ANNUAL REPORT

FISH RESEARCH PROJECT

OREGON

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INTRODUCTION

Ocean pink shrimp (*Pandalus jordani*) are harvested by trawl fisheries off the Washington, Oregon, and California coasts in depths ranging from 50 to 150 fathoms (Zirges and Robinson, 1980). The shrimp fleet is quite mobile and vessels routinely fish and land shrimp in different states. In recognition of the regional nature of this fishery, the Pacific Fishery Management Council developed a draft Fishery Management Plan for pink shrimp in the late 1970's. The three states are currently using this plan as the basis for shrimp resource management through consistent state regulations. The Shrimp Resource Assessment project was initiated to supplement the Oregon Department of Fish and Wildlife's fishery monitoring activities and to specifically address the need for an interjurisdictional management approach for pink shrimp.

This annual report for project #1-IJ-11 covers contract activities during calendar year 1991. Research results submitted for publication in peer reviewed journals are not reported upon in detail in this report. Reprints of the resultant journal articles will be forwarded as attachments as soon as they are available.

Project Objectives

The primary objective of the Shrimp Resource Assessment project is to provide scientific information and alternative resource use strategies for the management of the pink shrimp fishery resource. To accomplish this objective, we developed five specific annual tasks:

1. Collect and code shrimp fishery logbook data, match logbook information to official landing records, and summarize in a form readily useable in mathematical models.

2. Collect shrimp market samples dockside and compile age, sex, maturity, length, and weight data.

3. Analyze fishery catch data and biological market samples.

4. Provide fishery managers in neighboring states with reports describing location of catch, total catch and effort, catch per unit effort (lb/trip, lb/h, lb/vessel), and biological parameters of the shrimp caught in the fishery.

5. Communicate fishery and research problems and strategies to other state and federal agencies and provide management recommendations for the entire harvest area.

FY 91 Accomplishments

We completed all of the planned tasks in 1991. Summarization and analysis of the 1991 trawl logbook data is complete. We collected and analyzed shrimp market samples for the months April through October for all state statistical areas receiving substantial fishing effort (Figure 1).

We improved management coordination with resource managers from California and Washington in 1991. As in past years, monthly shrimp landing reports, including summaries of market sample data, were provided to the states of California and Washington. In February 1991, a meeting of staff biologists from all three states was held to exchange technical information, and discuss the future management of the pink shrimp fishery. At the February meeting the group agreed that annual technical meetings on pink shrimp would be beneficial in helping to coordinate data collection and management oriented activities. One spinoff from this meeting is that we completed, in cooperation with Washington staff biologists, a preliminary survey of codend mesh sizes being used by the shrimp trawl fishery off these two states.

FISHERY CATCH AND EFFORT

Approximately 21.7 million pounds of pink shrimp were landed in Oregon during 1991, about 10.2 million pounds less than in 1990 (Table 1). The 1991 catch was below the ten year average catch of 27.2 million pounds. The 1991 season began quickly with no price-related delays. The opening price was 54¢/lb for all legal grade shrimp. This is an increase of 9¢/lb over last years opening price. The ex-vessel price rose to 60¢/lb during the last week of May. Nearly all shrimp fishing stopped coastwide after about 17 July when fishermen tied up in response to a price decline.

Table 1. Preliminary catch (lbx1000) , effort (trips) and catch/effort (C/E) statistics for the Oregon pink shrimp fishery for 1990 and 1991.

		Month							
Statistic		Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Catch,	1991	3,153	3,446	4,022	2,134	4,231	2,888	1,803	21,677
	1990	6,079	7,593	7,504	4,013	3,464	2,360	881	31,894
Effort,	1991	378	347	308	159	328	292	178	1990
	1990	329	481	449	359	351	286	148	2,403
C/E,	1991	8.3	9.9	13.1	13.4	12.9	9.9	10.1	10.9
	1990	18.5	15.8	16.7	11.2	9.9	8.3	6.0	13.3

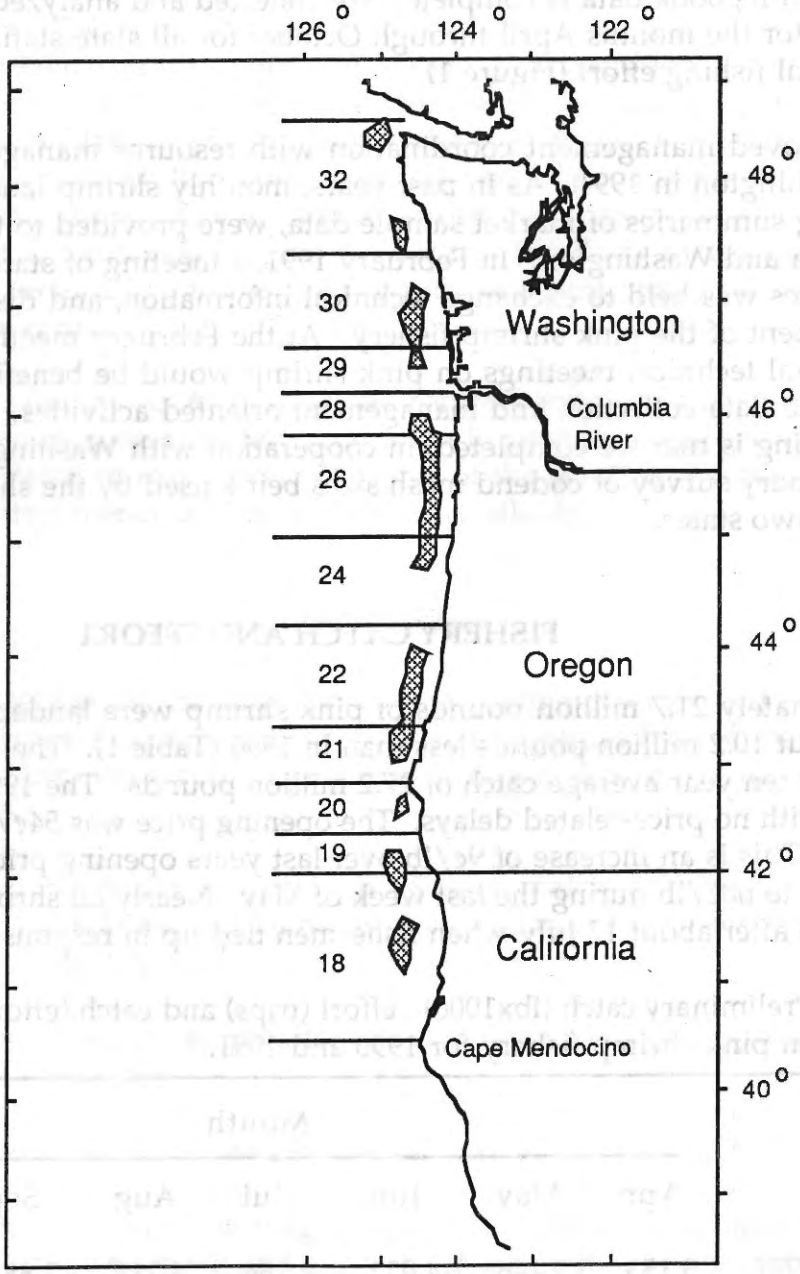

Figure 1. Oregon state statistical areas 18-32 and commercial concentrations of pink shrimp along the Washington, Oregon and northern Califronia coasts.

The dispute lasted into the first week of August when fishermen accepted a price of 53¢/lb. The price remained stable through the remainer of the season. Split pricing based on grade did not occur this year. Monthly landing totals were below average for each month except August, when landings peaked at about 4.2 million pounds. The 1991 season was unusual in that early season landings were depressed, making monthly landings more uniform throughout the season. The effects of the 1989 year class failure were evident in the poor showing of two year old shrimp during the 1991 season. In recent years, early season (April, May and June) landings have typically been composed primarily of age-1 and age-2 shrimp. The relative absence of age-2 shrimp this year meant that fishermen had a harder time finding large volumes of shrimp while still maintaining an average count below 160 shrimp/lb. The low landings shown for July resulted mostly from the prolonged tie-up over price.

BIOLOGICAL DATA COLLECTION

Sampling Methods

We attempted to collect 4-6 samples of approximately 100 shrimp from each of Oregon state statistical areas 19-32 during each month of the fishing season (Figure 1). Statistical areas 19-32 encompass the area from the Oregon-California border to the U.S.-Canada border. Shrimp samples were obtained at the docks prior to processing. We measured carapace lengths and determined average weight expressed as the number of whole shrimp per pound. Each shrimp was classified as male, female or transitional based upon close examination of the inner ramus of the first pleopod after Tegelberg and Smith (1957).

Individual samples within a month and statistical area were combined for analysis of age and sex composition. When sample size deviated substantially from 100 shrimp, the raw length and sex frequency data were rescaled proportionally to a sample size of 100 before combining with other samples. As a result, samples were given equal weight in determining age and sex composition.

Age composition for each month and statistical area was then determined by identifying modes in the combined length frequency histogram. We assigned ages using nadirs in the histograms to set a range of carapace lengths corresponding to each age group. After the age and sex of each shrimp were assigned, age and sex composition and mean length at age were compiled for each month and area.

Results And Discussion

We collected market samples for most areas and months which received fishing effort in 1991. Sample coverage was very light in areas 18 and 29, reflecting low levels of fishing effort by Oregon vessels in some months, and the fact that catch

from these areas was often landed in other states. Near the end of the season it also became difficult to obtain samples from state areas 26 and 28 since effort in these areas had dropped off to nearly nothing.

The age composition of the catch (Table 2) shows low levels of age 2 shrimp throughout the season, except in the most northern areas. In many areas and months age two shrimp represented an equal or lower component of the catch than age three shrimp, which have experienced an extra year of heavy fishing and natural mortality. This suggests just how severely depressed the age two year class was in 1991. The fairly high count-per-pound values shown in many months also reflects the relative weakness of the age two year class.

Age zero shrimp were found in all six areas sampled in October (Table 2), and comprised a fairly large component of some samples in the southern areas. The wide geographic range of age zero shrimp is a positive sign for 1992 recruitment. The strong presence of these shrimp in southern areas is especially encouraging. When pink shrimp recruitment is weak it is usually worst in the southern areas and stronger recruitment in general is often accompanied by larger catches to the south (Hannah 1991 ODFW, draft).

Mean lengths at age (Table 3) fall in the low end of the range reported by Hannah and Jones (1991) for years after 1978, suggesting that growth in recent years has been average, to lower than average. Age zero shrimp were fairly small, similar to 1991. The October sex composition (Table 4) shows moderately high levels of primary females, as expected. This accelerated sex change at age one is in response to the weak age two year class (Charnov et al. 1978). In 1992 the age composition of the stock is expected to be better balanced and lower levels of primary females are expected.

RESEARCH ACTIVITIES

Research activities in 1991 continued to focus on evaluating environmental and parent-stock influences on recruitment in pink shrimp. This work has been completed and a paper is in preparation for submission to a peer-reviewed journal. Our results suggest that large scale seasonal and cyclical fluctuations in the north Pacific ocean-atmosphere system explain roughly 70% of the variation seen in shrimp recruitment.

A second area in which research progressed in 1991 is in our efforts to collect data on changes in shrimp trawl gear. During the 1970's the shrimp fleet was rapidly converting from Gulf-style trawls to high rise box trawls (Zirges and Robinson 1980). At that time, very little data was collected documenting how fast the changes occured, or the effect on average vessel efficiency. At about the same time smaller codend mesh sizes apparently also came into use, confounding the issue somewhat. The lack of basic data on the specific trawl gear being fished in those years has made

Table 2. Monthly pink shrimp age composition (percent) , count per pound (Ct), and number Sampled (N) by Oregon state statistical area, 1991.

State Area	Age	Apr	May	Jun	Jul	Aug	Sep	Oct
32	0	0.0	0.0	0.5	0.0	0.0	0.2	0.3
	1	20.5	58.5	59.5	87.7	71.3	86.8	75.7
	2	55.5	30.2	34.5	6.9	17.8	10.0	14.4
	3+	24.0	11.4	5.9	5.4	10.9	3.0	9.7
	Ct	108.9	140.0	132.2	142.6	121.7	140.5	137.7
	N	200	378	388	391	394	803	362
30	0	0.0	0.0	0.0	11.0	0.0	0.4	1.0
	1	24.4	86.7	80.3	85.0	91.0	88.9	88.4
	2	37.9	7.3	11.3	3.0	4.5	7.2	53.1
	3+	37.7	6.0	8.4	1.0	4.5	3.5	7.4
	Ct	98.4	181.2	158.7	157.2	149.2	136.7	124.5
	N	398	300	406	100	400	936	956
29	0	--	--	0.0	--	--	0.2	--
	1	--	--	95.4	--	--	74.4	--
	2	--	--	4.6	--	--	8.2	--
	3+	--	--	0.0	--	--	17.1	--
	Ct	--	--	192.3	--	--	99.3	--
	N	0	0	109	0	0	414	0
28	0	0.0	0.0	0.0	0.0	0.0	--	--
	1	58.0	75.0	90.6	92.1	93.1	--	--
	2	24.7	15.3	5.0	4.5	5.9	--	--
	3+	17.3	9.7	4.5	3.4	1.0	--	--
	Ct	138.1	139.4	155.7	140.1	155.5	--	--
	N	486	629	202	292	204	0	0
26	0	0.0	0.0	0.0	0.0	0.0	--	--
	1	18.7	55.2	80.7	86.7	77.7	--	--
	2	29.0	27.5	10.9	8.8	9.0	--	--
	3+	52.3	17.3	8.4	4.5	13.3	--	--
	Ct	84.2	107.1	140.1	137.1	101.5	--	--
	N	999	375	393	600	399	0	0

Table 2. Continued.

State Area	Age	Apr	May	Jun	Jul	Aug	Sep	Oct
24	0	0.0	0.0	0.0	0.0	0.0	0.0	--
	1	34.7	79.6	87.7	54.3	65.4	85.9	--
	2	21.5	13.4	5.2	11.9	16.5	8.8	--
	3+	43.9	7.0	7.2	33.8	18.1	5.2	--
	Ct	90.9	142.5	155.4	90.5	92.5	100.3	--
	N	303	299	601	302	188	716	0
22	0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
	1	29.3	76.5	85.1	89.0	71.9	85.6	96.2
	2	26.9	9.1	10.0	9.0	10.4	4.6	2.2
	3+	43.8	14.4	5.0	2.0	17.7	9.8	1.2
	Ct	88.9	143.2	148.0	133.9	100.3	108.2	111.2
	N	502	701	201	100	402	1109	1327
21	0	0.0	0.0	0.0	0.0	5.7	0.0	6.0
	1	47.8	57.8	96.3	87.1	74.7	91.9	86.2
	2	18.7	21.2	2.0	5.5	18.4	3.1	3.4
	3+	33.6	21.0	1.7	7.4	1.2	4.9	4.4
	Ct	102.7	126.6	171.3	129.9	105.5	112.1	104.1
	N	402	410	408	310	419	830	319
20	0	0.0	0.0	0.0	0.0	0.0	5.8	24.0
	1	51.5	91.1	93.4	82.4	96.8	90.0	68.7
	2	20.0	2.7	4.7	10.2	2.2	2.2	4.6
	3+	28.5	6.2	2.0	7.3	0.7	1.9	2.8
	Ct	117.6	167.0	152.9	114.9	125.2	122.3	124.0
	N	200	406	407	205	410	722	654
19	0	0.0	0.0	0.0	0.0	1.4	11.0	16.8
	1	74.0	64.3	92.3	94.9	86.3	76.8	70.1
	2	8.0	15.2	5.5	2.9	3.5	6.1	7.1
	3+	18.0	20.5	2.2	2.2	8.7	6.2	6.1
	Ct	144.8	113.7	142.8	126.6	102.3	101.0	101.8
	N	100	409	507	414	423	628	865
18	0	--	--	0.0	0.0	--	--	--
	1	--	--	97.5	88.3	--	--	--
	2	--	--	1.5	11.7	--	--	--
	3+	--	--	1.0	0.0	--	--	--
	Ct	--	--	140.0	124.1	--	--	--
	N	0	0	203	206	0	0	0

Table 3. Mean pink shrimp carapace lengths (mm) at age, by month and Oregon statistical area, 1991.

Area	Age	Apr	May	Jun	Jul	Aug	Sep	Oct
18	0	--	--	--	--	--	--	--
	1	--	--	16.1	16.9	--	--	--
	2	--	--	21.3	21.1	--	--	--
	3+	--	--	23.8	--	--	--	--
19	0	--	--	--	--	7.8	9.2	10.3
	1	14.4	15.3	15.7	16.7	17.4	18.1	18.4
	2	19.9	20.3	21.1	21.4	21.4	22.6	23.3
	3+	22.8	23.2	24.0	23.6	23.4	24.7	25.2
20	0	--	--	--	--	9.0	9.0	10.1
	1	13.7	14.9	15.4	16.3	16.6	17.1	18.0
	2	19.5	20.4	21.2	20.9	21.4	22.2	22.7
	3+	22.2	22.5	23.3	23.2	25.5	24.4	24.6
21	0	--	--	--	--	--	--	10.4
	1	13.6	14.6	15.2	15.6	16.7	17.0	17.7
	2	19.7	20.4	19.8	21.2	21.6	21.8	22.2
	3+	22.7	22.7	22.6	23.7	23.7	23.6	24.2
22	0	--	--	--	--	--	--	9.3
	1	13.2	14.2	14.7	15.7	16.3	17.0	17.4
	2	19.1	20.2	20.9	20.8	21.7	22.4	22.0
	3+	22.7	22.7	23.4	23.0	23.8	24.4	24.2
24	0	--	--	--	--	--	6.5	--
	1	13.8	14.6	14.8	15.9	16.5	17.2	--
	2	19.4	20.5	20.6	21.4	21.8	22.2	--
	3+	22.5	22.9	23.0	23.3	23.6	24.1	--
26	0	--	--	--	--	--	--	--
	1	13.4	14.6	14.8	15.6	16.6	--	--
	2	19.4	20.6	20.4	20.9	21.5	--	--
	3+	22.6	23.4	22.8	23.3	24.1	--	--
28	0	--	--	--	--	--	--	--
	1	14.0	14.4	14.8	15.4	15.7	--	--
	2	19.5	20.5	20.5	21.0	20.6	--	--
	3+	22.7	23.3	23.3	23.2	23.5	--	--

Table 3. Continued

Area	Age	Apr	May	Jun	Jul	Aug	Sep	Oct
29	0	--	--	--	--	--	11.5	--
	1	--	--	14.2	--	--	16.6	--
	2	--	--	21.4	--	--	21.8	--
	3+	--	--	--	--	--	23.9	--
30	0	--	--	--	--	--	8.0	8.9
	1	13.2	13.9	14.6	15.5	15.7	15.9	16.4
	2	19.1	19.6	19.4	21.0	20.5	21.1	20.6
	3+	22.0	22.4	22.3	24.0	22.9	23.0	22.5
32	0	--	--	--	--	--	7.5	7.0
	1	13.2	13.5	14.6	15.4	15.7	15.7	14.8
	2	18.5	18.8	19.6	20.0	20.3	21.0	19.8
	3+	21.4	21.8	22.4	22.4	22.9	23.4	22.3

Table 4. Sex composition of the pink shrimp catch during April, September and October, 1991.

Month	Area	Males (%)	Trans. (%)	Females (%)	Prim Fem** (%)	Primary Females*	N
April	18	--	--	--	--	--	--
	19	87.0	2.0	11.0	0.0	0	100
	20	86.5	2.5	11.0	0.0	0	200
	21	76.4	4.0	19.7	0.0	0	402
	22	60.6	2.6	36.9	0.0	0	502
	24	66.7	5.3	28.1	0.0	0	303
	26	45.9	23.0	31.0	0.0	0	999
	28	59.1	21.6	19.3	0.0	0	486
	29	--	--	--	--	--	--
	30	24.9	40.5	34.7	0.0	0	398
	32	20.5	56.5	23.0	0.0	0	200
September	18	--	--	--	--	--	--
	19	59.5	6.5	34.0	28.4	118	536
	20	71.6	7.0	21.4	18.4	68	412
	21	61.3	8.5	30.2	24.5	162	721
	22	58.2	8.6	33.2	23.6	143	708
	24	--	--	--	--	--	--
	26	--	--	--	--	--	--
	28	--	--	--	--	--	--
	29	53.1	0.5	46.4	28.2	87	414
	30	68.0	0.3	31.8	23.1	137	674
	32	68.4	3.8	27.8	15.7	67	500
October	18	--	--	--	--	--	--
	19	67.3	3.2	29.5	24.3	147	865
	20	65.6	3.0	31.4	31.4	125	541
	21	56.7	6.0	37.3	35.3	97	319
	22	50.8	9.3	39.9	38.3	339	927
	24	--	--	--	--	--	--
	26	--	--	--	--	--	--
	28	--	--	--	--	--	--
	29	--	--	--	--	--	--
	30	59.3	0.2	40.5	34.3	184	605
	32	68.4	3.8	27.8	10.8	43	500

* The number of females at age one.

** (The number of females at age one/The total number of age one shrimp) X 100

Individual samples were weighted before being combined by month and area.

Transitionals with headroe were not combined with females.

modelling work with the historical database more difficult. To improve this situation, we began a gear survey in 1991 which we hope to continue in 1992, and also hope to repeat in future years.

FY-92 ACTIVITIES

We hope to continue all basic data collection activities in 1992, including collecting more data on shrimp trawl gear. We also hope to complete manuscripts describing both the trawl gear survey and our research on environmental effects on shrimp recruitment.

ACKNOWLEDGEMENTS

Many people made significant contributions to collecting and analyzing the information in this report. Neil Richmond, Terry Link, and Bruce Miller collected and analyzed data. We also thank Jim Golden for his careful editing of this report.

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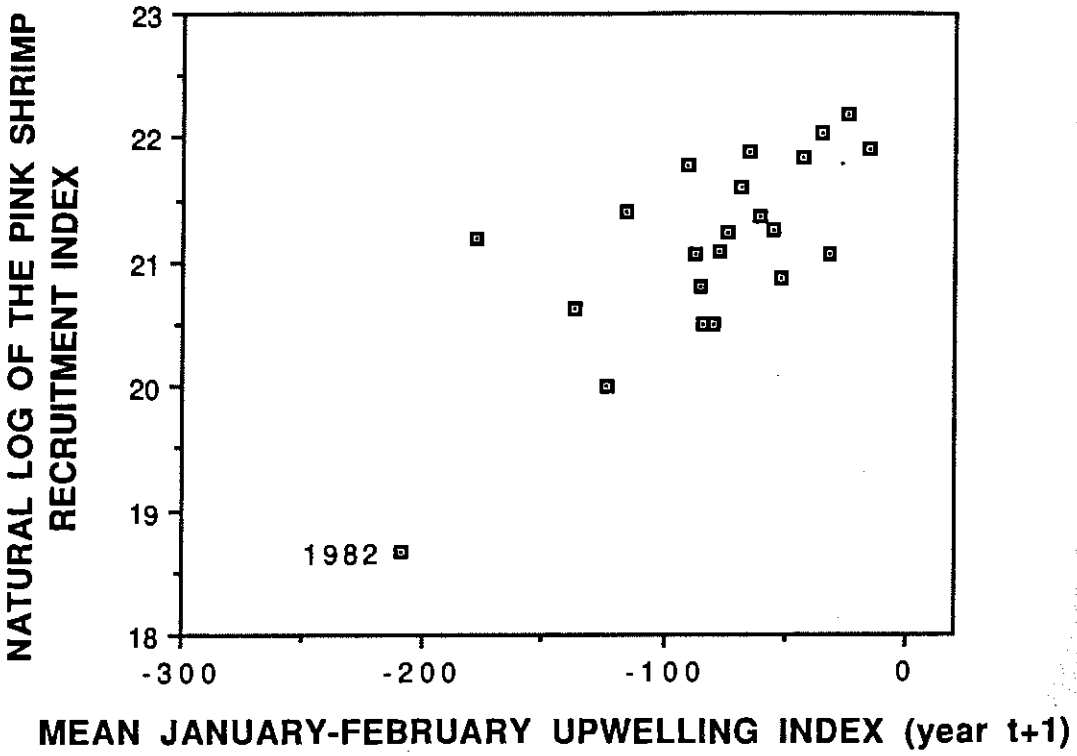

Figure 6. The natural log of the pink shrimp recruitment index versus the mean upwelling index at 45° N. latitude, 125° W. longitude, during January-Fenruary of the year following larval release. Data shown are for spring larval release, 1967-88.