A review of large whale entanglement

MATTILA, DAVID K[1]. AND TERI ROWLES[2]

[1]*Hawaiian Islands Humpback Whale National Marine Sanctuary, 726 S. Kihei Road, Kihei, HI 96753 USA*
[2]*Marine Mammal Health and Stranding Response Program, Office of Protected Resources, National Marine Fisheries Service, 1315 E. West Highway, Silver Spring, MD 20910 USA*

ABSTRACT

Entanglements of large whales in manmade materials have been documented in virtually all regions of the world where the two overlap. While large whales have been reported entangled in a variety of materials, the majority of entanglements documented to date have involved stationary or drifting, as opposed to actively towed, fishing gear. Estimating the extent and impact of these occurrences has been difficult as the most common method used to measure levels of "bycatch" is through observer programs aboard vessels that are actively fishing. However, growing evidence indicates that many large whales drag all or part of the gear away from the location where the fisherman expects to retrieve it. Therefore various other methods have been used to estimate the species, numbers of individuals, gear and impacts involved in these events. These include: the examination of stranded animals, the collection of opportunistic reports, the collection of data while releasing entangled whales; and the examination of diagnostic scarring on survivors. Here we provide a review of some of we know currently about the species, numbers, impacts and entangling gear, based on these efforts.

OVERVIEW

Entanglement is a documented source of injury and mortality to cetaceans, including all large whale species (see Table 1). Extrapolating from known fisheries with appropriate observer programs, Read et. al. (2006) estimated that over 300,000 cetaceans die as bycatch in the world's fisheries annually. However for large whales, the frequency of entanglement events, the risk factors involved, and biological impacts are just beginning to be understood. In the case of bycaught large whales the likelihood of the fisher or a fisheries observer witnessing an entanglement is quite low unless the gear is very heavy and strong (e.g. set nets and cod traps), as large whales frequently drag all or part of the gear away from the location where the fisherman set and expects to retrieve it (Lyman et al, 2007 and Robbins et al, 2007). In order to better understand large whale entanglement, managers and scientists in some countries have depended on alternate methods for estimating large whale entanglement frequency and impact, including: examination of stranded animals, opportunistic reports from fishers and the general public, information gathered from releasing entangled whales, and the examination of diagnostic scarring on entanglement survivors.

Information from Stranded animals

One way to understand the scope and impacts of entanglement on large whales is through the examination of stranded individuals. There are inherent biases and constraints with these data, some of which include: 1) the individual must float and die close to shore, with favorable wind and currents or be in an area where it can be observed; 2) there is a limited "time window" in order for much of the information to be useable; 3) there must be access to the stranding site, which may not be a level beach, in order to both find and properly examine the carcass; 4) even if all of the above are met and there is evidence of entanglement, it may not be possible to establish the cause of death. However, even with these limitations, many important findings on this subject have come from examining these carcasses. Kraus (1990) made one of the first attempts to examine stranding data for insight into the scope of entanglement in one large whale population. Using data from stranded North Atlantic right whales, he found that 32% apparently died from two human activities (ship strikes and entanglements), while the cause of death for the rest was undetermined. Since that review, stranded carcasses of other species (humpbacks, Wiley et al, 1995), and from other countries (gray whales, Canada, Baird et al, 2002 and humpbacks, Ecuador, Alava et al, 2005), have found entanglement to be implicated in the mortalities of these species at 20% to 60% (Wiley et al, 1995) of cases where probable cause of death could be determined or inferred.

In addition to the valuable information about the types and pathobiology of wounds created by documented entanglements (Cassoff et al, draft circulated for this workshop), this information has been used; 1) to help ground-truth other methodologies (Kraus, 1990, Robbins and Mattila, 2001), 2) in the design of laboratory experiments (Woodward et. al., 2006), and 3) ultimately to inform management determinations (Knowlton and Kraus, 2001, and NOAA 2008). These will all be discussed in more detail at this workshop.

Opportunistic reports of live entangled animals

Many countries have well designed Fisheries Observer Programs for documenting and estimating bycatch of non-target species, such as seabirds, turtles and small cetaceans. While these programs may place well trained observers on board vessels, they rarely see and/or document bycatch of large whales. Therefore, many countries rely on opportunistic reports of large whale entanglements for assessing the rates of large whale bycatch for management purposes and for reporting in their IWC national progress reports (see summary Table 1). These reports can come from a variety of both experienced and inexperienced sources, and may receive various levels of validation and screening prior to inclusion in the reports. Subsequent documentation of large whale entanglements by trained observers, or even professional rescue (disentanglement) teams can provide a level of verification of these opportunistic reports (Lyman et al, 2007 and Robbins et al, 2007). These studies looked at reports called into marine mammal emergency hotlines on the Atlantic coast of the United States and the Hawaiian Islands. They found frequent large discrepancies between what is reported and what is eventually found by experts. These differences can be as extreme as: misidentification of species (even: genus, family, order, class and phylum), severity of the entanglement and the type of manmade rope, net, debris or other material. Major findings include (updated by Lyman et al 2007):

- fewer than half (45.6%,n=411) of evaluated reports were actually confirmed entangled;
- careful screening using non-leading questions by experienced personnel produced a low species error rate, but gear type and configuration were still likely to be in error (38% of screened reports);
- the best reports came from fishers and marine mammal experts, but even these could still make errors within their expertise (i.e. gear type and species respectively);
- and, the location of the first report of an entangled whale was very often not the location where the entanglement originally occurred, even if the whale was reported as "anchored". In fact, if the point of entanglement was subsequently determined (usually by tracking the gear back to the fisher that lost it), the average displacements were 7-nm for humpback whales (std=13.63-nm) and 290-nm for right whales (std=386.05-nm) along the Atlantic coast, but in Hawaii, approximately half of the humpback whales become entangled in gear encountered over 2,000-nm away in Alaska.

In addition to the accuracy of these reports, growing evidence suggests that many entangled whales are never observed and/or reported, even along coasts with extensive human use and well-advertised reporting protocols (Landry et al., 2007). Analyzing annual acquisition of entanglement wounds on humpback whales in the Gulf of Maine, Robbins and Mattila (2001) reported that only 3% of the estimated annual entanglements were reported to a well-established response network. It should be noted that the data for both studies came from a region where most of the fishing gear is traps, pots, longlines and some nets. Most of the gear is lighter and therefore may be more likely not to anchor the whale where the fisherman would find it and report it. It is likely that in countries and regions with a higher number of heavy nearshore gear (e.g. set nets, pounds, cod traps…etc.), the reporting rate would be higher (e.g. Japan, Korea and Newfoundland). However, if these regions also have significant amounts of lighter and/or offshore gear, these may be missed or underreported (Ledwell, this workshop).

Information from sighting networks has also helped to better understand the progression of wound healing and health. Conversely, it has also provided information on the slow debilitation that serious entanglements can cause, if the animal does not die from the initial entanglement (Moore et al, 2006)

Information collected by responding to entanglements

Trained entanglement responders and disentanglers can, through careful and systematic documentation of the species, individual, wounds, general health, gear and entanglement configuration, gather valuable data that helps to understand the scope and impacts of large whale entanglements, which may ultimately lead to mitigation and/or prevention. Much of the data that is currently being collected in some regions is reviewed by Mattila et al (2007). In addition to contributing to the verification of opportunistic reports discussed above, the data collected has been valuable in analyzing several components of large whale entanglement, including: gear type (Johnson et al, 2005; Lyman, 2009) and configuration on the whale; individual whale identification (i.e. photo-ID and/or genetics) for estimating survivorship; and wound documentation for development of better assessment and prognosis tools (NOAA, 2008), as well as improving scar or wound based studies (see below).

The National progress reports submitted to the IWC Scientific Committee show that all large whales are at risk to life-threatening entanglements in manmade ropes and nets (Table 1). In addition, it is apparent from those

reports that virtually all types of fixed or drifting ropes and nets can entangle a whale (Table 2). Analyses of the gear removed and/or well documented on entangled whales by trained responders so far suggest that virtually any passive rope or net in the water column that whales inhabit, whether actively fished, stored or derelict (Mattila and Lyman, 2006), is potentially implicated. Because the majority of this material is related to fisheries, they contribute the vast majority of rope and net found on entangled whales. However, rope, cable, strapping and net of other origins are also found and removed from whales.

Inferences made from wounds and scars on survivors

Entanglements produce injuries that can be detected even after gear is removed or shed naturally, and the diagnostic scars from these encounters have been examined, categorized and ground-truthed for several species, including right whales (Kraus, 1990), humpback whales (Robbins and Mattila, 2001) and gray whales (Bradford et al, 2009). These methods have, until recently, been used only to learn about those individuals that have survived their entanglement, giving insight into the frequency of encounters by individuals, including age and sex class, and populations, including the first synoptic view for an Ocean basin (Robbins et al, 2007). Since the development of these techniques with the long-term studies of right and humpback whales in the Gulf of Maine, they have used to gain insight into other populations (Neilson et al, 2007) and species (Bradford et al, 2009). In all areas of the Northern Hemisphere studied so far entanglement scar percentages have been greater than 20% and in many places, over 50%. Currently there are no comparable results available from the Southern Hemisphere.

In addition, where these studies have been carried out over the long-term in conjunction with a long-term database on given population, and where there are established entanglement response networks, further analyses are possible. For instance, working with a long-term humpback whale database and a response network in the Gulf of Maine, USA, Robbins (2010) has been able to show that an average of 12.2% of the humpback population acquire new entanglement wounds each year, and yet less than 12% of these are observed and reported to the established existing network. Also, using information on the long-term survivorship of entangled humpback whales, Robbins et al (2009) was able to produce the first estimate of annual entanglement mortality for the whole Gulf of Maine population, based on inference from scarring. Updates on this will be presented at this workshop.

Fishing gear and other materials documented in large whale entanglement

An examination of the annual National Progress reports submitted to the IWC (summary Table 2), along with annual reports from the Canadian Whale Release and Stranding Group (summarized at this meeting), when combined with analyses of gear removed from entangled whales (Johnson et al, 2005 and Lyman 2009), indicate that large whales can become entangled in virtually any manmade, fixed or drifting ropes and nets that they encounter. And this can occur in the full range of their habitats (i.e. feeding, migratory and breeding).

Given the significant differences between the various types of fishing gear, it is very difficult to determine which type is most likely to entangle a whale, and of those, which is more potentially lethal. Clearly, entanglements in heavy coastal gear like set nets and cod traps are more likely to both anchor the whale and to be observed. But given the rates of entanglement currently being documented in some areas that have lighter and/or more offshore gear, it could be misleading to infer that the former is the greater threat.

Further complicating the process of determining the greatest risk is the species' and individual's reaction to the process of becoming entangled. Ford and Reeves (2008) showed that different species react quite differently to threats from predators, and Landry et al (2003) showed that they also react differently to the process of disentanglement.

CONCLUSIONS

There are severe limitations to estimating large whale entanglement based on either fishery observer programs or opportunistic reports no matter the amount of coverage and quality of the screening. In addition there can be tremendous differences between countries, depending on incentives, level of awareness and even perceived disincentives to the reporter. Growing evidence suggests that in most regions of the world both methods underestimate the number of entanglements by an order of magnitude, if not more.

As indirect methods to estimate entanglement mortality improves, the higher than expected and/or previously documented estimates obtained from some studies suggest that entanglement may play a significant role in the recovery of some populations. For instance, based on inferences from entanglement wounds, combined with

data on long-term survivorship of entangled individuals, Robbins et al (2009) calculated an annual mortality of 3.7% for a population of humpback whales in the Gulf of Maine. If the mortality rate for other populations of large whales is similar, it may help to explain the variability in long-term growth rates documented for different populations of the same species in other regions of the world's Oceans.

It is clear that professionally trained entanglement response teams with the proper instructions, personnel, equipment and support can accomplish a level of data collection and documentation of entanglement events that can be extremely valuable for variety of analyses (many reviewed here), along with successfully freeing whales and increasing their chance of survival.

Large whales can become lethally entangled in virtually any man-made rope or net that is drifting or anchored. In addition, contrary to earlier assumptions based on the amount of gear, average turbidity of the water and riskier whale behavior (i.e. feeding), entanglement is not limited to the feeding areas. It can occur in the often clearer waters found on migration (e.g. Australia) and in breeding grounds (e.g. Hawaii), where may not be feeding. It is also likely that entanglement in "lighter" gear, which is not as likely to anchor the whale in place as compared to heavier gear (e.g. set nets and cod traps), is underreported and therefore its impact is underestimated.

As Moore et al (2006) showed, if large whales do not drown immediately, their time to death can be very long.

ACKNOWLEDGEMENTS

All of the disentanglement work done by the U.S. Networks discussed here is carried out under the authorization of a NOAA Fisheries, Endangered Species enhancement permit (#932-1489). As mentioned, these networks are staffed and supported by many individuals, institutions and agencies, far too numerous to name here. However, it should be clear from the discussions of the personnel required to safely release, while thoroughly documenting, entangled whales can be substantial. In particular we thank other members of the PCCS Disentanglement team: Charles Mayo, Greg Krutzikowsky, Bob Bowman, Dave Moran and Brian Sharp, as well as other members of the Atlantic Large Whale Disentanglement Network: all of the New England Aquarium right whale research team, Chris Slay and Mackie Green. As well as the organizational and follow up support of NOAA Fisheries through Jamison Smith, Barb Zoodsma, John Kenney and John Higgins and many others. In addition, we appreciate the logistical support of the U.S. Coast Guard, and many State agencies along this extensive coastline. In Hawaii, we would like to thank David Schofield and the State of Hawaii Department of Land and Natural Resources, as well as the professional ocean user community of researchers and tour boat operators.

References cited

Álava, J. J., Barragán, M., Castro, C. and Carvajal, R. 2005. A note on strandings and entanglements of humpback whales (*Megaptera novaeangliae*) in Ecuador. *J. Cetacean Res. Manage*. 7(2):163-168.

Bradford, A.L., D. W. Weller, Y. V. Ivashchenko, M. Burdin and R.L. Brownell. 2009. Anthropogenic scarring of western gray whales (*Eschrichtius robustus*). Marine Mammal Science, 25(1): 161–175.

Clapham P., P. Berggren, R. Leaper, D. Mattila, J. Robbins. 2003. Report of the Intersessional Working Group on Large Whale Entanglement. Unpublished report to the Scientific Committee of the International Whaling Commission. SC/54/BC2

Ford, J.K.B. and R.R. Reeves. 2008. Fight or flight: antipredator strategies of baleen whales. *Mammal Rev*. 2008, Volume 38, No. 1, 50–86.

Johnson, A., G. Salvador, J. Kenney, J. Robbins, S. Kraus, S. Landry and P. Clapham. 2005. Analysis of fishing gear involved in entanglements of right and humpback whales. Marine Mammal Science 21:635-645

Knowlton, A.R., Marx, M.K., Pettis, H.M., Hamilton, P.K. and Kraus, S.D. 2001. Scarification analysis of North Atlantic right whales (*Eubalaena glacialis*): monitoring rates of entanglement interaction. Report to the US National Marine Fisheries Service under contract 43EANF030107. [Available from New England Aquarium, Central Wharf, Boston, MA 02110].

Landry S., D. Morin, R. Bowman, D. Hartley, D. Mattila and C. Mayo. 2003. The Success of a Disentanglement Event May Depend upon the Species. Presentation at the 15th Biennial Conference of the Marine Mammal Society. Greensboro, North Carolina, USA - 14-19 December 2003

Landry.S., R. Bowman, D. Mattila, and J. Robbins. 2007. Needle in a Haystack: evidence of a low reporting rate of entangled whales. Presented to the 17th Biennial Conference of the Marine Mammal Society. Capetown, South Africa.

Lyman E.G., R. Bowman, D. Mattila and C. A. Mayo. 1999. A technique for disentangling large free-swimming whales. Abstract in the proceedings of the 13th Biennial Conference on the Biology of Marine Mammals. Maui, Hawaii. November 27 - December 3.

Lyman E.G., J. Kenney. S. Landry, D.K. Mattila, J. Robbins. 2007. Reliability of eyewitness reports of entangled large whales: what do formal disentanglement programs tell us about this global problem? Abstract in the Proceedings of the 17th Biennial Conference on the Biology of the Marine Mammal Society. Capetown, South Africa.

Lyman, E.G.. 2009. A preliminary investigation of gear entangling humpback whales, *Megaptera novaeagliae*, in the North Pacific. In the Report of the Symposium on the results of the SPLASH humpback whale study, Quebec, Canada.

Mattila D.K. and E. Lyman. 2006. A note on the entanglement of large whales in marine debris. Unpublished report to the Scientific Committee of the International Whaling Commission, St. Kitts and Nevis: SC/58/BC2

Mattila, D.K.. S. Landry, E.G. Lyman, J. Robbins and T. Rowles. 2007. Scientific information that can be gained through large whale disentanglement. Unpublished report to the Scientific Committee of the International Whaling Commission, Anchorage, AK, USA. SC/59/BC1.

Moore M, Bogomolni A, Bowman R, Hamilton P, Harry C, Knowlton A, Landry S, Rotstein D, Touhey K. 2006. Fatally entangled right whales can die extremely slowly. *Oceans'06 MTS/IEEE-Boston, Massachusetts September 18-21, 2006 - ISBN: 1-4244-0115-1,* 3 pp

Neilson, J.L., J.M. Straley, C.M. Gabriele and S. Hills. 2007. Non-lethal entanglement of humpback whales (Megaptera novaeangliae) in fishing gear in northern Southeast Alaska. Journal of Biogeography (J. Biogeogr.)

NOAA. 2008. Differentiating Serious and Non-Serious Injury of Marine Mammals: Report of the Serious Injury Technical Workshop 10-13 September 2007, Seattle, Washington. NOAA Technical Memorandum NMFS-OPR-39.

Robbins J. and D. Mattila. 2001. Monitoring entanglements of humpback whales (*Megaptera novaeangliae*) in the Gulf of Maine on the basis of caudal peduncle scarring. Unpublished report to the Scientific Committee of the International Whaling Commission: SC/53/NAH25

Robbins J., J. Kenney, S. Landry, E. Lyman and D. Mattila. 2007. Reliability of eyewitness reports of large whale entanglement. SC/59/BC2, this meeting.

Robbins J., J. Barlow, A. M. Burdin, J. Calambokidis, P. J. Clapham, J. K. B.Ford, C. M. Gabriele, R. LeDuc, D. Mattila, T. J. Quinn, L. Rojas-Bracho, J. M. Straley, J. Úrban, P. Wade, D. Weller, B. H. Witteveen, K. Wynne and M. Yamaguchi. 2007. Preliminary minimum estimates of humpback whale entanglement frequency in the North Pacific Ocean based on scar evidence. SC/59/BC15 submitted to the 59th annual meeting of the Scientific Committee of the IWC.

Robbins, J., Landry, S. and Mattila, D.K. 2009. Estimating entanglement mortality from scar-based studies. Report submitted to the 61st annual meeting of the Scientific Committee meeting of the International Whaling Commission. SC/61/BC2

Robbins, J. 2010. A review of the frequency and impact of entanglement on Gulf of Maine humpback whales. 2010. At this meeting. IWC/A10/E3.

Tables

Table 1) Summary of six years of large whale bycatch data from National Progress Reports* submitted to the IWC Scientific Committee annual meetings (56-61), generally covering the years: 2003-2008**

SPECIES

COUNTRY	Minke	Humpback	Right	Fin	Brydes	Gray	Sei	Bowhead	Blue	Sperm	TOT
Argentina	1	0	0	0	0	-	0	-	0	0	1
Australia	1	82	3	0	1	-	0	-	0	4	91
Brazil	0	1	1	0	1	-	0	-	0	0	3
Denmark	1	12	0	0	-	-	0	2	0	0	15
France	0	0	0	1	0	-	0	-	0	1	2
Iceland	6	3	0	0	-	-	0	0	0	0	9
Ireland	0	1	0	0	-	-	0	-	0	0	1
Italy	0	1	-	0	0	-	0	-	0	7	8
Japan†	783	19	1	2	3	4	1	-	0	1	814
Korea	488	3	0	3	1	0	0	-	0	1	496
Netherlands	0	0	0	0	-	-	0	-	0	0	0
New Zealand	0	0	0	0	0	-	0	-	0	0	0
Norway	0	0	0	0	-	-	0	0	0	0	0
Spain	0	2	0	0	0	-	0	-	0	3	5
Sweden	0	0	0	0	-	-	0	-	0	0	0
UK	7	3	0	1	-	-	0	-	0	0	11
USA††	14	24	10	6	2	1	1	0	1	3	62
TOTAL	1301	151	15	13	8	5	2	2	1	20	1518

* Some countries either submitted reports to each meeting, but bycatch data was incomplete (e.g. Mexico and Chile), or did not submit reports to all of the meetings summarized here (e.g. South Africa, Peru, Portugal)

** Some countries experience a delay in compiling their data (e.g. USA data is from 2001-2006).

† The Government of Japan allows fishermen to kill several species of whales found entrapped or entangled in their nets (most notably minke whales), as long as they are reported and registered. This practice helps to explain the very high numbers of minke whales reported.

†† More up-to-date summaries of large whale entanglement in the USA will be presented at this workshop.

Table 2) Types of manmade materials reported to have entrapped or entangled large whales. Summarized from National Progress Reports* submitted to the IWC Scientific Committee annual meetings (56-61), generally covering the years 2003-2008**

FAO GEAR TYPE

COUNTRY	SV	SX	TX	TMS	GND	GN	FPN	FPO	FYK	FSN	FIX	LLS	LLD	LL	NSC
Argentina	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
Australia†	-	-	-	-	-	X	-	X	-	-	X	X	-	X	X
Brazil	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
Denmark	-	-	-	-	-	X	X	X	-	-	-	-	-	-	-
France	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
Iceland†	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-
Ireland	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
Italy	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-
Japan††	-	-	-	-	-	X	X	-	-	-	X	-	-	-	-
Korea	X	X	X	-	X	X	X	X	X	X	-	-	-	X	-
Netherlands	-	-	-	-	-	-	-	-	-	-		-	-	-	-
New Zealand	-	-	X	-	-	-	-	-	-	-		-	-	-	-
Norway	-	-	-	-	-	-	-	-	-	-		-	-	-	-
Spain	-	-	-	-	X	-	-	X	-	-		-	-	X	-
Sweden	-	-	-	-	-	-	-	-	-	-		-	-	-	-
UK	-	-	-	-	-	X	-	X	-	-		-	-	-	-
USA†††			X		X			X				X		X	

* Some countries either submitted reports to each meeting, but bycatch data was incomplete (e.g. Mexico and Chile), or did not submit reports to all of the meetings summarized (e.g. South Africa, Peru, Portugal)

** Some countries experience a delay in compiling (e.g. USA data is from 2001-2006).

† Both Australia and Iceland reported whales entangled in "aquaculture"

†† The vast majority, 805 (99%), of entanglements reported in Japan's Progress Reports were in pound or "set nets".

††† More up-to-date summaries of the materials involved with large whale entanglement in the USA will be presented at this workshop.

Table 3. FOA fishing descriptions and codes

FAO FISHING GEAR CATEGORIES:		**FALLING GEAR**	
SURROUNDING NETS		Cast nets	FCN
With purse lines	PS	Falling gear (not specified)	FG
One-boat operated purse seines	PS1	**GILLNETS AND ENTANGLING GEAR**	
Two-boat operated purse seines	PS2	Set gillnets (anchored)	GNS
Without purse lines (lampara)	LA	Driftnets	GND
SEINE NETS		Encircling gillnets	GNC
Beach seines	SB	Fixed gillnets (on stakes)	GNF
Boat seines	SV	Trammel nets	GTR
Danish seines	SDN	Combined gillnet-trammel nets	GTN
Scottish seines	SSC	Gillnets and entangling gillnets (not specified)	GEN
Pair seines	SPR	Gillnets (not specified)	GN
Seine nets (not specified)	SX	**TRAPS**	
TRAWLS		Stationary uncovered pounds nets	FPN
Bottom trawls	TBB	Pots	FPO
Beam trawl	OTB	Fyke nets	FYK
Otter trawls (side or stern)	PTB	Stow nets	FSN
Pair trawls	TBN	Barriers, fences, weirs, etc	FWR
Nephrops trawls	TBS	Aerial traps	FAR
Shrimp trawls (not specified)	TM	Traps (not specified)	FIX
Midwater trawls			
Otter trawls (side or stern)	OTM	**HOOKS AND LINES**	
Pair trawls	PTM	Handlines and pole-lines (hand operated)	LHP
Shrimp trawls	TMS	Handlines and pole-lines (mechanised)	LHM
Midwater trawls (not specified)	TM	Set longlines	LLS
Otter twin trawls	OTT	Drifting longlines	LLD
Otter trawls (not specified)	OT	Longlines (not specified)	LL
Pair trawls (not specified)	PT	Trolling lines	LTL
Other trawls (not specified)	TX	Hooks and lines (not specified)	LX
DREDGES		**GRAPPLING AND WOUNDING**	
Boat dredges	DRB	Harpoons	HAR
Hand dredges	DRH	**HARVESTING MACHINES**	
LIFT NETS		Pumps	HMP
Portable lift nets	LPN	Mechanised dredges	HMD
Boat-operated lift nets	LNB	Harvesting machines (not specified)	HMX
Shore operated stationary lift nets	LNS	**MISCELLANEOUS GEAR**	MIS
Lift nets (not specified)	LN	**RECREATIONAL FISHING GEAR**	RG
		GEAR NOT KNOWN OR NOT SPECIFIED	NK
		SHARK CONTROL NETS	NSC
		DERELICT FISHING GEAR	