

The North Sea Regional Advisory Council



A Long Term Management Plan for North Sea *Nephrops*

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1. The Scope of the Long Term Management Plan

This Long Term Management Plan (LTMP) is intended to set out clear objectives and a range of options for managing the *Nephrops* fisheries of the North Sea, Skagerrak and Kattegat. The overall goal is to ensure that further development and improvement in the *Nephrops* fisheries can take place in a sustainable way, without affecting natural resources adversely.

The plan has been 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: to 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 management plan has anticipated those changes and is intended to work within a new, reformed, regional CFP, where participation of fishers and others in fisheries management has become accepted.

Individuals and communities must be involved in any management decisions that will significantly affect them. In developing this plan for the *Nephrops* fisheries the NSRAC has aimed at a plan that has industry “buy in”. The plan has not simply been passed down from above but has been developed from discussions with fishers and other interested parties, including those responsible for accrediting the *Nephrops* fisheries.

This version of the management plan consolidates objectives that were discussed with stakeholders at meetings in Eyemouth, Fraserburgh, Pittenweem and Whitley Bay and then developed further at a meeting of the NSRAC *Nephrops* LTMP Development Group called specifically to consolidate this approach to the plan.

Fishers have so far supported the preparation of a Long Term Management Plan for *Nephrops* and have welcomed measures that would provide them with greater stability. They have emphasised the problems caused to them by the lack of continuity under the current regime, where circumstances change not only from year to year but also from day to day. Many of the recent developments in the fishery have been detrimental to fishers. A great influx of effort into the North Sea has taken place with restrictions on the west coast grounds, and also with the changes under the cod recovery plan; where vessels have been forced to target *Nephrops* because of the restrictions on catching cod and other whitefish. In addition, vessels are being forced to use small meshes to retain their status as *Nephrops* vessels although there are clear conservation benefits from moving to larger meshes. Boats targeting whitefish can fish for *Nephrops* but *Nephrops* vessels are now unable to target whitefish. This has led to an overcrowded *Nephrops* fishery. The *Nephrops* fishery has become a fishery of last resort in the face of restricted opportunities to fish for whitefish. That makes management very difficult. Overall there is a need to slow expansion of the fishery down, especially in those areas at risk of over-fishing.

Long Term Management Plans must meet biological and ecological objectives whilst ensuring that fishing businesses are prepared for the economic stresses that are inevitable when exploiting a variable natural resource in an uncertain global economy. There is a real challenge in developing plans for sustainable fisheries that are both

biologically orientated and fleet orientated. The objectives must bring together biological and business related factors. The output of the plan must also sit comfortably with the aims of any accreditation schemes being entered into by the fishing industry.

This Long Term Management Plan for North Sea *Nephrops* aims to:

- Analyse the current position of *Nephrops* fisheries in the North Sea and state clearly what we are now trying to achieve;
- Set out the balance which must be struck between economic, social and environmental priorities and outline a series of objectives and future targets;
- Describe the instruments needed to reach those targets and deliver sustainability for the *Nephrops* fishery;
- Identify the roles and responsibilities of different parties, including stakeholders, in meeting those targets and achieving sustainability;
- Outline the institutional changes that will be necessary to ensure that our vision of a sustainable *Nephrops* fishery can be achieved

Under this plan it is important that fishers should become more responsible for recording what they remove from the sea. It will be their responsibility to:

- Ensure that landings are within quota
- Reduce discards and show that they have reduced discards

The Long Term Management Plan is multi-annual, and is intended to last for ten years with regular review. It is designed to be adaptive and capable of being adjusted to match any major change in circumstances. It is also intended to be compatible with and interdependent on other management plans. Once the plan is agreed and put into operation then progress with implementing it must be monitored.

One recent development that may affect this plan is the implementation of the Marine Strategy Framework Directive, which will eventually require additional steps to be taken to protect the marine environment. The plan has taken the Directive into consideration and is intended to anticipate its requirements.

Ultimately, this plan will have to be approved by the European Commission and Council of Ministers. The European Parliament will have to be consulted. The plan will have to be put in place under the rules of the Common Fisheries Policy. However the plan has been prepared with the full engagement of fishers, and has been put forward by the North Sea Regional Advisory Council, which represents all interested parties.

2. Summary of the Long Term Management Plan

In the table below we summarise the proposals contained within this Long Term Management Plan for the North Sea *Nephrops* fisheries. The objectives and instruments are set out in more detail in Section 3.

The overall goal:	
To ensure that further development and improvement in the <i>Nephrops</i> fisheries can take place in a sustainable way, without affecting natural resources adversely.	
Where do we want to go?	How do we get there?
<p>Biological objectives</p> <p>The <i>Nephrops</i> fisheries as a whole must move progressively towards lower fishing mortalities and higher yields.</p> <p><i>Nephrops</i> in the North Sea should be exploited at rates that are sustainable by setting a TAC based on a target fishing mortality (F) consistent with F_{MSY} and set for each of the functional units</p> <p>In the absence of an agreed value or proxy for F_{MSY} then an F between $F_{0.1}$ and F_{MAX} (and an equivalent harvest ratio) should be used as a precautionary target fishing mortality</p> <p>In the absence of immediate biological risk to any of the stocks assessed by UWTV, then the target F should be reached gradually, in an incremental way</p> <p>Should stock size fall below 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 UWTV surveys</p> <p>Should stocks increase the F should be increased in line with the increase in stock size shown by the UWTV surveys up to the agreed F_{MSY} proxy.</p> <p>A TAC should be set for the North Sea as a whole, consistent with the aggregated assessments for the individual functional units.</p> <p>Management at the functional unit level should be achieved through the adoption of</p>	<p>Instruments</p> <p>An F should be set of between $F_{0.1}$ and F_{MAX} for each of the functional units and the TAC for the North Sea should be consistent with that value. The target F would be reached gradually, through incremental annual reductions in fishing mortality through reduced TACs</p> <p>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 UWTV surveys. If recruitment improves and stock size increases, then F should be increased accordingly.</p> <p>Measures for the functional units should be dealt with by <i>Sustainable Fishing Plans</i> tailored to each unit. Each sustainable fishing plan will propose measures for limiting fishing pressure.</p> <p>The measures to be adopted for a particular functional unit would be prepared and proposed by the regional management body as part of the sustainable fishing plan, with the support and participation of the fishers who fish that ground, and other stakeholders, and subject to evaluation by STECF.</p> <p>Where there is a lack of information on the fishery or the stock the sustainable fishing plan should include proposals to remedy the deficiency.</p>

<p>specific management measures for vulnerable functional units or for functional units for which there are few data. Those measures should reflect the particular circumstances on those grounds.</p> <p>Fishing mortality upon <i>Nephrops</i> must be properly monitored and controlled</p>	
<p>Ecological objectives</p> <p>Reduce discards of both <i>Nephrops</i> and whitefish in the fishery</p> <p>Minimise damage to threatened, endangered and protected species</p> <p>Minimise impacts on benthic habitats and associated communities.</p>	<p>Instruments</p> <p>Instruments for reducing discards are different for different fleets.</p> <p>Options include:</p> <ul style="list-style-type: none"> • 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. <p>It is for fishers to adopt measures for reducing discards and by-catches and it is their responsibility to:</p> <ul style="list-style-type: none"> • Ensure that landings are within quota and demonstrate that this is so • Reduce discards and demonstrate that this has been achieved <p>Other management measures include:</p> <ul style="list-style-type: none"> • 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) • Promoting the development of environmentally friendly fishing

	<p>practices, for example gears with less bottom contact, larger meshes and better selectivity profiles</p> <ul style="list-style-type: none"> • Improving data recording systems to identify capture and damage to endangered, threatened and protected species • Safe and speedy return to the sea of endangered and threatened species
<p>Economic objectives</p> <p>Provide incentives for fishers to move the fishery in the direction of lower fishing mortality while enabling them to meet their own business aims and objectives</p> <p>Avoid regulation that makes fleets less efficient or provides perverse incentives which act to the detriment of the fishery and the <i>Nephrops</i> stock</p> <p>Any change imposed on the fishery to meet biological and ecological objectives must take place at a rate that can be absorbed by individual businesses and communities</p>	<p>Instruments</p> <p>It is for member states, producer organisations and fishing businesses to decide how to deal with changing economic pressures.</p> <p>There are no specific economic instruments that require to be imposed by this management plan. However, in meeting the biological and ecological objectives it is important to avoid regulation that makes fleets less efficient or provides perverse incentives that act to the detriment of the fishery and the <i>Nephrops</i> stock. It is also important to provide incentives for individual fishers to change to meet new business aims and objectives.</p> <p>Measures imposed on the fishery to meet biological and ecological objectives must take place gradually</p>

Sustainable Fishing Plans

A key element of this Long Term management is the preparation of sustainable fishing plans for each of the *Nephrops* functional units in the North Sea. Each plan 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 such a plan would be to ensure that full information is being collected and made available on the vessels engaged in the fishery, the state of the fishery, and the state of the resource the fishery depends upon. The plan would then consider how the *Nephrops* stock could be exploited in a sustainable way; in a manner that was fair and equitable to all fishers. Such a plan would not be a purely local plan; it 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.

3. Preparation of the Long Term Management Plan

Where we are now?

There has been a great increase in the landings of *Nephrops* from the North Sea since the 1950s. Landings have progressively increased in a series of steps. ICES scientists have noted that most stocks appear to be stable in terms of abundance and size composition.

However, despite this apparent stability the scientific advice from ICES and STECF is that there are benefits to be gained from the *Nephrops* fishery as a whole moving progressively towards lower fishing mortalities giving higher yields.

Currently, in the North Sea itself, *Nephrops* stocks are divided into eight separate Functional Units (FUs). For some of these functional units, like the Fladen ground, *Nephrops* has shown a marked increase in abundance over the years. In others, like the Farne Deeps, the population has recently fallen.

It was recognised at all the ports visited that it is in everyone's interests to make the fisheries sustainable and not to fish too hard. In doing this for *Nephrops*, for which conventional stock assessments are not appropriate, it is sensible to do this in terms of setting a target fishing mortality (F) rather than a target biomass, as catch rates are easier to monitor. Currently, F values are set for each of the functional units. A consistent target value for each unit might be set slightly higher than the value which currently prevails on grounds like the Fladen, but lower than the current value for the North Sea as a whole. This target F could be approached gradually for each functional unit.

The scientific advice from ICES and STECF is 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 the functional units. Catches can be taken anywhere in the North Sea and vessels are free to move between grounds, allowing effort to develop on some grounds free of any restriction. This freedom, although it permits flexibility for fishing vessels, may lead to unacceptably high harvest rates from some of the functional units.

A major management consideration for *Nephrops* stocks therefore is whether management should be at the functional unit level rather than a North Sea level. Management at the functional unit level would provide the controls to ensure that catch opportunities and effort were compatible and in line with the scale of the resources in each of the stocks defined by the functional units.

In assessing the North Sea *Nephrops* trawl fishery for accreditation it has already been recommended that there should be a formal stock rebuilding strategy with monitoring to demonstrate recovery. The stock must be above the point where recruitment would be impaired and should be at or fluctuating around a target reference point. ICES should be supported in its recommendations and advice. A particular difficulty in obtaining accreditation is that the state of some functional units is not currently assessed.

Transfer of effort into the North Sea *Nephrops* fishery has occurred recently as an unintended consequence of restrictions imposed on other sectors of the fleet and in other areas, some of them outside the North Sea. This issue must be addressed in the management plan. It is also evident that reduction of discards must form an important component of the plan, and that impacts of the fishery upon the ecosystem must also be addressed.

Fishing fleets should be economically resilient, with an ability to withstand changes in their circumstances. We should be aiming for a modern, safe, fishing fleet, which is earning profits. However, this is a management plan, not a business plan. The fleets themselves are very diverse and conditions in member states differ. Although this plan will set out some general economic guiding principles, it will not be prescriptive in defining economic measures to be taken by member states, producer organisations or fishing businesses.

Where we want to be - the objectives of the LTMP

Biological objectives

Setting overall targets

An important role of the plan for North Sea *Nephrops* must be to match overall fishing capacity to the long-term sustainable yield. Fishing must be at a level that will allow *Nephrops* stocks to renew themselves.

Overall the *Nephrops* stocks in the North Sea do not appear to be over exploited. STECF has remarked that there does not seem to be an immediate biological risk to any of the stocks assessed by means of underwater television surveys. One objective might be for the *Nephrops* fisheries on those stocks to continue at about the current level, maintaining the existing rate of fishing mortality. However, even under constant fishing mortality, the size of the stock will vary due to fluctuations in recruitment. The overall objective must be to match fishing capacity to a longer-term sustainable yield, whilst accommodating fluctuations in the state of the stocks. STECF (2009) has stressed that long term management plans should be developed with the objective of achieving high long-term yields and low risk to the stocks.

What might that appropriate level of fishing mortality be? Under international obligations the Commission must restore fish stocks to levels and conditions in which they are capable of providing maximum sustainable yields. 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 MSY i.e. with a fishing mortality (F) set at F_{MSY} ; where MSY is defined as the largest average catch or yield that can continuously be taken from a stock under existing environmental conditions. A proxy for the Commission's general target of F_{MSY} for *Nephrops* would lie between $F_{0.1}$ and F_{MAX} . If a consistent F of between $F_{0.1}$ and F_{MAX} is maintained then there should be no need to change this value with variations in the stocks. Each year, a consolidated TAC can be set for the North Sea, consistent with the size of the stocks in each functional unit and the target F set for each of those units.

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

STECF has suggested that there are wide benefits to be gained from the *Nephrops* fishery as a whole moving progressively towards lower fishing mortalities giving higher yields. It has recommended a precautionary target for fishing mortality of $F_{0.1}$ should be adopted for North Sea *Nephrops* until a better proxy for F_{MSY} can be derived.

Setting a target value between $F_{0.1}$ and F_{MAX} would result in lower fishing mortalities than those currently prevailing in the North Sea.

There may be a case in the future for merging biological with economic objectives. Fishing to Maximum Economic Yield (MEY) may provide more appropriate reference point.

In the North Sea we are currently moving from a state where species that prey upon *Nephrops*, like cod, have been at a very low level, to a state where they may become more abundant. It is necessary to take account of these species interactions and other changes to the ecosystem that may have a significant effect in the future upon *Nephrops* stocks. Ecological systems are dynamic and unpredictable with major effects, for example from climate change, which we cannot influence. Management systems and management plans must be robust in the face of uncertainty. They must be adaptive and capable of changing with circumstances.

Fishers are sceptical over risks to *Nephrops* stocks from a recovering cod stock. However, they accept that there might be other circumstances under which particular stocks become highly depleted, for example as a result of environmental change. It is acknowledged by 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 stocks. The 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.

Thus, there is agreement that a biomass trigger point needs to be set which will prompt a revision of the target value for fishing mortality. A value for $B_{TRIGGER}$ has yet to be set for *Nephrops* in the North Sea in any of the functional units. However, if such a value can be reached, then an appropriate management response would be to reduce the target value set for F in line with the decline in biomass. Such a measure would ensure that the plan is adaptive. The intention would be to monitor developments in the stocks and to look at the implications of any increase in natural mortality upon the F reference point.

Managing fisheries within the functional units

Even with a more sustainable approach towards the total *Nephrops* stock in the North Sea, there will be a risk to *Nephrops* in some of the functional units. Some have already shown evidence of over-exploitation. In addition there is a pronounced lack of

information on some of the functional units (e.g. Botney Gut and the Noup), where UWTV abundance estimates are lacking. It is also evident that there is a question over the designation and assessment of the functional units. There may be a case for designating the Devil's Hole (and perhaps other separate and identified fisheries areas within the central North Sea) as a discrete functional unit.

Fishers have expressed concern concerned about the accuracy of the stock assessments and the scientific advice. They are concerned that for many of the functional units there is insufficient information for scientists to deliver valid advice on the state of the stocks and on TACs. Fishers do accept, however, that some of the functional units are vulnerable to over-exploitation, and that steps must be taken to minimise the impact of this.

Thus, the objectives for the management plan for *Nephrops* must set out how potential damage to the vulnerable functional units might be limited. A form of management is required which will take account of local depletions. One issue is whether certain functional units should currently receive some permanent and specific form of protection. If the management plan is to be consistent with ICES and STECF advice, and with the recommendations of accreditation agencies, then management at a functional unit level must be introduced with the aim of safeguarding individual functional units against depletion.

Thus, the essential problem for any *Nephrops* management plan is one of having adequate safeguards to avoid depletion of resources in individual functional units.

There is no support from fishers for the allocation of quotas to each of the functional units through separate TACs. Moreover, the introduction of '*of which no more than*' restrictions for vulnerable functional units is not seen as an appropriate solution.

The concept of FU specific quota raises a number of rather difficult questions in relation to allocation. The first of these is the issue of relative stability and how Member State allocations would be distributed; the second is related to the internal Member State distribution of the quota. In the UK quotas are distributed by Fixed Quota Allocations (FQAs) which are based on historic landings within a defined, set reference period, most of which would have been derived from inshore grounds. Reconciliation of the differences between the fishing activity that generated the entitlement and current fishing patterns, particularly in light of the increased offshore activity of the UK fleet, would pose a problem and could result in vessels effectively unable to fish due to unsuitable entitlements. A poorly designed allocation mechanism may also increase the costs of fishing throughout the fleet, reducing its resilience. Whatever the internal allocation mechanism, the additional management costs will be prohibitive and the benefits that will be provided and the instability and upheaval that it will cause do not balance.

Further, there is a high risk that larger, nomadic vessels may utilise opportunities in the more distant, non-traditional units first, thus gaming may become a prominent feature of the North Sea *Nephrops* fishery putting artisanal fisheries, and fishers at risk. Regulations to prevent such acts would be both complicated and cumbersome.

Management of the functional units by setting individual TACs or catch limits is not favoured in this plan. Instead, the plan proposes that specific measures should be

adopted for each functional unit, which properly reflect the degree of risk and the particular circumstances.

Transfer of effort into the North Sea *Nephrops* fishery has occurred recently as an unintended consequence of restrictions imposed on other sectors of the fleet and in other areas, some of them outside the North Sea. This issue must be addressed in this management plan. Currently transfers from other areas are not a problem as effort caps are imposed within the North Sea as a result of the cod recovery plan. Those measures were not imposed to protect *Nephrops* but to curb illegal landings and reduce discards. Should the days at sea regime be removed, perhaps as a result of cod recovery, then other mechanisms may need to be sought to reduce the risk of effort transfers into the *Nephrops* fisheries of the North Sea. In practice, North Sea TACs may limit any transfer of effort from other regions. Increase in effort should not be a problem if fishing mortality is properly controlled and monitored.

It is important for fishermen to participate in the designation of measures for dealing with areas that become depleted and are judged by ICES as being vulnerable. We propose that this should be done through the preparation of a Sustainable Fishing Plan for each functional unit.

Where insufficient data are available for particular functional units, either in terms of poor landings data, a lack of UWTV survey data or lack of information on discarding then the plan proposes that an essential feature of the sustainable fishing plan for that unit would be proposals for evaluating the state of the stock. Where it is not feasible to conduct full UWTV surveys then alternative methods should be considered. There is a strong case for the ICES assessment working group considering ways of conducting more comprehensive surveys of *Nephrops* stocks in the North Sea, and seeking indices for those stocks which are not currently surveyed.

Taking all the above considerations into account we are proposing the following biological objectives for the North Sea *Nephrops* fishery:

- To exploit *Nephrops* in the North Sea at rates that are sustainable by setting a target fishing mortality (F) consistent with F_{MSY} and set for each of the functional units
- In the absence of an agreed value or proxy for F_{MSY} then an F between $F_{0.1}$ and F_{MAX} (and an equivalent harvest ratio) should be used as a precautionary target fishing mortality for each functional unit
- In the absence of immediate biological risk to any of the stocks assessed by UWTV, then the target F could be reached gradually, in an incremental way
- Should stock size fall below 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 UWTV surveys
- Should stocks increase the F should be increased in line with the increase in stock size shown by the UWTV surveys up to the agreed F_{MSY} proxy.

- A TAC should be set for the North Sea as a whole, consistent with the aggregated assessments for the individual functional units.
- Management at the functional unit level should be achieved not through the setting of individual TACs but through the adoption of specific management measures for vulnerable functional units or for functional units for which there are few data. Those measures should reflect the particular circumstances on those grounds. They should be developed through the preparation of sustainable fishing plans for vessels and fleets fishing the designated functional units
- Fishing mortality upon *Nephrops* must be properly monitored and controlled

Wider ecological objectives

Ecological sustainability is an important aspect of plan. Management practices should be set so as to maintain ecological processes and minimise impact on other species and on habitats for the benefit of future generations. This aspect of the plan should be complementary to the other aspects of the plan. Ecological objectives must be part of the overall strategy and should be a consideration in the preparation of sustainable fishing plans.

The Marine Strategy Framework Directive establishes a framework for Member States to take steps to achieve or maintain good environmental status in their marine waters. Good environmental status is to be determined on a regional seas basis – in our case for the North Sea. The Member States sharing a marine region or sub-region are obliged to cooperate to ensure that the Directive's objectives are achieved.

The overall goal of the Directive is to overall goal is to conserve marine ecosystems and, where practicable, restore marine areas which have been damaged by preventing and eliminating pollution and by protecting our waters from the adverse effects of human activities like fishing.

The Directive was transposed into Member States' legislation in 2010. It requires there to be:

- An assessment of the current state of the seas by July 2012
- A detailed description of what Good Environmental Status means, and the development of targets and indicators by July 2012
- Establishment of a monitoring programme to measure progress towards GES by July 2014
- Establishment of a programme of measures for achieving GES by 2016

In September 2010 the Commission adopted a series of criteria for maintaining GES. From a fisheries standpoint these criteria require:

- Maintenance of biodiversity – conservation of species and habitats
- 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.
- All elements of the marine food are to occur at normal abundance and diversity and at levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity
- Sea-floor integrity is to be at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.

A key aspect of this *Nephrops* fishery LTMP must therefore be to minimise impacts on the ecosystem. Steps will need to be taken to protect vulnerable species and habitats. The seabed must receive particular attention, and animals that are not being fished for, but which might be badly affected by the fisheries, will need to be protected. Achieving overall ecological sustainability is also important. Management practices must be set so as to maintain ecological processes and minimise impact on other species and on habitats for the benefit of future generations.

ICES has already stressed that 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 catch composition rules. The catch composition rules are seen by fishers as unnecessarily restrictive. Fish are not caught in neat numerical proportions and the setting of catch composition rules leads inevitably to discarding. Fishers have asked that consideration be given to alternative solutions.

The plan must address this problem. Currently it does so by suggesting a range of measures for reducing discards. An important component of the sustainable fishing plan for each functional unit will be the inclusion of specific measures for reducing discards, whether these are based on technical conservation measures or more general measures based on total removals.

It is also clear that with implementation of the Marine Strategy Framework Directive there is a need to reduce the impact of the *Nephrops* fishery on threatened endangered and protected species, as well as the effects of bottom disturbance from *Nephrops* trawls upon habitats and sensitive benthic communities. Parts of the seabed with a soft substrate, where *Nephrops* are found, are highly diverse, productive and of high ecological value.

We have identified three objectives to achieve these ecological goals:

- Reduce discards in the fishery

- Minimise damage to endangered, threatened 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.

An important requirement is to improve data recording systems to identify capture and damage to endangered, threatened and protected species and also to define the spatial footprint of the fishery as a whole.

Economic objectives

One of the starting points for fishers was - what has this plan got to do us, and what will it do to keep fishing communities alive? If it results in still more restrictions upon fishing then there will be no fishing communities.

The main economic aim for any fishery must be to achieve economic resilience based on a sustainable level of profit; to provide increased revenue and profits for vessels operating in the *Nephrops* fishery. Profitability is also a necessary precondition for higher compliance with fishery regulations. In economic terms the *Nephrops* plan should aim in the long term (say over the next 10 years) for a modern, safe fishing fleet, able to renew itself, capable of providing a stable supply of fish matched to the needs of the market at reasonable prices. Essentially the plan must provide conditions where all those involved in the industry can achieve the best possible outcome for their businesses – but without specifying in detail how those individual businesses should operate.

There is an emerging problem in that the biological objective of progressively reducing F in the interests of long-term sustainability may exacerbate any mismatch between fleet capacity and fishing opportunities. Failure to match fleet capacity to the future state of the resource will both reduce long-term profitability and undermine compliance with the regulations. One objective must therefore be to provide incentives for fishers to move the fishery in the direction of lower fishing mortality while enabling them to meet their own business aims and objectives

It is also recognised that there is a problem with technology creep and that fishing capacity will tend to increase in a progressive way with time. Failure to match fleet capacity to the future state of the resource will both undermine compliance and mean that revenues are flowing into businesses with no chance of long-term profitability.

Under a more accountable system of quota and effort management any increase in capacity will have adverse effects not on the *Nephrops* stocks but upon the fleets themselves. It is for Member States and fishing business to decide how to reduce those economic pressures.

There are already heavy additional costs placed upon fishers as a result of current regulations, and the need to lease quota and days at sea. Effort restrictions imposed

under the cod recovery plan have had a profoundly negative effect upon profitability. There is also a need to rationalise and harmonise various management measures and regulations that make fleets less efficient.

The economic objectives of the plan are:

- To provide incentives for fishers to move the fishery in the direction of lower fishing mortality while enabling them to meet their own business aims and objectives
- To avoid regulation that makes fleets less efficient or provides perverse incentives which act to the detriment of the fishery and the *Nephrops* stock
- Any change imposed on the fishery to meet biological and ecological objectives must take place at a rate that can be absorbed by individual businesses and communities.

The main instruments of the management plan - How are we going to get there?

Biological instruments

In the absence of full analytical assessments for *Nephrops*, and in the absence of any definite reference points, there should be a pragmatic approach to managing the *Nephrops* fisheries. We accept that there are benefits to be gained from the *Nephrops* fishery as a whole moving progressively towards lower fishing mortalities and higher yields.

In setting the biological objectives the plan suggests that fishing mortality (F) should progressively be moved to a target fishing mortality of F_{MSY} . It has been suggested that this be achieved by ICES setting an F of between $F_{0.1}$ and F_{MAX} and applying this consistent value to each of the functional units within the North Sea. The target is to be reached gradually, through incremental annual reductions in fishing mortality through reduced TACs.

If stock abundance falls to a level at which recruitment is likely to be significantly impaired, as indicated by the UWTV surveys, the plan suggests that F should be reduced in line with the reduction in stock size indicated by the UWTV surveys.

If recruitment improves and stock size increases, then F should be increased in line with that.

Fishers have expressed concern over the state of stocks in the Farne Deeps and other inshore functional units, and have asked how these grounds might be protected against the heavy invasion of fishing effort that has characterised the fishery in recent years. The Farne Deeps provides a winter fishery, and it enables vessels to do land daily and return to port more often. However, there are currently too many vessels fishing that

ground. It is appreciated that some of the local fishermen do not have the option of fishing elsewhere because of their small 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 Deeps heavy effort is being concentrated into a small area and this is affecting the *Nephrops* in that functional unit adversely. Some fishers have expressed particular concern over the damage being done by larger twin-rig vessels where the heavy 'clumps' used to couple the nets together are capable of damaging the seabed.

Similar problems are reported from the Firth of Forth. Fishers fear that further regulation of that fishery will mean the end of fishing by local boats – which do not have the option of fishing elsewhere.

ICES and others have also laid great stress on the need to safeguard functional units against local depletion. The plan suggests that this should not be achieved by setting separate TACs for the different functional units. Individual TACs for the functional units limit the flexibility of fishers and would give rise to problems of relative stability and in the allocation of TACs, both domestically and internationally. They provide only a crude management measure.

Instead, the plan proposes that a TAC should be set for the North Sea as a whole. However, specific measures should be adopted to protect each functional unit, based on the particular circumstances within that unit. Much of the discussion that took place with fishers at the ports concerned this problem of defining protective measures for vulnerable functional units.

One solution to prevent sudden influxes of fishing pressure onto vulnerable grounds for the Farne Deeps might lie in allocating quotas to those fishers with a track record in the affected area. 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. The North Sea POs might be less prepared to trade this quota in future. In general, however, it is thought that such restrictions would limit flexibility as well as bearing heavily upon local fishers. There is a common belief that restricting fishers in terms of the areas they can fish would have a negative impact and would further reduce the flexibility of the fleet.

It is accepted that the risk of damage to the relatively narrow strip of *Nephrops* grounds in the Farne Deeps from the deployment of more damaging gears cannot readily be resolved through agreements which directly favour local vessels, as many of the fishers deploying these gears come from ports some distance away. It has been suggested, however, that the problem might be resolved through the adoption of additional ecological conservation measures aimed at reducing the impact of more damaging gears.

Looking at fishing gears more widely, the use of multiple rigs by some EU vessels, while others are restricted by domestic legislation to twin or single rigs, is viewed by some fishers as having a negative impact on the *Nephrops* stocks.

Some fishers expressed concern that vessels from different Member States fishing in the same areas do not operate to the same conservation rules. It was hoped that one outcome of a Long Term Management Plan would be that fleets operating in an area

would have to abide by the same rules. The current system was seen to be unfair to those fishers who had adopted stringent conservation measures.

Other fishers, however, thought that gear restrictions act against the interests of those fishers who are especially successful and entrepreneurial. Many fishers want to make their vessels fish more effectively and they do not support regulations which restrict their ability to do better for themselves, either in terms of larger vessels or more effective gears. They accept that this will lead to 'technology creep', and that if every fisher improves their efficiency then this will place more pressure on the stocks. However, they feel strongly that the fishery management regime should not curb the freedom of fishers to fish more efficiently.

Other fishers favoured a solution to over-fishing in particular functional units based on restricting the horsepower of vessels fishing in these more vulnerable areas, or restricting the gear types that can be used in those areas. They suggested that there is a need to encourage the use of fishing methods that have less effect upon the stocks. At the smaller ports, the idea of restricting fishing to single trawls and a ban on multi-rig trawls was proposed for the affected areas, although not all fishers agreed with this suggestion. One solution might be to settle on a maximum gear spread – say 280 feet – which could be fished with a single trawl or twin rig. Others thought this would be too difficult to enforce. Another solution is to restrict days at sea based on the type of gear used. However, there was a general plea from fishers not to introduce too many restrictions. There is already a need to change cod-end on moving to the Farne Deeps simply because of differences in the Scottish and English regulations.

In this plan we propose that the problems arising with particular functional units should be dealt with by sustainable fishing plans tailored to that unit. Each sustainable fishing plan will propose measures for limiting fishing pressure. Those measures might include:

- A cap on the size or engine power of vessels permitted to fish within that functional unit
- Gear restrictions within that functional unit – for example restricting gears to single or twin rig
- Designation of permitted vessels (based on historic activity) allowed to fish within that functional unit.
- Application of days at sea (or 'of which' days at sea) restrictions within that functional unit.
- Linkage of vessel quota to a preferred area. Those declaring for an area would be able to take their full quota from it. Others might have a multiplier applied if they fished a depleted area that was not their preferred area. Their landings would be increased by a factor.
- Temporary, seasonal or real-time closure of that functional unit or within it

The measures to be adopted for a particular functional unit would be proposed by the regional management body in the form of a sustainable fishing plan or plans, with the

support and participation of the fishers who fish that ground, and subject to evaluation by STECF. For some functional units, where F was below the target level and there were no signs of stock depletion, the sustainable fishing plan would impose minimal measures. In the case of more vulnerable functional units a range of measures would be introduced, with the agreement of fishers, to allow *Nephrops* stocks to recover.

Where there is a lack of information on the fishery or the stock, and insufficient support for the preparation of a full sustainable fishing plan, then the sustainable fishing plan would have as a key objective the need to improve knowledge of the stock.

Wider ecological instruments

The plan 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

ICES advice notes that in some functional units, where many small *Nephrops* are encountered, *Nephrops* discard rates are high.

Fishers report that very few small *Nephrops* are caught on offshore grounds like the Fladen where the majority of vessels are already using very large meshes. The smaller *Nephrops* in that fishery are generally tailed.

However, high grading is taking place in some of the North Sea fisheries for *Nephrops*. Where quotas are restrictive smaller *Nephrops* caught earlier may be discarded and larger ones substituted. One option is to keep the smaller *Nephrops* and tail them but there is a penalty incurred in doing that as 1 kg of tails is treated as equivalent to 4 kg of whole prawns. In this case discarding is a consequence of limited quotas, or a perception that quota will later become limited. The solution is for better management of the quota by POs, to ensure that the quota is fully utilised.

On some grounds, 'scufflers' (small *Nephrops*) are caught especially by the 80 mm fleet. These are below the minimum landing size, and are discarded. There was discussion at the ports of whether there might be benefits from removing MLS restrictions and landing all *Nephrops*. Those *Nephrops* being discarded do not survive and there are advantages to fishers in not targeting small *Nephrops*, as they are difficult to process. There are already incentives for reducing these as a proportion of the catch, either by moving away from areas where small *Nephrops* are abundant or through adopting more selective fishing gears. There would also be advantages from landing the whole *Nephrops* catch in terms of providing valuable data to scientists. A discard 'allowance' could perhaps be added to the current TACs to enable discards to be landed. However, some 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 in overall mesh size because that would render the vessel liable to classification as a whitefish vessel. Although there are undoubted advantages to taking away MLS restrictions and landing all *Nephrops* there are obstacles in the way of achieving this.

ICES has noted that in some functional units there is an unwanted by-catch of juvenile haddock and whiting. In others, cod is a significant by-catch species in the *Nephrops* fisheries. Fishers point out that one of the factors causing discards of fish is the imposition of restricted TACs upon fish species that are abundant. One way to reduce discards is to match the quantity of quota available to the *Nephrops* fleet to the actual abundance of fish on the grounds. There is a perennial problem in some of the *Nephrops* fisheries over the discarding of large marketable whiting because of lack of quota. There is a mismatch of quota availability with high whiting abundance in this area, as in other areas. This problem has already been identified by the NSRAC.

There are differing views on the potential for technical measures to reduce discarding. Some fishers thought that much was already being achieved through the adoption of square mesh panels and other measures. One skipper suggested that separator trawls could offer a solution in some circumstances. Another skipper thought large meshes immediately behind the headline was another adaptation that offered some potential.

Fishers were especially concerned at the hypocrisy regarding the use of 80mm nets and the increase in the number of days allocated relative to vessels that previously used nets in excess of 100mm when targeting *Nephrops*. This perversity was unanimously seen as being contrary to effective conservation because it increased discards, as the smaller mesh generally retained more undersized fish and other marine organisms.

Reducing discards in the *Nephrops* fishery is therefore an important objective. There are many instruments available for achieving this, but they are different for different fleets. Gears must be adjusted to suit particular circumstances depending on whether vessels have quota for whitefish, and the fleet category into which they fit.

This management plan 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.

Options for both avoiding the capture of juvenile fish, and fish for which a vessel has no quota, 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.

There is a particular need to adopt appropriate measures and to improve the exploitation pattern within the 80 mm fisheries.

Under this plan it is for fishers to adopt measures for reducing discards and by-catches. It will be their responsibility to:

- Ensure that landing are within quota and demonstrate that this is so
- Reduce discards and demonstrate that this has been achieved

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. Discard reduction measures have to be tailored to the particular fleet or vessel. These targets should therefore be set out in the sustainable fishing plan for each functional unit. 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). Scottish vessels also use single 4 twine in the cod-end as opposed to the double 5 twine used by other fleets. The former effectively makes the mesh size larger. Further selective measures are also being considered. It is suggested that similar incentive schemes, where rewards are provided for those using selective gears, are applied to all of the *Nephrops* fisheries across the North Sea.

In the longer term, the Commission may be introducing measures where vessels are required to land all that they catch. Under such a regime there would be no need to specify mesh size alternative measures for making nets more selective. The specific measures could be left to fishers to decide. In those circumstances the sustainable fishing plan should describe the required output rather than specify the detailed measures by which the output would be achieved.

Endangered, threatened and protected species

In terms of the capture of ETP species, fishers opined that the main problems were likely to be through the catching of sharks, skates and rays. Few of these were being caught but it was recognised that this may be a consequence of their current low abundance. There were already major provisions in place to prevent such protected species from being landed.

There were gear options for permitting the escape of particular threatened or endangered species, although these were not applicable to all types of vessel. Incentives need to be provided to encourage the adoption of such measures.

It was agreed that it is important to monitor the capture of any endangered or threatened species. Fishers welcomed the opportunity to increase observer coverage, particularly if it could be accompanied by an exemption from the effort system; allowing vessels carrying observers more days at sea. Any capture of such animals should routinely be recorded in the electronic logbooks. They should be recorded by species; as not all skates and rays, for example, are classed as endangered. In terms of improving the survival of live specimens returned to the sea, the sustainable fishing plan could set out procedures for best practice. Tagging of specimens might also be undertaken as a voluntary measure. Advice on handling these fish with minimal damage can be obtained from Seafish and the Shark Trust. If there were severe problems with the capture of

endangered species then the sustainable fishing plan could specify additional measures. The inclusion of such measures would ensure that the management plan was fully compatible with the Marine Strategy Framework Directive.

Damage to the seabed and vulnerable organisms

Nephrops grounds are often on very fine mud that may be susceptible to damage. 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. However, here is a lack of evidence on the damage done to the seabed by the different gears used to catch *Nephrops*. This deficiency needs to be addressed by scientists. Provision for implementing more environmentally friendly fishing gears would be possible within the sustainable fishing plans.

Fishers accept the need to limit the overall environmental footprint of the fishery. However, they are not supportive of the idea of closing additional areas to fishing. They suggest that areas already set aside for oil and gas platforms, pipelines, renewable energy installations and conservation areas already serve the purpose of providing areas free from the effects of fishing. There are already major plans for protected areas and for large wind farms in areas like the Moray Firth where much of the firth will be closed to fishing because of these developments.

Marine Protected Areas can provide a solution to conserving vulnerable sea life and habitats. There has been pressure for Member States to move in this direction from the Commission through various Directives. In addition, some member states are taking their own initiatives (like the English 'Net Gains' proposals). Fishers are concerned about these initiatives. They are unhappy at the current procedures for identifying these areas, where these areas are often designated before the consultation process has begun. There is little support for closed areas as a management tool if they are going to be imposed upon fishers without full consultation. There is already a burden placed upon fishers through existing closures, including real-time closures. Those areas declared under the Natura 2000 had been chosen without regard for the impact upon fishers, and had been declared simply to meet targets – without real evidence for the value of protecting some of those areas. Fishers have not had a good experience of collaborating with nature conservation agencies. They are therefore reluctant to 'volunteer' areas for designation or to collaborate with conservation agencies. They are concerned that cooperation with those seeking to declare MPAs would simply lead to very large areas being designated. On the other hand, some fishers have remarked that cooperation in other areas like Rockall Bank has resulted in solutions satisfactory to all parties.

There are undoubted advantages from the closure of areas to fishing in terms of enabling comparisons to be made between fished and un-fished areas and assessing impacts on the seabed and the fragile animals that live there. Such areas may also protect especially vulnerable species and habitats. However, a series of marine protected areas are currently being imposed by member states in both inshore and offshore waters. By 2013 there will be an extensive network of MPAs, offering protection to a wide range of species and habitats. Fishers will be required to respect those areas and at present they do not see the need for additional protective measures to be taken.

Ecological instruments

This plan recognises the need to respect the wider obligations to reduce the impact of the *Nephrops* fishery on threatened endangered and protected species, as well as the effects of bottom disturbance from *Nephrops* trawls upon habitats and sensitive benthic communities. There is evidence that some gears, including twin-rigged and multi-rigged trawls, may have a more detrimental effect on *Nephrops* habitat and the seabed as they employ heavy weights to couple the gears together.

Ecological objectives can be achieved through the following management measures:

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

To ensure that problems of damage are identified and that the measures adopted effectively address these problems the plan will need to set out a research & monitoring programme to address data gaps within the fishery and on its wider environmental impact. Monitoring should include fishery dependent and independent data collection, including the material that is currently provided by the various research institutes. It will be especially important to assess impacts on habitat and associated species communities, including benthic communities, by different fishing gears. It is also important to identify the distribution of especially vulnerable habitats and species.

Economic instruments

Fishers agreed that the main economic target should be a profitable fishing industry. It is not just *Nephrops* fishers who are not making the profits they would like to. Some processors too are currently unprofitable. Profitability depends on the *Nephrops* stocks remaining in a good state. Some fishers believe that number of vessels engaged in the *Nephrops* fishery should not rise above the current number.

More information is needed on the economic performance of the fleets within the fishery and of the fishery as a whole to assist in the development of economic targets and indicators

Markets for *Nephrops* and marketing issues were a constant theme throughout meetings in the UK. The depressed market conditions, alongside ever increasing operating costs, were seen to be the biggest barrier to profitability. It was suggested that measures should be introduced to reduce the oversupply of certain grades of *Nephrops* as the quickest way to deliver an increase the price of the product. An increase in mesh size and quotas on tails was also suggested but fishers accepted that stabilising the supply would also have an impact on overall price. The need to promote the product, particularly in the UK, was highlighted and the prevalence of product substitution with cheaper imports was noted.

One way of improving profitability was to increase the price of *Nephrops*. This might be achieved by landing less, or landing them more evenly, or by improving quality. Having fewer boats fishing would improve profitability and might redistribution of the quotas to active fishers, rather than allocating it to 'slipper skippers' might remove the need to lease quota and days. Producer organisations can of course act collectively or individually to moderate the supply of *Nephrops* to the market. It is recognised, however, that there are difficulties in reaching agreement to obtain higher prices.

In some Member States, auctioning prawns while the vessel was still at sea was seen as one way to go – to do what the pelagic fleet does and what fishers in other countries do. Currently *Nephrops* are often sold on a contract basis. In general there is a need to place fishermen in a stronger position for marketing their produce.

At all the meetings with stakeholders strong emphasis was placed by fishers on flexibility and the ability to diversify as being essential for providing economic resilience. Fishers are accustomed to changing their fishing practices as the seasons change and as fishing prospects and opportunities change. They value the ability to switch the areas they fish in, and to adjust their fishing habits to suit the seasons. Currently the regulations stand in the way of achieving greater diversity in fishing opportunities. Fishermen want to catch a range of species, matching their fishing to the seasons and other factors.

One economic problem was thought to be the great influx of larger more mobile vessels into the *Nephrops* fleet when other fisheries came under restrictions. Fishing for *Nephrops* is seen as the fallback position. Although that gives flexibility to some fishers, it has had an adverse effect upon conservation of the stocks in some areas and has a strong economic and social impact upon those fishermen normally operating in those areas. Some fishers thought that in especially vulnerable areas there might be advantages in having a more restrictive licensing regime, or restrictions to particular gear types. Where decommissioning is thought to be a solution, people have to be able to leave the industry with dignity and with safeguards. The imposition of blunt measures by fishery managers has been a problem in the past. Restrictions in quotas and in days at sea affect profitability. Reform of the CFP should lead to greater provision for regional and local measures and might enable vessels to become more profitable.

It is widely felt that there should be a method of capping entry into the *Nephrops* fleet to improve the profitability of the existing fleet by stabilising the competition for both quota and markets. Removing latent capacity (hip pocket licences) is seen as a positive step.

The number of vessels is thought to be a comparatively minor issue; pegging the capacity of the fleet is deemed to be more important with the expansion of higher capacity vessels enabled by the availability of licences. It appears that the latent capacity within the system is more of a problem than the active licenses.

There is general agreement amongst fishers that one important aim should be to move to a lower volume, higher value fishery – as the *Nephrops* fishery had been in the past. This would benefit both catchers and processors. However, there is no obvious solution to achieving this aim in the context of a fishery with wide access and with the current system of rights-based management.

Some UK fishers thought that there might be advantages in adopting a different system of quota trading, like the Danish model, where small boats can buy quota from other small boats and from large boats, but larger vessels can only buy from large boats – a kind of non-return valve for protecting smaller vessels. National systems for quota trading need to be adapted to local conditions, however, and require adequate safeguards to prevent excessive consolidation. There is a need to protect local infrastructure and training facilities but this can be difficult within a free market. Some of these issues are for Member States to resolve.

Economic success is seen by fishers as being necessary to provide for the social needs and the health of the communities associated with fishing; profitable businesses lead to local employment and increased disposable income that is then spent in the community while reducing the social costs associated with lower incomes. However, that there is a need to ensure that business rationalisation does not result in consolidation of the fishing industry, with a few large vessels owned by a small number of individuals or businesses. The diverse nature of the fleet is seen as positive characteristic, enabling vessels to target certain species while avoiding over exploitation.

Several fishers highlighted the need for reinvestment and regeneration of the fleet, although they felt that progress in this direction would encourage consolidation. Scrap and build and preferential loan schemes are seen as possible interventions as well as other instruments that would encourage a small amount of consolidation. Shrinkage of the fleet is seen to be almost inevitable, as weaker businesses are weeded out, and is considered by most fishers as a positive step, although it is acknowledged that, in the current tough economic climate, it would be survival of the fittest.

The issue of new entrants and the continued survival of the industry through succession met with very different opinions from stakeholders. Some contributors feel that public assistance and licensing rules should make it easy for new entrants to obtain the assets they required to become skippers and owners. Other contributors feel strongly that such assistance would reduce the fitness of the industry overall by diluting the resilience and determination of new entrants, adversely affecting the success of vessels and the profitability of the fleet into the future. Members of the industry are not clear what their role should be in promoting such succession. There are widely differing views. It is agreed that a profitable and well-managed sector is the best way to attract the next generation of skippers and crew.

An important over-riding objective within this management plan is to prevent any increase in mortality rates on *Nephrops*. Technological developments must not threaten stocks. With a properly accountable system of management the mortality rate will be

controlled. If there is any expansion in fishing capacity, brought about for example by technology creep, then the pressure will not fall on the stocks but upon the fleets.

This plan does not propose that there should be effort restrictions imposed upon vessels in order to protect *Nephrops*. The imposition of effort restrictions would have a profoundly negative effect and would drive the race for fish.

Rather, it is for member states and fishing businesses to decide how to deal with changing economic pressures. There are no specific economic instruments that require to be imposed by this management plan. However, it is sensible to add the proviso that in meeting the biological and ecological objectives it is important to avoid regulation that makes fleets less efficient or provides perverse incentives which act to the detriment of the fishery and the *Nephrops* stock. It is also important to provide incentives for individual fishers to change to meet new business aims and objectives. Moreover, any change imposed on the fishery to meet biological and ecological objectives must take place at a rate that can be absorbed by individual businesses and communities.

Monitoring of the management plan

An important feature of the management plan should be to track its successes and failures. The extent to which the Management Plan is achieving the range of stated goals and objectives should be assessed using a combination of indicators designed to measure performance of the fishery. These performance indicators may be biological or non-biological. Possible performance indicators are:

Level of fishing mortality (with respect to the target F)

Abundance trends obtained through UWTV surveys (with respect to a trigger point for assessing deterioration in the stock)

Levels of discarding

Uptake of environmentally friendly fishing practices

Number of Marine Protected Areas

Economic indicators including revenue, profitability, average prices etc.

Social Indicators – number of businesses (vessels), numbers employed, average earnings, quota prices (linked to ability to access the fishery), number of new entrants etc.

Linkage with other management plans

It is important that the plan should take account of the existence of other management plans for particular stocks or for other fisheries. There must be interdependence between plans. Currently, the fishery for *Nephrops* in the North Sea is greatly affected by the cod recovery plan. Additional effort has been transferred into the *Nephrops* fleet

as a result of the heavy restrictions placed on vessels fishing for whitefish. That change has been detrimental to the *Nephrops* fishery. There has also been a perverse incentive to reduce the size of mesh used by vessels fishing for *Nephrops* in order to achieve a favourable classification under the cod recovery plan. Indeed, it is not possible to tackle the problem of discards by 80 mm *Nephrops* vessels through an increase overall mesh size because that would render the vessel liable to classification as a whitefish vessel. This is a most unsatisfactory situation, which militates against the adoption of conservation measures.

Fishers have suggested that it is not possible to separate management of prawns from management of haddock and other species. What is needed is a total management approach, which applies the whole fishery, rather than a species by species approach. There are management plans for haddock and saithe already in place and a plan for whiting is under consideration. Somehow, all these plans had to be brought together.

Some fishers have suggested that *Nephrops* quotas should be interchangeable with quotas for other species. Every functional unit brings a by-catch of fish. Essentially, fishers catch what is actually present on the fishing grounds. Setting immutable quotas for single species fails to recognise this fact of nature, and inevitably leads to discarding. 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.

In preparing this draft management plan we recognise that the fleets catching *Nephrops* were very diverse. A few vessels catch only prawns but many more are dependent on a wide range of species. Fishers have been forced to think of themselves as prawn fishermen because fishing opportunities for other species have been removed.

Future institutional structures

It is important that greater stakeholder involvement should develop over time in the management of the fishery, the aim being to develop a sense of stewardship and full 'co-management'. New institutional structures for implementation of this and other LTMPs must now be discussed in the context of reforms to the CFP. It will be critical for this management plan to be put forward, endorsed, adopted and monitored by a regional management body on which fishers and other interests are fully represented.

4. Background information

The Norway lobster

The Norway lobster, *Nephrops norvegicus* (L.), also called the prawn, Dublin Bay 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 mud at depths ranging from 20m to 800m (Rice & Chapman, 1971; dos Santos & Peliz, 2005). The presence of suitable mud 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). 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). There is also a seasonal pattern of burrow emergence associated with mating and moulting, and this is most pronounced in mature female *Nephrops*. After spawning, berried females largely remain in their burrows for the entire incubation period, which is generally 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. *Nephrops* may be more abundant when these fish species are scarce and this has implications for the management of the *Nephrops* and other fisheries. The advice from ICES is that it may be expected that *Nephrops* stocks in the North Sea may decrease when cod recovers.

Currently, in the North Sea (which is ICES Sub-area IV) *Nephrops* stocks are divided into eight separate Functional Units (Figure 1) plus the Skagerrak and Kattegat in Sub-area III. 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 (Jensen, 1965; Chapman, 1982).

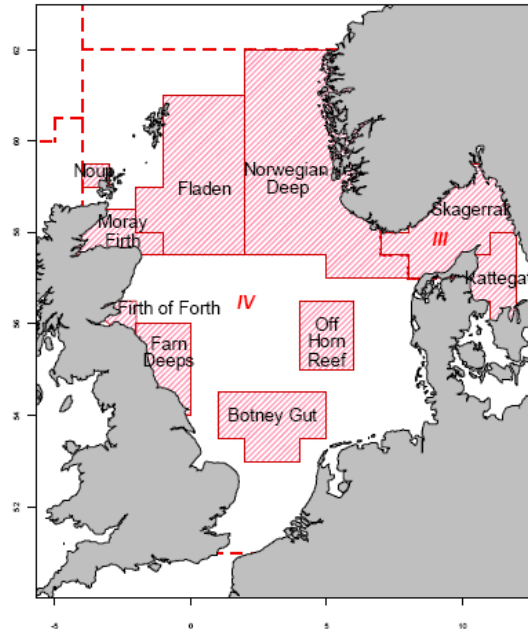


Figure 1: *Nephrops* functional units in the North Sea and Skagerrak/Kattegat region

The functional units in the North Sea (Area IV) are:

- Botney Gut - Silver Pit (FU 5)
- Farn Deeps (FU 6)
- Fladen Ground (FU 7)
- Firth of Forth (FU 8)
- Moray Firth (FU 9)
- Noup (FU 10)
- Norwegian Deep (FU 32)
- Off Horn's Reef (FU 33)

In 2010 there are two Functional Units in Division IIIa:

- Skagerrak (FU 3)
- Kattegat (FU 4).

This separation was based on observed variable differences between Skagerrak and Kattegat regarding size composition in catches in the 1980s and 1990s. However, the distribution of *Nephrops* is continuous from southern Kattegat into Skagerrak, and exchange of recruits between the southern and northern areas is very likely. With longer data series available now, it seems as differences in size compositions between the two areas more likely are random or caused by factors from fishing operations. ICES advice has been recommended that these two FUs are merged into one single FU.

Within a functional unit, the *Nephrops* distribution may vary in terms of density, size, sex and biological characteristics depending on sediment composition (Tully & Hillis, 1995; Tuck et al., 1997). Some of the functional units are regularly surveyed by means of underwater television (UWTV) 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.

The *Nephrops* fisheries

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 – those caught incidentally during the capture of whitefish were often 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 for *Nephrops* (87% in 2009). Other countries with an interest are Belgium (5%), Denmark (5%) and Holland (3%). The Belgian quotas are often traded with other countries. *Nephrops* is especially valuable to Scotland, where 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. Currently, in the North Sea, *Nephrops* are mainly caught in otter trawls. Originally the trawls were single-rig, but more recently twin-rig trawls and multi-rig trawls have been applied. 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.

The *Nephrops* fisheries in the Skagerrak and Kattegat show differences to those in the North Sea. Mesh sizes are larger and are not tailored especially 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.

Fisheries in each of the functional units differ. On some grounds, like the Fladen, there is predominantly a mixed fishery and whitefish are an important part of the catch. On other grounds there is a small by-catch of white fish which nevertheless can make an important contribution to the earnings of the vessel. On some grounds, like the Firth of Forth, the whitefish by-catch is very small.

In the North Sea the *Nephrops* fisheries have been managed in the past through the setting of an overall 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 and with the type of vessel – for example whether it is targeting mainly whitefish or *Nephrops*. By-catch limits have been imposed. *Nephrops* fishers have recently adopted a series of 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, 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* into the North Sea.

Note: 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 under-10m fleet.

Markets for *Nephrops*

There are two distinct markets for *Nephrops* from the North Sea: further processing of the *Nephrops* “tails” into breaded scampi, sold into caterers and supermarkets in the UK and Ireland; and packing into trays for sale as “whole” *Nephrops*, mainly sold into Italy, France and Spain.

In the UK, *Nephrops* are not sold at auction; boats are contracted to agents or landing directly to processors. Boats typically align themselves to one agent or factory. With delays in communicating with boats a glut can develop, leading to large quantities having to be processed all at once, and working capital resources exhausted. This leads to processors capping volumes from the boats, who in turn seek other outlets for their catch, while the fishing is still good. This can lead to a general oversupply on the market, which forces suppliers to drop prices significantly. The reverse can happen during periods of poor weather and undersupply, with processors battling to maintain and win new supply, and prices being bid up.

In the Netherlands and Denmark *Nephrops* are sold through auctions in the normal way.

Difficulties in auctioning *Nephrops* in the UK are said to be due to quality variation, product deterioration and the high cost of *Nephrops*. Attempts have been made in the UK to introduce an auction, as in other countries, but due to a lack of interest by buyers and processors have failed to be sustained.

The whole langoustine, exported mainly to mainland Europe, need to be carefully graded, usually by eye, or placed piece by piece on to conveying graders. This laborious task makes up a large part of the processing itself, as the *Nephrops* can snag into each other's claws which without careful handling, causes costly damage to takes place. An auction therefore relies both on grading at sea and trust between boat and processor with regards to the grade and the freshness of the *Nephrops* landed. It is easier to auction *Nephrops* tails. However, as this is only a small part of the catch by value, it cannot be handled separately without extra transport and administrative costs being generated.

In terms of supply, the different FUs have different peak landing seasons determined by weather and spawning pattern of the stock. For instance in the Southern North Sea, the Botney Gut fishery takes place from mid May – September. The fishery is in shallow water, as shallow as 11 fathoms, so that bad weather makes fishing there outside that period impossible. The Farne Deep *Nephrops* are most abundant from Mid September to Mid April. Here weather and location of the FU plays a large role, as the prevailing south westerly's are offshore, thus causing less swell than deeper sea FUs (such as the

Fladen Ground). The other FUs in the North Sea have similar characteristics, so that it is possible for an oversupply to develop should settled weather coincide with good fishing periods.

There is a seasonal problem with “green sac” in *Nephrops* females where the egg sac develops behind the head and discolours the shell.

5. Major trends in the *Nephrops* fisheries

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 implementation of the “buyers and sellers” regulations in the UK 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 landings and landings per unit effort (lpue) may result from the increase in reporting levels and do not necessarily reflect changes to the stock. A ban on the use of multi-trawl gears (3 or 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. STECF (2008) stated that the overall effort (kW*days) by demersal trawls, seines and beam trawls shows a substantial reduction since 2002. However, there have also been substantial changes in the usage of the different mesh size categories by the demersal trawls. In particular there has been a sharp reduction in usage of gears with a mesh size of between 100 mm and 119 mm (targeting whitefish), and a subsequent general increase in effort by vessels using smaller mesh sizes (targeting *Nephrops* for instance) or larger (targeting whitefish).

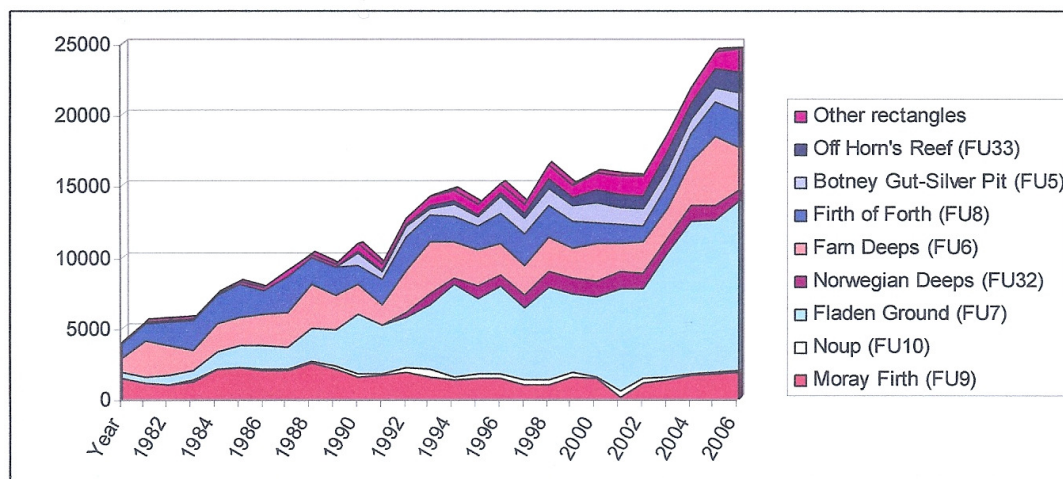


Figure 3: *Nephrops* in ICES Subarea IV. Total landings divided into functional units and other rectangles (tonnes)

ICES scientists have noted that most stocks appear to be fairly stable in terms of abundance and size composition. Notable exceptions are the Fladen Ground stock that 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 2010, it is reported that effort is becoming limiting for Nephrops vessels with the result that vessels are remaining in port for longer periods during strong tides or other periods of likely low catchability.

Trends according to the Fishers' North Sea Stock survey are shown below.

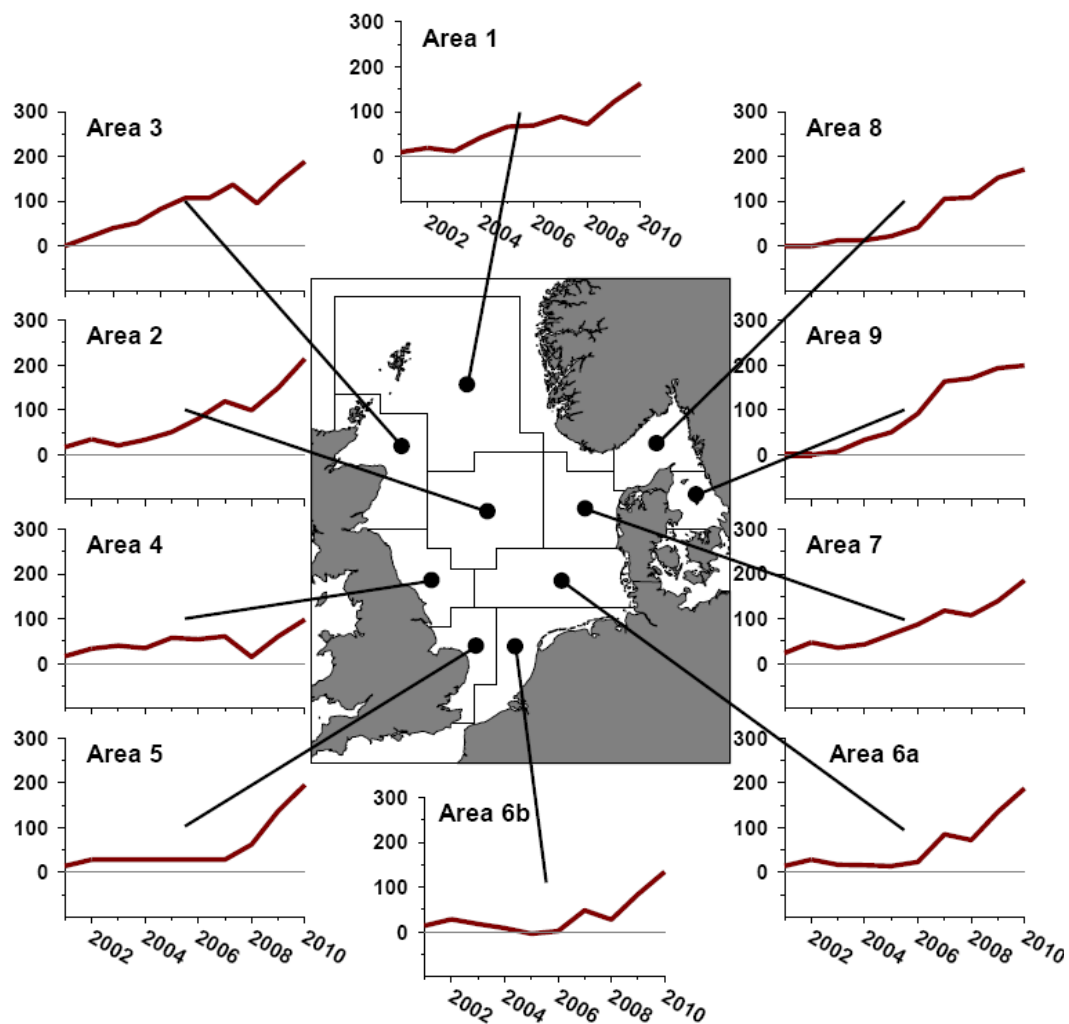


Figure 4: Results of the North Sea Fishers' Survey 2010

6. The state of *Nephrops* stocks

Assessment of the *Nephrops* 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 process of stock assessment is very technical and requires specialist knowledge. The assessments are rarely presented in a form which can readily be understood by non-specialists, including fishermen. As part of this LTMP 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.

For the North Sea, ICES has defined eight *Nephrops* functional units for the purposes of stock assessment and the provision of advice. There is a lack of information on some of the functional units (e.g. Botney Gut and the Noup). It is also evident that there is a question over the designation and assessment of some of the functional units.

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. *Nephrops* are crustaceans, which periodically moult. It is not yet possible to determine their age. 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 in the future using length-based assessments.

Historical landings have been uncertain for *Nephrops* stocks, making assessments based on catch data unreliable. Recently, these data have greatly improved (since the introduction of buyers and sellers legislation), but a longer time series of data are required before they can be used fully in the assessments.

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. However, the main method for assessing the state of *Nephrops* stocks is by underwater television (UWTV) surveys.

A number of the FUs in the North Sea (FUs 6, 7, 8, 9 and occasionally 10) are examined directly through these 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 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. Further details of the UWTV survey protocols can be found in the reports from recent ICES workshops (ICES, 2007 & 2009b).

Landings from outside the FUs account for 9.6% of total landings. Vessel Monitoring System (VMS) data for vessels > 15 meters are being successfully used to match survey and fishery areas.

The UWTV surveys provide estimates of abundance that are independent of the fishery itself. STECF (2005) suggested that a combination of an absolute abundance estimate from an UWTV survey and a harvest rate based on an estimate of fishing mortality could be used to calculate appropriate landing limits. This approach has been further elaborated and evaluated by ICES (ICES, 2007 and 2009a).

An ICES Benchmark meeting on *Nephrops* (ICES 2009a) addressed concerns that had previously been raised in relation to factors that could potentially bias the UWTV survey results. The main sources of bias were estimated for each functional unit and an overall bias correction factor introduced which could 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 different fishing mortality rates for each FU and agreed a protocol for providing a catch options table (ICES, 2009a).

ICES advice at the end of 2010 was that the overriding management consideration for North Sea *Nephrops* stocks is that management should be at the functional unit (FU) rather than the ICES Subarea level. Management at the functional unit level should 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. Current management of *Nephrops* in Subarea IV (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 vessels are free to move between grounds, allowing effort to develop on some grounds in a largely uncontrolled way and this has historically resulted in inappropriate harvest rates from some parts. This is a particular problem in the Farne Deeps where increased vessel activity from other parts of the UK occurred resulting in low stock levels.

The advice is presented separately for each functional unit. There are increasing and significant landings from some isolated patches outside the functional units, most notably the Devil's Hole, which suggests that additional functional units should be considered.

There are no precautionary reference points defined for *Nephrops*. 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 value or proxy for F_{MSY} STECF recommended that $F_{0.1}$ (and an 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 the $F_{0.1}$ target could be reached through incremental annual reductions in fishing mortality.

In 2010, under the new ICES MSY framework, exploitation rates which are likely to generate high long-term yield (and low probability of stock overfishing) were explored and proposed for each functional unit. Owing to the way *Nephrops* are assessed, it was not possible to estimate F_{MSY} directly and hence proxies for F_{MSY} were determined. Three candidates for F_{MSY} were $F_{0.1}$, $F_{35\%SpR}$ and F_{MAX} . There may be strong difference in relative exploitation rates between the sexes in many stocks. To account for this, values for each of the candidates were determined for males, females and the two sexes combined. The appropriate F_{MSY} candidate was selected for each functional unit independently according to the perception of stock resilience, factors affecting recruitment, population density, knowledge of biological parameters and the nature of the fishery (relative exploitation of the sexes and historical Harvest Rate vs stock status).

ICES (and STECF) have 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 ICES subarea IV 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 free of restriction. 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.

There are a number of gaps in information that we need to fill if the assessments for *Nephrops* are to be improved:

If full analytical assessments are to be made (and this may or may not be necessary) then further research is required to enable the age of *Nephrops* to be determined. Alternatively, length-based assessments must be developed.

Further work is needed to ascertain whether the current division into functional units adequately reflects the distribution of *Nephrops*. Are there other areas containing *Nephrops* which should be incorporated into the assessments? Are there small pockets of *Nephrops* at different locations that should be brought into the assessments?

It has been pointed out by those considering accreditation of the fishery that current management advice is based on a fixed harvest ratio rather than biological reference points. In a situation where stocks are stable or increasing this can be appropriate, however recent information indicates that some stocks may be declining. Therefore there is a risk of the harvest ratio approach failing to protect these stocks. They opine that action is therefore required in consultation with the appropriate scientific and management bodies to develop appropriate biological reference points for the fishery.

Assessment of the *Nephrops* stocks by functional unit

In 2010 ICES presented their advice for each functional unit.

***Nephrops* in Division IV – North Sea**

Botney Gut – Silver Pit (FU 5)

The state of this stock is unknown. Landings per unit effort (lpue) fluctuate without trend. The *Nephrops* fisheries in the Botney Gut are solely bottom trawl fisheries. For many years Belgium was the only country exploiting *Nephrops* in this area. Since 2005 years

the Netherlands and the UK have become the most important exploiters of this stock, taking around 80% of the total international landings. Reported landings were at a high level in 2007 but have declined in recent years. No reliable assessment can be presented for this stock, because of insufficient data. There have been relatively few length measurements from the fishery and there is currently no TV survey in this FU. Therefore, fishing possibilities cannot be projected. Following the ICES MSY framework implies that landings in 2011 should be reduced from recent level. ICES cannot quantify the rate of reduction required. In light of the fact that the l_{pue} is fluctuating without trend, indicating a stable stock status, landings in 2011 should not exceed 980 t (the average of the past 3 years).

Farn Deeps (FU 6)

The UWTV survey, fishery data and length frequency data all point to the stock continuing to be at a low level. *Nephrops* in FU6 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 gears observed in this area are likely to have increased the effective fishing power per kW hour. Fishing effort in 2009 increased on the 2008 levels although this remains below the 2006–2007 peak. The high cost of fuel combined with the relative coastal proximity of this ground may result in it attracting additional fishing effort.

Following the ICES MSY framework implies Harvest Ratio to be reduced to 10.3 % (20% lower than F_{MSY} because SSB is 20% below $B_{TRIGGER}$), resulting in landings of 1 400 t in 2011. Following the transition scheme towards the ICES MSY framework implies fishing mortality to be reduced to $(0.8 \cdot F_{2010} + 0.2 \cdot F_{MSY} \cdot SSB_{2011} / MSY_{B_{TRIGGER}}) = 13.5\%$ resulting in landings of 1900 t in 2011.

Increases in abundance in other FUs (i.e. Firth of Forth and the Fladen grounds) are likely to translate to increases in TAC, 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. Recent observed Harvest Ratios (2008 excepted) have been in excess of those equivalent to F_{MSY} and the stock has shown considerable signs of over-exploitation. Without suitable controls on the movement of effort between functional units there is nothing to prevent the effort in 2011 returning to levels observed prior to 2008 most of which have been above the level of F_{MSY} .

The Fishers' North Sea stock survey reported an increase in abundance in the area compared to 2008. This is not in agreement with the UWTV survey which shows a decline.

The perception of the state of the stock has not changed since the assessment in 2008. The indicators show that the stock has been substantially reduced from a relatively high abundance in 2006.

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 framework (landings of 1900 t).

Fladen Ground (FU 7)

The perception of the state of the stock has not changed substantially since the assessment in 2009. The UWTV abundance is still at a high level relative to the historical time series although there has been a 25 % reduction in 2009 from the 2008 value. The stable mean sizes in the length compositions of catches (of individuals >35 mm CL) and recent estimated harvest ratios (removals/TV abundance) relative to per-recruit reference points suggest that the stock is being exploited sustainably.

Over 95 % of the landings are taken by Scottish vessels. Nearly three quarters of the landings are made by single-rig vessels and one-quarter by twin-rig vessels. 80 mm mesh is the commonest mesh size. Nearly 40% of the Nephrops landings at Fladen are reported as bycatch, in fisheries which may be described as mixed.

The total catch (2009) was 13.85 kt; 96 % landings, 4 % discards.

For this FU, the absolute density observed on the UWTV survey is low (average of just over 0.2 m⁻²) suggesting the stock may have low productivity. In addition, the expansion of the fishery in this area is a relatively recent phenomenon and as a result the population has not been well-studied and biological parameters are considered particularly uncertain. Furthermore, historical harvest ratios in this FU have been below that equivalent to fishing at $F_{0.1}$ and therefore an appropriate proxy for F_{MSY} would be $F_{0.1}$ for combined sexes.

Following the ICES MSY framework implies the harvest ratio to be increased to 10.2 %, resulting in landings of less than 13 300 t in 2011.

The Fishers' North Sea stock survey suggests that moderate or high amounts of recruits are apparent in Area 1 (which the Fladen FU lies largely within) compared to 2008. The time series of perceived abundance in Area 1 increases up to 2009.

The advice in 2009 was based on a decision rule for choosing the 2010 harvest ratio based on trends in the UWTV survey and current F relative to per-recruit reference points. The advice in 2010 is based on the MSY framework.

Firth of Forth (FU 8)

The perception of the state of the stock has not changed substantially since the assessment in 2009. The UWTV abundance has been at a relatively high level since 2003 and the 15 % reduction observed in 2009 is within the confidence bounds of the 2008 value. The TV survey information, taken together with information showing stable mean sizes, suggests that the stock does not show signs of overexploitation. The calculated harvest ratio in 2009 (dead removals/TV abundance) is above F_{max} .

The population of *Nephrops* in the Firth of Forth appears to consist of a high density of small individuals in comparison to other FUs.

The *Nephrops* fishery in the Firth of Forth is dominated by UK (Scotland) vessels with low landings reported by other UK nations. *Nephrops* discard rates are high (34% by number and 14 % by weight in 2009) and unwanted by-catch of haddock and whiting occurs. There is a need to reduce these and to improve the exploitation pattern of the 80 mm fisheries. The total catch (2009) was 3.05 kt; 86 % landings and 14 % discards

For this FU, the absolute density observed on the UWTV survey is relatively high (average of $\sim 0.8 \text{ m}^{-2}$). There is a long time series of relatively stable landings (average reported landings ~ 2000 tonnes), well above those predicted by currently fishing at F_{MAX} , while the stock abundance has been stable, suggesting a productive stock. It is suggested that F_{MAX} for combined sexes is chosen as the F_{MSY} proxy.

Following the ICES MSY framework implies the harvest ratio should be reduced to 15 %, resulting in landings of less than 1400 t in 2011. Following the transition scheme towards the ICES MSY framework implies the harvest ratio should be reduced to 21.7 % ($0.8 * F_{2010+} + 0.2 * F_{\text{MSY}}$), resulting in landings of 2000 t in 2011.

Estimated discarding rates are 34% by number in the Firth of Forth in 2009. This arises from the use of mainly small-meshed (80 mm) nets and the population size structure which appears to arise from slower growth. Local markets for small whole *Nephrops* are seasonally important.

The minimum landing size for *Nephrops* in the North Sea is 25 mm carapace length. The apparent small size of *Nephrops* in this area results in high discard rates.

The advice in 2009 was based on a decision rule for choosing the 2010 harvest ratio based on trends in the UWTV survey and current F relative to per-recruit reference points. The advice in 2010 is based on the MSY transition scheme (2000 t).

Moray Firth (FU 9)

The perception of the state of the stock has not changed substantially since the assessment in 2009. The TV survey suggests that the population is stable, but at a lower level than that evident from 2003–2005. There is no evidence from the mean size information to suggest overexploitation of the FU although the current low discard rate suggests that recruitment may be lower than it has been previously. There has also been an apparent increase in female catchability which when observed in other FUs has been associated with the stock having been overexploited.

The Moray Firth *Nephrops* fishery is essentially a Scottish fishery with only occasional landings made by vessels from elsewhere in the UK. Vessels typically conduct day trips from the nearby ports along the Moray Firth coast. Occasionally larger vessels fish the outer Moray Firth grounds on their way to/from the Fladen or in times of poor weather.

Moderate absolute densities are generally observed on the UWTV survey of this FU. Although variable, harvest ratios (which are likely to have been underestimated prior to 2006) appear to have been around or above $F_{35\% \text{SPR}}$ and in addition there is a long time series of relatively stable landings (average reported landings ~ 1500 tonnes, above those predicted by currently fishing at $F_{35\% \text{SPR}}$). It is suggested that $F_{35\% \text{SPR}(T)}$ is chosen as the F_{MSY} proxy.

Following the ICES MSY framework implies the harvest ratio should be decreased to 12.7 %, resulting in landings of less than 1200 t in 2011. Following the transition scheme towards the ICES MSY framework implies the harvest ratio to be increased to 13.7 % ($0.2 \times \text{harvest ratio}(F_{2010}) + 0.8 \times \text{harvest ratio}(F_{\text{MSY}})$), resulting in landings of less than 1300 t in 2011.

Discarding rates averaged over the period 2006–2009 for this stock were about 10% by number. This represents a reduction in discarding rate compared to the average for the period 2003–2005. This may arise from the increasing use of larger size meshes in the northern North Sea, although reduction in recruitment may also account for this change.

The advice in 2009 was based on a decision rule for choosing the 2010 harvest ratio based on trends in the UWTV survey and current F relative to per-recruit reference points. The advice in 2010 is based on the MSY transition scheme (1300 t).

Noup (FU 10)

The state of the stock is unknown. The *Nephrops* fishery at the Noup is prosecuted by only 3–4 vessels on a regular basis and landings are < 1 % of the North Sea total. There is no discard information for this fishery. The time series of UWTV survey data is incomplete and no survey has been conducted in 2008 or 2009. There are no reliable effort data for this FU and therefore no resulting lpue.

In 2008, biennial advice was given for 2009 and 2010 of average landings over 2003–2005 (equivalent to less than 240 t). Based on the lpue indicator and mean size in the catches, it was concluded that the stock was stable and apparently supporting current levels of exploitation. These indicators are no longer available (no reliable effort data and no discard sampling). Therefore there is no basis for advice for 2011 and 2012.

Norwegian Deep (FU 32)

Landings per unit effort (lpue) have been relatively stable over the last 16 years and suggest that current levels of exploitation are sustainable. A slight increase in mean size in the catches in 2007 could indicate a reduced exploitation pressure.

Nephrops in FU 32 are caught in 120 mm trawls (mixed fishery) and as by-catch in shrimp trawls. The stock is fished by Danish and Norwegian fishers, where the Danish vessels take the majority of catches (69 % in 2009). Danish fishers only exploit the western part of the stock, indicating that only part of the stock is exploited at present. Sediment maps for this area indicate that there are possibilities for the fishery to expand into new grounds, which have scarcely been fished to date. The recreational fishery for *Nephrops* along the Norwegian coast has increased in recent years, but the extent of this fishery is not known.

Total catch (2009) was 515 kt; 477 t landings (93 % trawls, 7 % creels), 38 t discards.

The Nephrops directed trawl fisheries are characterised by large amounts of non-commercial by-catch and Nephrops below MLS. The discard mortality is considered to be high (75%, Wileman et al., 1999).

No reliable assessment can be presented for this stock. The main cause of this is lack of data and a UWTV survey. Therefore, fishing possibilities cannot be projected. The state of the stock is unknown but lpue is fluctuating without trend indicating a stable stock status. Following the ICES MSY framework landings in 2011 should be reduced from recent levels. ICES cannot quantify the rate of reduction required.

Recent trends in overall size distribution in the catches indicate that the *Nephrops* stock in the Norwegian Deep is not overexploited. The trend in lpue does not indicate any decline in stock abundance. ICES advice concludes that the level of exploitation of this stock is sustainable. Historic average annual landings have been approximately 1000 t (2002–2007), while recent average landings are 575 t (2008–2009).

The EU fisheries are managed by a separate TAC for this area, which for 2006–2008 was 1300 t, but decreased to 1200 t in 2009. The TAC has not been taken the last four years. The minimum legal size is 40 mm CL.

Off Horn's Reef (FU 33)

The state of this stock is unknown. lpue has been increasing up to 2008, probably reflecting increase in gear efficiency (technological creep) in the last years. The mean sizes in 2005 catches and the increased lpue's in the subsequent years could indicate a high recruitment in 2005. The development in 2009 then suggests that the contribution of the 2005 recruitment to the stock now has faded.

The Nephrops fisheries in the Horns Reef area are bottom trawl fisheries. Total landings peaked in 2007. For several years Denmark was the only country exploiting Nephrops in FU 33 (Off Horn Reef), and accounted for more than 90% of total landings up to 2005. However, in recent years Germany Netherlands and the U.K. have expanded their share of exploitation of this stock.

No reliable assessment can be presented for this stock. There are few length measurements and no TV survey in this FU. Therefore, fishing possibilities cannot be projected. The state of the stock is unknown but lpue and recruitment indications suggest no major changes in stock status. Following the ICES MSY framework landings in 2011 should be reduced from recent level. ICES cannot quantify the rate of reduction required.

The NSCFP stock survey trends show an increase between 2001 and 2002, a stable period to 2004, and an increase in 2005. There were no strong indications of changes in recruitment or discarding levels.

The advice given for 2009 and 2010 was based on precautionary considerations. The basis for the advice is the same as last years but extended by MSY considerations.

Nephrops in Division IIIa

The state of the stock is unknown. Commercial fishery indices (lpue, landings per unit effort) have been increasing in recent years suggesting that the stock is exploited sustainably. High catch rates of small *Nephrops* in 2007, 2008 and 2009 may indicate strong recruitment in these years.

There are two types of fisheries: trawl fisheries and creel fisheries. The trawl fisheries can be divided into trawls with sorting grids and trawl without grids. Creel fisheries take place mainly on locations where trawling is impossible or difficult, along the Swedish and Norwegian coasts. Note that due to a current minimum landing size of 40 mm CL the amount of discards is large.

Nephrops is taken mainly in bottom trawl fisheries which can be classified as mixed fisheries. This may have implications for those stocks in mixed fisheries where *Nephrops* is targeted, unless species and size selectivity of the gears are improved. Cod and sole are significant by-catch species in these fisheries in IIIa.

The state of the stock is unknown but effort data indicate an increase in lpue, suggesting that stock status is stable or increasing slightly. Therefore, following the ICES MSY framework catches in 2011 should not exceed the average of the past 3 years, 4700 tonnes.

At present there are two Functional Units in Division IIIa: Skagerrak (FU 3) and Kattegat (FU 4). This separation was based on observed variable differences between Skagerrak and Kattegat regarding size composition in catches in the 1980s and 1990s. However, the distribution of *Nephrops* is continuous from southern Kattegat into Skagerrak, and exchange of recruits between the southern and northern areas is very likely. With longer data series available now, it seems as differences in size compositions between the two areas more likely are random or caused by factors from fishing operations. It is therefore recommended that these two FUs are merged into one single FU.

ICES advice is currently for a zero TAC for cod in Division IIIa, which is a significant by-catch species in the *Nephrops* fisheries. The current effort regulation (limiting days at sea for gears not using selective sorting grids) may increase the incentives to use sorting grids, which may reduce the by-catch of cod.

7. Mixed Fishery Considerations

Much of the North Sea *Nephrops* trawl catch was originally taken in mixed fisheries, and that is still the case in many areas like the Fladen ground, the Skagerrak and Kattegat and in the Scottish, Dutch and Danish fisheries. In the case of the Noup, fishers are seeking monks and megrims but also benefit from the capture of *Nephrops* there. Most of the functional units were fished seasonally in the past. They previously formed part of a network of grounds that were explored at different times of the year and under different weather conditions. Moreover, when fishing in one area was poor fishers were accustomed to moving on to other grounds. A range of vessels catches *Nephrops* while at the same time targeting other species like plaice, cod, whiting or haddock. Even where *Nephrops* is the main target a significant income may be obtained from the whitefish species caught. Days at sea restrictions, together with real-time closures had restricted the range of fishing opportunities and disrupted traditional fishing patterns. The seasonal nature of the fisheries previously provided some protection. Now fishers are prevented from entering some areas because they have insufficient quota for some of the species they will find there. Fishermen have already given up a great of flexibility, gaining little in return.

As a result of the cod recovery plan, vessels targeting whitefish are now 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. Trawling for *Nephrops* results in by-catch and discards of other species, including cod, haddock, and whiting. 80 mm is the predominant mesh size used in *Nephrops* fisheries and the resulting proportion of fish discarded can be high. Some initiatives are in place to reduce discarding. By-catches of cod in the inshore *Nephrops* fisheries of the North Sea are currently fairly small (ICES 2009c). However, 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. Two of the three retained by-catch species, cod and whiting, are currently considered outside biological limits although effective management strategies have been imposed to assist their recovery. These two species, as well as haddock, may be discarded. The risk of catching whitefish is 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. 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). Further selective measures are being considered.

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 catch composition rules. The technical conservation regulations that specify catch compositions in relation to a number of mesh ranges require discarding to take place if the vessel is to fish legally.

Days-at-sea regulations and cod recovery measures have reduced opportunities for directed whitefish fishing. The STECF effort database suggests that effort transfer to the smaller mesh *Nephrops* fisheries of the North Sea took place shortly after the introduction of the regulations. In addition, restrictions on fishing in other areas, including western waters, has also resulted in effort being transferred to the North Sea.

Any further reductions in whitefish effort can be expected to result in a transfer of further effort into the *Nephrops* fishery, perhaps with an impact upon the by-catch.

Transfer of effort into the North Sea *Nephrops* fishery has been the unintended consequence of restrictions imposed elsewhere and on other sectors of the fleet. This issue must be addressed in the LTMP. It is also evident that reduction of discards must form an important component of the plan.

8. Ecosystem Considerations

Any LTMP must consider ecological, as well as social, and economic objectives. In particular, the plan must address the complexity of natural ecological processes and adopt an adaptive and precautionary management approach in the face of uncertainty. We have already commented on the relationship between *Nephrops* and predatory fish and have pointed out that increasing abundance of cod, in particular, may have an impact upon *Nephrops* populations.

We have mentioned concerns over by-catch and discards of non-target whitefish. There may also be a problem with the capture of undersized species including other crustaceans, fish and small *Nephrops*. The LTMP must address the issue of discarding by vessels fishing for *Nephrops*.

The high mud content and soft nature of *Nephrops* grounds means that trawling readily marks the seabed, trawl marks remaining visible for some time. Burrowing fauna can be seen re-emerging from freshly trawled grounds, implying that there is some resilience to trawling. Impact upon sensitive seabed habitats has been raised as a problem by Environmental NGOs. There is 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), some of which live upon the seabed. 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.

A number of ecosystem objectives have been discussed. The target of ecological sustainability for all North Sea fisheries acknowledges the need to minimise the impacts of fishing on the ecosystem.

Ecological sustainability of the North Sea's fisheries is essential not only for long-term species and ecosystem viability but also to underpin economic sustainability. A key goal of the *Nephrops* fishery LTMP is to minimise its impacts on the ecosystem. Such factors and impacts have to be accounted for and addressed by the plan if it is to meet its overall goals.

The extent to which the Management Plan is achieving the range of stated goals and objectives should be assessed using a combination of indicators designed to measure

performance of the fishery. These performance indicators may be biological or non-biological. Possible performance indicators are:

- Level of fishing mortality (with respect to a target F)
- Abundance trends obtained through UWTV surveys (with respect to a trigger point for assessing deterioration in the stock)
- Level of discarding
- Uptake of environmentally friendly fishing practices
- Number of Marine Protected Areas

9. Research and Monitoring

There is insufficient information available on some of the *Nephrops* fisheries, and this deficiency must be addressed as part of the Long Term Management Plan. Although some of the functional units are regularly surveyed by means of underwater television, others are not, and information on the distribution and numbers of *Nephrops* in these un-surveyed areas is limited. For some of the FUs with lower levels of landings (e.g. Botney Gut), there are no UWTV abundance estimates. This problem must be addressed. Further development and extension of fishery independent surveys, including UWTV surveys, are an important feature of the plan, not only to aid the assessment of prawn stocks, and aid the overall fishery management process, but also to play a crucial role in monitoring the fishery's broader ecological performance.

It is also important that there should be no incentive to withhold information on the fishery in particular functional units.

Nephrops are also caught in areas outside the functional units. The advice from ICES is that the definition of additional functional units should be considered, particularly for the Devil's Hole. Further work is needed to ascertain whether the current division into functional units adequately reflects the distribution of *Nephrops*. Are there other areas containing *Nephrops* which should be incorporated into the assessments? Are there small pockets of *Nephrops* at different locations which should be brought into the assessments?

The *Nephrops* assessments are not currently presented in a form which can readily be understood by non-specialists, including fishermen. As part of this LTMP 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 understood by those responsible for stewardship of the fishery.

There is a general lack of effort data, especially for the under-10m fleet. National authorities should provide information on the numbers and types of vessels and their capacity, from all nations, operating within the different functional units.

A case can be made for mapping of fishing effort for *Nephrops* in the North Sea, using VMS and other sources, for protective purposes, to monitor the distribution of effort between functional units and to ensure that any displacement of effort as a result of MPA and wind-farm proposals can be evaluated

We have already identified in this plan 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 within particular functional units. The advantages of taking away MLS restrictions and landing all *Nephrops* need to be investigated further. Landing the small *Nephrops* would provide scientists with valuable information.

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 in the North Sea where threatened endangered and protected species and habitats are likely to be adversely affected by trawling for *Nephrops*. This is a task for national authorities under the Marine Strategy Framework Directive.

There is a lack of evidence on the damage done to the seabed by the different gears used to catch *Nephrops* which needs to be addressed by scientists.

There are undoubted advantages from the closure of areas to fishing in terms of enabling comparisons to be made between fished and un-fished areas and assessing impacts on the seabed and the fragile animals which live there. However, the choice of areas to intend vulnerable organisms and habitats must be based on sound scientific evidence. There is deep distrust by fishers of those bodies responsible for defining such areas.

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 which recognise the diverse nature of the fisheries. Many fishers are interested in initiatives which would allow them to land all their catch and have said that this would influence both gear design and fishing behaviour. Such initiatives should be explored further.

Thus, there are a number of research and monitoring requirements for the *Nephrops* fishery to achieve the objectives of this Management Plan.

- The development and extension of fishery independent surveys, including UWTV surveys, is an important feature of the plan, not only to aid the assessment of prawn stocks, and aid the overall fishery management process, but also to play a crucial role in monitoring the fishery's broader ecological performance.
- If full analytical assessments are to be made (and this may or may not be necessary) then further research will be required either to enable the age of *Nephrops* to be determined, or to employ suitable length-based techniques

- 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 understood by those responsible for stewardship of the fishery.
- Further work is needed to ascertain whether the current division into functional units adequately reflects the distribution of *Nephrops*. Are there other areas containing *Nephrops* which should be incorporated into the assessments? Are there small pockets of *Nephrops* at different locations which should be brought into the assessments?
- 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 under-10m fleet.
- Data gaps within the fishery and on its wider environmental impact must be addressed. It will be especially important to evaluate the impacts of the fishery, including different gear types, on habitat and associated species communities, including benthic communities.
- Wider information is required on the distribution of vulnerable and protected species and habitats in the North Sea in relation to the *Nephrops* fishing grounds.
- There is also a need to improve data recording systems to capture fishing interactions with endangered, threatened and protected species.
- Many fishers are interested in initiatives which would allow them to land all their catch and have said that this would influence both gear design and fishing behaviour. Such initiatives should be explored further.

10. Uncertainties

ICES advice consistently recommends that the fisheries should be managed by functional units, in recognition of the relatively localised and isolated nature of *Nephrops* stocks. *Nephrops* continue to be managed as if they were a single North Sea stock. This may be appropriate, as some of the functional units are of uncertain status and it is by no means certain that all the potential functional units have been identified. It must be recognised, however, that some functional units are especially vulnerable to large incursions of fishing effort, which can bring about damage in a very short time. In considering the North Sea *Nephrops* fishery for accreditation it has been recommended that catch from the Farn Deeps functional unit be excluded from the unit of certification because of its vulnerable nature.

Protection of these vulnerable units by the allocation of individual TACs is a blunt instrument for promoting conservation. In this plan a different approach is taken. Vulnerable units are to be identified by ICES and then specific management measures implemented to protect them. Where incursion of effort is a problem, then the fishing methods which can be applied in the area need to be restricted. Where discarding of fish is a problem, then more selective fishing gears must be applied.

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. The management plan will need to consider whether additional information is required for management to be effective, and how that additional information might be obtained. Where there is uncertainty about the status of a functional unit there should be no incentives for continuing to maintain uncertainty. The plan suggests that functional units for which there is insufficient data should be managed through 'of which no more than' provisions.

Another uncertainty for the *Nephrops* fisheries is the extent to which the fishing grounds include vulnerable species and habitats. Such areas may be affected by international and national initiatives to introduce marine protected areas (MPAs). 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.

A case can be made for defensive mapping of fishing effort for *Nephrops* in the North Sea, using VMS and other sources, to ensure that any displacement of effort as a result of MPA and wind-farm proposals can be evaluated.

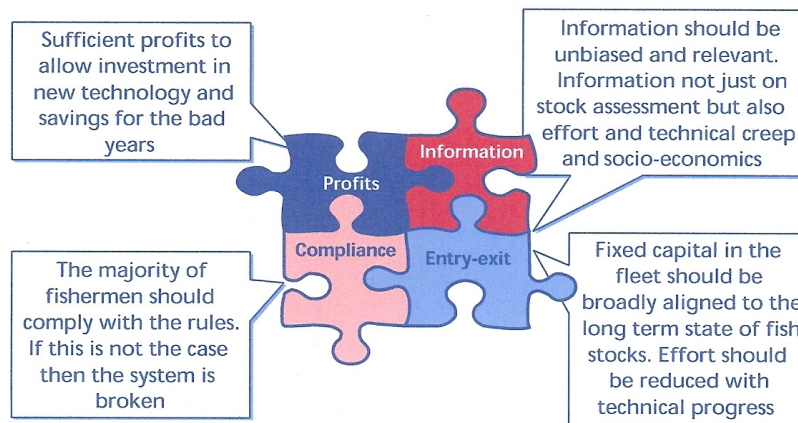
A particular problem for *Nephrops* from a management standpoint is the absence of a full analytical assessment. It is most unlikely that analytical assessments and forecasts will be available for the different *Nephrops* stocks in the foreseeable future. In these

circumstances it may be more appropriate to move towards a more pragmatic management approach.

11. Defining the Objectives

The Report on Long-term Management of North Sea Fisheries produced for the NSRAC pointed out that it is only by taking account of ecological, economic, and social factors within an appropriate institutional structure that development can continue without exhausting natural resources. It went on to point out that the overall goal of achieving sustainable fisheries could not be achieved by prioritising any one of the components of sustainability to the exclusion of others – for example targeting a high biomass or making profit maximisation the only goal. All aspects of sustainability had to be considered together.

This point has been echoed within the Net Benefits Report from the UK Cabinet Office. There is a management jigsaw, where all the separate issues must mesh together to create the overall picture:



Ecologically, the general reductions in mortality rate for the North Sea can be brought about by agreeing a time scale for reducing fishing mortality significantly. Problems with vulnerable functional units can be resolved by the application of specific management measures aimed at resolving the particular problems experience in that unit..

Economically, fishing businesses must be to achieve economic resilience based on sustainable level of profit. There is also a need to rationalise and harmonise various management measures and regulations, many of which currently make fleets less efficient.

Socially, it is preferable for change to take place at a rate that can be absorbed by businesses ports and communities, especially if change is imposed through regulation. It is also important for stakeholders to be involved in any decisions that will have significant impact upon them.

Biological Objectives

The main biological objective is to avoid over-exploiting the resource. *Nephrops* in the North Sea must remain at or close to their full reproductive capacity and must be kept

away from a state where they would be unable to replace themselves. There must be a low risk of the stocks showing a reduced production potential. They must be well above the lowest observed level of biomass.

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 and other grounds 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 have also occurred which may have been due to increased effort in the fishery on this functional unit. ICES has made it clear that *Nephrops* should be managed by functional unit, rather than at an over-arching North Sea level. Our management plan agrees with that diagnosis, but rather than adopt the blunt instrument of setting TACs for each functional unit, it is proposing specific remedial measures for those vulnerable units.

We have already mentioned the need for management plans to take account of species interactions and other changes to the ecosystem which may have a significant effect upon *Nephrops* stocks. Within the North Sea there is a risk that a recovery of whitefish stocks, and especially cod, may result in increased predation upon *Nephrops*, leading to a decline in the available resource. The management objectives must deal with this possibility. They do so through the setting of a trigger point, where changes are made to the target fishing mortality.

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 abundance and trends.

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 legislation (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.

Economic Objectives

The overall economic objective might be to achieve a modern, stable and profitable fishing industry; with a fishing fleet able to renew itself; able to provide a supply of fish matched to the requirements of the market at appropriate prices for the processing industry and consumers; operating in a way which would enable the costs of all the participants to be met.

It is important to recognise that some of the markets for *Nephrops* are quite volatile and current 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 substantial, and may not provide an adequate return on investment.

In developing this management plan we have decided that it is not a business plan. Rather, we have concluded that member states and fishing businesses must be able to set their own economic and social priorities.

In addressing those economic issues member states and fishers may need to consider:

- Whether fleets are of the right size and type and have 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, how can that position be maintained?
- How can the problems of technology creep and the introduction of more efficient fishing methods (like multi-rig trawls) be dealt with at a time when greater stability in fishing capacity is being sought. There may be economic advantages in limiting the gear types which can be used.
- There are issues over the maintenance of open access to inshore fishing grounds (see section on Social Objectives below)
- There are issues over the extent to which effort should remain mobile over the different functional units within the North Sea
- Perhaps the major economic risk for the *Nephrops* fisheries is likely to come from excess fishing capacity. 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. There are indications that North Sea *Nephrops* fleets are already over capacity.

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 must be quite high compared to alternative business investments. Capacity in the *Nephrops* fishery may already be too high (judging from the relative low profitability of individual vessels) and total capacity is 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 by the Commission 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.

However, managing fleet capacity is not part of this management plan. It is not the role of any LTMP to instruct fishing enterprises on how they should operate or take their own economic decisions. Nor should this plan set out to micro-manage the fishing industry. This plan is a management plan not a business plan.

Social Objectives

It has become increasingly apparent that it is not only ports and coastal communities which benefit from fisheries. People in centres elsewhere and even away from the coast also derive income from it and are affected by any changes in the fishery. The important social objective is to ensure that changes do not harm the resilience of the fleet and all those people engaged in the industry. There must be fairness and equity in managing changes to the fishery and steps must be taken to ensure that any human impacts fall within reasonable bounds and do not take place at a speed which is difficult for dependents to deal with.

12. Instruments

Currently a TAC is applied to *Nephrops* across the North Sea. A different TAC is set for *Nephrops* in the Skagerrak/Kattegat. There is an issue over whether the TAC should be set for the North Sea, or for the various functional units. This plan acknowledges that some functional units may require additional measures to protect them if stocks fall outside given parameters. It will be necessary to consider a number of options for achieving this, for further discussion. Some of those measures might require clearer definition of the vessels attached to particular functional units, 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 has already gone some way in reducing impacts upon whitefish stocks. Scientists have 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 minimise 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.

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 placed less emphasis on this important initiative.

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, 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, larger meshes, and better selectivity profiles may offer a solution in some fisheries. Other measures might include the provision of dropout openings, and “wheeled” foot-gears replacing rock-hoppers.

13. Timeframe

The NSRAC sees the LTMP for *Nephrops* fisheries as a gradual sequential response to risk operating over a period of about 10 years. The plan needs to be responsive and adaptive, changing as circumstances change.

It is suggested that the plan should be reconsidered at 5 year intervals.

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