GHOSTFISHING PROBLEMS AND PREVENTION

by

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Abstract

Ghostfishing is the fishing activity of lost or abandoned fishing gears or theirarts. This invisible fishing activity of unknown number of fishing gears may have contributed the global depletion of fisheries resources. Gillnets and pots are two gear types known to have severe ghostfishing problems. Synthetic materials making up gillnets and pots can last for many years when left in water. There are no worldwide survey or estimates of annual loss of gillnets or pots, but the number is likely in millions. Prevention, clean up, de-ghosting technological research, and awareness training are some of the strategies which can be adopted to curb the ghostfishing problem. This presentation will review the problems of ghostfishing in gillnet and pot fisheries, actions taken by some countries to counteract gear losses and ghostfishing, and future prospectus in combating ghostfishing problems.

1. INTRODUCTION

Fishing gears can become lost during normal fishing operations due to adverse weather or sea conditions, or when in conflict with other fishing gears or vessel traffic. Some lost gears continue to fish after being lost, resulting in "ghostfishing". Ghostfishing can be defined as "the ability of fishing gear to continue fishing after all control of that gear is lost by fishermen (Smolowitz, 1978). Types of fishing gear known to ghostfish include gillnets and crustacean/fish pots. However, other fishing gears and their parts (such as trawls, seines or longlines) may also cause various problems to the resource and the environment. With the introduction of synthetic materials in gear construction, these lost fishing gears may continue to fish for several years before they become inactive. World-wide decline in fisheries resources leads one to question whether ghostfishing has contributed to the problem and whether there are measures which can be taken to combat ghostfishing by lost gears.

Fishing gears lost unintentionally, abandoned or otherwise disposed at sea, have a similar effect on animals and the environment. In this review, therefore, all fishing gears no longer under the control of a fisherman can be treated as "lost gears". Gears which continue to catch animals after being lost are called "ghost gears", "ghost nets" or "ghost pots". Fishing gear designs and operating practices intended to counter or reduce ghostfishing activities of lost gears are referred to as "de-ghosting" technologies.

2. GHOSTFISHING - THE PROBLEM

2.1 Gear loss and ghostfishing in pots

Pots can be lost for a variety of reasons. Normal wear and tear in the course of repeated use can result in the loss of pots. Vessel traffic and conflicts with other fishing operations (e.g. gillnetting, trawling, or trolling) can result in cut buoy lines. Rough weather and other unusual oceanographic conditions including tides, current and icebergs can move pots far from their set positions. Birds can sometimes destroy buoys, and sea mammal entanglements can remove or dislocate fishing gear (Smolowitz, 1978a; High, 1985). Several studies on lobster and crab pot loss document a variety of annual loss rates, most of which range between 5-30% (Table 1).

Ghostfishing by lost pots has been demonstrated on both sides of the North American continent. Evaluations of ghostfishing by lost pots were made through the retrieval of lost pots, laboratory and field simulations of animals entrapped by and escaping from various types of pots, and underwater observations of lost pots. Ghostfishing does occur in all major shellfish pot fisheries, including American lobster, Alaskan King crab, and Dungeness crab. Breen (1990) reported that a Dungeness crab pot that had been lost for 10 months contained 20 crabs when it was retrieved. In another study by Breen's (1987) ten simulated lost pots were observed for one year. During that period, 169 crabs were trapped, half of which died.

However, Miller (1977) found that "lost" snow crab pots had very insignificant ghost fishing capacity after the original bait had been consumed. After three weeks of underwater observations, he concluded that dead crabs in the pot repelled rather than attracted crabs of the same species. A recent review by the same author (Miller, 1990) indicated that this conspecific repellent effect appeared to be true in several other shellfish species. However, a recent experiment by Vienneau and Moriyasu (1994) demonstrated that snow crab pots were still capable of catching crabs after almost one full year in Chaleur Bay in the Southwest part of Gulf of St. Lawrence.

Annual loss of crabs or lobsters due to ghostfishing varies with species and location. Miller (1977) estimated that the loss of snow crabs due to lost pots in Newfoundland in 1974 was only around 10 tons or 0.5% of landings, while Breen (1987) estimated the ghostfishing loss of Dungeness crab in British Columbia waters as 7% of landing in 1985. In the sablefish pot fishery in British Columbia, Scarbrook *et al.* (1988) estimated an annual loss of more than 300 metric tonnes (MT) or 7.5 - 30 % of landings (Table 1).

Table 1. Summary of gear loss and ghostfishing capacity of lost pots.

Gear	Gear loss and ghostfishing impacts	Reference
Dungeness crab pot	British Columbia, Canada: pot loss 11%, ghost fishing: 16.9 crab/pot over one year, 59% of them died.	Breen, 1987
,,	California, US: pot loss 100,000 annually.	Kennedy, 1986
King crab pot	Alaska, US: annual pot loss: 10%. ghosting mortality: 12%	High & Worland, 1979
Snow crab pot	Newfoundland, Canada: annual pot loss: 8.3%; ghostfishing mortality: 0.5% of landing (10 MT)	Miller, 1977
,,	New Brunswick, Canada: annual pot loss 2466 pots; ghostfishing: 44.3 crabs/pot; or 100 MT annual loss.	Mallet *et al.* 1988
,,	New Brunswick, Canada: number of crab increased to 1.6 times after 318 days in water	Vienneau & Moriyasu, 1994
,,	Gulf of St. Lawrence, Canada: annual pot loss: 3,000.	Anon. 1995
Lobster pot	New England, US: ghost pot catch rate: 10% of regular pot.	Pecci *et al.* 1978
,,	US east coast inshore: pot loss 5-10%. 93,000-187,000 annually	Breen, 1990
,,	US east coast: ghost pot catch: 670 MT	Smolowtz, 1978b
Sablefish pot	British Columbia, Canada: ghost pot caught 326 MT sablefish annually between 1977 and 1983.	Scarbrook *et al.* 1988

2.2 Gear loss and ghostfishing in gillnets

Gillnets may be lost due to bad weather or sea conditions, conflicts between fishing gears, collision with large marine mammals, or bad seabed conditions. Gillnets may also be abandoned at the end of the fishing season or after engaging in illegal fishing activity.

Fosnae (1975) estimated that 5000 gillnets were lost annually in the Newfoundland cod fishery in 1970s, while CFCL (1994) further estimated that around 8000 gillnets were lost annually in the Atlantic Canadian waters. Gillnet losses must be occurring in some large numbers because lost gear retrieval operations have retrieved quantities of gillnets. There are also concerns that the problem of gear loss may be aggravated by the increased use of gillnets in deep waters and in more hostile sea conditions such as deep water turbot gillnetting in Labrador Sea. Cooper et al. (1988) conducted video camera surveys by a remotely-controlled underwater vehicle in the Gulf of Maine and estimated that there might be 2497 nets (91 m each) on the 64 square nautical miles (nm^2) area of the traditional gillnet grounds on Stellwagen Bank and Jeffries Ledge of New England coast in northeastern US, equivalent to 39 lost nets per nm^2.

Gillnets are believed to continue fishing for many years. When lost gillnets are retrieved, they often contain large amounts of fish and shellfish (Way 1976, 1977; RPPNG, 1992). Direct observations on lost gillnets or simulated "lost" gillnets confirm that these nets do ghostfish. High (1985) estimated that lost salmon nets might fish for three years for fish, and six year for shellfish such as crabs. Gillnets lost in shallow waters tend to become overgrown by algae. Since these algae-laden nets are more visible, their fishing capacity is correspondingly reduced (Carr & Harris, 1994). However, shallow water is normally rich in marine life so catch rates can still be considerable. It was estimated that a lost gillnet may fish at 15% of the capacity of a regularly tended gillnet (Carr & Cooper, 1988). Impact of lost gillnets on the resource is scarcely known. Table 2 lists some of the published data on gear loss and ghostfishing capacity of lost gillnets.

Table 2. Summary of gear loss and ghostfishing of lost gillnets.

Gear	Gear loss and ghostfishing impacts	Reference
Groundfish gillnet	Newfoundland, Canada: cod fishery, 5000 pieces annually	Fosnae, 1975
,,	Atlantic Canada: Groundfish fishery 8000 pieces annually, or 2%; caught 3,600 MT annually	CFCL, 1994
,,	New England, US: lost net density traditional gillnet grounds: 39 nets/sq. nm.	Carr et al. 1988
,,	New England, US: 74 -day cumulative catch: 25 fish and 48 crab/net	Carr et al. 1985
,,	New England,US: ghost fishing rate 15% of regular nets	Carr & Cooper, 1988
,,	Newfoundland, Canada: revoered net, 20 kg/net fish, and 10 kg/net crab, >80% live	Way, 1976
,,	Newfoundland, Canada: revoered net, 29 kg/net fish, 15 kg/net crab	Way, 1977
Herring gillnet	British Columbia, Canada: nets containing fresh herring after being lost for 7 years	Breen, 1990
Salmon gillnet	US west coast: ghostfishing 2 years for fish, 6 years for crabs	High, 1985
Pacific drift gillnet	North Pacific: 0.05% per deployment - 90 km of 180,000 km nets used	Gerrodette et al. 1990

3. GHOSTFISHING PROBLEM - THE SOLUTION

There are some solutions available to the ghostfishing problem. Some of them are: preventing gear loss, reducing damping of old gears at sea, employing de-ghosting technologies in gear designs, and retrieving lost gears.

3.1 Preventing gear loss

Some of the gear loss may be inevitable, but many loss can be avoided, or lost gear can be recovered with some effort. Measures to prevent gear loss include:

a) improving skills of skippers/fishing masters

b) improving design/operation of fishing gear

c) using gear retrieving/re-locating devices (Figure 1)

d) promoting public awareness of the impact of gear loss and ghostfishing, e.g. responsible fisheries training workshops

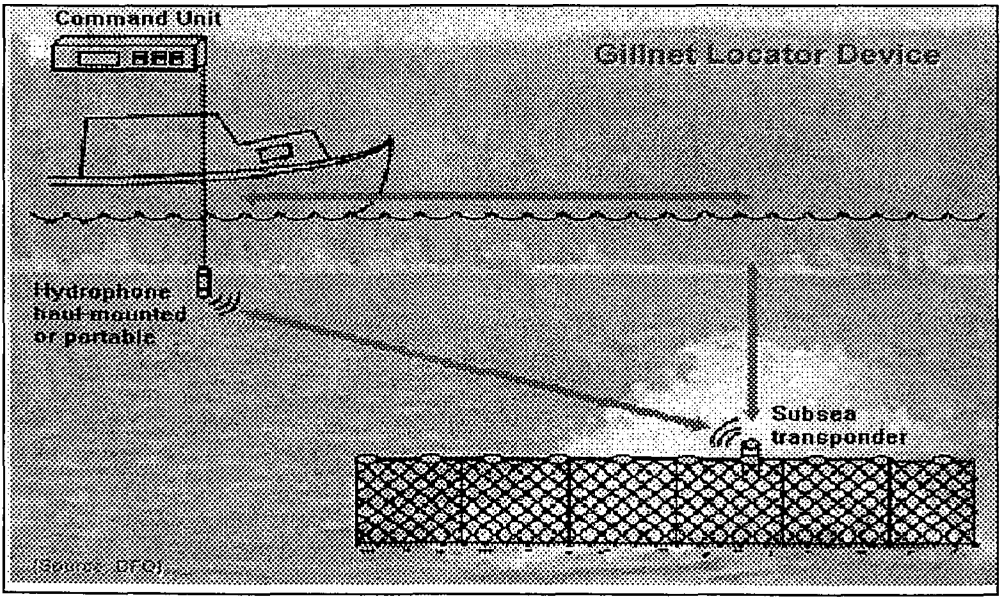


Figure 1. Schematic drawing of a gillnet equipped with a re-locating device. The device was designed by NNA Associates Ltd. and it still in development.

3.2 Reducing damping of old gears at sea

Damping of old gears at sea is prohibited by the law (e.g. United Nations Law of Sea). However, damping activities do occur. The most effective measure to reduce damping or other disposal of used gears is public education. Other means include recycling of used gears and providing damping stations in docks.

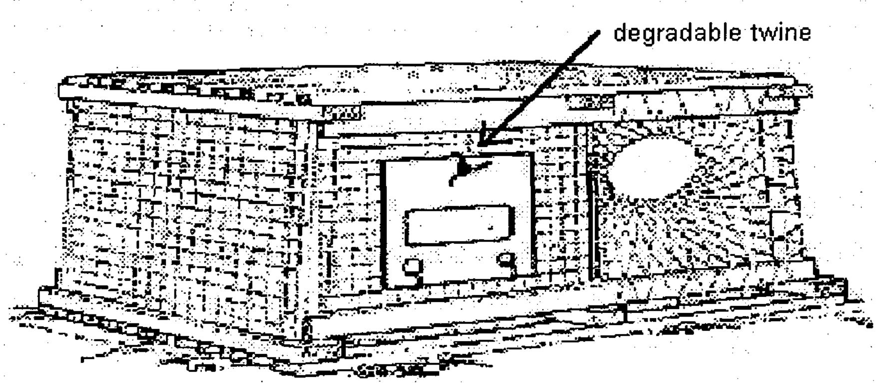
3.3 De-ghosting technologies

De-ghosting means reducing ghostfishing capacity or ghostfishing life of lost gears. Some of the de-ghosting technologies are available and have been applied in pots and other gears.

3.3.1 De-ghosting technologies in pot

Sublegal escape vents. Sublegal escape vents are now required in almost all lobster pots in North America. These sublegal escape vents not only release small animals during normal fishing, they also allow undersized animals to escape in the event of gear loss (Smolowitz, 1978). This is especially important when the ratio of sublegal to legal sized animals is high. Pecci *et al.* (1978) found that pots equipped with sublegal escape vents caught fewer sublegal and legal size (45 mm, carapace length) lobsters during simulated ghostfishing. Furthermore, there were lower mortality rates and fewer injuries among lobsters trapped in pots equipped with sublegal escape vents during simulated ghostfishing situations.

Timed-release de-ghost doors. For de-ghost doors to function on a timed-release basis, the door must be installed on a hinge and secured by degradable twine or a degradable latch. Blott (1978) fitted lobster pots with timed-release de-ghost doors within which was built a sublegal escape vent (Figure 2). Pecci et al. (1978) tested Blott's de-ghost doors and found that these devices "are an effective means of releasing entrapped lobsters". In Nova Scotia, de-ghost doors with built-in sublegal escape vents are mounted on the side of parlours of wire mesh lobster pots by ordinary steel hog rings which last



Catch escape door installed on pot (from Blott, 1978)

Figure2. Catch escape door fastened with a degradable twine installed on a lobster pot (Boltt, 1978).

about a year in sea water (R. Miller, pers. comm.). Failure of the steel hog rings will create a de-ghost opening of not less than 89 mm in height and 152 mm in width as required by Atlantic Fishing Regulations.

<u>Timed-release de-ghost panels</u>. A recent study by Gagnon & Boudreau (1991 a&b) reported a very successful application of galvanic timed-release devices (GTRs) in de-ghost panels in crab pots in the Gulf of St. Lawrence (Canada) snow crab fishery. They cut five knots off the pot webbing near the bottom on the side of the pot and sewed the separated webbing together using two polypropylene twines connected by a GTR as shown in Figure 3. In a commercial fishing tests lasting between 25 and 43 days, the catch rates of pots fitted with the de-ghost panels were not affected. In fact, none of their 333 GTRs (75-day and 100-day release time) failed due to corrosion during 43 days of commercial fishing. After the commercial fishing tests were completed, further observations were made on GTRs and de-ghost panels in 13 pots. When the GTRs degraded and broke apart, 66% of the pots developed an opening which was 75% or more of the maximum anticipated de-ghost panel size and 95% of the crab trapped during the time these pots simulated ghost-fishing were released after the de-ghost panel opened.

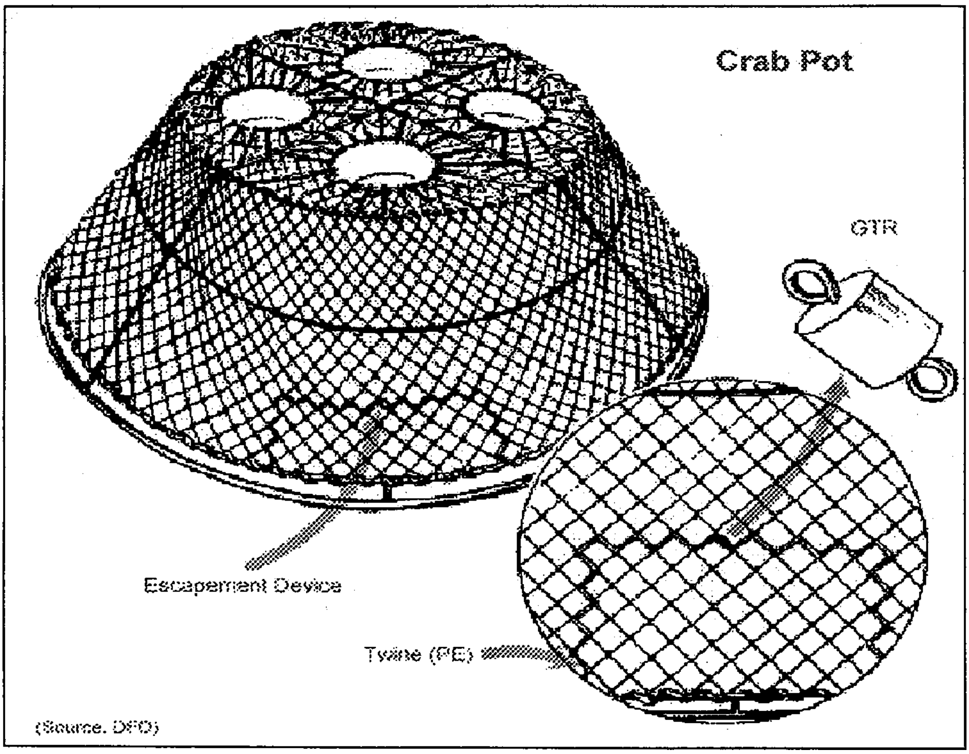


Figure 3. Schematic drawing of a snow crab pot rigged with an escape panel and a timed-release device (GTR).

Scarbrook et al. (1988) tested three shapes of de-ghost panels for sablefish pots. The panel shapes were square, slot and triangular. Pots with unsecured square panels or slots and control pots containing no de-ghost panels were set to fish for 10 and 15 days. Pots with square panels released 99% of their sablefish catch while the pots with slots released only 56% in comparison with the control. In another set of comparative fishing trials conducted by the same authors, the performance of pots fitted with triangular panels fastened by means of twines and GTRs and other pots fitted with unsecured triangular panels were compared to the performance of control pots with no de-ghost panels. After fishing for 19 days, the pots with GTR equipped de-ghost panels released an average of 90% of their catch while the unsecured pots released 99% of their catch. Results indicated that both square and triangular panels were effective in releasing captured sablefish in the event of gear loss. These trials also proved that GTRs can be used in sablefish pots as a timed-release mechanism.

Degradable material in door straps. The lids of some crab or lobster pots are closed using a strap with a hook. Breen (1987) observed 10 simulated lost stainless steel Dungeness crab pots for a year. He then unhooked the lids of the pots but left them in the closed position. When the lids were unhooked, they contained 29 crabs. Within seven days of unhooking, 22 of 29 crabs (76%) had escaped from the pots and 7 of the 10 pots were completely empty. These observations support the conclusion that, if degradable materials were used to connect the straps and the hooks in Dungeness crab pots, at least three quarters of Dungeness crab trapped in lost pots would escape within a week after failure of the degradable material. Degradable pot lid straps have been adopted as a conservation measure in British Columbia Dungeness crab fishery (Figure 4).

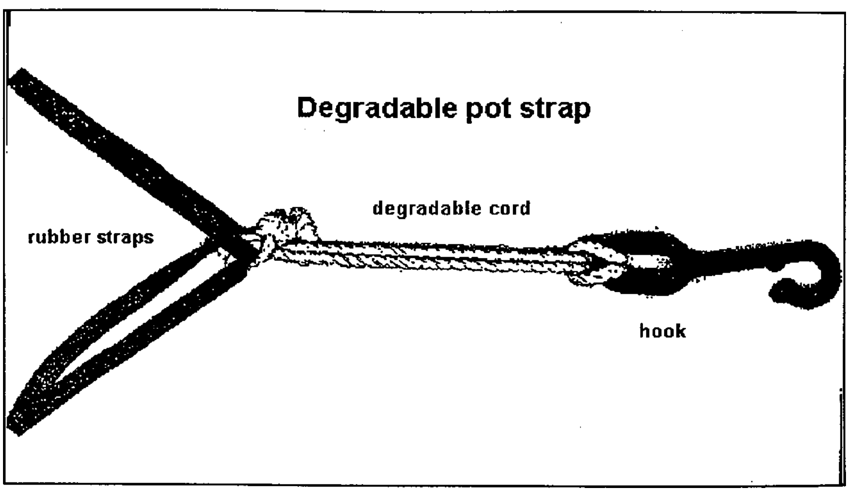


Figure 4. Degradable crab pot door strap required in British Columbia (Canada) Dungeness crab fishery.

3.3.2 De-ghosting technologies in gillnets

Use of degradable materials in part of a net. Inshore gillnets use floats on the headline and leadrope on the footrope to spread the net vertically. Therefore, use of degradable material which causes the gillnet to lose floatation after the gear is lost could reduce the vertical profile and hence reduce ghosting capacity. In 1960s, Icelandic fishermen were required to use untarred and uncoloured sisal twine of less than 5 mm in diameter to attach floats to the headline (G. Thorsteinsson, pers. comm.). Sisal twine failed after the gear was submerged in water for a period of time. The failure of the twine released the floats causing the net to lose flotation. However, the requirement to use degradable twine was dropped due to objections from fishermen. More frequent gear maintenance was needed which resulted in lost fishing time and therefore decreased fishing capacity. Frequent breakage also occurred in the natural twine causing increased loss of floats. Even though others also recommend the use of degradable natural fibre twines as hanging twines in the headline of a gillnet (Way, 1977; van Brandt, 1984), practical problems, similar to those encountered by Icelandic fishermen, have prevented implementation of these ideas.

Carr et al. (1992) tested the use of degradable plastics for attaching floats to the headline of gillnets (Figure 5). The gear was set to simulate ghost fishing for a period of 220 days. Two types of degradable plastics were used. Divers made underwater observations to check net profiles and catch. Only two of the 20 degradable attachment panels partially degraded after 220 days. No significant differences in catch was observed between sections of the net rigged with degradable float attachments and those with regular rigging.

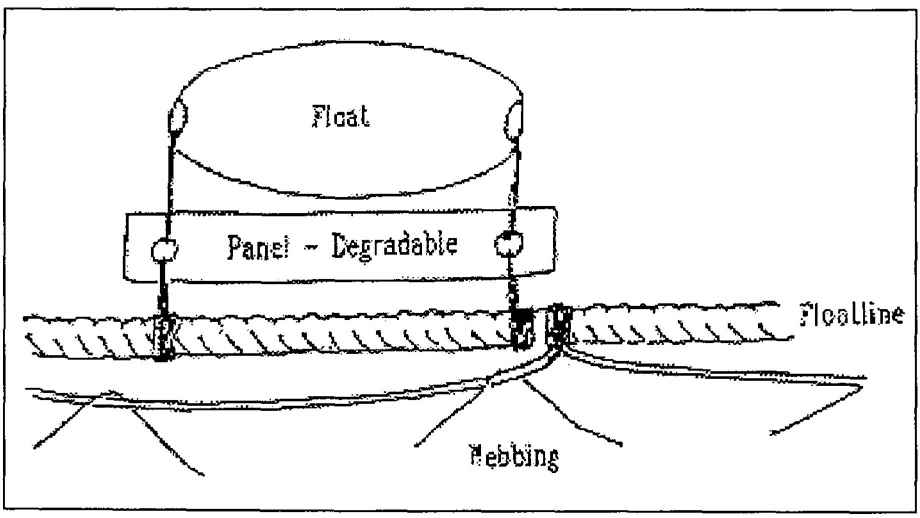


Figure 5. Test rig of a degradable panel used to attach gillnet floats to the headline (Carr et al., 1992).

Degradable nets. It was reported that Japanese have developed degradable fishing nets (Anon. 1993). The report indicated that this degradable material lost 60-70% of its weight after being buried in soil for a year. The biodegradable net was tested and was reported to maintain the required tenacity during normal fishing, yet disintegrate after two years. A weight loss of between 70.0 and 99.3% was recorded when the degradable material was left in seawater for 28 days at 25 °C (M. Yamashita, pers. comm.). Field tests on the fishing performance of flying squid drift gillnets made of this biodegradable material were conducted (T. Watanabe, pers. comm.). While the full report is not yet available, an abstract of a presentation at a meeting of the Japanese Society of Scientific Fisheries indicated that the fishing performance of the biodegradable net is better than the ordinary nets (Watanabe, 1992). However, the strength of the test net is only 36% of standard monofilament nylon nets of the same twine diameter. Therefore, more breakage was experienced in the test net especially in rough seas. Results of field tests on the degradation of the test net are not yet available.

4. CONCLUSIONS

Both pots and gillnets can become lost under various conditions and the lost gears continue to fish for a period of time. The rate and magnitude of gear loss varies with gear type and region. Pot loss rate in north America is believed within 5-30% annually. De-ghosting technologies are available for pots and have been applied in some fisheries. There are so far no satisfactory mean dealing with ghost fishing of lost gillnet. Some of strategies dealing with ghostfishing problems include:

a) Conduct public awareness campaign and responsible fisheries training programs which communicate potential ghostfishing problems of lost or otherwise disposed gears and their impact on the resource and the environment;

b) Research into ghostfishing capacity of lost gears under various conditions and in different geographical locations;

c) Carry out surveys of gear loss through interviews with and questionnaires to fishermen to estimate annual gear loss and the location of the losses;

d) Organize systematic "clean-ups" on fishing grounds where large quantities of gear are known to have lost and for those gears known to have ghostfishing problems;

e) Research into gear design, operation and instrumentation which can prevent/reduce gear loss or which can aid recovery of lost gears;

f) Establish a used gear returning and recycling program to reduce gear damping and encourage return of incidentally retrieved gears and/or their parts.

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