Marine Ecological Surveys Ltd.

FISHING AND THE HISTORIC ENVIRONMENT

PREPARED FOR ENGLISH HERITAGE

Marine Planning Consultants

Fjordr
Marine and Historic Environment Consulting

- Marine Ecological Surveys Limited -
3 Palace Yard Mews, Bath BA1 2NH Tel: +44 (0)1225 442211

Title	EH 6204 Interaction between fishing and the historic environment.
Author(s)	Antony Firth, Liam McAleese, Rodney Anderson, Rohan Smith, Tania Woodcock
Derivation	New document
Origination Date	9/11/2012
Reviser(s)	TW
Date of last revision	9/1/2014
Version	Final (internal tracker – v1.8)

Status / Required Action	Final
Circulation	Client
Approval	Dr Lindsay Jane Seiderer

This report should be cited as: Firth, A., McAleese, L., Anderson, R., Smith, R., and Woodcock, T. 2013. *Fishing and the Historic Environment*. EH6204. Prepared for English Heritage.

Correspondence: Lindsay Jane Seiderer
Marine Ecological Surveys Limited
3 Palace Yard Mews
Bath
BA1 2NH
Email: marine@seasurvey.co.uk
Tel: 01225 442211

Acknowledgments

This project was commissioned by English Heritage as part of the National Heritage Protection Plan. We would like to thank Christopher Pater and Ed Salter of English Heritage for their direct assistance in this project. We would also like to thank Serena Cant and Neil Guiden of English Heritage's National Record of the Historic Environment (NRHE) for the provision of historic environment data, and the staff of the National Heritage Protection Commissions Programme.

The successful production of this report was enhanced and facilitated by the support, patience, collaboration, and dedication of many people. Substantial comments which served to improve the final report were provided by Ed Salter, Christopher Pater, and a number of English Heritage representatives; Philip MacMullen, Head of Environment, Seafish; Robert Yorke, Chairman of Joint Nautical Archaeology Policy Committee; Elizabeth Bourke, Executive Officer and a number of representatives of The National Federation for Fishermen's Organisations; Tony Delahunty, Creels and Pots Fisherman, Sussex; Sussex Inshore Fisheries and Conservation Authorities officers; Wessex Archaeology; Dr Ben Ferrari; Natural England; Eastern IFCA Officers; Maritime Archaeology Trust; Mark Beattie-Edwards, Nautical Archaeological Society; Holderness Fisheries Local Action Group; Maritime Historical Studies Centre, University of Hull; Professional Association of Diving Instructors; and Cefas.

We are grateful for the contributions from MMO officers for vessel monitoring and surveillance data; and the Marine Conservation Society, for inputs on seabed and habitats images.

We extend our thanks to all those contributors who have not been mentioned by name.

Jack Pitts, Robert Goodchild and Caroline Chambers contributed high quality GIS maps which supported spatial analysis components of this report; also, many thanks to Dr Lindsay Jane Seiderer for quality reviewing and invaluable advice.

This project which provides significant insight into the current challenges and opportunities of our fishing and marine heritage environment was funded by English Heritage, for which the Project Team and Stakeholders are truly grateful.

LIST OF ABBREVIATIONS

ALDFG	-	Abandoned, Lost or otherwise Discarded Fishing Gear
AMAA 1979	-	Ancient Monuments and Archaeological Areas Act 1979
Cefas	-	Centre for Environment, Fisheries and Aquaculture Science
CFP	-	Common Fisheries Policy
DCMS	-	Department of Culture, Media and Sport
Defra	-	Department for Environment, Food and Rural Affairs
EBFM	-	Ecosystem-Based Fisheries Management
EFF	-	European Fisheries Fund
EH	-	English Heritage
EIA	-	Environmental Impact Assessment
EMFF	-	European Maritime and Fisheries Fund
EMS	-	European Marine Site
ERAEF	-	Ecological Risk Assessment for the Effects of Fishing
FAO	-	Food and Agriculture Organization of the United Nations
FIPAD	-	Fisheries Industry Protocol for Archaeological Discoveries
GES	-	Good Environmental Status
HELM	-	Historic Environment Local Management
IFCA	-	Inshore Fisheries and Conservation Authority
ISSCFG	-	International Standard Statistical Classification of Fishing Gear
JNAPC	-	Joint Nautical Archaeology Policy Committee
MALSF	-	Marine Aggregate Levy Sustainability Fund
MCAA	-	Marine and Coastal Access Act
MCZ	-	Marine Conservation Zone
MESL	-	Marine Ecological Surveys Ltd
MMO	-	Marine Management Organisation
MPA	-	Marine Protected Area
MPC	-	Marine Planning Consultants
MSC	-	Marine Stewardship Council
nmi	-	Nautical Mile
PSA	-	Productivity Susceptibility Analysis
PWA 1973	-	Protection of Wrecks Act 1973
RBF	-	Risk-Based Framework
REC	-	Regional Environmental Characterisation
rMCZ	-	Recommended Marine Conservation Zone
SAC	-	Special Area of Conservation
SEA	-	Strategic Environmental Assessment
SICA	-	Scale Intensity Consequence Analysis
SPA	-	Special Protection Area

CONTENTS

EXECUTIVE SUMMARY

This project examines interactions between commercial fishing and the marine historic environment, and the models and approaches that can be used to assess these interactions. It reviews current and emerging policies in order to inform a series of recommended management and research proposals, with the aim of offering practical and deliverable options to use as a basis for discussion with stakeholders.

The project objectives were as follows:

- To examine how different fishing techniques employed in English waters can interact with heritage assets on the seabed.
- To collate and assess evidence of the extent of interactions between commercial fishing and the historic environment.
- To examine frameworks and practices of commercial fisheries through which *in situ* management and / or mitigation of heritage assets might be effectively implemented.
- To identify further research requirements in respect of better understanding interactions between commercial fishing and the historic environment.
- To develop options for management and mitigation in line with fisheries management practices.
- To engage with and seek feedback from stakeholders.
- To share knowledge and perspectives gained in the course of the project through a project report and action plan.

Two broad sets of interactions between fishing and the historic environment have been identified and are considered in the project.

- The first set of interactions arises where fishing activity in the past has resulted in the incorporation of fishing material into the historic environment. Fishing is one of humanity's earliest attested activities and can be better understood and appreciated through archaeological investigation. The physical remains of fishing onshore, in intertidal areas and underwater, make a contribution to the overall historic environment that warrants conservation.
- The second set of interactions arise when archaeological material originating from a very wide range of past human activities is now present on both the foreshore and the seabed, with the likelihood of being encountered in the course of commercial fishing.

A number of potential and evidenced interactions between commercial fishing and heritage assets have been identified within the report. Beneficial and adverse interactions have been identified for both fishers and heritage. The key focus for heritage management, arising from discussion of these interactions, is the significance and extent of damage (to both fishing gear and heritage assets) caused by interactions; and the delivery of long-term management and mitigatory actions. The advent of technological improvements to fishing gear and improvements in our understanding of the marine historic environment would suggest that with further research and changes to management it will be possible to mitigate negative fishing-heritage interactions and enhance positive interactions with shared benefits for stakeholders.

A number of multi-disciplinary management options and research needs have been prepared and are summarised in **Appendix 5**.

The report is structured as follows:

Section 1 Introduction: providing details on the need for English Heritage to commission a project of this nature, as well as the objectives, scope, method, and resources employed in order to achieve the project deliverables.

Section 2 Commercial Fisheries and Gear Type: provides an introduction to the English commercial fishing fleet, methods, and gear types; together with descriptions of common commercial species which are caught within the case study areas and likely impact of fishing gear on the seabed.

Section 3 Management Frameworks and Practices: provides details on the current management frameworks and practices for heritage and fisheries, and discusses changing and emerging policies.

Section 4 Assessing Interactions between Commercial Fishing and the Historic Environment: provides details on the conceptual framework for the marine historic environment, habitat characterisation, and approaches for assessing interaction.

Section 5 The contribution of Fishing-related materials to the Historic Environment: provides details on contribution made by physical activities and remains of fishing to the overall historic environment. Details of options for management and research are provided based on current provisions for terrestrial planning and designation.

Section 6 Indirect Interaction between Commercial Fishing and the Historic Environment: provides details on indirect interactions between commercial fishing and the historic environment; including constraints through management and opportunities for commercial fishing and archaeological investigations to contribute useful information.

Section 7 Direct Interactions between Commercial Fishing and the Historic Environment: provides details on the direct interactions between commercial fishing and the historic environment; including damage to fishing gear and heritage, and resulting archaeological discoveries.

Section 8 Mapping Fishing Effort, Habitats, and Heritages Assets: provides details and maps the distribution of fishing activities, habitat characteristics, and heritage assets. Details of fishing effort based on vessel monitoring and surveillance systems are provided.

Section 9 & 10 Proposal, Action plan, and Conclusion: provides details on potential opportunities for responsible management and co-existence of commercial fishing and heritage assets, and concludes the report.

1. INTRODUCTION

In November 2012, English Heritage commissioned a consortium comprising Marine Ecological Surveys Ltd (MESL), Fjordr Ltd and Marine Planning Consultants Ltd (MPC), to examine the interaction between commercial fishing and the marine historic environment (project ref: EH 6204).

The coastal waters of England are rich with marine heritage assets, valued and non-renewable cultural assets of society that, when considered together, form the marine historic environment. The significance of marine heritage is recognised at an international level.

> *"It is important to acknowledge the importance of underwater cultural heritage as an integral part of the cultural heritage of humanity and a particularly important element in the history of peoples, nations, and their relations with each other concerning their common heritage"*
>
> Convention on the Protection of the Underwater Cultural Heritage (UNESCO, 2001)

Marine heritage assets face the risk of deterioration and destruction, particularly when located in exposed and heavily used areas of the seabed. They may be affected by natural and anthropogenic influences such as sediment scour, dredging and anchoring (Gregory *et al.*, 2012). The unpredictable nature of the historic environment, particularly within a marine context, makes it difficult to identify and manage such risks (English Heritage, 2008).

Eastwood *et al*. (2007) estimated fishing to be the greatest human pressure on the UK seafloor in terms of affecting a greater spatial extent when compared with other major offshore human activities. As a commercial sector, fishing is therefore likely to interact with marine heritage assets. The type and extent of these interactions (here in referred to as 'fishing-heritage interactions') are varied and poorly understood, with potential for both positive and negative effects upon fishers and heritage.

There has been concern for several decades about the potentially wide-ranging impact of fishing on the marine historic environment, both in the UK and abroad.[1] Fishing activities, and the consequences of fishing, were routinely observed from at least the mid-1980s during the course of fieldwork to monitor sites designated under the Protection of Wrecks Act (1973). There were numerous cases of potting on designated wrecks, and examples of fishing net tangled around timbers.

The potentially damaging effects of fishing-heritage interactions upon heritage assets have become a contentious issue in recent years, and there has been considerable debate about the archaeological implications, for example, of trawling in the English Channel (Kingsley, 2009). However, such claims appear to be coloured by a vested interest in using fishing impacts to rationalise commercial recovery of heritage assets from the seabed (MacMullen, 2011).

[1] For example, see recent papers presented by UNESCO: http://www.unesco.org/new/en/culture/themes/underwater-cultural-heritage/impacting-factors/trawling-and-fishing/

International frameworks such as both Article 2 and Annex Rule 1 of the UNESCO Convention (UNESCO, 2001), and Article 4 of the Valetta Convention (Council of Europe, 1992) express a preference for in situ preservation. This preference for conserving heritage assets *in situ "stresses the importance of and the respect for the historical context of the cultural object and its scientific significance and recognizes that such heritage is under normal circumstances preserved underwater owing to the low deterioration rate and lack of oxygen and therefore not necessarily per se in danger" (*Grenier *et al*., 2006). It is, therefore, important to establish a clear understanding of the nature of fishing-heritage interactions; consideration of how marine heritage assets have been impacted by past commercial fishing activities and how they will be impacted in the future will play an important part in the conservation and management of heritage assets.

The changes introduced as part of the Marine and Coastal Access Act (2009) offer English Heritage, as the Government's statutory adviser on the historic environment, an opportunity to enhance existing management. The marine planning process is a key example where the Marine Management Organisation (MMO) is actively seeking to understand and incorporate the potential for 'co-location' between sectors, activities and protected features (for example, fishing activity and the historic environment) into the plan making process. However, there are also risks involved. The increase in the number of Marine Protected Areas (MPAs) such as Special Areas of Conservation (SACs) and Marine Conservation Zones (MCZs), the first tranche of which will be designated in 2013, may displace existing fishing activity from these sites, potentially exposing unknown heritage assets to new or increased fishing-heritage interactions.

Positive steps are already being taken with the fishing industry to improve fishing-heritage relations and understanding of impacts caused by commercial fishing activities. Following establishment of the Inshore Fisheries and Conservation Authorities (IFCAs), English Heritage established a dialogue and partnership activities with them to protect historic assets, which included 'historic environment' training for IFCA officers and Committee members delivered through Historic Environment Local Management (HELM) networks (Defra, 2011). Future efforts will also build upon such work as the recent introduction of the Sussex IFCA pilot of the Fisheries Industry Protocol for Archaeological Discoveries (FIPAD) [Wessex Archaeology, 2012] and efforts to apply Strategic Environmental Assessment (SEA) principles to the fishing sector (North East Sea Fisheries Committee, 2008). In addition, fishers, fishery managers, and independent scientists have collaborated in 2012-13, during the Project Inshore review of operations of England fisheries according to the Marine Stewardship Council (MSC) sustainability principles.

The outcome of these efforts and engagements included enhanced awareness of both scale and extent of impact from mobile and non-mobile fishing activities on seabed habitats and ecosystems. Consequently, fishers and fishery managers are exploring and developing management options which are expected to result in modified fishing activities that do not cause impacts which are serious or irreversible on seabed habitats and ecosystems (Southall *et al.,* 2013).

When considering the marine historic environment it is useful to recognise that, in addition to interacting with heritage, the fishing industry also forms a significant part of this heritage, be it historic wrecks, lost gear or coastal structures including fish traps. By acknowledging the cultural value of fisheries heritage we hope to not only develop our historical understanding but to also build positive relationships with the fishing industry and coastal communities.

Improving understanding and awareness of the potential interactions between commercial fishing and the marine historic environment will inform future management actions and allow us to improve protection of the historic environment whilst minimising and mitigating for socio-economic impacts upon the English fishing industry.

1.1. Aim and Objectives

This project examines interactions between commercial fishing and the marine historic environment, and the models and approaches that can be used to assess these interactions. It reviews current and emerging policies in order to inform a series of proposed management recommendations, with the aim of offering practical and deliverable options to use as a basis for discussion with stakeholders.

The project objectives were as follows:

- To examine how different fishing techniques employed in English waters can interact with heritage assets on the seabed.
- To collate and assess evidence of the extent of interactions between commercial fishing and the historic environment.
- To examine frameworks and practices of commercial fisheries through which *in situ* management and / or mitigation of heritage assets might be effectively implemented.
- To identify further research requirements in respect of better understanding interactions between commercial fishing and the historic environment.
- To develop options for management and mitigation in line with fisheries management practices.
- To engage with and seek feedback from stakeholders.
- To share knowledge and perspectives gained in the course of the project through a project report and action plan.

1.2. Scope

The project scope encompasses:

Commercial Fishing Activities - all commercial fishing methods practised in English waters using either mobile or static gear to catch fish or shellfish.

The Marine Historic Environment - all forms of heritage asset making up the historic environment in English waters, including submerged prehistoric land surfaces and deposits, archaeological sites and remains of coastal activities, the wrecks of boats and ships, and aircraft crash sites.

The geographic scope covers the English zone of the UK Marine Area. With a focus on the English Inshore Region (Territorial Sea; up to 12 nautical miles (nmi)) which falls under the remit of English Heritage, and also covering the English Offshore Region (from 12 nmi out to the UK Continental Shelf off England).

1.3. METHODOLOGY

In order to examine fishing-heritage interactions it is important to understand the nature of potential interactions. For the purposes of this project, two broad sets of interactions between fishing and the historic environment have been identified:

- The first set of interactions arises where fishing activity in the past has resulted in the incorporation of fishing material into the historic environment. Fishing is one of humanity's earliest attested activities and can be better understood and appreciated through archaeological investigation. The physical remains of fishing onshore, in intertidal areas and underwater, make a contribution to the overall historic environment that warrants conservation.
- The second set of interactions arise when archaeological material originating from a very wide range of past human activities is now present on both the foreshore and the seabed, with the likelihood of being encountered in the course of commercial fishing.

Undoubtedly there are overlaps between these interactions. For example, archaeological material relating to past fishing activity may be encountered by fishing activity today. Direct interaction with its own heritage may provide an important opportunity for commercial fishing to engage more strongly with the historic environment and its management.

The first set of interactions, concerning fishing-related heritage assets, is addressed in Section 5. The second set of interactions, between commercial fishing and heritage assets on the foreshore and seabed irrespective of their origin, are addressed in Sections 6 (Indirect) Indirect Interactions Between Commercial Fishing and the Historic Environmentand 7 (Direct).

Resources Used

This project was conducted as a desk-based exercise, focussing on readily available data, published sources and accessible grey literature. A number of resources have been accessed, including primary literature and historic charts, with useful sources listed below:

- The Archaeology Data Service (http://archaeologydataservice.ac.uk/archives/)
- Department for Environment Food and Rural Affairs (https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs)
- Food and Agriculture Organisation of the United Nations (www.fao.org)
- Google Scholar (http://scholar.google.co.uk).
- IFCAs
- The Marine Aggregate Levy Sustainability Fund (http://www.cefas.defra.gov.uk/alsf.aspx)
- The Marine Management Organisation (www.marinemanagement.org.uk)
- The MESL in-house library
- The National Record of the Historic Environment (NRHE)
- The United Kingdom Hydrographic Office (UKHO)
- Science Direct (www.ScienceDirect.com)
- Seafish (www.seafish.org/fishermen/fishing)

Data sourced for the project are summarised below and detailed in **Appendix 1.**

Fisheries data were sourced from the MMO and relevant Inshore Fisheries and Conservation Authority (IFCAs). The following data were provided:

- Satellite-based Vessel Monitoring System (VMS) data for the years 2007-2010
- Vessel surveillance data for the years 2010-2012
- North Eastern IFCA (NE-IFCA) fishing effort survey data for 2011

Archaeological data were provided by the NRHE in response to requests from the project team. The following data were provided:

- Monument records for the two study areas for the following monument types: wreck; findspot; fishermen's fastener; and aircraft
- Findspot data
- Historic Seascape Characterisation Geographic Information System (GIS) layers

Consultation

Feedback was sought during the study from a steering group of selected experts and open stakeholder consultation. The steering group comprised: English Heritage representatives; Philip MacMullen, Head of Environment, Seafish; Robert Yorke, Chairman of Joint Nautical Archaeology Policy Committee (JNAPC); Elizabeth Bourke, Executive Officer of National Federation of Fishermen's Organisations (NFFO); and Tony Delahunty, Creels and Pots Fisherman, Sussex.

The following stakeholders were identified and targeted for consultation:

- Government and non-departmental public bodies – Defra, the MMO and Natural England
- The Crown Estate
- Marine Scotland
- The Association of Inshore Fisheries and Conservation Authorities (IFCAs), and regional IFCAS - North eastern, Eastern, Sussex and Southern
- Fisheries sector representatives - Seafish, the NFFO, and the Shellfish Association of Great Britain
- North Sea Regional Advisory Council
- Centre for Environment, Fisheries and Aquaculture Science (Cefas)
- University of East Anglia Fisheries Research
- Fisheries Local Action Group (FLAG) – East Riding of Yorkshire
- Local Council - East Sussex County Council, and Brighton and Hove City Council
- Marine Stewardship Council (MSC)
- Marine Conservation Society
- Association of Local Government Archaeological Officers (ALGAO)
- Nautical Archaeological Society
- Council for British Archaeology (CBA)
- JNAPC
- Independent heritage experts

Consultation documents sent out to stakeholders are shown in **Appendix 2**. Responses received from the client group, steering group, and stakeholders were recorded, evaluated, and incorporated into the revised final report. A summary of responses is provided in **Appendix 6**.

Study Areas

The potential scope of the project is very wide and therefore, use has been made of case studies to provide a focus for data gathering. The case study areas have been used to demonstrate instances of fisheries interactions, and also to present their spatial extent and scope for management.

The case studies focus on two areas (shown in Figure 1) selected from the first areas to undergo the MMO's marine planning process; the East and South inshore and offshore Marine Plan areas.

The areas were selected on the basis of previous projects and initiatives that have a bearing on this project's objectives, for instance the prospects for marine planning, and the range of heritage asset types likely to be present. In addition, both regions - the Outer Humber (Area 1) and the Eastern English Channel (Area 2) have previously been the subject of extensive study under the Marine Aggregate Levy Sustainability Fund (MALSF) research program including the MALSF Humber Regional Environmental Characterisation (REC) – a major multidisciplinary study of the geology, biology and archaeology off the east coast of England (Tappin *et al.*, 2011), the English Channel REC Synthesis (James *et al.*, 2011), the assessment for Areas of Maritime Archaeological Potential for shipwrecks (Merritt, 2008), and wrecks on the seabed (Wessex Archaeology, 2007b).

Examples from around the UK and further afield will be used where they illustrate important points about interactions and their management.

Area 1

Area 1 is located within the North Eastern (NE) IFCA district and the MMO's East Marine Plan area, and extends from Flamborough Head to the Humber estuary, corresponding with the southerly border of the NE IFCA. An inshore boundary was selected to the south of the river Hull. The offshore boundary for both Areas 1 and 2 was set at the UK adjoining zone, 24 nmi offshore. In archaeological terms, the potential for the presence of submerged prehistoric material arises from its location on the margins of the North Sea, with significant early prehistoric sites known on land. There is also potential for coastal material arising from the 'lost villages' of Holderness, with maritime activity from prehistory to the present represented again by sites at the coast, if not from discoveries offshore. In addition, the area saw extensive losses of merchant ships, fishing vessels and minor warships during WWI and WWII, as well as air crashes associated with convoys and the Allied strategic bombing offensive.

Area 2

Area 2 is located within the boundaries of the Sussex IFCA and the MMO's South Marine Plan area, extending from Beachy Head near Eastbourne to the west of Dungeness. As in Area 1, there is potential for submerged prehistoric archaeology bordering the former Channel River and its tributaries, together with a rich history of maritime activity, for which there is evidence from prehistory to the present. Shipping activities were heavily targeted by enemy action in both world wars, resulting in many upstanding wrecks. Area 2 was also on the front line for much aviation activity in WWII, represented by a number of aircraft wrecks.

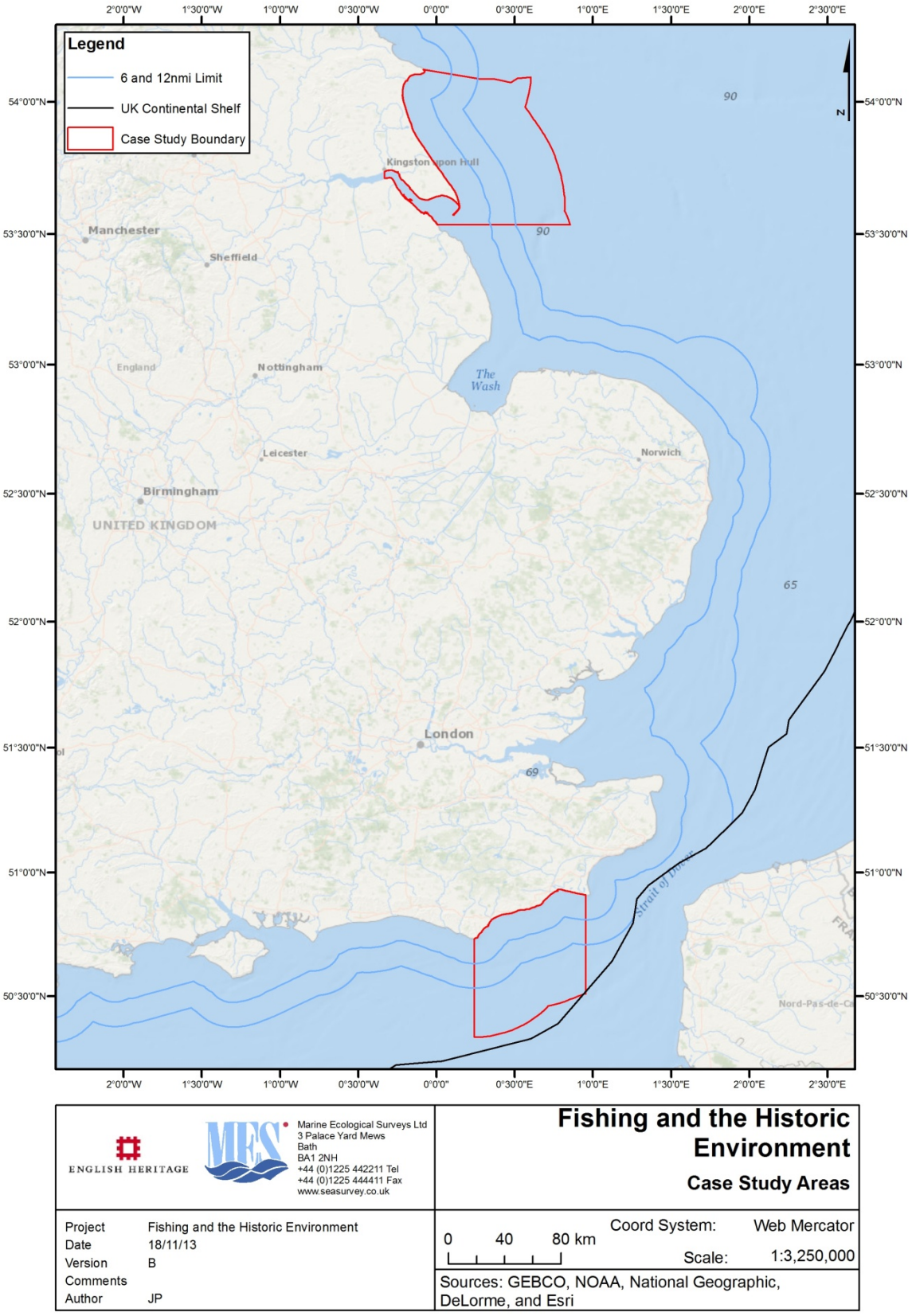


Figure 1: Case study Areas 1 (north-east) and 2 (south-east) are shown in red. Seaward boundaries including 6nm, 12nm, and the UK continental shelf illustrate areas of control and monitoring, respectively, by the regional IFCA's, national MMO, and under the European Common Fisheries Policy.

2. COMMERCIAL FISHERIES AND GEAR TYPES

2.1. OVERVIEW

In order to identify the range of fishing gears employed by commercial fishermen, it was useful to first develop an account of the English fishing fleet. In 2012, there were over 3000 registered fishing vessels in England, of which 82 % were 10 m or under in length (MMO, 2013). A breakdown of the fleet structure by size can be seen in Table 1.

Table 1: English fishing fleet by vessel length, 2012. Adapted from MMO UK Sea Fisheries Statistics. (Original Source: Maritime and Coastguard Agency and Fisheries Administrations in the UK)

Overall length of vessels	8.00m and under	8.01 - 10.00m	10.01 - 15.00m	15.01 - 18.00m	18.01 - 24.00m	Over 24.00m	Total Summed
Number of vessels	1,744	818	382	41	55	73	3,113
Gross tonnage	2,933	5,873	8,107	2,470	6,577	35,318	51,278
Engine power (kW)	55,933	85,922	61,084	8,552	15,421	75,583	302,496

Within this range from small, artisanal fishers to large, industrial trawlers, and from inshore to offshore fleets, a wide variety of fishing gear types are used.

There are a number of ways by which commercial fishing gear types are categorised, for example;

- The Food and Agriculture Organization of the United Nations (FAO) suggests that "A common way to classify fishing gears and methods is based on the principles of how the fish or other preys are captured and, to a lesser extent, on the gear construction" (FAO, 2013).
- Jennings *et al*. (2001) suggests categorising fishing gears into two types – active, when they pursue their catch; and passive, when the catch typically moves into the non-mobile gear.
- Galbraith and Rice (2004) suggest a more detailed categorisation where towed gear are used to actively pursue and catch fish on the seabed, just above the seabed, and in mid-water, as well as mobile dredges for catching low mobility fish on the seabed. There are also seine gears for actively gathering large shoals of fish in open-water and smaller shoals congregating in coastal waters. In addition, there are passive or static gears such as static nets that catch fish by tangling them, traps for trapping various fish, and baited hook and lines set to catch fish.

Further information can be found in Von Brandt (1984) – Fish Catching Methods of the World, and Sainsbury (1996) – Commercial Fishing Methods: an introduction to vessels and gears.

For the purposes of this project, gear type and methods of commercial fishing shall be considered within two typical groupings – demersal, that is, operating on or in close contact with the seabed; and pelagic, operating within the water column. We have identified and defined gear types in accordance with the FAO document *'Definition and Classification of Fishing gear categories'* prepared in accordance with the International Standard Statistical Classification of Fishing Gear

(ISSCFG); the MMO Fishing Gear Glossary used by the Management of Fisheries in European marine sites implementation group; and the Seafish Basic Fishing Methods handbook (Seafish, 2005). See Table 2 for a matrix of commercial fishing gears as determined by the project team.

Table 2: Commercial fishing gear types commonly used in English waters

	Mobile	Static	Passive
Pelagic	• Purse seine • Mid-water trawl (single and pair)		• Drift (gill)nets • Drifting long lines • Pole and line
Demersal	• Beam trawl • Otter trawl (single and pair) • Multi-rig trawl • Seine • Beach seine • Scallop dredge • Shellfish (Mussels, clams, oyster) dredge • Hydraulic dredge • Hand dredge • Hand raking • Hand capture (diving)	• Set nets (Tangle, Trammel and Anchored Gill nets) • Anchored long lines • Pots and traps (including: creels, cuttle pots, and fish traps)	

The gear types listed here are in general agreement with those identified in the recently prepared report for the major English inshore fisheries study 'Project Inshore' (Nimmo and Southall, 2012).

Data for UK fishing methods and vessel landings into English ports for 2010 (see Figure 2) show that the highest proportion of landings by value was attributable to potting, followed by mobile demersal gear types.

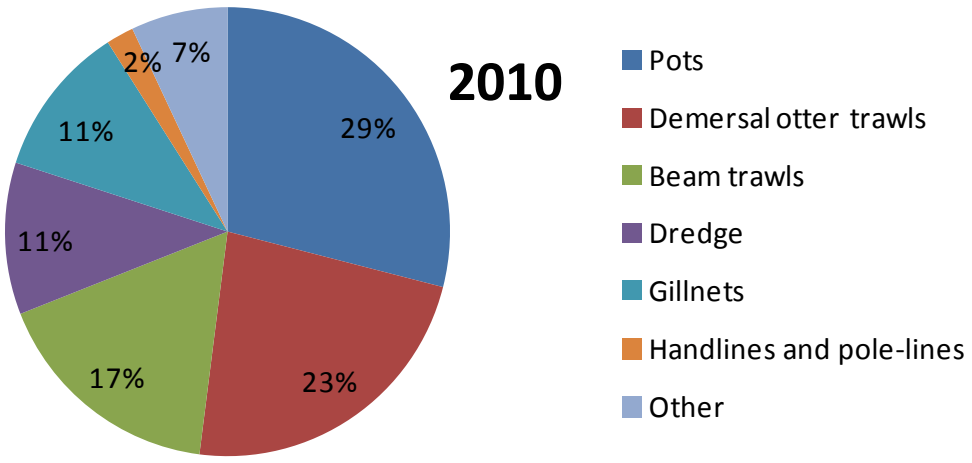


Figure 2: Proportion of landings value by gear type for UK vessels into English ports. (Source: Adapted from Nimmo and Southall, 2012)

The categorisation of gear types, as defined above, have been used to frame our descriptions of fishing gear components. The following section provides an introduction to and illustrations of relevant gear types, together with references to their likely interactions with the seabed habitat and structure.

2.2. Pelagic: Mobile

Purse Seine

Purse seine netting is an encircling gear type, typically used for the capture of pelagic fish species. The gear is unlikely to make contact with the seabed, therefore having little to no effect on seabed structure. Lost gears are, however, likely to settle on seabed habitats (Macfadyen *et al.,* 2009).

Purse seine netting operations involve encircling a shoal of pelagic fish with a circular wall of netting (Figure 3) and drawing the bottom of the net together (equivalent to the drawing of a purse string – as shown by the 'a' in Figure 3) to enclose the catch before hauling (Galbraith and Rice, 2004).

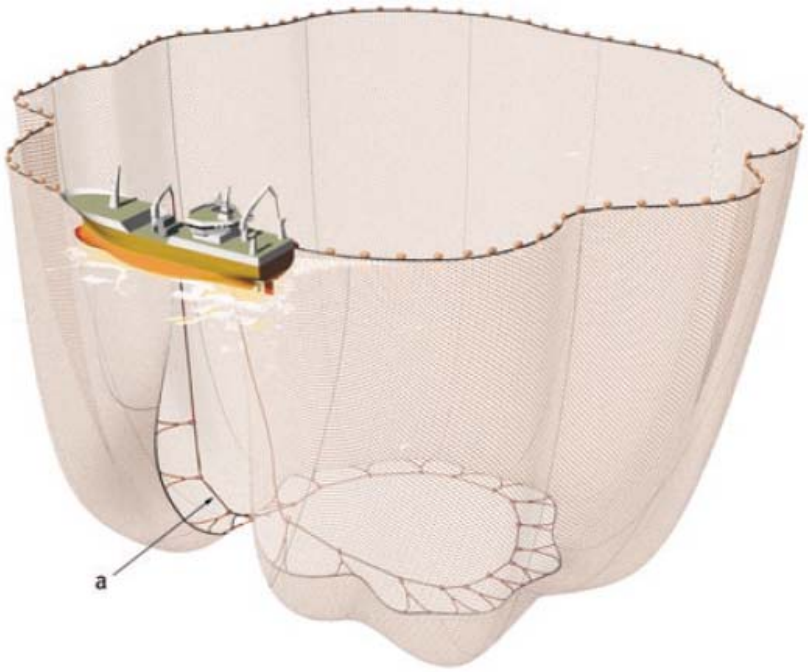


Figure 3: Typical purse seine netting (Source: Galbraith and Rice, 2004).

Mid-water Trawl

Mid-water trawlers target pelagic shoaling species and do not, therefore, interact directly with the seabed.

Trawl gear consists of netting in the shape of an elongated funnel or cone-shaped bag (see Figure 4). The end of the net is closed by a cod-end knot for retaining the catch. Otter boards (trawl doors) are used to hold the net mouth open horizontally and bridle weights are used to position the mouth open vertically. Sensors and monitors are strategically placed along the net to facilitate continuous monitoring and fishing efficiency; sonar technology is typically used to identify levels in the water column where shoals of fish are located in order to position the nets.

Considerable vessel power is required to tow these fishing gears through the water column at great speed in order to capture the target species. Trawls may be operated as single or paired gears where the net is towed by two vessels, with the distance between the vessels maintaining the mouth opening.

Figure 4: Typical configuration for pelagic trawl, single vessel (left) and paired vessels (right) – (Source: Galbraith and Rice, 2004).

Mobile pelagic gears (purse seining and mid-water trawling) are typically operated in offshore waters, with limited activity seen within the inshore region frequent by smaller fishing vessels. These gear types are commonly use to pursue commercial stocks of herring (*Clupea harengus)*, mackerel (*Scomber scombrus)*, sardines (*Sardina pilchardus)*, and sprats (*Sprattus sprattus)* [Nimmo and Southall, 2012].

2.3. Pelagic: Passive

Drift (gill) nets

Drift nets consist of a single wall of netting (gill net) hung vertically within the water column. The net is buoyed at the water's surface by floats and left to passively drift with the tide or current (Figure 5). A floating marker buoy provides tracking for retrieval of the net. Environmental impacts of drift netting have largely been focused on fisheries bycatch, and drift nets are unlikely to cause damage to the seabed due to their pelagic nature. Most impacts are expected to arise from the entanglement of lost or abandoned fishing gear. Within certain inshore areas, byelaws require drift nets to be attended at all times in order to avoid gear loss and accidental fishing (MMO, 2012; Nimmo and Southall, 2012).

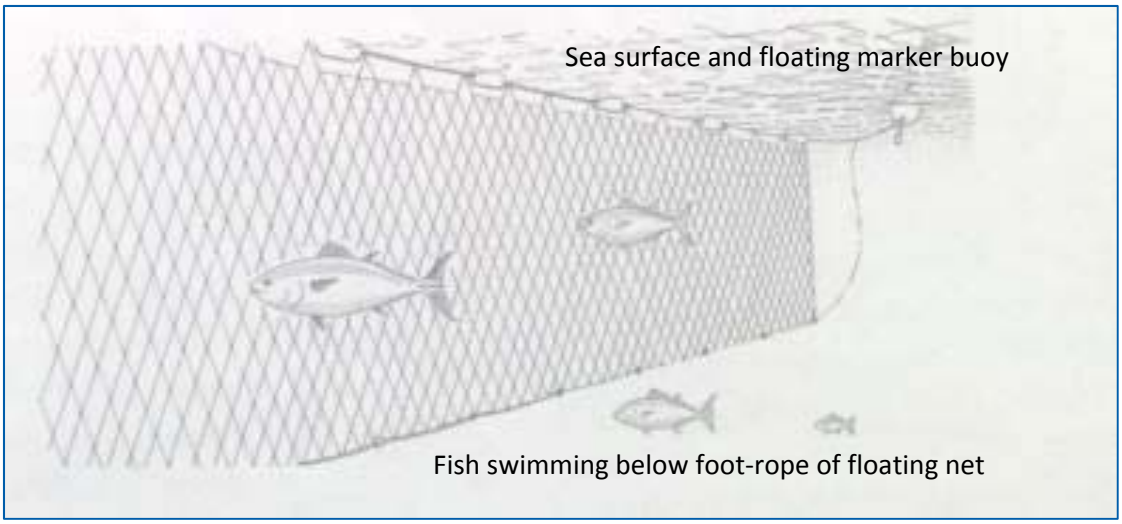


Figure 5: Typical configuration of pelagic gill-net (Source: modified from Jennings *et al*. 2001).

Drifting Longlines

During line fishing, the bait and lures are attached to a hook which is fixed to the end of a line or snood (see Figure 6). A large number of hooks are deployed per line during each phase of fishing. Line fishing is considered to have little to no impact on the seabed when conducted properly to avoid damages from anchoring (Nimmo and Southall, 2012).

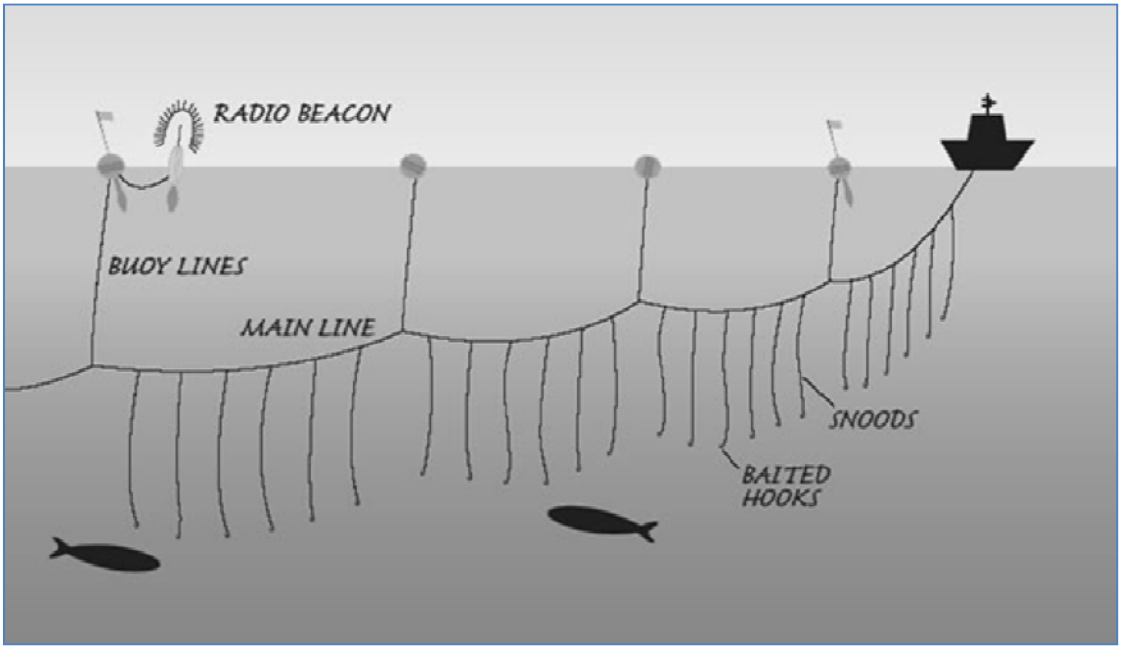


Figure 6: Typical configuration of drifting pelagic longlines (Source: modified from The Australian Fisheries Management Authority (AFMA) http://www.afma.gov.au)

The pelagic netting and line fisheries are largely concentrated in the southern inshore regions, with some effort observed off the north eastern coast of England (Vanstaen and Silva, 2010). Drift nets and lines are typically used for catching species such as herring (*Clupea harengus*), bass (*Dicentrarchus labrax*), whiting (*Merlangius merlangus*), and rays (*Raja* spp.), amongst others.

Pole and Line

Pole and line gears are typically used by small-scale fishers working one to a number of baited lines, which are hauled by hand, and sometimes by mechanical jigging machines (FAO, 1990; Nimmo and Southall, 2012). As for long lines, pole and line fishing is considered to have little to no impact on the seabed other than possible damage from anchoring.

2.4. Demersal: Mobile

Trawl Fishing Gear

Demersal trawl gear is similar to that of pelagic trawls, with added adaptations for working in contact with or near the seafloor. Headline ropes are fitted with buoyancy aids to keep the net mouth vertically open and in position above the seabed, whilst foot ropes are weighted with grounded attachments to maintain contact with the seabed. The nets are held open horizontally by bridle wires and trawl doors or otter boards (Seafish, 2005).

The extent to which demersal trawls interact with the seabed is dependent upon the gear design, and particularly the weight of the gear. It is, however, anticipated that there will be some impact upon the seafloor, with observable flattening of topography and trawl scars of varying depths, which are physically represented as grooves or furrows in the sediment resulting from penetration of the seafloor by gear components.

Demersal trawls have been categorised into two main types:

Demersal Otter Trawl

Demersal otter trawls are designed for catching species on or just above the seabed. The typical configuration of a demersal otter trawl is shown in Figure 7.

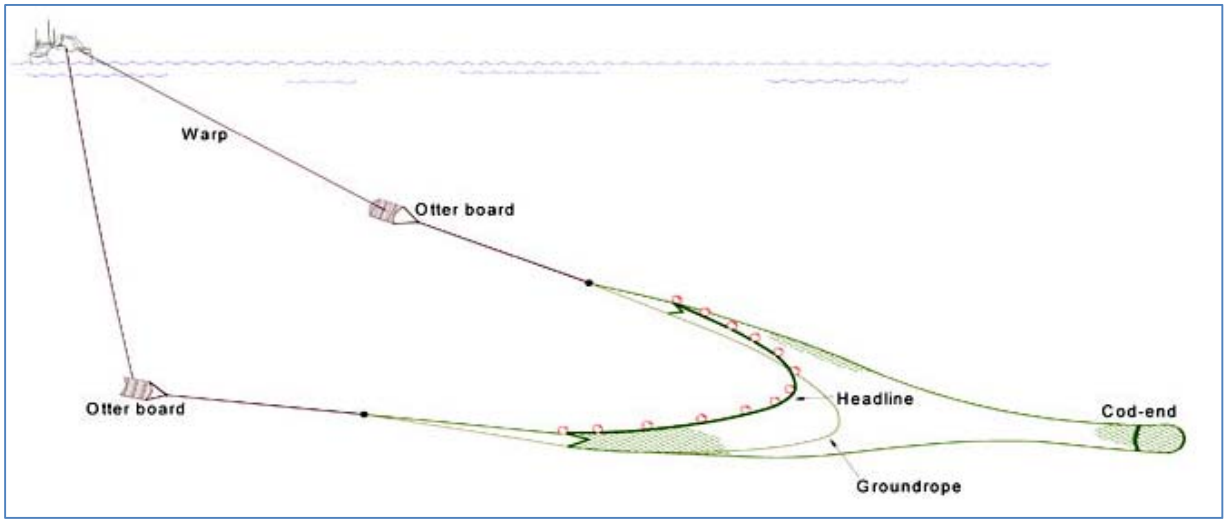


Figure 7: Typical demersal otter trawl configuration (Source: Løkkeborg, 2005).

Otter trawls may be operated as single, pair or multi-rig (where one vessel is equipped with two or more nets). Multi-rigged trawls are common where the catch needs to be of a sufficiently large volume to compensate for the greater fishing effort and time (Jennings *et al,.* 2001).

As well as maintaining the net opening, the otter boards are sufficiently weighty to keep the gear in contact with the seabed. See Figure 8 for examples of otter board designs.

Figure 8: Typical otter board designs found on demersal trawls (Source: Galbraith and Rice, 2004).

As the trawl is towed along the seabed the gear disturbs the sediment (see Figure 9), driving benthic and epibenthic species into the net.

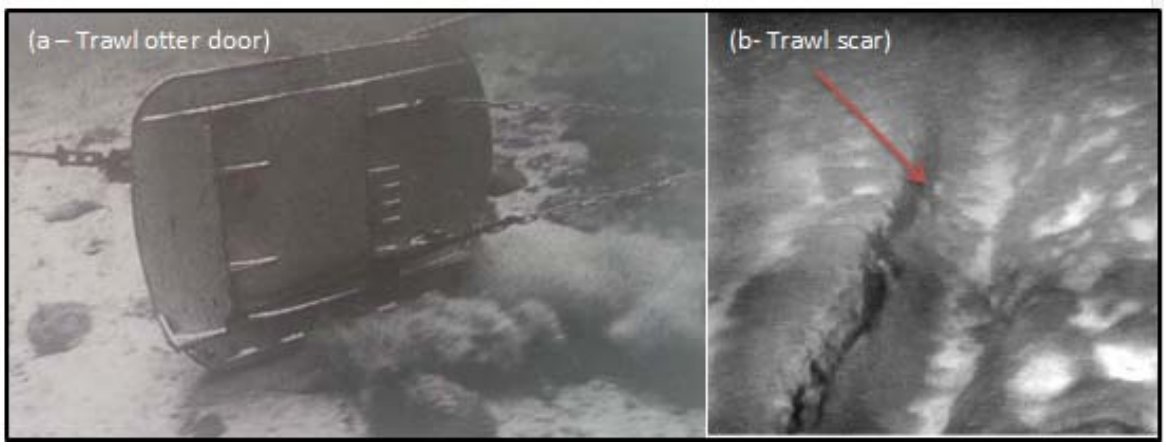


Figure 9: Typical indication of trawl door on the seabed (a); and trawl marks in soft seabed sediments (b); (Source: (a) Jennings *et al.* 2003; (b) Hopkins 2003).

Substrate loss is considered the most dramatic disturbance to areas characterised by soft sediments and biogenic structural habitats. Suspended sediments are known to smother (on resettlement),

reduce available light, and damage marine species (Sewell *et al.,* 2007). Trawl gears are seen to reduce structural complexity of the seabed resulting in a more homogenised structure. The impact of demersal otter trawling on the seabed is well documented by a number of researchers such as Jennings *et al.* (2001), Trimmer *et al*. (2005), Hiddink *et al.* (2006), Hopkins (2003) and Vanstaen *et al*. (2010).

The trawl scars caused by the use of heavy otter boards may be detected for some time afterwards using side scan sonar systems. These trawl marks may be as much as 0.5 m deep and 1 m wide, or greater depending on the seabed substrates and tidal currents of the areas (Figure 9b).

It is becoming a more common operational practice for demersal otter trawl gear to consist of instruments such a sensors (Figure 10) for monitoring geometry (bottom contact, door distance, vertical opening, and trawl symmetry), trawl depth, and weight of catch. Fundamentally, these technologies are used to assist the fisher in avoiding obstacles on the seabed. In addition, the use of ballast elements to maintain the net's position near the seabed without coming into contact with it offers some potential of reduced impact (Valdemarsen and Suuronen, 2001).

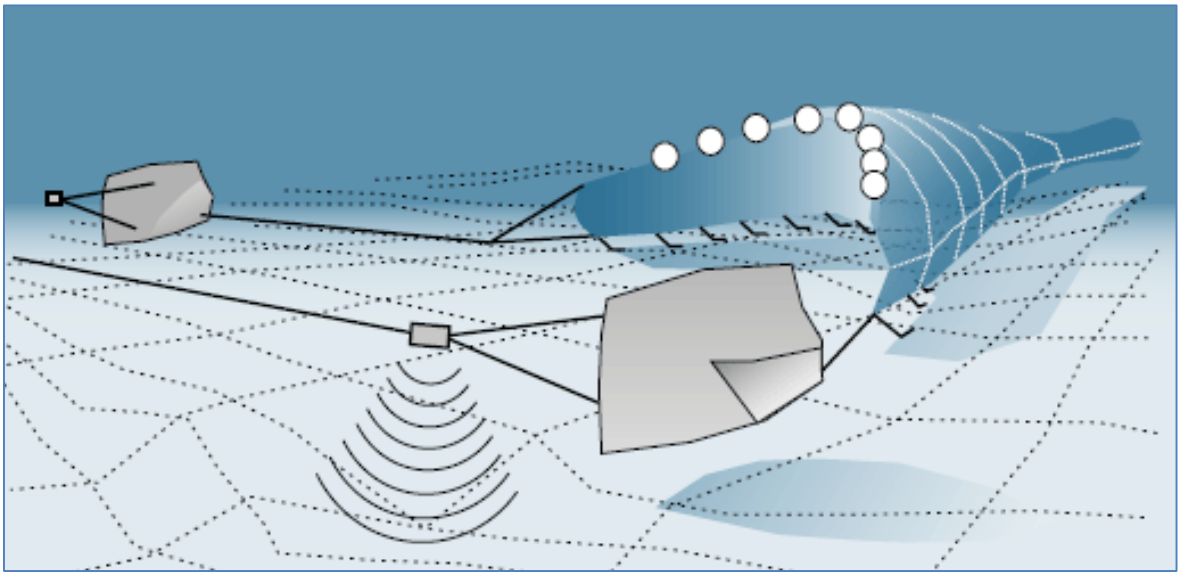


Figure 10: Trawl sensor technology used to reduce seabed damage from bottom trawling (Source: Valdemarsen and Suuronen, 2001)

Demersal Beam trawl

In comparison to otter trawls, beam trawls target species on or within the seabed substrate, resulting in more significant disturbance to the seabed. The trawls are designed with a heavy steel beam placed horizontally across the front of the net to maintain the opening, which is supported by trawl heads at each end. Tickler chains or chain mats are mounted along the width of the trawl to disturb benthic species and drive them backwards into the net. The typical configuration of a beam trawl, as described above, is shown in Figure 11.

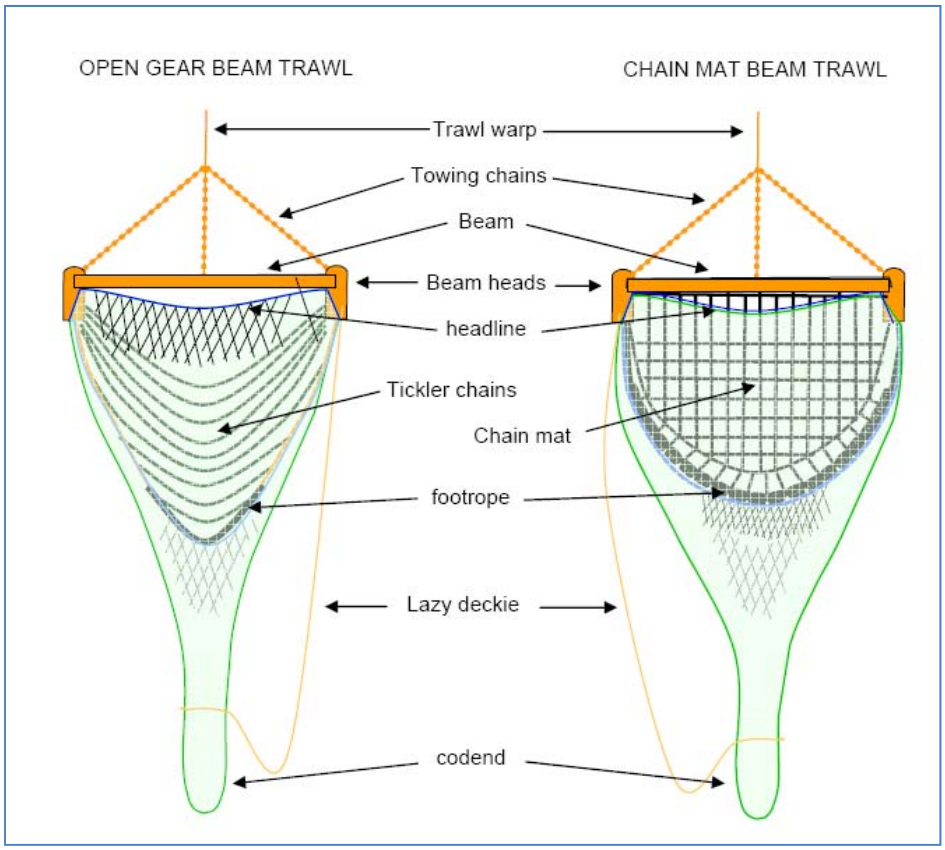


Figure 11: Typical beam trawl configuration showing a trawl with tickler chains (left) and a trawl with a chain mat (right)-(Source: Seafish, 2005).

The substrate over which the gear is towed is usually of a sandy character, however, modifications such as the addition of hopper and roller wheels to the beam, as well as flip-up footropes, facilitate the working of harder and uneven grounds.

Unlike the demersal otter trawl, for which seabed impacts are limited to the area under the otter boards; the trawl heads, ground rope, and tickler chains or chain mats of a beam trawl all come into contact with the seabed, resulting in a greater area of impact (Grieve *et al*., 2011). The extent of pressures exerted on seabed habitats by this gear type is estimated by Fonteyne (2000) to be 0.2 to 1.1 Newton per cm^2 or 2 to 3 times these levels depending on the use of additional equipment such as a Sole-plate for targeting sole (*Solea solea* and *Microstomus kitt*) and plaice (*Pleuronectes platessa*).

Towing of beam trawl gear might be in the form of a single stern beam of approximately 4 m width on smaller vessels. Larger multi-rigged vessels may be equipped with two beams as wide as 12 m from mid-ship derricks, which project from each side (see Figure 12). During operations, tow durations and contact with seabed might be as long as 30 minutes at speeds of 4 knots or higher, on each instance, based on vessel power and target species (Seafish, 2005).

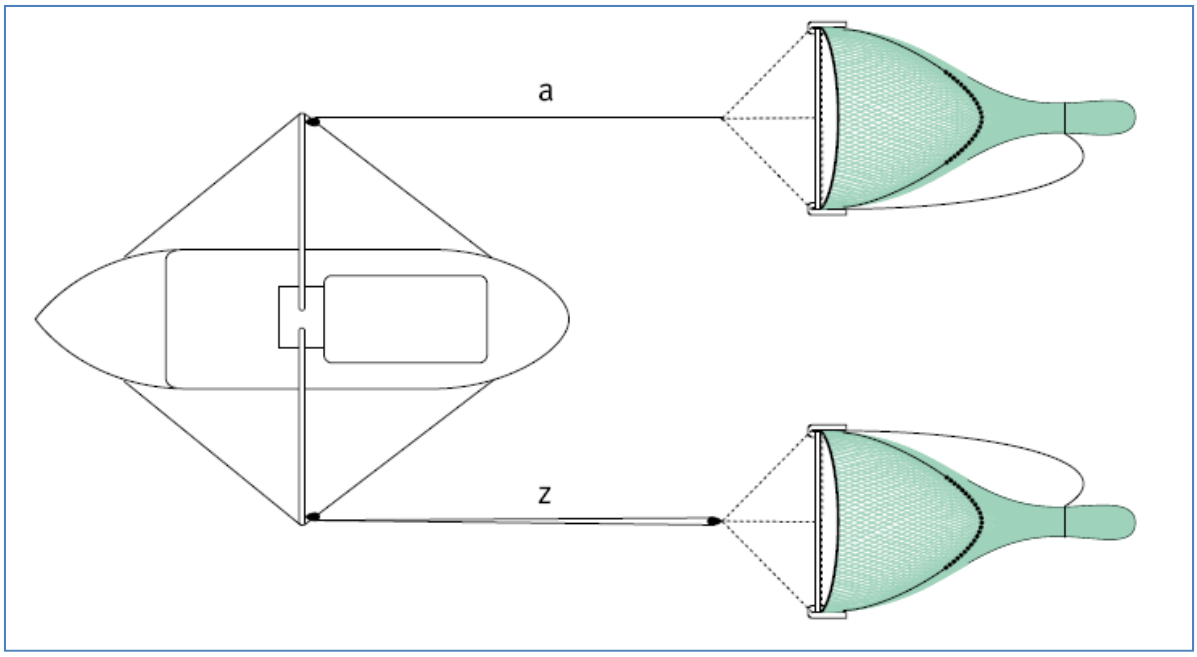


Figure 12: Multi-rigged beam trawl vessel, showing a single (a) and double (z) warp wire (Source: Galbraith and Rice, 2004).

Beam trawling activities are regulated by national legislation which limits their engine power and overall length of the beams. Vessels not complying with the relevant national legislation are restricted from fishing within the 12 nmi zone. Further details with regards to England and EU fisheries legislation are available from the MMO current Blue Book.[2]

Demersal trawling activities (otter and beam trawling) occur around the English coastline, with greatest intensity of activity observed in the English Channel off the south-west and south-east coast, and additional otter trawl activity on the north-eastern coast (Vanstaen and Silva, 2010; Nimmo and Southall, 2012). Common species caught by demersal trawls in English waters include ground fish such as haddock (*Melanogrammus aeglefinus*), cod (*Gadus morhua*), monkfish (*Lophius piscatorius*), Dover sole (*Solea solea*) and plaice (*Pleuronectes platessa*); and crustaceans including prawns, shrimp (*Pandalus* and *Crangon* spp.) and nephrops *(Nephrops norvegicus)*.

Seine

Seine nets are an early form of encircling gear, with long ropes used for driving catch into the net. Demersal seine gear types include anchor and fly seines. Netting operations may take place in waters as deep as 220 m.

During fishing operations, one end of the fishing rope is deployed with a marker-buoy. The vessel then travels in a triangular shape, shooting the net and more rope before proceeding back to the marker-buoy (as shown in Figure 13). Winches are then used to haul and retrieve the net from the seabed and land the catch. Anchor seines operate in a similar manner, with the addition of an anchor attached to the marker buoy (Grieve *et al*., 2011).

[2] http://www.marinemanagement.org.uk/fisheries/monitoring/regulations_bluebook.htm

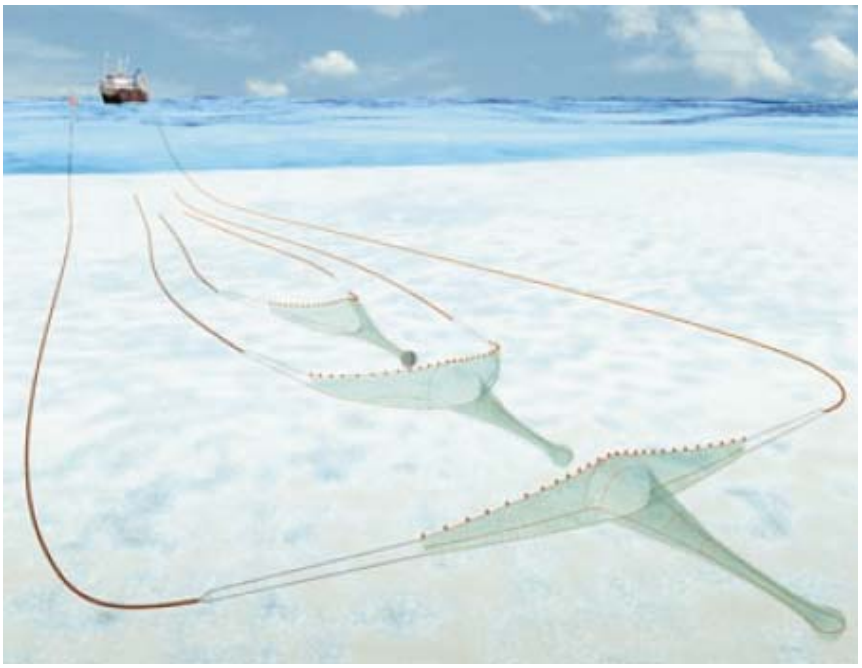


Figure 13: Shooting the seine net (Source: Galbraith and Rice, 2004).

This method of fishing is considered to be in decline due to trends of targeting ground fish in deeper waters (Seafish, 2005). However, with on-going increases in fuel prices, together with developments in more fuel-efficient fishing methods, attention is likely to shift towards greater use of these methods (Grieve *et al*., 2011).

Beach Seine Netting

Beach seine netting is common to coastal and shallow inshore areas. One end of the rope is deployed and the net is released in a loop or horse shoe shape. The boat returns to shore with the other end of the ropes. The nets are then landed by manual or mechanical pulling over the seabed. Beach seine netting is commonly practiced for capture of migratory fish or species congregating in inshore waters (Galbraith and Rice, 2004).

Figure 14: Typical beach seine netting (Galbraith and Rice, 2004).

Around the coast of England, small groups of fishermen continue the tradition of fishing for sea bass (*Dicentrarchus labrax)* and mullet (*Mugil cephalus)* using beach seine netting. This is a small-scale operation which is dependent on fish species aggregating close to the shore (Gray, 1995).

Mechanical Dredge Fishing Gear

Dredging operations are similar to those of demersal trawling. Mechanical dredges are designed to glide along the seabed, scraping its catch into a bag-like structure called a back-netting or a steel-ringed bag, which is pulled behind the dredge (Galbraith and Rice, 2004).

Scallop Dredge

Scallop dredges are fitted with spring-loaded tooth-like bars which rake through the seabed substrate, lifting out scallops and driving benthic species into the net (Figure 15). On hard seabed substrates, the spring mechanisms aid the back-swinging of each tooth or knife, therefore allowing the dredge to clear obstacles on the seabed. Adjusting compression and tension levels of the springs allows the gear to work rocky and stony grounds with reduced incidents of stones being collected in the dredge, however, higher levels of substrate or gear damage may result from higher teeth tension.

Warp wire connects the vessel to a tow bar, which might be connected to a series of dredges. It is common for dredging vessels to conduct fishing using two beams (one on either side of the vessel) from mid-ship out-rigging arrangements, in a similar manner to beam trawling (Grieve *et al*., 2011). National legislation limits the number of dredges allowed per side, per fishing vessel within the 12 nmi areas, restricting the area over which the fishing gear can interact with the seabed.

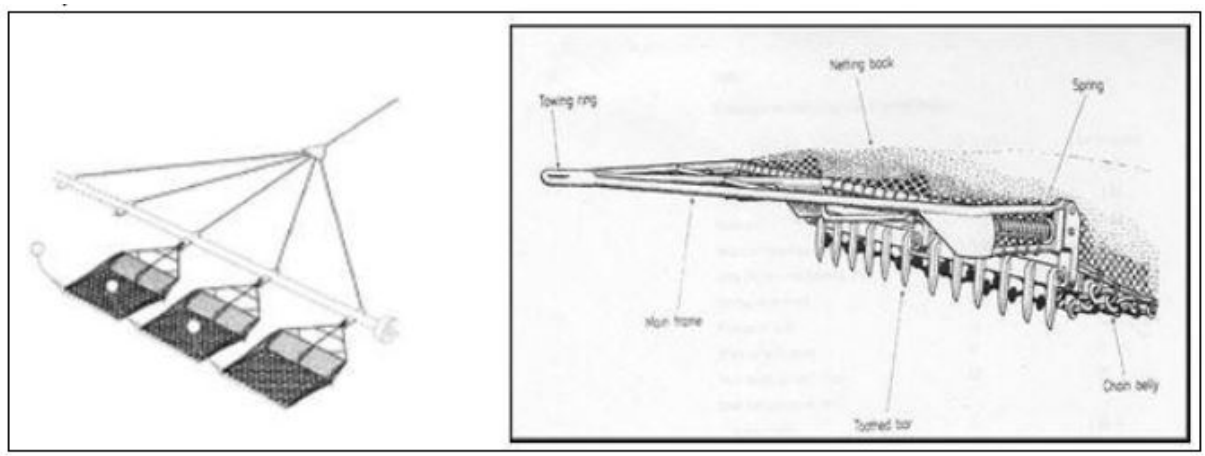


Figure 15: Typical configuration for scallop dredging (left), and detailed dredge outline (right) – (Source: Chapman *et al.,* 1977 and Galbraith and Rice, 2004).

Due to the nature of their operation in contact with the seabed, the use of scallop dredgers is likely to result in benthic impacts. Impacts include flattening of seabed structures and the creation of dredge scars (see the Glossary for Trawl Scars). The toothed bars are known to disturb the upper layer of seabed sediments, creating multiple furrows. The depth of penetration is variable with sediment type and weight construction of the gear. The back-netting and steel rings are also known to damage seabed features in the tow-path of the dredge (Grieve *et al*., 2011).

Scallop dredge fisheries are considered to be valuable to many coastal communities. New developments such as toothless-scallop dredges have been tried in the Isle of Man and Scottish queen scallop fisheries, whereby the toothed bar has been replaced with a rubber mat fixture. Vessels using the new toothless gear have found that drag and damage to the seabed are reduced, and fuel consumption is improved, as the gear is lighter.[3]

Shellfish Dredge

Dredging gears used for mussels, clams and oysters are operated in a similar manner to scallop dredgers, but have an altered bar at the front of the dredge which is fitted with a flat blade for scooping shellfish into the bag.

Mechanical dredging is traditionally used for commercial harvesting of shellfish species including king (*Pecten maximus*) and queen scallops (*Aequipecten opercularis*), oysters (*Ostrea* spp. and *Crassostrea* spp.), and mussels *(Mytilus* spp.).

Hydraulic Dredge

Hydraulic dredges are also used for harvesting shellfish species, such as cockles (*Cerastoderma edule)* and clams (*Tapes philippinarum* and *Ensis* spp.). During harvesting, water is pumped into the seabed to fluidise the surrounding sediments, thereby allowing the dredge to scoop up the target catch using a suction mechanism. This is then collected in a steel basket to the rear of the dredge. A connected airlift mechanism then transports the catch from the basket to the vessel deck. Hydraulic dredging has been identified as resulting in a large environmental footprint (Nimmo and Southall, 2012).

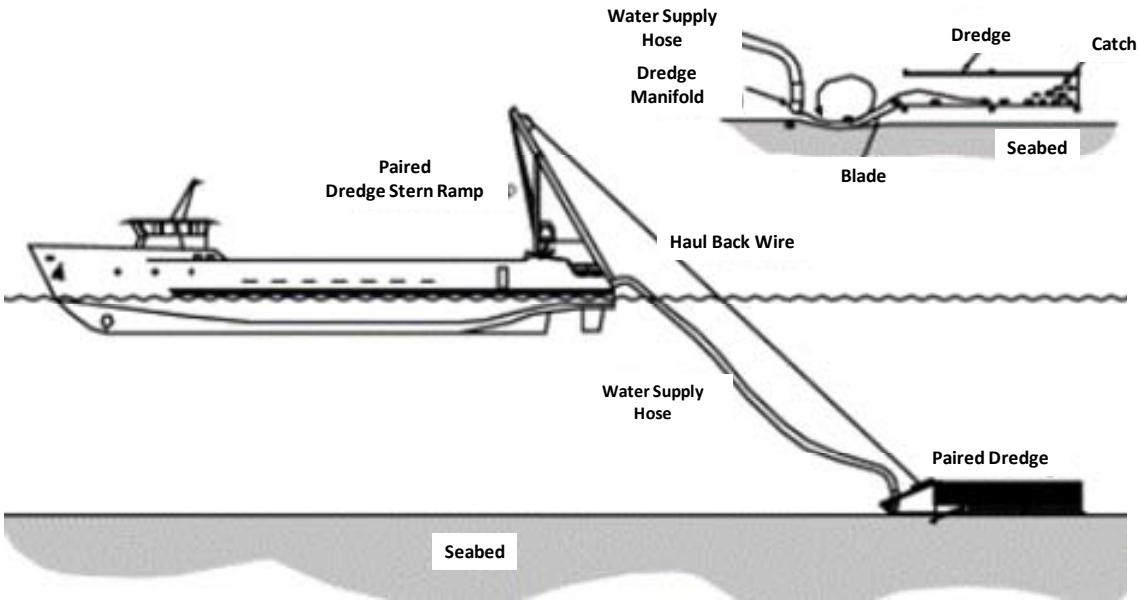


Figure 16: Hydraulic dredge set-up (Source: www.sciencedirect.com; http://chioggia.scienze.unipd.it/DB/fishingTechniques2.html).

[3] See: http://www.seafoodscotland.org/Catching-Methods/scallop-dredging.html

Hand Dredges

Hand dredges are typically small and light-weight, toothed devices operated by hand in shallow waters or from the shore, as well as from small boats (Prado and Nédélec, 1999).

Effort from dredging (mechanical, hydraulic, and hand) activities is most intense on the south coast of England (the English Channel) and in the Wash on the east coast of England (Vanstaen and Silva, 2010; Nimmo and Southall, 2012).

Hand Raking

Hand raking is an alternative method of shellfish harvesting often used when collecting cockles. Raking activities are conducted with hand-held devices, commonly in coastal areas, which scrape the seabed to dislodge and collect the catch (Nimmo and Southall, 2012).

Hand Capture

Hand capture by diving is typically used for scallop harvesting at scales and extents which are considered to present little or no impact or disturbance to seabed substrates (Nimmo and Southall, 2012). It is considered to be the most environmentally sustainable method of capture, with the greatest control of the catch. However, its application in a commercial fishery is very restricted. It is a highly specialised technique that is limited by working depth (<50 m using air), constraining it as a commercial fishery operation (Grieve *et al*., 2011).

Around the English coast, hand capture by diving is considered a small-scale operation with high value fisheries.

2.5. Demersal: Static

Pots, Creels and Traps

Pots, creels, and traps consist of baskets or cages of various shapes and materials, for example steel, plastic, and wicker (as shown on the right of Figure 17), depending upon the target species, which are typically baited with fish and fish products. A funnel allows the shellfish to enter and inhibits exit.

Pots may be laid individually on the seafloor, or as a string of connected traps attached to a weighted rope, with a buoy or physical marker on the floating end. Most commercial fishermen use strings of trap rather than single traps, and larger vessels may haul hundreds of pots in a day (Galbraith and Rice, 2004). Fishermen deploy their pots for soaking durations of 24-48 hours before retrieval by hand or hydraulic haulers.

Figure 17: Typical configuration for potting, creel, and trap fishing (left), examples of pots (right) – (Source: Galbraith and Rice, 2004).

Potting is considered to have a low level of impact on the seabed, with impacts typically only arising from the setting and hauling of the gear, where in, the use of potting gear may result in flattening or snagging of seabed structures, or incidental loss of fishing gear.

Potting occurs around the English coast, with effort predominantly concentrated within the 6 nmi zone, and in particular, off the south coast (Vanstaen and Silva, 2010). Potting operations target shellfish, including brown crabs (*Cancer pagurus*), velvet crabs (*Necora puber*), spider crabs (*Maja squinado*), lobsters (*Homarus gammarus*), whelks (*Buccinum undatum*), and nephrops (*Nephrops norvegicus*).

Set Nets

Set nets (gill, tangle and trammel nets) are static gear used in a similar manner to drift nets, with the exception that they are anchored or ballasted to the seafloor. Set nets may be either single mesh (gill and tangle nets), or triple-meshed (trammel nets). Tangle nets are hung more loosely than other set nets, entangling fish within the slack netting (Galbraith and Rice, 2004).

A location buoy and flagged marker are commonly used to identify the set (Figure 18). Anchors are placed at both ends to facilitate stability of the nets.

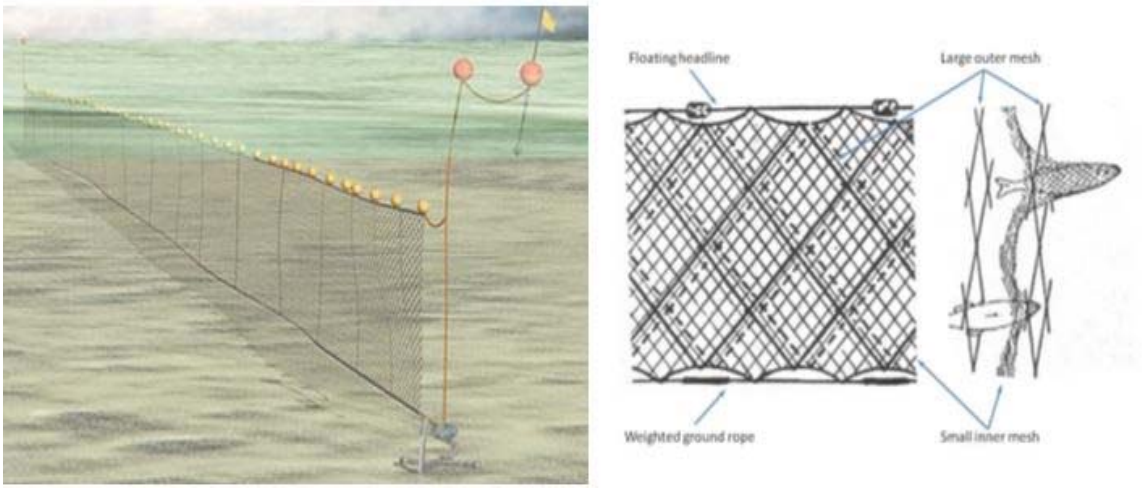


Figure 18: Typical Set net configuration (left), close-up with fish catch in trammel net (right) – (Source: Galbraith and Rice, 2004; FAO fishing Fact sheet)

Nets may be used in areas of rough seabed, for example, wreck sites, where other demersal methods, such as trawling, cannot operate. As for pelagic netting activities (see above), both static demersal netting activities are seen to operate most intensively along the south coast of England, within the 6 nmi zone (Vanstaen and Silva, 2010). Set nets target a range of species within coastal waters, and fishing can be non-discriminatory. Typical catch from set nets might include: pollack (*Pollachius pollachius*), sole (*Solea solea*), plaice (*Pleuronectes platessa*), rays (*Raja spp*), cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), ling (*Molva molva*), and sea bass (*Dicentrarchus labrax)*.

Anchored Longlines

As for set nets, anchored longlines are used in a similar manner to drifting longlines, with the exception that they are anchored or ballasted to the seafloor. Lining activities are limited and most frequently seen off the south coast of England (Vanstaen and Silva, 2010). Anchored longlines are used to target rays (Raja spp), cod (*Gadus morhua*) and sea bass (*Dicentrarchus labrax)* (Nimmo and Southall, 2012).

2.6. Commercial Fisheries and Gear Types in Area 1 and Area 2

Area 1

Area 1 supports a significant shellfishery. Typical landings from the NE IFCA district include brown crab, lobster, nephrops, cod, haddock, and whiting; in 2010, landings were dominated by catches of brown crab caught by potting vessels under 15 m (Nimmo and Southall, 2012).

Figure 19: Species commonly landed by the North Eastern IFCA commercial fishing industry: brown crab (*Cancer paguras*), whiting (*Merlangius merlangus*), and lobster (*Homarus gammarus*). © (Left and middle) www.seasurvey.co.uk, and (Right) Mark Coombes).

Inshore access by shellfisheries is restricted to vessels under 16 m in length by the NE IFCA (North Eastern IFCA, 2012*)*. Dredging is prohibited within the 3 nmi zone, beyond which it is only permitted during the months of October-June. There are also a number of trawling restrictions within the area (including an area off the Holderness coast with which the Holderness Inshore rMCZ is aligned). These do not allow fishing by trawler vessels over 18.3 m within the 3 nmi. Beyond this, trawling is restricted to vessels under 28 m in length which hold historic rights for fishing within the district prior to the making of the byelaw.[4]

[4] See North Eastern IFCA Byelaws: http://www.ne-ifca.gov.uk/legislation-and-byelaws/byelaw-regulations/

Detailed information regarding the local commercial fisheries operating from key fishing harbours is provided below:

Flamborough: A handful of fishermen are based out of Flamborough port, working the pot fishery throughout the year and a small net fishery for cod and other roundfish from autumn to spring (Holderness Coast FLAG, 2011).

Bridlington: The majority of fishers in Area 1 are potting vessels operating out of Bridlington Harbour, as shown in the 2011 Fishing Effort Survey (see Table 3). Individual vessels set as many as 800-2000 pots. A small number of nets are also set along the coast (Walmsley and Pawson, 2007).

Hornsea: A small number of beach-launched vessels operate from Hornsea; with most potting for crab and lobster. A number of vessels also operate a small net fishery for cod and whiting during the winter season (Holderness Coast FLAG, 2011).

Tunstall and Withernsea: There are 10 to 15 beach-launched vessels, each setting up to 400 pots, with a few vessels also working nets (Walmsley and Pawson, 2007).

Grimsby: Previously a major fishing fleet, there are now a small number of demersal trawlers, and a small static fleet consisting mostly of longliners operating out of Grimsby (Walmsley and Pawson, 2007).

Table 3: Fishing effort survey data (no. of vessels) for ports within case study Area 1 in the southern area of the North Eastern IFCA district (Source: North Eastern IFCA, 2011).

Port	Pots	Nets	Trawls	Lines
Flamborough	3	1	0	0
Bridlington	44	1	2	0
Hornsea	8	3	2	2
Tunstall	1	1	0	0
Withernsea	9	2	0	0
Easington	2	1	0	0
Hull	1	0	0	0
Grimsby	2	2	4	3

Area 2

Landings from the wider area of the Sussex IFCA district include sole, scallops, whelks, bass, plaice, lobster and cuttlefish (*Sepia officinalis*) [Nimmo and Southall, 2012]; in 2010, landings were dominated by catches of whelk, typically caught with the use of pots.

Sussex IFCA byelaws prohibit the use of scallop dredgers within 3 nmi and the use of fishing vessels exceeding 14 m in length within the 6 nmi zone.[5]

Under the Fishing Instruments byelaw, scallop dredging may only be conducted using the spring-loaded 'Newhaven' dredge type (Carleton *et al.*, 2009). Set netting is the most common form of fin

[5] See Sussex IFCA byelaws, available at: http://www.sussex-ifca.gov.uk/index.php?option=com_contentandview=articleandid=98andItemid=184

fishing in the region and is mostly conducted using trammel nets, with some gill and tangle nets also used (Vause and Clark, 2011).

Figure 20: Species commonly landed by the Sussex IFCA commercial fishing industry, whelk (*Buccinum undatum*), plaice (*Pleuronectes platessa*), and mackerel (*Scomber scombrus*) - (Source: MESL).

Detailed information regarding the local fisheries is provided below with reference to the main fishing harbours, Eastbourne, Rye, Hastings and Dungeness:

Eastbourne: Around 30 vessels operate from Eastbourne with most using small under 10 m vessels for potting and netting. High potting effort occurs around Eastbourne and individual boats may set as many as 1000 pots within the 6 nmi zone. Most netters work inshore using gill and tangle nets, a small number of fishers also set drift nets around wrecks. A number of vessels are also involved in otter trawling (Walmsley and Pawson, 2007).

Rye: There is a fleet of around 15 mostly under 12 m otter trawlers based at Rye harbour targeting flatfish, cod, and whiting. The smaller vessels fish within Rye Bay whilst larger vessels fish up to 20 nmi offshore (Walmsley and Pawson, 2007). The netting fleet target flatfish (Dover sole and plaice) and cod with the use of static gill, tangle and trammel nets, and passive drift nets are used for catching herring, sprats and bass (Carleton *et al.*, 2009).

Hastings: Hastings supports a beach-launched fishing fleet of around 20 under 10 m vessels. Net use is heavy within nearby fishing grounds. The most valuable fisheries for this port are for Dover sole and plaice which are mainly caught with the use of trammel nets (Intertek Moody Marine, 2012). A number of Hastings fisheries have undergone MSC assessment: the pelagic herring and mackerel drift net fisheries, with a fleet of three to five vessels, were certified as sustainable in 2005; the herring fishery was then re-certified in 2012 (Marine Stewardship Council, 2013a); and the mackerel fishery is currently undergoing re-assessment (Marine Stewardship Council, 2013b). The demersal Dover sole trammel, trawl and gill net fishery (originally assessed separately) was certified as sustainable in 2005 / 2009 and re-certified in 2012 (Marine Stewardship Council, 2013c).

Dungeness: Dungeness supports a small fleet of beach-launched vessels using fixed nets and trawls, and a few vessels also work the scallop fishery (Walmsley and Pawson, 2007).

The Sussex IFCA fishing community already have strong associations with the marine historic environment, taking part in the pilot FIPAD programme.

3. MANAGEMENT FRAMEWORKS AND PRACTICES

3.1. HERITAGE MANAGEMENT

The Government's overall policy with respect to the historic environment of England has been set out in the following terms (HM Government, 2010):

That the value of the historic environment is recognised by all who have the power to shape it; that Government gives it proper recognition and that it is managed intelligently and in a way that fully realises its contribution to the economic, social and cultural life of the nation.

This vision is given statutory effect throughout the UK Marine Area by the following policy within the UK Marine Policy Statement (HM Government, 2011):

The view shared by the UK Administrations is that heritage assets should be enjoyed for the quality of life they bring to this and future generations, and that they should be conserved through marine planning in a manner appropriate and proportionate to their significance.

In England, practical policies on the enjoyment and conservation of the historic environment are informed by English Heritage's *Conservation Principles: policies and guidance for the sustainability and management of the historic environment* (English Heritage, 2008). The Conservation Principles are intended to reconcile protection of the historic environment with the economic and social needs and aspirations of the people who live in it.

The principal means of managing the marine historic environment in England are as follows:

- designating selected heritage assets as protected sites;
- requiring the reporting of 'wreck' under the Merchant Shipping Act 1995;
- regulating marine development such that appropriate provision is made for heritage assets;
- maintaining publicly-accessible inventories of heritage assets;
- carrying out strategic research;
- supporting voluntary initiatives.

In the English Inshore Zone (i.e. within the territorial sea), heritage assets can be designated under the Protection of Wrecks Act 1973 (PWA 1973) or the Ancient Monuments and Archaeological Areas Act 1979 (AMAA 1979), administered by English Heritage; in practice the PWA 1973 is most commonly used. The Protection of Military Remains Act 1986 (PMRA 1986) can also apply to heritage assets (including aircraft), but its main concern is military wrecks where there has been significant loss of life and, accordingly, it is administered by the Ministry of Defence. The implications of heritage asset designation for commercial fishing are discussed below in Section 6.1.

Anybody who finds and takes possession of 'wreck' in the UK territorial sea, or brings wreck within the UK territorial sea, is obliged to report the discovery to the Receiver of Wreck under the Merchant Shipping Act 1995 (MSA 1995). This includes wreck that is historic (over 100 years old). This system of reporting is important in ensuring that discoveries come to the attention of archaeologists and applies equally to fishers who recover archaeological material in their gear as to other sea users, such as recreational divers or dredging companies. As discussed below, fishers can be an important source of reports of archaeological material, but reporting by fishers through the Receiver of Wreck is far from consistent. FIPAD, which is being piloted in the Sussex IFCA district, is

voluntary, but it also helps fishers to implement their legal obligations under the MSA 1995. The implications of reporting by commercial fishermen are discussed in further detail in Section 7.4.

Regulating marine development to ensure that appropriate provision is made for heritage assets has been a key area for introducing new approaches and methods to the management of the marine historic environment in recent years. Commercial fishing is not subject to the same assessment and consenting processes as marine development. Nonetheless, some of the approaches and methods of development-led archaeology may be relevant to commercial fishing. Commercial fishing can both benefit from, and contribute to, the improvement of knowledge and understanding of the historic environment that is arising as a result of marine development-led archaeology.

The principal national inventory of heritage assets at sea is within the National Record of the Historic Environment (NRHE), which is maintained by English Heritage. As well as being a source of data on heritage assets and obstructions on the seabed, the NRHE receives information from fishermen, and other stakeholders. Local authorities maintain Historic Environment Records (HERs), which include sea areas in some instances. As these inventories are publicly accessible, any person can use them to find places where there are wrecks or other features to avoid. The UK Hydrographic Office also maintains an archive, but its focus is on wrecks and debris that might form a hazard to navigation rather than their archaeological interest.

The main source of funding for strategic projects in England is the National Heritage Protection Commissions Programme (NHPCP) administered by English Heritage in accordance with priorities set out in the National Heritage Protection Plan (NHPP). A wide range of marine projects has been carried out, including the development of FIPAD and this project to examine interactions between commercial fishing and the historic environment. Project reports can be accessed via the Archaeology Data Service (ADS) archive.[6]

In addition to the FIPAD voluntary scheme for fishermen, much of the activity in respect of managing marine historic assets is carried out voluntarily, with the support of English Heritage and other organisations. For example, many licensed investigators of designated marine heritage assets are volunteers, and the Nautical Archaeology Society (NAS) provides training at a variety of levels for those wishing to become more engaged with the marine historic environment. Outreach to individuals and communities forms an important element of the management of the marine historic environment in England.

3.2. Fisheries Management

Fisheries rights and management are defined spatially within British fishery limits. These extend from the UK baseline (typically the low water mark) to 200 nmi offshore or the median line. Most of the waters off England border fisheries limits of neighbouring countries and, therefore, the median line is generally the defining boundary. English waters also adjoin waters managed by the Welsh Assembly Government, the Scottish Government, the Channel Islands and the Isle of Man. Within English waters, fisheries management responsibilities are divided into three main spheres:

[6] http://archaeologydataservice.ac.uk/archives/

Beyond 12 nmi – EU – Common Fisheries Policy

Within the EU, the Common Fisheries Policy (CFP) is the principal regulatory framework for fisheries management. Exclusive competence for fisheries under the CFP rests at EU level with joint decision-making between the European Parliament on most matters, but in practice competence is shared with member states. For example, fishing allowances and quotas are determined in Brussels for each member state, but distributions within the national allocation are for national decision. With regards to surveillance monitoring and control at EU level. The European Fisheries Control Agency[7] (EFCA) was established in 2005 to organise and share operational coordination of fisheries control and inspection activities by the Member States and to assist them to cooperate so as to comply with the rules of the Common EU Fisheries Policy in order to ensure its effective and uniform application. From this mechanism, non-UK registered vessels from member states, operating within UK waters may be monitored according to any relevant policy. For instance, where there are regulations for reporting of findings (and fishing-heritage) from vessels termed "deep water fishing fleets".

6-12 nmi – National – MMO/Defra

Member states are legally obliged to ensure compliance with the CFP in the waters they govern. In English waters this is primarily the responsibility of the MMO, operating within the policy framework set by Defra (under the guidelines of the CFP). The regulatory responsibilities apply to all fishing vessels operating within the UK fishery limits. Under a derogation of the CFP, Member States may adopt conservation and management measures to protect their fisheries resources in territorial waters (0-12 nmi), provided they are compatible with the CFP objectives.[8] Access to these waters is exclusive to UK registered vessels with the only exception where foreign vessels have historic fishing rights in the 6 – 12 nmi zone. A considerable number of foreign vessels have such access off the English coast. The UK cannot apply domestic (as opposed to EU) legislation to regulate these vessels and can only do so in the case of UK registered vessels. The MMO's management role includes vessel licensing, quota and effort allocations, and management, as well as surveillance monitoring and control of all sea fishing activity governed by the CFP and UK national legislation.

0-6 nmi – Regional – IFCAs

English inshore fisheries operating within the 6 nmi region, that is, UK registered vessels only, are managed by 10 IFCA districts in alignment with the onshore local authority boundaries. It is the responsibility of the IFCAs to sustainably manage inshore sea fisheries resources within their respective districts. The IFCAs have byelaw-making powers and much of the inshore fisheries regulation stems from these byelaws. There is a degree of overlap between the respective responsibilities of the MMO and the IFCAs in respect of fisheries, with joint working being encouraged.

[7] http://cfca.europa.eu/pages/home/home.htm

[8] See Council Regulation (EC) No 2371/2002 of 20 December 2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy.

3.3. Changing and Emerging Policy

Common Fisheries Policy

The CFP is currently undergoing reform and the changes are expected to be far reaching. The Council of Ministers and the European Parliament reached agreement in June 2013 on the high level terms of the reform of the CFP. The main features are:

- The phased introduction of a discards ban, starting in 2015 with pelagic species.
- Legally binding limits on total catch levels to maximum sustainable yields by 2015 "where possible" and by 2020 at the latest.
- More devolved decision making by regional groups of member states (less centralisation); though decision making will not be formally devolved.
- More support for small scale fisheries and aquaculture.
- Member states will have to demonstrate that fleet capacity is in balance with fishing opportunities.
- Producer Organisations will have new powers and responsibilities to enable them to play a stronger role in shaping markets.
- The EC will introduce new marketing standards on labelling, quality and traceability.
- Implementation will largely rest on the existing control regulations, though the Commission has stated that it proposes additional monitoring and control obligations to ensure compliance.
- The EC will undertake to do more to avoid exporting unsustainable fishing practices to non-EU countries.

Although this agreement was an important milestone, there remains a considerable amount of detail to be worked through before the effects of these changes are known. The new European Maritime and Fisheries Fund, which is planned to replace the existing European Fisheries Fund at the beginning of 2014, will potentially be an important instrument of change. The priorities agreed by the Council of Ministers in July 2013 for the Fund are improving scientific advice and control, increasing selectivity and helping to reduce discards, supporting small-scale fisheries, promoting innovation, facilitating sustainable fishing practices to keep within maximum sustainable yield limits and improving the information available to consumers.

It is too early to reach firm views on how fishing-heritage interactions might be affected, but the reforms, particularly the new European Maritime and Fisheries Fund, could well present opportunities to enhance those interactions, but might also present risks. This is discussed further in Section 6.2.

The Marine Strategy Framework Directive

The Marine Strategy Framework Directive, which requires Member States to put in place management measures to achieve Good Environmental Status (GES) by 2020, will have an impact on fisheries management and consequently could affect the interactions between fishing and marine heritage. As the UK's programme of measures has not yet been developed it is difficult to assess the resulting knock-on impact of the programme on the historic environment. In December 2012, the UK

Government published the '*UK Marine Strategy Part 1: UK Initial Assessment and Good Environmental Status*'[9] which includes an assessment of the current state of UK waters and descriptors of GES. Among these descriptors are outcomes that have a direct bearing on fishing activities and relate indirectly to heritage sites. For example, "properties and quantities of marine litter do not cause harm to the coastal and marine environment". The Directive leaves Member States with considerable discretion over how to achieve GES. The UK will need to have a programme of measures developed by 2015 and in place by 2016. *UK Marine Strategy Part 1* notes that while existing measures will support the achievement of GES under the Directive, these measures alone are unlikely to be sufficient to achieve GES and some additional measures are likely to be needed, particularly in relation to reducing the impacts of fisheries on the marine environment. There is still significant uncertainty regarding what might be required in order to achieve GES, in particular, in relation to how far existing measures will take us and what additional measures might need to be put in place. As the additional measures are developed there could be opportunities for improving knowledge about marine heritage sites and for strengthening their protection.

Marine and Coastal Access Act 2009

The introduction of the Marine and Coastal Access Act (MCAA) into UK legislation in 2009 provides a legal basis, at both a national and local level, for the inclusion of marine heritage management and protection within the wider remit of marine management. This includes the introduction of marine planning.

The UK Government, Scottish Government, Welsh Assembly Government and Northern Ireland Executive jointly published the Marine Policy Statement (MPS) in 2011. This set the framework for preparing marine plans. It provides the high level policy context, within which national and sub-national marine plans will be developed, implemented, monitored, and amended. The MPS also sets the direction for marine licensing and other relevant authorisation systems. It is binding on all authorisation or enforcement decisions taken by public authorities, including those relating to marine heritage. This could have a direct bearing on fisheries management decisions by, for example, the MMO or IFCAs which affect the interface with marine heritage prior to the publication of marine plans.

As the marine planning authority, the MMO are introducing marine plans into England. The first set of draft plans for the areas off the East of England have been prepared and the 12 week consultation period ran from July to October 2013. Following consultation, the MMO and the Secretary of State will have to consider whether there is a need for an independent investigation. The decision on whether to have an independent investigation will rest on the extent to which issues raised during consultation remain unresolved. There is no fixed timescale for an investigation, so the timing of publication of the first set of final plans remains uncertain.

Plan making has also begun in two further South Marine Plan areas. The Statement of Public Participation has been published and meetings have been held on the south coast. The MMO is

[9]Available at http://www.defra.gov.uk/publications/files/pb13860-marine-strategy-part1-20121220.pdf [Accessed 01 March 2013]

currently gathering evidence and identifying the key issues. The draft plans are scheduled to be published at the end of 2014.

The MCAA requires the MMO to keep cultural matters (marine heritage) under review during the planning process.[10] The MPS adds weight to this by setting out specific considerations. The draft plans published in July discuss the relationship between fishing (and other) activities and heritage assets. The Marine Plans and the associated licensing as well as enforcement processes offer useful and specific opportunities to ensure that informed assessments are made of the historic marine environment, information is gathered and adequate protections are in place. Consultation of the first set of marine plans will represent the next formal opportunity to set this agenda. The draft marine plans state that the plan policy on heritage assets will be delivered within existing mechanisms, for example Environment Impact Assessment (EIA), where already required. The aim of the policy is to ensure that all heritage assets, whether formally designated or not, are considered in the decision-making process. The issue of displacement is also discussed and the draft implementation plan contains specific proposals on displacement. The primary aim is to seek to ensure co-location where this is possible (or failing) as well as to minimise and mitigate the impacts. Whether looking at protecting heritage assets on specific sites or considering the effects of displacement on such assets, it will be important that the marine plans recognise not just known impacts and interactions, but also present a framework for assessing and managing consequential knock-on effects of future developments and restrictions on activities. It warrants further consideration as to whether the recently published draft plans will deliver this.

Other relevant changes arising from the Marine and Coastal Access Act 2009, including MCZ designation and the management of inshore fisheries, have a direct relevance to interaction between (the management of) commercial fisheries and the historic environment and are discussed in Section 6.2.

3.4. Management Frameworks in Area 1 and Area 2

Area 1

There are no fully-submerged designated heritage assets in Area 1; the closest is the Filey Bay wreck site, designated under the PWA 1973, to the north of Flamborough Head. There are, however, several Listed Buildings that have foundations on the seabed or in intertidal areas, including Bull Sand Fort (List Entry Number (LEN) 1083477) and Haile Sand Fort (LEN 1240990) in the mouth of the Humber, and the north and south piers of Bridlington Harbour (LEN 1389155; LEN 1389156). Built historic environment features such as these represent a significant and readily apparent hazard to fishing vessels, so the structures themselves are unlikely to be subject to fishing activity. They may, however, attract potting and lining activity nearby.

The Scheduled Monument protecting Hull Dock Decoys (LEN 1020022) in the Humber extends partly over an intertidal area, which may in principle be subject to various forms of commercial fishing at high water. The Scheduled Monument around the moated sites at Grimston Garth (LEN 1021241)

[10] See Marine and Coastal Access Act 2009 c.23 Available at: http://www.legislation.gov.uk/ukpga/2009/23

extends only to high water, but in view of the high level of erosion on this coast it is possible that material lost from the Scheduled Monument could be affected by commercial fishing.

Area 1 falls within the area of the draft East Inshore and East Offshore Marine Plan. This plan includes the following objective:

> *Objective 5: To conserve heritage assets and ensure that decisions consider the character of the local area.*

Policies relating to heritage assets are set out under the heading 'SOC - social and cultural'; these include:

> *SOC2: Proposals that may affect heritage assets, should demonstrate, in order of preference:*
>
> *a) that they will not compromise the heritage asset,*
> *b) how, if there are impacts on a heritage asset, they will minimise or mitigate these,*
> *c) the case for proceeding with the proposal if it is not possible to minimise or mitigate the impacts.*

The draft Plan notes that 'not all heritage assets are subject to formal designation measures, but nonetheless, these still help to shape the character of an area and should be treated as being of equivalent significance as designated assets' (para. 116).

The Policy Implications statement accompanying the draft plan makes the following notes:

Public Authorities: This policy provides clear direction to public authorities on the significance they should place on heritage assets within the decision-making process. They should consult with the relevant regulator and advisors, local authorities and other bodies (such as Civic Trusts) to ensure that designated assets, and also non-designated assets that have a cultural, social or economic value, are considered in the decision-making process.

Government: This policy clarifies existing government policy, namely the MPS and NPPF (National Planning Framework and heritage assets). The MPS states that "some heritage assets have a level of interest that justifies statutory designation, the purpose of which is to ensure that they are protected and conserved..." However, not all heritage assets are subject to formal designation measures; but nonetheless, these still help to shape the character of an area and should be treated as being of equivalent significance as designated assets. They should be conserved and managed in recognition of their contribution to the overall historic environment. This policy provides clear direction to public authorities that will enable them to deliver on Government policy

Inshore fisheries in Area 1 are managed by the NE IFCA, whose jurisdiction extends 6 nautical miles (nmi – 1.852 km) seaward, from the River Tyne to a point drawn True East from 'Haile Sand Fort' on the South Bank of the Humber Estuary.

NE IFCA byelaws of relevance to fishing gear types in Area 1, that is, those that affect where, when and which gear type may be used, are outlined below:

- III. Trawling: Prohibition: Exceptions
- IV. Seine Net, Draw Net or 'Snurrevaad': Prohibition of (Prohibits seine netting within three miles of the Authority's jurisdiction)
- V. Push Net
- XVIII. Fixed Engine Byelaw
- XXII. Permit to Fish for Lobster, Crab, Velvet Crab and Whelk
- XXIII Method and Area of Fishing (Dredges) Byelaw
- XXIV. Cockle Management Byelaw
- XXVI. Flamborough Head Fishing Byelaw
- XXVII. Flamborough Head No Take Zone

Within the North Eastern IFCA region there are currently 7 bylaws, in addition to 2 shellfish permit schemes with relevance for management of crustacean species. Commercial Shellfish permit requires annual renewal. In a similar manner, Hobby Shellfish permit or Limited Shellfish Permit, for any individual, whether a vessel owner or not, who does not qualify for the criteria of a Shellfish Entitlement Holder Permit, will require annual renewal of authorisation to fish. In addition, this applies to unlicensed hobby fishermen, recreational fishermen, bait collecting, and shore gathering. The shellfish permit scheme is designed to restrict access to inshore fisheries to vessel of 16 m or less. Data and information collected by the permit conditions facilitates the regulation of fishing effort and landings, for overall sustainability of the relevant stocks (NEIFCA 2013).

Area 1 includes the protected conservation sites; Flamborough Head Special Area of Conservation (SAC) and the Humber estuary European Marine Sites (EMS). Within the area, two sites were recommended as Marine Conservation Zones (rMCZs) by the Regional Project Net Gain: Holderness Inshore, and Holderness Offshore. They were not taken forward for consultation in the 2013 tranche of designations but may receive designation at a later date (Defra, 2012).

Area 2

Area 2 includes four fully-submerged designated heritage assets protected under the PWA 1973: the *Amsterdam*, the *Anne*, the *Holland No. 5,* and the Norman's Bay Wreck. There are also some Listed Buildings that have foundations in the seabed, namely Beachy Head Lighthouse (LEN 1393889), Eastbourne Pier (LEN 1353116) and Hastings Pier (LEN 1192411). Area 2 falls within the boundaries of the FIPAD pilot in the Sussex IFCA district. It is not yet known whether any discoveries have been reported from Area 2 through FIPAD. A review of the FIPAD programme is underway with reports due to be publicly available from http://www.fipad.org/.

The Sussex IFCA manages the inshore fisheries in Area 2. Its jurisdiction extends 6 nmi seawards, from Hayling Island to the west of Dungeness Point.

Sussex IFCA byelaws of relevance to fishing gear types in Area 2 are outlined below:

- Dredging for, fishing for and taking of oysters & clams and removal of cultch
- Fixed Engines Byelaw
- Vessel Length Byelaw
- Fishing Instruments Byelaw
- Trawling Exclusion Byelaw

- Scallop Closed Season Byelaw

Area 2 includes the protected areas, Dungeness SAC and the Dungeness to Pett Level SPA. Beachy Head East, together with Inner Bank and East Meridian were recommended as MCZs by the Regional Project Balanced Seas although, as for Area 1, they have not been taken forward for consultation in the 2013 tranche of designations (Defra, 2012).

4. ASSESSING INTERACTIONS BETWEEN COMMERCIAL FISHING AND THE HISTORIC ENVIRONMENT

4.1. THE MARINE HISTORIC ENVIRONMENT

In order to the address the aims of the project, consideration has been given to the development of a conceptual framework for the marine historic environment that is amenable to incorporation within an assessment of fishing interactions.

Themes

Past human activity in the marine environment (i.e. below high water) can be represented in terms of four principal themes:

1. Maritime — Remains that have arisen from various forms of seafaring from the prehistoric period onwards, encompassing all manner of vessels from logboats to C20th warships. Although generally small in overall extent, shipwrecks can include very dense concentrations of significant archaeological material.

2. Prehistory — Remains dating from the earliest human inhabitation of the British Isles through to the Roman period, when sea-level approached its current height. Sea-level has fallen and risen repeatedly over the past million years so changes in sea-level are of paramount importance to understanding early human activity. At times of lower sea level, very large areas of land that are now submerged as part of the UK Continental Shelf were available for humans to inhabit.

3. Aviation — Aircraft crash sites at sea have become a particular concern in recent years because of the frequency with which they have come to light as a result of marine development, and the importance of the material that has been uncovered. Even though aircraft were mass produced, surprisingly few examples of some types have survived in museums; some types and versions are effectively extinct unless examples are found in archaeological contexts.

4. Coastal — An enormous range of archaeological material is found at the coast. Some of it was intended to have a coastal location including landing sites, ship-building sites, fish traps, defensive installations and a range of industrial sites for the production of salt and pottery, for example. In addition, some archaeological material just happens to be present at today's shoreline as a result of coastal change. The widest range of periods may be represented, from early prehistory to the modern period.

Forms of Heritage Asset

The historic environment includes all aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged. Heritage assets are the elements of the historic environment – buildings, monuments, sites or landscapes – that merit consideration because they

have been positively identified as holding a degree of value or 'significance' to this and future generations because of their archaeological, architectural, artistic or historic interest (UK MPS para. 2.6.6.1. (HM Government, 2011)).

Despite the wide range of heritage assets that are associated with the four themes outlined above, physical remains in the marine environment tend to survive in just three forms: as sites; as scatters or debris fields; and as findspots. All heritage assets also have surroundings in which they are experienced: these surroundings are referred to as 'setting'. Hence, in considering interactions with commercial fishing, the historic environment typically has the four forms set out in Table 4:

Table 4: Physical expression of heritage assets

Form	Description
Site	A relatively discrete (bounded) structure, feature or area.
Scatter or debris field	The areas over which structure / artefacts have been dispersed following construction / deposition. May have arisen from a single original source or multiple sources.
Findspot	The place where one or more artefacts have been found. May prove to be associated with a site, other finds, natural features etc., or isolated (no apparent relationships)
Setting	The surroundings within which a site, scatter or findspot is experienced

By way of example taken from the aviation theme, an aircraft wreck may be found in the form of a site, as a scatter, or as one or more findspots. These different forms are not exclusive: an aircraft wreck may consist of a site with a debris field and outlying findspots. Whether its form is simple or complex, the remains of the aircraft will also have a setting, i.e. the surroundings in which it is experienced, though this may only encompass a small area immediately around the remains.

Archaeological material in these physical forms can be interpreted at a range of scales by reference to other heritage assets or other sources of historical information such as documents and maps. Continuing the aviation example, a findspot or debris field might be related to an original aircraft, together with other aviation remains, the heritage asset might also be understood in terms of a wider pattern of aviation activity, such as a common flight path to a coastal airfield. Even more broadly, remains from the seabed might build into an understanding of a whole 'landscape' of past aviation comprising numerous instances of material being found offshore. In this way, remains attributable to individual aircraft contribute to the appreciation of extensive air campaigns such as the Battle of Britain or the combined RAF-USAAF strategic bombing offensive.

Although illustrated here in terms of the aviation theme, examples could be presented equally for the prehistory, maritime or coastal themes. In short, the conceptualisation of interactions between commercial fishing and heritage assets in terms of sites, scatters, findspots and their setting does not mean that the importance of those interactions for broader areas and landscapes is being disregarded.

Consequently, sites, scatters, findspots and settings can therefore be regarded as the principal receptors for considering interactions across the four themes of marine heritage (Maritime, Prehistory, Aviation and Coastal) and the wide variety of assets that fit within these themes.

Known and Unknown Assets

A further key distinction to make when considering the marine historic environment is the difference between 'known' and 'unknown' heritage assets. A known site can be observed, examined and interpreted, but whilst the presence of heritage assets that are as yet unknown may be reasonably anticipated, their location and character remains speculative. Key examples of unknown heritage assets include:

- large numbers of documented shipping losses from the last few centuries, and even larger numbers of ships that were lost in periods or circumstances for which no documented records are available
- aviation sites, for although very many aircraft were lost in a well-documented period, both the circumstances of crashing and the slight form of aircraft remains on the seabed mean that only a small proportion of losses have become known
- the presence of submerged prehistoric material, which is even more tantalising as other than in a few instances that have demonstrated the presence of highly important prehistoric material, the only available evidence is indirect, concerned with the palaeo-geography of now-submerged areas and the presence of deposits as well as surfaces that might prove to contain human artefacts.

It is widely accepted that the number of known heritage assets is small in comparison to the potential number of currently unknown heritage assets, and therefore it is important to consider the extent of fishing-heritage interactions for both known and unknown sites.

4.2. Habitat Characterisation

The fact that the location of many heritage assets in the marine environment are still unknown causes difficulties in trying to evaluate the character and extent of interactions between commercial fishing and the historic environment. Evidence is more widely accessible regarding fishing and habitat interactions (Roberts *et al.,* 2010 and Grieve *et al*., 2011); raising the possibility that impacts on the seabed could be used as a proxy for impacts on heritage assets. Specifically, the vulnerability of habitat structure, that is, the physical form of a habitat and its composition, has parallels with the vulnerability of heritage assets. The nature of fishing-habitat interactions may therefore serve as an indicator of the types of interactions between commercial fishing and the historic environment and of the pathways through which they are likely to occur.

It may also be useful to consider the distribution of habitat (sediment) types when investigating the spatial extent of fishing-heritage interactions. Seabed habitat characteristics act as an indirect driver for fishing-heritage interactions by affecting the spatial variability of commercial fishing activities and heritage assets (and therefore spatial variability in likelihood of fishing-heritage interactions). We can identify simplistic relationships between habitat characteristics and the spatial extent of commercial fishing activities and marine archaeological resources.

The spatial distribution of fishing activities is affected by variation in species distribution and the ability of certain gear types to operate over fishing grounds, both of which are affected by seabed characteristics. For instance, marine areas with coarse or mixed sediments and weak or moderate tide stress are heavily fished using gear types that have a direct physical impact on the seabed including demersal trawls and dredgers (Stelzenmüller *et al.*, 2008). An estimation of location and

scale of fishing activities can be drawn from this relationship, being of most use in data-limited situations where little is known of past or current fishing activities, however, also providing opportunities to predict where future fishing activities may occur, for example, as a result of displacement from protected areas.

The survival of marine heritage assets is largely affected by likelihood of preservation, which is affected by the nature of the marine habitat characteristics, including sediment type and depth, and tidal energy. For instance;

- Wooden wrecks have the highest potential for preservation in areas of fine grained, sediment (Merritt, 2008), together with low oxygen and low tidal energy.
- Wrecks recorded as exposed or only marginally buried (and therefore subject to greater risk from interactions) tend to be found in areas of shallow coarse-grained sediment and high energy (Seazone, 2011).

The nature of this relationship between heritage assets and their environmental setting, however, is not well understood (Wessex Archaeology, 2005), and use of sediment type as a spatial proxy for heritage assets must be undertaken with these limitations in mind.

There are a number of seabed habitat maps and datasets for the UK including survey and predictive maps. For this project, use is made of UKSeaMap 2010[11], which provides a broad-scale overview of habitat characteristics (as seen in Figure 21) based on the European Nature Information System (EUNIS) habitat classification system. UKSeaMap 2010 builds on the previous work of MESH (2008), UKSeaMap (2006) and the Irish Sea Pilot (2004). The map contains data layers for:

- Seabed substrates
- Depth
- Proportion of surface light reaching the seabed
- Energy (disturbance) at the seabed caused by tidal currents
- Energy (disturbance) at the seabed caused by waves

The key layers relevant to this project are substrate and energy. Substrate types are classified as; Rock, Coarse sediment, Mixed sediment, Sand and Mud; while tidal energy is classed as; 'Low', 'Moderate' and 'High'.

[11] http://jncc.defra.gov.uk/page-2117

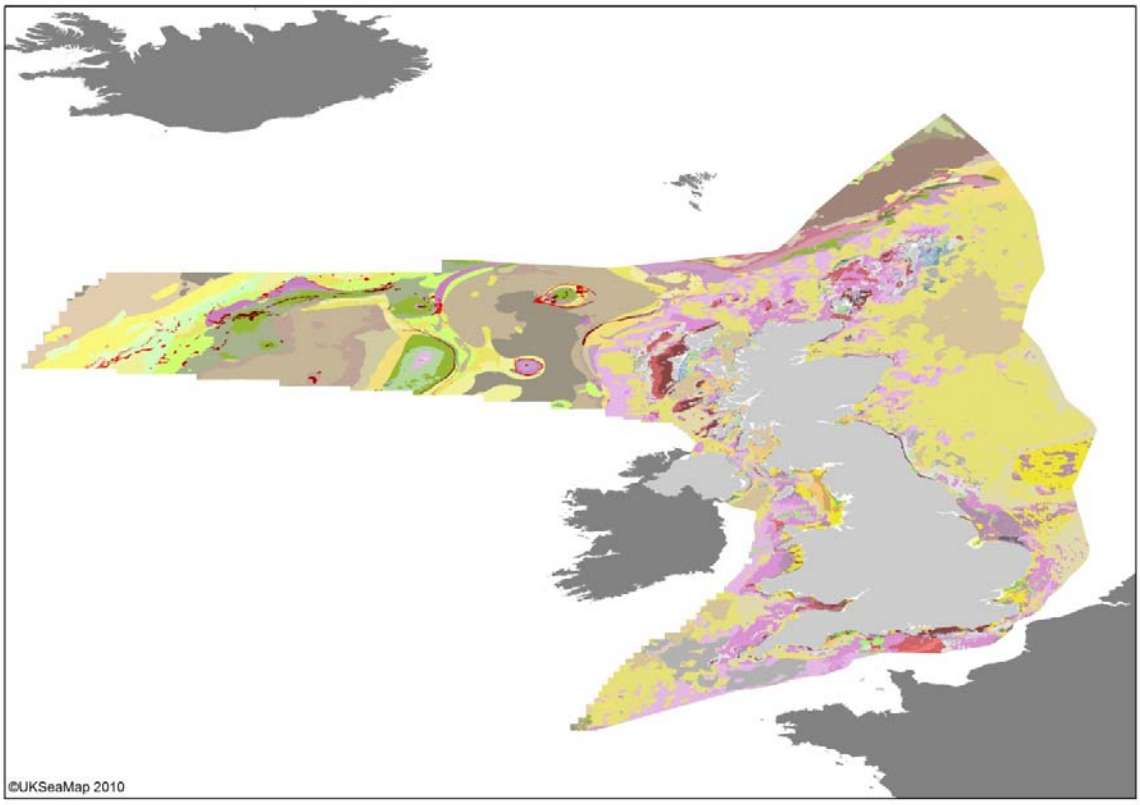


Figure 21: UKSeaMap 2010 - Predictive seabed habitat mapping (Source: McBreen *et al.*, 2011)

4.3. Approaches to Assessing Interactions

Three approaches were considered for assessment of interactions between the fishing industry and the historic environment. These were:

- Environmental Assessment
- Source-Pathway-Receptor-Consequence
- Scale Intensity Consequence Analysis

By applying proven, accepted, and established assessment methods for use in fisheries management, environmental management, and archaeological assessment to the assessment of interactions between fishing and the historic marine environment it is suggested that we can provide appropriate results and recommendations which are both thorough and robust, as well as fitting for the current ways of thinking and collective management across these sectors.

Environmental Assessment

Environmental Assessment methodologies are widely used for identification of effects, including direct, indirect, secondary and cumulative impacts of various activities on environmental receptors, such as heritage assets, and their likely significance. Environmental Assessment methodologies will continue to be used in circumstances that are directly relevant to fisheries and archaeology, including the assessment of marine plans. It is therefore important that the examination of fishing interactions pursued in this project can be reconciled with these processes. The widely established use of these methods provides a common language for application to assessments, which can be incorporated into the assessment of fishing-heritage interactions.

Environmental Assessment is capable of being applied to specific proposals and to wider strategic planning. It applies to private institutions and to public authorities. It should be borne in mind, however, that Environmental Assessment is designed to deal with new or anticipated circumstances, and not with an existing situation. Typically, these methodologies tend to be mechanistic, conflating different types of changes to arrive at an overarching 'effect' or becoming very unwieldy and repetitive. Environmental Assessment also tends to be opaque or provide limited resolution with respect to the actual pathways through which impacts occur, as its concern is for gauging the consequences, not necessarily understanding the processes.

Notwithstanding, Environmental Assessment has many useful characteristics in this context:

- it applies explicitly to archaeological heritage and landscape
- it makes an important distinction between 'impacts' (changes arising from the actions being assessed) and 'effects' (the consequences of those changes)
- it sets a threshold for concern – 'likely to be affected significantly by' – that enables attention to be concentrated on major implications
- it deals with Cumulative Effects
- it deals with Trans-boundary Effects or Co-located Effects, both of which are especially important in the marine environment.

Environmental Assessment also considers both positive (beneficial) and negative (adverse) effects. Anticipated impacts can be scoped in or out at a relatively early stage in order to concentrate attention on the main interactions. Explicit provision is made to factor-in the consequences of mitigation – avoidance, reduction or remedy – and to assess Residual ('with mitigation') Effects. Environmental Assessment practice also distinguishes between impacts occurring during different phases of projects, usually characterised as exploration, construction, operation, and decommissioning. In its lexicon, Environmental Assessment provides for Direct Effects and any Indirect and Secondary Effects, Permanent and Temporary Effects; and Short, Medium and Long Term Effects.

Typical forms of environmental assessment include both Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) methods which are employed during the decision-making process for planning and licensing of activities in UK waters.

- Environmental Impact Assessment is "the assessment of the environmental effects of those public and private **projects** which are likely to have significant effects on the environment."[12]
- Strategic Environmental Assessment is *"the assessment of the effects of certain **plans and programmes** on the environment"*[13]. It is a high level tool used to integrate environmental considerations into the preparation of plans, programmes and policies.

[12] EU Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification).

[13] EU Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment.

Current EIA and SEA Directives [12, 13] both include explicit requirements for application of environmental assessment to impacts upon archaeological or 'cultural' heritage. For example, the EIA process for industry sectors, such as marine aggregate dredging, involves the assessment of known and potential (unknown) heritage assets, their importance and the likely significance of impacts from the activity being assessed (Hamel, 2011). However, the EIA Directive does not directly apply to the assessment of effects from capture fisheries (see Annex listing[12]).

Using SEA methodologies to assess the impacts of commercial fishing is expected to bring the industry in line with other sectors, such as aggregate extraction and offshore wind developments, and can be expected to assist in the integration of fishing within marine planning.

In 2004, the Prime Minister's Strategy Unit recommended that "Fisheries departments should introduce Strategic Environmental Assessments of both inshore and offshore fisheries by the end of 2006 as the first stage of establishing comprehensive Environmental Management Systems" (Prime Minister's Strategy Unit, 2004). The earlier North Eastern Sea Fisheries Committee, (now the North Eastern Inshore Fisheries and Conservation Authority (NE IFCA)), piloted the use of SEA for shellfisheries in 2008. Prior to this, the use of SEAs had not been applied in a fisheries context within the UK and EU (Mott MacDonald, 2008a). The pilot was applied to the assessment of the likely environmental effects of implementing the NE IFCA Shellfish Fisheries Management Regime. Following from this pilot, a generic SEA framework for fisheries was prepared including example objectives against which fisheries plans may be assessed. The heritage objectives suggested were to:

- Protect and, where appropriate, enhance the marine and land-based historic and cultural assets.
- Protect existing known archaeological sites in the area and other sites discovered through fishing in the area.

The SEA process involves a number of key stages - screening, scoping, assessment and reporting, consultation, decision-making, and monitoring. There are a range of environmental assessment methodologies, varying in complexity and data requirements. Common tools include checklists and impact matrices. The Leopold matrix, for example, is a useful, systematic tool for prediction of impacts upon the environment, which provides for identification of activities or environmental components which are most significant to interactions.

This widely used matrices approach has been adapted for a conceptual assessment of fishing-heritage interactions (see Table 5). Use of this approach is expected to provide the ability to scope out interactions of low to no significance from further detailed assessments.

Based on the scoping approach, where an interaction is not anticipated, the cell is left blank. Scoring is based on the sensitivity of the heritage form, and the likelihood of an interaction with each gear type categorisation, assuming a "worst-case" scenario. Scores are indicated using a scale of low (green), moderate (yellow) or high (orange) significance.

Table 5: Environmental assessment of commercial fishing interactions with marine heritage forms showing the scale of significance - low (green), moderate (yellow) or high (orange).

		Marine Heritage Forms			
Fishing Activities		Site	Scatter	Findspot	Setting
Pelagic (static / passive)	Drift (Gill) net				
	Long line				
Demersal (mobile)	Trawl				
	Seine				
	Dredge				
Demersal (static / passive)	Nets				
	Anchored long lines				
	Pots and traps				

The allocation of these scores is based on the following concepts:

- As pelagic towed gear, mid-water trawls and purse seines are unlikely to come into contact with heritage assets and therefore interactions are not anticipated, except for incidental gear loss.
- Interactions with drift nets and pelagic long lines may have a low significance resulting from entanglement and snagging on heritage assets.
- Demersal trawl and dredge gears are widely used and are most likely to interact with heritage assets. As heavy bottom gears, direct interactions are likely to be significant. However, archaeological resources may not be discovered without interactions with fishing gear and therefore, significance of the interaction with findspots is marked as moderate as a result of both positive and negative impacts.
- Interactions with demersal seine netting may have a low to moderate significance resulting from limited interaction with the seabed by the ropes used to haul the seine net.
- Interactions with static / passive demersal nets and long lines may have a low to moderate significance resulting from a higher likelihood of entanglement and snagging, and anchoring impacts.
- Interactions with pots and traps may have a low to moderate significance resulting from flattening, snagging, and anchoring impacts.

In summary, Environmental Assessment approaches can be used to develop a characterisation of fishing interactions with widely-used terminology. These characterisations can be used to scope-in and scope-out interactions for more detailed assessment, based on their likely significance.

Source-Pathway-Receptor Approach

Having identified significant interactions using the environmental assessment methodology, the benefit of the source-pathway-receptor (S-P-R) approach lies in its ability to tease out pathways for

complex interactions, allowing a focus on '**how**' interactions occur, rather than '**if**' they occur. For example, distinctions can be made between the pathways of discarded fishing gear that might become entangled with subsequent sedimentation or substrates which might help protect a heritage feature; and discarded fishing gear which might become entangled with consequential hazard to other users of the marine environment, such as divers, or create a negative load-bearing effect which threatens both the stability and structure of a heritage feature.

This focus on 'how' provides a clearer indication of data needs and management options, which are key objectives of this project.

The S-P-R approach is also capable of being used at different levels of granularity. That is to say, the approach can be used at a broad scale, to look at pathways of interactions between demersal fishing and heritage assets in general, for example. But it can also be used at a fine scale, to examine the pathways through which the footrope of an otter trawl interacts with the upstanding elements of assets in a debris field, for example (see Table 6).

Table 6: Fishing-heritage interaction Sources and Receptors at different levels of detail.

Example Sources	Granularity
Commercial Fishing	Broad
↳Demersal Fishing	⇕
↳Mobile Demersal Fishing	
↳Demersal Otter Trawling	
↳Footrope of Otter Trawl	Fine

Example Receptors	Granularity
Historic Environment	Broad
↳Heritage Asset	⇕
↳Maritime Craft (i.e. shipwreck)	
↳Debris Field	
↳Upstanding Elements of Debris	Fine

The capacity of the S-P-R approach to be applied to understanding pathways at different levels of granularity is an advantage over Environmental Assessment approaches, which tend to conflate interactions to higher levels in order to identify their overall effect.

In order to understand the relationship between fishing activity and any resulting interaction with heritage features, the S-P-R approach attempts to describe the casual connections from source activities through various pathways to the interaction with various overlapping receptors such as heritage assets. The nature of interaction created by a source element, for instance, fishing gear, with associated receptors is anticipated to be dependent on their characteristics, vulnerability, frequency of encounters, and degree of overlap; which together are all required to be considered in assessing any impact and associated risk. Importantly for the study of commercial fishing, pathways can be characterised in terms of their changes through time.

As the chain of activities from source through to receptor might include various connections and uncertainties, a simplified approach is outlined in Figure 22 to aid understanding.

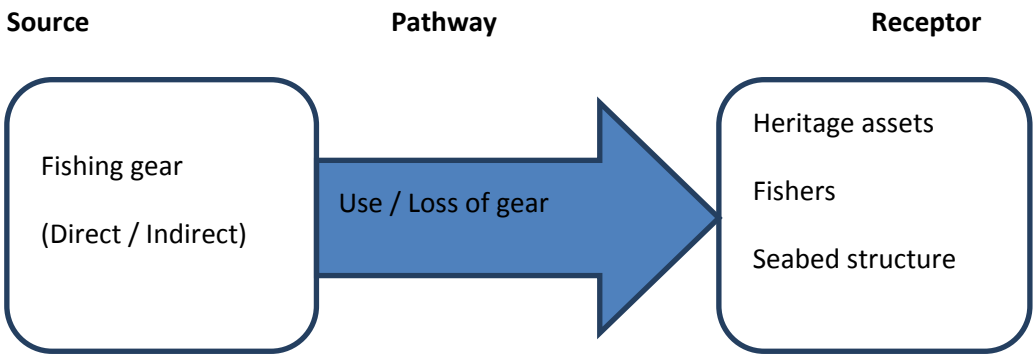


Figure 22: Structure of the Source Pathway Receptor Approach

There is the possibility for a wide-ranging number of pathways associated with interactions between source activity and receptors. However, in order to deliver an appropriate and robust evaluation of associated risk, it is sufficient to identify priority source, pathways and impacts which are expected to contribute towards major interaction between fishing and historic features, and are therefore most relevant. The identification of the priority source, pathways, and impacts is based on a comprehensive review of relevant literature and stakeholder information, and balanced by common-sense and rational justifications.

Our current understanding is limited to known and assumed connections between source and receptor. The reliability and consistency of this approach is relevant to common-sense interpretation of the connections between source, pathways and receptors. Therefore, the approach is designed to appropriately evaluate risk for which known and justified connections between fishing and historic features have been established. Below (see Table 7) are a number of examples showing direct and indirect interaction pathways for the main gear and heritage types identified in the environmental assessment matrix.

Table 7: Example pathways for fishing-heritage interactions.

Source - Fishing Gear Type	Receptor - Heritage Form	Pathway	Direct / Indirect
Demersal trawl and dredge	Site	Trawl and dredge gear may flatten the site or move features away from the site, rendering it unstable. The site may be unburied and exposed.	D
	Site	Sediment disturbance when the gear is dropped, towed and retrieved may cause chemical instability, including oxygenation in the heritage receptor.	I
Pelagic trawl	Site	Pelagic trawls may come into contact with upstanding heritage sites during towing.	D
Pelagic Drift (Gill) Nets	Scatter	Abandoned, Lost or otherwise Discarded Fishing Gear (ALDFG) may become entangled upon heritage assets.	I
Passive / static Nets	Site	Nets may be set over heritage assets, resulting in snagging and disturbance.	D
Pots	Site	Pots and anchors may be dropped on top of a heritage asset. Retrieval of gear may also cause snagging damage and entanglement.	D

Habitat characteristics are likely to have a strong role in framing S-P-R relationships with respect to commercial fishing and the historic environment. As noted in Section 4.2, habitat characteristics, such as sediment type, are drivers both for the presence of fish species and for the use of different fishing gear types. Hence, there is a close relation between habitat character and the type of commercial fishing that is carried out in a particular area, and therefore habitat can be used – to some extent – as a proxy for fishing gear as a source of interaction.

In contrast, habitat is not a definite determinant for past human activity in an area of sea, or for physical material from such activity being lost into the archaeological record. That is, habitats beneath the open sea cannot serve generally as a proxy for either human activity having taken place, or for archaeological material to have been deposited – as receptors – into the marine environment and historical and cultural factors will have been the key drivers.

Although not important in causing archaeological material to be deposited on the seabed, habitat characteristics may have an important influence on the subsequent survival and form of archaeological material once it has been deposited. Geology and natural sedimentary as well as oceanographic processes, together with flora and fauna, can strongly influence the post-depositional sequence that archaeological material undergoes. They also influence the ways in which heritage assets may be affected by subsequent human activity, affecting their ability to withstand impacts and modifying how those impacts occur.

Habitat character is therefore important to the source of interaction (commercial fishing), to the receptor of interactions (the surviving form and condition of heritage assets) and to the pathways between them. Hence, there is scope to use habitat character as a proxy for addressing S-P-R relationships and to use habitat-based methods for assessing interactions.

Habitat-based methods of assessment are already in use in fisheries management. Habitat character is also being investigated and mapped spatially, including through primary data gathering. Habitat characterisation data are far more extensive and comprehensive than marine historic environment data. Habitat-based approaches, therefore, provide for a more secure evidence base and an opportunity to directly integrate the historic environment within existing fisheries management. In light of this, this project is examining the potential application of the habitat-based approach Scale Intensity Consequence Analysis (SICA) to assessing interactions between commercial fishing and the historic environment. The SICA methodology is outlined below.

The use of habitats as a proxy is valuable when considering interaction pathways for which there is little or only anecdotal evidence of fishing-heritage interactions.

Scale Intensity Consequence Analysis

The adoption of the Ecosystem-Based Fisheries Management (EBFM) approach in Australia saw the development of a risk assessment framework known as the Ecological Risk Assessment for the Effects of Fishing (ERAEF) (Hobday *et al*., 2011). This new framework was novel in its application of the precautionary approach to ecological uncertainties and has since been adapted by the Marine Stewardship Council (MSC) for use in their fisheries sustainability assessment methodology, termed the Risk-Based Framework (RBF).

Uncertainty in the number and location of marine heritage features presents some difficulties with regards to assessing the extent of interactions between fishing and historic features, thus inviting the use of a precautionary risk-based approach such as the one described above and now established as a proven methodology by the MSC certification programme.

The MSC certification process for sustainable fishery management makes use of the RBF to conduct risk assessments in data-limited situations. The RBF is constructed of two analytical approaches, the qualitative Scale Intensity Consequence Analysis (SICA) and the semi-quantitative Productivity Susceptibility Analysis (PSA).

SICA is used to determine the scale and intensity of fishing activities, and assess and identify which activities (fisheries) have a significant impact on any species, habitat or ecosystem. The PSA is less attuned to providing an appropriate assessment of impact of fishing activities on habitats and ecosystems, and we have therefore focused on the use of the SICA approach.

SICA scores are assigned for scale (temporal and spatial), intensity and consequence of the risk-causing activity (in this case, use of a selected fishing gear) (Marine Stewardship Council, 2010). The intended outcome of this assessment method is to determine to what extent commercial fishing activities might cause serious or irreversible harm to marine habitat structure (considered on regional and bioregional basis) and functions.[14] For the purpose of this project, marine habitat structures are extended to include marine heritage features, as defined within the project scope. Again, it is worth mentioning that, within considerations of the limitation of this proxy approach, habitat might demonstrate recoverability opportunities, which is not the case when heritage items are impacted.

Assessment of the scale and intensity of interactions can be considered for both an individual site, for example a wreck site, and at a broader geographic scale where it may cover a number of heritage assets (both known and unknown). For intensity, susceptibility, and consequences, the assessment considers the extent to which fishing activities overlap in terms of spatial, temporal, geographic range, depth, and habitat structure, and the susceptibility of the heritage features to the fishing gear type and fishing operations. Each of these scoring elements is assessed using tables (**App-Table 1, 2, 3, 4, and 5** in **Appendix 3**), that group the possible outcomes into three categories such as “low risk, medium risk, or high risk”. This method is typically appropriate for the identification of priority interactions and risk to heritage assets.

Secondary and stakeholder information regarding fishing activities, habitat structure, and heritage assets are generally gathered for assessing the scale and intensity of interactions. In summary, this process is associated with gathering information types, such as:

- Details of the type of fishing gear being used, and nature of the fishing operations
- Details of the heritage features within known and uncertain areas

[14] See Consultation Document: http://improvements.msc.org/database/benthic-impacts/consultations/early-consultation-benthicimpacts/Benthic_Background_Paper_1.pdf

- Details of the fish species being targeted
- Details and maps of the distribution of habitat structure such as substratum or sediment, geomorphology or seafloor topography, and dominant biological communities
- Details of the fisheries and maritime management system, and jurisdictional area
- Maps of the distribution of fishing effort by gear type and fish species

To conduct the SICA process and understand the associated interaction of fishing activities and historic features, a number of critical steps are advised.

Step 1: requires the determination of the "worst plausible case" of combination of fishing activity and scoring elements (fishing-heritage interaction), and preparation of a SICA scoring template for the fishing gear, historic feature, and habitat type. Resulting hazards and vulnerabilities of the habitat structure and historic features interacting with fishing activities are quantified to identify and determine the combination of risk-causing activities.

Step 2: requires the scoring of the spatial scale of the activity potentially causing an impact to the scoring element. This is based on percentages of the overlapping distribution of the heritage feature and habitat structure within the distribution of fishing activity.

Step 3: requires the scoring of the temporal scale of known activity, as well as activities potentially causing an impact to the scoring elements. The highest temporal frequency is used to determine the temporal scale of overlapping interactions.

Step 4: requires the scoring of the intensity of the interacting activities. The intensity and impact level of interacting activities are based on overlapping spatial and temporal scales of activities, their nature and extent.

Step 5: requires the identification of the most vulnerable subcomponent of the scoring elements, as well as scoring the consequences of the relevant activities on the selected subcomponent. All available information should be included in forming the determinant score that is qualitatively derived from the scale and intensity scores awarded in Step 2-4.

Step 6: requires the conversion of the consequence score into an MSC score using the scoring conversion table.

Interactions of converted consequence and MSC scores ranging between 80 and 100 are considered 'low risk' (and considered as best industry practices), those below 80 but above 60 are 'medium risk' (and considered as good industry practices with areas for improvements) and those below 60 are 'high risk' (and considered as industry practices requiring priority action plans and improvements).

Examples of SICA outcomes for towed demersal gear, passive, static nets and pots are shown in Table 8.

Table 8: Summary SICA outcomes illustrating scale and intensity of interaction from selected risk-causing fishing activities

Risk-causing activities from fishing gear and method - Known and estimated disturbance of physical features and processes by:	Spatial scale of activity (score 1-6)	Temporal scale of activity (score 1-6)	Intensity of activity (score 1-6)	Consequence score 1-3	MSC Score ≥80 60-80 <60	**Habitat Outcome:** The fishing activity does not cause serious and irreversible harm to habitat types, structure, function, and heritage features **Relevant subcomponents** **Habitat types:** Rock Coarse sediment Mixed sediment Sand Mud **Habitat structure and function:** Support and shelter **Heritage feature:** Site Scatter Findspot Setting
Demersal beam trawl fishing, and Gear loss	3	5	4	3	60	
Pot and creel fishing Gear loss, and Anchoring	4	4	2	1	80	
Set net fishing Gear loss, and Anchoring	2	5	1	1	80	
Mechanical /scallop dredging, and Gear loss	5	5	4	3	60	

Consequence scores relevant to each fishing activity and their likely impact to seabed habitats and heritage features are evaluated from available literature in order to form an understanding and score of the spatial and temporal scale of impacts.

Existing fishing operations are conducted under varying levels of management which are relevant to their unique operating practices. The above outcome SICA scores indicate that fishing with static gears such as pots and set nets are likely to result in fewer significant fishing-heritage interactions, and are therefore within good industry practices, although they require some level of improvement based on their respective situations. In comparison, fishing with mobile demersal gears such as beam trawls and scallop dredges are likely to result in a greater number of more significant fishing-heritage interactions, and will therefore require monitoring and improvements in order to ensure fisheries operate within good industry practices.

These preliminary scoring and comparisons evidence the use of the SICA methods to identify levels of risk and need for any priority actions required to improve fishing-heritage interactions.

Detail SICA evaluation and justification for relevant scores are provided in **Appendix 4**.

5. THE CONTRIBUTION OF FISHING-RELATED MATERIAL TO THE HISTORIC ENVIRONMENT

5.1. OUTLINE

As noted in the Introduction, there are two broad sets of interactions between fishing and the historic environment. The first set of interactions arises where fishing activity in the past has resulted in the incorporation of the physical evidence of fishing into the historic environment. It is important to understand this set of interactions in its own right, as a significant component of England's history. It is also important to address this set of interactions because valuing the contribution of fishing communities to England's past can provide a sound basis for discussing how fishing communities can contribute to sustainable use of England's marine historic environment in future.

The second set of interactions –where archaeological material is encountered by commercial fishing on the foreshore and seabed irrespective of its origin – are discussed in Sections 6 and 7.

Fishing is one of humanity's earliest attested activities and can be understood and appreciated through archaeological investigation. In addition, the physical remains of fishing make a contribution to the overall historic environment that adds to peoples' sense of place and warrants conservation.

There are four main classes of fishing-related material that contribute to the historic environment:

- the buildings, harbours, houses, and other infrastructure present onshore
- the sometimes numerous remains of fish traps and weirs in predominantly intertidal areas, dating to prehistory or to Medieval and later periods, again with infrastructure and links to shore-based heritage assets
- the large number of fishing vessel wrecks that are known or can be anticipated, mainly offshore but also in intertidal contexts
- the wide array of fishing-related artefacts that occur as apparently stray finds onshore, in intertidal contexts and offshore.

These assets – and the activity of fishing itself through to the present day – can make an important contribution to the character of places both on land and at sea. This contribution has been captured through both Historic Landscape Characterisation (HLC) and Historic Seascape Characterisation (HSC) [Seazone and Maritime Archaeology Limited, 2009].

5.2. ONSHORE

Fishing has made a major contribution to the wider historic environment of many coastlines, resulting in many features that are regarded either as important heritage assets in their own right or which contribute generally to the historic character of many coastal places. Indeed, many coastal settlements owe their origins or development to the fishing industry and their overall character may be strongly tied to historical changes to fishing communities. The contribution of fishing to the historic environment may range in scale therefore, from whole settlements set within a wider cultural landscape in which fishing has played an important role, through to individual features such as specific buildings, wharves, capstans or bollards. To this can perhaps be added, fishing vessels that

are still in use, including the areas where they are moored or drawn up, which often encapsulate vessel forms and fishing practices that have deep historical roots.

Fishing-related heritage assets onshore can be affected by changes to commercial fishing but also by a wide array of different activities. Onshore, existing planning and consenting processes – supplemented by designation – can be expected to address potential impacts presented by fishing (for example construction of new fish markets; and harbour improvements) and by other forms of development. As this project focuses upon interactions with submerged heritage assets, interactions with assets onshore are not considered further.

5.3. FISHTRAPS

As noted above, fish traps and weirs are a widespread and locally numerous form of heritage asset that have been subject to extensive investigation, usually in the context of coastal or land-based research and management. English Heritage has published an *Introduction to Heritage Assets on River Fisheries and Coastal Fish Weirs* (English Heritage 2011) that provides an outline of their different forms and chronology. Except in a few cases where there is a continuing tradition of using 'fixed engines' – traps and weirs – for fishing, there does not appear to be a close relationship between contemporary commercial fishing and historic fish traps. Equally, vessel-based commercial fishing is unlikely to take place over the inter-tidal waters where most fish traps are found, even at high water, because of the hazardous navigation and the risk posed by relict traps to both vessel and gear. Intertidal fishing – for shellfish and bait-digging for example – could present an overlap with former fish traps. The negative interactions are likely to be minor, whilst the potential for archaeological reporting of discoveries, or monitoring changing asset condition, could be high.

5.4. FISHING VESSEL WRECKS

Typically, wrecks of older fishing vessels are likely to be under-represented in the record of both known wrecks and documented casualties because they tend to be relatively small vessels that would not present prominent remains on the seabed, and because military and merchant shipping has been the main focus of historic records of shipping losses. That said, the entire record of known wrecks prior to 1850 is small in number; specific action to seek to quantify and characterise fishing casualties and wrecks prior to (and even after) 1850 may be advisable. Archaeological investigations of vernacular fishing vessel wrecks have been few: the recording of a bawley – a small wooden sailing vessel used on the Thames – in the course of the London Gateway project provides a rare example (Firth *et al*., 2012).

There are greater numbers of known fishing vessel wrecks from the later C19th and C20th, including examples in both of the study areas of this project. English Heritage has recently set out the significance of fishing vessels in this later period, when steam was being introduced to the fleets but sail remained important (English Heritage, September 2012). WWI and WWII were a particular cause of losses, both of fishing vessels engaged in fishing – which were sunk deliberately by enemy action or lost to mines – and of fishing vessels that had been transferred to military service, often in the especially hazardous role of minesweeping. Some vessels were built for military service and subsequently converted to fishing. Losses both in and out of wartime were also caused by the normally hazardous nature of fishing, with vessels sunk by collision, foundering, and fire and so on.

Although they are more numerous, C20th fishing vessel wrecks have also not been the subject of a great deal of archaeological investigation. Some examples have been covered by geophysical surveys which have been subjected to archaeological interpretation, supplemented by documentary research. Fishing vessels are covered in the general assessments of known wrecks carried out by Wessex Archaeology (2011a; 2011b; 2011c), but there has yet to be a broadly-based assessment specifically of fishing vessel wrecks and casualties.

As noted above, there are appreciable numbers of fishing vessel wrecks in the two study areas of this project, as shown in data provided by the NRHE. However, it is not straightforward to query the data in order to provide a quantitative breakdown. Instead, the snapshots below indicate the range and character of known fishing vessel wrecks in Area 1 and Area 2. In some cases, very little is known, underlining the degree to which the material remains of fishing are under-studied. In other cases, there are several documentary leads that could be used to pursue avenues relating to their design and building, including the history of shipyards, owners, fishing companies and families. In addition to data from the NRHE, the snapshots below draw upon wrecksite.eu (http://www.wrecksite.eu) and *Royal Navy Trawlers* (Toghill, 2003; 2004).

Area 1

Crux (UID 907874)

Very small wreck known locally as the *Crux*, which stranded at Out Newton (to the south of Withernsea) in 1912. Assumed to have a wooden hull – only boiler, engine, prop shaft and cast iron propeller are apparent.

Jersey (UID 978613)

Steam trawler captured by a German U-boat on 4 October 1916: crew forced to abandon ship and the *Jersey* was sunk offshore Withernsea by scuttling charges placed below. Built by Mackie and Thompson, Glasgow in 1896. Owned by Consolidated Steam Fishing and Ice Company; fishing from Grimsby when captured.

Thomas Deas (UID 907841)

Built at Southbank-on-Tees by Smiths Dock in 1917 as *James Johnson*. Completed as a minesweeper in 1919. Renamed *Thomas Deas* in 1921. Sold into fishing – Milford Haven (M 253). Subsequently owned by J Marr and Son, Fleetwood. Exploded about 4 miles from Spurn Head on 16 February 1941 as a result of a mine, whilst fishing out of Fleetwood. All 13 crew and 1 pilot lost. Wreck dispersed in 1945 though debris still present.

Staxton Wyke (UID 1525233)

Sunk off Hornsea on 23 August 1959 following a collision with a bulk carrier in fog while returning to Hull from the Icelandic fishing grounds, with the loss of five crew. Steam trawler built as *Lady Hogarth* by Cook, Welton and Gemmell, Beverly in 1937. Requisitioned in 1939 serving throughout the war as Auxilliary Patrol Vessel and in Anti-Submarine role: employed on Atlantic and Mediterranean convoys. Took part in landings in Sicily and at Salerno. Returned to owners in May 1946. Renamed as *Kingston Emerald* and subsequently as *Staxton Wyke*.

Area 2

Boy Billy (UID 901843)

No information other than that the *Boy Billy* was mined 6 miles off Dungeness on 10 April 1943. Regarded as a 'dead' (unconfirmed) wreck by UKHO.

HMS *Caulonia* (UID 901742)

Steam trawler built at Cochranes, Selby and launched in 1912. Requisitioned in WWI as a minesweeper. Returned to owners in 1919. Requisitioned and converted to Auxilliary Patrol Vessel and then as minesweeper. Went aground in Rye Bay in 1943 with the loss of three crew.

Linnet (UID 1316587)

An Eastbourne vessel that sank on 4 December 1925 whilst returning from herring fishing in the Channel. In dense fog, the *Linnet* was in collision with a Spanish vessel. Cut in two, the *Linnet* sank quickly but the crew were picked up by the Spanish vessel and transferred to a local fishing boat, which landed them at Folkestone. Regarded as a 'dead' (unconfirmed) wreck by UKHO (United Kingdom Hydrographic Office).

Smack, Rye Bay (UID 812879)

A fishing smack of unknown name recorded in November 1918 and subsequently buoyed.

These examples illustrate the complex histories of individual vessels: some built for fishing; some built as minor warships; some lost from military action; and some lost through accident. They also indicate the non-military hazards of fishing in the C20th, including collision. The examples include vessels built in the C19th, even though they were lost in the C20th. However, few fishing vessel remains are known for periods earlier than the mid-C19th, illustrating a bias that is common to all forms of shipping. Further archaeological work is required to start understanding the potential for fishing vessels prior to the mid-C19th.

5.5. Stray Finds Relating to Fishing

Examples of stray finds relating to fishing appear to be increasing in number as a consequence of finds reported through the Marine Aggregate Industry's Protocol for Reporting Finds of Archaeological Interest (MAI Protocol)[15]. Fishing weights made of stone, lead or ferrous metal have been reported on several occasions (for example, UID 1524807; 1500476; 1500476; 1496688; 150014; 1499391), as has material interpreted as fishing gear (UID 1496688). Fishing-related finds have been reported in other circumstances, for example, a Late Bronze Age fish hook was reported from the Thames (UID 413592).

Fishing–related finds have also been made that are only stray in the sense that they do not form a fishing-related site in their own terms, but have been found associated with other historic material. For example, during the recording of the wreck of the Gresham Ship, lost in the C16th in the Princes

[15] See http://www.wessexarch.co.uk/projects/marine/bmapa/arch-interest.html

Channel, Thames Estuary, part of a small beam trawl was recovered. This attests to the past impacts of fishing gear on this shipwreck, but also presents an opportunity for archaeological investigation to focus upon fishing as a use of the environment in earlier times (Auer and Firth, 2007). Another example is the C16th wreck of the *Santa Lucia*, off Yarmouth, which had numerous pieces of rolled lead around its exposed timbers. It is presumed that the rolled lead was used on lines or fine nets that snagged on the timbers in the intervening centuries; the lead was only found in surface deposits and was not present in the underlying sediments that were excavated (Watson and Gale, 1990).

5.6. Options for Management and Research

As noted above, fishing-related heritage assets onshore are subject to the same provisions of planning and designation as apply to other types of heritage on land, which are not considered in any further detail here. In intertidal and fully subtidal contexts, fish traps, fishing vessel wrecks and stray finds are all capable of being encountered in the course of commercial fishing, but these encounters are essentially the same as encounters between commercial fishing and other types of heritage asset in intertidal and subtidal areas. Interactions between commercial fishing and fishing-related heritage assets in intertidal and subtidal contexts are therefore discussed alongside other types of intertidal and subtidal asset in relevant sections below on indirect and direct fishing-heritage interactions.

Although the interactions are not substantially different from interactions with other types of heritage asset, the presence of fishing-related heritage assets presents a very valuable opportunity. On the one hand, there is considerable scope to increase awareness and appreciation of the importance of fishing to England's story amongst the wider public; on the other hand, archaeologists can show how their management frameworks are intended to serve the heritage of fishing communities themselves, not just to protect others' heritage from fishing.

The options for management and research set out in Table 9 below are intended, therefore, both to build greater appreciation of fishing-related heritage in England, and to provide a firmer basis for working together with fishing communities in safeguarding all types of heritage, as discussed in subsequent sections.

Fishing-related harbours fall within the scope of several other English Heritage projects that are still underway. Readers are invited to cross refer to these projects in due course.

Table 9: Options for management and research - The contribution of fishing-related material to the historic environment

Interaction	Scope	Objective	Management Options	Research Needs
Material relating to the history of fishing adds to the historic environment (Mutually beneficial)	General	Increase recognition and representation of fishing heritage in story of England	Explore value of enhancing awareness of fishing heritage in perception / marketing of fish Encourage greater recognition of fishing as historical activity in shaping marine environment	Develop archaeological understanding of history of fishing and its effect on England's society and (marine) environment
	Fishing-related harbours, houses and other infrastructure	Out of scope – but cross refer to EH 6262 / 6305	Out of scope – but cross refer to EH 6262 / 6305	Out of scope – but cross refer to EH 6262 / 6305
	Fish traps	Avoid damage and improve monitoring of coastal fish traps	Formulate and promote a Good Practice Guide to avoid damage from for example, bait digging, shell fish gathering Encourage reports on changes to survival / condition (monitoring) Encourage reporting of new discoveries through FIPAD	Review extent of commercial inter-tidal fisheries and their potential interactions with historic environment
	Fishing vessel wrecks	Increase attention to FV wrecks as monuments to fishing communities and to the role of fishing in England's history	Identify management options and priorities for fishing vessel wrecks on basis of thematic assessment	Undertake thematic assessment of fishing vessel wrecks (in conjunction with fishing vessels in preservation), building upon Assessing Boats and Ships

Interaction	Scope	Objective	Management Options	Research Needs
	Stray finds relating to fishing	Demonstrate value to fishing industry of reporting protocols, based on contribution being made by other sectors to history of fishing	Encourage / support reporting of fishing-related finds through protocols for other sectors Involve fishing experts in identification / advice in relation to fishing related finds	Review accounts of previous archaeological surveys and investigations to identify more material evidence of historic fishing activities on archaeological sites.

6. INDIRECT INTERACTIONS BETWEEN COMMERCIAL FISHING AND THE HISTORIC ENVIRONMENT

As noted at the start of Section 5, two broad sets of interactions between fishing and the historic environment have been identified. The first set of interactions – the contribution of fishing-related material to the historic environment – has been outlined in Section 5. The second set of interactions arise when archaeological material originating from a very wide range of past human activities is now present on both the foreshore and the seabed, with the likelihood of being encountered in the course of commercial fishing.

There are a number of general types of interaction where heritage assets are encountered by commercial fishing (as set out in Table 10). These interactions can be characterised as 'direct' where there is a physical encounter between fishing gear and heritage assets; and 'indirect' where the interaction is not necessarily physical but may be no less important.

These interactions can also be characterised in terms of whether they are mutually beneficial, or adverse for either fishing or heritage. In these terms, five interactions are beneficial to fishers or heritage, two interactions are adverse with respect to commercial fishing and two are adverse with respect to the historic environment.

Table 10: An outline of beneficial and adverse fishing-heritage interactions types

	Indirect	Direct
Beneficial interactions	• Commercial fishing contributes to archaeological investigation • Archaeological investigation generates information useful to commercial fishing • Heritage assets improve commercial fishing opportunities • Fisheries management conserves heritage assets	• Commercial fishing results in archaeological discoveries
Adverse interactions for commercial fishing	• Management of heritage assets constrains fishing activity	• Heritage assets are hazardous to gear and vessels
Adverse interactions for historic environment	• Commercial fishing impedes access and interpretation of heritage assets	• Commercial fishing damages heritage assets

The indirect interactions are the subject of this section. They are quite diverse and are considered first because of the breadth they bring to the consideration of all the interactions between commercial fishing and the historic environment. As a consequence of this breadth and diversity, the management options for indirect interactions are best framed in terms of each interaction, rather than collectively.

The direct interactions – the hazard presented by heritage assets to gear and vessel; the potential damage to heritage assets caused by commercial fishing; and the archaeological discoveries

generated by commercial fishing – are closely related, and may in fact occur simultaneously. They are considered together in Section 7 and, because of their close interrelationship, their management options are considered collectively.

Before proceeding, it is important to note that there is a complex overlap between past fishing and present fishing with respect to the historic environment. In the course of the development of commercial fishing over the decades, interactions have changed. The changing relationship between fishing and heritage assets is part of the history of fishing, and underlines the need for caution in using historic evidence as a basis for predicting future interactions.

This point is worth elaborating. It seems very likely that the adverse impacts of fishing on heritage assets underwater increased in the late C19th and C20th as a consequence of the industrialisation of fishing, which increased the overall effort of the industry in terms of volume and extent as well as the power with which fishing gear could be deployed by individual vessels. Knowledge of the presence of material which we now regard as heritage assets is also likely to have been less at the time, because instrumentation (echosounders and position-fixing) and charting was not very advanced. Irreversible damage may have occurred historically with some of the evidence of interactions between commercial fishing and the historic environment dating to the period in which damage was occurring.

Although commercial fishing may have had a major impact on the marine historic environment in the past, it does not follow that all archaeological material has been removed: there are clear examples that demonstrate the continued survival of significant heritage assets despite adverse impacts from fishing. Equally, evidence for past impacts cannot be extrapolated into the future, because the character of commercial fishing is again changing in terms of its capabilities and management. In seeking to understand interactions between commercial fishing and the historic environment, it is essential to understand the historical context within which interactions occur. In this respect, understanding fishing-heritage interactions is also a study of the history of fishing.

6.1. Management of Heritage Assets Constrains Fishing Activity

Scope of Interaction

The principal means through which the management of heritage assets could constrain fishing activity is through designation, notably through the Protection of Wrecks Act 1973 (PWA 1973). The other main form of designation, scheduling under the Ancient Monuments and Archaeological Areas Act 1979 (AMAA 1979), has yet to be applied widely below low water in England, but may constrain fishing activities – such as intrusive shell fisheries and bait digging – in intertidal areas.

Designation may be intended to constrain commercial fishing if this is regarded as a specific risk to the heritage asset; designation may also constrain commercial fishing unintentionally, where designation is intended to address a different risk but also has implications for fishing. In each case, however, designation may offer less of a constraint than might be supposed.

Fishing is not restricted explicitly under the PWA 1973, except that hand-gathering by diving would fall under the restriction on diving under section 1(3) (b)). Fishing activity is unlikely to come within the scope of the restriction on depositing anything ‘so as to fall and lie abandoned’ in section 1(3)

(c)) because fishing gear is recovered, though intentionally discarding fishing gear in a designated area would be an offence.

Most forms of fishing activity would only constitute an offence under section 1(3) (a) if they damaged or removed archaeological material from the designated area. The possibility of such damage occurring and thereby causing an offence may be sufficient to cause fishermen to avoid a designated area. However, the difficulty of proving that damage or removal has occurred, and that it can be attributed to specific fishermen, presents severe practical difficulties; even observing a trawler with its gear down within a restricted area would only prove that the activity has taken place, not that damage has resulted. The presence of material from a designated asset within fishing gear is likely to provide sufficient evidence of an offence if it could be demonstrated that the material originated within the designated area, but such instances create a policy dilemma: there would be a strong incentive to discard the material to avoid prosecution rather than to report the impact so that the material could be recorded and damaged assessed.

The application of the AMAA 1979 is different from the PWA 1973 as it applies to 'works' that are broadly defined as resulting in the demolition or destruction of, or any damage to, a scheduled monument. Though a formal legal opinion should be sought, it would seem that 'works' may be sufficiently broad to encompass commercial fishing practices, by analogy with agricultural practices. Unless they fall within the terms of a general provision known as a 'class consent', agricultural works – including ploughing – require scheduled monument consent. That is to say, the activity itself may give rise to an offence. If the analogy between fishing and agriculture holds, then fishing activity might be regarded as 'works' for which Scheduled Monument Consent (SMC) is required. The need to obtain SMC, or to avoid designated assets where SMC is required, would be a constraint on commercial fishing but, as noted above, the AMAA 1979 has yet to be applied extensively below low water in England, hence this potential constraint is not prevalent.

Although not heritage legislation as such, the Protection of Military Remains Act 1986 (PMRA 1986) operates in a similar way to the PWA 1973 with respect to Protected Places and Controlled Sites, where it is an offence to tamper with, damage, move, remove or unearth remains (section 2(1) (a); section 2(1) (c)). Aircraft crash sites are automatically regarded as Protected Places; it is sufficient for a person to believe or have reasonable grounds for suspecting that there are remains present that would be protected for an offence to occur (section 2(1) (b)). Although in each case it is an offence to damage etc., it is not an offence to fish or to carry out activities likely to cause damage (other than excavation, diving and salvage); hence, the PMRA 1986 offers little direct constraint to fishing.

In sum, designation as a means of managing a heritage asset might constrain fishing activity if, as a precaution, fishermen stayed outside the designated area to avoid any possibility of causing an offence of actual damage. Under the PWA 1973 and the PMRA 1986, fishing is unlikely to give rise to an offence except where actual damage occurs; obtaining evidence sufficient to secure a conviction even in respect of actual damage presents practical difficulties. If fishing is considered to be 'works' for the purposes of the AMAA 1979, the situation may be different in respect of scheduled monuments in the territorial sea, but these are currently very few in number. Numerous instances have demonstrated that some fishermen at least do not feel constrained to avoid designated heritage assets. Practically, therefore, management of heritage assets does not appear currently to have a noticeable adverse effect on commercial fishing. Even if fishing was the principal threat to a

heritage asset, designation under heritage legislation alone does not appear to offer a particularly effective management tool.

Evidence

There have been numerous instances where fishing has taken place on designated wreck sites, though it is important to note that no offence has necessarily been committed in these instances. Ferrari (1994) reports an example of oyster dredgers being employed within the Studland Bay designated area. He notes that 'the overall impression gained was that the dredging had been done in full awareness of the presence and nature of the site'. In the case of trawling at Langdon Bay 'the fisherman involved would have been well aware of the presence and status of the site' and at Hazardous a fisherman who used tangle nets 'was well aware of the status of the site which is clearly buoyed. He simply appears to have ignored the legislation' (Ferrari, 1994). All of these instances suggest that in terms of offences, evidence, precaution or moral imperative, the PWA 1973 does not create a major constraint on commercial fishing. As Ferrari (1994) points out, this reflects ministerial assurances given in the House of Commons at the time the act was introduced: 'There will be no bar on any kind of fishing from the surface, either commercially or for sport' (Hansard HC, 4 May 1973 cols. 1682-707).

There are no designated fully-submerged heritage assets in Area 1. Aside from some Listed Buildings that have their foundations on the seabed, there is one scheduled monument – a WWII decoy site – that encompasses a small area of intertidal ground. There are four areas designated under the PWA 1973 in Area 2. It is not known whether any of these designated assets have constrained commercial fishing in the area as a consequence of their legal status. One of the designated wrecks in Area 2, *Norman's Bay*, was found as a result of fishing (lobster potting); and another, the *Holland No. 5,* has been found to be covered in fishing gear on several occasions since it was designated (Wessex Archaeology, 2009), though it is not clear if this gear reflects a direct impact in the course of fishing, fishing gear that has been dumped, or material that has 'washed in'.

Options for Management and Research

As noted above, designation under the PWA 1973 does not generally preclude commercial fishing. Whilst damage is an offence, it may be difficult to prove in respect of an individual vessel. At the same time, fishermen have not desisted from fishing on designated historic assets, suggesting that there is a value to fishing in designated areas. Short of changing heritage legislation, the best option would seem to be to identify methods of fishing that can be practiced in areas designated under the PWA 1973 without risking damage. As a specific example, it may be possible to develop forms of potting within designated areas such that potential impacts are avoided, using a combination of better seabed mapping and additional care during deployment and recovery. In the meantime, it would be advisable to seek clarification about the application of heritage legislation to commercial fishing.

Table 11: Options for management and research - Management of heritage assets constrains fishing activity

Interaction	Scope	Objective	Management Options	Research Needs
Management of heritage assets constrains fishing activity (Adverse for commercial fishing)	Designated heritage assets	Facilitate sustainable fishing practices on designated heritage assets whilst precluding unsustainable practices	Develop and test sustainable fishing methods on designated sites	Seek legal advice to confirm application of heritage designations to commercial fishing

6.2. Fisheries Management Conserves Heritage Assets

Scope of Interaction

The management of commercial fishing has an interaction with the historic environment because fisheries management influences the areas to which fishing effort is directed. This is especially true where fisheries management has an express spatial element. Interactions with heritage assets will be less in areas from which fishing is directed away and greater in areas that are favoured or to which fishing is displaced. It is not just these spatial elements that have implications for heritage assets. Many aspects of fisheries management will affect the character and extent of interactions with the historic environment. Where the intention of fisheries management is to reduce adverse effects on habitats and seabed features, then it is likely to be the case that heritage assets – both known and unknown – will be conserved as a result.

Evidence

Marine Conservation Zones

The development of a network of MCZs under the MCAA 2009 is currently underway, with a view to designating the first tranche of sites during 2013. Of the 127 sites originally proposed by the Regional Projects, 31 have now been taken forward by Defra in the proposals for the first tranche of designations. There may be both positive and negative impacts to the marine historic environment following the designation of MCZs, with particular implications for unknown (and, therefore, unprotected) heritage assets. Potential impacts are discussed below:

Where a marine heritage asset falls within a designated MCZ it may incidentally receive protection, as a result of exclusion of certain or all fishing activities, for example where commercial fishing activities such as bottom trawling and dredging are restricted or excluded, this may result in greater protection to assets that are exposed or finely covered by sediment.

On the other hand, designation of MCZs may result in adverse impacts upon marine heritage assets; where MCZs result in the displacement of fishing activities, there is the potential for new or increased risk of fishing-heritage interactions in alternative fishing grounds as a result of increased localised fishing effort.

Additional responses to MCZ designation may include changes in fishing gear use / type and target species by fishers, enabling them to continue fishing within the same geographical area or in response to relocation of effort, which could also impact upon the extent of fishing-heritage interactions.

The impact assessments prepared to date by the regional projects (Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas, 2012) do not address these implications of designation, instead, handling fishing and archaeological interests separately. It is therefore suggested that heritage was not assessed appropriately or adequately during the MCZ Impact Assessments, with work limited to restrictions that the MCZs might impose on 'archaeological activities' directly related to heritage sites such as diver trails, surveys and full site excavations (Finding Sanctuary *et al.*, 2012). Whilst these restrictions would be of use (the assessments did not, however, reach a conclusion) there is still the opportunity for the Secretary of State to have regard to the wider implications. The MCAA Section 117 (7) states that *"In considering whether it is desirable to designate an area as an MCZ, the appropriate authority **may** have regard to **any** economic or social consequences of doing so." Section (8) makes clear tha*t *the reference to "social" consequences of designating an MCZ includes any consequences of doing so for sites of historic or archaeological interest.*

For the purposes of this project, the impacts of displacement of fishing activities upon heritage were considered in relation to case study Areas 1 and 2, however, it was found that although a number of rMCZs were proposed by the Regional Projects for the case study areas, none of these were taken forward for the tranche one consultation.

We suggest that where management scenarios are most restrictive, for example, where all fishing activities are excluded, this is likely to have a significant impact upon displacement of fishers. The extent to which this will impact upon heritage sites is likely to depend on the fishers' ability to absorb economic impacts and / or adapt their fishing activities. Softer management scenarios where only the most destructive fishing gears are restricted, and / or where MCZs are used to strengthen current standing legislation, such as IFCA byelaws, may reduce displacement impacts by minimising the burden of additional management regulations and their spatial impact.

As the percentage coverage of Marine Protected Areas, such as MCZs, grows and other developments, such as renewable energies expand, fishers are likely to find their access to traditional fishing grounds increasingly restricted. These restrictions will not only impact upon the financial viability of fishers but could also unintentionally put increasing pressure on the marine historic environment. It is therefore essential that the MCZ process recognises, as envisaged in the MCAA and the Marine Policy Statement that the marine historic environment is a central consideration and that full account is taken of potential effects arising not just within proposed MCZs but also outside of those areas.

Management of Inshore Fisheries

At a local and regional level, IFCAs with their new duties and responsibilities may to an extent still be becoming familiar with their role and structure. In conjunction with the MMO, they are in the process of reviewing existing byelaws created under the Sea Fisheries Committees (due for completion by December 2014) and establishing how they can best work together, for example, on

the implementation of MCZs. The IFCAs have a prime role in managing inshore fisheries and it is open to the Secretary of State to extend their remit to 12 nmi. In addition to the management of regional fisheries, the IFCAs are required by the MCAA to consider the protection of the marine environment (which includes "features of archaeological or historic interest"), they must –

> *"...seek to balance the social and economic benefits of exploiting the sea fisheries resources of the district with the need to protect the marine environment from, or promote its recovery from, the effects of such exploitation…"*[10]

The recent application of the pilot SEA process to the NE IFCA shellfisheries provides an opportunity for further work of this kind throughout England, which if applied appropriately, will bring fisheries in line with other activities in the marine sector.

The first challenge in conducting an SEA for existing fisheries will be in determining the plans and programmes to which it is to be applied, as this process is designed for application to new plans. The SEA process is clearly set out in the SEA directive. However, the project authors for the NE IFCA pilot indicated a need for "continuous thinking 'outside the box' from the SEA and fisheries specialists to ensure that this novel way of looking at fisheries issues fully addressed environmental concerns" (Mott Macdonald, 2008b). Initially, difficulties are likely to be faced by IFCAs in other districts (and in application to other fishery types) if taken forward. However, each application of the SEA will be a learning experience which may provide guidance for future improvement. The NE IFCA will be taking forward this approach from May 2013 with a fin fish SEA which will complement the work of the shellfish SEA project.

The process provides significant scope for stakeholder consultation, a key contributor to the success of fisheries and community-based projects, although it should be noted that this type of engagement can also happen outside of a formal SEA process.

The IFCAs may face challenges over the next few years in adapting to their extended role in relation to protecting the marine environment and finding the capacity and resources to meet their obligations. They are, however, well placed to tap into local and regional knowledge and to assist with protection of heritage sites in the inshore area.

In addition to IFCA management, a number of strategies are being applied under Axis 4 of the European Fisheries Fund (EFF), a programme supporting the sustainable development of fisheries areas. The programme is being delivered in England by six Fisheries Local Action Groups (FLAGs), covering around 20 per cent of the English coastline (MMO, 2013). High level strategies include strengthening of local fishing communities, enhancement of local markets, and advocacy for fishermen.[16] Funding such as this may provide a number of opportunities for the management of fishing and heritage, for example, using local fishing heritage to build relations between fishers and archaeologists, improve knowledge of archaeological resources and provide socio-economic benefits through the use of local maritime heritage as a basis for tourism within fishing communities.

[16] See Flag factsheets. Farnet, 2013.

Regulatory driven changes – the risk of unintended consequences

As a result of a combination of factors, including cuts in quota of specific species and capacity being out of alignment with fishing opportunities in some sectors and areas, fishers will target different species and change gear types. This can have beneficial effects on marine heritage where less potentially damaging fishing methods are employed (for example a switch from bottom trawling to more passive gears), but can also raise the risk of adverse interactions. An example of the latter is the move into scallop dredging in English waters by many vessels in recent years as the result of regulatory changes, leading to severe cuts in the days each vessel is permitted to fish. This in turn, has resulted in vessels fishing some grounds more frequently, intensifying the fishing effort in concentrated areas, whilst also exploring new grounds closer to home.

There are other examples of regulatory measures leading to concerns about adverse impacts. Industry critics have pointed out that new regulations to limit access to inshore waters by larger scallop vessels could have the perverse effect of increasing fishing effort in the inshore area. Quota swops by the UK during the current year have provided access to high powered seine fishing by Dutch vessels in waters off the English coast, which is causing concern because of the environmental impact. It has to be recognised that fisheries management is highly complex and is surrounded by uncertainties. Consequently all decisions tend to be difficult and a matter of balancing conflicting interests. However, when day to day decisions are taken these tend to be taken in isolation and in response to singular objectives. Moreover, when Defra, the MMO and the IFCAs introduce new regulations and byelaws, there is currently no mechanism for reviewing the cumulative impact. Increasingly, the MMO is using licence variations to control and restrict fishing activity. These are not subject to consultation and do not require impact assessments. Each proposal and action is considered piece by piece. The risk of unintended consequences and adverse impacts on the marine heritage is consequently high.

The draft marine plans recognise the problem. They state *"The current data available on fisheries is varied and unfortunately does not provide a complete view of fishing activity with a high degree of accuracy. Many limitations of the evidence base have been identified".* The draft plans go on to say that officials are seeking to address the problem for the purpose of future plans.

Technical advances in fisheries

As with any other industry, the fishing industry has year on year technical and efficiency gains. This can create opportunities and risks for the fisheries heritage interaction. New gears can be more environmentally sensitive but design changes to improve catch rates can also enable fishers to access areas that previously were uneconomical to fish. Fishers have also exploited technology to enable them to better target fish stocks, including providing them with high quality information about the sea bed and what lies on it. This information could be helpful in identifying heritage features and ensuring their protection. Fishermen could be encouraged to play a significant part in mapping and monitoring marine heritage, possibly with the assistance of new European Grant regimes such as the European Maritime and Fisheries Fund (EMFF).

Similarly, monitoring and surveillance techniques for fisheries management purposes are also increasingly making use of new technology. The MMO has been trialling inshore VMS for under 10m vessels and over the next few years it is likely that this type of equipment will come into widespread use. This will provide more data about fishing patterns and could assist, for example, IFCAs to meet

their obligations to protect features of archaeological or historic interest. Other surveillance equipment such as gear sensors are likely to become more widely used, adding to the data available from fishing activities and strengthening the ability to monitor and control activities that interact with heritage sites.

European Marine Sites

Defra quite recently changed its policy on and approach to managing commercial fishing activities in all European Marine Sites (EMS) and potential Special Protection Areas (pSPAs) and possible Special Areas of Conservation pSACs in England. It strengthened the application of the precautionary principle and all existing and potential commercial fishing activities will be subject to an assessment of their impact. Where the activity is judged to represent an unacceptable risk to the conservation objectives, appropriate management measures will be introduced. This modified approach is still being rolled out. The Department has undertaken that by the end of 2016, all fishery operations potentially damaging EMSs should have been identified and be subject to appropriate management.

To the extent that heritage assets co-exist within European Marine sites and require protection from damaging fishing activities, Defra's new EMS management policy could be helpful. There are also synergies with the IFCA obligations. For sites located between 0-6 nmi, the IFCAS will be the lead regulatory body. Beyond that or where the sites feature straddles the 6 nmi line the MMO will be the lead authority. The picture becomes more complicated where foreign vessels have access to a site. Ministers have given an undertaking that UK and foreign fishers will be treated equally. To introduce controls over foreign vessels will require the UK to seek agreement at EU level through the CFP mechanisms. However, most European Marine Sites are within 6 nmi.

Attitudes within the catching sector

Pertinent to considering interactions arising from the management of fisheries are the perceptions and attitudes of those in the fishing industry and particularly the catching sector, in other words, the interaction between people where fisheries meets heritage. In a research report commission by Defra (Creative Research, 2009) it was found that "Fishermen are collectively extremely angry and frustrated with their lot and feel under attack from all sides", including the government, sea fisheries committees (now IFCAs), the Marine and Fisheries Agency (now the MMO) and the environmental lobby. "For many of those interviewed, 'Defra' is a catch all for a variety of Government bodies." There were also conflicts and tensions within the fishing community, for example between owners of over- and under-10m vessels. The industry is highly fragmented and is populated by people who are often fiercely independent.

Attitudes towards protecting the marine environment were revealing and relevant to heritage sites. Most of the fishermen were reluctant to engage with environmental issues, especially in relation to fishing practices. A few were willing to accept that there were issues here but felt that they faced a dilemma; they need to earn a living and this was already difficult enough without worrying about the environmental impact. On the other hand, the study also found that fishers were immensely proud of their heritage and their community and this sense of belonging goes a long way to defining how they see themselves. There could well be opportunities for using this as the bridgehead to foster positive attitudes towards protecting the marine environment.

Options for Management and Research

Marine Planning

Marine planning represents one of the strongest opportunities to ensure that heritage assets are identified and protected. The draft plans for the eastern inshore and offshore areas reiterate the policies set out in the Marine Policy Statement and stress the importance of heritage assets. Consideration should be given to how the plan policies on the interactions between commercial fishing and heritage assets would work in practice. Would, for example, all fishery licensing and licence variations be subject to the requirement that "heritage assets should be part of the decisions making process"? This would be a departure from current practice and would strengthen the prospect of protecting heritage assets. Could the plans be stronger on the need to obtain evidence rather than rely on available evidence (which might not exist)? The EIA Directive does not apply to commercial fishing so existing mechanism are weak compared to the requirements placed on other industries. Another issue is displacement and the effects on heritage assets. The fishing industry is highly mobile and so displacement is a significant concern. Again, while the draft marine plans discuss the issue, do they go far enough to ensure that displacement effects are known before decisions are taken?

The requirement to have regard to marine heritage is not triggered by the marine plans, though they should be expected to provide more detail. The Marine Policy Statement is a legally binding document. All public bodies are required to have regard to the MPS when taking authorising and enforcement decisions. This is reflected in the memorandum of understanding between English Heritage and the MMO in relation to marine licensing policies and decisions. However, this document does not seem to cover fisheries management. Fisheries management is not exempt from the MPS obligations. We suggest that English Heritage should seek clarification from the MMO about how they are currently exercising this duty and we also suggest that it would be helpful to develop a memorandum of understanding specifically about fisheries management and marine heritage interactions.

Working with IFCAs

IFCAs have a statutory obligation to balance the social and economic benefits of exploiting the sea fisheries resources of the district with the need to protect the marine environment from, or promote its recovery from, the effects of such exploitation. All IFCAs could be reminded that this duty extends to protecting features of archaeological or historic interest. This might be done initially through the Association of Inshore Fisheries and Conservation Authorities. IFCAs could be invited to set out how they are approaching this aspect of their responsibilities. Whilst IFCAs will no doubt feel under pressure financially, there are indications that at least some do have an interest in this area of their work. It should be possible to build on the pilot voluntary 'Fishing Industry Protocol for Archaeological Discoveries' of the Sussex IFCA district. Extending this across all IFCAS could be one means of the IFCAs ensuring that they can show that they are acting in accordance with the MCAA. Additionally there was the 2008 SEA pilot in the now North Eastern IFCA area. IFCAs could be encouraged to apply the SEA approach more widely utilising the generic SEA framework prepared as part of the follow up to the pilot project.

With the application of Project Inshore to all English IFCA districts, the IFCA officers' growing familiarity with the MSC assessment process alongside further guidance provided by English Heritage

may allow for the application of the SICA approach to local fisheries and heritage in order to identify risks.

Defra can issue guidance to the IFCAs as has been done on a number of topics. Included among these is guidance on sustainable development. This makes reference to heritage assets, though does not appear to fully reflect the requirements of the MCAA. There is room for more specific guidance on protecting features of archaeological or historic interest. English Heritage could work with Defra on this to ensure that there is clarity among the IFCAs about their responsibilities. It is helpful that the IFCAs are required to have regard to the guidance when carrying out their functions.

Under the MCAA, the MMO and IFCAs have the authority to implement byelaws, providing the opportunity for archaeologists to work alongside these organisations to incorporate heritage needs within localised management. Use of conservation measures, such as marine protected areas, should be explored for their potential application to direct or indirect protection of heritage assets. As an example, the MCAA Section 129 (3) (f) may be used to implement a byelaw for the protection of a heritage asset where they are deemed of importance to MCZ conservation objectives. By integrating heritage protection into fisheries conservation measures such as these, it may be possible to reduce the level of regulations required for protection, for example, as an alternative to providing designated status to a wreck site.

The MMO and the IFCAs are currently reviewing the IFCA's legacy bylaws. There will be formal consultation, but English Heritage might want to be involved at an early stage in the process to ensure that their interests are reflected in the merging proposals.

Environmental assessments of MPAs

The change of policy by Defra on European Marine Sites in relation to commercial fishing could also be helpful. Defra have agreed that appropriate assessments will be carried out in all cases where licensed fishing activity may have a significant effect on site features. It could be expected that this principle would be similarly applied to MCZs. Where heritage assets happen to sit in MPAs it might be possible to integrate heritage protection into other marine environment protection within the MPA framework. Also, the gathering of evidence for the purposes of the assessments and subsequent monitoring could provide useful sources of additional information about heritage assets. Defra Minister's insistence that there should be good evidence and effective management in place in the case of MCZs suggests that resources will be concentrated on these and European Marine Sites. English Heritage and local archaeological groups could explore the scope for joint working with Defra, the MMO and IFCAs.

Avoiding unintended consequences

In Section 6 above, we discuss the risks of unintended and adverse consequences arising from fisheries regulation by Defra, the MMO and IFCAs if regard is not given to the possible impact of decisions on heritage assets. Putting in place a memorandum of understanding with the MMO on fisheries should help in this respect. The marine plans, when finalised, might further strengthen this discipline, but the regulators could be encouraged to ensure that the cumulative effects of their separate regulatory processes and decisions are assessed and that English Heritage are consulted on the cumulative impact before decisions are taken that could affect commercial fishing and heritage assets interactions.

Marine Strategy Framework Directive

A considerable amount of research and monitoring will probably continue to be carried out in preparation for implementation of the Marine Strategy Framework Directive and far reaching measures will need to be agreed to enable the UK to meet its obligations to achieve Good Environmental Status (GES) under the Directive. This might offer opportunities for data gathering about the impacts of fishing on heritage assets as well as other elements of the marine environment. Synergies should be sought when management measures are proposed and implemented.

Application of new technology

Discussions could be held with Defra and the IFCAs on the capabilities of new fisheries surveillance equipment and techniques that might offer opportunities for gathering more information about heritage assets and how they might be affected by fishing activity.

In summary, the options for management and research in respect of fisheries management are concerned primarily with clarifying existing provisions in law and policy, and seeking to bring these obligations to bear in a way that supports fisheries management in making better provision for the historic environment.

Table 12: Options for management and research - Fisheries management conserves heritage assets

Interaction	Scope	Objective	Management Options	Research Needs
Fisheries management conserves heritage assets (Beneficial)	Known and unknown heritage assets	Maximise opportunities for using fisheries management to contribute to conservation of heritage assets	Explore use of fishing conservation measures (for example, byelaws) to manage fishing on sites that would otherwise be designated. Explore use of nature conservation measures e.g. MCZs, to manage fishing on sites that would otherwise be designated. Develop MOU on fisheries management and the historic environment	Seek legal advice on application of fishing / nature conservation measures to historic environment in light of statutory requirements with respect to the historic environment in the MCAA 2009. Clarify the application of UK MPS and Marine Plan policies relating to the historic environment to fisheries management decision-making by Defra, the MMO and IFCAs. Examine the scope for using monitoring and surveillance data for GES / fisheries management to generate information relating to interactions between commercial fishing and the historic environment.

6.3. Commercial Fishing Impedes Access and Interpretation of Heritage Assets

Scope of Interaction

The principal impediments from commercial fishing to access and interpretation are likely to arise unintentionally where gear, especially net and line, collects around a wreck. Net and line is commonly present on wreck sites and often obscures elements of the site. In some cases it can also present a hazard to divers or underwater remotely operated vehicles (ROVs). Net, line and other gear can also impede remote survey techniques. As a result, archaeologists and recreational divers may be discouraged from visiting sites, or their capacity to observe sites may be confined to areas that are not obscured. In archaeological investigations, obscured material may make survey, recording or interpretation difficult, or require valuable time to be spent in removing net and line before work can progress.

Fishing gear can impede access and interpretation irrespective of the cause of the gear being present, as indicated by the term 'Abandoned, Lost or otherwise Discarded Fishing Gear' (ALDFG).

There may be anecdotal accounts of commercial fishermen seeking to impede access by archaeologists or members of the public to heritage assets, but such interaction seems unlikely to be widespread. It is, for example, not always prudent for archaeologists to leave shot lines overnight and expect them to be present next morning, but this is a question of general site security that prevails in archaeological work on land as well as at sea. In an example reported from the Salcombe Cannon Site, excellent relations with the local fishing industry did not prevent the deliberate severing of shot lines and positioning buoys by a rogue fishing boat from out of the area. Although it is possible that the crew of the rogue boat did not realise they were damaging the infrastructure of an archaeological investigation, the damage was 'clearly malicious'.[17] Incidents such as this, however damaging they are at the time, do not appear to reflect any widespread antipathy of fishermen towards archaeological investigations.

A minor source of fishing activity impeding interpretation might be argued where fishermen name a site and archaeologists could be misled by the naming. This is more a case of a lack of source-criticism on the part of archaeologists, however, as fishermen may name a site to suit their own needs in the present rather than any concern for historical accuracy.

Evidence

There are comments in respect of a number of wrecks in both study areas to the effect that hydrographic surveying has not been fully effective due to the presence of fishing floats (UID 907868; 907870) or lobster pots (UID 907894).

There is an example in Area 1 that illustrates how archaeological interpretation might be impeded if information is only taken at face value: A wreck confirmed as the *Feltre* was also known locally as the *Cap Morel* or *Cattermole*: 'but these are thought corruptions of the name of a land feature used by fishermen to locate the wreck' (UID 907939).

[17] http://divernet.com/home_diving_news/155554/salcombe_site_damaged.html

Options for Management and Research

The options for management and research are principally concerned with reducing or removing ALDFG on heritage assets, such that less fishing gear is abandoned (noting that such abandonment on areas designated under the PWA 1973 is, in any case, likely to be a criminal offence) and gear already present is removed. There may be scope to collaborate with other initiatives directed at ALDFG for nature conservation purposes, for example. It should be noted that removing fishing gear is potentially hazardous and proper arrangements need to be in place for its disposal.

Table 13: Options for management and research - Commercial fishing impedes access and interpretation of heritage assets

Interaction	Scope	Objective	Management Options	Research Needs
Commercial fishing impedes access and interpretation of heritage assets **(Adverse for historic environment)**	Known heritage assets	Reduce new incidence of gear on heritage assets	Support and seek integration with initiatives that discourage dumping of gear at sea Increase awareness of offences in respect of dumping gear on designated heritage assets	
		Remove existing gear from heritage assets	Carry out work to remove fishing gear from (designated) heritage assets	Collate information on presence of fishing gear on (designated) heritage assets and its implications for access and interpretation Assess implications for heritage asset survival and condition of removing fishing gear from (designated) heritage assets.

6.4. Heritage Assets Improve Commercial Fishing Opportunities

Scope of Interaction

Positive interactions can arise from the potential for improved fishing around heritage sites. Wreck sites, for example, provide an artificial reef structure suitable for colonisation by a variety of species, and the benthic fauna of wreck sites has been shown to differ from surrounding areas (Løkkeborg, 2005; Wessex Archaeology 2008b). Well established vessel-reefs, such as World War II wrecks provide artificial habitat with fish assemblages, abundances, species diversity, and prey-predator relationships which are similar to natural reef communities (Fowler and Booth, 2012). In addition, these structures may function in a similar way to MPAs, acting as a spawning refuge and an area of

conservation for different marine species life stages, which may then lead to enhanced replenishment of populations in surrounding areas.

Evidence

The viability of commercial gill net fishing above wrecks for Pollack (*Pollachius pollachius*) within the English Channel was reported to be a feasible option as well as an alternative to fishing in areas where minimising bycatch is an issue.[18] In addition, a wide diversity of species (see Table 14) with commercial fishing value was identified as being supported by these wrecks.

Table 14: Example composition of commercial fisheries supported by wrecks (Source: Randal *et al*., 2012)

Common Name	Scientific name
Angler monkfish	*Lophius piscatorius*
Black seabream	*Spondyliosoma cantharus*
Cod	*Gadus morhua*
Common dragonet	*Callionymus lyra*
Common ling	*Molva molva*
Cuckoo wrasse	*Labrus mixtus*
Dab	*Limanda limanda*
Dover sole	*Solea solea*
Edible crab	*Cancer pagurus*
European conger eel	*Conger wilsoni*
European lobster	*Homarus gammarus*
European plaice	*Pleuronectes platessa*
European seabass	*Dicentrarchus labrax*
Lesser spotted dogfish	*Scyliorhinus canicula*
Nurse hound	*Scyliorhinus cervigoni*
Pollack	*Pollachius pollachius*
Poor cod	*Trisopterus minutus*
Pout	*Trisopterus luscus*
Red gurnard	*Chelidonichthys cuculus*
Red mullet	*Mullus barbatus barbatus*
Scallop	*Pecten maximus*
Spiny spider crab	*Maja squinado*
Spurdog	*Squalus acanthias*
Starry smooth hound	*Mustelus asterias*
Streaked gurnard	*Trigloporus lastoviza*
Tope	*Galeorhinus galeus*
Turbot	*Scophthalmus maximus*
Velvet swimming crab	*Necora puber*
Whiting	*Merlangius merlangus*

[18] See http://www.cefas.defra.gov.uk/media/573272/mf046gillnetpollacksurveyfinalreportpjr.pdf

There has been some debate over whether increased numbers of fish on wreck sites are a result of aggregation or increased productivity - see attraction / production hypotheses (Brickhill *et al.*, 2005). Whatever the cause, we see a number of fishers keen to fish on or close to wreck sites in search of improved catches.

Options for Management and Research

The principal research need is to better establish whether commercial fishing opportunities are enhanced by the presence of heritage assets and, if so, to understand why this is so. If commercial fishing opportunities are enhanced around assets, then the key management option is to develop and test methods through which these enhanced commercial fisheries can be exploited without damaging the assets (which are the source of the benefit) or the wider environment.

Table 15: Options for management and research - Heritage assets improve commercial fishing opportunities

Interaction	Scope	Objective	Management Options	Research Needs
Heritage assets improve commercial fishing opportunities (Mutually Beneficial)	Known heritage assets	Facilitate sustainable fishing practices on undesignated heritage assets	Develop and test sustainable fishing methods on undesignated sites	Develop better evidence on the degree to which commercial species are enhanced by the presence of heritage assets

6.5. Commercial Fishing Contributes to Archaeological Investigation

Scope of Interaction

Aside from the major contribution from commercial fishing through the reporting of chance discoveries, which is discussed below, there are instances where fishing has contributed to the archaeological investigative process.

Evidence

A prime example of the contribution of fishing to investigation is where commercial fishing has been employed to acquire archaeological data. This occurred in the case of one of the best known fishing-related discoveries: Roman Samian pottery from Pudding Pan, off Whitstable in the Thames. In the 1770s, antiquarians interested in the source of Samian pottery from the area went with oyster fishermen to dredge expressly for further examples (Jacob, 1782). Controlled trawling also formed part of the suite of techniques employed in the course of the Roman Shipwreck Project around Pudding Pan by the Centre for Maritime Archaeology, University of Southampton.[19]

Further afield, Dutch palaeontologists have taken part in investigations using commercial fishing methods to acquire faunal material from the southern North Sea (Mol *et al*., 2008). A scientific beam trawl – much smaller than commercial gear – has also been used archaeologically in the course of

[19] See http://www.britishmuseum.org/research/projects/the_roman_shipwreck_project.aspx

investigation of the Middle Palaeolithic Assemblage from Area 240, off Great Yarmouth (Tizzard *et al.*, 2011).

Another case where commercial fishing has a role as a source of information to archaeologists is where information about sites is maintained over time in fishing communities and families as 'oral tradition'. One example is a wreck off Flamborough – on the boundary of Area 1 – which in 1969 was 'said by local fisherman to be DUNSTAFFANITCH'; the *Dunstaffnage* sank in 1908 (UID 907952). Similarly, the *Broderick* (UID 911960) is identified on the basis of information from fishermen in the 1950's, though the wreck sank in 1918. As illustrated by the earlier example of fishermen 'mis-naming' a wreck site, information arising from oral traditions must be subject to source criticism, but the potential value of this contribution to archaeological interpretation should also be recognised.

Options for Management and Research

The capacity for commercial fishing to contribute to archaeological investigation and interpretation is a potential source of new knowledge, but also an opportunity to engage with fishing communities so that they can share a clearer understanding of archaeological objectives and methods. Whether it is directly through applying or adapting fishing techniques for archaeological purposes or more generally through employing fishing vessels and skippers, increased communication might be expected to create tangible results.

Table 16: Options for management and research - Commercial fishing contributes to archaeological investigation

Interaction	Scope	Objective	Management Options	Research Needs
Commercial fishing contributes to archaeological investigation (Mutually beneficial)	Known heritage assets	Make best use of latent fishing industry knowledge of historic environment	Engage with fishermen about their knowledge of sites, findspots etc. through for example, 'social landscape' initiatives; FisherMap, Geography of Inshore Fishing and Sustainability(GIFS) project etc.	Incorporate findings from fishing within NRHE
		Increase fishing industry awareness of archaeological objectives and methods	Undertake practical trials that increase collaboration between archaeologists and fishermen in conducting archaeological investigations	

6.6. Archaeological Investigation Generates Information Useful to Commercial Fishing

Scope of Interaction

Archaeologists generate information about the seabed, seabed features and marine life that may be of interest or value to commercial fishermen. For example, whereas wrecks tend to be recorded as point positional data, sidescan and multibeam data provide information on form, orientation and overall topography that could be useful to fishermen seeking to avoid wrecks, or in setting and

recovering pots. Archaeologists' photographs and video may also indicate the range and composition of fish populations around wrecks.

Evidence

This is a potential interaction that is not evidenced by any particular case and the extent to which fishers would benefit from such data is unknown. However, the increased availability of high-resolution imagery from archaeological investigations over the last 10-15 years - including geophysical data such as multibeam and sidescan, and digital video and stills photography - means that archaeologists have a great deal more to offer than previously. This includes imagery created in the course of archaeological fieldwork, and imagery derived by archaeologists in the course of interpreting other datasets for archaeological purposes. Altogether, this represents a very major change in the capacity of archaeologists to inform other sea-users.

Options for Management and Research

Although this potential interaction is not supported by direct evidence, the scope for archaeologists to provide information in order to facilitate commercial fishing practices that are sensitive with respect to heritage assets is worth exploring further.

Table 17: Options for management and research - Archaeological investigation generates information useful to commercial fishing

Interaction	Scope	Objective	Management Options	Research Needs
Archaeological investigation generates information useful to commercial fishing (Mutually beneficial)	Known heritage assets	Increase fishing industry awareness of value of archaeological investigations to understanding marine environment	Test the provision of detailed archaeologically-derived data to fishermen	

7. DIRECT INTERACTIONS BETWEEN COMMERCIAL FISHING AND THE HISTORIC ENVIRONMENT

7.1. INTRODUCTION

This section considers three direct interactions where physical encounters can occur between fishing gear and heritage assets:

- Heritage assets are hazardous to gear and vessels
- Commercial fishing damages heritage assets
- Commercial fishing results in archaeological discoveries

There is a particularly close relationship between these three interactions as any one encounter can invoke all three. In view of the close relationship between all three interactions, the proposed options for management and research are considered collectively in Section 7.5.

7.2. HERITAGE ASSETS ARE HAZARDOUS TO GEAR AND VESSELS

Scope of Interaction

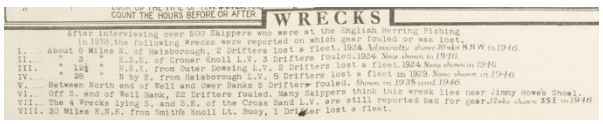
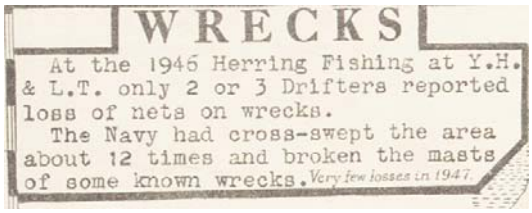
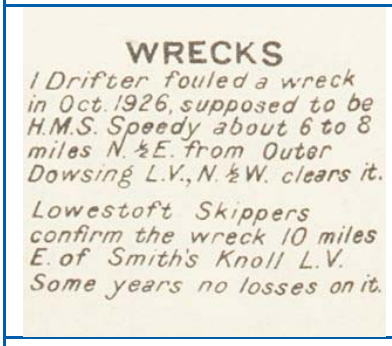
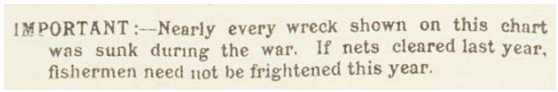
Fishermen contend that, in using mobile gear, their concern is always to avoid impacting wreck sites and other such features because of the risk to gear and vessels. This contention is supported by the long-standing tradition of fishermen marking snags (fishermen's fastenings) on their charts. It is in the fisherman's interest, operationally and commercially, to chart snags accurately so that they can avoid them with as little margin as possible. Not wishing to snag their gear does not mean that fishermen will give known wrecks a wide berth: fish congregate around wrecks so fishermen may seek to get as close as possible; but the consequences of actually snagging are considerable.

As the accurate positioning of snags is operationally and commercially valuable, snag information is compiled by the fishermen themselves and may be regarded as highly confidential. The potential archaeological value of this privately-held information could be considerable. Some steps have been taken to encourage fishermen to make this information available to archaeologists through, for example, the Sussex FIPAD pilot. This effort is worth pursuing.

As well as snag information held privately, large quantities of snag information are now in the public domain. Snags have been charted historically on published fishermen's charts – notably those published by Albert Close in the early-mid C20th and by Kingfisher since the 1960s – and on Admiralty Charts. Kingfisher charts were one of the core sources used to populate the NRHE when it was first extended to the Territorial Sea in the early 1990s: snags are included in the NRHE as Monument Type 'Fishermen's Fastener'.

Evidence

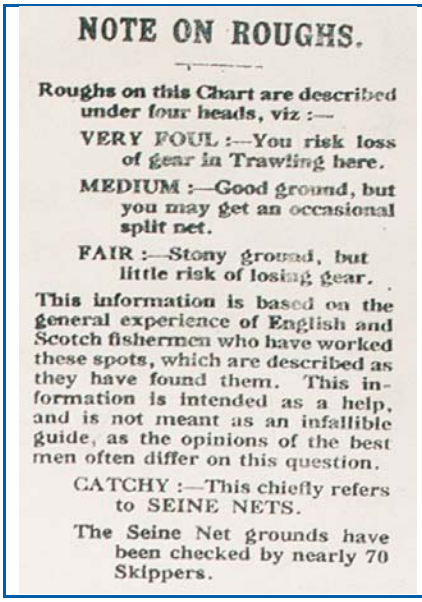
The hazard to fishing vessels and gear from snags and wrecks is attested by several forms of evidence. The charts published by Close include annotations that make it plain that snags and their avoidance was a major concern. *Close's Chart from the Humber to Dover, Calais and Ostend* (corrected to Sep. 1948) includes the following annotations:

	After interviewing over 500 Skippers who were at the English Herring Fishing in 1938, the following Wrecks were reported on which gear fouled or was lost: [list I to VIII]
	At the 1946 Herring Fishing at Y.H. and L.T. only 2 or 3 Drifters reported loss of nets on wrecks. The Navy had cross-swept the area about 12 times and broken the masts of some known wrecks. Very few losses in 1947. N.B. Y.H = Yarmouth, and L.T = Lowestoft
	1 Drifter fouled a wreck in Oct. 1926, supposed to be H.M.S. Speedy about 6 to 8 miles N. ½ E. from Outer Dowsing L.V., N. ½ W. clears it.
	IMPORTANT:-- Nearly every wreck shown on this chart was sunk during the war. If nets cleared last year, fishermen need not be frightened this year.

These annotations demonstrate the concern for snagging and indicate that snagging was to be feared. Examples of snagging are presented, but the overall volume does not appear to be great. It is also clear that the presence of wrecks does not preclude fishing, it just adds a hazard. It is also noteworthy that these annotations all refer to drifters rather than trawling. This may reflect the importance of drifting in the area charted, but perhaps avoidance by trawlers was a matter of course. It is also worth noting that the Navy was directly engaged in activities that were intended to damage wrecks by breaking their masts.

If Close's Chart from the Humber to Dover seems concerned principally with drifters, the annotations for the English Channel (corrected to 1921) are mostly directed at trawling. It notes that '400 wrecks and 30 U Boats sunk during the War are shown on the General Chart', but 'No wrecks shown inside the 3 Mile Limit'. The chart also includes annotations to the effect that in many areas, steam trawling within local Fishery Board limits – shown in red – is prohibited.

Close's Chart of the English Channel also raises the point about seabed ('ground') regarded as 'foul' or 'rough', as marked on charts and incorporated within fishermen's place names (for example North West Rough). Such annotations are common on charts, including Close's. Although they signify a hazard or at least operational inconvenience to fishing using mobile gear, it does not follow that they are not fished. For example, off North Cornwall Close's annotation reads 'For about 15 Miles offshore is foul but Trawlers work it and lose considerable Gear'. Close's Chart of the North Sea (corrected to 1938) includes the following categorisation that shows that roughs are a hazard to be judged rather than a no go area:



NOTE ON ROUGHS.

Roughs on this Chart are described under four heads, viz :—

VERY FOUL :—You risk loss of gear in Trawling here.

MEDIUM :—Good ground, but you may get an occasional split net.

FAIR :—Stony ground, but little risk of losing gear.

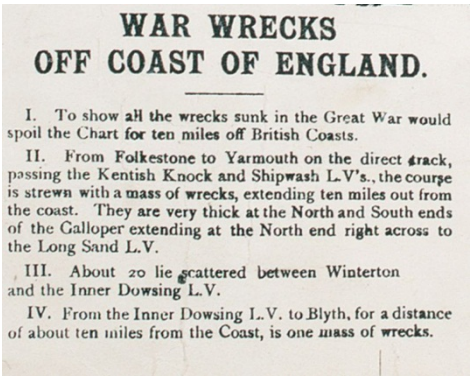
This information is based on the general experience of English and Scotch fishermen who have worked these spots, which are described as they have found them. This information is intended as a help, and is not meant as an infallible guide, as the opinions of the best men often differ on this question.

CATCHY :—This chiefly refers to SEINE NETS.

The Seine Net grounds have been checked by nearly 70 Skippers.

Very Foul: -- You risk loss of gear in Trawling here.
MEDIUM: -- Good ground, but you may get an occasional split net.
FAIR: -- Stony ground, but little risk of losing gear.

The archaeological implications of areas marked foul or rough are not clear, as their source is likely to be attributable in most cases to the natural form of the seabed (for example rocky outcrops and boulders) rather than features that may be of archaeological interest; yet heritage assets may be present in areas marked foul or rough and in some cases the presence of wreck debris over a wide area may be the source of the foul. The capacity of wreck material to 'spoil' extensive areas of seabed for commercial fishing is also indicated in Close's North Sea chart, which includes the following annotations:



WAR WRECKS
OFF COAST OF ENGLAND.

I. To show all the wrecks sunk in the Great War would spoil the Chart for ten miles off British Coasts.

II. From Folkestone to Yarmouth on the direct track, passing the Kentish Knock and Shipwash L.V's., the course is strewn with a mass of wrecks, extending ten miles out from the coast. They are very thick at the North and South ends of the Galloper extending at the North end right across to the Long Sand L.V.

III. About 20 lie scattered between Winterton and the Inner Dowsing L.V.

IV. From the Inner Dowsing L.V. to Blyth, for a distance of about ten miles from the Coast, is one mass of wrecks.

I. To show all the wrecks sunk in the Great War would spoil the chart for ten miles off British Coasts.
II. From Folkestone to Yarmouth on the direct track … the course is strewn with one mass of wrecks, extending ten miles out from the coast …
III. About 20 lie scattered between Winterton and the Inner Dowsing L.V.
IV. From the Inner Dowsing L.V. to Blyth, for a distance of about 10 miles from the coast, is one mass of wrecks.

Although Close is concerned principally with losses to gear, it should be recognised that snags may also present a hazard to vessels and their crew. The NRHE records for the study areas include the wreck of the *Hannah Louise*, sunk off Flamborough in 1978; the trawler's nets became fast and they foundered with the loss of two crew members whilst attempting to haul-in (UID 1525312). In another example, the Brixham beam trawler *Scaldis* snagged on the wreck of a German bomber (UID 1521327) in 1974 and sank with the loss of the entire crew.

Heritage assets are a hazard to commercial fishing vessels and mobile gear, and evidence suggests that fishermen will seek to avoid impacts. This is not a case of absolute avoidance, however, but of seeking to strike a balance between the risks of damaging or losing gear and the benefits of fishing in

the immediate vicinity. Consequently, there are occasions when the attempt to avoid known snags will fail and impacts to heritage assets may result.

The balance between risks and benefits of fishing close to known snags is sought on the basis of information, as indicated by the quantity of information about snags held privately and in the public domain. In order to facilitate avoidance of significant heritage assets, it might be in the interests of archaeologists to adopt the approach already taken by fishermen. That is to say, archaeologists could facilitate avoidance by providing better information about site position, extent, orientation, form and character. This possibility would have to be based on a degree of appreciation by fishermen of archaeological concerns, not as a means of reducing margins: Ferrari (1994) cites the case of HMS Pathfinder that fishermen believed to be intact and gave a wide berth; but better positioning made it apparent that the wreck was in three sections so they trawled between them.

Plainly, fishermen cannot avoid sites of which they are not aware so this part of the discussion does not offer a solution to the issue of inadvertent impacts to as yet unknown heritage assets. There is also a question of sites being known to some parties but not others, given that there may be a commercial imperative not to pass-on details of snags to competitors. In this regard, specific attention may need to be paid to encourage fishermen to come forward promptly with information about heritage assets that are not widely known, and to be prepared for this information to be circulated to facilitate avoidance by all.

A further question concerns the balance of judgement that fishermen apply. Damage to a heritage asset from fishing may occur at a lower threshold than any damage to gear arising from the heritage asset towards the gear. In short, fishermen may avoid the main part of a wreck but fish across its margins where the gear is less exposed to risk but damage to the asset is still as likely. Awareness-raising may be necessary to raise the risk to the heritage asset perceived by fishermen alongside the risk to gear, to counter the perceived commercial benefits of getting in close.

Extending this point about fishing on the margins of heritage assets, there may be instances where a heritage asset is known and susceptible to damage from fishing, but its character on the seabed poses no risk of damage to gear. For example, a shipwreck that has negligible relief at the seabed would be unlikely to cause a snag; elements that are buried might, however, be susceptible to general attrition and changes to the preservation environment if its upper layers are repeatedly remobilised by the passage of fishing gear. Despite the risk of archaeological damage, there would be little incentive for the fishermen to avoid such heritage sites. It is difficult to establish whether known wrecks with no relief are being subject knowingly to commercial fishing, and whether indifference may have increased with the strength and power of mobile gear and fishing vessels.

7.3. Commercial Fishing Damages Heritage Assets

Scope of Interaction

As noted previously, the capacity of commercial fishing to damage heritage assets is not contested. Direct evidence of the negative impacts of fishing upon heritage assets is, nonetheless, limited, and most cases are not attributable to a particular incident and are typically anecdotal. Impacts of fishing gear upon the marine habitat have been more widely studied and evidence is thus presented where appropriate.

Sites, scatters, findspots and their settings can all be considered in terms of their sensitivity to damage. Damage to heritage assets may follow several different pathways. In his analysis of impacts from fishing, Ferrari (1994) makes use of Wildesen's categories - burial, removal, transferral and alteration. These can be illustrated as follows:

- Burial - Archaeological material becomes buried by sediment, prompted by the presence of snagged gear or changes to seabed composition attributable to fishing.
- Removal - Archaeological material is transported by fishing gear to the surface and is not returned to the seabed; structures and deposits are truncated.
- Transferral - Archaeological material is moved from its previous context either by being pushed or dragged by gear, by becoming trapped within gear until falling back to the seabed, or by being 'thrown-back' from the vessel.
- Alteration - The form of structures, objects, deposits and relationships is changed by being broken, disarticulated, abraded, etc.

Ferrari (1994) also makes use of the ICES categories - scraping, penetration and pressure, with the addition of 'pulling strain', which focus attention on the mechanics of fishing gear operating on the seafloor: gear exerts forces downwards, either penetrating the deposits of the seafloor or pressing down upon them; gear exerts forces laterally, usually in the direction of travel; and gear can exert forces upwards, especially when it is being recovered.

Impacts are discussed below in the context of mobile and static, and pelagic and demersal gear types. Whilst likely pathways can be identified it must be noted that fishing does not stand-alone and other factors, such as hydrodynamics and seasonal changes, will influence the resulting impact from fishing-heritage interactions. The significance of an impact by identical gear types may, therefore, vary between sites.

Evidence

Mobile Gears

Pelagic gears, such as the purse seine, have little to no direct contact with the seabed, however; they may come into direct contact with upstanding heritage assets such as wrecks during towing or if left to drift. When deployed, pelagic gears are suspended within the water column and are often supported by trawl-monitoring sensors which alert fishers in order to take evasive actions from changes in depth or seabed obstructions. Lost fishing gear might be interpreted as interacting indirectly with seabed features causing snagging, cloaking, load-bearing, dislodging, or accumulating and protecting (Good *et al*., 2007; UNEP, 2005).

Mobile demersal gears have been said to cause the greatest disturbance to the seabed in comparison to other fishing gear types (Kaiser *et al.*, 2006). The purpose of bottom trawls and dredgers is to disturb and remove benthic and epibenthic species and they were therefore originally designed to maximise contact with the seabed, thus heavy bottom trawls and dredges pose the most significant risk to the historic environment *if* an interaction occurs. However, as stated previously, fishermen aim to avoid heritage assets when using mobile gears in order to avoid damage to gears, and therefore it is largely unknown assets which may be subject to impacts from such gear.

Impacts will vary in extent between gear types due to differences in size, weight and method of use. For example, impacts from an otter trawl with doors weighing 2,300 kg and a shrimp trawl with doors weighing 125 kg will differ greatly in severity (Løkkeborg, 2005), the nature of the physical impact to seabed features will be similar between similar gear types. Effects of towed demersal gear might include flattening (Thrush *et al*., 1995; Kaiser *et al*., 1996), dislodging (Currie and Parry, 1996; Hall-Spencer *et al*., 1999), snagging and protecting (Revill and Dunlin, 2003), and smothering (Brown *et al*., 2005; Eno *et al.,* 2001).

The towing of beam trawls and dredgers typically results in a flattening of the bottom topography, scallop dredgers, for example, are equipped with a chain-meshed net for use over rough ground, which results in significant changes to the seabed (Sewell and Hiscock, 2005). In studies of the Lyme Bay, UK scallop fishery, habitat structure was seen to change from a boulder and cobble-dominated reef to a sand and gravel habitat with occasional boulders following repeated experimental tows with a scallop dredger (Devon Wildlife Trust, 2007). Similar effects upon benthic habitat structure have been seen in previous studies. For example, large areas of biogenic reefs have been destroyed by heavy dredgers in the Irish Sea (Veale *et al.*, 2000). This change in habitat structure indicates that there would be a flattening and clearing of heritage sites, and displacement of heritage asset components away from the site, if direct interactions with this type of gear were to occur.

Towing of some demersal gears also results in sediment penetration, with depths varying between gear and also sediment types. Although penetration may arise from all the elements of gear in contact with the seabed, including the net itself and tickler chains, the greatest penetration tends to be limited to specific elements which are of limited extent, such as the otter boards of trawls which create furrows within the seabed (Løkkeborg, 2005) and the sole plates of beam trawls. Otter trawl doors typically penetrate the top 5 cm of sediment but have been known to create furrows as deep as 20 cm in the seabed, other sections of netting leave a less prominent mark along the trawl path (Krost *et al*., 1990; Løkkeborg, 2005). Studies suggest that generally fishing gear does not penetrate the seabed deeply; even heavy mobile methods, such as otter trawling, dredging and scalloping appear to penetrate the seabed by only a few centimetres. This implies that the potential damage on buried or partially buried heritage assets from penetration and pressure – which could, in principle, result in alteration – may not be great. However, unlike the seabed, from which trawl scars can disappear within months (Løkkeborg, 2005); heritage assets will not recover from such damage.

Much more concern is warranted in respect of lateral damage, which can result in material being removed by nets, displaced (transferred) through both simple and complex pathways, and altered by breakage and abrasion. Where structural material is snagged it may be displaced or broken, which may also result in buried material erupting into the water column. The degree of damage is likely to vary between different gear types, being greatest where the gear is intended to disturb the sediment as is the case with shellfish dredges. But it does not follow that impacts from even 'aggressive' gear types will necessarily break even fragile artefacts, as numerous recoveries of intact artefacts have demonstrated.

It is also well-documented that the lateral action of mobile gears causes significant sediment plumes; although archaeological material is unlikely to be mobilised in the plume, this sediment may contribute to archaeological material being buried in the vicinity. A study into the impacts of mussel dredging showed that suspended particulate material increased significantly following towing, returning to normal levels after an hour (Rieman and Hoffmann, 1991). The removal and alteration

of seabed material by these lateral forces may contribute to overall changes in the character of the seabed that could have consequences for the survival and setting of archaeological material.

Heritage assets survive where deterioration is slowed because a relatively stable equilibrium is reached between the heritage asset and its surrounding environment. Thus, a change in the surrounding environment of an asset may result in destabilisation and increased rate of deterioration (Gregory, 2006). Fishing in the North Sea has been shown to increase ammonia and decrease oxygen levels, and also to enhance phosphate levels due to sediment disturbance (Johnson, 2002), hence it is possible that there may be indirect impacts from towed demersal gears resulting from the re-suspension of sediment and changes in sediment and water chemistry at a localised site level, for example.

Upward forces will occur when gear is being recovered either as part of the planned operation or in response to snagging. Attempts to recover snagged mobile gear by lifting could result in very large forces being applied: Ferrari (1994) quotes an account from the 1940s of snagged trawls being hauled tight so that the buoyancy of the vessel lifting on each wave will pull upwards – sometimes gently and with patience, sometimes brutally.

The damaging effects of fishing-heritage interactions upon marine archaeological resources have been compared to those of ploughing upon terrestrial archaeology (Kingsley, 2012); bearing in mind that ploughing has been demonstrated to be a major source of damage to heritage assets. There are parallels in the history of fishing and ploughing insofar as both have occurred for millennia without seeming to have caused major damage until the advent of steam in the C19th and the massive increase in the power of machinery in the later C20th (Oxford Archaeology, 2010). There are, however, some very significant differences. Agricultural practices on land take place in areas that are largely subject to the exclusive use and management of one person; where a monument is designated, this person is identifiable as having responsibilities towards it. Fishing is conducted in an area of common resource: each fisherman does not have control, individually, over the conduct of fishing activities; nor do they have responsibilities that can be enforced with respect to individual sites. Correspondingly, the application of effort and machinery to an area of seabed is quite different to its application to a cultivated field.

Nonetheless, the relationship between ploughing and the historic environment is instructive in relation to commercial fishing. Agricultural cultivation and the historic environment has been subject to considerable research and to the development of management measures, with the evidence base recently strengthened by the COSMIC (Conservation of Scheduled Monuments in Cultivation) projects (Oxford Archaeology, 2010). Studies have included sampling of large numbers of monuments for the principal causes of degradation, the development of national risk maps, development of risk-assessment methodologies, awareness campaigns, and field investigations and experimentation to look at the actual effects of cultivation, all of which could have parallels in developing approaches towards better understanding and management of interactions between commercial fishing and the historic environment. The COSMIC projects have shown that damage from ploughing is associated in particular with:

- cultivation of areas that have not previously been cultivated;
- encroachment where cultivation takes place very close to monuments that are protected;
- cumulative effects arising from erosion attributable to repeated ploughing;

- cultivation that is deeper than previously or occurs through other practices such as improving drainage.

In each of these cases – new areas, encroachment, cumulative effects, deeper or different practices – a parallel with the interactions between mobile demersal gear and heritage assets is apparent.

Like the use of mobile demersal gear, the direct impact of ploughing is relatively shallow. Nonetheless, experimentation has shown that repeat ploughing has an erosive effect over time, though at relatively low rates. Upstanding monuments (i.e. earthworks) are particularly prone to damage from cultivation and can be usefully assessed through the use of historic air photographs (and potentially LiDAR); especially as historic photographs can indicate the history of cultivation as well as the changing condition of monuments. The risk assessment methodology developed by COSMIC considers archaeological factors, site intrinsic variables (such as soil and slope) and management; a range of management options have been proposed, including cultivation ceasing, and changes being made to cultivation practices and gear. It is worth noting in particular that the COSMIC project provides for continued cultivation of heritage assets, even where they are designated (and therefore of national importance), where risks have been assessed as minimal (Oxford Archaeology, 2010). COSMIC thus provides a very valuable model for arriving at an evidence-based approach to facilitating commercial fishing in a way that reduces adverse impacts on heritage assets. COSMIC 3 – EH 6144, a £1.8M project – is currently underway.

Static and Passive Gears

The use of static gear, such as pots, is thought to be considerably less damaging to benthic habitats than towed demersal gears. However, the setting and retrieval of gear may cause damage to fragile structures (Sewell and Hiscock, 2005). Experimental observations of potting showed that environmental conditions such as high wind and strong currents caused the lead pot to bounce on the seabed following deployment, and the dragging of pots along the seabed during hauling (Eno *et al.*, 2001). Actions such as this are likely to cause flattening or snagging of heritage assets. When static gear is intentionally placed on wreck structures there is clearly an increased risk of such damage.

As for pots, interactions with set nets are largely expected to occur through snagging during retrieval of gear (Grieve *et al*., 2011). The impact of an anchored set net on the seabed, as caused by contact with the anchors and leadline, is thought to be minor, with an estimated sediment penetration depth of 2 mm by the anchors and 0.1 mm by the leadlines (Grieve *et al*., 2011).

As for pelagic gears, drift nets and lines have little to no contact with the seabed and are therefore expected to have a minimal chance of direct interaction with heritage assets.

Although static and passive fishing gears such as nets, lines and pots are thought to have limited ability to cause direct impact, they have a greater potential to cause indirect impacts upon heritage assets as abandoned, lost or otherwise discarded fishing gear (ALDFG) (Macfadyn *et al.*, 2009). ALDFG may interact with heritage assets by becoming entangled or snagged on an asset. During diver surveys of 11 wrecks off the coast of north-east England, the remains of 27 separate gillnets were found on seven of the 11 wrecks over a period of 117 diver days, indicating continued loss of nets by fishers. The net remains ranged in size from small scraps to whole nets (Revill and Dunlin, 2003). Interviews with fishers from three static fisheries around the UK revealed the extent of gear

loss occurrences. Wreck fishers experienced the worst loss with netting lost on every fishing trip, although typically only pieces of netting were lost having snagged on the wreck (a direct interaction). The tangle net fishers experienced the worst loss of whole nets, with 263 nets lost in one year by 18 vessels, of which two thirds were not recovered.[20]

A single interaction event with static / passive gears may have very little impact upon a heritage asset, however; fishing grounds are typically subjected to repeated fishing activity throughout the year, indicating the potential for cumulative impacts.

Tolerance of Heritage Assets

Having considered the ways in which damage may occur and the parallels between fishing and agricultural cultivation, it is appropriate to consider the tolerance of marine heritage assets, i.e. their ability to withstand impacts. It should be restated that heritage assets are non-renewable; they do not have the capacity to recover from damage and are not, therefore, resilient.

Many factors have implications for the tolerance of heritage assets to damaging impacts. In broad terms there is, however, a degree of correlation between the tolerance of assets with respect to fishing and the forms of asset outlined previously. Sites – which, by definition, have a degree of coherence spatially and structurally – are less likely to be tolerant of the direct impacts associated with commercial fishing because their coherence may be disrupted. In general terms, scatters and debris fields have less coherence and might, therefore, be regarded as more tolerant of impacts. However, an asset may take the form of a scatter as a consequence of previous impacts, representing a cumulative impact, and any degree of coherence that the asset still retains may be both highly important and highly intolerant of further disruption. Findspots are singular artefacts that do not have an apparent relationship to other artefacts and structures. Nevertheless, their spatial attributes (position) may still be important and could be impacted by displacement. Setting – the area within which a heritage asset is appreciated – is probably the most tolerant to commercial fishing impacts, though it is conceivable that, for example, divers' appreciation of a heritage asset such as a wreck might be impaired by the effects of fishing on the surrounding seafloor.

The tolerance of heritage assets with respect to commercial fishing gears will also vary according to the characteristics of the assets themselves. Material type is already known to be a factor in the degree to which many sites are prominent on the seabed. Specifically, metal wrecks are relatively robust and are therefore likely to be more tolerant (and present more of a deterrent) to commercial fishing than wooden wrecks. This point holds for wreck sites, debris and isolated findspots: physically robust structures and objects are likely to be reasonably tolerant of fishing impacts.

At a smaller scale, the material type of individual artefacts, whether they comprise isolated finds or form part of a site or scatter, will be a major factor in their tolerance to commercial fishing impacts. Metal, stone and to some extent ceramic and bone artefacts are likely to be more tolerant than wood and many other organics, which may be susceptible to immediate changes and to subsequent physical, biological and chemical degradation. Numerous examples demonstrate that a wide variety of artefacts have survived being caught within fishing gear and returned to the surface.

[20] EC contract FAIR-PL98-4338, 2003.

The matrix of deposits and relationships (spatial; stratigraphic; chronological) within which artefacts and structures are situated is likely to be highly intolerant to commercial fishing impacts. These deposits and relationships are extremely important to the survival and understanding of archaeological remains, as well as their having the potential to contain material of palaeo-environmental interest. Consequently, it is a mistake to think that only the elements of heritage assets that are upstanding on the seafloor are at risk from commercial fishing, even if the depth of penetration is slight. Where material is buried, impacts to embedded structural material may be highly damaging to surrounding deposits, even if buried artefacts and structures are untouched by the initial impact.

In general, damage to heritage assets is not intentional; the preceding section indicates that fishing using mobile gear seeks to avoid known seabed features. Nonetheless, damage may occur from encroachment if fishing is directed at the margins of known sites where the risk to gear is less but archaeological material is still present.

Damage may also occur with respect to known sites where fishermen are indifferent to the presence of a heritage asset because it presents no risk to gear, or the vessel and gear is strong/powerful relative to the asset. By way of example, Ferrari (1994) cites a Rye Bay fisherman explaining that 'on a site known as the Hop Pole Barge [UID 904120], traces from echo sounders used indicate an obstruction standing 2m above the seabed. Now fishermen trawl over the spot with no damage to their gear'. He concludes 'it is assumed that the site has been flattened and dispersed as a result of intensive beam trawling'. An extension of this apparent indifference would be the deliberate targeting of wrecks to disperse them to make trawling easier: this type of motivation has been indicated with respect to the destruction of cold water coral reefs in Norwegian waters (Fossa *et al*., 2002); but no instances of similar action with respect to wrecks has come to light in the course of this project.

Beyond these circumstances, the key concern is for impacts on as yet unknown sites, for which there is no information that can enable avoidance. Again, it is not contested that as-yet unknown heritage assets are impacted by commercial fishing. Discoveries of 'new' sites by fishermen – in which a degree of damage is inherent – demonstrate that exactly this situation occurs from time to time, even in areas that have been fished extensively for years. Fishing activity may have incremental effects on seabed topographies that eventually result in heritage assets being exposed to impact; but it is perhaps more likely that natural changes caused by tidal currents or storm events are primarily responsible for the exposure of heritage assets which then become vulnerable to fishing impacts.

Firm evidence of damage to known heritage assets from commercial fishing in England is less common than might be supposed. To clarify, there are numerous cases where fishing gear is found on wrecks and other assets, and there are cases where fishing vessels have become snagged on heritage assets. However, the presence of fishing gear does not necessarily indicate that damage to the asset has occurred: the asset may have served only to trap gear that had already been lost, discarded or deposited on a known snag; and fishing activity may not be intrinsically damaging. Even a snag need not result in substantial damage if the crew seek to release themselves by skill rather than force. The relatively numerous references to fishing gear on archaeological sites – including designated wreck sites – do not establish that damage has actually occurred. For example, Ferrari (1994) cites examples of fishing activity on the Yarmouth Roads Wreck (pots); Hazardous (pots;

tangle nets), Landgon Bay (trawling) and Studland Bay Wreck (oyster dredgers). Noting that diving teams investigating the sites took actions to prevent pots being dragged into wreck material to reduce potential damage, Ferrari does not say that any actual damage occurred, with the exception of the Studland Bay wreck; but even in this case no details of the actual damage are provided.

Putting aside, therefore, references to the presence of gear and snags occurring, details of damage to heritage assets that is directly attributable to commercial fishing are relatively rare. Looking at data provided by the NRHE for this project, there are only two cases where damage from fishing appears to be recorded. A tailwheel from a Hurricane aircraft (UID 1498953), recovered as a result of aggregate dredging in the case study Area 2, is presumed to have been moved from an adjacent site by scallop dredging in the area – though this conclusion is only circumstantial. On the Thomas Lawrence (UID 911513), diving archaeologists observed that the topmost staves of a number of barrels – which are a principal feature of the site – were missing 'as if they had been exposed and come away, or had been torn off, for example through fishing activity'. Patterning in damage to artefacts that is indicative of damage attributable to fishing is also reported in respect of Samian pottery from Pudding Pan Rock, where repeated instances of broken bases, for example, has been used to infer damage to an in situ cargo from oyster dredging (Ferrari, 1994).

Damage attributable to fishing is reported on sites investigated by OME in the Western Approaches, though in some cases this evidence is disputed.[21] Kingsley (2012) also refers to post-discovery damage occurring on the Stirling Castle where the disappearance of very large structural timbers is attributed to gillnetters acting inadvertently, though this is not demonstrated. Even in the case of the Hop Pole Barge referred to by Ferrari (discussed above) the reported damage is hearsay, not direct evidence. Except where fishermen come forward to report (usually 'new') archaeological material in their gear, distinguishing causation from correlation in the relation between fishing activity and damage to heritage assets remains very difficult, even amongst examples reported internationally (for example, Kingsley, 2012). That is to say, there are numerous examples of fishing taking place or fishing gear being present, but firm evidence of fishing causing impacts usually requires direct observation by divers or ROVs, or geophysical survey. Direct observation of causality rather than simply correlation is still rare.

In contemplating damage attributable to commercial fishing in English waters it is important to consider when this damage may have occurred, and whether it represents frequently repeated impacts or rare occurrences. Determination of major damage has to take account of the other human processes that have affected heritage assets in the last century or so, especially clearance for navigational purposes and commercial salvage of cargoes and non-ferrous metals. Natural processes will also have played a part in the collapse of structural material and degradation of timber, in particular.[22]

[21] See Kingsley, 2009; 2012; MacMullen, 2011; Parham, 2009.

[22] It is worth noting that in the course of a consultation exercise for this report, two respondents from archaeological organisations indicated that there was more evidence of damage (or potential damage) available, but that it would require resources in order to access it from project archives. Examples of damage cited included shellfish dredging on deposits of prehistoric interest (included cases of dredges being abandoned after having struck the deposits) and lines from lobster pots

Establishing what damage has occurred that is attributable to commercial fishing is likely to require direct observation and relatively detailed investigation by archaeologists. Not many sites in English waters have been subject to such a degree of investigation, which may account for the paucity of evidence.

7.4. Commercial Fishing Results in Archaeological Discoveries

Scope of Interaction

As outlined below, there are numerous examples of archaeological discoveries made by the commercial fishing industry. Such discoveries are a highly beneficial interaction as new archaeological information is introduced to the discipline and, in consequence, measures can be taken to conserve such sites for the future. The recent introduction of the FIPAD is intended to build upon this positive interaction, and has helped open-up possibilities of even greater co-operation. However, in some cases of archaeological finds, the actual location of the heritage site may remain unknown due to the distance travelled before nets / lines are hauled and the site and find "remain divorced" (Kingsley, 2012). Although discovery of a heritage asset is a positive interaction, the archaeological material that was in situ – and likely to be stable – is removed from its original context, rendered unstable (especially if it is organic or ferrous), and is probably accompanied by impacts to associated material that is still on the seabed.

Evidence

Evidence for the occurrence of this interaction comes mainly from reported finds of artefacts by fishers. Commercial fishing gives rise to discoveries of sites, scatters and findspots. In some case they may be entirely new (i.e. previously unknown); in other cases the discovery can help clarify the extent, period or character of a site that was already known. It is important to recognise that a heritage asset that is encountered initially as a findspot or as a scatter may prove to be a site.

Discovery of Sites

Several very significant heritage assets have first come to the attention of archaeologists as a result of net snags, including 10 wrecks that have subsequently been designated under the Protection of Wrecks Act 1973[23]; these are listed below in Table 18.

Table 18: Wrecks designated under the PWA 1973 that were discovered as a result of fishing

Designated Wreck	Lost	Location	Discovered	Means of Discovery
Admiral Gardner	sank 1809	Goodwins	1983	Site located by divers investigating a fisherman's snag

cutting into prehistoric deposits as they are pulled back to the fishing boat. Damaging incidents on three designated heritage assets were also referred to, but as in other instances the actual character of the damage was not set out.

[23] See summary details from http://www.english-heritage.org.uk/discover/maritime/map/

Designated Wreck	Lost	Location	Discovered	Means of Discovery
Dunwich Bank	C16th	Southwold	1993	A Southwold fisherman brought up ship timbers and concreted shot in his trawl
Filey Bay	Post-medieval	Filey	1975	Reportedly found by a diver after removing fishing nets from some large planking
HMS/M *A1*	1901	Solent	1989	A local fisherman snagged the wreck by chance
Invincible	Sank 1758	Solent	1979	Discovered by a local fisherman when his fishing nets became caught on an obstruction
Norman's Bay	C17th-18th	East Sussex	2005	Local divers trying to free a lobster pot
Northumberland	Sank 1703	Goodwin Sands	1980	Discovered as part of the systematic investigation of fishing net fastenings
Restoration	Sank 1703	Goodwin Sands	1980	Discovered as part of the systematic investigation of fishing net fastenings
Stirling Castle	Sank 1703	Goodwin Sands	1979	First located when local divers from Thanet were investigating a fisherman's net fastening.
Studland Bay	C16th	Poole	1983	Discovered by divers investigating a fisherman's net fastening

A further example is *The Flower of Ugie*, which sank in 1852 and was discovered in 2003 when a fisherman snagged his nets (Whiteright and Satchel, 2011). As noted above, the Princes Channel Wreck and Yarmouth Roads wreck both appear to have been snagged at some point in their histories, resulting in historical fishing gear becoming incorporated within each site.

Unfortunately, records rarely provide sufficient information to be able to determine the type of gear used, or even to distinguish between pelagic and demersal gear. Some snags at least, such as Dunwich Bank, appear to be from trawling. Detailed accounts of discoveries are rare, and therefore the account of the discovery of the Invincible is especially valuable, showing that the fishers were trawling for sole from the 27ft fishing boat *Vanessa of Portsmouth* (see http://www.invincible1758.co.uk/):

They had laid out trammel nets and left them for two hours while they went trawling for sole. When they came back and began to raise the nets there was plenty of weight in them, but it turned out to be seaweed and so they went back to trawling. The net was put over the stern, along with the otter boards which held it open as it was pulled along, and the warps, ropes and chain which were used for the towing. The boat proceeded eastwards along the Horse Tail bank, outside Langstone Harbour. After about 15 minutes it was brought to an abrupt stop by a tremendous jerk, which nearly knocked the fishermen off their feet. The net had caught on an underwater obstruction.

The fishermen tried to get the net free. The boat was taken back so that she was almost above the obstruction, and, with some slack in the net, they hauled in one of the warps and tried to lift one of the otter boards free. Having failed at that they decided to try to pull the obstruction away using the power of the boats engines. The warps were tied around the boat's samson posts, and the engine was put in forward gear, the throttle was opened full. The boat surged forward and the net came away suddenly, rather like a tooth being pulled, and was hauled in. Its head rope was torn off, the ground chain was broken and the net itself had been pulled to pieces. Entangled in the mesh of the net was the cause of all the trouble - a piece of wood, which had obviously broken off from something very solid under the water.

Norman's Bay is an important case of discovery arising as a result of potting, emphasising the point that it is not only mobile gear that results in interaction.

It is also difficult to determine the degree to which snagging has caused damage. Dunwich Bank provides an example where archaeological material was removed from the seabed by fishing, drawing attention to the site but also amounting to damage[24], as does the reference to a timber being recovered on discovery of the Invincible. In the other instances (except the Thomas Lawrence, discussed previously) there is no particular reference to snagging having resulted in damage; damage might be inferred, but it is not evidenced.

In the case study areas, the following heritage assets recorded in the NRHE have been found as a result of fishing, including both aircraft and ship wrecks:

Table 19: NRHE records of heritage assets found as a result of fishing within the case study areas 1 and 2

Description	Place	Ref No. (UID)
Area 1		
Possible remains of vessel **'found with fishermens sonar'**	Holderness	908406
Area 2		
Easy Dog, Lancaster, 1943: 'divers found the wreck when clearing nets for a fisherman from a fastening which was said to be an old boiler	Pevensey Bay	974949
Monument recorded as Fishermens Fastener, reported by Rye fisherman as 'possibly an aircraft'	Rother	904129
Thomas Lawrence, 1862: 'A wreck site was known to fishermen in the local area for some time, a request to free nets caught on the vessel that brought it to the attention of divers in 1983' [sic]	Off Hastings	911513

[24] Kingsley (2012) states that ship's timbers and shot were brought up in a trawl net on at least three occasions between 1974 and 1993, citing Wessex Archaeology Designated Site Assessment (2006); the WA report is equivocal as to whether the timbers etc. were from this particular site.

The examples cited here are only likely to form a proportion of the number of sites found by fishing; extending the query beyond the two Study Areas to all cases where Monument Type is 'Wreck' across the entire NRHE and searching for fishing related keywords is likely to result in a much larger population from which firmer inferences might be drawn.

As noted previously, the Norman's Bay wreck site in Area 2 was discovered by divers whilst searching for a trapped lobster pot (Wessex Archaeology, 2007). A further important example from Area 2 is the case of the medieval rudder from Rye Bay. This case is instructive as the rudder was initially regarded as evidence of the presence of a site that would be highly significant. The rudder was recovered by Mr. Ruck in the Alethea Anne whilst trawling on 23 November 1983. It is over 6.7m long, weighs nearly 1.5 tons and is now in the Shipwreck Heritage Centre. However, Ferrari records that the rudder had been previously raised a considerable distance away by another fisherman – Mr. Blight –and thrown back; a third fishermen was thought also to have snagged it (Ferrari 1994 129-130; figs 89-91). The rudder might indicate the presence of a medieval wreck site which, given the size and survival of the rudder could be expected to retain a fair degree of coherence. However, the reported history of the rudder since being snagged suggests that the position where it was eventually recovered may not be a good guide to any site which may remain.

Discovery of Scatters and Findspots

A large number of findspots attributable to fishing are recorded in the NRHE, which can be supplemented with further examples. Tables 20-22 are based on queries for monument type 'findspot' and landuse 'Marine' or landuse 'Coastal'. The resulting dataset from which the records were drawn is indicated as 'marine' or 'intertidal' under 'source'. Examples were predominantly found by searching for keywords relating to fishing. As a result of ambiguity in the terms used in NRHE records, particularly the term 'dredging' (see **Appendix 1** for discussion of Data Sources), all of the 'marine' results were also scanned for records that might be attributable to fishing, based on context. These are indicated as 'marine-possible' under source. It is worth noting that many of these findspots are based on museum holdings or gazetteers, so the information available through the NRHE is often brief and not especially concerned with the implications for commercial fishing: examination of primary sources relating to these findspots could provide further useful information. Other findspots that do not appear to be recorded in the NRHE have been included in the course of reviewing literature. Several key assemblages are also included here, including Pudding Pan Rock and assemblages from Ryde Middle Bank and Southampton Water examined by Ferrari. The Michael White collection of prehistoric material from the Solent and Southampton Water – catalogued by Wessex Archaeology in the course of the Artefacts from the Sea project – is also included.

The findspots are presented in three tables below:

- Table 20: Prehistoric
- Table 21: Roman
- Table 22: Medieval to Post-medieval.

The range of finds represents submerged prehistoric, maritime and coastal themes; no discoveries by fishermen of aircraft parts are recorded, but this may be because aircraft have only been regarded as having archaeological interest – by archaeologists as well as fishermen and the wider public – in the last couple of decades. That is to say discoveries of aircraft-related finds have undoubtedly been made but they appear not to have been previously recorded as being 'archaeological'. This general tendency may account for the predominance of recorded discoveries of Roman and prehistoric material. Such material is often plainly 'archaeological' in character, and so perhaps more likely to be reported, whereas the character and interest to archaeologists of more recent material may be less evident.

The list of findspots and scatters is quite diverse, encompassing discoveries made from the C18th to the 1990s. Discoveries have been made at many different places though records are most numerous in the Thames and along the South Coast. Details about the form of fishing are sketchy, but there are examples of finds being made by trawling, shellfish dredging and drifting. There are also examples of finds made during bait-digging and by fishermen who may not actually have been fishing at the time. Biases in reporting and recording probably mean that this list cannot be taken to be representative and may only indicate a tiny fraction of what has been found by fishermen; but the list does at least indicate the variety of discoveries and circumstances in which this particular interaction takes place.

Table 20: Prehistoric Findspots attributed to fishing.

Discovery	Circumstances	Location	Year	Source	Ref (UID)	Period
Hand axe	Found in the mud beside while bait-digging	Netley Hard, Southampton Water	1978	Intertidal	229703	Palaeolithic
Michael White Collection	Oyster dredging; clam dredging	Solent and Southampton Water	Pre –2004	Assemblage	WA 2004	Palaeolithic - Mesolithic
Colinda harpoon	Trawled up in her fishing nets (NB Colinda was a drifter)	Between Leman and Ower Banks	1931	Marine	1401518	Upper Palaeolithic
Bone harpoon	Found by fisherman	off Trimingham, North Norfolk	c. 1950	Marine	1449593	Mesolithic
Tranchet axe	Found in the Thames	Queenborough, Kent	Pre-1977	Marine – possible	420268	Mesolithic
Tranchet axe	Found in Christchurch Harbour	Christchurch, Dorset	Pre-1977	Marine – possible	458695	Mesolithic
Tranchet axe	Dredged from the sea … sailing from Yarmouth	?Newtown, Isle of Wight	Pre-1977	Marine – possible	460806	Mesolithic
Two Thames picks	Dredged up	Pan Sands, Thames Estuary	1921	Marine – possible	465416	Mesolithic
Thames picks and flints	Found in the West Last Buoy	Herne Bay	Pre-1925	Marine – possible	465406	Mesolithic
Thames pick	Probably dredged up	Reculver	Pre-1897	Marine – possible	467148	Mesolithic
Tranchet axes and picks	Oyster trawling	Western Solent	1985	Literature review	Tomalin (2011)	Mesolithic
Trepanned skull	Trawled from the sea	off Ovingdean gap, East Sussex	1935	Marine	402254	Neolithic / Bronze Age
Polished axe	Found at the junction of the Thames and the Medway	Thames Estuary	Pre-1978	Marine – possible	420258	Neolithic
Socketed axe head	Recovered through dredging by oystermen'	Off Whitstable	Considerably earlier than 1953	Marine	465490	Late Bronze Age
Socketed axe head	Said to have been brought up together by oyster dredger	Off Whitstable	1916	Marine	465496	Late Bronze Age
Socketed axe head	Brought up a by an oyster dredger	Off Whitstable	1916	Marine	465499	Late Bronze Age
Bronze Axe	Found in sea	Bournemouth	1937	Marine – possible	458958	Bronze Age
Macehead	Found	Bracklesham Bay	1958	Marine – possible	462166	Bronze Age

The recorded finds of prehistoric date show a bias towards early prehistory, especially the Mesolithic, which might reflect a 'real' pattern commensurate with the presence of former landsurfaces from early prehistory. In later prehistory, the effect of sea-level change and changes to the coast through – for example – reclamation are such that submerged landsurfaces are less likely to be encountered by commercial fishing. Later prehistoric finds are more likely, therefore, to reflect material arising from maritime activity, in the form of losses overboard. The distinctive character and forms of bronze artefacts no doubt contributes to their being picked out and reported.

Table 21: Roman findspots attributed to fishing

Discovery	Circumstances	Location	Year	Source	Ref (UID)	Period
Roman Flagon	Brought up from the sea-bed … in a fishing net	Ryde Middle Bank	1982	Marine	975076	Roman
Greek pottery (suspected 'plant')	Found by fisherman	Selsey (shore cliffs)	1860	Marine	462476	Roman
Roman water bottle	Fished up	Pegwell Bay	Pre-1932	Marine	469446	Roman
Terracotta wine jar	Trawled up from a depth of 16 fathoms on the trawling-ground …	Off the Longships, Land's End	1931	Marine	421225	Roman
Mortaria	Dredged up	Beachy Head, Sussex	Pre-1980	Marine – possible	970441	Roman
Pottery	Found during dredging	Brightlingsea, Essex	Pre-1930	Marine – possible	385978	Roman
Samian pottery	Dredged up	Brightlingsea, Essex	Pre-1905	Marine – possible	385981	Roman
Pottery	Recovered from Poole Harbour	Poole	1933	Marine – possible	457491	Roman
Four glass vessels	Dredged up	Selsey, West Sussex	About 1860	Marine – possible	462419	Roman
Samian pottery	Recovered from the sea	Pegwell Bay, Kent	Pre-1931	Marine – possible	469455	Roman
Red terracotta vase	Said to have been netted by a Fisherman	Morecombe Bay	Pre-1943	Intertidal	39413	Roman

Discovery	Circumstances	Location	Year	Source	Ref (UID)	Period
Ornamental upper terminal of one leg of a folding tripod	Discovered by fishermen	Sidmouth	1840	Intertidal	449004	Roman
Copper coin	Turned up from about a foot and a half below the bed of the river by a fisherman while digging shell fish.	River Medina, Isle of Wight	1849	Intertidal	461736	Roman
Bead rim and body sherd	Dredged up by fishing boat	Woodside Bay, Isle of Wight	Pre-1978	Intertidal	461768	Roman
Pottery vessel	Poole fishermen brought up with their nets a limpet covered clay jug	Little Channel, Poole	1951	Intertidal	458212	Roman
Hoard of coins	Found while digging for bait	Warden Bay, Kent	1968	Intertidal	463756	Roman
Amphora	Trawled up	Pan Sand, Thames Estuary	1983	Marine	Sealey and Tyres 1989	Roman
Fragments of amphorae	Reported by fisherman	Yarmouth Roads	1985	Marine	Tomalin (2011)	Roman
Pudding Pan Assemblage	Oyster dredging	Pudding Pan Rock, Thames Estuary	1720 – present	Marine	1369283 etc.	Roman
Ryde Middle Assemblage	Oyster dredging	Ryde Middle Bank, Solent	Pre-1994	Marine	Ferrari (1994)	Roman to Post-medieval

Roman discoveries are predominantly ceramics, including whole vessels. Again, their distinctiveness is likely to have caused them to be picked out and reported. As with discoveries from later prehistory, the Roman material is more likely to be a reflection of maritime activity than representing submerged former landsurfaces, though coastal erosion may be responsible for some. The number and geographical diversity of Roman discoveries attributable to fishing suggests that it offers an already-useful dataset with which to better understand Roman (maritime) activity in English waters, with real potential for greater insight if the level of reporting were to increase.

Table 22: Medieval and Post-medieval findspots attributed to fishing

Discovery	Circumstances	Location	Year	Source	Ref (UID)	Period
Earthernware bottle from Levant	Recovered in the trawl net	Off Start Point, Devon	1994	Literature review	Armitage and Armitage (2008)	Medieval
Dugout timber	Trawled up	Off Coverhithe, Suffolk	1998	Literature review	Kingsley (2012)	Early Medieval
Southampton Water Assemblage	Oyster dredging	Southampton Water	1992	Assemblage	Ferrari (1994)	Late Medieval; Post-Medieval
Portuguese swivel gun	Found by fishermen sweeping with drag gear for anchors	Gull-stream, Goodwin Sands	1775	Marine	895188	Post-medieval (?C16th)
Admiralty pattern anchor	Recovered by fishing vessel	West Dorset	Not recorded	Marine	832502	Post-medieval (pre-1850)
Cannon	Dredged up … by an oyster or scallop boat	Carrick Roads, Falmouth	1932	Marine	1549589	Post-medieval (1720)
Iron cannon	Trawled up	Off Kessingland, Suffolk	1975	Literature review	Kingsley (2012)	Post-Mediaeval
Large anchor fluke	Reported by local fisherman	Stert Flats	1993	Intertidal	971235	Uncertain

Records of Medieval, and later material, show a preponderance of cannon and anchors, again reflecting the characterisation by fishermen of some classes of artefact as being of interest. The recorded discoveries are all indicative of maritime activity; their relatively small number does not detract from the potential importance of specific discoveries.

Virtually all of the discoveries listed above involved material that has been removed to the surface from its original context by fishing activities. Discovery is, therefore, associated with a degree of damage. Gauging the damage arising from these discoveries is difficult because it is unclear whether the material in its pre-fishing context was part of a site or a scatter, or was an isolated findspot resulting from an item being discarded overboard, for example. In some cases the descriptions, although limited, indicate that the find related to a site that was reasonably intact. In the case of the iron cannon off Kessingland, for example, Kingsley states 'the snagged gun carriage and decking were thrown back into the sea' (Kingsley, 2012). Where a site is present, it is likely to have been impacted adversely by the process that gave rise to the recovery of artefacts and may indicate that further impacts will occur as fishing in the vicinity continues. In some cases, however, recovery may indicate the presence of a snag, and fishermen may desist from fishing close to it as a potential hazard. If the findspot relates to a site, then fishing may cause the same range of damage as to other sites: removal, transferral, alteration of structures, deposits and relationships. The same range of

damage may occur where a findspot proves to be a scatter or debris field, diminishing any residual patterning. For findspots, scatters and sites alike there will also be damage to individual artefacts, including breakage. Ferrari's thesis (1994), for example, included a detailed analysis of sherds from assemblages recovered by oyster dredging to establish the consequences of fishing for their size and morphology, with a view to being able to use this information to 'unscramble' an assemblage affected by fishing in the course of its interpretation. Although fishing can plainly result in ceramics being broken, it is striking that largely complete, undamaged vessels are also recovered, and the list above also includes examples of the recovery of glass artefacts and other delicate items. As Ferrari suspected, various selective processes are in play between the material in situ and what is eventually reported and recorded. Extensive damage may be occur, but the available evidence favours what has survived; demonstrating that commercial fishing does not obliterate all archaeological material in its path.

Where finds survive and are reported by fishermen, the addition to archaeological information about the historic environment is considerable and, as-yet, not fully realised by archaeologists. Findspots reported by fishermen can be important as individual finds, broadening the spatial, chronological and thematic understanding of the marine historic environment and feeding in to desk-based assessments of the presence and potential of particular sea areas. Findspots from fishing may also indicate specific sites that can be sought after, as has been the case with the elusive Roman wreck indicated by the Samian recovered around Pudding Pan; several of the findspots in the list above suggest the presence of more than an isolated artefact. Fishermen's findspots can also help in understanding more extensive marine areas such as possible anchorages or seaways, or submerged landscapes; the Colinda harpoon, for example, has repeatedly found itself being extrapolated in the interpretation of the entire southern North Sea basin.

The Michael White Collection has particular potential as a set of discoveries made by fishermen that could be used to generate significant improvements in archaeological understanding. Unlike many discoveries, it has proved possible to localise the source of material recovered by fishing, based on discussion with the finder and his notes and charts (Wessex Archaeology, 2004). The assemblage points to the presence of submerged prehistoric – especially Mesolithic – artefactual material at 38 locations around the Solent and Southampton Water. These are listed in Table 23, which illustrates the wide range of locations and the degree to which specific areas can be distinguished as being potentially significant on the basis of finds made by fishermen.

Each of the locations identified from the Michael White Collection could warrant investigation to establish whether there is further early prehistoric material present in an interpretable context and, given the very small number of confirmed prehistoric sites in English waters, any one of them would be individually significant. Their collective potential is, however, perhaps even more important because they suggest the presence of extensive early prehistoric material that might start to be understood at landscape scales through the interrogation of discoveries made by fishing. Pursuit of this possibility would help demonstrate to fishermen why their reporting of discoveries to archaeologists is so important.

Table 23: White Collection: sites of submerged prehistoric material indicated by discoveries made by fishermen. (Source: adapted from Wessex Archaeology, 2004).

1	off Corrals Wharf, River Itchen (NB clam dredging)	20	off Pitts Deep, Sowley, Solent
2	Solent	23	btw. Pennington Sewer and Lymington River, Solent
3	Chilling, Southampton Water	24	on the corner of Oxey Lake and Mystery Lake, Solent
4	off Lymington River mouth, Solent	25	off Oxey Lake, Solent
5	Southampton Water	26	off Pennington Sewer, Solent
6	Stanswood Bay, Solent	29	btw. Hawkers Lake and Pennington Sewer
7	off Stone Point, Lepe, Solent	30	Pennington
8	off the Cables, Lepe, Solent	31	off Pennington, Solent
9	off Sowley, east side of Sowley Boom, Solent	32	off Marchwood, Southampton Water
10	off Pitts Deep, west side of Sowley Boom, Solent	33	off Yarmouth, Solent
11	off Sowley Boom, Solent	44	off Pylewell, Solent
12	off Hamstead Ledge, IOW, Solent	45	off Tanners Lane, Solent
13	east of Newtown, IOW, Solent	46	close inshore at Tanners Lane, Solent
14	Newtown Gravel Banks, IOW, Solent	48	west side of hot water outlet at Fawley, Solent
15	off Newtown River mouth, IOW, Solent	49	in Lymington River mouth
16	btw. Hamstead Point and Newtown River mouth, IOW, Solent	50	just outside the starting box, Lymington River mouth, Solent
17	just east of Newtown River mouth, IOW, Solent	51	off Bourne Gap, Stanswood Bay, Calshot, Solent
18	west side of Newtown River mouth, IOW, Solent	52	by Bourne Gap, Stanswood Bay, Calshot, Solent
19	off Netley, Southampton Water	68	Pennington submerged forest

A further important example of fishermen's discoveries being capable of greater archaeological interpretation is presented by work currently underway at the University of Southampton. A total of 844 specimens of faunal remains recovered by trawling are being examined, including examples from museum collections and large collections held by fishermen. This work shows how fishing-derived material can be subject to detailed archaeological investigation and, in so doing, can help build relationships with fishing communities (Bynoe, pers. com.).

7.5. Options for Management and Research

There is a close relationship between the three key interactions between fishing and the historic environment: heritage assets – in the forms of snags – presenting a hazard to commercial fishing; the potential for commercial fishing to damage heritage assets; and the reporting of new archaeological discoveries by fishermen. These three aspects are so closely related that they need to be addressed in combination, establishing a much firmer evidence-base. This evidence base has to focus on causality rather than correlation, and be much more precise in how fishing activity and damage are recorded. In the meantime, more has to be made of the archaeological data that has already become available as a result of reports arising from commercial fishing, to demonstrate its utility and value.

Table 24: Options for management and research - Direct Interactions between commercial fishing and the historic environment

Interaction	Scope	Objective	Management Options	Research Needs
Heritage assets are hazardous to gear and vessels (Adverse for commercial fishing) **Commercial fishing damages heritage assets (Adverse for historic environment)** **Commercial fishing results in discoveries (Mutually beneficial)**	Known – Designated Sites and Settings	Decrease damage to designated heritage assets	Increase awareness of position, extents and restrictions applicable to designated areas. Develop and test sustainable fishing methods on designated sites and promulgate through Good Practice Guide Implement and enforce statutory provisions	Review designated sites for firm, detailed evidence of damage from commercial fishing Explore scope to offer amnesty when notifying EH of (accidental) impacts from fishing on designated heritage assets
	Known – Undesignated Sites and Settings	Facilitate avoidance of known sites	Increase dissemination of information about position etc. of known heritage assets via Kingfisher and other navigation/GIS tools	Collate and enhance asset data in preparation for wider dissemination Discriminate between wrecks as to whether they are 'important' heritage assets
		Discourage indifference to presence of known heritage assets	Increase awareness of value of undesignated heritage assets	
		Discourage encroachment on known heritage assets	Increase awareness of tolerances of undesignated heritage assets	Review the effect of increasing information to fishermen on site position, form, orientation etc. of heritage assets

Interaction	Scope	Objective	Management Options	Research Needs
	Fishermen's fasteners	Decrease damage to heritage assets revealed as fishermen's fasteners	Clarify archaeological views on the character of fasteners as heritage assets	Improve understanding of fasteners and rough / foul ground and their archaeological implications based on existing and / or newly acquired geophysical data Review / enhance recording of fasteners in NRHE
	Unknown Sites	Decrease initial damage to unknown sites	Encourage prior assessment of areas exposed to new / different commercial fishing (SEA) Support and seek integration with development of technical measures to reduce impacts on seabed features Encourage use of technical measures (gear modifications) to reduce damage in high risk areas Encourage gear choices (for example, long lining) that will reduce damage in high risk areas	Review risk factors leading to previously unknown sites being encountered, including history of fishing, seabed character, gear type, seasonal factors and events (for example, storms) Develop regional IFCA-based risk maps of areas susceptible to damage to as-yet unknown sites Reconcile risk-based approach with EH Risk Management Handbook (2008)

Interaction	Scope	Objective	Management Options	Research Needs
		Improve early reporting of previously unknown sites	Enhance and expand FIPAD with particular emphasis on reporting of fasteners Specific campaign through FIPAD to capture legacy information on fasteners Increase awareness of examples of important sites identified initially as fasteners Make provision for specific and prompt measures to investigate reported fasteners	

Interaction	Scope	Objective	Management Options	Research Needs
		Decrease damage to previously unknown sites subsequent to discovery	Develop measures to enable rapid dissemination to fishermen of information on important new sites Develop and promulgate Good Practice Guide on fishing methods and gear that can continue to be used in vicinity of important new sites Clarify to fishermen the circumstances in which formal restrictions (designation; byelaws) may need to be introduced to protect important new sites	
	Unknown Scatters and Findspots	Increase comprehensiveness and speed of finds reporting by fishermen	Enhance and expand FIPAD in light of results of Sussex IFCA Pilot Demonstrate value of fishermen's finds through prompt and visible responses to discoveries, and by using data to inform management	Enhance existing records of finds in NRHE, with particular emphasis on identifying details of fishing practices through which discoveries occurred. Carry out research based on previously reported finds to demonstrate their contribution to understanding historic environment

Interaction	Scope	Objective	Management Options	Research Needs
		Improve initial handling and recording of finds	Through FIPAD, increase awareness and informal training of fishermen in finds identification, handling, photography and storage Provide waterproof information cards for use in wheelhouses	

8. MAPPING FISHING EFFORT, HABITATS AND HERITAGE ASSETS

8.1. ASSESSING THE EXTENT OF FISHING-HERITAGE INTERACTIONS

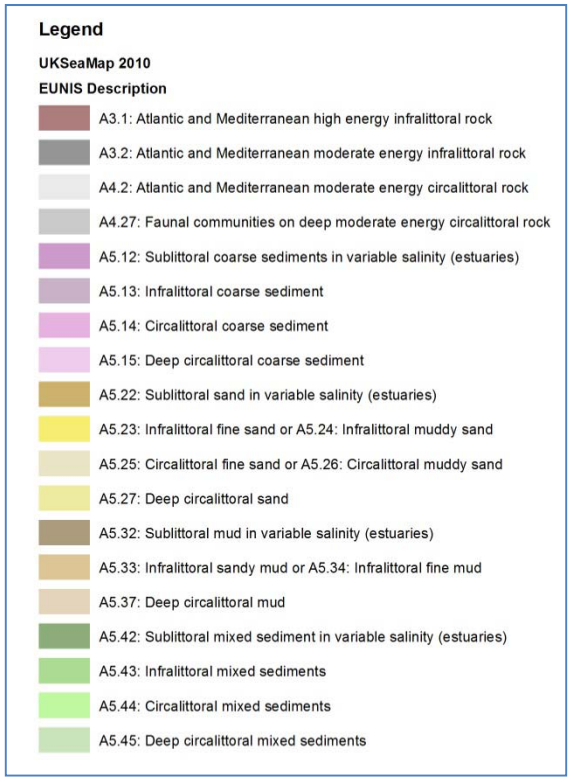
Direct evidence of fishing-heritage interactions can arise only if the heritage asset is known or becomes known through the interaction. For the large number of unknown assets, the absence of direct empirical evidence means that a different approach must be taken. It can be postulated that where fishing activities overlap spatially with heritage assets in the marine environment, than interactions may occur. By considering evidence for the extent of commercial fishing activities, and the distribution of heritage assets and habitat types, it is suggested that we may be able to surmise the extent of fishing-heritage interactions.

Evidence for commercial fishing activities in the two study areas was derived from a number of sources including satellite-based vessel monitoring system (VMS) data, IFCA byelaws and reports, Cefas reports, and the Project Inshore Stage 1 report. Evidence for the distribution of known heritage sites was drawn from NRHE wreck data, including designated wreck sites. Fishermen's fastener data was also collated and reviewed alongside fishing effort and habitat data for its use as an indicator for unknown heritage sites.

Areas where high fishing effort coincides with known heritage assets and areas with a high potential for unknown assets (based on likely preservation due to habitat characteristics, and observation of fishermen's fasteners), may be a useful indicator for areas where interactions may occur. Identification of such areas may assist researchers and regulators in prioritising of further study and consideration of management options.

8.2. HABITAT CHARACTERISTICS AND FISHERMEN'S FASTENERS

Sediment characteristics (UKSeaMap 2010) for Areas 1 and 2 have been overlain with observation records of fishermen's fasteners (as shown in Figure 23 and Figure 24: UKSeaMap 2010 data showing EUNIS level 3 habitat classifications for case study Area 2) to see if there is a correlation between sediment type and location of fasteners.



Area 1 is characterised by an extensive area of coarse sediment, with areas of mixed sediment interspersed throughout the area. The estuary mouth is characterised by sand and mud.

Area 2 is characterised by a large area of rock and sand inshore; beyond 12 nmi the area is largely characterised by coarse sediments. The East English Channel, within which Area 2 falls, is subjected to sediment transport from the west, resulting in the build-up of sandy sediment in the east of the study area (James *et al.*, 2011).

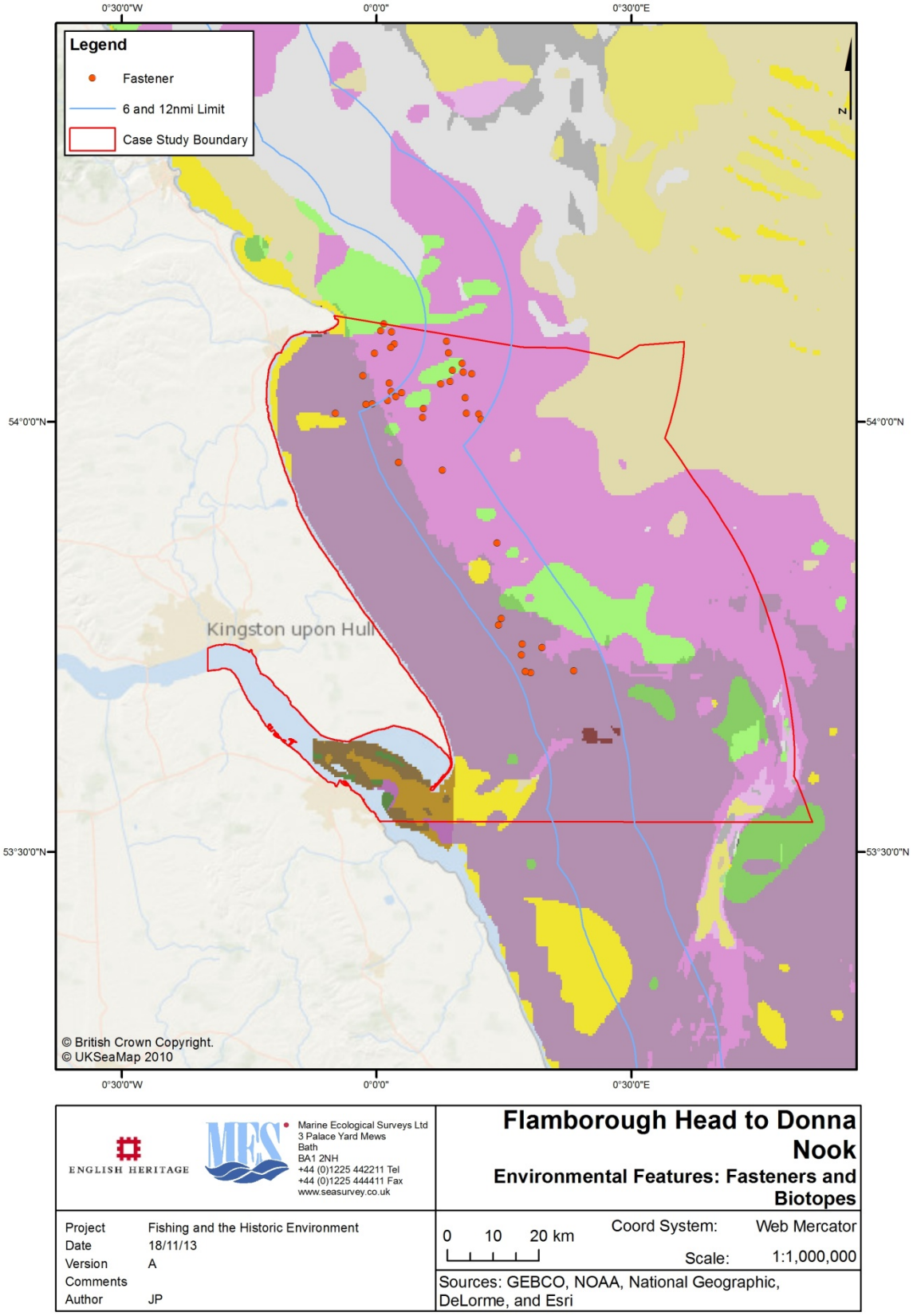


Figure 23: UKSeaMap 2010 data showing EUNIS level 3 habitat classifications for case study Area 1

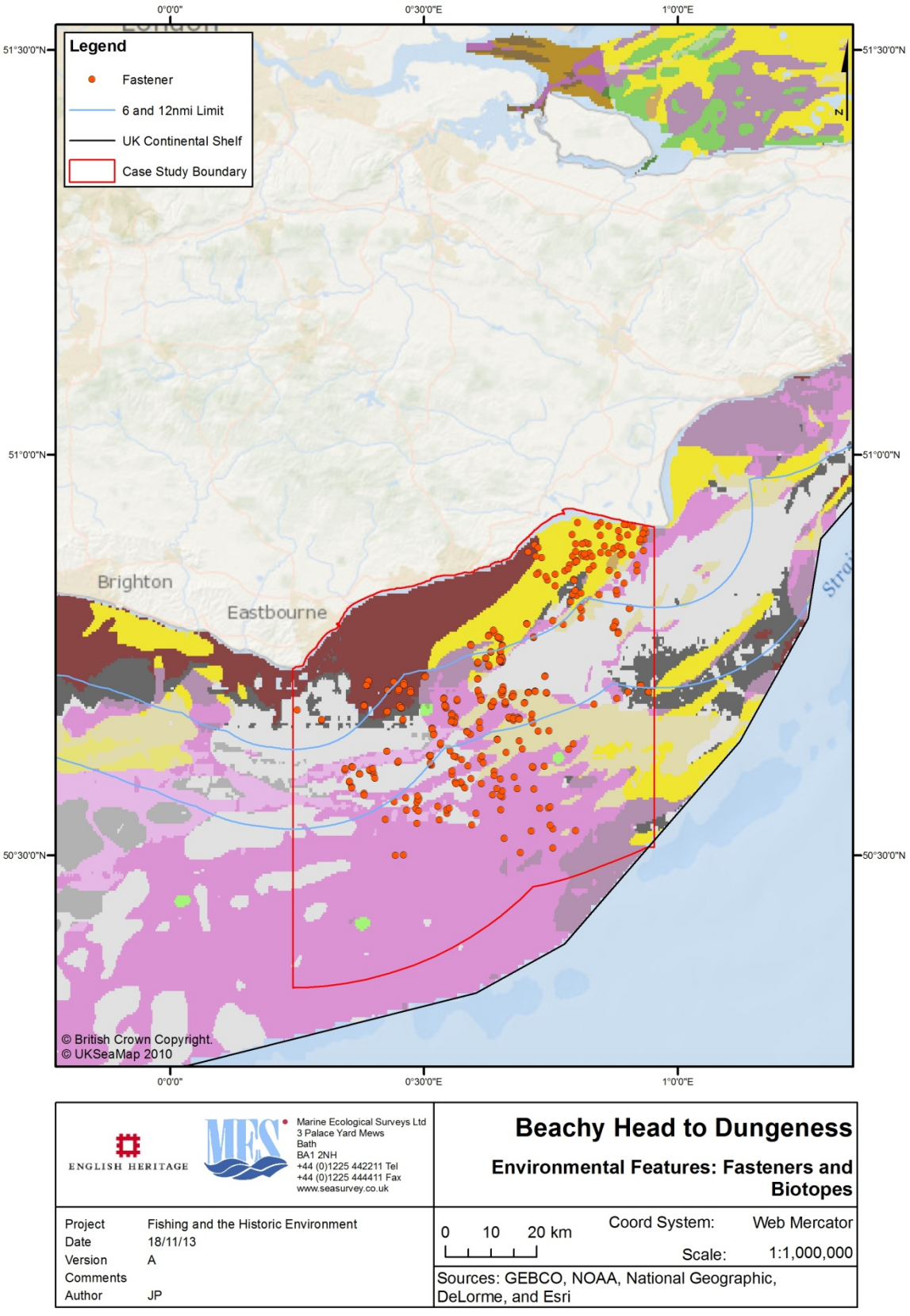


Figure 24: UKSeaMap 2010 data showing EUNIS level 3 habitat classifications for case study Area 2

The NRHE includes 41 records of fishermen's fasteners in Area 1 and 353 in Area 2. The records themselves usually take the form 'Unidentified seabed obstruction reported by fishermen. Possibly indicative of wreckage or a submerged feature' though in some instances their relation to other specific sites – as associated debris or variant positions – is also noted. The form on the seabed of fishermen's fasteners recorded in the NRHE has not been corroborated or evaluated by geophysical and archaeological investigation[25], hence their actual character is not usually known; they may not prove to be heritage assets and their avoidance by fishermen may have no bearing on the historic environment. Nonetheless, on numerous occasions the investigation of snags by divers has led to the discovery of highly significant heritage assets (see Section 7.4), so the fishermen's fasteners recorded in the NRHE can be regarded at least as possible heritage assets.

It can also be argued that fishermen's fasteners recorded in the NRHE might serve as a proxy for fishing activity having occurred in an area, and for the environment to be conducive to the survival of features such as heritage assets. It is important, however, to recognise that the distribution of fishermen's fasteners in the NRHE is likely to be a product of recording biases in the source data, rather than reflecting a real distribution of snags. As noted previously, snag information is valuable and held privately by fishermen; thus only a sub-set of such data has been transferred into the public domain.

The uncertainties surrounding fishermen's fasteners recorded in the NRHE are illustrated strikingly by the difference in numbers of fishermen's fasteners between the two study areas, with over 30 times as many in Area 2 as in Area 1. This disproportion seems unlikely to be attributable to fishing activity, the environment, or the actual quantity of features on the seabed. Differences in the degree to which snag information becomes available in the public domain seem more likely to be the cause.

Notwithstanding the likely presence of recording biases, there is a degree of correlation between fasteners and environment in both study areas:

Table 25: Fishermen's fasteners and associated sediment types (EUNIS level 3) within the case study areas

Habitat (UKSeaMap 2010)	Area 1	Area 2
Rock	0	106
- High energy infralittoral rock		22
- Moderate energy infralittoral rock		12
- Moderate energy circalittoral rock		72
Sublittoral coarse sediment	36	116
Sublittoral sand	0	130*
Sublittoral mud	0	1
Sublittoral mixed sediments	5*	0
Total	41	353

* In each study area, one fastener is outside the coverage of the habitat data and has been attributed to the habitat type to which it is closest.

[25] One comment during the consultation exercise for the project report was that fishermen's fasteners as recorded in the NRHE very rarely correspond to anomalies identified by geophysical assessment.

In Area 2, there are large numbers of fasteners in areas of rock and coarse sediment. This may indicate that archaeological material is present above seabed level as the scope for it to become buried is constrained by the substrate; however, it is also likely that coarse sediment and rock may themselves be causing snags. Conversely, sand substrate seems unlikely to cause snags, suggesting that, leaving aside erratic boulders, the origin of a large proportion of fishermen's fasteners in these areas is anthropogenic. The lack of fasteners on mud might imply that anthropogenic material, although present, has become buried in the fine-grained sediment and does not form potential snags on the seabed. As suggested previously, further work on the character of recorded fasteners using geophysical data is recommended to understand their true implications as heritage assets and for commercial fishing.

8.3. Fishing Effort

Combining fishing effort data with known wreck and aircraft site data gives an indication of spatial overlap. Available data has been identified and evaluated for its use as a spatial indicator of areas with high fishing-heritage interaction potential.

Vessel monitoring system (VMS) data was provided by the MMO for 2007-2010, covering vessels over 15 m in length. The 2010 data was mapped for the case study areas, showing cumulative effort (minutes) for mobile and passive fishing gears in 2007-2010.

VMS evidence for the extent of commercial fishing in Area 1 shows that use of mobile fishing gear is limited, corresponding with dredge and trawl restrictions set by the NE IFCA byelaws, with mobile effort mostly limited to the north of the case study area (see Figure 25). The main gear types used in Area 1 are static pots and nets. Static effort is largely focused within the 3 to 12 nmi zone, extending off the coast of Hornsea down to the Humber mouth (see Figure 26). Recorded wreck sites within Area 1 are most densely seen within the Humber estuary entrance. This is likely to be caused by a combination of factors including: increased chance of wrecking due to navigational hazards and attacks on shipping in WWI and WWII, increased chance of asset preservation within the sand and mud habitat, and increased chance of discovery due to shallower waters and high maritime traffic.

Evidence for the extent of commercial fishing in Area 2 shows that the majority of mobile gear (trawling and dredging) effort is focused within 12 to 24 nmi, for which we do not have wrecks and aircraft data (see Figure 28). It is, therefore, difficult to assess the likely extent and magnitude of fishing-heritage interactions within this offshore region. The data indicates an overlap of moderate mobile gear activity with heritage assets. Mobile gear fisheries within the region comprise a number of bottom gear types hence there is a risk that interactions with unknown heritage assets are likely to be greater in number and magnitude. The extent to which these pose a risk to heritage assets is unknown, and is dependent upon factors including the form of heritage assets and the extent of any existing damage caused by historical activities.

In comparison, passive and static gear (potting / trapping and netting) effort is focused within 3 to 6 nmi off the coast of Beachy Head to Hastings but extends from the coastline out to 12 nmi,

overlapping with a number of known wreck sites (see

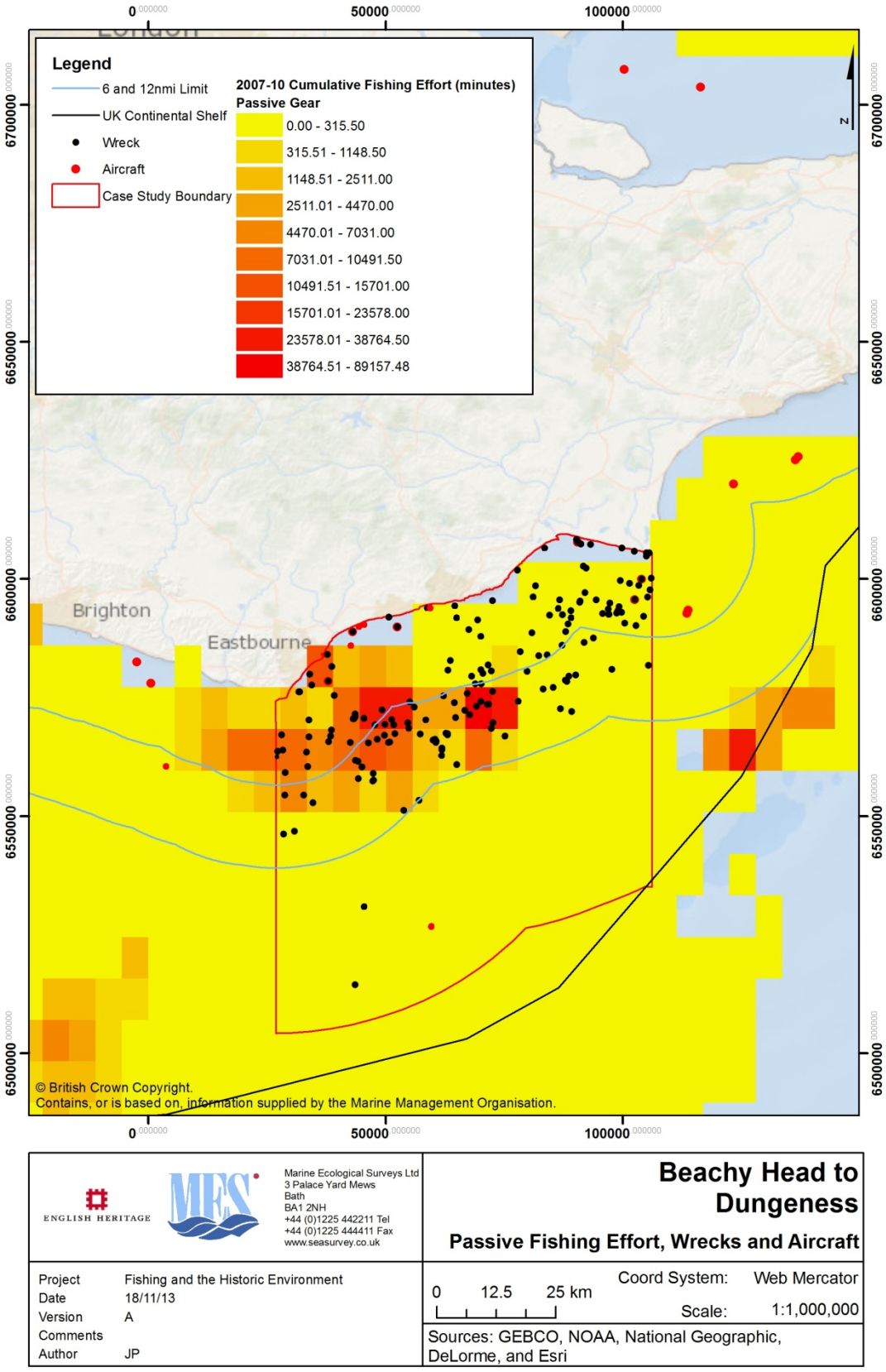


Figure 29). There is also reference to setting of nets over wrecks within the area, indicating that there may be a high likelihood for fishing-heritage interactions within this region.

Satellite-based VMS data provides a useful overview of cumulative fishing effort; however, its use at a finer scale is limited with vessel positions only recorded at two hourly intervals. Previous work by Cefas has suggested the use of geophysical data to provide further evidence of fishing effort at a finer scale - demersal dredging and trawling activities create distinctive scars on the seabed which can be assessed using side-scan sonar. These fishing scars would be expected to corroborate VMS data for spatial extent and intensity. Geophysical (side-scan sonar) data was found to correspond well with VMS data when mapping the extent of fishing activities (Vanstaen *et al*., 2010). However, this technique is time-consuming and costly, and is therefore most suitable for use on a small-scale study area.

Distinguishing between vessel activities (steaming, fishing) when interpreting VMS data should be done with a caveat, particularly if differing methods are used between studies; Lee *et al*. (2010) indicate that misclassification for towed gears is < 5 %, however, this has not been well quantified for static gears (Jennings and Lee, 2012). In addition, static gear, which in some areas forms a major component of the fishing fleet, may be misrepresented as the gear is likely to be anchored and left unattended whilst the vessel works other locations.

Currently, VMS data is used to track the positions of fishing vessels over 12 m in overall length (as of 2012); however, as identified in Section 2.1 the majority of the English fleet are under 15 m (approximately 95 %) and therefore VMS data is not representative of the English inshore fishing fleet. Recent trials conducted by the MMO and local IFCAs within the Lyme Bay and Torbay candidate SAC were used to evaluate the effectiveness of a low cost, inshore VMS (iVMS) as a management tool for MPAs (MMO, 2012). The iVMS was used to send vessel position reports at intervals of one minute, using mobile phone network technology to transmit satellite global positioning system (GPS) data. By reporting the vessel position at regular intervals and to a GPS accuracy of 2 m, the system is designed to provide a high degree of spatial accuracy. The trials demonstrated that although the system needs improvement before it is suitable for widespread use, there is potential for the use of iVMS to benefit inshore fisheries management.

Whilst iVMS is still being developed, supplementary spatial information can be obtained from MMO and IFCA vessel sightings data. Sightings data is recorded during air and at-sea patrols for all vessel lengths and categorised by gear type. Therefore, surveillance data provides a useful indicator for inshore activity which VMS currently lacks. The most recently available MMO data (2010-2012) was provided upon request and all vessels recorded as ‘fishing’ have been mapped for the case study

areas (see Figure 27 and

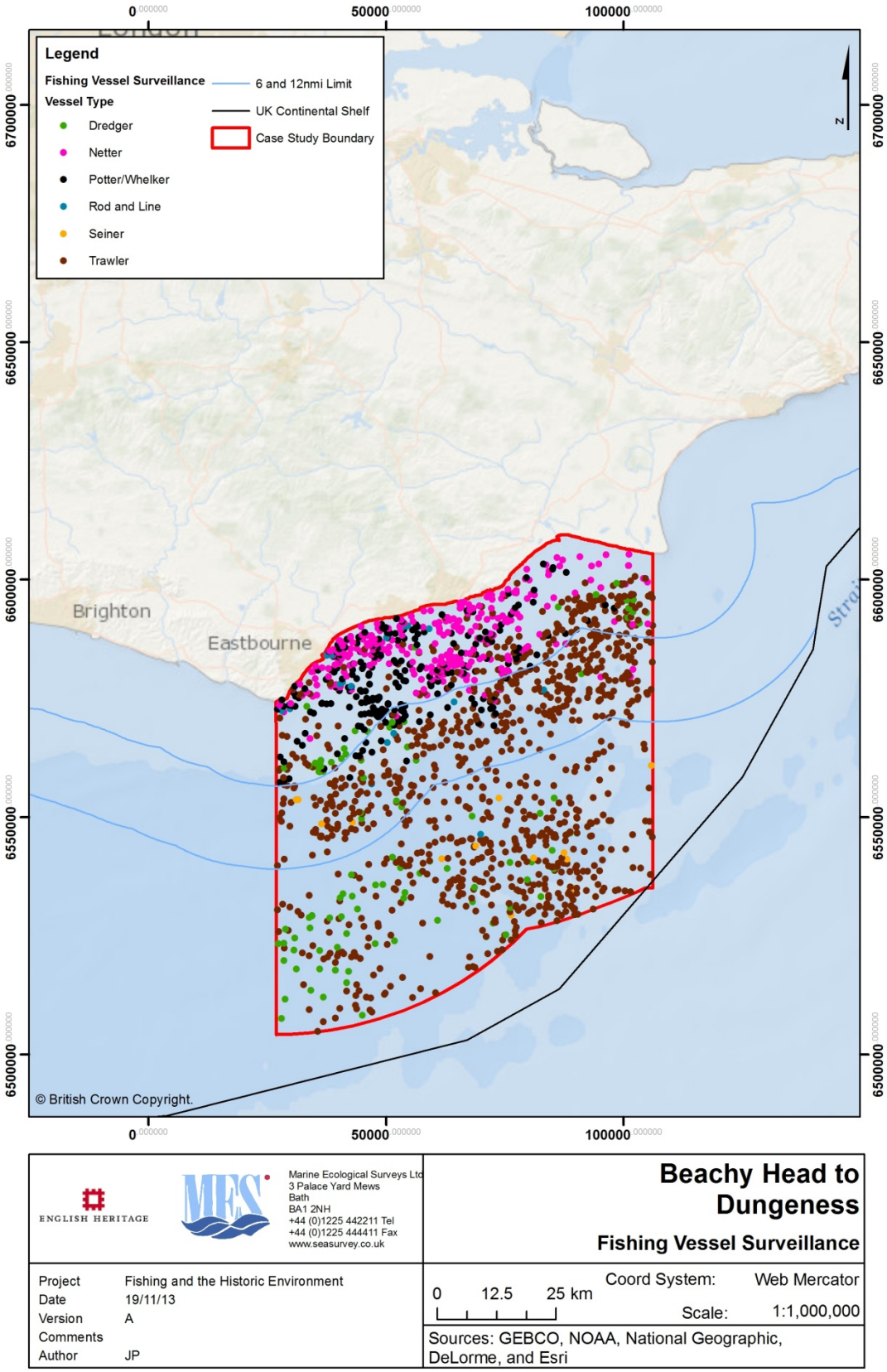


Figure 30).

The surveillance data provides a clearer indicator of the spread of potting activity within the inshore region of Area 1. It also shows a greater level of mobile gear (trawling) activity beyond 12 nmi than seen in the VMS data, suggesting that it is largely dredger activity that has been recorded by the VMS. The surveillance data for Area 2 shows high mobile activity (trawling) in the eastern region of the area, in comparison with the VMS data which suggests that mobile gear effort is greatest to the west, again suggesting that it is largely dredger activity that has been recorded by the VMS.

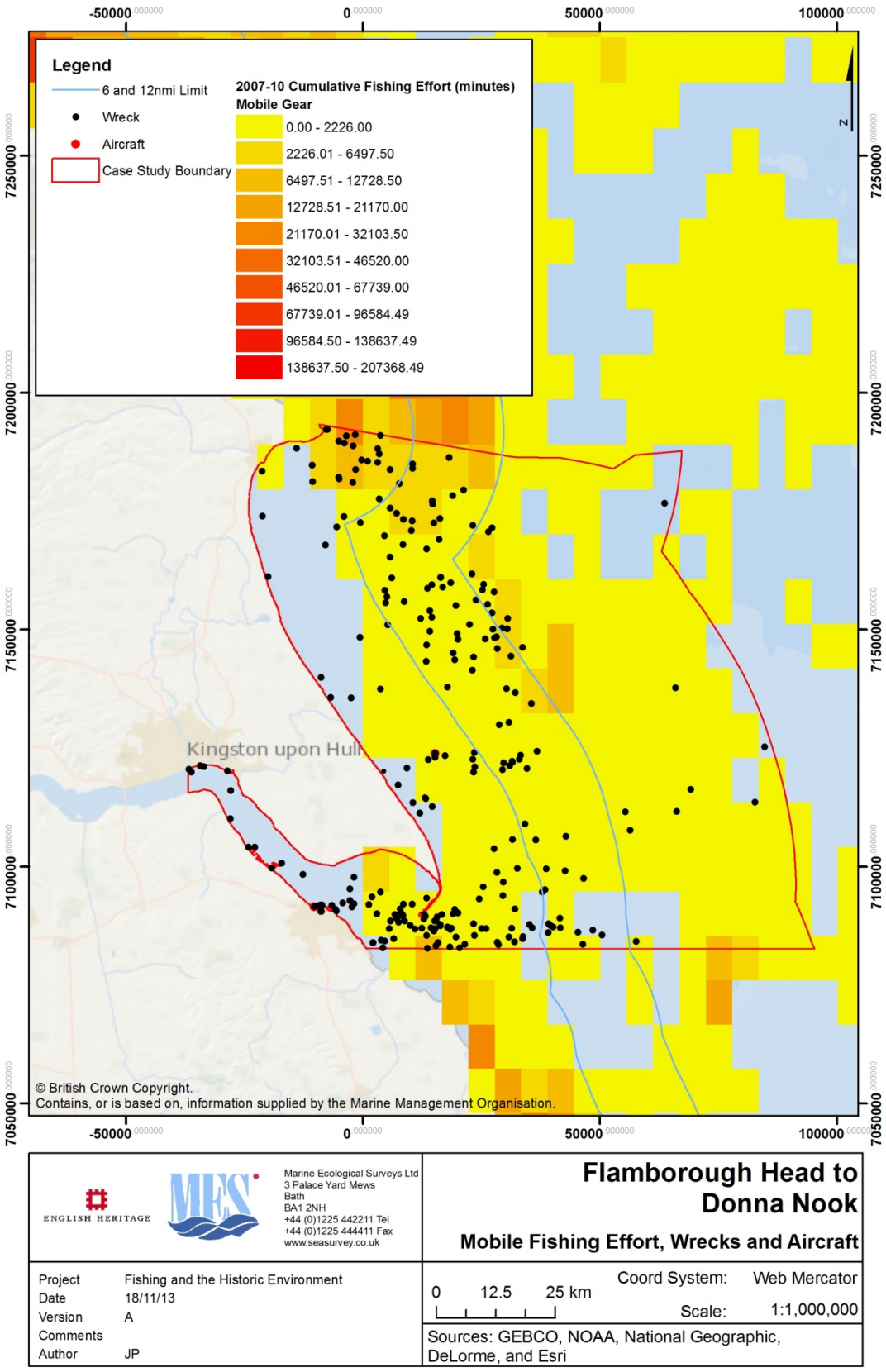


Figure 25: VMS effort data for mobile gears in Area 1, 2010 (Data provided by the MMO, 2013)

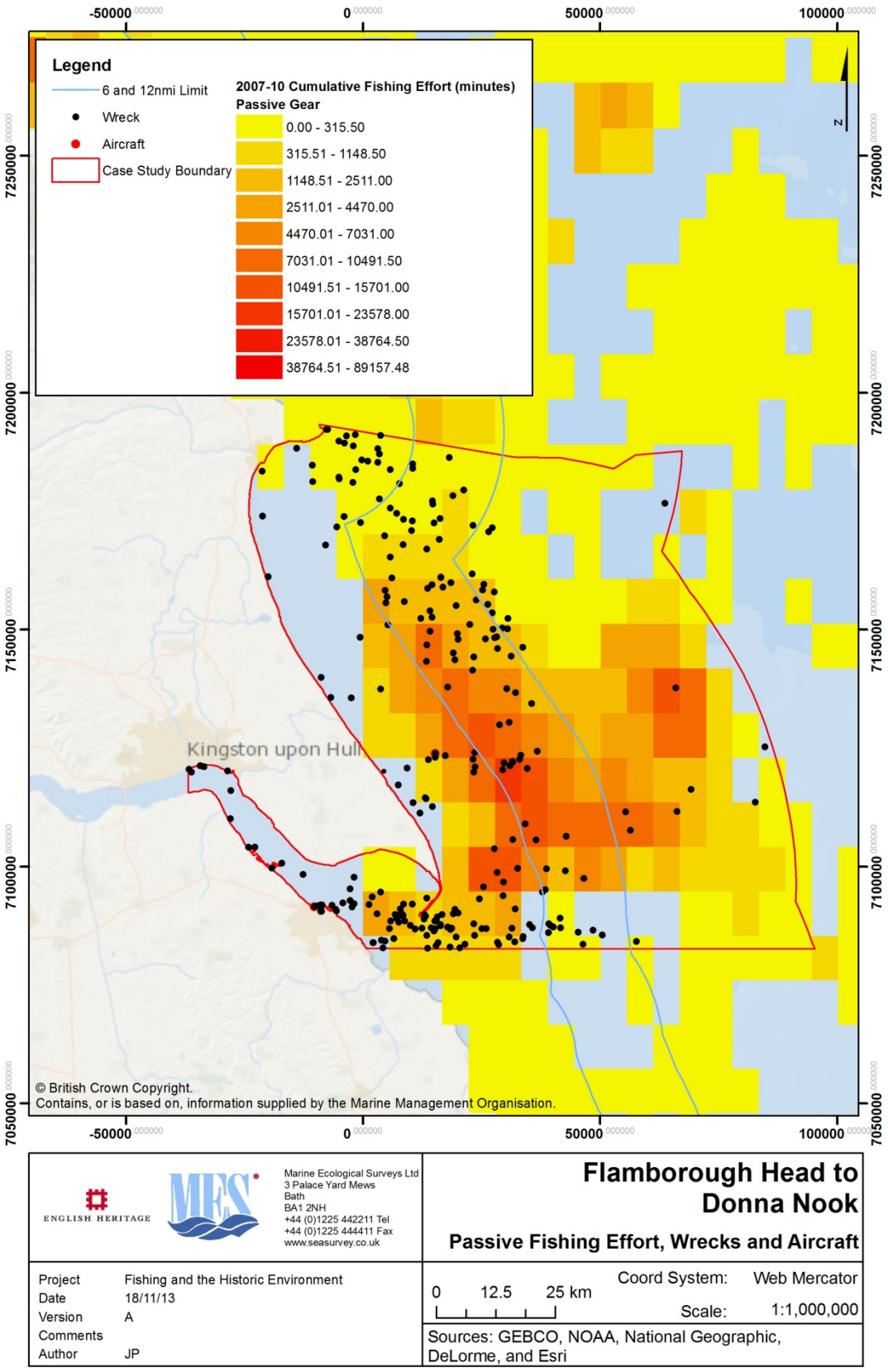


Figure 26: VMS effort data for passive gears in Area 1, 2010 (Data provided by the MMO, 2013)

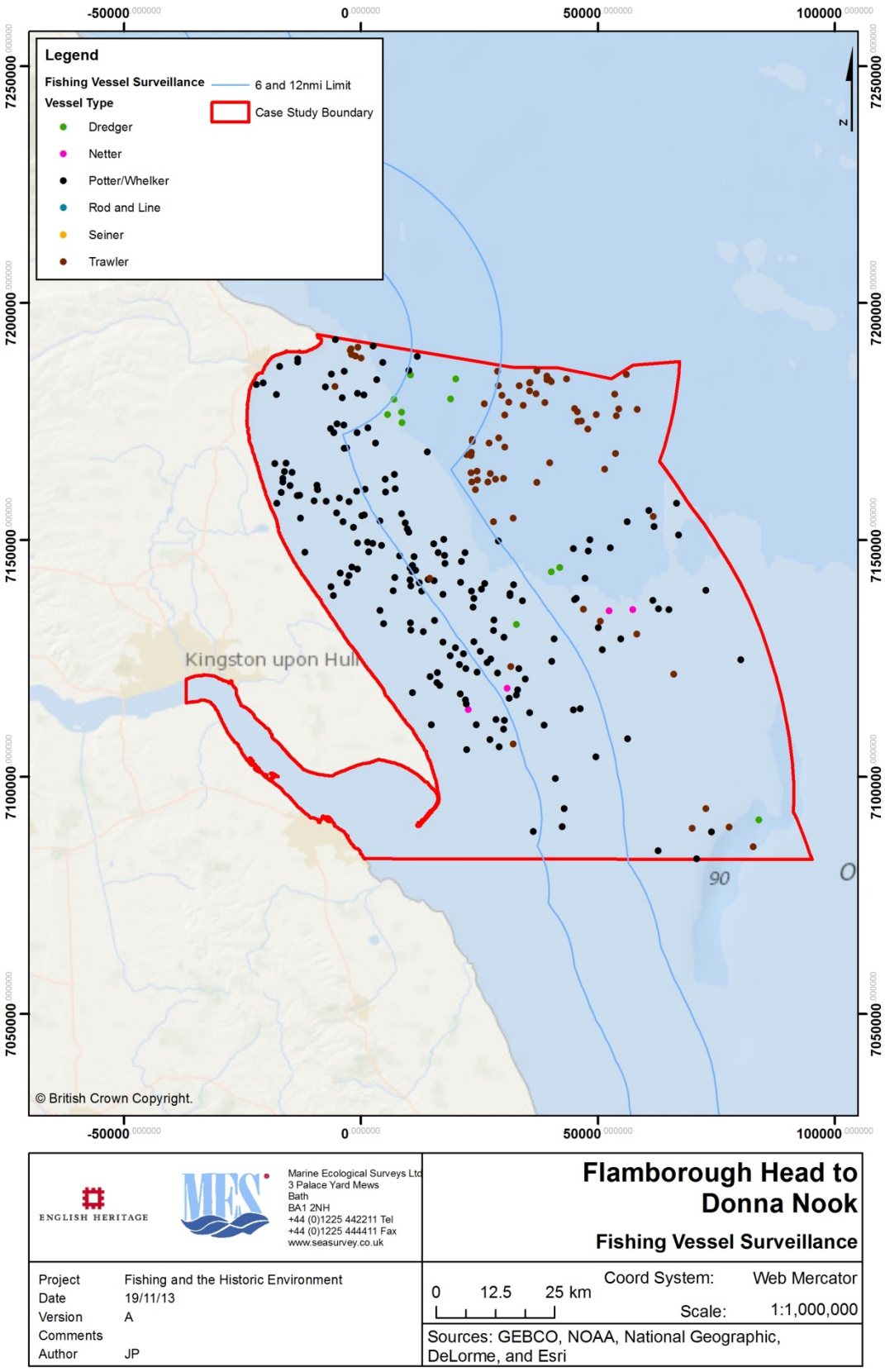


Figure 27 Vessel surveillance data (air and sea) 2010-2012 (Data provided by the MMO, 2013)

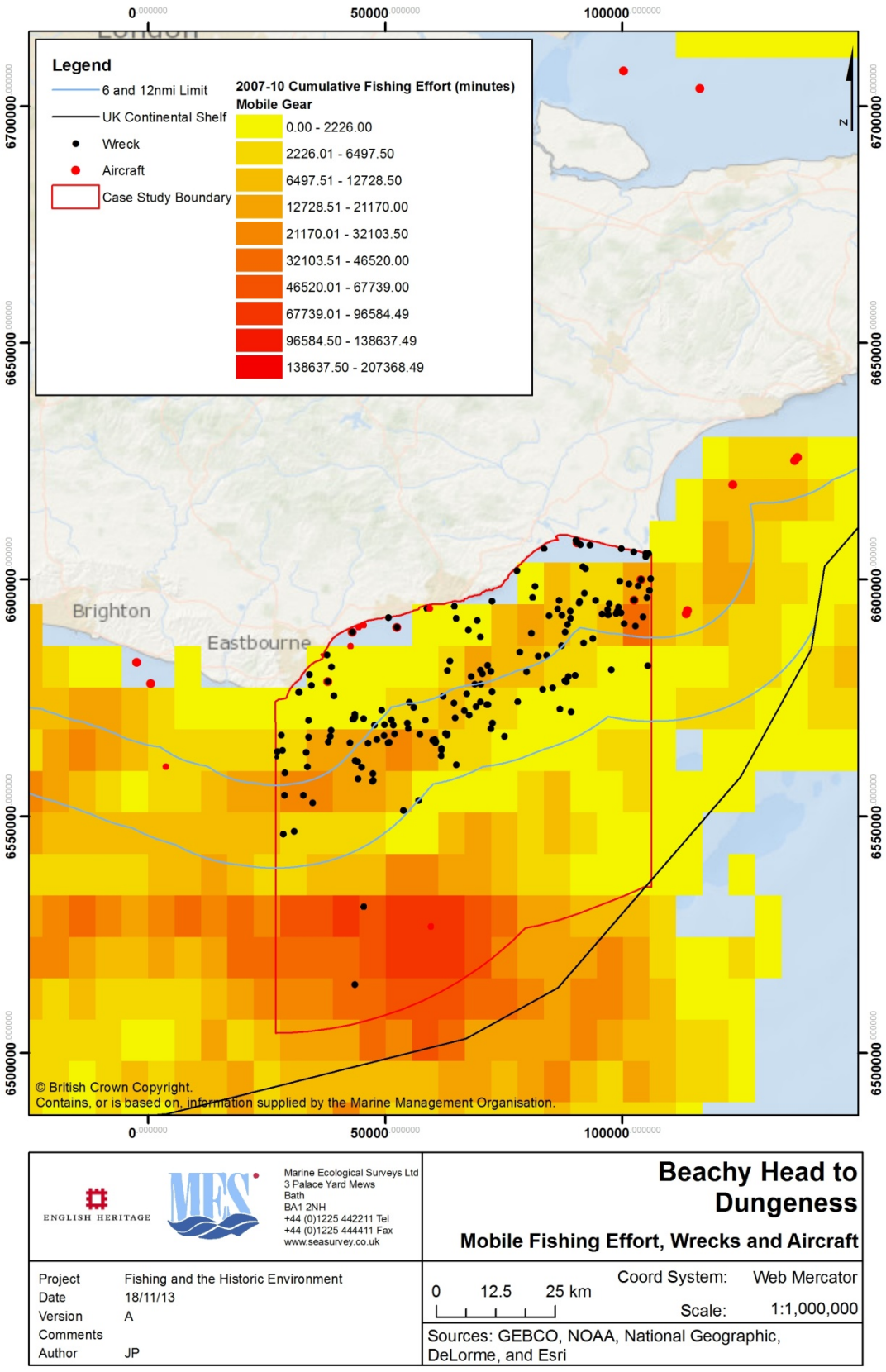


Figure 28: VMS effort data for mobile gears in Area 2, 2010 (Data provided by the MMO, 2013)

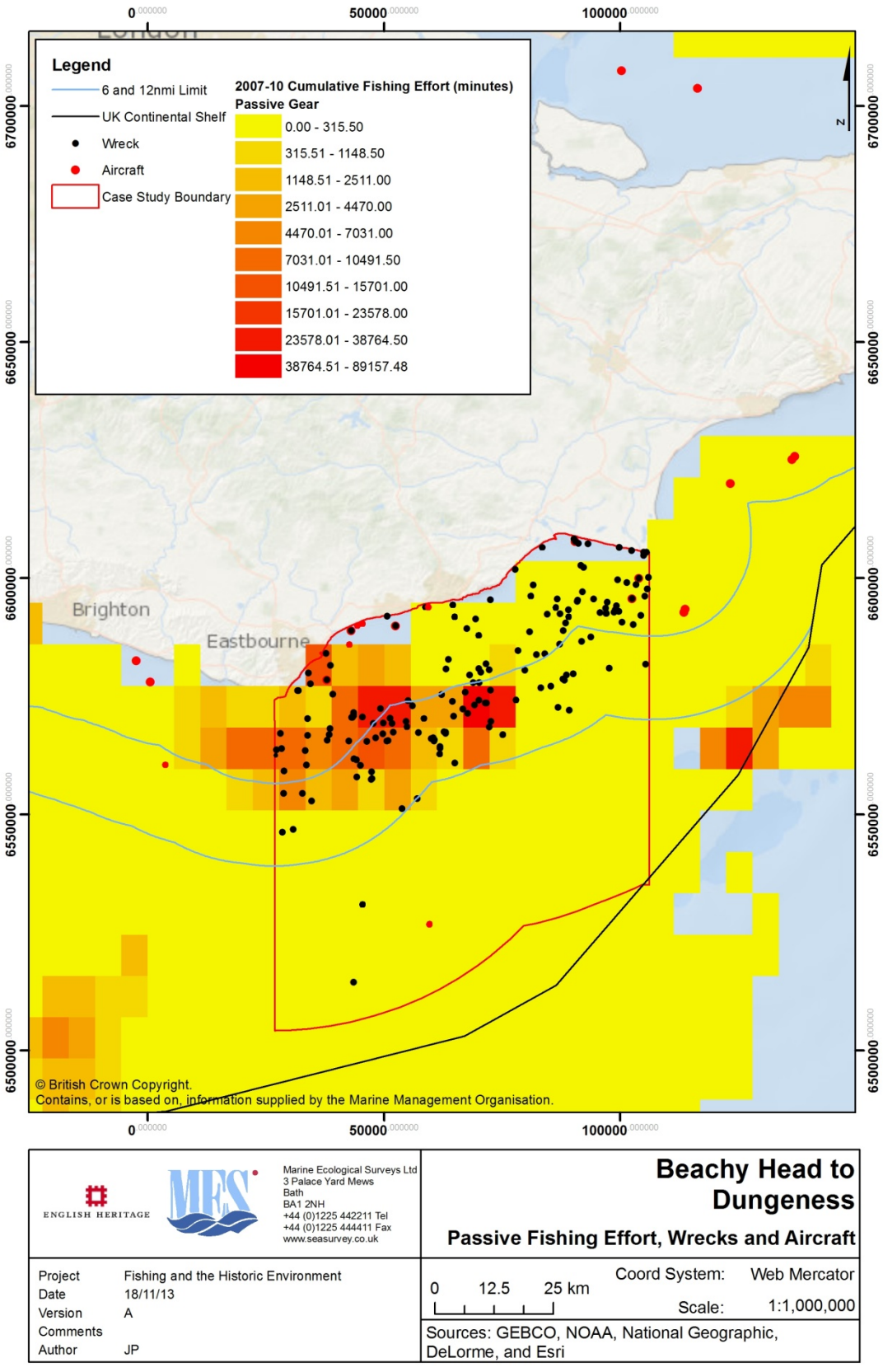


Figure 29: VMS effort data for passive gears in Area 2, 2010 (Data provided by the MMO, 2013)

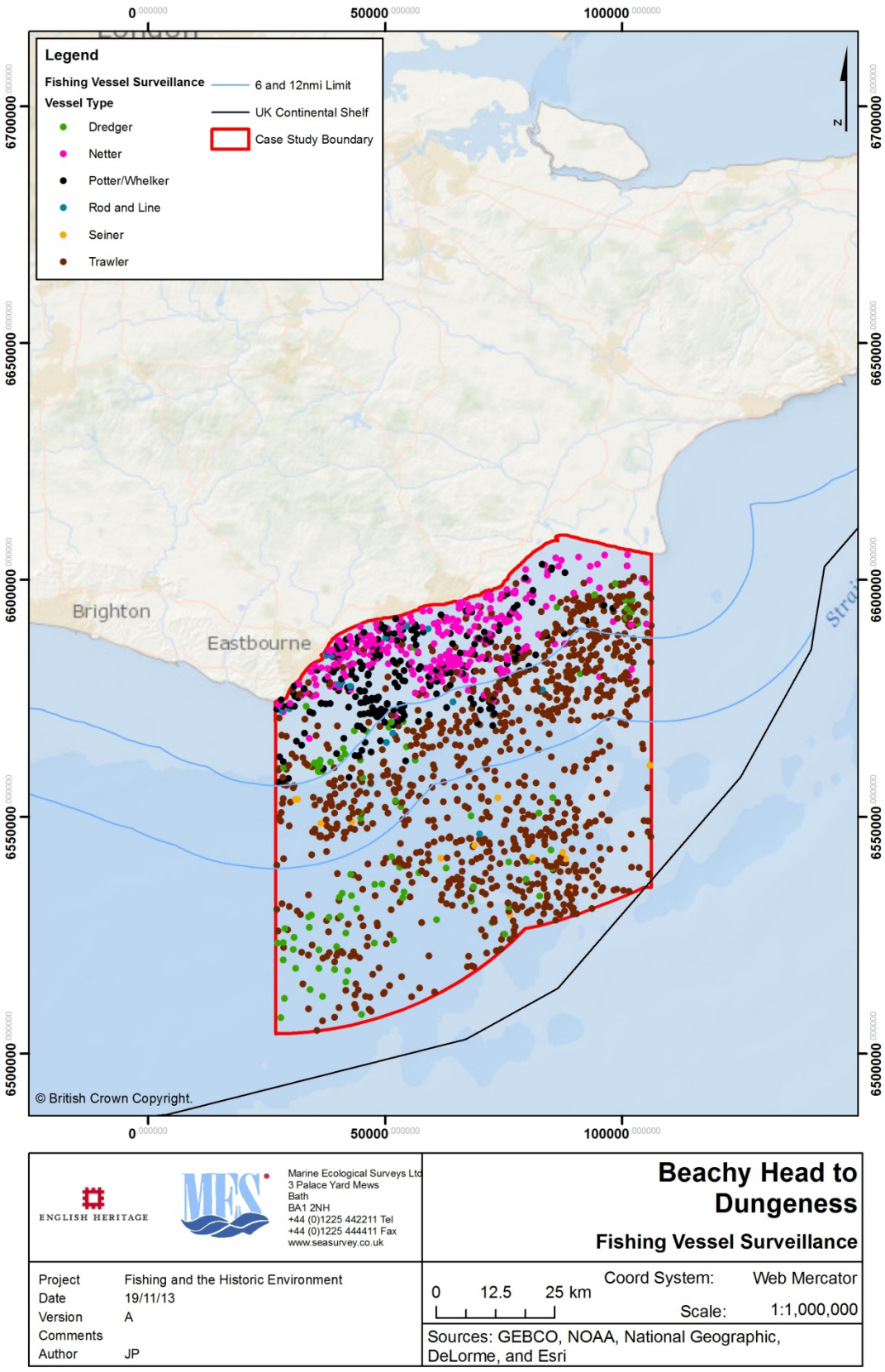


Figure 30: Vessel surveillance data (air and sea) 2010-2012 (Data provided by the MMO, 2013)

8.4. DISCUSSION

Anticipating the extent of fishing-heritage interactions, particularly those occurring with unknown heritage sites, is clearly limited by the current limitations in fisheries distribution data and the need to investigate the origin of fishermen's fasteners. Confidently mapping the extent of interactions between commercial fishing and the historic environment will depend on significant improvements in baseline data relating to fishing effort and the actual presence and character of heritage assets on the seabed. It is not proposed that any specific additional mapping is carried out, but the management options and research needs already identified should be addressed in such a way as to make best use of spatial fisheries management data, and to result in dependable mapped outputs on the presence of heritage assets.

9. PROPOSALS/ACTION PLAN

Throughout this document, specific management options and research needs have been identified in the course of setting out the scope of, and evidence for, specific interactions between commercial fishing and the historic environment. These management options and research needs are summarised in **Appendix 5**; implementation of these recommendations should take full account of the need to work collaboratively with industry and other stakeholders.

The key to successful management of the historic environment and commercial fishing is the establishment of a strong working relationship between stakeholders: archaeologists, fishers, scientists and regulatory bodies. Mistrust and a lack of shared understanding will prevent appropriate actions for the protection of both heritage and fishers' rights from being taken.

Over the past 40 years, the UK fishing industry has been subject to ever increasing levels of EU and domestic regulation and has seen sharp reductions in fishing opportunities. The regulatory burden faced by the industry is substantial. This influences attitudes towards taking on additional burdens and working with government and other official bodies. There can also be a cultural divide between officialdom and fishers who make their living from what is still the most dangerous occupation in the UK. It is important that this is understood when considering how to enlist the support of the industry. Whilst fishers are proud of their marine heritage and will often be willing to share their knowledge and experiences, they are unlikely to welcome more paperwork and bureaucracy without some benefit to them and their business.

There are opportunities to provide suitable incentives which could directly benefit individual fishers as well as provide additional information about heritage assets and facilitate their protection. As already indicated, the FLAGs have funds available through the EFF. The FLAGs could be encouraged to develop projects that would build relations between fishers and archaeologists, improve knowledge of archaeological resources and provide socio-economic benefits through the use of local maritime heritage as a basis for tourism within fishing communities. The EFF comes to an end in 2013 (though funding can continue on projects agreed before then) and it seems that there is a likelihood of the UK under-spending (the MMO's latest corporate plan refers to the possibility of de-commitment).

Other EFF funds are available under Axis 1 for equipment on fishing vessels that improves sustainability including equipment to minimise the impact of fishing on the wider marine environment. Discussions could be held with fishermen's organisations, local and regional groups and the MMO about whether these funds might be used as part of a project with groups of fishermen to build up information about the location of heritage assets and to develop gear types that would minimise the risk of damage.

The successor grant regime, EMFF, is still in the course of development. But it seems likely that it will afford similar opportunities to EFF and, indeed, it might go further in terms of enabling fishers to diversify and to become more involved in marine science, seabed mapping and managing the marine environment. Defra will be consulting on the Operational Programme in 2013 which will enable input into the shape and priorities of EMFF as applied in England and the UK. We suggest that English Heritage and local archaeological groups could work alongside the MMO to ensure that the

Operational Programme recognises the importance of heritage assets and how fishers could contribute to identifying, protecting and monitoring sites.

The issue of non-UK registered vessels having access to English waters and possibly placing heritage assets at risk as the result of damaging fishing activities is a complex problem. It is not unique to heritage assets, though there is not the same level of protection EU-wide for heritage assets as, for example, under the Habitats Directive. This is another area we suggest where English Heritage will want to work with Defra, the MMO, and the Fisheries Regional Advisory Councils perhaps with a view to developing protocols that might be agreed with the various parties involved. There might even be the possibility of developing joint funding initiatives though EMFF.

Many fishing vessels already carry sophisticated equipment to increase their ability to catch target species. For relatively modest investment they might be willing to share data, such as the location of wrecks or high resolution seabed maps, which would provide information useful to English Heritage and archaeological groups. Alternatively, it might be possible to find nil cost options which offered non-monetary or indirect benefits to fishers (for example, by providing flexibility in the interpretation and application of fisheries management regulations or sharing detailed archaeologically-derived data).

We suggest that English Heritage engage with Seafish, the MMO, IFCAs and industry representatives to prepare good practice guidelines on how damage to heritage assets can be avoided, for example, guidance on gear handling. Such guidance could be disseminated in a number of ways including practical workshops and waterproof documents for use by fishers onboard their vessel.

All communications with the industry need to take into account the pressures that they are under, their priorities, their fields of expertise and how information can best be shared. Whilst protection of the marine historic environment is an important goal, the needs and perceptions of the fishing industry should also be respected. Failure to do so could endanger conservation goals on all sides and may also have significant socio-economic impacts.

By acknowledging the value of fishing heritage, it is believed that a positive interaction can be formed between fishing and archaeology, stakeholder relations can be improved and fishers and local communities may be provided with a sense of cultural pride and value.

10. CONCLUSION

As a non-renewable asset, the marine historic environment requires careful management in order to conserve and protect our cultural heritage from threat of damage and deterioration. It is widely accepted that commercial fishing, as a major anthropogenic influence on the marine environment, will have and has had some interaction with marine heritage assets. The nature of these interactions, however, has remained elusive.

In order to address the aims of the project, an account of the English fishing fleet, and the range of fishing gears employed by commercial fishermen, has been developed alongside a conceptual framework for the marine historic environment, for incorporation within an assessment of fishing-heritage interactions.

A number of potential and evidenced interactions between commercial fishing and heritage assets have been identified within this report. Beneficial and adverse interactions have been identified for both fishers and heritage. The key focus for heritage management arising from these interactions is the significance and extent of damage caused by interactions to both commercial fishers and heritage assets, and the delivery of mitigatory management actions.

Limited evidence for fishing-heritage interactions, with much of it anecdotal, has led to wide conjecture regarding the extent of interaction impacts, some of which may no longer be as relevant as they once historically were, as gear types and scale and intensity have changed over time.

The advent of technological improvements to fishing gear and improvements in our understanding of the marine historic environment would suggest that with further research and changes to management it will be possible to mitigate negative fishing-heritage interactions and enhance positive interactions.

A number of multi-disciplinary management options and research needs have been identified in this report, which, if taken forward are expected to contribute positively to the sustainable management of both archaeological and commercial fishing interests.

GLOSSARY

Commercial fishing activity	The activity of catching and landing seafood for commercial gain.
Cumulative impacts	Impacts arising from a number of interactions, of the same or differing source, which together have greater consequence.
Demersal fishing	Fishing activities occurring on or near the seafloor.
Dredges	Fishing gear used to capture sedentary demersal and benthic species, the dredge may be mechanically or hydraulically operated.
Mussels, clams, oyster dredge	A mouth frame with a chain-meshed net.
Scallop dredge	A toothed-dredge with a chain-meshed net which is towed along the seafloor. The 'teeth' are designed to disturb scallops which are slightly buried within the sediment.
Findspot	The place where one or more artefacts have been found. This may prove to be associated with a site, other finds, natural features etc., or isolated (no apparent relationships).
Fisheries sustainability assessment methodology	The methodology followed by assessors when assessing conformity against a fisheries sustainability standard (principles and criteria).
Ghost fishing	Continued capture of seabirds and marine life by abandoned, lost or otherwise discarded fishing gear
Gillnets	A single wall of netting in which the target species becomes caught by the gills as they try to swim through. Gillnets may be statically anchored i.e. affixed near to or on the seabed, or allowed to passively drift with the current (drift nets).
Habitat function	The range of services provided by an ecosystem which influences the behaviour of organisms, such as trophic interactions and sanctuary.
Habitat structure	The amount, composition, and three-dimensional arrangement of biological and physical matter in an area, providing sanctuary and surface area within a marine ecosystem.

Heritage asset	Heritage features - buildings, monuments, sites, or landscapes - identified as of significant value to this and future generations because of their heritage interest, thus meriting consideration in planning decisions.[26] These include designated heritage assets and assets identified by the local planning authority.[27]
Historic environment	Includes aspects of the environment resulting from the interaction between people and places through time, including physical remains of past human activity, whether visible, buried or submerged, and landscaped and planted or managed flora.[26,27]
Historic features	Archaeological sites and remains which collectively make up the historic environment.
Pelagic fishing	Fishing activities occurring within the water column.
Pots and traps	Cages or baskets used to capture fish and crustaceans, typically baited with a funnel opening to allow the target species in but not out. Pots may be set individually or in a number connected by a line.
Precautionary approach	Operating in a conservative manner for situations where there is a lack of scientific certainty.
Risk-Based Framework (RBF)	Assessment tools used to determine levels of interaction in cases where insufficient data and information are available.
Scatter / debris field	The area over which the structure / artefacts have been dispersed following construction / deposition. This may have arisen from a single original source or multiple sources.
Scoring elements	These constitute a list of matters to be taken into account when identifying and determining the performance score of an indicator, for example, a sub-division of individual parts of the habitat which are affected by fishing operations.
Seine nets	Encircling nets, operated from the shore or boats, with two long ropes attached at the ends of the net.

[26] HM Government, 2011. *UK Marine Policy Statement*, London: The Stationary Office. Available at: https://www.gov.uk/government/publications/uk-marine-policy-statement

[27] See Annex 2: Glossary, National Planning Policy Framework, Department for Communities and Local Government, 2012

Beach seine	A seine net operated by the shore.
Purse seine	A seine net used for surrounding pelagic schools of fish, with a purse line at the bottom of the net allowing it to be drawn closed thus preventing fish from escaping the bottom of the net.
Setting	The surroundings within which the site / scatter / findspot is experienced.
Tangle nets	A single wall of slack netting in which the target species becomes entangled as they try to swim through, similar to gillnets.
Trammel nets	A wall of three nets with differing mesh hole sizes, in which the target species becomes entangled as they try to swim through.
Trawling	Towing of a cone-shaped net fitted with a cod-end. Trawl nets may be deployed as mid-water (pelagic) or bottom trawls (demersal). The method of keeping the trawl net open is dependent upon the type of trawl. The mouth of bottom trawl nets may be fitted with heavy chains known as **tickler chains**, which are used to disturb fish from the seabed and encourage them into the net.
Pair trawl	A trawl towed between two vessels, may be a mid-water or bottom trawl.
Beam trawl	A bottom trawl, held open by a horizontal beam.
Otter trawl	A bottom trawl, held open by otter boards (also known as trawl doors)
Multi-rig trawl	Two side-by-side otter trawls towed by an individual vessel.
Trawl scars	grooves or furrows in the sediment resulting from penetration of the seafloor by gear components

REFERENCES

Auer, J. and Firth, A., 2007. The 'Gresham Ship': An Interim Report on a 16th-century Wreck from Princes Channel, Thames Estuary. *Post-Medieval Archaeology*, 41 (**2**) (December 1): 222–241. doi:10.1179/174581307X318967.

Brickhill, M. J., Lee, S. Y and Connolly, R. M., 2005. Fishes Associated with Artificial Reefs: Attributing Changes to Attraction or Production using novel Approaches. *Journal of Fish Biology*, 67, 53-71.

Brown, J., Macfadyen, G., Huntington, T., Magnus, J. and Tumilty, J., 2005. *Ghost Fishing by Lost Fishing Gear.* Final Report to DG Fisheries and Maritime Affairs of the European Commission. Fish/2004/20. Institute for European Environmental Policy / Poseidon Aquatic Resource Management Ltd joint report.

Carleton, C., Medley, P., Southall, T., Nimmo, F., Tarrant, D., Gill, M., Dapling, D., Clark, R. and Vause, B., 2009. *UK Inshore Fisheries Sustainability Project – Pilot Phase*. Stage 2 Report: pre-assessment of twenty-six fisheries to the MSC standard.

Coelho, R., K. Er zini, L. Bentes, C. Correia, P. G. Lino, P. Monteiro, J. Ribeiro, and J. M. S. Gonçalves. 2005. Semi-pelagic Longline and Trammel Net Elasmobranch Catches in Southern Portugal: Catch Composition, Catch Rates and Discards. *Journal of Northwest Atlantic Fishery Science*, 35, 531-537. doi:10.2960/ J.v35.m482.

Council of Europe, 1992. European Convention on the Protection of the Archaeological Heritage [revised]. Valetta, 16 January 1992.

Creative Research, 2009. A Fisherman's Tale: Being a Fisherman in England in 2009, Report of Research Findings. Prepared for Defra.

Currie, D.R. and Parry, G.D., 1996. Effects of scallop dredging on a soft sediment community: a large-scale experimental study. *Marine Ecology Progress Series*, 134, 131–150.

Defra, 2011. *Fishing Focus*, Issue 23. Autumn 2011.

Defra, 2012. *Marine Conservation Zones: Consultation on proposals for designation in 2013*. Available at: http://www.defra.gov.uk/consult/2012/12/13/marine-conservation-zones-1212/ [Accessed 08 January 2013].

Devon Wildlife Trust, 2007. Lyme Bay Reefs – A 16 year search for sustainability.

Eastwood, P.D., Mills, C.M., Aldrige, J.N., Houghton, C.A. and Rogers, S.I., 2007. Human activities in UK offshore waters: an assessment of direct, physical pressure on the seabed. *ICES Journal of Marine Science*, 64, 453–463.

EC contract FAIR-PL98-4338, 2003. A study to identify, quantify and ameliorate the impacts of static gear lost at sea. (FANTARED 2).

English Heritage, 2002. Taking to the Water: English Heritage's Initial Policy for the Management of Maritime Archaeology in England. London: English Heritage.

English Heritage., 2007. *Monument No. 1401518*. [online] Past Scape. Available at: http://www.pastscape.org.uk [Accessed 09 January 2013].

English Heritage, 2008, *Conservation Principles: policies and guidance for the sustainability and management of the historic environment.* English Heritage.

English Heritage, 2008. Protected Wreck Sites at Risk, A Risk Management Handbook. Available at:

http://www.english-heritage.org.uk/publications/protected-wreck-sites-at-risk-handbook/ [Accessed 26 March 2013].

English Heritage, 2011. *River Fisheries and Coastal Fish Weirs*. Introductions to Heritage Assets. English Heritage.

English Heritage, 2012. *Protected Wreck Sites FAQ*. [online] Available at: http://www.english-heritage.org.uk/caring/listing/protected-wreck-sites/protected-wreck-sites-faqs/ [Accessed 24 January 2013].

English Heritage, September 2013, *Introductions to Heritage Assets. Ships and Boats: 1840 to 1950*. English Heritage.

Eno, N. C., MacDonald, D. S., Kinnear, J. A. M., Amos, C. S., Chapman, C. J., Clark, R. A., Bunker, F. St P. D., and Munro, C., 2001. Effects of crustacean traps on benthic fauna. *ICES Journal of Marine Science*, 58: 11–20.

FAO. 1990. *Definition and Classification of Fishing gear categories*, FAO Fisheries Technical Paper 222 Rev.I Rome.

FAO, 2013. *Fishing gear and methods: Definitions* [online] Available at: http://www.fao.org/fishery/topic/1617/en [Accessed 07 January 2013].

Farnet, 2013. *United Kingdom FLAG factsheets* [online] Available at: https://webgate.ec.europa.eu/fpfis/cms/farnet/united-kingdom-flag-factsheets [Accessed 24 April 2013].

Ferrari, B., 1994. Physical Biological and Cultural Factors Influencing the Formation, Stabilisation and Protection of Archaeological Deposits in UK Coastal Waters, PhD thesis, University of St. Andrews.

Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas, 2012. Impact Assessment materials in support of the Regional Marine Conservation Zone Projects' Recommendations.

Flatman, J., 2009. A Climate of Fear: Recent British Policy and Management of Coastal Heritage. *Public Archaeology*, 8 (**1**), 3–19.

Fonteyne, R., 2000. Physical impact of beam trawls on seabed sediments. p.15-36, in: M.J. Kaiser and S.J. de Groot (eds). *The Effects of Fishing on Non-target Species and Habitats*. Oxford, UK: Blackwell Science.

Fossa, J. H., Mortensen, P.B. and Furevik, D.M., 2002. The Deep-water Coral Lophelia Pertusa in Norwegian Waters: Distribution and Fishery Impacts. *Hydrobiologia* 471 (**1-3**), 1–12.

Fowler, A. M. and Booth, D. J., 2012. How well do sunken vessels approximate fish assemblages on coral reefs? Conservation implications of vessel-reef deployments. *Marine Biology*, 159 (**12**), 2787-2796.

Galbraith, R.D. and Rice, A. after Strange, E.S., 2004. *An introduction to commercial fishing gear and methods used in Scotland*. FRS Marine Laboratory, Scottish Fisheries Information Pamphlet No. 25/2004. [online] Available at:

http://www.scotland.gov.uk/Topics/marine/science/Publications/FRS-Reports/Information-Pamphlets/SFIPNo25 [Accessed: 07 January 2013].

Gray, M.J. 1995. *The coastal fisheries of England and Wales, Part III: A review of their status 1992-1994*. Fisheries Research Technical Report No. 100. Directorate of Fisheries Research, Lowestoft, United Kingdom.

Good, T.P., June, J.A., Etnier, M. and Broadhurst, G., 2007. Quantifying the impact of derelict fishing gear on the marine fauna of Puget Sound and the Northwest Straits. ICES CM 2007/Q:09.

Gregory, D., Jensen, P. and Strætkvern, K., 2012. Conservation and in situ preservation of wooden shipwrecks from marine environments. *Journal of Cultural Heritage*, 13 (**3**) Supplement, S139–S148.

Grenier, R., Nutley, D. and Cochran, I., (Eds.) 2006. *Underwater Cultural Heritage at Risk: Managing Natural and Human Impacts.* Heritage at Risk – Special Edition.

Grieve, C., Brady, D.C., and Polet, H., 2011. Best Practices for Managing, Measuring, and Mitigating the Benthic Impacts of Fishing: Final Report to the Marine Stewardship Council. Unpublished work.

Hall-Spencer, J.M., Froglia, C., Atkinson, R.J.A. and Moore, P.G., 1999. The impact of Rapido trawling for scallops, Pecten jacobaeus (L.), on the benthos of the Gulf of Venice. *ICES Journal of Marine Science*, 56, 111–124.

Hamel, A., 2011. Wrecks at Sea: Marine ALSF Research in Context*. Marine ALSF Science Monograph Series No. 6* (Ed. J. Gardiner). MEPF 10/P152. (Edited by R. C. Newell and J. Measures). 54pp. ISBN: 978 0 907545 50 7.

Hansard HC Deb 04 May 1973 vol 855 cc1682-707.

Hiddink, J. G., Jennings, S., Kaiser, M. J., Queirós, A. M., Duplisea, D. E., and Piet, G. J. 2006a. Cumulative impacts of seabed trawl disturbance on benthic biomass, production and species richness in different habitats. *Canadian Journal of Fisheries and Aquatic Sciences*, 63: 721-736.

HM Government, 2010, *The Government's Statement on the Historic Environment for England 2010*. Department of Culture, Media and Sport.

HM Government, 2011, *The UK Marine Policy Statement*. HMSO.

Hobday, A.J., Smith, A.D.M., Stobutzki, I.C., Bulman, C., Daley, R., Dambacher, J.M., Deng, R.A., Dowdney, J., Fuller, M., Furlani, D., Griffiths, S.P., Johnson, D., Kenyon, R., Knuckey, I.A., Ling, S.D., Pitcher, R., Sainsbury, K.J., Sporocic, M., Smith, T., Walker, T.I., Wayte, S.E., Webb, H., Williams, A., Wise, B.S. and Zhou, S., 2011. Ecological Risk Assessment for the effects of fishing. *Fisheries Research*, 108, 372-384.

Holderness Coast FLAG, 2011. *Holderness Coast Fishery Local Action Group Draft Strategy*. Available at: http://www.eastriding.gov.uk/corp-survey/snapform/Weblinks/FLAGdraftstrategy.pdf [Accessed 14 March 2013].

Hopkins, C.C.E., 2003. *The dangers of bottom trawling in the Baltic Sea*. A report for Coalition Clean Baltic.

Intertek Moody Marine, 2012. Hastings Fleet Dover Sole Trammel Net, Gill Net and Trawl Fisheries: Public Certification Report. Marine Stewardship Council.

Jacob, E., 1782. Observations on the Roman Earthen Ware Taken from the Pan-Pudding Rock. *Archaeologia,* 6: 121–124.

James, J.W.C, Pearce, B., Coggan, R.A., Arnott, S.H.L., Clark, R., Plim, J.F., Pinnion, J. et al. 2010. *The South Coast Regional Environmental Characterisation*. British Geological Survey report OR/09/051.

James, J.W.C., Pearce, B., Coggan, R.A., Leivers, M., Clark, R.W.E., Plim, J.F., Hill, J.M., Arnott, S.H.L., Bateson, L., De-Burgh Thomas, A. and Baggaley, P.A., 2011. *The MALSF synthesis study in the central and eastern English Channel*. British Geological. Survey Open Report OR/11/01. 158pp.

Jennings, S., Dinmore, T.A., Duplisea, D.E., Warr, K.J. and Lancaster, J.E., 2001. Trawling disturbance can modify benthic production processes. *Journal of Animal Ecology*, 70, 459-475.

Jennings, S., Kaiser, M.J. and Reynolds, J.D., 2001. *Marine Fisheries Ecology*. Blackwell Publishing company, Oxford, UK.

Jennings, S. and Lee., J., 2012. Defining fishing grounds with vessel monitoring system data. *ICES Journal of Marine Science*, 69 (**1**), 51-63.

Johnson, K.A., 2002. *A Review of National and International Literature on the Effects of fishing on Benthic Habitats.* NOAA Technical Memorandum NMFS-F/SPO-57. Available at: www.vliz.be/imisdocs/publications/134254.pdf [Accessed 30 January 2013].

Kaiser, M. J., Hill, A.S., Ramsay, K., Spencer, B.E., Brand, A.R., Veale, L.O., Prudden, K., Rees, E.I.S., Munday, B.W., Ball, B. and Hawkins, S.J., 1996. Benthic disturbance by fishing gear in the Irish Sea: a comparison of beam trawling and scallop dredging. *Aquatic Conservation Marine and Freshwater Ecosystem*, 6, 269–295.

Kaiser, M.J., Clarke, K.R., Hinz, H., Austen, M.C.V., Somerfield, P.J. and Karakassis, I., 2006. Global analysis of response and recovery of benthic biota to fishing. *Marine Ecology Progress Series*, 311, 1–14.

Kingsley, S., 2009. Deep-Sea Fishing Impacts on the Shipwrecks of the English Channel and Western Approaches. *Odyssey Papers 4*. Odyssey Marine Exploration. [online] Available at: http://www.shipwreck.net [Accessed 17 January 2013].

Kingsley, S., 2010. Deep-Sea Fishing Impacts on the Shipwrecks of the English Channel and Western Approaches. In *Oceans Odyssey: Deep-sea Shipwrecks in the English Channel, Straits of Gibraltar and Atlantic Ocean*. Oxford: Oxbow Books.

Kingsley, S., 2012. *Out of Sight, Out of Mind? Fishing and Shipwrecked Heritage*. Wreck Watch Int., London, UK. [online] Available at: http://wreckwatch.files.wordpress.com/2012/08/fishingheritage-kingsley1.pdf [Accessed 26 November 2012].

Krost, P., Bernhard, M., Werner, F. and Hukriede, W., 1990. Otter trawl tracks in Kiel Bay (Western Baltic) mapped by side-scan sonar. *Meeresforschung,* 32, 344–353.

Lee, J., South, A. B., and Jennings, S., 2010. Developing reliable, repeat-able, and accessible methods to provide high-resolution estimates of fishing-effort distributions from vessel monitoring system (VMS) data. *ICES Journal of Marine Science*, 67, 1260–1271.

Løkkeborg, S., 2005. *Impacts of trawling and scallop dredging on benthic habitats and communities*. FAO Fisheries Technical Paper. No. 472. Rome, FAO. 58p.

Mott MacDonald, 2008a. *Pilot Shellfish Fisheries Strategic Environmental Assessment*. North Eastern Sea Fisheries Committee. Bridlington, East Riding of Yorkshire, YO16 4LP.

Mott MacDonald, 2008b. *Pilot Shellfish Fisheries Strategic Environmental Assessment Overarching Report.* North Eastern Sea Fisheries Committee. Bridlington, East Riding of Yorkshire, YO16 4LP.

Macfadyen, G., Huntington, T. and Cappell, R., 2009. *Abandoned, lost or otherwise discarded fishing gear.* UNEP Regional Seas Reports and Studies, No. 185; FAO Fisheries and Aquaculture Technical Paper, No. 523. Rome, UNEP/FAO. 115p

MacMullen, P.H., 2011. *Underwater Cultural Heritage, an Assessment of Risks from Commercial Fishing*. Report prepared by SeaFish UK for the Joint Nautical Archaeological Policy Committee, Seafish Report CR643.

Marine Stewardship Council, 2010. *Fisheries Assessment Methodology*, Version 2.1.

Marine Stewardship Council, 2013a. *Hastings fleet pelagic herring* [online] Available at: http://www.msc.org/track-a-fishery/fisheries-in-the-program/certified/north-east-atlantic/hastings-fleet-pelagic-herring-and-mackerel [Accessed 11 January 2013].

Marine Stewardship Council, 2013b. *Hastings fleet pelagic mackerel* [online] Available at: http://www.msc.org/track-a-fishery/fisheries-in-the-program/in-assessment/north-east-atlantic/hastings-fleet-pelagic-herring-and-mackerel [Accessed 11 January 2013].

Marine Stewardship Council, 2013c. *Hastings fleet Dover sole* [online] Available at: http://www.msc.org/track-a-fishery/fisheries-in-the-program/certified/north-east-atlantic/Hastings-fleet-Dover-sole-trawl-and-gill-net [Accessed 11 January 2013].

Maritime Archaeology Ltd, and Seazone Group / HR Wallingford., 2011. Historic Seascape Characterisation: Hastings to Purbeck and Adjacent Waters.

McBreen, F., Askew, N. and Cameron, A., 2011. *UKSeaMap 2010: Predictive mapping of seabed habitats in UK waters*. JNCC Report, No. 446.

Merritt, O., 2008. *Refining Areas of Maritime Archaeological Potential for Shipwrecks - AMAP 1*. Prepared for English Heritage under the Marine ALSF 5083.

MMO, 2012. *Lyme Bay and Torbay candidate Special Area of Conservation Vessel Monitoring System Trial – Joint Final Report*. MMO, 2013. Axis 4. [online] Available at: http://www.marinemanagement.org.uk/fisheries/funding/eff_axis4.htm [Accessed 24 April 2013].

MMO, 2013. UK Sea Fisheries Statistics 2012.

Mol, D., de Vos, J., Bakker, R., van Geel, B., Glimmerveen, J., van der Plicht, H. and Post, K., 2008. *Kleine encyclopedie van het leven in het Pleistoceen: mammoeten, neushoorns en andere dieren van de Noordzeebodem*. Diemen: Veen Magazines.

Nautical Archaeology Society, 2013. *Holland 5 Submarine*. [online] Available at: http://www.nauticalarchaeologysociety.org/projects/holland5.php [Accessed 01 February 2013].

Nimmo, F. and Southall, T. 2012. *Project Inshore – Stage 1 Report*. Seafish Industry Authority (www.seafish.org).

Nédélec, C. and Prado, J. 1999. Definition and classification of fishing gear categories. *FAO – Fisheries Technical Paper 222.* Fisheries Industry Division.Rome. Italy.

North Eastern IFCA, 2011. *Summary of fishing effort.*

North Eastern IFCA, 2012. *Quarterly Meeting, Agenda*. 06 December 2012.

North Eastern IFCA. 2013. *Byelaw XXVIII Crustacean Conservation Byelaw – Impact Assessment.* [online] Available at: http://www.ne-ifca.gov.uk/legislation-and-byelaws/byelaw-regulations/ [Accessed 07 August 2013]

Oxford Archaeology, 2010. Heritage Protection Reform Implementation - COSMIC Implementation: Pilot Project East Midlands Region Stage 1 Final Report. Unpublished report ref: 5621.

Parham, D., 2009. Comments on Odyssey Paper 4 - Deep-sea Fishing Impacts on the Shipwrecks of the English Channel and Western Approaches.

Prime Minister's Strategy Unit., 2004. Net Benefits, a Sustainable and Profitable Future for UK Fishing [online] Available at:

http://webarchive.nationalarchives.gov.uk/+/http://www.cabinetoffice.gov.uk/strategy/work_areas/fisheries.aspx [Accessed 23 January 2013].

Randall, P., Armstrong, F. and Peach, D., 2012. *Gillnet Pollack Survey*. Cefas, Lowestoft, UK.

Revill, S.A., and Dunlin, G. 2003. The fishing capacity of gillnets lost on wrecks and on open ground in UK coastal waters. *Fisheries Research*, 64, 107-113.

Rieman, B. and Hoffmann, E., 1991. Ecological consequences of dredging and bottom trawling in the Limfjord, Denmark. *Marine Ecology Progress Series*, 69, 171-178.

Roberts, C., Smith, C., Tillin, H., and Tyler-Walters, H. 2010. *Evidence – Reviewing of existing approaches to evaluate marine habitat vulnerability to commercial fishing activities*. Report SC080016/R3. Environment Agency, Bristol. UK.

Roberts, P. and Trow, S., 2002. Taking to the Water: English Heritage's Initial Policy for The Management of Maritime Archaeology in England. English Heritage.

Sainsbury, J.C. 1996. Commercial Fishing Methods: an Introduction to Vessels and Gear. Fishing News Books, Oxford. UK.

Seafish, 2005. *Basic Fishing Methods handbook*. Seafish Industry Authority (www.seafish.org).

SeaZone, and Maritime Archaeology Ltd., 2009. HSC - Demonstrating the Method (North East Coast and Seas).

Seazone, 2011. Characterising the potential for Wrecks – AMAP 2. Marine ALSF 5653.

Sewell, J. and Hiscock, K., 2005. *Effects of fishing within UK European Marine Sites: guidance for nature conservation agencies*. Report to the Countryside Council for Wales, English Nature and Scottish Natural Heritage from the Marine Biological Association. Plymouth: Marine Biological Association. CCW Contract FC 73-03-214A. 195 pp.

Sewell, J., Harris, R., Hilmar, H., Votier, S., and Hiscock, K. 2007. An Assessment of the Impact of Selected Fishing Activities on European Marine Sites and a Review of Mitigation Measures. Seafish Industry Authority. ISBN - 0 903941 69 4.

Southall, T.D., Cappell, R., Hambrey, J.B., Hervas, A., Huntington, T.C., Medley, P.A.H., Nimmo, F., Pfeiffer, N., and Tully, O. 2013. *Project Inshore – Stage 2 Draft v3 Report*. Seafish Industry Authority (www.seafish.org).

Stelzenmüller, V., Rogers, S.I. and Mills, C.M., 2008. Spatio-temporal patterns of fishing pressure on UK marine landscapes, and their implications for spatial planning and management. *ICES Journal of Marine Science*, 65 (**6**), 1081-1091.

Tappin, D R, Pearce, B, Fitch, S, Dove, D, Geary, B, Hill, J M, Chambers, C, Bates, R, Pinnion, J, Diaz Doce, D, Green, M, Gallyot, J, Georgiou, L, Brutto, D, Marzialetti, S, Hopla, E, Ramsay, E, and Fielding, H., 2011. *The Humber Regional Environmental Characterisation*. British Geological Survey Open Report OR/10/54. 357pp.

The Joint Nautical Archaeology Policy Committee, 2007. Response to; A SEA CHANGE: A MARINE BILL WHITE PAPER.

Thrush, S.F., Hewitt, J.E., Cummings, V.J. and Dayton, P.K. 1995. The impact of habitat disturbance by scallop dredging on marine benthic communities: what can be predicted from the results of experiments? *Marine Ecology Progress Series*, 129, 141–150.

Tizzard, L., Baggaley, P. and Firth, A., 2011. Seabed Prehistory: Investigating Palaeolandsurfaces with Palaeolithic Remains from the Southern North Sea. In *Submerged Prehistory*, 65–74. Oxford: Oxbow Books.

Toghill, G., 2003. Royal Navy Trawlers. Part One: Admiralty Trawlers. Liskeard: Maritime Books.

Toghill, G., 2004. Royal Navy Trawlers. Part One: Requistioned Admiralty Trawlers. Liskeard: Maritime Books.

Tomalin, D., "Sailing into Prehistory." In: Momber, G., Tomalin, D., Scaife, R., Satchell, J., and Gillespie, J., 2011. *Mesolithic Occupation at Bouldnor Cliff and the Submerged Prehistoric Landscapes of the Solent.* London : Council for British Archaeology, 222 pp. ISBN 9781902771847

Trimmer, M., Petersen, J., Sivyer, D.B., Mills, C., Young, E., Parker, E.R., 2005. Impact of long-term benthic trawl disturbance on sediment sorting and biogeochemistry in the southern North Sea. *Marine Ecology Progress Series,* 298, 79-94.

UNEP (United Nations Environment Program). 2005. *UNEP regional seas programme, marine litter and abandoned fishing gear*. Report to the Division of Ocean Affairs and the Law of the Sea, Office of Legal Affairs, UNHQ. Regional Seas Coordinating Office, UNEP, Nairobi; April 2005.

UNESCO (United Nations Educational, Scientific and Cultural Organisation),2001. *Convention on the Protection of the Underwater Cultural Heritage*. Paris, 2 November 2001.

Valdemarsen, J.W., and Petri Suuronen, P. 2001. *Modifying fishing gear to achieve ecosystem objectives*. Fishing Technical Service. Fishery Industry Division. FAO, Rome.

Vanstaen, K., Clark, R., Ware, S., Eggleton, J., James, J.C.W., Cotteril, C., Rance, J. Manco, F. and Woolmer, A., 2010. *Assessment of the distribution and intensity of fishing activities in the vicinity of aggregate extraction sites*. MALSF-MEPF Project 08/P73. Cefas, Lowestoft, 116pp.

Vanstaen, K., Limpenny, D., Lee, J., Eggleton, J., Brown, A., Stelzenmüller, V., and James, C., 2010. The scale and impact of fishing activities in the Eastern English Channel: an initial assessment based on existing geophysical survey data. MALSF-MEPF Project 07/04. Cefas, Lowestoft.

Vause, B. J and Clark, R. W. E., 2011. *Sussex Inshore Fisheries and Conservation Authority Baseline Fisheries Information*. 103pp. First published October 2011, last update August 2012. Available at: http://www.sussex-ifca.gov.uk

Veale, L.O., Hill, A.S., Hawkins, S.J. and Brand, A.R., 2000. Effects of long-term physical disturbance by commercial scallop fishing on subtidal epifaunal assemblages and habitats. *Marine Biology*, 137, 325-337.

Von Brandt, A. 1984. Fish Catching Methods of the World. Fishing News Books. Blackwell Science, Oxford, United Kingdom.

Walmsley S.A. and Pawson, M.G., 2007. *The coastal fisheries of England and Wales, Part V: a review of their status 2005–6*. Science Series Technical Report, Cefas Lowestoft, 140, 83pp.

Watson, K. and Alison, G., 1990. Site Evaluation for Marine Sites and Monuments Records: The Yarmouth Roads Wreck Investigations. *International Journal of Nautical Archaeology,* 19 (**3**), 183–192.

Wessex Archaeology. 2004. Artefacts from the Sea: Catalogue of the Michael White Collection. Unpublished report ref: 51541.05a.

Wessex Archaeology, 2005. Strategic Environmental Assessment, SEA 6: Irish Sea, Maritime Archaeology. Technical Report, Ref: 58890.

Wessex Archaeology, 2007. *Norman's Bay Wreck, East Sussex: Designated Site Assessment*. Archaeological Report Ref: 53111.03zz. Prepared for English Heritage.

Wessex Archaeology, 2007b. *Wrecks on the Seabed*. York: Archaeology Data Service [distributor] (doi:10.5284/1000316).

Wessex Archaeology, 2008a. *Michael White*. [online] Available at: http://www.wessexarch.co.uk/projects/marine/alsf/artefacts_sea/michaelwhite.html [Accessed 22 January 2013].

Wessex Archaeology, 2008b. *Wrecks Ecology 2007-08 Final Report*. Prepared for English Heritage under the Marine ALSF.

Wessex Archaeology, 2009. *HMS/m Holland No.5, English Channel*. Designated Site Assessment – Archaeological Report. Prepared for English Heritage.

Wessex Archaeology, 2011a. *Assessing Boats and Ships 1914-1938*. Unpublished report ref: 70861.02.

Wessex Archaeology, 2011b. *Assessing Boats and Ships 1939-1950.* Unpublished report ref: 70861.03.

Wessex Archaeology, 2012. Fishing Industry Protocol for Archaeological Discoveries: Protocol Handbook for Sussex IFCA Pilot Project. Prepared for English Heritage.

APPENDICES

1. DATA SOURCES

- **Satellite-based Vessel Monitoring System (VMS) data for the years 2007-2010**. The database comprises of vessel geographical position, course and speed recorded for all UK vessels over 12 m in length. Data are automatically transmitted as "pings" or electronically relayed, on a two-hourly frequency. Vessel speed is then used as an indicator to distinguish between vessels that are fishing, steaming or stationary. Fishing effort is presented as mobile and passive gear effort and cumulative time spent fishing in minutes.
- **Vessel surveillance data for the years 2010-2012.** The data comprised recorded sightings of vessels during air and at-sea patrols by the MMO. Vessels were categorised by gear type, for example potter, and activity (fishing, steaming or laid stationary).
- **Fishing effort survey data for 2011.** The data comprised number of vessels and fishers by gear type for ports within the North Eastern IFCA district.
- **Monument records for the two study areas for the following monument types: wreck; findspot; fishermen's fastener; and aircraft.** The data comprised GIS files (21/01/13) and PDFs (30/01/13) of Complete Monument Records. The number of records received was as follows in Table 26.

Table 26: Number of archaeological records received during data sourcing that fall within the case study Areas 1 and 2

	Area 1	Area 2	Total
Wreck (see note)	263	179	442
Findspot	0	4	4
Fishermen's Fastener	41	353	394
Aircraft	2	11	13

NB: it should be noted that some monuments classed as 'wreck' are described as 'Unidentified seabed obstruction reported by fishermen' and might be better classed 'fishermen's fastener'.

- **Findspot data** across the whole NRHE where Land use is Coastland 1 (Marine) or Coastland 2 (Intertidal). The data (21/02/13) comprised PDFs of Complete Monument Records: 388 records of marine findspots; 507 records of intertidal findspots.
- **Historic Seascape Characterisation GIS layers** showing the character areas arising from of the two Study Areas.

The monument records for the two study areas were mapped in GIS for comparison with spatial data on seabed habitat and fishing activity. The PDFs were searched for keywords relating to fishing (including 'fish'; 'trawl'; 'net'; 'potting'; 'lobster pot'; 'creel'; 'drift'; 'bait').

The findspot data across the entire NRHE for 'marine' and 'intertidal' was searched for keywords relating to fishing, as above.

It is worth noting that interactions with fishing are not a specific focus of recording within monument records (other than where Maritime Craft Type is Fishing Vessel, Trawler etc.), hence reliance on keyword searches for finding examples of interactions, should not be considered on its

own, as an appropriate source of conclusive information. The limitations of keyword searches include ambiguity in terms or choice of words. For example, 'dredging' has been a very important source of marine findspots but it encompasses both a form of fishing (for example, oyster dredging) and of civil engineering (maintenance or capital dredging). For many records no distinction is made, presumably because the original source made no such distinction but this is exacerbated by an absence of interpretation when records were compiled. Consequently, the complete records of marine findspots were scanned in their entirety for findspots that appeared to have arisen from fishing – including 'dredging' – based on contextual information in the record.

A series of projects, under the programme *England's Historic Seascapes,* were used to map England's historic coastal and marine environment. These projects resulted in a number of Historic Seascape Characterisations (HSC), of which three sit within the remit of our case study areas. Characterisation data were provided for two HSC projects overlapping with the two Study Areas, namely Hastings to Purbeck (March 2011) and Demonstrating the Method (North East Coast and Seas – November 2009). Characterisations relating to fishing for Hastings to Purbeck and North East Coast and Seas were mapped. The characterisation layers relate to the results of the characterisation process, so the areas identified as having a fishing-based character are cut by areas where a different character is regarded as dominant. Although the HSC data does not include the spatial data relating to fishing that had been used as a source of the characterisation, references to the source are included in the characterisation data. In study Area 1 the North East Coast and Seas HSC cites Close's Fisherman's Chart of the North Sea, and in study Area 2, the Hastings to Purbeck HSC used the South Coast REC as the source for fishing. It should be noted that the South Coast REC data comprise polygons relating to current fishing, citing references from 2003-2008 (James *et al*., 2010), whereas the references to Close's Chart indicate that the characterisation relates to historic fishing. It is not clear how historic fishing data from Close's Chart has been translated into polygons for use in the characterisation.

The HSC characterisation data is accompanied by character type descriptions for the Broad Character Type 'Fishing' from both National and Regional Perspectives. The Broad Character Type includes sub-types that largely correspond with typologies for fishing gear but sometimes overlap (for example 'Bottom trawling' and 'Demersal trawling'; 'Fishing ground'). It is also worth noting that different forms of fishing may overlap spatially and temporally without any single one being dominant.

2. STAKEHOLDER CONSULTATION DOCUMENTS

August 2013

Invitation to Consultation

Commercial Fishing & the Marine Historic Environment

Fjordr
Marine and Historic Environment Consulting

MES

mpc
Marine Planning Consultants

Our coastal waters are rich with marine archaeological resources, including a potentially great number of as yet undiscovered sites. These resources comprise historic shipwrecks and aircraft crash sites, submerged prehistoric landscapes and remains of coastal structures such as early fish traps. The protection of our marine historic environment is important to our cultural heritage.

Commercial fishing methods practised in English Waters – using either mobile or static gear to catch fish or shellfish – have the potential to interact with historic material. These interactions can be both positive e.g. where they bring to light new archaeological discoveries, and negative e.g. where they cause damage or instability.

© Ian Oxley, English Heritage

ENGLISH HERITAGE

The extent of interactions is unclear and therefore, English Heritage have commissioned Marine Ecological Surveys Ltd (MESL), in consortium with Marine Planning Consultants (MPC) and Fjordr Limited, to explore these themes.

The project aims to identify fishing-heritage interactions, consider the evidence for such interactions, provide suggestions for the development of management and mitigation measures, and identify further research requirements to address gaps in data and understanding.

We now invite stakeholders to review and comment on the draft report using the questionnaire provided. This consultation will be open for six weeks from **28th August** and will end on the **9th October**. At the close of the consultation period, feedback will be collated and incorporated, where appropriate, into the final report.

We encourage all interested stakeholders to participate in the consultation process and ask that you pass on this invitation to colleagues and other interested parties.

Consultation documents are available for download from http://www.seasurvey.co.uk

© Crown copyright, taken by Wessex Archaeology.

If you have an enquiry, please contact:

Rohan Smith
Project Manager, MESL
+ 44 (0)1225 442211
rohan@seasurvey.co.uk

Edward Salter
Project Assurance Officer, English Heritage
+ 44 (0)1483 252057
Edward.Salter@english-heritage.org.uk

Marine Ecological Surveys Ltd
24a Monmouth Place, Bath BA1 2AY • 01225 442211

Page 1

Marine Ecological Surveys Ltd.

FISHING & THE HISTORIC ENVIRONMENT

Prepared for English Heritage

CONSULTATION – AUGUST 2013

Responses are invited via email or post, with a preference for email, to be sent to:

tania@seasurvey.co.uk

T Woodcock
Marine Ecological Surveys Limited
3 Palace Yard Mews
Bath
BA1 2NH

Please take the time to fill out your contact details below.

Name / Organisation
Organisation name (if applicable)

Surname	Forename

Contact Details

Any data provided will be bound by the respondent's requested terms of confidentiality. We will process any personal data in accordance with the Data Protection Act 1998.

All responses will be collated anonymously. We will share your response internally with English Heritage and the Steering Group. Please let us know if you would prefer your response to remain anonymous.

I am happy for my personal information to be shared internally ☐ Yes ☐ No

We would like to thank you for taking the time to complete this consultation, the project team are grateful for all comments received. Any feedback provided will be incorporated into the final report and recommendations where appropriate.

Please give your thoughts on the fishing-heritage interactions recognised within this report. If you have identified any other potential interactions please indicate them below, providing examples where possible.

Do you believe that there is any useful evidence missing from this report? If so, please indicate below.

Do you have any feedback on the proposed management and research options?

Do you have any further suggestions as to how English Heritage can work with fishers and other stakeholders to further increase understanding and evidence of interactions with the historic environment?

3. Scale and Intensity Consequence Analysis Tables

App-Table 1: SICA spatial scale scoring table (adopted from the MSC)

< 1%:	1 - 15%:	16-30%:	31-45%:	46-60%:	>60%:
1	2	3	4	5	6

Adopted from the MSC CR- v1.2, 2012

App-Table 2: SICA temporal scale scoring table (adopted from the MSC)

1 day everyday 10 years or so	1 day every few years	1-100 days per year	100-200 days per year	200-300 days per year	300-365 days per year
1	2	3	4	5	6

Adopted from the MSC CR- v1.2, 2012

App-Table 3: SICA intensity scoring table (adopted from the MSC)

Level	Score	Description
Negligible	1	Remote likelihood of detection of activity at any spatial or temporal scale
Minor	2	Activity occurs rarely or in few restricted locations and evidence of activity even at these scales is rare
Moderate	3	Moderate detection of activity at broader spatial scale, or obvious but local detection
Major	4	Detectable evidence of activity occurs reasonable often at board spatial scale
Severe	5	Easily detectable localised evidence of activity or widespread and frequent evidence of activity
Catastrophic	6	Local to regional evidence of activity or continual and widespread evidence.

Adopted from the MSC CR- v1.2, 2012

App-Table 4: SICA consequence scoring table (adopted from the MSC)

Subcomponent	1	2	3
Habitat type	No direct impact on habitat types. Impact unlikely to be detectable. Time taken to recover to pre-disturbed state on the scale of hours to days	Detectable impact on distribution of habitat types. Time to recover from local impact on the scale of days to weeks. At larger spatial scales recovery time up to one year.	Impact reduces distribution of habitat types. Time to recover from local impact on the scale of months to a few years. At larger spatial scale recovery time of several years to less than two decades.
Habitat structure and function	No detectable changes to the internal dynamics of habitat or population of species making up the habitat. Time taken to recover to pre-disturbed state on the scale of hours to days.	Detectable impact on habitat structure and function. Time to recover from impact on the scale of up to one year, regardless of spatial scale.	Impact reduces habitat structure and function. For impacts on non-fragile habitat stricture, this may be for up to 50% of habitat affected, but for more fragile habitats, to stay in this category to % area

			affected needs to be smaller – up to 20%. Time to recover from impact up to two decades.

Adopted from the MSC CR- v1.2, 2012

App-Table 5: SICA consequence categories and associated MSC scoring table (adopted from the MSC)

Consequence category	MSC equivalent score Habitat and ecosystem
1	100
2	80
3	60
>3	<60

Adopted from the MSC CR- v1.2, 2012

4. Scale and Intensity Consequence Analysis Tables Illustrating Consequence Outcomes

Performance Indicator 1.1	Risk-causing activities from fishing gear and method	Spatial scale of activity (score 1-6)	Temporal scale of activity (score 1-6)	Intensity of activity (score 1-6)	Relevant subcomponents	Consequence score 1-3	MSC Score ≥80 60-80 <60
Habitat Outcome: **The fishing activity does not cause serious and irreversible harm to habitat types, structure, function, and heritage features**	Known and estimated disturbance of physical features and processes by: Demersal beam trawl fishing, and Gear loss	3	5	4	Habitat types: Rock Coarse sediment Mixed sediment Sand Mud	3	60
					Habitat structure and function: Support and shelter		
					Heritage feature: Site Scatter Findspot Setting		
Rationale for selecting worst	Impacts from demersal beam trawl fishing on seabed habitats are typically known. However impacts to heritage features of the marine						

plausible case scenario	environment are less known. Wherever and whenever heritage features are co-located with seabed substrates, the interactions are estimated to be similar. As such seabed habitats are considered an appropriate proxy for assessing impacts from beam trawl fishing on marine heritage features. From the various literature, it is interpreted that the chains, bars, shoe, roller-hoppers, and net bag (including cod-end) of beam trawlers result in impacts such as flattening (Thrush *et al*., 1995; Kaiser *et al*., 1996), dislodging (Currie and Parry, 1996; Hall-Spencer *et al*., 1999), snagging and cloaking (Revill and Dunlin, 2003), and smothering (Brown *et al*., 2005 and Eno *et al*., 2001). However scale and extent of impact are also likely to vary based on resilience of resident substrates (Lokkeborg, 2005; MacMullen, 2011). For instance, fishing areas which were subjected to high and regular fishing pressure tend to lose structural complexity, and might become rather homogenised from a reduction process where boulders are reduced to cobble and then gravel and sand. As an indication of sensitivity, reef structures of natural and artificial origin, sandy, and gravel substrates are considered to be most sensitive to disturbance. However, sandy substrates exposed to regular high levels of natural disturbance are considered to be more resilient to fishing disturbance of this type.
Rationale for Spatial scale **of activity**	Beam trawl fishing highly regulated within 12nm zones by National Legislation. This protocol together with greater fishing opportunities further offshore contributes to the interpretation that beam trawl fishing operates at a spatial scale of about 30% of England inshore waters where strong clusters of heritage features also occupy. However, the situation is likely to be higher than 30% in offshore regions where cluster of heritages features are largely unknown.
Rationale for Temporal scale **of activity**	It is not unlikely for beam trawl vessels with appropriate fishing quota to fish Mondays to Fridays (5 days) weekly or 71%/260day of the year, where weather permits. For this reason a temporal score of 5 is allocated.
Rationale for Intensity **of activity**	Where beam trawl fishers operate the evidence of their activity on seabed habitat is very detectable. Therefore , “major” score for intensity of interaction is allocated – meaning “detectable evidence of activity occurs reasonably often at broad spatial scale”
Rationale for choosing most vulnerable **sub-component**	High risk and vulnerability are anticipated for habitat types, habitat structure and function, as well as heritage features, where beam trawl fishing operates.
Rationale for Consequence **score**	While beam trawl fishing are reported to result in impacts which reduce marine habitat distribution, habitat structure and function, as well as heritage features; there are a certain level of balance to consequence of these interaction which is based on the implementation of smart fishing technologies such as sensors and monitors which provide real-time information for vessels to steer away from protected areas, and seabed obstacles.

Performance Indicator 1.2	Risk-causing activities from fishing gear and method	Spatial scale of activity (score 1-6)	Temporal scale of activity (score 1-6)	Intensity of activity (score 1-6)	Relevant subcomponents	Consequence score 1-3	MSC Score ≥80 60-80 <60
Habitat Outcome: **The fishing activity does not cause serious and irreversible harm to habitat types, structure, function, and heritage features**	Known and estimated disturbance of physical features and processes by: Pot and creel fishing Gear loss, and Anchoring	4	4	2	Habitat types: Rock Coarse sediment Mixed sediment Sand Mud Habitat structure and function: Support and shelter Heritage feature: Site Scatter Findspot Setting	1	80
Rationale for selecting worst plausible case scenario	The impacts of creel and pot fishing on benthic habitats for species such as crabs, nephrops, lobsters, whelks and cuttlefish are reported by, Eno *et al*., 2001. Generally, potting activities are assumed to cause little physical damage to benthic habitats and communities. However, erect and delicate features present in their path might be damaged or become permanently detached on contact with pots or creels. Dragging action, be-it during retrieval of fishing pots or resulting from stormy wave swells, dynamic sandy waves, and tidal						

	regime might also impact seabed features (MacMullen, 2011). This method of fishing is known to bend, flex, smoother, and even uproot seabed features which they encounter on muddy substrates, however their effects is observed to be less impacting on rocky substrates. As a proxy, it is very likely that this method of fishing would demonstrate similar impact when encountering any sensitive heritage features on the seabed.
Rationale for Spatial scale **of activity**	Spatial this method of fishing takes place mostly inshore (possible at 45 % of available areas) where there are high clusters of known heritage features.
Rationale for Temporal scale **of activity**	During fishing, pots, creels, and traps are typically soaked for 2-3 days, which is approximately 120 days or 28 % of the year where they are allowed to fish. While this might be the case in some areas, there are known situations where fishing only takes place on weekends to avoid conflict with other user of the fishing areas. Fishing equipment when rest at sea during non-fishing periods are known to bundle and smoother seabed habitats which is the likely impact to heritage features.
Rationale for Intensity **of activity**	Minor intensity of activity is interpreted from this method of fishing on marine seabed and heritage features – "activity occurs rarely or in few restricted locations and evidence of activity even at these scales is rare"
Rationale for choosing most vulnerable **sub-component**	Activities such as bundling of rested equipment, anchoring, and any dragging to retrieve equipment are likely to pose risk and vulnerability to marine seabed and heritage features.
Rationale for Consequence **score**	The overall consequence of fishing by pots, traps, and creels is interpreted to pose no irreversible direct impact to habitat types, as well as no long-term detectable change to habitat distribution, structure, and function, or heritage features as a proxy.

Performance Indicator 1.3	**Risk-causing activities from fishing gear and method**	**Spatial scale of activity (score 1-6)**	**Temporal scale of activity (score 1-6)**	**Intensity of activity (score 1-6)**	**Relevant subcomponents**	**Consequence score 1-3**	**MSC Score ≥80 60-80 <60**
Habitat Outcome: The fishing activity does not cause serious and irreversible	Known and estimated disturbance of physical features and processes by: Set net fishing	2	5	1	Habitat types: Rock Coarse sediment	1	80

harm to habitat types, structure, function, and heritage features	Gear loss, and Anchoring				Mixed sediment Sand Mud Habitat structure and function: Support and shelter Heritage feature: Site Scatter Findspot Setting		
Rationale for selecting worst plausible case scenario	The viability of commercial Set net (gill net) fishing above wrecks for Pollack (*Pollachius pollachius*) within the English Channel was reported by Randal *et al*. 2012 to be a feasible option as well as an alternative to fishing in areas where minimising non-target catch is an issue. Catch landed from 100 hauls was 7.1 tonnes, representative of an estimated first sale value of £8.3 k to the fishermen. In addition a wide species composition with commercial fishing value was identified to being supported by these wrecks. Demersal set nets for catching species such as Sole, and Plaice are known to interact with seabed and marine heritage features. Interactions are likely to be from anchoring or gear loss. The risk of dislodging or smothering are typically noted as the associated impacts. Mid-water or pelagic set notes present little impact except in situations of anchoring and gear loss (Brown *et al* 2005).						
Rationale for Spatial scale **of activity**	Set net activities are understood to take place mostly within inshore areas which are traditionally known to be snag free for demersal or home to clusters of certain species for pelagic set nets. Set net fishing is interpreted to take place within approximately 15 % of spatial marine inshore areas which are areas of high cluster of marine heritage features.						
Rationale for Temporal scale **of activity**	It is not unlikely for set net vessels with appropriate fishing quota to fish Mondays to Fridays (5 days) weekly or 71 % / 260 days of the year, where weather permits. For this reason a temporal score of 5 is allocated.						
Rationale for Intensity **of**	The intensity of set net fishing activity on seabed habitats and heritage features is interpreted to be Negligible – "remote likelihood of						

activity	detection of activity at any spatial or temporal scale". With the exceptions of anchoring and gear loss, set net make little or no contact with seabed habitat and marine features. In addition scale of operations is limited to fishing opportunities and appropriate inshore fishing areas. The use of smart fishing technology such as sonars, GPS, and updated seabed maps are providing valuable support to set net fishers in regards to avoiding areas and obstacles which might damage fish gear.
Rationale for choosing most vulnerable **sub-component**	Risk and vulnerability to seabed habitat and heritage features from set net fishing are likely to be related to anchoring and loss gear, or retrieval of loss gear. Dislodging or smoother are the likely impacts when encounter takes place.
Rationale for Consequence **score**	An overall consequence score of 1, meaning - No direct impact on habitat types and No detectable long-term change to habitat dynamics, structure, and function, as well as heritage features are the likely consequence when fishing with set nets.

Performance Indicator 1.4	**Risk-causing activities from fishing gear and method**						
Habitat Outcome: **The fishing activity does not cause serious and irreversible harm to habitat types, structure, function, and heritage features**	Known and estimated disturbance of physical features and processes by: Mechanical / scallop dredging, and Gear loss	Spatial scale of activity (score 1-6)	Temporal scale of activity (score 1-6)	Intensity of activity (score 1-6)	Relevant subcomponents	Consequence score 1-3	MSC Score ≥80 60-80 <60
Habitat Outcome: **The fishing activity does not cause serious and irreversible harm to habitat types, structure, function, and heritage features** **Rationale for selecting worst plausible case scenario**	Known and estimated disturbance of physical features and processes by: Mechanical / scallop dredging, and Gear loss	5	5	4	Habitat types: Rock Coarse sediment Mixed sediment Sand Mud Habitat structure and	3	60

					function: Support and shelter Heritage feature: Site Scatter Findspot Setting		
Rationale for Spatial scale of activity	National Legislation restricts the number of mechanical dredges pre side on scallop vessels while operating inshore; however spatially, dredging takes place both within inshore and offshore areas. Inshore areas consist of known high clusters of heritage features which are likely to overlap with habitats where shellfish species are in high abundance and of good fishing value. These situations are likely to result in high level of spatial overlap and interaction, hence a score of 5.						
Rationale for Temporal scale of activity	With the exception of closed-season for inshore waters; dredge fish is likely to take place every day where weather and quota allocation permits. A high temporal scale is anticipated hence a score of 5.						
Rationale for Intensity of activity	Although there are high spatial overlap, and temporal scales of activity within areas where clusters of heritage features are high, it is interpreted that intensity of activity is "major" rather than severe or catastrophic. Where dredging takes place, there will be "detectable evidence of activity occurring reasonably often at broad spatial scale". However intensity of activities would vary in different areas. For instance 3mn, 6mn, 12nm, and beyond are managed by different effort regulations which consequently results in different levels of fishing efforts and interactions.						
Rationale for choosing most vulnerable sub-component	High risk and vulnerability to seabed habitat and heritage features are anticipated from mechanical dredge fishing. Direct dredging activity is reported to change habitat features and structures, while gear loss is likely to cloak, compact, or smoother habitats where it accumulate.						
Rationale for Consequence score	Mechanical dredge fishing such as scallop dredging is reported to result in impact which reduces distribution of habitat types, and reduces habitat structure and function, as well as associate heritage features. Implementation of smart fishing technology such as Eco-dredge, toothless dredge, GPS, and I-VMS, have enhance a higher level of responsibility within this fishing sector which as supported some fisheries in attaining sustainability certification. Based on these trends and their uptake by fishers a consequence score of 3 is allocated.						

5. Summary of Proposed Options for Management and Research

Interaction	Scope	Objective	Management Options	Research Needs
The contribution of Fishing-related Material to the Historic Environment				
Material relating to the history of fishing adds to the historic environment (Mutually beneficial)	General	Increase recognition and representation of fishing heritage in story of England	• Explore value of enhancing awareness of fishing heritage in perception / marketing of fish • Encourage greater recognition of fishing as historical activity in shaping marine environment	• Develop archaeological understanding of history of fishing and its effect on England's society and (marine) environment
	Fishing-related harbours, houses and other infrastructure	Out of scope – but cross refer to EH 6262 / 6305	• Out of scope – but cross refer to EH 6262 / 6305	• Out of scope – but cross refer to EH 6262 / 6305
	Fish traps	Avoid damage and improve monitoring of coastal fish traps	• Formulate and promote a Good Practice Guide to avoid damage from, for example, bait digging, shell fish gathering • Encourage reports on changes to survival / condition (monitoring) • Encourage reporting of new discoveries through FIPAD	• Review extent of commercial inter-tidal fisheries and their potential interactions with historic environment
	Fishing vessel wrecks	Increase attention to FV wrecks as monuments to fishing communities and to the role of fishing in England's history	• Identify management options and priorities for fishing vessel wrecks on basis of thematic assessment	• Undertake thematic assessment of fishing vessel wrecks (in conjunction with fishing vessels in preservation), building upon Assessing Boats and Ships
	Stray finds relating to fishing	Demonstrate value to fishing industry of reporting protocols, based on contribution being made by other sectors to history of fishing	• Encourage / support reporting of fishing-related finds through protocols for other sectors • Involve fishing experts in identification / advice in relation to fishing related finds	• Review accounts of previous archaeological surveys and investigations to identify more material evidence of historic fishing activities on archaeological sites.

Interaction	Scope	Objective	Management Options	Research Needs
Interactions between Commercial Fishing and the Historic Environment				
Management of heritage assets constrains fishing activity (Adverse for commercial fishing)	Designated heritage assets	Facilitate sustainable fishing practices on designated heritage assets whilst precluding unsustainable practices	• Develop and test sustainable fishing methods on designated sites	• Seek legal advice to confirm application of heritage designations to commercial fishing
Fisheries management conserves heritage assets (Mutually Beneficial)	Known and unknown heritage assets	Maximise opportunities for using fisheries management to contribute to conservation of heritage assets	• Explore use of fishing conservation measures (for example, byelaws) to manage fishing on sites that would otherwise be designated • Explore use of nature conservation measures e.g. MCZs, to manage fishing on sites that would otherwise be designated. • Develop MOU on fisheries management and the historic environment	• Seek legal advice on application of fishing / nature conservation measures to historic environment in light of statutory requirements with respect to the historic environment in the MCAA 2009. • Clarify the application of UK MPS and Marine Plan policies relating to the historic environment to fisheries management decision-making by Defra, the MMO and IFCAs. • Examine the scope for using monitoring and surveillance data for GES / fisheries management to generate information relating to interactions between commercial fishing and the historic environment.
Commercial fishing impedes access and interpretation of heritage assets (Adverse for historic environment)	Known heritage assets	Reduce new incidence of gear on heritage assets	• Support and seek integration with initiatives that discourage dumping of gear at sea • Increase awareness of offences in respect of dumping gear on designated heritage assets	

Interaction	Scope	Objective	Management Options	Research Needs
	Known heritage assets	Remove abandoned, lost or otherwise discarded fishing gear (ALDFG) from heritage assets	• Carry out work to remove ALDFG from (designated) heritage assets	• Collate information on presence of fishing gear on (designated) heritage assets and its implications for access and interpretation • Assess implications for heritage asset survival and condition of removing fishing gear from (designated) heritage assets.
Heritage assets improve commercial fishing opportunities (Mutually Beneficial)	Known heritage assets	Facilitate sustainable fishing practices on undesignated heritage assets	• Develop and test sustainable fishing methods on undesignated sites	• Develop better evidence on the degree to which commercial species are enhanced by the presence of heritage assets
Commercial fishing contributes to archaeological investigation (Mutually beneficial)	Known heritage assets	Make best use of latent fishing industry knowledge of historic environment	• Engage with fishermen about their knowledge of sites, findspots etc. through for example, 'social landscape' initiatives; FisherMap, Geography of Inshore Fishing and Sustainability(GIFS) project etc.	• Incorporate findings from fishing within NRHE
	Known heritage assets	Increase fishing industry awareness of archaeological objectives and methods	• Undertake practical trials that increase collaboration between archaeologists and fishermen in conducting archaeological investigations, e.g. through use of fishing industry drop cameras to investigate anomalies.	
Archaeological investigation generates information useful to commercial fishing (Mutually beneficial)	Known heritage assets	Increase fishing industry awareness of value of archaeological investigations to understanding marine environment	• Test the provision of detailed archaeologically-derived data to fishermen	

Interaction	Scope	Objective	Management Options	Research Needs
Heritage assets are hazardous to gear and vessels (Adverse for commercial fishing) **Commercial fishing damages heritage assets (Adverse for historic environment)** **Commercial fishing results in discoveries (Mutually beneficial)**	Known – Designated Sites and Settings	Decrease damage to designated heritage assets	• Increase awareness of position, extents and restrictions applicable to designated areas. • Develop and test sustainable fishing methods on designated sites and promulgate through Good Practice Guide • Implement and enforce statutory provisions	• Review designated sites for firm, detailed evidence of damage from commercial fishing • Explore scope to offer amnesty when notifying EH of (accidental) impacts from fishing on designated heritage assets
	Known – Undesignated Sites and Settings	Facilitate avoidance of known sites	• Increase dissemination of information about position etc. of known heritage assets via Kingfisher and other navigation/GIS tools	• Collate and enhance asset data in preparation for wider dissemination • Discriminate between wrecks as to whether they are 'important' heritage assets
	Known – Undesignated Sites and Settings	Discourage indifference to presence of known heritage assets	• Increase awareness of value of undesignated heritage assets	
	Known – Undesignated Sites and Settings	Discourage encroachment on known heritage assets	• Increase awareness of tolerances of undesignated heritage assets	• Review the effect of increasing information to fishermen on site position, form, orientation etc. of heritage assets
	Fishermen's fasteners	Decrease damage to heritage assets revealed as fishermen's fasteners	• Clarify archaeological views on the character of fasteners as heritage assets	• Improve understanding of fasteners and rough /foul ground and their archaeological implications based on existing and/or newly acquired geophysical data • Review / enhance recording of fasteners in NRHE

Interaction	Scope	Objective	Management Options	Research Needs
	Unknown Sites	Decrease initial damage to unknown sites	• Encourage prior assessment of areas exposed to new / different commercial fishing (SEA) • Support and seek integration with development of technical measures to reduce impacts on seabed features • Encourage use of technical measures (gear modifications) to reduce damage in high risk areas • Encourage gear choices (for example, long lining) that will reduce damage in high risk areas	• Review risk factors leading to previously unknown sites being encountered, including history of fishing, seabed character, gear type, seasonal factors and events (for example, storms) • Develop regional IFCA-based risk maps of areas susceptible to damage to as-yet unknown sites • Reconcile risk-based approach with EH Risk Management Handbook (2008)
	Unknown Sites	Improve early reporting of previously unknown sites	• Enhance and expand FIPAD with particular emphasis on reporting of fasteners • Specific campaign through FIPAD to capture legacy information on fasteners • Increase awareness of examples of important sites identified initially as fasteners • Make provision for specific and prompt measures to investigate reported fasteners	
	Unknown Sites	Decrease damage to previously unknown sites subsequent to discovery	• Develop measures to enable rapid dissemination to fishermen of information on important new sites • Develop and promulgate Good Practice Guide on fishing methods and gear that can continue to be used in vicinity of important new sites • Clarify to fishermen the circumstances in which formal restrictions (designation; byelaws) may need to be introduced to protect important new sites	

Interaction	Scope	Objective	Management Options	Research Needs
	Unknown Scatters and Findspots	Increase comprehensiveness and speed of finds reporting by fishermen	• Enhance and expand FIPAD in light of results of Sussex IFCA Pilot • Demonstrate value of fishermen's finds through prompt and visible responses to discoveries, and by using data to inform management	• Enhance existing records of finds in NRHE, with particular emphasis on identifying details of fishing practices through which discoveries occurred. • Carry out research based on previously reported finds to demonstrate their contribution to understanding historic environment
	Unknown Scatters and Findspots	Improve initial handling and recording of finds	• Through FIPAD, increase awareness and informal training of fishermen in finds identification, handling, photography and storage • Provide waterproof information cards for use in wheelhouses.	

6. Stakeholder Consultation Summary

The EH 6204 project team invited comments on the draft report 'Fishing and the Historic Environment'. The consultation was open to all interested stakeholders, with 41 persons from a range of organisations targeted specifically by invitation. The consultation ran for six weeks from 28th August to 9th October, with a short extension upon request from the client to 14th October.

Stakeholders

We received 13 responses to the consultation, which are summarised below. All responses were received by email. Of the responses, two were from individuals and 11 were provided on behalf of organisations. See Table 27 for the list of respondents.

Table 27: EH 6204 consultation respondents and affiliated organisations

Name	Affiliation
Ed Salter	English Heritage (Client)
Rebecca Walker	Cefas
Eden Hannam	Eastern Inshore Fisheries and Conservation Authority
Dr Robb Robinson	East Riding of Yorkshire Fisheries Local Action Group and University of Hull
Ben Ferrari	Independent Heritage Expert
Robert Yorke	Joint Nautical Archaeology Policy Committee
Duncan Vaughan	Natural England
Mark Beattie-Edwards	Independent Heritage Expert (Nautical Archaeology Society)
Elizabeth Bourke	National Federation of Fishermen's Organisations
Suzanne Smith	Professional Association of Diving Instructors
Tim Dapling	Sussex IFCA
Garry Momber	The Hampshire & Wight Trust for Maritime Archaeology / Maritime Archaeology Limited
Andrew Roberts	Wessex Archaeology

Responses were received from a range of stakeholder sectors, as shown in Table 28.

Table 28: Number of consultation responses received during the EH 6204 consultation from different stakeholder sectors

Stakeholder	No. of responses	Percentage of total responses %
Archaeological	7	53.8
Fisheries management and research	4	30.8
National Government and Public bodies	1	7.7
Marine Recreational	1	7.7

In addition to the responses detailed above, the MMO provided a letter confirming that they had no comments to submit on the report.

Response Format

Responses were provided as comments, suggestions and questionnaire answers, with six stakeholders choosing not to use the questionnaire approach.

The numbers of responses provided to each question are shown below:

- Question 1 – six
- Question 2 – five
- Question 3 – seven
- Question 4 – seven

Responses to each question have been summarised below:

Question One

Additional potential interactions indicated –

- Artificial reef creation by fishers
- Heritage as habitat / wrecks as refuges for marine life
- Anchoring by vessels engaged in recreational and commercial rod and line fishing
- Anchoring and putting down shot-lines for scuba diving to collect shellfish such as scallops.

Question Two

Useful evidence missing –

- None
- IFCA fishing location / activity sighting data
- Diver observations
- Sussex IFCA effort information
- REC habitat maps
- Data from sidescan and multibeam surveys collected for identification of rMCZs.

Question Three

Feedback on proposed management options –

- Need to refine definitions used in the conceptual heritage framework
- Changes suggested to the proposed Environmental Assessment matrix
- Feasibility of approach to management questioned if using habitat character as an indicator of likely locations of unknown heritage assets
- Quantitative analysis of fishing-heritage interactions is perceived to be unrepresentative by assuming a worst case scenario; Environmental Assessment and the S-P-R approach were considered more descriptive and allow for uncertainties to be made clear

- Engagement by English Heritage with other research and conservation bodies for joint survey opportunities
- Research to quantify impacts – respondent suggests that there is potential through the Maritime Archaeology Trust photo archive
- Awareness raising not considered effective therefore, laws must be changed to deter fishers
- The Sussex IFCA are willing to explore opportunities for working alongside the local Hastings FLAG on archaelogical conservation issues
- Research opportunities involving remote sensing and verification with drop down video have potential with a view to further integrating habitat and archaeological surveys
- Raising public awareness particularly within the fishing community is important – respondent suggests the use of website, short films and presentations at appropriate forums e.g. IFCA meetings and fishing association meetings.

Question Four

Further suggestions as to how English Heritage can work with fishers and other stakeholders –

- None
- Provision of a waterproof information card regarding marine archaeological finds for fishers
- Use of case study areas where local archaeological diving groups can work with the fishing community to address the benefits and impacts of fishing around sensitive sites
- Placing emphasis upon the consequences of illegal activities to discourage fishers
- Buoy marking of protected sites to prevent anchor damage by visitors
- Raising awareness of underwater cultural heritage within the fishing community, this could be undertaken through the media, and local awareness raising, e.g. at fishermen's meetings
- Meeting to discuss opportunities for collaborative work between English Heritage, the Sussex IFCA and the local fishing community.

Comments from all responses, including non-questionnaire responses, were addressed by the project team and where appropriate, feedback has been incorporated into the main report.

The team would like to re-extend their thanks to all respondents for their useful, detailed comments which have helped to improve the report and information provided to English Heritage.

.