



## UPDATE TO 2017 OF THE FISHERY INDICATORS FOR ROCK CRAB (*CANCER IRRORATUS*) IN THE SOUTHERN GULF OF ST. LAWRENCE

### Context

An update of the fishery indicators for the rock crab fishery of the southern Gulf of St. Lawrence (sGSL) was last completed in 2016 with information up to 2015 (DFO 2017). The most recent stock assessment was completed in 2013, with information up to 2011 (DFO 2013; Rondeau *et al.* 2014). The update of the fishery status indicators was requested by DFO Gulf Region Fisheries and Aquaculture Management (FAM). This Science Response Report results from the Science Response Process on the update of the indicators to 2017 of the rock crab (*Cancer irroratus*) fishery in the southern Gulf of St. Lawrence which took place November 23, 2018.

### Background

The rock crab (*Cancer irroratus*) fishery in the sGSL (Fig. 1) is comprised of three distinct components: the directed fishery, the bycatch fishery, and the bait fishery. The directed fishery is conducted by rock crab licence holders, during the rock crab fishery. The bycatch and bait fisheries are conducted during the lobster fishery by lobster licence holders.

The management of the directed rock crab fishery is based on effort controls, including the number of licences, individual trap allocations, restrictions on gear characteristics, individual catch allocations, defined fishing seasons, a minimum legal size (MLS), and a prohibition on the landing of females. While individual allocations are used, these are not based on stock status or biomass estimates. All rock crab landings from the directed fishery must be recorded through a dockside monitoring program (DMP). Logbooks are mandatory for the directed rock crab fishery and must record daily catch, effort, and fishing locations. The bycatch and bait fisheries have fewer management restrictions but include a defined fishing season (lobster fishing season) and a prohibition on the landing of females. There are no reporting requirements for the bycatch and bait fisheries but rock crab that is sold through buyers is recorded in landing slips.

### Analysis and Response

This update is mainly based on fishery-dependent indicators: landings, catch per unit effort, and the percentage of licence holders reaching their individual allocation. The data used are derived from logbook reports, DMP records and DFO records of sale transactions (directed and bycatch fisheries) and issued licenses. The records of bycatch sales are incomplete. There are no data on the use of rock crab as bait.

The only fishery-independent data available are from the industry-led bio-collectors study in the coastal waters of Prince Edward Island (seven locations) and Nova Scotia (one location) (Fig. 1). A rock crab settlement index from this program is available for the period 2008 to 2018.

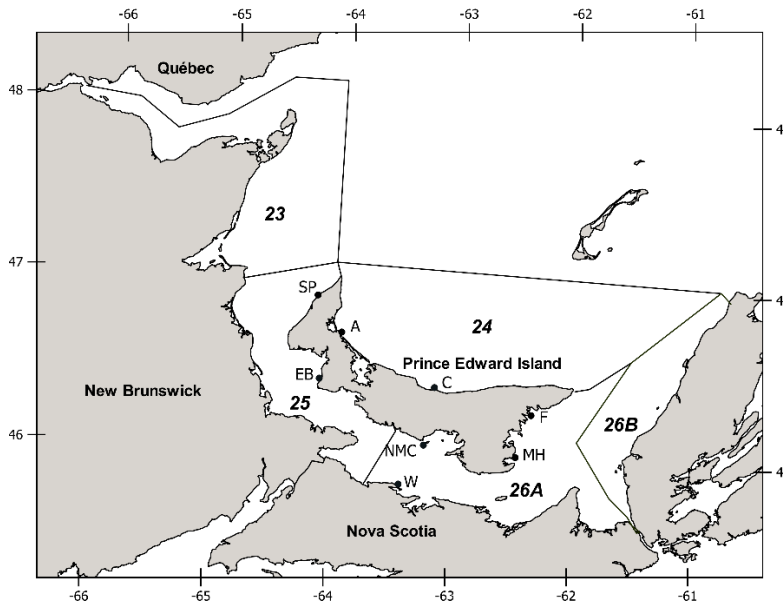


Figure 1. Lobster Fishing Areas (LFA) used in the management of the rock crab fishery and locations of bio-collector sites in the southern Gulf of St. Lawrence; in LFA 24 (A=Alberton, C=Covehead), in LFA 25 (EB=Egmont Bay, SP=Skinner's Pond) and LFA 26A ( F=Fortune, MH=Murray Harbour, NMC=Nine Mile Creek).

**Fishery-dependent indicators**

**Total fishery landings**

Prior to 2000, rock crab landings were not partitioned by fishery type (directed and bycatch) (Fig. 2). Overall, landings increased over the period 1985 to 2000, with relatively large inter-annual variability. Since 2000, total landings have decreased, as a result of decreases in both the directed fishery and the bycatch fishery. The bycatch fishery now represents only 1% of the total rock crab landings in 2017. The catches from the bait fishery are unknown as data are not collected.

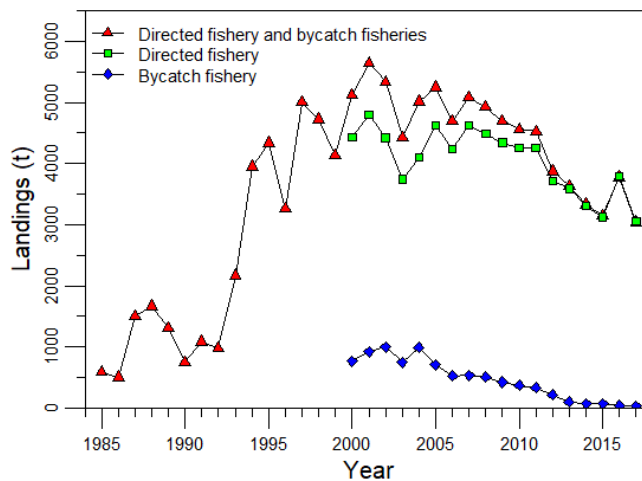


Figure 2. Recorded rock crab landings (t) from the directed and bycatch fisheries in the southern Gulf of St. Lawrence from 1985 to 2017. Prior to 2000, only the total reported landings (directed and bycatch) are available. Data for 2017 are preliminary.

**Gulf Region**

**Directed fishery landings**

Annual landings from the directed fishery were relatively stable over the period 2004 to 2011 and have generally decreased since. The landings of 3,007 t in 2017 are the lowest level since 2000 (Table 1). Relative the previous update, with data up to 2015, preliminary landings in 2017 have increased in LFA 24 and LFA 26A, by 64% and 20%, respectively, and decreased in LFA 23 and LFA 25, by 10% and 20%, respectively. There have not been any recorded landings in LFA 26B since 2012. Overall, total landings increased by 21% between 2015 and 2016, and then decreased by 19% from 2016 to 2017. Landings are generally decreasing across all LFAs and the trend corresponds to changes in effort (see Directed fishery effort, below).

In 2016 and 2017, 74% and 72%, respectively, of rock crab licence holders recorded sales (active licence holders). Preliminary landings of 3,007 t in 2017 represent 46% of the total allocation (6,584 t) (Table 1). Based on the available time series for 1985 to 2017, landings have consistently been below the maximum allocation.

*Table 1. Recorded rock crab landings (t), by Lobster Fishing Area, from the directed fishery, 2000 to 2017. For 2006 to 2017, the percentage of the total allocation of rock crab landed is shown in parentheses. Data on allocations prior to 2006 were unavailable. LFA 24 did not have an allocation prior to 2015. The maximum recorded value of the time series for each LFA is shown in bold. Data for 2017 are preliminary.*

Year	23	24	25	26A	26B	Total
2000	995	<b>237</b>	1,186	1,917	24	4,360
2001	<b>1,128</b>	211	1,300	<b>2,063</b>	25	<b>4,727</b>
2002	1,007	177	1,378	1,769	18	3,343
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 (51%)	212	1,361 (69%)	1,574 (69%)	<b>43 (13%)</b>	4,172 (61%)
2007	957 (50%)	221	1,551 (80%)	1,796 (79%)	24 (7%)	4,549 (67%)
2008	846 (44%)	181	<b>1,687 (85%)</b>	1,685 (74%)	18 (6%)	4,417 (65%)
2009	1,051 (55%)	162	1,568 (79%)	1,477 (65%)	17 (6%)	4,274 (63%)
2010	817 (42%)	167	1,578 (79%)	1,624 (72%)	1 (1%)	4,187 (65%)
2011	764 (40%)	187	1,510 (76%)	1,731 (76%)	4 (1%)	4,195 (65%)
2012	534 (28%)	139	1,474 (74%)	1,504 (66%)	1 (1%)	3,653 (57%)
2013	542 (29%)	155	1,416 (73%)	1,422 (61%)	0 (0%)	3,536 (55%)
2014	448 (24%)	88	1,171 (59%)	1,552 (63%)	0 (0%)	3,259 (49%)
2015	636 (35%)	49 (25%)	1,281 (67%)	1,107 (49%)	0 (0%)	3,073 (48%)
2016	717 (39%)	84 (42%)	1,469 (74%)	1,458 (64%)	0 (0%)	3,728 (57%)
2017	575 (31%)	81 (40%)	1,023 (52%)	1,327 (58%)	0 (0%)	3,007 (46%)

**Bycatch fishery landings**

Reported bycatch landings of rock crab sold during the lobster fishery have greatly decreased in all LFAs (Table 2). In total, 34 t of rock crab were sold in 2017 compared to a high of 985 t in 2002. Rock crab landings from the bycatch fishery have never exceeded 20% of the total landings, and since 2004, have steadily decreased. In 2017, landings from the bycatch fishery represented only 1% of total landings.

The decrease in reported landings from the bycatch fishery is likely due in part to increases in the size of the escape mechanisms on lobster traps. Larger escape vents facilitate the escape of rock crab. Another possibility is that rock crab caught as bycatch during the lobster fishery is increasingly being used as bait instead of being sold.

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*Table 2. Reported rock crab bycatch landings (t) by Lobster Fishing Area, 2000 to 2017. The maximum recorded value of the time series for each LFA is shown in bold. Data for 2017 are preliminary.*

Year	23	24	25	26A	26B	Total bycatch	% of Total landings
2000	284	18	230	223	0	755	15%
2001	244	22	<b>278</b>	370	0	914	16%
2002	<b>352</b>	17	272	344	0	<b>985</b>	18%
2003	227	16	191	302	0	736	17%
2004	261	20	203	<b>492</b>	0	976	<b>19%</b>
2005	194	37	172	293	< 0.1	696	13%
2006	170	21	101	227	<b>0.1</b>	519	11%
2007	121	30	141	239	0	531	10%
2008	85	11	143	266	< 0.1	505	10%
2009	68	<b>39</b>	84	227	< 0.1	419	9%
2010	71	14	68	216	< 0.1	369	8%
2011	27	12	43	246	< 0.1	328	7%
2012	0.3	5	12	200	< 0.1	217	6%
2013	2	2	20	72	0	96	3%
2014	0	1	17	56	0	74	2%
2015	0	0.2	12	64	0	76	2%
2016	< 0.1	0.3	17	30	0	47	1%
2017	0	0.3	2	32	0	34	1%

**Directed fishery effort**

The number of fishing trips in the directed fishery increased during 2015 to 2016 then decreased into 2017, to the lowest level since 2000 (Table 3). The 2,273 trips recorded in 2017 represent a 10% decrease relative to trips recorded in 2015. There has not been any reported fishing activity in LFA 26B since 2012. Longer term, the number of recorded fishing trips is decreasing across all LFAs, corresponding to declines in landings.

*Table 3. Number of recorded fishing trips in the directed rock crab fishery by Lobster Fishing Area from 2000 to 2017. The maximum recorded value of the time series for each LFA is shown in bold. Data for 2017 are preliminary.*

Year	23	24	25	26A	26B	Total
2000	1,497	<b>400</b>	1,100	1,795	68	4,860
2001	<b>1,556</b>	335	<b>1,355</b>	<b>2,159</b>	<b>82</b>	<b>5,487</b>
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	662	161	1,093	1,231	7	3,154
2012	564	157	1,057	1,190	3	2,971
2013	511	195	1,042	1,155	0	2,903
2014	454	129	954	1,071	0	2,608
2015	519	77	881	1,056	0	2,533
2016	607	105	1,024	1,197	0	2,933
2017	488	93	667	1,025	0	2,273

Gulf Region

**Directed fishery catch rate**

Catch rates (kg per trap) in all LFAs are variable through time but some increases were observed in LFAs 24, 25, and 26A between 2015 and 2017, with the highest values in LFAs 25 and 26A (Table 4). In 2017, catch rates in LFAs 23, 25, and 26A were above the respective median catch rates for the period 2000 to 2017. LFA 24 had the lowest catch rate in 2017, only slightly below the median catch rate of the period 2000 to 2017.

*Table 4. Catch rate (kg per trap; mean with coefficient of variation in parentheses) of rock crab in the directed fishery by year and by Lobster Fishing Area, 2000 to 2017. The maximum value of the time series in each LFA is shown in bold. Data for 2017 are preliminary. The median is calculated over the time period 2000 to 2017. Years when no fishing activity was recorded are shown as “na”.*

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	<b>12.5</b> (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)	<b>10.6</b> (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	<b>12.5</b> (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	12.1 (0.5)	9.2 (0.5)	14.2 (0.4)	16.3 (0.4)	<b>10.6</b> (4.0)
2012	9.8 (0.4)	7.2 (0.5)	13.9 (0.4)	14.4 (0.3)	5.9 (1.8)
2013	11.1 (0.5)	6.8 (0.4)	14.0 (0.4)	14.0 (0.4)	na
2014	11.1 (0.5)	6.6 (0.6)	13.6 (0.4)	<b>17.5</b> (0.5)	na
2015	12.3 (0.5)	5.3 (0.4)	14.6 (0.4)	11.7 (0.4)	na
2016	12.3 (0.7)	6.5 (0.4)	14.7 (0.4)	14.0 (0.5)	na
2017	12.0 (0.5)	7.0 (0.7)	<b>15.2</b> (0.4)	15.4 (0.4)	na
Median	11.0	7.5	13.7	14.1	na

**Attainment of individual allocation in the directed fishery**

In the LFAs with recorded landings in 2017, less than half of active licence holders landed 90% or more of their individual allocation (Table 5). In 2017, the percentages of active licence holders reaching 90% or more of their individual allocation in LFAs 23, 25 and 26A were below the median for the period 2006 to 2017. In LFA 24, the time series is too short for this comparison.

Fewer active licence holders are landing the majority of their allocation but this decrease is likely related to the decrease in the number of fishing trips by individuals (Table 3). Catch rates, while showing inter-annual variability, are not decreasing (Table 4).

*Table 5. Percentages of active rock crab licence holders reaching 90% or more of their individual total allocated landings, by Lobster Fishing Area, for 2006 to 2017. The maximum value of the time series in each LFA is shown in bold. Individual allocations were implemented in 2015 in LFA 24, values in prior years are shown as “nd”. Data for 2017 are preliminary. Years when no fishing activity was recorded are shown as “na”.*

Year	23	24	25	26A	26B
2006	30%	nd	40%	59%	0%
2007	23%	nd	<b>64%</b>	<b>73%</b>	0%
2008	21%	nd	<b>64%</b>	69%	0%
2009	33%	nd	51%	40%	0%
2010	26%	nd	58%	60%	0%
2011	19%	nd	53%	70%	0%
2012	12%	nd	50%	48%	0%
2013	35%	nd	55%	50%	na
2014	22%	nd	42%	69%	na
2015	33%	17%	57%	31%	na
2016	<b>41%</b>	<b>33%</b>	63%	47%	na
2017	17%	29%	40%	42%	na
Median	25%	nd	54%	55%	na

## **Fishery-independent indicator**

### **Rock crab settlement index**

The abundance of rock crabs <16 mm of carapace width was estimated using data from bio-collectors deployed at seven locations around Prince Edward Island and one location in Nova Scotia (Fig. 1). Of the eight locations monitored, three have consistently had very low densities of < 1.5 crabs per m<sup>2</sup>: Egmont Bay in LFA 25, Nine Mile Creek and Wallace, both in LFA 26A. The highest densities are observed at Alberton and Covehead, both in LFA 24 (Fig. 3).

Since 2014, a significant decline in the density of small rock crabs in bio-collectors has been observed at Alberton (LFA 24), from an average of 141.7 crabs per m<sup>2</sup> to 6.3 crabs per m<sup>2</sup> in 2018. Similarly, the average densities of small rock crabs have decreased at Covehead (LFA 24) and Skinner’s Pond (LFA 25), since 2016 and 2015, respectively (Fig. 3). Average densities at the two sites in LFA 26A (Murray Harbour and Fortune) show more variability but densities have also decreased since 2014.

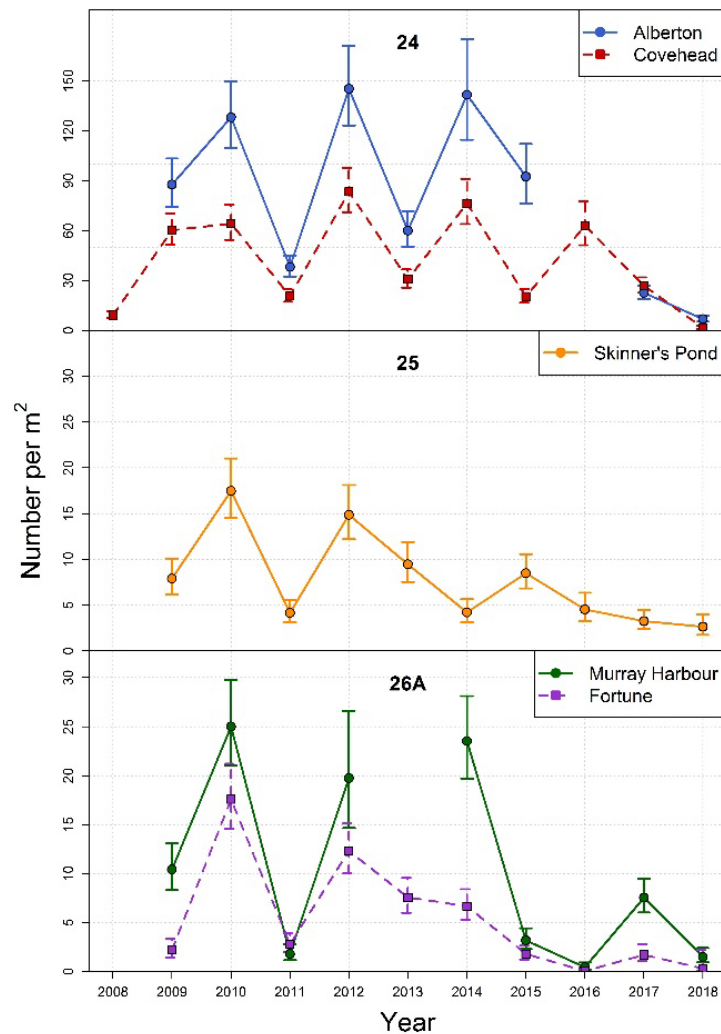


Figure 3. Density (number per m<sup>2</sup>; mean and one standard deviation as vertical lines) of small rock crab (<16 mm carapace width) from bio-collectors at two sites in LFA 24 (top), one site in LFA 25 (middle) and two sites in LFA 26A (bottom), during 2008 or 2009 to 2018.

## Conclusions

Landings from the directed fishery increased during 2015 to 2016 but decreased into 2017 to the lowest level recorded since 2000. This is consistent with the decline in the number of fishing trips over the same time period, with 2017 having the lowest number of trips recorded.

While landings and the number of fishing trips are decreasing, catch rates varied throughout the time series (2000 to 2017) and the highest values are observed in different years according to the LFA. It is unsure whether the recent higher catch rate values observed in LFAs 24 and 25 are a reflection of increases in stock abundance or the result of changes in fishing practices.

Bycatch fisheries landings have decreased and represented 1% of the total landings in 2017. The increase in the size of the escape mechanisms on lobster traps likely reduced the amount of rock crab caught during the lobster fishery. Another possible factor explaining the proportional reduction of reported bycatch landings is the increased use of rock crab as bait in the lobster fishery, for which reporting is not required.

**Gulf Region**

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Contrasting patterns in abundance among sites continue to be observed from the rock crab settlement index. In recent years, a decrease in the density of rock crab settlers has been observed at all sites.

The assessment of the rock crab fishery relies on a limited number of fishery-dependent indicators. Fishery data are obtained through several unrelated processes (e.g. logbooks, sales records) that increase the chance of data errors and result in delays in data availability. Complete, accurate, and timely mandatory logbook entries are required.

Most indicators used in this update were derived from mandatory logbook data and official catch statistics from sale transactions. Observed variations in these indicators may not reflect changes in the rock crab abundance as catch and effort trends could have been influenced by management decisions and market demands. Landings appear to be mainly related to fishing effort and may not reflect changes in biomass.

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### Sources of Information

This Science Response Report results from the Science Response Process of November 23, 2018 on the update of the indicators of the rock crab (*Cancer irroratus*) fishery of the southern Gulf of St. Lawrence. No other publications are expected from this science review process.

DFO. 2013. Assessment of the Rock Crab (*Cancer irroratus*) fishery in the southern Gulf of St. Lawrence for 2006 to 2011. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/030.

DFO. 2017. Update of the fishery indicators for rock crab (*Cancer irroratus*) in the southern Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Sci. Rep. 2016/053.

Rondeau, A., Hanson, J.M., and Comeau, M. 2014. Rock crab, *Cancer irroratus*, fishery and stock status in the southern Gulf of St. Lawrence: LFA 23, 24, 25, 26A and 26B. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/032. vi + 52 p.

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*MPO. 2019. Mise à jour jusqu'en 2017 des indicateurs de la pêche du crabe commun (Cancer irroratus) dans le sud du golfe du Saint-Laurent. Secr. can. de consult. sci. du MPO, Rép. des Sci. 2019/007.*