

**REPORT OF THE  
STUDY GROUP ON THE BIOLOGY AND  
LIFE HISTORY OF CRABS**

**By Correspondence**

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## 1 INTRODUCTION

### 1.1 Background of the Study Group

The first meeting of the Study Group on crab met in Jersey, UK, in 1993 to review progress on the research and fishery management of two commercially important Majidae species, the spider crab (*Maja squinado*) and the snow crab (*Chionoecetes opilio*), fished on the two sides of the Atlantic and in the Pacific, as reported in C.M. 1993/K:3. The Study Group recognised the need for more intensive coverage of the life history particularities of the two species, and a better geographical representation of crab experts, leading to a second meeting at La Coruna, Spain, which reviewed new information available on the life history and fishery management of the Spider crab and *Chionoecetes* species (*opilio*, *bairdii*, *tanneri*), as reported in C.M. 1996/K:1. It was recommended that the SGCRAb should meet on a 3 years basis and that the remit be enlarged to include other commercially important crab families (notably portunid and cancrinid crabs) which are not covered by ICES assessment working groups or study groups. The third meeting of SGCRAb was convened in Brest, France, 4–7 may 1998). This meeting led to successful exchange of knowledge and research on crab. Results also indicated that some crab stocks were subject to a high level of exploitation and that assessment methods and status of the stocks need to be reviewed accordingly. The Study Group has since worked by correspondence.

### 1.2 Terms of Reference

The Study Group on the Biology and Life History of Crabs [SGCRAb] (Chair: M. R. Dufour, Canada) will work by correspondence in 2000 to:

- a) plan to complete the compilation of information and data on the stock structure, recruitment, life history parameters, and the effect of environmental variation, on eastern Atlantic stocks of edible crab, spider crab, and velvet crab, and North American stocks of snow crab, blue crab and red crab;
- b) plan for a meeting in 2001 to assess the status of these stocks;
- c) develop proposals for co-operative studies on the pre-recruit ecology of crab;
- d) review the results of national programmes to monitor the effects of habitat disturbance on edible crab populations;
- e) assess the potential of “no harvest” marine protected areas for conserving crab population reproductive potential and in protecting important habitats used by crabs in their life cycles.

SGCRAb will report to the Living Resources and the Marine Habitat Committees at the 2000 Annual Science Conference.

### 1.3 Participants

|                        |                         |
|------------------------|-------------------------|
| Bannister, R.C.A.      | United Kingdom          |
| Bossy, S.              | United Kingdom (Jersey) |
| Dufour, R. (Chair)     | Canada                  |
| Fahy, E.               | Ireland                 |
| Freire, J.             | Spain                   |
| Gonzalez-Gurriaran, E. | Spain                   |
| Hallbäck, H.           | Sweden                  |
| Hébert, M.             | Canada                  |
| Jamieson, G.S.         | Canada                  |
| Kuzmin, S.             | Russia                  |
| Latrouite, D.          | France                  |
| Shields, J.            | USA                     |
| Taylor, D.M.           | Canada                  |
| Tremblay, J.           | Canada                  |
| Tully, O.              | Ireland                 |

All old and new group members were contacted to provide information on the work done since the last meeting of the group in 1998. Most members reported on developments related both to the terms of reference and also the wider interests of the Study Group.

Among noticeable changes brought forward since the last meeting of SGCRAb in 1998 is the creation of a new group of European Crustacean biologists. EDFAM (European project on Assessment and Management of Decapod Fisheries) is a concerted action project funded by the 5<sup>th</sup> framework programme of the European Commission and co-ordinated by O. Tully of Ireland. Main goals of EDFAM are to: 1) review sampling and assessment programs currently in place in Europe and 2) taking into account world wide developments in decapod research, recommend new approaches to the sampling, assessment and management of these resources. Four of the European institutes forming EDFAM are also represented in SGCRAb: CEFAS (UK); UDC (Spain), BIM (Ireland) and IFREMER (France).

Some progress has been made concerning the collection of information on the two terms of reference (biology and stock assessment) were the ones most covered by members. Some information on the next three terms of reference which are related to more specific topics (co-operative studies, effects of habitat disturbance on edible crab and marine protected area) was also received. Finally, information not directly related to the main topics but still of interest to the group discussion will be brought forward for more detailed discussions. Most members sent the title and a brief description of the subjects that they want to discuss in detail at the next meeting. A few members sent detailed abstracts, attached as an appendix at the end of the report.

The European edible crab (*Cancer pagurus*) and spider crab (*Maja squinado*) as well as the Canadian snow crab (*Chionoecetes opilio*) were the species of main interest concerning stock status and biology. Two members from Ireland (O. Tully and E. Fahy) suggested to update and present new information related to the biology and the status of the edible crab fishery along the south eastern, south western and north western coast of Ireland. Effects of habitat disturbance on and status of edible crab from England and Wales (English East Coast and English Channel) will also be covered by C. Bannister and colleagues (Appendix 1). E. Gonzalez Gurriaran and J. Freire will present new information about the biology and the structure of the Spain spider crab populations (migrations, reproductive biology and growth). Spatio-temporal variations of the major crustacean species living along the French Atlantic coast (côte Bretonne) should also be discussed (D. Latrouite). Atlantic snow crab stocks will be covered by many Canadian contributors: Newfoundland stock status (D. M. Taylor), Southern gulf of St. Lawrence stock status (M. Hébert), Scotian Shelf stock status (J. Tremblay) and Estuary and northern gulf of St. Lawrence stock status (R. Dufour). An update of the new biological insights should also be provided for this species as well as an update of the Bitter crab disease, which is known to affect many crustaceans, on the Newfoundland snow crab stocks (D. Taylor).

Stock status and the basic biology of new crab species not previously discussed by the group will also be brought forward at the next meeting. One paper (Appendix 2) will bring clues on the status of the newly introduced red king crab (*Paralithodes camtschaticus*) in the Barents Sea (S. Kuzmin). Some contacts have been made with Alaskan biologists working on king crabs and tanner crabs in order to obtain basic information on the stock status and biology of these exploited Pacific coast crab species. Biology and status of the Rock (*Cancer irroratus*) and Jonah crabs (*Cancer borealis*) on the Atlantic coast of Nova Scotia (Canada) should also be discussed in more details (J. Tremblay) as well as an update on progression of the Green crab (*Carcinus menas*) in the gulf of St. Lawrence (M. Hébert). Basic information on the biology and status of the blue crab (*Callinectes sapidus*) on the USA Atlantic coast and on the Greenland snow crab should also be discussed.

Potential use of Marine Protected Areas (MPA) in sustaining stocks was a subject of discussion during the 1998 meeting. An update of their real values, in association with the need to have appropriate oceanographic data and data on the spatial pattern of spawners within refuge should be presented (G. Jamieson, E. Gonzalez Gurriaran and J. Freire). J. Shields from USA, a new member of SGCRAb, will present a review of the parasite and disease impacts on certain crab stocks. Finally, a few papers will deal with conflicts between the inshore fisheries for whelk and edible crab in the Southwest Irish Sea (E. Fahy), plus snow crab trawl and traps selectivity in relation to the development of index of abundance (M. Hébert, Appendix 3 and D.M. Taylor).

Progress has been made on basic research and assessment of these species which are of prime interest for both Europeans and Americans. Updates on the use of marine protected areas for sustaining stocks and impacts of parasite and disease on crab stocks are also essential for the management and the conservation of these stocks. Opportunity to examine data on these subjects would be welcome. The Study Group therefore recommends that it will meet in the year 2001.

### 3 VENUE AND DATES

At the last meeting of SGCRAB (Brest 1998), E. Fahy of Ireland offered to organise the next meeting of the Study Group. It is therefore suggested that the next meeting of the Study Group takes place in Dublin, Ireland for 5 days (25 to the 29<sup>th</sup> March) in 2001. The host institute has confirmed that this arrangement would be acceptable.

### 4 PROPOSED TERMS OF REFERENCE

It is proposed that the following terms of reference be discussed at the next meeting:

- Update information on the stock structure, recruitment, life history parameters and effect of environmental factors on crab stocks;
- Assess the status of the main European and American stocks of crabs (edible crab, spider crab, snow crab, king crab) and if possible the following other crab stocks (Scotian shelf rock and Jonah crab, American blue crab, Spain velvet swimming crab *Necora puber*);
- Review and disseminate progress on the development of assessment methodologies and survey tools for crabs, using appropriate examples
- Evaluate the results of national programs to monitor the effects of habitat disturbance on crab populations, and identify what research is needed to develop more effective monitoring programmes;
- Assess the potential of Marine Protected Areas for the conservation of crab stocks;
- Review the impact of parasites and diseases on the principal crab stocks;

## APPENDIX 1

R.C.A. Bannister  
FSMG CEFAS, Lowestoft  
United Kingdom

### **Stock structure and assessment of *Cancer pagurus* on the English east coast.**

CEFAS Lowestoft is comparing the distribution of the east coast edible crab fishery with information about crab spawning (based on plankton surveys), the nature of the sea bed (from habitat mapping), and what may be inferred about crab migration and movements from historical tagging experiments. Of particular interest is the crab spawning area between Flamborough Head (54°N) and the Norfolk coast (53°N). Seasonal size distribution data from sampling at sea in the offshore Norfolk fishery are being analysed and compared with data collected routinely at the principal landing places in order to provide a basis for estimating fishing mortality and calculating yield per recruit curves using length based methods. Estimates of local abundance are also being derived from sea-sampling using estimates of the capture efficiency and sampling area of pots (traps). Capture efficiency has been determined by short-term localised mark-recapture experiments, and used to convert pot catch per effort into an estimate of abundance within the capture area. The effective capture area of a pot has been deduced by analysing pot-by-pot catch data along strings of pots with known spacing.

### **Assessment of *Cancer pagurus* in the English Channel**

Investigation has commenced into the problems of assessing the edible crab stock in the Channel using length based methods to analyse recent English port-based size-distribution data, for comparison with assessments made previously in the 1970's using tagging data. Preliminary compilations of size distributions for the inshore and offshore parts of the eastern and western Channel for the period 1983–1998 are being analysed using length cohort analysis, with various underlying assumptions about natural mortality and growth rate based on previous work. Indications are that estimates of fishing mortality are very variable across the size range, ranging from 0.1 to 1.0 on the size range 140–180 mm carapace width (CW), and from 0.6 to 2.0 in the size range 180–240 mm CW. Not surprisingly, outputs are very sensitive to the assumptions made about growth at the top end of the size range. The problem of aggregating basic size data to take account of migration and stock structure also needs to be taken more fully into account. These aspects need to be explored further before reliable results can be expected. Part of this exploration will include the collection and analysis of data from depletion experiments to be carried out in various parts of the Channel fishery over the next two years.

### **Threats to *Cancer pagurus* from gravel extraction**

Extraction of gravel from the sea bed represents a potential threat to edible crab populations and fisheries in two main areas, the northern side of the English Channel from the Isle of Wight to Dover Straits, and off the English east coast from the Humber to Norfolk.

In the eastern Channel, CEFAS is investigating the alleged threat to migrating crabs in a fishery for mature female crabs in 20–30 m depth at Shingle Bank, south of Hastings. The concern is that because of dredging on Shingle Bank itself, sediment from both the dredge-head and vessel spillways could settle out and be transported to the crab migration pathway two miles or so further south, and affect the fishery there. The study is based on catch per effort data from fishery logbooks, plus data on sediment transport collected by seabed sediment traps. Results will be presented to show that in 1991, at about the time dredging commenced on Shingle Bank, there was a sudden step down in crab catch per effort between one and two miles south of the dredging area, but no such change occurred in a control area further west out of reach of the likely sediment pathway. It is alleged that this treatment effect must be due to the dredging, but paradoxically there is as yet no conclusive evidence from the sediment data that fines from the spillways do reach the fishing area in significant concentrations. Furthermore, five years of pot data on the distribution of crab catch per effort with increasing distance south of the Bank do not show any patterns to suggest that crabs are avoiding the near-Bank area, as might occur if they were reacting to additional sedimentation or noise.

For the English East Coast, the threat from gravel extraction is to areas likely to be spawning centres. The results of the spawning ground and habitat mapping studies described above will therefore be examined in order to assess the likely risks posed by prospective gravel extraction in particular parts of the spawning distribution. The results will be linked to a risk assessment model being developed to investigate how the combined effect of fishing mortality and egg-production loss might effect the sustainability of a hypothetical crab population.

## APPENDIX 2

S. Kuzmin  
PINRO, Murmansk  
Russia

### **Russian investigations on the stock of red king crab *Paralithodes camtschaticus* in the Barents Sea**

An independent self-reproducing population of a valuable commercial crab species *Paralithodes camtschaticus* has formed due to work on acclimatisation done by the Soviet (Russian) specialists in the Barents Sea. The investigations done by PINRO in 1993–2000 showed that the distribution of red king crab in the Barents Sea is linked with zones of penetration of warm Atlantic waters. Red king crab in the Russian waters reached (in the east) the possible borders of the area.

It was determined that red king crab do age and seasonal migrations in the Barents Sea similar to those in the original area. The interannual dynamics of the size composition of the population, as well as the other peculiarities of the size and weight growth of crabs, are discussed. Mass moulting of red king crab males takes place in spring. Histological and morphometric indices of males maturity are similar to those in the original areas. Results of investigations of crabs spawning are presented. It was revealed that hatching of larvae takes mainly place in March/April. Maximum density of larvae distribution is registered in the Varanger Fjord, Motovsky Bay and in the area of the Kildin Island.

Species dominating in the red king crab feeding are bivalves and gastropods, echinoderms and polychaetes. Crabs themselves were found in the food diet of some demersal fish species. When introducing crabs into the Barents Sea, no parasite was transported from the pacific area.

At present, the exponential growth of total abundance, and commercial and spawning stocks are specific to the population of red king crab in the Barents Sea.

Stock condition of red king crab population in the Barents Sea and the analysis of their main biological characteristics are the reasons to consider the harvesting of crabs on the basis of the proposed management scheme as worthwhile.

## APPENDIX 3

M. Hébert  
DFO, Moncton  
Canada

### Results of a study on snow crab trap selectivity in the southwestern Gulf of St. Lawrence

The size of the mesh used on snow crab traps has an impact on the size of captured crabs. Presently, the minimum length, measures taken inside the knots, for each mesh side has been regulated to 65 mm without regulation for the maximum length. According to fishermen, traps with wider mesh sizes seem to catch larger crabs and are more and more frequently used. Harvesting only larger size crabs in the population may affect the reproductive potential of the stock.

To further study the relationship between the size of captured crabs and mesh size of traps, we used data collected from the at-sea sampling during the 1999 fishing season. The length of one mesh side was measured at the nearest mm with a caliper at three different places on the trap. Three similar meshes were sampled at the bottom part of the trap. The trap types and the soak time were also noted. The data were grouped into five groups according to mesh sizes; 60–64 mm, 65–69 mm, 70–74 mm, 75–79 mm and 80 + mm and also into two groups; 24–48 hours and 48 + hours according to soak time. A two-way ANOVA (using the mesh size and soak time) was used to compare the size of captured crabs. To make the test robust, we randomly chose an equal number of traps for each factor. A Scheffe test was used for pairwise comparisons in case where ANOVA showed a significant difference in the mean size of crabs according to mesh size and/or soak time.

Selectivity on crab size may depend on the shape, the length and the disposition of the mesh. Also, mesh size may have an impact on the size and could allow animals of small sizes to escape the trap. Furthermore, certain mesh size could allow sub-legal sized prawns (*Pandalus platyceros*) to escape the trap without affecting the catches of legal sized prawns. In some cases, mean size of prawns caught was independent from soak time (24hrs, 48hrs and 72hrs).

Harvesting exclusively larger sized crabs from the exploitable biomass could have a negative impact on the stock. When crab molt to the terminal phase, the carapace become older with time and if these crabs of smaller size, but still of legal size, are not harvested, they will become older and die. Such practice would create an artificial increase of the exploitation rates on a portion of the larger-sized crabs, resulting in a substantial diminution of the population reproductive potential.