FINAL REPORT

FISH/2007/03/Lot No. 3

Studies and Pilot projects in support of the Common Fisheries Policy

Lot 3: Evaluation of various marker buoy techniques for the marking of passive fishing gears

for

The European Commission

Directorate - General for Fisheries and Maritime Affairs

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1 Executive Summary

It has long been recognised that it is necessary for passive fishing gears such as set nets, drift nets, pots and longlines to be properly marked and identified and on the basis of a thorough review carried out by an Expert Consultation Group convened by the FAO in 1991 it was identified that any system of gear marking should have the following requirements:

- Provide a simple, workable and enforceable means of identifying the ownership and position of a fishing gear;
- Provide a system, which can be universally adopted.
- Aid resource management systems and meet obligations of international conventions.

There is no doubting the need for regulation for gear marking and identification within EU waters, particularly given the number and diversity of fisheries and gears being used. Simple gear marking regulations have been in place since 1987 in the EU, and Commission Regulation No. 356/2005, amended by 1805/2005 sought to improve these regulations and to achieve the aims set out by the FAO, taking account of an earlier 1967 International Convention as well as existing regulations internationally. Concerns, however, have been raised by fishermen in a number of countries about the current requirements under the regulations. A subsequent study carried out by the Irish fisheries institute, Bord Iascaigh Mhara in 2006 did highlight several practical difficulties with the existing legislation.

Based on the results of this study and notably the concerns expressed by the NWWRAC, the European Commission acknowledged the need to address the issues raised, and Bord Iascaigh Mhara were subsequently contracted to find solutions to these issues under the EU Call for Studies and Pilot Projects for carrying out the Common Fisheries Policy (FISH/2007/03/Lot No. 3).

A full review of international legislation on gear markings has been undertaken and has shown that the current EU and Norwegian regulations are among the most comprehensive and as such represent the most significant attempt to address the issue of standardisation of gear marking. On the basis of a series of interviews conducted with fishermen from Ireland, UK, France, Spain, UK, the Netherlands and Norway it was apparent that there was general agreement amongst fishermen for the need for regulations but that the detailed specifications mean that elements of both the EU and Norwegian buoys are felt to be unduly complex and expensive e.g. the need for radar reflectors and multiple lights were indicated as unnecessary by the majority of fishermen interviewed. The general view was that the regulation should be simplified to take account operating practice and cost of component parts.

Interviews were also conduced with representatives from control and enforcement agencies in the UK and Ireland. While all of these representatives indicated strong agreement with the need for standardised legislation, it was apparent there was in fact only limited compliance with the regulations and only limited attempts to enforce them by fisheries inspectors for a variety of reasons. This is the strongest possible indication that the legislation is not achieving its desired objectives in totality. In Norway it is reported that there is better compliance with the regulations by the larger longline and gillnet vessels but that radar reflectors, which are optional are not used by any vessels and lights are fitted but not always operational with the fishermen preferring to use reflective tape and searchlights to locate gear at night time.

Interviews with other marine users including the merchant shipping and marine leisure sectors indicated a slight different view of the legislation. The yacht owners interviewed felt that the legislation was useful if perhaps a little complex but felt the use of radar reflectors and lights necessary. Most of their encounters with gear markers, however, where within 12 nm so outside the scope of the current regulations The merchant seamen interviewed agreed with the

need for legislation but indicated that the actual specification of gear markers was not a major issue for them as they usually were not in a position to avoid gear markers even if they were visible given the size of the vessels in question and requirements to adhere to shipping lanes.

Taking on board the review of legislative requirements, gear marking systems currently in use, and stakeholder opinions from the interviews, a new prototype gear marking system has been developed and is suggested as an improvement to the current legislation. In the proposed prototype, the overall length and weight of the buoys has been decreased which provides an effective solution to the problems identified with the size of the original marker buoy. The requirement for marker buoys to carry radar reflectors are considered unnecessary by fishermen and this is to some degree corroborated by expert opinion from the MAIB in the UK and also by the trials carried out by BIM as part of this study. The use of lights is seen as an integral part of the buoy when gear is fishing in hours of darkness, however, the number of lights needed could be reduced. The provisions for differentiating between East and West buoys are simplified by reducing the number of flags to be used and the specifications for intermediary buoys have been adapted to take account standard practice prior to the introduction of the legislation and also safe working practices when using such buoys. Most of the other components contained within the legislation such as luminous bands, flag size and mast height are recommended to be unchanged in any new regulation.

This prototype was compared to the current regulation buoy during trials carried out by BIM in December 2008 as part of this study. These trials looked at the performance of the buoys in differing sea and weather conditions, the practical handling of the two buoys and also looked at the effectiveness of radar reflectors. These trials demonstrated that the proposed amendments to the EU regulation buoy will not interfere with the aim of the European Commission which is to provide a safe and standardised specification for net and longline marker buoys, ensuring orderly conduct of fishing operations in EU waters. The prototype buoy is approximately one third of the cost of the original regulation buoy, although is still slightly more expensive to make than simple buoys commonly used before the regulations were introduced. The need, however, to look at new technologies for the component parts of the buoys such as rechargeable batteries, solar powered LED lights and radar reflective flags is highlighted.

It is apparent from the questionnaires that many of the difficulties with the marking of gear occurs within 12 nautical miles, particularly with leisure craft and a standardised system inside and outside 12 nautical miles would be desirable. This is backed up by the gillnet focus group of the NSSRAC. It is also clear from the results of the questionnaire that some form of standardised gear marking system would be desirable for all vessels > 12 metres and this type of approach has been successfully adopted in countries such as the US and Australia. On this basis it is recommended that serious consideration be given to amending the regulation to apply to vessels over 12 metres rather than to vessels fishing outside 12 nautical miles.

No gear marking system can substitute for better communication amongst fishers. Codes of Conduct for the relaying positional information of static gears are also considered a simple and practical way of reducing gear conflicts and if respected reduce the need for very detailed gear marking regulations and an example of such a Code of Conduct in NW Donegal is described.

It is also evident in much of the other international legislation that the issue of identification of gears and tagging of individual gear components is seen as at least as important as the actual marking system used. The current EU regulation has this component included in the legislation requiring simple durable tags to be attached to gears but RFID and acoustic technologies may provide alternatives to enhance and improve the identification of gears in the future. As part of this study trials with a RFID system have been completed and indicated it possible to transmit data from tags mounted on the buoys and transmit this data to a vessel

fitted with a reader unit at a distance of between 150m to 200m from the tagged buoy. Wind and wave action had only a negligible effect on transmission distance. A number of improvements to the system have been highlighted to improve efficiency including the need for an omni-directional aerial. With these improvements it is felt that this system maybe useful for control and enforcement agencies, as well as fishermen to identify individual buoys. Acoustic detection systems may also potentially provide a means of better identifying static gears although this technology at present is untested for this purpose.

2 Background

Both Section 8.2.4 of the FAO Code of Conduct for Responsible Fishing and Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) make reference to the need for proper marking and identification of fishing gear. The Code of Conduct states, "*fishing gear should be marked in accordance with national legislation in order, that the owner of the gear can be identified. Gear marking requirements should take into account uniform and internationally recognisable gear marking systems*". The guidelines for the application of Annex V call for "*fisheries managers to utilise fishing gear identification systems which provide information such as vessel name, registration number and nationality, and encourages governments to consider the development of technology for more effective fishing gear identification*".

An Expert Consultation was convened by the FAO Committee of Fisheries in 1991 (FAO, 1991). This Group reviewed the 1967 Convention and concluded that any system of gear marking and identification should have the following requirements:

i. Provide a simple, workable and enforceable means of identifying the ownership and position of fishing gear.
ii. Provide a system, which can be universally adopted.
iii. Aid resource management systems and meet obligations of international conventions.

Some form of regulation for gear marking and identification within EU waters is therefore required, particularly given the number and diversity of fisheries and gears being used. Council Regulation (EC) No. 356/2005 seeks to address this requirement but serious issues have arisen amongst key stakeholders, such as fishermen represented by the North Western Waters Regional Advisory Council (NWRAC), on the practicality of implementing the regulation.

An assessment of the end marker buoys prescribed in the regulation was carried out by the Irish Sea Fisheries Board (BIM) (Robson *et al.,* 2006) concluded as follows:

- The costs associated with the construction and long-term operation of regulation gear marking buoys represents a large and significant increase when compared to the previous systems employed by fishermen.
- The use of substantially larger regulation gear marking buoys increases health and safety risks faced by static net fishermen, particularly in smaller vessels.
- The regulation gear marking buoys may pose a more substantial hazard to navigation than those previously in use.
- The use of regulation gear marking buoys may in fact contribute to gear losses rather than mitigate against them.

Based on the results of this study and concerns expressed by the NWWRAC (NWWRAC, 2006), the European Commission acknowledged the need to address the issues raised, and BIM were contracted to find solutions to these issues.

3 Objectives

The principal objective of this study is to carry out a review of current legislation, gear marker systems (GMS) and opinions of relevant stakeholders in order to propose practical modifications to Council Regulation (EC) No. 356/2005. The project also examines other communications and technical systems which could improve gear identification and navigational safety.

The aims of the project are:

- Examine EU fisheries affected by the regulation
- Assess EU and international legislation on GMS
- Assess current GMS and additional potential components
- Document the opinions of relevant stakeholders in relation to the practicalities of implementing the regulation
- Develop and test an alternative GMS
- Assess the practicalities of implementing the proposed modifications to the Regulation
- Examine other elements of the regulation which could be improved such as the scope and definition of passive gears.
- Examine alternative systems and new technologies which could improve gear identification systems.

The report is structured into three work packages (WPs) that deal with the current EU regulations as follows:

WP 1: Collation and assessment of legislative and technical information on gear marking systems used in EU and International Fisheries.

WP 2: Development of an alternative gear marking system

WP 3: Implementation of modified systems

In addition separate sections deal with the scope of the current regulations, the adoption of codes of conduct to avoid gear conflict and also detail possible gear identification systems that may be adopted in the future to supplement the regulations including the use of RFID tags, and acoustic detection systems.

4 Work Package 1 – Collation & Assessment of legislative & technical information

4.1 Legislation

It has long been recognised that it is necessary for passive fishing gears such as set nets, drift nets and longlines to be marked to facilitate retrieval, establish ownership and to reduce interactions with other vessels or fishing gears. As such fishermen, fisheries control officers and non fishers navigating through fishing grounds share the same objective. These groups, however, do not always agree on how best to achieve these objectives resulting in legislation which has been limited in its scope in many parts of the world. Existing national and multinational legislation adopted by cross border Fisheries Organisations covering larger management areas are summarised below. Annex 2 includes a full list of the legislation reviewed.

4.1.1 The 1967 Convention on the Conduct of Fishing Operations in the North Atlantic

The first attempt to standardise gear marking and introduce comprehensive legislation was conducted under the 1967 Convention on the Conduct of Fishing Operations in the North Atlantic (insert reference). This Convention would appear to be very much the basis for all current gear marking legislation and all subsequent regulations largely follow the guidelines agreed at this convention.

The Convention on Conduct of Fishing Operations in the North Atlantic was adopted in June 1967 following a conference involving the major fishing nations in Europe and North America. The Convention built on, and in effect replaced, an informal code of conduct agreed upon in 1882 by Great Britain, Germany, Denmark, Holland, Belgium and France originally for the purpose of regulating the North Sea Fisheries.

The requirements for Gear marking and identification agreed under the Convention are contained in Article 5, with specific details contained in Annex II and Annex IV to the Convention. Annex II Rule 1 point (4) specifies that,

> *"Small boats and, where practicable, all fishing implements shall be marked with the letter or letters and number of the fishing vessel to which they belong. The ownership of nets or other fishing implements may be distinguished by private marks".*

Annex IV specifies the following:

> "(*1) The ends of nets, lines and other gear anchored in the sea shall be fitted with flag or radar reflector buoys by day and light buoys by night sufficient to indicate their position and extent. Such lights should be visible at a distance of at least 2 miles in good visibility.*
>
> *(2) By day the westernmost (meaning the half compass circle from south through west to and including north) end buoy of such gear extending horizontally in the sea shall be fitted with two flags one above the other or one flag and a radar reflector, and the easternmost (meaning the half compass circle from north through east to and including south) end buoy shall be fitted with one flag or a radar reflector. By night the westernmost end buoy shall he fitted with two white lights and the easternmost end buoy with one white light. In addition a buoy fitted with one flag or a radar reflector by day and one white light by night may be set 70-100 metres from each end buoy to indicate the direction of the gear.*

> *(3) On such gear extending more than 1 mile additional buoys shall he placed at distances of not more than 1 mile so that no part of the gear extending 1 mile or more shall he left unmarked. By day every buoy shall be fitted with a flag or a radar reflector and by night as many buoys as possible with one white light. In no case shall the distance between two lights on the same gear exceed 2 miles.*
>
> *(4) For driftnets where the gear is attached to a fishing vessel a buoy shall not be required at the end attached to the fishing vessel.*
>
> *(5) The flagpole of each buoy shall have a height of at least 2 metres above the buoy".*

Specifically for Drift net gear Rule 2 of Annex IV states the following:

> *"(1) Nets or lines which drift in the sea shall he marked at each end and at distances of not more than 2 miles by a buoy with a pole not less than 2 metres above the buoy. The pole shall carry a flag or a radar reflector by day and a white light by night visible at a distance of at least 2 miles in good visibility.*
>
> *(2) On gear which is attached to a fishing vessel a buoy shall not be required at the end attached to the fishing vessel".*

4.1.2 European Commission

Regulations for the marking and identification of fishing gears were first introduced into EU fisheries under Article 2 paragraph 2 of Commission Regulation (EEC) No. 1381/87. This article very much followed on the general provisions within the 1967 Convention but did not specify any of the detail included within Annex IV of the Convention. Article 2 stated:

> *"Marker buoys and similar objects floating on the surface and intended to indicate the location of fishing gear shall be clearly marked at all times with the letter(s) and number(s) of the vessel to which they belong".*

This legislation remained in force until it was replaced by the current regulations under Commission Regulation (EEC) No. 365/2005, which is the subject of this study. Commission Regulation (EC) No. 356/2005 laid down more detailed rules for the marking and identification of passive fishing gear as well the identification of fishing gear with durable labels. This regulation came into force in October 2005 and requires gillnet fishermen to mark each end of their gear and also use intermediary buoys. For the purposes of this regulation, passive gear is defined as gillnets, entangling nets, trammel nets, drifting gillnets and longlines. These regulations are very detailed with a variety of components required based largely on the 1967 Convention. Figure 1 shows the specifications required. The regulations apply only to vessels fishing in Community waters outside 12 nautical miles measured from the base lines of the Coastal Member States. This regulation was enacted by the European Commission as it was felt that updating gear marking regulations was necessary for the effective monitoring and inspection of fishing activities. Buoys constructed to the specifications contained in the regulation are similar to those constructed to comply with the 1967 Convention (if constructed for deployment in both daylight and darkness). This Regulation was subsequently amended by Commission Regulation (EC) 1805/2005, which revised the frequency of deployment of intermediary marking buoys as experience gained and advice from Member States had shown that the deployment of these buoys, as required in Article 14 of Regulation No 356/2005, had caused practical difficulties in their full implementation. The amendments applied from 1 January 2006.

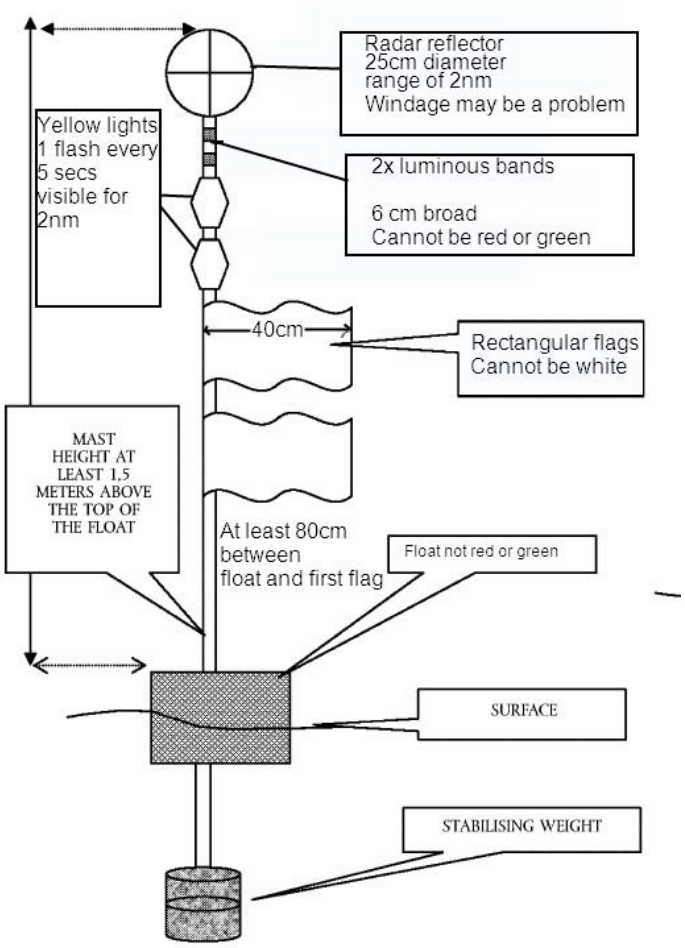

Figure 1 Western gear marking buoy.

(Eastern and Intermediary marker buoys require one less luminous band, light and flag)

4.1.3 North-East Atlantic Fisheries Commission (NEAFC)

Annex IV of the 1967 Convention is used as the basis for the gear marking requirements set out in the North-East Atlantic Fisheries Commission (NEAFC). NEAFC came into force in 1963 but was reformed in 1982 under the Convention on Future Multilateral Co-operation in the North East Atlantic Fisheries. At present NEAFC has 5 contracting parties; EU, Denmark (in respect of Faroe Islands and Greenland), Iceland, Norway and the Russian Federation. Cooperating non-contracting parties include New Zealand, Japan and Canada. The NEAFC regulatory area is FAO area 27 in international waters. This Scheme was transposed into Community law by Council Regulation (EC) no 2791/1999 of 16 December 1999 laying down certain control measures applicable in the area covered by the Convention on future multilateral co-operation in the north-east Atlantic fisheries

The provisions for gear marking and identification are included Article 6 of the NEAFC Schedule of Control and Enforcement, which came into force in July 1999. Article 6 merely states that:

> *"Each Contracting Party shall ensure that gear used by its fishing vessels in the Regulatory Area is marked consistent with the Convention on Conduct of Fishing operations in the North Atlantic signed in London on 1 June 1967"*.
>
> And that:
>
> *"Marker buoys or similar objects floating on the surface and intended to indicate the location of fixed fishing gear shall display the registration number of the fishing vessel to which they belong"*.

4.1.4 Northwest Atlantic Fisheries Organisation (NAFO)

Annex IV of the 1967 Convention is also used as the basis for gear marking requirements by the North Atlantic Fisheries Organisation (**NAFO**). Currently, NAFO has 12 Members. Canada, Cuba, Denmark (in respect of Faroe Islands and Greenland), European Union, France (in respect of St. Pierre et Miquelon), Iceland, Japan, Republic of Korea, Norway, Russian Federation, Ukraine and USA. The NAFO Convention Area encompasses a very large portion of the Atlantic Ocean and includes the 200-mile zones of Coastal States jurisdiction (USA, Canada, St. Pierre et Miquelon and Greenland). Management by NAFO, however, applies only to the areas straddling and outside the EEZs (Exclusive Economic Zones). The provisions for gear marking and identification are included in Article 17 of the NAFO Control and Enforcement Measures (include reference), which was adopted in 1979. Article 17 uses the same wording as in Article 6 of the NEAFC Control and Enforcement Schedule.

4.1.5 Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR)

The Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) came into force in 1982 and established a commission to manage the marine living resources of the continent of Antarctica and the waters surrounding it. With respect to gear marking and identification, regulations came into effect in 1998 and are almost identical to the NEAFC and NAFO provisions. Conservation measure 10-01 (1998) of the CCAMLR Convention states:

> *"All Contracting Parties shall ensure that their fishing vessels licensed[2] in accordance with Conservation Measure 10-02 to operate in the Convention Area are marked in such a way that they can be readily identified in accordance with internationally recognized standards, such as the FAO Standard Specifications and Guidelines for the Marking and Identification of Fishing Vessels"*.

And that:

> *"Marker buoys and similar objects floating on the surface and intended to indicate the location of fixed or set fishing gear shall be clearly marked at all times with the letter(s) and/or numbers of the vessels to which they belong"*.

4.1.6 South East Atlantic Fisheries Organisation (SEAFO)

The South East Atlantic Fisheries Organisation (SEAFO) is a regional fisheries management organisation in South East Atlantic Ocean established in line with the provisions of the United Nations Law of the Sea (Article 118) and United Nations Fish Stocks Agreement (UNFSA). The objective of its Convention (The Convention on the Conservation and Management of Fisheries Resources in the South East Atlantic Ocean) is to ensure the long-term conservation and sustainable use of the fishery resources in the Convention Area through the effective implementation of the Convention. The Convention Area excludes exclusive economic zones of the coastal states in the region. The Convention was signed in April 2001 in Windhoek by Angola, the European Community, Iceland, Namibia, Norway, Republic of Korea, South

Africa, United Kingdom (on behalf of St. Helena and its dependencies of Tristan da Cunha and Ascension Islands) and the United States of America. It entered into force on April 2003 after the deposit of instruments of ratification by Namibia and Norway and approval by the European Community as required under Article 27 of the Convention. States that have participated in the negotiations but have not signed the Convention are Japan, Russian Federation and Ukraine.

Interim measures relating to gear marking are included in paragraph 12 of Conservation Measure 07/06, which came into force in October 2006. They are identical to the provisions used by NEAFC, NAFO and CCAMLR given above.

4.1.7 Norway

Under Norwegian legislation, which amended the regulations relating to marine fisheries and came into force in December 2007, Chapter XVI specifies detailed regulations for the marking and identification of fishing gears.

This regulation represents the most up to date instrument for regulating Norwegian fisheries and is similar to the EU regulations, containing many of the same provisions regarding the use of radar reflectors, lights, height of buoys and use of intermediary buoys. It applies in the internal waters, territorial seas and EEZ of Norway with specific provisions outside 4 nautical miles and also in the capelin fishery. The main provisions include the following:

- All fixed and drifting gears i.e. gillnets and longlines shall be clearly marked with the registration number of the vessel and in the case of vessels where registration is not mandatory with the owner's name and address.
- If the gear has no buoys, the gear itself shall be marked.
- Outside four nautical miles during daytime, each end of the gear shall have a buoy with a stake mounted on it, equipped with a radar reflector or a flag. After sunset, each end of the gear shall have a buoy covered with light-reflecting material and a stake equipped with a light, so that the end buoys indicate the position and length of the gear.
- During the day, the marking buoy at the western end of the gear shall carry two flags, one above the other. The distance between the flags shall be at least 25 cm. A radar reflector may be used instead of the top flag. After sunset, the buoy shall be equipped with two lights. The distance between the lights shall be at least 50 cm. The marking buoy at the eastern end of the gear shall carry one flag and again a radar reflector may be used instead of the flag. After sunset, the buoy shall be equipped with one light.
- The distance between the marking buoys on fixed gear shall not exceed one nautical mile. Gear that is longer than one nautical mile shall have one or more intermediate marking buoys between the end buoys. For drifting gear intermediary buoys should be used every two nautical miles.
- The stake mounted on a marking buoy shall reach a height of at least 2 m above the waterline. The buoy, stake or top marking shall be equipped with light-reflecting material such that light is reflected in all directions.
- The light on the stake of a marking buoy shall be yellow and shall be visible at a distance of at least two nautical miles in good visibility and in the dark. The light may either be illuminated the whole time, and of constant brightness, or a flashing light. It is not permitted to use both constant and flashing lights on the same buoy. Flashing lights shall flash between 20 and 25 times a minute. If two flashing lights are used on the same marking buoy, these shall be synchronised so that they flash in time with each other.
- In areas less than four nautical miles from the baselines at times when fishing for capelin using trawls and purse seines can be expected to be in progress, Vessels of a length under 35 feet may use stakes that reach a height of at least 1 m above the marking buoys but it is prohibited to use floating marker lines between the buoys and the upper third of the marker line.

- Buoys, including lights, light-reflecting material and radar reflectors, used by Norwegian vessels shall be type approved by the Directorate of Fisheries.

Figure 2 below shows the specific provisions for the eastern and western buoys.

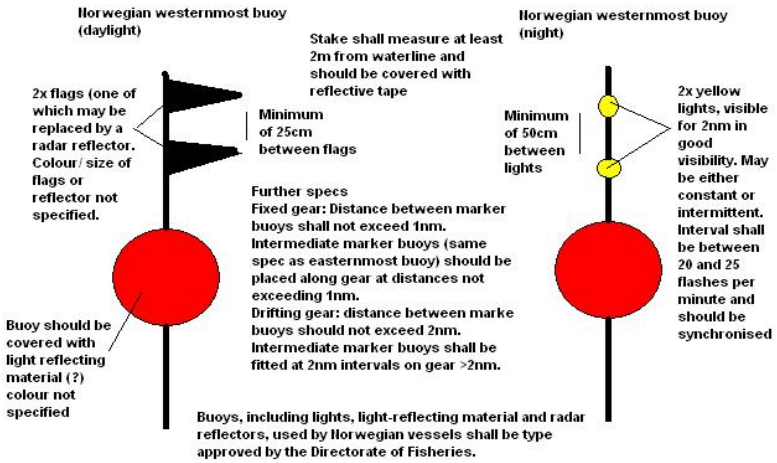

Figure 2 Norwegian eastern and western buoys

4.1.8 Iceland

In Iceland there are specific gear marking regulations for anchored bottom set nets targeting cod. These provisions are contained in Regulation No. 115 of 13 February 2006. Paragraph 4 states that all anchors for set nets must be marked with the district registration and number of the boat. Buoys must be fixed at both ends of the nets and buoys must be marked clearly with district registrations and the number of the boat. Paragraph 5 states that the buoy attached at the west end of the nets must be marked with a net-ring (a floating ring ~ 20 cm in diameter). If nets are set in an area where bottom trawling also occurs the west end buoy must be marked with one white blinking light. No other specific provisions were found.

4.1.9 Faroe Islands

Under Faroese Fishery Regulations static and drift nets as well as longlines and pots must be marked with buoys with the harbour registration number. All end buoys must have a mast of 15m with a flag on the end. This flag must also be marked with the harbour registration number. If the boat is recreational craft the buoys must be marked with the name and address of the owner. For small scale fisheries for lobster with pots the east end must be marked with one flag and the west end with two flags.

4.1.10 Canada

Regulations for gear marking and identification in Canada are contained in the Fisheries Act (SOR/93-53) Fishery (General Regulations). The regulations are fairly general and other than specific requirements for numbering of buoys are not specific in terms of types of marking systems used. The latest edition of this regulation came into force in January 2008 and the relevant provisions are included in Part III paragraph 27. The main provisions are as follows:

- No person shall set, operate or leave unattended in the water any fishing gear other than mobile gear or handlines unless the gear is marked with the vessel registration number as set out in the licence authorizing the use of that gear or in any other case, the name of the person who owns the gear.

- The vessel registration number or name shall be painted on or otherwise securely affixed to a tag, float or buoy attached to the gear and be legible and readily visible at all times without the necessity of raising the gear from the water or, where the water is ice covered, without the necessity of removing any snow or ice.
- The numerals in a vessel registration number shall be solid block Arabic numerals without ornamentation; not less than 75 mm in height; and in a colour that contrasts with their background. In the case of an owners name block capital letters in Roman characters should be used.
- In tidal waters where one end of the fishing gear is fastened to the shore, a buoy shall be affixed to the end of the gear farthest from the shore; and in any other case, be affixed to each end of the gear.
- No person shall display any number, name or validation tab on fishing gear or on a tag, float or buoy attached to fishing gear that is so similar to a number or name required as to be capable of being mistaken for any such number, name or validation tab.

There are specific provisions for gillnets used to target Pacific salmon as follows:

- Buoys shall be orange in colour and at least 125cm in circumference.
- The end of the gillnet not attached to the vessel shall be marked with a light that gives a steady white light during the period beginning one hour after sunset and ending one hour before sunrise.

There are also specific provisions for the roe herring gillnet fishery as follows:

- Buoys shall be at least 125cm in circumference and of the same colour.
- The validation tab issued with the licence under which the gillnet is being used shall be attached to a buoy that is attached at one end of the gillnet.

4.1.11 USA

The Magnuson-Stevens Fishery Conservation and Management Act of 1996 (reference) is the framework for US fishery management. State and federal legislation under the Magnuson-Stevens Act is enacted through eight US Fishery Council Areas. Within each of these areas, there are a vast number of quite diverse gear marking regulations in place. Many of these concentrate more on the physical tagging of individual pots and nets and merely require buoys to be marked with the vessel identification details and licence numbers with no specification requirements for the buoys used. Others are more prescriptive and give detailed specifications. One other piece of gear marking legislation has a completely different purpose than control and enforcement in that it seeks to use gear markers as a way to protect marine mammals. The most relevant of these by Council area are summarised below although it should be noted this may not necessarily be definitive.

4.1.11.1 NEW ENGLAND COUNCIL

The New England Fishery Management Council covers the States of Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut and has authority over the fisheries in the Atlantic Ocean seaward of such States.

The majority of the regulations regarding gear marking are specific to all areas of the Council areas and the following are the main points of the legislation by fishery.

NE Atlantic Multispecies & Monkfish

Bottom-tending fixed gear, including, but not limited to, gillnets and longlines fishing for multispecies or monkfish are covered under New England State Regulation 648.48. This regulation stipulates the following:

- Buoys must have the name of the owner or vessel or the official number of that vessel permanently affixed to any buoys, gillnets, longlines, or other appropriate gear so that the name of the owner or vessel or the official number of the vessel is visible on the surface of the water.
- Bottom-tending fixed gear, must be marked so that the westernmost end (measuring the half compass circle from magnetic south through west to, and including, north) of the gear displays a standard 12-inch (30.5-cm) tetrahedral corner radar reflector and a pennant positioned on a staff at least 6 ft (1.8 m) above the buoy. The easternmost end (meaning the half compass circle from magnetic north through east to, and including, south) of the gear need display only the standard 12-inch (30.5-cm) tetrahedral radar reflector positioned in the same way.
- Continuous gillnets must not exceed 6,600 ft (2,011.7 m) between the end buoys.
- Gillnet gear set in an irregular pattern or in any way that deviates more than 30° from the original course of the set must be marked at the extremity of the deviation with an additional marker, which must display two or more visible streamers and may either be attached to or independent of the gear.

NE Atlantic Red Crab Fisheries

Gear marking requirements for red crab pot fisheries in the north east Atlantic are covered under Regulation 648.264. This stipulates the following:

- The letters “RC” in letters at least 3 inches (7.62 cm) in height must be painted on top of each buoy.
- The vessel's permit number in numerals at least 3 inches (7.62 cm) in height must be painted on the side of each buoy to clearly identify the vessel.
- The number of each trap trawl relative to the total number of trawls used by the vessel (i.e., “3 of 6”) must be painted in numerals at least 3 inches (7.62 cm) in height on the side of each buoy.
- High flyers and radar reflectors are required on each trap trawl.

Cape Cod Bay Critical Habitat Restrictions

The gear marking requirements in the Eastern US Federal waters covered by the New England Council are also driven by the Atlantic Large Whale Take Reduction Plan (ALWTRP). This plan was developed by the National Marine Fisheries Service in 1997 to reduce the level of serious injury and mortality of three strategic stocks of large whales (North Atlantic right, humpback, and fin) in commercial gillnet and trap/pot fisheries. The plan consists of various measures such as time/ area closures and gear modifications such as incorporating weak links into buoy lines.

The specific gear marking component of the plan specifies that:

- Lobster trap gear and gill net gear set within specified areas must be marked with two colour codes, one designating the gear type, the other indicating the area where the gear is set. Each colour of the two-colour code must be permanently marked on or along the buoy line or lines.
- Each colour mark of the colour codes must be clearly visible when the gear is hauled or removed from the water.
- Each mark must be at least 4 inches (10.2 cm) long. The two colour marks must be placed within 6 inches (15.2 cm) of each other.
- If the colour of the rope is the same as or similar to a colour code, a white mark may be substituted for that colour code. In marking or affixing the colour code, the line may be dyed, painted, or marked with thin coloured whipping line, thin coloured plastic, or heat-shrink tubing, or other material; or a thin line may be woven into or through the line; or the line may be marked as approved in writing by the Assistant Administrator of the plan.
- In addition surface buoys should be marked to identify the vessel or fishery with either the owner’s motorboat registration number, or U.S. vessel documentation

number, the federal commercial fishing permit number, or whatever positive identification marking is required by the vessel's home-port state.
- The letters and numbers used to mark the gear must be at least 1 inch (2.5cm) in height, block letters or Arabic numbers, and in a colour that contrasts with the colour of the buoy.

Massachusetts

Under Division of Marine Fisheries Massachusetts Regulation 322 the following minimum requirements apply to the marking of fixed gear within 12 nautical miles of the Massachusetts coast.

- For gillnets the east end must be marked with a high flyer and standard 12-inch tetrahedral corner radar reflector; the west end shall be marked with a high flyer with flag and a standard 12-inch tetrahedral corner radar reflector.
- For pots the east end must be marked with a double buoy, consisting of any combination of two 7" x 7" or 5" x 11" buoys and one or more three foot sticks. The west end of a pot trawl shall be marked with a single 7" x 7" or 5" x 11" buoy with a three foot stick and a flag. Single pots shall each be marked with a single 7" x 7" or 5" x 11" buoy. Sticks are optional, but if used, must not have a flag attached.
- All buoys used to mark all fixed gear shall be permanently and visibly marked or branded with the permit number of the owner.

4.1.11.2 MID-ATLANTIC COUNCIL

The Mid-Atlantic Fishery Management Council consists of the States of New York, New Jersey, Delaware, Pennsylvania, Maryland, Virginia, and North Carolina and has authority over the fisheries in the Atlantic Ocean seaward of such States.

The following are some of the regulations currently in force in this region.

Virginia

Under Virginia state regulations 4 VAC 20-430-20 and 4 VAC 20-430-55 the following marking requirements are specified for gillnets and drift nets:

- One end of each gill net shall be marked by a flag of square dimensions, which shall measure at least 144 square inches.
- The end of each gill net opposite the square flag marker shall be marked by either a triangular flag of at least 144 square inches or a floating ball of at least 50 inches circumference.
- Each flag shall be supported on a staff sufficient to maintain the bottom of the flag at least three feet above the surface of the water. The end-marker flags on the same net or flag and floating ball on the same net shall be of identical colour.

Under regulation 4 VAC 20-430-30 the following marking requirements are specified for staked gillnets:

- All flag staffs shall be marked with two stripes of two-inch wide reflective material that shall be visible from all sides;
- All end-marker floating balls shall be marked on three sides with patches of approximately two-inch by two-inch reflective material that shall be visible from all sides above the water line.

New Jersey

Gear Marking regulations specified by the New Jersey Division of Fish & Wildlife Marine Fisheries Administration specify the following:

- All gear (except purse seines and crab dredges) must be legibly and indelibly marked with the gear identification number (ID) of the owner.
- Stakes used to mark the various nets shall be marked with at least one of the following which shall be placed at least 2 feet above mean high water and be visible from all sides: reflectors of not less than 2 inches in diameter; reflecting tape not less than 2 inches in width; light coloured flags not less than 2 feet square; or light coloured jugs or buoys not less than 12 inches in diameter.
- In addition to the general gear marking requirements, drifting gill nets shall be marked at each end with a fluorescent orange float at least 12 inches in diameter or a fluorescent orange flag at least 12 inches square and suspended at least three feet above the water.
- A white float measuring at least eight inches in diameter shall be located approximately 20 feet inside of each end marker.
- In addition to the general gear marking requirements, staked and anchored gill nets shall be marked at the end of a net or series of nets with a fluorescent orange float at least 12 inches in diameter or a fluorescent orange flag at least 12 inches square and suspended at least three feet above the water. A white float measuring at least eight inches in diameter shall be located approximately 20 feet inside of each end marker.
- Lobster, Fish and Conch pots should be marked at both ends with a buoy. All gear must be legibly and indelibly marked with the gear identification number (ID) of the owner.

New York State

Part 44.2 of the Fish and Wildlife Act of New York State Department identifies gear marking regulations for pot fisheries as follows:

- All pots or traps, while in operation, must have a floating buoy or identification marker attached which must be constructed and placed as to be clearly visible on the surface of the water. Plastic containers, bottles or jugs originally designed to contain liquids must not be used as buoys or markers to identify the location of lobster pots or traps.
- Each buoy or marker attached pot or trap must be of a distinctive colour and have the permit number of the owner painted or otherwise affixed on each buoy or marker in a contrasting colour, or branded on each buoy or marker, in clearly visible characters not less than two inches in height. The same colour or combination of colours must be used on all buoys or markers bearing the same permit number.
- The same number appearing on a buoy or marker shall also be marked or branded, in characters not less than three-fourths inch in height, on all pots or traps identified by that buoy or marker.
- Pots shall not be placed within 25 feet of designated navigation channels, and all floating buoys or identification markers and lines attached to such pots shall remain outside designated navigation channels at all times.

4.1.11.3 SOUTH ATLANTIC COUNCIL

The South Atlantic Fishery Management Council consists of the States of North Carolina, South Carolina, Georgia, and Florida and has the authority over the fisheries in the Atlantic Ocean seaward of these states.

Only several regulations for fisheries off Florida covered by the South Atlantic Council were considered relevant in this region. The main provisions of these are summarised below:

- For all pot fisheries a buoy must be attached to each stone crab trap or at each end of a string of traps. Each buoy must display the official number and the color code assigned by the RA so as to be easily distinguished, located, and identified.

The owner or operator of a vessel that is used to harvest spiny lobsters in the EEZ other than off Florida must meet the following vessel and gear identification requirements:

- A buoy or timed-release buoy of such strength and buoyancy to float must be attached to each spiny lobster trap or at each end of a string of traps.
- A buoy used to mark spiny lobster traps must bear the vessel's assigned colour code and be of such colour, hue, and brilliancy as to be easily distinguished, seen, and located.
- A buoy used to mark spiny lobster traps must bear the vessel's Florida crawfish license or trap number or, if not licensed by Florida, the vessel's Federal vessel permit number in numbers at least 2 inches (5.08 cm) high.
- A spiny lobster trap must bear the vessel's Florida crawfish license or trap number or, if not licensed by Florida, the vessel's Federal vessel permit number permanently and legibly affixed.

4.1.11.4 CARIBBEAN COUNCIL

The Caribbean Fishery Management Council consists of the Virgin Islands and the Commonwealth of Puerto Rico and has authority over the fisheries in the Caribbean Sea and Atlantic Ocean seaward of such States.

There are several provisions for gear marking under regulations from the Caribbean Fishery Management Council as follows:

- All fish traps or spiny lobster traps used or possessed in the Caribbean, Gulf and South Atlantic EEZ's must display the official number specified for the vessel by Puerto Rico or the U.S. Virgin Islands so as to be easily identified.
- All buoy attached to a trap or pot must display the official number and assigned colour code of the vessel.
- Traps or pots used in the Caribbean spiny lobster or Caribbean reef fish fisheries that are fished individually or tied together in a trap line, must have at least one buoy attached that floats on the surface.
- Each buoy must display the official number and colour code assigned to the vessel by Puerto Rico or the U.S. Virgin Islands, whichever is applicable.
- In the South Atlantic EEZ, buoys are not required to be used, but, if used, each buoy must display the official number and colour code assigned by the RA. However, no colour code is required on a buoy attached to a golden crab trap.
- In the Spanish mackerel gillnet fishery the float line of each gillnet possessed, including any net in use, must have a maximum of nine distinctive floats, i.e., different from the usual net buoys, spaced uniformly at a distance of 100 yd (91.4 m) or less. Each such distinctive float must display the official number of the vessel.

4.1.11.5 GULF COUNCIL

The Gulf of Mexico Fishery Management Council consists of the States of Texas, Louisiana, Mississippi, Alabama, and Florida and has authority over the fisheries in the Gulf of Mexico seaward of such States.

Texas

Under regulations from the Texas Park and Wildlife Service the following gear marking requirements are specified:

- Static Gears must be marked with yellow flagging attached to stakes or with a yellow floating buoy not less than 6 inches in height and 6 inches in width, attached to end fixtures. Floats must be yellow. Buoys or floats may not be made of plastic bottle(s) of any color or size.
- Crab pots must be marked with a white floating buoy not less than 6 inches in height, 6 inches in length and 6 inches in width. Buoys must be marked with a commercial crab fisherman's license plate number in letters of a contrasting colour at least 2 inches high attached to the trap. Buoys or floats may not be made of plastic bottle(s) of any colour or size.

Louisiana

Under regulations from the Louisiana Department of Wildlife and Fisheries Department all crab traps must be marked with a solid float, six inches in diameter or greater, attached with a non-floating line 1/4 inch minimum diameter or better.

Mississippi

Under regulations from the Mississippi Department of Marine Resources all crab trap floats must be visibly marked with the corresponding commercial or recreational crab license number. In addition, all crab traps fished from a boat must also be marked with the vessel's Mississippi registration number. A crab trap float line must be of non-floating or weighted material and easily cut with a knife. All floats must measure 6 inches in diameter. It is illegal to place any crab trap so that the trap, the trap line or float is in any navigable waterway and interferes with normal boat traffic.

Florida

The Florida Fish and Wildlife Conservation Committee specify that for gill nets used in the federal gill net fishery must be marked at each end with the SPL number of the vessel operator or vessel from which it is deployed. Seines must be tended and marked with the SPL number at each end. Specifically for black sea bass traps, the owner's license number must be permanently attached to the trap and each buoy attached to such trap shall have the letter "B" and the owner's saltwater products license number affixed to it in legible figures at least 1.5 inches high.

4.1.11.6 PACIFIC COUNCIL

The Pacific Fishery Management Council consists of the States of California, Oregon, Washington, and Idaho and has authority over the fisheries in the Pacific Ocean seaward of such States.

WASHINGTON

The Washington Department of Fish and Wildlife stipulates crab buoy and pot tagging requirements under regulation WAC 220-52-040. This states that:

- Every shellfish pot used in the coastal Dungeness crab fishery must bear a tag that identifies either the name of the vessel being used to operate the pot or the Dungeness crab fishery license number of the owner of the pot, and the telephone number of a contact person.
- In the Puget Sound, all crab pots must have a durable, non-biodegradable tag securely attached to the pot and permanently and legibly marked with the license owner's name or license number, and telephone number.

Oregon

The Oregon Department of Fish and Wildlife Fisheries Division have fairly broadly regulations and merely specify that, "*Pot and longline gear which is fixed or anchored to the bottom shall not be left unattended for more than seven days. Longline and pot gear shall be marked at each terminal surface end with a pole and a flag, light, and radar reflector, and buoy showing clear identification of the owner or operator*".

Specific regulations are also stipulated for vertical hook-and-line gear that state that such gear that is closely tended may be marked only with a single buoy of sufficient size to float the gear.

4.1.11.7 NORTH PACIFIC COUNCIL

The North Pacific Fishery Management Council consists of the States of Alaska, Washington, and Oregon and has authority over the fisheries in the Arctic Ocean, Bering Sea, and Pacific Ocean seaward of Alaska.

Alaska

The main gear marking regulations in the North Pacific Council Area are specified for Alaskan fisheries for Red Crab, Dungeness Crab, Tanner Crab, gillnet and longline fisheries.

For red crab Regulation 5AAC 34.051 specifies:

- At least one buoy on each king crab pot or ring net must be legibly marked with the permanent ADF&G vessel license plate number of the king crab vessel operating the gear.
- The buoy must bear only the number of the vessel used in operating the gear. The number shall be painted on the top one-third of the buoy in numerals at least four inches high, one-half inch wide, and in a colour contrasting to that of the buoy.
- The buoy markings must be visible on the buoy above the water surface when the buoy is attached to the crab pot.
- In registration areas where a king crab pot limit is in effect, each king crab pot must have one identification tag issued by the department placed on the main buoy or on the trailer buoy if more than one buoy is attached to the pot.

For Dungeness crab regulation 5AAC 34.051 specifies:

- Each Dungeness crab pot or ring net must have at least one buoy. At least one buoy on each Dungeness crab pot and at least one buoy on each Dungeness crab ring net must be legibly marked with the permanent ADF&G vessel license plate number of the vessel operating the gear.
- The buoy must show only that number. The number must be in symbols that are at least one and one-half inches high, and the symbols must have lines that are at least one-quarter inch wide and that are in a shade or colour that contrasts with the background.

For Tanner Crab Regulation 5AAC 35.051 specifies:

- At least one buoy on each Tanner crab pot or ring net must be legibly marked with the permanent ADF&G vessel license plate number of the Tanner crab vessel operating the gear.
- The buoy must bear only the number of the vessel used in operating the gear. The number shall be painted on the top one-third of the buoy in numerals at least four inches high and one-half inch wide, in a colour contrasting to that of the buoy.
- The buoy markings must be visible on the buoy above the water surface when the buoy is attached to the crab pot.

For gillnet fisheries Regulation 5AAC 39.280 specifies:

- The owner or operator of a set gillnet in operation shall have at each end of the set gillnet a red keg, buoy, or cluster of floats, or, in the case of set gillnets anchored to land, shall have a red keg, buoy, or cluster of floats at the outer end of the net.
- The kegs, buoys, or clusters of floats must be plainly and legibly marked with the fisherman's five-digit CFEC permit serial number.
- Longlines marker buoys carried on board or used by any vessel regulated under this part shall be marked with the vessel’s name; Federal fisheries permit number; or ADF&G vessel registration number.
- Markings shall be in characters at least 4 inches (10.16 cm) in height and 0.5 inch (1.27 cm) in width in a contrasting colour visible above the water line and shall be maintained so the markings are clearly visible.

4.1.11.8 WESTERN PACIFIC COUNCIL

The Western Pacific Fishery Management Council consists of the States of Hawaii, American Samoa, Guam, and the Northern Mariana Islands and has authority over the fisheries in the Pacific Ocean seaward of these states and Commonwealths.

Gear marking regulations as laid down by the Western Pacific Fisheries Management Council are specified for longlines, crustacean and coral reef fisheries as follows:

- For longlines the operator of each permitted vessel in the fishery management area must ensure that the official number of the vessel be affixed to every longline buoy and float, including each buoy and float that is attached to a radar reflector, radio antenna, or flag marker, whether attached to a deployed longline or possessed on board the vessel. Markings must be legible and permanent, and must be of a colour that contrasts with the background material
- For crustaceans the vessel's official number must be marked legibly on all traps and floats maintained on board the vessel or in the water by that vessel.
- For coral reef fisheries the vessel number must be affixed to all fish and crab traps on board the vessel or deployed in the water.

4.1.12 Australia

The marking of fishing gear in Australian waters is the responsibility of the various state fishery agencies and the Australian Fisheries Management Authority (AFMA). The state fishery agencies manage fisheries to the 3 nautical mile mark from the shoreline and AFMA manages all Commonwealth fisheries which are usually past the 3nm mark. Within New South Wales, Queensland, Western Australia and Tasmania the following gear marking regulations have been found.

New South Wales

In New South Wales there are specific regulations requiring the dimensions of buoys under Fisheries Management (General) Regulations of 2002 as follows:

- The position of fish traps must be indicated by a buoy which is moored so as to be positioned above the trap, and has a diameter above the water of not less than 150 mm, and a weight of not less than 500 gm suspended not less than 5 metres under the float so that no rope is floating on the surface of the water. Buoys must displays “FL” followed by the commercial fishing licence number of the commercial fisher who set the trap and “F” at the end of that number, in clearly visible letters and figures which are not less than 50 mm in height and are of a colour which contrasts with that of the buoy

- The position of a lobster trap must be indicated by a buoy which is moored so as to be positioned above the trap, and has a diameter above the water of not less than 100 mm, and has a weight of not less than 50 gm suspended not less than 1.5 metres under the float so that no rope is floating on the surface of the water. Buoys must display the words “L” followed by the name of the person who set the trap, in clearly visible letters which are not less than 50 mm in height and are of a colour which contrasts with that of the buoy.

- The position of crab traps must be indicated by a buoy which is moored so as to be positioned above the trap, and has a diameter above the water of not less than 100 mm, and a weight of not less than 50 gm suspended not less than 1 metre under the float so that no rope is floating on the surface of the water. Buoys used by a commercial fisher must display the words “FL” followed by the commercial fishing licence number of the commercial fisher who set the trap and “C” at the end of that

number, in clearly visible letters and figures which are not less than 50 mm in height and are of a colour which contrasts with that of the buoy, and in the case of any other trap-displays the words “CRAB TRAP” followed by the name of the person who set the trap, in clearly visible letters which are not less than 50 mm in height and are of a colour which contrasts with that of the buoy.

- The position of eel traps must be indicated by a buoy which is moored so as to be positioned above the trap, and has a diameter above the water of not less than 100 mm, and has a weight of not less than 50 gm suspended not less than 1 metre under the float so that no rope is floating on the surface of the water. Buoys must display the letters “LFB” followed by the licence number of the boat used to set the trap and “E” at the end of that number, in clearly visible letters and figures which are not less than 50 mm in height and are of a colour which contrasts with that of the buoy.

- Both ends of a set net must be marked on the surface of the water by a white buoy displaying, in clearly visible figures and letters that are not less than 50 mm in height, the letters “FL” followed by the commercial fishing licence number of the fisher who set the net, followed by the letter “M”. The buoy is to have a diameter above the water of not less than 300mm and a weight (of not less than 50 grams) attached to the rope connecting the buoy and the net. The weight is to be suspended not less than 1.5 metres under the buoy.

- For all gears the net or gear must be identified by having securely attached to a part of the net or gear which is at or above water level a tag with dimensions of at least 80 mm by 25 mm on which are legibly and durably displayed in capital letters the person’s name and licence number.

Queensland

Under the Queensland Fisheries Regulations of 2008 there are general provisions for the marking of set nets as follows:

- A set mesh net used during the day must be marked by light coloured floats not more than 20m apart along its length; and a white float, at least 15cm in any dimension, with the person’s name written on it at its end farthest from the shore.
- A set mesh net used at night must also be marked be if the combined length of the net and equipment used in setting it is not more than 50m.
- A white light, visible at least 400m in all directions from the light, at its end farthest from the shore; and a reflectorised float, at least 15cm in any dimension, at its end nearest the shore.
- A set mesh net used in offshore waters must be marked by 6 floats along its length, each not less than 15cm in any dimension and a pole with an orange flag on it at least 2m above the water attached to its end farthest from the shore.

There are also provisions for marking crab pots as follows:

- Crab pots must have a tag with the owner’s name written on it or be marked with the boat mark for the owner’s primary boat.

- If the crab pot is not fixed to something while it is being used, the pot must have attached to it a light coloured float that is at least 15cm in all it dimensions; and is marked with the boat mark for the primary boat of the owner of the pot.

Western Australia

Under Western Australia legislation, identification of rock lobster pots by floats is stipulated as follows:

- A rock lobster pot is attached to a surface float that has a diameter of not less than 150 millimetres if the float is spherical and has a length of not less than 200 millimetres and a width of not less than 100 millimetres; and is marked by branding or stamping with legible characters not less than 60 millimetres high and not less than 10 millimetres wide showing in the licence holders name and boat

There are also regulations regarding the use of drift nets that specify that "*A surface fishing net must have end floats of at least 150 millimetres in diameter clearly marked with the licensed fishing boat number of any boat used in connection with the net*"

Tasmania

In Tasmania there are specific requirements for marking gillnets. These regulations stipulated that gillnets must be marked with a white buoy of at least 195mm in diameter at each end and the buoy must be specifically designed as a buoy and float on the surface of the water. The buoys can be marked with no other markings other than the licence number and the marks should be in figures not less than 70 mm high and 12 mm wide.

4.1.13 New Zealand

Under the 1996 Fisheries Act in New Zealand the requirements for marking of fishing vessels and fishing gear for identification in accordance should be uniform and internationally recognizable vessel and gear marking systems, such as the Food and Agriculture Organization of the United Nations Standard Specifications for the Marking and Identification of Fishing Vessels.

4.1.14 Japan

No official references to Japanese gear marking legislation could be found but a reference to State Regulations for freshwater fisheries commencing in 2002 was found at the Yaska fishing company website (www.yaskafishing.com). According to this source nets shall be marked as follows:

- All gill nets set in depths greater than fifteen feet shall have a staff buoy at each end with at least four feet exposed above the surface of the water with a red or orange flag no less than twelve inches by twelve inches bearing the license number of the fisher and affixed to the top of the staff.
- Any gill net or portion of a gill net set in water less than fifteen feet deep shall have: a red or orange float not less than one gallon in size, or a red or orange PVC float that is at least six inches by fourteen inches inn size, on each end that is in water less than fifteen feet deep. The floats at the ends of the net shall bear the license number of the fisher.
- In addition, each such net shall also have either an additional float of the size described above spaced every three hundred feet or less along the length of the net that is in water less than fifteen feet
- Standard commercially available fluorescent orange floats at least one and one-half inches by four inches in size along the coralline not less than every twelve feet in water less than fifteen feet.

4.1.15 Namibia

Under the Namibian Marine Resources Act, 2000, Part VIII paragraph 38 and Annex O stipulate that, "*The holder of a licence under which a fishing vessel operates must ensure that*

all fishing gear set in the sea and not attached to the fishing vessel is clearly marked in accordance with the requirements set out as follows":

- For gill nets, set nets, drift nets, longlines, drifting longlines each and every buoy used for setting any of the aforementioned gear must be marked with the licence or permit registration number assigned to the vessel utilising the gear;
- The identification mark must be in block lettering and numbering throughout letters and numbers must be as large as the surface of the buoy permits.
- The identification marks must be in either white or black, whichever colour gives the higher contrast to the colour of the buoy and good quality paints must be used for applying the identification marks. The identification marks and the surrounding background must be maintained in a good condition at all times.
- Each trap used in either rock lobster or crab fishing must have firmly clipped onto it a non-removable tag of a minimum size of 30 by 60 mm made of non-corrodible material into which either the name or an abbreviation of the name of the person or company utilizing the trap has been stamped.

4.2 Comparison of Legislation

It is apparent from this review of International gear marking legislation that the current European and Norwegian regulations, which are adapted from the 1967 Convention and take account of FAO Report No. 485 are the most comprehensive sets of regulations in place globally. As such they represent the most significant attempt to address the issue of standardisation of gear marking in one specific regulation. This is in contrast to the approach taken in the US and Australia where there are a large number of specific regulations applied to specific fisheries or gear types, many dealing with small scale pot fisheries that are not covered by the EU regulations. The provisions of these regulations vary markedly from area to area. Therefore, in making a critical analysis of the present EU buoys, the Norwegian and 1967 Convention seem of most relevance although there are elements of some international legislation that is worth noting. Table 1 below summarises the main provisions of the EU, Norwegian and the 1967 Convention, a full comparison is given in Annex 7.

Table 1 Comparison of marker buoy specifications from the most relevant regulations/ Conventions

	EC 356/2004 (Westernmost buoy)	**1967 Convention (Westernmost buoy for use in both daylight and darkness)**	**Norway 2007 (westernmost buoy for use in both daylight and darkness)**
Mast height above sea level	1.5m	2m*	2m
Mast material	Not specified	Not specified	Not specified
Float specification	Not red or green	None	None
Reflectivity	2x luminous bands (6cm width)	None	Yes but no spec
Flag(s)	2x flags	2x flags**	2x flags**
Light(s)	2x lights	2x lights	2x lights
Light specifications	Yellow, 1 flash every 5 secs, visible for 2nm	White, visible for 2nm	Yellow, visible for 2nm***
Radar reflector	Required	Required but may be substituted for topmost flag	Required but may be substituted for topmost flag
Vessel ID	Vessel reg on buoy	Vessel reg on buoy	Vessel reg on buoy
Type approval required	No	No	Yes

*above float

**or 1 flag and radar reflector

*** Both must be either constant or flashing. If flashing must be synchronised

Comparing these three regulations there are obvious commonalities between them with all three requiring:

- Vessel registration details to be put on the buoy;
- The use of lights (slight differences in the specifications);
- Differentiation of eastern and western buoys;
- The use of intermediary buoys; and
- Specifications regarding the height of the mast above the sea surface.

In contrast only the EU regulations make the use of radar reflectors mandatory and give detailed specifications for such radar reflectors. Radar reflectors are similarly required in specific gillnet fisheries in New England and Massachusetts but in no other regulations reviewed. In both the Norwegian and 1967 Convention the use of radar reflectors is optional.

The 1967 Convention does not prescribe the dimensions and colour of the flags used or has no provision for the use of reflective tape, where as these are both well defined in both the EU and Norwegian regulations. It is worth noting that the size and colour of flags are also defined in regulations from a number of other countries, which also give minimum dimensions and colours for buoys used. Neither the EU and Norwegian regulations mention buoy size but the EU legislation does refer to colour.

The Norwegian regulations require the components to be type approved but no other legislation includes this provision. According to an inspector in the Norwegian Directorate in practice this is not enforced currently (Norwegian Fisheries Directorate., pers. comm.).

It is also apparent in much of the other international legislation looked at that the issue of tagging individual gear components is seen as at least as important as the actual marking system used. Only the current EU regulations has this component included in the legislation but is less prescriptive than many of the international regulations, particularly the US and Australia. While this issue is largely outside the scope of this project, reference is made to it in Section 8.

4.3 Gear Marking Systems

4.3.1 Pre Regulation Gear marking systems

Static gear such as gillnets and longlines generally fall into 2 categories; short soak time and long soak time. For short soak time fisheries, gear is usually shot and hauled within a 24 hour period. Good example of this are gillnet and longline fisheries for hake. The quantity of gear that vessels engaged in short soak fisheries can carry is limited by the length of gear it is possible to shoot and haul within 24 hours. Vessels usually remain close by their gear when it is deployed and maintain a watch for possible threats in the form of other fishermen, especially active gear vessels. When a trawler is identified using radar etc. it is hailed and generally an attempt is made to relay the coordinates of the gear although language can be issue. When such vessels return to port they generally haul all their gear thereby reducing the likelihood of damage to untended gear. The necessity for sophisticated gear marking systems for such vessels is limited, given that the gear is nearly always tended by the owner.

Long soak time fisheries are usually associated with tangle net or trammel net fisheries and because of the length of the gear it is usually not possible for the vessel to carry all of it on board at any one time. An example of such a fishery is the deepwater monkfish tangle net fishery. It is therefore necessary for the vessel to make several trips in order to deploy and haul all its gear on the ground. Consequently the vessel must leave gear in the water while returning to port. Unattended static gear is at increased risk of damage by towed gear. In order to reduce the risk of gear damage, coordinates are relayed amongst other vessels in the vicinity but generally this is restricted to vessels from the same port or nationality. In these fisheries the necessity of sophisticated gear marking systems is much higher as the gear is by its nature much longer and can be left unattended for periods of time.

Specifications of gear marking systems used in different fisheries by 9 countries prior to the introduction of the Council Regulation are outlined Annex 3. This information was obtained from fishing gear suppliers and from interviews with fishing vessel owners. Although not referred to in the regulation, details of gear marking systems used in several large-scale trap/pot fisheries are included for comparison purposes. As indicated above basic marker buoy systems which are cheap to construct and carry few components, are used in fisheries where there is a high probability of losing them through collisions or interactions with other vessels, for example Irish and UK gillnet fisheries. More sophisticated and robust marker buoy systems tend to be used by large vessels travelling relatively long distances from home and/or operating in relatively deep water, for example monkfish tangle net fisheries off the west coast of Ireland. The basic components used in GMS across all fisheries prior to legislation can be described as follows:

4.3.1.1 Mast Components

Masts

The mast heights above sea level included in the tables in Annex 3 are generally half the size of the total length of the mast (above and below sea level). Heights (above sea level) varied from zero in some fisheries where gear markers are limited to buoys only, up to 3m in various other offshore fisheries. Bamboo was the principal material used to construct masts of various sizes in most fisheries. Aluminium, wood and plastic covers over radio antennae were also used. Aluminium is obviously more robust than bamboo but is more expensive and safety issues may arise where potential exists for other vessels to collide with aluminium masts.

Floats/Buoys

Floats can be divided into 2 main categories; CC3 Polyform buoys and simpler polystyrene floats. The Polyform floats are more robust but cost more than polystyrene floats. They are generally used in offshore conditions where expensive equipment such as radio transmitters may be attached, and also where they constitute most of or all of the marker system as in the case of offshore pot fisheries for crab. Polystyrene floats were also used in more offshore locations, possibly in areas where there is increased potential of gear loss from passing shipping or fishing activities, thereby reducing the cost of replacing the floats.

Counter weights

Counter weights which provide stability are placed at the bottom of the masts and materials used varied from stainless steel in more expensive systems with radio transmitters to pieces of scrap metal or chain or chain in cement in more basic systems.

4.3.1.2 Visual aids

4.3.1.3 Flags

Flags remain the most common type of visual aid used both prior to and after regulations have been introduced. They are cheap, simple to use and are considered to be adequate for their purpose during daylight hours of permitting vessels to locate their own gear using positional data. They obviously can not be used for warning other vessels to the presence of fishing gear or the gear marker at night but were used to differentiate ends of gear by using different colours or multiple flags.

4.3.1.4 Reflective bands

Reflective bands have been used in a number of fisheries such as Irish, UK, French and Norwegian demersal longline and gillnet fisheries for a long time. In Irish fisheries, vessels also commonly use reflective tape which is attached to the buoys and is a cheap alternative to reflective bands. Reflective bands are relatively inexpensive, easy to apply and generally work well for the purpose of assisting vessels in locating their own fishing gear using GPS positions and search lights. Similar to flags reflective bands are not suitable for warning other vessels to the presence of fishing gear or the gear marker at night.

4.3.1.5 Lights

Lights or “winkies” have been used intermittently by fishermen for a long number of years. The lights used in commercial fisheries generally consisted of a simple alkaline battery powered flashing light which may or may not have had a photon cell which restricts flashes to during the day and conserves battery power. The type of light used were relatively inexpensive to purchase at approximately €25 but the batteries had relatively short life cycles lasting a maximum of 7 days and fishermen may have been reluctant to use them given the cost of batteries (~ €200 per annum) and the extra work created in continually replacing them. Lights were used in Spanish, Turkish, Italian, Icelandic and Norwegian fisheries but were generally not used in Irish, UK or French fisheries, except in tuna driftnet fisheries where gear lengths used were long. Apart from helping fishermen locate their gear, lights have the added benefit of alerting other vessels to the presence of marker buoys and fishing gear at night.

4.3.1.6 Radar reflectors

In the context of commercial fishing, radar reflectors can be used in fishing gear markers systems primarily as a navigational aid to assist vessels in avoiding contact with gear markers and/or fishing gear. Prior to the introduction of the regulation, radar reflectors were not used in any commercial fisheries with the exception of Spanish and French surface longline fisheries presumably to assist in protecting radio transmitters which were also present on these gear marking systems.

4.3.1.7 Other gear location and identification aids

Radio beacon transmitters are still used primarily in surface longline fisheries where the ends of the gear may be floating freely and are used by vessels to locate their gear. The vessel registration number which is unique to all vessels and in some cases the vessel name were painted onto the floats of the marker systems in all fisheries. This text was used by fishing vessels and control and enforcement to identify the owners of fishing gear.

4.3.2 Post Regulation Gear Marker Systems

In considering the gear marking systems used after the EU regulations were introduced it is important to note that the legislation only impacts on a relatively few large scale fisheries.

Many EU gillnet and longline fisheries still are small boat fisheries carried out by vessels < 12m, predominantly inside 12 miles. Outside 12 miles gillnet and longline fisheries are prosecuted by larger vessels > 15m, although smaller vessels quite commonly from time to time venture outside 12 miles in periods of good weather. The fisheries in Table 2 have been identified as being directly affected by the regulations. While it is difficult to estimate with any degree of accuracy the total number of vessels involved, it is safe to assume that is less than 1,000 vessel spread across the different fleets.

Table 2 EU Static Gear fisheries outside 12 miles impacted by Regulation 365/2005

Country	Species	Gear Type	Areas
France	Hake	Gillnet	VI, VII, VIII
France	Porbeagle Shark	Surface Longline	VII, VIII
France	Albacore tuna	Surface Longline	VI, VII, VIII
Germany	Monkfish	Tangle net	IV, VI, VII, IX, X
Ireland	Hake	Gillnet	VI, VII
Portugal	Monkfish	Tangle net	VIII,IX,X
Portugal	Tuna, Swordfish	Surface Longline	X, CECAF
Spain	Hake	Gillnet	VI, VII, VIII
Spain	Monkfish	Tangle net	IV, VI, VII, VIII, IX,X
Spain	Hake	Longline	VI, VII, VIII
Spain	Tuna, Swordfish	Surface Longline	Mediterranean
Spain	Tuna, Swordfish	Surface Longline	VIII, X,CECAF
UK	Hake	Gillnet	VII

In addition to these fisheries there are several large scale pot fisheries for crustacean species, mainly brown crab and deepwater red crab that also work outside 12 miles which are not included in the regulations. These fisheries are prosecuted by vessels from Ireland, UK and Spain and the number of vessels is ~30.

Since the introductions it would appear that of the fleets listed in Table 2, few are actually fully compiling with the regulations for practicality reasons. The Anglo-Spanish deepwater gillnet fleet working predominantly in Area VII have, however, attempted to adapt to the provisions and many of these vessels are now using custom made “regulation” buoys. The components and costs of these buoys are shown in Table 3. The total lengths and dry weights are 4.2m and 16.5kgs for the West buoy and 3.25m and 12.8kgs for the East buoy with a cost of approximately €217 for a west buoy and €199 for an east buoy. This is the only example that could be found of vessels using custom made buoys to meet the requirements of the regulations. In all other countries elements of the legislation including the use of lights, reflective tape and flags were common but not fully in compliance with the regulations.

Table 3 Spanish GMS used in complying with the Council Regulation

Component	Length (m)	Weight (kg)
Counter weight		10.00 (W) 7.00 (E)
Stainless Steel (base)	2.00	2.60
Nylon pole	1.50 (West) 0.75 (East)	1.70 (West) 0.85 (East)
Radar reflector	0.25 (diameter)	0.70
Set of 2 lights		1.60
1 Float cc3 Polyform-y		
Totals	4.2 (West) 3.35 (East)	16.6 (West) 12.75 (East)

5 Workpackage 2 – Development of an Alternative Gear Marking System

5.1 Opinions from Stakeholders

It is apparent that fishermen view the detailed specifications make both the EU and Norwegian buoys as complex, impractical and relatively expensive fishermen. It is also apparent that within the EU there is limited knowledge within certain countries, limited compliance with the regulations and only sporadic attempts to enforce them by the fisheries inspectors. This is the strongest possible indication that the legislation is not achieving its desired objectives in totality. In Norway it is reported that there is better compliance with the regulations by the larger longline and gillnet vessels but that radar reflectors, which are optional are not used by any vessels and lights are fitted but not always operational with the fishermen preferring to use reflective tape and searchlights to locate gear at night time (Hareide., pers. Comm.).

Therefore at an early stage it was identified that some questions needed to be asked with a view to refining the specification of the buoys as follows:

- Is it necessary for enforcement authorities to be able to differentiate between the ends of the gear given if one end of the gear can be identified then intuitively the opposite end of the gear lies within an arc of 180degrees and a radius of 5 nautical miles?
- Can the western and eastern end of the gear be differentiated in an alternative but equally effective manner?
- Is the radar reflector necessary?
- Are complex lights necessary?
- Are intermediary buoys needed?
- What about other marine users?

These questions formed the basis of direct interviews with active fishermen Producer Organisations / Co-Operatives from Spain, UK, Ireland, France and Norway as well as merchant seamen and representatives from the marine leisure industry. Information was obtained from fishermen engaged in directed gillnet and longline fisheries affected by the regulations as well as from interacting fleets e.g. trawlers and inshore static gear vessels. The questionnaire used for the interviews is shown in Annex 5.

A total of sixty five questionnaires were completed following contact with relevant parties, see Table 4 for a breakdown. Questionnaires were completed by respondents in person or where this was not possible phone interviews were conducted. Care was taken to go through the questionnaire thoroughly with each interviewee.

Table 4 Breakdown of respondents to questionnaire regarding regulation EC 356/2005

Respondents	Numbers
Fishermen/Fishermen's Representatives	51
Control & Enforcement	7
Commercial Marine	5
Leisure	2

Table 5 summarises the main points taken from the questionnaire. Not all respondents answered all questions so there are discrepancies with the number of answers for each question, because of this a percentage value was used to quantify the responses. Figures represent percentage breakdown of responses for yes, no or N/A (includes unanswered)

The following section is a summary and interpretation of the main points raised for each question divided into three interested parties; fishermen, enforcement and leisure. Table 5 summarises the results.

The responses have been collated by similarity and have not being taken verbatim from completed questionnaires. Care was taken, where possible, to reflect all the views of those that responded. See Annex 4 for a full list of people who were interviewed and those that were approached by did not respond. Annex 5 gives a list of other information sources that were contacted.

Table 5 Summary of questionnaire results

	Is the regulation an improvement?		
Sector	Yes	No	N/A
Yachtsmen/Commercial	33	50	17
Enforcement	0	33	67
Fishermen	0	100	0
	Are radar reflectors necessary?		
	Yes	No	N/A
Yachtsmen/Commercial	50	50	0
Enforcement	33	0	67
Fishermen	0	95	5
	Is reflector tape necessary?		
	Yes	No	N/A
Yachtsmen/Commercial	50	33	17
Enforcement	17	17	67
Fishermen	71	24	5
	Are Winkie lights necessary?		
	Yes	No	N/A
Yachtsmen/Commercial	50	33	17
Enforcement	33	0	67
Fishermen	24	68	8
	Are flags necessary?		
	Yes	No	N/A
Yachtsmen/Commercial	67	0	33
Enforcement	33	0	67
Fishermen	87	8	5
	Should there be identification on the buoy?		
	Yes	No	N/A
Yachtsmen/Commercial	83	0	17
Enforcement	100	0	0
Fishermen	97	0	3
	Should there be east and west distinctions?		
	Yes	No	N/A
Yachtsmen/Commercial	33	17	50
Enforcement	17	50	33
Fishermen	21	74	5

Summary of Questionnaire Results

Do you think that the EU specified buoy is an improvement on past systems given the change in materials; from bamboo to aluminium pole and addition of lights etc.

Other Marine Users

- It is an improvement. Anything that aims to improve and standardise the marking of fishing gear is a positive step.

Fisherman/Fishermen Organisations

- No. The EU specified buoys are not an improvement. They pose a danger to fishermen during deployment and when taking them onboard. The required amount of buoys could also pose a threat to navigation in areas where fleet concentration is high.
- No, they represent a health and safety hazard to crews, a danger to navigation and are unnecessary.
- No. The change in buoy constructions results in a buoy that is too heavy, too long and takes up too much space on the deck especially on smaller vessels.
- No. Their size poses a health and safety threat to the crew.
- No. On vessels with a shelter deck these buoys will be difficult to work with.
- No. The new regulation is positive in that it makes the end of the gear more prominent, but it is not suitable from a safety and practical point of view.
- No. We have no problems with bamboo, floats and a weight.
- No. There is too much weight at the top of the flag.
- No. The monitoring and inspection of offshore passive fishing gears is necessary in terms of sustainable development and rational exploitation of fisheries resources. The regulation affects, by default, inshore vessels (10-18m) that pursue small-scale seasonal gillnet fisheries in waters outside 12nm. Should include a downscaled gear marking system for vessels up to 18m.

Enforcement

- At the onset of this legislation it was welcomed as a positive step from the point of view of control and enforcement especially in the deeper waters of Porcupine and Rockall. It is now felt that the size of the buoys makes the legislation problematic for small vessels. However if the vessels are large the regulation is still a positive move and it is felt that the limit of 12nm will exclude small vessels and so this problem should be negligible.
- The legislation is very complicated and possibly unnecessary.

Do you think a radar reflector is necessary/ effective on a marker buoy? Do you think that the specified type in particular is effective? If not can you suggest a more suitable type?

Fisherman/Fishermen Organisations

- No. A large concentration of these reflectors in an area of high fishing concentration could make navigation difficult.
- No. Many vessels stay in close proximity to their gear or notify other vessels in the area of its position.
- No. The right radar is needed to pick up the reflectors. The radar needs to be set to pick up the reflectors and can result in the radar being poor at scanning ahead for ships.
- No. These do not work unless the sea state is calm when you get up to a 1.5 nm range, but this is very rare.

- No. Unnecessary, excessively expensive and ineffective due to limited detection potential caused by an inability to maintain a vertical position due to weather, tides and other factors.

Other Marine Users

- One respondent thought that the radar reflector was both necessary and effective.
- Yes radar reflectors are necessary but would question the effectiveness of the model in the legislation.
- It should only be needed in deep water.
- No. They are not necessary.
- There is concern that the radar reflector will cause the buoy to keel over, especially in rough weather.

Enforcement

- Yes. A radar reflector can be useful but its effectiveness will depend on its type and orientation. Effective reflectors could cause navigation issues if there is a high concentration of gear in one area.

Do you think reflective tape is necessary on the marker buoy? Tape is visible in darkness when light is reflected from close range.

Other Marine Users

- No, as this tape can only be seen at short range.
- Yes it would be useful for fishermen, and at night when there is a moon it would also be useful.

Fisherman/Fishermen Organisations

- Yes. Reflective tape is useful when searching for gear at night.
- Yes. It is useful at night when a spotlight, in conjunction with the plotter, can be used to find the gear.
- No. A small number of fishermen felt it was not necessary but that it could remain as an option.

Enforcement

- Yes, this can be useful but only if you know where the gear is located. It could prove more useful for smaller vessels in lieu of lights.

Do you think a winkie (light) is necessary on the marker buoy? EC spec is that the light be yellow, blink once every 5 seconds and be visible in darkness for 2nm.

Other Marine Users

- Yes
- Yes, but it would depend on weather conditions.
- No, this will confuse those that see the buoys.

Fisherman/Fishermen Organisations

- No. These lights cost a lot of money to buy and maintain and can be unreliable.
- No. These lights are not necessary once you have the gear position and the buoys are marked with reflective tape.
- No. Most vessels stay close to the gear so there is no need for them.
- Yes but they should only be a requirement in deeper water, on vessels over 18m in length or in areas with heavy traffic.
- If the vessel is not staying close to its gear then they should be required.
- No they are not necessary.

Enforcement

- Yes, but only for larger vessels.
- These can be useful as they can usually be seen before the buoy is visible on radar.

Do you think flags on the marker buoys are necessary? What colour in your opinion is most visible during daylight hours?

Other Marine Users

- Yes, flags are necessary and should be black in colour.

Fisherman/Fishermen Organisations

- Yes, flags are necessary and should be black, orange, yellow or red in colour.
- Yes but there are questions as to the regulated size.
- Two flags of contrasting colours should be used to denote the buoys orientation.
- Yes they are useful.

Enforcement

- No. They are better than nothing but they are inefficient markers and are usually wrapped around the mast of the buoy or damp and hanging.
- Yes and they should be red in colour.

Can you comment on the buoy's current specifications?

Other Marine Users

- Fail to see the reason why the regulation was brought in.
- Overall the buoys in the regulation look awkward. The light and radar are a good idea but there overall size seems problematic and may cause damage to merchant vessels if caught in the propeller.

Fisherman/Fishermen Organisations

- It is too complicated. The current systems that are used are sufficient. The most important thing is to have the gear marked with the vessel registration number.
- There isn't a need for western and eastern buoys as laid out in the regulation. As a compromise it has being suggested that there is prescription for double flags for the western buy and a single flag for the eastern buoy or the buoys are of different colours to denote east and west.
- It needs to be simplified; a simple dahn is all that is needed along with vessel identification. It should be up to the skipper whether there is a light or not.
- It is very unsafe for the crew of the vessel, and safety is paramount.
- Too heavy would pose a danger to the crew. Both hands necessary to hold them let alone deploy them. Multiple radar signals would cause problems for navigation and Search and Rescue authorities in the event of an emergency.

Enforcement

- There could be a distinction made for vessels of different sizes in the regulation. Safety is a concern on small vessels where the size of the buoys could pose a problem.
- Common sense dictates that the buoys should be of manageable dimensions.
- The light will improve visibility and is a good addition where possible.
- The buoy needs to be visible by either radar or the eye.
- If it is necessary to have east and west identification a colour scheme for the buoys or flags should be adopted similar to the cardinal scheme.

5.2 Development of a Prototype Gear Marking System

The information reviewed on legislative requirements, gear markers systems currently in use, and stakeholder opinions from the interviews conducted has been used to design a new prototype gear marking system as described in the following sections. The rationale for selection of the modified component parts is outlined as follows:

5.2.1 Display of identification

EC Specification

EC 365 of 2005, Article 10 states that:

"Each end marker buoy and intermediary buoy shall display the external registration letters and numbers displayed on the hull of the vessel to which they belong as follows:

> *(a) letters and numbers shall be displayed as high above the water as possible so as to be clearly visible;*
> *(b) in a colour contrasting with the surface on which they are displayed.*

The letters and numbers displayed on the marker buoy shall not be effaced, altered or allowed to become illegible".

Proposed amendment to regulation

It is proposed that this should not be amended.

Rationale

This provision is in line with international best practice and is fundamental to the regulation. While some international regulations specify the height of the lettering this is felt not to be necessary and impossible to enforce so the current wording if felt appropriate.

5.2.2 Cords

EC specification

Article 11 of EC 356 of 2005 states that:

"The cords linking the buoys to the passive gear shall be of submersible material, or shall be weighted down".

"The cords linking the end marker buoys to each gear shall be fixed at each end of the gear".

Proposed amendment to regulation

The regulation should take into account industry practices and therefore it is proposed that the rope attaching the surface buoy to the anchor should indeed be a leaded cord or rope However, the rope attaching linking different surface buoys should be buoyant.

Rationale

It is common practice in all static gear fisheries to use more than one surface marker buoy to increase visibility and make it easier to retrieve the gear. In Figure 3 Buoy A, which is attached to the anchor rope is more likely to be submerged in strong tides, removing the strain and increasing the visibility of the principle marker Buoy B. In addition, having more than one buoy at the surface aids fishermen in retrieving gear as the rope attaching the buoys is easily

grappled and brought to hand. As the purpose of setting a series of buoys is to increase buoyancy and aid retrieval it does not make sense for leaded rope to be used as the link between he 2 buoys.

Figure 3 Rope attachments to buoy

5.2.3 Mast height

EC Specification

Article 12, paragraph 2 of EC 356 of 2005 states that:

"*The mast of each end marker buoy shall have a height of at least 1.5 metres above the sea level measured from the top of the float.*"

Proposed amendment to EC regulation

It is proposed that the minimum height of the mast remain at 1.5m as set out in EC 356 of 2005.

Rationale

The 1.5m fits common practice and there seems no need to amend the regulations. It should be noted, THOUGH that in practice it is difficult to accommodate all of the elements of the current regulations within a mast height of 1.5m. It should also be noted that in order to balance the buoy a relatively large counterweight is required, increasing the overall length of the buoy beneath the float. This means the actual dimensions of the regulation marker buoy is around 4.70m with approximately 3.10m above the water. This is corroborated by the custom made buoys used by Spanish fishermen and the findings of the BIM trials in 2006 (Robson et al., 2006).

5.2.4 Buoy colour

EC Specification

Article 12, paragraph 3 states that:

"*End marker buoys shall be coloured, but may not be red or green*".

Proposed amendment to EC regulation

This paragraph should be amended in the regulation

Rationale

The regulation should take into account that the majority of buoys used by the fishing industry are offered for sale as a shade of orange or red in colour (See Figure 4) and so it should not be prohibited to use this colour buoy. It is felt given these buoys have been used for a long time in the fishing industry and will not lead to confusion with other marine users mistaking such buoys as markers of other obstructions. In addition green markers buoys are used rarely if ever so there is little point in prohibiting their use. Simple white polystyrene floats are also commonly used and while white is not as visible as other colours, the fact that such floats are readily available make it sensible for the use of such floats is permitted.

Figure 4 Commercially available red/orange buoys as well as white polystyrene buoy

5.2.5 Rectangular flag(s)

EC specification

Article 12, paragraph 4 (a) of EC 356 of 2005 states that:

"*Each end marker buoy shall include one or two rectangular flag(s) whose side measures at least 40 centimetres; where two flags are required on the same buoy, the distance between them shall be at least 20 centimetres; the distance between the water and the first flag shall be at least 80 centimetres; flags indicating the extremities of the same net shall be of the same colour, which may not be white, and of the same size.*"

Proposed amendment to regulation

It is proposed that the dimensions and shape of the flag specified in the regulation should not be changed given that flags sold commercially meet the specifications of the regulations. It is further proposed that the orientation of a marker buoy, i.e. the western or eastern extent of the gear, should be identified through the use of distinctively coloured flags. Therefore it would only be necessary for buoys to carry one flag unless otherwise desired by individual fishers. If more than one flag is attached as in the case of ownership marks the flag denoting the orientation of the buoy should be uppermost on the mast. It is proposed therefore that in all cases the west buoy be marked with a yellow flag(s) and the east buoy with a black flag(s). The minimum requirement should be one flag on each end.

Rationale

Throughout European waters fishers attach flags to the mast of marker buoys to assist them in locating their gear primarily during daylight hours. The dimensions and shape of the flags specified in the regulation do not represent a departure from industry practice prior to the

regulation coming into force. The use of a colour coded scheme would negate the requirement for some marker buoys to have 2 flags, thereby increasing the overall size of the marker buoy. In terms of potential flag colours, at sea the probability of recognizing, or even detecting, white on its own is quite low. Orange is probably the most conspicuous colour but from a distance may be confused with red or yellow. Fluorescent colours are much more conspicuous in most conditions and black is considered by smaller vessels as being easily detected. Figure 5 shows examples of commercially available flags.

Figure 5 Commercially available marker buoy flags (photo Nils Roar Hareide)

5.2.6 Light(s)

EC specification

Article 12, paragraph 4 (b) of EC 356 of 2005 states that:

"*Each end marker buoy shall include one or two lights, which shall be yellow and give one flash each five-second (F1 Y5s) and be visible from a distance of at least two nautical miles*."

Proposed amendment to regulation

The requirement for lights to be yellow should be retained. Lights, however, should only be required during hours of darkness. In addition both constant and flashing lights should be permitted, but a maximum flash interval of 5 seconds should apply as this is the general specification of lights currently available commercially..

Rationale

Lights are effective in darkness only so should only be required during hours of darkness to save battery power and related financial and environmental costs. Constant lights are currently used in some EU fisheries and their use should not be precluded unless navigational concerns exist in relation to their use which is unlikely in the open sea. Constant lights are permitted under Norwegian law.

Figure 6 Flashing light attached to mast of marker buoy

5.2.7 Top sign/radar reflector

EC specification

Article 12, paragraph 4 (c) and (d) of EC 356 of 2005 states that:

(c) *Each end marker buoy shall include a top sign on the top of the buoy which shall be a sphere of a diameter of at least 25 centimetres topped with one or two luminous band which shall be neither red nor green and shall beat least 6 centimetres broad. A spherical radar reflector may be used as the mark on top of the buoy*;

(d) *A spherical radar reflector may be used as the mark on top of the buoy*.

Proposed amendment to EC regulation

It is recommended that:

A luminous/ retro-reflective band should be required at the top of the buoy

A top sign of 25cm other than a radar reflector should not be required as it is considered unnecessary as it adds extra weight to the buoy and increases the area affected by windage.

The use of a radar reflector should not be required.

Rationale

Reflective bands are commonly in use in gillnet fisheries in European waters. They are a cheap, simple and effective method for fishers to locate their gear at night. Additional top signs should not be required as they serve no practical purpose and represents a major departure from international gear marking practice.

Radar reflectors are not widely used to mark the ends of gear in static fisheries internationally. Their omission from fishing operations are based on a number of factors such a lack of benefit to fishermen in conducting their operations, lack of navigational benefits and technical limitations of devices which are commercially viable. In addition, major health and safety

concerns arose regarding their use arose during practicality trials carried out by BIM (Robson et al, 2006).

By their nature static gear fisheries are anchored and so do not move. To locate the ends of the gear, the owner of the gear has only to return to the position where it was shot. In more mobile forms of fishing such as driftnets and pelagic longlines, radio transmitter buoys are used a more robust form of gear location. During the practicality trials, a maximum detection range of 0.5 nm was found to apply to 25cm diameter spherical radar reflectors and therefore the use of a good sized float and flag is just as effective for locating marker buoys during the day, while a light and reflective band works as well if not better at night Also during the practicality it was found that this type of radar reflector acted as a sail during strong wind, and since it was mounted at the top of the mast, caused the buoy to lie flat, negating the effectiveness of the other buoy components. Radar reflectors are therefore of very little practical use to fishermen. Furthermore shooting and hauling marker buoys is an inherently dangerous activity for crewmen. The risk involved is substantially increased by the addition of the sharp edges of a radar reflector at the highest point of the buoy something which as been consistently highlighted by the NWWRAC (NWWRAC, 2006).

In terms of general navigation and the benefits of radar reflectors on gear marker buoys for other sea users, serious concerns have been raised regarding their effectiveness. The UK Marine Accident Investigation Branch (MAIB) commissioned QinetiQ Funtington, the UK's main type approval test house for radar reflectors, to carry out a "Performance investigation of Marine Radar Reflectors on the market". The investigation was commissioned to establish the performance characteristics of commonly available radar reflectors. The report gives recommendations for small vessels such as yachts on ways to improve their Radar Cross Section. The report calls in to question the effectiveness of most of the least expensive passive radar reflectors available, including the Davis Echomaster the most similar reflector to the type specified in EC 356 of 2005. It was found that this model failed to meet ISO8729 (Ships and marine technology -- Marine radar reflectors) or even get close to it. Its average Radar Cross Section was measured at only 1.75m^2 against a peak value of 7.5 m^2. QinetiQ recommends that poorly performing radar reflectors are not fitted as it is possible that the user could be lulled into a false sense of security believing that their chances of detection has been enhanced. More effective radars described in the report are commercially available but both the cost and weight of these devices makes them unsuitable for use in static gear fisheries.

It should be noted though that during the interviews with the yachtsmen and some merchant seamen they indicated a strong preference for the maintenance of radar reflectors. However, in the case of yachts, most activity is within 12nm so outside the scope of the regulation. For the merchant shipping sector it seems this maybe a bigger concern although it was indicated that radar reflectors on buoys are unlikely to be seen on their radar systems based on the information from the MAIB. Given the evidence presented against the effectiveness of radar reflectors it is felt the case for removing their use in the regulation is strong.

5.2.8 Requirement for different western and eastern end marker buoys

EC specification

EC 356 0f 2005, Article 12 paragraph 4 (a) states that

"Each end marker buoy shall include:

(a) one or two rectangular flag(s) whose side measures at least 40 centimetres; where two flags are required on the same buoy, the distance between them shall be at least 20 centimetres; the distance between the water and the first flag shall be at least 80 centimetres; flags indicating the extremities of the same net shall be of the same colour, which may not be white, and of the same size";

EC 356 0f 2005, Article 13 (a) and (b) states that:

(a) The buoy in the western sector (meaning the half compass circle from south through west to and including north) shall be rigged with two flags, two striped luminous bands, two lights and a label.

(b) The buoy in the eastern sector (meaning the half compass circle from north through east to and including the south) shall be rigged with one flag one striped luminous band, one light and a label.

Proposed amendment to regulation

Article 12, paragraph 4 (a) should be amended to include separate colour coded flags on the eastern and western sector marker buoys.

Article 13 should be amended.

Rationale

Colour coded flags could be used to distinguish east and west buoys as described earlier, effectively reducing the overall size and cost of western gear marker buoys. Icelandic fisheries legislation tackles this problem by requiring fishermen to attach a 20cm diameter floating ring (Figure 7) to the marker buoy at the western end of their gear.

Regarding lights, Control and Enforcement (C&E) need to be able to differentiate the western from the eastern end of static gear in order to quantify the gear during the day. As pointed out in the interviews conducted as part of this study, C&E do not however, approach buoys during the hours of darkness in order to avoid entanglement in ropes, tending to stay a working distance from unattended gear. Therefore it is not necessary for Control and Enforcement vessels to be able to identify marker buoys as being in the western or eastern sector of the gear, and one light on each end marker buoy should therefore be sufficient for navigational safety.

Figure 7 Icelandic gear marking ring, 20cm diameter, for identifying western end of anchored bottom set-nets targeting cod

(Photo courtesy Haraldur Einarsson of the Icelandic Marine Research Institute)

5.2.9 Intermediary Buoy

EC specification

Article 14 of EC 365 of 2005 states that:

"Intermediary marker buoys shall be fixed to passive gear extending more than 1 nautical mile.

Intermediary marker buoys shall be deployed at distances of not more than 1 nautical mile so that no part of the gear extending 1 nautical mile or more shall be left unmarked.

Intermediary marker buoys shall have the same characteristics as those of the end marker buoy in the eastern sector except for the following:

(a) the flags shall be white;

(b) every fifth intermediary marker buoys shall be fitted with a radar reflector giving an echo at least two nautical miles".

This was subsequently amended by Regulation 1805/2005 which allowed the distance between intermediary buoys to be increased to 5 nautical miles.

Proposed amendment to regulation

Article 14 paragraph 3 should be amended.

Rationale

Prior to the regulation coming into force the standard deepwater intermediary buoy consisted of a Polyform CC-2 or CC-3 buoy fitted with a flashing light and a lead counterweight. The sheathing modification facilitates the storage of the rope that is attached to the gear when deployed. (See Figure 8). Similarly in surface longline fisheries, the intermediary buoys ranges from small plastic bottles to plastic footballs or custom made durable floats

Intermediary buoys have always been commonplace along static gear as they play a major role in both fishing gear performance and successful retrieval of the fishing gear. They are typically placed halfway along a set of gear as is the case in demersal longline and gillnet fisheries, and more frequently along the gear in surface longline fisheries in relation to hook spacings and the depths fished. They are available ready made at a cost of around € 75.00. At present the rope is wrapped around the intermediary buoy which means that the buoy and the rope can be shot at the same time. This procedure would not be possible with markers buoys of similar design to end marker buoys. All of these fisheries typically deploy their gear at speeds between 7 and 10 knots so major health and safety concerns would arise even if was technically feasible to do this.

Figure 8 Typical Intermediary buoy commonly used

5.2.10 Counterweight

EC specification

EC 356 of 2005 does not specify that a counterweight be attached to the base of the pole but this is necessary to balance the buoy.

Proposed amendments to regulation

It is recommended that the regulation specify that sufficient weight be attached to the base of the buoy in order to keep it upright, but care should be taken with such counterweight to prevent negative buoyancy occurring.

Rationale

If sufficient weight is not attached below the float of a marker buoy then the buoy will most likely lie flat on the surface of the water thereby negating its effectiveness as a gear marking buoy.

5.3 Specification of Prototype Gear Marking System with respect to Regulation 365/2005

Taking the findings of Section 5.2 the following is the proposed specification of a prototype gear marking system amending Regulation 365/2005

Display of Identification: External Registration Letters & Numbers (No change in current legislation)

Cords: Cords linking the end marker buoys shall be of submersible material (No change in current legislation), but cord joining the marker flags to any subsidiary buoy should be allowed to be rigging in floating rope to facilitate retrieval.

Mast Height: Mast of each end marker buoy to be a minimum of 1.5m above sea level (No change in current legislation).

Colour of End Marker Buoys: The colour of marker buoys should not necessarily specified but standard “Red/orange” polyfrom floats or white polystyrene floats should be permitted.

Size, Shape of Flags: At least one rectangular flag on each marker. The sides to measure at least 40 cm (no change in current legislation).

Lights: One yellow/white light on each buoy visible for 2nm. May be either constant or flashing with an interval of no more than 5 seconds. Lights should be required for the hours between sunset and sunrise only (as per Norwegian legislation).

Radar Reflector: Not felt to be required.

Top Sign: Two luminous bands at least 6cm broad (No change in legislation).

Fixing of End Marker Buoys: West end buoys to be fitted with one black flag and East end buoy to have one red flag (Different colours may be adopted). Although it should be noted that the number of flags at one end could be increased if felt easier to distinguish.

Intermediary Marker Buoys: Intermediary buoys required every 5 miles but allowed to be standard round buoys with or without lights and marked with vessel name and registration number.

Table 6 below sumamrises the main dimensions and weights of the EU regulation buoys and the prototype buoy. The prototype buoy can be made shorter and lighter than the current regulation buoys.

Table 6 Summarises the main dimensions and weights of the EU regulation buoy compared to the prototype buoy

Buoy type	Pre-EC 365/ 2005 buoy	EC 365/ 2005 buoy (western)*	Proposed buoy
Mast height above surface (m)	1 to 5m	2.9m	1.5m
Length overall (m)	2 to 7.5m	5.7m	3.0m
Weight (kg)	2 to 12kg	17kg	4 to 10kg

*** Based on specification of Spanish custom made buoys and findings of 2006 BIM trials**

Figure 9 shows a schematic diagram of the prototype gear marking system. In the photograph on the left both buoys meet the specifications of the prototype buoy but the smaller white buoy is designed for easier handling on smaller vessels. Figure 10 shows a schematic diagram of the proposed system.

Figure 9 Two prototype marker buoys (left) and a prototype buoy alongside a regulation buoy

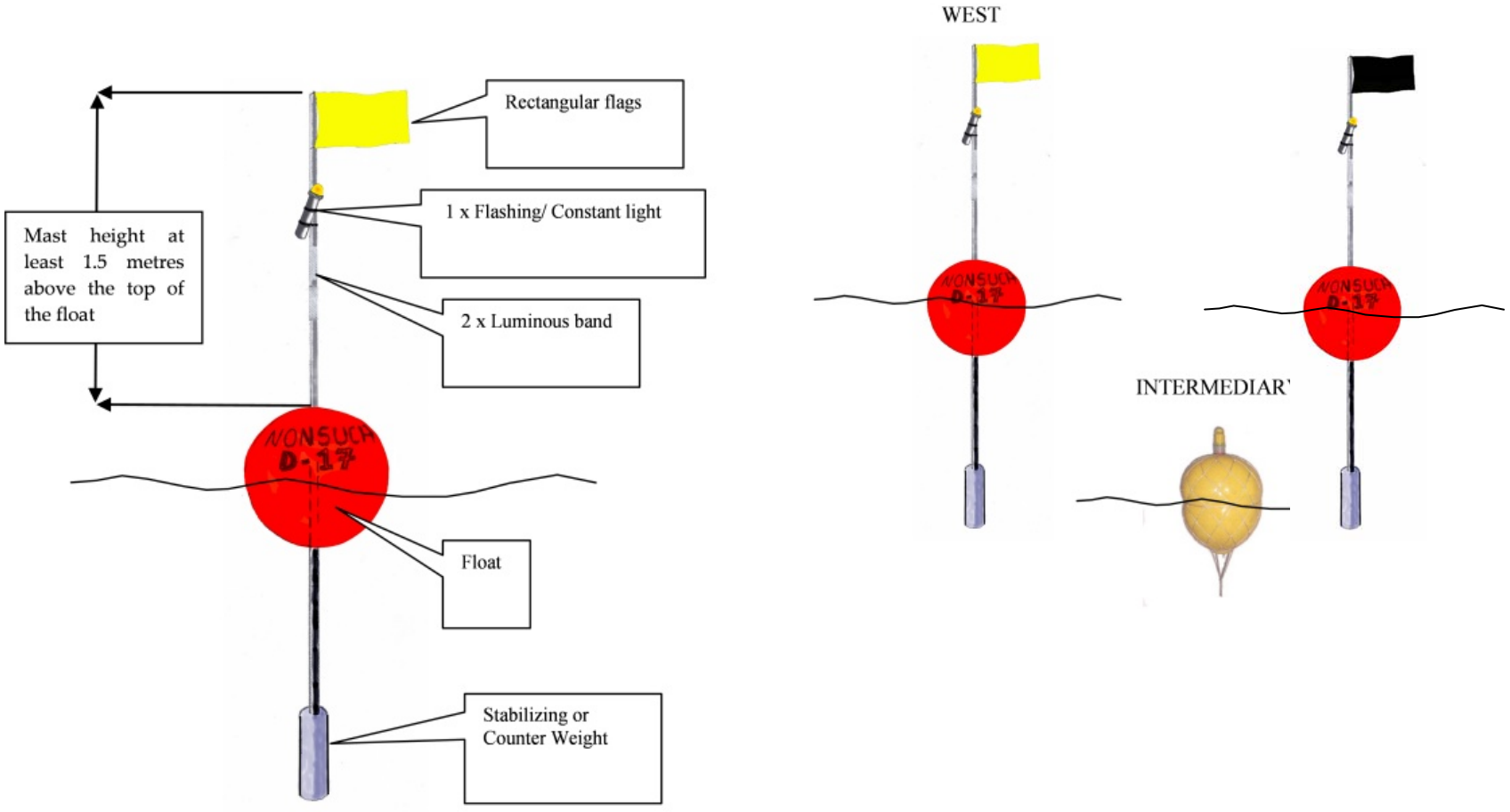

Figure 10 Prototype specifications for alternative marker buoy

5.4 Trials with EU Regulation and Prototype Buoys

Objectives

The EU regulation buoy and the prototype gear marking system including an intermediary buoy were tested in sea trials carried out in December 2008. These trials had the following objectives:

- Observe the buoys under varying sea states, wind and tidal conditions;
- Compare the deploying, hauling and storage of the buoys on board; and
- Evaluate efficiency of radar reflector as required under 365/2005.

Trial vessels

Two vessels were chartered for the trials. The MFV "Rebecca Jane" from the port of Duncannon and the MV "Osprey", a motor-sailer craft from New Ross in Co. Waterford on the South-east coast of Ireland.

The Cygnus hulled *MFV Rebecca Jane* (W37) measures 8.1m LOA and is equipped for potting/ trawling and gill netting. The vessel is typical of vessels that fish using tangle and gill nets seasonally up to and beyond 12nm from the Irish coast. This vessel was used to deploy and haul all buoys and also remained on station with the buoys during the radar reflector trials.

The "*n'Atant*" motor sailor *MV Osprey* measures 7.5m LOA and is equipped with sounder, GPS and radar. The radar is a FURUNO model 1623. This system operates in the X-band with a power output of 2.2kW, its range is 16 nautical miles and its scanner is mounted 2.5m above sea level. This vessel was used to observe the buoys and also to measure the radar visibility during the radar reflector trial.

Figure 11 shows the two trials vessels.

Figure 11 *MFV Rebecca Jane* (left) and *MV Osprey* (right)

Trial location

The trial was conducted in Waterford Harbour downstream of Cheekpoint at four locations – Shelburne Bay, SE of Seedes Bank, Northern part of Drumroe Bank and the exposed Creadan Bank south of Creadan Head. These trial sites were chosen because of the availability of sheltered conditions upstream and exposed conditions downstream at the mouth of the estuary.

Gear Marking Buoys tested

The following gear marking buoys were used for these trials:

- EC Regulation Western end marker buoy
- Prototype End marker buoy
- Proposed Intermediate buoy

(Note: above pictures not to scale)

Figure 12 Buoys tested: 1. EU regulation; 2. Prototype buoy; 3. Prototype Intermediate buoy

The EU buoy was constructed as per the legislation for a west marker buoy. The prototype buoy and intermediate buoys were constructed as described in section 5.2. Table 7 shows the main elements of the buoys as deployed.

Table 7 Construction details of marker buoys

Detail	Protoype	Intermediate	Regulation
Marker shaft	Bamboo pole	None	Bamboo pole
Float type	Foam	Polyform	Foam
Reflective tape	Yes	No	Yes
Lights	Yes	One	Yes
Flags	Yes	No	Yes
Radar reflector	No	No	Yes

Methodology

The buoys were attached to an anchor line with a suitable weight attached along with two standard polyform buoys. They were then deployed in selected locations along the course of the estuary and in more exposed locations to simulate open sea conditions. This ensured that all marker buoys were observed in practically all common sea conditions, i.e. from calm weather and negligible current, up to Force 6 wind and c. 3 knots of tide. As these trials were purely observational the findings are purely subjective and so should be treated accordingly.

Results – Observational Trials

EU regulation Buoy

Initially the regulation buoy was connected to the anchor-line and photos taken of its profile once deployed as shown in Figure 13. At the sheltered site in calm conditions with negligible current, the regulation marker was observed to retain an upright position but this depended greatly on the state of tide. With increasing current the buoy tended to heel over markedly as shown in Figure 14. To try to rectify this extra counterweight was added but this proved ineffective and at a certain threshold negative buoyancy occurred and the buoy started to sink.

Figure 13 Regulation buoy on deployment in calm conditions with negligible tide

Figure 14 Regulation buoy in calm conditions but with a strong tide. Note heeling of the buoy

At the exposed site the wind was blowing Westerly force 5 and gusting against a strong ebbing tide, creating exposed sea conditions. The regulation buoy was deployed with difficulty by one person and it immediately heeled over in the direction the wind was blowing (5 to 10 degrees to the vertical). In this condition the radar reflector was so low to the water's surface as to make it impossible to detect using radar (sea-clutter) and only at close proximity using the naked eye. The mast is top heavy as the 2 lights and 4 D-cell batteries are fixed at

the top and even light winds catch in the radar reflector. Although visibility of the marker is still possible its orientation is not ideal as shown in Figure 15. This was similar to what had been observed in the earlier BIM trials reported in Robson et al. (2006).

Figure 15 End Marker Buoy as per regulation in open sea in a Force 5 & gusting westerly wind and a 3-knot tide.

Prototype End marker buoy

The trials were repeated with the prototype buoy, marked as an east end buoy with a single black flag, luminous strips, one light but no radar reflector. The prototype mast is significantly shorter than the regulation buoy and did not carry as much weight (one light and 4 d-cells) with this being mounted lower down the mast.

In the sheltered location in calm conditions the prototype buoy naturally adopted a vertical position as shown in Figure 16. With increasing tide the buoy did heel in a similar manner to the regulation buoy as shown in Figure 17, although it general orientation in the water was judged to better than the regulation buoy and was not as prone to heeling over in gusting winds.

Figure 16 Prototype end marker buoy after deployment in calm conditions

Figure 17 Prototype end buoy deployed in calm conditions with strong

In the open sea conditions with strong wind and tide, again the prototype marker buoy was observed not to adversely heel over, with the mast remaining closer to vertical and clearly visible to the naked eye at a reasonable distance as shown in Figure 18.

Figure 18 Prototype Marker Buoy in still water conditions, in open sea at bottom of tide and in a Force 5 westerly wind and a 3-knot tide

Intermediate buoy

Finally the intermediate marker buoy as described in section 5.8 was deployed, similarly connected to the anchor-line and its orientation in relation to the sea state was observed. The intermediary buoy was deployed in calm water with a 2.2 knot ebbing tide as shown in Figure 19. As anticipated no problems were observed with the buoy given its simplicity and no further deployments were undertaken.

Figure 19 Intermediate buoy on deployment in calm conditions in a 2.2 knot tide

Handling of the buoys:

The regulation buoy proved difficult to handle even during construction and then subsequently when putting aboard the vessel. This was due to the combination of its length (4.7m) and weight (16.5kg). It should be noted that during the earlier BIM trials many variations of the regulation had been made up but it was found very difficult to reduce the overall height and weight much below the buoy deployed in these trials.

Deployment and retrieval of the marker single handed on board *MFV Rebecca Jane* was both difficult and dangerous at both locations. The conditions at the exposed site meant that two persons were required to take the buoy on board as shown in Figure 20. (Note that this vessel is relatively and hence the physical length of the marker in relation to the total vessel size added to the difficulties experienced and a larger vessel with more space deployment and hauling would be easier).

Figure 20 Difficulties encountered onboard the Rebecca Jane whilst retrieving the regulation marker

The prototype buoy was safer to handle throughout the trial. Its reduced length (2.96m) and weight (6.5kg) meant it was easier for one person to manoeuvre during shooting and hauling.

At the sheltered site the buoy was shot and hauled with ease by one person. The conditions at the exposed site made approaching the buoy difficult but once the buoy was alongside retrieval was executed promptly by one person without undue difficulty as shown in Figure 21.

Figure 21 Prototype buoy being lifted aboard by single crewman

Storage of the buoys

During the trial it was clear that a vessel of this size (8m LOA) would simply not be able to carry sufficient numbers of regulation marker buoys as required under the legislation, even though these vessels commonly fish outside 12nm. The main problem is the height of the mast which means they interfere with the rigging of the vessel and make stowage problematic. Reducing the height of the mast improved storage of the buoys and was felt manageable on even small vessels.

Radar reflector assessment trials

A spherical radar reflector measuring 25cm in diameter, meeting the requirements of the regulation was fitted as a top sign to the mast of the regulation marker buoy at an approximate height of 3m above sea level. The regulation buoy carrying the radar reflector was then deployed at both sites and the FURUNO radar system on board *MV Osprey* was used to assess the effective detection of the reflector.

This was conducted by steaming at various angles to the buoy and recording the distance at which the radar reflector ceased to return a viable radar signal using standard performance parameters; i.e. gain, sea-clutter, rain clutter as per weather and tidal conditions. Figure 22 shows the radar display with sea clutter around the regulation buoy during the trials.

Figure 22 Display showing sea-clutter for regulation buoy during trials

Results

Sheltered site

The regulation buoy performed well at the sheltered site bearing in mind that the mast had heeled over thus lowering the reflector height. The range at which the radar reflector was detected depended on adjustments to the sensitivity of the radar using the gain control but could be seen up to a distance of about 0.5nm.

Table 8 Reflector performance at sheltered site

GAIN	SEA-CLUTTER	RAIN-CLUTTER	LOSS OF ECHO (Nautical Miles)
43	AUTO - CALM	-	0.204nm
46	AUTO - CALM	-	0.360nm
49	AUTO - CALM	-	0.473nm

Exposed site

The regulation buoy did not perform well at the exposed site. The wind was blowing an estimated force 5 gusting to force 6 with a 2m swell and a 3-knot ebbing tide. Consequently the radar reflector at the top of the buoy's mast lay quite close to the crests of the waves and as a result the radar reflector was not detectable from any distance as shown in Table 9. Several tests runs were undertaken to verify this finding.

Table 9 Reflector performance at exposed site

GAIN/ AUTO GAIN	A/C SEA	A/C RAIN	LOSS OF ECHO (Nautical Miles)
AUTO-GAIN MODERATE	(Preset) ROUGH	40	Negative

Conclusions

The overall conclusions from the trials were as follows:

- The regulation buoy has a tendency to heel over even in calm weather due to it being top heavy and also because of increased windage of the radar reflector.

- The prototype buoy assumed a much better orientation in the water and did not show the same heeling tendency even in rough conditions. However, both buoys did have a tendency to heel markedly in strong tidal conditions.
- There were no apparent difficulties observed with the intermediate buoy.
- Due to its height and weight the prototype buoy was found to be easier to deploy, haul and store on board.
- The range at which the radar reflector mounted on the regulation buoy could be detected in calm conditions was depended on adjustments to the sensitivity of the radar using the gain control but could be seen up to a distance of about 0.5nm.
- With a force 5 wind, 2m swell and a 3-knot ebbing tide the radar reflector was observed to lie quite close to the crests of the waves and as a result the radar reflector was not detectable from any distance.
- Overall it was apparent that the most important issue with regard to the maximum range at which a radar reflector can be detected is how much time and effort can be allocated to tune the receiver unit.
- In rough weather marks/ targets or radar echoes from the sea surface and rainfall, commonly called “clutter”, are received over a large distance around the ship and can easily mask nearby marks/ targets or radar echoes. Subsequent alteration of the radars’ operational parameters or in some cases, failure to optimise the equipments use can easily result in decreasing the radars sensitivity to other vessels or targets and this could compromise the safety of the vessels navigation.

6 Workpackage 3: Implementation of modified systems

6.1 Practicalities

Based on the preliminary trials carried out it is felt that the proposed amendments to the EC regulation buoy will not interfere with the aim of the regulation which is to provide a safe and standardised specification for net and longline marker buoys and ensure orderly conduct of fishing operations in EU waters. The amendments to EC 365 of 2005 proposed in this review reflect International best practice, up to date technical advice and a desire to reach a practical compromise that takes account of a broad range of the opinions of a broad range of stakeholders. The practicalities of implementing the proposed modified gear marker buoy system in terms of technical and economic issues are outlined as follows.

6.1.1 Technical Issues

Size and weight of gear marker buoys

The following issues with the overall size and weight of the gear marker buoys prescribed in EC 356 of 2005 were highlighted in a BIM assessment of the practical implications of the regulation (Robson *et al*, 2006) and again in the 2008 trials. The large size and weight of the gear marker buoys made them very cumbersome on board smaller fishing vessels that from time to time fish outside 12 nautical miles. On shelter deck vessels the lengths of the buoys mean they have to be stowed on top of the shelter deck. Crewmen are subsequently obliged to rig the buoys for shooting on top of the shelter deck, which is hazardous in bad weather. In two cases reported recently two crewmen on board the Spanish vessels "*Celerio*" and one crewman on board the vessel "Canto Nuevo" were drowned whilst shooting regulation marker buoys as reported in the La Vvoz de Galicia (Anon., 2008). While it is impossible to fully conclude that this was a direct result of the buoy construction and not bad weather or other factors it is safe to assume that the heavy weight and height of the buoys does represent a potential hazard for fishermen.

The added weight also has implications for vessel stability and carrying capacity. The length and weight of the buoys prevented them being shot away quickly and clear of the propeller and increased the likelihood of fouling the gear. The weight of the buoys required could also result in gear anchors being dragged, making it more difficult to locate gear which could lead to gear loss. Given the height of the buoys and the addition and positioning of radar reflectors, windage problems occurred, causing the buoys to lie flat on the water, further compounding problems in locating the gear.

In the proposed prototype, the overall length and weight of the buoys has been decreased which provides an effective solution to all of the problems identified with the size of the original marker buoy. The proposed minimum mast height of 1.5m above the surface of the water and the associated reduction in weight of the buoy represents a significant reduction in the overall dimensions of the buoy. It is hoped that these measures will allow the crews of all EU vessels to operate in an environment that presents less risk to their health.

The review of Gear Marking Systems in use in EU waters prior to EC 356 of 2005, reveals that the height above water of marker buoy masts in general use by EU set-net and longline vessels, varies from 1 to 3m. It should be noted that prior to the introduction of EC 356 of 2005, there was no legislative requirement for gear marking buoys to be equipped with a mast. The disparity in mast heights between fishers and fisheries, reflects the practicalities faced by individual fishers and the restrictions vessel size places on them, in terms of the overall dimensions of buoys they can practically accommodate on board. It is suggested that if the proposed amendments to the regulation are implemented by the EC, then fishers that wish to

use buoys equipped with longer masts will continue to do so, the crucial difference being that fishers with smaller vessels are also accommodated.

Radar reflectors

A number of problems were found with radar reflectors. During the BIM practicality trials, the sharp metal edges caused major safety concerns during handling on small vessels at sea. Issues regarding the functionality of radars also arose as it was not possible to detect the radar reflectors until the vessel was less than a half a mile away and only when the gain on the radar was increased to a high level. Fishermen contend there is no need for radar reflectors as most gillnet vessels stay with their gear and provide the positions to other vessels operating in the area. In addition, an increased number of buoys with radar reflectors in an area where beam trawlers, potters and gillnetters are operating makes watch keeping more difficult as the number of targets in a small area is increased significantly. This can also negatively affect other sea users such as yachts and commercial shipping.

The proposed removal of the requirement for marker buoys to carry radar reflectors provides a solution to these problems. This omission is supported by expert opinion as documented in the report commissioned by the MAIB which advised that spherical radar reflectors of 25cm diameter do not function satisfactorily and their use is not recommended. This is further corroborated by the results from the trials carried out as part of this study that showed a detection range of 0.5nm in calm conditions and it to be undetectable in rough weather. The differences between the practices of long soak and short soak set-net fisheries has been highlighted during the course of this review. Short soak set-net fisheries are more likely to be monitored by the owner vessel than long soak set-net fisheries. No buoy can substitute for communication with fishers and alternative communication systems between fishers and other sea users are discussed later in this report under Section 7.1...

Lights

The use of flashing or constant lights, with a visible range of 2nm in clear conditions at night, represents an increase in cost to netters not already using them. The requirement to use one light instead of two on the western end marker buoy will result in some reduction in costs. In addition, it is hoped that as demand rises for gear marking lights so too will the availability of more efficient alternatives such as solar powered LEDs which will also assist in reducing costs in the long term.

6.1.2 Additional Components

Although not currently utilised in commercial fisheries the following devices are commercially available and could also be considered in drawing up proposed prototype GMS and improve the efficiency of the systems adopted. The adoption of better technologies in the construction of buoys in the future would enhance the regulations.

6.1.2.1 Rechargeable batteries

Flashing lights with photo cells which restrict light emission to hours of darkness are the most common type of light used in commercial fisheries. These units cost approximately €25 each and are visible for up to 2 nautical miles. Even with the photo cells, however, the alkaline batteries in these lights last a maximum of 7 days. Replacing batteries in these devices costs around €200 per annum and environmental issues arise regarding the correct disposal of expired batteries. Using rechargeable batteries may assist in decreasing the cost and waste associated with alkaline batteries. The amount of handling may actually increase for fishermen though as using them would require fishermen to maintain multiple charging devices in addition to physically replacing batteries in lights at intervals of several days.

6.1.2.2 Solar powered LED lights

Solar powered LED lights are commonly used on large marine moorings such as ship navigation buoys and aquaculture sites. These devices range in cost from around €200 for a basic factory programmed unit with a range of 1 nautical mile up to €350 and more for more complex user programmable devices with ranges of 2 or more nautical miles. Battery lives range from 3 – 5 years so the devices potentially require no maintenance or additional cost during this period, providing major advantages over the alkaline battery powered basic lights. The cost of the solar LEDs is initially relatively high and their durability under the harsh working conditions of commercial fisheries has yet to be tested. If suitably robust devices can be sourced, however, the units could pay for themselves in less than 2 years with major additional environmental benefits by negating the need to dispose of large quantities of alkaline batteries.

6.1.2.3 Radar Flags

Radar flags which are purported to be radar visible for up to 4 miles are commercially available from manufacturers in the US. They cost $60 per flag and may offer some potential as an alternative component to standard radar reflectors (www.radarflag.com).

6.1.2.4 Telescopic Masts/poles

Telescopic poles which typically consist of two x 3.1m aluminium poles of different diameters so that one slides down into the other for easy storage when not in use are commercially available from companies such as Lindgren Pitman in the US (www.lindgren-pitman.com). These masts may be of use in fisheries where a relatively large number of buoys need to be carried and storage space is limited.

6.1.3 Economics

6.1.3.1 Cost of gear marker buoys

Based on the earlier BIM trials and the specifications of the proposed prototype buoy, Table 10 below outlines the costs of rigging a general specification marker buoy prior to the regulation, the marker buoy prescribed in the regulation buoy, and the prototype buoy proposed in this study. These costs are based on prices quoted from an Irish supplier. The prototype buoy is approximately one third of the cost of the original EU regulation buoy but still costs almost 70% more than the general buoys used before the regulation was introduced.

Table 10 Cost comparison of buoys

Component	Cost per Unit	No. Required per Fleet of nets (<5 miles length)		
		Pre- existing buoy	EC regulation buoy	Proposed buoy
Radar reflector	€15.00	0	2	0
Luminous bands	€01.30	2	3	2
Flashing light	€17.50	0	3	2
Batteries (D cell)	€02.75	4	6	4
Flag	€02.25	2	3	2
Float polystyrene	€09.50	1	0	1
Float - inflatable	€32.50	0	2	0
Weight (2.5kg each)	€07.80	2	5	2
Bamboo pole (5.8m approx.)	€08.50	1	4	1
Total cost		€51.70	€247.65	€86.70

6.1.3.2 Cost implications for selected fisheries

An analysis of the costs of the buoys used prior to regulation, costs using the EU buoys and costs with the proposed gear marking system for the hake longline, hake gillnet and monkfish are detailed in following sections.

Hake Longliner -- [Typical length of one longline – 250m]

Prior to Regulation

Conducting effort in shallow waters (< 250m) a typical hake longliner would work up to 4 fleets per day. It would be thus necessary to have onboard a total of;

- Dhan buoy (end marker) 16
- "Cabra" (intermediary buoys) 16

It should note that with the saturation of maritime traffic coupled with increased speed with regards to gear retrieval and the shallower depths the gear markers may be of a less durable construction than those used in deep water.

The same vessels can work in deeper waters (> 350m) in the same trip and here it would be a case of working up to 2 fleets. As most of the deepwater liners would work an accompanying rope along with the lines there is a greater spacing between the intermediary buoys. Nevertheless such extra end and intermediary buoys would have to be carried onboard:

- Dahn buoy (deepwater) 8
- "Cabra" (intermediary buoys) 5

Table 11 shows the summary gear marking costs for this vessel based on the assumptions above.

Table 11 Summary of Costs prior to the regulation for this fishery

Marker Type	Quantity	Cost	Total Cost to vessel
Dahn buoys	16	€ 51.70	€ 827.20
Dahn buoys	8	€ 75.00	€ 600.00
Buoy loss (per annum)	30% (8)	c. € 51.70	€ 413.60
Intermediary	21	c. € 75.00	€ 1575.00
Buoy loss (per annum)	50% (10)	c. € 75.00	€ 750.00
	Total cost to vessel		€ 4165.80

Post-Regulation

On introduction of the regulation the buoy system used would not change except that the cost of the end markers would have increased considerably, while the addition of intermediary buoys as per Article 14 of the Regulation effectively means an increase of approximately 6 dahn buoys. As Table 12 shows **the total cost to the vessels has more than doubled.**

Table 12 Summary of Costs post regulation

Marker Type	Quantity	Cost	Total Cost to vessel
Dahn buoys	30	c. € 247.65	€ 7429.50
Buoy loss (per annum)	30% (8)	c. € 247.65	€ 1981.20
Intermediary	21	c. € 75.00	€ 1575.00
Buoy loss (per annum)	50% (10)	c. € 75.00	€ 750.00

	Total cost to vessel	€ 11735.50

Prototype system

Based on the recommendations for the prototype buoy system, the vessels total cost in relation to the marking of gear would incur approximately a 29% increase to the systems used prior to regulation as shown in

Table 13 below:

Table 13 Summary of Costs using the Prototype Gear Marking System

Marker Type	Quantity	Cost	Total Cost to vessel
Dahn buoys	16	€ 86.70	€ 1387.20
Dahn Buoys	8	€ 109.70	€ 877.60
Buoy loss (per annum)	30% (8)	(4 x 86.7 + 4 x 109.7)	€ 785.60
Intermediary	21	c. € 75.00	€ 1575.00
Buoy loss (per annum)	50% (10)	c. € 75.00	€ 750.00
	Total cost to vessel		**€ 5375.40**

Monk Tangle-netter – [Typical set net length – 50m]

Prior to Regulation

Regardless of the depths where fishing effort is being conducted a typical monk netter would work up to 6 fleets of nets at any one time. It would be thus necessary to have onboard a total of;

- Dahn buoy (end marker) 24
- "Cabra" (intermediary buoys) 12

It should be noted that with nature of the gear being used and the extended soak times within this fishery the gear markers are of a heavy duty construction. Similar to a hake longliner the total cost with regard to gear marking prior to the regulation would have been in the region of € 3,750. Table 14 summarises the costs for this type of vessel.

Table 14 Summary of Costs prior to Regulation for A Monkfish Tamglenet Vessel

Marker Type	Quantity	Cost	Total Cost to vessel
Dahn buoys	24	c. € 109.70	€ 2632.80
Buoy loss (per annum)	30% (8)	c. € 109.70	€ 877.60
Intermediary	12	c. € 75.00	€ 900
Buoy loss (per annum)	50% (6)	c. € 75.00	€ 450
	Total cost to vessel		€ 4860.40

Post-Regulation

As with the hake longline vessel the requirement for intermediary buoys has effectively meant an increase of approximately 12 extra dahn buoys. Again the total cost to the vessels have more than doubled as shown in Table 15.

Table 15 Summary of Costs as per the Regulation for a Monkfish Tanglenet Vessel

Marker Type	Quantity	Cost	Total Cost to vessel
Dahn buoys	36	c. € 247.65	€ 8915.40
Buoy loss (per annum)	50% (18)	c. € 247.65	€ 4457.70
	Total cost to vessel		€ 13373.10

Prototype

Based on the recommendations for the prototype buoy system, the vessels total cost in relation to the marking of gear would incur approximately a 6% increase to the systems used prior to regulation as shown in Table 16 below:

Table 16 Summary of Costs adopting the Prototype System

Marker Type	Quantity	Cost	Total Cost to vessel
Dahn buoys	24	c. € 109.70	€ 2632.80
Buoy loss (per annum)	30% (8)	c. € 109.70	€ 877.60
Intermediary	12	c. € 75.00	€ 900.00
Buoy loss (per annum)	50% (10)	c. € 75.00	€ 750.00
	Total cost to vessel		€ 5,160.40

7 Scope of the regulation

Currently EC No. 356/2005 applies to vessels fishing in community waters outside 12 nautical miles measured from the base lines of the Coastal Member States. A number of issues with this geographical limit were raised by parties who answered the questionnaires. Yachtsmen and owners of pleasure craft stated that negative experiences with static fishing gear markers normally occurred within 12nm of the coast. Enforcement agencies acknowledged that the size of the proposed marker buoys makes the legislation problematic for small vessels. The same point was made by the North Sea Regional Advisory Council (NSRAC) focus group on Gillnet fisheries, which also suggested that gear marking systems should be standardised in EU waters for all net types inside and outside 12nm. This should be discussed further with the RAC's to agree the appropriate scope for future regulation.

In its current format the regulation permits vessels of any size to deploy large quantities of fishing gear inside 12nm where principal navigational problems have been highlighted by other marine stakeholders. Changing the scope of the regulation to apply to vessels of 12m in total length or over may help to address this situation. Larger vessels which carry the most fishing gear would be required to use standardised GMS in all areas. Smaller vessels under 12m are likely to use less gear would be precluded from the regulation. This type of restriction would operate on the same basis as EC No 812/2004 which requires vessels of 12m in total length or over to use "pingers", thereby simplifying C&E procedures.

Given the large quantities and diverse range of under 12m vessels using static gears in EU waters, it is difficult to make a specific recommendation on the use of a standardised GMS for this sector. It is clear from the results of the questionnaire, however, that some form of standardised GMS would be desirable for smaller vessels and this type of approach has been successfully adopted in countries such as the US and Australia.

In order to encourage the use of standardise gear marking system, consideration should also be given to funding first replacement of gear marking systems under the European Fisheries Fund (EFF). The precedent for this is the allowance for the funding of pingers required under regulation 812/2004 under the previous FIFG. This would assist fishermen in complying with the regulations, speed up the process of standardisation and may also lead to further development of more efficient marker systems. The testing of more advanced component parts as outlined in section 6.1.2 could also be considered for research funding in the future.

7.1 Codes of Conduct

On fishing grounds where both static and towed gears operate in close proximity, gear conflicts can occur, commonly resulting in static gear such as gillnets or longlines being removed or damaged by towed gears such as trawlers, which may also negatively affect the towed gear operations. Formal systems of agreement and communications also known as Codes of Conduct (COC) are currently successfully employed in some commercial fisheries.

For example a COC exists between pot/trap fishermen which target edible crabs, and demersal and pelagic trawl fishermen off the north west coast of Ireland. Under the COC pot fishermen deploy their gear in a north south direction in certain areas, leaving swathes of suitable seabed clear for trawlers to operate. In addition pot fishermen relay the positions of their pots to an independent third party who collates and forwards this information to all trawler men operating in the same area. The COC also includes a mechanism for compensating vessels for lost or damaged gear, provided the claimant has carried out fishing operations in accordance with the agreement. Similar to the Irish COC a less formal agreement also exists between static and towed gear fishermen off Scotland. These agreements have worked well at national

level and this type of mechanism could be used as a potential solution to gear conflicts at multinational level in common access EU waters. This type of approach could be examined further and developed under the Regional Advisory Councils (RACs).

8 Alternative Gear Identification Systems

In its present format the EC No. 365/2005 relies solely on the display of a vessel's registration number on maker buoys as a basic system of identifying which fishing gear belongs to which vessel and simple tagging of individual nets with durable tags as required under Article 7 and 8 of the regulation. These provisions are is simple and effective but vessel identification is the only piece of information provided and this is of limited value to other fishing vessels and C&E agencies in terms of interpreting more detailed gear characteristics. For example other fishing vessels seeking to carry out fishing operations in the same general area would benefit if more information was available on the specific direction in which the gear was deployed. Also C&E may require information on the time or period of gear deployment as is required in deepwater gillnet fisheries under EC No. 40/2008. A number of potential systems could be used to address these issues which could be of benefit to fishermen, C&E and other vessels.

8.1 Radio Frequency Identification Tags (RFIDs)

Radio-frequency identification (RFID) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. The technology basically consists of an RFID reader which picks up information in the form of through air radio waves, from an active or passive RFID tag. The technology is widely used in land based industries but to date has been of limited use in marine applications due to problems inherent in a harsh working environment and interference of water and steel with transmitted radio waves. Recent technological advances suggest that these devices could now be used in marine applications such as GMS which could potentially benefit fishermen, C&E and also potentially work as navigational aids.

In their simplest format RFIDs located on GMS could store a vessel registration number which could be linked to more detailed information such as vessel name, registration number, port, owner, and contact details. Information on gear characteristics such as deployment position and date, gear and direction could also be included and these data could possibly be updated automatically on tags at the time of deployment through transmissions from the ships GPS.

The data on the tags could be made available in various levels of detail to parties in possession of a suitable receiver and possibly a database containing associated data, such as C&E, and other fishermen in compliance with relevant COCs. It may also be possible to combine RFID systems with the Automatic Identification System (AIS). AIS provides a means for ships to electronically exchange ship data including: identification, position, course, and speed, with other nearby ships, which could be a very useful navigational aid. BIM are currently involved with a Spanish electronics company in a project which aims to test commercially available, credit card sized RFIDs with a reading range of 60m in commercial fishing conditions.

8.1.1 Trials with RFID Tags

These devices were preliminary tested by BIM and engineers from the Spanish company AdActiv Ltd as part of the trials referred to in Section 5.4. The trials were carried out using the same vessels (mfv "Rebecca Jane" and mv "Osprey") and in the same areas in Waterford Harbour.

All of the equipment was supplied by AdActiv and is commercially available and used within the Industrial, Medical and Scientific arenas. The RFID system tested uses special Active Tags. An Active tag is a self-powered electronic device with the ability to receive data through a transmission from a transceiver located within the wheelhouse of the owner vessel,

store it and once the tag is deployed, actively transmit the data-set at set time intervals to be received via a dedicated antenna onboard other vessels when within reception range. Figure 23 shows a schematic diagram of the system deployed.

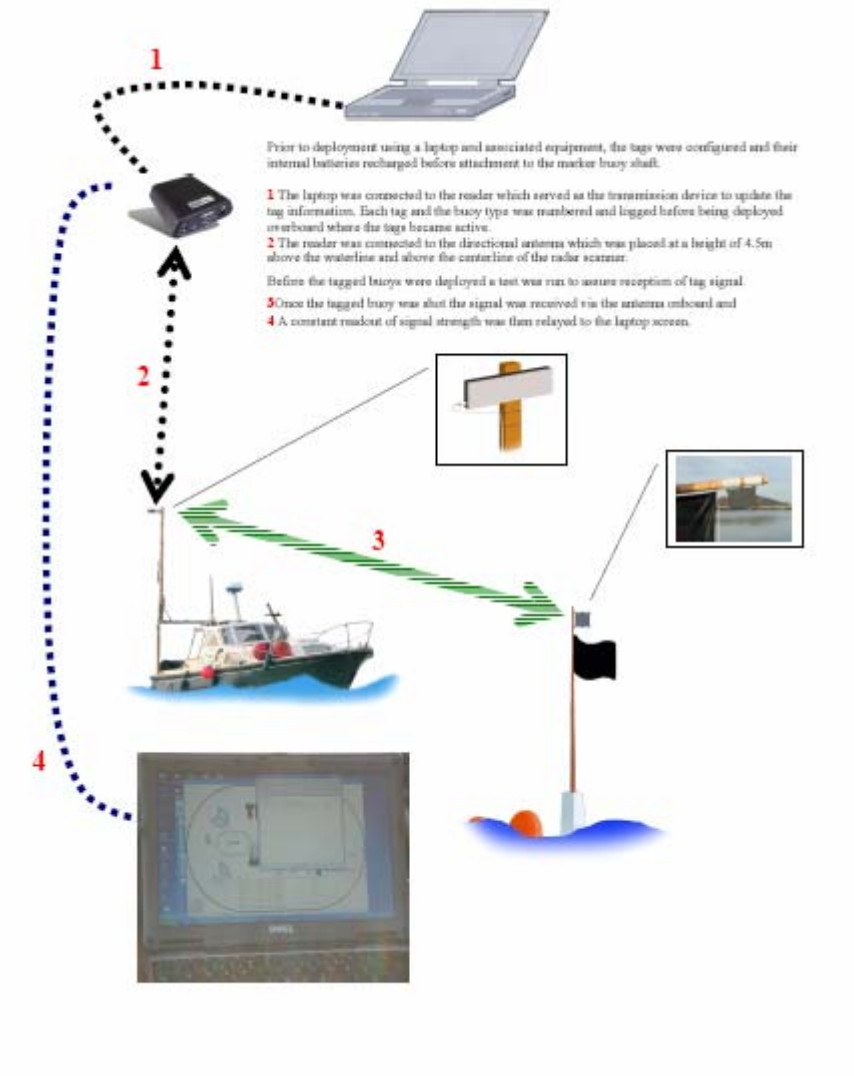

Figure 23 Diagram of the component parts of the RFID system tested

Specification of Trial Equipment

The Active tag used for these trials is as shown in Figure 24. It works off two different frequencies as follows:

- 125KHz (LF) for activation and to receive specific data to be stored into the internal memory
- 868MHz (VHF) for transmission of the signal to be detected by the receiver unit

Figure 24 Active Tag

The tags used have a 1kb of memory (1000 characters). The device is sheltered in an IP64 reinforced plastic case adequate for industrial purposes and has the basic standard characteristics as shown in Table 17.

Table 17 Basic specification of Active Tag

Active tag ID 004		
Receiving	Band	LF
	Frequency	125 KHz
Transmission	Band	UHF
	Frequency	868MHz (EC ISM Band)
	Power	+ 2dBm
	Range	50 m (on land – line of sight)
Data	ID	134 million possibilities
	Signalization	State of the battery
Electrical specs	Source	Lithium battery: 2,2 to 3,2 Vdc
	Autonomy	2.000.000 operations (~3 years)
Environmental	Storage Temp	-20^0 C to + 60^0 C
	Working temp	-10^0 C to + 50^0 C
Mechanical	Dimensions	106 x 76 x 12 mm (HxLxD)
	Weight	72 g +/- 5%
	Protection	IP65

The tags were attached to the top of the buoys above and below the flag as shown in Figure 25.

Figure 25 Tag attached to top of buoy marker

A standard RFID Tag-reader, the LTR-003 as shown in Figure 26 was connected to a labtop computer and to a directional antenna to establish the detection limits for reception of signals from the active tag.

Figure 26 LTR-003 RFID reader unit

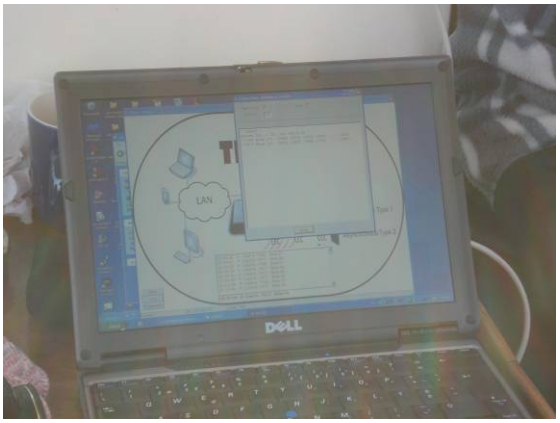

Figure 27 Labtop connected to reader unit with information received

The specification of the reader unit is given below in Table 18.

Table 18 Specification of LTR-003 unit

Reader LTR-003		
Receiving	External	868MHz (EC ISM Band): ANT-

	Module	003
Transmission	Band	LF
	Frequency	125KHz (EC ISM Band)
	Range	1,5 m
Communication interface with a PC	RS232 or TCP/IP	DB9 connector / RJ45
Electrical specs	Source	External 220Vac/ 12Vdc converter
	Power consumption	15 Watt
Environmental	Storage Temp	-20^0 C to + 60^0 C
	Working temp	-10^0 C to + 50^0 C
Mechanical	Dimensions	140 x 130 x 37 mm
	Weight	170 grammes
	Protection	IP65

The directional aerial connected to the reader is shown in Figure 28. This aerial was fitted at a height of 4.5m above the waterline and above the centreline of the vessel's radar scanner as shown in Figure 29.

Figure 28 Directional Aerial

Figure 29 Position of Directional Aerial

The specification of the aerial is given below in Table 19.

Table 19 Specification of the Directional Aerial

External dimensions:	86 x 105 x 10mm (45° version) 256 x 105 x 10mm (25° version)
Material:	Reinforced plastic
Humidity protection:	IP65
Colour:	White / blue
Radio Regulation:	ETS300-440Rx, TX Class8, Duty Class2
Safety:	EN 50364:2001
Frequency:	2.4GHz
Back ratio:	45db
Storage temp.:	-40°C up to +70°C
Operation temp.:	-10°C up to +60°C
Reading Range:	Up to 60m

Trials Procedure

A decision was made to initially conduct the test in calm waters to facilitate any modifications necessary. Once confirmation of reception was possible and the tags worked adequately the tagged buoy was then deployed in open sea. Initially the tag was placed between the lights on the regulation buoy but due to the windage problems reported with this buoy causing it to lean over awkwardly, the tag was transferred to the prototype marker and placed at the highest point above the flag, consideration being given to swell height and the possibility of tilting.

Thus for the trials an unique Active tag and deployed by the mfv “Rebecca Jane”, which remain on station with the buoy during the trials. As there was no need for a detailed array of information, the tag was configured to send only a simple test message made up of a letter and four digits i.e. C-7191 L1234. In addition a three digit code indicated the signal level along with a further three digit code that gives the average signal strength over the last 15 data strings.

The reader unit connected to the labtop was installed on board the mv “Osprey”. The specific position coordinates were taken as a reference position, identified as “Point Zero”. This position was plotted on the vessels GPS. Then the signal was recorded on the laptop screen and the vessel proceeded to steam away from the buoy until that signal was negligible. The vessel then turned around and approached the buoy until reception was resumed. Once again the distance was logged. The vessel turned around once again, following a steering a route around the buoy at the maximum detection range. All distances relative to Point Zero of the detection or loss of signal were recorded as indicated by Figure 30.

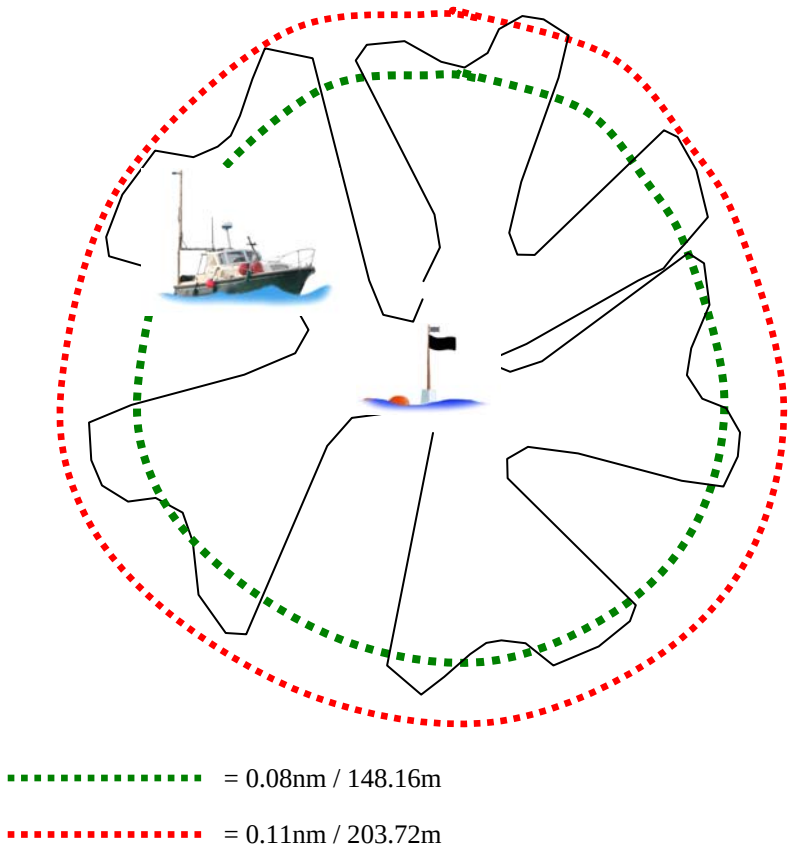

Figure 30 Plan of route to detect suitable reception of data set from tag on marker buoy

This pattern was executed at all points around the marker buoy and the broken red line depicts the maximum range achieved. Similarly the broken green line depicts the maximum range achieved in open sea conditions.

Results

Following initial testing two test runs were completed as follows:

1st Deployment

The tagged buoy was deployed in a position just outside of the shipping channel between Shelburne Bay and Catherine's Bay at 52° 17.50"N/ 006° 58.93"W. Weather conditions were Southerly Force 2-3 and there was a 2.1 knot tide running in that section. The buoy pole was tilting approximately 30° off the vertical from the effects of tide and wind. Table 20 summarizes the results obtained.

Table 20 Logged distances as per signal received from the tag covering a track around the tagged buoy (points on the red dashed line)

Logged Distances in nautical miles at 13 random points around the tagged buoy in nautical miles												
0.10	0.08	0.09	0.11	0.10	0.11	0.11	0.12	0.13	0.10	0.11	0.08	0.09

2nd Deployment

The tagged buoy was deployed off Creadan Head in open sea conditions at position 52°10.315"N/ 006° 56.833"W. Weather conditions were fine, Southerly Force 2 with a 2m swell running and bottom of the tide. Table 21 summarizes the results from this test

Table 21 Logged distances as per signal received from the tag covering a track around the tagged buoy (points on the green dashed line)

Logged Distances in nautical miles at 7 random points around the tagged buoy in nautical miles						
0.05	0.06	0.08	0.07	0.06	0.06	0.07

From the tests completed maximum detection distances were recorded and found to be inside a consistent radius of 0.08 nautical miles and 0.11 nautical miles or 148.16m and 203.72m. In the heavier weather conditions in the exposed sight, detection range was slightly reduced to 0.08 nautical miles.

Discussion

Bearing in mind that the equipment used in this trial was of a standard land based application where the effective range is calculated at < 60m, the achievement of logging reception of all data transmitted from the tags over a distance of between 148.16m and 203.72m was encouraging. Up to these limits the reception of the full character set as preprogrammed into each tag was received. Arriving at, and beyond these limits, partial information was logged with no signal received beyond 0.13nm (240.76m). The tags used were placed at the highest point of the marker buoy (c. 1.97m above the waterline) and consideration was not given to placing the tags at other heights as this exercise was purely to ascertain the viability of such RFID tag information being received over a distance.

In this particular trial a directional antenna was used as applicable to the systems use on land. However, as the principle of a directional antenna is the radiation or reception of a signal in one direction, this is not particularly suitable for a marine application. Therefore an Omni directional antenna, which radiates or receives signal uniformly in one plane with a directive pattern shape in a perpendicular plane, usually the horizontal one parallel to the earth's surface, would be required to make this system effective for marine usage and would almost certainly increase efficiency.

It is concluded from this short trial that Radio-frequency Identification (RFID) technology could be an effective solution for the remote identification of gear markers, however there is a need for further development with regards to the following:

- The design of a simple user-friendly on-board transceiver capable of being used by the skipper and capable of uniquely identifying each tag, updating the tags position (GPS coordinates) and loading any other data required prior to their deployment.
- The design of the tag casing needs to be improved to be suitable for the harsh conditions encountered in the marine environment and the possibility of the marker buoy being submerged (water pressure).
- The design of the tag needs to facilitate its deployment on the shaft of the marker or as a collar on the Intermediary Buoy, including the redesigning of the duplex antenna providing an absolute omni directional radiation
- The design of a simple user-friendly on-board human interface, capable of being used by fishers, control and enforcement and other marine users.
- Definition of onboard reader capabilities and respective software, in order to give out the necessary information, depending on the destination groups.
- The reshaping and modification of the physical and electronic characteristics of the external antenna carried onboard such other maritime user vessels
- Design of adaptor to facilitate AIS reception of GMS data.

Annex 8 details the component parts required and the potential capabilities of a potential commercial system.

8.2 Acoustic systems

A number of subsea communications systems are used in marine industries such as oil and gas, which transmit acoustic signals at specific frequencies from transmitters connected to sub sea structures, to receivers located on ships or other marine platforms which decode the signals (www.subsea.org). Other acoustic systems include long range cetacean deterrent (pinger) detection devices which have been developed by the German government to detect pingers attached to gillnets from C&E vessels which possess hydropone/receiver systems from a distance in excess of 400m (ICES WGFTFB, 2008).

This type of technology could potentially be applied to GMS, with transmitters located for example at the bottom of surface floats or near the counter weight, and transmitted signals picked up by receivers onboard C&E. If they can be made cost effective, these systems may represent a less sophisticated but potentially more robust solution than RFIDs but to date have not been tested.

9 Conclusions

Conclusions Specific to EU Regulation 365/2005

1) It is apparent from this review of International gear marking legislation that the current European and Norwegian regulations are the most comprehensive sets of regulations in place. As such they represent the most significant attempt to address the issue of standardisation of gear marking.

2) Basic marker buoy systems which are cheap to construct and carry few components, are used in fisheries where there is a high probability of losing them through collisions or interactions with other vessels. More sophisticated and robust marker buoy systems tend to be used by large vessels travelling relatively long distances from home and/or operating in relatively deep water.

3) On the basis of the series of interviews conducted with fishermen it is apparent that fishermen consider the detailed specifications of both the EU and Norwegian buoys make elements of them complex and impractical as well as expensive.

4) It is also apparent that within the EU there is limited compliance with the regulations and only limited attempts to enforce them by the fisheries inspectors. This is the strongest possible indication that the legislation is not achieving its desired objectives.

5) In Norway it is reported that there is better compliance with the regulations by larger longline and gillnet vessels but that radar reflectors, which are optional are not used by any vessels and lights are fitted but not always operational with the fishermen preferring to use reflective tape and searchlights to locate gear at night time.

6) The review of legislative requirements, gear marking systems currently in use, and stakeholder opinions from the interviews conducted have been used to design a new prototype gear marking system.

7) In the proposed prototype, the overall length and weight of the buoys has been decreased which provides an effective solution to some of the problems identified with the size of the original marker buoy.

8) The requirement for marker buoys to carry radar reflectors is considered unnecessary and this is supported by expert opinion as documented in the report commissioned by the MAIB which advised that spherical radar reflectors of 25cm diameter do not function satisfactorily. This has been corroborated during the trials carried out.

9) The requirement to use one light instead of two on the western end marker buoy will result in some reduction in costs. In addition, it is hoped that as demand rises for gear marking lights so too will the availability of more efficient alternatives such as solar powered LEDs which will also assist in reducing costs in the long term.

10) The prototype buoy is approximately one third of the cost of the original regulation buoy, although is still slightly more expensive to make than simple buoys commonly used before the regulations were introduced.

11) The proposed amendments to the EC regulation buoy will not interfere with the aim of the European Commission which is to provide a safe and standardised specification for net and longline marker buoys, ensuring orderly conduct of fishing operations in EU waters. This has been partial verified during trials conducted as part of this study.

Other Conclusions relating to Scope of the Regulations, Gear Identification and Codes of Conduct

12) It is clear from the questionnaires that many of the difficulties with the marking of gear occurs within 12 nautical miles, particularly with leisure craft and a standardised system inside and outside 12 nm would be desirable. This is backed up by the gillnet focus group of the NSSRAC (for gillnets only).

13) Codes of Conduct for the relaying positional information of static gears are a simple and practical way of reducing gear conflicts and if respected reduce the need for very detailed gear marking regulations.

14) Trials carried out as part of this study have shown it possible to transmit data from RFID tags mounted on the buoys and transmit this data to a vessel fitted with a reader unit at a distance of between 150m to 200m from the tagged buoy. With some modification this system may have commercial applications for improved gear identification for fishermen control and enforcement agencies and other marine users.

15) Acoustic detection systems may also provide a potential way for better identification of static gear but have not been tested specifically for this purpose as yet.

10 Recommendations

Specific to EU Regulation 365/2005

1. The opinions of fishermen, enforcement agencies and other stakeholders interviewed as part of this project should be taken into account in modifying EC No. 356/205.

2. Proposed alterations to the end marker buoys specifically include:

    a) Removal of the requirement to double the number of components on the buoy in the western sector. Colour coded flags are proposed as a viable and less cumbersome alternative.

    b) Removal of the requirement to use radar reflectors

    c) Requirement to use an end marker buoy of at least 1.5m in height above sea level, which includes at least one colour coded flag, one constant or flashing light, one reflective band, and a stabilising weight of sufficient weight to ensure that the marker buoy remains upright.

    d) Removal of the requirement to use intermediary buoys of the type specified in the current regulations. Simple polyform float intermediary buoys as used as standard by fishermen should be allowed to be used.

    e) The colour of marker buoys should not necessarily be specified. Standard red/orange polyform buoys or white polystyrene buoys should be permitted.

    f) Cords linking the end marker buoy should be of a submersible material but cords joining the marker flags to any subsidiary buoy should be allowed to be rigging in floating rope to facilitate retrieval.

    g) All other provisions of the regulation regarding display of identification on buoys, mast height, the use of luminous bands and shape of flags should remain unaltered.

3. Financial assistance, possibly through the EEF, should be provided to fishermen to assist them in coping with the increased costs of upgrading their gear marker buoys in order to comply with EU regulations.

4. This assistance could be extended to assist fishermen in testing and purchasing higher priced marker buoy components, such as suitable solar powered LED lights, which have major environmental benefits over cheaper models which use alkaline batteries.

Other Recommendations

5. Depending on final scope of EC No. 356/2005, introduction of a standardised end maker buoy for vessels less than 12m or vessels operating inside 12 nautical miles should be examined and also discussed at RAC level.

6. Pot or trap fishing gear which in terms of end marker buoys operate under the same basic principles as other forms of entangling gear, should also be defined as a form of ‘passive gear’ for the purposes of the regulation. Although given the number of fisheries and vessels this may not be practical. This should be discussed with the RACs.

7. With support from the RACs, fishermen should be encouraged to draw up codes of conduct to improve communications between static and towed gear fishermen, on the positions and deployment characteristics of static gear.

8. Based on the results of trials completed as part of this study further research should be encouraged on the application of new technologies particularly RFIDs to gear identification systems as a means of improving the quality of information associated with static fishing gear, control and enforcement and navigational safety. Alternative systems using acoustic detection may also be considered.

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Annex 1: Glossary of Terms

AFMA - Australian Fisheries Management Authority

AIS - Automatic Identification System

BIM – Bord Iascaigh Mhara (Irish Sea Fisheries Board)

CCAMLR - Convention on the Conservation of Antarctic Marine Living Resources

C&E Control and Enforcement

COC - Codes of Conduct

EEZ – Exclusive Economic Zone

EU – European Union

EFF – European Fisheries Fund

FAO - Food and Agriculture Organization

GMS - Gear Marking Systems

ICES – International Council for the Exploration of the Sea

IMO - International Maritime Organisation

ISEFPO.- Irish South and East Fish Producers Organisation

IUU – Fishing Illegal, Unregulated and Unreported

MAIB - Marine Accident Investigation Board

MARPOL - International Convention for the Prevention of Pollution from Ships

NAFO - Northwest Atlantic Fisheries Organisation

NEAFC - North-East Atlantic Fisheries Commission

NSRAC – North Sea Regional Advisory Council

NWWRAC – North Western Waters Regional Advisory Committee

RAC's – Regional Advisory Committees

RFID – Radio Frequency Identification

SEAFO - South East Atlantic Fisheries Organisation

SFPA – Sea Fisheries Protection Authority (Ireland)

UNFSA - United Nations Fish Stocks Agreement

WGFTFB – Working Group Fishing Technology and Fish Behaviour

Annex 2: Legislation

European Legislation

Commission Regulation (EEC) No 1381/87 of 20 May 1987 establishing detailed rules concerning the marking and documentation of fishing vessels.

Commission Regulation (EC) No 356/2005 of 1 March 2005 laying down detailed rules for the marking and identification of passive fishing gear and beam trawls

Commission Regulation (EC) No 1805/2005 of 3 November 2005 amending Regulation (EC) No 356/2005 laying down detailed rules for the marking and identification of passive fishing gear and beam trawls

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Washington Fish and Wildlife Commission. WAC 220-52-040, Commercial Crab Fishery--Lawful and Unlawful Gear, Methods, and Other Unlawful Acts;

North Pacific Council Area. Regulations 5 AAC 34.051, AAC 34.051 and AAC 39.280.

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Annex 3: Gear Marking System Specifications By Country

Country : Spain

Fishery	Demersal Longline/ Net Fishery >100m	Surface Longline Fishery (Bluefin)
Mast height above sea level	c.2.5m	2m
Mast material	Steel/ Nylon	Radio antenna covered with plastic pipe
Float specification	CC3 Polyform Red	CC3 Polyform Red
Counter weight type	Steel bar twice diameter of dahn pole shaft	solid stainless steel
Weight of buoy	Unknown	Unknown
Reflective band	No	No
Flag(s)	No	No
Light(s)	yes, one white or blue	No
Light specifications	white flashing or blue flashing	None
Western and eastern end of gear identification	No	No
Radar reflector	No	sometimes/ spherical
Other accessory	Radio transmitter (27mhz am)	Radio transmitter (27mhz am)
Ownership markings	Vessel name & reg number	Vessel name & reg number
Cost to construct individual marker buoys	Unknown	Unknown

Country: France

Fishery	Demersal Longline/ Net Fishery >100m	Demersal Longline/ Net Fishery <100m	Surface Longline Fishery (Albacore)
Mast height above sea level	up to 2.5m	up to 3m	2m
Mast material	Bamboo	Bamboo - in the case of no dahn pole being used, one or two plastic 5 litre bottles	Radio antenna covered with plastic pipe
Float specification	Polysterene Floats (Various shapes/ forms - 2500gr-12000gr flotation)	Polysterene Floats (Various shapes/ forms - 2500gr-12000gr flotation)	CC3 Polyform Red
Counter weight type	chain and cement inside a 2-litre plastic botle	chain and cement inside a 2-litre plastic botle	solid stainless steel
Weight of buoy	c.4kg	c.4kg	Unknown
Reflective band	Yes	Yes	No

Flag(s)	Yes	Yes	No
Light(s)	No	No	No
Light specifications	None	None	None
Western and eastern end of gear identification	No	No	No
Radar reflector	No	No	sometimes/ spherical
Other accessory	None	None	Radio transmitter (27mhz am)
Ownership markings	Vessel name & reg number	Vessel name & reg number	Vessel name & reg number
Cost to construct individual marker buoys	c. €30.00	€ 0.00 - c. €30.00	

Country: Ireland

Fishery	Gillnet/ tanglenet/ wrecknet fisheries	Pot fisheries (brown crab) outside 12nm	Pot fisheries (inside 12nm)
Mast height above sea level	1 to 3m	n/a	n/a
Mast material	Bamboo	n/a	n/a
Float specification	Polystyrene	Polyform buoys	Polyform buoys, polystyrene, air filled cartons etc.
Counter weight type	Weight from sash window, scaffolding tube or pieces of scrap metal	n/a	n/a
Weight of buoy	2 to 5kg	1kg	Less than 1kg
Reflective band	Yes	Reflective tape use on buoys	Reflective tape use on buoys
Flag(s)	Yes (1x) red or black	No	No
Light(s)	No	No	No
Light specifications	n/a	n/a	n/a
Western and eastern end of gear identification	No	No	No
Radar reflector	No	No	No
Other accessory			
Ownership markings	Vessel registration number	Vessel registration number	Vessel registration number
Cost to construct individual marker buoys	€15 each	Buoys cost €30 to €40 each	€0 to €15

Country: UK, Denmark, Turkey

Country	UK	Denmark	Turkey
Fishery	Gillnet/ tanglenet/ wrecknet	Gillnet/ tanglenet/ wrecknet	Gillnet/ trammel nets/ longlines (Regulation)
Mast height above sea level	1 to 3m	1 to 3m	Not specified
Mast material	Bamboo	Bamboo	Not specified
Float specification	Polystyrene	Polystyrene	Not specified
Counter weight type	Weight from sash window, scaffolding tube or pieces of chain	Lead weight, metal tube/ scrap metal	Not specified
Weight of buoy	2 to 6kg	2 to 6kg	Not specified
Reflective band	Yes	No	Not specified
Flag(s)	Yes (1x) red or black	Yes (2x) red or black	Yes
Light(s)	No	No	Yes (at night)
Light specifications	n/a	n/a	Not specified
Western and eastern end of gear identification	No	No	No
Radar reflector	No	No	No
Ownership markings	Vessel registration number	Vessel registration number	Vessel registration number
Cost to construct individual marker buoys	£17 each	€20 each	Not specified

Country: Italy, Iceland, Norway

Country	Italy	Iceland	Norway
Fishery	Fixed nets and longlines (Regulation)	Anchored bottom-set nets for cod (Regulation)	Gillnets and longlines outside 4nm (Regulation)
Mast height above sea level	1 to 3m	Not specified	2m
Mast material	Wood	Not specified	Not specified
Float specification	Not specified	Not specified	Not specified
Counter weight type	Not specified	Not specified	Not specified
Weight of buoy	Not specified	Not specified	Not specified
Reflective band	No	Not specified	Mast or buoy or top sign must be equipped with light-reflecting material
Flag(s)	Yes	Not specified	Yes (2x)
Light(s)	Yes	Yes	Yes
Light specifications	Yeelow, visible for 0.5nm	White flashing (only if nets set in an area where bottom trawling occurs)	Yellow, flashing, visible for 2nm and 3 sec interval
Western and eastern end of gear identification	No	No	Yes
Radar reflector	No	No	May be subsituted for flag

Ownership markings	Yes	District and vessel registration	Vessel registration number
Cost to construct individual marker buoys	Not specified	Not specified	Not specified. Buoy requires type approval from Norway directorate of fisheries

Annex 4: Interviews Conducted

The following persons, bodies and groups completed the questionnaire.

Commercial

- Merchant Skipper
- Master Marine Pilot
- Irish Ferries
- Ferry Operator – Finistmer (France)
- Norwegian Pilot Boat Skipper

Leisure Craft

- Anon – Yachtsmen x 2

Control & Enforcement

- Irish Naval Services (2 officers)
- Scottish Fisheries Protection Agency (4 officers)
- Sea Fisheries Protection Authority of Ireland (1 officer)
- Norwegian Fisheries Directorate (1 officer)

Fishermen

- North Sea Regional Advisory Council
  - Derk Jan Berends (Chair of NSRAC gillnet Focus Group)
- North Western Waters Regional Advisory Committee
  - Ian Gatt - Trawler
  - Juan Carlos Corras Arias - Gillnetter
  - Paul Trebilcock (Cornish Fishermen's Producers Organisation) - Gillnetter
- Irish South & West Fish Producers Organisation Ltd.
- Irish South & East Fish Producers Organisation Ltd.
- Irish Fishermen
  - Ger Foley – Mellifont – Gillnetter/Trawler
  - Michael O'Connell – Gillnetter
  - Michael Foley – Western Dawn - Gillnetter
  - Richard Power – Girl Geraldine - Gillnetter
  - Michael Barrett - Helen B - Potter
  - Mick Murphy – Owner of 1 x 12m and 1 x 17m dual purpose vessels
  - John Moriarty – Celtic Sun - Gillnetter
  - Daniel Healy – Marden – Gillnetter/Potter
  - Donal Healy – Lauralena - Gillnetter
  - Ger Harrington – Trawler/Potter
  - Sean Harrington – Trawler
- Norwegian Fishermen
  - Anon - Coastal Gillnet Vessel- Straumingen
  - Ny Argo - Offshore longline and Gillnet Vessel
  - Offshore longline and gillnet vessel – Leienbris
  - Anon – Coastal gillenet
  - Peter Petterson – Coastal gillnet – Måtind
  - Gudmund Rogan –Herslep
- Spanish Fishermen
  - Anon. - Potter - M.P. Fresan
  - Anon. - Longliner
  - Sr. Jesus Fraga - M.P. Sueiras

- Angel Fernández Véquez – Longliner - M.P. Mariavidal
- Ramiro Espoxito- Longliner - M.P. Madre Querida
- Jose Antonio Pernas Prieto - Bottom Trawler - M.P. Minchos Septimo
- Manuel J.C. Monteblanco - Longliner
- Jose V. Vazquez – Longliner - M.P. Valle Fraga

- French Fishermen

Port of St. Gilles Croix-de-Vie

- Christophe Buchou – Galejeur - Gillnetter
- Patrice Favgeran – Navsica - Gillnetter
- René Guittonmean –Condor – Gillnetter/Longliner
- Stephane Boulineau –Kuala - Gillnetter
- Claude Herbretean – Majorie – Gillnetter/Longliner
- Bertrand Carpentier –Angelot - Gillnetter

Port of St. Jean de Luz

- Walter Parancle – Leuna - Gillnetter
- Patrick lespielle – Samatheo - Gillnetter

Port of Noirmoutier

- Philipe Jandreau – Corto Martez II - Gillnetter
- Phillipe Corbregaud – Sterne II - Gillnetter

Port Joinville, Ile d'Yeu

- Willy Durond – Leslaissedire – Gillnetter/Longliner
- Girard Eril – Aurore Boreale I – Gillnetter/Longliner
- Anon Skipper 1 - Gillnetter
- Anon Skipper 2 - Trawler
- Pascal Billon – Odyssee - Gillnetter
- Alan Voisin – Mariel – Gillnetter/Longliner

Les Sables d'Olonne

- José Jouneau – Anthineas - Gillnetter
- Pascal Faayf – Rochebonne – Gillnetter
- Patrick LeGendre – Spapirou - Gillnetter

Annex 5: Example of Questionnaire Used

Give the individual the reasons why this review is being carried out emphasising our desire to consult with the fishing industry and other mariners and it being a good opportunity to have a direct impact on future legislation.

1. Do you think that the EU specified buoy is an improvement on past systems (see Fig.1) given the change in materials; from bamboo to aluminium pole and addition of lights etc.

2. What radar band(s) is available to you at sea? If more than one which do you rely on most. (See note on radar below). If none please note.

3. Do you think a radar reflector is necessary/ effective on a marker buoy? Do you think that the specified type in particular is effective? If not can you suggest a more suitable type?

4. Do you think reflective tape is necessary on the marker buoy? Tape is visible in darkness when light is reflected from close range.

5. Do you think a winkie (light) is necessary on the marker buoy? EC spec is that the light be yellow, blink once every 5 secs and be visible in darkness for 2nm.

6. Do you think flags on the marker buoys are necessary? What colour in your opinion is most visible during daylight hours?

7. How would you improve the buoy's current specifications to make it a more effective gear marker?

Note on Radar Bands

Marine radar is typically X-band and S-band. Ships will typically carry both, while small vessels are limited to the smaller X-band units. X-band radar offers greater resolution and detection of smaller targets, but is more susceptible to interference from rain and seas (sea clutter). S-band radar has longer range and less interference from rain and sea clutter, but has less sensitivity for small targets.

*** Please note: Not all questions were asked to each individual and the interviews were conducting based on the experience and expertise of the individual interviewee.**

Annex 6: Other Information Sources

Technical/ fishing industry sources

1. Frank Chopin, Senior Fishery Industry Officer, FAO, Italy.
2. Huseyin Ozbiligin, University of Yelsin, Turkey.
3. Alessandro Lucchetti, ISMAR-CNR, Italy.
4. Haraldur Einarsson, Icelandic Marine Research Institute, Iceland
5. Kristin Zacharissen, Faroese Fisheries Laboratory, Faroe Islands.
6. Richard Caslake, Seafish, UK.
7. Harald Weinbeck, Institute of Fishery Technology and Fishery Economy, Germany.
8. Alain Frechet, Maurice Lamontagne Institute, Canada.
9. Nils Roar Hareide, Runde Environmental Centre, Norway.
10. Bertrand Fortino, Cooperative Maritime Saint Gilles, France.
11. North Western Waters Regional Advisory Council (NWWRAC).
12. North Sea Regional Advisory Council (NSRAC).
13. Irish South and West Fish Producers Organisation, Ireland.
14. Irish South and East fish producers Organisation, Ireland.
15. Killybegs Fishermen's Organization, Ireland.

Technical specialists

16. Steve Luke, QinetiQ, Radar specialists, UK.
17. Fernando Mobley, ID-Tronic, RFID specialists, Spain.
18. Andy Smerdon, Aquatec Subsea, Acoustic specialists, UK.

Gear suppliers

19. Efectos Navales POMBO S.L., fishing gear suppliers, Spain.
20. Iron Strand, fishing gear suppliers, Denmark.
21. South East Netting, fishing gear suppliers, UK.
22. Cavangh Nets, fishing gear suppliers, Ireland.
23. Swan Net-Gundry, fishing gear suppliers, Ireland.
24. Western Marine, Marine suppliers, Ireland.
25. Viking Marine, Marine suppliers, Ireland.
26. Dyrkorn AS, Ålesund, Norway
27. Refa Frøystad AS, Fosnavåg, Norway

Control and Enforcement agencies

28. Sea Fisheries Protection Authority, Ireland.
29. Scottish Fisheries Protection Agency, Scotland
30. Irish Naval service, Ireland.
31. Administration Maritime Fisheries – Les Sables d'Olonne, France.
32. Directorate of Fisheries, Bergen, Norway

Rescue services

33. Irish Coast Guard, Department of Transport, Ireland.
34. RNLI, Ireland.

Annex 7: Comparison of Marker Buoy Specifications from relevant regulations

	1967 Convention on Conduct of Fishing Operations in the North Atlantic	Commission regulation (EC) 356/ 2005 laying down detailed rules for the marking and identification of passive fishing gear and beam trawls	Norwegian regulations amending the regulations relating to sea-water fisheries (2007)
Scope	Convention applies to nets, lines and other gear in the waters of the Atlantic and Arctic Oceans set out in convention.	Regulation applies to vessels fishing longlines, gillnets, entangling nets, trammel nets, driftnets and beam trawls in European Community waters. Does not apply within 12nm measured from the Coastal Member State	Gill nets and longlines located in the territorial sea outside four nautical miles from the baselines or in the Economic Zone of Norway
Differentiates between buoys for use during daylight and nightime ?	Yes	No	Yes
Differentiates between buoys for marking the westernmost and eastermost extent of the gear?	Yes	Yes	Yes
Float specification	None	Not red or green in colour	None
Mast minimum height (m)	2m above water level	1.5m above sea level measured from top of float	2m above above the waterline.
Specification for the marking of gear with vessel registration details	Where practicable, all fishing implements shall be marked with the letter or letters and number of the fishing vessel to which they belong. The ownership of nets or other fishing implements may be distinguished by private marks.	Each end marker buoy and intermediary buoy shall display the external registration letters and numbers displayed on the hull of the vessel to which they belong in a colour contrasting to that of the buoy as high above the water surface as possible. In addition the same information must be permanently displayed on labels attached to the upper first row of the passive gear at intervals not exceeding 1nm.	Fixed and drifting gear shall be clearly marked with the registration number of the vessel
Label specification	N/A	Shall be made of durable material, securely fitted to the gear, 65mm broad by 75mm long	N/A
Reflectivity	None specified	Luminous band at least 6cm broad on the mast above the flag(s)	The buoy, stake or top marking shall be equipped with light-reflecting material such that light is reflected in all directions
Flag(s)	Must be present, colour and shape not specified, must be fitted one above the other.	Rectangular, not white in colour, flags on same buoy must be the same colour. Side measuring at least 40cm	Must be present, colour and shape not specified, must be fitted one above the other.
Vertical distance between flags	No specified	At least 80cm between first flag and the water surface. At least 20cm between flags	At least 25cm between flags
Lights	White, visible for at least 2nm in good conditions	Yellow, visible for at least 2nm, one flash every 5	Yellow, visible for at least 2nm in good visibility

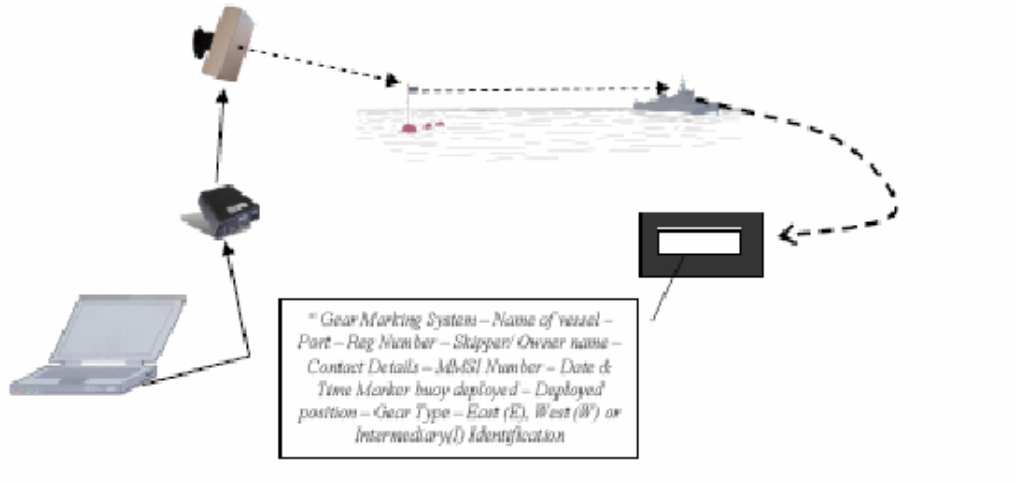
		seconds	and the dark. The light may either be constantly illuminated or a flashing light. It is not permitted to use both constant and flashing lights on the same buoy. Flashing lights shall flash between 20 and 25 times a minute (1 flash every 2.4 to 3 seconds). Flashing lights used on the same buoy must be synchronised.
Radar reflector	No specification. May take the place of one flag during daylight hours not necessary at night	Diameter of 25cm, giving an echo of at least 2nm	No specification. May take the place of one flag during daylight hours not necessary at night
Intermediate/ additonal buoys for gear over 1nm in length	Spaced at distances of not more than 1nm and having the same spec as an easternmost buoy	Spaced at distances of not more than 1nm and having the same spec as an easternmost buoy	Spaced at distances of not more than 1nm and having the same spec as an easternmost buoy
Westernmost buoy specification	Daylight: 2 flags (radar reflector may be substituted for top flag). Nightime: 2 lights (white).	2 flags (not white), 2 luminous bands, 2 lights (yellow), 1 radar reflector and 1 label carrying vessel registration.	Daylight: 2 flags (radar reflector may be substituted for top flag). Nightime: 2 lights (yellow)
Easternmost buoy specification	Flag or radar reflector during daylight, nightime 1 white light	1 flag (not white), 1 luminous band, 1 radar reflector, 1 radar reflector and 1 label	Daylight: 1 flag or 1 radar reflector. Nightime :1 light (white)
Intermediary buoy specification	Placed at distances of not more than 1nm. By day every buoy shall be fitted with a flag or a radar reflector, by night with one white light. The distance between 2 lights on the same gear shall not exceed 2nm.	Placed at distances of not more than 1nm. Buoy shall have the same specification as the easternmost buoy except the flag must be white and every fifth intermediary marker buoy must be marked with a radar reflector visible for 2nm.	Placed at distances of not more than 1nm. By day every buoy shall be fitted with a flag or a radar reflector, by night with one white light. The distance between 2 lights on the same gear shall not exceed 2nm.
Type approval required?	No	No	Yes, buoys, including lights, light-reflecting material and radar reflectors, used by Norwegian vessels shall be type approved by the Norwegian Directorate of Fisheries

Annex 8: Component parts and capabilities of a potential commercial RFID System

The proposed e-Buoy system would use ACTIVE tags. An active tag is a self-powered electronic device with the ability to receive data through a transmission from a transceiver located within the wheelhouse of the owner vessel, store it and once the GM is deployed, actively transmit the data-set at set time intervals to be received via a dedicated omni-directional antenna onboard other vessels when within reception range.

System

The system as a whole would be thus formed by four elements as illustrated below:



ACTIVE TAG (Designated with the acronym e-Buoy)

This is the element that would be attached to the marker buoy equipped with an omni-directional antenna. The design of the tag could be tubular or such a design necessary to facilitate its attachment/ removal from both the end markers and intermediary markers. The device would be inside an IP68 suitable reinforced case adequate to withstand the harsh marine environment and possible submersion up to a predefined depth. Bearing in mind that important attributes such as are service life, load characteristics, maintenance requirements, self-discharge costs and safety are paramount a suitable energy pack/ battery would be provided giving an adequate life-cycle.

Transceiver

This apparatus would be installed onboard the owner vessel and would be connected to a GPS receiver. Its prime task would be to facilitate updating the necessary information to the e-buoy tags once the markers were onboard and prior to deployment. Also it would have the ability to receive data from its own tags during fishing operations and limited information from other vessels tags when within range.

Antenna

This would be a dedicated omni-directional antenna capable of receiving such signals from the active tags on the buoys. Both the owner vessel and any vessel wishing to identify the buoys e.g. a naval vessel would be required to have such an aerial installed.

Receiver

This unit would be similar to the unit used during this trial and would need to be installed on all vessels wishing to receive information transmitted by the tagged buoy and be able to present this in a readable format. Similarly

for those vessels equipped with AIS, an adaptor with its own omni-directional antenna would display the information on the AIS screen.

Indicative data received would include the following:

- Object ID i.e. Gear Marker (GMS)
- Parent Vessel Name
- Port
- Registration number
- Owner
- Contact details
- MMSI or DSC N°
- Date & Time of deployment
- GPS position at time of deployment
- Gear type
- E, W or I* marker buoy

A sample of stored e-Buoy information would be:

GMS - REBECCA JANE – DUNCANNON -
W37- M. W. FOLEY - +353519990001 -
252000666 - 12/12/09 – 1323 –
5201235N/ 00645324W – GNS - E

Access to data stored on e-Buoy:

Within the system it would be possible to control what information is received depending on the user. For example the complete data-set could be made available to Control & Enforcement agencies and other fishermen. In the case of the control and enforcement agencies this could be linked to a database containing associated data onboard such vessels i.e. provide a unique identifier for a vessel's gear as encountered. Less information might be supplied to other marine users such as merchant ships or recreational craft, merely identifying that it a gear marker and the position of the marker.

- GMS - 252..... - 12/12/09 – 1323 –
5201235N/ 00645324W – GNS – E -

Similarly to Merchant Shipping or Recreational Users the following could be an example of the level of information displayed;

- GMS - 5201235N/ 00645324W
GNS – E -

Modification Capabilities

The example of the data storage capabilities of such an e-Buoy, as shown previously, has a total of 117 characters including spaces. The tags used in these trials have 1kb of memory (1000 characters). For security reasons and to prevent abuse of the system access to the modification or alteration of specific parts of the character sets would be limited to solely the parent vessel.