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EXPERT CONSULTATION ON THE MARKING OF FISHING GEAR

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OUTSTANDING ISSUES AND POTENTIAL FOR IMPROVEMENT

DRAFT

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Acronyms Used

AFMA ..... Australian Fisheries Management Authority
AIS ..... Automatic Identification System
BIM ..... Bord Iascaigh Mhara (Irish Sea Fisheries Board)
CPUE ..... Catch Per Unit Effort
EEZ ..... Exclusive Economic Zone
FAD..... Fish Aggregation Device
FAO..... Fisheries and Agriculture Organization (of the United Nations)
GDP..... Gross Domestic Product
GMS..... Gear Marking Systems
GPS ..... Global Positioning System
IALA ..... International Association of Marine Aids and Lighthouse Authorities
ICES..... International Council for the Exploration of the Sea
IFCA ..... Inshore Fisheries and Conservation Agency
IMO..... International Maritime Organisation
ISEFPO ..... Irish South and East Fish Producers Organisation
IUU ..... Illegal, unreported and unregulated (fishing)
M&E ..... Monitoring and Evaluation
MAIB ..... Marine Accident Investigation Board
MARPOL..... International Convention for the Prevention of Pollution from Ships
MCS ..... Monitoring, Control and Surveillance
NAFO..... Northwest Atlantic Fisheries Organisation
NEAFC ..... North-East Atlantic Fisheries Commission
NM ..... Nautical mile (equal to 1.825 kilometres)
NSRAC ..... North Sea Regional Advisory Council
NWWRAC.... North Western Waters Regional Advisory Committee
PLN ..... Port Letter Numbers
RACs..... Regional Advisory Committees
RFB ..... Regional Fisheries Body
RFID ..... Radio Frequency Identification Device
SEAFO..... South East Atlantic Fisheries Organisation
SFPA ..... Sea Fisheries Protection Authority (Ireland)
TOR..... Terms of Reference
UNFSA ..... United Nations Fish Stocks Agreement
USAID ..... United States Agency for International Development
VMS ..... Vessel Monitoring System
WGFTFB ..... Working Group Fishing Technology and Fish Behaviour

1 ANALYSIS OF POTENTIAL GEAR MARKING STANDARDS AND THE IDENTIFICATION OF ISSUES THAT MAY CAUSE DIFFICULTIES IN THEIR IMPLEMENTATION

This brief analysis looks at gear marking standards and assesses their difficulties in their implementation.

To the author's knowledge, there has been no comprehensive review of gear marking standards since the expert consultation in 1991, although the subject has been raised in a number of COFI and other for a since then (see Section 3). However, the impact and effectiveness of legislation putting these guidelines into law has been reviewed on a number of occasions, especially in Europe, and a number of examples are provided below.

Ireland: in 2006 BIM undertook an assessment of the EU Commission Regulation (EC) No 356/2005 of 1 March 2005 (as amended by Commission Regulation (EC) No 1805/2005 of 3 November 2005) laying down detailed rules for the marking and identification of passive fishing gear and beam trawls in EU waters outside of territorial waters. The main findings (Robson *et al*, 2006) were as follows:

- The large size and weight of the buoys make them very cumbersome on board.
- On shelter deck vessels the length of the buoys mean they have to be stowed on top of the shelter deck. Crewmen must rig the buoys for shooting accordingly on top of the shelter deck, which is hazardous in bad weather.
- The added weight has implications for vessel stability and carrying capacity.
- The length and weight of the buoys prevent them being shot away quickly and clear of the propeller and increase the likelihood of fouling the gear.
- The radar reflectors are of a light aluminium construction with sharp metal edges and are a major safety concern whilst being handled at sea.
- Given the height of the buoys and the addition and positioning of the radar reflectors, there are windage problems, causing the buoys to lie flat on the water and making detection difficult.
- The weight of the buoys needed can lead to gear anchors being dragged.
- In the BIM trials the radar reflectors could not be detected until the vessel was less than a half a mile away and only when the gain on the radar was turned up.
- Fishermen contend there is no need for radar reflectors as most gillnet vessels stay with their gear and provide the positions to other vessels.
- 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.
- There also may well be an added risk / confusion to yachts and commercial shipping with this additional number of targets.

This report was followed by another BIM report in 2007 evaluating various marker buoy techniques for the marking of passive fishing gears (BIM, 2009). This study conducted interviews with national control and enforcement authorities in the UK and Ireland, as well as stakeholders from merchant shipping and the marine leisure sector. The results of this second study included the following:

- 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, 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.
- From interviews with control authorities 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.

BIM then go on to propose a new prototype gear marking system where the overall length and weight of the buoys was decreased, the requirement for marker buoys to carry radar reflectors are was reduced and the number of lights needed could be reduced. It also simplified the provisions for differentiating between East and West buoys by reducing the number of flags. Most of the other components contained within the legislation such as luminous bands, flag size and mast height were recommended to be unchanged in any new regulation.

The EU standards were updated by EU Commission Implementing Regulation (EU) No 404/2011, now including pot and trap fisheries in EU waters outside of 12 nm, as well as all beam trawls and passive gear within all EU (inc. territorial) waters and resulting in no longer requiring radar reflectors and Intermediate buoys required for gear lengths exceeding 5 nm rather than 1 nm. However the updates have been criticised as not going far enough in addressing stakeholder concerns e.g. the inclusion of the need to mark pots and traps[1], the methods of differentiating western and eastern buoys, and that fact that the changes were not consulted with the relevant Regional Advisory Centres (RACs) (Daragh Browne, BIM, pers.

[1] The issue raised was over the marking of buoys and the not marking, which had been always covered by previous legislation derived from the FAO guidelines.

comm., 07 October 2015). No amendments on fishing gear marking and identification have been issued by the EU since then.

United Kingdom: as discussed in Section 3.2.1 above, the UK has adopted various measures under the EU Commission Regulation 356/2005, as amended by 1805/2005, to enable each EU Member State more easily to identify and check fishing gear used by Community fishing vessels operating within the waters under the sovereignty or jurisdiction of that Member State (these measures will also apply to vessels flying the flag of a third country when operating in Community waters). As part of the process the Department for Environment, Food and Rural Affairs (DEFRA) conducted a regulatory impact assessment to assess the potential impacts of new legislation on key stakeholders (DEFRA, 2006).

The stakeholder concerns were mainly on the **financial cost** of implementation. The main additional costs imposed by the Regulations concern the requirement for nets and longlines to have marker buoys attached. These must be attached to each end of each gear with intermediate marker buoys at intervals of no more than five nautical miles. The cost of compliance varied depending on the amount of net and line used, with the cost per buoy estimated at approximately £50 (USD 76), and the number of buoys required will vary due to the type of fishery and lengths of nets used. However, the cost of purchasing the additional equipment for a typical netter was between £800 (1,225) and £1,600 (USD 2,450). There would also be ongoing maintenance costs of around £20 (USD 30) a year in maintaining the equipment, replacing lost parts and batteries etc. For a typical long liner, the cost of purchasing the necessary equipment is estimated at around £120 (USD 185), with ongoing maintenance costs of around £10 (USD 15) a year. The measures will have different impacts on different businesses, depending on the type of gear they use. The cost burden of marking the actual gear was considered to be easily met at minimal cost e.g. for beam trawls the requirement to clearly display on the beam the external registration letters and numbers of the vessel and for those using longlines and nets, the requirement to attach a label displaying the external registration letters and numbers at intervals no greater than one nautical mile (1nm). No **social or environmental costs** were anticipated for these gear marking measures. In general most fishermen are reluctant to add any extra cost for purely compliance purposes (UK South East Netting, pers. comm, 4 Sept 2015), although there is obviously an incentive to mark gear well to prevent it from being towed away or lost.

Another issue is the implications of using marked gear on handling. For instance, in order to include visible information (e.g. to include the Port Letter Number PLN) often requires the use of larger buoys. One complication is that in some inshore fishing areas only small buoys, with long tails (with a number of floats) are used, as the larger the buoy, the more drag (some gear is designed to run under the water when the tide is running). This is a particular issue in coastal areas with large tidal flows.

2 ANALYSIS OF RESOURCE MANAGEMENT ASPECTS RELATED TO INTERNATIONAL GEAR MARKING STANDARDS

2.1 Gear conflict

As a result of both accidental and deliberate actions, the damage, destruction or loss of fishing gear is an inevitable consequence of multiple use zones, be these through mobile / static fishing or fishing / other marine user interactions. The consequences of lost gear can be severe and can lead to vessel accidents as well as environmental impacts (see Section 2.1. for more details). The classic case of gear conflict involves static gear e.g. successive tiers of surface-set gill nets or strings of bottom pots and towed mobile gear such as bottom trawls. With soak times measured in days, often the static gear is left unattended and thus relies on both good marking and communication with other users to ensure it is left alone. But given that such gear may be tens of kilometres in length, and often set over busy fishing grounds such as rocky banks, they are particularly vulnerable to conflict with other sea users. Therefore marking of gear over its entire length e.g. through the use of intermediary marker buoys, or at least providing good and unambiguous information on the way it is set, is essential, both at day and at night.

As with many national and international gear standards, the EU gear marking legislation relies solely on the display of a vessel's registration number on marker 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 control and enforcement 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 (BIM, 2009). Also control authorities may require information on the time or period of gear deployment, such as is required in deep water gillnet fisheries under EC legislation.

As described above, some gear marking standards have been criticised as being too complex and demanding, with consequences for both vessel and crew safety, as well as imposing an unnecessary cost burden. In some cases this has been addressed e.g. by the EU's decision to increase the distance for intermediary buoys from one nm to five nm. However many fisheries organisations such as the North Western Waters Regional Advisory Council in the NE Atlantic say that they are still onerous can could be made much more practical and cost-effective[1]. They maintain that furthers simplification such as reducing the number of lights and flags on western sector buoys and intermediary buoys not requiring masts, only lights should be considered. BIM (2009) and others suggest that the use of simple techniques such as reflective tape should be more widely included in standards, as well as the adoption of new technology such as LED lighting and other electronic gear marking and indention techniques (see Section 4.3 for more details).

There are other approaches to reducing gear conflict than gear marking, including spatial and / or temporal zonation of fishing areas to restrict certain fishing methods and better communication between marine users. On the latter, the increased use of electronic logbooks linked to navigation systems potentially allows static gear fishermen to easily record and transmit the position and nature of gear deployment (see Section 4.3.1 for more details). However the willingness to do so is limited, even in the face of losing thousands of dollars' worth of fishing gear.

[1] Letter from NWWRAC to DG Mare on 9 February 2012 on the subject of EU Regulation No. 404/2011 – rules on marking of fixed gears and beam trawls.

2.2 Regulating and controlling gear use

The basic premise of most fisheries management plans is the ability to limit fishing effort through a number of approaches, including limiting the units or amount of fishing gear that can be deployed by a fishing vessel, or through other approaches such as temporal or spatial closures. Such input controls require considerable effort by control agencies to license gears and then to monitor compliance. With mobile gear this can be largely achieved through the use of vessel monitoring systems (VMS) but with static gear, where gear may be left unattended, the situation is more complex. This is particularly so in inshore areas where there may be large numbers of small-scale operators working in confined waters. In such cases gear marking and identification is particularly important. However there is limited statutory requirements for gear marking and identification in such inshore waters.

Fishing gear identification can be linked to gear registration and monitoring systems. It may have particular application on trap or pot fisheries where total gear limits have been applied e.g. restricting ownership or deployment of the number of pots in the water. This can only be done if pots are marked or tagged with owner identification and possibly gear serial numbers and other specific information. However this approach would have considerable demands in terms of management and enforcement e.g. accounting for gear retirement, theft and loss. Therefore it may be cost-effective in small, limited access fisheries but not so relevant to larger open access situations (Robert Clarke, CFO Southern IFCA, 15 September 2015, pers. comm.).

2.3 Gear loss and subsequent identification of ALDFG

The loss of all or part of fishing gear is both a financial loss for the vessels concerned, as well as a potential safety and environmental hazard. Whilst most vessels do try to retrieve lost gear with variable levels of success (see Macfadyen *et al.*, 2009; and Brown *et al.*, 2005) considerable amounts of ALDFG – both mobile and static – remains in the marine environment. Whilst the majority degrades over time or is bound up in the substrate, some is brought to the surface by other fishing boats or is washed ashore. There are also a number of marine and coastal marine litter recovery programmes, such as the NOAA Gulf of Mexico Marine Debris Project. It is evident that in such cases it would be useful to know where the gear was lost and by who, either for attempts to estimate the scale and nature of gear loss or in the case of persistent and deliberate gear discarding, to assist in providing evidence to control authorities.

The biggest challenge to allowing the identification of ALDFG is that often only certain parts, usually the marker buoys, are provided with written identification or identification tags. As a result the majority of the gear lost is unidentifiable. It may be possible to embed identification marks into gear components such as gillnet sheets and trawl panels, but this is likely to require the development of very low cost and low profile marking technology to allow this to happen. It may be possible to embed Radio Frequency Identification (RFID) tags (see Section 4.3.2 for more details) into plastic components, but the cost and logistical requirements might well outweigh the benefits. This is especially so, given that potentially non-compliant vessels using illegal gear or fishing in closed areas are unlikely to adopt this technology.

3 REVIEW OF POTENTIAL NEW GEAR MARKING AND IDENTIFICATION TECHNOLOGIES

This brief review examines the technologies that have been developed in both gear marking and identification since the FAO guidelines were originally developed in 1991.

3.1 Gear marking

The purpose of gear marking is to allow fishing vessels, control authorities and other maritime users to easily locate and therefore avoid fishing gear that has been deployed, especially where the responsible fishing vessel is absent. Based on the analysis in Section 4.1, the key requirements for the marking of fishing gear are as follows:

- Marking equipment (e.g. flags, lights, buoys, etc.) should not be so big as to be cumbersome on deck, with consequence for crew safety and vessel stability
- Likewise marking equipment should not be difficult to dangerous to shoot away
- Radar reflectors should be well designed as to not contain sharp edges (like many current aluminium designs), effective and not lead to a false security of being detected
- Lighting should be powerful, robust and energy efficient
- The cost of gear marking needs to be affordable in the context of the fishery involved.

On this basis, various options exist to both make fishing gear more detectable, but at the same time address the issues raised above. These include:

LED lighting: light emitting diode (LED) lighting has been around for about 30 years, but major advances in brightness, power efficiency and form have been made over the last decade, making LEDs an obvious choice for marine lighting. Furthermore they can be provided in a number of different colours (commonly red, green, white, yellow and blue), can be programmed to standard International Association of Marine Aids and Lighthouse Authorities (IALA) flash characters as well as customised to new flash patterns. Depending upon their size, they can have a visible range of 1 nm to over 12 nm. They can be robust (e.g. rated as IP68 in terms of protection against water ingress) and maintenance free with service lives of in excess of ten years. Power can be provided by batteries and / or solar power. 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.

Gear marking transponders: transponders are now a common feature in many large-scale fisheries with the satellite tracking of vessels for safety and MCS purposes, and the use of transponders on gear such as marker buoys or floats is becoming more readily available. The fitting of transponders to gear improves the ability to locate gear in the water. This is an added cost to the fisher and is therefore most likely to be used by fishing operations where gear tends to be larger and more expensive than in artisanal fisheries. Large vessels operating mobile gear may already use transponders or sensors attached to the gear to aid net deployment and operation. These large vessels are also more likely to have the capacity to locate and retrieve gear if it is lost.

Acoustic marking systems: a number of subsea communications systems are used in marine industries such as oil and gas (BIM, 2009), which transmit acoustic signals at specific frequencies from transmitters connected to subsea structures, to receivers located on ships or other marine platforms which decode the signals. 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 hydrophone / 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 on-board control and enforcement. 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.

Marine power generation: with the increased use of autonomous electronics as described above, providing sufficient power is a major limitation. This has been met through developments in solar, wind and tidal generation, but delivering this at a small scale is a challenge, both in terms of efficiency and cost.

Integrating gear positioning into e-reporting and e-monitoring: one approach to improving gear marking and providing spatial information on the location of set gear is using global positioning system (GPS) data and integrating this into electronic reporting (e-reporting[1]) and monitoring (e-monitoring[2]) systems. This allows skippers to electronically mark the start and finish of passive gear shooting and potentially sharing this data with other marine users and control authorities. There are evident concerns of confidentiality, but such reporting could solve issues of gear conflict over busy areas such as banks that might be targeted by both mobile and static fishermen.

3.2 Gear identification

Gear identification is more straightforward and the associated issues less controversial than for gear marking. Essentially it entails the recording of fishing vessel or owner details on fishing gear, thus allowing gear to be identified, both when fishing or potentially if it is abandoned, discarded or otherwise lost. The main issues include (i) requiring a large buoy to display written information if required that might interfere with their handling and storage (see gear marking issues in the section above) and (ii) achieving a balance of providing identification information on different parts of the gear in case only segments are recovered with cost and performance / handling implications.

Various new technologies have been developed to address this as follows:

Electronic tagging: electronic tagging, such as the use of Radio Frequency Identification (RFID) tags can be produced relatively cheaply and be embedded with considerable amounts of user-definable information. RFID tags are already being used in some fisheries, such as in SW England where fishermen who have been allocated a potting permit will now be supplied with RFID tags that are secured to each pot. Marine enforcement officers are then able to scan each pot using a hand-held RFID reader to ensure that only those fishermen with permits are operational within their jurisdiction. Any pots without a tag will be removed from the water. One limitation is that the reading distance is only about one meter, which means gear will effectively have to be hauled in order to access RFID data, which is usually avoided by control agencies.

Other forms of tags: coded wire tags can be implanted into netting and scanned for identifying data when required. Alternatively rogue yarn (a yarn of different twist or colour from the rest) can be inserted into multi-strand twines. This has been used in Japan to distinguish gear from fishers based in specific management areas (Macfadyen *et al.*, 2009). Hand-held laser read bar coding is also easy and cheap to produce and print onto plastic tags.

[1] E-reporting is the open recording and transmission of fisheries information, which is either downloaded at the end of a trip or in the case of critical data, in real-time via satellite or mobile networks.

[2] E-monitoring is a closed system that does not allow external or manual manipulation of data e.g. VMS

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