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INJURY AND APPARENT MORTALITY RATES FROM INCIDENTAL TRAWL CATCHES OF HALIBUT, KING CRAB, AND TANNER CRAB IN THE KODIAK AREA, 1978-81

By: Jim Blackburn and Dana Schmidt

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Alaska Department of Fish and Game
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INTRODUCTION

At the present time the stocks of red king crab in the Kodiak area are extremely low. There has been no fishery since 1983 and there is concern for stock recovery. This problem has resulted in regulations on the trawl fishery to minimize incidental catch of king crab, Tanner crab, and halibut. This report summarizes available observations on the condition of red king crab (Paralithodes camtschatica), Tanner crab (Chionoecetes bairdi), and halibut (Hippoglossus stenolepis) when captured by trawl.

METHODS

Alaska Department of Fish and Game observers made trips on domestic trawl vessels which were fishing in the Kodiak area, sorting their catch on deck and delivering to shore based processing plants. Since 1978, observers sampled the catch to obtain estimates of total incidental catch of prohibited species and species composition of the catch. Between 1978 and 1981 observers also recorded the apparent viability, using the criteria in Table 1, of samples of crab and halibut that were caught. All samples were taken in the normal course of fishing without special actions or precautions by the vessel crew; thus the samples represent conditions in the commercial fishery. A maximum of 20 individual halibut and crab of each species were taken from each haul; the size and viability were recorded for each individual in the

sample. Occasional variation from this procedure included general statements of percent viability. On the first few observer trips animals were classed only as dead versus alive.

Table 1. Viability codes used by Alaska Department of Fish and Game groundfish observers for evaluating the condition of prohibited species caught incidentally in the trawl fishery.

Code	Description
Crab Viability Codes	
1	No external injuries, vigorous movement of legs.
2	No external injuries, weak movement of legs or movements of only the mouth parts.
3	External injury, legs missing or injured but with vigorous movements.
4	External injury, legs missing or injured with weak movements of legs or movement of mouthparts only.
5	Cracked carapace or no movement, dead.
Halibut Viability Codes (after Hoag, 1975)	
1	Excellent : vigorous body movement before or after release; could close the operculum tightly, minor external injuries if any.
2	Good : feeble body movements; could close operculum tightly, minor injuries if any.
3	Fair : no body movements; could close operculum tightly; minor external injuries if any.
4	Poor : no body movement; could move the operculum but not close it tightly, severe injuries (bleeding).
5	Dead : no body or opercular movement.

Note: Salmon were considered killed by capture and were not systematically recorded. All that were recorded were dead.

The condition of animals sampled by observers represents the condition as they came from the net and does not reflect effects of time on deck, sorting, or delayed mortality caused by injuries.

Since data were recorded in two different ways, they were tabulated for this report into six classifications: alive (when only alive/dead were recorded) plus the five categories in Table 1. The data were expanded into numbers of animals caught in each of the six condition categories before summaries were made.

Several different tests of statistical significance were used on the data. Some significance tests were conducted by separating the sampled hauls into two groups, hauls with dead animals present versus hauls without dead animals. The Wilcoxon rank sum test of a common mean (Connover, 1980, p 217) among samples was used when the attribute of interest was a continuous variable such as total catch weight. A Chi-Square test was used when the attribute of interest was a class such as season or observer. Significance tests were also performed on estimated numbers of animals dead versus estimated numbers alive. Chi-square tests were used for these, and when the table was a two by two classification, a finite population correction factor was used.

RESULTS

There were 221 hauls in which viability of king crab, Tanner crab, or halibut was assessed. In these hauls red king crab occurred in 68, Tanner crab in 144, and halibut in 170 (Table 2).

Table 2. Summary of data collected on viability of king crab, Tanner crab, and halibut in the Kodiak area by Alaska Department of Fish and Game groundfish observers on trawl vessels during 1978 through 1981.

	King Crab				
	Molting*	Hard Shell	Total	Tanner Crab	Halibut
# samples with viability assessed	10	58	68	144	170
# samples with dead animals	10	8	18	78	84
Condition 1-4 (alive)					
No Animals	1,301	1,746	3,047	35,570	2,601
Percent	78.9%	98.8%	89.2%	82.8%	79.3%
Condition 5 (dead)					
No Animals	348	21	368	7,386	679
Percent	21.1%	1.2%	10.8%	17.2%	20.7%
Total Number	1,649	1,768	3,416	42,955	3,280

* Note: One trip in Viekoda Bay between 30 April and 4 May 1978 yielded large numbers of softshell (molting) king crab on every haul. These were the only tows in which softshell king crab were caught in large numbers and the only tows made in this bay. Only five other crab were recorded as being softshell. Since these tows are unique in shell condition of crab captured, mortality rate observed, and location fished; they are separated from the other tows to more accurately reflect the data collected.

King Crab

Mortality of hardshell king crab averaged 1.2 % overall (Table 2). Large numbers of king crab were caught in soft shell condition in 10 hauls in Viekoda Bay between 30 April and 4 May 1978. These 10 hauls were unique;

they were the only tows with large numbers of softshell king crab, the only tows observed in Viekoda Bay, and the only tows with high mortality of king crab. These tows are probably representative of what may occur when softshell king crab are caught, but the relative frequency of occurrence of such tows in the fishery is not necessarily reflected accurately by the frequency in these samples (in other words it is inappropriate to project that 10 trawls out of 221 made by the fishery are made on molting king crab). In these hauls the observer recorded percent mortality which ranged from 10% to 50%, averaging 21% (Table 2).

The hauls in which observers used all five of the condition categories in classification of hardshell king crab provide an indication of the proportion injured but alive: in condition 1 were 98.0% (1,689 of 1,723 king crab), in condition 2 were 0.3% (5 of 1,723), in condition 3 were 0.2% (4 of 1,723), in condition 4 were 0.6% (11 of 1,723), and in condition 5 (dead) were 0.8% (14 of 1,723).

Tanner Crab

Mortality of Tanner crab averaged 17% overall. One haul had an estimated 20,430 juvenile Tanner crab that weighed an estimated 1,000 pounds. These were all very small crab, described by the observer as in a ball or single mass, and due to its large size and the small crab, a high proportion were dead. Eighteen of these crab were examined by the observer four of which

were considered dead, four were in fair condition and 10 were in excellent condition. The presence of this extremely large catch with a high mortality rate may bias estimates of mortality. Average mortality of Tanner crab, excluding this catch, was 12.6%.

Estimated percentages of Tanner crab by condition category from hauls where all five condition categories were used by the observers are: condition 1, 63.9%; condition 2, 2.3%; condition 3, 14.9%; condition 4, 0.8%; and condition 5, 18.7%.

Halibut

The mortality of halibut over all hauls examined was 21%.

Estimated percentages of halibut by condition category from hauls where all five condition categories were used by the observers were: condition 1, 76.4 condition 2, 2.3%; condition 3, 0.5%; condition 4, 0.1%; and condition 5, 20.7%.

Seasonality of Mortality

Due to the infrequent occurrence of king crab in the catches, only two time periods were separated for study of seasonality effects. During the 16 June through 14 February time period 0.9% (14 of 1549) of the king crab captured were in condition 5 (dead). During the 15 February through 15 June time period 19.0% (355 of 1867) of the king crab captured were dead (Table 3).

Table 3. Number and percent of king crab by condition, area caught, and time of year, as assessed by Alaska Department of Fish and Game groundfish observers when captured by commercial trawl vessels in the Kodiak area, 1978-81.

Time of Year	-Number of Tows- Total	With Dead	--Number of Crab-- Alive	Dead	Total	--Percent-- Alive	Dead
15 Feb - 15 June	39	14	1,513	355	1,867	81.0	19.0
16 Jun - 14 Feb	29	4	1,535	14	1,549	99.1	0.9
Total	68	18	3,047	369	3,416	89.2	10.8

The condition of Tanner crab by quarter year is presented in Table 4. There is no significant seasonality in the frequency of occurrence of dead Tanner crab in individual hauls (Chi-Square = 5.85, 3 df, p=0.13).

There is no significant seasonal trend in presence of dead halibut in catches (Chi-Square = 0.494, 2 df, p>0.75).

Table 4. Number and percent of Tanner crab by condition and quarter year, as assessed by Alaska Department of Fish and Game groundfish observers when captured by commercial trawl vessels in the Kodiak area, 1978-81.

Quarter Year	-Number of Tows- Total	With Dead	--Number of Crab-- Alive	Dead	Total	--Percent-- Alive	Dead
1	39	23	4,956	374	5,330	93.0	7.0
2	75	42	13,705	2,332	16,037	85.5	14.5
3	15	11	16,161	4,615	20,776	77.8	22.2
4	15	2	765	65	830	92.2	7.8
Total	144	78	35,587	7,386	42,973	82.8	17.2

Note: Numeric totals vary slightly due to rounding.

Differences by Total Catch Weight

The total catch (sum of the weight of everything in the catch) may be related to the rate of mortality of incidental species.

The hauls in which dead king crab occurred had total catches (total weight of everything caught) which were significantly lower than average (Wilcoxon rank sum test of a common mean, $T = 2.856$ ($p<0.005$)).

There was no significant relationship between total catch weight and mortality of halibut (Wilcoxon $T= .14$, $p=.89$), or of Tanner crab (Wilcoxon $T=.15$, $p=.88$).

DISCUSSION

An important limitation of the data reported here is the lack of experimental determination of actual survival related to the apparent condition. Animals which appear to be dead may survive and those that appear alive may die after release. Despite these limitations, several features can be clearly stated.

A small proportion (3% in this study) of hardshell king crab appeared either dead or injured. INPFC (1956) reported 1.6% (427 dead of 26,271 caught) mortality in a study of survival of king crab captured by trawl. Hard shell red king crab were the least susceptible to damage among the species examined. Softshell king crab were much more susceptible to damage; our observer reported 21% mortality and INPFC (1956) reported 32% (236 dead of 729 caught). In this study, this represents an 18-fold difference in mortality rates between molting and non-molting crab.

This study is limited in that the observer data reflects a very limited sample of the trawl fleet during this period. The relative viability differences observed between seasons and between species are highly likely to reflect the general trend in mortality that is incurred by the fleet. The mortality rates are probably lower than what actually occurred, because the procedures used did not account for any delayed mortality related to sorting, deck time, or injuries. The higher catch rates of crab often occurred in very restricted areas, reflecting the particularly high degree of aggregation exhibited by this species.

There does appear to be major seasonal differences in the mortality rate of red king crab, apparently associated with molting. This did not appear to be true with Tanner crab or halibut. Both of these species exhibited a higher mortality rate than hard shell king crab.

LITERATURE CITED

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