2. Magnitude and composition of ALDFG

First, this chapter considers what proportion of marine litter generally is comprised of ALDFG. It then identifies available information on the magnitude of abandoned, lost or otherwise discarded fishing gear and highlights information gaps. It also examines the characteristics of abandoned, lost and discarded gear as described by UNEP Regional Seas Programme and attempts to provide an indication of the magnitude of the issue in different parts of the world.

The main sources of marine litter are either sea-based or land-based, and fishing activity is just one of many different potential sources.

In 1997, the United States Academy of Sciences estimated the total input of marine litter into the oceans at approximately 6.4 million tonnes per year, of which nearly 5.6 million tonnes (88 percent) was estimated to come from merchant shipping (UNEP, 2005a). The Academy also noted that some 8 million items of marine litter are estimated to enter oceans and seas every day, about 5 million (63 percent) of which are solid waste thrown overboard or lost from ships (UNEP, 2005a). Furthermore, it has been estimated that currently over 13 000 pieces of plastic litter are floating on every square kilometre of ocean. In 2002, 6 kg of plastic was found for every kilogram of plankton near the surface of the central Pacific gyre[5] (Moore, 2002).

There is no information available on the overall proportion of marine litter that is made up of ALDFG. A number of studies suggest that there are large differences in the proportion of ALDFG found among all marine litter in various regions. For example:

- "In urban areas or beaches close to major urban centers between 75% and 80% of all debris originates from terrestrial sources. In areas remote from urban development it is typically the fishing and shipping industry that is responsible for the majority of marine debris, contributing between 50% and 90% (Faris and Hart, 1994)".
- In Brazil, fishery-related debris represented 46 percent of total marine litter most commonly found in the subtidal benthic environment (Oigman-Pszczol and Creed, 2007).
- In a 1988 survey in Japan, of over 35 000 objects recovered from a beach litter survey, 1 percent and 11 percent were comprised of fishing nets and fishing

TABLE 2
Sources of marine litter

Sea-based sources	Land-based sources
• Merchant shipping, ferries and cruise ships • Fishing vessels and fish farming • Naval vessels, research ships and pleasure craft • Offshore oil and gas platforms	• Waste from municipal landfills located on the coast • A wider context of waste management • Discharge of untreated municipal sewerage and storm water • Industrial facilities • Deforestation • River transport • Tourism and beach users' debris

Source: UNEP, 2005a.

[5] An ocean circulation system that tends to concentrate ALDFG and other flotsam.

gear, respectively – the rest was styrofoam (27 percent), petrochemical products (22 percent), wood (15 percent) and seaweed (17 percent) (Watanabe *et al.*, 2002).
- Evidence from a five-country UNEP survey suggested that fishing gear generally was relatively rarely found along the beaches of the Mediterranean (UNEP/IOC/FAO, 1991; Golik, 1997).
- In nationwide beach clean-ups in the United States of America, fishing or boating gear comprised 6.1 percent of the total litter items collected by number in 1988 (O'Hara, 1990).
- In the most recent United States National Marine Debris Monitoring Program results (Sheavly, 2007), 17.7 percent of beach litter originated from the ocean. Fishing nets, fishing line, rope, fish baskets, floats and buoys and traps and pots represented 1.4 percent, 3.4 percent, 5.5 percent, 1.5 percent and 0.9 percent, respectively.
- In the United Kingdom, fishing debris such as line, nets, buoys and floats is the second biggest source of marine debris after visitor's litter (Marine Conservation Society (MCS), 2007), representing about 11.2 percent (MCS Beachwatch, 2006 survey).

OVERVIEW OF EFFORTS TO ASSESS THE MAGNITUDE OF ALDFG

A number of countries and regions, such as the National Oceanic and Atmospheric Administration (NOAA) Marine Debris Program in the United States of America, the Carpentaria Ghost Nets Programme in Australia, and the Marine Debris Collection Program in the Republic of Korea (including ALDFG, see Donohue *et al.*, 2001; Boland and Donohue, 2003; Dameron *et al.*, 2007), have developed initiatives to assess the quantities and nature of marine debris in the water column, on the sea bed and washed up on the shore. There are also a number of cases where initiatives have focused specifically on determining the rates attributable to gear abandonment/loss/discarding from certain fisheries with the aim of developing regulatory measures, management approaches and awareness programmes to reduce input of ALDFG into the marine system.

Much of the earliest work in assessing the magnitude of ALDFG was conducted in North America, and it was focused particularly upon lost traps and gillnets. The first documented work on lost gillnets appears to be that of Way (1977) in Atlantic Canada. A number of other studies followed (such as High, 1985, and Carr *et al.*, 1985) but most tended to be in response to specific incidences of loss or following some opportunistic identification of an accessible lost net. The exception to this general observation concerns the high value trap fisheries in North America, which were investigated systematically for many years (see Blott, 1978; Stevens *et al.*, 2000; High and Worlund, 1979). However, most of these studies focused on the general impact of ALDFG in terms of ghost fishing and habitat destruction rather than on the causes and rates of gear loss.

More recent efforts to assess the magnitude of fishing gear being abandoned, lost or otherwise discarded have included:
- the FANTARED 1 project (EC Project no. 94/095, 1995 to 1996) focusing on gillnets in the United Kingdom, Spain and Portugal;
- the FANTARED 2 project (FAIR-PL98-4338, 1998 to 2005), focusing on Norway, Sweden, United Kingdom, Spain, Portugal, France (on gillnets in all counties and on traps in Portugal);
- the DeepNet project (Hareide *et al.*, 2005), focusing on deepwater fixed net fisheries on the Shelf Edge to the west and north of Great Britain, Ireland, around Rockall and Hatton Bank;

- The South Pacific Commission (SPC) Fisheries Observer Program in the South Pacific, where observer data is collected on the extent and causes of ALDFG from pelagic longline fisheries but has not been collated or published to date; and
- International Pacific Halibut Commission Logbooks, which uses logbook data to estimate adult halibut mortality due to lost/abandoned longline gear in the halibut fishery and has produced reasonable estimates of ALDFG.

Unlike many fisheries indicators, there are few sector-wide processes (i.e. institutional or vessel-based monitoring systems) to quantify gear loss at a national or regional level. Most existing information is from small-scale surveys and underwater censuses, and is thus indicative and case-specific rather than systematic. The following analysis is therefore based on information on the quantities and distribution of ALDFG globally.

REVIEW OF ALDFG FROM GILLNET AND TRAP FISHERIES BY REGIONAL SEA

The Baltic, the Northeast Atlantic and the Mediterranean Regional Seas

Gillnets

Baltic. In 1998, under FANTARED 2, the gear loss from active Swedish gill-netters operating in the Baltic Sea in 1998 was examined, especially the loss from those vessels operating in open sea conditions, either in coastal waters or in distant grounds. It was found that regular gear loss only occurred among fishers targeting demersal species (turbot and cod) with bottom-set gillnets, and particularly those operating in the open sea away from the coast. The total estimated loss per year was about 1 500 nets, equal to 155–165 km in length, and equal to 3.6–3.8 nets per active vessel, although this was less than 0.1 percent of nets lost per year (FANTARED 2).

The recovery rate of nets by the fishers themselves was estimated to be close to 10 percent. Because fishing gear conflicts were reported as the main reason for gear loss, the areas with higher gear loss rates could be identified. Eventual “ghost nets”[6] were identified (usually in trawl hauls) in two forms: (a) longer nets found apparently in the vicinity of the conflict area; and (b) small remnants found randomly over a larger, less defined area.

Northeast Atlantic (shelf fisheries). The majority of nets lost in Norwegian fisheries tend to be those used in offshore operations, especially those targeting spawning saithe, although this represented less than 0.1 percent of the nets used in the whole capture fisheries sector. In general most of the Norwegian fisheries had a high rate of net recovery of around 80–100 percent. Despite these reportedly low loss rates, between 1983 and 1997 the Norwegian net retrieval programmes recovered 6 759 gillnets targeting Greenland halibut (Humborstad *et al.*, 2003). This survey represents the longest time period available and the situation in a highly regulated fishery, so despite the mandatory requirement to report lost nets and controls on net length and soak time, there is clearly still a need to conduct retrieval surveys (Dr Norman Graham, Marine Institute (Ireland), personal communication, 2008).

Studies around the United Kingdom examined a combination of the hake (western approaches and the Channel), tangle netting and wreck netting. The tangle net losses were the greatest, consisting of 263 nets per year from 18 vessels. On average, a third of the lost nets were recovered. The hake métier of 12 vessels lost 62 nets per year, of which half were recovered. Within the wreck métier[7], whole gear was seldom lost, although there was a high incidence of reported snagging and resultant losses of portions of net sheets and segments (884 incidences from a fleet of 26 vessels). In France, most gillnet

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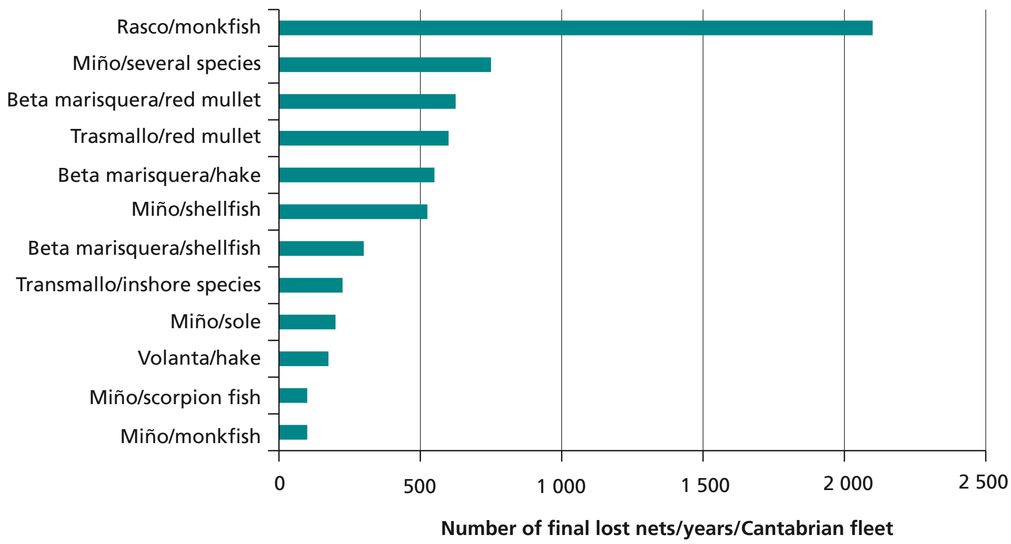
[6] A net that continues fishing after all control of the fishing gear is lost by a fisher.

[7] Métier: A group of vessel voyages targeting the same (assemblage of) species and/or stocks, using similar gear, during the same period of the year within the same area.

FIGURE 2
Net loss in the Spanish Cantabrian fleet by fishing métier



Source: Reproduced from FANTARED 2 (2003).

fisheries lost less than 0.5 percent of their nets annually, although loss at the seabass fishery was significantly higher, at 2.11 percent (FANTARED 2).

A detailed study under FANTARED 2 looked at net loss from the gillnet fishing fleet in the Cantabrian region of northern Spain (around 645 vessels, 79 percent of which have a tonnage of under 10 GT). An average annual loss of 13.3 nets per vessel was recorded, where the fishing métiers with the greatest losses per vessel (27.9 nets per vessel) are those practiced in waters on the outer part of the continental shelf or platform, between 70 and 600 fathoms (for rasco/monkfish), mainly due to the interaction of trawling gear (see Figure 2). Generally, larger vessels have greater net losses than those under 10 m (16.2 nets per larger vessel, against 10.4). Other fishing métiers with high losses are bottom-set net fisheries close to the coast (beta marisquera/shellfish, trasmallo/red mullet, trasmallo/coastal species) with losses ranging between 7 and 15 nets/vessel/year. The rest of the fishing métiers have losses of less than 4 nets/vessel/year.

The FANTARED 2 study conducted a rare extrapolation of these loss rates to the entire Cantabrian fleet. The biggest losses occur in the rasco/monkfish métier, with 2 065 nets lost. Another fishing métier with important losses (774 nets/year) is that fishing for miño/different species. It is worth highlighting that the fishing métier of red mullet with betas lose between 550 and 650 nets per year. The rest of the fishing métiers, mainly in shallow waters (except for the volanta/hake métier), have annual losses of between 100 and 500 nets per year.

In Brittany in France, an examination of the three key fishing métiers showed that wreck gillnetting results in the largest proportional loss – just under 3 percent of nets – although the largest net length loss is by the flatfish and monkfish métier (just under 5 km of net per vessel per year). On the Algarve coast of Portugal, under the FANTARED 2 project, net fishers in the local, coastal and hake fisheries were interviewed about the extent and causes of gear loss and retrieval rates. This FANTARED work is also reported in Santos *et al.* (2003a). The number of nets lost in these fisheries was considered to be very low because of fishers' success in retrieving their nets. It was estimated that the mean number of sheets effectively lost by boat per year was 3.2, 6.0 and 7.4 for the local, coastal categories and hake métier, respectively. The rate of net loss is slightly higher in the hake category due to the greater distance from shore and water depths of the fishing operations.

Northeast Atlantic (deepwater fisheries). Building on the findings and concerns from the FANTARED work, the DeepNet project (Hareide *et al.*, 2005) examined the deepwater and upper-slope net fisheries of the northeast Atlantic in more detail, including an estimate of gear loss. It was considered highly likely that large quantities of nets would be lost, and there is also evidence of illegal dumping of sheet netting in the northeast Atlantic deepwater net fisheries (largely north and northwest of the United Kingdom and Ireland). The vessels involved in the deepwater net fisheries are often not capable of carrying their nets back to port (the net stores are used to hold fish) and only the headline and footropes are brought ashore while the net sheets are discarded, being either bagged on board, burnt or dumped at sea (Hareide *et al.*, 2005).

The amount of lost and discarded nets is poorly estimated. Hareide *et al.* (2005) note that anecdotal evidence from one shark vessel suggests that on a typical 45-day trip approximately 600 x 50 m sheets of net (30 km) are routinely discarded after having been damaged. Taking the level of effort to be in the region of 1 881 days (based on the German and United Kingdom effort data in Hareide *et al.*, 2005), a crude estimate of gear loss by these vessels in the region is 1 254 km of sheet netting per year. Based on the relationship between water depth and net loss rate and estimates of net loss in the Greenland halibut net fishery, it was estimated that in the deep-slope fisheries these vessels lose approximately 15 nets (750 m) per day.

Mediterranean. The extensive use of gillnets, trammel nets and traps in many small-scale Mediterranean fisheries, plus the very large number of small-scale vessels involved in fishing in Greece and Italy in particular, makes ALDFG a potentially important problem in Mediterranean waters, but to date it has attracted limited attention. The level of gear loss in the Mediterranean has only been studied in the western European countries, particularly in France. Only in the French hake gillnet fishery has an estimate been made of total net loss, as data from other fisheries is considered insufficiently reliable (FANTARED 2, 2002). However, a number of studies into gillnet and coastal fisheries indicate that gears are lost (Baino *et al.*, 2001; Sacchi *et al.*, 1995). The French gillnet fishery mentioned above consists of two components, the coastal fleet and the offshore fleet. The 65 vessel-strong offshore fleet loses around 0.2 percent of its nets annually (between 36 and 73 nets). The 32-strong coastal fleet has a similar rate of loss, but with a lower set rate, of about 9 to 17 nets per year. Other French fisheries that have been examined include other gillnet fisheries, where the quantity lost per year and per boat is between 0.7 km for red mullet métier and 1.2 km for hake and crawfish, and the percentage of lost nets represents 0.2 to 3.2 per boat and per year, respectively, for hake métier and sea bream métier. For the crawfish métier, it is 1.2 km/boat per year or 1.6 percent of all gear deployed.

Bingel (1989, in Golik, 1997) also attempted to estimate the quantity of all types of fishing gear lost in the Mediterranean Sea, based on an extrapolation of data from the Turkish industry's losses, vessel numbers, coastline length and shelf area. The estimate varies between 2 637 and 3 342 tonnes of fishing gear lost per year.

Table 3 provides a preliminary estimated summary of the extent of gillnet loss from those fisheries selected for study under FANTARED 2. These figures should be used with some caution as they represent estimates made in the period from 1998 to 2005 and the scale, nature and therefore extent of ALDFG may have changed since then. Furthermore, these fisheries represent only a small fraction of gillnet fisheries in the whole northeast Atlantic region.

TABLE 3
Estimates of gillnet loss in selected Northeast Atlantic fisheries

Region **Northeast Atlantic**	Fishery	No. of vessels in fishery	Km of net lost (boat / yr)	% loss (nets/boat/yr)	No. of nets lost (per year)
Continental shelf fisheries					
Baltic (Sweden)	Mixed (mainly cod)	...	156	0.10	1 448
North Sea & NE Atlantic (Norway)	Spawning saithe	...	...	0.09	431
	Cod	...	...	0.02	187
	Monkfish	...	...	–	–
	Greenland halibut	...	...	0.04	5
	Blue ling and ling	...	...	0.04	62
UK (all coastal fisheries)	Tangle	18	24	...	263
	Hake	12	12	...	62
	Wreck	26	n.a.	...	...
English Channel and North Sea (France)	Flatfishes & monkfish	...	1.5	0.42	...
	Cod	...	1.2	0.24	...
	Wreck	...	0.4	0.33	...
	Seabass	...	0.8	2.11	...
	Sole & plaice	...	2.8	0.20	...
	Plaice	...	1.1	0.37	...
	Cuttlefish	...	n/a	n.a	...
Brittany (France)	Flatfishes & monkfish	...	5.0	0.50	...
	Spider crab	...	0.3	0.04	...
	Wreck	...	0.2	2.81	...
Cantabria (North Spain)	Red mullet (bottom gillnet)	413	...	...	661
	Hake (bottom gillnet)	309	...	...	556
	Sole (trammel)	217	...	...	195
	Several species (trammel)	215	...	...	774
	Shellfish (trammel)	158	...	...	521
	Scorpion fish (trammel)	111	...	...	100
	Red mullet (bottom gillnet)	79	...	...	600
	Monkfish (bottom gillnet)	74	...	...	2 065
	Hake (gillnet)	59	...	...	159
	Monkfish (trammel)	53	...	...	101
	Inshore species (bottom gillnet)	34	...	...	228
	Shellfish (bottom gillnet)	22	...	...	332
Algarve (Portugal)	Inshore species (gill/trammel)	439	...	...	3
	Coastal (gill/trammel)	64	...	...	6
	Hake (gill/trammel)	22	...	...	7
Mediterranean (France)	Crawfish	...	1.2	1.60	...
	Hake	...	1.2	0.20	...
	Sea bream	...	1.2	3.20	...
	Scorpion fish	...	1.1	1.00	...
	Red mullet	...	0.7	0.50	...
	Sole	...	0.9	0.25	...
	Hake (inshore)	32	...	0.15	13
	Hake (offshore)	65	...	0.20	55
Deepwater fisheries	**N & NW of UK & Ireland**		**1 254**		**25 080**

Source: Brown *et al.* (2005), derived from EC contract FAIR-PL98-4338 (2003).
Note: ... = not available.

Traps and pots

Northeast Atlantic. There are few quantitative studies into the rate of pot losses in the northeastern Atlantic, mainly because of the lack of a perceived problem with this gear type, which is largely regarded as environmentally benign due to its small footprint and static nature. In the United Kingdom, Swarbrick and Arkley of the Seafish Industry Authority examined the reasons behind the loss of traps around the country and the effectiveness of "ghost fishing preventers" (Swarbrick and Arkley, 2002), but

TABLE 4
Pot losses in Portuguese octopus fishing fleets

Fleet	Zone	Trap type	
		Octopus	Cuttlefish
Local	Barlavento	30.9 ± 55.4	78.8 ± 147.5
	Sotavento	145.6 ± 102.2	13.5 ± 11.1
Coastal	Barlavento	213.0 ± 213.8	113.3 ± 19.3
	Sotavento	318.5 ± 507.8	10.0

Source: EC contract FAIR-PL98-4338 (2003).

no attempt was made to quantify trap losses, as their contribution to overall shellfish mortality was considered to be low.

Surveys were conducted in ten ports of the Algarve coast in southern Portugal in 2003 as part of the FANTARED 2 project. They examined the rate of pot losses by both the local and coastal fleet components of boats licensed to fish with small octopus traps and large cuttlefish traps. The average number of octopus traps lost at sea per vessel and per year for each port and fleet type is presented in Table 4. On average, the number of small octopus traps lost at sea is higher for the coastal fleet than for the local fleet.

For the larger cuttlefish traps, the results are the opposite, in that the local fleet loses more traps than the coastal fleet. Although the study produced relative loss rates, absolute figures for permanently lost pots were not determined, even though the recovery rates were estimated. It should be noted that loss of these octopus traps does not necessarily lead to ghost fishing (Andrew Smith, FAO, personal communication, 2008).

In summary, while the effects of lost pots in European waters have been studied in greater depth than in net fisheries, studies have been far from systematic, with small-scale surveys of certain pot types in a few locations. Therefore estimates of overall pot loss rates are lacking. While the FANTARED work looked at this in Portuguese trap fisheries, and reported that loss rates are low because of successful retrieval, the results are not presented in a manner that permits deduction of total gear loss. The same is true for the studies undertaken in the United Kingdom pot fisheries. In both cases loss rates were not considered to be high enough to warrant concern because of high retrieval rates, and pots lost generally being subject to damage because of gear conflicts.

Trawl nets and other mobile gear

Apart from the Norwegian, FANTARED and some Irish and United Kingdom surveys, there is little other reference in European literature to the levels of loss of trawl nets and other mobile gear. Anecdotal information suggests that considerable effort is put into the immediate recovery of lost gears due to their high value, combined with improvements in navigation and gear marking technologies. However, it is apparent that some trawl nets are lost, possibly even in considerable volume (John Willy Valdemarsen, personal communication, 2007), and it is likely that trawl warps are sometimes discarded at sea.

The South Asian Seas, the Red Sea and the Gulf of Aden, and the ROPME Sea Area (Arabian/Persian Gulf)

Gillnets

Bottom-set gillnets are extensively used for inshore coastal fishing and larger-mesh gillnets are used in open water for large pelagic species such as kingfish (*Scomberomorus commersoni*) and the smaller tunas. However very little information appears to be available on either the rates or magnitude of gillnet loss in these three regional seas.

Pots and traps

Red Sea and Gulf of Aden. Al-Masroori (2002), in a study to estimate ghost fishing rates of lost traps off Muscat and Mutrah in the Sultanate of Oman, estimated that trap loss rates might be as high as 20 percent per year in this fishery. Huntington and Wilson (1997) also reported that trap loss in the Hadramout lobster fishery in the Yemen is likely to be high, although again difficult to quantify.

ROPME Sea Area[8]. Lost traps and resultant ghost fishing have been considered a major issue in the Arabian Gulf. A quantitative estimate of the number of abandoned traps was conducted in the waters of the United Arab Emirates in 2002 that showed approximately 260 000 traps being lost per year (Gary Morgan, personal communication, 2007). The United Arab Emirates authorities have since made degradable panels in traps mandatory.

The East Asian, the Pacific and the Northwest Pacific Regional Seas

Gillnets

Brainard *et al.* (2000) summarizes ALDFG data for the Pacific as follows:

- Dedicated vessels combined with vessels of opportunity have been used in Pacific-wide surveys conducted by the Fisheries Agency of Japan from 1986 to 1991 (Matsumura and Nasu, 1997). They reported fishing net density to be higher in parts of the eastern Pacific Ocean. They also noted a high density of fishing nets on the Pacific Ocean side of Japan.
- Mio *et al.* (1990) and Mio and Takehama (1988) previously reported a high-density area of ALDFG nets northeast of Hawaii during sighting surveys conducted in 1986. . Other baseline studies on ALDFG numbers have been conducted in the North Pacific (Dahlberg and Day, 1985; Ignell, 1985; Ignell and Dahlberg, 1986; Day *et al.*, 1990).
- Altamirano *et al.* (2004) reported that data from the Inter-American Tropical Tuna Commission's (IATTC) On-Board Observer Program, which includes records of sightings of discarded fishing gear (DFG), indicates that ALDFG appears to have increased in the eastern Pacific from 1992 to 2002.

There are few studies attempting to quantify the abandonment, loss or discard of fishing gear in southeast Asia or the western central Pacific. Only the Republic of Korea, Japan and Australia have actively identified ALDFG as a significant issue and responded with attempts to examine the problem (Raaymakers, 2007). Most studies have examined the extent of fisheries debris being recorded from coastal areas, and some attempt to identify the likely origin of these items.

Various studies in Australia (Alderman, *et al.*, 1999; Kiessling and Hamilton, 2001) have indicated that over three-quarters of fishing debris in Cape Arnhem, Northern Territory in Australia, consists of trawl nets, and that the majority of fishing debris is of southeast Asian manufacture (around 79 percent)(see Table 5).

Limpus (personal communication, cited in Kiessling, 2003) estimated on the basis of aerial surveys of the eastern Gulf of Carpentaria (between Torres Strait and the Northern Territory border), that a total of around 10 000 nets (or around 250 kg of fishing net per km) litter the Queensland coastline. The ongoing Carpentaria Ghost Net Programme (see www.ghostnets.com.au) indicated that in 29 months of collection to November 2007, 73 444 m of net had been collected from the Gulf of Carpentaria (see Figure 3). Although 41 percent is of unknown origin, 17 percent is of Taiwanese origin, 7 percent of Indonesian and Taiwanese/Indonesian origin, 6 percent of Korean

[8] Regional Organization for the Protection of the Marine Environment (ROPME) Sea Area includes Bahrain, Iran, Iraq, Kuwait, Sultanate of Oman, Qatar, Saudi Arabia and the United Arab Emirates.

TABLE 5
Origin of fishing debris recorded at Cape Arnhem, Northern Territory, in Australia

Country of manufacture	Net type	Number of nets	Proportion of total nets *(percentage)*
Taiwan	Trawl	108	26
	Gill (drift net)	94	
	Subtotal	**202**	
Indonesia	Trawl	131	17
	Gill	6	
	Subtotal	**137**	
Taiwan/Korea	Trawl	99	13
Japan	Trawl	63	8
Philippines	Trawl	52	7
Japan/Korea	Trawl	25	3
Thailand	Trawl	23	3
Republic of Korea	Trawl	19	3
	Gill	1	
	Subtotal	**20**	
Australia	Trawl	68	12
	Gill	26	
	Subtotal	**94**	
Unknown	Trawl	7	9
	Gill	3	
	Unknown	59	
	Subtotal	**69**	
TOTAL		784	100
Trawl	76%	SE Asia	79
Gill (drift net)	12%	Australia	12
Gill (other)	5%	Unknown	9
Unknown	8%		
Total	**100%**	**Total**	**100**

Source: Derived from Kiessling, 2003.

origin and 5 percent of Australian origin. No details are provided on the type of nets, but it is understood they mainly consist of gillnets and trawl net fragments.

The Gulf of Carpentaria is a typical example of a circulating gyre system, where ALDFG is stuck in a repetitive cycle of fishing, being washed ashore and being washed back into the water during a storm or spring-tide event. On the eastern side of the Gulf (western Cape York) the nets arrive during the monsoonal season from November to March, while on the western shores the nets are swept in during the southeast trade winds, mainly between May–September (see Figure 3).

Northwest Pacific. A detailed survey in the Republic of Korea (Chang-Gu Kang, 2003) located an estimated 18.9 kg/ha of marine litter in fishing grounds, 83 percent of which was composed of fishing nets and related materials (e.g. ropes). A six month survey of the Incheon coastal area located 194 000 m^3 of marine debris weighing 97 000 tonnes, mainly originating from fisheries (Cho, 2004). A subsequent follow-up programme has resulted in recovery of 91 tonnes of marine-related debris per km^2 on an annual basis, of which 24 percent was of marine (as opposed to coastal) origin. Over the six-year period 2000 to 2006, 10 285 tonnes of fishing-related debris was recovered from coastal areas through a nationally coordinated coastal clean-up campaign (Hwang and Ko, 2007) (see Figure 4).

Up to 1 000 tonnes of ALDFG are recovered from the Sea of Japan annually, mostly bottom gillnets and pots, which are apparently mainly of non-Japanese origin (Inoue and Yoshioka, 2002).

The United States National Marine Fisheries Service estimated that 0.06 percent of driftnets deployed are lost each time they are set, resulting in 12 miles of net lost each

FIGURE 3
Examples of ALDFG in northern Australia

A 6 tonne Taiwanese gillnet with large entangled shark washed ashore in Arnhem Land.

Aboriginal rangers loading an ALDFG fishing net collected from the shore onto a truck for recycling/ disposal, Arnhem Land, Australia.

Source: www.ghostnets.com.au

FIGURE 4
Recovery of ALDFG in the Republic of Korea

Source: Hwang and Ko, 2007.

night of the season and 639 miles of net lost in the North Pacific Ocean alone each year (Paul, 1994[9]). In Hawaii, fisheries-related marine debris surveys over 1998–2002 (Northwestern Hawaiian Islands Multi-Agency Marine Debris Cleanup) showed that debris consists mainly of trawl/seine nets (83.6 percent) with the balance being mono- and multifilament gillnets (5.2 percent and 3.2 percent, respectively) (Donohue and Schorr, 2004; Dameron *et al.*, 2007; Pichel *et al.*, 2007; Donohue and Foley, 2007). To date, over 600 metric tonnes of ALDFG have been removed from the Hawaiian

[9] www.earthtrust.org/dnpaper/waste.html

archipelago by NOAA and its partners (Elizabeth McLanahan, NOAA, personal communication, 2008).

Pots and traps

A survey of commercial crabbers in the blue swimmer crab fishery in Queensland, Australia, conducted in early 2001 showed that significant pot loss occurred during a fishing season (McKauge, undated). The vast majority of respondents stated that they had lost pots during the previous 12 months, with an average loss of about 35 pots per annum (range 0 to 400). Given these figures, it was estimated that over 6 000 pots are lost each year in the fishery. The actual proportion of the pots that remain in the environment is difficult to estimate as some are trawled up and others disappear through theft and cannot be regarded as ALDFG. It was estimated by the researchers that less than 50 percent of lost pots remain in the environment.

The Southeast Pacific and the Northeast Pacific Regional Seas

Gillnets

There appears to be little published information on gillnet losses in either the Southeast or Northeast Pacific. Given the intensity of both Pacific salmon and halibut netting in the Northeast Pacific, ALDFG might be considered an issue that deserves more attention.

Pots and traps

Considerable numbers of pots are also lost each year from some fisheries in the Northeast Pacific, although estimates vary greatly between different studies. For example, Kruse and Kimker (1993) estimated that in 1990 and 1991, 31 600 pots per year were lost in the North American Bristol Bay king crab (*Paralithodes camtschaticus*) fishery, whereas Paul *et al.* (1994) and Stevens (1996) estimated that losses from the same fishery were, respectively, 20 000 and 7 000 pots per year. In a one-year study of Dungeness crab pots of British Columbia, Canada, the estimated annual trap loss rate was 11 percent (Breen, 1987).

The Wider Caribbean Regional Sea and the Northwest Atlantic

Gillnets

The Wider Caribbean. A recent NOAA and United States Department of State co-hosted Caribbean-wide Derelict Fishing Gear Workshop in Key West, Florida, 17–19 July 2007 brought representatives from many Caribbean nations together to discuss topics related to ALDFG, but no proceedings are available as yet (Leigh Espy, NOAA, personal communication, 2007).

It is understood that the workshop concluded that in discussing ALDFG in the Wider Caribbean, there appears to be little information or agreement on whether it is viewed as a significant issue (Bisessar Chakalall, FAOSLAC, personal communication, 2007). The meeting was not sure how big a problem ALDFG was in the region, or whether the primary causes were storm events or the lack of disposal facilities onshore or if the primary cause of ALDFG in the region was in outside sources. The general view was that fish traps and gillnets have the greatest potential of contributing to ghost fishing. One participant claimed that on the basis of empirical evidence, most ALDFG was from outside the region.

Northwest Atlantic. The first documented work on lost gillnets appears to be that of Way (1977) in Atlantic Canada. Over two years, Way retrieved 148 and 167 net fragments in 48.3 and 53.5 hours of trawling with a grappling device. A number of other studies followed (e.g. High, 1985; Carr *et al.*, 1985) but most tended to be in response to specific incidents of loss or following some opportunistic identification of an accessible lost net.

Studies that have attempted to estimate the amount of lost nets in a given area by using remotely operated vehicles (ROVs) or by net retrieval include Barney (1984), Carr and Cooper (1987), Cooper *et al.* (1987) and Carr *at al.* (1985). Fosnaes (in Breen, 1990) estimated an annual loss rate of Newfoundland cod gillnets of 5 000. Carr and Cooper (1987) estimated that in an area of 64 km^2 traditionally fished by gillnets, there were 2 240 lost nets. Canadian Atlantic gillnet fisheries were estimated to suffer a 2 percent loss rate (8 000 nets per year) up to 1992 (Chopin *et al.,* 1995). More recently, Anon. (2001) (in EC contract FAIR-PL98-4338, 2003) reported losses of 80 000 nets or net sheets between 1982 and 1992 throughout Canadian Atlantic waters.

Pots and traps

The Wider Caribbean. In Puerto Rico, 24 percent of fishers are unable to locate and retrieve traps if lost (Schärer *et al.*, 2004). Of the 40 000 Caribbean traps around Guadeloupe, about 20 000 are lost each year during hurricane season, but continue to catch fish for many months (Burke and Maidens, 2004). Otherwise there is little specific information available on the level of gear losses in this shallow sea.

Northwest Atlantic. In the snow crab (*Chionoecetes opilio*) trap fishery in the Gulf of St. Lawrence, it was estimated that over 19 000 traps were lost at sea between 1966 and 1989 (Chiasson *et al.,* 1992). This is equal to an average of around 792 traps per year. Anecdotal reports of lobster pot loss rates off New England, in the United States of America, run as high as 20–30 percent per year (Smolowitz, 1978a). Along the Maine coast the pot loss rate reported in 1992 was 5–10 percent (ICES, 2000).

Conservative estimates suggest that more than 500 000 commercial crab traps are deployed in the Chesapeake Bay on a typical day during the summer months. It is suggested that each commercial fisher may lose as many as 30 percent of his traps for a variety of reasons over the course of one year (NOAA Chesapeake Bay Office, 2007). This would equate to losses of around 150 000 traps annually in this one large bay. Estimates of ALDFG trap densities for the surveyed portions of the Lower York River and the Chesapeake main stem adjacent to the South River range from 20 to 690 traps per km^2. Cost-effective methods for retrieval of these traps are currently being considered (NOAA Chesapeake Bay Office, 2007).

Estimates derived from trap loss calculations suggest an ALDFG trap number of 605 000 in 1993 in Florida, Alabama, Mississippi and Louisiana, though Guillory and Perret (1998) state that this number is probably an underestimate. Guillory *et al.* (2001), using an annual total number of one million traps fished commercially and a 25 percent loss/abandonment rate, suggests that 250 000 derelict traps are added to the Gulf of Mexico annually, with ghost fishing leading to a loss of four million to ten million blue crabs each year in Louisiana (GSMFC, 2003). This figure underestimates the actual number of derelict traps because of the cumulative addition of derelict traps over time and exclusion of traps used by recreational fishers (Brown *et al.*, 2005).

GLOBAL REVIEW OF ALDFG ORIGINATING FROM OTHER FISHERIES AND AQUACULTURE

Other fisheries

Longlines and jigs

The extensive use of longlines, their often extremely long-set configuration and low cost, means that the overall quantity of longlines lost is likely to be high. But figures to substantiate this are few and far between. The SPC fisheries observer schemes have been collecting data on lost/discarded gear since about 2003 but this has never been compiled into an electronic format or summarized/reported. However, anecdotal information suggests that data are likely to show a high rate of gear discarding when tangled or damaged (Brett Moloney, personal communication, 2007).

Logbook data are used by the International Pacific Halibut Commission (IPHC) to estimate adult halibut mortality due to lost/abandoned gear in the halibut fishery. The IPHC reported that in the Alaskan halibut (Hippoglossus stenolepis) fishery, 1 860 "skates"[10] were lost in 1990 alone, with an estimated gear replacement cost per fisher of US$200 per skate. Overall gear losses have decreased markedly since the introduction of individual transferable quotas – when excessive amounts of gear are no longer necessary, less gear is lost and there is more time for its retrieval because of the longer season (Barlow and Baake, undated).

In the Maldives, it was found that a number of hooks were lost from longlines after most fishing nights (Anderson and Waheed, 1988). It is assumed that most of this damage was done by sharks, although large billfish may also have been responsible. The rate of hook loss on fish aggregating devices (FADs) is estimated at about 3 percent per set.

Fish aggregating devices (FADs)

The use of FADs is now widespread in the world's tuna fisheries, and indeed the use of FADs has increased significantly over recent years, making this type of fishing gear a potentially important component of ALDFG.

FADs essentially consist of an anchored or free-drifting, floating object that might be constructed of anything from netting or palm fronds, to tires or high tech rafts with locator beacons. They are used to aggregate fish before setting purse seines or handlining around them. FADs can be highly concentrated – for instance there are over 900 FADs in the Papua New Guinea waters of the Bismarck Sea alone (Kumoro, 2003). However, due to their vulnerability to storm damage or to having their anchor ropes accidentally severed during adjacent fishing operations, FADs are frequently lost to a fishery. They may also be deliberately abandoned in the oceans, in contravention of MARPOL Annex V (if made of synthetic materials).

Box 1, which charts the history of FAD deployment in Samoa, demonstrates the vulnerability of these devices to loss.

Data on global FAD loss are very poor. The contribution of lost FADs to marine litter has not received much attention, although studies by Donohue (2005) and SPC (unpublished) are notable, and the recent draft United States National Research Council report (2008) places considerable emphasis on the FAD issue but notes that "the ability to infer the extent to which derelict FADs are contributing to the marine debris problem is hampered by a lack of information on FAD use and their contribution as components of the DFG stream" (NRC, 2008).

The NRC study, however, reports some interesting data. The IATTC fleet deployed 8 188 FADs in 2006 and 8 721 FADs in 2007, while the number of FADs retrieved during these years was 6 163 in 2006 and 7 769 in 2007. But the difference between deployment and retrieval numbers does not permit an estimate of abandoned FADs, as some may still be actively "fishing" or may have been appropriated by other vessels. The NRC study also notes with respect to the central and western Pacific that "information on how many FADs are deployed and the rate of FAD loss, appropriation, and recovery is unknown for the WCPFC fleet", and that "Skipper surveys from French and Spanish purse-seine vessels operating in the western Indian Ocean estimated the total number of actively monitored FADs at approximately 2 100 at any given time." (NRC, 2008).

Aquaculture

While aquaculture lies outside the main scope of this report, it is worth commenting briefly on the potential contribution of coastal mariculture to the marine litter problem.

[10] Longline gear uses "skates" (leaded ground line 300 fathoms long) with approximately 140 hooks attached to them by "gangion" lines. Skates are tied together in "sets". Each set lies on the ocean bottom with anchors and buoys attached at each end.

BOX 1

Fish aggregating device (FAD) losses in Samoa between 1979 and 1999

Five FADs were deployed in 1979 off Samoa by NOAA staff from Hawaii. All five FADs were lost in less than one year. The Samoa Fisheries Division then deployed seven FADs in late 1980, all around ten miles off the coast and in depths over 1 000 fathoms. In 1981, six of the FADs deployed in 1980 were lost. They were replaced and another four deployed. In 1982, 8 FADs were lost and another 11 deployments were made. During 1983 and 1984 another 17 FADs were deployed, but at the end of 1984, only 1 FAD remained. The losses were attributed to purse-seine vessels setting their nets and cutting the mooring lines. Limited FAD were deployed from 1989 to 1993, and a cyclone in 1990 caused the loss of all FADs. In 1993 and 1994, eight FADs were deployed – four of them were lost in 1994. In August 1999, four FADs were deployed, and one was lost in the first six months.

Source: SPC, unpublished report.

It is accepted that greater control can be exerted on these mainly static facilities. The main sources of ALDFG in aquaculture would be associated with sea-based farms, such as cages, longlines, poles and other floating and fixed structures used for culture of marine animals and plants. There are no global estimates of the levels of ALDFG from aquaculture to date. The types of material lost would depend on the type of culture systems, construction quality, vulnerability to damage, and management practices.

- For marine fish cages, the major losses would be nets and cage structures (wood, metal).
- For seaweed systems, the major losses would be lines or floating raft structures.
- For mollusc farming, the debris could include poles, bags, lines, concrete, and other structures. Some mollusc farming areas contain large amounts of debris from damaged or discarded poles, some of which are discarded after removal of mussels or oysters.

Because many of these items are expensive, one might expect farmers to take considerable care to avoid losses. The most significant losses are likely in events such as ship collisions, storms and other extreme events. One such extreme event was the Indian Ocean tsunami in December 2004. This led to the partial or total loss of much of the rapidly expanding marine cage farming infrastructure in Aceh and Nias in Indonesia. The losses are briefly summarized in Box 2 below to illustrate the magnitude of the event.

OCEAN CIRCULATION, MOVEMENT AND ACCUMULATION OF ALDFG

ALDFG found accumulating on many coastlines of the world often originates from sources far afield, sometimes even from the other side of a vast ocean. In developing actions and measures to address ALDFG, it is therefore important for scientists, regulators and industry to have an understanding of ocean circulation patterns.

Over the long term, the mean of these generic patterns are probably indicative of ocean circulation. However, over shorter time periods and at larger scales, which are of more relevance to the assessment and management of ALDFG, the real situation is far more complex, highly variable and seasonally dynamic. In reality, ALDFG will not follow generic, mean ocean circulation patterns, but will be driven by rather more complex patterns resulting from a combination of wind-driven currents, wave-driven currents and thermohaline, or density-driven, currents (Brainard *et al.*, 2000).

BOX 2

Infrastructure loss of marine cage farming in Indonesia as a result of the 2004 tsunami

The main losses in marine cage culture were in Aceh province and in Nias island in North Sumatra. Losses included nets and floating and fixed cage structures. It is estimated that all 80 cages were lost on Kota Subang (100 percent loss), and 57 out of 65 units on Simeuleu island (88 percent loss). In Simeulue, all the floating and fixed marine fish cages on the island, a total of 65 units (each with approximately eight to ten cages) located in Sinabang Bay and Teluk Dalam Bay, lost crops. Cages were culturing tiger grouper (E. fuscoguttus) and greasy grouper (E. tauvina) and lobsters, which were also lost during the tsunami. Of the floating nets used for grouper culture on the island, two were lost, two were seriously damaged, and two suffered light damage, for a loss of Rp50 million (US$5 500). Fixed pen nets suffered severe damage. Twenty-six units were lost, 27 units were seriously damaged and six units were lightly damaged, for total damages estimated at Rp305 million (US$33 000). On Kota Sabang, some cage cultures (two units, each unit with 40 cages (for a total of 80 cages) were lost. These cage cultures were used for grouper and previously kept milkfish for tuna longline near Pulau Klah in Sukakarya subdistrict.

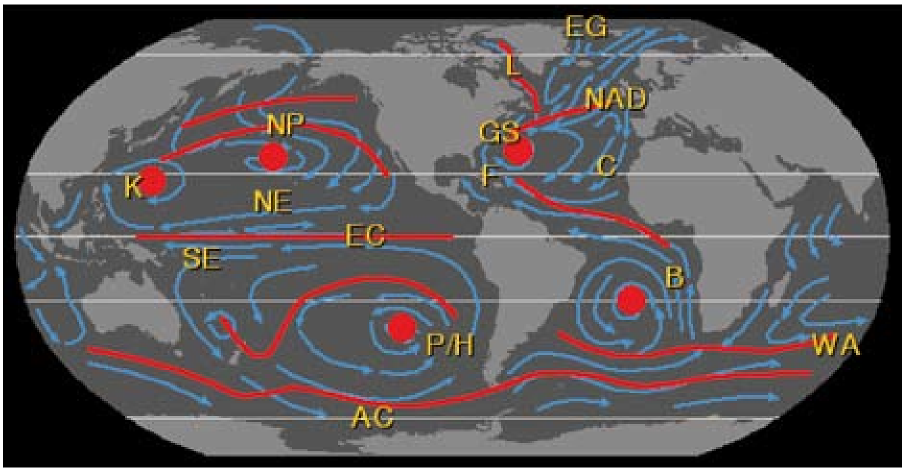
Source: Phillips and Budhiman, 2005.

In recent years significant advances have been made in the mapping and modeling of complex ocean circulation patterns, at various scales, and incorporating the different elements that drive these patterns. The outputs of such models, based on satellite imagery and remote sensing, can greatly assist scientists and managers in interpreting the results. Today an array of satellite sensors can be used by oceanographers to measure various aspects of the world's oceans, including parameters such as surface winds (e.g. QuickSCAT), sea surface height and computed geostrophic currents (TOPEX/Poseidon), sea surface temperature (e.g. GOES) and chlorophyll as indicated by ocean color (e.g. SeaWiFS). When combined with numerical modeling, and supported by in-field oceanographic data collection and physical tracking to ground-truth/verify the models, these systems provide powerful tools to assist in the assessment and management of ALDFG.

There are many examples of the use of oceanographic tracking and modeling in the assessment and management of ALDFG. For example, Kubota (1994) tracked virtual marine debris in the North Pacific using a simple numerical model over five years, which indicated the accumulation of debris from the whole North Pacific in the northern Hawaiian Islands. The results of this predictive modeling have been verified by real-life sightings in this area, including the current NOAA Marine Debris Program – which is undertaking significant work in collaboration with many others to address ALDFG in the northern Hawaiian Islands, as outlined above – and including further use of ocean circulation models (Donohue, 2004). More recent work has been conducted by Kubota *et al.* (2005), Morishige *et al.* (2007), Pichel *et al.* (2007) and Donohue and Foley (2007).

Work by various parties has shown that ALDFG tends to accumulate (and often reside for extended time periods) in ocean convergence zones and move away from ocean divergence zones. Mass concentrations of marine debris in high seas accumulation areas, such as the equatorial convergence zone, are of particular concern. In some such areas, rafts of assorted debris, including various plastics; ropes; fishing nets; and

FIGURE 5
Examples of ocean convergence zones



The red dots indicate where marine litter may accumulate

Source: Penn State School of Earth and Mineral Sciences.

cargo-associated wastes such as dunnage, pallets, wires and plastic covers, drums and shipping containers, along with accumulated slicks of various oils, often extend for many kilometres (Steve Raaymakers, pers. obs. 1989, 1998 and 2000). Such zones have been modeled and mapped by various researchers (Figure 5), and this information is vital to improving the monitoring and management of ALDFG.

In order to be effective in addressing ALDFG, oceanographic models need to be developed and applied at much finer scales than that shown in Figure 5, and also regional, national and local scales.

SUMMARY OF MAGNITUDE AND COMPOSITION OF ALDFG

In a summary of net loss across all European Union (EU) fisheries, Brown et al, (2005) concluded that "In relation to the total number of nets being used in EU waters, the rates of permanent net loss appear to be rather low – well below one percent of nets deployed[11]. This is largely because most nets are deployed in shallow waters, and after they are first lost a significant proportion of nets are then recovered through the use of global position systems (GPS); fishers typically go to considerable lengths to recover nets given their cost. However, because the total length of nets being set is high, the total length of netting permanently lost may be significant, although exact figures are not available. An exception to the low loss rates seen in most European fisheries is in the deep water net fishery targeting deep water shark and monkfish in the north east Atlantic[12]."

In North America, studies that have attempted to estimate the amount of lost nets in a given area by using remotely operated vehicles (ROVs) or by net retrieval include Barney (1984), Carr and Cooper (1987), Cooper *at al.* (1987) and Carr *et al.* (1985). Fosnaes (in Breen, 1990) estimated an annual loss rate of Newfoundland cod gillnets of 5 000. Over two years, Way (1977) retrieved 148 and 167 nets in 48.3 and 53.5 hours of trawling with a grappling device. Carr and Cooper (1987) estimated that in an area of 64 km^2 traditionally fished by gillnets, there were 2 240 lost nets. Canadian Atlantic

[11] It is not possible or wise to estimate any total figure of net loss in EU fisheries from this estimate because the fisheries studied to date by projects such as FANTARED represent only a tiny proportion of total fisheries in the EU, so any estimates would be highly unreliable.

[12] Conducted on the continental slopes between 150 and 1 200 m from south of Porcupine Bank (49° N) to Tampen (61° N) and the Rockall and Hatton Banks.

TABLE 6
Summary of gear loss/abandonment/discard indicators from around the world

Region	Fishery/gear type	Indicator of gear loss (data source)
North Sea & NE Atlantic	Bottom-set gillnets	0.02–0.09% nets lost per boat per year (EC contract FAIR-PL98-4338 (2003))
English Channel & North Sea (France)	Gillnets	0.2% (sole & plaice) to 2.11% (sea bass) nets lost per boat per year (EC contract FAIR-PL98-4338 (2003))
Mediterranean	Gillnets	0.05% (inshore hake) to 3.2% (sea bream) nets lost per boat per year (EC contract FAIR-PL98-4338 (2003)
Gulf of Aden	Traps	c. 20% lost per boat per year (Al-Masroori, 2002)
ROPME Sea Area (UAE)	Traps	260 000 lost per year in 2002 (Gary Morgan, personal communication, 2007)
Indian Ocean	Maldives tuna longline	3% loss of hooks/set (Anderson & Waheed, 1998)
Australia (Queensland)	Blue swimmer crab trap fishery	35 traps lost per boat per year (McKauge, undated)
NE Pacific	Bristol Bay king crab trap fishery	7 000 to 31 000 traps lost in the fishery per year (Stevens, 1996; Paul *et al.*; 1994; Kruse and Kimker, 1993)
NW Atlantic	Newfoundland cod gillnet fishery	5 000 nets per year (Breen, 1990)
	Canadian Atlantic gillnet fisheries	2% nets lost per boat per year (Chopin *et al.*, 1995)
	Gulf of St Lawrence snow crab	792 traps per year
	New England lobster fishery	20–30% traps lost per boat per year (Smolowitz, 1978)
	Chesapeake Bay	Up to 30% traps lost per boat per year (NOAA Chesapeake Bay Office, 2007)
Caribbean	Guadeloupe trap fishery	20 000 traps lost per year, mainly in the hurricane season (Burke and Maidens, 2004)

gillnet fisheries were estimated to have a 2 percent loss rate (8 000 nets per year) up to 1992 (*in* Chopin *et al.*, 1995).

The United States National Marine Fisheries Service estimated that 0.06 percent of driftnets[13] were lost each time they were set, resulting in 12 miles of net lost each night of the season and 639 miles of net lost in the North Pacific Ocean alone each year (Davis, 1991, in Paul, 1994[14]). More recently, Anon. (2001, in FANTARED 2, 2003) reported losses of 80 000 nets between 1982 and 1992 throughout Atlantic Canadian waters.

Outside of Europe and Northern America, the picture provided of the extent and nature of ALDFG is much more patchy, in terms of rates for different gears and thus the ability to estimate the overall magnitude of ALDFG. The rate and magnitude of ALDFG from the South and Central Pacific, southeast Atlantic, the Caribbean and much of the Indian Ocean is still largely unknown.

Table 6 summarizes ALDFG indicators from a number of fisheries around the world. It should be noted that information on fisheries in which ALDFG has been reported is drawn from sources published over an extended period. It is possible that some of these fisheries have changed in nature and that the information presented may not reflect the current ALDFG situation.

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[13] A UN General Assembly adopted a resolution that bans driftnet fishing in international waters effective December 1992. The United States of America still permits drift gillnet fisheries within United States waters, and as of March 2007, there were over 1 300 vessels fishing with driftnets in European waters (www.ec.europa.eu/fisheries/fleet/index.cfm?method=Search.menu). The use of driftnets in EU waters is carefully regulated, and driftnets exceeding 2.5 km in length have been banned since the early 1990s. The use of driftnets of any length in fisheries targeting specific species, including tuna and swordfish, was banned in 1998. The prohibition on the use of driftnets was extended to EU waters of the Baltic Sea from 1 January 2008.

[14] www.earthtrust.org/dnpaper/waste.html

Table 6 demonstrates the wide variability of loss rates from different fisheries and also highlights the lack of recent data on ALDFG. It should be emphasized that these figures simply attempt to bring a sense of scale to the issue, but given the current reliance on patchy and largely survey-based information (as opposed to first-hand observation), it is difficult to provide any robust quantification of the level of gear lost in the world's oceans on an annual basis, or of its overall contribution to marine debris as a whole.

The main difficulties in estimating the level of ALDFG from the world's fisheries are as follows.

- Most gear is not deliberately discarded – the predominant source of ALDFG is through loss resulting from gear conflicts, loss in storms or strong currents (see Chapter 4) – but this may not be immediately apparent, thus compromising reporting.
- Some of the gear lost is from IUU fishing, especially in artisanal fisheries where the use of light monofilament nets is common.
- The abandonment, loss or discard of gear has not been considered a major issue in fisheries management. As a result it is rarely required to be quantified in mandatory or voluntary reporting requirements.
- The best way to quantify gear loss is through independent observations, yet the level of observer coverage is low and is usually instigated for some other reason, such as bycatch monitoring, and thus may not capture high risk fisheries.
- There is no accepted standard for recording gear loss. There needs to be a standard that reflects the difference in gear designs and vulnerable components, such as dhans and headropes, and standardizes terms such as "nets" (is this a single sheet or a whole fleet of sheets?).
- Many of the experimental studies on gear loss (and particularly on its subsequent impact) are compromised by poor experimental design, which often does not reflect either the commercial or environmental conditions in which they are most likely to be used.
- Many studies of gear loss indicate relative rates of gear loss, yet rarely indicate the total level of usage of that gear by the studied fishery and thus the absolute levels of gear lost.

This chapter also emphasizes the importance of global oceanic currents in concentrating marine litter in oceanic gyres or convergence zones. These areas are well known and relatively easily monitored, thus allowing the targeted recovery of floating marine debris, including ALDFG, that might have accumulated.