

THE DUNGENESS CRAB FISHERY IN OREGON ESTUARIES
MARINE REGION
OREGON DEPARTMENT OF FISH AND WILDLIFE
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INTRODUCTION

Oregon's estuaries are focal points in an important recreational and commercial fishery for Dungeness crab. This report describes crabbing in Oregon's estuaries and includes brief notes on crab biology, catch statistics, major fishing areas, fishing regulations, problems, and proposed solutions.

GENERAL LIFE HISTORY OF THE DUNGENESS CRAB

In Oregon, Dungeness crabs breed from May through July. Mating occurs in both the bays and the ocean, but most females leave the estuaries before the eggs are extruded in the fall (C. Dale Snow, personal communication). The fertilized eggs are carried under the abdominal flap until hatching which usually occurs between December and April. The larvae are pelagic for about three months and then settle to the bottom (Reed, 1968). Newly metamorphosed crabs (true adult form) can be found in bays and the ocean.

Butler (1961), studying Dungeness crabs in the Queen Charlotte Islands off British Columbia, found that small crabs averaged five or six molts a year for the first two years, slowing to once a year or less thereafter. Males reached commercial legal size of $6\frac{1}{4}$ inches, excluding the lateral spines, in carapace width in their fourth year of life. The maximum age attained by male crabs was estimated to be 8 years. Cleaver (1949) determined that male crabs in Washington reached $6\frac{1}{2}$ inches in body width in their fourth year. Poole (1967) reported that some male Dungeness crabs in Bodega Bay, California, reached $6\frac{1}{4}$ inches in their third year although the majority were in their fourth year of life. The life history of Oregon's Dungeness crabs approximates that of crabs in Washington and British Columbia.

Butler (1960) found that breeding activity of males was not appreciable until they reached a carapace width of about $5\frac{1}{4}$ inches, in their third year. Female crabs were sexually mature at two years, at a carapace width of about 3- $\frac{5}{8}$ inches.

The magnitude of the ocean movement of Oregon Dungeness crabs is not known but apparently they move inshore during spring and summer and offshore during fall and winter (Stewart, 1974a). Most recoveries of tagged crabs have been within a few miles of the release site although some have traveled over 100 miles. North-south movement of crabs is probably not significant and therefore not important in a management sense.

Tagging studies have shown that crabs move in and out of estuaries. This suggests that ocean and bay crab are not separate populations although other information shows that extended bay residency occurs for a portion of the crabs

in the bay. Since "berried" female crab (those with eggs) are not commonly found in the bays, hatching must occur in the ocean with subsequent movement of larvae or small crab into the bays. Migrations of larger crab into the bay is evidenced by periodic increased fishing success and the appearance of "new" crabs in the bay.

The abundance of Dungeness crabs, in common with many other animal populations, fluctuates over the years. This is reflected in the annual commercial landings of Dungeness crabs in Oregon from 1952-1976 (Table 1). Past landings have varied from a high of 14.7 million pounds in 1971 to a low of 3.1 million pounds in 1973, with a 25-year average of 8.0 million pounds. The 1977 total will exceed 15 million pounds (a record). The reason for this fluctuation in abundance is not known. Reed (1968) suggested that a possible prolonged larval life during cold temperatures coupled with unfavorable currents could result in high larval mortality. Peterson (1973) suggested that a relationship exists between ocean upwelling and annual crab catches. He concluded that increased food supplies during high upwelling years would result in increased numbers of crabs molting and reaching commercial minimum size $1\frac{1}{2}$ years later off Oregon. Lough (1975) suggested a correlation between February and March environmental conditions, especially surface salinities, and subsequent success of Dungeness crab year classes.

Table 1. Annual Oregon Commercial Crab Landings (thousands of pounds) for the 1952 through 1976 Seasons. Includes Bay-Caught Crabs.

Season ^{1/}	Pounds	Season ^{1/}	Pounds
1952	5,207	1964	3,540
1953	6,949	1965	6,221
1954	10,178	1966	10,187
1955	6,106	1967	9,428
1956	8,602	1968	10,215
1957	11,560	1969	11,965
1958	10,080	1970	13,849
1959	7,033	1971	14,735
1960	8,093	1972	6,780
1961	10,816	1973	3,143
1962	5,813	1974	3,462
1963	3,546	1975	3,335
		1976	9,099
		25-year average	7,998

^{1/} Includes December of preceding year.

THE FISHERIES

Crab Fishing Regulations in Estuaries

Regulations for taking Dungeness crab differ between the estuaries and the ocean for both personal use and commercial fisheries.

Commercial:

- A. *Season* - Open the entire year in estuaries except in the Columbia River where the open season coincides with the ocean season (December 1-August 15).
- B. *Fishing gear* - Crabs may be taken by crab pots or rings, except they may be taken only by rings in Alsea, Coos, Nehalem, Siletz, and Yaquina bays. Crab pots must have at least two circular escape rings of at least 4-3/8 inch inside diameter on top or side if constructed after January 1, 1975.
- C. *Size and sex* - Only male Dungeness crabs at least 6 1/4 inches in carapace width, exclusive of spines, may be taken. Any undersized or female Dungeness crab taken from a bay must be released immediately unharmed into the fishing area and not brought to the dock.

Personal Use:

- A. *Season* - Open the entire year.
- B. *Fishing gear* - Crabs may be taken by hand, dip net, baited lines with or without hooks, and by rake, crab ring or crab pot. One person may not use more than 3 crab rings or crab pots or a combination of the two.
- C. *Size and sex* - Only male Dungeness crabs at least 5-3/4 inches in carapace width exclusive of spines may be taken.
- D. *Bag limit* - Not more than 12 legal size male Dungeness crabs may be taken in any one day or more than 24 legal size male Dungeness crabs in any seven consecutive days.
- E. *Other restrictions* - It is unlawful to: (1) remove any legs or pinchers of a crab or in any other way injure a crab before releasing and returning it to the water; (2) drop, throw, release, or transfer any crab to the water in any manner which might be expected to injure such crabs; and (3) transport across the waters of this state any crab taken for personal use which is dismembered or disfigured to the extent that its size and sex cannot be determined.

The difference between the 5-3/4 inch minimum size sport limit and the 6-1/4 inch commercial size limit stems from an original belief (no longer valid) that bay and ocean crabs were separate populations, with bay crabs being smaller. Hence, the bay crab size limit for both sport and commercial fishermen was originally lower than in the ocean. The present difference in size limits for sport and commercial users in estuaries was maintained to insure a reasonable harvest for the recreational crabber who is restricted, for practical reasons, to crabbing in bays. Also the bay crab harvest was not believed to be large enough to justify a more stringent size limit for sport crabbers.

Commercial Bay Crabbing

Prior to 1971, landings of bay-caught crabs were included with those caught in the ocean. Bay crab landings are available only for the 1971 through 1974

seasons. Total landings during this period from all estuaries varied from 251,255 pounds in 1971 to 44,289 pounds in 1974 (Table 2). Tillamook Bay had the most intensive commercial fishery for crabs, accounting for 50% of the 4-year average of total bay crabs landed. The 4-year average for the Columbia River was 22% of the total bay crab average but this is misleading since it reflects the unusually high landings made there in 1971. Subsequent landings were much lower. The Columbia River estuary crab fishery takes place just inside the north jetty where conditions are almost the same as in the ocean. For this reason, the Columbia River has the same season as the Pacific Ocean. Coos Bay and Netarts Bay together accounted for 17% of the average bay crab landings during 1971-74. Commercial landings from the Yaquina, Alsea, Siuslaw, Umpqua, and Coquille estuaries varied from 1-4% of the average total landings from bays.

Commercial bay crab landings comprised less than 2% of the total commercial crab landings in any one year, 1971 through 1974. During years of low crab abundance such as in 1973, high crab prices attracted more "part time" fishermen into the bay fishery. In 1971, 15 bay crab fishermen landed crabs whereas in 1973, 54 fishermen landed bay crabs. Most commercial bay crab landings occur from July through November although some sizable landings of bay crabs were also made in December 1970 through February 1971 (Table 3). In contrast, most of the ocean-caught crabs were landed between December and June of each season.

Bay-caught crabs constitute a small and irregular part of the total amount of crab sold at most seafood outlets in Oregon. The commercial bay crab fishery is insignificant compared to the ocean fishery but it is of local importance, particularly in the Tillamook Bay area during the closed ocean season, August 15-December 1. During this time, the Tillamook Bay seafood outlets supplement frozen ocean crab caught during the ocean season with landings of fresh crab from Tillamook and Netarts bays. In other areas, frozen crabs caught earlier in the year off Oregon are supplemented with crabs from Alaska and Puget Sound.

Recreational Crabbing in Estuaries

Recreational crabbing data are available from the Fish Commission's 1971 Estuary Resource Study (Table 4). During March through October 1971, an estimated 124,512 crabber-trips were made. A total of over 200,000 Dungeness crabs (about 300,000 pounds) were harvested from 14 estuaries. The 1971 estimated sport catch was about 20% greater than the commercial bay catch in 1971; it was nearly three times the 4-year mean commercial catch. Coos and Yaquina bays had the heaviest use and harvest. Tillamook, Alsea, Netarts, and Nehalem estuaries also had substantial sport crab landings.

Crabbing was incidental to other fishing activities in the Chetco River but success was highest with 3.8 crabs landed/crabber trip. Tillamook Bay success averaged 2.9 crabs/crabber trip followed by Yaquina and Alsea bays and the Salmon River, all with 2 crabs/crabber trip. The overall crab catch/trip was 1.6 (Table 4). Dungeness crabs were especially important in the boat fishery, dominating the catch in all estuaries except the Columbia and Chetco Rivers (Gaumer et al 1973).

Table 2. Oregon Annual and Average Commercial Bay Crab Landings, in Pounds, by Estuary and Season.

Estuary	SEASON ^{1/}				4-year average landing	Percent of total 4-year average landing
	1971	1972	1973	1974		
Columbia	93,570	0	1,008	2,103	24,170	21.9
Tillamook	95,987	58,593	42,316	26,507	55,851	50.6
Netarts	21,871	8,501	220	931	7,881	7.1
Yaquina	5,925	3,890	3,458	2,125	3,849	3.5
Alsea	3,316	1,482	336	2,740	1,968	1.8
Siuslaw	3,800	5,197	613	51	2,415	2.2
Umpqua	2,417	1,025	1,454	159	1,264	1.1
Coos	24,339	7,074	4,679	9,673	11,441	10.4
Coquille	0	5,451	854	0	1,576	1.4
Total	251,225	91,213	54,938	44,289	110,416	100.0

^{1/} Annual except in Columbia River where season extends from December 1 of previous year to August 15 of current year.

Table 3. Oregon Commercial Crab Landings in Pounds and Percent from Ocean and Bays, by Month, from December 1970 through November 1974.

Month	SEASON1/										Percent Bay Landings
	1971 Landings ^{2/}		1972 Landings ^{2/}		1973 Landings ^{2/}		1974 Landings ^{2/}		4-Year Average Landings ^{2/}		
	Bay	Ocean	Bay	Ocean	Bay	Ocean	Bay	Ocean	Bay	Ocean	
December	78,259	1,608,271	5,712	1,542,306	1,936	1,328,580	5,210	495,693	22,779	1,243,712	1.8
January	49,599	1,956,409	2,048	1,873,087	1,272	535,330	3,668	861,129	14,147	1,306,564	1.1
February	14,221	2,610,234	2,606	1,165,297	1,739	268,137	1,364	748,048	4,982	1,197,911	0.4
March	6,046	2,246,156	5,124	963,235	2,632	119,455	1,472	430,656	3,818	393,875	1.0
April	6,649	2,399,332	1,369	467,012	1,203	196,149	1,412	301,190	2,591	840,907	0.3
May	4,712	1,800,429	1,822	251,124	919	180,453	1,998	277,328	2,363	627,333	0.4
June	2,932	1,569,183	1,342	160,625	3,212	134,646	129	91,207	1,904	488,915	0.4
July	11,433	387,743	15,155	130,890	3,084	155,175	1,345	62,962	7,754	184,192	4.0
August	14,107	142,745	15,124	128,588	3,537	206,395	5,396	90,839	9,541	142,142	6.3
September	19,199	42,634	11,000	97,907	15,141	0	4,530	58,460	12,467	49,750	20.0
October	25,673	0	18,341	0	15,351	0	11,072	0	17,609	0	100.0
November	18,395	0	11,570	0	4,912	0	6,693	0	10,392	0	100.0
Total	251,225	14,763,136	91,213	6,780,071	54,938	3,124,320	44,289/3,417,512	110,416	7,021,259	1.5	

1/ Annual except in Columbia River and the Pacific Ocean where the season extends from December 1 of the previous year to August 15 of current year.

2/ The landings include December of the previous year through November of the current year.

Table 4. Sport Harvest of Dungeness Crabs from Oregon Estuaries^{1/} in 1971.

Estuary	Crabber Trips ^{2/}		Crab Catch		Crabs/Trip	Crab/trip if Commercial Bay catch is included
	Number	Percent of total	Number	Percent of total		
Nehalem	11,593	9.3	17,962	8.9	1.5	1.5
Tillamook	11,109	8.9	32,731	16.1	2.9	6.9
Netarts	10,165	8.1	19,092	9.4	1.9	2.9
Sand Lake	438	0.4	238	<0.1	0.5	0.5
Nestucca	911	0.7	1,663	0.8	1.8	1.8
Salmon	440	0.4	876	0.4	2.0	2.0
Siletz	8,519	6.8	8,731	4.3	1.0	1.0
Yaquina ^{3/}	22,075	17.7	43,728	21.6	2.0	2.1
Aisea	11,918	9.6	23,642	11.7	2.0	2.1
Siuslaw	10,579	8.5	7,024	3.5	0.7	0.8
Umpqua	9,037	7.3	3,671	1.8	0.4	0.5
Coos	25,548	20.5	40,065	19.8	1.6	2.0
Coquille	2,113	1.7	3,018	1.5	1.4	1.4
Chetco	67	<0.1	253	0.1	3.8	3.8
Total	124,512	100.0	202,694	100.0	1.6	2.2

- ^{1/} Columbia River Estuary has been excluded since not enough data was available on sports crabbing to allow expansion of data.
- ^{2/} Includes boat crabbers, shore crabbers, tideflat users.
- ^{3/} Data from Oct. 1970 to Oct. 1971. Data from other estuaries are from March 1971 through Oct. 1971.

Because 1971 was a peak year for crabbing off Oregon (see Table 1), the mean bag/crabber trip in 1972-75 may have been less than in 1971. Likewise, crabber success in 1976 and 1977 may be more similar to 1971. Unfortunately, little or no sport crabber data were collected between 1971 and 1977.

The peak recreation season (including all estuary uses) was between May and September although crabbing was done during all months. The 1971 Estuary Study also showed that on a coast-wide basis, 73% of all sport fishermen were from outside the county where the fishery took place (Gaumer, unpublished data).

Problems in the Bay Crab Fishery

Commercial crabbing has been the object of occasional complaints to our Department by individual sport crabbers for several years. These sport crabbers believed that when commercial crabbers are in the bay, the sport crabbers have very little chance to catch large crabs (6¼ inch or larger across the back). Some commercial crabbers, however, maintain that sport crabbers have an unfair advantage over them since sport crabbers can harvest crabs 5-3/4 inches.

User conflicts have been reported between sport and commercial crabbers in two Oregon estuaries, Netarts and Coquille. Netarts is a small estuary and the buoys on commercial pots are quite noticeable when they are in the water. To avoid conflicts, one commercial crabber who has fished Netarts for many years makes it a practice not to crab in the bay during June, July, and August and some weekends at other times. A similar conflict occurred in the Coquille Estuary in 1972 although commercial crabbing in the Coquille is much more sporadic than in Netarts. Interestingly, Tillamook Bay, which had the most intensive commercial effort and the third highest sport catch of crabs among Oregon's estuaries in 1971, has not had any user conflict of which the shellfish staff is aware. However, it is difficult to assess how many people are involved in these conflicts and to what extent conflicts actually occur.

Another recurring problem, not unique to estuaries, is the peak summer molt period when large numbers of newly molted crabs are present. These crabs are soft and easily injured during handling. Their meat is watery and of low yield. Apparently, many sport crabbers are unaware of the poor quality of these "soft-shelled" crabs and harvest them. This problem became acute on the ocean beach just south of Yaquina Bay in 1974. Large numbers of soft-shelled crabs became accessible to sport crabbers during low tides. Many sublegal crabs were injured or killed and some of the legal crabs taken were so soft that they literally fell apart when handled. The area was subsequently closed to crabbing for 60 days.

DISCUSSION

The sustainable supply of Dungeness crabs is protected by gear, size, and sex restrictions. The problems in the fishery are matters of resource allocation, handling mortality, and utilization. In view of the Fish and Wildlife Department's responsibility as stated in the statutory definition of the policy on food fish management (Ore. Comm. Fishing Laws 506.109) there is justification for maintaining a good recreational crab fishery in Oregon's estuaries.

There have been conflicts reported between sport and commercial crabbers fishing in estuaries but there is little information to adequately assess the problem.

Some assessment can be made of the impact of commercial bay crabbing on sport crabbing by examining the sport and commercial catch data for 1971. Commercial landings of bay crabs during the 1971 season (December 1970-November 1971) were 118,833 crabs (Table 5). This compared with 198,994 crabs taken by sport crabbers in March through October. An unknown but lesser sport catch is made during November-February. If the sport crabbers had taken all of this commercial catch, the 1.6 crabs/trip would have increased a maximum to 2.2 crabs/trip (+38%). Of individual estuaries, Tillamook Bay would have experienced the most significant change, from 2.9 to 6.9 crabs/trip (Table 4). If no commercial harvest were allowed in Netarts Bay and the same crabs had been sport caught, the sport landings (19,092) would have increased by 10,444. Assuming commercial crabbing were allowed only in larger estuaries such as Coos, Umpqua, Yaquina, and Tillamook bays, the total sport catch could have increased by 7% (13,859 crabs). If all estuaries had been closed to commercial crabbing between June 1 and September 30, 1971, the sport catch could potentially have increased by 11% (22,919 crabs). These increases assume sport crabbers could catch the number of crabs caught by commercial crabbers. Since crabs move in and out of estuaries, this assumption is not necessarily true. In terms of pounds of crabs landed, the increase in sports catch would have been even greater because the commercially caught crabs are larger.

Additional information on average catch, effort, size, and condition of crabs is being obtained during 1977. This information along with that from the 1971 Resource Use Study will provide us with a better measure of the relative success of sport crabbers and a better understanding of actual conflicts between users.

Regarding the problem of soft-shelled crabs we do not have condition data on crabs harvested by sport or commercial bay crabbers prior to 1977 nor do we know the percentage of soft-shelled crabs handled that are injured or killed. Data obtained by the Washington Department of Fisheries suggested up to 15% handling mortality might occur among soft-shelled crabs in the ocean (Stewart 1974b). Peak sport crab catches in Oregon occurred in July and August of 1971 and there were substantial commercial landings in July and August of 1972. Although the peak of molting may vary from year to year, a large number of soft-shelled crabs were probably handled both years.

The ultimate supply of crabs is probably not threatened by handling or harvesting soft-shelled animals, but some wastage and poor utilization of the crab resource does occur. In the state of Washington it is illegal to take soft-shelled crabs. In California, the fishery is closed to sports crabbing in late summer (Stewart 1974c). The biological rationale for the ocean season closing August 15 in Oregon is that on the average a large number of soft-shelled crabs occur in the population by that date. Normally, most of the fleet has switched to other fisheries long before this closing date. The Oregon Department of Fish and Wildlife has not adopted a similar season for bay crabbing because the "soft-shell season" was not distinct in the bays (C. Dale Snow, personal communication).

Table 5^{1/}. Number of Dungeness Crab Caught in Oregon Estuaries by Estuary and User Groups from March 1 through October 31, 1971.

Estuary	Number of Crabs Caught			Percent of Total Catch Caught by Sportsmen
	Sports ^{2/}	Commercial ^{3/}	Total	
Columbia	51	44,914	44,965	<1
Nehalem	17,962	0	17,962	100
Tillamook	32,731	44,383	77,114	42
Netarts	19,092	10,444	29,536	65
Sand Lake	238	0	238	100
Nestucca	1,663	0	1,663	100
Salmon	876	0	876	100
Siletz	8,731	0	8,731	100
Yaquina	39,977	2,834	42,811	93
Aisea	23,642	1,591	25,233	93
Siuslaw	7,024	1,824	8,848	79
Umpqua	3,671	1,160	4,831	76
Coos	40,065	11,683	51,748	77
Coquille	3,018	0	3,018	100
Rogue	0	0	0	0
Chetco	253	0	253	100
TOTAL	198,994	118,833	317,827	63
PERCENTAGE	63%	37%	100%	

^{1/} Table adapted from Stewart, Table 3 (1974 c).

^{2/} Sport catch is for the period March 1 through October 31, 1971. Hence, Yaquina Bay catch total is different from that in Table 4 which includes data from October 1970 to February 1971.

^{3/} Commercial catch is for the 1971 season which includes December of the previous year. Data in original reports given in pounds. A conversion of 25 pounds per dozen was used to estimate number of crabs caught.

Since the recreational fishery is restricted to the bays as a matter of logistics, and there is an extensive ocean commercial fishery for crab, one could ask why have a commercial fishery in the bays? The only legitimate answer is that the public is best served by doing so. Whether this is the case needs to be evaluated.

Initially commercial fishing occurred in the bays as a matter of convenience in harvesting the resource. The recreational fishery was inconsequential. Today the recreational fishery is dominant with only Tillamook, Netarts, and Coos bays supporting continuous commercial fisheries. Commercial fishing in other bays occurs when price and crab availability warrant it.

Observation of the recreational fishery shows that good catches are made periodically but that periods of poor fishing are common. Slack fishing could mean that the crabs simply are not "biting" but more reasonably it means that legal crab are not abundant in the area being fished. Under these conditions the recreational fishery has the ability to harvest the crab available. When a new migration of crab moves into the bay, catches go up but possibly not to a high enough level to harvest all that came in before they returned to the ocean.

Since unharvested bay crab return to the ocean and are subject to the commercial fishery there and at other times the recreational fishery has adequate harvesting capability for the crab available there would appear to be no need for the bay commercial fishery to harvest crab. However, recognizing that the reason for a commercial fishery is to make a resource available to the owning public having a commercial fishery in the bays when the supply of ocean crab is down is justifiable. Reduced supplies occur during the ocean season because of weather but are of short duration. A predictable and longer period when fresh crab are not available occurs during the 2-3 month fall closure of the ocean fishery. It is at this time that a bay commercial fishery for crab best serves the public.

A secondary basis for commercial fisheries is to provide employment (better thought of as a happy consequence of having commercial fisheries). This goal can be recognized in other than the fall months by allowing fishing in the bigger bays at other times of the year with seasonal or daily closures (night fishing only) to reduce peak or direct conflict with the recreational fishery.

A benefit to the crab fishing public resulting from a reduced commercial fishery is an increase in the average size and number of crabs in their bag. Needless to say this would be applauded by the recreational crabber.

Assuming that Oregon's human population will continue to increase, the sport crabbing segment of it will increase also. The time may come when some, at least, of Oregon's estuaries will have too much effort to allow unlimited crabbing. If need for a different allocation of the bay crab resource becomes necessary it could be accomplished by:

- (1) Closing all estuaries to commercial crabbing.
- (2) Closing all but the largest (Coos, Umpqua, Yaquina, Tillamook) estuaries to commercial crabbing.
- (3) Closing all or some estuaries to commercial crabbing during the peak recreation season (June 1-August 31).

- (4) Allow only rings to be used in the commercial fishery.
 (5) Reduce the personal use daily bag limit. Allow only rings to be used.

The problem of harvesting and handling soft-shelled crabs will probably always exist to some degree in estuaries for there are soft-shelled crabs present throughout the year. Emergency closure should be considered in specific areas or during times of high concentrations of soft-shelled crabs. In addition, a program should be undertaken to inform sport crabbers why it is best not to harvest soft-shelled crabs and how these crabs should be handled to prevent injuries. Such a program could include a regulation making retention of soft-shelled crab illegal. However, problems in enforcement could make it more of a paper regulation or educational instrument than an effective prohibition.

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