COMMENCEMENT BAY SEAFOOD CONSUMPTION STUDY

Preliminary Report

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ABSTRACT

The seafood consumption habits and demographics of non-commercial fishermen catching potentially hazardous seafood in Commencement Bay, Washington are examined. The ultimate aim of this study is to develop a health/risk model to project the potential health impact of eating contaminated seafood.

INTRODUCTION

In response to evidence that some Commencement Bay sediments contain significant levels of toxic and/or carcinogenic pollutants and evidence indicating a higher incidence of diseased fish/crustacea within the waterways areas (NOAA Technical Memorandum OMPA-2), the Tacoma-Pierce County Health Department initiated a fish/crustacea catch consumption study. The objectives of the study were as follows:

1. To determine the extent to which resident fish/crustacea are used for food.
2. To determine which species of fish/crustacea are consumed.
3. To determine the manner in which the fish/crustacea are prepared for consumption.
4. Utilizing the Environmental Protection Agency's (EPA) data regarding toxicant levels in the edible tissues, develop a health risk model for fish/crustacea consumers in Commencement Bay.

It should be noted that although salmon are a popular food fish caught in Commencement Bay, they have been excluded from this study. Due to their migratory nature, these fish have a minimal amount of contact with pollution sources in Commencement Bay.

Materials and Methods

Sample Area

The study area was defined as all salt water areas inside (Southeast) a straight line between the Browns Point Light House and Point Defiance. However, due to the heavy fishing pressure at Point Defiance, fish caught immediately off the Point (technically outside the study area) were included in our study. (See Map Appendix p. 1) Initial investigations showed that the area was too large to be sampled accurately by a single researcher. Thus, the shores of Commencement Bay were broken into four (4) sub-areas.

1. Browns Point to the Middle Waterway
2. City Waterway including the area east of the Continental grain elevator
3. Old Town, the grain elevator Northwest to Asarco
4. Point Defiance pier

During the first half of the survey (July - Sept. 11) each of the sub areas was sampled five (5) mornings and five (5) evenings. One morning period and one evening period equals one survey day. The sampling periods were from 7:30 AM to 3:30 PM and from 4:30 to as late as 1:00 AM. In the second half of the survey (Sept. 15 - Nov. 23) the boat ramp at Point Defiance was added to include the significant fishing activity which was missed in the first half. In this second half, Areas #2, #3, #4 and #5 (boat ramp) were sampled four (4) complete survey days. Because Area #1 had very light fishing pressure in the first half, the sampling effort in the second half was reduced to two (2) mornings and two (2) evenings. Dates for sampling were obtained from a random number table (ZAR, 1974).

Data Collection

The researcher contacted fishermen within the area being sampled and conducted an interview with successful fishermen. Persons not having fish were not interviewed. During the interview the researcher, with the fishermen's consent, identified the species of fish/crustacea caught and recorded fork length and wet weight data. The fishermen were then asked to volunteer information regarding the size of their living group, place of residence, fishing frequency and planned use of their fish/crustacea. Data on the fishermen's approximate age, sex, race and mode of fishing were also recorded. (See Appendix p. 2) At the end of the interview the fishermen were asked if they could be contacted by telephone for a follow-up survey. If they

had a phone and consented, their names and telephone numbers were recorded. Approximately one week later, the fishermen were contacted by phone and asked if they had eaten the subject fish/crustacea. If they had, they were asked how they prepared the fish/crustacea and to note any problems such as distaste, discolor or parasites they had noticed in their catch.

Results

Distribution of Fish Catch

In the first half of the study, over 95% of the fish, as measured in gross pounds, were caught on the southwest side of the Bay. The Point Defiance Pier and Old Town Dock accounted for over 77% of the catch. Roughly, 18% of the fish were caught in the City Waterway, while the entire Browns Point to Middle Waterway area accounted for less than 5% of the total catch. (See Appendix pages 3 and 4)

With the addition of the Point Defiance Boat Ramp in the second half of the survey, a large segment of the Commencement Bay fish catch was added. This boat ramp produced 59.9% of the fish catch. Most of these fish were caught just off the north shore of Point Defiance. The Point Defiance Pier accounted for 25.4% of the fish while the Old Town Dock, City Waterway and Area #1 produced 9.1%, 5.5% and .1% respectively. (See Appendix pages 5 and 6) Excluding fish from the boat ramp, the data can be directly compared to the first half of the survey. Nearly all (99.8%) of the fish were caught on the southwest side of the Bay. The Point Defiance Pier accounted for 63.5% of the catch while the Old Town Dock remained virtually unchanged at 22.5% of the fish. The City Waterway dropped to 13.8%, while Browns Point produced only one Striped Seaperch during four (4) survey periods, roughly .2% of the total catch. (See Appendix p. 6)

Thirty-seven (37) distinct species of fish were caught (and kept) during the survey. Two of these species (Pacific Hake and Walleye Pollock) dominated the catch, accounting for 69.3% of the total as measured by gross weight. By including two more species (Pacific Cod and Pacific Tomcod) we can account for 79.4% of the catch. These four (4) fish ranked in the five (5) most prevalent fish in both halves of the study. The addition of three more species (Pile Perch, Black Rockfish and Speckled Sandab) raises the percentage of catch to 88.3%. Of the remaining thirty (30) species, none account for more than 1.4% of the catch as measured by weight. (See Appendix pages 3-6)

In response to rumors of significant fishing activity at the Old Town Dock from midnight to dawn, a survey was conducted one (1) morning. There were only three (3) fishermen but they caught 13.75 pounds of fish. These fishermen, (one black, two whites) commented that the frequent Asian fishermen were not there. While one survey period cannot be used in a statistical analysis, it does indicate that all night fishing could account for a significant portion of the Commencement Bay fish catch.

Distribution of Crustacea

Two types of crustacea were caught within the study area. These were the Japanese Red Rock Crab and the Dungeness Crab. In the first half of the study, 41 crustacea (34.4% of total crustacea) were taken from the Blair and Hylebos Waterways in Area #1. The City Waterway produced 52.9% of the crustacea, while Areas #3 and #4 produced only 11.8% and .8% of the crustacea respectively. (See Appendix p. 11)

Who is Affected

In the first segment of the survey the racial composition was as follows:

White, 58.9%; Black, 22.7%; Oriental, 15.5%; Mexican, 2.6%, and a single Puyallup Indian accounted for .3% of the fishing population. With the change in the season from late summer to fall, there was a reduction in the number of fishermen. The racial composition in the second half was 60.8% White, 23.5% Oriental, 15.2% Black and .5% Mexican. It is interesting to note that the first half which composed of five (5) survey days interviewed 47 Orientals, while the second half with only four (4) survey days interviewed 48 Orientals. Because of the reduction in sampling effort this reflects an increase in Oriental fishing effort of 27.7%. (See Appendix p. 12)

In the first half of the study, school was out and 17.1% of the fishermen were aged 0 - 15 and 8.2% were over 50 years of age. In the second half of the study, school vacation was over and there was a significant drop in the number of children fishing. Only 2.9% were 0 - 15, 37.8% were 15 - 30, 40.7% were 30 - 50 and 18.6% were over 50. Excluding the boat ramp the numbers were 3.4%, 43.1%, 38.4% and 15.1% respectively. (See Appendix p. 13)

Despite the changes in racial composition and age distribution, the ratio of male to female remained unchanged. This was 85.9% male, 14.1% female in the first half, and 86.3% male, 13.7% female in the second. (See Appendix p. 14)

Fishermen were asked to reveal their place of residence in an effort to determine how broad an area the Commencement Bay fishery might impact. In the first half 78.8% of those who consented to this segment of the interview indicated they lived in Tacoma. Of the 21.1% who did not live in Tacoma 82.8% indicated they did live within Pierce County. Thus, only 3.6% of the interviewees indicated they lived outside of Pierce County. (See Appendix p. 15)

In the second part of the survey only 69.7% of the fishermen said they lived in Tacoma. However, at the boat ramp, 51% of the fishermen indicated they did not live in Tacoma. If this data is excluded for reasons of compari-

son, 78.6% indicated they are Tacoma residents. Yet, of the 21.4% remaining, only 57.1% (compared to 82.8% in the first half) indicated they live in Pierce County. This caused the incidence of non-County fishermen to rise to 9.2% (See Appendix p. 15) This must be tempered by the fact that one fisherman from Illinois who was visiting for two months was interviewed three times.

The data does not indicate any significant differences in living group size from area to area or season to season. By all indications, the Commencement Bay fisherman is the "average family unit" of, roughly, 3.5 members. The wide spread of family size in Area #1 is due to the relatively few interviews which were conducted in this area rather than a true difference in demographics. (See Appendix p. 16)

Fishermen were asked what they intended to do with their fish/crustacea. In both halves of the survey, roughly 95% (94.4% and 95.8%) indicated they intended to eat all or part of their catch. The majority of the remaining interviewees indicated they would give their catch to people who would eat it. This indicates that 98% - 99% of the catch is intended for human consumption. The remainder (six respondents in all) were undecided or intended to use some or all of their fish as animal food or fertilizer in their gardens. (See Appendix p. 17)

Fishing frequency produced surprisingly consistent results despite the deterioration of the weather associated with the arrival of fall. Excluding Area#5, the portion of daily fishermen only dropped from 10.4% to 8.3%. Weekly fishermen rose slightly from 50.3% to 52.3%, monthly from 20.1% to 15.9%, bimonthly from 6.7% to 3.8%, twice per year from 4.4% to 6.1% and the annual fishermen rose from 8.1% to 13.6%. (See Appendix p. 18)

Taking the average number of fishermen per day per area, one can estimate the average number of fishermen per day fishing on Commencement Bay. During the summer months approximately 60 fishermen/day are fishing on Commencement Bay (excluding the boat ramp which can be extremely busy during these months).

In the fall, only about 52 fishermen/day (37 fishermen/day excluding Area #5) are fishing in Commencement Bay. (See Appendix p. 19)

One objective of the survey was to determine how large a group is potentially impacted by Commencement Bay fish. If the percent of fishing frequency is multiplied by the average number of fishermen/day, this produces the number of fishermen in each frequency category on an average day. Multiplying the number of fishermen/category on an average day by a coefficient reflecting fishing frequency, we can approximate the number of unique fishermen potentially affected. (See Appendix p. 20)

Tables I and II of the data are directly comparable, whereas table III is not. This is due to the inclusion of data from area #5 in table III. The disparity between table I, which calculated 3187 unique fishermen and table II, which calculated 2631 unique fishermen, is due to the reduced number of fishermen seen during the fall months. The question "How often do you fish on Commencement Bay?" was intended to elicit a response indicating average fishing frequency over the entire year. If this question had been answered accurately, there would not have been as severe a change in the calculated number of unique fishermen. Fishermen tended to respond with how often they fished during the current season, not an annual average. This would tend to inflate the fishing frequency data and correspondingly, the calculated number of unique fishermen. Additionally, the data is subject to the interviewer's interpretation (i.e. is once every two weeks recorded as monthly or weekly?).

Despite the fluctuations in the data, it can be determined that approximately 2900 unique fishermen fish the shores of Commencement Bay each year. Table III shows that, with the addition of data from area #5, the calculated total number of unique fishermen increases to 3391. It must be remembered this is only the fall months. During the summer the boat ramp can be extremely busy. While no data was collected during the summer months, one would expect the calculated number of unique fishermen to be significantly higher.

Discussion

For reasons of direct comparison, most tables of the appendix have been provided with a column "% excluding Area #5" (the boat ramp) so they can be easily compared to the data gathered in the first half of the study. Also, when looking at the raw data, it must be remembered that July 5th through September 11th had five (5) survey days, while September 13th through November 23rd consisted of only four (4) survey days, except Area #1 which had only two (2) survey days.

As the ultimate objective of this study is to determine what, if any, health impact the consumption of Commencement Bay seafood might have, one must determine the seafood consumption rates of those involved.

On an average summer day (excluding boat fishing), approximately 60 people catch Commencement Bay fish. Of these, 94% indicate that they will eat their catch. Thus, about 57 people take fish home for personal consumption. The average daily catch is about 208 lbs. This means, roughly, 197 lbs. of fish are taken home by fishermen for personal consumption/day. Thus, the average successful fisherman takes home approximately 3.46 lbs. of fish. Of this 3.46 lbs. net weight, approximately 1.7 lbs. are in edible tissues. If these edible tissues are divided by 3.74, the average size living group, this works out to, roughly, .45 lbs. per person. The addition of the boat ramp brought the fall average daily catch to 409 lbs. Repeating the above process, we find the average fishing day produces, roughly, 1 lb. of edible fish tissue per day per person.

In an effort to determine whether a significant portion of the Commencement Bay boat fishermen were missed by our survey, information was obtained from the Washington State Department of Fisheries regarding bottom-fishing success at Narrows Marina. Narrows Marina has a public boat ramp five (5) statute miles south of Point Defiance. All fishermen recorded in the

data had caught and kept some type of "bottomfish". Unsuccessful bottom fishermen and salmon fishermen were not counted. (See Appendix 21) It must be remembered that the data table reflects only the interviewed portion of the fishing effort and catch. The survey form used by the Department of Fisheries appeared to miss many fishermen. Also, the data reflects only a limited number of days. For example, during the month of January (1980), only 34 bottom fishermen were contacted. However, the researcher only went to Narrows Marina a limited number of times.

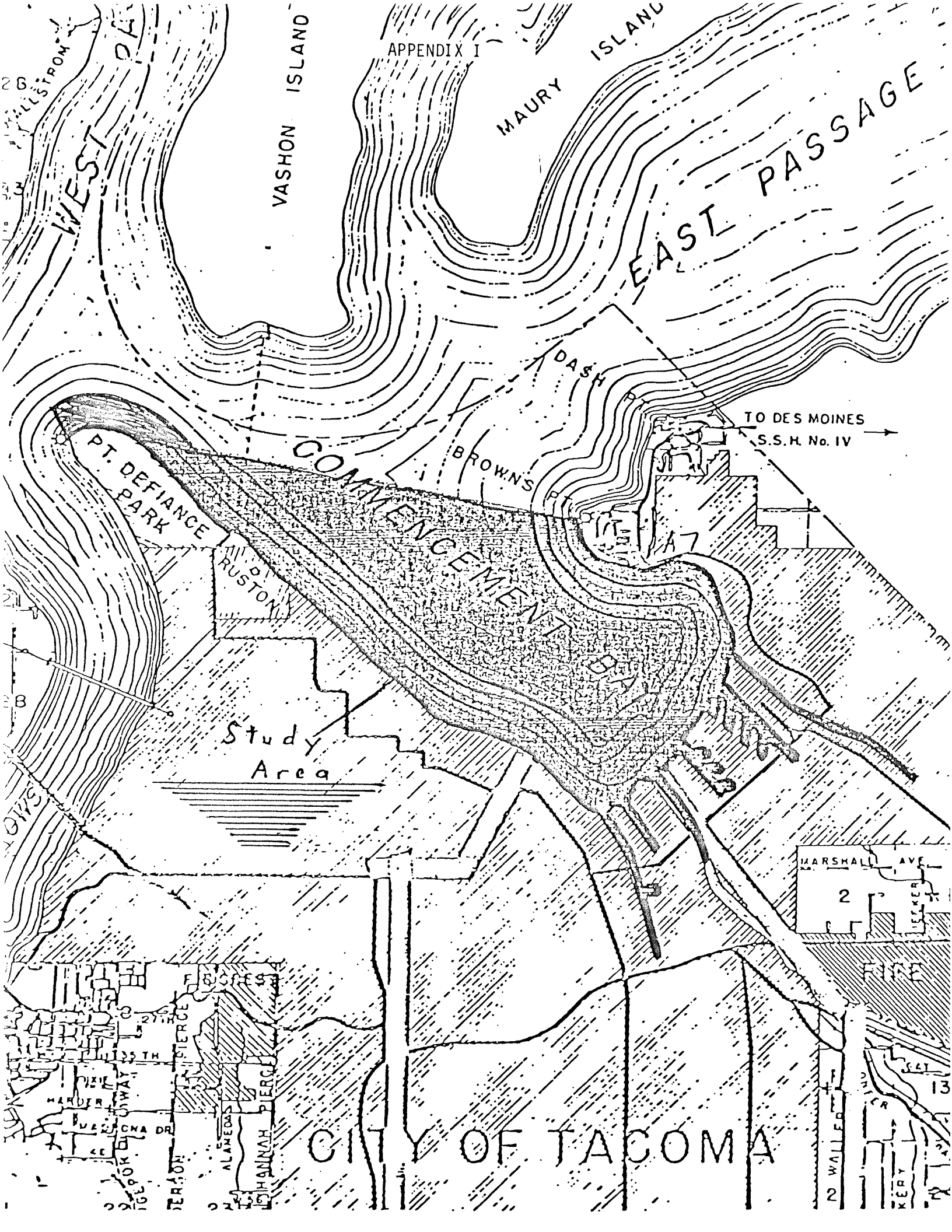
The second table of Appendix 21 shows the number of fish, by species, caught in punchcard Area #11 during each month of the year. While Commencement Bay is only a small portion of punchcard Area #11, the fishermen putting in at Narrows Marina and fishing punchcard Area #11 will tend to fish four (4) general areas. These are Point Evans, Salmon Beach, Dalco Pass and Point Defiance. While most of the rockfish were probably caught in the Narrows and can be dismissed, it is the opinion of this researcher that a significant portion of these fishermen are fishing the area around Point Defiance. If the EPA data indicates a potential health risk associated with eating large quantities of fish in the area of Point Defiance, fishermen from Narrows Marina could be adversely affected.

There were some concerns about the health impact potentially contaminated fish might have on the Puyallup Indian tribe. The Puyallup tribe runs a commercial salmon fishery and questions were raised about the extent of their non-salmon fishing activities. Interviews conducted with tribal fishermen and the tribal fisheries' biologist indicate that virtually no non-salmon Commencement Bay fish are consumed by the tribal members for three reasons. First, the tribal fishing council has discouraged consumption of resident fish due to pollution concerns. Secondly, the nets used for gill-netting salmon are a very selective 5¼ " to 6" mesh which discriminates against most

resident fish. Finally, these fishermen consider Hake, Pollock, Flounder and Perch to be "garbage fish", much like the devout sport salmon fishermen. Apparently, the only species involved in our study are very large Lingcod and Rockfish caught outside the study area.

Conclusions

Until data regarding the toxicant levels in the edible tissues of fish are obtained, no firm conclusions can be drawn. However, the data so far indicates there is a distinct Commencement Bay fishing population. This fishing population catches a significant amount of fish which, depending on the EPA findings, could represent a potential health risk to those who consume large quantities of fish. The seven (7) most common species (by weight) are probably the most important in terms of health impact since they are the only fish which are likely to be consumed in large volume. However, some species, such as Shiner Perch, are only caught (and consumed) by a very small segment of the fishing population. If these fish are found to have high levels of toxicants, there could be a health impact which exceeds the apparent risk.


WEST PASSAGE
VASHON ISLAND
MAURY ISLAND
EAST PASSAGE
DASH PT.
TO DES MOINES
S.S.H. No. IV
PT. DEFIANCE PARK
BROWNS PT.
COMMENCEMENT BAY
RUSTON
Study Area
MARSHALL AVE
CITY OF TACOMA
35TH
PIERCE
HARBOR
ALAMEDA
HANNAH
WALLER

APPENDIX 2

CREEL SURVEY

DATE ___/___/___ TIME ___:___ am/pm INTERVIEW # _____

SITE _____ RESPONDENT RACE _____

SEX ____Male ____ Female NUMBER IN LIVING GROUP _____

AGE OF RESPONDENT ____ 0-15, ____ 15-30, ____ 30-50, ____ over 50

MODE OF FISHING ____ Pier, Dock, ____ Bridge, ____ Beach, Bank,

____ Private Boat, Other _____

INTERVIEW STATUS ____ Agrees ____ Refuses

TACOMA RESIDENT ____ yes ____ no County _____ Other _____

IF FISHING FROM BOAT, WAS IT DONE WITHIN THE STUDY AREA?

____ yes ____ no ____ N/A

WHAT ARE YOU GOING TO DO WITH THIS FISH? _____

_____ # of fish caught _____

HOW OFTEN DO YOU CATCH FISH IN THE TEST AREA? ____ Daily ____ Weekly

____ Monthly ____ Bimonthly ____ Every six months ____ Yearly

SPECIES	LENGTH	WEIGHT
	/	/
	/	/
	/	/
	/	/
	/	/

NAME OF RESPONDENT _____ PHONE # _____

GOOD TIME TO CALL _____

REMARKS _____

APPENDIX 3

FISH CATCH

July - Sept. 11
1981
Weight (lbs.)

SPECIES	AREA #1 AM	AREA #1 PM	AREA #2 AM	AREA #2 PM	AREA #3 AM	AREA #3 PM	AREA #4 AM	AREA #4 PM	TOTAL WT SPECIE
1 Pacific Hake			3.7	16.25	14.5	185.45	1.5	110	331.4
2 Walleye Pollock			1	77.4	4	93.55	28.9	64.05	268.9
3 Pile Perch	16.1		15	5.25	21.2	15.65	5.2	24.95	103.3
4 Pacific Cod	3	1.75		9.85		8.2	54.15	8	84.9
5 Pacific Tomcod	1.85	1.4	12.9	13.45		17.15	1.05	18.75	66.5
6 Rock Sole	3.3	.45	1.35	3.85		7.8	3.5	3.25	23.5
7 Striped Seaperch	9.85		2.7	.3	4.6	4.55		1.25	23.2
8 Speckled Sandab				.1			9.8	12.4	22.3
9 Brown Rockfish	2.1		1.85	1.5	1.85	1.95	6.4	4.35	20
10 Sand Sole			2.6	8.35	.75	4.8	.8		17.3
11 English Sole		.5	1.55	4.1		5.8	.75	1.4	14.1
12 Big Skate								12	12
13 Copper Rockfish				.55	.3	1		5	6.8
14 Quillback Rockfish		.55				1.5	4.05		6.1
15 Black Rockfish	2						4		6
16 Spiney Dogfish						3.5		2.5	6
17 Starry Flounder				.3		4.05	.7		5.0
18 White Spotted Greenling	.65	1.8	.3	.25	.4		.25	.6	4.1
19 Shiner Perch				1.3	1.8		.4		3.

APPENDIX 4

FISH CATCH

July - Sept. 11
1981
Weight (lbs.)

SPECIES	AREA #1 AM	AREA #1 PM	AREA #2 AM	AREA #2 PM	AREA #3 AM	AREA #3 PM	AREA #4 AM	AREA #4 PM	TOTAL WT. SPECIE
20 Canary Rockfish								3.5	3.5
21 Red Irish Lord								2.5	2.5
22 Dover Sole				.85		.6	1		2.45
23 Bocaccia Rockfish							2		2
24 Flathead Sole			.7	.85					1.55
25 Pacific Sandab						1.2			1.2
26 Staghorn Sculpin	.85			.2					1.05
27 Petrale Sole						.85			.85
28 Butter Sole							.5		.5
29 C-O				.3					.3
30 Blenny								.1	.1
TOTAL	39.7	6.45	43.65	145.0	49.4	357.6	124.95	274.6	1041.35
% of Total	3.8	.6	4.2	14.0	4.7	34.3	12.0	26.4	

APPENDIX 5

FISH CATCH

Sept. 15 - Nov. 23
1981
Weight (lbs.)

Four Survey Days Except
Area #1 = Two Survey Days

SPECIES	AREA #1 AM	AREA #1 PM	AREA #2 AM	AREA #2 PM	AREA #3 AM	AREA #3 PM	AREA #4 AM	AREA #4 PM	AREA #5	TOTAL WT./ SPECIE
Walleye Pollock			10	30.85	8.2	17		79.05	809.55	954.65
Pacific Hake			3.9	12.75	5.2	75.55		180.95	24.2	302.55
Pacific Cod			2.3	1.5		17	9.1	18	45.45	93.35
Pacific Tomcod			1.55	4	.4	5.15	.8	39.15	1.15	52.2
Black Rockfish				.3	3.8		5.75	4	37.95	51.8
Speckled Sandab					1.85	4.2	7.95	9.15	17.85	41
Shiner Perch			3.9	4.26		.5	3.62	9.54		21.82
Pile Perch			5.3	1.6		2.75	6.1	1.5		17.25
Copper Rockfish				2.1		.6	.2	4.05	6.6	13.55
Brown Rockfish				.5			.3	.7	12.4	13.9
Quillback Rockfish								1.9	10.3	12.2
Rock Sole			1.2	.5	1.05	.85	3	1.8	3.6	12
Canary Rockfish								3.75	7	10.75
Pacific Sandab						3.6	.25	2.85	3.8	10.5
Big Skate								9.5		9.5
Starry Flounder								8.1		8.1
Sand Sole			1.1	1.6			.5		3.65	6.85
Spiney Dogfish									6.3	6.3
Red Stripe Rockfish									5.3	5.3

APPENDIX 6

FISH CATCH

Sept. 15 - Nov. 23
1981
Weight (lbs.)

Four Survey Days Except
Area #1 = Two Survey Days

SPECIES	AREA #1 AM	AREA #1 PM	AREA #2 AM	AREA #2 PM	AREA #3 AM	AREA #3 PM	AREA #4 AM	AREA #4 PM	AREA #5	TOTAL WT./ SPECIE
Irish Lord								.25	3.8	4.05
Staghorn Sculpin			.25					3.75		4
English Sole						1.85		1.8		3.65
Striped Seaperch	1.3						1.15	1		3.45
Dover Sole						.2		1.25	1.75	3.2
YelloweyeRockfish								2.45		2.45
Sablefish									1.8	1.8
Cabazon								1.5		1.5
Arrowtooth Flounder						1.4				1.4
Petrale Sole				1.25						1.25
Kelp Greenling			1.1							1.1
Buffalo Sculpin								.8		.8
White Spotted Greenling									.7	.7
Bocaccia Rockfish				.2				.25		.45
Blenny						.25				.25
TOTAL WEIGHT/AREA	1.3	0	30.6	61.41	20.5	130.9	38.72	387.04	1003.15	1637.62
% of Total Including Area #5	.1	0	1.8	3.7	1.3	7.8	2.3	23.1	59.9	
% of Total Excluding Area #5	.2	0	4.6	9.2	3	19.5	5.8	57.7	--	

APPENDIX 7

FISH CATCH

July - Sept. 11
1981
(Quantity)

Five Survey Days

SPECIES	AREA #1 AM	AREA #1 PM	AREA #2 AM	AREA #2 PM	AREA #3 AM	AREA #3 PM	AREA #4 AM	AREA #4 PM	TOTAL #
Pacific Tomcod	8	7	53	80		82	7	97	334
Walleye Pollock			1	85	3	145	26	69	329
Pacific Hake			6	18	10	177	1	97	309
Pile Perch	14		12	14	13	23	5	20	101
Speckled Sandab				1			37	50	88
Rock Sole	8	2	4	12		24	9	8	67
English Sole		1	4	16		17	1	3	42
Brown Rockfish	3	6	3	7	3	5	5	6	38
Shiner Perch				15	18		4		37
Pacific Cod	1	1		4		4	21	4	35
Sand Sole			5	12	1	6	2		26
Striped Seaperch	10		2	1	3	6		2	24
Copper Rockfish				2	1	3		4	10
White Spot Greenling	2	2	1	1	1		1	1	9
Starry Flounder				1		4	2		7
Dover Sole				3		2	1		6
Quillback Rockfish		2				1	3		6
Flathead Sole			2	3					5
Staghorn Sculpin	4			1					5

APPENDIX 8

FISH CATCH

July - Sept. 11
1981
(Quantity)

Five Survey Days

SPECIES	AREA #1 AM	AREA #1 PM	AREA #2 AM	AREA #2 PM	AREA #3 AM	AREA #3 PM	AREA #4 AM	AREA #4 PM	TOTAL #
Black Rockfish	3						1		4
Pacific Sandab						4			4
Irish Lord								4	4
Petrale Sole						3			3
Canary Rockfish								2	2
Big Skate								2	2
Spiney Dogfish						1		1	2
Bocaccia Rockfish							1		1
C-O Sole						1			1
Butter Sole							1		1
Blenny								1	1
TOTAL	53	21	93	276	53	508	128	371	1503

APPENDIX 9

FISH CATCH

Sept. 15 - Nov. 23
1981
(Quantity)

Four Survey Days Except
Area #1 = Two Survey Days

SPECIES	AREA #1 AM	AREA #1 PM	AREA #2 AM	AREA #2 PM	AREA #3 AM	AREA #3 PM	AREA #4 AM	AREA #4 PM	AREA #5	TOTAL #
Walleye Pollock			12	30	10	14		79	580	725
Shiner Perch			40	49		5	41	123		258
Pacific Tomcod			7	17	2	22	4	179	4	235
Pacific Hake			3	10	2	58		136	24	233
Speckled Sandab					4	11	20	24	48	107
Pacific Sandab						12	1	11	9	33
Pacific Cod			1	1		4	3	7	13	29
Rock Sole			3	1	3	5	7	4	5	28
Quillback Rockfish								4	18	22
Copper Rockfish				3		1	1	6	5	16
Pile Perch			4	1		2	5	1		13
Brown Rockfish				1			1	1	9	12
Staghorn Sculpin			1					11		12
Black Rockfish				2	1		1	1	6	11
Sand Sole			3	2			1		5	11
Starry Flounder								9		9
English Sole						6		1		7
Red Stripe Rockfish									7	7
Striped Sea Perch	1						2	1		4

APPENDIX 10

FISH CATCH

Sept. 15 - Nov. 23
1981
(Quantity)

Four Survey Days Except
Area #1 = Two Survey Days

SPECIES	AREA #1		AREA #2		AREA #3		AREA #4		AREA	TOTAL
	AM	PM	AM	PM	AM	PM	AM	PM	#5	#
Irish Lord								1	3	4
Yelloweye Rockfish								3		3
Canary Rockfish								1	2	3
Dover Sole						1		1	1	3
Spiney Dogfish									2	2
Bocaccia Rockfish				1				1		2
Kelp Greenling			2							2
Blenny						2				2
Arrowtooth Flounder						1				1
Sablefish									1	1
White Spotted Greenling									1	1
Petrale Sole				1						1
Cabazon								1		1
Buffalo Sculpin								1		1
Big Skate								1		1
TOTAL	1	0	76	119	22	144	87	608	743	1800

APPENDIX 11

CRUSTACEA CATCH

July - Sept. 11
1981
(Quantity)

Five Survey Days

	AREA #1		AREA #2		AREA #3		AREA #4		TOTAL
	AM	PM	AM	PM	AM	PM	AM	PM	
Red Rock Crab	11	21	1	42		11		1	87
Dungeness Crab	5	4	1	19	1	2			32
Total Crustacea	16	25	2	61	1	13		1	119

CRUSTACEA CATCH

Sept. 15 - Nov. 23
1981
(Quantity)

Four Survey Days

	AREA #1		AREA #2		AREA #3		AREA #4		AREA #5	TOTAL
	AM	PM	AM	PM	AM	PM	AM	PM		
Red Rock Crab		10		8		16		12	–	46
Dungeness Crab				5		3			–	8
									–	
Total Crustacea		10		13		19		12	–	54

APPENDIX 12

RESPONDENTS RACE

July - Sept. 11
1981

Five Survey Days

	AREA #1		AREA #2		AREA #3		AREA #4		TOTAL	%
	AM	PM	AM	PM	AM	PM	AM	PM		
White	8	6	9	22	9	60	31	34	179	58.9
Black	5	1	10	19	2	19	1	12	69	22.7
Oriental		1	3	11	4	11	5	12	47	15.5
Mexican				3		4		1	8	2.6
Indian				1					1	.3
TOTAL	13	8	22	56	15	94	37	59	304	

RESPONDENT's RACE

Sept. 15 - Nov. 23
1981

Four Survey Days

	AREA #1		AREA #2		AREA #3		AREA #4		AREA #5	TOTAL	%
	AM	PM	AM	PM	AM	PM	AM	PM			
White	1	1	6	6	1	34	11	11	53	124	60.8
Black			7	8	1	9		3	3	31	15.2
Oriental			6	2	4	3	5	26	2	48	23.5
Mexican								1		1	.5
TOTAL	1	1	19	16	6	46	16	41	58	204	

RESPONDENT'S AGE

July - Sept. 11
1981

Five Survey Days

	AREA #1		AREA #2		AREA #3		AREA #4		TOTAL	%
	AM	PM	AM	PM	AM	PM	AM	PM		
0-15	1	1	5	11	4	12	11	7	52	17.1
15-30	4	2	9	21	3	47	7	22	115	37.8
30-50	8	5	7	19	7	32	12	22	112	36.9
50+			1	5	1	3	7	8	25	8.2
TOTAL	13	8	22	56	15	94	37	59	304	

RESPONDENT'S AGE

Sept. 15 - Nov. 23
1981

Four Survey Days

	AREA #1		AREA #2		AREA #3		AREA #4		AREA #5	TOTAL	%	EXCL. #5 %
	AM	PM	AM	PM	AM	PM	AM	PM				
0-15			2	1		1		1	1	6	2.9	3.4
15-30	1	1	6	6	2	25	8	14	14	77	37.8	43.1
30-50			8	8	2	15	5	18	27	83	40.7	38.4
50+			3	1	2	5	3	8	16	38	18.6	15.1
TOTAL	1	1	19	16	6	46	16	41	58	204		

APPENDIX 14

SEX OF RESPONDENTS

July - Sept. 11
1981

Five Survey Days

	AREA #1		AREA #2		AREA #3		AREA #4		TOTAL	%
	AM	PM	AM	PM	AM	PM	AM	PM		
Male	12	8	17	47	15	80	33	49	261	85.9
Female	1		5	9		14	4	10	43	14.1

SEX OF RESPONDENTS

Sept. 15 - Nov. 23
1981

Four Survey Days

	AREA #1		AREA #2		AREA #3		AREA #4		AREA #5	TOTAL	%
	AM	PM	AM	PM	AM	PM	AM	PM			
Male	1	1	19	13	6	38	13	35	50	176	86.3
Female				3		8	3	6	8	28	13.7

APPENDIX 15

RESPONDENT RESIDENCY

July - Sept. 11
1981

Tacoma Resident?	AREA #1 AM	AREA #1 PM	AREA #2 AM	AREA #2 PM	AREA #3 AM	AREA #3 PM	AREA #4 AM	AREA #4 PM	TOTAL	%
Yes	5	6	19	47	13	82	27	39	238	78.8
No	8	2	3	8	2	11	10	20	64	21.2

If Not Tacoma, Pierce County?

Yes	4	2	3	8	1	10	8	17	53	82.8
No	4				1	1	2	3	11	17.2

RESPONDENT RESIDENCY

Sept. - Nov. 23
1981

Tacoma Resident?	AREA #1 AM	AREA #1 PM	AREA #2 AM	AREA #2 PM	AREA #3 AM	AREA #3 PM	AREA #4 AM	AREA #4 PM	AREA #5	TOTAL	%	% EXCL. #5
Yes			13	14	5	32	11	28	28	131	69.7	78.6
No	1	1	4	2		11	4	5	29	57	30.3	21.4

If Not Tacoma, Pierce Co.?	AREA #1 AM	AREA #1 PM	AREA #2 AM	AREA #2 PM	AREA #3 AM	AREA #3 PM	AREA #4 AM	AREA #4 PM	AREA #5	TOTAL	%	% EXCL. #5
Yes	1	1	3	2		7		2	16	32	56.1	57.1
No			1			4	4	3	13	25	43.9	42.9

APPENDIX 16

AVERAGE NUMBER IN LIVING GROUP

July - Sept. 11
1981

AREA #1	AREA #2	AREA #3	AREA #4
AM 3.77	AM 4.27	AM 3.3	AM 4.28
PM 5.24	PM 3.38	PM 3.52	PM 3.68

AVERAGE NUMBER IN LIVING GROUP

Sept. 15 - Nov. 23
1981

AREA #1	AREA #2	AREA #3	AREA #4	AREA #5
AM 1	AM 4.04	AM 4.22	AM 2.58	3.38
PM 2	PM 3.25	PM 3.18	PM 4.52	

APPENDIX 17

UTILIZATION OF CATCH

July - Sept. 11
1981

Five Survey Days

	AREA #1		AREA #2		AREA #3		AREA #4		TOTAL	%
	AM	PM	AM	PM	AM	PM	AM	PM		
Eat	13	8	20	53	13	88	33	58	286	94.4
Give Away (Sell)			1	2	1	6	3	1	14	4.6
Fertilizer			1						1	.3
Undecided					1		1		2	.7

UTILIZATION OF CATCH

Sept. 15 - Nov. 23
1981

Four Survey Days

	AREA #1		AREA #2		AREA #3		AREA #4		AREA #5	TOTAL	%
	AM	PM	AM	PM	AM	PM	AM	PM			
Eat	1	1	16	16	5	40	15	33	56	183	95.8
Give Away (Sell)			1			3			1	5	2.6
Animal Food			1	1					1	3	1.6

APPENDIX 18
FISHING FREQUENCY

July - Sept. 11
1981

Five Survey Days

	AREA #1		AREA #2		AREA #3		AREA #4		TOTAL	%
	AM	PM	AM	PM	AM	PM	AM	PM		
Daily		2	2	11	2	10	2	2	31	10.4
Weekly	6	3	12	28	4	45	17	35	150	50.3
Monthly	4	2	6	8	3	16	7	14	60	20.1
Bimonthly	1		1	3	3	4	5	3	20	6.7
2x/year	1	1		2	1	4		4	13	4.4
Yearly	1		1	3	1	12	5	1	24	8.1

FISHING FREQUENCY

Sept. 15 - Nov. 23
1981

Four Survey Days

	AREA #1		AREA #2		AREA #3		AREA #4		AREA #5	TOTAL	%	EXCL.#5 %
	AM	PM	AM	PM	AM	PM	AM	PM				
Daily			2	2	1	1	3	2		11	5.8	8.3
Weekly			8	9	2	24	5	21	28	97	51.0	52.3
Monthly		1	2	3	2	6	4	3	19	40	21.1	15.9
Bimonthly			1			2	1	1	3	8	4.2	3.8
2 x/Year	1		1	2		3	1		4	12	6.3	6.1
Yearly			3			8	1	6	4	22	11.6	13.6

APPENDIX 19

AVERAGE FISHERMEN/DAY

July 5 - Sept. 11
1981

AREA #1	AREA #2	AREA #3	AREA #4	TOTAL
4.2/day	15.6/day	21.8/day	18.6/day	60.2 fishermen/day

AVERAGE FISHERMEN/DAY

Sept. 13 - Nov. 23
1981

AREA #1	AREA #2	AREA #3	AREA #4	AREA #5	TOTAL	TOTAL EXCL. AREA#5
1/day	8.75/day	13/day	14.25/day	15.5/day	52.5 fish-men/day	37 fishermen/day

APPENDIX 20

TOTAL FISHERMEN

July - Sept. 11
1981

FREQUENCY	FREQUENCY %	NUMBER OF FISHERMEN ON AN AVERAGE DAY	CO-EFFICIENT	NUMBER OF UNIQUE FISHMEN
Daily	10.4	6	1.2	7
Weekly	50.3	30	7	210
Monthly	20.1	12	30.4	364
6 x yearly	6.7	4	60.8	234
2 x yearly	4.4	3	182.5	547
Yearly	8.1	5	365	1825
			TOTAL UNIQUE FISHERMEN	3187

TOTAL FISHERMEN
Sept. 13 - Nov. 23
1981

FREQUENCY	FREQUENCY %	NUMBER OF FISHERMEN ON AN AVERAGE DAY	CO-EFFICIENT	NUMBER OF UNIQUE FISHERMEN
Daily	8.3	3	1.2	4
Weekly	52.3	19	7	133
Monthly	15.9	6	30.4	182
6 x yearly	3.8	2	60.8	122
2 x yearly	6.1	2	182.5	365
Yearly	13.6	5	365	1825
			TOTAL UNIQUE FISHERMEN	2631

TOTAL FISHERMEN

Sept. 13 - Nov. 23
1981

FREQUENCY	FREQUENCY %	NUMBER OF FISHERMEN ON AN AVERAGE DAY	CO-EFFICIENT	NUMBER OF UNIQUE FISHERMEN
Daily	5.8	3	1.2	4
Weekly	51	27	7	189
Monthly	21.1	11	30.4	334
6 x yearly	4.2	2	60.8	126
2 x yearly	6.3	3	182.5	548
Yearly	11.6	6	365	2190
			TOTAL UNIQUE FISHERMEN	3391

APPENDIX 21

WASHINGTON STATE DEPARTMENT OF FISHERIES DATA

NUMBER OF FISHERMEN LAUNCHING AT NARROWS MARINA - 1980

MONTH	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
AREA #11													
No. of Narrows Bridge	34	36	44	48	76	107	59	41	66	60	36	13	620
AREA #13													
So. of Narrows Bridge	0	151	122	132	157	144	181	73	69	70	40	40	1179

WASHINGTON STATE DEPARTMENT OF FISHERIES

PUNCHCARD AREA #11 CATCH - 1980

NARROWS MARINA

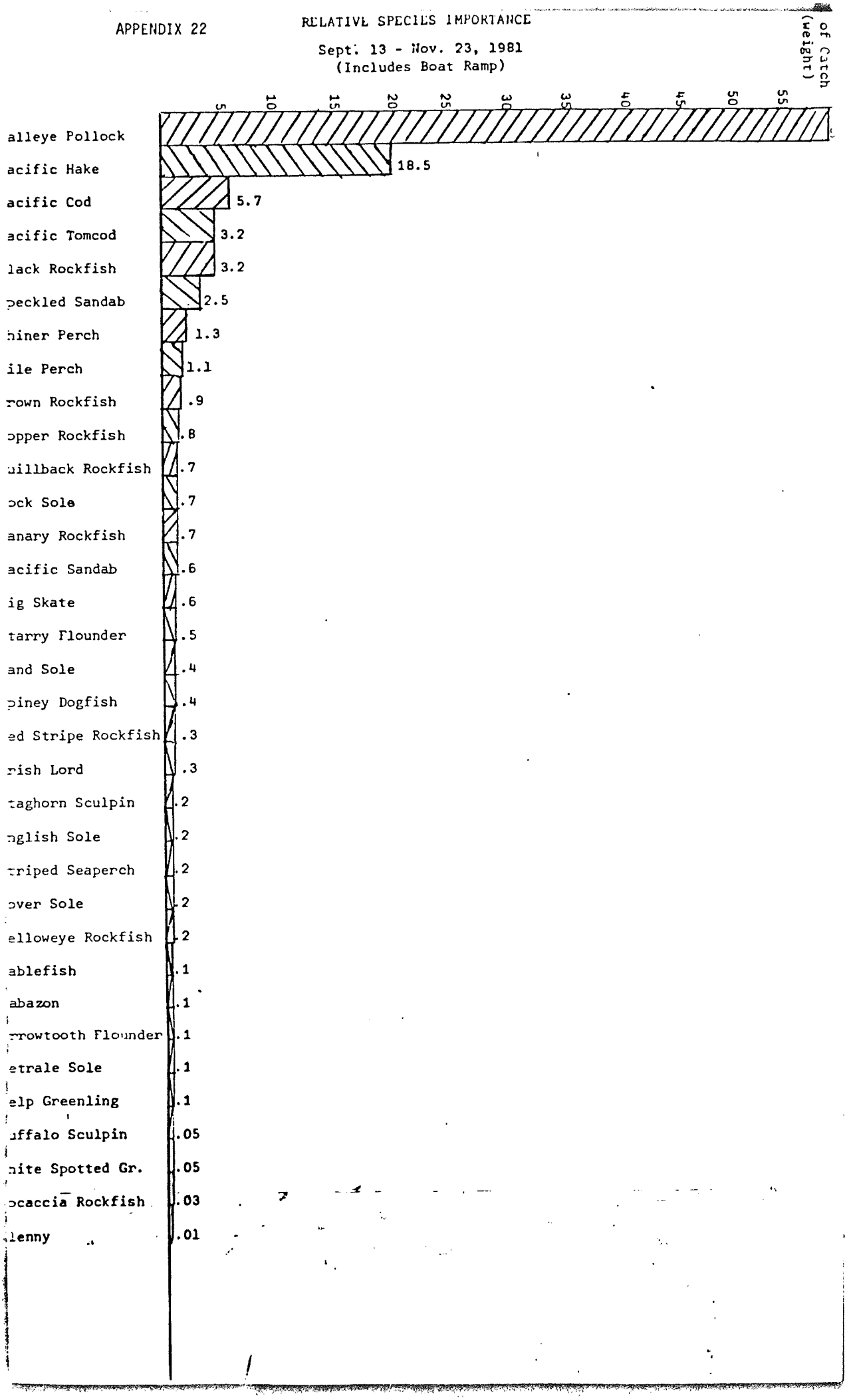
(Quantity by Month)

MONTH	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
Walleye Pollock	102	87	137	110	204	439	126	36	126	203	75	108	1753
Pacific Cod	14	8	3	19	16	36	6	0	11	69	40	2	224
Brown Rockfish	12	6	9	5	4	12	5	3	14	11			81
Copper Rockfish	2	1	13	2	12	8	16	3	4	6			67
Quillback Rockfish	4		5	8	4	3				14			38
Redstripe Rockfish			35	4						4	1		44
Black Rockfish	6		2			1					1		10
Yellowtail Rockfish	1			1	3	1			1	4			11
Canary Rockfish						5			1	2	1		9
Bocaccia Rockfish	1												1
Yelloweye Rockfish			3										3
Rockfish (other)	3	1	23	17	3	5	24	13		17	7		113
Pacific Hake					1	8	6	11	6				32
Sablefish				3									3
Greenling					1								1
Pacific Tomcod	2	2	1								1		6
Spiney Dogfish		2				1				2			5
Irish Lord	2			2					1	1			6
Silvergrey										7			7
Rock Sole	1		2	8	3			1	3	30			48
Sandab										3			3
Flounder (other)		2	4	16	17		2	7	4	8	5		65

APPENDIX 22

RELATIVE SPECIES IMPORTANCE

Sept. 13 - Nov. 23, 1981
(Includes Boat Ramp)



APPENDIX 25

RELATIVE SPECIES IMPORTANCE

July 5 - September 11, 1981