



#### Background

The deep sea red crab, Chaceon (=Geryon) quinquedens, has a distinctive deep red-orange color. Its body, or carapace, is squarish when viewed from above, the legs are relatively long, and the left and right claws are similar. The red crab is widely distributed in the Atlantic, Pacific and Indian oceans. In Atlantic Canada, the red crab is at the northern edge of its range, and populations are most dense on mud, sand and hard bottoms, in depths of 300 - 900 m and at temperatures between  $5-8^{\circ}$  C. Although red crabs are conspicuous members of the deepwater benthic community on the continental shelf and the slope of the western Atlantic, the ecology and behavior of this crab is poorly understood. Males can reach a carapace width (CW) of about 180 mm and a weight of nearly 1.7 kg, while mature females are smaller, reaching a CW of 136 mm and 0.7 kg. The abdomen of the female changes shape at the size of maturity; its broad bulk serving to shield the extruded eggs. Preliminary research on Canadian red crab found all males over 75 mm CW (of 347 animals sampled) to be mature. While egg-bearing females of 75 mm CW were noted, some females (of 423 sampled) were still virgin at 94 mm CW. Egg-bearing females are present year-round off New England, with a peak incidence in November, and egg hatching most prevalent from January to June. The larvae require 23-125 days to develop through six stages before settling to the bottom and substantial numbers have been collected between Georges Bank and Halifax in coastal waters, and out to 270 km offshore. Settlement is thought to occur at the base of the continental shelf. Immediate upslope migration to warmer water  $(>6^{\circ}C)$  likely occurs to enhance growth rates. Laboratory studies suggest that the red crab would require 5-6 yrs to attain 114 mm CW.

#### DFO Science Stock Status Report C3-11



### The Fishery

The fishery began in the late 1960's when intermittent commercial trapping took place off Nova Scotia. Historical catch records are sparse and probably do not reflect actual landings. Fishing ceased in the mid-1970's due to unfavorable economic conditions. In 1984, by-catch of red crab was allowed in a pilot Jonah crab fishery, and two large vessels subsequently directed for red crab during 1984 and 1985. A TAC of 1,300 t was set in 1984, based on 50% exploitation of the commercial biomass greater than 115 mm carapace width. The commercial biomass was estimated from a research trapping survey which used "effective fishing area" techniques to expand trap catch rates and crab size distribution, to crab population abundances.

Commercial **landings** during 1984 and 1985 were 120 t and 468 t respectively, landed from the LaHave Bank area.



Due to low profitability the fishery stopped in 1985, and no further activity occurred until 1993, when a small one-vessel experimental fishery landed 31 t.

#### **Annual Landings (tonnes)**

Total	31	345	734	683	240
TAC	1300	1300	1300	1300	1300
	1993	1994	1995	1996	1997*

\* preliminary to August 31, 1997

Three exploratory licenses were issued in 1994, the fishing area expanded to include the area adjacent to Baccaro and Browns banks to 64°30"W, and 345 t were landed. Starting in 1995, five vessels have been active, and the fishery has expanded to Georges Bank. Landings increased to 734 t and 683 t in 1995 and 1996. However, cumulative landings in 1997 (at 240 t to August 31, 1997) are less than half those experienced to the same date in 1995 and 1996 (at 46% and 48%, respectively). Cumulative fishing effort (at 54,737 trap hauls to August 31, 1997) is also lower than in 1995 and 1996, at 70% and 59%.

A shift in landings between the five offshore fishing grounds, noted in the 1996 assessment, has continued in 1997. Landings from LaHave Bank, which was the initial exploration target of when fishing recommenced in 1993, have fallen progressively from 1995 to 1997, whereas Georges Bank has seen a major increase in fishing activity. Emerald Bank remains the principal fishing area. No landings have been reported from Western-Sable Island Bank since June 1995.

Relative Distribution of Landings by Fishing Area

Year	Georges Bank	Browns Bank	LaHave Bank	Emerald Bank
1995	9%	18%	32%	40%
1996	30%	15%	23%	32%
1997*	33%	13%	7%	47%

\* preliminary to Aug 31, 1997

Currently, there are five exploratory licenses. The fishery is 100% dockside monitored and is managed by size and effort controls, under the original TAC. There is a 100 mm CW minimum size and a prohibition on landing females. The trap limit per license is 450 tagged traps. Offshore lobster traps are used, fixed with an escape vent and a degradable panel. The fishing grounds extend from the U.S.-Canadian boundary on Georges Bank to the eastern boundary of NAFO area 4W, in depths greater than 370 m (200 f).

### **Resource** status

The offshore red crab fishing grounds are now fully exploited with evidence of stock depletion on offshore banks with the longest catch series. This evaluation is based on examination of monthly landings and catch rates from log books, sales slips and dockside monitoring documents, together with sampling of commercial catch length frequencies.

**Catch rates** (CPUE) decreased from the high rates of up to 20 kg per trap haul (kg/th) experienced during initial explorations of offshore fishing areas in 1984, and at the start of the current developing fishery, but appeared to have stabilized in recent years at between 5-10 kg/th. Conversely, total effort has increased, particularly in 1995 and 1996, where between 10,000-20,000 trap hauls were made monthly in the spring (April-July), as compared to approximately 5,000 trap hauls per month during 1985, and again in 1993. However, these aggregate CPUE values were strengthened by higher CPUE's as Browns, and Georges banks were subjected to exploitation, from May 1995, and August, 1995, respectively.

During 1997, monthly CPUE's from each bank have been below 6 kg/th (with two exceptions), and in the period April to July, minimum CPUE's of 2.22, 2.85, and 2.54 kg/th were obtained on Browns, LaHave, and Emerald banks



The initial biomass estimate, and derivation of TAC did not include Georges Bank, and the relevance of that assessment, conducted over ten years ago, is problematic. If landings from Georges Bank are not considered, expanded levels of fishing effort in the areas of initial biomass estimation have not yielded landings anywhere close to the original quota. Based on earlier resource surveys and initial catch rates on LaHave Bank, it is known that red crab will enter traps in high numbers, so these lower annual landings and

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CPUE's reflect monthly may lower population abundance. Research on red crab fisheries in South Africa suggests that "effective fishing area" trap survey approaches may over-estimate biomass. compared to survey techniques such as underwater photographic and video transects, or mark-recapture programs

**Biological sampling** of the red crab fishery in 1997 has emphasised cooperative studies with industry on reproductive biology and some limited sea sampling coverage.

Samples of red crab were obtained four times from December 1996 to June 1997. representing 770 animals in total (347 males; 423 females) to estimate size-at-maturity. All males over 74 mm CW were mature. The smallest female carrying eggs was 75 mm CW, whereas some females were still in a virgin condition at 94 mm CW. Additional samples of both male and female crab are required before size at 50% maturity (commonly used in crustacean stock assessment) can be determined. Importantly, these preliminary analyses have suggested that there may be a terminal moult in red crab. If this is substantiated, then the exploitation strategy of this species should be modelled after snow crab. In the southern Gulf of St. Lawrence, where reliable biomass estimates are available, exploitation rates on snow crab of around 35% have been found to be sustainable.

**Port sampling** suggests that the average size (median CW) of crab has not declined since the current fishery began. However, crab landed from Emerald and LaHave banks tends to be smaller than that from Georges and Browns banks. Although the current Canadian minimum size limit is 100 mm CW, the percentage of crab between this size and the US measure (114 mm CW) varied from 4% to 47% in port samples. Based on port sampling, it appears that high-grading of the catch may be occurring, reflecting market size-preferences (in relation to the US size measure of 114mm CW). A **combined at-sea and port sample** was obtained in July 1997 from Georges Bank. While at-sea trap samples of males found 39% to be in the size-range 100-114mm, only 12% of the port sample of males was in this size range. Discarding is a concern, as the survival of small, discarded crab is unknown. Because of the great depth (>600m) and narrow width (<1km) of the crab grounds, the survival is probably low.

### Sources of uncertainty

The longest catch series (LaHave Bank; four "years" of fishery data from July 1993) shows progressive reduction and а dampening of seasonal variation in monthly CPUE's. For Emerald Bank and Browns Bank a similar landings pattern may be emerging, but there are only three, and two "years" of landings, respectively. While CPUE's from Georges Bank were substantially lower in Feb-July 1997 (3.7-5.5 kg/th), than in the same period in 1996 (5.1 -11.4 kg/th), CPUE for Aug 1997, at 6 kg/th is the same as that experienced in 1995 and 1996.



Determining resource status based on trends in catch rates is problematic, as there are a number of factors which influence catch rates. Industry representatives indicate that gear conflicts were experienced with the swordfish longline fishery in 1997 which led to changes in fishing practices (longer soak times). Discarding of male crab 100-115mm carapace width is based on market preference for larger crab, which may change from year to year. Catch rate data from logbooks which document landed catch do not include discards and are therefore biased downwards.

## Outlook

The existing fishery does not appear to be viable with the current level of fishing effort, and conversion to a permanent fishery is considered premature for the 1998 season. These factors suggest that management should continue to take a cautious approach:

- The offshore red crab fishing zone is very narrow (380 - 760m), and all known commercial grounds are now fully exploited. Catch rates have declined since the inception of the fishery in 1984, and the reduced landings and CPUE's in 1997 suggest that red crab on Browns, LaHave, and Emerald banks may be depleted.
- The initial TAC set for the exploratory phase of the fishery has never been met and may reflect unrealistic initial assumptions about available commercial biomass. Current year landings (to August 31) are 240 t, only 46%, and 48% the level of landings to the same date in 1995 and 1996. Landings from Georges Bank, which was not included in the initial biomass estimate, represent 33% of 1997 landings to date.
- The rapid expansion of effort and landings from Georges Bank was noted as a concern in last year's assessment. Although there was a reduction in monthly CPUE from Georges Bank early in 1997, CPUE for August is comparable with two earlier years. As the southernmost population available for Canadian exploitation, there may be greater potential for recruitment from U.S. waters.

- The present minimum size was derived from studies undertaken in the southern portion of the red crab's range. Preliminary data on female maturity on Canadian grounds indicates that the minimum size for males should be raised to ensure that large males are available to female red crab, some of which may not be mated until 95 mm CW. Additionally, red crab may exhibit a terminal moult based on initial analysis of male crab. Males smaller than 115mm may be functionally immature and should be protected.
- Recent landings, port and (limited) at-sea sampling indicate a market preference for crab larger than 100 mm CW, the current minimum size. Raising the minimum size in 1998 to 115 mm CW would be a prudent interim stock conservation measure until reproductive studies on red crab are completed. This increase would be best implemented by modifications to crab traps (via escape vents).
- In light of the declining catch rates in all areas, and likely changes in management strategy if terminal moult is confirmed in red crab, the current TAC is considered to be too high. The TAC was set initially at 50% of the estimated exploitable biomass (which of itself was likely an overestimate). There is a lot of uncertainty about the size of the resource and on the appropriate exploitation rate. As a conservation measure, the 1998 TAC should be reduced to at least the level of current catches, 650 t. There is no rationale at present for apportioning the TAC by fishing banks.

# For More Information

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# References

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