The North Sea Regional Advisory Council

A Draft LTMP for North Sea *Nephrops*

1. Background Information

The Norway lobster

The Norway lobster, *Nephrops norvegicus* (L.), (also called the Dublin Bay prawn, prawn, langoustine or scampi) is a pale orange crustacean which may 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 & Thomas, 1967). It is also found in the Mediterranean Sea, particularly the northern Adriatic. *Nephrops* is common across the North Sea and into the Skagerrak and Kattegat.

Nephrops live in shallow, often branching burrows, in soft stable cohesive mud at depths ranging from 20m to 800m (Rice & Chapman, 1971; dos Santos & Peliz, 2005). The presence of suitable sediment defines the habitat and 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 & 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), but in deeper water this activity is reversed and individuals may be more active by day (Höglund and Dybern, 1965; Hillis, 1971). At intermediate depths, greatest activity occurs at dawn and dusk (Chapman and Howard, 1979). *Nephrops* also exhibit seasonal burrow emergence patterns associated with mating and moulting, and these are most pronounced in mature female *Nephrops*. After spawning, berried females largely remain in their burrows for the entire incubation period, which for most functional units is from late summer until spring (Redant, 1987; Sardà, 1991; Briggs, 1995).

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, and therefore *Nephrops* may be more abundant when these fish species are scarce.

The lack of age-structured data and the particular life-history features of *Nephrops*, including the highly variable and sexually dimorphic growth rates make the use of standard stock assessment methods very difficult to apply. An approach which makes use of an underwater TV survey of Nephrops burrows to estimate population abundance has therefore been developed (ICES 2007).[H1]

Currently, in the North Sea (ICES Sub-area IV) *Nephrops* are assessed by ICES as eight separate Functional Units (or stocks) (Figure 1) based on discrete areas of muddy sediment on which Nephrops live. (Additional landings of Nephrops are also taken from smaller, isolated patches of mud elsewhere in the North Sea such as Devil's Hole). It is unlikely that there is exchange of individuals between functional units, except possibly at the planktonic stage, as adult *Nephrops* are relatively sedentary, seldom moving more than a few hundred metres (Jensen, 1965; Chapman, 1982). However, within a functional unit, the *Nephrops* distribution can be quite heterogeneous, in terms of density, size and sex composition and biological characteristics (possibly dependent on sediment composition) and therefore the existence of separate sub-stocks within some of the larger functional units cannot be ruled out (Tully & Hillis, 1995; Tuck *et al*., 1997)[H2]. There are therefore spatial problems in carrying out stock assessments and setting TACs[H3].

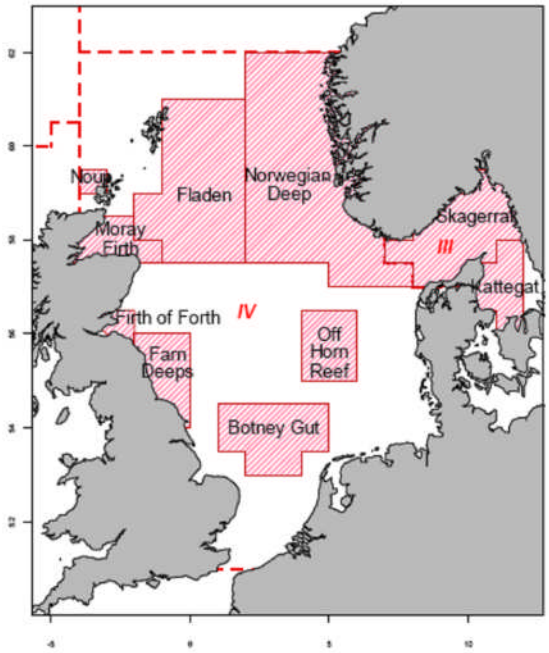

Figure 1: *Nephrops* functional units in the North Sea and Skagerrak/Kattegat region

The *Nephrops* fisheries[H4]

Nephrops are caught by two markedly different fishing methods. In some areas they are caught in baited creels or pots, fished by small vessels[H5]. In others they are caught in otter trawls. Originally the trawls were single, but more recently twin-rig trawls and multi-rig trawls have been applied in the *Nephrops* fisheries. Scotland has introduced a ban on all Scottish boats using multi-trawl gears; the ban also extends to all British vessels in Scottish waters, limiting the expansion of fishing capacity but also potentially limiting the business efficiency of vessels which are capable of multi-rig trawling. In some areas (but rarely in the North Sea) there may be conflict between creel fishers and trawl fishers.

In the North Sea the *Nephrops* fisheries are managed through the setting of a TAC. Minimum Landing Sizes apply and is 25mm in the North Sea and 40mm in the Skagerrak and Kattegat. Minimum net mesh sizes are also set, but these also vary with area. By-catch limits have been imposed. *Nephrops* fishers have recently adopted technical measures including mesh size, square mesh panels and twine thickness to conserve fish stocks.

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 white fish vessels, with large mesh nets and fewer days at sea, and *Nephrops* vessels, with smaller mesh nets and more days at sea, may have resulted in transfer of effort into the *Nephrops* fleet shortly after the introduction of the regulations.

The *Nephrops* fisheries started in the North Sea in the early 1950s. Before that the stocks were not exploited – any caught incidentally during the capture of whitefish were discarded. There has since been a great increase in the global catch of *Nephrops*. North Sea landings have increased in a series of jumps. The UK holds the bulk of the North Sea TAC (87%), the remainder being taken predominantly by Denmark and Belgium. *Nephrops* is an especially valuable stock to Scotland.

The *Nephrops* fisheries in the Skagerrak and Kattegat show differences to those in the North Sea. Mesh sizes are larger and are not tailored solely for *Nephrops* as the fishery is a mixed one. Selection grids are used in the Swedish inshore fisheries in the Kattegat, but as they remove a large part of the fish catch they are not used in the mixed fisheries. [H6]

Nephrops[H7] is a luxury product and exports are the bulk of all sales by UK processors and traders,, the main export markets being in Spain, Italy, & France, but with emerging markets in Russia, the Far East and Middle East. The bulk of *Nephrops* are sold as fresh or frozen tails or whole lobsters, but there is also an important market for live langoustines.

Assessment of the *Nephrops* stocks

In the North Sea, ICES has defined 8 *Nephrops* functional units (stocks) for the purposes of stock assessment and advice provision, viz:

Off Horns' Reef (FU 33)
Botney Gut (FU 5)

Fladen Ground (FU 7)
Norwegian Deeps (FU 32)
Farn Deeps (FU 6)
Noup (FU 10)
Moray Firth (FU 9)
Firth of Forth (FU 8)

The lack of age-structured data and the particular life-history features of *Nephrops*, including the highly variable and sexually dimorphic growth rates make the use of standard stock assessment and forecasting methods very difficult to apply. In addition, the historic landings have been uncertain for a number of stocks, making assessments based on commercial catch data unreliable, although these data are now greatly improved (since the introduction of buyers and sellers legislation).

Sampling of *Nephrops* landings is carried out at markets & processors to obtain information on the size composition of landings. In addition, discards are monitored at sea. A number of the FUs in the North Sea (FUs 6, 7, 8, 9 and occasionally 10) are also examined directly through underwater TV (UWTV) 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 counted along a track. The surveys are randomly stratified by sediment type, with 10 min 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 functional unit. Further details of the UWTV survey protocols can be found in the reports from recent ICES workshops (ICES, 2007 & 2009b).

The UWTV surveys have enabled the development of fishery-independent indicators of abundance. STECF (2005) suggested that a combination of an absolute abundance estimate from an UWTV survey and a harvest rate based on $F_{0.1}$ from a combined sex–length cohort analysis (LCA) and the mean weight and selection pattern from the commercial fishery could be used to calculate appropriate landings. This approach has been further elaborated and evaluated by ICES (ICES, 2007 and 2009a).

The recent ICES Benchmark meeting on *Nephrops* (ICES 2009a) addressed the concerns which had previously been raised in relation to factors which could potentially bias the UWTV survey results. The main sources of bias were quantified (based on simulations (Campbell et al., 2009) and expert opinion) for each functional unit and an overall bias correction factor which can be used to adjust the estimates of abundance and allow them to be treated as absolute abundance levels. In addition, the workshop calculated harvest ratios equivalent to fishing at $F_{0.1}$ and F_{max} for each FU and agreed a protocol for providing a catch options table (ICES, 2009a).

Due to the lack of full analytical assessments, precautionary reference points have not been determined for *Nephrops*. ICES has suggested that $F_{0.1}$ estimates from a yield-per-recruit analysis based on a combined sex–length cohort analysis (LCA) could be used as a fishing mortality reference point (i.e. as a proxy for F_{msy}). There are no agreed management objectives for North Sea Nephrops stocks. STECF (2009) has recommended that management plans be developed with the objective of achieving high long-term yields and low risk to the stocks and that such plans should be applicable to separate FUs.

In 2009, ICES based their advice on the approach outline above, with their choice of harvest ratio (equivalent to either $F_{0.1}$, F_{max} or F_{2008}) dependent on the current estimate of F and the recent trend in the UWTV abundance. For FUs without an UWTV survey, no new advice was provided in 2009. However, typically in such cases, ICES advises for landings on the basis that there should be no increase above the recent average.

In its review of the ICES advice, STECF (2009) noted that in the long-term, the aim for management should be to exploit *Nephrops* at rates that will give rise to Maximum sustainable yield. In the absence of an agreed proxy for F_{msy}, STECF recommended that $F_{0.1}$ (and equivalent harvest ratio) should be used as a precautionary target fishing mortality. They also concluded that given there does not seem to be an immediate biological risk to any of the stocks assessed by UWTV, then annual incremental reductions in fishing mortality towards the $F_{0.1}$ target.

ICES (and STECF) has opined that current management of *Nephrops* in the North Sea (both in terms of TACs and effort) does not provide adequate safeguards to ensure that local effort is sufficiently limited to avoid depletion of resources in functional units. In the current situation catches can be taken anywhere in the subarea and this could imply inappropriate harvest rates from some regions. More importantly, vessels are free to move between grounds, allowing effort to develop on some grounds in a largely uncontrolled way. This appears to have been a particular problem in the Farne Deeps in 2006 where increased activity by vessels from other parts of the UK occurred.

An overriding management consideration for these stocks is therefore that management should be at the functional unit rather than the ICES subarea level. Management at the functional unit level could provide the controls to ensure that catch opportunities and effort are compatible and in line with the scale of the resources in each of the stocks defined by the functional units.

2. Major Trends

Nephrops landings have progressively increased over the years. There have been jumps in the upward trend, perhaps associated with transfers of effort from other fisheries but perhaps also because of rectification of misreporting. The introduction of the buyers and sellers regulations in Scotland in 2006 considerably tightened up the levels of reporting for *Nephrops*, and the landings figures since then are considered to be more reliable. Recent increases in reported landings) may just be the result of the increase in reporting levels rather than an increase in actual landings. In addition, effort in terms of hours fished is a non-mandatory record on the log sheets and therefore landings per unit effort do not necessarily reflect changes to the stock. ICES has noted that most stocks appear to be fairly stable in terms of abundance and size composition. Notable exceptions are the Fladen Ground stock which showed a marked increase in abundance and the Farne Deeps stock where the population size dropped in 2007 and unusual changes in the seasonal sex-ratio pattern occurred.

In 2009, ICES provided updated assessments and information on stock status for those FUs for which UWTV surveys are available. The advice was presented separately for

each Functional Unit. In addition, there were increasing and significant landings from some isolated patches outside the Functional Units, most notably the Devil's Hole area. In 2008 overall landings in Subarea IV were around 22 100 tonnes, similar to landings in 2005. Landings from other rectangles have risen steadily and amounted to over 1 600 tonnes in 2008. To provide some guidance on appropriate future landings for these areas, the use of average landings of no more than 1500 tonnes (2006–2008) could be considered.

The economics of the *Nephrops* fishery are changing and marketing issues are becoming increasingly important to all fisheries in the current economic climate. Prices for *Nephrops* dropped significantly in 2008 and 2009.

3. Mixed Fishery Considerations

Much of the *Nephrops* trawl catch was originally taken in mixed fisheries, and that is still the case in the Skagerrak and Kattegat [H8]and in the Dutch and Belgian fisheries where other species like plaice are also being targeted. In general, however, in the North Sea itself there has been a move towards separation between whitefish vessels and *Nephrops* vessels[H9], brought about largely because of the cod recovery plan. Vessels targeting whitefish are required to use 120 mm nets, which lose a large part of the *Nephrops* catch. Such vessels are subject to greater days at sea restrictions. *Nephrops* vessels are permitted to use smaller meshes, and the risk of catching whitefish is then 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.

Trawling for *Nephrops* does result in by-catch and discards of other species, including cod, haddock, and whiting. Although by-catches of cod in the inshore *Nephrops* fisheries of the North Sea are currently fairly small (ICES 2009c), the *Nephrops* fishery at the Fladen has a by-catch of cod and ICES has stressed that it is important that emerging year classes should not be subject to mortality as by-catch. 80 mm is the predominant mesh size used in *Nephrops* fisheries and the resulting discarding of whitefish can be high. The capture of juvenile fish or other species such as haddock is considered to be a problem in some of the functional units and discarding of these is a problem in some years[H10]. This problem can be addressed with the use of more selective gears and Initiatives are in place to reduce the discard problem with respect to small fish. Efforts are being made in Scotland through the Conservation Credits scheme, requiring vessels targeting *Nephrops* to use gear with larger square meshed panels (110 mm). Subject to evaluation of the effectiveness of these measures, ICES considers that further action may be required to reduce by-catch[H11].

Days-at-sea regulations have reduced opportunities for directed whitefish fishing. The STECF effort database suggests some effort transfer occurred to the smaller mesh fisheries of the North Sea shortly after the introduction of the regulations; since then effort in these categories has been fairly stable.

It is worthy of note that currently far reaching recovery arrangements have been put in place for a very cheap fish (cod) which preys on a much more expensive species (*Nephrops*)[H12].

4. Ecosystem Considerations

Some concern has been expressed over the environmental consequences of fishing for *Nephrops* (whether with creels or otter trawls). This concern is focused on discards (of non-target species and undersized commercial species) made up of other crustaceans, fish and small *Nephrops*. There is also concern over the impact of trawling upon areas of seabed by weighted ground lines and otter doors. Organisms which might be particularly affected by trawling include the sea pens (sea pens are colonial corals supported by internal skeletal structures which live partly imbedded in fine sediments on the sea floor, extending well above the sea surface) and echinoderms (including sea urchins, sea cucumbers, crinoids, starfish and brittle-stars).

Towed fishing gears such as otter trawls and beam trawls can alter the physical structure of the seabed. The impact on benthic communities and ecosystems will vary with the sensitivity and natural disturbance of the seabed. The high mud content and soft nature of *Nephrops* grounds means that trawling readily marks the seabed, and trawl marks may remain visible for some time. Twin-rigged and multi-rigged trawls may have a more detrimental effect on *Nephrops* habitat and the sea bed as they employ heavy weights to couple the gears together.

Burrowing fauna can be seen re-emerging from freshly trawled *Nephrops* grounds, implying that there is some resilience to trawling. Nevertheless, technical measures to reduce seabed impacts should be encouraged.

The loss of locked up carbon from disturbed sediments may need investigation.

NB. It would be useful to consider in more detail the damage which Nephrops trawls cause to the seabed and marine fauna, and to define any problems in more detail. That might then lead to consideration of any measures which might be introduced to reduce impact

5. Uncertainties[H13]

Appropriate Stock Definition?

As outlined above, ICES has opined that current management of *Nephrops* in the North Sea (both in terms of TACs and effort) does not provide adequate safeguards to ensure that local effort is sufficiently limited to avoid depletion of resources in functional units.

This is because catches can be taken anywhere in the subarea and this could lead to over-exploitation of some functional units. ICES has suggested that management should be at the functional unit rather than the ICES subarea level. However, there is currently no certainty that these are the most appropriate functional units. The defined areas may not be completely separate and recruitment from one may affect another. [H14]On the other hand, some of the units are very large and there may be smaller sub-units within them that behave differently.

Differences in the importance of *Nephrops* to different Member States means that there are differences in the level of commitment to scientific research into *Nephrops* and in the collection of data to support scientific assessments. In the main, scientific studies of *Nephrops* are confined to the UK and Denmark. There are few data available for some of the functional units. For example, for some of the FUs with lower levels of landings (e.g. Botney Gut), there is no UWTV abundance estimate and in addition, commercial sampling data (length frequency information) have often only been gathered in recent years.

One uncertainty for the *Nephrops* fisheries is the extent to which fishing grounds may be affected by international and national initiatives to introduce marine protected areas. The Netherlands portion of Botney Gut is about to be designated a Natura 2000 Special Area of Conservation (SAC) under the Habitats and Species Directive, which may affect the activities of fishers from all Member States.

Further threats may develop from proposals to site wind-farms and other energy-based developments.

Climate change and regime shift has the potential to affect *Nephrops* fisheries, but the extent of this problem cannot yet be assessed.

There is concern that the *Nephrops* fisheries have been greatly affected by measures taken under the cod recovery plan. The effort regime introduced to protect cod has certainly restricted the activities of *Nephrops* fishers and may have resulted in a transfer of effort into the *Nephrops* fishery. There is a perception that concern over cod, which is now a relatively unimportant stock for the North Sea, is driving the management of all the North Sea fisheries.

Nephrops fishers are especially concerned about measures which regulate the catch composition to a minimum percentage of *Nephrops*. Vessels legitimately targeting *Nephrops* may catch quantities of haddock, whiting and cod but they may be forced to discard these marketable fish to comply with the catch composition rules. Indeed, the technical conservation regulations which specify catch compositions in relation to a number of mesh ranges ***require*** discarding to take place if the vessel is to fish legally.

A particular problem for *Nephrops* from a management standpoint is the absence of a full analytical assessment. It is most unlikely that analytical assessments will be available for the different *Nephrops* stocks in the foreseeable future. In these circumstances it may be more appropriate to move towards the more pragmatic management approach outlined in the Commission's non-paper on Managing Fish Stocks without Catch Option Tables. This paper sets out a new approach for stocks subject to poor scientific advice. The NSRAC has welcomed the Commission's initiative on this issue, which is a very important one[H15]. It has particular relevance to North Sea *Nephrops* and provides a starting point for discussion on how to deal with *Nephrops* stocks, where analytical assessments may never be achievable. This theme is developed further below.

6. Defining Objectives

The NSRAC has proposed that LTMPs plans should embrace economic and social as well as biological objectives.

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Economic Objectives

Currently, the only economic information available to the NSRAC [h17]is from the Scottish fleet. Figures published by Seafish for Scottish vessels only, show that for >10m nephrops vessels in 2007, those using single rig trawl (106 vessels, average length 14.4m) achieved average fishing income of £183,000, while those using twin rig trawl (100 vessels, average length 19.9m) achieved average fishing income of £532,000. . For all Scottish *Nephrops* creel vessels (9m – 9.99m) the average value of the landings per vessel is £73,000 per annum. At first sight the income per crew member is not large, especially for creel vessels, where some of the owners and crew have other sources of income in addition to fishing. Further examination of the economic information, in particular estimations of capital invested is necessary to determine the level of profitability and return on investment within *Nephrops* fleets throughout the North Sea. Until that is done it is difficult to set clear economic objectives or to develop options for the future[h18]. However, it is important to recognise that the markets are now quite volatile and current 2009 prices are low. At the same time retailers are increasingly insisting on products which can be guaranteed to originate from a sustainable fishery. The costs of achieving certification of a particular fishery are high[h19].

One starting point is to consider what the market wants. The preferences of buyers may differ from country to country, however, and in the case of *Nephrops* many of the ultimate consumers are in southern Europe and elsewhere.

Economic issues which might be addressed through the setting of objectives within the LTMP include:

> Whether the fleet is the right size and type and has the right balance in terms of overall profitability and in terms of the fishing opportunities available
>
> Whether there is scope for further growth in the market, and the implications of that growth for management of the fisheries
>
> What degree of overall economic stability should be sought? If the fleet is currently acceptably profitable, and stocks stable, should we aim to maintain that position?
>
> Dealing with the problems of technology creep, and the introduction of more efficient fishing methods (like multi-rig trawls) at a time when greater stability in fishing capacity is being sought.

Issues over the maintenance of open access to inshore fishing grounds (see section on Social Objectives below)

Issues over the extent to which effort should remain mobile over the different functional units within the North Sea, or should be allocated by post code

Perhaps the major economic risk for the *Nephrops* fisheries is likely to come from expansions in fishing capacity[h20]. Excess capacity in a fleet implies unnecessary excess investment in fixed assets which must then achieve higher amounts of profit to generate an acceptable return for that increased investment. Because fishing is a fairly risky business venture, the required return on investments should be quite high compared to alternative business investments. Fishing capacity is the maximum quantity of *Nephrops* over a period of time that can be caught by the fishing fleet if it is fully utilized. Whereas fishing effort can be measured in terms of kilowatts or other physical parameters the capacity expresses the ability of the fleet to catch *Nephrops*. Capacity in the Nephrops fishery may already be too high (judging from the relative low profitability of individual vessels). Total capacity is also likely to increase within the North Sea *Nephrops* fisheries as more vessels enter the fishery, attracted by the high value of the product, the stable state of the stocks, the pressure on other stocks, the lack of barriers to transfer into the fishery and into the area from another under the open access provisions of the CFP, and also as existing vessels become more capable due to the inevitable technology creep resulting from the ingenuity of fishers in developing increasingly efficient gears. Technology creep alone is estimated[h21] to result in a 2-4% increase in fishing capacity every year. Such an expansion in capacity may threaten the economic stability of some, if not all, sectors of the fleet as well as threatening the stability of *Nephrops* stocks. Increase in capacity leads to poor economic performance and low resilience to external pressures, including pressures on the stocks.

The impact on stocks of Such expansion in capacity can only be limited by limiting total fishing effort (number of vessels or days at sea) or by limiting fishing efficiency (for example by controlling improvements to the efficiency of fishing gears[h22]).

In developing objectives it may be necessary to explain to the different industry sectors how they might benefit from developing a management strategy for *Nephrops*. It is important to recognise, however, that it is not the role of any LTMP to instruct fishing enterprises on how they should operate or take their own economic decisions, or to micro-manage the industry. This plan is a management plan not a business plan.

One of the major problems in setting out the economic goals and objectives is a lack of data on the economics of the *Nephrops* fishery. The collection of appropriate data from all Member States engaged in the fishery should be a priority.

The table below shows that, in the North Sea *Nephrops* single rig trawl >10m fleet segment, if all participating vessels had delivered 80% of the maximum days at sea achieved, then only 41 vessels, rather than 50, could have landed the same volume of *Nephrops*. This indicates that the vessels in the fishery are not being used to generate income as much as they could be and that the total volume of fish landed could have been landed by fewer vessels and therefore with less capital invested, and therefore generating a higher return on capital employed.

This table suggests that Scottish North Sea *Nephrops* fleets are already over capacity judged by a technical measure, and recent reports on fleet financial performance support that assessment, showing low levels of profit.

	No. of vessels	Sum of days at sea	Sum of landings (Tonnes)	No. of vessels required if all did max days at sea	No. of vessels required if all did 80% of max days at sea
NS Nephrops single rig trawl > 10m	50	7,163	3,987	33	41
NS Nephrops twin rig trawl > 10m	100	18,934	21,803	64	80
WoS Nephrops single rig trawl > 10m	112	18,396	7,305	66	83
WoS nephrops twin rig trawl > 10m	32	5,938	3,999	20	25
Pots and traps under 10m	169	22,645	4,853	69	87

Table **Error! No text of specified style in document.**.1 Capacity utilisation, 2007
Source: Profitable Futures for Fishing: First Interim Report, Seafish, 2009

	Segment Total	Average Per Vessel
Number of Active Vessels	106	
Length (m)		14.4
Power (kW)	9,327	187
VCU	7,902	158
Registered Tonnage (GT)	2,225	44
Days at Sea	7,163	143
Volume of Landings (Tonnes)	3,987	80
Value of Landings (£)	£9,124,397	£182,488
Vessel Age (years)		28

Table **Error! No text of specified style in document.**.2 Segment characteristics, 2007 - NS nephrops single rig trawl over 10m (Scottish vessels)
Source: Profitable Futures for Fishing: First Interim Report, Seafish, 2009

	Segment Total	Average Per Vessel
Number of Active Vessels	100	
Length (m)		19.9
Power (kW)	39,224	392
VCU	30,975	310
Registered Tonnage (GT)	14,002	140
Days at Sea	18,934	189
Volume of Landings (Tonnes)	21,803	218
Value of Landings (£)	£53,145,899	£531,459
Vessel Age (years)		18

Table **Error! No text of specified style in document.**.3 Segment characteristics, 2007 – NS nephrops twin rig trawl over 10m (Scottish vessels)
Source: Profitable Futures for Fishing: First Interim Report, Seafish, 2009

Social Objectives

We have seen that current management of *Nephrops* in the North Sea does not provide adequate safeguards to ensure that local effort is sufficiently limited to avoid depletion of resources in the functional units. Catches can be taken anywhere in the North Sea and this might result in very heavy harvest rates from some regions. As vessels are free to move between grounds, effort may develop on some grounds in a largely uncontrolled way. This appears to have been a particular problem in the Farne Deeps but it may occur on other grounds.

There are particular social problems where such grounds are situated close inshore. In many cases the larger vessels are able to spread their fishing over several functional units. However, small local vessels may only be able to fish local grounds, and they may be severely disadvantaged by a large influx of larger nomadic vessels. This mobility of effort may be a disincentive to local fishermen to take conservation measures on grounds in their proximity as any benefits will be wasted if larger additional vessels arrive. One option which may need to be considered is strengthening the fishing rights of local vessels, or vessels which commit themselves to particular conservation measures.

Below it is suggested that the stability of the various *Nephrops* functional units should be achieved through a 'no more than' clause. Thus, the TAC set for the North Sea would be accompanied by a statement 'of which no more than x tonnes shall be taken from functional unit X'. The 'no more than' figure might be set at a level which would enable local fishers to remain operating. However, on its own this measure would not protect local fishers from an influx of large nomadic vessels.

NB. The NSRAC needs to develop a view on this, including a series of options for dealing with the problems which have arisen and are likely to occur again. This kind of problem (of protecting local stocks) also occurs with other species, and the CFP currently has not developed effective mechanisms for protecting local stocks in a non-discriminatory way. Options for dealing with this problem need to be developed.

Biological Objectives

Most of what is written in this section is about the harvest rules that might be used to ensure the biological objectives are met rather than about the biological objectives per se. Surely exploitation consistent with high yield and low risk of stock collapse (refer to MSY?) should be the main point under this title. Possible harvest rules should go elsewhere?

Nephrops stocks in the North Sea for which assessments are available are considered to be stable in terms of abundance and size composition (except for the Farn Deeps). Indeed, *Nephrops* on the Fladen Ground have showed a marked increase in abundance in recent years. However, the Farn Deeps stock showed a population size drop in 2007 and unusual changes in the seasonal sex-ratio pattern also occurred which may have been due to increased effort in the fishery in this FU. ICES has therefore made it clear that *Nephrops* should be managed by functional unit, rather than at an over-arching North Sea level.

Assessments of the *Nephrops* functional units within the North Sea utilise a number of approaches, including TV surveys, length composition information, and basic fishery data such as landings and effort. Owing to uncertainties in the accuracy of historic landings and to inaccurate effort figures in some fisheries, increasing attention is paid to the TV survey information and size composition data as an indicator of stock stability.

In terms of a LTMP for *Nephrops*, the main biological objective will be to keep stocks within sustainable limits[H23]. STECF (2009) has recommended that management plans be developed with the objective of achieving high long-term yields and low risk to the stocks and that such plans should be applicable to separate FUs.
A decision rule is required for setting the TAC, and trigger points need to be defined[H24]. For other species these rules have depended on traditional methods of assessment and reference points derived from the assessment results. The lack of an analytic assessment and forecast means that any decision rule for Nephrops stocks would probably have to be based on the UWTV survey abundance. The current approach of applying a harvest ratio (to the TV abundance) equivalent to fishing at an F_{msy} proxy ($F_{0.1}$ or F_{max}) could be part of the HCR. However, there are currently no agreed or even proposed stock size reference points (based on the TV abundance, or otherwise) below which a reduction in F (to below the target level) might be required.

We have suggested above that it may be more appropriate in managing *Nephrops* to move towards the more pragmatic management approach outlined in the Commission's non-paper on Managing Fish Stocks without Catch Option Tables. Thus, any decrease in the index of stock status derived from UWTV surveys might be accompanied by a decrease in TAC. For precautionary reasons, the decrease might be disproportionate, so that if the index goes down by say 20% the TAC would go down by more than 20%. The reverse would apply as the index of stock abundance increases. An increase of 20% in the stock index might be accompanied by a rather smaller increase in the TAC. This aim of this type of approach is to move *Nephrops* stocks in the right direction[H25].

The index of stock status might be based on the various empirical indicators discussed above.

There is of course an issue over the extent to which the TAC should be set for the North Sea, or for the various functional units. It may be necessary to restrict the quantities taken from a particular functional unit. Rather than set individual TACs the Development Group suggests that this should be achieved through a 'no more than' clause. Thus, the TAC set for the North Sea would be accompanied by a statement 'of which no more than x tonnes shall be taken from...'. The 'no more than' figure attention might be set to enable local fishers to remain operating.

It is expected that the quality of fishery data available for the *Nephrops* stocks will continue to improve. The UK registration of buyers and sellers (since 2006) has led to more accurate landings information from these stocks and within a few years this should improve the basis for assessment and forecasts of catch. Stock monitoring continues, and enhanced work on observer trips on-board commercial vessels should furnish additional data on by-catches and discards. However, if future management is to be based largely on the results from UWTV surveys then it is important to extend these surveys to cover all the functional units. This will require action by all Member States significantly engaged in the *Nephrops* fishery.

NB. To be considered further and discussed. There will be a tendency for ICES scientists to try to make Nephrops conform with finfish species and to set conventional targets. However, there may be more direct and pragmatic ways of proceeding, using simple indicators for each functional unit, and with robust harvest control rules based on those indicators.

How do we deal with catches from outside the main functional units or include new functional units?

ICES collates catches from outside the main FUs and includes them in their N Sea advice document. Although they do not officially provide advice for the non-FU areas, they do usually provide 'guidance' on future landings from these areas – typically average landings over the most recent 3 years.
The Devil's Hole is the most important non-FU area – some commercial sampling and occasional TV surveys carried out by Marine Scotland – Science. Not sure what the process is for including a new FU – make case to ICES?

7. Instruments

NB. The measures to be taken to achieve management objectives need to be set out as a series of options for agreement by fishers themselves at the ports. The sections above need to be developed further and they need to end with a set of agreed objectives, stated in a very clear way so that fishers can understand them.

In some respects the biological objectives may be the easiest to deal with for the *Nephrops* fishery. It would seem that the TAC system applied to the *Nephrops* fishery is effective and appropriate for controlling the impact of the fishery upon *Nephrops* stocks[H26], although there is a clear problem in deciding whether the TACs should relate to each functional unit or to the North Sea as a whole. The Development Group is proposing that the main control should be through the setting of North Sea TACs, with the functional units being dealt with through 'no more than' clauses.

Some functional units may require additional measures to protect them if stocks fall outside given parameters. In this situation consideration may need to be given to measures which provide some protection for those local fishers unable to fish elsewhere. Such measures would require clear definition of such vessels, perhaps in terms of their commitment to a particular conservation code or agreement to restrictions on fishing method.

In terms of impacts upon other stocks, the *Nephrops* fishery, especially in Scotland, has already gone some way in reducing impacts upon whitefish stocks. ICES has stressed the importance of not subjecting emerging year classes to capture. This problem is already being addressed through the use of more selective gears and initiatives are in place to reduce the discard problem with respect to small fish. 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). There is the possibility of linking mesh size changes to new Minimum Landing Sizes. There may still be some scope for improving gear selectivity. The introduction of Real Time Area Closures (RTCs) may be effective in some areas in reducing impact upon young fish. The imposition of permanent or seasonal restrictions on fishing in cod nursery areas offers an additional tool.

The NSRAC recognises the wish of the Commission to eliminate discarding by 2012. By-catch and discards are amongst the most serious challenges in seeking sustainable fisheries and reducing them is part of 'the ecosystem approach' to fisheries management. It is also part of the process for achieving certification of a fishery, as discard reduction is often a requirement for receiving certification. However, the Commission has not yet defined what it means by "discards" and whether the term refers to all finfish and crustaceans in the by-catch or to commercial/quota species only. The *Nephrops* fleets will continue to trial measures to improve selectivity and is now confident that further improvements can be achieved. Any initiatives taken will need to be monitored and their efficacy assessed.

NB It is possible the Nephrops could provide a pilot project for dealing with discards. The Commission previously mentioned the possibility of a series of discard pilot projects, but has recently given less emphasis on this as a result of the Commissioner's own wish to introduce a discard ban for all fisheries.

There is legitimate concern by fishers over catch composition rules in the *Nephrops* fishery which force the discarding of species like cod. It is recognised that there is a need to discourage excessive targeting of white fish by vessels using smaller mesh gears without quota to land the fish. However the catch composition rules can result in discarding even where quota is available and whitefish are not being targeted. Some thought needs to be given to resolving this problem. Perhaps now that cod is recovering in the North Sea there is scope for easing the catch composition rules[H27], as part of an adaptive approach.

It is acknowledged that bottom disturbance from *Nephrops* trawls may have an impact upon benthic communities and ecosystems. Emerging proposals to establish marine protected areas in the North Sea may facilitate study of these impacts and provide some basis for the protection of especially vulnerable organisms. Alternative towed gears with less bottom contact may offer a solution in some fisheries. Other measures might

include the provision of dropout openings, and "wheeled" foot-gears replacing rock-hoppers.

Measures will need to be put forward as part of a strategy for dealing with expected increases in fishing capacity within the *Nephrops* fishery. The main options are:

Setting a limit to fishing effort (number of vessels, days at sea, fuel restrictions, kW restrictions)

Limitations in fishing efficiency (for example by restricting the use of twin-rig and multiple-rig gears

Acceptance of the decline in economic performance of vessels that would follow if no action at all was taken.

Measures to meet social objectives have still to be discussed. There is an issue over the extent to which local fishers should receive preferential treatment within a particular functional unit.

Taken together, these measures should ensure that the *Nephrops* fisheries are stable, sustainable, well managed and profitable.

NB. The above section needs extensive further discussion. We have only made a start in considering the measures to be adopted as part of the management plan.

8. Timeframe

The NSRAC sees the LTMP for *Nephrops* fisheries as a gradual sequential response to risk. The plan needs to be responsive and adaptive, changing as circumstances change.

9. Conclusions

To be considered

10. Review of Progress & Adaptive Management

To be considered

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