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SPOT SHRIMP *Pandalus platyceros* SURVEYS IN THE PRINCE WILLIAM SOUND MANAGEMENT AREA, 1989 - 1993

By

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Introduction

The department began a yearly spot shrimp ***Pandalus platyceros*** survey in 1989 as the sampling component of the damage assessment project "Injury to Prince William Sound Spot Shrimp", following the Exxon Valdez oil spill (EVOS). The final project report is available through the Oil Spill Public Information Center (645 G street, Anchorage, Alaska 99501). Funding for the EVOS project terminated in 1991. Recognizing the survey's value as a management tool, the department has continued the survey to the present time. The goal of the current survey is to determine the overall health of the spot shrimp stock in western Prince William Sound (PWS) by establishing a relative index of abundance and documenting the sex, size, and egg condition of spot shrimp.

Spot shrimp are protandric hermaphrodites. They mature first as males and later transition to females. Larger males and the entire population of females are targeted in the fishery. Tagging conducted in PWS during the early 1980's produced three findings with important implications for the management of the spot shrimp resource. First, females may produce more than one egg clutch, therefore, each female represents more than one reproductive opportunity. Second, growth averaged approximately 3 mm carapace length (c.l.) per year for adults with up to two molts per year. A long lived species such as this cannot be harvested at as high a rate as a short lived species because individuals are typically captured before they are sexually mature. Third, lateral movement after settlement is limited (ADF&G, 1987). Two of the above findings, slow adult growth and multiple egg clutches are contrary to published life history information from southern British Columbia (B.C.). Butler (1980) indicates that in southern B.C. growth rates are higher and shrimp are believed to die after producing a single egg clutch. These disparate observations may be attributable to the difference in latitude and the fact that spot shrimp in PWS are at the northern extent of their range.

The Traditional Harvest Area (THA) (Figure 1), which includes the historically important spot shrimp producing areas of northern and western PWS, is the area of focus in the survey. This

area is characterized by steep-sided fjords and passages.

The commercial harvest of spot shrimp in PWS was first documented in the 1950's. Harvests remained at a low level until the late 1970's when rapid expansion of the fishery began (Table 1). In 1978, nine vessels harvested 15,466 pounds and by 1986 the fishery peaked at 290,632 pounds and 80 vessels. Currently, there are two regulatory areas of harvest in PWS, the THA and the Eastern district (Figure 1.) The most recent commercial harvest from the Traditional Harvest Area occurred in the fall of 1991 when 15 vessels harvested 17,302 pounds in 45 landings over a 45 day season. Catch per unit effort (cpue) averaged 0.8 pounds of whole shrimp per pot. This is comparable to the 1990 department survey cpue of 0.9 pounds per pot. Spot shrimp have historically comprised 95% or more of the pot shrimp harvest from the PWS management area.

Based upon it's success in providing an indication of stock condition, the department's spot shrimp survey has been continued to the present. The objectives of the survey have evolved over time. Initially the objectives were to document hydrocarbon contamination in spot shrimp tissues or damage to tissues attributable to exposure to petroleum hydrocarbons, and to detect any year class failures due to the spill.

Objectives

The current objectives of the spot shrimp survey are as follows:

1. Document shrimp catch per pot by species, weight and number.

2. Collect data on sex, carapace length, and egg bearing condition of spot shrimp.

3. Compare catch data between sites and years.

4. Identify other potential survey sites through establishment of experimental stations.

These data will be used in part to determine management strategies for each season which may include closures of areas and seasons.

Methods

Methods have varied little over the life of the survey. Changes have been noted where they occurred. Pots were deployed in six to eight locations in northern and western PWS (Figure 2). The survey locations were as follows: Unakwik, Golden, lower Culross Passage, Herring Bay, North Chenega, and Green Island. In 1992 experimental sites were established at South Chenega and the north end of Prince of Wales Passage. Two additional changes occurred in the study in 1992. First, the survey date was moved from November to October. The original reasoning for the November survey period was to ensure that egg extrusion was complete. However, an earlier survey period provided potentially better weather and more daylight without detriment to other aspects of the survey. The second change occurred in the depths fished. For the period 1989-91 (EVOS project dates), fishing depths were separated into two strata, 20-70 fathoms and 70-120 fathoms. Sets were made in a manner which maximized the range of depths fished. Beginning in 1992 a single depth stratum ranging from 20-80 fathoms was targeted. This change allowed the department to survey more locations. It was also supported by the occurrence of small catches at depths greater than 80 fathoms and the time involved in surveying the deep stratum.

Originally, a sampling objective of 500 shrimp per stratum was set. This resulted in pots being reset at a site when the sampling objective was not achieved in a single set. For the purposes of this report only the first set was considered. The second set targeted depths that had produced the greatest number of shrimp and compromised the relative index which is the focus of later surveys.

At least two strings were set at each location. Each string consisted of 11 pots spaced 10

fathoms (60') apart along a groundline and buoyed at both ends. "Kite" style pots were used. The pot dimensions were 16"x16"x36". Pots were covered with black colored woven plastic fabric (engineers cloth) except in the two opposing tunnel ends which had a 2.5" tunnel set 7" into each end and enclosed by 1/2" stretched mesh web. A single 2.5 qt. perforated plastic jug of chopped herring was placed in each pot at the time of deployment. The soak time objective was a minimum of 18 hours.

Upon retrieval all spot, pink ***P. borealis***, and coonstripe ***P. hypsinotus*** shrimp in each pot were speciated, counted and weighed. All non-shrimp bycatch was noted and counted. All spot shrimp were retained for collection of sex and carapace length data. Additional observations of ovigerous females included egg condition (eyed or uneyed), egg color and number of dead eggs. For nonovigerous females the presence or absence of breeding dress was noted. Butler (1980) describes breeding dress as "...the presence of long, simple, and plumose setae on the protopodites of pleopods", a condition indicative of a mature female. All data codes are listed in Appendix A. 1. Catches from damaged pots are not included in the analysis. Lost pots are excluded from effort totals.

Results

Survey dates and locations can be found in Appendix B. Survey bycatch of coonstripe and pink shrimp are tabled in Appendices C.1 and C.2.

1989 Survey

In 1989 the survey was conducted November 7 - 13. Twenty-two pots were set at each of 6 sites for a total of 132 pot lifts (Table 2). The catch consisted of 4,958 (96%) males and 234 (4%) females and averaged 39 spot shrimp per pot overall. Among females 224 (96%) were ovigerous (Table 4). Catches of male spot shrimp by site ranged from a high of 2,181 at Golden

to a low of 168 at Green Island. Female spot shrimp catches ranged from a high of 132 at Unakwik to none at Green Island. The survey average size for males was 27.7 mm and 41.3 mm for females (Table 5). Survey cpue averaged 1.3 pounds of whole shrimp per pot.

1990 Survey

A total of 197 pots was set at 6 sites during the period November 5 - 13, 1990 (Table 2). Site three, Culross Passage, received the most effort at 55 pots and Golden the least at 21 pots. A total of 4,283 spot shrimp were captured. The average was 22 shrimp per pot. Males accounted for 91% (n = 3,911) and females 9% (n = 372) of the total number of shrimp caught. Ovigerous females numbered 348 and accounted for 94% of the total females caught (Table 4). Survey average size by sex was 29.3 mm for males and 41.9 mm for females (Table 5). Survey cpue averaged 0.9 pounds of whole shrimp per pot.

1991 Survey

The 1991 survey was completed November 4 - 11 with a total of 194 pots set at 6 sites. These yielded 5,964 spot shrimp for an average of 31 shrimp per pot (Table 2). The number of pots per site ranged from 65 at Culross Passage to 21 at Green Island. Males comprised 93% (n = 5,542) and females 7% (n = 422) of the total number of shrimp captured at traditional sites. Among females, 326 (77%) were ovigerous (Table 4). The high percentage of animals reported in breeding dress at the Golden site is likely in error due to confusion in identifying the condition. However, the data are presented as they were tabulated. Average size by sex was 30.5 mm for males and 41.3 mm for females (Table 5). Survey cpue averaged 1.3 pounds per pot.

An additional location in front of Snug Harbor on Knight Island yet near the Green Island site was fished in 1991 (Table 3). Eleven pots yielded 24 male and 1 female spot shrimp. Sizes of shrimp at this site were consistent with other sites (Table 5).

1992 Survey

The 1992 survey occurred October 7 - 14 and included the six traditional sites as well as two experimental sites at south Chenega and Prince of Wales Passage. The traditional sites yielded a total of 3,962 spot shrimp in 260 pots for an average of 15 shrimp per pot (Table 2). Males numbered 3,479 (88%) and females 483 (12%). Average size by sex was 32.0 mm for males and 41.6 mm for females (Table 5). There were 461 (96%) females in an ovigerous condition (Table 4). Survey cpue averaged 0.8 pounds of spot shrimp per pot.

The yield from two experimental sites was 1,085 (88%) males and 148 (12%) females with average sizes of 33.0 mm and 43.0 mm respectively (Table 5). The average cpue at experimental sites was 0.6 pounds of whole shrimp per pot.

1993 Survey

The 1993 survey occurred from October 20 - 28 and again included two experimental sites at South Chenega and Prince of Wales Passage. Catches of spot shrimp at traditional survey sites were low in 1993 totalled 1,654 (80%) males and 421 (20%) females from 250 pots for an average of 8 shrimp per pot (Table 2). Average size by sex was 29.1 mm and 42.2 mm for males and females respectively (Table 5). Ovigerous females totalled 413 (98%) (Table 4). Survey cpue averaged 0.4 pounds of whole shrimp per pot.

Experimental site catches were low with 371 (86%) males and 61 (14%) females from a total of 86 pots (Table 3). Average shrimp size by sex was 27.5 mm and 43.3 mm for males and females respectively (Table 5). Average cpue was 0.2 pounds of whole shrimp per pot.

Discussion

The PWS spot shrimp survey is in its fifth year of sampling traditional sites. The addition of two experimental sites in the southwestern portion of PWS in 1992 provided better coverage of historically strong commercial spot shrimp producing areas (Figure 2). Overall, the survey has indicated a pattern of continuing decline in abundance. This decline is evident in cpue in both pounds and number of shrimp per pot (Tables 2 & 3). From 1991 to 1993 cpue in pounds declined from 1.3 to 0.4. During the same period the number of shrimp per pot declined from 31 to 8.3.

Until 1993, length frequencies from the survey indicated an increase in the percentage of large shrimp comprising the catch (Figures 3-11). The percentage of females, or large shrimp, increased from 4 to 20 from 1989 to 1993. The corollary to this is the decrease in male, or small shrimp comprising the catch. This shift coupled with the decline in overall abundance indicates an aging stock with little recruitment in the near term.

The drop in cpue seen in the 1993 survey dictates a continuing conservative management approach to the spot shrimp fishery. The department plans to continue the spot shrimp survey on an annual basis. A target survey cpue of 1.3 pounds has been tentatively set as the decision point for the next fishery. This figure equates to approximately 0.7 pounds of tails per pot and is comparable to the commercial fishery cpue after full development. The department's experience in managing crustacean fisheries has shown that once a drop in cpue occurs on a fishery wide basis, overharvest has already occurred. The stock rebuilding process for a long lived animal is typically slow when compared to similar species with a shorter life cycle. Therefore, when cpue rises above the current survey high of 1.3 pounds of whole shrimp per pot and indicates strong upcoming recruitment, conservative harvest levels will be set and fishery performance data gathered to aid in continued evaluation of the status of the stock.

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Table 1. Pot shrimp harvest, Prince William Sound Management Area 1960 - 1993.

Year	Vessels	Landing	Spot	Coonstripe	Other	Total [1] whole wt.
1960						4,988
1961						—
1962						3,576
1963						1,101
1964						4,248
1965						4,356
1966						—
1967						749
1968						6,866
1969						5,146
1970						19,776
1971						13,073
1972						6,949
1973						6,370
1974						24,978
1975						4,150
1976						2,410
1977						7,516
1978	9	17	N/A	N/A	N/A	15,466
1979	17	98	N/A	N/A	N/A	52,208
1980	23	155	84,787	5,174	67	90,028
1981	51	509	153,017	20,055	465	173,537
1982	57	397	205,746	7,250	784	213,781
1983	71	646	198,719	14,119	583	213,420
1984	79	513	198,729	7,911	640	207,280
1985	78	528	271,928	3,919	860	276,707
1986	80	540	286,105	3,715	812	290,632
1987	86	498	265,707	3,795	151	269,653
1988	76	433	191,630	764	48	192,442
1989	33	69	28,884	431	0	29,315
1990	23	59	36,378	358	0	36,737
1991	15	45	17,302	278	0	17,580
1992			S E A S O N	C L O S E D		
1993			S E A S O N	C L O S E D		

[1] Catches converted from tail weight to whole weight using a conversion factor of 2.

Table 2. Traditional station catch statistics from the Prince William Sound spot shrimp surveys, 1989 - 1993,

Year	1989	1990	1991	1992	1993
Number of pots	132	197	194	260	250
Number of pounds	170	176.8	259.8	202.1	104.9
Mean weight per pot (lb)	1.3	0.9	1.3	0.8	0.4
Number of shrimp	5192	4283	5964	3962	2075
Mean # shrimp per pot	39	22	31	15	8.3
Number of males	4958 (96%)	3911 (91%)	5542 (93%)	3479 (88%)	1654 (80%)
Number of females	234 (4%)	372 (9%)	422 (7%)	483 (12%)	421 (20%)
Number of ovigerous females	213	346	326	461	413
Mean size males (mm)	27.7	29.3	30.5	31.7	28.1
Mean size females (mm)	41.3	41.9	41.3	41.9	42.5

Table 3. Experimental station catch statistics from the Prince William Sound spot shrimp surveys, 1989 - 1993.

Year	1991	1992	1993
Number of pots	11	110	86
Number of pounds	1.2	70.4	19
Mean weight per pot (lb)	0.1	0.6	0.2
Number of shrimp	25	1233	432
Mean # shrimp per pot	2	11	5
Number of males	24 (96%)	1085 (88%)	371 (86%)
Number of females	1 (4%)	148 (12%)	61 (14%)
Number of ovigerous females	1	147	58
Mean size males (mm)	31.4	33.0	27.5
Mean size females (mm)	40.4	43.0	43.3

Table 4. Egg condition by year and site from spot shrimp surveys in Prince William Sound, 1989 - 1993.

			Ovigerous				Non-ovigerous		
			Eggs	Eggs			Breeding Dress		
	Site	No. Pots	uneyed	eyed	Total		Yes	No	Total
1989	1	22	127	1	128		4	0	4
	2	22	43	0	43		2	0	2
	3	22	31	1	32		1	0	1
	4	22	4	1	5		1	0	1
	5	22	13	3	16		0	2	2
	6	22	0	0	0		0	0	0
	Total	**132**	**218**	**6**	**224**	**96%**	**8**	**2**	**10**
1990	1	22	186	0	186		1	11	12
	2	21	117	0	117		7	1	8
	3	55	19	0	19		0	2	2
	4	33	4	0	4		0	1	1
	5	33	21	0	21		0	1	1
	6	33	1	0	1		0	0	0
	Total	**197**	**348**	**0**	**348**	**94%**	**8**	**16**	**24**
1991	1	31	218	1	219		6	58	64
	2	22	29	0	29		22	0	22
	3	65	6	0	6		2	0	2
	4	22	40	0	40		0	2	2
	5	33	30	0	30		0	7	7
	6	21	1	0	1		0	0	0
	6 A [a]	11	1	0	1		0	0	0
	Total	**205**	**325**	**1**	**326**	**77%**	**30**	**67**	**97**
1992	1	42	195	0	195		0	14	14
	2	44	116	0	116		0	3	3
	3	43	23	1	24		0	0	0
	4	44	43	1	44		0	2	2
	5	43	56	0	56		0	2	2
	6	44	26	0	26		0	1	1
	7 [a]	55	105	2	107		0	1	1
	8 [a]	55	40	0	40		0	0	0
	Total	**370**	**604**	**4**	**608**	**96%**	**0**	**23**	**23**
1993	1	43	141	0	141		0	5	5
	2	43	130	0	130		0	0	0
	3	44	65	0	65		0	2	2
	4	43	28	0	28		0	0	0
	5	44	42	0	42		0	0	0
	6	33	7	0	7		0	1	1
	7 [a]	43	32	0	32		0	3	3
	8 [a]	43	26	0	26		0	0	0
	Total	**336**	**471**	**0**	**471**	**97%**	**0**	**11**	**11**

[a] Experimental sites.

Table 5. Number and mean carapace length (mm) by site of spot shrimp from Prince William Sound surveys, 1989 - 1993.

Year	Site	No. pots	Males			Females		
			Total no.	Mean no. per pot	Mean length (mm)	Total no.	Mean no. per pot	Mean length (mm)
1989	1	22	693	31.5	31.5	132	6.0	40.8
	2	22	2181	99.1	27.9	45	2.0	42.7
	3	22	511	23.2	28.1	33	1.5	42.4
	4	22	537	24.4	27.3	6	0.3	41.0
	5	22	868	39.5	25.2	18	0.8	40.2
	6	22	168	7.6	24.9	0	0.0	—
	Total	132	4958	37.6	27.7	234	1.8	41.3
1990	1	22	1326	60.3	31.5	198	9.0	41.2
	2	21	765	36.4	31.3	125	6.0	43.4
	3	55	492	8.9	25.9	21	0.4	41.1
	4	33	232	7.0	28.1	5	0.2	40.2
	5	33	1055	32.0	27.0	22	0.7	40.5
	6	33	41	1.2	26.4	1	0.0	41.3
	Total	197	3911	19.9	29.3	372	1.9	41.9
1991	1	31	897	28.9	34.2	283	9.1	41.1
	2	22	290	13.2	34.5	51	2.3	43.8
	3	65	841	12.9	28.2	8	0.1	42.5
	4	22	1347	61.2	29.3	42	1.9	39.9
	5	33	1806	54.7	29.9	37	1.1	41.2
	6	21	361	17.2	29.8	1	0.1	41.4
	6A[a]	11	24	2.1	31.4	1	0.1	40.4
	Total	205	5566	27.2	30.4	423	2.1	41.3
1992	1	42	534	12.7	35.1	209	5.0	41.7
	2	44	224	5.1	34.1	119	2.7	42.8
	3	43	575	13.4	29.7	24	0.6	41.3
	4	44	723	16.4	30.0	46	1.0	40.6
	5	43	762	17.7	32.4	58	1.3	42.1
	6	44	661	15.0	30.5	27	0.6	41.1
	7 [a]	55	578	10.5	33.8	108	2.0	42.7
	8 [a]	55	507	9.2	32.2	40	0.7	43.4
	Total	370	4564	12.3	31.9	631	1.7	42.1

-Continued-

Table 5. (page 2 of 2)

Year	Site	No. pots	Males			Females		
			Total no.	Mean no. per pot	Mean length (mm)	Total no.	Mean no. per pot	Mean length (mm)
1993	1	43	233	5.4	34.2	146	3.4	42.5
	2	43	292	6.8	30.6	130	3.0	43.1
	3	44	441	10.0	26.4	67	1.5	42.8
	4	43	493	11.5	24.6	28	0.7	40.8
	5	44	109	2.5	30.6	42	1.0	41.1
	6	33	86	2.6	28.5	8	0.2	42.7
	7 [a]	43	159	3.7	27.3	35	0.8	43.5
	8 [a]	43	212	4.9	27.7	26	0.6	43.0
	Total	336	2025	6.0	28.0	482	1.4	42.6

[a] Experimental sites.

Table 6. Catch per unit of effort (cpue) by site and year from Prince William Sound spot shrimp surveys , 1989 - 1993. [a]

Year	Site	Total			Mean	
		# Pots	# Shrimp	Shrimp weight (lb)	# Shrimp pot^{-1}	Shrimp weight pot^{-1} (lb)
1989	1	22	825	43.3	38	2.0
1990	1	22	1524	75.4	69	3.4
1991	1	31	1180	75.7	38	2.4
1992	1	42	531	52.0	13	1.2
1993	1	43	379	29.7	9	0.7
1989	2	22	2226	68.5	101	3.1
1990	2	21	890	46.1	42	2.2
1991	2	22	341	22.0	16	1.0
1992	2	44	343	25.2	8	0.6
1993	2	43	422	27.2	10	0.6
1989	3	22	544	18.3	25	0.8
1990	3	55	513	14.8	9	0.3
1991	3	65	849	28.0	13	0.4
1992	3	43	599	24.2	14	0.6
1993	3	44	508	20.8	12	0.5
1989	4	22	543	15.6	25	0.7
1990	4	33	237	7.7	7	0.2
1991	4	22	1389	50.8	63	2.3
1992	4	44	769	31.7	17	0.7
1993	4	43	521	13.9	12	0.3

Table 6. (page 2 of 2)

Year	Site	Total # Pots	Total # Shrimp	Total Shrimp weight (lb)	Mean # Shrimp pot^{-1}	Mean Shrimp weight pot^{-1} (lb)
1989	5	22	886	20.5	40	0.9
1990	5	33	1077	31.1	33	0.9
1991	5	33	1843	69.8	56	2.1
1992	5	43	820	41.4	19	1.0
1993	5	44	151	9.4	3	0.2
1989	6	22	168	3.4	8	0.2
1990	6	33	42	1.8	1	0.1
1991	6	21	362	13.5	17	0.6
1992	6	44	688	27.6	16	0.6
1993	6	33	94	3.9	3	0.1
1991 [b]	6A	11	25	1.2	2	0.1
1992 [b]	7	55	686	41.8	12	0.8
1993 [b]	7	43	194	9.2	5	0.2
1992 [b]	8	55	547	28.6	10	0.5
1993 [b]	8	43	238	9.8	6	0.2

[a] Lost or damaged pots not included in computations.
[b] Experimental stations.

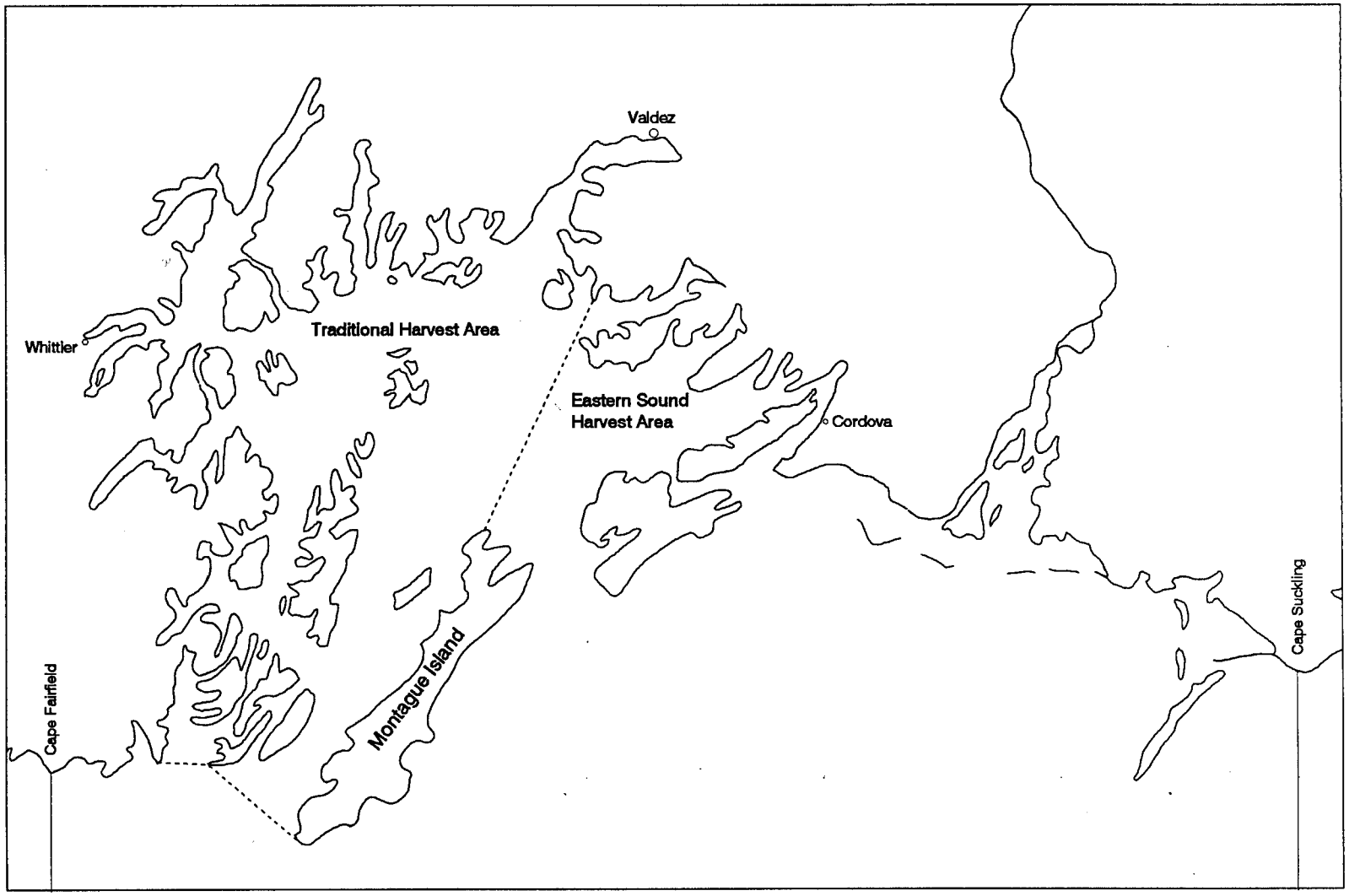

Figure 1. Prince William Sound Pot Shrimp Management Areas.

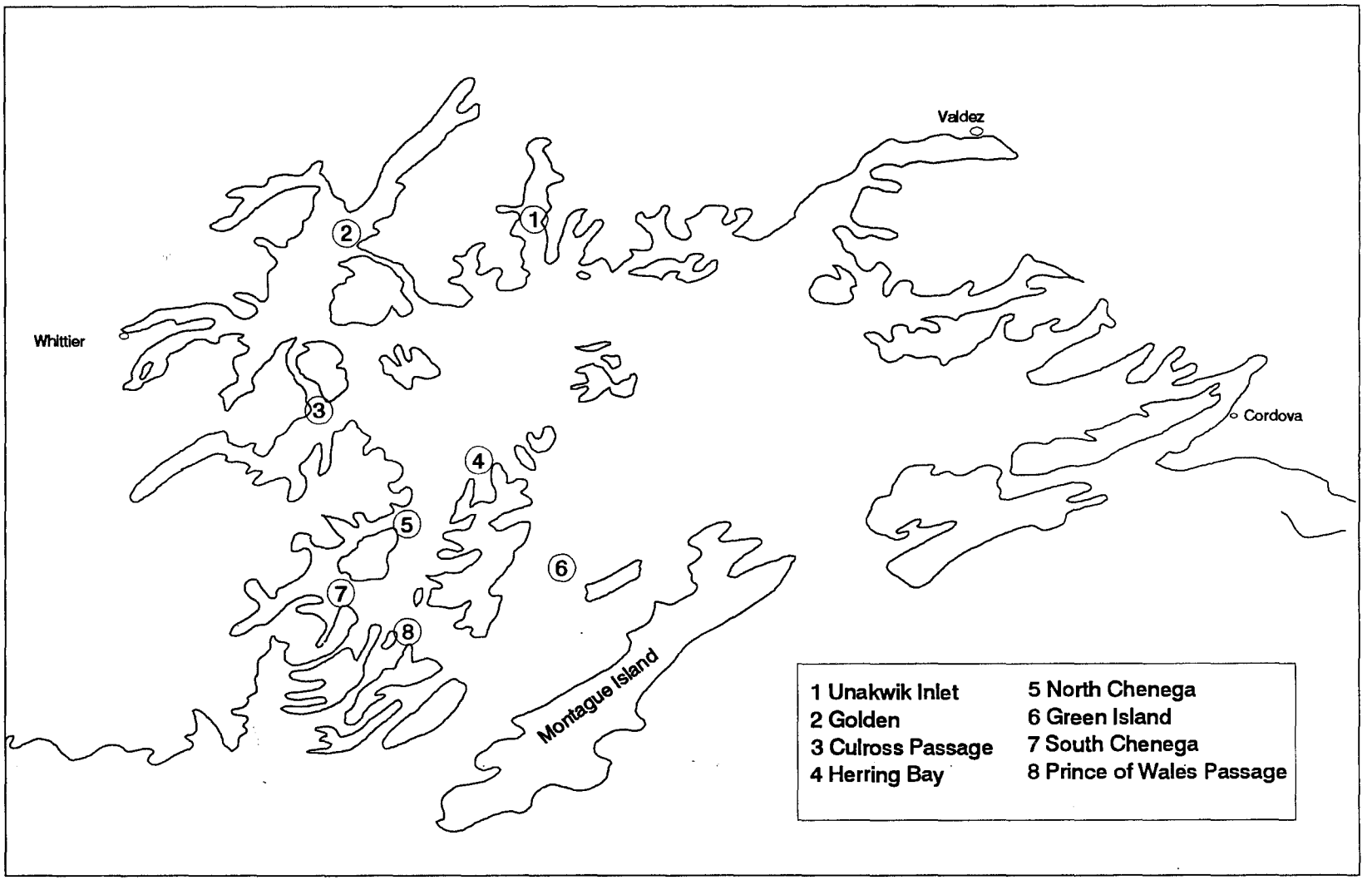

Figure 2. Prince William Sound pot shrimp survey locations, 1989 - 1993.

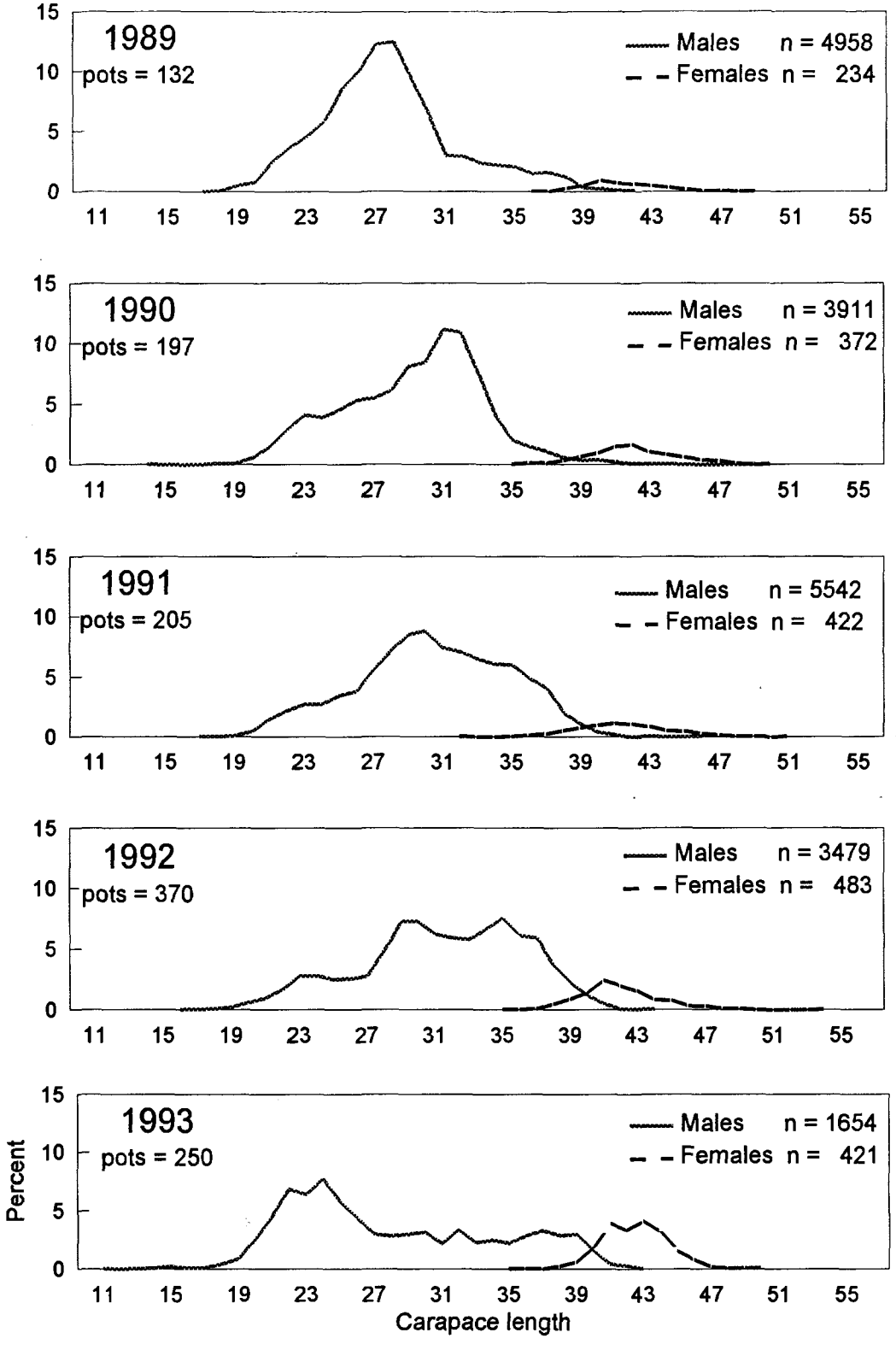

Figure 3. Length frequency by sex of spot shrimp from all traditional sites, PWS spot shrimp surveys, 1989 - 1993.

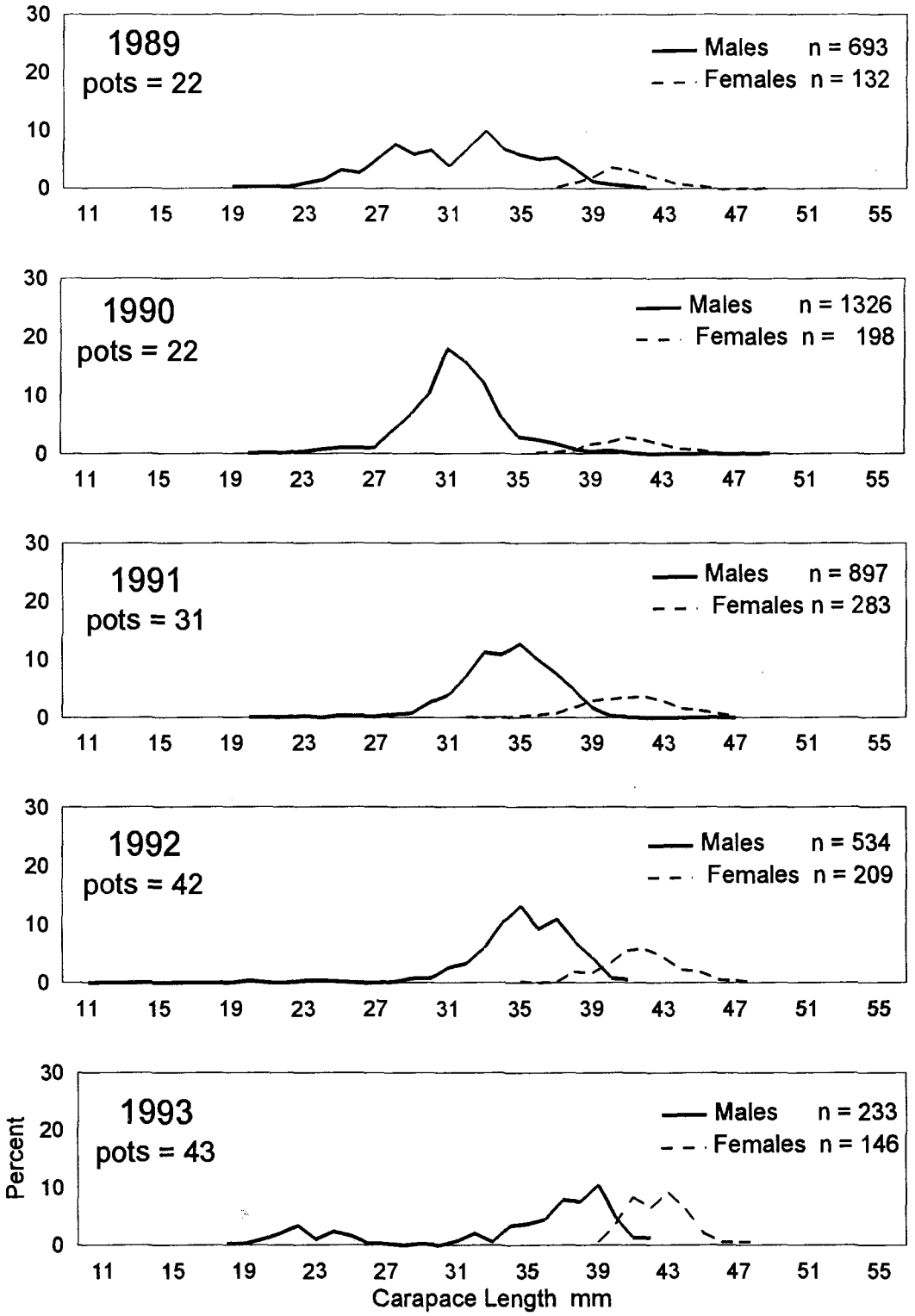

Figure 4. Length frequency by sex of spot shrimp from Unakwik, PWS spot shrimp surveys, 1989 - 1993.

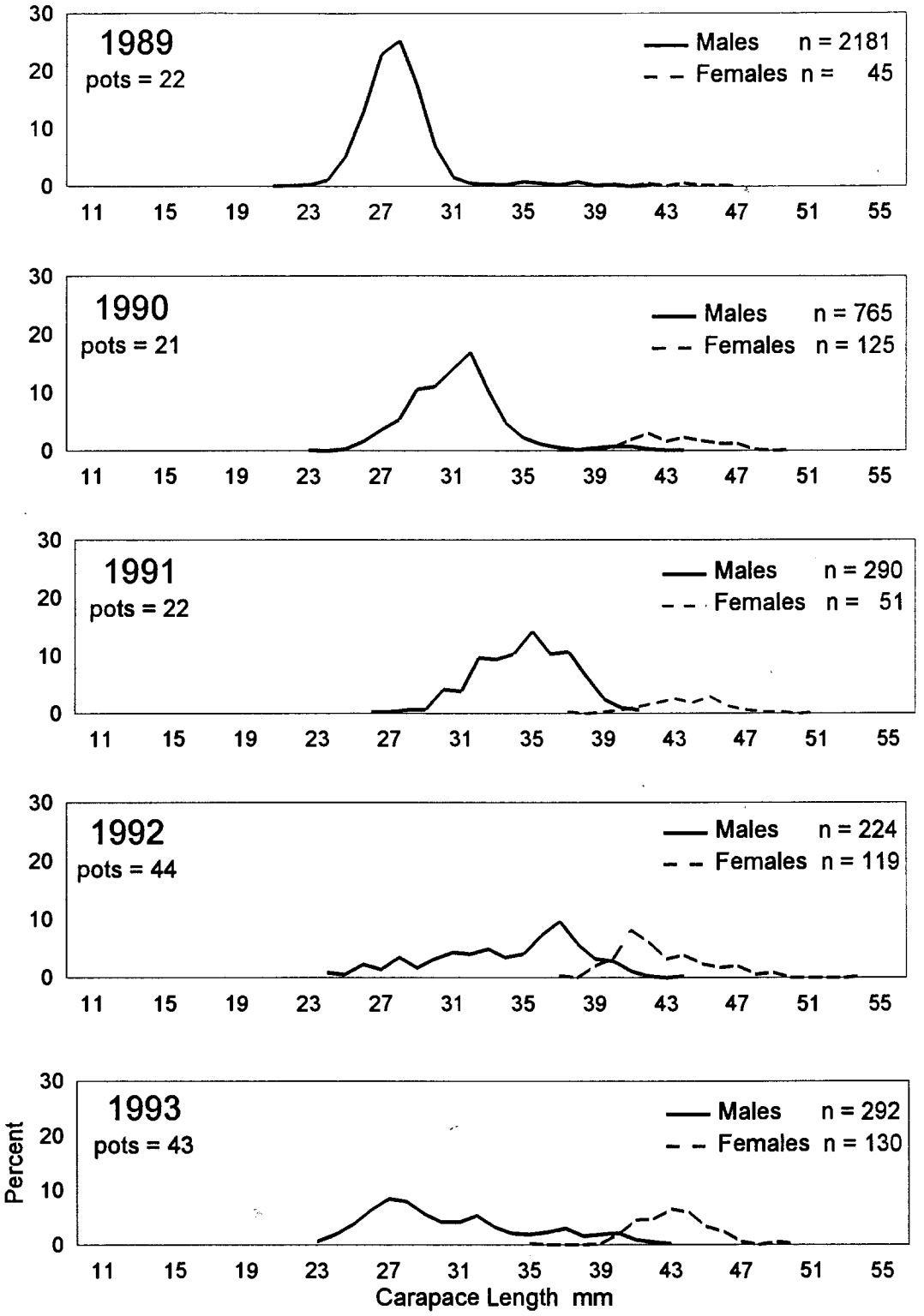

Figure 5. Length frequency by sex of spot shrimp from Golden, PWS spot shrimp surveys, 1989 - 1993.

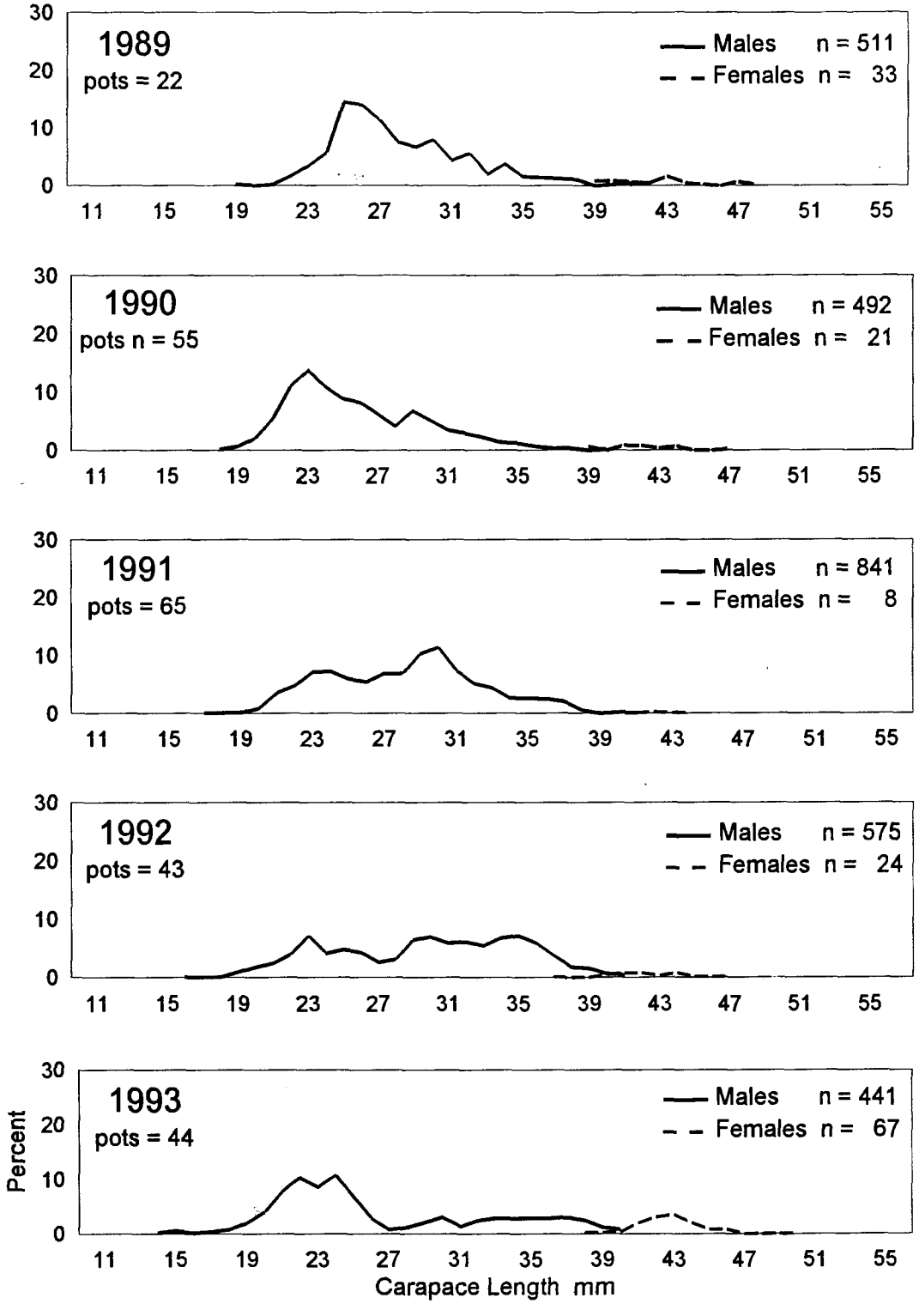

Figure 6. Length frequency by sex of spot shrimp from Culross Passage, PWS spot shrimp surveys, 1989 - 1993.

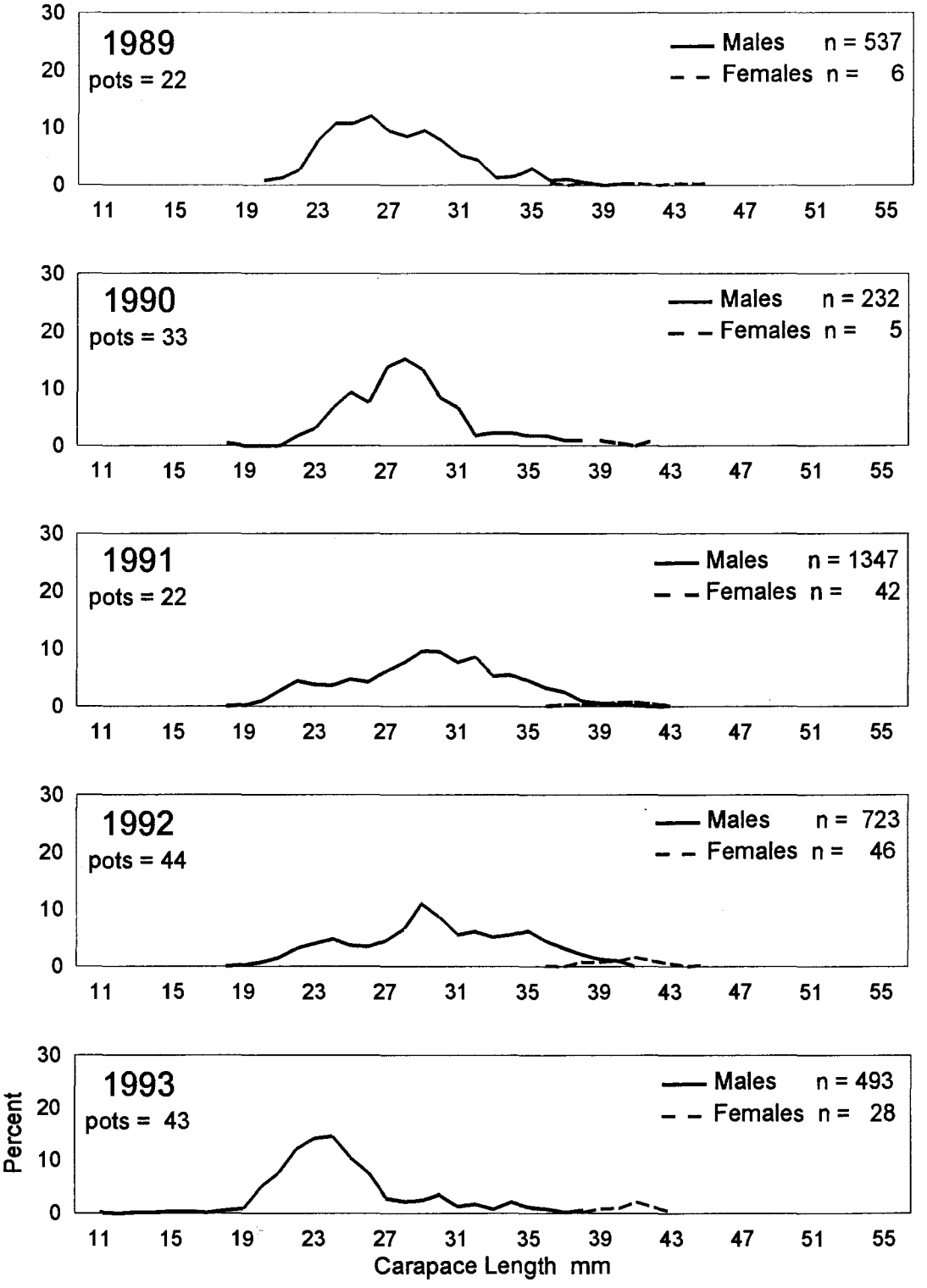

Figure 7. Length frequency by sex of spot shrimp from Herring Bay , PWS spot shrimp surveys, 1989 - 1993.

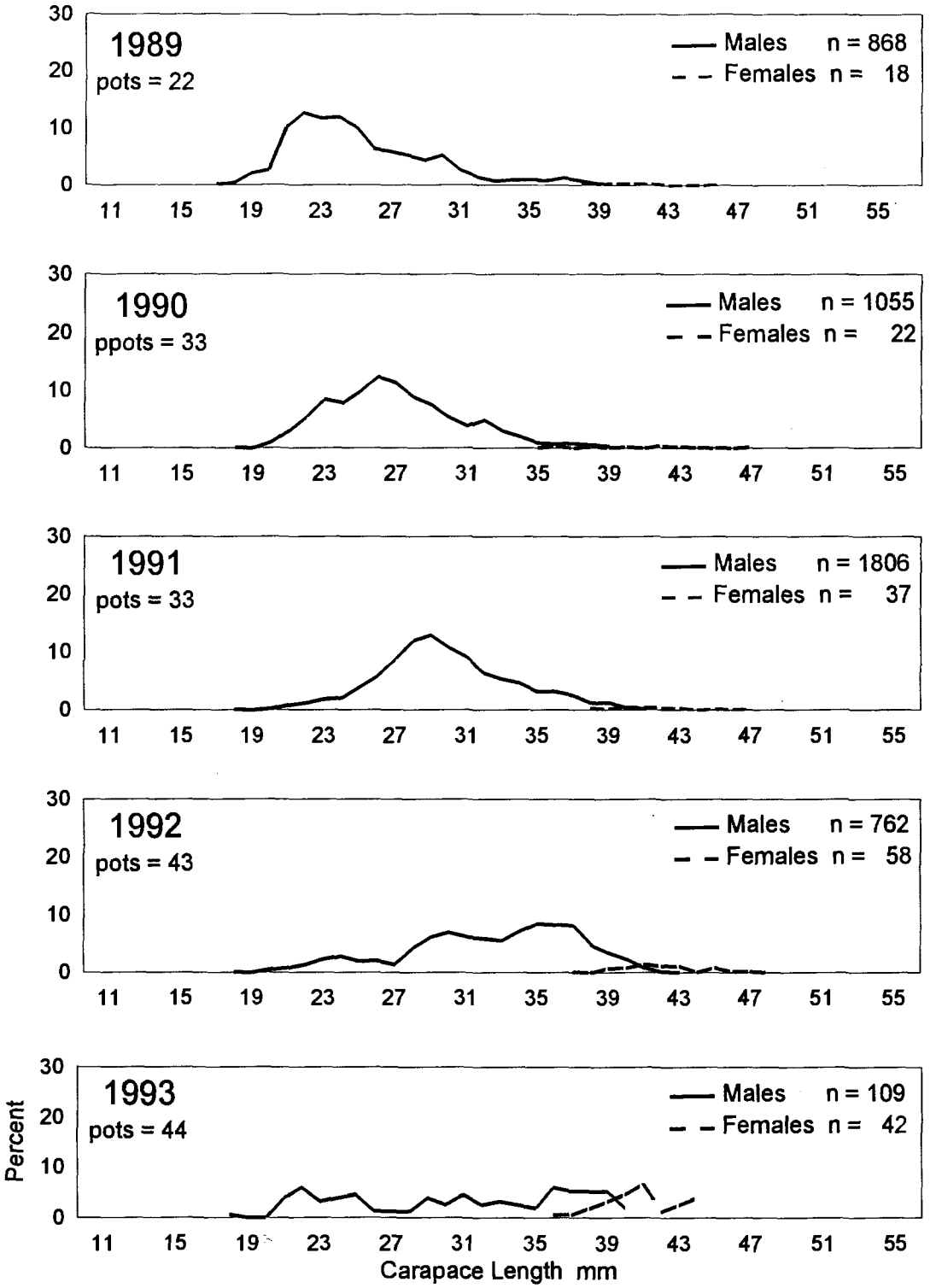

Figure 8. Length frequency by sex of spot shrimp from north Chenega Island , PWS spot shrimp surveys, 1989 - 1993.

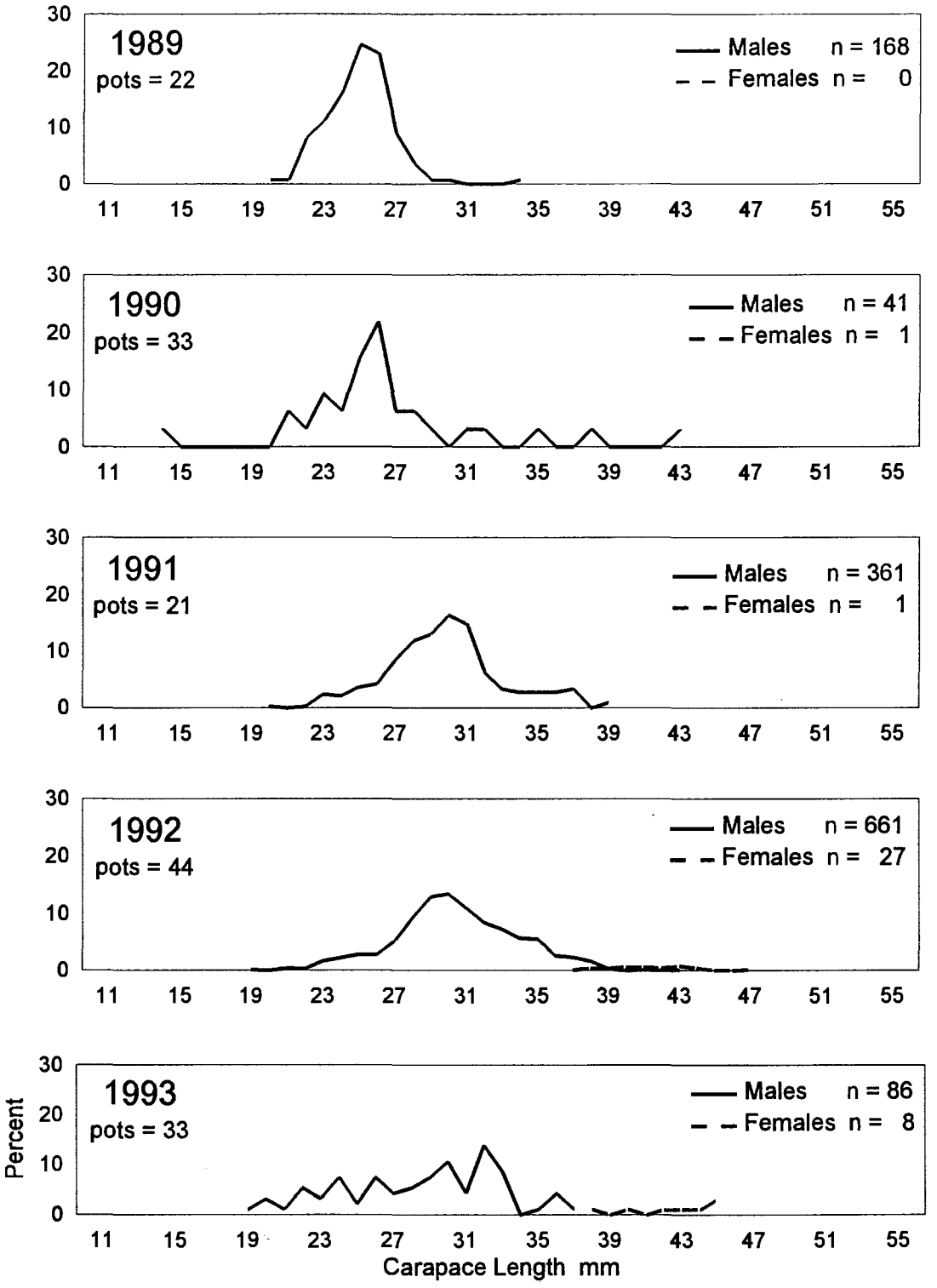

Figure 9. Length frequency by sex of spot shrimp from Green Island , PWS spot shrimp surveys, 1989 - 1993.

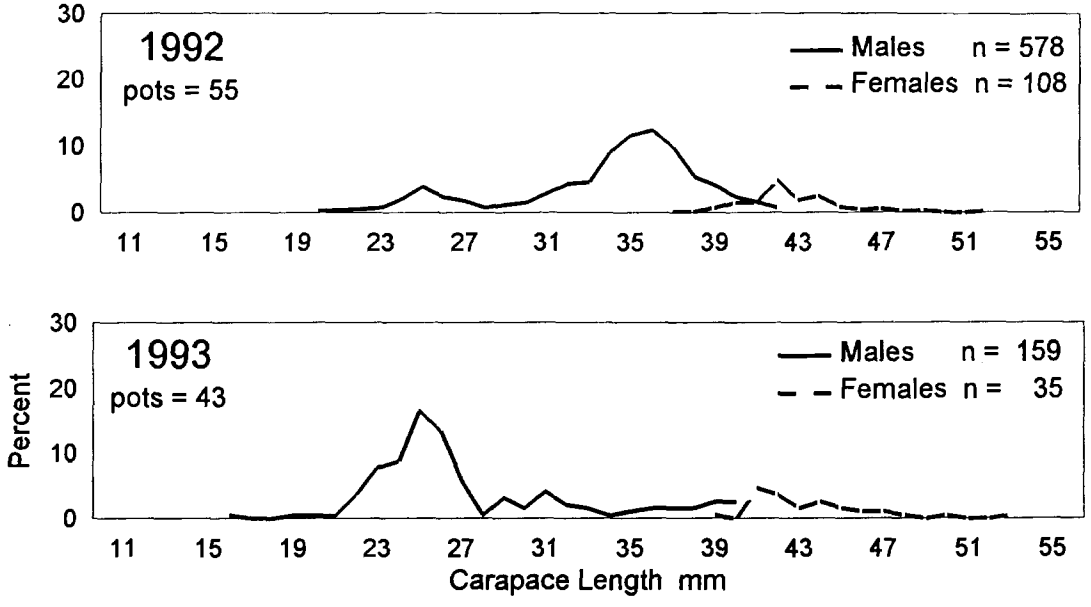

Figure 10. Length frequency by sex of spot shrimp from South Chenega site, PWS spot shrimp surveys, 1992 and 1993.

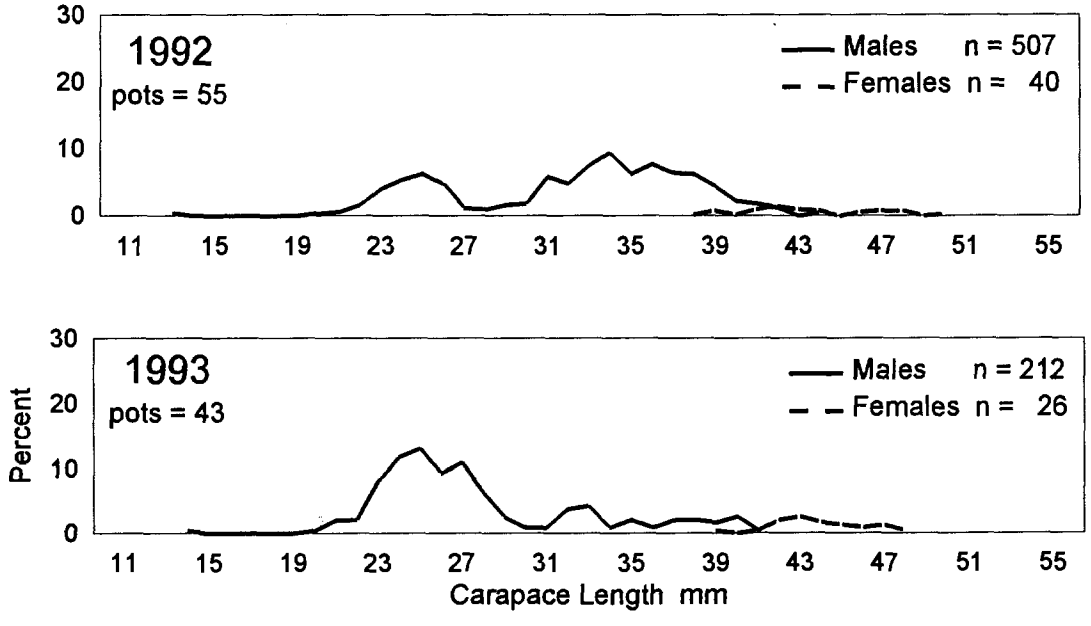

Figure 11. Length frequency by sex of spot shrimp from Prince of Wales site, PWS spot shrimp surveys, 1992 and 1993.

APPENDIX A. Table 1

CODES FOR SPOT SHRIMP FORMS

Sites
- 1 = Unakwik Inlet
- 2 = Golden
- 3 = Culross Passage
- 4 = Herring Bay
- 5 = North Chenega
- 6 = Green Island
- 7 = South Chenega
- 8 = Prince of Wales Passage

Species
- 1 = Sidestripes (Pandalopsis dispar)
- 2 = Pinks (Pandalus borealis)
- 3 = Coonstripes (Pandalus hysinotus)
- 4 = Humpies (Pandalus goniuris)
- 5 = Spots (Pandalus platyceros)

Sex
- 0 = Immature
- 1 = Male
- 2 = Female
- 3 = Transitional
- 4 = Sex Not Determined

Breeding Dress (Females Without Eggs Only)
- 0 = No
- 1 = Yes

Egg Condition
- 0 = No eggs
- 1 = Uneyed eggs
- 2 = Eyed eggs

Egg Color
- 1 = Dark Reddish/Brown
- 2 = Brown
- 3 = Amber
- 4 = Orange
- 5 = Blue

Parasites
- 0 = None
- 1 = Egg Predator
- 2 = Parasitic Externa
- 3 = Carapace Parasite
- 4 = Necrosis

Appendix B. 1. (page 1 of 3) Station data from PWS spot shrimp surveys 1989 – 93.

Site	Station	Date set	Latitude	Longitude	Depth (fathoms) minimum	maximum	Soak time (hr)
1	A	11/07/89	61° 00'	147° 33'	32	43	16
1	B	11/07/89	61° 00'	147° 32'	45	55	18
2	A	11/08/89	60° 58'	148° 2'	35	50	17
2	B	11/08/89	60° 58'	148° 1'	52	65	17
3	A	11/09/89	60° 39'	148° 12'	55	70	17
3	B	11/09/89	60° 39'	148° 12'	40	60	17
4	A	11/11/89	60° 28'	147° 44'	35	65	17
4	B	11/11/89	60° 28'	147° 45'	50	62	17
5	A	11/12/89	60° 25'	147° 58'	50	70	17
5	B	11/12/89	60° 23'	147° 59'	45	55	17
6	A	11/13/89	60° 19'	147° 29'	35	46	18
6	B	11/13/89	60° 18'	147° 29'	57	64	17
1	A	11/05/90	61° 00'	147° 33'	40	65	17
1	B	11/05/90	61° 0'	147° 33'	33	64	17
2	A	11/06/90	60° 58'	148° 2'	30	65	42
2	B	11/06/90	60° 58'	148° 1'	25	57	42
3	A	11/08/90	60° 39'	148° 11'	30	65	16
3	B	11/08/90	60° 39'	148° 11'	31	61	16
3	C	11/09/90	60° 36'	148° 12'	35	70	19
3	D	11/09/90	60° 36'	148° 12'	47	65	19
3	E	11/09/90	60° 36'	148° 12'	45	60	18
4	A	11/10/90	60° 28'	147° 46'	40	58	19
4	B	11/10/90	60° 28'	147° 46'	50	65	19
4	C	11/10/90	60° 29'	147° 46'	59	70	19
5	A	11/11/90	60° 25'	147° 58'	50	70	18
5	B	11/11/90	60° 23'	147° 59'	41	67	18
5	C	11/11/90	60° 25'	147° 58'	36	64	18
6	A	11/13/90	60° 19'	147° 29'	47	68	18
6	B	11/13/90	60° 19'	147° 25'	41	60	18
6	C	11/13/90	60° 19'	147° 30'	35	50	18
1	A	11/04/91	61° 00'	147° 33'	27	70	18
1	B	11/04/91	61° 00'	147° 33'	35	70	18
1	C	11/04/91	61° 00'	147° 33'	40	65	19
2	A	11/05/91	60° 58'	148° 2'	31	67	17
2	B	11/05/91	60° 58'	148° 2'	28	62	17
3	A	11/07/91	60° 39'	148° 12'	35	55	18
3	B	11/07/91	60° 39'	148° 12'	28	68	18
3	C	11/07/91	60° 39'	148° 12'	34	64	18
3	D	11/10/91	60° 36'	148° 12'	32	65	17
3	E	11/10/91	60° 36'	148° 11'	30	68	17
3	F	11/10/91	60° 36'	148° 11'	35	70	–0–
4	A	11/09/91	60° 29'	147° 46'	36	70	18
4	B	11/09/91	60° 29'	147° 46'	30	61	18
4	C	11/09/91	60° 28'	147° 46'	28	43	19
5	A	11/08/91	60° 25'	147° 58'	32	64	17
5	B	11/08/91	60° 25'	147° 58'	38	55	18

–Continued–

Appendix B. 1. (page 2 of 3)

Site	Station	Date set	Latitude	Longitude	Depth (fathoms) minimum	maximum	Soak time (hr)
5	C	11/08/91	60° 23'	147° 59'	39	54	18
6	A	11/11/91	60° 17'	147° 31'	44	68	17
6	B	11/11/91	60° 16'	147° 33'	41	55	17
6 [a]	A	11/11/91	60° 15'	147° 41'	35	52	17
1	A	10/07/92	61° 00'	147° 33'	27	67	17
1	B	10/07/92	60° 60'	147° 33'	40	68	17
1	C	10/07/92	60° 55'	147° 33'	26	56	20
1	D	10/07/92	60° 55'	147° 33'	32	70	20
2	A	10/08/92	60° 58'	148° 2'	28	61	18
2	B	10/08/92	60° 58'	148° 2'	35	80	18
2	C	10/08/92	60° 58'	148° 2'	30	60	19
2	D	10/08/92	60° 57'	148° 2'	27	55	19
3	A	10/09/92	60° 36'	148° 11'	34	60	19
3	B	10/09/92	60° 36'	148° 11'	28	68	20
3	C	10/09/92	60° 36'	148° 12'	30	60	21
3	D	10/09/92	60° 36'	148° 12'	30	72	21
4	A	10/10/92	60° 29'	147° 46'	33	73	20
4	B	10/10/92	60° 29'	147° 46'	26	75	20
4	C	10/10/92	60° 29'	147° 46'	36	69	20
4	D	10/10/92	60° 28'	147° 46'	27	70	20
5	A	10/13/92	60° 25'	147° 58'	28	58	18
5	B	10/13/92	60° 25'	147° 58'	36	54	18
5	C	10/13/92	60° 23'	147° 59'	32	58	19
5	D	10/13/92	60° 23'	147° 59'	29	48	20
5	E	10/13/92	60° 24'	148° 0'	33	43	19
6	A	10/11/92	60° 17'	147° 32'	42	53	19
6	B	10/11/92	60° 16'	147° 33'	40	50	19
6	C	10/11/92	60° 16'	147° 33'	30	40	18
6	D	10/11/92	60° 16'	147° 33'	37	56	18
7	A	10/14/92	60° 19'	148° 10'	27	40	18
7	B	10/14/92	60° 19'	148° 10'	42	62	19
7	C	10/14/92	60° 17'	148° 9'	29	80	18
7	D	10/14/92	60° 17'	148° 8'	27	69	20
7	E	10/14/92	60° 16'	148° 5'	28	62	20
8	A	10/12/92	60° 11'	148° 2'	29	58	19
8	B	10/12/92	60° 11'	148° 0'	30	70	19
8	C	10/12/92	60° 11'	148° 0'	32	63	19
8	D	10/12/92	60° 8'	147° 59'	30	59	20
8	E	10/12/92	60° 8'	148° 0'	27	73	20
1	A	10/20/93	61° 00'	147° 33'	30	74	22
1	B	10/20/93	61° 00'	147° 33'	44	69	22
1	C	10/20/93	60° 55'	147° 33'	20	58	23
1	D	10/20/93	60° 55'	147° 33'	36	64	23
2	A	10/21/93	60° 58'	148° 2'	37	63	18
2	B	10/21/93	60° 58'	148° 2'	30	71	18
2	C	10/21/93	60° 58'	148° 2'	23	52	18

–Continued–

Appendix B. 1. (page 3 of 3)

Site	Station	Date set	Latitude	Longitude	Depth (fathoms) minimum	maximum	Soak time (hr)
2	D	10/21/93	60° 57'	148° 2'	37	60	18
3	A	10/22/93	60° 36'	148° 11'	37	54	19
3	B	10/22/93	60° 36'	148° 11'	24	55	19
3	C	10/22/93	60° 36'	148° 11'	30	66	20
3	D	10/22/93	60° 36'	148° 12'	28	65	20
4	A	10/23/93	60° 29'	147° 46'	25	50	20
4	B	10/23/93	60° 29'	147° 46'	30	60	20
4	C	10/23/93	60° 29'	147° 46'	38	73	20
4	D	10/23/93	60° 28'	147° 46'	31	75	21
5	A	10/24/93	60° 25'	147° 58'	30	58	20
5	B	10/24/93	60° 25'	147° 58'	34	53	20
5	C	10/24/93	60° 23'	147° 59'	38	60	20
5	D	10/24/93	60° 23'	147° 59'	25	47	21
6	A	10/27/93	60° 16'	147° 33'	41	51	19
6	B	10/27/93	60° 16'	147° 33'	37	53	20
6	C	10/27/93	60° 16'	147° 33'	29	55	20
7	A	10/25/93	60° 17'	148° 9'	29	69	20
7	B	10/25/93	60° 17'	148° 7'	25	74	20
7	C	10/25/93	60° 17'	148° 9'	31	80	20
7	D	10/25/93	60° 17'	148° 8'	25	70	20
8	A	10/26/93	60° 11'	148° 2'	32	66	19
8	B	10/26/93	60° 11'	148° 0'	33	90	19
8	C	10/26/93	60° 8'	147° 59'	36	58	20
8	D	10/26/93	60° 8'	148° 0'	24	66	20

Appendix C. 1. Coonstripe shrimp catch in pounds and number of shrimp from the PWS surveys, 1989 - 1993.

Site	1989		1990		1991		1992		1993	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
1	403	6.50	235	3.70	766	11.16	666	9.33	413	7.39
2	242	3.37	148	2.49	670	9.18	571	10.03	188	3.51
3	262	4.04	167	1.99	352	4.83	153	2.57	64	1.18
4	91	1.47	286	3.72	570	7.09	367	6.73	254	4.25
5	221	3.28	384	4.72	389	5.50	207	3.44	135	2.80
6	6	0.11	53	0.59	77	1.27	41	0.94	21	0.41
7	N/A	N/A	N/A	N/A	17	0.29	641	9.93	117	2.24
8	N/A	N/A	N/A	N/A	N/A	N/A	172	2.76	87	1.70
Total	1225	18.76	1273	17.21	2841	39.32	2818	45.72	1279	23.49

Appendix C. 2. Pink shrimp catch in pounds and number of shrimp from the PWS surveys, 1989 - 1993.

Site	1989		1990		1991		1992		1993	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
1	16	0.08	15	0.07	25	0.15	175	1.21	908	5.00
2	6	0.04	9	0.05	45	0.31	537	4.24	352	2.66
3	4	0.04	63	0.37	148	1.24	268	2.17	171	1.50
4	213	1.30	1037	6.40	74	0.38	537	3.82	512	4.34
5	142	1.10	130	1.04	25	0.17	200	1.52	69	0.64
6	143	1.08	439	4.49	120	1.18	532	5.06	109	0.86
7	N/A	N/A	N/A	N/A	15	0.07	862	8.41	230	2.24
8	N/A	N/A	N/A	N/A	N/A	N/A	774	7.49	1538	7.12
Total	524	3.633	1693	12.42	452	3.499	3885	33.92	3889	24.36