TRAWL SHRIMP INDEX FISHING IN THE SOUTHERN DISTRICT OF THE COOK INLET AREA

SPRING 1990

By: Lee F. Hammarstrom

Regional Information Report[1] No. 2H90-06

Alaska Department of Fish and Game
Division of Commercial Fisheries, Central Region
333 Raspberry Road
Anchorage, Alaska 99518

June 1990

[1]Contribution 90-06 from the Homer area office. The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate needs for up to date information, reports in this series may contain preliminary data.

TRAWL SHRIMP INDEX FISHING IN THE SOUTHERN DISTRICT OF THE COOK INLET AREA

MAY 9 - 10,
MAY 14 - 18
and
MAY 22, 1990

Lower Cook Inlet Data Report Number 90-06

by

Lee F. Hammarstrom
Assistant Area Shellfish Biologist

Alaska Department of Fish and Game
Division of Commercial Fisheries

Don W. Collinsworth - Commissioner
Ken Parker - Director of Commercial Fisheries

3298 Douglas Street
Homer, Alaska 99603

June 1990

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX TABLES

INTRODUCTION

The commercial trawl shrimp fishery in the Cook Inlet Management Area (H) began with intermittent harvests in the 1950's and early 1960's, but the small catches did not accurately reflect the size of the stocks in the area. In the late 1960's trawl catches reached the five million pound level annually and remained near that level through the early 1980's (Table 1). More recently, the commercial fishery has been closed since the fall of 1986 due to low abundance levels. Pink shrimp (*Pandalus borealis*) historically made up the bulk of the commercial catch, with sidestripes (*Pandalopsis dispar*) seasonally making up a lower but still significant portion of the catch. Humpy shrimp (*Pandalus goniurus*) at times comprised up to 50 percent of the annual commercial harvest, but this species appears to undergo the most erratic population fluctuations and their contribution to the most recent fisheries were minor. Finally, coonstripes (*P. hypsinotus*) consistently made up approximately five percent or less of the harvest. Effort has varied from a low of one vessel during 1968 to a high of 23 in 1981.

Trawl shrimp population abundance index surveys have been conducted by the Department in the Southern District once each year (May) from 1971 through 1975 and twice annually (May and October) since then. Results of the surveys have been used to monitor stock status and establish harvest guidelines for each of the three regulatory sub-seasons (summer, fall, and winter) during the fishing year. During the spring of 1988, the number of stations sampled east of Homer Spit was increased over the number sampled during previous surveys because this area had become the major area of shrimp occurrence. Expanding the number of stations in this area also increases the statistical accuracy of the survey estimate of abundance.

METHODS

The spring 1990 trawl index survey was conducted aboard the state research vessel **PANDALUS** on weekdays only from May 9 through May 22, except that two weekdays during this period were missed, one due to vessel breakdowns and one due to weather. The survey utilizes a 61-foot NMFS-designed high opening shrimp net. This particular style of net, used in the surveys since 1975, replaced a 66-foot Nordby trawl net with assumed 50 percent net efficiency utilized during surveys conducted between 1971 through 1974. Based on side-by-side comparisons with the old net, the newer NMFS net has 100 percent assumed net efficiency.

Individual one nautical mile tows were made in systematically selected one-square mile stations throughout Kachemak Bay, Tutka Bay, and Sadie Cove. In recent years, to reduce the potential of net damage, one-half mile tows were utilized in stations west of Homer Spit which have had a recent history of no shrimp catch. If

tows in the one-half mile stations indicate presence of shrimp, the tow is repeated with a length increase to the standard distance of one mile.

Upon completion of each tow, the total catch was weighed to the nearest two pounds using a digital electronic hanging scale and subsequently dumped on the rear deck. For those catches containing shrimp, two random subsamples of approximately 10,000 grams each were collected from individual tows of five hundred pounds or more; for catches of less than five hundred pounds, one such subsample was collected. Each 10,000 gram bucket subsample was then separated by fish and non-shrimp (which include finfish, shellfish other than shrimp, and any miscellaneous debris) and shrimp, and each of these groups was weighed on an electronic platform scale to obtain percentages of the total catch. A 2,500 gram subsample was randomly selected from the shrimp in the original 10,000 gram subsample and separated by species, with each species weighed separately for species composition. In addition, small quantities of shrimp from the subsample were labelled and retained for later length frequency analysis in the laboratory. In the case of pink shrimp, which generally comprise the highest percentage of each shrimp subsample, a quantity of approximately 350 to 400 grams is retained from each station. For the other species, normally all individuals are retained since they usually amount to a relatively small number of shrimp per station subsample. For those catches which contained no shrimp, a basket sample of approximately 15,000 to 25,000 grams was collected in an attempt to better identify and enumerate the species composition of the fish.

RESULTS

A total of 34 successful tows in traditional stations only yielded an overall average catch of 103.4 pounds of Pandalid shrimp per one nautical mile tow (Table 2). For comparative purposes, when the eight newly added stations east of Homer Spit are included in the calculations, the average catch of shrimp in all stations amounted to 220.9 pounds per nautical mile. These figures do not include any catch data from the Tutka Bay/Sadie Cove areas since those areas are closed to commercial trawling. An attempted tow at station 020, a non-traditional station east of the Homer Spit, contained approximately seven derelict crab and shrimp pots and significant amounts of mud and debris. Due to time limitations, the tow could not be repeated. As a result, no weights were recorded for this station, and this station was not utilized in any abundance estimate calculations.

The average catches of Pandalid shrimp per nautical mile by respective area were 374.0 pounds per tow east of the Homer Spit (traditional stations only), 556.7 pounds per tow east of the Homer Spit (all stations combined), 6.0 pounds per tow west of the Spit, and 303.5 pounds per tow in Tutka Bay/Sadie Cove (Table

3). The abundance index estimate for the Southern District based on the results of the spring 1990 survey for the traditional stations only ranged from 0.2 to 3.2 million pounds with a midpoint of 1.7 million pounds. Calculating in the non-traditional stations east of the Spit, the abundance index midpoint estimate is 3.7 million pounds, with a range of 0.9 to 6.5 million pounds. Formulas and explanations used to calculate the midpoint estimate and range are shown in Appendix Table 1.

Shrimp species composition for the traditional stations is represented in Table 4. As expected pinks dominated the catches at 74.4 percent. Humpies comprised 17.9 percent of the catches, the highest percentage of this species in the spring surveys over the last ten years. Sidestripes contributed only 2.6 percent of the total, while coonstripes contributed 4.0 percent to the catches. Incidence of "other" shrimp, such as *Crangon* sp. and *Eualis* sp. was approximately 1.1 percent. Preliminary average counts per pound for pink shrimp in the traditional stations east of the Homer Spit were 164 and 134, respectively, for the closed commercial waters north and northeast of Glacier Spit and the open commercial waters south and west of Glacier Spit (Table 5). West of Homer Spit, the average pink shrimp count per pound was 94 for the fifteen stations from which samples were obtained.

The largest single catch of Pandalid shrimp, totalling 4,786 pounds, occurred in station U27 (Table 6), the most northeasterly station in the survey (Figure 1) and a non-traditional station located approximately 1.0 mile due west of Bear Cove. Although dominated by pinks (81 percent), this particular station contained significant amounts of both humpy (603 pounds) and coonstripe (224 pounds) shrimp. The station adjacent to this station, T26, had a Pandalid shrimp catch in excess of 2,000 pounds. Ten stations had a zero catch of shrimp, all west of Homer Spit. The catch from the single tow in Tutka Bay totalled 425 pounds of shrimp, 96 percent of which was pinks and only 0.5 percent coonstripes.

Percentages of fish and non-shrimp species by weight in the catches of the traditional stations only were 67.7 percent for the area east of the Homer Spit and 98.5 percent west of the spit (Table 7). The former figure is the highest ever recorded for the spring survey in the history of the survey program. East of the Homer Spit, the two largest single station catches of fish and non-shrimp species occurred approximately four miles east of the tip of the Spit, both in excess of 1,000 pounds. The largest of the two, station N22 totalling about 1,400 pounds of fish and shellfish other than shrimp, was dominated by Tanner crab (*Chionocetes bairdi*) at just over 57 percent of the non-shrimp catch, followed by flathead sole (*Hippoglossoides elassodon*) at 13 percent and walleye pollock (*Theragra chalcogramma*) at 9 percent. If the Tanner crab are considered separately, this species represents 813 pounds, or just under 57 percent, of the

total combined catch for this tow. The finfish amounted to 607 pounds, or about 42 percent of the total combined catch, with flathead sole representing about 30 percent of this total and pollock representing about 20 percent.

West of the Homer Spit, one station had a fish and non-shrimp catch of approximately 1,200 pounds, station L17, located approximately two miles southwest of the tip of the Homer Spit. This non-shrimp catch contained nearly equal amounts of flathead sole and king crab (*Paralithodes camtshaticus*), each at about one-third of the total. In Tutka Bay and Sadie Cove, the two tows averaged 1,300 pounds of fish each, both dominated by a variety of sculpin species followed by pollock.

The most commonly occurring non-shrimp species throughout the survey were pollock, flathead sole, and arrowtooth flounder. In terms of total weight, flathead sole represented the largest portion of the non-shrimp catches west of the Homer Spit, followed by pollock and arrowtooth flounder (Table 8). East of the spit, only two tows were accurately analyzed for non-shrimp species, with Tanner crab dominating the catch in one station and flathead sole dominating the other.

DISCUSSION

The average catches of shrimp from traditional stations only from both east and west of the Homer Spit are increases over the surveys of 1989, while the Tutka/Sadie average is an all time low for that area. The resulting abundance midpoint estimate of 1.7 million pounds is a slight increase over both the previous spring and fall surveys. When the non-traditional stations are considered, the calculated overall abundance shows a substantial increase over recent surveys which included the non-traditional stations, to a mid-point estimate of approximately 3.7 million pounds. Both estimates, however, suffer from a high percentage of statistical error because the two very large tows near the head of Kachemak Bay are much greater than any of the other tows in the survey. These two tows are by far the highest single tows in the survey program over the past ten years.

Examination of Figure 1 shows that the highest catches of shrimp occurred in the commercially closed area north and northeast of Glacier Spit, primarily due to the two previously mentioned large tows. The six stations in this area averaged over 1,300 pounds of shrimp per tow, which compares with about 500 pounds per tow in the fall of 1989 and 729 pounds per tow in the spring of 1989 for the same area. Overall for the ten successful stations west and southwest of Glacier Spit (open commercial area), the spring 1990 shrimp catches averaged 104 pounds per tow, compared with 197 pounds per tow in these stations during the fall 1989 survey and only 22 pounds per tow in the spring 1989 survey.

Catches of fish and non-shrimp species, which included crab species, in the closed commercial area east of the Spit averaged 694 pounds per tow, while those in the open area averaged 686 pounds. Both are considered high for those respective areas and are similar to the averages from the fall 1989 survey but are increases over the averages from the spring 1989 survey. West of the Spit, fish and non shrimp species catches averaged 406 pounds per tow, the lowest average for this area since the spring survey of 1987.

Count per pound information collected in the field suggests that the pink shrimp found in the closed commercial area east of the Homer Spit were a mixture of females, males, and juveniles. In the open commercial area, the lower number counts per pound suggest that shrimp in this area were larger, consisting of mostly males and females but fewer juveniles. West of the Spit the very low number counts indicate mostly females.

Shrimp survival and reproductive success appear to have been better over the past year than in previous recent years. Counts per pound would suggest an improved age/size structure, and the increased abundance estimate would suggest more individuals within the reproductive segment of the population. The majority of shrimp continue to be found in the northeast portion of Kachemak Bay. Incidence and abundance of fish species seems to be similar to 1989 east of the Spit but decreased in the area west of the Spit compared to recent years.

Current environmental factors seem to be the primary element influencing the pink shrimp stocks in Kachemak Bay. Based on the results of the spring 1990 survey, the pink shrimp stocks would appear to be experiencing better survival rates and increased abundance. Additionally, stocks of fish which potentially prey upon shrimp within Kachemak Bay may be decreasing, which would tend to further improve the potential for shrimp survival. However, the shrimp stocks have not yet returned to levels seen in the 1970's and remain low by historical standards. Enhancing shrimp reproductive success and survival could be accomplished by continuing to eliminate fishing mortality and reducing predation levels.

Table 1. Historical trawl shrimp catches by guideline harvest level for the Kachemak Bay trawl shrimp fishery in the Cook Inlet Management Area (H).

SEASON	NUMBER OF VESSELS	CATCH (lbs) JUN 1-OCT 31	NOV 1-MAR 31	APR 1-MAY 31	TOTAL
1969-70[a]	7	1,289,656	1,692,854	889,330	3,871,840
1970-71[a]	3	3,211,924	2,076,228	617,836	5,905,988
1971-72[a]	7	2,618,630	1,761,569	140,707	4,520,906
1972-73[a]	10	2,772,422	2,109,660		4,882,082
1973-74[b]	13	2,502,154	2,323,780		4,825,934
1974-75	4	2,512,764	2,519,148		5,031,912
1975-76	4	1,997,563	2,421,456		4,419,019
1976-77	5	2,545,885	2,453,101		4,998,986
1977-78	7	2,490,969	2,546,977		5,037,946
1978-79	6	2,952,733	3,060,066		6,012,799
		JUL 1-SEP 30	OCT 1-DEC 31	JAN 1-MAR 31	
1979-80	7	2,013,298	2,052,646	1,731,483	5,797,427
1980-81	15	1,780,298	2,691,746	1,704,706	6,177,129
1981-82	23	1,614,868	1,686,781	1,693,850	4,995,499
1982-83	15	998,522	1,012,388	1,009,857	3,020,767
1983-84	10	CLOSED	CLOSED	525,508	525,508
1984-85	10	519,651	528,506	518,529	1,566,686
1985-86	5	488,606	257,782	503,340	1,249,728
1986-87	3	504,206	CLOSED	CLOSED	504,206
1987-88	0	CLOSED	CLOSED	CLOSED	0
1988-89	0	CLOSED	CLOSED	CLOSED	0
1989-90	0	CLOSED	CLOSED	CLOSED	0

[a] Catches listed for comparative purposes by seasons established in 1973.
[b] June 1 - October 31 and November 1 - March 31 seasons with respective guidelines established.

Table 2. Abundance index estimates of commercial species of Pandalid shrimp (millions of pounds) in the Southern District (Kachemak Bay), by sampling period and year, based on pounds of shrimp caught per one nautical mile tow (traditional stations only).

MONTH	YEAR	MEAN CATCH (lbs/tow)	NUMBER OF STATIONS	% ERROR	ABUNDANCE INDEX (Mill. of lbs.)	(Mill. of lbs.)
SPRING						
May	1971	130.2[a]	56	20.0	3.7	3.0 to 4.5
May	1972	271.1[a]	66	35.5	7.7	5.0 to 10.5
May	1973	592.8[a]	59	27.8	16.9	12.2 to 21.6
Jun	1974	476.6[a]	30	22.8	13.6	10.5 to 15.7
May	1975	1,136.9[b]	37	27.9	16.2	11.7 to 20.7
May	1976	541.3	36	28.3	7.7	5.5 to 9.9
Jun	1977	407.9	40	17.1	5.8	4.8 to 6.8
May	1978	810.9	36	25.2	11.5	8.6 to 14.5
May	1979	743.7	41	20.9	10.6	8.4 to 12.8
May	1980	513.7	39	19.5	7.3	5.9 to 8.7
May	1981	486.1	37	18.4	6.9	5.6 to 8.2
May	1982	306.8	38	21.8	4.4	3.4 to 5.3
May	1983	204.0	37	24.8	2.9	2.2 to 3.6
May	1984	282.3	34	34.2	4.1	3.0 to 5.2
May	1985	197.5	34	39.7	3.2	1.9 to 4.5
May	1986	157.2	34	50.9	2.6	1.3 to 4.0
May	1987	178.8	34	45.2	3.0	1.6 to 4.3
May	1988	247.5	33	45.0	4.1	2.3 to 6.0
May	1989	90.5	31	65.9	1.5	0.5 to 2.5
May	1990	106.5	33	87.1	1.7	0.2 to 3.2
FALL						
Oct	1976	719.8	33	21.6	10.3	8.0 to 12.5
Nov	1977	738.1	36	28.9	10.5	7.5 to 13.5
Oct	1978	1,160.3	32	25.5	16.5	12.3 to 20.7
Oct	1979	1,133.3	32	23.3	16.1	12.4 to 19.9
Oct	1980	1,689.4	37	19.3	24.1	19.4 to 28.7
Oct	1981	604.8	35	26.9	7.9	5.8 to 10.0
Oct	1982	519.2	36	26.3	7.4	5.4 to 9.3
Oct	1983	481.3	36	36.6	6.9	4.9 to 8.8
Oct	1984	531.9	35	26.3	7.6	6.1 to 9.1
Oct	1985	284.9	34	32.0	4.1	2.8 to 5.4
Sep	1986	154.0	34	37.9	2.6	1.6 to 3.6
Sep/Oct	1987	227.0	34	66.1	3.8	1.3 to 6.3
Nov	1988	152.3	28	64.8	2.5	0.9 to 4.2
Sep	1989	84.8	32	49.0	1.4	0.7 to 2.1

[a] 66' Nordby net, 50% assumed net efficiency.
[b] From this survey to present, a 61' NMFS net with 100% assumed net efficiency has been used.

Table 3. Mean catch of Pandalid shrimp in pounds per one nautical mile tow, by area (traditional stations only), by period, and by year, captured during trawl shrimp index surveys in the Southern District (Kachemak Bay) of the Cook Inlet Management Area (H).

		MEAN CATCH OF PANDALID SHRIMP (lbs/tow)		
Month	Year	West of Spit	East of Spit[a]	Tutka/Sadie[b]
SPRING				
May	1971[c]	126.5	69.3	
May	1972[c]	366.9	75.7	
May	1973[c]	759.2	156.1	
Jun	1974[c]	492.1	211.2	
May	1975[d]	1,250.0	660.0	
May	1976	479.6	802.0	
Jun	1977	317.6	678.7	
May	1978	749.5	1,175.7	
May	1979	786.0	633.9	
May	1980	488.1	539.2	
May	1981	454.5	584.7	1,492.3
May	1982	268.6	413.3	452.0
May	1983	97.2	536.2	1,830.8
May	1984	56.0	910.0	1,179.8
May	1985	2.6[e]	830.4	2,027.0
May	1986	2.0[e]	588.4	1,102.9
May	1987	24.0[e]	609.0	714.3[f]
May	1988	39.1[e]	898.9	2,006.0[g]
May	1989	2.7	342.8	508.0[h]
May	1990	6.0	374.0	303.5[h]

[a] Traditional stations only.
[b] The Tutka/Sadie area was not surveyed prior to 1981.
[c] Nordby trawl net (66' ground rope, 53' head rope, 60' tickler chain) with 50% assumed net efficiency.
[d] From this survey to present, a 61' NMFS net with 100% assumed net efficiency has been used.
[e] Extremely small shrimp catches (less than 10% of total) were not processed for actual weight and are referred to as "trace shrimp", and are considered zero for calculations.
[f] Only 2 of the 3 tows in Sadie Cove included.
[g] Only one tow in Sadie Cove made and its weight was estimated due to a malfunctioning electronic scale.
[h] Only one tow made in Sadie Cove.

Month	Year	MEAN CATCH OF PANDALID SHRIMP (lbs/tow) West of Spit	East of Spit[a]	Tutka/Sadie[b]
FALL				
Oct	1976	574.7	1,127.0	
Nov	1977	695.6	456.6	
Oct	1978	1,310.2	626.0	
Oct	1979	1,263.7	805.6	
Oct	1980	1,764.4	1,456.2	
Oct	1981	626.6	541.9	734.0
Oct	1982	303.4	1,274.4	1,309.5
Oct	1983	48.1	1,607.6	3,492.3
Oct	1984	305.7	1,185.5	2,741.0
Oct	1985	88.8	829.8	876.9
Sep	1986	18.0[c]	518.9	1,188.9
Sep/Oct	1987	2.0[c]	852.0	667.7
Nov	1988	1.3[c]	471.0	597.5[d]
Sep	1989	3.5	292.6	461.5[d]

[a] Traditional stations only.
[b] The Tutka/Sadie area was not surveyed prior to 1981.
[c] Extremely small shrimp catches (less than 10% of total) were not procesed for actual weight and are referred to as "trace shrimp", and are considered zero for calculations.
[d] Only 1 tow made in Sadie Cove.

Table 4. Catch composition (percent) of Pandalid shrimp species in the Southern District (Kachemak Bay) trawl abundance index surveys by sampling period and year (traditional stations only). "Other" shrimp (*Crangon* sp. and *Eualis* sp.) are additional to those years where figures do not add up to 100 percent.

YEAR	MONTH	PINK	HUMPY	COON	SIDE	ABUNDANCE INDEX (Million lbs.)
SPRING						
1971	May	83.8	9.9	1.9	4.4	3.7
1972	May	62.0	33.2	1.3	3.5	7.7
1973	May	67.5	27.3	1.8	3.4	16.9
1974	Jun	81.6	7.9	2.2	8.3	13.6
1975	May	74.8	16.6	2.7	5.9	16.2
1976	May	82.6	5.3	3.6	8.5	7.7
1977	Jun	83.4	3.3	6.1	7.2	5.8
1978	May	67.9	24.8	1.3	6.1	11.5
1979	May	78.3	14.3	2.3	5.1	10.6
1980	May	63.4	23.6	1.9	11.1	7.3
1981	May	72.7	13.8	4.2	9.3	6.9
1982	May	73.2	12.6	3.4	10.8	4.4
1983	May	71.3	1.4	1.4	25.9	2.9
1984	May	85.4	1.8	0.9	11.8	4.1
1985	May	89.0	1.6	1.0	8.4	3.2
1986	May	70.6	7.4	1.3	20.1	2.6
1987	May	78.3	10.1	2.1	9.6	3.0
1988	May	67.5	17.9	2.2	10.5	4.1
1989	May	94.3	1.4	1.4	2.0	1.5
1990	May	74.4	17.9	4.0	2.6	1.7
FALL						
1976	Oct-Dec	69.0	20.8	3.0	7.2	10.3
1977	Nov	58.1	29.2	2.0	10.7	10.5
1978	Oct	47.4	45.9	1.7	5.0	16.5
1979	Oct	45.2	50.4	0.7	3.7	16.1
1980	Oct	57.8	34.5	1.5	6.2	24.1
1981	Oct	57.8	30.4	1.6	10.2	7.9
1982	Oct	71.2	16.0	2.5	10.3	7.4
1983	Oct	72.1	15.4	2.6	9.8	6.9
1984	Oct	68.4	19.8	2.9	8.9	7.6
1985	Oct	71.7	1.1	2.9	19.2	4.1
1986	Sep	75.5	2.3	3.9	12.1	2.6
1987	Sep/Oct	63.6	8.5	3.0	19.4	3.8
1988	Nov	78.1	10.3	3.2	4.9	2.5
1989	Sep	86.7	3.1	2.9	2.0	1.4

Table 5. Historical average numbers of pink shrimp (*Pandalus borealis*) per pound by area from samples taken during ADF&G trawl index surveys in the Southern District (Kachemak Bay) of the Cook Inlet Management Area (H).

	East of Homer Spit			West of	Combined Avg.
Year	Open Commercial Area Pink Count/lb.	Closed Commercial Area Pink Count/lb.	Combined Avg. Pink Count/lb.	Homer Spit Pinks/lb.	All Areas Pinks/lb.[a]
Spring Survey					
1971	230.3	213.4	220.0	159.6	180.4
1972	185.3	203.1	196.7	137.3	151.9
1973	230.4	167.2	182.5	152.0	158.5
1974	133.8	125.6	129.5	126.0	126.8
1975	154.6	143.5	150.0	135.9	138.1
1976	169.6	157.8	165.9	107.5	126.7
1977	144.7	142.7	143.5	109.0	120.5
1978	155.0	163.6	158.6	123.7	130.2
1979	170.7	203.3	185.1	126.6	147.1
1980	173.6	190.1	181.7	112.0	127.5
1981	193.1	190.9	192.2	111.7	134.9
1982	180.8	177.2	178.7	112.8	129.2
1983[May/Jun]	151.3	176.2	164.0	102.6	128.3
1983[Jul]	169.3	194.4	177.0	106.7	161.0
1984	177.5	224.2	206.7	98.5	142.6
1985	193.8	244.3	220.9	199.0	218.2
1986	155.5	229.4	200.5	NO SAMPLES	200.5
1987	134.8	271.4	212.6	108.5	204.7
1988	107.5	247.3	209.8	95.0	175.5
1989	121.3	197.7	184.4	85.0	176.3
1990	133.9	163.8	157.1	93.7	144.7

-Continued-

Table 5, page 2 of 2.

Year	East of Homer Spit: Open Commercial Area Pink Count/lb.	East of Homer Spit: Closed Commercial Area Pink Count/lb.	East of Homer Spit: Combined Avg. Pink Count/lb.	West of Homer Spit Pinks/lb.	Combined Avg. All Areas Pinks/lb.[a]
Fall Survey					
1976	NO SAMPLES	144.1	144.1	112.5	123.0
1977	NO SAMPLES	164.0	164.0	144.1	152.7
1978	148.1	159.6	155.0	133.4	140.3
1979	149.8	NO SAMPLES	149.8	135.0	138.4
1980	150.8	183.0	173.3	135.4	144.2
1981	112.9	182.0	154.2	127.2	139.5
1982	202.0	181.9	191.1	106.8	149.5
1983[Oct]	198.9	232.7	217.8	146.2	200.9
1983[Dec]	118.3	218.4	170.2	NO SAMPLES	170.2
1984	183.8	205.8	196.3	142.6	168.9
1985	190.0	246.7	234.7	247.5	239.1
1986	215.3	230.7	223.2	131.4	207.7
1987	115.0	184.0	152.0	NO SAMPLES	152.0
1988	109.5	146.5	138.8	83.1	138.6
1989	145.3	188.8	178.0	92.0	174.7

[a] Does not include any samples from the Tutka Bay/Sadie Cove area.

Table 6. Catches by station in pounds per one nautical mile tow in the Southern District (Kachemak Bay) during the spring trawl shrimp index survey, May 9-10, May 14-18, and May 22, 1990 (61-foot high opening NMFS net).

TOW NO.	DEPTH (fm)	STATION NO.	SHRIMP Pink	Humpy	Coon	Side	Other[a]	Total Lbs.	%	FISH Total Lbs.	%
West of Homer Spit											
1[b]	40-41	K11	0	0	0	0	0	0	0.0	190	100.0
2[b]	45-40	L10	T	0	0	0	T	1	0.4	227	99.6
3[b]	45-40	L09	T	0	0	0	T	1	0.4	227	99.6
4[b]	49-43	K09	T	0	0	0	0	T	0.0	114	100.0
5[b]	35-36	J07	0	0	0	0	0	0	0.0	576	100.0
6[b]	41-35	H05	0	0	0	0	0	0	0.0	118	100.0
7[b]	45-46	H08	0	0	0	0	0	0	0.0	222	100.0
8[b]	46-51	H07	0	0	0	0	0	0	0.0	222	100.0
9[b]	54-58	I09	T	0	0	0	0	T	0.0	346	100.0
10[b]	48-46	J11	1	0	0	0	0	1	0.4	261	99.6
11[b]	59	I12	4	0	0	0	0	4	1.6	242	98.4
12[b]	54-40	H12	1	0	0	0	T	1	0.2	551	99.8
13[b]	45-51	H11	0	0	0	0	T	T	0.0	249	100.0
14[b]	51-45	H10	0	0	0	0	0	0	0.0	249	100.0
15	44-46	H14	T	0	0	0	1	1	0.1	987	99.9
16	42-50	I14	0	0	0	0	1	1	0.2	473	99.8
17	65-56	J13	21	0	0	T	T	21	5.3	373	94.7
35	62-50	L16	16	0	0	2	2	20	3.6	538	96.4
36	60-64	L17	3	0	0	3	2	8	0.7	1,204	99.3
39	28-24	J15	0	0	0	0	0	0	0.0	424	100.0
40	47-43	L15	38	1	0	0	1	40	5.5	683	94.5
41	52-46	L13	2	0	0	0	T	2	0.4	480	99.6
42	70-55	K14	19	0	0	1	T	20	3.6	528	96.4
43	87-77	K15	22	0	0	4	1	27	7.5	333	92.5
44	94-90	K16	7	0	0	3	1	11	3.3	327	96.7
Subarea											
Total			134	1	0	13	9	159	1.5	10,144	98.5
Percent			84.3	0.6	0.0	8.2	5.7				
Mean per tow			5.4	0.0	0.0	0.5	0.4	6.4	1.5	405.7	98.5

[a] Includes other shrimp such as *Crangon sp.* and *Eualis sp.*
[b] One-half mile tow doubled to represent standard one mile tow.

TOW NO.	DEPTH (fm)	STATION NO.	SHRIMP Pink	Humpy	Coon	Side	Other[a]	Total Lbs.	%	FISH Total Lbs.	%
East of Homer Spit (Traditional)											
18	22-29	T26	1,702	591	19	43	7	2,362	71.4	944	28.6
22	28-25	S25	183	6	5	1	3	198	25.0	594	75.0
23	28	R25	149	8	5	1	2	165	24.6	506	75.4
24	34-27	Q24	209	7	73	4	9[b]	302	30.0	706	70.0
26	40-39	O22	68	1	0	18	2	89	7.2	1,143	92.8
28	29-32	O24	120	23	19	3	6	171	28.2	435	71.8
29	25-29	R24	67	2	8	1	5[c]	83	10.5	705	89.5
33	45-46	N21	8	0	0	10	2	20	2.9	672	97.1
34	41-47	N22	9	0	1	2	1	13	0.9	1,419	99.1
Subarea											
Total			2,515	638	130	83	37	3,403	32.3	7,124	67.7
Percent			73.9	18.8	3.8	2.4	1.1				
Mean per tow			279.4	70.9	14.4	9.2	4.1	378.1	32.3	791.6	67.7
Kachemak Bay											
Total			2,649	639	130	96	46	3,560	17.1	17,268	82.9
Percent			74.4	17.9	3.7	2.7	1.3				
Mean per tow			77.9	25.6	3.8	2.8	1.4	104.7	17.1	507.9	82.9
Tutka Bay/Sadie Cove											
37	41-48	C/D20	407	9	2	4	3	425	27.7	1,111	72.3
38	43-39	H18	176	4	5	0	3	188	11.1	1,504	88.9
Total			583	13	7	4	6	613	19.0	2,615	81.0
Percent			95.1	2.1	1.1	0.7	1.0				
Mean per tow			291.5	6.5	3.5	2.0	3.0	306.5	19.0	1,307.5	81.0

[a] Includes other shrimp such as *Crangon sp.* and *Eualis sp.*

[b] "Other shrimp" in this tow include a small amount of *P. platyceros*.

[c] "Other shrimp" in this tow include a small amount of *P. danae*.

TOW NO.	DEPTH (fm)	STATION NO.	SHRIMP Pink	Humpy	Coon	Side	Other[a]	Total Lbs.	%	FISH Total Lbs.	%
East of Homer Spit (Non-traditional)											
19	25-23	U27	3,881	603	224	78	19	4,805	87.2	707	12.8
20	19-25	P21	179	2	26	0	5[b]	212	35.3	388	64.7
21	29-28	P22	171	2	4	2	5	184	22.9	620	77.1
25	36-34	O21	155	1	2	1	5[c]	164	26.3	460	73.7
27	40-35	O23	38	2	3	14	10	67	16.9	329	83.1
30	32-33	P23	111	3	6	8	9	137	20.0	547	80.0
31	38	N20	23	0	0	2	1	26	3.0	842	97.0
32	29-30	O20	B A D		T O W,	N O		W E I G H T S		T A K E N[d]	
Subarea											
Total			4,558	613	265	105	54	5,595	59.0	3,893	41.0
Percent			81.5	10.9	4.7	1.9	1.0				
Mean per tow			651.1	87.6	37.9	15.0	7.7	799.3	59.0	556.1	41.0

[a] Includes other shrimp such as *Crangon sp.* and *Eualis sp.*

[b] "Other shrimp" in this tow include a small amount of *P. danae*.

[c] "Other Shrimp" in this tow include a small amount of *P. platyceros*.

[d] Although completed, this tow was considered unsuccessful because it contained 7 derelict crab and shrimp pots and a significant amount of mud and debris; due to time constraints, the tow could not be repeated.

Table 7. Percent composition of fish during trawl shrimp index surveys in the Southern District (Kachemak Bay) based on catches of fish and shrimp per one nautical mile tow, by sampling period and year (traditional stations only).

YEAR	EAST OF SPIT (241-13, 14, 15) MAY	EAST OF SPIT (241-13, 14, 15) OCT	WEST OF SPIT (241-11 and 241-12) MAY	WEST OF SPIT (241-11 and 241-12) OCT
1972	36.2		5.5	
1973	22.2		7.9	
1974	6.9		3.9	
1975	10.6		9.0	
1976	9.0	11.9	16.1	13.8
1977	8.6	20.3	30.4	18.7
1978	29.4	14.8	19.6	16.7
1979	18.6	16.7	12.8	17.5
1980	10.7	17.7	13.7	16.1
1981	5.1	38.2	35.2	40.8
1982	19.1	35.4	32.1	64.5
1983	30.4	42.0	59.5	87.9
1984	18.0[a]	35.3	75.0[a]	57.0
1985	7.4	22.0	99.3	92.9
1986	10.8	18.1	99.3	94.3
1987	23.2	42.1	90.4	99.8
1988	40.4	60.6[b]	94.4	99.9[b]
1989	38.9	75.1	99.6	99.7
1990	67.7		98.5	

[a] Does not include large cod and halibut.
[b] Survey actually occurred Nov. 13-19 aboard R/V RESOLUTION.

Table 8. Breakdown of fish catches by species in the Southern District (Kachemak Bay) trawl shrimp index of abundance survey, May 9-10, May 14-18, and May 22, 1990.

Fish Species	EAST OF SPIT (2 Tows) Occurrence # of Tows	Total Lbs.	% of Total	WEST OF SPIT (25 Tows) Occurrence # of Tows	Total Lbs.	% of Total
Halibut	2	35	1.7	13	245	2.4
Pacific cod	2	49	2.3	17	513	5.1
Pollock	2	229	11.0	25	2,211	21.8
Flathead sole	2	396	18.9	25	2,962	29.2
Arrowtooth flounder	2	64	3.1	25	976	9.6
Rex sole	0	0	0	24	441	4.3
Dover sole	0	0	0	23	389	3.8
Rock sole	0	0	0	9	37	0.4
Butter sole	0	0	0	5	110	1.1
Yellowfin sole	0	0	0	3	83	0.8
English sole	0	0	0	3	42	0.4
Blackcod	0	0	0	3	25	0.2
Tomcod	1	7	0.3	14	52	0.5
Smelt	1	1	0.1	9	16	0.2
Sculpins/ Irish Lords	1	74	3.5	16	187	1.8
Poachers	0	0	0	9	4	T
Tanner crab	2	885	42.3	12	230	2.3
Dungeness crab	2	173	8.3	3	9	0.1
King crab	0	0	0	4	432	4.3
Starry flounder	0	0	0	1	284	2.8
Pricklebacks	2	11	0.5	5	23	0.2
Skates	0	0	0	3	44	0.4
Herring	0	0	0	1	2	T.
Searchers	0	0	0	3	68	0.7
Rockfish	0	0	0	11	227	2.2
Eelpouts	2	28	1.3	12	131	1.3
Pink scallop	0	0	0	5	6	0.1
Weathervane scallop	0	0	0	1	0	T
Urchins	0	0	0	6	1	T
Octopus/Squid	0	0	0	2	4	T
Starfish	0	0	0	5	29	0.3
Sandfish	0	0	0	3	2	T
Snailfish	0	0	0	1	T	T
Clams/snails	0	0	0	1	14	0.3
Sea Pens	0	0	0	1	1	T
Sea Anemones	0	0	0	5	93	0.9
"Other" crab	0	0	0	2	1	T
Parastichopus	0	0	0	1	1	T
Pentamera	0	0	0	1	4	T
Cucumaria	0	0	0	1	1	T
Wrymouth	0	0	0	1	1	T
Kelp/rocks/ shells/debris	2	140	6.7	21	220	2.2
TOTALS	2	2,091	100.0	25	10,141	100.0

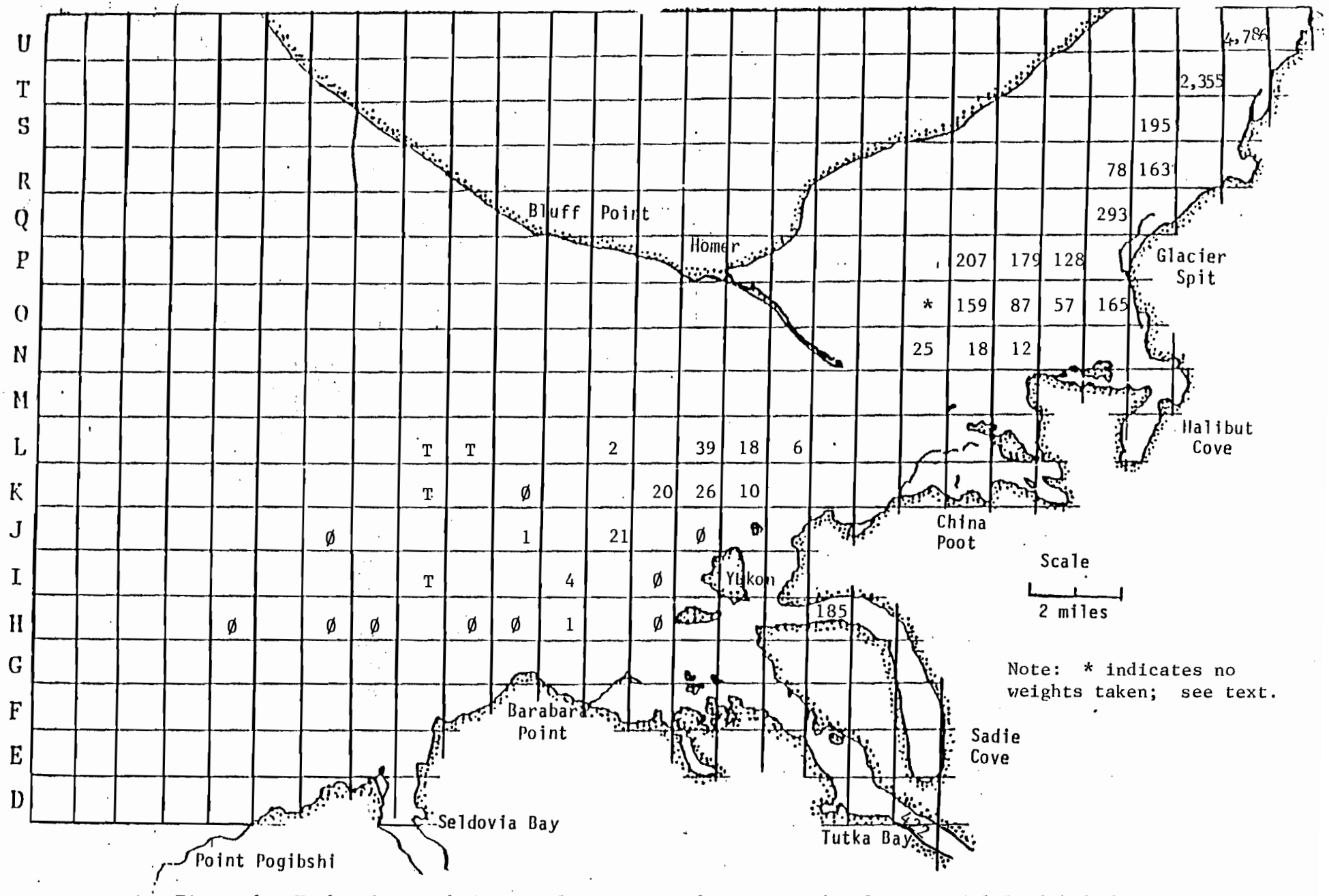

Figure 1. Kachemak Bay shrimp trawl survey catches in pounds of commercial Pandalid shrimp per one nautical mile tow (61' high opening NMFS net, R/V PANDALUS) during May 9-10, May 14-18, and May 22, 1990.

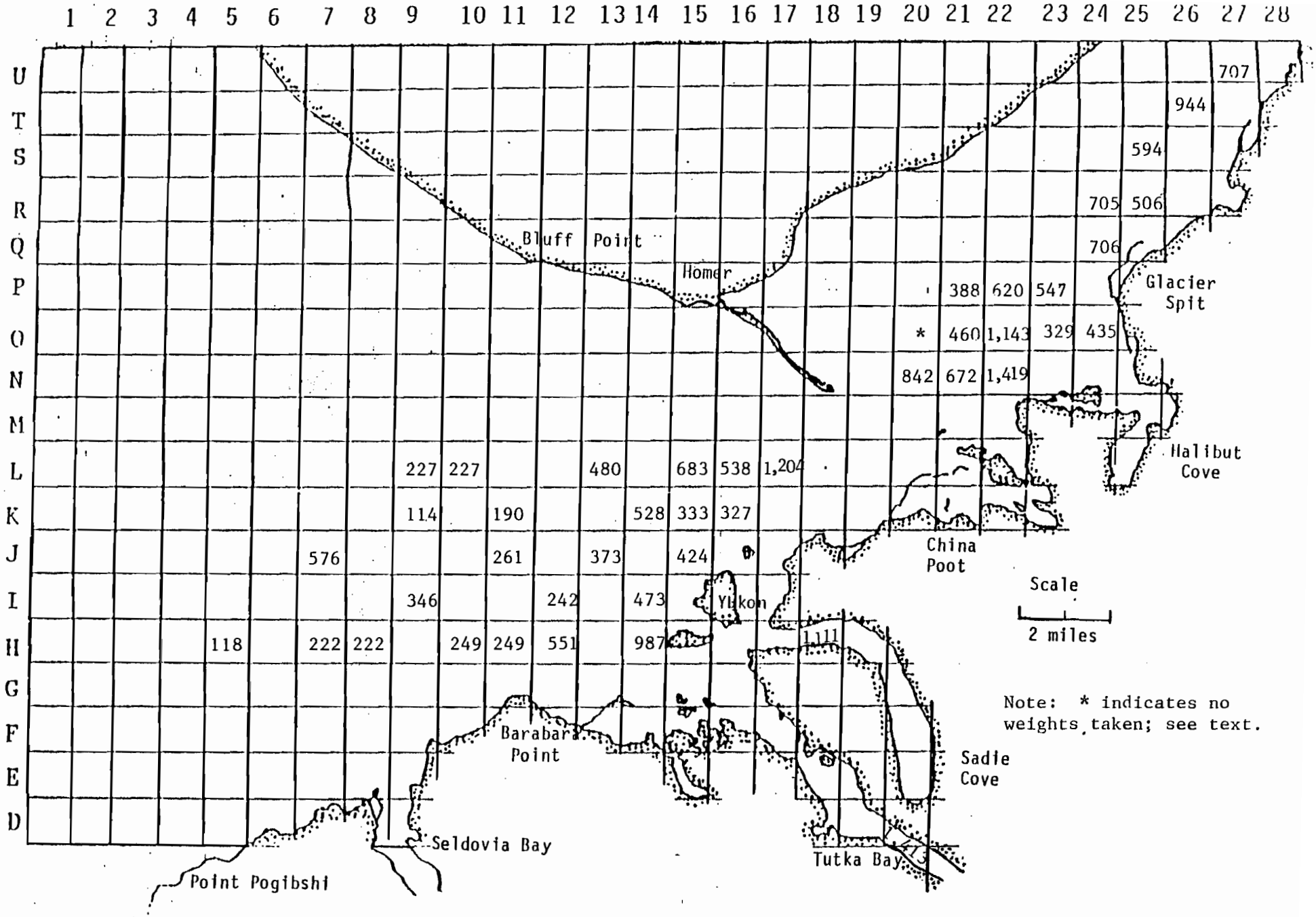

Figure 2. Kachemak Bay shrimp trawl survey catches in pounds of FISH and NON-SHRIMP matter per one nautical mile tow (61' high opening NMFS net, R/V PANDALUS)during May 9-10, May 14-18, and May 22, 1990.

Appendix Table 1. Formulas and explanations for calculations of abundance estimate and range for Pandalid shrimp in the Southern District of the Cook Inlet Management Area (H).

$$\text{Mean shrimp catch} = \frac{\sum_{i=1}^{N} x_i}{N} = \bar{x}$$

Area - total area (Nm^2) considered = A

Total number of tows = N

$$\text{Sample variance (SV)} = \frac{1}{N-1} \sum_{i=1}^{N} (x_i - \bar{x})^2$$

where $x_1, x_2, \ldots, x_N$ are the standardized (1 nm) catches of shrimp from each tow.

$$\text{Standard deviation (SD)} = \sqrt{SV}$$

$$\text{Standard error of the mean (SE)} = \frac{SD}{\sqrt{N}}$$

$$\text{Population estimate (p)} = \left(\frac{6076}{32} \times A\right) \bar{x}$$

Standard deviation of the population estimate (Sp) =

$$\left(\frac{6076}{32} \times A\right) SE$$

$$\text{Percent error} = \frac{1.3 \times SE}{\bar{x}} \times 100$$

Notes: 6,076 is the number of feet in a nautical mile; 32 is the effective width of the net; 88 is the area of the stratum (A) in square nautical miles; and x is the mean catch.

Percent error: 1.3 is the value from the normal distribution statistical table giving an approximate 80% confidence interval.

Source: Watson, Leslie. 1981. Shrimp trawl survey manual. May 1, 1981. ADF&G, Kodiak, AK. 44 pp.

EEO STATEMENT

The Alaska Department of Fish and Game operates all of its public programs and activities free from discrimination on the basis of race, religion, color, national origin, age, sex, or handicap. Because the department receives federal funding, any person who believes he or she has been discriminated against should write to:

O.E.O.
U.S. Department of Interior
Washington, DC 20240