COWRIE

COWRIE Secretariat
COWRIE Limited
c/o 36 Kingfisher Court
Hambridge Road
Newbury RG14 5SJ
United Kingdom
Tel: +44 (0)1635 550380
Fax: +44 (0)1635 550230
cowrie@offshorewind.co.uk
www.offshorewind.co.uk

# Options and opportunities for marine fisheries mitigation associated with windfarms

Final report for COWRIE Contract FISHMITIG09

ichthys marine

COWRIE

COWRIE Secretariat
COWRIE Limited
c/o 36 Kingfisher Court
Hambridge Road
Newbury RG14 5SJ
United Kingdom
Tel: +44 (0)1635 550380
Fax: +44 (0)1635 550230
cowrie@offshorewind.co.uk
www.offshorewind.co.uk

# Options and opportunities for marine fisheries mitigation associated with windfarms

**© COWRIE Ltd.**

**ISBN: 978-0-9565843-4-2**

**Published by COWRIE Ltd.**

**This publication (excluding the logos) may be re-used free of charge in any format or medium. It may only be re-used accurately and not in a misleading context. The material must be acknowledged as COWRIE copyright and use of it must give the title of the source publication. Where third party copyright material has been identified, further use of that material requires permission from the copyright holders concerned.**

This work would not have been possible without the generous support of Dr. Carolyn Heeps (COWRIE), Eleanor Partridge and Brigitte Ruiz (Nature Bureau), Will Wright (K&ESFC), Duncan Vaughan (ESFJC), Rob Clark (SSFC), Bill Cook (NWNWSFC), Duncan Ayling, Peter Madigan and Paul Reynolds (RenewableUK), Dale Rodmell (NFFO), David Jarrad (SAGB), Dave Cuthbert (NUTFA), Michael Sutherland and John Watt (SFF), Merlin Jackson and Chris Wightman (commercial fishermen), Jerry Percy (WFFA), Jo Harvey (SSE Renewables), Cathryn Hooper (Mainstream Renewable Power), Karen McKenzie (Centrica), Andrew Prior (PMSS), Mark Thomas (RWE npower), Gero Vella (Renewable Energy Systems), Tom Blasdale (JNCC), Helen Stevens and Ian Campbell (NE), Isabella Murfin and Marcia King (Defra), Robert Lilly (DECC), Dr. Karema Warr (CEFAS), Chris Lloyd (The Crown Estate), Dr. Jim Andrews (AWJ Marine), and Dr. Mike Pawson.

This report can be cited as:

**Blyth-Skyrme, R.E. (2010). Options and opportunities for marine fisheries mitigation associated with windfarms. Final report for Collaborative Offshore Wind Research Into the Environment contract FISHMITIG09. COWRIE Ltd, London. 125 pp.**

## Acronyms

| | |
|---|---|
| ASC: | Aquaculture Sustainability Council |
| ASFC: | Association of Sea Fisheries Committees |
| BERR: | Department for Business, Enterprise and Regulatory Reform |
| BMAPA: | British Marine Aggregate Producers' Association |
| CNCC: | Council for Nature Conservation and the Countryside |
| CCW: | Countryside Council for Wales |
| CEFAS: | Centre for Environmental, Fisheries and Aquaculture Science |
| CFP: | Common Fisheries Policy |
| COWRIE: | Collaborative Offshore Wind Research Into the Environment |
| DECC: | Department for Energy and Climate Change |
| Defra: | Department for the Environment, Food and Rural Affairs |
| EAG: | Expert Advisory Group |
| EFF: | European Fisheries Fund |
| EIA: | Environmental Impact Assessment |
| EIS: | Environmental Impact Statement |
| EMS: | European Marine Site |
| ESFJC: | Eastern Sea Fisheries Joint Committee |
| FEPA: | Food and Environment Protection Act 1985 |
| FLOWW: | Fishing Liaison with Offshore Wind and Wet renewables group. |
| FRS: | Fisheries Research Services |
| ICES: | International Council for the Exploration of the Sea |
| IFCA: | Inshore Fisheries and Conservation Authorities |
| IFG: | Inshore Fisheries Group |
| IMP: | Integrated Maritime Policy |
| IPC: | Infrastructure Planning Commission |
| JNCC: | Joint Nature Conservation Committee |
| LOA: | Length over all |
| MAIB: | Marine Accident Investigation Branch |
| M&FA: | Marine and Fisheries Agency |
| MCEU: | Marine Consents and Environment Unit |
| MCZ: | Marine Conservation Zone |
| MMO: | Marne Management Organisation |
| MPA: | Marine Protected Area |
| MSC: | Marine Stewardship Council |
| NE: | Natural England |
| NFFO: | National Federation of Fishermen's Organisations |
| NUTFA: | New Under-Ten Fishermen's Association |
| NWNWSFC: | North Western and North Wales Sea Fisheries Committee |
| RDA: | Regional Development Agency |
| SAC: | Special Area of Conservation |
| SAGB: | Shellfish Association of Great Britain |
| SEA: | Strategic Environmental Assessment |
| SFIA: | Sea Fish Industry Authority |
| SFF: | Scottish Fishermen's Federation |
| SFC: | Sea Fisheries Committee |
| SNH: | Scottish Natural Heritage |
| SPA: | Special Protection Area |
| SSFC: | Sussex Sea Fisheries Committee |
| SSSI: | Site of Special Scientific Interest |
| SWOT: | Strengths, weaknesses, opportunities and threats analysis |
| WFFA: | Welsh Federation of Fishermen's Associations |

# Executive Summary

Government has committed to the UK generating 30% of its electricity from renewable sources by the year 2020 in order to reduce carbon emissions, combat climate change and secure the UK energy supply. A significant proportion of this renewable energy will come from windfarms sited off the UK coast. The establishment of windfarms at sea has the potential to cause disruption to commercial fishing activities, including through the loss of access to some fishing grounds for the operational life of the windfarm.

In light of the potential for fishermen to lose access to significant sea areas within offshore windfarms, this project was focused on supporting commercial fishermen and dependent fishing communities ashore over the long term by investigating options and opportunities for marine fisheries mitigation associated with windfarms. The overall aim of the project was to develop a menu of possible mitigation options which would be of use to fishermen, developers, regulatory and statutory bodies and marine resource managers in discussions related to current and future windfarm developments, as well as in other offshore industry developments and in any future consideration of marine spatial planning issues. In brief, the aim of this project can be summarised as "*Identifying ways to keep fishermen fishing*".

A key concern for this project from the beginning was the involvement of stakeholders. It was considered vital that fishermen, windfarm developers and fisheries and environmental management bodies were offered the opportunity to contribute at every stage. Three main strategies to increase stakeholder engagement were adopted: Firstly, an expert advisory group (EAG) was established and was invited to disseminate information on the project, to comment on project documents and to attend two project workshops to develop and refine the list of possible mitigation options. Secondly, the project and any project outputs were advertised on the COWRIE website and through the publication of articles in Fishing News. Finally, a questionnaire was developed which was then made available online and sent out to stakeholders in order to gather information and promote the project.

The EAG and the project workshops were found to be critical to ensuring that stakeholders were able to input detailed information to the project at key stages. In fact, the EAG was instrumental in proposing the second workshop, when only one workshop was initially planned in the project. Advertising the project and making the interim outputs available online was also apparently effective in ensuring that stakeholders were aware of the project and were able to access project information. In contrast, the questionnaire approach to data collection was not found to be useful, as little additional information was obtained.

As a result of the research undertaken and through the support of the EAG, 26 possible mitigation options were identified during the course of this study. These were grouped into four categories:

1) Pre-construction options to limit any impacts on commercial fishing activities (five options):

   These options are focused on reducing or eliminating any negative impacts of windfarms on commercial fishing activities through early and constructive consultation.

2) Options to enhance stocks of targeted species and associated habitats (five options):

   These options are focused on promoting existing fishing activities within and around wind farm sites.

3) Options to support existing fishing activities (12 options):

   These options are focused on increasing access to fisheries, enhancing performance, reducing costs, increasing product price or enhancing marketability.

4) Options to develop new fisheries or other non-fisheries opportunities (four options):

   In the event of loss of access, these options are focused on opportunities to switch to new or alternative fisheries and other activities.

In order to provide windfarm developers and fishermen with additional information that should assist in determining whether particular mitigation options might be suitable for a development, a strengths, weaknesses, opportunities and threats (SWOT) analysis of each option was undertaken. In addition, an overarching SWOT analysis was undertaken of mitigation as an approach to managing impacts on the commercial fishing industry.

Key strengths identified in the overarching SWOT analysis include the well-organised associations representing both fishermen and windfarm developers, and the strong entrepreneurial spirit within both industries. A key weakness identified was that the fishing industry is made up of many individuals and a large number of sectors, which may have conflicting individual or sectoral needs. An additional weakness is that there are relatively poor spatial and economic data available on fishing activities, which can create uncertainty in discussions relating to impacts and mitigation options.

The complete results of the SWOT analyses are provided within this report, together with guidance on the probable timescale for work on a mitigation option to be implemented and for the results of any action to begin delivering benefits to impacted fishermen. An indication of the likely scale of costs associated with successfully implementing each option to the extent that significant benefits may be delivered is also provided. It was not possible to provide precise cost estimates for each option because these could vary greatly from project to project depending on the scale of any work and on the local situation.

The list of mitigation options developed through the project was extensive, but was never intended to be definitive or exhaustive. Each of the options presented will need to be considered and appraised in the context of individual offshore developments. Although the project had national scope, many of the options may be found to be unsuitable for particular developments or areas because of specific local issues. Fishermen and developers, with the support of fisheries managers, fisheries scientists and representatives of statutory bodies, are therefore encouraged to use this full project report and the separate, brief summary report as information sources while identifying their preferred process for managing any impacts on commercial fishing.

## Key findings

A number of factors were considered to be critical in taking forward options to mitigate any impacts on commercial fishing activities resulting from windfarm developments.

- The need for early consultation between developers and fishermen during the planning process was stressed. If fishermen were only consulted late in the planning phase there would inevitably be little opportunity to modify plans for windfarms or to incorporate features that could mitigate any impacts. An effective consultation process is needed for each development, and fishermen and fishermen's associations must contribute to discussions.

- In considering mitigation rather than compensation as a means to address fisheries impacts, it was noted that a variety of external funding sources exist to promote the sustainability and viability of fisheries, and that these may be targeted in an effort to increase the level of funding available for mitigation projects. In contrast, it was thought unlikely that external funding for compensation would be made available.

- A significant issue with any mitigation project is likely to be ensuring that the fishermen who are impacted are also able to benefit from the mitigation. In comparison, compensation is likely to be relatively simple to distribute and can be targeted directly at specific individuals.

- An issue identified for UK fisheries as a whole, and for inshore fisheries in particular, is that data showing where fishermen work and the value of different areas to different fisheries sectors are available only at a broad scale. In the absence of reliable data on fishing activity, developers may be understandably cautious in providing funding for mitigation or compensation options.

# Contents

## List of Tables



## List of Figures

# 1 Introduction

## 1.1 Project overview

The idea for this project was generated by Officers from a number of Sea Fisheries Committees and from Collaborative Offshore Wind Research Into the Environment Ltd (COWRIE). They identified the need to investigate the options and opportunities to mitigate any impacts of offshore windfarms on commercial fishing activities. After a period of constructive project development, Dr. Blyth-Skyrme of Ichthys Marine Ecological Consulting Ltd. was commissioned for the work. This report represents the culmination of the project process.

The overall aim of the project was to develop a menu of possible mitigation options which would be of use to fishermen, developers, regulatory and statutory bodies and marine resource managers in discussions related to current and future windfarm developments, as well as in future consideration of marine spatial planning issues.

For the purposes of the project, mitigation was defined as "*Measures taken to limit the adverse effects, or enhance the positive effects, of offshore windfarms on the commercial fishing industry*".

The list of mitigation options developed through the project was never intended to be definitive or exhaustive. Each of the options presented will need to be considered and appraised in the context of individual offshore developments, and many of the options may be found to be unsuitable because of specific local issues. Fishermen and developers, with the support of fisheries managers, fisheries scientists and representatives of statutory bodies, are therefore encouraged to use this report as the first step in identifying their own preferred process for managing any impacts on commercial fishing.

## 1.2 Stakeholder engagement

A key concern for this project from the beginning was the involvement of stakeholders. It was considered vital that fishermen, windfarm developers and fisheries and environmental management bodies were offered the opportunity to contribute at every stage.

A number of strategies were employed in order to promote stakeholder engagement. The primary mechanism was through the establishment of an expert advisory group (EAG). This group was intended to be representative of the experts and interests relevant to offshore windfarm and fisheries issues around the UK. Windfarm development, commercial fishing, fisheries management, fisheries science and nature conservation organisations were contacted and asked to nominate a representative who would be sent project documents to comment on as they became available, and who could disseminate and collect relevant information. Two independent fishermen also contacted the project and were invited to join the EAG (Table 1).

The EAG members were also asked to attend two workshops in London, one in November 2009 and one in March 2010. The original project proposal was for just one workshop to take place but the second workshop was proposed by the EAG members, primarily in order to have a further opportunity to review the list of mitigation options. Notes of the findings from the two workshops are provided in this report as Appendix 3 and Appendix 4.

In order to obtain input from a wider range of stakeholders, a questionnaire was created shortly after the project commenced (Appendix 5). This was intended to both elicit information on any existing examples of fisheries mitigation, and to promote the project to windfarm and fisheries professionals. The questionnaire was sent to the EAG, contacts for 41 different windfarm developments in the UK, Europe and the USA, the Fishing Liaison with Offshore Wind and Wet Renewables (FLOWW) group, and was advertised through the COWRIE website and a brief article published in Fishing News. The questionnaire was also sent to representatives of the marine aggregates, oil and gas and port industries as it was assumed that valuable input could be provided.

Table 1: Membership of the expert advisory group

| Sector | Organisation |
|---|---|
| Fishing industry | Independent commercial fishermen (2)<br>National Federation of Fishermen's Organisations (NFFO)<br>New Under-Tens Fishermen's Association (NUTFA)<br>Shellfish Association of Great Britain (SAGB)<br>Scottish Fishermen's Federation (SFF)<br>Welsh Federation of Fishermen's Associations (WFFA) |
| Windfarm industry | Representatives of windfarm companies (6)<br>RenewableUK<br>Collaborative Offshore Wind Research Into the Environment (COWRIE) |
| Fisheries managers | Eastern Sea Fisheries Joint Committee (ESFJC)<br>Kent and Essex Sea Fisheries Committee (K&ESFC)<br>Marine and Fisheries Agency (M&FA)<br>North Western and North Wales Sea Fisheries Committee (NWNWSFC)<br>Sussex Sea Fisheries Committee (SSFC) |
| Other organisations | Centre for Environmental, Fisheries and Aquaculture Science (CEFAS)<br>Crown Estate<br>Department for the Environment, Food and Rural Affairs (Defra)<br>Joint Nature Conservation Committee (JNCC)<br>Natural England (NE) |

The final method of obtaining stakeholder input was through offering the draft project documents for comment via the COWRIE website. This has included a project brief, the draft mitigation options list, notes of both workshops, and the final draft project report. The consultation period for the final report was set at one month, covering April 2010.

## 1.3 Project actions and timeline

A brief description of the project timeline is provided below, together with the actions undertaken at each stage. This also summarises the main points during the project at which stakeholders were provided opportunities to engage with the project.

- Jun 2009: Project initiation.

  A literature review was undertaken, to determine if there were existing examples of fisheries mitigation work at offshore developments, and to establish the current status of policy and legislation concerning offshore developments in the UK.

- Jul 2009: Stakeholder expert advisory group established.

  Stakeholders were contacted and invited to join the EAG. EAG members were provided with a terms of reference for their engagement with the project.

- Aug 2009: Questionnaire on fisheries mitigation published on the COWRIE website.
  Press release published by Fishing News highlighted questionnaire.

  The mitigation questionnaire was created to elicit views from fishing and windfarm industry professionals on the idea of mitigation generally, and to identify if there were examples of mitigation projects that had not been reported publicly. The project and the questionnaire were advertised through the COWRIE website and in an article in Fishing News. Two further commercial fishing industry representatives joined the EAG after the article was published.

- Sep 2009: Questionnaire on mitigation sent out widely to relevant organisations.
  Project introduction sent to EAG.

  Windfarm and other offshore industry representatives were contacted directly and asked to complete the questionnaire. Text that formed the introductory sections of this report was sent to the EAG for review.

- Oct 2009: Draft list of possible mitigation options produced and sent to EAG.

  As many options and opportunities for mitigation were identified as possible. The options were based on responses to the project questionnaire, research undertaken in the early stages of the project, and discussions held with EAG members. Each of the draft mitigations options was described briefly, and a full list provided to EAG members for review.

- Nov 2009: First EAG workshop held in London.

  EAG members were invited to London for a one-day workshop. The aims of the workshop were to assess the interest in mitigation as an approach to managing impacts on fishing activities, and to review and refine the mitigation options list. 13 EAG members attended the workshop.

- Dec 2009: Revised draft list of possible mitigation options placed on COWRIE website.
  Press release published by Fishing News.

  Following the workshop, the revised draft mitigation options list and a note of the workshop discussions were published on-line, and a press release was provided to Fishing News.

- Jan - Feb 2010: SWOT analysis of mitigation options undertaken.

  Using the revised draft mitigation options list, a strengths, weaknesses, opportunities and threats (SWOT) analysis of each of the options was undertaken. This was then provided to the EAG members for review.

- Mar 2010: Second EAG Workshop help in London.

  EAG members were invited to London for a one-day workshop. The aims of the workshop were to review the SWOT analysis of mitigation options, determine if there were opportunities to take forward pilot mitigation projects, and to investigate cumulative fisheries impact assessment from multiple developments.

- Apr 2010: Draft Final Report published on COWRIE website for a one month consultation.
  Press release sent to Fishing News.

  A consultation was held on the draft Final Report. Responses to the consultation were summarised and are presented as Appendix 7.

- Jun 2010: Final Report published on-line by COWRIE.

## 1.4 Summary aims

This project was focused on supporting commercial fishermen and fishing communities over the long term by investigating options and opportunities for marine fisheries mitigation associated with windfarms.

In brief, the aim of this project can be summarised as "*Identifying ways to keep fishermen fishing*".

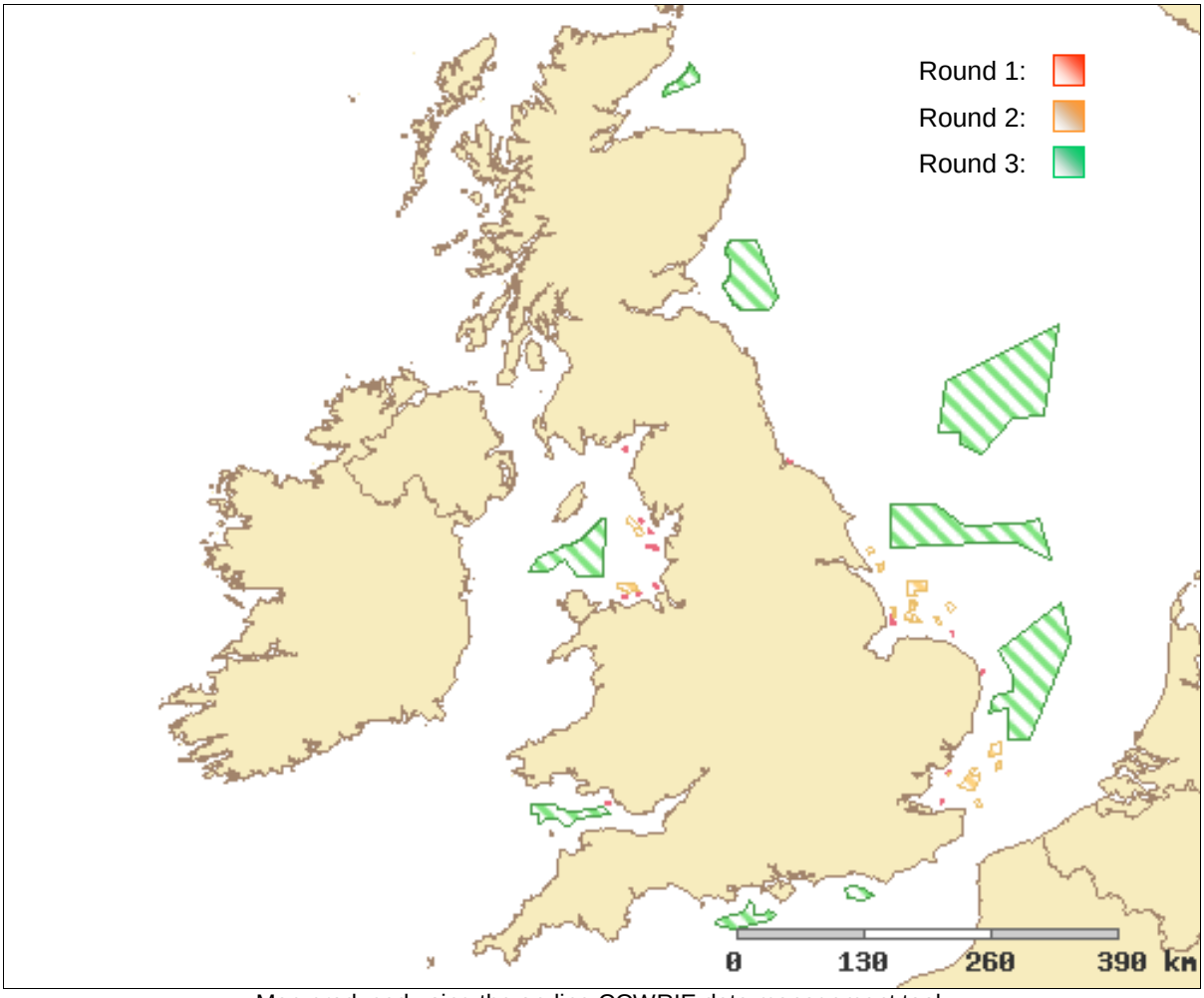
The project had national scope, although the diversity of environmental conditions and fishing techniques that are found around the UK mean that not all mitigation options will be relevant to all situations where windfarms and commercial fisheries interact. It is important to note that the results of the project are in no way intended to eliminate or constrain discussions between windfarm developers and the fishing industry, or amongst other stakeholders including fisheries management, science and statutory bodies. Instead, it is intended that the work is used to support and enhance discussions between the parties associated with any UK offshore windfarm development.

# 2 Project context

## 2.1 The UK offshore windfarm industry

The offshore windfarm industry has developed rapidly in response to the increasing demand for renewable energy. In the UK, the first offshore windfarm was commissioned at Blyth in December 2000 (BWEA 2009). Also in December 2000, the Crown Estate, which leases the majority of the seabed development rights around the UK, invited companies to tender for the right to build small offshore windfarms of up to 30 turbines. This first, pilot phase of development was termed Round 1, and was quickly followed in 2003 by the Crown Estate's announcement of Round 2, which was for much larger windfarms to be built in waters further off the coast. Round 2 sites are focused in three strategic development areas- the Greater Thames, Greater Wash, and eastern Irish Sea.

The bulk of the UK wind generating capacity is currently onshore, with 210 projects totalling 3091 MW already commissioned, and another 435 projects totalling 11,633 MW generating capacity under construction or in the consenting and planning phases (BWEA 2009). While there are a greater number of projects onshore, the average size of the projects is far higher offshore. Across the UK, there are now eight fully operational offshore windfarms totalling 598 MW generating capacity, with another eight totalling 1,742 MW of capacity under construction and a further 12 totalling 5,093 MW of capacity either consented or in the planning phase (BWEA 2009).




Map produced using the on-line COWRIE data management tool.

Figure 1**:** Round 1 and 2 windfarm lease locations, and Round 3 strategic areas.

The majority of offshore windfarm development in the UK has been in English waters, with just the 60 MW North Hoyle and 90 MW Rhyl Flats windfarms being located in Welsh waters (Figure 1). However, in 2008 the Scottish Government and the Crown Estate called for bids on potential sites in Scottish waters. This call has resulted in ten 'exclusivity awards' being granted for sites in Scottish waters that reportedly may result in more than 6 GW of offshore wind power being generated (CE 2009).

In June 2008 the Crown Estate announced a more extensive Round 3 of offshore windfarm development. This is the latest development phase in UK waters, and has come in response to Government's call for 15% of the UK's power to be generated from renewable energy by 2020. Under Round 3, the Crown Estate has offered further areas in the Greater Thames, Greater Wash and eastern Irish Sea strategic areas, as well as in two areas off the Scottish east coast.

A potentially significant, recent development was the establishment of the first floating, commercially-sized wind turbine in the North Sea (Statoil 2009). This pilot project, named Hywind, is reportedly capable of operating in water depths of between 120 m and 700 m, opening up considerably greater areas of the marine environment than were previously available to offshore wind power. It is clear that the offshore wind industry is in a very significant growth phase, and will be an important feature of UK waters for the foreseeable future.

## 2.2 The UK fishing industry

Commercial fishing is an historic and socio-economically important activity in many coastal areas of the UK. Data from the Marine and Fisheries Agency (M&FA) show there were 12,729 active fishermen in the UK in 2007, working from 6,763 vessels (M&FA 2008). The role of sustainable fisheries in supporting long-term food security for the UK has also been recognised (PMSU 2008).

Upstream and downstream elements of the fishing industry include boat builders and engineers, equipment manufacturers, and processing, marketing and distribution businesses. These activities add considerably to the UK fishing industry's overall economic value, such that, while the first-sale value of the landed catch was £644 million in 2007, the economic contribution of the whole fishing industry to the UK was estimated to exceed £4 billion (Andeson & Curtis 2008). The social and cultural value of the UK fishing industry is also high, and contributes substantially to coastal communities.

The catching part of the fishing industry is made up of a number of different sectors, including those using static or towed gears, and those fishing multi-day trips or those that work day trips only. Across the UK, almost 80% of the fishing fleet is made up of small vessels of less than 10 m length, which are typically worked in inshore waters of within the 12 Nm UK territorial limit. However, there are significant regional differences in fleet structure, such that just over 60% of the Northern Irish fleet is made up of small vessels, in comparison to 70% of the Scottish fleet, 80% of the English fleet and just less than 90% of the Welsh fleet (M&FA 2008). These differences occur because of variations in the species targeted, the environment and operating conditions found on the fishing grounds, and the infrastructure available ashore.

Around the UK, there has been a gradual decline in the number of active fishermen and fishing vessels over time (M&FA 2008). It seems likely that intense financial pressures caused by high fuel prices in late 2008 will have caused a further reduction in the number of fishermen and vessels that is yet to be reflected in official statistics. A reduction through time is, though, to be expected if fishing effort is to remain constant. This is because technological advances in navigation, fish-finding, fishing gear design and materials, as well as increasing engine power, contribute to increasing fishing efficiency of individual vessels. For example, the average power of new UK-registered fishing vessels doubled from 103 kW from 1971-1980 to 206 kW from 2001-2007 (M&FA 2008).

The state of targeted fish stocks is a key determinant in maintaining the viability of the EU fishing industry. A policy document produced by the European Commission prior to the main European Fisheries Council meeting in December 2008 highlighted the continuing poor status of many European fish stocks, with 88% of assessed stocks considered to be underperforming (EC 2008). It is important to note that this high figure suggests that more fishing livelihoods could be supported in the medium to long term if stocks of targeted species were healthier.

## 2.3 Fishing and windfarms

Offshore windfarms have been an issue of concern for UK commercial fishing interests for less than a decade and, to date, most UK fishermen are unlikely to have been significantly affected. However, the scale and speed of windfarm development offshore means that that situation is likely to change in the relatively near future.

The primary concern for fishermen is the potential loss of access to fishing grounds within turbine arrays, with associated increases in steaming times and in competition for other grounds (Mackinson *et al.* 2006). Fishermen may take many years to learn their local grounds, and the species targeted are often mobile (for example, crustaceans and some mollusc species) or highly mobile (for example, most fish species). Therefore, in order to maintain viable operations across the year, fishermen often need the flexibility to follow target species or to target different species in season. As well as through spatially explicit fishing regulations and quotas, the ability of fishermen to move freely between fishing grounds has been impacted by the development of offshore industries, including oil and gas, aggregate dredging, ports and telecommunications. These industries limit access to fishing grounds through legislative or competitive exclusion, or because of safety concerns. More recently, the designation of marine nature conservation sites and, now, the development of offshore windfarms, may further reduce the availability of fishing grounds.

In contrast to UK statutory regulations for the oil and gas industry which exclude fishing activities from within 500 m of all relevant installations other than pipelines (DTI 1987), UK legislation for offshore windfarms requires only that a 50 m exclusion zone is established around each turbine (BERR 2007). This will potentially leave significant areas open to fishing within turbine arrays. However, the earliest offshore windfarms used a relatively small minimum inter-turbine spacing, for example 400 m at Robin Rigg (Edwards & McCallum 2002) and 350 m at North Hoyle (NWPO 2002). This spacing is sufficiently close that fishing may be difficult due to manoeuvring issues, while the risk of snagging means that fishing with any gear type may be unsafe in poor weather or strong tidal runs (Mackinson *et al.* 2006).

While the decision to fish or not to fish within windfarms could be the choice of individual fishermen, in a letter to NE concerning European Marine Site (EMS) designations the Sea Fish Industry Authority (SFIA) noted that "*Recent demonstrations ... show that ... towed gears are deployed with an accuracy of just a very few meters – typically +/- 3 m*" (SFIA 2010). This would appear to suggest that manoeuvring between turbines should be possible. Proposals for the latest windfarms employing higher capacity turbines indicate an increased minimum inter-turbine spacing, for example 630 m at Docking Shoal (Centrica 2008) and 500–800 m at Humber Gateway (E-on 2009). It therefore appears that the potential for fishing within windfarms will increase in future developments. Windfarm developers may, though, apply for exclusion orders from the Secretary of State for activities that have the potential to damage windfarm infrastructure. This may include towed bottom fishing gears. It is unclear at the present time how many windfarms are likely to request an operational-phase exclusion for towed gears, although this has been at least suggested for Gunfleet Sands II (DongEnergy 2007), London Array (RPS 2005) and Sheringham Shoal (SOE 2006). In contrast, bottom trawling will apparently be permitted at some sites, such as Barrow (RSKEnvironment 2002), North Hoyle (NWP 2002) and Oriel (AFIS 2007).

There are no known proposals for static gears to be prohibited at any windfarm site. In fact, static gear fishermen have the potential to benefit from windfarms, as static gears cannot generally be used in the same areas as towed gears without risking gear loss. Gear conflict can be a significant issue, and a number of static gear-only fishing areas have been established around the UK for many years, for example off south Devon (Blyth *et al.* 2002) and off the coast of northeast England (Rogers 1997). Therefore, where towed gears are prohibited, static gear fishermen may benefit from a level of increased access to fishing grounds. The safety concerns associated with snagging the bottom in poor weather or strong tidal runs while having limited manoeuvrability are likely to apply, however.

While there may be risks and opportunities associated with fishing within windfarm arrays, the FLOWW group noted that damage may occur to exposed power cables through anchoring or trawling. While snagging cables presents a risk to safe fishing operations, a punishable offence may have been committed if any damage is proven to have been caused wilfully or by culpable negligence (BERR 2008). While compensation is payable if gear is sacrificed in order to prevent damage to windfarm

infrastructure, there may be still be some unwillingness from commercial fishermen to fish within windfarms where snagging risks are apparent.

The process of laying cables is a further factor which has the potential to impact commercial fishing activities. Where cables connecting arrays to electricity grids ashore are buried, the trenching process poses risks to towed gears where deep or wide trenches may be difficult or dangerous to cross. Even if back-filling of trenches is carried-out, there is a possibility that hitches or snags may be revealed. These can also cause problems for towed gears or, particularly, for bottom-set drift nets, which are only fishable if the seabed is smooth. Cables that cannot be buried and must be armoured instead present an obstacle to mobile gears of any sort. Conventional rock armouring is likely to be particularly problematic, although concrete and frond mattresses have been developed to promote cable burial over time, for example 'Frond Flexiform' (SLP 2010), and this may reduce risks.

Although the potential negative impacts of offshore windfarms are of greatest interest to fishermen, some positive impacts may also result. In particular, there is considerable interest in the potential for turbine bases and associated scour protection or rock armouring material to act as artificial reefs that attract and hold target species, or that help to improve stock status through providing structured habitat for juveniles. In the UK and globally, a number of windfarm Environmental Impact Statements (EIS) or other project documents refer to the role that turbines may play as artificial reefs, including those for Côte d'Albâtre (Enertrag 2006), Dudgeon (DOW 2009), Gunfleet Sands II (DongEnergy 2007), Horns Rev (ElsamEngineering & ENERGIE2 2005), Kentish Flats (EmuLtd. 2002), Oriel (AFIS 2007), Ormonde (EEC 2005) and Sheringham Shoal (SOE 2006).

The role of artificial reefs in aggregating or enhancing target stocks has been discussed in the scientific literature for some years (Polovina 1989; BERR 2008). The potential to enhance targeted stocks through artificial reefs appears to be greatest if population bottlenecks, either in terms of habitat or food availability, can be addressed (Pickering & Whitmarsh 1997; Powers *et al.* 2003). While enhancing stocks through promoting recruitment would likely be of benefit to commercial fishermen, the benefits are less clear where artificial reefs serve only to aggregate targeted fish (Polovina 1991; Lindberg & Loftin 1998). In such cases, careful management fisheries management may be required in order to prevent over-exploitation of vulnerable stocks.

## 2.4 Inshore, offshore and EU fisheries

A variety of fisheries legislation limits the size and power of fishing vessels that are able to work within UK inshore waters. For example, a number of Sea Fisheries Committees impose length restrictions on fishing vessels working within six Nm of the coast, including ESFJC (15.24 m), K&ESFC (17 m) and SSFC (14 m), while Council Regulation No. 2371/2002 prevents beam trawlers of greater than 221 kW and 9 m aggregate beam length from operating within 12 Nm of the UK coast. The aim has been to push larger vessels offshore in order to provide opportunities for fishermen using small vessels inshore, because small vessels tend to be operationally more limited by range and weather.

For the same operational reasons, it is likely that the loss of access to any particular fishing ground will affect the activities of small fishing vessels more than those of large vessels. Vessels undertaking day-trips incur proportionally greater costs than multi-day vessels when steaming, while opportunities for fishermen to relocate to adjacent grounds are likely to be more limited in busy, inshore areas. However, inshore vessels are often somewhat multi-purpose, and so alternative fisheries may be available in adjacent areas. It should also be noted that, while individual fishermen are required to determine what constitute safe working conditions for their vessel, small vessels are potentially more suited to working within the confines of windfarms than large ones.

As offshore windfarms are increasingly being sited away from the coast, their potential to impact the activities of large fishing vessels increases. Round 2 and, in particular, Round 3 windfarms will extend across considerable areas (Figure 1). While offshore fishing vessels are necessarily capable of working in very inclement weather, it is likely that, in such conditions, it would be impractical or unsafe to fish within windfarms even if permitted. As discussed in Section 2.3, permission to fish will be a significant issue, however, as the majority of large, offshore vessels are specialised towed-gear vessels. It should be noted again that fishing within windfarms does appear possible for large trawlers, as monitoring has been undertaken within the Barrow windfarm using a 23.4 m, 478 hp fishing vessel, equipped with a commercial-scale otter trawl (RSKEnvironment 2007).

Vessels of other EU-Member States are not permitted to work within 6 Nm of the UK coast, while only vessels with historic access rights are able to work in waters within the 6–12 Nm UK territorial limits. Outside the 12 Nm territorial limit, vessels of other EU Member States are permitted to fish. While operational differences exist between inshore and offshore fishing vessels, this project has assumed that there are no fundamental differences between UK and non-UK vessels fishing in UK offshore waters. As such, the possible mitigation options presented in this report, and the process of managing any impacts on fishing activities, were presumed to apply equally to UK-based and non-UK fishermen.

The Common Fisheries Policy reform process has been considered under Appendix 1, but the needs and activities of non-UK fishermen working around UK offshore windfarms have not been explicitly addressed in this report.

Table 2: Summary of operational issues for different-sized fishing vessels.

| Fishing vessel size | Summary of operational issues |
|---|---|
| Small<br>(< 10 m length over all) | Greatly limited by weather<br>May be very range limited, although modern, fast vessels can have considerable daily range<br>Tend to be day-trip vessels only<br>Never restricted by size or power regulations inshore<br>Unlikely to operate over a wide area— may be very locally focused.<br>May be somewhat multi-purpose and so adaptable to different fishing opportunities<br>Depending on gear, may work within windfarms |
| Medium<br>(10–15 m LOA) | Somewhat limited by range and weather<br>Tend to be day-trip vessels, but may undertake short multi-day trips<br>Rarely restricted by size or power regulations inshore<br>Likely to be relatively locally focused, but may operate over quite a wide regional area, or undertake seasonal movement to follow fisheries.<br>Limited adaptability to different fishing opportunities<br>Depending on gear, may work within windfarms |
| Large<br>(> 15 m LOA) | Rarely limited by range or weather<br>Tend to be multi-day vessels<br>Often prevented from fishing inshore by size or power regulations<br>Likely to operate over a wide geographic area as opportunities allow<br>Likely to be highly specialised for a particular mode of fishing<br>Likely to use heavy towed gears and therefore may not be permitted to fish within windfarms |

## 2.5 Fisheries compensation and mitigation

As the number of active fishermen and vessels has declined through time, the knock-on effects on employment and cultural heritage in dependent, coastal communities have been identified as key concerns by fishermen and fisheries managers (Mackinson *et al.* 2006). The concern for coastal communities and businesses ashore is of great importance for this report, which is focused on identifying mitigation options with the aim of 'keeping fishermen fishing' by increasing access,

enhancing performance, reducing costs, increasing product prices or enhancing marketability, rather than simply paying affected fishermen compensation money when access to an area is lost.

A potential risk with adopting a policy of direct monetary compensation is that this will provide only temporary relief to fishermen, and that it will be of limited benefit if fishing opportunities have been lost in the longer term. Essentially, fishing communities and associated businesses rely on fishermen remaining active. However, it is not intended that this report provides guidance on whether compensation or mitigation is appropriate, or which mitigation option might be suitable, or to determine how much financial support windfarm developers should be asked to commit to any option. In order to decide if compensation or mitigation is appropriate and desirable at any windfarm development, fishermen and developers will need to engage in detailed discussions at the local level.

It is assumed that any calculation to determine the appropriate level of financial support for compensation or mitigation options will be based on evidence of fisheries impacts. The availability of data showing evidence of fishing activity and impacts will therefore be of fundamental importance. FLOWW (BERR 2008) recommended that key determinants of the level of compensation should include, but should not be restricted to:

- Historical fishing activity on the project site (including log book evidence);
- Level of restriction on fishing desired by the developer;
- Willingness of fishermen to continue fishing the site once it's constructed;
- Pressure on other fishing grounds by displaced fishermen;
- Types of fishing methods employed;
- Species of fish caught;
- Estimated value of the catch from the project site.

The UK Renewable Energy Strategy also referred to fisheries mitigation, and noted that any mitigation requirements imposed on windfarm developers must be proportionate to their impacts on the fishing industry (DECC 2009). The need to ensure proportionality applies equally to both fishermen and developers, so that neither party is unfairly penalised. The data that are available to investigate fisheries activity and impacts are discussed more in Appendix 2.

In considering either mitigation or compensation, it is important to remember that windfarm developers are also businesses, and that cost-effective solutions to development issues will be required. There are therefore a number of potentially important features of mitigation in comparison to compensation that may be considered by all parties in discussions. In particular, a variety of external funding sources exist to promote the sustainability and viability of fisheries, and these may be targeted in an effort to increase the level of funding available for mitigation projects. Regional Development Agencies (RDAs) and, in particular, the European Fisheries Fund (EFF), have budgets and clear remits to support local businesses and communities. Importantly, mitigation projects in support of keeping local fisheries going are much more likely to be supported by external funders than simple compensation packages that pay affected fishermen, which almost certainly must rely solely on funding from developers.

A further issue that may be in favour of mitigation is that the process of working proactively with fishermen towards long-term sustainability could provide interesting and positive stories for use in a developer's marketing materials. The trade-off might be that developers could be encouraged to provide greater financial support to such projects than to compensation alone. Individual developers will, though, need to consider the importance and value of such opportunities to their own businesses.

Finally, there is the potential for developers and fishermen to group resources when considering options for mitigating cumulative and in-combination impacts from multiple windfarm developments. Essentially, implementing any particular mitigation option may be impractical at the local scale but possible at the regional scale when finances are combined. In contrast, compensation resulting from multiple developments is only likely to be provided on a piece-by-piece basis, and following repeated discussions with individual developers and fishermen.

An analysis of the strengths, weaknesses, opportunities and threats associated with mitigation options is provided in Section 5.1.

# 3 Identifying possible mitigation options

The identification of possible mitigation options has benefited greatly from the process of stakeholder engagement described in Section 1.2. In particular, members of the EAG provided considerable support through suggesting options and by commenting on the options list and SWOT analyses presented. The workshops in November 2009 and March 2010 were well attended and EAG members provided input and support to the work (Appendix 3, Appendix 4).

While Fishing News willingly published the press releases provided to them on the project, the questionnaire that was sent out to fishermen, windfarm developers and other offshore industries was not found to be particularly successful, as very few responses were received back. However, those responses that were received did provide extremely valuable contextual input to the project, as well as identifying a number of existing approaches to mitigation.

Possible mitigation options were developed using responses to the project questionnaire, the literature review and research undertaken during the project, and discussions held with EAG members. The options presented are not intended to be definitive or exhaustive. They represent a range of options that may be rejected or added to as required by developers and fishermen working to address impacts at specific developments.

Four categories of possible mitigation options were identified:

1) Pre-construction options to minimize any impacts on commercial fishing activities.

   There are a considerable number of factors that constrain where offshore windfarms may be constructed, including water depth, substrate type, the availability of a grid connection, nature conservation interests, shipping lanes and visual impacts. However, there may be options available to reduce or eliminate any negative impacts of windfarms on commercial fishing activities through early and constructive consultation between developers and the fishing industry. The options in this section reflect that approach.

2) Options to enhance stocks of targeted species and associated habitats.

   A key determinant in maintaining the viability of the fishing industry is the state of targeted fish stocks, while many stocks are affected in turn by the availability and condition of seabed habitats. These options are therefore focused on promoting existing fishing activities within and around wind farm sites, by identify opportunities to enhance or otherwise support populations of targeted species and/or the habitats on which they depend.

3) Options to support existing fishing activities.

   Beyond the availability of fish to catch, there are a range of factors that influence the viability of fishing operations. These include the availability of ground in which to fish, the cost of fishing operations and the value and marketability of the landed catch. Options in this category are therefore focused on increasing access, enhancing performance, reducing costs, increasing product price or enhancing marketability.

4) Options to develop new fisheries or other non-fisheries opportunities.

   A loss of access to favoured fishing grounds is likely to present a significant challenge to fishermen, and particularly for those using small, inshore vessels which are likely to be constrained by weather and operating range such that alternative grounds may not be available. In such circumstances, and in order to support ongoing fishing activities, a switch to new or alternative fisheries may be possible. Although potentially of less benefit to businesses and communities directly associated with commercial fisheries, a switch to activities other than fishing but which require experienced seamen may also be options worth considering. The options in this section reflect these considerations.

# 4 The SWOT analysis

An overarching strengths, weaknesses, opportunities and threats (SWOT) analysis detailing generic issues that were thought to be applicable to all the identified mitigation options was carried out during the course of the project. This analysis is presented in Section 5.1. Specific SWOT analyses were then carried out for each mitigation option. These analyses are provided on the following pages.

In addition to the SWOT analyses, for each option an indication was made of the likely timescale and costs for implementation. It was not considered possible to be very specific on the timescale and costs as for every option these will depend greatly on, amongst other things, the availability of resources (money, time, expertise, etc.), the number of fishermen involved, the local situation of the windfarm and the ambition of fishermen and developers.

## 4.1 Timescale

The timescale was assessed as being the likely time taken for work to be undertaken and for the results of any action to begin delivering benefits to impacted fishermen. In general, it was assumed that options that would be dependent on biological factors would take a longer time to deliver any benefits, whereas it was assumed vessel or technology related options would deliver benefits more quickly. Five time periods were identified:

- Immediate
- 0–6 months
- 0.5–2 years
- 2–5 years
- 5–10 years

## 4.2 Costs

The costs section provided a qualitative assessment of the likely costs of successfully implementing the option to the extent that significant benefits may be delivered. For all of the options, the cost would be highly dependent on a range of factors specific to each development. Three general categories of costs were identified:

- Low: These options are likely to be relatively inexpensive, in the order of up to several tens of thousands of pounds (GB £).
- Medium: These options are more expensive and are expected to require investment in the order of a hundred thousand pounds (GB £).
- High: These options are likely to cost several hundreds of thousands of pounds, or more. It is highly likely that additional funding from external sources would be required in order to achieve a level of intervention which would have the potential to deliver significant benefits.

## 4.3 Other information

The 'other information' section provides additional information relevant to each option and summarises what are considered to be the most important points identified in the SWOT analysis. The factors considered included issues affecting the speed of delivering benefits to impacted fishermen, key regulatory obstacles, the dependence on unpredictable biological or ecological processes, examples of similar initiatives or ideas that have been taken forward already, potential hurdles or issues, or suggestions as to how an option might be taken forward. Each of the options is independently referenced in an effort to make reading through the list easier.

In the second EAG workshop in March it was agreed that any text in support of or against particular options should be removed from this section, so that developers and fishermen were left the decision to adopt or reject a mitigation option during detailed discussions at the site level.

# 5 Results

## 5.1 Overarching SWOT analysis of mitigation

This overall SWOT analysis brings together characteristics of both the windfarm and fishing industries. To varying degrees, the highlighted strengths, weaknesses, opportunities and threats may be applied to all of the identified options and opportunities for mitigating any impacts on marine fisheries.

### Strengths

Strengths were defined as attributes or characteristics of the relevant organisations, industries or activities that are *helpful* to achieving the objective of mitigating any impacts on fisheries.

- Several strong, well-organised fishing industry associations.
- Strong, well-organised windfarm developers and organisations.
- Increasing recognition within both industries of the need to work collaboratively on windfarm and fishing issues.
- Some healthy fisheries, particularly inshore.
- Strong entrepreneurial spirit within both industries.
- Good reputation for UK fishing industry products.
- Increasing market interest in sourcing sustainably produced fish, and fishing industry interest in supplying the market.
- Potential to focus on quality and high-end fresh or live markets.
- Inshore fleet is usually relatively flexible and able to take advantage of new opportunities.
- Strong existing links to local, national and international markets for seafood.
- Skills and adaptability of UK fishermen.

### Weaknesses

Weaknesses were defined as attributes or characteristics of the relevant organisations, industries or activities that are *unhelpful* to achieving the objective of mitigating any impacts on fisheries.

- There is a level of commercial confidentiality at the start of developments which limits the potential for discussions to begin at the earliest stages.
- The fishing industry is made up of many individuals and a large number of sectors, which may have conflicting individual or sectoral needs.
- Some reluctance of fishing industry to engage and cooperate with developers.
- Poor spatial and economic data on fishing activities can create uncertainty in discussions.
- Limited information on what fishing activities will be permitted at different sites.
- Need for the fishing industry to adapt to or to seek methods for working within windfarms.
- Constraints on what can be safely carried out in windfarms, or on accessing developments undergoing maintenance work.
- Limited availability of start-up funding within the fishing industry for new initiatives.
- Ageing fleets and increasing average age of fishermen make conversion to new activities difficult.
- Any option other than compensation may be felt to benefit some fishermen to the detriment of others.
- Compensation is likely to require the least effort from developers.

**Opportunities**

Opportunities were defined as external conditions that are *helpful* to achieving the objective of mitigating any impacts on fisheries

- A strong Government steer of the need to 'make windfarms happen'.
- New Marine and Coastal Access Act should promote innovative thinking on planning, management and resource use.
- External funding to promote local, sustainable, inshore fisheries appears likely to be available, for example from the European Fisheries Fund and Regional Development Agencies.
- Much increased public interest in sustainably and locally sourced fish and fish products.
- Opportunity for developers to show commitment to supporting local industries— mitigation options could be highlighted in marketing material.
- Cumulative and in-combination effects from different windfarms and other developments may lead to opportunities for increased funding and scope for mitigation options across regions.

**Threats**

Threats were defined as external conditions that are *unhelpful* to achieving the objective of mitigating any impacts on fisheries

- Environmental change, including climate change, may move fisheries in space and time, making it difficult to predict impacts and potentially limiting benefits.
- Reduced public support for the fishing industry because of concerns over environmental impacts.
- In the short term, national and global economic slow-down may limit spending on projects and anything perceived to be excessive.
- Perception/reality that windfarms are coming irrespective of what fishermen say or do.
- Perception/reality in some fisheries that there are too many fishermen chasing too few fish.
- Environmental opposition to fishing, particularly with towed gears.
- Other countries overtaking the UK in developing windfarm-fisheries options, cornering niche markets.
- Fisheries management outside the UK 6 Nm Territorial Limit can usually only be undertaken with the agreement of other EU Member States.
- Failure to cultivate/encourage the next generation of commercial fishermen.
- Displaced fishermen could impact other fishermen, and understanding where displacement effects end may be critical.
- In-combination effects from different windfarms and other developments.

## 5.2 Pre-construction options to minimize impacts on commercial fishing activities

### 5.2.1 Combining windfarms with Marine Conservation Zones

Outline

There is increasing pressure on space for different activities and industries at sea. The new Marine Conservation Zones (MCZs) proposed in the Marine and Coastal Access Act may limit or, in some cases, prevent fishing, so there may be potential to combine offshore windfarms with MCZs in order to minimize restrictions on fishing activities. Where windfarms are developed on fishing grounds, fishermen may find opportunities to conduct environmental and fisheries monitoring.

**Strengths**

- Could minimize the combined impacts on fishing from windfarm developments and the MCZ network designation process.
- The MCZ network design process is currently underway; early proposals from fishermen and developers may be welcomed.
- May not need every part of every windfarm to be included as an MCZ; zoning could be used to balance nature conservation and fisheries interests.
- Boundaries of some existing and planned windfarms already extend into existing and proposed EMSs.
- Windfarm service vessels could support MCZ boundary enforcement efforts.
- Fishermen could be involved in monitoring MCZs.
- Benefits to habitats and targeted stocks may develop.

**Weaknesses**

- Some fishermen may want to retain access to windfarm sites where they are important grounds.
- Windfarm sites may not be suitable or desirable as MCZs.
- Windfarms in the early design process may be too late to engage with the MCZ network design process, which is scheduled to end in 2012.
- Likely to be limited job creation potential from monitoring of MCZs directly.
- Any fisheries benefits from MCZs may develop slowly.
- Windfarms may not be large enough to protect targeted stocks, other than of sessile or site-attached species.
- Many windfarm sites on shallow sandbank areas appear likely to be of low biological interest for MCZs.

**Opportunities**

- There is already significant interest in combining windfarms and MCZs, because towed-gear fisheries appear likely to be restricted at most windfarms.
- High quality research should be possible with a number of windfarms forming replicate treatments for studies.
- Monitoring work could be linked to retraining for fishermen, for which EFF funding may be available.

**Threats**

- There remain concerns about turbines and scour material acting as stepping-stones for non-native and invasive species.
- Noise and electro-magnetic field effects on elasmobranch fish and other marine species are generally considered unlikely to be significant, but some questions remain.
- There are concerns that turbines could reduce the value of any site as a MCZ.
- If no fisheries benefits are observed, the MCZs may be considered a failure by the fishing industry.

Timescale: **Immediate**

Any immediate benefits are conferred through avoiding the negative impact of losing access to additional fishing grounds, rather than to benefiting from a positive impact. Any positive benefits for targeted stocks would take some time to develop, if at all, and would need to be considered on a case-by-case basis.

Costs: **Minimal, but more if monitoring is included**

It appears likely that combining the boundaries of MCZs with those of windfarms could be readily achieved, although any training for fishermen associated with monitoring would be more costly.

Other information

This study is not aware of any examples where boundaries of marine protected areas (MPAs) were deliberately drawn to reflect windfarm boundaries, but there is an extensive literature on the impacts of towed fishing gears on seabed communities and habitats (e.g., [1,2]), suggesting that conservation benefits may develop within windfarms even if only towed gear use is prohibited. Relevant examples include the Inshore Potting Agreement off south Devon[3] and the Isle of Man closed area[4]. Static gears can also impact species, communities and habitats, but are generally considered to be less damaging[5]. Any positive effect on communities and habitats from excluding towed gears will be minimized where the seabed is subject to regular natural perturbation and is made up of mobile sediments[6,7].

There is considerable concern within the fishing industry over the loss of access associated with MPAs. For example, the NFFO and SFF have recently combined to launch the MPA Fishing Coalition[8]. The main effect of this mitigation option would be to minimize the combined impacts of windfarm developments and MPAs on the fishing industry, rather than to enhance existing fisheries or to create jobs.

It is likely that any reduction of the area of ground lost to windfarms and MPAs will be welcomed by fishermen from the towed gear sectors, although some fishermen from static gear sectors may wish to maintain access to important fishing grounds within windfarms. In cases where different fisheries are excluded or permitted within windfarms, it may be feasible to include the whole windfarm, or the some parts thereof, within an MPA network as a site with a lower level of protection.

There is concern from an environmental perspective that the impact of turbine arrays on habitats, and the effect of noise and electromagnetic field (EMF) on species, communities and habitats may make windfarms unsuitable for MCZ designation[9,10]. Further, windfarms are unlikely to be developed in areas that cover a full range of representative marine habitats (e.g., reefs). As such, it is clear that areas outside of windfarms will be put forward as MCZs irrespective of whether windfarms are incorporated into MCZ networks.

---

[1] Blyth, R. E., Kaiser, M.J., Edwards-Jones, G. & P.J.B. Hart (2004). Implications of a zoned fishery management system for marine benthic communities. *Journal of Applied Ecology*, V. 41, pp. 951-961.

[2] Duplisea, D. E., Jennings, S., Warr, K. J. & Dinmore, T. A. (2002). A size-based model to predict the impacts of bottom trawling on benthic community structure. *Canadian Journal of Fisheries and Aquatic* Science V.59, pp. 1785-1795.

[3] Blyth-Skyrme, R.E., Kaiser, M.J., Hart, P.J.B., Edwards-Jones, G. and D. Palmer (2007). Evidence for greater reproductive output per unit area in areas protected from fishing. *Canadian Journal of Fisheries and Aquatic Sciences*, V. 64, pp. 1284-1289.

[4] Beukers-Stewart, B.D., Vause, B.J., Mosley, M.W.J., Rossetti, H.L. & A.R. Brand (2005). Benefits of closed area protection for a population of scallops. *Marine Ecology Progress Series*, V. 298, pp. 189-204.

[5] *Jennings, S. & M.J. Kaiser (1998). The effects of fishing on marine ecosystems. Advances in Marine Biology V. 34, pp. 201-352.*

[6] Queirós, A.M., Hiddink, J.G., Kaiser, M.J. & H. Hinz (2006). Effects of chronic bottom trawling on benthic biomass, production and size spectra in different habitats. *Journal of Experimental Marine Biology and Ecology*, V. 335, pp. 91-103.

[7] M. J. Kaiser, M.J., Edwards, D.B., Armstrong, **P.J.,** Radford,K., Lough, N.E.L., Flatt, R.P. & H. D. Jones (1998). Changes in megafaunal benthic communities in different habitats after trawling disturbance. ICES Journal of Marine Science, V.55, pp 353-361.

[8] http://www.nffo.org.uk/news/coalitions_landmark.html

[9] Gill, A.B., Gloyne-Phillips, I., Neal, K.J. & J.A. Kimber (2005). The potential effects of electromagnetic fields generated by sub-sea power cables associated with offshore wind farm developments on electrically and magnetically sensitive marine organisms- a review. COWRIE-EM FIELD 2-06-2004. COWRIE, UK: 128 pp.

[10] DECC (2009). UK offshore energy strategic environmental assessment; future leasing for offshore wind farms and licensing for offshore oil and gas and gas storage. London, Department of Energy and Climate Change: 861 pp.

### 5.2.2 Selecting sites with minimal impact within a windfarm development zone

Outline

There may be some opportunity to select between sites for windfarm development. Effective, early consultation and discussion could reveal opportunities to minimize impacts on the fishing industry through selecting areas for development that are of lower fishing importance.

**Strengths**

- May be able to minimize impacts on the fishing industry.
- If windfarms were moved further offshore, it is possible that fewer fishermen would be severely impacted as offshore vessels generally have greater mobility.
- Promotes and enables early dialogue between fishermen and developers.
- Site selection to minimize conflicts with fisheries and other interests is consistent with the offshore windfarm Zone Appraisal and Planning (ZAP) process.

**Weaknesses**

- Many factors other than fishing affect windfarm siting, including seabed type, water depth, conservation interests, shipping lanes, grid connection, visual impacts, military sites, etc.
- Moving from one area to another is likely to shift impacts from one set of fishermen to another.
- Fishing activity data suggest that the Greater Thames, Greater Wash and Liverpool Bay areas already have lowest fishing levels around the UK.
- Costs may increase greatly if favoured sites for windfarms are not selected.
- Developers may have limited control over site selection based on Crown Estate zoning.
- Climate effects may result in fisheries moving spatially.
- Would require sound evidence base of fishing activity and value.

**Threats**

- Other developments, commercial and social interests, as well as seabed licensing issues, constrain the ability to move sites.
- The limited existing application of marine zoning could mean that, if a developer chose not to use a site, another interest could seek to use it instead.

**Opportunities**

- More likely to be an option if very early consultation was undertaken between developers and fishermen.
- Would very clearly show that developers were listening to fishermen.

Timescale: **Immediate**

Costs: **Low**

Although any changes to windfarm locations later in the planning process are likely to be very expensive to accommodate, these costs may be minimized through very early consultation.

Other information

Fisheries enforcement overflight data suggest that the areas identified for offshore windfarm development in Rounds 1-3 support some of the lowest densities of fishing effort around the UK coast[11], so identifying wide areas with lower fishing pressure appears unlikely.

The range of factors that are critical to windfarm placement will limit the potential to move locations within a zone, while it seems inevitable that some fishermen will be impacted wherever windfarms are located. Very early consultation with the fishing industry may allow the identification and avoidance of important fishing grounds, so minimizing any costs that would be incurred in selecting alternative locations. The Crown Estate's zone appraisal and planning (ZAP) process is likely to be important in ensuring early consultation takes place[12,13].

[11] DECC (2009). UK offshore energy strategic environmental assessment; future leasing for offshore wind farms and licensing for offshore oil and gas and gas storage. London, UK Department of Energy and Climate Change: 861 pp.
[12] http://data.energynpsconsultation.decc.gov.uk/documents/npss/EN-3.pdf
[13] http://www.thecrownestate.co.uk/uk_offshore_wind_report_2010.pdf

### 5.2.3 Designing windfarms or micro-siting turbines to avoid particular fishing grounds

Outline

There may be benefits for the fishing industry in maintaining access to particular tows (for trawling) or drifts (for drift netting) where a small number of turbines would restrict access to favoured grounds, prevent vessels fishing along corridors between grounds, or where construction activities might reveal snags or hitches that would prevent fishing.

**Strengths**

- May be able to keep particular trawl lanes or drifts open, to minimize impacts.
- Provides the potential for developers to take direct action to 'keep fishermen fishing'.

**Weaknesses**

- Turbines are vulnerable to wake effects and turbulence causes vibration, so spacing can impact turbine reliability and maintenance costs.
- Many other factors are relevant in siting windfarms, including seabed type, water depth, conservation interests, shipping lanes, and visual impacts, etc.
- Moving turbines to avoid one fishery being impacted may result in affect other fisheries.
- Costs may increase greatly if favoured sites for windfarms are not selected.

**Opportunities**

- More likely to be an option if very early consultation was undertaken between developers and fishermen.
- Would show clearly that developers were listening to fishermen.

**Threats**

- Other developments, commercial and social interests, as well as seabed licensing issues, constrain the ability to move sites.

Timescale: **Immediate**

Costs: **Low**

Although agreeing to move even a small number of individual turbines within an array at a late stage in planning is likely to be very expensive, costs may be minimized through very early consultation.

Other information

During the early planning stages, it is apparent that there is usually some potential to modify the turbine layout at any windfarm. For example, three different array designs were presented at both the Oriel[14] and Gwynt y Môr[15] windfarms, although visual impact was reported to be the main issue at Oriel in comparison to turbine generating capacity at Gwynt y Môr. The Thanet environmental impact statement (EIS) also referred to the need to micro-site turbines in order to avoid nature conservation interest[16].

A wide range of factors are considered in siting windfarms, some of which may need to be considered higher priority than fishing interests, including shipping lanes and seabed types. However, a range of turbine placement options are almost always considered at the planning stage, and specific fishing interests should be regarded as one of the relevant issues at that point. Early and meaningful discussions between developers and the fishing industry would seem to provide the best opportunity of addressing impacts in specific, favoured fishing grounds. These discussions should occur through the ZAP process[17].

[14] http://www.orielwind.com/documents/Vol_II_Main_Text/Main%20Text.pdf
[15] http://www.rwe.com/web/cms/mediablob/en/340090/data/306614/56150/rwe-npower-renewables/sites/projects-in-development/wind/gwynt-y-mr/summary/English.pdf
[16] http://www.warwickenergy.com/pdf/ThanetNTSlr.pdf
[17] http://data.energynpsconsultation.decc.gov.uk/documents/npss/EN-3.pdf

### 5.2.4 Designing turbines bases or using scour protection to enhance fisheries

Outline

There is considerable interest in the value of turbine bases, and any scour protection material, as artificial reefs for attracting commercially targeted and other marine species. There may be opportunities to maximise any fisheries value through the use of specific base designs or through the use of greater quantities or specific designs of scour material.

**Strengths**

- Recent work has shown that the value of scour protection material as habitat to different species can be increased through using specific designs.
- Species that may to be attracted to or benefit from artificial reefs, such as crustaceans and fish including bass or cod, can be targeted by gears that are likely to be permitted within windfarms.
- Any benefits are likely to be felt locally.
- EISs from a number of developments refer to the value of turbines and scour protection material as habitat, and its potential role in enhancing fisheries.

**Weaknesses**

- Turbine bases are reportedly a particularly cost-sensitive issue for developers and so there may be very little that can be done to change designs.
- Any design changes would require testing, which would take time to acquire.
- Different foundation designs are best suited to specific water depths and substrate types.
- Specially designed scour protection material may be more expensive than dredge rubble or other conventional material.
- The UK Government advice is that scour protection material should be minimized where possible.
- A FEPA license is required in order to place scour protection material.
- Management may be required to reduce risk of honey-pot effects and over-exploitation.

**Opportunities**

- There is extensive experience of using different scour protection materials from other marine industries.
- There may be opportunities to conduct a lessons-learned exercise from the Round 1 windfarms (e.g., Beatrice) and the oil and gas industry's use of scour material.
- FEPA licence studies may also provide useful data.

**Threats**

- The presence of scour protection material may prevent or limit the use of towed gears, where these are still permitted within windfarms.
- There may be nature conservation concerns regarding the loss of existing habitats under scour protection material.
- Some concerns remain about the impact of noise and EMF from windfarms during construction and operational phases on target fish populations.
- SAC and SPA designations may require impacts and scour protection material use to be minimized.
- There remain concerns about turbines and scour material acting as stepping-stones for non-native and invasive species.
- There is an ongoing scientific discussion about the role of artificial reefs in aggregating target fish rather than in enhancing fisheries production.
- Round 2 versus Round 3 windfarm developments will likely pose different engineering challenges.

Timescale **2–5+ years**

It will take time for any biomass and communities to build up in addition to existing animals, although relatively rapid aggregating effects may make some species easier to target in the short term.

Costs: **Medium–Very High**

Designing turbine bases specifically for fisheries benefits appears unlikely to be possible for financial reasons. It is, however, noted that the Oriel Wind Farm EIS stated "the design of platforms should be considered carefully in order to maximise the benefits to the local fish population"[18]. Options regarding scour material choice may, though, be available.

Other information:

The oil and gas industry has dealt with scouring issues for decades, and a variety of specialist materials have been developed (e.g., concrete and frond mattresses[19]) to manage scour. However, there appears to be relatively little information available on the effect of the use of these materials on marine communities or commercial species[20,21]. In addition, UK Government advice is currently to limit the amount of scour protection material used where possible[22].

Documents from a number of windfarm developments have noted the potential value of turbines and/or scour protection material in enhancing local biodiversity as artificial reefs, and have been somewhat positive about their potential role in enhancing targeted fish and shellfish populations[23,24,25]. In contrast, the UK Government SEA for windfarms was less positive on the potential for there to be fisheries benefits, citing the relatively small area normally covered by scour material (typically 10-20 m radius of material around each turbine) and the large distances between turbines[19]. For example, if scour protection was laid over a 20 m radius around each turbine, a 50 turbine array would include just more than six hectares of additional habitat in addition to the turbine bases. This area may or may not provide significant enhancement, depending on the material used and species, habitats and fisheries present.

There are some environmental concerns regarding the potential role of hard structures, such as turbines and scour protection material, acting as stepping-stones for non-native species[26]. It may be that increasing the amount of scour protection material used at a site could increase the potential for this effect to occur.

Although the potential costs for designing specific fisheries-enhancing features into turbine bases may be prohibitive at present, this situation may change in future as technology develops and as any results from windfarm reef-effect studies are collected and analysed.

A general conclusion from relevant studies is that if aggregation or enhancement of target species occurs, appropriate management needs to be in place to address the potential for a build-up of fishing pressure which could adversely impact any fisheries opportunities[27,28].

[18] http://www.orielwind.com/documents/Vol_II_Main_Text/Main%20Text.pdf
[19] http://www.slp-eng.com/Submat/Concrete-Mattresses.asp
[20] Langhamer, O. & D. Wilhelmsson (2009). Colonisation of fish and crabs of wave energy foundations and the effects of manufactured holes - a field experiment. *Marine Environmental Research*, V. 68, pp. 151-157.
[21] BERR (2008). Review of reef effects of offshore wind farm structures and potential for enhancement and mitigation. Department for Business, Enterprise and Regulatory Reform in association with Defra. London**:** 132 pp.
[22] DECC (2009). UK offshore energy strategic environmental assessment; future leasing for offshore wind farms and licensing for offshore oil and gas and gas storage. London, Department of Energy and Climate Change**:** 861 pp.
[23] http://www.dongenergy.com/SiteCollectionDocuments/NEW%20Corporate/Gunfleet/Gunfleet_FINALGS2NTS_lowres.pdf
[24] http://www.rwe.com/web/cms/mediablob/en/340090/data/306614/56150/rwe-npower-renewables/sites/projects-in-development/wind/gwynt-y-mr/summary/English.pdf
[25] http://www.kentishflats.co.uk/multimedia/kentish_flats_nts.pdf
[26] OGP and IPIECA (2010). Alien invasive species and the oil and gas industry: guidance for prevention and management. OGP Report number 436. The International Association of Oil and Gas Producers, London, UK. 88 pp.
[27] Powers, S.P., Grabowski, J.H., Peterson, C.H. & W.J. Lindberg (2003). Estimating enhancement of fish production by offshore artificial reefs: uncertainty exhibited by divergent scenarios. *Marine Ecology Progress Series*, V.264, pp. 265-277.
[28] Pickering, H. & D. Whitmarsh (1997). Artificial reefs and fisheries exploitation: a review of the 'attraction versus production' debate, the influence of design and its significance for policy. *Fisheries Research*, V. 31, pp. 39-59.

### 5.2.5 Planning cable routes to minimize potential impacts

Outline

Cables are likely to be buried wherever possible during construction, but the trenching process may expose rocks or other material that could cause the loss of trawl or drift net fishing grounds. Appropriate routeing may help to minimize this risk at particular sites.

**Strengths**

- Local consultation should allow the locations of main drift or trawl grounds to be identified.
- Possibly a relatively easy win for developers and the fishing industry.
- Siting cables away from mobile-gear fishing grounds may provide greater cable security for developers.
- Likely to be particularly relevant to sites where drift netting is undertaken.
- There may be options on the various modern trenching techniques available.

**Weaknesses**

- There may be significant cost implications to alter cable routes away from the most direct options.
- Start and finish points of cables are likely to be relatively non-negotiable.
- Different fishermen and fishing sectors will have different grounds, so satisfying all fishing interests may be difficult and potentially divisive.

**Opportunities**

- Represents an opportunity for developers to a show direct commitment to maintaining local fisheries.
- Post-construction surveys may be undertaken to check cable route, with remedial action taken to remove potential hitches, including exposed cables.
- Where cable routes cross established static gear grounds, it is possible that these fisheries could be enhanced through above-surface cabling and appropriate use of scour protection material.
- Early consultation is being required through the ZAP process.

**Threats**

- Routing options likely to be limited by seabed type, nature conservation constraints, other pipelines and cables, etc.
- Attempts to limit any EMF may require cables to be buried deeply, with associated higher risk of leaving trenches unfilled or uncovering snags or hitches.

Timescale: **Immediate**

Cost implications: **Variable**

Carefully routing cables to avoid impacting particular tows or drifts could occur at relatively low cost, if the cable length and substrate types were not dissimilar to the preferred route. However, if rock armouring was required because it was not possible to bury the cable in any area, or if extra cable length was required, then the costs could be expected to increase considerably.

Other information

Some developments have referred to the need to choose cable routes carefully for reasons including environmental concerns, such as at Race Bank[29] and Thanet[30], while this is also recommended by Natural England's for cable routes planned in the Wash[31]. Importantly, route selection is also referred to as a fisheries mitigation measure in Government advice[32].

Cable routes are a significant issue for commercial fishermen. This is particularly the case where drift-net and trawl grounds may be impacted. Careful cable route planning to avoid conservation features appears to be an established practice and, while other issues may take precedence, avoiding relevant fishing grounds would provide a strong indication of a developer's intent to minimize impacts.

[29] http://www.centricaenergy.com/files/pdf/RaceBank_NonTechnical_Summary.pdf
[30] http://www.warwickenergy.com/pdf/ThanetNTSlr.pdf
[31] http://www.naturalengland.org.uk/Images/0809119offshoreenergyAnnex_tcm6-10991.pdf
[32] BERR (2008). Review of cabling techniques and environmental effects applicable to the offshore wind farm industry: Technical Report. Department for Business, Enterprise and Regulatory Reform in association with Defra. London: 164 pp.

## 5.3 Options to enhance stocks of targeted species and associated habitats

### 5.3.1 Stock enhancement from hatchery seed

Outline

Direct stock enhancement may be possible for species such as oysters, scallops and lobsters, where hatchery production is already established at commercial or near-commercial scales. Enhancement of shellfish species is relatively widely practised. Fish are also produced in hatcheries, but wild enhancement is not currently thought to be economically feasible.

**Strengths**

- Good potential for designating some areas within windfarms for bivalve shellfish cultivation.
- Could be linked with Several and Regulating orders (see related SWOT analysis).
- More stable/predictable production from enhanced fisheries may provide long-term job security.
- Clearly focused on keeping fishermen fishing.
- Some species (mainly oysters) are already cultivated in this way.
- As a profit-making process, enhancement should aim to become self-perpetuating.

**Weaknesses**

- Lack of technical knowledge limits hatchery production levels.
- May take a considerable time to boost hatchery production levels if demand increases.
- Hatcheries may be vulnerable to disease and water quality issues, leading to fluctuating supplies.
- The use of towed gears (e.g., shellfish dredges) may be prohibited within most windfarms.
- Mobile shellfish and, particularly, fish juveniles can move long distances before reaching legal size.
- Many windfarms are in relatively exposed areas, and may be unsuitable, as stock may be subject to waves and tidal streams.
- Knowledge of technology and techniques for on-growing may be lacking in local areas.
- A shellfish water harvesting classification would be needed for beds in areas without a classification.
- Insurance costs for fishermen and developers would need to be considered.

**Opportunities**

- Represents an opportunity for developers to a show direct commitment to maintaining local fisheries.
- Increased reliability of supply from enhanced fisheries may help to increase market demand for products.
- Increasing public and Governmental interest in aquaculture as a reliable source of healthy and locally-produced food.
- Environmental concerns over towed gears mean dive-caught/long-line produced shellfish may achieve price premium.
- There are good links to European Fisheries Fund or other external funding.

**Threats**

- Environmental concerns with seed movement causing genetic contamination of local stocks.
- Environmental concerns over producing seed from some species where these are non-native and invasive in UK waters.
- May requires stock ownership rights to be conferred to impacted fishermen, to limit risk of stock being harvested by other people.

Timescale: **2–5 years**

New stock would need time to grow, but stocking could occur quickly if juveniles were available.

Costs: **Medium, reducing over time.**

Regular purchase of stock would be required to maintain enhanced fisheries. As the enhancement system developed, the aim should be to replace external investment in stock with reinvestment from profits generated by the fishery.

Other information

Oysters are grown commercially in three British hatcheries for supply to commercial farms[33,34,35], while lobsters are grown in Cornwall[36] and Scotland[37], for local release. A French scallop hatchery at Brest produces up to 10 million scallop juveniles for re-seeding annually[38]. Although scallop hatchery production is not well developed in the UK, there is potential, and a scallop ranching trial started recently at two sites in the Isle of Man with the release of 200,000 wild-caught individuals[39].

Fisheries enhancement can help to increase and stabilise the supply of fishery products to market. A major constraint to this option, at least in the short term, may be in achieving meaningful additional levels of hatchery production for any species. While oysters, scallops and lobsters are produced in UK hatcheries, it seems unlikely that a large excess capacity exists.

Cod, turbot and bass are also produced in UK hatcheries but these species are unlikely to be sufficiently site faithful in open systems for local fisheries benefits to be generated.

Maintaining ownership of the stock may be a significant issue[40]. This may be overcome through the introduction of Several and Regulating Orders, or, possibly, through developers offering special permission for local vessels to use towed gears where these are normally prohibited within sites. These options will need to be investigated further at the site level.

Priority axis 2 of the UK National Operational Programme for the EFF includes investment in aquaculture and diversification of farmed species[41].

[33] http://oysterhatchery.com/index.shtml
[34] http://www.seasalter.org.uk/hatchery.htm
[35] http://www.guernseyseafarms.com/
[36] http://www.nationallobsterhatchery.co.uk/
[37] http://www.seafoodscotland.org/index.php?option=com_content&task=view&id=287&Itemid=34
[38] Alban, F. and J. Boncoeur (2008). Sea-ranching in the Bay of Brest (France): technical change and institutional adaptation of a scallop fishery. Pp. 41-51 in: *FAO Fisheries Technical paper 504, Case studies in fisheries self-governance*, R. Townsend, R. Shotton and H. Uchida (eds). Food and Agriculture Organisation, Rome.
[39] http://www.iomguide.com/news/general-news.php?story=105012
[40] Buck, B.H.B.H, Krause, G. & H. Rosenthal (2004). Extensive open ocean aquaculture development within wind farms in Germany: the prospect of offshore co-management and legal constraint. *Ocean & Coastal Management*, V. 47, pp. 95-122.
[41] Defra (2008). The United Kingdom Operational Programme for the European Fisheries Fund (2013-2013). Department for the Environment, Food and Rural Affairs, London**:** 179 pp.

### 5.3.2 Stock enhancement from wild seed

Outline

Spat or juveniles of oysters and mussels are available from wild beds in some locations around the UK in large, commercially viable quantities. These may then be stocked into sites for on-growing. Scallop spat may also be collected and on-grown after settling on specially-designed mesh collectors.

**Strengths**

- Excellent potential for designating particular areas for bivalve shellfish cultivation within windfarms.
- Could be linked with Several and Regulating orders (see SWOT analysis for 'Support for appropriate assessments or EMS management plans' option).
- More stable opportunities from aquaculture may provide long-term job security.
- Clearly focused on keeping fishermen fishing.
- Wild spat collection and on-growing is widely employed in UK and Europe, mainly for mussels.
- As a profit-making process, enhancement should aim to become self-perpetuating.

**Weaknesses**

- Variable and potentially limited availability of wild seed for stocking.
- May require special permission for harvesting undersized animals for stocking purposes.
- Knowledge of on-growing techniques may be lacking in associated fishing communities.
- The use of towed gears (e.g., shellfish dredges) may be prohibited within many windfarms.
- Many windfarms are in relatively exposed areas, and may be unsuitable, as stock may be subject to waves and tidal streams.
- A shellfish water harvesting classification would be needed for beds in areas without a classification.
- Risk that movements could also result in shellfish disease or non-native species transmission..

**Opportunities**

- Enhanced wild fisheries are now being accepted for sustainability assessment by the Marine Stewardship Council.
- Increased reliability of supply from enhanced fisheries may help to increase market demand for products.
- Increasing public and Governmental interest in aquaculture as a reliable source of healthy and locally-produced food.
- Environmental concerns over towed gears mean dive-caught/long-line produced shellfish may achieve price premium.
- Possible links to external funding, including the EFF.

**Threats**

- Environmental concerns with seed movement concerning associated transport of non-native, invasive species and disease.
- Environmental concerns with seed movement regarding genetic contamination of local stocks.
- Environmental concerns over harvesting seed from some species when these are commonly a food resource for protected bird species, or may be a protected feature in their own right in European Marine Sites (EMSs).
- May requires stock ownership rights to be conferred to impacted fishermen, to limit risk of stock being harvested by other people.

Timescale: **2–5 years**

Where spat are available, and environmental conditions are suitable, opportunities to grown some species (mussels, oysters) may be relatively rapidly taken up. Scallops are likely to be a longer-term prospect, where spat availability is less consistent, grow-out is longer and techniques are not well established. Stocking for any species could occur quickly if juveniles were available.

Costs: **Medium, reducing over time**

Stock would need to be sourced or purchased to maintain enhanced fisheries. Scallop spat, which are collected after settling on suspended, mesh collectors, are likely to be the most expensive to source, although final product price is high. As the enhancement system developed, the aim should be to replace external investment in stock with reinvestment from profits generated by the fishery.

Other information

Wild mussel spat have been collected from well known settlement sites around the UK for relaying and on-growing in managed fisheries for a number of decades. Particularly active mussel relaying fisheries exist in North Wales, the Wash and Northern Ireland[42]. Wild scallop spat collection is not suitable for all UK locations[43], but is practised in Ireland and Scotland[44,45]. Enhanced fisheries for

scallop in Japan are some of the largest scallop fisheries globally, with the majority of the stock being derived from wild-collected seed[46]. A scallop ranching trial started recently at two sites in the Isle of Man with the release of 200,000 wild-caught individuals[47].

Fisheries enhancement can help to increase and stabilise the supply of fish products to market. The major constraint to this option may be obtaining significant levels of spat for any species, and because availability of spat in natural systems is likely to fluctuate considerably. The availability of oysters and mussels is likely to be more consistent, based on the capacity and existing knowledge of the fishing industry. Scallop spat availability is likely to be less predictable, while suspended lantern-net culture systems for scallops seem unlikely to be permitted within windfarm sites due to navigation and safety issues.

There is clearly the potential to transmit disease or non-native species when shellfish are transported between sites, as occurred in 2007 when the slipper limpet, *Crepidula fornicata*, was transported to the Menai Straits with a shipment of mussel seed[48]. It is likely that CEFAS and nature conservation bodies would need to be consulted closely if proposals to move shellfish between different regions were developed.

Maintaining ownership of the stock is also likely to be a significant issue[49],[50]. This may be overcome through the introduction of Several and Regulating Orders, or, possibly, through developers offering special permission for local vessels to use towed gears within specific areas within sites where these are normally prohibited. These options will need to be investigated further at the site level.

Priority axis 2 of the EFF in the UK allows for investment in aquaculture and diversification of farmed species[51].

---

[42] Bannister, C. (2006). Towards a National Development Strategy for Shellfish in England. Seafish Industry Authority, Hull.

[43] Maguire, J.A. & G.M. Burnell (1999). The Potential for Scallop Spat Collection in Bantry Bay, Ireland. *Biology and Environment: Proceedings of the Royal Irish Academy*, Vol. 99B, pp. 183-190.

[44] http://www.marlab.ac.uk/FRS.Web/Uploads/Documents/Productionshell04.pdf

[45] http://www.ecoserve.ie/biomar/mulroy.html

[46] Kosaka, Y. and H. Ito (2006). Japan. Chapter 22, pp. 1093-1141. In, *S.E. Shumway and G.J. Parsons (Eds). Scallops: Biology, Ecology and Aquaculture.* Elsevier B.V., Amsterdam.

[47] http://www.iomguide.com/news/general-news.php?story=105012

[48] http://www.ccw.gov.uk/about-ccw/newsroom/press-releases/mussel-farmers.aspx

[49] Buck, B.H.B.H, Krause, G. & H. Rosenthal (2004). Extensive open ocean aquaculture development within wind farms in Germany: the prospect of offshore co-management and legal constraint. *Ocean & Coastal Management*, V. 47, pp. 95-122.

[50] http://www.seafish.org/upload/file/about_us/Aqua%20Level%202%20Native%20Oyster%20Cult.pdf

[51] Defra (2008). The United Kingdom Operational Programme for the European Fisheries Fund (2013-2013). Department for the Environment, Food and Rural Affairs, London**:** 179 pp.

### 5.3.3 Laying cultch for oysters

Outline

Settlement of juvenile oysters can be promoted by placing appropriate material (cultch) on the seabed (e.g., shells). This is a widely practised approach to enhancing oyster fisheries.

**Strengths**

- Laying cultch is an established oyster fishery enhancement technique.
- Relatively cheap process and uses available resources (e.g., oyster or scallop shells).
- Excellent potential for designating particular areas for oyster cultivation within windfarms.
- Could be linked with Several and Regulating orders (see related SWOT analysis for 'Development of several and regulating orders' option).
- More stable opportunities from aquaculture may provide long-term job security.
- Clearly focused on keeping fishermen fishing.

**Weaknesses**

- Laying cultch is currently practiced in a limited number of locations.
- Knowledge of appropriate techniques may be lacking in many places.
- Relies on availability of wild spat for settlement.
- A shellfish water harvesting classification would be needed for beds in areas without a classification.
- The use of towed gears (e.g. shellfish dredges) may be prohibited within most windfarms.
- Many windfarms are in relatively exposed areas, so stock may be subject to waves and tidal streams.
- Some question over the need to expose Pacific oyster to the air to promote shell hardness.

**Opportunities**

- Increasing public and Governmental interest in aquaculture as a reliable source of healthy and locally-produced food.
- Enhanced wild fisheries are now being accepted for sustainability assessment by the Marine Stewardship Council (MSC).
- Increased reliability of supply from enhanced fisheries may help to increase market demand for products.
- Native oyster enhancement may be supported through links to the Native oyster Biodiversity action Plan.
- Potential links to external funding under the EFF.

**Threats**

- It is understood that a FEPA licence is not currently required for laying cultch in designated shellfish areas, although it is not clear if this is a definitive ruling by the MFA.
- May requires stock ownership rights to be conferred to impacted fishermen, to limit risk of stock being harvested by other people.
- Increased availability of wild Pacific oysters due to escapes from fish farms may reduce demand for seabed cultivated oysters from farms.
- Native oysters are vulnerable to *Bonamia ostreae*, a parasitic disease that greatly impacts oyster beds.

Timescale **2–5+ years**

The preparatory work to establish the site may be undertaken relatively quickly, but the grow-out phase for oysters is around 3 years. This may be longer or shorter depending on location.

Costs: **Low**

Although laying cultch is unlikely to be particularly expensive, a number of processes, including gaining a Shellfish Waters Classification and reviewing the suitability of the site for spat settlement and subsequent growth will need to be undertaken.

Other information

Laying cultch is a widely practised and accepted oyster fishery enhancement process. It is understood that the SFIA have negotiated with the MFA to ensure that a FEPA licence is not needed to place cultch in recognised shellfish growing areas[52].

Although cultch is generally laid only in relatively sheltered waters, and is dependent on the availability of wild spat for settlement, at least some of the issue may be in securing reliable access to and protection of the sites. Such protection may be available within windfarms, where towed gears appear likely to be prohibited in many cases. Further work may be needed at the site level to review the availability of spat and the suitability of the ground for laying cultch.

One of the funding areas covered by the European Fisheries Fund in the UK is investment in aquaculture and diversification of farmed species[53]. It seems likely that laying cultch would qualify under the specified criteria.

As with other enhanced fishery or aquaculture options, maintaining ownership of the stock is likely to be a significant issue[54,55]. This may be overcome through the introduction of Several and Regulating Orders, or, possibly, through developers offering special permission for local vessels to use towed gears in agreed, specific areas of the sites where these are normally prohibited. These approaches would need to be investigated further at the individual site level.

[52] http://www.seafish.org/upload/file/waste_utilisation/Cultch.pdf
[53] http://www.mfa.gov.uk/grants/eff.htm
[54] Buck, B.H.B.H, Krause, G. & H. Rosenthal (2004). Extensive open ocean aquaculture development within wind farms in Germany: the prospect of offshore co-management and legal constraint. *Ocean & Coastal Management*, V. 47, pp. 95-122.
[55] http://www.seafish.org/upload/file/about_us/Aqua%20Level%202%20Native%20Oyster%20Cult.pdf

### 5.3.4 Catch and release of large, broodstock animals

Outline

If stocks are heavily exploited and post-capture survival of adults is high when animals are returned (e.g., lobsters and some skates), a programme to support the return of large-sized, mature animals may be viable. This may result in an increase in the average age and size of animals in local populations and, subsequently, the reliability of recruitment at the local level.

**Strengths**

- Provides immediate incentive for proactive stewardship of fisheries resources.
- For lobsters, builds on fishing industry calls for management concerns of over-fishing and proposals to introduce a maximum landing size.
- For skates and rays, may help to address some environmental concerns over diminishing stock size.
- May address fisheries management concerns over diminishing genetic health of stocks (i.e. decreasing size and age of maturity, and reducing capacity to adapt following future environmental perturbation).

**Weaknesses**

- Would probably require the full market value of the animals to be paid to fishermen.
- Animals may need to be brought to port for capture confirmation, before subsequent live release.
- Would require a level of active, on-going management.
- May take at least one generation of the target species for stock benefits to begin developing.
- Mobile species could move out of the windfarm (or wider project) area and be harvested by other fishermen.
- Any recruitment benefits derived from protecting the broodstock may be masked by natural variability in stock-recruitment relationships, so benefits may be hard to detect.

**Opportunities**

- Addresses environmental concerns over the lack of larger animals in populations to fulfil ecological roles.
- Provides opportunities for environmental good news stories.
- Benefits may develop for fisheries away from the windfarm site if egg or larval drift occurs.
- Could be linked with a tagging programme for increased understanding of target species.
- V-notching could provide lobsters some protection from being landed by other fishermen, and prevent repeated counting in catch and release system.
- Good potential for join-up between developers and fishermen within strategic development areas.

**Threats**

- Abuse of system by individuals would be damaging for fishing industry-windfarm developer relationship.
- Failure to generate long-term behavioural changes in fishermen would lead to benefits disappearing once funding stopped.

Timescale: **5–10 years**

It is likely that it would take a considerable time (i.e. more than one generation time) for any stock benefits to show. This could be at least 5 years for ray species and lobsters[56,57]. Fishermen would, though, be paid immediately for the animals they returned.

Costs: **Low–Medium**

A programme could be given a maximum allocation per year, or in total, with the scheme closing when the available funds were used up. Under the EFF priority axis 3, one of the funding areas is the support of "*common actions that will contribute to improved management, sustainable exploitation of resources*"[58].

Other information

It is illegal to land berried (egg-bearing) lobsters from a number of Sea Fisheries Committee districts. National legislation prevents the landing of v-notched lobsters[59]. Although rates of voluntary v-notching of berried lobsters are unknown, a number of subsidised v-notching schemes have occurred,

including by North Eastern SFC[60], North Wales and North Western SFC[61], off the Shetland Isles[62] and Ireland[63]. The existence of these schemes suggests that this does have potential as a mitigation option for fishermen working within windfarms and who either continue fishing or are displaced to nearby areas. Importantly, evidence suggests that for small scale fisheries with high exploitation levels, substantial increases in the reproductive potential of the population can be achieved through v-notching programmes[64].

The associated costs of the scheme would depend on the size at which lobsters were purchased. A scheme that replaced all legal-sized lobsters would be more expensive than one which aimed to purchase back only lobsters > 110 mm carapace length.

A similar programme for thornback could be attempted, but retaining ray species alive and in good condition aboard fishing vessels for any length of time, ready for release back to sea after confirmation of capture and weighing to determine market value, is impractical. It seems likely that if ray species were to proceed under this system, a procedure to release rays at sea after immediately capture would be needed.

The survival rates of ray species after capture and release has also been investigated, and can be high where the animals are caught in good condition[65,66]. There are no known subsidised catch and release schemes for skates and rays.

There may be potential for developing catch and release programmes at the regional level, across strategic windfarm development areas.

---

[56] Tully, O. (Ed.) (2004). The biology and management of clawed lobster (*Homarus gammarus* L.) in Europe. Fisheries Resource Series, Bord Iascaigh Mhara (Irish Sea Fisheries Board), Dun Laoghaire, Ireland. Vol. 2, 2004, 31pp.

[57] http://www.fishbase.org/Summary/SpeciesSummary.php?id=2059

[58] Defra (2008). The United Kingdom Operational Programme for the European Fisheries Fund (2013-2013). Department for the Environment, Food and Rural Affairs, London**:** 179 pp.

[59] Walmsley, S.A. & M.G. Pawson (2007). The coastal fisheries of England and Wals, Part V: a review of their status 2005-9. Science Series Technical Report, no. 140. Cefas, Lowestoft, 86 pp.

[60] http://www.eastriding.gov.uk/az/face_content_frame_proc?p_ref=APP119&p_spec=SPEC31&p_media=INTERNET

[61] http://www.nwnwsfc.org/archive/8thsept06/lobsters.htm

[62] http://www.ssqc.co.uk/Portals/0/Files/fdn22_vnotch.pdf

[63] http://www.bim.ie/templates/text_content.asp?node_id=798

[64] Tully, O. (2001). Impact of v-notch technical conservation measure on reproductive potential in a lobster (*Homarus gammarus* L.) fishery in Ireland. *Marine and Freshwater Research, V.* 52, pp. 1551-1557.

[65] Catchpole, T.L., Enever, R. and Doran, S. (2007). Bristol Channel ray survival. Cefas, Lowestoft, *Fisheries Science Partnership Report* 21, 15 pp

[66] Enever, R., Catchpole, T.L., Ellis, J.R. & A. Grant (2009). The survival of skates (Rajidae) caught by demersal trawlers fishing in UK waters. *Fisheries Research*, V. 97, pp. 72-76.

### 5.3.5 Research into species of fisheries or aquaculture interest

Outline

Native oysters have been afflicted by a variety of problems including TBT (tributyltin) pollution and the *Bonamia* parasite, and hatchery cultivation has varying success. Lobster cultivation is developing to commercial scale. There is keen interest in increasing fisheries production of these species, so support for relevant research programmes may be appropriate.

**Strengths**

- Results could lead to sustainable, long-term benefits.
- Results could have wide geographic application.
- Impacted fishermen could be employed to undertake any at-sea research components.
- Shows a long-term commitment to sustaining fishing livelihoods.
- Addresses identified fisheries research needs.
- Research could be used to support the EIS process.

**Weaknesses**

- Any benefits would be slow to filter to fishermen.
- Any benefits would be broadly spread when impacts are felt locally.
- Realising any benefits from research may take additional funds.
- Identifying suitable, specific research topics may be challenging in a diverse fishing industry.
- A mechanism to decide fishing-specific research topics would be needed.

**Opportunities**

- Could build on existing Defra fishery-science partnership process.
- Good potential to show commitment and collaboration between windfarm and fishing industries to focus on long-term sustainability.
- Potential to provide opportunities to gain further funding from external sources.
- Research may be used to support sustainable fishery certification processes (e.g., MSC).

**Threats**

- Research may be perceived as not directly helping impacted fishermen.
- Scientists may be thought to benefit more than the fishermen.
- Research may lead to more questions and few additional answers.
- Would need to ensure any work was scientifically robust and results disseminated effectively.

Timescale: **5–10+ years**

Direct benefits from appropriate research are unlikely to be derived quickly, but are project specific.

Costs: **Variable, depending on project**

Costs are likely to be medium to high if significant levels of vessel-based fieldwork were incorporated. One of the funding areas covered by the European Fisheries Fund in the UK is investment in aquaculture and diversification of farmed species[67].

Other information

The fisheries-science partnership programme has been run by Defra for four years. A range of projects have been proposed and completed, all of them incorporating significant levels of engagement with and employment of local fishermen[68,69]. This model may provide a useful precedent.

It may be difficult to benefit fishermen directly and across the range of sectors that may be represented at windfarms with research alone. There may, though, be opportunities in some areas where fisheries with enhancement potential are particularly important. There may also be potential in developing methods or gear for fisheries to be undertaken within windfarms. These activities are directly focused on sustaining and enhancing fisheries.

[67] http://www.mfa.gov.uk/grants/eff.htm
[68] http://www.defra.gov.uk/environment/marine/documents/science/marine-fish-year2008-9.pdf
[69] http://www.defra.gov.uk/environment/marine/documents/science/marine-fish-year2007-8.pdf

## 5.4 Options to support existing fishing activities

### 5.4.1 New fishing gear or equipment

Outline

In order to fish within windfarms, some fishing activities may need to be adapted in order to continue. For example, pot strings may need to be shortened, towed gear fishing activities, if permitted, may need to be carried out with smaller or more manageable gear in order that safe operations can be continued, or long-lines used instead. Such gear may be expensive to purchase in the first instance, but may open up windfarms to conventional fishing activities.

**Strengths**

- Directly addresses issues of needing to adapt gear or methods for fishing inside windfarms.
- Is clearly focused on keeping fishermen fishing.
- Focuses on the fisheries that local fishermen are already engaged in and know well.
- Could help to inject new enthusiasm into local fisheries.
- May require less adaptation and novel thinking than many other options.
- The most up to date gear designs could be considered, incorporating environmental features such as increased selectivity, benthic release mats, escape gaps, etc.

**Weaknesses**

- Would require clarification over what fishing activities were prohibited/allowed inside windfarms.
- Some fishermen will not need or want new equipment or be capable of adapting, so this may be divisive in the industry.
- Would need to avoid increasing effort through technical creep as a result of new gear introduction.
- Fishermen report not wanting to risk using towed gears (particularly) within windfarms.

**Opportunities**

- Provides opportunities for good news stories of windfarm developers and the fishing industry working together to overcome technical issues.
- Could be used to develop and promote a focus on high quality/high price markets.
- External funding may be available from the EFF.

**Threats**

- Towed gears can impact seabed species, habitats and communities, so funding these fisheries may be perceived negatively by some.

Timescale: **0–6 months**

The time lag between identifying appropriate fishing gears and using them could be negligible. It must be determined if there are any towed gears that could be used in windfarms, or within specific areas, under agreement with developers.

Costs: **Medium**

Fishing gears may be a significant capital cost to fishermen, but, relative to other mitigation options, the overall costs are likely to be minimized by focussing on fisheries that fishermen are already experienced in and equipped for.

Other Information

The introduction of new fishing gear could help to invigorate and redevelop fisheries that are potentially impacted by the development of windfarms. The fact that this option builds on the existing fishing practices is likely to be a significant, positive factor

There are at least two recent examples of UK regional proposals and projects which have aimed to introduce new fishing gear to develop sustainable fisheries[70,71]. The UK National Operational Programme for the EFF includes an aim to "*...maintain the activity of small scale coastal fishing thereby contributing to the socio-economic health of many of our small coastal fishing communities.*" . If the gear was designed to introduce conservation measures at the same time, there is additional

potential for assistance to be provided through the EFF. Under EFF Priority axis 1, investments in new gear and fishing practices to improve selectivity and reduce discards are permitted[72].

For towed gear fishermen, a key issue may be the need to determine if any towed gears may be used within windfarms, or within certain areas of windfarms. There are also concerns, particularly from towed gear fishermen, about the risks associated with fishing within arrays. Although funding for gears that may be used outside windfarms may still be very useful, it seems likely that these issues will need to be resolved if this option is to be taken forward across both static and towed gear fishing sectors.

[70] http://wales.gov.uk/docs/drah/publications/091003collectiveinvestmentfishingpr0ocessingmarketingnote2.doc
[71] http://www.scotland.gov.uk/News/Releases/2009/05/08115337
[72] Defra (2008). The United Kingdom Operational Programme for the European Fisheries Fund (2013-2013). Department for the Environment, Food and Rural Affairs, London: 179 pp.

### 5.4.2 Fisheries or vessel accreditation

Outline

Ever-increasing focus is being placed on the sustainability of fisheries by supermarkets and their customers. Gaining vessel certification (i.e. the Seafish Responsible Fishing Scheme) or fisheries certification (i.e. the Marine Stewardship Council) can provide assurance that fisheries are being managed appropriately and that sustainability is a key concern, helping existing fisheries to maintain and develop markets.

**Strengths**

- Responsible Fishing Scheme (RFS) vessel certification is seen as first step to demonstrating commitment to sustainable sourcing.
- Commitments from some major UK and European supermarkets to only source fish from certified sustainable sources by 2012.
- Fisheries certification would significantly enhance a fishery's market profile.
- Inshore fisheries often have great potential for fisheries certification, but may lack funds to proceed.
- The MSC fishery certification process includes a confidential pre-assessment, which gives an indication of certification potential.

**Weaknesses**

- RFS vessel certification does not address stock sustainability and may have limited standing in the market.
- MSC certification can be expensive, and there is no guarantee of success.
- Even if successful, MSC certification may require that changes are made to existing fisheries management practices.
- MSC certification requires the support of fisheries managers, scientists and environmental partners.
- MSC certification takes a minimum of 18 months from start to finish.
- MSC certificates last for only 5 years, annual audits are also required.
- MSC certificates only cover fishing operations. Processors and markets require additional 'Chain of Custody' certification.

**Opportunities**

- Increasing public and market interest in sustainably sourced fish products.
- Could be linked with local, regional or national fishery promotions.
- External funding for certification may be available.
- The Aquaculture Sustainability Council is being established and may provide opportunities for sustainable certification.

**Threats**

- Failure to achieve fisheries certification could mean the money could be perceived as being wasted.
- Perception that certification will increase the value of fish caught may not be realised.

Timescale: **0.5–2 years**

The RFS vessel certification process can commence rapidly and may be completed relatively quickly, whereas the MSC fisheries assessment process takes a minimum of 18 months to organise and proceed through, and may take considerably longer.

Costs: **Medium**

The RFS is likely to be a relatively low cost option, while MSC costs can be considerable. However, sustainable sourcing initiatives have attracted great interest from external funding bodies, and it seems likely that additional funds would be available if this option was pursued. Certification leads to ongoing costs, with annual surveillance audits being required, together with recertification after five years.

Other Information

343 UK vessels have now achieved certification under the Seafish RFS[73], and the scheme appears to be growing in popularity and recognition[74]. A significant number of relevant inshore fisheries have now been certified under the MSC, including those for handline mackerel[75], sole using gill nets[76], dredge mussel[77], *Nephrops* creel[78] and plaice using otter trawls[79]. Other relevant fisheries are also certified or are going through the assessment process.

The National Operational Programme of the EFF, running from 2007-2013, has included a provision under priority axis 3 to support "*quality certification (e.g. support for certification schemes such as the Marine Stewardship Council and the Responsible Fishing)*"[80]. A number of MSC assessments have also been at least part-funded by Regional Development Agencies.

Although the RFS does not address stock sustainability issues, the scheme is growing in popularity as a means for buyers to identify vessels which operate to good industry practice guidelines. It may be an option where there is little enthusiasm to try to go forward to an MSC assessment.

The MSC is the global market leader in sustainable fisheries certification. Although there is no guarantee that prices will increase as a result of being certified, the increasing interest and demand for MSC certification is helping to persuade an increasing number of fisheries to pursue certification in order to maintain and develop markets. The Hastings inshore fleet fisheries[81,82,83] may provide a model for other local fisheries to achieve assessment, and could work well for fisheries undertaken within and around offshore windfarms.

A key issue with the MSC process is that there is no guarantee of a successful assessment. The confidential pre-assessment, a cheaper and much more rapid process than the full assessment, should provide a clear steer on the likelihood of achieving certification, however.

The Aquaculture sustainability Council is in the process of being formed by WWF, and this may provide opportunities for aquaculture ventures associated with windfarms to gain sustainable certification and high market profile[84].

---

[73] http://rfs.seafish.org/
[74] http://rfs.seafish.org/rfs_news
[75] http://www.msc.org/track-a-fishery/certified/north-east-atlantic/south-west-mackerel-handline
[76] http://www.msc.org/track-a-fishery/certified/north-east-atlantic/dfo-gill-net-sole
[77] http://www.msc.org/track-a-fishery/certified/north-east-atlantic/denmark-blue-shell-mussel
[78] http://www.msc.org/track-a-fishery/certified/north-east-atlantic/loch-torridon-nephrops-creel
[79] http://www.msc.org/track-a-fishery/certified/north-east-atlantic/Ekofish-Group-North-Sea-twin-rigged-otter-trawl-plaice
[80] Defra (2008). The United Kingdom Operational Programme for the European Fisheries Fund (2013-2013). Department for the Environment, Food and Rural Affairs, London**:** 179 pp.
[81] http://www.msc.org/track-a-fishery/certified/north-east-atlantic/Hastings-fleet-Dover-sole-trawl-and-gill-net
[82] http://www.msc.org/track-a-fishery/certified/north-east-atlantic/hastings-fleet-dover-sole
[83] http://www.msc.org/track-a-fishery/certified/north-east-atlantic/hastings-fleet-pelagic-herring-and-mackerel
[84] http://www.worldwildlife.org/what/globalmarkets/aquaculture/council-faqs.html

### 5.4.3 Local or regional fisheries promotions

Outline

Together with the demand for sustainably-produced food, there is increasing focus on locally-produced food. There may be opportunities for fishing operations impacted by windfarm developments to increase their viability and profitability by selling products directly to customers, for example through establishing a presence at local markets or shows, or by online e-marketing.

**Strengths**

- May help to improve price of products and profitability of fishing operations for fishermen.
- Could help to boost profile and improve perception of local industry.
- Could have benefits across a wide range of fisheries at the local or regional level.

**Weaknesses**

- Costs associated with such approaches may include food hygiene training, packing materials and promotional material.
- Markets and shows would require people to prepare and run fresh fish stalls.
- Markets and shows are unlikely to be the main source of fish sales, so may be more hassle than many fishermen are prepared for.

**Opportunities**

- Could be linked to existing local or regional food promotions or markets.
- There is potential for external funding for fisheries promotions.
- Existing fisheries promotion skills and knowledge in Seafood Scotland, SFIA and SAGB.
- Could be linked to online fish sourcing guides.

**Threats**

- Failure to achieve a sales boosts relatively quickly could be very discouraging.

Timescale: **0.5–2 years**

Fisheries promotions may have a noticeable impact on sales in the short term, but a long-term commitment to marketing may be required in order to generate lasting effects.

Costs: **Low–Medium**

Advertising costs are likely to be highly variable, based on the format and media chosen. Facilities and training to store, package and deliver or display fish products may be somewhat expensive, although it would be appropriate for cooperatives or fishermen's organisations to combine efforts in order to reduce costs. Boosting sales through promotion at shows may be relatively time-consuming.

Other information

As well as featuring at regional shows, a wide range of fisheries-specific promotions are undertaken annually in the UK as a means to promote specific fisheries[85,86] or fisheries across regions more generally[87,88]. There are also opportunities for online marketing, such as through the Seafish Directory[89] or the Seafood Information Network[90].

An excellent range of expertise around marketing fish products is available in UK industry and the public sector. The range of species specific and regional promotions already undertaken suggests strongly that there is a benefit to marketing products in this manner.

With appropriate funding, it seems likely that campaigns could be developed around local fisheries. It is relevant that one of the funding areas for the EFF is marketing fisheries products[91].

[85] http://www.whitstableoysterfestival.com/
[86] http://www.cromercrabfestival.co.uk/
[87] http://www.newlynfishfestival.org.uk/
[88] http://www.dorsetseafood.co.uk/
[89] http://www.seafishdirectory.com/
[90] http://sin.seafish.org/portal/site/sin/
[91] http://www.mfa.gov.uk/grants/eff.htm

### 5.4.4 Development of Several and Regulating Orders.

Outline

Several and Regulating Orders are fisheries management tools which remove the public right to fish. They increase the security of fishing opportunities for those with the right to fish, and can lead to increased sustainability of fishing operations for listed shellfish species.

**Strengths**

- Orders confer property rights to a specific set of fishermen.
- Orders greatly increase the security of tenure for fisheries and fishermen.
- Orders can help to increase the sustainability of fishing operations.
- Orders provide greatly enhanced management potential.
- Orders are often sought after by fishermen and fisheries managers.
- Only specific fishermen would have access to the sites, which may be a benefit to windfarm operators seeking to manage vessel traffic within the site.
- A new process for granting Orders has been laid out by Defra through the Marine and Coastal Access Act.

**Weaknesses**

- Orders exclude some fishermen and can lead to division within fishing communities.
- New Orders can be time consuming (up to two years) and costly to introduce.
- Orders are limited to shellfish species (mainly oysters, mussels, cockles, clams, scallops, queen scallops, lobsters and crabs).
- Challenges to new Orders being granted may result in a Public Inquiry, which can greatly increase costs.
- Likely limited to UK waters within 12 nautical miles of the coast.
- Bivalve mollusc Orders inside windfarms may be constrained by a prohibition on towed gears.
- A shellfish water harvesting classification would be needed for beds in areas without a classification.

**Opportunities**

- Orders could be timed to operate for the life of the windfarms (Orders can be granted for up to 60 years, but 5-10 years is reportedly normal for Several Orders, 20-30 years for Regulating Orders).
- Establishing Orders within windfarms may help to overcome existing legal issues associated with Orders.
- There appear to be good opportunities to utilise external funding.
- This option may be combined with other mitigation options related to shellfish stock enhancement.

**Threats**

- The time taken to introduce an Order could lead to frustration.

Timescale: **2–5+ years**

Establishing an Order and generating benefits would almost certainly take a number of years.

Costs: **Medium**

The documentation and consultation required for the introduction of Several and Regulating Orders can be considerable. These include charts, permissions, a management plan and, if the site is within a European marine site, an appropriate assessment[92]. Preparation of these documents may be costly. If a proposal was to proceed to Public Inquiry due to any objections being put forward, the costs would increase dramatically.

Other information

A range of different Orders have been introduced around the UK. The Regulating Orders in the Wash[93] and the Thames[94] are some of the most valuable and profitable coastal fisheries in the UK, while Several Orders across UK estuarine and inshore waters are highly regarded, for example in the Menai Strait[95] and the Exe Estuary[96], allowing individual fishermen to develop shellfish fisheries in private lays.

Several and Regulating Orders are two of the main tools available for supporting and enhancing shellfish fisheries and management in UK inshore waters. They confer property rights to a limited number of fishermen, and reduce the 'race to fish' for fishery resources. Defra has recently drafted new guidance on granting Orders, and the process described should make obtaining Orders less time consuming, and it being less likely that there would be a need to go through a Public Inquiry process[97].

While the relatively exposed nature of offshore windfarm sites may limit the potential for shellfish cultivation, the main constraint for bivalve mollusc cultivation may be in determining if towed gears (dredges) could be used in specific parts of windfarms.

An important consideration is that Orders limit the number of fishermen who have access to fishing opportunities. This may be advantageous for windfarm developers in helping to manage fishing activities and vessel traffic, but may also result in challenges to any Order process from excluded fishermen, leading to a Public Inquiry and additional time and cost.

Under the National Operational Programme for the EFF, up to 60% funding is available in the form of premiums for improved management and control of access to fishing areas[98].

[92] http://www.defra.gov.uk/corporate/docs/forms/fish/FIS3.pdf
[93] http://www.esfjc.co.uk/species.htm
[94] http://www.kentandessex-sfc.co.uk/id21.html
[95] http://www.nwnwsfc.org/fisheries/fisheries_text.htm
[96] http://www.exmouthmussels.com/
[97] Defra (2010). Shellfish orders (Draft) notes for guidance. Department for the Environment, Food and Rural Affairs, London: 14 pp.
[98] Defra (2008). The United Kingdom Operational Programme for the European Fisheries Fund (2013-2013). Department for the Environment, Food and Rural Affairs, London: 179 pp.

### 5.4.5 Develop a quota leasing programme

Outline

The availability of quota for inshore fishermen has been the subject of considerable debate in recent years, in particular among the under-10 m and non-sector fleets, as the available quota has shrunk to the point that viability is often threatened. The introduction of windfarms may result in increased travel times or reduced access to favoured grounds for fishermen, and this may further reduce viability. However, quota may be purchased or leased to help overcome this problem.

**Strengths**

- Addresses a common complaint, particularly among owners of smaller (< 10 m LOA) vessels, that there are fish to be caught but not enough quota to land them.
- Should help to increase profitability by helping to reduce discarding and reduce the need for leasing quota.
- A quota leasing scheme could support existing fishermen now, and new entrants in time.

**Weaknesses**

- Not all fishermen fish for quota species.
- Not all fishermen catching quota species lease or require additional quota.
- This option would require the establishment of a management scheme, with a potentially high level of management input required.
- This would require a long term commitment from the scheme managers.
- Despite the trade in quota, UK Government does not consider quota to have a value.

**Opportunities**

- Could follow the Duchy Fish Quota Management Company and attempt to gain public and private support and contribution to scheme funding.
- Can provide opportunities and a structure for the local community to become involved in directly supporting the fishing industry.

**Threats**

- Potential for a quota scheme to be divisive in the local fishing community, between those who have access to additional quota, and those who don't.

Timescale of beneficial impact: **2–5+ years**

Establishing the scheme and obtaining quota may take a considerable length of time. Arranging leasing contracts and other management actions is likely to be complicated.

Cost implications: **Medium–High**

To make a substantive difference, initial costs may be high. These costs would have to include a scheme manager to deal with purchase and leasing of quota, while a Board of Directors may need to he established in order to provide advice covering strategic decisions on quota purchase.

Other information

The Duchy Quota Fish Quota Company has established a community quota leasing system that may provide a model for similar programmes in other parts of the UK[99]. Quota is purchased using money either donated or loaned to the Company, and this quota is then leased to local fishermen for one year at a time. Any profits from the process are reinvested in more quota.

The complexity of managing a quota purchase and leasing scheme may be considerable. Purchasing appropriate quota could only be carried out with expert knowledge of the local fisheries and quota markets. It is likely that proposals and concrete actions to establish such a scheme would need to come from within the fishing industry, but could be supported by developers.

If the scheme was to be significant, a number of management approaches could be employed in order to give impacted fishermen enhanced opportunities while avoiding excluding other fishermen. For example, impacted fishermen could be offered quota for free, while charging other fishermen, or impacted fishermen could be offered quota at a reduced rate.

[99] http://www.duchyfishquota.co.uk/

### 5.4.6 Establish a fuel purchase subsidy programme

Outline

A significant percentage of the overall costs associated with fishing can be in the fuel used, and high fuel prices can significantly impact the profitability of fishing operations. Fishermen may have to travel further or fish in less favoured grounds as a result of windfarms being built, so the introduction of a fuel purchase support programme that stabilised prices may address these issues.

**Strengths**

- Directly addresses a key concern of fishermen working around windfarms that steaming times will be longer or fishing less efficient because of reduced opportunities.
- Would be of value to all fishermen, not just a sub-section.
- Because of higher fuel consumption, a subsidy may be of greatest value to fishermen using towed-gears- these are also the fishermen least likely to be able to fish within windfarms and so will be most likely to need to fish elsewhere.

**Weaknesses**

- It may be difficult to decide which fishermen receive subsidised fuel, and at what discount.
- Fuel price is a highly emotive subject, and subsidised fuel may be very divisive within the fishing industry.
- This approach implicitly promotes the continued use of inefficient engines and fishing techniques, which appears inconsistent with renewable energy generation.

**Opportunities**

- The installation of electronic fuel meters, to help reduce fuel use, may be a more sustainable and acceptable option than a fuel purchase subsidy.

**Threats**

- In the longer term, fossil fuels are only likely to become more expensive.
- A subsidy scheme may be perceived in the same anti-competitive light as French and Spanish fuel subsidies in 2008.

Timescale: **Immediate**.

Costs: **Variable and ongoing.**

The costs would clearly depend on the level of subsidy provided. In order to control costs, it is assumed that any subsidy would have to be in the form of a certain fixed reduction off the fuel price, rather than setting the price of fuel at a certain level.

Other information

There are a number of examples of fishermen receiving a subsidy for fuel purchases, most notably in 2008 when fuel prices quickly rose to record levels. However, it should be noted that while France and Spain chose to subsidise the fuel purchased by their fishing fleets, the UK did not, and the French and Spanish arrangements were investigated by the EU for being anti-competitive. A package of alternative measures was then proposed by the EU to help fleets deal with the high price[100]. Noticeably, fuel subsidies were not part of the package.

The promotion of and support for fuel intensive fishing approaches may be somewhat contrary to the general thrust of the windfarm industry[101]. It would also be contrary to the approach taken by the UK and the EU during the fuel crisis in 2008. Other options, such as installing electronic fuel meters to help improve fuel efficiency may be more appropriate.

[100] http://ec.europa.eu/fisheries/press_corner/press_releases/2008/com08_53_en.htm

[101] Sumaila, U.R., Teh, L., Watson, R., Tyedmers, P. & D. Pauly (2008). Fuel price increase, subsidies, overcapacity, and resource sustainability. ICES Journal of Marine Science, V. 65, pp. 832–840.

### 5.4.7 Establishing local biodiesel production facilities

Outline

Although there is an ongoing debate about the environmental costs and benefits associated with biofuel production, there is potential for biodiesel produced from fish waste or from vegetable oil recovered from food production units to be used in marine engines. The installation of biodiesel production units at ports could lead to reduced use of conventional red diesel in the fishing industry. This option could help to support the development of a more viable and sustainable local fishing industry into the future.

**Strengths**

- With a strong environmental focus this option may have particular appeal to the windfarm industry.
- May result in cheaper fuel being made available.
- May help to stabilise the price of fuel and reduce impact of volatile fossil fuel prices.
- New biodiesel production techniques apparently produce fuel that requires no modifications to standard marine diesel engines.
- As well as reducing the carbon footprint, the emissions of sulphur oxides from biodiesel are only 20% of the emissions from low sulphur fossil fuel.
- Fish waste biodiesel may rely on fishing industry by-products for raw material.

**Weaknesses**

- Biodiesel use in fishing vessels is not yet established and accepted.
- The technology has been tested, but not on a large scale in the UK.
- May not result in cheaper fuel- may be more expensive if economies of scale not available.
- Possibly limited availability of raw materials.
- A biodiesel unit would require ongoing support and staff to run the unit.
- Any fuel produced may only be convenient for a limited number of fishermen based locally to the unit.
- May be difficult to agree which fishermen should have access to fuel from the unit.

**Opportunities**

- Excellent opportunities for presenting a positive environmental image publicly.
- A biodiesel production unit could form part of a port redevelopment.
- May be advantages for the first adopters of biodiesel if the price of fossil fuels was to rise dramatically.

**Threats**

- Prices for biodiesel ingredients may rise if demand increases.
- Continuing discussions about the environmental costs and benefits of biodiesel.

Timescale: **2–5+ years**

Establishing the infrastructure for the plant, including supply of material for production, would almost certainly take some time. At present, the lack of established UK plants as examples would delay the introduction of this technology. Detailed feasibility studies or trials could, however, be conducted.

Costs: **Medium–High**

The infrastructure for a vegetable oil biodiesel plant with a capacity of 210,000 litre per year was estimated to cost £15,000. The cost of fuel was estimated at £0.28–£0.55 per litre. Additional costs, including for raw materials and labour would be incurred for running the plant.

The cost of building and operating a fish-waste biodiesel plant of an appropriate scale would need to be determined, but appears unlikely to be any cheaper than a vegetable oil plant.

Other information

With expert contractors, the SFIA has undertaken trials of two different plant based fuels; biodiesel and pure plant oil (PPO)[102]. The PPO trial was somewhat successful although the vessel required modifications and the fuel appeared to cause some engine damage. The biodiesel trial was more successful, and appeared to show great promise, with no modifications required and little loss of power over standard diesel fuel. Some engine reliability problems were again identified, however.

A relatively low-technology process to produce biodiesel from fish waste has also been developed[103]. This appears to have potential application in fishing communities. Although the process relies on the

availability of methanol and caustic soda, a number of plants in different locations worldwide are already producing fuel from fish-waste.

In the longer term, biodiesel from vegetable oils, fish waste and other products such as microalgae appear highly likely to become accepted as a necessary alternative to limited fossil fuels. At present, though, it appears that the technology is in too early a stage for biodiesel to be widely taken-up by the fishing industry. If engine reliability issues were resolved, and prices of the final fuel product were competitive, then biodiesel would almost certainly gain a strong following and become a realistic option for mitigation.

A potentially strong point in biodiesel's favour is that it contains only approximately 20% of the sulphur of even low-sulphur conventional fossil fuels, and approximately 1% of the sulphur contained in red diesel[104].

In the UK, funding areas covered by the European Fisheries Fund include modernising fishing vessels to minimize environmental impact, pilot and collective actions by industry, and improvements to processing and port facilities[105]. It seems likely that a biodiesel production unit would fit under these categories.

[102] Rossiter, T. and R. Caslake (2008). Biofuels for the fishing industry final report. Hull, Sea Fish Industry Authority: 18 pp.
[103] http://aquaticbiofuel.files.wordpress.com/2009/08/fishwaste-biodiesel.pdf
[104] http://www.seafish.org/pdf.pl?file=seafish/Documents/FS27_04.09%20_Fuel%20emissions.pdf
[105] http://www.mfa.gov.uk/grants/eff.htm

### 5.4.8 Supporting the provision of new vessel engines to replace old, inefficient units

Outline

The replacement of old vessel engines with new, more efficient and reliable models should allow fishermen to reduce costs and operate more safely. Replacing engines may have particular relevance to windfarms where fishermen may have to travel further to reach fishing grounds or operate in close association with turbines.

**Strengths**

- Has precedent in the structural European Fisheries Fund, running from 2007 – 2013.
- Directly addresses issues of profitability and potentially increased costs associated with fishing within and around windfarms.
- Should increase fuel efficiency and reduce carbon, sulphur and nitrogen oxide emissions, which may be of particular interest to windfarm developers associated with green technologies.
- Can reduce annual and unscheduled maintenance costs.
- Can improve safety through reliability.

**Weaknesses**

- Would need to avoid any possibility of increasing fishing effort/capacity.
- Fishermen with newer vessels may not need or want new engines.
- May be unfair to fishermen who have carefully maintained their engines.
- Has the potential to be very divisive within the fishing industry.

**Opportunities**

- Increasing efficiency may be an attractive option to developers naturally associated with green technologies.
- Provides support for local engineering firms and engine suppliers.
- Can be linked to external funding opportunities with the EFF.
- If new engines are not desired, the installation of an electronic fuel meter, to establish optimum steaming speeds, may be a cheaper option to reduce fuel use.

**Threats**

- Vulnerable to criticism that new engines can increase effort when the perception, and the reality in some fisheries, is that there are too many boats chasing too few fish.

Timescale: **0.5–2 years**

It may take some time for appropriate engines to be specified and for engineering facilities to become available.

Costs: **Medium–High**

Engines represent a significant capital cost, while removal of old engines and installation of new units can be time-consuming, requiring specialist engineering facilities.

Other information

The majority of fishing vessels are powered by red diesel. This commercial fuel is chemically similar to conventional white diesel, but has a much higher sulphur content of up to 1000 parts per million (ppm), in comparison to a maximum of 50ppm sulphur in road fuels[106]. As well as reducing carbon dioxide emissions, improving the efficiency of fishing vessel engines therefore has important environmental as well as economic justification.

The FIFG, European Structural Fund for fisheries that ran from 2000-2006 included provisions for replacing old, inefficient engines with new ones[107]. This system received some criticism from external groups concerned that the process allowed fishing vessel power to increase despite the concern that overfishing was occurring[108,109].

The National Operational Programme of the EFF, running from 2007-2013, has included a provision under priority axis 1 to ensure UK fishing vessels are able to "*operate competitively and efficiently by*

*upgrading the fleet to become more efficient and environmentally friendly*"[110]. Applications for support to replace old fishing vessel engines for more efficient units may therefore be welcomed, although there are clear guidelines to ensure fishing effort does not increase as a result.

An alternative, less costly, but less effective measure might be the installation of electronic fuel meters to help identify the most fuel-efficient steaming and fishing speeds and fishing methods. The SFIA has a range of research projects focused on reducing fuel bills, which appear likely to provide benefits[111].

[106] http://www.seafish.org/pdf.pl?file=seafish/Documents/FS27_04.09%20_Fuel%20emissions.pdf
[107] http://europa.eu/legislation_summaries/maritime_affairs_and_fisheries/fisheries_sector_organisation_and_financing/l60017_en.htm
[108] http://www.globalsubsidies.org/en/subsidy-watch/commentary/the-problem-with-european-fisheries-fund
[109] http://ipsnews.net/new_focus/subsidies/newsletter/8_note.asp
[110] Defra (2008). The United Kingdom Operational Programme for the European Fisheries Fund (2013-2013). Department for the Environment, Food and Rural Affairs, London: 179 pp.
[111] http://www.seafish.org/upload/file/seafish_news/Seafish%20News%20-%20Issue%202%202008.pdf

### 5.4.9 Support for maintenance or annual refit costs

Outline

Safety and efficiency during fishing activities are factors that may be improved through the completion of regular vessel maintenance. Support for the completion of thorough annual refits may allow fishermen to operate more safely and effectively within and around windfarm sites.

**Strengths**

- All vessels require maintenance, so has very wide application.
- Could improve safety when working around windfarms by supporting rigorous checks and replacement of essential equipment.
- Can improve profitability by minimizing costs and losses associated with unscheduled maintenance.
- Can support the professional image of the industry through helping to ensure vessels are well maintained and smartly presented.
- Can help to maintain associated dockside industries, such as engineering and equipment suppliers.
- The need for maintenance is recognised by both fishermen and windfarm developers.

**Weaknesses**

- Different vessels have different maintenance needs, depending on age, hull material, engine type etc.
- Larger vessels have higher costs, so developing a fair scheme may be challenging.
- May not benefit fishermen who have carefully maintained their vessels over time, and has the potential to be divisive within the fishing industry.

**Opportunities**

- Possible links to external funding opportunities through the EFF.

**Threats**

- Would need to be focused on maintenance rather than anything that could result in increasing effort in order to avoid criticism from external parties.

Timescale: **0–6 months**

Maintenance would need to be scheduled into the fishing year, but could occur relatively quickly.

Costs: **Low but ongoing**

The level to which support for maintenance was provided would dictate the costs. Maintenance is, by its nature, ongoing, although support could be time or funding limited.

Other information

Routine maintenance is required for every fishing vessel. This is important for safety and profitability, in ensuring that problems are identified and dealt with at an early stage, and so that the vessel is able to go to sea when fishing opportunities arise. As fishing within and around windfarms presents challenges over and above normal fishing activities, support for maintenance from developers may provide appropriate mitigation.

The Marine Accident Investigation Branch reports that machinery failure was by far the greatest cause of accidents in fishing vessels in the period 1999-2008, with 2063 out of 3308 incidents (62%) attributed to this cause[112].

[112] http://www.maib.gov.uk/cms_resources.cfm?file=/Annual%20Report%202008.pdf

### 5.4.10 Provision of vessel or personal safety equipment

Outline

Fishing is a hazardous occupation, and many fishermen have expressed concern about operating within windfarm sites due to the increased risk associated with fishing near to the turbines. Appropriate, well maintained vessel safety equipment, such as radar, echo-sounders, GPS, life rafts, rope-cutters, EPIRBs and flares, and personal equipment such as the RNLI MOB Guardian system, lifejackets and floatation suits, may help to increase safety levels.

**Strengths**

- Addresses some of the safety concerns about fishing within or around windfarms.
- Improves safety generally, even if fishing is not carried out inside a windfarm on any particular day.

**Weaknesses**

- Could be seen as encouraging risk taking.
- May provide a false sense of security for working around turbines.
- Doesn't create fishing opportunities, or necessarily encourage fishermen to keep fishing.
- Some vessels may already have all/most of the equipment needed or advised, and therefore alternative mitigation would be needed.

**Opportunities**

- Good for the public image of the fishing industry- well equipped boats and minimal risk taking.
- May be linked to vessel accreditation or workboat coding.
- This option could be combined with a safety survey provided by the MCA.
- External funding opportunities exist for safety items.

**Threats**

- None perceived.

Timescale: **0–6 months**

Safety equipment may be introduced quickly, while organising safety surveys may take a little time.

Costs: **Low**

Although the MCA safety survey is free, installing and maintaining safety equipment on fishing vessels can represent a significant cost. For example, the RNLI MOB Guardian system is currently £1713.50 for a base station and two personal safety devices. Other items, such as radar systems, GPS, EPIRBs, lifejackets, flares, etc. are variable cost.

Other information

Although this option does not necessarily enhance fishing opportunities, vessel and personal safety are key issues for the fishing industry. Ensuring that vessel and personal safety is maximised may help to reduce concerns about fishing within and close to windfarms. The Marine Accident Investigation Branch (MAIB) reports that there were 723 injuries, including 121 losses of life, in the fishing industry over the period 1999-2008[113].

Seafish provide grants towards safety training for fishermen (basic survival at sea, basic fire-fighting and basic first-aid)[114]. Seafish Marine Services also undertake surveys of existing vessels to ensure they meet the construction standards for small fishing vessels. The MCA or Seafish then undertake a free safety inspection, which includes a review of safety equipment and crew qualifications[115].

The RNLI has recently introduced its MOB Guardian system, which is designed to provide safety cover for individual crew during man overboard situations and for the vessel as well as[116].

[113] http://www.maib.gov.uk/cms_resources.cfm?file=/Annual%20Report%202008.pdf
[114] http://www.seafish.org/sea/training.asp?p=ef153
[115] http://www.mcga.gov.uk/c4mca/mcga07-home/shipsandcargoes/mcga-shiptype/mcga-shiptype-fishingvessel/ds-newpage-102.htm
[116] http://www.rnli.org.uk/what_we_do/sea_and_beach_safety/fishing_safety/mob/moredetails

### 5.4.11 Insurance for vessels to fish inside windfarms

Outline

Some fishermen have expressed concern that insurance costs would increase if they were to fish inside windfarms, and that this would constitute at least part of the reason not to fish inside any developments. If insurance premiums did increase, support for any additional insurance costs might be considered appropriate mitigation in order to allow fishermen to operate within wind farms.

**Strengths**

- Directly addresses one of the fishermen's concerns.
- Neutralises one of the potential additional costs associated with fishing inside windfarms.

**Weaknesses**

- Increases in insurance premiums may not be required by all insurers.
- Costs are likely to be variable between insurers, fishing activities and sites.
- Some fishing activities appear likely to be prohibited inside windfarms in any case.
- Some fishermen say the risks associated with fishing inside windfarms are simply too high.

**Opportunities**

- Group rates for fishermen's cooperatives or regional groupings may be negotiable.
- May be combined with the provision of vessel or personal safety equipment (see relevant SWOT, 'Provision of vessel or personal safety equipment').
- Promoting risk management may help fishermen to understand the issues associated with fishing inside windfarms.

**Threats**

- Accidents or incidents may result in an increase in insurance premiums.
- Accidents or incidents may result in additional gear or vessel types being prohibited from windfarm sites.

Timescale: **Immediate**

If insurance premiums were raised, these increased costs could be covered quickly.

Cost implications: **Low but ongoing**.

It is understood that there are no current plans to increase insurance premiums if fishing is undertaken within windfarms. However, insurance is an ongoing cost and risks as perceived by insurers may change as greater experience is gained.

Other information

Five UK-based marine insurance companies were contacted as part of this project. They were advised at that time that their comments would not be attributable in this report. Two replied and stated that, while perceived risks and exposure from fishing inside windfarms may change as more information becomes available, there were no plans at the present time to increase insurance premiums for fishermen fishing inside arrays.

While insurance premiums are not currently predicted to increase, covering any increase would seem to provide appropriate mitigation. It does not, however, address the loss of access to any prohibited fishing gear types, or any unwillingness of fishermen to work within windfarms due to safety concerns. However, where fishermen are prepared to work inside windfarms, covering insurance costs, or any additional insurance costs, appears to be an area that would bring immediate benefits.

### 5.4.12 Improvement of port or beach-landing facilities

Outline

Well maintained port or beach-landing facilities are important for the efficient and safe operation of every fishing vessel. Port facilities may include derricks, gear or fuel storage facilities, freezers, shelters or other equipment. Tractors or haulers are also required to launch and retrieve beach-launched boats, and their reliable operation can be critical.

**Strengths**

- Improvements provide long-term benefits for fishermen.
- Development projects can be well defined, with clear objectives and deadlines.
- Efficiency can be improved, reducing the length of the fishing day for fishermen.
- Projects can be targeted to improve the safety of port or beach landing facilities.

**Weaknesses**

- It may take some time for any developments to occur, including obtaining planning permission and/or Harbour Revision Orders.
- Improvements may be quite locally focused, so are unlikely to benefit all impacted fishermen.
- Improvements lead to indirect benefits rather than the maintenance of fishing activities.

**Opportunities**

- May be able to combine fishing port improvements with port developments associated with windfarms.
- Good potential exists for port or landing facility improvements to be linked to other external funding opportunities.

**Threats**

- Lack of fishing opportunities could render port or beach-landing facilities superfluous.

Timescale: **2–5 years**

Some simple improvements or equipment purchases may be made relatively quickly, but full scale developments are likely to take much longer.

Costs: **Variable, but may be very high**.

Simple equipment purchases may be made at relatively low cost; port redevelopments may be very expensive, requiring the production of EIAs and detailed plans in addition to the cost of any works.

Other information

A number of improvements or significant developments to fishing ports have been undertaken in recent years with the help of external funding. For example, Brancaster Staithe received £260,000 from various sources[117], while Brixham received almost £9M from the RDA[118]. Recently, Withernsea was approved for £296,000 off EFF funding for a new commercial fishing slipway, while Newhaven was also approved for £82,981 for a fishing stage[119]. Significant opportunities may exist to link fishing facility developments with port developments required for the windfarm industry.

Funding from other external sources would almost certainly be required for any significant port projects, but a number of possible sources exist. One of the funding areas covered by the European Fisheries Fund in the UK is improvements to processing and port facilities[120], while the RDAs also state they are focused on helping regions prioritise essential infrastructure needed for economic development[121]. The RDAs have previously released funds for port development projects.

As well as the cost and complexity, a key issue for this option appears likely to be that only a limited number of fishermen will benefit from any particular port improvement scheme. Fishermen based at other sites would be unlikely to benefit significantly.

[117] http://www.ports.org.uk/port.asp?id=50
[118] http://findarticles.com/p/news-articles/western-morning-news-the/mi_8027/is_20070130/pounds15m-scheme-port-jewel-crown/ai_n44117242/
[119] http://www.mfa.gov.uk/news/press/100222.htm
[120] http://www.mfa.gov.uk/grants/eff.htm
[121] http://www.eeda.org.uk/files/Annual_report_and_accounts_2008_09.pdf

## 5.5 Options to develop new fisheries or other activities.

### 5.5.1 Training for new fisheries opportunities or on maximising product quality

Outline

While fishing opportunities may exist or develop around windfarm sites, it is not necessarily the case that the appropriate fisheries knowledge to take advantage of such opportunities will be available locally. It may be possible to conduct training or field visits to other areas, or other countries, to promote knowledge exchange and the development of new fishing opportunities. Product quality training may help fishermen to make the most out of any existing or new opportunities.

**Strengths**

- Where certain gears are excluded from windfarms, retraining may offer new fishing opportunities.
- Peer-to-peer learning between fishermen has the potential to be very effective.
- New techniques to promote fish quality (onboard handling, bleeding, storage, etc) may help to improve the market value of fished products.
- There are existing fisheries training opportunities at a number of different organisations.

**Weaknesses**

- There may be no new fishing opportunities to develop.
- Any new fishing opportunities may develop slowly.
- There may be only limited opportunities so few fishermen could benefit.
- Training would be dependent on support from external specialists (e.g., from Seafish or from other fishermen) in order to maximise learning opportunities.

**Opportunities**

- Training could be combined with the purchase of new fishing gear to promote fisheries.
- Could focus on gaining access to high quality/high value markets.

**Threats**

- Failure to identify appropriate training opportunities.

Timescale: **0.5–2+ years**

Identifying appropriate training opportunities may depend on identifying fisheries opportunities in the first instance. Other more general training around product quality could be delivered quickly.

Costs: **Low**

Organising training opportunities appears likely to be relatively inexpensive. If training can be organised in groups and coordinated at the local or regional level, then costs could be minimized.

Other Information

A range of courses are already available that promote product quality, for example at the Welsh Sea Fish Industry Training Association[122], Seafish[123] and the North Atlantic Fisheries College[124]. Seafish has also looked to run an industry visit to the USA[125], while the Isle of Man Government recently ran a visit for fishermen to a scallop hatchery in France[126].

New fishing opportunities may be slow to develop within windfarms, but training opportunities associated with maximising catch value through a focus on quality may provide benefits at the local level relatively quickly. Some fishermen will already closely manage product quality issues.

There is potential for some fisheries to develop quickly inside windfarms, for example for highly mobile fish such as bass, or where some permitted gear types could be used inside windfarms to target species that would normally be targeted by prohibited gears. Examples might be long-lining or commercial angling instead of trawls. In those cases, and where local knowledge of techniques is missing, such skills may be most quickly and easily transferred through peer-to-peer training.

[122] http://www.welshseafishindustry.co.uk/index_18.htm
[123] http://www.seafish.org/land/training.asp?p=fe175
[124] http://www.nafc.ac.uk/WhiteFishQualityImprovementInitiative.aspx
[125] http://www.seafish.org/doc.pl?file=seafish/news/SustainMinutesMay06.doc
[126] http://gov.im/lib/news/daff/visittofrancetos.xml

### 5.5.2 Support for Appropriate Assessments or EMS fishery management plans

Outline

An increasing number of European Marine Sites (EMSs) (i.e., SACs and SPAs) may be found around the UK coast. Fisheries undertaken within these sites that have a 'likely significant effect' are required to pass through an appropriate assessment. This can be a complex and time consuming process, particularly for new fisheries. Fishery management plans that define agreed management principles and criteria may help to expedite these processes and allow fisheries to occur more quickly and meet seasonal demands.

**Strengths**

- Many windfarms appear likely to coincide with existing and new European sites.
- May help to accelerate access to European sites for new fisheries.
- Ever increasing need for fishery managers to demonstrate compliance with European legislation.
- Management plans can help to increase certainty in fisheries through establishing management criteria.
- Management plans can help fisheries to start on time each season.
- Management plans can help to simplify and speed up the annual appropriate assessment process.
- Baseline data that may inform appropriate assessments or management plans will be collected through for the EIS required by the Infrastructure Planning Commission (IPC).

**Weaknesses**

- May take a long time to proceed through the entire Appropriate assessment process.
- No guarantee that any fishery deemed to have a 'likely significant effect' will gain access to European sites even after an appropriate assessment.
- Appropriate assessments may be considered the responsibility of the 'Competent Authority' of the fishery, not fishermen or developers.
- Management plans may be time-consuming to develop, and require fishery managers to be risk-averse.
- Anyone developing an appropriate assessment or a management plan would be required to coordinate between a number of organisations (e.g., Competent Authority, a statutory nature conservation organisation, fishermen, and any funding bodies).

**Opportunities**

- Appropriate assessments could help to facilitate fisheries access for vessels if they are displaced into European sites.
- Funding for the development of management plans may be available through the EFF.

**Threats**

- It is possible that Government already has plans for dealing with the appropriate assessment of fisheries that may be undertaken inside the new European sites.

Timescale: **0.5–2+ years**

Preparation of appropriate assessments and associated fishery management plans can take a considerable time, depending on the complexity of the fishery, the potential for the fishery to impact designated features, and the amount of information that is available on the fishery.

Costs: **Low – Medium**

Although the preparation of appropriate assessments and management plans can be carried out, in the main, as desk-based work, the time and therefore the costs to develop these documents can be considerable. If any field or survey work was required in order to inform the appropriate assessment, costs could be expected to increase significantly.

Other information

The increasing number and extent of European sites in inshore and offshore waters requires that fishermen and fisheries managers are capable of proceeding through the appropriate assessment process, where fisheries are deemed to have a 'likely significant effect'. This process is time consuming and resource intensive, and must be carried out annually prior to licensing such fisheries.

An appropriate assessment of the American razorshell (*Ensis directus*) fishery was undertaken by CEFAS on behalf of Defra in 2004-05, after the fishery was originally closed almost immediately after

opening in 1998 due to concerns of likely significant effect[127]. Work to complete an appropriate assessment was delayed, although a small experimental fishery was finally opened in 2006[128].

During 2005-2008, management plans were prepared by the Eastern Sea Fisheries Joint Committee with Natural England for the Wash mussel, sublittoral mussel and cockle fisheries[129]. These have allowed annual appropriate assessments for those fisheries to proceed rapidly, which means those fisheries are opened on time, catches have been stabilised, and the fishing industry have increased certainty for the future. The policies have been widely welcomed[130]. Other fisheries that are currently delayed or restricted by the appropriate assessment process could also find that the preparation of a management plan would provide benefits.

A key consideration for the development of management plans may be that the fisheries in question have already been through a number of appropriate assessments so that a history of management input and fishery response has been established. Where information is lacking, or where there are no previous appropriate assessments to review, the development of a management plan may be very challenging.

The EFF European structural fund, running from 2007-2013, has included a provision under priority axis 3 to grant support for measures that "*contribute sustainably to better management or conservation of resources*"[131].

[127] http://www.seafish.org/pdf.pl?file=seafish/Documents/SR606_Ensis%20FIFG%20report.pdf
[128] http://www.seafish.org/doc.pl?file=seafish/news/Shellfish%20Advisory%20Minutes%20171006.doc
[129] http://www.esfjc.co.uk/management%20policies%2008.pdf
[130] http://www.ecasa.org.uk/Documents/shellnews25.pdf
[131] Defra (2008). The United Kingdom Operational Programme for the European Fisheries Fund (2013-2013). Department for the Environment, Food and Rural Affairs, London: 179 pp.

### 5.5.3 Develop long-line or lantern-net aquaculture

Outline

This option is specific to the development of bivalve or algae culturing techniques inside windfarms, and would require investment in specialised equipment and facilities for handling lines and other equipment. Technical competence is also likely to be a key requirement. This option could be combined with the establishment of Several Orders for stock protection.

**Strengths**

- Strong governmental support for the development of aquaculture opportunities.
- Potential for designating particular areas for cultivation within windfarms.
- More stable opportunities from aquaculture may provide long-term job security.
- Employs many of the skills fishermen already possess (e.g., seamanship, vessel and gear handling).
- Long-line and lantern-net systems are already employed in parts of the UK and Europe.
- Likely to be high quality, clean water at offshore windfarm locations, suitable for aquaculture.

**Weaknesses**

- Clear access to turbines would need to be maintained for windfarm service vessels.
- Would require considerable investment in equipment, including new vessels.
- Many windfarms may not be in suitable locations due to high exposure or strong tidal currents.
- Knowledge of technology and techniques for such systems is likely to be lacking in many areas.
- A shellfish water harvesting classification would be needed for shellfish in areas without a classification.
- Would prevent the activities or development of other fisheries.
- Would be dependent on the availability of spat for stocking or wild settling larvae.
- Combining windfarms and long-line systems is untested on a large scale.
- Proposals would require clarification with the Crown Estate.

**Opportunities**

- Could be combined with the mitigation option for training.
- Enhanced wild bivalve fisheries are now being accepted for sustainability assessment by the Marine Stewardship Council.
- Increased reliability of supply from enhanced fisheries may help to increase market demand for products.
- Increasing public and governmental interest in aquaculture as a reliable source of healthy and locally-produced food.
- Environmental concerns over towed gears mean dive-caught/long-line produced shellfish may achieve price premium.
- Good links to external funding, including the EFF.
- Could be combined with the introduction of Several Orders.

**Threats**

- Environmental concern that seed movement may cause genetic contamination of local stocks.
- Catastrophic loss of stock and equipment due to storms.
- Entanglement of lines around the turbines in the event of any breakages or anchor-dragging.
- Entanglement of cetaceans, seabirds, pinnipeds, etc. in culture lines.
- Buoys could be a navigation hazard for any transiting vessels.
- Insurance costs may be high.

Timescale: **2–5+ years**

Technology and techniques for long-line cultivation of bivalves and algae are currently in use in the UK, Europe and globally, but exposure levels at windfarm sites are likely to be higher than those encountered at most existing farm sites.

Cost implications: **High**

Significant investment in equipment would be required in order to establish a commercially-viable long-line or lantern-net system. Existing fishing vessels may provide a suitable platform for some work,

but specialised management and harvest vessels are likely to be needed if a farm was built at a commercially significant scale.

Other information

The feasibility of combining aquaculture and windfarm developments has been considered in Europe[132,133,134] and elsewhere globally[135,136]. It appears that technology for exposed sites is available, but would almost certainly need to be tested in UK waters before large-scale production could be initiated[137].

The technical and economic challenges that would arise in taking this option forward are considerable. There would be several main considerations:

- The lack of commercial-scale tests of combining offshore windfarms with aquaculture must be considered a major factor.
- Windfarm developers will need to maintain clear access to turbines for maintenance and other activities. Any reduction in access would likely be a cause for significant concern.
- The capital costs of establishing a long-line system, and purchasing the specialised long-line handling equipment, will be high.

A further important consideration is likely to be that very few, if any, fishermen impacted by windfarm development will have experience of offshore aquaculture. There are very considerable technical and practical challenges to establishing and managing a commercially viable, offshore long-line culture system, such that considerable commitment to the project would be needed. Additional, technically competent partners would almost certainly be needed.

[132] http://www.awi.de/index.php?id=1153&type=123&L=1&filename=awi.pdf
[133] http://www.awi.de/en/research/new_technologies/marine_aquaculture_maritime_technologies_and_iczm/projects/marine_aquaculture_projects/offshore_aquaculture/
[134] http://www.offshoreaqua.com/proceedings/Patricia%20Daly%20-%20Moving%20Mussels%20Offshore.ppt
[135] http://www.whoi.edu/page.do?pid=12466&tid=282&cid=7301
[136] http://conservation.govt.nz/upload/documents/science-and-technical/Musselfarms01.pdf
[137] http://www.thefishsite.com/articles/466/potential-for-offshore-mussel-culture

### 5.5.4 Adapt to take advantage of tourism, recreation or other roles.

Outline

Fishermen typically possess unrivalled knowledge of their local sea area, and this may provide opportunities to supplement income or change focus. Relevant opportunities may arise with windfarm developments, such as providing maintenance support services, surveying or sight-seeing and recreational angling trips. Other opportunities may include providing recreational or commercial diving support.

**Strengths**

- Fishermen possess excellent knowledge of their local sea areas.
- Fishermen possess skills and attributes that make them suited to offshore jobs (seamanship, practicality, ability to work independently and out-of-hours).
- Some inshore fishing vessels may be readily converted to other uses.
- Diving, recreational sea angling and sight-seeing will be permitted inside windfarms.

**Weaknesses**

- Not all vessels will be suitable for conversion to other applications.
- Converting commercial fishing vessels to other applications is typically costly.
- The Code of Practice for the Safety of Small Workboats and Pilot Boats or the Safety of Small Commercial Motor Vessels is complex and detailed, with, potentially, considerable cost implications.
- Fishermen may require additional training to undertake other activities, but may not be academically inclined.
- Jobs requiring dealing with the public as customers may not suit independently-minded fishermen.
- Windfarms may be located in areas that lack significant tourism or recreational interest.
- Recreation opportunities will be very unlikely offshore.
- Could be divisive if some fishermen are able to access opportunities but others aren't.

**Opportunities**

- The development of the windfarm industry appears likely to provide opportunities for appropriately skilled personnel and suitable support vessels.
- EFF funding is available for diversification and redirecting economic activities.

**Threats**

- Windfarms could lose their novelty value, and so the public's interest in paying to view them could diminish also.
- Fishermen leaving the industry could drive the number of fishermen below the critical mass required for support services to be maintained.
- Fisheries of recreational interest may not exist or develop within windfarms.

Timescale: **0.5–2 years**

Adapting fishing vessels to provide additional services, together with obtaining appropriate training, can be expected to take a considerable length of time. If multi-purpose vessels were obtained instead, fishermen may be able to adapt more quickly.

Costs: **High**

As well as being time consuming, converting vessels to different activities is also likely to be costly. However, the costs would be specific to each case.

Other information

The number of fishermen and fishing vessels has declined over time, as vessels have become more efficient and as fishing opportunities have decreased. As such, and with limited quotas and high fuel prices continuing to restrict profitability, opportunities to supplement income or adapt to alternative activities may be of interest to fishermen.

The UK Renewable Energy Strategy was published in July 2009[138]. The document makes it clear that Government intends to support increases in the supply of renewable energy, and that it is anticipated that 0.5 million new jobs will be created in the UK renewable energy sector. It would appear likely that well motivated and skilled fishermen could find employment in the offshore sector in the future.

Key issues with adapting to new opportunities are likely to be identifying an appropriate alternative activity to switch to, and securing sufficient funds to accomplish the move, where workboat or small commercial vessel coding is required[139].

The EFF European structural fund, running from 2007-2013, has included a provision under priority axis 4 to promote investment in projects which "*Restructure and redirect economic activities, e.g. by promoting ecotourism*", and that "*Diversify activities including creating additional jobs outside the fisheries sector*"[140].

[138] DECC (2009). The UK renewable energy strategy. Department of Energy and Climate Change, London. 238 pp.
[139] http://www.mcga.gov.uk/c4mca/brown-withpage8.pdf
[140] Defra (2008). The United Kingdom Operational Programme for the European Fisheries Fund (2013-2013). Department for the Environment, Food and Rural Affairs, London**:** 179 pp.

# 6 Discussion

The UK Renewable Energy Strategy was published in July 2009 (DECC 2009). This document made it clear that renewable energy will be an integral part of the UK's strategy for reducing carbon emissions. A key commitment in the Strategy was that more than 30% of UK electricity will be generated from renewable sources by 2020, up from about 5.5% in 2009, with more than two-thirds of the increase to be achieved using wind power.

The release of large areas offshore for windfarm development under the Crown Estate's Round 2 and Round 3 licensing proposals provides evidence of the speed with which developments will be coming forward in upcoming years. It also provides evidence of the need for the fishing industry to work with developers to minimize and mitigate impacts on fishing activities wherever possible. Essentially, there is a risk that if options and opportunities are not sought to mitigate any impacts then the viability of fishing activities and associated businesses ashore will decline as the ground available for fishing decreases.

This report was produced with the aim of identifying options and opportunities for marine fisheries mitigation associated with windfarms. The resulting list of 26 possible mitigation options is intended to be of use to fishermen, developers, regulators, statutory advisors and marine resource managers in discussions related to present and future windfarm developments, although it may also be of use when considering developments of other industries and when considering marine spatial planning issues more generally.

Although stakeholder input to this project was actively encouraged, for example by establishing the EAG, the menu of options is not considered or expected to be comprehensive, and may not provide ideas that are appropriate for every situation. Discussions will need to be held between developers and fishermen to decide how to proceed at every site.

## 6.1 Consulting early and understanding development and fisheries issues

One point that was repeatedly stressed during the EAG workshops was the need for early consultation between developers and fishermen during the planning process. EAG members were especially concerned that when fishermen were consulted late in the planning phase there would inevitably be little opportunity to modify plans for windfarms or to incorporate mitigating features that could minimize any impacts. An example was highlighted of a cable route that had crossed an important drift net ground, when other routes were available very close by that apparently could have been used with minimal or no impact on fishing activities.

The appointment by windfarm developers of Fishery Liaison Officers nominated by the fishing industry has been a positive step in ensuring that day-to-day fishing and construction activities are understood by both groups. However, it was also suggested that the development process would benefit from developers spending time at sea with fishermen, to obtain an understanding of the fishing industry and potential impacts on their activities from windfarms, and *vice versa*, so as to facilitate discussions from an early stage. It is understood that a number of valuable contacts were made by members of the EAG in this regard, and it is hoped that appropriate opportunities for fishing trips are taken up in future.

When working with the fishing industry, it is important to appreciate that fishermen are often independent by nature, and may hold widely differing views on issues affecting fisheries. Naturally, fishermen are also influenced by the sector they operate in, so that towed gear fishermen may not share the same views as static gear fishermen. As such, generating a widely supported agreement on approaches to mitigation may be very challenging. There is no easy way to address this issue, but it highlights the need for broad and thorough consultation by developers to ensure that individual fishermen are informed and provided the opportunity to input to debates. Fishing industry representatives will also need to ensure fishermen are aware of issues and opportunities so that the best, informed choices regarding compensation or mitigation are made.

A very important point was made at the second EAG workshop regarding the new Zone Appraisal and Planning (ZAP) process. This new process, first described in November 2009, requires developers to demonstrate to the Infrastructure Planning Commission (IPC) that fishermen were consulted early, and that the site selection process for any development was undertaken to reasonably minimize adverse effects on fish stocks and fishing activity (DECC 2009). It seems very likely that the ZAP will promote consultation and collaboration as developers will otherwise risk failing to obtain consent to build windfarms.

## 6.2 Obtaining and distributing funding

A key factor in any mitigation proposal will be obtaining and distributing funding. Government guidance has made it clear that developers will not be required to provide funding beyond the level to which fishermen have been affected (DECC 2009), while windfarm developers will doubtless be keen to ensure that the costs of any mitigation projects remain proportionate. As such, and in order to maximise the opportunities for significantly-sized projects to proceed, external funding should be sought in order to boost any funding that is provided by developers.

It appears likely that the EFF and the RDAs will provide the best opportunities for sourcing additional funding for projects linked to sustaining viable fisheries and fishing communities. The possible mitigation options presented in this report are focused on maintaining and enhancing viable fishing businesses, and this should be entirely compatible with the remits of the EFF and the RDAs.

Other external funding opportunities may be available from, for example, the European Social Fund for support for professional training, while the European Agricultural Fund for Rural Development may be used for aquaculture related projects and for research, technological development and innovation pilot projects (Defra 2008). It is possible that local councils may also be targeted for infrastructure development projects.

Distributing the funding appropriately to ensure that impacted fishermen benefit fairly from mitigation programmes is likely to be one of the main obstacles to taking any mitigation proposal forward. In comparison, compensation is likely to be relatively simple to distribute equitably. As with trying to generate a consensus on approaches to mitigation, there is no easy solution to the problem of implementing a mitigation project fairly. FLOWW suggested that a managed ‘community fund’ could be established with each windfarm development, or with groups of developments, in order to distribute funds on merit and need (BERR 2008). While recognising that this may not necessarily benefit those most directly impacted by a particular development, FLOWW identified that such a fund could be used for projects which benefit the whole fishery. It is understood that this approach is being taken forward at one site in the Greater Thames with some success.

## 6.3 Compensation versus mitigation

Attendees to the second project workshop identified the difference between mitigation and compensation as being an issue of significant concern. In particular, a number of the possible mitigation options in the third category ('Options to support existing fishing activities') were thought to be more akin to compensation that mitigation. For example, while the provision of gear that allowed fishermen to adapt to the new environment formed by windfarms is readily recognisable as mitigation, the provision of a fuel subsidy allowance may be considered more akin to compensation.

It is important to note, though, that this report is intended to be used to help maintain the viability of fishing activities that support local communities. In this regard, an attempt has been made throughout this report to make a clear distinction between compensation that is a simple monetary payout, and mitigation that is focused on increasing access, enhancing performance, reducing costs, increasing product prices or enhancing marketability. For this reason, mitigation options are included which, although not directly related to the impact of windfarms, may still help to support local fishing activities.

No options were removed from the final report as a result of the concerns expressed by the EAG in the second workshop, but it is appropriate to draw readers attention to the issue as similar concerns may be expressed.

## 6.4 Summary findings

- The number and size of offshore windfarm developments will increase dramatically in the near future. Fishermen must engage with developers to ensure that fishing activities are appropriately considered at the early planning stages.

- Government has a stated commitment to ensuring that the fishing industry remains healthy and viable into the future, including through Fisheries 2027 that '*Fisheries contribute to the local economies and culture of coastal communities.*'

- An effective mechanism must be in place to ensure that dialogue between developers and fishermen is started as early as possible in the planning phase. The ZAP process should be carefully designed to ensure it delivers appropriate levels of consultation.

- There was little well-researched information available on the impacts, positive or negative, of windfarms on targeted stocks. This will need to be addressed in order that effective mitigation options can be developed.

- There is very limited information available on what fishing activities are possible and appropriate within windfarms. This lack of data will need to be addressed.

- Data, showing where fishermen work and the value of different areas to different fisheries sectors, are available only at a very broad scale. For fishermen with small vessels that are not monitored with Vessel Monitoring System (VMS) nor required to submit logbooks, there is a particular need to supply data that can provide evidence of activity and potential economic loss resulting from a development. In the absence of reliable data on fishing activity, developers may be understandably unwilling to offer mitigation or compensation options.

- There was strong support from windfarm developers and representatives of the fishing industry, fishery managers and statutory bodies for minimizing and mitigating fisheries impacts associated with windfarms, rather than necessarily seeking compensation for lost access.

- A decision to mitigate or compensate for any fisheries impacts must be taken by developers and fishermen at the individual site level.

- Stakeholders other than fishermen and developers are likely to have an important role to play in identifying and enabling the development of appropriate mitigation options. These include fishery managers, fishery scientists and representatives of statutory bodies.

- Nature conservation and the impacts of any proposal on EMSs will need to be considered carefully within the EIA process.

- The assessment of in-combination or cumulative impacts on fisheries is likely to remain highly challenging, particularly because understanding how fishing effort displacement will affect fishing activity continues to be problematic.

- It appears very likely that the funding available for mitigation options, but not for compensation, could be boosted considerably by external funding sources.

- Information on any mitigation projects taken forward at windfarm developments should be included into future, updated versions of this report in order to provide case-studies.

# References


ABPmerLtd (2009). Development of spatial information layers for commercial fishing and shellfishing in UK waters to support strategic siting of offshore windfarms. Newbury, Collaborative Offshore Wind Research Into the Environment**:** 44 pp.

AFIS (2007). Oriel Windfarm Ltd. offshore windfarm environmental impact statement. . Galway, Aqua-Fact International Services Ltd.**:** 636.

Andeson, J. & H. Curtis (2008). The economic impacts of the UK sea fishing and fish processing sectors: an input-output analysis. Hull, Sea Fish Industry Authority 12 pp.

BERR (2007). Gas storage in your area- your questions answered. London, Department for Business, Enterprise and Regulatory Reform**:** 15 pp.

BERR (2007). Statutory Instruments 2007 No. 1948. The Electricity (Offshore Generating Stations) (Saftey Zones) (Application Procedures and Control of Access) Regulations 2007. 1948. E. a. R. R. Departmnet for Business. London, The Stationery Office Limited **1948**.

BERR (2008). Atlas of UK marine renewable energy resources. London, Department for Business Enterprise and Regulatory Reform**:** 26 pp.

BERR (2008). Fishing liaison with offshore wind and wet renewables group (FLOWW) recommendations for fisheries liaison; best practice guidance for offshore renewables developers. London, Department for Business, Enterprise and Regulatory Reform**:** 34 pp.

BERR (2008). Review of reef effects of offshore wind farm structures and potential for enhancement and mitigation. E. a. R. R. Department for Business, in association with Defra. London**:** 132 pp.

Blyth, R.E., M.J. Kaiser, G. Edwards-Jones & P.J.B. Hart (2002). "Voluntary management in an inshore fishery has conservation benefits." Environmental Conservation **29**: 493-508.

BP (2009). BP statistical review of world energy, June 2009. London, BP**:** 48 pp.

BWEA. (2009). "http://www.bwea.com/statistics/."

BWEA. (2009). "http://www.bwea.com/ukwed/operational.asp."

CE. (2009). "http://www.thecrownestate.co.uk/scottish-offshore-wind."

Centrica (2008). Docking Shoal offshore windfarm; Environmental statement non-technical summary, Centrica (DSW) Ltd**:** 32 pp.

Clark, R. (2008). Sussex inshore fisheries. Part I: the inshore fisheries off the Sussex coast: a description of the methods and spatial extents, 2004-2007. Shoreham-by-Sea, Sussex, Sussex Sea Fisheries Committee**:** 13.

COWRIE. (2009). "http://data.offshorewind.co.uk/."

CrownEstate. (2009). "http://www.thecrownestate.co.uk/mars."

CrownEstate. (2009). "http://www.thecrownestate.co.uk/wave-tidal."

DECC (2009). Draft national policy statement for renewable energy infrastructure (EN-3). London, Department of Energy and Climate Change**:** 75.

DECC (2009). Severn tidal power, phase one consultation. London, Department for Energy and Climate Change**:** 236.

DECC (2009). UK offshore energy strategic environmental assessment; future leasing for offshore wind farms and licensing for offshore oil and gas and gas storage. London, Department of Energy and Climate Change**:** 861 pp.

DECC (2009). The UK renewable energy strategy. London, Departmnet of Energy and Climate Change**:** 238 pp.

Defra (2007). Delivering Fisheries 2027- towards an implementation plan. London, Department for the Environment, Food and Rural Affairs**:** 16 pp.

Defra (2007). Fisheries 2027; a long-term vision for sustainable fisheries. London, Department for the Environment, Food and Rural Affairs**:** 20 pp.

Defra (2008). The United Kingdom operational programme for the European Fisheries Fund (2007 - 2013). London, Department for the Environment, Food and Rural Affairs**:** 179 pp.

Defra (2009). Managing our marine resources- licensing under the Marine Bill. London, Department for the Environment, Food and Rural Affairs**:** 20 pp.

Defra (2009). Managing our marine resources: the Marine Management Organisation. London, Department for the Environment, Food and Rural Affairs 40 pp.

des Clers, S., C. Dat & S. Carrier (2001). Survey of Greater Thames eestuary knowledge, Final Report to Essex Estuary Initiative, Essex Estuary Initiative.

DongEnergy (2007). Gunfleet Sands 2 offshore wind farm, non-technical summary of environmental statement. Fredericia, Denmark, Dong Energy**:** 20.

DOW (2009). Dudgeon offshore wind farm environmental statement, Non technical summary. Wellesbourne, Dudgeon Offshore Wind Ltd.**:** 16.

DTI (1987). Petroleum Act,1987 Chapter 12. D. f. T. a. Industry. London.

DTI (2007). Government response to public consultation: offshore natural gas storage and liquified natural gas import facilities. London, Depatrment of Trade and Industry**:** 33 pp.

DTI (2007). Meeting the energy challenge; a white paper on energy. London, Department of Trade and Industry**:** 343 pp.

E-on. (2009). "http://www.eon-uk.com/generation/1303.aspx."

EC (2004). Fishing in Europe; Industrial fisheries in nine questions and answers. Brussels, European Commission. **22:** 12 pp.

EC (2007). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions; an integrated maritime policy for the European Union. C. o. t. E. Communities. Brussels**:** 16 pp.

EC (2008). Fishing opportiunities for 2009; policy statement from the European Commission. COM(2008) 331 final. Brussels, Commission of the European Communities**:** 16 pp.

EC (2009). Green paper; reform of the Common Fisheries Policy. C. o. t. E. Communities. Brussels**:** 28 pp.

EC. (2009). "http://ec.europa.eu/fisheries/cfp_en.htm."

Edwards, T. & F. McCallum (2002). Robin Rigg offshore wind farm (navigation and fishing) Scotland) Bill. Edinburgh, The Scottish Parliament, The Information Centre**:** 24 pp.

EEC (2005). Ormonde project environmental impact assessment non technical summary. . Grantham, Eclipse Energy Company Ltd.**:** 16.

ElsamEngineering & ENERGIE2 (2005). Review Report 2004: The Danish offshore wind farm demonstration project: Horns Rev and Nysted offshore wind farm environmental impact assessment and monitoring. . Fredericia, Denmark, Elsam Engineering and Energi E2**:** 135.

EmuLtd. (2002). Kentish Flats offshore windfarm; non-technical summary. Southampton, Emu Ltd**:** 8.

Enertrag (2006). Centrale éolienne Côte d'Albâtre (non-technical summary in French). Cergy-pontoise Cedex, France, Enertrag**:** 10.

ESFJC (2008). Fisheries management policies. King's Lynn, Norfolk, Eastern Sea Fisheries Joint Committee**:** 22.

FaberMaunsell & MetocPLC (2007). Scottish marine renewables strategic environmental assessment (SEA), non-technical summary. Edinburgh, The Scottish Executive**:** 21 pp.

FindingSanctuary. (2009). "http://www.fs.no-ip.com/MainPage.aspx#."

Gateway (2007). Gateway gas storage project, offshore environmental statement, non-technical summary. Edinburgh, Gateay Storage Company Ltd.

James, J.W.C., R.A. Coggan, V.J. Blyth-Skyrme, A. Morando, S.N.R. Birchenough, E. Bee, D.L. Limpenny, E. Verling, K. Vanstaen, B. Pearce, C.M. Johnston, K.F. Rocks, S.L. Philpott & H.L. Rees (2007). The eastern English Channel marine habitat map. Cefas Science Series Technical Report No. 139. Lowestoft, CEFAS.

JNCC (2004). Developing regional seas for UK waters using biogeographic principles. Peterborough, The Joint Nature Conservation Committee**:** 14 pp.

JNCC (2009). "http://www.jncc.gov.uk/page-1445."

JNCC (2009). "http://www.jncc.gov.uk/page-1455."

JNCC (2009). "http://www.jncc.gov.uk/page-4559."

Lindberg, W.J. & J.L. Loftin (1998). Effects of artificial reef characteristics and fishing mortality on gag (*Mycteroperca microlepis*) productivity and reef fish community structure, Florida Department of Environmental Protection, Office of Fisheries Management and Assistance Services. **Grant Agreement MR-073:** 47.

M&FA (2008). UK sea fisheries statistics 2007. C. Barratt and C. Irwin. London, Marine and Fisheries Agency**:** 104 pp.

M&FA. (2009). "http://www.mfa.gov.uk/protection/closures.htm."

Mackinson, S., H. Curtis, R. Brown, K. McTaggart, N. Taylor, S. Neville & S. Rogers (2006). A report on the perceptions of the fishing industry into the potential socio-economic impacts of offshore wind energy developments on their work patterns and income. Lowestoft, Centre for the Environment, Food and Aquaculture Research**:** 99.

MAGIC (2009). "http://www.magic.gov.uk."

MEDIN. (2009). "http://www.oceannet.org/."

MOJ (1996). The fishing boats (European Economic Community) designation (variation) order 1996 London, Ministry of Justice. **(No. 248):** 3.

NE (2009). "http://www.naturalengland.org.uk/Images/inshore-locations_tcm6-11664.pdf."

NE. (2009). "http://www.naturalengland.org.uk/ourwork/marine/protectandmanage/mpa/conservationzones.aspx."

NFFO (2006). NFFO News, April 2006. N. F. o. F. s. Organisations**:** 4 pp.

NWP (2002). North Hoyle offshore windfarm environmental statement, non-technical summary. Swindon, NWP Offshore Ltd.**:** 13.

NWPO (2002). North Hoyle offshore wind farm environmental statement; Chapter 6- mitigation measures. Swindon, National WInd Power Offhshore Ltd**:** 9 pp.

Pickering, H. & D. Whitmarsh (1997). "Artificial reefs and fisheries exploitation: a review of the 'attraction versus production' debate, the influence of design and its significance for policy. ." Fisheries Research **V. 31,**: 39-59.

PMSU (2004). Net benefits; a sustainable and profitable future for UK fishing. London, Prime Minister's Strategy Unit, Cabinet Office**:** 170 pp.

PMSU (2008). Food matters: towards a strategy for the 21st century. London, The Prime Minister's Strategy Unit, Cabinet Office**:** 144 pp.

Polovina, J.J. (1989). "Artificial reefs: nothing more than benthic fish aggregators." California Cooperative Ocenaic Fisheries Investigations **30**: 37-39.

Polovina, J.J. (1991). Fisheries applications and biological impacts of artificial habitats Artificial habitats for marine and freshwater fisheries. J. Seaman, W.J. and L. Sprague. San Diego, Academic Press Inc**:** 153-176.

Powers, S.P., J.H. Grabowski, C.H. Peterson & W.J. Lindberg (2003). "Estimating enhancement of fish production by offshore artificial reefs: uncertainty exhibited by divergent scenarios " Marine Ecology Progress Series **V.264** 265-277.

RDEEIPB. (2009). "http://www.mfa.gov.uk/environment/energy/documents/090702-ECPB_Final-high-level-statement.pdf."

Rogers, S.I. (1997). A review of closed areas in the United Kingdom Exclusive Economic Zone. Science Series Technical Report. Lowestoft, Centre for Environemnt, Fisheries and Aquaculture Research**:** 24 pp.

RPS (2005). London Array offshore wind farm environmental statement. Abingdon, RPS Group Plc.**:** 657.

RSKEnvironment (2002). Barrow offshore wind farm, non technical summary. , RSK Environment Ltd**:** 8.

RSKEnvironment (2007). Barrow offshore windfarm fisheries monitoring survey Oct 2007. Bridgend, Titan Environmental Surveys Ltd. . **Final report No. CS0189 (D2/V1):** 72.

ScottishGovernment. (2008). from http://www.scotland.gov.uk/Topics/marine/Sea-Fisheries/InshoreFisheries/IFGsMap.

ScottishGovernment (2009). Marine (Scotland) Bill; Policy memorandum. Edinburgh, The Scottish Government**:** 24 pp.

ScottishGovernment (2009). Marine Scotland; 2009 strategy statement. Edinburgh, The Scottish Government**:** 32 pp.

ScottishGovernment. (2010). from http://www.oqps.gov.uk/legislation/acts/acts2010/pdf/asp_20100005_en.pdf.

SFIA (2010). Comments on the proposed marine Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) in English waters. Grimsby, Sea Fish Industry Authority**:** 6.

SLP. (2010). from http://www.slp-eng.com/Engineering/Uploads/17131985_Frond%20Flexiform.pdf?Sheets=../Engineering/Uploads/17131985_Frond+Flexiform.pdf.

SOE (2006). Sheringham Shoal offshore wind farm environmental impact statement. . London, Scira Offshore Energy Ltd**:** 722.

Statoil. (2009). from http://www.statoil.com/en/TechnologyInnovation/NewEnergy/RenewablePowerProduction/Offshore/Hywind/Pages/HywindPuttingWindPowerToTheTest.aspx.

Stern, L.N. (2007). Stern review on the economics of climate change. London, HM Treasury**:** 619 pp.

Walmsley, S.A. & M.G. Pawson (2007). The coastal fisheries of England and Wales, part V: a review of their status 2005 - 6. . Science Series Technical Report. Lowestoft, Centre for Environment, Fisheries and Aquaculture Science. **140:** 86 pp.