assist in ensuring users are respecting the regulations, including the prevention of illegal fishing (Randall 2020).

Vessel monitoring system (VMS)	• Assess VMS plots to identify possible areas of gear loss for recovery (Macfadyen *et al.* 2009). **Note**: VMS is not mandatory for all vessels and the regulations differ by country. For example, a VMS may only be mandatory for vessels above a certain registered length, or when fishing for a specific marine species.

1.3.3. Development of this guide

The guide was developed from a collaborative process, employing workshops, meetings and interviews with stakeholders who either have an understanding of African fisheries or have an expert knowledge of ALDFG and EOLFG issues. Stakeholders that were involved included fishery representatives, ALDFG researchers, government representatives and fishing gear manufacturers. Stakeholders were invited to an in-person, three-day workshop (**Figure 5**), and additional collaborators were invited to virtual meetings to review input to-date and to share their experiences through case studies. All efforts were made to include fishers' input in the development of the best practices guide, however, more input and involvement is always desired. In Africa, it is especially difficult to engage with artisanal fishers across the continent without face-to-face interactions. Should you, as a fisher (commerical or artisanal), wish to provide further input into the best practices guide, please reach out by emailing us at info@sstafrica.org.za. Furthermore, representatives from African countries were invited to respond to five short questions related to the state of ALDFG in their country. The five questions were:

***Figure 5**: Delegates at the Best Practices for ALDFG in Africa Workshop, Gqeberha, South Africa, in February 2023.*

1. Does your country collect data on abandoned, lost or otherwise discarded fishing gear?
2. Does your country have legislation for the reporting of fishing gear that is lost or found at sea?
3. Do the fisheries in your country mark any of their gear?
4. Do your country's ports have waste reception facilities for unwanted fishing gear?
5. What happens to most unwanted fishing gear in your country?

The questions were developed to allow a greater understanding of the experiences of African countries with fishing gear waste, and responses have been considered when discussing recommendations in **Chapters 2** and **3**.

1.3.4. Topics covered in this guide

The guide examines options on the types of data that should be collected, how that data should be collected and by whom, as well as who is responsible for reporting on ALDFG data (**Figure 6**). The potential challenges to both ALDFG data collection and data reporting are also considered. The guide examines the feasibility of marking fishing gear in Africa as well as exploring the modification of gear design, for example the use of biodegradable materials to replace traditional plastics, through partial or whole gear replacement, to reduce the degree of ghost fishing when ALDFG is created.

A lack of port reception facilities and suitable port waste management plans for EOLFG are often drivers for the creation of ALDFG (Gallagher *et al.* 2023; Mengo *et al.* 2023). The guide considers these particular aspects and examines options for recycling, repurposing, energy production and NGO-provided port waste facilities. Examples of the work already being undertaken throughout Africa are presented within the guide; case studies on gathering ALDFG data, providing outreach to communities to raise awareness of ALDFG and its implications, as well as innovative solutions for dealing with EOLFG.

***Figure 6**: Points for discussions and brainstorming at the Best Practices for ALDFG in Africa Workshop held in February 2023, in Gqeberha, South Africa.*

The review that follows is a culmination of input received from interested stakeholders across the African continent and is intended to provide support to African countries that wish to implement best practice measures for ALDFG within their country. A summary of the discussions held at workshops is provided in **Appendix 3**.

CHAPTER 2: RECOMMENDATIONS FOR ALLEVIATING ALDFG IN AFRICA

Figure 7: *An ALDFG net found on a beach in Cape Coast, Ghana. Such ALDFG largely goes unreported, and hence unrecorded.*

2.1. Background

Globally, but especially so for Africa, there is a lack of data on the abundance, distribution and trends of ALDFG (Richardson *et al.* 2019a; GESAMP 2021). It is only with data that we can begin to better understand the extent of the African ALDFG problem, determine its context-specific impacts and identify appropriate counter measures (GESAMP 2021). It is estimated that annually, 5.7% of fishing nets, 8.6% of traps and 29% of fishing line are lost globally (Richardson *et al.* 2019a). However, fishing gear losses to the environment vary by region and region-specific gear types (Richardson *et al.* 2019a). For example, in the North Pacific Garbage Patch, it is estimated that more than 75% of the mass of floating plastic litter is from ALDFG alone (Lebreton *et al.* 2022). Since no scientific estimates for ALDFG from the African continent have been published to date (Richardson *et al.* 2019a), there is a need to move towards harmonised studies across regional areas to quantify the abundance of ALDFG in Africa, and support global scale studies.

2.2. Data collection

2.2.1. What data should be collected in Africa and by whom?

In Africa, it is important to prioritise the recording of quantitative ALDFG data (**Figure 7**), and qualitative data can be recorded to support the quantitative data. The suggested types of data and responsible parties are listed in **Table 2** below.

It is important to note, there will be variation between the ALDFG data sources used.

- Fisheries independent data (not from fisheries) are likely to provide low volumes of data, with low variability in the data.
- Fisheries dependent data (from the fisheries) are likely to provide high volumes of data with high variability in the data.

***Table 2**: Types of ALDFG data that should be prioritised in Africa, with suggestions of parties responsible for collecting the data.*

Data type	Details	Who
Quantitative	Location, date, time of lost or found	Fishers, observers, NGOs, scientists
	Characteristics/types of gear lost or found	Fishers
	Manufacturer and sales records	Manufacturers, retailers, end-users
	Landfilled and stockpiled	Government
	Collected and recycled	Recyclers
	Observations/records of found gear. Mobile applications can be used to record found gear.	NGOs, researchers, fishers, citizen scientists
Qualitative	Social surveys (questionnaires, interviews) pertaining to observations and perceptions of fishers regarding ALDFG.	NGOs and researchers to conduct social surveys

2.2.2. How should ALDFG data be recorded in Africa?

Standardised units to describe the size of gear are needed across the continent, so that data can be spatially comparable. Within the Global Ghost Gear Initiative data portal, the most basic characteristic of gear is weight.

For Africa, it was advised that the units should be used in the following order of preference:

1. **Absolute weight of the gear item (in metric units)**
   It is important to distinguish between wet and dry weight. Gear found at sea will be wet and heavier than dry gear. Ideally, both wet and dry weight should be recorded. Note that biofouling of gear will add to the weight of the gear, and where possible, gear should be cleaned before weighing.
2. **Dimensions (in metric units)**
   Dimensions could be used to develop a conversion table for weight, once a large enough database of weight and related dimensions has been developed. The conversion factor would depend on the gear type.
3. **Categorical estimates**
   As a final option, weight ranges or classes (in metric units) could be used. Estimations, although imprecise, are especially important for ALDFG that cannot be accessed or is too large or heavy to be accurately weighed. In such cases, ranges or classes of weight such as “between 30 and 50 kg”, “between 50 and 100 kg”, “greater than 100 kg” are suggested.

It is important to note that measurements taken for collected ALDFG are not limited to only intact gear items. ALDFG may be found fragmented or broken and measurements are still needed in such cases. The fragments can be measured individually, and if it is clear that the fragments are pieces from the same gear item, their individual weights can be added together to get the weight of the whole original gear item. If it is not clear whether fragments are from the same item, it is best to record their weight as individual

items. However, it is important to note the material that the fragmented item is made of. For example, a fragment of hard plastic, a short piece of synthetic rope, or a piece of metal from a fishing hook.

In addition to standardised units, there is a need to standardise the names of gear for recording purposes. To do so, a photo library of types of gear in Africa and their accepted names in Africa, should be supported. One such classification that already exists, is FAO's classification and illustrated definition of fishing gears (He *et al.* 2021). Rather than reinventing the classification for Africa, it is advised to use FAO's classifications when recording gear types and identify any gear types that have not been included in the classification to date. By utilising this one gear classification system a harmonised naming convention is ensured.

2.2.3. Expected challenges for ALDFG data collection in Africa

a) IUU fishing activities

As in other regions of the world, illegal, unreported, and unregulated (IUU) fishing in Africa contributes to ALDFG in the environment (Macfadyen *et al.* 2009). IUU fishing may occur both within a country's EEZ or in the high seas and may be driven by economic, moral and/or social factors (Sumaila *et al.* 2006). West African coastal countries who permit foreign vessels to actively fish in their waters experience greater illegal fishing incidences (e.g. number of offenses identified during a vessel inspection by the Coast Guard), particularly from the foreign vessels (Belhabib and Le Billon 2022a). Vessels may also operate as an open register vessel (also known as a flag vessel), which is when the vessel operates under the flag of a country other than the country of its operator or owner (Marine Resources Assessment Group (MRAG) 2005). West Africa in particular, has been identified as an illegal fishing hotspot with associated non-fishing related crimes including drug trade (Petrossian 2018; Belhabib and Le Billon 2022b).

Due to the very nature of illegal fishing, if there is a risk of being caught, illegal fishers may intentionally abandon their gear into the marine environment. As this dumping at sea is done illegally, to hide IUU activities, it is an unquantifiable contribution to ALDFG in Africa. Additionally, illegal fishing often occurs under the cover of night to avoid being seen. With decreased visibility at night, gear is more likely to be lost. Organisations that track or monitor illegal fishing are advised to work with those studying ALDFG in an effort to estimate how much gear could be lost from illegal fishing activities.

b) Maritime sector contributions

Common items, such as ropes, found in the environment may incorrectly be attributed to fisheries, despite multiple maritime industries using them. By assigning all abandoned, lost or otherwise discarded rope to the source of fisheries, the contribution of fisheries to sea-based waste is over-represented. There is a need to distinguish fishery-application rope from rope used in other applications such as mooring rope. Colour-coding of ropes may be an option in Africa but needs to consider several issues, including a) the colouring must be acceptable by the users, b) it must consider wildlife conflict and c) the fading of colours from the seawater and exposure to ultraviolet (UV) light needs consideration. Additionally, it is important to include other maritime activities, not only fishing, when assigning responsibility for common items such as ropes.

c) Fishery contributions

Some fisheries may contribute more to ALDFG than others (GGGI, 2021; **Table 3**). Those with greater contributions, should be prioritised for the quantifying of their gear loss in Africa. In addition to the fisheries most likely to lose gear, it is important to consider the extent of the fishery – some fisheries may contribute more to ALDFG in Africa simply due to the sheer size of their operations.

***Table 3**: The total risk (potential likelihood and impact)* of different gear types becoming ALDFG. The potential likelihood and impact are scored out of 5 where a score of 1 is very low and 5 is very high. Adapted from GGGI 2021.*

Gear type	Likelihood of loss	Impact once lost	Total risk
Gillnets	5	5	25
FADs	5	4	20
Traps and pots	4	4	16
Longlines	3	3	9
Bottom trawl	2	3	6
Hooks and lines	3	2	6
Mid-water trawl	1	2	2
Seine nets	1	2	2

* **Likelihood of loss**: this is the possibility that a specific fishing gear will become ALDFG. **Impact once lost**: the impact that a specific gear type, once it becomes ALDFG, has on aquatic organisms and the environment in general, and considers a) the likelihood of ghost fishing, b) the risk of entanglement of mammals, reptiles and birds, c) potential damage to the habitat, d) degradation of the plastic elements of the gear leading to the production of microplastics and consequently the release of plastic-related pollutants.

d) Community engagement

The need for capacity building, education and awareness raising across all stakeholder groups is a high priority in Africa, as in all regions (Richardson *et al.* 2021). It is with awareness raising that stakeholder groups may understand the reasons for the urgent need to prevent, mitigate and remediate ALDFG and be more willing to implement best practice measures. It is important to focus on the negative impacts that ALDFG can have both directly (e.g. on fish stocks) and indirectly (e.g. on jobs associated with fishing such as sales of fish) on fishers and communities as a whole. In addition, there is a need to build trust with communities and/or stakeholder groups that the best practice measures apply to – for example, small-scale and commercial fishers. The implementation of measures is more likely to be successful if all stakeholders are involved in their development.

2.2.4. Case studies of ALDFG in Africa

***Case study 1**: Finding solutions for mitigating the negative impacts and marine waste of drifting fish aggregating devices (dFADs) in the Atlantic and Indian Oceans*

By: David M. Kaplan

***Figure 8**: A drifting FAD in the process of being deployed by a purse seine vessel. Visible is the square surface raft and floats, to which a tracking buoy will be attached, as well as the 30-80 m subsurface cord.*

Drifting fish aggregating devices (dFADs) are artificial rafts deployed by tropical tuna purse seine (PS) fishers (among others) to aggregate tunas and facilitate their capture (**Figure 8**). These devices are associated with a number of negative environmental impacts, including juvenile catch, higher bycatch than fishing on tuna schools not associated with floating objects and generation of ALDFG. Many of these impacts have been quantified via a series of publications based on catch-effort and dFAD trajectory data from the French purse seine fleet operating in the Atlantic and Indian Oceans (Kaplan *et al.* 2014; Maufroy *et al.* 2017; Imzilen *et al.* 2021, 2022, 2023; Wain *et al.* 2021; MacMillan *et al.* 2022; Pons *et al.* 2023; Vogt-Vincent *et al.* 2023). There are several major take-home messages from these studies. One is that dFADs are indeed associated with very real negative environmental impacts. Over 100,000 of these devices are deployed globally each year (Maufroy *et al.* 2017; Escalle *et al.* 2021), boosting fishing efficiency to potentially unsustainable levels (Wain *et al.* 2021). More than 40% of dFADs drift outside fishing grounds (Imzilen *et al.* 2022) where they either sink in the open ocean or, for at least 15-25% of all deployed dFADs, strand in coastal environments (Imzilen *et al.* 2021; MacMillan *et al.* 2022). Though the contribution of dFADs to total marine waste is small, they are a major component of large-sized marine waste from fisheries (Gilman *et al.* 2021).

A second take-home message is that when developing management responses to these impacts, it is important to bear in mind that fishing with dFADs yields a major source of relatively inexpensive protein, catching over 1.5 million tonnes of tuna each year (Pons *et al.* 2023). Tropical tunas are among the most robust fish species to exploitation on the planet (e.g. no tuna fishery has ever really collapsed) and PS fishing has a low carbon budget, equivalent to that of aquaculture for tilapia and over five times lower than that of terrestrial beef production (Parker *et al.* 2015). Tropical tuna PS bycatch rates are low relative to many other fishing gears, such as longline and gillnets (Kaplan *et al.* 2014). Therefore, it is important to find efficient solutions to their negative impacts without eliminating these benefits.

Fortunately, a growing body of research indicates that solutions can be found to many of dFADs' negative impacts. For example, Imzilen *et al.* (2021) showed that appropriately-placed spatial closures for dFAD deployments can significantly reduce strandings without necessarily impacting catch. Imzilen *et al.* (2022)

showed that there is strong potential for recovering dFADs at sea before they are lost or discarded, and there has been major progress on limiting the number of dFADs and making them more biodegradable (Zudaire *et al.* 2021). Nevertheless, putting these solutions in place will require several concrete actions from scientists, managers, fishers, NGOs and civil society. Among them, one key action is making dFAD tracking data much more widely available, particularly when dFADs enter coastal areas, exit fishing zones or are otherwise declared no longer of interest to the fishery. This will allow scientists to fully quantify their impacts and empower civil society to decide on appropriate cleanup or recovery measures, instead of letting industry decide what to do (or more often not do). Another action is that a polluter-payer system needs to be implemented so that dFAD cleanup efforts are properly funded by those that are producing the impacts. Finally, NGOs and other civil society actors need to organise and collaborate with scientists, managers and fishers so that dFAD recovery programmes and/or mitigation measures can become a reality.

***Case study 2**: Baseline ALDFG data collection in South Africa*

By: Danica Marlin and Tayla Gifford

No baseline data exist for the amounts and types of ALDFG in South Africa. Data are needed to know the extent of the ALDFG issue in the country so that appropriate interventions can be taken to prevent, mitigate or remediate ALDFG. To address this lack of data, Sustainable Seas Trust (SST) has been collecting information and data on discarded fishing gear, inside and outside of Algoa Bay, Gqeberha (previously known as Port Elizabeth), since August 2022.

Algoa Bay has several inshore commercial fisheries, including purse-seine for small pelagic fish, chokka-squid jig fishery, demersal shark longline and inshore demersal trawl for shallow-water Cape hake and East Cape sole (Chalmers *et al.* 2014; Holness *et al.* 2022). Subsistence fisheries are not well quantified but low numbers have been indicated previously (Chalmers 2012). The number of subsistence fishers is exceeded by the number of recreational fishers which include rock and surf (i.e. coastal angling), spear and offshore boat fishing (Mann *et al.* 1997; McGrath *et al.* 1997; Sauer *et al.* 1997; Chalmers 2012). Algoa Bay also houses a bivalve (oyster and mussels) mariculture facility (Algoa Bay Project 2019). In addition to the fishing activities, Algoa Bay has two ports, the Port of Port Elizabeth and the Port of Ngqura. The Port of Port Elizabeth is a multi-purpose port for, among other things, the fishing industry, while the Port of Ngqura is primarily for container handling. With the presence of two ports, Algoa Bay experiences high shipping (Algoa Bay Project 2019) and fishing vessel traffic and was therefore an ideal area to begin monitoring ALDFG in South Africa.

SST is collecting ALDFG data (amounts and types) inside and outside of Algoa Bay using different approaches: 1) fishing gear is collected every two months for a week, with gear being collected from 100 m long transects at eight popular recreational fishing sites on rocky shores, and 2) fishing line bins (**Figure 9**) have been placed at selected sites in Algoa Bay to encourage recreational fishers to dispose of their gear responsibly, and the gear in the bins is collected every two weeks for analysis. Additionally, a network of data collectors across South Africa has been established to report on ALDFG found along the country's coastline (**Figure 10**). The data collectors have received online training on how to collect and report data, and all collectors use the same datasheets to ensure the data are comparable. The data collectors send their data to SST and this

feeds into an ALDFG database. All ALDFG is removed during the surveys and disposed of responsibly, except heavy gear e.g. heavy and long ropes, which are reported to the municipality for removal. Data collection is planned for the long term to determine trends and changes in ALDFG in South Africa. Eventually, the aim is to expand the data collectors network to other African countries.

***Figure 9**: A fishing line bin installed at Noordhoek, a popular recreational fishing spot in Gqeberha, South Africa.*

***Figure 10**: Distribution of data collectors contributing to the SST database on ALDFG along the South African coast.*

2.3. Reporting and record keeping

ALDFG gear reporting involves the maintenance of records for fishing gear that has been known to be found, abandoned, lost or otherwise discarded. When the location of lost or found gear is reported, it may allow for gear to be retrieved, assist in identifying hotspots of lost gear and support a greater understanding of the causes of losing gear (Gilman *et al.* 2016; Drinkwin 2022). Commonly suggested information to report on includes: the gear type, location and time that gear was lost, the owner/operator (fisher and/or vessel) and a reason for the loss (Richardson *et al.* 2019b; Drinkwin 2022).

2.3.1. Reporting of lost or found gear

It is advised that the reporting of lost or found gear be brought into legislation for reporting to be successfully implemented in African countries. The development of legislation in Africa may be a long process, and countries may need to make use of by-laws (legislation made by local authorities) to allow reporting to begin while the national legislative process takes place. Under MARPOL Annex V, owner/operators have a responsibility to report the loss or discharge of fishing gear into the environment, to the flag State. However, the responsibility to report lost gear does not apply in all circumstances, but rather when the gear may pose a "significant threat to the marine environment" and "where the loss or discharge occurs within waters subject to the jurisdiction of a coastal State" (regulation 7.1.3 in MARPOL Annex V, see also Hodgson 2022).

2.3.2. How should lost or found gear be reported?

Reporting of ALDFG could be achieved if reporting conditions are part of fishing permits. Importantly to note, however, is that this would not apply to all African fisheries, such as the Kenyan octopus fishery, that have open access fishing rights. Gear loss reporting could be incorporated in the following ways:

- Including gear loss events in mandatory vessel trip reports.
  - Gear loss reports should not only report on whole gear loss, but also include when portions of gear (for example, panels) are lost.
- Recording gear quantities when exiting and entering ports.
- Penalties when lost gear is not reported.
  - It should be noted that this is not necessarily easy to determine without pairing with the recording of gear quantities at port. If gear is not reported prior to exiting ports and is then lost at sea but not reported, it is difficult to identify those who are not reporting.
- Establish community-based forums and whistleblower phone numbers for the public and fishers to report occurrences of illegal dumping of gear.

Important considerations:
The above listed methods to report gear loss are more easily implemented by formalised, commercial fisheries. The same ways of reporting are likely not suitable for artisanal fisheries. Artisanal fishers may be incentivised to report lost gear, but this needs to be carefully considered as the existence of the lost gear would need to be confirmed before any incentives are provided. However, reporting of lost gear by artisanal fishers has been successful in Ghana, see section 2.3.4.

2.3.3. Expected challenges with lost or found gear reporting in Africa

Non-African countries such as Norway and more broadly the European Union, have legislation regarding the loss of gear at sea, which places responsibility on the vessel to retrieve their gear (Hodgson 2022). However, the reporting and retrieving of lost or found gear is currently not mandatory in most African

countries (based on workshops discussions, but please see the footnote[1]). Consequently, there are no systems in place that identify the responsible parties for reporting to occur i.e. who is responsible for the reporting, and who for record keeping and maintenance?

a) Gear conflict

Gear conflict can cause gear loss, and the responsibility of reporting needs to be considered. If gear is lost, it should be reported by the owner/operator of the gear. Spatial and/or temporal management of fisheries would reduce the occurrence of gear conflict and resulting gear loss, and is a common measure suggested in fisheries best practice guides.

b) Enforcement

The enforcement of reporting lost or found gear was raised as a concern. Legislation alone is not enough to ensure that lost or found gear is reported; there needs to be enforcement of the legislation. In many African countries, enforcement may be difficult due to limitations in resources and capacity. For example, South Africa only has two vessels dedicated to patrolling the entire coastline (1,740 miles or 2,800 kilometres), and patrolling is restricted to identifying IUU and is not used for reporting lost gear (South African Maritime Safety Authority, pers.comm.).

c) Data management

An important consideration for the reporting of ALDFG is to determine the management of the reported data. A recommendation is to have the data managed by a local authority per region.

d) Incentives

i. Monetary

Incentives should be provided for those who declare the losing or finding of fishing gear in the environment. However, incentives need to consider the health and safety of vessels at sea. It is not wise to create such a great incentive that vessel crew would risk endangering their safety to haul in gear even if this may result in placing themselves and/or their vessel in danger. It is important to note there was disagreement regarding monetary incentives among the workshop delegates, with some delegates strongly objecting to their use.

ii. Non-monetary

Incentives do not need to be directly monetary. It is of great value for fishers not to have ALDFG in the environment – ALDFG can damage active gear, be a navigational hazard, harm marine habitats and ghost fish. With greater focus on community engagement, it is possible to highlight the ecological incentives of declaring and retrieving ALDFG. By declaring ALDFG, fishers also add data to the development of an ALDFG database.

[1] *In Kenya, it is mandatory to report an incident where a vessel becomes entangled with fixed fishing gear, and an authorized officer can apply to the Court to dispose of fishing gear if the officer believes the gear has been abandoned (Kenya Fisheries Management and Development Act of 2016). However, the Act does not mention any other reporting relating to ALDFG.*

2.3.4. Case study for reporting of ALDFG in Africa

***Case study 3**: Ghana's fish landing beaches and lost gear reporting system*
By: Anthony Appiah and Tayla Gifford

In Ghana, fish is the preferred and a cheap form of protein and accounts for 60% of animal protein intake by the population, making the country one of the top consumers of fish globally (Sarpong *et al.* 2005; FAO 2014). Dominant fish species targeted include small pelagic (e.g. round and flat sardinella *Sardinella aurita* and *S. maderensis*; European anchovy *Engraulis encrasicolus*) and large pelagic fish (e.g. yellowfin tuna *Thunnis albacares*), demersal fish (e.g. gilt-head bream *Sparus aurata*) and molluscs and crustaceans (Sarpong *et al.* 2005). The marine fishing industry of Ghana includes artisanal, semi-industrial and industrial sectors. Artisanal fisheries are currently open access and contribute the greatest in economic value, operating from beaches using dug-out canoes with gear including gillnets, seine nets (purse- or beach-seine), or fishing line (Akyeampong *et al.* 2013). The semi-industrial fisheries are license-controlled and make use of wooden vessels with improvised inbuilt engines of approximately 450 hp, and the gear used includes trawl and purse-seine nets. Lastly, industrial fisheries are license-controlled and make use of steel-hulled motorised vessels with gear including trawl and purse-seine nets, pole and line (Addi *et al.* 2016).

A lack of policy on fishing gear specifications has been identified as a challenge against effective fisheries management and enforcement of fisheries laws, in both the artisanal and industrial sectors. Making gear specifications a component of existing licencing conditions for the semi-industrial and industrial fishers would require constructive engagement of all stakeholders including vessel operators, enforcement officers, crew and crew managers, fisheries inspectors, observers and fish wholesalers, to ensure successful implementation.

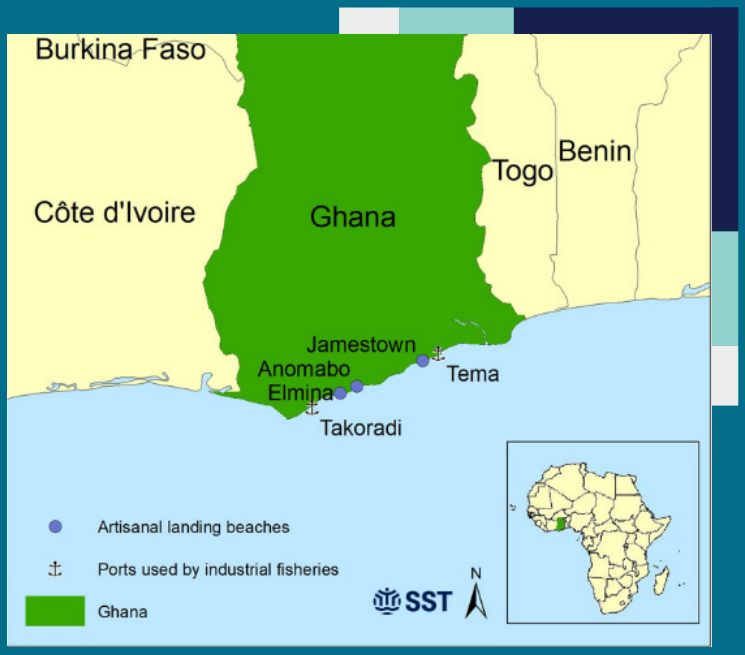

Figure 11: Ports used by industrial fisheries, as well as three out of the estimated 300 fish landing beaches in Ghana.

Ghana is home to approximately 300 beaches used for landing artisanal catch for the marine fishing industry. Artisanal fish landing beaches include Jamestown, Elmina and Anomabo (**Figure 11**). The fish landing beaches are important gathering places for fishers to bring their catch and engage in local trade. In the case of industrial fisheries, vessels make use of two ports (Tema and Takoradi) where they offload their catch to the local market and to processing plants for export. Each of the beaches has a Chief Fisherman, who is a respected leader responsible for co-managing artisanal fisheries, managing landing beaches, enforcing fisheries by-laws and assisting in improving data collection and records. In cases where gear is lost, fishers return to their landing beach and report the loss to the Chief Fisherman. The exact process of reporting may differ between landing beaches but may keep to the general outline as follows:

The Chief Fisherman announces the lost gear and asks that it be brought back to the landing beach if found. The Chief Fisherman also informs Chief Fishermen of nearby landing beaches, so that they too can ask that the gear be brought back if it is found.

If the lost gear is found, the fisher will identify and collect their lost gear, and the individual who found the gear is rewarded a small token, to recognise their efforts. By promoting the reporting of lost gear, Ghana fishers may assist ALDFG in being better quantified, and potentially retrieved.

2.4. Gear recovery – is it a viable option for Africa?

In Africa, gear recovery at sea is a viable option but it would require the formulation and adoption of policies and plans to ensure that ALDFG's offshore recovery trips are feasible and successful. Some of the challenges to gear recovery encountered in Africa include:

- Environmental conditions – waters, specifically in West Africa, may be murky and therefore retrieval of gear by divers is difficult as visibility may be very low. Creeping for gear may be possible and is not reliant on good visibility, however, creeping should only be used in habitats not sensitive to towed gear.
- Weak enforcement of laws to protect the marine ecosystem. For example, the reporting of lost gear and the retrieval of gear is not mandatory.
- Lack of resources and equipment, such as vessels with warp tension meters, underwater drones, appropriate diving gear and underwater airlift bags for ALDFG gear retrieval diving.
- Lack of a dedicated body of divers that specialise in gear retrieval.
- Lack of skippers and crew with gear retrieval experience.
- Lack of appropriate training of fishers or divers focused on gear retrieval.
- High cost of gear retrieval trips.
- Health and safety risks of fishing gear recovery divers.
- Lack of data on ALDFG to establish hotspots where gear recovery may be viable.

2.5. Gear marking and modifications

Most modern-day fishing gear is composed of plastic. The plastic material creates strong and durable fishing gear that can tolerate the harsh conditions of the ocean: saline water, UV damage, rough seas and heavy loads. However, plastic persists in the environment for decades to come (Chamas *et al.* 2020). Many measures aimed at reducing ALDFG focus on the prevention of gear becoming ALDFG in the first place to prevent any negative impact. However, in cases where gear does become ALDFG that can lead to ghost fishing, some measures to alleviate its potential negative impacts include modifications, such as making gear or parts of it from biodegradable materials, and gear retrieval (Drakeford *et al.* 2023). It has been noted that for fishers to consider using biodegradable gear, some financial assistance would be required (Drakeford *et al.* 2023).

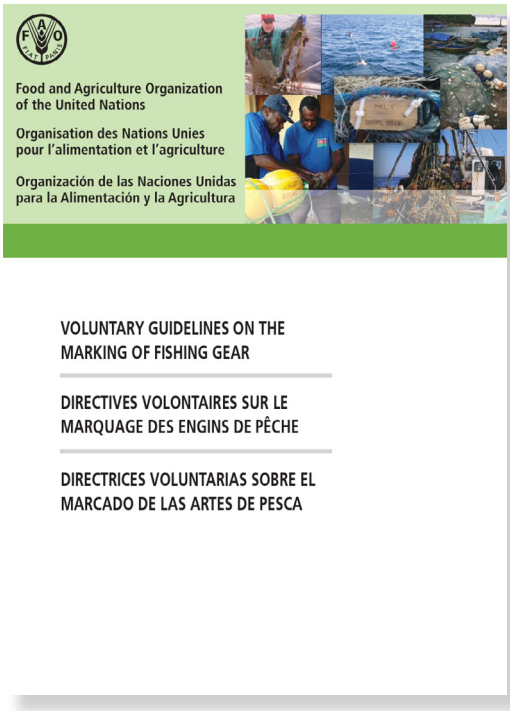

***Figure 12**: FAO's guide to voluntary marking of fishing gear.*

The marking of fishing gear ensures the gear owner/operator can be identified, and it is considered a valuable measure for the reduction of ALDFG and aids in the reporting of lost or

found gear and ALDFG retrieval (FAO 2022b). FAO advises that all types of fishing gear should be marked, unless the relevant authority decides otherwise after conducting a risk and feasibility assessment. Gear marking guidelines have been developed by FAO (2019; **Figure 12**).

2.5.1. Gear marking

It is advised that African countries make use of FAO's guidelines for voluntary marking of gear (FAO 2019). For Africa specifically, it remains best to keep gear marking as voluntary, due to the potential costs involved. Should marking be made mandatory in Africa, focus should first be on large commercial operators for trial purposes. Importantly, all marking recommendations need to be considered in close consultation with the users (fishers), and the marking of gear must not interfere with the fishing efficiency or be costly. Gear types in Africa that are easiest to mark, and should be prioritised, are FADs as well as fishing pots and traps. Marking needs to consider the spacing of the mark, the additional weight added to the gear, the components most likely to be lost and the cost.

2.5.2. Biodegradable gear in Africa

Biodegradable alternatives to traditional plastic fishing gear are being explored in a number of countries (Cerbule *et al.* 2023; Kim *et al.* 2023; Mengo *et al.* 2023) and may be part of the solution to ALDFG in Africa.

Several important aspects need to be considered before biodegradable gear can be brought to market:

- Research and development into biodegradable alternatives to plastic fishing gear, bearing in mind that fishing nets were once made from cotton and hemp, both of which are biodegradable.
- Cost
- Feasibility

Certain gear types can be biodegradable, either partially or fully. FADs, pots and traps can be modified to include biodegradable panels or rot cords, which will not impact fishing efficiency. Several tuna RFMOs have, in recent years, established resolutions enforcing the use of nonentangling FADs and encouraging biodegradable FADs (IATTC 2022; Murua *et al.* 2023) to reduce incidences of ghost fishing and marine entanglement.

There are, understandably, concerns raised by African fishers on the cost and greater wear and tear of biodegradable gear. Due to the very nature of biodegradable gear being made to degrade faster than conventional plastic gear, fishers may need to replace their fishing gear more frequently. In Africa, fishing gear is maintained and repaired for as long as possible, as a cost-saving technique due to the high expense. Small-scale or artisanal fishers may be apprehensive to switch to biodegradable alternatives. For biodegradable fishing gear to be suitable for Africa, it will need to be targeted towards specific markets such as large commercial fishing companies which tend to be more inclined to consider sustainability as part of their corporate social responsibility. Where possible, it is advised to introduce biodegradable components, rather than replacing entire gear items (e.g. as a deliberately sacrificial component to trawl nets, dolly rope is a prime candidate for being replaced by biodegradable material). Aside from biodegradable gear components, non-biodegradable gear in Africa should be manufactured when viable, using monopolymer plastics (plastics that are made from a single type of polymer), to increase the likelihood of recycling. Plastic items made from multiple polymers can be difficult to recycle (de Mello Soares *et al.* 2022).

2.5.3. Case study for biodegradable fishing gear*

***Case study 4**: A collaborative research project on biodegradable fishing nets*
By: Emma Algotsson and Terry Achieng

One of the most visible impacts of marine sector waste is the ingestion, suffocation, and entanglement of marine species in dumped or lost fishing nets. Equally harmful, but perhaps less obvious to the eye, is when marine litter breaks down from UV exposure and mechanical wear and tear, into small particles of plastic. Microplastics from fishing nets that enter the marine biosphere as abandoned, lost or otherwise discarded waste cause harm to marine organisms and marine ecosystems.

Catchgreen is a cross-sector collaborative research project that aims to replace environmentally harmful nylon and polyethylene ropes and fishing nets with biodegradable alternatives, made in an innovative application of Biodolomer®, by Swedish-based GAIA Biomaterials. Fishing gear made in Biodolomer®Ocean does not float, but rather sinks to the bottom of the ocean due to its high density, limiting or eliminating trapping or killing of marine life, compared to conventional fishing gear. Even though there is still more research work needed before Biodolomer®Ocean is commercially available, it is expected that its degradation at sea will leave no microplastics, and it can also be industrially composted, where it breaks down into beneficial agricultural mulch. Laboratory trials show that Biodolomer®Ocean takes approximately two years to break down into biomass, water and carbon dioxides.

Catchgreen has teamed up with the South African fishing industry and two research institutes (Kenya Marine and Fisheries Research Institute (KMFRI) in Kenya, and Stiftelsen for industriell og teknisk forskning (SINTEF) in Norway) to pilot Biodolomer®Ocean fishing nets and ropes in real-life conditions. The first manufacturing trials took place at ALNET, a fishing nets manufacturer, in Cape Town, South Africa. The core objective of the trials was to understand how the developed biopolymer would function and behave under different settings (temperature, pressure, processing speed). One of the challenges identified so far, is the preconditions of biodegradable fishing gear that meet accepted standards for biodegradability and composting ability, whilst simultaneously performing with the same efficiency as conventional ropes and nets. Other trials of Biodolomer®Ocean ropes are underway in Kibuyuni village in Kenya (**Figure 13**), where women have planted seaweed with the biodegradable ropes side by side with normal plastic ropes and compare the growth rate of the seaweed and dry biomass of the two ropes. The ropes are tested regularly for strength and biodegradability. Bringing seaweed farming and scientific research to the village is capacitating women to take ownership of the marine environment on which they depend for their livelihoods.

**We note that there are uncertainties over the microplastic production of naturally biodegradable plastics. The views expressed in this case study do not necessarily reflect Sustainable Seas Trust's official policies.*

***Figure 13**: Seaweed farmers in Kibuyuni village in Kenya are testing Biodolomer®Ocean ropes.*

Catchgreen is under contract to deliver research outputs and outcomes for the Sustainable Manufacturing and Environmental Pollution (SMEP) programme. The UK Government funds this research through UK Aid. The views expressed herein do not necessarily reflect the UK government's official policies.

CHAPTER 3: END-OF-LIFE OPTIONS FOR FISHING GEAR

***Figure 14**: End-of-life fishing nets and ropes at a collection point in Nigeria, as part of the Fishing Net Gains project run by the SOFER Initiative. The nets and ropes have components made from different materials e.g. metal, ropes composed of different plastic polymers, making them difficult to recycle but not necessarily difficult to repurpose.*

3.1. Background

Once fishing gear has reached end-of-life (EOL), measures need to be put in place to dispose of it responsibly. Currently in Africa, most EOLFG goes to landfill. In South Africa, nets are considered as hazardous waste and are therefore disposed of at hazardous waste landfill sites, which is expensive (TNPA pers. comm.). Due to the condition of EOLFG regularly being fouled and deteriorated (from exposure to UV and sea water), landfilling is often the most suitable pathway of disposal (Lebrasse 2021). Biofouling organisms may cover ALDFG within one year of submersion in water (Enrichetti *et al.* 2021). Even though biofouling and deterioration occur, gear can be recovered and cleaned, and thereafter recycled or repurposed. For example, fishing nets have been repurposed in various ways; as soccer goal nets, garden fencing or hammocks, to give just a few examples.

Across five communities in Nigeria and one in Cameroon, 65% of respondents stated that EOL nets are *buried*, 29% of respondents *burned* their EOL nets, while 11% of respondents *repurpose* EOL nets by using them as sponge and barricades for small farms (unpublished data, SOFER Initiative). This chapter discusses various options for EOLFG and recovered ALDFG in Africa, by drawing examples from countries outside of Africa and determining whether these solutions are feasible in African countries.

3.2. Options for end-of-life fishing gear

3.2.1. Recycling of fishing gear

Fishing gear recycling can be difficult because of the composition of synthetic fibres, as well as other materials (**Figure 14**), from which gear is made, e.g. trawl nets are made from plastic in the form of polypropylene, polyethylene and nylon, and also rubber and steel (Feary *et al.* 2020). Fishing nets are mostly made up of Polyamide (PA), High Density Polyethylene (HDPE) or Polypropylene (PP), and the ease of recycling these various plastics differs (Basurko *et al.* 2023). Frequently, fishing gear is a composite of a large number of polymers making recycling very complex (de Mello Soares *et al.* 2022). Furthermore, the presence of contaminants and minerals from the ocean makes recycling more difficult. EOLFG that is biofouled must be thoroughly cleaned both for the purposes of recycling or repurposing. Nets can be washed to remove salt, debris and soil. However, the economic cost of cleaning the nets should be taken into consideration when opting for gear recycling as a solution to EOLFG.

Fishing gear recycling can be done either through material recycling or thermal processing, both of which have advantages and disadvantages. The decision to use material recycling or thermal processing will depend on various factors such as the type and condition of the gear, the availability of processing facilities, and the economic feasibility of the process. Ultimately, the goal is to find the most sustainable solution based on the options available to handle EOLFG processing locally.

***Figure 15**: Repurposing of end-of-life fishing nets to make hammocks, Kenya.*

Gear recycling in Africa is carried out by organisations that collect or retrieve nets in Africa, store them and finally ship them to recycling facilities in Europe or America. There are a few recycling plants globally that, according to their websites, accept fishing gear for recycling and incorporating into some of their products. These include Aquafil, Plastix, Baden Aniline and Soda Factory (SASF), Trinamix GmbH, and Bureo*. These companies specialise in recycling fishing gear and other forms of plastics through a mechanical process that involves separating the different plastic waste materials and breaking them into constituent molecules before being used to produce new products. While these companies are among the leaders in the recycling of fishing gear, none of them are located in Africa, which means transport costs may make recycling in Africa non-viable. Additionally, the carbon footprint of transporting gear to another country must also be considered. Therefore, there is still a need for further innovation and investment in this area to develop more sustainable and efficient solutions for managing EOLFG. With the lack of proper recycling facilities in Africa, an alternative solution is repurposing, as discussed next.

3.2.2. Repurposing of fishing gear

Fishing gear repurposing has been accomplished on a small scale in some coastal communities in Africa. In Nigeria, local farmers use unwanted gear as barricades to protect small farmland against pests and rodents, trawl nets are tied under trees as makeshift swings for relaxation while some local women convert the nets to sponges for washing utensils and bathing (SOFER Initiative, unpublished report, also see 3.2.6), and in Kenya EOL fishing nets are repurposed as hammocks (**Figure 15**). Many African countries

**SST does not accept responsibility for incorrect information given on these websites. Please contact the businesses directly for more information.*

are classified as underdeveloped, or developing (Siyum 2018), and the repurposing of gear can bring economic benefits to coastal communities. Importantly, there needs to be a market for the repurposed items, which varies regionally. Due to the frigidity of EOLFG, it is difficult to repurpose and even when it is repurposed, the quality of the finished product can be below the desired market standards, making it a daunting task to drive sales.

3.2.3. Combustion of fishing gear to generate electricity

End-of-life fishing gear may be used as fuel through pyrolysis which does not require the cleaning or drying of the fishing gear (Schneider *et al.* 2023). There is a possibility of burning EOLFG to generate electricity, but in Africa, this may not be feasible as facilities required to do so are limited.

3.2.4. Port considerations

Under MARPOL, ports are responsible for providing adequate port waste reception facilities (**Figure 16**). Additionally, MARPOL Annex V Regulation 8(2) requires that IMO be notified when port facilities are found not to be adequate (Hodgson 2022). There is limited information available on ports and their waste reception facilities in Africa, which makes it difficult to ensure that adequate port waste management takes place. The limited reports available indicate that the infrastructure of several African ports is in disrepair, with improvements to waste facilities at ports being very costly, hampering the process of complying with MARPOL regulations. The provision of efficient and cost effective port reception facilities is crucial to the management of EOLFG. The cost of using the facilities at some ports in South Africa has been known to cause vessels to withhold their waste (APWC 2020). Port facilities enable easy monitoring, easy access to data, accountability, transparency, and collective responsibility to properly dispose of EOLFG. According to MARPOL Annex V, any form of garbage is prohibited from being discharged at sea. MARPOL further obliges signatory countries to provide adequate waste reception facilities at ports and terminals for the collection of garbage from ships and vessels. Currently, 34 African countries[2] have ratified MARPOL Annex V. However, not all ports in Africa have been able to provide these waste management facilities, therefore garbage from ships and vessels may be dumped at sea indiscriminately. In Nigeria, SOFER Initiative has introduced a solution for port waste reception facilities called the Fishing HubNet, which is a solution for ports that are unable to provide such facilities (see 3.2.6. for details).

***Figure 16**: Skips for hazardous waste provided as part of port waste reception facilities at the Port of Port Elizabeth, Gqeberha, South Africa.*

3.2.5. Extended Producer Responsibility

An environmental policy approach where the producer or manufacturer of a product or item is responsible for its EOL options and its health and safety issues, i.e. an extended producer responsibility (EPR) approach, is necessary to curb the environmental effects of ALDFG. This approach is intended to ensure that producers are operationally and financially responsible for their waste and encourage them to divert

[2] *Algeria, Angola, Benin, Cabo Verde, Cameroon, Comoros, Congo, Côte d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Libya, Madagascar, Malawi, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Nigeria, São Tomé and Principe, Senegal, Siera Leone, South Africa, Tanzania, Togo, Tunisia (https://www.ecolex.org; ECOLEX is an information service on environmental law, operated jointly by FAO, IUCN and UNEP).*

such waste away from landfills and promote recycling. However, EPR has its challenges, especially when producers or manufacturers are permitted to self-regulate, for instance, by setting their own levies.

Several EPR programmes have been introduced for certain products in Africa. For example, in 2021 South Africa introduced legally binding obligations for producers and importers of paper and plastic packaging in terms of the Regulations regarding Extended Producer Responsibility, 2020 published under Government Notice R.1184 in Government Gazette 5 November 2020 to give effect to section 18 of the National Environmental Management: Waste Act 2008 (Plastics SA). In 2014, the Nigerian Federal Ministry of Environment adopted the EPR policy (for packaging items and other waste) via the National Environmental Standards and Regulations Enforcement Agency (NESREA) (NESREA 2018). However, the incorporation of the policy into waste management legislation of Nigerian states has not been successful (Allen-Taylor 2022).

An EPR policy for ALDFG has been discussed in Africa but has not yet been legislated in any African country. The lack of a standard framework to ensure that an EPR policy also covers fishing gear in Africa is a major setback. Without a proper framework in place, it will not be possible to use an EPR programme to obtain fees for gear retrieval costs.

3.2.6. Case study for port reception facilities

Case study 5: *SOFER Initiative's Fishing Net Gains Project in the west coast of Africa*
By: Joshua Nathaniel and Emmanuel Sofa

SOFER Initiative partners with coastal communities, engages with relevant government agencies and marine stakeholders, and pushes for a change in policy and regulations to improve the marine ecosystem by addressing ALDFG. The work of SOFER includes a) creating awareness on the negative impacts of ALDFG in coastal communities, b) retrieving ALDFG from the ocean and shores and providing reception facilities for ALDFG (the Fishing HubNet), and c) training women in coastal communities to craft items from waste nets.

Figure 17*: A repurposed fishing net being used to protect a thatched roof in a village in Nigeria.*

Most fishing gear used in coastal communities in Nigeria are synthetic nets imported from countries such as Norway, China and Bangladesh. Fishing gear, specifically nets, are difficult to recycle, however, there are other solutions for Africa. The Fishing Net Gains Project is a community-based project carried out by SOFER Initiative and currently involves five communities in Nigeria and one in Cameroon. The Fishing Net Gains Project repurposes EOL nets (**Figure 17**) into shoes, bags, trinkets, earrings, flower vases and interior decor items. The most innovative idea has been the production of the Fishing Gear Fabric (FGF) using a local version of the machine called 'loom'. The fabric is very durable and strong and can be used to make clothes, shoes, and furniture. The use of the loom machine to produce the FGF was discovered by one of the community women who was trained by SOFER Initiative. SOFER Initiative is still working on improving the quality and value of the FGF. This idea, if properly harnessed, may take repurposing EOLFG to a new level in Africa. Associated with

the Fishing Net Gains Project is HubNet, a kiosk-like reception facility for fishing gear, constructed by SOFER Initiative. A HubNet is stationed at each of six coastal communities, with the aim of connecting recycling facilities to a source of EOLFG, encouraging local fishers and commercial fishing vessels to return EOLFG ashore instead of dumping them offshore, and providing opportunities for repurposing by local communities. Additionally, through the HubNet project, community agents are employed to collect and record data (net weights), and clean and store the nets for recycling or repurposing. The HubNets therefore provide an additional source of income for locals and generate the relevant data that are lacking in Africa when it comes to tracking and monitoring ALDFG.

***Figure 18**: SOFER Initiative team with community members at a fishing nets recovery facility in Limbe, Nigeria.*

Through the Fishing Net Gains Project, the following progress has taken place:

- 673 workshops delegates, consisting of local fishers, community residents and government representatives, have been informed about ALDFG and its dangers to marine ecosystems;
- 278 women have been trained in upcycling of EOL nets;
- 96 local divers attended divers' workshops where they gained knowledge on the importance of ALDFG retrieval;
- Over 1 600 kg of nets have been recovered onshore and 88 kg have been recovered offshore across three project locations;
- 18 community members have been employed as data collectors.

It was important to be cognisant of the norms and beliefs prevalent in the coastal communities as these had a great effect on the number of nets the artisanal fishers discarded or brought to the HubNets. The involvement of the communities throughout the project's lifecycle was imperative to its success (**Figure 18**). For example, communities donated land space for the construction of the HubNets, coordinated fishers and women to attend the various workshops, and ensured the safety of the project team. Also, formulations of resolutions and recommendations to improve fisheries management and trigger policy change discussions were made possible by the communities.

The Fishing Net Gains project was initially funded by Oceans Conservancy and thereafter by the Department of Fisheries and Oceans, Canada, under the Sustainable Fisheries Solutions Retrieval Support Contribution Program (SFSRSCP).

CHAPTER 4: SUMMARY

***Figure 19**: African trawler en route to land at Cape Town, South Africa. Conditions in African countries need to be considered carefully when developing best practices for ALDFG.*

This guide has described how abandoned, lost or otherwise discarded fishing gear, in addition to the environmental impacts that are evident from all forms of marine plastic, also has the potential to ghost fish. Although best practices guides for ALDFG exist, they tend, in the main, to have a global perspective with much of the research they are based on coming from developed countries that may not be applicable

to Africa. As a result, it was considered necessary to develop a guide specific to the needs of Africa (**Figure 19**). The guide was developed from a collaborative process, employing workshops, meetings and interviews with stakeholders who either have an understanding of African fisheries or have an expert knowledge of ALDFG and EOLFG issues.

With the lack of data on ALDFG in African countries, it is vital to collect baseline data in each country and then initiate a regular monitoring programme. It is important that data collection is conducted in a harmonised way to enable comparisons between regions/countries and to better understand the extent of ALDFG for the African continent as a whole. Data collection and monitoring will reveal drivers of ALDFG in Africa and capture any changes in trends and amounts. Data collection on the quantities of ALDFG can inform whether the African ALDFG problem is domestic or transboundary, and feeds into policy to take appropriate action to address the issue. The guide examines options on what data should be collected, also how the data should be collected and by whom, as well as who is responsible for reporting on ALDFG data. Potential challenges to both ALDFG data collection and data reporting in Africa are also considered. The guide examines the feasibility of marking of fishing gear in Africa as well as modification of gear design. For example, the use of biodegradable materials to replace traditional plastics, through partial or whole gear replacement, will reduce the degree of ghost fishing when ALDFG is created.

A lack of both port facilities and appropriate port waste management plans for EOLFG are often drivers for the creation of ALDFG. The guide considers these particular aspects and looks at options for recycling, repurposing, energy production and NGO-provided port waste facilities. Throughout the guide are examples of case studies to showcase the work already being undertaken in African countries; towards gathering ALDFG data, outreach to communities to raise awareness of ALDFG and its implications, as well as innovative solutions for EOLFG. The guide is a live working document and serves as a starting point to develop best practices for ALDFG for African fisheries. Any further consultation/collaboration or future case studies will be added to the guide to ensure clean, healthy, sustainable oceans around Africa that support the adjacent coastal communities.

4.1. Recommendations for addressing ALDFG in Africa

Before the issue of ALDFG can be improved, it is important to understand the extent of the problem and thereafter to make country-specific decisions based on scientific evidence. It is therefore recommended that any programme striving to address ALDFG follows the steps outlined below:

1. **Collect baseline ALDFG data**; in a harmonised way, against which future measurements can be compared.
2. **Establish a long-term monitoring programme**; ensure that methods for collecting data are harmonised, among studies and countries.
3. **Conduct targeted outreach programmes**; based on the data and evidence collected.
4. **Research informs policy**; present data collection results to policy- and decision-makers in a clear language to enable informed decisions based on scientific evidence.
5. **Encourage the marking of fishing gear**; the voluntary marking of fishing gear should be encouraged to enable traceability of fishing gear and to assist identification of IUU fishing.
6. **Biodegradable alternatives**; explore the use of biodegradable alternatives to plastic fishing gear.
7. **Fishing gear recovery**; the recovery of lost fishing gear should be legislated, possibly by incorporating reporting within the permit to fish.
8. **Report lost fishing gear**; the blame-free reporting of lost or found fishing gear should be legislated, possibly by incorporating reporting within the permit to fish.

4.2. Recommendations for EOLFG in Africa

Options for dealing with EOLFG in an environmentally responsible manner are currently inadequate in Africa due to the limited facilities available for recycling gear. However, several innovative options for gear repurposing already exist and could be expanded. EOLFG recommendations are as follows:

1. **Provide adequate waste reception**; ensure that ports and harbours have efficient and cost-effective waste reception facilities for EOLFG.
2. **Prepare EOLFG for repurposing/recycling**; ensure the gear is thoroughly cleaned (i.e. remove any biofouling) and separate component parts before taking further steps to either repurpose or recycle the gear.
3. **Identify EOLFG markets**; identify potential markets for either repurposed or recycled fishing gear.
4. **Recycling investment**; invest in recycling facilities that are capable of processing fishing gear.
5. **Extended Producer Responsibility**; explore the viability of an EPR scheme for fishing gear.

Acknowledgements

We thank all participants of our workshops for the valuable discussions that initiated the development of this guide. The following people are thanked for contributing case studies and assisting with obtaining country-specific information: Anthony Appiah, Dave Japp, David Kaplan, Emma Algotsson, Emmanuel Sofa, Jacques Abe, Joshua Nathaniel and Terry Achieng. The editors would especially like to thank Sifiso Mbambo, Tanna Hewett , Amarein Fourie and Makhosi Khuzwayo for their contributions to the development of the guide.

References

Addi EA, Ofori-Danson PK, Nunoo FKE, Abdulhakim A and Tayib Y. 2016. Trends and effects of gears on the catches of tuna landed in Ghana. *Elixir Bio Diver* 93: 39593–39598.

Adeleke B, Robertson-Andersson D, Moodley G and Taylor S. 2020. Aquaculture In Africa: A comparative review of Egypt, Nigeria, and Uganda vis-à-vis South Africa. *Reviews in Fisheries Science & Aquaculture* 2: 167–197.

Akyeampong S, Amador K and Nkrumah B. 2013. *Report on the 2013 Ghana marine canoe frame survey*. Fisheries Scientific Survey Division, Report No. 35.

Algoa Bay Project. 2019. Algoa Bay systematic conservation plan: key places for keeping the bay blue for nature and people. Port Elizabeth, 108 pp.

Allen-Taylor KO. 2022. Combining Extended Producer Responsibility (EPR) and deposit refund system (DRS) policy for higher recovery and recycling of plastic bottles and sachet water waste: application of vending machine and designated return deposit depot centre in Lagos, Nigeria. *Open Journals of Environmental Research* 3: 22–34.

APWC 2020. South Africa: *Port Reception Waste Facilities Audit*. Commonwealth Litter Programme, Cefas Report. Asia Pacific Waste Consultants.

Basurko OC, Markalain G, Mateo M, Peña-Rodriguez C, Mondragon G *et al*. 2023. End-of-life fishing gear in Spain: Quantity and recyclability. *Environmental Pollution* 316: 120545.

Belhabib D and Le Billon P. 2022a. Adjacency and vessel domestication as enablers of fish crimes. *Frontiers in Marine Science* 9: 936174.

Belhabib D and Le Billon P. 2022b. Fish crimes in the global oceans. *Science Advances* 8: eabj1927.

Cerbule K, Herrmann B, Trumbić Ž, Petrić M, Krstulović Šifner S *et al*. 2023 Use of biodegradable materials to reduce marine plastic pollution in small scale coastal longline fisheries. *Journal for Nature Conservation* 74: 126438.

Chalmers R. 2012. Systematic marine spatial planning and monitoring in a data poor environment: a case study of Algoa Bay, South Africa. PhD Thesis, Rhodes University, South Africa.

Chalmers R, Oosthuizen A, Gotz A, Paterson A and Sauer WHH. 2014. Assessing the suitability of commercial fisheries data for local-scale marine spatial planning in South Africa. *African Journal of Marine Science* 36: 467–480.

Chamas A, Moon H, Zheng J, Qiu Y, Tabassum T *et al*. 2020. Degradation rates of plastics in the environment. *ACS Sustainable Chemistry & Engineering* 8: 3494–3511.

Consoli P, Sinopoli M, Deidun A, Canese S, Berti C *et al*. 2020. The impact of marine litter from fish aggregation devices on vulnerable marine benthic habitats of the Central Mediterranean Sea. *Marine Pollution Bulletin* 152: 110928.

de Mello Soares CT, Ek M, Östmark E, Gällstedt M and Karlsson S. 2022. Recycling of multimaterial multilayer plastic packaging: Current trends and future scenarios. *Resources, Conservation and Recycling* 176: 105905.

Drakeford BM, Forse A and Failler P. 2023. The economic impacts of introducing biodegradable fishing gear

as a ghost fishing mitigation in the english channel static gear fishery. *Marine Pollution Bulletin* 192: 114918.
Drinkwin J. 2022. *Reporting and retrieval of lost fishing gear: recommendations for developing effective programmes. Rome:* FAO and IMO.
Edström S. 2022. Object detection for autonomous trash and litter collection. Master's thesis. KTH Royal Institute of Technology, Sweden.
Environmental Investigation Agency. 2020. *Nothing fishy about it: meaningful measures on fishing gear at IMO*. Available at: https://eia-international.org/wp-content/uploads/EIAreport- Nothing-Fishy-About-It-IMO-Briefing-spreads.pdf
Enrichetti F, Bavestrello G, Betti F, Rindi F, Tregrosso A *et al.* 2021. Fate of lost fishing gears: experimental evidence of biofouling colonization patterns from the Northwestern Mediterranean Sea. *Environmental Pollution* 268: 115746.
Escalle L, Hare SR, Vidal T, Brownjohn M, Hamer P *et al.* 2021. Quantifying drifting fish aggregating device use by the world's largest tuna fishery. ICES *Journal of Marine Science* 78: 2432–2447.
FAO. 2014. *The state of world fisheries and aquaculture: opportunities and challenges*. Rome.
FAO. 2019. *Voluntary Guidelines on the Marking of Fishing Gear*. Rome. 88 pp. Licence/ CC BY-NC-SA 3.0 IGO. http://www.fao.org/3/ca3546t/ca3546t.pdf
FAO. 2022a. *The state of world fisheries and aquaculture: Towards blue transformation*. Rome: FAO. https://doi.org/10.4060/cc0461en.
FAO. 2022b. *Report of the FAO Workshop on Gear Marking Technology and Trials*, Ancona, Italy, 29 June–1 July 2022. FAO Fisheries and Aquaculture Report No. 1388. Rome. https://doi.org/10.4060/cc2884en
FAO, Duke University and WorldFish. 2023. *Illuminating Hidden Harvests - the contributions of small-scale fisheries to sustainable development*. Rome: FAO, Duke University and WorldFish.
Feary D, Aranda M, Russell J, Cabezas O, Rodríguez Climent S. *et al.* 2020. *Study on circular design of the fishing gear for reduction of environmental impacts.* European Commision: Brussels, Belgium. https://cinea.ec.europa.eu/system/files/2021- 03/StudyCircularDesing-EMFF2018.pdf
Gallagher A, Randall P, Sivyer D, Binetti U, Lokuge G. *et al.* 2023. Abandoned, lost or otherwise discarded fishing gear (ALDFG) in Sri Lanka – A pilot study collecting baseline data. *Marine Policy* 148: 105386.
García-Gómez J C, Garrigós M and Garrigós J. 2021. Plastic as a vector of dispersion for marine species with invasive potential. A review. *Frontiers in Ecology and Evolution* 9: 629756.
GESAMP. 2016. *Sources, fate and effects of microplastics in the marine environment: part two of a global assessment*. (Kershaw PJ and Rochman CM. Eds.). (Imo/Fao/Unesco- Ioc/Unido/Wmo/Iaea/Un/ Unep/ Undp Joint Group Of Experts On The Scientific Aspects Of Marine Environmental Protection). Rep. Stud. GESAMP No. 93. http://www.gesamp.org/publications/reports-and-studies-no-90
GESAMP. 2021. *Sea-based sources of marine litter*. (Gilardi K. ed.) (IMO/FAO/UNESCOIOC/ UNIDO/ WMO/ IAEA/UN/UNEP/UNDP/ISA Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). Rep. Stud. GESAMP No. 108. http://www.gesamp.org/site/assets/files/2213/rs108e.pdf
Gilman E, Chopin F, Suuronen P and Kuemlangan B. 2016. Abandoned, lost or otherwise discarded gillnets and trammel nets: Methods to estimate ghost fishing mortality, and the status of regional monitoring and management. FAO *Fisheries and Aquaculture Technical Paper* 600: 1–79.
Gilman E, Musyl M, Suuronen P, Chaloupka M, Gorgin S *et al.* 2021. Highest risk abandoned, lost and discarded fishing gear. *Scientific Reports* 11: 1–11.
Giskes I, Baziuk J, Pragnell-Raasch H and Perez Roda A. 2022. *Report on good practices to prevent and reduce marine plastic litter from fishing activities*. Rome and London: FAO and IMO.
Global Ghost Gear Initiative. 2021. *Best practice framework for the management of fishing gear*: June 2021 update. Prepared by Huntington T. of Poseidon Aquatic Resources Management Ltd. 94.
GloLitter 2022. GloLitter Knowledge Product: *Guidance Document on Developing Port Waste Management Plans*.
He P, Chopin F, Suuronen P, Ferro RST and Lansley J. 2021. Classification and illustrated definition of fishing

gears. *FAO Fisheries and Aquaculture Technical Paper* 672: I–94.
Hodgson S. 2022. *Legal aspects of abandoned, lost or otherwise discarded fishing gear*. Rome: FAO. https://www.fao.org/responsible-fishing/resources/detail/en/c/1469915/
Holness SD, Harris LR, Chalmers R, De Vos D, Goodall V *et al.* 2022. Using systematic conservation planning to align priority areas for biodiversity and nature-based activities in marine spatial planning: a real-world application in contested marine space. *Biological Conservation* 271: 109574.
IATTC. 2022. Recommendations of the Scientific Advisory Committee (SAC) to the commission. Recommendations presented at the 14th Inter-American Tropical Tuna Commission's Scientific Advisory committee meeting, California, USA.
Imzilen T, Lett C, Chassot E and Kaplan DM. 2021. Spatial management can significantly reduce dFAD beachings in Indian and Atlantic Ocean tropical tuna purse seine fisheries. *Biological Conservation* 254: 108939.
Imzilen T, Lett C, Chassot E, Maufroy A, Goujon M *et al.* 2022. Recovery at sea of abandoned, lost or discarded drifting fish aggregating devices. *Nature Sustainability* 7: 593–602.
Imzilen T, Kaplan DM, Barrier N and Lett C. 2023. Simulations of drifting fish aggregating device (dFAD) trajectories in the Atlantic and Indian oceans. *Fisheries Research* 264: 106711.
Jepsen EM and De Bruyn PJN. 2019. Pinniped entanglement in oceanic plastic pollution: a global review. *Marine Pollution Bulletin* 145: 295–305.
Kaplan DM, Chassot E, Amandé JM, Dueri S, Demarcq H *et al.* 2014. Spatial management of Indian Ocean tropical tuna fisheries: potential and perspectives. *ICES Journal of Marine Science* 1: 1728–1749.
Kim J, Park S, Bang J, Jin HJ and Kwak HW. 2023. Biodegradation in Composting Conditions of PBEAS Monofilaments for the Sustainable End-Use of Fishing Nets. *Global Challenges* 2300020.
Kühn S, Bravo Rebolledo EL and Van Franeker JA. 2015. Deleterious effects of litter on marine life. In: Bergman M, Gutow L and Klages M (eds), *Marine Anthropogenic Litter*. Springer Nature. pp 75–10.
Lebrasse C. 2021. Biofouling organisms tell all about the age of lost fishing gears. *Oceanbites*. Available at: https://*Oceanbites*.Org/Biofouling-Organisms-And-Lost- Fishing-Gears-A-Sticky-But-Lasting-Relationship/
Lebreton L, Slat B, Ferrari F, Sainte-Rose B, Aitken J *et al.* 2018. Evidence that the Great Pacific Garbage Patch is rapidly accumulating plastic. *Scientific Reports* 8: 1–15.
Lebreton L, Royer SJ, Peytavin A, Strietman WJ, Smeding-Zuurendonk I *et al.* 2022. Industrialised fishing nations largely contribute to floating plastic pollution in the North Pacific subtropical gyre. *Scientific Reports* 12: 12666.
Lovell TA. 2023. Implementing the voluntary guidelines for the marking of fishing gear in eastern Caribbean small-scale fisheries: An assessment of gear marking provisions. *Marine Pollution Bulletin* 194: 115292.
Macfadyen G, Huntington T and Cappell R. 2009. *Abandoned, lost or otherwise discarded fishing gear*. Rome: Food and Agriculture Organization of the United Nations (FAO). https://www.fao.org/3/i0620e/i0620e.pdf
MacMillan I, Attrill MJ, Imzilen T, Lett C, Walmsley S *et al.* 2022. Spatio-temporal variability in drifting Fish Aggregating Device (dFAD) beaching events in the Seychelles Archipelago. *ICES Journal of Marine Science* 79: 1687–700.
Mann BQ, Scott GM, Mann-Lang JB, Brouwer SL, Lamberth SJ *et al.* 1997. An evaluation of participation in and management of the South African spearfishery. *South African Journal of Marine Science* 18: 179-93.
Marine Resources Assessment Group. 2005. *Review of Impacts of Illegal, Unreported and Unregulated Fishing on Developing Countries*. Rome: FAO.
Maufroy A, Kaplan DM, Bez N, De Molina AD, Murua H *et al.* 2017. Massive increase in the use of drifting Fish Aggregating Devices (dFADs) by tropical tuna purse seine fisheries in the Atlantic and Indian oceans. *ICES Journal of Marine Science* 74: 215–225.

McGrath MD, Horner CC, Brouwer SL, Lamberth SJ, Mann BQ *et al.* 1997. An economic valuation of the South African linefishery. *South African Journal of Marine Science* 18: 203–211.

Mehdi H, Lau SC, Synyshyn C, Salena MG, Morphet ME *et al.* 2021. A comparison of passive and active gear in fish community assessments in summer versus winter. *Fisheries Research* 242: 106016.

Mengo E, Randall P, Larsonneur S, Burton, Hegron A. *et al.* 2023. Fishers' views and experiences on abandoned, lost or otherwise discarded fishing gear and end-of-life gear in England and France. *Marine Pollution Bulletin* 194: 115372.

Miralles L, Gomez-Agenjo M, Rayon-Viña F, Gyraitė G and Garcia-Vazquez E. 2018. Alert calling in port areas: Marine litter as possible secondary dispersal vector for hitchhiking invasive species. *Journal for Nature Conservation* 42: 12–18.

Murua H, Zudaire I, Tolotti M, Murua J, Capello M *et al.* 2023. Lessons learnt from the first large-scale biodegradable FAD research experiment to mitigate drifting FADs impacts on the ecosystem. *Marine Policy* 148: 105394.

National Environmental Standards and Regulations Enforcement Agency. 2018. Extended Producer Responsibility Programme is a Must. Available at: https://www.nesrea.gov.ng/extended-producer-responsibility-programme-is-a-must/

National Environmental Management: Waste Act (Act No. 59 of 2008). *Government Gazette, South Africa* 525 (32000).

NOAA Marine Debris Program. 2015. *Impact of "Ghost Fishing" via derelict fishing gear*. Silver Spring, Maryland.

Parker RW, Vázquez-Rowe I and Tyedmers PH. 2015. Fuel performance and carbon footprint of the global purse seine tuna fleet. Journal of Cleaner Production. *Journal Of Cleaner Production* 103: 517–524.

Petrossian GA. 2018. A micro-spatial analysis of opportunities for IUU fishing in 23 western African countries. *Biological Conservation* 225: 31–41.

Pew Charitable Trust, SYSTEMIQ. 2020. *Breaking the plastic wave: a comprehensive assessment of pathways towards stopping ocean plastic pollution*.

Plastics SA. *Extended Producer Responsibility*. Plastics SA. Available at: https://www.plasticsinfo.co.za/sustainability/extended-producer-responsibility/

Pons M, Kaplan D, Moreno G, Escalle L, Abascal F *et al.* 2023. Benefits, concerns, and solutions of fishing for tunas with drifting fish aggregation devices. *Fish and Fisheries* 24: 979–1002.

Qiang M, Shen M and Xie H. 2020. Loss of tourism revenue induced by coastal environmental pollution: a length-of-stay perspective. *Journal of Sustainable Tourism* 28: 550–567.

Randall P. 2020. *South African marine fisheries and abandoned, lost and discarded fishing gear*. Commonwealth Litter Programme - South Africa.

Richardson K, Hardesty BD and Wilcox C. 2019a. Estimates of fishing gear loss rates at a global scale: a literature review and meta-analysis. *Fish and Fisheries* 20: 1218–1231.

Richardson K, Asmutis-Silvia R, Drinkwin J, Gilardi KV, Giskes I *et al.* 2019b. Building evidence around ghost gear: global trends and analysis for sustainable solutions at scale. *Marine Pollution Bulletin* 138: 222–229.

Richardson K, Hardesty BD, Vince JZ and Wilcox C. 2021. Global causes, drivers, and prevention measures for lost fishing gear. *Frontiers in Marine Science* 8: 690447.

Ryan PG, Dilley BJ, Ronconi RA and Connan M. 2019. Rapid increase in Asian bottles in the South Atlantic Ocean indicates major debris inputs from ships. *Proceedings of the National Academy of Sciences* 116: 20892–20897.

Sarpong DB, Quaatey KN and Harvey KS. 2005. *The economic and social contribution of fisheries to gross domestic product and rural development in Ghana*. FAO Sustainable Fisheries Livelihoods Programme (SFLP).

Sauer WH, Penney AJ, Erasmus C, Mann BQ, Brouwer SL *et al.* 1997. An evaluation of attitudes and responses

to monitoring and amangement measures for the South African boat-based linefishery. *South African Journal of Marine Science* 18: 147–163.

Scheld AM, Bilkovic DM and Havens KJ. 2016. The Dilemma of Derelict Gear. *Scientific Reports* 6: 19671.

Schneider F, Parsons S, Clift S, Stolte A, Kruger M *et al*. 2023. Life cycle assessment (LCA) on waste management options for derelict fishing gear. *The International Journal of Life Cycle Assessment* 28: 274-290.

Siyum N. 2018. Why Africa remains underdeveloped despite its potential? Which theory can help africa to develop? Open Access *Journal of Bio-Informatics* 33: 23–35.

Sumaila UR, Alder J. and Keith H. 2006. Global scope and economics of illegal fishing. *Marine Policy* 30: 696–703.

Tiller R, Arenas F, Galdies C, Leitão F, Malej A *et al*. 2019. Who cares about ocean acidification in the Plasticene? *Ocean and Coastal Management* 174: 170–180.

UNEP. 2017. *Marine Litter Socio Economic Study, United Nations Environment Programme, Nairobi*. Nairobi: UNEP.

Vlachogianni T. 2017. *Understanding the socio-economic implications of marine litter in the Adriatic-Ionian macroregion*. Athens: IPA-Adriatic DeFishGear Project and MIO-ECSDE.

Vogt-Vincent NS, Burt AJ, Kaplan DM, Mitarai S, Turnbull LA *et al*. 2023. Sources of marine debris for Seychelles and other remote islands in the Western Indian Ocean. *Marine Pollution Bulletin* 187:114497.

Wain G, Guéry L, Kaplan DM and Gaertner D. 2021. Quantifying the increase in fishing efficiency due to the use of drifting FADs equipped with echosounders in tropical tuna purse seine fisheries. *ICES Journal of Marine Science* 78: 235–245.

WIOMSA 2022. Gap analysis report and developed guidelines on regulatory frameworks on marine litter in Africa. Contract No. WIOMSA/MLL/2021/2 [Unpublished report].

Zudaire I, Moreno G, Murua H, Murua J, Tolotti MT *et al*. 2021. Biodegradable dFADs: current status and prospects. *IATTC AD HOC PERMANENT WORKING GROUP ON FADs*.

APPENDIX 1: Summary of international legislation relevant to ALDFG

Legislation	Details
International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)	• Administered by the IMO, legally binding. • Regulations to prevent and minimise pollution from ships, Annex V pertains to plastic pollution (Giskes *et al.* 2022).
United Nations Convention of the Law of the Seas (UNCLOS 1982)	• Constitution for the oceans, legal order. • UNCLOS is fundamental to marine law, but UNCLOS does not dictate fishing gear or ALDFG law directly (Hodgson 2022). Instead, states have the right to regulate the issue of ALDFG through their own legislation (Giskes *et al.* 2022).
United Nations Fish Stocks Agreement (UNFSA 2005)	• Implemented following UNCLOS. • Conserves highly migratory fish species. • Article 5 details principles for fishing in the high seas and mentions "lost or abandoned gear" (Giskes *et al.* 2022).
Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated fishing (PSMA 2009)	• Fishing gear is mentioned in relation to a) fishing activity in high sea regions and b) gear marking (Hodgson 2022). • Fishing gear is mentioned for port state inspections (Giskes *et al.* 2022).
London Convention and London Protocol	• London Convention: Controls marine pollution sources. • London Protocol: Prohibits dumping (Giskes *et al.* 2022).
Basel Convention (1989)	• Guidelines to reduce the transboundary movements of hazardous waste (plastic has recently been included) between nations (WIOMSA unpublished report).
FAO Code of Conduct for Responsible Fisheries (CCRF 1995)	• Voluntary principles and international standards. • Ensure the conservation, management and development of living aquatic resources. ALDFG mentioned in section 7.2, 7.6 and 8.4 (Giskes *et al.* 2022).
International Guidelines on Bycatch Management and Reduction of Discards (2011)	• Voluntary guidelines. • Reference instrument for managing bycatch and reducing discards. Mentions ghost fishing (Giskes *et al.* 2022).
FAO Voluntary Guidelines on the Marking of Fishing Gear (FAO 2019)	• Voluntary guidelines. • Marking of gear to improve safety at sea, reduce ALDFG and aid recovery of gear (Giskes *et al.* 2022).
UNEP's Regional Seas Programme	• Action plans to combat marine litter, including ALDFG (Giskes *et al.* 2022).
United Nations General Assembly (UNGA)	• Encourages states to take action against ALDFG. • Actions may include understanding the drivers of gear loss at sea, the recording of gear loss and quantifying the economic impacts of ALDFG on fisheries, tourism and other industries (Hodgson 2022).
Agenda 21 – Chapter 17 (1992)	• United Nations action plan. • Aimed at eliminating the transport and leaching of substances into the ocean (litter and plastic, metals, polycyclic aromatic hydrocarbons) (WIOMSA unpublished report).
The Montreal Guidelines for the Protection of the Marine Environment against Pollution from Land-based Sources (1985)	• Provides guidelines for the protection of the marine environment from various forms of pollution (WIOMSA unpublished report).

APPENDIX 2: Regional conventions and legislation relevant to ALDFG in Africa

Legislation	Details
Abidjan Convention (Official name: Convention for the Cooperation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region)	Adopted in 1981 with the aim of addressing environmental challenges faced by the coastal and marine areas of the Western and Central African region. The convention promotes the following: • Protection of the marine and coastal environments of the region. • Prevention and reduction of pollution from land-based sources, maritime activities and dumping of hazardous waste. • Conservation and sustainable use of marine and coastal resources.
Barcelona Convention (Official name: Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean)	Adopted in 1976 and entered into force in 1978, with the aim of protecting the marine environment and promoting sustainable development in the Mediterranean Sea region. The convention's key objectives include: • Prevention and reduction of pollution in the Mediterranean Sea from various sources including land- and sea-based activities. • Strengthening sustainable development through integrated coastal zone management and sustainable fishing practices. • Promoting cooperation and scientific research.
Jeddah Convention (Official name: Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment)	Adopted in 1985, this convention prioritizes the need for collaboration in the control of marine pollution, scientific and technical assistance, environmental management and the development of environmental standards of the Red Sea and Gulf of Eden, and their coasts. The convention's key objectives include: • Prevention, abatement and combatting of marine pollution from all sources. • Cooperation in scientific and technological activities. • Adoption of procedures for civil liability and compensation.
Nairobi Convention (Official name: Nairobi Convention for the Protection, Management and Development of Coastal and Marine Environment of the Western Indian Ocean (WIO) region)	Adopted in 1985 as part of UNEP's Regional Seas Programme, this convention enables better management and envisages sustainable use of the marine environment of the Eastern Africa region, specifically countries that border the Western Indian Ocean. The convention's key objectives include: • Address the accelerating degradation of the world's oceans and coastal areas through the sustainable management and use of the marine and coastal environment. • Engaging countries that share the Western Indian Ocean in actions to protect their shared marine environment.
LBSA Protocol (Official name: Protocol for the Protection of the Marine and Coastal Environment of the Western Indian Ocean from Land-based Sources and Activities)	Adopted in 2010, this convention is a project of the Nairobi Convention which focuses on the deterioration of marine and coastal environments by land-based pollution sources through objectives of research, regional plans, and capacity building (WIOMSA, unpublished report). The convention's objectives include: • Provide a framework upon which contracting parties seek to address the principle source of pollution of the marine and coastal environment, namely; pollution from substances and energy entering the marine environment by run off from land, rivers, pipelines and other outfall structures and pollution from the atmosphere, generated from land-based activities.

APPENDIX 3: Summary of workshop discussions

ALDFG data for Africa	
Why do we need the data?	• Informs spatial and temporal patterns. • Can measure the effectiveness of current ALDFG prevention measures. • Identify the *risks and extent* of the ALDFG problem.
Standardising data	• Standardising data is most important as it is needed for comparisons among regions. • Standardise units (e.g. metres, feet, kilograms). • Give detailed and clear guidelines (could use photos, make a photo library) of different gear types and gear sections (i.e. rope with knots may not be a rope in itself but part of a trawl). • Data should be easy to collect. • Communities take ownership of the data (make use of citizen scientists). • There should be options for quantitative data and categorical estimates.
What type of data should be collected?	• Quantitative and/or qualitative, but preferably both. • Consider the unit of measurement, in order of preference, e.g. – Weight (actual). – Dimensions. – Categorical estimates. • Characterising the types of gear. • Location, date, time of lost and found gear. • Lost at sea (weather, rough seas). • Abandoned (on beaches). • Collected and recycled. • Landfilled and stockpiled. • Manufacturer and sales records (retailer and customer). • In datasheets, need to include mandatory and voluntary fields. • Collect data on all fishing gear types. • Understand the value chain and what happens to EOL gear. • Collection can be done on a small scale e.g. in Kenya, nets are taken to the beach management units (BMUs). Two types of data collection: 1. *Check in – check out (of gear on vessel) monitoring*: – Linked to individual fisher/fishery. – Linked to registry/*permit*. – Responsibility of regional/national gov/authority. Likely at designated launch sites/harbours. 2. *Responsibility for ALDFG provides the info/data*: – Managed by local authority who collects/measures and reports data. – Not linked to an individual but to an area or community. – Likely at areas where dispersed/informal fishery exists.
How can data be collected?	• Data can be collected using questionnaires, but the following must be considered: – Carrot vs stick approach. – Use informed people to conduct questionnaires to avoid possibility of being condescending. – Give positive feedback post surveys and report back on findings. – If possible, give something practical back in return for the respondents' involvement (e.g. arrange a skip if they do not have one in port).

	- Open discussion, no-blame. - Keep questionnaires short for the fishers themselves, can be longer and more technical for managers. - Consider language, culture. Manage the narrative i.e. failure to retrieve gear can have negative economic impact in the long run. - Data can be collected at ports. - Ensure there is a facility where gear can be taken to. - Provide incentives for those that report ALDFG (provide certification i.e. Marine Stewardship Council certification). - Fishers can be encouraged to do beach clean-ups, this can raise awareness. - Make use of data collection mobile applications (apps). - Licencing should include reporting of gear e.g. in Namibia nets are weighed as part of licensing. - Involve all relevant stakeholders. - Make videos of communities telling stories or shared experiences in home language.
Who should collect data?	• Scientists and citizen scientists. • Fishers (subsistence, recreational, commercial). • Manufacturers. • NGOs. • International and regional organizations. • Observers. • Skippers/fishermen. • Government (institutes, parastatals). • Industrial bodies: industry to be responsible for fishing gear (e.g. environmental management principles – paid levies for each unit of plastic used). • Fishing industry. • Approach different stakeholders differently. Take account of level of education.
Challenges with data collection	• IUU fisheries (e.g. in SA patrols at sea take place but IUU throw gear overboard so as not to get caught). There is a need for better international control of IUU fisheries. • Education and awareness raising. • Small-scale, illegal fishing e.g. poaching. • If using apps to collect data: - These should be in official languages. - Data and Wi-Fi access considerations. • Need to gain trust of communities, establish a rapport. • Interpretation of data. • Training and capacity development. • Language barriers, communication challenges. • Classification of plastic. • Manufacturers of fishing gear are not known or identifiable to make them responsible. • Cheap, foreign gear used in territorial waters, then it is difficult to control value of plastic chain or have the manufacturers responsible.
Other discussion points	• Gear loss of commercial fisheries can be done, but gear loss of subsistence fishers is more difficult to quantify and record. • Long-term solutions (in order of importance): - Colour-code gear per sector (first, different colours for fishing sector vs merchant shipping; then different colours per fishing sector). - Colours must be acceptable to the fishermen. - Avoid colours that attract birds.

Reporting of lost/found gear	
Do African countries need legislation for reporting gear, and why?	NOTE: *All* workshop attendees agreed that legislation was needed. Why: • Sensitisation is very important. • Understand impacts, shortfalls (gaps). • Making fishers aware (*educate*) to demonstrate long term negative environmental impacts. • Reporting could form part of fishing industry's code of conduct for fishers. • Legislation is needed for government to allocate resources (e.g. funding). • Framework for action guides at all levels. • Set up legal structure for data to be collected, e.g. ALDFG data, ecological damage, economic losses, aesthetic value loss/intrinsic value.
How should lost/ found gear be reported?	• Enforcement – add to permit conditions; restrict supply to only registered fishers and across the value chain (producer to user). • Reporting of losses, in trip reports (there should be reports on gear loss). • Penalties on not reporting of gear loss (formal fisheries/ commercial vessels). • Report gear in and out of port (only works for large scale). • Report on end of life: where does it go? • Permits for fishing could include gear marking regulation. • Provides levies and incentives. • Deposit for old net return. • Sectoral approach in reporting of gear loss (sector specific). • Community-based forums on reporting illegal activities. • Structure – where does gear go once found? company, place, local government where individuals place gear. • Convenience → accessible, easy and affordable mechanisms in place. • Have toll-free phone numbers for reporting.
Challenges	• Management of data. • If collected, how to recycle? • Gear conflict – who is responsible for reporting? • How to prove if gear was lost or dumped? • Retrieval is expensive so if gear is marked, the "marker" should pay. • Enforcement necessary if reporting is mandatory.
Other ALDFG legislation needs to be prioritised	• Gear marking. • Promoting of innovation and technology of gear (e.g. biodegradable fishing nets). • Link to national waste management regulations. • Limits on amount of gear that can be deployed. • Broad international regulations exist BUT need additional/ specific elements relating to ALDFG (e.g. obligation to retrieve). • "Domestication" of existing laws (small and large scale). • Any marking ONLY works on large-scale. • Electronic monitoring of gear (FADs)- for large-scale.
Gear design and marking	
Is biodegradable gear an option for Africa? (Gear design)	Yes, but the following needs to be considered: • Much research and development still required. • Biodegradable gear is fishery-dependent. • It is not an absolute solution. • Do a risk assessment – is it feasible? • Have only parts of gear biodegradable. • Will need subsidies (initially).

	• Can this kind of gear be recycled or repurposed? • Keep biodegradable voluntary.
Gear marking	• FAO voluntary guidelines to be considered (e.g. seabird issues with long-line fisheries). • There is a need for legislative framework for enforcing gear marking to all fishing vessels. • Marking of gear at different levels. • Install electronic tagging where possible. • Tracking system needs to be feasible. • Hold fishers responsible (for gear loss). • Marking should be voluntary until there is evidence that it works regarding the reporting of gear loss.
How should we go about marking gear?	• Need engagement with industry. • Make use of colour combination already in use. Note: recreational fishing market has many colours, will be difficult to get buy-in for marking.
Why should gear be marked?	• Identification for the gear owner. • Gear can be tracked/detected to avoid gear conflict.
Other considerations for gear marking	• Gear levies should be used by *formal independent body* (government not to have access to the money). Levies used to run the independent body, fund gear retrieval, buy-back. • Awareness for why you should buy marked gear. • Gear should be made from monopolymers. • Small-scale fishers: these fishers make their own nets, unlikely to want marking of gear due to cost.
What types of gear should be marked?	• Pots/traps: partial biodegradability may be possible, could be marked electronically or physically but electronic marking is unlikely. Most are already marked. • Lines: partial biodegradability may be possible, electronic marking is unlikely, physical marking is possible. • FADs: can be biodegradable, electronic marking (GPS monitored) is possible, and physical marking is possible. • Nets: can be biodegradable, electronic and physical marking is possible. Note: nets would need more than one marking on them since only parts of nets may be torn off. • Manufacturers should mark gear before sales. Manufacturers can innovate gear that has marking already on it. • Retailers must keep records of sales (should be made mandatory?) but do not need to mark gear since manufacturers should be doing that. • Mandatory
End-of-life options for fishing gear	
Gear EOL in Africa: what are the challenges and opportunities?	• Currently, most EOL gear in Africa goes to landfill (these quantities should be recorded), some is repurposed or incinerated to energy. • Recycling is not ideal due to: – Gear being lower quality once used – Needs to be cleaned – Very few factories recycle fishing gear globally – Gear is often not made of recyclable material • Rather than recycling, repurposing of gear should be the primary focus in Africa. • Greenwashing needs to stop.

Is recovery of gear at sea a viable option for Africa?	• This should not be a priority focus for African countries. • Very costly with no known funders – extended producer responsibility (EPR) and government levies should be considered. • Limited applications – only possible for some gear types and in some environments. • Drones can be used to find gear, but this is costly.
Aside from recycling or landfill, what other EOL options do we have?	• Repurposing of gear – Market research is needed. – EOL nets can be used in the agricultural sector – for fencing or shade cloth, and/or construction sector – walkways and furniture. – Opportunities to use gear in art applications.
What port considerations do we need to include?	• Ports are key for EOL gear. • Ports need adequate reception facilities and storage facilities. • Opportunity for data collection of EOLFG at reception facilities. • Ports can link with waste management operations.

SUSTAINABLE SEAS TRUST

Gqeberha, South Africa
Cell: +27 76 608 3587
Email: info@sstafrica.org.za
Website: sst.org.za