Dungeness Crab Leg Loss in the Columbia River Estuary

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ABSTRACT—Sampling carried out in the Columbia River estuary from 1971 to 1973 to investigate the incidence of leg loss and subsequent regeneration among Dungeness crab, Cancer magister, *indicated an average of 45 percent of the catch had one or more missing legs. This is more than twice the frequency of leg loss reported in either Washington's Puget Sound or coastal waters. Leg injuries occurred with a high incidence of bilateral symmetry. Claws were lost and regenerated more frequently than any other pair of legs. Possible reasons for the high incidence of leg loss in the estuary are maintenance dredging, commercial crab and finfishing activities, predation, and competition.*

Introduction

Monetarily the Dungeness crab, *Cancer magister*, fishery is the most important crustacean fishery in the western United States from California to Washington. It is the second largest crustacean fishery in pounds landed and only the pandalid shrimp fishery is greater (PMFC, 1983).

Sampling was conducted from 1971 to early 1973 in the Columbia River estuary by personnel from the National Marine Fisheries Service (NMFS) to investigate the temporal incidence of leg loss and subsequent regeneration in Dungeness crab. Missing or newly regenerated legs could impair the crab's ability to move, feed, and molt—ultimately affecting survival. If decreased growth or survival occurs in a large portion of the population, there could be an adverse impact on commercial and sport harvests.

Methods

Commercial crab pots, as described by Waldron (1958), were baited and fished 1 day each month in the Columbia River estuary from late December 1971 until February 1973, except during July 1972 (Fig. 1). Although pots were placed at various locations throughout the western half of the estuary, most of the fishing effort was along the north side of Clatsop Spit and the south side of the Sand Islands. Both areas are in, or adjacent to, the two major deep channels of the estuary. Information recorded for each crab included the following: 1) Sex, 2) carapace width (mm) immediately anterior to the tenth anterolateral spine, and 3) position and number of missing or regenerated legs.

Crabs missing a leg for 1 or 2 days will form a scab or brown sheath covering the previous attachment site; very recent injuries (within hours) do not have the sheath. To eliminate including data on crabs that might have been injured in the trapping process, injuries that did not have the scab or sheath were not included in this study. Budding of a new leg was considered regenerated when it had broken through the sheath.

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Table 1.—Carapace widths for 3,085 Dungeness crabs from the Columbia River estuary, 1972.

Year and month	Male		Female	
	Number	Mean width (mm)	Number	Mean width (mm)
1972				
January	136	145	9	105
February	126	146	2	134
March	192	146	6	115
April	235	135	22	109
May	264	138	42	115
June	435	112	158	106
July				
August	61	127	22	127
September	233	136	49	122
October	265	142	8	125
November	335	144	5	129
December	212	146	9	116
1973				
January	180	141	9	125
February	70	142	0	0
Total	2,744		341	
Grand mean		136		113

Results

A total of 3,085 crabs were captured (Table 1). Males composed 89 percent of the catch with a mean size of 136 mm carapace width (range 70-197 mm). Females composed 11 percent of the catch with a mean carapace width of 113 mm (range 62-162 mm). Coincident with increased river flows during the spring freshet in June, the catch of large male crabs decreased dramatically, whereas the catch of smaller crabs of both sexes increased. The largest catches of crabs (593) were made in June; these crabs were also the smallest (mean width 110 mm).

The majority of crabs captured were less than the legal commercial size (159

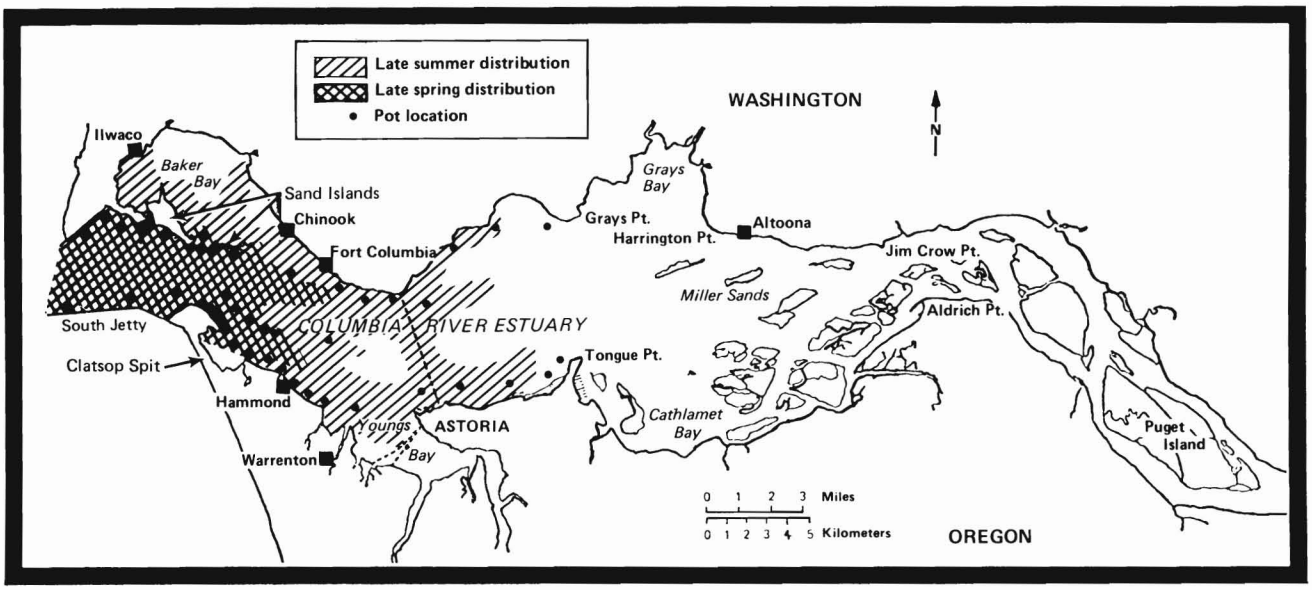

Figure 1.—Crab pot sampling locations and distribution of Dungeness crabs in the Columbia River estuary, 1971-73.

Table 2.—Monthly changes in the number and percentage of injured and intact Dungeness crabs from the Columbia River estuary, 1972.

Year and Month	Crabs with missing legs only		Crabs with regenerating legs only		Crabs with both missing and regenerating legs		Intact crabs	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1972								
January	57	39	32	22	21	15	35	24
February	53	42	21	16	27	21	27	21
March	88	44	36	18	41	21	33	17
April	71	28	52	20	54	21	80	31
May	90	29	64	21	72	24	80	26
June	157	27	90	15	50	8	296	50
July								
August	28	34	13	16	17	20	25	30
September	63	22	63	22	24	9	132	47
October	75	28	56	20	34	12	108	40
November	89	26	82	24	54	16	115	34
December	46	21	71	32	38	17	66	30
1973								
January	57	30	43	23	44	23	45	24
February	18	26	20	28	20	29	12	17
Total	892		643		496		1,054	
Average (%)		29		21		16		34

mm). The average size of both male and female crabs indicated they were sexually mature; however, no females with an egg mass (sponge) were captured.

Throughout the study, crabs with missing or regenerating legs composed 66 percent of the total catch (Table 2). In 1972, the percentage increased from January through March to a high of 83 percent, decreased to a low of 50 percent in June, and generally increased again through February 1973.

Injured crabs may exist in one of three conditions: Having 1) one or more legs missing but none regenerating, 2) one or more legs regenerating but none missing, or 3) at least one leg missing and one leg regenerating. During the sampling, 29 percent of the crabs caught had one or more legs missing (maximum of five) with none regenerating, 21 percent had one or more legs regenerating (maximum of five) with none missing, and 15 percent had legs missing and regenerating (maximum combined was six for one individual).

From June through September, when females were most abundant, 271 females and 993 males were examined. Sixty-one percent of the males were injured as were 45 percent of the females. The pattern of injury during the summer was identical to that for the entire study (i.e., crabs with missing legs but none regenerated were the most abundant, there were fewer with regenerated legs but none missing, and still fewer with legs missing and some regenerating).

Injuries occurred with obvious bilateral symmetry—of 3,920 legs that were lost or regenerated, 1,963 oc-

curred on the left and 1,957 on the right; missing legs occurred 1,104 times on the left and 1,106 on the right; and regenerating legs occurred 859 times on the left and 851 on the right. Chelipeds (claws) were injured more frequently than any pair or all of the walking legs collectively. Injury to the paired walking legs occurred in the following order of frequency: 1) First pair, 2) second pair, 3) fourth pair, and 4) third pair. Regardless of location, loss was more frequent than regeneration.

Discussion

Needham (1953) discussed leg loss and regeneration in eight species of crustacea and concluded that such injury paralleled the degree of exposure of the limbs. The claws and first, second, and last pair of walking legs are more exposed to damage by being near the ends of the crab. Consequently, these were lost more often than the third pair of walking legs. Needham also indicated there was a marked bilateral asymmetry of appendage damage in crustacea which tend to move predominantly in one direction, and a more symmetrical loss in those which move randomly. The frequency of bilaterally symmetrical leg injuries for Dungeness crab implies that they move randomly.

During our study, crabs with missing legs composed 45 percent of the total catch. This was more than twice that reported by either Cleaver (1949) or Ames[1]. Cleaver found in Washington coastal waters that 16 percent of the crabs examined in 1947 and 20 percent examined in 1949 had missing legs. Ames reported that a study in Puget Sound, Wash., from 1970 through 1972 found that 17 percent of the crabs caught in Port Gardner Bay had missing legs. Both studies involved primarily commercially legal male crabs; whereas only a small proportion of the total population in the Columbia River estuary attains this size—the estuary is a nursery for juvenile crabs.

There are many probable causes of the high frequency of crab injury in the Columbia River—natural and/or related to human activity. Predation by mammals or other crabs and competition for both food and space are probable natural causes. Human-related causes may include rough handling incidental to commercial crab and finfish (trawl and gillnet) fisheries, and maintenance dredging of the main navigation channel and entrance bar.

There is no comparable information on crab leg damage in other large, nearby coastal estuaries such as Grays Harbor and Willapa Bay, Wash., or Tillamook Bay, Oreg. These estuaries are much shallower than the Columbia River estuary and present a different environment to crabs, injured or not.

[1]Warren Ames, NMFS Northwest and Alaska Fisheries Center, Seattle, WA 98112. Pers. commun., 1980.

Summary

Dungeness crabs taken with pots in the Columbia River estuary in 1972-73 had a high percentage of injury. The degree of injury was much greater than that found either in Washington coastal waters 25 years earlier, or in Puget Sound from 1970 to 1972. It is not known whether this is a common occurrence in the estuary, or if it still exists. The effect of the injured population on the subsequent numbers of harvestable adults in coastal waters was not determined.

Acknowledgments

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