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Interim Report of the Working Group on the Biology and Life History of Crabs (WGCRAB)

3–5 November 2015

Brest, France

ICES
International Council for the Exploration of the Sea

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Conseil International pour l'Exploration de la Mer

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Executive summary

The Working Group on the Biology and Life History of Crabs met in Brest, France, 3–5 November 2015 with AnnDorte Burmeister as Chair. The meeting was attended by 12 participants from 7 countries; Russia, Canada, Greenland, France, Norway, UK, including Scotland and Jersey, and Ireland.

The objectives of the meeting were to update and provide data and knowledge on landings, fisheries and biology of the important crab and lobster stocks in the ICES area. In addition, essential objectives were furthermore to discuss important crab and lobster stocks to identify gaps in assessment programs and review application of biological and management reference points for crab fishery. The WG also reviewed alternative indicators in assessment of crab stocks without fishery independent data.

Data and results related to the different ToRs were presented orally, and several oral presentations on other relevant issues were given at the meeting. The first 2 days were spent with ToRs a, b, and c. Updates on landings and stock assessments on Brown crab and lobster in UK, Scotland, France and Brown crab in Norway; Snow crab in Canada, Greenland and Russia (Barents Sea); Spider crab in France and Red King crab in Russia and Norway were presented. Furthermore, the group discuss the presentation of a standard methodology/protocol and collaboration on size at maturity study on *Cancer pagurus*. ToR e was discussed day 3 including a presentation of preliminary result of a PhD on the Cancer crab in Norway.

The WG discussed and agreed to continue review prospects for future assessment, advice including data availability, assessment methods and research on the biology of crab and lobster. The group agreed to make progress in evaluating assessment methods, sharing new knowledge of the species and working toward collaborating projects.

Furthermore, the group still wish to include more researchers working with lobster. The brown crab (*Cancer pagurus*) and the European lobster (*Homarus gammarus*) are both highly valuable shellfish species in the Northeastern Atlantic, but at present, whilst ICES WGCRAB provides a useful forum for brown crab scientists, there is only few lobster equivalent. Both species are typically caught using baited traps and although targeting does occur, they are often regarded as being exploited as a mixed fishery. Availability of fishing activity data and the similarity of their respective biological attributes has led to fisheries scientists using the same or similar stock assessment methodologies for both species. Furthermore, the same fisheries scientists within each fisheries institute are often responsible for both crab and lobster stock status assessments. The working group will also include lobster on the agenda for the future ICES WGCRAB meeting with additional time allocated to the meeting if required.

The WG agreed also to highlight effects of climate drivers on important crab and lobster species within the ICES, Atlantic Canada and West Greenland, including increased ocean acidification.

The background history for the establishment of the WGCRAB is comprehensively described in the Report from the Group in 2010, and will not be dealt with here.

It is a general agreement among the Group members that the annual meeting is of great value for each member, both to sum up the development in the different regional crab fisheries, and as a forum to discuss challenges in the management of the fisheries. WGCRAB is also a suitable arena for discussing particular issues on crab and lobster biology which is important since specialists working with the assessment on those species are mostly single scientists in this field at the different national institutions. Despite a limited number of attendants at the recent meetings, all members of the Group are enthusiastic to continue the work within the Group through annual meetings.

1 Administrative details

Working Group name

The **Working Group on the Biology and Life History of Crabs** (WGCRAB)

Year of Appointment

2013

Reporting year within current cycle (1, 2 or 3)

2

Chair(s)

AnnDorte Burmeister, Greenland Institute of Natural Resources, Greenland

Meeting venue

Brest, France

Meeting dates

3–5 November 2015

2 Terms of reference

ToR	Description	Background	Science Plan topics addressed	Duration	Expected Deliverables
a	Compile data on landings, discards, effort and catch rates (CPUE) and provide standardised CPUE, size frequency and research survey data for the important crab and lobster (Homarus) fisheries in the ICES area, and Atlantic Canada and Greenland.	The fisheries for crabs and lobster are socio-economically important and trans-national in Europe and Canada with the demise of fin fisheries in some regions.	212.321	3 years	Landing, discard, effort and catch data on listed species, from each country. WG report chapter.
b	Evaluate assessment of the status of crab and lobster (Homarus) stocks including use of indicators, empirical assessment, analytical assessment in relation to data sources and data quality, development and suitability of reference points for management.	Management of stocks in Europe is primarily by technical measures only and in most countries there are generally no management instruments to control fishing effort. Knowledge of the population dynamics of these species is still weak. These stocks may be at risk from over-fishing due to the lack of control of fishing effort, and hence an evaluation of the	311, 334	3 years	Report on evaluation of alternative assessment methods.

		sustainability of these fisheries is necessary.			
c	WGCRAB wish to produce assessment and advice of the main crab and lobster species in the ICES area in future. (Year 1 -2014) Review prospects for future assessment, advice including data availability, management units, and possible reference points and assessment methods. Initiate preliminary assessment exercises. (Year 2 - 2015) Review management measures applied in crab fisheries and future options. Continue exploratory assessments (Year 3 – 2016) Preliminary assessments of stock status for relevant crab and lobster species according to MSFD D3 WGCRAB will discuss with ACOM, SCICOM, SSGEF the feasibility of including e assessment and advice within its future ToRs.;	WGCRAB aims to produce assessments and advice on a management unit basis. Evaluate current assessment methods and identify reference points. Develop assessment methods to identify position with respect to MSY proxies and harvest rules. It would be of great interest to make progress on assessment of stock status and further develop ideas on reference points. WGCRAB will discuss advantages and disadvantages of emphasis advice on a management basis. Secondly WGCRAB will include a workshop at the 2015 or 2016 meeting to look at prospects for future assessment and management and will aim to draft management plans for certain stocks. Third step is to consult with ACOM regarding assessment and advice from the WGCRAB.		3 years	(Year 1) Report on data availability, management units, reference points and assessment methods (Year 2) Report on management options for crab fisheries (Year 3) Preliminary report on stock status of selected species
d	Review the impact of climate drivers on important crab and lobster species within the ICES, Atlantic Canada and West Greenland, including increased ocean acidification;	WGCRAB will investigate the relative importance of fishing and environment on crab and lobster recruitment. Furthermore there is a growing concern in the WG about the consequences of future climate change for important crab species in our region. Observed increases in sea water temperatures have already entailed expanded distribution areas of some species in the northeast Atlantic. However, a rise in the seawater pH would probably be the most serious consequences of the climate change on crustaceans such as	112, 113	3 years	Highlight important issues to be basis for research on effect of climate changes on important crab stocks. WG report chapter (2016)

		crabs. These issues will be dealt with by the WGCRAB in future.		
e	Review research and new knowledge on vital crab and lobster population biology parameters;	Several stock parameters are important for analytical assessments. Biological information is therefore required to provide standardised indices and for use in analytical assessments. Crab stock parameters may change due to size selective and single sex fisheries, through by-catch in other fisheries or through the impact of other seabed uses, such as gravel extraction. Since important crab stocks in Europe are managed without fishery independent data it may be an option to investigate any useful stock parameter indicators for assessment purposes	141	Updated knowledge on crucial stock parameters for important crab stocks.

Summary of the Work Plan

Year 1	Annual standard outputs for a, b. Continue analysis for ToR d, e. Tentative plan for ToR c.
Year 2	Annual standard outputs for a, b. Continue analysis for ToR d, e.. Complete evaluation of useful assessment methods to assess crab and lobster species in ICES areas
Year 3	Annual standard outputs for a, b. Combine analysis, research and report ToR d and e.

Supporting information

Priority	High. The fisheries for crabs and lobster are socio-economically important and trans-national in Europe and Canada with the demise of fin fisheries in some regions. Management of stocks in Europe is primarily by technical measures only and in most countries there are generally no management instruments to control fishing effort. Knowledge of the population dynamics of these species is still weak. These stocks may be at risk from over-fishing due to the lack of control on fishing effort, and hence an evaluation of the sustainability of these fisheries is necessary. The activity of the Group is therefore considered to be of high priority in particular if its activity can move towards resource assessment without losing biological inputs.
Resource requirements	The research programmes which provide the main input to this group are already underway, and resources are already committed. The additional resource required to undertake additional activities in the framework of this group is negligible.
Participants	The Group is normally attended by some 10–15 members and guests.
Secretariat facilities	None.

Financial	No financial implications.
Linkages to ACOM and groups under ACOM	There are no obvious direct linkages today, but if the EG is going to produce stock assessments in the future WGCRAB will have linkages to several EGs under ACOM.
Linkages to other committees or groups	The EG aims to be able to give advise on how to exploit important crab stocks in the ICES area and is therefore related to EGs such as WGCRAN and the ICES/NAFO NIPAG.
Linkages to other organizations	

3 Summary of workplan

The new draft resolutions running from 2014 to 2016 were introduced and the agenda structure of the meeting followed these main themes.

ICES SharePoint was made available before and during the meeting, and was proved to speed up the work and make exchange information more efficient.

Practicalities for the meeting and reporting were introduced. Sarah Clarke and Rosslyn McIntyre were appointed to rapporteur during the meeting.

a) The group adopted the agenda following the ToRs: Compile data on landings, discards, effort and catch rates (CPUE) and provide standardised CPUE, size frequency and research survey data for the important crab fisheries in the ICES area; (Updated tables are available in Annex 3)

b) Evaluate assessments of the status of crab stocks, identify gaps in assessment programmes, and review the application of biological and management reference points for crab fisheries;

c) Evaluate current assessment methods and identify reference points. Furthermore the group wants to develop assessment methods to identify position with respects to MSY proxies and harvest rules.

d) Review the impact of climate changes on important crab populations in the ICES area, including increased ocean acidification.

e) Review research and new knowledge of vital crab population biology parameters.

4 List of Outcomes and Achievements of the WG in this delivery period

Publications

UK - England

Scotland

Ireland: Shellfish Stocks and Fisheries Review is published annually and available on the Marine Institute website (http://www.marine.ie)

France

Russia

Norway

Advisory products

UK - England

Scotland

Ireland: The Marine Institute give advice on the stocks of *Cancer pagurus* and *Homarus gammarus* in Irish waters through the Shellfish Stocks and Fisheries Review published annually and available on the Marine Institute website (http://www.marine.ie)

France

Russia

Norway: Søvik, G. 2015. Taskekrabbe. P. 198 i: Bakketeig I.E., Gjøsæter H., Hauge M., Sunnset B.H. og Toft K.Ø. (red.) 2015. Havforskningsrapporten 2015. Fisken og havet, særnr. 1–2015. (In Norwegian only)

Greenland:

Burmeister AD (2015) Opdatering af bestandsstatus for krabber ved Vestgrønland og rådgivning for 2015. Pinngortitaleriffik, Grønlands Naturinstitut, 45 pp (In Danish and Greenlandic only)

Burmeister AD (2014) Asessment of snow crab in West Greenland 2015 and 2016. Technical Report no.r. 93, Pinngortitaleriffik, Grønlands Naturinstitut, Greenland Institute of Natural Resources. 48 pp

Datasets

UK - England: The assessments use official fishery landings

Scotland:

Ireland: The Irish landings data for over 10 meter vessels come from logbooks. The landings for under 10 meter vessels is collected from first sales notes. The size data is collected via a Sentinel Vessel Programme (coordinated by Bórd Iascaigh Mhara) and an Observer sampling programme (coordinated by the Marine Institute). All size data is maintained by the Marine Institute**.**

France: All the assessments use the data from the national database. The data come from the logbooks or from the national fishing sheet for vessels under 12 m. In addition, size samples come from the national plan and some self-sampling data complete the dataset. Currently, there is not specific survey for the large crustaceans.

Norway: The assessment use official fishery landings as well as logbook data from a reference fleet of commercial fishing vessels. The data are collated by IMR and held in IMR databases (stored as excel-files).

Russia:

Canada: Newfounland & Labrodor: The assessments use dockside monitored landings data, at-sea observer measurement data, harvester logbooks, post-season trap and trawl

surveys, vessel monitoring system data, and physical oceanographic (temperature) data. All data are collected and maintained by the Department of Fisheries and Oceans Canada, Newfoundland and Labrador region.

Greenland: The assessments use official fishery landings and logbooks data (from Greenland Fishery License Control) as well as data from annual trap surveys in two management units conducted by Greenland Institute of Natural Resources (GNIR). Those data is collated by GNIR and held in GNIR Access database.

Modelling outputs

UK - England: Length Cohort Analysis assessments lead to estimates of F trends and population numbers

Scotland:

Ireland: No assessments are currently undertaken on Irish stocks.

France: The GLM approach is mainly used to estimate abundance indices. This situation is due to the good quality data of some time series. Assessment models are not much used for the moment. Nevertheless some works are in development because some size samples start being compiled.

Norway: no modelling outputs is available

Russia:

Canada: Labrador and Newfoundland: none

Greenland: no modelling outputs is available

5 Progress in relation to the Terms of Reference

During the meeting a series of summary tables in which data and information discussed and presented under ToRs a and b are presented as a standard (see Annex 3) is and will be presented as routine information in the annual reports. Only the main commercially exploited crab species such as brown crab (*Cancer pagurus*), snow crab (*Chionoecetes opilio*), red king crab (*Paralithodes camtschaticus*) spider crab (*Maja brachydactyla*) and lobster are reported. The WG recognise that some important fisheries are not covered by this report because some countries were not represented at the WG meeting and no data have been provided. Nevertheless, the aim of the WG is that all commercially exploited crab stocks from all countries should be handled and reported by the WG.

5.1 Fishery, survey data and assessment

Data on landings, discards, effort and catch rates (CPUE) was provided for important crab and lobster fisheries in the ICES area, and tables were updated. (See Annex 3 for updated tables).

An increased understanding of stock structure is necessary for a proper management particularly for the brown and spider crab stocks, both nationally and internationally. Information on general biology as well as genetic studies and the physical environment, are critical in identifying the stock structure of crabs to ensure effective stock manage-

ment. The WG also highlights the application of biological reference points in the assessment and management of crab stocks.

The question of whether to change from a study group to an assessment group was discussed. The consensus was that an assessment group wouldn't be appropriate. The change to an assessment group would mean the research component would have to be dropped, which no-body wants to happen. Other concerns included the amount of time that would be required to prepare for an assessment group, restrictions on sharing data in some cases, and the lack of assessments produced by some countries.

For the future it was suggested that fisheries that overlap share data and assessment methods, possibly having an extra day at the beginning or end of the meeting to break up into species groups and share knowledge on assessments.

5.2 An overview of *H. gammarus, Maja squinado and Cancer Pagurus* research in Jersey, Channel Islands

This presentation gave a brief overview of the Bailiwick of Jersey's geographical position, unique constitutional arrangement with the UK and corresponding relation-ship with the European Union and other member states. Once detailing the legal and regulatory framework of the island, both locally and internationally, this presentation also discussed international and trans-boundary management of fisheries through the Granville Bay Treaty between the UK and France and the joint Marine Stewardship Council certification of the Lobster fishery between Jersey and Normandy. An overview of data from the fishery was presented including landings for the main commercial shellfish species, European Lobster (*Homarus gammarus*). Pot lifts and landings per unit effort were also presented, along with corresponding figures for the commercially important by-catch species of Spider Crab (*Maja squinado*) and Brown Crab (*Cancer pagurus*). Data from fishery-independent surveys by the Environment Department of the States of Jersey, were also presented. Data presented included carapace length histograms, maturity data and information on the management of the fishery and the structure of the commercial fleet licensed by Jersey.

5.2.1 Stock status of lobster in Scotland

Total Scottish landings of lobster fluctuated between 400 and 1200 tonnes from 2005 to 2014 (Table 4). The main fishing areas for lobster are the South East, East Coast, Orkney, Hebrides, and South Minch; landings from these areas account for around 87% of the total. The majority of lobsters fished in Scottish waters are landed in the third and fourth quarters of the year. Stock assessments based on LCAs for the period 2009–2012 were carried out for eight of the twelve assessment units, providing estimates of fishing mortality in relation to the F_{MSY} proxies (Table 5). There were insufficient sampling data from the Mallaig, North Coast, Sule and Ullapool areas to conduct LCAs. Lobsters in all the assessed areas were fished above the F_{MSY} proxy to some extent, particularly males. Fishing mortality was estimated to be above F_{MSY} for both males and females in Clyde, South Minch, East Coast and South East. In the Hebrides, Orkney and Papa, fishing mortality for females was at F_{MSY} or below while males were fished above F_{MSY}. In Shetland, males were fished below F_{MSY} and females above F_{MSY}. Overall, assessments for the period 2009–2012 show that most lobster assessment units in Scotland were fished close to or above

the F_{MSY} proxy. A higher yield and biomass per recruit in the long term could potentially be obtained in all assessment units by reducing the level of fishing mortality (effort).

5.2.2 An update of lobster assessment in France

The landings of lobster in France are around 450–500 tons. Some regions target and land more lobster than others as Normandy and Brittany. The pot is the main fishing gear to target lobster. Nevertheless, many different sizes of pot are used along fishing areas link to sea condition (current, swell and fishing depth). In all the regions, to target lobster, a vessel need a licence. This first management rule led to limit the number of vessel in fisheries. After, the number of pot are limited by fisherman between 200 and 250 according to the fishing region. These two rules really permit to control the fishing effort.

Currently, the sampling programs have been changed in order to get size structure to develop size structured models. Today, we don't have enough data to perform a good analyse even if some test have been realised. The quality of the data from the logbook or fishing sheet are used to develop abundance index from CPUE. A GLM model allows to integrate the seasonal effect and fishing power of the vessels to estimate a good index where the trend of the abundance is well observed.

Using this approach, the estimated indices for the two main fishing areas show a steadily increase of the abundance (Figure 1 and 2). The same trend are observed and the increase starts at the same period around 2006. First at all, the respect of the rules have led to this evolution. Among this, the respect of the MLS is really a great change in the practice of the fishermen.

In parallel, the dynamic of the recruitment seems to have changed a lot. A scientific survey in the North of Normandy performed since 1985 give a good information on the dynamic the population (Figure 3). The general trend really shows an increase which is more important in the last 8 years. At the moment, it is really difficult to analyse the elements which can explain this trend. Our future works will be concentred on this point.

The global situation of the lobster stock for the coast of Brittany and Normandy can be considered as good. Some discussions always exist to improve the management and more precisely for the recreational fishing activity with a maximum of one lobster per day.

5.2.3 Update on the status of Atlantic Canadian snow crab

This presentation details trends in landings, biomass, and recruitment for Atlantic Canadian snow crab (*Chionoecetes opilio*). The snow crab resource in Atlantic Canada is spatially broad-based, covering thirteen of the Northwest Atlantic Fisheries Organization (NAFO) Divisions (2HJ3KLNOP4RSTVWX) and four separate regions of the Department of Fisheries and Oceans (DFO), which utilize different techniques for assessment and management. Thus, data quality is variable and a broad-scale view of stock status is difficult. However, the latest stock status reports from the four DFO regions show that overall landings have been stable at around 95 000 t for over a decade and no major changes to the exploitable biomass are expected in the short-term in most areas. However, the largest area of supply on the Grand Bank off eastern Newfoundland (NAFO 3LNO) is expected to experience declining recruitment into the exploitable biomass over the next few years. Overall stock productivity has been relatively low from about 2003/04 to recent

years, but there is an emerging broad-scale indication of improving abundance of small crabs in most areas in the past two years. A general broad-scale cooling of the climate system since the very warm conditions experienced in the early 2010s should be positive from improved long-term prospects, particularly if they continue.

5.2.4 Update on the status of snow crab in West Greenland waters

Total Greenlandic landings increased from approx. 1000 tons in 1995 to a peak of approx. 15 000 tons (Quota 26 800 tons) in 2001. Since landings as well as quota has been markedly reduced. From 2001 to 2007 total catch declined by approx. 89% to 2189. In the subsequent years landings has been stable at approximately 2200 tons and total landings was 2157 tons in 2014. Landings with in each of the management areas have fluctuated over time and in 2014 approx. 52% of total landings were taken in Management area Nuuk-Paamiut, whereas the contribution from Disko Bay and Sisimiut amounted 21% and 23% respectively. Contributions from the management areas Maniitsoq_Kangaamiut and Narsaq Kap Farvel amounted less than 4% of the total landings.

In the management area Disko Bay all available indices from the commercial fishery and survey data indicate that there has been no recent increase in commercial crab biomass despite a considerable reduction of the fishery removal and fishing effort from 2001 to 2014. Since snow crab enter the fishery at age 8 to 10, the current relatively low biomass level might be a result of poor recruitment at the time when spawning biomass were at record low level, as observed from 2003 to 2006.

In the management area Sisimiut inshore, survey indices indicating a downward trend in the stock from 2009 to 2011, it remains remain low in 2013 and 2014, but show some minor increase in 2015. Standardized CPUE from the commercial fishery indicate the same trend. Since 2002 new-shelled crabs have accounted for a most of the males caught in the scientific catches, whereas the proportion of intermediate and old crabs has been decreasing. Since 2009, abundance of recruits continuous declined to a record low level in 2014. However, a minor increase recruitment was observed in 2015, suggesting moderately recruitment prospect to the stock in near future.

In the offshore site of Sisimiut all available indices shown a significantly drop in biomass in 2009, in the succeeding years biomass remain on a low level and well below the 16-yr mean . The minor sign of increasing biomass as observed in 2015, is namely attributable to significant reduction of commercial catches from 2004 up to 2014, Recruitment indices for the offshore area are disturbingly poor and indicate low or no recruitment prospects in the short term.

Nuuk-Paamiut; Catches and effort have steadily increased from 2008 to 2013 and CPUE have remained relatively high without a sharp decline, suggesting that the snow crab stock offshore is in a stable *condition.* There is no is fishery independent data available from this area

5.2.5 Update on the status of snow crab in Barents Sea (Norwegian EEZ)

The snow crab (*Chionoecetes opilio*) stock has increased rapidly both in distribution and abundance in the Barents Sea since the first five specimens were found in 1996 at the Goosebank in south eastern part of the Barents Sea. The population is expanding its distribution primarily westwards and northwards into the Norwegian zone.

The snow crab is therefore now found in large parts of the Barents Sea, but still the largest part is in Russian exclusive economic zone (EEZ). The snow crab is defined as a sedentary species, which entail several challenges regarding management of the species. The Barents Sea continental shelf, including the Loophole, belongs to Russia and Norway. The border Norway and Russia agreed upon in 2010 lined up the dividing of the continental shelf between the two Parties. This implies that most of the Loophole continental shelf belongs to Russia. The development in the distribution is followed closely and new maps showing the distribution area is produced every year. A new map showing the distribution for 2015 is not yet finished.

At present, most of the snow crab fishery in the Barents Sea takes place in the Loophole. There has been a fishery for snow crab in the Barents Sea for four years. It started with only small landings of 2.5 tons in 2012, and so far in 2015 there is landed 8000 tons. At the moment, 21 boats from different nationalities are participating in the fishery for snow crab in the Barents Sea.

Norwegian data on the snow crab stock in the Barents Sea originate mainly from bycatches in the regular routine cruises conducted by the Institute of Marine Research using a multispecies trawl. We have therefore some knowledge about the stock structure and basic biological parameters for the Barents Sea snow crab. Our priority task at the moment is elaborating the use of "collections bags" mounted on the trawl-gears, to be used as a future sampling device for snow crab by the Institute of Marine Research.

5.2.6 Brief overview of the snow crab study in NEAFC regulatory Convention area in the in Barents Sea (Russian EEZ)

The report presents the results of snow crab stock study in NEAFC Regulatory & Convention Area in Barents Sea during commercial fishing in July 2014. It contains the model of crab's distribution, the catch per trap and data from the bioanalisys of 2407 snow crab males including size distribution, percentage of injured crabs in catch, meat content. It was noted that the main part of catch was legal size males with carapace width over 10 cm.

5.2.7 Update on the status of King crab in Barents Sea (Russian EEZ)

The presentation shows the results of two surveys of the king crab in Barents Sea. The first was held in July 2015 in a 12-miles zone from the Varanger Fjord in the East to Kanin Cape in the West. The second survey was carried out on a fishing vessel in September and October 2014 in the area of commercial fishing of red king crab in the Russian economic zone. The map of stock distribution, data of bioanalysis, size distribution and catch per trap were presented. Also the dynamics of the data from similar surveys carried out over the last five years was shown. It noted an increase in stock of red king crab legal size males in the commercial fishery area and adult females in the coastal zone.

5.2.8 Stock status of brown crab in Scotland

Total Scottish landings of brown crab fluctuated between 8300 and 12 300 tonnes from 2005 to 2014 (Table 6). The main fishing areas for brown crab are the Hebrides, East Coast, Sule, Papa, South Minch and Orkney; landings from these areas account for around 80% of the total. The majority of crabs fished in Scottish waters are landed in the

third and fourth quarters of the year. Stock assessments based on LCAs for the period 2009–2012 were carried out for nine of the twelve assessment units, providing estimates of fishing mortality in relation to the F_{MSY} proxies. There were insufficient sampling data from the Mallaig, Ullapool and Clyde areas to conduct LCAs. Of the nine assessed areas, six were fished above the F_{MSY} proxy to some extent Table 7). Fishing mortality was estimated to be above F_{MSY} for both males and females in South Minch, Orkney, East Coast and South East. In Sule and Hebrides, fishing mortality for males was at F_{MSY} or below while females were fished above F_{MSY}. In the North Coast, Papa and Shetland, recent fishing mortality was approximately at F_{MSY} or lower. Overall, assessments for the period 2009–2012 showed that most brown crab assessment units in Scotland were fished close to or above the F_{MSY} proxy. In many of the assessment units, a higher yield and biomass per recruit in the long term could potentially be obtained by reducing the level of fishing mortality (effort).

5.2.9 An update of crab assessment in Norway

The resource of edible crab in Norwegian waters is considered and managed as one stock. There has been a northward migration of the species in the last years, and at present the stock is distributed from Skagerrak to Finnmark. As there are biological differences among crabs along the Norwegian coast, monitoring and data compilation are carried out per statistical areas as defined by the Norwegian Directorate of Fisheries. There are no regulations of the stock except for a minimum landings size (Swedish border to Rogaland (area 8): 11 cm CW; north of Rogaland: 13 cm CW), a maximum number of traps (20) for recreational fishers, and compulsory escape gaps for lobsters in crab pots in areas 8 and 28. The fleet consists of small vessels <15 m, fishing with traps.

The stock is data deficient, with no logbook data and no survey. The fishery started at the beginning of the 20th century. Landings peaked in the late 1940s and again in 2007. Annual present landings are around 5000 tons, with Trøndelag (area 7) and the Helgeland coast (area 6) as the main fishing areas (around 70% of total landings in 2014). In south Norway, the fishery takes place year round, while the season is contracted moving northwards. Generally, the main season is from August to November.

To collect data from the stock and the fishery, a Crab Reference Fleet was established in 2001. Recruited fishermen are equipped with four standard reference traps with no escape gaps and a calliper, and are asked to record all catch (numbers, CW, sex, berried females, discard) in the reference traps on a weekly basis during ten weeks. In 2014, 12 fishermen participated, measuring a total of 4444 crabs. Most fishers are recruited from areas 6 and 7. Catch rates may vary quite a lot among fishers, thus annual mean catch rates depend on the participating fishers, especially when few fishers are participating. Catch rates (landed catch) vary between years in the south (area 8), but are quite stable in areas 6 and 7. Stocks are concluded to be stable. Discard rates are highest in the south (area 8) and in little exploited areas (area 28), while they are lowest in the north (area 5). Mean CW of landed female crabs seems to have decreased in area 6 compared with area 7. Landings are dominated by females except in area 8.

5.2.10 An update of crab assessment in France

The landings of brown crab stay very stable year after year, around 6000 tons. This situation is really link to the composition of the fleet which targets brown crab. In effect, 45%

of the 6000 tons of the landings come from 12 offshore potters. These vessels use the same strategy each year and target only brown crab. For more than 10 years, the fishing effort of the fleet stays at the same level. Using all the data available from this fleet, the abundance index developed gives us some information for the stock. The general trend show a steady increase of the abundance if we consider the catchability is equivalent year after year (Figure 3).

Nevertheless, some interannual changes can be observed by area. In 2014, the abundance has increased in Western Channel and slightly decreased in the Bay of Biscay. Other potters target brown crab along the coast of Normandy, Brittany and Loire Atlantic but only a few target it all the year. The majority have a seasonal activity where the brown crab is targeted only from September to November. For these coastal fleet, the trend in the abundance is less clear. Some environmental factors and the movement of the brown crab explain the coastal annual variability of the presence of brown crab.

In parallel, the others fleet, trawlers and netters stay really significant in the total landings where they represent 20%. The repartition of the landings (Figure 4) permit to observe the weight of each fleet in the landings. The Fileyeurs Caseyeurs fleet target brown crab with pots, only a little part of the brown crab landing is from nets.

5.2.11 Data on *Cancer pagurus* from Ireland

Irish vessels fish for crab in ICES Areas IV, VI and VII. In 2010 the WG agreed a series of assessment units covering fisheries exploited by vessels from UK, Ireland, France, Norway and Sweden. Four of these assessment units, (Malin, SW Ireland, SE Ireland/Celtic Sea, N Irish Sea) surround the Irish coast and Irish inshore vessels fish in all four units. Landings (tonnes) into Ireland from 2004 to 2014 for these four assessment units and adjacent assessment units by Irish vessels are shown in Table 1. These landings are collated from the operational landings database. Table 2 shows the landings (tonnes) for the under 10 metre vessels that fish around the Irish coast within 12 nmiles of the shore.

The quality of the landings data from the official national databases are variable and may at times reflect changes in the efficacy of recording rather than the crab fishery itself. Landings data for 2015 is incomplete at this time and therefore has not been included.

Size distribution data was only collected from the Malin and SW Ireland assessment units during 2014. A total of 3845 brown crab were measured overall. Female brown crab were more prevalent in catches and landings from both assessment units. Female crab from the Malin assessment unit ranged from 65-240 mm carapace width with a mode size of 150 mm, while male crab from the same stock ranged from 60–250 mm carapace width with the majority being 170 mm. In the SW Ireland assessment unit female brown crab ranged in size from 65–210 mm carapace width and males ranged from 75–210 mm carapace width. Female brown crab from the SW Ireland had a mode size of 170 mm whereas the mode for males from the same stock was smaller at 110 mm carapace width.

No assessment methods are currently being utilised by Ireland on the four stocks/assessment units around the Irish coast.

5.3 Assessment consideration

5.3.1 Thinking outside the box – a possible approach to reference points for Newfoundland snow crab

Precautionary Approach frameworks for fisheries management are intended to promote caution in the absence or uncertainty of scientific advice and aim to avoid serious harm to fish stocks and their ecosystems. For finfish stocks, it is commonplace to employ biomass- or exploitation-based reference points in relation to historic levels of both metrics toward identifying how a given stock is performing in the present. Such approaches have been adopted in the Southern Gulf of St. Lawrence and the Eastern Scotian Shelf for the assessment and management of snow crab (*Chionoecetes opilio*) in those regions. This presentation examines the biology of snow crab and the management regime used in Newfoundland and Labrador toward determining if such approaches are advisable to implement for assessment and management of the resource in Newfoundland and Labrador. Finding that the fishery impacts only a very small portion of the population (largest males), which are not normally found in close association with breeding females, no stock-recruitment relationship between largest males and small crab abundance, and that productivity is predominately environmentally-driven, the presentation concludes there is little biological basis for implementing such 'conventional' reference points. Alternative approaches are being pursued, focusing on fecundity levels of females. With the fishery having virtually no effect on female fecundity, the underlying intent of harvest control rules being explored to accompany the proposed reference points are aimed at efficient prosecution of the fishery, specifically maximizing yield-per-recruit and minimizing recruitment overfishing via discard mortality.

5.3.2 King crab – assessment methods and available data

The harvest of the red king crab (*Paralithodes camtschaticus*) in northern Norway has a fishery history going back to 1994. Until present the management of this fishery has undergone several changes. Being a male-only fishery for the first 14 years and since 2008 an additional small quota on female crabs has been implemented. In addition, there is a dual management regime with two goals. Goal number one is to maintain a long term commercial harvest in a limited geographical area with total allowable catch (TAC) and restricted participation (East Finnmark). The other goal is to limit further spread of the crab and minimize crab abundance outside the commercial area (West Finnmark).

The Institute of Marine Research carry out two annual cruises in the quota regulated area to assess the stock and advising on harvest. In addition, we perform a trap survey in coastal areas west of the quota regulated area to monitor the spread of the crab. After five years of surveillance, it seems that the free fishery is able to limit the rate of spread, and keeping the stock at low levels in areas where the crab is established.

During the last six years the landings and the catch value of the red king crab in East Finnmark has been stable. About 550 fishermen participate in the fishery and the value of the landings has varied between 100 and 150 million Norwegian kroner.

We are presently emphasizing improvement of logbook data from the fishery. This will give us knowledge about fishery pattern such as catches, fishing depths and effort.

Data collected on the red king crab surveys are analysed using a compound production model. This model provides alternative harvest options with affiliated risk analysis. The quota has been stable and varied between 1000 and 1300 tones the five last years.

5.4 Impact of climate divers and increased ocean acidification on important crab and lobster species

The main conclusion was that increasing temperatures is not favourable for snow crab and increasing ocean acidification might not be favourable for crustaceans in general.

There is a growing concern in the WG about the consequences of future climate change for important crab species in our region. Observed increases in sea water temperatures has already entailed expanded distribution areas of some species in the northeast Atlantic. However, a rise in the seawater pH would probably be the most serious consequences of the climate change on crustaceans such as crabs. These issues will be dealt with by the WGCRAB in future.

One key crab resource in the North Atlantic showing responses to warming conditions is the Newfoundland and Labrador snow crab (*Chionoecetes opilio*), with warming associated with declining productivity in the stock. The most recent stock assessment of this resource has shown consistent strong relationships between a lagged thermal habitat index (areal extent of cold bottom water in shallow nursery areas) versus fishery catch per unit of effort (used as an index of biomass) in the four major assessment units of the stock (see figures in Annex 3). The lags in the relationships (7–9 years) infer warm conditions during early ontogeny are unfavourable for snow crab survival. In general, although variable, predictions from the relationships indicate that the warm conditions that have occurred during the past decade will result in continued low productivity in the stock.

5.5 Research and new knowledge on vital crab and lobster population

Collaboration with research was also discussed. It was suggested that projects could be presented and shared before work begins and enable early collaboration and encourage joint publishing of papers.

5.5.1 Biology and eco-physiology of *Cancer pagurus* in Norwegian waters – contents and some preliminary results

In the biological part of the PhD the aim is to identify spatial and temporal differences in size (or age) at maturity, as well as geographical variation in the timing of reproductive events along the coast of Norway. Preliminary results on size at maturity indicate no difference between northern and southern Norway in the size where 50% of the crabs are mature, and no difference when the results are compared with identical studies conducted in the same areas 10 year ago. Future work will focus on determining if there is a geographical difference in the age at (same) size, and hence a difference in age at 50% maturity. In support of this hypothesis, the registrations of soft crabs by the reference fleet of crab fishers indicate a reduced frequency of molting, and hence a slower growth, with increasing latitude. The results are currently being subjected to statistical analysis to confirm these observations.

The data from the reference fleet have also been used to identify spatial differences in reproductive events, where the results suggest that there is a geographical difference in the timing for molting in females, with a delayed onset with increasing latitude. This suggest that there is a geographical difference in the main period for mating. Similarly, industry data on Near-Infra Red scanning of crabs show that there is a delayed development of gonad with increasing latitude. Data collection and analysis is ongoing, but overall the aim is that data from the reference fleet and industrial data on crab quality will allow a better understanding on the spatial (and temporal) differences in life cycle events.

In the eco-physiological part of the PhD the focus is on the geographical differences in thermal preference and the effect of temperature on *Cancer pagurus* metabolism. The temperature preference of crabs from northern and southern Norway will be investigated by monitoring their movement in a raceway system with a thermal gradient. Further, the experiments will be conducted on crabs from different geographical locations that have been stored under the same environmental conditions for one year. The results will help to determine if the crabs are adapted or acclimated to different thermal environments. Thermal preference studies will be followed with respiration experiments to determine how metabolic activity is affected by temperature.

The aim is to present further results from the on-going investigation at the next WGCRAB meeting (in 2016).

5.5.2 Maturity of brown crab in Scottish waters

In this study, the size at maturity of brown crab was estimated using a variety of reproductive and morphometric criteria from samples obtained in the east and west coast of Scotland; this was estimated as the carapace width (CW) at which 50% of the sample was mature (CW50). Testes and ovaries were staged to estimate the size of gonadal maturity. When stage 2 males were defined as mature, a significant difference between east (100.5 mm) and west (107 mm) coast samples was identified; no significant difference was found between areas when stage 2 males were defined as immature (170 mm east and 171 mm west). There was also no significant difference between the size of gonadal maturity between east (145.5 mm) and west (145.6 mm) coast females. Sperm plugs were considered in addition as an indicator of behavioural maturity. Although none were found in east coast females, 84% of west coast females contained them internally; this could be indicative of differences in reproductive cycles. Size of morphometric maturity was estimated using cheliped measurements of males and abdomen/pleopod measurements of females. Although a significant breakpoint was identified for cheliped depth of east coast males, no other breakpoints were found to be significant. The change from isometric to allometric growth of these features was instead best represented by a gradual change.

5.5.3 Summary of research into improving recruitment estimates for Edible crab and European lobster in UK

Cefas has been working on this four year project funded by DEFRA that began in 2012. The project involves the testing of practical methods of tracking year-class strengths to give estimates of future recruitment for edible crab (*Cancer pagurus*) and European lobster (*Homarus gammarus*).

The difficulty in ageing crustacea means length-based models are used to produce regional stock assessments. Two of the most limiting factors on the quality of these assessments are estimates of recruitment and growth, both which are assumptions in the model. The aim of the Piecrust project is to provide recruit estimates which are currently lacking, and more accurate growth estimates that are available at the moment.

The project is based on four different work streams which involve the testing and evaluating the suitability of potting surveys, intertidal surveys, growth studies and observer surveys. Fieldwork was carried out off the North Norfolk coast where there is an active crab and lobster fishery, and there is suitable chalky reef habitat for intertidal surveys. Another benefit of this location is the proximity to the Cefas laboratory which is less than two hours away, thus making it easy for regular fieldwork to be carried out by Cefas staff.

Growth experiment: The aim of the growth experiment is to improve length models to produce a more robust stock assessment by carrying out a semi-captive experiment. Crabs and lobsters caught during the potting survey were kept on the seabed in adapted cages. The pots were serviced and the animals were fed regularly. Size and moult frequency were recorded, and modelling concentrated on moult increment.

Over 100 moults for crab were seen over the course of the experiment, and some crabs moulted up to three times. Lobsters did not respond well to being kept in cages for long periods of time. Their carapaces tended to get encrusted with growth which impeded moulting.

Intertidal surveys: The aim of the intertidal surveys was to investigate the suitability of this technique to provide recruit estimates for crab and lobster. The first year was spent trialling different survey designs and refining the method. Crabs were found in large numbers, but very few lobsters were found, therefore the survey focussed on searching for crabs only. During the subsequent three years, monthly surveys were carried out between spring and autumn at low water spring tides. Two searchers began searching a transect approximately two hours before low water, following the ebb tide out. Crabs were searched for in shallow pools, under stones and in damp sandy patches. Carapace width was measured, the animals were sexed where possible, and the location of the crab was recorded. Sizes of crabs found ranged between 7–138 mm. Peak abundance was late summer. One concern was that different searchers would have different levels of success and confound the results. However, when looking at effect of searcher on abundance of crabs it showed no significant effect. Large differences were seen between years, although this could be due to a combination of different factors including weather conditions, food availability, habitat changes or year class strength.

Potting survey: A potting survey was carried out between 5–10 miles off the north Norfolk coast. Strings of parlour pots were adapted to retain small animals and keep large ones out of the pots by using fine mesh and restrictor rings on the openings. A fishing vessel was chartered for the duration of the project and pots were laid out in strings on a pre-designed survey grid. Regular trips (weekly in summer, weather dependant) were made to service the pots. The pots were emptied, re-baited and the animals were measured and sexed.

The gear proved successful at targeting undersized crabs and excluding most animals over the minimum landing size (115 mm carapace width). The timing of peak catches

varied by a month between years and was correlated to seabed temperatures. An apparent increase was seen in mean size of crabs with increasing distance from the coast.

5.5.4 Preliminary results of discard mortality experiments on Newfoundland snow crab

This presentation provides updates on an on-going experiment to investigate discard mortality rates in Newfoundland and Labrador snow crab. The experiment, being conducted haphazardly as part of stock assessment research cruises in various bays around Newfoundland since 2011, is lowering snow crab (*Chionecetes opilio*) back down to the seafloor in small-meshed covered pots after initial capture for assessment of mortality upon subsequent re-haul. Overall, trial results have been consistent in showing about 30% of crabs of all shell conditions and maturity stages are rendered critically weak or are killed by the process. Various explanatory variables including location, time out of water, crab size, and re-deployment times, have had little effect on the results. A secondary experiment conducting reflex impairment tests on six physiological response indicators prior to re-deployment toward predicting imminent death has shown consistency in the predictive power of all responses which include leg flaring, retraction, and kicking ability, claw and mouth closure strength, and eye retraction ability. Although soft-shell crabs have been poorly represented in the study to date, for which mortality is expected to be very high, present results are suggesting that discard mortality is a concern for even the hardiest of crabs in the population and with declining recruitment into the exploitable biomass in many areas, a focus on minimizing discarding is warranted to maximize fishery yield from this resource.

5.5.5 Snow crab migration activity in the Barents Sea

It shows the first results of snow crab migration study in Barents Sea based on data from tagged crabs. In total over 3000 male crabs were tagged in the Barents Sea in the last two years and about 4% of the tags have been returned at the moment. The report presents the data on the main directions and average speed of crab's migration. This study suggests that main trend of snow crab migration in the NEAFC Regulatory & Convention Area in Barents Sea was in the western direction.

6 Revisions to the work plan and justifications

There were no revisions or justifications to the work plan

7 Next meeting

The group agreed to hold the next meeting on 31 October – 4 November 2016 in Aberdeen, Scotland. Carlos Mesquita from Marine Scotland Science, Aberdeen, Scotland kindly offered to host the meeting.

The Chair thanked the local host Martial Laurens at IFREMER in Brest, France for his excellent hospitality and generosity. The excursion in the surrounding country and the delicious dinner at cosy restaurant "Le crabe Marteau" were much appreciated during the 2015 meeting.

Annex 1: List of participants

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Annex 2: Recommendations

None

Annex 3: Updated tables – fishery and survey data

Table 1a: Stock summary for *Cancer pagurus* in England, Scotland, Ireland, France and Norway.

Cancer pagurus						
	Ireland	**Scotland**	**England**	**Jersey Channel Islands**	**France**	**Norway**
Number of stocks in which national fleet is active	4	12	6	1		1
Stock areas (cross reference to map)	Malin	Clyde	Central North Sea	Western Channel	Eastern Channel	Whole Norwegian coast, Swedish border to Troms
	Celtic sea	East Coast	Southern North Sea		Western Channel	
	Irish sea	Hebrides	Eastern Channel		Celtic Sea	
		Mallaig	Western Channel			
		North Coast	Celtic Sea			
		Orkney				
		Papa				
		Shetland				
		South East				
		South Minch				
		Sule				
		Ullapool				
Indicator			Irish Sea			
Landings	1990-2014	1974-2014	1983-2013	1996-2014	1985-2014	1914-2014
Effort	1990-2014		1983-2013	1996-2015	1985-2014	
LPUE	1990-2014		1983-2013	1996-2016	1985-2014	2001-2014
DPUE	1990-2014		No		No	2001-2014
Size frequency data	1990-2014	1974-2014	1983-2013 (for most assessement units)	2004-2014	2000-2014	2001-2014
Others						
Analytical assessment methods						No
LCA	No	Yes	Yes (length based VPA excluding Irish Sea)	No	No	No
Production	No	No		No	One test	No
Change in ratio	No	Yes		Yes		No
Depletion methods	No	No		No		No
Others			LPUE selected logbook vessels		Index LPUE from selected logbook vessels	No
Data sources						
Surveys			1989 (EC & WA), 1993 (NS) + Various non targeted		No	No
Larval	2002	No				
Juvenile index/biomass	Index	No				
Adult index/biomass	Biomass	No				
Non target surveys	Scallop dredge	Scallop dredge				
Commercial						
Observer/self reporting/reference fleet	Observer/ref fleet	Observer	Selected logbook vessels from 1985		Selected logbook vessels from 1985	reference fleet
Size frequency data	Yes	Yes	Yes	No	Yes	Yes
Logbooks	Yes	Yes (EU logbooks)	Yes	Yes	Yes	Yes
Tag returns	Yes	Yes	Yes	No	Yes	No
VMS	Yes	Yes (boats > 12m)	Yes (Commercial inconfidence)	No	Yes (Commercial inconfidence)	No
Electronic logbooks	No	No	No	No	From 2013	No
Others					National logbooks for vessels under 12 m	
Biological parameters						
M	0.2	0.1	0.1 and 0.2 assumed feasible scenarios	No	0.2	No
Growth data	k = 0.1-0.2	197 ; $Linf_m$=220; K_f=0.172 ; Lin	k=0.191 (female), 0.196 (male). Linf 240mm CW	No	0.1-0.2	No
Fecundity			a=0.0187 and b=0.0268, $f=ae^{bl}$	No		No
Size at maturity	125 - 140	130 - 150	Regional 89-105 (male), 110-126 (female)	No	130 for female, less for male	Females: L50 112 (mature), external roe: 130 mm or larger
Others		Terminal F=0.5				
Analytical assessment outputs						
Biomass	Yes	Yes	Yes	No	No	No
Spawning stock	No	No	Yes	No	No	No
Recruitment	No	No	No	No	No	No
Fishing mortality	Yes	Yes	Yes	No	No	No

Table 1b: Stock summary for *Chionoecetes opilio* in Canada, France, Greenland, Norway and Russia.

Chionoecetes opilio						
	Canada - Newfoundland	**Canada Southern Gulf**	**Greenland**	**Norway**	**Russia**	**France**
Number of stocks in which national fleet is active		4	6			
Stock areas (cross reference to map)	NAFO 2H, 2J, 3K, 3L, 3N, 3O, 3Ps, 4R	Eastern Canada, Southern Gulf of St., Lawrence	West coast	Barents Sea	Barents Sea	3PS
Indicator						
Landings	1979-2014	1979-2014	1996 - 2015	2013-	2013-2014	1996-2014
Effort	1979-2014	1979-2014	2003 - 2015	No	2013-2014	1996-2014
LPUE/CPUE	1979-2014	1985-2014	2000 - 2015	No	2013-2014	1996-2014
DPUE		Not estimated but possible to do				
Size frequency data	1979-2014	1989-2014	1997 - 2015	2004-	2004-2014	Yes, few data
Others	1979-2014	1989-2014	1997 - 2015		2004-2014	
Analytical assessment methods						
LCA	No	No	No			No
Production	Yes	No	No		Yes	No
Change in ratio	No	No	Yes			Yes
Depletion methods	Yes	Yes 1985-1989	No			No
Others	Stratified Random Biomass Estimatation	Yes 1989-2014 (Trawl survey)	Yes		Yes 2004-2014 (Trawl survey)	Yes
Data sources						
Surveys		Yes 1989-2014 (Trawl survey)	Yes 1997 - 2015		Yes 2004-2014	No
Larval	No	Sporadically	No	No	No	No
Juvenile index /biomass	Yes	Yes (Abudance estimates)	Index	No	Yes	Index
Adult index/biomass	Yes	Yes (abundance & Biomass estimates)	index	No	Yes	Index
Non target surveys	Yes	September groundfish trawl survey		No	Yes	
Commercial						
Observer/self reporting/reference fleet	Yes	At sea observer at the cxoverage of approximately 20% of total sea days	Fleet	No	Yes	Yes
Size frequency data	Yes	Yes	No	No	Yes	Yes, few data
Logbooks	Yes	Yes	Yes	No	No	Yes
Tag returns	Yes	Between 1985 and 2000	Yes	No	No	No
VMS	Yes	Yes	No	No	Yes	No
Electronic logbooks	No	No	No	No	Yes	No
Others	Dockside Monitored Landings					
Biological parameters						
M	Yes	0.47 (2013)	0.2	No	No	No
Growth data	Yes	Yes	Yes	No	Yes	No
Fecundity	Yes	Yes (until 2010)	Yes	No	Yes	No
Size at maturity	Yes		52 - 150 mm CW	No	Yes	No
Others	Environment (Temperature)					
Analytical assessment outputs						
Biomass	Yes	Yes	Yes		No	No
Spawning stock	No	Yes			No	No
Recruitment	Yes	Yes	Yes		No	No
Fishing mortality	Yes	Yes			No	No

Table 1c: Stock summary for *Paralithodes camtcshaticus* in Norway and Russia.

Paralithodes camtschaticus		
	Norway	**Russia**
Number of stocks in which national fleet is active		
Stock areas (cross reference to map)	ICES Aera 03	ICES Area Ib Russian coast of South-East of Barents Sea
Indicator		
Landings	1994-2015	1994-2014
Effort	1994-2015	1994-2014
LPUE		1994-2014
DPUE		
Size frequency data	Yes	Yes
Others		
Analytical assessment methods		
LCA		
Production	2011-2015	
Change in ratio		
Depletion methods		2010-2014
Others		CSA (2006-2013)
Data sources		
Surveys		
Larval		
Juvenile index/biomass		Yes
Adult index/biomass	Annual	Yes
Non target surveys		Yes
Commercial		
Observer/self reporting/reference fleet		Yes
Size frequency data		Yes
Logbooks	Yes	No
Tag returns		Yes
VMS	Yes	Yes
Electronic logbooks	No	Yes
Others		
Biological parameters		
M	0.2	0.08961
Growth data	Increment and moulting frequency	Yes
Fecundity	Yes	Yes
Size at maturity	Yes	Yes
Others		
Analytical assessment outputs		
Biomass	Yes	Yes
Spawning stock	Yes	No
Recruitment	Yes	Yes
Fishing mortality	Yes	Yes

Table 1d: Stock summary for *Maja brachdactyla* in England, Scotland, France, Ireland and Jersey Channel Islands.

Maja brachdactyla					
	England	**Scotland**	**France**	**Ireland**	**Jersey Channel Islands**
Number of stocks in which national fleet is active				2	1
Stock areas (cross reference to map)				SW Ireland	Western Channel
				Malin	
Indicator					
Landings	1983-2013	2006-2013	1973-2014	2004-2014	1996-2014
Effort	Targetted potting and netting effort not available	No	Targetted potting and netting effort not available	No	1996-2015
LPUE	No	No	No	No	1996-2016
DPUE	No	No	No	No	
Size frequency data	Yes. At least recent i.e. 2004-2013 maybe much longer series	No	Few data from some periods	Data from some target studies, 1985, 2000, 2003-2007 and 2009	2004-2014
Others	No	No		No	
Analytical assessment methods					
LCA	No	No	No	No	No
Production	No	No	No	No	No
Change in ratio	No	No	No	No	Yes
Depletion methods	No	No	No	No	No
Others	No	No	No	No	no
Data sources					
Surveys			Yes (1986-1996)	Yes (1985, 2003 & 2009)	
Larval	No	No		No	
Juvenile index /biomass	Possibly	No	No	No	
Adult index/biomass			Yes		yes 2004-214
Non target surveys					
Commercial					
Observer/self reporting/reference fleet	No	No	No	Data for some years; 2003 & 2009	No
Size frequency data	Yes	No	Few data from some periods	Data for some years; 2003 & 2009	No
Logbooks	No	No	Yes	Yes from reference fleet	Yes
Tag returns	No	No	No	No	No
VMS	No	No	Yes	Yes (2005 - 2007)	No
Electronic logbooks	No	No	For some vessels	No	No
Others	No	No		No	No
Biological parameters					
M			No	No	No
Growth data			No	No	No
Fecundity			No	No	No
Size at maturity			No	No	No
Others					No
Analytical assessment outputs					No
Biomass	No	No	No	No	No
Spawning stock	No	No	No	No	No
Recruitment	No	No	No	No	No
Fishing mortality	No	No	No	No	No

Table 1e: Stock summary for *Homarus gammarus* in Scotland, France, Ireland, Jersey Channel Islands and England.

Homarus					
	Scotland	**France**	**Ireland**	**Jersey Channel Islands**	**England**
Number of stocks in which national fleet is active	12		4	1	5
Stock areas (cross reference to map)	Clyde	Western Channe	Malin	Western Channel	Northumberland Durham
	East Coast	Bay of Biscay	SW Ireland		Yorkshire Humber
	Hebrides		SE Ireland		East Anglia
	Mallaig		N Irish Sea		Southeast and South coast
	North Coast				Southwest
	Orkney				
	Papa				
	Shetland				
	South East				
	South Minch				
	Sule				
	Ullapool				
Indicator					
Landings	1974-2014	Yes	1995-2014	1996-2014	1983-2013
Effort		Yes		1996-2015	1983-2013
LPUE		Yes	1995-2004	1996-2016	Yes
DPUE		No			No
Size frequency data	1974-2014	Yes	1995-2014	2004-2014	
Others					
Analytical assessment methods					
LCA	Yes	Yes	No	No	Yes (length based VPA)
Production	No	Yes	No	No	No
Change in ratio	Yes	No	No	Yes	No
Depletion methods	No	No	No	No	
Others				Index LPUE from selected logbook vessels	LPUE selected logbook vessels
Data sources					
Surveys		No			
Larval	No	No	No		No
Juvenile index /biomass	No	one test in 2015	No	Yes Index and CL (2 per year, very small - 180 pot lifts)	No
Adult index/biomass	No	No	No	Yes Index and CL (2 per year, very small - 180 pot lifts)	No
Non target surveys	No		No		No
Commercial					
Observer/self reporting/reference fleet	Observer	Yes	Yes	ref fleet	Selected logbook vessels from 1985
Size frequency data	Yes	Yes	Yes	no	
Logbooks	Yes (EU logbooks)	Yes	Yes (EU & some regional areas for some years)	yes	
Tag returns	No	Yes	Yes	no	
VMS	Yes (boats > 12m)	Few data	Yes (boats > 12m)	no	Yes
Electronic logbooks	No	No	No	no	No
Others				1 off volunteer survey of CL and berried proportions	
Biological parameters					
M	0.1	0.2	0.1-0.2	No	0.15
Growth data	K_m=0.11 ; $Linf_m$=173.4; K_f=0.13 ; $Linf_f$=150;	k arround 0,25	k=0.12; Linf=172	No	
Fecundity		Yes		No	
Size at maturity	~80 mm	L50, from 93 to 104	L50 95mm	No	
Others	Terminal F=0.5				
Analytical assessment outputs					
Biomass	Yes	Yes from few areas	No	No	Yes
Spawning stock	No	Yes from few areas	No	No	Yes
Recruitment	No	Yes from few areas	No	No	No
Fishing mortality	Yes	Yes from few areas	No	No	Yes

Table 2a: Management measures table for *Cancer pagurus* in England, Scotland, Ireland, Jersey Channel Islands, France and Norway.

Species: *Cancer pagurus*	Legislation and in particular local bylaws are continually reviewed. The following may not be current.													
	Central North Sea	Southern North Sea	Eastern Channel	Western Channel	Celtic Sea	Irish Sea	Norwegian coast	Scotland	Eastern Channel	Western Channel	Celtic Sea	Bay of Biscay	Ireland	Jersey, Channel Islands
Management measure	UK	UK	UK	UK	UK	UK	Norway	UK	FR	FR	FR			
Licensing	MSAR/EU	MSAR/EU	MSAR/EU	MSAR/EU	MSAR/EU	MSAR/EU	No	MSAR/EU	Yes	Yes	Yes	Yes	Yes	yes
Limited Entry	Yes for <10m	Yes for <10m	Yes for <10m	Yes for <10m	Yes for <10m	Yes for <10m	No	Yes for <10m	Yes	Yes	Yes	Yes	No	Yes 3-12nm (Granville Bay Treaty Area permit -capped Numbers)
Closed seasons	No	Generally No but regional ban on white footed crab Nov-June	No	No	No	No	No	No	No	No	No	No	No	No
Days at sea	No	No	No	No	?	No	No	No Under EU Regulations the annual fishing effort of UK vessels over 15 m participating in the brown crab fishery is restricted to 702,292 KW days in ICES areas V and VI and 543,366 KW days in ICES are VII.	No	No	No	No	ICES Area V, VI Vessels >15m, are limited to 465,000 kw.days ; ICEAS Area VII, Vessels >15m are limited to 40,960kw.days; ICES Area VII (Biologically Sensitive Area), Vessels >10m are limited to 63,198 kw.days	No
Closed areas	No	No	No	No	Lundy	No	No	Fishing with creels is prohibited in certain areas (Article 5 of The Inshore (Prohibition of Fishing Methods) (Scotland) Order 2004).	No	Yes	Lundy	Yes	No	No
Others														Closed area to parlour pots
Minimum size	130mm CW (140mm north of 56N)	115 and 130mm CW	130mm in Southern Bight and 140mm CW	Various/regional 140mm - 150mm(CRH) 140-160mm (CRC)	Various/regional 130mm - 150mm(CRH) 130-160mm (CRC)	Various/regional 130mm - 140mm(CRH) 130-140mm (CRC)	110mm CW Swedish border-59 30 N, 130mm CW northwards	130mm CW 140mm north of 56N 150mm in the Hebrides	140 mm CW	140 mm CW	140 mm CW	130 mm South of 48°	130mm Area VII, Area VI south of 56°N; 140mm Area VIIf, e, d (Channel), Area IV and VI north of 56°N	140mm
Maximum size	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Berried female legislation	Yes	Yes	Yes	Yes	Yes	Yes	No but release	Yes	No	No	No	No	No	
Soft crabs	Yes	Yes	Yes	Yes	Yes	Yes	No but release	Yes	Yes	Yes	Yes	Yes	No	Yes
Single sex fishery	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Claws or parts	Claws <1% by wt. or <75kg for other gears. No parts regional	Claws <1% by wt. or <75kg for other gears. No parts regional	Claws <1% by wt. or <75kg for other gears	Claws <1% by wt. or <75kg for other gears. No parts regional	Claws <1% by wt. or <75kg for other gears. No parts regional	Claws <1% by wt. or <75kg for other gears	Not sufficient information	Claws <1% by wt. or <75kg for other gears. No parts regional	Claws <1% by wt for potters or quotas by fisherman of others gears	Claws <1% by wt for potters or quotas by fisherman of others gears	Claws <1% by wt for potters or quotas by fisherman of others gears	Claws <1% by wt for potters or quotas by fisherman of others gears	Claws <1% of total catch weight	Claws <1% by wt. or <75kg for other gears
Use as bait	Regional	Regional	No	No	No	No		Regional	No	No	No	No	Yes	
Vessel size	Regional <12 and 16m inside 6nm	Regional <16 and 17m	Regional <14 and 17m	Regional <11, 15.24 and 16.46m	Regional <14, 15.2 and 16.46m and 21m	Regional <12, 13.7, 14, 15 and 21m	< 21.35 m inside 4nm	Regional	No	No	No	No	No	In certain zones or areas
Vessel power	No	No	No	No	No	No	No		No	No	No	No	No	In certain zones or areas
VMS	>15m	>15m	>15m	>15m	>15m	>15m	>15m	>12m	>12m	>12m	>12m	>12m	>12m	>12m
Log book returns	Yes	Yes	Yes	Yes	Yes	Yes	>15 m	Yes	Yes	Yes	Yes	Yes	EU logbooks	Yes
Others							logbooks from reference fleet		National log book for vessel under 12 m	National log book for vessel under 12 m	National log book for vessel under 12 m	National log book for vessel under 12 m	Fishing activity reports for some vessels as part of the Sentinel Vessel Programme	National logbook for under 10m vessels, EC Logbook for over 10m. E logs for over 12m
									National VMS system for some vessels under 12 m	National VMS system for some vessels under 12 m	National VMS system for some vessels under 12 m	National VMS system for some vessels under 12 m		
							No limits for commercial fishery, max 20 per recreational fisher	No						
Trap limits	Yes	No	Regional	No	No	No	No	No	Yes, Regional and National. Max 1200 traps per vessel and max 250 traps per fisherman.	Yes, Regional and National. Max 1200 traps per vessel and max 250 traps per fisherman.	Yes, Regional and National. Max 1200 traps per vessel and max 250 traps per fisherman.	Yes, Regional and National. Max 1200 traps per vessel and max 250 traps per fisherman.	No	Yes
Trap size	No	No	No	No	No	No	Yes, for lobster, regional	No	No	No	No	No	No	No
Entrance size							No	No	yes, minimum of 14 cm diameters	yes, minimum of 14 cm diameters	yes, minimum of 14 cm diameters	yes, minimum of 14 cm diameters	No	Yes
Escape vents	No	Regional and gear specific Yes	Regional and gear specific Yes	Regional and gear specific Yes	Regional and gear specific Yes	Regional	Yes	Regional	No	No	No	No	No	Yes
Biodegradable panels	No	No	No	No	No	No	no	No	No	No	No	No	No	no
Marked gear	Regional	Regional	Regional	Regional	Regional	Regional	yes	Regional	National Regional	National Regional	National Regional	National Regional	No	Yes

Table 2b: Management measures table for *Chionoecetes opilio* in Canada, France, Greenland, Norway and Russia.

***Species:* Chionoecetes opilio**						
	West coast of Greenland	Newfoundland	Sourthern Gulf	SouthNova Scotia	Barent Sea	Barents Sea
Management measure	Greenland	Canada	Canada	France, Saint Pierre et Miquelon	Norway	Russia
Licensing	Yes	Yes	Yes	No	Yes	No
Limited Entry	Yes for < 75 Brt	Yes (no new licences available)	Yes	Yes	No	No
Closed seasons	No	Yes	Yes	Yes	No	No
Days at sea	No	No	No	Yes	No	No
Closed areas	Yes	Yes	Yes		No	No
Others		Dockside Monitored Landings, Soft-shell protocols, Trip Limits	Soft crab control			
				95 mm CW		
Minimum size	100 mm CW	95mm CW	95mm CW	No	No	No
Maximum size	No	No	No	Yes - prohibation to land females	No	No
Berried female legislation	Yes - prohibation to land females	Yes - prohibation to land females	Yes - prohibation to land females	Yes	No	No
Soft crabs	Yes	Yes	Yes - prohibation to land soft crab	Yes		
Single sex fishery	Yes	Yes	Yes	no	Yes	Yes
Claws or parts	no	no	No	No	No	No
Use as bait	Squid	Squid / Herring	Mackerel, Herring, Squid	Squid	No	Herring
Vessel size	Regional <10m	Various fleet sectors (<40', 40-64'11", 65-89'11")	65 fts or less	No		49.6-54.8 m
Vessel power	No	No	No	No		700-1700 hps
VMS		Yes	Yes	No	Yes	Yes
Log book returns	Yes	Yes	Yes	Yes	Yes	No
Others		Observer Coverage	100% dock side landing monitoring & at-sea observer coverage at approximately 20%			
				Yes		
Trap limits	No	Yes	Yes (the number varies depending on the area from 50 to 150/ licence), Area 19 has total trap number at 1699	No	No	No
Trap size	Yes (meshsize 1400mm)	Yes (135mm)	Yes (volume should not exceed 2 cubic meter) and maximum and minimum mesh sizes at 65 and 75 mm	Yes	No	No
Escape vents	No	No	No but see below	No	No	No
Biodegradable panels	No	Yes	Biodegradable twine	No	No	
Marked gear	Regional / overseas trade	Yes	Yes			

Table 2c: Management measures table for *Paralithodes camtschaticus* in Norway and Russia.

Species: *Paralithodes camtschaticus*		
	Barents Sea	Barents Sea
Management measure	Norway	Russia
Licensing	Yes	Yes
Limited Entry	Yes	Yes
Closed seasons	No	Yes
Days at sea	No	No
Closed areas	No	Yes
Others		
Minimum size	130mm CL	150mm
Maximum size	No	No
Berried female legislation	No	Yes - prohibation to land females
Soft crabs		
Single sex fishery	No	Yes, only males
Claws or parts	No	Sections by different weight
Use as bait	Herring	Herring
Vessel size	6-22 m	49.6-54.8 m
Vessel power		700-1700 hps
VMS	Yes	Yes
Log book returns	Yes	No
Others		
Trap limits	Yes	Yes
Trap size	Yes	Yes
Escape vents	Yes	No
Biodegradable panels	No	Yes
Marked gear	Yes	No

Table 2d: Management measures table for *Maja bracdactyla* in UK and France.

Species: Maja Bracdactyla		
Management measure	UK	France
	All	
Management measure	E&W	
Licensing	Yes	Yes
Limited Entry	<10m	Yes
Closed seasons	No	(September to 15 October)
Days at sea	>15m in Celtic Sea	No
Closed areas	No	Yes
Others		
Minimum size	120mm CL females; 130mm for males	120 mm CL, male and female
Maximum size	No	No
Berried female legislatior	No	No
Soft crabs	No	No
Single sex fishery	No	No
Others		
Vessel size	Regional	No
Vessel power	No	No
VMS	>15m	>12m
Log book returns	Yes	Yes
Others		National log book for vessel under 12 m
Trap limits	Regional	Yes
Trap size	No	No
Escape vents	Regional and gear specific	No
Biodegradable panels	No	No
Others	No	yes, minimum of 14 cm diameters
Marked gear	Regional	Yes for pots
Gillnet limits		Yes
Gillnet mesh		Yes

Table 2e: Management measures table for *Homarus gammarus* in England, Scotland, Ireland, Jersey Channel Islands and France.

Species: Lobster						
Management measure	Scotland	France	Norway	Ireland	Jersey, Channel Islands	England
Licensing	MSAR/EU	Yes	Yes?	Yes	Yes	Yes
Limited Entry	Yes for <10m	Yes	Yes?	No	Yes 3-12nm (Granville Bay Treaty Area permit -capped Numbers) No for 0-3nm limit of territorial waters	Yes
Closed seasons	No	No	Yes?	No	No	No
Days at sea	No	No	?	No	No	No
Closed areas	Fishing with creels is prohibited in certain areas (Article 5 of The Inshore (Prohibition of Fishing Methods) (Scotland) Order 2004).	Yes	Yes?	No	No	MCZ restrictions (regional)
Others					Closed area to parlour pots	
Minimum size	87mm CL (all areas except Shetland and Hebrides) 90mm CL (Shetland) 90mm CL (Hebrides)	87 mm CL, male and female	250mm	87mm CL for both sexes	87mm	87mm CL national, 90mm within 6 miles of coast (Devon, Cornwall, Isles of Scilly)
Maximum size	Yes - for famales only 155mm CL 145mm CL (Hebrides)	No	No?	127mm CL (since Jan 2015)	No	No
Berried female legislation	No	No	Yes	No	Yes but not in effect - has to be brough in by Ministerial Order	Yes (regional)
Soft crabs	No	No	?	No	Yes	Yes
Single sex fishery	No	No	Yes	No	No	No
Claws or parts	It is illegal to land 'V'-notched lobsters, or animals that have been mutilated in any way. Lobsters can only be retained on board or landed whole.	No	?	It is illegal to land 'V-notched' or mutilated lobster. Lobsters can only be retained on board or landed whole.	Must be retained whole	Limits on percentage/ quanitity caught (regional)
Use as bait	No	No	?	No	Not Lobster	
Vessel size	No	No	?	No	In certain zones or areas	Yes (regional)
Vessel power	No	No		No	In certain zones or areas	
VMS	>12m	>12m		>12m	>12m	>12m
Log book returns	Yes	Yes	No?	No	Yes	Yes
Others		National log book for vessel under 12 m		Sentinel Vessel Programme data	National logbook for under 10m vessels, EC Logbook for over 10m. E logs for over 12m	
Trap limits	No	Yes	Yes	No	Yes	Yes (regional)
Trap size	No	No		No	No	No
Escape vents	No	No		No	Yes	Yes (regional)
Biodegradable panels	No	No		No	No	No
Marked gear	Regional	Yes for pots		No	Yes	Yes (regional)
Entrance size		yes, minimum of 14 cm diameters		No	Yes- parlours	No
Parlour pot		Regional Legislation			Prohibited in some areas	No

Table 3a. Landings (tones) of *Cancer pagurus* in England, Scotland, France, Norway, Ireland and Jersey (UK).

Species: *Cancer pagurus*						
Total catch tons						
Site	England	Scotland	France	Norway	Ireland	Jersey, Channel Islands
Year						
1990		4,282	6,076	1,374		
1991		5,485	5,310	1,462		
1992		4,648	5,583	1,316		
1993		3,820	5,896	1,641		
1994		4,759	6,086	1,781		
1995		6,092	6,823	1,806		
1996		5,528	6,527	1,889		495
1997		7,470	7,000	2,205		523
1998		8,021	6,490	2,984		521
1999		7,437	6,087	2,836		473
2000	12,363	9,650	5,182	2,890		440
2001	13,013	8,458	5,513	3,478		447
2002	11,973	7,874	5,963	4,344		524
2003	13,349	7,525	6,327	4,944		540
2004	10,825	6,761	7,813	5,248	11,662	541
2005	8,484	8,332	6,259	5,671	7,911	438
2006	11,043	10,430	5,423	6,205	8,779	349
2007	12,074	11,919	6,178	8,514	6,486	412
2008	11,697	9,336	6,416	5,295	6,737	481
2009	11,001	9,466	4,353	4,970	10,934	361
2010	11,902	10,857	5,487	5,774	11,394	409
2011	12,089	11,859	5,690	5,319	6,964	434
2012	13,844	10,892	5,990	4,981	6,195	474
2013	13,804	10,891	5,570	5,242	5,755	358
2014	16,330	12,306	5901	4,629	7,257	

Table 3b. Landings (tones) of *Chionoecetes opilio* in Canada, Greenland, Norway and Russia.

Species: *Chionoecetes opilio*		Chionoecetes opilio			
Total catch tons					
Site	Canada	Greenland	Norway	Russia	France
Year					
1990	26,233				
1991	35,295				
1992	37,232				
1993	47,819				
1994	60,662				
1995	65,505	997			
1996	65,505	563			189
1997	71,388	3,214			368
1998	75,236	2,094			354
1999	95,381	4,982			589
2000	93,411	10,521			550
2001	95,241	15,139			485
2002	106,547	11,174			139
2003	96,360	7,179			83
2004	102,776	6,295			159
2005	95,996	4,213			157
2006	89,271	3,305			191
2007	90,280	2,189			166
2008	93,166	2,354			123
2009	96,635	3,191			169
2010	83,393	2,363			236
2011	83,979	2,015			242
2012	92,760	1,983			325
2013	98,089	2,162	189	62	251
2014	95,532	2,157	1,850	3,100*	100
2015			2,770		
*provisional					

Table 3c. Landings (tones) of *Paralithodes camtschaticus* in Norway and Russia.

Species: Paralithodes camtschaticus			
Total catch tons			
Site	Norway	Russia	
Year			
1990			
1991			
1992			
1993			
1994	11,000	22	
1995	11,000	9	
1996	15,000	24	
1997	15,000	63	
1998	25,000	90	
1999	37,500	143	
2000	37,500	113	
2001	100,000	300	
2002	100,000	900	
2003	200,000	1,950	
2004	280,000	1,105	
2005	280,000	3,021	
2006	300,000	9,389	
2007	300,000	9,953	
2008	596,000	8,823	
2009	1,185	6,142	
2010	900	3,787	
2011	1,200	3,698	
2012	1,000	5,209	
2013	1,000	5,531	
2014	1,100	6,000*	
2015	1,300		
*provisional			
Norway: 1994-2008: Number of individuals			

Table 3c. Landings (tones) of *Maja brachdactyla* in France, Ireland, Scotland and Jersey (UK).

Species: *Maja Brachdactyla*				
Total catch tons				
Site	France	Ireland	Scotland	Jersey, Channel Islands
Year				
1990				
1991				
1992				
1993				
1994				
1995				
1996				383
1997				162
1998				160
1999				175
2000				172
2001				236
2002	3,618			270
2003	3,692			233
2004	3,876	180		223
2005	3,744	141		163
2006	4,287	153	0.7	129
2007	4,297	70	0.1	106
2008	4,074	153	3.1	179
2009	2,547	443	6.0	177
2010	3,351	415	3.1	173
2011	3,925	290	1.2	144
2012	3,451	818	1.7	108
2013	3,321	229	0.2	77
2014	4,552	113		

Table 3d. Landings (tones) of Homarus gammarus in England, Scotland, Ireland, France and Jersey (UK).

Species: Lobster					
Total catch tons					
Site	England	Scotland	Ireland	France	Jersey, Channel Islands
Year					
1990		769			
1991		687			
1992		513			
1993		369			
1994		457			
1995		565			
1996		453			164
1997		653			166
1998		638			157
1999		509			153
2000	786	411			128
2001	776	289			130
2002	832	341		294	157
2003	1,008	353		348	167
2004	921	404	853	339	167
2005	910	409	635	324	139
2006	1,587	711	625	388	131
2007	1,700	890	308	475	155
2008	1,695	915	498	444	163
2009	1,640	953	431	329	177
2010	1,531	1,100	477	863	225
2011	1,845	1,219	735	802	257
2012	1,888	1,132	249	535	237
2013	1,821	1,026	374	465	198
2014	2,020	1,208	585	654	

Table 4. Annual Lobster landings (tonnes) into Scotland by creel fishery assessment unit from 2005–2014. Data from Fisheries Management database.

Assessment unit	Year									
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Clyde	6.3	18.5	16.8	22.2	17.4	24.8	26.3	24.7	23.5	46.2
East Coast	29.4	86.7	129.8	147.5	163.9	207.3	279.3	265.5	214.9	226.1
Hebrides	96.4	168.3	203.5	161.3	142.5	155.8	141.7	139.0	97.3	148.6
Mallaig	1.5	0.9	1.1	3.5	0.4	0.9	1.2	12.7	0.6	1.0
North Coast	5.6	15.5	14.3	15.0	12.0	14.3	15.4	10.0	10.0	10.7
Orkney	124.1	121.6	132.7	138.6	160.3	170.8	177.8	155.5	117.4	163.6
Papa	8.1	7.4	8.4	7.0	10.4	10.3	6.4	5.7	5.7	7.8
Shetland	2.3	9.3	14.1	19.8	25.7	29.8	29.2	36.8	35.9	39.7
South East	60.3	136.2	180.5	204.3	257.3	277.8	374.6	334.4	387.8	409.2
South Minch	48.4	94.6	101.7	111.4	99.8	112.0	89.9	84.7	75.2	101.3
Sule	4.9	5.3	4.8	4.8	4.0	3.4	3.6	2.1	0.6	0.7
Ullapool	9.6	20.0	24.5	13.9	12.3	18.7	10.8	11.6	15.1	16.7
Outside Assess. Units	12.2	26.9	57.9	65.8	46.8	74.4	62.9	49.7	41.8	36.3
Total	**409.2**	**711.1**	**890.2**	**915.0**	**953.0**	**1100.3**	**1219.1**	**1132.5**	**1025.9**	**1207.8**

Table 5. Lobster stock status, relationship between F and F_{MSY} proxy for 2002–2005, 2006–2008 and 2009–2012.

		F (Fishing Mortality)			
		2002-2005	2006-2008	2009-2012	
Clyde	Males	?	✗	✗	Above
	Females	?	✗	✗	Above
Hebrides	Males	✗	✗	✗	Above
	Females	✓	✓	✓	Below
North Coast	Males	?	?	?	Unknown
	Females	?	?	?	Unknown
Papa	Males	?	?	✗	Above
	Females	?	?	✓	Below F_{MSY}
Shetland	Males	✗	✗	✓	Below
	Females	✗	✗	✗	Above
Sule	Males	?	?	?	Unknown
	Females	?	?	?	Unknown

		F (Fishing Mortality)			
		2002-2005	2006-2008	2009-2012	
East Coast	Males	?	✗	✗	Above
	Females	?	✗	✗	Above
Mallaig	Males	?	?	?	Unknown
	Females	?	?	?	Unknown
Orkney	Males	✗	✗	✗	Above
	Females	✓	✓	o	At F_{MSY}
South East	Males	✗	✓	✗	Above
	Females	✗	✗	✗	Above
South Minch	Males	✗	?	✗	Above
	Females	✓	?	✗	Above
Ullapool	Males	?	✗	?	Unknown
	Females	?	✓	?	Unknown

Table 6. Annual Brown crab landings (tonnes) into Scotland by creel fishery assessment unit from 2005–2014. Data from Fisheries Management database.

Assessment unit	Year									
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Clyde	39.6	198.2	250.3	213.7	99.4	139.3	137	182.8	159.3	189.6
East Coast	405.9	830.4	884.2	866.9	778.6	1029.0	1091.3	1213.9	1271.3	1305.9
Hebrides	1730.0	2279.4	2340.0	1738.4	1822.3	1885.8	2433.3	1996.5	2130.2	2667.2
Mallaig	5.2	7.7	67.0	32.4	8.5	12.9	21.3	69.6	6.7	17.5
North Coast	488.1	435.8	513.8	348.7	568.3	681.9	428.7	514.2	571.2	537.8
Orkney	1582.2	1467.9	1555.4	1187.3	1155.6	1462.1	1746.6	1693.7	1906.2	1958.8
Papa	454.1	838.2	798.0	764.1	1002.0	878.2	884.2	828.2	936.3	1239.4
Shetland	193.8	640.8	522.4	566.9	390.2	334.4	419	478.4	604.9	666.1
South East	166.0	273.8	281.8	325.5	308.0	345.7	356.7	447.1	469.9	396.2
South Minch	1389.1	1316.2	2149.6	1141.0	1000.7	1651.3	1632.4	1094.4	869.8	1191.6
Sule	1357.9	1663.1	2026.1	1836.2	1981.8	1928.9	2275.5	1611.2	1491.6	1703.6
Ullapool	271.7	358.1	376.0	241.9	192.1	245.4	244.9	687.2	439.0	400.9
Outside Assess. Units	249.0	120.5	154.1	73.1	158.7	261.9	188.2	74.7	34.3	31.5
Total	**8332.5**	**10430.3**	**11918.7**	**9336.1**	**9466.1**	**10856.7**	**11859.1**	**10891.9**	**10890.6**	**12306.0**

Table 7. Brown crab stock status, relationship between F and F_{MSY} proxy for 2002–2005, 2006–2008 and 2009–2012.

		F (Fishing Mortality)			
		2002-2005	2006-2008	2009-2012	
Clyde	Males	?	✗	?	Unknown
	Females	?	✗	?	Unknown
Hebrides	Males	✗	✗	✓	Below
	Females	✗	✗	✗	Above
North Coast	Males	✗	✗	✓	Below F_{MSY}
	Females	o	✗	✓	Below F_{MSY}
Papa	Males	✓	?	✓	Below F_{MSY}
	Females	✓	?	✓	Below F_{MSY}
Shetland	Males	✓	✗	o	At F_{MSY}
	Females	✓	✓	✓	Below
Sule	Males	✗	✗	o	At F_{MSY}
	Females	✗	o	✗	Above

		F (Fishing Mortality)			
		2002-2005	2006-2008	2009-2012	
East Coast	Males	✗	✗	✗	Above
	Females	o	✗	✗	Above
Mallaig	Males	?	?	?	Unknown
	Females	?	?	?	Unknown
Orkney	Males	✗	✗	✗	Above
	Females	o	✗	✗	Above
South East	Males	✗	✗	✗	Above
	Females	✗	✗	✗	Above
South Minch	Males	✗	✗	✗	Above
	Females	✗	✗	✗	Above
Ullapool	Males	?	?	?	Unknown
	Females	?	?	?	Unknown

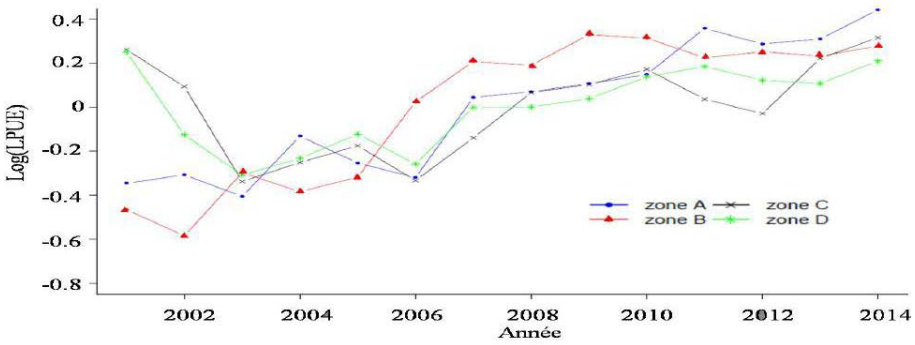

Figure 1. Abundance index in four fishing areas in North Brittany.

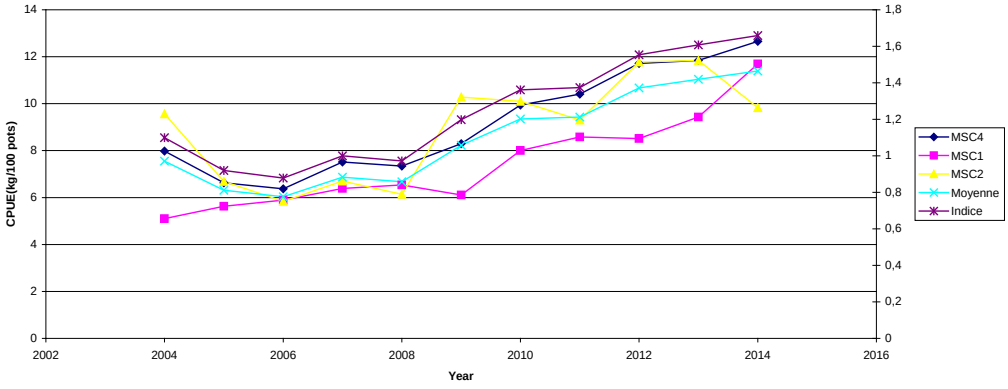

Figure 2. Abundance index in three fishing areas in Normandy.

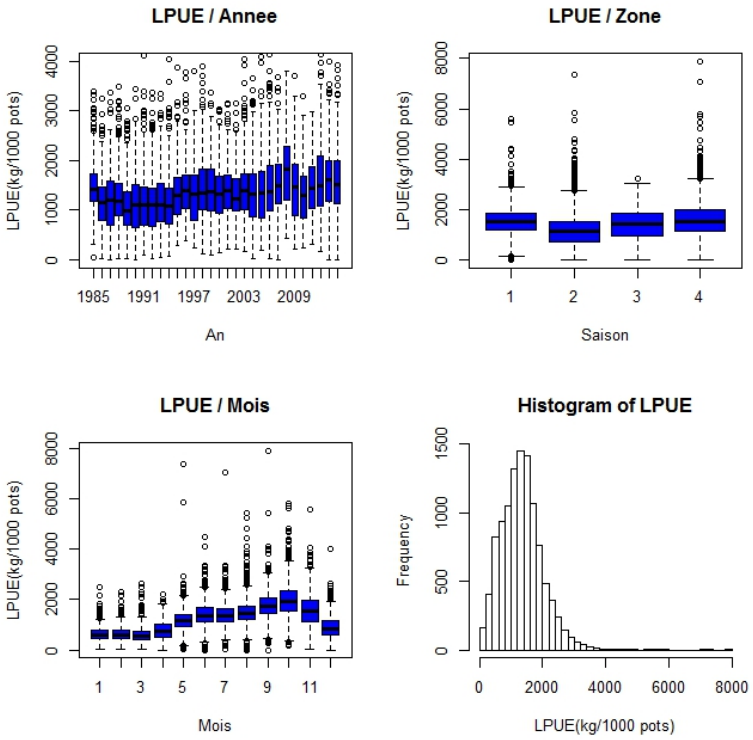

Figure 3. Trend of the CPUE by year, month or area for the existing times series since 1985.

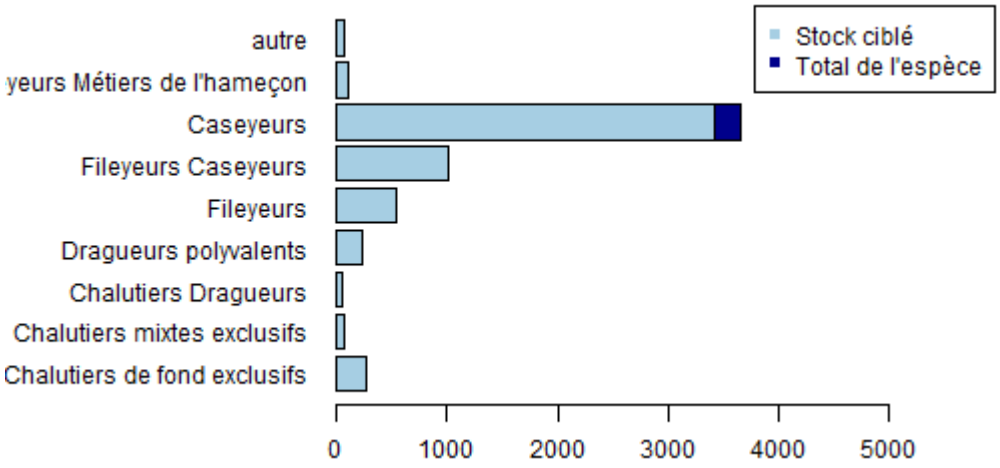

Figure 4. Distribution of the landing (Tons) by fleet.