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Best Practice Guidance for Fishing Industry Financial and Economic Impact Assessments

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Guidelines based on outputs from
a technical workshop organised by the
UK Fisheries Economics Network

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prepared by

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1. INTRODUCTION

1.1. The UK Fisheries Economic Network (UKFEN) was founded by Seafish in 2011 as an informal network for economists and analysts working in connection with fishing and seafood industries. Further details are available at http://www.seafish.org/about-seafish/ukfen-–-uk-fisheries-economics-network.

1.2. UKFEN identified the need for developing best practice guidance for preparing economic impact assessments (IAs) that assess impacts on commercial fisheries as a result of areas closed or restricted to fishing. It was considered that such guidance would be beneficial to researchers, consultants, policy-makers and the industry. Poseidon was commissioned to produce a background paper that presented international examples of IAs and suggested areas where further guidance in relation to fishing would be useful.

1.3. A technical workshop was held in Edinburgh on 27th and 28th March 2012 to consider and agree the draft content of these best practice guidelines. A list of the 25 workshop attendees is presented in Appendix A. This report presents the output from that workshop: a working draft of best practice guidance for Impact Assessments focusing on the fishing industry. The intended target audience for this guidance is practitioners undertaking fisheries financial and economic impact assessments within the UK, noting that financial and economic IAs often form part of social and environmental IAs (as explained in more detail below).

1.4. The guidance focuses on impacts to the fishing industry as a result of areas that are closed or restricted to normal fishing operations. This closed or restricted area is referred to as a Proposed Intervention Area (PIA).

1.5. With the continued commitment of UKFEN members and other stakeholders, it is hoped that this best practice guidance will be reviewed and refined as experience develops.

TYPES OF IMPACT ASSESSMENT INVOLVING FISHERIES

1.6. Impact Assessment is a tool for making better decisions and ensuring that management and policy options under consideration are sound and sustainable. Commercial fisheries can form one aspect of an IA that analyses impacts across multiple sectors (e.g. shipping & navigation, tourism, ecology etc), or can be the only sector being assessed. Impacts are usually considered to fall into four main categories: economic, financial, social and environmental impacts.

1.7. An economic impact assessment considers the consequences for the UK economy and analyses the impact in terms of economic growth and competitiveness (based on the theory of welfare economics). It includes quantifiable impacts on goods and services that are traded (such as commercial fisheries landings, fuel costs etc) and qualitative impacts on goods and services (such as the impacts on the safety of vessels and their crew, and the value that some people gain from knowing that good examples of the marine habitats are being conserved, for example).

1.8. A financial impact assessment attempts to identify the costs and revenues of any change resulting from a plan, policy or project and focuses on the monetary impacts on operators. An assessment can effectively compare the costs and revenues to determine if, for example, an area closed to fishing will have negative and/or positive financial effects and the extent or magnitude of those effects. The analysis is generally based on revenues, expenditures, changes in service levels and additional capital costs.

1.9. Social impact assessments consider monetary impacts for operators and assess impacts on human capital, changes in employment levels or job quality, social exclusion and poverty, impacts on health, safety, consumer rights, security, education, training and culture.

1.10. An environmental impact assessment (EIA) is an analytical process that systematically examines the possible environmental consequences of implementing a plan, policy or project. EIA identifies the potential effects of a development on different elements of the natural environment and also covers potential social-economic impacts. The EIA report may advise how to avoid, reduce or offset any adverse effects through mitigation measures and may present a further assessment of impacts of the proposed development should the proposed mitigation measures be adopted. For fisheries, the boundaries for assessing impacts are generally not defined in financial or economic terms and an EIA process does not normally quantify impacts on a fleet or individual vessel basis. Under the European Union EIA Directive (85/337/ European Economic Community), EIAs are legally required for a wide range of defined public and private projects.

1.11. Formal Impact Assessments (IA[1]) undertaken for government are used to assess the need for, and likely impact of, proposed policies, primary legislation, secondary legislation and codes of practice or guidance. Such Impact Assessments are generally categorised as economic impact assessments. HM Government (2011) defines an Impact Assessment as both:

i. A continuous process to help think through the reasons for government intervention, to weigh up various options for achieving an objective and to understand the consequences of a proposed intervention; and

ii. A tool to be used to help develop policy by assessing and presenting the likely costs and benefits and the associated risks of a proposal that might have an impact on the public, private or third sector, the environment and wider society over the long term.

1.12. An overview of assessments that would consider economic, financial, social and environmental impacts on fisheries is presented in Table 1.

Table 1: Types of economic, financial, social and environmental impact assessments on fisheries

Types of impact assessment	Types of policies, plans or projects, uses and applications
Economic: considers consequences for UK economy	Formal impact assessments that are undertaken for government to assess the impacts of: • Designating Marine Protected Areas including, Marine Conservation Zones, marine Special Areas of Conservation and marine Special Protection Areas; • The introduction of additional regulatory management for fisheries; • Changes in government policy or regulations that have significant impacts on the private sector.
Financial: considers monetary impacts for operators	• Compensation claims • Financial assessments also inform economic and environmental impact assessments, so projects listed for these categories are also relevant.
Social: considers impacts on jobs and communities	Social Impact Assessments generally form part of an economic or environmental IA; the projects/plans under these categories are relevant.
Environmental: considers environmental context, with some social & economic aspects	Environmental Impact Assessments for offshore developments including: • Offshore wind farms; • Wave and tidal developments; • Offshore oil and gas developments; • Sub-sea cables and telecommunication cables; • Aggregate extraction; and • Port and harbour developments.

[1]In 2007 the Better Regulation Executive (BRE) renamed 'Regulatory Impact Assessment' as 'Impact Assessment'.

EXISTING GUIDANCE

1.13. The Department for Business Innovation and Skills (BIS) provides guidance for undertaking formal impact assessments. In 2010 BIS developed an IA template which simplifies the IA process and leads assessors through a pro forma reporting template (BIS, 2010). The BIS guidance is applicable to Economic Impact Assessments and indicates that analysis should apply the methods set out in the HM Treasury Green Book (HM Treasury, 2011). UK government departments are required to undertake IAs according to this process and therefore it remains the over-riding guidance for production of formal IAs for government.

1.14. There are alternative approaches to and variants of IA that serve different objectives. At the technical workshop two broad types of IA were identified: IAs conducted within or for UK government departments and IAs or variants on IA conducted for other groups. Workshop attendees agreed that these best practice guidelines should be helpful in both these situations and should focus on providing clarification and guidance on fishing-specific issues.

SCOPE AND STRUCTURE OF GUIDANCE

1.15. The scope of this guidance is limited to impacts on commercial fishing and does not include aquaculture or recreational fishing. Workshop attendees noted the following:

1.16. Aquaculture occurs within geographically well-defined and confined locations and is akin to agricultural farming, future activities can be predicted more accurately than in wild-capture fisheries[2].

1.17. Recreational fishing is an important sector for many local economies in coastal areas and impacts on recreational fishing can be considered within an IA where relevant. The recreational fishing sector shares many similarities with tourism as it provides a service to customers and if required, assessment of potential impacts of development or area closure should be approached in a similar manner to impacts on tourist activities.

1.18. This guidance does not repeat general methods for undertaking economic and financial impact assessments as these are provided in existing sources (such as BIS guidance, The Green Book etc). However, this guidance does cover some issues that concern assessments more generally, in order to inform fishery-specific considerations.

1.19. The guidance is structured in relation to aspects of particular significance to fisheries, with sections on scope of assessments, approach, data and methods of calculation.

[2] One aquaculture-related activity that may be considered within fishing is the harvesting of mussel spat for on-growing elsewhere.

2. SCOPE OF ASSESSMENTS

2.1. The scope of assessment has varied in fishing-focused IAs to date, due to a number of reasons such as the range of policies, plans and projects being assessed, the type of IA and the resources available for undertaking the IA. This has made it difficult to compare the scope applied across IAs. Consideration is often not given to the scope and extent of impacts along the fisheries supply chain and in other sectors.

2.2. In this section we consider the 'scope' of fishing-focused assessments, covering the purpose of the IA, the sectors included, the appropriate study area, developing options and the types of impacts and costs & benefits that can be included within an IA.

PURPOSE OF THE IMPACT ASSESSMENT

2.3. The purpose of the IA should be defined up front, clarifying whether it is to be used to inform management and/or for providing a descriptive background and estimate of economic or financial impact to the fisheries sector. The type of impact assessment (as described in Section 1: Types of Impact Assessments of Fisheries) will assist in determining the overall purpose of the IA and the degree to which quantitative assessment is necessary.

2.4. The time period for assessment should be clearly stated, e.g. are impacts assessed across the entire lifespan of intervention or is the time period for year one only? Practitioners should address the difficulty in predicting the future value of fishing. This will depend on a wide range of factors including (among others) quotas, variation in biological productivity, market prices, availability of alternative fishing grounds and input prices such as fuel.

2.5. Depending on the purpose of the IA, practitioners should ensure the relevant guidance is considered e.g. Green Book, BIS, Derfa's guide on valuing ecosystem services (Defra, 2007), ecosystem processes and services (e.g. the Economics of Ecosystems and Biodiversity) or consider similar IA applications (e.g. listed in the Environmental Valuation Reference Inventory).

SECTORS INCLUDED

2.6. Changes in activity and revenues in the catching sector have implications for the upstream sector (suppliers to the catching sector) and reductions in raw material supply will impact the downstream sector (the customers of the catching sector such as processors and wholesalers). The sectors included and excluded from the IA should be clearly stated, and context provided on the extent to which they are assessed. In addition management costs to be included in the IA should be identified e.g. implementation, enforcement, transition etc. The overall scale of the impacts being measured will assist determining the scale at which sectors are included e.g. local economies, national economy, global.

STUDY AREA

2.7. The spatial study area, or Proposed Intervention Area (PIA), should be defined for the IA. For a Marine Protected Area (MPA) or marine developments this will be in the form of a distinct spatial area, however for other types of IAs this may be less applicable e.g. assessment of certain Common Fishery Policy measures.

2.8. Study areas are discussed further in Section 4: Detail and application of data.

DEVELOPING OPTIONS AND MANAGEMENT SCENARIOS

2.9. Options and/or management scenarios should be developed for the PIA which will be dependent on the type of plan, policy or project and the type of IA. For example, a formal

government IA assesses the likely outcome for industry if the intervention goes ahead and compares that to outcomes expected under the status quo option (i.e. no intervention). Alternative management options or scenarios may be used to reflect uncertainty about what management measures may be implemented if an area is designated as protected in some way. The level of management required may depend on the purpose of the intervention or the design of the project e.g. a wind farm, or the particular species or habitat being protected. In such cases, where management scenarios have not yet been developed, practitioners should assess impacts of the most realistic scenario, including total exclusion of fishing vessels (for steaming and catching) as a scenario if the management is likely to require this. Where possible, practitioners should assess impacts of a range of management scenarios that are based on low- and high-cost estimates of management that would be plausible to achieve the stated aims of the intervention (e.g. where some vessels, perhaps using static gear, may continue to operate within the PIA).

2.10. Management scenarios to be assessed should be clarified with the customer group at an early stage of the IA process as they will inform data requirements and appropriate methods of calculation. All assumptions relating to management options/scenarios should be clearly stated in the IA report.

2.11. The baseline scenario, or non-intervention scenario, is an estimate of future business outcomes that could be expected if the intervention does not proceed. Outcomes of management scenarios are compared to this scenario and the differences between them are taken to the impacts of the management scenarios. Baseline scenarios should be built assuming most recent or average of, for example, last five years annual values (e.g. average fish sale prices, average fuel price) depending on whether there is a clear trend in recent data or noise around average values in recent annual data. Please see section 5. Methods of Calculation for more detail on assumptions relating to baseline scenarios.

TYPES OF IMPACTS

2.12. The types of cost and benefit impacts to be assessed will depend on the nature of the plan, policy or project that is being proposed and the management options/scenarios assessed. For example a no-take zone within a MPA will exclude fishing in the area of the zone and may cause displacement of effort to other areas, while a wind farm may allow some fishing to continue during operational phase, but will cause disruption to fish resources due to construction noise that may impact the catch rate during and after construction.

2.13. A list of the types of cost and benefit impacts is provided below although this list is not exhaustive and impacts are dependent on the type of plan, policy or project:

Costs (increase in costs or reductions in revenues):

- Seasonal closures or restrictions on types of gear used leading to exclusion of some or all fishing vessels from established fishing grounds: causing reduction in fishing income.
- Displacement of fishing vessels leading to longer steaming distances to alternative fishing grounds: causing potential increase in fuel cost and potential reduction in revenues.
- Displacement of fishing vessels leading to increased conflict over diminished fishing grounds: may cause increase in loss of static fishing gear, increased stress, and loss of traditional trawling areas (if static gear is moved out of one area into another).
- Displacement of fishing vessels leading to changes in fishing patterns including gears used and species targeted: change in costs and earnings profile of vessels.

- Loss or damage to fishing gear (due to anchor or gear snagging on infrastructure including cables and/or construction debris): causing increase in gear costs and loss of fishing time and therefore loss of fishing revenue.
- Displacement or disruption of commercially important fish and shellfish resources (due to noise, vibration, sedimentation, water quality, disposal of spoil etc): causing loss of catch and fishing income.
- Increased risk of collision between project-related vessel and fishing vessel.

Benefits:

- Provision of refuge for fish and shellfish species including potential creation of artificial reef habitats: potential increase in stocks, catch rate and ratio of fishing income to fishing costs.
- Protection of habitats that are important to fish and shellfish species, for example as spawning and nursery grounds.
- Provision of information on the impacts of different management regimes on fish and shellfish populations.

MULTIPLIERS

2.14. Multipliers can give an indication of the supply chain and indirect employment impacts of a policy. They are most likely to be useful if a policy is expected to have a large economic and/or employment impact. However multipliers do not take account of displacement of supply chain activity to other parts of the fishing industry or other industries, therefore are likely to overstate the medium to longer run impacts. Due to the uncertainty about displacement effects, it is generally not recommend that multipliers are used in headline figures to assess the economic impact of a fishing closed area. They may be of some use for indicating the local economic impacts of a closure (if reliable multipliers are available), but a more location-specific analysis of the social impacts would be preferable.

2.15. There are very few sources of fisheries-specific multipliers; the Fraser of Allander Institute undertook work for Seafish in 2004 and their report is one of the most cited. However, with the consolidation of the industry and other developments seen in the sector, this is considered to be somewhat outdated.

In terms of scope, good examples of IAs for practitioners to review include:
Lyme Bay: http://www.naturalengland.org.uk/Images/LBT-finalIA_tcm6-21648.pdf
Dogger Bank SAC:
http://jncc.defra.gov.uk/PDF/DoggerBankSACFinal%20IA_04Julcomplete.pdf
Studland to Portland SAC: http://www.naturalengland.org.uk/Images/studland-portland-consultation-impact-assessment_tcm6-27406.pdf

3. APPROACHES

GENERAL APPROACH

3.1. The overall IA and the approach to analysis should be proportionate to the size of the potential problem or impact, and to the time and resources available for IA. Having identified all possible impacts during scoping (as described in Section 2: Scope), practitioners should undertake a screening procedure, ideally informed by stakeholder consultation, to scope out any impacts that are not applicable to the circumstances of the particular IA. The remaining impacts should then be carried forward to the next level of assessment.

3.2. During initial stages of the fishing industry IA, practitioners should define which fish stocks are likely to be affected and group by fleet segment, fleet métier or other appropriate grouping e.g. static or passive vs mobile or active gear; gear type; vessel nationality. The data obtained to inform the analysis (as outlined in Section 4: Data and Appendix B) should provide sufficient detail to allow analysis to the level of aggregation/grouping chosen as appropriate for the PIA.

3.3. The level of confidence and/or uncertainties, including any potential bias, in data should be clearly detailed (as further outlined in Section 4: Data and Appendix B). This may usefully inform appropriate responses where there are conflicts in the signals from different data sets, should this occur. Where both qualitative and quantitative information have been gathered, the potential to combine data sets using a scoring method such as Analytic Hierarchy Process (AHP) may be appropriate.

3.4. If the necessary data are available, then ideally quantitative estimates should be made of the impact of the intervention on commercial fisheries. Quantitative modelling may be considered as an option if the data, resources and skill are available to the practitioner. If possible quantitative modelling within an IA is desirable because it provides a structural approach to the assessment, improves knowledge on the role and impact of assumptions and promotes a better understanding of the data sources used in the assessment. Quantitative modelling can be used within a fisheries IA in a number of ways; for example to explore stock assessments or to model the value of an area as was done in the Marine Conservation Zone Fisheries Model (see Appendix E).

3.5. In reality, quantitative modelling of the impact of an intervention is often difficult and expensive due to the high data demands. If quantitative modelling is to be used, some approaches that may be considered include the following:

- If the model's objective is to estimate the impact on the dynamics of the fish population, the relevant stock assessment should be used. This would take account of likely changes in TAC as well as catches. However, this is only worthwhile if catch for the entire stock is expected to change significantly as a result of the intervention. Also, if a stock assessment has not been conducted, it is unlikely that it would be possible to estimate impacts of the intervention on the fish stock dynamics (stock productivity and sustainability).
- Generalised additive models (GAM) and/or generalised linear models (GLM) could be used to deal with some uncertainty (e.g. observation error) and can separate the effects of explanatory variables. For example, WKCPUEFFORT (ICES, 2011) provides examples of using GLMs to standardise catch per unit effort (CPUE) which is a similar task albeit for a different purpose. VMStools (http://code.google.com/p/vmstools/) provide useful tools for dealing with VMS effort data, and R provides a cohesive platform for conducting analyses.

APPROACH TO CONSULTATION

3.6. Overall a comprehensive and transparent approach to consultation should ideally be adopted across a range of fisheries stakeholders during the assessment process of the IA. Recommendations for Fisheries Liaison have been developed by FLOWW (Fishing Liaison with Offshore Wind and Wet Renewables Group). These are specific to renewable energy developments where IA and liaison are undertaken over a longer period of time (e.g. throughout EIA and construction period) and require appointment of Fishing Liaison Officers. However the guidance includes useful recommendations for establishing contact and introducing projects (BERR, 2008) and can be downloaded from the FLOWW website: http://www.thecrownestate.co.uk/energy/offshore-wind-energy/working-with-us/floww/.

3.7. Practitioners should develop a Communication Plan outlining methods of consultation, key organisations to consult and the purpose of the consultation. Consultation methods include:

- Focus groups / workshops / group meetings
- Individual meetings
- Use of questionnaires / semi-structured interviews
- Email and telephone communication

3.8. It may be possible to collect primary data and/or "ground truth" secondary data while consulting stakeholders. Consultation may also provide a helpful initial step in collecting information on likely impacts and principle concerns of fishing vessel owners.

Table 2: Key UK fisheries stakeholders

Type of stakeholder	Organisation
National Fishing Federations	• National Federation of Fishermen's Organisations (NFFO) (covering England, Wales and Northern Ireland) • Scottish Fishermen's Federation (SFF)
Industry groups	• Producer Organisations (see Appendix F for a list of POs) • Fishermen's Associations – lists can be obtained from Federations • NUTFA – New Under Ten Fisherman's Association
Government Departments	• Defra • Marine Scotland • Welsh Assembly Government • Northern Ireland Dept for Agriculture and Rural Development
Government agencies	• Marine Management Organisation • Environment Agency • Environment Agency Wales • Scottish Environment Protection Agency • Northern Ireland Environment Agency (NIEA)
Inshore fisheries management bodies/groups	England Inshore Fisheries and Conservation Authorities (IFCAs) for: North Western, Northumberland, North Eastern, Eastern, Kent & Essex, Sussex, Southern, Devon & Severn, Cornwall, Isles of Scilly. Scotland Inshore Fisheries Groups (IFGs) for following regions: Clyde, Moray Firth, North West, Outer Hebrides, Small Isles and Mull, and South East. Contact details from Marine Scotland.
Industry Authority	• Seafish
Statutory nature conservation advisers	• Joint Nature Conservation Committee (JNCC) • Natural England • Scottish Natural Heritage (SNH) • Countryside Council for Wales (CCW) • Council for Nature Conservation & the Countryside (N. Ireland)

3.9. Table 2 presents key UK fisheries stakeholders that practitioners should consider contacting during the IA. Primary industry contacts include national federations (NFFO; SFF), Producer Organisations and Fishermen's Associations. Government agencies on a national and/or local basis can provide key information and knowledge on fishing activities.

3.10. European stakeholders should be contacted where areas are likely to overlap fishing grounds targeted by international fleets. This includes areas between 6 and 12 nautical miles, where European fleets have historical rights to fish, and beyond 12 nautical miles. As with UK stakeholders, the principle industry contacts will be Producer Organisations and Fishermen's Associations. If practitioners are unsure which European fleets to contact then advice should be sought from the NFFO and/or SFF. Practitioners may also consider exploring potential contacts within Regional Advisory Committees (RAC) e.g. North Sea Demersal RAC. If the IA considers a change in management under the CFP, data on fisheries of other member states is required to be formally requested by the MMO or Marine Scotland from the government body that manages fisheries statistics in that state.

APPROACH TO MONITORING AND EVALUATION

3.11. Monitoring and evaluation relates to analysing the actual effects that have occurred as a result of the intervention following its implementation. Whether monitoring and evaluation occurs is dependent on the scope of the IA e.g. if post monitoring is required as a condition of consent for an offshore wind farm, or whether funding is available for post monitoring of MPAs etc.

3.12. If it is known that evaluation will be required, the necessary baseline data should be collected prior to implementation for use in the assessment of impact and measures should be put in place to enable provision of data post-implementation. The approach to monitoring and evaluation can be dependent on the original approach to the IA and the data sets used. For instance, if surveys of vessel owners were undertaken during the IA to provide primary data, then practitioners should consider repeating the surveys at an appropriate time after the closure. Alternatively if secondary data sets informed the IA, practitioners should collate data that cover the period following implementation. The data should cover an area that is sufficient to study the impacts of displacement of effort as well as the direct effects of management required for the intervention. It may be necessary to find out from vessel owners which other areas they are fishing in as a result of implementation.

3.13. It can be difficult to distinguish impacts specifically attributed to the intervention from other changes that have occurred over the same period e.g. changes in fish prices, fuel prices, quotas & TACs. They should consider what changes in business performance might have or would have occurred anyway even if the intervention had not been implemented.

4. DATA

4.1. Ideally, the method for analysis should be decided based on individual IA needs and then the appropriate data can be obtained. However, in reality it is useful to first understand what data sources are available and therefore this section on data is presented before Section 5: Methods of Calculation, as available data sometimes dictates analysis methods chosen.

4.2. As already discussed, the approach to IA should be appropriate to the time available to undertake the analysis. It takes time for data to be supplied, and the length of time varies depending on the type and complexity of the data requested. Sufficient time for obtaining data should be incorporated into the project plan for work on the IA. If the IA completion deadline does not allow enough time to request and receive data, this may preclude the use of certain data and other approaches may have to be considered.

DATA TYPES AND SOURCES

Primary and secondary data collection needs

4.3. The definitions of primary and secondary data are as follows:

> Primary data: New data derived or collected specifically as part of the IA being undertaken e.g. survey data, questionnaires etc.
>
> Secondary data: Data that has already been collected by and is available from other sources e.g. landings statistics, VMS data etc.

4.4. For **secondary data** sources, preference should be given to data officially collected and verified by statutory authorities. For example operators of all EU vessels ≥10m in length are required to submit declarations of landings to relevant authorities within 48 hours of landing (EC 2847/93). These data can be verified from source log sheets and can be cross referenced with landings and at-sea inspection reports, so are considered officially collected and verified. In the UK the registration of buyers and sellers (RBS) legislation (implemented in 2005 in England, Scotland and Northern Ireland, 2006 in Wales) has greatly improved accuracy of data on landings, although uncertainties and low confidence in data may still exist on a local basis particularity for under 10m vessels.

4.5. The IA should state and describe the data used in the analysis, including any data limitations. Practitioners should ensure that the sources (official/non official) and verification status of all data are clearly understood and stated. A hierarchy in confidence of data can be summarised as follows:

1. Official collected and verified
2. Official collected
3. Quantitative data supplied by vessel owners
4. Quantitative data supplied by crew
5. Qualitative/anecdotal data from vessel owners or crew

4.6. **Primary data** includes information collected via surveys and interviews with fishers (vessel owners and crew) e.g. as undertaken for Fishermap (see Appendix B Secondary Data Sources for further details). Consultation with the industry is considered a vital route to gathering primary data, as well as corroborating secondary data. A site visit to key ports to observe fishing vessels and port activity may also assist filling data gaps and aid in assessing accuracy in various types of information. Plotter data may be provided, at the discretion of individual fishermen, and collated through consultation with the industry.

4.7. Practitioners are encouraged to consider using an effective repository for data to enable data sharing amongst practitioners and improvement in the quality of assessments that can

be provided. Where appropriate primary data should be deposited with a suitable data archive such as Marine Environmental Data and Information Network (MEDIN).

4.8. Primary and secondary data can be used to establish the numbers and nature of the following elements of business that are likely to be affected by the intervention:

- Numbers and characteristics of vessels (including vessel length, engine power)
- Home ports / typical landings ports of vessels likely to be affected
- Vessel activity and effort levels, where possible related to fishing locations
- Number of crew and number of full time equivalent jobs on relevant vessels
- Species landed, by weight (tonnes) and value (£) per year, and e.g. per season
- Gear types employed by vessels in the PIA – define gear types consistent with groups of gear type that are subject to additional management measures in the scenarios/options assessed in the IA. e.g nets and lines that have bottom contact may be considered separately from nets and lines that do not have bottom contact.

4.9. Appropriate valuation of indirect impacts should be considered for businesses upstream and downstream in the supply chains of affected vessels. The level of analysis depends on the scope of the IA. In the first instance, the supply chains should be determined and characterised, including estimates of the number and type of businesses likely to be affected. The second sale value (processed value) could be collated from processors. This information may not be readily available and primary data collection may be resource intensive depending on how far along the supply chain is investigated. Where resources do not allow primary indirect data for second sale values to be collected then the use of segment average prices for species should be explored along with potential use of Seafish published figures on processing sector costs and earnings (e.g. Garrett, 2011).

Secondary data sources

4.10. Details of secondary data sources are provided within Appendix B. Table 3 below summarises these sources and outlines the accessibility, robustness, confidence, collection methods and timeframes for obtaining secondary data sets.

4.11. **Accessibility** reflects how readily available data is and is ranked as follows:

- Low accessibility (requires effort, cost and significant time to obtain);
- Medium accessibility (requires submission of data request and 1-4 weeks turnaround);
- High accessibility (freely and immediately available e.g. online).

4.12. **Robustness** relates to whether data are insensitive to small departures from the assumptions on which they depend, such as the assumption that certain vessel speeds signify active fishing. Robustness is ranked as follows:

- Low (data depends on many assumptions which may be highly sensitive);
- Medium (data depends on some assumptions of medium sensitivity); and
- High (data depends on a small number, or no, assumptions of low sensitivity).

4.13. Levels of **confidence** have been determined using the confidence rankings recommended by the International Programme on Climate Change (IPCC, 2005). In this context the confidence relates to the level of certainty that data is accurate.

- Low confidence (20% chance that data is accurate);
- Medium confidence (50% chance);
- High confidence (80% chance); and
- Very high confidence (90% chance).

Table 3: Accessibility, robustness and confidence in fish industry data sets

Data source	Accessibility	Robustness	Confidence	Collection method	Timeframe	Comments
iFISH dataset	Medium	High	>10m: High <10m: Medium	Data request to MMO or Marine Scotland Science	2-4 weeks	Generally provided free of charge, although the increase in requests may necessitate data charges
VMS data	Medium	Medium	High	Data request to MMO or Marine Scotland Science	2-6 weeks	Detail varies depending on scale and form of data provided e.g. coordinate points for each VMS ping or mapped output of effort presented in a scale of divisions of ICES rectangle.
Surveillance data	Medium	Low	Medium	Data request to MMO or Marine Scotland Science	2-4 weeks	Is not consistent, only provides a snap-shot
UK Fishing Vessel List	High	High	High	Available for download from MMO website	Immediate	Does not identify activity level (full time, part time) or inactive vessels
Seafish Fleet Costs and Earnings	High	High	Very high	Survey of vessel owners combined with official MMO data on vessels, fishing income and activity.	Immediate for published reports. By arrangement for bespoke analyses.	Covers entire UK fleet based on declared activity and landings of every active vessel. Costs are estimated for all vessels based on sample of vessel accounts supplied by owners; detailed methods included in Curtis and Brodie. Bespoke analyses may be available for particular groups of vessels expected to be affected by a closure.
Seafish fish processing sector data	High	High	High	Survey for financial data and census every two years for structure of industry	Immediate for published reports. By arrangement for bespoke analyses.	Covers the UK seafood processing sector, including number of businesses, employees and estimates of turnover. Arranged by region, fish type, business size, etc.
Succorfish database	Low	High	High	Online access or digital download. Ask Succorfish, www.succorfish.com for login to access data.	Not known	Succorfish data set is for limited vessel numbers and areas at present. Need permission to access. Ask if any vessel owners among those likely to be affected have any VMS data for their vessels. Vessels can be easily fitted with equipment for

Data source	Accessibility	Robustness	Confidence	Collection method	Timeframe	Comments
						Succorfish, covers activity to a high resolution of spatial detail.
ICES Stock assessments	High	High	Medium-High	Available for download from ICES website	Immediate	Stock assessments are generally available for quota species, but not for non-quota species, including lobster and crab.
Scientific and grey literature	High	Specific to the source		Website based	Immediate	Usefulness is dependent on location and scale of development.
Annual Economic Report (AER) on the EU fishing fleet	High	Medium	Very high	Available for download from Europa website	Immediate	Provides useful basis to compare economic performance of European fleets on gear and vessel length basis.
EUROSTAT	High	High	High	Available for download from Europa website	Immediate	Will provide a strategic overview of landings per nationality and species.
Survey and interview data	Low	Low/Medium	Low/Medium	Primary data collection	2-8 weeks	Depending on scale may be resource intensive, but provide very useful local and/or anecdotal context.

Industry acceptance and support

4.14. Practitioners should consider business data to be personal when collected on individual fishing businesses and should be sensitive and respectful of anonymity (this is further explored under confidentiality). Primary data surveys often necessitate personal questions relating to economic performance and practitioners should remain respectful and show understanding if individuals do not want to answer specific questions. Consideration should be given to the cultural context and uses of data e.g. how accustomed are people to having their data collected and used?

4.15. Effective consultation is an important way to achieve industry acceptance and support. This can include group meetings with vessel owners to present and check the accuracy of baseline data and to discuss likely impacts of the proposed intervention.

DETAIL AND APPLICATION OF DATA

Spatial and temporal detail and business level aggregation.

Spatial

4.16. Practitioners should choose and apply a spatial level of detail for the analysis that is appropriate to the spatial scale of the impact being considered. In general, this is often likely to be at a spatial scale more detailed than ICES rectangles

4.17. ICES rectangles form a useful boundary for defining study areas with regard to obtaining statistical data (including landings statistics by area of catch, VMS and surveillance data). ICES rectangles consist of a grid of 0.5° latitude by 1° longitude (approx 1100 nm^2 at 52° latitude). The scale of ICES rectangles provides a very coarse resolution when compared to the spatial structure of most fishing activities and therefore should be considered as the appropriate spatial scale for providing a broad context rather than a detailed analysis.

4.18. Other forms of data may provide area of catch for landings at a more detailed scale than an ICES rectangle, for example, VMS data may indicate the spatial distribution of vessel activity across distinct fishing grounds within an ICES rectangle. Landings data may also be available by area of catch per sub-rectangle e.g. for the under 10m fleet, which is recorded to a scale of 16 sub-rectangles (4x4), although this may depend on region or IFCA area.

Temporal

4.19. The Centre for Environment, Fisheries and Aquaculture Science (Cefas) recommends using data for 5 years for assessing trends and seasonal variations in vessel landings and effort (Cefas, 2004). Ideally, practitioners should employ 10 years of reliable data if this is available, to reflect the inherent variability in fisheries. In the UK, value of landings data collated after introduction of RBS (2005/2006) is considered to be more reliable than pre-RBS data. Any major changes or shifts that occurred during the baseline period and that may affect baseline data should be noted, for example, introduction of RBS in 2005/6 and decommissioning schemes prior to 2007 etc.

Business aggregation

4.20. Aggregation of data on individual fishing businesses in terms of one or several of the following criteria may be appropriate when assessing data: vessel nationality (where registered), home port, landings port, length category of vessel, gear type or species.

4.21. When considering the categories of vessel length to use, practitioners should ensure they are appropriate to the area and the situation, bearing in mind lengths of vessels that are required to employ VMS (15m and above until 2012 and 12m and above thereafter) and/or categories used in Seafish Economic data analysis (see Curtis and Brodie). Vessel categories employed would also usefully be based on the information on impacts that is sought (for example, there could be a particular interest in the impacts on under 10m vessels).

4.22. Ideally, practitioners should identify all fishing vessels operating within the PIA (including fully commercial, low activity level, local, nomadic and non-UK vessels); identify the total annual landings for these vessels over the baseline period; and the proportion of effort or landings that arise from the PIA.

Collection methods

Guidance for obtaining secondary data

4.23. For secondary data consider the following:

- Ensure sufficient time to obtain data;
- Consider how the data has been collected and whether it will be on the scale or level of detail required for assessment;
- Provide information on the potential errors and omissions in the data, sources of uncertainty and the estimated level of confidence in the data (which is discussed under secondary data sources;
- Age of data; and
- Terms of use (bear in mind what purpose the data was collected for).

Guidance for primary data collection

4.24. The main form of primary data likely to be useful is information obtained through surveys and interviews. Experience of UKFEN members is that postal and/or online surveys are generally unsuccessful with very poor response rates. Phone surveys have a higher chance of success, but may be resource-intensive and consideration should be given as to how to approach interviewees. Practitioners will require contact details of relevant vessel owners which could be obtained from IFCAs, IFGs, fishery associations, POs, fishery officers, vessel agents, harbour offices, etc. IFCAs or equivalent fishery officers may wish to initiate such consultation by sending letters to vessel owners.

4.25. Face-to-face meetings are useful but are resource-intensive, in terms of time and cost of travel. Meetings with PO and/or Fishermen's Association representatives in the first instance should assist in defining which vessel owners are most appropriate to consult for the area under assessment. Group consultation as well as individual interviews should be considered if this is appropriate for the scale and detail of the IA. Focus group consultation can be very useful, but care must be taken to ensure group discussions are not dominated by the person who speaks the loudest. Bear in mind that in a group, people may not want to discuss information that they feel is commercially sensitive and which might help their competitors. All information reported by vessel owners about their activity should be considered as unverified (which does not mean untrue!) unless it can be backed up with vessel sightings, or other evidence such as verification from IFCAs, MMO or equivalent.

4.26. Other points to note in relation to primary data:

- Going to sea to collect vessel survey data is unlikely to be necessary, or cost-effective, for the scope of economic assessment.
- It can sometimes be unhelpful to meet in venues where alcohol is likely to be consumed – consider potential implications for accuracy of data and personal safety.

Use of Seafish Costs and Earning data & AER

4.27. Seafish costs and earnings profiles are presented per calendar year for each segment of the UK fleet. Practitioners should carefully check the fleet segmentation criteria included at the end of the Seafish fleet economic reports to ensure that they select the most appropriate segment or

segments for use in their analysis. If in doubt about the most appropriate fleet segment to use for a particular impact assessment, practitioners should contact Seafish economists to ask for advice.

4.28. For most segments, average fuel use per day at sea is available within Seafish Fleet Economic Reports and this can be useful if conducting a detailed impact assessment. Data on average catch composition (i.e. landings) is also presented for each segment.

4.29. Annual average income and profit data from the Seafish reports may not be detailed enough to support full quantitative impact assessments in some circumstances, but can in most cases give a robust starting point for outlining average annual income and profit levels of vessels likely to be affected by the intervention. If the PIA can be said to represent x% of income (on average) for a group of vessels then the average annual income and profit figures can be used to give a broad estimate of likely annual impacts.

CONFIDENTIALITY AND DATA PROTECTION

4.30. Much of what is covered in this section is general good practice concerning data use and management, but because of its importance it is included in this guidance.

Data Protection Act

4.31. Practitioners should familiarise themselves and ensure compliance with the Data Protection Act 1998 which is available from: http://www.legislation.gov.uk/ukpga/1998/29/contents

4.32. Other guidance for implementing the Data Protection Act are available from the Information Commissioners Office (ICO) that regulate this Act:

http://www.ico.gov.uk/for_organisations/data_protection/the_guide.aspx

4.33. The first principle under the Data Protection Act requires that personal data is processed fairly and lawfully. In practice, this means that you must:

- Have legitimate reasons for collecting and using the personal data;
- Not use the data in ways that have unjustified adverse effects on the individuals concerned;
- Be open and honest about how you intend to use the data, and give individuals appropriate privacy notice or a fair processing notice (further details are provided below) when collecting their personal data;
- Handle people's personal data only in ways they would reasonably expect; and
- Make sure you do not do anything unlawful with the data.

4.34. Fairness generally requires transparency with provision of clear and open details about how information will be used. One of the requirements of the Data Protection Act's fair processing provisions is that certain information is given to the individuals concerned. This can be in the form of an oral or written statement referred to as a privacy notice or a fair processing notice. A Privacy Notices' Code of Practise is available from:

4.35. http://www.ico.gov.uk/for_organisations/data_protection/topic_guides/privacy_notices.aspx

4.36. Practitioners should commit to a data disposal policy where appropriate, providing commitment to destroy raw data after use.

Confidentiality

4.37. Confidentiality issues for secondary data supplied by the MMO and Marine Scotland will be addressed through confidentiality agreements and the appropriate aggregation of data. Practitioners should ask what can be provided in each case.

4.38. In the collection of primary data there is a trade-off between offering the level of confidentiality that businesses seek in order to feel comfortable providing information but ensuring that some of

the data that is collected can be used. If complete confidentiality is provided for all the data that is collected none of it can be used. It is good practice to provide interviewees with a fair processing notice which sets out which organisations will manage the data, how it will be used, and requests that the interviewee indicates any information that should be treated as confidential. For instance, Seafish often states that they will not give out data to anyone else, will publish only averages, totals, etc based on aggregated data, and will not identify any individual vessel in any report. For information that the interviewee indicates is confidential, find out whether it could be published if it was aggregated with data from other businesses (from at least three sources in total) or whether it should not be published at all. If the interviewee indicates that the information is not confidential and they provide information that could be commercially sensitive, check that the interviewee is content for that information to be published and cited as concerning their business. It may be that they are content for the information to be published but would prefer for the source to be anonymous. If they are content to be cited, the source can be specified as a personal communication, citing the organisation the interviewee comes from (or their name if they are not employed by an organisation) and the date.

4.39. Useful guidance on data management and collection include the following:

- UK Data Archive managing and sharing data – a best practice guide for researchers: http://www.data-archive.ac.uk/media/2894/managingsharing.pdf
- NERC data policy guidance: http://www.nerc.ac.uk/research/sites/data/documents/datapolicy-guidance.pdf
- Economic and Social Research Council research data policy: http://www.esrc.ac.uk/_images/Research_Data_Policy_2010_tcm8-4595.pdf

4.40. The level of confidentiality agreed with individuals should be respected at all times and information should be managed appropriately.

4.41. Commercial sensitive data (including primary data interviewees are content to have published, and secondary financial/economic data) should be amalgamated and/or averaged ensuring an appropriate sample size that does not allow individual values to be determined. Ideally data from at least 5 businesses are aggregated to protect confidentiality, although aggregation of data from 3 businesses will also provide confidentiality. When expressing statistics/data in terms of quartiles data from at least 10 businesses must be used so there is data from more than 3 businesses in each quartile. Quantitative ranges of lowest and highest values should not be reported as these are figures from individual businesses and may allow identification of the individuals at the low and high extremes.

4.42. When using secondary data practitioners should establish clear data agreements with the data provider detailing how the data will be handled, managed and presented. Data providers may issue data that allows individual vessels to be identified (for example provision of vessel ID number within VMS or landing statistics data). Care must be taken to ensure appropriate aggregation when presenting such data and appropriate management of the data given its high level of confidentiality.

4.43. Practitioners should be proficient in the use of encryption software (such as WinZip) noting that sensitive data may be encrypted prior to issuing of raw data and may require encryption when stored/filed. Practitioners may require additional software to provide the necessary encryption (as specified in good practice for data management guidance).

4.44. Consideration should be given to who owns the data and necessary permissions sought where appropriate e.g. use of officially collected VMS data and Succorfish VMS data (see Appendix B). Practitioners should also consider the original purpose for the collection of any secondary data that they use.

RESOURCE LIMITATION AND/OR DATA POOR SCENARIOS

Data-poor situations

4.45. Where data are not available at an appropriate scale or resources hinder collation of necessary datasets, practitioners should in the first instance consult local fishery officers (including IFCA, MMO, Marine Scotland etc) to obtain local knowledge which is informed by years of experience.

4.46. Where data are too broad in spatial or temporal scale then further detail may be available from IFCAs, MMO, Marine Scotland etc. Data and information available on other locations may also be applicable or transferable to the PIA. Where necessary, caveats relating to use of data should be provided. There is potential to use suitable models to infer missing elements of data sets.

4.47. Where no data exists at the scale necessary then surveys of vessel owners or industry representatives should help to fill in data gaps or verify / validate data not already verified.

4.48. Practitioners may also consider circulating an email around the UKFEN member list requesting help and assistance with specific situations. Check with Seafish for the up to date list.

Proxies and transferability of data

4.49. The level of confidence in each data type and source used in the IA should be clearly stated, including explanation for the use of proxies and any related assumptions. Examples of potential proxies include:

- Where historical distribution of effort is not available, at least collect or use information on areas typically fished. Assume even spread of effort, unless evidence is available to weight the distribution of effort;
- Use of national averages where more detailed landings data are not available e.g. value or price per species;
- Assume total loss of profit from fishing as a proxy of net impact on profit for area being affected;
- Historic profit as a proxy for potential profit lost in the first instance of area closure;
- Distribution of effort as a proxy for distribution of value of landings.

4.50. Data from other locations may also form a reasonable proxy where ground characteristics and/or stock status similarities exist.

Resource limitations

4.51. Creating, manipulating and interrogating data sets require skill and resources. For example, GIS skills may be necessary for VMS or other spatial data analysis, and knowledge of how to manipulate spreadsheet pivot tables will be necessary for analysis of landing statistics.

4.52. Some evidence bases may be unavailable in the required time due to resource limitations of data providers including MMO, Seafish etc. For example, if a data extract is required in a very short notice period, the necessary staff resource may not be available to provide the data.

4.53. Ensure a good understanding of data sets and the implications and meaning contained. Contact Cefas, Marine Scotland Science, MMO or Seafish if there is uncertainty about data. Check with fish industry representatives if the meaning or implications of the data set being used are unknown.

4.54. Practitioners should be aware that there might be a charge to supply a data set for an IA.

5. METHODS OF CALCULATION

GENERAL ASPECTS AND APPROACH

5.1. Corresponding with the overall approach to the IA (Section 3: Approaches), the method of calculation should be proportionate to the resources and time available and should be driven by the specific objectives of the IA.

5.2. Expert judgement and ideally consultation should be used to establish which method of calculation is most appropriate for the IA being undertaken. Reasons for using one method over another should be clearly stated within the IA, as should all assumptions.

5.3. In the absence of more detailed information, the impact on fishing revenues of an intervention can be estimated crudely by assuming the total loss of value of landings that would have been caught within the PIA (had it not been for the intervention) for all vessels affected. Affected vessels may be all vessels that would be likely to fish in the PIA or, for example, may be only vessels that deploy certain gears. However, this crude approach does not take the following points in to consideration:

- Fishing businesses may respond to the intervention by targeting different species, deploying different gears or fishing elsewhere and so may not experience the equivalent of total loss of revenue from landings that were caught in the PIA;
- The above responses may impact on the value of landings for other fishing businesses either within the PIA or outside the PIA (as a result of displacement of effort).
- The loss of revenue experience if prevented from fishing in the PIA may be so significant to some fishing businesses that the owners decide to cease trading rather than attempt to make up the revenues by fishing elsewhere or with different gear types. This can occur particularly with small vessels if the PIA is close to their home port and will disrupt both fishing and steaming.

5.4. Appropriate consideration should be given to existing closures and regulations that apply to the fishing industry for all methods of calculation. This is necessary if some of the management that will be required for the intervention is already provided by existing management rules, in which case this situation should be identified and taken into account in the analysis.

5.5. The methods detailed within this section should be applied to data for non-UK vessels as well as UK vessels if they fish in the PIA.

5.6. If resources allow, consider comparing results from two or more calculation methods which provide a range of values that can be used for internal validation through triangulation. Take care in presenting such results to limit the risk of confusion.

5.7. For annual landings statistics it is recommended that average values across an appropriate time period (e.g. 5 years) are used, while being aware of changes in the level of uncertainty and confidence in the data over time (e.g. following introduction in RBS in 2005/6). Practitioners should determine whether seasonal analysis is necessary (e.g. where temporary closures are being considered) and if it is, screen landings data to establish if landings are highly seasonal.

5.8. More data on the spatial distribution of effort of small vessels is becoming available, with introduction of VMS for ≥ 12m vessels, as well as Succorfish. Surveillance data can also be used to determine inshore activity. Consultation with knowledgeable people in local ports, such as harbour masters, will also be useful for inshore areas and skipper consultation may result in provision of plotter data.

5.9. In relation to effort data, different fishing methods will catch different values of fish per equivalent unit of effort i.e. the catch per day of fishing differs by gear type. As a result of this,

distribution of effort should be estimated for each gear type where it is possible to do so. Average volume and value of catch per day is available for vessels in Seafish fleet segments in the Seafish fleet economic reports.

5.10. This section describes specific techniques that can be used to assess the value of fishing revenues generated from within a PIA. Method including the following:

- Proportional area technique
- Effort as a proxy for landed value
- Effort as a proxy for financial performance
- Consultation approach
- Resource valuation
- Direct methods

5.11. Practitioners should also explore whether additional costs are likely to occur as a result of vessel owners response to closed areas, such as effort displacement that could negatively affect fisheries in other areas or increased steaming costs. This is discussed further later in this section.

SPECIFIC TECHNIQUES

Proportional area technique

5.12. The proportional area technique is one of the simplest methods of estimating the value of revenues generated from a fishing area. The method uses the value of landings from the ICES rectangle containing the PIA (if it is located within one rectangle). It estimates the total value of landings from the PIA based on the proportion of the ICES rectangle covered by the PIA. It assumes that fishing effort and catches are evenly distributed over each entire ICES rectangle. This is, however, an unrealistic assumption, particularly for ICES rectangles within 12nm of the coast. For this reason, this technique should be used only in the unlikely event that fishing activity and catches are known to be relatively homogenous across the ICES rectangle, data on spatial distribution of effort are not available or sufficient time is not available to use such data.

> **WARNING**: This method is quick but can be highly inaccurate. For instance, if a PIA covers 100% of the scallop beds in a rectangle but only 20% of the rectangle area, then the value of scallop revenues affected will be 100% of value from that rectangle, not 20%. Practitioners should therefore check habitat maps, local knowledge, existing effort distribution or any other sources that can provide further context and detail. Appropriate consideration should be given to key species catch areas (determined from aforementioned sources), and existing closures and regulations can be used to identify areas where fishing activity which is subject to existing management measures will not have been occurring.

5.13. Whilst this method is relatively quick to carry out, if affords little confidence in the accuracy of the outputs. This method calculates the area of the Proposed Intervention Area (PIA) (Marine Protected Area, wind farm, aggregate extraction site etc.) relative to the area of the ICES rectangle or rectangles in which it is located. The proportion of the PIA located in each rectangle is multiplied by the MMO iFISH value of landings data for that rectangle. If necessary the proportion is adjusted to reflect that some coastal ICES rectangles include some areas of land and therefore only part of the rectangle covers the sea.

5.14. The underlying assumption of this method is that all areas of sea are of equal financial value in fisheries terms. This is rarely the case, and it is advisable to refine the estimate of value by cross reference to some other source such as VMS or surveillance data or through consultation with the fishing industry operating in the region. Cross reference with habitat mapping can be used to

identify areas where fisheries may or may not take place, for example demersal fisheries are unlikely to take place over very rocky terrain.

5.15. It is advisable to analyse a time series of landings data (minimum of 5 years) to determine if there are any clear trends that may influence the conclusions drawn from this analysis. If there are no clear trends in value of landings over the chosen period, then average value over that period should be used. This method may also be affected by existing regulations (which may be different within 6nm, between 6nm and 12nm and beyond 12nm) and other closed areas. If there is significant catch of highly mobile species (e.g. mackerel, herring) then consider that these species may still be caught outside of the PIA once they have passed through it.

Effort as a proxy for landed value

5.16. The focus of this section is on estimating the value of revenues from an area using data on spatial distribution of effort and MMO iFISH value of landings data for each ICES rectangle containing the PIA. This assumes that areas of highest effort correlate with areas of highest value of catch. The two most widely available sources of data on distribution of effort are from VMS and surveillance data. Data on the locations of fishing grounds can be collected from local industry representatives (as discussed in Section 4) who can provide spatial data on fishing effort, particularly for the under 15m or under 12m fleet (officially-collected VMS data are not available for these vessels).

Using VMS data

5.17. The coarsest analysis would be to determine the proportion of VMS location pings that come from within the PIA in relation to the overall number of ping records from the ICES rectangle(s) that contains the PIA. This proportion is then applied to the overall value of landings from that rectangle or those rectangles. This approach assumes that vessels are fishing at every location for which there is a VMS location ping. It does not distinguish between locations where vessels were steaming and locations where they were fishing.

5.18. A more sophisticated analysis uses VMS data to estimate distribution of fishing effort, based on assumptions about the speed at which vessels fish (as described in Appendix B). The data on distribution of effort can be combined with data on value of landings by ICES rectangle to estimate distribution of value of landings. Explanation of a method that may be adopted for this is provided in Appendix E.

5.19. Given that different fishing methods will catch different values of fish per equivalent unit of effort (e.g. catch per day fishing) distribution of value of landings should be estimated separately for different categories of gear type where possible. This is likely to be determined by the categories of gear type that are employed for the distribution of effort data (so is an important consideration when requesting secondary data). If data on distribution of effort are provided for individual vessels these can be combined according to the gear type that they use. The proportion of effort that is within the PIA is calculated relative to the effort within the ICES rectangle that contains the PIA. This proportion is used to estimate the proportion of the total value of landings for the ICES rectangle (using MMO iFISH data) that comes from within the PIA.

5.20. MMO may supply value of landings per sub-ICES rectangle for vessels >15m, based on VMS data.

5.21. Some analysts may have access to the logbooks of individual and identifiable fishing vessels, allowing positional information to be directly correlated with a known catch. Data in the logbooks such as time and position of shooting and hauling the fishing gear can be correlated to the catch breakdown for that period as given in the logbook. A value of revenues can then be ascribed to a unit of effort (such as per hour fishing) if market prices are known. This data could be scaled up across all vessels of that type fishing in the area and applied to the number of vessels that processed VMS data indicate have fished within the PIA.

5.22. A highly refined method for the use of VMS data can be found in Mills et al, 2007, but this will generally be found to be beyond the resources of most analysts of fisheries data.

Using MMO surveillance data

5.23. The raw surveillance data should be filtered to exclude vessels not actively fishing. The proportion of sightings inside and outside of the PIA is calculated (by gear type if required) and these proportions are applied to the value of landings (by gear type if required and the data are available) from the whole ICES rectangle. A relatively long time series of data is recommended (at least 5 years) and any trends in activity or landings value should be considered when using the outputs of this exercise. Seasonal or monthly analysis may be carried out if required.

5.24. Sightings data can be used to corroborate or question information on which vessels have been fishing in PIA in recent years.

5.25. Other sources of data include, for instance, patrol sightings data from IFCAs, see Clark (2008) for an example. Further discussion on the uses and shortfalls of surveillance data can be found in Carlin and Rogers (2002) and are detailed in Appendix B.

> **WARNING:** Use of surveillance sightings data is likely to be subject to a high level of inaccuracy as the sightings are occasional snap shots and provide only partial information on the vessels that fish and the distribution of effort.

Using Fishermap and other industry-derived data

5.26. Fishermap data provide an estimate of the spatial distribution of fishing effort by gear type for vessels of less than 15m. Fishermap was a survey of fishers conducted by the MCZ Regional Projects that obtained information on where fishers fish, what they fish for, with what gear and at what time of year. The Fishermap data cover the period between 2004 and 2010. Further details of Fishermap are provided in Appendix B: Secondary Data Sources.

5.27. This method assumes that accurate data have been given. Fishermen are often reluctant to disclose data about fishing locations and earnings from these locations. An atmosphere of mutual trust is essential for this approach to work and this is not always readily achievable, particularly if fishing vessel owners perceive that they may lose fishing opportunities.

Effort as a proxy for financial performance

5.28. This technique is similar to using distribution of effort as a proxy for distribution of origin of landed value, but it uses spatial distribution of effort as a proxy for spatial distribution of the annual operating profit of fishing businesses.

5.29. Using this method, practitioners should determine profit, or profit plus crew share for GVA, per day/hour (from Seafish fleet economic reports) then apply this to the spatial distribution of effort data. Profit is suggested as a good indicator of where fishermen will choose to fish, for example Smith and Wilen (2003, 2004) modelled economic factors into spatial behaviour in sea urchin fishing. This approach is only likely to be viable if existing evidence of financial performance is available.

5.30. For economic assessments, GVA is generally used as the closest approximation of the value of the activity to the economy (GVA should be equivalent to the added value of the outputs). However, an expected proportion reduction in fishing revenues (arising because of a closed area) does not imply the same proportion reduction in GVA, as the costs incurred in generating the reduced revenues may not have reduced in the same proportion. For example if vessels are still using the same amount of effort but catching less fish then operational costs will not be reduced and most of the lost landings will also be lost GVA/profit.

Consultation approach

5.31. As discussed throughout this guidance, consultation with fishing vessel owners, representatives and authorities is important to ensure a transparent and thorough IA. Consultation allows corroboration of secondary data and can assist in gaining trust and acceptance from the industry. Collection of primary data such as location and value of fishing (e.g. through surveys/interviews with fishers and other stakeholders) can be resource- and time-intensive, but may generate a useful insight and access to data that may otherwise not be available, such as observing plotter data to corroborate other spatial secondary data.

5.32. The consultation approach should be undertaken in conjunction with a method outlined above and used to add clarity to secondary and/or primary data.

5.33. Practitioners should be aware of potential problems with consistency and bias of primary data collection. If attempted, it should be extensive enough to ensure an adequate sample size and findings should be corroborated with other stakeholders or forms of secondary data.

Resource valuation

5.34. Valuation of a fish or shellfish resource does not consider the financial cost to fishermen of harvesting that resource, but is useful to indicate the value of fish and shell fish stocks in an area to inform assessment of potential costs and benefits of management measures. The resource valuation approach is likely to be more applicable to benthic resources that have a stronger association with habitat biotope (e.g. scallops & Nephrops burrows) rather than mobile species, and is also dependent on stock/recruitment relationships. For each species concerned, practitioners should determine the biomass and then define the exploitable levels. This is only likely to be possible if existing data sources (such as ICES stock assessments) are available.

5.35. When considering potential benefits that may arise as a result of intervention, this approach may be useful for establishing any positive responses resulting from protection of spawning and nursery grounds (particularly for species that spawn on the sea bed, e.g. herring). Practitioners should note however that the size of such grounds, as well as species stock boundaries, are likely to be at a much larger scale than the area under assessment.

Direct methods

5.36. Potential direct methods of valuing fishing areas include direct haul data, CCTV (on vessels) and/or on-board observers. All of these methods are highly resource intensive.

5.37. If a direct method is used (and therefore the value of landings is known) then there is no need to attempt proxy estimates, although the assessment may need to rely on use of average trip prices and costs, for example if using direct haul data.

Summary

5.38. A summary of the techniques outlined above, together with pro's and con's of each approach and recommendations for use are provided in Table 4.

5.39. Overall, using distribution of effort (refined as far as possible) as a proxy for distribution of area of catch for landings value is thought to be a better method of assessment than other methods including the proportional area method, consultation approach or resource evaluation. Direct methods are unlikely to be within the remit of the IA, unless the data are already being collected for another purpose (e.g. for a Fully Documented Fishery) and can be used for IA.

Practitioners should check that expected impacts indicated by analysed data are likely and make logical sense given what is known about the PIA and vessels likely to be affected; if estimated impacts do not seem likely then advice should be sought from the MMO, Marine Scotland, Cefas or Seafish.

Table 4: Summary of specific valuation techniques

Technique	Data Required	Approach/Formula	Advantages	Disadvantages	Recommendation
Proportional area technique	• Landings statistical data per ICES rectangle	[Proposed area / total ICES rectangle area] * total ICES rectangle landings	• Standardised data relatively easy to access • Quick to undertake	• Likely to be very inaccurate as assumes even distribution of value across ICES rectangle	**Avoid where possible**
Effort as a proxy for landed value	• Landings statistical data per ICES rectangle • Effort data (VMS, surveillance or Fishermap etc)	[Effort in proposed area / effort in total ICES rectangle area] * total ICES rectangle landings	• Data moderately easy to access • Allows comparison of landed value of different areas of ICES rectangles	• Constrained by accuracy and coverage of effort data (e.g. VMS only for >15 m vessels)	**Recommended**
Effort as a proxy for financial performance	• Seafish Cost & Earnings data • Effort data (VMS, surveillance or Fishermap etc)	To value Proposed Area alone: Effort in Proposed Area * Seafish Cost Earnings To value Proposed Area relative to wider ICES Rectangle: [Effort in Proposed Area * Seafish Cost Earnings] / [Effort in Total ICES Rectangle Area * Seafish Cost Earnings]	• Data moderately easy to access Allows comparison of profitability/GVA of different areas of ICES rectangles	• Based on 'Average' profit/GVA data	**Recommended**
Consultation approach	• Interviews/surveys/focus group/meeting transcripts	Collation and analysis of communications from proposed area stakeholders	• Methodology is easy to explain	• Resource intensive and likely to be costly. • Subject to usual survey/response bias • Non-standardised data set	**If time permits may be useful**
Resource valuation	• ICES stock assessments • Local / national stock assessments	Determine biomass of resource on a species/stock basis and define exploitable levels to determine overall value of the resource	• Useful for assessing benefits of any intervention to stocks	• Data intensive and therefore likely to be costly.	**If time permits may be useful**
Direct method	• Direct haul data • CCTV/ fully documented fishery • On-board observer reports	Use of direct value of landings, although average trip prices and costs may have to be assumed	• No need for use of proxy estimated	• Resource intensive • May be based on average trip prices and costs	**Recommended if data available**

IMPACTS OF THE ADAPTATIONS MADE BY FISHERS IN RESPONSE TO THE INTERVENTION

5.40. In addition to analysing immediate financial and economic impacts of an area being closed or restricted to fishing, the impacts of displacement of vessels to other fishing grounds should be considered. This is the impacts of fishers responding to the intervention by increasing their fishing effort in other grounds or using alternative gear on other species in the PIA.

5.41. An approach for assessing the vulnerability to displacement is provided below:

a. Determine the relative impact on fishers of the management scenarios/options within the PIA (Indicators: Proportion and primacy of grounds affected); this means, determine what proportion of fishing income will be disrupted by the intervention, for vessels affected.
b. Determine the extent of alternative opportunities for fishers (Indicators: range of operations - which includes consideration of small vessel safety, availability and accessibility of alternative areas, vulnerability to additional marginal costs; adaptability: ability to change gear or target species);
c. Use (a) and (b) to assess whether it is likely that affected fishing businesses will be able to continue their operations. Then:
    i. If continued operation is likely to be viable: Assess secondary impacts through redistribution of effort (Indicators: gear conflicts, conflicts with other marine sectors; environmental/ecological: risk of local depletion of fish and shellfish stocks, net changes in the impact on habitats – changes in magnitude and distribution of spatial footprint, relative sensitivity of habitats in the PIA and the areas that effort is displaced to).
    ii. If continued operation is not likely to be viable: indicators of secondary impacts on and their significance for fish supply chain (upstream/downstream), fishing port infrastructure viability etc.

5.42. Dependent on the level of consultation undertaken, accounting for displacement may involve assumptions regarding operational range for example:

- Smaller vessels are likely to be displaced to the local area, based on their operational range. Depending on the location of the PIA in relation to ICES rectangle boundaries, it could be assumed operation might remain within the same ICES rectangle.
- But do not exclude the possibility that vessel operators may change the home port of smaller vessels, rather than continue to operate from the current home port. Many vessel owner-operators commute from their home town to the port where the vessel operates from.
- Displacement of effort by larger vessels cannot be assumed to be confined to the remainder of the ICES rectangle.

5.43. Effects of displacement are not limited to the vessels fishing within a PIA, but also those external to the area where displacement may cause competition and/or gear conflict. Displacement can be very difficult to predict and qualitative consideration may be the only option for this element of the assessment.

5.44. The cost to fishing businesses of an intervention assessed using methods described in Section 5: Methods of Calculation could then be reduced with estimate of displacement (i.e. estimated replacement revenues generated by displacing effort elsewhere) or conversely may increase if cumulative interventions reduce profitability below a threshold level causing fishers to leave the fishery due to unprofitability. Due to the high level of uncertainty about how fishers will respond to an intervention (when asked, many owners find they cannot say what they would do instead if

not allowed in their habitual fishing grounds), great care needs to be taken in how such adjustments are made to expected operating costs and revenues and any adjustments made should be clearly presented and explained.

5.45. Monitoring how fishing businesses respond to the intervention and the impact of their responses (including displacement of effort) will be important to allow evaluation of the impacts that do arise as a result of the intervention.

VALUING BENEFITS

5.46. Interventions may result in benefits to fish stocks and fishing businesses (including stock recovery, reduced gear conflict etc.). Any expected benefits should be described in relation to the scale of the PIA and fish stocks and fishing vessels present including the gear type used.

5.47. When assessing the economic impacts upon fisheries of closed areas, experience from the MCZ impact assessment, highlights that decision makers may require the assessment to be presented within the framework of ecosystem goods and services. Ecosystem goods and services are defined as the benefits that society derives from natural environmental processes (Defra, 2007). They are categorised into provisioning, regulating, cultural and supporting services (MEA, 2005). Whilst an assessment of costs borne to ecosystem goods and services is the conventional focus of economic impact assessments (particularly in the case of fisheries due to closed areas to fishing for example), an assessment of anticipated benefits is also required to identify the marginal value of a proposed intervention and the resulting change in economic welfare. This assessment depends on the availability of management scenarios for the PIA, evidence of how ecological processes within and adjacent to the PIA would change as a result of the management scenarios, and market values (and even non-market values) to attribute to the change in ecosystem goods and services (for example, evidence to support the anticipated change in lobster catch from static gear in the absence of mobile gear).

5.48. The assessment of ecosystem goods and services entails considerable uncertainty, in particular with regard to the long term nature of benefits derived from closed areas, however this may be managed with the appropriate use of sensitivity analysis. Evidence is currently lacking for the marine environment compared to the terrestrial environment and therefore 'benefit transfer' values are lacking.

5.49. Benefits should therefore be recognised within the IA, but this may only be on a qualitative basis given uncertainty about the beneficial impacts and future long term trends. The level of detail will vary based on the information available for the particular stock and fishery.

5.50. Obtaining scientific advice on the likely benefits will be useful and practitioners may consider bio-economic modelling to identify the scale of benefits (although not necessarily monetise the benefits). Such modelling may be beyond the budget and time frame for many IA though.

5.51. It may be helpful for practitioners to explore how non-monetised benefits have been defined in other studies, including the following examples:

- Benefits of Leigh marine reserve (also known as Goat Island), New Zealand (Kelly *et al*., 2000);
- Benefits to scallop recruitment in closed areas and/or protected marine reserves e.g. Isle of Man and Lamlash Bay (Howarth *et al*., 2011);
- US Alaska Cook Inlet Beluga Whales (ENTRIX, 2009);
- Benefits of the Lundy Not Take Zone to lobster stocks (Hoskin *et al*., 2009); and
- Impacts on scallop stocks of the ministerial closure in Lyme Bay (Attrill *et al.,* 2011).

SENSITIVITY ANALYSIS

5.52. Sensitivity analysis can be used to determine how the uncertainty in the output of a model (numerical or otherwise) can be apportioned to different sources of uncertainty in the model input data (Saltelli *et al.*, 2008). A related practice is uncertainty analysis which focuses on quantifying uncertainty in model output. Ideally, uncertainty and sensitivity analysis should be run in tandem.

5.53. In more general terms uncertainty and sensitivity analysis investigate the robustness of a study when the study includes some form of statistical modelling. It can also show what the expected impacts might be under some other possible circumstances.

5.54. A number of areas of uncertainty could be explored including:

- Sensitivity of the results to landings data over different time frames;
- Sensitivity to fuel prices could be a key factor in calculating impacts on profit and GVA; and
- Sensitivity to fish prices is likely to be important in estimating the value of landings affected, noting that a closed area is unlikely to affect fish prices on a national level but may do at a local level.

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APPENDIX A: UKFEN WORKSHOP ATTENDEES

Name	Organisation
Andy Read	Dept of Environment, Food and Agriculture, Isle of Man Government
Arif Al-Mahmood	Defra, economist for Marine & Fisheries Directorate
Crick Carleton	Nautilus Consultants
Dale Rodmell	NFFO
David Mallon	Marine Scotland
Fiona Nimmo	Poseidon ARM
Fran Moore	MCZ Irish Sea
Frin Ross	JNCC
Hazel Curtis	Seafish
John Coppock	Gannet Scientific Services Ltd
Jon Travis	Defra economist, MCZs
Kevin Brady	Marine Scotland Science
Martin Esseen	Independent fisheries specialist
Nigel Proctor	Precision Marine Survey Ltd
Paul Medley	Independent consultant / Nautilus Consultants
Phil Coates	Welsh Government
Rebecca Clark	Natural England
Rod Cappell	Poseidon ARM
Rupert Haines	Finding Sanctuary (SW)
Sarah Horsfall	Seafish
Sarah Martin	MRAG
Sasha Maguire	Marine Scotland
Simon Mardle	Fishor Consulting Ltd
Simon Mason	Independent fisheries & aquaculture specialist
Stephen Mangi	Cefas

APPENDIX B: SECONDARY DATA SOURCES

Secondary data sources

Data on UK vessels

MMO iFISH dataset: provides landings by species, weight and value (previously Fisheries Activity Database). As a guide practitioners could request a combination of the following detail to be provided as an excel file with columns for each of the following headings:

- Nationality (country of vessel registration)
- Gear type (ensuring appropriate classification, see Appendix C)
- Vessel length category (grouped appropriately for IA e.g. under 10m, 10-12m, 12-15m and over 15m)
- ICES rectangle (for further details on ICES rectangles see Appendix D)
- ICES sub-rectangle (if available)
- Date of landings record
- Port of landings
- Vessel home port
- Species
- Weight
- Value

Due to data confidentiality the MMO will not provide (or may suppress) any row entries that record data for less than 5 vessels. This may affect the level of detail and/or combination of column headings/attributes that can be provided.

iFISH data can be provided as an excel file (with columns for each of the above headings) or as a pivot table. The former is probably of more use as it allows practitioners to develop their own pivot tables, depending on the categories to be analysed. The preferred format of data should be clearly stated within the submitted data request and it may be helpful to discuss with a member of the MMO fisheries statistics team before drafting the request in writing.

iFISH data is provided as an aggregated data set so that individual vessels cannot be identified. This is discussed further under Section 4: Confidentiality and Data Protection. Where individual vessel data is required (subject to recipients signing a confidentiality agreement) then additional detail may be available from vessel source or from Inshore Fisheries and Conservation Authorities (IFCAs) such as the date of departure and date of return from a fishing trip.

Data from before introduction of the RBS may be less robust or less accurate for under 10m vessels. RBS legislation was implemented in 2005 in England, Scotland and Northern Ireland, and in 2006 in Wales. It is noted that some UK countries (for example Wales) may have lower compliance with RBS for under 10m vessels and therefore lower data confidence.

iFISH data is normally supplied by the MMO, but may also be available in Scotland from Marine Scotland and in England from IFCAs for the district area that they cover.

It is recommended that data requests should be made to the MMO Statistics and Analysis Team:

Tel: 020 7979 8573 Email: statistics@marinemanagement.org.uk

Website: http://www.marinemanagement.org.uk/fisheries/statistics/index.htm

Officially collected Vessel Monitoring System (VMS) data all EU fishing vessels of over 15m registered length are currently required to use a VMS, though it will become mandatory for all vessels of over 12m in 2012. A satellite signal of the position of the vessel is sent typically every 2 hours and is received and recorded by the Fisheries Monitoring Centre of the appropriate fisheries management body. From this positional information an average speed can be calculated

over the period between transmissions. Data can also be provided on the nationality of the vessel and date and time of the transmission. The MMO provide VMS data categorised by gear types of mobile (including trawl, dredge etc) and static (including gill net, pots etc). Practitioners should seek a breakdown of exactly which gears are represented within the mobile and static data categories.

Although initially designed for fishery control and enforcement, VMS provides valuable sources of spatial and temporal information on fisheries activity at multiple scales. The constancy of VMS data makes it the best available summary of the presence of fishing vessels.

VMS can be used to estimate the location of fishing grounds and effort distribution and the relative importance of grounds to individual fishers (if data are available at this scale) and to fleets. MMO and Marine Scotland provide these data which are normally in the form of GIS data layers at a resolution of 0.05 degree rectangles (approximately 3 x 1.75 nautical miles or 200^{th} of an ICES rectangle). MMO provide VMS data based on time of fishing, and also link logbook data and VMS to provide landings weight and value. Practitioners should note that GIS skills will be required to extract information. VMS was introduced for all vessels ≥24m on 01 January 2000; this was amended to ≥18m in 2004, ≥15m in 2005 and ≥12m in 2012. As of 01 January 2012 all vessels ≥12m in length should have VMS installed and therefore should be included in VMS data sets for effort recorded after this date, although confirmation of this should be sought during data acquisition.

Whether a vessel is actively fishing or not can be determined based on assumptions of speed at which a vessel is likely to be fishing, dependent on gear type. The MMO often assume active fishing when a vessel is travelling at between 1-6 knots, regardless of gear type.

The use of VMS data in an impact assessment has a number of drawbacks and limitations which include:

- VMS does not usually provide direct information on the activity of the vessel; activity has to be deduced from the vessel's speed, assuming that between certain speed bands fishing is taking place and outside of these values the vessel is engaged in some other activity (e.g. steaming, at anchor).
- VMS data provides data only for entire fleets that are using VMS. It does not provide information on the activities of smaller vessels. In coastal waters where fisheries legislation often excludes larger vessels, VMS data will provide information only on the activity of larger vessels that use VMS. It cannot be used to infer activity by smaller vessels as these are likely to target different species, deploy different gears and fish different grounds to larger vessels. In areas well offshore where it is unlikely that smaller vessels will be able to operate, VMS data may provide a complete picture of the activities of fishing vessels. With the introduction of the requirement for all vessels over 12m in length to use VMS, VMS data will be collected for more vessels. Additionally a mobile phone based system for smaller vessels (Succorfish) is being tested in parts of the UK which may serve to further fill gaps in positional data (further details are provided below). However, until VMS data are collected for a significant proportion of under 12 metre vessels, it will continue to be difficult to estimate the distribution of effort for the large number of small vessels that there are in the UK fleet.
- VMS data cannot give information on the value of the catch taken at any given location or time. Estimates of distribution of effort based on VMS data can be combined with data on value of landings from the MMO iFISH dataset to provide an estimate of the spatial distribution of the value of landings. The value of landings data is usually provided at the scale of an ICES rectangle, though it may be available for a sub-rectangle. Within the rectangle, it is assumed that all records of effort are of equal value. While this may tend to be true when averaged over a long time period, there may be cases where a short term

and highly localized fishery is highly valuable to the industry (e.g. a seasonal squid fishery) and the assumption of equal value for all records can distort the estimate of the value of an area. Consultation with the industry and the gaining of a wider knowledge of the fishery in an area under study is recommended. If vessel logbook data is available then the value of an individual haul at a precise location can be calculated, though difficulties may arise when the vessel has been fishing both within and outside of the PIA.

- VMS data sets often include large numbers of records where the fishing method is not identified which can make estimation of the fishing activity by gear type difficult.
- Datasets can be very large and require considerable resources to analyse. Use of Geographical Information System software (GIS) is recommended.

VMS data can be obtained, subject to aggregation to protect confidentiality, from the MMO (for all UK vessels) and Marine Scotland (for Scottish vessels), contact details can be found from the following websites:

MMO: http://www.marinemanagement.org.uk/

Marine Scotland: http://www.scotland.gov.uk/Topics/marine/Compliance/satellite

Surveillance (sightings) data: The UK has seven national fisheries patrol vessels and four surveillance aircraft. The patrol vessels spend approximately 1,645 patrol days a year in all waters within British fishery limits, typically undertaking about 1,500 inspections at sea, and sighting more than 9,000 fishing vessel during these patrols (MMO, 2011).

UK surveillance aircraft are used to construct an ongoing picture of fishing activity within British fishery limits and to make effective use of patrol vessel activity by coordinated use of surveillance data. The aircraft spend nearly 2,000 hours on task each year, during which they typically sight over 12,000 UK and foreign fishing vessels (MMO, 2011). These sightings are used to check compliance with all EU legislation.

The MMO collects sighting information from patrol aircraft and from fisheries protection vessels. These data include, for each individual sighting of a fishing vessel, the following information:

- Date
- ICES statistical rectangle and sub square (each rectangle divided into 4 parts)
- Position sighted, in degrees and decimal minutes
- Nationality
- Vessel type (*e.g.* trawler, longliner)
- Activity (*e.g.* fishing, steaming)

These data cannot be considered to give an accurate picture of the actual level of activity. However, it is a fact that a certain number of vessels were seen fishing in a certain area. What is not known is how many others there may have been at times when patrols were not taking place or how many were not seen by the patrol vessels or aircraft. The data can be used to suggest trends, to identify the nationalities of vessels involved in the area and to give an approximation of the levels of activity in and around the PIA. Furthermore, the MMO use sightings per unit of surveillance effort to map distribution of effort, to account for some areas being subject to more surveillance than others.

There are however limitations on the use of surveillance data including:

- The patrol effort by Sea Fisheries Committees (now Inshore Fisheries and Conservation Authorities), Royal Navy Fisheries Patrol Vessels and patrol aircraft are optimised for enforcement purposes and not collection of sightings data. Areas with

fewer fisheries enforcement issues are therefore likely to be visited less often and result in lower data confidence.

- Surveillance data are only indicative of areas where fishing activities occur, as there is no continuous monitoring of activities.
- This is very much a snapshot of activity in the area. It cannot be assumed that as no vessels have been sighted fishing in the PIA that no fishing takes place there.
- Vessels fishing at night would likely remain undetected.
- The data assumes that all vessels in the sub-square are detected when a patrol ship or aircraft enters that sub-square. On days of poor visibility it is likely that even the air patrols will not be able to see all vessels in the area.
- The data may include multiple sightings of the same vessel as it crosses into another sub-square.
- There are relatively few data points, though a sufficiently long time series of observations should give an unbiased picture of the relative importance of different areas.
- Sightings data may not record the gear type used.

The advantages of using surveillance data are:

- They include fishing vessels of all lengths, thereby allowing complete fleet coverage;
- The activity of the vessels is given, making elimination of vessels that are laid stationary or steaming straightforward;
- In coastal areas where fishing by vessels of greater than 15m in length are often prohibited, this may be the only data available on the distribution of effort.
- Data is available on the numbers of patrols per month, so that an accurate index of seasonal activity can be calculated.
- Datasets are relatively small and easily manipulated.

Surveillance data can be sourced from the MMO and Marine Scotland, contact details can be found from the following websites:

MMO: http://www.marinemanagement.org.uk/

Marine Scotland: http://www.scotland.gov.uk/Topics/marine/Compliance/satellite

Cefas have recently developed national inshore fisheries data layers based on surveillance data collated from Sea Fisheries Committees and MMO patrols (Cefas, 2010). The final report presents effort maps per gear type, engine power and vessel length.

FisherMap: FisherMap was a survey of UK fishers undertaken by the regional MCZ projects during 2009 and 2010. The purpose was to capture information direct from fishers on where they fish (fishing grounds), what they fish for, with what gear and at what time of year. Fishers were asked to describe the pattern of their activities over the previous 5 years. The FisherMap data therefore describe fishing activity over the period 2004 to 2010. The IAs undertaken for the regional MCZ projects considered FisherMap data:

- To provide the most comprehensive source available of the spatial distribution of commercial fishing effort for UK vessels of under 15 metres; and
- To provide a high resolution.

The FisherMap survey was undertaken by a team of regional MCZ project liaison officers, who visited ports and harbours around England and surveyed individual skippers. The team aimed to capture information from at least 50% of vessels of under 15 metres based at each port. Information was gathered from fishers using a survey questionnaire and charts. Fishing grounds

were drawn on the charts, and these were digitised for use in the MCZ Fisheries Model. The limitations of the data and of their use in the MCZ Fisheries Model include the following:

- As a sample of fishers was surveyed for FisherMap, the information from it represents the activity of a sample of active vessels. Overall, 28%, 47%, 72% and 20% of UK vessels under 15 metres that were active in the Finding Sanctuary, Balanced Seas, Net Gain and Irish Sea Conservation Zones project areas, respectively, were surveyed. While the samples were randomly selected, successful surveys were only carried out with willing fishers.
- The quality of the information collected depended on the ability of the interviewee to accurately draw the fishing grounds used. This information cannot easily be verified.
- The data that were collected cover a relatively short period (2004 to 2010) and so do not fully reflect the considerable annual variability in the distribution of the value of landings within ICES Rectangles.

Fishermap report is available for download from:

http://findingsanctuary.marinemapping.com/06_all%20project%20reports/Fishermap%20report%20November%202008.pdf

UK Fishing Fleet Register: provides data for all UK registered and licensed vessels with separate files for Over 10 metres and Under 10 metres including the following details:

- Administrative port
- Home port
- Vessel name
- Registry of Shipping and Seamen number
- Licence number
- Fish producer organisation
- Overall length
- Registered tonnage
- Engine power (KW)
- Vessel capacity units
- Year built
- Shellfish licence

UK website: http://marinemanagement.org.uk/fisheries/statistics/vessel.htm

European website: http://ec.europa.eu/fisheries/fleet/index.cfm

Seafish Fleet Costs and Earnings: Seafish provides annual analyses of UK fleet economic performance and reports (e.g. Curtis and Brodie) are available from the Seafish website:

http://www.seafish.org/publications-search

There is also a multi-annual data set for the UK fleet provided by Seafish and available via the Seafish website. This gives a time-series of operational and economic data for each fleet segment.

All active vessels in the UK fleet are included in the analysis in Seafish reports, which are based on official government data and vessel accounts and survey data collected by Seafish. Vessels are grouped into segments and average figures per segment are published. For specific impact assessments it may be possible, time allowing, for Seafish to prepare a bespoke analysis of vessel performance for a particular group of vessels likely to be affected by an intervention. Contact Seafish economists on 0131 524 8660.

Seafish processor survey data: Seafish collects and publishes information on the structure, size and business performance of the UK fish processing sector. Reports are available from the Seafish website (e.g. Garrett) and include numbers of businesses, number of full time equivalent employees and estimates of turnover.

Website: http://www.seafish.org/publications-search

Succorfish database: VMS technology developments have enabled not only larger vessels, which have a legislative requirement to report position using VMS, but also small vessels to access this technology. Mobile phone communication technology has provided a cost-effective means of providing vessel positional data at high levels of resolution on even the smallest vessels. Linked to an RFID (Radio Frequency Identification) unit an individual vessel's fishing and non-fishing activities can be differentiated allowing estimation of the distribution of effort as described for VMS data earlier in this Appendix. Seafish has collaborated in a project with Succorfish to trial an inshore VMS system among vessels in South West England.

Succorfish data can be obtained through online access or digital download from the Succorfish website. Some vessel owners may also have privately collected positional data and it may be worth asking owners of affected vessels whether such positional data could be made available.

Website: www.succorfish.com

Stock assessments: provide biological data (age structure of the stock, age at first spawning, fecundity, ratio of males to females in the stock, natural mortality, growth rate, spawning behaviour, critical habitats, migratory habits, food preferences, and an estimate of either the total population or total biomass of the stock) and fisheries data (fishing mortality). Based on these data, stock assessments can be used to identify levels of fishing that are consistent with maximum sustainable yield, and also set limits for fishing mortality and spawning stock biomass. Stock assessments may usefully inform IAs depending on the fishery/species under assessment. They provide an understanding of the scale at which certain metiers can fish e.g. if the stock of a certain species is only located within the closed area, then fishers cannot displace effort elsewhere. Stock assessments will also provide insight to the historical trends of the fishery.

Website: http://www.ices.dk/committe/acom/comwork/report/asp/advice.asp

MEDIN: Marine Environmental Data and Information Network (MEDIN) is a partnership of UK organisations committed to improving access to marine data. It provides guidance on metadata generation for data sets and advice on the information that should be recorded when different types of data are being collected. It also provides information on international metadata and data standards.

Website: http://www.oceannet.org/

Scientific and grey literature: a search using bibliographic software, if it is available, plus a general internet search will provide many useful sources of information for example SEAs, EIAs and IAs. In addition JNCC and Natural England MCZ Project reports may help inform development of management scenarios for an IA including advice on the impacts of fisheries the on interest features in marine protected areas and the mitigation that may be required (for example, JNCC and Natural England, 2011a and JNCC and Natural England, 2011b).

UKFEN: where data sources are lacking practitioners should consider submitting a request for information to the UKFEN whose members may have access to applicable data or information. Requests can be distributed to the UKFEN membership via Seafish.

Website: http://www.seafish.org/about-seafish/ukfen-—-uk-fisheries-economics-network

Data on non-UK vessels

Landings statistics and VMS: as per MMO iFISH database and VMS, other Member States will hold equivalent data sets and should be approached when non-UK vessels are active across the site being assessed. Relevant authorities include: Dutch Institute for Marine Resources and Ecosystem Studies (IMARES), French Research Institute for Exploration of the Sea (IFREMER), German Federal Ministry for Food, Agriculture and Consumer Protection (BMELV), Danish Fisheries Directorate, Swedish Board of Fisheries etc. Ease in obtaining data and the time required for data provision, as well as associated charges, are likely to vary between organisations. Formal Impact Assessments for the government may necessitate formal data requests to be submitted by the MMO.

Annual Economic Report (AER): an AER on EU Fishing Fleets is published annually by the Scientific, Technical and Economic Committee for Fisheries (STECF) detailing the following for 22 EU Member States:

- National fleet structure
- National fleet fishing activity and output
- National fleet economic performance
- Fleet composition

Website: https://stecf.jrc.ec.europa.eu/reports/economic

EUROSTAT: is the statistical office of the European Union. It provides fisheries statistics for catches by fishing regions and fishing fleet data, as well as figures for TACs and Quotas, long term fisheries statistics data sets.

Website: http://epp.eurostat.ec.europa.eu/portal/page/portal/fisheries/introduction

APPENDIX C: FISHING GEAR TYPE CODES

Gear code	Gear type
DRB	Boat dredges
DRH	Hand dredges
FIX	Traps
FPN	Pound-nets
FPO	Pots
FYK	Traps
GN	Gillnets
GNC	Encircling gillnets
GND	Drift nets
GNS	Set gillnets
GTN	Combined gillnets-trammel nets
GTR	Trammel nets
HMD	Mechanized dredges
LA	Lampara nets
LH	Trolling lines
LHM	Hand and pole-lines mechanized
LHP	Hand and pole-lines
LL	Longlines
LLD	Drifting lines
LLS	Set lines
LNB	Boat operated lift nets
LNS	Shore operated stationary lift nets
LTL	Trolling lines
LX	Other lines/hooks
MIS	Other
NO	No gear
OTB	Bottom otter trawl
OTM	Pelagic otter trawl
OTT	Twin trawl
PS	Purse seine
PTB	Bottom pair trawl
PTM	Pelagic pair trawl
SB	Seines
SDN	Danish seine
SPR	Pair seiners
SSC	Scottish seines (fly shooting)
TB	Bottom trawl
TBB	Beam trawl
TM	Trawl
UNK	Unknown

Source: EC, 2011

APPENDIX D: ICES STATISTICAL RECTANGLES

ICES statistical rectangles provide a grid covering the area between 36°N and 85°30'N and 44°W and 68°30'E.

Latitudinal rows, with intervals of 30', are numbered (two-digits) from 01 at the southern boundary (latitude 36°00'N) and increasing northwards to 99. The northern boundary of the statistical rectangle system is, thus, latitude 85°30'N.

Longitudinal columns, with intervals of 1°, are coded according to an alphanumeric system, beginning with A0 at the western boundary (longitude 44°00'W), continuing A1, A2, A3 to longitude 40°W. East of 40°W, the coding continues B0, B1, B2, ..., B9, C0, C1, C2, ..., C9, etc., using a different letter for each 10° block, to the eastern boundary of the area covered. Note that the letter I is omitted. The longitudinal column of ICES rectangles and respective coordinates are presented below.

Longitudinal column of ICES rectangle	Coordinates
A	44°W-40°W
B	40°W-30°W
C	30°W-20°W
D	20°W-10°W
E	10°W-00°W
F	00°-10°E
G	10°E-20°E
H	20°E-30°E
J	30°E-40°E
K	40°E-50°E
L	50°E-60°E

When citing an ICES rectangle, the northern coordinate is stated first. Thus, the rectangle of which the south-west corner is 54°00'N 03°00'E is cited as 37F3.

Usually, it is necessary to specify an area with more precision than is possible with a statistical rectangle designation. Therefore, a sub-rectangle designation must be given (as a fifth character) by dividing a statistical rectangle into nine (10' latitude x 20' longitude) sub-divisions, as follows:

1	4	7
2	5	8
3	6	9

For example, the location 58°12'N 10°33'E would, therefore, lie within ICES rectangle/sub-division: 45G05

APPENDIX E: THE MCZ FISHERIES MODEL

The following is an extract from the Irish Sea Conservation Project Impact Assessment (Annex H6) describing the method used in estimating impact to commercial fisheries.

THE MCZ FISHERIES MODEL

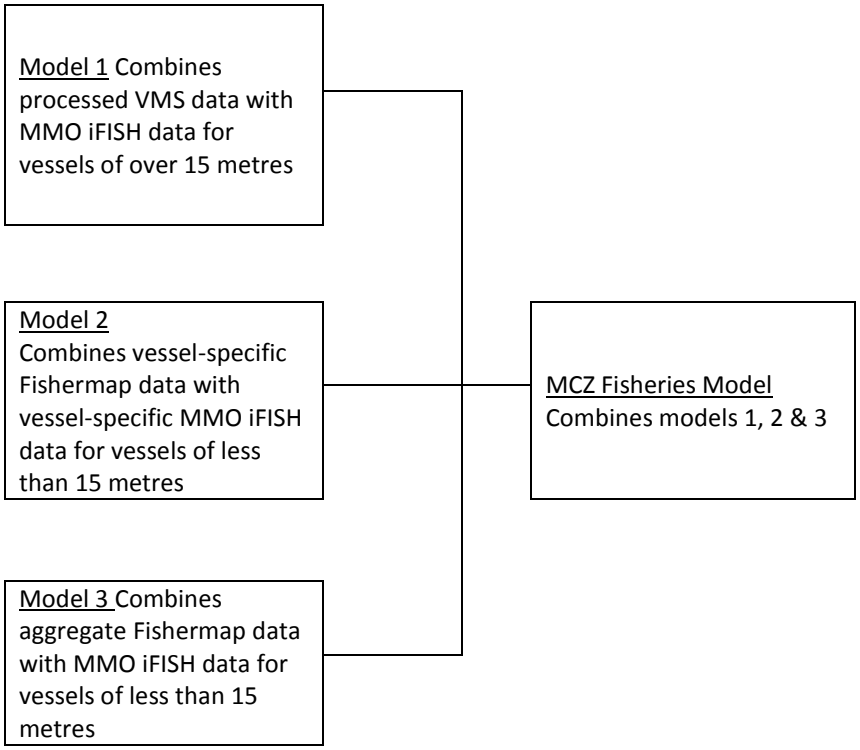
An MCZ Fisheries Model was created that generates estimates of the value of landings taken from each rMCZ by the UK fleet between 2007 and 2010. The model provides information on the spatial distribution of the value of landings by gear type.

The MCZ Fisheries Model distributes the value of landings attributed to a particular ICES Rectangle, using data on the spatial distribution of fishing effort. The data inputs for the model are sourced as follows:

- MMO iFISH data provided comprehensive information on the value of landings by vessel, gear type, landings port, species and ICES Rectangle in which landings were caught. The IA employs data for the period 2007 to 2010. (iFISH is the UK data repository for fishing vessel activity.)
- Processed VMS data provided an estimate of the spatial distribution of fishing effort by gear type, for vessels over 15 metres. Processed VMS data use a number of parameters, one of which is vessel speed, to identify when a boat is fishing. The data were processed by the MMO using the methods developed by the Centre for Environment, Fisheries and Aquaculture (Cefas) (Lee, South & Jennings, 2010). VMS data identify the movements of fishing vessels over 15 metres in length, and are collected by the MMO at a spatial resolution of 0.05 degrees longitude by 0.05 degrees latitude (approximately 3km by 5.5km) (henceforth referred to as 'VMS squares').
- FisherMap data provided an estimate of the spatial distribution of fishing effort, by gear type, for vessels of less than 15 metres. FisherMap was a survey of fishers – conducted by the regional MCZ projects – that obtained information on where fishers fish, what they fish for, with what gear and at what time of year. The FisherMap data cover the period between 2004 and 2010.

Within the MCZ Fisheries Model are three underlying models that calculate value layers. Each model calculates a value layer for a different group of vessels, using a different combination of the three datasets mentioned above. An overview of the model is provided in Figure E.1.

Figure E.1 MCZ Fisheries Model



Model 1: Value layers created for UK vessels of more than 15 metres

For UK vessels of more than 15 metres, the spatial distribution of their fishing effort within any given ICES Rectangle was described for each category of gear type (gear type defined on the International Standard Statistical Classification of Fishing Gear (ISSCFG) - see Table 1 below) by the VMS data of each vessel. The information was combined with information on each vessel's value of landings for each category of gear, taken from the MMO iFISH database. The analysis was conducted at the level of individual vessels, combining the iFISH and the VMS data for each individual vessel, in order to create vessel-specific and gear-specific value layers. These layers were then combined to provide fleet-level value layers for each broad-scale gear type. In order to protect the confidential data of each vessel used in the model, this analysis was undertaken by the MMO on behalf of the regional projects. Further information on the data used is provided below, in the section on 'Data sources and technical specifications of the MCZ Fisheries Model'. The value layers provide data at the spatial scale of VMS squares – 0.05 degrees by 0.05 degrees. A simplified graphical example is shown in Figure E.2.

Assumptions include:

- The distribution of the value of landings within an ICES Rectangle for a given vessel of over 15 metres, using a given ISSCFG gear type, can be described by the distribution of its VMS data.
- Processed VMS data provide information on the number of hours fishing. It is assumed that the number of hours fishing can be used as an adequate proxy for fishing effort.
- Within an ICES Rectangle, the value of landings associated with 1 hour of fishing for an individual vessel using a specific gear type is uniform across the rectangle.

Figure E.2 Graphical representation of Model 1

Hours fishing in each VMS square of ICES Rectangle Z by vessel X, using gear Y

	A	B	C	D	E
1	36	30	20		
2	8	20	4	2	
3		16	2		
4					
5				32	30

Landings by vessel X using gear Y from ICES Rectangle Z

=> £50,000 **=>**

Landings value in each VMS square of ICES Rectangle Z by vessel X using gear Y (£000s)

	A	B	C	D	E
1	9	7.5	5		
2	2	5	1	0.5	
3		4	0.5		
4					
5				8	7.5

Model 2: Value layers created for vessels of less than 15 metres, skipper interviewed for FisherMap

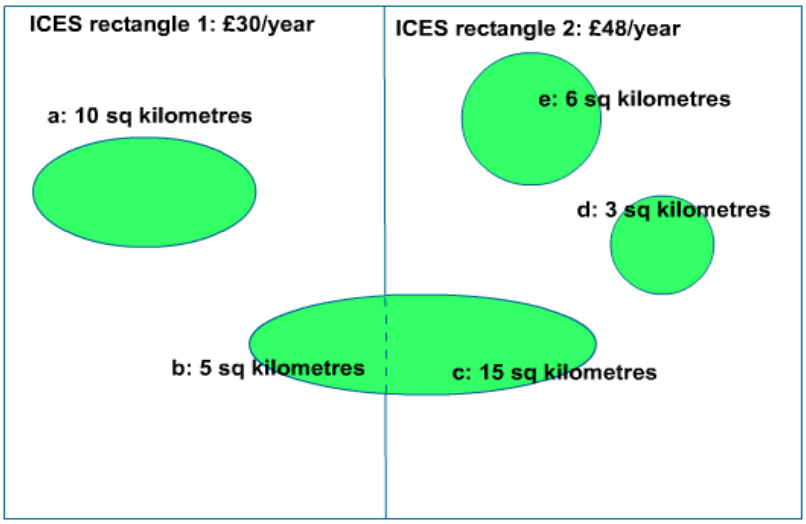
For those vessels of less than 15 metres whose skippers were interviewed for FisherMap, the spatial distribution of their fishing activity within any given ICES Rectangle was described, based on the fishing grounds targeted by the vessel. Fishing grounds are discrete spatial areas that those fishers interviewed drew to show where they fish. Information on the value of landings for each vessel, by ISSCFG category of gear type (specified in Table 1), was taken from the MMO iFISH database. The value layer produced by the model was analysed at a spatial scale of 1km by 1km. For further details on the data, see the section below on 'Data sources and technical specifications of the MCZ Fisheries Model'.

Assumptions include:

- The value of landings from a given fishing ground was assumed to be evenly distributed within that fishing ground.
- Where a fisher had not indicated how a vessel's value of landings was distributed between the fishing grounds, it was assumed that, within any given ICES Rectangle, the distribution of the fisher's value of landings between the fishing grounds was in proportion to the size of the fishing grounds. The example below (Figure E.3) describes how this was done.

In the example, the four fishing grounds (shown in green) were identified for a single vessel through the FisherMap survey. The fishing grounds extend over two ICES Rectangles. The average annual values of landings for the vessel of £30,000 and £48,000 were identified from the iFISH database for ICES Rectangles 1 and 2, respectively. Grounds a and b combined cover 15km2 of ICES Rectangle 1. The value of landings from Ground a is estimated to be: (10/15) x £30,000/year = £20,000/year.

Figure E.3 Graphical representation of model 2 (value of landings ('000s) from a number of fishing grounds)



Model 3: Value layers created for vessels of less than 15 metres, skipper not interviewed for FisherMap

For each vessel of less than 15 metres in length whose skipper was not interviewed for FisherMap, the spatial distribution of its fishing activity within any given ICES Rectangle was described by aggregated FisherMap data for the relevant gear type (i.e. spatial distribution indicated by the whole FisherMap sample). Information on the value of landings for each vessel, by gear type, was taken from the MMO iFISH database. The value layers provide data at a spatial scale of 1km by 1km.

Assumptions include:

- The value of landings for vessels whose skippers were not interviewed for FisherMap is sourced from the MMO iFISH database at the level of ICES Rectangles.
- The distribution of the value of landings within an ICES Rectangle for a given vessel, using a given gear type, can be described by the aggregate distribution of fishing effort for the sample of the fleet which (a) uses that gear type and (b) provided information to FisherMap.
- Spatial distribution of fishing effort is an adequate proxy for spatial distribution of the value of landings.

The steps undertaken in creating the model were:

- Step 1: The distribution of the value of landings for each gear type across each ICES Rectangle was estimated using the spatial value of landings data layers created in Model 2. A grid of 1km by 1km was placed over the spatial value of landings data layer created for each vessel in Model 2. For each grid square, the values of landings for all vessels using each gear type were added together to give a total value of landings for each gear type for each square. The values of landings for each grid square in an ICES Rectangle were summed and converted into percentages, so that within each ICES Rectangle they totalled 100%. This provided a layer that described, for those vessels interviewed for

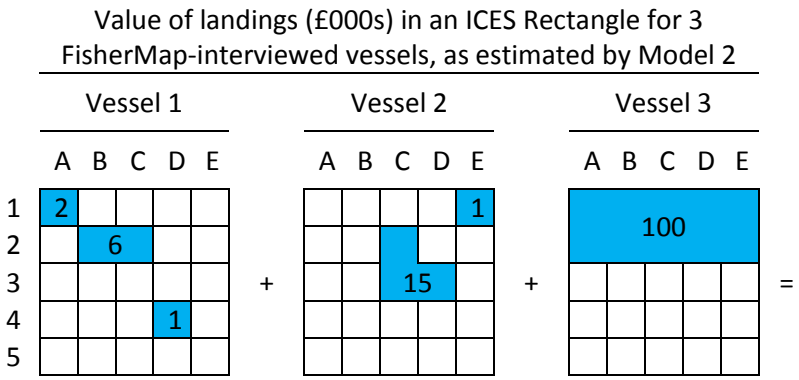
FisherMap, the proportion of the value of landings taken from an ICES Rectangle that should be attributed to each grid square.

- Step 2: For each vessel whose skipper was not interviewed for FisherMap, the value of its landings from an ICES Rectangle was distributed across the grid squares using the relative proportions created in Step 1, using the spatial data layer for the gear type that the landings were caught with.

Figure E.4 below describes the first part of Step 1. In the example, FisherMap had collected information through three interviews that described the activity of 3 vessels using a particular gear type within an ICES Rectangle.

Figure E.4 Graphic representation of Model 3 (Step 1 only)

Step 1: For a given gear type, add together the value of landings for each FisherMap square.



Total value of landings (£000s) for the 3 vessels

	A	B	C	D	E
1	12	10	10	10	11
2	10	13	18	10	10
3			5	5	
4				1	
5					

APPENDIX F: UK FISH PRODUCERS' ORGANISATIONS

Membership as at 1 January 2011[(a)]		
	2011 [(b)]	
	Vessels in membership	**Members as a % of total**
Scottish FPO Ltd	195	*14%*
Northern Ireland FPO Ltd	112	*8%*
Cornish FPO Ltd	105	*8%*
South Western FPO Ltd	73	*5%*
Eastern England FPO Ltd	40	*3%*
Anglo Scottish FPO Ltd	40	*3%*
Anglo Northern Irish FPO Ltd	42	*3%*
Shetland FPO Ltd	38	*3%*
Northern Producers Organisation Ltd	36	*3%*
North East of Scotland FO Ltd	32	*2%*
West of Scotland FPO Ltd	30	*2%*
Fleetwood FPO Ltd	25	*2%*
Fife FPO Ltd	19	*1%*
Aberdeen FPO	13	*1%*
North Sea FPO Ltd	17	*1%*
Isle of Man Non-Sector	18	*1%*
The FPO Ltd	17	*1%*
Lowestoft FPO Ltd	9	*1%*
Orkney FPO Ltd	10	*1%*
Wales and West Coast FPO Ltd	9	*1%*
Interfish	8	*1%*
Klondyke	3	*0%*
Lunar Group	3	*0%*
North Atlantic FPO Ltd [(c)]	2	*0%*
Non-sector vessels [(d)]	492	*35%*
Total	**1,388**	***100%***

Source: Fisheries Administrations in the UK

(a) Vessels over 10 metres only. Excludes vessels 10 metres and under in FPO membership.
(b) Includes some Channel Islands and Isle of Man vessels.
(c) North Atlantic FPO Ltd was created in 2010
(d) Over 10m vessels not in FPO membership.

Source: MMO, The UK Fishing Industry 2011, Structure and Activity

APPENDIX G: ACRONYMS

AER	Annual Economic Report
AHP	Analytic Hierarchy Process
BERR	Department of Business Enterprise and Regulatory Reform (UK, now defunct)
BMELV	German Federal Ministry for Food, Agriculture and Consumer Protection
BIS	Department of Business Innovation and Skills (UK, replacing much of BERR remit)
BRE	Better Regulation Executive
BRIA	Business and Regulatory Impact Assessment (Scotland)
CCW	Countryside Council for Wales
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CFP	Common Fisheries Policy
CHD	Critical Habitat Designation (US)
COFI	Committee on Fisheries
CPUE	Catch Per Unit Effort (often used to mean landings per unit of effort)
DECC	Department of Energy and Climate Change
DG MARE	Directorate General for Fisheries and Maritime Affairs
EC	European Commission
EIA	Environmental Impact Assessment
FAD	Fisheries Activity Database
FAO	Food and Agriculture Organisation (of the United Nations)
FLO	Fisheries Liaison Officer
FLOWW	Fishing Liaison with Offshore Wind and Wet Renewables Group
GAM	Generalised additive models
GLM	Generalised linear models
IA	Impact Assessment
ICES	International Council for Exploration of the Sea
IFCA	Inshore Fisheries and Conservation Authorities
IFG	Inshore Fisheries Groups
IFREMER	French Research Institute for Exploration of the Sea
IMARES	Dutch Institute for Marine Resources and Ecosystem Studies
JNCC	Joint Nature Conservation Committee
LTMP	Long Term Management Plan
MCZ	Marine Conservation Zone
MPA	Marine Protected Area
MMO	Marine Management Organisation

NIEA	Northern Ireland Environment Agency
NPS	National Policy Statement
PIA	Proposed Intervention Area
RAC	Regional Advisory Committees
RBS	Registration of buyers and sellers
RFID	Radio Frequency Identification
RIA	Regulatory Impact Assessment
RIR	Regulatory Impact Review (US)
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SEIA	Socio-economic Impact Assessment
SNH	Scottish Natural Heritage
SPA	Special Protection Area
STECF	Scientific, Technical and Economic Committee for Fisheries (EC)
UKFEN	UK Fisheries Economics Network
VMS	Vessel Monitoring System
WTP	Willingness to Pay

APPENDIX H: GLOSSARY

Analytic Hierarchy Process	A structured technique for organizing and analyzing complex decisions. It uses pair-wise comparisons of criteria to determine the most appropriate choices using a decision matrix.
Anecdotal	Information based on personal accounts rather than facts or research.
Catch Per Unit Effort	The total catch divided by the total amount of effort used to harvest the catch.
Commercial fisheries	Any form of fishing activity legally undertaken for taxable profit.
Economic cost	The benefit that could have been gained from an alternative use of the same resource.
Environmental Impact Assessment	An analytical process that systematically examines the possible environmental consequences of the implementation of projects, programmes and policies.
Financial cost	Costs expressed in terms of monetary value at the time incurred.
Fishery	A group of vessel voyages which target the same species or use the same gear.
Fleet	A physical group of vessels sharing similar characteristics e.g., nationality.
Generalised additive models	Statistical models in which more general (e.g. nonlinear) relationships between variables can be examined.
Generalised linear models	Statistical models in which flexible generalization of ordinary linear regression allows for response variables that do not have a normal distribution.
Gross value added	A measure of the value of goods and services produced in an area, industry or sector of an economy. It is primarily used to monitor the performance of the national (and regional) economy and is often used to measure the overall economic well-being of an area.
ICES Rectangle	An ICES Rectangle is an area defined by the International Council for the Exploration of the Sea (ICES) for the purposes of statistical reporting. An ICES Rectangle measures one degree latitude by half a degree longitude.
Impact Assessment	A process aimed at structuring and supporting the development of policies. It identifies and assesses the problem at stake and the objectives pursued. It identifies the main options for achieving the objective and analyses their likely impacts in the economic, environmental and social fields. It outlines advantages and disadvantages of each option and examines possible synergies and trade-offs.
Indirect impacts	Impacts which are not a direct result of the project, often produced away from or as a result of a complex pathway. In the case for fisheries economics impact assessments, indirect impacts are often considered to occur within the supply chain either upstream or downstream from the direct impact to the fisher e.g. impacts at second point of sale.
Metadata	Metadata can be loosely defined as “data about data”. Discovery metadata should provide information that allows a user to discover

	the existence of a particular data set, along with key information about its content, location, ownership, how to obtain it and any associated costs.
Métier	An homogenous subdivision, either of a fishery by vessel type or a fleet by voyage type.
Multipliers	The multiplier effect can be defined as: Multiplier = (Direct Effects + Indirect Effects + Induced Effects) / Direct Effects, wherein the direct effects are the initial investment into the economy and the indirect and induced effects are the subsequent spending resulting from that original investment.
Primary data	Data that has not been previously published, i.e. the data is derived from a new or original research study and collected at the source.
R	R is an open source programming language and software environment for statistical computing and graphics. The R language is widely used among statisticians for developing statistical software and data analysis.
Secondary data	Data that is already available having been collected or collated by and readily available from other sources.
Strategic Environmental Assessment	A range of analytical and participatory approaches that aim to integrate environmental considerations into policies, plans and programmes and evaluate the inter-linkages with economic and social considerations.
Supply chain	The movement of materials as they flow from their source to the end customer, including purchasing, processing, warehousing, transportation, customer service, demand planning, and supply planning.
TAC	The total allowable catch (TAC) is a catch limit set for a particular fishery, generally for a year or a fishing season. TACs are usually expressed in tonnes of live-weight equivalent, but are sometimes set in terms of numbers of fish. In reality, they are usually a limit to landings rather than actually a limit to catch.