**Stock Status, Trends and Recent Survey Issues**

Stock status is assessed from various abundance and biomass indices calculated using kriging with external drift (KED) with depth as a secondary variable (DFO 2012a; Wade et al. 2014) applied to standardized survey catches (numbers or weights per trawl swept area). Commercial crab biomass (legal-sized adult males) was sub-divided by residual biomass (hard-shelled adult males of legal size remaining after the fishery) and recruitment biomass (soft-shelled adult males >= 95 mm CW referred to as R-1 that will be available to the fishery the following fishing season). Predictors of four- three- and two-year fishery recruitment indices are also estimated, referred to as R-4, R-3 and R-2, respectively. A population recruitment index is estimated from survey catches of small male crabs (34-44 mm CW), which take at least six years to reach the commercial size.

The change in survey vessel in 2019 was accompanied by significant increases of 30-40% among male crab from 35mm to 95 mm CW and mature female crab (Figure 5). These catch increases strongly suggest an increase in survey catchability, as natural processes such as recruitment, migration or low mortality cannot account for these increases over such a broad size range. Investigations suggested that an increase of unaccounted bottom trawling during the hauling of the net, referred to as the passive trawling phase, partially accounted for ~12% of the increase (Ref). Measures to control the passive phase during the 2020 survey only resulted in a modest 5-10% catch decrease in the above groups.

In contrast, commercial sized-crab abundance and biomass remained at stable levels over the same period (2018-2020). However, uncertainty around the mechanisms underlying the catchability increase among sub-legals, plus the complex dynamics of the commercial stock, means that quantifying their impact on the commercial component is difficult to resolve. Hypotheses were proposed to explain this apparent stability of the commercial index of the crab stock despite the survey catchability increases seen among sub-legal crab. Among the probable hypotheses are 1) a strong increase in commercial-sized crab mortality in 2019 and 2020 that counterbalanced a survey catch increase among commercial crab that would otherwise have been observed; and 2) that survey catchability increases are size-dependent and strongly focused on sub-legal sizes. Other proposed hypotheses were large-scale crab migration, or increases in catchability located in areas of high female and sub-legal male abundance. However, neither of these hypotheses can account for the strength of the increases, nor their restricted association with sub-legal sizes.

Two indirect methods of estimating the bias on the commercial stock were proposed. One was a classical Leslie analysis, which estimated pre-fishery biomass based upon trends in observed weekly fishery CPUEs, and the other based on the difference between the 2020 residual biomass and its predicted value based on 2020 landings and the 2019 total commercial biomass with a 30% annual mortality. Estimated overestimation biases for 2020 were estimated 14.X% using the Leslie analysis and X% using the residual biomass method, relative to 2018….

In summary, all sub-legal abundance indices for 2019 and 2020 are over-estimated by 30-40%, while indirect methods suggest commercial-sized crab are over-estimated by approximately X%. These uncertainties will be considered in the conclusions and risk analysis, though corrections will not be directly applied, unless otherwise stated.

The uncorrected biomass of commercial-sized adult males in the sGSL from the 2020 trawl survey was estimated at 77,748 t (Table 6; Figure 6). The estimated recruitment to the fishery at the time of the 2020 survey represented 75% of the commercial biomass estimate. The remaining 25% is the residual biomass estimate, at 58,438 t, comprising 75% of the commercial biomass (Table 6; Figure 6). The recruitment to the fishery in 2020 is similar to the 2019 estimate. The residual biomass (carapace conditions 3 to 5) of commercial-sized adult male crabs after the 2020 fishery was estimated at 19,107 t, a decrease of 5.8% compared to the 2019 estimate (Table 6; Figure 5).

In contrast, commercial sized-crab remained at similar levels over the same period (2018-2020). The behavior of the trawl during the passive trawling phase, in contrast to regular trawling, is not well characterized. The uncertainty surrounding the mechanisms underlying the catchability among sub-legals, plus the complex dynamics of the commercial stock, mean that quantifying their impact on the commercial component was difficult to resolve.

Two indirect methods of estimating the bias on the commercial stock were proposed. One was a classical Leslie analysis, which estimated pre-fishery biomass based upon trends in observed weekly fishery CPUEs, and the other based on the difference between the 2020 residual biomass and its predicted value based on 2020 landings and the 2019 total commercial biomass with a 30% annual mortality. Estimated overestimation biases for 2020 were estimated 14.X% using the Leslie analysis and X% using the residual biomass method, relative to 2018….

A 30-40% jump in abundance of sub-legal males (35-95 mm) and a 40% jump in females in 2019 compared to 2018. Green and blue bars and lines show immature and mature crab densities for 2018, respectively. Light and dark grey bars show immature and mature crab densities for 2019.

|  |  |
| --- | --- |
| Macintosh HD:Users:crustacean:Desktop:Stock-Assessment-2020:size-frequencies 2018-2019 - males - english.pdf | Macintosh HD:Users:crustacean:Desktop:Stock-Assessment-2020:size-frequencies 2018-2019 - females - english.pdf |
| Figure 5. Comparison of average size-frequencies from the 2018 (lines) and 2019 (grey bars) snow crab surveys for male (left panel) and female (right panel) snow crab. Vertical dash red line indicates the 95 mm CW legal size. | |