

Deep sea red crab; Appendix 1

Red crab size composition analysis

Based on the ratio of minimum mature size, and ratio of mean size in 1974, we assume that males must be at least 25% larger than females to mate successfully (alternative assumptions could be explored). This analysis examines the impact of the fishery on the size structure of the population, specifically with regard to the ratio of number of males to the number of females small enough for the males to fertilize.

Direct analysis of survey results has the benefit of being able to explore the sex ratio in terms of observed densities of crabs, but lacks the ability to interpret those results in terms of a reference point of no fishing. It may be possible to interpret the 1974 survey as representing size distributions under light fishing, so that 1974 could serve directly as a reference distribution.

Direct analysis of survey densities

Table 1a shows summary statistics of mature red crabs from the 1974 and 2003-2005 surveys. Females are assumed to mature at 70mm, and males at 90mm. The densities of mature male crabs per 30-minute tow declined slightly, but the density of female crabs increased substantially in the later survey. This poses some difficulty for interpretation, with the main hypotheses being that it is due to imprecision (including differences in survey locations—all this needs to be explored), or alternatively that it is due to exploitation effects on a population that otherwise would have been more abundant in the later period. If the 1974 ratio of males to females is applied to the density of females in 2003-2005, the expected male density would have been approximately 30, in which case the relatively low observed value of 15 is presumably due to exploitation effects. Mean size of females is similar in the two surveys, but mean size of males declined as would be expected from exploitation effects including a shift of minimum marketable size from 114mm to 90mm. By tabulating the sum of densities of females smaller than the minimum sized female each male size class is capable of mating with, table 1a below shows the mean number of females available to the males, weighted by the size frequency of males. In order to maintain a similar level of fertilization, the average male in 2003-2005 must mate with 2.33 times the number of females that it did in 1974. If the 1974 size composition already showed exploitation effects, the population impact is greater than is shown in table 1a.

Table 1a. Summary of size composition analysis.

Survey date	1974		2003-2005	
	males	females	males	females
Size at maturity (mm)	90	70	90	70
total density (n per 30-min tow)	17.2	17.8	15.0	31.3
mean size of mature crabs (mm)	113.8	94.1	105.7	95.1
mean ratio of size-dependent available females to males		25.3		58.9