Fisheries and Oceans Canada | Pêches et Océans Canada
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Canadian Science Advisory Secretariat (CSAS)

Research Document 2016/086

Gulf Region

Review of the 2015 snow crab (*Chionoecetes opilio*) fishery in the southern Gulf of St. Lawrence (Areas 12, 19, 12E and 12F)

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October 2016

Canada

Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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Published by:

Fisheries and Oceans Canada
Canadian Science Advisory Secretariat
200 Kent Street
Ottawa ON K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/
csas-sccs@dfo-mpo.gc.ca

ISSN 1919-5044

Correct citation for this publication:

Hébert, M., Wade, E., DeGrâce, P., and Moriyasu, M. 2016. Review of the 2015 snow crab (*Chionoecetes opilio*) fishery in the southern Gulf of St. Lawrence (Areas 12, 19, 12E and 12F). DFO Can. Sci. Advis. Sec. Res. Doc. 2016/086. v + 43 p.

Aussi disponible en français :

Hébert, M., Wade, E., DeGrâce, P., et Moriyasu, M. 2016. Revue de la pêche au crabe des neiges (Chionoecetes opilio) dans le sud du golfe du Saint-Laurent (zones 12, 19, 12E et 12F) en 2015. Secr. can. de consult. sci. du MPO. Doc. de rech. 2016/086. *v + 44 p.*

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ABSTRACT

The review of the 2015 snow crab (*Chionoecetes opilio*) fishery in the southern Gulf of St. Lawrence (Areas 12, 19, 12E and 12F) is presented. Total landings in the sGSL in 2015 were 25,911 t out of a quota of 25,842 t. In Area 12, landings were 23,080 t (quota of 23,021 t). The mean catch-per-unit-of-effort (CPUE) from logbooks increased in 2015 (67.9 kg per trap hauled (kg/th)) compared to 2014 (61.8 kg/th). The mean size of commercial-sized adult males decreased from 113.2 mm of carapace width (CW) in 2014 to 111.9 mm CW in 2015. The incidence of soft-shelled crab remained low at 4.9%. In Area 19, landings reached 2,129 t (quota of 2,130 t). The mean CPUE remained high in 2015 at 144.8 kg/th and is comparable to 2014 (147.4kg/th). The mean size of commercial-sized crabs remained high in 2015 (115.7 mm CW). The incidence of white crabs increased from 1.0% in 2014 to 5.5% in 2015. In Areas 12E and 12F, landings were 192 t (quota of 189 t) and 510 t (quota of 502 t), respectively. In Area 12E, the mean CPUE increased in 2015 (65.8 kg/th) compared to 2014 (47.3 kg/th). The incidence of soft-shelled crab increased from 7.8% in 2014 to 9.8% in 2015. In Area 12F, the mean CPUE in 2015 (38.2 kg/th) is comparable to 2014 (38.1 kg/th) while the incidence of soft-shelled crabs remained low at 3.3% in 2015.

RÉSUMÉ

La revue de 2015 de la pêche au crabe des neiges, *Chionoecetes opilio*, dans le sud du golfe du Saint-Laurent (sGSL ; zones 12, 19, 12E et 12F) est présentée. Les débarquements dans le sGSL en 2015 ont atteint 25 911 t sur un quota de 25 842 t. Dans la zone 12, les débarquements ont atteint 23 080 t (quota de 23 021 t). La prise par unité d'effort (PUE) moyenne selon les carnets de bord a augmenté en 2015 (67,9 kg par casier levé (kg/cl)) comparativement à 2014 (61,8 kg/cl). La taille moyenne des mâles adultes de taille commerciale a diminué passant de 113,2 mm de largeur de carapace (LC) à 111,9 mm LC en 2015. L'incidence des crabes à carapace molle est demeurée basse en 2015 à 4,9%. Dans la zone 19, les débarquements étaient de 2 129 t sur un quota de 2 130 t. La PUE moyenne a demeuré élevée en 2015 à 144,8 kg/cl et comparable à 2014 (147,4 kg/cl). La taille moyenne des mâles adultes de taille commerciale est demeurée élevée en 2015 (115,7 mm LC). L'incidence des crabes blancs a augmenté passant de 1,0% en 2014 à 5,5% en 2015. Dans les zones 12E et 12F, les débarquements ont atteint 192 t (quota de 189 t) et 510 t (quota de 502 t), respectivement. Dans la zone 12E, la PUE moyenne a augmenté en 2015 (65,8 kg/cl) comparativement à 2014 (47,3 kg/cl). L'incidence de crabes à carapace molle a augmenté passant de 7,8% en 2014 à 9,8% en 2015. Dans la zone 12F, la PUE moyenne en 2015 (38,2 kg/cl) est comparable à celle de 2014 (38,1 kg/cl) et l'incidence des crabes à carapace molle est demeurée basse en 2015 à 3,3%.

1.0. INTRODUCTION

Snow crab, *Chionoecetes opilio*, has been commercially exploited in the southern Gulf of St. Lawrence (sGSL) since the mid-1960s. Until 1994, the snow crab fishery in Area 12 (Fig. 1) was exploited by 130 mid-shore fish harvesters from New-Brunswick, Quebec and Nova-Scotia. In 1997, the Prince Edward Island coastal fishery (formerly called Areas 25/26) was integrated into Area 12. In 2003, a portion of the coastal fishery off Cape Breton (formerly called Area 18) was also integrated into Area 12 and a northern part of Area 18 was set as a buffer zone (non-snow crab fishing zone) (Fig. 1). For the purpose of this assessment, Area 12 refers to the new management unit (Fig. 1). In 1978, Area 19 (Fig.1) was established for the exclusive use of Cape Breton inshore fish harvesters with vessels less than 13.7 m (45 feet) in length. Areas 12E and 12F were introduced in 1995 as exploratory fishery areas. In 2002, the status of these fishery areas was changed from exploratory to commercial.

There are four individually managed fishing areas (Areas 12, 19, 12E and 12F) (Fig. 1), among which Area 12 has the largest surface area, the largest number of participants, and the highest landings. There is no biological basis for the delimitations of snow crab management areas in the sGSL (Chiasson and Hébert 1990; Hébert et al. 2007, 2008; DFO 2009). Crabs in these management areas are considered part of a single biological population and the sGSL is considered as one unit for assessment purposes.

Baited traps, constructed of tubular steel, are used to catch crab, mainly on mud or sand-mud bottoms at temperatures ranging from -0.5 to 4.5°C, and depths ranging from 50 to 280 m.

Management of this fishery is based on quotas (by management area and distributed among license holders) and effort controls (number of licenses, trap allocations, trap dimensions, and fishing seasons).

In Areas 12, 12E and 12F, the fishing season generally starts as soon as the sGSL is clear of ice, in April to early May, and ends in mid-July if the quotas are not reached. In Area 19, the fishing season starts in July and ends in mid-September if the quota is not reached. The landing of females is prohibited and only hard-shelled males ≥ 95 mm carapace width (CW) are commercially exploited. Different trap limits apply to each license depending on the harvester groups and fishing areas.

In the sGSL, molting of snow crab occurs from December-April, prior to the fishery (Watson 1972; Conan et al. 1988; Sainte-Marie et al. 1995; Benhalima et al. 1998; Hébert et al. 2002). Crab normally molt every year until they reach the adult phase via a final or “terminal” molt (Conan and Comeau 1986). Males reach the terminal molt at sizes ranging from 40 to 150 mm CW, whereas females reach terminal molt at smaller sizes, ranging from 30 to 95 mm CW (Conan and Comeau 1986). The longevity of adult males (after reaching the terminal molt) is approximately 5 years (Sainte-Marie et al. 1995) to 7.7 years (Fonseca et al. 2008).

Since 1990, a protocol for monitoring and managing the capture of soft-shelled male crabs has been in place in the sGSL fisheries. Soft-shelled male crabs have low commercial value due to their lower meat content and are discarded at sea by fishermen. This activity results in mortality of soft-shelled male crabs and may reduce the recruitment to the fishery for the following years (Dufour et al. 1997). Soft-shelled and white crabs are the molters of the year which are identified by their carapace conditions 1 or 2. Soft shelled or white commercial-sized adult males represent the recruitment to the fishery for the following year as the crab harden and fill up with meat becoming crab of carapace condition 3, the best commercial quality on the market. Commercial-sized adult males of carapace conditions 4 and 5 molted more than two years ago are less desirable on the market because of the accumulation of moss, scars and scratches on

their carapace. However, commercial-sized adult males of carapace condition 4 are the best reproducers (Sainte-Marie et al. 1995).

This report presents the review of the 2015 snow crab fishery in the sGSL (Areas 12, 19, 12E and 12F). Fishery monitoring of the sGSL fisheries is based on logbook data, dockside monitoring of the catch, and at-sea sampling by observers.

2.0. METHODS

2.1. LOGBOOKS AND LANDING MONITORING

Raw data on catches and fishing effort were obtained from mandatory logbooks and the quota monitoring report, which is based on dockside monitoring of landings. The data were compiled by Informatics and Statistics Branches of the Quebec and Gulf Regions of The Department of Fisheries and Oceans (DFO), and verified by Science Gulf Region.

The geographic distribution of fishing effort was presented as the total number of trap hauls within each 10 by 10 minutes latitude-longitude grid. The fishing positions were obtained from logbooks.

The mean catch-per-unit-of-effort (CPUE) in kilograms per trap hauls (kg/th) of the fleet in year (i) was calculated as the ratio of total catches (y_i) and the corresponding number of trap hauls (th_i) as reported in the logbooks: $CPUE_i = y_i / th_i$. As not all trap hauls were reported in the logbooks, the total trap hauls had to be estimated. Thus the total effort in the fishery (total number of trap hauls, TH) was estimated from the total landings from the quota monitoring report (Y_i) divided by the unadjusted mean CPUE: $TH_i = Y_i / CPUE_i$. Trap immersion times were taken from the logbooks.

2.2. AT-SEA OBSERVER SAMPLING

Since 1990, DFO has implemented an intensive observer sampling program (see appendices 1 to 6 for detailed protocol) onboard commercial vessels to provide an annual assessment of the percentage of soft-shelled crabs, CPUE, and the size structure of males caught. Two types of sampling have been conducted on the commercial fishing vessels: before discarding and after discarding (retained catch). The sampling effort ratio was two samples before discarding to one sample after discarding for the entire fishing activity of the sampled boat. Locations of traps sampled are shown in Figure 2.

2.2.1. Sea sampling before discarding

Observers from consultant companies Biorex and Javitech were deployed randomly on fishing boats and the vessels selected to be sampled. The observers were distributed equally among the different harvester groups (First Nations, traditional harvesters, and new entrants). The observer randomly selected traps during the entire period of fishing activity. For each trap sampled, a sub-sample of 40 males of all sizes were chosen at random from the total catch and the following measurements were taken: CW, chela height (CH), carapace condition (Hébert et al. 1997), and hardness at the base of the right claw (Foyle et al. 1989); see Appendices 1 to 6 for detailed information on the at-sea sampling protocol. The hardness measurement was determined with a 2.25 kg gauge durometer (Pacific Transducer Corp., California, U.S.A.) on a scale of 0 to 100 units. The positions of the sampled trap, depth of fishing, and total number of males for each sampled trap were also recorded.

In Areas 12, 12E and 12F, crab of carapace conditions 1 and 2 and claw hardness less than 68 units on the durometer were categorized as soft-shelled crabs (Hébert et al. 1992). In Area 19

(a summer fishery), crabs with carapace conditions 1 and 2 and a claw hardness less than 72 on the durometer reading were considered as soft and white crabs. White crab is defined by shell hardness < 78 durometer units and includes both new soft (condition 1) and clean hard shelled crab (condition 2).

2.2.2. Sea sampling after discarding

The observer randomly selected traps during the entire fishing activity to determine the composition of the retained catch (landing composition). A random sub-sample of 20 male crabs from the retained catch of each sampled trap was taken and the same information as described for the sampling before discarding was recorded. The following additional information was recorded for each sampled vessel: name of the boat, date of sampling, and total quantity landed.

The catch composition from the sea samples (% of different categories of crab) was estimated based on the carapace hardness, size (legal and sub-legal) and morphometric maturity (adult – terminal molt; adolescent – non-terminal molt). The annual mean weighted percentages of soft-shelled males were calculated based on the size structure obtained from the sea sampling prior and after discarding (Hébert et al. 1992). Sea samples are weighted by the landing from each sampled vessel. The at-sea observer CPUEs for each trap sampled were calculated based on the number of commercial-sized adult males with carapace conditions 3, 4 and 5 measured and converted into weight using the size-weight relationship for adult hard-shelled males (Hébert et al. 1992) and the CW (mm) distributions from sampling. CPUE are weighted by the landing from each sampled vessel.

2.2.3. Soft-shelled crab and white crab protocol monitoring

The soft-shelled crab monitoring program was carried out again in 2015 for Areas 12, 12E and 12F. This protocol allows the closure of smaller areas (grids or sectors) of the fishery with high incidence of soft-shelled males in the catch without closing the entire fishery. A given grid or sector was closed for the season on a mandatory basis when the incidence of soft-shelled males exceeded 20% in number for a period of 15 days. This criterion (20%) was not based on biological considerations, but rather on the economic viability limit with which fishermen and the fishing plants had agreed to in order to continue their operations (Hébert et al. 1992). An advance notice (DFO Fishery Act) of 5 days was given to fishermen to leave the grids or sectors when the percentage of soft-shelled males exceeded 20% in number within a 15-day analysis period. A comparable protocol was applied in Area 19. The mean percentage of soft-shelled used to close grids or sectors is calculated using the ratio of the number of soft-shelled males and the total number of males caught in commercial traps before discarding.

3.0. RESULTS

3.1. FISHERY PERFORMANCE

Since 1969, snow crab landings in the sGSL have shown three periods of high landings (exceeding 20,000 t): 1981 to 1986, 1994 to 1995, and more recently from 2002 to 2009 (Table 1; Fig. 3). The peak landings were reported in 2005 (36,118 t). The landings in the sGSL were 25,911 t in 2015 (quota of 25,842 t) while they were 24,439 t in 2014 (quota of 24,230 t) (Table 1; Fig. 3).

3.1.1. Area 12

The 2015 fishing season in Area 12 opened on May 11 and the last landings were recorded on July 22 with reported landings of 23,080 t from a quota of 23,021 t. Harvesters participating in the fishery were from New-Brunswick, Quebec, Nova Scotia and Prince Edward Island. The number of participating boats decreased from 307 to 292 between 2014 and 2015.

Logbooks

Main fishing grounds are shown in Figure 1. The estimated fishing effort in Area 12 has varied from 243,339 to 544,454 trap hauls (th) between 1987 and 2009, but decreased considerably to 161,148 th in 2010, the lowest value of the time series since 1987 (Table 1). The fishing effort increased since then to 339,912 th in 2015 (Table 1). During the 2015 fishing season, fishing effort in Area 12 was concentrated mostly in Chaleur Bay, Bradelle Bank, Shediac Valley, the Magdalen Channel and the Cape Breton Corridor (Fig. 4) where the majority of landings were taken (Fig. 5).

The mean CPUE (called CPUE hereafter) estimated from logbooks in Area 12 was 67.9 kg/th in 2015, an increase compared to 2014 (Table 1). High CPUEs were observed in the northern part of the Magdalen Channel, Chaleur Bay, Bradelle Bank, Shediac Valley, Cape Breton Corridor, and American Bank (Fig. 6).

The CPUE by group harvesters are presented in Table 2.

The mean trap immersion times are summarized in Table 3. Since 1997, the mean trap immersion time in Area 12 has varied from 55 hours in 2003 to 86 hours in 2013 (Table 3; Fig. 7). The mean trap immersion time increased from 2010 to 2013 and decreased afterward (Table 3; Fig. 7).

At-sea observer sampling

In 2015, the target at-sea observer coverage in Area 12 was 20%. The number of trips sampled was 438 consisting of 2,476 traps sampled and 97,187 crabs measured (Table 4; Fig. 8a).

The mean CPUE estimated from the at-sea observer sampling decreased from 65.1 kg/th in 1997 to 40.2 kg/th in 2000, gradually increased to 82.3 kg/th in 2007 and then decreased to 59.1 kg/th in 2009 (Table 5, Fig. 9). Since 2009, the CPUE has increased to reach 74.2 kg/th by 2015 (Table 5, Fig. 9).

In accordance with the soft-shelled crab protocol, 41 of 323 grids, which included the sector of Chaleur Bay, were closed during the 2015 fishing season (Fig. 10). The incidence of soft-shelled crabs (Table 6) in the catches was 4.9% in 2015, comparable to 2014 and has remained low compared to 12.5% observed in 2000.

Within the commercial-sized adult male catch, the percentage of crabs with carapace conditions 1 and 2 (prior to discarding) decreased from 2000 (11.7%) to 2008 (1.4%), and has varied between 1.7% and 6.8% from 2009 to 2014 (Table 7). The percentage of crabs with carapace conditions 1 and 2 was 1.3% in 2015 (Table 7). The percentage of crabs with carapace condition 3 decreased from 89.6% in 2005 to 68.4% in 2009 but has increased to 88.1% by 2015 (Table 7). The percentage of commercial-sized adult males with carapace conditions 4 and 5 decreased from 24.3% in 2000 to 6.0% in 2005 and has been between 11.8% and 25.6% from 2008 and 2014 (Table 7). The percentage of these categories 4 and 5 decreased to 10.6% in 2015.

The Area 12 mean size of commercial adult males increased from 109.0 mm CW in 2002 to 115.2 mm CW in 2010 but decreased to 111.3 mm CW by 2013 (Fig. 11). The mean size of

commercial adult males increased to 113.2 mm CW in 2014 but decreased to 111.9 mm CW in 2015 (Fig. 11).

3.1.2. Area 19

The 2015 fishing season in Area 19 opened on July 15 and the last day of landings were recorded on August 19 with reported landings of 2,129 t from a quota of 2,130 t. The number of boats fishing in Area 19 in 2015 was 103 (all from Cape Breton).

Logbooks

The fishing effort during 2015 in Area 19 was concentrated in the southern and central parts of the zone where the highest landings were taken while high CPUEs were observed all over the zone (Figs. 4, 5 and 6). The fishing effort has varied from 16,733 th to 55,977 th between 1987 and 2009, but decreased considerably to 11,138 th in 2010, the lowest value of the time series (Table 1). The fishing effort in 2015 was 14,703 th (Table 1).

The mean CPUE remained high in 2015 (144.8 kg/th) and is comparable to 2014 (Table 1). The highest mean CPUE was observed in 2012 at 178.1 kg/th (Table 1).

Since 1997, the mean trap immersion time in Area 19 has varied from 28 hours (2004) and 38 hours (2003) (Table 3; Fig. 7). There was an increase in the mean trap immersion time from 2010 to 2013 (Table 3; Fig. 7). The mean trap immersion time increased in 2015 compared to 2014 (Table 3; Fig. 7).

At-sea observer sampling

In 2015, the target at-sea observer coverage in Area 19 was 10%. A total of 72 trips were sampled with 199 traps sampled and 7,184 crabs measured (Table 4, Fig. 8b).

Between 1997 and 2009, the Area 19 mean CPUE estimated from the observer sampling has varied between 62.9 kg/th to 125.9 kg/th (Table 5; Fig. 9). Since 2009, the CPUE has increased to reach 200.6 kg/th by 2012 (Table 5; Fig. 9). The CPUE increased to 171.1 kg/th in 2015 compared to 163.5 kg/th in 2013 (Table 5; Fig. 9).

In accordance with the white crab protocol, two sectors within Area 19 were closed during the 2015 fishing season (Fig. 12). The percentage of white crabs in the catches increased from 6.1% in 2006 to 11.6% in 2009, decreased to 6.4% in 2010 and increased again to 11.5% in 2011 (Table 6). The percentage of white crabs decreased to 1.0% in 2014 but increased to 5.5% in 2015 (Table 6).

Within the commercial-sized adult male catch, the percentage of carapace conditions 1 and 2 was 3.9% in 2015, an increase compared to 2014 (1.2%) but below the highest value (16.6%) observed in 2000 (Table 7). The percentage of crabs with carapace condition 3 increased from 63.1% in 2009 to 91.6% in 2012 but decreased to 58.1% in 2013 (Table 7). The percentage of crabs with carapace condition 3 increased to 86.1% in 2015 (Table 7). The percentage of commercial-sized adult males with carapace conditions 4 and 5 decreased in 2015 (10.0%) compared to 2013 (34.4%), but remained higher than the lowest value (2.8%) observed in 2012 (Table 7).

The Area 19 mean size of commercial adult males fluctuated from 120.5 mm CW in 1995 to 109.6 mm CW in 2002, increased to 117.3 mm CW in 2007 but decreased to 114.8 mm CW in 2012 (Fig. 11). The mean size of commercial adult males increased to 115.7 mm CW by 2015 (Fig. 11).

3.1.3. Area 12E

In Area 12E, the 2015 fishery opened on May 10 and the last day of landings were recorded on June 24, with reported landings of 192 t from a quota of 189 t. Only four fish harvesters (two from New-Brunswick, one from Québec and one from Prince Edward Island) were active for the 2015 fishing season.

Logbooks

Harvesters concentrated their fishing effort in the southeastern part of the area adjacent to Areas 12 and 12F (Fig. 4). The fishing effort decreased from 9,232 th in 2008 to 1,825 th in 2010 but increased to 5,623 th in 2012 (Table 1). The fishing effort decreased to 2,918 th by 2015 (Table 1).

The Area 12E mean CPUE estimated from logbooks in 2015 was 65.8 kg/th, an increase compared to 2014 (Table 1). The mean CPUE has been increasing since 2009 (Table 1).

Since 1997, the mean trap immersion time has varied between 30 hours in 1998 and 72 hours in 2009. The mean trap immersion time increased in 2015 compared to 2014 (Table 3; Fig. 7).

At-sea observer sampling

In 2015, the target at-sea observer coverage in Area 12E was 20%. Five trips were sampled with 42 traps sampled and 1,637 crabs measured (Table 4; Fig. 8c).

Between 1997 and 2012, the mean Area 12E CPUE estimated from the observer sampling has varied between 13.6 kg/th to 88.9 kg/th (Table 5; Fig. 9). The CPUE increased in 2015 compared to 2014 (Table 5; Fig. 9).

In accordance with the soft-shelled crab protocol, no grids within Area 12E were closed during the 2015 fishing season (Fig. 13). The percentage of soft-shelled males in the catches was 9.8% in 2015, an increase from 2014 (Table 6).

Within the commercial-sized adult male catch, the percentage with carapace conditions 1 and 2 was low in 2015 at 0.4% compared to 8.5% in 2010 (Table 7). The percentage of commercial-sized adult males with carapace condition 3 increased from 87.0% in 2008 to 96.9% in 2015. The percentage of commercial-sized adult males with carapace conditions 4 and 5 remained low in 2015 at 3.5% (Table 7).

The Area 12E mean size of commercial-sized adult males increased from 105.8 mm CW in 2000 to 115.1 mm CW in 2007, but decreased to 106.6 mm CW by 2012 (Fig. 11). Since 2012, the mean size of commercial-sized adult males increased to reach 113.6 mm CW in 2015 (Fig. 11).

3.1.4. Area 12F

In Area 12F, the 2015 fishery opened on May 16 and the last day of landings were recorded on July 17 with reported landings of 510 t from a quota of 502 t. There were 16 traditional fish harvesters in 2015 among which ten were from the Magdalen Islands and six from Cape Breton.

Logbooks

The fishing effort was distributed all over Area 12F (Fig. 4). The fishing effort decreased from 16,890 th in 2012 to 11,086 th in 2013 but increased to 23,163 th in 2014 (Table 1). The fishing effort decreased to 13,351 th in 2015 (Table 1).

The Area 12F mean CPUE estimated from logbooks in 2015 (38.2 kg/th) is comparable to 2014 (38.1 kg/th, Table 1).

Since 1997, the mean trap immersion time has varied between 49 hours (1997) and 118 hours (2011). The mean trap immersion time in 2015 (92 hours) remained at the same level as 2014 (Table 3; Fig. 7).

At-sea observer sampling

In 2015, the target at-sea observer coverage Area 12F was 15%. Seven-teen trips were sampled with 70 traps sampled and 2,731 crabs measured (Table 4; Fig. 8d).

Between 1997 and 2008, the Area 12F mean CPUE estimated from the observer sampling has varied between 28.1 kg/th to 113.4 kg/th (Table 5; Fig. 9). The CPUE has gradually been increasing from 2008 to reach 55.4 kg/th by 2013 and has decreased to 38.7 kg\th in 2014. In 2015, the CPUE increased to 43.8 kg\th (Table 5; Fig. 9).

According to the soft-shelled crab protocol, no sectors within Area 12F were closed during the 2015 fishing season (Fig. 14). The percentage of soft-shelled males in the catches increased from 1.7% in 2014 to 3.3% in 2015 (Table 6).

The percentage of commercial-sized males of carapace conditions 1 and 2 increased from 1.5% in 2009 to 5.3% in 2011 but deceased to 2.2% in 2012 (Table 7). The percentage of these crabs increased to 8.9% in 2013 but decreased to 0.6% in 2015 (Table 7). The percentage of commercial-sized adult males of carapace condition 3 remained stable in 2015 (88.9%) compared to 2014 (89.5%), (Table 7). The percentage of commercial-sized adult males of carapace conditions 4 and 5 was 10.5% in 2015, an increase compared to 2013 (4.7%), (Table 7).

The Area 12F mean size of commercial sized adult males increased from 107.9 mm CW in 2000 to 113.6 mm CW in 2005, decreased to 108.5 mm CW by 2009 but increased to 110.0 mm CW in 2011 (Fig. 11). The mean size of commercial sized adult males decreased to 107.7 mm CW in 2012 but increased to 113.9 mm CW in 2014 (Fig. 11). The mean size of commercial sized adult males decreased to 112.3 mm CW in 2015 (Fig. 11).

4.0. DISCUSSION

The mean CPUE values are not standardized and do not account for changes in management measures and fishing practices and as a result may not be directly proportional to biomass. The relationship between the commercial-sized adult male biomass estimated from the trawl survey and CPUE calculated from logbooks in the sGSL is weak; $r^2 = 0.22$ (Fig. 15).

The mean CPUE in 2015 estimated from the logbooks data (confirmed with at-sea observer data) increased in Areas 12 and 12E, remained stable in Area 12F and remained high in Area 19 where it reached the fourth highest value observed since 1987. The percentage of soft-shelled males or white crabs in the catch was low in all areas. The mean size of commercial-sized adult males decreased in Areas 12, 19 and 12F and increased in Area 12E. The catch composition of commercial-sized adult males of carapace conditions 4 and 5 remained low in all areas.

The high mean CPUEs observed in Area 19 in recent years (2010 to 2015) cannot be explained by either erroneous logbook information or increases in trap immersion time because the relationship between the CPUEs estimated from the logbooks data corroborated well with the at-sea observer sampling data in each management area ($0.96 > r^2 > 0.89$, Fig. 16), and the trap immersion time has varied little in the past seven years.

A factor which might explain the increase in CPUE in Area 19 since 2010 is the immigration of commercial-sized adult crabs from the eastern Cape-Breton management areas, especially

from northern Eastern Nova Scotia (n-ENS: former Areas 20-22) (Hébert et al.,2012). The possibility of immigration from the adjacent Area 12 (Biron et al. 2008; Hébert et al. 2012) to Area 19 has also been pointed out. Other factors such as change in fishing gear (especially trap size) or fishing pattern may influence the catch rate. The introduction of the precautionary approach in 2010 which resulted in significantly diminishing the exploitation rate should have had a positive impact on the catch rate in Area 19. Further investigation is required to elucidate this CPUE increase since 2010.

5.0. ACKNOWLEDGEMENTS

The authors wish to thank B. Zisserson (DFO Maritimes Region) for his valuable information on eastern Nova Scotia snow crab fishery.

6.0. REFERENCES CITED

Benhalima, K., Moriyasu, M., and Hébert, M. 1998. A technique for identifying the early-premolt stage in the male snow crab, *Chionoecetes opilio*, (Brachyura: Majidae) in Baie des Chaleurs, southern Gulf of St. Lawrence. Can. J. Zool. 76: 609-617.

Biron, M., Ferron, C., and Moriyasu, M. 2008. Movement of adult male snow crab, *Chionoecetes opilio*, in the southern Gulf of St. Lawrence and eastern Nova-Scotia, Canada. Fish. Res. 91:260-270.

Chiasson, Y., and Hébert, M. 1990. Literature review on stock delimitation pertaining to the Western Cape Breton Island snow crab (*Chionoecetes opilio*) and advice on a spring fishery in Area 18. DFO CAFSAC Res. Doc. 90/65.

Conan, G.Y., and Comeau, M. 1986. Functional maturity of male snow crab, (*Chionoecetes opilio*). Can. J. Fish. Aquat. Sci. 43: 1710-1719.

Conan, G.Y., Moriyasu, M., Comeau, M., Mallet, P., Cormier, R., Chiasson, Y., and Chiasson, H. 1988. Growth and maturation of snow crab (*Chionoecetes opilio*), p. 45-66. In G.S. Jamieson and W.D. McKone (eds.). Proceedings of the international workshop on snow crab biology, December 8-10, 1987, Montréal Québec. Can. MS Rep. Fish. Aquat. Sci. 2005. 145 p.

DFO. 2009. Assessment of Snow Crab in the Southern Gulf of St. Lawrence (Areas 12, 19, E and F). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/006.

DFO. 2013. Assessment of Nova Scotia (4VWX) Snow Crab. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/060.

Dufour, R., Bernier, D., and Brêthes, J.-C. 1997. Optimization of meat yield and mortality during snow crab (*Chionoecetes opilio*, O. Fabricius) fishing operations in Eastern Canada. Can. Tech. Rep. Fish. Aquat. Sci. 2152.

Fonseca, D.B., Sainte-Marie, B., and Hazel, F. 2008. Longevity and change in shell condition of adult male snow crab *Chionoecetes opilio* inferred from dactyl wear and mark-recapture data. Trans. Am. Fish. Soc. 137: 1029-1043.

Foyle, T.P., Hurley, G.V., and Taylor, D.M. 1989. Field testing shell hardness gauges for the snow crab fishery. Can. Ind. Rep. Fish. Aquat. Sci. 193.

Hébert, M., Gallant, C., Chiasson, Y., Mallet, P., DeGrâce, P., et Moriyasu, M. 1992. Le suivi du pourcentage de crabes mous dans les prises commerciales de crabe des neiges (*Chionoecetes opilio*) dans le sud-ouest du golfe du Saint-Laurent (zone 12) en 1990 et 1991. Rapp. Tech. Can. Sci. Halieut. Aquat. 1886.

Hébert, M., Wade, E., DeGrâce, P., Biron, M., and Moriyasu, M. 1997. 1996 assessment of snow crab (Chionoecetes opilio) stock in the southern Gulf of St. Lawrence (Areas 12, 18, 19, 25/26, and Zones E and F). DFO Can. Stock Assess. Sec. Res. Doc. 97/86.

Hébert, M., Benhalima, K., Miron, G., and Moriyasu, M. 2002. Molting and growth of male snow crab, *Chionoecetes opilio*, (O. Fabricius, 1788) (Crustacea: Majidae) in the southern Gulf of St. Lawrence. Crustaceana 75: 671-702.

Hébert, M., Wade, E., Surette, T., and Moriyasu, M. 2007. The 2006 assessment of snow crab (*Chionoecetes opilio*) stock in the southern Gulf of St. Lawrence (Areas 12, 19, E and F). DFO Can. Sci. Advis. Sec. Res. Doc. 2007/028.

Hébert, M., Wade, E., DeGrâce, P., Bélanger, P., and Moriyasu, M. 2008. The 2007 assessment of snow crab (*Chionoecetes opilio*) stock in the southern Gulf of St. Lawrence (Areas 12, 19, E and F). DFO Can. Sci. Advis. Sec. Res. Doc. 2008/040.

Hébert, M., Wade, E., Biron, M., DeGrâce, P., Landry, J.-F., and Moriyasu, M. 2012. The 2011 assessment of snow crab (*Chionoecetes opilio*) stock in the southern Gulf of St. Lawrence (Areas 12, 19, 12E and 12F). DFO Can. Sci. Advis. Sec. Res. Doc. 2012/080.

Sainte-Marie, B., Raymond, S., and Brêthes, J.-C. 1995. Growth and maturation of the benthic stages of male snow crab, *Chionoecetes opilio* (Brachyura: Majidae). Can. J. Fish. Aquat. Sci. 52: 903-924.

Watson, J. 1972. Mating behavior in the Spider Crab, *Chionoecetes opilio*. J. Fish. Res. Board Can. 29: 447-449.

7.0. TABLES

Table 1. Landings, fishing effort and catch- per- unit-of effort (CPUE) from logbooks in the southern Gulf of St. Lawrence snow crab, Chionoecetes opilio, fisheries (Areas 12, 19, 12E and 12F) since 1987.

	Landings (t)					Effort (number of trap hauls)				CPUE (kg per trap haul)			
Year	12	19	12E	12F	Southern Gulf	12	19	12E	12F	12	19	12E	12F
1987	11,782	1,151	-	-	12,933	449,293	37,987	-	-	26.2	30.3	-	-
1988	12,355	1,337	-	-	13,692	528,844	22,794	-	-	23.4	58.7	-	-
1989	7,882	1,334	-	-	9,216	356,442	29,978	-	-	22.1	44.5	-	-
1990	6,950	1,333	-	-	8,283	254,578	28,422	-	-	27.3	46.9	-	-
1991	10,019	1,337	-	-	11,356	326,671	16,733	-	-	30.7	79.9	-	-
1992	11,235	1,678	-	-	12,913	362,967	17,140	-	-	31.0	97.9	-	-
1993	14,336	1,678	-	-	16,014	344,698	18,204	-	-	41.6	92.2	-	-
1994	19,995	1,672	-	-	21,667	390,833	24,495	-	-	51.2	68.3	-	-
1995	19,944	1,575	217	317	22,053	416,890	24,854	4,033	11,561	47.8	63.4	53.8	27.4
1996	15,978	1,342	164	238	17,722	318,796	24,583	2,714	5,604	50.1	54.6	60.3	42.4
1997	15,413	1,386	163	287	17,249	303,286	21,930	4,695	6,390	50.8	63.2	34.7	44.9
1998	11,136	1,988	161	290	13,575	243,339	31,232	5,624	6,035	45.8	63.1	28.6	48.1
1999	12,682	1,979	159	290	15,110	289,003	19,088	5,415	5,072	43.9	103.7	29.4	57.2
2000	15,046	3,225	150	291	18,712	436,782	55,977	6,528	5,136	34.5	64.1	22.9	56.7
2001	13,819	3,910	155	378	18,262	326,382	46,251	6,700	5,736	42.3	88.5	23.2	63.0
2002	21,869	3,279	165	378	25,691	544,454	43,662	2,916	4,437	40.2	72.3	56.6	85.2
2003	16,898	3,103	345	817	21,163	337,960	29,952	5,471	10,460	50.0	103.6	63.1	78.1
2004	26,626	3,894	349	806	31,675	484,991	56,517	6,277	10,775	54.9	68.9	55.6	74.8
2005	32,363	2,827	449	479	36,118	508,053	41,512	5,571	5,112	63.7	68.1	80.6	93.7
2006	25,934	1,989	411	787	29,121	402,702	23,566	10,074	14,079	64.4	84.4	40.8	55.9
2007	23,243	3,034	220	370	26,867	353,775	42,553	5,914	12,252	65.7	71.3	37.2	30.2
2008	20,911	2,929	187	431	24,458	370,762	38,388	9,232	15,504	56.4	76.3	20.3	27.8
2009	20,896	2,370	67	309	23,642	433,527	33,193	4,653	14,045	48.2	71.4	14.4	22.0
2010	7,719	1,360	50	420	9,549	161,148	11,138	1,825	14,335	47.9	122.1	27.4	29.3
2011	8,618	1,701	76	313	10,708	162,604	12,761	2,413	9,631	53.0	133.3	31.5	32.5
2012	18,159	2,906	185	706	21,956	267,044	16,317	5,623	16,890	68.0	178.1	32.9	41.8
2013	22,645	2,657	204	543	26,049	296,398	17,890	5,097	11,086	76.4	148.5	40.1	49.0
2014	19,633	3,745	178	882	24,439	317,689	25,407	3,765	23,163	61.8	147.4	47.3	38.1
2015	23,080	2,129	192	510	25,911	339,912	14,703	2,918	13,351	67.9	144.8	65.8	38.2

Table 2. Catch-per-unit-of-effort (CPUE; kg per trap haul) by group of harvesters in Area 12 of the snow crab fishery, 2001 to 2015.

Year	Traditional Area 12	First Nations	Traditional 18	Traditional 25-26	New entrants	Area 12 mean
2001	43.5	38.8	na	62.7	32.3	42.3
2002	42.3	33.8	na	45.2	31.0	40.2
2003	50.5	51.4	66.0	43.6	45.6	50.0
2004	55.5	55.8	64.4	63.9	48.4	54.9
2005	66.2	64.5	70.3	80.2	50.3	63.7
2006	68.7	59.7	66.2	79.8	53.8	64.4
2007	69.4	65.8	61.4	66.2	54.4	65.7
2008	57.3	56.0	77.3	54.6	49.3	56.4
2009	46.6	49.8	76.7	48.3	48.7	48.2
2010	48.7	45.2	36.3	54.0	51.0	47.9
2011	54.3	50.9	53.3	46.6	51.6	53.0.
2012	67.7	67.8	133.1	66.0	60.5	68.0
2013	77.0	75.4	114.5	71.1	69.6	76.4
2014	62.1	61.4	88.6	53.4	57.8	61.8
2015	70.1	66.0	78.9	61.6	61.1	67.9

Table 3a. Summary statistics (mean, standard error and number of observations (N)) of the trap immersion time (hours) for management areas 12 and 19 in the southern Gulf of St. Lawrence snow crab fisheries for 1998 to 2015.

Year	Area 12 Mean	Area 12 Standard error	Area 12 N	Area 19 Mean	Area 19 Standard error	Area 19 N
1997	65	1.0	2,553	29	0.4	1,396
1998	71	1.4	1,471	29	0.3	2,438
1999	71	0.7	2,837	29	0.4	1,391
2000	75	0.6	4,865	30	0.2	4,447
2001	58	0.6	4,498	31	0.3	3,514
2002	67	0.4	7,053	30	0.2	3,497
2003	55	0.4	4,640	38	0.5	2,359
2004	71	0.4	7,144	28	0.2	4,288
2005	65	0.5	7,311	31	0.3	3,207
2006	71	0.6	6,191	28	0.6	1,768
2007	69	0.6	5,118	33	0.6	2,874
2008	70	0.9	3,237	33	0.5	2,442
2009	68	0.7	3,906	33	0.3	2,097
2010	64	1.2	1,514	30	0.7	627
2011	80	1.4	1,558	33	0.7	763
2012	80	1.1	2,445	34	0.6	1,134
2013	86	1.0	4,196	35	0.6	1,201
2014	84	0.9	2,531	32	0.5	1,597
2015	82	0.6	4,808	36	0.6	981

Table 3b. Summary statistics (mean, standard error and number of observations (N)) of the trap immersion time (hours) for management areas 12E and 12F in the southern Gulf of St. Lawrence snow crab fisheries for 1998 to 2015.

Year	Area 12E Mean	Area 12E Standard error	Area 12E N	Area 12F Mean	Area 12F Standard error	Area 12F N
1997	44	4.1	56	49	3.1	60
1998	30	5.1	39	63	2.2	133
1999	48	4.3	66	61	2.2	165
2000	63	5.3	78	73	2.7	177
2001	59	5.6	79	72	2.5	165
2002	54	7.6	35	89	3.9	128
2003	50	5.5	67	69	1.7	335
2004	71	5.2	68	95	2.6	254
2005	63	6.9	67	96	4.2	127
2006	66	5.7	121	98	2.4	343
2007	58	6.2	72	103	2.8	272
2008	62	6.1	64	93	3.2	75
2009	72	11.3	30	95	5.0	82
2010	67	14.7	18	87	6.3	70
2011	33	6.0	16	118	5.6	66
2012	59	7.2	49	84	3.8	71
2013	53	5.9	53	99	2.7	247
2014	32	3.9	26	92	4.1	109
2015	42	5.2	32	92	3.1	234

Table 4. Fishery characteristics and at-sea observer coverage by management area in the southern Gulf of St. Lawrence snow crab fisheries in 2015.

Characteristics	12	19	12E	12F
Number of fished grids in the area	149	22	8	12
Total fishing days	73	36	45	63
Number of trips	3,192	922	19	178
Number of trips with observer coverage	418	72	5	17
Total estimated traps hauled	339,912	14,703	2,918	13,351
Number of trap sampled by observers	2,476	199	42	70
Number of crab sampled	97,187	7,184	1,637	2,731

Table 5a. Summary statistics (mean, standard error and sample size (N)) of the catch-per-unit-of-effort (kg per trap haul) based on at-sea observer sampling in the southern Gulf of St. Lawrence snow crab fishing areas 12 and 19, 1997 to 2015.

Year	Area 12 Mean	Area 12 Standard error	Area 12 N	Area 19 Mean	Area 19 Standard error	Area 19 N
1997	65.1	0.7	2,598	64.0	2.0	191
1998	56.4	0.8	1,399	62.9	2.6	203
1999	53.1	0.8	1,507	102.3	4.8	99
2000	40.2	0.5	3,118	74.0	2.1	370
2001	51.0	0.8	2,442	94.4	3.7	233
2002	46.5	0.5	5,888	80.6	3.1	257
2003	59.6	0.7	4,929	125.9	4.6	177
2004	67.1	0.6	6,681	87.6	3.1	358
2005	75.8	0.6	6,370	84.7	2.8	309
2006	77.9	1.0	4,329	94.3	3.8	242
2007	82.3	0.7	3,924	76.0	2.0	550
2008	73.8	0.9	2,468	86.3	2.7	617
2009	59.1	0.8	2,635	79.7	2.5	709
2010	64.5	1.7	1,058	172.2	8.3	177
2011	62.7	1.0	1,771	164.5	6.1	179
2012	74.7	0.9	2,849	200.6	5.8	250
2013	85.6	0.9	3,103	163.5	5.5	241
2014	75.4	0.9	2,244	172.4	4.7	358
2015	74.2	0.8	2,257	171.1	7.2	171

Table 5b. Summary statistics (mean, standard error and sample size (N)) of the catch-per-unit-of-effort (kg per trap haul) based on at-sea observer sampling in the southern Gulf of St. Lawrence snow crab fishing areas 12E and 12F, 1997 to 2015.

Year	Area 12E Mean	Area 12E Standard error	Area 12E N	Area 12F Mean	Area 12F Standard error	Area 12F N
1997	37.5	2.8	57	50.7	2.1	124
1998	41.0	3.8	40	53.3	2.2	88
1999	32.7	3.2	72	70.5	3.8	82
2000	29.0	2.0	94	76.1	5.0	83
2001	31.9	2.1	111	85.3	3.8	125
2002	63.4	4.4	47	105.9	4.5	105
2003	71.9	4.4	104	89.1	2.2	265
2004	62.3	3.5	94	89.0	2.0	270
2005	88.9	4.1	105	113.4	4.4	120
2006	47.6	2.8	124	63.7	2.3	245
2007	46.0	4.3	76	38.5	3.8	215
2008	22.4	2.0	72	28.1	1.7	227
2009	13.6	1.8	43	28.7	1.9	236
2010	49.4	6.1	32	36.5	2.5	181
2011	38.8	5.3	37	40.4	4.1	55
2012	29.9	2.3	54	40.1	2.1	156
2013	40.5	3.2	58	55.4	2.9	127
2014	47.3	5.1	31	38.7	1.9	186
2015	68.7	5.9	42	43.8	4.8	59

Table 6. Average percentage of soft-shelled males in catches (based on sea sampling, before discarding) by fishing area for the southern Gulf of St. Lawrence snow crab fisheries, 1986 to 2015.

Year	Area 12	Area 19[1]	Area 12E	Area 12F
1986	4.9	-	-	-
1987	10.8	-	-	-
1988	7.5	-	-	-
1989	37.2	-	-	-
1990	16.8	19.4	-	-
1991	11.5	5.1	-	-
1992	8.6	6.6	-	-
1993	6.1	1.9	-	-
1994	5.6	5.5	-	-
1995	2.5	3.5	0.6	11.8
1996	4.2	10.8	4.6	5.3
1997	5.0	15.1	4.3	1.5
1998	2.8	10.0	2.9	1.1
1999	4.9	3.3	8.0	1.1
2000	12.5	6.2	8.3	2.4
2001	6.2	6.5	0.7	1.3
2002	4.6	5.5	0.3	0.5
2003	3.3	3.9	1.2	0.4
2004	3.0	7.9	1.5	0.6
2005	3.9	7.7	2.9	0.8
2006	3.1	6.1	7.8	3.5
2007	2.0	7.4	1.3	2.4
2008	3.0	9.0	10.1	7.3
2009	5.0	11.6	7.8	11.4
2010	6.5	6.4	14.7	8.6
2011	6.2	11.5	8.4	2.6
2012	3.7	4.5	3.3	9.4
2013	2.8	3.0	15.9	2.4
2014	4.4	1.0	7.8	1.7
2015	4.9	5.5	9.8	3.3

[1] In Area 19, the soft-shell male category is based on a durometer reading of 72 instead of the reading of 68 used in Areas 12, 12E and 12F.

Table 7a. The percentages by carapace conditions (CC) 1 to 5 of commercial-sized adult male snow crab based on sea sampling (before discarding) for fishing areas 12 and 19, in 2000 to 2015.

	Area 12					Area 19				
Year	CC 1	CC 2	CC 3	CC 4	CC 5	CC 1	CC 2	CC 3	CC 4	CC 5
2000	5.5	6.2	64.0	19.5	4.8	2.0	14.6	51.8	30.9	0.8
2001	2.5	3.5	82.7	9.5	1.8	1.8	6.5	78.6	12.8	0.3
2002	3.0	1.7	86.4	8.2	0.7	3.2	5.6	70.2	20.6	0.5
2003	2.3	1.4	87.6	8.1	0.6	2.4	2.5	80.4	14.5	0.2
2004	1.9	1.5	86.7	9.2	0.7	2.9	12.5	69.6	14.4	0.6
2005	1.9	2.4	89.6	5.5	0.5	0.9	14.3	73.9	10.6	0.3
2006	1.7	2.5	88.9	6.4	0.5	0.8	10.3	83.8	4.9	0.2
2007	0.8	2.4	89.1	7.0	0.7	1.9	8.2	75.1	14.1	0.7
2008	0.4	1.0	72.9	23.4	2.2	4.2	5.7	74.9	14.9	0.3
2009	0.7	5.9	68.4	21.9	3.1	3.7	10.1	63.1	21.7	1.4
2010	1.3	3.2	78.9	14.8	1.8	1.3	10.9	67.6	18.2	2.0
2011	2.2	4.5	75.5	15.8	1.9	0.6	11.6	80.0	7.5	0.3
2012	0.4	1.8	87.4	9.9	0.6	0.5	5.1	91.6	2.7	0.1
2013	0.2	2.4	87.5	9.5	0.4	0.7	6.8	58.1	34.3	0.1
2014	0.6	1.1	86.5	11.3	0.5	0.0	1.2	86.7	12.1	0.0
2015	0.3	1.0	88.1	10.3	0.3	0.8	3.1	86.1	9.9	0.1

Table 7b. The percentages by carapace conditions (CC) 1 to 5 of commercial-sized adult male snow crab based on sea sampling (before discarding) for fishing areas 12E and 12F, in 2000 to 2015.

	Area 12E					Area 12F				
Year	CC 1	CC 2	CC 3	CC 4	CC 5	CC 1	CC 2	CC 3	CC 4	CC 5
2000	1.2	3.1	77.1	13.9	4.8	0.3	6.2	84.4	8.11	1.0
2001	0.2	0.7	84.8	12.8	1.5	0.3	1.3	87.8	10.0	0.5
2002	0.1	0.6	91.7	7.1	0.5	0.0	14.7	79.8	5.4	0.1
2003	0.1	2.4	92.0	5.3	0.1	0.0	0.8	92.2	6.5	0.5
2004	0.1	0.2	95.0	4.1	0.6	0.1	1.6	87.1	10.7	0.4
2005	0.0	1.9	95.1	2.4	0.5	0.2	2.8	89.6	7.2	0.3
2006	0.9	1.0	92.9	4.7	0.5	2.0	1.8	91.6	3.6	0.9
2007	0.0	0.0	98.5	1.4	0.0	4.5	7.6	79.6	6.8	1.4
2008	2.1	2.5	87.0	7.4	1.0	0.7	5.7	87.0	6.2	0.4
2009	1.1	3.2	87.5	8.2	0.0	0.7	0.8	96.8	1.6	0.1
2010	0.0	8.5	89.7	1.8	0.0	0.5	1.4	97.3	0.6	0.1
2011	0.1	4.3	93.5	2.1	0.0	0.6	4.7	93.6	1.0	0.1
2012	0.1	1.0	94.7	3.9	0.2	0.7	1.5	96.1	1.7	0.0
2013	0.1	0.5	95.6	3.8	0.0	0.3	8.6	86.4	4.6	0.1
2014	0.0	0.0	96.5	3.5	0.0	0.4	0.8	89.5	8.7	0.6
2015	0.0	0.4	96.9	2.6	0.1	0.1	0.5	88.9	9.8	0.7

8.0. FIGURES

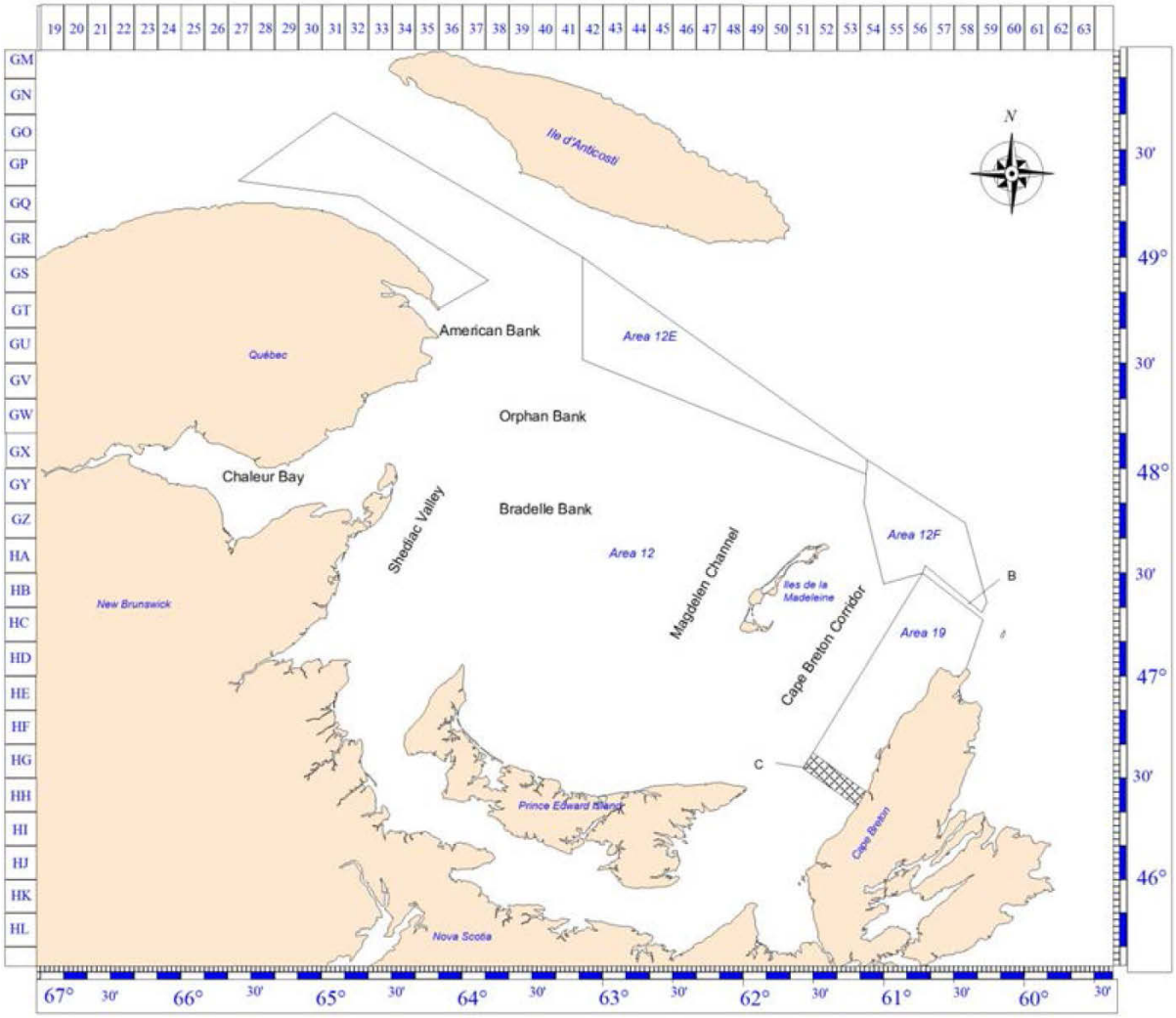


Figure 1. Locations of snow crab (Chionoecetes opilio) fishing grounds and management areas in the southern Gulf of St. Lawrence. Areas B and C are buffer zones.

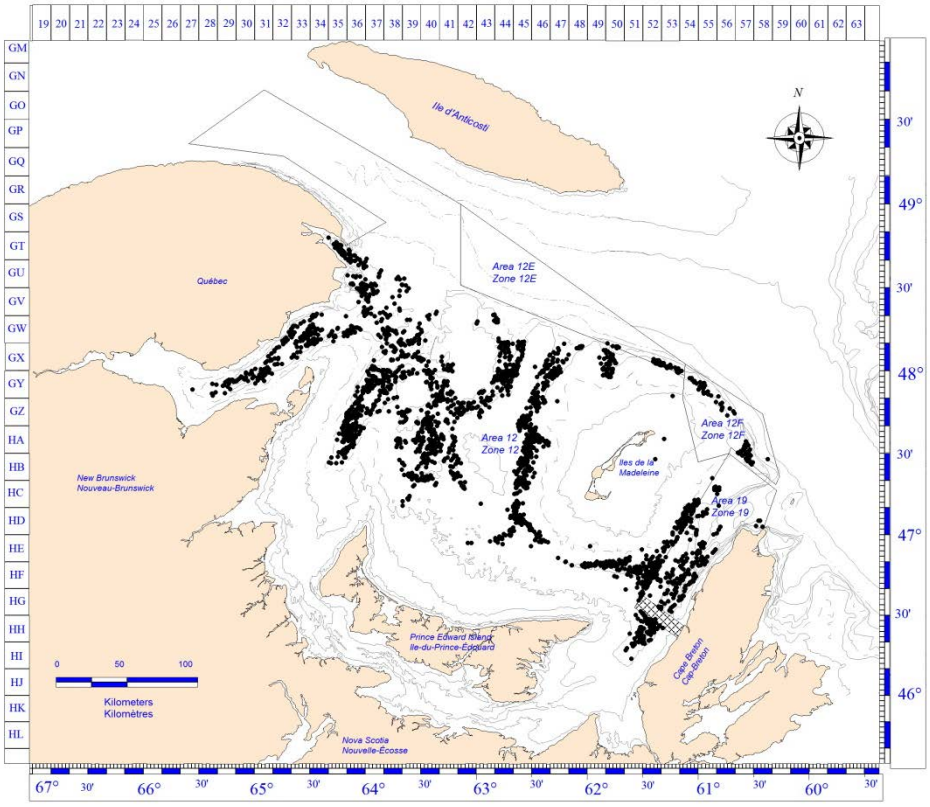


Figure 2. Locations of traps sampled aboard snow crab fishing vessels within the management areas of the southern Gulf of St. Lawrence during the 2015 fishing season.

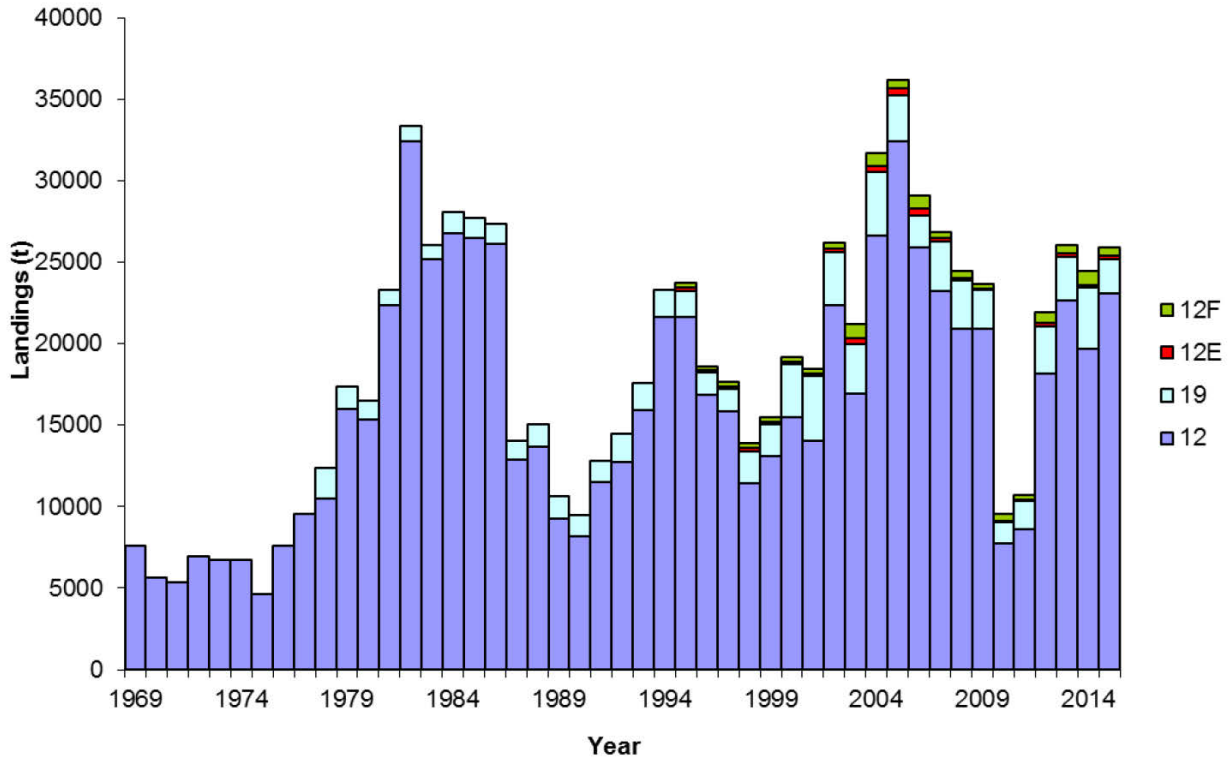


Figure 3. Landings (t) by fishing area and overall in the southern Gulf of Saint Lawrence snow crab fishery, 1969 to 2015.

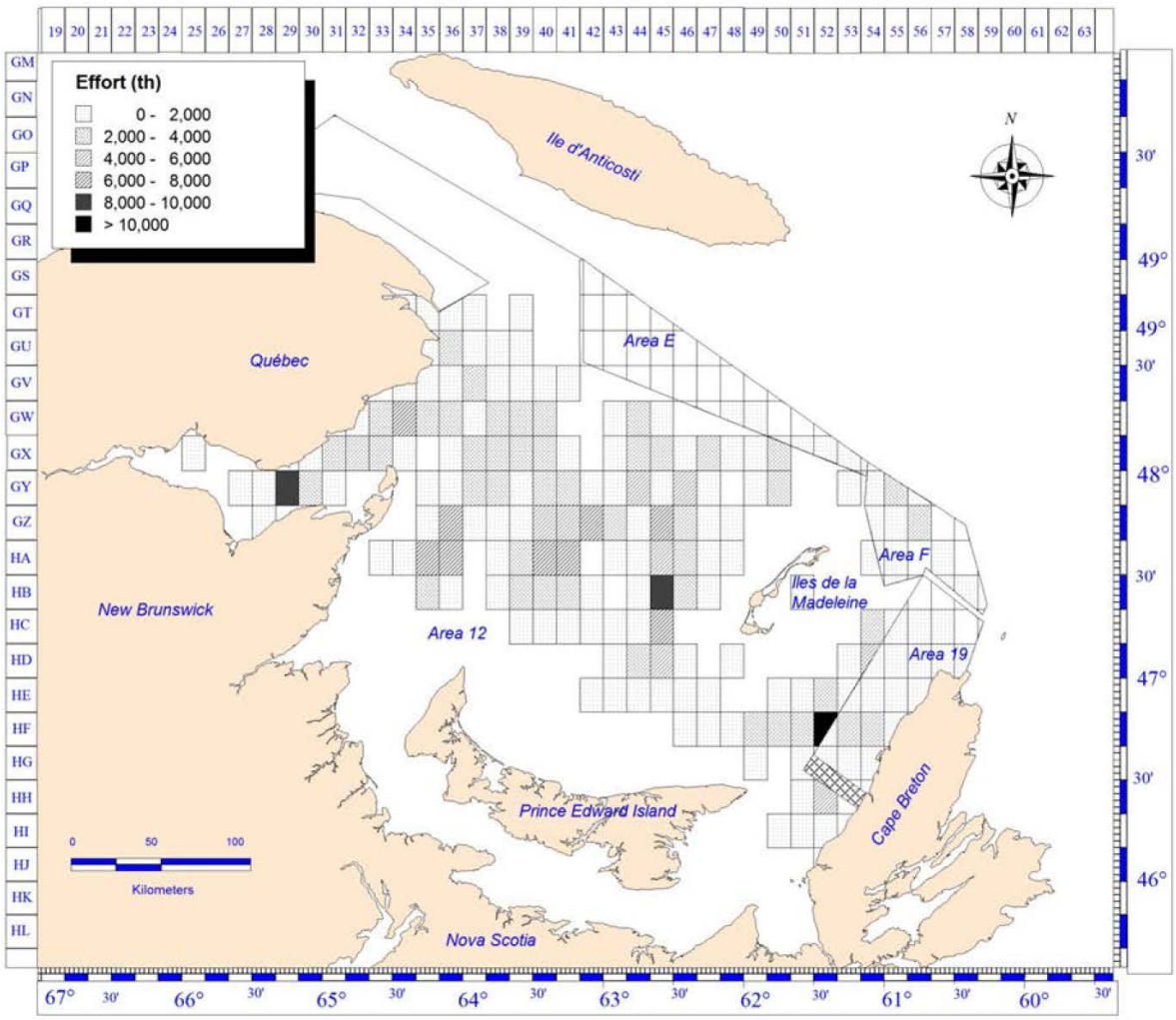


Figure 4. Geographic distribution of fishing effort (trap hauls) by snow crab fishery management area during the 2015 fishing season.

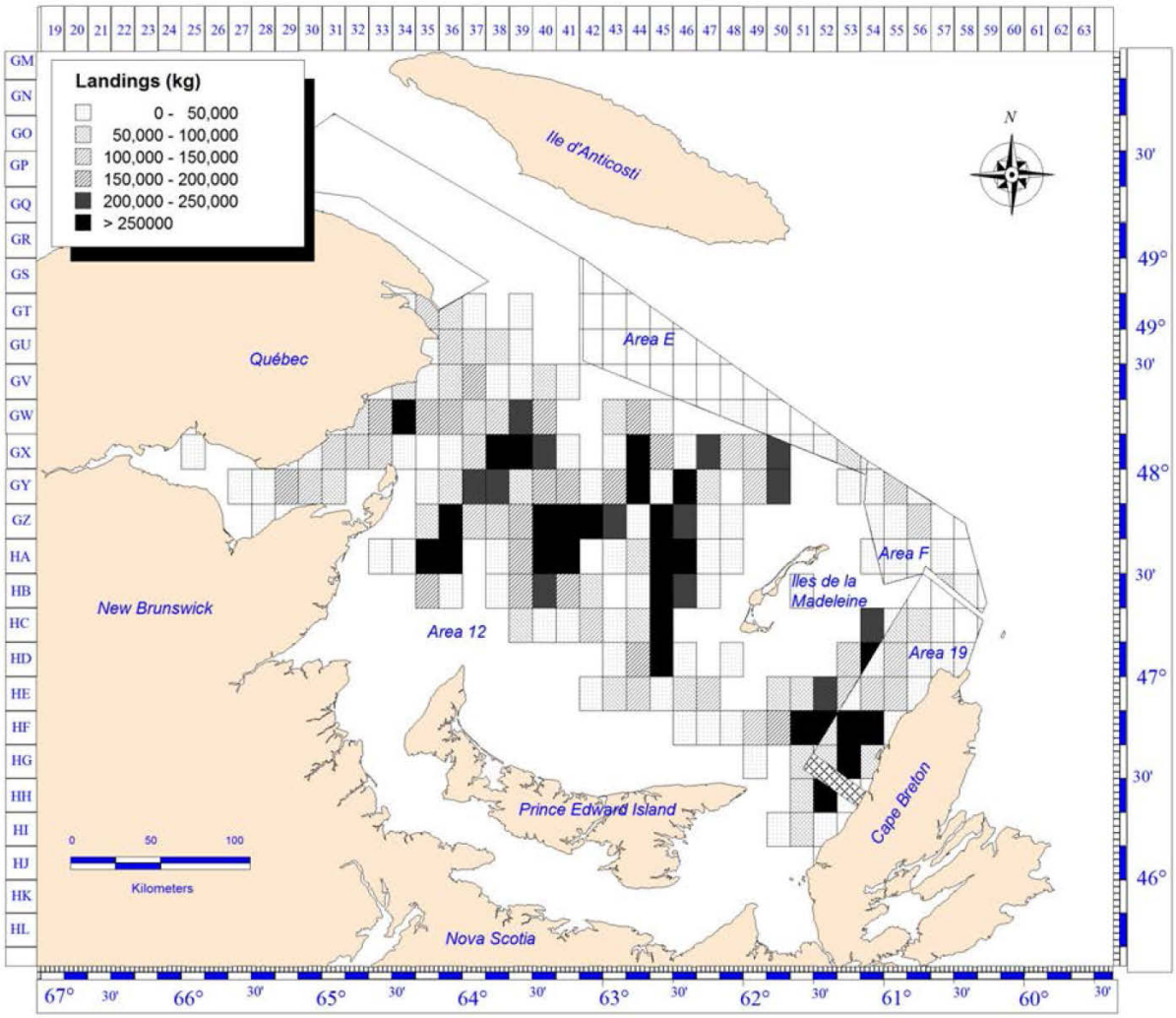


Figure 5. Geographic distribution of landings (kg) in snow crab fishing management areas during the 2015 fishing season.

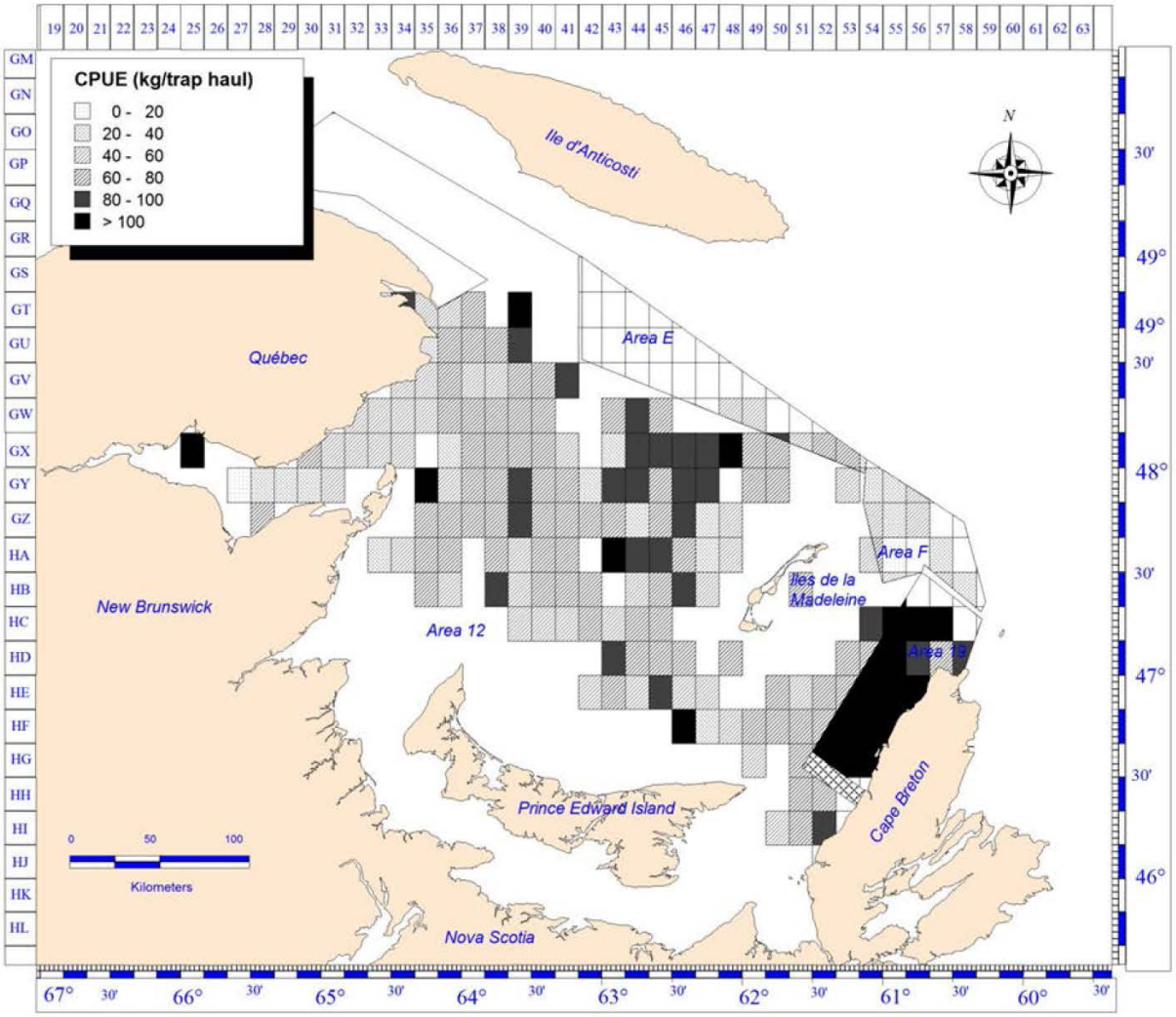


Figure 6. Geographic distribution of mean catch-per-unit-of-effort (CPUE; kg / th), in the snow crab fishery management areas during the 2015 fishing season.

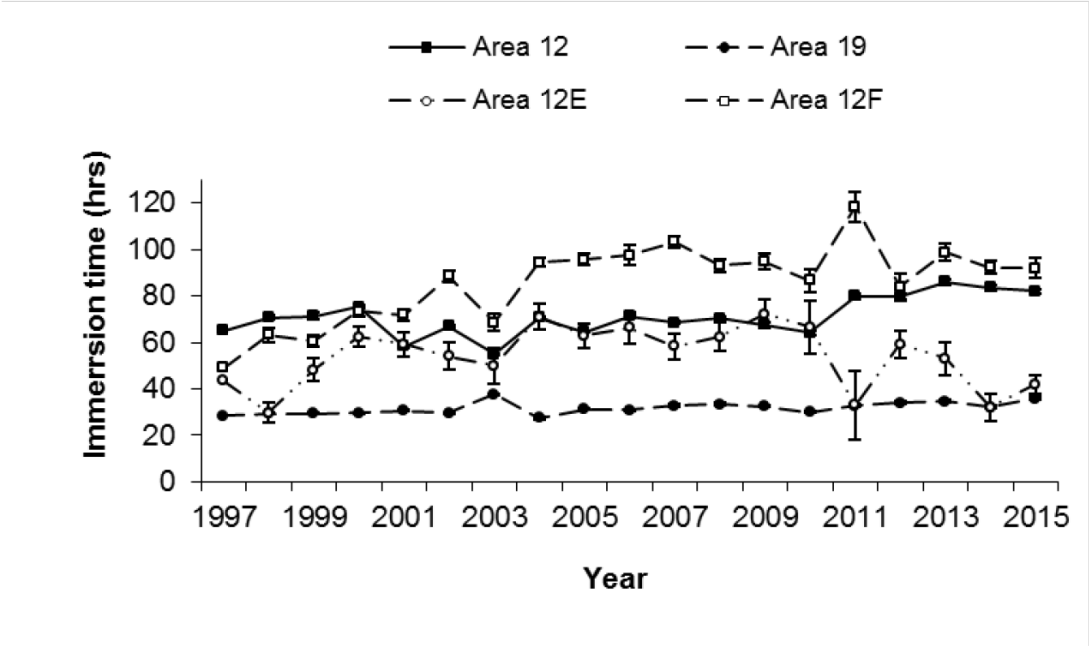


Figure 7. Mean (and one standard error bars) reported immersion time (hours) of traps by management areas in the southern Gulf snow crab fisheries, 1997 to 2015.

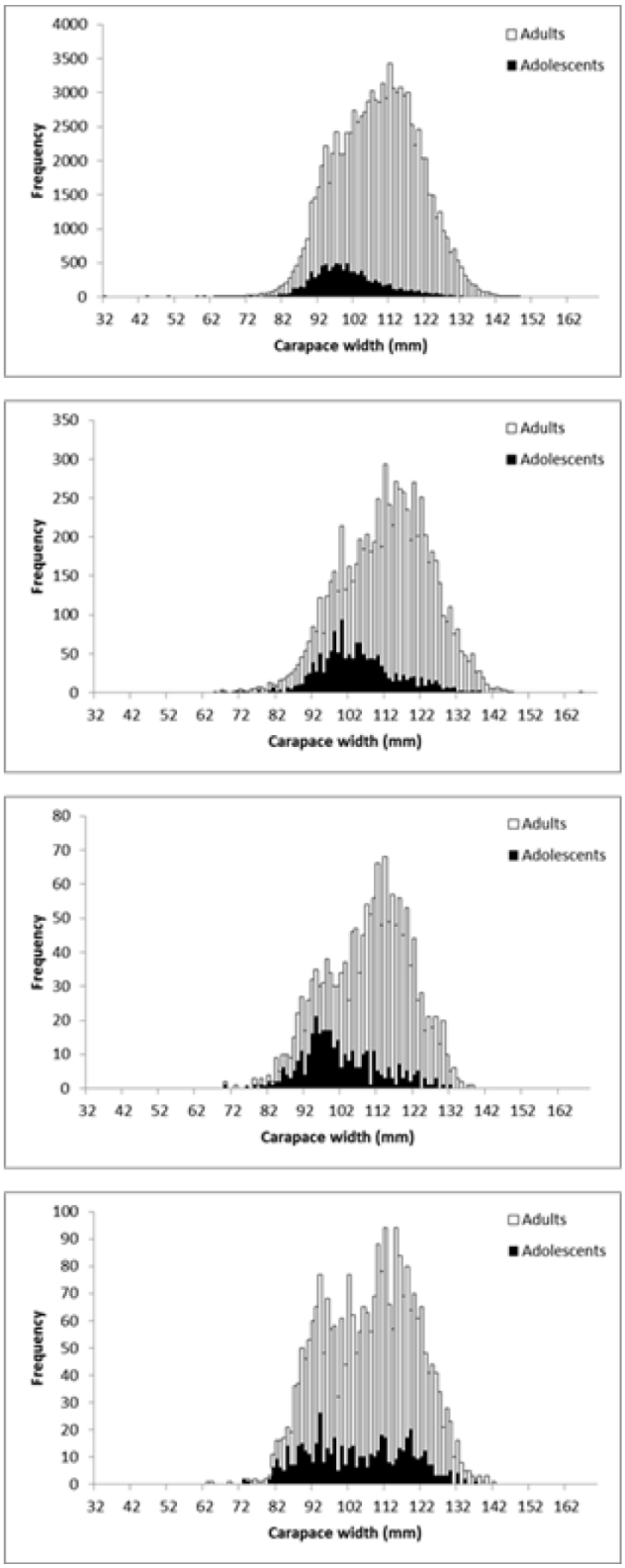


Figure 8. Size frequency distributions by maturity stage of all male crabs measured during at-sea sampling (before discarding) in Areas 12 (panel A), 19 (panel B),12E (panel C) and 12F (panel D) in 2015.

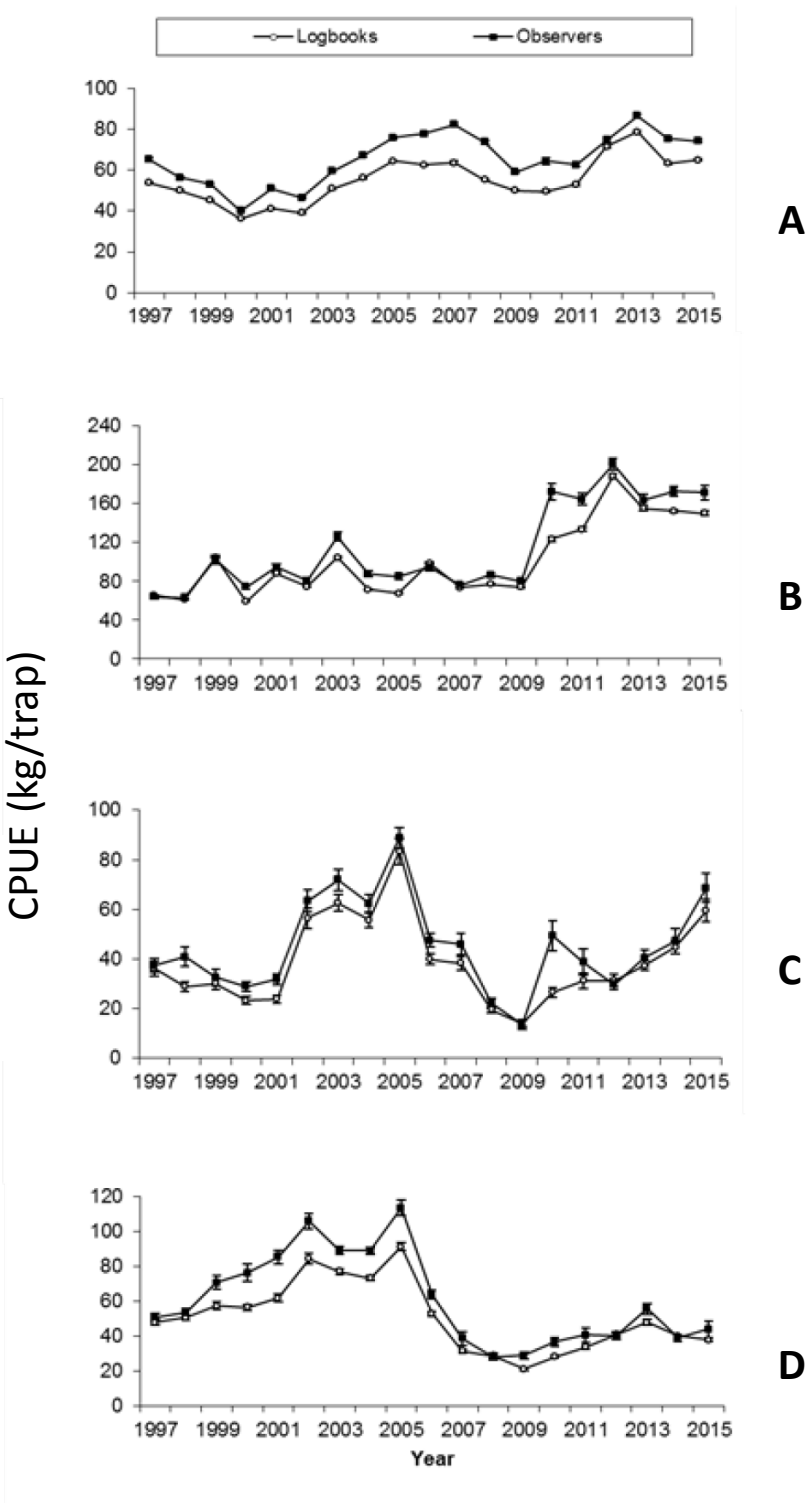


Figure 9. Comparison of catch-per-unit-of-effort (CPUE;kg / th, mean and one standard error bars) between the logbook data and at-sea observer sampling data by management area for 1997 to 2015.

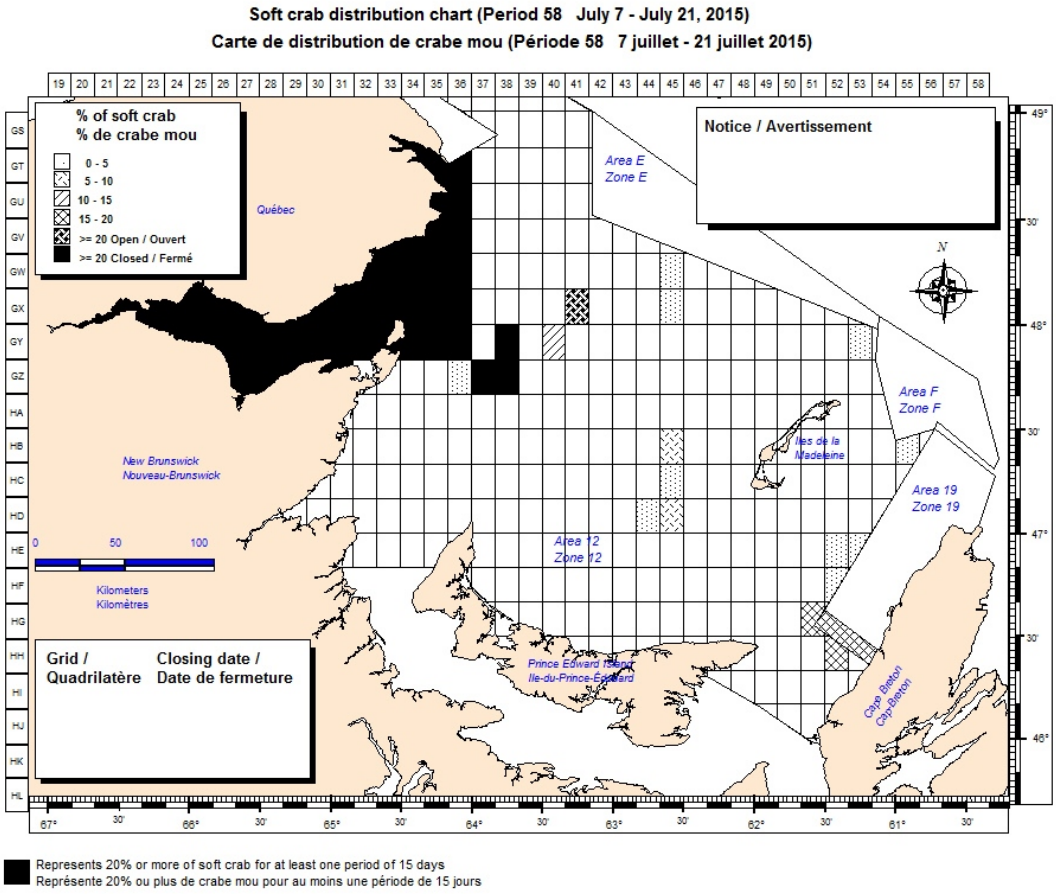


Figure 10. Seasonal reports of percentage of soft-shelled males by grid in snow crab management Area 12 and locations of grids which were closed during the 2015 season. Sector of Chaleur Bay was closed on July 7, 2015.

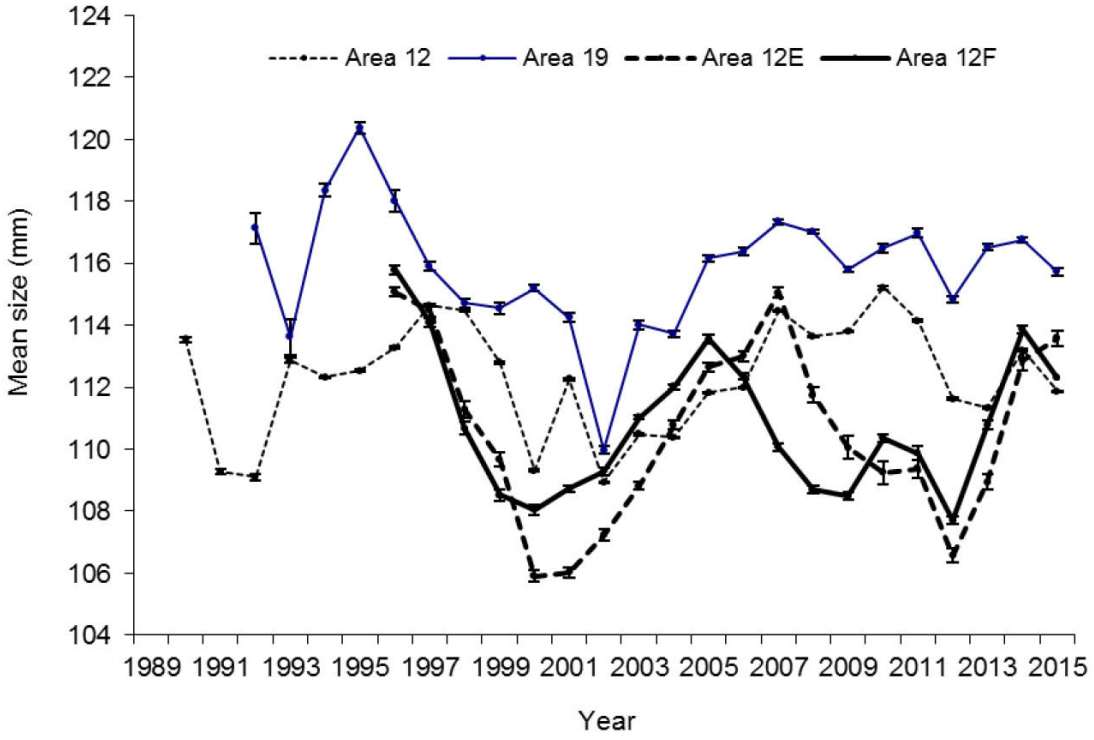


Figure 11. Carapace width (mm; mean and one standard error bar) of commercial-sized adult male snow crab in the catches from management areas 12, 19, 12E, and 12F for 1990 to 2015.

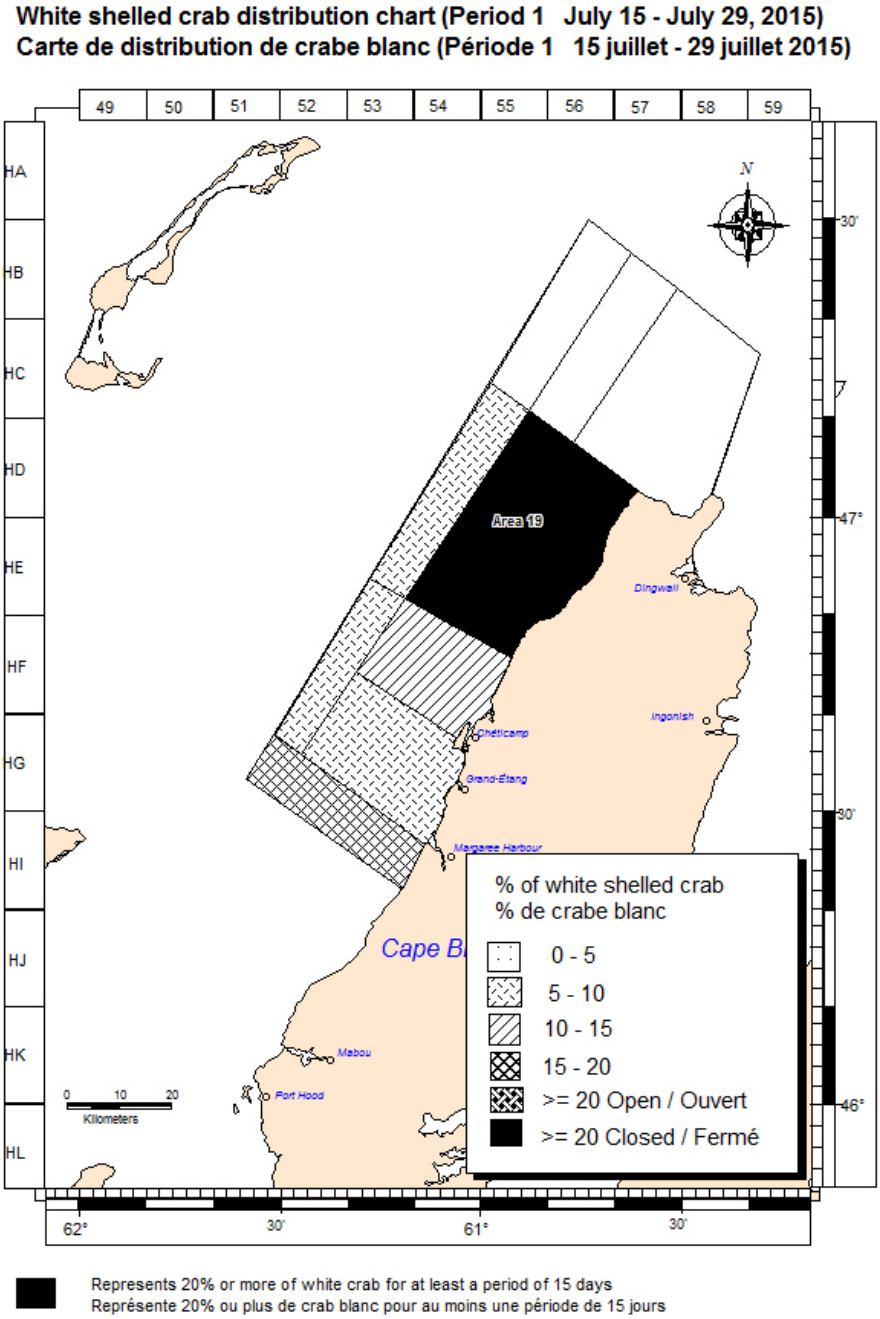


Figure 12. Seasonal report of percentage of white-shelled male snow crab in the catches in the fishery of management area 19 in 2015.

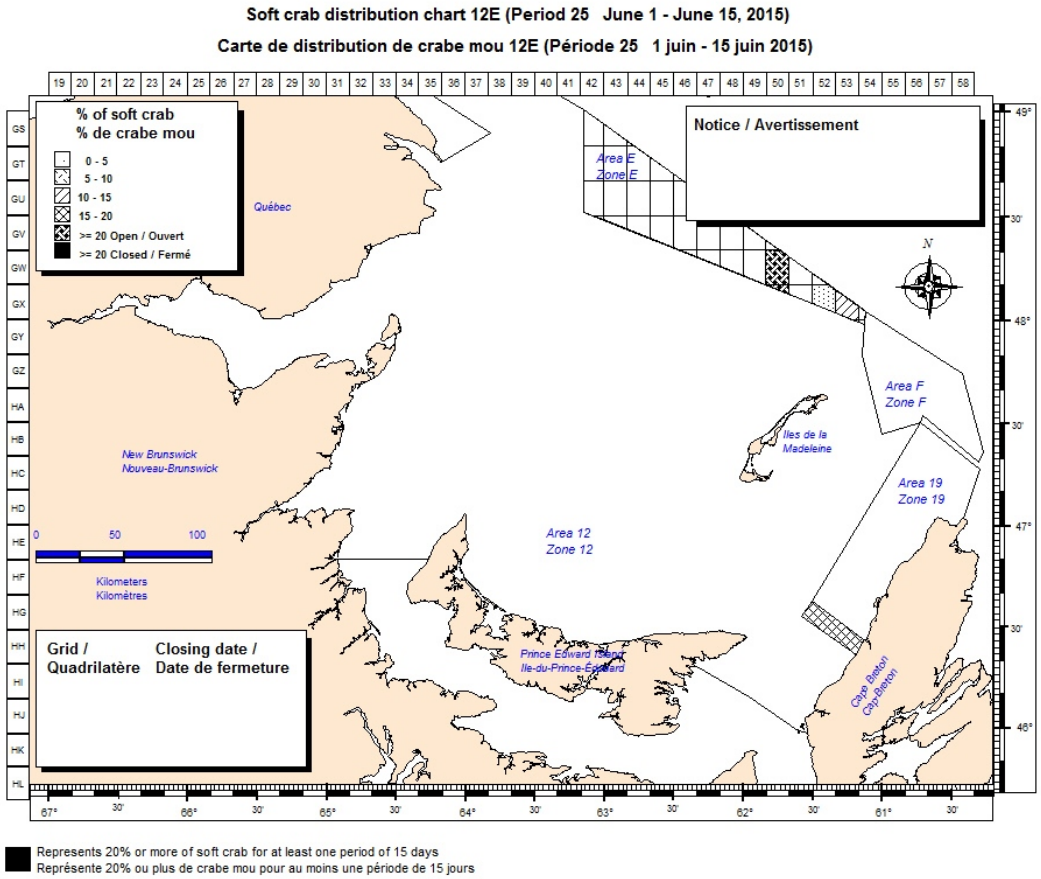


Figure 13. Seasonal report of percentage of soft-shelled male snow crab in the catches of the fishery in management area 12E in 2015.

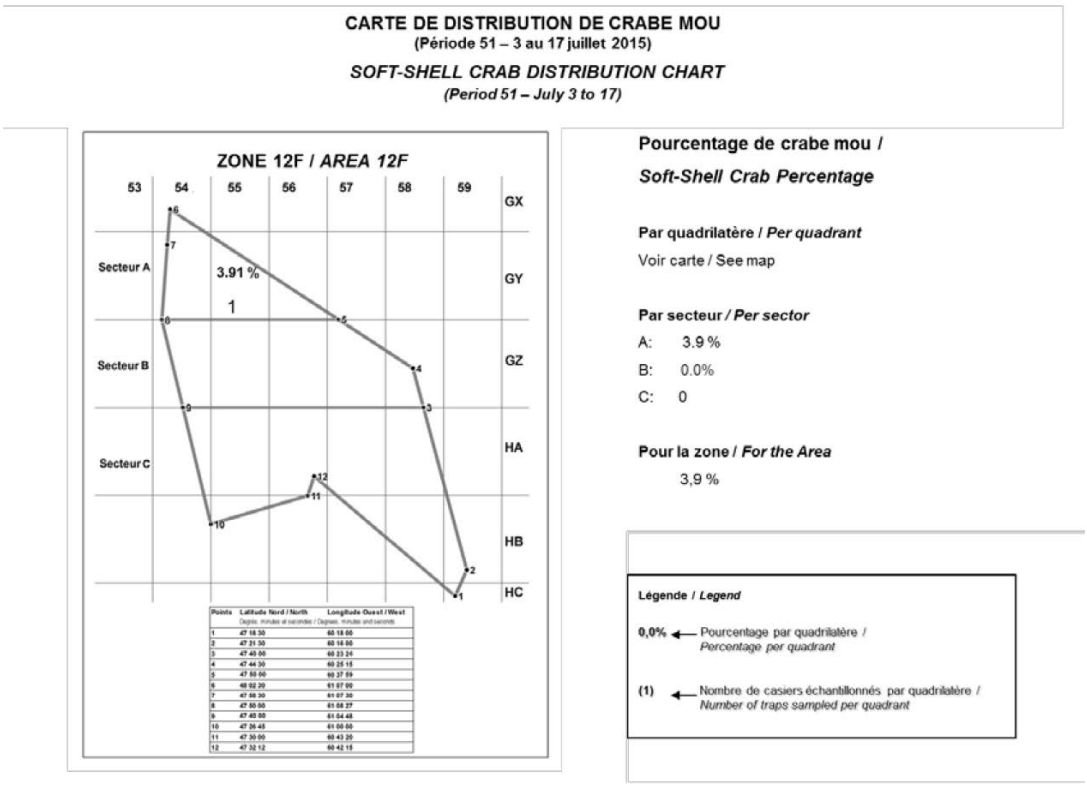


Figure 14. Seasonal report of percentage of soft-shelled male snow crab in the catches of the fishery in snow crab management area 12F in 2015.

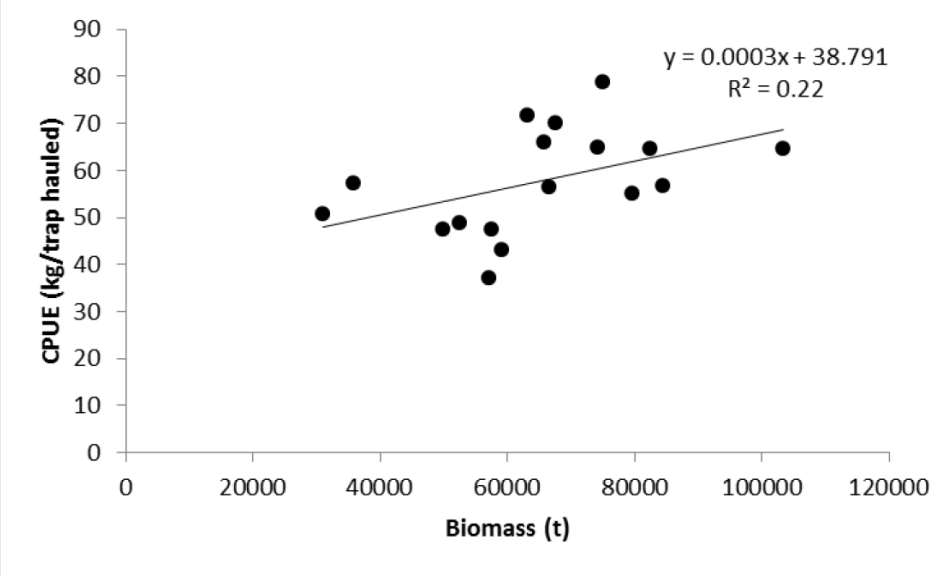


Figure 15. Relationship between the commercial-sized adult male biomass (t) estimated from the trawl survey and catch-per-unit-of-effort (CPUE) from the logbook data in the southern Gulf of St. Lawrence, 1997 to 2015.

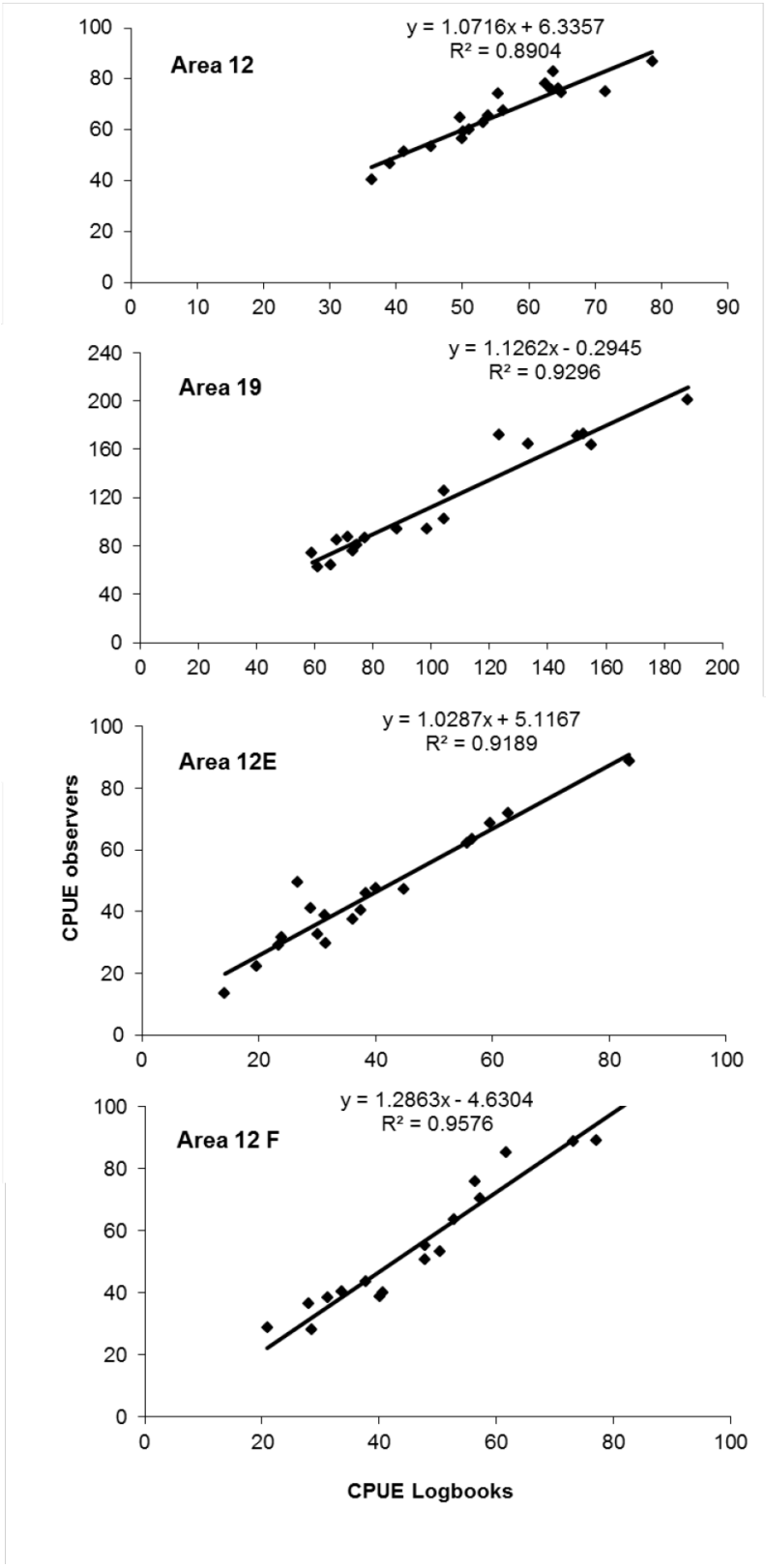


Figure 16. Relationship of catch-per-unit-of-effort (CPUE) between the logbook data and at-sea observer sampling by management area for 1997 to 2015.

9.0. APPENDICES

APPENDIX 1. BIOLOGICAL SAMPLING FOR 2015

FIELD EQUIPMENT (each observer)

- calipers
- durometer
- sampling sheets

SAMPLING METHODS

The supervisor of the observers (Consultant Company) will advise which vessels the observers have to sample, as requested by DFO. The observers will have to conduct two types of sampling: a) before discarding, and b) after discarding. These two types of sampling have to be done for the entire fishing activity. These two samples have to be done randomly to make a ratio of 2 to 1. Two samples before discarding to one sample after discarding for the entire fishing activity.

Before discarding

A random sub-sample of forty (40) male crabs per trap. This should be done as follow:

1. Randomly select 40 crabs (male only).
2. Count the remaining male crabs and give them back to the crew.
3. Measure the forty (40) male crabs previously selected and give them to the crew.

After discarding

A random sub-sample of twenty (20) male crabs.

INFORMATION TO BE COLLECTED

An explanation of the information to be taken is as follows: (see appendix 2 - Sampling sheet).

TRIP NUMBER: The company provides that number to the observer.

DATE: The date at the time the sample is taken.

PAGE: Page number / total number of pages per trip.

LOGBOOK NUMBER: This number is at the bottom of the logbook (example: C604502 or 343444).

VRN, VESSEL, OBSERVER: Each observer is to place his / her name, the vessel registration number (VRN) and the name of the boat on all of the sampling sheets.

AREA: 12 - Area 12, 18, 25/26

19 - Cape Breton 19

12E - Area 12E

12F - Area 12F

POSITION: The position and the depth where the trap is sampled. The position has to be in latitude / longitude (degrees, minutes, to one hundredth of a minute).

DATA TYPE: 1 - Landing (after discarding)

2 - Trap at sea (before discarding).

TYPE OF TRAP AT SEA: See company code.

SPECIES: See company code.

LANDED WEIGHT (KG): Total weight of the landing in kilograms (kg).

TRAP NUMBER: This is the number of the trap sampled and must be written on each sampling sheet.

TOTAL NUMBER OF MALES IN TRAP: Note the total number of males in the trap sampled including the 40 measured crabs.

TRAP FISHING DURATION (DAYS): Note the number of fishing days (immersion time) for the sampled trap (ex: 36 hours = 1.5 days).

DEPTH: The depth of the trap sampled should be noted in meters (m).

SEX: Only male crabs are measured. Male (M).

CARAPACE WIDTH, CLAW HEIGHT: See appendix 3.

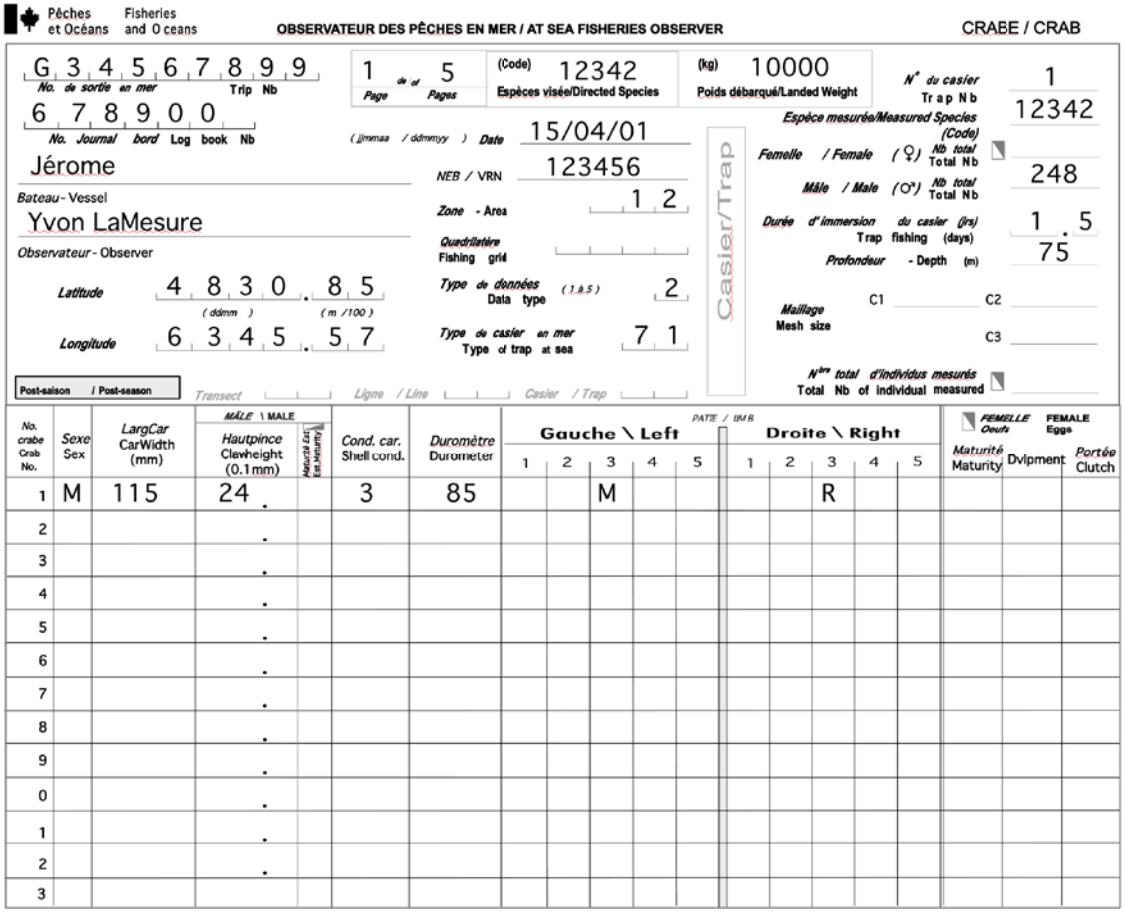
CARAPACE CONDITION: See Appendix 4.

DUROMETER: See appendix 5.

MISSING LEGS: See appendix 6.

REMARKS: Any abnormal observations and / or comments.

APPENDIX 2. EXAMPLE OF AN AT-SEA OBSERVER SAMPLING FORM



Pêches et Océans / Fisheries and Oceans

OBSERVATEUR DES PÊCHES EN MER / AT SEA FISHERIES OBSERVER

CRABE / CRAB

No. de sortie en mer / Trip Nb: G 3 4 5 6 7 8 9 9

No. Journal bord / Log book Nb: 6 7 8 9 0 0

Page / Pages: 1 de / of 5

(Code) Espèces visée/Directed Species: 12342

(kg) Poids débarqué/Landed Weight: 10000

Date (jjmmaa / ddmmyy): 15/04/01

Observateur - Observer: Jérome

NEB / VRN: 123456

Bateau - Vessel: Yvon LaMesure

Zone - Area: 1 2

Quadrilatère Fishing grid:

Latitude (ddmm) (m /100): 4 8 3 0 . 8 5

Longitude: 6 3 4 5 . 5 7

Type de données / Data type (1 à 5): 2

Type de casier en mer / Type of trap at sea: 7 1

Post-saison / Post-season

Transect | Ligne / Line | Casier / Trap

Casier/Trap

N° du casier / Trap Nb: 1

Espèce mesurée/Measured Species (Code): 12342

Femelle / Female (♀) Nb total / Total Nb:

Mâle / Male (♂) Nb total / Total Nb: 248

Durée d'immersion du casier (jrs) / Trap fishing (days): 1 . 5

Profondeur - Depth (m): 75

Maillage / Mesh size: C1 C2 C3

Nbre total d'individus mesurés / Total Nb of individual measured

No. crabe / Crab No.	Sexe / Sex	LargCar / CarWidth (mm)	MÂLE \ MALE: Hautpince / Clawheight (0.1mm)	Mature? Est-Maturity	Cond. car. / Shell cond.	Duromètre / Durometer	PATTE / LIMB: Gauche \ Left 1	2	3	4	5	Droite \ Right 1	2	3	4	5	FEMELLE / FEMALE: Maturité / Maturity	Dvlpment	Portée / Clutch
1	M	115	24 .		3	85			M					R					
2			.																
3			.																
4			.																
5			.																
6			.																
7			.																
8			.																
9			.																
0			.																
1			.																
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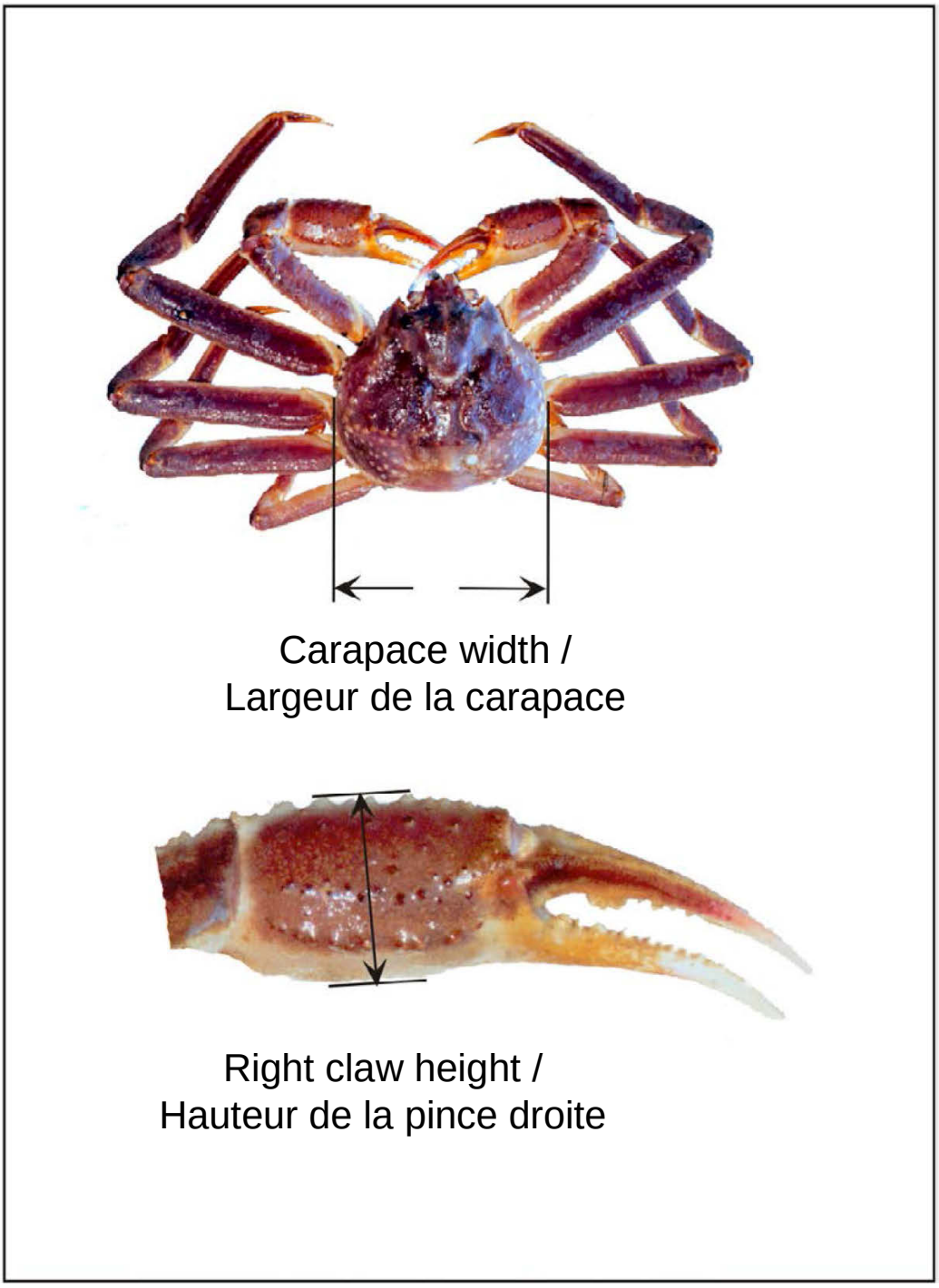
3																			

APPENDIX 3. DESCRIPTION OF CARAPACE WIDTH AND CLAW HEIGHT MEASUREMENTS



APPENDIX 4. DESCRIPTIONS OF EACH CARAPACE CONDITION WITH IDENTIFICATION KEYS

Condition 1 – New soft

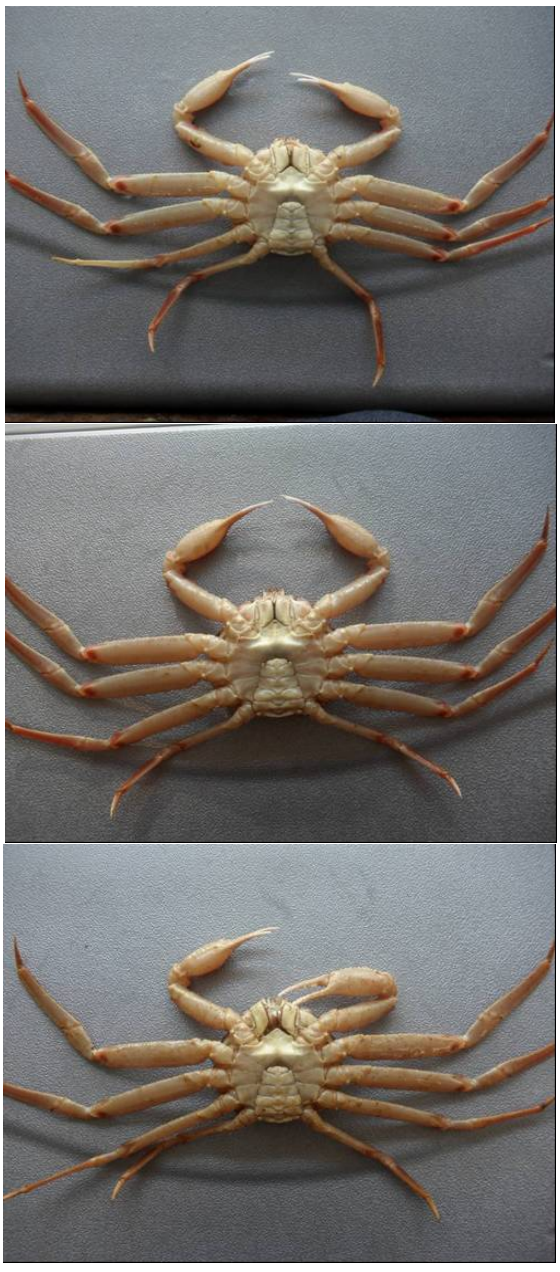
This recently molted crab has a carapace that is soft or firm but flexible, the claw is easily broken under thumb pressure. The dorsal surface is light brown and the ventral one is transluscent. Iridescence is apparent at different spots on the carapace. Neither wear nor scars are shown on the carapace, spines and dactyls are very sharp. The carapace is very clean, no trace of epibiontes (moss, balanus, spiroide and leech eggs) are visible at this stage. The crab stays in that condition for approximately three months and during that period of time, the meat yield is at its lowest level.

Condition 2 – New hard

This crab molted during the current year, the carapace is rigid and the claw is hardly broken under thumb pressure. The dorsal surface of the carapace is light brown and underneath is white and opaque, appearance of iridescence at multiple places on the carapace. No appearance of wear or scratch, spines are really sharp. The crab is clean and the carapace may have presence of epibiontes (moss, balanus, spiroide and leech eggs). This condition starts around three months after the crab molt and last for approximately 9 months. During that period, the meat yield becomes low to medium.

Condition 3 – Intermediate

This crab molted more than one year ago. The carapace is hard and firm, the claws are unbreakable under thumb pressure. The dorsal surface of the carapace is light brown and the ventral surface is yellow-beige, iridescence is only showing in very few places on the carapace. Spines and dactyls are still sharp but signs of wear are starting. Scars are visible on the ventral surface. The meat yield is at its maximum level. This crab has very few or no moss spot (bryozoans) on the carapace. Some other organisms (balanus and / or spiroide) are generally present.



Condition 4 – Old

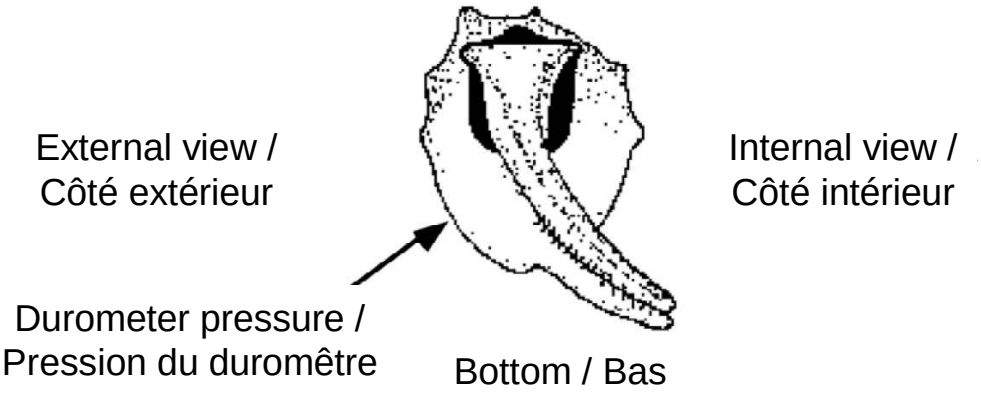
The carapace is hard and firm and the claws are unbreakable by simple thumb pressure. The dorsal surface is dark brown and the ventral surface is yellowish brown, no iridescence. Signs of wear and ageing are evident; there are a lot of scars and scratches on the carapace. Spines and dactyls are rounded. The organisms (moss, balanus and / or spiroide) are always present.

Condition 5 – Very old

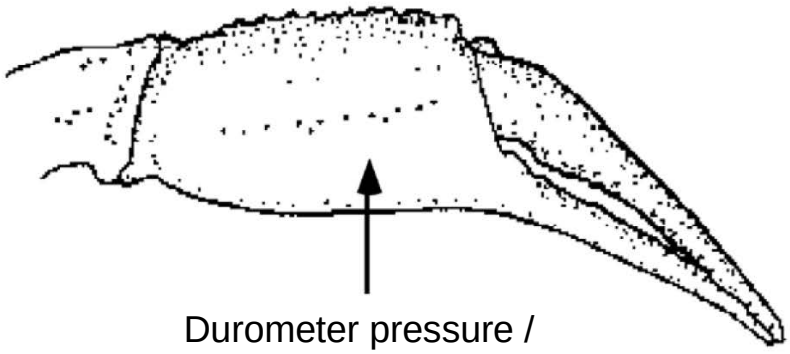
The carapace is dirty and claws and articulations are softening due to decalcification. The dorsal and ventral surfaces are dark brown, no iridescence. Scars are everywhere on the carapace. Appearance of wearing is widespread on the carapace, spines and dactyls are rounded and sometime damage. The organisms (bryozoa, balanus and spiroide) are always present.

APPENDIX 5. CLAW ILLUSTRATIONS AND LOCATION OF DUROMETER HARDNESS MEASUREMENT

Claw (front view)
Vue de face de la pince droite

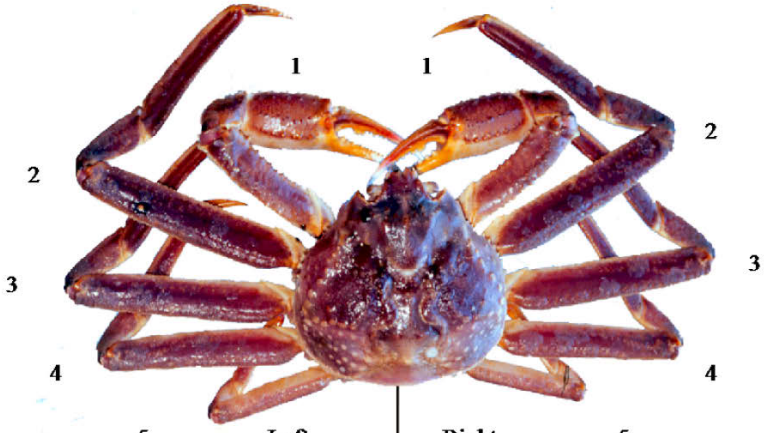


Claw (external view)
Pince vue du côté extérieur



APPENDIX 6. PROTOCOL FOR DOCUMENTING MISSING AND REGENERATED LEGS

Missing and regenerated legs /
Pattes manquantes et régénérées



Legs / Pattes :
M = Missing legs / pattes manquantes
R = Regenerated legs / pattes régénérées