

A Study of Golden King Crab Commercial Fishing Gear Selectivity in the Aleutian Islands after Crab Rationalization



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Objective

Directly estimate the size-selectivity of male golden king crab *Lithodes aequispinus* by pot fishing gear as it is currently fished in the rationalized Aleutian Islands (AI) commercial fishery.



Figure 1. Crewmen aboard the *F/V Aleutian No. 1* emptying catch from a commercial king crab pot fished during the 2012/13 Aleutian Islands golden king crab fishery season. Note the larger sized escape mesh on the pot door which they hold flipped up to release crab.

Background

Commercial king crab fisheries in Alaska are prosecuted with traps (pots, Figure 1) and only males of a minimum legal size may be retained for harvest. One intended benefit of the Bering Sea/Aleutian Islands Crab Rationalization Program was to foster fishing practices to reduce bycatch of nonretained females and sublegal-sized males. Following rationalization of the AI golden king crab commercial fishery in the 2005/06 season, a reduction in the bycatch of nonretained crab has, in fact, occurred (Figure 2).

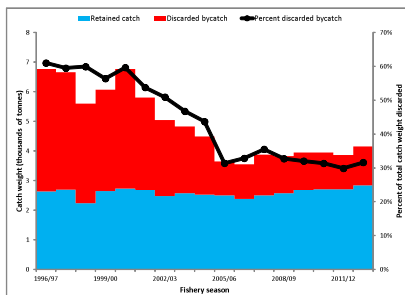


Figure 2. Retained catch and discarded bycatch of female and sublegal-sized male golden king crab in the Aleutian Islands golden king crab fishery, 1996/97–2012/13.

Males captured by the fishery showed a notable shift to larger crab after rationalization; sublegal males accounted for 31–46% of the biomass of males captured during 1996/97–2004/05 and 16–21% during 2005/06–2012/13. Reasons cited for those trends include the use of increased soak times (Figure 3) and of more extensive coverage of escape mesh on pots since rationalization of the fishery. It has been unclear, however, what role such changes in fishing practices and gear, as opposed to changes in areas fished or changes in population size composition, have played in effecting bycatch reduction since rationalization of the fishery.

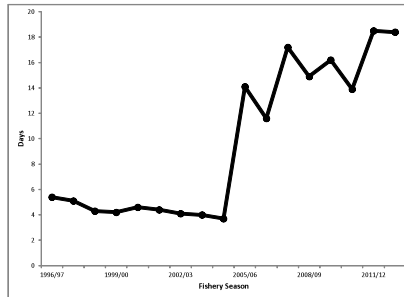


Figure 3. Average soak time (days) of pots fished in the Aleutian Islands golden king crab fishery east of 174° W longitude, 1996/97–2012/13.

Methods

Research pots were set and fished within the longlined strings of the pots commercially fished by a commercial fishing vessel, the *F/V Aleutian No. 1*, during the 2012/13 AI golden king crab fishery season. The research pots were webbed with 64 mm stretched-mesh and lacked the escape mechanisms (rings or large mesh) required in regulation for commercial pots. The pots commercially fished by the *F/V Aleutian No. 1* exceeded the minimum requirements for escape mechanisms, typically with 229 mm stretched mesh webbing installed on all of one vertical surface and on the sides and tops of the pot tunnels. One research pot, baited the same as the commercial fishing pots, was set in a random position within each of 31 longlined strings of 30–50 commercial pots fished by the *F/V Aleutian No. 1*. Data were collected on the size and sex of all golden king crab captured in the research pot and in the next commercial pot hauled in the string (the paired commercial fishing pot).



We estimated the logistic selection curve for male golden king crab of size l by the commercial fishing pots,

$$S(l) = \frac{e^{(a-b/l)}}{1 + e^{(a-b/l)}}$$

according to the methods of Millar and Fryer (1999). Approximate 95% confidence intervals for the selection curve parameters were estimated from the bootstrap distribution of statistics. In the context of our study, selection at size l is the probability that a crab of size l that has entered a pot is still retained by the pot when it is hauled on board the fishing vessel.

Results

Catch of golden king crab was higher in the 31 research pots (R) than in the 31 paired commercial fishing pots (C; Table 1). The within-pot-pair differences in catch were statistically significant ($P < 0.05$, 1-sided t-test and 1-sided Wilcoxon signed rank test) for each of 3 defined sublegal male size classes and for females, but were not for legal males.

Table 1. Catch of golden king crab by sex-size classes in 31 research (R) pots and 31 paired commercial-fishing (C) pots.

	Pot Type		
	C	R	Total
Males	1,477	3,615	5,092
Legal	1,172	1,378	2,550
Sublegal	305	2,237	2,542
<101 mm CL	4	479	483
101–120 mm CL	25	796	821
>120 mm CL	276	962	1,238
Females	286	2,524	2,810
Mature	268	1,785	2,053
Immature	17	733	750
Unknown sex	0	6	7
Total	1,763	6,146	7,909

The size frequency distribution of males captured by commercial fishing pots was similar to those from the rationalized commercial seasons; the size frequency distribution of males in research pots was more similar to earlier prerationalized seasons (Figure 4).

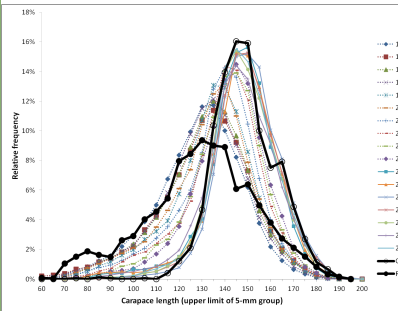


Figure 4. Relative size frequency distribution of male golden king crab in 31 research (R) and 31 paired commercial fishing (C) pots, with comparison to size frequency distributions from the 1996/97–2011/12 commercial fishery seasons.

The 31 research pots captured more than 9 times as many females as did the 31 paired commercial fishing pots; 71% of the females captured by the research pots were reproductively mature (Table 1). From the fitted selection curve (Figure 5 and inset table), we estimated that the size at 50% probability of retention for males by the pots fished during the current commercial fishery is 135 mm CL—i.e., comparable to the 136 mm CL that is used as a proxy for the minimum legal size defined by carapace width. Estimated probability of retention of males by commercial pots decreases steeply from 50% at 135 mm CL to 25% at 128 mm CL.

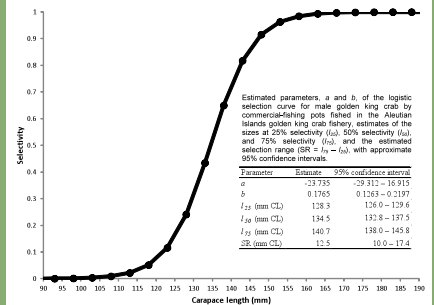


Figure 5. Estimated selectivity curve for male golden king crab by commercial pots fished in the rationalized Aleutian Islands golden king crab fishery.

Conclusion

The pots fished at the soak times used in the rationalized AI commercial golden king crab fishery are highly effective in reducing retention and bycatch of females and sublegal males. Results suggest that the reduction in bycatch that occurred with fishery rationalization is largely attributable to increased soak times and increased coverage of escape mesh on pots.

References

Millar, R. B., and R. J. Fryer. 1999. Estimating the size-selection curves of towed gears, traps, nets and hooks. *Reviews in Fish Biology and Fisheries* 9:89–116.

Acknowledgements

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