Centre for Environment Fisheries & Aquaculture Science

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South African Marine Fisheries and Abandoned, Lost and Discarded Fishing Gear.

Commonwealth Litter Programme - South Africa

Author(s): Peter Randall

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Project Manager:	Principal Investigator: Thomas Maes Project Manager: Julia Baker County Lead: Fiona Preston-Whyte
Report compiled by:	Peter Randall
Quality control by:	Umberto Binetti, Fiona Preston-Whyte
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Executive Summary

The Commonwealth Litter Programme (CLiP) is an initiative delivered by the Centre for Environment, Fisheries and Aquaculture Science (Cefas) and funded by the United Kingdom's Department for Environment, Food and Rural Affairs. The initiative supports developing countries across the Commonwealth in preventing plastics from entering the ocean.

The objective of the following report is to examine the fisheries sectors of South Africa in relation to marine litter, specifically the likelihood for litter from fishing to become Abandoned, Lost and Discarded Fishing Gear (ALDFG) with the potential to ghost fish.

The report depicts the major fisheries sectors of South Africa describing bottom and midwater trawling, both demersal and pelagic long-lining, pole fishing for tuna, traditional line fishing, trap and pot fishing, seining and fishing with gillnets. The report defines ALDFG, the potential impacts of ALDFG and the reasons for ALDFG. Methods for reducing ALDFG are described from a global perspective. Replicating the global risk analysis presented by the Global Ghost Gear Initiative (GGGI) and applying that analysis to the various fishing sectors of South Africa, suggests that the fishing sector with the greatest risk of ALDFG is the gillnet sector, the second highest risk is in the sectors of West Coast rock lobster (trap only, not hoopnet), South Coast rock lobster and the exploratory octopus trap fishery. The remaining fisheries have a low risk of creating ALDFG.

A more detailed examination of the potential for ALDFG within the fisheries of South Africa suggests there is some inevitable minor gear loss, and most lost gear does not remain active for long. The expense of fishing gear encourages owners to attempt retrieval. Plus, any significant gear loss must be reported to the the Department of Agriculture, Forestry and Fisheries (DAFF) as a condition of the permit to fish. There is some degree of voluntary gear marking, but gear marking is not a requirement of the fishing permit in most South African fisheries. Also, there is some education and awareness for the industry. Some sectors haveing a best practice or code of conduct, while the sectors were ALDFG may be more likely have mitigation measures in place. Certain South African fish processing plants are reutilizing numerous waste materials including fishing equipment; that are either repaired or sold to a third party for recycling.

Although in general the fisheries of South Africa seem well managed, there is room for improvement. Recommendations to improve tackling ALDFG in South Africa are proposed: making gear marking a requirement of the permit to fish would assist in the identification of Illegal, Unregulated and Unreported (IUU) fishing gear, (IUU is a particular problem in South African waters); modifying port state measures to include the inspection of fishing gear to aid identification of IUU; provision of appropriate low cost collection facilities for unwanted fishing gear to discourage discarding unwanted gear at sea; encourage owners/operators of fishing gear to make every reasonable effort to retrieve ALDFG; and finally encourage the use of appropriate biodegradable material, escape mechanisms, or passive deterrents to reduce the time that lost fishing gear remains active.

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1 Introduction

1.1 Fisheries of South Africa

South Africa has a coastline that spans two ecosystems over a distance of 3 623 km, extending from the Orange River in the west on the border with Namibia, to Ponta do Ouro in the east on the Mozambique border. The western coastal shelf has highly productive commercial fisheries similar to other upwelling ecosystems around the world, while the East Coast is considerably less productive but has high species diversity, including both endemic and Indo-Pacific species. South Africa's fisheries are regulated and monitored by the Department of Agriculture, Forestry and Fisheries (DAFF) and are managed either as commercial, small-scale or recreational sector. All fisheries in South Africa, as well as the processing, sale in and trade of almost all marine resources, are regulated under the Marine Living Resources Act, 1998 (No. 18 of 1998) (MLRA). (Wilkinson and Japp, 2018)

Approximately 17 different commercial fisheries sectors currently operate within South African waters. Table 1.1 lists these along with ports and regions of operation, landed catch and number of active vessels and the number of rights holders for 2016 (Modified from Wilkinson and Japp, 2018). Figures 1.1 and 1.2 show the proportional volume of landings and national wholesale value landed by each of these sectors in 2016. In respect to economic value the principal fisheries are the demersal (bottom) trawl and demersal long-line fisheries targeting the deep-water Cape hake (*Merluccius paradoxus*) and shallow-water Cape hake (*M. capensis*), known collectively as Cape hakes (Wilkinson. and Japp, 2018). Landings of Cape hake constitute approximately 26% by weight and 46% by value of national landings. The principal fishery in respect to overall tonnage of landings is the pelagic-directed purse-seine fishery targeting small species of pelagic fish including South American pilchard (*Sardinops sagax*), European anchovy (*Engraulis encrasicolus*) and Whitehead's round herring (*Etrumeus whiteheadii*) (Wilkinson and Japp, 2018). Landings of these small pelagic fish constitutes approximately 63% by weight and 33% by value of national landings. Highly migratory tuna and tuna-like species are caught on the high seas and seasonally within the South African waters by both the pelagic long-line and pole fisheries. Targeted species include albacore (*Thunnus alalunga*), bigeye tuna (*T. obesus*), yellowfin tuna (*T. albacares*) and swordfish (*Xiphias gladius*) (Wilkinson. and Japp, 2018). The traditional line fishery is the largest fishery in terms of both number of rights holders (422) and number of vessels (450), targeting a large assemblage of species close to shore; including snoek (*Thyrsites atun*), Hottentot seabream (*Pachymetopon blochii*), geelbek croaker (*Atractoscion aequidens*), kob (*Argyrosomus japonicus*), yellowtail (*Seriola lalandi*) and other reef fish (Wilkinson and Japp, 2018). At time of release of this report, the gillnet fishery has a Total Allowable Effort (TAE) of 162 right-holders using 48 – 54 mm mesh gillnets to target thinlip grey mullet (*Chelon richardsonii*), known locally as Harder. Within St Helena Bay, the 80 local right holders are permitted to use two larger mesh nets (178 mm mesh), as well as, their two mullet nets, to target Cape elephantfish (*Callorhinchus capensis*), a species of chimaera, locally known as the St Joseph shark (Stephen Lamberth, DAFF, pers. comm.).

Table 1.1: South African offshore commercial fishing sectors, landings, number of rights holders, wholesale catch value and target species (Modified from original, Wilkinson and Japp, 2018)

Sector	Areas of Operation	Main ports in Priority	No. of Vessels	Rights Holders	Landed Catch (t)	Wholesale Value (R 000)	Target Species
Small pelagic purse seine	West, South Coast	St Helena Bay, Saldanha, Hout Bay, Gansbaai, Mossel Bay, Port Elizabeth.	101	111	399 612	3 210 924	Anchovy (*Engraulis encrasicolus*), sardine (*Sardinops sagax*), Redeye (*Etrumeus whiteheadi*)
Demersal trawl (offshore)	West, South Coast	Cape Town, Saldanha, Mossel Bay, Port Elizabeth.	51	50	151 456	3 927 000	Deepwater hake (*Merluccius paradoxus*), shallow-water hake (*Merluccius capensis*)
Demersal trawl (inshore)	South Coast	Cape Town, Saldanha, Mossel Bay.	31	18	6 956	131 793	East coast sole (*Austroglossus pectoralis*), shallow-water hake (*M.* capensis), juvenile horse mackerel (mackerel (*Trachurus capensis*)
Mid water trawl	West, South Coast	Cape Town, Port Elizabeth.	6	34	30 000	N/A	Adult horse mackerel (*T. capensis*)
Demersal longline	West, South Coast	Cape Town, Saldanha, Mossel Bay, Port Elizabeth, Gansbaai.	64	146	9 027	338 600	Shallow-water hake (*M.* capensis)
Large pelagic longline	West, South, East Coast	Cape Town, Durban, Richards Bay, Port Elizabeth.	31	30	7 492	123 367	Yellowfin tuna (*Thunnus albacares*), big eye tuna (*Thunnus obesus*), Swordfish (*Xiphius gladius*), southern bluefin tuna (*Thunnus maccoyii*)
Tuna pole	West, South Coast	Cape Town, Saldanha.	128	170	2 809	124 009	Albacore tuna (*Thunnus alalunga*)
Traditional line fish	West, South, East Coast	All ports, harbours and beaches around the coast.	450	422	6 445	109 763	Snoek (*Thyrsites atun*), Cape bream (*Pachymetopon blochii*), geelbek (*Atractoscion aequidens*), kob (*Argyrosomus japonicus*), yellowtail (*Seriola lalandi*), Sparidae, Serranidae, Carangidae, Scombridae, Sciaenidae
South Coast rock lobster	South Coast	Cape Town, Port Elizabeth.	12	13	735	351 196	*Palinurus gilchristi*
West Coast rock lobster	West Coast	Hout Bay, Kalk Bay, St Helena.	105	240	1 033	537 516	*Jasus lalandii*
KwaZulu Natal prawn trawl	East Coast	Durban, Richards Bay.	5	6	181	17 859	Tiger prawn (*Panaeus monodon*), white prawn (*Fenneropenaeus indicus*), brown prawn (*Metapenaeus monoceros*), pink prawn (*Haliporoides triarthrus*)
Squid jig	South Coast	Port Elizabeth, Port St Francis.	138	92	8 500	781 908	Squid/chokka (*Loligo vulgaris reynaudii*)
Gillnet	West Coast	False Bay to Port Nolloth.	N/A	162	634	N/A	Thinlip grey mullet (Chelon richardsonii), Cape elephantfish (Callorhinchus capensis)
Beach seine	West, South, East Coast	N/A	N/A	28	1 600	10 433	Thinlip grey mullet (Chelon richardsonii, and as linefish above
Seaweeds	West, South, East Coast	N/A	N/A	14	6 172	N/A	Mixed beach-cast seaweeds including kelp, *Gelidium spp* and *Gracilaria spp*
Abalone	West Coast	N/A	N/A	N/A	86	N/A	*Haliotis midae*
Octopus Trap	West Coast	Saldanha Bay to Plettenburg Bay.	2	N/A	14 (2015)	N/A	*Octopus vulgaris*

Crustacean fisheries comprise a trap and hoop net fishery targeting West Coast rock lobster (*Jasus lalandii*, [Cape rock lobster]), a line trap fishery targeting the South Coast rock lobster (*Palinurus gilchristi*, [Southern spiny lobster]) and a trawl fishery based solely on the East Coast targeting penaeid prawns, langoustines (*Metanephrops andamanicus*, [Andaman lobster] and *Nephropsis stewartia*, [Indian Ocean lobsterette]), deep-water rock lobster (*Palinurus delagoae*, [Natal spiny lobster]) and red crab (*Chaceon macphersoni*, [Pink Geryon]) (Wilkinson and Japp, 2018). Other fisheries include a mid-water trawl fishery targeting Cape horse mackerel (*Trachurus trachurus capensis*) predominantly on the Agulhas Bank, South Coast and a hand-jig fishery targeting chokka squid (*Loligo vulgaris reynaudii*) exclusively on the South Coast (Wilkinson and Japp, 2018).

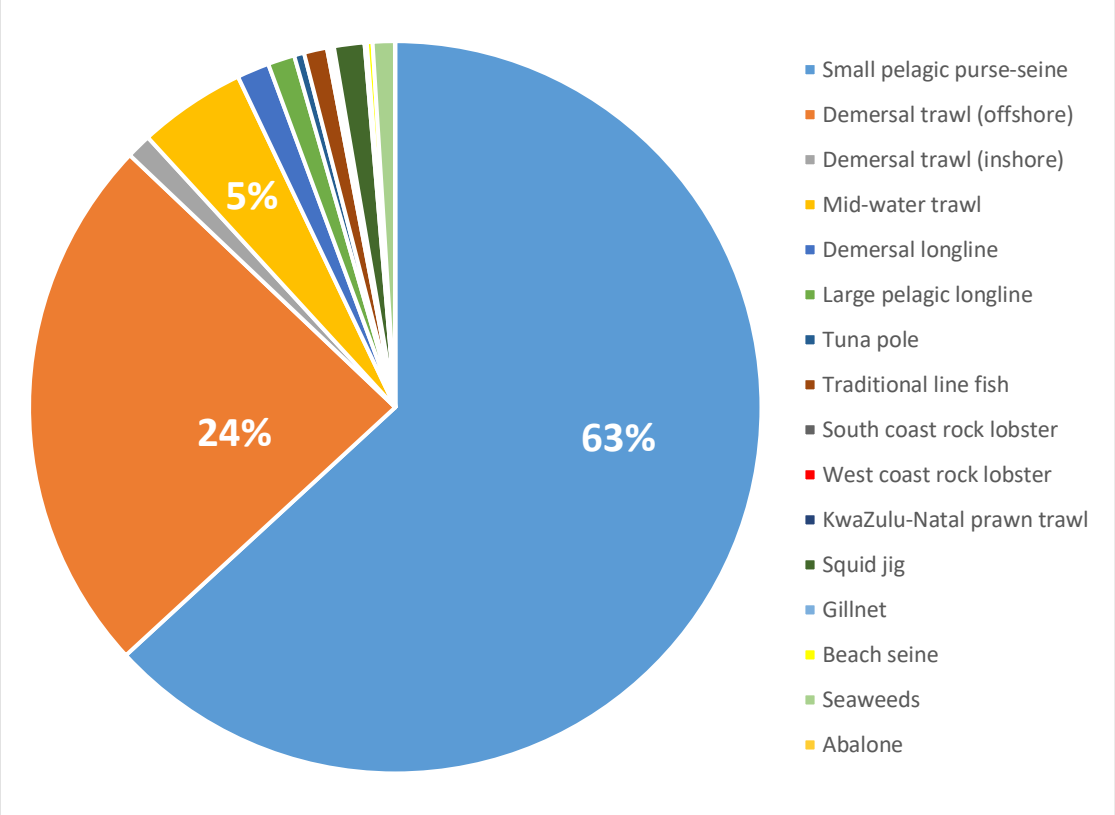

Figure 1.1: Pie chart showing percentage of landings by weight of each commercial fishery sector as a contribution to the landings for all commercial fisheries sectors combined for 2016

Since 2002 there has been an exploratory trap fishery for octopus; this was suspended from 28th June till 15th November 2019 due to a number of whale entanglements, some of which led to the whale's death. South Africa is currently in the process of implementing a small-scale fishery to capture artisanal/subsistence fishing effort (Deon Durholtz, DAFF, pers. comm.). In addition to commercial sectors, recreational fishing occurs along the coastline comprising shore angling and small, open boats generally less than 10 m in length. The commercial and recreational fisheries are reported to catch over 250 marine species, although fewer than 5% of these are actively targeted by commercial fisheries, which comprise 90% of landed catch (Wilkinson and Japp, 2018).

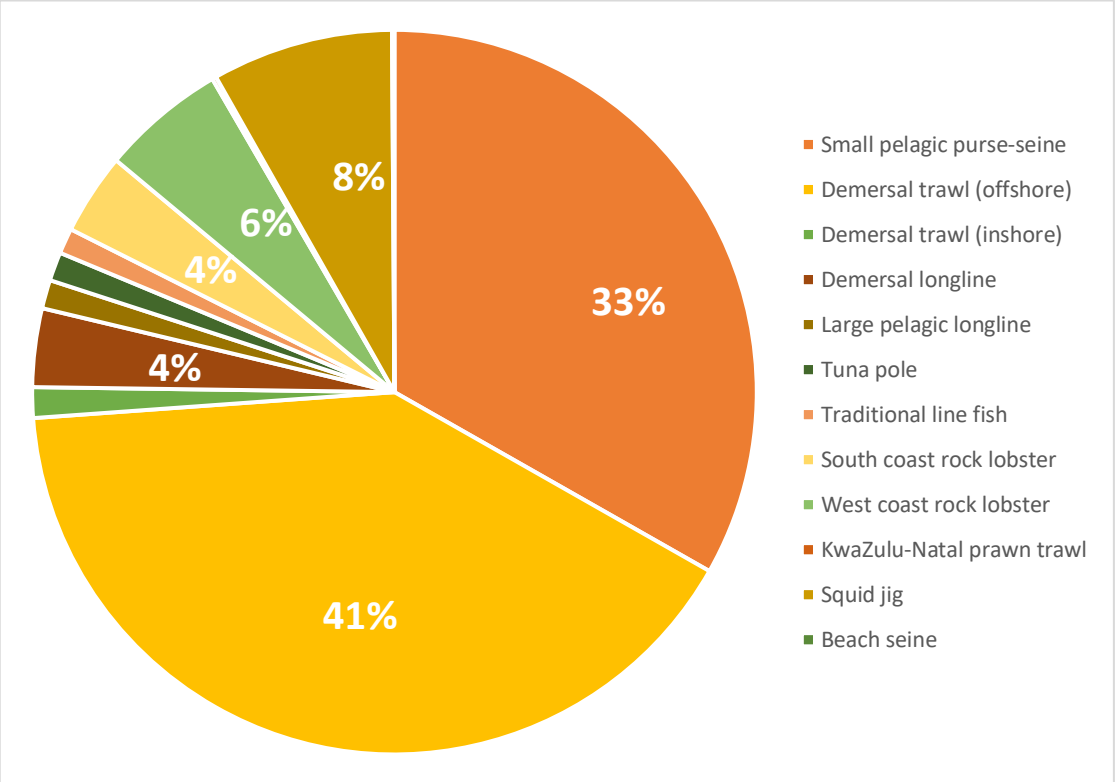

Figure 1.2: Pie chart showing percentage of national wholesale value of each commercial fishery sector as a contribution to the landings for all commercial fisheries sectors combined for 2016.

2 Abandoned, Lost or otherwise Discarded Fishing Gear (ALDFG)

2.1 Definition of ALDFG

When fishing gear is no longer in the control of the owner there is a risk that it will become ghost gear i.e. that it will continue to be active and fish (ghost fish) even though it is no longer managed by an individual. The alternative term for ghost gear is abandoned, lost or otherwise discarded fishing gear (ALDFG). ALDFG is defined as follows;

"abandoned fishing gear" means fishing gear over which the owner/operator has control and that could be retrieved by owner/operator, but that is deliberately left at sea due to force majeure or other unforeseen reasons.

"lost fishing gear" means fishing gear over which the owner/operator has no control and that cannot be located and/or retrieved by the owner/operator.

"discarded fishing gear" means fishing gear that is released at sea without any attempt for further control or recovery by the owner/operator.

2.2 Impact of ALDFG

The ability of ALDFG to ghost fish is dependent on the type of fishing gear and the conditions under which it became ALDFG, that is on whether the gear has been abandoned, lost or discarded and operates at maximum. It also depends on the nature of the local environment, especially in terms of currents, depth, substrate type and location (Macfadyen *et al.*, 2009). Within their "Best Practice Framework for the Management of Fishing Gear", the Global Ghost Gear Initiative (GGGI) make a comparison of various fishing gear classes, examining the gear's characteristics and their contribution to ALDFG. A subjective risk score of 1-5 was applied to the attributes of "likelihood" and "impact" for the gear classes of bottom trawls, mid-water trawls, seine nets, gillnets, hooks and lines, traps and pots and finally fish aggregating devices (FADs). These attributes were then multiplied by one another to produce a "total risk" of a gear becoming ALDFG. The result was that gillnets were found to have the greatest risk of becoming ALDFG, followed by traps and pots, then FADs (Table 2.1). Replicating the risk analysis presented by GGGI on the various fishing sectors of South Africa, suggests that the fishing sector with the greatest risk of ALDFG is the gillnet sector, the second highest risk is in the sectors of West Coast rock lobster (trap only, not hoopnet), South Coast rock lobster and the exploratory octopus trap fishery (Table 2.2).

Table 2.1: Likelihood, potential impact, and total risk of a gear class becoming ALDFG (Huntington, 2016a)

GEAR CLASS	LIKELIHOOD	IMPACT	TOTAL RISK
Gillnets	5	5	25
Traps and pots	4	4	16
Fish Aggregating Devices	4	3	12
Hooks and lines	3	3	9
Bottom trawls	2	3	6
Mid-water trawls	1	2	2
Seine nets	1	2	2

Macfadyen (*et al.*, 2009) also suggests that gillnets and traps/pots have the ability to ghost fish, and that lost trawls and longlines rarely ghost fish. However, he does point out that trawls have other impacts such as smothering the benthos and damaging delicate habitats such as coral reefs, while longlines can become entangled or the hooks may have an impact on seabirds.

In the case of both gillnets and traps/pots, although they may continue to fish when no longer under control, there is a tendency that the effectiveness of the fishing will steadily decline, although the duration of this cycle can vary widely depending upon pot design, material the pot is made of and the local environmental conditions.

Table 2.2: Likelihood, potential impact, and total risk of a fishing sector gear becoming ALDFG based on the Global Ghost Gear's risk analysis (Huntington, 2016a)

Sector	Likelihood	Impact	Total Risk
Small pelagic purse-seine	1	2	2
Demersal trawl (offshore)	2	3	6
Demersal trawl (inshore)	2	3	6
Mid-water trawl	1	2	2
Demersal longline	3	3	9
Large pelagic longline	3	3	9
Tuna pole	3	3	9
Traditional line fish	3	3	9
South Coast rock lobster	4	4	16
West Coast rock lobster (trap)	4	4	16
KwaZulu-Natal prawn trawl	2	3	6
Squid jig	3	3	9
Gillnet	5	5	25
Beach seine	1	2	2
Octopus trap	4	4	16

Although the level of entanglement and ingestion may not be particularly relevant to commercial fish stocks, entanglement and ingestion become more significant when considering Protected, Endangered, and Threatened Species (PETS) for example; marine mammals, turtles, birds, sharks and rays, as well as some species of fish. There are few comprehensive global studies on the overall significance of this, but specific studies have indicated that ALDFG may be a significant cause for mortality for some species at local level (Macfadyen, *et al.*, 2009). Three entanglements within the South African exploratory octopus trap fishery resulted in the deaths of both a humpback and Bryde's whale in June 2019, leading to the suspension of the exploratory fishery on the 28th June 2018. It is estimated in the last four years there have been eight entanglements of whales leading to the deaths of six individuals[1]. The suspension of the octopus fishery was lifted on 15th November 2019 subject to the immediate implementation of mitigation measures through the permit conditions for this fishery[2].

[1] www.france24.com/en/20190628-safrica-halts-cape-town-octopus-fishing-after-2-whales-die
[2] www.news24.com new-octopus-fishing-rules-imposed-to-save-cape-towns-whales-20191108

As plastic-made fishing gear slowly breaks down over time it has the potential to introduce microplastics (fragments <5mm, according to Arthur et al., 2008) in the environment and eventually into the food chain. These fragments are considered secondary microplastics since they derive from the breakdown of bigger pieces, as opposed to primary microplastics (such as beads in cosmetic products) that leak in the environment when they are already under 5mm of size (Andrady, 2017). Plastics can last up to 600 years in the marine environment, depending on environmental conditions (Huntington, 2016b). There is concern for the potential impact of microplastics on the environment, human activities and human health (Thompson *et al.,* 2009). CLiP included the analysis of microplastics under its 'Education and Science' pillar and established laboratories in several countries (including two within South Africa), training at the same time local technicians to increase the countries' capacity. The scope was to analyse microplastics concentration in sediment, water and in biota and to identify the constituting polymer when possible. CLiP found microplastics in commercially viable species in all the countries were the analysis was carried out.

ALDFG can have an impact on the health and safety of marine users; by becoming a danger to navigation (FAO, 2018). Ropes and nylon line can foul propellers, drive shafts, etc., affecting a vessel's propulsion and ability to manoeuvre. This can lead to operational delays and in extreme cases, the potential for collision, capsize, injury and the loss of life.

2.3 Reasons for ALDFG

Macfadyen (*et al.*, 2009) describe the causes of ALDFG in detail, summarised below.

2.3.1 Gear Conflict

ALDFG can be the result of conflict between different fisheries, in areas where more than one fishing gear can be used, there is the potential for competition. ALDFG arising from conflict is most commonly reported as a result of mobile fishing gear being used in an area where static gear has been set.

2.3.2 Operational and Environmental Factors

Due to the environment where fishing takes place and the technology used, one must accept that some loss of fishing gear is inevitable. Gear loss may be unintentional; however, it may also be intentional but unavoidable. It may be that the time required to retrieve gear is more costly (e.g. lost time fishing) than the cost to replace the gear.

Currents, rough ground or fasting's, strong winds and swell may impact on a vessel's ability to safely deploy and subsequently retrieve fishing gear.

2.3.3 Shoreside Disposal

The availability, convenience and cost of shoreside disposal facilities will determine whether unwanted or old gear are landed for disposal or simply dumped at sea.

2.3.4 Illegal, Unregulated and Unreported (IUU) Fishing

Fishing gear may be deliberately abandoned or discarded to disguise IUU fishing activities. IUU fishing is a particular area of concern internationally and was discussed at the 33rd session of the Committee on Fisheries (FAO, 2018a).

2.3.5 Vandalism and Theft

ALDFG can be the result of deliberate vandalism and/or theft. This can be an aspect of conflict between fishers or due to conflict with other marine users.

2.4 Reducing ALDFG

The problem of ALDFG is recognised on an international level and considered significant enough to merit action. Measures implemented to deal with ALDFG are frequently conducted within the wider issue of litter in the marine environment. The measures taken under the UNEP Regional Seas Programme on Marine Litter and Abandoned Fishing Gear are presented in the report by the Regional Seas Coordinating Office (UNEP, 2005). The report recognizes that lost and abandoned fishing gear is only one aspect (or component) of the global marine litter problem but it needs to be separately addressed (Macfadyen, *et al.*, 2009).

There are a number of existing methods to reduce ALDFG. Macfadyen (*et al.*, 2009) divides these methods into three categories; preventative, mitigating and curative. A brief description of the methods to reduce ALDFG are provided below following Macfadyen's (*et al.*, 2009) catergorisation. Reducing ALDFG specifically in South Africa is discussed below in Section 4 - Recommendations to tackle ALDFG in South Africa.

2.4.1 Preventative Measures

Avoiding the occurrence of ALDFG in the marine environment.

2.4.1.1 Gear Marking

The application of an identification mark to fishing gear is a practise which could be as old as the practise of fishing itself. The mandatory marking of fishing gear to enable identification of ownership is far less common. The issue of marking fishing gear was first raised at the Food and Agriculture Organization of the United Nations (FAO) in 1987 during the 17th Session of Committee on Fisheries (COFI). The FAO recognised the environmental impacts caused by abandoned, lost and otherwise discarded fishing gear being also concerned with the related illegal, unreported and unregulated fishing (FAO, 2016). The issue has received further attention since then, culminating in the convention of an Expert Consultation on the Marking of Fishing Gear (FAO, 2016) as well as a Technical Consultation on the Marking of Fishing Gear (FAO, 2018a) resulting in the formulation of the Voluntary Guidelines for the Marking of Fishing Gear which were endorsed at global level at the Thirty-third Session of FAO's Committee on Fisheries in July 2018 (FAO, 2019). On board location technology Global Positioning Systems (GPS) are prevalent in many fisheries, as are various forms of sea-bed mapping technology. Vessel GPS systems have a high level of accuracy; accurate to just a few

metres. Sea-bed mapping technology allows accurate mapping of known obstacles or fasting's allowing fishing gear to be deployed avoiding these features. Providing fishing gear is not relocated by an environmental event or by being towed away, these systems will reliably locate fishing gear.

Fishing gear tracking can be improved by the use of transponder technology attached to the gear. However, this technology inevitably comes with a cost.

2.4.1.2 Port state measures

As mentioned above (2.3.4), IUU is a contributor to ALDFG and of great concern at an international level. The FAO are encouraging the improvement of port state measures as a critical method to combat IUU. Port inspections that will enabling the examination of any areas of the fishing vessel that is required, to verify compliance with relevant conservation and management measures. By including fishing gear and related equipment within the inspection, port state measures can contribute to the implementation and enforcement of preventative measures. Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL) (IMO, 1973) deals with the prevention of pollution by garbage from ships and entered into force on 31 December 1988. Thus, the dumping of any fishing gear at sea is in contravention of MARPOL Annex V.

The provision of appropriate facilities for the collection of old, damaged or unwanted fishing gear may encourage fishers to land said gear rather than dumping at sea. Disposal can often come at a cost but if the cost is incorporated into harbour costs or landing fees it removes any economic incentive to dump fishing gear at sea.

Figure 2.1: Fishing line receptacle provided in Bonaire to protect coral reef and turtles (© Copyright Peter Randall)

2.4.1.3 Reduce fishing effort

Reducing overall fishing effort (e.g. by limiting fishing time or the amount of gear per vessel or requiring that gear not be left unattended by the vessel) is a fisheries management measure that can have secondary effect of also affecting rates of ALDFG. In the case of static gear, the greater the amount of gear in the water and the longer the soak time the more chance that gear will be lost, therefore reducing fishing effort reduces the chance fishing gear will become ALDFG.

2.4.1.4 Spatial management (zoning scheme)

By restricting were particular fishing gears can be deployed it is possible to avoid both conflicts between fishing sectors and conflicts with other marine users. e.g. deploying gear away from shipping lanes reduces the chances the gear will become a navigational hazard and the chances the gear will be accidentally towed away.

Figure 2.2: Otter trawl fouled by ALDFG gill net in the Western Channel, United Kingdom (© Crown Copyright).

2.4.2 Mitigative Measures

Reducing the impact of ALDFG in the marine environment.

2.4.2.1 Biodegradable materials

The use of alternative materials to plastic in fishing gear can either reduce the microplastic load or avoid the risk of the gear remaining active for long periods, once it is no longer in the

control of an operator. A number of shellfish fisheries use degradable escape panels in traps. The use of "rot cord" will allow animals to escape and prevent the trap from actively fishing.

2.4.2.2 Reduce ghost catches

Fishing gear with the potential to capture Protected, Endangered and Threatened species when in the control of a fisher may also be a risk to those species if the gear becomes ALDFG. Some measures that are effective in either deterring or guiding bycatch away when active such as acoustic deterrents ("Pingers"), electropositive metals (mishmetal) or lights will have limited effectiveness over time due to battery life or chemical processes. Measures not reliant on electricity or chemistry may maintain some effectiveness if the gear becomes ALDFG (e.g. square mesh panels, excluders or streamer lines).

Figure 2.3: Porpoise bycatch in a gill net in the North Sea (© Crown Copyright).

2.4.3 Curative Measures

Removing ALDFG from the marine environment.

2.4.3.1 Locating lost gear

Considering the substantial cost of fishing gear, fishers will make every possible attempt to recover their own gear, though there may become a point when the cost of replacement outweighs the cost of recovery. The use of GPS or mapping technology should aid in locating gear.

2.4.3.2 *Better reporting of gear loss*

Fishers should be encouraged to report lost fishing gear, either their own, or any unattended gear they encounter, to aid recovery.

Under MARPOL Annex V all vessels greater than 100GT are required to follow a garbage management plan (which includes fishing gear). Smaller vessels could be encouraged to do likewise.

2.4.3.3 *Gear recovery programmes*

Gear recovery programmes can entail the towing of a grapnel across the seabed a process known as "creeping" to retrieve lost gear. There have been a number of recovery programmes in recent years including Deepnet (Hareide *et al*. 2005) and Fantared 2 (Brown *et al*. 2005). In the United Kingdom, the Centre for Environment, Fisheries and Aquaculture Science (Cefas) conducted gillnet retrieval surveys under the Fisheries Science Partnership programme (Large *et al*. 2005, Large *et al*. 2006) which led to the international collaboration "Deepclean" (Large *et al*. 2009).

Figure 2.4: Recovering ALDFG using a "creeper" (Large *et al*. 2006, © Crown Copyright)

In sensitive habitats were creeping has the potential to damage the habitat, alternative methodologies need to be used, for example diver recovery in shallow waters (Drinkwin, 2019; WAP, 2019). Similar operations were carried out under the umbrella of the CLiP project in Vanuatu, in the South Pacific (WAP, 2019).

Some gear recovery programmes target known hotspots or sensitive habitats while some conduct transect surveys to establish the extent of ALDFG within an area. (Large *et al*. 2009).

2.4.3.4 Disposal & Recycling

There are numerous examples of recycling fishing gear. Fishing net can be melted down into plastic pellets and repurposed e.g. recent examples are recycling as surfboards, skateboards, sunglasses, toys, carpets and other textiles.

Figure 2.5: Mossel Bay SeaVuna – fishing gear for recycling from APWC (2020).

3 Potential ALDFG in the fisheries sectors of South Africa

Noone may fish commercially in South African waters unless they have been granted a "Right to Fish" through the formal Fishing Rights Allocation Process and be in procession of a vessel licence. The Rights are of variable duration (7 to 15 years), but a permit must be applied for an annual basis (Deon Durholtz, DAFF, pers. comm., Johan Augustyn, SADSTIA, pers. comm.) Permits are also required for small-scale or recreational fishing (Anon, 1997; Anon, 2016).

3.1 Small pelagic purse-seine

The 2019 purse-seine fishery for small pelagic fish currently has 91 Rights holders operating 63 active fishing vessels of approximately 11 – 48m in length. This fishery's catches consist

predominantly of anchovy (*Engraulis encrasicolus*), sardine (*Sardinops sagax*) and redeye round herring (*Etrumeus whiteheadi*). In the last five years, average total catch has been around 350 000t with an estimated value varying from about 2 to 3 billion Rand, dependent on how much of the total catch is sardine – recently sardine Total Allowable Catches have been low compared to anchovy (Janet Coetzee, DAFF, pers. comm.).

Purse seines are deployed in open water and remain attached to the vessel. They have no contact with the seabed and are buoyed by numerous buoys on the headrope, so accidental loss of parts or the whole seine is unlikely. Furthermore, considering the cost of the gear, purse-seines are regularly maintained and if they did become lost, they would be retrieved.

3.2 Demersal trawl

The trawl fisheries in 2019 for Cape Hake are composed of an inshore fishery prosecuted by approximately 16 vessels with an overall vessel length of 14 – 30m, and an offshore fishery of about 65 vessels with a length range of 23 – 90m fishing at depths greater than 110m (Deon Durholtz, DAFF, pers. comm.) As demersal trawls target the same species and grounds as the demersal longline fishery there is the potential for overlap, there is occasional interaction between trawls and longlines reported, with sporadic loss of longlines and fouling of trawls. The trawl fisheries have a ring-fenced area primarily for monitoring control and surveillance purposes that separates the fisheries to some degree (David Japp, CapMarine, pers. comm.).

As demersal trawls are in contact with the seabed there is always the possibility of some damage due to fasting's which could lead to some fraction of the mesh detaching from the trawl. The loss of the entire trawl is unlikely but due to the cost of the gear and ancillary equipment such as net sensors, recovery would certainly be attempted. All demersal fisheries are required (by permit conditions) to report gear loss (including the GPS co-ordinates) to the Department of Agriculture, Forestry and Fisheries (Deon Durholtz, DAFF, pers. comm.).

3.3 Mid-water trawl

The mid-water trawl fishery targeting cape horse mackerel (*Trachurus capensis*) operates offshore in water deeper than 110m and is prosecuted by just six vessels in 2019 (Deon Durholtz, DAFF, pers. comm.).

The trawl is deployed in open water and towed from the vessel without any contact with the seabed making gear loss extremely unlikely.

3.4 Demersal longline

The demersal longline fishery targets cape hake both inshore and offshore as the demersal trawl fisheries do, and as stated above (section 3.2) there is the potential for some overlap and therefore interaction between the fisheries. The fishery is conducted by approximately 75 vessels in the 18 – 50m length range (2019). Loss of gear is common, however, such gear is unlikely ghost fish, but there will be an impact to the substrate and longlines can be picked up by other gears. Again all demersal fisheries are required (by permit conditions) to report gear

loss (including the GPS co-ordinates) to the Department of Agriculture, Forestry and Fisheries (Deon Durholtz, DAFF, pers. comm.).

3.5 Large pelagic longline

The longline fishery targeting large pelagic species of fish is conducted seasonally in South African waters and on the high seas all year round, operated by around 31 vessels (Wilkinson and Japp, 2018). Loss of gear is minimal, and ghost fishing unlikely though fouling of substrate is possible, as is a potential for longlines to foul other fishing gears.

3.6 Tuna pole

The tuna pole fishery has about 170 Rights holders with 128 fishing vessels targeting Albacore tuna (*Thunnus alalunga*) (Wilkinson and Japp, 2018). The fishery is seasonal with vessels active predominantly between November and May and peak catches recorded from November to January. Considering the nature of the fishery, the use of a rod and line with a barbless hook and live bait, there is unlikely to be an issue with ALDFG or ghost fishing in this fishery. However, as the fishery is reliant on live bait, the method of capture of the live bait could be relevant to ALDFG, e.g. seine nets.

3.7 Traditional line fish

The traditional line fishery is the largest fishery in South Africa in terms of both number of rights holders (422 in 2016) and number of vessels (450 in 2016), targeting a variety of fish species close to shore (Wilkinson and Japp, 2018). This is an extremely environmentally friendly way of fishing. Vessels are monitored by Vessel Monitoring System (VMS) and permit conditions require that catch be reported for each fishing trip; however, logbook data are unverified and may underestimate total landings (Wilkinson and Japp, 2018). It is very much a targeted fishery with no by-catch, and if bycatch does occur there is potential to release the bycatch alive. Fishing occurs at surface level so there is no seabed impact at all. Some loss of handlines and therefore the potential to foul other fishing gear, but unlikely to become active ALDFG.

3.8 South Coast rock lobster

There are between 9 and 12 vessels targeting Southern spiny lobster (*Palinurus gilchristi*) with traps. There has been significant research involving rope, buoy and trap manufacturers to increase the life span of all gear and prevent loss. The traps are rigged with a tripper line system to help prevent gear loss. Buoys, anchors and rope design has been significantly improved over the years in an attempt to prevent any loss (Mike Berg, DAFF, pers. comm.). Some gear loss however is inevitable.

Marking of fishing gear is not a requirement of the permit to fish, however, all buoys and ropes are marked according to vessel and traps are colour coded specific to operators / vessels.

All vessels must comply with MARPOL Annex V by complying with waste disposal regulations and completing a garbage record book which is periodically inspected by the South African Maritime Safety Authority (SAMSA). Damaged/old traps are disposed of ashore.

The cost of the fishing gear is considerable, and any gear lost would initiate an extensive effort to recover the gear. If recovery failed, then the loss would be reported to the vessel's company. In certain instances, there may be ghost fishing by ALDFG pots and traps, but research suggests that once the bait is exhausted that animals may escape.

3.9 West Coast rock lobster

There are approximately 240 rights holders and 105 vessels fishing for West Coast rock lobster (*Jasus lalandii*). The fishery is split into two sectors; the nearshore sector uses hoopnets and would be restricted by virtue of their gear to depths shallower than 30m. The offshore sector use traps and would generally fish in depths between 30 – 100m. Both these fishing methods are usually away from other fishing methods thus no conflict with other sectors (Fishery technician, DAFF, pers. comm.). The lobster fishery is a well-regulated fishery. All vessels have to be registered and at all times have their fishing permits on board the vessel. Season restrictions have been in place since the 1980's and have recently been revised (shortened) to limit the time vessels spend at sea. Closed areas are in place and in some areas, gear restrictions are also in place.

Marking of fishing gear is not a requirement of the permit to fish, however, all buoys would be marked with the vessel registration number. The cost of the gear is such that damaged gear would be repaired if possible, or brought ashore for disposal if not, and there would be an attempt recover any lost gear. There would be no risk of ALDFG and ghost fishing from Hoopnets. There is the possibility of gear loss and ghost fishing from traps. However, lobsters can escape from the traps once the bait has depleted (Fishery technician, DAFF, pers. comm.) plus traps have cotton openings that decay over time (David Japp, CapMarine, pers. comm.).

3.10 KwaZulu-Natal prawn trawl

A small fishery with just 6 rights holders and 5 small trawlers targeting various species of prawn (Wilkinson and Japp, 2018). The fishery is divided into a shallow-water sector (5 – 40m) mostly catching white prawns *Fenneropenaeus indicus*, and a deep-water sector catching pink (*Haliporoides triarthrus*) and red (*Aristaeomorpha foliacea*) prawns as well as langoustines (*Metanephrops mozambicus* and *Nephropsis stewartia*), rock lobster (*Palinurus delagoae*) and red crab (*Chaceon macphersoni*). The abundance of shallow-water prawns on the fishing grounds is highly variable between years, depending on recruitment, due to a 1-year life span and recruitment dependent on their estuarine juvenile stage. The fishery is managed via effort control.

As stated above (section 3.2) as demersal trawls are in contact with the seabed there is always the possibility of some damage due to fasting's which could lead to some fraction of the mesh

detaching from the trawl. The loss of the entire trawl is unlikely but due to the cost of the gear and ancillary equipment such as net sensors, recovery would certainly be attempted. All demersal fisheries are required (by permit conditions) to report gear loss (including the GPS co-ordinates) to the Department of Agriculture, Forestry and Fisheries (Deon Durholtz, DAFF, pers. comm.).

3.11 Squid jig

The squid jig fishery operates inshore within bays away from the other fisheries, targeting Cape Hope Squid (*Loligo vulgaris reynaudii*) known locally as chokka, in depths less than 200m (Wilkinson and Japp, 2018). There were 92 Rights holders and 138 vessels fishing for chokka in 2016, fishing exclusively on the South Coast, landing approximately 8.5K t of squid worth about 780K Rand.

As with the other line fisheries loss of gear can be common, and although it may not ghost fish, there can be an effect to marine life and birds. Also, there will be an impact to the substrate and longlines can be picked up by other gears or be washed ashore.

3.12 Gillnet

The gillnet fishery of South Africa has a total allowable effort of 162 Right-holders each of whom, depending on the "Netfish Area" in which they hold a right, may use 1-4 surface set nets of 75m length, 5m deep with a mesh of 48 – 54mm to fish for Thinlip mullet (*Chelon richardsonii*). However, within St Helena Bay, 80 right-holders are permitted to use two St Joseph shark bottom set nets 75m in length and 2.5m deep with a 178 mm mesh set in less than 50m depth, in addition to their mullet nets. There are a number of mitigation measures in place including exclusion zones and the nets having to be attended and attached to the vessels all the time (Stephen Lamberth, DAFF, pers. comm.).

The legal gillnet fishery is relatively well regulated in South Africa (Stephen Lamberth, DAFF, pers. comm.). However, there is a substantial illegal gillnet fishery throughout South Africa targeting high value species both in inland waters, and throughout the west, south and east coasts. Illegal gillnetting on the West Coast is mostly directed at galjoen (*Dichistius capensis*) and smooth-hound shark (*Mustelus mustelus*) in the sea, and both Thinlip and flathead mullets (*Mugil cephalus*) and elf (*Pomatomus saltatrix*) in estuaries. Illegal gillnetting on the south and east coasts is largely confined to estuaries and directed at, amongst others, dusky kob (*Argyrosomus japonicus*), spotted grunter (*Pomadasys commersonnii*) and a range of mullet species. (DAFF, 2016). The illegal gillnet fishery is a problem with respect to unattended gear (to avoid authorities) and lost gear leading to mortalities of various protected, endangered, and threatened species such as sharks (e.g. seven-gill cowshark, *Notorynchus cepedianus*), birds (e.g. African penguin, *Spheniscus demersus*) and cetaceans (e.g. Heaviside's dolphin, *Cephalorhynchus heavisidii*).

3.13 Beach seine

A small fishery with just 28 Rights holders in 2016. The beach-seine fishery operates primarily on the West Coast of South Africa between False Bay and Port Nolloth with a few permit holders in KwaZulu-Natal targeting mixed shoaling fish during the annual winter migration of sardine (Wilkinson and Japp, 2018). Beach-seining is an active form of fishing in which woven nylon nets are rowed out into the surf zone to encircle a shoal of fish. The nets are then hauled shoreward by a crew of 6 – 30 persons, depending on the size of the net and length of the haul. Nets range in length from 120m to 275m. Fishing effort is coastal and net depth may not exceed 10m (Wilkinson and Japp, 2018).

As a shore-based fishery where gear is in constant control of the fisher, creation of ALDFG is unlikely, as is the probability of ghost fishing.

3.14 Octopus trap

A small experimental fishery targeting the common octopus (*Octopus vulgaris*) that evolved from a pilot to investigate the potential of a commercial fishery. Difficulties caused by gear loss and damage from rough seas, vandalism and theft, access to suitable vessels and equipment, and the rigidity of the original experimental framework, resulted in this experimental fishery not yielding sufficient information to assess the feasibility of establishing a commercial fishery (DAFF, 2016). However, the potential of this fishery continued to be explored.

The identification marking of the gear in this fishery is a requirement of the permit, right holders must inform local harbours of the locations of all gear to prevent encounters with vessels. Communities are informed of fishing practices to prevent tampering with gear, though tampering still occurs (Sanjay John, DAFF, pers. comm.). As with the other trap fisheries, the fishing gear is expensive, so fishers make every effort to ensure that they do not lose gear, and attempt recovery on the rare occasion loss does occur. Ghost fishing should be rare in this fishery as the traps are designed so that animals can enter and exit the trap freely without entrapment. Although ghost fishing should be minimal in this fishery, there has been an issue with the entanglement of various species of whales, leading to the suspension of fishing from June to November 2019. Development of the gear continues, and it has been modified over the years to reduce, with the aim to eradicate the issue with entanglement. There are initiatives to investigate the use of acoustic release buoys, applying sinking bottom ropes and taught buoy lines with PVC surface pipes to mitigate entanglement.

4 Recommendations to tackle ALDFG in South Africa

As stated earlier, measures to tackle the problem of ALDFG can be preventative, mitigative or curative, but as curative measures generally only remove ALDFG after it has been in the marine environment for a period of time, preventative measures are likely to be more effective in reducing ALDFG and its impacts.

It is likely that a combination of several preventative, mitigative or curative measures will be required to reduce the problem of ALDFG.

IUU fishing activities are a contributor to ALDFG, most preventative measures will only be effective in dealing with legitimate operators. International action to tackle IUU fishing is also therefore an important factor in the reduction of ALDFG. Various international agencies are progressing actions within the fisheries or maritime sectors that have direct or indirect consequences for ALDFG. This includes UNEP's marine litter programme and recent FAO actions on Port State measures, IUU fishing and a global vessel register (Macfadyen, *et al.*, 2009).

In general, the fisheries of South Africa seem well managed and there looks to be only minor gear loss, and most lost gear does not remain active for long. The expense of gear encourages owner retrieval. Plus, any significant gear loss must be reported as a condition of the permit to fish. There is some degree of voluntary gear marking, but marking is not a requirement of the fishing permit, with the exception of the exploratory octopus trap fishery. Also, there is some education and awareness within the industry, with some sectors having a best practice or code of conduct in place (David Japp, CapMarine, pers. comm.). There are mitigation measures in place for many fisheries as well e.g. for the gillnet, octopus trap, rock-lobster trap fisheries and a well-established disentanglement network of government and non-government organisations exist to deal with cetacean, shark, bird and other entanglements, mostly due to ghost gear (Stephen Lamberth, DAFF, pers. comm.).

However, there is room for improvement. Making gear marking a requirement of the permit to fish would assist in the identification of IUU fishing gear. The FAO Voluntary Guidelines for the Marking of Fishing Gear (FAO. 2019a) may assist States in meeting their obligations under international law, including relevant international agreements and related governance frameworks, as well as contribute to improved safety at sea by reducing the hazard to navigation caused by ALDFG and helping to identify IUU fishing activities. States are also encouraged to take these Guidelines into consideration, as appropriate, when developing gear marking systems for inland waters. The issue with IUU in both coastal and inland waters of South Africa could benefit from the advice in these guidelines.

South Africa has accessioned to the FAO Agreement on Port State Measures to Prevent, Deter and Eliminate IUU Fishing, including conditions in relation to the marking of the fishing gear (FAO, 2019b). The agreement on Port State Measures is seen to be a cost effective and potent tool to combat IUU fishing. Port State inspection of fishing gear could be conducted in accordance with the procedures set out within the agreement. Port inspections including fishing gear and related equipment, would mean port state measures could contribute to the implementation and enforcement of measures to prevent ALDFG. Currently the inspection of fishing gear is not mentioned within South Africa's port state measures (FAO, 2010-2019).

Appropriate collection facilities should be provided for unwanted fishing gear to discourage discarding unwanted gear at sea, with the cost incorporated into harbour costs or landing fees removing any economic incentive to dump fishing gear at sea. South Africa handles port-generated waste well, however ship-generated waste has much lower levels of control. In fact during a recent audit of waste management in South Africa, under CLiP, it proved challenging

to get a clear picture of the management of ship-generated waste received at commercial ports (APWC, 2020). MARPOL-compliant waste management practices on board international vessels are being confounded by port waste reception norms at South Africa's commercial ports, for example categorisation of waste in South Africa is different from that of MARPOL. Another issue found in the audit was the cost of port reception facilities, costs were found to be sufficiently high that vessels withheld waste at some ports. Some remote ports were found to discourage discharge (APWC, 2020). There is variability in port facilities, although some of the major ports are reasonable there are numerous small harbours built in the 1960s that are in an extreme state of disrepair, with minimal facilities. With reference to the fishing industry the audit found some understanding of waste management. The South African Maritime Safety Authority (SAMSA) and South African Bureau of Standards (SABS) provide environment and safety education for crew members of fishing vessels. All fishing vessels are subject to regulations regarding waste management practices on board, but the application of those practises is variable being dependent on the vessel's captain or owner. The auditors were advised the regular inspections from government patrol vessels was common and that fines were enforced for any dumping of garbage overboard (APWC, 2020). An encouraging finding was that some fish processing plants are reutilizing numerous waste materials. In one example old fishing equipment including nets and ropes are either repaired or sold to a third party for recycling.

Currently in South Africa it would appear appropriate collection facilities for unwanted fishing gear do not exist in many ports, and that the cost of waste management could disincentivise fishing vessels to land unwanted gear. Both these facts suggest a risk of the deliberate dumping of fishing gear at sea. However, the recycling and reuse or sale of old fishing gear by fish processing plants suggest that some of the cost of landing old fishing gear could be offset if port facilities were improved and the infrastructure to transport fishing gear waste was in place.

States should encourage owners/operators of fishing gear to make every reasonable effort to retrieve ALDFG. It appears that this is the case in South Africa and that the cost of fishing gear is incentive enough to attempt recovery. In the event of failure of recovery, it should be reported, in fact in South Africa any significant gear loss must be reported as a condition of the permit to fish. Fishers should be actively encouraged or incentivised to report the location of ALDFG they encounter, and to bring damaged gear ashore for disposal or recycling. However, this will only be practical with improvements to waste management processes, as described above.

The use of biodegradable material, escape mechanisms, or passive deterrents could reduce the time that lost gear remains active. States, and other interested parties should conduct research into measures which would reduce the negative impact of fishing gear if lost, abandoned or discarded, for example, non-entangling and biodegradable materials, and escape mechanisms for trapped animals (FAO, 2019a). A note of caution regarding biodegradable materials; some materials branded as biodegradable may only be biodegradable in certain conditions. It is imperative to use only those materials that are biodegradable within the environment in which they are destined to be deployed (UNEP, 2015, Haider *et al.*, 2019).

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