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The Burgeoning Fishery for Iceland Scallops on the Grand Banks of Newfoundland

by

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Abstract

The directed fishery for Iceland scallops on the Grand Bank of Newfoundland is relatively recent (1993) and driven largely by the lack of opportunities in the groundfish sector. The high economic return form the scallop fishery has quickly resulted in a disproportionately large shift in fishing effort into this sector. In just three years total catch from the Grand Banks of Newfoundland has surpassed 11,000 t round. Over half (55.5%) of this was taken in 1995. The majority (93%) of removals during the period was from NAFO Div. 3N, particularly from the highly productive grounds near the Lilly Canyon and Carson Canyon. Scallops here tend to be larger than elsewhere on the bank and consequently attracts most of the effort. Overall mean daily catch/tow had declined in 1994; a similar decline is not evident in 1995. The proportions in the catch of small meats to large ones from the Canyons continue to increase. Much of the remaining removals came from aggregations trending northeast just outside of the box but within Div. 3N.

Only sporadic effort was directed outside (77 days) of these two areas resulting in a further removal of 170 t (or 3% of 1995 total).

Résumé

La pêche dirigée du pétoncle d'Islande sur le Grand Banc est relativement récente, ayant débuté en 1993 en grande partie en réponse à la pénurie de poisson de fond. Le rendement économique élevé de cette pêche a rapidement donné lieu à un virage disproportionné de l'effort de pêche vers ce secteur. En trois ans seulement, le total des prises a dépassé 11 000 t en poids entier. Plus de la moitié de ce total, soit 55, 5 %, a été récolté en 1995. La plupart des prises 1995, soit 93 %, proviennent de la division 3N de l'OPANO, plus précisément des très riches gisements situés à proximité des canyons Lilly et Carson. À ces endroits, les pétoncles ont tendance à être plus gros qu'ailleurs sur le banc et, par conséquent, sont la cible de la plus grande partie de l'effort. En général, les prises moyennes quotidiennes par trait avaient diminué en 1994, ce qui n'était pas le cas en 1995. Le pourcentage de petits muscles par rapport aux gros muscles dans les prises récoltées dans les canyons continue d'augmenter. La plupart des autres prises proviennent de gisements s'étendant vers le nord-est juste à l'extérieur de la «boîte», mais dans les limites de la division 3N.

Seul un effort sporadique a été déployé à l'extérieur de ces régions (77 jours de pêche), effort qui s'est traduit par des prises de 170 t (ou 3 % du total 1995 des prises).

Introduction

The directed fishery for Iceland scallops on the Grand Banks of Newfoundland is quite recent. After several years of exploratory fishing and commercial trials (see Naidu and Cahill 1989, 1990), fishing activity began in earnest in 1993 with ten vessels participating. Nominal catch is estimated at 459 t round (Table 1). In the first year of operations the majority of removals came from NAFO Div. 3L, the remainder (3 t) being from 3N. A variety of gear types had been used including the New Bedford rake, the Labrador rake (from 4R) and Digby buckets. Catch rates were highly variable with meat count generally in the 40-80/lb range.

The initial foray into the Grand Banks resulted in a six-fold increase in 1994 in the number of vessels participating (to 57 vessels). Most of the removals (98%) in the second year came from 3N from the Lilly and Carson Canyons.

Encouraged by the high economic return from this fishery (up to $8.00/lb!), interest in offshore scallop aggregations continued unabated into 1995. The fishery was placed under a TAC regime in 1995: 1,000 t shellstock for 3L (northern area) and 3,000 t shellstock for 3N (Lilly and Carson Canyons) (Fig. 1). A total of 48 vessels, mostly in the 55-64 ft LOA range (Table 2) participated. Nominal catch is estimated at 6,300 t round (Table 3). Much of the interest remained around the Canyons (Fig. 2) (977 out of 2,212 effort days or 44%) which together produced most of the removals in 1995 (3,023 t out of 6,126 t or 49.4%, Table 4). The TAC of 3,000 t was taken between March and August resulting in a shift northeastwards just outside the area under the TAC regime (Fig. 2). This bed is contiguous to aggregations around the Canyons and runs northeast. This "new" area outside of the TAC box produced almost as much as the Canyons (2,913 t versus 3,023 t or 47.6%).

Research Surveys

Science Branch involvement in surveys for the mollusc over the eastern Grand Banks of Newfoundland did not commence until 1989. The areas involved (Table 5) were such that we decided only to look at NAFO Div. 3N. An area approximately 15,750 mi^2 was examined. Only 66 (or 43%) of the 152 survey sets produced scallops, mostly north of 44°30'N (Naidu and Cahill 1990). Catches were highly variable, pointing to the very patchy distribution of this species (Gilkinson and Gagnon 1991). The better catches ($\geq$500 scallops/tow mile with 12 ft. offshore rake) came from two areas, one just southwest of Carson Canyon in a 75 mi^2 area within 31-50 fm and a smaller (15 mi^2) aggregation in the slope area straddling the 31-50 and 51-100 fm isobaths off the Lilly Canyon. Separate patch estimates had been developed: (8,000-16,000 t ($\bar{x}$ = 12,000 t) and 43-5000 t ($\bar{x}$ = 2,600 t) round weight, respectively. The very large confidence limits ($\pm$32 and $\pm$98%, respectively), particularly for the small aggregation was probably the result of the very low number of sets (N = 5). Only twenty sets had been made in the larger aggregation.

Once the aggregations were identified we returned to the areas in 1994 and research effort was confined to these areas. Fishable biomass was estimated at between 20,000-38,000 t ($\bar{x}$ = 29,000 t) round (C.I ± 30%). Applying a 10% exploitation rate, a TAC of 3000 t shellstock had been proposed for the Lilly and Carson Canyon areas. Research vessel catch rates in 1994 had dropped by 50% in comparison to those encountered in 1989 (17.3 versus 35.2 kg/tow mile). It had been noted that natural mortality had increased by 65%.

We had planned to return to this area in the spring of 1996, but unforeseen demands relative to mounting a mission to 3Ps resulted in our deciding to only undertake ROXANN sweeps of the area (between 45°40'N and 46°00'N). Covering some 3,471 mi^2, this will result in a more efficient and cost-effective survey in the future, possibly as early as next year (1997). The results of the ROXANN work will be presented when the stock is reassessed in 1997.

1995 Research Survey

Limited shiptime and resources in 1995 did not permit a return to the Canyons to reassess stock status in 3N. Instead it was decided to conduct a resource survey to now include the extension of the aggregation running northeast between Lilly Canyon and Carson Canyon, including portions of NAFO Div. 3LN that straddle the Canadian 200 mi Economic Zone (Fig. 4).

Following our recent success with the two-phase survey design for scallops, we spent 76 hours running ROXANN sweeps between latitude 45°26' and 46°30N. Spaced 5 mi apart, approximately 2,144 n mi^2 of seabed was classified to determine extent of benthic assemblages containing scallops. This optimization of the survey design resulted in the delineation of an area approximately 1152 n mi^2 (out of 2,144 mi^2 or 54%) as most likely to contain scallop aggregations. A total of 57 sets was then completed over the area, the majority (N = 36) of them over favourable bottom (Table 6 and 7; see also appendices). Of the 57 survey sets 30 (or 52%) were in 3L and the remaining 27 (or 48%) were in 3N (Table 8). Better catches were again encountered in 3N than in 3L. Also, scallops from 3N are slightly larger (Table 9) and provide higher yield than scallops from 3L (12.8% versus 11.3% respectively) and hence lower counts (45 versus 61/500 g, Table 10).

Mean catch per one-mile tow with a 12 ft. offshore rake was 26.5 ± 49.2 kg; in areas where catches were greater than the overall mean it was 70.3 ± 49.2 kg. Catch rates inside and outside the 200 mi Economic Zone were similar (26.7 ± 40.3 kg/tow versus 25.8 ± 44.0 kg/tow). The best catch (182.4 kg) came from 55 fm at 45°41.9'N, 48°28.2'N.

Shell-Height/Meat-Weight Regression (Table 11)

3N: $\log W = 2.9548 \log SH - 4.6070$ ($r^2 = 0.9094$; N = 202)
3L: not done

Not unexpectedly, the MDB estimated for the whole area appears to be unrealistically high (Table 12). Even when the estimate is derived only for the area designated a suitable "scallop" bottom, the estimate of MDB is spuriously high (Table 13). It is unrealistic to achieve any precision in biomass estimation over such a large area, particularly for a highly aggregated and sedentary species. Two patch estimates each covering an area approximately 50 and 138 n mi^2 (Fig. 5) probably provides the best estimate of fishable biomass (i.e. 3,000-9,000 t ($\bar{X}$ = 6,000 t) round). Using 20% gear efficiency we estimate fishable biomass from these aggregations at between 15,000-45,000 ($\bar{X}$ =30,000 t). At 10% exploitation this would translate to annual removals in the order of 3,000 t round.

Changes in CPUEs

Other than the continued reduction in the proportion of large meats to smaller ones (Tables 14 and 15), first reported in 1994, no clear pattern is discernable in the CPUEs (kg round/tow, Tables 16 and 17). This holds for both the area currently under a TAC regime and the contiguous area to the northeast of it. Overall, catch rates at $\geq$100 kg/tow (Table 18) is considered quite good (versus, say, 26 kg/tow in 4R, Naidu et al. 1996). Evidently, the fishing strategy is to locate and fish down new patches within a megapopulation (Table 19). As soon as catch rates begin to decline vessels move on to the next patch. This strategy to maintain economic or threshold catch rate no doubt will conceal real declines in CPUE.

Natural Mortality

Natural mortality computed from the percent occurrence of cluckers (Dickie 1995; Mercer 1974) points to higher M values for 3N than for 3L suggesting fishery induced mortality in 3N where most of the effort had been directed (0.23 versus 0.09, Table 20). As elsewhere (3Ps) it is possible that starfish predation has also increased. Unfortunately, other than anecdotal information, we do not have any data to support any increase in their numbers.

Resource Status and Perspectives

Under pressure from fishermen and industry and before scientific advice became available, the fishery resumed in March 1996 with an interim (pre-emptive) quota of 1,000 t for the Lilly and Carson Canyons. An additional 500 t interim quota (also management invoked) was established for other areas. With 36 vessels participating this was quickly taken. As of May 7, 1,536 t had already been taken, i.e. an overrun of 54%. Resource Management Branch requested and was granted an extension to the interim quota for the canyons by a further 500 t to 2,000 t (from the initial 1,000 t round) round and the interim quota outside the canyon to 1,000 (from 500 t) (see L. W. Coady Note to File dated May 7, 1996).

References

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Table 1. Nominal catch (t, round) and effort of Iceland scallops from NAFO Div. 3LNO. All figures are based on the species-specific conversion factor of 9.2.

Year	No. vessels	NAFO Division 3L	3N	3O	3LNO
1992	1	17	2	-	19
1993	10	456	3	-	459
1994	57	91	4,478	2	4,571
1995	48	174	6,126	3	6,303
Totals		738	10,609	5	11,352

Table 2. Size range of vessels in Canyons in NAFO Div. 3N, 1995.

Vessel size (LOA)	No. of vessels (%)
55′-64′	33 (75.0)
45′-54′	8 (18.2)
35′-44′	3 (6.9)
<35′	0
Total	44

Table 3. Summary of scallop landings from eastern Grand Banks, 1995.

NAFO Div.	No. of boats	No. of fishing days	Landings[1] (kg, round) (% of total)
3L	20	150	174,349 (2.7)
3N	44	2,052	6,125,681 (97.2)
3O	3	10	3,254 (0.1)
Offshore only (east of 51° long.)	45	2,089	6,222,250 (98.7)
All of 3LNO (total)	48	2,212	6,303,285

[1] sum of daily log estimates x 9.2

Table 4. Summary of removals by area from NAFO Div. 3N.

Area	No. of fishing days	Landings[1] (kg, round)
Lilly/Carson Canyons	977	3,023,141 (49.4%)
North of LCC (45°40′-46°00′N)	998	2,913,238 (47.6%)
Remainder of 3N	77	189,304 (3.0%)
Σ of 3N	2,052	6,125,681
Total 3LNO	2,212	6,303,285

[1] sum of daily log estimates x 9.2

Table 5. Areas contained ≤100 fm in NAFO Div. 3L, 3N, and 3O.

NAFO Div.	Nautical mi^2	km^2
3L	26,004	89,194
3N	15,750	54,023
3O	17,316	59,394
Total	59,070	202,611

Table 6. TELEOST Trip #13, 1995 Iceland scallop survey - Grand Bank.

TOTAL AREA SURVEYED (approximate)	2144.03 nmiles^2
TOTAL AREA OF SCALLOP BED (approximate)	1151.55 nmiles^2
LINEAR MILEAGE OF SURVEY LINES	234.4 nmiles
LINEAR MILEAGE OF SETS	57 nmiles
TOTAL LINEAR MILES	291.4 nmiles
ROXANN SURVEY LINES	
NO. OF TRACK POINTS SCALLOP BOTTOM	17400
% SCALLOP BOTTOM	50.15
NO. OF TRACK POINTS (HARD & SOFT BOTTOM)	16772
% HARD & SOFT BOTTOM	48.34
NO. TRACK POINTS (BAD DATA)	527
% BAD DATA	1.52
TOTAL TRACK POINTS	34699

Table 7. TELEOST Trip #13 - Summary of ROXANN data for survey sets.

	Area A	Area B	TOTAL
NO. OF SETS BY AREA	36	20	56
TOTAL CATCH (kg) IN EACH STRATUM	1412.79	96.31	1509.1
MEAN CATCH (kg)/TOW	39.24	4.82	26.48
NO. OF TRACK POINTS (SCALLOP BOTTOM)	9335	398	9733
% SCALLOP BOTTOM	78.17	10.87	62.37
NO. OF TRACK POINTS (HARD& SOFT BOTTOM)	2279	3235	5514
% HARD & SOFT BOTTOM	19.08	88.34	35.34
NO. TRACK POINTS (BAD DATA)	328	29	357
% BAD DATA	2.75	0.79	2.29
TOTAL TRACK POINTS	11942	3662	15604
NAUTICAL MI^2 (approximate)	1151.55	992.48	2144.03
% OF TOTAL AREA SURVEYED	53.71	46.29	100

AREA A = SCALLOP BED WITHIN SURVEY AREA

AREA B = AREA OUTSIDE SCALLOP BED WITHIN SURVEY AREA

Table 8. Area-specific mean numbers and weights (kg) of Iceland scallops per tow mile on Grand Bank, June 1995.

NAFO Div.	Depth fished (m) Mean	Depth fished (m) Range	No. of sets	Mean number (±S.D.)	Mean weight (±S.D.)
3L	102	82-157	30	346.8 (±386.7)	23.1 (±26.1)
3N	111	77-153	27	372.5 (±640.6)	30.3 (±53.1)
Overall	106	77-157	57	359.0 (±517.8)	26.5 (±40.9)

Table 9. Area-specific mean and modal shell heights (mm) of Iceland scallops on Grand Bank, June 1995.

NAFO Div.	N	Mean shell height (mm) (±S.D.)	Modal shell height (mm)	Range	
				Min.	Max.
3L	3,624	73.2 (±6.4)	75	12	94
3N	2,236	78.4 (±7.5)	76	18	99
Overall	5,860	75.2 (±7.3)	75	12	99

Table 10. Area-specific biological meat yields, average meat weights and meat counts/500 g for Iceland scallops from Grand Bank, June 1995.

NAFO Div.	N	Whole weight* (kg)	Meat weight (kg)	$\bar{x}$ meat weight (g)	Count (#/500 g)	Yield (%)
3L	530	38.55	4.352	8.2	60.9	11.3
3N	707	61.25	7.851	11.1	45.0	12.8
Overall	1,237	99.80	12.203	9.9	50.7	12.2

* whole weight = weight of scallops as caught. No barnacles/ epibionts cleaned off shells.

Table 11. Size-specific meat weights (g) for Iceland scallops from NAFO Div. 3N computed from shell height/meat weight regressions, June 1995.

Shell height (mm)	NAFO Div. 3N
40	1.3
45	1.9
50	2.6
55	3.4
60	4.4
65	5.6
70	7.0
75	8.6
80	10.4
85	12.4
90	14.7
95	17.3
100	20.1

Div. 3N:

$$\log W = 2.9548 \log SH - 4.6070 \quad (r^2 = 0.9094;\ N = 202)$$

Table 12. Estimates of minimum dredgeable biomass (MDB, t, round) for Iceland scallops on the Grand Banks, June 1995.

Stratum	Area (n mi^2)	No. of sets	MDB
1	49.55	9	442-1,785 ($\bar{X}$ = 1,114)
2	137.65	11	1,980-8,023 ($\bar{X}$ = 5,001)
3	1956.83	37	4,551-12,798 ($\bar{X}$ = 8,675)
Combined	2144.03	57	9,832-19,747 ($\bar{X}$ = 14,790)

Table 13. Estimates of minimum dredgeable biomass (MDB, t round) for Iceland scallops in the area surveyed over the Grand Banks in 1995.

All areas considered suitable through sea-bed classification (ROXANN)

13,300 - 31,350 t ($\dot{X}$ = 22,300 t) 1152 n mi^2

Two patches considered suitable for fishing

Stratum	Area (n mi^2)	No. sets	MDB
Bed 1	49.5	9	440-1,800 ($\dot{X}$ = 1,110)
Bed 2	137.6	11	1,980-8,000 ($\dot{X}$ = 5,000)
Total	187.1	20	3,000-9,000 ($\dot{X}$ = 6,000)

Table 14. Changes in percent composition of meat counts in scallop catches from 3N (Lilly Canyon/Carson Canyon), 1994-95.

Meat count (nos./lb.)	April 1994	October 1994	August 1995
1-9	0	0.1	0
10-19	2.4	1.5	0
20-29	34.8	29.2	0.4
30-39	40.2	36.6	5.5
40-49	17.5	22.0	21.5
50-59	4.0	8.0	25.2
60-69	0.9	2.2	23.3
70-79	0.3	0.3	12.7
80+	0.1	0.1	11.4
N	2,209	1,071	1,629

Table 15. Percent composition of meat counts in scallop catches from the NE of Carson Canyon (3N), 1995.

Meat count (nos./lb)	June 1995	August 1995
1-9	0	0
10-19	0.2	0.1
20-29	5.2	2.1
30-39	30.2	17.7
40-49	35.1	33.9
50-59	17.4	27.8
60-69	7.9	12.2
70-79	2.3	4.2
80+	1.8	2.1
N	1,527	2,652

Table 16. Montly CPUE estimates for the Lilly/Carson Canyon area of NAFO Div. 3N, 1995.

Month	Removals[1] (t, round)	Fishing days	CPUE		
			kg/day	kg/hour	kg/tow
March	-	-	-	-	-
April	171	67	2559	216	80
May	275	102	2695	205	93
June	333	92	3617	266	120
July	1113	366	3043	223	92
August	982	305	3221	208	98
September	76	21	3637	879	200
October	53	18	2923	206	99
November	19	6	3199	140	94
Overall	3023	977	3095	223	98

[1] sum of daily log estimates x 9.2

Table 17. Monthly CPUE estimates for that portion of Div. 3N north of the Lilly/Carson Canyon zone, 1995.

Month	Removals[1] (t, round)	Fishing days	CPUE		
			kg/day	kg/hour	kg/tow
March	15	17	902	235	30
April	117	54	2180	357	120
May	48	20	2379	335	105
June	24	8	2988	535	172
July	321	99	3244	350	127
August	772	246	3140	286	124
September	933	318	2935	270	109
October	565	188	3005	256	101
November	117	48	2432	191	82
Overall	2913	998	2920	279	110

[1] sum of daily log estimates x 9.2

Table 18. Monthly CPUE for Div. 3N, 1995 (LCC + portion north of LCC combined).

Month	Removals[1] (t, round)	Fishing days	CPUE kg/day	CPUE kg/hour	CPUE kg/tow
March	15	17	902	235	30
April	289	121	2390	249	90
May	322	122	2643	214	95
June	357	100	3567	276	122
July	1435	465	3085	244	98
August	1755	551	3185	237	108
September	1010	339	2978	284	112
October	618	106	2997	251	101
November	136	54	2517	180	84
Overall	5936*	1975	3006	247	103

[1] sum of daily log estimates x 9.2

* 97% of total 3N removals
95% of total 3LN "offshore" removals

Table 19. Mean daily catch (kg round) per tow by month in Div. 3N, 1995.

Month	Lilly/Carson Canyon $\bar{X}$ (±S.D.)	3N north $\bar{X}$ (±S.D.)	Combined $\bar{X}$ (±S.D.)
March	-	19.7 (±34.3)	19.7 (±34.3)
April	83.8 (±40.8)	123.3 (±63.3)	98.3 (±53.4)
May	106.0 (±70.7)	155.3 (±208.5)	115.4 (±111.5)
June	147.3 (±121.2)	187.7 (±71.4)	150.3 (±118.4)
July	108.5 (±67.4)	148.4 (±97.5)	116.1 (±71.1)
August	106.2 (±61.9)	139.8 (±65.8)	119.9 (±65.5)
September	221.9 (±84.4)	123.0 (±77.0)	129.8 (±81.4)
October	106.0 (±56.1)	106.5 (±41.7)	106.4 (±43.1)
November	92.9 (±13.9)	87.6 (±41.7)	89.9 (±39.1)
Overall	112.2 (±74.8)	123.6 (±74.9)	117.7 (±75.0)

Table 20. Area-specific natural mortalities for Iceland scallops on Grand Bank computed from ratio of cluckers to live scallops, June 1995. Clucker numbers are adjusted by a factor of 1.221 to allow for tow-induced disarticulation.

NAFO Div.	Live	Cluckers	M
3L	3,848	211.23	0.090672
3N	2,306	352.87	0.232762
Total	6,154	564.10	0.146762

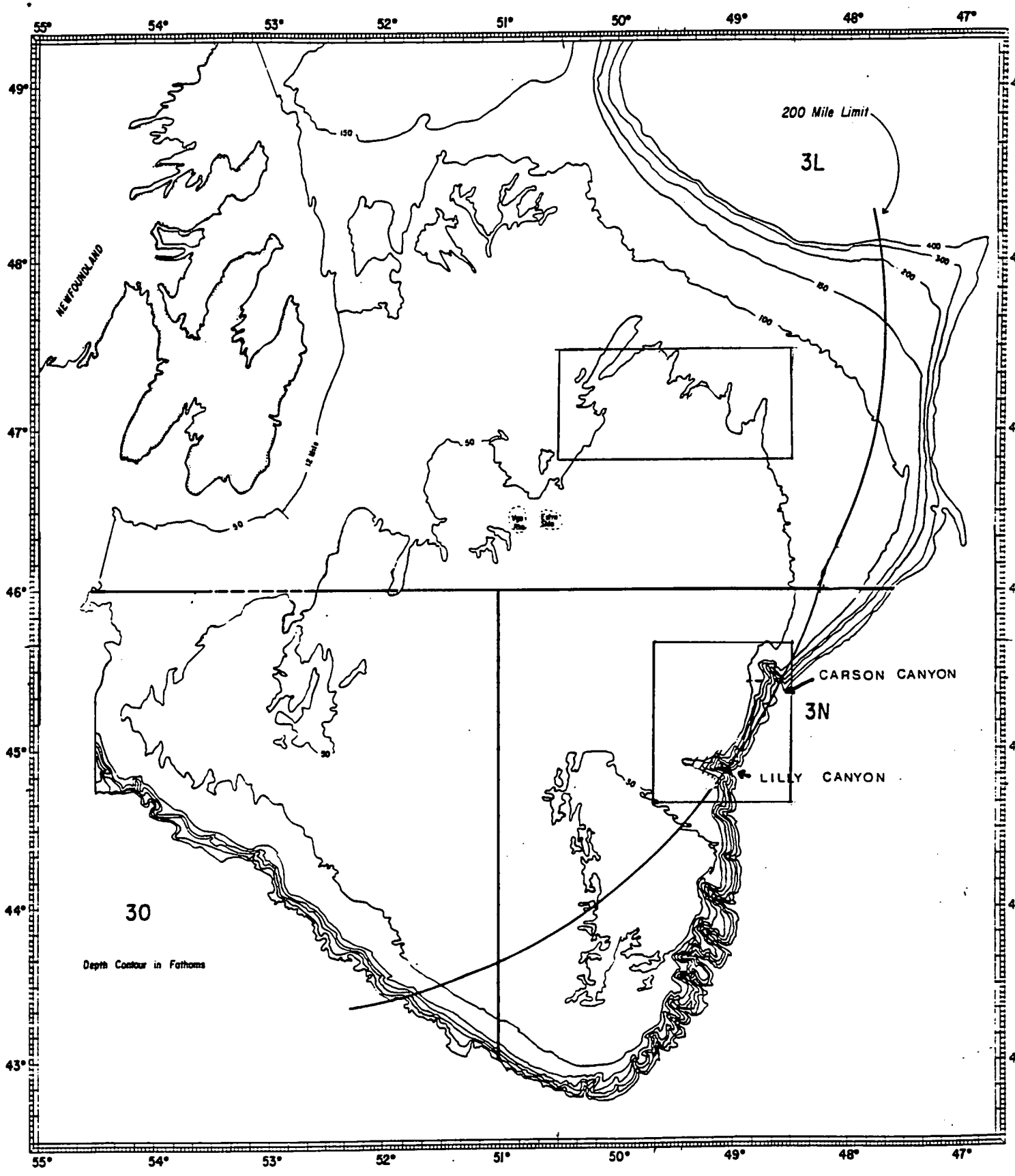


Fig. 1. Two areas (boxes), one each in NAFO Div. 3L and 3N under TACs in 1995.

1. Lily/Carson Canyons defined as the area bounded by the following co-ordinates:

45 40'N 49 40'W
45 40'N 48 30'W
44 40'N 48 30'W
44 40'N 49 40'W

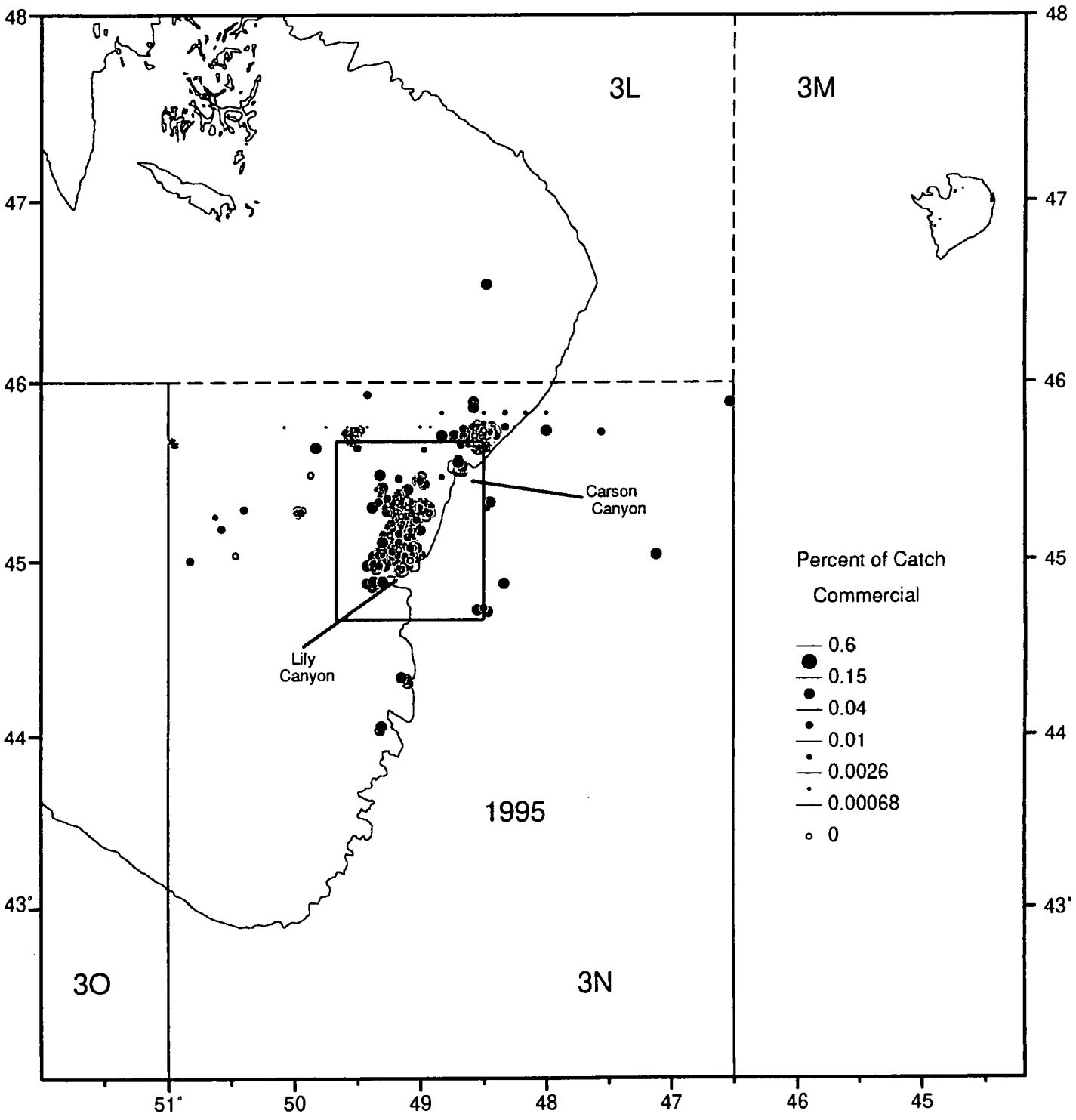


Fig. 2. Distribution of fishing effort in NAFO Div. 3LN in 1995.

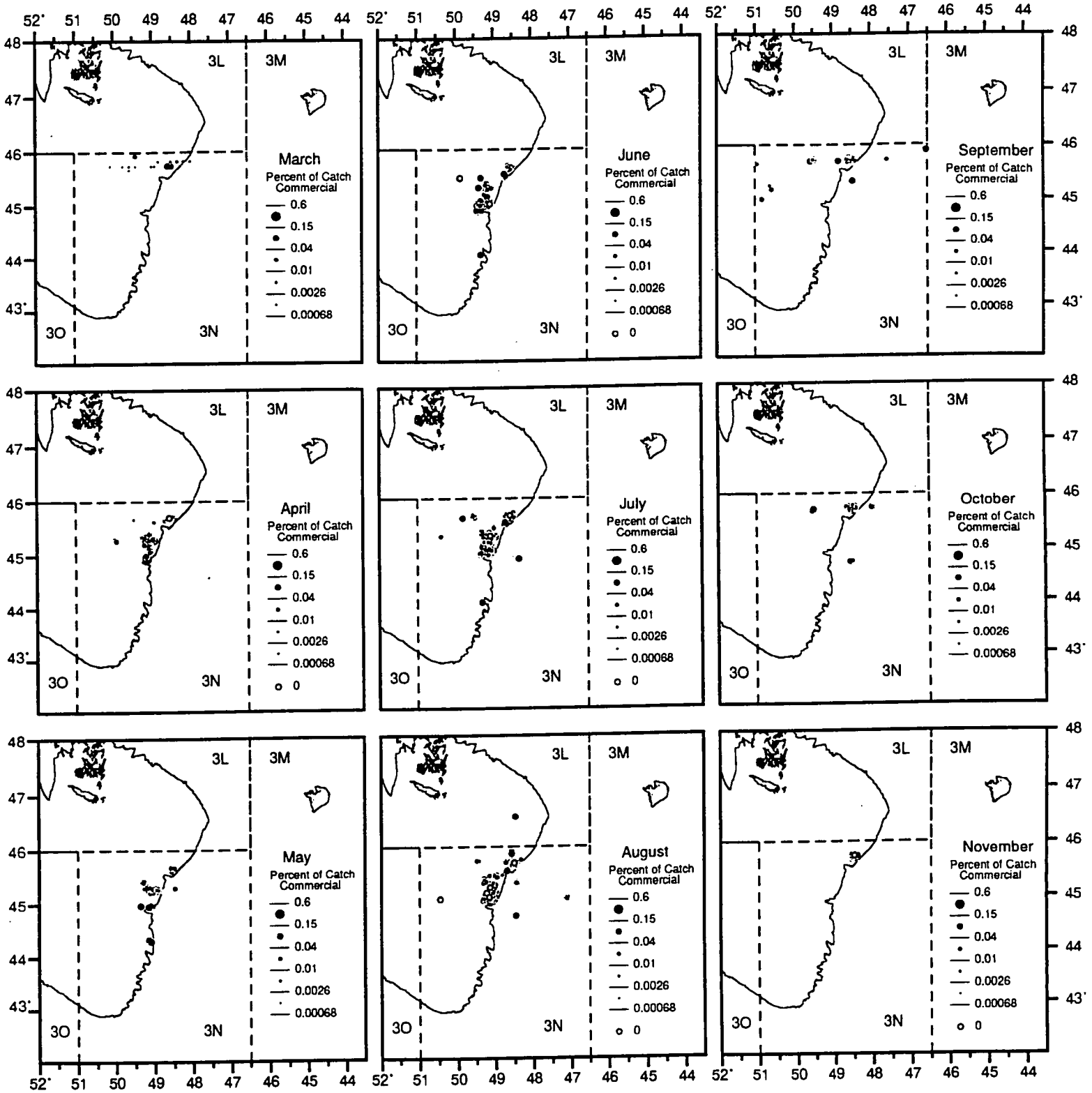
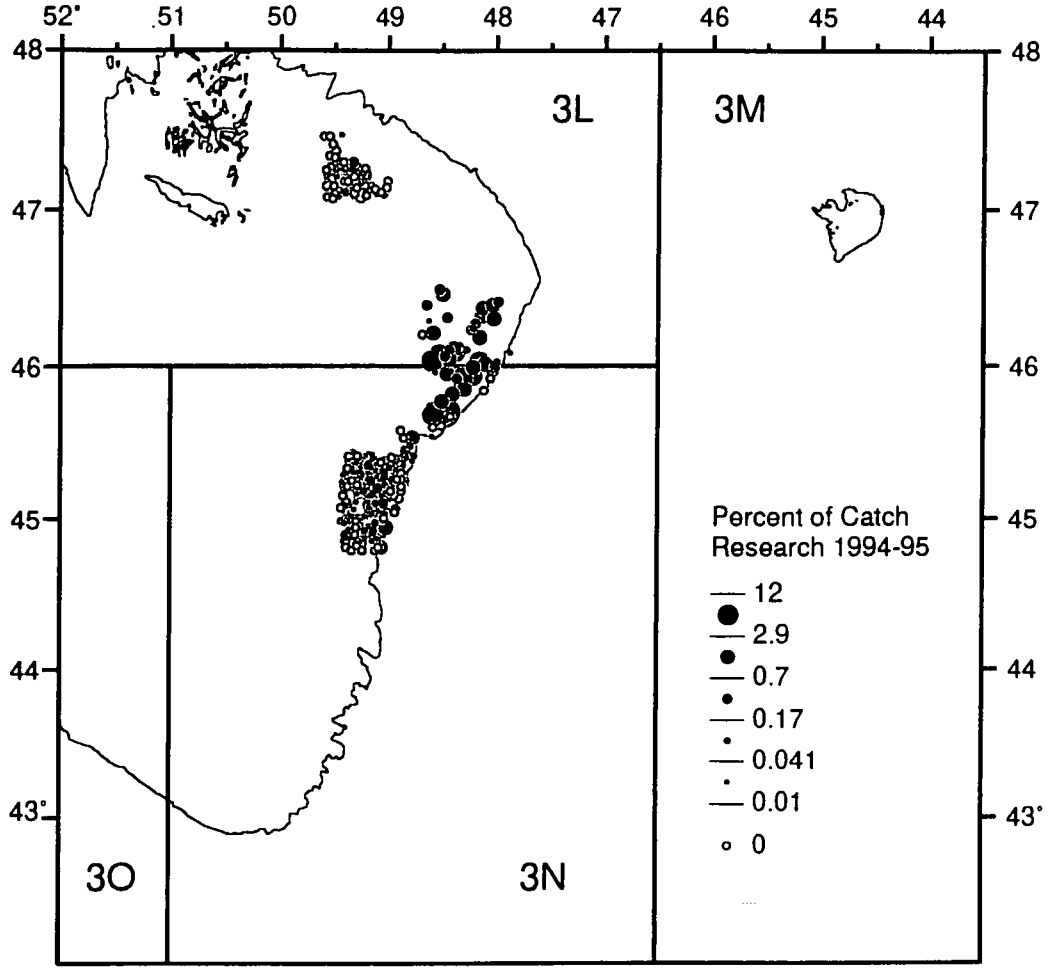


Fig. 3. Distribution of fishing effort by month in 1995.



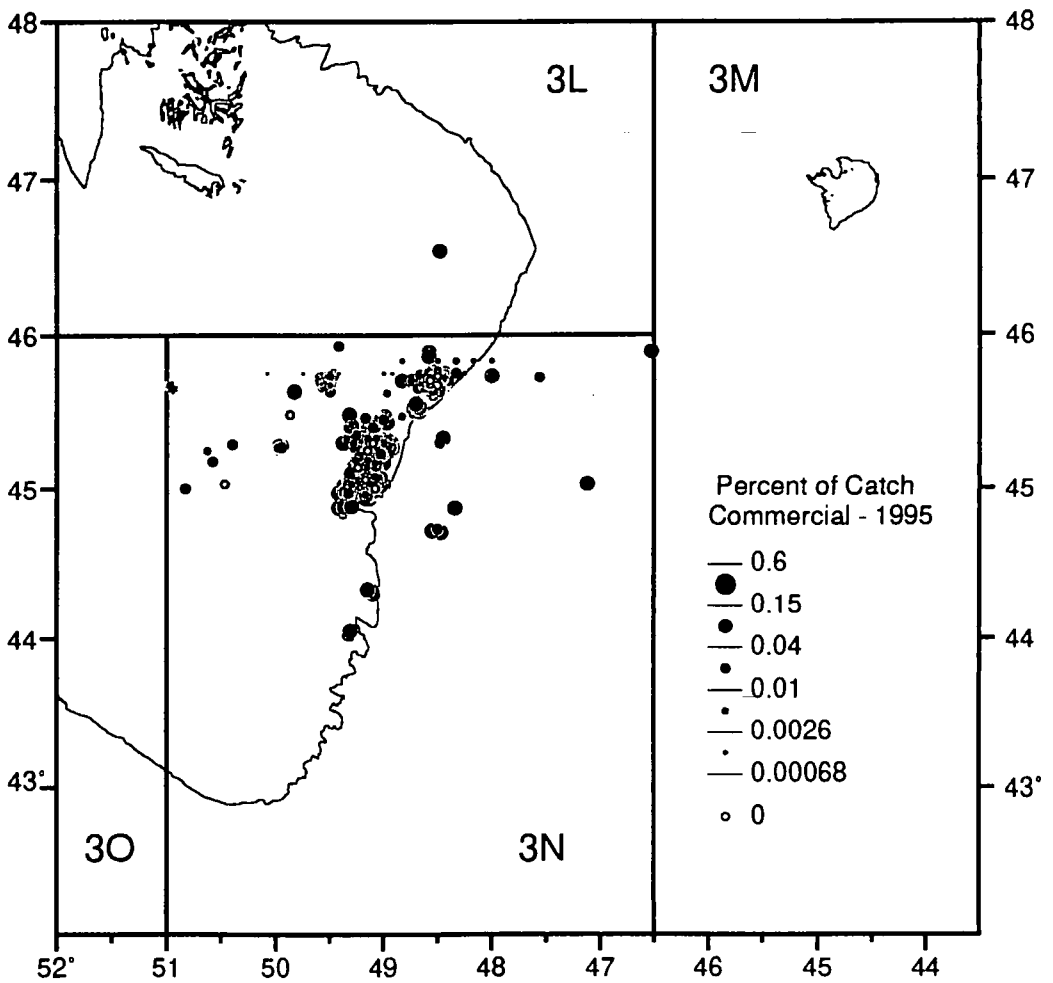


Fig. 4. Distribution of commercial effort (1995) and research survey (1993-95).

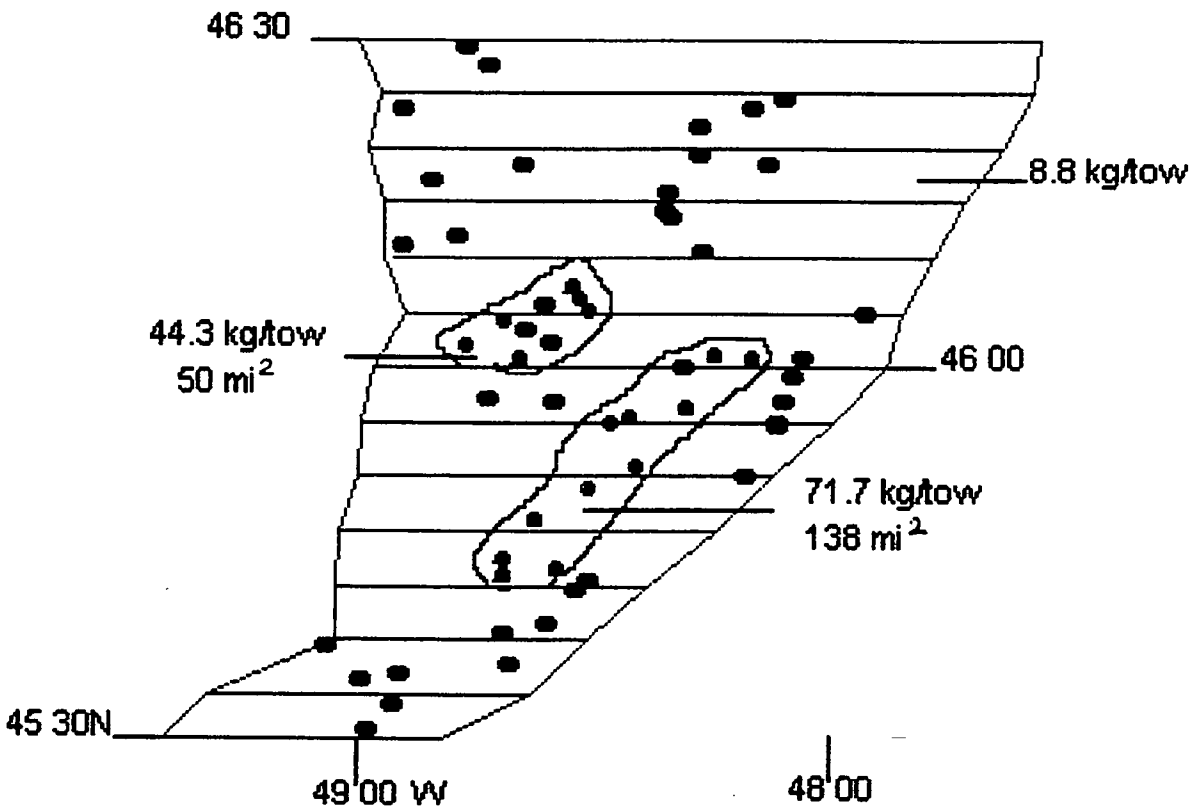


Fig.5. Scallop aggregations in 3LN, surveyed in 1995.

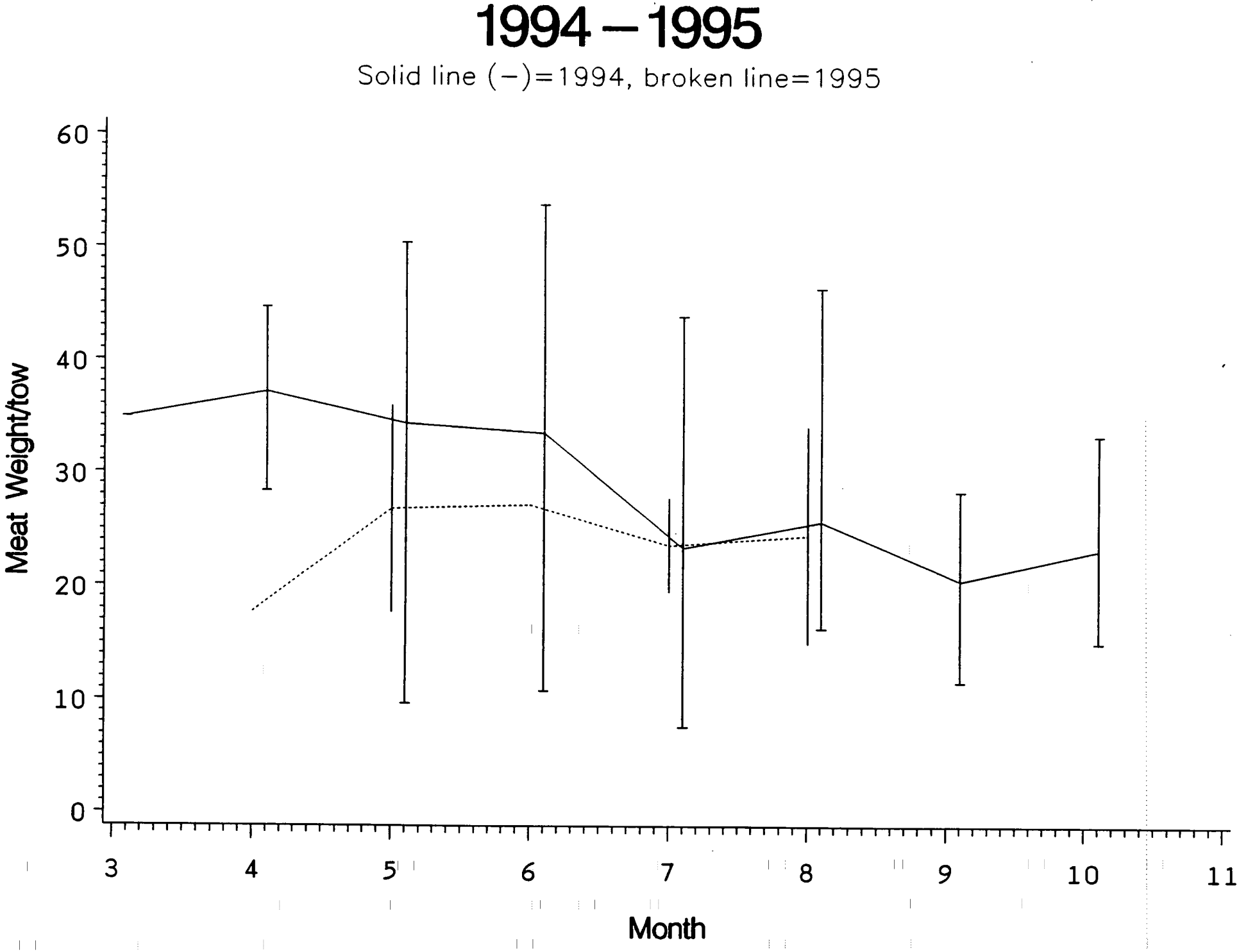


Fig. 6. Average monthly catch per tow (lb. meats) from the Lilly Canyon and Carson Canyon area for vessels reporting catches ≥30,000 lb/yr in 1994 and 1995.