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The Prince Edward Island snow crab (<u>Chionoecetes opilio</u>) stock assessment for 1991.

by

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ABSTRACT

An exploratory snow crab fishery was established off northern Prince Edward Island (P.E.I.) with the issuance of 16 exploratory permits in 1985 and 14 additional permits in 1986. The 16 original permits were reissued as licenses in 1987. The fishery operated under a quota limitation for the first time in 1990. The fishing took place in the spring with a global quota of 500 t. Total landings of 546 t were recorded during that period. The 1991 quota (600 t) was attained (615 t).

Biological information was obtained from sea sampling and a trawl survey while catch, effort and distribution of fishing effort were obtained from fishermen's logbooks and processor's sales slips. Twenty-eight stations within the P.E.I. fishery were surveyed and analyzed for biomass estimation.

Logbook records for the season represented 65% of the total catch of 615 t. The mean CPUE in 1991 (33.4 kg/trap haul) calculated from logbooks for the season was higher than the 1990 season (24.8 kg/trap haul). Fishing locations were concentrated at the edge of the zones.

A large percentage of small claw crab in the catch may indicate that the exploitation is high in this zone. The trawl survey data suggested that a good recruitment into the fishery is expected in the future. However, this recruitment should be protected by avoiding the catch of newly molted crab. It is therefore highly recommended to protect the recruitment of newly molted crab which is expected to appear in the fishery in 1992 by closing the fishery as soon as the soft shell crab enter the fishery.

RÉSUMÉ

Une pêche exploratoire du crabe des neiges a été établie au nord de l'Ile-du-Prince-Edouard (I.-P.-E.) avec l'émission de 16 permis exploratoires en 1985 et 14 nouveaux permis en 1986. Les 16 permis originaux ont été émis à nouveau comme licenses en 1987. Un contingent a été établi pour la première fois dans cette pêcherie en 1990. La pêcherie a eu lieu au printemps avec un contingent global de 500 t. Des débarquements de 546 t ont été enregistrés durant cette période. Le contingent de 1991 (600 t) a été atteint (615 t).

Les caractéristiques biologiques pertinentes ont été obtenues lors de l'échantillonage en mer pendant la saison de pêche et à partir d'une campagne de chalutage après la saison de pêche. La prise, l'effort et la distribution d'effort ont été obtenus des carnets de bord des pêcheurs et des bordereaux d'achat. Vingt-huit stations à l'intérieur de la zone de l'I.-P.-E. ont été échantillonnées et analysées pour l'estimation de la biomasse.

Les prises rapportées des carnets de bord représentaient 65% de la capture totale de 615 t. La prise par unité d'effort moyenne (P.U.E.) en 1991 (33,4 kg/casier) calculée à partir des carnets de bord était supérieure à 1990 (24,8 kg/casier levé). Cette pêcherie a été toujours concentrée à la frontière des zones de pêche.

Un haut pourcentage de crabes à petites pinces dans les prises peut indiquer que le taux d'exploitation est haut dans cette zone. Les données de chalutage suggèrent un bon recrutement dans la pêcherie dans le futur. Cependant, ce recrutement devrait être protégé en évitant la capture du crabe récemment mué. Il est alors fortement recommandé de protéger le recrutement de crabe récemment mué qui entrera dans la pêcherie de 1992 en fermant la pêcherie aussitôt que le crabe mou entre dans les casiers.

INTRODUCTION

An exploratory snow crab fishery was initiated off the coast of Prince Edward Island (P.E.I.) in 1985 and is composed of management zones 25 and 26 (Fig.1). The number of exploratory permits was increased from 16 in 1985 to 30 in 1986 (Davidson <u>et al.</u>, 1986; Comeau and Davidson, 1987). The initial 16 exploratory permits were issued as licenses for the 1987 snow crab fishing season. The fishermen are allowed to fish 30 traps.

From 1985 to 1987, the P.E.I. snow crab fishery had no quota limitation and the fishing season was from April 1st to November 30th.

In 1988, the fishery management plan proposed a 10 week spring fishing season from April 28th to July 5th which coincided with the midshore (southwestern Gulf) crab fishing season. Despite of CAFSAC advice not to open a fall fishery for 1988, an opening was supported by the Province of P.E.I., processors from Eastern P.E.I. and 13 fishermen out of 30. A 4 week fall fishery took place and the first landings were recorded on October 3rd and the last landings on October 31st (Moriyasu et al., 1989).

In 1989, the crab fishing season was the same as the southwestern Gulf. It opened on April 9th and closed on May 29th because of high percentage of newly molted crab in the catches (DeGrâce et al., 1990). No fall fishery was permitted.

In 1990, the fishery opened on April 21st with a global quota of 500 t. The last landings were recorded on May 18th for a total of 546 t of crab landed for the season.

In 1991, the season opened on May 4th with a global quota of 600 t. The closure of the season occurred May 27th as the quota was reached (615 t).

MATERIAL AND METHODS

SEA AND PORT SAMPLING

Sea samples (prorated to the landings; Mallet, pers. comm.) were obtained from the 4 weeks of the fishery (starting on May 4th). Location of capture, size in mm (carapace width (CW) and chela height (CH)), sex and shell hardness using a carapace hardness gauge (durometer, Foyle <u>et al.</u>, 1989) was noted for all crabs sampled at sea during the 1991 fishing season. The mean size (CW) and the percentage of undersized, morphometrically immature (Conan and Comeau, 1986) and soft shelled crab were calculated for the males sampled at sea. In the present document, at the request of the Steering Committee in order to standardize the terminology between the regions, the morphometrically immature and mature crab will be called small and large claw crab respectively (Comeau <u>et al</u>, 1991). The small claw and the large claw are the crabs falling in the lower and the upper cloud, respectively, of a plot of chela height versus carapace width. A soft crab is a crab with a durometer reading of less than 68 and a white crab is a crab that molted the same year. Overall size distributions were generated and the percentages of large claw and small claw male crabs in the sea samples and port samples were plotted according to their carapace size.

LOGBOOK DATA

Catch/effort data for the P.E.I. fishery was obtained from fishermen's logbooks by the Department of Fisheries and Oceans Electronic Program coordination and Economics Branch and contained the following information:

a) Canadian Fisheries Vessel number (CFV)

b) date fished

c) date landed

d) fishing position (Loran C or latitude/longitude)

e) number of traps hauled

f) catch estimated in pounds by the fishermen

The seasonal CPUE (total catch / number of trap hauls) was calculated from the logbook data. The geographical fishing positions were plotted to identify the major fishing effort concentrations.

POST SEASON TRAWL SURVEY

A post season trawl survey was conducted in the southern Gulf of St. Lawrence between July 10th and November 7th, 1991 and included 22 stations within the P.E.I. crab fishing zones 25 and 26 (Fig.2).

A standard 20m <u>Nephrops</u> trawl equipped with SCANMAR electronic net sensors was used on a chartered vessel for the research survey. Stations were sampled on a twelve hour basis during daylight. The tow duration varied from 4 to 8 minutes at a speed of 1.5-2.5 knots. A standard trawl haul started when the predetermined amount of cable (usually three times the depth) was let out and the winch drums locked. The catch was sorted out by sex, size, percentage of small and large claw males, molt stages and the presence/absence of the external eggs for females.

The kriging, a geostatistical technique (Conan, 1985; Conan <u>et al.</u>, 1988) was used to estimate the biomass for the P.E.I. fishing zones. Biomasses were estimated based on a variogram calculated from samples collected over the southwestern Gulf.

A size frequency distribution was produced for males captured during the survey. The catch in number of large claw male crab larger than 95 mm CW from the 1991 trawl survey was used for estimating the commercially exploitable (hard carapace) biomass at the beginning of the 1992 fishing season. A hard carapace crab is a crab that molted at least one year prior to the fishing season (which gives a durometer reading of at least 68). The catch in number of small claw crab larger than 56 mm CW from the 1991 trawl survey was used for estimating the biomass of newly molted crab larger than 70 mm CW for the 1992 spring season using the global growth rate independently from the claw size maturity. Numbers of crab were converted to weight by using the size-weight relationships according to the molt stage, percentage of small and large claw and the sampling season.

The fishable area in the P.E.I. crab fishery was estimated according to the historical fishing effort distribution. The surface swept by the trawl net was estimated from the data on net opening width measured by the SCANMAR electronic net sensors and the distance towed.

RESULTS AND DISCUSSION

LOGBOOK DATA

Usable logbook records (completed logs) received from fishermen accounted for 402 t or 65% of the total catch (615 t).

FISHING EFFORT AND CATCH PER UNIT OF EFFORT

The seasonal total fishing effort, catch rates and total catch since the start of the fishery are summarized as follows:

| Year | Trap hauls | (#weeks) | CPUE | | Total catch | | |
|------|------------|----------|------|------|-------------|-------|-------|
| | S | F | S | F | S | F | |
| 1985 | 11756 (13) | 3404 (7) | 57.2 | 37.9 | 672.6 | 129.1 | - |
| 1986 | 30824 (13) | 7182 (9) | 32.7 | 32.2 | 1007.7 | 231.3 | |
| 1987 | 19069 (11) | 5919 (6) | 15.1 | 28.5 | 287.9 | 168.7 | |
| 1988 | 16478 (10) | 4813 (4) | 26.5 | 47.6 | 436.7 | 229.1 | |
| 1989 | 15726 (06) | - | 47.5 | - | 747 | - | |
| 1990 | 22016(04) | - | 24.8 | - | 546 | - | |
| 1991 | 18413 (04) | - | 33.4 | - | 615 | - | |

S: spring season, F: fall season

Weeks : duration of the fishing season in weeks

The calculated total fishing effort decreased from 22016 trap hauls in 1990 to 18413 trap hauls in 1991. The duration of the season decreased from 1986 to 1988, both in the spring and the fall, and decreased again in 1989 and 1990 and remained stable in 1991. The CPUE calculated for the 1991 season (33.4 kg/trap haul) increased compared to 1990 (24.8 kg/trap haul).

The distribution of fishing effort (Fig.3) showed one concentration in the center of zone 26 and another one at the intersection of zone 25 and 26.

BIOLOGICAL INFORMATION FROM THE TRAWL SURVEY

The catch from the trawl survey comprised 70.2% of white crab compared to 78.9% in 1990 and 96.7 in 1989 survey. The percentage of small claw crab increased from 85.5% for the 1989 survey to 89.7% for the 1990 survey and decrease again in 1991 to 81.7%. The composition of the catch from the 1991 survey was as follows

| | White crab | | | Hard shell | | | Total | | |
|------------|------------|------|------|------------|-----|------|-------|------|-------|
| | ı — | M | Т | I | М | Т | | М | Т |
| Legal size | 10.7 | 13.4 | 24.1 | 5.7 | 2.0 | 7.7 | 16.4 | 15.4 | 31.8 |
| Total | 56.1 | 14.1 | 70.2 | 25.6 | 4.2 | 29.8 | 81.7 | 18.3 | 100.0 |

(I=small claw, M=large claw, T=total)

The comparisons over a period of four years are as follows:

| Year of the survey | 1988 | 1989 | 1990 | 1991 |
|--------------------|------|------|------|------|
| Mean size | 64.9 | 78.7 | 75.0 | 81.5 |
| % small claw males | 90.6 | 85.5 | 89.7 | 81.7 |
| % white crab | 83.0 | 96.7 | 78.9 | 70.2 |

The increase in the mean size from 1988 to 1989 is probably due to a shift towards larger sizes of small claw crab(56-58 mm) in 1989. The shift towards smaller mean size in 1990 can probably be attributed to a pulse of recruitment of smaller size (32-40 mm) small claw crab in 1990 (Figure 4). This mode shifted towards larger sizes in 1991 bringing the mean size up from 1990.

BIOLOGICAL INFORMATION FROM SEA SAMPLING AND PORT SAMPLING

The biological information (in percentages from the total) for the five samples collected at sea during the fishing season is as follows (n=698):

| | Soft shell | | | | Hard shell | | | Total | | |
|---------------------------------------|---------------------|-------------------|---------------------|---|---------------------|---------------------|---------------------|---------------------|---------------------|-----------------------|
| | Ī | М | т | | | М | T | I | М | Т |
| Legal size Sub-legal size Total | 29.1 5.9 35.0 | 1.3 0.1 1.4 | 30.4 6.0 36.4 | • | 26.4 2.8 29.2 | 31.0 3.4 34.4 | 57.4 6.2 63.6 | 55.5 8.7 64.2 | 32.3 3.5 35.8 | 87.8 12.2 100.0 |

(I=small claw, M=large claw, T=total)

In 1991, the overall size frequency distribution of the sea samples (Fig. 5) showed an average size of 104.3 mm CW compared to 101.2 mm CW in 1990.

The percentage of small claw males in the sea samples from 1986 to 1991 are as follows:

| 1986 | 1987 | 1988 | 1989 | 1990 | 1991 |
|------|------|------|------|------|------|
| 17.1 | 50.9 | 45.1 | 12.0 | 76 | 64 |

The percentage of soft shell collected during the spring fishing season showed a continuous increase from 17.3% in 1986, 54.9% in 1987, 62.0% in 1988 (Moriyasu <u>et al.</u>, 1988) to 97% in 1989 and began to decrease to 55.3% in 1990 and 36.4% in 1991.

The overall size frequency distribution of the port samples (Fig. 5) showed an average size of 104.4 mm CW and the seasonal percentage of small claw males in the samples was 47%. 26% of the crab in the port samples was soft.

BIOMASS ESTIMATION

Total fishable surface estimated for the P.E.I. fishery based on the commercial fishing effort distribution was 2442.51 km² (Moriyasu <u>et al.</u>, 1989).

The variogram plots for the large claw male crabs larger than 95 mm CW and the small claw male crabs larger than 56 mm CW showed a range of approximately 10.2 km and 10.1 km respectively beyond which no more spatial covariance effects are detected (Fig. 6).

By using Kriging techniques, the biomass estimation for males at the beginning of the spring of 1992 based on the 1991 trawl survey for different biological categories gave the following results:

| Category | Surface (km2) | Crabs/km2 | Biomass(t) | ±2SD |
|------------------------|---------------|-----------|------------|------|
| Large claw hard ≥95 mm | 2442.51 | 1672.8 | 2665.0 | 1661 |
| white crab ≥70 mm | 2442.51 | 7182.0 | 7283.1 | 3620 |

The estimated biomass of large claw crab \ge 95 mm CW increased by 2% from 1990 (1319.9 t ± 1295.5 t) to 1991 (1325 t ± 950 t) and than increased by 101% in 1992(2665 t ± 1661 t).

The estimated biomass of white crab \geq 70 mm CW increased by 31% from 1990 (5880.8 t ± 4140 t) to 1991 (7704 t ± 2890 t) and than decreased by 5% in 1992 (7283 t ± 3620 t).

RECOMMENDATION

Comeau and Davidson (1987), Comeau <u>et al.</u>, (1988), Moriyasu <u>et al.</u> (1988), and Moriyasu <u>et al.</u> (1989) all reported low level of fishable biomass of snow crab in the P.E.I. zones for 1986, 1987 and 1988 respectively. From 1987 to 1989, exploitation rates (over 75%) have always been higher than the CAFSAC reference level of 50-60 % except for the 1988 fall season (52%; DeGrâce <u>et al.</u>, 1990).

The increase in the estimated biomass from 1991 to 1992 is assumed to be the result of a larger recruitment to the fishery in 1991 compared to 1990. Based strictly on the mid value of the estimated biomass from the 1991 survey, a translation of the 50% exploitation rate would represent a TAC of 1333 t for the two zones.

The high percentages of small claw males found during the trawl survey from 1988 to 1990 (Chiasson <u>et al.</u>, 1991) suggest that there was a good recruitment to enter the fishery in 1991. The 1991 sea sampling data suggests that a large percentage of the small claw crab did not molt in the spring of 1991 and were caught as small claw crab which represents a wastage of the resource. Since the mode of small claw pre-recruit crab is still present in 1991, the situation will probably remain for 1992.

Since this fishery depends highly on recruitment, it is recommended to exploit the increase of biomass of large claw animals over more than one year. This could allow an accumulation of large claw crab on the grounds, a reduced dependency on soft and small claw crab and a possible stabilization of this fishery.

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Figure 2. Geographic locations of the post season trawl survey sampling stations in the P.E.I. zones in 1991. Each dot represents one 4 to 8 minute tow.



Figure 3. Overall distribution of fishing effort based on the logbook data for the 1991 P.E.I. snow crab fishery. Each dot represents the location of at least one trap haul.

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Percentage of small claws in black, percentage of total in white.





Figure 5. Overall size distribution of male snow crab, <u>Chionoecetes opilio</u>, present in the sea and port samples collected in the P.E.I. snow crab fishery in 1991.

Percentage of soft shell in black, percentage of total in white.



Figure 6. Variograms for large claw males ≥95 mm CW and small claw males ≥56 mm CW used in the kriging calculations for the 1991 trawl survey.



Figure 7. Density contours of large claw males ≥95 mm CW for 1989 to 1992 based on trawl survey data from 1988 to 1991 respectively.



<u>1990</u>



- 5000 crab/ km² 0 5000 - 10000 crab/ km² $10000 - 15000 \text{ crab}/\text{ km}^2$ 15000 - 20000 crab/ km²

Figure 8. Density contours of small claw males ≥70 mm CW for 1989 to 1992 based on trawl survey data from 1988 to 1991 respectively.