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Future Management of Brown Crab in the UK and Ireland (IPF_D123)

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Final Report: Future Management of Brown Crab in UK and Ireland

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Executive Summary

Fleet

There are some 3,700 licensed fishing vessels in the UK and Ireland with entitlements to fish with pots. These vessels mainly target lobster, brown crab, nephrops and whelks, but can also focus on velvet crab, green crab and shrimp. Most of this fleet (>80 per cent) comprises vessels under 10m in length operated by one or two fishermen per vessel, exploiting resources close inshore, and on a daily basis. Most of these vessels target lobster, with a bycatch of brown crab. In addition, however, a significant proportion of this fleet component is inactive – between 15 and 20 per cent.

At the larger end of the fleet, up to 30 vessels in the size range 14m to 35m exploit offshore grounds, and are capable of staying at sea for several weeks at a time, and holding live crab on-board – the nomadic vivier vessels. These predominantly exploit crab grounds to the west and north of Scotland, and in the German Bight.

In between these small and large scale components of the fleet is to be found a segment comprising medium scale dedicated brown crab vessels that, together with the nomadic viviers, is responsible for as much as 90 per cent of all crab landings. Some of these vessels put to sea for trips of between 3 and 10 days, whilst the majority return to port each day. This medium-sized fleet comprises some 300 vessels.

Landings

Landings of brown crab from the UK and Irish fleets have held steady over the last decade at between 30,000 and 35,000t per year, with a significant dip in landings recorded for 2005. Current evidence suggests that the market is over-supplied – as a result of weakened demand, changing consumer preferences, and increased supplies of competing crab and other substitute products from other parts of the world. Whilst prices have weakened there is no evidence as yet that the sector has hauled back on production levels.

As matters stand there are relatively few constraints on the fishing of crab outside the holding of a valid potting entitlement, and the landing of firm bodied crab in excess of the minimum size limit. There are no restrictions on the number of pots that any one vessel can operate, the regularity at which the pots are to be inspected and emptied, or the amount of crab that can be landed. Even the smallest of vessels now handle several hundred pots, with the larger and more active vessels setting anything from 500 to 1500 pots, and the largest vessels handling 2,000 or 3,000 pots. And the number of pots being operated increased year on year.

Production from inshore fisheries is widely dispersed around the UK and Irish coasts, and might be reasonably assessed as contributing between a quarter and a third of overall supplies. As a whole, however, production is concentrated in perhaps five areas – the fisheries of the West of England (>8,000t per year), the fisheries to the north and west of Scotland (>8,000), the fisheries to the north of counties Donegal and Antrim (>4,500t), the Yorkshire / North Sea fisheries (>3,000), and the German Bight fishery (>2,000). Outside the small vessel inshore fisheries, most of these landings are the result of the operations of some 350 vessels.

Pot limits

There is wide industry recognition that caps need to be placed on effort and possibly also on landed volume. This has formed the basis of regular debate over the last ten years, but a failure to achieve consensus on how to implement such caps has resulted in no decision being made as to how to progress. This has now come to a head as a result of the deteriorating market conditions and their

impact on the operating economics of the fleet. And whilst an across the sector cut-back in production would undoubtedly alleviate the current market over-supply situation - firstly there is no mechanism in place to achieve this, secondly it is unlikely that the current market impasses is a simple over-supplyl issue, and thirdly this would not address the main underlying weakness within the sector which is the absence of coherent management. This absence of management itself encourages operators to continually increase effort and production to protect their competitive standing – a condition that is essentially self-defeating.

What is proposed is for regional caps to be put on both effort (essentially pot-days) and overall landings (tones). Per vessel upper limits would then be placed on the number of pots that can be handled by individual vessels – probably allocated on the basis of a combination of the physical parameters of the vessel and the scale of operation of the business. For those potting vessels landing shellfish of a value exceeding a certain threshold figure a per vessel catch quota would also be applied – the intention being to focus this second-tier control on that part of the fleet landing the most crab.

Latent effort

To allow such a system to function as intended, there is an urgent requirement to first remove the threat to such a system posed by "latent effort" – that part of the fleet that is currently inactive, or is operating at a level well below potential, or is currently engaged in other fisheries but continues to hold entitlement to fish crab. Under the current license regime any or all of these operators could step-up their involvement in the brown crab sector at any time in the future, and so undermine efforts to cap effort and landings. In the first instance it is suggested that a retrospective "use it or lose it" rule should be applied. This should then be taken forward in the form of a "sunset clause" applying to all entitlements – i.e. if the entitlement is not exercised, then it lapses. A corollary to this is that entitlements would not be tradable – permits would lapse if unused, and pot or landings allocations could not be enhanced through exchanges between owners. As an additional measure, where fishing takes place within an existing inshore management regime, consideration should be given to implementing a permit scheme as a means of matching the regional caps with the size and composition of the local fleet.

Stock assessment / harvest control rules

There is general acceptance that the current level of crab fishing is at or in some places may be slightly beyond that level that is biologically sensible. It is in part for this reason that the industry is open to the introduction of caps. But there is also logic to tying the level of such caps to the underlying condition of the stock – and particularly since this is likely to change with time. This will require that the effort applied to stock assessment is stepped up, and that rules are developed to tie the regional caps to relevant indices of stock condition – probably standardised CPUE and the size distribution of catches.

Quality considerations

It is expected that the introduction of regional caps and per vessel allocations will greatly improve confidence within the sector, and allow owners the increased certainty to better plan future operations. This is also likely to result in significant improvement in the quality and value of crab landed, as operators switch from landing volume to landing quality.

In the matter of Minimum Landing Size, there is commercial merit to increasing MLS, particularly given that in most areas the industry actually operates to a larger MLS than legislation requires. But this is primarily a commercial matter, and given differences in practice and circumstances across the UK and Ireland, and recognising that there remains demand for smaller sized crabs, any changes to MLS should be undertaken on a regional basis.

Actions

To progress the matter of effort and landings caps, five issues need to be addressed in the first instance:

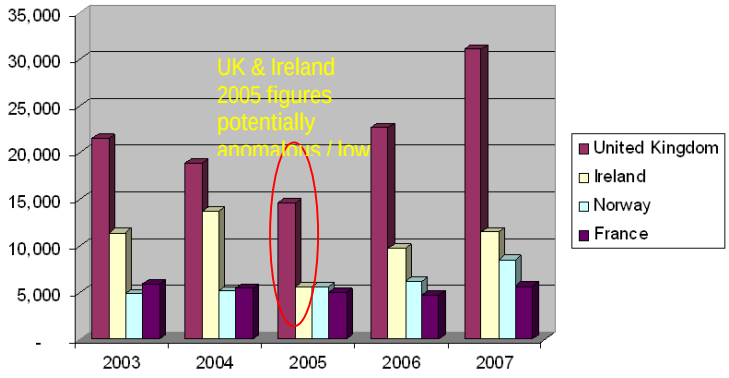
- Achievement of broad industry support for the principle of the management measures proposed;
- Investigation of the legal basis for removing latent effort - including interventions at a national level, and interventions at a local level;
- Further investigation of the bases for allocating pot limits and landings limits to the fleet – either on a banded métier basis, or ideally on a per vessel basis;
- Focus further analysis on how best to sub-divide regional management of the fisheries to the west and north of Scotland (the locus of continued increases in effort and landings), and the fisheries of the West of England (the locus of the greatest changes in distribution of effort and landings);
- Identify how to achieve improvements in the assessment of the stock condition, and the use of indicators (CPUE) as indicators of stock status – focusing on funding and standardising of methods.
- Divide the waters around the British Isles into a number of crab management areas, broadly equivalent to the current stock assessment boundaries used by Cefas (England & Wales), Marine Scotland: Science (Scotland), and the Marine Institute (Ireland).
- For each of these areas set an upper ceiling for pot numbers and landings set at no higher than the levels operating today. Where appropriate these levels should be sub-divided between inshore and offshore regimes.
- Pot limits, per vessel, should be established based on the outcome of the further analysis of fleet metiers described above.
- For those vessels with a turnover in excess of something like £100k per year, a per vessel landings quota should be considered as an additional management tool, set at levels based as a proportion of recent landings levels.
    - This has particular relevance as a management tool in the area to the north west of Ireland and the west and north of Scotland where there has been significant year on year growth in fisheries in recent years, and where a cap needs to be placed on the scale of these fisheries as a matter of urgency.
    - In most other areas of the British Isles the pattern and level of crab exploitation has been developed over a long period of time and fishing activity and corresponding management systems are generally stable. In these areas it can be argued that greater priority should be given to removing latent effort and developing the mechanisms by which pot numbers can be varied according to assessments of stock condition (as probably reflected in changes in CPUE).

1. Background and objectives

1.1 Context

The brown crab fisheries of the British Isles – the UK and the Republic of Ireland – contribute in excess of 70 per cent of all brown crab landings, as shown in Fig 1. Clearly the fisheries from these countries are critical in the supply of brown crab to local and mainland European markets, and, though other sources of processed non-brown crab products compete with brown crab, the UK and Ireland dominate the supply of live crab to this specialist market segment, exemplified by markets for live crab in France and Spain, and markets for processed crab products in the UK and across western Europe. So how the UK and Ireland chose to manage their brown crab fisheries impacts on sector profitability both in terms of catches relative to costs, but also in terms of the price that can be commanded in the market place.

Fig 1 – Main landings of brown crab – 2003-2007 - tonnes



Source: FAO FishStat+ - category of "edible crab from the North East Atlantic"

At present the industry is beset by a number of problems: the brown crab market is over-supplied, there is strong evidence that stocks are fully or over-exploited, and industry economics are poor. Two factors compound the seriousness of this situation:

- the fishery management systems in place in the brown crab sector are not able to substantively alter these conditions; and
- in an effort to maintain some semblance of continued profitability the industry matches worsening catch rates and market prices with increased deployment of pots, increased effort, and increased (and often lower quality) landings.

Under these conditions the future for the industry is poor – falling catch rates and declining sector profitability, followed quickly by significant and long-term industry contraction, impacting negatively on employment and the number of businesses involved.

Establishing improved and effective management of the sector – most notably in capping and then reducing effort – is now imperative. Yet there is a lack of clarity as to how to achieve this, and the prognosis for successful implementation of management measures, based on an inability to reach consensus for action, remains poor. Some of the reasons behind this state of affairs may be illustrated as follows:

- this is a very complex fishery,
- it includes inshore and offshore fishing components,
- it includes a mixed fleet of large and small vessels deploying the same type of gear but operating at different levels of intensity,
- there are regional variations in practice and management preference,
- the fishery is subject to management control within a number of legal jurisdictions,

- the industry has failed, over an extended period of time, to build consensus around any one plan of action, and
- for managers the crab fishing sector may not be at the top of their agenda, particularly given competing and current pressure:
  - to improve general management within the inshore sector (which includes crab, but where focus is directed to addressing fishing of quota species),
  - to deal with CFP reform, and
  - to re-align activities within new institutional structures under the banner of integrated marine management.

Further indication of how difficult it has been to move matters forward may be gauged from the following illustration, taken from the introduction to the paper "On the Management of Brown Crab Fisheries" recently (September 2009) produced by Dr R C A Bannister, Chair of the SAGB Crustacean Committee:

> *"The following principal meetings or discussions were held on brown crab during the last decade:*
>
> | | |
> |---|---|
> | *2000* | *Defra shellfish conservation meeting: discussed possible pot limit.* |
> | *2005* | *International Crab Workshop at SAGB. Major review of crab management.* |
> | *2006* | *Defra Discussion Paper on Limiting Brown Crab Exploitation.* |
> | *2007* | *NFFO Shellfish Committee paper on crab and lobster management.* |
> | *2008* | *SAGB Crustacean Committee discussions on effort limitation.* |
> | *2008* | *Defra expert workshop on crab & lobster measures & priorities.* |
> | *2008/9* | *Transnational stakeholder meetings (Edinburgh, York, Dublin).* |
> | *2009* | *SAGB meeting (January) with Defra officials.* |
> | *2009* | *Defra meeting (May) with SAGB & NFFO: Consultation preview.* |

Despite extensive debate, supported by a mounting library of well-informed documentation, the sector has been unable to reach agreement on a way forward.

1.2 Study objectives

Against this backdrop, this current piece of work is presented as one component in a programme of work intended to bring resolution to the problems facing the brown crab sector. Its intention is to provide an agreed definition and understanding of the condition the industry finds itself in, and the tools available to industry and managers - and so provide a common language that all parties may access when debating and negotiating management plans and processes.

The descriptions of these tools presented in this report, together with details of how they work, are placed within the context of international practice, and just how they might be applied to the crab fishing sector in the British Isles. They are illustrated with examples of where they have been successfully used and, where available, where they have been unsuccessful in application.

It is not the intention of this study to present proposals for the future management of the sector, but it is the intention of this study to inform the debate that will need to take place in coming

months to resolve the current impasse – a number / range of potential management tools, but no consensus as to how and in what conformation they might be applied.

In summary, the objective of this project is to contribute to the sustainable management of the brown crab fishery in UK and ROI by providing an independent and evidence based review of:

- where and how different management tools might be applied in the management of crab fisheries,
- how application of these tools might impact on different elements in the fishery, and
- the extent to which application of these tools – separately or in combination – might improve sector management from the perspectives of stock management, profitability and market price.

This report draws on available literature, the outputs of various meetings held on crab management over the last ten years, and evidence from relevant case study material.

Full referencing to statistic data used within the report is provided and any uncertainties surrounding the accuracy of the data are highlighted.

1.3 Terms of Reference

The work is the initiative of industry interests, which have drawn together as a Transnational Brown Crab Working Group – a conformation that explicitly recognises the cross-jurisdictional nature of the problem and recognises that any remedies will need to be applied *in toto* or in part across these jurisdictions. The core membership of the Transnational Group covers:

- The Scottish Lobster and Crab Working Group
- The UK Lobster and Crab Working Group
- The Shellfish Association of Great Britain (SAGB)
- The UK Seafish Industry Authority (Seafish)
- The Irish Sea Fisheries Board (an Bord Iascaigh Mhara – BIM)
- The National Federation of Fisheries Organisations (NFFO – covering interests in England, Wales and Northern Ireland)
- The Scottish Fishermen's Federation (SFF)
- The Welsh Federation of Fishermen's Associations (WFFA).

The specific Terms of Reference include requirements as follows:

1. Present an overview of the current status of crab fishing in the British Isles
   - fleet components,
   - catches,
   - fishing effort,
   - latent effort, and
   - management systems.
2. Assess[1] the relative merits of the key effort controls that could be implemented:
   - Licensing and entitlements;
   - Pot capping / limitations;
   - Quota and other methods of resource allocation;

[1] Assessment of management measures should address:

- the intended conservation benefit to be achieved by each measure;
- implementation issues associated with each measure (e.g. administration, policing, industry buy-in);
- the distribution of economic impacts and timeframe over which impacts are expected to occur for alternative measures according to regions or fleet metiers;
- potential impacts upon markets of the selected measures;
- the common ground, particularly when it comes to markets.

- Days at sea or time limitation / seasonal variation

3. Assess the relative merits of the key technical measures that are or could be implemented:
   - Technical conservation measures (including MLS);
   - Pot marking
   - Access to licensing / permits ~ new entrants / transfers;
   - Area based management (seasonal and long term closures, and permits and annual entitlements to fish within those areas);
4. Assess the framework for enabling regional / zonal management of crustacean resources including:
   - Existing policy mechanisms at regional, national and European level;
   - Barriers to delivering regional management (e.g. management jurisdiction);
   - Implications for proposed management measures;
   - Options for taking forward regional based management.

The study is primarily based on desk research, but augmented by industry input through a series of regional workshops. In this context, six meetings were held as follows:

- Aberystwyth – 2nd Sept
- Kingsbridge – 3rd Sept
- York – 10th Sept
- Galway – 17th Sept
- Inverness – 18th Sept
- Belfast - 2nd Oct

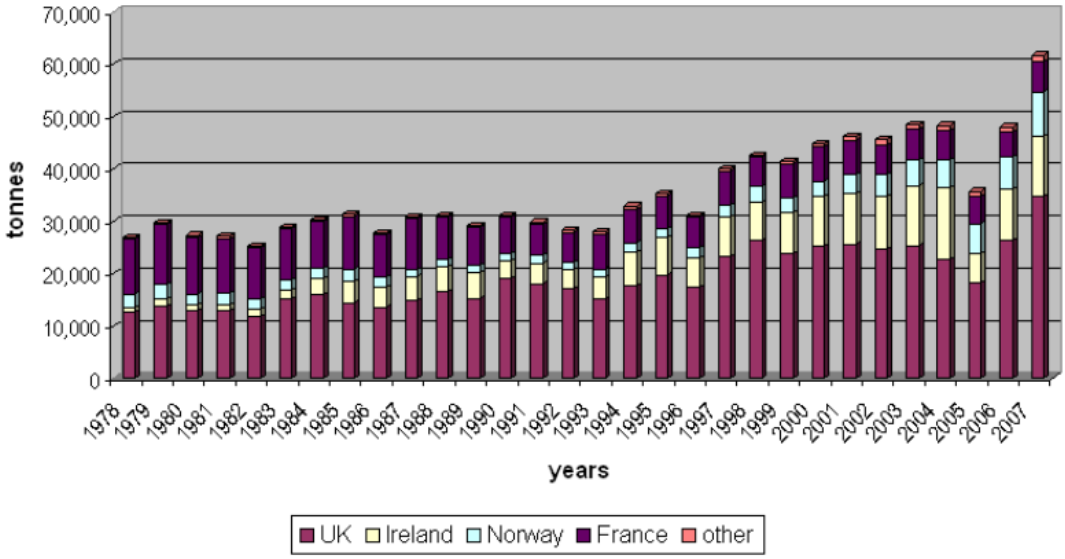
In total, some 130 people attended these meetings with the majority being fishermen and vessel owners, but also including traders, processors, industry representatives, scientists and managers.

2. Overview of the brown crab fishery in the UK and Ireland

2.1 Evolution of landings

The scale of harvesting of brown or edible crab (*Cancer pagurus*) has increased steadily over the last twenty years, rising from some 26,000t in 1978 to some 60,00t in 2007 (Fig 2). Most of this increase may be attributed to developments in the UK and Irish industries, but there has also been recent and significant development in the Norwegian fishery, whilst the French industry has shown some minor decline.

Fig 2 – Brown crab landings, 1978 to 2007



Source: FishStat+ - category "edible crab from the North East Atlantic"

Note: the drop in UK and Irish landings for 2005 stands out, but there is no clear explanation as to the reasons for this;

the introduction of the Registration of Buyers and Sellers legislation in 2006 may have resulted in a fuller disclosure of landings figures for the UK under 10m fleet component in relation to 2007

in the early 2000s profitability in the whitefish sector, and opportunities to fish whitefish, were in decline and many UK and Irish owners elected to exit fisheries dependent on quota, and to enter non-quota fisheries, such as potting; at the time there were few barriers to entry to the potting sector

2.2 Evolution of the fleet

At the core of developments in the UK and Ireland has been significant evolution of the fleets. Three underlying changes in fleet composition may be cited:

- the first is the steady increase over a period of some thirty years in the fishing capacity of the traditional potting fleet – from small, typically open, motorised vessels fishing a couple of hundred pots, to larger decked potters capable of fishing several hundred pots;
- the second is the emergence in the mid to late 1980s of a small number of larger "vivier" vessels capable of staying at sea for several days on end, and storing their catch in seawater tanks below deck (this type of vessel first emerged in the French Brittany fleet, was then

adopted and extended by Channel Island owners, and subsequently adopted and further extended by owners in South West England);

- the third is the much more recent development of altogether more sophisticated vessels that combine the features of speed, capacity to handle large numbers of pots, and flexibility to work as day boats or to stay at sea storing catches in seawater tanks; such vessels can be found in most parts of the UK and Ireland, and most replacement vessels are of this type.

Today there are perhaps thirty vessels in the UK and Irish fleet that may be reasonably referred to as "nomadic super-crabbers" – no longer just the preserve of owners in the Channel Islands and South West England, ownership now extends to Scotland and Ireland. These vessels are mainly in the size range of 14 to 22m in length, fishing between 2,000 and 4,000 pots each. They can hold between 10 and 20t of live crab on-board at any given time. Landings are typically discharged to "vivier" lorries – lorries fitted with sophisticated temperature controlled seawater systems capable of keeping shellfish alive for at least several days – which typically ship the product to live holding facilities in France and Spain. This fleet component was responsible for extending potting into deep waters towards the edge of the continental shelf, but has been particularly hard hit by recent changes in operating economics. Landings per vessel are typically in excess of 500t per year, extending to 1,000t per year or more.

There are perhaps another 100 to 200 modern UK and Irish vessels fitted with "vivier" capacity that fish between 1000 and 2000 pots each, operating trips on a daily or weekly basis in both inshore and offshore waters. Most vessels in this fleet component are less than ten years old, and a significant number less than five years old. This is the element of the fleet that is growing, the fleet component that is most heavily reliant on borrowings, and thus the fleet component that is likely to be worked hardest. Landings of between 300 and 500 t per vessel per year are likely.

There are perhaps a further 1000 to1500 vessels that may be categorised as the more traditional fleet component, though this fleet is far from homogenous. These vessels vary in length from perhaps 6m to 15m, and work between 50 and 800 pots per boat. Landings may range in scale from perhaps 5t per vessel per year to perhaps 100t per year.

Whilst those vessels fishing the most pots tend to focus on fishing brown crab, most of the rest of the fleet, and particularly the smaller vessels, tend to preferentially target the more valuable lobster. In this fishery brown crab might be more appropriately seen as a bycatch species. In some areas lobster fisheries are extended by fishing for velvet or swimming crab, and for spider crabs. But there are also potting vessels that focus on creeling for nephrops, and there are others that focus on potting for whelks. The same potting license will allow an owner to access any of these fisheries.

In addition to the above, brown crab is also caught as a bycatch in a range of static net fisheries, and in mobile beam and otter trawl fisheries. Landings of brown crab from these fisheries is limited to a few per cent of total.

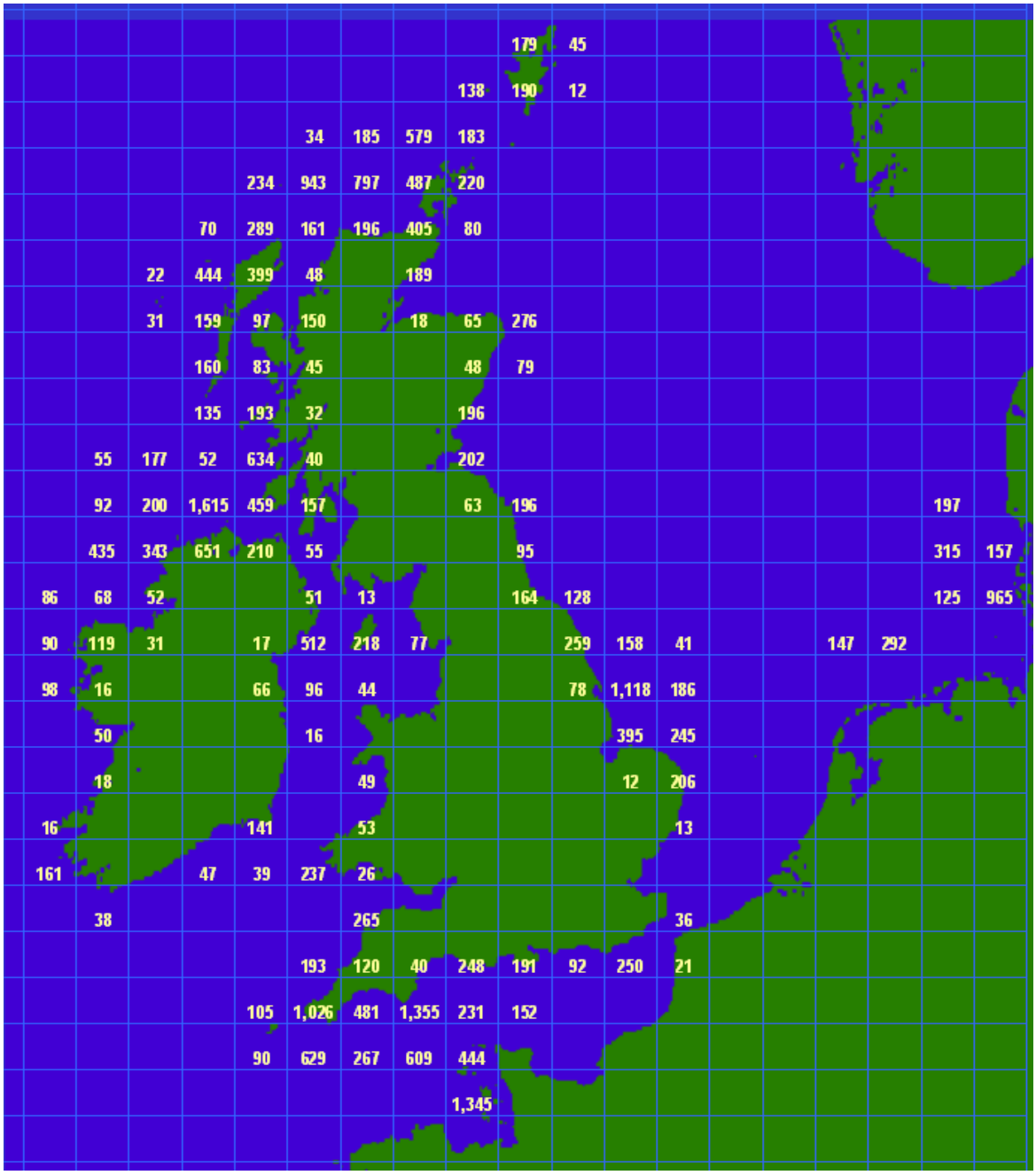
2.3 The geography of catches

The geography of crab catches is illustrated in Figs 3, 4 and 5. Fig 3 shows 2008 catches per ICES statistical rectangle for the UK and Irish fleets. The distribution of catches provides illustration of where effort is concentrated (on the assumption that high landings equate to high effort – a position supported by the industry). Fig 4 shows landings by port, cumulative for the period 2004 to 2008. Fig 5 shows the recent evolution of catches by sea area over the last ten years (note that in this graphic UK and Irish figures for 2005 have been treated as anomalous, and replaced by figures reflecting the average of reported landings for the previous and following years).

The 2008 figures shown in Fig 3 give a fair indication of where fishing effort is concentrated, and crab densities are highest. Fig 4 indicates where the main fleets operate from and land to. The main fisheries are briefly described below.

English Channel

Fig 3 - Brown crab catches per ICES rectangle for UK (incl. IoM & CI) and RoI fleet, 2008 (tonnes)



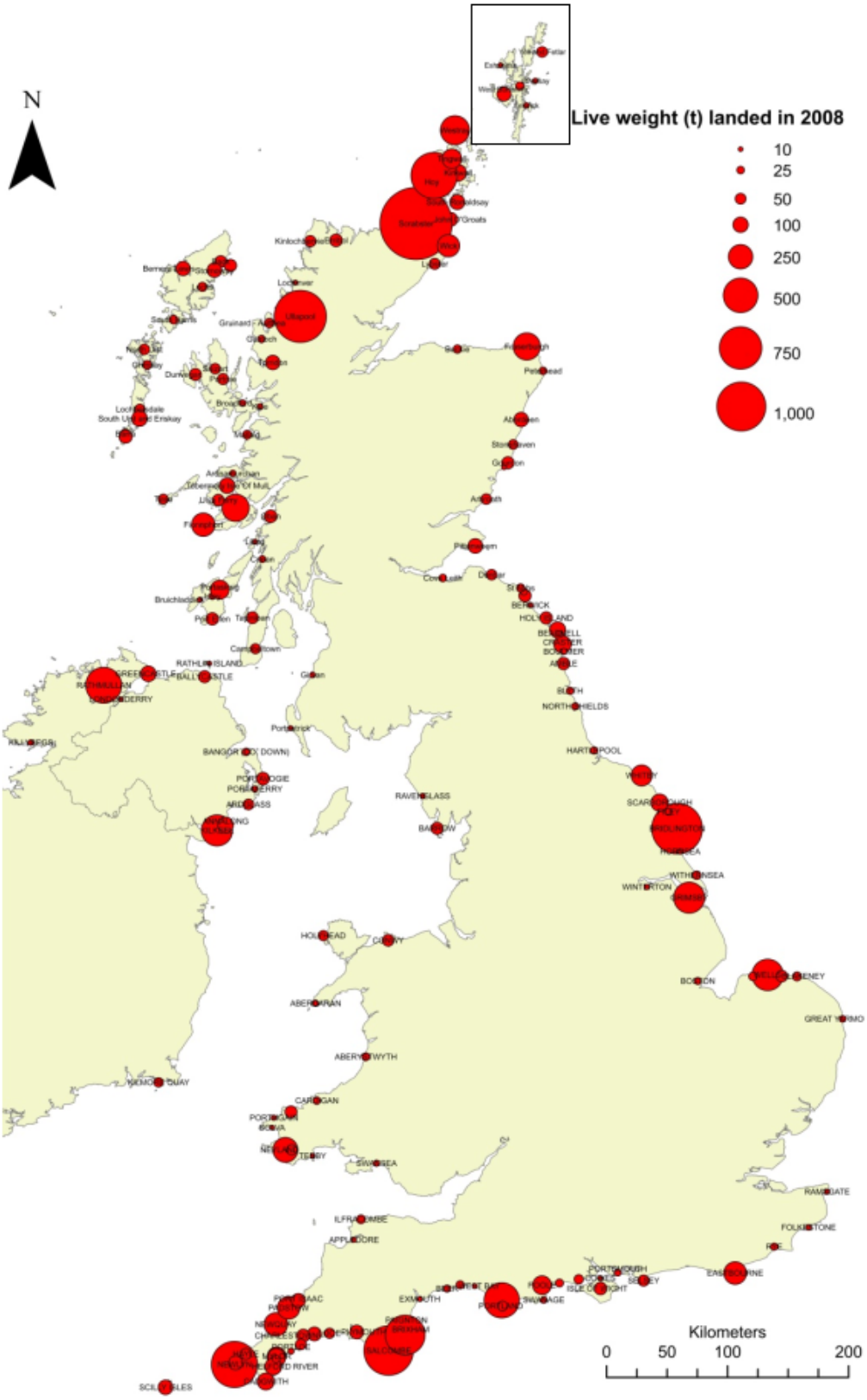
Source: MFA, Marine Scotland, & Marine Institute Ireland

Notes: to improve graphic clarity, catches of 10t or less per ICES rectangle have been excluded

for Channel Island statistics, 2007 landings for Guernsey have been carried over, as a suitable approximation, to 2008

Channel Island catches have all been allocated to 27E7

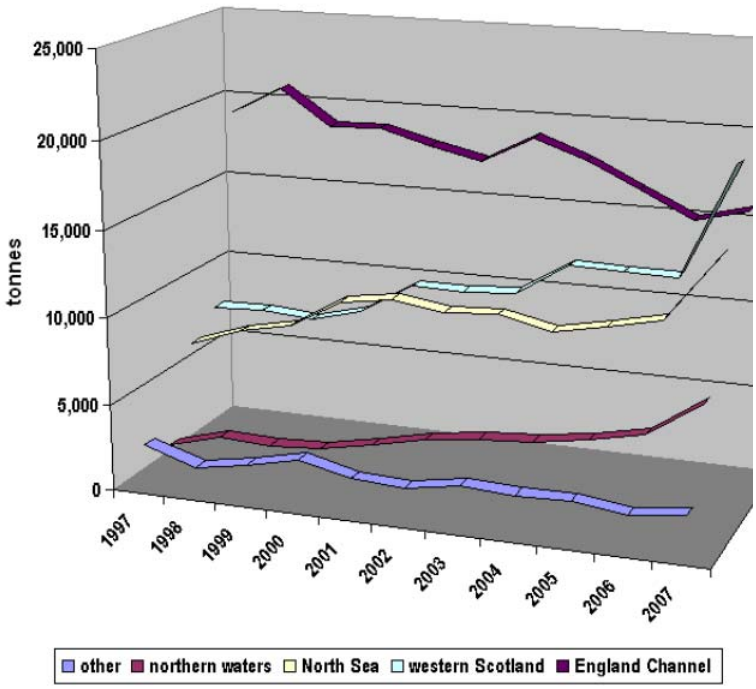
Fig 4 – Landings of crab from UK registered vessels, by port – 2008 - tonnes



Source: Statistics from MFA & Marine Scotland

The English Channel has provided the mainstay of the brown crab fishing over many decades, focused on fleets operating from northern Brittany, the Channel Islands and South West England. Over time, the French fisheries have fallen back slightly (see Fig 1), and the development frontier of the sector was been taken up in the 1980s by owner / skippers in the Channel Islands, with the development of the important mid-Channel crab fisheries, and the west of Scotland distant water offshore fisheries. But from the early 1990s the baton has been rather taken up by operators in the South West of England – fishing the local inshore waters (including the very productive fisheries of the Start Point area), the mid-Channel fisheries, and further developing the distant water offshore fisheries to the north and west of Scotland, and offshore in the North Sea. At the core of the local South West England activity are the ports of south Devon, and more recently still the Cornish port of Newlyn (see Fig 4). As can be seen from Fig 5, overall landings from the English Channel area have fallen off steadily over the last decade from a high of 20,000t to a current level of some 16,000t – and this despite a substantial increase in the number of pots used.

Fig 5 – Evolution of landings by sea area, 1978 to 2007



Source: FishStat+ - category "edible crab"

North Sea

- A second traditional crab hotspot has been the south Yorkshire fisheries, centred around the ports to the north and south of the Humber. Here fisheries are conducted in relatively shallow waters, but extending out some 20 or 30 miles into the North Sea. This fishery has remained fairly steady, showing some increases as vessels have sought to work grounds further offshore. Over the last decade landings have grown from somewhere in the order of 5,000t to perhaps 8,000t.
- But this growth in the south Yorkshire fisheries should not be confused with the very rapid and significant growth in the North Sea fishery shown in Fig 5. This is the emergence in the last five or so years of a significant fishery in the eastern North Sea off the coasts of Germany, Holland and Denmark. This fishery has been pioneered by large South West England owned "vivier" vessels, and expanded as some of the other larger crabbers have joined this fishery. Here landings have grown from nothing to perhaps 5,000t. This fishery appears to be exploited solely by UK and Irish vessels, landing catches into northern Holland, East Anglia and south Yorkshire.
- There are also other North Sea fisheries that are of more local significance – all of which are conducted primarily in the inshore sector. Together these account for something in the order of a further 3,000t of product. The largest of these are the fisheries of the east coast of north east of Scotland (the Grampian region and Moray Firth) and eastwards of the Northern Isles (the Orkney and Shetland Islands). To the south of there are the south east

Scotland and northern England fisheries (the Angus, Fife and Berwickshire fisheries, and the Northumberland to north Yorkshire fisheries). Further south still is the north Norfolk or Cromer crab fishery, a fishery of long tradition, with the unusual feature of harvesting, over many decades, a generally smaller sized crab.

West and North of Scotland

- Whilst potting has formed a core element of coastal fishing along the Scottish west coast and off the Scottish islands – Inner Hebrides, Outer Hebrides, Orkney Isles and Shetland Isles – it is the move to larger vessels capable of working in heavy weather and further offshore that has made this the new centre of the crab industry in the British Isles. This activity started when the Channel Island super-crabbers started to work grounds to the north of Ireland and west of the Outer Hebrides. These were soon replaced by vessels from South West England, and later joined by vessels from the Irish Republic and from Scotland itself. Today, potting takes place right out to the edge of the continental shelf, with most activity focused on vessels that spend between 5 and 20 days at sea at a time. Some of the biggest vessels now fish 2,000 to 3,000 pots in several sets of gear, operating round-the-clock in shifts. There is now less evidence of "nomadic" behaviour, with most of these large "visitor" vessels based all-year-round from ports adjacent to the fishing areas. Key landing ports for this fleet are Scrabster, Kirkwall and Ullapool in Scotland, and Rathmullen and Greencastle in Donegal, Ireland. But it is also the case that there has been a general increase in the average size of vessels operating to the north and west of Scotland, reflecting the difficult sea and weather conditions typical of this area. As a result, effort and landings have been increased across the board. Over the last decade landings from this area have increased from some 8,000t to 19,000t, as indicated in Fig 5.
- As this north of Ireland / west of Scotland fishery has evolved, so some changes in licensing rules plus new investments in modern vessels have subtly altered the disposition of the fleet.
    - The closure of the "Windsock" area to whitefish vessels as part of the cod recovery programme has provided "new" ground for the crab fleet.
    - The activities of some large Irish owned super-crabber vessels operating out of Donegal have been adversely impacted by kilowatt days legislation. In possession of polyvalent licenses – able to fish whitefish and shellfish using static and mobile gears – the capping of the fleet as part of the EC cod-recovery programme has meant that these vessels have found themselves short of days-at-sea. As a result, they have been forced to undertake at least a part of their fishing activity to the east of the 4° line – around the Orkney and Shetland Isles, and in the North Sea. And their operations have been delivered a further blow with the sudden removal of their entitlement to fish for whitefish – limiting their freedom of operation still further, and putting their operating economics under additional pressure.
    - At one and the same time, the fishermen of County Mayo in Ireland have also expanded their crab fishing activities. Investment in new and larger vessels has allowed them to exploit crab resources further to sea and, along with increased activity from the small and middle sized elements of the Donegal fleet, have expanded effort and catches to the west and north of Ireland – in part taking up some of the slack left by the forced movement of the Irish super-crabber fleet northwards.

Other fisheries

- There are five other fisheries of note:
    - The last five years have seen the emergence of a significant though small volume fishery off the coast of County Down, Northern Ireland. Fishing activity takes place within the Irish Sea and tends to be confined to areas within 12 miles of shore. This

fleet operates from the ports of Portavogie, Ardglass and Kilkeel, with landings currently amounting to some 600t.

- The Isle of Man largely manages its own affairs, exploiting resources out to about 12 miles. The local fleet harvests about 400t per year.
- As with the west of Scotland the Welsh coastal waters have supported a significant small-scale inshore crab and lobster fishery. Key areas have been Anglesey, the Llyn Peninsula, and Pembrokeshire. These fisheries are exploited by locally owned and based boats, and activities are generally confined to within 6 miles of shore. Recent years have seen significant growth in the Pembrokeshire fishery, now responsible for perhaps 250t out of a total of 400t for the whole of Wales.
- For the rest of Ireland – from the Connemara / Mayo border in the far west round to Wexford harbour in the southeast corner, the crab fishery is small in scale, prosecuted by small mainly traditional inshore vessels. Landings are in the order of 1,500t per year.
- There has always been a fishery to the north of Cornwall and Devon, but the scale of this has grown considerably across the last decade – currently landing in the order of 500t of crab per year. This may reflect the increased importance of Newlyn as a centre for brown crab landings, and perhaps also the fact that landings from the English Channel have fallen off by a couple of thousand tonnes.
- The Channel Islands have long formed the centre of a very productive brown crab fishery. Together, Guernsey and Jersey currently produce about 1,400t from their coastal waters, but Guernsey landings have fallen from 1800t to 900t over the last decade, whilst those of Jersey have remained relatively stable at between 450 and 550t per year.

Norwegian fisheries

- As shown in Fig 5, over the last decade landings from "northern waters" has risen from 1,500t to 7,500t. Most of this is the result of increased activity in southern Norway. Anecdotal evidence suggests that there are substantial under-exploited brown crab resources along the Norwegian coast, and that the Norwegian fleet has recently started to build-up this fishery. It is not known what scale of resource may exist, or the intent of the Norwegians to expand this fishery. It is noted, however, that the potential to further increase landings from this fishery presents a significant threat to the dominant position of the UK and Irish industry in supplying the European brown crab market.

3. Crab stock

3.1 Crab biology

Brown crab (*Cancer pagurus*), also referred to as edible crab, is abundant throughout the northeast Atlantic as far as Norway in the north and northern Africa in the south. Brown crab is found to inhabit sea areas where substrate comprises mixed coarse grounds, mud and sand, with depths ranging from shallow sublittoral areas to depths of approximately 100m in offshore waters. It is frequently found inhabiting cracks and holes in rocks but is occasionally also found in open areas[2].

Females reach maturity at carapace widths of ~127 mm and males at ~110 mm. Breeding takes place in winter. For a period before mating, the male holds onto a female until she moults, at which time she is receptive to mating and copulation takes place. The female digs a pit in the sediment which she retreats into to lays the eggs.

The females then carry their eggs under their abdomen – a condition commonly referred to as being 'berried'. Large female can carry up to 3 million eggs at any one time. Berried females rarely feed or move, instead they lay in pits dug in the sediment or under rocks – as such they may be less likely to be caught in a baited pot[3]. Around late spring / early summer (6 - 9 months after copulation) the larvae are released into the water column. The larvae (zoeae) remain in the plankton for 2 months and then settle to the seabed as juveniles in the intertidal zone in late summer / early autumn. They remain in the intertidal zone until they reach a carapace width of 60 - 70mm (which takes about 3 years) then they migrate to subtidal areas.

Growth rate varies with age, gender and water depth from 1 - 10mm increase in carapace width per year. Generally growth rate decreases with age, is higher in deeper waters and males grow faster than females. Brown crabs are known to live up to 20 years of age.

Because crabs, like all arthropods (includes all insects and crustacea), have an external rather than internal skeleton, to grow they need to periodically replace their exoskeleton. This process of moulting is known as ecdysis. In the run-up to shedding the old shell, crabs invest much energy in removing as much material as possible of the old shell (recycling) whilst also building up the resources to build the new shell. When the hard shell is shed, it is replaced by a new shell that has been formed underneath it. To achieve the required growth the animal pumps itself up with water to expand the soft shell, and then rests up whilst the new shell hardens. During the time – which extends for several days during which the animal hides and stops feeding - the crab is particularly vulnerable to predation. But even when the crab returns to feeding – and can be caught in traps - parts of the crab can remain "soft" for considerably longer. Across this whole period of moulting – from the pre-moult reabsorption of the hard shell to the post-moult hardening of the new shell – the amount and quality of the brown and white meat in the animal is below commercial requirements. Such "soft-shell", "white-legged" or "lantern shell" tends to be rejected by the trade, and identifying crab in these conditions forms an important part of on-board sorting and on reception by the trader / processor.

It is of some note that generally between 60 and 80 per cent of all crabs removed from pots are returned to the sea (lower proportions in, for example the North Sea and Channel fisheries) – because they fall under the legal minimum landing size (MLS) requirements, or fall under the commercial minimum size (typically higher than the MLS), or are of insufficient quality to meet market requirements (softshell, crippled, diseased).

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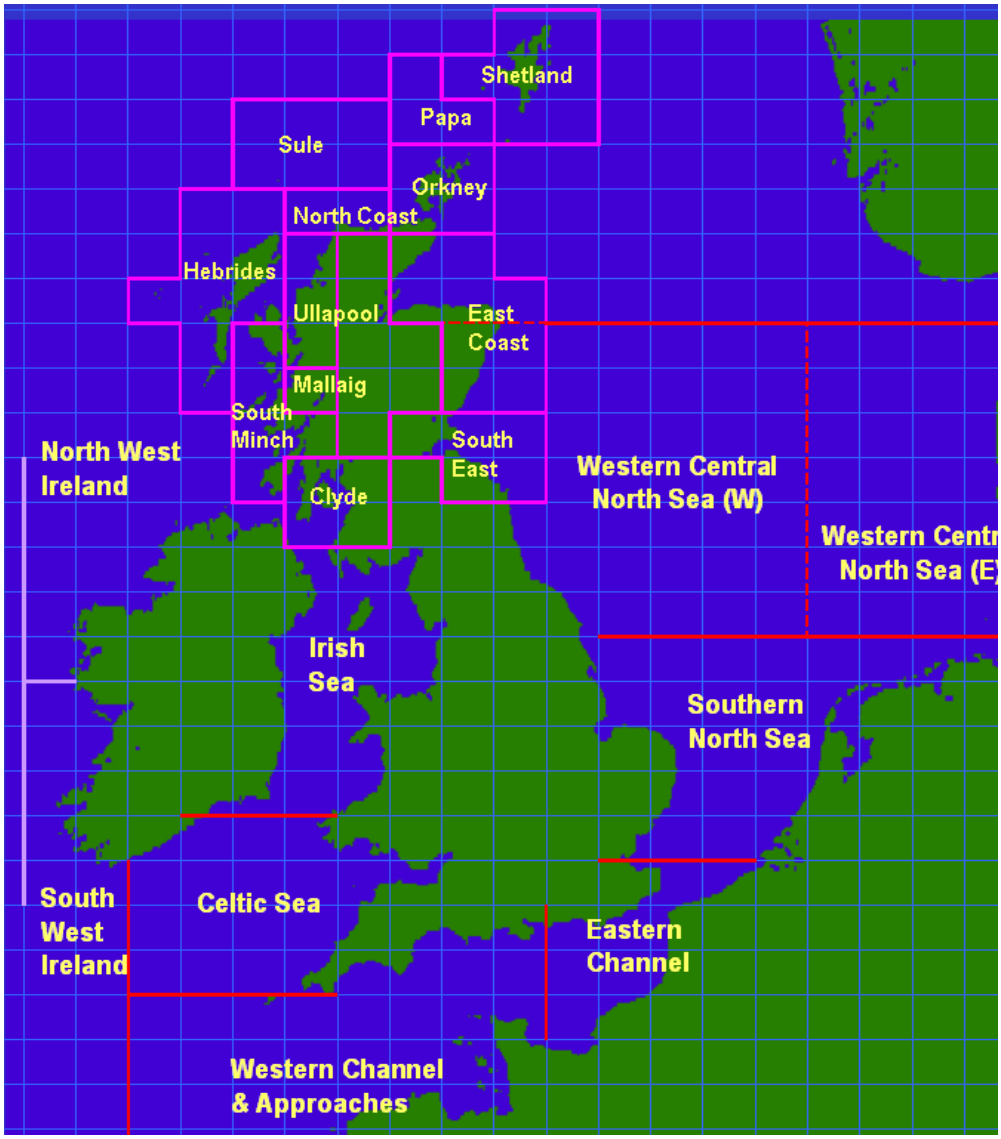
[2] Wilson, E. (1999) Cancer pagurus. Edible crab. Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme [on-line]. Plymouth: Marine Biological Association of the United Kingdom: http://www.marlin.ac.uk/species/Cancerpagurus.htm

[3] Brown, C.G., and Bennett, D.B. 1980. Population and catch structure of the edible crab (*Cancer pagurus*) in the English Channel. *Journal du Conseil*. 39, 88-100.

3.2 Stock status

One of the key difficulties in assessing stock condition in brown crabs is that there is no easy way of aging crab. There are also a wide range of environmental and behavioural conditions that impact on growth rate – and growth rates are considered to vary widely across the geographic distribution of brown crab. As a result it is near impossible to estimate stock biomass using conventional stock modelling techniques typically used in managing fin fish stocks, and alternate methods need to be employed. Management measures are informed by such parameters as the size distribution of the population, gender balance, size at maturity, catch per unit effort, larval survey and recruitment. A reference point system (see Table 1), has been proposed around a combination of an estimate of that fishing mortality commensurate with achievement of maximum sustainable yeild, and the proportion of crabs in any one year that are harvested (yield per recruit). But there are still many uncertainties

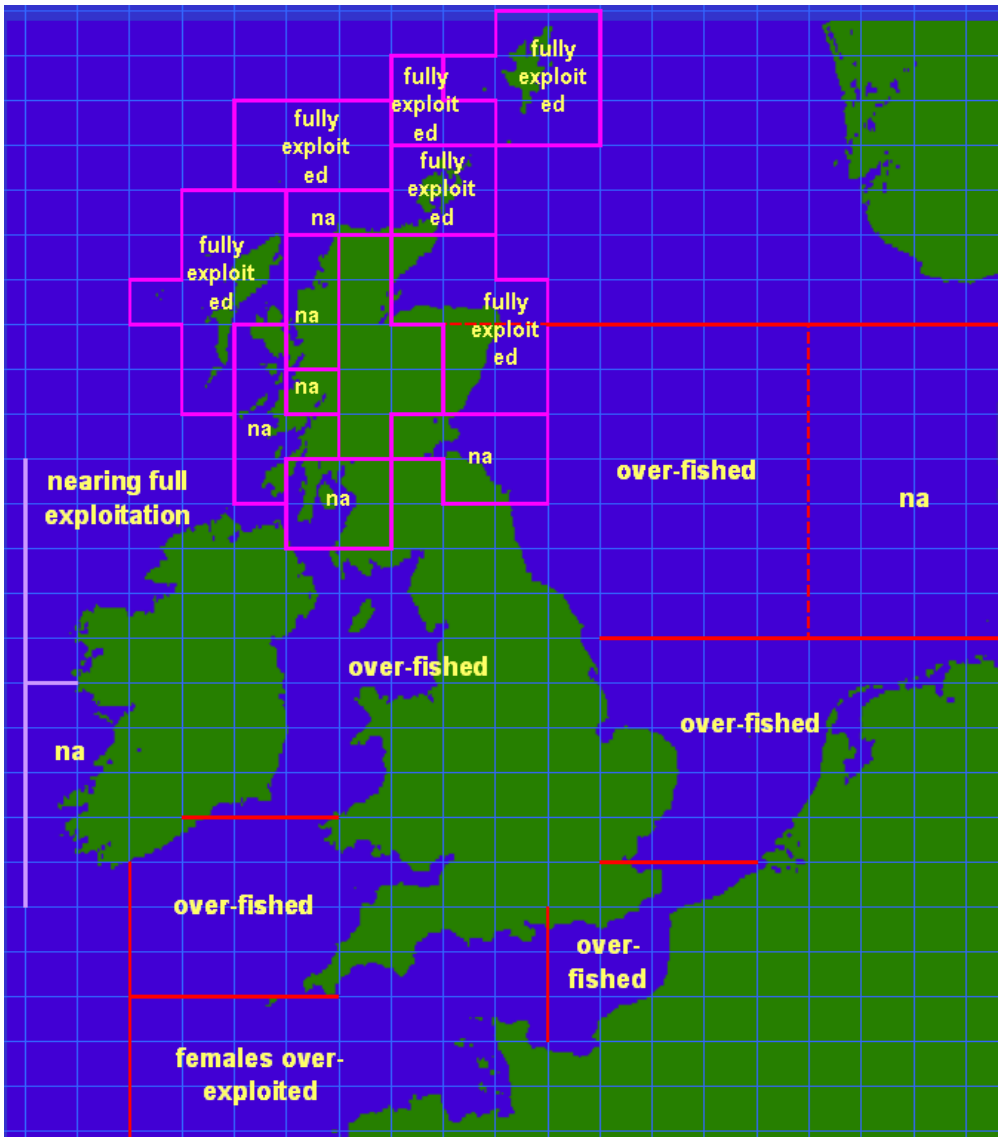
Fig 6 – Current brown crab stock monitoring areas



Source: Cefas and Marine Scotland: Science

concerning the parameters being measured and the relationships between parameters, making modeling of these populations particularly difficult and uncertain.

Fig 7 - Indicative status of brown crab stocks



Source: derived from Bannister R C A (2009) On the Management of Brown Crab Fisheries; SAGB

Whilst there is some variation in the detail of the approaches taken by Cefas, Marine Scotland: Science and the Marine Institute Ireland, in both data collection and basis of analysis, it is possible to broadly assess stock state against these management targets. Fig 6 shows the delimitations of fishing areas that are subject to monitoring at present. Fig 7 indicates how the stock in each area stands relative to the target reference points. All in all, most areas are fished beyond levels commensurate with maximum sustainable yield.

To bring these fisheries within what might be termed sustainable and precautionary management – an aspiration that is widely recognised as good practice in fisheries management – catches need to be substantially reduced in the short-term (to allow stock re-building), and matched by some long-term capping of effort, and establishment of some form of harvest control rule linking effort to stock status.

Table 1 – Summary of stock assessment / management parameters

Stock assessments and reference points

- *Average of the frequency of sizes in the landings over recent years*
- *Split into age classes (using growth from tagging)*
- *Estimate current harvest rate (F) from decline of numbers with "age"*

Yield curves

- *Compare yield at current harvest rate (F) with yield at lower and higher rates*
  Identify F at maximum on the curve = F_{max}

Egg Production

- *Potential egg production for a range of fishing rates*
- *Convert to % age of unfished (virgin) egg production*
- *Set reference points / indicators*
  possible precautionary (or target) indicators e.g. 25% of virgin egg production
  possible limit indicator e.g. 10% of virgin egg production
- *Proposed reference points are based on:*
  Proxies for F_{msy} (fishing commensurate with acheiveing maximum stustainable yield)
  such as F_{max} derived from yield—per recruit curves
  Egg production per recruit curves

Source: Bannister R C A (2009) On the Management of Brown Crab Fisheries - SAGB

3.3 Location of increased pressure

To provide further evidence of how catches and effort have increased over time, Fig 8 provides a comparison between the distribution of catches per ICES rectangle in 2004 and in 2008, five years later. This information should be viewed as indicative only, given that there may be differences in the data collection systems used to compile each data-set, and some differences in the quality of data so collected. This said, Fig 8 shows changes that compare well with anecdotal information.

Overall, recorded catches and landings for the two years were 23,378t and 30,222t respectively. But as can be seen from the colour coding (the more intense the red, the greater the tonnage increase, and the more intense the blue, the greater the tonnage decrease), increased catches have been recorded in many more areas than decreases. And in some areas there have been very substantial increases. These more extreme increases (and some decreases) are highlighted in Fig 9.

Taken together, Figs 8 & 9 show four main areas of change:

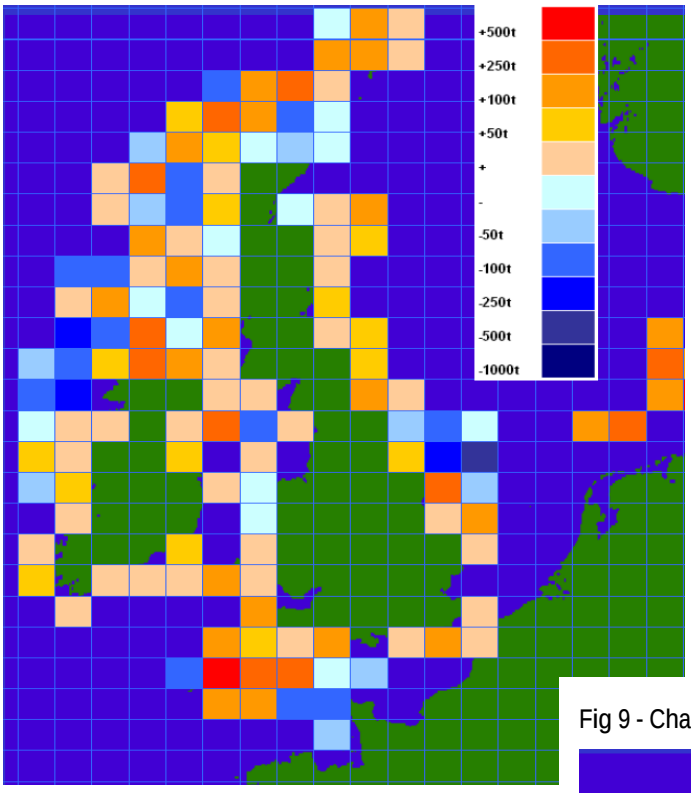
- major increases in activity and catches in the far South West of England (Cornwall) – increase in the order of 2,500t;
- substantial increases in activity and catches over a very larger area to the west and north of Scotland – particularly out towards the edge of the continental shelf – increase in the order of 2,500t;
- development of a new fishery in the German Bight – increase in the order of 2,500t;
- increases in activity north of the Donegal and Antrim coasts – increase in the order of 1,000t.

More localised increases (between 100 and 300t per area) are identified around Milford Haven, Eastbourne, north Norfolk, The Wash, the Durham coastline, Fraserburgh, and the southern Minches.

Two areas of significant reduction are identified as:

- west of Bridlington and the Humber – a reduction of 1,700t;
- north and west of counties Mayo and Donegal – a reduction of something over 1,000t.

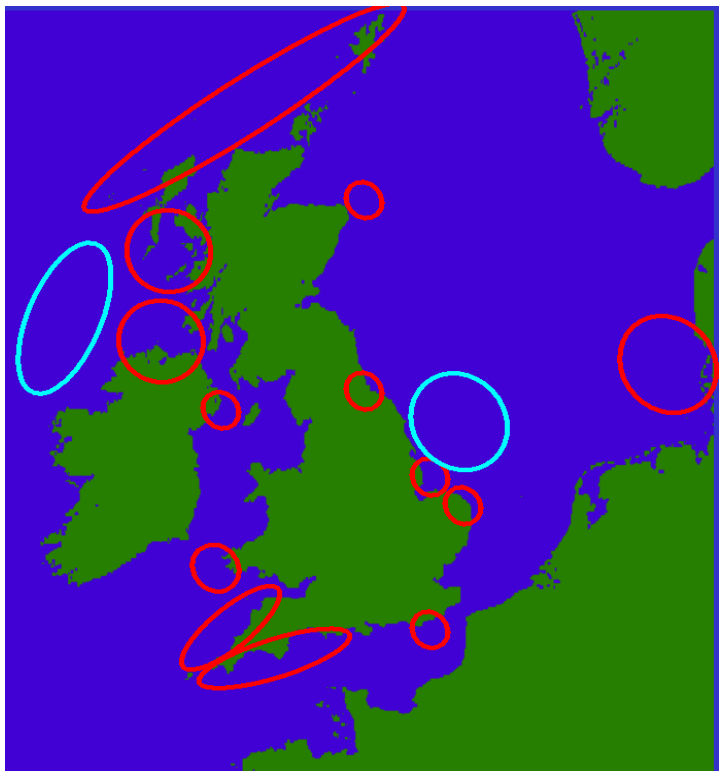
Fig 8 - Change in catches per ICES rectangle between 2004 and 2008



Source: MFA, Marine Scotland and Marine Institute Ireland statistics

Notes: to improve clarity, rectangles showing a change of less than +/-10t not included

Fig 9 - Change in catches per ICES rectangle between 2004 and 2008



Source: MFA, Marine Scotland and Marine Institute Ireland statistics

Notes: areas circled in red have shown substantial increases in catch to improve clarity, rectangles showing a change of less than +/-10t not included

4. The balance between inshore and offshore regimes

4.1 Relevance of inshore and offshore regimes

Across the EU, Territorial Waters are recognised and designated as extending 12 nautical miles from coastal baselines. Within this zonal structure vessels that are not registered with the home country are precluded from fishing within the 12 miles unless there are prior historical rights. Where such rights exist, they are generally exercised in the 6 to 12 miles zone. Such vessels are typically precluded from operation within the 6 mile zone.

Larger vessels from the home country are typically allowed to fish up to the 6 mile zone, unless there are prior historical rights – in which case such vessels may be permitted to fish up to the 3 mile zone. The exercise of this sort of "permitting" is usually a matter of local law – through secondary legislation or local byelaw.

In England and Wales, waters within the 6 mile limit have been, for over 100 years, subject to management by local Sea Fisheries Committees. In Scotland, Northern Ireland and the Republic of Ireland no similar structures exist (though some are in the process of being established), and control of the 6 mile zone is a matter for central government.

This broad situation is shown graphically in Fig 10. Structures to manage inshore fisheries in Scotland, Northern Ireland and the Republic of Ireland are in the early stages of establishment. The Sea Fisheries Committee structure applied within England and Wales is in the process of being restructured and modified.

In this context it is therefore relevant to identify what portion of the crab fleet operates within and without the 6 mile limit, to establish if these fleet components can be readily identified – and thus potentially subject to separate management – and is one or other of these spatial regimes is more amenable to certain types of management / control.

In the foregoing chapters it has been useful to examine the disposition of crab catches by ICES rectangle. But in helping to interpret the dynamics within the brown crab sector this statistical system has two drawbacks:

- the recording system cannot discriminate between catches made inside and outside the 6 mile limit, and
- for the same reasons it is not so helpful in identifying what fleet components are responsible for catches from inside and outside the 6 mile limit.

It should also be noted that whilst all the "nomadic vivier vessels" are big vessels, and that other bigger vessels tend to catch more crab than smaller vessels, it is not the case that all big and small vessel behave in this way, or that only small vessels fish within the 6 mile limits, or that only large vessels fish outside 6 miles. Yet it remains possible, if not also probable, that there will be some discrimination in the type or degree of application of management tools either side of the 6 mile limit.

In the following section we shed some light on the scale and nature of activity inside and outside of the 6 mile limit.

4.2 Fishing inside and outside the 6 mile boundary

The crab landing statistics for the UK and the Republic of Ireland distinguish between vessels over and under 15m in length. Fig 11 & 12 show the respective landings arising from these two fleet segments.

Fig 10 - UK and Republic of Ireland regional fisheries management

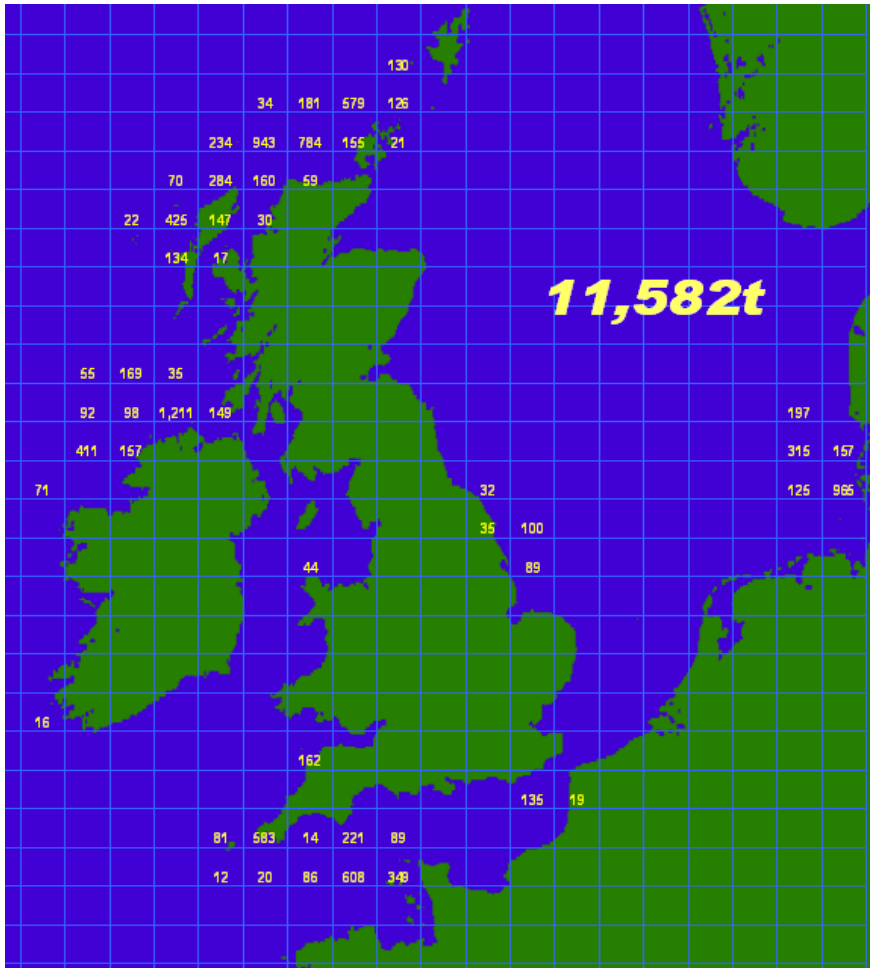
Note: the inshore zones indicated for the Republic of Ireland are proposed only, and refer only to lobster fishing

Fig 11 – Distribution of 2008 catches by the <15m fleet

Source: MFA, Marine Scotland & the Marine Institute, Ireland

Notes: excludes IoM and CI

Fig 12 – Distribution of 2008 catches by the >15m fleet



Source: MFA, Marine Scotland & the Marine Institute, Ireland

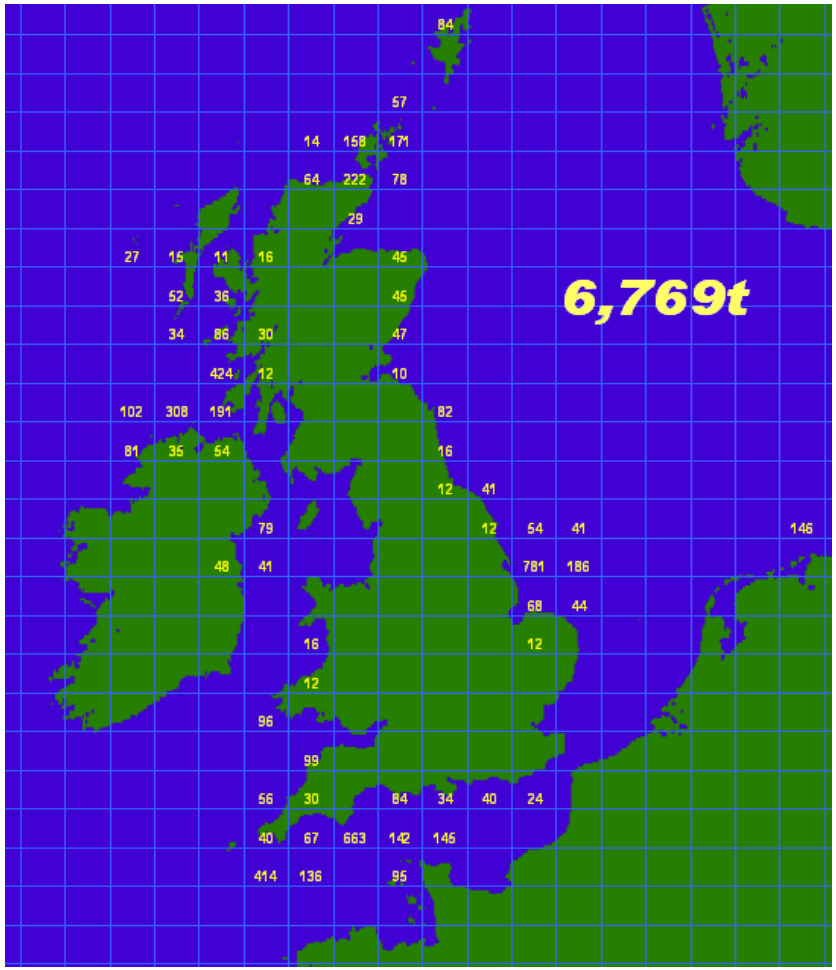
Notes: excludes IoM and CI

Fig 13 – Distribution of 2008 catches by UK <10m fleet

Source: MFA & Marine Scotland

Notes: excludes ROI, IoM and CI

Fig 14 – Distribution of 2008 catches by UK 10-15m fleet



Source: MFA & Marine Scotland

Notes: excludes ROI, IoM and CI

These figures show quite clearly the role of the larger vessels in exploiting resources to the north and west of Scotland, to the north of counties Donegal and Antrim, in the English Channel, and in the German Bight.

For the UK only, the available statistics split catches by fleet segment still further, separating out <10m, 10-15m and >15m fleet segments. Figs 13 & 14 show the distribution of catches for the <10m and 10-15m UK fleet segments. These suggest that with the possible exception of fisheries to the south of Cornwall most catches by the under 10m fleet come from areas close to shore. This may also be the case for many of the 10-15m fleet – though elements of this fleet component clearly participate in the mid-Channel fisheries, the German Bight fishery, the Bridlington offshore fishery, and the fisheries to the north of Ireland, and to the west of Scotland.

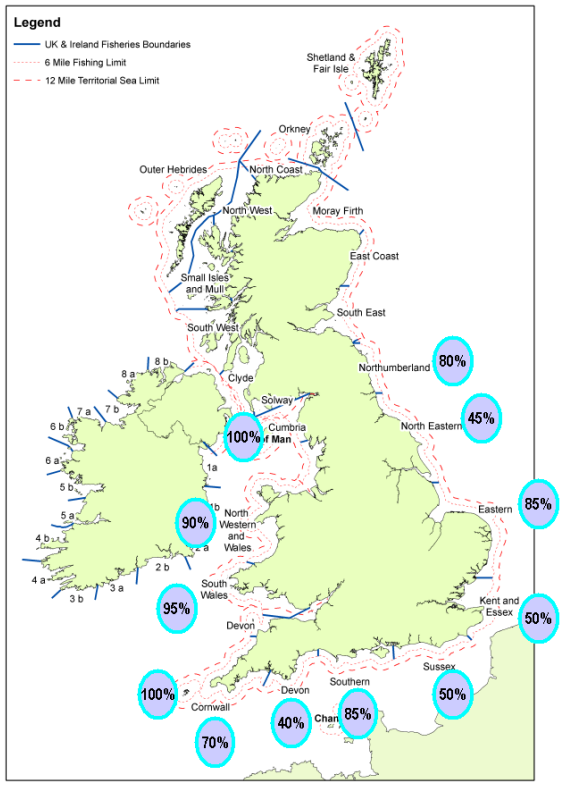
Fig 15 – Plot of fishing effort by the English over-15m crab fleet, derived from 2006 VMS data

Source: CEFAS (2008) Draft Informal Paper: 'Distribution of crab and lobster pot fisheries in England and Wales',

As further corroboration of the spatial distribution of effort, Fig 15 shows a consolidated plot of the fishing effort of the English over 15m crab fleet for the year 2006.

In addition to the above, Cefas also canvassed the Sea Fisheries Committees (SFCs) to get an estimate of the proportion of brown crab landed to each SFC area that was caught within the SFC district (within the 6 nm limit). This is displayed graphically in Fig 16.

Fig 16 – Proportion of crab landed to an SFC district estimated to have been caught within that district



Source: adapted from Cefas survey data

This shows that for Cumbria, North Western and Wales, South Wales, north Devon, the Scilly Isles, Cornwall, Southern, Eastern (including the Cromer fishery) and Northumberland SFCs most crab is caught within the 6nm zone.

For south Devon SFC and to some extent Cornwall and Southern SFCs, a significant proportion of landings comes from the mid-Channel fishery. For the North Eastern SFC, the local fishery extends far out into the North Sea, and it is this that explains the low reliance on product from within the 6nm zone. The low local content of crab landings to Kent & Essex and Sussex SFCs is more difficult to explain – crab originates from just outside the 6nm zone, as well as some from the mid-Channel fishery.

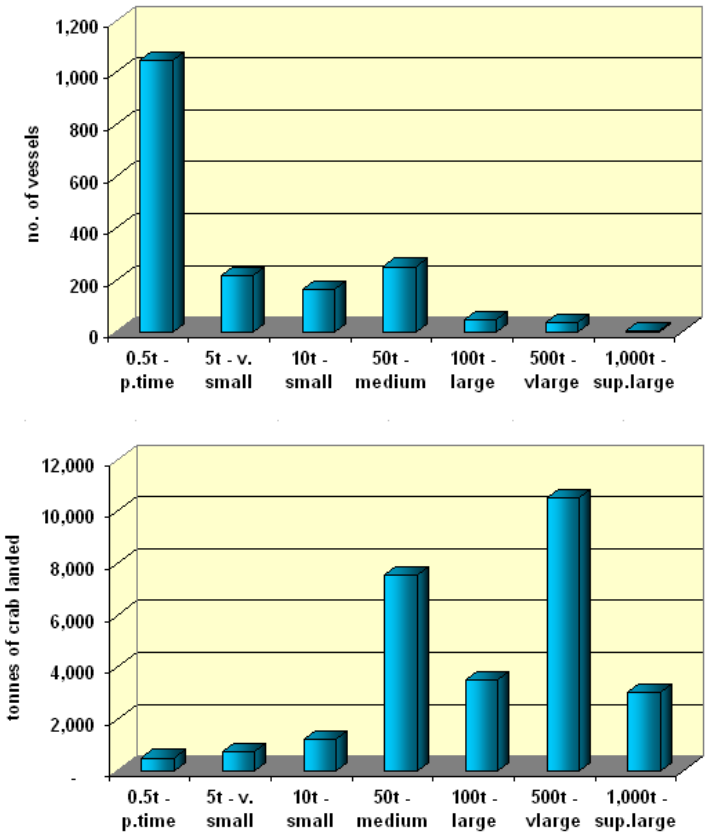
The key information to note from this data-set is that there are substantial parts of the crab fishery in England and Wales that can be managed almost exclusively on the basis of SFC. Similar states of affairs – management within some form of inshore regime – are likely to also apply to the southern half of Ireland, northern Ireland, and the east coast of Scotland.

For the rest, the mid-Channel fishery could feasibly be managed as a single fishery, and the fishery extending east of Bridlington could be managed as a single fishery. The more problematic fisheries to manage are those to the north of Ireland, and to the west and north of Scotland. In these fisheries, the larger and most evidently offshore component is prosecuted by vessels of 15m and over – offering the possibility of being able to distinguish between offshore and inshore activity. For example, the management of inshore fisheries on the basis of Scottish IFGs could be expected to handle 3,093t from the local under 10m fleet, and probably much of the 2,188t from the local 10-15m fleet. This leaves some 4,337t caught by the larger over 15m fleet, comprising a mix of local boats, boats based in the area but originating from the South West of England, and boats from the Republic of Ireland.

4.2 Fleet activity and latent effort

To better inform the debate on management of UK brown crab and lobster fisheries, Defra ran a search on all those vessels in possession of a shellfish entitlement to identify the extent of participation in both of these fisheries. Part of this data-set is displayed graphically in Fig 17.

Fig 17 – Analysis of participation in the UK crab fishery - 2008



Source: derived from Defra analysis undertaken for the NFFO

The upper part of this graphic shows the number of vessels landing crab by scale of landing – up to half a tonne a year, up to 5t per year, up to 10t per year, etc.. This indicates that out of an active fleet of some 3,000 vessels, 60 per cent land less than 500kgs of crab per year, and a further 27 per cent of the fleet lands less than 10t of crab per year. Of note, these same fleet components are responsible for landing 14 per cent and 37 per cent of all lobster respectively.

The lower part of the graphic shows a gross estimate[4] of the volume of crab landed by each vessel category (segmented according to volume of crab landed per vessel per year). This shows that 80 per cent of crab landings are made by boats landing more than 10t per vessel per year. 252 boats, landing between 10 and 50t per vessel, are responsible for landing 28 per cent of all crab landings, but 86 vessels, landing more than 50t per vessel per year, are responsible for landing 63 per cent of all crab landings.

This suggests that some 338 vessels are responsible for landing 90 per cent of all crab, that 1,424 vessels land 10 per cent of all crab, and that 929 vessels fish for something else (whelks, nephrops). Further, there are 640 vessels that are in possession of a shellfish entitlement but were inactive in 2008.

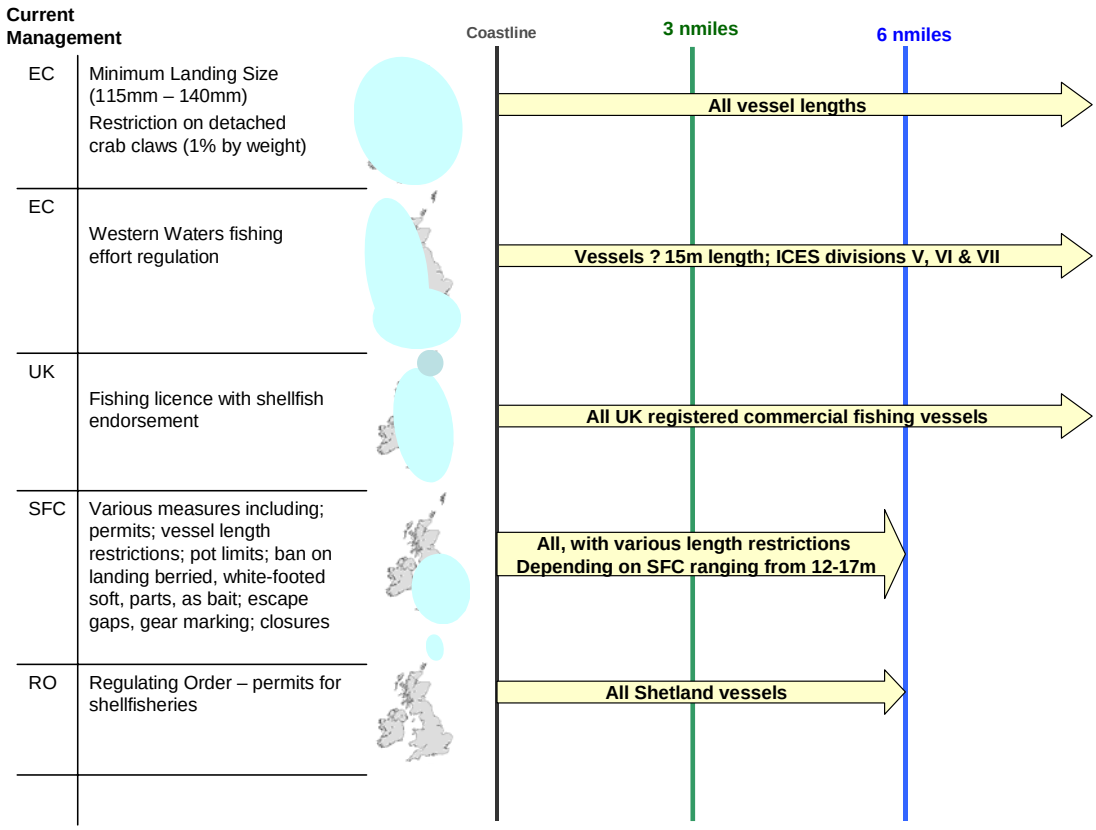
[4] Volume calculations are indicative only - the total volume of crab landed has been calculated by simply taking the mid-point of each category and multiplying by the number of boats

This would suggest that focusing management on the more active component of the fleet – the 338 vessels landing 90 per cent of all crab – would have a significant impact on the total volume of landings, and on stock management and conservation. But by the same token there are another 2,000 vessels that hold valid entitlement to fish crab, the owners of which do not currently elect to do so, or do so at a relatively minor level. If circumstances were to change, any of these vessels could step up their crab operations, and they could rapidly escalate landings in a way that would cancel out the value of any controls applied to the currently more active components of the fleet. The extent of this latent effort is considerable. And even if most of these vessels were under-10m in length, and thus could not be replaced by or aggregated to vessels larger 10m, there are under-10m vessels quite capable of landing 50t or more of crab per year.

5. Management practices

Brown crab resources are heavily exploited commercially throughout their range. Management is delivered at European and national levels. Examples of current management systems in place for brown crab are illustrated in Fig 18, and described in the following sections.

Fig 18 – An example of the hierarchy of management of crab fisheries in the British Isles



At the European level, responsibility for marine environmental management is shared between the EU and the relevant member state. In territorial waters (0-12 nm) member states are entitled to develop their own management regime for inshore fisheries. In the UK, there is an additional layer of management associated with further systems of regional inshore fisheries management (typically 0-6 nm).

European regulations apply throughout Member State waters; where there is any conflict between European and national or regional management requirements, the stricter regime generally applies.

The Common Fisheries Policy (CFP) is the European Union's instrument for the management of fisheries and aquaculture and it outlines principles for the conduct of fishing in Member State waters out to 200 nm. The CFP aims to ensure the sustainable exploitation of fisheries, and uses a variety of measures to achieve this. For example, to ensure that fishing pressure is not higher than stocks can sustain, the conservation measures under the CFP set up rules for total allowable catches, limitation of fishing effort, technical measures, and impose obligations to record and report landings. The CFP also includes several measures to limit the environmental impact of fishing. Among them are the protection of non-target species and the protection of sensitive habitats.

In response to continually declining fish stocks and the fact that many EU fishing fleets are making either very low profit or a loss, the European Commission launched mid-term review of the CFP in 2008. The review will be based on an analysis of the achievements and shortcomings of the current policy, and will look at experiences from other fisheries management systems to identify potential avenues for future action. In April 2009 the Commission adopted a Green Paper on a reform of the CFP, used to encourage public debate on policy reform. After consultation and public debate the Commission will develop a proposal to be presented to the Council and the European Parliament with a view to adoption for a reform to be in effect from 2013 (30 years after the original introduction of the CFP in 1983).

Changes to the CFP may relate to the current system of managing fish stocks under fixed shares between EU countries ("relative stability"), subsidies to the fisheries sector, agreements with countries outside the EU, and the responsibility of the fisheries sector for managing stocks.

Brown crab is a non-quota species. Management is therefore via the implementation of technical measures, primarily Minimum Landing Size (MLS) (see Section: Technical Conservation Measures), under European Council Regulations. There is also a restriction placed on the landing of detached crab claws, with an allowance of 1% by weight (which is mainly used by vessels that catch crab as a bycatch – for example otter and beam trawlers).

Further effort restrictions are in place for Western Waters under Council Regulation No 1415/2004, which fixes a maximum annual fishing effort for certain fishing areas and fisheries. The area extends from the Canary Islands and the Azores to the north and north-west of Ireland and the UK, and is known as the Western Waters. Limits relate to the annual average effort exerted by vessels 15 m and over, with a reference period from 1998-2002 (some of the Irish vivier vessels have been caught out in this regulation, and have had to take to fishing crab for part of the year to the east of the 4°W line). A biologically sensitive area to the south-west of Ireland has also been established where a specific effort regime applies for vessels 10m and over. The fisheries concerned include demersal fisheries (including fisheries for Norway lobster and shrimp) as well as fisheries for scallop, edible crab and spider crab. The fishing effort will be allocated on the basis of kilowatt/days which Member States concerned will share among their fleets.

UK pot fisheries for crabs and other shellfish species are controlled through a shellfish licensing scheme, making it illegal to land shellfish without a shellfish entitlement (described further in the following chapter).

Management of the inshore fisheries around the UK and ROI is delivered regionally through Sea Fisheries Committees in England and Wales, and directly by the fishery administrations in Ireland, Northern Ireland and Scotland (though the on-going establishment of Inshore Fishery Groups in Scotland is expected to assume at least some responsibility for management in Scottish waters) (Fig 10).

5.1 England and Wales

SFCs

There are currently 12 Sea Fisheries Committees (SFCs) in England and Wales (Fig 10). SFCs are local authority committees wholly funded by levy on their constituent local Councils (except for some EC grants for fisheries enforcement). Half the members on each SFC are appointed by its constituent Councils with the remainder being drawn from the Environment Agency and relevant stakeholder groups such as fishing industry representatives. SFCs usually meet in full 4 times a year and there may be a number of SFC subcommittee meetings for members to attend. There is also an annual meeting of all SFCs with the Fisheries Minister.

SFCs regulate sea fisheries in their districts out to 6 nautical miles, enforcing National and EU fisheries legislation, and addressing localised management issues by means of byelaws. Byelaws can regulate fishing methods and fishing gear, restrict fishing seasons, set minimum sizes for fish and shellfish, manage and protect shellfish beds or control fishing for environmental purposes. SFC byelaws cannot be less restrictive, but may be more restrictive than national or EC fisheries legislation (further information and examples of byelaws are provided in Appendix 3 - Case Studies).

Marine and Coastal Access Bill

The Marine and Coastal Access Bill, which will come into force in 2010, aims to ensure clean, healthy, safe, productive and biologically diverse oceans and seas, by putting in place better systems for delivering sustainable development of the marine and coastal environment.

The Bill comprises eleven parts, and several of these relate to changes in the management of inshore fisheries in England and Wales, and to changes in the legislation relating to commercial fishing and the management of shellfisheries. Fisheries are perceived to be one of the main industries, along with ports and harbours, aggregates dredgers and renewable energy developers, which will benefit from the measures proposed in the Bill.

A number of the fisheries management responsibilities currently handled by Defra will be transferred to the newly established Marine Management Organisation (MMO).

The Bill will modernise inshore fisheries arrangements in England and Wales in the following ways:

- SFCs will be replaced with Inshore Fisheries and Conservation Authorities (IFCAs)
- additional duties will be placed on the new IFCAs;
- IFCAs will have the power to apply increased penalties for fisheries offences;
- the structure of existing shellfish legislation will be simplified; and
- the Bill provides powers for Welsh Ministers to enable them to undertake the management of fisheries in Wales in the same way that IFCAs will undertake that management in England.

10 regional IFCAs will be established around the English coastline; the boundaries of which are to be determined early in 2010. Like SFCs, IFCAs will have powers to make byelaws for the management of sea fisheries within their districts, including the introduction of chargeable permits, effort limitation and areas restricted to fishing. They will, however, have a wider range of duties than SFCs, taking a greater role in ensuring that marine conservation objectives are furthered in addition to managing sea fisheries. This is part of wide sweeping reform planned for English and Welsh inshore fisheries management that may see fishing licences that differentiate between vessels targeting quota species and those primarily catching non-quota species.

In Wales, a Welsh Fisheries Zone is proposed that will give responsibility for fisheries management and enforcement functions off the Welsh coast up to the median lines between Wales, Northern Ireland, England, Isle of Man and the Republic of Ireland. This would extend the control of the Welsh Assembly Government in some places out to 25 nm offshore rather than 6 nm.

Fisheries Strategies

In 2007 Defra published "*Fisheries 2027 a long-term vision for sustainable fisheries*", along with "*Delivering Fisheries 2027 – towards an implementation plan*". The plan sets out nine vision statements to deliver sustainability, stating that in 2027:

1. economic returns are optimised

2. there are rights of access to fisheries coupled with clear responsibilities
3. stocks are plentiful and sustainably harvested
4. fishing activity contributes to coastal communities
5. the environmental impact of producing and consuming fish products is acceptable
6. a Common Fisheries Policy (CFP) is delivering sustainable fisheries
7. management is integrated and devolved to the most appropriate national, regional or local level
8. management is responsive and based on agreed criteria for assessing impacts on stocks and the environment more widely
9. fish are a readily available and valued source of protein.

In relation to brown crab, vision statement 3 states an action for Defra to consult on the management of brown crab and lobster stocks and develop proposals with other UK Fisheries Administrations.

The Welsh Assembly Government launched the "*Wales Fishery Strategy*" in 2008. The Strategy aims to 'support the development of viable and sustainable fisheries in Wales as an integral part of coherent policies for safeguarding the environment'.

To achieve the goals of the Strategy, the Welsh Assembly Government and the Commercial Fisheries, Aquaculture, Recreational Sea Angling and Inland Fisheries sectors, in partnership with fisheries management and nature conservation representatives, have developed an Implementation Plan.

The Strategy sets out fundamental priorities common to all sectors, such as '*sustainably managed fisheries based upon long term objectives and an adequate, scientifically derived knowledge base*', but also sets specific priorities for the capture fisheries sector.

Within the capture fisheries sector, crab and a number of other shellfish species are recognised as priority species. Priorities for the capture fisheries include undertaking further research to assist in assessing the sustainability of fisheries and to provide information to feed into management plans, and establishing an effective representational structure for the capture fishing industry. Under these broad priorities are more specific work tasks, and the deadline for achieving several of these is early 2010.

5.2 Scotland

Marine (Scotland) Bill

In Scotland a separate Marine Bill is expected to be implemented in 2010. The Scottish Bill and Marine and Coastal Access Bill both share fundamentally similar aims, though importantly a number of planning functions under the UK Bill will be executively devolved to the Scottish Ministers. The Scottish Ministers will retain their responsibility for marine planning out to 12nm, and the UK Bill allows for marine planning functions (relating to licensing, fisheries and nature conservation) from 12nm - 200nm in waters adjacent to Scotland to also sit under the control of the Scottish Ministers.

Fisheries Strategy

The "*Strategic Framework for Inshore Fisheries in Scotland*" (Scottish Executive, 2005) produced in close partnership with the Scottish Inshore Fisheries Advisory Group (SIFAG) sets out the key elements for the future of inshore fisheries including Inshore Fisheries Groups (IFGs) and a set of high level objectives for the management of inshore fisheries:

- Biological: to conserve, enhance and restore commercial stocks in the inshore and its supporting ecosystem;
- Economic: to optimise long-term and sustained economic return to communities dependent on inshore fisheries, and to promote quality initiatives;
- Environmental: to maintain and restore the quality of the inshore marine environment for fisheries and for wildlife;
- Social: to recognise historical fishing practices and traditional ways of life in managing inshore fisheries, to manage change, and to interact proactively with other activities in the marine environment;
- Governance: to develop and implement a transparent, accountable and flexible management structure that places fishermen at the centre of the decision-making process, and that is underpinned by adequate information, legislation and enforcement.

An initial set of three IFG pilots - the Outer Hebrides, Clyde and the South East - became operational in 2008 followed soon after by a further three - the North West, the Moray Firth and the Small Isles & Mull Groups.

IFGs focus on fisheries within the 6-mile limit of the territorial waters around Scotland. They will be responsible for developing local objectives - complementary to the high level objectives - for inshore fisheries management within their respective areas; developing management plans to deliver those objectives and promoting the measures needed to deliver those management plans. IFGs will also be able to undertake other activities to complement their core objectives depending on their particular requirements and local circumstances.

The IFGs model provides commercial fishermen with a stronger voice on decision-making processes about the management of inshore fisheries, whilst at the same time involving a range of stakeholders in inshore policy and decision-making at the localized level. The key component parts of an IFG are:

- an Executive Committee made up of representatives from the commercial fishing sector in the IFG area; and
- an Advisory Group made up of representatives from the relevant advisory statutory bodies and other key stakeholders to provide technical advice and expertise to the Executive Committee; and
- an IFG Local Coordinator.

IFGs will be non-statutory bodies. The IFG Local-Coordinator will work with the Executive Committee to develop a local management plan. This management plan will be approved by the Advisory Group and SIFAG (Scottish Inshore Fisheries Advisory Group). The local IFG management plan and associated management measures will be delivered through a time-bound implementation plan which will identify the lead parties responsible; timing; resources; funding requirements and sources. The impact of the management measures will be monitored using relevant indicators.

Shetland – Regulating Order

The Shetland Shellfish Management Organisation (SSMO) was established in 1995 to apply for a Regulated Fishery Order for shellfish fisheries in the waters around Shetland, and to use the powers granted by the Order to implement a management system for these fisheries.

Under the terms of the Shetland Islands Regulated Fishery Order the SSMO has the right to manage commercial shellfish fisheries (for 'oysters, mussels, cockles, clams, lobsters, scallops, queens, crabs, whelks and razorshells') from the low water mark to the six mile limit around Shetland.

The principle management mechanism is a licensing system. No person is permitted to fish for shellfish on a commercial basis within the six mile limit around Shetland unless they have a licence (for a specific named vessel) issued by the SSMO. Licences are valid for one year and are renewable on payment of an annual licence fee.

Licences were initially granted to all applicants that could demonstrate a track record of fishing for shellfish around Shetland. Since then, persons wishing to enter the fishery have been required to apply to the SSMO for a licence.

5.3 Isle of Man

The Isle of Man Government is responsible for managing fisheries within its territorial waters out to 12nm offshore. In 2008 an Isle of Man Sustainable Fisheries Strategy was published (Kaiser *et al.,* 2008).

There are currently a number of fishery and effort regulations in place for crab within Isle of Man waters, these include:

- a cap on the number of pots that can be fished in Isle of Man waters (currently 7500);
- ban on the landing of berried female crab;
- there is a vessel limit of 300 pots per boat inside 3 nm and 500 pots per boat in total;
- the recent introduction of a pot tagging scheme (with funds recycled into research);
- compulsory use of escape hatches to release undersized individuals (from 2008/2009); 7,500 escape panels were given to fishermen during 2008 - this is primarily for lobster fishermen, but also benefits crabs;
- hobby fishers are limited by license and limited to 5 pots per person with a bag limit of 1 lobster and 5 brown crab per day.

5.4 Northern Ireland

Within 6 nautical miles, fisheries in Northern Ireland are managed by the Department of Agriculture and Rural Development (DARD).

DARD launched a Review of Inshore Fisheries in Northern Ireland in 2005, bringing together the Northern Ireland Inshore Fisheries Stakeholder Advisory Group (SAG). The group included representatives of the fishing industry, the mariculture and angling sectors, environmental NGOs, local government, government departments, scientists and other interested parties. The role of this SAG was to advise, and make recommendations to, the DARD Minister on strategies for the future development and management of inshore fisheries.

Working groups were established to identify concerns and make recommendations for individual inshore fisheries. Further working groups also examined the overarching issues of sustainability and management structures. The recommendations of the report highlighted six vital areas:

- improved knowledge of inshore fisheries,
- adoption of an ecosystem-based approach,
- strengthened management,
- a review of legislation,

- adequate resources to develop the sector and
- enhanced communication.

The report also recommended that DARD Fisheries develop a strategy for the development of the inshore fishery which would serve as a response to the report. The Report of the Review of Inshore Fisheries was finalised in January 2007 and a strategy is awaited.

The Review recommended that a single Inshore Fisheries Development & Management Group be established covering the Northern Ireland coast. Members would include local councillors or officials, environmental NGO representatives, recreational sea angling interests, and aquaculture representatives and with representatives from the fishing industry.

The role of the Management Group is to:

- advise government on issues affecting inshore fisheries in Northern Ireland to assist DARD in developing policies and strategies for the inshore fishery;
- develop regional management plan(s) (rolling over a 3-5 year cycle) to implement the regional strategy for inshore waters in Northern Ireland, and
- set clear objectives and measurable targets for management and environmental integration.

5.5 Republic of Ireland

A Management Framework for Shellfisheries was established in 2005 to oversee the sustainable development and management of the shellfisheries sector in Ireland (BIM, 2005). The Framework is a co-operative management model between state and industry, centred around four Species Advisory Groups (SAGs). The Species Advisory Groups will develop management plans for crab (3 species), lobster (2 species), shrimp (1 species) and molluscs (minimum 8 species). At present these structures have an advisory role.

The Advisory Groups are made up of constituent Local Advisory Committees and provide recommendations to the licensing authority, the Department of Agriculture, Fisheries and Food. Local Advisory Groups have been established for the North West, South West and South East, and serve a purely advisory role at this stage. Approximately six state and six industry representatives comprise each SAG, and it is the intention that each SAG appoint working groups to advise on every aspect of the stocks that fall within their remit.

3-5 year management plans to be produced by the SAGs are to outline policy and regulations for each of the main fisheries. The plans will outline the objectives, targets, access rules, regulations and current status of each fishery. Management plans will be reviewed by the Inshore Fisheries Review Group (IFRG) before being referred to the Minister for effective implementation.

6. Management tools

Fisheries regulation for stock management can be broadly divided into:

- input control (e.g. effort limitation by licensing);
- output control (e.g. setting of quotas); and,
- technical measures (e.g. enforcement of minimum landing sizes).

Currently brown crab stocks are managed primarily through input control and technical measures and generally not through quota allocation (Seafish, 2008).

The various management tools available for application are described in the sections below. Table 2 provides examples of existing approaches to brown crab fishery management – drawing on practice in the EU, UK, and further afield.

Crab fisheries in the UK are currently managed under a hierarchy of management measures. At the highest level they are subject to EU regulations, at the next level there are a number of national regulations that apply throughout the UK, and finally there are regional management measures, enacted and enforced through bylaws of the local Sea Fisheries Committees (SFCs) in England and Wales. This hierarchy is illustrated in Fig 18.

Examples of are summarised in Table 2 below. References to management tools applied to other shellfish species are listed where it is thought that methods could be transferable to the brown crab fishery.

6.1 Input controls - licensing and entitlements

UK Restrictive Shellfish Licensing Scheme

This current national licensing scheme introduced by Defra in 2004 limits entry to the UK shellfishery, puts by-catch limits on trawlers and sets daily catch limits for vessels not entitled to a shellfish licence. The scheme seeks to maintain exploitation at current levels by limiting increases in fishing effort that could threaten stocks. While the scheme restricts entry of vessels without entitlement to the fishery, it cannot control increases in effort by vessels that are licensed but fishing below their current capacity (or fishing in other sectors). In other words, the scheme does not restrict the number of days fished or the number of pots used.

There has been discussion about the introduction of a 'sunset clause' into the UK Restrictive Shellfish Licensing Scheme. This would attach provisions to the vessel license that require it to be used either within a particular period, or regularly, and would also restrict the transfer of a licence when the owner stops fishing. This would further halt the flow of boats being recruited into the sector and help address the problem of reserve capacity (i.e. latent effort) (Isles of Scilly Sea Fisheries Committee, 2007). The industry has expressed some concern regarding a sunset clause, particularly as licences are viewed as a valuable asset used in the trading of vessels (Crab and Lobster Commercial Strategy Group, undated).

Fishery Orders

The use of Fishery Orders (under the Sea Fisheries (Shellfish) Act 1967) as a management tool to improve the status of shellfisheries has been extremely variable in both scope and application in the UK. The two basic orders (Several and Regulating) have different operating perspectives in the context of stocks being managed. The granting of a Several Order to an individual for a defined area of seabed or foreshore and named species of shellfish, effectively removes the area and stock from

Table 3 Existing approaches to brown crab management.

Example	Management Structure	Management Scope	Management Tools	Assessment and Monitoring	Enforcement
EU					
EU technical regulations	Implemented by various European legislation, including: EU Technical Regulation 850/90 and amendments, and Council Regulation (EC) 1415/2004	Fisheries occurring in maritime waters of Member States.	Sets Minimum Landing Sizes for a number of species including brown crab – MLS varies by ICES area. Restricts landings of detached crab claws (1% for pots, maximum 75kg for other gears). Restriction on kW days for vessels >15m limits maximum annual fishing effort for certain fishing areas and fisheries, including brown crab.	Official statistics on quantity, value, and fishing effort for capture shellfisheries are collected by Defra and some SFCs under permit schemes.	Enforced by MFA and SFCs
UK					
UK SFC Byelaws	Byelaws applied by 12 English and Welsh SFCs	Byelaws apply out to 6nm and vary regionally, though several management tools are commonly implemented by all SFCs.	Management tools commonly include: Regional Minimum Landing Size (may vary from European MLS); Permit schemes; Restrictions on landing berried crabs, soft crabs and parts of crabs; Bans on landing white-footed crab or	Official statistics on quantity, value, and fishing effort for capture shellfisheries are collected by Defra and some SFCs under permit schemes.	Enforcement is led by the SFCs.

Example	Management Structure	Management Scope	Management Tools	Assessment and Monitoring	Enforcement
			crab for bait; Gear marking; Limits on unlicensed take; and Temporary closures.		
Scottish Inshore Fisheries Groups	12 IFGs around Scotland are planned. 6 are currently in operation. The IFG Executive Committee is made up of representatives from FA's and non affiliated fishermen in the area. The Executive Committee develops a local management plan with the assistance of a Local Coordinator. This management plan must then be approved by an Advisory Group and SIFAG, though exact details of these processes are still to be finalised.	Applied within IFG waters where there is scientific evidence to show that certain stocks or grounds are over-exploited.	Number of objectives currently in development, including: Limits on creel numbers, set by vessel length; Return of crippled crabs; and Increase in current MLS.	IFGs are in the process of developing draft implementation plans intended to monitor management measures using pre-defined milestones set across a range of timescales.	Many measures set under voluntary agreement and code of conduct. Marine Scotland: Compliance
UK Shellfish Licensing Scheme	Implemented by Defra / Marine Fisheries Agency	UK Waters out to 12nm.	Limits vessels in the shellfishery by restricting entry to the sector. Restricts shellfish by-catch limits for trawlers.	Fishermen have an obligation to submit monthly catch returns to the MFA.	MFA, SFCs, Marine Scotland: Compliance.

Example	Management Structure	Management Scope	Management Tools	Assessment and Monitoring	Enforcement
			Restricts daily landings for vessels without a 'shellfish entitlement' to a maximum of 25 crabs / day.		
Shetland Islands Regulated Fishery (Scotland) Order 1999	Overseen by Shetland Shellfish Management Organisation, established specifically to develop and implement the Order.	All shellfish fisheries within 6nm around Shetland coastline.	Effort primarily limited through issue of permits and restrictions on vessel size.	Management decisions taken on basis of annual stock assessments undertaken by North Atlantic Fisheries College. Relatively good set of historic stock data.	Enforced by Shetland Shellfish Management Organisation and Marine Scotland: Compliance.
Inshore Potting Agreement	Voluntary management system applied from 1978 by inshore fishers in South Devon. National legislation passed in 2002 to protect the system.	Fisheries within a bounded area out to 6nm around South Devon (approx. 500km^2).	Partitioning of area, with areas closed to trawling/reserved for static gear. Seasonal closures also applied.	Limited assessment of crab stocks or knowledge of crab movements.	Policing of the IPA is now carried out by the Devon Sea Fisheries Committee.
Lundy No-Take Zone	No-Take Zone mandated by Devon SFC byelaw.	Waters to east of Lundy Island within 100m of low water mark around local feature, Knoll Pins.	Closed area – no use of pots or traps within defined area in Lundy Island Marine Nature Reserve.	Monitoring programme includes experimental potting for brown crab to compare animal abundance and size within / outwith NTZ.	Enforced by Devon SFC.
Strangford Lough Pot Fishery Management Plan (IN CONSULTATION)	Developed by the Department of Agriculture and Rural Development, in consultation with local fisheries stakeholders.	Waters within Strangford Lough, Northern Ireland, as defined in the Management Plan Consultation Paper.	Number of proposals to control fishing effort: Permits required for pot fishing; Pot limits for the fishery (150 pots for commercial permit holders; 5 for recreational permit holders); Marking of gear; Increase in minimum landing size;	Propose expanded monitoring of pot fisheries to examine spatial distribution of fishing and seasonal variations in catches. Also biological examination of catches.	To be enforced by the Department of Agriculture and Rural Development.

Example	Management Structure	Management Scope	Management Tools	Assessment and Monitoring	Enforcement
			Escape hatches fitted to pots; and Seek environmental accreditation (e.g. Marine Stewardship Council).		
UK/French Granville Bay Treaty	UK and French Governments – a joint advisory committee has been established with representatives from Jersey and France.	Waters around Jersey and France.	Number of tools, including a ban on parlour pots in a 70 square mile area of Les Minquiers Reef, and a pot-tagging scheme.		By respective governments
Isle of Man	Department of Agriculture, Fisheries and Forestry (DAFF), Isle of Man Government	Isle of Man territorial waters, out to 12nm.	• A cap on the number of pots that can be fished in Isle of Man waters (currently 7500). • Ban on the landing of berried female crab. • There is a vessel limit of 300 pots per boat inside 3 nm and 500 pots per boat in total. • The recent introduction of a pot tagging scheme (with funds recycled into research). • Compulsory use of escape hatches to release undersized individuals (from 2008/2009). 7500 escape panels will be given to fishermen during 2008. This is primarily for lobster fishermen, but also benefits crabs. • Hobby fishers are limited by license and limited to 5 pots per person with a bag limit of 1 lobster and 5 brown crab	Application for licences. Log books.	By DAFF

Example	Management Structure	Management Scope	Management Tools	Assessment and Monitoring	Enforcement
			per day.		
Overseas & other shellfish species					
Canada - Dungeness and red rock crab	Crab Sectoral Committee including representatives from Fisheries and Oceans Canada, commercial licence eligibility holders, processors, First Nations, recreational harvesters, the Province of B.C., and others with an interest in the resource	British Colombia - Pacific Region	Management of crab resources are primarily based on size limits, a sex restriction, and seasonal closures (termed three 'S' management). Other management measures include • biodegradable escapement devices on traps to limit ghost • fishing and escape holes to allow small crab to get out of traps	Log book records and regular patrols. Stock assessment.	Fisheries and Ocean Canada
Alaska - King crab and tanner crab	Alaskan Department of Fish and Game – Division of Commercial Fisheries.	Eastern Bering Sea	Development of management strategies centred around Harvest Control Rules. Using quantitative analyses of abundance, biological and fisheries data to assess population and stock synthesis via a length-based model	Development of length-based population estimation models, analyses of stock-recruit relationships, and evaluation of the utility of thresholds and harvest rates to optimise the trade-offs between high yield and low variability in yield.	Alaskan Department of Fish and Game
Australia - Giant crab	Victorian Government, Australia	Commonwealth waters adjacent to Victoria, Australia	• Minimum size limits • Closed seasons to protect spawning stock (closed for females Jun-Nov and males Sep-Nov) • Quota holdings each year when a license is renewed, a quota notice is issued with the individual quota units	The number of giant crabs caught are recorded in the daily catch record book and then reported by telephone using the integrated voice response system (IVR). Fisheries officers regularly inspect giant crab catches and fishing gear, the number and weight of giant crab	Victorian Government

Example	Management Structure	Management Scope	Management Tools	Assessment and Monitoring	Enforcement
			owned by each license holder. • A reduction in number of pots being used is currently proposed.	reported using the IVR, daily catch records, catch disposal records and compliance with pot construction and escape gaps.	
Canada - Atlantic lobster	Canadian waters separated into 41 Lobster Fishing Areas. A different plan for each area is developed to take into account the particularities of each lobster fishing area and set out management measures accordingly. Different management for inshore and offshore waters.	Canadian waters – primarily the Gulf of the St Lawrence and in the coastal and offshore waters off southwest Nova Scotia	Inshore lobster fishery is managed by effort control via gear limits and days at sea. Lobster fishing seasons are designated for each lobster fishing area and they are staggered to protect summer molts. Some areas have restrictions on fishing at night and on Sundays. The offshore fishery is open year-round and effort is limited by total allowable catch. Lobster traps have escape hatches and biodegradable panels to prevent ghost fishing if gear is lost.	Science Advisory Reports by the Canadian Science Advisory Secretariat Also currently undergoing MSC assessment	Fisheries and Oceans Canada

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the public fishery, with management measures and property rights deferred to the holder. The granting of a Regulating Order is typically to a group of individuals, or a public body, charged with managing the fishery for named species within a defined area. The holder of the Regulating Order can grant licences to operate within the Regulated fishery (Shellfish Industry Development Strategy, 2008).

The most extensive use of the Regulated Fishery Order legislation in terms of both geographic area and species covered has occurred in Scotland. The coastal waters out to 6nm around the Shetland Islands have been designated as a single Regulated Fishery Order area, with all shellfish stocks (excluding nephrops) under management. Under the Order fishermen are issued a permit by the management body, with permit numbers informed by annual stock assessments. The permitting scheme has not been welcomed by all Shetland fishermen - some of whom feel alienated from the permit issue decision-making process.

SFC Permit Schemes

Several SFCs currently operate permitting schemes. Permits are issued to vessel owners and allow fishing for shellfish in SFC waters; they are non-transferable. Permit applications are made directly to the SFC, which may put restrictions on permits in terms of maximum vessel length. Vessels that do not have permits may land only a small and predetermined number of crabs. SFCs are not currently able to charge for permits and thus the issuing of permits can place a large burden on the resources of committees.

The UK Restrictive Shellfish Licensing Scheme was expected to make SFC permit schemes redundant, but to date has not done so.

Other Proposed Schemes

The UK Shellfish Industry Development Strategy (SIDS) (a Seafish-funded, SAGB-facilitated, project) looks to sustainably develop UK shellfisheries. A SIDS report published in 2008 recommended that a permit scheme should be introduced to ensure more accurate catch and effort statistics are available at district and national levels and to provide data for stock assessment and conservation measures. The report proposes an English Shellfish Permit Scheme (ESPS) for inshore waters, which will be overseen by future IFCAs created under the Marine Bill. Permits issued under the scheme would allow the opening and closure of fisheries on a non-discriminatory emergency basis. The report concludes that in order to progress the development of the English Shellfish Permit Scheme, and allow appropriate administrative and legislative measures to be put in place, that a pilot programme be established. The existing UK Shellfish Licensing Scheme would be maintained and the ESPS would only be open to existing Shellfish Licence holders.

Vessel Size Restrictions

SFC byelaws currently limit vessel sizes in inshore waters out to 6nm, with restrictions varying regionally (limits currently range from approximately 12-17m). In 2006 Defra raised for discussion the potential to more formally introduce and increase the restriction on vessel sizes, with only vessels under 7m length being allowed to fish within 3nm of the coast (Isles of Scilly Sea Fisheries Committee, 2007). Defra recognised that vessel length actually bears little relation to catching ability, and that it may be necessary to look at a matrix of other measures to restrict vessel capacity, such as engine power.

Responses from the industry on Defra's proposal indicated that the industry was not supportive of measures to limit the access of vessels. Concern focused on the health and safety implications of 'forcing' smaller vessels beyond the 3nm limit, though the industry also felt that the measure would restrict the flexibility of fishermen to fish different grounds at different times of the year (Crab and Lobster Commercial Strategy Group, undated).

Pot limits

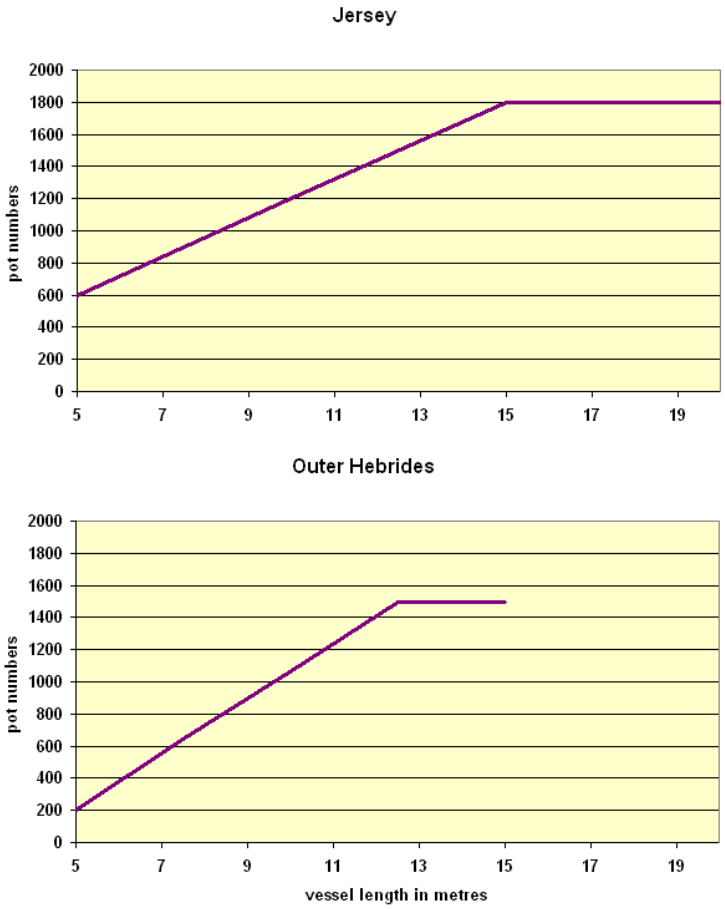
There has been periodic discussion as to the potential value of pot limits as an input control on effort. Both Jersey and the Isle of Man have had pot limit schemes in place for some years, a pot limits scheme is in place for Strangford Lough in Northern Ireland, a scheme has just been introduced by the Northumberland SFC, and there are proposals on the table as to how a pot limits scheme might be introduced to the Outer Hebrides.

The Northumberland Sea Fisheries Committee has placed an upper limit of 800 pots for any vessel issued with a permit to fish pots. Anyone setting more than five pots must mark each pot with a uniquely numbered commercial (yellow) tag, and anyone fishing with fewer pots must mark each pot with a recreational (white) tag. There is a mechanism for the issuing of new tags for lost pots, but anyone losing more than 10 per cent of their pots is required to make a written statement regarding the circumstances associated with the loss.

The Isle of Man has an upper limit of 7,500 pots as the total number that may be fished inside IoM waters. Vessels licensed to fish inside the 3nm limit are allowed a pot limit of 300, and vessels fishing outside this limit – to the 12nm limit – are allowed a pot limit of 500.

Jersey has a similar marking scheme to that being introduced by the Northumberland SFC, but pot limits are set according to the length of vessel, with an upper cap of 1500 pots per vessel. Pot numbers per vessel are varied along a straight line relationship, from 200 pots for a 5m vessel to 1500 pots for a vessel of 12.5m (see Fig 19). If a vessel loses more than 10 per cent of issued pots, the skipper must make a written submission to the Committee, but also present himself to a small committee of SFC members and his peers. The number of parlour pots deployed in Jersey waters has varied between 17,000 and 24,000 over the last seven years.

Fig 19 – Examples of the simple linear relationship between vessel length and pot numbers



Source: Jersey Fisheries Department Annual Report, and Minutes from the Meeting of the Outer Hebrides Inshore Fisheries Group (IFG)

Notes: Jersey has imposed a maximum pot limit, but no formal limit has been proposed for the Outer Hebrides as yet

The Outer Hebrides, as part of the process of preparing a Fishery Management Plan for the newly established Inshore Fishery Group, has proposed a scaled pot limits scheme similar to that used in Jersey. For the Outer Hebrides it is proposed that an 8m boat fish up to 700 pots, and a 12m vessel up to 1400.

Cefas has been monitoring pot numbers in relation to vessel length in England and Wales, as well as pots hauled per day per vessel. Relevant graphics are presented in Bannister R C A (2009) On the Management of Brown Crab Fisheries; SAGB. These data show that there is a general and clear relationship between vessel size and pots hauled per day. But the relationship between vessel length and pots per vessel is less clear. Data is also presented for vessels in the Devon SFC.

In any further analysis of how best to set pot limits, it may be useful to make a distinction between those vessels with a onboard vivier facilities – the ability to hold crab in recirculated seawater – since these vessels will necessarily need to be larger and beamier than day boats that simply need to be hold a days catch in the hold and on deck. In this regard, Gross Registered Tonnage, a measure of volume, may be a more useful measure. Another might be the UK metric of Vessel Capacity Unit – (length x breadth) x (0.45 x power) – which combines elements of both the volume and engine power of a vessel. It should also be noted that the above mentioned pot

limit schemes are applied to vessels fishing within the 6 mile limit – i.e. inshore; reservations have been stated by industry members as to the practicality of applying the same sort of limits to the offshore fleet, but the efficacy of such application has yet to be tested.

Pot marking

A pot marking scheme has been in place in Jersey in the Channel Islands for some years (see case study in Chapter 7), and is considered to be effective and straightforward to administer. This involves the annual issuing of a fixed number of uniquely numbered pot markers to each vessel owner. Replacement markers can be provided during a year, subject to explanation as to why they are required.

A similar scheme is to be introduced with the Northumberland SFC pot limit scheme.

In Northern Ireland, legislation is in place to limit the number of crab and lobster that can be landed by recreational fishermen (or those not holding a commercial license). Here, such fishermen can only fish five pots, and take home up to five crabs and one lobster per day. It is a condition of this legislation that such pots be marked with a buoy or similar floating device with the name of the boat or of the owner clearly and indelibly displayed. To retain the effectiveness of this legislation, the same marking condition is applied to commercial fishermen.

Day-at-sea

Another form of effort limitation is days-at-sea. This is now widely used in the management of demersal whitefish fleets, and has practical spill-over impact on the Irish and UK over-15m potting fleet. Thus, the Irish over 15m potters have insufficient kW-days to allow them to fish a yearly cycle in ICES Area Via, and so the fleet needs to shift to areas east of the 4°W line for at least part of the year. The UK over-15m fleet, by contrast, has sufficient kW days allocation to provide effective freedom of movement.

As a measure of effort control days-at-sea has some merit in that it effectively caps the number of pots that a vessel can haul in a given period. The impact of this would probably be increased if also linked to pot limits, but it does have its drawbacks. Most crab vessels haul pots during the day and either return to port at the end of the day, or ride out the night before starting again the following dawn. But some vessels operate with two crews and work a 24hr cycle – in part as a means of getting around the strictures of kW days limitations.

It is also the case that in the British Isles it is the practice to leave pots in the water almost continuously – both as a means of being able to fish more pots, but also as a means of holding ground against other users. In the past it has been general practice to haul a pot every day or so, but now pots can be left in the water for many days before they are hauled, inspected and re-baited. These practices have allowed for an escalation in the number of pots that can be handled by any one vessel, but also have an impact on both quality and conservation. In these circumstances some skippers favour use of pots that do not readily allow crabs (and lobsters) to escape – so allowing catches to be held in the pots for longer. It is concern about this practice that has lead some in the industry and in management to consider banning the use of parlour pots altogether.

6.2 Output controls

The only output control is the volume and composition of landings. Composition and quality considerations are addressed through Technical Measures and through market forces. What remains is the possibility of deploying some form of landings quota system. No such system is in use in the British Isles at present, but it is certainly a matter of open debate within the industry.

Quotas set against some element of historic catch record are of interest to those with significant track records. But such a system might unduly penalise those that under other circumstances might fish crab, but who have in reality targeted other species – for example lobsters, whelks, or nephrops – or the deployment of other gears – nets, trawls or dredges. And there are others that for one reason or another have not fished at all.

A quota system has some considerable attraction to the larger vessels fishing outside the 6 mile zone – primarily because it is these vessels that routinely fish for volume (they all retain good historic catch records), but also because landings quotas can be relatively easily monitored.

6.3 Technical conservation measures

The technical measures considered below cover minimum landing size, maximum landing size, ban on landing soft-shelled crab, reduction in landing crab claws, ban in landing of berried crab and crab for bait. These provide the backdrop against which fishing takes place, but any beneficial impact they bring can be all too easily cancelled by ever increasing effort – as has been seen across the last few decades. Technical measures only come to the fore when a fishery is also subject to some form of effort control - such as pot limits, quota and/or the eliminating latent effort.

Minimum Landing Size

Historically the brown crab fishery was managed around Britain through a conservation measure brought in during the 1870s making it illegal to catch crabs of too small a size. This was formalised by the introduction of minimum landing sizes (MLS) at a European level.

MLS is the smallest size at which it is legal to keep or sell fish any shellfish. In relation to brown crabs, MLS is based upon carapace width (CW). It is a management measure that is primarily intended to ensure future recruitment to fish stocks by allowing a proportion of individuals within the stock to reach sexual maturity and breed before being harvested.

The MLS is used as a management measure for a number of crustacean species throughout the world. For the Canadian Dungeness crab fishery MLS is the primary conservation measure and set at 165mm for all crab (Fisheries and Oceans Canada, 2009). Size limits are used as the primary conservation measure in the Dungeness crab fishery, followed by a sex restriction allowing only males to be landed (although females rarely grow over the MLS).

A recent study was undertaken into setting a minimum landing size for the otherwise unregulated deep-water red crab, *Chaceon affinis* (Robinson, 2008). This crab species is targeted by both potters, who land whole live crab, and netters that land crab claws and therefore requires a technical measure that does not discriminate between capture method. It was found that an MLS for carapace width would be the most appropriate measure in the first instance, followed by a claw MLS for those landed without bodies. Robinson believed that the introduction of two MLSs – for carapace width and claws – would "*act as a guide and stimulus to the development of management measures to conserve the species in the absence of another form of regulation, and until more robust, seasonally available biological data on which to base regulation become available*". In other words, MLS can be seen as a sensible first stage of management.

In the maritime waters of European Member States, MLS has been set under EU Technical Regulation 850/90 (and amendments). The MLS varies geographically to reflect regional differences in brown crab growth rate. MLS are also set regionally in the UK under SFC byelaws, and these are often 'stricter' that European standards. It is also the case that the industry itself tends to apply higher MLSs, dictated by trade considerations – but not across all fisheries, or at all times of the year. Table 3 below outlines current EU and UK MLS for brown crab.

Table 3 - European and UK MLS for brown crab. Source: Bannister (2006).

Area	EU MLS	UK MLS
North Sea south of 56 degrees N to the Essex/Kent border (except the 'Cromer' fishery)	-	130mm
The 'Cromer' fishery (coasts of Lincolnshire, Norfolk and Suffolk)	115mm	115mm

Area	EU MLS	UK MLS
Scottish west coast and North Sea north of 56 degrees N (excluding the Firth of Forth)	140mm	140mm
North of 55 degrees N on the west coast of Scotland (including Loch Ryan)	130mm	130mm
South of 56 degrees N on the west coast except ICES areas	130mm	130mm
Off Devon, Cornwall and the Isles of Scilly within ICES VII e and f	140mm	Males – 160mm Females – 140mm
The Bristol Channel and the remainder of the English Channel	140mm	140mm

In 1986, the minimum landing size (MLS) of edible crab (*Cancer pagurus* L.) was increased on the south coast of England and Wales from 115 mm carapace width (CW) to varying sizes of up to 160 mm CW depending on district (Addison, 1992). The MLS has remained at 115 mm, however, along the coasts of Lincolnshire, Norfolk and Suffolk and is known as 'Cromer crab'.

Research indicates that 75 per cent of hen crabs will mature at 115 mm CW in Norfolk, and at 110 mm CW in Yorkshire. While, in the English Channel most hens will be mature at 140 mm CW (Bannister 1999). It is believed that the Cromer crab has a slower growth rate than the same species elsewhere and anecdotal evidence suggests this is due to the benthic habitat in this area. Similar conditions may apply in relation to south east Scotland and in the Clyde.

The majority of the UK shellfishery understands the benefits associated with implementing MLS and has responded positively to suggestions of an increase in MLS by 10mm or more to ensure that females reach maturity and have a chance to spawn. However, how an increased MLS would be applied (spatially across regions and temporally) continues to be subject to debate.

In some UK regions (e.g. Devon and Dorset) where MLS is already large, increasing the limits would remove all but the largest males from the fishery and therefore would be unlikely to be welcomed by fishermen. Furthermore, UK fishermen may feel that if stricter limits are adopted, these should be applied consistently across the EU to avoid unfair advantage. This sentiment is echoed when considering enforcement, since a range of MLS is more difficult to police and may be confusing to buyers. Consultation indicates that buyers may stipulate they will only accept the larger MLS from an area that has a boundary of size restrictions.

It may therefore be sensible to increase the MLS to 140mm at all locations around UK and Ireland, to ensure a consistent approach to management and consistent size for market. The exception to this, however, would be for Cromer crab where the impact of a 25mm increase in MLS to the industry would be significant and economically unviable. Further research into the size at sexual maturity and growth rate of Cromer crab is recommended.

Ban on landing of berried crab

Female crab carrying fertilised eggs under their abdomen are known as berried[5]. The edible crab can carry up to 3 million eggs at one time. There is no commercial market for berried crabs, and it is illegal across the UK and Ireland to land berried crabs. Berried crabs are returned by fishermen to the sea, allowing them to complete their reproductive cycle by releasing their eggs. Returning berried female crab to sea is an easy process that is currently undertaken by a number of fishermen. This is a practice widely upheld by the industry.

[5] Berried females are also known as ovigerous.

Quality Control Improvements

Price per kilogram depends on the quality of the crabs. Good-quality crabs have high meat yield, i.e. the content of muscle (white meat), brown meat (mainly hepatopancreas) and roe (female gonads).

The average size for a female is 150 mm (CW) corresponding to approximately 0.5 kg live weight (Woll *et al*. 2006). For a good-quality female of this size, the meat yield should exceed 30% distributed as approximately 15% white muscle, 9% brown meat and 6% roe (Woll 2006).

Meat yield has an annual variation due to the moulting and breeding cycle. The onset of female gonad development commences in a defined period, which is specific for each species within the Decapoda (Charniaux-Cotton & Payen1988). For edible crab, this period starts in summer after the female has moulted and when internal fertilization takes place, during which time she is known as 'soft-shelled'. The female then bears her eggs and carries them with her offshore before spawning takes place in late autumn and early winter (Bennet1995). During this 7-8 month period the female is of a lower quality with a lower meat yield (Woll *et al.* 2006).

Not only does lower quality crab have a lower meat yield, but they are also reported to have reduced survivability in transit to their market destination. A *Fishing Focus* article generated reports of 30% mortality rates for animals sent to France, with some vessels regularly suffering 45% to 50% losses during transit, and between landing and processing. It was reported that the French processors were considering only sourcing animals for the cooked whole crab market which were caught in October or November to try and guarantee quality (Crab and Lobster Commercial Strategy Group minutes, April 2008).

With a ban on landing both soft shelled crab and berried females, it can be inferred that overall quality of females landed would increase. However, it is not certain that these returned creatures would go on to reproduce or even survive. A study in Alaska of soft-shelled Dungeness crab *C. magister* found increased mortality rates when they were returned to sea due to handling out of the water (Kruse *et al.*, 1994).

Further research may therefore be necessary to ascertain survivability of soft and berried females when they are returned to sea after handling on board and to a potentially new location / habitat. Opportunities exist to study survivability at locations where berried and soft crab are currently returned e.g. at Northumberland and Eastern SFC districts.

There is debate as to how quality control initiatives should be driven i.e. by processors / buyers or at sea by fishermen. Furthermore, it is not clear how control measures can be enforced. At sea, for example, experienced fishermen will immediately be able to identify low quality crab; however, less experienced crew will not, and time and effort will be required to train them.

A project titled Crustasea has developed a land-based near infra-red quality scanner for crab for use in processing facilities. The Norwegian partner of this project has also developed a smaller version for mobile use. Initial investigations of this smaller device suggest that it may not be economically viable for general industry use, but full commercial trials are yet to be undertaken.

Ban on landing for bait

In recent years a market as whelk bait has grown up for the sale of crab that does not meet full commercial quality requirements. Whilst this might have originally simply started as a means of disposing of the small quantities of poor specification crab landed to port, there is good circumstantial evidence that there is now a significant market in this product – leading to significantly reduced precision in the quality grading of crab on-board (when poor crab can be easily returned to the sea).

This practice has wide ramifications across the trade. It leads to increased costs across the supply chain as various operators need to select and remove such poor quality crab, and it leads to a reduced reputation in the market place as more poor quality crab gets through the system than might otherwise have been the case. Allowing this trade to flourish encourages lax grading on-board, but it may also be the case that some operators are simply seeking to raise the volume of catch landed, just in case catch quotas might be set against historical records.

Crab is recognised as being a particularly effective whelk bait, which makes the situation still more difficult, but many in the industry feel that this market should be closed down. The use of crab for whelk bait is currently banned in Northumberland, Eastern and North Eastern SFC districts. Elsewhere it is illegal to trade in, for example, soft-shell crab, but it is not illegal to have soft-shell crab on-board a vessel. To stop this trade it is considered that there would need to be industry wide agreement to do so on a voluntary basis (which is unlikely given that all parts of the trade are implicated in sale of whelk bait), or legislation needs to be brought in that makes it illegal to carry soft-shell crab on-board a vessel. But, and it remains a big but, whilst it may be possible to recognise poor quality crab in 90 or 95 per cent of cases, even the best graders have difficulty in sorting some crab correctly.

There have been reports that poor quality crab can regularly account for 10 per cent of landings (and rejections on quality grounds), but that there are instances when maybe a third of a vessel's landings are rejected on this basis.

Reduction in crab claw and crab part landing

EU rules on weight of crab claws that can be retained or landed are 1% for catches made by pots and creels and 75 kg for any other type of fishing. The current regulations permitting landing of claws do recognise and allow for significant capture of crabs as bycatch in the whitefish sector. Allowing the landing of crab claws addresses the practical issue that crabs damaged during fishing operations may not survive being returned to sea, and are not suitable for landing, but their claws are. On the other hand, allowing large amounts of claws to the landed encourages poor practice – the removal of claws from poor quality crabs that should otherwise be returned live to the sea.

Any change in the rules governing the landing of claws would need to be achieved at EU level by seeking amendment to the Technical Conservation Regulation 850/98 and might be opposed by other Member States. It may, however, be possible for inshore managers to apply stricture rules within their area through permit schemes.

Ban on landing crippled crab

Bans on the landing of crippled crabs have also been proposed, though many crabbers already return crippled crabs to sea. Anecdotal evidence suggests that returned crippled crab have a high rate of survival.

7. Case Studies

In order to explore the performance of alternative existing brown crab management tools, a number of case studies are presented below. The case studies are intended to show where valuable management lessons can be learnt and mistakes avoided. The case studies are s follows:

- Case Study 1 - The South Devon Inshore Potting Agreement
- Case Study 2 - The Shetland Regulating Order
- Case Study 3 - The Lundy No-Take-Zone
- Case Study 4 - SFC Byelaws
- Case Study 5 - The Granville Bay Treaty

7.1 Case Study 1 – South Devon Inshore Potting Agreement

Management Tool: Area partitioning and seasonal closures.

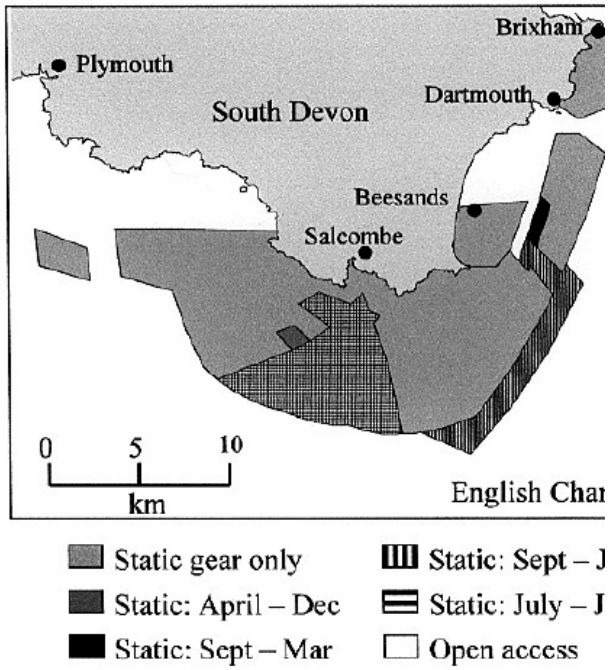
Background

Improvements in fishing gear technology and expanding areas of operation led, in the mid-1970s, to conflict in the Devon inshore fishery between fishers using fixed gear and those using towed mobile gear (Blyth *et al*, 2002).

The Fishery

The principle catch in the area is brown crab, though spider crabs and lobsters are also caught. Modern vessels that target crabs are 10-15 m long and can operate up to 1600 pots, although most use 600 – 700 (Blyth *et al*, 2002). In addition to the potters, who form the majority of the fishing fleet in the area, there are a small number of 10-15 m vessels that trawl for demersal species. Some potters trawl for demersal fish between Christmas and Easter when returns from the crab fishery are at their lowest. The area is also visited by a small number of 10-15 m scallop dredgers.

Fig 20 - IPA area and times at which areas are open to potters



Source: Hart *et al* (undated)

Management Tool Application

A voluntary Inshore Potting Agreement (IPA) was brokered between the South Devon and Channel Shellfishermen's Association and the Trawlermen's Association in 1978, which led to the partitioning of inshore waters most heavily exploited by potters into areas reserved exclusively for potting, and other areas where mobile gear could be worked either all of the time or seasonally.

The agreement covered an area bounded on the east by Brixham and on the west by Plymouth and covered water out to 6 nautical miles. When established in 1978 the IPA covered 527 km^2 of which 291 km^2 was reserved for static gear only, and boundaries have been variously revised over time. Trawlers are not confined to the IPA

area and may fish outwith it. Fig 20 shows the coverage of the IPA with boundaries based on those agreed in a 2003 revision of the area.

Enforcement

The IPA remained voluntary until 2002 when national legislation was passed to protect the IPA with formal legislation, with the consequence that transgressors can now be fined up to £50,000. Policing of the IPA is now carried out by the Devon Sea Fisheries Committee.

Outcomes

While primarily introduced to reduce conflict amongst the local fleet, the IPA has eased fishing pressure on crab stocks. Prior to the agreement potters would move gear seasonally to take account of crab movements; now each fisher retains a static area and fishing effort can not be significantly increased as there is little or no room for additional pots. New entries to the fishery are prevented and in this sense the closed areas have set a ceiling on the amount of gear that can be deployed at any one time.

Perceptions of the IPA are generally a function of the gear type used; potters generally consider the agreement a good thing that benefits them whilst fishers using towed gear see the system as being less favourable. Potters see the system as providing conservation of resources and therefore sustaining their livelihood. There is evidence to support the theory that IPA closures have protected fish and shellfish resources, with the greatest benefits accruing to more static fauna (Hart *et al*, undated).

The IPA is generally considered to be a management success and evidence indicates that it has worked because it was a 'homegrown system', which grew out of specific local needs (Hart *et al*, undated).

7.2 Case Study 2 – Shetland Regulating Order.

Management Tool: Permit system.

Background

Prior to the establishment of the Shetland Regulating Order there was no specific regulatory framework, with the exception of a general UK fishing vessel licensing scheme, for the management of the shellfish industry in Shetland. Lack of effective regulation had resulted in over exploitation, stock decline and consequent reduction in earnings. The Shetland Fisherman's Association (SFA) were prompted to look at an alternative management approach.

The Fishery

The Shetland shellfish industry is worth around £4million per year to the 150 or so inshore vessels which participate in the fishery. The principle species caught are lobster, crab (brown and velvet), scallops (king and queen) and whelks.

Management Tool Application

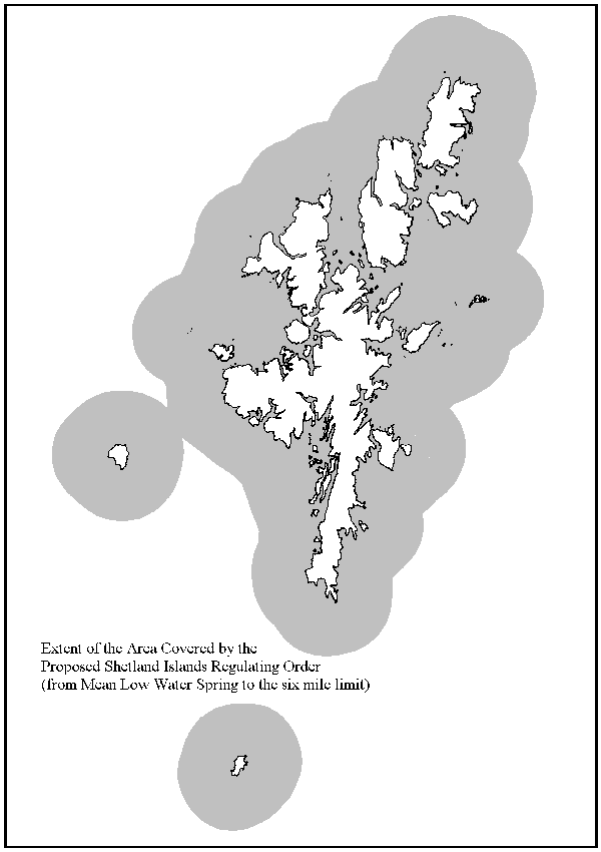
Existing legislation – the Sea Fisheries (Shellfish) Act 1967 – provides for the establishment of Regulating Orders. A Regulating Order enables a fishery to be managed by an organisation set up for the purpose of conserving the stock and improving the fishery. A management group, the Shetland Shellfish Management Organisation (SSMO) was set up in 1996 and consisted of representatives from local government, community councils, shellfish processors, environmental groups, fisheries scientists and the SFA.

The SSMO defined Regulating Order objectives. The Order would apply to all shellfish stocks within 6 nautical miles (Fig 21) and the principle purpose of the Order would be to conserve shellfish stocks and enable sustainable exploitation. This would be achieved through effort limitation via a 'capping' of fishermen numbers;

initially all fishermen with a historic performance in the Shetland fishery would receive a permit and after that new permits would only be issued if the state of the stocks allowed (based on scientific advice regarding stocks). The trading of permits would be prohibited. In addition to the permit system, the Regulating Order would provide for additional restrictions covering vessel size, gear type, closed areas and seasonal closures.

Following extensive debate the Shetland Islands Regulated Fishery (Scotland) Order was established in 1999 by the Scottish Parliament and came into force in 2000. Since then over 170 permits have been issued, a size limitation on crabber vessels has been brought in and a Minimum Landing Size has been introduced for certain species (Goodland, undated).

Fig 21 - Extent of the Regulating Order



Source: SSMO website

Enforcement

Marine Scotland: Compliance has a duty under the terms of a memorandum of understanding to enforce the Regulating Order. Scientific research undertaken by the North Atlantic Fisheries College (NAFC) forms the basis of management decisions and issuing of permits. Shetland is in the unique position of having over 9 years of stock assessment data for the shellfish fishery (SSMO website).

In terms of issuing permits, the SSMO has developed a process by which a set of criteria are used to score each licence application. The issuing of permits also requires permit holders to fill in a detailed logbook, which results in improved data availability for stock assessment.

Outcomes

Assessments undertaken by the NAFC as part of the annual Shellfish Stock Assessment Programme indicate that the brown crab stock is currently healthy (e.g. Leslie *et al*, 2008).

While the Regulating Order has been welcomed by some who think that national shellfish regulations do not go far enough to safeguard stocks, a number of Shetland fishermen (who have not been issued with licenses) have consistently objected to the Order because they feel alienated from the decision-making process (Shetland Marine News website). In 2009 a new association, the Shetland Inshore Fishermen's Association (SIFA) was established, which opposes the Order.

7.3 Case Study 3 – Lundy No-Take Zone.

Management Tool: Permanent closure.

Background

Lundy is an island in the Bristol Channel, 11 miles from the coast of North Devon. The island is the only significant rock outcrop in an area where the seabed is otherwise comprised of mud and sand. As such, it provides important habitat for marine species that require rocky habitat.

The Fishery

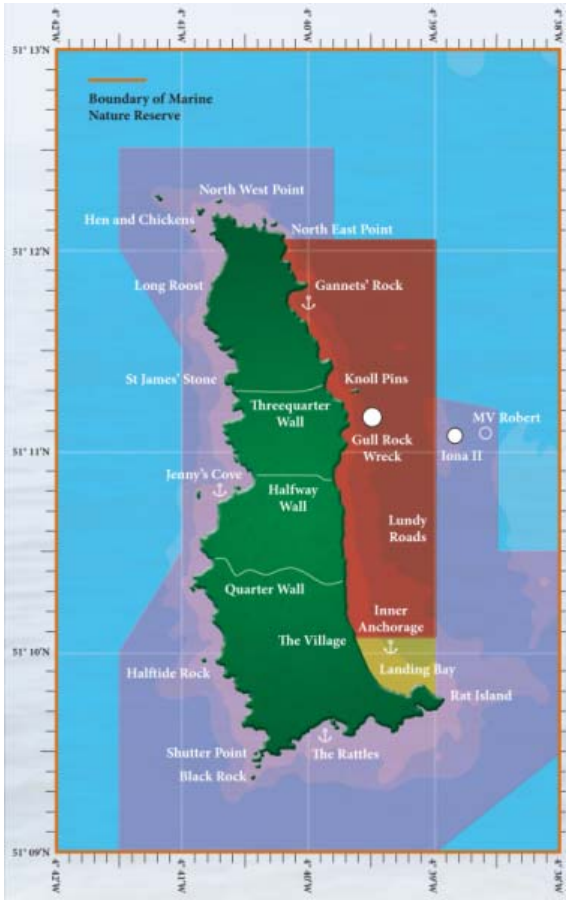
Although not a significant crab fishing ground, the seabed around Lundy, and particularly the nearshore waters adjacent to the island, were historically targeted by crab and lobster potters.

Management Tool Application

In 2003 a No-Take Zone (NTZ) was established off Lundy by the conservation agency, Natural England, and the Devon Sea Fisheries Committee. The NTZ is a form of Marine Protected Area established to limit fishing and other activities that may result in adverse effects on marine life. The Lundy NTZ was primarily created to restrict commercial crab and lobster potting, which is now prohibited within the NTZ. Potting continues outwith the NTZ through the summer season. The NTZ covers approximately 4km^2.

It was thought that the NTZ could be used to provide insurance against future shellfish management failures and stock collapses, and also improve catches in waters around the NTZ as a result of either the migration of adult crabs from the NTZ and/or planktonic dispersal of reproductive propagules.

Fig 22 - Lundy NTZ, shaded in red



Source: Lundy Field Society website

Enforcement

Lundy in the UK's only statutory NTZ and is protected by a byelaw from the Devon SFC.

Outcomes

There is apparent acceptance within the shellfishery sector of the NTZ approach, though there remains some skepticism regarding the potential for long-term fisheries benefits and a feeling that if the NTZ were any larger it would be detrimental to local fishermen (McCarthy, 2008).

Monitoring is ongoing and includes experimental potting of crab and lobster populations. The size, abundance and biological characteristics of caught animals are being recorded and catch data is being compared from within and beyond the NTZ. Initial results indicate that the NTZ has caused an increase in both the numbers and sizes of lobsters (Hoskin *et al*, 2004); results relating to crab populations are not available.

7.4 Case Study 4 – SFC Byelaws

Management Tool: Various.

Background

The twelve Sea Fisheries Committees (SFCs)[6] that regulate local sea fisheries around the entire English and Welsh coastline are empowered to make byelaws for the management and conservation of their districts'

[6] The are analogous local management bodies (Inshore Fisheries Groups) in Scotland, a number of which are still to be established. In Northern Ireland crab fisheries are regulated through the devolved government and EU legislation.

fisheries. Byelaws, which are approved by Defra on the basis of scientific advice, can apply to all fishing activities within the district and are several are commonly applied to crab potting fisheries.

The Fishery

The nature of crab fisheries within each SFC district is highly variable, with crab fisheries being more important within certain SFCs – for example Devon and Cornwall SFCs.

Management Tool Application

A range of tools are variously applied via byelaws enacted in the different SFCs. Those tools implemented most widely across SFCs include:

- Minimum Landing Sizes – these differ regionally as a result of geographical variations in EU MLS and the use of SFC-specific MLS;
- Vessel size restrictions – commercial fisheries vessels are typically restricted by length, and restrictions vary by SFC from 12-17m; and
- Temporary seasonal or area closures – while closures may not be commonly enacted, many SFCs may enforce a closure in relation to a shellfishery or a shellfish bed.

Table 4 below summarises SFC byelaws which involve the application of crab management tools.

Enforcement

SFCs regulate sea fisheries in their districts out to 6 nautical miles enforcing National and EU fisheries legislation, addressing localised management issues by means of byelaws. Byelaws can regulate fishing methods and fishing gear, restrict fishing seasons, set minimum sizes for fish and shellfish, manage and protect shellfish beds or control fishing for environmental purposes. SFC byelaws cannot be less restrictive, but may be more restrictive, than national or EC fisheries legislation. Where byelaws are breached prosecutions can be south and fines applied.

Outcomes

SFC byelaws represent a long-established approach to the management of inshore fisheries, including brown crab fisheries. Byelaws move beyond the requirements of European and national legislation and demonstrate SFC commitment to protecting the local stocks on which inshore fleets depend.

Several core management tools are consistently applied across all SFC districts, and several byelaws are considered to have proven extremely beneficial to local fisheries (TheFishSIte website). However, trends in some regional fisheries would indicate that current measures are not sufficient to ensure sustainable stocks.

SFC powers are viewed by some to be outdated, and it is expected that their structure and powers will be amended once the Marine Bill is enacted.

Table 4 - SFC Byelaw summary (relevant to crab fisheries).

Management Tool	SFC											
	Northumberland	North Eastern	Eastern	Kent & Essex	Sussex	Southern	Devon	Cornwall	IOS	South Wales	NWNW	Cumbria
Minimum Landing Size			✓									
115mm carapace width (CW)	✓	✓		✓							✓	✓
130mm CW					✓	✓	✓		✓	✓		
140mm CW								✓				
150mm CW							✓	✓				
160mm CW												
Vessel size restrictions	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Temporary closure (for shellfishery or shellfish bed)		✓	✓	✓		✓	✓			✓	✓	✓
Marine reserve							✓					
Ban on landing of berried animals	✓		✓									

Management Tool	SFC											
	Northumberland	North Eastern	Eastern	Kent & Essex	Sussex	Southern	Devon	Cornwall	IOS	South Wales	NWNW	Cumbria
Ban on landing of soft animals	✓		✓									
Ban on landing of white-footed animals			✓									
Ban on landing as bait	✓	✓	✓									
Ban on landing parts	✓	Allow 10% by-catch	✓				✓	Allow 10% by-catch		✓		
Escape gap in pots				✓			✓					✓
Marking of gear	✓	✓		✓				✓		✓	✓	✓
Permit required	✓	✓						✓		✓	✓	✓
Unlicensed take limits	✓	✓						✓		✓	✓	✓

7.5 Case Study 5 – Granville Bay Treaty

Management Tool: Parlour pot ban

Background

The Channel Island of Jersey is located west of the Cherbourg Peninsula, in the Bay of Granville on the South side of the English Channel. Jersey is essentially within the coastal zone of France and this means that there is joint exploitation of marine resources by both Jersey and the French coastal fishing fleets targeting shellfish stocks. There has historically been a certain amount of interaction between the two groups of fishermen, and it became clear that some form of management was required to clarify fisheries boundaries and entitlements. Over 14 years ago the British Government commenced discussions with the French Government in order to seek some form of shared agreement.

The Fishery

The vessels that work from Jersey are 8-13m in length, fishing strings of 30-50 pots, primarily targeting lobster. Approximately 50-60 vessels work out of Jersey, and a total of about 17,000 parlour pots and 6,000 inkwell pots are used. This does not include French effort. Pots are set daily within 12nm of the coast. The catch of lobster has remained very constant over the past number of years and at the moment is between 150-160 tonnes per year. By comparison the catches of spider crab and brown crab vary and are currently about 300 and 600 tonnes per year respectively (Tully, 2004).

Management Tool Application

A Granville Bay Treat was signed in 2000; it clarified the extent of the Granville Bay zone and access for different fishing communities within it. The treaty encompassed a number of shellfish management tools, but notably banned the use of parlour pots in a 70 square mile area of Les Minquiers Reef in order to protect juvenile shellfish stocks.

Enforcement

There is a joint advisory committee composed of four Jersey fishermen, four Breton fishermen, and four Basse-Normandie fishermen, together with biologists and administrators. They advise a senior management committee and the respective governments on management measures they feel need to be implemented. This advice is vetted to ensure that it does not conflict with EU or other National Legislation and then implemented in the respective legislation of the Jersey and French Governments. The Granville Bay Treaty also covers control and enforcement, and it identifies the levels of fines and penalties for breaches of regulations.

Outcomes

After 10 years of negotiations and several years of developing new national legislation, the treaty was welcomed.

8. Consultation – regional workshops

As part of this study a series of six regional workshops was convened to explore industry views on the future management of the industry. In total a little over 100 people attended these meetings – mainly owners, skippers and crew, but also industry representatives, managers and scientists.

Each of the six meetings developed a character and basis of debate of its own, driven mainly by the mix of people attending, but also by regional interests and conditions. Nonetheless, the regional dimensions of the debate were less obvious than relatively consistent attitudes towards management of inshore and offshore fisheries, and small-scale and large-scale activity.

Two features of the debate stand out:

- The first is that where the local fishery did not directly involve the deployment of large viviers, the general view was that the local fishery was, in general, doing well and to leave well alone. Under these circumstances, it was said that what was needed was to significantly constrain the activities of the large vessels fishing offshore grounds. In contrast, where the fishery integrally involved these larger vessels – Scotland, Ireland and to some extent south Devon – there was more inclusive debate and recognition of the important role played by these larger vessels in the overall operations of the industry. This sense of "us and them" runs through most discussions of industry development – and there is also a sense that many fisheries can indeed be managed on a local regional basis.

- The second was the attitude towards quality, the landing of soft-shell crab, and the use of crab as whelk bait. Almost without exception attendees were highly critical of the fact that far too much poor quality and out of specification crab was being landed and traded through the system. But at the same time there was sufficient finger pointing – to the large viviers, to new entrants, to traders, to processors – to suggest that most elements of the trade are implicated in this practice. Everyone felt that something should be done about it, but non-one was going to make the first move.

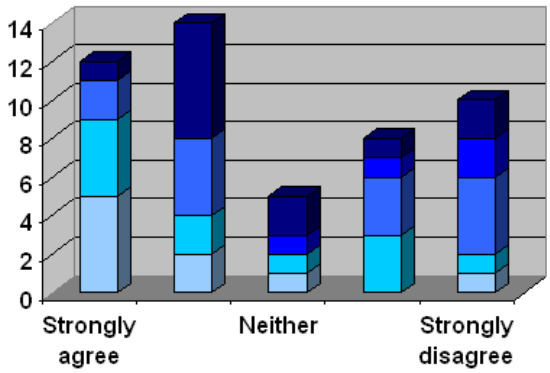
Towards the end of each workshop, attendees were asked to fill in a short questionnaire, as a means of capturing some of their attitudes and preferences for future management. A copy of this questionnaire is shown as Appendix 2, and below we describe the outcomes in respect of a subset of 47 returns submitted by owners, skippers and crews. For analytical purposes responses have been separated into five categories - those associated with vessels fishing 300 pots, 500 pots, 1000 pots, 1500 pots and over 1500 pots. In the following graphics, the deeper the colour, the more pots deployed.

As a general comment, the responses conform to what might be reasonably and rationally expected from the activity groups presented – which is reassuring.

8.1 Access restrictions

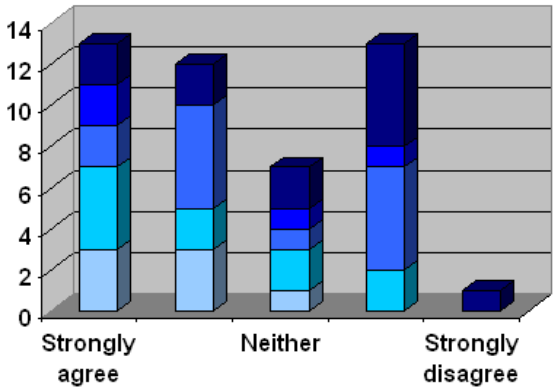
a. Maximum vessel size of 10m within 3nm: the smaller the scale of operator the more in favour of this position, though there is also considerable support for this position from at least some, but not all, of the larger scale operators.

Fig 23 – Maximum vessel size of 10m within 3nm



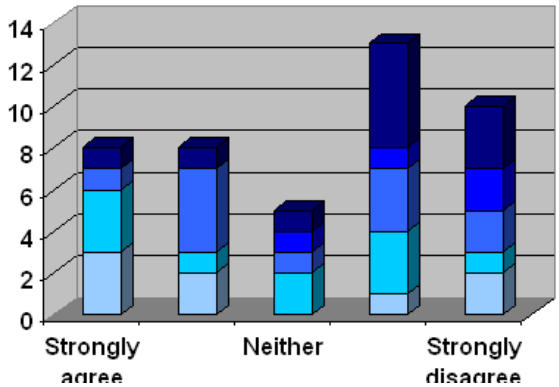
b. Maximum vessel size of 15m within 3-6nm: much as above, there is strong support for this proposition from most elements of the fleet, but with a significant proportion of the larger scale operators in some disagreement, though very few in strong disagreement. This suggests that there are larger vessels that wish to be able to fish within the 6 mile zone – as the VMS evidence in relation to the Start Point and off Eastbourne suggests (Fig 15).

Fig 24 – Maximum vessel size of 15m within 3-6nm



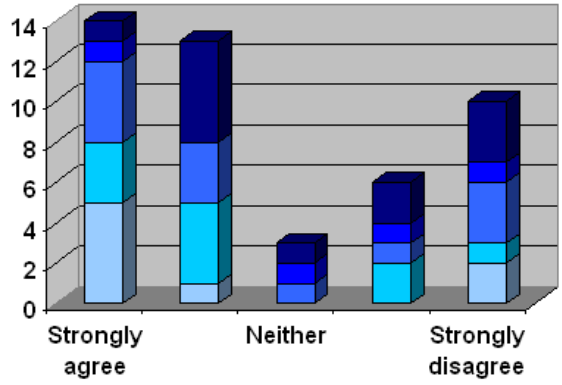
c. No vessels with onboard tank live storage (viviers) within 6nm: the smaller scale operators are evenly split between agreeing and dissenting, whereas the larger scale operators are more in disagreement with the proposition, though a significant proportion of the middle scale operators (1000 pots) are in agreement with the proposition. This is probable recognition that tank boats generally operate with a 1000 pots or more.

Fig 25 – No vessels with onboard tank live storage (viviers) within 6nm



d. Zonal management i.e. for potting and other fishing methods: broad support for this proposition from across the scales of operation, but more dissent from the larger scale operators. This reflects the reasonable view that zonal management would tend to exclude or operate against the larger scale operators.

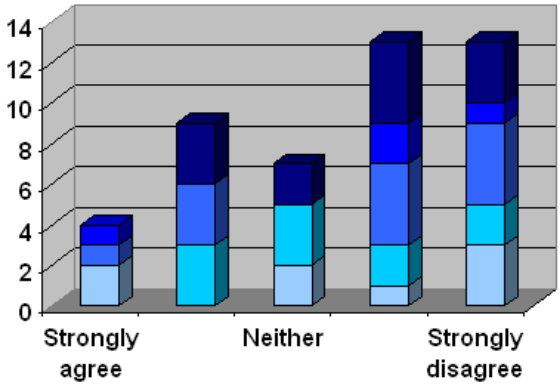
Fig 26 – Zonal management i.e. for potting and other fishing methods



8.2 Pot limitations

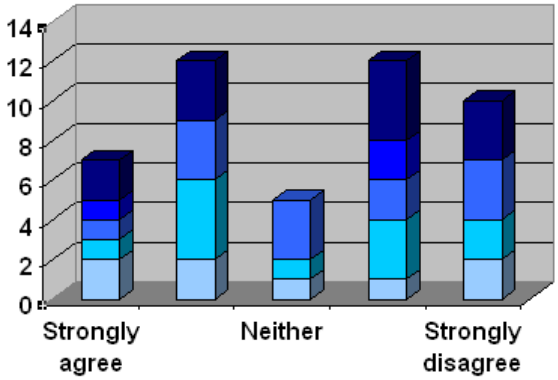
a. Pot limits only within 6nm (i.e. other management outside 6nm): there is general disagreement with this proposition – from all scales of operation – though a little under a third of respondents are in agreement with the proposition, equally spread across all scales of operation. This can be interpreted two ways - fairly strong support for a pot limits scheme; or a preference for application of the same instrument in inshore and offshore domains.

Fig 26 – Pot limits only within 6nm (i.e. other management outside 6nm)



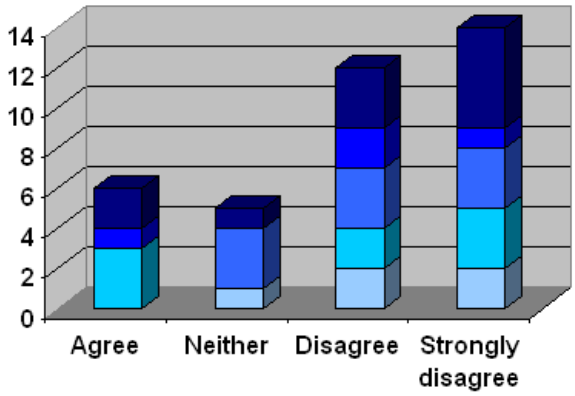
b. Banded limit scaled by vessel length (e.g. different pot limits for under 8m, 8-10m, 10-12m, 12-15m and over 15m): essentially a balanced viewpoint across all scales of operation, with as many agreeing and dissenting from the proposition.

Fig 27 – Banded limit scaled by vessel length (e.g. different pot limits for under 8m, 8-10m, 10-12m, 12-15m and over 15m)



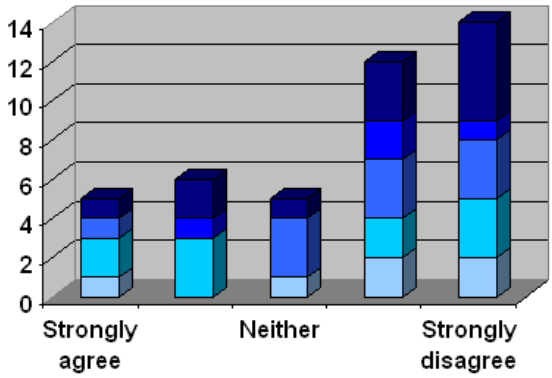
c. Banded limit scaled by vessel power: Many more respondents disagreed with this proposition than agreed, with a fairly even spread across the scales of operator. This an interesting result in that the larger vessels tend also to have bigger engines, and the more active vessels (fishing more pots, and working further to sea) also tend to have larger engines – all good reasons why power might be a useful means of defining, at least in part, fleet metier.

Fig 28 – Banded limit scaled by vessel power



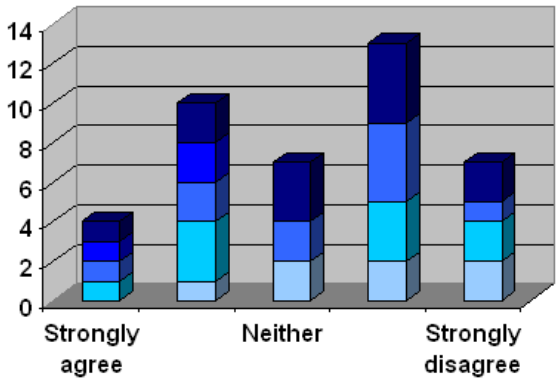
d. Single maximum pot limit for all vessels: again, there is overall disagreement with this proposition, from all scales of operator, though there are some in agreement, most notably from the 500 pot scale of operator (who might be expected to benefit, or be least constrained, but such a move). This result should be compared with b. above, where there is an even split for and against pot limits by vessel category – i.e. there is no clear support for an alternate basis for establishing pot limits. An alternate is that there is no appetite for the use of pot limits as a management tool.

Fig 29 – Single maximum pot limit for all vessels



e. Freeze existing pot numbers for each vessel: Here there is something of a split view, with slightly more disagreeing as agree, but with a relatively small number doing so strongly.

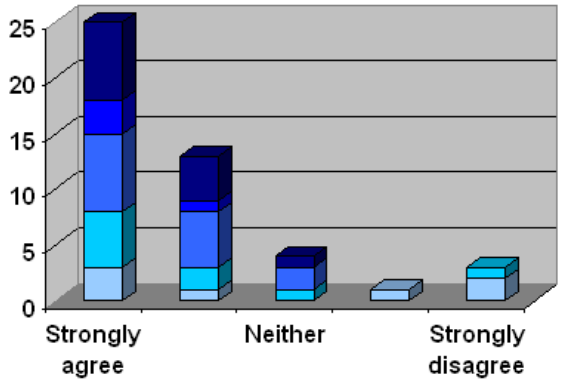
Fig 30 – Freeze existing pot numbers for each vessel



8.3 Shellfish licences / permits

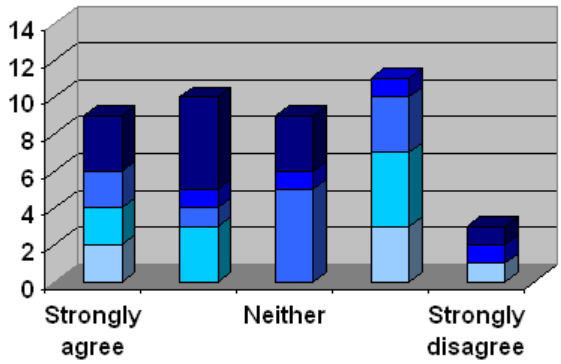
a. Introduce sunset clause to remove unused shellfish licences: This indicates that there is very strong support for the removal of latent effort through the mechanisms of a sunset clause.

Fig 31 – Introduce sunset clause to remove unused shellfish licences



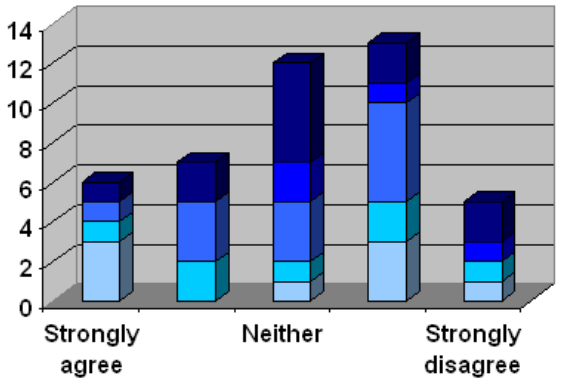
b. Introduce permit system: given that most SFCs, for example, already operate permit schemes, it is a little surprising to see how many of the smaller scale operators are not in favour of such systems. By contract, most of the largest scale operators are in favour of this – though they might also be least impacted by such systems.

Fig 32 – Introduce permit system



c. Introduce permit system in conjunction with pot limit: there is rather less support for this proposition, most notably from those operators deploying in the order of 1000 pots. This could simply reflect the proposition that it is this scale of operator who might be excluded from an area that he may currently have access to but which he might be refused access to under a permit system.

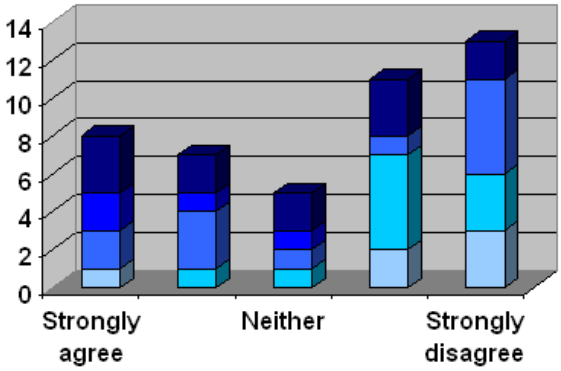
Fig 33 – Introduce permit system in conjunction with pot limit



8.4 Quotas and TACs

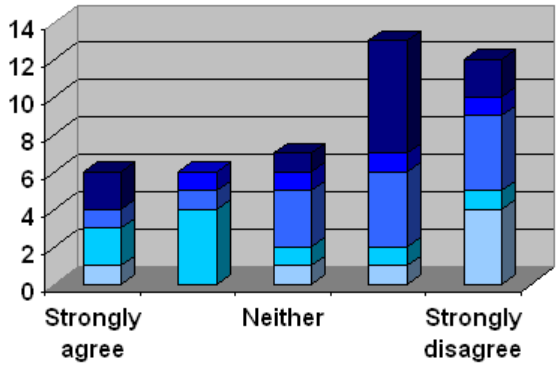
a. Introduce quotas based on reference period for all vessels: the overall weight of opinion is against this proposition, but heavily weighted towards the smaller scale operators (though not exclusively so). Larger scale operators are more likely to be of the opinion that they have a reasonable track record; the smaller scale operators, particularly if they have any ambitions to increase scale, will not be so happy with track record.

Fig 34 – Introduce quotas based on reference period for all vessels



b. Introduce quotas only for vessels fishing outside 6nm (assuming inside 6nm managed via pot limits): there is fairly strong detraction from this proposition, most notably from the larger scale operators, but also from the smallest scale operators. This may simply reflect self-interest; the larger scale operators fear that a less restrictive control system inside 6nm would adversely affect their businesses, through raised catches and effort from this quarter. The smallest scale operators may fear that a failure to control operators working in the order of 500 pots would squeeze them off inshore grounds.

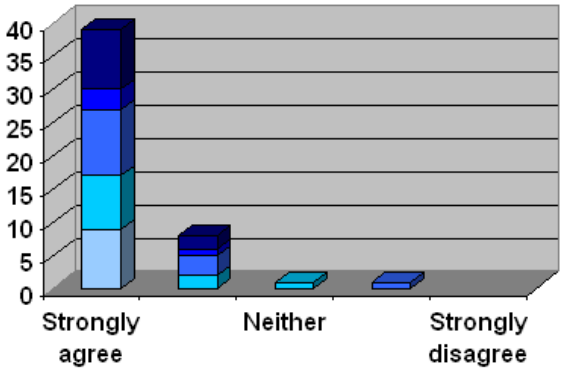
Fig 35 – Introduce quotas only for vessels fishing outside 6nm (assuming inside 6nm managed via pot limits)



8.5 Returning crab & MLS

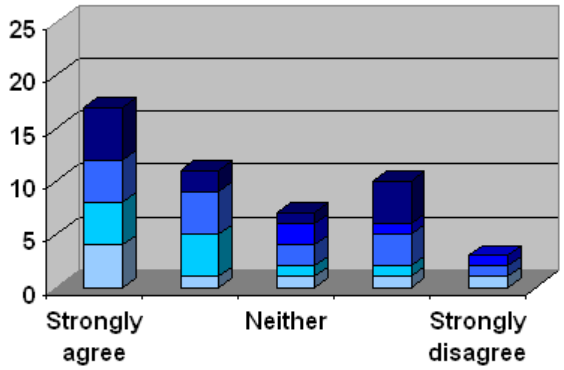
a. Return berried or soft crab: Overwhelming support for what is in effect already the legal requirement – but there appears to be widespread abuse of the rule applying to soft crab.

Fig 36 – Return berried or soft crab



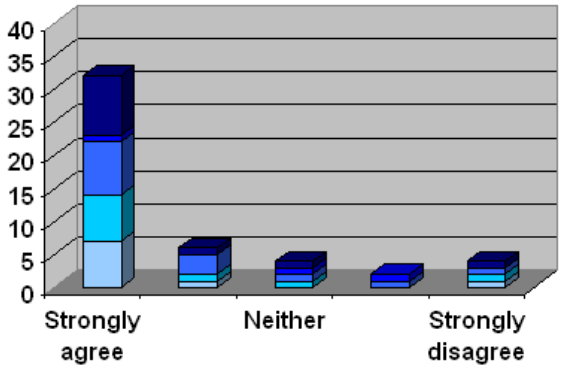
b. Return crippled crab: there is less clear-cut support for the returning of crippled crabs – but then this is not a clear-cut issue. If the market for low specification crab were to be closed, then this position might be more straightforward.

Fig 37 – Return crippled crab



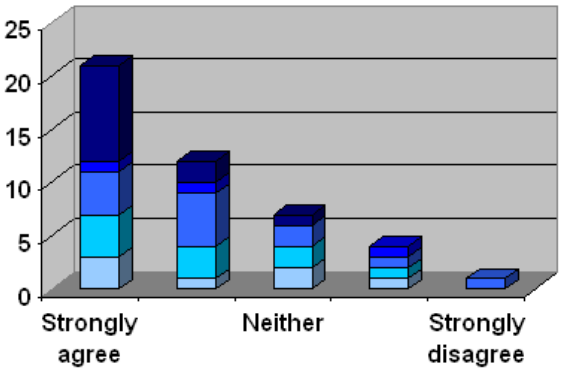
c. Reduce or ban landing of crab claws: there is overwhelming support for this position, though it is fair to say that those catching crab as bycatch – in nets or trawls – are unlikely to take the same view.

Fig 38 – Reduce or ban landing of crab claws



d. Increase MLS by 10mm in steps: again, strong support for this measure. In most areas commercial practice puts the size higher than the legal MLS. But industry members also point out that there are market niches for smaller crab, and Cromer (and Dunbar) crab have made a business out of supplying small crab. This issue is not straightforward – and perhaps not as straightforward as these results suggest.

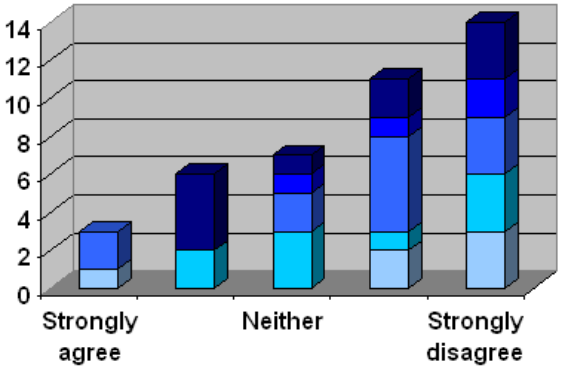
Fig 39 – Increase MLS by 10mm in steps



8.6 Gear

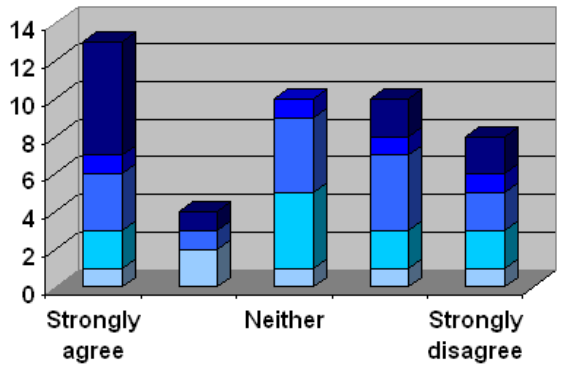
a. Ban parlour pots (replacements fundable under EFF): a pretty clear result against the banning of parlour pots. Current practices increasingly rely on leaving pots un-inspected in the water for longer. If effort could be substantially reduced, then there might be more support for banning parlour pots – but all the current evidence suggests that this is unlikely.

Fig 40 – Ban parlour pots (replacements fundable under EFF)



b. Introduce escape hatches to all pots: This is a very mixed result, with slightly more against this proposition than for it, but with a fair number of respondents in strong support of the proposition, particularly from the largest scale operators. It could be argued that day-boats tend not to leave pots unattended for long, except in periods of poor weather, and can handle / sort the larger volumes of crab that not fitting an escape hatch might involve. For the larger offshore vessels, on-deck handling time is at a premium, and anything to help reduce the numbers of small crabs brought up in the pots might be considered a significant advantage.

Fig 41 – Introduce escape hatches to all pots



9. Assessment of Management Measures

In the following tabulation we examine the merits of the different management measures under the following headings:

- Implementation: implementation issues associated with each measure (e.g. administration, industry buy-in);
- Enforcement: policing;
- Conservation: the intended conservation benefit to be achieved by each measure;
- Monitoring: can the effect of the management measure be picked up by monitoring?
- Economic Impacts: the distribution of economic impacts and timeframe over which impacts are expected to occur for alternative measures according to regions or fleet metiers;
- Market Impacts: potential impacts upon markets of the selected measures;
- Common Ground: the common ground particularly when it comes to markets.

	Implementation	Enforcement	Conservation	Monitoring	Economic Impacts	Market Impacts	Common Ground
Licensing and Entitlements	Licensing forms part of a well-established administrative system – both at national and regional levels; current entitlements extend to basic access only; in some inshore regimes such access to fishing within that regime is by separate permit.	Well-established data-sets, good paper trail, and status of individual vessels easily checked as desk-based exercise. Enforcement of licenses is administratively straightforward and well exercised.	Restrictive shellfish licensing has achieved the status for the fishery of a limited entry fishery, though there is significant latent effort still locked within the system. Limited entry is an essential part of both input and output controls, but latent effort has to be removed before any conservation benefits	Well-established data-sets, good paper trail, and status of individual vessels easily checked. This data-base is routinely accessed and checked by fishery officers when engaged in at-sea or on landings inspections.	At a time of significant over-capacity across the fishing sector, restrictive licensing has been an essential management measure – but a consequence of this is that it reduces flexibility in how fishing opportunities are exploited. This has impacted negatively on the Irish super-crabbers. But in other	Without realistic control of effort and/or output, licensing and current entitlements have no direct impact on the market – though it can be reasonably argued that the failure to put in place effective input and output controls has supported the "race for fish"; both to "hold ground" and to compensate for the	Most are of the view that the introduction of restrictive shellfish licensing was too late, and was not restrictive enough (though the counter-argument is that any such licensing needs to provide for some flexibility in fishing opportunities – for example between crab and lobster, crab and whelks, lobster,

	Implementation	Enforcement	Conservation	Monitoring	Economic Impacts	Market Impacts	Common Ground
			can be realised.		parts of the fleet the restrictive shellfish licensing has not been restrictive enough, and the threat posed from vessels with entitlement that is not used or not currently fully exploited has major economic implications for those vessels actively fishing crab and lobster.	fall-off in catch per unit effort fishermen have invested in ever more pots leading to both over-production and over-exploitation. But failure to put in place input and output controls has also created a situation where some owners may be protecting their future interests by building up track record – and as a result contributing to the over-supply of the market.	crab and nephrops). Most agree to the introduction of sunset clauses on licenses. Most appear content with the constraints (mainly technical measures) on activity that come with access entitlement, but are split on the issue of catch entitlement / quotas (output controls).
Pot marking	This comes at a cost, but is effectively managed in other parts of the world, and locally in Jersey (up to 25,000 pots), in the Northumberland SFC, and in the Isle of Man. Replacement tags for losses of <10% can be readily issued, losses of >10% require explanation and possible presentation before a scrutiny committee.	Once the system has bedded down, high level of industry compliance and self-policing. In the absence of a requirement to bring all pots ashore, then need to undertake at-sea inspections. This is costly and time consuming; all the more so for vessels fishing offshore. Most such schemes are limited to vessels fishing within the	Pot marking provides an appropriate mechanism for capping pots per vessel – and thus might be considered a pre-requisite to pot limitations. On the other hand, if a culture of compliance is in practice established fairly early on in the implementation of this sort of policy, then pot marking may be an unnecessary expense.	Because in the UK and Ireland general practice is to leave pots in the water, monitoring becomes difficult. Deterrence can be achieved within an inshore regime by checking pots lifted during regular at-sea patrols, but this is a costly exercise. Effectiveness is mainly reliant on compliance and self-policing – which	Cost to fishermen and management authority. But starts to have significant beneficial economic impact if allows the industry / management regime to bring about a measured reduction in deployment of pots – with presumed increase in catch per unit effort. Also, pot marking tends to cool the impetus to "race to fish" and allows	Any resolution to the current situation where it is not practically possible to limit the number of pots in the water or the amount of crab landed is likely to stabilise both supply and prices. Pot marking may play a contributory role to controlling the numbers of pots set by each vessel, but may not be essential to such an outcome.	Most fishermen sea pot marking as an unnecessary and costly piece of bureaucracy. Fishermen invest in more pots because other fishermen invest in more pots – the "race to fish". Part of the driving force behind the "race to fish" is the need to "hold ground" against other fishermen and other gear – i.e. more

	Implementation	Enforcement	Conservation	Monitoring	Economic Impacts	Market Impacts	Common Ground
		inshore regime.		should be achievable.	greater focus on issues of quality – which can raise unit prices.	If fishermen routinely set more pots than the management regime allows, then the impact on the market will be limited.	pots does not necessarily mean raised catches. Many fishermen raise the number of pots set as a means of compensating for reductions in CPUE – i.e. the opposite of what good management practice would dictate.
Pot capping/limitations	At any given time vessel owners typically work a fixed number of pots that matches the scale of the vessel, number of crew, grounds to be worked, the season, and type of competition for position on the ground. Owners vary the number to hold ground against the competition and to compensate for (low) catch rates. There has been a tendency to leave pots un-inspected for longer, allowing skippers to	The only time when the total number of pots worked becomes visible is when they are brought ashore at the end of the season. Some vessels work their pots year round, and so pots are only brought to shore for the purposes of significant repair, and then only in fleets. Accordingly, direct independent inspection of pots is not easy. Marking each pot with a unique identifier can encourage compliance, but for full	In most if not all areas, the same volume of crab could be harvested using fewer pots. The persistent increase in the number of pots worked by the fleet is more a result of the "race to fish" brought about by a failure on the part of managers to effectively cap the size of the fleet and the number of pots that can be worked – i.e. it is mainly a product of competitive forces. Therefore simply putting a cap on the number of pots	There is no sure fire way of monitoring the number of pots worked by each vessel. The level of at-sea inspections needed to effectively monitor pot numbers would be prohibitively expensive and inefficient. Requiring skippers to land all their pots to shore at a given time could help, but there would be all sorts of ways around fully complying with this.	Hands-on monitoring and enforcement would involve significant costs – unlikely to be cost-effective. Attaching an upper pot limit to the license would provide an appropriate administrative route to management, but at much lower cost. Changes in pot limit could be effected through a permit scheme (probably most appropriate in the matter of inshore management).	Any action that leads to a halt in the "race to fish" and provides increased security in terms of projected income – very much along the lines of one vessel owner agreeing to changed behaviour as long as the same rules are also applied to the other owners – would bring about increased order within the sector, and halt recent moves to establish "track record", whether in pots fished or tonnes landed. This would almost overnight	Most owners agree that too many pots are being fished. Most owners agree that their moves to increase the number of pots fished is only because they need to "protect their interests" against competing fishermen. Most operators within the sector – fishermen, processors and traders – blame someone else for the need to handle more crabs than the market requires and to handle more poor quality crab

	Implementation	Enforcement	Conservation	Monitoring	Economic Impacts	Market Impacts	Common Ground
	work larger numbers of pots. Capping or reducing the number of pots should not be that difficult if it is applied to all, and it has the cooperation of the industry.	effect this still requires independent verification. Probably the most effective and lowest cost form of enforcement is industry compliance and self-policing. Most skippers have a fair idea of how many pots are being worked by other vessels, and know when a skipper has purchased additional pots. Making public how many pots each vessel is licensed to operate would go a long way towards achieving voluntary policing of compliance.	to be worked in an area will have little to no conservation effect. If pot numbers are substantially reduced, then there comes a time when the reduced effort will have an impact on conservation.		Reducing the number of pots fished – overall and per vessel – would reduce the capital outlay on the part of vessel owners, and in time tighter management of this fishery would result in raised and stable prices, and in increased CPUE – to the significant benefit of operators. One area of particular weakness is where operators could legitimately switch effort from another pot fishery – lobster, whelk, nephrops – to crab when profitability increases, but as long as this is not excessive this is simply a reasoned response to changed economic circumstances.	remove poor quality landings from the market-place, and encourage focus on landing of only high quality animals – with positive impacts on the market.	than is sensible or required. Most operators agree that this behaviour is in part dictated by the lack of long-term security in the current and future management of the sector – i.e. the absence of any decision with respect to pot limits and landing quotas – so behaviour is dictated by the need to protect all possible future outcomes.
Quota and Resource Allocation	This would be relatively easy to apply on the basis of track record, but some operators have been	There are well developed administrative processes for recording catches and	Output controls such as landings quotas have potentially direct conservation values – in that quotas can be	Systems to allow monitoring of landings are in place and well exercised in general, though under-	Resolution of how the crab fisheries are to managed would return major dividends to the sector, allowing	Greater security of resource access and improved operating economics would result in significant	Part of the industry is very much in favour of vessel landings quotas, but this is generally those

	Implementation	Enforcement	Conservation	Monitoring	Economic Impacts	Market Impacts	Common Ground
	building up track-record as a means of seeking strategic advantage (i.e. they could gain from poor or selfish behaviour – boosting landings by landing poor quality crab, or by operating unsustainably high numbers of pots), whilst a per vessel allocation penalises those vessels that currently or recently have focused on fishing other species. An allocation procedure that is not overly reliant on track record has advantages – vessel size, crew number, etc. – possibly within overall catch limits per area / management unit	landings, though these are under-utilised at present – there is a potential disjoint between the systems used by central government and those used by local area managers, for example the Sea Fisheries Committees. There are currently limited at-sea inspections.	varied to better reflect stock conditions. An area of weakness is that it is possible – as appears to be the case today – for vessels to land significant quantities for poor quality crab, which works against conservation interests. This would in all likelihood disappear once an effective system of landings quotas and/or pot limits had been put in place.	exercised with specific regard to crab (it has not been a priority area for inspection). Monitoring systems could be tightened up without much additional effort.	greater prediction of catch levels, costs and income than is the case today. Establishing a landings quota system – on a per vessel basis and/or on a management area basis would go a long way to creating the confidence in owners to bring their activities into better balance with the size of resource, and as a result bring down operating costs, stabilise and strengthen market prices, and improve profitability.	reduction in the landing of poor quality crab, and increase interest in sorting crab for quality. Together this is likely to result in a smaller volume of crab landed, and high quality of crab landed – both of which would be expected to yield market advantages.	owners who have or have built up good landings track records. There are other parts of the industry that are vehemently against landings quotas for one or both of the following reasons – that the quota regime in the UK in particular has lead to the decimation of the whitefish fleet and that nothing good can be said of such a system (and the crab sector does not want to go the same way as the whitefish sector); and that a quota system based on track record would only reward those vessel owners that had strategically increased landings in recent years, a process that had resulted in the mess (over-supply and large quantities of poor quality crab landed) that the industry now finds itself in.

	Implementation	Enforcement	Conservation	Monitoring	Economic Impacts	Market Impacts	Common Ground
Area Based Management	A well-developed system of inshore management is already in place across England, Wales and Northern Ireland, and a similar regime is being rolled-out in Scotland. No similar regime exists in Ireland, though management of lobster fisheries (which is predominantly inshore) does have a regional management dimension. UK fishery scientists also monitor the condition of the crab stock according to areas delimited according to ICES statistical rectangles, which has the potential to provide another dimension to area based management. There are, of course, crab fisheries that clearly span the inshore / offshore	Because crab fisheries are not currently managed on the basis of effort or output controls, but primarily on the basis of compliance with MLS and no soft-shell crab, very limited enforcement resources are currently applied to this fishing sector. In any future regime, there are well-developed systems in place in inshore and offshore regimes – administrative and at-sea and on-landing inspections – that could be relatively easily stepped up to enforce the management regime.	The fishing behaviour of the crab fishing sector is fairly regular and predictable, with most operators exploiting the same mix of grounds, and many operators "holding ground" on a permanent or seasonal basis. The life-cycle of crab tends to focus on movement inshore and offshore; wider movements, either at larval or adult stages, appear to be limited. Whilst not perfect, this gives the idea of area management real merit, and strengthening features of local accountability, focused monitoring, and relevant catch and effort targets – all of which would be very positive for conservation.	Providing a more local focus to management would strengthen the local relevance and effectiveness of monitoring activities. Systems are already well-developed in the inshore regimes in England, Wales and Northern Ireland, but less so in Ireland and Scotland; but these systems do not at present achieve the depth of monitoring that effort and output controls would require. All vessels over 15m in length already comply with satellite tracking requirements, and this feature will shortly be extended to cover all vessels of 12m in length. For the more active vessels that are not captured within this legislation, it may be appropriate to consider requiring them to carry some form of effective position tracking	Apart from providing locally relevance and accountability, on its own area based management would be expected to have a neutral economic impact on the fleet, though there may be increased costs relating to monitoring, control and enforcement.	Area based management on its own would be expected to have limited impact on the market, but it would be expected to enhance the market impacts of effort and/or output controls. Area based management might also enhance the opportunities for certification / branding of place of origin.	Overall the industry is very much in favour of area based management – as long as it does not "restrict" their activities; i.e. "as long as it constrains the activities of the fisheries / fleet segments that constrain our marketing opportunities we have no problem with this". On a more positive note, most elements of the fleet consider that they are already subject to area based management, but would like to see greater control of the activities of those vessels that fish in the "offshore" regime, and particularly the activities of the nomadic vivier fleet. The nomadic vivier fleet appears content to be subject to more specific management controls, but that any

	Implementation	Enforcement	Conservation	Monitoring	Economic Impacts	Market Impacts	Common Ground
	divide (for example the Yorkshire coast / North Sea fishery) where greater coordination between inshore and offshore regimes will be required. For key offshore regimes (for example to the west and north of Scotland) area based management may be a little more difficult, but the size of the fleet exploiting these offshore grounds is very small, and could be managed a as an entity.			equipment – for example a simple data-logger – to better monitor their activities, and strengthen input to further refinement of sector management.			controls should be measured and proportionate – i.e. there are other elements of the fleet that would probably need to be subject to the same or similar controls.
Access to licensing/permits ~ new entrants/transfer	Outside the basic requirement to hold a current shellfish entitlement (for which access is now effectively capped) there are currently few limitations – shellfish entitlements can be passed on with the sale of a vessel, and the eligibility criteria attaching to permit	The administrative procedures covering licensing and allocation of shellfish entitlements are relatively straightforward. Where the problems arise is with regard to the existence of latent effort – where entitlements are not currently exercised.	The desired conservation impacts of any moves to manage the crab sector through effort and/or output controls will be undermined as long as there remains significant latent effort within the sector. Some but not all of this problem could be addressed through	The administrative procedures for monitoring licensing, permitting and transfers are well established and exercised.	Any management measures that improve the economic performance of crab fishing will encourage at least a proportion of those with shellfish entitlements that are not currently exploiting crab to move into this particular fishery. This may run counter the intended	The market is currently over-supplied, and demand is weakened as a result of the recession. As long as there remains uncertainty as to how the industry is to be managed, and what controls are to be applied to achieve this, individual	As a whole the industry recognises that current levels of effort are excessive, and current landings levels are more than is sensible. These conditions will only change once the issue of how the sector is to be managed is resolved. The industry is of the

	Implementation	Enforcement	Conservation	Monitoring	Economic Impacts	Market Impacts	Common Ground
	schemes are reasonable and locally relevant. At present there appears to be a surfeit of shellfish entitlements that are not utilised or are under-utilised, and which could be acquired by a new entrant. If much or all of such latent effort is removed from the fleet, however, more specific mechanisms that accommodate new entrants to the sector will need to be developed. The same applies should sunset clauses be introduced to existing entitlements.	Any management system will need to provide some flexibility to allow holders of shellfish entitlements the opportunity to also exploit other fisheries. But at present it is the general view that as much latent effort should be removed from the fleet as possible. For any inshore management regime (or other regimes managed by permit), the conditions of permit could be set so as to only allow those meeting specific activity criteria.	permit schemes, but there will remain a requirement to moderate the number of shellfish entitlements that are not currently taken up.		conservation and profitability intentions of management measures.	operators are likely to protect and enhance their track record – and thus contribute to over-supply of the market. The presence of significant levels of latent effort within the sector will also continue to pose a threat to market stability.	view that an opportunity to further control effort was missed when the new shellfish licensing regime was applied in the UK, and that this excess capacity / latent effort remains a major and potent threat to the achievement of "good order" within the sector.
Days at sea or time limitation/seasonal variation	On balance days at sea fails as an effective effort control because typically several sets of pots are in the water at any one time and serviced at intervals of between 24hrs up to several days – longer during	It is relatively easy to get information as to whether or not a vessel is at sea. This covers controls on days at sea, and observance of closed periods – assuming vessels declare which type of gear they are	Weak conservation value. At the extreme there are only so many pots that a particular vessel can haul in a day – therefore some element of days at sea provides some limit to fishing activity,	Current reporting requirements cover the days that a vessel is at sea, and should but does not always, include details of pots hauled; there should also be details in the record of how many pots set, but this is not	Limited impact unless pots are removed from the sea on daily basis, or during closed season. Strong incentive to keep pots in the water to "hold ground" against other operators – therefore pots continue to fish.	Insignificant.	There is no obvious support to remove pots from the water. If pot limits were introduced it would become feasible to ramp down the overall number of pots used (likely to improve catch per unit effort

	Implementation	Enforcement	Conservation	Monitoring	Economic Impacts	Market Impacts	Common Ground
	periods of inclement weather.	using at any given time. It does not cover pots in the water – i.e. a more definitive measure of fishing effort.	but it is a very coarse control measure. Some large viviers are reported to operate double crews and work through the night; larger vessels also routinely operate several sets of gear – and leave each pot un-inspected for longer.	consistent. For over 10m vessels all need to complete log books, for over 15m vessels, soon to be reduced to over 12m vessels, all must carry a VMS. For under 10m vessels in England and Wales, owners must submit a monthly summary of effort and landings under inshore permit schemes – but not consistent across UK and Ireland.	Seasonal closures might have greater impact, but only if pots removed from water.		and reduce operating costs), but this is not the same as days-at-sea controls.
Technical conservation measures							
Minimum Landing Size	Relatively straight forward to implement as MLS already exists. Will be a case of advertising new MLS via usual channels.	No additional enforcement as MLS already enforced.	The existing MLS is considered to be sufficient to allow the majority of crabs to spawn at least once – and this is the conservation objective of the technical measure. Using a higher MLS will offer further marginal conservation benefits, but its main intended benefit is to limit supply to the market.	Resources may be required for more localised biological monitoring including changes to spawning stock biomass Can be monitored via landings and logbook records.	Lower short-term CPUE but will improve over the long term. Will require reasonable transition period.	The market is looking for a wide range of sizes of crab – including small crab. Current industry practice favours the landing of larger crab than the MLS requires – primarily because it commands a higher price, and because in conditions where the market is over-supplied, and in the absence of any other controls, it provides a	MLS is widely recognised as a landings control mechanism. Most elements of the industry are open to the idea of some modest increase in MLS, but there are concerns that areas dependent on landing a smaller size of crab will lose out if this occurs, and there is concern that without other forms of effort

	Implementation	Enforcement	Conservation	Monitoring	Economic Impacts	Market Impacts	Common Ground
						voluntary, but even handed, mechanism for limiting supply.	control any benefits in limiting supply will be undermined by increased effort.
Ban on landing of berried crab	Many fishermen already return berried crab and therefore implementation expected to be straight forward.	No additional enforcement anticipated.	Has potential to increase spawning biomass. Greater juvenile availability will benefit predators. Research on survivability of returning berried crab may be necessary.	Can be monitored directly through observer schemes and log books, and indirectly via recruitment indices.	Research on survivability of returning berried crab.	Removes berried crab / crab roe from the market place.	Will formalise measure already practises voluntarily by a number of fishermen and provide uniform measures across fishery management boundaries.
Quality Control Improvements	Either via training of crew or through hand held on board scanners (NB technology new and expensive)	Enforcement at landing point will require processors/buyers to have quality infra-red scanner. Simpler method may be by measuring average weight per x number of crab.	Has potential to increase spawning biomass by protecting female during her reproductive season (when she is at lower meat yield quality).	Can be monitored by observer schemes and log books	Lower short-term CPUE. Increased quality should obtain better market price. Potentially more economic impact for large super-crabbers. Cost associated with crew training.	Increased market price expected.	Increased prices will provide an incentive to land higher quality product. Fishermen currently landing good quality will be rewarded.
Ban on landing for bait	It is currently illegal to land soft-shell crab, but not illegal to have soft-shell crab on-board.	Potential enforcement issues for vessels operating both creels and whelk pots.					Industry is largely in favour of banning landing of crab for bait, but at least small but significant section of the industry participates in and

	Implementation	Enforcement	Conservation	Monitoring	Economic Impacts	Market Impacts	Common Ground
							benefits from this trade.
Reduction in crab claw and crab part landing	Restriction currently at EU level, therefore should already be implemented. Potential to remove latent effort for netters.	No additional enforcement anticipated.	Depends on fishing method: if crab being smashed out of net then no new benefit; however if claws being landed because crab below MLS then benefits to stock biomass.	Can be monitored by observer schemes and log books	If less claws in market place then price for whole crab likely to improve.	May impact current market for crab claw.	This is not a big issue for crab fishers. It is an issue for other fishing methods where crab is caught as by-catch – but can argue that by supporting this trade, discourage these fishermen from seeking to find ways of reducing incidence of crab bycatch.
Ban on landing crippled crab	Many fishermen already return crippled crab and therefore implementation expected to be straight forward.	No additional enforcement anticipated.	Conservation benefits if able to regenerate limbs or to spawn	Can be monitored directly through observer schemes	Possible benefits but uncertain long term increase in CPUE	Essentially neutral	

10. Management options analysis

Management imperatives

Our work suggests that there is:

- an urgent requirement to cap and then reduce the number of pots in the water
- an urgent requirement to cap the volume of crab landed
- an urgent requirement to remove latent effort from the fleet
- a need to manage the crab fisheries of the British Isles in concert, but to apply this management at a regional / local scale
- a longer term need to be able to vary the effort and/landings caps according to changes in stock status and condition.

Overview of the status of crab fisheries

Review of existing information suggests that the crab stock around the British Isles is heavily exploited, and in most places it is exploited at levels that are at or may be slightly beyond those that are considered sensible on a biological basis. The scientific evidence for this is opaque, but mainly because limited resources are applied to assessment of stock status, and relatively small amounts and limited time series of data have been used in examining stock condition.

In most areas, the distribution of effort (which at a general level is considered to be broadly equivalent to landings) and the landings from these fisheries appear to be broadly stable.

Recent changes in the distribution of catches may indicate that some areas are commercially over-exploited and effort has been relocated to other areas (Figs 5, 8 & 9) but the underlying reasons for such changes are complex and without more detailed study this conclusion is conjectural.

There have, however, been significant recent localised increases in landings associated with fisheries off Milford Haven, south Wales; off Co. Down, Northern Ireland; and off Fraserburgh, North East Scotland. These are broadly indicative of increased local interest in these fisheries on commercial grounds – primarily local opportunities in other fisheries have diminished, and crab fishing has become a marginally attractive growth area.

In addition to this, many of the recent historical increases in effort in, for example, the west and north of Scotland, may also be attributed to switches from other fisheries, most notably whitefish fishing.

There have also been significant overall increases in landings from a number of offshore grounds, namely grounds to the north of counties Donegal and Antrim, around the Outer Hebrides, to the north and west of Cape Wrath and the Orkney Isles, and in the German Bight (off the coasts of Denmark, Germany and Holland). Much, but not all, of this is as a result of increases in the activity of large vivier crabbers that can operate at sea for several weeks, and the emergence of a class of generally smaller vivier crabbers that tend to stay at sea for a week at most – both are classes of vessel that can work in sea conditions that the more traditional crabber cannot.

Opportunities for area based management

In a number of areas crab fishing takes place almost exclusively within 6 miles of the shoreline – and this distribution of activity thus lends itself to management under an inshore management regime, such

as the SFCs of England and Wales, the inshore regime in Northern Ireland, and the emerging inshore regime in Scotland. Such fisheries include:

- the fisheries of the east coast of mainland Scotland
- the fisheries covered by the Northumberland SFC and the northern half of that area covered by the North Eastern SFC
- the fisheries covered by the Eastern SFC
- the fisheries covered by the Kent and Essex SFC
- the fisheries covered by the Sussex SFC
- the fisheries covered by the South Wales SFC and the North and North West SFC – most of which is shortly to come under the control of the Welsh National Assembly
- the fisheries between the Dee estuary and the Solway Firth – those of the northern part of the N&NW SFC and those of the Cumbria SFC
- the fisheries of Northern Ireland
- those inshore fisheries of the Republic of Ireland stretching from the Co Mayo / Galway border southwards around the whole of southern Ireland up to its eastern border with Northern Ireland.

It is probable that the fisheries of the Yorkshire coast – Flamborough Head down to the Wash, and extending well out into the North Sea towards its mid-line – can and should be managed as a single unit.

There is strong logic to the German Bight fishery being managed as a single unit.

It is probable that the fisheries of the English and Bristol Channels – running from the Isle of Wight westwards to include fisheries off the coasts of counties Hampshire, Dorset, Devon and Cornwall, and covering the northern coasts of Cornwall and Devon – could be managed on a regional basis incorporating both inshore and offshore components, with probable functional sub-divisions. This area includes long-standing and broadly stable fisheries where there is a good chance that management rules can be based on or drawn from existing industry practices.

A similar approach could be taken with regard to the fisheries to the north of Ireland and west and north of Scotland, but here the situation is much more complex – primarily because fishing activity comprises a mix of long-established activity (for example in the inshore areas around the Outer Hebrides, the Inner Hebrides, the Orkney Isles and the Shetland Isles), and much more recently established, primarily offshore, fisheries (to the north of counties Donegal and Antrim, and the outer edges of the continental shelf to the west of the Outer Hebrides and northwards to the west of the Orkney Isles). Because of the more severe weather conditions occurring in this area, vessels tend to be larger overall, and a significant component of the fleet has vivier capacity and exploits both inshore and offshore grounds. It is probable that, for most of this fishery, management could be applied on the basis of inshore and offshore regimes, but there are some fleet components and some areas where this may not be an appropriate management solution – for example in the case of the Orkney Isles (where fishing takes place in inshore waters, but also along the north coast of Scotland, and in the offshore areas of Papa and Sule). It is this area to the north of Ireland and north and west of Scotland that poses the biggest logistical challenge in terms of area based management – but also the locus where some form of area based management is most sorely required.

Basis of management

Pot limits

In the first instance the basis of management is broad recognition of the need to stop the continuing escalation in overall fishing effort for crab – the total number of pot days. On the one hand as long as no cap is put on effort, owners are encouraged to increase fishing capacity and the number of pots fished. On the other there is wide expectation across the industry that some form of effort cap will be

put in place. Accordingly many of the larger scale enterprises have been strategically increasing landings and pots fished so as to put their businesses in the best possible position when caps are put in place. Getting a resolution, in the first instance, to the implementation of some form of cap will stop such activity, and create a platform of stability on which wider ranging management measures can be established. This will probably lead to a reduction in the volumes of crab landed in the medium and longer-terms, but we would caution that if over-generous caps, particularly applying to the smaller-scale operators, are implemented, short-term landings levels may well increase over current levels.

This said, there is no clear rationale as to the level at which caps should be set. Information from the monitoring of stock condition does not provide clear guidance on this, primarily because insufficient data are available on which to base rigorous assessment, but also because assessing stock condition in crabs is particularly difficult.

One logical approach would be first to cap effort at current levels – but there is not as yet clear nomination of the number of pots being fished by each vessel (though there is disclosure by some elements of the fleet as part of normal catch reporting procedures – mainly those fishing inshore waters - and regulations do allow for the capture of pot number data, but this option is not widely applied).

The fall-back position is thus to establish a basic formula for allocating maximum pot limits – on the basis of one or more of vessel length, deck area, crew numbers, VCUs, etc.. The impact of this process will in all likelihood be to set overall pot limits at figures well above those currently fished (i.e. the multiple of vessels per category and maximum pots per vessel in each category will far outstrip the actual number of pots currently deployed – once again creating a situation of substantial latent effort), on the basis that many vessels will not be fishing up to the limits set. This has the advantage of at least setting the cap, but will require that in subsequent years this cap will need to be brought down – for which a mechanism will still have to be devised.

As a matter of principle this is fine, but it would be much simpler if the number of pots that can be fished is more specifically moulded to the capacity of each vessel. If this cannot be achieved through a global administrative process, then at the very least it should be applied at the local level through area specific permit schemes. For these it might be appropriate to set an upper limit for the area as a whole, and upper limits per vessel by fleet metier. The incorporation of a pot-marking scheme in conjunction with this process (as, for example, used in Jersey – see case study in Chapter 7) improves the clarity of the process, though this comes at a cost and is by no means essential to the efficacy of the process.

Fleet metiers

There are four key parameters dictating the capacity of a vessel to fish brown crab – deck space (a proportion of length times breadth), engine power (kW), vessel volume (GRT), and number of crew.

National fleets are typically divided into metiers on the basis of size and the predominant gear used. The key size categorisations are typically under 10m, 10-15m, 15-24m, and >24m. Amongst the gear designations is typically shellfish static, and /or potting. In terms of potting for brown crab, length overall (Loa) is not an effective parameter in defining metiers in this sector since it is possible to have a highly efficient and effective “fast crabber” at 9.9m capable of fishing a similar number of pots to an older vessel of, say, 14m in length. Similarly a “fast crabber” can practically access grounds on a daily basis that a larger and less powerful vessel cannot.

Whilst most vessels in the fleet fish on a day basis, returning to base port each day, where a vessel is also fitted with some form of vivier holding facility, it has the option of staying at sea for two or more days. And when it comes to the larger vessels, in the Channel fisheries vessels tend to operate “between tide cycles” – with 9 day trips, whereas to the north and west of Ireland and Scotland vessels stay at sea until their tanks are full, and some carry a double crew so that pots can be hauled throughout the 24hrs of the day. These characteristics are not sufficiently reflected in the overall length of the vessel.

As far as designation as a potter is concerned, pots are used to fish lobster, nephrops, whelks, velvet crabs, green crabs and shrimp and as well as brown crab, and, as matters stand, a potting license allows an owner to shift focus between these fisheries. In addition, many owners holding a potting license also hold netting and/or dredging and/or trawling licenses that they use on a seasonal basis. Any allocations of pot numbers will need to be able to also accommodate retention of such flexibility in fishing activity as this forms a key element in the operations of at least a proportion of the brown crab fleet.

We are of the view that the brown crab fleet might be best divided into metiers on the basis of three characteristics:

- Vessel Capacity Unit (VCU), combining the characteristics of volume and power (VCU = (length x breadth) x (power x a constant)) – *captures elements of scale, and the geography of operation*
- Number of crew – *reflects the number of pots that can be hauled per day*
- Average vessel grossings per year (could be combined with the number of crew as grossings per crew member) – *reflects the commercial intensity of the fishing operation*.

Out of a fleet of some 3,700 vessels listed on fleet registers as licensed to engage in potting for brown crab, about 2,900 (78%) are vessels under 10m in length with engines of less than 50kW. Another 300 (13%) are slightly larger vessels (up to 12m) with engines of between 75 and 200 kW. This leaves some 350 vessels at the larger end of the fleet, registering VCUs above 500, incorporating vessel sizes from 9m up to 35m, and engine sizes from 100kW to 650kW.

The above suggestions are based on preliminary examination of fleet data (see Appendix 4), though we are not in a position to be in any way prescriptive in this matter – this area requires further, targeted and detailed, analysis. Nevertheless, we do believe that it is possible to come up with a generic tool for allocating pot limits per vessel based on the use of a composite of the above measurements. Over 90 per cent of the fleet will be found to comprise small one and two man vessels fishing relatively small quantities of brown crab and lobster in inshore waters. Fewer than 350 vessels will be found to be operating at a substantially larger scale than this, and where the nomination of maximum pot numbers is likely to be more critical, and should be more specific to the capacity of the individual vessel.

Landings limits

It is also evident that some form of output control – landings per area, and/or a landings limit per vessel – would also provide an effective management tool. But whilst there are problems, as with pot limits, in deciding exactly what the basis for setting landings limits might be, the bigger problem probably lies with establishing and allocating limits per vessel. In this instance the problem is less to do with how to allocate catch limits to the fewer than 350 vessels operating at a significantly larger scale than the other 90 per cent or more of the fleet – these vessels will have established fairly clear track records, and for most of them brown crab will make up more than 95 per cent of annual grossings (there are some exceptions, where vessels also fish whelks). The problem is more to do with how to set limits for the smaller scale operators without overly restricting their flexibility of operation.

In this context it is evident that most of the larger scale operators would be happy to operate to a per vessel quota based on track record. Since most of these vessels tend to exploit grounds outside the 6 mile limit (though they may also seasonally exploit fisheries within the 3 to 6 mile region), given the relatively small size of this fleet it may be possible to manage this fleet component separately from the rest of the fleet.

In this context, the scale of enterprise may provide a useful mechanism for clarifying fleet metier. A small single vessel enterprise fishing lobster and crab would expect to land about 100kgs of lobster per week, and between 200kgs and 1t of brown crab per week. At 200kgs of crab per week plus 100kgs of lobster, using average 2008 prices, this would yield a total landed value of some £75k per year; at 1t of crab per week plus 100kgs of lobster, this would equate to some £170k per year. As crab landings are

increased above an average of 1t per week, so the overall operation becomes more focused on crab, and lobster plays a much lesser role in revenues – i.e. these vessels are most likely to be dedicated brown crab potters. Also, a vessel that is targeting lobster will in all likelihood fish inshore waters, and can be managed under local permit schemes.

On this basis it might be feasible to look at a threshold of annual turnover of about £100k as separating those elements of the potting fleet that could be simply subject to a pot limit, and those more substantial businesses where both a pot limit and/or a catch quota ceiling might be an appropriate means of managing the fishery.

It should also be noted that a corollary of these processes – setting pot limits and landings limits - is that there should be no trading in crab entitlements; i.e. pot limits or landings limits cannot be enhanced through trade.

Determining how to vary effort / landings

The above provides a possible basis for setting a cap to fishing effort, but it does not provide a basis for varying effort to reflect changes in stock abundance / condition. Good practice suggests that this should be based on periodic assessment of the stock, and regular monitoring of stock status. As matters stand there is still some way to go to achieving broad and consistent assessment of the stock – though this is more related to the level of resources and priority given to this task, than to any particular problem associated with stock assessment. As a stock of significant commercial value we believe that greater priority should be given this task.

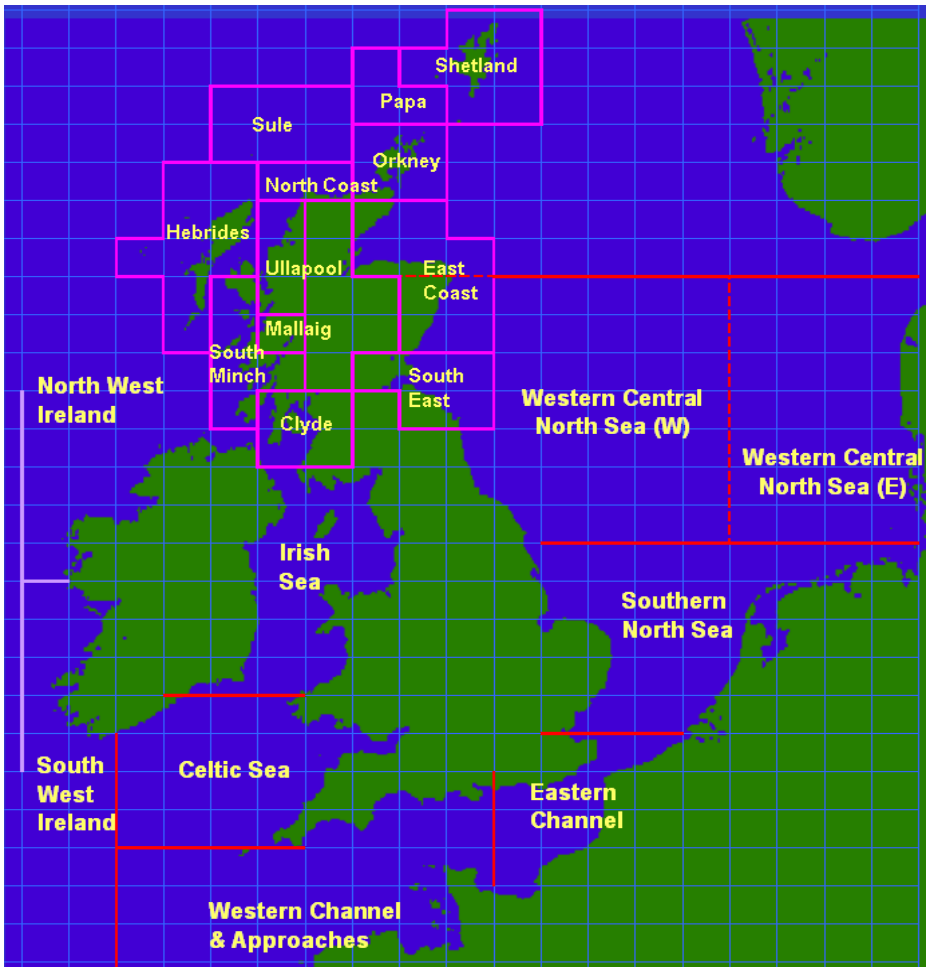
As to monitoring stock status, and using the outputs of such monitoring to allow variation in effort and landings, this is conceptually simpler, but more difficult to put into practice. The parameters to be monitored are most likely to be catch per unit effort (CPUE) and the size and gender composition of catches. Here the biggest obstacle seems to be the need to generate standardised data. Ideally this should relate to a particular type of pot, baited with a standard bait and left in the water for a fixed period of time before being lifted and the catch examined. At present relatively limited CPUE data are routinely analysed, though data are routinely collected and stored in one form or another. This needs to be remedied. The more data that are collated and analysed, the less important distortions of pot type and soak time become – to an extent. In addition, however, it will still be necessary to develop data sets that record standard CPUE – particularly in relation to soak time.

Such data series can then be used as a management tool to influence how total pot numbers and total landings from a management area can be varied between years. For example, the *status quo* established for a particular management area might be a ceiling of 1,400t of crab, an inshore pot ceiling of 50,000 pots, pot days of 10 million, and a recorded CPUE of 0.02kg per pot per day (maximum potential catch 600t), and offshore a pot ceiling of 20,000 pots, pot days of 4 million, and a recorded CPUE of 0.6kg per pot per day (maximum potential catch of 800t) (an example based roughly on the conditions found in the south Yorkshire crab fishery). As CPUE varies outside pre-defined ranges, so changes can be made to pot and landings caps. The basis for setting up such an arrangement – a Harvest Control Rule (HCR) – should be determined by the stock condition given by a stock assessment, and information on how that condition is likely to change under different HCRs.

Stock management units

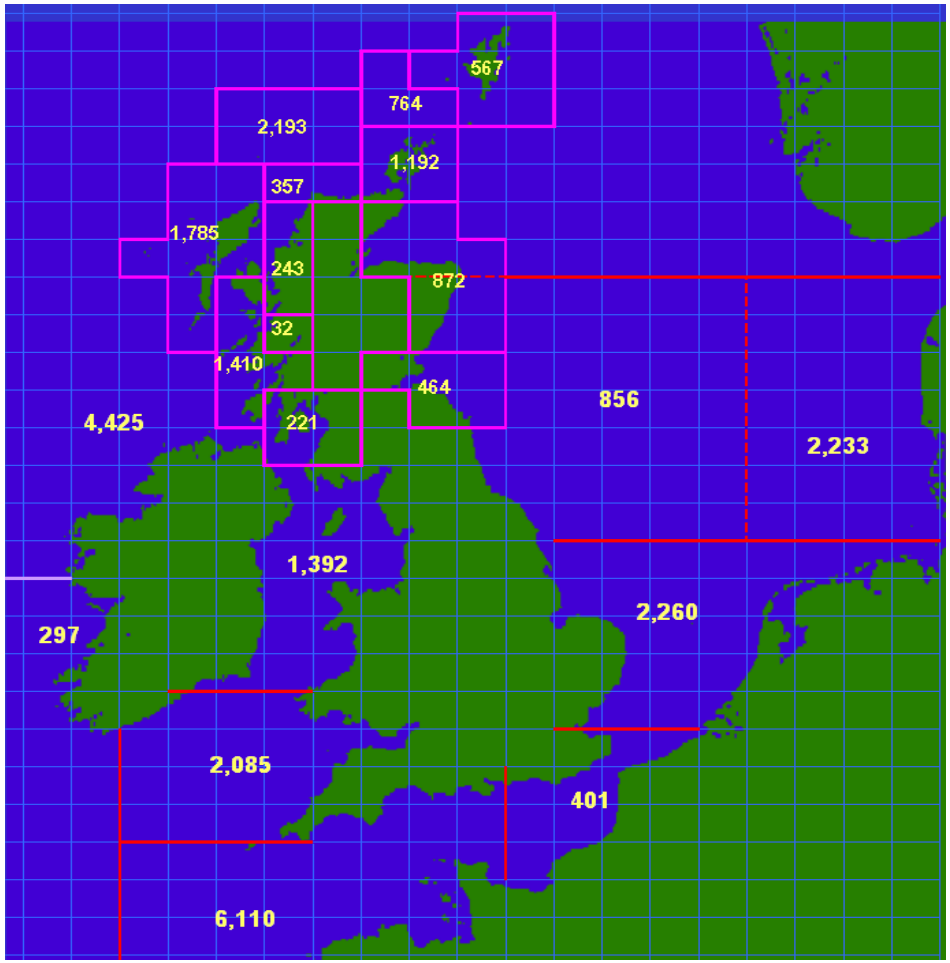
Whilst monitoring of crab stocks has been undertaken in different areas around the British Isles, there does not appear to be clear evidence of regional stock components – functional biological separation. On the other hand the life cycle of brown crab is well understood, and reasoned arguments can be presented to support the idea that, for any given sea area, as long as that area includes both inshore and adjacent offshore areas there is a high likelihood that most of the recruitment to that stock unit might be expected to originate from the progeny of the adults found in that area. The larger the area of the stock / management unit, the more likely this argument is to hold true.

Fig 42 – Current brown crab stock monitoring areas



Source: Cefas and Marine Scotland: Science

Fig 43 - 2008 brown crab catches by UK (incl. IoM & CI) and RoI fleets, by those areas (stock components) monitored by UK and Irish fishery laboratories



Source: derived from national statistics, and areas monitored by Cefas, Marine Scotland and Marine Institute fishery scientists

In the British Isles stock condition is currently monitored on the basis of a small number of regions, as shown in Fig 42. These fit well with the requirements of the fishery management units, though consideration might be given to trying to reduce the number of monitoring areas used in Scotland. Fig 43 indicates how the distribution of landings by management unit looks.

It is suggested that stock models be developed and tested for each of these areas to assess the levels of confidence that can be placed in assessments of stock status and stock dynamics. This information can then be used to inform management on a more local basis – for example the establishment of local HCRs.

It should be stressed, however, that the absence of robust stock models should not be used as an excuse not to progress with the capping of pots and landings on a regional basis, and the allocation of per vessel caps across the fleet exploiting fisheries in each area.

Action areas

On the basis of the above, there are a number of areas where immediate action is required to move the management of the crab fishery, and capping of fishing effort, forward.

The first is for industry and government to reach broad agreement on how the sector is to be managed – ideally more or less along the lines outlined in the above.

To provide for the development of more specific proposals as to how pot limits and landing limits can be allocated across the fleet, further analysis of brown crab fleet metiers needs to be undertaken. Defra holds the relevant data-sets for such analysis for the UK. The Irish Sea Fisheries Protection Authority holds such data-sets for Ireland.

There is an urgent requirement to establish more clearly how latent effort can be removed from the crab fleet, or the threat to the effective management of the brown crab fishery posed by this latent effort satisfactorily defused and/or removed. As described, this can be achieved through the establishment and then exercise of sunset clauses, or can be accelerated by some form of entitlement buy-back. In the inshore regime at least, in some jurisdictions it could be achieved through locally applied permit schemes – as is already used by some England SFCs. The legal basis of these proposals needs to be checked through, and strategies for implementation prepared.

It will also be necessary to give further consideration to the impact of any of the proposed management changes on those vessels that currently target lobster, whelks, nephrops, and velvet crab – where in some if not most cases they will retain at least some entitlement to switch effort onto brown crab at any time in the future should they so wish. In most cases this can probably be addressed through local inshore management regimes, but this needs to be thought through carefully.

Overall, we are of the view that a number of management areas, broadly equivalent to the current stock assessment boundaries used by Cefas (England & Wales), Marine Scotland: Science (Scotland), and the Marine Institute (Ireland) should be agreed upon. Further discussion will be required to achieve this with respect to the west and north of Scotland where it makes sense to combine some of the current stock assessment areas into larger management areas. For each of these areas an upper ceiling should be set for pot numbers and landings set at no higher than the levels operating today. Where appropriate these levels should be sub-divided between inshore and offshore regimes.

Pot limits, per vessel, should be established based on the outcome of the further analysis of fleet metiers described above.

For those vessels with a turnover in excess of something like £100k per year, a per vessel landings quota should be considered as an additional management tool, set at levels based as a proportion of recent landings levels. This has particular relevance as a management tool in the area to the north west of Ireland and the west and north of Scotland where there has been significant

year on year growth in fisheries in recent years, and where a cap needs to be placed on the scale of these fisheries as a matter of urgency. In most other areas of the British Isles the pattern and level of crab exploitation has been developed over a long period of time and fishing activity and corresponding management systems are generally stable. In these areas it can be argued that greater priority should be given to removing latent effort and developing the mechanisms by which pot numbers can be varied according to assessments of stock condition (as probably reflected in changes in CPUE).

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Appendix 2 – Crab Landings - UK & ROI Fleets

Landings data is recorded at a national level by the following bodies:

- England, Wales and Northern Ireland: Marine and Fisheries Agency (MFA)
- Scotland: Marine Scotland: Compliance
- Ireland: Dept. of Agriculture, Fisheries and Food pre-2007, and since 2007 Sea Fisheries Protection Authority

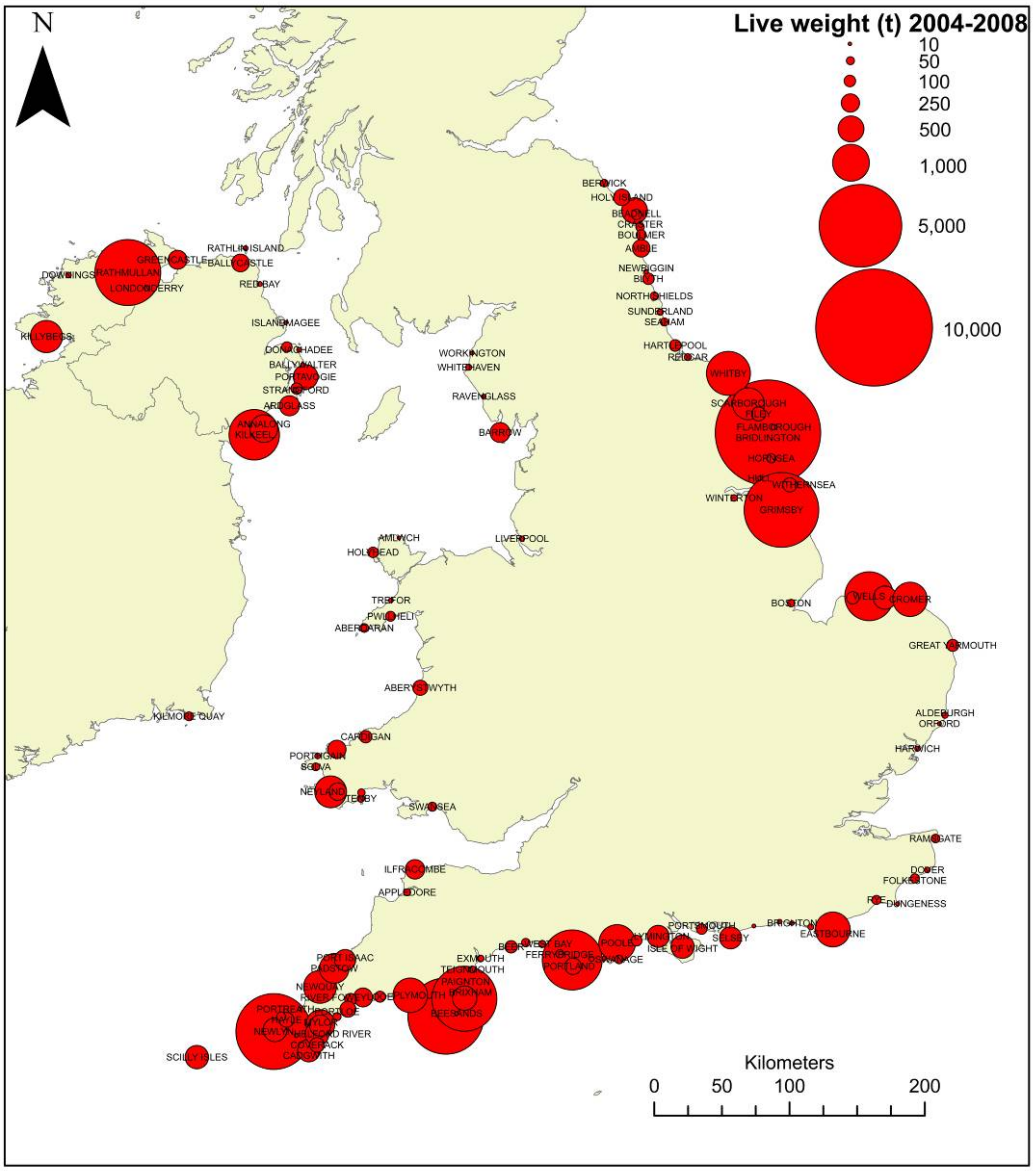


Figure A1.1 Live weight of Brown crab landed into English, Welsh and Northern Irish ports 2004-2008, showing ports that landed >10 tonnes (Data provided by the MFA).

MFA data shows that during the last five years the highest of brown crab landings (tonnes, live weight landed) have been concentrated around: ports on the central east coast of England such as Bridlington and Grimsby; ports on the south west coast of England such as Salcombe, Newlyn, Dartmouth and Weymouth and ports on the North coast of Northern Ireland such as Rathmullan and Kilkeel (Figure A1.1 and A1.2). Other ports located on the south and east coasts of England such as Wells, Whitby, Poole, Cromer, Kingswear and Newquay are also important for landings of brown crab as is Killybegs located on Northern Ireland's south west coast (Figure Xa and Xb).

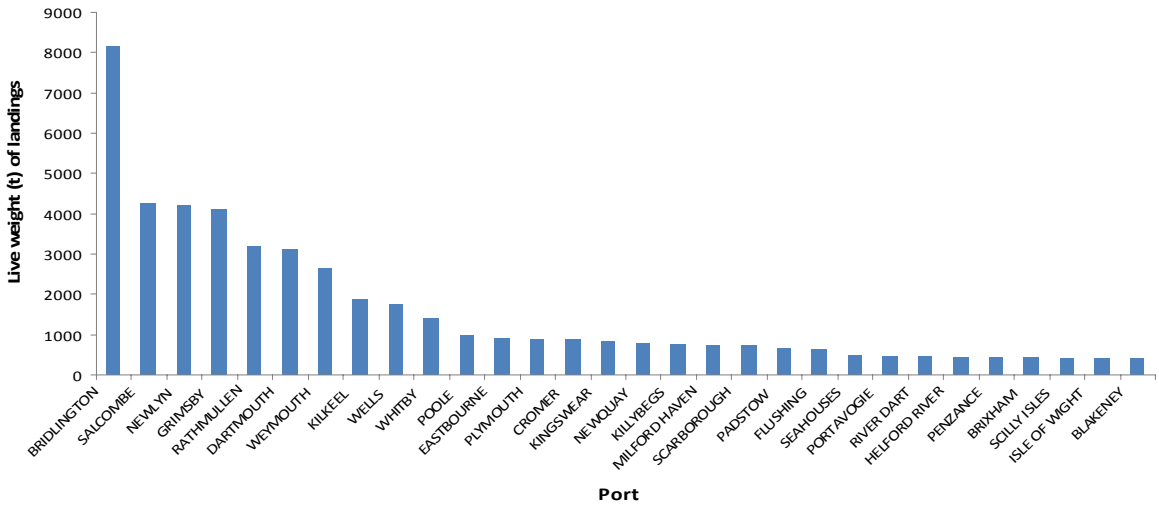


Figure A1.2 Live weight of Brown crab landed into English, Welsh and Northern Irish ports 2004-2008 showing the top 30 ports (Data provided by the MFA).

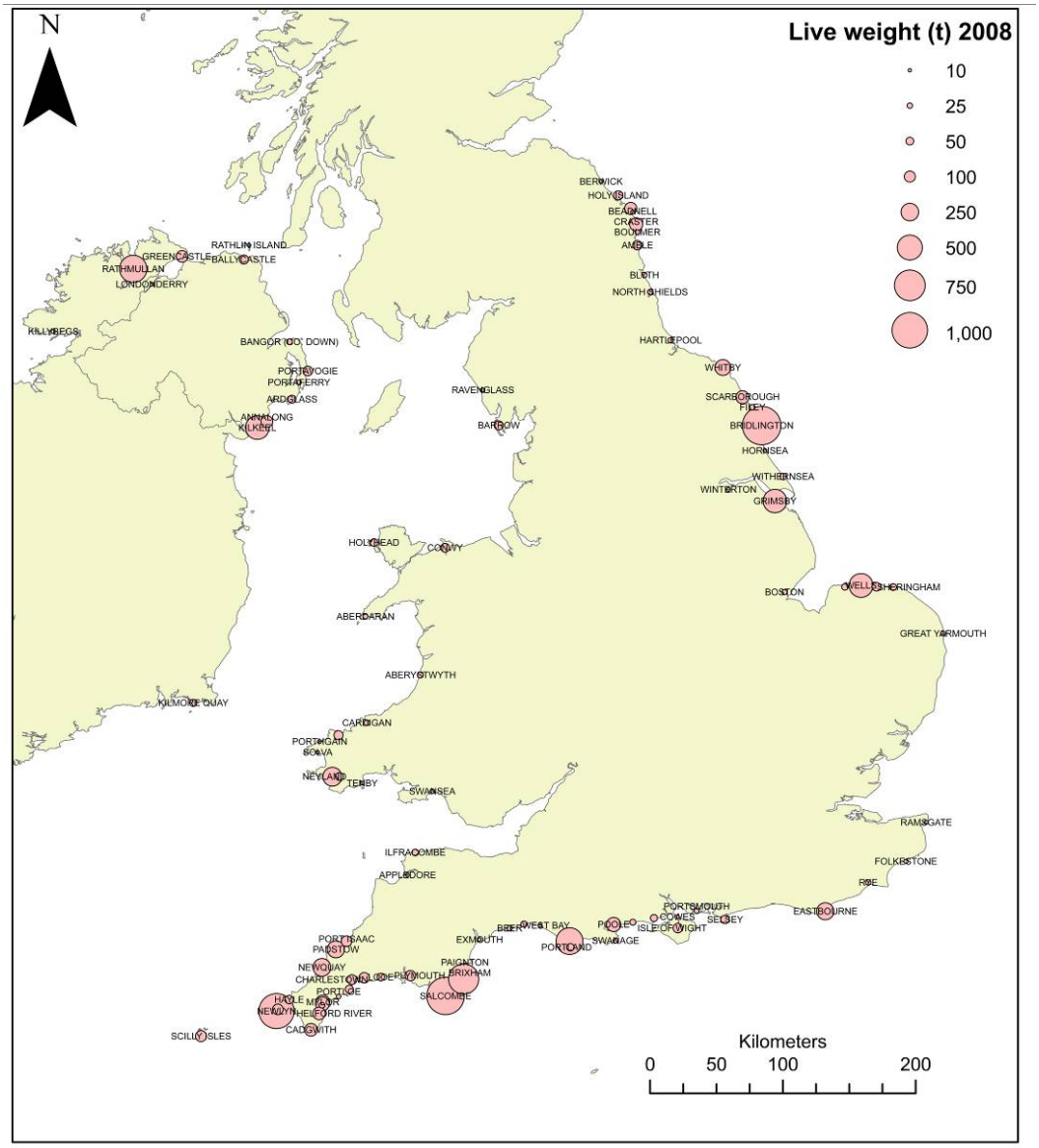


Figure A1.3 Live weight (t) of brown crab landed into English, Welsh and Northern Irish ports in 2008 showing ports that landed >10 tonnes (Data provided by the MFA).

The majority of ports with high landings over the last five years also landed large amounts in 2008. Nine of the top ten ports over the last 5 years were also in the top ten for 2008, notably only Whitby was absent and had the 14th highest landings in 2008 (Figure A1.3 and A1.4). Landings at Whitby reached a peak of nearly 370 tonnes in 2006 and 2007 before dropping to nearly half that in 2008.

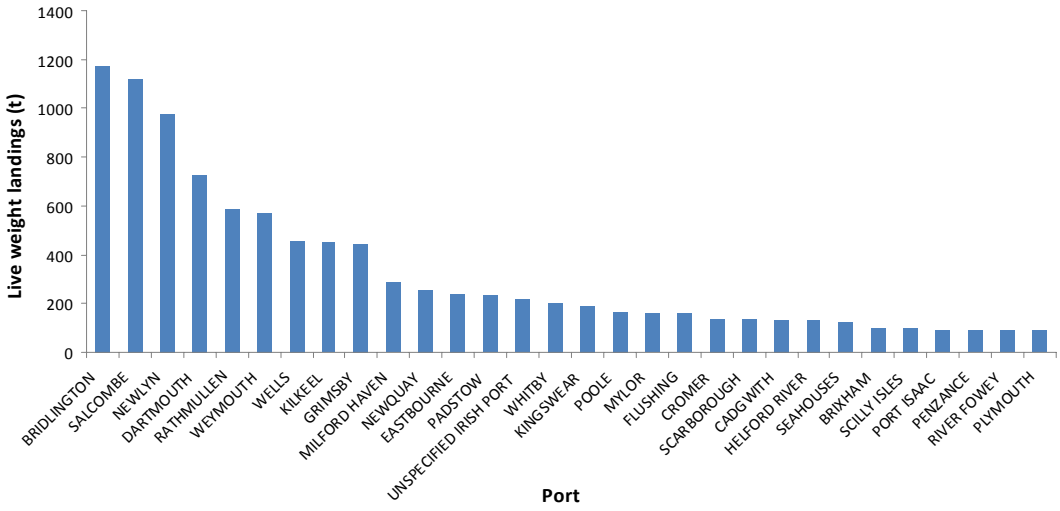


Figure A1.4 Live weight (t) of brown crab landed into English, Welsh and Northern Irish ports in 2008, showing the top 30 ports (Data provided by the MFA)

With Whitby absent from the top ten ports with the highest landings in 2008, landings at Milford Haven were the 10th highest. Landings at Milford Haven were much higher in 2008 than they had been in the previous 4 years.

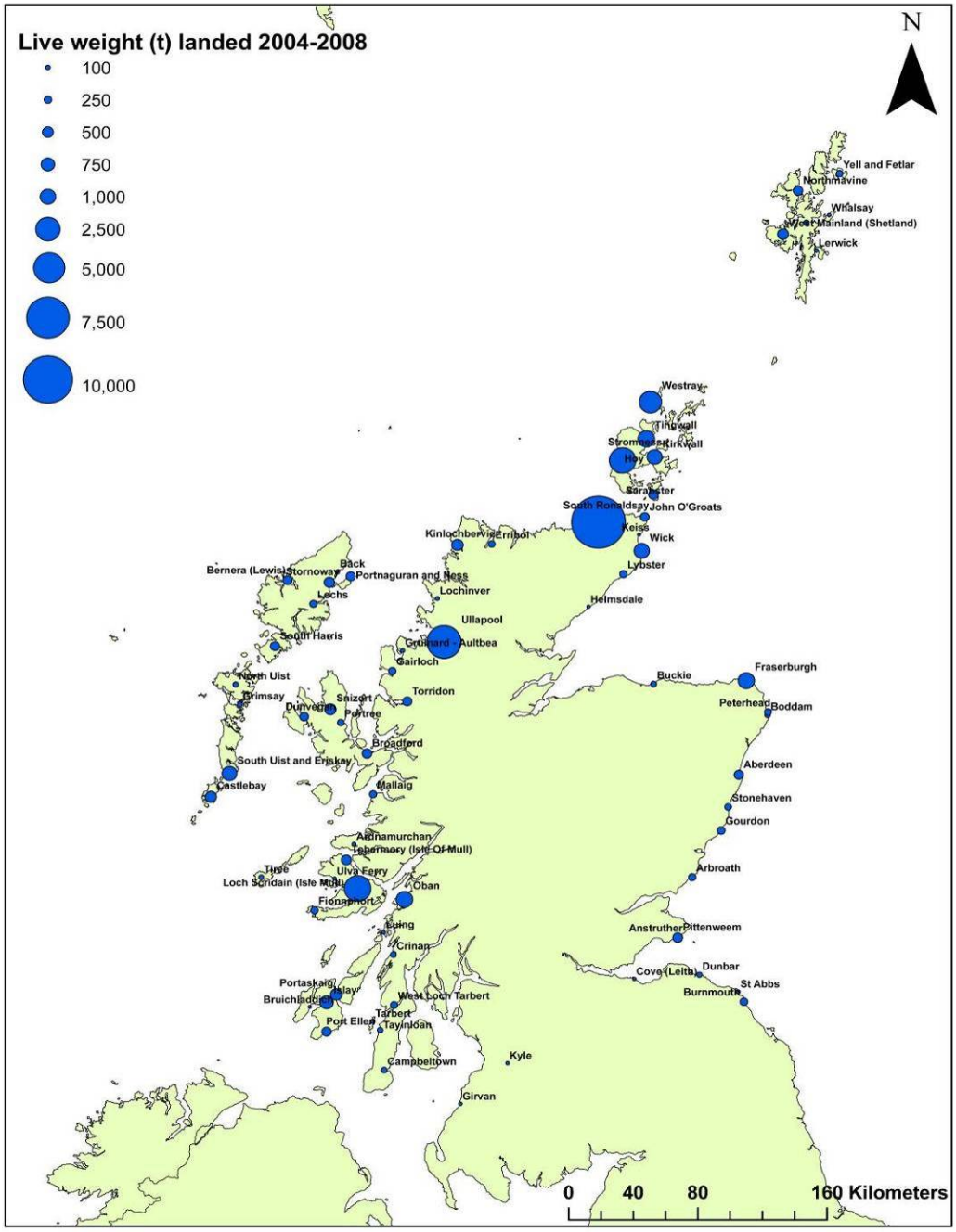


Figure A1.5 Live weight (t) of Brown crab landed into Scottish ports in the last five years, 2004-2008 (Top 30 ports)

Marine Scotland data shows that high landings of brown crab in Scotland over the last 5 years occurred: on the north coast at ports such as Scrabaster; on the west coast at ports such as Ullapool and Loch Scridain (Isle Mull) and on the Orkney Islands at ports such as Stromness and Westray (Figure A1.5 and A1.6). This Pattern was also seen when 2008 data was analysed separately (Figure A1.7), showing that 2008 represents a typical year in terms of locations in Scotland at which brown crab are landed.

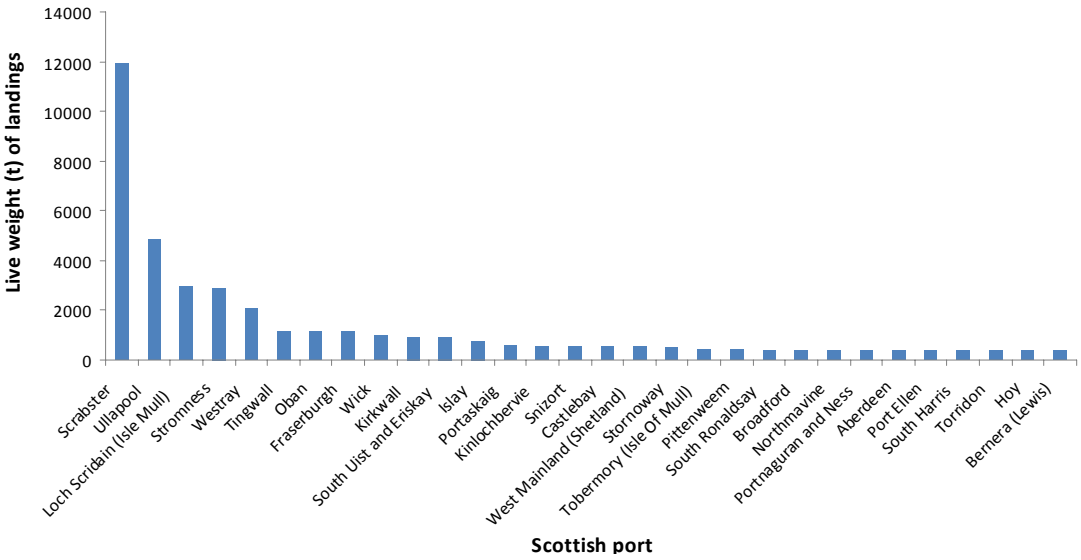


Figure A1.6 Live weight of Brown crab landed into Scottish ports in the last five years 2004-2008 (Top 30 ports)

Eight of the top ten Scottish ports which landed the largest amounts (tonnes) of brown crab over the last five years were also in the among the ten highest in 2008 (Figure A1.4 and A1.6), with the exceptions being Oban which landed only the 25th highest amount in 2008 and Kirkwall which landed the 12th highest amount.

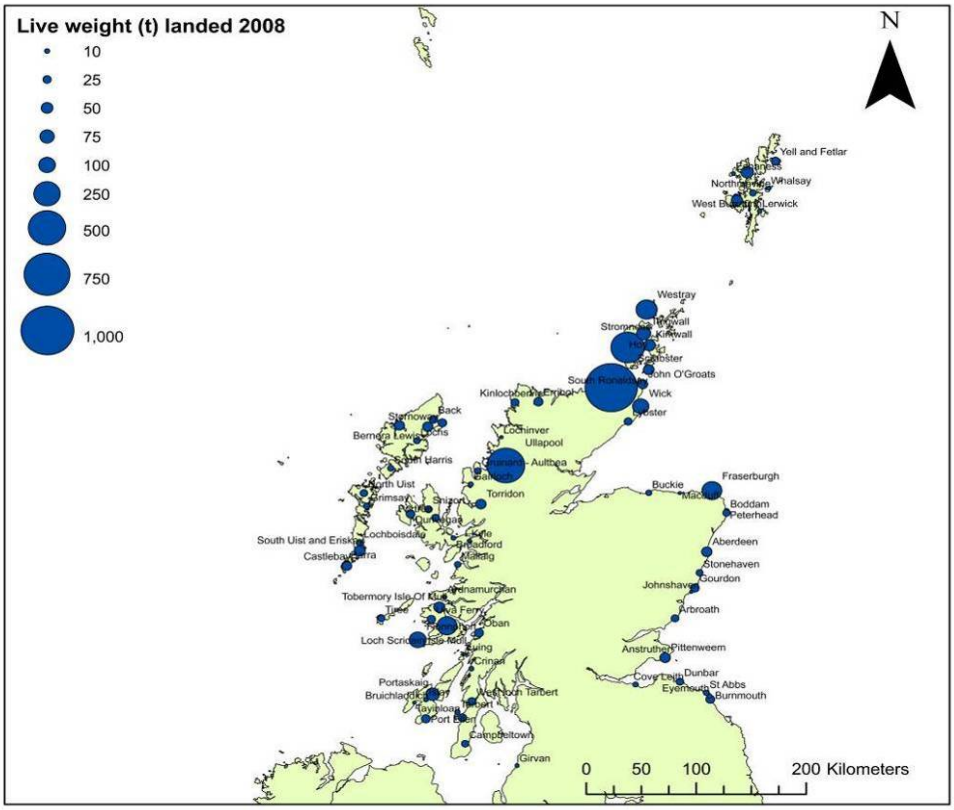


Figure A1.7 Live weight (t) of Brown crab landed into Scottish ports in 2008 (Top 30 ports)

Landings at Oban and Kirkwall in 2008 were the at their lowest of the last five years with landings at Oban in 2008 being only 11% of those seen four years earlier and landings at Kirkwall appearing to be declining slightly year on year.

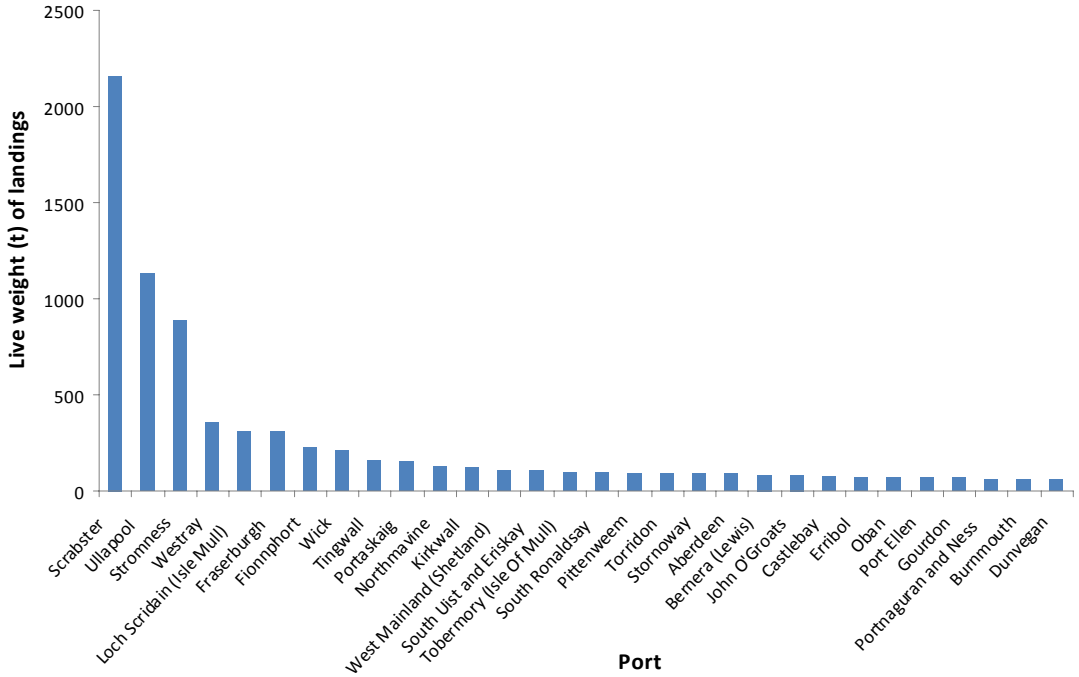


Figure A1.8. Live weight (t) of brown crab landed into Scottish ports in 2008 (top 30 ports)

According to the data provided by the BIM the majority of brown crab landed into Irish (Republic of) ports was caught off the northern and western coasts (Figure A1.9). The ICES rectangle from which the most brown crab was landed was 40E2 (Figure A1.10).

Note: data provided by the BIM does not include the port of landing, and therefore figures compiled using this data are not comparable to Figures A1.1 and A1.3.

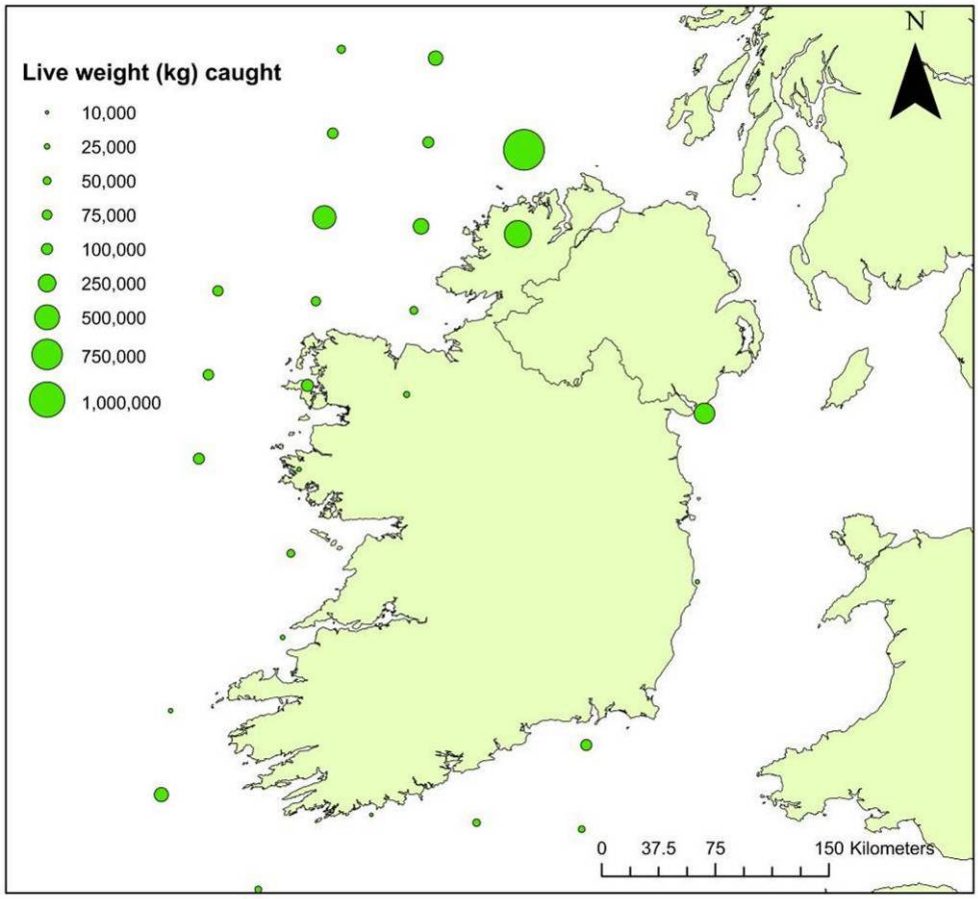


Figure A1.9 Live weight (kg) caught from ICES rectangles and landed into Republic of Ireland ports in 2008.

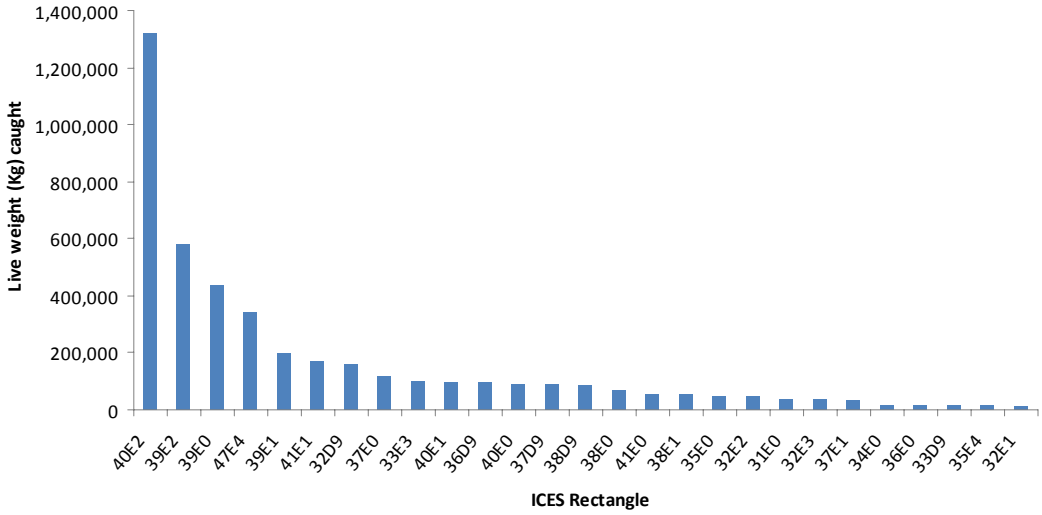
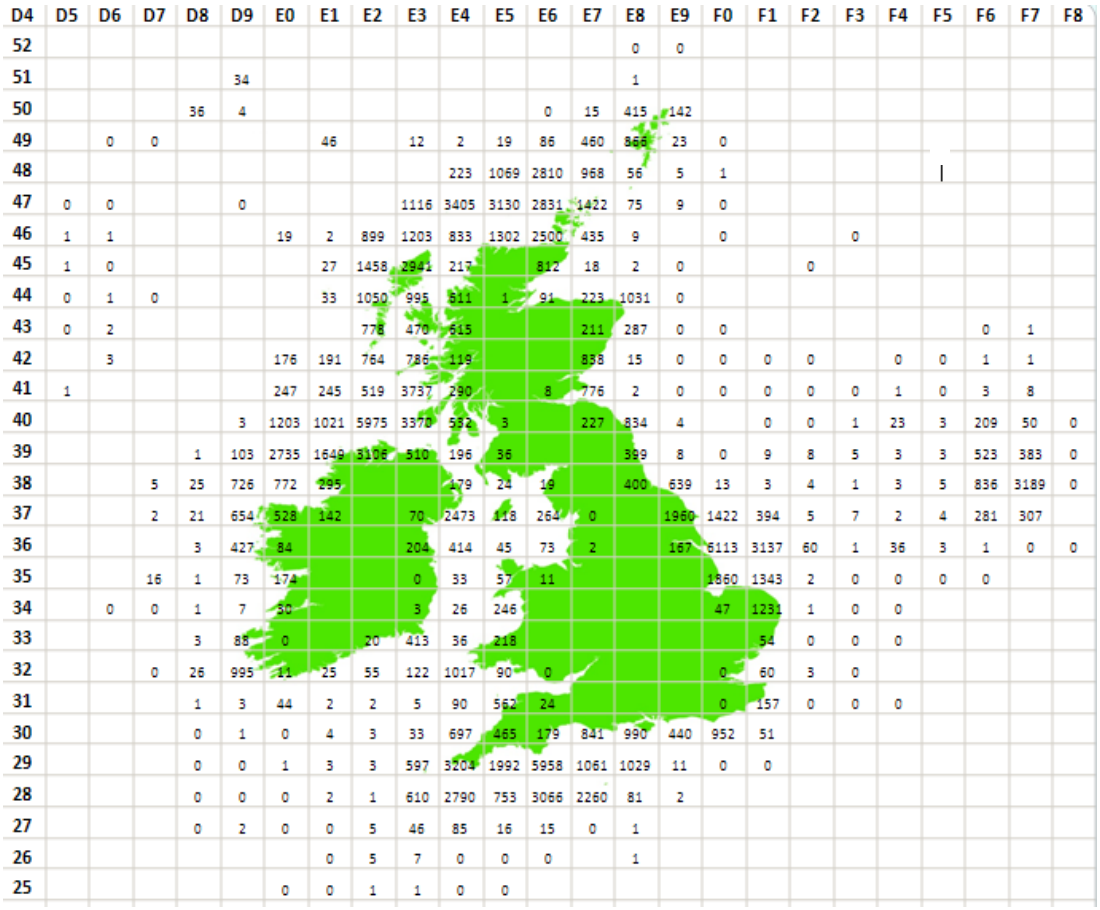


Figure A1.10 Live weight (kg) caught by ICES rectangle of Brown crab and landed in Republic of Ireland ports in 2008 (top ICES rectangles).

Over the last 5 years the majority of brown crab landed into the UK and the Republic of Ireland was landed from: the western English Channel, the north western North Sea off the Yorkshire and Lincolnshire coast, the eastern North Sea and off the Northern and western coasts of Scotland (Figure A1.11)



D4	D5	D6	D7	D8	D9	E0	E1	E2	E3	E4	E5	E6	E7	E8	E9	F0	F1	F2	F3	F4	F5	F6	F7	F8
52														0	0									
51					34									1										
50				36	4							0	15	415	142									
49		0	0				46		12	2	19	86	460	866	23	0								
48										223	1069	2810	968	56	5	1								
47	0	0			0				1116	3405	3130	2831	1422	75	9	0								
46	1	1				19	2	899	1203	833	1302	2500	435	9		0			0					
45	1	0					27	1458	2941	217		812	18	2	0			0						
44	0	1	0				33	1050	995	811	1	91	223	1031	0									
43	0	2						778	470	615			211	287	0	0						0	1	
42		3				176	191	764	786	119			838	15	0	0	0	0		0	0	1	1	
41	1					247	245	519	3737	290		8	776	2	0	0	0	0	0	1	0	3	8	
40					3	1203	1021	5975	3370	532	3		227	834	4		0	0	1	23	3	209	50	0
39				1	103	2735	1649	3108	510	196	36			399	8	0	9	8	5	3	3	523	383	0
38			5	25	726	772	295			179	24	19		400	639	13	3	4	1	3	5	836	3189	0
37			2	21	654	528	142		70	2473	118	264	0		1960	1422	394	5	7	2	4	281	307	
36				3	427	84			204	414	45	73	2		167	5113	3137	60	1	36	3	1	0	0
35			16	1	73	174			0	33	57	11				1860	1343	2	0	0	0	0		
34		0	0	1	7	30			3	26	246					47	1231	1	0	0				
33				3	88	0		20	413	36	218						54	0	0	0				
32			0	26	995	11	25	55	122	1017	90	0				0	60	3	0					
31				1	3	44	2	2	5	90	562	24				0	157	0	0	0				
30				0	1	0	4	3	33	697	465	179	841	990	440	952	51							
29				0	0	1	3	3	597	3204	1992	5958	1061	1029	11	0	0							
28				0	0	0	2	1	610	2790	753	3066	2260	81	2									
27				0	2	0	0	5	46	85	16	15	0	1										
26							0	5	7	0	0	0		1										
25						0	0	1	1	0	0													

Figure A1.11 All landings (tonnes) of brown crab landed into UK and Republic of Ireland ports from ICES rectangles as recorded by the MFA, Marine Scotland and the BIM between 2004 and 2008.

Landings into the UK and Republic of Ireland fluctuated over the last five years being at there lowest in 2005 and at their highest in 2006 (Figure A1.12)

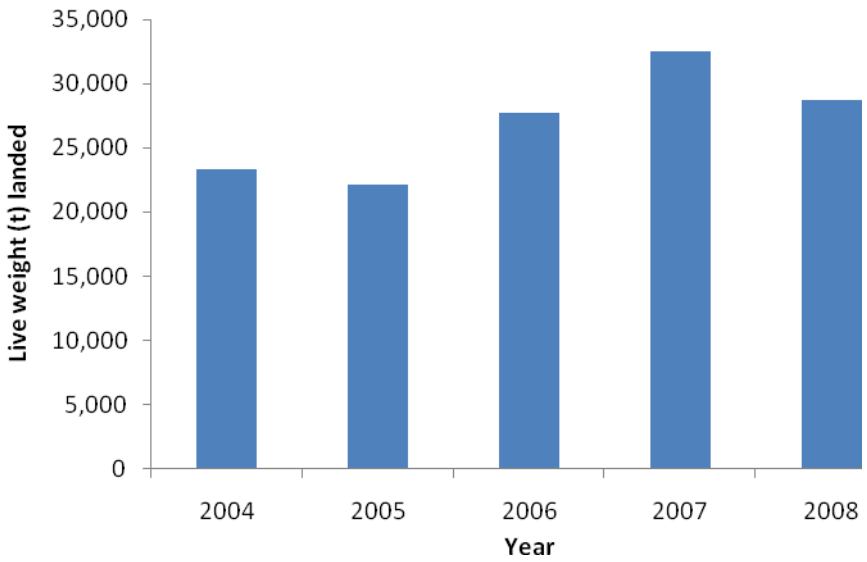


Figure A1.12 All landings of brown crab into ports in the UK and Rebublic of Ireland by year. Data provided by the MFA, Marine Scotland and BIM.

Appendix 3 – Questionnaire distributed at industry workshop

#	Management Measure	Strongly agree	Agree	Neither	Disagree	Strongly disagree
1	**Access restrictions**					
	a. Maximum vessel size of 10m within 3nm					
	b. Maximum vessel size of 15m within 3-6nm					
	c. No vessels with onboard tank live storage (viviers) within 6nm					
	d. Zonal management i.e. for potting and other fishing methods					
2	**Pot limitations**					
	a. Pot limits only within 6nm (i.e. other management outside 6nm)					
	b. Banded limit scaled by vessel length (e.g. different pot limits for under 8m, 8-10m, 10-12m, 12-15m and over 15m)					
	c. Banded limit scaled by vessel power					
	d. Single maximum pot limit for all vessels					
	e. Freeze existing pot numbers for each vessel					
3	**Shellfish licences / permits**					
	a. Introduce sunset clause to remove unused shellfish licences					
	b. Introduce permit system					
	c. Introduce permit system in conjunction with pot limits					
4	**Quotas and TACs**					
	a. Introduce quotas based on reference period for all vessels					
	b. Introduce quotas only for vessels fishing outside 6nm (assuming inside 6nm managed via pot limits)					
5	**Returning crab & MLS**					
	a. Return berried or soft crab					
	b. Return crippled crab					
	c. Reduce or ban landing of crab claws					
	d. Increase MLS by 10mm in steps					
6	**Gear**					
	a. Ban parlour pots (replacements fundable under EFF)					
	b. Introduce escape hatches to all pots					

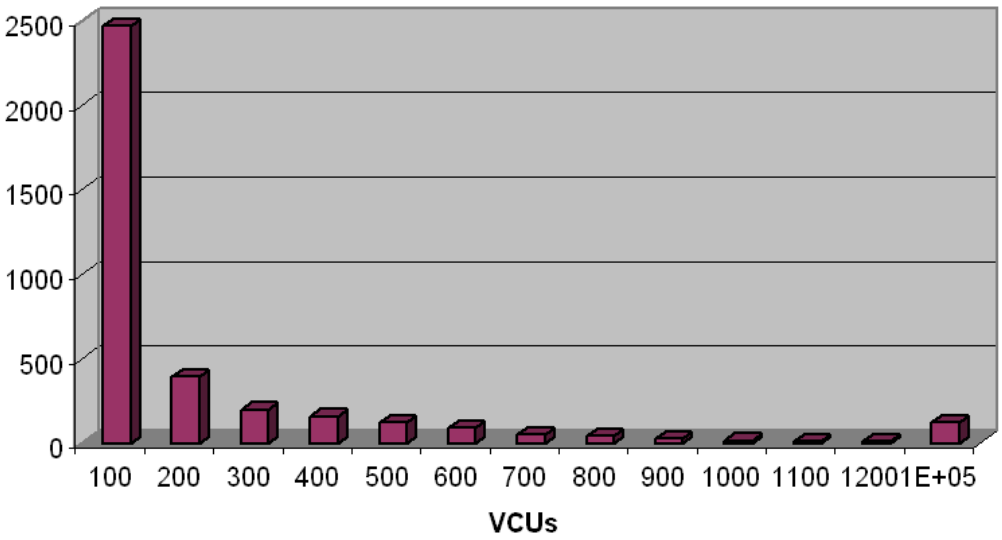
Information about you & your brown crab fishery

7	**Position in industry**	fisherman		trader	process.	manager	scientist
8	**Type of vessel**	full-time	part-time	<10m	10-15m	>15m	super crabber
9	**Scale of operation**	<300 pots		<500	<1000	<1500	>1500

Appendix 4 – Indicators of how to divide the fleet into metiers

The UK and Irish fleet of vessels with licenses to fish brown crab with pots numbers nearly 3,700 vessels. Over 90 per cent of this number may be reasonably assessed as small scale – small in size and fitted with low powered engines. Fig A4.1 illustrates this, showing the distribution of these vessels according to VCU - (length x breadth) x (a constant x engine power).

Fig A4.1 – Frequency distribution of the crab fleet by VCU



The following graphics explore whether or not characteristics of these vessels can be used to sub-divide the largest of these vessels (>1,000 VCU) still further on any functional basis.

Fig A4.2 – The distribution of the 148 largest vessels (registering over 1,000 VCU) according to Length Overall (Loa)

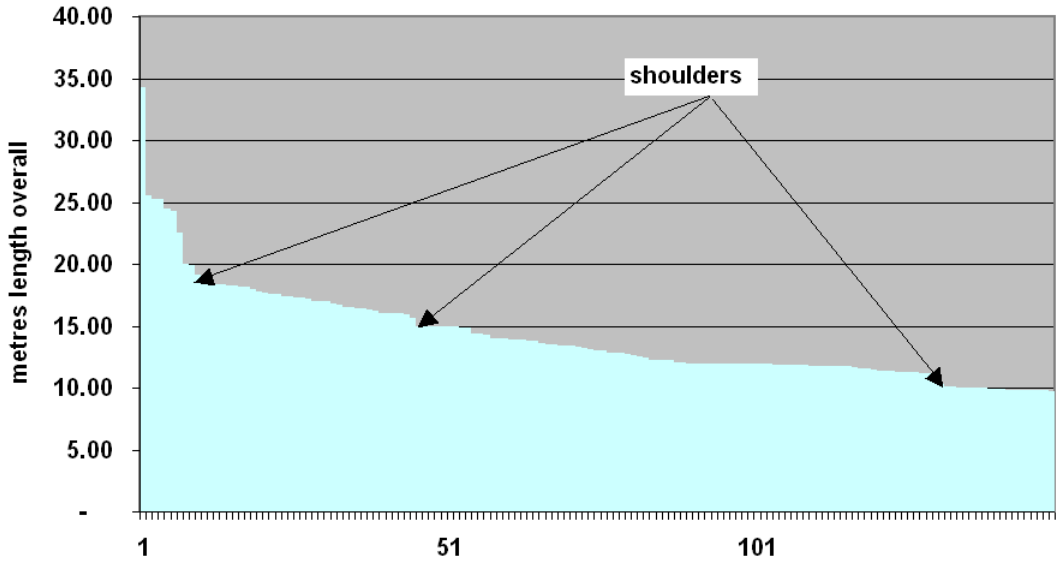


Fig A4.3 – Distribution of the 148 largest vessels (registering over 1000 VCU) according to GRT

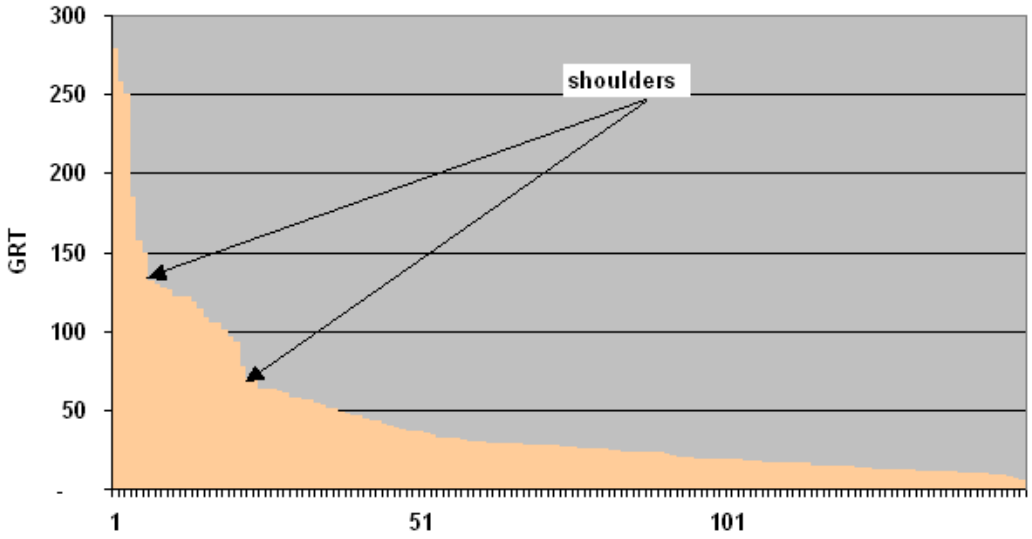


Fig A4.4 – Distribution of the 148 largest vessels (registering over 1000 VCU) according to engine power (kW)

Fig A4.5 – Distribution of the 148 largest vessels (registering over 1000 VCU) according to VCU