ICES WGCRAB REPORT 2013

SCICOM Steering Group on Ecosystem Functions

ICES CM 2013/SSGEF:10

Ref. SCICOM

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

27–31 May 2013

Dublin, Ireland

ICES International Council for the Exploration of the Sea
CIEM Conseil International pour l'Exploration de la Mer

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

H. C. Andersens Boulevard 44–46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

Recommended format for purposes of citation:

ICES. 2013. Report of the Working Group on the Biology and Life History of Crabs (WGCRAB), 27–31 May 2013, Dublin, Ireland. ICES CM 2013/SSGEF:10. 83 pp.
https://doi.org/10.17895/ices.pub.8835

Contents

Executive summary

The Working Group on the Biology and Life History of Crabs met in Dublin, Ireland, 27–31 May 2013 with Jan H. Sundet as chair. The meeting was attended by 11 participants from 8 countries; Russia, Canada, Greenland, France, Ireland, Wales, Norway and UK. Apologies were received from members from Shetland, Scotland and Sweden, and these will contribute to the report by correspondence.

The objectives of the meeting were to update and provide data and knowledge on landings, fisheries and biology of the important crab stocks in the ICES area. In addition, important objectives were to discuss important crab 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), continuing with a presentation of a planned PhD on the brown crab in Wales. Updates on landings and stock assessments on Brown crab in UK, France and Norway; Snow crab in Canada, Greenland and Russia (Barents Sea); Spider crab in France and Red King crab in Russia and Norway were presented. A PhD project on the edible crab in South Devon was presented, in addition to a presentation on artificial production of red king crabs for stock enhancement in Russia. There was no presentation on ToR d: "Impact on ecosystem and distribution of introduced crab species", and the WG agreed to omit this ToR. The WG discussed and agreed to propose a new Terms of reference including lobster as a species in the WG. The brown crab (*Cancer pagurus*) and the European lobster (*Homarus gammarus*) are both highly valuable shellfish in the North Eastern Atlantic, but at present, whilst ICES WGCRAB provides a useful forum for brown crab scientists, there is no 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 recommends that lobster is included on the agenda for the next ICES WGCRAB meeting with additional time allocated to the meeting if required.

The Group also agreed to combine the existing ToR b) and c) into a new ToR b): "Evaluate assessments of crab and lobster (*Homarus*) stocks including use of indicators, empirical assessments, analytical assessments in relation to data sources and data quality, development and suitability of reference points for management."

The WG agreed also to highlight effects of climate changes and ocean acidification on crab stocks in future, and assessment methods (including models) as subjects for the ToRs, in 2013.

2013 is the last year of the sitting chair's 3-year period, and the WG agreed to propose AnnDorte Burmeister, Greenland Nature Institute, as new chairperson for WGCRAB during 2014–2016.

1 Introduction

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 biology which is important since specialists working with the assessment on crabs are mostly single scientists in this field at the different national institutions. Despite a limited number of attendants on the recent meetings, all members of the Group are enthusiastic to continue the work within the Group through annual meetings.

2 Adoption of the agenda

The suggested agenda (see Annex 2) was adopted and rapporteurs appointed at the beginning of the meeting.

3 Terms of Reference 2012

The **Working Group on the Biology and Life History of Crabs** (WGCRAB), chaired by Jan H. Sundet, Norway, will meet in Dublin, Ireland, 27–31 May 2013 to:

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 fisheries in the ICES area;

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) Review knowledge on stock parameters as indicators in assessment of crab stocks without fishery independent data, and other biological information for crabs that are required for providing standardised indices and for analytical assessments;

d) Review the potential impact of introduced crab species and changes in the distribution of crab species in relation to climate change;

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

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

4 Progress in relation to the Terms of Reference

ToR a: Data on landings, discards, effort and catch rates (CPUE) was provided for important crab fisheries in the ICES area, and tables updated.

ToR b: Application of biological reference points in the assessment and management of crab stocks were discussed and agreed to be an important issue in the coming meetings.

ToR c: There was a presentation on a new fishing sheet in Ireland that integrates information of both fishing effort in the brown crab fishery as well as data on vessel economy and biological data on crab. A planned project on collecting biological data on brown crab during commercial fishery using video recordings, in South Devon waters, was presented. In addition, a data gathering project from brown crab fishery in Wales and the Isle of Man was presented.

ToR d: There were no presentations or discussions regarding ToR d. Therefore, the WG decided to suggest omitting ToR d from the Terms of Reference for the WG.

ToR e: There were two presentations on the effect of sea water temperature on the snow crab in eastern Canada and on Greenland. The main conclusion was that the snow crab food intake at high temperatures may cause local food limitations.

ToR f: There was a presentation and a following discussion on life history parameters of the red king crab in Norwegian waters. A study on artificial production of red king crab larvae for stock enhancement was also presented. The UK project PIECrust aiming to study regional growth rates and recruitment indices of brown crab, was presented, in addition to a research project on the sustainability of the edible crab fishery in South Devon.

The Working Group decided to suggest to include lobster in the WG and suggest to change ToR b) and c) (see Annex 3).

4.1 Introduction

In this report there are only progresses related to the Terms of Reference established during the recent year and not reported earlier. A series of summary spreadsheets, graphics and texts in which data are presented as a standard (see Report of the Working Group on the Biology and Life History of Crabs 2010), is and will be presented as routine information in the annual reports. Due to limited time at the WG meeting only the main commercially exploited crab species such as *Cancer pagurus*, snow crab (*Chionoecetes opilio*), red king crab (*Paralithodes camtschaticus*) and spider crab (*Maja brachydactyla*) 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 *Cancer pagurus*

Assessment units

Earlier agreements on several assessment units covering the fishing activities for the *Cancer pagurus* in northern Europe (Figure 5.1), are presented. In general, these units reflect how fishery data and assessment have been presented in previous WG reports. There are, however, still some unsettled boundaries between units where fishery from several countries takes place.

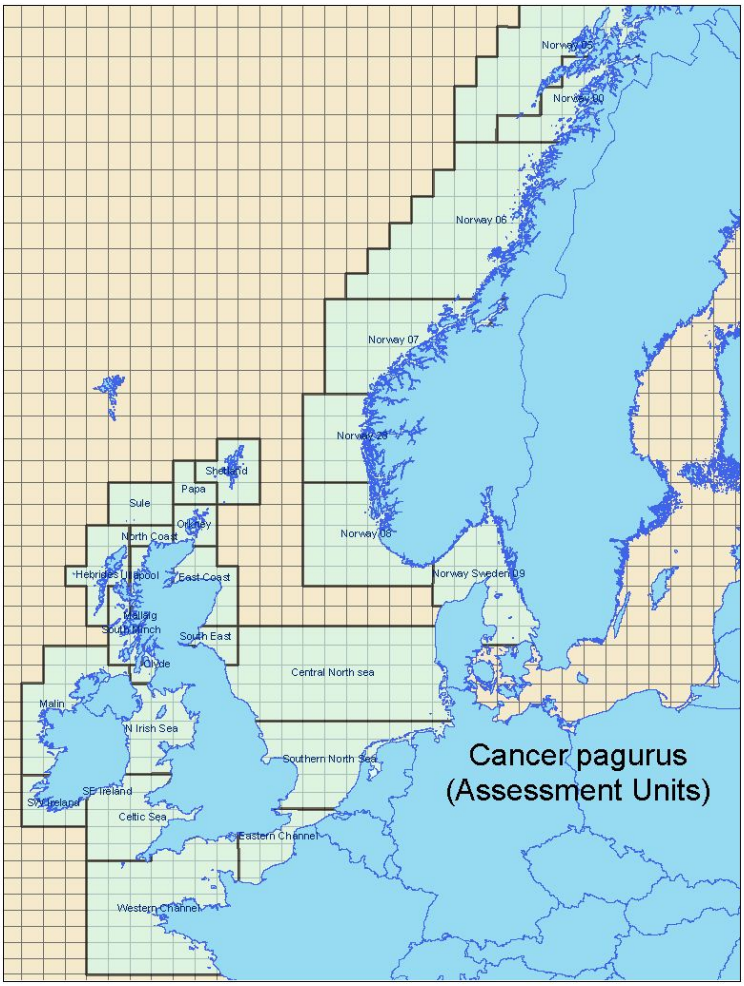

Figure 5.1. Assessment units for *Cancer pagurus* fished by vessels from UK, Ireland, France, Channel Islands, Norway and Sweden.

Data sources, assessment methods and management

Regarding *Cancer pagurus*, most basic data for assessment originate from landing statistics and logbooks in the fishery. Some countries or regions use observers onboard commercial fishing vessels and landings time series are used as indicators in the assessment in some countries. Except for a few time limited studies (tag-recapture studies and larval studies) there are no known fishery independent data available for the stock assessment in any of the Cancer stocks studied.

Summary of assessments for edible crab (*Cancer pagurus*)

Summaries of the status and assessments of the various Cancer stocks were provided by England and Wales, Ireland, Scotland and Norwegian scientists (see table 5 A and B). These assessments summaries will be updated annually, although not all countries provides updated stock parameters each year. Table contents will therefore not necessary be different from one year to another.

Table 5 A. Stock summary for *Cancer pagurus* in England, Isle of Man (data from 2012), Scotland and Norway.

Cancer pagurus

	Ireland	Scotland	England	Norway
Number of stocks in which national fleet is active	4	12	6	1
Stock areas (cross reference to map)	Malin	Clyde, East Coast, Hebridies	Central North Sea	Whole Norwegian coast, Swedish border to Troms
	Celtic sea	Mallaig,North Coast, Orkney	Southern North Sea	
	Irish sea	Papa, Shet-land,South East	Eastern Chan-nel	
		South Minch,Sule Ullapool	Western Channel	
			Celtic Sea	
			Irish Sea	
Indicator				
Landings	1990–2010	1974–2012	1983–2012	1914–2012
Effort	1990–2010		1983–2012	
LPUE	1990–2010		1985–2012	2001–2012
DPUE	1990–2010		No	2001–2012
Size frequency data	1990–2010	1974–2012	1983–2012 (for most as-sessement units)	2001–2012
Others				
Analytical assessment methods				
LCA	No	Yes	Yes (Length based VPA, excl. Irish sea)	No
Production		No		No
Change in ratio		No		No
Depletion methods		No		No
Others			LPUE select-ed logbook vessels	No

Data sources				
Surveys			1989 (EC & WA), 1993 (NS) + Various non targeted	No
Larval	2002	No		
Juvenile index /biomass	Index	No		
Adult index/biomass	Biomass	No		
Non target surveys	Scallop dredge	Scallop dredge (Data are currently being organised in a database)		
Commercial				
Observer/self reporting/reference fleet	Observer/ref fleet	Observer	Selected logbook vessels from 1985	Observer/ref fleet
Size frequency data	Yes	Yes	Yes	Yes
Logbooks	Yes	Yes (EU logbooks)	Yes	Yes
Tag returns	Yes	Yes	Yes	No
VMS	Yes	Yes(Commercial inconfidence)	Yes (Commercial inconfidence)	No
Electronic logbooks	No	No	No	No
Others				
Biological parameters				
M	0,2	0,1	0.1 and 0.2 assumed feasible scenarios	No
Growth data	k = 0.1–0.2	K_m=0.197 ; $Linf_m$=220; K_f=0.172 ; $Linf_f$=220;	k=0.196 (female), 0.191 (male). Linf 240mm CW	No
Fecundity			A=0.0187 and b=0.0268, $f=ae^{bl}$	No
Size at maturity	125 - 140	130–150	Regional 89–105 (male), 110–126 (female)	Females: L50 112 (mature), external roe: 130 mm or larger
Others		Terminal F=0.5		
Analytical assessment outputs				

Biomass	Yes	Yes	Yes	No
Spawning stock	No	No	Yes	No
Recruitment	No	No	No	No
Fishing mortality	Yes	Yes	Yes	No
Yield per recruit		Yes	Yes	No

Table 5 B. Management measures table for *Cancer pagurus* in England, Wales, Ireland, Scotland and Norway.

Species	***Cancer pagurus***				Legislation and in particular local by laws are continually reviewed. The following may not be current.						
	Central North Sea	Southern North Sea	Eastern Channel	Western Channel	Celtic Sea	Irish Sea	Celtic Sea	Western Channel	Eastern Channel	Scotland	Norwegian coast
Management measure	UK	UK	UK	UK	UK	UK	France	France	France	UK	Norway
Licensing	MSAR/EU	MSAR/EU	MSAR/EU	MSAR/EU	MSAR/EU	MSAR/EU	yes	Yes	no	Yes	no
Limited Entry	Yes for <10m	Yes for <10m	Yes for <10m	Yes for <10m	Yes for <10m	Yes for <10m	no	Yes	no	Yes	no
Closed seasons	No	Generally No but regional ban on white footed crab Nov-June	No	No	No	No	no	no	no	No	no
Days at sea	No	No	No	No	?	No	no	no	no	No	no
Closed areas	No	No	No	No	Lundy	No	no	yes (very limited surface)	no	No	no
Others								no activity during high tide			no
Minimum size	130mm CW (140mm north of 56N)	115 and 130mm CW	130mm in Southern Bight and 140mm CW	Vari-ous/regional 140mm - 150mm(CRH) 140–160mm (CRC)	Vari-ous/regional 130mm - 150mm(CRH) 130–160mm (CRC)	Vari-ous/regional 130mm - 140mm(CRH) 130–140mm (CRC)	140	140 and 130 under the 48° of latitude	140	130/140 mm (140 mm to the north of 56º N and 130 mm CW to the south of 56º N (except for the Firth of Forth))	110 swedish border-59 30 N, 130 mm northwards
Maximum size	No	No	No	No	No	No	no	no	no	No	no
Berried female legisla-tion	Yes	Yes	Yes	Yes	Yes	Yes	no	no	no	Yes	No but release
Soft crabs	Yes	Yes	Yes	Yes	Yes	Yes	no but release	no but release	no but release	Yes	No but release

Single sex fishery	No	No	No	No	No	No	no	no	no	No	no but release
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		increase of the claw fishery	mainly a claw fishery by the Boulogne-sur-Mer netters		Not sufficient information
Use as bait	Regional	Regional	No	No	No	No					regional
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	>18m	from 7 to 25 for potters and others métiers (netters and trawlers in some areas catch a lot crabs)	only 2 offshore potters (22 meters) during 2 months and 10–15 meters coastal potters and some netters as bycatch	No	< 21.35 m inside 4nm
Vessel power	No	No	No	No	No	No				No	no
VMS	>15m	>15m	>15m	>15m	>15m	>15m	yes	one part (25%)	one part (25%)	Yes	>15 m
Log book returns	Yes	Yes	Yes	Yes	Yes	Yes	yes	yes	yes	Yes	>15m
Others								for little boat (national fishing sheet)	for little boat (national fishing sheet) and few information from the netter by-catches	No	Logbooks from payed fishermen
Trap limits	Yes	No	Regional	No	No	No	yes (1200)	yes (200 by fisherman and a maximum of 1200 by boat)	yes (200 by fisherman and a maximum of 1200 by boat)	No	No limits for commercial fishery, max 20 per recreational fisher
Trap size	No	No	No	No	No	No	yes	yes	yes	No	no
Escape vents	No	Regional and gear specific Yes	Regional and gear specific Yes	Regional and gear specific Yes	Regional and gear specific Yes	Regional	no	on few pots	no	No	Yes for lobster, regional differences

Biodegradable panels	No	No	No	No	No	No	no (very few lost)	no	no	No	No
Marked gear	Regional	Regional	Regional	Regional	Regional	Regional	no	in many areas parlour pots are forbidden		No	yes

Landings of *Cancer pagurus*

Table 5 C. Landings (tonnes) of *Cancer pagurus* in England and Wales from 2000 to 2012.

Stock Management Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Western-central North Sea	1548.3	1277.6	1095.6	1202.2	1073.8	1121.2	1426.1	1293.1	996.4	1183.2	1217.2	1309.4	1803.3
Eastern-central North Sea	5.3	3.9	8.0	9.2	10.0	68.0	799.8	1339.6	1020.0	953.3	828.5	801.5	560.6
Southern North Sea	3745.5	4408.8	4116.7	4793.2	4037.2	2871.7	2584.8	2360.9	2274.2	1943.1	2337.3	2003.0	2767.8
Eastern English Channel	390.9	437.4	320.0	291.1	282.7	273.5	370.9	282.3	401.3	406.3	410.7	457.4	525.2
Western English Channel	5787.9	5464.8	5444.4	6166.6	4542.2	3427.8	4389.7	5078.9	5018.5	4512.1	4671.3	5129.6	6097.1
Celtic Sea	1284.2	1504.0	1012.4	905.4	982.5	902.6	2144.1	2402.2	2808.9	2839.7	3533.0	3576.2	3250.0
Irish Sea	35.7	44.4	100.4	88.4	91.1	16.0	188.5	217.6	199.1	102.9	101.0	83.0	77.3
Outside	71.6	229.3	121.0	32.9	15.4	1.6	47.9	3.5	4.6	4.7	5.5	13.7	22.5
Total	12869.4	13370.0	12218.6	13489.0	11034.9	8682.4	11952.0	12978.1	12723.1	11945.2	13104.5	13373.9	15103.7

Table 5 D. Landings (tonnes) by assessment unit of *Cancer pagurus* by Irish vessels from 2004 to 2012. Data is based on operational data from logbooks and does not include landings from under 10 metre vessels ('Outside' refers to landings caught from outside the assessment units agreed upon at WGCRAB 2010.)

Assessment Unit	2004	2005	2006	2007	2008	2009	2010	2011	2012
Central North Sea	1290.1	2726.4	1550.6					6.1	79.9
Clyde							2.6		
Hebrides				0.9			850.2		
Malin	460.9	403.1	1436.1	3177.2	4462.8	8931.2	6029.7	3146.2	2631.0
N Irish Sea	0.9		0.5	147.8				34.7	43.4
North Coast							249.9		
Orkney	0.1								
Outside	7.0			614.0	28.0		692.7	2.0	2.0
Papa	830.9								
SE Ireland Celtic Sea	353.2	143.3	585.4	595.2			110.8	296.5	220.2
Shetland	101.4								
South Minch							157.7		
Southern North Sea								979.7	1182.1
Sule							855.2		
SW Ireland	0.3	42.1	23.0	114.3	807.1	843.2	554.2	339.6	520.3
Western Channel	0.2			0.8				35.4	
Total	**3045.1**	**3314.9**	**3595.6**	**4650.1**	**5297.9**	**9774.4**	**9503.0**	**4840.3**	**4678.9**

Table 5 E. Landings (tonnes) by assessment unit of *Cancer pagurus* by Irish vessels under 10 metre vessels from 2004–2011.

Assessment Unit	2004	2005	2006	2007	2008	2009	2010	2011	2012
Malin	4402.5	3825.7	3220.3	827.9	1135.8	712.7	863.0	816.6	17.8
N. Irish Sea	137.0	107.0	68.5	173.2	261.9	2.0	65.9	326.7	17.8
SE Ireland/Celtic Sea	1041.1	1116.5	91.5	45.0		249.5	609.9	807.4	1014.7
SW Ireland	3036.7	592.1	1684.3	25630.2	147.0	195.9	300.5	173.4	465.4
Total	**8617.3**	**5641.3**	**5064.6**	**26676.4**	**1544.7**	**1160.0**	**1839.3**	**2124.1**	**1515.7**

Table 5 G. Annual *Cancer pagurus* landings (tonnes) into Scotland by creel fishery assessment unit from 2001–2012. Data from Fisheries Management database.

Assessment unit	Year											
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Clyde	86.7	53.8	57.0	21.0	39.6	198.2	250.3	213.7	99.4	139.3	137.0	182.8
East Coast	855.3	529.1	426.5	369.5	405.9	830.4	884.2	866.9	778.6	1029.0	1091.3	1213.9
Hebrides	1831.4	1613.3	1452.9	1381.9	1730.0	2279.4	2340.0	1738.4	1822.3	1885.8	2433.3	1996.5
Mallaig	17.9	2.0	1.6	6.7	5.2	7.7	67.0	32.4	8.5	12.9	21.3	69.6
North Coast	614.9	497.1	793.4	318.2	488.1	435.8	513.8	348.7	568.3	681.9	428.7	514.2
Orkney	1539.2	1498.6	1362.2	1309.5	1582.2	1467.9	1555.4	1187.3	1155.6	1462.1	1746.6	1693.7
Papa	694.8	771.9	785.2	463.5	454.1	838.2	798.0	764.1	1002.0	878.2	884.2	828.2
Shetland	416.2	331.8	217.1	33.3	193.8	640.8	522.4	566.9	390.2	334.4	419.0	478.4
South East	148.1	96.8	23.0	129.0	166.0	273.8	281.8	325.5	308.0	345.7	356.7	447.1
South Minch	1112.7	1195.5	1116.3	961.2	1389.1	1316.2	2149.6	1141.0	1000.7	1651.3	1632.4	1094.4
Sule	788.2	952.4	865.6	1389.7	1357.9	1663.1	2026.1	1836.2	1981.8	1928.9	2275.5	1611.2
Ullapool	146.1	199.8	233.2	194.2	271.7	358.1	376.0	241.9	192.1	245.4	244.9	687.2
Outside Assess. Units	206.9	131.5	190.7	183.8	249.0	120.5	154.1	73.1	158.7	261.9	188.2	74.7
Total	**8458.4**	**7873.7**	**7524.6**	**6761.3**	**8332.5**	**10430.3**	**11918.7**	**9336.1**	**9466.1**	**10856.7**	**11859.1**	**10891.9**

Table 5 H. Landings (tons) of *Cancer pagurus* in Norway per area 1977–2011.

	Landings with unknown area	North Sea (area 41)	Skagerrak (area 9)	Southwest Norway (area 8)	Middle Norway (area 28)	South-Trøndelag /Møre and Romsdal (area 7)	North Trøndelag / Helgeland (area 6)	Lofoten (area 0)	Vesterålen (area 5)	Troms (area 4)	Total
1977	1 078			198	282	577	216				2351
1978	106		1	205	369	1 434	449		2		2565
1979	349			186	341	1 405	439		2		2721
1980	193			216	330	1 231	200		8		2178
1981	53			181	367	1 308	262		1	4	2175
1982	33		6	181	470	1 150	223		12		2074
1983	134		19	175	253	1 013	186		5		1784
1984	191		188	59	261	1 093	275		2	2	2070
1985	218			479	319	913	361		12		2302
1986	76			390	296	936	356		46	1	2101
1987	14			276	154	640	199		25		1307
1988	4		18	290	266	583	129		58		1349
1989	8			290	259	681	173		38		1449
1990	1			175	306	718	173		1		1374
1991			1	210	307	820	125				1462
1992			2	236	203	842	33				1316
1993			2	330	249	1 046	13				1641
1994			1	308	246	1 029	196				1781
1995			1	368	214	1 085	139				1806
1996			1	414	242	1 110	122				1889
1997			2	490	305	1 166	243				2205
1998			1	518	277	1 711	476				2984
1999			1	540	257	1 440	598				2836
2000			1	465	206	1 499	718	1			2890
2001			2	432	242	2 116	684	2			3478
2002			4	496	366	2 676	800	2	1		4344
2003			4	527	532	2 247	1 589	28	17		4944
2004			5	677	503	1 994	2 013	54	2		5248
2005			7	625	486	1 858	2 392	298	5		5671
2006		2	9	640	334	2 116	2 768	336	1		6205
2007			11	735	466	2 619	4 172	510	2		8514
2008		1	6	658	172	2 056	1 998	402	1	1	5295
2009			6	692	226	2 140	1 605	301	1		4970
2010		0	38	682	300	2 324	2 381	49			5774
2011		0	46	795	299	2186	1954	36	3	0	5319

5.1 Stock summary for *Cancer pagurus* fisheries in England and Wales

Provided by Cefas

Assessment

Background

Brown (or edible) crab is the most valuable crab species exploited around the coasts of England and Wales with landings in 2012 of around 15 000t worth in excess of €23 million at first sale. With the aim of informing fisheries managers, Cefas currently produce an annual stock status report. Each report contains information describing the status of stocks in six crab assessment areas in English and Welsh waters which are a subset of those defined by the Working Group. This year and for the first time, Cefas produced a two page summary for five of the assessment areas which have been published online and available to the public.

Method

The general methodology for assessing the status of the stocks involved consideration of three datasets; Fishing activity data as recorded on an official national database, catch and effort data from a subset of vessel logbooks and the size structure of the landings generated from biological samples acquired at the quayside. A time series of aggregated landings and effort data for the whole fleet provided a perspective of the fisheries and their exploitation levels. Individual time series of catch rates from a subset of selected fishing vessels provided abundance indices in each assessment area. Length based VPA (LVPA, Jones, 1981 and 1984) and per recruit analysis (Beverton & Holt, 1957) provided an analytical perspective on stock and fishery status including reference points derived from aggregated length distribution data. Whereas the stock status report provided detailed and technical information for fisheries managers and scientists, the online summaries were designed to provide a clearer interpretation of the stock status, suitable for the public (not for Irish Sea assessment unit). They used a traffic light approach for four key indicators of stock status; Minimum Landing Size (MLS), discarding, exploitation rate and stock size, where green suggests a satisfactory situation, amber highlights some concerns and red indicates that the stock as represented by this particular indicator does not achieve the minimum recommended limits. Proxy MSY levels were derived from 35% virgin Spawner per Recruit (SpR) reference levels and the limit was defined as 15% virgin SpR.

Results

The two page summaries for each assessment area were presented (all areas except Irish Sea). In terms of the four key indicators the stock status for assessment units Western English Channel (WEC) and Celtic Sea (CS) showed no cause for concern. The MLS provided protection to the spawning stock by allowing some spawning to occur before recruitment. Discard mortality is considered low for all assessment units. Exploitation rate was considered to be at about the level required to generate Maximum Sustainable Yield (MSY) or at least below the maximum recommended level. In contrast the stock status for the assessment unit Southern North Sea (SNS) in terms of three of the key indicators shows there are concerns. The MLS is too small to enable significant spawning opportunity before recruitment (amber), the exploitation rate on females is higher than the maximum recommended level (red) and the stock

size of females is below the minimum recommended level (red). For the Central North Sea (CNS) the MLS allows some opportunity for spawning before recruitment, but exploitation rate and stock size are considered around the respective recommended limits (amber). The stock status in the Eastern English Channel (EEC) in terms of three of the key indicators show no cause for concern but the exploitation rate is considered moderate and approaching the maximum recommended limit (amber).

Discussion

This approach generally provided useful and plausible results, broadly indicative of the exploitation of English crab stocks. However, problems associated with data consistency, parameter selection and model assumption violations generally provide a view of stock status that is considered pessimistic. Of the five stocks where analytical assessments are carried out, two appear to be fished in a sustainable manner. One of the stocks may be fished above levels required for sustainability and the other 2 stocks could benefit from reductions in exploitation rate.

Conclusions

The assessment of crab stocks and reporting procedures adopted by Cefas in recent times has evolved this year to include a traffic light approach to 4 key stock indicators and the use of biological reference points. Online publication of two page summaries has made this information available to a wider audience.

It is intended that improvements to data collection procedures, parameter accuracy and inclusion of international landings (facilitated by the WG) will improve reliability of future assessments. Current research at Cefas designed to develop suitable abundance indices for pre-recruit and recruiting crabs should enable the use of alternative assessment tools, providing information on exploitation with which to compare that from currently deployed methods.

References

Beverton, R.J.H. and Holt, S.J., 1957. On the dynamics of exploited fish populations. Fish. Invest. Lond. Ser. II, 19. 533p.

Jones, R., 1981. The use of length composition data in fish stock assessments (with notes on VPA and cohort analysis). FAO Fish Circ., (734), 55p.

Jones, R., 1984. Assessing the effects of changes in exploitation pattern using length composition data. FAO Fish. Tech. Pap. 256: 118p.

5.2 Cancer pagurus from Ireland

Provided by the Marine Institute

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 2012 for these four assessment units and adjacent assessment units by Irish vessels are shown in Table 5 D. These landings are collated from the operational landings database. Table 5 E 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 2012 may be incomplete at this time.

The Irish Sea Fisheries Board, Bórd Iascaigh Mhara (BIM), run a self-sampling sentinel programme on lobster and crab vessels around the Irish Coast. In 2012 data from 4415 brown crab were collected by 22 vessels fishing in four of the assessment units around the coast of Ireland. A total of 1414 sampling trips were undertaken. The majority (58.4%) of these trips were undertaken in the Malin assessement unit. A further 28.6% were landed from the SW Ireland Assessment Unit. The remaining 13% of trips were divided between the N. Irish Sea (8.7%) and the SE Ireland/Celtic Sea Unit (4.3%).

Marine Institute observers measured 1718 Brown Crab over 6 sampling trips between March and September 2012. The majority of crab sampled (69.4%) were caught within the SW Ireland assessment unit, while 16.6% were caught off the southeast coast. A further 14.1% were sampled from the Malin assessment unit.

Results of both sampling programmes showed female crab dominating the catches by approximately 65–80% to 20–35% males.

Table 5.2.1. Counts of female and male brown crab by Assessment Unit and County recorded in 2012 through both the Bórd Iascaigh Mhara (BIM) sentinel self-sampling programme and the Marine Institutes (MI) observer programme.

Assessment Unit	County	Sentinel Vessel Programme		MI Observer Progamme	
		Female	Male	Female	Male
Malin	Donegal	1292	659	112	129
SE Ireland/Celtic Sea	Waterford	21	8	259	26
SW Ireland	Cork	371	164	771	165
	Kerry	98	36	239	17

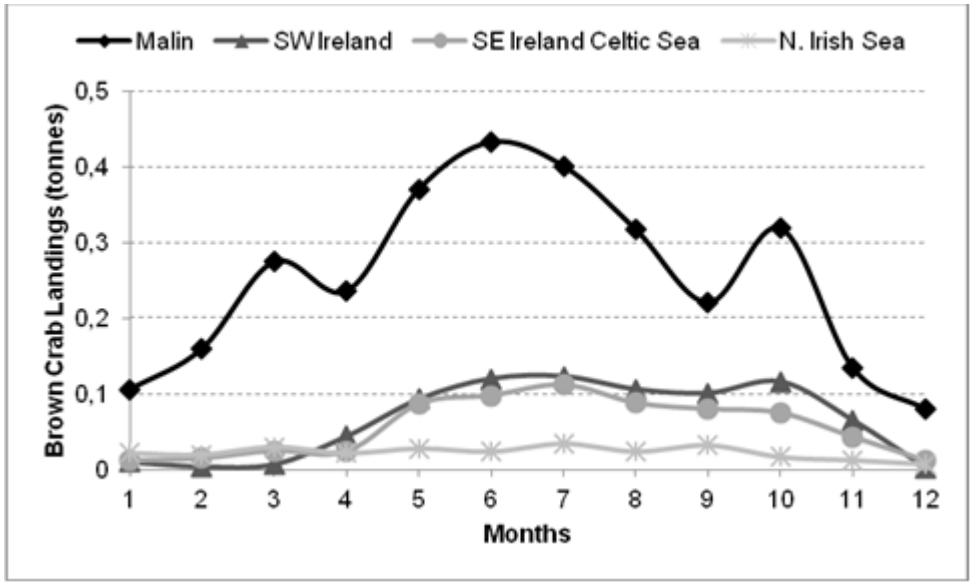

Figure 5.2.1. Monthly operational landings (tonnes) for the four (Malin, SW Ireland, SE Ireland/Celtic Sea and N. Irish Sea) assessment units around the Irish coast for 2012.

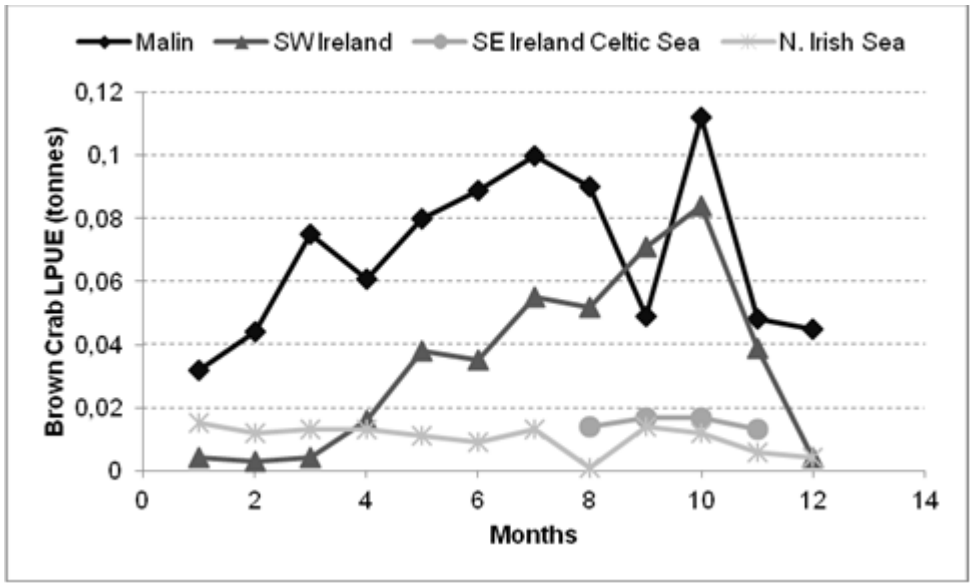

Figure 5.2.2. Monthly LPUE Sentinel Vessel Data(tonnes) for four assessment units in 2012.

Figure 5.2.1 shows the monthly operational landings (tonnes) for the four assessment units around the Irish coast during 2012. Landings from the Malin unit are the highest throughout the year, with those from the N. Irish Sea being the lowest.

Malin

The Malin assessment unit is the largest in extent around the Irish coast. Tag return data shows extensive return migrations from north Donegal to Mayo and between inshore coastal waters northwest to the 200m depth contour (Tully *et* al., 2006). These data also show some connection between west Mayo and the Clare coast. The northern boundary is unknown but fishing activity and landings are low in offshore waters between 56–57°N.

Operational landings of brown crab from the Malin assessment unit were the highest around the Irish coast in 2012, however 2631 tonnes is the lowest figure recorded for this unit since 2006. Landings recorded for the under 10 metre vessels were low compared to previous years, however these data may be incomplete for 2012 as all the under 10 metre data may not have been uploaded to the national database when this report was produced.

The figures reported in ICES WGCRAB Report 2011 were incomplete and the actual operational landings for Brown Crab in 2011 were 3146.2 over twice as high as the 1423.9 tonnes that were included in the 2011 report.

The majority of brown crab fishing in inshore Irish waters occurs within the Malin assessment unit. A total of 2,943 crab were measured through the BIM sentinel sampling programme and a further 243 were measured by the MI observer programme. Figure 5.2.2 shows the size frequency data (5mm bins) of the catch for female and male crab caught in the Malin assessment unit in 2012.

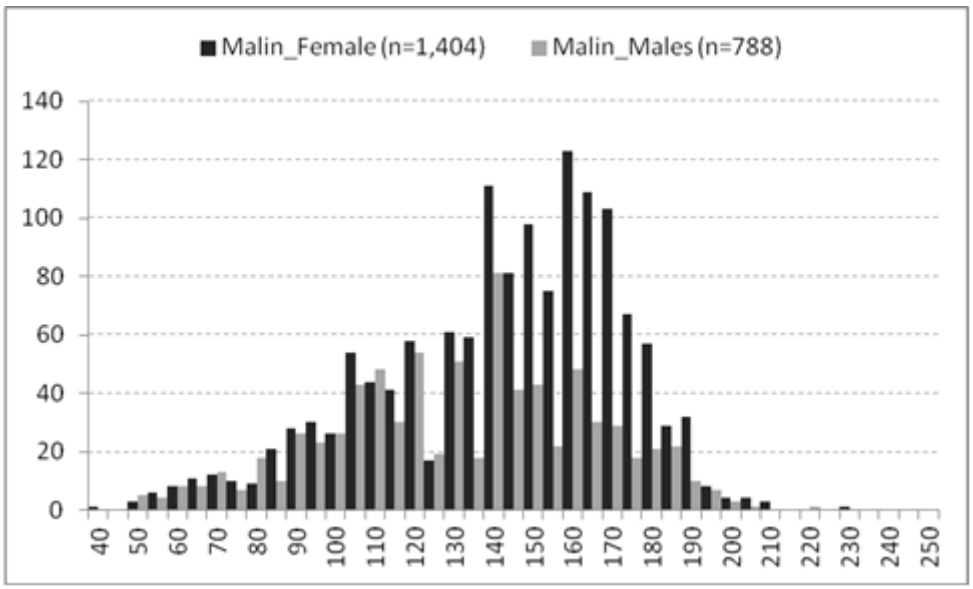

Figure 5.2.3. Size frequency data (5mm bins) of the catch for female and male crab from the Malin assessment unit in 2012.

Assessment methodology

None.

Stock status

Unknown, however operational landings from this area have decreased since 2009 which is probably resulting from fishing pressure.

SW Ireland

Fishing activity is restricted to coastal waters inside the 12 nm limit. Crab survey data for offshore waters in this area (outside 12 nm limit) indicates that crabs are not very abundant in deeper waters. Larval dispersal simulations from the southern border of the Malin assessment unit at the Shannon Estuary indicates a northerly

transport while larvae from the SW Ireland unit have limited northward transport thereby reducing the connectivity between these two units. Tagging studies in 2006/2007 indicates limited inshore offshore migrations but no extensive alongshore movement.

Operational landings of brown crab in 2012 from the SW Ireland unit of 520.3 tonnes were higher than in 2011 (the complete figure for 2011 was 339.6 tonnes), however they were lower than landings for this area from 2008–2010.

In 2012 females made up 77% of the 1620 brown crab sampled in the SW Ireland assessment unit.

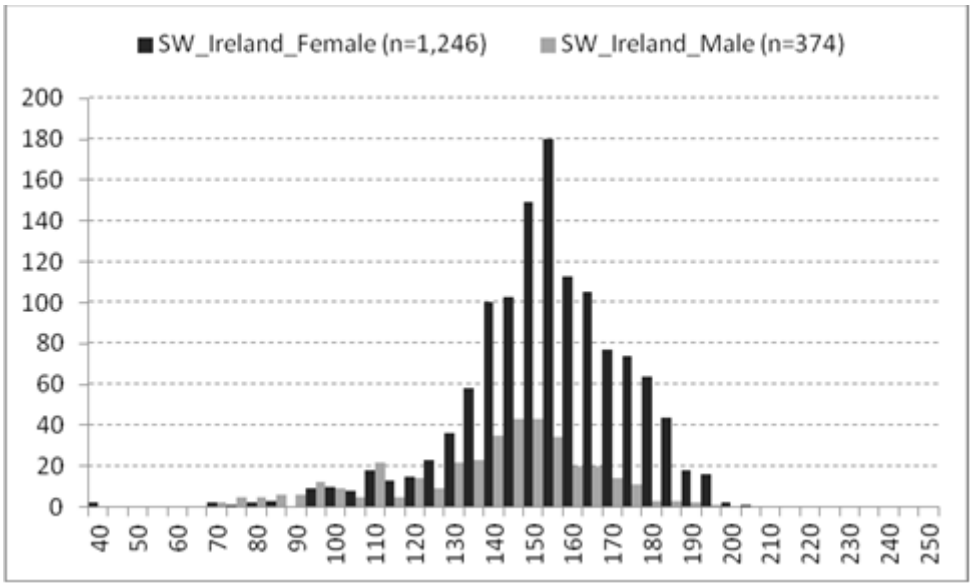

Figure 5.2.4. Size frequency data (5mm bins) of the catch for female and male crab from the SW Ireland assessment unit in 2012.

Assessment methodology

None.

Stock status

From analysis carried out in 2010 (see ICES WGCRAB Report 2010) the nominal standardised LPUE index declined from 2000–2004 but was stable at just above 1.5 kgs per pot lift from 2005–2009. Data for 2008 is thought to be unreliable. Size at 50% maturity is lower than the average size of crab in the stock and well below the market landing size which is over 140 mm.

Fleets from other countries do not fish this stock.

SE Ireland (Celtic Sea)

The border between the Celtic Sea and Irish Sea unit is close to the Irish Sea front in the Georges channel which limits larval connectivity between the Celtic and Irish Seas. Oceanographic models show an anti-clockwise flow from the southern part of the unit north to the Georges Channel, west along the Irish south coast and south into the Celtic Sea where directional transport is weak especially over the Celtic Deep. Adult crabs migrate seasonally to and from the Irish coast. Crabs tagged on the Irish coast have been recovered near Lands End at the southern edge of the unit. Fishing

activity occurs in inshore waters off the Irish coast, further offshore and also off north Cornwall.

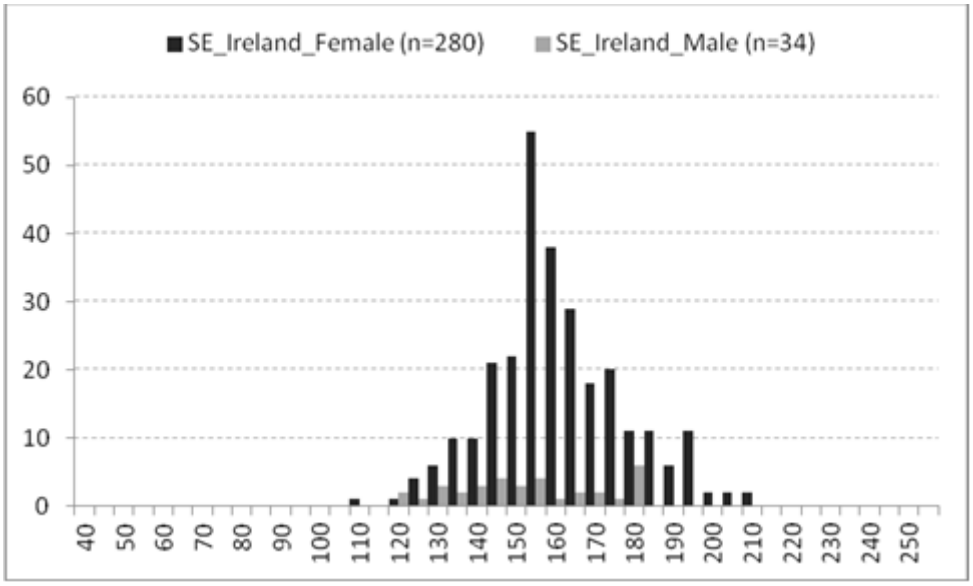

Figure 5.2.5. Size frequency data (5mm bins) of the catch for female and male crab from the SE Ireland assessment unit in 2012.

Brown crab operational landings of 220.2 tonnes were recorded from the SE Ireland Celtic Sea assessment unit, which were approximately 70 tonnes lower than the corrected figure of 296.5 tonnes landed in 2011.

A total of 314 brown crab were sampled in the SE Ireland unit. Female crab dominated (89%) the catches, however the sample size for this assessment unit in 2012 is quite small.

Assessment methodology

None.

Stock status

The LPUE time-series analysed in 2010 (see ICES WGCRAB Report 2010) is insufficient.

Fleets from France and UK fish this stock.

N Irish Sea

The northwest Irish Sea is a retention area which may retain crab larvae spawned along the north east coast. However, there is no data on the migration of adult crabs in the area.

Landings of 244.0 tonnes were only recorded from the under 10 metre data for this assessment unit.

No brown crab measurements were undertaken in this assessment unit during 2012, so no length frequency data is available.

5.3 Stock summaries for Scotland

Provided by Marine Scotland Science

Management units / stock units

Scottish waters are divided into twelve assessment units for crabs and lobsters as shown in Figure 5.3.1. These units are based on the previous district and creek system for reporting Scottish landings data, but have been revised to include two offshore areas – Papa, which lies to the west of Shetland, and Sule, which is to the north and west of Orkney and includes the Rona, Sulisker and Sule-Skerry banks.

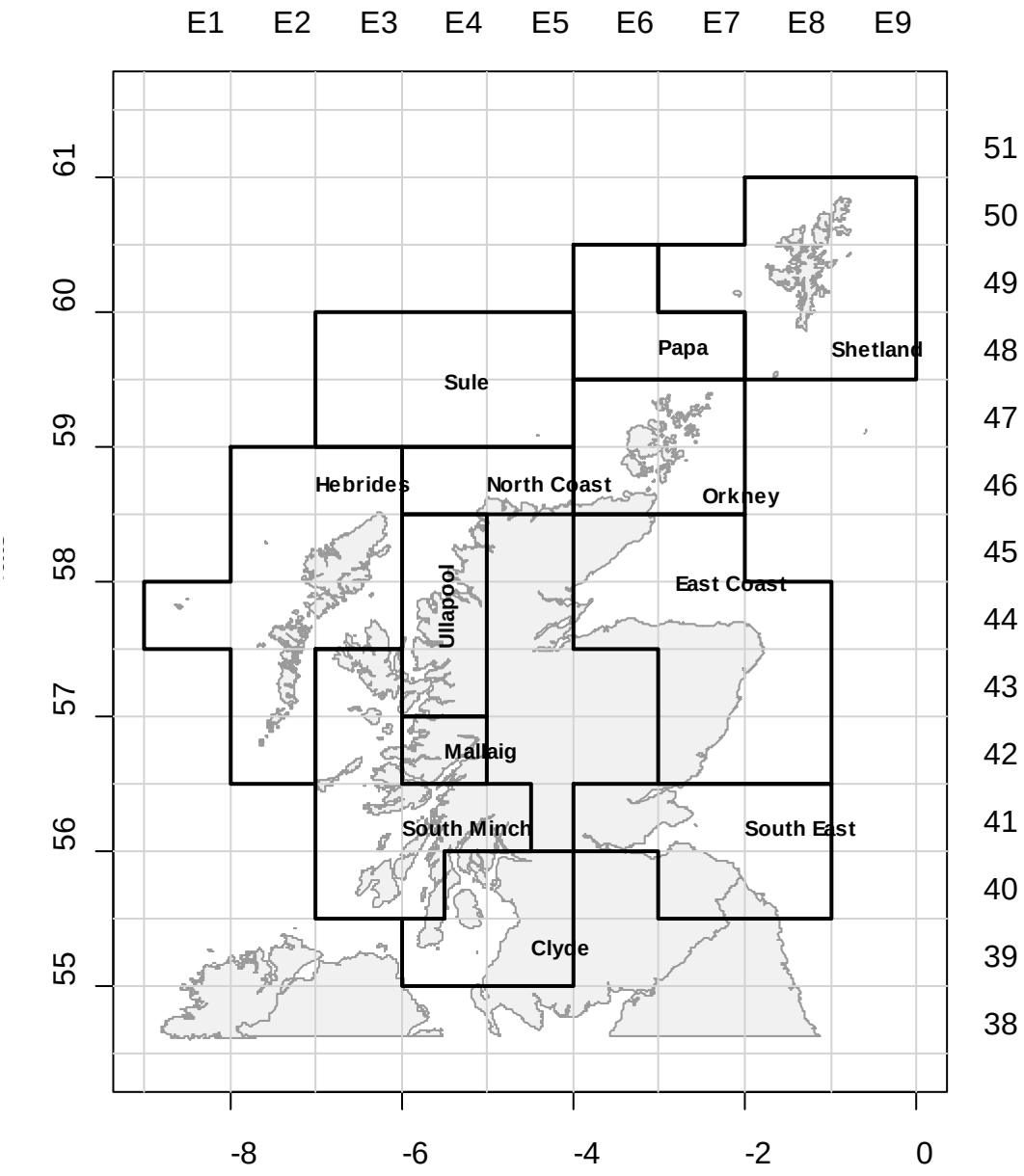

Figure 5.3.1. Crab and lobster creel fishery assessment units in Scotland.

Data by management unit

Landings by unit

Total Scottish landings of brown crab fluctuated between 6700 and 12 000 during 2003 to 2012 (Figure 5.3.2, Table 5 G). 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.

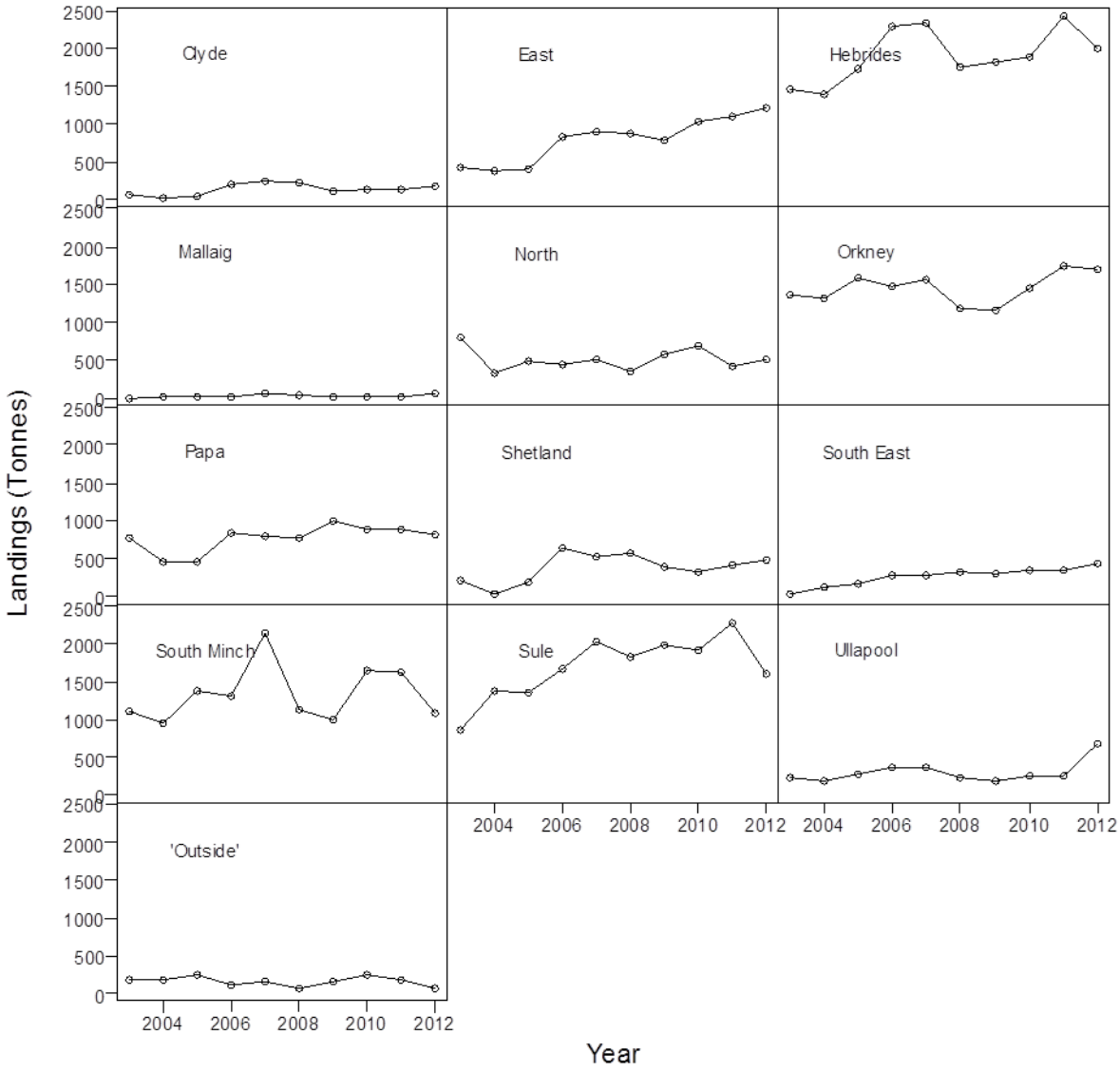

Figure 5.3.2. Annual brown crab landings (tonnes) into Scotland by creel fishery assessment unit 2003–2012. Data from the Fisheries Management Database; 'Outside' relates to brown crab landed outside the creel assessment units; see Figure 1 for area locations.

Discards

Discards in crab fisheries are sampled only on an irregular basis.

Fishing effort

There are no requirement for creel boats to report the number of creels fished to achieve a standardized measure of catch per unit of effort and the use of "days absent" from port represent only a crude measure of effort that is confounded by the variability of creels fished per day and time taken to get to the fishing grounds. Currently, Shetland is the only area for which fishing effort data are available and routinely collected since the Shetland Regulating order requires licensed fishers to return logbook information detailing catch location and number of creels.

LPUE/CPUE/DPUE – standardised or not?

Data on fishing effort and catch rates are currently lacking. An EU project investigating ways of obtaining better information on catch and effort data through the use of self-sampling and GPS loggers to monitor fishing activity has been carried out. This suggested that indicators of landings-per-unit-effort could be obtained by linking GPS/VMS data and logbook records (Anon, 2010). Detailed information on catch and gears has become recently available for a Vivier crab boat fishing off the West Coast of Scotland that will provide the basis for a LPUE analysis in the future.

Assessment methodology

Length Cohort Analysis (LCA) is used to assess brown crab assessment units in Scottish waters. The LCA method uses the commercial catch size composition data (length-frequency data) and estimates of growth parameters and natural mortality to estimate total stock biomass and fishing mortality at length. The results can be used to predict long-term (equilibrium) changes in the stock biomass and yield-per-recruit based on changes in mortality, fishing effort or minimum size regulations.

Sources of data used in the assessments of brown crab in Scottish waters are described below.

Official landings data

The assessments use official landings data, which detail the location, the species and the weight landed into ports in Scotland. These data are collated by Marine Scotland Compliance from sales notes and EU logbook and Shell 1 forms, and held in the Marine Scotland Fisheries Information Network (FIN) database.

Numbers at length

Length-frequency data are collected by MSS as part of the market sampling programme. The data are held in the MSS Fisheries Management Database (FMD).

Data raising

Length frequency data obtained from market sampling and official landings data are combined to provide a raised annual catch-at-length distribution for input into LCA. This is carried out on a quarterly basis, applying a length-weight relationship to multiply up the length frequency measurements for each sex to reflect the weight of the quarterly landings. The data from each quarter is then combined to give total annual raised length frequencies for each sex. Data sets are averaged over a number of years and aggregated into 5 mm length classes for use in the LCA.

Biological parameters

Information about the growth of brown crabs around the UK comes mainly from tagging studies carried out in the 1960s and 70s (Table 5.3.2). Estimates of the von Bertalanffy growth parameters: asymptotic length (L_∞) and instantaneous growth rate (K), were obtained from Ford-Walford plots. Length-weight relationships (parameters a and b shown in Table 5.3.2) are from Marine Scotland Science (MSS) unpublished market sampling measurements of length and weight.

Table 5.3.2. Biological parameters used in stock assessment for brown crab.

	Growth parameters		Length-Weight relationship		Terminal F	Mortality	Source
	K	L_∞	a	b	F	M	
Cancer pagurus							
Males	0.197	220	0.000059	3.214	0.5	0.1	Chapman, 1994
Females	0.172	220	0.000302	2.8534	0.5	0.1	Chapman, 1994

Uncertainties

The LCA approach assumes that the length distribution is representative of a typical cohort over its lifespan. However, this is only true of length frequency data from a single year if the population is in equilibrium and therefore LCA is usually applied to data averaged over a number of years during which recruitment and exploitation rates have been stable. LCA also assumes uniform growth among animals. The approach gives an indication of the exploitation of the stock in terms of growth overfishing, but does not provide any indication of short-term stock dynamics or recruitment over-fishing. It is therefore best to interpret the LCA analyses in conjunction with other information such as catch rate (CPUE) data. The growth parameters used in the LCAs are taken from other studies elsewhere and assumed fixed across all regions (except Shetland). LCA is very sensitive to these parameters and the choice of input parameters may critically influence the results obtained. Differences in size composition across areas suggest that area specific values may be more appropriate. The population structure of brown crab stocks around Scotland is not well understood and improved knowledge of stock identity may lead to a redefinition of the assessment units for brown crab.

Stock status

Assessments based on LCAs for the period 2006–2008 were carried out for nine of the twelve assessment units (a new round of stock assessments will be conducted in 2013 using 2009–2012 data). There was insufficient sampling data from the Mallaig, Ullapool and Papa units to conduct LCAs. Of the assessed units, the majority were growth overfished to some extent, particular male stocks. In the units of major importance for brown crab landings, fishing mortality was estimated to be significantly above F_{MAX} for both males and females in Clyde, South Minch and South East whilst in the Hebrides and Sule, current fishing mortality is approximately F_{MAX}. In Orkney, North Coast and East Coast, the fishing mortality for female stocks is close to F_{MAX} while males are being fished above F_{MAX}.

Fisheries Regulations

Vessels landing brown crab in Scotland are required to have a license with a shellfish entitlement. Vessels without this entitlement are only allowed to land limited amounts (25 crabs per day). The main regulatory mechanism is a minimum landing size of 140 mm CW to the north of 56º N and 130 mm CW to the south of 56º N (except for the Firth of Forth).

References

Anon (2010). Joint data collection between the fishing sector and the scientific community in Western Waters. Final report to the European Commission Directorate-General for the Fisheries and Maritime Affairs. Contract SI2.491885, Ref. FISH/2007/03; 267p.

5.4 Stock summary of the *Cancer pagurus* in France

Provided by IFREMER – Brest

Administrative aspects of the fleet management in France

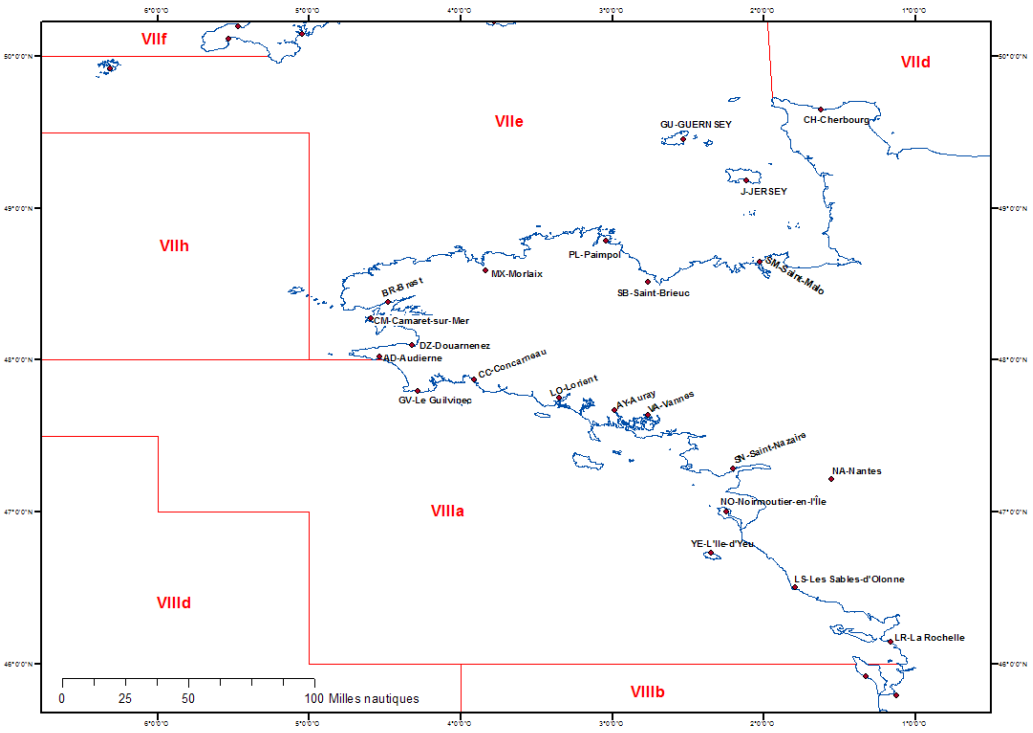

Figure 5.5.1. Location of the administrative area for the Western part of France, from Cherbourg to La Rochelle.

In France, the coast is divided in administrative area including a various number of harbours (Figure 5.5.1). Each boat, professional or not must be registered in the administrative area which includes its attached harbour. The management of the fisherman declaration data are performed in a first stage in each administrative area. In France, in addition to the logbooks, some fishing forms are used for the vessels under 12 meters. These forms are equivalent to the logbooks; in some case they are more precise, mainly to the definition of the fishing area because some fine coastal areas are designed. These national fishing forms have been developed at the beginning of the year 2000. Step by step the quality of the data and the percentage of declaration have

increased. In parallel, Ifremer have developed its own database to get synthetic information for all the French fishing boats we have its fishing activity calendar, on a monthly base we know the 2 main "métier" and the fishing area. The third source of information comes from the auction network with the sales notes of all the fishing vessels which are stored in a national database.

Use of different data

Development of the SACROIS model

This application is crossing different sources of fishing statistics (fishing fleet register, logbooks, fishing forms, sales notes, VMS, fishing activity calendars), and compile them into a single, verified and consistency, controlled data flow, with the aim of displaying validated and qualified landings per species and effort data series.Qualification of the data flow produced is emphasised and SACROIS tool provides indicators about data quality and completeness. For the crabs, all the fishing vessels are located in Atlantic. The overlap for this area by the SACROIS approach is considered as high for the vessel size (Table 5.5.1, % active "vessel month").

Thanks to SACROIS approach, we get more accurate data on the landings by gear and area. This stage is really an advanced to improve the assessment of the stocks. In the case of the crustaceans, we will see that some incertitude yet existed but the situation is improving.

Table 5.5.1. Synthesis of the data generated with the SACROIS model.

2011							
Region	Length class	Nb active vessels	% active "vessel-month" in	Nb vessels SACROIS	Nb SACROIS trips	Total landings (ton) SACROIS	Total value (k€) SACROIS
Atlantic	<10m.	1 519	87%	1 461	146 930	34 761	98 308
Atlantic	[10-15[m.	884	98%	882	133 446	99 227	242 162
Atlantic	>=15m.	609	99%	609	50 880	231 308	528 018
Mediterranean	<10m.	1 048	46%	616	40 364	2 186	12 746
Mediterranean	[10-15[m.	142	49%	93	5 571	751	4 167
Mediterranean	>=15m.	121	100%	121	17 110	12 038	41 833
Overseas	<10m.	1 803	4%	107	6 257	331	1 391
Overseas	[10-15[m.	101	14%	15	430	630	3 224
Overseas	>=15m.	43	97%	43	584	1 903	7 317
				3 947	**401 572**	**383 137**	**939 166**

Towards the estimation of a LPUE

We have seen that the SACROIS approach improves the quality and the completeness data. In order to estimate some abundance index without scientific survey, the used of fisherman declaration stays a solution, supplying enough data to estimate a LPUE. In this way, the information in the logbooks or in the fishing forms are directly used. For the crustaceans, the selection of the potter vessel declarations is the better way to estimate an index. Even if other gears can catch crustaceans, they are mainly considered as bycatch and the discard processes can lead to much bias in the estimation. Thereby the available data is on a daily base, where we know by vessel, the number of pots used the soak time, the fishing area and the catches. The global quality of the

data is really high. The main problems are the absence of declaration effort or the absence in the database of logbooks or fishing forms due the loss of the original or because some declarations have not been registered.

Situation of the French brown crab fishery.

The French production reaches more than 6000 tons in 2012 and 2011 (Figure 5.5.2). The majority of the production comes from the potters. The gillnetters in some areas can catch a lot of edible crab as bycatch. The catch from the trawlers is low but miss declaration in the logbooks generates under estimation. In general, the trawlers do not declare the large crustaceans as lobster, crayfish, edible crab and spider crab.

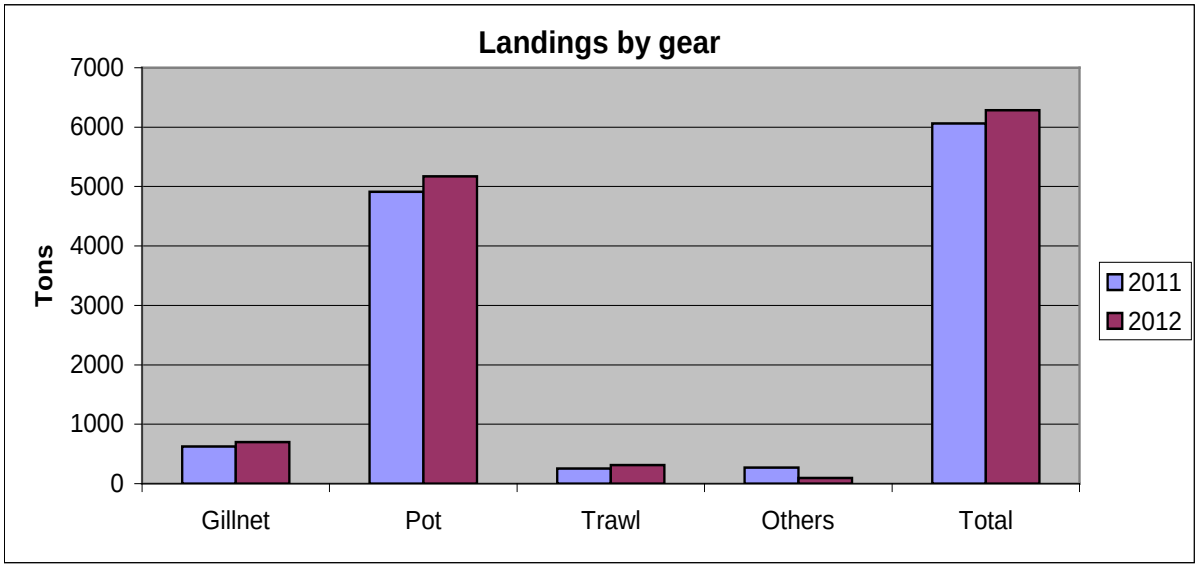

Figure 5.5.2. Production by gear for the edible crab in France.

The number of potter which declares edible crab in their landings is 325 in 2012. The production by vessel is very variable (Figure 5.5.3). In fact, half of the potters catch less than 1 ton per year. Inversely, only few vessels catch more than 200 tons per year. These last vessels are the offshore potters which can store the crabs in tank for more than one week trip.

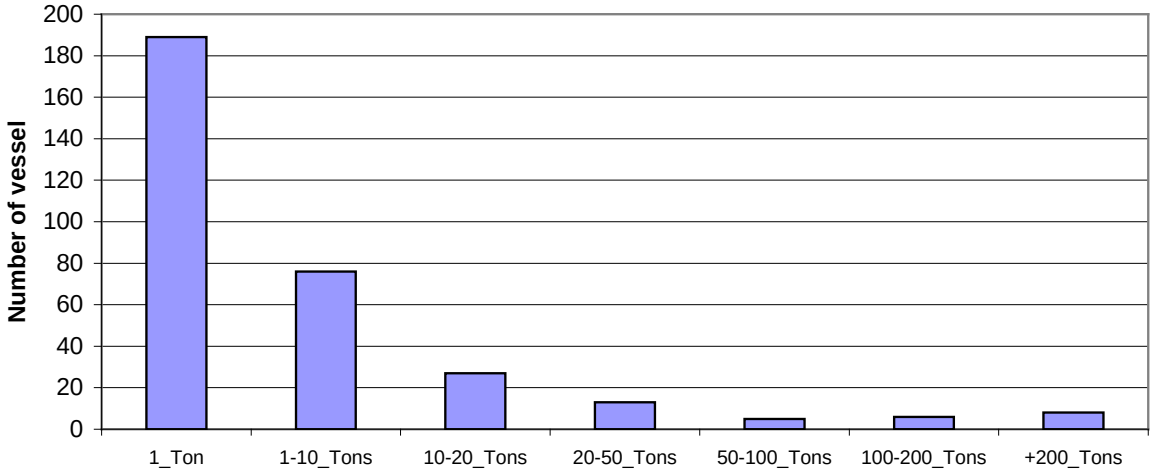

Figure 5.5.3. Distribution of the French potter in function of their annual landings.

Production by area

The French potter production mainly comes from two ICES division, the 7E and 8A. For the Western Channel area (7E), the fishing areas are along the coast and also in the middle of the Channel for the offshore potters. For the North Bay of Biscay (8A), the fishery is less located along the coast and more off shore, especially along the continental slope around the Chapelle area. The third area is the 7H. This situation shows the possible link between the Western Channel and the Bay of Biscay and the assumption of a single stock for this large area. This assumption seems to be validated by the tagging results.

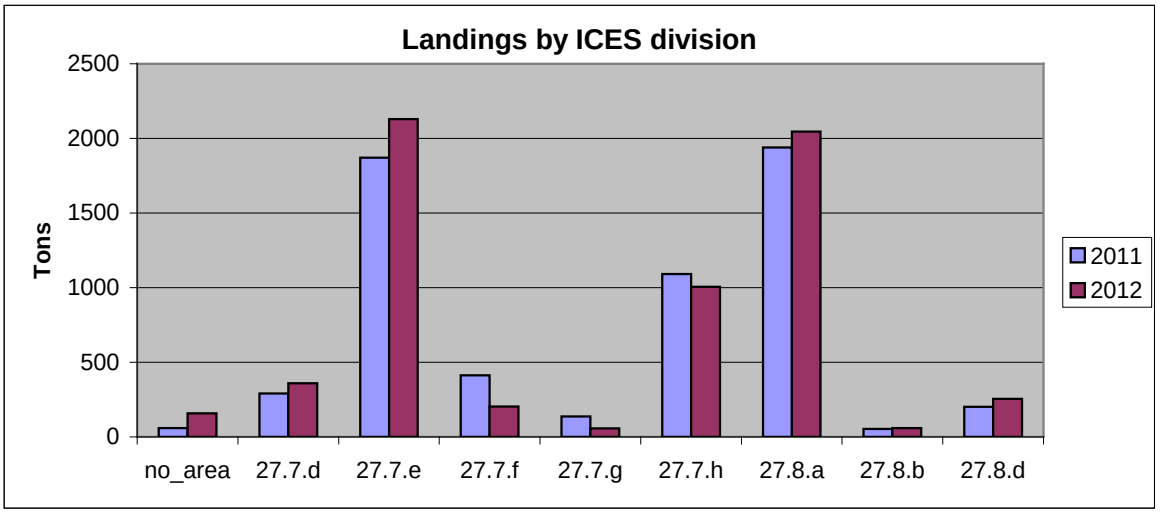

Figure 5.5.4. Distribution of the French landings in function of their fishing areas.

Status of the stock

Abundance index

The quality of the French data is really variable. For some fleets, the time series is too short and the quality of the sample is low. Moreover, several fleets target seasonally edible crab and some years vessels can choose to target other species. In this situation, the best available French data stays the offshore potter fleet. This fleet is the only one which specially targets edible crab all the year in all areas (Figure 5.5.4).

The time series is from 1985 to 2012 and during this period, the number of boat decreases from 26 to 13, but in the same time the effort has stayed stable. In fact, the size of the new boats has increased with more pots on board and longer trip.

Using the logbook data and direct contacts with the fishermen, we built a file with the following structure: Year, Month, Day, Area, Area1, Vessel, Trip, Catch, and Effort. We consider 2 area variables, the first one is the ICES rectangle (Area) and the second is the ICES division (7E as example). We consider this distinction because during a trip a vessel can change of fishing area. Because the data change a little during the period, the base file for the analyses is a cluster of the daily trip data in each ICES rectangle. If a vessel visits 2 ICES rectangles during the same trip, we will have 2 lines for this trip where we do a sum the daily catch and effort per rectangle. The vessel

information is considered in order to conserve the data at the level of the trip per vessel.

The analysis performed in order to estimate an index abundance uses a GLM model where the effects of the variables and the cross effects are taken in account. A first exploratory approach shows some global features about the situation of the edible crab stock target by the French offshore potters (Figure 5.5.5). The trend of the CPUE on period indicate a steadily increase with some annual variations. The seasonality is well observed with the LPUE per month, very low values in winter and a maximum in autumn. This annual evolution is well correlated with the known biology of this species. The zone variable correspond to the ICES divisions, with 7F and 7G included in the zone 1 (Celtic Sea), 7E and 7H included in the zone 2 (Western Channel) and 7D in the zone 3 including and 8A and 8D in the zone 4 (Bay of Biscay). The maximum value of the CPUE is around 4500 kg per 1000 pots. This value is confirmed by the fishermen and the average value around 1700 kg/1000pots.

To really focus on the abundance index, we exclude to analyse zone 3 because the number of observation is low and only concentrated in winter. Moreover, we conserve the data from June to November. A log transformation of the CPUE is performed to get a distribution close to a normal one. The number of data is 6153 and in average each year 220 observations are available.

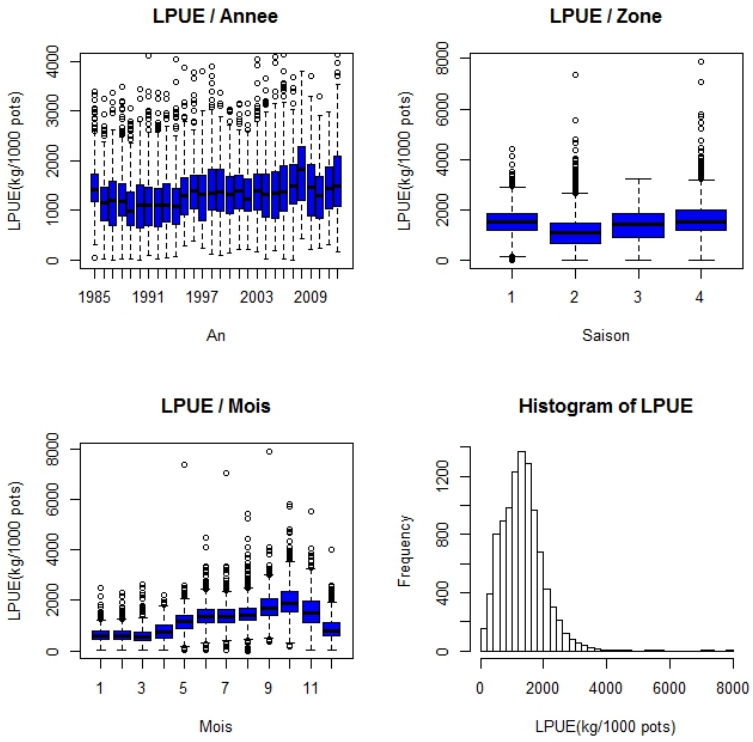

Figure 5.5.5. Boxplot of the LPUE in function of the variables Year (Annee), Month (Mois) and Area (Zone). The last figure shows the distribution of the LPUE.

Result of the GLM model

The model retained keeps the three variables and the cross effect between Year and Zone. The analyses of the residuals show that the model is well fitted to the data. The model explains more than 90% of the variance of the data (Figure 5.5.6).

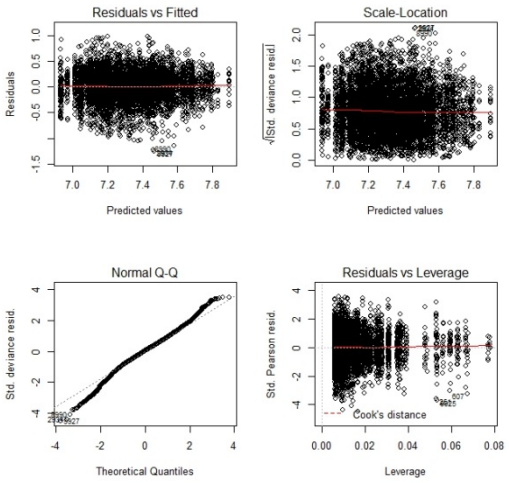

Figure 5.5.6. Distribution of the residuals of the GLM model.

The results of the model are used to estimate an abundance index for each area. Using the results, we estimate an average index which can take into account the all seasonality effect and we estimate too an autumn index when the seasonal abundance is maximum. This last index includes the months from September to November. For the three areas, the worst period is between 1990 and 1995 (Figure 5.5.7). Since this period, the global trend indicates an increase of the abundance even if some annual variations are observed. In Celtic Sea, over the last 5 years, the abundance stays at some high level. For the two other areas, after the huge abundance in 2008, a decrease has been observed but the values stay at a high level compared to the time series. The year 2012 is the second highest of the time series. These three indexes seem to indicate that in a large scale distribution, the stock of brown crab target by the French vessels show a stable abundance. Nevertheless, it can exist in some local areas different trends. The general situation on this stock looking the French data is good.

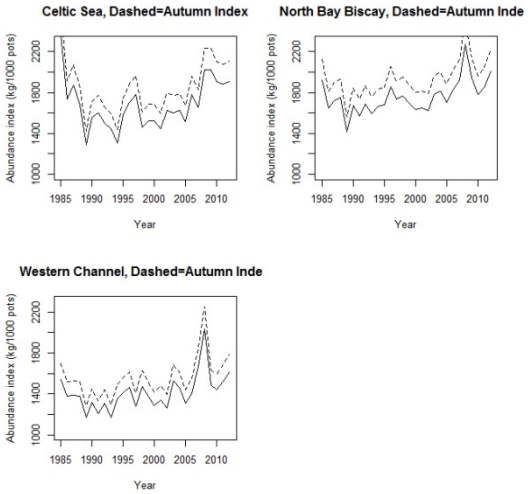

Figure 5.5.7. Abundance index for the three areas; an average and autumn index.

5.5 Stock status of the *Cancer pagurus* from Norway

Provided by the Norwegian Institute of Marine Research

Management units / stock units

All *C. pagurus* along the Norwegian coast from the Swedish border to West-Finnmark are treated as one stock and there are no separate management units. No genetic investigations have, however, been carried out to verify this assumption. There are regional differences along the Norwegian coast regarding landings, LPUE (landings per unit effort), discards, size, and sex ratio. Data are therefore presented separately for seven different assessment units. These assessment units/geographical areas are statistical areas as defined by the Norwegian Directorate of Fisheries (Figure 5.6.1).

Assessment data

The Norwegian *C. pagurus* stock is assessed based on data from a reference fleet (Table 5.6.1), providing data on discards, LPUE (unstandardised), and carapace width in catches (landings/discards). The reference fleet consists of selected fishers providing data from one fishing trip per week in 10 consecutive weeks. The fishers are equipped with four standard, experimental traps with no escape vents (linked into the chain of ordinary traps) from which the following data are recorded:

- Carapace width
- Sex
- Females with external roe (discards)
- Soft crabs (discards)
- Crabs below minimum legal size (MLS) (discards)
- Other discards (damaged crabs, crabs with black spots)
- Total number of traps deployed during fishing trip when data are recorded from the experimental traps
- Total catch in kg from fishing trip when data are recorded from the experimental traps
- LPUE (kg/experimental trap)

There are no data on total fishing effort from the Norwegian crab fleet as there are no logbook data available.

Table 5.6.1. Number of fishers in the reference fleet per statistical area (2001–2013), and total number of crabs caught in the experimental traps (2001–2012).

	Statistical area							
Year	8	28	7	6	0	5	Total	Total # crabs
2001			10	8		1	19	20 614
2002	4		9	9		3	25	29 831
2003	4		9	9		3	25	27 028
2004	3		6	9		1	19	7 875
2005			3	7		1	11	7 515
2006			4	8	2	1	15	5 169
2007	4		4	6		1	15	7 135
2008	1		2	4		1	8	3 778
2009	3		1	1			5	2 966
2010	2	2	3	3			10	4 769
2011		2	2	3			7	2 877
2012	2		4	6		2	14	9 098
2013	2		4	7		1	14	

Landings

The Norwegian landings of edible crab increased from 2009 to 2010, and then decreased again in 2011. The total landings have decreased from 2010 to 2012.

Crabs are probably sold unregistered in all of Norway. From 2010 onwards all crabs sold to consumers in area 9 must be reported.

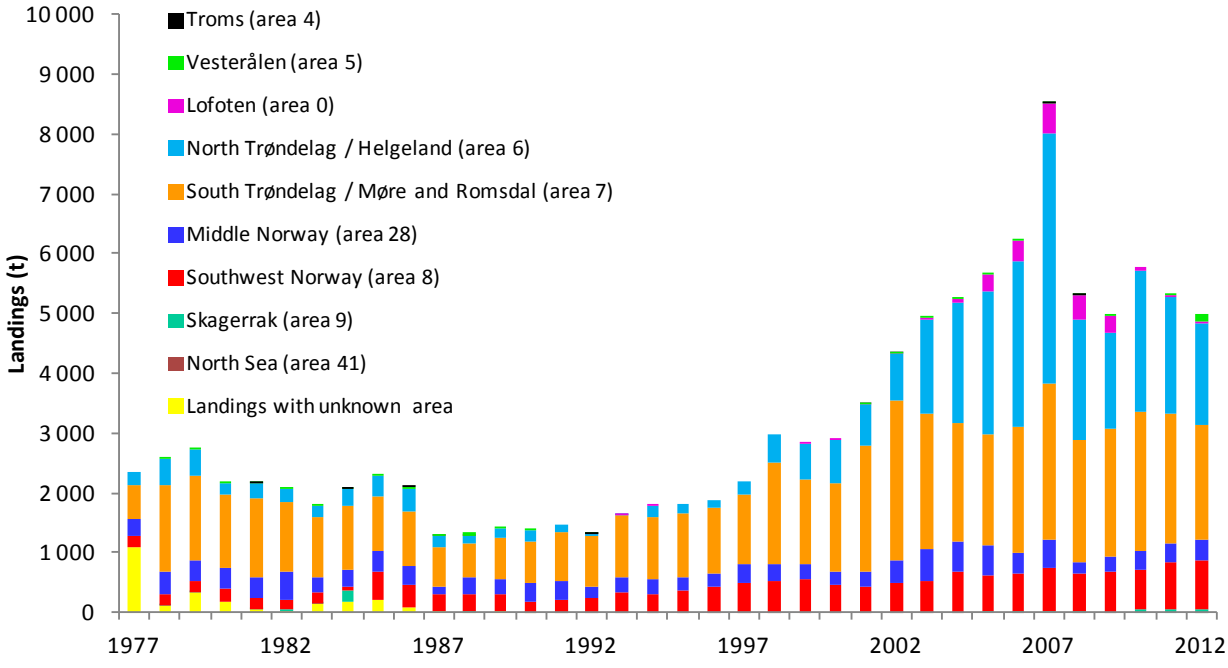

Figure 5.6.1. Norwegian landings of *Cancer pagurus* per statistical area, 1977–2012. Data from the Norwegian Directorate of Fisheries.

State of the stock

Due to few fishers in the reference fleet in 2008, 2009, and unfortunately also in 2011, the LPUE-data from these years are uncertain. For some statistical areas the index is based on data from only one fisher, and for some statistical areas data are lacking. The data situation improved in 2012.

It is difficult to say something certain about the total stock development. Stock indicators (LPUE, mean CW of landings) indicate a stable stock (Figures 5.6.2, 5.6.3). The drop in LPUE in area 6 in 2009 was due to sales organization introducing a MLS of 14 cm this year. This arrangement was not continued in 2010. The legislated MLS is 13 cm.

Discard rates vary from year to year and between areas. The rate of discards is generally lower in the northernmost areas (areas 0 and 5); (Figures 5.6.2, 5.6.4). In area 8 (southernmost area) more than half the catch was discarded in some years (soft crabs, females with external roe, specimens below MLS).

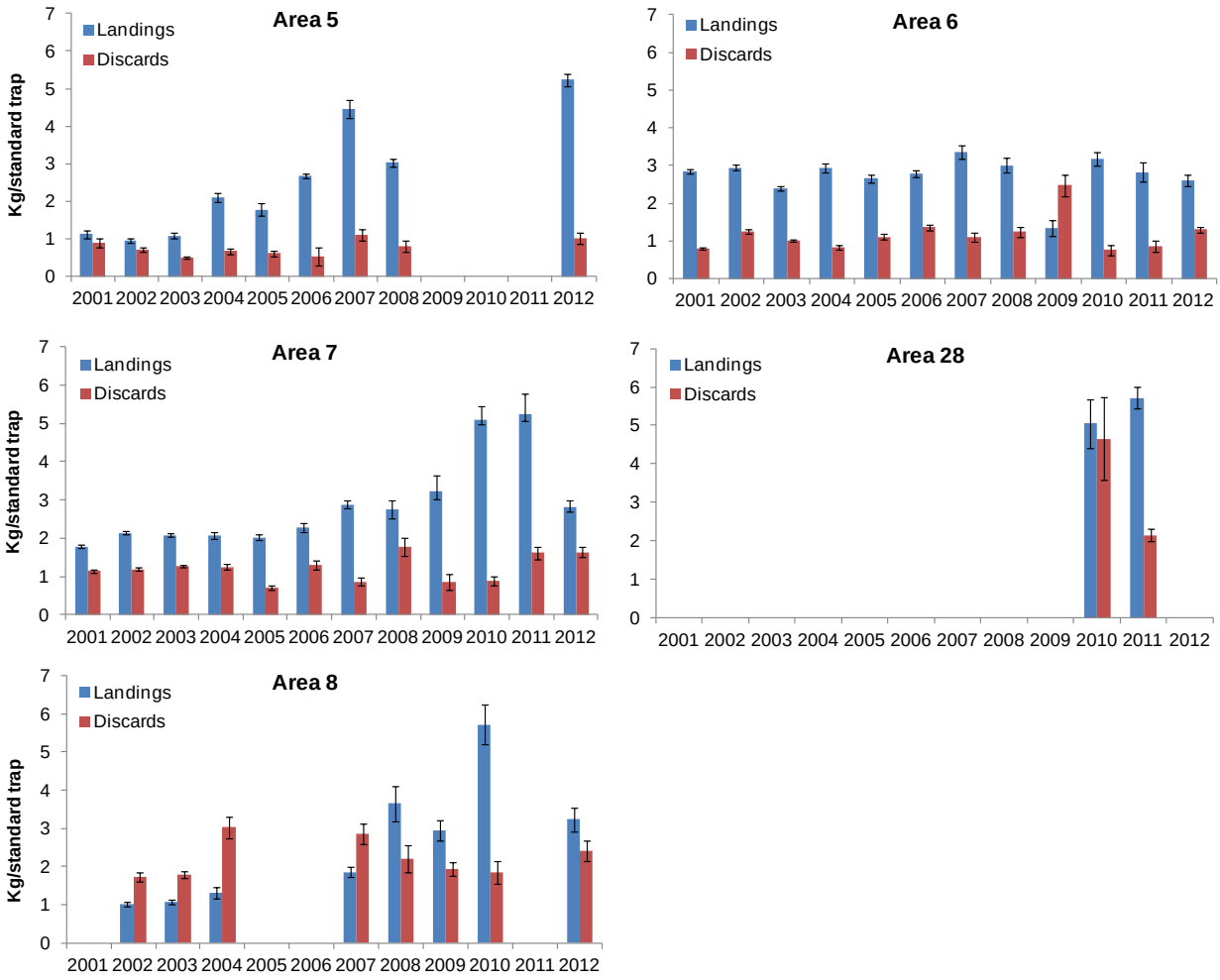

Figure 5.6.2. Indices of LPUE and discards per unit effort (experimental trap) from the reference fleet of crab fishers, per statistical area (Figure 5.6.1) for 2001–2012.

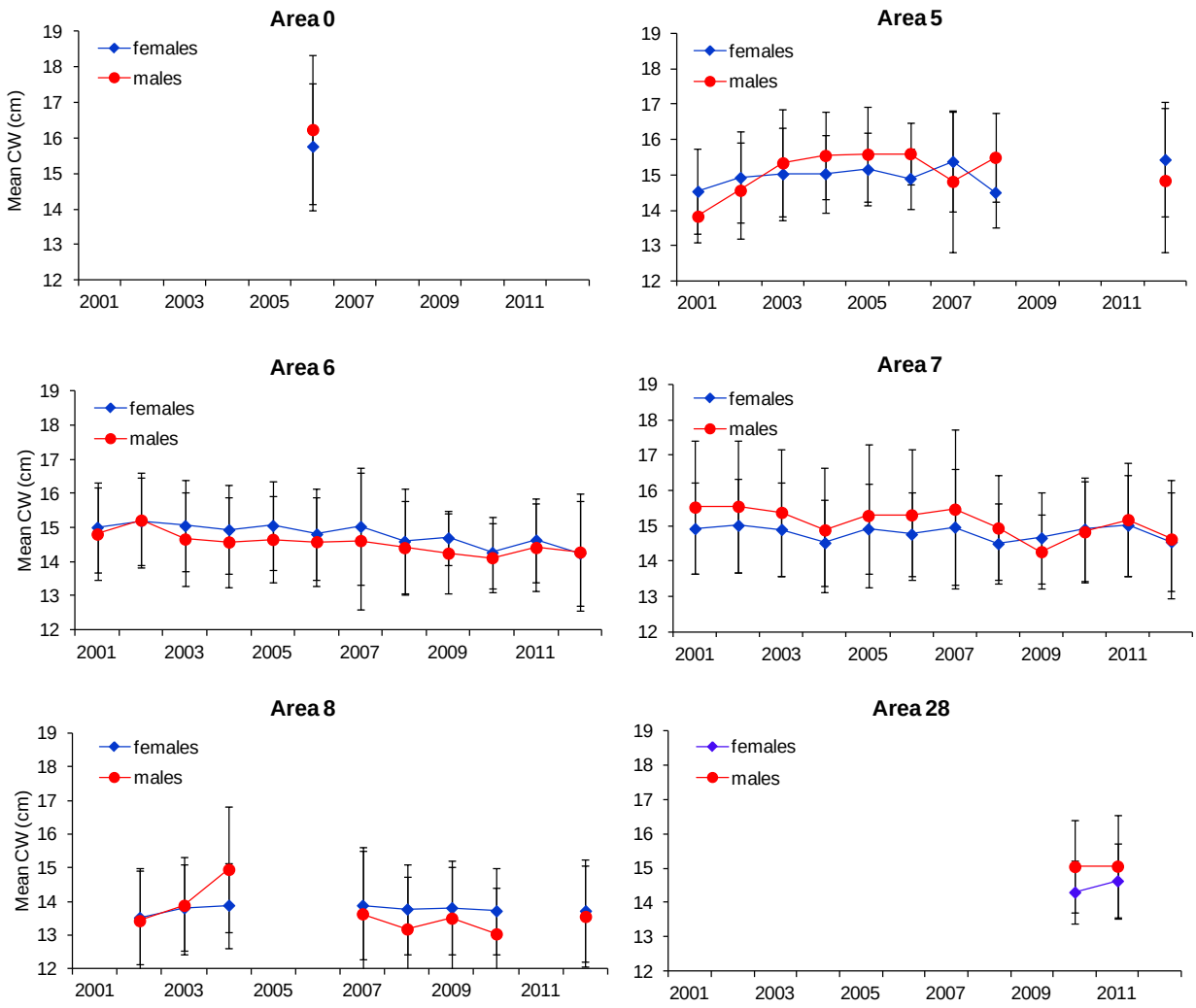

Figure 5.6.3. Mean CW of males and females in landed catch from the reference fleet of crab fishers, by statistical area (Figure 5.6.1) for 2001–2012.

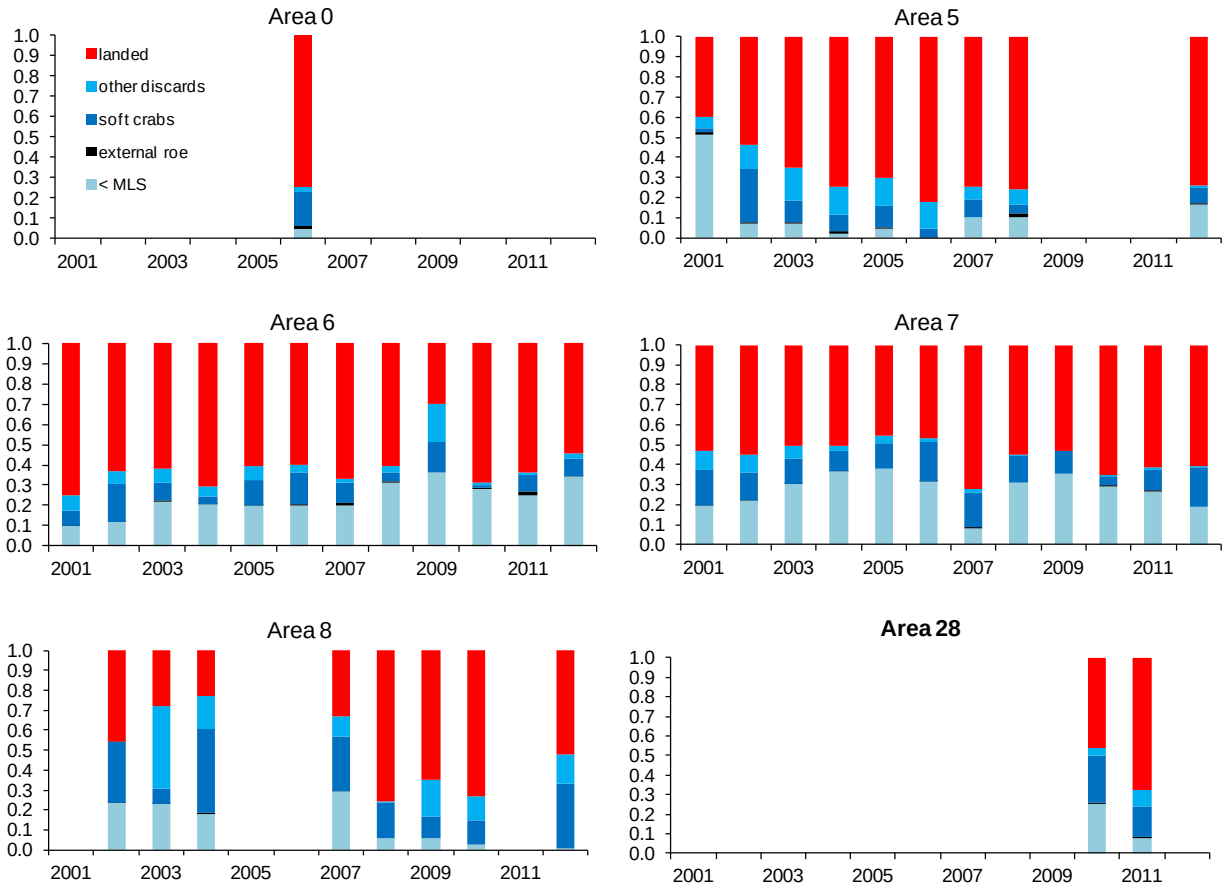

Figure 5.6.4. Proportions of landed and discarded catch from the reference fleet of crab fishers, by statistical area (Figure 5.6.1) for 2001–2012.

6 Red king crab (*Paralithodes camtschaticus*)

Provided by PINRO and IMR

Stock status of the red king crab (*Paralithodes camtschaticus*) in the Barents Sea

Assessment units

The introduced red king crab is extending its distribution continuously and is now occupying significant parts of the southern Barents Sea. The broadest distribution is in the Russian zone extending eastwards along the Kola coast to the Koguljev Island. There is also a notable off shore distribution in the Russian part, which is not the case in Norwegian waters. In Norway, the core distribution goes west to about 25° E, with some single catches further south and west (Figure 6. 1). Since 2007, the red king crab is managed separately between Norway and Russia; regarded as one stock in Russian and one in Norwegian waters.

Figure 6.1. Current geographical distribution and single observations of red king crab.

Data sources, assessment methods and management regulations

Information on the available indicators, assessment methods applied, data sources, biological parameters in models and types of output generated are presented in Table 6. 1. Current management measures are presented in Table 6. 2.

There is no closed area for catch of red king crab in Norwegian waters of the Barents Sea, while in the Russian part the near coastal zone is closed for crab fishery (Figure 6. 2).

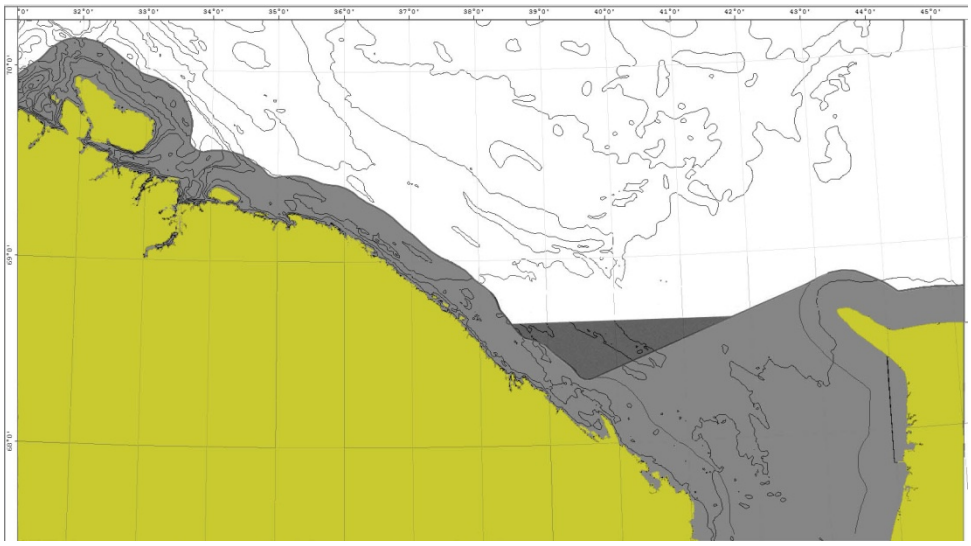

Figure 6. 2. Areas closed for red king crab fishery along the coast of the Kola Penninsula, Russia.

Table 6. 1. Summary of available fisheries indicators, analytical assessments used data sources, biological parameters and output from assessment for the Norwegian red king crab.

	Norway	**Russia**
Number of stocks in which national fleet is active		
Stock areas (cross reference to map)	ICES Area 03	
Indicator		
Landings	1994–2012	1994–2012
Effort	1994–2012	2004–2012
LPUE		2007–2012
DPUE		
Size frequency data	yes	yes
Others		
Analytical assessment methods		
LCA		
Production	2011 - 2013	1994–2012
Change in ratio		
Depletion methods		2007–2012
Others		CSA, LBA with Bayesian approach
Data sources		
Surveys		
Larval		1996–2001
Juvenile index /biomass		
Adult index/biomass	annual	annual
Non target surveys		
Commercial		
Observer/self-reporting/reference fleet		2–3 vessels are covered by observers annually
Size frequency data		observer data

Logbooks	yes	
Tag returns		
VMS	Yes > 15 m	yes
Electronic logbooks		yes
Biological parameters		
M	0,2	0,153
Growth data	incerment and moulting frequency	Norwegian data
Fecundity	yes	yes
Size at maturity	110	90–110
Analytical assessment outputs		
Biomass	yes	yes
Spawning stock	yes	yes
Recruitment	yes	yes
Fishing mortality	yes	yes

Table 6.2. Management measures for red king crab in Norway and Russia

Management measures	**Norway**	**Russia**
Licensing	Yes	Yes
Limited Entry	Yes	No
Closed seasons	No	Yes
Days at sea	No	No
Closed areas	No	Yes
Minimum size	130 mm	132 mm (150 mm CW)
Maximum size	No	No
Berried female legislation	No	No
Soft crabs	No	No
Single sex fishery	No	Yes
Vessel size	< 22 m	50 - 90 m
Vessel power		1100–2500 HP
VMS (AIS)	Yes	Yes
Log book returns	Yes	No
Trap limits	Yes	No
Trap size	No	No
Escape vents	Yes	No
Biodegradable panels	No	Yes
Others		

Landings

Landings for the period 1995 to 2012, in Norway, show an increase in exploitation of the red king crab resource over the recent years in line with management plans. In Russian waters the landing in 2012 has increased considerably since 2010 (Table 6.3).

Table 6.3. Landings of red king crab from 1995 to 2012 in Norwegian and Russian part of the Barents Sea. N.B. Norwegian catches from 1995–2008 are given in number of crabs (x 1000), and in 2009–2012 catches are given in tons.

YEAR	Catch in quota regulated area (Norway)	Catch in free fishing area (Norway)	Russian landings, t (official statistics)
1995	11		9
1996	15		24
1997	15		63
1998	25		90
1999	37,5		143
2000	37,5		113
2001	100		300
2002	100		900
2003	200		1950
2004	280		1105
2005	280		3021
2006	300		9389
2007	300		9953
2008	679		8823
2009	1185 t	4915 t	6142
2010	936 t	969 t	3787
2011	1370 t	354 t	3698
2012	900 t	250 t	5208

Summary of assessment for the red king crab (*Paralithodes camtschaticus*)

Fishery and management

Management of the red king crab in Norwegian waters has two main goals, (a) to obtain a predictable long term harvest in a limited geographical area (Commercial area), and (b) to limit the spread of the crab beyond this limited area (Unrestricted fishery area). From May 2010 the borders for the commercial area were all areas east of 26° E and south of 71° 30′ N. The commercial fishery in this area is regulated by TAC and vessel-quotas, and only male and female crabs larger than 130 mm carapace length are legal for catch.

In 2011 landings of king crabs increased in the quota regulated area, but decreased significantly in the unrestricted area. The crab stock in the regulated area was at a steady state while there was a heavy depletion of the crab stock west of North Cape (26 ° E). In 2012 the catches in the unrestricted areas decreased substantially, and a slight decrease in the TAC in the regulated area. From a management point of view the unrestricted fishery seems to have reduced the rate of the spread of the king crab

further westwards along the coast of northern Norway. Targeted surveys in the recent three years have confirmed this opinion.

The objectives for the management of the red king crab fishery in Russian waters are to maintain a healthy crab stock and a long term sustainable fishery. Two main management instruments are applied to achieve these objectives:

- TAC regulation to prevent overexploitation of the commercial stock;
- Technical measures to minimize mortality of non-commercial crabs (size and sex limitations, season and area restrictions).

The Russian commercial fishery was characterized by a rapid increase in fishing pressure in 2006. The number of vessels participating in the fishery was 30, and the main harvesting area was in the eastern areas off the Kola Peninsula. Maximum actual catch in 2005/2006 was estimated at 9000–10 000 tons. The TAC for the Russian fishery has then been reduced to 4000 t in 2010/2011 with an increase to 5500 t in 2012.

Surveys and assessment

The king crab stock in the Norwegian regulated area is surveyed yearly during autumn. There is one cruise covering the four fjords where crab density is obtained using a specially designed crab trawl. In addition traps are used to investigate areas where it is not possible to trawl and to increase the number of crabs that are available for measurement of size and sex composition. Only traps are used in the open sea areas to attain figures for crab densities. Stock indices are established by applying a probability approach to handle the challenge with too many zero observations in sampling. Estimates of crab stock indexes are estimated using a survey model (Hvingel *et al*. 2012), and these indexes are main input data in a population dynamics model to establish prognoses, risk analysis etc.

In Russian waters research surveys have been the basis for assessment of the crab stock until 2009. However, in the recent two years, the accuracy of index estimation has been seriously criticized because of limited coverage. Nevertheless, the abundance indices for trawl surveys, together with data on LPUE, are the main parameters indicating the stock status. In 1994–2006, there were additional trawl surveys carried out in spring in order to study crab spawning migrations. From 2007 to 2010, trap surveys for crab were conducted, but this survey was not carried out in 2011 due to technical reasons. Besides, since 2008, trap and diving surveys have been conducted in the coastal zone of the Kola and Kanin Peninsulas.

Assessment approaches to the red king crab stock

As noted above, management of the red king crab in Norway has two main objectives; 1) to sustain a predictable fishery at a certain level within a limited geographical area, and 2) to prevent further dispersal of the crab westwards along the coast and northwards into the Barents Sea. A MSY–approach in the assessment is therefore questionable. Nevertheless, since 2010 the MSY-concept has been applied as an assessment tool for the advice for harvest on this stock.

Assessment of the stock status in Russian waters is based on analytical models including CSA, LBA, production and depletion by Leslie. CSA (catch survey analysis) is the main assessment tool developed for minor stocks of red king crabs with quite low catches during annual surveys (Zheng *et al.*, 1997). At present, biological reference points are not used to assess TAC in the prediction years. These reference points may

only be estimated technically with high uncertainty, and assumptions which will have a significant influence on accuracy of such estimates.

Stock indices and exploitation rate

There was a small increase in the legal male stock indices decreased from 2012 to 2013 in Norwegian waters. This is probably due to a better coverage of the stock during the autumn cruise, particularly in the fjords. However, the size distribution of the crab in different parts of eastern Finnmark confirms partly this observation revealing more crabs larger than 130 mm carapace length (MLS). Exploitation rates of legal male stock in the Norwegian king crab fishery have increased substantially in recent years from about 30 % in 2007 to about 70% in 2012. Most catches of crabs today therefore consist of recruits. Stock indices of pre-recruits in 2012 are at a medium level and there are few signs of numerous year classes in any areas in Norwegian waters.

The results from running models showed gradual reduction in the red king crab commercial stock in Russian waters since 2005. The enhancement of recruitment observed in 2006/2007 had no influence on the continuing reduction in the commercial stock abundance. In addition, catch reductions during 2008–2011 and recruitment enhancement in 2010 influenced positively on the negative tendencies of the commercial stock abundance in 2011/2012. Exploitation rates of the legal male stock in the Russian king crab fishery have decreased substantially in recent years from about 43 % in 2007 to about 12 % in 2012.

Conclusions

The overall decrease in the king crab stock in recent years indicates that the crab stock in Norwegian waters probably have reached its maximum level of production. In order to meet the objective to limit the spread of the crab further westwards, increased exploitation rates and a lower minimum legal size is probably necessary.

Increase of the commercial stock in the last 3 years in the Russian Economic Zone (REZ) under the conditions of relatively low level of exploitation can be considered as a positive trend in response to the recovery of the population. Relatively high numbers of pre-recruits in 2010/2011 probably ensured recruitment to the commercial stock, which increased in 2011/2012. The commercial stock may reach its maximum size in the next 3–4 years if the current trends remain in the future.

7 Snow crab (Chionoecetes opilio)

7.1 Canada snow crab fishery

Provided by DFO, Canada

Overview of Newfoundland and Labrador Region

Summary

- Total landings increased by 22% from 44 000 t in 2005 to 53 500 t in 2009, and since declined marginally to 50 500 t in 2012, with an increase in the South (Div. 3LNOPs) and a decline in the North (2HJ3K).
- The multi-species trawl surveys indicate that the exploitable biomass declined from 2008 to 2011 and was unchanged in 2012.
- Recruitment has recently declined and is expected to decline further in the short term (2–3 years).
- Long-term recruitment prospects are unfavourable due to a recent warm oceanographic regime.

Divisions 2HJ

- Landings decreased by 37% since 2008 to 1600 t. Meanwhile effort increased by 55% to 2011 before decreasing by 23% in 2012. The TAC has not been taken in the past 2 years.
- CPUE most recently peaked in 2008, then declined steadily by half to 2011, and was unchanged in 2012.
- The exploitable biomass, as indicated by the post-season trawl survey, declined steadily from 2006 to 2011 and was unchanged in 2012.
- Recruitment declined from 2006 to 2011, changed little in 2012, and is expected to remain low in the short term (2–3 years). The post-season trawl survey pre-recruit index decreased sharply in 2005 and has since fluctuated without trend.
- Long-term recruitment prospects are unfavourable due to a recent warm oceanographic regime.
- The exploitation rate index has increased steadily after 2007 to its highest level since 2004.
- The pre-recruit fishing mortality rate index has been at its highest level since 2004 during each of the past two years. The percentage of the catch handled and released in the fishery increased from about 10% in 2008 to about 35% in 2012 implying a potential increase in pre-recruit mortality.
- Maintaining the current level of fishery removals would likely result in little change in the exploitation rate in 2013 but would likely result in high mortality on soft-shelled immediate pre-recruits.

Division 3K Offshore

- Landings peaked at 12 600 t in 2009 but decreased by 52% to 6000 t in 2012. The TAC was not achieved in the past 3 years. **Effort** peaked in 2009 and has since declined by 31%
- CPUE declined by half from 2008 to 2011 and changed little in 2012.

- The exploitable biomass, as indicated by the post-season trap and trawl surveys, declined by more than half from 2008 to 2011 and was unchanged in 2012.
- Recruitment declined after 2008 and prospects remain poor in the short term (2–3 years). Post-season pre-recruit biomass indices from both trap and trawl surveys have decreased by about 55% after 2008.
- Long-term recruitment prospects are unfavourable due to a recent warm oceanographic regime.
- The trawl survey-based exploitation rate index increased sharply from 2008 to 2010 and changed little in 2011 before decreasing in 2012.
- The pre-recruit fishing mortality rate index increased from 2007 to 2011 but decreased in 2012. The percentage of the catch handled and released in the fishery increased from about 7% in 2008 to about 20% in 2012 implying a potential increase in pre-recruit mortality.
- Maintaining the current level of fishery removals would likely result in little change in the exploitation rate but would likely result in high mortality on soft-shelled immediate pre-recruits in 2013.

Division 3K Inshore

- Landings increased from 2200 t in 2005 to 2900 t in 2009, but decreased by 34% to 1900 t in 2012. The TAC was not taken in the past 4 years in 2 of the 3 management areas. Effort increased by 70% from 2008 to 2011 before decreasing by 19% in 2012.
- CPUE increased sharply from 2005 to a record high level in 2008, then declined by more than half before increasing slightly in 2012.
- The exploitable biomass, as indicated by the post-season trap survey, decreased from 2007 to 2009 and since changed little but there is considerable variability among management areas.
- While uncertain, recruitment prospects appear to have changed little and there is considerable variability among management areas.
- The trap survey-based exploitation rate index changed little between 2011 and 2012.
- Data are insufficient to estimate the pre-recruit fishing mortality rate index.
- Maintaining the current level of fishery removals would likely result in little change in the exploitation rate in 2013. However, it would likely result in high mortality on soft-shelled immediate pre-recruits in some management areas in 2013.

Divisions 3LNO Offshore

- Landings decreased by 11% from 24 500 t in 2006 to 21 900 t in 2009 but since increased by 20% to 26 200 t in 2012. Effort increased by 80% from 2000 to 2008 and has since declined by 23%.
- VMS-based CPUE declined to its lowest level in 2008, but has since increased steadily to above the average of the series.
- The trawl survey index of exploitable biomass declined from 2009 to 2011 and changed little in 2012. The index from the trap survey, which tends to capture older-shelled crabs relatively better than new-shelled crabs in this area, peaked two years later in 2011 and changed little in 2012.
- Recruitment has recently peaked and will likely decrease in the short term (2–3 years).

- Long-term recruitment prospects are unfavourable due to a recent warm oceanographic regime.
- The exploitation rate index increased during the past two years following a sharp decrease from 2008 to 2010.
- The pre-recruit fishing mortality rate index decreased from 2008 to 2011 but increased in 2012. The percentage of the catch handled and released in the fishery decreased from about 20% in 2008 to 12% in 2012, implying a potential decrease in pre-recruit mortality.
- Maintaining the current level of fishery removals would likely result in little change in the exploitation rate in 2013.

Division 3L Inshore

- Landings increased by 19% from 6100 t in 2005 to 7300 t in 2010, and have since changed little, at 7400 t in 2012. **Effort** increased by 24% from 2008 to 2010 but has since declined by 22%.
- CPUE increased sharply in 2012 to its highest level since 1995, after varying about the long term average for the previous 5 years.
- The post-season trap survey index suggests that the exploitable biomass increased in 2012 to its highest level in the time series.
- Recruitment has recently peaked and is in decline, although there is considerable variability among management areas. Short-term (2–3 years) prospects are uncertain.
- The trap survey-based exploitation rate index changed little in 2012 but there was considerable variability among management areas.
- Data are insufficient to estimate a pre-recruit fishing mortality rate index.
- Maintaining the current level of fishery removals would likely result in a decrease in the exploitation rate in 2013.

Subdivision 3Ps Offshore

- Landings almost doubled from 2300 t in 2006 to a peak of 4300 t in 2011, before decreasing by 14% to 3700 t in 2012. Effort increased by 57% from 2008 to 2011 before decreasing slightly in 2012.
- CPUE increased from 2005 to 2009 and has gradually declined since.
- The exploitable biomass, as indicated by both the spring trawl survey and the post-season trap survey indices, increased steadily from 2006 to 2009 before declining sharply from 2009 to 2011 and changed little in 2012.
- Recruitment has recently declined and is expected to decline further in the short term (2–3 years). Pre-recruit biomass indices from both trap and trawl surveys declined sharply from 2009 to 2011 and changed little in 2012.
- Long-term recruitment prospects are unfavourable due to a recent warm oceanographic regime.
- Exploitation and pre-recruit fishing mortality rates, as indicated by spring trawl survey indices, decreased from 2007 to 2009 but increased sharply to 2011 and changed little in 2012.
- Maintaining the current level of fishery removals would likely result in little change in the exploitation rate in 2013.

Subdivision 3Ps Inshore

- Landings peaked at 3500 t in 1999, declined to 700 t in 2005, then more than tripled to 2500 t in 2012. Effort declined from 2005 to 2010 and increased by 36% to 2012.
- CPUE increased steadily from 2005 to 2010, its highest level since 1996, and has since changed little.
- The exploitable biomass, as indicated by the post-season trap survey index, increased substantially between 2006 and 2010 and has since changed little.
- Recruitment has recently decreased. The index of pre-recruit-sized males has recently decreased, suggesting a further decline in recruitment in the short term (2–3 years).
- The post-season trap survey-based exploitation rate index changed little during 2008 to 2011 but increased in 2012.
- Data are insufficient to estimate a pre-recruit fishing mortality rate index.
- Maintaining the current level of fishery removals would likely result in little change in the exploitation rate in 2013.

Division 4R Offshore

- Landings declined by 83% from 190 t in 2007 to a historical low of 30 t in 2010, but increased back to 190 t in 2012. Effort increased by a factor of four in 2011 following the historical low in 2010 and changed little in 2012. The TAC has not been taken since 2002.
- VMS-based CPUE declined from 2004 to its lowest level in 2009 before increasing to the average of the series in 2012.
- The exploitable biomass remains low relative to other areas.
- Recruitment prospects are uncertain in the short term (2–3 years).
- Long term recruitment prospects are unfavourable due to a recent warm oceanographic regime.
- Data are insufficient to calculate the exploitation rate and pre-recruit fishing mortality rate indices.
- The effect of maintaining the current level of removals on the exploitation rate in 2013 is unknown.

Division 4R Inshore

- Landings declined by 80% from 950 t in 2003 to a historical low of 190 t in 2010. They more than doubled to 450 t in 2011 and increased further to 550 t in 2012. Effort declined by 95% from 2004 to 2010 and doubled in 2011 before decreasing substantially in 2012. The TAC has not been taken since 2002.
- CPUE declined by more than half from 2002 to 2007 and changed little to 2010 before more than doubling to 2012.
- The exploitable biomass, as indicated by the post-season trap survey, fluctuated at a low level from 2006 to 2010 but tripled in 2011 and changed little in 2012.
- Recruitment has recently increased and is expected to remain strong in 2013, but short-term (2–3 years) prospects are unfavourable.
- The post-season trap survey-based exploitation rate index decreased sharply in 2012.
- Data are insufficient to estimate a pre-recruit fishing mortality rate index.

- Maintaining the current level of fishery removals would likely result in little change in the exploitation rate in 2013.

Overview of Northern Gulf of St. Lawrence Region

Zone 17

Conclusion and advice

- The TAC increased by 15% between 2011 and 2012 to 1809 t and was met.
- The catch rate during the 2012 commercial fishery decreased and was near average. Landings consisted primarily of intermediate-shell crabs.
- The catch rate in the post-season survey decreased slightly in 2012 and has remained below average since 2007. This survey suggests that 2013 fishing yields could decrease slightly compared to those of 2012 and that mainly, intermediate-shell or old crab will be available.
- The combined commercial CPUE and post-season NPUE index suggests that there will be less biomass available to the fishery in 2013 than there was in 2012.
- The size of crabs caught in the commercial fishery remained stable in 2012 and was high, but it should decrease in 2013 according to the post-season survey.
- The post-season survey suggests that there will be little recruitment to the fishery in 2013. This is consistent with the results of the 2011 trawl survey, which indicates that the stock is currently in a recruitment trough.
- Maintaining of increasing 2012 catches in 2013 would result in a harvesting intensity greater than that in 2012. An increase in catches may result in a greater reduction of the legal-size adult male biomass because of low recruitment; this would make the fishery more vulnerable to the presence of white crab in catches when recruitment resumes in 2014. Moreover, a significant decrease in large adult males could result in a decline in reproductive success because, according to the trawl survey, primiparous females will remain abundant in 2013 and 2014.

Recommendation

- Maintaining the 2012 TAC (1809 t) in 2013 to avoid creating an excessively high harvesting intensity and to protect against possible White Crab issues.

Zone 16

Conclusion and advice

- The TAC decreased by 20% in 2011 and remained stable at 3686 t in 2011 and in 2012, when it was met.
- The catch rate increased to above average during the 2012 commercial fishery. Landings have consisted primarily of recruits since 2006.

- The post-season survey suggests that there will be more biomass available to the fishery in 2013 than there was in 2012 and that landings will still consist primarily of recruits.
- The combined commercial CPUE and post-season NPUE index is very high and suggests that there will be more biomass available in 2013 than there was in 2012.
- The size of crabs caught in the commercial fishery decreased slightly in 2012 but remains well above average. It should remain stable in 2013 according to the post-season survey.
- The post-season survey indicates high recruitment in 2012. This is consistent with the trawl survey conducted in the western part of the area. Therefore, the fishery should be driven by a recruitment wave that should continue until 2015.
- The increase in the combined biomass index and the maintenance of high recruitment of legal-size crabs indicate that catches can be increased in 2013 without creating an excessively high harvesting intensity.

Recommendation

- For 2013, increasing catches to a maximum of 25% (4607.5 t) of the 2012 TAC would not result in an excessively high harvesting intensity.

Zone 15

Conclusion and advice

- The TAC and landings have peaked at 593 t since 2008.
- The commercial fishery catch rate increased to above average in 2012. Landings consisted of a slight majority of intermediate-shell crabs although there was a significant proportion of recruits.
- The post-season survey suggests that fishing yields will remain high in 2013 and include mostly intermediate-shell crabs and a relatively high proportion of recruits.
- The combined commercial CPUE and post-season NPUE index is relatively high and suggests that there will be more biomass available in 2013 than there was in 2012.
- The size of crabs caught in the commercial fishery increased and remains well above average. It should remain high in 2013 according to the post-season survey.
- The abundance index of recruits and of adolescents ≥ 78 mm in the post-season survey remained high in 2012, foreshadowing the maintenance of high recruitment in the short term.
- The increase in the combined biomass index and the maintenance of high recruitment of legal-size crabs indicate that catches could be slightly increased without creating an excessively high harvesting intensity.

Recommendation

- For 2013, increasing catches to a maximum of 10% of the 2012 TAC (652.3 t) would not result in an excessively high harvesting intensity.

Zone 14

Conclusion and advice

- The TAC was 407 t in 2011 and 2012 and was met.
- The commercial fishery catch rate has been stable but below average since 2010. In 2012, landings consisted primarily of intermediate-shell crabs although the proportion of recruits had been increasing since 2008.
- The post-season survey suggests that the commercial fishery catch rate will be higher in 2013 than in 2012 and that landings will consist of a higher proportion of recruits.
- The combined commercial CPUE and post-season NPUE index suggests that there will be more biomass available in 2013 than there was in 2012.
- The size of crabs caught in the commercial fishery has decreased since 2009 and was well below average in 2012. It should remain low in 2013 according to the [missing text].
- The post-season survey indicates that the abundance of adolescent crabs ≥ 78 mm and of recruits increased to the highest level in the series in 2012.
- The increase in the combined biomass index and the high recruitment of legal-size crabs indicate that catches could be slightly increased without creating an excessively high harvesting intensity.

Recommendation

- For 2013, increasing catches to a maximum of 10% of the 2012 TAC (447.7 t) would not result in an excessively high harvesting intensity.

Zone 13

Conclusion and advice

- Following a five-year moratorium (2003 to 2007), the area was opened with a TAC of 150 t for 2008 and 2009 and a TAC of 188 t for 2010 and 2011. The TAC was decreased to 169 t in 2012 and landings were 163 t.
- The commercial fishery catch rate increased between 2011 and 2012 but remains below the 1988–2011 average. Fishing effort was higher in the southern part of the area. Since 2008, landings have consisted primarily of intermediate-shell crabs although the proportion of recruits has increased since 2010.
- North and south post-season surveys suggest that the commercial fishery catch rate will be higher in 2013 than in 2012. If the fishing effort remains higher in the south, landings will still primarily consist of intermediate-shell crabs.
- The combined commercial CPUE and post-season NPUE index suggests that there will be more biomass available in 2013 than there was in 2012.

- The size of crabs caught in the commercial fishery was well above average in 2012 and according to the post-season survey in the south, it should remain high in 2013.
- The post-season survey indicates a sharp increase in the abundance of recruits and of adolescents ≥ 78 mm in the north, which is consistent with the results of the trawl survey that indicates the presence of a recruitment wave in this part of the area. The south post-season survey indicates a slight decrease in recruits and adolescents.
- The increase in the combined biomass index, coupled with stronger recruitment of legal-size crabs, suggests that catches could be increased slightly without creating an excessively high harvesting intensity.

Recommendation

- An increase in 2013 catches to a value not exceeding 188 t would not result in an excessively high harvesting intensity.

Zone12A

Conclusion and advice

- The TAC increased by 40% between 2011 and 2012 to 162 t and was met.
- The catch rate during the commercial fishery decreased in 2012 but remains high. Landings consisted primarily of intermediate-shell crabs.
- According to the post-season survey, fishing yields will decrease in 2013 and catches will consist primarily of intermediate-shell crabs.
- The combined commercial CPUE and post-season NPUE index suggests a decrease in the biomass available to the fishery in 2013 compared to 2012.
- The size of crabs caught in the commercial fishery is at the highest value in the series since 2011, but should decrease in 2013 according to the post-season survey.
- The post-season survey indicates a sharp decrease in the abundance of recruits and of adolescent crabs ≥ 78 mm to well below average values.
- Maintaining 2012 catch levels or increasing them in 2013 would result in a harvesting intensity greater than that in 2012. An increase in catches may result in a greater reduction of the legal-size adult male biomass because of low recruitment; this would make the fishery more vulnerable to the presence of White Crab in catches when recruitment resumes in 2014.

Recommendation

- Maintaining the 2012 TAC (162 t) for 2013 should avoid creating an excessively high harvesting intensity and guard against possible White Crab issues.

Zone 12B

Conclusion and advice

- The TAC increased by 20% between 2011 and 2012 to 325 t and was met.
- The catch rate in the commercial fishery increased slightly and is well above average. Landings consisted primarily of intermediate-shell crabs.

- The post-season survey suggests that the commercial fishery catch rate will be higher in 2013 than in 2012. Landings should consist primarily of intermediate-shell or old crabs if the entire area is harvested.
- The combined commercial CPUE and post-season NPUE index is high and suggests that more biomass will be available in the 2013 season than there was in 2012.
- The size of crabs caught in the commercial fishery has increased gradually since 2009 and was well above average in 2012. It should remain high in 2013 according to the post-season survey.
- The 2012 post-season survey indicates that the abundance of recruits and of adolescents ≥ 78 mm remained near the historical average.
- The increase in the combined biomass index and the maintenance of recruitment of legal-size crabs indicate that catches could be increased without creating an excessively high harvesting intensity.

Recommendation

- An increase of 15 to 20% in the 2012 TAC for 2013 would not result in an excessively high harvesting intensity.

Zone 12C

Conclusion and advice

- The TAC has peaked at 320 t since 2008 and was met in 2012.
- The commercial fishery catch rate has been below average since 2009 despite a slight increase in 2012. Landings consisted primarily of intermediate-shell crabs.
- The post-season survey suggests that the commercial fishery catch rate will be slightly higher in 2013 than in 2012 and that landings will consist primarily of intermediate-shell crabs.
- The combined commercial CPUE and post-season NPUE index suggests that slightly more biomass will be available in 2013 than there was in 2012.
- The size of crabs caught in the commercial fishery decreased slightly in 2012 compared to 2011 but remains above average. It could decrease slightly in 2013 according to the post-season survey.
- The post-season survey indicates a decrease in the abundance of adolescent crabs ≥ 78 mm and recruits to values that are near and slightly above average, respectively.
- The slight increase in the combined biomass index and the maintenance of recruitment of legal-size crabs at an above-average level indicate that catches could be slightly increased without creating an excessively high harvesting intensity.

Recommendation

- For 2013, increasing catches to a maximum of 10% of the 2012 TAC (352 t) would not result in an excessively high harvesting intensity.

Zone 16A

Conclusion and advice

- The TAC has peaked at 426 t since 2009 and was met in 2012.
- The commercial fishery catch rate has remained low since 2009 despite a slight increase in 2012, when landings consisted primarily of intermediate-shell crabs although there was an increase in recruits.
- The post-season survey suggests that the commercial fishery catch rate will be higher in 2013 than in 2012 and that landings will still consist primarily of intermediate-shell crabs.
- The combined commercial CPUE and post-season NPUE index suggests that there will be more biomass available in 2013 than there was in 2012.
- The size of crabs caught in the commercial fishery in 2012 was greater compared to 2011 and well above average. It should remain high in 2013 according to the post-season survey.
- The post-season survey indicates a high abundance of recruits and of adolescent crabs ≥ 78 mm since 2010, foreshadowing the maintenance of high recruitment in the short term.
- The increase in the combined biomass index and the maintenance of high recruitment of legal-size crabs indicate that catches could be increased slightly without creating an excessively high harvesting intensity.

Recommendation

- For 2013, increasing catches to a maximum of 10% of the 2012 TAC (i.e. to 468.6 t) would not result in an excessively high harvesting intensity.

Overview of Southern Gulf of St. Lawrence Region

Summary

- Snow crab in fishing areas 12, 19, 12E, and 12F comprise a single biological population and the southern Gulf of St. Lawrence stock is considered as one unit for assessment purposes.
- The landings of snow crab from the southern Gulf of St. Lawrence in 2012 were 21 956 t from a quota of 22 007 t.
- The assessment in 2012 was conducted as per the recommendations of the Snow Crab Assessment Methods Framework Science Review held November 2011. The major change to the assessment methodology in 2012 was a revised sampling design that distributed sampling effort equally among 325 sampling grids.
- The exploitation rate of the 2012 fishery was 34.8%.
- The 2012 post-fishery survey biomass of commercial-sized adult male crabs was estimated at 74 997 t (95% C. I. 65 822 to 85 086 t), an increase of 18.7% from 2011. The available biomass for the 2013 fishery, derived from the 2012 survey, is within the healthy zone of the Precautionary Approach framework.
- Sixty five percent (65%) of the 2012 survey biomass, available for the 2013 fishery, is composed of new recruitment (48 969 t). The recruitment to the commercial biomass from the 2012 survey increased by 66.7% relative to the previous year.

- The residual biomass (26 028 t) from the 2012 survey decreased by 22.9% compared to 2011.
- The abundance of mature females remained high in 2012 relative to the low values observed during 2005 to 2009.
- The available predictions of recruitment of commercial-sized adult male crab indicate that they should remain at levels comparable to that of 2012 until the 2016 fishery.
- A risk analysis of catch options relative to reference points for the 2013 fishery is provided.

Fishery performance in 2012 in Area 12

- The 2012 landings in Area 12 were 18,159 t (quota of 18 143 t).
- The CPUE (expressed as kg per trap haul (kg/th)) in 2012 (68.0 kg/th) increased compared to 2011 (53.0 kg/th).
- The incidence of soft-shelled crab remained low at 3.7% compared to 6.2% in 2011.

Fishery performance in 2012 in Area 19

- The 2012 landings in Area 19 were 2906 t (quota of 2907 t).
- The CPUE in 2012 (178.1 kg/th) increased compared to 2011 (133.3 kg/th) and represents the highest value observed since records began in 1987.
- The incidence of white-crab decreased from 11.5% in 2011 to 4.5% in 2012.

Fishery performance in 2012 in Area 12E

- In Area 12E, the landings were 185 t (quota of 251 t).
- The CPUE in 2012 (32.9 kg/th) slightly increased compared to 2011 (31.5 kg/th).
- The incidence of soft-shelled crab in 2012 decreased to 3.3%, compared to 8.4% in 2011.

Fishery performance in 2012 in Area 12F

- The 2012 landings in Area 12F were 706 t (quota of 706 t).
- The CPUE in 2012 (41.8 kg/th) increased compared to 2011 (32.5 kg/th).
- The incidence of soft-shelled crab increased from 2.6% in 2011 to 9.4% in 2012.

Overview of Maritimes Region

Summary

- Landings in 2012 for N-ENS and S-ENS were 603 and 11 707 t, respectively, and they were 345 t in 4X for the 2011/12 season, representing an increase of 13%, a decrease of 4% and no change relative to the previous year. Total allowable catches in 2012 were 603, 11 733 and 346 t in N-ENS, S-ENS and 4X.

- Non-standardised catch rates in 2012 increased by 6% in N-ENS, decreased by 8% in S-ENS and decreased by 24% in 4X, relative to the previous year. In S-ENS, decreased catch rates were attributed to a 14% decrease in CFA 24.
- In N-ENS, the estimated soft shell crab discard (% of total landings) increased to 8.9% in 2012, vs. 1.7% in 2011, possibly due to increased summer fishing activities. In S-ENS, 2012 estimated soft shell discards remained near 6.3% of the TAC. Soft shell discards in 4X are negligible.
- The post-fishery fishable biomass decreased by 8.7% in N-ENS and by 3.6% in S-ENS relative to 2011. In 4X, the preliminary pre-fishery fishable biomass decreased by 29.2% relative to 2010/2011, but further analysis of the 4X survey data is required to account for extreme temperature conditions in 2012.
- The recruitment index has decreased in all areas. Recruitment is currently at intermediate levels in S-ENS and low levels in N-ENS and 4X. In S-ENS, recruitment will likely continue for the next 4–5 years. However, for N-ENS and 4X little to no recruitment is expected for the next 4–5 years.
- High relative densities of predators were found in areas with high densities of immature snow crab. This predation may lower future recruitment to the fishable biomass and affect movement patterns of snow crab.
- Female snow crab abundance and associated egg production in all areas continue to decline after reaching highs in 2007/2008. Egg production is now below the long-term mean and is expected to remain so for at least 2–4 years due to a lack of maturing female crab.
- In ENS, estimates of bycatch were 0.01% of snow crab landings. 4X shows higher (relative to ENS) bycatch rates at 0.02 % of snow crab landings. Bycatch levels are extremely low in this fishery.
- A reference points-based Precautionary Approach has been implemented in this fishery. The Limit Reference Point is 25% of carrying capacity and the Upper Stock Reference is 50% of carrying capacity. The target Removal Reference is 20% of the fishable biomass in each area and the Removal Reference is not to exceed FMSY. Various secondary (population and ecosystem) indicators are taken into consideration for management decisions.
- In N-ENS, fishable biomass has been stable and in the "healthy" zone (FB > USR) over the past three years. This positive outlook is, however, for the short-term. In the medium to long-term, there is a need to be mindful of the gap in recruitment which may limit the scope for flexibility in this area without immigration from other areas. A status quo TAC is recommended.
- In S-ENS, the population is considered to be in the "healthy" zone (FB > USR). As the fishable biomass continues to be near historically high levels with recruitment expected for at least the next three to four years, there is considerable scope for flexibility. A status-quo to a marginal decrease in TAC would maintain current exploitation rates.
- In 4X, fishable biomass is in the "healthy" zone (FB > USR). However, as recruitment and potential immigration into the 2011/2012 season is uncertain, a more conservative harvest strategy is recommended pending further analysis before the 2013/2014 season.

- There have been an increasing number of anecdotal reports of unreported illegal landings, particularly in S-ENS. Such activities negatively impact the assessment and the application of a precautionary approach and must be addressed.

Table 7.1.1. Landings of snow crab in Atlantic Canada 1979–2012.

	NL								GSL			NS					
	2HJ	3K	3L	3NO	3LNO	3Ps	4R3Pn	Total NL	4S	4T	Total GSL	4X	4VsW	4Vn	4V	Total NS	Overall
1979		849	10,315		10,315	13		11,177	645	17397	18042		669	1,007	1,676	1,676	30,895
1980		581	8,833		8,833			9,414	1578	16531	18109		413	414	827	827	28,350
1981		1,303	12,855		12,855	38		14,196	1802	23284	25086		103	86	189	189	39,471
1982		2,443	11,041		11,041	14		13,498	3040	33362	36402		315	249	564	564	50,464
1983		4,898	6,211		6,211	4		11,113	3789	26070	29859		183	123	306	306	41,278
1984		5,031	4,524		4,524			9,555	5079	28099	33178		93	46	139	139	42,872
1985	332	4,001	2,638	7	2,645	705	291	7,974	5818	27731	33549		63	14	77	77	41,600
1986	468	4,277	3,506		3,506	584	133	8,968	5367	27359	32726		98	25	123	123	41,817
1987	232	2,678	3,133		3,133	587	50	6,680	5255	14016	19271		241	120	361	361	26,312
1988	456	2,681	5,319	327	5,646	723	82	9,588	3873	15026	18899		370	256	626	626	29,113
1989	483	2,346	4,423	531	4,954	528	15	8,326	2622	10632	13254		444	255	699	699	22,279
1990	602	4,309	5,394	78	5,472	597	46	11,026	4496	9491	13987		929	291	1,220	1,220	26,233
1991	1003	8,353	6,430	19	6,449	309	48	16,162	4743	12826	17569		1,210	354	1,564	1,564	35,295
1992	1,494	7,543	6,992		6,992	170	238	16,437	4566	14437	19003		1,338	454	1,792	1,792	37,232
1993	2,267	10,463	9,074	148	9,222	829	141	22,922	5325	17562	22887		1,432	578	2,010	2,010	47,819
1994	2,971	10,724	11,944	106	12,050	1,538	634	27,917	7830	23324	31154	17	1,179	395	1,574	1,591	60,662
1995	3,189	12326	14007	14	14,021	1929	869	32,334	7879	23727	31606	11	1,126	428	1,554	1,565	65,505
1996	3,102	14210	16416	427	16,843	2974	838	37,967	7416	18626	26042	4	1,124	368	1,492	1,496	65,505
1997	3,183	14796	20691	1454	22,145	4675	927	45,726	6274	17655	23929	42	1,157	534	1,691	1,733	71,388
1998	4,098	16839	23289	730	24,019	6624	1060	52,640	6447	13864	20311	70	1,558	657	2,215	2,285	75,236
1999	5,428	21386	26220	6506	32,726	7905	1597	69,042	7104	15517	22621	119	2,700	899	3,599	3,718	95,381

2000	3,673	15390	22600	4173	26,773	7887	1627	55,350	8947	19183	28130	213	8,701	1,017	9,718	9,931	93,411
2001	3,738	15288	23469	4697	28,166	7839	1683	56,714	9611	18426	28037	376	9,048	1,066	10,114	10,490	95,241
2002	3,521	16352	25013	5023	30,036	7637	1851	59,397	10372	26171	36543	221	8,891	1,495	10,386	10,607	106,547
2003	2,532	16502	26046	5592	31,638	6113	1562	58,347	6233	21163	27396	289	8,836	1,492	10,328	10,617	96,360
2004	1,925	16460	25746	5283	31,029	4720	1462	55,596	5790	31675	37465	289	8,022	1,405	9,426	9,715	102,776
2005	1,576	8679	27219	4740	31,959	3173	859	46,246	6382	36165	42547	424	6,228	551	6,779	7,203	95,996
2006	2,139	10712	28279	2464	30,743	3105	539	47,238	7776	29076	36852	308	4,389	484	4,873	5,181	89,271
2007	2,523	12271	28391	2499	30,890	3962	562	50,208	7797	26867	34664	320	4,855	233	5,088	5,408	90,280
2008	2555	15068	27971	2227	30,198	4522	381	52,724	7586	24458	32044	220	7,951	227	8,178	8,398	93,166
2009	2,387	16184	26666	2367	29,033	5559	288	53,451	8266	23642	31908	230	10,469	578	11,046	11,276	96,635
2010	2,131	12420	29115	2304	31,419	6026	218	52,214	8208	9549	17757	230	12,616	577	13,193	13,422	83,393
2011	1,931	10744	30276	2636	32,912	6717	637	52,941	7490	10708	18198	346	11,959	536	12,495	12,840	83,979
2012	1,606	8390	29907	3701	33,608	6208	783	50,595	7866	21,956	29822	344	11,404	595	11,999	12,343	92,760

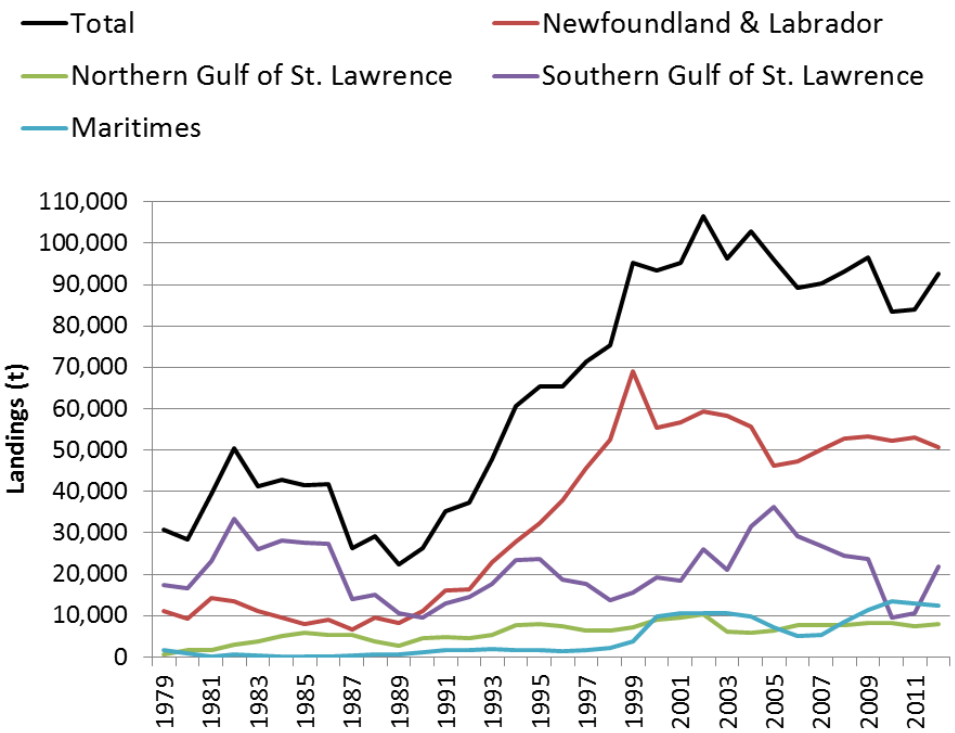

Figure 7.1.1. Atlantic Canada snow crab landings by Region.

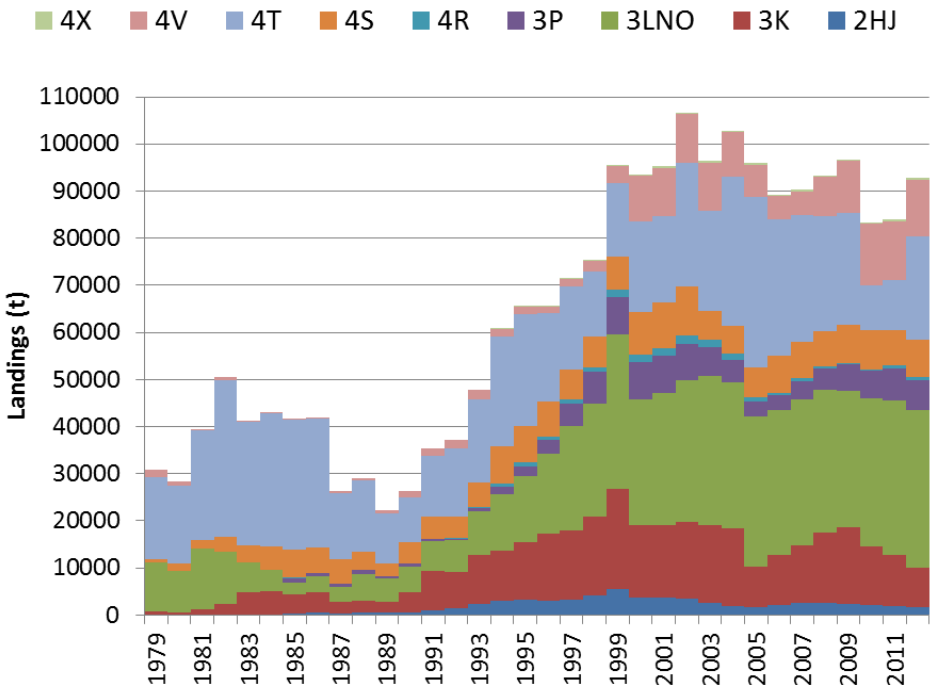

Figure 7.1.2. Atlantic Canada snow crab landings by NAFO Division.

7.2 Greenland snow crab fishery

Provided by Greenland Institute of Natural Resources

Regulations

Snow crabs are distributed along the West coast of Greenland and are commercially exploited primarily from Disko Bay in the North (up to 71° 30N) to Paamiut in the South (60° 45N). Commercial fishing for snow crab began primarily in inshore areas (within basis-line) in the mid-1990s and from 1999, also included offshore areas (outside basis-line).

Since 2004, the crab resource in Greenland has been managed in 6 areas (from North to South - Upernavik, Uummannaq-Disko Bay, Sisimiut, Maniitsoq-Kangaamiut, Nuuk-Paamiut and Narsaq-Qaqortoq, Figure 7.2.1). The fishing fleet is made up of two components; small vessels (less than 75 GRT), which have exclusive rights for fishing inshore within the basis-line as well as offshore. Small vessels are, however, restricted to fishing in only 2 management areas during the year. Large vessels (greater than 75 GRT) may only fish in all offshore areas (outside the basis-line), but not within the "Crab Boxes". Quota restrictions have been imposed to each of the 6 management area since 1995 and individual quotas to vessels larger > 75 GRT, but have only limited the catch in 2004. Management decisions allow increasing quota in each of the 6 management area, when the catch achieved the first fixed quota. Unused quota from larger vessels is re-allocated to the inshore fleet (small vessels < 75 GRT). Basically, there is now quota restriction for the small vessel. The fishery is regulated by prohibitions to land females and undersized males (<100 mm CW), logbooks for all vessels larger than 10 meters and closure of the fishery north of 64°N for 3 months (1 January to 31 March).

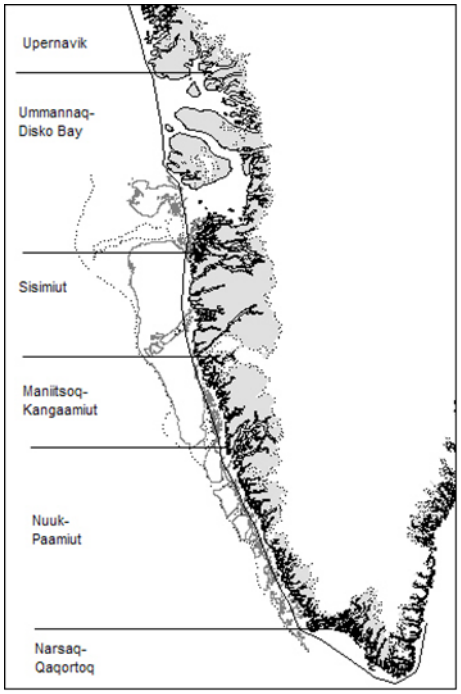

Figure 7.2.1. Map of West Greenland outlining the 6 management areas for the snow crab fishery.

The fishery

The historical development of the crab fishery in Greenland is shown in Figure 7.2.2 and table 7.2.1. 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 approx. 2.100 tons and total landings was 2.015 tons in 2011.

Landings with in each of the management areas have vary over time (Figure 7.2.3) and in 2012 30% of total landings were taken in Management area Sisimiut and Nuuk-Paamiut, whereas the contribution from Narsaq-Kap Farvel amounted 22 %.

The total fishing effort (trap hauls) has declined by 91% since 2001 (from 3,416 to 319 thousand trap hauls during 2001–2012); (Figure 7.2.3). The decline in fishing effort has been mostly due to a declining number of participants in the fishery.

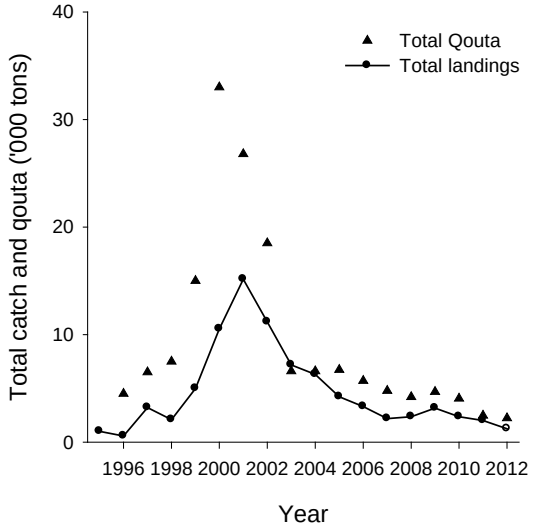

Figure 7.2.2. Total catch and quota from 1995–2012. Data from 2012 is preliminary and incomplete.

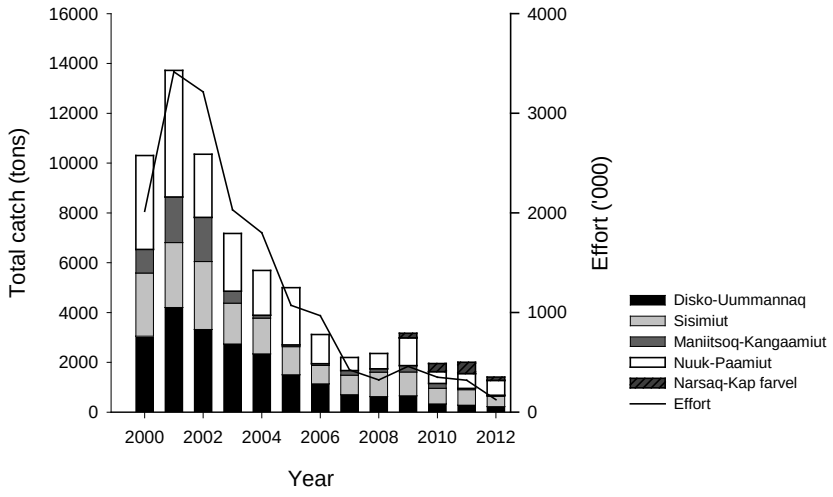

Figure 7.2.3. Snow crab landings in the 4 most important management areas of West Greenland 2000–2012 and used total effort. Data for 2012 are preliminary and incomplete.

Objective of recommendations in Greenland

There are no specific long-term management objectives for the snow crab resource in West Greenland, however since 2004 the main objective of recommendations from GINR has been to stop the decline in biomass of the crab resource in the different management areas. The recommendations are not expected to result in increased stock biomass in the short term, but only stop the current decline. If a rebuilding of the stock to achieve a higher exploitable biomass and better catch rates is the objective, then the recommended catches should be further reduced to allow the stock to grow.

Stock status

The accumulated biomass available to the fishery in 2013 is highly variable according to the stocks. Generally, in 2012, stocks in each management area along the west coast of Greenland were characterized as stable at a low level (management areas of Disko Bay and Nuuk-Paamiut) or significantly decreasing commercial biomass in management area of Sisimiut. Recommendations for 2013 are status quo in terms of TAC in all areas. In Sisimiut management area the offshore site were recommend close until the stock rebuild.

Management area Uummannaq – Disko Bay

Landings declined by 88% from 4 202 t in 2001 to 513 t in 2012, while effort decreased by 96% (Figure 7.2.4 and Table 7.2.1). The exploitable biomass has been stable within the past 4 years in the Northern part of Disko Bay, has decreased until 2011 but increased in 2012 in the southern part of the management area (Figure 7.2.5). Recruitment has decreased since 2010 in the southern part and is expected to be low over the next several years. In the northern part of the management area recruitment decreased significant over 2011 (Figure 7.2.6).

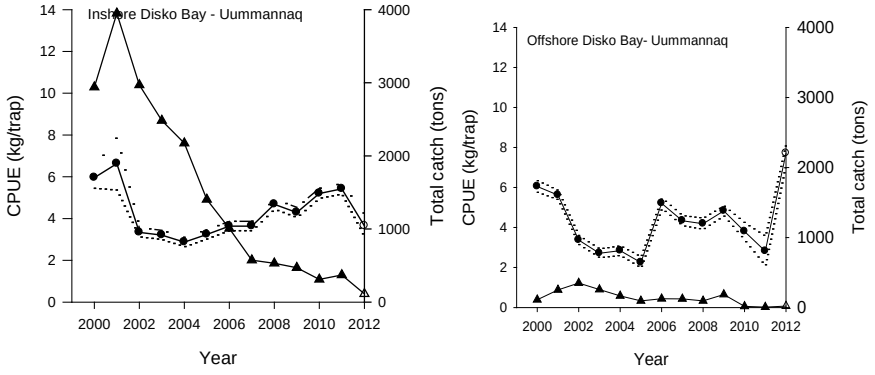

Figure 7.2.4. Standardised CPUE index and total catch based on logbook information inshore Uummannaq-Disko Bay Area from 2000–2012. Data for 2012 is preliminary and incomplete. (● is standardized CPUE, ▲ total catch and dotted line lower and upper confidence limits).

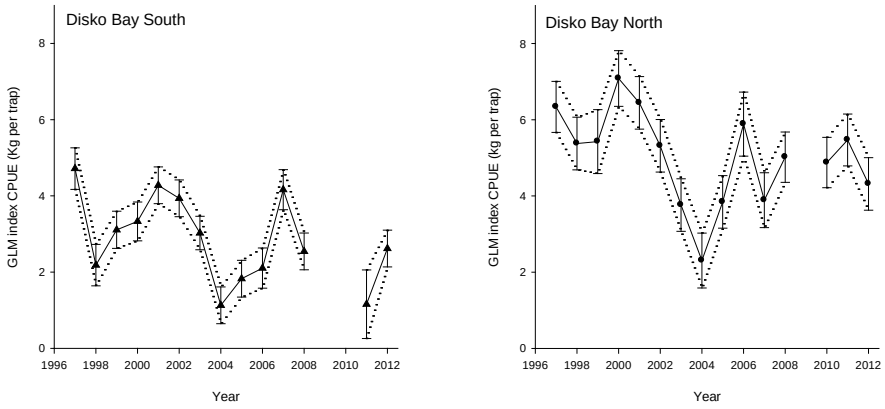

Figure 7.2.5. Annual trends in CPUE (kg/trap) of legal-size males (≥100mm CW) from the trap survey in Disko Bay Survey Area "Disko Bay South" and Area "Disko Bay Nord" (1997–2012). ●: CPUE (kg/trap) and dotted line is lower and upper confidence limits.

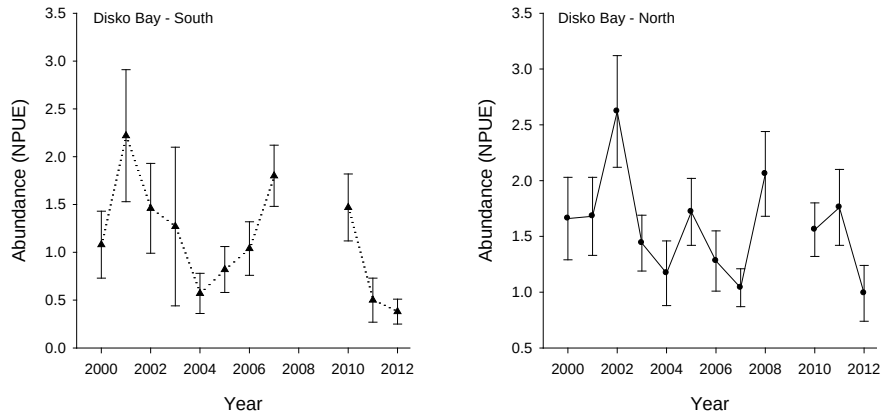

Figure 7.2.6. Annual trends in NPUE (No. of crabs per trap) ± S.E. of adolescent males (ADO-1: 82.2–100 mm CW) in Disko Bay South and Disko Bay North, expected to recruit to the fishery the following year. The overall mean NPUE of ADO-1 in the time series are for Disko Bay South 1.1/trap and for Disko Bay North 1.6/trap.

Management area Sisimiut (inshore and offshore)

Inshore landings declined by 71% from 1111 t in 2004 to 324 t in 2012 (TAC 300 t in 2012), while effort decreased by 93% (Figure 7.2.7 and table 7.2.1). Offshore landings declined significantly by 86% from 2275 tons to 354 t in 2009 (the offshore site has been closed for fishery since 2010). The exploitable inshore biomass has declined significantly inshore as well as offshore since 2009 and is at a low level (Figure 7.2.8). Recruitment decreased in 2009 as was especially for the offshore site reflected by the abrupt decrease in exploitable biomass while landings increased little (Figure 7.2.9). In inshore sites recruitment improve in 2012. Recruitment is expected to be reduced for 2013, but longer term prospects remain uncertain.

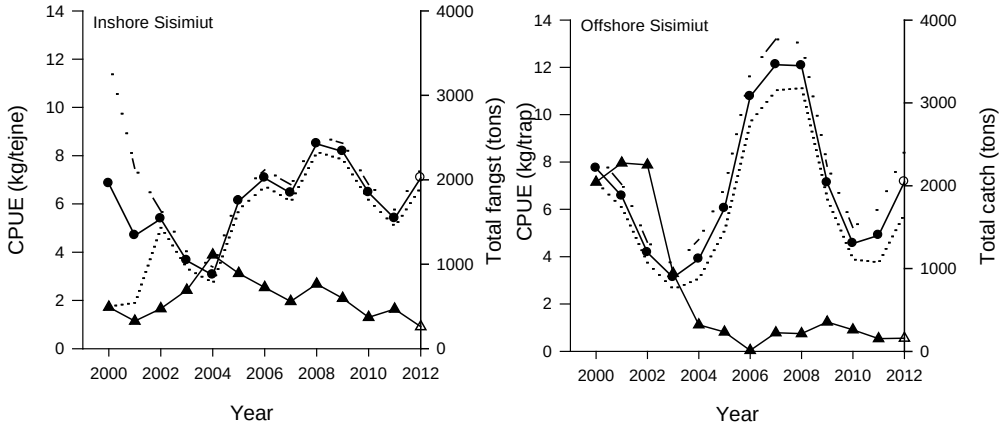

Figure 7.2.7. Standardised CPUE index and total catch based on logbook information inshore and offshore Sisimiut from 2000–2012. Data for 2012 is preliminary and incomplete. (● is standardized CPUE, ▲ total catch and dotted line lower and upper confidence limits).

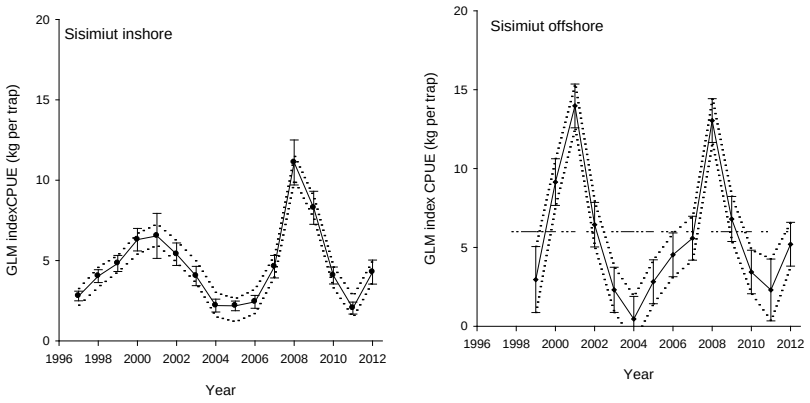

Figure 7.2.8. Annual trends in CPUE (kg/trap ± S.E.) of legal-size males (≥100mm CW) from trap surveys in Sisimiut in- and offshore from 2000 to 2012. ●: CPUE (kg/trap) and dotted line is lower and upper confidence limits.

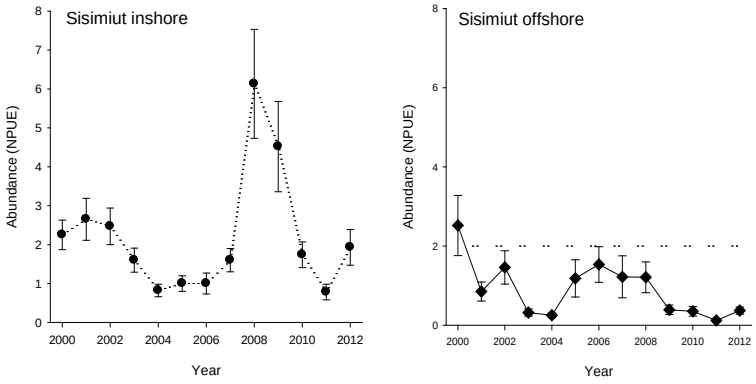

Figure 7.2.9. Recruitment index (ADO-1: 82.2–100 mm CW) of adolescents males from the annual trap survey in the inshore and offshore sites of Sisimiut management area, 2000–2012.

Managemnet area Maniitsoq – Kangaamiut

Landings and effort have steadily declined since 2002 to a historical low level in 2011. However, landings increased in 2012 (Figure 7.2.3 and table 7.2.1). No biological survey is conducted in that management area.

Management area Nuuk–Paamiut (inshore and offshore)

Landings declined by 91% from 5077 t in 2001 to 470 t in 2010, while effort decreased by 92% (Figure 7.2.3 and table 7.2.1). The exploitable biomass and recruitment were declining from 2006 to 2010. In 2011 and 2012 landings increased to 595 t and 784 t, respectively and CPUE remain at a high level. The TAC has not been achieved since 2006, except 2009. Due to cut down expenses the biological survey has since 2011 been permanently cancel.

Managemnet area Qaqortoq – Kap Farvel

Landings and effort have steadily increased since 2009 from 187 tons to 450 tons in 2011, followed by a significant drop in landings to 268 tons in 2012 (Figure 7.2.3 and table 7.2.1). No biological survey is conducted in that management area.

Biological information of snow crab – ongoing research in Greenland

This research proposes to study some aspects of the reproductive potential of snow crab in the coastal waters of West Greenland. Fisheries exploited and non-exploited stocks will be compared as well as populations in hydrographical systems subject to different temperature regimes. Various life history traits will be examined and related to reproductive potential at three study sites along a latitudinal gradient: Disko Bay (north), Sisimiut (middle) and Nuuk (south). The goals of this project are to better understand the reproductive potential of the snow crab, as it relates to temperature conditions and fishing pressure, and to provide essential baseline information for adaptive management and conservation strategies. What is very unique about this study is the possibility of investigating life history traits of an unexploited population of snow crab, something non-existent elsewhere in the world. There are 4 components to this study. The effects of temperature and exploitation on snow crab population dynamics and – especially – on reproductive potential are multifaceted, complex and possibly synergistic.

Tables

Table 7.2.1. Catches, catch rates (CPUE) and effort in management area Disko Bay – Uummannaq inshore and offshore areas from 2000–2013. *2013 data is preliminary and incomplete.

Management Area	Year	Total catch (tons)	Quota	Number of issued permits	Number of active vessels	Inshore catch (tons)	Inshore CPUE (kg/trap)	Inshore effort ('000)	Offshore catch (tons)	Offshore CPUE (kg/trap)	Offshore effort ('000)
	2000	3,052	--	--	--	2,940	4.8	613	112	5.5	20
	2001	4,202	--	--	--	3,950	3.1	1,274	252	3.6	70
Uummannaq-Diskobugt	2002	3,319	--	--	--	2,970	3.3	900	349	3.0	116
	2003	2,739	--	--	67	2,482	3.7	679	257	2.6	97
	2004	2,341	--	--	48	2,103	3.3	630	238	3.6	65
	2005	1,500	1718	43	36	1,361	3.5	392	139	3.7	38
	2006	1,134	1600	43	31	977	4.1	239	157	6.3	25
	2007	698	1530	39	24	572	4.2	137	126	5.1	25
	2008	628	1400	25	11	550	5.0	110	78	5.1	15
	2009	657	700	22	15	518	5.4	97	139	5.5	25
	2010	329	600	19	11	315	5.4	58	14	4.6	3
	2011	376	500	5	13	371	4.8	77	5	3.8	1
	2012	513	500	15	12	485	5.2	93	28	7.5	4
	2013*	251	500	14	2	244	4.8	51	7	5.3	1
	2000	2,534	--	--	--	491	2.8	175	2,043	6.4	319
	2001	2,602	--	--	--	327	2.9	113	2,275	4.6	495
Sisimiut	2002	2,724	--	--	--	473	4.6	103	2,251	3.5	643
	2003	1,633	--		49	692	3.7	187	941	3.1	304
	2004	1,432	--		34	1,111	3.9	285	321	4.9	65
	2005	1,125	900	12	23	953	6.7	143	172	6.4	27
	2006	926	750	12	15	768	8.9	86	158	11.1	14
	2007	783	850	9	15	562	7.3	77	221	12.8	17
	2008	980	700+300	11	13	736	10.2	72	244	13.1	19
	2009	952	500+300	21	28	552	9.2	60	400	7.6	53
	2010	638	800	19	22	359	7.0	51	279	5.5	51
	2011	527	500	14	18	459	6.1	75	68	6.5	10
	2012	324	300	9	12	254	9.1	28	70	8.4	8
	2013*	339	300	9	13	286	10.0	29	53	8.3	6
	2000	944	--	--	--	563	4.3	131	381	7.6	50
	2001	1,835	--	--	--	1009	3.7	273	826	5.0	165
Maniitsoq-Kangaamiut	2002	1,775	--	--	--	1032	3.8	272	743	2.7	275
	2003	485	--	--	18	40	3.5	12	445	2.8	160
	2004	116	--	--	13	92	3.2	29	24	2.1	11
	2005	73	200 (inshore)	12	10	64	4.4	15	9	3.6	2
	2006	72	100 (inshore)	16	7	61	4.3	14	11	4.3	3
	2007	187	300	11	4	14	3.0	5	173	10.2	17
	2008	130	300	13	12	25	6.3	4	105	9.0	12
	2009	259	250	21	17	108	6.2	17	151	5.9	25
	2010	189	300	18	9	98	4.6	21	91	5.1	18
	2011	52	300	7	6	50	9.6	5	2	5.5	0
	2012	100	300	13	12	77	6.8	11	23	5.4	4
	2013*	32	300	12	2	7	9.6	1	25	11.8	2
	2000	3,769	--	--	--	2,430	5.3	458	1,339	5.4	248
	2001	5,077	--	--	--	4,157	5.3	784	920	3.8	242
Nuuk-Paamiut	2002	2,531	--	--	--	1,770	2.8	632	761	2.8	272
	2003	2,315	--	--	48	704	3.4	207	1,611	4.2	385
	2004	1,795	--	--	46	129	4.5	29	1,666	8.5	196
	2005	2,295	--	26	44	250	5.6	45	2,045	6.9	296
	2006	1,173	1,800	24	35	192	7.6	25	981	5.8	169
	2007	521	1,600	25	19	110	7.5	15	411	7.3	56
	2008	618	1,600	24	9	194	7.2	27	424	9.1	46
	2009	1,111	700+300	31	22	270	7.5	36	841	7.3	115
	2010	470	1000	22	24	216	6.2	35	254	6.3	40
	2011	595	700	18	20	182	5.3	34	413	9.5	43
	2012	784	700	22	27	329	8.1	41	455	8.5	54
	2013*	709	800	21	22	212	7.3	29	497	9.0	56
	2000	2	--	--	--	0	--	--	2	--	--
	2001	822	--	--	--	822	--	--	0	--	--
Narsaq-Qaqortoq	2002	643	--	--	--	642	--	--	1	--	--
	2003	133	--	--	12	123	--	--	10	--	--
	2004	34	--	--	10	32	3.9	8	2	1.0	1
	2005	76	--	7	6	76	8.3	9	--	--	--
	2006	--	--	3		--	--	--	--	--	--
	2007	--	--	4		--	--	--	--	--	--
	2008	--		0		--	--	--	--	--	--
	2009	187	?	12	5	187	9.2	20	--	--	--
	2010	326	450	15	7	319	6.8	47	7	8.7	1
	2011	465	430	8	8	464	6.9	67	1	4.8	0
	2012	268	430	8	6	266	5.9	45	2	6.2	0
	2013*	48	430	7	3	47	5.9	8	1.0	5.2	0

7.3 Saint Pierre et Miquelon snow crab fishery

No contribution on snow crab from Saint Pierre et Miquelo.n

7.4 Snow crab in the Barents Sea

Provided by PINRO and IMR

Background

At present, the snow crab in the Barents Sea is considered both as a commercial and a non-indigenous invasive species with no management legislations.

The first *C. opilio* catch in the Barents Sea was in 1996. The number of reports on by-catch of the crab has been considerably increasing since 2003, and most bycatches are done on the Norwegian-Russian annual ecosystem survey in the Barents Sea. The crab has now distributed to most of the Russian part of the Barents Sea, with some recordings also on the Norwegian side (Figure 7.4.1). The highest densities are found the eastern part of the Barents Sea whereas occurrence in the central and western parts is considerably lower. The increase of the crab concentrations in the eastern parts of the sea gave rise to optimistic forecasts for its commercial harvest.

Assessment units

The snow crab occurs in catches throughout joint Russian-Norwegian ecosystem surveys that cover practically the whole Barents Sea except for the northernmost ice-covered areas. The above surveys showed that the crab is occupying a waste area (530 000 km^2) and abundance indices for this area are estimated by swept-area method (Doubleday, 1981).

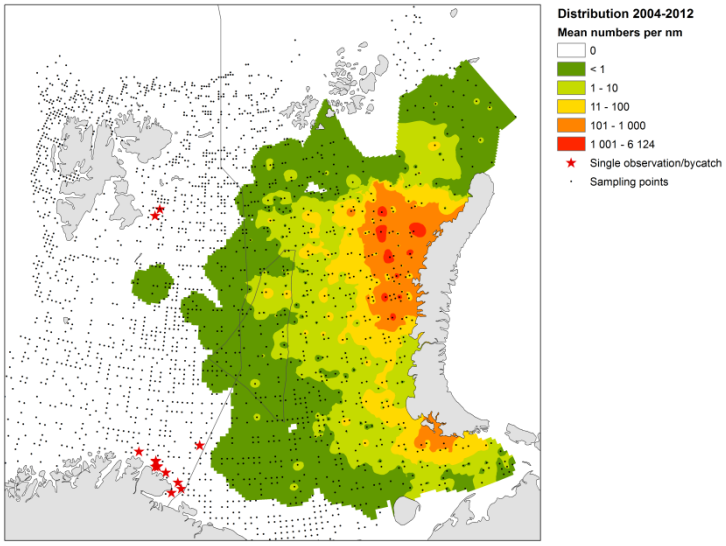

Figure 7.4.1. Distribution of snow crabs in the Barents Sea, 2012. Based on bycatches in bottom trawl hauls.

Data sources and assessment methods

The estimate of the stock status was performed on the basis of the data obtained in the course of integrated multi-species surveys in 2005–2012, three crab-targeted trawl

surveys in 2007–2009 and the snow crab by-catch data from other species surveys and fishery in 2000–2012.

The stock abundance and prediction are estimated with Schaefer production model. To assess the parameters of the model the Bayesian approach was used. To estimate the carrying capacity the data on snow crab from the Grand Banks of Newfoundland (GBN) surveys was used (Dawe *et al.*, 2001). Such a comparison benefits from the fact that bottom trawl surveys both at GBN and in the Barents Sea are conducted by the same fishing gear (Campelen 1800) and with the same trawl design. Presumably maximum density distribution of the snow crab in the Barents Sea may reach the maximum reported density for certain areas of the GBN in certain years.

Stock status

The snow crabs in the Barents Sea and north-west of the Kara Sea were caught at 38–450 m depth. The highest concentrations were observed at Novaya Zemlya Bank, the Admiralty peninsula and north of the Novaya Zemlya shallow area at 100–200 m depth. In 2011 catches of the small crabs (less than 100 mm CW) were 100–1200 individuals and 1–9 individuals of the legal size per 15 minutes of trawling. Carapace width varied from 7 to 166 mm. Males under the minimum legal size (less than 100 mm) in the Barents Sea in 2012 constitutes 96% of the stock.

Legal male abundance demonstrated a rapid growth from 1999, and was assessed in 2012 to be 151 million individuals or 86 thousand tons. However the production model does not allow for precise estimation. Legal stock with 95% confidence interval varies between 61 and 547 million individuals. B_{MSY} is estimated to 436 million individuals while maximum sustainable yield (MSY) could be 120 million individuals.

Conclusion

The survey in 2012, revealed commercial concentrations of the snow crab in the Barents Sea. Dense concentrations and the spatial distribution are so far insignificant. It is reasonable to believe that future research will confirm a rapid growth in the commercial stock and provide strong reasons to recommend commercial fishery for the snow crab.

8 Spider crab (*Maja brachdactyla*)

8.1 Spider crab fishery in England and Wales

Spider crab (*Maja brachydactyla*) – this is the second largest crab fishery in England and Wales. Distribution is in the Celtic Sea and the Western Channel, with the largest landings around Cornwall. Spider crabs are most commonly caught in nets, but are also caught in pots as a bycatch from brown crab and lobster fisheries (Tables 8.1.2 and 8.1.3.) Landings in 2012 were around 1150 tonnes (Table 8.1.1.).

Table 8.1.1. Landings of spider crab (*Maja brachdactyla*) in England and Wales 2000–2012.

Year	Landing (tonnes)
2000	1116
2001	1301
2002	1278
2003	1085
2004	685
2005	548
2006	2022
2007	1780
2008	1235
2009	1120
2010	948
2011	1246
2012	1153

Table 8.1.2. Management measures for spider crab (*Maja brachdactyla*) in England and Wales.

Species	*Maja brachydactyla*	
	Stock	All
Management measure		E&W
Licensing		Yes
Limited Entry		<10m
Closed seasons		No
Days at sea		>15m in Celtic Sea
Closed areas		No
Others		
Minimum size		120mm CL females; 130mm for males
Maximum size		No
Berried female legislation		No
Soft crabs		No
Single sex fishery		No
Others		
Vessel size		Regional
Vessel power		No
VMS		>15m
Log book returns		Yes
Others		
Trap limits		Regional
Trap size		No
Escape vents		Regional and gear specific
Biodegradable panels		No

Others		No
Marked gear		Regional

Table 8.1.3. Stock summary for spider crab fishery in England and Wales.

	England
Number of stocks in which national fleet is active	None currently defined but fisheries in eastern English Channel, western English Channel, Celtic Sea and southern Irish Sea
Stock areas (cross reference to map)	
Indicator	
Landings	1983–2010
Effort	Targetted potting and netting effort not available
LPUE	No
DPUE	No
Size frequency data	Yes. At least recent i.e. 2004–2010 maybe much longer series
Others	No
Analytical assessment methods	
LCA	No
Production	No
Change in ratio	No
Depletion methods	No
Others	No
Data sources	
Surveys	
Larval	No
Juvenile index /biomass	Possibly
Adult index/biomass	
Non target surveys	
Commercial	
Observer/self reporting/reference fleet	No
Size frequency data	Yes
Logbooks	No
Tag returns	No
VMS	No
Electronic logbooks	No
Others	No
Biological parameters	
M	
Growth data	
Fecundity	
Size at maturity	
Others	
Analytical assessment outputs	

Biomass	No
Spawning stock	No
Recruitment	No
Fishing mortality	No
Yield per recruit	No

8.2 Spider crab fishery in France

The spider crab fishery is large. All along the coast from Boulogne to Arcachon, boats catch spider crab. The main "métier" targeting it are the net crustacean in North Brittany and potters in Brittany and Normandy (Figure 8.2.1). The net crustacean fleet is located in the North Brittany (SM and PL), mainly around the Bay of Saint Brieuc and Granville (Figure 8.2.2). The number of boat in this fleet is around 65. Their activity is at maximum between the middle of October until the end of March. This fleet catch more than the half of the landings. From the logbook data of this fleet, it is really difficult to develop an abundance index. Indeed, the net fishing time is very irregular from 2 or 3 days until 15 days. Moreover, in function of the fullness of the crab, the discard evolves a lot during the season. We are starting to work with a selection of boat to get more precise data in order to propose an abundance index.

Another part of the landing is caught by potters. These potters catch spider crab during spring when the spider crab move towards the coast. Among these potters, a large part target lobsters and spider crab is a little considered as bycatch. The number of boat of this potter fleet is 305 and the majority from Brittany and Normandy.

All these boat (netters and potters) have a licence to target spider crab. Inversely, the trawlers cannot have a licence and the catch of spider crab cannot exceed 10% of the total catches. Regularly, some trawlers try to get the crustacean licence because their spider crab catch in their fishing areas can be higher than the 10%.

The official landings are estimated to 3800 tons in 2012, but the real landings are more close to 6000 tons. Indeed, a part caught by little potters are directly sold by fishermen without any declaration in auction and one part of the trawler landings are not declared because they exceed the 10%.

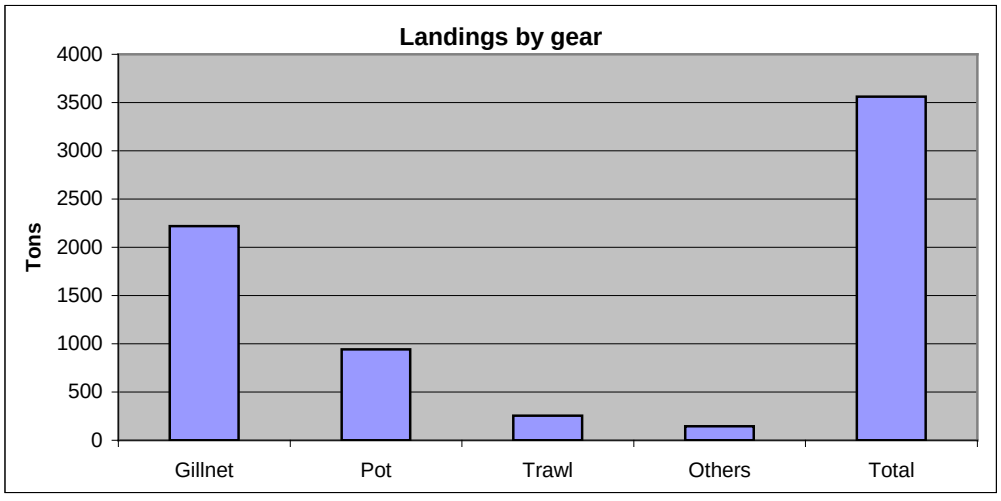

Figure 8.2.1. Distribution of landings per gear in 2012.

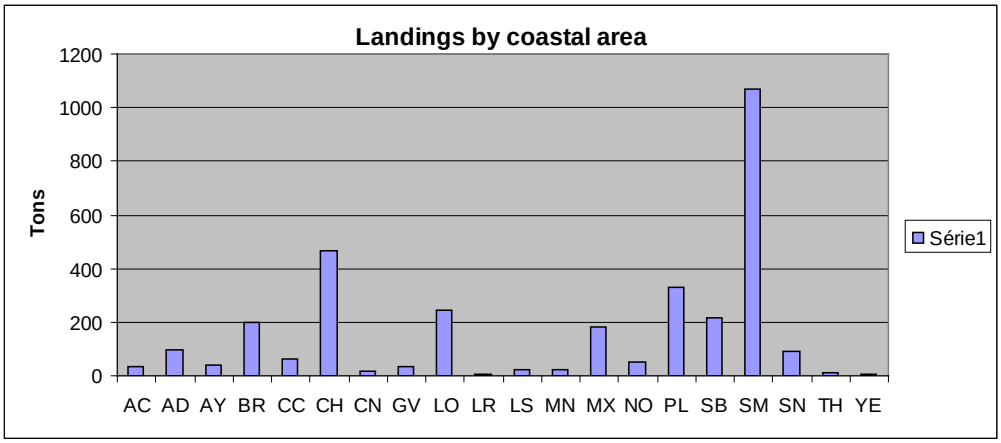

Figure 8.2.2. Distribution of landings by administrative coastal areas in 2012.

9 Miscellaneous

Velvet crab (*Necora puber*) - England

Velvet swimming crab (*Necora puber*) – Most landings of velvet crab are exported, as there is no market for them in the UK. Landings peaked in 2006 but have declined in recent years, possibly due to several cold winters in a row decreasing the population, and a lack of marketing infrastructure. Landings in 2012 were around 155 tonnes with a value of £213,400 (Table 9.1).

Stone crab (*Lithodes maja*) – England

Stone crab (*Lithodes maja*) – There is a stone crab fishery in the Central North Sea. Landings are often misreported as spider crab as they are similar in appearance, but the distribution of the two species does not overlap, therefore mistakes are easily identified. Landings in 2012 were 6 tonnes with a value of £1600 (Table 9.1).

Shore crab (*Carcinus maenas*)

The market for shore crab is as bait for whelk fisheries and recreational anglers. As a result, shore crab has the highest unit value of any crab species in the UK. Crabs are caught using pots, or hand caught at low tide using tiles, under which they shelter. Landings in 2012 were 4 tonnes with a value of £2200 (Table 9.1).

Deep water red crab (*Chaceon affinis*)

Historically Anglo-Spanish vessels have reported landings for deep water red crab from offshore grounds such as Rockall. There is no fishery near the coast of England or Wales. There have been no reported landings since 2009.

Table 9.1. Crab landings (tonnes) and value (£) by British vessels into England and Wales and English and Welsh vessels elsewhere in 2012.

Species	Landings (tonnes)	Value (£)
Necora puber	155	213 410
Lithodes maja	6	1648
Carcinus maenas	4	2229
Chaceon affinis	0	0

10 Working Group discussions on ToRs b)– f)

10.1 Terms of Reference b)

Stock status of the brown crab from UK, Ireland France and Norway were presented, in addition to the stock status on the snow crabs in Greenland, Canada and in the Barents Sea. The snow crab is a new species in the Barents Sea and has shown a rapid increase in abundance since the first recordings in 1996. Russian scientists expect an onset of a fishery for this species within 2–3 years.

There was also a presentation and a discussion on the application of biological reference points in the assessment and management of crab stocks.

10.2 Terms of Reference c)

Results from a research project on practical indicators of exploitation in crustacean fisheries were presented. This project aimed to establish methods to provide recruit estimates and data on crab growth. There were also a presentation and a discussion on principles for MSC accreditation in brown crab fisheries.

10.3 Terms of reference d)

There were no presentations on ToR d at the meeting.

10.4 ToR e) Review the impact of climate changes on important crab species within the ICES, including increased ocean acidification

There were two presentations on temperature effects on the distribution of the snow crabs in Canadian and Greenland waters.

10.5 ToR f) Review research and new knowledge of vital crab population biology parameters

Results from several research programs and projects were presented and discussed under this ToR:

- Effects of MPAs on the stock size of the snow crab in eastern Canada;
- Life history parameters of the red king crab in Norwegian waters;
- Artificial reproduction of red king crab in Russia (VNIRO);
- Sustainability of the edible crab stock in South Devon;
- Gathering data from the edible crab fishery in Wales and the Isle of Man.

In addition there was a discussion at the WG meeting on the proposals for new ToRs. The Group agreed on a proposal for including lobster in to the WG.

There is overlapping aims among ToR b) and c), and the Group therefore suggest a new ToR b): "Evaluate assessments of crab and lobster (Homarus) stocks including use of indicators, empirical assessments, analytical assessments in relation to data sources and data quality, development and suitability of reference points for management."

Annex 1: List of participants

Name	Address	Email
AnnDorte Burmeister	Greenland Institute of Natural resources, Nuuk, Greenland	anndorte@natur.gl
Darrell R. Mullowney	DFO, ST Johns, Newfoundland, Canada	Darrell.Mullowney@dfo-mpo.gc.ca
Nikolina Kovatcheva	VNIRO, Moscow, Russia	kovatcheva@vniro.ru
Sergey Bakanev	PINRO, Murmansk, Russia	mombus@gmail.com
Martial Laurans	IFREMER, Brest, France	martial.laurans@ifremer.fr
Jan H. Sundet (Chair)	Institute of Marine Research, Tromsø, Norway	jan.h.sundet@imr.no
Emma Pearson (guest)	Univ. Of Leicester/CEFAS, UK	
Sarah Clarke	Marine Institute, Galway, Ireland	sclarke@marine.ie
Andy Lawler	Cefas, Lowestoft, UK	andy.lawler@cefas.uk
Jodie Haig (guest)	Bangor Univ. Wales	j.haig@bangor.ac.uk
Oliver Tully	Marine Institute, Ireland	Oliver.Tully@Marine.ie

Annex 2: Agenda

ICES WGCRAB 2013, Dublin, Ireland, May 28th – 30th.

Draft agenda

Monday, May 27th

Arrivals to Dublin

Tuesday, May 28th

0900 Welcome

- Housekeeping information
- Presentation of participants and a short review on TORs.
- Format of the WGCRAB report for 2013
- Adding planned oral presentations to the agenda.
- Appointment of rapporteur

1000 ***TOR a***. Compiling data on landings, discards, effort and catch- rates (CPUE) and provide standardized CPUE, size frequency and research survey data for the important crab fisheries in the ICES area.

Updating tables and formatting new information for the report

Presentations….

!030–1045 Coffee brake

1045 – 1300 ***TOR a***. Continued

1300 – 1400 Lunch

1400 – 1545 ***TOR b***. Evaluate assessments of the status of crab stocks, identify gaps in assessment programs, and review the application of biological and management reference points for crab fisheries.

I hope to have an introductory lecture by Dr. Jae Choi, DFO, Canada, here…

Other presentations…

1545 – 1800 ***TOR b***. Continued

Wednesday, May 29th

0900 – 1030 ***TOR b cont.***

1030 – 1045 Coffee brake

1045 – 1200 ***TOR c***. Review knowledge on stock parameters as indicators in assessment of crab stocks without fishery independent data, and other biological information on crabs stocks required for providing standardized indices and for analytical assessments.

Presentations …

1200 – 1300 Lunch

1300 – 1830 ***TOR d.*** Review the potential impact of introduced crab species on receptive ecosystems

Thursday, May 30th

0900 – 1030 ***TOR e.*** Review the impact of climate changes on important crab species within the ICES, including increased ocean acidification.

Presentations...

1030 – 1045 Coffee brake

a) 1045 – 1300 ***TOR f***. Review research and new knowledge of vital crab population biology parameter.

b) Presentations....

1300 – 1400 Lunch

1400 – 1545 ***TOR f cont.***

1545 – 1600 Coffee brake

1600 –1800 – New chair for WGCRAB

- Venue for the 2014-meeting.
- Contributions to the 2013 report, AOB.

1800 Close of meeting

Friday, May 31st

Departure

Annex 3: Draft resolution for the next meeting

The **Working Group on the Biology and Life History of Crabs** (WGCRAB), chaired by AnnDorte Burmeister, Greenland Nature Institute, Nuuk, Greenland, will meet in VENUE, DATE May 2014 to work on ToRs and generate deliverables as listed in the Table below.

WGCRAB will report on the activities of 2014 (Year 1) by 1 August 2014 to SSGEF.

ToR descriptors

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 sustainability of these fisheries is necesasary.	311, 334	3 years	Evaluation of alternative assessment methods.

c	Produce assessment and advice of the main crab and lobster species in the ICES area in future. (Year 1) Exlore prospects for future assessment, advice and possible assessment methods. (Year 2) Request of including assement and advice group and delevery advice to ACOM;	WGCRAB wants to produce assessments and advice on a management unit basis. Assessments methods, reference points and harvest rules would be discussed. It would be of great interest to make progress on assessment of stock status and further develop ideals on reference points. WGCRAB will hold a workshop to look at prospects for future assessment and management.		2 years	(2015 or 2016) Request to ACOM, SCICOM, SSGEF about possible change in emphasis
d	Review the impact of climate changes on important crab and lobster species within the ICES, Atlantic Canada and West Greenland, including increased ocean acidification;	There is a growing concern in the WG about the consequences og 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 crabs. These issues will be dealt with by the WGCRAB in future.	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)

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. Complete request to ACOM and SCICOM (being both an assessment, advice and working group)
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 necesasary. The activity of the Group is therefore considered to be of high priority in particular if it's 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 will produce stock assessments in future WGCRAB will have linkages to several EGs under ACOM.
Linkages to other committees or groups	The EG aims to be able to give advises 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	