FINAL REPORT TO:

NORTHERN IRELAND FISH PRODUCERS ORGANISATION (NIFPO)

Northern Ireland Brown Crab Strategy

Department of
Agriculture and
Rural Development
www.dardni.gov.uk

AN ROINN
Talmhaíochta agus
Forbartha Tuaithe

MÄNNYSTRIE O
Fairms an
Kintra Fordèrin

European Fisheries Fund
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POSEIDON
Aquatic Resource Management Ltd

TEL.: 01590 610168
info@consult-poseidon.com
http://www.consult-poseidon.com

Disclaimer and Report Information

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Poseidon Aquatic Resource Management Ltd, Windrush, Warborne Lane, Portmore, Lymington, Hampshire SO41 5RJ, UK

Tel: 01590 610168
Email: info@consult-poseidon.com
URL: http://www.consult-poseidon.com

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Acronyms

AFBI	Agri-Food and Biosciences Institute
ANIFPO	Anglo-Northern Irish Fish Producers Organisation
CEFAS	Centre for Environment Fisheries and Aquaculture Science (England & Wales)
CPUE	Catch Per Unit Effort
CW	Carapace Width
DARD	Department of Agriculture & Rural Development
EC	European Commission
ENIS	European Nature Information System (ENIS)
GIS	Geographical Information System
ICES	International Council for Exploration of the Seas
IFCA	Inshore Fisheries and Conservation Authority (England)
IFG	Inshore Fisheries Group (Scotland)
IQF	Individually Quick Frozen
MESH	Mapping European Seabed Habitats (a European research project)
MLS	Minimum Landing Size
MFA	Marine Fisheries Agency (England & Wales, now replaced by MMO)
MMO	Marine Management Organisation
MSC	Marine Stewardship Council
MSY	Maximum Sustainable Yield
NCLFA	North Coast Lobster Fishermen's Association
NELCO	North East Lobster Fishermen's Organisation
NI	Northern Ireland
NIFPO	Northern Ireland Fish Producers Organisation
NIPFC	Northern Ireland Pot Fishing Council (a proposed group)
PO	Producer Organisation
QUB	Queen's University Belfast
SAGB	Shellfish Association of Great Britain
SFC	Sea Fisheries Committee (in England & Wales; to be replaced by IFCAs)
SSCF	Small Scale Coastal Fisheries

SUMMARY

Extensive consultation with those involved in the Northern Ireland crab fishery identified the need for improved management of brown crab and other inshore fisheries. The potential for more localised management is evident, but additional organisation and representation at a local level is required.

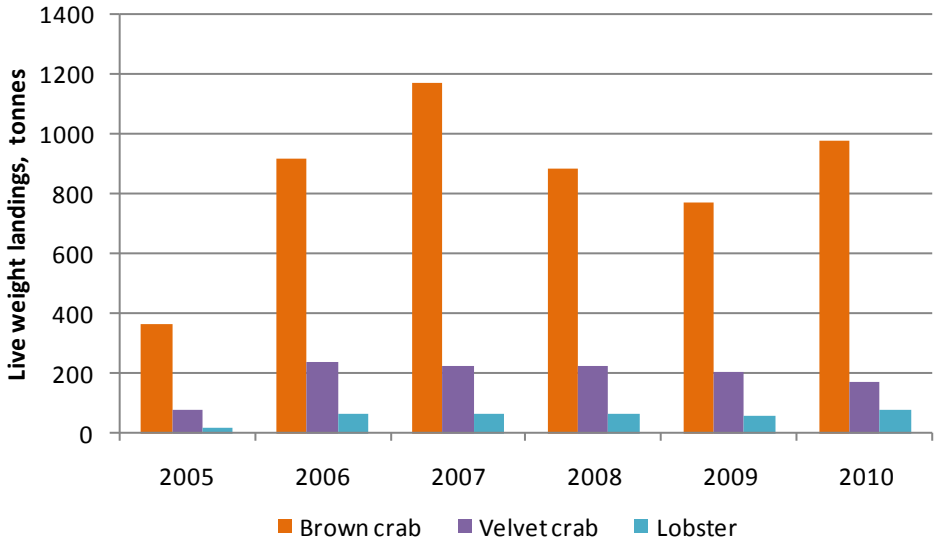
The following strategy is proposed to progress local management in parallel with a number of other components to improve the fishery (legislation, marketing & science), ensuring the sustainability of the crab resource in Northern Ireland and the potting fleet dependent on it.

Effective industry consultation remains a key component of the strategy going forward.

I. THE FISHERY

Northern Ireland's potting fleet landed around 1,000 tonnes of brown crab into NI ports in 2010 (figure I). This is an increase of 27% (by weight) on 2009 landings, but lower than the recent peak of 1,170 tonnes of brown crab landed into Northern Ireland in 2007. For velvet crab, after a significant increase across 2005-2006, landings have remained stable over the past four years at approximately 230 tonnes with a slight decrease in 2010. Lobster landings remained fairly consistent across 2006 to 2009 at around 60 tonnes, with an increase to 78 tonnes in 2010.

Figure I: Live weight landings (tonnes) of brown crab, velvet crab & lobster into Northern Irish ports from 2005 to 2010.



Source: DARD, 2011

Landings into Northern Ireland occur throughout the year, the targeted fishery is from June to December with peaks in September and October.

There are substantial landings of crab by UK vessels into the Republic of Ireland, some of which is caught in Northern Ireland's waters. Under the *Voisinage* agreement, Republic of Ireland vessels are also permitted to fish in Northern Ireland's inshore waters, landing their catch back in Republic of Ireland ports. This additional fishing effort is important to consider in the future management of crab in Northern Ireland's waters.

Crab caught by the larger Northern Irish vessels towards the North West is most likely from the north western stock, which is also subject to fishing by vessels from the Republic of Ireland and from Scotland. Crab landed from the north coast east of Inishowen could also belong to this north western stock.

There are indications that vessels catching crab on the Irish Sea coast are exploiting a separate, but so far unidentified and undefined stock, possibly with links into wider Irish Sea populations. Such crab may or may not show inshore-offshore migrations comparable to those observed further west. Further investigation into stock distribution is proposed as part of the strategy.

II. THE FLEET

The Northern Ireland fishing fleet remains focused at the three east coast fishing ports of Ardglass, Kilkeel, and Portavogie. However an increasingly significant proportion of the under 10 meter fleet also operates from numerous small harbours around the coast.

Between 1995 and 2010 the Northern Irish under 10m fleet grew by 22% as the number of over 10m vessels decreased by 34%.

Of the 214 under 10m registered vessels at 1st October 2010, 184 (86%) have a shellfish entitlement. This represents a large amount of latent capacity in the fleet.

The large increase in pot numbers in recent years results from more vessels entering the fishery with landings recorded at 37 landing points in 2009 compared to 26 in the previous year. The number of pots fished by NI vessels targeting crab is estimated to total at least 17,500 (60% from the Co. Down ports, 28% on the North Coast and the remainder between Larne and Strangford Lough). There are also vessels based in the Republic of Ireland setting pots in NI waters. The entry of one large vessel into the fishery would substantially increase the fishing capacity.

Four geographically distinguishable potting areas are identified that could form the basis of more localised inshore management:

North coast – dominated by lobster, but with a significant crab fishery where the stock may be linked with the offshore crab resources to the North and West that are targeted by *vivier* crabbers.

North Down & Outer Ards –a mixed fishery with seasonal importance for both brown crab & velvets.

Strangford Lough – one of the key velvet crab areas with an important *Nephrops* pot fishery, but also significant lobster & brown crab.

South Down – this area has the largest number of crabbing vessels, which also target lobster.

The potting fleet operating in each area has characteristics in common, but also show some area-specific issues and therefore some differing management priorities.

III. KEY ISSUES

Consultation with stakeholders in Northern Ireland raised the following issues:

- **Effort** – on the increase, mainly due to more vessels entering the fishery;
- **Latent capacity** – with most under 10's holding a shellfish entitlement and many currently operating on seasonal basis, there is significant latent capacity in the fleet;
- **Unlicensed or hobby fishermen** – still identified as a problem in certain areas despite recent legislation;
- **Stock information** – very limited information on the fishery, particularly the resource dynamics;
- **Quality** – the landing of low quality crab (white/soft-shelled) continues;
- **Sizes** – the current MLS does not support market requirements;
- **Toeing** – the removal of claws at sea prevents confirmation of crab size and use of the remaining crab, which undermines management;
- **Gear conflict** – an issue between potters and mobile gears (scallopers & *Nephrops* trawlers), but also within the potting fleet, particularly with seasonal fishers;
- **Environmental designations** – concerns amongst fishermen that future management of designated sites will restrict operation or even prevent access all together;
- **Offshore renewable energy** – proposals for large scale developments that would further restrict fishing operations; and
- **Links with other fisheries** – management must recognise that brown crab is part of a mixed pot fishery that includes lobster, velvets, and closely associated with the buckie whelks, *Nephrops* and *Palaemon* pot fisheries.

IV. MARKETS

The small volume landed into Northern Ireland compared to the rest of the UK and the Republic of Ireland (the 1000t landed in NI in 2010 represents 4% of total UK landings) inevitably means NI crab operators (both fishermen, processors and wholesalers) are 'price-takers' rather than 'price-setters'.

Brown crab from Northern Ireland can be broadly divided into two distinct markets;

- **Processed market** – the majority of crab landed from the Co. Down ports (accounting for 60% of total NI landings) and from south of Larne, including the Ards Peninsula & Strangford Lough (25% of landings) go to processors.
- ***Vivier* market** - crab from the North Coast (15% of NI landings) enters a *vivier* market which could be seen as an extension of the live lobster fishery.

Northern Ireland crab remains in a difficult market position as it is:

1. highly dependent on an export market;
2. logistically more remote than competing suppliers;

3. with a comparatively low volume of landings; and
4. no clear distinction of Northern Irish product in the market.

Skippers know the difference between good and poor quality crab, but processors are competing with each other to ensure boats land their catch to them and so they are accepting of and pay for poor quality crab causing some fishermen to continue to favour quantity over quality. Those trading in whole or live crab are less accepting of lower quality crab.

V. MANAGEMENT MEASURES

Based on industry consultation and assessment, **Table** Table I presents the management measures proposed for inclusion in the strategy and identifies whether these may be delivered through legislation or local management plans.

Delivery through local management plans allows the introduction of measures that may not be required in all areas, but as part of a local management plan would still endorsed by DARD.

Table I Proposed measures by type and implementation

Management measure		Sub-options	Change in legislation	Local management plan
a	**Increase Minimum Landing Size to 140mm**		✓	
b	**Limit type of vessels permitted inshore**	size of vessel	✓	
c	**Limit on hobby fishermen** (in addition to current legislation)		✓	
d	**Ban landing of soft-shelled crab**		✓	
e	**Ban landing crab claws** (above well-defined limits)		✓	
f	**Ban on landing berried crab, velvets & lobster (unless v-notching)**		✓	
g	**Gear measures**	ban on parlour pots		✓
h	**Escapement**	escape gap		✓
		biodegradable fastening		✓

It is recommended that a Northern Ireland Permit for potting vessels be established to cap capacity and address the latent capacity evident in the fleet. A permit would be issued to all vessels able to show that they already fish in Northern Ireland's waters.

A potting permit would enable measures that cannot be readily applied in legislation to be introduced as conditions of permit. If established on an area basis, a permit would also support more localised management measures via local management plans.

VI. STRATEGY

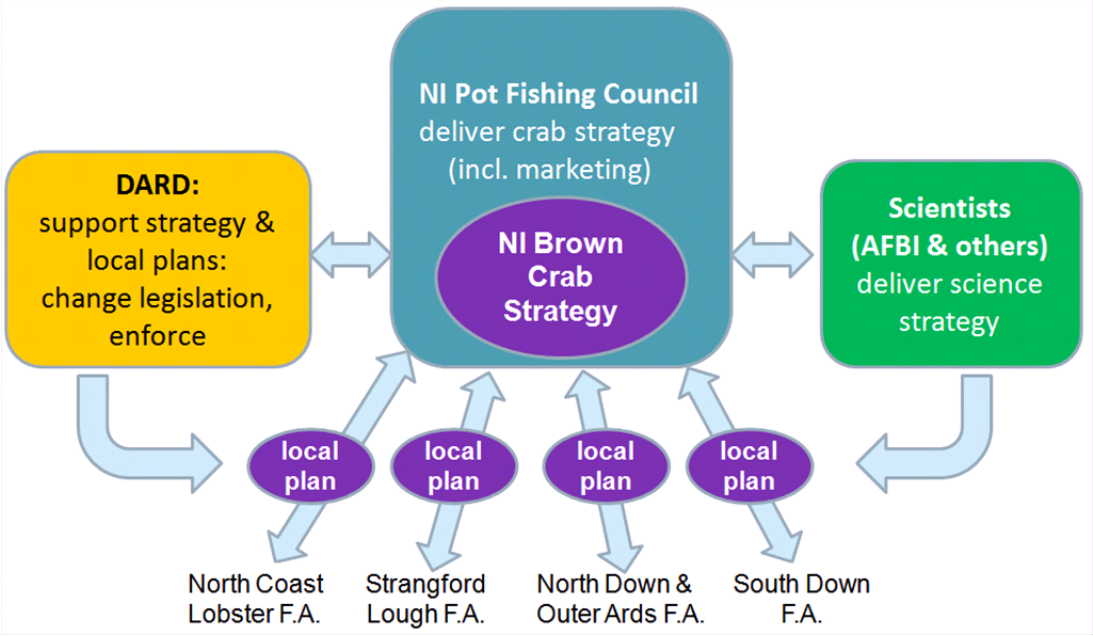
The improved management of the brown crab fishery (and Northern Ireland's other pot fisheries) should be delivered through a strategy containing the following components:

1. Changes to legislation;

2. Area-based local management plans;
3. A science strategy; and
4. A marketing strategy.

These components and their inter-relationships are illustrated in figure II below.

Figure II Components of the Northern Ireland Brown Crab Strategy



The delivery of the strategy should be overseen and steered by a suitable group, here named the Northern Ireland Pot Fishing Council (NIPFC). To maintain the fishing industry-led emphasis of the strategy, the NIPFC should include fishermen's associations (F.A.s) from each of the four potting areas as well as the involvement of responsible agencies (DARD); scientific support (AFBI); and links with the industry in the Republic of Ireland.

A representative of the post-harvest sector would be a welcome addition to the NI Pot Fishing Council. At present such representation does not exist and until such time that it does, the main linkage with post-harvest operators should be through the Seafish representative, who would perform a liaison and dissemination role for the Pot Fishing Council.

Changes to legislation

It is proposed that DARD produces new potting and crab legislation in Northern Ireland waters that collates, clarifies & strengthens existing legislation (particularly in relation to landing crab claws and the operations hobby fishermen) with the following additions:

1. Increase the Minimum Landing Size for brown crab to 140mm carapace width.
2. Ban the landing of soft-shelled crab based on an enforceable definition with measurable units (following a pilot study to define those units).
3. Ban the landing of berried brown crab, velvet crab and lobster (with the exception of landing berried lobster as part a recognised v-notching scheme).

4. Limit the size of vessel permitted to fish in Northern Ireland's waters to 12m and under (with a grandfathering clause to exempt existing operators).

It is recommended that DARD develops a Northern Ireland permit scheme for crab and other pot fisheries to better control potting effort and provide a framework for future area-based management. It is expected that a NI potting permit would be allocated to all vessels able to show evidence of operating in Northern Ireland waters, but with some provision for new entrants. Further consultation with the industry will be required to reach agreement on and fully define the permit scheme.

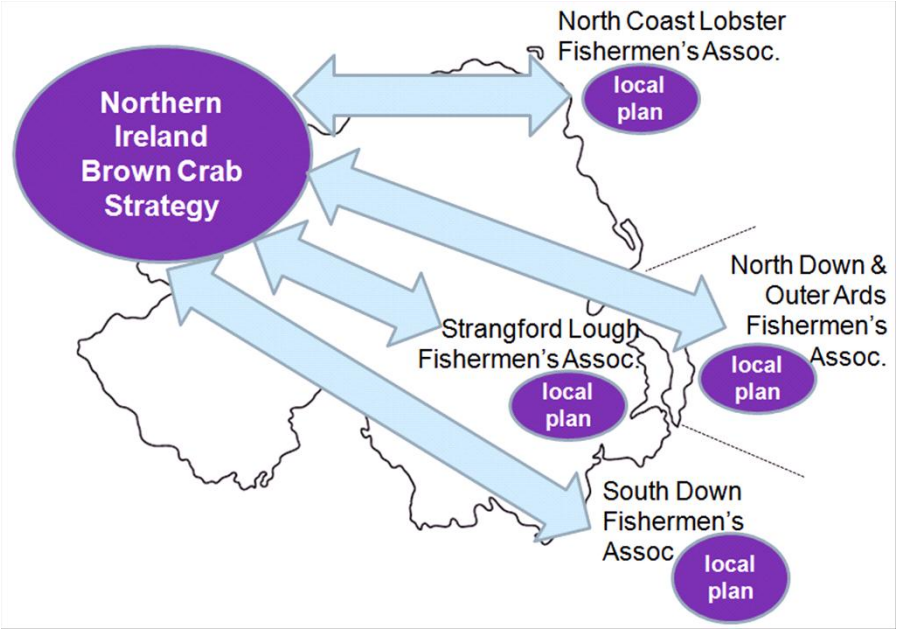
Area-based local management

The development of localised management is expected to be informed by this strategy and local management should in turn inform strategy delivery (figure III). Representatives from these area groups would be key members of the NI Pot Fishing Council, providing feedback on the effective delivery of the strategy and leading the development of localised management.

To aid the successful delivery of the strategy, develop local management plans and retain buy-in from all sections of the industry, regional inshore catching sector representation is needed for the North Down & Outer Ards area and in the South Down area.

It is recommended that DARD and Northern Ireland's Producer Organisations, being established industry organisations, encourage and assist these areas in forming industry associations, which can be supported via EFF funding.

Figure III Linkage between the Northern Ireland Brown Crab Strategy and Area-based management



Marketing strategy

The marketing strategy should:

1. **Focus on the catching sector**: to promote the positive actions of the industry and managers laid out in this strategy. This could be in the form of promotional material

and awareness-raising events. Buyers and processors can then incorporate elements of catching sector marketing on an individual basis as they see fit.

2. **Establish quality assurances**: this should be supported by legislation and the management efforts to ban the landing of soft-shelled / low quality crab (use of durometers, training for at sea grading).
3. **Highlight sustainable credentials** of the fishery: low impact, small scale, improved management.

With no obvious lead organisation to take the marketing strategy forward, this component should be delivered via a project that is overseen by NIPFC. The project should be eligible for EFF funding and is estimated to last 9-12 months starting in year 2 when new legislation is expected to be in place and with local management in development.

Science strategy

A six-year scientific strategy is proposed to support sustainable crab management in Northern Ireland with the following components:

1. Define fishing segments (strata)
2. Determine fishing effort per strata
3. Stratified biological sampling
4. Tagging and re-capture studies
5. Larval studies
6. Stock assessment
7. Provision of management advice

The delivery of the above components is proposed via an integrated research project involving AFBI, DARD and the industry. This multi-stakeholder approach should make it eligible for EFF funding as a collective action.

A fleet of volunteer sentinel vessels completing (ideally electronic) logbooks appears to be the most workable approach, rather than whole-fleet reporting.

The next step is for AFBI, DARD and industry representatives to develop a detailed research plan. This will identify where existing budgets and work streams could be adapted to incorporate the components of this strategy and contribute to match funding in an EFF funding bid.

Roadmap for the Strategy

Each strategy component has outputs to monitor progress and inform revision of the strategy if necessary (Figure IV).

Industry consultation will remain a key aspect of the strategy going forward. Initially this will be needed to further define certain management measures and to help lead partners in developing detailed project specifications. Once developed, project funding should be sought, i.e. via applications to the European Fisheries Fund (EFF).

Figure IV Roadmap for Strategy Implementation (★ = reviewable outputs)

Strategy Component	lead partner	duration	Year 1 Q1	Q2	Q3	Q4	Year 2 Q1	Q2	Q3	Q4	Year 3 Q1	Q2	Q3	Q4	Year 4 Q1	Q2	Q3	Q4	Year 5 Q1	Q2	Q3	Q4	Year 6 Q1	Q2	Q3	Q4
Industry consultation	**NIPFC**	ongoing																								
Legislation																										
increase MLS	DARD	6 months				★																				
limit vessel size	DARD	6 months				★																				
pilot durometer project	AFBI/industry	6 months			★																					
ban berried & white crab	DARD	3 months				★																				
develop permit system	DARD/industry	12 months				★																				
implement permit system	DARD	ongoing																								
Local management plans																										
develop inshore representation	P.O.s	9 months																								
develop local plans	Associations	12 months								★																
implement local plan	Assoc/DARD	ongoing																								
review local plan	Associations	3 months																								
revise local plan	Associations	3 months															★									
Marketing																										
Develop promotional material	NISC	3 months						★																		
Implement marketing	NISC	6 months																								
Report on acheivements	NISC	3 months									★															
Science																										
trial crab science projects	AFBI	1 year				★																				
distribution of fishing	AFBI	4 years																					★			
fishing effort recording	AFBI	4 years																					★			
stratified sampling assessment 1	AFBI	2 years													★											
stratified sampling assessment 2	AFBI	2 years																					★			
tagging programme	AFBI	2 years																								
recapture programme	AFBI	3 years																						★		
larval survey - north	AFBI	6 months															★									
larval survey - north east	AFBI	6 months																			★					
stock assessment 1 & prelim advice	AFBI	6 months															★									
stock assessment 2 & full advice	AFBI	6 months																							★	

1 INTRODUCTION

Poseidon Aquatic Resource Management Limited (Poseidon) is pleased to present the following:

"Northern Ireland Brown Crab Strategy"

for the Northern Ireland Fish Producers Organisation (NIFPO) and the NI Crab industry steering group. This work was funded by the Department for Agriculture and Rural Development (DARD) and the European Fisheries Fund (EFF).

The strategy has evolved from an extensive consultation exercise that explored how to develop a Northern Ireland management plan for brown crab. The views of Northern Ireland's crab fishermen consulted as part of this study and the key issues they raised have shaped the resulting strategy. It presents a number of components that will improve management to ensure the sustainability of the crab resource in Northern Ireland and the potting fleet dependent on it.

1.1 OBJECTIVES & TASKS

The objective of the contact was to work with stakeholders to develop a management plan for Northern Ireland's brown crab fisheries.

The terms of reference identifies the following tasks:

1. Short literature review on existing state of NI brown crab fishery.

2. Assess the relative merits of key management measures for the Northern Ireland brown crab fishery. These may include:
    i. Licensing and entitlements;
    ii. Technical conservation measures, including Minimum Landing Size (MLS)/ ban or limit on landing berried females;
    iii. Pot marking and registers, effort monitoring/ limitation and pot capping/ limitations;
    iv. Quota and other methods of resource allocation;
    v. Area based management (reduction in season, closed areas);
    vi. Access to licences/ permits- new entrants, transfers, part timers, latent effort.
    vii. Examine the potential for development of a voluntary code of practice to manage crab stocks.
    - Define quality standards required by processors and look at the potential for sorting catch at sea to reduce mortality of crabs which are unsuitable for the market.
    - Undertake to hold stakeholder meetings around the coast of Northern Ireland to get stakeholder views and input into new management plans.
    - Define the size and area of crab fisheries around Northern Ireland e.g. plotting of information on GIS to include areas fished, gear used and key spawning grounds.
    - Assess:

i. Implementation issues associated with each measure (e.g. administration, policing, industry buy-in);
ii. The distribution of economic impacts and timeframe over which impacts are expected to occur for alternative measures according to fleet metiers;
iii. Potential impacts upon markets of the selected measures;
iv. Expected benefits for stock conservation for alternative measures.

3. Assess the framework for enabling local management of brown crab resources including:
    - Existing policy mechanisms at regional, national and European level;
    - Barriers to delivering local management
    - Recommendations for taking forward a local management strategy.

4. Look at current marketing of crab and lobster in NI and make recommendations for a future marketing strategy for the benefit of the whole industry.

After extensive consultation, the potential for local management of brown crab and other inshore fisheries is evident, but additional organisation and representation at a local level is required. Therefore a strategy has been developed that identifies how this can be progressed in parallel with NI-level developments (legislation, management & science). Effective industry consultation is essential and this remains a key component of the strategy going forward.

1.2 OUTPUTS & TIMING

The Terms of Reference requests the following outputs (with proposed timescale):

- The project produced a preliminary report in November 2010 giving a detailed project plan with dates for stakeholder meetings and any other consultation.
- Three well-attended stakeholder meetings were held in November/December seeking the opinions of fishermen, buyers and other interested parties on the objectives for management of crab in Northern Ireland and potential measures.
- Additional meetings and discussions were held in January with the main buyers focusing on quality and market aspects.
- An interim report was submitted in January summarising the team's findings to date.
- The team then presented the interim report to three further stakeholder meetings held in April to seek views on findings and explore potential delivery models for a management plan.
- The team revised outputs based on discussions with the industry to produce this final report by the end of May 2011.
- Once approved by the steering group, the report will be presented to the industry before being submitted to DARD.

2 APPROACH & METHODOLOGY

2.1 APPROACH

The Terms of Reference recognise the importance of consulting widely with participants in the fishery. This was a consistent feature of the work with a number of well-attended industry meetings and the industry steering group informing the resulting strategy and detailed proposals. The methodology to deliver the strategy is presented sequentially below

2.1.1 Inception meeting

An inception meeting was held on the 23rd September 2010 at Millbrook Lodge, Ballynahinch. Minutes of the meeting are appended to this report. The meeting confirmed deadlines, the location and timing of stakeholder meetings, methodology and key contacts. The group agreed the need to include BIM and Donegal/ Louth industry contacts as the cross border element of this project including the implications of *Voisinage* are highly relevant. An Irish fishing industry representative, who also co-ordinates the *vivier* crab working group was consulted with and subsequently joined the steering group.

2.1.2 Literature Review

A literature review was undertaken to collate and present the knowledge base to date. References are provided throughout the report, but key documents included:

- All relevant DARD & AFBI reports & data on crab fishery & resource
- Fisheries Forum Updated Implementation Plan (DARD, August, 2010)
- Inshore Fisheries Development Strategy (AFBI, July 2010)
- Report to the Minister for Agriculture and Rural Development (Northern Ireland Fisheries Forum, June 2010)
- Review of Inshore Fisheries Response to the Report of the Stakeholder Advisory Committee (DARD, June, 2009)
- Strangford Lough Pot Fishery Management Plan (DARD, 2009)
- Summary of the results of the consultation on the proposal for Strangford Lough Pot Fishery Management Plan (DARD, October, 2009)
- On the Management of Brown Crab Fisheries (Bannister, 2009)
- Future Management of Brown Crab in the UK and Ireland (Nautilus, 2009)
- Report of the Review of Inshore Fisheries Management in Northern Ireland from the (Northern Ireland Inshore Fisheries Stakeholders Advisory Group, 2007)
- Northern Ireland Fleet Futures Analysis (2004-2013)- Methodology and Results (CEMARE, 2006)
- The Shellfish Industry Development Strategy (SIDS) (SAGB, 2007)
- The Brown Crab (*Cancer pagurus* L.) Fishery: Analysis of the resource in 2004-2005 (Tully et al,2006)

2.1.3 Stakeholder meetings

It was agreed at the inception meeting that stakeholder meetings should be held as early in the process as possible to get fishermen's views on crab management. The dates and locations for local consultation with fishermen were:

18th November	7pm, Harbour Bar, Annalong
25th November	7.30pm, Ballyholme Yacht Club
2nd December	7.30pm, Glens Hotel, Cushendall

These were open meetings with advanced notification given to expected attendees via representatives, key contacts, local press and the Fishing News.

The team presented the findings from the literature review and analysis of DARD & MMO statistics relating to crab. This was followed by a structured discussion of management objectives and approaches to identify local priorities and issues.

2.1.4 Assessment of Existing and potential NI Brown Crab Management

The assessment of existing management (section 4) considers regulatory developments and how these may affect the NI crab fishery. Specifically the assessment looks at developments at a European level (such as CFP reform and Common Market Organisation reform); UK developments such as inshore fisheries reform, the introduction of IFCAs in England and IFGs in Scotland; and developments in Northern Ireland such as the Marine Bill (Northern Ireland).

A critique of potential management measures was undertaken, based on extensive consultation with stakeholders and experiences elsewhere. The assessment considers the legislative regime and management arrangements required to successfully apply these management measures. It explores particular opportunities and barriers for management in the context of the Northern Ireland crab fishery. It was presented to stakeholders for a second time and further refined based on that consultation and is presented in sections 6 and 7 of this report.

2.1.5 Quality Standards

The team met with processors and buyers to establish the specific quality standards required and the quality issues that can arise from the fishery. Discussions explored improved catch sorting at sea to reduce mortality of crabs and minimise landings of crab that are unmarketable or low value. The benefit of introducing simple quality indicators such as shell hardness for use by fishermen at sea was also explored. This was also an opportunity to explore market and marketing issues with the post-harvest sector to inform the market assessment element of the work.

2.1.6 Assessment of local management potential

The team presented the management measures assessment described in 2.1.4 to key stakeholders at three fishermen's meetings in April. This further consultation, including feedback on this interim report, informed the final assessment of local management potential.

The presentation included proposals for the practical and operational aspects to establish the likely shape and extent of any management plan. A key element will be the balance between developing new legislation and industry led action to develop the plan(s).

Further discussions with the Agri-Food and Biosciences Institute (AFBI) and Queens University Belfast (QUB) scientists were also undertaken to identify the scientific information available and how fisheries-dependent information could be used to improving the science-base.

2.1.7 Market assessment

It is expected that marketing aspects would be integrated into crab management plan(s) that are developed. The market assessment identified current markets and supply chains for Northern Ireland crab through discussion with key suppliers, transporters, processors and customers.

2.1.8 Appraisal of Lobster V-notching scheme

As per the requirements outlined in the project Terms of Reference, the team reviewed achievements and working arrangements of the lobster v-notching scheme. A separate paper reviewing lobster v-notching in Northern Ireland was produced for consideration of the steering group. This helped to inform the team's assessment of local management potential, in particular the viability of developing fisheries-dependent assessments and self-sampling programmes. The appraisal of the lobster v-notching schemes is presented in Appendix 3.

2.1.9 MSC Pre-assessment

As MSC fishery certifiers, the Poseidon team were able to undertake a rapid MSC pre-assessment of Northern Ireland's brown crab, velvet crab and lobster fisheries. The main purpose of this work was to highlight where improvements in fishery practice, management and information provision is needed to ensure a sustainable management framework. The MSC pre-assessment is presented in Appendix 4.

2.1.10 Final reporting

This final report provides a strategy for developing a Northern Ireland Brown Crab Management Plan. It lays out the necessary content of a plan and the most workable structure, detailing lead organisations and their responsibilities.

A clear way forward for management of the brown crab fishery in Northern Ireland is given. As a result of the work, management plan(s) will be able to be developed by the appropriate fisheries organisations in a short time-frame and submitted to DARD for the necessary consultation process prior to implementation of the plans.

3 THE NORTHERN IRELAND BROWN CRAB FISHERY

3.1 THE RESOURCE

3.1.1 Biology

Cancer pagurus, known as brown crab or edible crab is reddish-brown in colour, has an oval shaped body with a distinctive 'piecrust' edge and large black tipped pincers (Plate 1). Large individuals can have a carapace width of up to 250 mm although individuals are typically up to 150 mm (Neal and Wilson, 2008). Male (or cock) size range is from 50-270 mm reaching maturity at 110 mm, female (or hen) size range is 50-190 mm reaching maturity at 115 mm with a growth rate of 1-10 mm/year.

Plate 1 Brown crab (*Cancer pagurus*)

Source: jacksshed.co.uk

Female crabs move inshore in late spring to moult and shortly afterwards mate (Brown & Bennett 1980). The females store the sperm, then in late summer they move offshore again and use the stored sperm to fertilise their eggs in the winter (Hayward 1996). The females carry their eggs under their abdomen; this is commonly known as being 'berried'. Berried females rarely feed or move, instead they lay in pits dug in the sediment or under rocks and thus are less likely to be caught in a baited pot (Brown & Bennett, 1980). Around late spring/early summer (6 - 9 months after copulation) the larvae are released into the water column. The larvae remain in the plankton for 2 months and then settle as juveniles in the intertidal zone in late summer/early autumn. Larval dispersal potential is greater than 10km and adult dispersal is typically 1-10km. They remain in the intertidal zone until they reach a carapace width of 60 - 70mm (which takes about 3 years) then they migrate to sub-tidal areas.

Brown crabs are recorded all around the coast of Great Britain, Northern Ireland and the Republic of Ireland. A brown crab can travel 2 - 3km per day and they have been known to perform migrations of up to 200 nautical miles (Pawson, 1995). 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.

3.1.2 Brown crab stocks

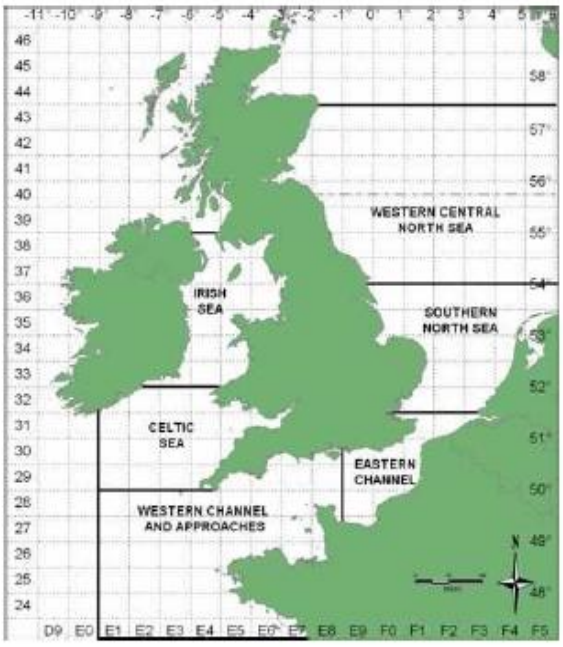
Separate stocks of a species can be defined when the fisheries are based on individual populations that are well separated geographically, or show area-specific differences in biology (e.g. growth rate or maturity), or are based on genuinely separate stocks that are genetically different. Stock structure requires long term data on where adults spawn and release larvae, backed by migration data from tagging, and comprehensive data on genetic differences (Bannister, 2009).

CEFAS data are available for the English East coast and the Western Channel, and Irish data for Mayo and Donegal. Addison (2009) presented areas of assessment considered appropriate by CEFAS (Figure 1 a). Tully (2008) mapped the distribution of crab larvae based on samples off the north west coast of Ireland in 2001 and found a wide distribution from coastal to offshore waters off Mayo and Donegal (Figure 1 b).

There are relatively few surveys of brown crab (larvae distribution and tagging), however the size and location of patches found so far by CEFAS are believed to be similar from year to year, and are at the regional rather than a local scale. Although crab data are incomplete, it is strongly suggested that stock structure is regional rather than local (Bannister, 2009). Therefore while the NI crab fishery, i.e. the fishing activity targeting a stock, can be defined as a distinct inshore fishery (as suggested in the Nautilus report), the same brown crab stock is being targeted by the offshore and inshore fisheries. Due to water distribution causing differences in larval distribution, there may be more distinction between North Coast and Irish Sea crab populations, but this remains an unknown.

Figure 1 a) CEFAS assessment areas and b) Stock structure in Ireland based on data from Mayo and Donegal

a)



b)

Source: Addison 2009, Tully 2008

3.1.3 Habitat

Brown crab are generally found on bedrock including under boulders, mixed coarse grounds, and offshore in muddy sand, but are found across a range of habitats including cobbles, pebbles, gravel / shingle, muddy gravel, coarse clean sand, fine clean sand, sandy mud, muddy sand, bedrock. They inhabit the lower shore, shallow sub-littoral and offshore areas to about 100 m and live in moderately strong (1-3 knots) to weak (<1 knot) tidal strengths.

Figure 3 presents benthic habitat mapping for the UK, amalgamated with Mapping European Seabed Habitats (MESH) predicted habitats which have been based on combining physical data layers. The habitat types are classified as per the European Nature Information System (ENIS).

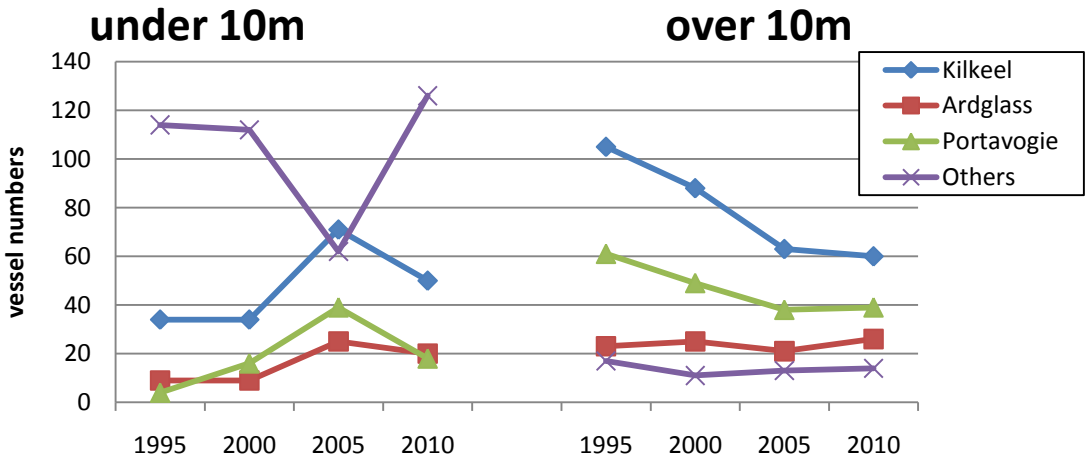
The inshore waters adjacent to coastal areas of Portavogie, Kilkeel and Annalong (and ICES square 37E4) are characterised by a large shelf mud plain, surrounded by shelf sand plains and patches of coarse sediment with moderate to strong tidal currents. The remaining waters (in ICES squares 38E4, 39E4 and 39E3) are typically characterised by areas of sand interspersed with coarse sediment and some areas of aphotic rock (adjacent to Glenarm and Carnlough) and shelf troughs (immediately north of Rathlin Island and east of Belfast Lough).

3.2 FLEET

The Irish Sea is the only sea area around the British Isles where the majority of brown crab landings by weight are from vessels under 10m in length. Around 115 potting vessels were actively fishing the Irish Sea in 2007; only five of these were over 10m in length.

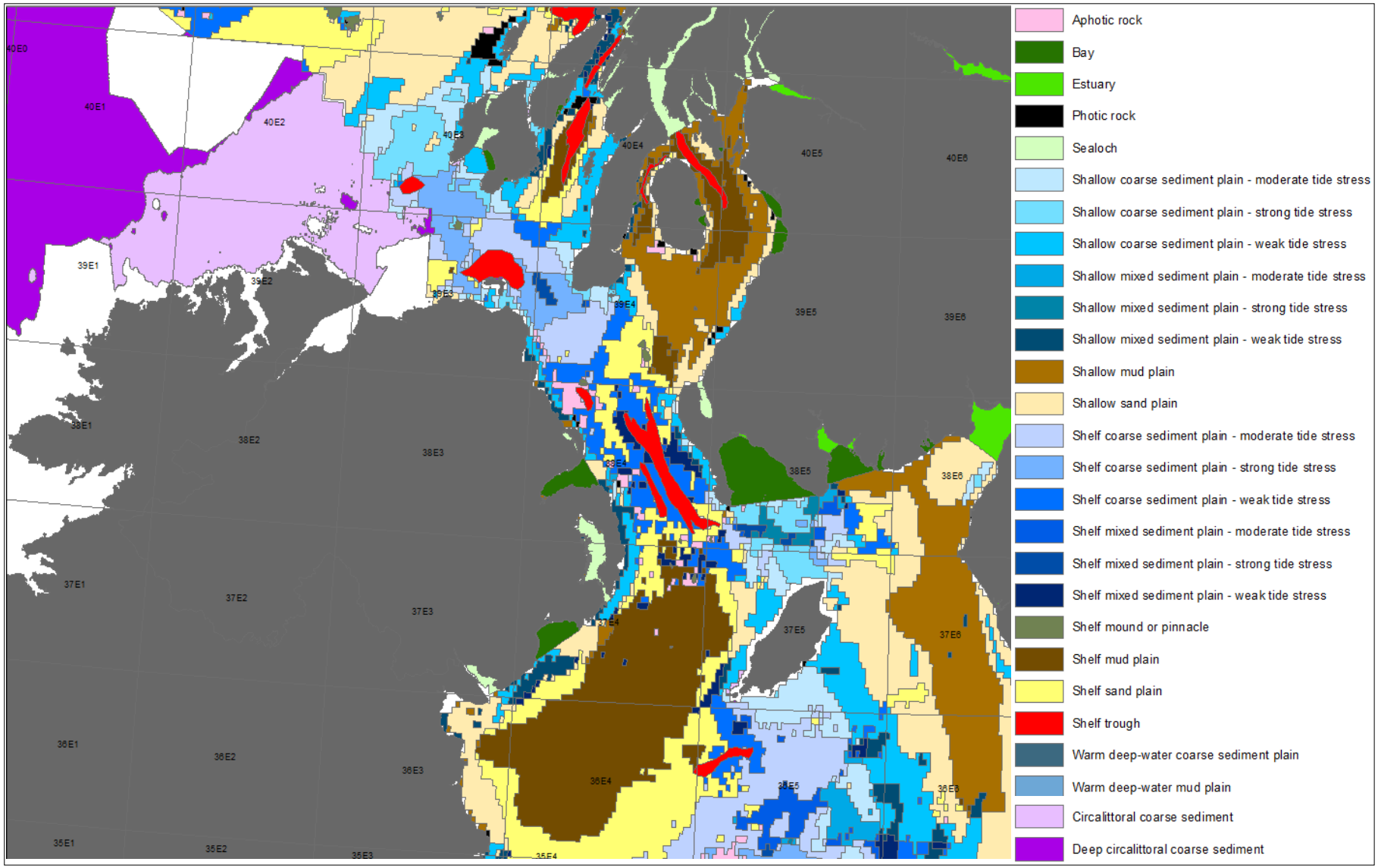
Figure 2 presents the number of vessels within the Northern Irish fleet between 1995 and 2010 indicating a 22% increase in the under 10m vessels and a 34% decrease in over 10m vessels during this period. In 2010 the Northern Ireland fishing fleet comprised 139 fishing vessels over 10 metres in length and 214 vessels under 10 metres in length. The last five years (2005 to 2010) saw a 9% increase in under 10m vessels and a 3% increase in the over 10m fleet. Of the 214 under 10m registered vessels at 1st October 2010, 184 (86%) have a shellfish entitlement. For the over 10m fleet, 23 (16%) hold a shellfish entitlement.

Figure 2 Number of vessels by main port 1995-2010



Source: DARD, 1995; MMO, 2010

Figure 3 Marine benthic habitat mapping (Source: MESH, 2010)



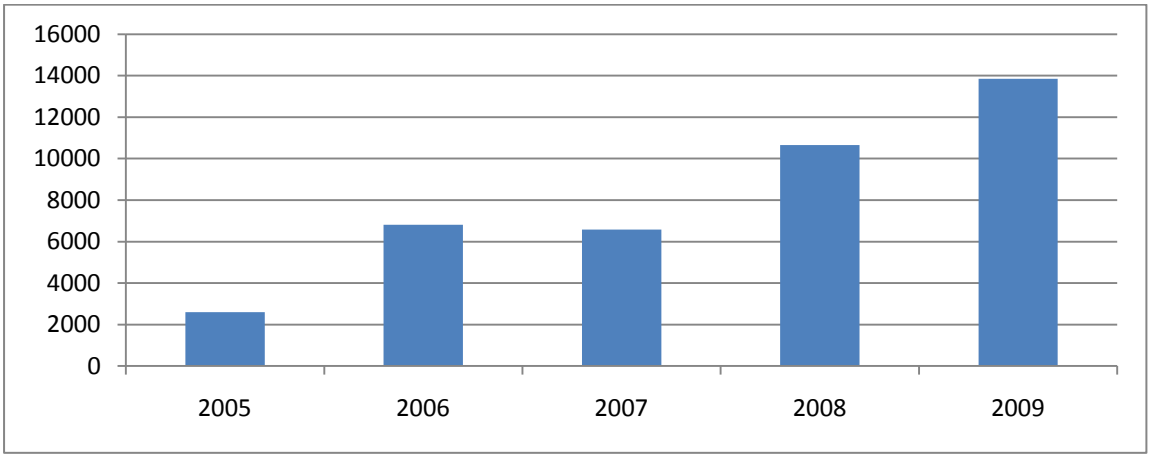
The Northern Ireland licensed sea fishing industry is concentrated at the three east coast fishing ports of Ardglass, Kilkeel, and Portavogie. The removal of vessels from the over 10m fleet with reinvestment in the under 10m fleet, particularly in the three main NI ports, is further evidenced by the average age of vessels in the under 10m fleet being 11 years younger at 21 years than the over 10m fleet average (32 years).

More recently the under 10m fleet has dispersed to operate from smaller ports around the coast. This may in part be due to being able to land closer to fishermen's homes, as more of NI's ports have the capacity for vessels under 10m. The wider distribution also reflects the need to distribute inshore effort around the coast, while maintaining proximity to home ports.

The under 10m fleet depends mainly on fishing opportunities in the Irish Sea and North Channel and it is the main UK fishery interest in the Irish Sea. Fishing activity for brown crab by under 10m vessels tends to be confined to areas within 12 miles off shore and mainly takes place within the Irish Sea although crabbing activity that is locally significant occurs all around the coast and within the Loughs.

Figure 4 presents the total number of pots fished 2005-2009. Figure 5 presents the total number of pots fished by Northern Irish vessels in 2009 per port. These are based on data from DARD collating information from shellfish forms, which is understood to contain inaccuracies, but is the most complete data set on pot numbers available.

Figure 4: Total number of pots fished by Northern Irish vessels from 2005-2009

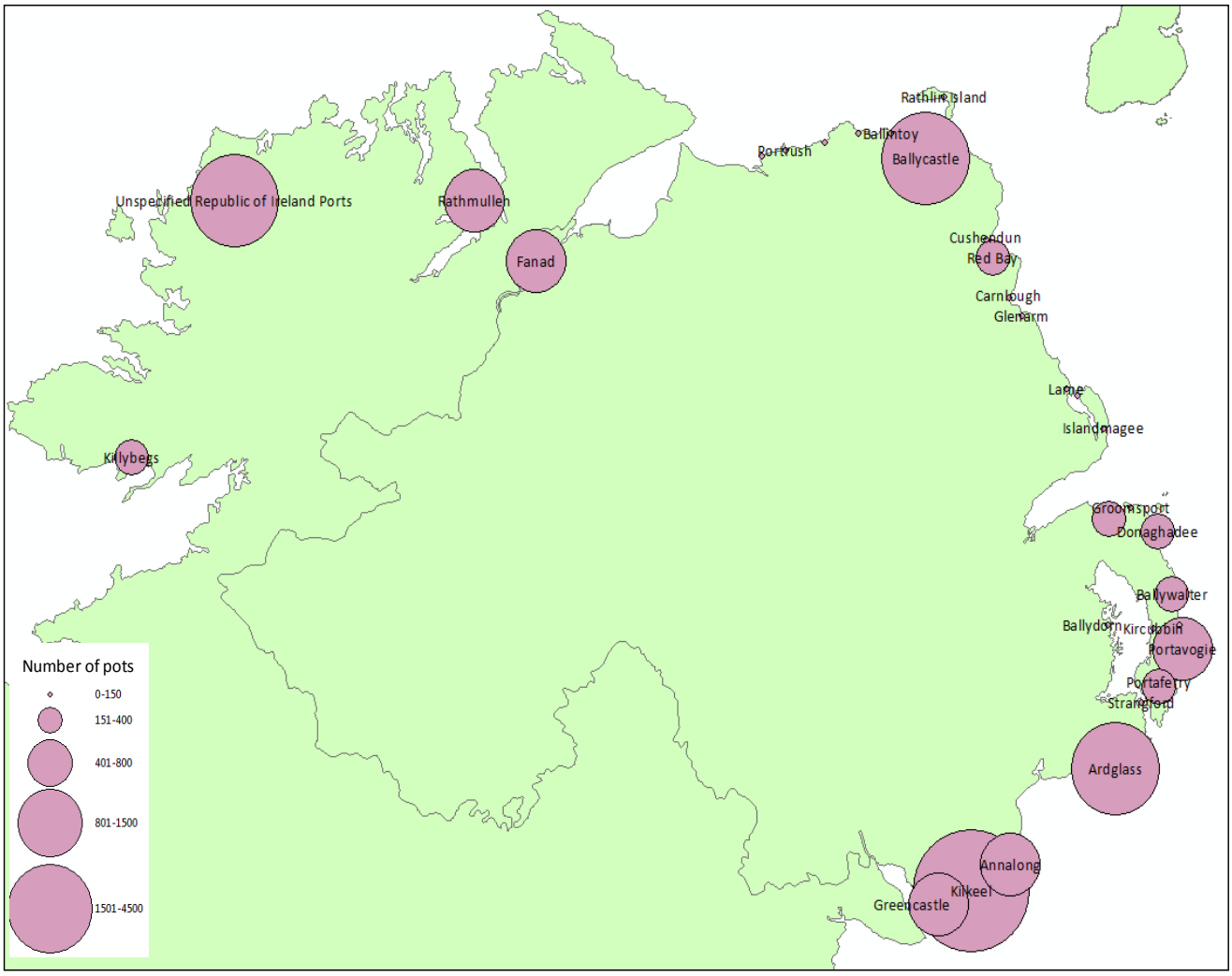


Source: DARD, 2011

The increase in number of pots seen from 2006 onwards may in part be explained by tighter management of inshore fisheries such as the introduction of the registration of buyers and sellers (RBS) in 2006/7. The large increase in pot numbers seen from 2008 results from more vessels entering the fishery with pot numbers being recorded at 37 landing points compared to 26 in the previous year. The number officially recorded in 2009 was close to 14,000 pots. Consultation with the industry around the coast of Northern Ireland at the end of 2010 suggests a higher number still, with pots set by vessels targeting crab totalling around 17,500 (60% from the Co. Down ports, 28% on the North Coast and the remainder between Larne and Strangford Lough).

It is evident from these statistics and from consultation that the number of pots fished in Northern Ireland waters has increased in recent years.

Figure 5: Total number of pots fished by Northern Ireland vessels in 2009 by port



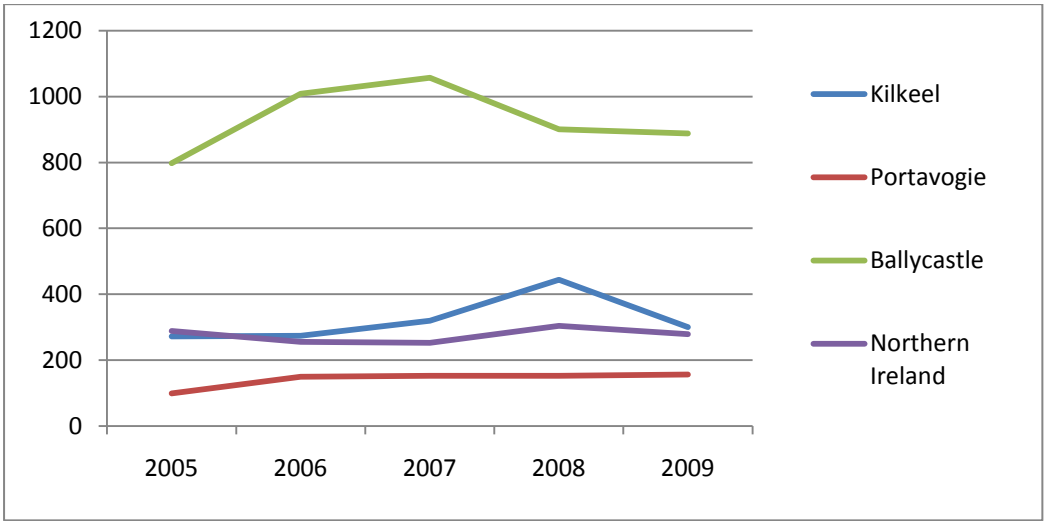
Source: DARD, 2011

The greatest effort (in terms of number of pots) is still associated with the three main ports of Kilkeel, Ardglass and Portavogie, with significant additional effort in South Down from Greencastle and Annalong (Figure 5). Significant numbers of pots fished are also recorded at Ballycastle as well as NI registered vessels fishing from Rathmullan, Fanad and other 'unspecified ROI ports'. The large number of pots fished in these North Coast ports results from a small number of over 10m vessels fishing between 1000 - 3600 pots, up to 10 times more than the average numbers of pots fished by most Northern Ireland vessels (Figure 6).

Figure 6 below presents the average number of pots fished by vessels for Northern Ireland as a whole and for some of the ports. The high average numbers for Ballycastle reflect the presence of some relatively large vessels between 9 and 12m length that operate on the North Coast. The Portavogie averages reflect the more common average number of pots per inshore vessel elsewhere in Northern Ireland. This highlights two aspects:

1. The number of pots fished per vessel has not increased markedly in recent years, instead increased effort has come from increases in the number of vessels entering the fishery;
2. The entry of one large vessel in a fleet substantially increases the fishing capacity.

Figure 6 Average pots fished per vessel in Northern Ireland and 3 ports

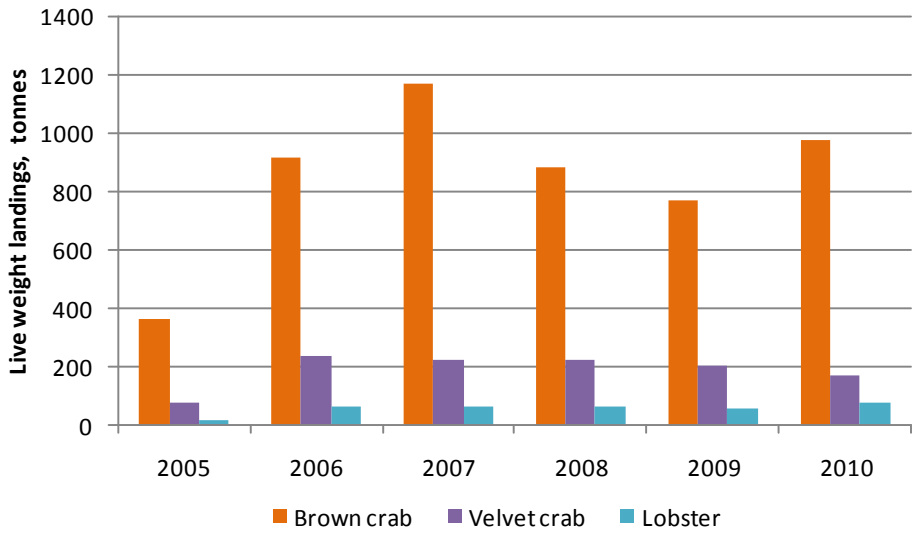


Source: DARD, 2011

3.3 CRAB LANDINGS

Northern Ireland's potting fleet landed around 1,000 tonnes of brown crab into NI ports in 2010. This represents an increase of 27% (by weight) compared to landings in 2009 which were 34% lower than 2007 figures when 1,170 tonnes of brown crab was landed into Northern Irish ports. For velvet crab, after a significant increase across 2005-2006, landings have remained stable over the past four years at approximately 230 tonnes with a slight decrease in 2010. Lobster landings have remained fairly consistent across 2006 to 2008 at just above 60 tonnes, with a slight drop from 2008 to 2009 followed by an increase to 78 tonnes in 2010.

Figure 7: Live weight landings (tonnes) of brown crab, velvet crab & lobster into Northern Irish ports from 2005 to 2010.

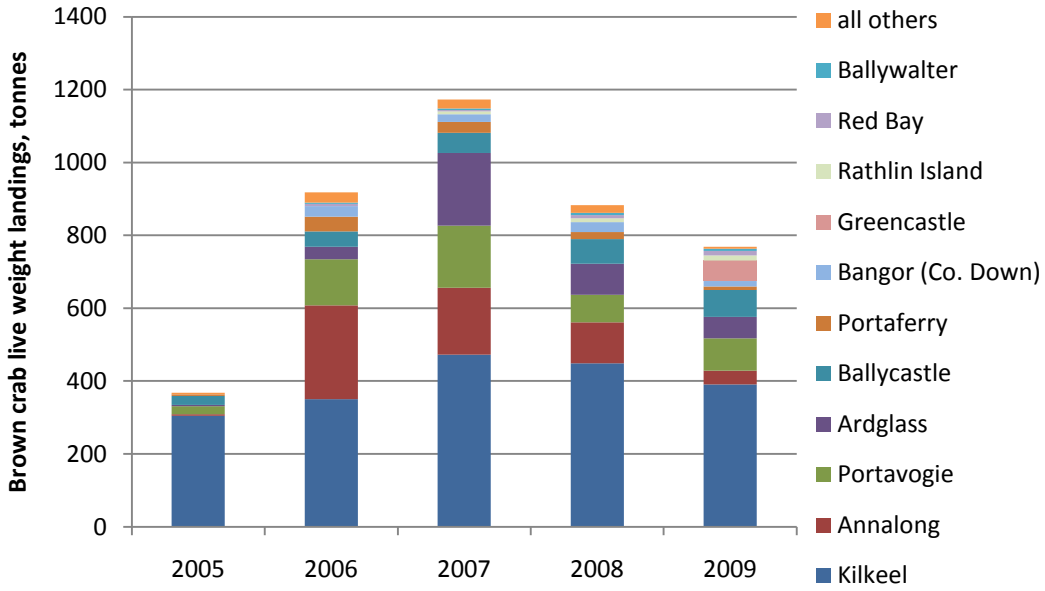


Source: DARD, 2011

The landings across 2005 to 2009 per port are presented in Figure 8. In 2009 Kilkeel took the largest proportion of landings (50%), with Portavogie second (11%), and Ballycastle third

(10%). There is a sharp deline in brown crab landings into Annalong from 2006 to 2009. Other than Ballycastle, landings into all main ports have decreased since 2007 peak landings. The 'all others' category includes landings to 24 different ports where landings have been recorded over the last five years.

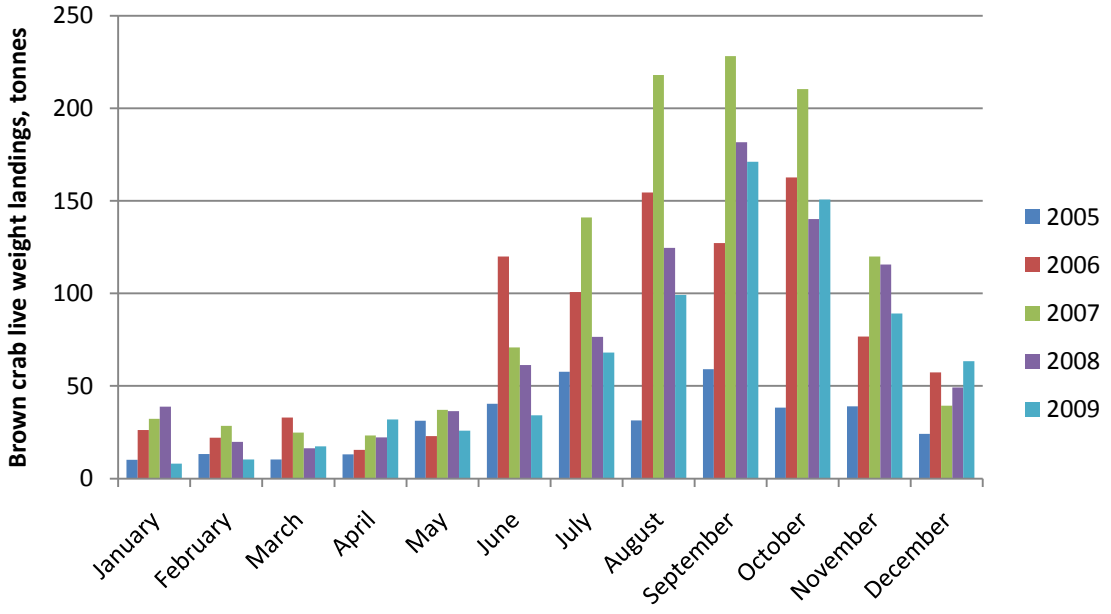
Figure 8: Live weight landings (tonnes) of brown crab by port from 2005-2009



Source: DARD, 2011

The seasonality of brown crab landings is presented in Figure 9 from 2005 to 2009. While landings do occur throughout the year, the targeted fishery occurs from June to December with peaks in September and October.

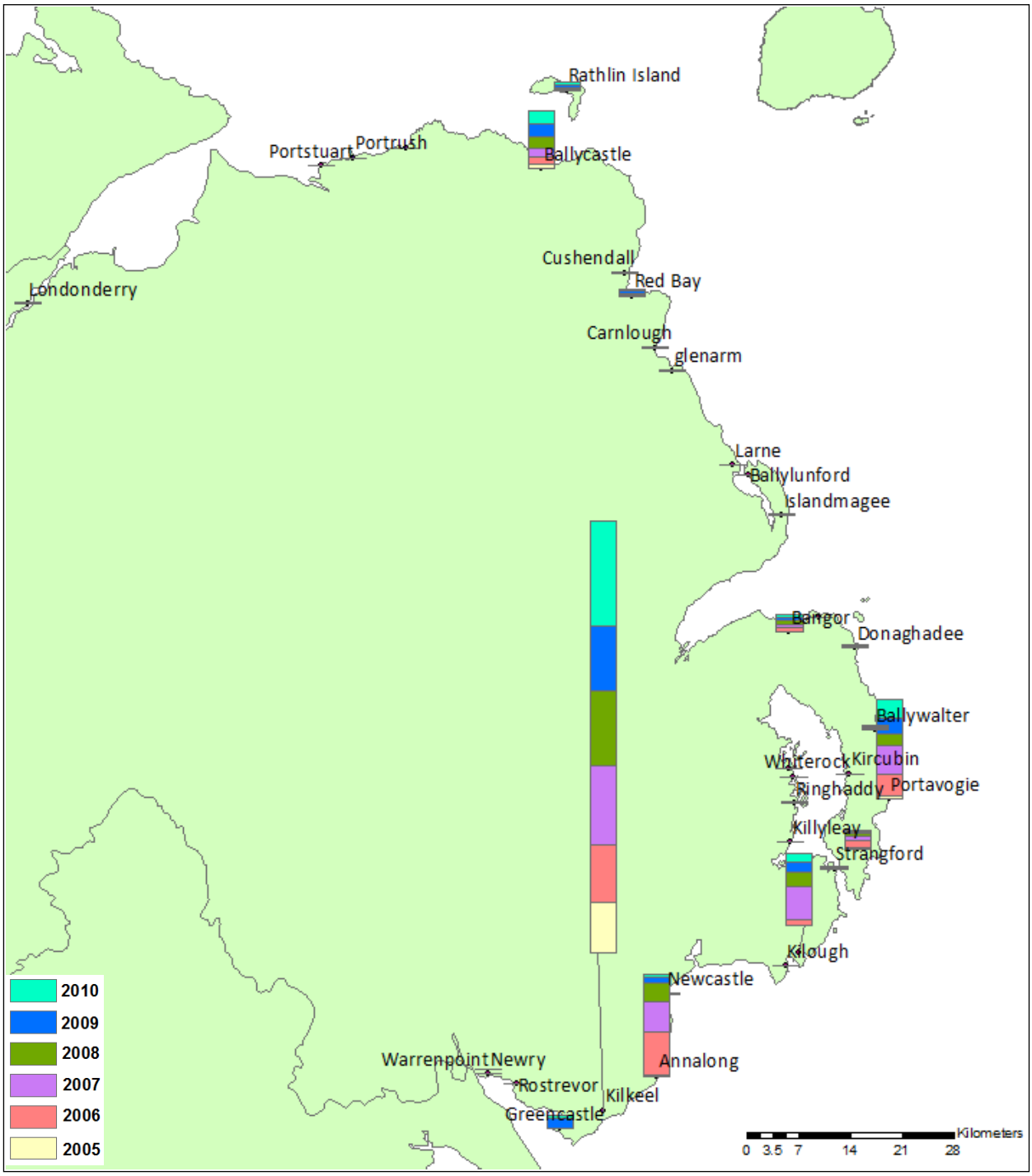
Figure 9: Seasonality of brown crab landings (tonnes) into Northern Irish ports from 2005 to 2009



Source: DARD, 2011

Figure 10 presents landing statistics graphically by port which highlights the significance of landings into Kilkeel, but also the highly dispersed nature of landings around the coast with 37 different landing points identified in the statistics. Landings into Kilkeel are likely to be from Irish Sea (ICES Division VIIa), while those into Ballycastle are likely to be from West of Scotland (ICES Division VIa).

Figure 10: Proportion of brown crab landings into Northern Irish ports, 2005-2010



Two data sets have been used to inform this report:

1. DARD statistics of brown crab, velvet crab & lobster landings into Northern Ireland ports & pot numbers.

2. Marine Fisheries Agency (now the Marine Management Organisation) statisitcs on brown crab landed by Northern Ireland registered vessels into UK ports from 2004-2008 (MFA, 2009).

The following section is based on the MFA data set. These data include landings by NI registered vessels throughout the UK rather than just into Northern Ireland, hence the higher reported landings.

Table 1 presents brown crab landings in 2008 by vessel length category (under 10m; 10-15m and over 15m) and gear type. Forty two percent of landings by weight were by under 10m vessels, 44% by 10-15m vessels and 14% by vessels over 15m in length. Most landings by the 10-15m category and all landings by NI crab vessels >15m are landed to Donegal as part of the larger *vivier* fishery operating to the north and West of Northern Ireland. As such, although these are by NI registered vessels, the bulk of these landings do not form part of the NI crab fishery.

As expected the overwhelming majority are taken by pots (97.5% by weight) and side opening pots are favoured over top opening pots. Parlour pots are used increasingly in the fishery. For the inshore vessels operating in the NI crab fishery these are small parlours that are hauled on a daily basis. So this development will represent a small but significant additional increase in fishing capacity.

Table 1: Crab landings (tonnes) in 2008 by vessel length category

	<10m	10-15m	>15m	Total	%
Side opening pots	772.23	803.86	253.83	1829.92	97.5%
Other or mixed pots	13.5	16.36	0	29.86	1.6%
Gill net	9.79	0.01	0	9.8	0.5%
Nephrops trawl	0.03	1.56	4.56	6.15	0.3%
Other otter trawl	0	0.23	0.15	0.38	0.0%
Unspecified dredge	0.26			0.26	0.0%
Total	795.81	822.02	258.54	1876.37	100.0%

The largest porportion of NI landings in 2008 by the under 10m fleet was into Kilkeel (35% by weight), followed by Annalong (14%), Greencastle (13.7%), Portavogie (8.9%) and Ardglass (6.7%).

Landing statistics show that in 2008 the 10-15m fleet predominately landed into Rathmullen in the Republic of Ireland (41%) and into other 'Unspecified Republic of Ireland ports'. The NI-registered vessels landing into the Republic of Ireland are mainly the 'supercrabber' vessels that are just below 15m in length and effectively fish as part of the large-scale offshore fishery. The over 15m fleet almost exclusively land in Rathmullen (97% by weight).

The greater proportion of landings from larger vessels on the North Coast is illustrated by Figure 11 to Figure 14 that map brown crab landings by Northern Ireland registered vessels by ICES square to present the distribution of fishing effort.

Figure 11 presents data from all vessels for 2008 landings. The highest proportion of landings are taken from ICES square 37E4 (27% by weight), followed by 40E2 (15%), 39E3 (11%) and 40E3 (10%).

When the different vessel sizes are taken into account the importance of the Irish Sea fishery to the under 10m fleet is evident. Figure 12 to Figure 14 present landings from 2004 to 2008 by vessel length categories for vessels under 10m, 10-15m and greater than 15m respectively. While the entire fleet targets coastal waters, the under 10m vessels have more reliance on these areas with highest effort in ICES squares 37E4 and 39E5. Waters adjacent to Ballycastle are targeted by the under 10m vessels, but effort is noteably higher in the Irish Sea. Landings by under 10m vessels from two North Sea rectangles shown in Figure 12 are anomalous and thought to be due to a vessel being sold.

Some effort by the 10-15m and over 15m vessels is recorded within the Irish Sea (Figure 13 & Figure 14), however activity is more pronounced in the West of Scotland ICES Division VIa waters off the North Coast of Northern Ireland. The 10-15m and over 15m vessels can target inshore waters, but effort is generally directed to offshore grounds further north and west of Northern Ireland. The waters around Islay are seen to be an important fishing ground for these larger Northern Irish vessels.

Figure 11: Brown crab (tonnes) landed by all Northern Ireland registered vessels by ICES square, 2008 (MFA, 2009)

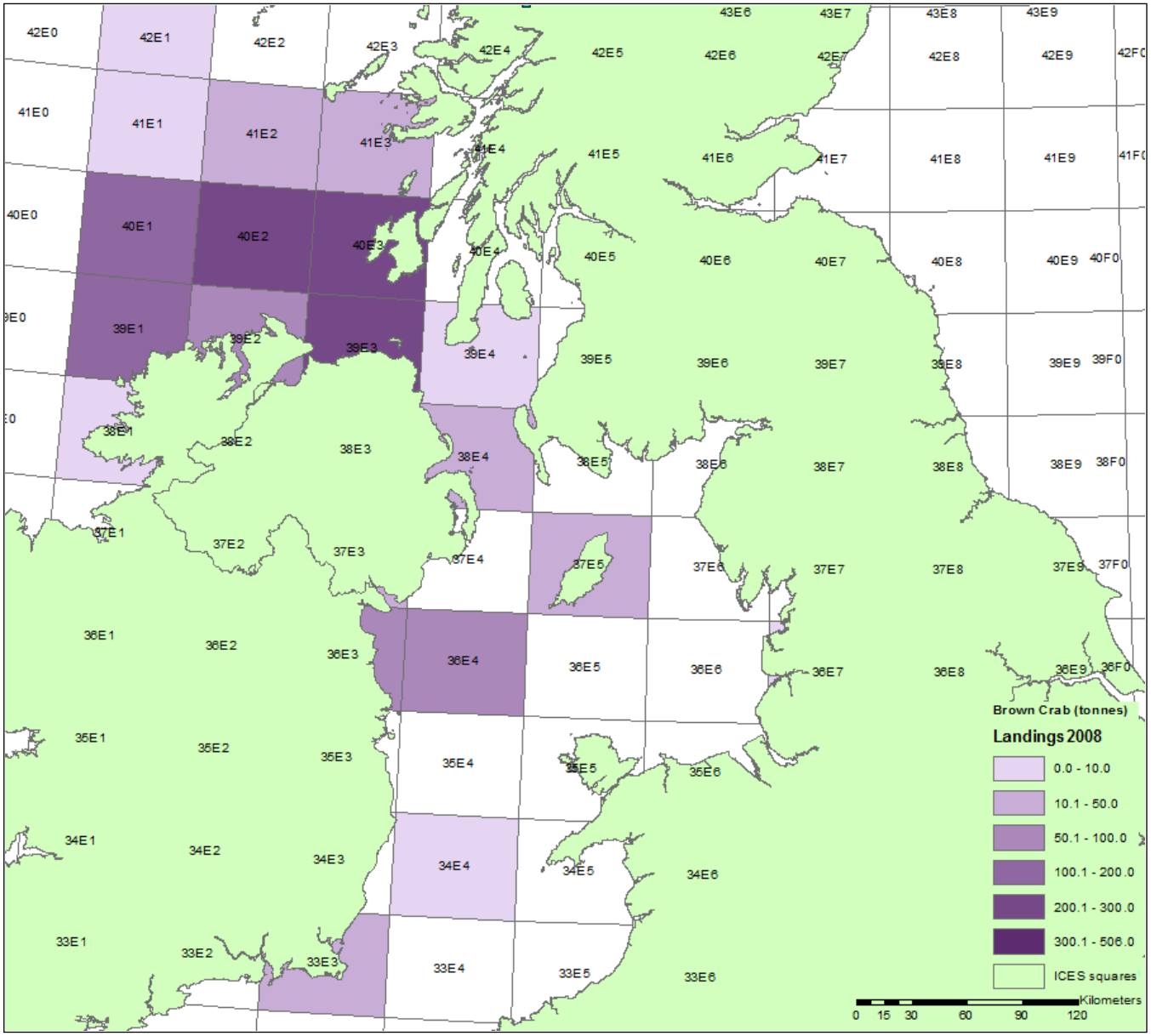


Figure 12: Brown crab (tonnes) landed by Northern Irish registered vessels <10m in length by ICES square, amalgamated for 2004-2008 (MFA, 2009)

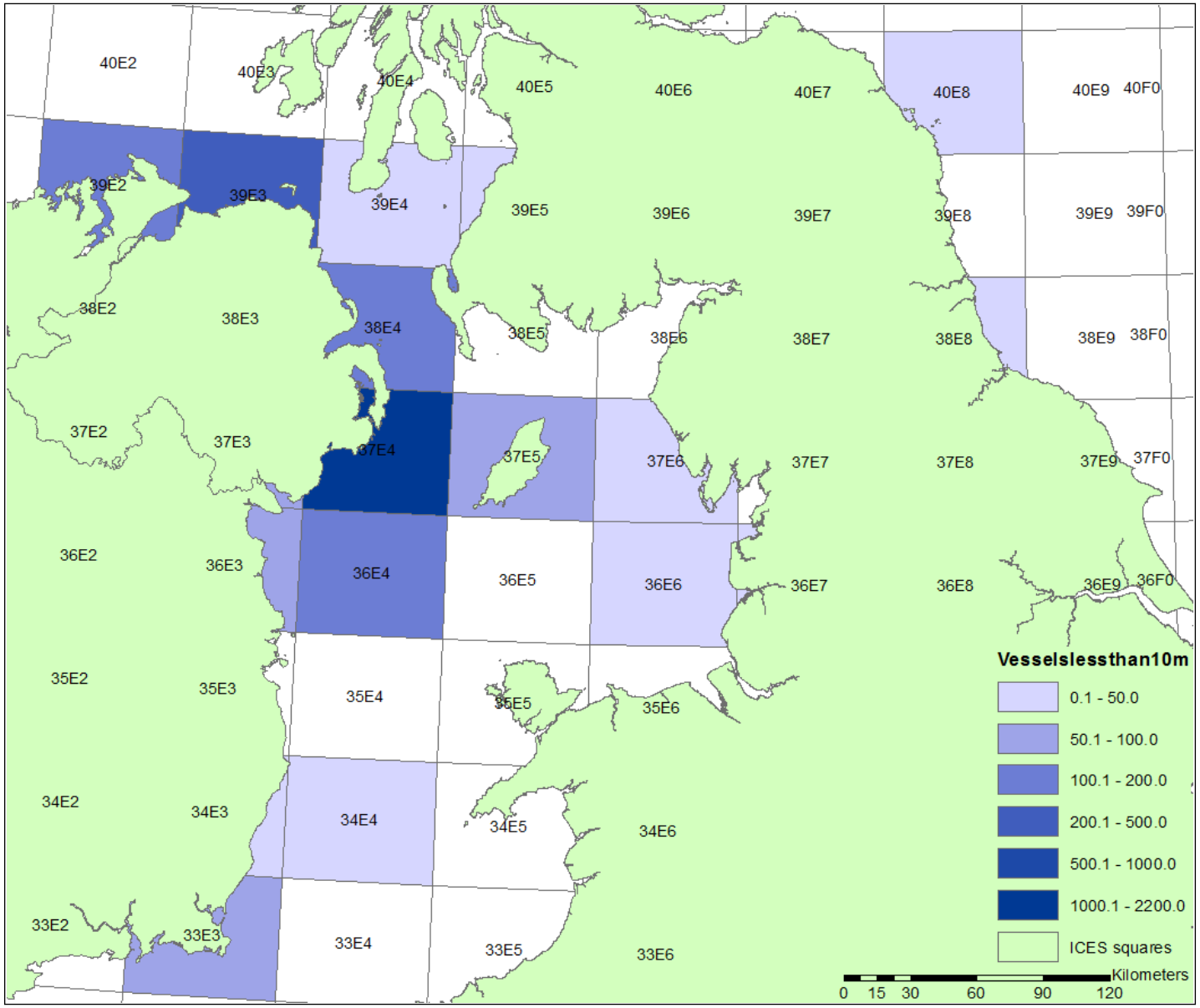


Figure 13: Brown crab (tonnes) landed by Northern Irish registered vessels 10-15 m in length by ICES square, amalgamated for 2004-2008 (MFA, 2009)

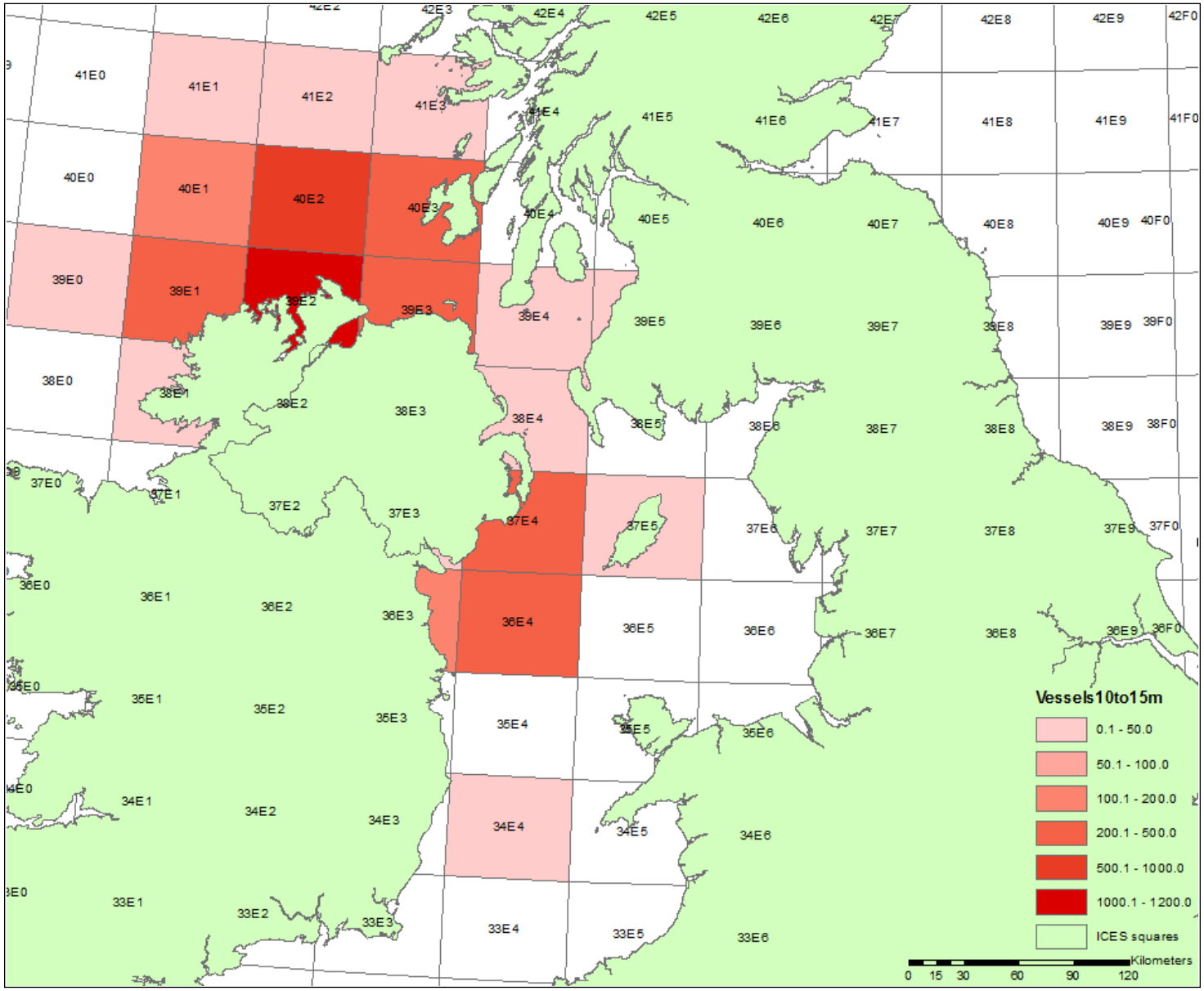
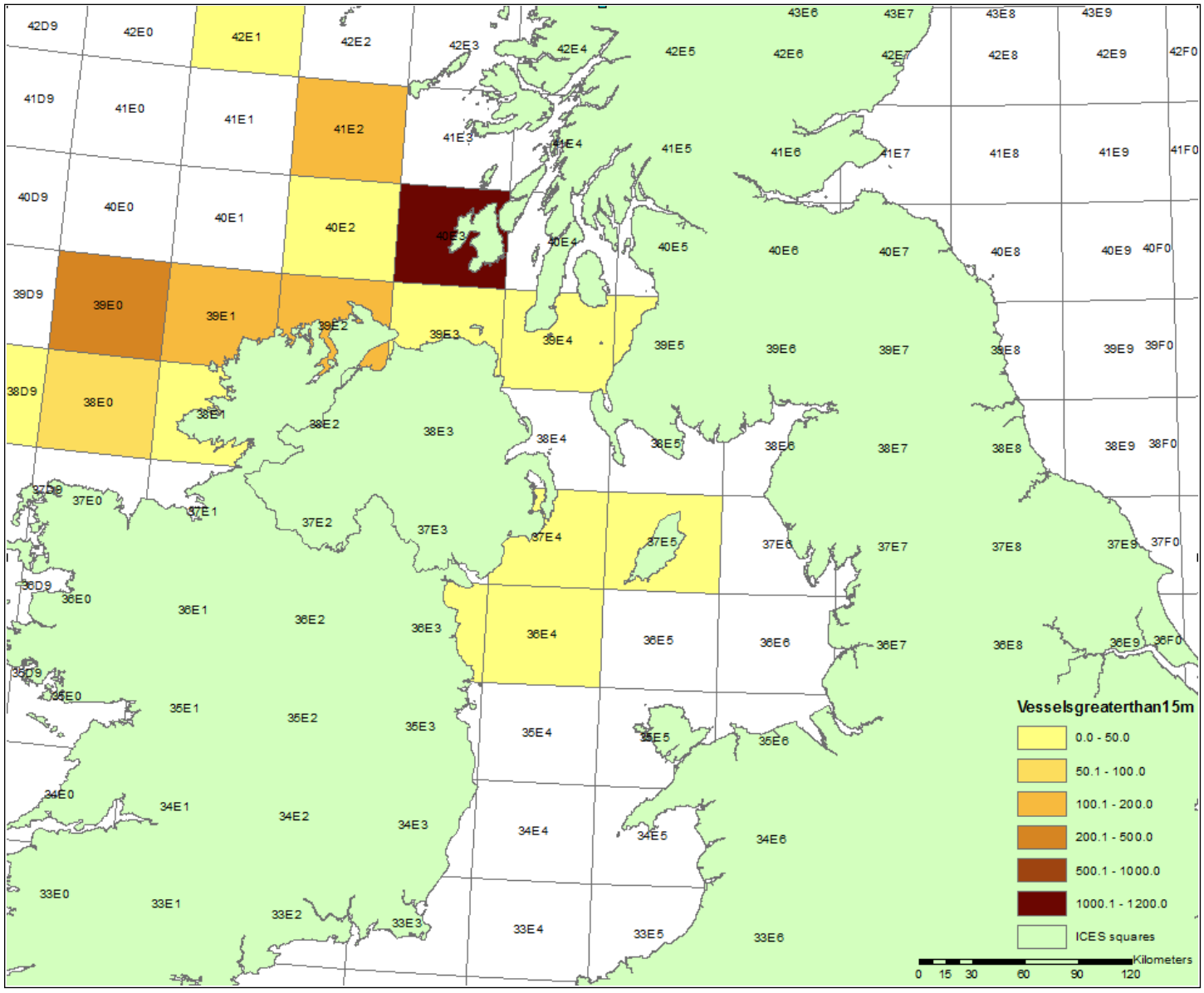


Figure 14: Brown crab (tonnes) landed by Northern Irish registered vessels >15 m in length by ICES square, amalgamated for 2004-2008 (MFA, 2009)

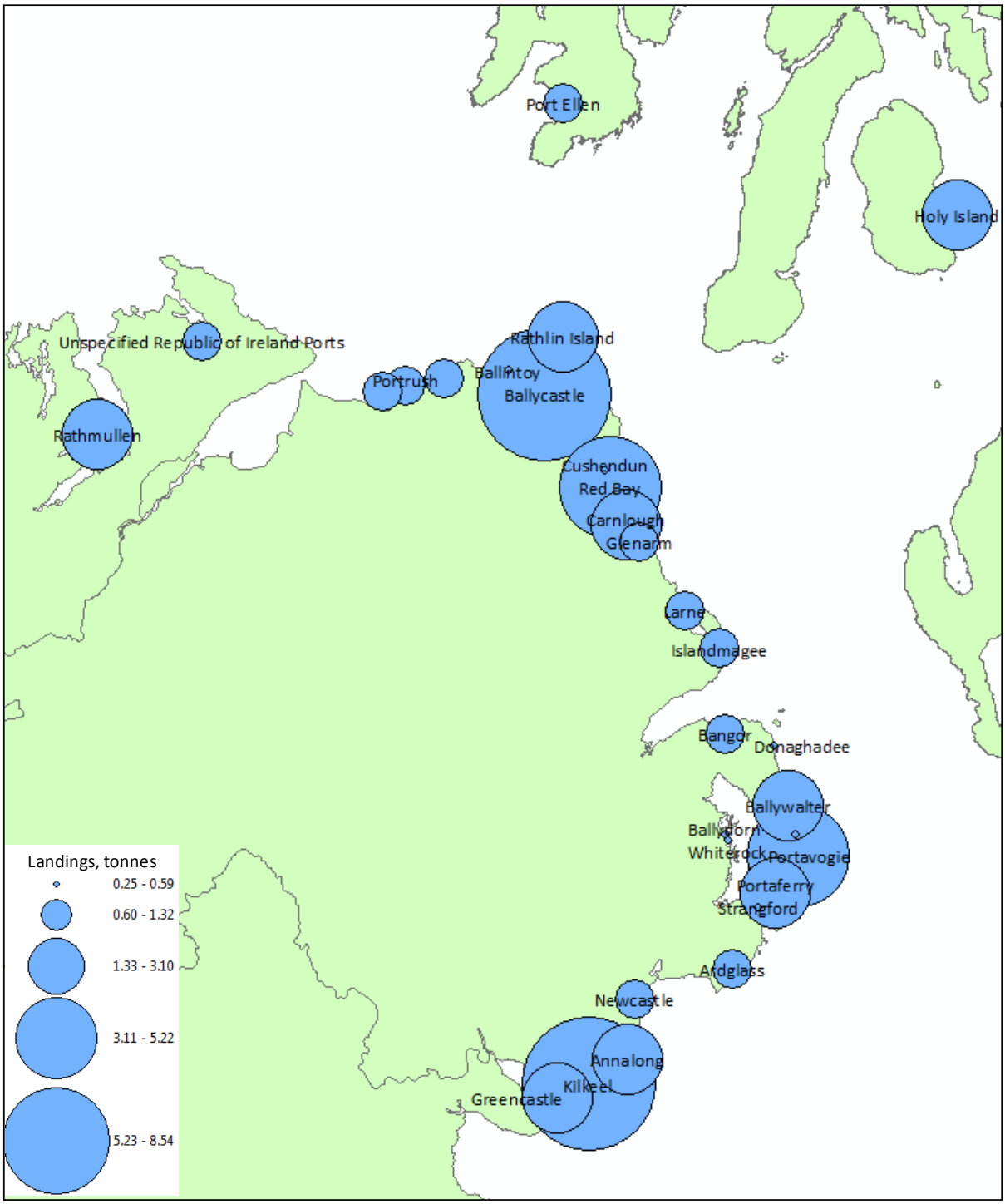


3.4 LOBSTER LANDINGS

The focus of this study is on the brown crab fishery, but there are intrinsic linkages with the lobster fishery and it is important to understand the characteristics of the NI lobster fishery.

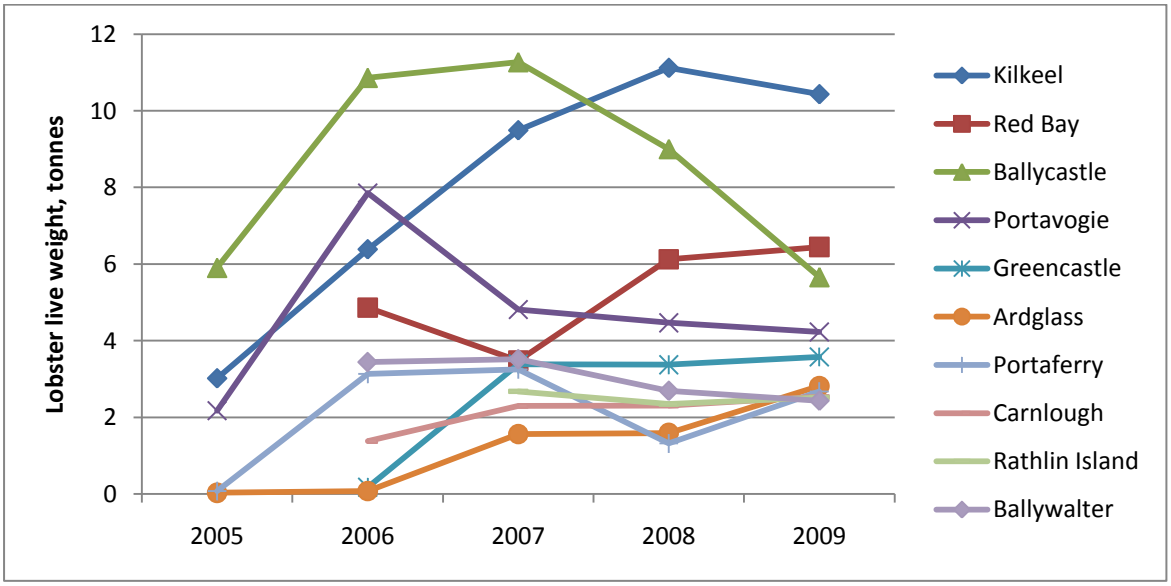
As Figure 7 showed, around 60 tonnes of lobster is landed into NI ports annually. Figure 15 indicates that the largest volumes of lobster are landed into Kilkeel, Ballycastle, Red Bay and Portavogie. Significant quantities are also landed by Northern Irish vessels outside of Northern Ireland including Holy Island, Port Ellen (Scotland), Rathmullen and other 'Unspecified Republic of Ireland ports'.

Figure 15: Annual landings of lobster (tonnes) per port averaged across 2005-2009



Recorded lobster landings by the Northern Irish fleet substantially increased from 2005 to 2006, which again can in part be explained by the introduction of RBS. Landings have since remained fairly consistent at just above 60 tonnes, with a slight drop from 2008 to 2009 followed by an increase to 78 tonnes in 2010. Fishermen consulted report that grounds are showing good numbers of lobsters, which they believe has been enhanced by many years of v-notching effort (see Appendix 3 for a review of lobster v-notching in Northern Ireland).

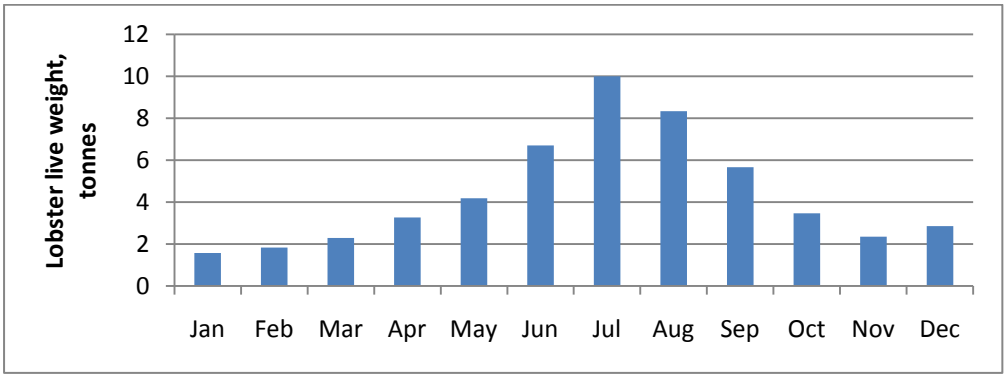
Figure 16: Landings of lobster (tonnes) into top ten Northern Irish ports from 2005-2009



Source: DARD, 2011

Seasonal landings of lobster are presented in Figure 17 (average monthly landings). Lobster landings occur throughout the year with a pronounced peak over the summer months and highest landings in July.

Figure 17: Landings of lobster (tonnes) per month, averaged across 2005-2009



Source: DARD, 2011

3.5 IMPLICATIONS FOR MANAGMENT

Combining recent brown crab landings data with DARD recorded number of pots fished per year does not reflect the true effort, since only the number of pots is known, rather than the number of pot lifts. Therefore at this time landings per unit effort (LPUE) can only be speculated. Given the growth in the inshore potting fleet that has resulting in the increase in pot numbers reported and the fluctuating volumes of brown crab landed over the last five years LPUE may be decreasing. Reduced landings may in part be due to market demand

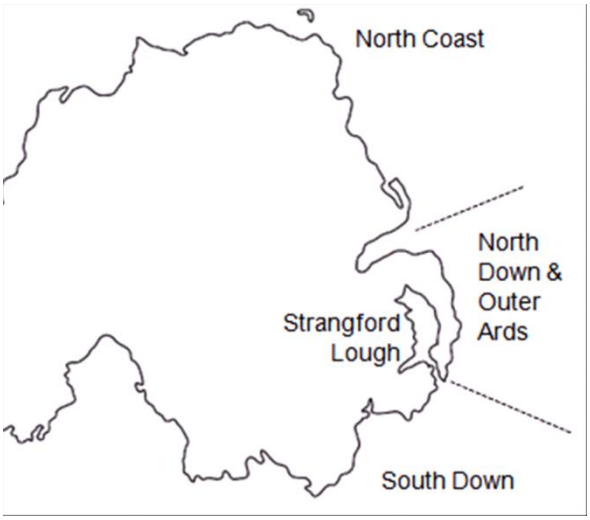
(and so price) influencing fishing patterns, but it does suggest landings are going down despite more pots in the water.

Better science-based information on the crab fishery is needed (see section 7 for suggested work). On a precautionary basis effort should at least be held at present levels until more is known and some common-sense management measures could improve the fishery ahead of science-based management decisions.

The various shellfish pot fisheries operating in Northern Ireland for brown crab, lobster and velvet crab are very closely linked. With the same vessels and gears targeting these species there is logic in developing a pot fishery management plan for Northern Ireland that includes additional species-based measures where necessary. When established the plan could be broadened out to include other existing or emerging pot fisheries such as the buckie whelk, *palaemon* and *Nephrops* pot fisheries.

Comparing the top crab landing ports (Figure 8) with the top lobster landing ports above, it is evident that while the pot fisheries are linked there are different characteristics and priorities around the coast. This suggests four geographically distinguishable potting areas that could form the basis of more localised inshore management (Figure 18):

Figure 18 Northern Ireland Potting Areas



North coast – dominated by lobster, but with a significant crab fishery that may be linked with the offshore crab resources to the North and West targeted by *vivier* crabbers.

North Down & Outer Ards –a mixed fishery with seasonal importance for both brown crab & velvets

Strangford Lough – one of the key velvet crab areas with an important *Nephrops* pot fishery significant lobster & brown crab.

South Down – has the largest number of crabbing vessels that are also targeting lobster.

The geography and fishery characteristics of these areas have already resulted in formal fishermen's associations for the North Coast and Strangford Lough. In the case of Strangford Lough proposals for a pot fishery management plan have already been drafted by DARD in consultation with the fishermen operating in the Lough. In the North Down & Outer Ards and South Down areas informal groupings are yet to result in the formation of fishermen's associations.

4 KEY ISSUES

4.1 GENERAL UK CRAB FISHERY ISSUES

The Nautilus report (2009) identifies a number of problems facing the UK brown crab fishery:
"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."

In response to concerns over the crab fishery the Shellfish Association of Great Britain's (SAGB) Crustacean Working Group noted in its March 2010 minutes that it would recommend that the UK fisheries Minister:

- imposes a cap on effort,
- using regional pot limits from 0-6 nautical miles,
- offshore quotas (not owned and not tradable), and
- removes latent effort.

The Group also supports higher regional landing sizes (a 10mm increase), and bans for using raw crab for whelk bait and landings of crab claws. The Group does not support a ban on landing cripples. Talks were continuing on quotas for markets reasons. The discussion highlighted regional differences in fishing behaviours and management preferences, and the need to make provision for new young entrants.

4.2 SPECIFIC NORTHERN IRELAND CRAB FISHERY ISSUES

In addition to some of the general issues such as NI product feeding into an over-supplied market with resulting poor prices, consultation with stakeholders in Northern Ireland as part of this work raised the following issues:

4.2.1 Effort

There is evidence elsewhere in the UK that the catch per unit effort (CPUE) in brown crab fisheries is decreasing and consultation within Northern Ireland indicates that this may also be the case with an increasing number of pots in the water. Increases in effort are reported in the County Down crab fishery and in Strangford Lough, while effort levels on the North Coast, where lobster is the primary pot fishery is reported to be relatively stable.

There is currently limited use of parlour pots by the NI inshore fleet. The handling of these larger, heavier pots is difficult for small inshore boats sometimes being fished single-handed. However some operators are already using parlour pots and there is concern that the inshore grounds would not sustain the additional effort resulting from all operators

switching to parlour pots. Experience elsewhere has shown that the switch to parlours can occur rapidly and areas around the UK are now trying to return to a fishery without parlour pots.

4.2.2 Latent capacity

Concerns about increasing fishing effort in the crab fishery include the potential impact of latent effort. A significant increase in effort would occur if those vessels that hold a shellfish entitlement, but are currently inactive or fishing below potential levels start to actively fish brown crab (and other shellfish species). Discussions have taken place at a national level (e.g. UK and Ireland Crab and Lobster Working Group) to introduce a "sunset clause" applying to all entitlements i.e. if the entitlement is not exercised, then it lapses, but no such clauses have been introduced to date.

In Northern Ireland the majority (86%) of licensed under 10m vessels hold a shellfish entitlement. However many licensed vessels are currently operated on a part-time basis. In some instances only 30 to 40 pots are being worked on a seasonal basis. Anecdotal information suggests that there has not been a step change in activity levels amongst this part-time group to date. The economic downturn and further decommissioning of the over 10m fleet may encourage these existing rights to be more fully exploited.

4.2.3 Unlicensed or 'hobby' fishermen

Recent legislation has been brought in by DARD to curb what was perceived to be a growing problem in certain areas with unlicensed vessels working pots. It may be too early to say whether this legislation has removed the problem. Certain aspects such as the specific reference to crab and lobster rather than all fishing with pots potentially create a loophole and a problem for enforcement. These efforts could be further supported with the requirement for adequately detailed marking of all commercial gear.

4.2.4 Stock information

Management of a fishery should be evidence-based and ideally based on sound science. Making decisions regarding appropriate target levels for effort are difficult without basic knowledge to determine certain reference points such as catch per unit effort (CPUE). Information on brown crab stocks is sparse as scientific resources are inevitably prioritised towards quota species. It is unrealistic in the current economic climate to expect additional stocks to receive more scientific attention from central agencies in the form of fishery-independent surveys. Information is still needed to inform management, however, which points to fishery-dependent information being the most likely route, i.e. data recorded and reported by the fishers themselves. This has proved successful where fishermen have greater involvement in the management of the resource and are afforded greater responsibility for its management (e.g. through co-management arrangements).

4.2.5 Quality

The landing of low quality soft shelled (white) crab is an issue on the Irish Sea coast. This could be linked to a declining CPUE (reducing catch levels making fishermen less selective) and also to the uncertainty of future management (i.e. the establishment of a larger track record), whereby maintaining quantity is favoured over quality. This is a wasteful practice and has overall implications for the reputation and marketing of Northern Ireland crab.

There is very little short-term benefit to landing low quality crab. Rather than fishermen not being paid for the landing and the material going for whelk bait, better sorting at sea would allow a better price to be taken for the resource in the long term.

4.2.6 Sizes

Processors report that crab at or just over the minimum landing size (MLS) of 130mm results in a product, particularly after cooking, that does not achieve the first size grade of 400g to 600g. Therefore the legal MLS is not consistent with the market MLS. Stock and market benefits could be expected from increasing the MLS to 140mm. If locally appropriate (a comparatively smaller crab is noted on the grounds off South Down), a further move to 150mm could be discussed in later years.

4.2.7 'Toeing'

Regulations permit 1% of the catch can be landed as crab claws from potting vessels and 75kg for all other gear such as netters. It is reported in the Review of Inshore Fisheries Management in Northern Ireland that the legislation is not effectively enforced and the practice of 'toeing' crabs is increasing. For pot fisheries this may be linked to the discarding of lower quality carapaces, with lower meat yield in the claws potentially more difficult to detect. It can therefore be a hindrance to quality control and also prevents the assurance that the crab was over the MLS.

4.2.8 Gear conflict

The Review of Inshore Fisheries Management in Northern Ireland identifies that there are occasional instances where trawling and potting activity come into conflict. A distinction between inshore potting grounds and prawn grounds targeted by trawlers further out means this does not appear to be as big a problem as elsewhere in the UK. However there are issues between potters and inshore scallopers as well as occasionally between prawn trawlers and potters.

There is also the potential for conflict between potters, particularly disputes over ground between those operating on a full time basis and those who are more seasonal. The review recommends that gear conflict could be resolved through better communication and that a code of practice developed and agreed by fishermen would be useful.

4.2.9 Environmental designations

The management plan proposed for Strangford Lough illustrates the fishing sectors responsible practice within an environmentally sensitive and internationally designated area. European designations are in place or proposed around much of Northern Ireland's coast and there is a clear movement in NI policy towards more integrated management of the marine environment with a Marine Plan expected by 2014. Therefore while some would argue that Strangford is a special case, others see it as the first of many instances where fisheries is a component of marine management and at risk of being further constrained or even prevented if it is unable to show it is operating responsibly.

4.2.10 Offshore Renewable Energy

In addition to the pressure felt by fisheries from environmental designations, the emerging renewable energy sector in Northern Ireland is also felt by many fishermen to pose a threat to their operations with further restrictions on where they are able to fish.

4.2.11 Links with other fisheries

All of Northern Ireland's pot fisheries are closely inter-twined with lobster, brown crab and velvet crab (as well as in certain places *Nephrops* and an emerging *Palaemon* fishery). It must be recognised that many measures that would be proposed for managing the brown crab fishery would have implications for these other pot fisheries.

5 MANAGEMENT

5.1 CURRENT LEGISALTION

Legislation that is applicable to the management of brown crab fisheries is set at European, UK and Northern Ireland levels. Within 12 nautical miles, fisheries in Northern Ireland are managed by the Department of Agriculture and Rural Development (DARD).

5.1.1 European legislation

EU Technical Regulation 850/98 and its amendments, and Council Regulation (EC) 1415/2004 set out the following management measures applicable to brown crab:

Minimum Landing Sizes (MLS) for brown crab set at 140 mm carapace width (CW) to the north of 56°N and 130 mm CW to the south of 56°N. For NI crab therefore the 130mm MLS is applied.

Restrictions to landing detached crab claws (or toes) are set at 1% by weight of catch for pots and a maximum of 75kg per catch for other gears.

It is interesting to note that Velvet crab (*Necora puber*) is not included in EC 850/98 on technical conservation measures.

Restrictions are imposed on vessels >15m with kW days, which limits maximum annual fishing effort for certain fishing areas and fisheries, including brown crab.

Council Regulations 1966/2006, 1006/2008 and 1224/2009 and Commission Regulations 1077/2008 and 201/2010 require certain UK vessels when operating in UK, EU and third country waters to record and report fishing activity data electronically. All vessels over 10m are currently required to maintain and submit a logbook. Vessels over 15m will be required to do so electronically by 1st July 2011 and vessels over 12m by 1st January 2012. Approved electronic software systems are provided on the DARD website. This is unlikely to apply to many NI potting vessels; the majority of which are under 12m in length.

The reform of the CFP in 2012 is expected to recognise the particular socio-economic contribution of small scale coastal fisheries (SSCF) and so ensure these are supported in some form. This may, however, only relate to the continuation of grant aid to the small scale sector as subsidies for larger vessels are phased out. Any preferential access to fishing opportunities for the small scale sector is likely to remain a matter for individual member state legislation.

5.1.2 UK legislation

The Sea Fishing (Enforcement of Community Conservation Measures) Order 2000 and the Undersized Edible Crabs Order 2000 establish the European Union measures described above within UK law, including within Northern Ireland Waters. These orders apply to British fishing vessels, but the Republic of Ireland has national legislation that also implements the EU regulations stated above.

The Undersized Velvet Crabs Order 1989 sets a MLS of 65mm, preventing the retention of velvet crabs smaller than 65mm carapace width on board British fishing boats. A similar Irish regulation is not in place.

The UK Shellfish Licensing Scheme was introduced by Defra in 2004 and is applicable for UK Waters out to 12nm. It limits the number of vessels that can exploit shellfisheries to those

issued with a shellfish entitlement and therefore restricts entry to the sector. The Licensing Scheme also puts shellfish by-catch limits on trawlers and sets daily catch limits for vessels not entitled to a shellfish licence. While the scheme restricts entry of vessels without entitlement to the fishery, it cannot control increases in effort by vessels that are licensed and fishing below their current capacity (or fishing in other sectors).

Section 17 of the UK Sea Fisheries (Shellfish) Act 1967 states that (excluding Scotland and Northern Ireland waters):

"(1)…any person who takes, has in his possession, sells, exposes for sale, buys for sale, or consigns to any person for the purpose of sale,—

- *any edible crab carrying any spawn attached to the tail or other exterior part of the crab, or*
- *any edible crab which has recently cast its shell,*

shall be guilty of an offence.

(2) A person shall not be guilty of an offence under subsection (1) of this section if he satisfies the court that the edible crabs found in his possession or alleged to have been sold, exposed for sale, bought for sale, or consigned to any person for the purpose of sale, were intended for bait for fishing.

Based on the above it is an offence in most circumstances to land berried and white crab. However the exemption for crab that is intended for bait and a lack of a clear definition for 'recently cast its shell' makes it very difficult to enforce this.

DARD has confirmed that section 17 of the act does not apply in Northern Ireland waters. This suggests that similar stock conservation measures should be developed for Northern Ireland and that the legislation needs to be with carefully worded with the condition of brown crab, velvet crab and lobster clearly defined.

5.1.3 Northern Ireland legislation

The Registration of Fish Buyers and Sellers and Designation of Fish Auction Sites Regulations (Northern Ireland) 2005 came into effect on 1 September 2005 and requires that all buyers and sellers of first sale fish are registered and must submit sales notes to their local fisheries office with 48 hours of any sale. Prior to this regulation, landings by the under 10m fleet were submitted on a voluntary basis. The implementation of Registration of Buyers and Sellers (RBS) therefore allows accurate collation of landings from all vessels for all species. There is similar RBS legislation applied in the rest of the UK.

The Inshore Fishing (Prohibition of Fishing and Fishing Methods) Regulations (Northern Ireland) 1993 stipulate various degrees of gear restrictions within Strangford Lough for suction dredges, beam trawls, use of tickler chains, trawling and dredging and also restrictions by vessel length. The 2008 amendment to these regulations relates to extension of the ban on suction dredging to all Northern Irish waters and further restrictions to dredging, seining and trawling within Belfast Lough. It is understood that no part of these regulations relate to brown crab.

The Unlicensed Fishing for Crabs and Lobster Regulations (Northern Ireland) 2008 were introduced by the Department of Agriculture and Rural Development (DARD) and have been

in force since 31 May 2008. The regulations set a level of fishing that can reasonably be described as "for personal use" and prohibit landing of more than five crabs and one lobster per boat per day and use of more than 5 pots unless the vessel owner has a shellfish license. Failure to comply may result in fines of up to £5,000 and possible forfeiture of gear.

5.2 RECENT DEVELOPMENTS

5.2.1 Inshore Fisheries Review

Recent developments of direct consequence to Northern Ireland's inshore sector include the recommendations of the Fisheries Forum (Implementation Plan, June, 2010). The Fisheries Forum recommends that fishing effort in the inshore sector should not be allowed to increase above current levels and measures should be introduced concurrently with restructuring of the "offshore fleet" to prevent effort transferring into this sector. DARD has agreed to discuss with the industry and other stakeholders feasible measures to limit inshore fishing effort in NI inshore waters. The Fisheries Forum recommended that this includes consideration of a cap on licence numbers and removal of Fixed Quota Allocations.

As a result of one of the Forum's recommendations, DARD are preparing and considering a business case for a possible decommissioning scheme available to all sectors of the Northern Irish fleet. If implemented this may well be taken up by owners of over 10m vessels that continue to operate under highly constrained fishing opportunities. Elsewhere decommissioning of the over 10m fleet has seen significant re-investment of monies into purchasing inshore vessels and thus increasing capacity in the fleet. While licence numbers are capped this could easily be by-passed through purchasing vessels with shellfish entitlements and so re-activating existing latent capacity.

DARD's response to the Review of Inshore Fisheries states that:

"*DARD will consider the introduction of sustainable harvesting plans to ensure that inshore stocks are harvested in a sustainable way. These could be for a particular stock or a discrete area or both. The recent consultation on the Strangford Lough Pot Fishery Management Plan is such an example.*"

Further recommendations by the Fisheries Forum include encouraging the industry to seek EFF funding for new technologies that would enhance the quality of fisheries products at all stages of the supply chain.

5.2.2 Strangford Lough Pot Fishing Management Plan

DARD developed proposals for a Strangford Lough Pot Fishery Management Plan in 2009, in consultation with the Strangford Lough Fishermen's Association. A summary of the proposals, which were open to wider stakeholder consultation, is presented in Table 2. The proposals were developed in response to the lack of control allowed by the shellfish licensing regime and local fisheries regulations in relation to levels of licensed and unlicensed pot fishing in the Lough.

The Strangford Lough Pot Fishing Management Plan is a useful early exploration of many of the issues that will face pot fishery management throughout Northern Ireland. It also highlights the need to establish where strategies and management plans sit in relation to each other. It may be that a Strangford Lough Pot fishing management plan is one of several that nests within a Northern Ireland Inshore Fishery Management Plan.

Table 2: Summary of proposals for a Strangford Lough Pot Fishery Management Plan

Controlling Fishing Effort	**Permits** for both commercial and recreational pot fishing issued to individual vessel owners and renewed annually. Proposed sanction for suspension of permit if non-compliant to permit conditions. Proposed that permits for commercial fishing available to those with demonstrable track record of pot fishing within the Lough. **Pot limits** proposed for commercial permit holders of 150 pots per vessel and for recreational permit holders of 5 pots per vessel. **Marking of gear** proposed for all commercial and recreational pots to be marked individually with a tag provided by the Department. Proposed that distinctively coloured buoys should mark a string of pots and be tagged with permit number and indicate number of pots on string. Proposed sanctions if gear not properly marked.
Stock Conservation	**Minimum Landing Size** (MLS) increases proposed for brown crab from 130mm carapace width to 140mm by 1st January 2010 and 150mm by 1st January 2011. **Reporting arrangements** proposed for catches (including species and location within Lough) to be recorded daily and reported weekly with potential for online reporting facility. Proposal to examine feasibility of satellite monitoring systems on all commercial vessels on the Lough. **Gear specifications** including proposed voluntary escape hatches and potential for biodegradable escape mechanisms to prevent ghost fishing. **Environmental accreditation** with proposals to work towards gaining independent accreditation such as Marine Stewardship Council (MSC) certification for Strangford Lough fisheries.

Source: DARD, 2009

The relationship between brown crab management and other NI pot fisheries needs to be recognised, including the well-established lobster management arrangements and structures such as North East Lobster Co-operative (NELCO) and the North Coast Lobster Fishermen's Association (NCLFA). As recently reported in Fishing News[1], the Northern Ireland v-notching schemes involving these organisations have maintained good buy-in from the industry and established important links with scientists (QUB and AFBI), which should inform the development of the crab plan. Further details on Northern Ireland's v-notching are presented in Appendix 3.

DARD's response to the Fisheries Forum agrees with the vision for inshore fisheries that any Northern Ireland crab management plan would be part of:

"A profitable inshore fishery which is fully aware of, and compliant with, its environmental responsibilities and contributes to viable and thriving communities by providing employment, economic success and a sense of cultural identity."

The Northern Ireland Fisheries Forum reiterated that a strategy for inshore fisheries is needed. DARD's implementation plan[2] indicated this strategy was to be completed by Agri-Food and Biosciences Institute (AFBI) as soon as possible and that an inshore fisheries

[1] "The Way Ahead for V-notching lobsters", Fishing News, 20th August 2010

[2] http://www.dardni.gov.uk/index/fisheries-farming-and-food/fisheries/sea-fisheries/fisheries_forum_implementation_plan.htm

subgroup was to be established. Recent discussions indicate that AFBI remain tasked with drafting the long-awaited Northern Ireland Inshore Fisheries Strategy.

5.2.3 Northern Ireland Marine Bill

Finally, and of considerable consequence for Northern Ireland inshore fisheries, is the development of the Northern Ireland Marine Bill. This could be in place by 2012 with a Marine Plan intended to be in place by 2014. It will have very similar objectives to the UK Marine Bill as it will contain provisions for marine planning and marine nature conservation within Northern Ireland's territorial waters (within the 12nm limit). This will set the framework for the management of all marine users, including fisheries, on a more integrated basis.

This strategy presents a critical opportunity for Northern Ireland's inshore fishermen to determine how their fisheries should be managed, allowing their fisheries management plan(s) to be recognised and integrated into the wider Marine Plan. If this opportunity is not taken, there is a risk that inshore fisheries management in Northern Ireland is shaped by the demands of other marine interests such as environmental designations and renewable development rather than those of inshore fishermen.

5.3 MANAGEMENT ELSEWHERE

5.3.1 England

Many English inshore areas have bans on landing berried females, soft pre-moult or recently moulted crabs, claws and using crab for bait. This is applied either as Sea Fisheries Committee (SFC) bye-laws or under voluntary agreements. For example the Eastern SFC has bye-laws stating:

"No person shall remove from any fishery any edible crab (*Cancer pagurus*) or lobster (*Homarus gammarus*) which is soft-shelled or berried (egg-bearing) but shall return such shellfish to the sea immediately."

"No person shall use any edible crab (*Cancer pagurus*) for bait."

"No person shall remove from any fishery any edible crab (*Cancer pagurus*) or part thereof, or velvet crab (*Necora puber*) or part thereof, or lobster (*Homarus gammarus*) or part thereof, which cannot be measured to ensure compliance with the Undersized Crabs Order 1986…"

There is no further detail on how a soft-shelled crab is defined. A listing of successful prosecutions shows one for landing berried lobster and another for undersized lobsters. There are no prosecutions against the other bye-laws such as landing soft-shelled crab.

The Northumberland SFC was one of the first to introduce pot limits in 2009 on a flat rate of total pots per vessel basis. The following byelaw relates to pot limitations[3] and shows the conditions that are introduced to support it:

[3] http://www.nsfc.org.uk/byelaws.html as at 04/11/10

"No person holding a permit (hereinafter called "a permit") as referred to in Committee byelaw 13 shall fish (including from a vessel) for any fish or shellfish (as referred to in the said committee byelaw 13) with more than 800 pots, creels, traps and cages within the Committee district."

"No person holding a permit shall fish with any pots, creels, traps and cages without affixing thereto a yellow tag with a serial number issued by the Chief Executive to the Committee from the Committee office and no such person shall receive more than 800 tags."

"Any vessel or person using 5 pots or fewer (in accordance with Committee byelaw 13) may not fish without affixing thereto a white tag with a serial number issued by the Chief Executive from the Committee office."

"Any person losing more than 10% of yellow tags or more than 2 white tags shall write to the Committee within 21 days explaining the loss and notifying the committee of the tag numbers lost and the cost of replacement tags will be paid by the owner thereof."

"No person shall haul any other vessel's or person's pot, creel, trap or cage without firstly obtaining the agreement of the Committee."

5.3.2 Canada

Fisheries and Oceans Canada, the statutory agency responsible for fisheries management in Canada developed an Integrated Fisheries Management Plan (IFMP) for a number of crab species in the Pacific region, which is divided into seven crab management areas. The non-statutory status of the IFMP is clearly defined:

"*This IFMP provides a common understanding of the basic "rules" for the sustainable management of the fisheries resource. This IFMP is not a legally binding instrument that can form the basis of a legal challenge. The IFMP can be modified at any time and does not fetter the Minister's discretionary powers set out in the Fisheries Act. The Minister can, for reasons of conservation or for any other valid reasons, modify any provision of the IFMP in accordance with the powers granted pursuant to the Fisheries Act.*"

The IFMP therefore establishes a basis for management as agreed by stakeholders. Where necessary this has been supported by legislation in the form of fishery regulations, i.e. the conditions of licence. However a new Bill (C-32) replacing the Fisheries Act states that "*If a fisheries management agreement establishes conservation, protection or management rules …those rules are conditions of every licence issued to a holder to whom the agreement applies.*"

Therefore in the case of the IFMP for crab, all those with a licence to fish crab in the area is effectively bound by the IFMP without the need for further specific legislation.

The 2011 crab IFMP identifies a problem with soft-shelled crab and the management response: "*Concerns with increased mortality from handling soft-shell crab and, from the industry perspective, with the marketing of inferior product led to the non-retention of soft-shell crab. A soft-shell crab is defined as a crab having a durometer measurement of 70 units or less. Additional measures, such as closures during soft-shell periods, are being considered to further protect moulting crab.*" A sampling programme is now underway to better understand and define the moulting period in key management areas.

This Canadian example shows that a measurable definition of soft-shelled crab is possible, using a simple and affordable tool, the durometer (Similar shell hardness sampling is carried

out in Washington State Dungeness crab fishery in the US where a higher proportion of soft-shelled crab results in weekly landing limits being imposed.

Plate 2). Research into the measurement of shell hardness found that classification of new-shell versus other shell hardness resulted in a 90.8% correct classification at a durometer reading of 66. The use of the durometer as a standardized management tool removes the subjectivity of existing shell hardness methods (Hicks & Johnson, 1999). However, the Canadians use the measurement of shell hardness as a justification for area closure, which is more readily enforceable.

Similar shell hardness sampling is carried out in Washington State Dungeness crab fishery in the US where a higher proportion of soft-shelled crab results in weekly landing limits being imposed.

Plate 2 Examples of analogue and digital durometers

Source: skatelogforum.com instron.itrademarket.com

5.3.3 Isle of Man

The brown crab and common lobster fishery in the Isle of Man currently employs 31 vessels of which the majority are over 10 m in length. The brown crab fishery is focussed entirely on the west coast of the Island (Kaiser et al, 2008). At the end of 2010 the Isle of Man government issued the following proposed changes to the management of the crab and lobster fishery in its waters:

- The mandatory use of individual pot tags, issued by the Department, to both hobby and commercial fishermen. With the help of commercial fishermen, the Department is currently running trials on a number of different types of tags. A decision will be made at the conclusion of these as to the type of tags that will be issued.
- The mandatory use of escape panels, by both hobby and commercial fishermen. A trial of different types of escape panels was undertaken in 2008 by Bangor

University, with the help of local fishermen, which concluded that 80 x 45 mm rectangular escape gaps are an acceptable size that will not, overall, result in losses of commercially viable lobsters. A minimum period of three months will be in place to allow fishermen to comply with this requirement.

- A reduction in the maximum number of pots to be fished by any vessel within the Territorial Sea to 300 pots, with no grandfather rights applicable to vessels currently fishing more than this number. Previously a total of 500 pots per vessel was permitted with 300 of these permitted within 3nm.

The new regulations are currently applicable in the 0-3 mile zone around the Isle of Man; UK agreement is required to extend these fully out to 12 miles as desired by the Isle of Man authorities.

The new bye-law also requires all vessels in the fishery to provide logsheets and catch information to the Department in order to give a better understanding of the state of the fishery. These more restrictive measures are being introduced ahead of findings from the additional science proposed in the sustainable fisheries strategy, illustrating a precautionary approach in response to concerns over exploitation rates. A lack of knowledge should not be an excuse for inaction if there are indications that measures should be taken.

5.3.4 Australian mud crab

The volume and value of the 2004 national commercial harvest for Mud crabs (*Scylla serrata*) exceeded 1500 tonnes and $20 million. The recreational and indigenous take of this species is also significant, with estimates for the 12 month period starting May 2000 in the order of a million crabs. In 2000, a state-funded National Research Strategy monitored the abundance and habitat of the northern Australian mud crab. This was completed in 2005 and quantified the area of critical mud crab habitat in the Northern Territory (NT) and Queensland, and developed methods to estimate the size of the mud crab stocks in northern Australia. A large amount of research on crab population dynamics continues to be undertaken.

This example illustrates that substantial resources and timescales can be used for scientific support. In the case of Northern Ireland, the smaller geographical extent of the fishery compared to NT and Queensland should enable some aspects to be determined over a shorter timescale and enlisting the assistance of the industry in collecting fisheries-dependent will be more manageable. One important initial piece of research was a review of fisher's knowledge regarding the distribution and abundance of juvenile mud crab. This was conducted in order to collect anecdotal evidence that can assist in the design of any future sampling programs for juvenile mud crabs.

Other research has focused on comparing durometer readings with the 'thumb test' to assess shell hardness. Work is ongoing with the next stage of the project requiring the purchase of a number of durometers in order to familiarise the mud crab market chain with the use of the instrument and also conduct an industry survey as to an appropriate transition point for male and female crabs.

6 IDENTIFICATION OF POTENTIAL MANAGEMENT MEASURES

6.1 APPROACH TO THIS ASSESSMENT

The assessment process consisted of the following steps:

1. Identify potential management measures
2. Consult stakeholders on measures
3. Assess pros & cons of measures
4. Assess likely comparative costs
5. Re-present assessment to stakeholders
6. Revise and prioritise measures

The findings from this process are presented in the sections below.

6.2 IDENTIFICATION OF MANAGEMENT MEASURES

A list of management measures was developed based on previous work and experience in fisheries and more specifically shellfish management. The measures are categorised under five broad categories of measures were:

Inputs - the amount of fishing capacity or effort applied to a fishery

Outputs - the amount of resource removed from a fishery

Quality - the type or form of that resource removed

Conservation – determining when, where and how fishing can take place

Other – anything else suggested, in this instance including consideration of the MSC label

Overall 16 management measures were identified, with some containing sub-options so that 24 management options were considered in total. Table 3 presents these potential management measures, identifying what these measures are intended to achieve (objectives) and the scale at which they are generally applied. As the table shows, many have the potential to achieve more than one objective.

6.3 CONSULTATION ON MEASURES

The table of potential measures was presented at three well-attended regional stakeholder meetings. Attendees (consisting mainly of industry) commented on the measures presented and were asked for other suggestions. Stakeholders were also given the opportunity to give their views at a later date through contacting the team and/or completing an assessment sheet (appendix 2).

The effectiveness and the scale of impact of the measures depends upon the specifics of the measures, i.e. the number of pots permitted in a pot limitation scheme, the level at which quota or effort caps are set, the change in MLS or the extent of a closed area, etc.. The assessment is therefore informed by the general perception of these measures by stakeholders.

Table 3 Characteristics of Potential Management Measures

Management measure		Sub-options	Suitable scale (all potters, crab only)	Management objective			
				Stock	Fleet	Quality	Habitat
Fishing Capacity							
1	**Shellfish Entitlement**	a. attached to fishing licence	all potters	n	y	n	n
		b. with sunset clause	all potters	n	y	n	n
		c. crab permit for active vessels	crab only	n	y	n	n
		d. crab permit with sunset clause for active vessels	all potters	n	y	n	n
2	**Limit type of vessels inshore**	a. size of vessel	all vessels	y	y	y	y
		b. type of gear	all vessels	y	y	n	y
3	**Pot Limits**	a. flat rate per vessel	all potters	y	y	n	y
		b. based on track record	all potters	y	y	n	y
4	**Gear measures**	a. ban on parlour pots	all potters	y	y	y	y
Outputs							
5	**Introduce TACs and quotas**	a. flat rate per vessel	just crab	y	n	y	n
		b. based on track record	just crab	y	n	y	n
6	**Increase Minimum Landing Size**		just crab	y	n	y	n
7	**Limit for hobby fishermen**		all potters	y	y	n	n
8	**Curfews**		all potters	n	y	n	n
Quality							
9	**Ban landing cripple crabs**		just crab	y	n	y	n
10	**Ban landing crab claws**		just crab	y	n	y	n
11	**Landing white / diseased crab**		just crab	y	n	y	n
12	**Ban on landing berried crab**		just crab	y	n	y	n
Conservation							
13	**Closed seasons for spawning**		all potters	y	y	n	y
14	**Closed areas**	a. Complete closure for all fishing activity	all fishing activity	y	y	n	y
		b. Closure to fishing activities with significant impacts	all mobile fishing activity	y	n	n	y
15	**Escapement**	a. Escape gap	all potters	y	n	y	n
		b. Biodegradable panels	all potters	y	n	n	y
Other suggestions							
16	**Certification**	a. Marine Stewardship Council	all crab potters	y	y	n	y

6.4 ASSESSMENT OF MEASURES

Table 4 presents an assessment of the potential management measures. Wherever possible the assessment is specific to the situation in the Northern Ireland crab fishery and draws on the opinions of the stakeholders consulted. The positives and negatives of each measure are presented along with implications for other fisheries.

Costs to the public sector in terms of additional management, science, compliance and legislation are estimated using a comparative scale of 0 to 3 with 0 being no significant additional cost, 1 being low, 2 medium and 3 high additional costs. The same scale is applied to estimates of costs to the private sector. These costs may relate to one-off costs of establishing a measure or for the ongoing costs of maintaining a measure.

The assessment can only readily quantify costs. There is no information on which to base an assessment on whether significant benefits would result and the scale of benefit is more dependent on the level at which a measure is set. For example, the introduction of pot limits would certainly incur public and private costs in implementing the scheme, however the benefits to stock and possibly the market of pot limits being introduced is unknown.

Table 5 is a summary comparative cost table, presenting the assessment as a ranked list under each broad category. While 'cheaper' should not necessarily be interpreted as 'better', cost is something that must be kept in mind for the public sector in managing a fishery with first hand sales value of less than £1million and in assessing how acceptable a measure is for the private sector.

Table 4 Management Measures Assessment in a Northern Ireland context

Management measure		Sub-options	General assessment		Implications for other fisheries	Public sector costs					private sector costs		TOTAL COST
			Positives	Negatives		Man'mnt	Science	Compliance	Legislation	total public			
Inputs (Fishing Capacity)													
1	**Shellfish Entitlement**	a. attached to fishing licence	already in existence	most have one - does not address latent capacity	limited – most prawn trawlers already have one (latent capacity)	0	0	0	0	**0**	none	0	0
		b. with sunset clause	simple - 'use it or lose it', would address some latent capacity	Affects UK license and some may do minimum to avoid loss	limits movement of capacity into crab fishery	1	0	0	1	**2**	none	0	2
		c. crab permit for active vessels	addresses latent capacity; can be area-specific and create framework for other measures (permit conditions)	new fishers excluded. More administration/ paperwork	All potting vessels likely to receive permit, but prevents movement of other capacity into crab fishery.	1	0	0	1	**2**	Low-medium depending on price of permit	2	4
		d. crab permit for active vessels with sunset clause	addresses latent capacity; can be area-specific and create framework for other measures (permit conditions)	new fishers excluded. More administration/ paperwork	All potting vessels likely to receive permit, but prevents movement of other capacity into crab fishery.	1	0	0	1	**2**	low/medium depending on price of permit	2	4

Management measure		Sub-options	General assessment		Implications for other fisheries	Public sector costs					private sector costs		TOTAL COST
			Positives	Negatives		Man'mnt	Science	Compliance	Legislation	total public			
2	**Limit type of vessels permitted in inshore waters**	a. size of vessel	prevents larger *vivier* targeting grounds	restricts fleet development	depends on distance - could affect trawl grounds	0	0	1	1	**2**	low - existing operators shouldn't be too affected	1	3
		b. type of gear	prevents some gear conflict and damage to grounds	current small inshore dredgers could be excluded. High compliance cost with vessel lacking VMS.	significant for inshore scallop dredgers	0	0	2	1	**3**	medium - some (clam dredge) may be affected	2	5
3	**Pot Limits**	a. flat rate per vessel	simpler to apply and equitable in some respects	Setting appropriate level difficult. May encourage those fishing less to increase to maximum.	limits all potting effort	1	0	2	2	**5**	Purchase of tags could be significant additional cost.	3	8
		b. proportional to track record	Can best reflect and cap current capacity.	Expansion likely if slow to be introduced.	limits all potting effort	2	0	2	2	**6**	Purchase of tags could be significant additional cost.	3	9
4	**Gear measures – only allow certain types or sizes**	a. ban on parlour pots	Prevents capacity increases seen elsewhere, rel. Easy to enforce	limits flexibility in fishing pattern, cost to those already using them	none	1	0	1	1	**3**	High for those with parlours.	2	5

Management measure		Sub-options	General assessment		Implications for other fisheries	Public sector costs					private sector costs		TOTAL COST
			Positives	Negatives		Man'mnt	Science	Compliance	Legislation	total public			
Outputs													
5	**Introduce TACs and quotas**	a. flat rate per vessel	can limit removals based on science or market	determining and agreeing TAC is difficult	may encourage more effort on those not limited by quota	2	2	1	2	**7**	high if tradable	3	10
		b. based on track record	can limit removals based on science or market	determining and agreeing initial allocations and TAC is difficult	may encourage more effort on those not limited by quota	2	2	1	2	**7**	high if tradable	3	10
6	**Increase Minimum Landing Size**		has stock and market benefits	Loopholes such as toeing and voisiange arrangements may undermine efforts.	potential short-term (one season) redirection of effort	0	0	0	1	**1**	low	1	2
7	**Limit for hobby fishermen**		improve consistency of existing measures e.g. MLS and future measures e.g. toeing		enforces limits on hobby fishermen	1	0	1	0	**2**	none	0	2
8	**Curfews**		can limit removals	reduces flexibility and may force pot retrieval in bad weather conditions depending on details of curfew	limits all potting effort, improve gear conflict with mobile gears	1	0	2	1	**4**	medium	2	6

Management measure		Sub-options	General assessment		Implications for other fisheries	Public sector costs					private sector costs		TOTAL COST
			Positives	Negatives		Man'mnt	Science	Compliance	Legislation	total public			
Quality													
9	**Ban landing cripple crabs**		Resource is returned, reduces onshore handling and waste.	Precise definition and application difficult.	none	0	0	1	1	**2**	low	1	3
10	**Ban landing crab claws**		ensures whole crab is used (or returned)	Current loophole for netting could be used. Onshore rather than at sea disposal of backs	none	0	0	1	1	**2**	low	1	3
11	**Ban landing white crab**		return at sea means available for capture at good price in a weeks, avoids landside waste	difficult to define in legislative terms	none	0	0	1	1	**2**	low	0	2
Conservation													
12	**Ban on landing berried crab**		returns breeding females		none	0	0	0	0	**0**	none	0	0
13	**Closed seasons for spawning etc.**		protects critical life stages	difficult to impose just on crab in a mixed potting fishery	limits all pot fisheries	0	0	1	1	**2**	depends on extent & impact on other fisheries	2	4
14	**Closed areas**	a. Complete closure for all fishing activity	protects critical species or habitats	Tricky to define appropriate area. Potters have limited impact on sensitive habitats, so could be unnecessarily restrictive to them	limits all fisheries	1	1	2	1	**5**	depends on extent & impact on other fisheries	3	8

Management measure		Sub-options	General assessment		Implications for other fisheries	Public sector costs					private sector costs		TOTAL COST
			Positives	Negatives		Man'mnt	Science	Compliance	Legislation	total public			
		b. Close to fishing activities impacting sensitive habitats and/or species, e.g. Natura 2000 sites	Protects sensitive and critical habitats and species. Will not limit potters. Will mitigate gear conflict in specific areas, although effort by potters should not increase in these areas.	should be based on Natura 2000 sites and the features they protect, therefore Appropriate Assessment required for existing and new sites	likely to limit all mobile fisheries	1	1	2	1	**5**	medium - high	2.5	8
15	**Escapement**	a. Escape gap	Simple to introduce and not too disruptive if a transition period.	Significant losses for velvet fishery.	would affect velvet fishery	0	0	1	1	**2**	low	1	3
		b. Biodegradable panels	Simple to introduce and not too disruptive if a transition period.	may decrease lifespan of pot		0	0	1	1	**2**	low	1	3
Other Measures													
16	**Eco-labelling e.g. MSC**		Potential to pass, subject to robust stock information. Market benefits for local, UK and some of continental Europe	cost of certification and future surveillance audits	potential to include lobster & velvet crab in assessment (as separate UoCs)	1	1	0	0	**2**	medium	2	4

Table 5 Ranking of measures by type and overall cost

Management measure		Sub-options	Scale of Public sector costs	Scale of private sector costs	Comparative Total costs
Inputs (Fishing Capacity)					
1	**Shellfish Entitlement**	a. attached to fishing licence*	**0**	0	0
1	**Shellfish Entitlement**	b. with sunset clause	**2**	0	2
2	**Limit type of vessels permitted inshore**	a. size of vessel	**2**	1	3
1	**Crab permit**	c. area-based permit	**2**	2	4
1	**Crab permit**	d. with sunset clause	**2**	2	4
2	**Limit type of vessels permitted inshore**	b. type of gear (mobile gear)	**2**	3	5
4	**Gear measures**	a. ban on parlour pots	**3**	2	5
3	**Pot Limits**	a. flat rate per vessel	**5**	3	8
		b. track record	**6**	3	9
Outputs					
6	**Increase Minimum Landing Size**		**1**	1	2
7	**Limit on hobby fishermen**		**2**	0	2
8	**Curfews**		**4**	2	6
5	**TACs/quotas**	a. flat rate per vessel	**7**	3	10
		b. based on track record	**7**	3	10
Quality					
11	**Ban landing white crab**		**2**	0	2
9	**Ban landing cripple crabs**		**2**	1	3
10	**Ban landing crab claws**		**2**	1	3
Conservation					
12	**Ban on landing berried crab**		**0**	0	0
15	**Escapement**	a. Escape gap	**2**	1	3
		b. Biodegradable panels	**2**	1	3
13	**Closed seasons for spawning etc.**		**2**	2	4
14	**Closed areas**	b. Close to damaging activities	**5**	2	7
		a. Complete closure	**5**	3	8
Other Measures					
16	**Eco-labelling e.g. MSC**		**2**	2	4

*currently in place

6.4.1 Fishing Capacity (input measures)

A shellfish entitlement associated with the UK fishing licence is currently in place and represents the status quo situation with no additional costs. There then follow proposed

modifications to that situation; a sunset clause whereby entitlements are lost if not used in a given timeframe or an additional crab permit based on the applicant being able to show a track record in the crab fishery.

As Table 5 illustrates, the comparatively high cost measures to tackle the level of effort being applied in the crab fishery are pot limits. A less costly precautionary approach while the necessary information on the fishery is being gathered (see section 8 on science strategy) is to introduce certain safeguards against substantial increases in effort in the fishery. The assessment identifies the following as being a relatively low cost approach to achieve this:

- **Introduce a sunset clause** on existing shellfish entitlements - removes some latent capacity;

Fishermen expressed concerns that a unilateral move by Northern Ireland to alter the shellfish entitlement could make purchase of vessels and licences (which are key assets to these operators) unattractive to other areas of the UK. Introducing sunset clauses at a UK level is not being proposed by Defra. Therefore alternative measures are considered to tackle latent capacity.

- **Northern Ireland Crab Permit (with or without sunset clause)** – prevents latent capacity becoming active, enables introduction of area-specific permit conditions

The introduction of a permit to fish for crab (and/or other shellfish) in Northern Ireland waters would incur some additional public sector administrative costs. It may be difficult to achieve cost recovery via charging for a permit if industry buy-in is to be encouraged. However, the public cost could be limited if a simple permit system is introduced based on evidence of landings from Northern Ireland waters (over an agreed reference period, to be determined).

A permit based on previous fishing activity could be on an area-basis that is aligned with more localised management, creating the potential to establish area-specific conditions of permit (via local management plans). The conditions of permit could also specify measures that may be more difficult to establish in legislature such as the quality/conservation measures. These added benefits, in addition to addressing latent capacity, would justify the limited cost to the public sector.

When a Northern Ireland crab permit was discussed at the fishermen's meetings it received a mixed reaction. In areas where fishermen were organised into an association (the North Coast) some form of permit to better limit entry into the fishery met with considerable support. At the meetings with Down & Outer Ards fishermen, many expressed concerns that additional controls would constrain their own activities. The Strangford Lough proposals already include a permit system and therefore two of the four areas identified (Figure 18) are in favour of permits, and two are not.

The potential for and details of a permit system clearly requires further debate with the industry and DARD.

A Northern Ireland potting permit remains a recommendation of this strategy as it does offer the benefits outlined above; first and foremost the primary objective of more accurately controlling potting effort in Northern Ireland's waters.

It is also recommended that those areas not currently organised into an association be assisted in establishing such a group so that regular, structured debate on these matters can occur between the fishermen. This would enable a consensus view to be developed and form the basis for future local management.

- **Ban parlour pots** – these can substantially increase capacity and change the nature of a fishery;

A ban on parlour pots was put forward at the fishermen's meetings as this method of fishing is understood to significantly increase effective fishing capacity. Elsewhere in the UK there are existing by-laws banning their use as well as ongoing efforts to ban this gear. However a ban was not supported by the majority of NI fishermen at the meetings as some already use this type of pot and others do not wish to be constrained if they wanted to use these in the future.

Fishermen suggest that the small parlours used on most NI inshore vessels are generally hauled on a daily basis and do not result in the substantial fishing capacity increases per pot that have been seen elsewhere. This measure is therefore not taken forward at present, but could form part of local management if the need to further limit fishing capacity is identified by the scientific information to be gathered.

- **Limit the size of vessel inshore** – to prevent unsustainable levels of fishing developing.

A number of stakeholders suggested that there is not a need to apply vessel limits as the encroachment of larger vessels onto inshore grounds is not a current problem. However, the risk of larger vessels fishing inshore grounds on an occasional, opportunistic basis remains. Removing these potential avenues for effort expansion before they become a problem appears sensible. A grandfathering clause, providing exemptions to larger NI vessels that are already part of the fleet is a possible adjunct to this measure.

6.4.2 Output measures

Setting TACs and quotas are a high cost approach to limiting the amount of crab removed. Irrespective of whether these measures are applied as a flat rate or based on track record, substantial costs to the public and private sector can be expected. However, the most fundamental reason for not recommending these measures at this time is that there is insufficient information on which to set pot limits or TAC. A precautionary approach would be to set these at current levels, in which case the costs would be incurred without any expected benefit.

Setting TACs and quotas therefore appears excessive in management terms, unfeasible without much more scientific information, and from consultation is very unpopular with the industry.

In the future there may be an instance where stock status is known enabling fisheries managers and/or the industry itself to agree a TAC for the fishery, but that is some years off. Instead one of the simplest and most workable measures, which would incur very few additional costs, is:

- **Increase minimum landing size** – leading to improvements in both stock and market.

An increase in the MLS is the only measure on which there is almost universal industry approval. As a MLS of 130mm is already in place, there is a small cost to amend legislation but no additional enforcement costs. A change to 140mm appears to be a market-appropriate level that met with industry agreement. An increase above 140mm could be agreed as an area-specific measure and applied through a local management plan.

- **Enforcement of legislation on hobby fishermen**

Tighter enforcement on the existing legislation on 'hobby' fishermen can remove a perennial nuisance to commercial fishermen, particularly if a permit system is introduced as proposed above. In this way dedicated seasonal fishermen can continue, but the more opportunistic elements would be dissuaded. This should also be supported by a marketing initiative raising awareness amongst buyers in the hotel and restaurant sector that purchases should be from licensed fishermen or registered buyers only.

6.4.3 Quality measures

The measures proposed to improve quality are assessed as being of low or no cost. Any short-term loss of landings from better grading at sea to return white, small, crippled or berried crab will be minimal as this crab does not receive good prices, if any. It should also be balanced by improved yields in the medium to long term. A number of these measures already exist in UK legislation (see 5.1.2), but they are not applicable in Northern Ireland's waters.

Northern Ireland legislation surrounding the catching and landing of crab and other shellfish targeted by pot fisheries needs clarification and enhancement to make it fit for purpose. The following is proposed:

- **Ban on landing white crab**

A ban on landing white (soft-shelled) crab causes problems for legislature. Many English IFCAs have this in place and there is some mention of soft-shelled crab in the Shellfish Act, but a ban cannot readily be enforced as it is not well-defined. The use of durometer readings (as in the Canadian example, see 5.3.2) allows shell hardness to be measured and defined. The difficulty in enforcement means that a threshold hardness level tends to be used to inform wider resource management, e.g. the temporary closure of areas. However, enforcing a measure with the will of the majority of catchers and buyers would be possible if specific acceptable levels were to be established.

It is recommended that a ban on soft-shelled crab is implemented following a pilot study to defined acceptable shell hardness. This would be established through working with the catching sector and processors to use durometers to specify unacceptable shell hardness and establish how this compares to the 'thumb test'. The catching sector could then receive training as part of quality grading at sea. Retaining soft-shelled specimens on board could then be banned, forming a condition of permit if a permit system is introduced.

- **Ban on landing berried crab & crab claws**

For conservation objectives a ban on landing berried brown crab, velvet crab and lobsters should be applied (with an exception for lobsters landed for v-notching as part of a recognised v-notching scheme). The legislation on the landing of crab claws should also be

well defined in updated legislation. This would help to remove any ambiguity in the rules caused by the claw allowance for netters & potters.

- **Ban on landing crippled or diseased crab**

A ban on landing crippled or diseased crab was discussed at the industry meetings. In terms of improving quality there is some merit to preventing these specimens from being landed. However, these individuals are not expected to regenerate to good quality specimens if returned. There is also a perception that removing good quality specimens while returning diseased specimens could perpetuate or even increase the prevalence of disease in the population. These specimens are also still able to be used and sold on by processors. A ban on landing crippled and diseased crab is not therefore proposed at this time.

6.4.4 Conservation measures

- **Introducing escape gaps and biodegradable fastenings for hatches.**

Information is not available to establish the extent of ghost fishing by lost pots, but removing the potential for ghost fishing would be a positive step. It would also be sensible in conservation and on-board handling terms to enable smaller crab to escape pots rather than haul them aboard. It is a relatively simple and low cost measure to introduce escape gaps and biodegradable fastenings for hatches. The retro-fitting of escape gaps to existing pots could receive funding through EFF.

It is recommended that escape gaps and bio-degradable fastenings are considered within any emerging local management plan for the practical benefits outlined above, and also for the support these measures would give to marketing based on a sustainability message. However, it is not proposed that these measures become mandatory requirements defined in legislation. Some areas (particularly where velvet crab fishing is most significant) may be concerned with losses due to escape gaps. Instead these measures may be introduced based on stakeholder agreement as part of local management and as conditions of an area's permit should a permit system be introduced.

- **Closed areas and seasons**

There is not sufficient information on the extent and dynamics of the crab stock being targeted by the Northern Ireland inshore fleet to justify the introduction of closed areas on a seasonal or permanent basis for fishery management objectives. These can be costly to the public sector in defining the precise dimensions and management of areas, as well as to an inshore industry that may have few alternative fishing areas.

Many suggest that the constraints on the inshore fishery, such as weather and the confinement of fishing to grounds not fished by mobile gear effectively create seasonal and spatial closed areas. There are also emerging additional constraints of environmental designations and renewable energy development.

With the introduction of more scientific information, specific areas may be identified where additional protection is warranted from a fishery management perspective (e.g. areas with large proportions of berried females in certain periods). Any such areas should be compared with the sea areas being identified for marine conservation objectives to determine if both objectives could be achieved.

At present no obvious candidate areas or seasons have been proposed and therefore the introduction of closed areas or seasons is not recommended in this strategy.

6.4.5 Other measures

The introduction of eco-labelling is identified as a measure with comparatively modest costs to both the public and private sector. The MSC pre-assessment conducted as part of this study (appendix 4) identified that a number of improvements to management and science are required to achieve the MSC standard. This is a useful framework with which to benchmark fisheries and therefore a similar exercise could be carried out to review progress at a later date.

Seeking eco-labelling certification is not currently viable or advocated by stakeholders and therefore is not proposed. Instead it is recommended that marketing emphasises the efforts being made to manage the fishery in a sustainable manner (see section 7.5 on marketing).

7 QUALITY AND MARKETS

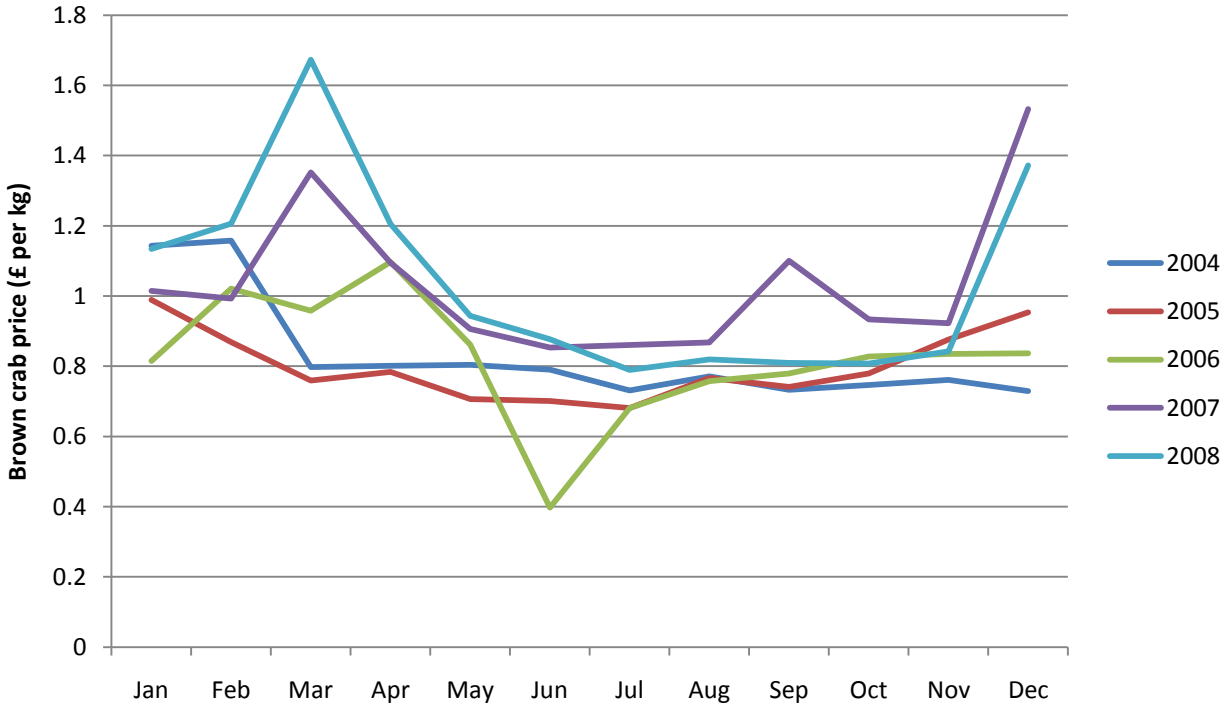
7.1 PRICE

The first sale price for brown crab landed by NI registered vessels from 2004 to 2008 is presented by month in Figure 19. The average price increased by 20% across the 6 year period, from 83p per kg in 2004 to £1 per kg in 2008. These data are, however, based on DARD valuation of brown crab landings rather than reported prices. The economic downturn since 2008 resulted in reduced demand from export markets and therefore reduced prices.

The small volume landed into Northern Ireland compared to the rest of the UK and the Republic of Ireland (the 1,000t landed in NI in 2010 represents 4% of total UK landings) inevitably means NI crab operators (both fishermen, processors and wholesalers) are 'price-takers' rather than 'price-setters'.

On average for 2010 it was reported that brown crab prices at first hand sale were 90p/kg and this drops for lower quality grades (based on meat yield). Large price variations are seen throughout the year, with peaks in March and December associated with the higher demand from the continent at Easter and Christmas.

Figure 19: Price variation (£ per kg) for brown crab per month for 2004-2008 (MFA, 2009)



Source: MMO

Fishermen are paid by buyers/processors on weight and size grade of crabs received. For those selling into the *vivier* market this can be further affected by mortality during transport. Therefore the price is determined irrespective of increasing the volume of landings using lower quality crab. It can even be counter productive to land higher volumes including poor quality crab mixed in with good quality crab if the price paid per kg is reduced significantly. However some processors will pay 30-50% of market price for poor quality

crab as this can be used for whelk bait and also helps to maintain supplies of the good quality crab. This can encourage fishermen to continue to land low quality crab.

7.2 MARKETS

Northern Ireland brown crab enters the main European markets for live or processed crab. The key European markets for crab are France, Spain and Italy. For France, there is a trend towards more frozen and processed products with falling live crab sales (Globefish, 2009). Size preferences can be distinguished within this European market with France seeking sizes 400g to 600g and Spain & Portugal showing a preference for the larger 600 to 800g sizes.

The UK exported 13,900t of crab (57% of total landed weight) in 2009 valued at £39million (MMO, 2010). The UK and the Republic of Ireland remain the two main countries exporting live crab to France, but supplies into French markets from Norway and Russia have increased significantly in recent years. The large volumes coming from Norway reduced the market price across the board. Spain receives most crab from Portugal and Uruguay, while Italy has a growing proportion of crab imports from China & Vietnam. These alternative suppliers of cheaper frozen and processed crab have been favoured as the economic downturn has hit seafood markets.

Table 6 Key European crab importing countries

Crab Imports (All Categories): Selected European Markets						
	2006 tonnes	2007 tonnes	%	2006 €'000	2007 €'000	%
France*	13 440	15 120	*13*	64 260	76 510	*19*
Spain**	10 980	12 780	*16*	40 920	47 900	*17*
Italy**	2 030	2 320	*14*	9 580	10 240	*7*
*Globefish/national trade statistics; *Jan-Nov; **Jan-Oct*						

Source: Globefish, 2009

Brown crab from Northern Ireland can be broadly divided into two distinct markets;

- **Processed market** – the majority of crab landed from the Co. Down ports (accounting for 60% of total NI landings) go to processors in Down and Donegal.
- ***Vivier* market** - crab from the North Coast (15% of NI landings) enters a *vivier* market which could be seen as an extension of the live lobster fishery.

The great majority of product is destined for the continental markets, mainly via France. Only a small proportion goes to UK and Irish buyers of products such as white meat and dressed crab. The UK market is growing, but with the current economic crisis sales to into the Republic of Ireland market have decreased significantly in recent months.

7.3 PROCESSING

The processed market is mainly based on cooked crab sold fresh or frozen and presented either whole, dressed or claws only ('toes'). There are about five Northern Ireland processors and *vivier* operators dealing in crab, with three Donegal-based processors also purchasing a significant amount of crab from Northern Irish vessels. There is some overlap

in products and markets, but Northern Ireland's processors maintain certain niches, such as for crab claws, whole individually quick frozen (IQF), crab meat or the live market.

Processors report that the continental market tends to simply define the product as "Irish crab", as distinguished from English and Scottish crab.

Fishermen are paid by the buyers (processors or *vivier* operators) based on the quality (mainly meat yield) of the crab. This is not based on weight at the point of landing as the crab shell may retain water rather than meat. For processors the total yield and therefore payment to fishermen is determined when the crab is cooked. For *vivier* transporters of live crab the price is determined on a weight basis, but at the delivery point in mainland Europe.

In both the processed and *vivier* markets, fishermen are dependent on establishing good relationships with their buyers. The widely-reported over-supply affecting the European market has kept prices depressed in recent years and so maintaining an outlet for crab landings is important for fishermen. These factors create a reactive local market where fishermen accept poor prices offered and it is unusual for alternative buyers to be sought.

At the same time, processors are competing with each other to ensure boats land their catch to them. This creates a situation where processors are accepting of poor quality crab, with some still paying around 50% for small or white crab that can be declawed or sold for whelk bait. Those trading in whole or live crab are less accepting of lower quality crab.

7.4 QUALITY

Product entering the live market commands the same price as A-grade product entering the processed market. The risk to *vivier* operators of accepting poor quality is that dead crab will affect water quality in transit (risking further mortality) as well as the final price of the consignment. A smaller volume of product will be sold on despite incurring the same transport costs. Consequently close grading by the fishermen and greater selectivity of what is retained is a pre-requisite of selling into the live market. Most North Coast operators sell into the live market and therefore already show this level of selectivity. For crab to survive to point of sale in the *vivier* market, it must certainly be of excellent quality and this lack of recognition for the additional robustness is perhaps surprising.

There is a general consensus that skippers know the difference between good and poor quality crab, but some continue to land poor quality. The inconsistencies in quality of landed product are more of a feature of those supplying the processed market.

Quality grades are used in the processed market, but as processors collect the catch (and therefore pay for transport and disposal of unmarketable crab) there appears to be no financial disincentive for fishermen to land as much as possible, irrespective of quality. Also on most occasions fishermen will still receive something for poor quality crab, as this can be used in some processed products or sold as whelk bait. This is one reason why some fishermen continue to go for volume over quality.

7.5 MARKETING STRATEGY

The brown crab market is mainly based on exports to continental Europe. This is subject to exchange rate fluctuations that have recently worked in favour of UK suppliers, but produces another uncertainty in the market.

Northern Ireland is at the western-most end of the logistics chain and so maintaining a route to market when demand from the continent falls is a constant challenge for processors.

Overall Northern Ireland crab remains in a difficult market position as it is:

1. highly dependent on an export market;
2. logistically more remote than competing suppliers;
3. with a comparatively low volume of landings; and
4. no clear distinction of Northern Irish product.

In relation to point 1; while some additional marketing effort could be applied to reducing the level of dependency on export markets, it is unlikely that the UK and Irish markets will grow sufficiently to take substantially greater volumes of product. It should also be recognised that there are numerous UK mainland suppliers that could also supply a growing UK market. Therefore the dependence on exports is expected to remain for some time to come.

There is little that can be done about points 2 and 3 as these are a consequence of geography and biology. Significantly increasing landings through increased effort could be damaging to this inshore fishery economically and biologically.

The final point, distinguishing Northern Ireland crab in the market, is where the marketing strategy should focus. At present in the eyes of European buyers, Northern Irish crab tends to be generically grouped in with Irish product as 'Irish crab'. There is no strong crab brand developed by NI processors as continental wholesalers use their own brand.

European buyers do recognise quality differences between individual suppliers, which results in preferential purchasing (rather than higher prices) and so helps these NI suppliers to maintain market access. However, this reputation, along with the wider reputation of 'Irish crab' can be damaged by one poor quality consignment.

As market access can be difficult to maintain, processors and wholesalers understandably guard their contacts and relationships with suppliers jealously. There is therefore very little potential for joint marketing of Northern Ireland product to build a brand with which to better distinguish NI product in the market. The recent experience with the now defunct Northern Ireland Seafood means that processors have no desire for joint marketing exercises. Instead they would each prefer to apply their own marketing strategy. Given the above, it is proposed that the marketing strategy should:

1. **Focus on the catching sector**. Promote the positive actions of the industry and management. This could be in the form of promotional material and awareness-raising events. Buyers and processors can then incorporate elements of this catching sector marketing on an individual basis as they see fit.

2. **Establish quality assurances**: this should be supported by legislation and the management efforts to ban the landing of white crab (use of durometers, training for at sea grading).
3. **Highlight sustainable credentials** of the fishery: low impact, small scale, improved management.

With no obvious lead organisation the marketing strategy should be delivered via a project, which should be eligible for EFF funding. The marketing project would be managed by a group to be established to oversee delivery of the whole crab strategy, the Northern Ireland Pot Fishing Council (NIPFC). The project is estimated to last one year and should be implemented in year 2 supported by the positive changes from new legislation and local management in development.

8 SCIENCE STRATEGY

This section discusses factors to be considered when developing monitoring and assessment of the crab resource, resulting in a science strategy to support the sustainable management of Northern Ireland's crab fisheries.

8.1 BACKGROUND

Section 6 of this report summarises the pros and cons of the various measures potentially available for improving brown crab management in Northern Ireland, and as a result of several discussions with stakeholders it identifies the measures that are most likely to be useful and acceptable to the industry at present. It cannot identify what management measures are essential, however, because although brown crab stocks have been assessed elsewhere in Great Britain, where there is clear evidence of the need to at least cap fishing effort at its present level (Bannister, 2009), there is no known assessment of brown crab stock status in Northern Ireland. This is a major gap that should be addressed in order to guide future management.

Adopting the precautionary approach, the gap in scientific knowledge is not an excuse for inaction. On the contrary, action of a precautionary nature (introducing certain measures to better limit effort and conserve the stock) is needed while information is gathered to inform management measures that can respond to the true status of the fishery. When this scientific information becomes available, management of Northern Ireland's crab fisheries can be reviewed to best ensure sustainable levels of exploitation.

8.2 THE PRINCIPLES OF STOCK ASSESSMENT AND DATA COLLECTION

To explain some key aspects of the suggested data collection and assessment programme, the following paragraphs introduce the principles of stock assessment prior to discussing a proposed strategy in more detail.

A stock assessment measures the impact of the current fishery by measuring the death rate due to fishing (called fishing mortality and considered to be proportional to fishing effort). It then models how, in the long term, landings (yield) and potential egg production from the female spawning stock will change if the fishing rate is either increased or reduced. Scientists can then advise whether changes in fishing rate and minimum legal size are needed to avoid overfishing and to promote an optimal harvest such as maximum sustainable yield. To meet the precautionary approach, and achieve accreditation standard, this advice should be determined by comparing stock status to benchmarks or signposts called reference points that are discussed in more detail later.

Crab assessments use size-based models. These start with the separate size distribution of cock and hen crabs in the landings. A size distribution is the relative number of crab of different sizes (carapace width), raised to the total annual landings from a stock, and averaged over two or three years to even out random variation.

The model first uses growth data (obtained from tagging results that estimate the annual moult increment) to convert numbers at size to numbers at estimated age. The fishing mortality rate is then derived from the rate at which numbers decline with age. Changes in fishing mortality over time should be proportional to changes in fishing effort, and should

cause corresponding changes in crab abundance that should be apparent from changes in the average catch per effort of the fishing fleet. Catch per effort is difficult to measure in potting fleets, where differences between the number of pots set and the number hauled on any one day can cause inconsistencies in the data, so this aspect needs careful consideration.

Obtaining biologically realistic cock and hen size distributions over time from samples of the fishery landings presents both logistical and biological problems. From the logistical viewpoint, the landings can originate from a variety of vessel sizes and pot types that fish numerous grounds along the coast throughout the fishing seasons, and land at numerous ports. There are therefore numerous potential season/vessel/pot/area/port sampling categories ('strata') which need to be identified and sampled regularly, whether at the point of landing, or at processors, or at sea on individual vessels. If crabs from the various strata are not properly represented, then the overall aggregate of the samples will be biased, leading to inaccurate results.

The size and sex ratio of crab almost certainly varies between different grounds and different seasons. This is because the localised intensity of fishing can vary spatially, or over time, or because crabs of different sex and sizes are found in different places at different times whether due to seasonal inshore and offshore migrations, or seasonal changes in catchability. More fundamentally, crabs along say the north coast may possibly 'belong' to the north western stock centred off Donegal whereas crabs along the north-east and east coasts possibly belong to a stock originating in the Irish Sea, and this stock structure could cause important differences.

To avoid bias, and to compile size distributions that are biologically realistic, may therefore require initial trials that begin by sampling crab from as many of the season/vessel/pot/area/port strata as possible. These should then be analysed to investigate the scale of random variation, and to identify similarities and differences that may make it possible to reduce the number of sampling strata in the main programme. Ideally the evaluation of biological structure requires other biological information and techniques (tagging to study migration, larval surveys to identify spawning areas, and possibly supporting genetic studies).

The management section has discussed aspects of quality control, including the issue of monitoring for soft crab using the durometer. There is scope to include durometer measurements in the crab measurement programme.

8.3 STRATEGY COMPONENTS

Table 7 shows the suggested components and timing of a six year stock assessment programme, which is explained in more detail below. This is a strategy rather than a full operational specification, since the latter would require a degree of in situ investigation that has not been possible with this project, but it should be sufficient for stakeholders and managers to understand the type and range of activity required, prior to reviewing the scope for funding, and setting up appropriate planning phases. Several of the elements in this strategy have been used successfully on the crab fishery in Donegal, as reported by Tully et al., 2006.

Table 7 Configuration of suggested scientific strategy

	Component	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
1	Distribution of fishing (GPS or VMS or log book recording on all vessels). Stratification baseline.	trials	prog	prog	prog	prog	report
2	Effort, catch per effort, quality, by strata (sentinel vessels, raised to fleet total).	trials	prog	prog	prog	prog	report
3	Stratified biological sampling (size by sex, sex ratio (egg status, durometer, opotional genetic samples. Choice of at sea/quayside/processor, or combo.	trials all strata	prog	prog	prog	prog	report
			average years 2 & 3 for assess 1		average years 3 & 4 for assess 2		
4	Seasonal /sub area tagging at sea (growth, migration and stock structure, Petersen estimate)	plan	tag	tag	recapture	recapture	recapture report
5	Optional larval survey for spawning areas (stock structure)			plan	north	north east	report
6	Stock assessment (growth, length cohort analysis, yield per recruit, egg per recruit, reference pts, Petersen estimate).		trials	assess 1 (yr 2+3)	prelim report	assess 2 (yr 4+5)	report
7	Management advice				prelim		final

8.3.1 Component 1. Distribution of fishing.

This study has identified the general scale, location and pattern of the crab fishing effort in Northern Ireland.

However, the fishery continues to develop and we require ongoing knowledge about when and where fishing occurs by vessels of different size (< 10m, 10-15m, >15m) and fishing different pot types, in order to identify vessel-size/pot-type/season/area/port strata. This is essential for identifying the stratification of the biological sampling programme, and to compare with data on stock structure. This could be achieved by introducing GPS/VMS on all vessels, or providing electronic log books for a selection of vessels in each stratum (volunteer sentinel vessels). The table indicates that Year 1 will likely be a year of trials, followed by a further five years of full programme.

A broad delineation of four crab fishing areas has been identified in Northern Ireland waters, each with under 12m vessels using a variety of potting gears. These areas may be a useful sub-fleet basis on which to establish more detailed strata if required and would support more localised management of these areas.

8.3.2 Component 2 Fishing Effort

We need to develop trends in an index of fishing effort (to compare with the estimate of fishing mortality that will come out of the size-based analysis), and an index of catch per effort in order to establish a trend in this proxy for crab abundance.

DARD already collects pot effort data via the shellfish form returns, but the quality of this data is easily compromised by confusion over pots set, pots hauled, and soak time, that is difficult to resolve retrospectively in a quayside recording system. The proposal is therefore

to use volunteer sentinel vessels belonging to each of the vessel-size/pot type/area strata identified in 1. At this stage it is hard to say how many are required, but that should become apparent once Component 1 and initial trials get under way.

The sentinel vessels should agree, and be instructed, to use log books (ideally electronic) to record comprehensive data on potting effort (pot type, pot number set, pot number hauled, and soak time,) catch (number of crab, or number of containers), and discards, per string per fishing day. This facilitates calculating effort, catch per effort and/or landings per effort. Data would be analysed statistically to obtain an average index of effort and catch per effort for the sentinel fleet/area strata, and a combined overall index.

If the total number of fishing days by non-sentinel vessels is also recorded by interview at the quayside there is an option to raise the index of sentinel effort up to the total fleet. Additional outputs would then be an overall annual index of crab effort and abundance for the whole fishery.

Abundance would be expected to decline if effort (=fishing mortality) increases, or if recruitment declines (if indicated by the abundance of small crab from biological sampling).

Sentinel vessels should also record, measure, and re-release any tagged crab that they catch, and should record the proportion of tagged to untagged crab in the haul, in order to provide mark-recapture data for a Petersen estimate (this type of estimate is described in the section on lobster v-notching)

There is an option for sentinel vessels to record data on quality (visual, hand-tested, or by durometer) and to collect samples for genetic analysis if needed. There is also an option to back up this component by sending scientific observers to sea to monitor periodically the performance of the sentinel vessels.

It is envisaged that trials will be required in year 1, followed by a further five years in support of the stock assessment outputs scheduled in years 4 and 6.

8.3.3 Component 3 Stratified Biological Sampling

For stock assessment it is essential to obtain representative, unbiased seasonal and annual size distribution for cock and hen crab for input to a size-based assessment model. This is fundamental.

Since crabs are being measured individually in this part of the programme there are options to record the maturity status of any berried females, to make durometer measurements, and to collect material for genetic analysis.

As proposed earlier, Year 1 should be a trial year in which the sex ratio, size distribution, (and, if agreed, hen maturity, durometer reading, and genetic samples) are collected from as many vessels and landings as possible in the perceived vessel-size/pot-type/season/area/port strata, in order to explore the variability, similarities and differences between strata, prior to defining the routine programme for the remaining years. Size is the carapace width measured by callipers, which could be electronic (connected to computer data base).

Samples should be taken monthly throughout the season. The number of crabs measured in a sample (probably 50 - 100) should be determined early in the trial period by inspection on

site. As the sample distributions should be raised to the total weight of crab landed by the vessel, for further aggregation to port level, it may be helpful to sample a representative box and raise to the total number of boxes in the landing. In the first instance, the number of landings in each stratum should be sufficient to assess the degree of variation between samples, between vessels of the same size, and between vessels of different size and different sub-areas of origin. If permitted by preliminary statistical analysis, this can be refined/simplified, whether by reducing the number of vessels, or ports, or sub-areas, or even seasons.

To extrapolate to a fleet level, estimates of the total weight of crab landed monthly at each port, and by all ports, will be required.

Local decisions may be required about when and where it is best to make the measurements (on the quayside, or at buyer/processor premises). There are also options to make this programme sea-based using observers (but that would reduce the number of samples that could be taken) or to develop a method whereby a proportion of the sampling at the smaller or more isolated ports could be undertaken at sea by fishers on a self-sampling basis following instruction and trials. Possibly a combination of all options would be appropriate.

It is essential that each sample is accompanied by the full landings data for that vessel on that day, and to enquire and record if there was any selection or discarding at sea.

Data on the proportion and abundance of small crab in the samples should be examined over time to investigate their utility as an index of recruitment.

8.3.4 Component 4. Tagging studies

A tag-recapture programme is required in order to study migration and stock relationships, growth rate, and stock abundance on the ground.

The study of stock structure and migration requires as many crab to be tagged as possible belonging to all available sizes, on both inshore and offshore grounds, in a range of coastal areas at appropriate seasons. The choice of tagging sites and seasons will depend on the information obtained in year 1 about a) where and when crab fishing takes place (from component 1), where and when crabs of different sexes and sizes become available (from component 3), and where and when crab are most abundant, or are most discarded (from component 2). The final choice should include consideration of a working hypothesis that north coast crabs are possibly related to the stock off Donegal, and that crabs off the north east and east coasts could belong to an Irish Sea stock (as discussed in section **Error! eference source not found.**). Tagging should aim to release significant numbers in several clusters scattered through the relevant area. There is an option for fishers who assist in the tagging and release of tagged crab to be paid on some appropriate basis similar to the ongoing lobster v-notching arrangements.

Crabs should be sexed and measured before release and there is an option to collect genetic material, which would greatly enhance the power of the work.

Because the tagging strategy will be based on data from components 1-3, tagging should not commence until year 2, and should terminate at the end of year 3 in order to allow time in years 4 and 5 for larval survey work. Recaptures will occur from year 2 to year 6.

There should be publicity to ensure the highest possible reporting of recaptures once mixing has occurred. There is an option to re-release the animal at the recapture site and to pay a reward for that. The publicity should be extended to fisheries outside of Northern Ireland (i.e. the Republic of Ireland, West of Scotland, the Isle of Man) in case of emigration.

At re-capture, whether at sea or at the quayside, the fisher or fishery officer should record the tag number, the size, sex, maturity, and condition of the crab (and collect genetic material if genetic studies are being undertaken). When a recapture is made at sea, the number of untagged crab caught by the recapture string should also be recorded, since the tagged/untagged ratios provide the data for estimating stock abundance using the Peterson method (see lobster v-notching text).

Growth rates are estimated by comparing the size on the date of recapture to the size at release. The recapture data must be sorted into 'anniversary groups' i.e. groups at one year intervals from the tagging date. That way the likely number of moults, and hence the size increment per moult, can be determined. There is a well-known literature on the analysis of the relationships between size at release, moult increment, and moult frequency, based on the use of derivatives of the von Bertalanffy growth equation.

It is likely that all the recapture data will have to be aggregated to obtain statistically meaningful results, but there is a possibility to test for differences between coastal sub-areas.

8.3.5 Component 5. Larval surveys

The previous components will all contribute information to inform stock structure. Of particular interest would be the occurrence of any aggregations (increases in catch rate) of mature females in specific areas in late autumn, where they are likely to overwinter and release their eggs at the beginning of the following summer. Should these occur there is obviously scope to use larval surveys to investigate the corresponding occurrence of crab eggs and larvae in the summer period, and their relationship with other coastal areas, such as Donegal, the West of Scotland, or the western Irish Sea.

Larval surveys are likely to be expensive because of ship time, but there is an option to undertake surveys in year 4 and year 5, once tagging work has been completed. The work could be split between the north coast (but overlapping into Donegal and offshore towards West of Scotland) in year 4, and the north east and east coast and into the North Channel, in year 5. Advice should be sought from Tully who conducted larvae surveys off Donegal.

8.3.6 Component 6. Stock assessment

Component 3 should produce an aggregated annual size distribution for cock and hen crabs averaged across years 2 and 3 to take out variability, and averaged across years 4 and 5, although if the year to year variability is very high a single overall average of years 2 to 5 may be preferable. This will be the basis for a preliminary assessment at the end of year 3 and a final assessment in year 6.

The individual annual components will in themselves be a weighted average of data from the various season/vessel/area/port strata for each year, and that average will have been raised up to the total landings from the fishery as a whole for that year. No firm

recommendations can be made at this stage for how the weighting and average should be done, other than to say that it will require an appropriate statistical analysis of variance, with transformations where appropriate or necessary.

The data should then be modelled using a length cohort analysis (see references in Smith and Addison, 2003, and Tully et al., 2006), mediated by growth data obtained from the tagging study. The assessment will also need data on the relation between female egg production and size, and it is proposed that this should be taken from the literature (Tully et al, 2006). Assumptions are also required for natural mortality, as described in Bannister, 2009.

Outputs from the length cohort analysis are:-

- The relationship between fishing mortality and size, which reflects the intensity of fishing, modulated by the selection pattern of the traps, the minimum legal size, and any discarding or quality selection at sea.
- The proportional change in yield per recruit as fishing mortality either increases or decreases. This should identify any change in fishing mortality required to reach maximum yield per recruit, which is one possible long term management objective.
- The proportional change in female egg production per recruit (scaled as a percentage of the virgin egg production at zero fishing mortality, as fishing mortality either increases or decreases. This should identify any change in fishing mortality required to reach egg production reference points (see supporting text).
- The effect on these relationships of any increase in minimum legal size.

Examples of the main outputs are explained and illustrated graphically for recent English and Scottish brown crab assessments in Bannister, 2009, and for the Donegal fishery in Tully et al, 2006.

The estimates of fishing mortality can then be linked to the estimates of fishing effort and catch per effort (proxy abundance) derived from Component 2, to act as a baseline for comparison with other fisheries elsewhere, and any further assessments made in Northern Ireland in the future that follows the termination of this suggested project scheme.

8.3.7 Component 7. Advice and Reports

On completion of Component 6 scientists should be able to advise managers on the need for any adjustments to fishing mortality, or any increase in minimum legal size, that are required to avoid the lower limit reference point, and to reach target reference points (expected to be based on MSY).

Managers could then discuss with stakeholders the management measures best suited to achieving these objectives, and over what time scale. Depending on the funding arrangements, detailed reports of the work will be required at the end of year 6, or down the line by local arrangement.

8.4 SCOPE

8.4.1 Geographic scale

There is some flexibility over the regional sub-units for which the assessments can be undertaken and the advice given. The foregoing sections imply that the size distribution inputs, and the length cohort analysis results, will use the highest possible degree of aggregation, since that will in general be the most representative of the fishery as a whole.

If the results of Components 1 to 5 indicate that there is significant regional sub-structure, however, such that crab along the north, north east and east coasts, should be assessed separately, then a lower level assembly of size distribution data for those sub units can be used as required, and separate runs of the assessment model made. Advice could then be given for these more local areas, which might in any case link better with any regional permit or other schemes that become established.

It should be stressed that the strategy presented here is intended to be as comprehensive as possible, to give best scientific advice. This scientific strategy would help the NI brown crab fishery to achieve the MSC standards for Principle 1 on stock status and Principle 3 on management. Irrespective of seeking MSC certification, the MSC standard is a useful benchmark for sustainable fisheries management.

8.4.2 Incorporating genetics

As noted in Table 7, there is scope to include in the crab measurement and crab tagging programmes the collection of crab tissue samples for genetic profiling. This would enhance the study of stock separation, and improve the estimation of stock abundance from tag-recapture data. Genetic profiling is already underway in Phase 3 of the lobster v-notching project, where it offers significant advantages, and would be equally valuable for the crab project.

A preliminary Defra-funded study of the genetics of brown crab in Great Britain has already developed the necessary primers, and analysed a number of samples from around Britain including Donegal and Wexford, but no samples were taken from the Northern Ireland fishery (Defra, 2008).

8.5 SUMMARY

If the management of crab fisheries is to be sustainable, it must be informed by the monitoring and assessment of brown crab fisheries and stocks. This section outlines a six-year scientific strategy to support sustainable crab management in Northern Ireland with the following components:

1. Define fishing segments (strata)
2. Determine fishing effort per strata
3. Stratified biological sampling
4. Tagging and re-capture studies
5. Larval studies

6. Stock assessment
7. Provision of management advice

The delivery of the above components is expected to be via an integrated research project involving AFBI, DARD and the industry. This multi-stakeholder approach should make it eligible for EFF funding as a collective action. A funding application should be produced when research plan details are finalised.

A fleet of volunteer sentinel vessels appears to be the most workable approach, rather than more detailed whole-fleet reporting. Skippers would be required to complete (ideally electronic) logbooks and allow observers on-board to conduct more detailed sampling on occasion. Involvement could be incentivised with funding for observer days and reporting rewards (e.g. calling in tags) could be included for the wider fleet.

The next step is for AFBI, DARD and industry representatives to develop a detailed research plan. This will also identify where existing budgets and work streams could be adapted to incorporate the components of this strategy and contribute to match funding in an EFF funding bid.

9 CONCLUSIONS AND STRATEGY

9.1 CONCLUSIONS

9.1.1 The fishery

Northern Ireland's potting fleet landed around 1,000 tonnes of brown crab in 2010

For velvet crab, after a significant increase across 2005-2006, landings have remained stable over the past four years at approximately 230 tonnes with a slight decrease in 2010.

Lobster landings have remained fairly consistent across 2006 to 2008 at just above 60 tonnes, with a slight drop from 2008 to 2009 followed by an increase to 78 tonnes in 2010.

Crab caught by the larger Northern Irish vessels towards the North West most likely belongs to the north western stock, which is also subject to fishing by vessels from the Republic of Ireland and from Scotland. Crab landed from the north coast east of Inishowen could also belong to this north western stock.

More investigation is needed, but there are indications that NI vessels catching crab on the Irish Sea coast are exploiting a separate but so far unidentified and undefined stock, possibly with links into the wider Irish Sea populations. Such crab may or may not show inshore-offshore migrations comparable to those observed further west.

9.1.2 The fleet

The Northern Ireland fishing fleet remains focused at the three east coast fishing ports of Ardglass, Kilkeel, and Portavogie. However an increasingly significant proportion of the under 10 meter vessels also operate from numerous other harbours around the coast.

Between 1995 and 2010 the Northern Irish under 10m fleet grew by 22% as the number of over 10m vessels decreased by 34%.

Of the 214 under 10m registered vessels at 1st October 2010, 184 (86%) have a shellfish entitlement. This represents a large amount of latent capacity in the fleet.

The large increase in pot numbers in recent years results from more vessels entering the fishery with pot numbers being recorded at 37 landing points compared to 26 in the previous year.

The number of pots fished in Northern Ireland waters by vessels targeting crab has increased in recent years, estimated to total around 17,500 (60% from the Co. Down ports, 28% on the North Coast and the remainder between Larne and Strangford Lough). The entry of one larger vessel into the fleet will substantially increase the fishing capacity.

Four geographically distinguishable potting areas are identified that could form the basis of more localised inshore management:

North coast – dominated by lobster, but with a significant crab fishery where the stock may linked with the offshore crab resources to the North and West targeted by *vivier* crabbers

North Down & Outer Ards –a mixed fishery with seasonal importance for both brown crab & velvets

Strangford Lough – one of the key velvet crab areas with an important *Nephrops* pot fishery, but also significant lobster & brown crab.

South Down – this area has the largest number of crabbing vessels, which also target lobster.

The potting fleet operating in each area has characteristics in common, but also show some area-specific issues and therefore some differing management priorities.

9.1.3 Key issues

Consultation with stakeholders in Northern Ireland raised the following issues:

- **Effort** – on the increase, mainly with more vessels entering the fishery;
- **Latent capacity** – with most under 10's holding a shellfish entitlement and many currently operating on seasonal basis, there is significant latent capacity in the fleet;
- **Unlicensed or hobby fishermen** – still identified as a problem in certain areas despite recent legislation;
- **Stock information** – very limited information on the fishery, particularly the resource dynamics;
- **Quality** – the landing of low quality crab (white/soft-shelled) continues;
- **Sizes** – the current MLS does not support market requirements;
- **Toeing** – the removal of claws prevents confirmation of crab size and use of the remaining crab;
- **Gear conflict** – identified as an issue between potters and mobile gears (scallopers & *Nephrops* trawlers), but also within the potting fleet, particularly with seasonal fishers;
- **Environmental designations** – concerns amongst fishermen that future management of sites will prevent access;
- **Offshore renewable energy** – proposals for large scale developments that would further restrict fishing operations; and
- **Links with other fisheries** – management must recognise that brown crab is part of a mixed pot fishery that includes lobster, velvets and closely associated with the buckie whelks, *Nephrop*s and *Palaemon* pot fisheries.

9.1.4 Lobster v-notching in Northern Ireland (Appendix 3)

V-notching lobsters and returning them to the sea is a potentially powerful tool for improving the spawning stock.

There are two long-running v-notching schemes operating around the Northern Ireland coast; one operated by the North-East Lobster Fishermen's Cooperative Society Ltd. (NELCO) and one by the North Coast Lobster Fishermen's Association (NCLFA). It is

expected that these schemes are having a positive benefit on the lobster stock in the north and north east of Northern Ireland.

Proving that the progeny of v-notched lobsters have recruited to the fishery requires special techniques for uniquely identifying those progeny. This is clearly addressed by the innovative adoption of genetic profiling in Phase 3 of the NELCO scheme.

Phase 3 also has the potential to establish whether as spawning stock increases, recruitment also increases in proportion, or whether recruitment becomes limited by ecological processes. The additional genetic profiling aspects make a compelling case to find the funding to continue Phase 3 for a further few years.

To gain maximum benefit from v-notching activities across Northern Ireland, the North Coast scheme should also contribute to the science being conducted with Queen's University, Belfast. This scientific link-up does not require an integration of scheme administration, merely the contribution of v-notch samples and data in the same way as NELCO participants. The interest in such participation should be explored with the North Coast Lobster Fishermen's Association.

9.1.5 MSC Pre-assessment of brown crab, velvet crab and lobster fisheries (Appendix 4)

A pre-assessment of Northern Ireland's brown crab, velvet crab and lobster fisheries against the Marine Stewardship Council (MSC) standard was carried out (Appendix 4). The MSC framework based around three principles (stock, environment and management) is a useful benchmark to identify where improvements in management are necessary and where more information on the stock and fishing operations needs to be gathered.

At present, these fisheries would not achieve MSC certification for Principle 1 (stock) or Principle 3 (management). A harvest strategy (the combination of monitoring, stock assessment, harvest control rules and management actions) is lacking for all these fisheries.

The comparatively low impact of potting gear on the environment means that the few minor issues on Principle 2 (environment) could be addressed with more information or through setting conditions.

To address shortcomings identified in relation to stock information, limit and target reference points should be developed (e.g. based on LPUE or egg production per recruit, for example see Tully *et al*, 2006 and Leslie *et al*, 2010), as well as coordinated and complete stock assessments on a regular (annual) basis. The development of reference points would also work towards achieving appropriate harvest control rules and harvest strategy.

Management plans for these fisheries should address the current lack of fishery specific management and incorporate the improved research planning needed to inform management.

9.1.6 Proposed measures

Management measures to address many of the issues raised during consultation were assessed and consulted on, resulting in the list of measures proposed in Table 8. It is proposed that these are either delivered through changes in Northern Ireland legislation or via local management plans. All measures are identified to provide benefits to the Northern

Ireland crab fishery and both legislation and local management would be endorsed and enforced by DARD. The choice of how measures are delivered is dependent on whether they are common to all or may be more favoured or prioritised in certain areas.

Table 8 Proposed measures by type and implementation

Management measure		Sub-options	Change in legislation	Local management plan
a	**Increase Minimum Landing Size to 140mm**		✓	
b	**Limit type of vessels permitted inshore**	size of vessel	✓	
c	**Limit on hobby fishermen** (in addition to current legislation)		✓	
d	**Ban landing of soft-shelled crab**		✓	
e	**Ban landing crab claws** (above well-defined limits)		✓	
f	**Ban on landing berried crab, velvets & lobster (unless v-notching)**		✓	
g	**Gear measures**	ban on parlour pots		✓
h	**Escapement**	escape gap		✓
		biodegradable fastening		✓

It is recommended that a Northern Ireland Permit for potting vessels be established to cap capacity and address the latent capacity evident in the fleet. A permit would be issued to all vessels able to show that they already fish in Northern Ireland's waters.

A potting permit would enable measures that cannot be readily applied in legislation to be introduced as conditions of permit. If established on an area basis, a permit would also support more localised management measures via local management plans.

9.1.7 Measures not forming part of the strategy

A number of other potential management measures were considered during this process. These were assessed and discounted for the following reasons:

- Introducing a sunset clause on the shellfish entitlement is difficult to progress as it is attached to the UK licence and unilateral changes by NI could affect saleability and are not welcomed by industry.
- Setting TACs and quotas is excessive in management terms; unfeasible without much more scientific information; and from consultation very unpopular with the industry.
- The ban on crippled or diseased crab was discounted as these can still be used by processors and there were concerns that returning diseased animals could adversely affect stock health.
- There is not sufficiently detailed information on the extent and dynamics of the crab stock being targeted by the Northern Ireland inshore fleet to justify the introduction of closed areas on a seasonal or permanent basis for fishery management objectives.
- The introduction of eco-labelling is not a viable option until the management and science improvement, as identified in an MSC pre-assessment conducted as part of this study, are implemented.

9.1.8 Markets

Brown crab from Northern Ireland can be broadly divided into two distinct markets;

- **Processed market** – the majority of crab landed from the Co. Down ports (accounting for 60% of total NI landings) and from south of Larne, including the Ards Peninsula & Strangford Lough (25% of landings) go to processors.
- ***Vivier* market** - crab from the North Coast (15% of NI landings) enters a *vivier* market which could be seen as an extension of the live lobster fishery.

Northern Ireland crab remains in a difficult market position as it is:

- highly dependent on an export market;
- logistically more remote than competing suppliers;
- with a comparatively low volume of landings; and
- no clear distinction of Northern Irish product.

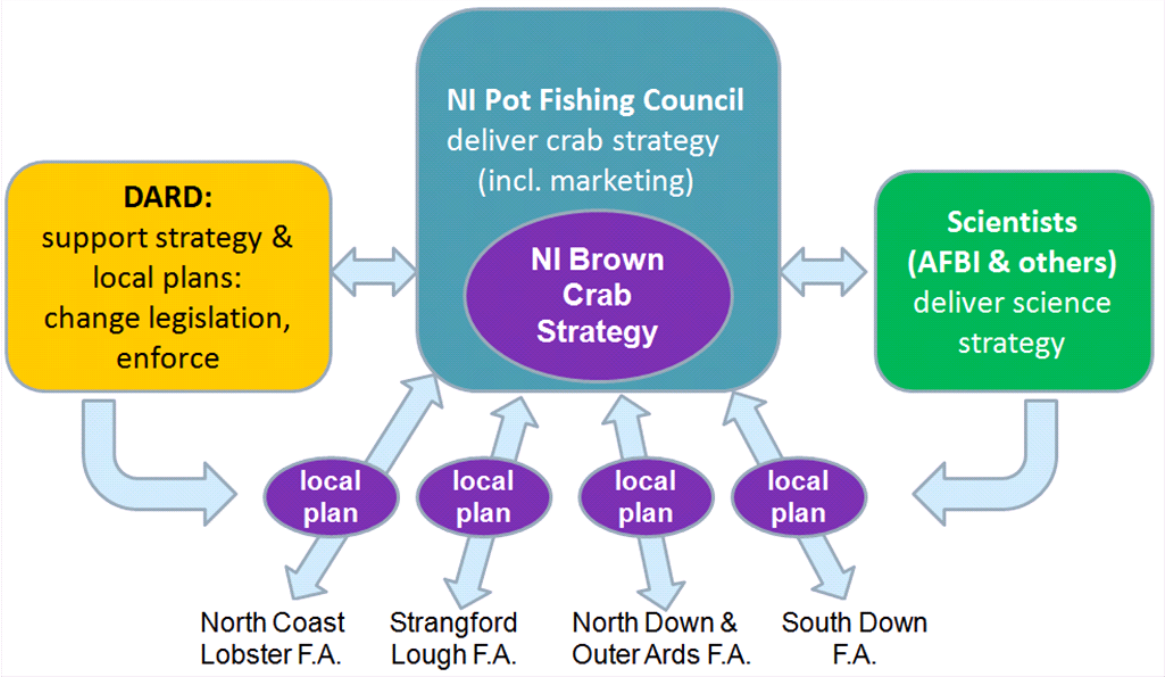
9.2 STRATEGY

The improved management of the brown crab fishery (and Northern Ireland's other pot fisheries) should be delivered through the strategy containing the following components:

1. Changes to legislation
2. Area-based local management plans
3. A science strategy
4. A marketing strategy

These components and their inter-relationships are illustrated in Figure 20.

Figure 20 Components of the Northern Ireland Brown Crab Strategy



9.2.1 Organisation

The delivery of the strategy should be overseen and steered by a suitable group, here named the Northern Ireland Pot Fishing Council (NIPFC). To maintain the fishing industry-led emphasis of the strategy, the NIPFC should include fishermen's associations (F.A.s) from each of the four potting areas as well as the involvement of responsible agencies (DARD); scientific support (AFBI); and links with the industry in the Republic of Ireland.

A representative of the post-harvest sector would also be a welcome addition to the NI Pot Fishing Council. At present such representation does not exist and until such time that it does, the main linkage with post-harvest operators should be through the Seafish representative, who would perform a liaison and dissemination role for the Pot Fishing Council.

9.2.2 Changes to legislation

It is proposed that DARD produces new potting and crab legislation in Northern Ireland waters that collates & clarifies existing legislation and adds the following:

- Increase the Minimum Landing Size for brown crab to 140mm carapace width
- Ban the landing of soft-shelled crab based on an enforceable definition with measurable units (following a pilot study to define those units).
- Ban the landing of berried brown crab, velvet crab and lobster (with the exception of landing berried lobster as part a recognised v-notching scheme).
- Limits the size of vessel permitted to fish in Northern Ireland's waters to 12m and under, with a grandfathering clause to exempt existing operators.

It is also recommended that DARD further explores the introduction of a Northern Ireland permit scheme for crab and other pot fisheries to better control potting effort and provide a framework for future area-based management.

It is expected that a NI potting permit would be allocated to all vessels able to show evidence of operating in Northern Ireland waters, but with some provision for new entrants. Further consultation with the industry will be required to reach agreement on and fully define the permit scheme.

9.2.3 Area-based local management

The proposed area-based development of localised management is presented in To aid the successful delivery of the strategy, develop local management plans and retain buy-in from all sections of the industry, regional inshore catching sector representation is needed for the North Down & Outer Ards area and in the South Down area.

It is recommended that DARD and Northern Ireland's Producer Organisations, being established industry organisations, encourage and assist these areas in forming industry associations, which can be supported via EFF funding.

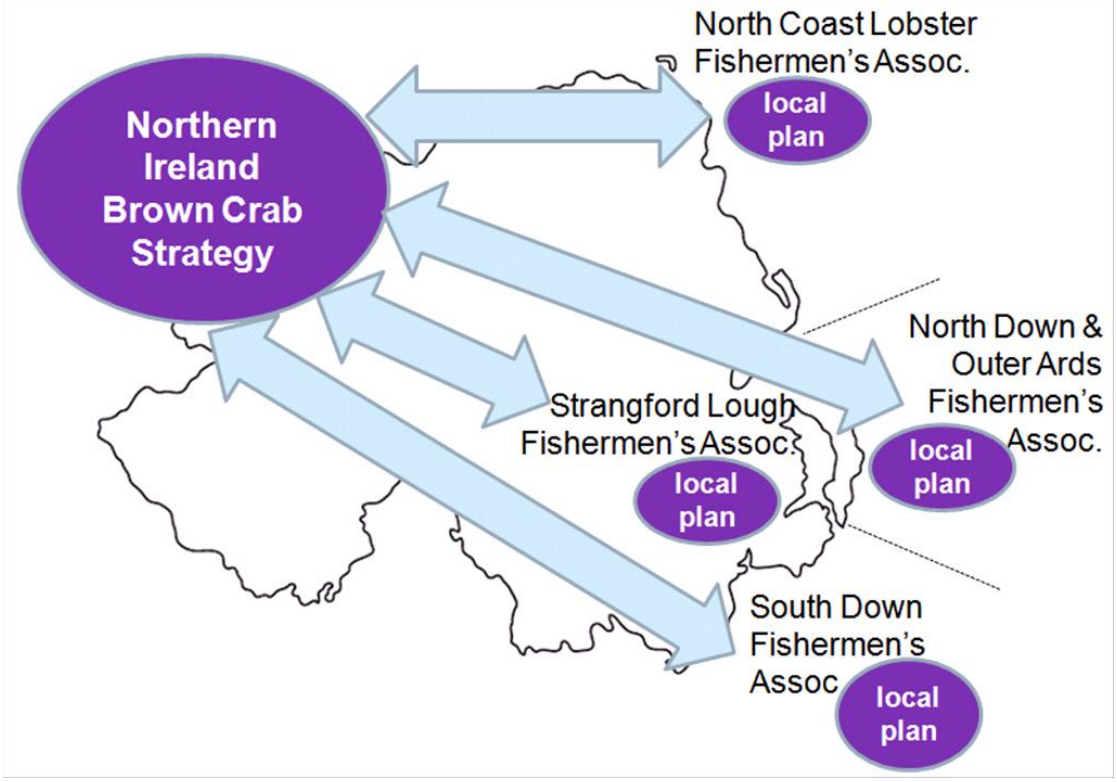
Figure 21. The development of localised management is expected to be informed by this strategy and local management should in turn inform strategy delivery.

Representatives from these area groups would be key members of the NI Pot Fishing Council, providing feedback on the effective delivery of the strategy and leading the development of localised management.

To aid the successful delivery of the strategy, develop local management plans and retain buy-in from all sections of the industry, regional inshore catching sector representation is needed for the North Down & Outer Ards area and in the South Down area.

It is recommended that DARD and Northern Ireland's Producer Organisations, being established industry organisations, encourage and assist these areas in forming industry associations, which can be supported via EFF funding.

Figure 21 Linkage between the Northern Ireland Crab Strategy and Area-based management



9.2.4 Marketing strategy

The marketing strategy should:

4. **Focus on the catching sector**. Promote the positive actions of the industry and managers. This could be in the form of promotional material and awareness-raising events. Buyers and processors can then incorporate elements of catching sector marketing on an individual basis as they see fit.
5. **Establish quality assurances**: supported by legislation and enforcement of white / soft crab ban (use of durometers, training for at sea grading).

6. **Highlight sustainable credentials**: low impact, small scale, improved management.

With no obvious lead organisation to take the marketing strategy forward, this component should be delivered via a project that is overseen by the NIPFC. The project should be eligible for EFF funding and is estimated to last 9-12 months starting in year 2 when new legislation is in place with local management in development.

9.2.5 Science strategy

A six-year scientific strategy is proposed to support sustainable crab management in Northern Ireland with the following components:

1. Define fishing strata
2. Determine fishing effort per strata
3. Stratified biological sampling
4. Tagging and re-capture studies
5. Larval studies
6. Stock assessment
7. Provision of management advice

The delivery of the above components is proposed via an integrated research project involving AFBI, DARD and the industry. This multi-stakeholder approach should make it eligible for EFF funding as a collective action and a funding application should be produced when research plan details are finalised.

A fleet of volunteer sentinel vessels completing (ideally electronic) logbooks appears to be the most workable approach, rather than more detailed whole-fleet reporting.

The next step is for AFBI, DARD and industry representatives to develop a detailed research plan. This will also identify where existing budgets and work streams could be adapted to incorporate the components of this strategy and contribute to match funding in an EFF funding bid.

9.2.6 Roadmap for the Strategy

Each strategy component has outputs to monitor progress and inform revision of the strategy if necessary (Figure 22).

Industry consultation will remain a key aspect of the strategy going forward. Initially this will be needed to further define certain management measures and to help lead partners in developing detailed project specifications. Once developed, project funding should be sought, i.e. via applications to the European Fisheries Fund (EFF).

Figure 22 Roadmap for Strategy Implementation(★ = reviewable outputs)

Strategy Component	lead partner	duration	Year 1 Q1	Q2	Q3	Q4	Year 2 Q1	Q2	Q3	Q4	Year 3 Q1	Q2	Q3	Q4	Year 4 Q1	Q2	Q3	Q4	Year 5 Q1	Q2	Q3	Q4	Year 6 Q1	Q2	Q3	Q4
Industry consultation	**NIPFC**	ongoing																								
Legislation																										
increase MLS	DARD	6 months				★																				
limit vessel size	DARD	6 months				★																				
pilot durometer project	AFBI/industry	6 months			★																					
ban berried & white crab	DARD	3 months				★																				
develop permit system	DARD/industry	12 months				★																				
implement permit system	DARD	ongoing																								
Local management plans																										
develop inshore representation	P.O.s	9 months																								
develop local plans	Associations	12 months								★																
implement local plan	Assoc/DARD	ongoing																								
review local plan	Associations	3 months																								
revise local plan	Associations	3 months														★										
Marketing																										
Develop promotional material	NISC	3 months						★																		
Implement marketing	NISC	6 months																								
Report on acheivements	NISC	3 months									★															
Science																										
trial crab science projects	AFBI	1 year				★																				
distribution of fishing	AFBI	4 years																					★			
fishing effort recording	AFBI	4 years																					★			
stratified sampling assessment 1	AFBI	2 years													★											
stratified sampling assessment 2	AFBI	2 years																					★			
tagging programme	AFBI	2 years																								
recapture programme	AFBI	3 years																						★		
larval survey - north	AFBI	6 months															★									
larval survey - north east	AFBI	6 months																			★					
stock assessment 1 & prelim advice	AFBI	6 months															★									
stock assessment 2 & full advice	AFBI	6 months																							★	

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Appendix 2 management measures response sheet

Please give us your comments on these management measures:

	Management measure	in favour (Yes/No)	Why?	What are the good and bad points?	How workable & enforceable?	How will it affect other fisheries?
1	**Limit shellfish licenses with a sunset clause**					
2	**Maximum vessel size in inshore waters**					
3	**Pot Limits**					
4	**Gear measures - permit certain types or sizes**					
5	**Introduce TACs and quotas**					
6	**Increase MLS**					
7	**Ban landing cripple crabs**					
8	**Ban landing crab claws**					
9	**Landing of white crab or diseased crab**					
10	**Closed seasons for spawning etc.**					
11	**Closed areas**					
12	**Escape hatches to stop ghost fishing**					
13	**Any other suggestions?**					

Appendix 3 Review of Lobster V-notching in Northern Ireland

Summary

- V-notching lobsters and returning them to the sea is a potentially powerful tool for improving spawning stock.
- There are two long-running v-notching schemes operating around the Northern Ireland coast; one operated by the North-East Lobster Fishermen's Cooperative Society Ltd. (NELCO) and one by the North Coast Lobster Fishermen's Association (NCLFA).
- It is more than likely that these schemes will have a positive benefit on the lobster stock in the north and north east of Northern Ireland.
- Proving that the progeny of v-notched lobsters have recruited to the fishery requires special techniques for uniquely identifying those progeny. This is clearly addressed by the innovative adoption of genetic profiling in Phase 3 of the NELCO scheme.
- Furthermore, Phase 3 has the potential to establish whether as spawning stock increases, recruitment also increases in proportion, or whether recruitment becomes limited by regulatory processes.
- NELCO Phase 3 is therefore an exciting project, with considerable potential to assist both lobster fishery managers in pursuit of benefits, but also lobster scientists in pursuit of the stock and recruitment question. This makes a compelling case to find the funding to continue Phase 3 for a further few years.
- It is also suggested that to gain maximum benefit from v-notching activities across Northern Ireland, the North Coast scheme should also contribute to the science being conducted with Queen's University, Belfast.
- This scientific link-up does not require an integration of scheme administration, merely the contribution of v-notch samples and data in the same way as NELCO participants. The interest in such participation should be explored with the North Coast Lobster Fishermen's Association.

Background

The terms of reference for this project include a requirement to assess the suitability and likely benefits of lobster v-notching that has been undertaken in Northern Ireland.

There are two v-notching schemes operating around the Northern Ireland coast; one operated by the North-East Lobster Fishermen's Cooperative Society Ltd. (NELCO) and one by the North Coast Lobster Fishermen's Association (NCLFA). Both have been in operation for more than ten years.

This paper provides some general background on lobster v-notching, describes a typical experiment that can be used as a benchmark, and then summarises and evaluates the structure and likely outcomes of the NELCO work. This assessment is based on existing knowledge and evidence related to v-notching and discussions with the secretary of NELCO, Colin Nelson and Dr Paulo Prödohl of Queen's University Belfast, who is leading research based on NELCO v-notch samples.

Lobster v-notching (v-notching the uropod of ripe females, returning them to the sea, and prohibiting their subsequent landing) is a tool aimed at boosting lobster stocks by reducing the harvest rate on mature females, and thus increasing female spawning stock. The hope is to increase total lobster egg production, and also the subsequent recruitment of progeny, although it is well known in fisheries research that for ecological reasons increased egg production does not necessarily translate into increased recruitment, as is discussed later. The v-notch concept dates from at least as far back as 1917, when it was first implemented in Maine, USA where it is still ongoing [Daniel,P., Bayer,R.,and C.Waltz.,1989, Egg production of v-notched American lobster (*Homarus americanus*) along coastal Maine. Journal of Crustacean Biology 9, 77-82].

V-notching schemes are invariably popular with stakeholders, whose participation and compliance are essential, because they have the tangible reward of seeing v-notched animals in subsequent catches, whilst in some schemes they are also paid for taking part (sometimes a flat fee, and sometimes the actual market value of the returned lobster, depending on the administrative set up). From the fishery manager's viewpoint, however, the challenge is to demonstrate proof of benefit. Thus a successful v-notching programme is not just a case of 'putting the animals back in the sea': it requires careful recording of the number of legal sized v-notched lobsters released, the rate of recapture of v-notched animals subsequently, their proportion in the total catch of legal sized lobsters, and the careful monitoring and recording of catch per effort of both legal and sub-legal lobsters by fishermen throughout the experiment.

The above components are well illustrated in a v-notching scheme in Wexford, Ireland, as reported by Tully[4]. By the end of the project, it was calculated that v-notched lobsters contributed 59% of total potential egg production, after correcting for likely losses due to natural mortality (but not emigration). In the last years of the study there was eventually a 37% increase in the catch per effort of undersized lobsters. The time-lag suggested that these might include progeny of the extra spawning population, but in the absence of a unique identifier, and without other evidence, it cannot be excluded that there were also other contributions to this surge, such as a chance increase in settlement due to temperature, or the quirks of larval transport.

The Wexford study illustrates the methodology and type of analysis of a well-run v-notching programme, and demonstrates the scale of results that can be obtained. It is cited here as a benchmark against which to judge the methods and eventual outcome of the NELCO v-notching programmes in Northern Ireland. The desirable operational and scientific components of a good v-notching programme are therefore as follows:-

1. Adopting a standard, biologically appropriate protocol for capture, v-notching, and return to the sea (the elements will differ somewhat between schemes that notch at sea or ashore).
2. Identifying the v-notched lobsters individually, using additional tagging (as in Wexford), or other appropriate means, so that the release and recapture history of individuals can be followed over time.

[4] Tully, 2001, Impact of the v-notch technical conservation measures on reproductive potential in a lobster (*Homarus gammarus L.*) fishery in Ireland. Marine & Freshwater Research, 2001, 52, 1551-7]

3. Keeping adequate records of a) how many lobsters are v-notched where and when, and their size, condition and reproductive status at release; and b) the number and location of subsequent recaptures, and their proportional contribution to the total catch of legal sized lobsters on the recapture occasions.
4. Analysing the above data by mark-recapture methods to estimate population size, and thence to calculate the contribution made by v-notched animals to the potential egg production of the stock from that population.
5. Collecting comprehensive data on the catch per effort of legal and sub-legal sized lobsters throughout the experiment, preferably using log-books kept by reliable sentinel fishermen in the main areas of the experiment.
6. Developing methods to infer or measure in later years the proportion of lobsters in the recruiting size classes that are likely to be the progeny of v-notched animals.

These components all present challenges in terms of field protocols, the keeping of comprehensive records, and the analysis of results. Point 6 is the ultimate challenge, however, firstly because identifying wild progeny from the v-notched stock requires special techniques, and secondly, because little or nothing is known about the pattern of survival from the release of eggs to recruitment at the minimum landing size. This period probably lasts about five years on average, and includes several biological phases from transport and settlement of larvae, through the early sea bed phase, to adolescence and recruitment[5]

The NELCO lobster v-notching programme undertaken in Northern Ireland

Since the inception of NELCO in 1995, members have v-notched berried female lobster in three phases as described below. This review is only concerned with the structure, biological aims, and scientific results of the programmes, and not with the financial administration.

Phase 1

From 1995/6 NELCO members undertook an informal voluntary v-notching scheme

Phase 2

From 1997-2000 a formal scheme was grant-aided by the International Fund for Ireland (IFI) and the EU PESCA fund. Berried females of legal size were taken ashore to holding cages, v-notched by NELCO under scrutiny of a fishery officer, then returned to the cages before being taken out and released at sea. Participants were rewarded financially. It appears that approximately 3000 lobsters were v-notched and returned to sea during this phase.

Phase 3

From 2003-2007 a joint project between DARD, NELCO and Queen's University, Belfast (QUB) was grant funded by the EU Building Sustainable Prosperity Programme, and administered by DARD. In this phase, 2000 berried females per year caught at sea by known NELCO members at recorded times and locations were measured, v-notched using a

[5] see the ecological discussion on p378 et seq. in Bannister, R.C.A. and J.T. Addison, 1998, Enhancing lobster stocks: a review of recent European methods, results, and future prospects. Bulletin of Marine Science 62, 369-387.

standard v-notch tool, and returned to sea at the same location after preserving in a vial the v-notch and a small sample of the fertilised eggs. The preserved material was returned to the QUB Fish Genetics Laboratory (Dr P Prodohl) for DNA profiling. This profiling produces a genetic identity for each v-notched female, and for her eggs, from which the genetic profile of the unknown fertilising male can be deduced by difference. The end result is a parentage data base for the v-notched fraction of the north east coast lobster population. Lobsters subsequently caught in the fishery can have their genetic profile checked against the parentage data base to identify survivors of the v-notched fraction, and, most importantly, any progeny from the same families once sufficient time has elapsed for these progeny to recruit to the minimum legal size. Over seven years 12000 lobsters have now been v-notched and sampled for genetic profiling in this Phase 3 project. Because of the likely time taken to grow to legal size, any progeny from lobsters v-notched as far back as 2003-2007 will likely have entered the legal sized catches only in the last year or two at the earliest, so additional funding from the EU European Fisheries Fund has been secured to extend the project into 2011 and 2012 in order to acquire additional data on the progeny issue. Given some of the comments below, an even longer extension may well be desirable.

Assessment of the Northern Ireland project undertaken by NELCO

There has been no opportunity to examine or verify the records of v-notched lobsters released and recaptured by NELCO, or any associated data and analysis, or any additional data that may have been collected in the form of fishery log books. A results-based review is therefore not feasible, but worthwhile comments can still be made about the nature and likely significance of the work being undertaken, sufficient to be wholly supportive of its continuation, as the following text makes clear.

<u>The Phase 2 project</u>

This project served to establish practical protocols for v-notching lobsters ashore and subsequently returning them to the sea, and contributed to the ongoing accumulation of v-notched lobsters in the area. Some NELCO members were concerned about the potential loss of eggs occasioned by the stress of handling, holding and transporting lobsters, and whilst this is a valid concern in relation to egg production, it does not prevent other potential benefits or information from being realised, such as

- Reduced fishing mortality on the v-notched fraction due to the ban on the subsequent landing of recaptured v-notched animals, thus increasing the number of spawning females
- Observations on how long a v-notch lasts before being filled in
- Any examples of movement of v-notched animals from release sites to other areas where no v-notching occurred.

Because the v-notching was conducted onshore, where it was verified officially for payment purposes, the number of v-notched lobsters released during Phase 2 will be known, but it is not clear whether NELCO fishermen have also kept records of how many v-notched lobsters were subsequently recaptured, and when and where and of what size. If this HAS been done, whether formally or informally, then the release-recapture data potentially offers scope for a Peterson estimate of stock size to be made as in Wexford. The principle of the

method is that the ratio of v-notch recaptures (R) in the total catch of lobsters (C) will be in the same proportion as the initial ratio of v-notched lobsters available for capture (Nt) to the unknown number of lobsters in the population (N)

i.e. R/C = Nt/N, so that N can be estimated as (Nt*C)/R.

If this has not been done then it is unfortunately a lost opportunity that it is too late to address, unless there are individual private records that could be used.

In this Phase there was no unique identifier for the individuals that were v-notched in the first place, and no means of positively identifying whether any surviving progeny from the v-notched animals contribute to subsequent recruitment.

Despite these likely quantitative weaknesses the potential benefits of this phase of v-notching still remain, based on the number of v-notched animals that have survived, but the assessment of long term benefit is restricted to either subjective impressions, or to inferences based on changes in the catch per effort of legal and sub-legal lobsters over time, again assuming that such records were kept.

Clearly the advent of the Phase 3 project was designed to redress some of these problems.

The Phase 3 project

Phase 3 involves the innovative and exciting introduction of genetic profiling, plus scientific control of aspects of the data recording for administrative purposes. The innovation means that the joint NELCO-DARD-QUB project has the opportunity to undertake all the desirable scientific components identified earlier, including the very challenging element 6.

Because the genetic sampling, and hence also the v-notching, are undertaken at sea, the stresses and potential egg loss previously encountered by bringing berried females ashore are avoided. Much more importantly, however, the parentage data base opens the way to detecting for the first time in subsequent catches the presence or absence of progeny from the v-notched population, once sufficient time has elapsed for the progeny to reach legal size. The unique identifier created by the genetic profile also improves the chances of detecting multiple recaptures of the v-notched animals, as well as their potential emigration, or exchanges between local areas.

As with Phase 2, it is not clear whether fishermen or scientists are recording the proportion of previously v-notched lobsters in their catch of legal sized lobsters, and therefore whether a Petersen estimate of stock size is feasible. If this is still not the case, it is recommended that this should be started in the remaining years of the project so that Petersen-type estimates of stock size can become available.

The same consideration applies to the sampling for progeny. It is not clear if the detection of progeny is being undertaken on an ad hoc qualitative basis only, or whether there is a quantitative sampling strategy that will allow the abundance of progeny to be estimated using the mark-recapture methodology. It is highly desirable that this should be done, because as the v-notched portion of the population increases over time it needs to be known if the number of progeny also increases in the same proportion, or whether the rate

of recruitment of progeny slows down at some point, indicating the onset of a regulatory population process, or saturation of the juvenile habitat.

If the sampling for progeny is currently not quantitative, it is highly desirable to remedy this in the remaining years of the project, in order to acquire data highly relevant to understanding this stock and recruitment question, which could be a quantum leap in lobster science.

In evaluating the potential benefits of the v-notching programme it is important to have in mind the outcome of the work in Wexford. The experiment in Wexford, where Tully considered the lobster population to be recruitment-limited, released 7916 v-notched lobsters over 6 years, and the NELCO total appears to be at least 15 000 over the 12 years of Phases 2 and 3. The NELCO total is therefore a pro-rata accumulation of v-notched animals at roughly the same annual rate as in Wexford, suggesting that in any one year the increment of v-notched lobsters into the sea was on average similar in both areas. Since the stock of v-notched lobsters in Wexford was sufficient to produce statistically useful stock estimates from the mark-recapture data, there is therefore every chance of obtaining similar precision from Phase 3 of the NELCO project, provided that the requisite data are being collected, and that the unmarked population in Northern Ireland is of similar density to that at Wexford. That said, a similar density of unmarked lobsters in both areas is only likely if the density of lobster ground, and the occupancy, demographics, and exploitation of lobster are similar in the two regions, so it is clear that a direct comparison of the results from Northern Ireland and Wexford would be very worthwhile. This strengthens the requirement to make stock estimates for Northern Ireland based on mark-recapture methods, so that if this is currently not possible because the requisite recapture ratios of v-notched lobsters and of progeny are not being recorded properly, it is highly desirable to rectify this in the remaining years of the work. Indeed, it could be that this point alone would justify a further extension of the work to make the best use of all the investment that has hitherto been expended. It is strongly recommended that it be done.

Conclusions

V-notching lobsters and returning them to the sea is a potentially powerful tool for improving spawning stock, and it is clear that, at a very minimum, a substantial number of v-notched lobsters has been returned to coastal waters in the north and north east of Northern Ireland, and these schemes can be congratulated for that achievement alone. While it is more than likely that this will have a positive benefit on the lobster stock, the wider challenge is to strive for proof of benefit.

The benchmark Wexford experiment shows what can be achieved by the quantitative analysis of comprehensive records of a) the number of v-notched lobsters that are released and recaptured, and their proportion in subsequent fishery catches, and of b) the fishery catch per effort of legal and sub-legal lobsters. The Wexford work met 5 of the 6 desirable elements of a v-notching programme. Without a detailed appraisal of the fishery records it is not clear whether this can be emulated for the NELCO Phase 2 project. Beyond that, proof that the progeny of v-notched lobsters have recruited to the fishery requires special techniques for identifying those progeny uniquely (element 6). This is clearly addressed by the innovative adoption of genetic profiling in Phase 3 which, if accompanied by the quantitative methods already described, can potentially meet all of the 6 desirable

elements. Furthermore, as described in the previous section, Phase 3 has the potential to unravel the key question as to whether, as spawning stock increases, recruitment also increases in proportion, or whether recruitment becomes limited by regulatory processes. NELCO Phase 3 is therefore an exciting project, with considerable potential to assist both lobster fishery managers in pursuit of benefits, but also lobster scientists in pursuit of the stock and recruitment question.

This leads to the conclusion that to capitalise on the investment made so far, there is a compelling case to find the funding to continue Phase 3 for a further few years, firstly to remedy any deficiencies in the collection and quantitative analysis of fishery data, as emphasised by the underlines in the previous section, so that stock assessment can be made (which may require access to a partner familiar with the statistical analysis of mark-recapture data), and secondly to pursue the lobster stock-recruitment question, whose scientific importance cannot be overstated.

It is also suggested that to gain maximum benefit from v-notching activities across Northern Ireland, the North Coast scheme should also contribute to the science described above. This does not require an integration of scheme administration, merely the contribution of v-notch samples and data in the same way as NELCO participants. The interest in such participation should be explored with the North Coast Lobster Fishermen's Association.

Finally, it is recommended a) that the stock estimates obtained from results in Northern Ireland and Wexford are compared in order to explore the demographic similarities and differences between coastal sites, and b) that stock estimates for different time periods be compared to any available trends in fishery catch per effort, in order to show whether the latter is really an effective proxy for lobster stock abundance. This is important because there is doubt about the validity of catch per effort in those lobster fisheries where habitat is patchy and fragmented, and therefore introduces spatially dependent bias into fishery time series.

Appendix 4 Pre-assessment of Northern Ireland's Brown crab, velvet crab and lobster fisheries using the Marine Stewardship Council (MSC) standard.

1. Introduction

This Marine Stewardship Council (MSC) pre-assessment has been undertaken to inform the Northern Ireland Brown Crab Strategy.

The aim of this pre-assessment is to:

- Provide a strategic / high level assessment of the Northern Ireland crab and lobster fisheries against the MSC standard
- Determine the most appropriate Unit of Certification for the fisheries
- Recommend where management and information should be strengthened to deliver positive outcomes in relation to a MSC assessment
- Establish whether MSC-certification is likely to be beneficial to the Northern Ireland crab and lobster fisheries (current & expected future market demand, cost/benefit)

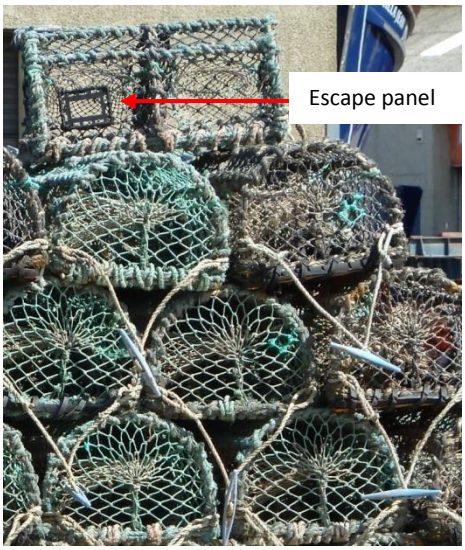
A simplified summary of the MSC Principles and Criteria is outlined in Annex 1.

2. Description of main fleets and gear

In total 209 Shellfish Entitlements are held by the Northern Irish fleet landing brown crab, velvet crab and lobster. Just under a third of these are based at Kilkeel with 10% each at Ardglass and Portagovie. Vessels with Shellfish Entitlement operate from 40 ports & landing points around Northern Ireland; with some Northern Ireland registered vessels operating from ports in the Republic of Ireland. The majority of the Northern Irish fleet are under 10m vessels, although there are also *vivier* vessels that do not fish in Northern Ireland's inshore waters.

Lobsters and crabs are targeted in pots or creels (including parlour pots), which have a very low level of negative interaction with the seabed habitat. Mesh size allows juveniles toescape and undersized species can typically be released alive when the catch is sorted. Occasionally gear may be lost, particularly after prolonged periods of poor weather, or if gear becomes entangled with passing shipping or mobile fishing gears. There is therefore a small risk of lost pots continuing to ghost fish. Some fishermen voluntarily fit escape panels to creels (Figure 23), which allow undersize crabs and lobster to escape without being hauled to the surface, sorted and discarded. This also mitigates to some extent against ghost fishing.

Figure 23: Creels at Kilkeel harbour, indicating escape panel (in top creel)



Further baseline and background to the fishery is provided in the main report.

3. Unit of certification

The MSC Guidelines to Certifiers specify that the unit of certification (UoC) is "The fishery or fish stock (biologically distinct unit) combined with the fishing method / gear and practice (= vessel(s) pursuing the fish of that stock) and management framework". It is an important part of the pre-assessment process to carefully consider exactly what the unit of certification will be as this will influence how the fishery is ultimately scored. Furthermore combining the UoCs into a single assessment streamlines the process for the fishery whereby one full assessment will be undertaken followed by single future surveillance audits etc – this has clear economic benefits.

For this fishery three main Units of Certification are defined as follows:

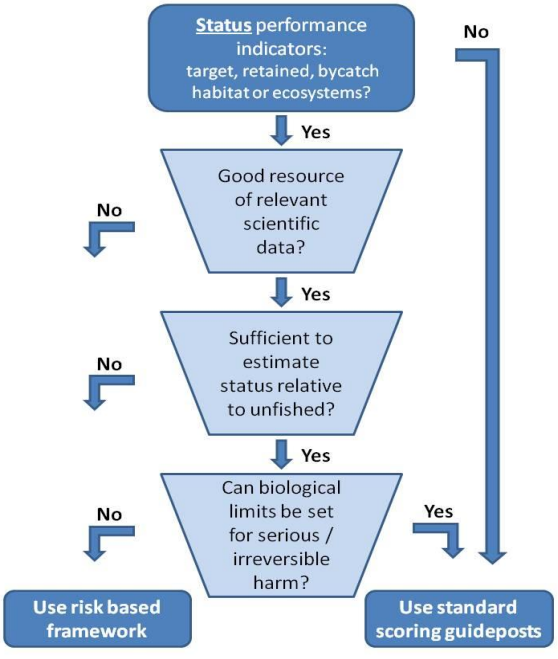
1. Brown crab targeted by Northern Irish registered vessels deploying creels/pots in ICES divisionsVIa andVIIa
2. Lobster targeted by Northern Irish registered vessels deploying creels/pots in ICES divisions VIa and VIIa
3. Velvet crab targeted by Northern Irish registered vessels deploying creels/pots in ICES divisions VIa and VIIa

These UoCs can be assessed during the same assessment and effectively have three UoCs for Principle 1, one for Principle 2 and one for Principle 3.

4. Scale, Intensity and Consequences Analysis (SICA)

The MSC developed an alternative method of assessment for small scale or data deficient fisheries called the Risk Based Framework (RBF). The RBF can be used to assess status performance indicators (PIs) for the target species and Principle 2 retained, bycatch, habitat and ecosystem. Figure 24 presents a simplified flow chart the process to determine whether a PI should be assessed using the RBF method.

Figure 24: Simplified flow process for selecting the risk based methodology (FCI, 2010; adapted from MSC FAM v2)



Given that information is often lacking when RBF is required this methodology is likely to be more precautionary, with fisheries required to demonstrate low risk (either low intensity on a large scale population or a highly productive population with low susceptibility to capture).

Only status performance indicators are covered by RBF and for Principle 1 it is still necessary to assess harvest strategy, harvest control rules and information / monitoring PIs as per standard methodology. Similarly for Principle 2 management and information PIs are scored in the standard methodology.

There are two main risk assessment tools

which can be used, the first a low level precautionary analysis of the scale and intensity of the fishery and the likely consequence (SICA analysis); the second a more in depth analysis of species productivity against susceptibility to capture (PSA analysis).

Given that in practice most SICA assessments are deliberately weighted to conclude high risk (given the low level of information), and indeed are not on their own sufficient for use to assess the target stock (Principle 1), the PSA analysis forms a more useful and insightful tool for use during pre-assessment.

The criteria for undertaking a Productivity / Susceptibility Analysis (PSA) are presented in Table 9. Cut-off values for scoring the productivity attributes as low, medium and high were developed by the MSC based on attribute values for a wide range of taxa from within Australia. In testing the approach in subsequent discussions around the world, and validating the attributes against intrinsic rate of increase, updated cut-offs are likely to be developed that are taxa and geographic specific (MSC FAM v2, 2009). These have not yet been developed by the MSC.

Table 9: Criteria for Productivity Susceptibility Analysis (PSA) (MSC FAM v2, 2009, MEP, 2011)

Productivity	Low productivity (high risk, score=3)	Medium productivity (medium risk, score=2)	High productivity (Low risk, score=1)
Average age at maturity	>15 years	5-15 years	<5 years
Average maximum age	>25 years	10-25 years	<10 years
Fecundity	<100 eggs per year	100-20,000 eggs per year	>20,000 eggs per year
Average maximum size	>300 cm	100-300 cm	<100 cm
Average size at maturity	>200 cm	40-200 cm	<40 cm
Reproductive strategy	Live bearer	Demersal egg layer	Broadcast spawner
Trophic Level	>3.25	2.75-3.25	<2.75
Susceptibility	**Low susceptibility (low risk, score=1)**	**Medium susceptibility (medium risk, score=2)**	**High susceptibility (High risk, score=3)**
Availability 1. Overlap of species range with fishery	<10% overlap	10-30% overlap	>30% overlap
Encounterability –Habitat and depth check	Low overlap with fishing gear	Medium overlap with fishing gear	High overlap with fishing gear
Selectivity – as developed by previous assessment for creel fishery (MEP, 2011)	1. Cannot physically enter the trap (e.g. too big for openings, sessile species, wrong shape, etc). 2. Can enter and easily escape from the trap, and no incentive to enter the trap (does not eat bait, trap is not attractive as habitat, etc.)	1. Can enter and easily escape from the trap, but is attracted to the trap (e.g. does eat the bait, or trap is attractive as habitat) 2. Can enter, but cannot easily escape from the trap, and no incentive to enter the trap (does not eat bait, trap is not attractive as habitat, etc.) 3. Species occasionally found in the trap.	1. Can enter, but cannot easily escape from the trap, and is attracted to either the bait, or the habitat provided by the trap. 2. Species regularly found in the trap
Post-capture mortality	Evidence of post-capture release and survival	Released alive	Retained species, or majority dead when released

The PSA for brown crab, lobster and velvet crab is presented in Table 10. Productivity attributes for each species are presented in

Table 11. For the Northern Irish fishery it is likely that target species and retained species would be assessed using the RBF methodology.

Table 10: Productivity Susceptibility Analysis for brown crab, lobster and velvet crab

	Productivity								Susceptibility					PSA Scores		
Species	Average age at maturity	Average max age	Fecundity	Average max size	Average size at Maturity	Reproductive strategy	Trophic level	Total Productivity	Availability	Encounterability	Selectivity	Post-capture mortality	Total Susceptibility	PSA Score	Risk Category	MSC score
Brown crab	2	3	1	1	1	1	2	1.57	3	2	3	3	2.33	2.81	Med	75
Lobster	2	3	1	1	1	1	2	1.57	3	2	3	3	2.33	2.81	Med	75
Velvet crab	1	1	1	1	1	1	2	1.14	3	2	3	3	2.33	2.59	Low	82

Table 11: Productivity attributes for brown crab, lobster and velvet crab

Attribute	Brown crab	Lobster	Velvet crab
Average age at maturity	6-10 years	5-7 years	1 year
Average max age	21-50 years	>25 years	6-10 years
Fecundity	250000-3000000 eggs	~50,000 eggs	300000-450000 eggs
Average max size	21-50 cm	50cm	3-10 cm
Average size at Maturity	12cm	20-30cm	3-10 cm
Reproductive strategy	Broadcast spawner	Broadcast spawner	Broadcast spawner
Trophic level	2.9	3	2.6

Based on the productivity attributes velvet crab are shown to be highly productive and brown crab and lobster have an overall medium productivity due to having a higher average age at maturity and maximum age. Trophic level scores medium risk for all three species since brown crab has a trophic level of 2.9; lobster 3 and velvet crab 2.6 (Fredriksen, 2003; MEP, 2011).

Creels are likely to be able to overlap with greater than 30% of the natural distribution of brown crab, lobster and velvet crab are therefore highly susceptible from an availability perspective.

Encouterability considers the overlap with habitat type and depth range of the species. There is considered to be some habitat refuges from fishing allowing a medium susceptibility score, which is concurrent with the findings of the recent MEP (2011) Public Comment Draft report for lobster using RBF. Habitat refuges include very shallow water into the low intertidal, where crab and lobster can be abundant and areas fished by mobile

gear such as trawls and scallop dredges which infrequently trap lobster or crab but which are inaccessible to static gear fishermen.

For selectivity of creels and traps MSC have provided advice (Policy Advisory 12; MSC, 2011) which states that the target species of the trap (or creel) fishery should be scored 3 for selectivity.

The conclusion of the PSA for the creel fishery is that brown crab and lobster are of medium risk (with a MSC score of 75 for stock status) and velvet crab is of low risk (with a MSC score of 82).

5. Principle 1 Stock Status pre-assessment

Units of Certification: brown crab, velvet crab and lobster

PI	Title	<60	60-79	≥80	Reference
Outcome					
1.1.1	Stock status **Brown crab & lobster**		75		MarLin, 2011; Fredriksen, 2003; MEP, 2011; MSC, 2011
1.1.1	Stock status **Velvet crab**			82	MarLin, 2011; Fredriksen, 2003; MEP, 2011; MSC, 2011
Explanatory Statement		As per RBF methodology presented in Table 9 and PSA presented in Table 10 and Table 11.			
1.1.2	Reference points (not if RBF)			80	n/a
Explanatory Statement		When RBF is used reference points automatically scores 80. If the fishery were to gain MSC certification using RBF method, then reference points would be required to be put in place five years from certification date. It is understood that there are currently no target or limit reference points for this fishery.			
1.1.3	Stock rebuilding				n/a
Explanatory Statement		Not expected to be rebuilding, and as RBF used to score 1.1.1 and 1.1.2 no score is given			
Harvest strategy					
1.2.1	Harvest Strategy	<60			
Explanatory Statement		Legislation that is applicable to the management of brown crab, lobster and velvet crab fisheries is set at European, UK and Northern Irish levels. Within 12 nautical miles, fisheries in Northern Ireland are managed by the Department of Agriculture and Rural Development (DARD). Minimum landings sizes for brown crab, lobster and velvet crab are set at an EU level and transposed into national law (Crabs and Lobsters (Minimum Size) Order(Northern Ireland) 1999; Undersized Lobsters Order 2000, Undersize Velvet Crab Order 1989). It is understood however that Irish vessels can fish for velvet crabs in Northern Irish waters and land into Irish ports without MLS restrictions.			

PI	Title	<60	60-79	≥80	Reference
		The UK Shellfish Licensing Scheme limits the number of vessels that can exploit shellfisheries to those issued with a shellfish entitlement (although latent capacity may exist). The Registration of Fish Buyers and Sellers and Designation of Fish Auction Sites Regulations (Northern Ireland) 2005 came into effect on 1 September 2005 and requires that all buyers and sellers of first sale fish are registered and must submit sales notes to their local fisheries office with 48 hours of any sale. The Unlicensed Fishing for Crabs and Lobster Regulations (Northern Ireland) 2008 prohibit landing of more than five crabs and one lobster per boat per day and use of more than 5 pots in less the vessel owner has a shellfish license. The Inshore Fishing (Prohibition of Fishing and Fishing Methods) Regulations (Northern Ireland) 1993 stipulate various degrees of gear restrictions within Strangford Lough. DARD recently developed proposals for a Strangford Lough Pot Fishery Management Plan (2009).Pot fisheries within Strangford Lough may therefore achieve a higher score for this PI. For Northern Irish pot fisheries in general the measures described above are not considered to form a robust and precautionary harvest strategy which is reactive to changing stock levels or that works to achieve stock management objectives.			
1.2.2	Harvest control rules and tools	<60			
Explanatory Statement		No harvest control rule has been determined for lobster, brown crab or velvet crab. It is therefore not clear what management actions would be taken in event of a change in either fishing mortality or spawning stock biomass, nor is it clear what would be the trigger points for any management action. In addition there are no stipulations about what would cause management measures (such as licence restrictions) to change (if at all), based upon the results of assessment. A harvest control rule linked to reference points is a vital element of MSC certification (and successful fisheries management). Without this the lobster, brown crab and velvet crab fisheries would automatically fail.			
1.2.3	Information / monitoring		60		DARD, 2011; MMO, 2010
Explanatory Statement		There is good information on landings of lobster, brown crab and velvet crab principally due to the Registration of Buyers and Sellers which allows a clear understanding of the volumes landed. There is also good fleet data and knowledge of the number of pots in use, although the current system of recording may not fully capture fishing effort (in order to permit LPUE calculations based on number of pot lifts). Another area of uncertainty is the level of landings taken by the Irish fleet and landed into Irish ports. Based on current information it is unlikely that this PI would score above 60.			
1.2.4	Stock Assessment (not if RBF)			✓	n/a
Explanatory Statement		Using the RBF stock assessment automatically scores 80. As with reference points, formal stock assessments would be required to be in place after five years of certification when the fishery would be re-assessed based on the			

PI	Title	<60	60-79	≥80	Reference
		default assessment methodology.			

All three UoCs would automatically fail since they are unable to meet the minimum requirements for Harvest Strategy and Harvest Control Rules and Tools.

6. Principle 2: Ecosystem impacts

Unit of Certification: Creels

PI	Title	<60	60-79	≥80	Reference
Retained species					
2.1.1	Retained spp Status		75		Henderson & Leslie, 2006; Dawson and Northbridge, 2010
Explanatory Statement		Each Unit of Certification in the creel fishery is likely to have a combination of the following retained species: brown crab, velvet crab, green crab and lobster. Each of these species is treated as an 'element' of the retained species assessment. Based on the RBF PSA as presented in Section 1 both brown crab and lobster score below 80 and therefore an overall score of 75 is likely for this PI. Discarding impacts on retained species are also taken into consideration for this PI. Generally these shellfish species are thought to have a high survivability when returned to sea. Survivability of velvet crab has been studied in Shetland by the North Atlantic Fisheries College with low mortality rates observed (Henderson & Leslie, 2006). The research concludes that mortality of the velvet crab by-catch (including those under the Minimum Landing Size) is unlikely to have a detrimental effect on the velvet crab stock. Recent research by Dawson and Northbridge (2010) studied the survival rate of brown crab discarded from the pot fishery on the west coast of Scotland and quantified the rate of anthropogenically induced mortality at 24% of discarded crabs.			
2.1.2	Retained spp management		70		
Explanatory Statement		Management of retained species is as discussed under Principle 1, namely Minimum Landing Sizes, ban on landing berried brown crab and lobster v-notching. These are considered to be measures, rather than cohesive strategies and therefore a score higher than 70 is not likely.			
2.1.3	Retained spp Information			80	DARD, 2011; MMO, 2010
Explanatory Statement		Quantitative information is available on the level of retained species landed, including average number of pots in use. This allows any increase in risk to be determined. Information is not sufficient to determine the outcome status of these species with a degree of certainty nor does it support the development of a comprehensive strategy or the evaluation of such a strategy. It is unlikely that score higher than 80 would currently be achieved.			
Bycatchspecies					
2.2.1	Bycatch spp Status			80	Nøstvik and Pedersen, 1999; Pilling et al. 2001; Thomsen et al, 2010
Explanatory Statement		The creel fisheries are known for being highly selective with limited discards. It			

PI	Title	<60	60-79	≥80	Reference
		is unlikely that there are any main by-catch species i.e. that constitute >5% by weight the overall catch. Furthermore due to the benign nature of the fish capture process, it is expected that the mortality of fish discarded from creels/traps may be low as the catch is usually alive, with low injury rates (Nøstvik and Pedersen, 1999) and low capture-related stress (Pilling et al. 2001 as cited in Thomsen et al, 2010). The bait used in the creel fishery would also be assessed under this PI, but is not expected to cause the fishery to score below 80.			
2.2.2	Bycatchspp Management			80	
Explanatory Statement		As determined in 2.2.1 Outcome status there are no main by-catch species. As per Section 7.1.25 FAM v2 if there are no main by-catch species then a management strategy is not required at SG60 or SG80. An overall score of 80 is therefore likely to be appropriate.			
2.2.3	Bycatchspp Information		70		
Explanatory Statement		As discussed in 2.2.1, it is understood that discarding is unlikely to occur in any significant quantities and highly unlikely that there are any main discarded species. However an unconditional pass requires that there is some quantitative information available on the level of main by-catch species. As per Section 2.1.28 FAM v2 this information should be collected in the area of the fishery and for the fishery under assessment. A conditional pass is therefore likely for this PI.			
Endangered Threatened and Protected (ETP) species					
2.3.1	ETP spp Status			90	Thomsen et al., 2010; Northridge et al., 2010
Explanatory Statement		When pots are set at sea ETP interactions can occur with the buoy lines from the surface to the pot on the seabed. Reviewed literature mentions potential entanglement on buoy lines recorded for right and humpback whales and leatherback turtles (Thomsen et al., 2010). A recent study by the Sea Mammal Research Unit (SMRU) (Northridge et al., 2010) investigated entanglement of minke whales in creel lines in Scotland. It was found that up to 22% of all sighted minke whales had signs of previous rope entanglement. It is expected that incidental entanglements of cetaceans and turtles in the Northern Irish creel fishery is highly likely to be within the limits of national and interactional requirements for the protection of these species and highly unlikely to create unacceptable impacts to these ETP species. A score somewhere in the region of 90 is expected.			
2.3.2	ETP spp Management		70		
Explanatory Statement		The ETP management PI requires a higher level of management than any of the other Principle 2 components. It requires that there is a strategy in place specifically for the fishery under assessment that is designed to (amongst other things) minimise mortality of the species when encounters occur. The following legislation pertains to marine turtles and cetaceans: • Wildlife and Countryside Act (1981, as amended) • Conservation (Natural Habitats, &c.) Regulations (1994) which transposes EC Habitats Directive 1992 to domestic legislation			

PI	Title	<60	60-79	≥80	Reference
		• Control of Trade in Endangered Species (Enforcement) Regulations (1997) • Council Regulation (EC) No. 338/97 • Council Regulation (EC) No. 812/2004 (cetaceans only) • Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS) (cetaceans only) • UK Biodiversity Action Plans The UK Turtle Code provides clear instructions on what to do when a turtle is encountered entangled at sea and how to report all encounters including what details to record and who to contact. No such code of practise exists for cetaceans and for this reason a conditional pass may be awarded.			
2.3.3	ETP spp Information		70		
Explanatory Statement		Knowledge is sufficient to broadly understand the impact of the creel fishery on ETP species and to determine whether the fishery may be a threat to protection and recovery of ETP species and support a full strategy to manage impact. However data is not available to allow quantitative estimation of the interactions and outcome of these interactions for the Northern Irish creel fleet and therefore a conditional pass is expected.			
Habitats					
2.4.1	Habitat Status			90	Rogers et al., 1998; Hamilton, 2000; Barnette, 2001; Enoet al, 2001
Explanatory Statement		In general, pots are often advocated on an environmental basis for having a lesser impact on habitat than mobile fishing gear such as trawls and dredges (Rogers et al., 1998; Hamilton, 2000; Barnette, 2001). Static gears in general have smaller and more localised impacts. Eno et al. (2001) examined the effects of fishing with crustacean pots and creels on benthic species in Great Britain through qualitative and quantitative experiments. This study examined the effects of lobster and crab pots being hauled from rocky substrates in southern England, and found that the habitats and their communities appeared relatively unaffected by potting. The slow-growing, long-lived, pink sea fan were frequently observed to flex under the weight of pots as they passed and then returned back to an upright position. A high score is therefore anticipated for habitat outcome.			
2.4.2	Habitat Management			90	
Explanatory Statement		No specific management strategy has been established due to the low risk posed by the fishery and an unconditional pass would be expected. Scores may not exceed 80 since no creel specific habitat management is in place (with possible exception of Strangford Lough), including potential impact of lost gear.			
2.4.3	Habitat Information			95	
Explanatory Statement		The distribution of habitat types is known over their range, and the occurrence of vulnerable habitat types is understood. A high score is anticipated, although further improvement could be made for more detailed knowledge on the location of creel effort by the Northern Irish fleet.			
Ecosystems					

PI	Title	<60	60-79	≥80	Reference
2.5.1	Ecosystem Status			80	
Explanatory Statement		Fishing with pots or creels is generally regarded as a very environmentally friendly technique, with few undesirable side effects when catching target species. Potting is often encouraged as an alternative fishing method to mitigate ecosystem impacts of other fishing gear, particularly for habitats interactions (replacing demersal trawl for example) and ETP species (replacing set nets for example). Predator-prey relationships for the target and retained species associated with this fishery (lobster, brown crab, velvet crab and green crab) are well understood. An unconditional pass is expected.			
2.5.2	Ecosystem Management			80	
Explanatory Statement		The potential impact of the SSMO creel fishery on the ecosystem structure and function is managed at an international scale under the EU framework and a national scale under UK and Northern Irish fisheries regulations. No issues are identified.			
2.5.3	Ecosystem Information			80	
Explanatory Statement		Information is adequate to broadly understand the functions of the key elements of the ecosystem. Key elements include the trophic structure, an understanding of the key prey, predators and competitors; community composition, productivity patterns and characteristics of biodiversity. Main impacts of the fishery on these key ecosystem elements can be inferred from existing information, but may not have been investigated in detail. An unconditional pas is expected.			

The minimum requirements for all Performance Indicators are met and the creel fishery is likely to pass Principle 2, with the possibility of conditions for retained, bycatch and ETP interactions.

7. Principle 3: Fishery management framework

Unit of Certification: Northern Irish registered vessels in ICES divisions VIa and VIIa

PI	Title	<60	60-79	≥80	Reference
Governance and policy					
3.1.1	Legal Framework			80	
Explanatory Statement		All fisheries management within the European Union is required to comply with the over-arching Common Fisheries Policy (CFP), whether it is applied directly from this legislation, or interpreted at the national, regional or local levels through national primary and secondary legislation. The Department of Agriculture and Rural Development (DARD) is responsible for managing sea fisheries in Northern Ireland out to 12 nmiles.			
3.1.2	Consultation			85	

PI	Title	<60	60-79	≥80	Reference
Explanatory Statement		There are well established management and consultation systems and mechanisms in place for the management of fisheries within the area covered by the Sussex SFDC. Roles and responsibilities are well defined, clear, and well known within management, industry and NGOs In terms of consultative processes, there are well-established structures for facilitating the exchange and dissemination of information and views, both amongst the commercial interests and between commercial interests and managers, and with other interested parties			
3.1.3	Long-term Objectives		70		
Explanatory Statement		At the governance and policy level, clear over-arching long term objectives are set out in the EU common fisheries policy. At a UK level Fisheries 2027: a long-term vision for sustainable fisheries sets out nine vision statements for delivering sustainability. The European Marine Strategy Framework Directive was transposed into UK legislation in 2010 and commits to the establishment of a programme of measures for achieving Good Environmental Status by 2016 The Northern Ireland Executive have complied with the above EU and UK requirements and have developed plans that, to some extent, set out the long term objectives for the sector and wider marine environment. These are delivered by DARD and include: • Northern Ireland Fleet Futures Analysis 2004-2013 • Fisheries Business Plan 2009/10 • Fisheries Forum Implementation Plan • Northern Ireland Biodiversity Strategy The long term objectives are not fully clear or explicit within management policy and therefore may require further consideration before an unconditional pass can be reached.			
3.1.4	Incentives			80	
Explanatory Statement		EU commercial and fishery policies are explicitly anti-subsidy and pro sustainable fishing. There remain programmes of financial support to structural change within the sector, and for further development of the sector. To ensure that these are in line with policy, all programmes of support are subject to close scrutiny by national and European authorities against detailed rules on EU State Aid. European and UK EFF programmes is designed to provide incentives to more sustainable behaviour, and to encourage the evolution of a safe and modern fleet whilst encouraging overall reduction in fleet size and capacity.			
Fishery specific management					
3.2.1	Fishery Objectives		60		
Explanatory Statement		There is a clear opportunity for improving the definition and distinction of both short and long term objectives for target stocks, the wider ecosystem and also socio-economic objectives. The current work to develop a Northern Irish Brown Crab Management Plan is recognised, however until this plan is implemented fishery-specific objectives are			

PI	Title	<60	60-79	≥80	Reference
		not likely to reach an unconditional pass.			
3.2.2	Decision making processes		70		
Explanatory Statement		Decision-making processes that influence the management of the crab and lobster fishery occur at an EU, national and local level. The European Commission (DG Mare) is responsible for many of the high level decision making process and make proposals based on inputs from a wide consultative structure, which includes scientific advice from ICES, scientific review from STECF, industry / stakeholder review from ACFA, and direct industry input. At a national level the work to develop a Northern Irish Brown Crab Management Plan is again recognised. As are local management plans such as the Strangford Lough Sea Fishing Exclusion Zones 2011 and the proposed Strangford Lough Pot Fishing Management Plan.			
3.2.3	Compliance & Enforcement		70		
Explanatory Statement		In Northern Ireland, enforcement of EU and national regulations is undertaken, both on land and at sea by DARD. For enforcement of EU rules of relevance to the crab and lobster fishery, the monitoring and control system makes use of logbooks, sales notes, vessels monitoring systems (where vessels are greater than 15m), landing inspections, inspections throughout the retail and supply chain (as a result of revised buyers and sellers registration requirements).			
3.2.4	Research Plan	<60			
Explanatory Statement		EU ecosystem level research is done by ICES which establishes study groups based on information requirements identified by national delegates, including through industrial representations. Working groups of relevance to this fishery include: • SGCRAB - Study Group on the Biology and Life History of Crabs • WGCRAB - Working Group on the Biology and Life History of Crabs • WGRED - Working Group for Regional Ecosystem Description However there are no known Northern Irish research plans proposed to inform stock related management for brown crab, velvet crab or lobster. Therefore, despite the EU level research, it is unlikely that this PI would pass the minimum MSC requirement.			
3.2.5	Performance Evaluation		70		
Explanatory Statement		At an EU level the review of the CFP (2002, 2008 and 2012) together with the regular convening of the ICES Working Groups (referred to in 3.2.4) is relevant for performance evaluation. At a national and local level the implementation of a national management plan for brown crab (currently in development) and future reviews of this plan would assist in achieving an unconditional pass.			

The UoC would fail since the minimum requirements for Research Plan are not met. Furthermore, even if the Research Plan were to pass, the overall average score at Principle level remains lower than 80 and therefore further improvements would be required for a number of PIs.

8. Recommendations

Recommendations for achieving MSC certification

Should MSC certification be sought it is recommended that the industry address a number of issues prior to entering full assessment. At current status it is unlikely that any of the UoCs would pass full certification for Principle 1 or 3. There are also some minor issues for Principle 2, but these are likely to be addressed either through the provision of additional information, or by conditions at the main assessment.

Key areas to address for Principle 1:

Harvest strategy and harvest control rules and tools fail to meet the minimum MSC standard.

Harvest control rules and/or management tools need to be based on plausible hypotheses about resource dynamics and be reasonable and practical, meaning that those measures possess a substantial likelihood of success. Harvest control rules by MSC definition are a set of well-defined pre-agreed rules or actions used for determining a management action in response to changes in indicators of stock status with respect to reference points. A harvest strategy is the combination of monitoring, stock assessment, harvest control rules and management actions.

Assuming a RBF approach (as undertaken for this pre-assessment) then reference points and assessment of stock status would automatically pass unconditionally. However, these PIs would require scoring as per default methodology after five years at re-certification. It would therefore be advantageous to begin consideration of developing limit and target reference points (e.g. based on LPUE or egg production per recruit, for example see Tully *et al*, 2006 and Leslie *et al*, 2010), as well as coordinated and complete stock assessments on a regular (annual) basis. The development of reference points would also work towards achieving appropriate harvest control rules and harvest strategy.

Key areas to address for Principle 3:

Research plan fails to meet the minimum MSC standard. All of the other fishery specific management systems currently meet a conditional pass and are likely to result in a below 80 average at principle level. This includes fishery specific objectives, decision making processes, compliance and enforcement and monitoring and management performance evaluation. At a governance and policy level long term objectives could also be improved.

The Development of a Northern Irish Brown Crab Management Plan is expected to improve most of the fishery specific management PIs.

Costs and benefits of certification

There are a number of costs and benefits of MSC certification which are summarised in Table 12. The costs to undertake a MSC full assessment are reported to range from €8,000 to €400,000, depending on the complexity of the fishery (Macfadyen & Huntington, 2007). There are then many other costs at various stages of the supply chain including logo licence fees at point of sale, which for the MSC is currently set at 0.5% of the product value.

Funding can be sought from various sources to fund the certification process including the European Fisheries Fund (2007-2013), Sea Change Investment Fund, Sustainable Fisheries Fund, NGO's, processors, retailers and governments, as well as public donations.

The MSC is ultimately market driven with benefits including securing current market share and/or developing new markets. Price increases have been reported from some MSC certified fisheries but can often not be differentiated from other economic drivers such as the recent global recession.

Table 12: Summary of the potential costs and benefits of MSC certification

Costs	Benefits
Direct costs to certify a fishery • Pre-assessment (this document); • Full assessment; • Chain of custody; • Logo licence fees; • Surveillance audits (annual); • Re-certification (5 years); and • Project management and preparation. Indirect costs (e.g. to prepare fishery for certification) • Development, implementation and enforcement of a management plan • Development of stock assessments • Potential short term economic and social costs as a result of worse financial performance due to tighter management	Direct benefits • Price increases • Improved client relationships • Improved management resulting in longer-term sustainability • Better knowledge of provenance/source • Continued/improved access to markets • Improved public image • Product differentiation and market segmentation Indirect benefits • Improved reputation • Political capital and positive public relations

A number of UK and Republic of Ireland shellfish fisheries are working towards, or are in the process of achieving MSC certification including the Shetland brown crab, velvet crab, lobster and scallop fisheries. Many others have or are currently undergoing pre-assessment. It is therefore advisable for the Northern Irish crab and lobster fishery to consider the market opportunities of achieving MSC certification. Ultimately the decision on whether to go for MSC certification must consider specific market place and retailer demands for both current and future markets.

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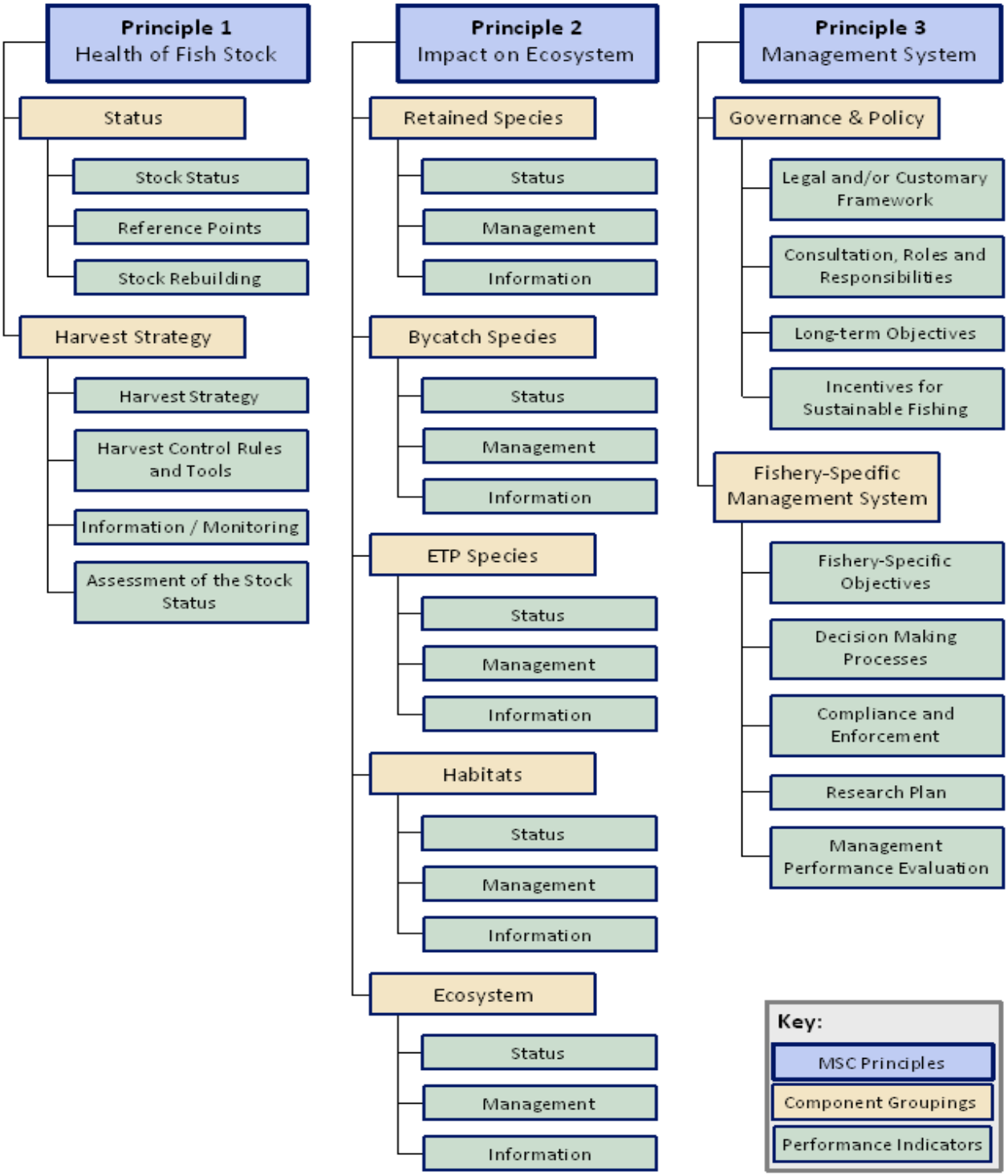
Annex 1 – MSC Principles & Criteria



The diagram above together with the descriptive text overleaf is based on information and methodology presented within the MSC Fisheries Assessment Methodology (v2, 2009) which has been summarised by Food Certification International (FCI, 2010).

A simplified summary of the MSC Principles and Criteriais outlined below for over-view purposes only. A fuller description of the MSC Principles and Criteria can be obtained from the MSC website (www.msc.org).

Principle 1

A fishery must be conducted in a manner that does not lead to over-fishing or depletion of the exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery.

Intent:

The intent of this Principle is to ensure that the productive capacities of resources are maintained at high levels and are not sacrificed in favour of short-term interests. Thus, exploited populations would be maintained at high levels of abundance designed to retain their productivity, provide margins of safety for error and uncertainty, and restore and retain their capacities for yields over the long term.

Status

» The stock is at a level that maintains high productivity and has a low probability of recruitment overfishing.

» Limit and target reference points are appropriate for the stock (or some measure or surrogate with similar intent or outcome).

» Where the stock is depleted, there is evidence of stock rebuilding and rebuilding strategies are in place with reasonable expectation that they will succeed.

Harvest strategy / management

» There is a robust and precautionary harvest strategy in place, which is responsive to the state of the stock and is designed to achieve stock management objectives.

» There are well defined and effective harvest control rules in place that endeavour to maintain stocks at target levels.

» Sufficient relevant information related to stock structure, stock productivity, fleet composition and other data is available to support the harvest strategy.

» The stock assessment is appropriate for the stock and for the harvest control rule, takes into account uncertainty, and is evaluating stock status relative to reference points.

Principle 2

Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends

Intent:

The intent of this Principle is to encourage the management of fisheries from an ecosystem perspective under a system designed to assess and restrain the impacts of the fishery on the ecosystem.

Retained species / Bycatch / ETP species

» Main species are highly likely to be within biologically based limits or if outside the limits there is a full strategy of demonstrably effective management measures.

» There is a strategy in place for managing these species that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to retained species.

» Information is sufficient to quantitatively estimate outcome status and support a full strategy to manage main retained / bycatch and ETP species.

Habitat & Ecosystem

» The fishery does not cause serious or irreversible harm to habitat or ecosystem structure and function, considered on a regional or bioregional basis.

» There is a strategy and measures in place that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to habitat types.

» The nature, distribution and vulnerability of all main habitat types and ecosystem functions in the fishery area are known at a level of detail relevant to the scale and intensity of the fishery and there is reliable information on the spatial extent, timing and location of use of the fishing gear.

Principle 3

The fishery is subject to an effective management system that respects local, national and international laws and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable.

Intent:

The intent of this principle is to ensure that there is an institutional and operational framework for implementing Principles 1 and 2, appropriate to the size and scale of the fishery.

Governance and policy

» The management system exists within an appropriate and effective legal and/or customary framework that is capable of delivering sustainable fisheries and observes the legal & customary rights of people and incorporates an appropriate dispute resolution framework.

» Functions, roles and responsibilities of organisations and individuals involved in the management process are explicitly defined and well understood. The management system includes consultation processes.

» The management policy has clear long-term objectives, incorporates the precautionary approach and does not operate with subsidies that contribute to unsustainable fishing.

Fishery specific management system

» Short and long term objectives are explicit within the fishery's management system.

» Decision-making processes respond to relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner.

» A monitoring, control and surveillance system has been implemented. Sanctions to deal with non-compliance exist and there is no evidence of systematic non-compliance.

» A research plan provides the management system with reliable and timely information and results are disseminated to all interested parties in a timely fashion.