Charleston

GROUNDFISH AND SHRIMP MANAGEMENT: Marine Resource Surveys of the Pink Shrimp (*Pandalus jordani*)

ANNUAL REPORT

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1979 Pink Shrimp Survey

Introduction

Surveys for the pink shrimp (*Pandalus jordani*) have been conducted by the Oregon Department of Fish and Wildlife (ODFW) formerly Fish Commission of Oregon (FCO) since 1951 when the FCO began exploratory fishing for shrimp (Pruter and Harry, 1952). Work was continued by the National Marine Fisheries Service (then Bureau of Commercial Fisheries) into the early 1960's (Alverson, et al, 1960; Ronholt and Magill, 1961). These studies identified major fishable concentrations of shrimp off Oregon before and during a period of slow growth and development of the fishery. Systematic surveys were begun by ODFW in 1966 to estimate standing crop biomass and to determine distributional characteristics seasonally and geographically. In addition, the age and sex composition, fecundity and time of spawning and the degree of association of shrimp with bottom type were determined (Robinson, 1971). Since 1971, surveys have been conducted by the ODFW on an annual basis to estimate standing crop biomass in attempts to index the abundance and availability of shrimp at the beginning of each season.

The purpose of the 1979 survey was to obtain standing stock biomass estimates of shrimp off Oregon in the area between 35-145 fm from Cape Blanco (Lat 42°54' N) to the Columbia River (Lat 46°15' N) and to determine age and sex composition and average size (count per pound) of shrimp. In addition, exploratory tows were made outside traditional boundary areas to determine if there were any shifts in concentration of shrimp and to determine the effects of these potential shifts on the biomass estimates.

Methods

Sampling Design

A systematic sampling scheme using a 4x4 n.m. grid was used to place station locations within the four survey strata from the Columbia River to Cape Blanco (Figures 1-2). The number of tows and sampling coverage (nm^2/tow) for North, North

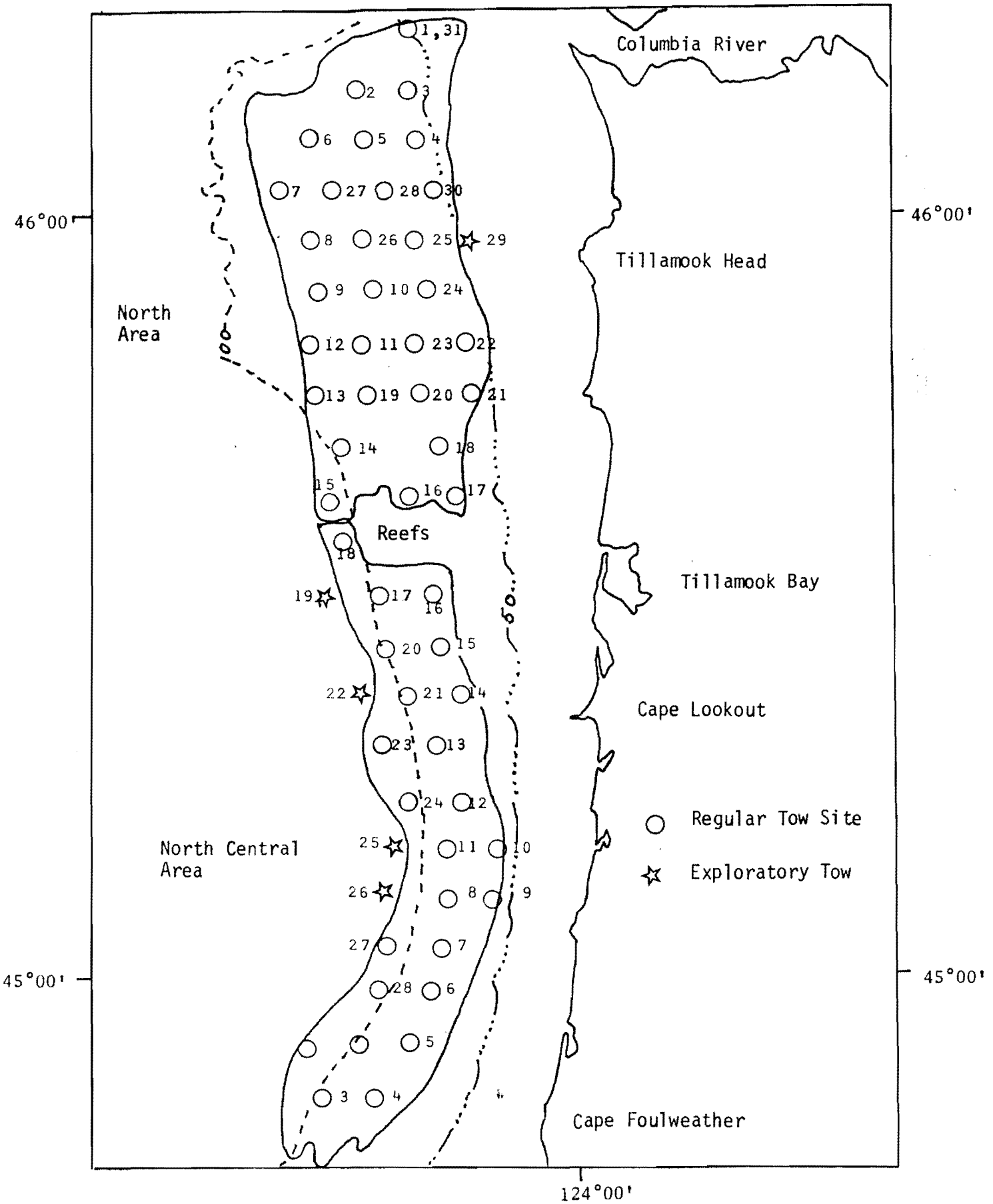

Figure 1. 1979 Pink Shrimp (*Pandalus jordani*) North and North Central survey areas. Depth contours in fathoms. Tow number adjacent to symbol. See Appendix Tables 1 and 2 for details.

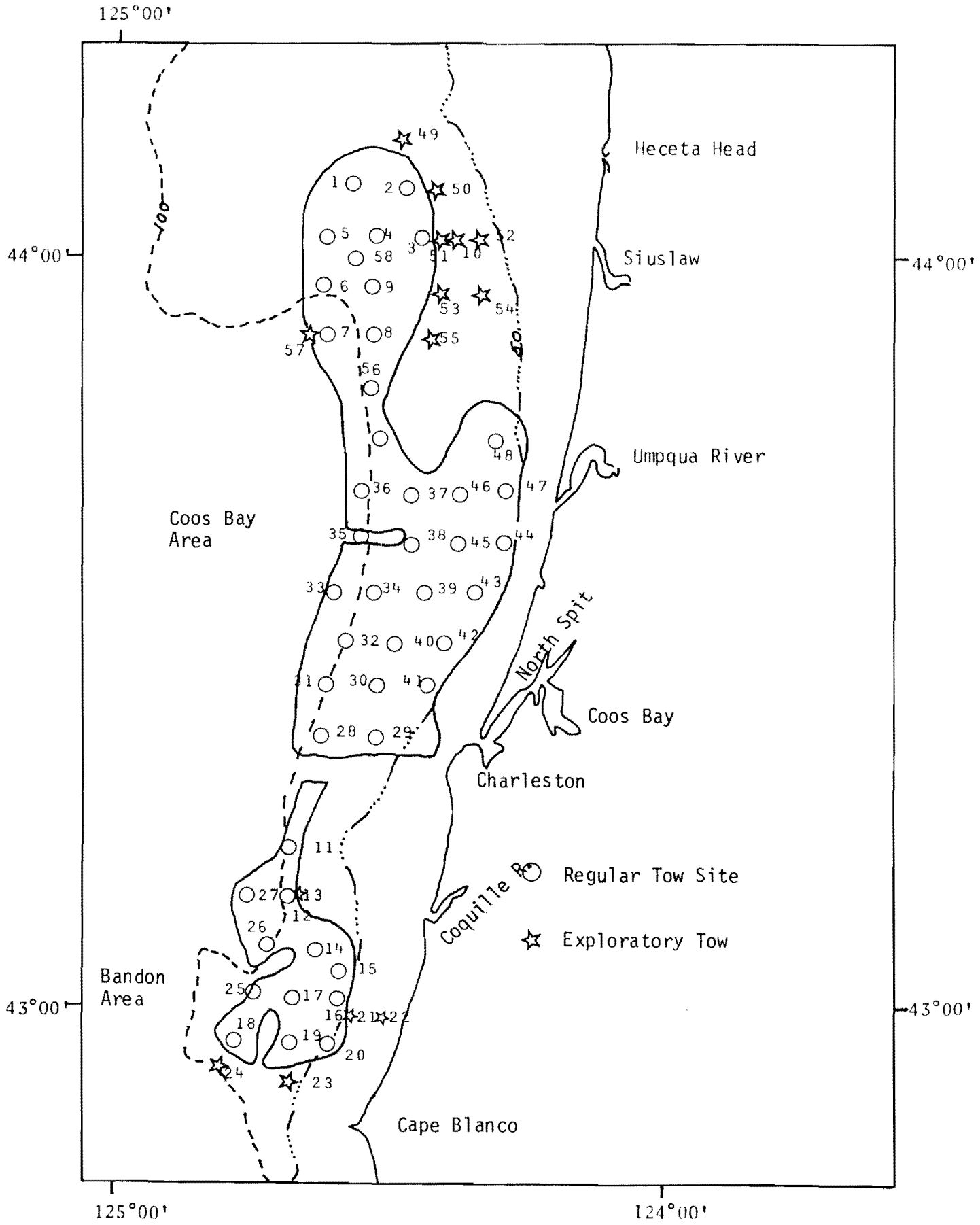

Figure 2. 1979 Pink Shrimp (*Pandalus jordani*) Coos Bay and Bandon survey areas. Depth contours in fathoms. Tow number adjacent to symbol. See Appendix Table 3 for details.

Central, Coos Bay and Bandon areas (strata) are listed in Table 1. In addition to the regular survey tows, additional towing stations were located outside the survey boundaries (Table 1). A tow was made outside if there was a catch of 10 lb/net or more at the inside station adjacent to the area boundary (see Figures 1 and 2). The survey was conducted from May 21-30, 1979.

Table 1. Number of regular and exploratory survey tows and area (nm^2) sampled during the 1979 pink shrimp (*Pandalus jordani*). The area sampled outside the traditional survey boundaries was determined by the sampling coverage within the boundaries[1]/. Approximate depth ranges of survey areas indicated in fathoms (fm).

Sampling Area	Depth (fm)	N. Lat.	Regular Survey Tows		Exploratory Tows	
			No. tows	Area (nm^2)	No. tows	Area (nm^2)
North	45-105	45°36'-46°15'	29	481	-	-
North Central	65-150	44°45'-45°36'	22	372	4	68
Coos Bay	35-145	43°20'-44°09'	33	488	8	118
Bandon	35-145	42°56'-43°20'	12	101	5	42

[1]/ Exploratory Area (nm^2) = $\frac{\text{Regular Survey Area } (nm^2)}{\text{No. Regular Survey Tows}}$ X No. Exploratory Survey Tows

Gear

The ODFW chartered two fiberglass-hull double-rig shrimp trawlers, the M/V Sea Blazer and M/V Olympic, for the survey. Both vessels were 75 ft long with respective beams of 21 and 22 ft. They were approximately 128 gross tons each and were outfitted with 365 h.p. diesel engines. Each had a pair of 7x7 ft wood and steel flat trawl doors weighing approximately 1,000 lb each.

The M/V Sea Blazer was outfitted with square jib design box trawls having 75 ft head and foot ropes. The M/V Olympic fished Pfister square-box style shrimp trawls with 90 ft head and foot ropes (Table 2). The estimated effective combined width swept by the two commercial trawls used on the M/V Sea Blazer was 83 ft and 100 ft on the M/V Olympic.

Table 2. Trawl design specifications for trawls used on the 1979 shrimp survey.

	M/V Blazer	M/V Olympic
Type	Double Rig	Double Rig
Net design	Square box trawl	Square box trawl
Headrope	75 feet	90 feet
Footrope	75 feet	90 feet
Headrope floats	Twenty-four 8-inch + one 16-inch float in center	Ten 12-inch
Footrope chain	Eleven droppers of 5/16-inch chain, 18 links per dropper	Ten droppers of 3/8-inch chain each 18 inches long
Webbing	Forward section 1.5 inch No. 15 thread, intermediate 1.5 inch No. 21 thread and 1.5 inch No. 42 thread nylon mesh cod end	1.5 inch, thread unknown
Tickler chain	Yes, design unknown	Eighty-two ft of 3/8-inch chain

Sampling Procedure

The catch from each net for a given tow was sorted and the shrimp were weighed and recorded to the nearest pound. A 2-5 lb (907-2270 g.) sample was drawn randomly from the shrimp catch to be used in estimating the age composition of the catch as well as the average count per pound. Total numbers of shrimp caught per tow were then estimated.

Analysis

Biomass estimates and associated variances for the four areas were based on the area-swept method described by Gunderson and Sample (1978) and were calculated using the FORTRAN program SHRIMP (Al Kaiser, 1971; modified by Golden, 1980). Catch data from optional tows which occurred within boundaries of pre-established sampling areas were pooled with catch data from regular survey tows prior to calculating biomass. Exploratory tows in areas outside normal survey limits were combined with the regular

tows and a separate biomass estimate was calculated and compared with the first. A similar technique was used by Golden et al. (1979) in estimating the effect of optional tows on the biomass estimates of Pacific ocean perch (*Sebastes alutus*).

The age composition of catch within regular survey areas was compared to age composition based on samples from exploratory plus regular survey tows. Survey age composition was also compared to estimates based on samples taken from commercial landings (Bruneau, 1980). Count per pound was compared in a similar fashion.

Results

Biomass estimates for the four traditional survey areas totalled 5,086,000 lbs (2,307 m.t.). When the exploratory tows and areas were included, the total biomass estimate increased 39% to 7,071,000 lbs (3,207 m.t.). Table 3 contains the biomass estimates and 95% confidence intervals based on regular survey tows as well as estimates

Table 3. 1979 biomass estimates of pink shrimp (*Pandalus jordani*) based on regular tows within traditional survey boundaries and based on regular tows plus exploratory tows outside the survey boundaries. 1979 annual shrimp landings for the areas surveyed are listed also. Biomass and 95% confidence intervals and landings are expressed in 1000's of lbs.

	Regular Survey Tows				Regular plus exploratory tows				Total Commercial
Sampling Area	No. tows	Area (nm^2)	Biomass x 1000 lb	95% CI	No. tows	Area (nm^2)	Biomass x 1000 lb	95% CI	landing, 1979 x 1000 lb
North	29	481	785	±55%	-	-	-	-[1]/	} 3,798[2]/
No. Central	22	372	190	±129%	26	440	574	±99%	
Coos Bay	33	488	2,640	±58%	41	606	3,446	±51%	6,132
Bandon	12	101	1,471	±61%	17	143	2,266	±48%	8,514

[1]/ Insufficient data to include exploratory tows

[2]/ North and North Central areas combined

that include exploratory tows. Annual commercial landings from areas approximating those covered in the survey are also contained in Table 4. Shrimp were found to be

abundant in deeper waters outside of the traditional survey boundaries in the North Central area. Conversely shrimp were found in higher concentrations in shallower water or at depths comparable to inside areas outside of the boundaries in the Coos Bay and Bandon areas. Average CPUE of exploratory tows made outside the boundaries was higher than the CPUE within survey boundaries in all three areas where exploratory tows were made, but not significantly so (Table 4). Large variances associated with the estimates of average CPUE are characteristic of animals having highly contageous distributions (Grosslein, 1971). Although the large confidence intervals mask any real differences that might exist between average CPUE within traditional survey boundaries and average CPUE estimates outside, the fact that shrimp are available outside would justify consideration of expanding the survey areas. Expanding the limits of the survey areas, intensifying sampling effort and stratifying the areas sampled may lead to a less biased and more precise estimate of biomass (Ulltang, 1977).

Table 4. Average catch per unit effort (CPUE) in lb/nm and 95% confidence intervals (CI) of survey tows within survey boundaries and of exploratory tows made outside these boundaries.

	Regular survey tows			Exploratory tows		
Area	No. tows	CPUE lb/nm	95%CI ±%	No. tows	CPUE lb/nm	95%CI ±%
North	29	22	±56%	-	-	-
North Central	22	8	±136%	4	93	±176%
Coos Bay	33	89	±158%	8	112	±130%
Bandon	12	240	±61%	5	311	±118%

Count per pound and the age composition was not appreciably affected by the inclusion of exploratory tows with the exception of the estimates from the North Central area (Table 5). More two- and three-year-old shrimp seemed to be available in exploratory tows made outside of the survey boundaries in deeper water. A better

grade of shrimp (lower count per pound) was seen in samples of commercial landings of shrimp caught in areas covered by the survey with the exception of the Coos Bay area (Table 6). This may have been due to the avoidance of smaller shrimp by commercial fishermen to insure a better grade.

Table 5. Count per pound and age composition (by number of shrimp) based on regular survey tows and on regular survey tows plus exploratory tows.

	Regular tows				Regular plus survey tows			
		Age Composition percent				Age Composition percent		
Area	Shrimp per lb	I	II	III+	Shrimp per lb	I	II	III+
North	78	15	37	48	78	15	37	48
North Central	147	86	11	3	103	52	29	19
Coos Bay	105	31	56	13	110	38	51	11
Bandon	148	66	29	5	150	70	24	6

Table 6. Count per pound and age composition (by number of shrimp) of commercial landings of shrimp harvested in May from areas that correspond to areas surveyed during the 1979 shrimp survey.

State area	Survey area	Shrimp per pound	Age composition percent I	II	III+
28	North		No Samples		
24,26	North Central	89	32	55	13
21,22	Coos Bay	122	55	40	5
20[1]/	Bandon	124	50	45	5

[1]/ April samples given, no samples in May

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Appendices

Appendix Table 1. Log of Oregon Department of Fish and Wildlife Shrimp Cruise 79-4, North Area, May 22-25, 1979; F/V Sea Blazer.

Tow	Date	Time Start PDT	Tow duration		Loran C (W)		Depth (fms)	Shrimp catch (lbs)	Shrimp grade (No/lb)	% Age (yrs)/numbers		
			Min.	Miles	Down	Haul				1	2	3+
1	5/22	0651	47	1.7	12117	12125	67-66	0	-	-	-	-
2	5/22	0840	41	1.7	12153	12161	66-68	0	-	-	-	-
3	5/22	1015	49	1.3	12143	12149	61-59	22	67	7.0	27.5	65.5
4	5/22	1140	46	1.3	12164	12171	56	19	92	27.4	64.6	8.0
5	5/22	1322	48	1.4	12176	12176	65-69	2	71	2.5	43.5	54.0
6	5/22	1504	34	1.2	12183	12196	73-74	1	-	-	-	-
7	5/22	1644	39	1.4	12218	12227	83-84	Trace	-	-	-	-
8	5/22	1818	42	1.2	12241	12247	83-82	41	81	12.9	56.7	30.4
9	5/22	1958	42	1.4	12267	12274	83	34	74	5.0	44.4	50.6
10	5/23	0617	40	1.4	12255	12262	78	13	76	9.0	39.8	51.2
11	5/23	0835	37	1.3	12292	12299	83-85	52	67	2.5	41.5	56.0
12	5/23	1005	37	1.1	12304	12311	88-90	8	66	0.5	39.0	60.5
13[1]/	5/23	1130	-	-	12325	-	94	-	-	-	-	-
14	5/23	1225	35	1.1	12354	12362	97-100	26	90	15.7	35.0	29.3
15[2]/	5/23	1349	41	1.4	12382	12389	106	5	69	19.3	26.4	54.3
16	5/23	1555	41	1.5	12374	12371	80-76	Trace	-	-	-	-
17	5/23	1716	36	1.4	12366	12359	66-62	0	-	-	-	-
18	5/23	1843	37	1.4	12343	12334	72	21	135	70.5	20.5	9.0
19	5/24	0707	33	1.2	12318	12315	83-81	6	104	34.2	42.2	23.6
20	5/24	0821	31	1.0	12312	12310	79-76	94	74	9.4	25.1	65.5
21	5/24	0935	35	1.2	12304	12298	64-58	Trace	-	-	-	-
22	5/24	1100	33	1.1	12281	12274	65-66	10	175	84.0	16.0	-
23	5/24	1220	38	1.5	12284	12287	79-81	147	68	1.0	21.2	77.8
24	5/24	1410	36	1.4	12253	12244	67-65	72	82	20.3	44.9	34.8
25	5/24	1541	37	1.4	12224	12216	67-68	108	65	1.9	24.4	73.7
26	5/24	1715	40	1.1	12232	12225	77	6	69	10.4	35.1	54.5
27	5/24	1847	40	1.1	12214	12206	78-76	11	89	28.2	43.1	28.7
28	5/24	2012	40	1.2	12204	12202	71-67	128	79	12.9	48.5	38.6
29[1]/	5/25	0630	38	1.1	12213	12204	53-47	0	-	-	-	-
30	5/25	0755	35	1.2	12196	12187	55-56	0	-	-	-	-
31	5/25	1037	38	1.2	12118	12112	60-54	3	-	-	-	-

1/ Excluded from analysis; tow not completed due to bad bottom.
2/ Outside traditional survey boundary.

Appendix Table 2. Log of Oregon Department of Fish and Wildlife Shrimp Cruise 79-5, North Central Area, May 27-30, 1979; F/V Olympic.

Tow	Date	Time Start PDT	Tow duration Min.	Tow duration Miles	Loran C (W) Down	Loran C (W) Haul	Depth (fms)	Shrimp catch (lbs)	Shrimp grade (No/lb)	% Age (yrs)/numbers 1	2	3+
1[1]/	5/28	0645	35	1.2	12874	12865	110-112	86	81	27.5	52.5	20.0
2[1]/	5/28	0800	34	1.1	12843	12835	112-115	147	81	12.0	72.4	15.6
3	5/28	1015	25	1.1	12776	12768	98	1	-	-	-	-
4	5/28	1143	37	1.3	12762	12754	81-80	Trace	-	-	-	-
5	5/28	1252	36	1.2	12739	12730	78-76	Trace	-	-	-	-
6	5/28	1420	35	1.1	12701	12693	79-82	0	-	-	-	-
7	5/28	1653	35	1.2	12666	12655	85-87	3	73	4.9	76.7	18.4
8	5/28	1725	35	1.0	12635	12628	91-94	3	71	4.3	66.7	29.0
9	5/28	1830	35	1.1	12630	12625	75-67	0	-	-	-	-
10	5/28	1940	35	1.2	12592	12584	70-67	0	-	-	-	-
11	5/29	0600	35	1.1	12599	12591	99-101	0	-	-	-	-
12	5/29	0740	35	1.2	12555	12547	83-84	Trace	-	-	-	-
13	5/29	0845	35	1.2	12530	12522	85	Trace	-	-	-	-
14	5/29	1012	36	1.3	12510	12500	84-83	Trace	-	-	-	-
15	5/29	1202	35	1.0	12470	12463	85	Trace	-	-	-	-
16	5/29	1223	35	1.0	12438	12435	74	0	-	-	-	-
17	5/29	1430	35	1.0	12440	12440	89	17	60	3.0	17.5	79.5
18	5/29	1540	35	1.5	12418	12418	104	Trace	-	-	-	-
*19	5/29	1730	35	1.2	12441	12450	130-138	245	88	29.0	48.5	22.5
20	5/29	1910	35	1.5	12468	12468	100-97	133	161	92.5	7.5	0.0
21	5/30	0620	35	1.2	12507	12498	95-96	92	151	83.5	16.5	0.0
*22	5/30	0753	37	1.0	12496	12504	106-110	3	-	-	-	-
23	5/30	0916	30	1.3	12532	12540	105-103	Trace	-	-	-	-
24	5/30	1040	40	1.1	12568	12575	102-106	Trace	-	-	-	-
*25	5/30	1225	11	0.5	12603	12606	140-160	6	63	5.5	36.0	58.5
*26	5/30	1353	32	1.2	12642	12635	151-155	189	71	10.9	42.1	47.0
27	5/30	1515	38	1.0	12667	12660	107-105	Trace	-	-	-	-
28	5/30	1708	35	1.1	12696	12704	103-101	0	-	-	-	-

[1]/ Excluded from analysis.

* Outside traditional survey boundary.

Appendix Table 3. Log of Oregon Department of Fish and Wildlife Shrimp Cruise 79-3, Heceta Head-Cape Blanco Area, May 21-25, 1979; F/V Olympic.

Tow	Date	Time Start PDT	Tow duration		Loran C (W)		Loran C (X)		Depth (fms)	Shrimp catch (lbs)	Shrimp grade (No/lb)	% Age (yrs)/number		
			Min.	Miles	Down	Haul	Down	Haul				1	2	3+
1[1]/	5/21	0703	33	1.2	13141	13141	27830	27833	64	Trace	-	-	-	-
2	5/21	0804	35	1.2	13141	13141	27838	27841	64	396.2	144.4	45.8	48.8	5.4
3	5/21	0940	33	1.0	13174	13182	27840	27839	66	350.0	99.5	18.5	66.5	15.0
4	5/21	1110	38	1.0	13181	13184	27830	27827	73	196.0	96.2	30.0	50.5	19.5
5	5/21	1253	35	1.0	13187	13196	27816	27814	75	188.0	156.0	51.2	43.1	5.7
6	5/21	1407	34	1.0	13221	13228	27812	27812	96	166.0	82.6	2.0	68.0	30.0
7	5/21	1520	35	1.4	13251	13252	27807	27810	114	0.5	86.4	15.8	71.1	13.1
8	5/21	1630	35	1.0	13243	13235	27820	27824	75	Trace	-	50.0	50.0	-
9	5/21	1800	36	1.1	13210	13201	27824	27825	80	4.0	100.0	6.5	78.8	14.7
*10	5/21	1930	35	1.2	13185	13180	27840	27844	67	240.0	101.0	15.0	63.3	21.7
11	5/22	0645	37	1.4	13583	13592	27728	27724	105	2.0	143.0	50.9	41.7	7.4
12	5/22	0837	38	1.1	13637	13646	27716	27714	98	814.0	113.4	47.2	44.8	8.0
*13	5/22	1000	35	1.0	13640	13627	27720	27720	81	56.0	94.8	13.5	75.1	11.4
14	5/22	1145	33	1.0	13666	13671	27714	27714	83	272.0	144.5	59.7	33.7	6.6
*15	5/22	1300	38	1.0	13678	13684	27716	27713	68	169.5	125.7	51.9	43.3	4.8
16	5/22	1415	65	1.0	13708	13716	27710	27708	57	382.0	187.6	85.4	13.6	1.0
17	5/22	1645	37	0.9	13708	13714	27698	27696	74	293.0	160.0	64.0	30.0	6.0
18	5/22	1705	35	0.9	13728	13735	27683	27686	83	94.0	160.8	72.1	23.9	4.0
19	5/22	1825	35	1.0	13738	13730	27690	27693	68	527.0	165.3	73.5	23.0	3.5
20	5/22	1930	37	1.0	13735	13727	27700	27704	50	10.0	196.2	86.3	12.2	1.5
*21	5/23	0655	35	1.0	13703	13710	27716	27714	48	729.0	175.4	81.5	11.5	7.0
*22	5/23	0810	35	0.9	13714	13706	27719	27721	34	6.0	137.9	71.0	25.0	4.0
*23	5/23	1045	35	1.0	13753	13756	27680	27678	81	315.0	124.7	60.0	23.7	16.3
*24	5/23	1220	30	1.0	13744	13745	27678	27672	87	449.0	150.7	77.7	16.1	6.2
25	5/23	1528	33	1.1	13702	13694	27697	27700	84	289.0	164.3	78.2	18.4	3.4
26	5/23	1700	30	1.0	13673	13666	27700	27703	105	22.0	138.5	57.1	40.5	2.4
27	5/23	1830	35	1.1	13639	13630	27712	27714	129	63.0	97.1	16.0	66.0	15.0
28	5/24	0650	33	1.0	13525	13517	27748	27750	90	51.0	99.5	26.7	68.4	4.9
29	5/24	0823	30	0.9	13518	13525	27762	27760	63	1.5	115.9	34.7	58.9	6.4
30	5/24	1015	30	1.0	13495	13487	27770	27773	63	0.3	180.0	92.6	7.4	0.0

Appendix Table 3. Continued.

Tow	Date	Start PDT	Tow duration Min.	Tow duration Miles	Loran C (U) Down	Loran C (U) Haul	Loran C (X) Down	Loran C (X) Haul	Depth (fms)	Shrimp catch (lbs)	Shrimp grade (No/lb)	% Age (yrs/number 1	2	3+
31	5/24	1140	34	1.0	13495	13487	27758	27762	89	17.0	151.0	47.5	46.1	6.4
32	5/24	1246	29	1.2	13446	13437	27770	27773	114	231.0	75.8	1.8	53.0	45.2
33	5/24	1418	34	1.0	13432	13429	27772	27774	141	23.5	63.6	0.0	12.3	87.7
34	5/24	1515	30	1.1	13422	13413	27782	27784	99	729.0	99.0	31.7	62.9	5.4
35	5/24	1705	35	1.1	13394	13385	27786	27788	106	251.5	91.7	12.5	76.0	11.5
36	5/24	1830	35	0.9	13360	13354	27794	27794	104	0.1	93.8	17.9	71.4	10.7
37	5/24	1940	35	1.0	13358	13352	27780	27770	59	0.0	-	-	-	-
38	5/25	0630	35	1.1	13391	13400	27796	27794	81	15.0	195.8	24.5	67.2	8.3
39	5/25	0800	32	0.9	13420	13428	27796	27794	67	237.0	118.6	51.6	43.9	4.5
40	5/25	0910	22	0.8	13454	13459	27787	27785	65	0.8	130.0	61.5	33.3	5.2
41	5/25	1025	35	1.0	13490	13482	27781	27784	54	Trace	190.5	-	-	-
42	5/25	1135	30	1.0	13462	13455	27793	27796	56	14.5	120.7	52.9	43.6	3.5
43	5/25	1255	32	1.0	13433	13424	27805	27807	54	75.0	94.9	19.7	53.2	27.1
44	5/25	1410	35	0.9	13401	13394	27814	27816	64	39.0	77.8	6.5	54.5	39.0
45	5/25	1516	42	1.1	13399	13390	27807	27810	61	64.5	78.3	5.4	54.3	40.3
46	5/25	1646	39	1.1	13369	13360	27810	27812	62	40.5	85.3	4.9	68.5	26.6
47	5/25	1802	33	1.0	13358	13348	27822	27824	57	1.5	76.9	1.4	70.0	28.6
48	5/25	1925	35	1.0	13330	13322	27825	27822	57	2.5	79.0	3.6	68.7	27.7
*49	5/27	0700	35	1.1	13113	13120	27852	27849	52	0.0	-	-	-	-
*50	5/27	0825	36	1.0	13147	13136	27842	27840	61	8.0	95.7	29.3	63.2	7.5
*51	5/27	0930	35	0.9	13181	13189	27840	27839	65	99.0	88.2	11.0	73.6	15.4
*52	5/27	1025	36	1.0	13184	13189	37844	27846	62	Trace	-	-	-	-
*53	5/27	1205	35	1.1	13206	13215	27833	27832	68	558.0	147.1	80.5	19.5	0.0
*54	5/27	1315	33	1.2	13215	13215	27840	27843	63	67.5	100.0	30.0	65.0	5.0
*55	5/27	1505	35	1.3	13240	13244	27825	27821	71	Trace	-	-	-	-
56	5/27	1628	37	1.1	13270	13279	27810	27804	100	0.0	-	-	-	-
57	5/27	1815	41	1.3	13241	13241	27801	27805	116	32.0	73.5	1.5	54.5	44.0
58	5/27	1930	35	1.1	13230	13222	27815	27815	90	6.0	75.1	6.4	69.8	23.8

1/ Shrimp catch from tow 1 of 3 shrimp was lost before detailed analysis could be obtained.

* Outside traditional survey boundaries.