Evidence Gathering in Support of Sustainable Scottish Inshore Fisheries

Work Package 1 Final Report

Establishing the Location of Offshore Fishing Activities within Scottish Inshore Areas Using Appropriate Technology

Project code: SFS001SIF

EFF: MI-NC-3-0093

This project was supported by a grant from the European Fisheries Fund

Published by Marine Alliance for Science and Technology for Scotland (MASTS)

This report/document is available on The MASTS website at http://www.masts.ac.uk/research/sustainable-scottish-inshore-fisheries/ and via the British Lending Library.

Dissemination Statement

Following the successful completion of the EFF funded project 'Evidence Gathering in Support of Sustainable Scottish Inshore Fisheries' the Sea Fish Industry Authority and Marine Scotland have consented to the free distribution/dissemination of the projects individual work package reports, in electronic format, via MASTS and the British Library.

Disclaimer

This report reflects only the view(s) of the author(s) and the Sea Fish Industry Authority, MASTS, Marine Scotland, the Scottish Government and the Commission are not responsible for any use that may be made of the information it contains.

This report was prepared for Sea Fish Industry Authority (Seafish)

Contact Mr. Craig Burton

Telephone +44 (0)1967 431 573

Email c_burton@seafish.co.uk

The report was completed by The Marine Alliance for Science and Technology for Scotland (MASTS) with contributions by Agroecosystems Ltd. and Kyla Orr Marine Ecological Consulting.

Contact Dr Mark James

Telephone +44 (0)1334 467 200

Email maj8@st-andrews.ac.uk

Recommended citation style James M.A., Thompson J.B., McKnight A., Orr K. 2015. Evidence Gathering in Support of Sustainable Scottish Inshore Fisheries: Establishing the Location of Offshore Fishing Activities within Scottish Inshore Areas Using Appropriate Technology. Published by MASTS. 34pp. ISBN 978-0-9934256-2-2

EFF: MI-NC-3-0093

This project was supported by a grant from the European Fisheries Fund

Contents

Disclaimer:

The contents of this Report/Response are offered in good faith and after due consideration. The author(s), as individuals or the University of St Andrews cannot be held responsible for any consequences arising from the use of this Report. Opinions expressed in this Report are those of the author(s) and any anonymous consultees who may have contributed to this document. The Sponsor of this study does not necessarily agree with, or endorse, the contents, conclusions or recommendations of this independent Report.

Acknowledgements:

We acknowledge the support of EFF grant number: MI-NC-3-0093. The authors of the report are indebted to the Marine Scotland and Seafish staff who contributed to the eventual success of WP1. Clint Blight of the University of St Andrews provided valuable input to the technical discussions and the text related to the storage and forwarding of AIS data. We are particularly indebted to the fishermen who participated in the project and displayed considerable patience and understanding with respect to the delay in the original fitting schedule. The ongoing and positive feedback from the inshore fishing community who have been involved in the project is of particular note. Their participation reflects a genuine interest and enthusiasm on the part of many in taking an active role in understanding and contributing to the management of the Scottish inshore fishery.

Budgetary Note:

The cost of delivering the management and facilitation of WP1 was covered under a separate project budget line which was originally allocated for the overall co-ordination of the seven Sustainable Inshore Fisheries Project Work Packages. Before and after the termination of the Succorfish M2M contract, the additional costs of delivering WP1 which related from the failure of this contractor to fulfil its obligations were absorbed by the co-ordination budget allocation and through considerable in-kind time commitments.

Project Details:

Start date:	**30/06/2014**
Completion date:	**30/09/2015**
Total project budget:	**£408,000 + VAT (see budgetary note)**
Staff inputs (days):	**Not applicable (see budgetary note)**

Work Package Objectives (revised)

It was necessary, due to the termination of the original contract with Succorfish M2M[1], to subsequently revise the objectives of this work package. Consequently, the revised objectives, as agreed with Marine Scotland, were to determine whether the;

1. Automatic Identification System (AIS)[2] could be used to help manage the inshore fishing sector in Scotland and specifically the West coast and islands where topography and the distribution of AIS receivers may preclude detection of AIS targets, and;

2. Establish whether inshore fishermen will be willing to accept and use AIS on-board their vessels.

[1] Details of the termination of the Succorfish M2M contract are lodged with Seafish

[2] The Automatic Identification System (AIS) is an automatic tracking system used on ships and by vessel traffic services (VTS) for identifying and locating vessels by electronically exchanging data with other nearby ships, AIS base stations, and satellites. AIS is primarily for safety use and not a dedicated Vessel Monitoring System

Background

Work Package Provision

The contract for work package SFS001SIF was originally awarded to Succorfish M2M. However, due to the failure of Succorfish M2M to meet their contractual obligations, it proved necessary for Seafish to first modify and then finally terminate their contract. After repeated delays Succorfish M2M informed the project management team on May 15th 2015 that, due to production issues, they would be unable to supply the required 300 Succorfish SC2 systems. It was subsequently agreed with the contractor that this provision would be reduced to 150 systems, contingent on the satisfactory installation of the first 40 units (later reduced to 39) by June 12th 2015. Due to the failure of Succorfish M2M to successfully install the initial 39 systems by the agreed deadline of June 12th 2015, it proved necessary for Seafish to terminate their agreement.

In order to supply and install the outstanding AIS systems, two replacement contractors were identified via open tender. These were Omnimarine Ltd. (based in Dundee) and Electrotech Marine Ltd. (based in Oban). Initially Omnimarine Ltd. was contracted to install 150 Vespermarine XB8000 Class B, AIS transponders (including all ancillary equipment) on project vessels located on the East coast and the Shetland Islands (the latter via subcontractor H. Williamson & Sons Ltd.). Upon the termination of the Succorfish M2M contract, this provision was expanded by a further 22 units/vessels. Electrotech Marine Ltd. was originally contracted to supply and fit 68 Vespermarine XB8000 systems to vessels located on the West coast and Outer Hebrides (the latter via subcontractor The Island Hub). Upon termination of the Succorfish contract this provision was expanded by a further 27 units (including the replacement of 30 of the original Succorfish M2M systems).

As well as the supply and installation of equipment the contractors also agreed to provide basic instruction to skippers/vessel owners on how to link to the Vespermarine unit via its integrated Wi-Fi and, where applicable, to use the 'WatchMate' smartphone app.

Automatic Identification System (AIS)

The Automatic Identification System (AIS) utilises ship to ship VHF transmission and reception, over spare frequencies on the marine VHF radio spectrum. It was originally conceived as a vessel safety system for collision avoidance and supplements marine radar, which continues to be the primary method of collision avoidance for waterborne craft. However, the versatility of AIS means it is now being investigated and developed for other uses, including; fishing fleet monitoring, maritime security, search and rescue coordination and cargo tracking.

The VHF transmissions utilised by AIS operate on line of sight (as radio waves travel approximately in straight lines) therefore any obstruction between the transmitter and receiver will result in the transmission being reduced or blocked. The range of a VHF transmission is determined by a combination of factors, primarily:

- Distance between the transmitter and receiver (provided there is clear line of sight)
- Transmitter/transmission power
- Aerial height, and
- Aerial quality.
- Receiver sensitivity

The AIS standard comprises several sub-standards or 'types' principal amongst these are Class A and Class B, but also include base stations, Aids to navigation (AtoN) and Search And Rescue Transponders (SARTs). Class A systems were established first with Class B developed to provide the safety and navigation benefits of AIS to smaller vessels, at lower cost. As the Class B system was developed after the introduction of Class A, it was designed to be compatible whilst protecting the safety critical operation of the Class A system for larger vessels. The International Maritime Organisation's International Convention for the Safety of Life at Sea requires Class A systems to be fitted to all vessels over 300 gross tons, as well as all passenger vessels (regardless of size). In addition, as of 2014 the EU mandated that all fishing vessels over 15 m in length, as well as the majority of commercial watercraft operating in inland waterways, must also operate Class A AIS systems. Class A systems have an output of 12.5 watts and with a clear line of sight have an effective transmission range of approximately 80 nautical miles (nm).

The AIS transponder system installed under this work package (comprising the Vespermarine XB8000 transponder and associated GPS and VHF antennas, Figure 1.) is a Class B system with an output (transmission) power of 2 watts, which translates to a maximum potential transmission range of 15 nm (the effective range however is typically less).

Figure 1: (Left) Vespermarine XB8000 Class B AIS transponder unit; (Right) The systems GPS and VHF 'whip' antennas

All AIS systems are capable of transmitting the following information;

- Vessel name,
- MMSI number and radio call sign
- Vessel type (e.g. passenger, cargo, fishing)
- Position (latitude and longitude)
- Course over ground (COG)
- Speed over ground (SOG)
- Bearing from your vessel
- CPA - Closest Point of Approach (i.e. distance)
- Time to the Closest Point of Approach
- Vessel dimensions (length, beam, draught)

In addition to the above, Class A systems provide further information, including the vessel's destination, estimated time of arrival and rate of turn. The above information may be collated from several sources; principal amongst these the unit/vessels GPS receiver. The data is transmitted via a tracking system which makes use of a Self-Organized Time Division Multiple Access (SOTDMA) datalink. The SOTDMA datalink ensures that the signals are

time multiplexed so that the VHF transmissions of different transponders do not occur simultaneously.

The two systems also differ in their rates of transmission. Class A systems transmit the above information every few seconds (whilst manoeuvring/under power); while Class B transmits far more infrequently (i.e. the interval may range from 30 seconds to a few minutes).

In addition to vessel based transponders there are also shore-based AIS transceivers which operate using SOTDMA. Base stations have a complex set of features and functions which in the AIS standard are able to control the AIS system and all devices operating therein, Figure 2 displays the locations of AIS base stations around the Scottish coast (plotted using data obtained from Ofcom; http://www.ofcom.org.uk/)[3].

As previously stated the effective transmission/reception range of an AIS transponder is reliant on several factors and will also vary with the vessels location (i.e. its position relative to other AIS equipped vessels and base stations).

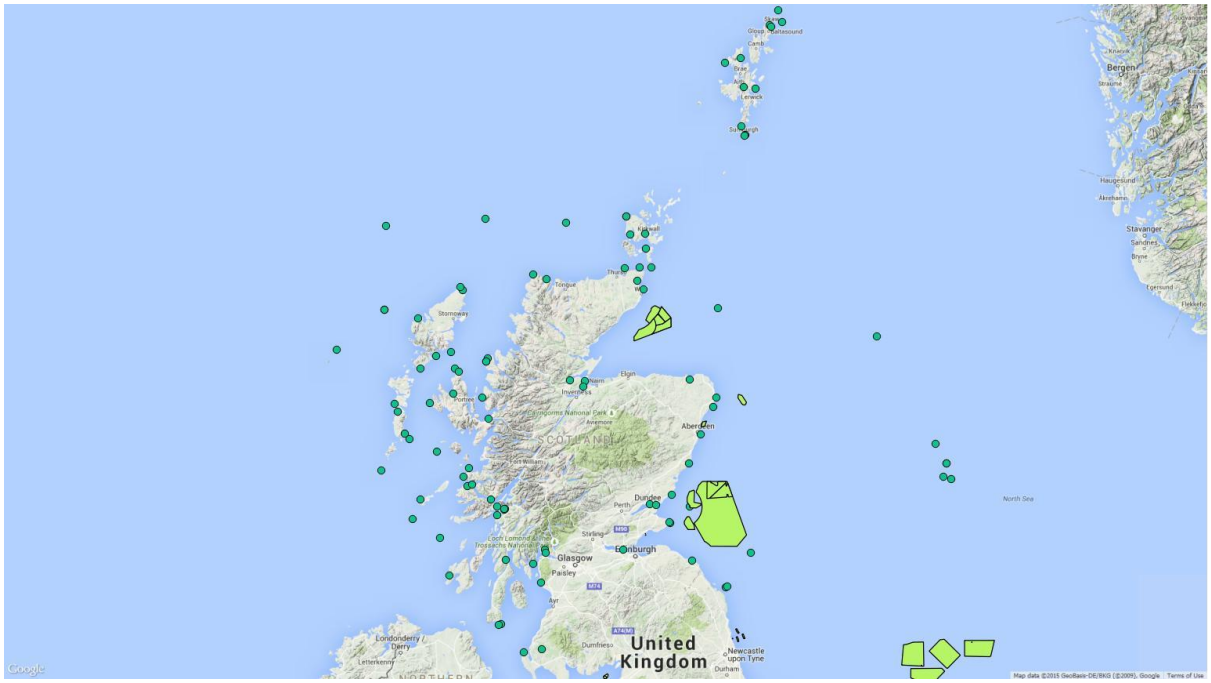

Figure 2: Locations of AIS equipped base stations around the Scottish coast

AIS Data Sourcing and Harvesting

As VHF frequencies are 'open' the information broadcast via AIS is freely available in the public domain and can therefore be accessed free of charge by anyone with the necessary equipment (i.e. a VHF aerial and AIS receiver connected to a computer/tablet installed with software capable of interpreting AIS data feeds). However, as stated in the previous section the range of VHF transmission/reception is limited to line of sight, therefore, in order to aggregate AIS data over a large geographic range (a requirement of this work package) a different approach was required.

[3] Note that some of location and receiver station data recorded on the Ofcom website is not correct. Some of the grid references provided are incomplete and can therefore not be used. The number of errors appears to be small and most of the locations plotted appear sensible.

There are numerous commercial suppliers of aggregated AIS data (the most well-known of these being Marine Traffic). These suppliers have commercial data provision agreements in place with a proportion of AIS base station owner/operators (and/or are owner/operators themselves). These agreements allow them to collate AIS data received from a large cross section of base stations and display this, in near real-time, via a graphical interface on their websites. While these real-time AIS data feeds are free to view, in order to gain access to historic AIS records either a subscription, or one off fee, is required.

With regard to this work package, the AIS data received from project vessels was to be collated by Succorfish M2M. With the termination of the contract with Succorfish M2M it proved necessary to identify an alternative means of obtaining these data. Through open tender UltraMap Ltd. were identified as the preferred supplier of collated AIS data on the inshore fishing vessels installed with Class B AIS systems under this work package.

UltraMap Ltd. was contracted to aggregate AIS records for all fishing vessels operating in Scottish waters out to the 12 nm limit (from June 16th to 30th September, 2015) and supply this (in comma separated value (CSV) format) at 15 minute intervals to the project management team. In addition, UltraMap Ltd. also provided a second dataset specific to those fishing vessels installed under the project, from the date of installation to 30th September 2015. Also included within the contract was unlimited access to UltraMap's 'Asset Monitor' online Graphical User Interface (GUI) Figure 3. The Asset Monitor GUI is able to display, in close to real-time, AIS vessel tracks received by those base stations owned and operated by organisations with which they have data access agreements. One of the primary incentives for contracting UltraMap Ltd. was their access to AIS data from a network of privately owned West coast base stations, which would otherwise have been denied to the project.

Post 30th September 2015, the compiled AIS data archive will be forwarded to Seafish and Marine Scotland.

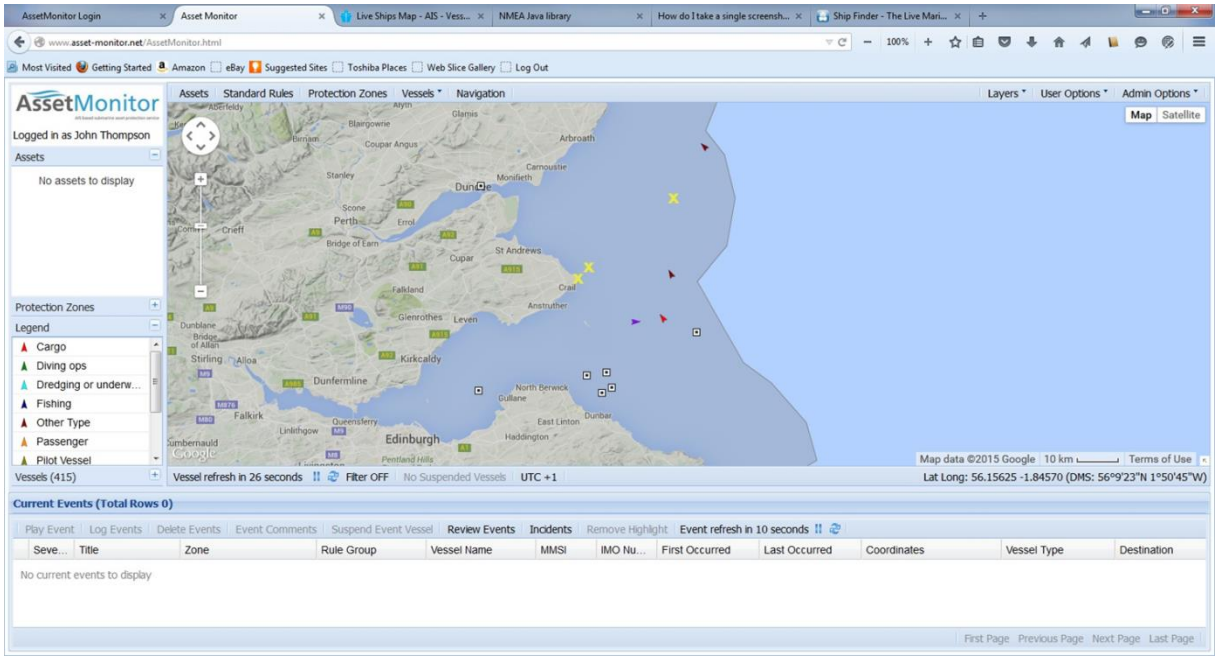

Figure 3: Screenshot from UltraMap Ltd.'s Asset Monitor GUI displaying several AIS targets in the Firth of Forth and within the 12 nautical mile limit around Fife.

Industry Engagement and Vessel Recruitment

Project Promotion

The Project Facilitators promoted Work Package 1 through a variety of direct and indirect communication and advertising.

Full engagement with the Inshore Fishing Groups (IFG's) was promoted through a "Project Update" agenda item being included at the majority of quarterly IFG Executive Committee meetings attended by one or both Facilitators, and/or Marine Scotland staff. IFGs circulated information accordingly to their respective contacts. Facilitators organised an additional 28 local meetings and drop-in-sessions for fishermen around the coast of Scotland (refer to Table 1 and Table 2 for a complete list of all meetings attended/organised). Many of the local meetings were in remote locations and were collectively attended by approximately 300 active fishermen (refer to Figure 4). A number of other *ad hoc* small harbour visits were also made traveling to and from events to promote the project through word of mouth and poster display.

The Facilitators also solicited the help of Fisherman's Associations, Federations, Harbour Officers, Fisheries Officers, and Coastal Partnerships to further advertise the project. In December 2014 the project was advertised in Fishing News, and was continually publicised online (on the Seafish and Marine Alliance for Science and Technology for Scotland (MASTS) websites). A dedicated 0800 project 'helpline' was also established to allow vessel owners to call and register their interest in the project or request further information.

All enquiries resulted in a 'project information pack' being provided, which contained the project summary (aims/objectives) and details of how to apply for an AIS unit. A copy of the information provided to fishermen is included in Appendix 1. Vessel owners were offered multiple application routes, namely via telephone (0800 number), email, postal application or online form. All applications were directed to the Project Facilitators. Information requested through the application included the applicant's name and contact details, vessel name and registration (PLN), vessel size, gear type, target catch, and Maritime Mobile Service Identity (MMSI) number (the latter being a requirement for the programming of the AIS unit). Once received, these details were forwarded to Marine Scotland (Compliance) for a basic licence check, and the skipper/owner was then notified once their vessel had been 'approved' for the project.

Table 1: Inshore Fisheries Group meetings attended by Project Facilitators and some Contractors

IFG meetings	Date	Location	Work package input/participation
2014			
East Coast – IFG	02-Sep	Perth	Facilitator Presentation given on all work packages
MF&NC – IFG	08-Aug	Inverness	Facilitator Presentation given on all work packages
North West – IFG	15-Aug	Fort William	Facilitator Presentation given on all work packages
Outer Hebrides - IFG	05-Sep	Stornoway	Facilitator Presentation given on all work packages
South West - IFG	09-Sep	Glasgow	Facilitator Presentation given on all work packages
Mull-Sub Goup - IFG	06-Nov	Craignure	WP1: Presentation by Facilitators
East Coast – IFG	25-Nov	Perth	Feedback on all Projects.
North West – IFG	28-Nov	Inverness	WP 5&6: Presentation by John Hambrey. Feedback on WP1, 2&3.
South West – IFG	02-Dec	Glasgow	WP4: Presentation by Clive Fox. Feedback on WP1, 2&3.
2015			
North West – IFG	20-Mar	Inverness	General EFF project feedback
East Coast - IFG	24-Mar	Perth	General EFF project feedback
MF&NC – IFG	27-Mar	Inverness	General EFF project feedback
East Coast – IFG	01-Jul	Perth	General EFF project feedback
MF&NC - IFG	10-Jul	Inverness	General EFF project feedback
North West – IFG	18-Sep	Inverness	General EFF project feedback
MF&NC – IFG	18-Sep	Inverness	General EFF project feedback

Table 2: Local meetings with fishing industry attended by Project Facilitators and some Contractors

Date	Location	Work package input/participation
2014		
03-Sep	Broadford, Skye	WP 1,2&3 recruitment.
16-Sep	Ullapool	WP 1,2&3 recruitment.
29-Sep	Aberdeen	All WP promotion, WP1 recruitment
06-Oct	Glasgow	WP4: Meeting with SAMS and Clyde Forum members .
11-Oct	Portree, Skye	WP 5&6: Presentation by John Hambrey/Crick Carleton. Feedback on WP1, 2&3.
16-Oct	Troon	WP1 recruitment
27-Oct	Bowmore, Islay	WP1 recruitment
28-Oct	Campbeltown	WP1 recruitment
06-Nov	Craignure, Mull	Joint with SWIFG sub-meeting above (high fishermen presence) WP1 recruitment
10-Nov	Lochinver	WP1 recruitment (Tel contact also made to Kinlochbervie)
14-Nov	Lochailort	WP1 recruitment
19-Nov	Newton Stewart	WP1 recruitment
20-Nov	Oban	WP1 recruitment
09-Dec	Shieldaig	WP 5&6: Presentation by John Hambrey. WP1 recruitment.
11-Dec	Elgin	WP4: Meeting between Clive Fox and Moray Firth stakeholders.
12-Dec	Scrabster	WP1 recruitment
16-Dec	Eyemouth	WP1 recruitment
17-Dec	Peterhead	WP1 recruitment
17-Dec	Stonehaven	WP1 recruitment
18-Dec	Arbroath	WP1 recruitment
18-Dec	Anstruther	WP1 recruitment
2015		
15-Jan	Whalsay	WP1 recruitment
16-Jan	Bixter	WP1 recruitment
17-Jan	Lerwick	WP1 recruitment
17-Jan	Scalloway	WP1 recruitment
19-Jan	Dunbar	WP1 recruitment
20-Jan	Gourdon	WP1 recruitment
27-Jan	Tarbert, Argyll	WP1 recruitment

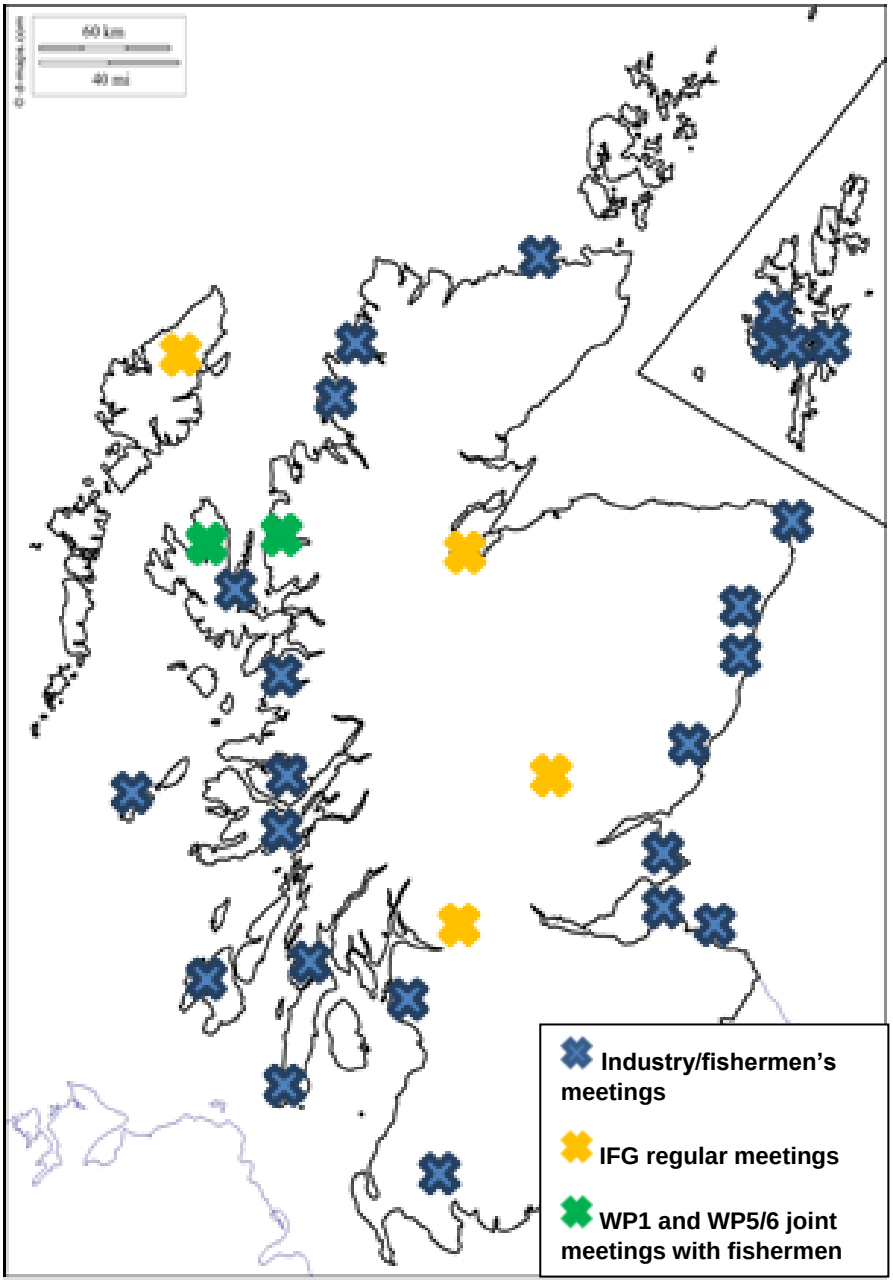

Figure 4: Map showing locations of meetings attended/organised by Project Facilitators to promote the EFF project in general, and WP1 specifically. Yellow = IFG ExComm meetings, Red = mainly WP1 promotion, Green = promotion of WP2&3, and WP5&6 in addition to WP1.

Recruitment

Recruitment of vessels commenced in August 2014, and the project was initially only open to applicants fishing on the West coast of Scotland (Figure 5). However, by mid-November 2014 less than 80 vessels had volunteered to receive a free AIS unit despite active, ongoing publicity. Therefore, the project was opened up to vessels operating around the East coast, Shetland and Orkney from the end of November 2014, which resulted in a significant increase in the number of volunteers. By March 2015 the number of applications received had plateaued and the decision was therefore taken to cease recruitment in early July 2015 (Figure 5).

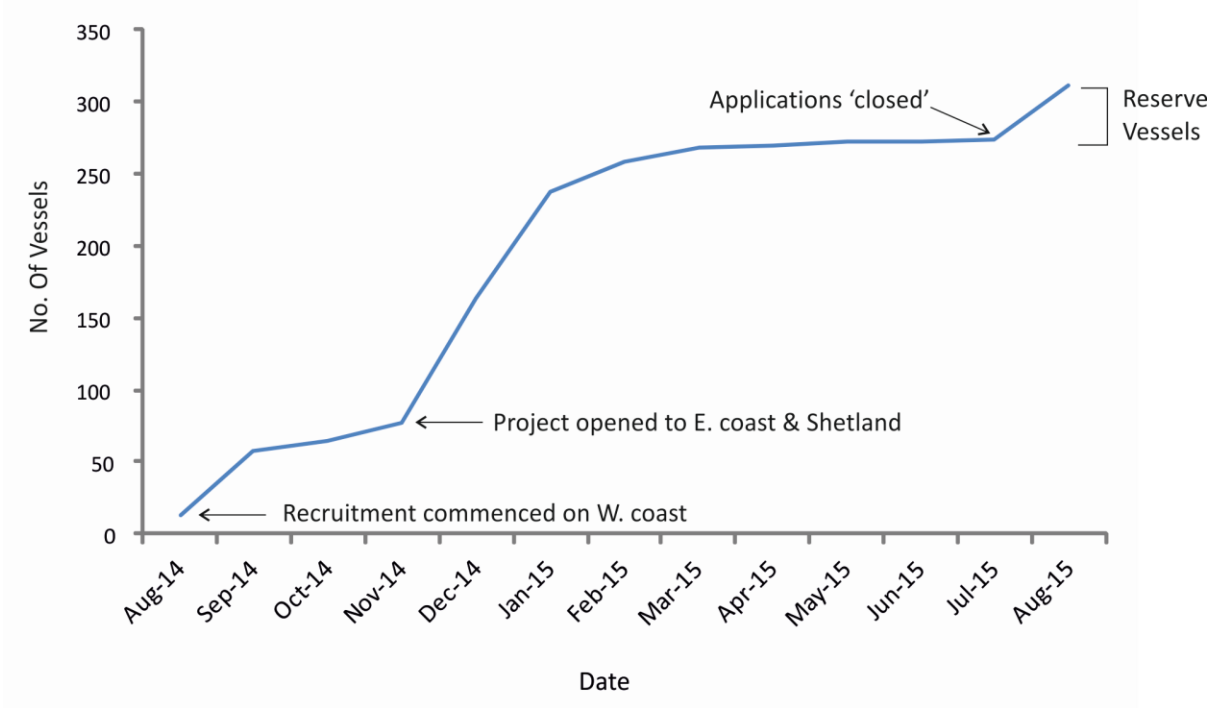

Figure 5: Timeline for recruitment of WP1 vessels

Vessel Uptake

Under the project a total of 274 AIS units have been installed, which represents approximately 18% of the 1,524 sub-12m fishing vessels registered in Scotland (MMO, 2015a, 2015b - data from 3rd September). Of the 333 inshore vessels that applied to the project and were approved for an AIS unit, 59 of these subsequently withdrew. Multiple reasons for withdrawal were noted including; the sale of vessels, the presence of a pre-existing AIS unit, the undertaking of fishing activity outside Scottish waters and simply a change of mind regarding participation. Once the installation phase commenced (and with recruitment officially ceased) a further 44 vessels submitted applications for inclusion on a 'reserve list' (Figure 5). However, restrictions on time and funding did not permit the installation of AIS units beyond the allocated 274 vessels. It should be noted that despite the cessation of active vessel recruitment by the Project Facilitators, during the installation phase, interest in the project increased primarily as a result of informal discussion between fishermen and installation engineers. This interest contributed to the creation of the reserve list which would have been employed should any AIS units have become available (i.e. due to vessels withdrawing). Many of the vessels on the reserve list remain interested in receiving an AIS unit (under future projects).

Vessel Distribution

The broad location of project vessels around the Scottish coast is displayed in (Figure 6). Of the 274 vessels fitted with AIS units, the majority (47%) operate on the East coast, followed by the West coast (22%), Outer Hebrides (16%), Shetland (14%) and East & North Coast (2%). Figure 7 displays the number of participating project vessels for each of the 18

administration ports or 'districts' in Scotland, relative to the total number of vessels ≤12m for that port (also refer to Appendix 2 for vessels by administrative ports).

The district with the largest number of project vessels operating within its boundaries is Stornoway, followed by Shetland, Anstruther, Eyemouth and Fraserburgh. On the West coast there are a several areas with very few or no project vessels relative to the total number of licensed sub-12m vessels, and these include the administrative areas of Campbeltown, Mallaig and Oban, Lochinver and Kinlochbervie. No vessels from the Isle of Mull (Oban FO) applied to participate in the project despite active promotion on the island. There were also few project vessels for the administrative area of Kinlochbervie (north-western tip of Scotland) and none from Orkney, again despite active promotion of the project in those areas (1 application from an Orkney vessel was received, however, the skipper later withdrew). Consequently, it is likely that these areas will prove to be 'data-poor' in terms of AIS transmissions from local sub-12m fishing vessels. It should be noted however, that other participating vessels may pass through these sea areas to fish and land their catches at major ports.

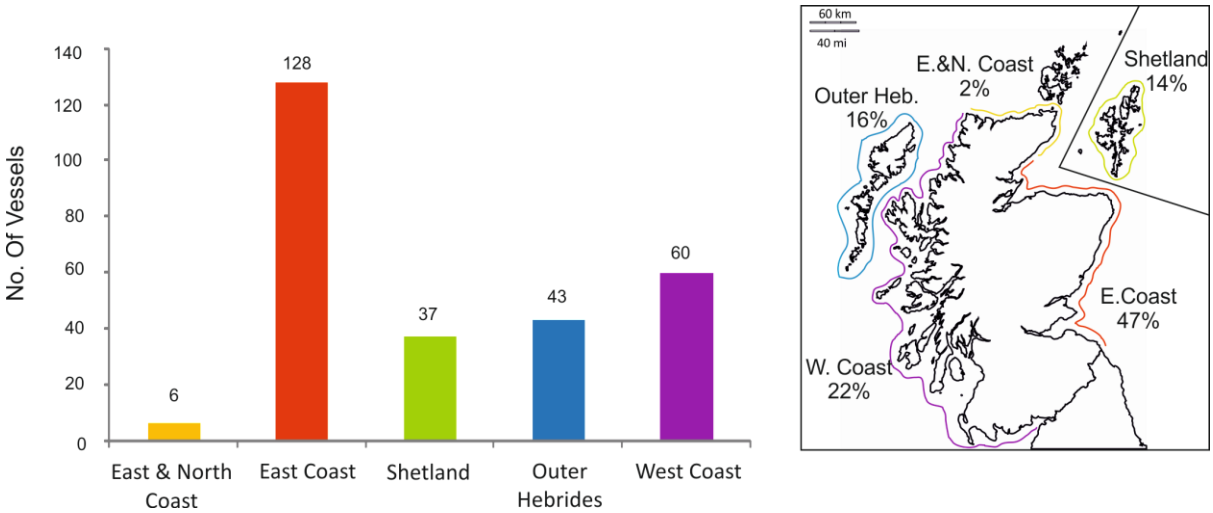

Figure 6: (Left) Number of project vessels in each coastal area, totalling 274. (Right) Map displaying percentage of project vessels (out of 274 total) for each area.

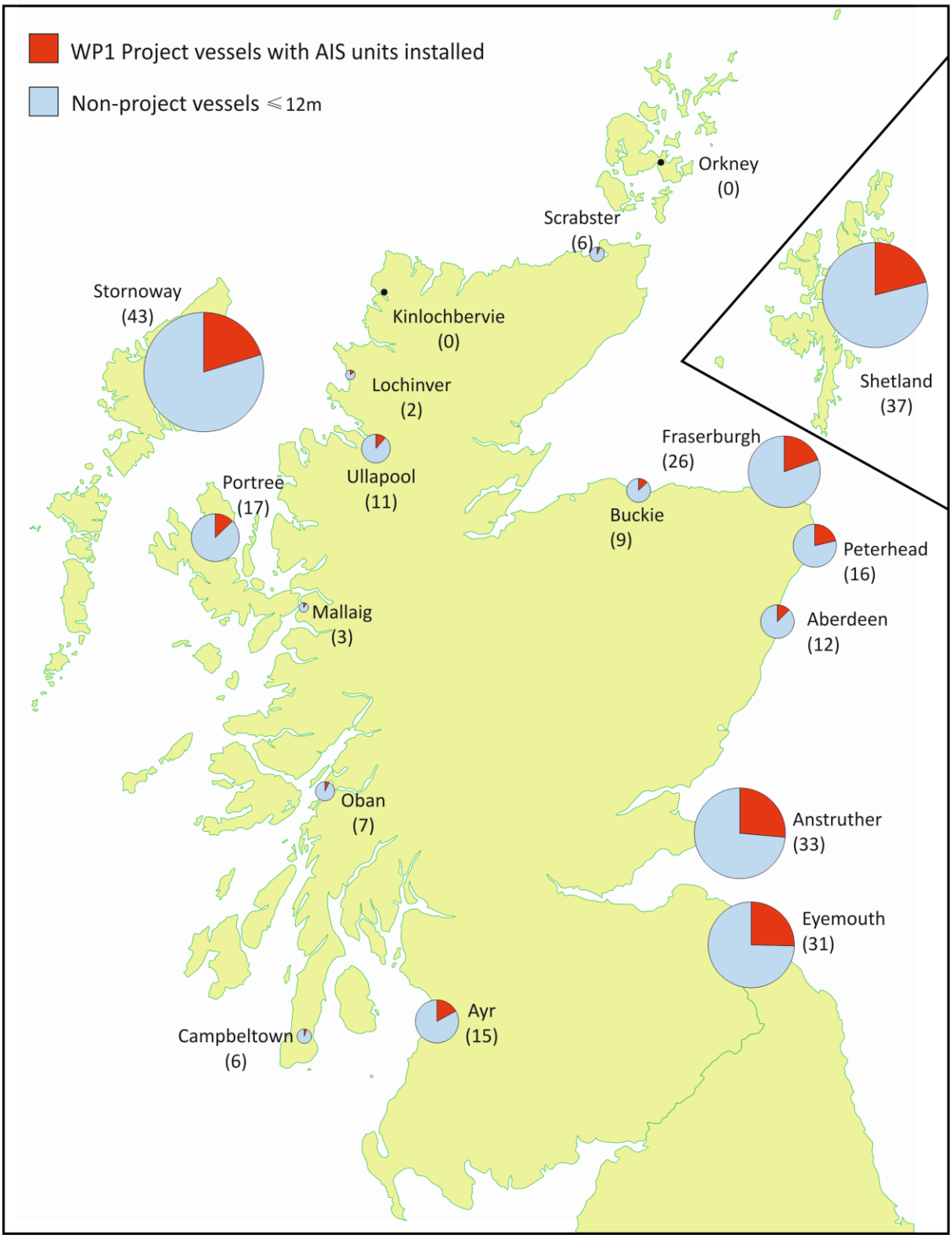

Figure 7: Number of project vessels with AIS units installed by administrative area/district. The pie charts are scaled relative to the number of project vessels.

[*Please note: The total number of vessels operating from individual ports around Scotland can be found in Appendix3.*]

Vessel Breakdown by Fishing Method

The project vessels are from a diversity of inshore fishing sectors, and operate a range of gear types (Figure 8). The majority (84%) are static gear operators (231 in total), that predominantly fish using creels (175 vessels) although some use a mixture of both creels and line (37 vessels) or exclusively line fish (14 vessels). Creels are mainly used to target *Nephrops*, crab, lobster, and other shellfish species while line is used to target fish species such as Mackerel and Cod. Mobile gear operators, who utilise bottom trawls and/or dredges, comprise only 14% of project vessels (39 vessels in total) of which 31 are trawlers exclusively targeting *Nephrops*. Four vessels utilise both dredge and trawl gear, while the remaining four mobile gear operators are scallop dredgers (Figure 8). None of the participating vessels are Scallop divers, primarily due to concerns relating to the public visibility of AIS vessels tracks, and associated competition for fishing grounds within the Scallop industry. In addition, none of the project vessels are demersal or pelagic trawlers, as these vessels tend to be over 12m in length and fish beyond the 6 nautical mile limit.

In 2014, the Scottish Government estimated that 87% of all 10m and under licensed vessels principally fished using creels (Scottish Government, 2015) therefore; it is unsurprising that nearly 80% of the vessels participating in this project fish using creels. In addition, creel fishermen were generally less concerned about making their fishing location publically known through AIS, as their gear (and hence fishing location) is already visibly marked at sea using buoys.

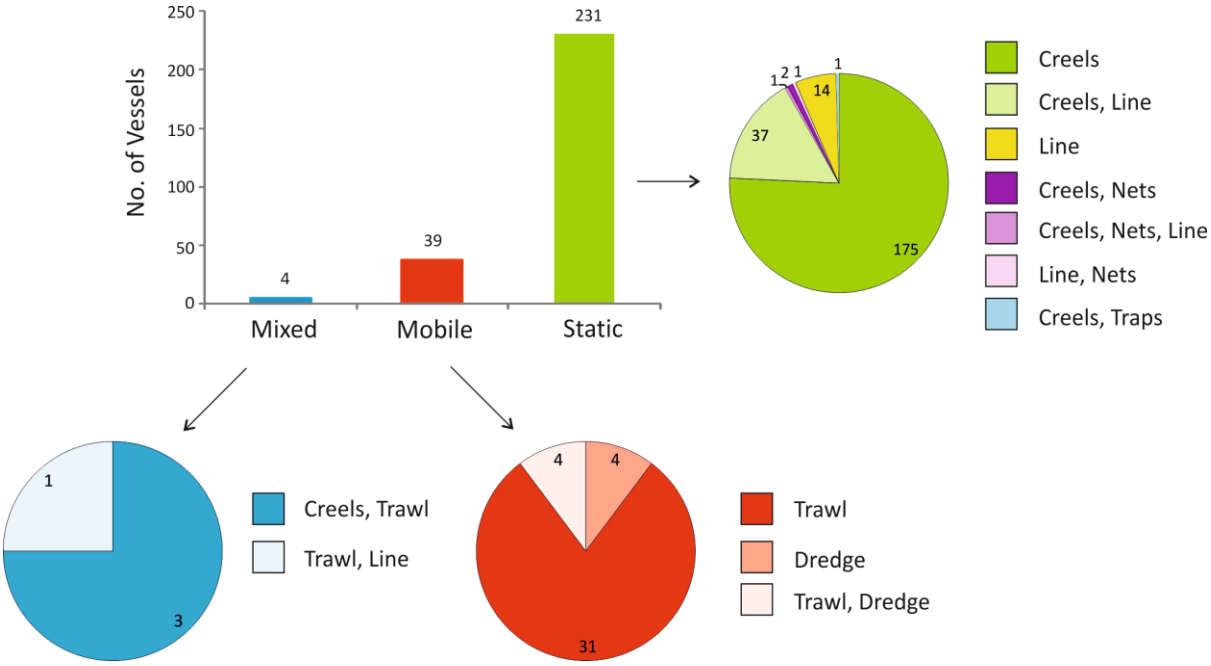

Figure 8: Bar chart showing number of project vessels per fishing sector (mobile gear, static gear or mixed gear operators) and pie-charts showing types of gear used within each sector.

Vessel Breakdown by Length

This project was open to all licensed Scottish inshore fishing vessels measuring 12m or less (overall length) and 90% of the 274 vessels that received AIS units measured 10m or less, overall length (Figure 9). In reality, the vast majority of project vessels fell in the 6m to 10m range, with only 19 found to be less than 6m long and 25 noted as being greater than 10m in length (Figure 9). This reflects the general demographics of the entire Scottish fleet, with at least 70% of all vessels licensed in Scotland measuring 10m or less (Scottish Government, 2015).

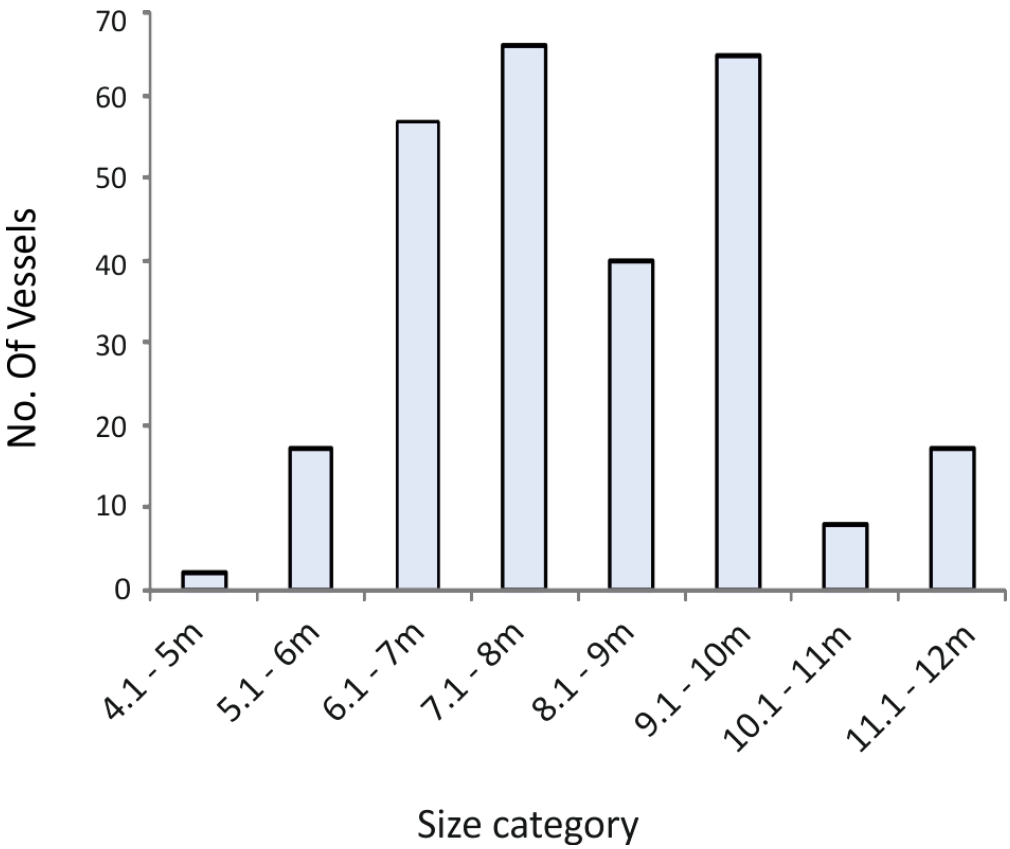

Figure 9: Project vessels by overall length (metres)

Installation Process

Methodology

The process of AIS unit installation on-board participating vessels began in late May 2015. As stated in the earlier section on Work Package Provision (page 3) following multiple delays in the supply of equipment, additional engineering contractors were sought mid-project to deliver within the required time-frame. This also resulted in the project employing a market-standard Class B AIS transponder unit, the XB-8000 manufactured by Vespermarine. Despite these delays, the Project Facilitators maintained good contact with participating skippers/vessel owners via regular email/text updates, as well as continued recruitment.

A protocol for communication and the arrangement/amendment of fitting appointments was established for use by the Project Facilitators, installation engineers and skippers. The aim of this being to streamline the process of arranging installations while minimising the risk of missed appointments.

Ports were targeted in a sequence pre-agreed with the installation engineers. The Facilitators contacted skippers by email (or telephone where no email address was supplied) offering a given timeslot for their installation appointment. The majority of installation appointments were arranged via electronic means, with reminder emails and texts issued 24hrs prior to all appointments. Rescheduling took place where necessary; however, the majority of vessels (79%) were fitted on their first appointment. On occasion, rescheduling was required at short notice (on the day of fitting) this took place through either the Facilitators or directly via the installation engineers. Such instances were rare and were generally the result of mechanical breakdown (e.g. engine failure) or the unavailability of the vessels MMSI number. It should be noted that while the majority of MMSI numbers were collated during the recruitment process delays were experienced as a small proportion of vessels required confirmation, or acquisition, of their numbers from Ofcom.

Delivery

Three contractors were engaged to supply and install the required AIS units on the 274 participating vessels, around the Scottish coast (Table 3). Two of these (Omnimarine Ltd. and Electrotech Marine Ltd.) engaged sub-contractors to deliver their provision for the Shetland Isles and the Western Isles, respectively. Figure 10 shows the breakdown of installations by contractor and area.

Table 3: WP1 AIS Installation Contractors

Succorfish Ltd (Tyne & Wear)	Initially contracted to deliver all fittings had their provision under the project reduced due to issues of equipment supply. This resulted in 38 full fittings and one partial fitting (not completed due to the vessel adopting a Simrad AIS transponder). All fittings were west coast from Wigtownshire to Lochinver, including the Isle of Skye.

OmniMarine Ltd. (Dundee)	In light of the Succorfish supply issue Omnimarine was contracted to install the Vespermarine XB-8000 unit on all East Coast and Shetland Isles project vessels (Shetland provision subcontracted to H. Williamson & Son Marine Ltd.)
Electrotech Marine Ltd (Oban)	In light of the Succorfish supply issue Electortech Marine was contracted to install the Vespermarine XB-8000 unit on all remaining West coast and Western Isles project vessels (with provision of the latter sub-contracted to The Island Hub Ltd, of South Uist.)

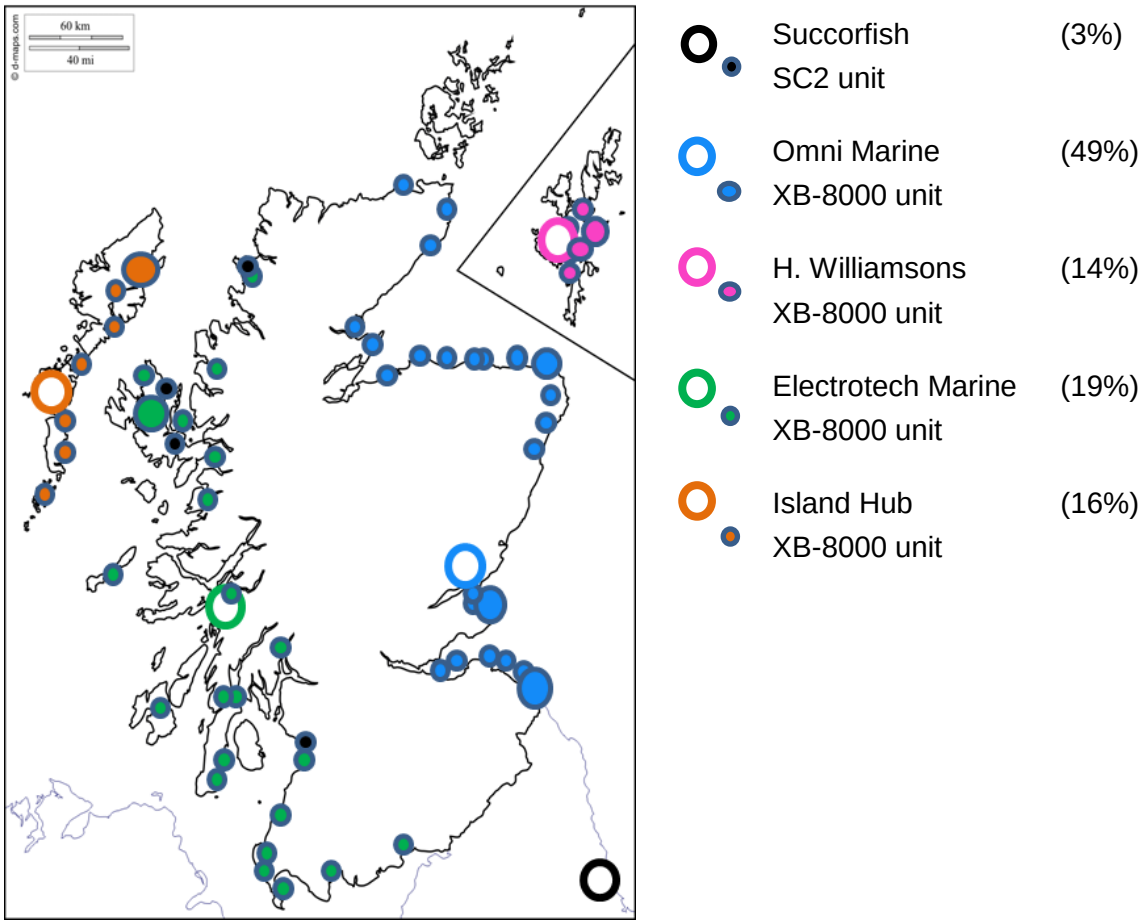

Figure 10: Distribution of vessels AIS by registered port

Installation Timeline

The cumulative installation profile against time is shown in Figure 11. The first 16 vessels were installed with Succorfish SC2 transponders over the 5th and 6th of June 2015 by Succorfish Ltd. engineers, utilising two back-to-back appointments to complete the installation. A further 22 SC2 units were fitted in a single installation appointments by 12th June. All Succorfish installations took place on the West coast at locations between Garlieston (Wigtownshire) and Lochinver (Sutherland) and encompassed the Isle of Skye.

OmniMarine Ltd. commenced installation of the Vespermarine XB-8000 units at Arbroath on 15th June before adding a second installation team to cover Fife, on 29th June. Due to the high proportion of project vessels located on the East coast, installation continued through July and August with the final vessel fitted at North Queensferry on 3rd September. The 37 Shetland vessels were all fitted (by H. Williamson & Son Marine Ltd.) between the 13th and 27th of July.

Electrotech Marine Ltd. commenced West coast installations on 10th July running through to 1st August. The Outer Hebrides installations (fitted by The Island Hub Ltd.) commenced on 11th July and were completed on 25th August.

Following concerns raised by several skippers who received the Succorfish SC2 unit, replacement Vespermarine XB-8000 transponders were offered. Of the 38 vessels to receive the SC2 unit, 6 vessels opted to retain the Succorfish device and 31 requested to have their unit replaced. It transpired that the remaining vessel already possessed a working Simrad AIS transponder and therefore could not be offered a replacement. The fitting of all replacement units was undertaken by Electrotech Marine Ltd over the course of 6 weeks from late July to early September.

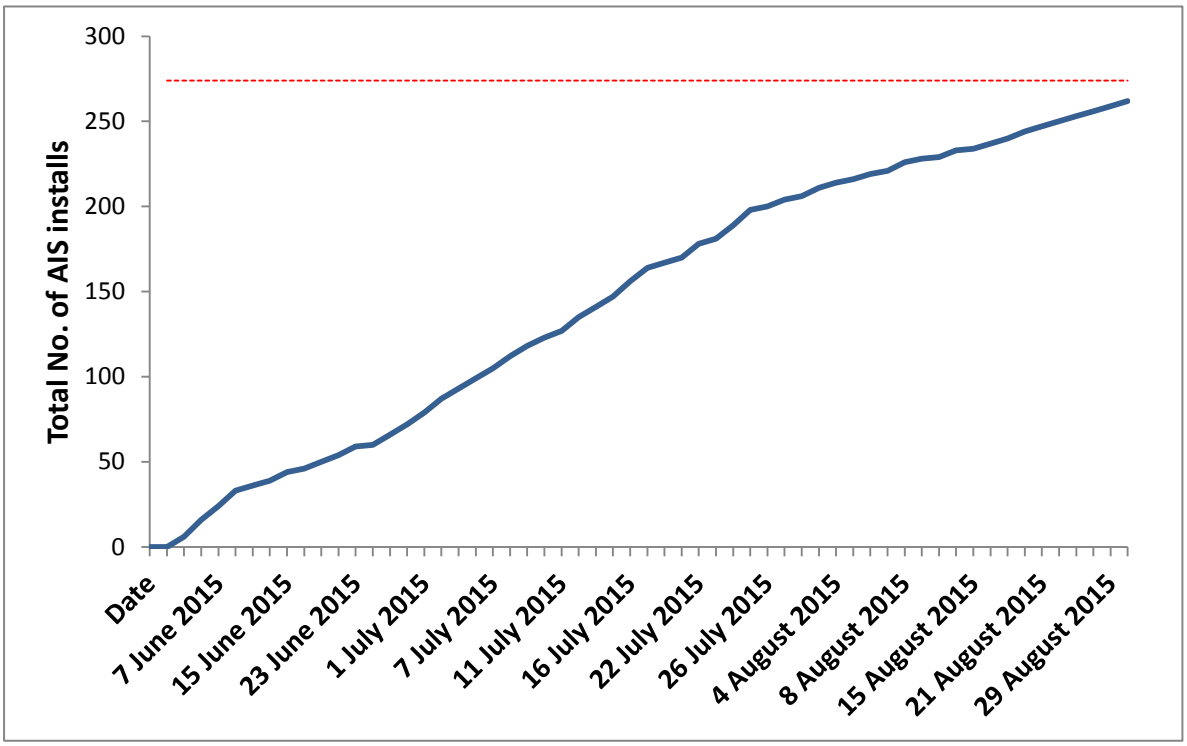

Figure 11: Fitting schedule across the project.

Support and Communication with Participants

A significant amount of communication by the Project Facilitators, with both vessel operators and engineers, was required to ensure the successful installation of AIS transponders on the 274 participating vessels. The majority of this was spent securing MMSI numbers to allow the programming of units. Additional discussions took place with a number of fishermen (typically part-time and/or older skippers) lacking MMSI numbers (i.e. who did not operate DSC VHF radios) on the merits of upgrading for safety and compliance purposes. It is estimated that 12 skippers/vessel operators purchase new DSC radio equipment as a direct result of such communication.

Follow-up communication was largely undertaken by the Project Facilitators on a reactive basis to enquiries received regarding transmission, reception, software operation and a small number of hardware problems. Where relevant these were passed on to engineers who contacted vessel operators directly to resolve any issues either via telephone contact or repeat visits. Five such repeat visits were necessary with all technical issues successfully resolved. Those fishermen enquiring about transmission were either observed on Marine Traffic and passed details regarding their vessel tracks or if no tracks were locatable were offered follow-up information towards the end of the project.

All project participants were provided detailed instruction, via email or post, on either the Succorfish interface software (GUI GPRS transmission tracking) or the Vesper Marine 'WatchMate' software operation and AIS track viewing options.

Visualisation and Recording of AIS Data

A requirement under the original specification for this work package was the ability for participating fishermen to view and review the AIS records (tracks) of their respective vessels, free of charge, for the duration of the project. It also became apparent as vessel recruitment progressed that a sizable subset of skippers were motivated to participate by the knowledge that they would gain the ability to record and store their historic AIS tracks, post project.

In an attempt to identify a user-friendly and preferably no cost solution by which fishermen could visualise and record their AIS tracks, it was agreed with Marine Scotland that a small piece of additional investigative work would be undertaken.

This additional investigation had three objectives;

1. To assess the efficacy of the open-source software OpenCPN in visualising and recording AIS data (tracks) received from a Vespermarine XB-8000 Class B AIS transponder.
2. In the event that OpenCPN proved suitable, create written and video resources to provide guidance in its setup and usage.
3. Identifying a low-cost mechanism by which AIS data (evidencing inshore fishing activity) could potentially be harvested remotely and effectively for fisheries management purposes.

With regard to the first of these objectives, it was determined that (when installed on a compatible laptop) OpenCPN easily connected to the XB8000 AIS transponder (via both the available USB and Wi-Fi pathways) and was proficient in displaying real-time AIS tracks (Figure 12). The program also provided the functionality to efficiently record and replay these tracks via an optional plugin, plus several other useful features, including a route manager and the ability to import and display, tide, current and weather forecast information.

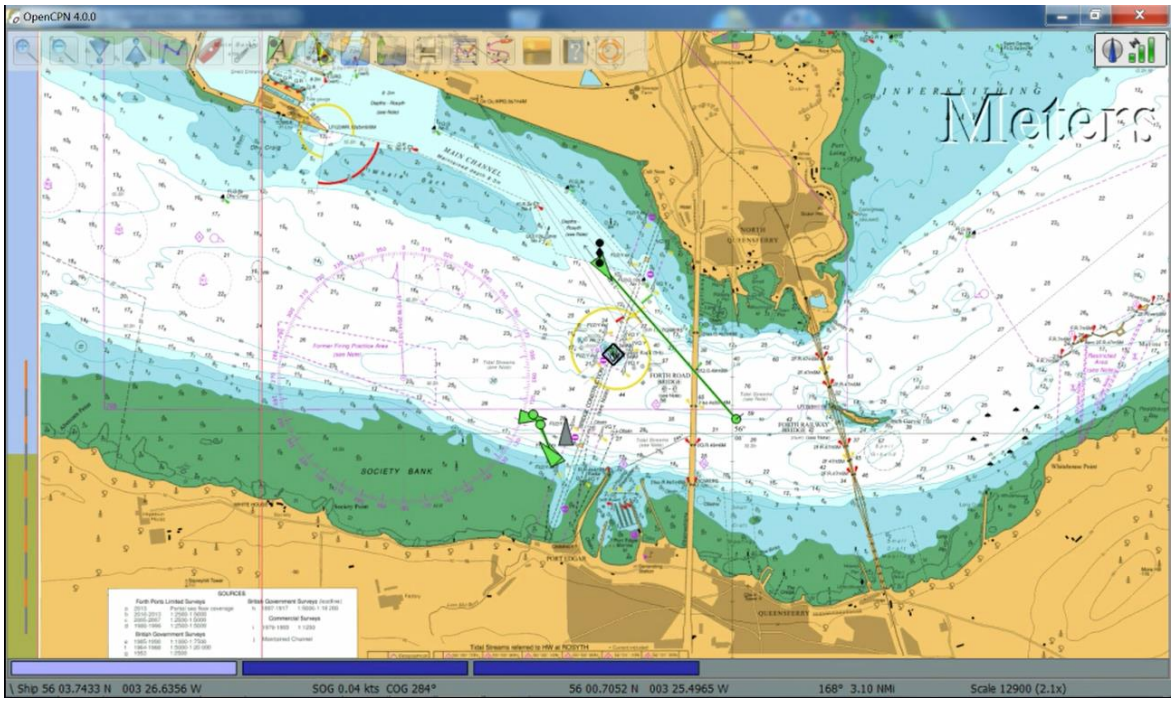

Figure 12: Screenshot from OpenCPN (Version 4.0.0) displaying AIS targets in the inner Firth of Forth

It should be noted that in order for OpenCPN to function effectively, it is necessary to import electronic charts of the region/s in which the vessel will be operating (an example of such a chart can be seen in Figure 12). For those skippers not in possession of electronic charts compatible with OpenCPN, a low cost, comprehensive source for these was also identified (www.visitmyharbour.com).

In order to satisfy the second objective, which was the provision of guidance material describing the setup and usage of OpenCPN, a detailed user manual with two supporting video tutorials were produced. The user manual is available as a downloadable PDF document from the project webpage (http://www.masts.ac.uk/research/sustainable-scottish-inshore-fisheries/) and in addition has been circulated to all work package participants who supplied an email address. The two, 20 minute tutorial videos have been uploaded to YouTube*, the links to which were also made available on the project webpage and were circulated to participants in conjunction with the user manual.

With regard to the third objective; the identification of a low-cost mechanism by which AIS data could potentially be harvested remotely for fisheries management purposes, options have been explored for the use of, for example, commercially available General Packet Radio Service (GPRS) mobile phone technology to store and forward AIS data. Some potential options for such a mechanism are discussed in the following section.

Options for Storage and Relay of AIS Data from Vessels Out of Base Station Reception Range

In the investigation undertaken two key assumptions have been made;

1. In areas where AIS reception is poor it is likely that Global System for Mobile Communications (GSM) coverage is also deficient, consequently, a requirement exists for AIS data to be stored for later transmission or retrieval.
2. That any AIS transponders utilised are able to output data via a serial connection; most likely NMEA 0183 strings via a Recommend Standard number 232 (RS232) serial connection.

As a consequence, any solution employed will require the ability to connect to an AIS transponder unit (in the context of this work package a Vespermarine XB8000) via the above stated serial connection and possess sufficient, preferably removable, on-board memory to store AIS data (NMEA 0183 strings). It is also a requirement that the solution employed offers a means by which the stored AIS information could eventually be merged with 'live' data collected by AIS receiving stations (i.e. transmitted later via GSM when within coverage).

With regard to the bulk transmission and receipt of stored AIS information there are several potential data 'push' options available over the GSM or Iridium communications networks, each of which has benefits and constraints;

- **SMS** (text message) – while this method only allows the sending of a small quantity of data per individual message, transmission success is far more likely in areas of poor coverage. An additional constraint is that this method also requires a means of receiving the messages, i.e. a computer with a GSM receiver and SMS software, or an M2M (computer to computer) connection from the mobile phone service provider.
- **Email** – while email is useful for the issuing of warnings or updates intended for human recipients it is less suitable for automated data collection and processing.
- **FTP** (File Transfer Protocol) – this is a standard network protocol used to transfer computer files from one host to another over a network, such as the Internet. The constraints associated with this approach are that it requires the creation of an FTP

*URLs for the OpenCPN tutorial videos provided below;
Video 1 https://www.youtube.com/watch?v=JkY9WhF6u0s
Video 2 https://www.youtube.com/watch?v=6_q4fpj4_4M&feature=youtu.be

site to receive the files. The received data then needs to be collected from the FTP site for processing or longer term storage.

- **HTTP** (Hypertext Transfer Protocol) – this is the underlying protocol used for all data communication via the World Wide Web and as such requires access to a webserver. To receive incoming information a "page" must be set up as well as a storage option into which the data can be saved (e.g. a database or folder).

Taking the above into consideration there are several potential solutions available, these have been divided according to the varying levels of additional technical development/ modification required.

i. Complete 'off-the-shelf' Commercial Solution

A search was undertaken for devices capable of both remotely logging American Standard Code for Information Interchange (ASCII) particularly NMEA strings, and then transmitting this data back via a mobile network. Multiple devices capable of logging general analogue and/or digital inputs where identified. However, in the majority of cases where the device possessed the required RS232 serial port it proved to be only for connection to a computer (i.e. data output) rather than for the logging of incoming data.

Only two applicable 'off the shelf' commercial solutions were identified and are described below;

- *Your Data Our Care - YDOC* (www.your-data-our-care.com/index.html)

  YDOC are a Dutch firm whose products provide a very close match to the stated requirements. Their data loggers support both analogue and digital inputs, are capable of sending data via GSM and utilise on-board SD card storage, but most importantly the logging of serial port data is also supported.

  The most suitable of the YDOC product range for the logging of AIS data on inshore fishing vessels appears to be the ML-2013 GPRS Logger (www.your-data-our-care.com/low-power-GPRS-datalogger-ML-2013.html). In addition to four analogue and four digital inputs the unit possess two RS232 serial ports for the connection of external sensors/probes, which are capable of receiving ASCII, MODBUS/RTU or NMEA-183 data. Furthermore, the unit is waterproof (IP67 rated) and comes equipped with a built-in QUAD-band GPRS-modem, 2 GB micro SD card plus an 2FF SIM card slot and is powered by an internal 3.6 Volt Lithium battery (an optional integrated 3xAA NiMH solar panel is also available).

  YDOC also offer software solutions for collating, organising and viewing data in the form of the Microsoft Windows compatible programme 'YDOC-Insights' (www.your-data-our-care.com/ydocinsights.html) as well as data collection and housing via their 'Your Data Our Server' service.

- *Symmetron* (www.symmetron.gr/)

  Symmetron are a Greek company which produces the Stylitis-10+GSM data logger (www.symmetron.gr/uploads/stylitis10BrochureEN.pdf).

  The Symmetron Stylitis-10 is a stand-alone, battery-operated data logger suitable for a wide variety of measurements, possessing a built-in GSM modem, two RS232 serial ports, on-board SD card storage and is NMEA logging capable. It also has the capacity to send SMS alarm/data messages and daily data emails. The unit's internal battery life is extremely limited in comparison to the YDOC units (a 9 volt alkaline battery with a typical operational life of 2 weeks) but can be connected to an external

DC supply. A further issue with regard to deployment on inshore fishing vessels is the fact that the Stylitis-10 is not waterproof.

ii. Commercial Solution Requiring a Degree of After-market Programming and/or Customisation

There are a variety of commercially available devices on the market designed for remote logging, networking or computing that provide, a typically Linux-based, environment in which end users can run code. Many of these devices are targeted at analogue and digital sensor measurements and/or providing remote two-way internet access between remote sites and a base. Again typically where these devices have a serial port it is often primarily to allow the device itself to be programmed or utilised as a modem/router. Therefore, it is important to confirm that programmatic logging of incoming serial data is supported before selecting a given device.

As in the previous section, two examples of applicable solutions are described below;

- *INSYS* (www.insys-icom.com/icom/en/products)
  INSYS is a manufacturer of components and solutions for data communication and M2M technology; some of whose GPRS products feature a reasonably well documented Linux 'Sandbox' in which users can run applications. This has support for Python and Java script as well 'C' and offers SQLite databases as potential data storage options.

  For the specified application the INSYS IMON fault monitors may be a possible solution (www.insys-icom.com/IMON). After review of the technical documentation provided on the INSYS website, it appears feasible that a program could be written relatively easily (e.g. in Python using pySerial) allowing the collection of data via the monitor's RS232 port. The monitor would subsequently process this data and store the required values. Another program could then be written which would periodically check for a mobile data connection and when one was detected transmit the stored data.

  A major potential constraint on the use of the IMON fault monitor is its limited on-board storage capacity. Designed primarily as a robust automated fault monitor/logger, the resources available to user processes are not particularly high, only 32mb of RAM, 50mb of file storage for programs and 100mb for storage of user data. Unfortunately, there does not seem to be an option to extend this limited storage via, for example, memory cards. This might prove acceptable if the frequency of data collection was limited or a regular connection for the transfer of stored data could be guaranteed (thereby freeing storage for reuse). However, given the potential for fishing vessels to be out of mobile network coverage for extended periods the systems memory could easily reach capacity. It would be possible to include code within the data collection program to detect the approach of this and cease the logging of information, or delete older data, this would however result in gaps in the time series.

- *Moxa* (www.moxa.com)
  Moxa is based in the USA and Taiwan and specialises in automation technology. Moxa offer a range of products for industrial networking, computing, and automation. Some of the industrial wireless computers in Moxa's range (e.g. the W300a GPRS Series http://store.moxa.com/a/product/w300a-gprs-series?id=M20101203001 and IA240 Series http://store.moxa.com/a/product/ia240-series?id=M20090309033)

utilise the Linux Kernel operating system and possess options for GSM networking, an SD card slot and either 2 or 4 serial ports (RS232).

The major drawback with utilising these units is, as supplied, they only appear to have support for program development in C or C++ and not for scripting languages such as Python or Java. The outcome of this is that while early prototyping may prove quite rapid writing the initial code for the data logging and transmitting applications could take some time and the final testing/debugging will likely also require a significant period.

iii. Purpose Built Mini-computer Based Solutions

An increasingly common solution for data logging applications involves the use of inexpensive mini computers, such as the Arduino and Raspberry Pi (www.raspberrypi.org/products/raspberry-pi-2-model-b/) together with appropriate additional expansion boards and shields. Such units are utilised as the basis upon which to build low cost custom prototypes and even the eventual solutions themselves.

The use of these 'hobbyist' mini computers potentially offers sizable benefits over the commercially available solutions; principally low production costs and a huge degree of flexibility with regard to customisation. Initial prototyping would likely be rapid particularly if utilising high level scripting language like Python. However, the transition from functional prototype to devices capable of standalone deployment may require significant additional development time. Despite this, if the number of devices required was to be relatively large then the low per-unit cost would, in the longer term, offset the outlay in development time.

iv. Alternative Options

a. *Offline serial port loggers*:
(E.g. The SpaceLogger® www.r-p-r.co.uk/spacelogger/s10.php)
These basic data loggers would save the AIS data received to on-board storage, typically a removable SD memory card. Such an approach would necessitate the periodic replacement and collection of the cards, which would result in a delay in the receipt of data. Such a low tech solution would, however, be less costly as significantly less development time would be required for coding, the setting up servers, etc.

b. *Existing GPS (rather than AIS) telemetry systems used in fleet and animal tracking*:
If the primary goal of the exercise is to be a system which could eventually provide data on vessel movements then GPS/GSM based loggers are commonplace and thereby relatively cheap. Any approach involving this technology would be based on existing solutions and therefore would require relatively little development and testing, allowing the rapid implementation of a working solution. However, this approach does not fit the requirements specified as it does not involve AIS.

Conclusions

AIS is a collision avoidance system that transmits publicly accessible VHF signals to other vessels equipped with AIS and other receivers and transceivers which are land based or attached to fixed infrastructure at sea. AIS transmissions identify the vessel carrying the device, together with its location, direction of travel and speed. Inshore fishing vessels under 12m are under no legal obligation to carry AIS.

An objective of this project was to determine whether a standard Class B AIS transceiver would, under operational conditions, when fitted to sub 12m inshore fishing vessels, provide data of sufficient geographic and temporal resolution to be useful for fisheries management purposes.

Inherent line of sight limitations of VHF transmissions, particularly in the complex topography of the Scottish coastline and its islands, coupled to the known locations of AIS receiver stations, suggested that in a limited number of areas, Class B AIS may not provide a consistent or reliable method of identifying fishing activity.

Preliminary mapping of fishing vessel activity derived from the vessels fitted with Class B AIS in this project indicates that there is reasonably comprehensive AIS coverage around the coast of Scotland. A separate study designed to model the range over which Class B AIS is likely to be effective with respect to detecting the activities of sub 12m fishing vessels has revealed some potential gaps in coverage which appear to be quite discrete and would need to be considered if this technology was to be used as a method for monitoring inshore fishing vessel activity in these areas. However, it is recommended that some defined higher resolution ground-truthing studies are conducted in areas where predictive mapping of AIS signal propagation and reception indicate a lack of signal.

Further investigation may then be warranted looking into the technical and financial feasibility of 'plugging' any identified gaps in coverage. It should also be noted that initial exploratory investigation was undertaken examining the potential of utilising GSM (mobile phone network) store and forward technology which may resolve the issue of VHF receiver coverage (refer to page 22).

Overall, the Class B AIS units fitted to the 274 vessels involved in this project have proven very reliable, and demonstrate that a significant and consistent body of data can be easily accumulated at relatively modest cost. These data can provide highly accurate positional and vessel track information approximately every minute. The distance covered by the vessel in the intervening period will be a function of its relative speed and this therefore determines the accuracy of any predicted track between data points. The mapping of a subset of these data is provided under a separate project.

An additional objective of this project was to determine the willingness of skippers of sub 12 m inshore fishing vessels to have AIS fitted to their vessel and to agree to the AIS unit transmitting VHF signals which could be interrogated by anyone with an appropriate receiver (when in range) or via freely available web applications.

Some skippers (principally those employing static gear) voiced reservations regarding the visibility of their activities to other fishermen, while many others highlighted the ability to visualise and record their fishing activity as the primary driver for their participation. With regard to the latter, while AIS data (vessel tracks) are free to view in the public domain at the point of broadcast (and are accessible via numerous websites such as Marine Traffic) access to historic or cumulative data is only available subject to charge. As a result, it became clear during the later stages of the project that it would be necessary to identify a low-cost solution that would allow participating fishermen to visualise and record their AIS vessel tracks. OpenCPN, an open source, free to use software package was demonstrated to be a powerful and versatile mapping tool that could be employed with relatively little effort

by those skippers wishing to do so. As a result comprehensive guidance material was produced and circulated to all fishermen participating in the project.

The project officially ended on 31st September 2015. A post project survey of vessels that participated in the project has been undertaken and will be reported separately. The main purpose of the survey is to determine the extent to which skippers are willing to continue to allow their AIS units to operate in a mode that will permit the public reception of their data beyond the period of the original project. Indications thus far are that the majority of skippers appear to be willing to do so. However, from a fisheries management perspective, it would be important to be able to definitively know if any given vessel is using its AIS unit continuously in open transmission mode, whether it is being used in silent mode (i.e. the vessel is not transmitting its position but can see other AIS equipped vessels within range) or is switched off. For those not wishing to disclose their data publicly, it may be possible to utilise standard mobile phone store and forward capability to transmit the relevant data to a secure server, but with additional contingent costs. An additional project is investigating the potential to use such technology coupled to a standard Class B AIS unit for this purpose.

In relation to the collation of cumulative AIS data under the project, it was noted that there was often significant variation in the AIS data displayed on the websites of commercial AIS data suppliers. It was discovered that this variation related back to the provision of data from the owner/operators of the various AIS base receiver stations. The nature of the AIS network means that these base stations are owned and operated by multiple organisations. As a result, there appears to be no single commercial data provider with access to data from all of the base stations around the Scottish coast. As a consequence it is likely that no single data provider offers comprehensive coverage of Scottish inshore waters. To establish this definitively, it would be necessary to know the location and technical specifications of the receivers that the commercial suppliers are accessing. The fact that AIS data would need to be accessed through third party suppliers is an important consideration, if these data are to be used for any statutory purposes.

To conclude, this project has demonstrated the potential of utilising existing AIS networks and technology to record fishing activity in Scottish inshore waters (for use in policy and fisheries management decision making). A large proportion of the Scottish inshore fleet (approximately 18% of sub-12 m fishing vessels) has actively participated in the project and there is a waiting list for those that would be willing to have AIS fitted to their vessels should the opportunity arise. Further investigation into the utility of using this technology in an operational capacity on sub 12 m inshore fishing vessels is strongly recommended. In addition, issues highlighted with respect to managing and interrogating the significant volumes of data produced requires careful consideration. Maximising the potential to use these data for a range of fisheries management purposes will require proper definition of the objectives and required outcomes of future work. Whilst the current project has been invaluable in demonstrating (contrary to conventional wisdom) that a large number of inshore skippers would be willing to embrace AIS technology voluntarily, it is recommended that future projects, as far as possible, use this capacity. Many of the skippers involved have expressed a willingness to take part in future studies. The logistics and risks associated with a time limited deployment of AIS technology on the scale achieved in this project has been significant, as has been the potential for failure with serious financial and reputational consequences. It is recommended that any future projects are phased and should focus on smaller deployments of equipment for testing purposes in the first instance before being rolled out on a fleet wide scale.

Appendices

Appendix 1: **Information Pack Provided to Fishermen**

SEAFISH INSHORE FISHERIES PROJECT

Evidence Gathering in Support of Sustainable Scottish Inshore Fisheries*

Introduction

The European Fisheries Fund (EFF) is providing £1.4 million of funding through Seafish to support research within Scottish inshore fisheries. This is in direct response to Scotland's Inshore Fisheries Groups (IFGs) recognition that there is a lack of evidence (data) upon which to better manage Scotland's inshore fisheries. The project 'Evidence Gathering In Support of Sustainable Scottish Inshore Fisheries' has been commissioned to take place between June 2014 and July 2015, in support of the future sustainability of the industry and consists of 7 sub-projects or 'Work Packages'. The funding from the EFF therefore aims to benefit the IFGs by addressing key knowledge gaps identified in their management plans. These include, for example, establishing the location and footprint of fishing activities, improving catch data to enable stock assessments, improving local market opportunities for inshore fisheries, and developing an information resource base for inshore fisheries management. This pilot work is part of a 7 year project plan which will include accessing additional funding from the European Maritime and Fisheries Fund (EMFF), thereby contributing to the longer-term development of the industry and sustainable fisheries management. The contractors commissioned to deliver the Work Packages are now seeking engagement with the industry to undertake their research. The results will be used to inform future fisheries policy, therefore ensuring the programme runs in close working partnership with IFGs, is of paramount importance.

Benefits of collecting fisheries data

Data collection and research are central to fisheries management and benefit the fishing industry by providing hard evidence to support management decisions. Scotland's IFG management plans call for fishing activities to be economically viable and environmentally sustainable. In order to achieve this aim it is essential to understand the extent of fishing activities and the state of stocks at a locally relevant scale. Economic data is required to understand fisheries market dynamics (e.g. the value of the landed species versus the costs of harvesting the species), and social data provides information on the degree to which communities are dependent on fisheries. Environmental data (e.g. habitat maps) can help managers and fishers identify sensitive areas, such as nursery habitats.

The marine environment is increasingly busy, and competition for space and resources is growing. Within Scotland this is partially due to the expanding marine renewable and aquaculture industries, and the designation of 30 new Marine Protected Areas (MPAs). Evidence of the location and scale of fishing activities will enable fishermen to be better represented in the marine spatial planning process (e.g. during the siting of aquaculture and renewable energy developments), and can be used to manage fishing activities within and around MPAs. In addition, data collection programs that are integrated with fisheries management plans can also allow fisheries to enter accreditation programs (e.g. MSC), and thereby access markets with improved premiums.

*Inshore fisheries are defined here as operating between 0 to 6 nautical miles, with vessels mainly <12 meters.

Project Work Package summaries

1. Establishing the location of fishing activities within Scottish inshore areas

This project invites skippers to test the innovative Succorfish SC2 vessel monitoring and communication system on up to 300 inshore fishing vessels. The Succorfish SC2 system uses GPS tracking that is accurate to 2 meters, and reports vessels position, course and speed at 1 to 2 minute intervals over Automatic Identification System (AIS), which operates through a VHF safety channel. The technology will be installed on vessels at no cost to the skipper/owner, and the data will be free to view in the public domain. During and after the project the industry may use the technology to benefit their business as they see fit. This project is available to skippers operating within West coast IFGs, and is seeking voluntary participation across all fishing sectors.

2. Monitoring fishery catch to assist scientific stock assessments in Scottish inshore fisheries

This pilot project aims to identify fisheries that have limited stock assessment information, and provide fishermen with the opportunity to learn how to collect data for stock assessment needs. Data collection by fishermen will initially be undertaken in conjunction with onboard observers. However, this work aims to build capacity for self-reporting by fishermen, as well as trial different methods of self-reporting directly with the industry. Fishermen that successfully complete the training and data collection may be registered as competent to undertake such work in the future, which will be of direct benefit to fisheries management within the IFGs.

3. Identifying catch composition using technology to enable self-reporting

This project will mainly test Electronic Monitoring Systems (EMS) as a method for verifying the accuracy of self-reporting by fishermen. The project contractors wish to fit a number of willing vessels with 2-3 video camera units, GPS, as well as rotation and hydraulic sensors. Other novel technology for collecting fisheries data will also be tested. The cost effectiveness of video cameras versus onboard inspectors will be assessed. In the long term, video monitoring could allow fishermen to demonstrate 'good practice' and show that they are adhering to management actions (e.g. total catch allowances and discards).

Projects 2 and 3 are complimentary, and are available to 10 fishing vessels (<10m) operating on the West coast. The target ports are Stornoway, Ullapool, Mallaig, Portree and Oban, and the project would like to include a Nephrops trawler, a scallop dredger and 8 vessels using static gear (creels/pots). All research will be conducted over 40 days at sea (combined), and skippers will receive financial recompense subject to successful completion of the work.

4. Pilot study to define the footprint and activities of Scottish inshore fisheries by identifying target fisheries, habitats and associated fish

This work will access and evaluate existing data that describes human activities in the marine environment, as well as physical and biological characteristics. Such data may include, for example, fishing activity (location, effort, gear types), location of renewable energy and aquaculture sites, shipping activities, marine habitats (sediment maps) and conservation boundaries. The data will be combined and presented into a user-friendly visual interface that is tailored to fisheries manager's needs. The pilot data visualisation tool will be internet-based, and will be tested by the industry to assess its ability to inform and support fisheries management. South West Scotland (Clyde) and the East Coast (Moray Firth) are proposed as the pilot study areas.

5. Improving market intelligence and co-ordination in Scottish inshore fishery production

This pilot study aims to engage directly with the inshore industry in order to evaluate the potential of opening up market opportunities and subsequent sales through strategic communication to direct, local markets. The project will assess supply requirements and constraints of both increasing catches and securing commercial sales and will seek to address identified obstacles through improved communication networks, collaboration and cooperation within the industry and with customers. The project aims to assess existing communication supply chain networks and creativities, and develop new initiatives to improve the understanding of both the local market and the potential capacity (volume, composition and seasonality of products) to meet and stimulate local demand. The project is seeking to engage with industry in several target areas around Scotland.

6. Integrating stock management considerations with market opportunities in Scottish inshore fisheries

This project aims to assess the economic and stock benefits of introducing a minimum market landing size (MMLS) for certain shellfish species. The contractors will evaluate how such an intervention could take place at a regional level for Nephrops and velvet crab fisheries. In addition, the project will assess the size distribution of shellfish landed (above MLS) on a seasonal basis, establish costs and returns associated with different sized specimens, establish consequences of increasing MLS through pilot economic assessments, and evaluate the potential for increased MLS as a tool for improved returns and fishery sustainability. The data will be collected via literature reviews, interviews, questionnaires and steering groups meetings. This project is seeking involvement from the fishing industry in several case study areas around Scotland.

7. Establishing a dedicated information resource base for Scottish inshore fisheries

This programme will develop and trial a web-based searchable database that is dedicated to Scottish inshore fisheries, with key input from all IFGs. The database will present fisheries data currently available within each IFG management plan, and will update information streams as and when new data becomes available. The database will also be tailored so that individual IFGs can easily identify and explore the information available for specific fisheries, and adapt their management plans accordingly. Information uploaded to the database per IFG may include (but is not limited to) vessel characteristics, gear use, fishing locations and landings. The database plans to simplify access to information, and improve knowledge exchange between IFGs for strategic and management planning. The project will be available for all IFGs across Scotland, with local, secure access to all sensitive data.

Project structure

Seafish, working in partnership with Marine Scotland Fisheries Policy, consulted the IFG management plans and formulated project proposals that would support evidence gathering for inshore fisheries management. The resulting European Fisheries Fund inshore fisheries project work package proposals were commissioned by competitive tender and have been awarded to independent contractors. The seven Work Packages will take place on a short-term, 'pilot scale'. The aim is not to supply conclusive data, but rather to test the suitability of technology and methodology that may benefit inshore fisheries management in the future with industry knowledge and experience.

The Work Packages require direct voluntary engagement with the fishing industry, either through commissioning vessels to assist with research, or via knowledge exchange and interviews. In all cases, the industry will be informed of why the data is being collected, how it is being used and how this can benefit fishermen. Participants will be assured of strict confidentiality protocols and will have the opportunity to feed into and benefit from techniques and trials. The research data to be collected is non-statutory information and will not be used for regulatory purposes.

Two regional project facilitators have been appointed to liaise directly with the fishing industry, and the Marine Alliance for Science and Technology Scotland (MASTS) will oversee general project management.

SEAFISH INSHORE FISHERIES PROJECT

Contact details

All general enquiries about the project should be directed to the MASTS Project Manager – Dr John Thompson at: jbt5@st-andrews.ac.uk

More detailed inquiries with respect to individual work packages should be directed to the Project Facilitators:

West Coast – Dr Kyla K. Orr

T 01599 – 544 739
M 07502 – 329 058
E kylaorr@gmail.com

East Coast – Ali McKnight (MCIEEM)

T 01540 – 662 083
M 07713 – 333 166
E alimcknight@agroecosystems.co.uk

Weblink

www.seafish.org/research-economics/evidence-gathering-in-support-of-sustainable-scottish-inshore-fisheries

Funders and partners

EUROPEAN FISHERIES FUND

SEAFISH the authority on seafood

Appendix 2: Number of WP1 project vessels for each 'Administrative Port' (i.e. Fisheries Office) in Scotland relative to the total number of <12m vessels registered with each of the ports

Administrative Port/ Fisheries Office	No. Project Vessels	Total <12m vessels in Scotland*	Project vessels as % of total <12m vessels in Scotland
Aberdeen	12	83	14
Anstruther/Pittenweem	33	92	36
Buckie	9	60	15
Eyemouth	31	91	34
Fraserburgh	26	107	24
Peterhead	16	59	27
Kinlochbervie	0	18	0
Scrabster	6	82	7
Ayr	15	73	21
Campbeltown	6	102	6
Lochinver	2	12	17
Mallaig	3	29	10
Oban	7	91	8
Portree	17	116	15
Ullapool	11	86	13
Stornoway	43	169	25
Kirkwall (Orkney)	0	114	0
Lerwick	37	139	27
	Total 274	**Total 1524**	**18% of Total**

* Data for September 3rd 2015 (MMO, 2015a, 2015b)

Appendix 3: Tables giving number of project vessels for each port in respective districts around the coast of Scotland: East coast (A), West coast (B), Outer Hebrides (C), East & North coast (D) and Shetland (E). Numbers in bold indicate totals for districts.

A. East Coast	
Aberdeenshire & Angus	**53**
Banff	1
Boddam	1
Cairnbulg	3
Fraserburgh	8
Gardenstown	9
Gourdon	2
Montrose	4
Pennan	1
Peterhead	15
Stonehaven	1
Whitehills	3
Arbroath	5
East Lothian	**30**
Cove	1
Dunbar	12
Eyemouth	3
N Berwick	3
Port Seton	6
St. Abbs	5
Fife	**32**
Anstruther	5
Crail	2
Pittenweem	18
St. Andrews	7
Midlothian	**3**
Fisherrow	1
North Queensferry	1
Moray	**11**
Buckie	1
Burghead	6
Findochty	1
Nairn	1
Portsoy	1
Cromarty	1
Grand Total	**128**

B. West Coast	
Argyll North	**1**
Oban	1
Argyll South (Clyde)	**5**
Campbeltown	1
Carradale	1
Tarbert Argyll	3
Argyll Islands	**7**
Islay	1
Tiree	6
Ayrshire	**6**
Ardrossan	2
Ballantrae	1
Girvan	1
Largs	2
Highland	**3**
Glenuig	3
Skye and Lochalsh	**11**
Elgol	1
Kyleakin	4
Plockton	1
Portree	3
Uig	2
Sutherland	**3**
Kylesku	1
Lochinver	2
Wester Ross	**15**
Achiltibuie/ Old Dorney	5
Applecross	1
Ardheslaig (Nr. Shieldaig)	5
Badachro (Nr. Gairloch)	1
Gairloch	1
Ullapool	2
Dumfries & Galloway	**9**
Garlieston	3
Girvan	1
Port Logan	1
Stranraer	2
Drummore	1
Annan	1
Grand Total	**60**

C. Outer Hebrides	
Barra	**3**
Ault Earsary	1
Castlebay	1
Vatersay Causeway	1
Benbecula	**2**
Eriskay	**2**
Harris	**12**
Amhuinnsuidhe, nr Huishinish	1
Loch Shell	2
Scalpay	7
Stockinish	2
Lewis	**5**
Breivig	1
Carloway	1
Kirkibost	1
Stornoway	2
North Uist	**11**
Berneray	1
Kallin	6
Lochmaddy	4
South Uist	**8**
Loch Carnan	2
Lochboisdale	5
Ludag	1
Grand Total	**43**

D. East & North Coast	
Caithness	**5**
Lybster	1
Scrabster	1
Wick	3
Sutherland	**1**
Helmsdale	1
Grand Total	**6**

E. Shetland	
Aith	1
Clousta, nr Bixter	1
Collafirth	1
Cunningsburgh	7
Hamnavoe	8
Lerwick	6
Outer Skerries, Lerwick	1
Scalloway	4
Symbister	7
Vidlin	1
Grand Total	**37**

References

Marine Management Organisation (MMO). 2015a. Vessel lists 10 metres and under. https://www.gov.uk/government/statistical-data-sets/vessel-lists-10-metres-and-under. Last updated 3 September 2015

Marine Management Organisation (MMO). 2015b. Vessel lists 10 metres and over. https://www.gov.uk/government/statistical-data-sets/vessel-lists-over-10-metres. Last updated 3 September 2015

Scottish Government (2014). Scottish Sea Fisheries Statistics 2014. A National Statistics Publication for Scotland. Marine Scotland. 108pp. http://www.gov.scot/Publications/2015/09/1961

Marine Alliance for Science and Technology for Scotland
C/O Scottish Oceans Institute
East Sands
University of St Andrews
St Andrews
Fife
KY16 8LB
Scotland/UK

T: +44 (0) 1334 467 200
E: masts@st-andrews.ac.uk
W: www.masts.ac.uk

MASTS Company Number: SC485726; Charity Number: SC045259

ISBN 978-0-9934256-2-2

EFF: MI-NC-3-0093

This project was supported by a grant from the European Fisheries Fund