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

6–8 November 2018

Jersey



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Executive summary

The main goal of the Working Group on the Biology and Life History of Crabs (WGCRAb) is to focus on the stock status of several crustacean species in North East and West Atlantic. All the members of this group present the data available for each stocks and the methodologies developed to assess their status. This year no great change have been noticed in the species which are followed in the different country. Nevertheless, some improvement are obverse for some fisheries. For each stock, a presentation of the evolution of the fishery is performed which include the landings, the effort, the size structure or the metier considering the more fine data. This work allows to understand the quality of the data by country, to discuss on the works and the protocols or samples used to get these data and to exchange on the futures orientations to improve its or the difficulty in each country.

For all countries, the data on the professional landings seem to be quite good. Inversely, only few information are available on the recreational activities and that point is really crucial for some stocks, like the lobster. Depending on the organization and the economical importance of a stock, the studies developed to get data change a lot. Only few scientific surveys exist, mainly on the crabs as the snow crab in Newfoundland. Samples of the size structure are in place for each stocks, but the quality and the quantity of data are really different from one country to another. The data on effort differ a lot too and some fisheries have no information or other know very specifically the number of fishing day or the number gear used per day. These different situations lead to develop various assessment methods to follow the state of stocks.

The methods develop to assess the stocks for the different country can be synthetised in two directions, one direction used the total landings and the size structure to run size or age structured model estimating the classical parameters (F , B_{lim} , B_{pa}) and another direction where the LPUE are used to estimate abundance indices. Some complementary approach are used when the data are available as recruitment index. At the fleet level, vms data bring specific information on the spatial distribution of the fishing activity and the trend when several years are available. The way to transfer the results at the stakeholders change a lot looking the final reports or products that are finalised. In England, final one page report sum up the main results of any stocks using the same way. The work on the precautionary approach on snow crab in Newfoundland or the assessment of King Crab in Norway show several improvement in the way to assess stock.

No big changes are noticed in the status of the main stock expect for the brown crab in Western Channel where the really decrease is observed in the French, Jersey and England fisheries. Looking the size structure and the effort trend, an increase of recruitment seem to the main point to explain the situation.

Several studies continue to improve the knowledge on the crab and lobster biology as the work of the age estimation in Norway or the crag tagged program in Orkney Island.

1 Administrative details

Working Group name

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

Year of Appointment within current cycle

2017

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

2

Chair(s)

Martial Laurans, France

Meeting dates

6–8 November 2018

Meeting venue

Jersey

2 Terms of Reference

- 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. Maps will be produced to synthesise the data. One part of these data sets will be provided to the ICES Data Centre.
- b) Evaluate assessment of the status of crab and lobster (*Homarus* sp.) 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.
- c) Review the impact of climate drivers (temperature, ocean acidification, changes associated climate change and disease) on important crab and lobster species within the ICES, Atlantic Canada and West Greenland. Studying the effects resulting from changes in decreasing pH (defined as ocean acidification). Specific parts will be achieved to work on the different subjects.
- d) Review research and new knowledge on vital crab and lobster population biology parameters.

3 Summary of 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.

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

Brown Crab (England)

On the different stock, the need of better data for stock assessment, particularly with length-based landings is really crucial. A Bluetooth electronic calipers has been developed to give to fishermen in association to tablets to record the data. The deal is to pay \$1pound per measure to fishermen. By this way, the aim is to collect discard data too and to have better data in some poor region. In 2018, more than 3100 measurements have been done.

Monitoring Inshore Fisheries with Technology – Isle of Man

Bumper year in crab fishing in 2018. This reflects a new fleet of big boats, fishing further from shore. The scallopers are fishing crab on the old scallop grounds. Following example of New Zealand to move toward electronic reporting, in Isle of Man, they wanted to assess their successes and failures in implementing technology to their region. Using Zebra technology, an onboard computer records information from probes measuring time, depth, temperature information on the fishing hauls. The fleet is very keen. Whatever information is desired can be captured by the software. All the data are upload in database and provide to fishermen too thanks to different maps. Incentive to fishermen is that the data can be used for their own purposes.

King Crab Assessment (Norway)

In Norway, a new stock assessment has been developed on the king crab using a surplus production model. Thanks to this work the stock assessment is based on Bmsy and Fmsy and Blim defined as $0.3B_{msy}$ and $F_{lim}=1.7F_{msy}$. The aim is for low risk to go beyond F_{lim} and above B_{lim} . The current situation is that the Biomass is just below B_{msy} for past three years and F high at F_{lim} for past three years.

5 Progress report on ToRs and workplan

ToR a)

All the countries continue getting their historical data to follow the stocks. At the same time, some improvement are noted. In Scotland, a plan is developing to obtain the data effort of the main fleets. In a first time, thanks to the logbooks, reinforcing the rules where the fishermen have to declared. On a second hand, developing the use of VMS in the small boat will supply very fine data. This option should appear in 2020 and the work has started to equip the vessel at time.

In France, the development of a real sampling strategy along the coast will bring size structure data in all the main fishing areas. The data on the lobster and brown crab will increase in quantity and quality. It is the case too in Jersey where the sampling are in place since 2018.

In Isle of Man, as said just before, the data quality increase a lot using automatic systems to integrate many parameters of each fishing trip. This development has to look as an example to improve the situation in many other fisheries.

ToR b)

Abundance index for brown crab and lobster in France and Jersey

Jersey and France work together in order to improve the way to estimate the abundance index of lobster and brown crab using standardized LPUE. For that, glm model are developed using parameters as year, month, area and vessel identification. The last work has been performed to improve the quality of the data and the fitted of the model. A simple program has been developed to test the quality of vessel data, effort and production at daily level to exclude wrong data. The second improvement is linked to the distribution function considered to describe the LPUE where the gamma function with a link log is now used. Thanks to these two changes, the fitted has been improved a lot and the conserved models explain more than 60 % of the variance. Such results is really high and the abundance index can be consider as robust and well characterize the trend of the abundance.

Precautionary approach for snow crab in Newfoundland

Precautionary approach (PA) to be brought to the major stocks. A Working Group was established to look at PA for snow crab after MSC awarded. WG says that current management should be sufficient – recommended PA not to be a biomass based framework. For that, the development of multiple indicators for stock health should be looked because sustainability is complex and one indicator in isolation may not be sufficient. The indicators propose were: female egg clutches, CPUE, discards. CPUE is used in all areas and gives more flexibility for the fishery to adapt. Several analyses of time series on egg, CPUEs and discards presented lower (set in stone) and upper (negotiable) limits for reference points. Projections based in mixed models to predict CPUE and discards include effects of biomass, exploitation and climate. Finally, peer review process to establish limit reference points and an upper reference value for harvest rate have to be done.

Brown Crab Survey Information in Scotland

Compared to offshore fishery where the VMS permit to get spatial information, little information on spatial distribution for inshore fleet exist even though about half of landings. In this situation, are scallop dredge surveys where everything caught is sampled could be used to study other species? The main by catch species is the brown crab. It is why, the data are looked to analyse what type of indices it could be developed from 3 sites around the coasts. Each year, about 100 stations per area are followed in June with standardized tows of 30 minutes at 2.5 knots. Catch rates are adjusted to metre of dredge for comparison with other data.

The results show that highest catch rates of brown crab closest to shore with size frequencies same across sexes and similar to other data and 50mm of CL for the smallest animals. The following results are observed:

- Loose negative relationship between catch rate and size.
- Loose negative relationship between catch rate and depth.
- Loose negative relationship between catch rate and distance from shore.
- No relationship between catch rate and time of day, although survey only occurs during day.
- Loose negative relationship between sex ratio and distance from shore, inferring more females offshore.
- Catch rates highest along the shore and less variance in catch rates close to shore.

ToR c)

Crustacean Recruitment Projects (France)

There is a lack of knowledge on recruitment for crustaceans face to climate change. Seeking to have surveys to track recruitment, a four-year programs of 1.6 mill euro funded has been developed. Initial the project was only on crayfish and the way to follow the recruitment. But the development of collectors for pelagic and settled juvenile lobster, spider crab, and edible crab will be done too.

Another part of the project is to monitor with fishermen catch rates and size structure of lobster and crayfish on different substrates using traps with specific entrances to target juveniles.

Discard Survival Brown Crab – (Orkney)

An study has been performed on the survival of discard Brown Crab using Onshore(tanks) and offshore (pots) trials. Many parameters are used to test the survival level which are estimated with the stoner vitality index. A GAMs model is used to explain the survival index and the best model included treatment on the vessel and size effects.

The high temperature observations, more than 16C, seem to involve some crab died. After, the bigger crab are more sensible and lead to higher mortality. Survival rate was superior to 75% for all crab, but the survival of missing limbs crab were lower than all other groups and the overall discard survival is superior to 90%. In the same way, the weakest crabs survived around 80% at level which was not expected.

Brown Crab Environmental Effects Life History (Norway)

A study on the size maturity has been done on the brown crab from 3 study sites. The found indicate no spatial difference in size-at-maturity from these three study sites. Moreover, estimates of size at physiological maturity appear random with no pattern across Europe including Norway. Onset of main molting period lags as go further north. Light could be the mechanism affecting this cline and not temperature. Size-at-maturity does not differ north to south but age-at-maturity does.

Conclusion, the temperature could be important for distribution and regulation molting dynamics as well as maturation schedule (reproductive cycle).

Cadmium in Brown Crab (Norway)

Cadmium (Cd) issue arose in 2009. Some surveys indicate some high contamination in pristine north area in Norway. In raw form, a high Cd in hepato is noted but not in claws. It is the same in cooked form, but with lower values. The evidence suggests almost all contamination is coming from the diet with a question around the bathymetric migration of brown crab and the diet at deep levels.

The results show a North-south cline, with northern crabs showing higher levels than southern crabs. Cline may be related to lower probability of molting due to slower growth in the north and so more accumulation time in the north. Moreover, different migratory patterns across regions also result in different foraging.

ToR d)

Lobster Aging Efficacy (Norway)

Activities are developing to look for new methods allowing to estimate the age of lobster. Using the gastric mill of the stomach, more precisely the bottom part (ptero-cardiac) is the best part to use. First, a strong linear relationship between pterocardiac (length/width) and carapace length are observed. Now, the works are concentrated to validate if the observed line of the pterocardiac are linked to the age.

Lobster – Functional Maturity Changes (Orkney)

Some declines in size-at-maturity in Canada and U.S. over long-term and recent decades are observed. One key question: is there changes in size-at-maturity in Scotland too? For that, a sample protocol are in place for many years looking the percentage of berried female in the catch. From the North to the South a decline in size-at-maturity is observed, smaller (85–87mm) in the southern management areas and larger (94–100mm) in the northern areas. L50 is generally higher than current MLS values. Nevertheless, L50s in Orkney is stable over past five years. In fact, it has not changed in 40 years despite heavy exploitation of the stock. One future project is to work at the Europe level.

Lobster (France)

In extension of the Scotland study, the French study show that the L50 varies a lot by month, so time is important to consider in any across-region comparison. The phenomenon is observed in a dataset of Normandy and South Brittany.

Brown Crab Tagging Project (Inshore Scotland)

Tagged crab project has been developed in Orkney in 2010–2016, where 7500 individuals were tagged, predominately soft-shell. Most crabs had been tagged west side of Orkney close to shore.

Mean distance travelled is <6km for males. Conversely, females move large distances, up to 250km in one year, predominately south and west. Movement appears to be inverse to the current. Only the females tagged to the extreme northeast stayed in the area. The results question the current management boundaries. One aim now is to develop interactive map for fishermen to upload data in and see results.

Preliminary Stomach Contents Snow Crab Barents Sea (Norway)

The study on the stomach content of Snow Crab in Barents Sea are based mainly on large males. The analyses only permit to identify fragments of stuff which are assigned to 31 categories but a high frequency of occurrence is unidentified stuff. Along the 31 categories, the highest frequency are bivalves, polychaetes, forams, plastics and gastropods.

The diet is really diverse, they eat whatever. Most crab would have 4–7 identified prey groups in the stomach at any point. What's they have observe is summed up below:

- Simple chi-square test showed some significant results among prey groups in north versus south areas.
- Simple chi-square test showed some significant results among size groups, with more plastics in big crabs.

6 Revisions to the work plan and justification

No changes to the current ToRs. Discussions are underway to see how to integrate the data in the ICES database. At the same time, we need to indicate more precisely the data used in all analyses.

7 Next meetings

Next meeting will take place in Trømsø, Norway, 4–8 November 2019.

Annex 1: List of participants

NAME	COUNTRY	EMAIL
AnnDorte Burmeister	Greenland (Natur)	anndorte@natur.gl
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Sara Clarke	Ireland (Marine Institute)	Sarah.Clarke@Marine.ie

Annex 2: Agenda

Tuesday, 6 November

09.00 Welcome

- Housekeeping information
- Presentation of participants and a short review on approved draft resolution incl. TORs.
- Presentation of agenda and adding additional planned oral presentations to the agenda.
- Format of the WGCRAb report for 2018
- Appointment of rapporteur

09.30-10.45 **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 and lobster fisheries in the ICES area.

Updating tables and formatting new information for the report

Lobster

Martial Laurans (France)

Carlos Mesquita (Scotland)

Matt Coleman (Orkney Inshore Fishery)

10.45-11.00 Coffee break

11.00 – 13.00 **TOR a.** Continued

Paul Chambers (Jersey)

Agnalt Ann-Lisabeth (Norway)

- A little update on lobster regulations in Norway. No great news for increase in the stock, as measured in CPUE, but still....

13.00 – 14.00 Lunch

14.00 – 15.45 **TOR a.** Continued **Crab – presentations**

Snow Crab

Ann Dorte Burmeister (Groenland)

Muldowney Darrell (Newfoundland)

15.45 – 16.00 Coffee break

16.00 – 18.00 **TOR a.** Continued **Crab** – presentations

Snow Crab

Hjelset Ann Merete (Norway in Barent Sea)

King Crab

Jan Sundet (Norway)

Wednesday, 7 November

09.00 – 11.00 **TOR a cont.**

Edible crab

Rosslyn McIntyre (England)

- English crab landings this year- why are they low?

Paul Chambers (Jersey)

11.00 – 11.15 Coffee break

11.15 – 13.00 **TOR a cont.**

Hjelset Ann Merete (Norway)

Carlos Mesquita (Scotland)

Martial Laurans (France)

13.00 – 14.00 Lunch

Afternoon, visit of Jersey.

Open discussion on the different studies performed and the futur projects where collaboration could be developed.

Diner at the Bass and Lobster Restaurant.

Friday, 8 November

09.00 – 13.00

TOR b and d. Evaluate assessments of the status of crab stocks, identify gaps in assessment programs, and review the application of biological and management. Review the impact of climate divers on important crab and lobster species within the ICES,

Sarah Clarke (Ireland)

-The contribution of 3 technical conservation measures to egg production in lobster stocks in Ireland.

Agnalt Ann-Lisabeth (Norway)

-An little update on age in lobster and an attempt to verify this by using lab-raised individuals from 1 to 7 years old. I am measuring the zones to assess the starting point etc.

Matt Coleman (Orkney Inshore Fishery)

-Modelling changes in Functional Maturity of Scottish European Lobsters (*Homarus gammarus* L.) stocks from 20 years of commercial catch data.

Agnalt Ann-Lisabeth (Norway)

-Sexual maturity in lobster, from the norway data.

Martial Laurans (France)

-What available data for integrate an european study on functional maturity of lobster.

10.45 – 11.00 Coffee break11.00 – 13.00 **TOR b and d.** Continued

Jack Emmerson (Isle of Man)

-Monitoring inshore fisheries in Manx water: following the New Zealand approach

Snorre Bakke (Norway)

-Environmental effects on life history and distribution of *Cancer pagurus* in Norway

Matt Coleman (Orkney Inshore Fishery)

-Scottish Regional Inshore Fisheries groups collaborative brown crab (*Cancer pagurus* L.). Tagging Project.

Carlos Mesquita (Scotland)

-Use of survey data to assess distribution of brown crab in Scotland.

13.00 – 14.00 Lunch

14.00 – 14.30 **TOR b and d.**

Muldowney Darrell (Newfoundland)

-Newfoundland's Approach to the Precautionary Approach for snow crab.

14.30-16 :00 **TOR e.** Review research and new knowledge of vital crab population biology parameter.

Laurans Martial (France)

-RECCRU project.

Martin Wiech (Norway)

-Contaminants in lobster and edible crab

Jan Sundet (Norway)

-Stomach content of the snow crab in the Barents Sea.

Elisabete Rodrigues (Orkney Inshore Fishery)

-Discard survival and condition in Orkney brown crabs (*Cancer pagurus* L.).