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Gulf Region

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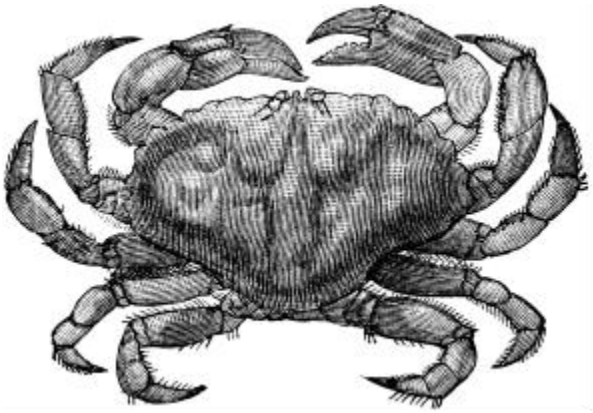
Science Advisory Report 2013/030

ASSESSMENT OF THE ROCK CRAB (*CANCER IRRORATUS*) FISHERY IN THE SOUTHERN GULF OF ST. LAWRENCE FOR 2006 TO 2011



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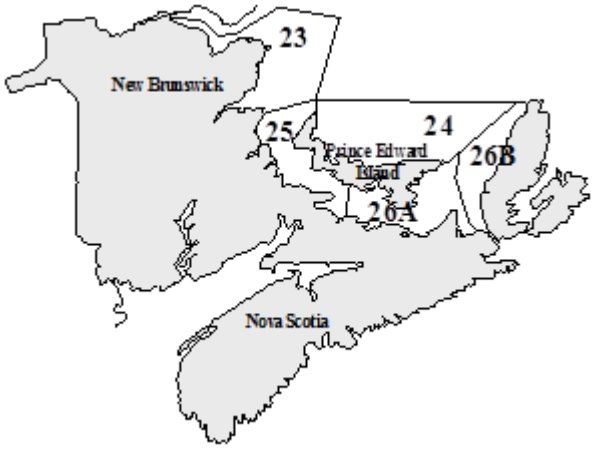

Figure 1. Lobster fishing areas used in the management of the directed rock crab fishery in the southern Gulf of St. Lawrence.

Context:

The rock crab (Cancer irroratus) fishery began during the 1960's as a bycatch in the lobster fishery, some of which was used as bait. A directed exploratory fishery began in 1974 on a small-scale until the late 1980's, when expanding markets and increased value resulted in substantial growth in effort. The five rock crab fishing areas are identical to lobster fishing areas: 23, 24, 25, 26A, and 26B (Figure 1). These areas do not reflect the biology of rock crab but are used for management purposes.

The directed fishery is conducted with defined management measures including a minimum legal size, prohibition to land females, individual allocation (except in area 24), limited access to the fishery, and catch-monitoring (mandatory dockside monitoring program and logbook). On the other hand, the bycatch and bait fisheries in the lobster fishery are only restricted to harvesting male rock crab and no data are available on the removals from the bait fishery.

The most recent assessment of the rock crab fishery was done in 2007 (DFO 2008). This Science Advisory Report provides an assessment of the rock crab resource and the fisheries of the southern Gulf of St. Lawrence to the 2011 fishing year. This report was developed at a regional peer review meeting that took place Feb. 28, 2013 in Moncton, New Brunswick. The terms of reference for the meeting were developed by DFO Science in response to a request for advice from DFO Gulf Region Fisheries and Aquaculture Management. Participants at the meeting were from DFO Science (Gulf, National Headquarters), DFO Fisheries Management Gulf Region, fishing industry from the three Maritime provinces, aboriginal groups, and provincial departments of New Brunswick and Prince Edward Island.

SUMMARY

- The rock crab fishery in the southern Gulf of St. Lawrence is comprised of three components: the bycatch fishery, the bait fishery, and the directed fishery. The bycatch and the bait fisheries are conducted during the lobster fishery by lobster licence holders.

- Between 2006 and 2011, total annual recorded landings averaged 4,734 t, with an average of 4,300 t from the directed fishery and 434 t from the bycatch fishery.

- Bycatch landings (sold, not personal use) of rock crab during the lobster fishery from 2000 to 2011 represented 7% to 24% of the total directed fishery landings with a declining trend since 2004.

- There is no estimate of quantities of rock crab caught and used as bait during the lobster fishery. The extent of the bait bycatch in lobster gear may be decreasing with the adjustment of escape mechanisms in lobster traps which could reduce the retention of smaller rock crabs.

- Catch rates derived from logbooks in 2011 were above the average of the 2000 to 2010 period for every fishing area.

- The percentages of active licence holders reaching 90% or more of their individual allocation were highest in lobster fishing areas 25 and 26A (51% and 71%, respectively), with a large amount of latent effort remaining in this fishery.

- A wide size frequency distribution and a balanced sex ratio of rock crab were observed based on the trawl survey.

- The minimum legal size used in the directed fishery is above the size at 50% and 95% maturity for males.

- Rock crab plays a major role in ecosystem structure and functioning. It is abundant and widely distributed in the coastal areas of the southern Gulf of St. Lawrence and is an important prey of a wide variety of organisms including lobster.

- There is no estimate of total biomass of rock crab in the southern Gulf of St. Lawrence, in terms of male biomass available to the fishery or estimates of exploitation rate. Landings are unlikely to be a proxy of biomass due to the limits placed on individual catches. Trawl surveys in 2010 and 2011 provided a snapshot of relative biomass in the two most heavily fished areas.

- Measuring effectiveness of management measures is limited due to lack of stock indicators against which to assess them.

BACKGROUND

Species Biology

Rock crab (*Cancer irroratus*) is distributed along the Atlantic coast, from South Carolina to Labrador, from the intertidal zone to a depth of 575 m. Rock crabs concentrate in shallow waters and seem to prefer sandy bottom, although they can be found on all types of substrate. They grow through the process of moulting where the hard outer shell is periodically shed; the moulting frequency slows once rock crabs become sexually mature. On average, female and male rock crabs mature at 57 and 75 mm carapace width (CW), respectively, but recent work suggests that the size at maturity for male is slightly smaller (73 mm CW for ≥ 95% maturity) for populations within Northumberland Strait, southern Gulf of St. Lawrence (sGSL). Mating occurs in late summer and fall, while the female carapace is still soft after moulting. Generally, female rock crabs extrude eggs soon after mating and carry the eggs beneath their abdomen for about 10 months. The hatching starts as early as mid-June and the pelagic larvae go through six stages and settle to the bottom by mid-September. Male rock crabs take about six years to reach commercial- size (≥102 mm CW).

Fishery

The rock crab fishery in the sGSL is comprised of three distinct components: the bycatch fishery, the bait fishery, and the directed fishery. The bycatch and the bait fisheries are conducted during the lobster fishery by lobster licence holders. The directed fishery is conducted at a different time, by rock crab licence holders.

The management of the directed rock crab fishery is based on effort control (number of licences, individual trap allocation, restrictions on gear characteristics, and limited fishing seasons), with individual catch allocations (except in lobster fishing area (LFA) 24), and by a minimum legal size (MLS, Table 1). The individual allocations are not based on stock status. Females cannot be landed. All rock crab landings from the directed fishery are verified through a dockside monitoring program (DMP). Logbooks are mandatory and must record daily catch, effort, and fishing locations.

The number of rock crab licences issued (including 24 exploratory licences in 2011) in the recent years has been stable at about 250 but not all licence holders were active in the fishery. Individual allocations have not changed since 2000 but they vary between LFAs (Table 1) and according to licence type. Most of the licences are classified either as commercial (individual) or commercial communal (aboriginal groups). Partnership and communal licences represent a very small fraction of the available licences but were still considered in the estimations of individual allocation attainment.

The bycatch fishery operated with daily limits and a MLS between 1999 and 2003, but those restrictions were dropped because they were contradictory to the Atlantic Fisheries Regulations (1985). Lobster licence holders are entitled to keep any size male rock crabs without a limit. There are no DMP and logbook requirements in the bycatch and the bait fisheries, and the potential number of harvesters is equivalent to the number of lobster licence holders.

Table 1. Key management measures in the directed rock crab fishery in the southern Gulf of St. Lawrence in 2011.

LFA	Minimum Legal Size (mm)	Trap Allocation	Fishing Season	Individual Allocation (kg)	Number of licenses	
					Issued	Active
23	102	100	Aug. 1 to Oct. 16	35,000	55	42
24	102	150	July 5 to Oct. 29	NA	16	9
25	102	100	June 27 to July 23 Oct. 20 to Nov. 30	25,000[1]	71	68
26A	108	90	Aug. 1 to Nov. 26	23,913	95	83
26B	108	100	Aug. 15 to Nov. 11	27,216	11	2

[1] Individual allocation for commercial communal licences is 35,000 kg

ASSESSMENT

Source of Information

The resource assessment was based primarily on the review of fishery-based abundance indicators and a number of fishery independent indicators. The fishery-based abundance indicators were the landings, the catch per unit effort (CPUE), and the percentage of licence holders reaching their individual allocation, derived from the mandatory logbook reports and DMP records. Data on bycatch of rock crab during the lobster fishery were compiled from sales transactions and other statistics were obtained from DFO Fisheries and Aquaculture Management Branch. Fishery independent data were collected from a bottom trawl survey conducted in the Northumberland Strait covering most of LFAs 25 and 26A. The survey was conducted between July 14 and August 8, 2010 and between July 21 and August 26, 2011 using a *Nephrops* trawl. Indicators from the survey include distribution, size frequencies, sex ratios, catch rates, and biomass estimates. Male maturity curves and CW - body weight relationships for both sexes were also derived from the trawl survey data. In 2011, a directed trap sampling program using conical traps with blocked escape vents was conducted at two sites in LFA 25 and one site in LFA 26A to collect information on size frequencies by sex. A rock crab settlement index was derived from standardized bio-collectors deployed in the sGSL between 2008 and 2012. Even if the bio-collectors were originally designed and deployed to monitor lobster settlement, they were the unique data source for the first benthic stages of rock crab.

Fishery dependent indicators

Prior to 2000, rock crab landings were not partitioned by fishery type. Total recorded landings of rock crab were about 1,000 t annually between 1985 and 1992 but rose to over 4,000 t per year by 1994 (Figure 2). Since 2000, landings from the directed fishery and the bycatch fishery can be separated. Between 2006 and 2011 (preliminary), total annual recorded landings of rock

crab from the directed fishery averaged 4,300 t, and 434 t from the bycatch fishery, with total annual recorded landings of 4,734 t (Figure 2).

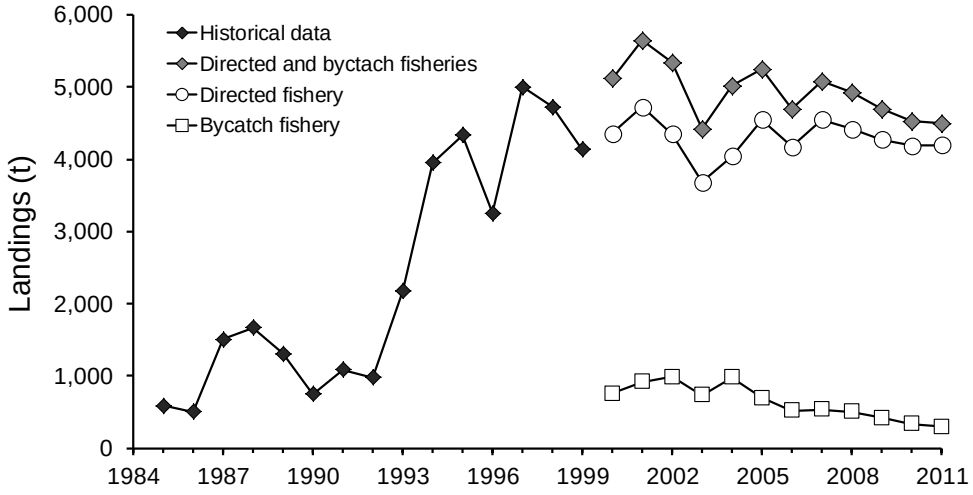

Figure 2. Total (directed and bycatch) recorded rock crab landings (t) in the southern Gulf of St. Lawrence between 1985 and 2011, with directed landings shown separately for 2000 to 2011. Data for 2011 are preliminary.

Directed fishery landings

Total landings from the directed fishery were relatively stable between 2000 and 2010 with an average of 4,301 t (ranging from 3,685 to 4,727 t, Table 2). Preliminary landings of 4,197 t for 2011 are slightly lower than the 2000 to 2010 average. Most landings come from LFA 26A (41%) and LFA 25 (36%) followed by LFA 23 at 18%, and LFA 24 at 4%. Only limited amounts of rock crab were recorded in the directed fishery in LFA 26B. Landings from the various LFAs have fluctuated in the recent years without distinct trends, except for LFA 26B where the directed fishing activity is very small.

Table 2. Recorded rock crab landings (t) by Lobster Fishing Area from the directed fishery. Data for 2011 are preliminary.

Year	23	24	25	26A	26B	Total
2000	995	237	1,186	1,917	24	4,360
2001	1,128	211	1,300	2,063	25	4,727
2002	1,007	177	1,378	1,769	18	4,349
2003	665	136	1,284	1,592	8	3,685
2004	956	183	1,290	1,591	21	4,041
2005	1,028	159	1,469	1,867	29	4,552
2006	982	212	1,361	1,574	43	4,172
2007	957	221	1,551	1,796	24	4,550
2008	846	181	1,687	1,685	18	4,417
2009	1,051	162	1,568	1,477	17	4,274
2010	817	167	1,578	1,624	1	4,187
2011	766	187	1,507	1,734	4	4,197

When landings are compared to the sum of individual allocations for all licences issued (6,480 t), it is clear that there is the potential for increased rock crab harvest. In 2011, only 76% of the sum of the total allocations of rock crab were landed in LFA 25 and LFA 26A (Table 3), which left 1,000 t that could have been fished. In LFAs 23 and 26B, only 40% and 1%, respectively, of the maximum allocations were landed which left 1,464 t of unused allocation in the directed fishery. Overall, the directed fishery on rock crab in 2011 only landed 62% of the total allocation (Table 3).

Table 3. Percentages per Lobster Fishing Area of the total allocation of rock crab landed in the directed fishery, 2006 to 2011. Data for 2011 are preliminary.

Year	23	25	26A	26B	Total
2006	51%	69%	69%	13%	61%
2007	50%	80%	79%	7%	67%
2008	44%	85%	74%	6%	65%
2009	55%	79%	65%	6%	63%
2010	42%	80%	72%	1%	62%
2011	40%	76%	76%	1%	62%

Directed fishery effort

While the total preliminary landings in 2011 were similar to those from 2006, the overall number of fishing trips recorded was 23% less than in 2006 (Table 4). There was a 17% decline in fishing trips in LFAs 25 and 26A, but the decline was more pronounced in LFA 23 (35%) which may explain in part the decrease in landings in this LFA. The number of fishing trips also decreased in LFAs 24 and 26B but there were very limited activities there initially.

Table 4. Number of recorded fishing trips in the directed rock crab fishery by Lobster Fishing Area from 2000 to 2011. Data for 2011 are preliminary.

Year	23	24	25	26A	26B	Total
2000	1,497	400	1,100	1,795	68	4,860
2001	1,556	335	1,355	2,159	82	5,487
2002	1,397	257	1,173	1,633	47	4,507
2003	637	178	1,102	1,341	19	3,277
2004	1,018	139	1,176	1,612	38	3,983
2005	1,063	166	1,138	1,276	49	3,692
2006	1,015	220	1,305	1,482	83	4,105
2007	993	211	1,277	1,349	66	3,896
2008	927	137	1,266	1,294	29	3,653
2009	924	167	1,256	1,422	30	3,799
2010	747	140	1,145	1,255	2	3,289
2011	663	161	1,089	1,233	7	3,153

The effort in the rock crab fishery is widely distributed in coastal waters of less than 35 m. In 2011, only 65% of trips had information on fishing locations, a slight increase from 59% in 2006. Fishing location information is mandatory in logbooks. The majority of fishing activities has

always been located in the Northumberland Strait (LFAs 25 and 26A), and on the eastern coast of New Brunswick in LFA 23 (Figure 3). No contraction or expansion of fishing grounds has been observed since 2006 suggesting no change in rock crab abundance. One area in central Northumberland Strait had low fishing activities and might reflect an area of low abundance (red ellipse in Figure 3). The same area had low catches of rock crab in the trawl survey.

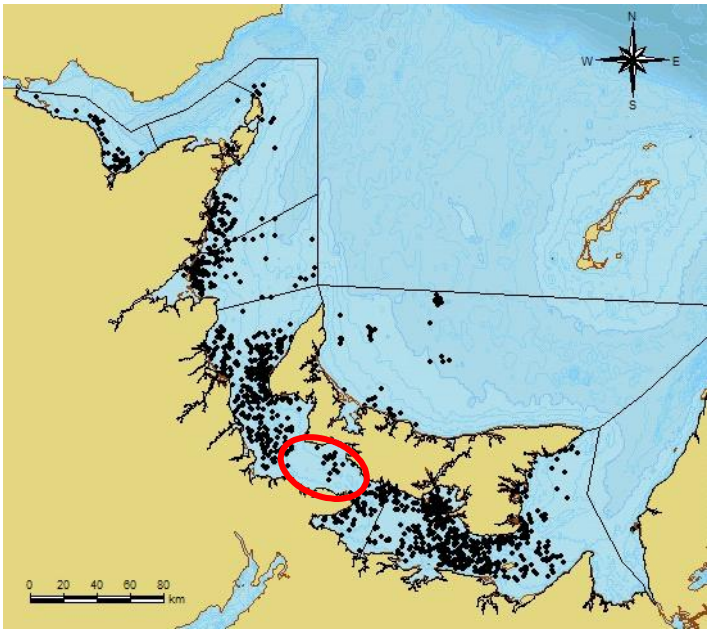

Figure 3. Distribution of fishing locations as recorded in mandatory logbooks during the 2011 rock crab directed fishery in the southern Gulf of St. Lawrence. The red elliptical region represents an area with consistently less fishing effort since 2006. Raw positions from logbooks are shown and lines represent Lobster Fishing Area boundaries.

Directed fishery catch rate

Several trap types are used in the directed fishery, but the most common is the conical trap. Catch rates have not been standardized according to trap type or for any other variables (soak time, number of trap hauls per trip). Therefore, part of the variation in the catch rate might result from factors other than the rock crab abundance.

Preliminary catch rates in 2011 were above the average of the 2000 to 2010 period for every LFA and, except for LFA 24, they were all higher than those observed in 2006 (Table 5). Catch rates were highest in LFAs 25 (14.5 kg/trap) and 26A (16.2 kg/trap), an increase of 28% and 33%, respectively compared to 2006. This was not, however, part of an increasing trend as there were higher values in previous years. In LFA 23, the average catch rate in 2011 (12.2 kg/trap) was 23% higher than in 2006 and catch rates have been stable at about 12 kg/trap for the last three years. Catch rates in LFAs 24 and 26B have fluctuated over the years with no trend. With only seven fishing trips recorded in LFA 26B, there is too little information to elaborate on catch rates for that LFA.

Table 5. Mean annual catch rate (kg/trap; +/- 95% confidence interval range) of rock crab in the directed fishery by Lobster Fishing Area from 2000 to 2011. Data for 2011 are preliminary.

Year	23	24	25	26A	26B
2000	7.5 (0.3)	6.1 (0.5)	11.2 (0.4)	13.2 (0.3)	4.4 (0.6)
2001	7.8 (0.3)	5.8 (0.5)	10.6 (0.7)	11.6 (0.3)	4.3 (0.8)
2002	8.0 (0.3)	6.7 (0.5)	12.2 (0.4)	13.7 (1.4)	5.5 (1.0)
2003	12.5 (0.5)	7.8 (0.6)	12.7 (0.4)	14.1 (0.4)	5.4 (1.2)
2004	10.8 (0.3)	10.2 (0.7)	12.1 (0.4)	11.6 (0.2)	9.5 (1.1)
2005	10.6 (0.3)	10.1 (0.8)	14.1 (0.6)	17.3 (0.6)	9.8 (1.2)
2006	9.9 (0.3)	10.6 (0.7)	11.3 (0.3)	12.2 (0.3)	6.1 (0.6)
2007	10.3 (0.4)	8.3 (0.6)	12.6 (0.3)	15.0 (0.4)	4.6 (0.6)
2008	10.8 (0.7)	9.5 (0.6)	13.9 (0.4)	15.4 (0.6)	7.3 (1.1)
2009	12.5 (0.4)	7.8 (0.5)	12.5 (0.3)	11.9 (0.2)	6.5 (0.7)
2010	11.9 (0.4)	9.8 (0.9)	14.3 (0.5)	15.1 (0.4)	8.4 (0.7)
2011	12.2 (0.5)	9.2 (0.5)	14.5 (0.5)	16.2 (0.4)	10.6 (4.0)
Mean 2000-2010	10.2 (1.1)	8.4 (1.0)	12.5 (0.7)	13.7 (1.1)	6.5 (1.2)

Attainment of Individual allocation in the directed fishery

No trend was observed in the percentages of active licence holders reaching 90% or more of their individual allocation but harvesters in LFA 25 and LFA 26A had the highest rate at 51% and 71%, respectively (Table 6). Only minor amounts of rock crab are caught in the directed fishery in LFA 26B and no individual allocation has ever been reached. The reason could be the low rock crab abundance and/or limited interest in the fishery. A large amount of latent effort remains in this fishery.

Table 6. Percentages of active licence holders by Lobster Fishing Area which recorded landings of at least 90% of their individual allocation during 2006 to 2011. Data for 2011 are preliminary. There is no individual allocation in area 24.

LFA	23	25	26A	26B
2006	30%	40%	59%	0%
2007	23%	64%	73%	0%
2008	21%	64%	69%	0%
2009	33%	51%	40%	0%
2010	26%	58%	60%	0%
2011	19%	51%	71%	0%

Bycatch fishery

Bycatch landings (sold, not personal use) of rock crab during the lobster fishery were low in LFAs 24 and 26B compared to LFAs 23, 25, and 26A (Table 7). Preliminary landings for 2011 show a total of 295 t of rock crab landed. From 2000 to 2006, total bycatch landings represented 12% to 24% of the total directed fishery landings. Percentages declined from 12% to 7% during the 2007-2011 period (Table 7). Rock crab bycatch landings were recorded from

12% (387) of lobster fishing licence holders in 2011, compared to 22% (705) in 2006. There is no estimate of the quantity of rock crab caught and used as bait during the lobster fishery.

Table 7. Rock crab landings (t) by Lobster Fishing Area as bycatch during the lobster fishery. Data for 2011 are preliminary.

Year	23	24	25	26A	26B	Total Bycatch	% of Directed	Total Directed
2000	284	18	230	223	0	755	17%	4,360
2001	244	22	278	370	0	914	19%	4,727
2002	352	17	272	344	0	985	23%	4,349
2003	227	16	191	302	0	736	20%	3,685
2004	261	20	203	492	0	976	24%	4,041
2005	194	37	172	293	0	696	15%	4,552
2006	170	21	101	227	0	519	12%	4,172
2007	121	30	141	239	0	531	12%	4,550
2008	85	11	143	266	0	505	11%	4,417
2009	68	39	84	227	0	419	10%	4,274
2010	71	13	66	186	0	335	8%	4,187
2011	29	12	42	211	1	295	7%	4,197

Fishery independent indicators

Spatial distribution from trawl survey

Rock crab were widely distributed in LFAs 25 and 26A and occurred at 94% of stations sampled in 2010 and 2011 (Figure 4). Rock crab occupied deeper waters than lobster and its depth distribution paralleled the depth distribution of the stations fished; the depths of 50% and 90% occurrence of rock crab were 20.6 and 36.0 m, respectively.

Commercial-size (≥ MLS) male rock crabs were most abundant in the northern portion of LFA 25 (western PEI) and generally throughout LFA 26A (Figure 5).

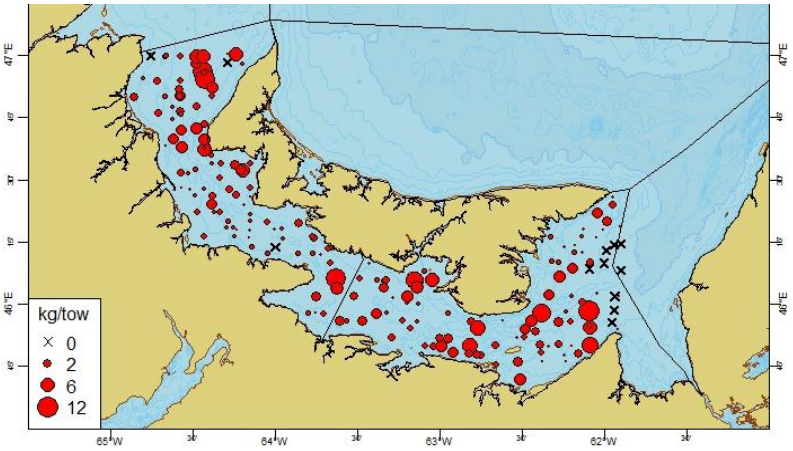

Figure 4. Standardized catch distribution (kg / tow) of rock crab (all sizes and sexes) at stations sampled during the 2010 and 2011 Northumberland Strait Nephrops trawl survey. Lines represent Lobster Fishing Area boundaries.

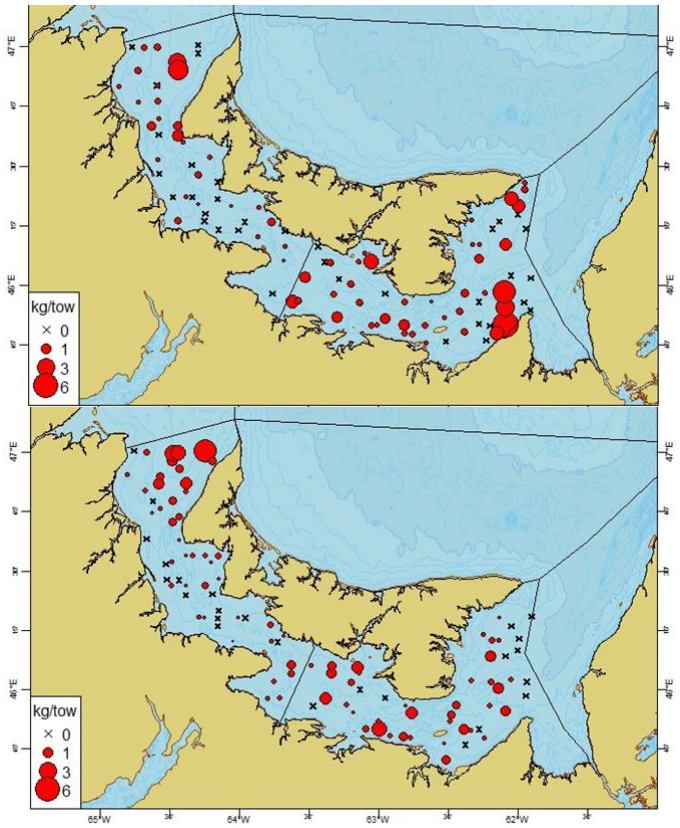

Figure 5. Standardized catch distribution (kg / tow) of commercial-size rock crab during the Northumberland Strait Nephrops trawl survey in 2010 (top) and 2011 (bottom). The minimal legal size used in Lobster Fishing Area 25 is 102 mm and 108 mm for 26A. Lines represent Lobster Fishing Area boundaries.

Size distribution and sex ratio of rock crab in trawl survey

Rock crab size distributions indicate that small animals were likely not well retained by the net used in the trawl surveys. Overall, there were proportionately more large males in LFA 26A than in LFA 25 (Figure 6). Male median CWs were 82 and 90 mm in LFA 25 compared to 100 and 95 mm in LFA 26A during the 2010 and 2011 surveys, respectively. In both LFAs and for both years, median CWs were below the MLS. There were more large females in LFA 26A than in LFA 25 in 2010 but it was the opposite in 2011. Female median CWs were 75 and 78 mm in LFA 25 and 81 and 80 mm in LFA 26A during the 2010 and 2011 surveys, respectively. The maximum size recorded for a female in both LFAs was 101 mm.

The percentages of commercial-size male rock crab from the survey in LFA 25 (≥102 mm) were 16% in 2010 and 25% in 2011 (Figure 6). The percentages of commercial-size male rock crab from the survey in LFA 26A (≥108 mm) were 33% in 2010 and 26% in 2011 (Figure 6). The timing of the trawl surveys was after the first part of the fishing season in LFA 25 but before the fishery in LFA 26A.

In LFA 25, the ratio of male to female rock crab, all sizes combined, was 1:1 for both years but in LFA 26A it was a male favored ratio of 1.6:1 in 2010 and a female favored ratio of 0.7:1 in 2011. When the two years were combined, the ratio was 1:1 for both areas.

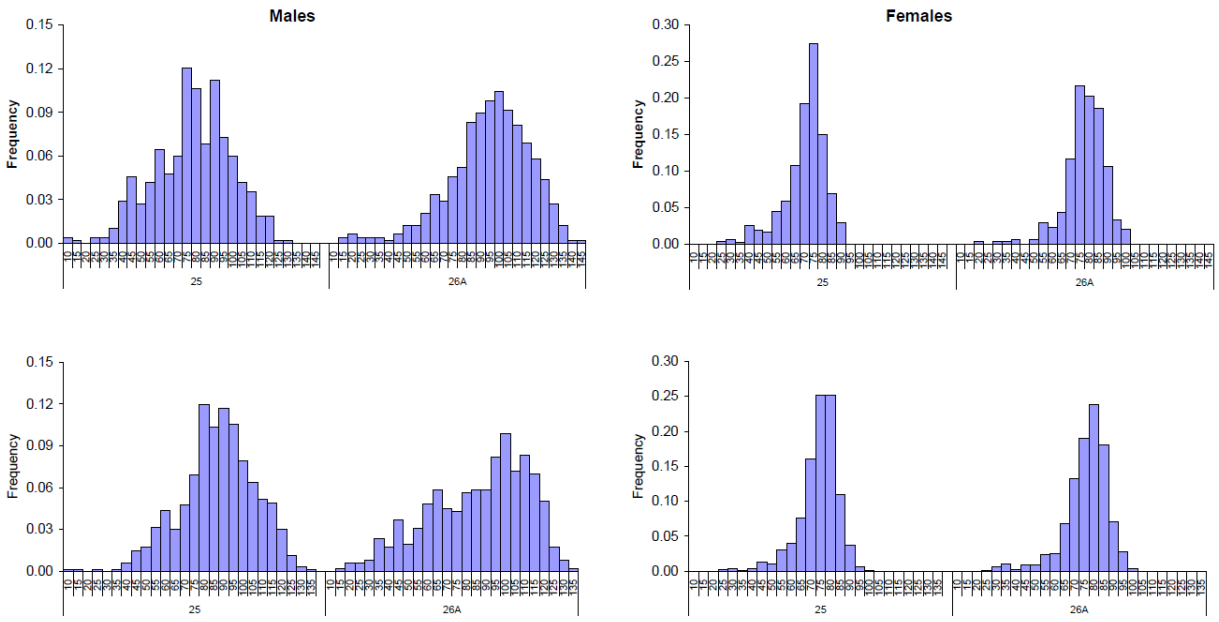

Figure 6. Size (carapace width) distributions (by 5 mm group) of male (left) and female (right) rock crab sampled during the 2010 (top panels) and 2011 (bottom panels) trawl surveys in Lobster Fishing Areas 25 and 26A.

Abundance indicators of rock crab in trawl survey

Biomass estimates (mean catch rate as kg per km² from survey catches raised to total survey area) of rock crab, sizes and sexes combined, from the surveys indicate that in terms of weight rock crabs were more abundant in LFA 26A than in LFA 25 (Table 8). Conversely to the increase of the total abundance observed between 2010 and 2011 in LFA 26A, a decline was

observed in LFA 25. Commercial-size male rock crab abundance was estimated to have been higher in LFA 26A than in LFA 25 but abundance declined between 2010 and 2011 in LFA 26A whereas it increased over the same time period in LFA 25 (Table 8).

Table 8. Biomass estimates (t) of rock crab, all sizes and sexes combined, and commercial size male rock crab in Lobster Fishing Areas 25 and 26A from the 2010 and 2011 trawl surveys.

LFA (surface area km²)	Year	Mean (95% confidence interval)		Total Annual Reported Landings (t)
		Sizes and Sexes Combined	Commercial-Size Male Rock Crab	
25 (5,482)	2010	7,165 (4,361 to 18,039)	1,506 (639 to 4,187)	1,644
	2011	6,520 (4,435 to 16,508)	1,890 (1,023 to 5,255)	1,549
26A (6,443)	2010	7,419 (5,073 to 17,699)	2,721 (1,892 to 6,450)	1,810
	2011	9,397 (6,629 to 21,812)	2,293 (1,522 to 5,440)	1,945

Exploitation rates of the directed and bycatch fisheries in LFAs 25 and 26A could not be estimated at this time from the trawl survey estimates of biomass. The directed fishery in LFA 25 occurs for two separate periods of which the first one preceded the trawl survey both in 2010 and 2011. In LFA 26A, the trawl survey overlapped with the first few days or weeks of the fishery. Also, male rock crab can molt and grow into the commercial-size category throughout the summer which confounds the estimates of the biomass available to the fishery.

Scientific trap survey

Size frequency distributions from the scientific trap samples were similar to those of the trawl surveys with more large animals in LFA 26A compared to LFA 25. At the two sites in LFA 25, where the MLS is 102 mm, the percentages of commercial-size males in the samples dropped from 39% and 41% before the fishery to 29% and 25% towards the end of the fishing season. In contrast, percentages of commercial-size males actually increased from 25% to 66% between sampling periods at the LFA 26A sampling site although the observed variation could be attributed to a change in sampling locations between the two sampling periods. The LFA 26A sampling site also differed from the LFA 25 sites as it had a high percentage of females >90 mm CW (56% to 58%) during both sampling periods, the largest female had a CW of 104 mm. In LFA 25, less than 4% of females were >90 mm CW and none was >99 mm.

Rock crab settlement index

The abundance of young-of-the-year (yoy) rock crabs in bio-collectors showed contrasting patterns between collectors in Northumberland Strait and those from north of PEI (LFA 24). Since 2008, the abundances of yoy rock crab have been very low (<1.0 per m²) in bio-collectors in the central Northumberland Strait portion of LFAs 25 and 26A. The highest yoy abundance values were observed at sites within LFA 24, with values greater than 60 and 82 per m² for the Alberton and Covehead sites, respectively, in all years except 2011. Patterns of rock crab settlement are similar to those of lobster, with highest densities observed in LFA 24 compared to LFA 25 and LFA 26A for both species.

Ecosystem Indicators

Rock crabs are primarily carnivorous with plant material representing <2.5% of their diet. Crustaceans were the most important prey eaten by rock crab followed by fish, mollusks, and polychaetes or detritus. No evidence of rock crab preying on lobster was found. Rock crabs were observed to be strongly cannibalistic with fresh rock crab remains comprising 13.8% of total prey biomass.

Rock crabs were an important prey (>5% of prey biomass) of four fish species (shorthorn sculpin, longhorn sculpin, cunner, winter skate) and of all three species of large decapod crustaceans (lobster, rock crab, lady crab) that occur in Northumberland Strait. Fresh rock crab material (excluding exuvia) accounted for 44% of lobster prey biomass. Rock crabs were a minor prey item of Atlantic cod and winter flounder. Atlantic cod and winter flounder consumed very small (<20 mm CW) rock crab, longhorn sculpin and winter skate ate individuals up to about 35 mm CW, and shorthorn sculpin ate rock crab up to 80 mm CW (Figure 7). All of the rock crabs >35 mm CW consumed by winter skate were newly molted individuals and most of the rock crab >50 mm CW consumed by shorthorn sculpin also had just molted. Larval rock crab were particularly important (>18% of prey biomass) prey for gaspereau (*Alosa* sp.). While windowpane flounder typically do not eat planktonic prey, small (<15 cm total length) windowpane consumed rock crab megalop larvae, presumably as the megalops were settling to the bottom.

Rock crab plays a major role in ecosystem structure and functioning. Rock crab has a similar high biomass as lobster but it is more widely distributed (occurs in more habitats). Both larvae and demersal stages are important prey of a wide variety of organisms. Rock crabs prey on a wide variety of organisms and diet varies with availability in the habitat. Rock crab is an essential prey for lobster molt processes. In contrast, lobsters are essentially a large-bodied predator, that consume very few prey types and are not important prey of fish or crustacean predators.

The extent of predation on rock crab by seals, particularly grey seals, in the sGSL is not known.

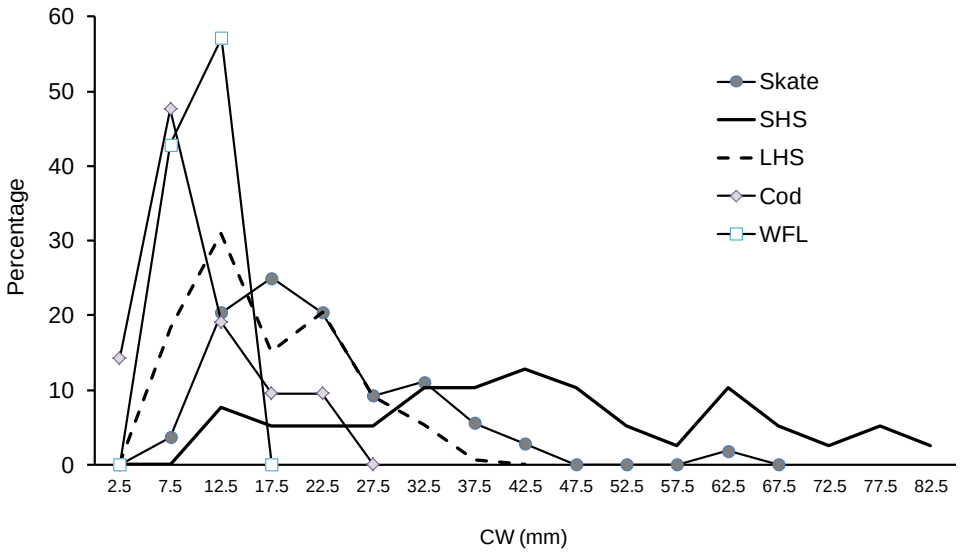

Figure 7. Percentages of rock crab by carapace width (mm) categories eaten by winter skate (Skate), shorthorn sculpin (SHS), longhorn sculpin (LHS), Atlantic cod (Cod), and winter flounder (WFL) from samples collected in Northumberland Strait.

Sources of Uncertainty

The rock crab stock assessment relies on a very limited number of indicators that are almost all fishery dependent. Fishery data are obtained through several independent processes that increases the chance of data errors and results in delays in data availability. Only preliminary data for 2011 were available for this assessment.

Total removals of rock crab are not known because no data are available for removals as bait and possible unreported rock crab bycatch during the lobster fishery. In certain areas, rock crab is commonly used as bait and this could represent large catches, especially when the access for more traditional bait species (herring, mackerel, etc.) is difficult. Market demands for rock crab products could be an incentive for the rather large lobster fleet to increase substantially the fishing pressure and bycatch landings that may not be completely reported.

Catch rates and fishing effort indicators derived from logbook data are uncertain given that not all the information is recorded. However, over the years, the quality and completeness of logbook data have increased.

Uncertainties are also present in the interpretation of catch rates given that in most LFAs there is a maximum individual allocation. Fishing strategies might also come into play to maintain high catches leading to hyper-stability in CPUE which could mask stock abundance fluctuations. In addition, catch rates are likely affected by environmental factors, such as water temperature, socio-economic considerations (market demands, access to other fisheries, etc.), and changes in fishing technology.

Stock structure and rock crab movements in the sGSL are not well understood. Rock crab larvae are the most abundant component in the plankton where such samples have been collected in the sGSL. Combined with information on currents, larval drift over large areas is expected.

Effects of changes in temperatures on rock crab larvae survival, benthic stages, recruitment, growth etc., and indicators of environmental stress are not known for rock crab.

Stock and recruitment dynamics are not well understood for rock crab which precludes estimates of traditional biomass or exploitation rate reference points. Alternate indicators such as those based on CPUE indicators or size frequency distributions require further considerations.

CONCLUSIONS

Most indicators used in the present assessment were derived from mandatory logbook data and official catch statistics. Observed variations in these indicators may not entirely reflect changes in the rock crab abundance because catch and effort trends could have been influenced by management decisions and market demands. New fishery-independent indicators were presented based on two years of Nephrops trawl survey data and bio-collector data, but the time series of these indicators is short.

Landings from the directed fishery have been relatively stable between 2006 and 2011. Catch rates in 2011 were above the average of the 2000 to 2010 period for every LFA and, except for LFA 24, they were all higher than those observed in 2006. Catch rates were highest in LFAs 25 (14.5 kg/trap) and 26A (16.2 kg/trap), and increased 28% and 33%, respectively, compared to 2006.

Rock crab was broadly distributed in LFAs 25 and 26A in 2010 and 2011 based on the fishery independent trawl survey.

A wide size frequency distributions and a balanced sex ratio were observed based on trawl survey data. The MLS used in the directed fishery is above the size at 50% and 95% maturity for males.

Potential increases in fishing effort on the rock crab resource exist in the bycatch fishery, the bait fishery, and from the latent effort in the directed fishery. Fishing effort is linked closely to market demands and an increase in the value of rock crab or bait availability issues could lead to substantially higher landings in a short period of time with unknown consequences on the rock crab population.

The bycatch and bait fisheries allow the removal of any size male rock crab. Concerns to the resource from increased removals by these fisheries could be reduced by the introduction of a MLS as is the case for the directed fishery. The extent of the rock crab bycatch in lobster gear may be decreasing with the adjustment of escape mechanisms in lobster traps which would reduce the retention of rock crab. The effect of this measure may vary among areas and has not been measured.

Rock crab plays a major role in ecosystem structure and functioning. Rock crab has a high biomass and is widely distributed in the coastal areas of the sGSL. Both larval and demersal stages are important prey of a wide variety of organisms; and rock crab eat a wide variety of prey. Rock crab is an essential prey for lobster molt processes.

There is no estimate of total biomass of rock crab in the sGSL, in terms of male biomass available to the fishery or estimates of exploitation rates. Landings are unlikely to be a proxy of biomass due to the limits placed on individual catches. Trawl surveys in 2010 and 2011 provided biomass estimates in the two most heavily fished areas and such a survey might provide estimates of biomass and exploitation rates in the future.

Measuring effectiveness of management measures is limited due to lack of stock indicators against which to assess them.

OTHER CONSIDERATIONS

Impact of rock crab fisheries on other species and habitat

The trophic link between lobster and rock crab is well documented but no regulation is focused on controlling rock crab removals to ensure lobster population health. In the directed fishery however the MLS mitigates the fishing impact on the lobster diet as lobster usually does not prey on large size crabs. If rock crab removals were to impede the population’s reproductive potential and recruitment many predator species would need to shift their diet with unknown consequences.

The gear impact “footprint” from the directed rock crab fishery on benthic habitat has not been assessed but is deemed to be minimal given the limited number of participants and trap allocations.

No information is available on bycatch during the directed rock crab fishery but no other species are allowed to be landed.

Impact of other fisheries on rock crab

Scallop fishery

Based on a study of bycatch during the scallop fishery, rock crab was the second most commonly incidentally captured species, after starfish. From 24 sampling trips done from 2006 to 2008, 4,311 rock crabs were caught (average of 209 crabs per fishing trip) and most animals were in good to excellent condition when returned to the water.

Lobster fishery

The only fishery in which rock crab are allowed to be kept and used is the lobster fishery. The proportion of rock crab removals as bycatch during the lobster fishery has decreased since 2006 and represented less than 10% of the directed fishery landings in the last three years. The extent of the rock crab kept for bait from the lobster fishery is unknown. The latent potential for an increase in fishing pressure on rock crab is significant with unknown consequences on the stock's health.

SOURCES OF INFORMATION

This Science Advisory Report is from the regional peer review meeting of February 26 to 28, 2013 on the assessment of the status of the lobster (*Homarus americanus*) and rock crab (*Cancer irroratus*) stocks of the southern Gulf of St. Lawrence. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

Benoît, H.P. 2011. Estimated amounts, species composition and pre-discard condition of marine taxa captured incidentally in the southern Gulf of St. Lawrence scallop fishery. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/031. iv + 20 p.

DFO. 2008. Assessment of the rock crab (*Cancer irroratus*) fishery in the southern Gulf of St. Lawrence Lobster Fishing Areas (LFA's) 23, 24, 25, 26A and 26B for 2000 to 2006. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2008/022.

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MPO. 2013. Évaluation de la pêche du crabe commun (Cancer irroratus) dans le sud du golfe du Saint-Laurent, de 2006 à 2011. Secr. can. de consult. sci. du MPO, Avis sci. 2013/030.