



A Sustainable Fishing Plan for the Farne Deeps *Nephrops* fishery

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Summary

In response to reform proposals affecting the European Common Fisheries Policy (CFP) regarding the regionalisation of fisheries management and emerging proposals from the European Commission to manage the North Sea *Nephrops* stock at functional unit (FU) level, the North Sea Regional Advisory Council (NSRAC) is producing a long term management plan (LTMP) for *Nephrops* in the North Sea. One suggestion is that *Nephrops* stocks should continue to be managed collectively for the North Sea, but that Sustainable Fishing Plans should be developed for any functional units that are vulnerable. The preparation of a draft Sustainable Fishing Plan (SFP) for one of those units, the Farne Deep *Nephrops* fishery, has been undertaken to provide a test bed for the principles identified in the draft LTMP, tailored to suit the unique characteristics of the Farne Deep *Nephrops* fishery.

Stock assessment of *Nephrops* in the North Sea is undertaken annually within nine functional units (FUs) that reflect regional differences in the biology and emergence behaviour of the species. The area of the main *Nephrops* fishing grounds within the Farne Deep FU boundary is very small and highly localised. In response to a marked increase of landings in 2005 a significant increase in fishing effort was observed on these grounds from 2006. The increase in effort was attributed to number of vessels with twin rig gear visiting the grounds from distant ports. Many of the visiting vessels are larger or more powerful than the local fleet that is characterised by a <10 m fleet towing single rig trawls.

From 2005 to 2010 annual landings of *Nephrops* from the Farne Deep became erratic (2722 +/- 1330 tonnes per year) and changes have been observed in the sex ratio of the Farne Deep stock. It is likely that such changes have resulted from overexploitation. During the period 1995 – 2004 average annual landings from the Farne Deep *Nephrops* fishery were 2291 +/- 204 tonnes per year. The latest scientific advice on the state of the Farne Deep stock is that it is vulnerable and that the harvest rate in 2012 should be 8% (less than 1400 tonnes); a yield far below that which appeared sustainable to 2004.

In order to identify the concerns of fishers operating within the fishery a consultation of fishers was undertaken during the 2011 – 2012 *Nephrops* season. The uptake of offers to participate in the consultation by fishers was lower than expected; however, 20 interviews were undertaken with fishers at venues from Edinburgh to Hartlepool and visits seeking the opinions of fishers were made to Hartlepool, North Shields, Blyth, Amble, Seahouses, Berwick upon Tweed, Eyemouth, Edinburgh and Fraserburgh. Fishers from North East England, Scotland and Northern Ireland who participated in the one to one interviews were invited to comment on the draft report.

There was a stark difference of opinion between fishers registered at ports in North East England and those from elsewhere. The main concern of those registered at ports close to the grounds was that the twin rig gears preferred by many visiting

skippers were damaging the seabed and taking too much from the fishery. Concerns were also expressed that the Farne Deep is a mixed fishery (*Nephrops* and whitefish) and that twin rig gear is too selective for *Nephrops*. Single rig gear was considered by those operating it as better suited to the mixed fishery and seabed conditions found on the fishing grounds. There was a strong call from many of the local fleet to ban twin rigging on the Farne Deep *Nephrops* grounds.

In contrast, those using twin rig gear were of the opinion that claims of seabed damage were unfounded and that bottom contact by heavy weights used by twin rig gear was minimal if it was set up correctly. They also argued that the effects of much larger twin rig gears on offshore *Nephrops* grounds in other functional units had not had a significant detrimental effect on those fisheries, and that it was the trawl doors common to both single and twin rig gears that were likely to have a greater effect on the seabed.

All skippers regardless of gear type were of the opinion that by-catch and subsequent discard of marketable whitefish for which there was no quota was a significant issue. All those interviewed were of the opinion that whiting and cod in particular were more abundant on the Farne Deep *Nephrops* grounds than the stock assessments would suggest. There was support from some fishers for reducing discards by limiting days at sea in return for a policy of land all you catch.

There was much more support for the adoption by fishers of measures tailored to particular fishing gears and capture species. Scottish skippers pointed out the measures already being taken by the Scottish industry with regard to improving gear selectivity by allowing escape of undersize whitefish through large mesh panels and grids in current trials. Efforts were also being made to assist net avoidance by whitefish in preference for cleaner catches of *Nephrops* that was intended to improve recovery of cod as part of the Cod Management Plan.

Reform of the CFP is proposed by January 1 2013. This may put new management procedures in place and renders the status of this developing SFP uncertain. However, taking into account current ICES advice on the state of the Farne Deep *Nephrops* stock, the concerns and views of fishers regarding the nature of the Farne Deep *Nephrops* fishery, CFP reform, the 2002 Johannesburg World Summit on Sustainable Development, and the Marine Strategy Framework Directive (MSFD) this report proposes a range of objectives, and instruments by which to achieve those objectives, in support of a Sustainable Fishing Plan of 5 years duration to be achieved before 2020.

The MSFD requires the establishment of a programme of measures for achieving Good Environmental Status in European seas by 2016 and achievement of Good Environmental Status in Europe's seas by 2020. The 2002 Johannesburg Summit agreed to achieve a maximum sustainable yield (MSY) for depleted fish stocks by 2015.

It is suggested that there should be further discussion of the plan within NSRAC and with the relevant statutory authorities including the MMO and Defra pending information becoming available on the new CFP regime. It is also recognised that such a plan would have to be subject to scrutiny by the Scientific, Technical and

Economic Committee for Fisheries (STECF) that gives scientific advice regarding fisheries management to the EU. The plan would also need to have the support of those engaged in the fishery.

The proposed draft SFP identifies a series of biological and ecological objectives;

- To exploit *Nephrops* at rates which are sustainable by setting a target fishing mortality (F) consistent with that of maximum sustainable yield (FMSY). Current ICES advice for the Farne Deep in 2012 is a harvest rate of 8% (or 1300 t).
- To set a threshold [trigger] level of biomass at which FMSY and the harvest rate must be reviewed (currently 879×10^6 *Nephrops*).
- To set a TAC at North Sea level but allocate a whole or part vessel quota to the Farne Deep, which has been identified as a vulnerable functional unit.
- To reduce by-catch and discards.
- To minimise damage to threatened, endangered and protected species.
- To minimise impacts on benthic habitats and associated communities.

From consultation the SFP proposes a number of provisional instruments for further discussion by which the objectives proposed could be met. Further discussion with fishers, the NSRAC and relevant statutory authorities including the MMO and Defra in preparation for CFP reform will expedite formal implementation of a short list of agreed instruments after January 1 2013. Provisional instruments for further discussion are:

:

- A cap on the size or engine power of vessels permitted to fish the Farne Deep within 12 nmi from shore. Alternatively, gear restrictions, e.g. restricting gears to single rig or vessels towing twin rig to those with <500 hp within 12 nmi of the coast.
- Designation of permitted vessels (based on historic activity) allowed to fish in specific areas e.g. inshore and/ or offshore grounds.
- Linkage of all or part of vessel *Nephrops* quota to the Farne Deep, dependent on track record on the Farne Deep and in other FUs.
- Temporary, seasonal or real-time closure of the FU or areas within it dependent on the level of landings or the *Nephrops* standing stock.
- The continued development of improved gear selectivity via:
 - Larger mesh and square mesh panels inc. appropriate selection grids in the main part of the net to assist escape of undersize fish.
 - Low headline height and reduced headline cover to assist net avoidance by non-target species.
 - Footrope and clump adaptations to reduce gear impacts on the seabed.
- Improved management of whitefish quota to reflect spatial and temporal changes in the distribution of whitefish abundance.

- Ensure that landings are within quota and demonstrate this through accurate logbooks and landing slips.
- Monitor the capture of endangered or threatened species via observers and/or CCTV recording on participating vessels.
- Real time closures to protect spawning grounds or aggregations of juvenile fish to be set away from the comparatively small area of recognised *Nephrops* grounds.
- Improved monitoring of the seabed during the winter season to determine the extent and significance of disturbance caused by different gear types.
- Improved understanding through research of the breeding cycle and factors affecting recruitment of *Nephrops* to the Farne Deep stock.

We see the implementation of the instruments supporting the objectives of the SFP as a gradual sequential process over a period of 5 years to be achieved by 2020.

1. Introduction

1.1. Project Rationale

Currently, the North Sea *Nephrops* stock is divided by area into nine functional units distributed across the North Sea. Functional units also exist for the Skagerrak and Kattegat respectively (Figure 1). Each functional unit is spatially distinct and there is marked dissimilarity between them in terms of the seasonality, biological, ecological and economic characteristics of each respective *Nephrops* fishery. In response to reform proposals affecting the European Common Fisheries Policy (CFP) regarding the regionalisation of fisheries management, and suggestions from ICES and the Commission that the North Sea *Nephrops* stock be managed at a functional unit level, the North Sea Regional Advisory Council (NSRAC) has embarked upon the preparation of a long term management plan (LTMP) for *Nephrops* in the North Sea.

It has become clear in developing that LTMP that the only way of counter-acting pressure to allocate separate TACs to functional units and to retain flexibility within the fishery is to come forward with proposals that will safeguard the sustainability of any functional units that are deemed vulnerable to exploitation. It has been proposed that the development of a Sustainable Fishing Plan (SFPs) for any functional unit that becomes vulnerable is a possible way forward. Such plans would allow the other functional units to be managed collectively, while providing measures to safeguard a particularly vulnerable unit. It is envisaged that such SFPs would have a fixed term, and that should the functional unit no longer be vulnerable it would revert to management within arrangements for the North Sea as a whole. An alternative discussion has proposed that SFPs should be developed for all the FUs for introduction once the stock showed signs of decline or impaired recruitment.

The drafting of an SFP for a particularly vulnerable functional unit, the Farne Deep *Nephrops* fishery, was seen as the best way to initiate the process. A project to develop such a plan provides a test bed for the principles identified in the draft LTMP and tailors them to suit the fishery's unique characteristics. Because of the complementary nature of the SFP to the LTMP, this report utilises the information within the draft NSRAC LTMP for *Nephrops* in the North Sea to a significant extent. We gratefully acknowledge the cooperation of the NSRAC to allow access to drafts of the LTMP and to observe its discussions regarding sustainable fisheries management. This SFP offers the opportunity to apply the principles of the draft LTMP in the field with the benefit of focused industry based consultation (alternative approaches to SFP production are presented in Appendix 1).

Due primarily to the small area of its *Nephrops* fishing grounds and their proximity to the coast and ports such as Amble, Blyth and North Shields the Farne Deep functional unit is seen by fishery managers as being particularly susceptible to marked changes in fishing effort. The high cost of fuel combined with the closeness of the grounds to ports has resulted in the fishery attracting additional fishing effort since 2006. Fisheries scientists consider such increases in effort inadvisable, given the current low level of the stock. Underwater TV survey data indicate that the Farne Deep *Nephrops* stock has declined substantially from a relatively high abundance in 2006.

High abundance of *Nephrops* on the Farne Deep ground in 2006 resulted in increased fishing effort during the 2006 – 2007 season. As a result, ICES scientists noted that the population size of the Farne Deep stock dropped in 2007 and unusual changes in the seasonal sex-ratio pattern occurred. An increase in the number of vessels visiting the grounds from distant UK ports using twin-rig gears was observed at the time and is likely to have increased the effective fishing power per kW hour.

Excepting fleet reduction, without suitable controls on the movement of catching effort between functional units in the North Sea there is nothing to prevent the effort returning to levels observed on the Farne Deep in 2006 and 2007 when fishing mortality was considered to be above that of the maximum sustainable yield.

This SFP and the draft NSRAC LTMP for *Nephrops* in the North Sea are being prepared at a time when reforms to the CFP are being discussed. Those reforms are expected to lead to a greater degree of self-management of fisheries within the North Sea and the adoption of a “stewardship” approach; where authorities delegate management responsibilities to stakeholders within set limits while retaining the right to intervene if the fishery moves in a damaging direction. There is also a wish to move towards a regional approach. This SFP is intended to work within a new, reformed, regional CFP, where participation and cooperation of fishers and others in fisheries management has become accepted.

In common with the LTMP we are proposing a SFP whereby industry individuals and communities will have been involved in any management decisions significantly affecting them. The draft SFP will have been developed from discussions with fishers and other interested parties. The approach adopted in the production of the present SFP reflects the LTMP model but it also takes into account the principles of an approach to SFPs outlined by the National Federation of Fishermen’s Organisations (NFFO) in 2009¹. It must be recognised, however, that not all fishers will be able to agree to a particular set of proposals. A perfect plan, acceptable to all parties, will be exceptionally difficult to achieve.

1.2. Project Objectives

For its LTMP to be sustainable NSRAC advises that fishery management should respond to the characteristics of each functional unit and the interactive effects with the LTMPs of other fisheries. Using the opinions, advice and information received during consultation with Farne Deep *Nephrops* fishers the aim of this study is to draft a SFP for NSRAC approval that can be forwarded to the MMO as the sponsor of the work. The draft SFP will then feed directly into the LTMP. If successful, it might subsequently enable SFPs to be developed for any other *Nephrops* functional units in the North Sea which might be deemed vulnerable in the future.

The aim of this project is through iterative consultations to investigate the acceptability, compatibility and relevance of measures other than the setting of a restrictive TAC that will properly reflect the degree of risk and particular sources of

¹ NFFO (2009). Sustainable Fishing Plans. A delivery mechanism for simplification of the Common Fisheries Policy. NFFO, November 2009. 3pp.

vulnerability. The specific objectives include incorporation into the SFP considerations of:

1. Limitations of gear and/ or vessel types;
2. How potential damage to the FU benthic habitat and ecosystem might best be managed and avoided;
3. Desirability of reducing by-catch and taking account of interactions with other stocks, such as impacts of the cod recovery plan, and other changes to the ecosystem (e.g. shifting distributions under climate change) which might affect the sustainability of the Farne Deep *Nephrops* fishery;
4. Effects on fishing of Marine Conservation Zones (MCZs) and Reference Areas (RAs) proposed for the Farne Deep functional unit area and the broader remit of the Marine Strategy Framework Directive; and
5. Uncertainties in marine ecosystem dynamics and robustness of the SFP to future environmental changes.

2. Background information

2.1. The Norway lobster (*Nephrops norvegicus* (L.))

The Norway lobster, *Nephrops norvegicus* (L.), also called the prawn, Dublin Bay prawn, langoustine, scampi or *Nephrops* is a pale orange crustacean that can grow up to 25 cm in length (9 -10 in) but is often much smaller. It is found in the north-eastern Atlantic Ocean and North Sea as far north as Iceland and northern Norway, and south to Portugal and Morocco (Figueiredo and Thomas 1967). *Nephrops* is common on suitable ground across the North Sea and into the Skagerrak and Kattegat and is also found in the NW Mediterranean and the NE Atlantic around Iceland.

Nephrops live in shallow often branching burrows in soft stable muds at depths ranging from 20 m to 800 m (Rice and Chapman 1971; dos Santos and Peliz 2005). The presence of suitable seabed habitat defines the distribution of the species. Burrows may be up to 10 cm in diameter, over a metre long and penetrate the sediment to a depth of 20-30 cm (Rice and Chapman 1971; Hillis 1974). Although *Nephrops* appear to be solitary animals, there may be several animals within the same burrow (Marrs et al. 1996). The burrows may also be shared by a variety of other species, including small fish. *Nephrops* typically remain within their burrows by day and emerge at sunset to forage during the night (Chapman and Rice, 1971; Hillis, 1971). In deeper water this activity changes and individuals may be more active by day (Höglund and Dybern 1965; Hillis 1971). At intermediate depths, greatest activity may occur at dawn and dusk (Chapman and Howard, 1979). Temporally scheduled trawl surveys of *Nephrops* in the NW Mediterranean (reviewed by Aguzzi and Sardà, 2008) revealed that *Nephrops* emerge from burrows at night on the shallow shelf (10 - 50 m deep), at crepuscular hours on the lower shelf (50 - 200 m), and at daytime on the slope (200 - 400 m).

There is also a seasonal pattern of burrow emergence associated with mating and moulting that is most pronounced in mature female *Nephrops*. After spawning, berried females largely remain in their burrows for the entire incubation period (Redant 1987; Sardà 1991; Briggs 1995).

Although much effort has been expended on publishing work on gear selectivity, reducing discards and the monitoring effects of fishing on the distribution and abundance of *Nephrops* on the Farne Deep grounds in recent years nothing of significance appears to have been published on the reproductive performance, recruitment, behaviour and sex ratio outside that of the annual stock assessment advice by ICES. The work of Symonds (1972) appears to be the most recent comprehensive biological review of the species on the Farne Deep (E. Bell, Cefas, pers comm.).

When comparing data and information on the sex ratio and spawning cycle of Farne Deep *Nephrops* Symonds (1972) noted that there was little change between the results of the earlier studies of Storrow (1912, 1913) and those of the 1960s. There were marked seasonal variations in the availability of females and to a lesser extent, males. Symonds (1972) attributed such changes in availability to behavioural patterns. Bell (2011) noted that vulnerability of *Nephrops* to trawling is strongly

related to burrow emergence behaviour, adding that in areas of winter fishing such as the Farne Deep there is a lower fishing mortality of females owing to the non-emergence of egg bearing individuals.

Storow (1912, 1913) showed that newly berried females (i.e. females with eggs in the early stages of development) were found in May increasing in proportion throughout the summer months to a maximum in September before falling off to zero in December. Females with eggs at an advanced stage of development were only found during the summer months. Symonds (1972) proposed that the seasonal variations observed in the availability of berried females from 1962–1968 appeared to be similar to those found by Storow (1912, 1913) although the proportion of berried females in the 1962-1968 samples was much lower. Off the Northumberland coast, larvae in the water column suggested that there was a hatching period of at least three months' duration from mid-May to mid-August (Jorgensen 1925) that agreed well with Storow's (1912, 1913) findings. The incidence of berried females from the Farne Deep fishery is currently noted to decrease rapidly after September although the reproductive cycle and spawning behaviour of the Farne Deep stock after to Symonds (1972) remains poorly understood.

Throughout their distribution there is marked geographical variation in the density of burrows, and the size and growth rate of *Nephrops* which may depend on physical factors such as the nature of the sediments on the sea bed, temperature and food availability (Tuck et al. 1997; Thompson et al. 1998). There is currently no standard method for determining the age of *Nephrops*.

Nephrops are preyed upon by many species of demersal fish (Farmer 1975), including cod, whiting and skates and rays. *Nephrops* may be more abundant when these fish species are scarce and this has implications for the management of the *Nephrops* and other fisheries in the vicinity of *Nephrops* grounds. Present advice from ICES is that it may be expected that *Nephrops* stocks in the North Sea will decrease as cod recovers under the measures of the cod recovery plan.

In the North Sea *Nephrops* stocks are divided into nine separate Functional Units plus the Skagerrak and Kattegat (Figure. 1). These functional units were defined by mapping the areas of muddy sediment in which *Nephrops* live. However, additional landings of *Nephrops* are taken from smaller, isolated patches of mud elsewhere in the North Sea in areas such as Devil's Hole. Although small planktonic *Nephrops* larvae are transported by the currents and may be carried from one part of the North Sea to another, it is believed that there is very little exchange of adults between functional units. Adult *Nephrops* are relatively sedentary, seldom moving more than a few hundred metres from their burrows (Jensen 1965; Chapman 1982).

Within a functional unit, the *Nephrops* distribution may vary in terms of density, size, sex and biological characteristics depending on sediment composition (Tully and Hillis 1995; Tuck et al. 1997). Some of the functional units including the Farne Deep are regularly surveyed by means of underwater TV mounted on towed sledges. Other units are not regularly surveyed, and information on the distribution and numbers of *Nephrops* in these un-surveyed areas is more limited.

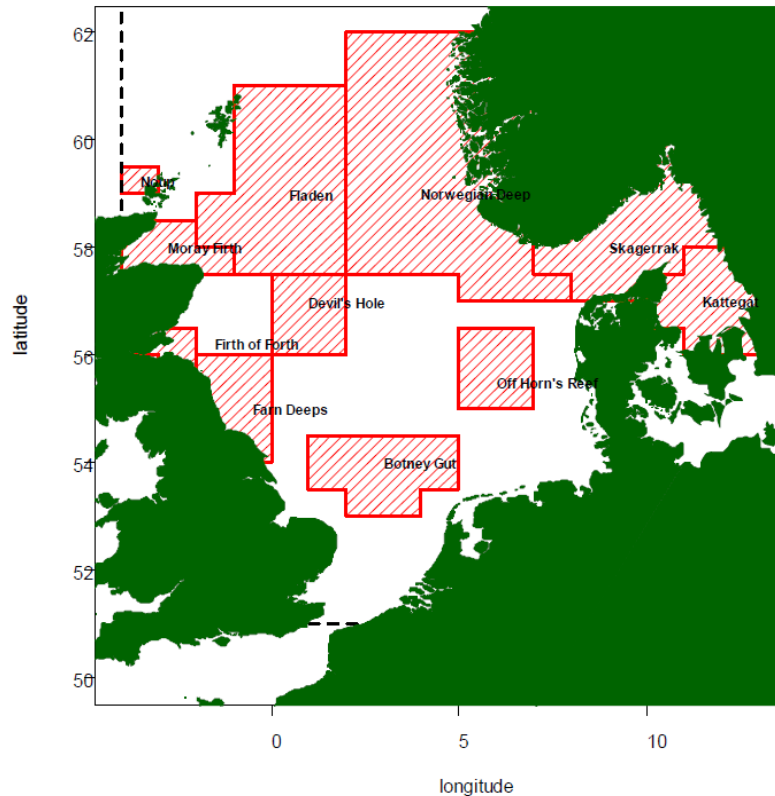


Figure 1: *Nephrops* functional units in the North Sea and Skagerrak/Kattegat region (Source: ICES 2012).

2.2. The *Nephrops* fisheries of the North Sea

The *Nephrops* fisheries began to grow in the North Sea in the early 1950s when demand for shellfish increased. Before that *Nephrops* were hardly exploited and those caught incidentally during the capture of whitefish were often discarded. There has since been a great increase in the global catch of *Nephrops* and North Sea landings have increased stepwise. The UK holds the bulk of the North Sea TAC for *Nephrops*. Other countries with an interest are Belgium, Denmark and Holland. The Belgian quotas are often traded with other countries. *Nephrops* is especially valuable to Scotland where approximately 80% of the landings take place.

Although there are some dedicated *Nephrops* vessels within the North Sea, *Nephrops* is also an important component of the catch for vessels fishing for other species. In addition, *Nephrops* vessels may also rely on catching other species to maintain their profitability. This is the case for the local fleet fishing the Farne Deeps *Nephrops* fishery from ports such as Seahouses, Amble, Blyth, North Shields and Hartlepool.

In the North Sea, *Nephrops* are primarily caught in otter trawls. Originally the trawls were rigged for a single net (single-rig), but more recently twin-rig trawls (two nets) and multi-rig trawls (where 4-8 nets can be towed) have been applied. Scotland has introduced a ban on all Scottish boats using multi-trawl gears and the ban also extends to all British vessels in Scottish waters. This can limit the expansion of fishing capacity of vessels and also has the potential to limit the business efficiency of vessels which are capable of multi-rig trawling.

The North Sea *Nephrops* fisheries have been managed in the past through the setting of an overall TAC. Minimum landing sizes (MLSs) apply (25 mm carapace length in the North Sea and 40 mm in the Skagerrak and Kattegat). Minimum net mesh sizes are also set, but these also vary with area and with the type of vessel; e.g. whether it is targeting mainly whitefish or *Nephrops*. By-catch limits have also been imposed and *Nephrops* fishers have recently adopted a series of technical measures including mesh size, square mesh panels, selection grids and twine thickness to conserve fish stocks.

The *Nephrops* fisheries in some areas of the North Sea are mixed (i.e. the by-catch of marketable demersal species can be significant) and some fishers depend upon such variety in order to make their business viable throughout the year. In such cases mesh sizes are often larger and are not tailored especially for the selection of *Nephrops*. Selection grids are used in the Swedish inshore fisheries in the Kattegat and are now being trialled in other areas; however, as they are highly selective and remove a large proportion of fish from the catch their use is not widely popular in the mixed fisheries such as those on the Farne Deep and the Fladen. In contrast, on some *Nephrops* grounds such as the Firth of Forth the whitefish by-catch is very small.

In addition to TACs, days-at-sea regulations introduced under the cod recovery plan have also reduced fishing opportunities for *Nephrops* trawlers. Division of the fleet into whitefish vessels, with large mesh nets and fewer days at sea (TR1), and *Nephrops* vessels, with smaller mesh nets and more days at sea (TR2), has resulted in a transfer of effort into the *Nephrops* fleet. Moreover, pressures on stocks elsewhere have resulted in an influx of vessels fishing *Nephrops* in the North Sea². The European Scientific, Technical, and Economic Committee for Fisheries (STECF) (2008) noted a sharp overall reduction in usage of gears in European fisheries with a mesh size of 100 -119 mm (those targeting whitefish), and a subsequent general increase in effort by vessels using smaller mesh sizes (such as those targeting *Nephrops*).

The TAC for *Nephrops* is currently set for the North Sea as a whole, allowing fishers to move from ground to ground. In recent years, ICES has recommended that *Nephrops* fisheries in the North Sea should be managed for each functional unit, with separate TACs applied to each one. The absence of such management has been seen as a potential weakness by those assessing the *Nephrops* fisheries for accreditation.

2.2.1. Major trends in the *Nephrops* fisheries of the North Sea

Nephrops landings from the North Sea have progressively increased over the years and the implementation of the “buyers and sellers” regulations in 2006 considerably tightened up the levels of reporting for *Nephrops*. Since 2006 the landings figures are considered to be more reliable and recent increases in landings and landings per unit effort (lpue) may have resulted from the increase in reporting levels, not necessarily actual changes to the stock. A ban on the use of multi-trawl gears (3 or

² There is a need for an analysis of the numbers and types of vessels and their capacity, from all nations, operating within the different functional units. There is a general lack of effort data, especially for the < 10m fleet.

more trawls) for all Scottish boats was introduced from April 2008, limiting the expansion of effective effort. Days-at-sea regulations and recently introduced effort allocation schemes (kW*day) have reduced opportunities for directed whitefish fishing.

ICES scientists have noted that most *Nephrops* stocks at FU level appear to be fairly stable in terms of abundance and size composition. Notable exceptions have been noted on the Fladen ground which showed a marked increase in abundance and on the Farne Deeps where the population size of *Nephrops* dropped in 2007 and unusual changes in the seasonal sex-ratio pattern occurred following increased fishing effort in 2006. In 2010, it was reported that effort was becoming limiting for *Nephrops* vessels with the result that vessels were remaining in port for longer periods during strong tides or periods of poor weather when catches were expected to be low.

2.3. The Farne Deeps *Nephrops* fishery

The Farne Deeps *Nephrops* fishery has a long history dating back to the mid 19th Century (Bell *et al.* 2006) and has always tended to be a mixed fishery for both *Nephrops* and demersal fish. It is a winter fishery generally operating from September to March. Symonds (1972) provided a description of the *Nephrops* fishery off the North East coast of England providing landings data for the period 1926–1969. Prior to that review published work on the fishery was very limited. Storrow (1912, 1913) reported on the commercial fishery and Cole (1965) compared the length distributions of *Nephrops* with those from other areas fished by the fleets of England and Wales.

Prior to 1969 the Farne Deeps *Nephrops* fishery was based mainly at North Shields although landings started to increase at other local ports such as Seahouses, Amble, Blyth and Hartlepool from 1966. Ports along the North East coast of England from Grimsby to Amble are still used by fishers to land their catches from the Farne Deeps; however, the main port or landings remains as North Shields.

In the 1960s, the fishing was undertaken by trawlers ranging in size from 12 m to 20 m averaging approximately 15 m in length. A few landings were noted from local seiners and foreign vessels. The gear used by local vessels at that time was a single otter trawl with a light ground rope. The same net was used for catching whitefish at other times of the year or when *Nephrops* catches were poor. The length of the footrope was 35-38 m compared to that of the headline of ca. 31-34 m. Mesh size was normally uniform throughout the net at 70 mm although larger meshes were sometimes used in the wings (Symonds 1972).

More recently the industry has developed more efficient fishing methods. The use of twin rig and multi rig gears where two or more nets are rigged together and towed behind the vessel had improved efficiency and increased fishing effort. As a result the proportion of landings by twin rig vessels has risen steadily with time replacing those made by single rig gears (ICES 2012).

Under the Scottish Conservation Credits 2012–2013 scheme the Scottish Government issued rules in February 2012 which specify that nets operating in the TR2 demersal trawls sector for *Nephrops* must have mesh size equal to or larger

than 70 mm and less than 100 mm. However, conditions under the scheme dictate that in order to gain access to the Farne Deep Scottish fishers must use an approved highly selective fishing gear such as the 'flip flap' trawl (Appendix 2).

The Scottish flip flap trawl (see appendices) has been designed to facilitate the escape of cod from the net so reducing by-catch as part of the cod recovery plan and the specification of the net is provided below. In addition, vessels must undertake specified exemption measures (which reduce cod to less than 1.5% of the catch by weight) during a number of TR2 fishing trips whose combined duration is not less than 20 days (480 hours). Currently, this additional measure is the Swedish Grid that operates as a further escape panel for cod. Compliance with this specification will earn the fisher additional days at sea over the flat rate of 200 days while also allowing access to the Farne Deep *Nephrops* fishery.

In England the MMO published the Days at Sea Scheme 2011/12 Cod Recovery Zone scheme rules in July 2011. The flat rate for TR2 gears in the North Sea is 125 days; however, eligible vessels notifying any regulated gear that agrees to catch less than 5% cod will be allocated additional days allowing 200 days at sea. The condition of use of regulated gear must be met during each trip. Under the English scheme vessels adopting the insertion of a 120 mm Square Mesh Panel (SMP) of minimum length three metres in the straight extension of the net or a 130 mm SMP in the taper where the rearmost row of the meshes of the SMP is no more than 12 metres from the cod line will receive 8 days extra allocation.

Under previous European and national legislation in 2009 *Nephrops* trawls were required to be fitted with a 90 mm square mesh panel and a large diamond mesh (140 mm) headline panel designed to reduce the unintentional catch of undersized whitefish including cod, haddock and whiting. Single rig trawls on the Farne Deep typically used mesh size in the range of 90 mm to 95 mm. They were fitted with a 110 mm square mesh panel and a 160 mm headline panel (Moody Marine Ltd., 2009).

On the Farne Deep, single rig trawls are generally favoured by English vessels although some English boats do deploy twin rig gear. Twin rig gear is generally favoured by Scottish boats and those from Northern Ireland; however, it was observed that at least one boat from Northern Ireland used a single rig gear during the 2011 – 2012 season. Although Scottish legislation has banned the use of multi rig gears in Scottish waters there is no restriction on the number of nets that can be used in a multi rig gear on the Farne Deep grounds and reports of the use of a quad rig gear by a visiting vessel were received from fishers landing at North Shields in December 2011.

Under EU Council Regulation 850/98 fishing regulations are complex with different catch composition rules applying to different mesh sizes North and South of 55° North (a line that bisects the Farne Deep fishing grounds). North of the line vessels using 80-109 mm mesh must land a minimum of 30% *Nephrops*. South of the line the limit is a minimum of 30% *Nephrops* plus other fish species (Moody Marine Ltd. 2009).

During the late 1960s main fishing effort for *Nephrops* on the Farne Deeps was concentrated during the last and/ or first quarters of the year (as it is today). At that time up to 30 local vessels worked from North Shields together with a similar number from the smaller ports identified. In addition, up to 60 visiting Scottish vessels mainly from the Firth of Forth also worked the North East coast of England landing at English ports at that time of year (Symonds 1972). More recently the fishery has gained in popularity. In 2007, approximately 230 vessels took part in the fishery at various times (CEFAS 2008).

Symonds (1972) reported that the *Nephrops* grounds worked most frequently by vessels from North Shields were located from 10 nautical miles (nmi) to 15 nmi from the coast east of the mouth of the River Tyne. Moody Marine Ltd (2009) reported that fishing on the Farne Deeps grounds takes place during daylight hours between 7 nmi and 25 nmi off the Northumberland coast and VMS data from the MMO indicate that this is broadly the case (Figure. 2) although the <10 m fleet is not represented in the data.

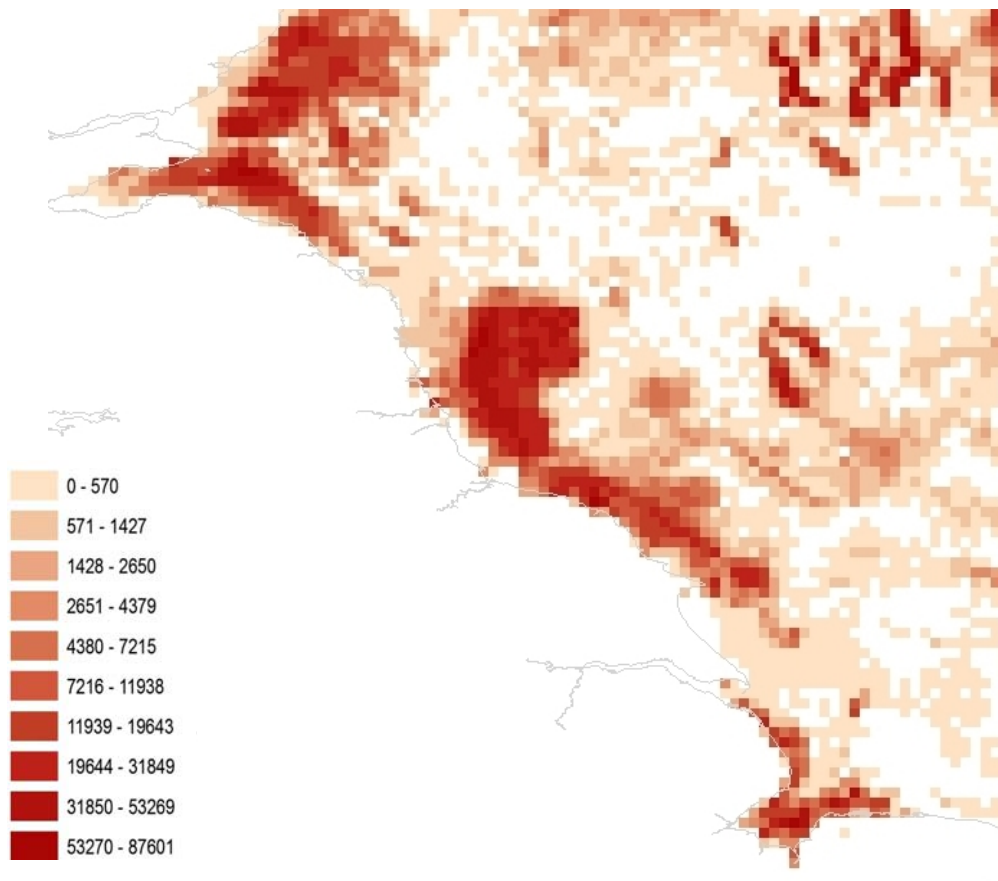


Fig. 2: Distribution of fishing effort (total hours 2007 - 2010) by all vessels >15 m in length towing TR1 and TR2 mobile-gear for 2007-2010 off the North East coast of England (MMO VMS data).

Based on 1962-1968 research surveys, Symonds (1972) reported that the main concentrations of *Nephrops* were within the 40 fm (approx' 70 m) depth contour extending south from the Farne Deeps glacial troughs, although the centre of

abundance was much further south in 1969 than it had been a decade earlier. One hypothesis for this was that the distribution of *Nephrops* might have responded to the rapid expansion of the fishery from 1960 and increased effort during the intervening period to 1969. Visual comparison of the distribution of *Nephrops* on the Farne Deep grounds in 1959 and 1969 (n/hour) (Symonds, 1972) and that in 2004 (kg/hour) (Bell et al, 2005) indicates a remarkable similarity in the extent of distribution within an area extending between 55.00° N – 55.30° N and 000.50° W and 001.15° W excepting local changes in areas of highest catch rate.

Symonds (1972) compared trends in effort between 1911 and 1969. In 1911 effort was lowest from February to April increasing to a maximum in August compared to 1969 where effort was highest in October and lowest in July. ICES (2012) noted that the Farne Deep fishery is essentially a winter fishery commencing in September and running through to March. Landings of *Nephrops* by visiting vessels have always been of significant importance to the smaller English ports north of North Shields. In 1969 for example, landings of *Nephrops* at Amble and Blyth accounted for 77% and 95% of the total landings at those ports respectively. This was compared to only 31% at North Shields in the same year (Symonds, 1972).

During the period 1945 to 1959 landings of *Nephrops* were at a very low level until a rapid expansion of the fishery in 1960 to 1968 when landings at North East ports reached 17600 cwt (ca. 900 tonnes). During expansion of the fishery in the 1960s landings at North Shields increased from 3500 cwt (ca 180 tonnes) in 1963 to 15000 cwt (ca. 765 tonnes) in 1969. During the same period effort increased five fold but CPUE fell by 21% (Symonds, 1972).

A time series of landings from the Farne Deep *Nephrops* fishery (Table 1, Figure. 3) shows that for much of the period 1981-2010 landings fluctuated around 2000 tonnes to 2500 tonnes without trend but increased markedly from 2004 to a peak of 4903 tonnes in 2006. Such high landings were above ICES recommendations and may have affected landings in subsequent years that were seen to decrease markedly. The provisional landings for 2010 totalled 1443 tonnes.

As stated, the Farne Deep *Nephrops* fishery is a mixed fishery that is characterised by a by-catch of demersal fish. Moody Marine Ltd. (2009) noted that by-catch of demersal species of fish accounted for between 38% and 47% of the total catch landed. In contrast, Symonds (1972) noted that during the period 1962 - 1969 the landings of by-catch (mainly cod, whiting and haddock) exceeded that of *Nephrops* to the order of approximately 2:1 (66%). Symonds (1972) also noted that CPUE of elasmobranchs (skates, rays and dogfish) accounted for between 3.0 and 8.2 cwt (ca. 0.15 and 0.42 tonnes) per 100 hours fishing during the same period.

Bella et al. (2008) considered the composition of trawl catches taken on the Farne Deep with commercial gears, examining the factors that determine catch rates of *Nephrops* and various commercial finfish species taken as by-catch. Only about 19% of the variance in *Nephrops* catch rates could be accounted for by variations in local density as measured independently by underwater TV survey of *Nephrops* burrows. Variations in *Nephrops* catch rates were dominated by changes over time, particularly in relation to tidal state. Five commercial species occurred as by-catch in significant quantities. Catch rates of haddock (*Melanogrammus aeglefinus*), whiting

(*Merlangius merlangus*) and lemon sole (*Microstomus kitt*) varied independently of *Nephrops*, whereas catches of cod (*Gadus morhua*) and plaice (*Pleuronectes platessa*) were inversely related to *Nephrops*.

Bella et al (2008) concluded that it was possible for the commercial *Nephrops* fishery to use spatial and temporal targeting to maximise catches of *Nephrops* whilst minimising the by-catch of some fish species. If catch statistics were to be used to identify *Nephrops* directed fishing metiers for fishery management purposes it was considered vital that data were examined at the level of individual hauls or fishing trips. Aggregation of data at a higher level risked obscuring the effectiveness with which the fishery is targeted at *Nephrops*.

The development of a large mesh escape window (panel) by Madsen et al. (2010) focused particularly on moving a large 300 mm mesh panel further back from the topsheet towards the codend. This was achieved by the design of a four-panel sorting section (or sorting box) where the large mesh panel was placed in the top section at about 3 m to 6 m from the codline. The sorting box design gained greater stability in the codend to avoid loss of *Nephrops* through the large meshes and a high reduction of flatfish and other roundfish species.

Earlier investigations on a coverless trawl to improve selectivity were identified through consultation. Revill et al. (2006) reported on a new design of *Nephrops* trawl (the cutaway trawl), tested in the Farne Deep fishery of the North Sea, and which reduced by-catches of whiting by 50% (across the length range), without any loss of *Nephrops*. The cutaway trawl trialled could potentially be used to reduce discarding of whiting in the *Nephrops* fishery. Earlier, Arkley (2000) and Arkley and Dunlin (2003) showed marked improvements to selectivity for *Nephrops* when a large mesh (200 mm) panel was included in the top of the net. Some preliminary work on a coverless trawl design was undertaken as a BSc. Honours project in 1993 at the University of Humberside³.

The resulting trawl design was referred to as the Seafish 'coverless' trawl. As the name suggests, the cover which is in place to prevent fish herded into the mouth area of the net from rising upward and escaping over the headrope was removed from a conventional prawn trawl design. This resulted in the net having a headrope equal to or slightly longer than the footrope. The inclusion of increased mesh sizes in the upper wings and upper netting panel immediately behind the headrope crown, coupled with reduced headline height, all serve to encourage the escape of fish species such as haddock and whiting in and around the mouth of the trawl.

Over a 12 year period the resulting coverless prawn trawl design has undergone extensive evaluations under commercial fishing conditions in a number of *Nephrops* fisheries around the UK. The results obtained demonstrated the conservation benefits of the new design by achieving by-catch reductions for haddock and whiting in excess of 60% without affecting the catches of *Nephrops*⁴.

³ Hay, F. (1993). The design and testing of *Nephrops* trawls. BSc Honours project (C. Radcliffe, Supervisor). University of Humberside. 75pp.

⁴ Seafish Authority. Design and Construction Guidance Notes: Evaluation of Technical Conservation Measures in UK *Nephrops* fisheries – New Trawl Designs. <http://www.seafish.org.uk>

By-catch of unmarketable fish or whitefish for which quota is not available leads to discarding. Catchpole et al. (2005a) concluded that a reduction in discard rates in North Sea fisheries is required for a long term solution to the ecological and economic costs of the practice, proposing that the development of discard reduction measures such as direct fishing effort controls, gear based measures, spatial management (temporary or permanent area closures), and discard utilisation implemented via the development of fishing opportunity incentives could promote the use of more selective fishing techniques. Catchpole et al. (2008) emphasised the importance of appropriate incentives to fishers to resolve the problems associated with discards without unnecessarily affecting short term profit maximisation.

Catchpole et al. (2005b) focused more on the role of social and environmental factors of discarding in the Farne Deep *Nephrops* fishery concluding that discards of whiting and small *Nephrops* were most influenced by the combined effect of trawl selectivity and market forces in preference to quota availability or minimum landing size. Catchpole et al. (2006) hypothesised that the degree of discarding in the Farne Deep *Nephrops* fishery was probably sufficient to allow larger populations of scavengers including crab spp., whelk spp., common starfish (*Asterias rubens*), hagfish (*Myxine glutosa*), and herring gull (*Larus argentatus*) to exist than would otherwise be possible.

Currently the European Fisheries Minister has made a commitment to banning of discards within the forthcoming reform of the CFP although the true social, economic and ecological effects of such a policy have yet to be determined for the Farne Deep *Nephrops* fishery. The European Commission is proposing a gradual approach to a discard ban in three steps: pelagic species in 2014, most valuable demersal species (cod, hake and sole) in 2015, and other species in 2016. The discard ban would cover the listed species, regardless of whether they are managed with quota or effort.

The EC advises that the new CFP would offer incentives to increase selectivity and to land all fish caught. Under the European Maritime and Fisheries Fund (EMFF) vessel owners would receive financial support for innovation (new technical and organizational knowledge), for increased gear selectivity (on size and species), to reduce incidental/accidental by-catches. Vessel owners and fishermen working on board vessels would also receive financial support for participating in trials and pilot projects and for collaborating with scientists. POs will also receive funding to help implement the discard ban, for better labelling of products and for the marketing of new products.

As part of regionalisation under a reformed CFP fishermen will work hand in hand with the administrations initially to develop concrete measures avoiding unwanted catches. These measures could be more selective gear, restricting access to juvenile aggregation areas, real time closures etc. Furthermore vessels likely to have a mixture of for example cod, haddock and whiting in their hauls should have quotas for all of these species. Small scale vessel owners would need to receive the right quota mix from national administrations. All other vessel owners should receive the right mix from the national administration in the form of transferable fishing concessions (TFCs).

The EC also advises that incentives can also take the form of quota allocation within Member States. Under the TFC system, Member States are free to allocate their national quotas to different vessel segments, giving for example more quota to vessels using gears or methods that reduce environment impacts and effects.

Table 1. Nominal landings (tonnes/year) of *Nephrops* from the Farne Deep (FU6) reported to ICES (ICES 2012).

Year	England & N. Ireland	Scotland	Sub-total	Others	Total
1981	1006	67	1073	0	1073
1982	2443	81	2524	0	2524
1983	2073	5	2078	0	2078
1984	1471	8	1479	0	1479
1985	2009	18	2027	0	2027
1986	1987	28	2015	0	2015
1987	2158	33	2191	0	2191
1988	2390	105	2495	0	2495
1989	2930	168	3098	0	3098
1990	2306	192	2498	0	2498
1991	1884	179	2063	0	2063
1992	1403	60	1463	10	1473
1993	2941	89	3030	0	3030
1994	3530	153	3683	0	3683
1995	2478	90	2568	1	2569
1996	2386	96	2482	1	2483
1997	2109	80	2189	0	2189
1998	2029	147	2176	1	2177
1999	2197	194	2391	0	2391
2000	1947	231	2178	0	2178
2001	2319	255	2574	0	2574
2002	1739	215	1954	0	1954
2003	2031	214	2245	0	2245
2004	1952	201	2153	0	2153
2005	2936	158	3094	0	3094
2006	4430	434	4864	39	4903
2007	2525	437	2962	4	2966
2008	976	244	1220	0	1220
2009	2289	414	2703	0	2703
2010	1258	185	1443	0	1443

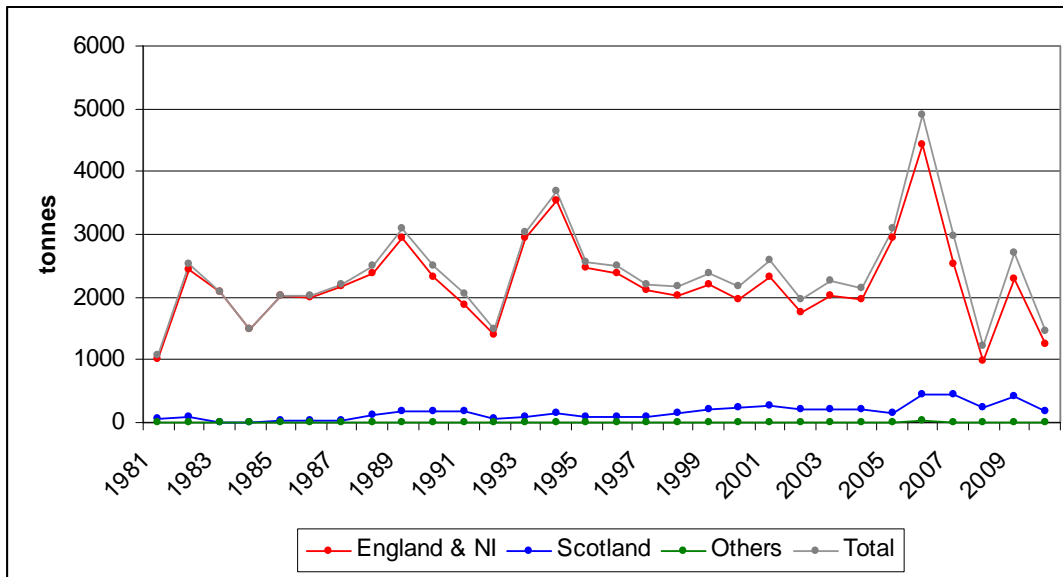


Figure 3. Nominal landings (tonnes/year) of *Nephrops* from the Farne Deeps (FU6) reported to ICES (ICES 2012).

2.4. Assessment of the stocks

Determining the existing status of the North Sea *Nephrops* stocks and advising on the potential yield from those stocks under different management strategies is the responsibility of ICES. The eight functional units in the North Sea are used for the purposes of stock assessment and the provision of advice although limited baseline information on a few of the functional units (e.g. Botney Gut and the Noup) remains a concern.

Vessel Monitoring System (VMS) data for vessels >15 m are being successfully used to match survey and fishery areas. Sampling of *Nephrops* landings is carried out at markets and processors to obtain information on the size composition of landings. In addition, discards are monitored at sea. However, the main method for assessing the state of *Nephrops* stocks is by underwater TV surveys. Most fish stocks are assessed by monitoring catches and by obtaining for successive years information on the age structure and growth rate of the species.

The very different growth rates of male and female *Nephrops*, and the lack of information on their age, make the use of standard stock assessment and forecasting methods very difficult to apply. Some progress may be possible using length-based assessments although there are some concerns for the quality of landings data prior to 2006. As a result, a longer time series of data is required before biometric data can be used in the stock assessment with full confidence.

A number of the FUs in the North Sea including the Farne Deeps are examined directly through these underwater TV surveys (Bailey et al. 1993; Marrs et al. 1996). A sledge carrying a TV camera is towed across the seabed, and the number of burrows observed is recorded. The surveys are carried out at stations in areas of different sediment type, with 10 minute tows at each station. A 1:1 occupancy rate is

assumed for the burrows and the total density of *Nephrops* is raised to the total area of that sediment type and summed across sediment types for the FU.

The underwater TV surveys provide estimates of abundance that are independent of the fishery itself; however, their accuracy has been questioned by fishers. It has been suggested that visual recognition of *Nephrops* burrows and “edge effects”, where single openings of burrow complexes at the sides of the viewed transect are counted, provided important sources of uncertainty. Campbell et al. (2009) showed edge effects to be responsible for an overestimation of population size of between 4% and 55%, depending on the width of the field of view and the mean size of the burrow complex.

This overestimation can be countered to some extent by variability in burrow entrance structure and interpretation of video footage by analysts. Campbell et al. (2009) also identified other factors that could affect accuracy of estimation including: variability in water clarity, burrow occupancy rates, and the presence of other burrowing species will all affect the degree to which *Nephrops* burrow complexes are successfully identified.

Campbell et al. (2009) stressed that FRS [Marine Scotland] underwater TV survey design has traditionally taken a conservative approach to *Nephrops* distribution, with surveys restricted to sediments containing up to 1% gravel and 90% sand, but that *Nephrops* are known to live in sediments of up to 5% gravel or 94% sand (Afonso-Dias, 1998). Moreover, the accuracy of sediment maps to whose area burrow densities are raised to produce population size estimates has been questioned and found to consistently underestimate the area of sediments suitable for *Nephrops* habitat (Campbell et al., 2008), which leads to *Nephrops* burrows going unrecognized. STECF advice has suggested that a combination of an absolute abundance estimate from an underwater TV survey and a harvest rate based on an estimate of fishing mortality could be used to calculate appropriate landing limits.

2.4.1. ICES advice for the Farne Deep stock in 2012

ICES advice (June 2011) for *Nephrops* in the Farne Deep (FU6) in 2012 (ICES, 2011) was that landings in 2012 should be no more than 1400 t and that to protect the stock, management should be implemented at the functional unit level. The underwater TV survey indicated that the stock status has been fluctuating around its maximum sustainable yield since 2007 although changes in survey methodology in 2007 (accuracy of GPS positioning and a revised method of raising abundance estimates) made comparison with the preceding series difficult.

ICES (2011) noted that increases in the numbers of vessels using twin-rig and multi-rig gears in FU6 were likely to have increased the effective fishing power per kW hour; however, fishing effort decreased substantially in 2010 to a level not recorded since the 1980s. Furthermore, ICES (2011) noted that the exploitation rate on males is usually considerably higher than on females and there is evidence of sperm limitation following harvest rates in the region of 20%. 2006 and 2010 mature females may not have been able to mate successfully and a larger male spawning potential is desirable as a result. ICES (2011) advised reducing the harvest rate of males to 8%. A harvest rate of 8% would result in landings of 1300 t in 2012.

Increases in abundance in other FUs (i.e. Firth of Forth and the Fladen grounds) are likely to translate to increases in TAC for the North Sea, increasing the risk of higher effort being deployed in the Farne Deeps FU. The high cost of fuel combined with the relative coastal proximity of the Farne Deeps to port may also result in attracting additional fishing effort which would not be advisable given the current low level of the stock (ICES, 2011).

The Farne Deeps stock has shown signs of overexploitation in recent years with an unbalanced sex ratio leading to poor recruitment. Males generally predominate in the landings averaging about 70% by weight in the period 1992 – 2005. Towards the end of the season in February to March there is usually an increase in female availability as mature females emerge from their burrow having released their eggs. There was an anomaly on the 2006 – 2007 and 2009 – 2010 fisheries with a predominance of females throughout each respective season and sex ratio in catches has become increasingly more variable in the 5 years since 2006 – 2007 than the 5 years preceding. The dominance of large females in landings during the 2009 – 2010 fishery suggests that they had not mated successfully. Subsequently, the potential for poor recruitment for 2011 and 2012 remains a concern (ICES, 2012).

Without suitable controls on the movement of effort between the functional units there is nothing to prevent the effort on the Farne Deeps in 2012 returning to those observed prior to 2008, most of which have been above the level of maximum sustainable yield. There has been a general increase in the number of vessels using multi-rig gear that has a higher fishing power than single rigs for *Nephrops* (ICES, 2011).

The most recent North Sea stock survey was undertaken in 2010 and after changes to the 2009 underwater TV survey and assessment methodology following the findings of Campbell et al. (2009), the results are considered a reliable estimate of absolute abundance. Contrary to information from the fishing industry that the Farne Deeps stock is increasing with good recruitment and a good range of sizes, the 2010 landings per unit effort levels (lpue) show a decline and a lack of small *Nephrops* in the catch samples (ICES, 2011).

In the previous year, ICES advice for 2011 was that the underwater TV survey, fishery data and length frequency data all pointed to the stock continuing to be at a low level and that 2011 landings should be in the region of 1400 – 1900 t. Actual landings data for 2011 are currently not available although 1443 tonnes were landed in 2010 (Table 1, Figure. 3).

The ICES assessment for the Farne Deeps emphasises the vulnerability of this functional unit, and underlines the need for an SFP as an alternative to the imposition of a separate TAC.

3. Consultation

3.1. Approach

Overall, 20 one to one interviews took place between August 2011 and February 2012. Locations visited during the consultation were Hartlepool, North Shields, Blyth, Amble, Seahouses, Berwick upon Tweed, Eyemouth, Kingsbarns (Fife), Aberdeen, and Fraserburgh. Skippers of 12 English boats, 6 Scottish boats and 2 boats from Northern Ireland were interviewed. Of these 12 used single rig gears while 8 used twin rig gears. Eight interviews were obtained from the <10 m fleet the remainder were from larger boats. Not all of the English boats used single rig gear.

Initial efforts to contact fishers in north east England were made via letters, email and telephone messages to the Chief Executive and senior officers of the National Federation of Fishermen's Organisations (NFFO)⁵ based in York, Whitby and Tynemouth. After an initial meeting with the Chairman of the NFFO North East Committee in August 2011, enquiries to 26 local fishers or their representatives were made. Of these, 4 responded and 3 were willing to come forward and provide input to the consultation. 13 additional enquiries to fishers and agents in north east England and Berwickshire returned 2 further appointments for interview.

Enquiries to the Anglo-Scottish Fishermen's Association (ASFA)⁶ produced 4 interviews and the opportunity to present the project to fishers at two meetings. The first took place in the Fishermen's Mission in Eyemouth on 2 September 2011; however, despite the meeting being well attended and *Nephrops* fishers being notified of the project in advance of the meeting by the ASFA Secretariat, no active *Nephrops* fishers attended the meeting and no interviews took place following the presentation. The second meeting took place at the office of the Anglo-Scottish Fish Producers Organisation (ASFPO)⁷ in Berwick upon Tweed on 14 October 2011. Again, fishers were given advance notice of the meeting and the project by the host. 2 active *Nephrops* fishers attended the meeting resulting in 1 interview.

An enquiry to the Chairman of the Fife Fishermen's Mutual Association (Pittenweem) (Fife FMA)⁸ on 19 September 2011 returned no interest to participate in the project; however, the names of 2 boats from Arbroath were provided although contact details were not available. One of the named boats from Arbroath was recorded in North Shields on 24 October although no interview was obtained.

⁵ The National Federation of Fishermen's Organisations (NFFO) ensures that the fishermen of England, Wales and Northern Ireland have a strong and clear voice when decisions are taken affecting their livelihoods. Its aim is to secure sustainable and profitable fisheries and a high degree of industry involvement in all fisheries management decisions.

⁶ The Anglo Scottish Fishermen's Association (ASFA) represents fishermen, skippers and boat owners in the area between the Rivers AIn and Forth. It has an Executive which meets six times a year and has representatives from all the ports in the area.

⁷ The Anglo-Scottish Fish Producers' Organisation was registered on the 14th of March 1974 and is now in membership of the Scottish Association of FPOs. This allows the organisation to discuss any problems within the industry. The ASFPO has 55 registered members from all fishing sectors which operate mainly in area IVb and the Norwegian sector. The economic area of the organisation stretches from Whitby to Gourdon.

⁸ The Fife Fishermen's Mutual Association (Pittenweem) Limited is a co-operative, formed in 1948. The primary role of the Association is the marketing and logistics required to sell the various species of fish and shellfish caught by its members within the Firth of Forth and North Sea. The Association expresses the views of East Neuk based fishermen's bodies.

Enquiries to the Scottish White Fish Producers Association (SWFPA)⁹ and the Scottish Fishermen's Organisation (SFO)¹⁰ from the onset of the consultation in 2011 provided the contact details of those fishers who they represent and who might be willing to contribute to the consultation. Contact details for Farne Deeps fishers represented by those organisations and whose boats are registered in the main Scottish ports of Fraserburgh and Peterhead were received in November 2011.

19 telephone and text enquiries were made to 18 telephone numbers forwarded by either the SFO or the SWFPA between 28 November and 7 December 2011. Where calls were not answered directly by fishers or telephone numbers were not available, a written enquiry was sent to the corresponding address. 16 letters were sent between 29th November and 6th December 2011 outlining the project and requesting participation. Two interviews resulted; one at North Shields on 1 December, the other in Edinburgh on December 14 2011. A third in Fraserburgh on 16 January 2012 had to be rescheduled for 17 February to coincide with a meeting of the SWFPA *Nephrops* group. Attendance at the SWFPA meeting of 17 February resulted in 2 interviews at North Shields on 19 February and the promise of 2 more by fishers who were later unable to commit to an interview.

Meetings with *Nephrops* specialist advisers took place in Kingsbarns (Fife) and Aberdeen on the 16 and 17 February 2012 respectively. The purpose of these meetings was to discuss general aspects of *Nephrops* research, behaviour and distribution.

Overall, the response from fishers to cold calling and email was poor. A higher proportion of interviews resulted from personal recommendations from those fishers interviewed, or speculative personal introductions on the quayside when fishers were landing their catch.

3.2. Structure of the interviews

Interviews were based on a series of subject headings that were introduced within the context of free discussion regarding the marine environment of the Farne Deeps, the management and regulation of the fishery, and the current state of the fishing industry. Interviews lasted for periods of between 35 minutes and 2 hours depending on the time available, the rapport established with individuals, their interest in the project and their willingness to participate.

The standard questions introduced during the interviews were as follows:

1. Is the Farne Deeps the only area fished? If not, where are the others?
2. What gear is used? Does this vary?
3. Is the vessel targeting *Nephrops* or is it engaged in a mixed fishery? Which are the other species caught or targeted? Which is the most important part of the catch? How is the vessel's *Nephrops* quota allocated (through the PO, bought or leased?).

⁹ The Scottish Whitefish Producers Association (SWFPA) is the largest Association of fishermen in the UK, its member's activities account for a significant proportion of Scottish and UK landings both in terms of volume and income. SWFPA members are the principle protagonists in the UK *Nephrops* sector.

¹⁰ The Scottish Fishermen's Organisation is a Producer Organisation (PO). It is one of the largest fisheries managers in Europe that currently has around 220 active vessel members in ports around the Scottish coast.

4. Are there any by-catches or discards in the fishery?
5. Is the fishery seasonal? Are there times when the vessel does not fish there? Why?
6. Are there any specific problems with the Farne Deep's fishery? How might these be resolved?
7. What is the future for the Farne Deep's fishery, and for the wider North Sea fishery?
8. What is the most important management step that the interviewee would like to see taken?
9. Is there a need to restrict fishing pressure in the Farne Deep's? If there is, what does the interviewee prefer in terms of different ways of limiting fishing pressure? What has been successful elsewhere, or in the past? Have any steps already been taken to reduce the pressure? Might the 'Net Gain' proposals help? Options might include:
 - A local TAC – as the Commission suggests:
 - Restricting access to particular vessels (which vessels? by length or power?).
 - Restricting gear types (which types?).
 - Effort controls – days at sea?
 - Area restrictions – areas closed to particular gears?
 - Seasonal restrictions – e.g. green sac periods?
10. Would the following ecological objectives be useful?
 - Reduce discards and by-catches in the fishery. Is discarding a problem? Where and when? What species?
 - Minimise damage to threatened, endangered and protected species. What species might be at risk?
 - Minimise impacts on benthic habitats and associated communities. What habitats are at risk?
 - Are there any features of the Farne Deep's that the interviewee would like to see protected?
11. To meet ecological objectives, and especially the reduction of discards, options might include:
 - Larger meshes in the main part of the net
 - Square mesh panels and other escape panels
 - Selection grids
 - Low headline trawls
 - Adaptations to the foot rope
 - Real time closures to protect spawning grounds or aggregations of juvenile fish
12. Can you suggest measures for reducing discards and by-catches and it is best to devise your own reporting procedures to:
 - Ensure that landings are within quota and demonstrate that this is so.
 - Reduce discards and demonstrate that this has been achieved.
13. Other ecological management measures might include:

- Identifying and implementing Marine Protected Areas. These include 'real-time', seasonal and permanent closed areas.
- Restricting the range of gears that can be used in vulnerable areas (including creel only areas, a ban on twin rigging in some areas).
- Promoting the development of environmentally friendly fishing practices, for example gears with reduced bottom contact, larger meshes and better selectivity profiles.
- Improving data recording systems to identify capture and damage to endangered, threatened and protected species.

The approaches used to engage with fishers were generally successful against a general feeling of resentment towards the fishery management regime and caution over the discussion of yet more management measures. By gaining the support of the respective chairs of the regional NFFO and ASFA the project was able to compile a list of contact details for fishers who might be interested in providing their views on the recommendation of those established and respected in the industry.

The first round of consultation focused upon one to one interviews with fishers. Because of the limited communication from fishers, the first group consultation of fishers took place on 17 February in Fraserburgh. A second group meeting of industry representatives took place on 23rd February at a Demersal Working Group meeting of the NSRAC. The intention to include group consultation in Fife was precluded by the absence of one to one interviews with fishers registered at ports in Fife and Angus. The response received from Fife was that fishers had no current interest in the Farne Deep *Nephrops* fishery; they were more concerned with safeguarding the *Nephrops* fishery in the Firth of Forth against the alleged effects of large twin rig gears.

A summary of salient points that emerged from the consultation are presented in the following sections 3.3 and 3.4. A condensed review of all responses to the one to one interviews is presented in Appendix 3.

Those fishers who participated in the one to one interviews from August 2011 to February 2012 were invited to provide further comment of the draft report in April 2012. The original intention was to present the draft report to groups of participating fishers at North Shields, Pittenweem and Fraserburgh; however, the poor response in numbers to the original consultation together with a general reluctance of participating individuals to attend a group meeting led to the decision to distribute the draft report for individual comment.

In all, 23 copies of the draft report were circulated on 25 April to fishers and representatives of participating Producer's Organisations and Associations including the Chair of the NSRAC *Nephrops* focus group. Responses were invited by letter, telephone, text or email. Overall 4 fishers and 3 PO's/ Associations responded. Comments received were incorporated into the draft report. This report will be presented by invitation to the NSRAC *Nephrops* focus group at its meeting in York on 28th May 2012.

3.3. Responses received from North East England

3.3.1 The fisheries

The majority of respondents from North East England chose to remain in the inshore waters of Durham and Northumberland throughout the year. They focused primarily on the *Nephrops* fishery during the winter months but relied on demersal whitefish at other times of the year. One fisher diversified into the use of pots for crab and lobster when *Nephrops* or whitefish were unavailable. The majority interviewed deployed single rig gear for *Nephrops* but used the same net at other times of the year, thus underlining the importance of a mixed year round fishery to the local fishing industry.

3.3.2 Single and twin rigs

The use of a single rig trawl with a higher headline height than more selective twin rig gears was justified by the added flexibility this provides to catch whitefish when quota was available.

3.3.3 Environmental impacts of rigs

Many felt that the most significant problem affecting the Farne Deep *Nephrops* fishery was the effect of twin rig gear, especially that of the clump or large central weight that is used between the mouths of the adjacent nets in order to stabilise the gear close to the seabed. It was argued that the heavy weights had a destructive effect on the quality of *Nephrops* habitat and that of associated epifauna and infauna in contrast to the much lighter footrope used on single rig gear. There was strong opinion that a light rubber footrope (a rope sheathed by light rubber discs) had little or no effect on the seabed in contrast to damage attributed to the use of heavy weights deployed on twin rig gear. The majority proposed an outright ban of the use of twin rig gear on the Farne Deep grounds.

Regardless of the size of vessel many opinions from the NE England shared the view that twin rig and larger gears are responsible for a significant degree of damage to the soft mud and sandy mud habitat, benthic invertebrates such as heart urchins that had been observed floating on the surface by some fishers and the burrow systems constructed by *Nephrops*. They also reported an unusually high occurrence of damaged *Nephrops* in their catches when twin rig gears were operating in the vicinity.

It was reported that one boat had reverted back to a single rig net as the perceived benefits of greater catches from twin rigging had proved uneconomical due to the cost of additional fuel; the skipper found that for his boat towing two nets in a twin rig formation did not return a 100% increase in catches over those provided by a single net.

3.3.4 Inshore vs offshore fishing

All interviewed skippers registered in NE England were highly defensive of the Farne Deep fishing grounds stating that they were unable to steam safely to other grounds further offshore and that larger boats had greater flexibility to fish on larger offshore

grounds such as the Fladen. All skippers interviewed were keen to point out that the actual fishing grounds of the Farne Deep represented only a very small percentage of the area defined by the boundary of the Farne Deep FU. They felt that management decisions regarding the Farne Deep FU were not representative of the issues affecting the fishing grounds as they represented only a small proportion of the area defined within the FU boundary (Figure 1.).

3.3.5 TACs

Interviewed skippers of boats >10 m were against the allocation of TAC by functional unit, preferring instead a unilateral approach to setting a single TAC for *Nephrops* in the North Sea. They felt that a TAC at FU level would restrict access to the Farne Deep at times when it may not be cost effective to operate in other functional units further offshore. All skippers interviewed were keen to safeguard the *Nephrops* resource and mud habitats of the Farne Deep grounds although opinions were split between a North Sea wide TAC and TACs at the FU level. Many of <10 m boats argued that they could not operate safely in offshore areas and that navigational safety in inshore waters was often compromised by the high numbers of larger visiting boats on the Farne Deep *Nephrops* grounds.

3.3.6 Gear selectivity and modifications

The skippers interviewed had confidence in square mesh and large mesh panels in the net as currently agreed, but there was resistance to the suggestion of additional selection grids such as the Swedish grid on the grounds that it was not designed to operate in a mixed fishery and presented an unacceptable risk to safe working, especially in the <10 m fleet. The use of grids is controversial. Many local boats from NE England have adequate quota to cover a mixed fishery on the Farne Deep and the use of grids makes a mixed fishery unviable.

It was thought that the larger Scottish and Irish vessels visiting the grounds tend to have little whitefish quota to cover their catches and this leads to discarding. By keeping their cod catch below 5% of the total landed, >10 m boats taking this option are allocated 200 fishing days a year. Within the local mixed fishery >10 m vessels landing in excess of 5% cod are allocated 100 fishing days a year. If vessels wish to claim 200 fishing days a year for landing less than 5% cod they should have to work gear that selects against the capture of cod.

Current proposals for improved selectivity of gear only apply to >10 m boats. The regulation appears to ignore the large number of <10 m vessels operating in the Farne Deep *Nephrops* fishery. If further selectivity measures are to be enforced within the fishery they should apply to all vessels to be effective.

Some fishers favoured low headline heights to allow some species of fish to escape while others preferred to maintain a greater degree of flexibility in the way their gear fished in order to retain valuable whitefish when quota was available for them. All were supportive of reducing discards and improving the marketable quality of the catch via new gear designs in preference to the application of further mesh panels and grids to existing nets. Simple gear design principles could be used to successfully reduce negative effects on habitats and biodiversity.

3.3.7 Days at sea restrictions

There was a view that the whitefish resource, especially that of cod, is improving. Any suggestion of further restrictions on days at sea was not welcomed. However, approximately half of those interviewed considered that a 'days at sea' restriction in the region of 170 days per year could work if they were allowed to land all of their marketable catch. The current level of quota restrictions on cod in particular was felt too restrictive leading to unnecessary discards of a valuable whitefish by-catch.

3.3.8 Record keeping

In respect of record keeping all skippers interviewed were of the opinion that the current level of detail required by landing sheets was adequate. The eLog system was universally unpopular particularly for the purpose of recording the time a boat leaves or enters port. It was felt that more effective measures to monitor the movements and activity of boats could be achieved remotely; e.g. via satellite tracking and GPS applications. Some were aware that additional detail on discards and rare species caught would be useful but felt that the time required to provide such information to a constant reliable standard (including training where necessary) was not available, especially on smaller boats landing their catch on a daily basis.

3.3.9 Area restrictions

In terms of area restrictions it was felt by all that the Farne Deep *Nephrops* grounds were too small for the imposition of area closures while keeping the fishery operational. There was little support from those interviewed for Marine Protected Areas (MPA) or the provisions of the Marine and Coastal Access Act 2009 with regard to Marine Conservation Zones. Many of those interviewed felt that the Net Gain consultation did not take sufficient account of the economic needs of the fishing industry and that the whole process towards site selection was largely predetermined and had been pushed through too quickly.

Some were aware of the publication of draft MPA site boundaries off the Northumberland coast and a compromise may have been reached with conservation organisations regarding the fisheries off the Farne Islands. Some were of the view that marine conservation would stop at nothing but a blanket ban of fisheries in the North Sea and "the preservation of the North Sea as an aquarium."

3.3.10 Conservation and environmental knowledge

No interviewees were able to identify epifaunal or infaunal invertebrates of conservation importance, and knowledge of species of conservation importance below group level; e.g. skates, rays and dogfish, or corals, was generally limited. In contrast, detailed knowledge of tidal and wind driven currents, the distribution of bottom types, the seasonality of fisheries and the behaviour of target species in response to environmental cues was widespread, thus indicating an over-riding professional concern for operating a profitable and financially sustainable business model.

3.4. Responses received from Scotland and Northern Ireland

3.4.1 The fisheries

Generally, interviewed skippers of boats visiting or with a previous record of visiting the Farne Deep seeking *Nephrops* were able to fish other grounds including those offshore in European seas. Many targeted *Nephrops* year round in preference to mixed fisheries as the whitefish quotas were too restrictive. They were also prepared to steam to grounds throughout the year where the fishing profitability was at its best. All except one used twin rig gear from boats ranging in length from 14 m to 21 m and power rating from 242 kW to 500 kW.

3.4.2 Quota

Some fishers interviewed received their quota allocation from a Producer's Organisation and utilised it within the PO's pool system; however, some PO members preferred to opt out of such cooperative working and to utilise their quota allocation independently. The buying or leasing of additional quota would be undertaken if it was available and the market was providing demand for the catch.

In order to provide clarity on quota management for the purpose of this report the SFO website advises that it purchases a number of quota entitlements. In addition, the SFO enters into a number of agreements to lease quota for the benefit of its members. Prior to the introduction of Fixed Quota Allocations, the SFO agreed that its members could acquire additional quotas for their own use and a number of members have now taken advantage of this provision. Any SFO member with disposable add on quota can offer it back to the SFO membership.

3.4.3 Twin rig environmental impacts

Twin rig gears are generally rigged for minimal environmental impact to the seabed although a variety of clump designs were used. These ranged from chain mats and rollers designed to spread the weight over a greater area when in contact with the seabed to chain balls that had a smaller contact patch with the seabed but could potentially have a greater disturbance effect. Rigging for minimal environmental impact usually included measures to improve selectivity for *Nephrops* such as a low headline height, minimal cover of the headline and top panel over the footrope, and square mesh panels. Different nets or the same net rigged to suit conditions were used on different grounds throughout the year.

In response to claims from skippers deploying single rig gears that the clump of twin rig gears was having an effect on habitat quality, twin rig skippers interviewed responded with concern that the trawl doors had a greater effect on the seabed. Offshore grounds beyond 12 nmi in international waters are open to much larger vessels that can tow larger and heavier multiple rig gears with heavier weights. If the problems reported of the clump ploughing in the burrows and spoiling the Farne Deep were true, then some skippers interviewed were of the opinion that more significant effects would have been evident on the offshore grounds where heavier gears operate in greater numbers and for longer periods.

The offshore grounds were felt to be able to remain productive despite the presence of large multi-rig vessels working them. A twin rig trawl when set up correctly with a light footrope it was claimed does not damage the seabed to the levels suggested. The general opinion was that trawl doors and clumps skim the surface and rarely dig in over level ground. The last thing fishers interviewed wanted to do was to destroy their resource; i.e. the *Nephrops* grounds and the mud habitats where they live.

3.4.4 Discards and by-catch

If an over-riding problem were to be identified it would most likely be that of by-catch and discards. If fishery managers were to recognise the increased abundance of whitefish on the grounds, and increase quotas as a consequence, then the problem of discards of marketable fish would also be addressed. The majority of skippers interviewed were keen to point out that the Scottish fishing industry had invested a significant amount of time and money into alternative gear design and sea trials in order to improve the selectivity of nets for *Nephrops*. The collective aim of the work was to allow juveniles and non-target species to avoid the gear altogether as escapees often suffered fatal levels of physical trauma or infection of damaged tissues once they had passed through the meshes of a net. This was seen as the most important management step that interviewees would like to see taken however time should not be wasted on selection grids.

During the consultation it was reported that the results of trials with an alternative inclined panel in the net were good off the east coast of Scotland, but unsatisfactory off the west coast due to fouling with weed. Many felt that in response to the time consuming development of complex and potentially costly modifications and adaptations of their nets, net avoidance by non target fish should be the primary consideration, not escape.

3.4.5 Stock assessment and monitoring

The quality of stock assessments needs improvement particularly with reference to the timing of surveys to the fishing season, the state of tide during surveys (strong tides¹¹ and poor weather can affect emergence behaviour of *Nephrops*), matching gear to vessel characteristics and the knowledge and experience of fishing mates on board research vessels. Other steps included the improvement of integration of research and industry data for the purpose of *Nephrops* stock assessments. The assumption of 1 *Nephrops* per burrow during the underwater TV stock surveys was considered by all to be too conservative.

A proposal to increase monitoring of stocks by scientists and regulators was not well received unless catch and landings data supplied from fishers could be better represented in analysis and decision making. The potential for collaboration between fishers and science re: stock assessment was raised. There was interest in exploring the possibility of commercial fishers acting as fishing mates on board research vessels during periods of tie up due to days at sea limitations and quota restrictions.

¹¹ The influence of tide on catches was noted by Bella et al. (2008).

3.4.6 Catch restrictions in general

Many skippers interviewed were of the opinion that the Farne Deep *Nephrops* fishery was not the subject of any specific problems and that it should retain open access to all without restriction. A minority were of the opinion that larger boats were affecting habitat quality on the *Nephrops* grounds; however, there was general consensus that *Nephrops* grounds must be fished in order to keep them productive.

Unreserved access bans tended to lead to changes in habitat quality that reduce catch rates and abundance of the target species. If effort restrictions are to be imposed, a ban on fishing at night may prove effective. The larger twin rig vessels tend to operate 24 hours/ day to cover costs and although there is evidence to suggest that *Nephrops* in shallow water emerge at night (see Aguzzi and Sardà, 2008), the majority of fishing activity by smaller boats on the Farne Deep occurs during daylight hours.

Based on past performance, the opinion of skippers interviewed on the future of the Farne Deep *Nephrops* fishery was that it appears secure. Overall, evidence from the sustainability of *Nephrops* fisheries in the North Sea was felt to indicate that the grounds are not at risk. Many were of the opinion that the present level of fishing pressure on the Farne Deep *Nephrops* fishery is only a fraction of what proved to be sustainable in the past. There was no need to restrict fishing pressure. The North Sea *Nephrops* fisheries should be kept as open access with no specific TAC at the level of FUs.

3.4.7 Impacts of cod recovery

The increase in the amount of whitefish seen in recent years was a concern. All were aware that cod in particular tends to prefer *Nephrops* as an important component of diet. Increased predation could therefore have a greater effect on the *Nephrops* stock than the levels of fishing in recent years. A number cited reports from the Newfoundland Banks that cod was showing a recovery, but fishers who have adapted to fish for *Pandalus* prawns, crab and scallops since the cod fishery collapsed are very concerned that the return of cod may affect what is actually a more profitable fishery for shellfish.

3.4.8 Area restrictions in general

The general consensus was that the current 6 and 12 nmi boundaries are well established and were all that was required. Areas with a long history as fishing grounds should remain as such and be managed sustainably. The MPA process appeared to be a reaction in favour of the conservation organisations although many conservation organisations do not appear to understand how demersal fisheries can act to manage and maintain habitats on fishing grounds. Skippers interviewed were keen to point out that they did not trawl on the hard reefs that were of particular conservation interest. Fisheries had coexisted with areas of conservation interest for centuries.

3.4.9 Offshore wind farms and MCZs

Some respondents pointed out that the development of offshore wind farms had gone ahead largely unopposed and that these were likely to have a significant effect on access to fishing grounds. *Nephrops* grounds further offshore could be affected by the MCZ proposals as the offshore MCZs tend to be larger. General concerns were for the effects that buffer zones around MCZs/RAs could have on access to fishing if they overlap with established fishing grounds in the vicinity of offshore wind farms.

3.4.10 Seasonal restrictions

In terms of seasonality, most skippers interviewed of twin rig boats <10 m were of the opinion that they fished on different grounds at different times of year to reflect the emergence and availability of *Nephrops* in UK seas. Until there was a better understanding of *Nephrops* biology that showed a detrimental effect from fishing on stocks at functional unit level at particular stages of the reproductive cycle and early life history, any call for seasonal restrictions would be unsubstantiated.

3.4.11 Vessel size restrictions

Some fishers from distant ports proposed that vessel size restrictions on twin rig gears within 12 nmi of the coast based on engine power limitations (ie. using lighter twin rig gears within 12 nmi), may prove beneficial to stability in the stock and improved yields over the longer term.

3.4.12 Record keeping

Manual reporting in logbooks was reaching the stage where all the information required could not be completed before the boat entered port and the requirements of the e-Log system recently introduced were taking some time to settle in. Most interviewees were of the opinion that any additional requirement to provide further information on movements to and from port, and of catch composition should be as automated as possible. Any further requirements for manual recording could present an unacceptable risk to navigational safety and modern aides to marine communications were more than capable of event logging.

4. The Sustainable Fishing Plan

4.1. The time frame of the SFP

Given the mixed nature of the Farne Deep *Nephrops* fishery, the early positive signs of the Cod Management Plan and the erratic nature of *Nephrops* landings since 2006 it is clear that trawl fishing off the North East coast of England will continue in the short term so long as there is a marketable product. Set against this backdrop, the overall goal of the SFP is to ensure that the *Nephrops* fishery regains stability and establishes sustainability over the long term from that stable platform.

In order to help facilitate the development of management measures we propose that an annual summer workshop attended by representatives of each stakeholder group (e.g. NSRAC, Fishers' Associations and POs, MMO, CEFAS, Marine Scotland, DARDNI) would facilitate the exchange of information and development of instruments designed to meet the agreed objectives. Any requirement necessitating significant financial investment by fishers would need to be tabled and agreed 12 months in advance of implementation within the fishery thus allowing adequate financial planning within the industry.

Present rules under the Cod Management Plan, and UK obligations to the Marine Strategic Framework Directive and CFP reform need to be incorporated in the SFP. We see the implementation of the SFP for the Farne Deep *Nephrops* fishery as a gradual sequential response to risk over a period of 5 years; it is unlikely that a plan can come into force until the CFP reforms have been implemented in 2013, as those reforms change the management framework substantially. The SFP must be responsive and adaptive, changing as circumstances change. SFP performance should be reviewed annually.

In order to stabilise and improve recruitment to the stock and hence landings we propose that subject to conditions, the fishery should continue during the 5 year period within the current annual stock monitoring framework. A 5 year period is considered appropriate because the full effect of the measures suggested will not be realised until juvenile *Nephrops* from the 2010 and 2011 year classes have reached sexual maturity and have had the opportunity to spawn.

4.1.1. The Cod Management Plan

The NSRAC is in the process of submitting comments to the European Commission and member states on the future of the Cod Management Plan for the North Sea. In the North Sea fishing mortality for cod has declined and spawning stock biomass has increased, however the Cod Management Plan has yet not delivered overall the large reductions in fishing mortality that it was intended to achieve in the North Sea.

The NSRAC has suggested that the automatic reductions in effort for the North Sea as required by the current Cod Management Plan be reconsidered. Advice should be sought from STECF and the RACs on alternative and better measures for reducing cod mortality. Pending a full revision of the Cod Management Plan it is suggested that advice should be sought from STECF and the RACs on ways of strengthening

the Plan in the short term to achieve the reductions in cod mortality being sought. Those provisions of the Plan that have been demonstrably at odds with the objective of reducing fishing mortality must be removed as soon as possible and replaced by more satisfactory provisions. Initiatives to reduce discarding of cod must also be encouraged.

4.1.2. Marine Strategy Framework Directive and CFP reform

Key requirements of the Marine Strategy Framework Directive (MSFD) are set against a time frame that lends itself to the establishment and implementation of the SFP. The key requirements of the MSFD are:

1. An assessment of the current state of UK seas by July 2012.
2. A set of detailed characteristics of Good Environmental Status for UK waters, the means by which Good Environmental Status will be achieved with associated targets and indicators by July 2012.
3. Establishment of a monitoring programme to measure progress toward Good Environmental Status by July 2014.
4. Establishment of a programme of measures for achieving Good Environmental Status by 2016.
5. Achievement of Good Environmental Status in Europe's seas by 2020.

Set against these time frames are the proposals for CFP reform that will enter into force in 2013. Against this background of change it would be premature to draft a fixed SFP now. Rather, we can put forward suggestions for the plan and mechanisms for refining a plan to fit within any new management arrangements for the North Sea.

4.2. The objectives of an SFP

Below we identify the biological and ecological objectives that are considered applicable to the principles of a SFP for the Farne Deep *Nephrops* fishery and, in the following section, the instruments by which they might be achieved. These measures are informed by the draft LTMP, scientific and other research literature, ICES advice on stock assessment of the Farne Deep FU, the current scheme rules under the Scottish Government's Conservation Credits scheme, the Days at Sea Scheme 2012/13 cod recovery zone scheme rules under the administration of the MMO, and the industry consultation undertaken as part of this study. Using the format of the draft LTMP, we summarise the biological and ecological recommendations of the SFP (Tables 2 and 3).

4.2.1 Biological objectives

Under international obligations, the European Commission must restore fish stocks to levels and conditions in which they are capable of providing maximum sustainable yields (MSY)¹², MSY being defined as the largest average catch or yield that can

¹² At the Johannesburg World Summit on Sustainable Development the European Commission and Member States signed up to the aim of achieving a maximum sustainable yield (MSY) for depleted stocks by 2015. Research has shown that management based on maximum sustainable yield (MSY) could restore 80 % of the European fish stocks currently affected by overfishing.

http://europa.eu/legislation_summaries/maritime_affairs_and_fisheries/fisheries_resources_and_environment/l66037_en.htm

continuously be taken from a stock under existing environmental conditions. In practice, this has been widely interpreted as the maintenance of stocks at a healthy size, fished at a rate that will, on average, deliver their maximum sustainable yield, i.e. with a fishing mortality F set at F_{MSY} .

An important role of the SFP must be to match overall fishing capacity to the MSY; fishing must be at a level which will allow the *Nephrops* stock to replenish itself. STECF has stressed that LTMPs should be developed with the objective of achieving high long-term yields and low risk to the stocks. In addition, the qualitative descriptors for determining good environmental status prescribed under the MSFD identify that populations of all commercially exploited fish and shellfish are to be within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock by 2020.

Fishing at this rate for *Nephrops* is estimated to be equivalent to capturing 10 -15% of the standing stock each year, the actual figure itself being determined from underwater TV surveys. However, a proportion of that stock will consist of undersized animals. The proportion of the harvestable stock which can be taken is more likely to be in the region of 30% of the standing stock.

STECF has suggested that there are wide benefits to be gained from the North Sea *Nephrops* fishery as a whole moving progressively towards lower fishing mortalities giving higher yields. It has recommended a precautionary target for fishing mortality should be adopted for North Sea *Nephrops* until a better value for F_{MSY} can be derived. Setting a target value for fishing mortality below the observed maximum would result in lower fishing mortalities than those currently prevailing. Fishing mortality reference points for the Farne Deep *Nephrops* fishery under ICES Advice for 2012 have not yet been provided (ICES, 2011).

It has been acknowledged by some fishers that it would be useful to set trigger points to enable fishing mortality to be adjusted in the event of a sudden collapse or increase in the stock. That trigger point might be based on results from the underwater TV surveys and the size distribution of *Nephrops* in the catches. ICES could provide advice on how a trigger level might be set and how an appropriate new value might be arrived at for circumstances where *Nephrops* become substantially less, or more, abundant.

There is some agreement that a biomass trigger point ($B_{TRIGGER}$) needs to be set which will prompt a revision of the target value for fishing mortality. A value for $B_{TRIGGER}$ for *Nephrops* on the Farne Deep is currently set at 879×10^6 *Nephrops* based on the most recent underwater TV survey data (ICES, 2011 and Appendix 4). In order to ensure that the SFP is adaptive, an appropriate management response would be to reduce the target value set for fishing mortality in line with the decline in biomass. The intention is to monitor developments in the stock from landings and market sampling data and to look at the implications of any increase in natural mortality upon the fishing mortality reference point.

During the consultation some fishers expressed concern about the accuracy of the stock assessment and the scientific advice based upon it. Nevertheless, based on the experience of 2006 when fishing effort increased markedly, many local fishers

accept that Farne Deep FU is vulnerable to over-exploitation and that steps must be taken to minimise the impact that over-exploitation can have.

In order to recognise this, the SFP must set out how potential damage might be limited. One issue is whether the Farne Deep fishery is always likely to be vulnerable and whether it should receive some permanent and specific form of protection.

If the SFP is to be consistent with ICES and STECF advice, management at FU level must be introduced with the aim of safeguarding against stock depletion.

There was little if any support from fishers for the allocation of a TAC at FU level. Visiting fishers with larger vessels are currently able to switch their efforts to other FUs and this flexibility is regarded by them as a valuable. Moreover, allocating TAC at FU level has some disadvantages in terms of conservation. Fishers might deliberately target particular grounds to safeguard grounds closer to home ('gaming'). Instead, the SFP for the Farne Deep proposes that specific measures should be adopted which properly reflect the degree of risk to resident and visiting fishers.

The SFP identifies three biological objectives:

- To exploit *Nephrops* at rates which are sustainable by setting a target fishing mortality (F) consistent with that of maximum sustainable yield (F_{MSY}). Current ICES advice for 2012 (ICES, 2011) is an annual harvest rate of 8% of standing stock = 1300 t.
- Set a threshold [trigger] level of biomass at which F_{MSY} and the harvest rate must be reviewed (currently 879×10^6 *Nephrops*).
- Set TAC at North Sea level but allocate whole or part of the quota for individual vessels to the Farne Deep.

4.2.2. Ecological objectives

A key aspect of the SFP is to minimise impacts on the ecosystem and to promote stock recovery. Ecological sustainability is an important aspect of the SFP. Management practices should be set so as to maintain ecological processes and minimise impact on other species and on habitats for the long-term future benefit of the fishery.

Consultation with fishers has identified concern for the effects of increased abundance of cod and other *Nephrops* predators within the mixed fishery. The North Sea is currently moving from a state where species such as cod that prey upon *Nephrops* have been at a very low level, to a state where cod are becoming more abundant. Many fishers on the Farne Deep rely on a by-catch of demersal species including cod throughout the year (including the *Nephrops* season) when quota is available. It is necessary to take account of the potential for increased predation on *Nephrops* and other changes to the ecosystem which may have a significant future effect upon *Nephrops* stock and the demersal species that prey upon them.

It is important that emerging year classes of other species of fish should not be subject to mortality as by-catch in the *Nephrops* fishery. The risk of catching whitefish is currently intended to be reduced by the imposition of catch composition rules and by the application of measures to improve the selection of *Nephrops* and reduce catches of whitefish. Vessels legitimately targeting *Nephrops* may catch quantities of haddock, whiting and cod but they may be forced to discard marketable fish to comply with the catch composition rules. The present consultation indicated that catch composition rules are seen by fishers as being unnecessarily restrictive. Fish are not caught in regular and predictable neat numerical proportions and the setting of catch composition rules leads inevitably to discarding. Fishers have asked that consideration be given to alternative solutions for reducing discards, for example 'land all that you catch' in return for fixed days at sea, or measures improving gear selectivity when deployed in a mixed fishery.

In response to the requirements of the MSFD it is also recognised that there is a need to reduce the impact of the *Nephrops* fishery on threatened, endangered and protected species, especially the potential for effects of bottom disturbance from *Nephrops* trawls to affect the biodiversity of sensitive benthic communities. Parts of the seabed with a soft substrate where *Nephrops* are found are likely to be highly diverse, productive and of high ecological value.

Referring to the qualitative descriptors for determining Good Environmental Status as required under the MSFD, we consider that three are directly relevant to the ecological objectives of the SFP:

1. Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.
2. All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.
3. Sea floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.

The SFP identifies three ecological objectives:

- Reduce by-catch and discards.
- Minimise damage to threatened, endangered and protected species.
- Minimise impacts on benthic habitats and associated communities.

Common to each of these objectives is a long-term aim of reducing fishing pressure on non-target species by whatever means are available. The development and implementation of environmentally friendly fishing gear and fishing practices must be encouraged to minimise impacts on the ecosystem. It is recognised that the Scottish fishing industry is taking a lead in this process.

4.3. The instruments of the SFP

4.3.1. Biological instruments

In order to achieve its biological objectives, the SFP proposes that fishing mortality should progressively be moved to a target fishing mortality of F_{MSY} . It has been suggested by ICES that this be achieved by setting an F below the observed maximum, i.e. between $F_{0.1}$ and F_{MAX} . The target is to be reached gradually, through annual incremental management of F . If stock abundance falls to a level at which recruitment in coming years is likely to be significantly impaired, the SFP suggests that fishing mortality be reduced in line with the reduction in stock size indicated by the underwater TV surveys. If recruitment improves and stock size increases, then F should be increased in line with that.

Both fishers and scientists have expressed concern over the state of stocks in the Farne Deep and have asked how these grounds might be protected against the heavy invasion of fishing effort which has characterised the fishery in recent years. It is appreciated that some local fishers do not have the option of fishing elsewhere because of the operational restrictions of their <10 m vessels. Although some flexibility in the ability to roam between different areas is considered advantageous and is provided for under the CFP, in the case of the Farne Deep heavy effort has been concentrated into a small area and this has jeopardised the *Nephrops* fishery.

ICES and others have also laid great stress on the need to safeguard FUs against local depletion. Although the draft LTMP proposes that a TAC should be set for the North Sea as a whole, vulnerable FUs such as the Farne Deep may benefit from conservation measures based on the particular circumstances prevailing on the grounds that can be adopted under the SFP to protect the *Nephrops* fishery. The consultation of fishers discussed the problem of defining acceptable protective measures via gear design and effort controls based on vessel size or power within set distance from shore.

One solution to preventing sudden influxes of fishing pressure into the Farne Deep would lie in allocating quotas to fish the Farne Deep only to those fishers with a track record on that ground. Alternatively, fishers might be required to declare which areas their quotas will be caught in. Currently, vessels from the Irish Sea and other areas are able to gain access to North Sea quota by trading with North Sea POs. Against this approach, there is a strong view that restricting fishers in terms of the areas they can fish would further reduce the flexibility of the fleet, especially that of vessels >10 m length. We think that these quota restrictions are worthy of further consideration, but recognise that there are many difficulties which stand in the way of their adoption.

We highlight the concern expressed by some fishers over the alleged damage being done by larger twin-rig vessels using heavy 'clumps' that are considered capable of damaging the seabed. The risk of damage from the deployment of damaging gears to the relatively narrow strip of *Nephrops* grounds in the Farne Deep FU cannot readily be resolved through agreements that directly favour smaller local vessels deploying lighter gears. Many of the fishers deploying heavier gears come from ports some distance away, but some are registered locally. It has been suggested that the

problem might be resolved through the adoption of additional ecological conservation measures aimed at reducing the impact of more damaging gears.

Concern was expressed by some fishers that vessels from non-UK EU member states fishing the Farne Deep did not operate according to the same conservation rules as UK vessels. They hoped that the SFP would indicate that fleets operating in the Farne Deep FU should abide by the same rules. The current system was seen to be unfair to those fishers who had been required to adopt stringent conservation measures that were not applicable to others. The solution to this problem is beyond the scope of the present study. Furthermore, landings from the Farne Deep by non-UK vessels are small (Table 1) and the UK holds the greatest allocation of *Nephrops* quota.

Some fishers favoured a solution to preventing over-fishing of the Farne Deep based on restricting the horsepower of vessels fishing the Farne Deep grounds within 12 nmi of shore. Some favoured restricting the gear types that could be used there. They suggested that there is a need to protect small-scale fishers who are having less effect upon the stocks. At the smaller ports, the view of restricting fishing to single rig trawls and placing a ban on twin or multi-rig trawls was strongest, although those fishing twin rigs felt that the grounds for such a ban were unsubstantiated. They considered that twin rig gear offered improved selectivity over single rigs, was more fuel efficient, and would not damage the seabed any more than single rig gear if set up and fished correctly.

Earlier consultation of fishers by NSRAC for its draft LTMP for North Sea *Nephrops* identified the possible option of a maximum gear spread (e.g. 280 feet) that could be fished with a single trawl or twin rig. Others consulted for the draft LTMP thought this would be too difficult to enforce. Another solution identified in the draft LTMP was to restrict days at sea based on the type of gear used. However, in both the LTMP and SFP consultations there was a general plea from fishers not to introduce too many restrictions.

This SFP proposes that the following instruments be discussed further in support of the biological objectives:

- A cap on the size or engine power of vessels permitted to fish within 12 nmi from shore or gear restrictions, e.g. restricting gears to single rig or vessels towing twin rig to those with <500 hp within 12 nmi of the coast.
- Designation of permitted vessels (based on historic activity) allowed to fish in specific areas e.g. inshore and/ or offshore grounds.
- Linkage of all or part of vessel *Nephrops* quota to the Farne Deep dependent on track record on the Farne Deep and in other FUs.
- Temporary, seasonal or real-time closure of the FU or areas within it dependent on the level of landings or the *Nephrops* standing stock.

4.3.2. Ecological instruments

The SFP has set three ecological objectives. It proposes that there should be a reduction of discards in the fishery; minimisation of damage to threatened,

endangered and protected species; and minimisation of impacts on benthic habitats and associated communities.

Discards of undersized *Nephrops* and juvenile whitefish are generally acknowledged as a problem in the Farne Deep *Nephrops* fishery. Small *Nephrops* which are below the minimum landing size are caught especially by the 80 mm fleet and are discarded. There was discussion at the ports of whether there might be benefits from removing the MLS restrictions and landing all *Nephrops* (and other marketable species). It is generally accepted that those *Nephrops* being discarded do not survive and there are also advantages to fishers in not targeting small *Nephrops* as they are difficult to process.

Although there are undoubted advantages to removing MLS restrictions and landing all *Nephrops*, there are obstacles to achieving this. However, an incentive for reducing the proportion of small *Nephrops* in the catch by moving away from areas where small *Nephrops* are abundant would be difficult to operate and monitor on small fishing grounds such as those of the Farne Deep. The alternative appears to be the adoption of more selective fishing gears. There would be advantages from landing the whole *Nephrops* catch in terms of providing valuable data to fisheries scientists. One major problem is that the smaller vessels do not have sufficient hold capacity to retain these small *Nephrops* for landing. Moreover, it is not possible to tackle this problem through an increase overall mesh size because that would render the vessel liable to classification as a whitefish vessel.

Fishers in the present survey pointed out that one of the factors causing discards of whitefish is the imposition of tightly controlled and restrictive TACs upon fish species that are abundant. It appears that there is a recurring problem in the *Nephrops* fishery over the discarding of large marketable whiting and codling because of lack of quota. A mismatch between quota availability and whitefish abundance in this area has been identified by the NSRAC.

There are differing views on the potential for technical measures to reduce discarding. Some fishers, especially those based at Scottish ports thought that much was already being achieved through the adoption of square mesh panels and other measures such as overall net design, escape panels such as the 'flip/flap' and 'letterbox', and the inclined grid (in preference to the Swedish grid).

The SFP does not favour catch composition rules, which lead to discarding and are difficult to comply with. The adoption of other measures to reduce discards would allow catch composition rules to be removed. These measures would include as 'land what you catch' in return for reduced days at sea, or tailoring of whitefish quota and days at sea to reflect changes in the distribution of whitefish abundance. We recognise that the development of measures to reduce discards is currently the focus of intense discussion. There is a particular need to adopt appropriate measures and to improve the exploitation pattern within the 80 mm fisheries and the Scottish industry in particular is taking a lead in this area.

It is proposed that targets should be set for reducing discards and by-catches and incentives provided to promote the use of more selective fishing gears in line with the current scheme rules for TR2 vessels. Efforts are being made in Scotland through

the Conservation Credits Scheme, requiring vessels targeting *Nephrops* to use gear with larger square mesh panels (110 mm) and further selective measures such as escape grids and panels being trialled by the Scottish industry with the cooperation of the Seafish Industry Authority.

Fishers interviewed were of the opinion that there was not a significant problem on the Farne Deep in terms of the capture of threatened or endangered species. Elasmobranchs such as skates, rays and dogfish (cat sharks) were not caught in any numbers compared to those observed elsewhere such as the west coast where dogfish were once abundant, although it was acknowledged by fishers that the general absence of specimens in catches may be a consequence of their current low abundance.

It was generally agreed that it is important to monitor the capture of any endangered or threatened species. Some, but not all, fishers welcomed the opportunity to increase observer coverage and/ or CCTV recording, particularly if such measures could be accompanied by an exemption from the effort system, for example allowing those vessels participating more days at sea.

The Farne Deep *Nephrops* grounds are characterised by soft muds and sandy mud which may be susceptible to damage by towed gears. It was said by some fishers that if there was any damage to the seabed then it was likely to come from the heavy 'clumps' associated with twin-rigging. Those fishers interviewed who were towing twin-rigs were of the opinion that the doors were likely to have a greater effect. They added that the clump would only touch the seabed when the gear was fishing effectively. The general impression gained was that the clumps used by the vessels twin rigging from Scotland and Northern Ireland were in the form of chain mats or rollers that were designed to minimise any environmental impact on the seabed. It was claimed that clumps composed of dead weights or balls of chain were not widely used. However, there is currently a lack of evidence on the level of damage done to the seabed by the different gears used to catch *Nephrops*.

Interviewed fishers accepted the need to limit the overall environmental footprint of the fishery; however, they were not supportive of the idea of closing areas to fishing. They suggested that areas already set aside for oil and gas platforms, pipelines, and renewable energy installations already served the purpose of providing areas free from the effects of fishing.

With the European Commission moving towards marine protected areas (MPAs) for conserving vulnerable sea life and habitats, fishers were concerned about the proposed designation of large areas of the North Sea areas as MPAs/ MCZs/ RAs. They were frustrated at the current UK consultation procedures for identifying these areas, where it is a common belief that the boundaries are often designated before the consultation process has begun.

There is little support from fishers for closed areas as a management tool if they are going to be imposed upon fishers. The Farne Deep *Nephrops* grounds were considered too small for such measures by all who had an opinion on the matter. They considered that there is already a heavy burden placed upon fishers through

existing closures elsewhere, including real-time closures such as that imposed on the Farne Deep in February 2012.

Those areas declared under Natura 2000 had been chosen without regard for the impact upon fishers. Fishers have not had a good experience of collaborating with nature conservation agencies and are reluctant to 'volunteer' areas for designation or to collaborate with them. Many interviewed were of the opinion that trawl fisheries in the North Sea had existed for hundreds of years without any significant detrimental effect on the marine environment, its habitats and species. They considered themselves as custodians and managers of the marine environments they operated in drawing similarities with heavily managed terrestrial environments such as open moorland, pine forests, cultivated fields and pastures.

All were of the opinion that areas of hard ground that were unsuitable for trawling were generally more species rich and diverse than the mud and soft ground providing *Nephrops* habitat. The hard ground was not of commercial interest to trawlers and was left well alone. Some fishers commented that there were examples where the fishing industry had worked well in cooperation with the conservation agencies; e.g. provision of information on the location of specific habitat types and coral species on the Rockall Bank had resulted in solutions satisfactory to all parties. However, during the Net Gain consultation there had been a general distrust of those bodies responsible for defining MPAs.

This SFP proposes the following instruments in support of the ecological objectives:

- The continued development of improved gear selectivity via:
 - Larger mesh and square mesh panels inc. appropriate selection grids in the main part of the net to assist escape of undersize fish.
 - Low headline height and reduced headline cover to assist net avoidance by non target species.
 - Footrope and clump adaptations to reduce gear impacts on the seabed.
- Improved management of whitefish quota to reflect spatial and temporal changes in the distribution of whitefish abundance.
- Ensure that landings are within quota and demonstrate this through accurate logbooks and landing slips.
- Monitor the capture of endangered or threatened species, if necessary via observers and/ or CCTV recording.
- Any real time closures to protect spawning grounds or aggregations of juvenile fish to be set away from the comparatively small area of recognised *Nephrops* grounds.
- Improved monitoring of the seabed during the winter season to determine the extent and significance of disturbance caused by different gear types.
- Improved understanding through research of the breeding cycle and factors affecting recruitment of *Nephrops* to the Farne Deep stock.

Table 2. A summary of the biological objectives and instruments of the SFP.

Biological Objectives	Instruments for further discussion
<p>Exploit <i>Nephrops</i> at a rate which is sustainable by setting a target fishing mortality (F) consistent with that of maximum sustainable yield (F_{MSY}). F_{MSY} to be reached incrementally subject to annual review from 2013 to 2017.</p> <p>Current ICES advice for 2012 is a harvest rate of 8% (or 1300 t). If stock abundance falls to a level at which recruitment is likely to be significantly impaired, then F should be reduced in line with the reduction in stock size indicated by the underwater TV surveys annually.</p> <p>If recruitment improves and stock size increases annually, then F should be increased accordingly.</p>	<p>Subject to evaluation by STECF, measures for limiting fishing pressure would be prepared and proposed by the relevant authority with the support and participation of the fishers who fish the Farne Deep.</p> <p>A cap on the size or engine power of vessels permitted to fish within 12 nmi from shore or gear restrictions; e.g. restricting gears to single rig, or vessels towing twin rig to <500 hp within 12 nmi.</p> <p>Designation of permitted vessels (based on historic activity) allowed to fish in specific areas; e.g. inshore and/ or offshore grounds. Linkage of all or part of vessel quota to the Farne Deep.</p> <p>Temporary, seasonal or real-time closure of the functional unit or areas within it only should conditions dictate.</p>
<p>Set a threshold [trigger] level of biomass at which FMSY and the harvest rate must be reviewed. Currently $B_{TRIGGER} = 879$ million <i>Nephrops</i>.</p>	
<p>Set TAC at North Sea level but allocate whole or part vessel quota to the Farne Deep.</p>	

Table 3. A summary of the ecological objectives and instruments of the SFP.

Ecological objectives	Instruments
Reduce discards in the fishery.	<p>The continued development of improved gear selectivity via:</p> <ul style="list-style-type: none"> • Larger mesh and square mesh panels inc. appropriate selection grids in the main part of the net to assist escape of undersize fish. • Low headline height and reduced headline cover to assist net avoidance by non target species. • Footrope and clump adaptations to reduce gear impacts on the seabed. <p>Improved management of whitefish quota to reflect spatial and temporal changes in the distribution of whitefish abundance.</p> <p>Ensure that landings are within quota and demonstrate this through accurate logbooks and landing slips.</p> <p>Monitor the capture of endangered or threatened species via observers and/ or CCTV recording on participating vessels.</p> <p>Real time closures to protect spawning grounds or aggregations of juvenile fish to be set away from the comparatively small area of recognised <i>Nephrops</i> grounds.</p> <p>Improved monitoring of the seabed during the winter season to determine the extent and significance of disturbance caused by different gear types.</p> <p>Improved understanding through research of the breeding cycle and factors affecting recruitment of <i>Nephrops</i> to the Farne Deep stock.</p>
Minimise damage to threatened, endangered and protected species.	
Minimise impacts on benthic habitats and associated communities.	

5. Recommendations to maintain SFP performance

We see the implementation of the instruments supporting the objectives of the SFP as a gradual sequential process over a period of 5 years. Reform of the CFP is proposed by January 1 2013. This may put new management procedures in place and renders the status of this developing SFP uncertain. It is suggested that there should be further discussion of the plan within NSRAC and with the relevant statutory authorities including the MMO and Defra pending information becoming available on the new CFP regime. It is already evident that there is stronger interest developing in the development of LTMPs, and that the implementation of a LTMP for *Nephrops* must be seen in that context.

Ideally this SFP requires further discussion before more precise management measures can be adopted. We propose that a summer workshop attended by representatives of each stakeholder group (e.g. NSRAC, Fishers' Associations and POs, MMO, CEFAS, Marine Scotland, DARDNI) would allow the exchange of information and development and agreement of instruments designed to meet the agreed objectives. Such an event would allow regulators to present a review of the current stock assessment and its trends, identifying where improvements to the sustainability of the fishery under the SFP might be made.

Once an SFP has been agreed and adopted, the extent to which it was achieving its objectives should be assessed using a combination of indicators designed to measure performance. Possible performance indicators include:

- Level of fishing mortality (with respect to a target F).
- Abundance trends obtained through underwater TV surveys, landings and market sampling data (with respect to the published trigger point for assessing deterioration in the stock).
- Level of discarding and the performance of any discard ban imposed.
- Uptake of gear selectivity improvement measures.

5.1. Improved collaboration between fishers and regulators

During the consultation fishers reiterated an urgent need for the establishment of greater trust and collaborative working between the fishing industry, fisheries scientists, regulators and managers. Conversely, several fishers were of the view that they should just be left alone to operate in a manner that would be governed ultimately by basic principles of economics where only the most successful would survive.

Regardless of the diversity of these views, it is important that there should be no incentive to withhold information from the fishery. The *Nephrops* assessments are not currently presented in a form that can readily be understood by non-specialists, including some fishers and some policy makers. As part of this SFP we believe that in future it will be important to express the results of the scientific assessments and the management objectives in clear every day language so that they may be accessed readily by those responsible for stewardship of the fishery. The annual workshop proposed would provide an ideal vehicle for this purpose as it would for any requirement necessitating significant financial investment. Provisionally, requirements would need to be tabled and agreed 12 months in advance of

implementation within the fishery thus allowing adequate financial planning within the industry.

With regard to implementation of the SFP's biological and ecological instruments, fishers could contribute to the workshop in many ways, for example by suggesting ways in which the instruments could be improved based on direct experience of past performance. Fishers and regulators could also liaise directly regarding the potential future performance of the fishery, and draft agreed recommendations on matters regarding, e.g. changes to gear selectivity or quotas with regard to reducing by-catch and discards, minimising disturbance of the seabed and *Nephrops* burrows, and optimisation of stock assessment survey methodology.

There is a general lack of effort data, especially for the <10 m fleet. In addition to providing information on the numbers and types of vessels and their capacity operating within the fishery from all nations, national authorities should provide clearer information on the distribution of fishing effort by each size class of boat operating in the Farne Deep. A case can be made for mapping of fishing effort by all vessels including the <10 m fleet using VMS and other sources, for protective purposes, to monitor the distribution of effort and to ensure that any displacement of effort to the Farne Deep as a result of MPA and wind-farm proposals can be evaluated. Currently, VMS data are limited to vessels >15 m in length.

5.2. Market sampling

Given the nature of limited understanding of early life history of *Nephrops* the setting of sustainability targets by juvenile indices from catch and underwater TV survey information may prove to be an unreliable measure. On that basis, the output of existing market sampling of landed catches in terms of size distributions as an indicator of age composition, sex ratio and the abundance of berried females present in the catches, coupled with the stock assessment and greater use of underwater TV footage to examine disturbance to the seabed from trawling will provide a more reliable means of monitoring the effectiveness of the biological and ecological objectives proposed when set against fishing effort.

We have already identified the need to monitor the discarding of fish for which a vessel has insufficient quota and to monitor the capture and discarding of undersized species including other crustaceans, fish and small *Nephrops*. There is also a need to improve data recording systems to capture fishing interactions with endangered, threatened and protected species. Some small *Nephrops* are discarded. The advantages of removing MLS restrictions on some boats so that they can land all *Nephrops* need to be investigated further against the benefits of an observer scheme. Sampling and data recording of small *Nephrops* would provide scientists with valuable information in support of the stock assessment. If full analytical assessments are to be made then further research will be required either to enable the age of *Nephrops* to be determined, or to employ reliable site specific length or size class based techniques.

Further work is also needed to ascertain whether the current functional unit boundary of FU6 adequately reflects the distribution of *Nephrops* within it; for example, are there other areas that currently are scarcely fished and containing *Nephrops* which should be incorporated into the assessments?

Although potentially more suited to a task for the relevant authority under the Marine Strategy Framework Directive, it is important to monitor the capture of any endangered or threatened species, including skates and rays. It will also be important to determine whether there are particular areas within the FU6 boundary where threatened endangered and protected species and habitats are likely to be adversely affected by trawling for *Nephrops*.

5.3. Determining disturbance of the seabed

There is a lack of evidence on the damage done to the seabed by the different gears used to catch *Nephrops* that needs to be addressed by collaborative research teams comprised of fishers and scientists. Further development and extension of fishery independent surveys, including underwater TV surveys is an important feature of the SFP, not only to aid the assessment of *Nephrops* stocks and the overall fishery management process, but also to play a crucial role in monitoring the fishery's broader ecological performance.

The underwater TV stock assessment surveys offer great potential to determine the type and degree of disturbance by trawl gears to the seabed. In response to calls for a ban on twin rigging, before any restrictions on gear type other than those currently in force can be made it may be necessary to quantify the degree and extent of disturbance to the seabed attributed to single, twin and multi-rig gears.

5.4. Closed areas

Closure of areas to fishing do enable comparisons to be made between fished and un-fished grounds and assessment of seabed impacts of fishing. However, the selection of areas supporting vulnerable habitats must be based on sound scientific evidence.

From consultation it is clear that there is a deep distrust by fishers of those bodies responsible for defining such areas, the most recent example of which was the real time closure imposed in the vicinity of the Farne Deep in late February 2012 in response to undersized whiting being found by officers of the Fisheries Protection Agency during a routine inspection at sea. The closure was put in place to protect juvenile whiting that are likely to have a wide distribution in the region; however, it could have had a significant effect on the *Nephrops* fishery which is much more limited in its distribution.

5.5. Quota management in mixed fisheries

Fish are not caught in neat ratios and management through a series of quotas for individual species does not recognise the reality of conditions on the fishing grounds. The mixed species aspects of managing fisheries have received insufficient attention. Major efforts are required to develop innovative management measures that recognise the diverse nature of the fisheries. Some fishers are interested in supporting initiatives that would allow them to land all their catch. Such initiatives may also influence both gear design and fishing behaviour and should be explored further.

5.6. Predator – prey relationships

An increase in the amount of whitefish seen in catches in recent years was reported by all fishers consulted. All were aware that cod in particular tends to prefer *Nephrops* as an important component of diet. It is possible therefore that increased predation resulting from the increased abundance of whitefish predators could have an effect on the *Nephrops* stock. Work is required to determine the potential effects of continued recovery of cod in particular, upon the abundance of *Nephrops* in relation to the trigger point in the level of the stock at which conservation measures can be taken. The implications of such work also extend towards whitefish quota management and the cod recovery plan. It may be unwise to promote the recovery of one fishery at the expense of another.

Thus, there are a number of research and monitoring requirements for the *Nephrops* fishery to develop, support and achieve the objectives of this SFP. The development and extension of fishery independent surveys, including underwater TV surveys, is an important feature of the plan, not only to aid the assessment of the *Nephrops* stock and aid the overall fishery management process, but also to play a crucial role in monitoring the fishery's broader ecological performance.

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Appendix 1. Sustainable Fishing Plans

A1.1. The National Federation of Fishermen's Organisations (NFFO)

In November 2009 the NFFO described one way of achieving the objective of delegated responsibilities through the mechanism of SFPs. It outlined an approach to SFPs and a delivery mechanism for simplification of the Common Fisheries Policy.

It was argued that as the arrival of co-decision making with the European Parliament required a longer timeframe for fisheries legislation to be adopted there was a greater need to find ways of moving away from a high degree of prescriptive micro-management. The top down system of administration had routinely introduced broad brush measures that had been weakened by derogations required to fit at local level. Within a regionalised CFP, legislation is made closer to the fishery and measures introduced in this way should have greater coherence from the start. Using the rationale outlined below the NFFO was of the opinion that SFPs would provide a way to provide a genuine bottom up approach with appropriate safeguards for fisheries managers.

Regionalisation of decision-making; in particular those decisions that can sensibly be made at the regional scale is an essential development if a more flexible, adaptive, and relevant Common Fisheries Policy. However, if the CFP was to move to a system with a high degree of responsibility and stewardship it would be necessary to move further; i.e. to a system in which responsibilities are delegated to provide greater representation of the fishing industry itself.

The NFFO proposed that the essential approach of delegated responsibility through sustainable fishing plans would be developed by self-defined fishing industry groupings. Producer organisations would be well placed in this respect but similarly the kind of industry groupings that were organising themselves to obtain Marine Stewardship Council accreditation would be the type of grouping with the organisational capacity to develop and submit a SFP.

A SFP would detail how the vessels in that group would fish sustainably over a defined period; e.g. 5 years. Each plan would have to meet certain preconditions and criteria in accord with standards and principles established at European level by the European Commission, Council and European Parliament. They would vary according to the specificities of the fisheries but could be expected to cover all the areas currently dealt with through prescriptive legislation such as technical conservation, quota uptake, discards reduction and seabed impact mitigation.

Once developed in collaboration with fishers, fisheries scientists, managers and economists, respective SFPs would be submitted for approval by the relevant authority. One of the key features would be an obligation to document the vessels' activities in a way that allows for periodic audit and so reversing the burden of proof. Audits would be undertaken by the relevant authorities to confirm that the vessels in the group were complying with the terms agreed. A system of stepped sanctions would apply to groups, whose vessels failed at audit, culminating with the removal of

delegated responsibilities and enforced return to the micro-management system of prescriptive rules.

Each SFP would be largely self regulating as it would be expected that a high degree of social pressure (or internal sanctions) would apply to any individual vessel operator breaking the terms of the group plan, and plans would be adapted over time to take account of new circumstances. The regional management body would oversee the process of producing and implementing the plans to ensure that overall objectives for the fishery were met.

SFP Implementation

The advent of sustainable fishing plans would be an important departure from the CFP in its current form; however, examples from other countries where systems similar to that described were already in operation; for example, Australia operates a system of delegated authority where fishing groups judged capable are offered the option of taking on responsibility for their fishery. A system of graduated responsibility is in effect through which the group can elect to take on partial or full responsibility. For those taking on responsibility, a contractual relationship between the group and the management authorities is put into place. It is possible for groups of fishermen to take on partial responsibilities as a stepping stone to full delegated responsibility. The Australian model recognises a progression through different phases of conflict, cooperation, co-management and delegated responsibility.

A move to delegated responsibility through sustainable fishing plans would be a major step for some fishermen, regulators and fisheries managers. However, the NFFO went on to point out that it was important to recognise that some parts of the fishing industry already undertook quota management responsibilities or other forms of co-management. Whilst some industry organisations were capable of moving quite rapidly to delegated responsibility, for others there would need to be a period of capacity building.

The different levels of preparedness reflect different objective conditions in each segment of the fleet. Capacity building would proceed more rapidly if it were supported financially by the appropriate means. The prime motivation for fishermen to form groups to develop and submit sustainable fishing plans would be to; escape the impact of blunt micro-management measures; to increase the security of their investments and; to take responsibility for the sustainable management of the fishery. It did not extend to the responsibility of consequences should the fishery collapse or its management have significant detrimental effects upon the marine ecosystem; its protected habitats and species.

SFPs and Fisheries Science

Various fisheries science projects across Europe have demonstrated the value of fishermen and scientists collaborating to deliver improvements in data and a shared view of the stocks. Sustainable fishing plans would take this a step further as fishermen and fisheries scientists would collaborate on the design and content of the plans to ensure that each plan would meet approval preconditions.

The NFFO paper envisaged that fisheries science would play a multi-faceted role in the new system, that of; advisors in the development of SFPs prior to adoption; auditors of adopted plans in partnership with industry representatives and the statutory authorities; and impartial stock assessors.

A1.2. The North Sea Regional Advisory Council (NSRAC)

In its draft Long Term Management Plan for *Nephrops* fisheries in the North Sea the NSRAC outlines its expectations of a SFP at functional unit level. Each SFP would be intended to meet the management needs of the particular functional unit and would be intended to fulfil biological, ecological and economic objectives.

The first step in preparing a SFP within such parameters is to ensure that full information is being collected and made available on the vessels engaged in the fishery. This information would summarise the state of the fishery and the state of the resource the fishery depends upon. The SFP should consider how the *Nephrops* stock could be exploited in a sustainable way; in a manner that was fair and equitable to all fishers. The SFP would not be a purely local plan and would not discriminate against particular fishers. Rather, it would set out to curb fishing practices that were unsustainable or damaging to the environment.

An important element of such a plan would be an analysis of how the functional unit had been fished in the past and in the present, and defining which fishing methods were compatible with maintaining a healthy *Nephrops* resource.

If the impact of the fishery has to be reduced it would have to be done in a fair and equitable way. The main elements of the plan would be concerned with protecting the *Nephrops* resource itself. However, it could also adopt wider ecological and economic objectives.

The overall objective of the SFP for *Nephrops* in the Farne Deep functional unit is to match fishing capacity to a long term sustainable yield whilst accommodating fluctuations in the state of the stock. In other words, the SFP will provide a form of management that will take account of local depletions; however, in preference to setting a TAC for the fishery at the functional unit level NSRAC proposes that specific measures should be adopted; e.g. setting limitations to gear or vessel type in discussion with fishers as part of the SFP.

The Farne Deep SFP will also set out how potential environmental damage to this vulnerable functional unit, especially its benthic habitat and associated ecology might be best managed; e.g. the SFP will take account of reducing by-catch and species interactions such as those from the cod recovery plan and other changes to the ecosystem which may have a significant future effect upon the *Nephrops* stock. Similarly, the potential designation of Marine Conservation Zones (MCZ) and Marine Protected Areas (MPA) in and around the Farne Deep functional unit with regard to protected habitats and species and the Marine Strategy Framework Directive will also be recognised.

Appendix 2. The Scottish Flip Flap trawl

The Flip Flap trawl must meet the following criteria:

- a top and lower wing tip double netting section of diamond mesh netting of at least 160 mm mesh size is permitted provided it is no greater than 4.4 m stretched length;
- all top wing netting to be made of diamond mesh netting of at least 160 mm mesh size;
- all remaining lower wing netting to be of diamond mesh netting of at least 100 mm mesh size;
- However, a lower wing bunt netting section (directly ahead of the belly panel) of less than 100 mm mesh size is permitted provided the stretched length is no greater than 4 m and made from diamond mesh netting of at least 80 mm mesh size;
- all top sheet netting ahead of the end tapered section to be made of diamond mesh netting of at least 160 mm;
- guard meshes constructed from double twine netting is permitted to attach the netting panels to the headline, footrope and selvages provided the total number of meshes is no greater than 5 meshes deep;
- the end tapered section to be no greater than 7 m stretched mesh length and made from diamond mesh netting of at least 80 mm mesh size;
- the internal Flip-Flap 'netting' Grid (FFG) must be made from square mesh netting of at least 200 mm mesh size and must be positioned no more than 500 mm from the rearmost meshes of the end tapered section;
- must be no less than 8 open mesh bars across by 10 open mesh bars deep;
- the top 8 x 5 bar meshes to be attached to the top netting section between selvages length for length;
- the lower 8 x 5 bar meshes can be left unattached across the trawls lower netting section but must have headline (or similar) of weight no less than 1kg/m attached around the edges of its full length;
- have an unblocked fish outlet cut out of the trawls top sheet netting immediate ahead of the FFG;
- the opening width of the posterior side of the fish outlet should be no less than 26 x 80 mm diamond meshes (or equivalent) across and cut out to a tip in the forward direction along mesh bars;
- a top sheet square mesh panel (SMP) made from netting of at least 200 mm mesh size must be placed within the end tapered section;
- the SMP must be no less than 3 m long;
- the SMP must have no less than 12 open mesh bars across its width;
- the rearmost meshes of the SMP must be no more than 0.5 m from the forward tip of the unblocked fish outlet.

Appendix 3. Fishers responses to questions.

A3.1. Responses received from North East England.

The following is a compilation of notes from the interviews of fishers registered at ports in North East England.

1. Is it the only area fished? Where are the others?

- The boat only fishes locally off the NE coast of England (x 9).
- The boat also fishes on the West coast but the main target through the year is *Nephrops*. The Farne Deep is favoured because of its proximity to the home port.
- Some boats also operate on the West coast of Scotland but the main target through the year is *Nephrops*. The Farne Deep is favoured because of its proximity to the home port. Processing of *Nephrops* (tailing and freezing prior to distribution) can take place locally.
- We can go as far as 40 miles offshore at other times of the year, but for the winter Farne Deep *Nephrops* fishery our main area of interest is within the 12 nmi limit off the Northumberland coast. We use the same ground for fish in the summer and prawns/ fish in the winter.

2. What gear is used? Does this vary?

- A single demersal trawl is used during the *Nephrops* season and for whitefish at other times. It provides the optimal performance for the size and power of the boat. It has a higher headline height than twin rig gears, but this provides flexibility to catch whitefish when quota is available during the *Nephrops* season (x 6).
- A twin rig system is used for *Nephrops*. It provides the optimal performance for the size and power of the boat and, because of the lower headline height, it ensures cleaner catches of prawns.
- A twin rig system is often used for *Nephrops*, but single rig trawls are more popular with smaller boats that operate closer inshore. Really, it is whatever provides the optimal performance for the size and power of the boat.
- Pots are also used extensively outside the *Nephrops* season for brown crabs, velvet crabs and lobsters.
- A single demersal trawl is used for *Nephrops* and whitefish at other times of year. The cod end is changed to allow us to do this. The net design provides flexibility to catch whitefish when quota is available during the *Nephrops* season (x 2).
- Although the net drum allows us to keep up to three nets available, a 35 fathom prawn net and a 35 fathom fish net are normally carried. This provides flexibility to catch whitefish when quota is available during the *Nephrops* season.

3. Is the vessel targeting *Nephrops* or is it engaged in a mixed fishery? Which are the other species caught or targeted? Which is the most important part of the catch? How is the vessel's *Nephrops* quota allocated (through the PO, bought or leased?).

- *Nephrops* is targeted during the winter, whitefish during the summer months. Other species include cod, haddock and whiting (x 8).

- *Nephrops* is targeted during the winter, whitefish during the summer months. Other summer target species include cod, haddock, whiting. Monkfish, lemon sole and plaice provide additional marketable fish from time to time, and whitefish (cod, haddock etc are becoming increasingly abundant on the *Nephrops* grounds (x 2).
- *Nephrops* is targeted year round.
- The *Nephrops* quota comes through the PO, but additional *Nephrops* quota will be bought if available (x 8).
- The *Nephrops* quota comes directly from the MMO and is adequate for our needs (x 2).
- We work closely with the PO to optimise our opportunities through trading and swapping of quota. Leasing quota in hasn't proved economically viable.

4. Are there any by-catches or discards in the fishery?

- Other species, particularly gadoids are caught in small numbers as a bycatch (x 4).
- Other species, particularly gadoids are caught in small numbers as a bycatch during the *Nephrops* season, but if quota is available for them they provide additional income. Whiting have fetching good prices in the past year (x 2).
- Good sized codling are present in high abundance over the *Nephrops* grounds.
- If quota is available for whitefish as a by-catch [cod, haddock, whiting] they provide additional income otherwise they have to be discarded (x 6).
- My cod quota for September was filled in one day so now I can't go out again until October. It's the same for nearly all the boats operating out of here, and as you can see, they're all tied up.
- Because of the large mesh panel and square mesh panel in the net, by catch and discard of juvenile fish is low (x 2).
- The conservation measures we employ in the net design work to keep the catch as clean as possible. These include large meshes towards the headline and square mesh panels further down the net. When the square mesh panel has been obstructed the quality of the catch can deteriorate significantly so we work hard to ensure that these simple but effective measures are maintained. If the catch is cleaner it takes less time to sort, discards of non commercial species are reduced, and we get a better product to market.

5. Is the fishery seasonal? Are there times when the vessel does not fish there? Why?

- The Farne Deep is a winter fishery (x 3).
- The Farne Deep predominantly a winter fishery although some prawns are being landed as early as August and September (x 6).
- The Farne Deep *Nephrops* fishery is a winter fishery but we operate year round off the Durham and Cleveland coasts. The Cleveland coast is made up of mixed and hard ground and is better for whitefish. *Nephrops* prefer the softer mud found off the Durham coast. *Nephrops* from further offshore (>12 nmi) are landed by other boats outside the winter Farne Deep season although catches appear to be poor this year (x 2).
- We use the same ground for fish in the summer and prawns/ fish in the winter. This year the start of the season is later than anticipated although some prawns are coming in. There are reports of larger boats working the Firth of

Forth *Nephrops* and moving south, so we expect they will be on the Farne Deep in October.

6. Are there any specific problems with the Farne Deep fishery? How might these be resolved?

- The main problem is seen to be the effect that twin rig gear (especially those of larger vessels from outside the region) is having on the grounds, especially those within 12 nmi (x 9).
- The main problem is the effect that large trawlers from outside the region are having on the abundance of prawns on the grounds and the environmental damage done to the seabed by larger multi rig gears (x 2).
- Some boats visiting from distant ports have been fishing within 6 nmi (x 4).
- Some boats visiting from distant ports have been fishing within 3 nmi.
- The large heavy weights used in twin and multi rig gears digs into the soft muds and also causes the foot ropes to dig in also. This destroys the seabed, the *Nephrops* burrows, and does much damage to the *Nephrops* left behind.
- Some large boats visiting from distant ports with twin rig gear have been fishing within 6 nmi. The large heavy weights used in twin and multi rig gears digs into the soft muds and also causes the foot ropes to dig in also. This destroys the seabed, the *Nephrops* burrows, and does much damage to the *Nephrops* left behind.
- Twin rig vessels within 12 nmi are causing the most damage to the inshore fishery and the <10m local fleet. The simplest way to resolve the problem is to restrict access of twin rig boats to inshore grounds and to keep them outside the 12 nmi limit. The areas they work systematically as a pack are barren afterwards.

7. What is the future for the Farne Deep fishery, and for the wider North Sea fishery?

- The future of the Farne Deep *Nephrops* fishery is at risk because of the effects of larger boats coming in from elsewhere for easy fishing. Subsequently, larger grounds further offshore are seen to be at less risk; however, small boats can't fish the offshore grounds safely.
- The future of the Farne Deep *Nephrops* fishery is seen to be at risk. The primary cause is the effect of larger boats from outside the region. The *Nephrops* fishery was almost wiped out 6 years ago (2006) by twin and multi rig trawlers coming to the grounds.
- The future of the Farne Deep *Nephrops* fishery is seen to be at risk due to larger boats coming in from elsewhere. The *Nephrops* grounds have been wiped out by twin and multi rig trawlers towing heavy weights (or clumps) of chain with their gear.
- The future of the *Nephrops* fishery is at risk because of the effects of larger boats coming in. It's easy fishing and costs can be kept low. Subsequently, larger grounds further offshore are seen to be at less risk; however, small boats can't fish the offshore grounds safely.
- The future of the Farne Deep *Nephrops* fishery is seen to be at risk because of the effects of larger boats coming in elsewhere for easy fishing. The *Nephrops* grounds have been wiped out by twin and multi rig trawlers towing heavy clumps of chain with their gear. This digs into the seabed and destroys the burrows.

- The future of the Farne Deep *Nephrops* fishery is seen to be at risk because of the effects of larger boats coming in elsewhere for easy fishing. The *Nephrops* grounds have been wiped out by multi rig trawlers towing heavy weights (or clumps) of chain with their gear (x 3).
 - The future of the Farne Deep *Nephrops* fishery is seen to be at risk because of the effects of larger boats coming in elsewhere for easy (low cost high returns) fishing. The *Nephrops* grounds of the Farne Deep and off the Durham coast have been wiped out by multi rig trawlers towing heavy weights (or clumps) of chain with their gear (x 2).
 - The future of the Farne Deep *Nephrops* fishery is seen to be at risk. Local *Nephrops* grounds between Eyemouth and Tynemouth within 12 nmi have been decimated by twin and multi rig trawlers towing heavy weights (or clumps) of chain with their gear. The larger twin rig boats can travel further afield than their local port and therefore have access to any number of *Nephrops* grounds in the North Sea. They move from ground to ground towing heavy gears that plough up the *Nephrops* burrows and damaging/ injuring the few *Nephrops* left behind.
 - Offshore grounds may be able to withstand such pressures (although this should be demonstrated) however, evidence since the 2006 influx of twin rig boats onto the Farne Deep shows that the local fishery cannot sustain such impacts and effects. The extra pressure of catch taken away through the intense twin rigging leaves nothing in that area.
 - The local <10m fleet does not have the capacity to steam to other grounds and is largely confined to the Farne Deep and grounds within approx 40 nmi of the home port. We fish with lighter single rig gears that have less effect on the seabed and, through generations of fishing heritage have been committed to operating a sustainable fishery that can support local and regional interests.
- 8. What is the most important management step that the interviewee would like to see taken?**
- Ban the large twin rigs from fishing the Farne Deep within 12 nmi of shore (x 9).
 - Ban the large twin and multi rig boats from fishing the Farne Deep (x 2).
 - Small single rig boats <10 m only within the 6 nmi limit (x 6).
 - Greater flexibility from MMO checking nets and mesh sizes. Prosecution for infringements 1 mm and less in mesh size are commonplace. The cost of fines and new gear for minor discrepancies in mesh size is prohibitive to maintaining the boat as a business.
- 9. Is there a need to restrict fishing pressure in the Farne Deep? If there is, what does the interviewee prefer in terms of different ways of limiting fishing pressure? What has been successful elsewhere, or in the past? Have any steps already been taken to reduce the pressure? Might the 'Net Gain' proposals help?**
- Fishing pressure on the Farne Deep needs to be controlled more rigorously (x 2).
 - A vessel size restriction on the grounds is seen as a potential solution; however, under the present arrangement of open access to grounds, the most significant step would be to scrap the functional units in order to open up the *Nephrops* fishery across the N. Sea.

- The official boundary of the Farne Deep for stock assessment purposes is seen as too large. The actual grounds cover only a small percentage of the area identified by the functional unit boundary (x 3).
- The banning of twin rig gears inshore would go a long way towards achieving a sustainable fishery (x 8). In the past this was the case and it worked well by informal agreement between fishers. The *Nephrops* grounds cover only a small area within the boundary defined by the functional unit although mud does extend south of the Tyne.
- Fishing pressure by trawling on the Farne Deep needs greater control and tighter restrictions on larger vessels towing twin rig and multi rig gears (x 7).
- To achieve greater control a vessel size restriction on the grounds is a potential solution.
- When the large boats have been through the grounds, the water is full of sea potatoes (not sure if sponges or heart urchins) on the surface. This shows how deep into the seabed the twin rig gear is going (x 2).
- A decommissioning scheme for large uneconomical trawlers that have excessive fuel and overhead costs would be welcomed by many owners.
- A non transferable days at sea scheme to control effort in the whitefish fishery would go a long way in bringing some sense back into fishery management. The limit could be set initially at 170 days/ yr. This could be controlled by use of satellite tracking and RBS.
- There are also serious flaws in the quota system. Trading of quota has got out of control with 'slipper skippers' inheriting or passing on quota within families of businesses, and non fishing investors buying quota to either sell or rent out at great profit. Quota needs to be bought back from third parties by government to be reallocated directly to the working fleet. Improved paper trails and audits of quota trading would give much better control of fishing effort, especially in regional fisheries such as the Farne Deep.
- In the past 'gentlemen's agreements' with buyers not to buy *Nephrops* from twin rig boats were upheld; however, increasing economic pressures have led such honourable agreements to lapse.
- The Net Gain process hasn't been met with wide support in the fishery. If formal assurances could be made that MPAs wouldn't encroach on productive fishing grounds, and that controls on gear type and boat size/ power within MCZs could be enforced then the process could prove beneficial to fisheries management. Currently, constructive negotiation is being held up by the radical views of some conservation bodies wanting blanket bans on the use of some fishing gears over wide areas. Sustainable fishing and conservation interests can be realised in our area, but the destruction of *Nephrops* habitat by heavy twin rig gears and the high number of visiting boats towing them throughout the winter isn't the way forward.

Options might include:

A local TAC – as the Commission suggests:

- NO (x 3).
- NO. A North Sea TAC is preferred as boats can retain flexibility across a wider area. The functional unit model is poor for future management.

- NO. Smaller boats with restricted means should have the opportunity to venture to other grounds. Farne Deep TAC would be too small to keep the boat running as overheads are too high.
- NO. A local TAC may outstrip the local stock in a bad year.
- NO. We must maintain flexibility to react to fluctuations in the local stock and elsewhere (x 3).
- Undecided on whether a local or N. Sea wide TAC is best; however, we must maintain flexibility to react to fluctuations in the local stock and elsewhere (x 2).
- NO. A local TAC would be complicated to manage and would most likely lead to misreporting.

Restricting access to particular vessels (which vessels? Done by length or power?).

- Ban large twin and multi rig boats (x 2).
- Ban twin rigs (x 4).
- Ban twin and multi rigs on inshore grounds (x 3).
- Ban large boats coming in from elsewhere from the Farne Deep.
- Power appears to be the determining factor, but size of boat and its gear is a limiting factor in an inshore fishery such as the Farne Deep *Nephrops*.

Restricting gear types (which types?).

- Smaller twin rigs are seen as acceptable, but the Farne Deep cannot sustain large twin or multiple rigs.
- Twin rigs and larger gears are unacceptable (x 9).
- Repeated fishing by large numbers of twin rigs and multi rig gears have serious effects on the seabed and are not economically or ecologically sustainable in such a small area - especially that close to shore (x 7).
- Twin rigs towed by small boats (<20m and 150hp) are acceptable, but the Farne Deep cannot sustain large twin and multi rigs. Gear restrictions should ban multi rigs.
- Repeated fishing by large numbers of twin rigs and multi rig gears have serious effects on the stocks and are not economically or ecologically sustainable in such a small area - especially within 12 nmi. Rather than damage the seabed as some claim, twin rigs and larger gears catch all that is there, leaving nothing.

Effort controls – days at sea?

- NO. The industry has suffered this type of restriction for too long. There are clear signs that whitefish stock are recovering in inshore waters and quotas are being easily filled. Days at sea need to be increased, not decreased (x 10).
- *Nephrops* could be more tightly controlled until a true recovery is underway (x 5).
- YES. Why not give each boat (regardless of size) 150 days per year at sea. Once the days were used up the boat would tie up from fishing for the remainder of the year. This would simplify the industry and fishermen could plan ahead for other work.
- YES. Why not give each boat (regardless of size) 170 days per year at sea. Once the days were used up the boat would tie up from fishing for the

reminder of the year. This would simplify the industry and fishermen could plan ahead (x 2).

- NO. A quota system via the PO works best for this boat. We don't work too many days due to the restrictions of weather and quota.

Area restrictions – areas closed to particular gears?

- The Farne Deep grounds are too small for closed areas (x 10).
- Large twin and multiple rigs are unacceptable (x 2).
- Twin rigs and larger gears have serious effects on the seabed and, economically, are not sustainable on the Farne Deep. Additional catch barely covers the additional cost of fuel.
- Closed areas might ruin recognised tows and favoured profitable locations.
- The Farne Deep grounds represent only a small area of the Functional Unit marked on the chart in the draft LTMP. Trawling with single rigs by the <10m fleet has been shown to be sustainable on these grounds in the past. Keeping twin rigs outside 12nmi is the most significant restriction that could be enforced, but additional closures over the grounds within 12 nmi wouldn't be sustainable for the <10m fleet due to the limitations of such boats to fish far offshore or elsewhere in coastal waters.

Seasonal restrictions – e.g. green sac periods?

- Not identified as significant.
- Generally, *Nephrops* only come out of their burrows in winter. At other times of year when light levels are too high they are at depth in the mud and inaccessible to single trawls. Landings of prawns in late summer are being caught at night (x 7).
- Real time closures for juvenile fish are irrelevant on the Farne Deep *Nephrops* grounds due to the small area and transient nature of juvenile fish. Closure of larger areas would be more effective, but at a cost to the *Nephrops* fishery early in the year.
- The boat operates around the year on whatever is seasonal and available to land. Hence pots and trawling.
- Early season landings of prawns (early Sept) are being caught at night. There are clear indications that *Nephrops* are very sensitive to environmental conditions – especially light and temperature. Even the tides (springs or neaps) have an effect on emergence behaviour.
- There are clear indications that *Nephrops* are very sensitive to environmental conditions – especially light and temperature. Extremes of tides (springs or neaps) have an effect on emergence behaviour. If the water is cold they can come out at night in summer (x 4).

10. Would the following ecological objectives be useful?

Reduce discards and by-catches in the fishery. Is discarding a problem? Where and when? What species?

- With the right gear design, by-catch and discards can be kept to a minimum (x 11).
- A certain amount of whitefish by-catch is always useful if quota is available. Codling up to 8lbs are currently being discarded in large numbers. We need some by-catch or many days become unprofitable (x 8).

- My cod quota for September of 70 boxes was caught in one day. Bycatch of whitefish may represent up to 50% of the prawn catch on some days – whitefish are so abundant.
- We employ large mesh and square mesh panels in our nets (x 2).

Minimise damage to threatened, endangered and protected species. What species might be at risk?

- Large gears damage the seabed and therefore have a negative effect on the species that live there – especially *Nephrops* (x 9).
- Large gears damage the seabed and therefore have a negative effect on the species that live there – especially mature female *Nephrops*.
- Sea potatoes [heart urchins] seen on surface after a large twin rig has been through the grounds (x 2).
- “Some skates, dogfish, and rays are caught, but very few. There are no measures to avoid catching the few that could be used other than using ridiculous 500 mm cod end mesh or banning fishing in the North Sea. I’m not aware of any corals etc in the area that need special protection. If there were, who is going to benefit from it 20 miles out at sea, out of sight! To close an area off in the middle of the sea because of some coral that’s there would bankrupt the fleet and for what? A pretty sentence in some ‘green’s’ leaflet?”

Minimise impacts on benthic habitats and associated communities. What habitats are at risk?

- The grounds and burrows of nephrops.
- The grounds and burrows of nephrops together with the ‘feed’ that supports them.
- The grounds and burrows of nephrops together with the feed communities on the seabed. Simple gear design principles can be used successfully to reduce negative effects of gears on habitats and species.
- The ‘feed’ that supports *Nephrops* and other shellfish. [‘Feed’ being epifauna, plankton and organic debris] (x 7).
- The main habitat at risk from heavy twin rig gears is the mud and the *Nephrops* burrows this supports. Lighter single rig gears catch less and only have superficial effects on this habitat – they don’t churn it up, and they leave some of the prawns and fish behind.

Are there any features of the Farne Deep that the interviewee would like to see protected?

- The grounds and burrows of nephrops. By stopping the effects of large gears on the grounds, the mud habitats will have a chance to function (x 2).
- The nephrops grounds.
- The fishing grounds. By stopping the effects of large gears on the grounds, the mud habitats will have a chance to recover and function over time but recovery would not be immediate.
- The mud habitats and burrows of nephrops (x 6).
- No areas should be closed because of damage caused by fishing. The area has always produced fish and prawns once prawns restock themselves.

11. To meet ecological objectives, and especially the reduction of discards, options might include:

Larger meshes in the main part of the net.

- NO (x 8).
- YES. We have a large mesh panel in the net (x 3).
- YES. Already used and effective.

Square mesh panels and other escape panels.

- NO (x7).
- These are not workable for *Nephrops* in the North Sea, but have been shown to work for whitefish fisheries elsewhere such as those on the Grand Banks Newfoundland where meshes of up to 150 mm have been observed. Even with these large meshes, boats were still catching fish.
- YES. We have a square mesh panel in the net (x 3).

Selection grids.

- NO (x 7).
- These have been shown to work on large nets towed in straight lines, but the net we tow is too small and the grounds require sharp turns that can cause such devices to foul the gear.
- NO. Too cumbersome to work on small boats (x 2).
- NO. Too cumbersome to use on small boats with net drums.

Low headline trawls.

- YES.
- YES, but keep some flexibility in the design to catch whitefish when quota is available (x 6).
- YES. Basic good design works.
- Not highlighted or discussed (x 2).
- They can be effective but we must keep some flexibility in the design to catch whitefish when quota is available. It is vital to take some fish in order to make a living.

Adaptations to the foot rope.

- YES (x 2).
- YES. Don't use heavy weights or chains (x 3).
- YES. Basic good design works.
- YES. Use single trawls that are lighter, don't use heavy weights, and don't tear up the seabed (and fleets of pots close inshore).
- YES. Don't use heavy weights. Note: changes to gear cost money. A new codend on this boat is £500 and, although they can be changed relatively quickly at sea, this fisher didn't want to be overburdened with gear changes at sea to reflect local catches on a day to day basis.
- YES. Don't use heavy weights. Keep the gear simple and light.
- YES. Keep the gear simple and light.
- NO. Nothing can be altered.

Real time closures to protect spawning grounds or aggregations of juvenile fish.

- The Farne Deep is too small for such measures (x 8).
- Real time closures for juvenile fish are irrelevant on the Farne Deep *Nephrops* grounds due to the small area and transient nature of juvenile fish.

Closure of larger areas would be more effective, but at a cost to the *Nephrops* fishery early in the year. Using the right gear for the ground conditions is important.

- If the prawns aren't there or their quality is low, the fishery will move elsewhere. Using the right gear for the ground conditions is important. The nets I use for *Nephrops* are specifically designed to have a lower headline height in order to reduce by-catch of fish species that live off the bottom, or swim up to escape the mouth of the net.
- Mature prawns only come out of their burrows in winter. Juvenile whiting are seen as a pest as they are present in such high numbers. Due to their high abundance by-catch is inevitable, but they are also undersize and cannot be landed. They also take time to sort from the catch.

12. It is probably best for fishers to suggest measures for reducing discards and by-catches and it is best left to them to devise procedures to:

Ensure that landing are within quota and demonstrate that this is so.

Reduce discards and demonstrate that this has been achieved.

- Other than net design to minimise by-catch, this was not discussed.
- Additional record keeping on catch composition wasn't seen as a good idea. Despite industry support, a recent discard study gave a poor impression of the fishery and fishers were guarded against and untrusting of scientist's projects.
- Additional record keeping on catch composition isn't a favoured option. Sufficient info comes from the landing slips and market data.
- Paperwork is already overbearing. Market data and existing landing info are seen as sufficient. Scientists and MMO are not willing to come away on trips to observe commercial operations so why should the fishery supply paper info that isn't trusted?
- Additional record keeping on catch composition isn't a favoured option, especially for a one man operation. Sufficient info comes from the landing slips.
- Additional record keeping on catch composition isn't popular. As the industry doesn't trust the science, and science isn't willing to believe the word of the fishermen, sufficient info is considered to be provided from the landing slips and market data. Any more would be a waste of time.
- Additional record keeping on catch composition isn't necessary. There is no trust between the industry and scientists. Sufficient info is provided on the landing slips and market data. Any more would be a waste of time. Sick and tired of endless consultations that produce nothing but useless reports. Sick and tired of endless promises by politicians. Celebrity chef doing more harm than good.
- Additional record keeping on catch composition isn't popular. As the industry doesn't trust the science or the MMO, and science/ MMO isn't willing to believe the word of the fishermen, sufficient info is considered to be provided from the landing slips and market data. We're sick and tired of endless consultations that produce nothing but useless reports, and the endless promises by politicians. Hugh Wittingstall and other celebrity campaigners are doing more harm than good.

- Additional record keeping on catch composition was supported following experience of a DEFRA pilot study where all fish were recorded by species and weight, and landed. The report from that study was hushed up as the diversity and high abundance of fish caught was much better than expected.
- Information of catch composition could be improved and doesn't take much extra effort to process at sea. It is the scientists who had problems processing the data on diversity.
- Although the paperwork is relatively simple, additional record keeping on catch composition and discards isn't a favoured option. Recent enquiries regarding accreditation for keeping additional records didn't offer any financial benefit to the business and there was no evidence to suggest that opting out of the scheme would have a detrimental effect on business.

13. Other ecological management measures might include:

Identifying and implementing Marine Protected Areas. These include 'real-time', seasonal and permanent closed areas.

Restricting the range of gears that can be used in vulnerable areas (including creel only areas, a ban on twin rigging in some areas).

Promoting the development of environmentally friendly fishing practices, for example gears with reduced bottom contact, larger meshes and better selectivity profiles.

Improving data recording systems to identify capture and damage to endangered, threatened and protected species.

- The Net Gain process and MPAs were seen as bad for fisheries if the grounds were within the MPA boundaries proposed (x 9).
- The NET Gain process has not given the process due consideration and has been pushed through too quickly (x 2).
- Gear restrictions should ban large twin and multi rigs. Twin rigs towed by small boats (<20m and 150hp) are acceptable. Simple gear design principles can be used successfully to reduce negative effects on habitats and species, by-catch and discards.
- Banning twin rigs and larger gears from the Farne Deep would provide a sustainable fishery. In other words. simple gear design principles can be used successfully to reduce negative effects on habitats and species (x 8).
- If it is to be periodically reviewed there may be advantages for sustainable fisheries.
- Partial access and gear restrictions within MPAs could, for example, provide a sustainable fishery without long term and significant damage to habitats and species.
- We already have selectivity measures in our nets.
- Improved data recording is possible if industry and scientists work together. However, there are some limitations if some fishers have poor IT and literacy skills.
- Areas don't need closing as all produce fish and prawns.

- There are no creel only areas required but restricting super efficient gears such as twin rig would help as they take too much stock away. The effects are clearly evident as the grounds were fine before the twin rig fleet turned up.
- Reduced bottom contact won't work. The gear has to be on the bottom in order to maximise the catch and make it profitable.

A3.2. Responses received from Scotland and Northern Ireland.

The following is a compilation of notes from the interviews of fishers who fish the Farne Deep for *Nephrops* but are registered at ports in Scotland and Northern Ireland.

1. Is it the only area fished? Where are the others?

- NO. We also fish the Fladen ground and two others in addition to the Farne Deep.
- NO. I also fish in the Irish Sea.
- NO. I also fish on the west coast of Scotland.
- NO. We also fish in the Irish Sea and the west coast of Scotland.
- NO. I also fish in the wider North Sea and the west coast of Scotland.
- NO. I also fish in the Fladen in the North Sea and the Moray Firth.
- NO. I also fish in the Moray Firth for squid and prawns.

2. What gear is used? Does this vary?

- We use twin rig gear that is rigged low to reduce bycatch of other species. It is rigged differently for whitefish; i.e. the headline height is higher.
- We use single rig gear that is rigged for low environmental impact to the seabed. In order to minimise effects on the seabed and to reduce the catch of immature flatfish and others [benthic community] we don't use bobbins on the footrope. We do use a light chain on the footrope that is also fitted with small rubber discs about 3 inches in diameter [rubber rope]. Sufficient down force on the net is provided by the rig without additional weights and control of speed over the ground to keep the net open.
- We use twin rig gear and have done so for a number of years now. Twin rig is used in preference to single rig as the headline height is lower. It gives a cleaner catch of prawns and can be more fuel efficient for the amount of catch landed over single rig gears.
- We use twin rig gear that is rigged for low environmental impact to the seabed. Twin rig is used in preference to single rig as the headline height is lower. In general twin rig gear is more fuel efficient for the amount of catch landed over single rig gears. Up until 2 years ago we used to use a semi pelagic demersal trawl for whitefish in the Irish Sea during the summer months. We now target prawns all the time.
- Although there are variations in setting up the gear between different grounds we use twin rig gear that is rigged for low environmental impact. This includes a low headline height (< 2 m), a chain mat clump, minimal cover of the headline and top panel over the footrope, and square mesh panels. The type of net used depends on the type of seabed.
- We use twin rig with a chain mat as the clump. Claims that the clump is responsible for significant damage to the sea bed are exaggerated. The doors can do more damage, and the chain mat we use only touches the sediment

i.e. only the bottom 2 - 3 links are polished. Rollers are another option and may be preferred by some but I find them impractical.

- We use twin rig with a roller as the clump. Claims that the clump is responsible for significant damage to the sea bed are exaggerated. The doors can do more damage. In the summer in the Moray Firth I use a single net for squid.

3. Is the vessel targeting *Nephrops* or is it engaged in a mixed fishery? Which are the other species caught or targeted? Which is the most important part of the catch? How is the vessel's *Nephrops* quota allocated (through the PO, bought or leased?).

- Although we target *Nephrops* during the season, whitefish are also targeted when quota for them is available.
- We target *Nephrops* all year because of lack of fish quota. Whiting were also present but not of best size and quality. The catch is sold through a local agent in North Shields. I prefer not to trade quota in order to avoid additional financial burden on the business, but do only when it is absolutely necessary.
- We steam to the Farne Deep's *Nephrops* grounds each winter because the prawns here are of a very high quality (x 2). So far this year prices have also been good. During the *Nephrops* season whitefish isn't targeted as quota is so small (x 2). We'll buy in or lease additional quota if it's available (x 2). We don't really agree with corporate ownership of quota outside the industry; however, everyone is just trying to make a living and the leasing of quota by the owner makes good business sense whoever that owner may be (x 2).
- At other times of the year we focus primarily on the west coast for prawns and whitefish.
- We have invested in additional quota independently in the past; however quota availability in the North Sea is currently lease only. Swapping of any quota is administered through the PO.
- We target *Nephrops* year round on various grounds in UK seas. Whitefish isn't targeted as quota is so small; however a small percentage of marketable bycatch is retained if quota is available. Prices for whiting can vary significantly and when the price is very low it isn't worth landing them as a bycatch so they are discarded. In order to maintain a derogation allowing 200 days/ yr at sea for *Nephrops* I have to be very careful in order to ensure that bycatch of cod is less than 5% of catch landed. We'll buy in or lease additional quota if it's available. Dealing in any quota is administered through the PO.
- We target prawns year round and manage our own quota without the use of a PO. By-catch is inevitable but catches so far on the Farne Deep's have been very clean.
- We target prawns year round and manage our quota through a PO. The squid fishing acts as backup through diversification. By-catch is inevitable but catches so far on the Farne Deep's have been very clean.

4. Are there any by-catches or discards in the fishery?

- This is largely quota dependent. Generally speaking, during the *Nephrops* season approximately 5% of the by-catch is cod.
- By-catch and discards of undersized and non commercial fish is inevitable. It's the nature of trawling i.e. the meshes under strain close up and, although square mesh panels do help, they have to be set right to ensure the mesh is

kept open. Square mesh panels still cause skin damage to escaping fish and although the efficiency of the net to catch undersize fish and non target species is reduced by square mesh panels, their effect is not likely to be of significant benefit to the survival of fish; i.e. the killing efficiency of the net remains largely unaffected. Discarding of marketable fish is quota dependent.

- By-catch and discards of some undersized and non commercial fish is inevitable; after all, trawl nets are designed to catch fish. The catch tends to be cleaner north of the Tyne. South of the Tyne the proportion of fish increases – possibly because of the harder ground further south and fish moving in from there to feed on the *Nephrops*. Prices for whiting can vary significantly. When the price is very low it isn't worth landing them as a by-catch so they are discarded (x 2).
- By-catch and discards of juvenile and non-commercial fish are inevitable but the Scottish *Nephrops* industry is working hard on gear design and sea trials in order to improve the selectivity of nets for *Nephrops*. The aim of the work is to allow juveniles and non target species to avoid the net altogether; e.g. low headline height and reduced/ no cover of the top panel and headline over the footrope. This works well for species such as haddock and whiting that swim up to avoid the net although cod can behave differently. We sometimes see monkfish in the catch but rarely see protected species such as some of the skates and rays.
- By-catch and discards of juvenile and non-commercial fish are inevitable but we don't want to catch them as it takes time to sort the catch. The Scottish *Nephrops* industry recognises this problem and is working hard on gear design and sea trials in order to improve the selectivity of nets for *Nephrops*. We rarely see protected species such as some of the skates and rays on the east coast (x 2).

5. Is the fishery seasonal? Are there times when the vessel does not fish there? Why?

- We fish for *Nephrops* from August through to March. The onset of the fishery is largely dependent on diminishing daylength (*Nephrops* are light sensitive). During July we sometimes fish at night for *Nephrops* but catches are not as good as during the winter on the Farne Deep.
- I fish for *Nephrops* on the Farne Deep from September through to the end of the year or as long as they are available. As *Nephrops* are light sensitive the onset of the fishery appears to be dependent on diminishing daylength. At other times of year we have fished in the Irish Sea and around the Isle of Man but *Nephrops* grounds there are now poor and some have been closed.
- The prawns in the Irish Sea tend to be small, queen scallops have moved into the grounds and fish have moved out. The Farne Deep is popular as the prawns are of very good quality and returns are generally very good. In the Irish Sea areas have been closed to prawn fishing. I prefer to fish coastal waters and to tie up in harbour each night.
- We fish for *Nephrops* on the Farne Deep from September through to the end of the year or as long as they are available (x 2).
- At other times of the year we focus primarily on the west coast for prawns and whitefish.
- At other times of the year we focus primarily on the Irish Sea and the west coast of Scotland for prawns.

- We fish for *Nephrops* year round on different grounds. We generally focus on offshore grounds in the North Sea such as the Fladen; however, we have also fished the west coast of Scotland and the Farne Deep in the past. The nature of the industry is nomadic in that fishers will always seek the best quality catch for the best price. Some *Nephrops* grounds provide summer fisheries, others provide winter fisheries. No-one seems to know why (2).
- The location of the boat when it is fishing is generally governed by the market, but it's a funny business. Just as you think you've got it taped and can predict where prawns will next appear, the fishery can suddenly disappear; for example, see recent changes against the trend on the west coast and in the offshore grounds of the North Sea.
- It is true to say that the emergence of *Nephrops* (and hence their availability) appears to react to environmental cues such as light, temperature and food availability for example but we [fishers and fishery scientists] just don't know enough of their behaviour in response to seasonal changes in their environment to be able to predict with certainty when they might emerge on a particular ground, or what stock levels are likely to withstand in terms of fishing pressure.
- We fish for *Nephrops* year round on different grounds (Sept – March on Farne Deep, March – Sept on Moray Firth). In recent years we have focused on the Moray Firth fishery and on offshore grounds but the prawn fishery there is now depleted due to big boats coming in.
- With the high price of fuel at the moment it is very cost effective to work grounds that are close to port (x 2).

6. Are there any specific problems with the Farne Deep fishery? How might these be resolved?

- Discard of valuable whitefish when quota isn't available is a problem. We should be able to land what we catch – especially whitefish. Current quota trials for North Sea cod look promising but we have concerns regarding the present severe limitation of quota for cod and other whitefish species. (Note: Vessels in the trials are not permitted to discard any North Sea cod, including those below the minimum size, with all catches counting against quota. Once the quota for these stocks is used up the vessels must stop fishing for all species, whereas under current rules vessels can continue to fish but discard over-quota fish and risk over-exploitation of the stocks).
- I see the main problem as environmental damage to the soft muds and *Nephrops* habitat from heavy gears. There used to be a 'gentlemen's agreement' from fishers here that twin rigs did not fish within the 12 mile limit. Since that has been ignored the *Nephrops* fishery has suffered. A significant increase in effort from increasingly powerful boats using heavier weights on larger rigs appears to be the core of the problem.
- Because scrapping and retirement have reduced the number of boats across North Sea and Irish Sea fisheries it can be argued that the total number of boats fishing in these areas today doesn't have the capacity to seriously affect the productivity of fishing grounds as it once did. In previous years the Farne Deep fishery was sustainable against a much larger fleet.
- Unfortunately, increased effort in key areas such as the Farne Deep has had a negative effect on yields in recent years. The failure of the CFP forces boats

to come to grounds such as the Farne Deep to fish for prawns due to the absence of whitefish quota.

- In order to control fishing effort, a reduction in the number of nets may not necessarily mean a reduction in the number of boats, rather a reduction in environmental impact through the use of single rig and other low impact gears, especially over ecologically fragile benthic habitats.
- The 12 mile limit is a good boundary to use. A power limitation of 500hp within 12 nmi would allow the local <10m boats to continue fishing by either single or twin rig, and would allow the use of twin rig gear by boats >10m with an engine producing less than 500hp. Larger more powerful boats would be able to use heavier twin rig and multi rig gears outside 12nmi.
- The CFP has caused boats to fish harder against dwindling quotas which leads to increased discarding of marketable fish. Discard of valuable whitefish when quota isn't available for them is a problem. Whitefish is everywhere in abundance at the moment and there needs to be a significant increase in the whitefish quota. Opting out of the CFP and keeping UK fisheries for the UK fleet may be a good move.
- There has been much made of the sustainable management of the fishery in recent years; particularly in favour of control of effort on the grounds during the *Nephrops* season. In recent years the number of boats has decreased significantly and it is our view that there isn't sufficient fishing effort on the *Nephrops* grounds at the moment to maximise yields of *Nephrops*. Before, all ports from Eyemouth to Hartlepool were full of boats fishing for prawns off the Northumberland coast. Only a fraction of that number are still in business today. The fishery was sustainable when being fished by a greater number of boats in the past and we don't consider that current levels of exploitation are detrimental to stocks (x 2).
- Reducing effort further could turn out to be detrimental to the fishery rather than beneficial. Fishing is a form of habitat management; i.e. a ground must be fished in order to maintain seabed habitats in a similar way to that of many land management practices in rural areas such as coppiced woodland or grazed moorland. If anything, fishing effort needs to increase in order to maintain (and potentially improve) yield (x 2).
- A limit to the days at sea during which all the catch can be landed would also assist stock levels and reduce the discarding of marketable fish. Whitefish is everywhere in abundance at the moment. It feeds on *Nephrops*, reduces the available stock and can't be landed as there is not sufficient quota for it (x 2).
- I don't see any specific problems with the Farne Deep *Nephrops* fishery. It should retain open access without restrictions on effort and should be allowed to develop according to market forces. The grounds are small by comparison to some of those further offshore but that provides a degree of protection from the large and very powerful offshore fleet.
- Claims from the local <10 m fleet using single rig gear that the clump used with twin rigs of larger boats damages the seabed are extraordinary. I haven't heard that one before although I can see their logic. The chain mat I use spreads the weight of the clump over a wider area. Furthermore, it is only the last two or three links of the chains that are in contact with the seabed. I have greater concern for the effects of trawl doors on the seabed although this is generally accepted as being unavoidable. If a demersal gear isn't in contact with the seabed it isn't fishing efficiently.

- If a problem were to be identified it would almost certainly be related to the problems of by-catch and discards. We are working towards better selectivity of gear to reduce the by-catch of juvenile fish in particular. If fishery managers were to recognise the increased abundance of whitefish on the grounds and increase quotas, then the problem of discards of marketable fish would also be addressed.
- This is our first year and so far we have not encountered or experienced any problems with the way the fishery is run. The fishing grounds aren't extensive and the number of boats operating on the grounds can give concerns regarding safety of navigation (x 2).

7. What is the future for the Farne Deep fishery, and for the wider North Sea fishery?

- The Farne Deep *Nephrops* fishery appears to be sustainable at the current level of effort. The presence of large European boats in the vicinity of the Farne Deep is a worry however and may take the fishery into decline. The offshore grounds appear sustainable but their distance from port, especially during periods of poor weather makes them less attractive than the inshore grounds of the Farne Deep where shelter and markets are readily available.
- At the level of fishing seen in 2006, the Farne Deep *Nephrops* fishery is unsustainable. Although it appears that *Nephrops* can recover from such events in 3 to 4 years to return a viable fishery once more, stock assessment methods are not seen as being particularly accurate or reliable.
- I recognise that fisheries science is undertaken with the best of intentions; however, the weight of scientific opinion counts for little against that of EU fisheries ministers. Opting out of the CFP and keeping UK fisheries for the UK fleet may be a good move.
- The use of industry data in stock assessments could be improved and may assist in building trust between the industry, science and ministers. Experience suggests that the Farne Deep *Nephrops* fishery performed best with single rig gear within 12 miles of shore and that it has not recovered its full potential since the events of 2006 despite anecdotal evidence of a 5 – 7 year cycle in the yield of the fishery.
- The presence of large modern boats twin rigging on the Farne Deep is a worry and may take the fishery once again into decline. The deeper water and distance from port of offshore *Nephrops* grounds, especially during periods of poor weather makes them less attractive to fishers who want to maximise their profits. Being close to shore the Farne Deep is ideally located providing ready shelter and markets where the catch can be sold in top condition.
- Based on past performance, the future of the Farne Deep *Nephrops* fishery appears secure but the increase in the amount of whitefish seen in recent years is a concern. Cod in particular tend to feed on *Nephrops*. This could have a greater effect on the *Nephrops* stock than current levels of fishing. Reports from the Newfoundland Banks are that cod is showing a recovery, but fishers who have adapted to fish for northern prawn [pandalus], queen crab and scallops since the cod fishery collapsed are very concerned that the return of cod may affect what is actually a more profitable fishery for shellfish! (x 3).
- Offshore grounds beyond 12 nmi in international waters are open to much larger vessels that can tow multiple rig gears and that have the capacity to

process and freeze their catch at sea. Although much larger than the Farne Deep in terms of area, these offshore grounds are able to remain productive despite the presence of large multi-rig vessels working them. Many consider it practically impossible to wipe out a local *Nephrops* stock. The nature of the burrows suggests that not all *Nephrops* will be taken in any season and *Nephrops* are good at becoming re-established to previous levels within 3 to 4 years if they are hit especially hard (x 2).

- The use of VTS data in order to monitor fishing effort and fleet movements is important and valuable to fishery managers (x 2).
- The wider North Sea fishery has been stable for a number of years although recently it has taken a down turn (the west coast of Scotland has shown the reverse). *Nephrops* were less on the North Sea grounds this year although last few weeks of 2011 there were good landings. These changes were unexpected and causes remain to be explained. Offshore grounds beyond 12 nmi in international waters are open to much larger vessels that can tow larger [heavier] multiple rig gears with heavier weights.
- If the problems reported of the clump ploughing in the burrows and spoiling the Farne Deep are true, then more significant effects would have been evident on the offshore grounds where heavier gears operate in greater numbers and for longer periods. The offshore grounds are able to remain productive despite the presence of large multi-rig vessels working them.
- Good. The levels of effort experienced by the fishery in 2006 won't be repeated as the number of boats in the fleet has been reduced significantly. Its catching ability has been decimated (x 2).
- Large European boats from outside the UK push the boundary limits at times. These could have an effect if they are allowed in past 12 nmi (x 2).

8. What is the most important management step that the interviewee would like to see taken?

- Simplify the rules! Current fishery management is too complex and leaves too many options open to exploit fisheries. North Sea *Nephrops* is okay but the mixed fisheries are in a bad state.
- Introduce a 500hp limit within 12 miles (x 2).
- Simplify the current rules and regulations; particularly in the area of quota management and trading.
- Keep quotas in the working industry i.e. no slipper skippers and no outside corporate ownership of quota.
- Introduce a scrap to build policy. This will provide safer working platforms, a reduced carbon footprint, improved crew conditions at sea, and better catch quality due to improved on board sorting and processing plant (e.g. chilled spray).
- The efficiency of gear has improved greatly in recent years and may therefore be counterproductive in terms of actually increasing catches despite reduced number of boats.
- Gear selectivity needs to be improved to increase the survival rate of fish that escape. Escaped fish often suffer skin damage and die of infection so current square mesh and large mesh panels aren't as effective as many think.
- Don't restrict fishers by placing TACs at FU level. Maintain unilateral approach to N. Sea *Nephrops*.

- Increase the amount of whitefish quota to truly reflect the amount of marketable whitefish out there. Also, improve the integration of research and industry data for the purpose of stock assessments (x 2).
 - Despite trying to work with the regulators with CCTV observations and other initiatives in return for greater flexibility on quotas the level of trust between us is low. This needs to be improved.
 - Catch composition is generally different north and south of the Tyne and local bylaws control the composition of landings from these areas. Unfortunately fish don't recognise these boundaries and catch composition either side of the Tyne can change. Subsequently, perfectly good fish that could be landed legally from one area one day cannot be landed if they are caught in the adjacent area the following day.
 - Continue to work on the improvement of gear selectivity, but don't waste time on selection grids. Net avoidance should be the primary consideration, not escape of fish and target species once in the net because physical trauma is too severe to allow survival.
 - Improve the integration of research and industry data for the purpose of *Nephrops* stock assessments in particular. The assumption of one *Nephrops* per burrow during the UWTV stock surveys is too conservative in my opinion.
 - Increase the amount of whitefish quota to truly reflect the amount of marketable whitefish out there.
 - Present work by the Scottish *Nephrops* industry to improve gear selectivity is showing good results. We should continue to work on the improvement of gear selectivity, but don't waste time on selection grids. We need to improve the integration of research and industry data for the purpose of *Nephrops* stock assessments in particular, and need to build trust between the industry, scientists and politicians.
 - Trying to run fishery management by days at sea AND a quota system isn't working. We need to scrap one or the other and, personally, I'd prefer to a system of limiting days at sea with the ability to land all you catch. This would go a long way in addressing the discard problem with valuable whitefish.
 - The assumption of one *Nephrops* per burrow during the UWTV stock surveys is too conservative in my opinion.
 - Cut the non UK multi rig boats.
9. **Is there a need to restrict fishing pressure in the Farne Deep? If there is, what does the interviewee prefer in terms of different ways of limiting fishing pressure? What has been successful elsewhere, or in the past? Have any steps already been taken to reduce the pressure? Might the 'Net Gain' proposals help?**
- NO. Present levels of exploitation on the Farne Deep are sustainable and a unilateral approach to North Sea fisheries management is the best way forward. National quotas and trading of quotas between countries in Brussels each year is not good fishery management. As already stated – Simplify the rules.
 - Net Gain is widely criticised in the fishing industry as an unproductive process. There is a perception that conservationists want to protect the whole of the North Sea from fisheries in particular. A North Sea Aquarium just isn't going to be achieved so long as people need to make a living from the sea –

this includes offshore engineering, shipping, fossil fuels, aggregates and renewable energy.

- A 500hp limit within 12nmi would allow twin rigging and the benefits it can provide (lower headline height etc.) to continue.
- I have strong views in support of management supporting conservation; however, the MPA consultation has been widely criticised in the fishing industry as an unproductive process. There is a perception that conservationists want to protect the all UK seas from fisheries in particular, but the resources our seas can provide in terms of putting food on the table and in generating revenue, investment and jobs are too important to allow fishing grounds to return to a totally natural state.
- Fishers must be permitted to manage marine habitats, particularly those on recognised fishing grounds and those grounds in proximity to reefs and other features important to conservation in order to safeguard biodiversity and maximise sustainable yields from fisheries.
- Currently the levels of fishing pressure in the Farne deeps *Nephrops* fishery is only a fraction of what proved to be sustainable in the past (x 3).
- We have been fishing the Farne Deep for over 20 years and there is no need to restrict fishing pressure further (x 2).
- We have been fishing the Farne Deep for 6 years now and I see nothing to be gained by restricting fishing pressure for *Nephrops* further. In the Irish Sea we generally fish 24 hours/day. The Farne Deep fishery is a daylight fishery during winter months when hours of daylight are in the region of only 8 hours. We come in each night.
- The fleet is smaller now than it once was e.g. 2006, and gear is becoming more selective so a restriction in fishing pressure on the Farne Deep isn't needed as much now as it was then. The conservation proposals will never stop and it is unlikely that a site would ever be declassified (x 2).
- The majority of fishermen are professional and responsible people who are trying to run their business to make a living. We don't seek to destroy the natural resource that supports us. Quota cuts bottleneck the fleet as it seeks to maintain an income – whitefish skippers move to prawns. This intensifies effort on to fewer grounds such as the Farne Deep (x 2).
- Agree days at sea and land what you catch. Scrap the quota system.
- 500 hp limit within 12 nmi as clumps from 1000 hp boats can damage the seabed (x 2).

Options might include:

A local TAC – as the Commission suggests:

- NO. A unilateral approach across the North Sea is the best way forward (x 6).
- NO. Set a North Sea wide TAC but maintain a degree of local control on fishing effort if required.

Restricting access to particular vessels (which vessels? Done by length or power?).

- NO. Keep the fishery open to trade freely (x 2).
- A max power restriction of 500 hp within 12 nmi (x 3).
- We currently operate outside 6 nmi. Larger international vessels operate outside 12 nmi. The local <10m fleet has access to inshore waters within 6

nmi and these boundary restrictions appear to work well while reflecting the power and length of boats operating to them (x 2).

Restricting gear types (which types?).

- NO. Keep the fishery open to trade freely.
- NO. Base restrictions on power.
- NO. Twin rig gears work well for *Nephrops*. If set correctly, the clump will only touch the seabed. If it continually digs into the mud the gear isn't fishing properly and it is the skipper's best interests not to allow this to happen if he wants to make his business work. Headline heights are lower improving selectivity and fuel is more cost efficient (x 5).
- Single rig options are too expensive to run with twin rig boats as we'd have to carry additional nets and meshes for which we don't have the space or resources. We prefer the cleaner catches of *Nephrops* caught twin rig gear.

Effort controls – days at sea?

- NO. Keep the fishery open to trade freely.
- Yes. 130 hourly days and land all the marketable catch.
- Yes. 100 – 130 days and land all you catch is a good starting point. Currently I can fish 200 days under a 5 % cod by-catch limitation.
- Yes. 160 – 170 hourly days and land all you catch is a good starting point. Currently I can fish 200 days under a 5% by-catch of cod limitation.
- Currently I can fish 200 days under a 5% bycatch of cod limitation. The boat would struggle to operate as a business on anything less; however, if even a restriction of e.g. 130 days were imposed on the fleet I would still manage the use of the boat to control supply to the market and hence control the price in order to generate a profitable income.
- A 200 days at sea limitation and land what you catch is preferable to a quota system. Both systems can't run together.
- A 200 days at sea limitation for *Nephrops* is already in place.

Area restrictions – areas closed to particular gears?

- NO. Keep the fishery open to trade freely.
- NO. Ban >500hp within 12 miles. With regard to MPAs, areas with long history as fishing grounds should remain as such and managed responsibly with input from fishers equal to that of science and ministers.
- NO. The current 6 and 12 mile boundaries work well and are all that is required. With regard to MPAs, areas with long history as fishing grounds should remain as such and managed responsibly. The MPA process appears to be reactionary in favour of the conservation organisations although many conservationists don't appear to have the first idea of how demersal fisheries can act to manage and maintain habitats on fishing grounds. We don't trawl on hard reefs which is where many conservation interests e.g. mearl beds and soft corals are (x 5).

Seasonal restrictions – e.g. green sac periods?

- NO. Keep the fishery open to trade freely.
- NO. Berried females are seen in early season (Aug – Sept) and there is a market for these; however, although some are caught the majority appear to return to their burrows just prior to the eggs hatching. Because of this

behaviour not all berried females are caught and *Nephrops*' ability to recover stock levels in 3 – 4 years supports this. If the berried females were wiped out, the fishery wouldn't be able to recover from natural or fishery induced declines in the stock so readily (x 2).

- We fish in different areas at different times of year to reflect the emergence and availability of prawns in UK seas. Until there is a better understanding of *Nephrops* biology that shows a detrimental effect from the fishery on stocks at Functional Unit level at particular stages of the reproductive cycle and early life history, any call for seasonal restrictions would be useless (x 3).

10. Would the following ecological objectives be useful?

Reduce discards and by-catches in the fishery. Is discarding a problem? Where and when? What species?

- Discards are a problem for over quota fish only.
- Discards are a problem for over quota and undersize fish. Increasing the whitefish quota to reflect current abundance of whitefish would reduce discards.
- Discards are a problem for over quota and undersize fish. The sheer numbers of whitefish present on the grounds is a problem and quotas need to be increased to reduce discards. By reducing the number of natural predators the stock of *Nephrops* will increase. Improved catches of the target species will naturally reduce the by-catch of unwanted species (x 3).
- Discards are a problem in the prawn fishery, particularly of juvenile fish including whiting and non target lesser gadoids such as poor cod. Developments in gear design are attempting to address by-catch and discards of them with some success (x 2).
- The Swedish grid is not favoured by small boats. It presents a risk to safe working on deck. Alternatives to the Swedish grid that meet the by-catch threshold (1.5% cod) are being sought by the Scottish fleet (x 2).

Minimise damage to threatened, endangered and protected species. What species might be at risk?

- Square mesh and large mesh panels in the roof of the net are effective in producing a cleaner catch. Grids are too complex to manage safely.
- Square mesh and large mesh panels in the roof of the net are effective in producing a cleaner catch but only if they are set up properly. Swedish grids are too complex to manage safely and may also lead to soft tissue damage in fish.
- Square mesh and large mesh panels in the roof of the net are effective in producing a cleaner catch but only if they are set up properly, and in the right place. If they are too far down the net, any escapees have suffered too much skin abrasion and trauma to stand any chance of long term survival (x 3).
- Selection grids are too complex to manage safely and may also lead to soft tissue damage in fish. By-catch in this area is largely confined to gadoids (cod, whiting, and haddock further offshore) and occasional monkfish. We just don't see skates, rays and dogfish (catsharks) here (x 3).
- A decade ago there were some dogfish but there are hardly any to be seen. In my opinion nothing to do with over fishing it is a factor of water temperature and feeding.

- We don't see the skates and rays on the east coast (x 2).

Minimise impacts on benthic habitats and associated communities. What habitats are at risk?

- The net is set up so as not to damage the seabed significantly. If it is digging into the seabed it isn't fishing properly and won't catch the target species. Any skipper who knows what he's doing won't have the net set incorrectly.
- A single trawl when set up correctly with a light footrope will not damage the seabed significantly. Doors skim the surface and rarely dig in unlike large heavy weights on other gears.
- A twin rig trawl when set up correctly with a light footrope will not damage the seabed significantly. Doors and clumps skim the surface and rarely dig in over level ground (x 3).
- The last thing we want to do is to destroy the prawn grounds and the mud habitats where they live. Evidence from the sustainability of *Nephrops* fisheries in the North Sea indicated that the grounds are not at risk (x 3).

Are there any features of the Farne Deep's that the interviewee would like to see protected?

- No. Keep the Farne Deep's open as a fishing ground.
- I know of species rich reef areas elsewhere that have existed alongside long established fishing grounds for hundreds of years and have suffered no damage as a result. Their longevity and importance to conservation is evidence of this. It is likely that similar features will exist on the Farne Deep's. Fishing and conservation can coexist – I have no wish to trawl on hard or undisturbed ground.
- YES. Areas of reef and hard ground are worthwhile conservation interests. These can't be fished by towed gear and are generally undesirable as grounds to trawlers. Maintain the Farne Deep's as a responsibly managed productive fishing ground (x 2).
- NO. Areas of peat and clay identified in the proposals for marine protected areas off the Northumberland coast aren't likely to be affected by the prawn fishery. Similarly, reef areas of hard ground have also been identified for conservation in the area. These can't be fished by towed gear and are generally undesirable as grounds to trawlers (x 3).
- *Nephrops* grounds further offshore may be affected by the MPA proposals as the offshore sites tend to be larger. General concerns are for the effects that buffer zones around MPAs could have on access if they overlap with established fishing grounds.

11. To meet ecological objectives, and especially the reduction of discards, options might include:

Larger meshes in the main part of the net.

- YES (x 2).
- YES. No more than 100 mm.
- YES. No more than 100 mm and in the top sheet only.
- YES. In the right place towards the mouth of the net.

Square mesh panels and other escape panels.

- YES.
- YES. No Swedish grid.
- YES, but in the right place. Hard selection grids are a bad idea and came from Swedish shrimp fishery. They can't be adapted to others such as a *Nephrops* fishery (x 3).
- It may be better to make changes to trawl design rather than fiddle on with minor changes to existing gear. New initiatives by Scottish industry are working towards reducing the amount of cover provided by the top sheet over the footrope.
- We use a letterbox net that is designed to allow unwanted species to escape (x 2).

Selection grids.

- NO (x 2).
- The Swedish Grid can't be adapted to the *Nephrops* fishery (x 5).

Low headline trawls.

- YES (x 2).
- Yes. Twin rigs have a lower headline height than single rig trawls (x 3).
- New initiatives by Scottish industry are working towards reducing the height of the headline in twin rig gears even further (x 3).

Adaptations to the foot rope.

- NO. Not required if the net is set up properly.
- YES. Keep it light over soft ground.
- YES but it is hard to make any changes effective. Best to keep them light over soft ground.
- We use local nets to fish local grounds. This ensures that we have minimal effect on the seabed; e.g. current footrope is a "rubber rope" with 3" rubber discs giving protection against abrasion from the sand in the mud.
- New initiatives by Scottish industry are working towards reducing the amount of cover provided by the top sheet over the footrope. In order to fish efficiently on the soft ground the footrope is kept in contact with the seabed, but is very light (x 3).
- We have lightened our footrope to work the Farne Deep's (x 2).

Real time closures to protect spawning grounds or aggregations of juvenile fish.

- NO. Not on the Farne Deep's (x2).
- NO. The Farne Deep's does not appear to be noted of importance as a spawning ground or nursery for fish.
- The Farne Deep's does not appear to be important as a spawning ground or nursery for fish during the winter months when we fish here. Any fish we process aren't in spawning condition and the net isn't designed to retain juvenile fish.
- When there is high abundance of juveniles there should be closed areas,; however, with highly selective gear on there is no reason why a vessel cannot continue to fish there and target the prawn fishery.
- With highly selective prawn gear on there is no reason why a vessel cannot continue to fish where there are juvenile fish. RTCs are unlikely to affect the

Farne Deep directly, but they may force (bottleneck) other boats to come here if other offshore areas are closed under RTC (x 2).

12. It is probably best for fishers to suggest measures for reducing discards and by-catches and it is best left to them to devise procedures to:

Ensure that landing are within quota and demonstrate that this is so.

Reduce discards and demonstrate that this has been achieved.

- Standard measures of recording in the log book are enough. Additional measures are seen as being too complex to complete effectively (x 3).
- Recordings of landings are sufficient to record the amount of catch landed by species. Clean catches mean that recording of bycatch species is unwarranted. Recording of discards of over quota fish is seen as useful – especially if it will help increase quotas in the future (x 2).
- Increase quota for whitefish inline with current abundance of these species.
- Additional recording measures are seen as being too complex to complete effectively and may be dangerous to boat safety when steaming in. Electronic means of recording such as touch screen technology on a laptop computer is okay in principle but at risk of theft while in port (x 2).
- The emerging use of smart phones and a bespoke application (“app”) that would allow info to be recorded by touch screen and uploaded to MMO/ Defra when in range would be a cost effective solution not requiring expensive satellite communications (x 2).
- Recording of discards of over quota fish may be useful – especially if it will help increase quotas in the future.
- Scottish work on reduction of discards and bycatch is ongoing (x 3).
- A skipper has enough paper work and work to attend to without adding more to the workload, it maybe that CCTV will address that problem in the future.

13. Other ecological management measures might include:

Identifying and implementing Marine Protected Areas. These include ‘real-time’, seasonal and permanent closed areas.

- Not relevant to main fishing ground of Farne Deep *Nephrops* fishery.

Restricting the range of gears that can be used in vulnerable areas (including creel only areas, a ban on twin rigging in some areas).

- There is no clear evidence that twin rigs are having a detrimental effect on seabed habitats or stock levels on the Farne Deep (x 4).
- Large gears may have an effect if very heavy clumps are being used (x 2).

Promoting the development of environmentally friendly fishing practices, for example gears with reduced bottom contact, larger meshes and better selectivity profiles.

- We support and await advice from gear specialists, fishery scientists and the Seafish Authority trials on new trawl designs, large mesh panels and square mesh panels (x 3).

Improving data recording systems to identify capture and damage to endangered, threatened and protected species.

- An observer programme might assist this; however I feel any information we willing give the scientists never appears to benefit the fishers, if anything it is used against them, resulting in skippers loosing respect of what is trying to be achieved.
- eLog is a disaster. There must be easier ways of recording a vessels position, course and speed remotely. It currently cost me £60/month in data transfers and communications. A 10p biro is just as effective (x 2).

Notes

- During the Farne Deeps *Nephrops* season, females dominate the catches before the end of the year, as the season progreses, males are present in increasing numbers.
- By mid November, the catches are much cleaner than at the start although there are a lot of whitefish about wherever we fish (North Sea and Irish Sea).
- MPAs are not relevant to main fishing ground of Farne Deeps *Nephrops* fishery that is a narrow strip approx a mile either side of the 6 mile boundary (x 2).
- A demersal trawl with reduced bottom contact isn't a demersal trawl and there is little faith in the suggestion of rollers in place of the clump as they may be in contact with the bottom for longer periods than a clump.
- Electronic means of recording catch composition by touch screen technology (see above) may be worth trialling, but bycatch of species other than gadoids and occasionally monkfish in this area is rare.
- Northumbrian / County Durham fishers who complain that their <10 m boats restrict their movements between grounds and that they are therefore at a disadvantage when compared to larger boats are the victims of their own making. Many chose to take advantage of the regulations by moving to <10 m boats in the past. They can't expect to retain these advantages and reserve a valuable fishing ground for their own exclusive use. In fishing you have to keep your options open and be able to adapt to changing markets.

Appendix 4. ICES Advice 2012.

ICES. (2011). ICES Advice 2012, Book 6, 2011. 6.4.14.2 *Nephrops* in Farn Deep (FU6), pp. 136 – 143.

6.4.14.2

Advice June 2011

ECOREGION North Sea
STOCK *Nephrops* in Farn Deep (FU 6)

Advice for 2012

ICES advises on the basis of the MSY transition that landings in 2012 should be no more than 1400 t.

To protect the stock in this functional unit (FU), management should be implemented at the functional unit level.

Stock status

F (Fishing Mortality)			
	2008	2009	2010
MSY (F_{MSY})	✓	✗	✓ Appropriate
Precautionary approach (F_{pa} - F_{lim})	?	?	? Undefined
SSB (Spawning-Stock Biomass)			
	2008	2009	2010
MSY ($B_{trigger}$)	✓	✗	✓ Above trigger
Precautionary approach (B_{pa} - B_{lim})	?	?	? Undefined

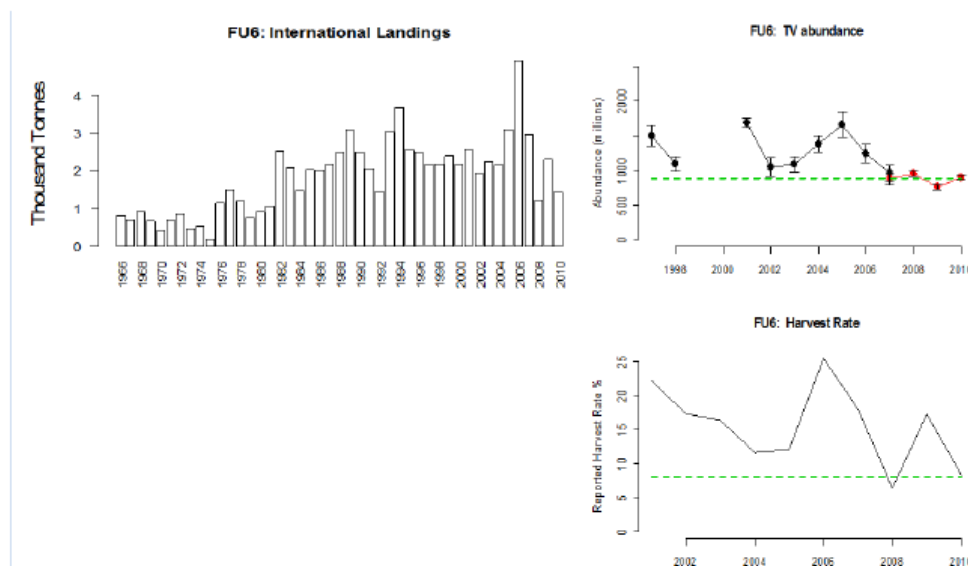


Figure 6.4.14.2.1 *Nephrops* in Farn Deep (FU 6). Long-term trends in landings, harvest rate, and UWT abundance (used as F and SSB proxies. Weights in '000 t, UWT in millions). Dashed green lines show proxies for F_{MSY} and MSY $B_{trigger}$. For the UWT abundance calculation a geostatistical method has been determined from 2007 onwards (red line).

The UWT survey indicates that the stock status has been fluctuating around MSY $B_{trigger}$ since 2007. Changes in survey methodology in 2007 make comparison with the preceding series difficult.

Management plans

No specific management objectives are known to ICES.

A Sustainable Fishing Plan for the Farne Deep *Nephrops* fishery

The fisheries

Nephrops in FU 6 are predominantly caught in trawl fisheries using meshes in the 80–99 mm category. A small amount of creeling takes place. Increases in the numbers of vessels using twin-rig and multi-rig gears observed in this area are likely to have increased the effective fishing power per kW hour. Fishing effort decreased substantially in 2010 to a level not seen since the 1980s.

Catch by fleet	Landings (2010) = 1443 t. Almost entirely taken in demersal trawl fisheries, either directed <i>Nephrops</i> or mixed <i>Nephrops</i> /demersal fish. 23% discards in numbers.
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Quality considerations

Market sampling misses portions of the tailed category of landings. For the purposes of assessment, only sampling of the full unsorted catch is used to estimate removals. Improvements in the recording of position (GPS) for the underwater TV survey from 2007 permit a more accurate estimate of absolute abundance than previously possible. Prior to this date there is a potential upward bias in the absolute estimate due to underestimation of the distance covered. The method used to raise the abundances in previous years has been found to be statistically flawed and a new raising procedure has been developed to avoid these errors. The 2010 assessment has reworked the abundance indices back to 2007, resulting in a change in the MSY $B_{trigger}$ proxy.

Scientific basis

Assessment type	Underwater TV survey linked to yield-per-recruit analysis from length data.
Input data	One survey index (UWTV -aut); Length–frequency data from the fishery.
Discards and bycatch	Included in the assessment.
Indicators	None.
Other information	Latest benchmark was performed in 2009.
Working group report	WGNSSK

6.4.14.2

Supporting information June 2011

ECOREGION North Sea
STOCK *Nephrops* in Farn Deep (FU 6)

Reference points

	Type	Value	Technical basis
MSY	MSY $B_{trigger}$	879 million	Bias-corrected UWTV survey index at start of current decline (2007) as measured by a geostatistical method.
Approach	F_{MSY}	Harvest rate 8%.	Equivalent to $F_{35\%SPR}$ male sin 2011.
Precautionary Approach	$F_{0.1}$	Not agreed.	
	F_{max}	Not agreed.	

(unchanged since: 2011)

Harvest rate reference points (2011):

	Male	Female	Combined
F_{max}	9.5 %	20.0 %	12.1 %
$F_{0.1}$	6.4 %	12.7 %	7.2 %
$F_{35\%SPR}$	8 %	18.7 %	11.5 %

For this functional unit (FU), the exploitation rate on males is usually considerably higher than on females and there is evidence of sperm-limitation following harvest rates in the region of 20%. There is evidence to suggest that in both 2006 and 2010 mature females have not been able to successfully mate and therefore a larger male spawning potential is desirable. To this effect the harvest rate equivalent to fishing at $F_{35\%SPR}$ for males is suggested as a proxy for F_{MSY} ($F_{35\%SPR}$, males = 8%).

A Sustainable Fishing Plan for the Farne Deep *Nephrops* fishery

Outlook for 2012

Basis: F_{2011} = average harvest rate over 2008–2010 = 10.7%; Bias-corrected survey index (2010) = 892 million; Mean weight in landings (2008–2010) = 25.0 g; Discard rate (dead, by number) = 25.5%; Survey bias = 1.2.

Basis	Harvest rate	Landings
	2.0%	330
	4.0%	670
	6.0%	1000
	7.0%	1200
F_{MSY}	8.0%	1300
MSY transition	8.2%	1400
F_{2011}	10.7%	1800
	11.5%	1900
	12.1%	2000
	12.7%	2100
	14.0%	2300
	16.0%	2700

MSY approach

Following the ICES MSY framework implies a harvest rate of 8%, resulting in landings of 1300 t in 2012.

Following the transition scheme towards the ICES MSY framework implies fishing mortality to be reduced to $(0.6 \cdot F_{2010} + 0.4 \cdot F_{MSY}) = 8.2\%$, corresponding to landings of no more than 1400 t in 2012.

Additional considerations

Increases in abundance in other FUs (i.e. Firth of Forth and the Fladen grounds) are likely to translate to increases in the overall TAC for Subarea IV, increasing the risk of higher effort being deployed in this FU. The high cost of fuel combined with the relative coastal proximity of this ground may result in it attracting additional fishing effort which would be inadvisable, given the current low level of the stock.

The stock has shown signs of overexploitation in recent years, with unbalanced sex ratio leading to poor recruitment. Without suitable controls on the movement of effort between functional units there is nothing to prevent the effort in 2012 returning to levels observed prior to 2008, most of which have been above the level of F_{MSY} .

The effects of regulations

The minimum landing size for *Nephrops* in the North Sea is 25 mm carapace length. Discarding rates of *Nephrops* are fairly stable between 2003 to 2010 at around 25% by number.

Changes in fishing technology and fishing patterns

There has been a general increase in the number of vessels using multi-rig gear, which has a higher fishing power than single rigs for *Nephrops*.

Information from the fishing industry

The most recent North Sea stock survey was carried out in mid-2010. In the opinion of the industry the stock is increasing in the area with good recruitment, a higher level of discarding and a good spread of sizes. This is not supported by the reported lpue levels for 2010, which show a decline and the lack of small *Nephrops* in the catch samples.

Uncertainties in assessment and forecast

General comments are found at the beginning of Section 6.4.14.

The UWTV survey in the Farne Deep for 2009 was hampered by poor weather and reduced visibility, especially in the areas which historically have given consistent high densities. The loss of these stations may have reduced the overall density estimate. A comparison with the 2008 data suggests that of the ~19% decrease, ~9% may be due to the missing stations with the rest due to genuine decreased abundance. The survey in 2010 did not suffer from poor weather.

Comparison with previous assessment and advice

The perception of the state of the stock has not changed since the assessment in 2010.

The advice in 2008 was based on recent landings as the UWTV surveys were considered inappropriate to use as absolute indices of abundance. Following the outcome of the benchmark in 2009, the major concerns of the UWTV survey have been addressed and the survey is now considered a reliable estimate of absolute abundance. This year's advice is based on the transition to the MSY transition.

Source

ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 4–10 May 2011. ICES CM 2011/ACOM:13.

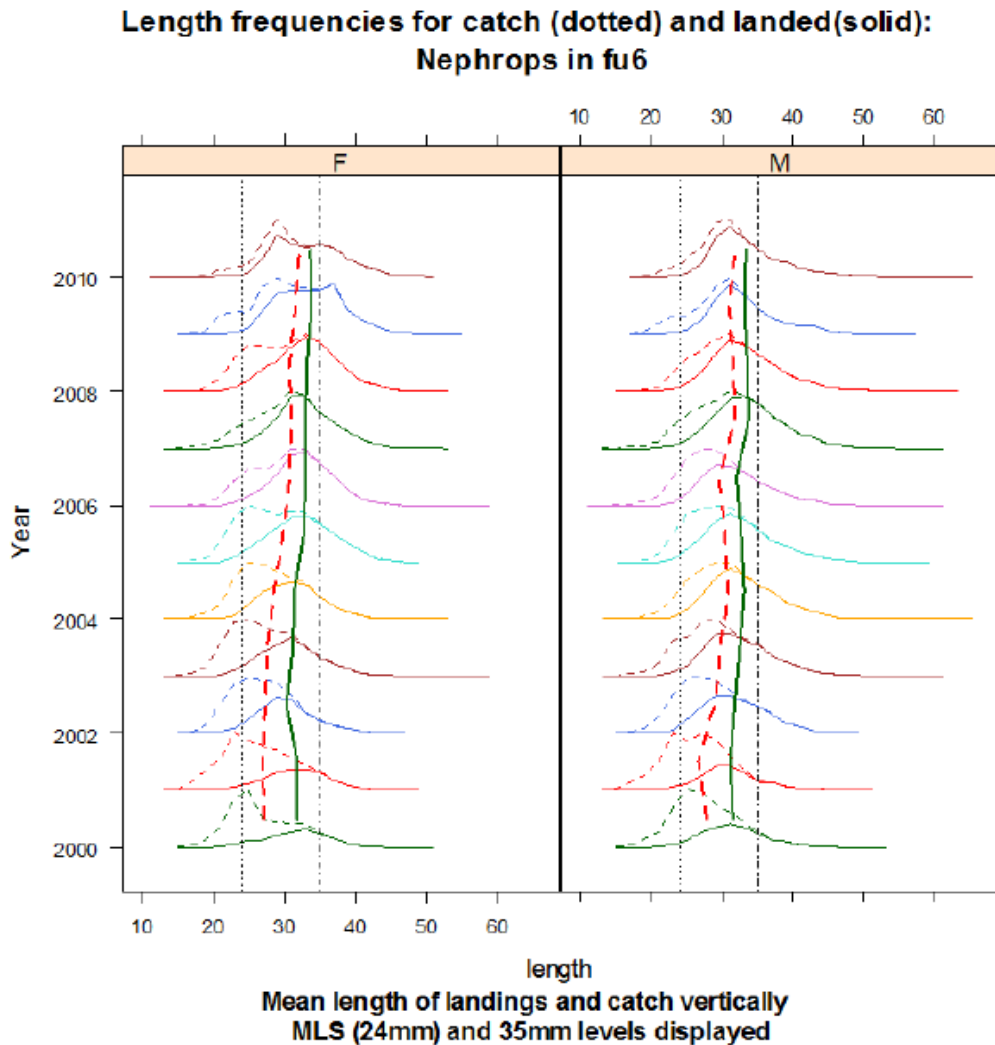


Figure 6.4.14.2.2 *Nephrops* Farne Deep (FU 6). Length composition of catch (dotted) and landed (solid) of males (right) and females left from 1996 (bottom) to 2010 (top). Mean sizes of catch and landings (using same line types) is shown in relation to Minimum Landing Size (MLS).

Table 6.4.14.2.1 *Nephrops* Farn Deep (FU 6). ICES advice, management, and landings.

Year	ICES advice	Recommended landings Farn Deep (FU 6)	Recommended landings FU 6+FU 8	ICES landings FU 6 ¹⁾
1987				2.2
1988				2.5
1989				3.1
1990				2.5
1991				2.1
1992			~4.6	1.5
1993			4.17	3.0
1994			4.17	3.7
1995			4.17	2.6
1996			4.17	2.5
1997			4.17	2.2
1998			4.17	2.2
1999			4.17	2.4
2000			4.17	2.2
2001			4.17	2.6
2002			4.17	2.0
2003			4.17	2.2
2004			4.17	2.2
2005			4.17	3.1
2006	No increase in effort		-	4.9
2007	No increase in effort, harvest rate <15%	3.5	5.0	3.0
2008	No new advice, same as for 2007	3.5	5.0	1.2
2009	No increase in effort and landings (2007)	< 3.0	²⁾	2.7
2010	Harvest Rate no greater than that equivalent to fishing at F ₂₀₀₈	<1.2	²⁾	1.4
2011	MSY transition	<1.9	²⁾	
2012	MSY transition	<1.4	²⁾	

Weights in '000 t.

¹⁾ Does not include discards.²⁾ Advice given at FU level only.

A Sustainable Fishing Plan for the Farne Deep *Nephrops* fishery

Table 6.4.14.2.2 *Nephrops* Farn Deep (FU 6). Official landings (tonnes).

Year	UK England & N. Ireland	UK Scotland	Sub total	Other countries**	Total
1981	1006	67	1073	0	1073
1982	2443	81	2524	0	2524
1983	2073	5	2078	0	2078
1984	1471	8	1479	0	1479
1985	2009	18	2027	0	2027
1986	1987	28	2015	0	2015
1987	2158	33	2191	0	2191
1988	2390	105	2495	0	2495
1989	2930	168	3098	0	3098
1990	2306	192	2498	0	2498
1991	1884	179	2063	0	2063
1992	1403	60	1463	10	1473
1993	2941	89	3030	0	3030
1994	3530	153	3683	0	3683
1995	2478	90	2568	1	2569
1996	2386	96	2482	1	2483
1997	2109	80	2189	0	2189
1998	2029	147	2176	1	2177
1999	2197	194	2391	0	2391
2000	1947	231	2178	0	2178
2001	2319	255	2574	0	2574
2002	1739	215	1954	0	1954
2003	2031	214	2245	0	2245
2004	1952	201	2153	0	2153
2005	2936	158	3094	0	3094
2006	4430	434	4864	39	4903
2007	2525	437	2962	4	2966
2008	976	244	1218	0	1218
2009	2289	414	2703	0	2703
2010*	1258	185	1443	0.039	1443
* Provisional.					
** Other countries includes Netherlands, Belgium, and Denmark.					

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Table 6.4.14.2.3 *Nephrops* Farn Deep (FU 6). Summary of the assessment.

Year	Bias-corrected TV abundance index	Landings (t)	Discard rate	Mean Weight (g)	N removed	Observed Harvest Rate
2001	1685	2574	66.40%	20.67	374	22.2%
2002	1048	1953	45.00%	20.53	182	17.3%
2003	1085	2245	41.30%	22.27	177	16.3%
2004	1377	2152	33.90%	23.58	160	11.6%
2005	1657	3094	33.90%	23.74	200	12.1%
2006	1244	4858	31.40%	22.55	317	25.5%
2007	801	2966	26.10%	25.00	158	18.1%
2008	949	1213	27.30%	25.41	61	6.4%
2009	759	2711	26.60%	24.60	131	17.3%
2010	892	1443	22.60%	25.00	74	8.3%