DISCUSSION ON CRAB MORTALITY ASSOCIATED WITH CERTAIN FISHERY PRACTICES 1/

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INTRODUCTION

One of the initial objectives of the State/Federal Dungeness Crab Management Program is to evaluate crab mortality caused by certain fishery practices. The areas of most concern include mortality caused by trawling, handling of softshell and sublegal crabs, lost pots that continued to fish, and inadequate escape ports in crab traps. A reduction in crab mortality caused by these factors theoretically could result in increased crab landings.

The use of escape ports in crab traps has been discussed in an earlier report (Stewart, 1974). The purpose of this report is to summarize the available information regarding crab mortalities resulting from trawl operations, handling of soft and sublegal crabs, and lost pots.

TRAWLING

Regulations on the Use of Trawl Nets in the Crab Fishery

In Washington and Oregon it is unlawful to take Dungeness crab with any type of trawl or dragnet. However, the State of California allows an "incidental" catch of up to 500 pounds of crab to be landed by trawl boats if they are caught beyond the three-mile limit.

Observations on Damage to Crabs by Trawl Nets

Damage to crabs caught by trawl gear was first investigated by Cleaver 2/

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2/ Observations by Fred Cleaver were excerpted from progress reports, which are on file with the Washington Department of Fisheries, Point Whitney Shellfish Laboratory, Brinnon, Washington.

in the early 1940's. During November 1943 he took crabs from two "heavy hauls" and held them in live boxes for 2 and 3 days, respectively. He reported that no crabs were injured and that all crabs were alive at the end of the holding periods. During February 1944 he examined crabs caught by two trawl boats and found that 4.7 and 4.9 percent were injured, respectively (Table 1). The injuries included loss of claws, walking legs, and abdomen (presumably Cleaver referred to the abdominal flap as the abdomen). Cleaver also noted that damage to egg bearing females may be considerable, because some of the eggs can be dislodged when an object is brused against them.

The Oregon Fish Commission made observations in 1947-48 on damage to crabs caught by trawl gear (Anonymous 1949). That reports reads as follows:

> Considerable controversy exists between various fishing groups as to the damage done to crabs when brought up in drag gear. Accordingly observations were made while tagging crabs on the drag boat "Captain Ludvig" out of Astoria during December and January, 1947-1948. Of 588 crabs brought up in regular commercial operations from depths ranging from 20 to 80 fathoms which were purposely examined for injury, only 25 or 4.2 percent were found to be damaged in any manner considered to be serious enough to cause the death of the crab. Further evidence of lack of damage is shown by the fact that tagged drag-caught crabs have been recovered in about the same proportion as those tagged from regular commercial crab pots.

The Washington Department of Fisheries made observations in 1970-71 on the mortality of crabs caught in groundfish trawls in the Strait of Georgia. A total of 1,514 crabs taken in 57 tows on 11 different days were examined (Table 2). The total observed mortality was 9 percent for softshells and 2 percent for hardshells with an overall mortality of 5 percent. Apparently, no records were kept on number of crabs injured but not killed.

No investigations have been done in California regarding the effect of trawl operations on crab mortality, but it is suspected that mortality may be relatively high on softshell crabs during the summer molt period in the San Francisco area (W.A. Dahlstrom, personal communication).

Table 1. Summary of Cleaver's Observations on Injury of Crabs Caught by Trawl Gear in Puget Sound.

Date	Depth Fished (fm)	Number Crabs Caught or Examined	Observations
November 1943	60	53 male 2 female	Crabs held two days in live box. No injuries.
November 1943	5	42 male 1 female	Crabs held out of water 12 hours then put in live box. After three days in live box all crabs were alive and undamaged.
February 1944	45	28 male 120 female	No male crabs were injured. Of the 120 females, 7 were injured. Injuries included loss of claws, walking legs, and abdominal flap.
February 1944	8	137 male 28 female	There were 5 male and 3 female crabs injured. Two of the females were soft-shelled. Injuries were same as above. An additional 137 crabs were thrown overboard, which included 3 dead soft-shell females.

Table 2. Summary of Washington Department of Fisheries Observations on Crab Mortality by Trawl Gear in the Strait of Georgia During 1970-71.

Date	Number Tows 2/	Number of Crabs Caught and Percent Mortality 1/								
		Softshell			Hardshell			Total		
		Number Caught	Number Dead	Percent Mortality	Number Caught	Number Dead	Percent Mortality	Number Caught	Number Dead	Percent Mortality
1/16/70	4	38	13	34	123	3	2	161	16	10
2/17/70	4	41	3	7	263	3	1	304	6	2
3/13/70	4	128	12	9	258	5	2	386	17	4
4/14/70	4	117	13	11	38	3	8	155	16	10
5/12/70	7	102	6	6	60	0	0	162	6	4
6/19/70	7	32	3	9	35	0	0	67	3	4
7/24/70	7	68	3	4	88	2	2	156	5	3
10/2/71	5	15	1	7	12	2	17	27	3	11
11/24/70	5	38	0	0	5	0	0	43	0	0
12/18/70	5	21	0	0	16	1	6	37	1	3
1/25/71	5	4	0	0	12	1	8	16	1	6
Totals	57	604	54	9	910	20	2	1,514	74	5

1/ Crabs ranged from 80-197 mm in carapace width.

2/ The length of tow and depth fished is not known.

Discussion

The few studies that have been done on the effects of trawling on Dungeness crabs indicate that perhaps 4 to 5 percent of the crabs caught by trawl boats are damaged (injured and/or killed). However, it is not known what the total crab catch is by trawl boats or how it may vary with season and crab abundance. Data are also lacking on mortality of crabs that are injured by trawl nets but are not caught.

The available information on depth distribution patterns of crab and location of major trawl fishing areas should be examined to determine the extent trawling takes place on major crab grounds. This would give some indication as to the potential magnitude of the problem and appropriate studies could be planned accordingly. However, if additional studies are undertaken they should be done in close cooperation with the respective state trawl investigation staffs.

DISCARD HANDLING OF SOFTSHELL AND SUBLEGAL CRAB

Regulations on the Harvest of Softshell Crab

In California and Oregon it is lawful to land male softshell crabs over 6¼ inches in carapace width. However, because of poor quality and low meat yield, very soft crabs are often sorted from the catch. In Washington it is unlawful to possess softshell crab.

Handling Mortality Studies

The Washington Department of Fisheries conducted studies between 1969 and 1972 on handling mortality of softshell crab caught in Willapa Bay, Washington. The studies were reported by Tegelberg (1970, 1972a, and 1972b) and Tegelberg and Magoon (1971). Following is a summary of results of those studies which was compiled from the above reports.

Crabs were caught in commercial traps that had fished overnight, graded and held for a short period of time in flowing seawater in a compartmented tank, and then placed in holding traps and held for varying lengths of time in 3-7 fathoms of water. The holding traps were commercial traps with the tunnels and escape rings wired shut.

In a series of experiments done in 1969, it was found that softshell [2/] crab handled under conditions similar to those found in the commercial fishery and then held in commercial traps suffered mortalities of 10 to 15 percent after 2 days, 15 to 16 percent after 4 days, and 22 to 25 percent after 6 and 7 days. Handling softshell crab three times in a 6-day period increased mortality to 33 percent. Mortality of hardshell crabs handled in the same manner ranged from 2 to 4 percent when held for periods up to 4 days. Mortality of crabs in intermediate condition was similar to that of hardshells. Crabs tagged with Petersen disc tags suffered mortalities 6 to 12 percent higher than untagged crabs. Softshell crabs injured by dropping them on the boat deck suffered a 57 percent mortality after 2 days.

In later studies an 8 percent mortality occurred among softshell crabs held 4 days, while no mortality occurred with hardshells held the same length of time. The lower mortality rate of softshell crabs, as compared to that in earlier experiments, was attributed to better condition of the softshell crabs used in the latter experiments. It was also found that breaking off one of the first walking legs of softshell crab caused a mortality of 42 percent, but crushing the carapace edge with pliers only caused a 7 percent mortality.

Discussion

These studies indicate that discard handling of softshell crabs may cause a significant amount of mortality. The magnitude of handling mortality in the fishery is not known, but as Tegelberg and Magoon (1971) point out, fishing crab during periods of high softshell abundance could cause a direct loss in total production.

2/ Most of the softshell crabs used in these studies were grade III. These are crabs that recently molted and the carapace and legs are still flexible and easily broken.

Handling mortality can not be eliminated, but it can be reduced by: (1) setting seasons to coincide with periods of low abundance of softshell crabs, and (2) requiring all commercial crab traps to have adequate escape ports to allow maximum escapement of sublegal crabs. The timing of the softshell period will be considered along with other factors in making final recommendations regarding season opening and closing dates, and it has been recommended that all crab traps be required to have two escape ports of at least 4 3/8 inches inside diameter.

LOST TRAPS THAT CONTINUE TO FISH

Field observations indicate that lost traps will continue to fish for crab, but the magnitude of crab loss due to lost pots is not known. We do not know the actual number of traps lost, what percent of the lost traps continue to fish, how long they may fish, or at what rate they may catch crabs. However, it is known that trap loss is significantly high and therefore crab loss from lost traps that continue to fish could theoretically be quite substantial.

Shellfish biologists along the coast have estimated that an average of 10 percent of the traps fished each year may be lost. Assuming that approximately 125,000 traps are fished along the coast each year, the annual loss could be on the order of 10,000 to 12,000 traps. Some of the lost traps will be washed up on shore, torn apart, or buried in sand where they will not fish. The remaining traps will eventually corrode and be destroyed, but they may fish for crab for several months.

No definite information exists on crab loss due to lost traps. However, a report by Demory (1971) gives some indication as to the potential magnitude of the problem. Demory reported that in October 1970, 140 crab traps were

found abandoned near Cannon Beach, Oregon. Presumably the traps had not been pulled for at least 30 days. Of the 140 traps, 117 were retrieved. These traps contained an average of 31.1 crabs per trap for a total of 3,629 crabs. Approximately 1,400 of the crabs were measured and sexed. Of these 91 percent were legal males, 6 percent were sublegal males, 2 percent were females, and 1 percent were dead.

There can also be a loss of crab associated with traps that become sanded in during storms. Sanded traps are often recovered, but if they had been completely buried in sand any crabs they may have contained would be killed.

California has done some preliminary work on development of a destruct mechanism for crab traps. Their objective was to find a metal or other material that would destruct in seawater in 5 to 6 months. This material would then be used to incorporate destruct sections in traps which would allow crabs to escape. They tried aluminum, copper, and some other metals but none proved to be successful. Unfortunately this study has been temporarily curtaile because of lack of funding and manpower.

Further research should be done on developing a destruct mechanism for crab traps and on designing a trap that would allow crabs to escape if the trap becomes buried in sand. The possibility of developing economically feasible recovery methods for lost traps should also be explored. Inasmuch as the study team's tentative plans do not include pursuing this problem, it is suggested that this work be done by the states or through a contract to some other institution such as a university sea-grant program.

CONCLUDING REMARK

Crab mortality caused by trawling, sorting and discarding softshell and sublegal crab, and lost gear that continues to fish could at times be quite substantial. However, data are not available to make any reliable estimates of the magnitude of these losses.

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