Canadian Atlantic Fisheries
Scientific Advisory Committee

CAFSAC Research Document 89/4

Comité scientifique consultatif des
pêches canadiennes dans l'Atlantique

CSCPCA Document de recherche 89/4

Scotia-Fundy Shrimp Stock Status - 1988

by

M.L. Etter and R.K. Mohn
Benthic Fisheries and Aquaculture Division
Biological Sciences Branch
Halifax Fisheries Research Laboratory
Department of Fisheries and Oceans
Scotia-Fundy Region
P.O. Box 550
Halifax, N.S.
B3J 2S7

Abstract

The Scotia-Fundy shrimp (*Pandalus borealis*) fishery covers three areas with depths > 100 fm, referred to as the Canso, Louisbourg, and Misaine holes. These areas have been continuously underexploited over the past years, as in 1988 only 82 t (3%) of the total quota of 2580 t were taken. This represents an exploitation rate of 1% based on the total biomass estimate (Etter and Mohn, 1988).

Effort was low again this year with eight boats reporting catches. Of these, three were from New Brunswick (>19.8 m) and accounted for about 96% of the total catch. Of the total, 75 t was taken from the Louisbourg area which was approximately 6% of the Louisbourg quota of 1160 t. The remaining 7 t was caught in Misaine and Canso. Four of the boats involved in the fishery were Cape Breton based vessels (>19.8 m) and the remaining boat was a northern offshore vessel from Nova Scotia (> 19.8 m). The fleet fished mainly with the Sputnik and Yankee 41 shrimp trawls with a regulation 40 mm mesh size. Access to this fishery is seriously affected by a 10% by-catch limit (which is difficult to attain in this area) and the heavily fished local cod stock.

Résumé

La pêche de la crevette de Scotia-Fundy (Pandalus borealis) se pratique dans trois endroits où les profondeurs sont supérieures à 100 brasses, soit les cuvettes de Canso, de Louisbourg et de Misaine. Ces lieux de pêche sont demeurés sous-exploités au cours des dernières années; en 1988, les prises n'étaient que de 82 tonnes, soit 3 % du contingent total de 2 580 tonnes. Cela représente un taux d'exploitation de 1 % de la biomasse totale estimée (Etter et Mohn, 1988).

Cette année encore, l'effort a été faible; huit bateaux seulement ont déclaré des prises. Trois d'entre eux (> 19,8 m), du Nouveau-Brunswick, ont capturé environ 96 % des prises totales. Dans le secteur de Louisbourg, on a pêché 75 t de crevettes, soit environ 6 % du contingent de ce secteur (1 160 t). Les 7 t restantes provenaient de Misaine et de Canso. Quatre des bateaux (> 19,8 m) ayant pris part à la pêche avaient leur port d'attache au Cap-Breton. Le bateau restant (> 19,8 m) venait de la flottille des hauturiers du nord de la Nouvelle-Ecosse. Ces crabiers ont pêché principalement avec des chaluts à crevette Sputnik et Yankee 41 à maillage réglementaire de 40 mm. La participation à la pêche de la crevette est très affectée par l'imposition d'une limite de 10 % aux prises accidentelles (difficile à atteindre dans cette zone) et par l'exploitation intense du stock de morue local.

Input Data

Commercial Data

Commercial data for this report came from logs submitted by the fishermen. The final report from the Foreign and Domestic Quota Monitoring Unit (Fisheries Operations Branch) was not available, so the commercial catches shown for 1988 are preliminary figures. The average yearly commercial catch rate (corrected values to Yankee 36 trawl) was 51.0 kg/h (Table 1) which is an increase from last year's all time low rate of 39.9 kg/h (Table 2). The correction factors used are shown in Table 3. The total landings this year of 82 t is the lowest exploitation seen in this fishery since it began. Table 3 shows commercial catch rates according to gear type. There seems to be a trend toward using larger nets in this fishery, as in the past two years the Sputnik has been used more often than in the past. This may also account for the low average catch rate of commercial vessels in 1987-88 as it is corrected for the smaller Yankee 36. After correction factors have been applied there appears to be a substantial difference between gear types, indicating perhaps overcorrection and a need for research on trawl efficiency.

Figure 1 shows monthly catch rates from the commercial fishery and research cruises for the period 1977 to 1988. The commercial catch rates show a falling trend through the years, although 1982, 1985 and 1988 are slightly different in that they do not really reflect a general decrease in catch rates during the season. This may be due to the small amount of commercial activity that takes place on a monthly basis. For example, the August 1988 catch rate was based on only one day of fishing. This figure also shows a very high catch rate in the fall research cruises of the past two years, that does not correspond to the commercial catch rate at the time.

Research Data

As has been the practice for the past six years, two research cruises were completed in 1988 (May and September). Standard tows were carried out, as in previous years, for half hour durations at a nominal speed of 2.5 knots using a Yankee 36 trawl with a 40 mm mesh size. An underwater camera was used to ascertain the trawl's performance. It showed the net was fully open and fishing well. The results of these two surveys are displayed in Table 4 and graphically in Figures 2 and 3. The shrimp catches from research cruises are corrected taking tow length into account. The holes are defined by the 100 fm depth contour, where stations were allocated randomly inside the single stratum for Canso and Louisbourg holes. The Misaine stations were random stations which are carried over from year to year to save searching time for fishable bottom.

The average catch (kg/tow) as seen in Table 5 shows a substantial increase in Canso catch rates over the past three years. Misaine has also increased in this time period, while Louisbourg has decreased slightly. The shrimp constitute approximately 56.5 and 42.6% of the total catch (Tables 6 and 7) for the two research cruises which are the highest rates ever seen. This is partially due to lower than usual redfish by-catches. As before, the commercial logs show a higher catch percentage of shrimp than the research cruises, presumably because the fishing captains are directing for clean catches. Looking at Table 7 we see a substantial amount of fluctuation in the catch rates of the major by-catch species over the years. It appears there is a general decrease in the amount of by-catch over the past seven years. Figure 4 shows the cod and redfish by-catch size distributions from the research cruises in 1988. Louisbourg has the highest catch rate for market-size cod, while Canso indicates a peak of smaller animals. For redfish, it appears the larger animals are found mostly in the Louisbourg hole while the smaller redfish are more evident in Canso and Misaine.

Samples of shrimp approximating 500 animals, were collected for each tow completed. These animals were individually measured and sexed to determine length frequency distributions. The animals were sexed on the basis of male, transitional or female with the females being divided into primiparous and

multiparous, as determined by the condition of the sternal spines (McCrary, 1971). The distribution figures are based on measurement of carapace length, to 0.1 mm, and then grouped into 0.5 mm groupings. Figure 5 separates the data by area showing similar distributions for the three holes. Grouping the data by sex we get Figures 6a and 6b, with the number at the top of each graph being the number of individuals in the total sample. In comparing the graphs from the 1982-1988 spring/fall research cruises we can see the large portion of transitionals that are present in the spring disappear from the population in the fall. We also detect two peaks of males supposedly representing two year classes which can be followed from spring to fall where they peak at a slightly higher length.

These samples were graphed using the sum of the actual numbers (frequency) of animals, and a comparison was done to determine if summing a percentage (abundance) would give different results (as suggested by the CAFSAC Steering Committee). Figure 7 shows virtually no difference between the two methods, indicating no need to change to the percentage method. (All of the years' data were compared in this manner, but only two cruises were shown here for simplicity.) Therefore, the length frequencies shown in Figures 6a and 6b were done using actual numbers of animals as in the past.

Two exploratory tows done in small near-shore holes in both the spring and fall cruises of 1987, were repeated in 1988 at the same locations. These tows showed similar distributions to the tows done in 1987, with relatively high catches of shrimp. This indicates that the biomass estimates based on the three fishing areas outlined do not encompass the complete abundance of animals and therefore would represent an underestimate. The length frequencies of the samples in these exploratory areas are shown in Figure 8 and indicate a high incidence of males and transitionals in the spring samples with virtually no females present. In the fall, the males are not as abundant and there is a large group of multiparous females present indicating some movement or migration of animals from one area to another. We also see a slightly smaller size of animal in the modes determined for these exploratory samples compared to the samples from the principal areas.

Figures 9a and 10a show normalized research catches for the Louisbourg and Canso holes. The catches from each station are normalized by dividing by the average catch for that particular area in that cruise and plotted according to area to make comparison possible. We can from these maps, subjectively define some patches of high concentrations of shrimp. These concentrations do not appear to be correlated with depth (Figures 9b and 10b) and do not seem to follow close to the 100 fm contour as reported by some fishermen. Misaine hole has not been analyzed in this way as the tows are repeated from year to year, and not randomly assigned.

When we consider biomass estimates we see a low value in April 1985 (Figure 11) with a gradual increase since that time. As an index of stock health, the number of ovigerous females was compared to those non-ovigerous (Table 8). In the fall virtually all females are ovigerous as in our fall sampling from 1982-1988, 224 out of 39,368 females were not.

Figure 12 indicates no relationship between length of tow and shrimp catch, however it does indicate a trend toward longer tows in the spring over the fall cruise. This trend is seen in past years' research cruises, and indicates a bias, probably due to the change of personnel (and their individual methods) on the bridge of the research vessel, from one survey to another. Although there is no evident correction required, research data is corrected for tow distance.

Bottom temperatures collected for approximately 55% of the research tows revealed a slightly increasing trend from 1982-1988 (Figure 13a). When grouped by area in Figure 13b, the consistency of Louisbourg's higher temperatures is evident. One anomaly was in May of 1986, where Canso had a very high bottom temperature, which coincided with the lowest catch rate ever seen in that area.

Assessment Results

For each hole, the biomass was estimated by areal expansion, where the horizontal opening of the research gear was assumed to be 36 ft. The standard tow was 1/2 h at 2.5 knots giving a length of 1.25 nautical miles and a swept area of approximately 1/135 of a square nautical mile. The areas of the three holes measured by polar planimeter (using the 100 fm contour) were 276.4, 472.2, and 442.2 square nautical miles for Canso, Louisbourg, and Misaine respectively. Tow lengths as seen in Figure 12, ranged from 0.6 to 2.0 km and show no relationship between longer tows and higher catches. The tows were however, corrected for length as defined by the start and end positions. The catches (kg/tow) from all the research cruises have been calculated taking tow distance into account. They were also standardized to Western 2A catch rates by multiplying by 1.5 to account for the vertical distribution above the Yankee 36 trawl (Labonté, 1980).

Biomass, standard error, and proposed catch levels (t) from survey data, 1988.

Area	Cruise			Recommended catch levels*
	May	September	Avg.	
Canso	2306 ± 786	3218 ± 762	2762	970
Louisbourg	2288 ± 339	3628 ± 586	2958	1040
Misaine	3258 ± 553	5667 ± 625	4463	1560
Total				3570

* Rounded to the nearest ten tons.

The recommended catch levels were derived from the biomass estimates (see above table) and an exploitation rate of 35%, as was used in previous analysis and recommended by CAFSAC.

Quotas (t).

Year	Canso	Louisbourg	Misaine	Total
1980	1086	1553	2382	5021
1981	-	-	-	-
1982	1000	1400	1800	4200
1983	1400	2000	2400	5800
1984	1400	1800	2500	5700
1985	1350	1790	2420	5560
1986	740	1460	1600	3800
1987	210	1070	860	2140
1988	370	1160	1050	2580
1989*	970	1040	1560	3570
1989**	770	1020	1340	3130

* Proposed values (see above table).
** Values based on the average of biomass estimates from 1987-88.

The recommended total catch level of 3570 t (determined from the average 1988 biomass estimates) is up from last year's value. However, when you determine the average biomass estimate for each area, using the last two years' estimates (Table 9) you get a slightly lower total value of 3130 t. Last

year's total quota was determined on the biomass averages of 1986 and 1987. The biomass estimates over the past 11 years are shown in Table 9 and show a general increase from 1985 in all three areas.

Discussion

The biomass estimate which showed a considerable decrease in 1985 from previously high levels, appears to be on the increase (Figure 11). Therefore, using a long-term average to determine recommended catch levels, suggests one is ignoring a strong indication of a change in biomass. An average over a short time period would be more likely to take these changes into account. Even so, exploitation rates have never reached their quota levels. The abundance of shrimp in Canso and Misaine seems to be on the rise in 1988 while Louisbourg has remained fairly stable. The numbers of shrimp seen in Canso, which were extremely low in the spring of 1986 are now increasing. The low number in 1986, may or may not have been related to the high temperatures and/or an increase in silver hake evident at that time. The temperatures and levels of by-catch have returned in 1988 to a value closer to the overall average for this area. Thus, the fluctuating biomass must be driven by biotic and/or environmental factors, rather than by fishing. The past four years saw virtually no commercial exploitation in this area.

The recommended catch level based on the 1988 biomass estimate is 3570 t. Using the average biomass estimate for 1987-88 you get a lower value of 3130 t. The recommended catch levels used to determine quotas in the past few years were based on the average of the biomass estimates of the two previous years.

Unless changes occur, this potentially valuable resource will likely continue to be underexploited. Prices for shrimp have dropped and the catch rates at this time are not high enough to entice participation. The by-catch limit poses a major problem, since it seems to be very difficult to adhere to this limit when directing for shrimp, and no cod quota is available to buffer the situation. This would seem to necessitate a provision in legislation.

References

Etter, M.L. and R.K. Mohn 1988. Scotia-Fundy Shrimp Stock Status - 1987. Can. Atl. Fish. Adv. Comm. Res. Doc. 88/12.

Labonté, S.S.M. 1980. An assessment of shrimp stocks off southeast Cape Breton, South Esquiman and North Anticosti. Can. Atl. Fish. Adv. Comm. Res. Doc. 80/67.

McCrary, J.A. 1971. Sternal spines as a characteristic for differentiating between females of some Pandalidae. J. Fish. Res. Bd. Canada 28: 98-100.

Table 1. Monthly commercial shrimp fishing information for Louisbourg and Misaine areas (1988).

		June	July	Aug	Sept	Yearly
Louisbourg:	Catch (kg)	39260	28828	1471	4284	73843
	Effort (un)	429.5	324.5	16.5	110.0	880.5
	Effort (cor)	711.4	608.9	21.5	143.0	1484.8
	CPUE (kg/h)	55.2	47.3	68.8	30.0	49.7
Misaine:	Catch (kg)	4922				4922
	Effort (un)	45.0				45.0
	Effort (cor)	58.5				58.5
	CPUE (kg/h)	84.1				84.1
Both areas:	Catch (kg)					78765
	Effort (un)					925.5
	Effort (cor)					1543.3
	CPUE (kg/h)					51.0

Table 2. Scotian Shelf commercial shrimp landings and CPUE.

Year	Catch (t)				CPUE (kg/h)	
	Canso	Louisbourg	Misaine	Total	Unstd.	Std.*
1977				269	128.5	104.5
1978				306	121.9	97.3
1979	534	295	8	838	174.6	128.0
1980	360	491	133	984	130.9	97.3
1981	10	418	26	454	131.8	92.8
1982	201	316	52	569	128.0	80.4
1983	512	483	15	1010	127.7	81.2
1984	318	600	10	928	109.5	77.6
1985	15	118	–	133	75.4	40.7
1986	–	126	–	126	87.3	58.1
1987	–	148	4	152	90.7	39.9
1988**	1	75	6	82	85.1	51.0

* Standardized to a Yankee 36 trawl.
** Preliminary totals from commercial logs.

Table 3. Corrected catch rates (kg/h) for commercial boats off southeastern Cape Breton, 1988.

No. of boats	Gear type	Louisbourg Area	Misaine Area	Cor. factor
1	Sputnik	33.8	–	3.0
3	Yankee 41	60.5	84.1	1.3

Table 4. Tow information from scientific research cruises, 1988.

Cruise	Area	Tow #	Depth (fm)	Bottom temp.	Shrimp (kg)	Cor. (kg)	Total (kg)
May 1988	Canso	1	106	0.9	31	21	46
		2	107	0.8	46	48	65
		3	111	1.0	4	3	15
		4	136	1.2	12	10	50
		5	118	1.6	42	30	59
		6	100	1.6	138	148	148
		7	122	2.4	55	39	88
		8	148		115	84	138
		9	125	5.2	33	21	72
		10	123	5.2	10	8	37
	Louisbourg	15	151	4.6	13	9	28
		16	142	4.9	40	29	66
		17	120	4.2	66	45	112
		18	138	4.8	43	31	71
		19	142	4.9	40	28	71
		20	142	4.9	38	25	74
		21	159	4.8	34	24	47
		22	152	4.9	32	22	57
		23	173	4.3	31	21	105
		24	170	3.8	6	5	140
	Misaine	11	131	3.2	12	8	39
		12	123	3.9	40	28	74
		13	115	4.1	101	68	120
		14	118	3.2	64	48	103
		25	123	3.7	58	40	111
		26	120	2.9	41	34	76
		27	123	3.1	53	39	141
		28	166	3.0	19	13	72
		29	111	3.5	70	48	99
Total					1397	977	2677

...Contd.

Table 4. Contd...

Cruise	Area	Tow #	Depth (fm)	Bottom temp.	Shrimp (kg)	Cor. (kg)	Total (kg)
Sept 1988	Canso	4	103	2.7	29	22	88
		5	102	2.6	52	38	95
		6	101	2.6	38	31	89
		7	134	3.3	35	36	119
		8	121	3.1	48	58	100
		9	118	2.6	40	37	133
		10	153	2.9	58	47	104
		11	137	3.4	81	62	113
		12	133	3.2	95	172	165
		13	104	3.1	76	72	132
	Louisbourg	26	197	4.4	16	17	295
		27	166	4.7	54	72	190
		28	129	4.9	37	46	71
		29	148	5.1	19	20	47
		30	159	5.2	21	25	239
		31	134	5.3	67	58	135
		32	141	5.2	25	23	69
		33	139	5.2	32	28	88
		34	143	5.1	63	59	181
		35	145	5.0	37	31	59
	Misaine	14	100	4.0	27	59	38
		15	108	3.9	83	62	120
		16	135	5.3	69	64	118
		17	114	3.9	73	57	95
		18	116	4.1	62	59	83
		19	137	3.4	31	30	88
		20	164	3.0	39	39	120
		21	134	3.2	73	66	102
		22	149	3.4	61	109	97
		23	119	3.5	80	85	160
Total					1640	1584	3950

Table 5. Average catch (kg/tow) from research cruises.

Year	Area		
	Canso	Louisbourg	Misaine
1982	56.8	41.4	34.2
1983	114.5	62.3	117.4
1984	45.6	44.5	57.0
1985	13.6	24.3	24.1
1986	8.2	39.3	30.7
1987	29.8	29.9	35.8
1988	49.4	30.9	50.3

Table 6. Percentage catch composition of shrimp tows in 1988.

Species	May	Jun	Jul	Aug	Sept		Nov	Dec
	Res**	Com*	Com*	Com*	Res**	Com*	Com*	Com*
Shrimp	56.5	84.4	82.0	80.3	42.6	49.9	47.6	67.7
Cod	16.6	12.3	3.5	4.3	16.8	49.3	14.1	32.3
Redfish	7.7	0.8	7.6	7.8	14.3	0.8	38.4	—
Flatfish	10.6	2.1	6.7	7.6	11.9	—	—	—
Hake	0.1	—	—	—	4.3	—	—	—
Halibut	—	—	0.2	—	—	—	—	—
Haddock	—	—	—	—	—	—	—	—
Pollock	—	0.4	—	—	—	—	—	—
Misc	8.5	—	—	—	10.1	—	—	—
Total shrimp catch (kg)	977	44182	28828	1471	1584	4284	2465	635

* Commercial log data.
** Research cruises.

Table 7. Corrected catch rates in kg/h (left-hand column) and percentages (right-hand column) of individual species in research cruises (1982-88).

Cruise	Shrimp		Cod		Redfish		Flatfish		Hake		Misc.		Total
Spring													
Apr 82	58	20	76	26	72	25	34	12	—		51	18	291
May 83	212	37	100	17	160	28	47	8	—		58	10	578
May 84	132	24	140	25	222	40	30	5	—		31	6	561
Apr 85	32	19	35	21	49	30	24	14	—		27	16	167
May 86	71	13	170	32	90	17	37	7	117	22	50	9	537
May 87	47	26	32	18	46	26	16	9	25	14	12	7	177
May 88	67	57	20	17	9	7	13	11	—		10	8	119
Fall													
Nov 82	120	21	117	21	50	9	86	15	147	26	48	8	568
Nov 83	169	33	83	16	16	3	58	11	122	24	62	12	510
Oct 84*	64	13	88	18	86	18	43	9	169	35	35	7	486
Oct 85	50	19	34	13	63	24	18	7	80	31	17	6	261
Oct 86	34	11	31	10	107	35	28	9	86	28	21	7	307
Oct 87	81	20	49	12	147	37	42	11	53	13	26	7	398
Sep 88	106	43	42	17	36	14	30	12	11	4	25	10	248

*Change of trawl door.

Table 8. Numbers of ovigerous/non-ovigerous individuals in samples from research cruises.

	Cruise	Non-ovigerous females	Ovigerous females
Spring	Apr 82	2638	650
	May 83	1330	2085
	May 84	2574	12
	Apr 85	3211	246
	May 86	1286	866
	May 87	351	1567
	May 88	2022	530
Fall	Nov 82	52	7016
	Nov 83	11	2917
	Oct 84	15	5716
	Oct 85	21	6551
	Oct 86	40	6396
	Oct 87	14	5852
	Sep 88	71	4920

Table 9. Research vessel biomass estimates (t).

Year	Area		
	Canso	Louisbourg	Misaine
1978	3900	5600	–
1979	2900	4300	9600
1980	–	–	–
1981	3000	4100	5000
1982	3180	3970	3080
1983	6410	5970	10560
1984	2550	4250	5120
1985	760	2330	2170
1986	460	3760	2760
1987	1670	2860	3220
1988	2760	2960	4460
Average	2760	4010	5110

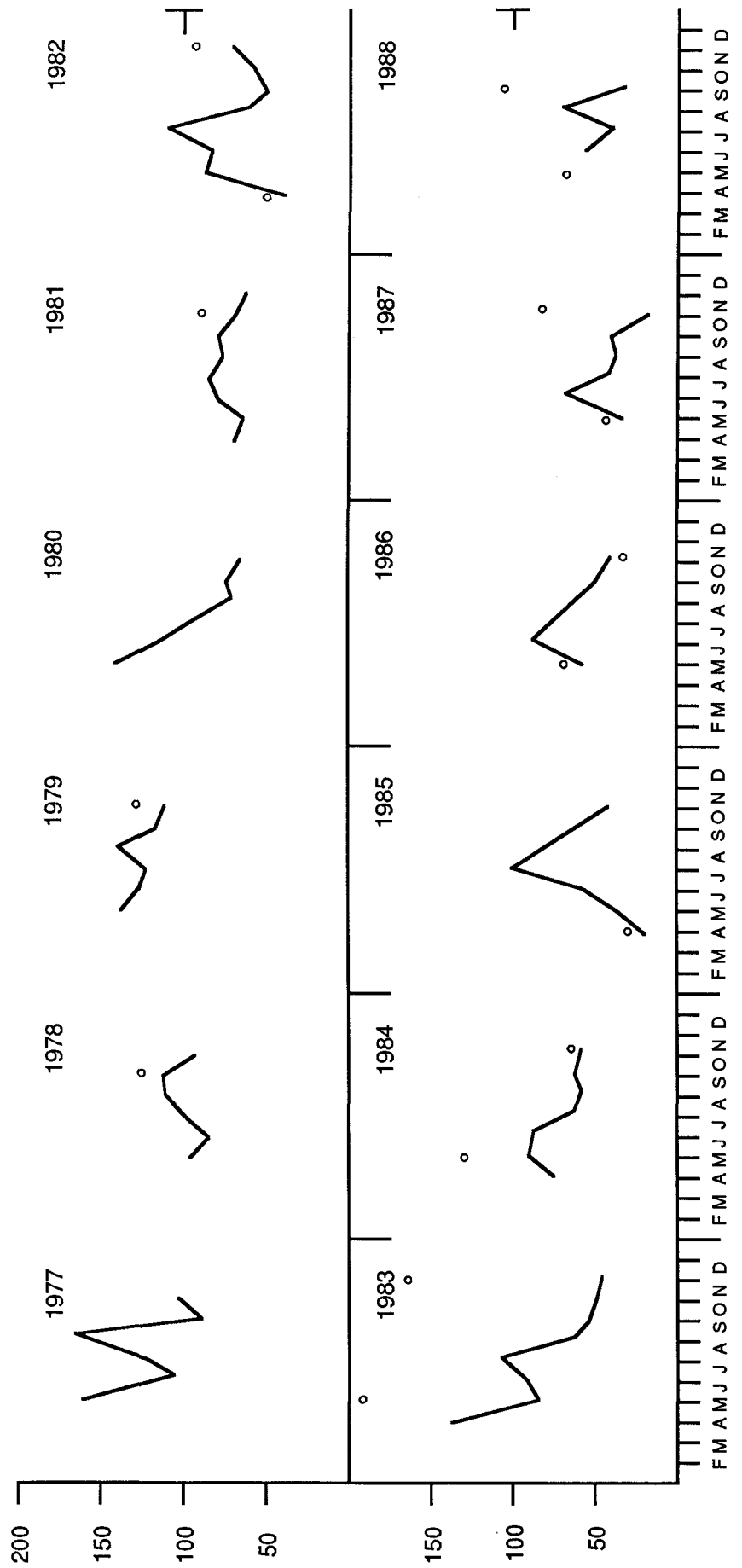

Figure 1. Shrimp catch rates by month from 1977-1988.

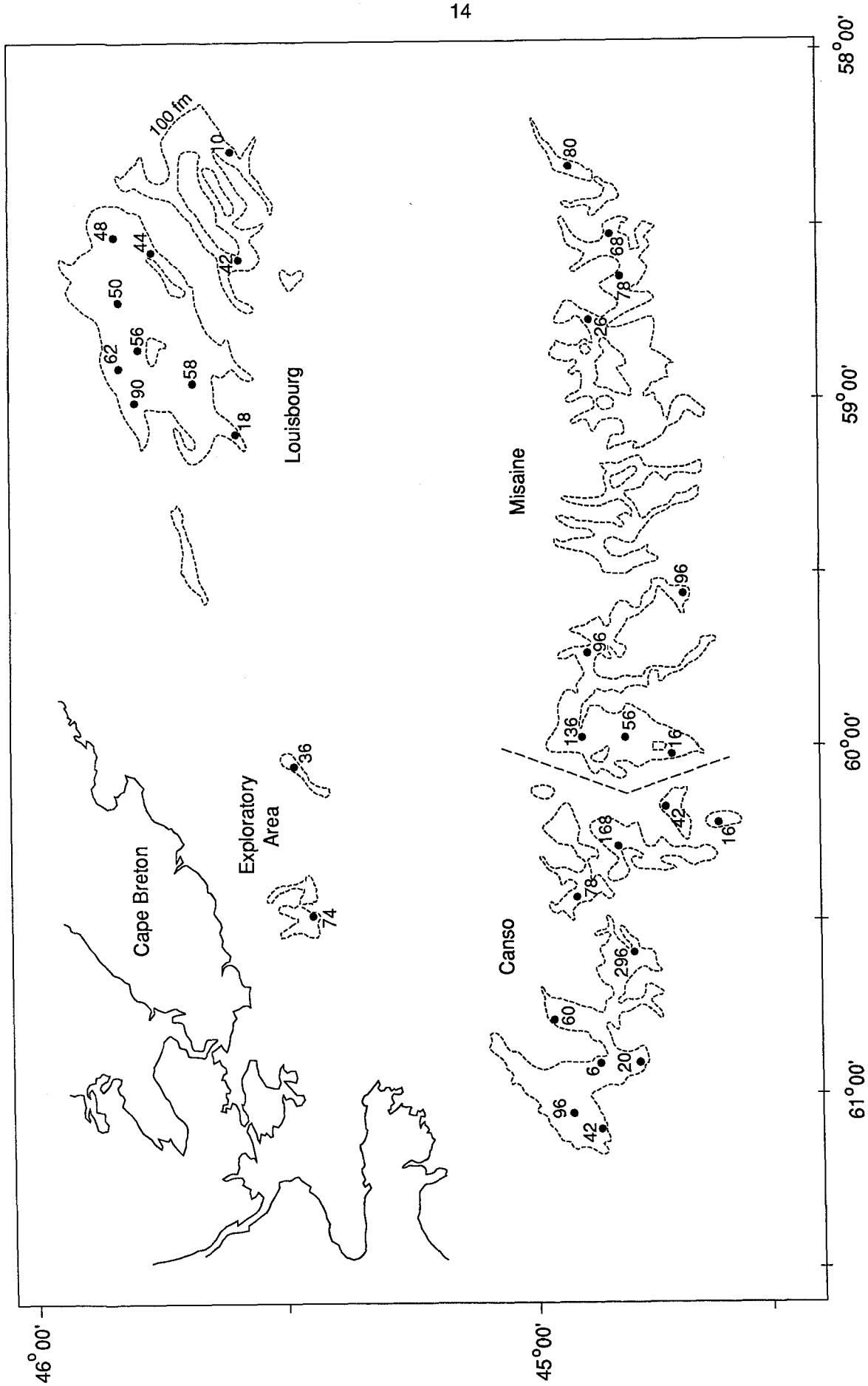

Figure 2. Corrected shrimp catch rates (kg/h) from the May 1988 research cruise.

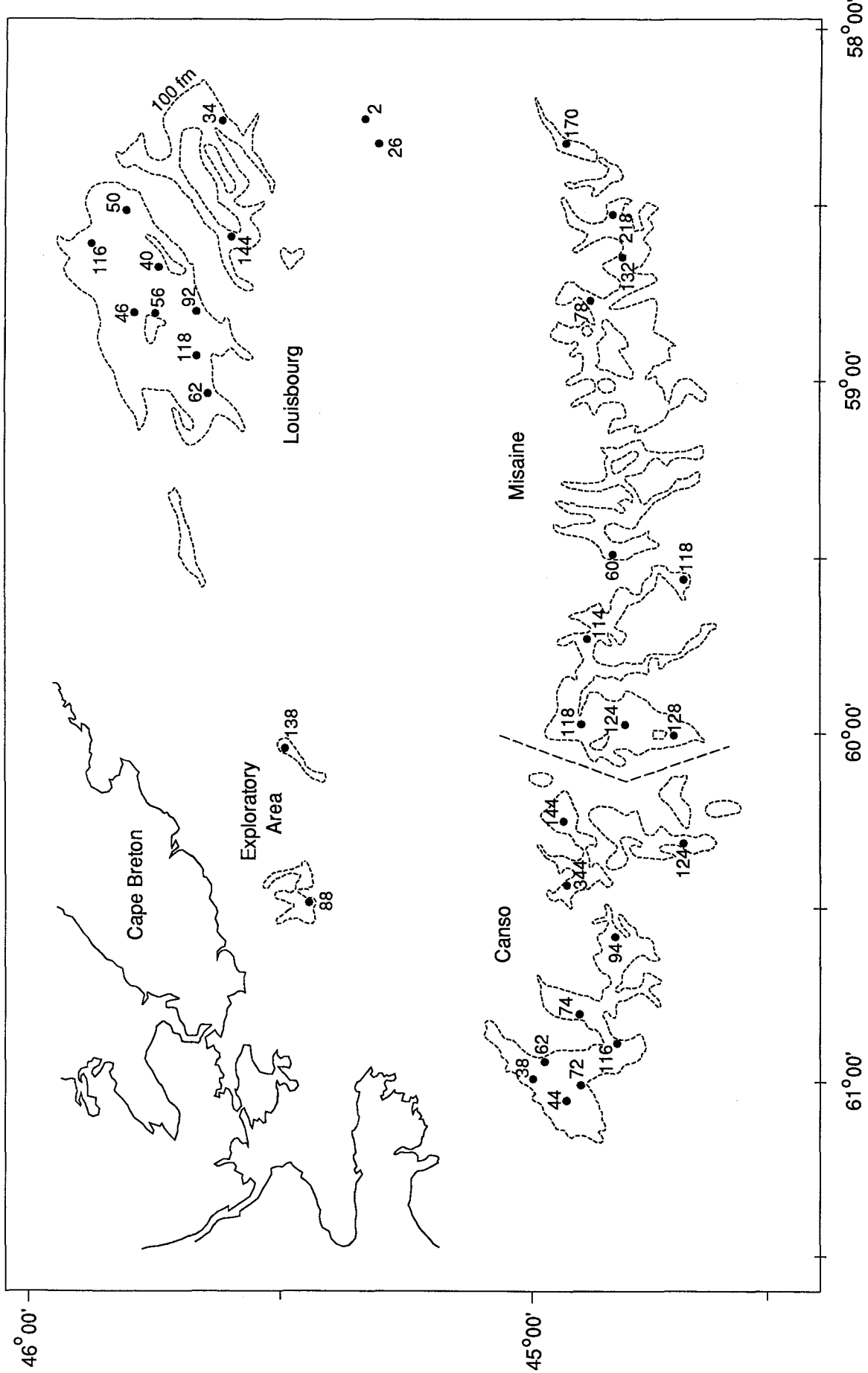

Figure 3. Corrected shrimp catch rates (kg/h) from the September 1988 research cruise.

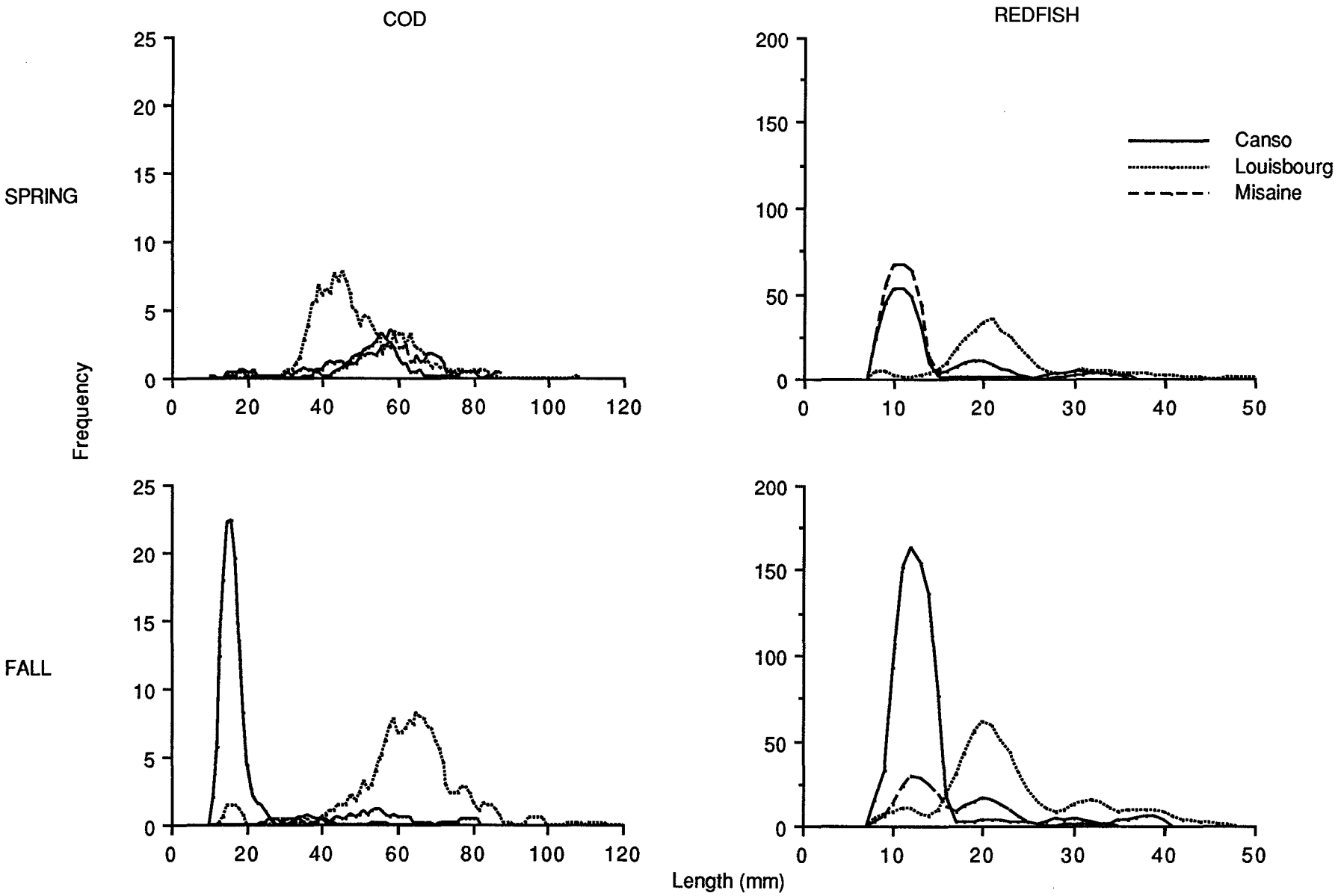

Figure 4. Length frequencies (by area) of cod and redfish by-catches in the 1988 research cruises.

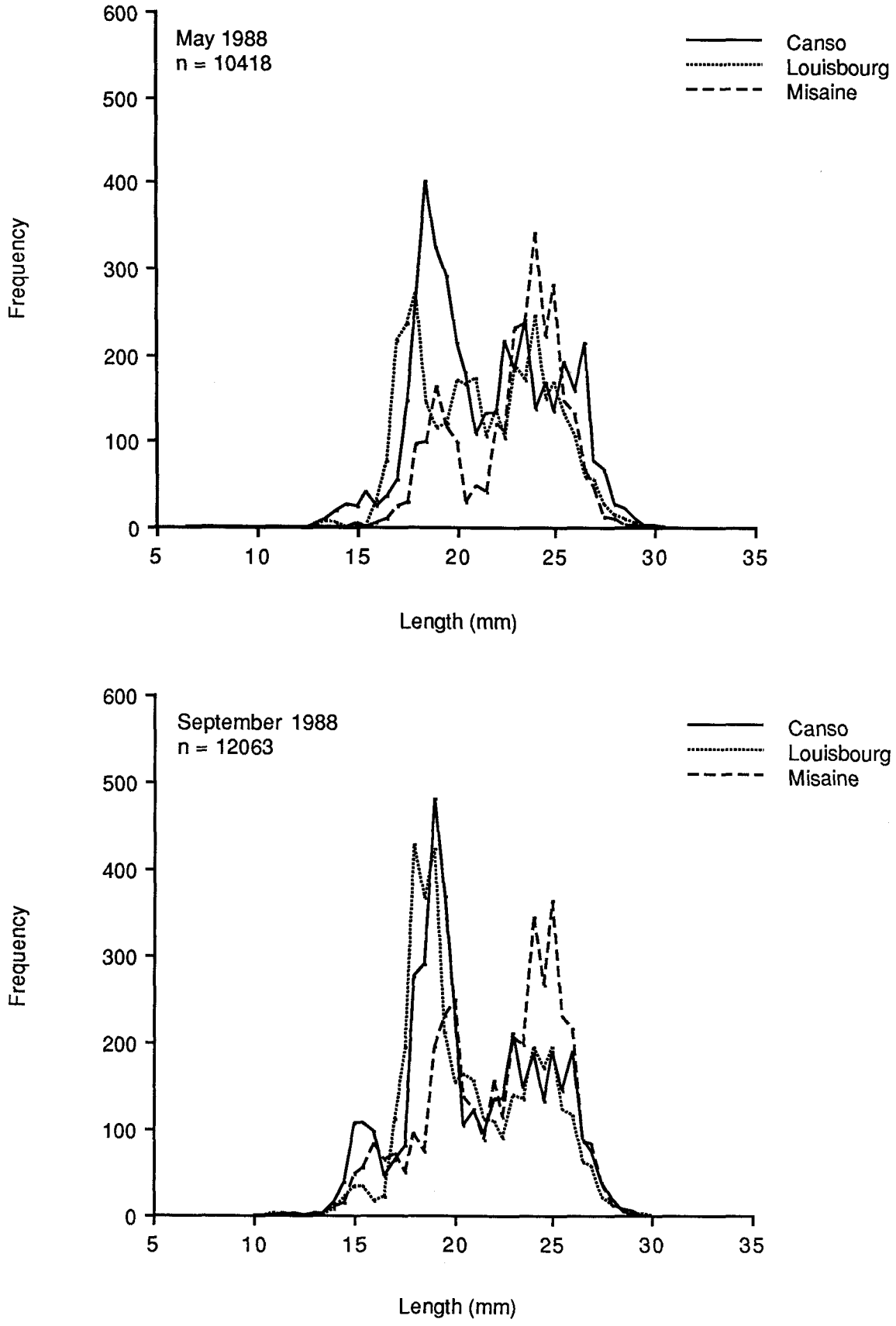

Figure 5. Shrimp length frequencies by area, from the 1988 research cruises.

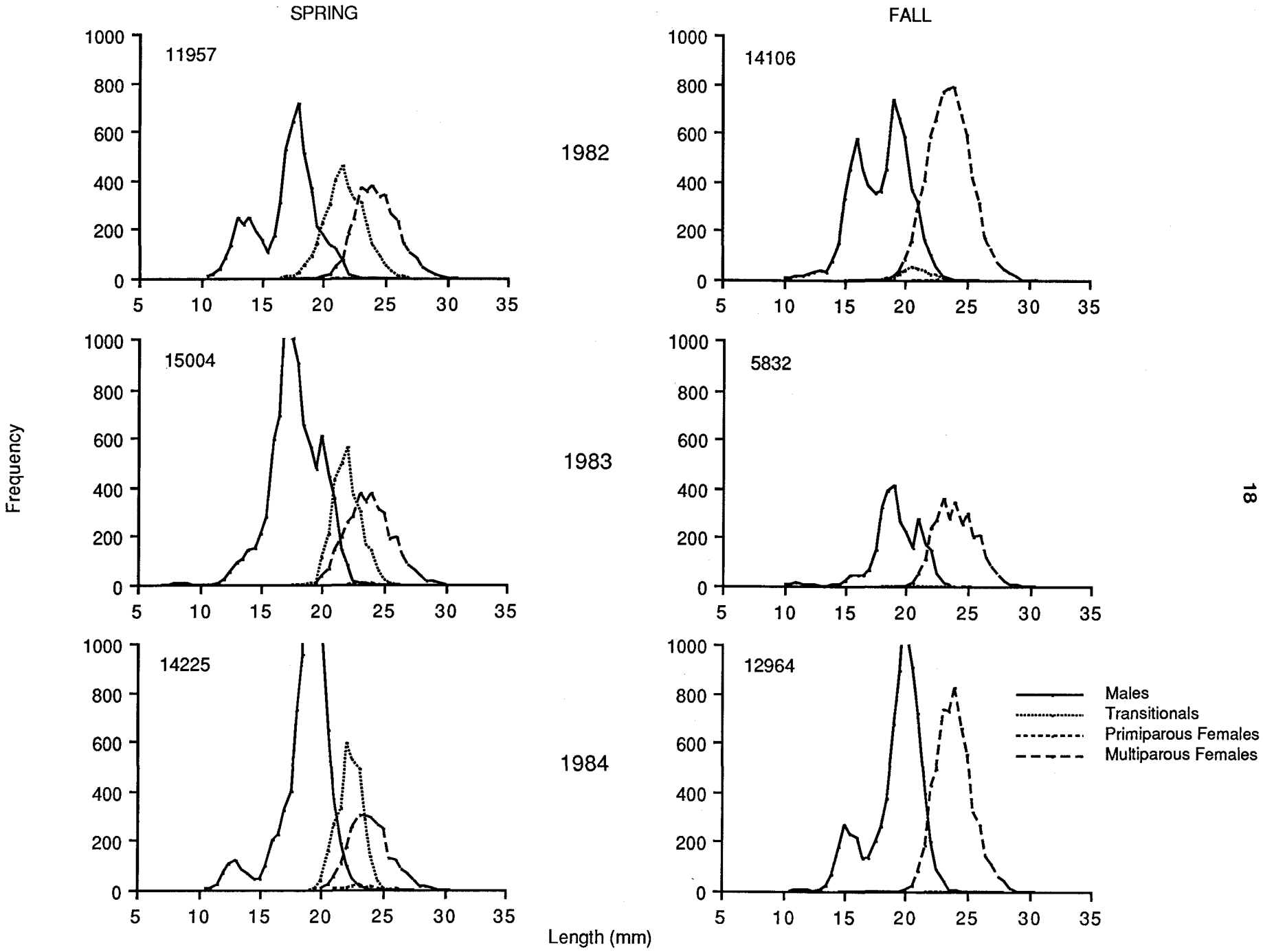

Figure 6a. Shrimp length frequencies by sex, from research cruises (1982-1984).

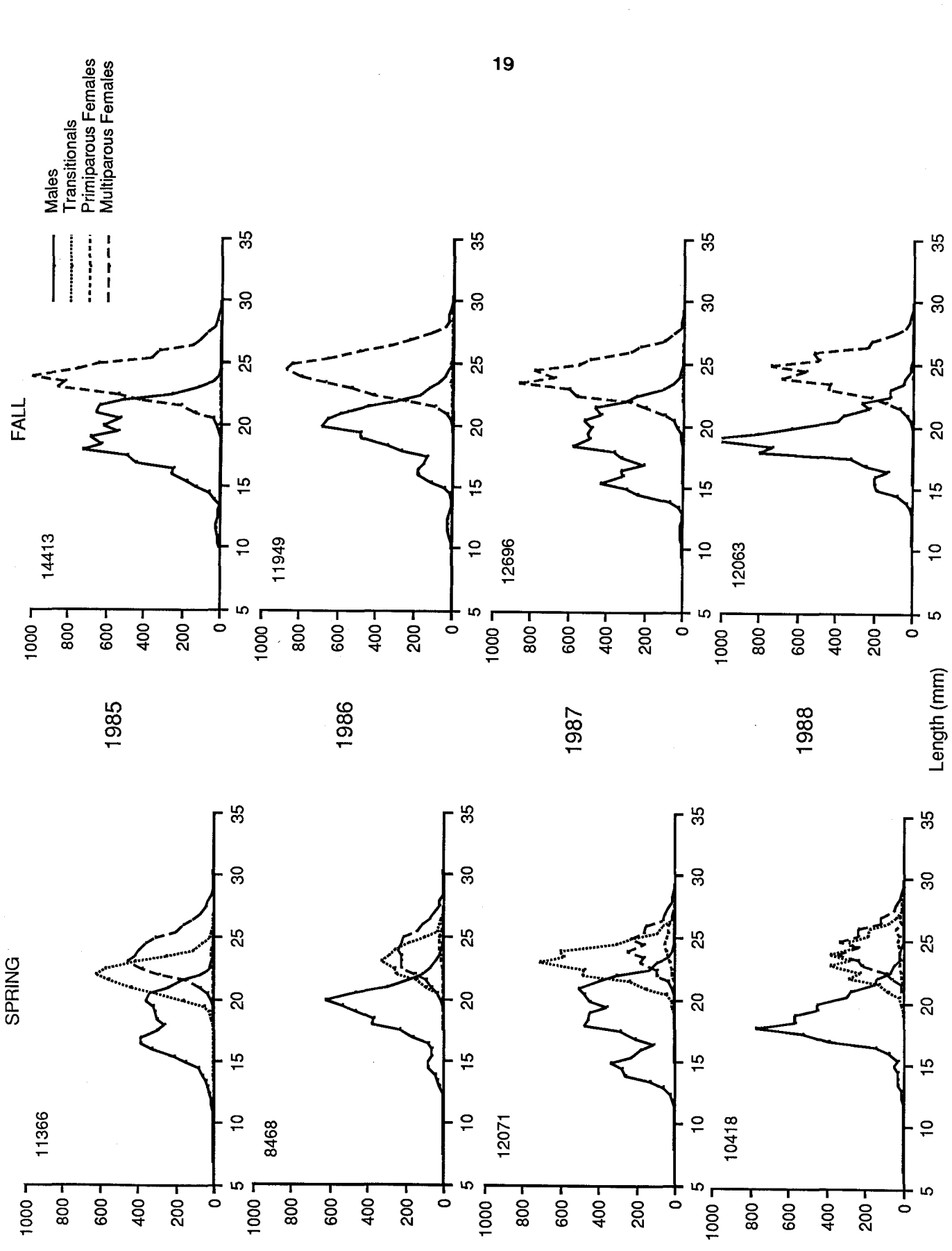

Figure 6b. Shrimp length frequencies by sex, from research cruises (1985-1988).

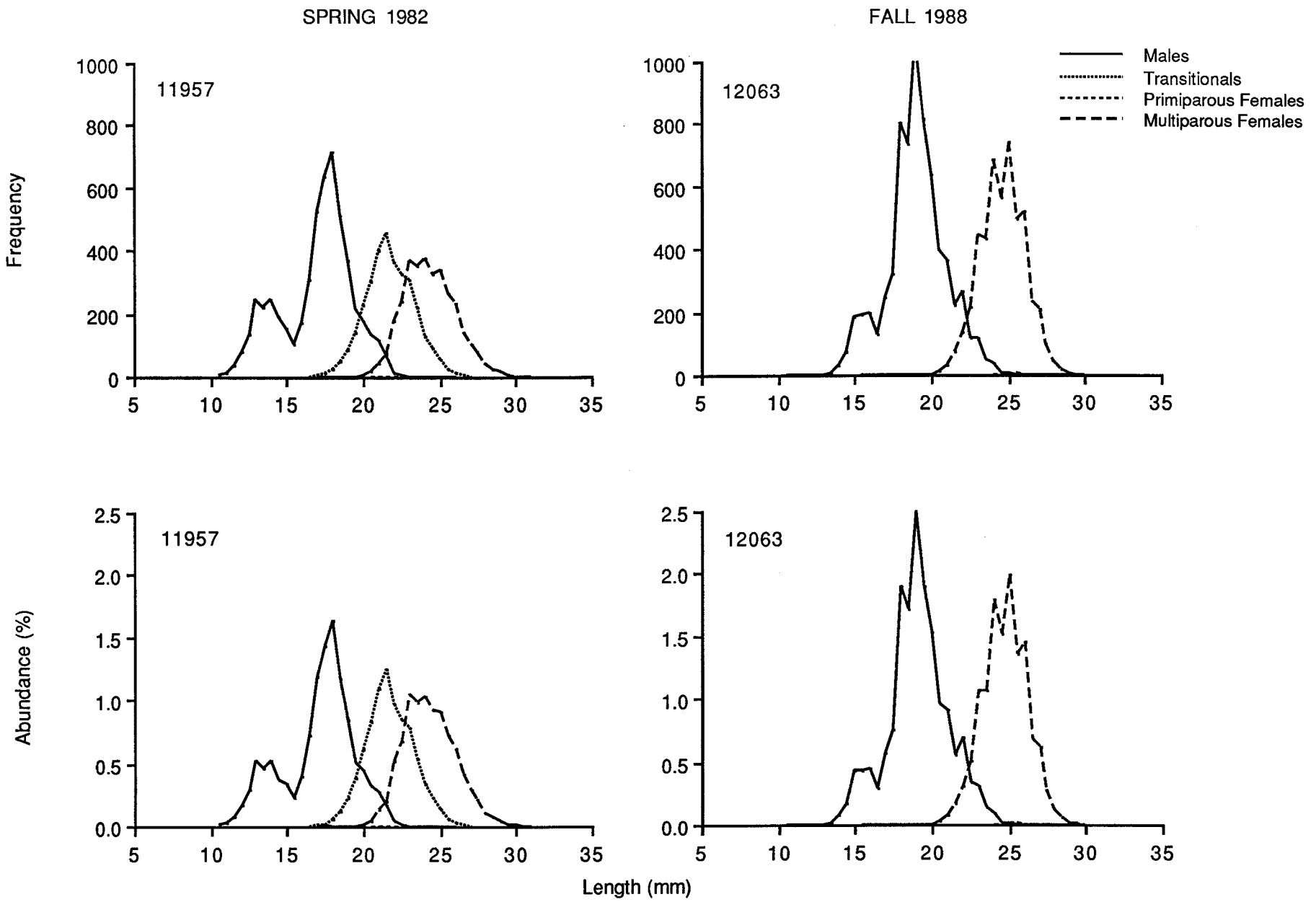

Figure 7. Comparison of shrimp length frequency and abundance distributions from Spring 1982 and Fall 1988.

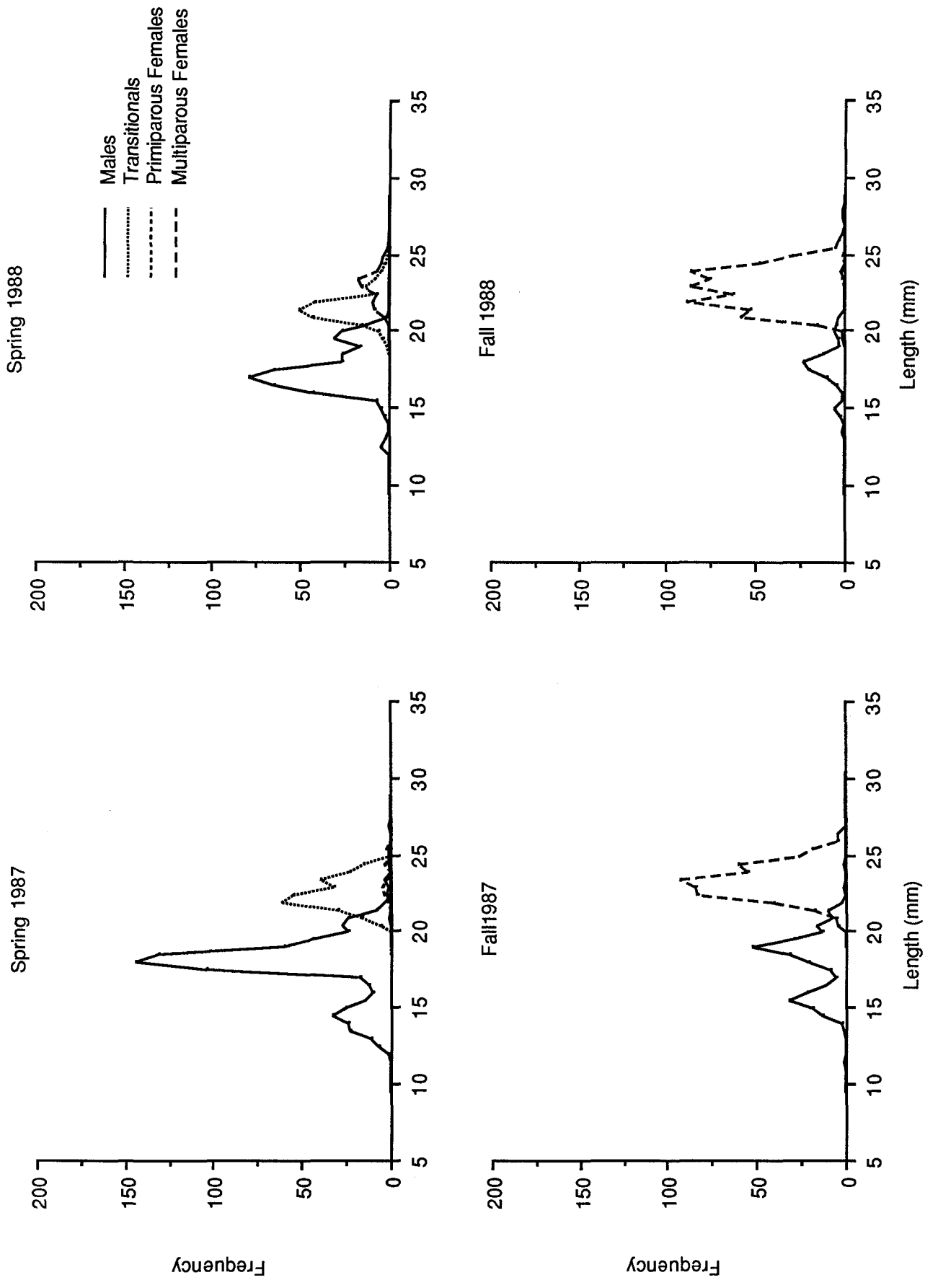

Figure 8. Shrimp length frequencies by sex, from the exploratory tows (1987-88).

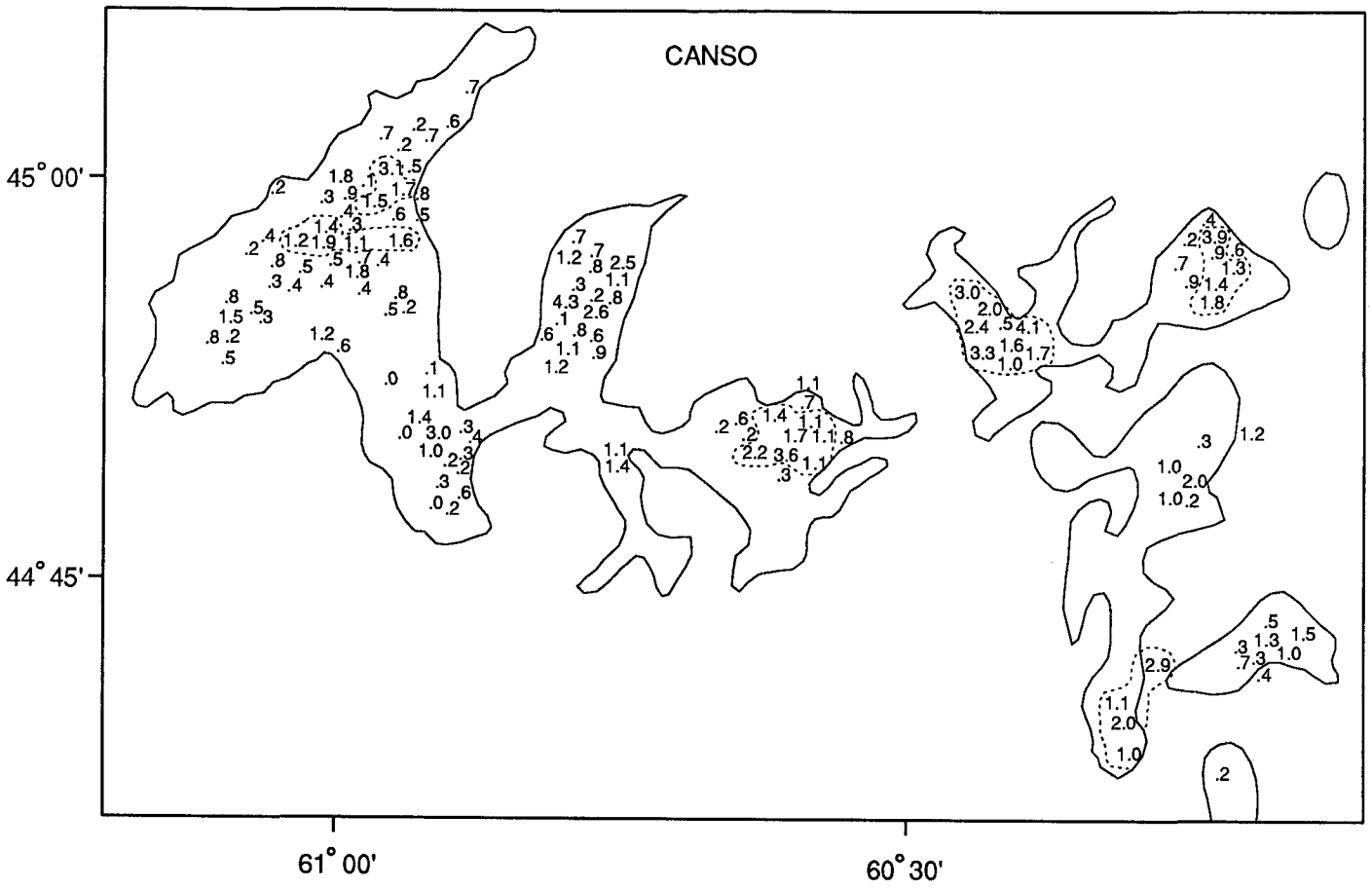

Figure 9a. Normalized catches from 1982-88 (Dashed lines are subjectively defined areas of higher catch rates).

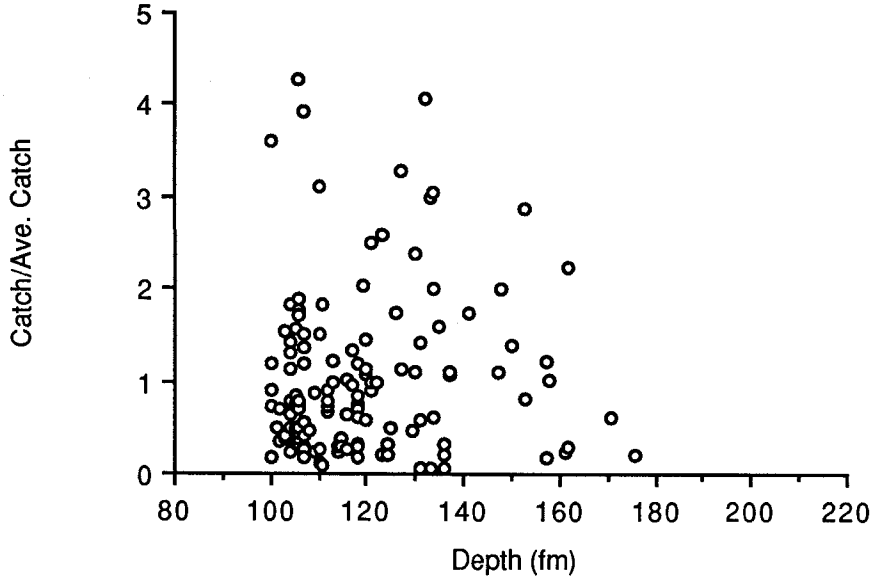

Figure 9b. Normalized catches verses depth (Canso).

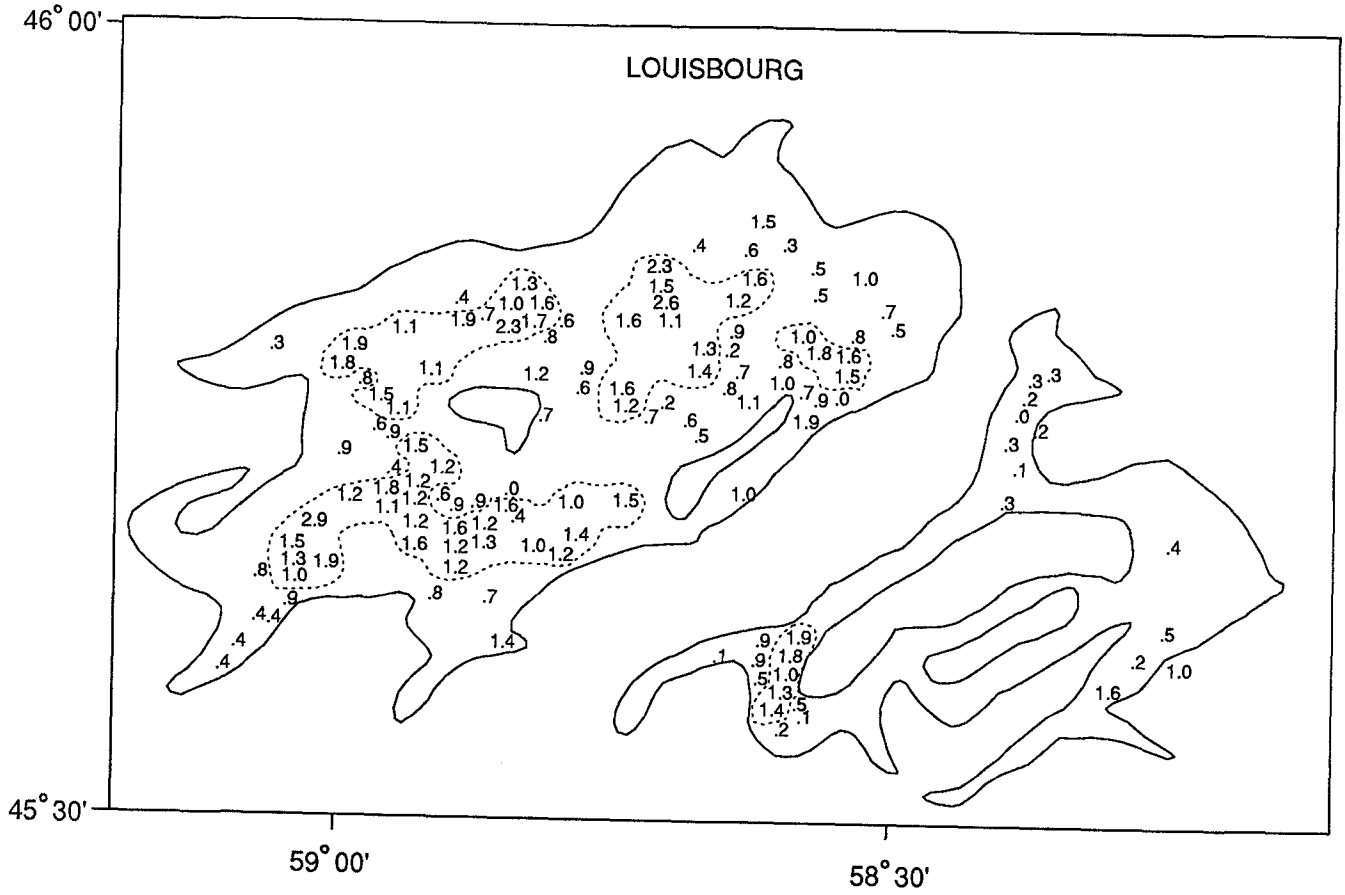

Figure 10a. Normalized catches from 1982-88 (Dashed lines are subjectively defined areas of higher catch rates).

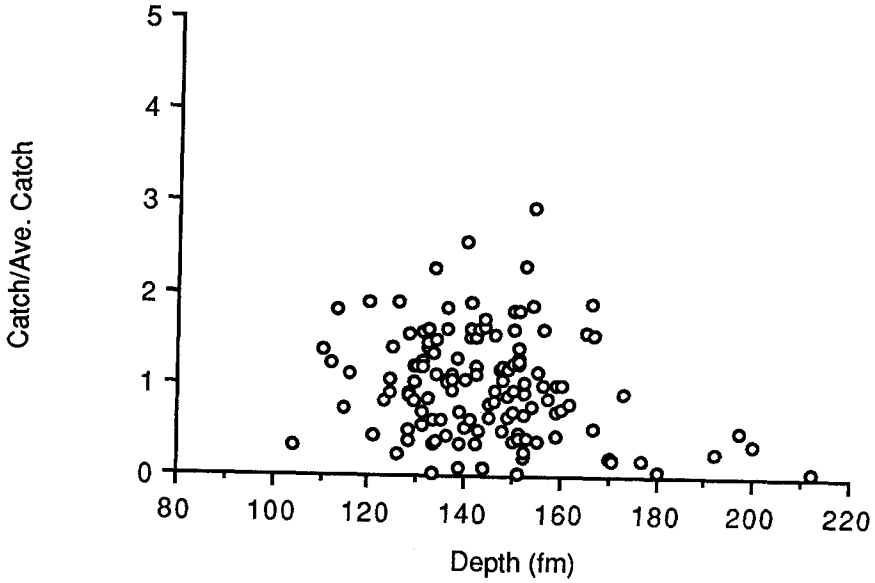

Figure 10b. Normalized catches verses depth (Louisbourg).

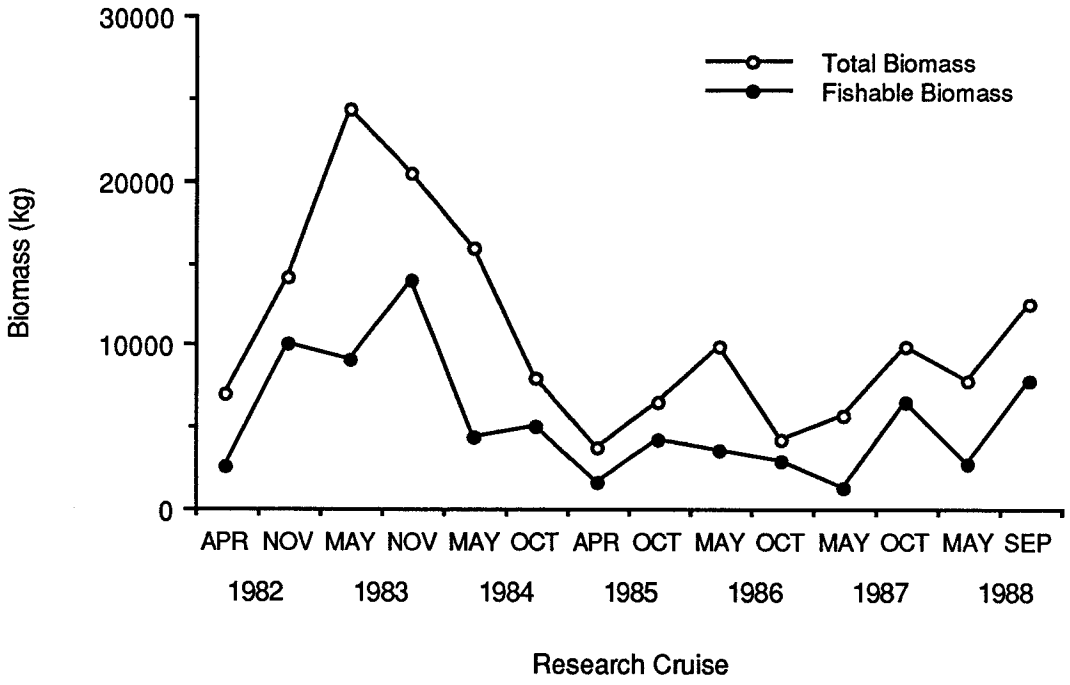

Figure 11. Biomass estimates from research cruises.

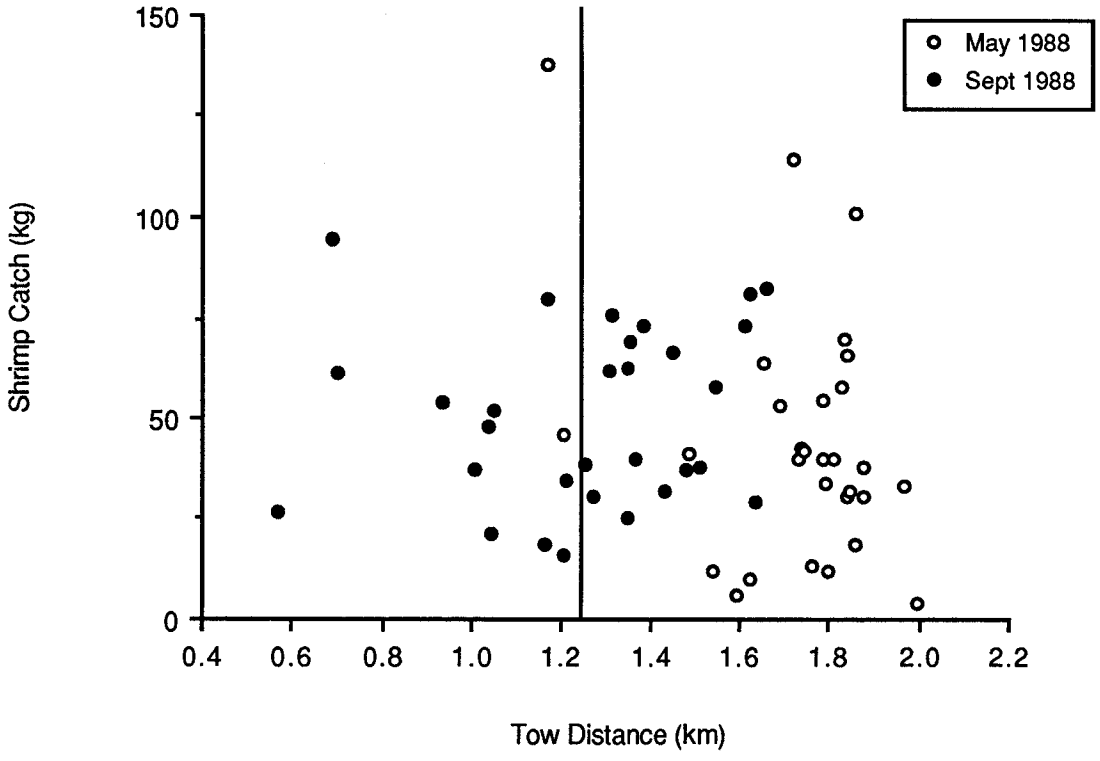

Figure 12. Shrimp catch per tow verses tow distance from 1988 research cruises.

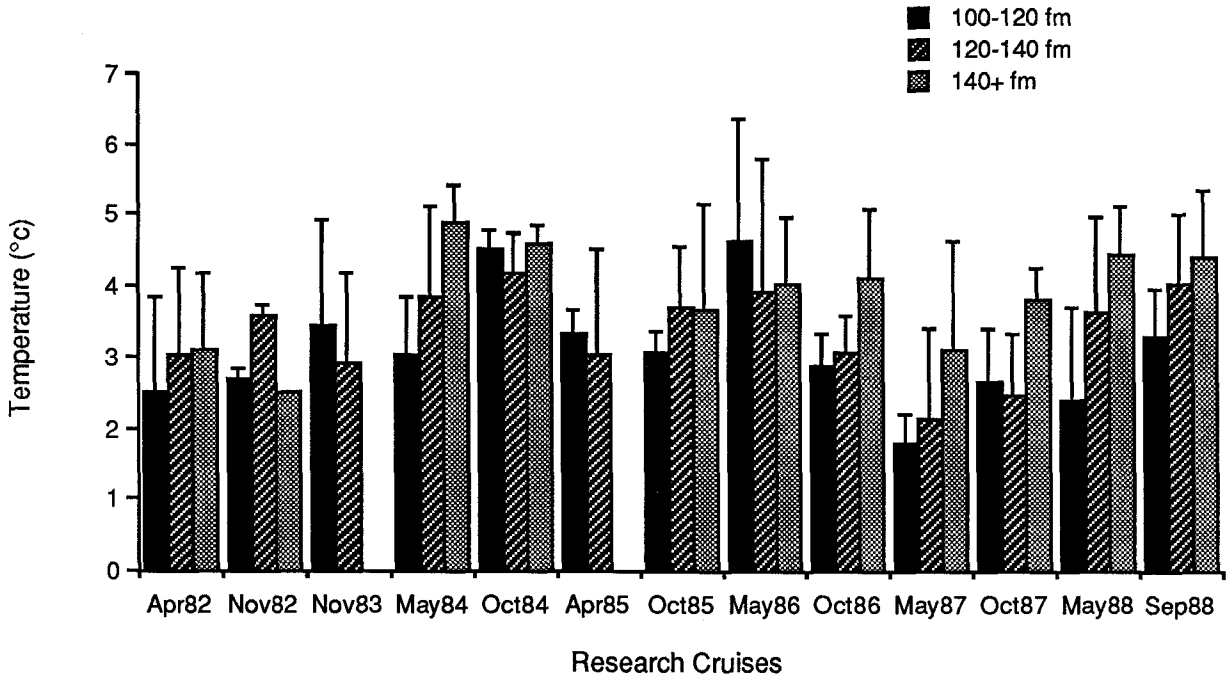

Figure 13a. Average temperatures by depth for research cruises.

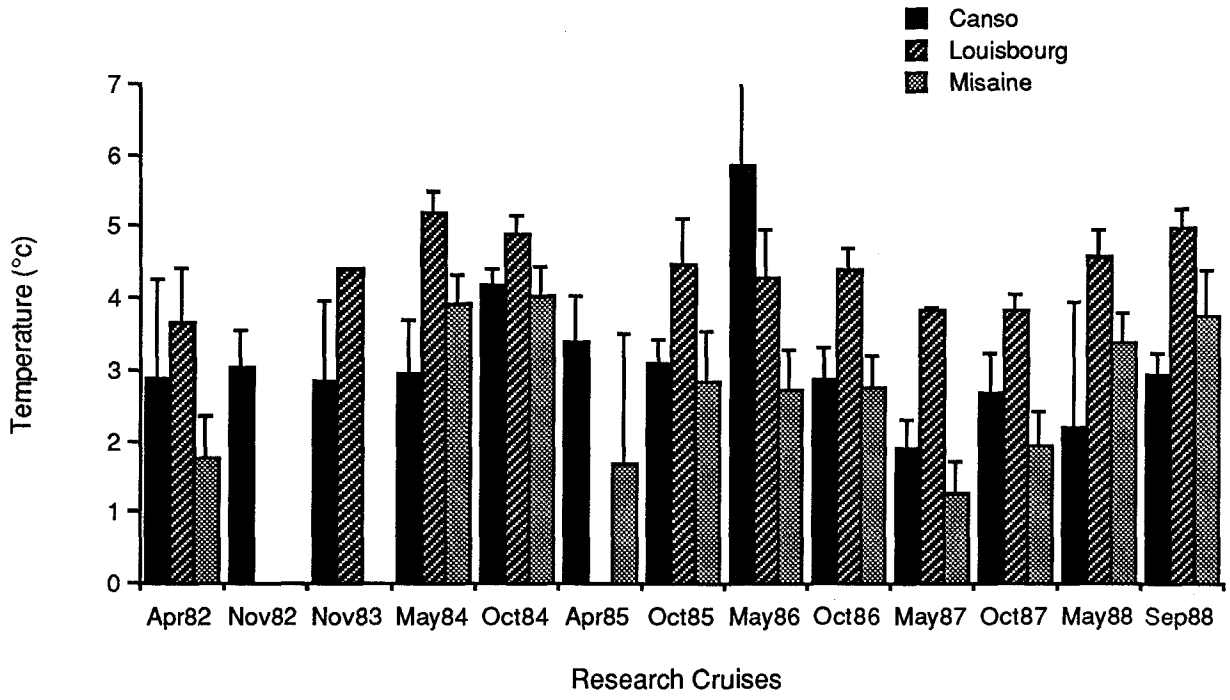

Figure 13b. Average temperatures by area for research cruises.