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COMPARISON OF CATCHER-PROCESSOR VESSEL AND CATCHER VESSEL FISHING PERFORMANCE IN THE 1989 BERING SEA RED KING CRAB FISHERY

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Abstract

This report is the third in a series, evaluating differences in catch rates between catcher processors and catcher vessels in the Bering Sea red king crab fishery. During the 1988 and 1989 Bristol Bay red king crab fishery, on-board observers were placed on catcher-processor vessels. In the 1989 fishery, the average pounds landed per catcher vessel was approximately 59,000 compared with an average of approximately 72,000 for the catcher-processor vessels when comparisons of vessels of similar sizes were made (130 ft-170 ft). The landing rate was 56 pounds per pot-lift versus 47 pounds per pot-lift respectively. In 1989 as in 1988, the pounds landed per pot-lift, and pounds landed per number of registered pots by catcher-processor vessels were not significantly larger than the catcher vessels but differences in these rates were highly significant in 1987. We conclude that the observer program which was instituted in the 1988 and 1989 fishery remains the primary factor contributing to the similarity in the catch per unit effort reported by the catcher fleet and the catcher-processor fleet. There does appear to be a shift in CPUE between the past two years, although not statistically significant. Continued vigilance is warranted to insure that observers remain effective in deterring undersized processing.

Introduction

This report is a continuation of previous examinations of the differences in catch rates observed between catcher-processor vessels and catcher vessels participating in the Bristol Bay red king crab fishery. The previous reports, hereafter referred to as the 1987 Report or the 1988 Report[2], addressed differences between the 1987 and 1988 fisheries. This observer program was first implemented during the 1988 Bristol Bay red king crab fishery. The differences in catch rates reported in the 1987 Report was one of the factors considered by the Board of Fisheries in establishing the mandatory observer program. This report addresses the catch rates observed between the catcher-processor fleet and the catcher fleet during the 1989 fishery and compares these results with the 1988 Report.

The number of catcher-processor vessels that participated in recent Bristol Bay red king crab fishery was similar to the previous year with 18 participating catcher-processor vessels in 1989 as compared with 20 in 1988.

This report examines apparent differences in catch rates between the catcher-processor vessels and catcher vessels in the 1989 fishery. Because of the high number of observers that were decertified, the effectiveness of the program as a deterrence to processing sub-legal animals has been questioned. The vessel size, the number of pots registered, and the number of pots lifted are examined in this report, similar to the 1988 Report. Because of the area manager's observation of potentially more pots being fished by catcher-processor vessels, and consequently, increased soak times, we have examined the number of pot-lifts closer by comparing them with the number of pots registered. The use of numbers of pots registered provides an alternative method of examining the effective amount of effort of a given vessel and coupled with pot-lift data, soak time effects on catch per unit effort (CPUE) can be evaluated. Catch per unit effort was projected by using the reported number of pot-lifts and the number of pots registered as the effort.

Therefore, the objective of this analysis is to determine if the pounds landed and the CPUE were significantly different for the catcher-processor vessels in the fishery held during September 1989 and to determine if on-board observers remained effective. If CPUE differences occurred, we examined if these differences can be explained by known differences between the two types of vessels or changes in soak time.

Methods

The methods used are the same as those reported in the 1988 Report. The data used in this analysis were obtained from the fish tickets and vessel registration forms. For catcher-processor vessels, a single fish ticket was usually submitted for the entire season, although on

[2]Schmidt, D. and B. A. Johnson. 1988. A Comparison of Catcher-Processor and Catcher Vessel Fishing Performance in the 1987 Bering Sea Red King Crab Fishery. Regional Information Report No. 4K88–14. Alaska Department of Fish and Game, Division of Commercial Fisheries, Kodiak.
Schmidt, D. and B. A. Johnson. 1989. A Comparison of Catcher-Processor and Catcher Vessel Fishing Performance in the 1988 Bering Sea Red King Crab Fishery. Regional Information Report No. 4K89–1. Alaska Department of Fish and Game, Division of Commercial Fisheries, Kodiak.

longer fisheries, a fish ticket is completed weekly. For catcher vessels, a ticket is completed at each landing. The basic data from the fish tickets consisted of pounds landed, number of crab landed, and number of pot-lifts. The basic data from the vessel registration forms consisted of numbers of pots registered and length of vessel. The data resolution is that of vessel, i.e. multiple fish tickets were combined for a single vessel.

For testing differences in means we used the non-parametric test that was used in the 1987 and 1988 Reports. The test used in known as the Mann-Whitney or Wilcoxon rank sum test (Conover 1980).

A graphical method was used to locate differences in the sampling distributions of these data. The quantile-quantile plot or Q-Q plot (Chambers et al. 1983, Hoaglin et al. 1983, and Gnanadesikan 1977) can be used to determine if a sample distribution is similar to some other distribution. The analysis of distributional differences was necessary because we could easily have had a segment of the catcher-processor fleet that landed crab at normal or sub-normal rates, while another segment of the catcher-processor fleet that experienced very high landing rates. Differences in means may be very minor in this case, but distributional differences could be very large. Because the distributional patterns did not show any patterns not observed in the 1988 and 1987 Reports, the plots were not included in this report.

Results

Comparisons of Pounds Landed and CPUE for 1989

All mean values for each variable except the pounds per pot-lift and pounds per pot registered were significantly greater for the catcher-processor vessels as indicated by the test statistics (Table 1). This is identical with the 1988 fishery data.

Table 1.— Test statistics for difference in mean values between catcher-processor vessel (N=18) and catcher vessel (N=193).

	Mean values			
Variable	Catcher vessel	Catcher-processor vessel	Ratio of means	P-value Wilcoxon test
Pounds landed	46276	74085	1.60	<0.01
Number of pot-lifts	957	1296	1.35	<0.01
Pounds per pot-lift	50.0	55.0	1.10	0.10
Number of pots registered	248	388	1.56	<0.01
Pounds per pots registered	187.1	189.4	1.01	0.45
Vessel length (ft)	100	161	1.60	<0.01

Examination of the Q-Q plot CPUE data for the entire data set or for the subset of data reflecting vessels in the 130 ft-170 ft category, did not suggest any trends not observable from the tabular data. Therefore the plots are not presented in this report.

Although the difference in average pounds landed between the two vessel types is significant ($\mathbf{P}<0.01$), the pounds landed may be affected by the number of pot-lifts or the size of vessel. As an alternative measure of effort, registered number of pots was also used as a comparative basis. For both measures of CPUE, the catcher-processor vessels did not have significantly different values when compared to the catcher vessels (Table 1). Note that the P-value for pounds per pot-lift is 0.10 as compared with 0.38 the previous year for the same parameter. This value is not considered significant using the P=0.05 criteria.

As in previous years, we further examined the data to determine if length of vessel would explain the differences observed. To provide similar size classes of both catcher-processor and catcher vessels, vessels of 130–170 feet were selected, identical to the procedures used in 1987 and 1988. This group included 10 catcher-processor vessels and 19 catcher vessels. This grouping provided sufficient numbers of vessels and low significant difference of length ($\mathbf{P}=0.03$) (Table 2).

Table 2.— Test statistics for difference in mean values between catcher-processor vessel (N=10) and catcher vessel (N=19) with length between 130 ft and 170 ft.

	Mean values			
Variable	Catcher vessel	Catcher-processor vessel	Ratio of means	P-value Wilcoxon test
Pounds landed	59392	71917	1.21	0.34
Number of pot-lifts	1305	1209	0.93	0.19
Pounds per pot-lift	47.0	56.1	1.19	0.18
Number of pots registered	332	391	1.18	0.04
Pounds per pots registered	176.0	180.9	1.03	0.48
Vessel length (ft)	152	159	1.05	0.03

For vessels of size 130–170 feet in length, there was not a statistical difference between mean pounds landed, contrary to the observations of 1988. Neither measure of CPUE shows a statistical difference between catcher-processor vessels and catcher vessels as would be expected from the previous examination of the full fleet (Table 2). The number of pot-lifts are not significantly different for the catcher-processor vessels, also differing from the 1988 fishery.

Comparisons of 1987, 1988 and 1989 Fisheries

We have analyzed the 1989 Bering Sea red king crab fish ticket data in an attempt to determine if a disparity existed in pounds landed per unit effort between the catcher vessels and

the catcher-processor vessels. If a disparity exists, two possible explanations are possible. Illegal catch could be one explanation, because of the high number of observers which were decertified during 1989. This suggests that their ability to act as deterrents to sub-legal processing may have been compromised. Increased soak times is one other possible explanation suggested by ADF&G management staff. This should be detectable as a discrepancy between the pounds landed per pot-lift, and the pounds landed per pot registered.

Table 3 tabulates the differences in the catch values between 1987, 1988 and 1989 for both vessel types between 130 and 170 ft in keel length. The pounds landed by the catcher-processor vessels in 1989 were approximately 1.2 times higher than the catcher vessels, when considering vessels of similar length. This compares with 2.5 times higher in 1987 and 1.3 times in 1988. It is a safe assumption that the pounds landed are relatively free from reporting errors. When comparing the vessels in total, the catcher-processor vessels had landings that were 1.6 times larger that of the catcher vessels in 1989 versus 2.3 times larger in 1987, and 1.4 times in 1988.

Table 3.— 1987, 1988 and 1989 mean values for catcher-processor vessel and catcher vessel with length between 130 ft and 170 ft.

	Catcher vessels			Catcher-processor vessels			Ratios		
Variable	1987	1988	1989	1987	1988	1989	1987	1988	1989
Pounds landed	54844	40131	59392	136074	53817	71917	2.48	1.34	1.21
Number of pot-lifts	1013	795	1305	1396	1043	1209	1.37	1.31	.93
Pounds per pot-lift	58.5	54.4	47.0	92.4	50.9	56.1	1.58	0.94	1.19
Number of pots registered	300	316	332	398	410	391	1.32	1.30	1.18
Pounds per pots registered	183.0	126.9	176.0	330.3	132.4	180.9	1.80	1.04	1.03
Vessel length (ft)	152	155	152	155	158	159	1.01	1.05	1.05

Note in Table 2 that there was not a significant difference in pots lifted between vessels for 1989 but a significant difference in the numbers of pots registered. Assuming all registered pots were fished, longer soak times would have occurred. Although CPUE values were not significant between vessel types, the change in CPUE expressed as pounds per pot from the 1988 data, may be explained by longer soak times reflecting nearly identical pounds per pot registered during 1988 and 1989. Note also that the differences from 1987 are still quite large, reflecting the continued effectiveness of on-board observers in providing similar CPUE values between vessels of similar size, regardless of processing modes.

Discussion

Analysis of vessels of all lengths indicates that catcher-processor vessels had average pounds landed per pot-lift higher than that of an average catcher vessel but not significant. When the vessels compared were vessels of similar keel lengths, average pounds landed per pot-lift

by catcher-processor vessels was again not significantly different than that reported by the catcher vessels.

When compared with 1988, the mean 1989 CPUE expressed as pounds per pot-lift increased. However the catch per pot registered stayed essentially the same. Since the number of pot-lifts reported by catcher-processor vessels dropped in 1989, the differences in CPUE observed can be explained by increased soak time. When compared with 1987, the effectiveness of the on-board observers remains obvious.

From the previous discussion, it appears that parity in the fleet has been maintained in 1989 by the presence of mandatory observers on the catcher-processor vessels. Changes in CPUE values expressed as pounds per pot-lift were not paralleled when CPUE was expressed as pounds per pot registered. Since pot-lifts dropped in the catcher-processor fleet, when compared with the equivalent sized catcher fleet, increased soak time may be a primary cause of the difference. The economic advantage of catcher-processor vessels, beyond the processing capabilities, previously explained by the increased number of pot-lifts in 1988, is now explainable by increased soak time of the number of pots registered. However, the difference in average pounds landed between the vessel types was not statistically significant in 1989. Equivalent sized vessels, based on total number of pounds landed in 1989, actually caught crab at a lesser rate in 1989 (1.21 differential) than in 1988 (1.34). If comparative increased CPUE from catcher-processor vessels were in part, caused by lack of observer diligence, the amount is too small to be detected by the analysis presented here.

Conclusions

We examined the pounds landed as a function of the number of vessels, the number of pot-lifts, and the number of pots registered to determine if significant differences occurred. With an on-board observer the pounds landed for catcher-processor vessels was larger than catcher vessels but not significantly larger in 1989. Both 1989 and 1988 rate of landings contrast sharply with 1987 data. Our conclusions have not changed since the 1988 report. To provide equal enforcement of size and sex regulations established for this fishery it is essential that a mandatory on-board observer program continue. The costs of continuing this program are very small when compared with the potential value of illegal crab taken by unobserved processing vessels.

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