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Analysis of the Snow Crab, Chionoecetes opilio, Fishery in Newfoundland for 1985

by

D. M. Taylor and P. G. O'Keefe
Science Branch
Department of Fisheries and Oceans
P. O. Box 5667
St. John's, Newfoundland A1C 5X1

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Abstract

Population size estimates for snow crab (Chionoecetes opilio) off the east coast of Newfoundland, based on Leslie analyses are presented for the 1985 fishing season. Within given crab management areas, estimates of population size ranged from 685 to 959 t and exploitation rates from 56 to 76%. Comparison of size frequency/shell conditions for 1984-85 in four management areas is also presented.

Résumé

Le présent document fournit des évaluations de l'importance de la population de crabe des neiges (Chionoecetes opilio) au large de la côte est de Terre-Neuve pour la saison de pêche 1985. Ces estimations sont fondées sur des analyses effectuées selon la méthode de Leslie. Au sein des zones de gestion du crabe considérées, les estimations de populations varient de 685 a 959 tonnes et les taux d'exploitation de 56 à 76 pour cent. Le texte présente également des comparaisons sur la fréquence des tailles et l'état des carapaces dans quatre zones de gestion pour 1984-1985.

Introduction

During 1985 the Newfoundland snow crab (Chionoecetes opilio) fishery continued to experience severe declines in catch rates and landings in all traditional fishing zones. These problems were especially severe in the Southern Zone where, in almost every area, the fishery was a complete failure. Many crab fishermen, particularly former 'highliners', were forced to sell their fishing gear and abandon the fishery completely. As a result, the offshore areas, 13, 15, 18 and 19 (Fig. 1), were virtually unfished.

In the Northern Zone catch rates were reduced over 1984 levels reflecting the trend first reported in 1984 (Taylor and O'Keefe 1985).

A positive development in the fishery was the beginning of fishing in Labrador and Fortune Bay and the recommencement of fishing activities in Placentia Bay.

Leslie analysis for most areas of the Southern Zone were not possible for several reasons. Extremely low levels of effort in many areas meant the fishery had virtually collapsed; once again logbook data are extremely unreliable; and, soft-shelled crabs were landed in large numbers from all areas of the Southern Zone, artificially inflating CPUEs and keeping them relatively constant for prolonged periods.

In the Northern Zone, although Leslie analyses are possible for several areas, it is felt that they are extremely unreliable. Resource Management Branch issued supplementary crab licenses to full-time fishermen having vessels from 35 to 64 ft in length. A trap limit of 150 was set and the fishing season was restricted from August 15-October 15. Unfortunately, logbooks were not provided to these fishermen, 42 of whom actively prosecuted the fishery so catch/effort details on this aspect of the fishery are not available despite landings of crab (Table 1).

Materials and Methods

Catch/effort data from fishermen's logbooks were analyzed and data for each management area compared to processors' sales slips in order to check their veracity. From these data biweekly catch/effort tables were constructed in order to determine whether Leslie analyses were feasible.

In addition to an examination of catch/effort data several research cruises were conducted using standard crab traps fished at randomly selected locations on the commercial fishing grounds in the Southern Zone. Catches were analyzed and size-frequency/shell condition histograms for various management areas were drawn. These histograms have been compared to those based on 1984 data and presented in Fig. 2 (Area 16), 3 (Area 18), and 4 (Area 25). Similarly, in areas where research cruise data are not available comparative size-frequency/shell condition histograms have been compiled using data obtained from port sampling. Only one area, Area 30, was sampled both in 1984 and 1985 and the size-frequency/shell conditions are illustrated in Figure 5.

Results and Discussion

As previously mentioned the fishery in the Southern Zone has virtually collapsed. In all offshore areas except Areas 10 and 12, CPUE has become so low that it is uneconomical for fishermen to prosecute the fishery (Table 2). Extremely low effort levels, the restriction of this effort to near shore areas and landing of soft-shelled crabs made Leslie analysis impractical for all areas except Bonavista Bay (Area 25).

In Bonavista and Conception Bays, the complete relaxation of soft-shell regulations resulting in artificially high CPUEs during the latter half of the season, made standard Leslie analyses for these areas impossible. Fortunately examination of logbooks and information gained from processors enabled the authors to pinpoint the exact date that significant quantities of soft-shelled crabs from Bonavista Bay were accepted for processing. Plant sampling conducted within 10 days of this date indicated that 57% of the landings were soft-shelled. Biweekly landings figures were reduced by this percentage from the period of July 28-August 10 onward and Leslie analysis for Area 25 was carried out using these revised figures (Fig. 7). The authors recognize that the percentage of soft-shelled animals would decline over the fishing season as animals recovered to the hard-shelled condition, but assume that the proportion of within-season recruits remains constant.

Effort levels in Conception Bay were extremely low in comparison with other years (half that of 1984), while mean CPUE again decreased (Table 2). Although processors accepted soft-shelled crabs for most of the fishing season, landings were so sporadic and small that a plant sample could not be obtained in order to determine the percentage of soft-shelled landings. Therefore catch/effort data for Conception Bay are not suitable for Leslie analysis.

Only three other areas in the Southern Zone experienced significant effort and landings; Areas 8, 10 and 12. While Areas 8 and 12 showed significant decreases in landings, effort and $\bar{X}$ CPUE, effort and landings increased in Area 10 while CPUE decreased slightly (Table 2). Unfortunately, these areas also had a large number of soft-shelled animals landed during most of the fishing season, thus precluding the utilization of Leslie analysis.

Recruitment

The abundance of soft-shelled animals on the fishing grounds in many areas of the Southern Zone (Areas 8, 10, 12, 14, 16, 22 and 25) indicate that yearly recruitment continues to occur. It is apparent, however, the current recruitment levels are not sufficient to sustain viable catch rates. It is now patently obvious that effort in Areas 8, 10, 12, 16, 22 and 25 should be reduced in an attempt to stabilize the fishery. It has been demonstrated in previous assessments where Leslie analyses have been possible that exploitation rates have been excessive for several years and in the short term at least, this overexploitation has rendered the fishery non-viable.

Water Temperature

Water temperatures on the commercial crab fishing grounds of Area 18 became cooler in 1982 and have remained quite cold until the present time. An exception is July of 1984 when bottom temperatures rose to -0.75° (Fig. 6). Taylor et al. (unpublished data) postulated that the continuous cold water temperatures experienced since 1982 resulted in a recruitment failure causing a rapid decline in catches with no apparent recovery. A research cruise conducted during June of 1985 discovered large numbers of soft-shelled and newly hardened crabs indicating that growth and recruitment had taken place during the winter and spring of 1985 (Fig. 3). We postulate that this molting activity is a direct result of the rise in temperature in July 1984, which caused these animals to enter the molting phase. Unfortunately water temperatures in this area during 1985 reached an all time low (Fig. 6) and it is possible that molting activity was again negligible.

Size-frequency/Shell Condition Distributions

Examination of size-frequency/shell conditions for areas 16 and 25 (Fig. 2 and 4) reveal that the proportion of large animals in both areas in 1985 are reduced from 1984. All areas show that recruitment levels are being maintained which is particularly gratifying in the case of Area 18 (Fig. 3). During 1984 there was virtually no recruitment in Area 18. However, while there is still a paucity of commercial-size animals in this area, it is encouraging that this population has maintained the ability to rebuild itself under favorable environmental conditions.

Reproductive Capacity

Research cruises were conducted in three areas (16,18 and 25) during 1984 and 1985. Samples of females were collected using small meshed traps and examined both internally and externally in order to determine their reproductive status. Results of those examinations are summarized and presented in Table 5.

Despite high exploitation rates in all areas, it would appear that the reproductive potential of the stocks is being maintained. The percentage of berried females has been maintained in areas 16 and 25 and only reduced by 10% in area 18. Of particular interest is the increase during 1985 of the percentage of females having new spermatophores indicating that they had molted during the spring. Also noteworthy is the high percentage of primiparous females in Bonavista Bay during 1985.

Northern Zone

CPUE declined in all areas of the Northern Zone and landings decreased in all areas except Area 40 which was first fished in 1984 (Table 3). Fishermen's log books indicated that all areas experienced large numbers of soft shelled animals during the summer months. While it appears that recruitment mechanisms are operating normally, it is becoming evident that yearly growth and recruitment are not sufficient to maintain catch rates in the face of such heavy fishing pressure. Comparison of size-frequency distributions for 1984-85 from port sampling in Area 30 shows a marked decrease in the proportions of large animals after only three years of fishing activity (Fig. 5). This

is despite the fact that two fishermen landed large quantities of crab from a previously unfished area.

Biomass estimates based on Leslie analyses of catch-effort data extracted from full time fishermen's log books indicate that biomass has declined from 1984 levels in Areas 32, 34, 36 and 38 (Fig. 8, 9, 10 and 11). As stated previously, these biomass estimates are to be viewed cautiously as they do not account for the landings and effort of the 97 vessels issued supplementary licences. These vessels provided the full time fleet with a great deal of competition for commercial fishing grounds, particularly in the near shore areas. In Areas 34, 36 and 38 this competition was particularly fierce. Several full time crab fishermen disillusioned by lower catch rates and competition for grounds they had always considered their own preserve, abandoned the crab fishery midway through the season and prosecuted the otter trawl fishery.

Supplementary Fishery

A total of 166 supplementary licences were issued in Areas 3K, 2J and 3Ps. These licences accounted for 1465 t of landings, mostly from 3K and 3Ps (Table 1). Fishermen were limited to 150 traps and a two month fishing season beginning August 1 in 2J, August 15 in 3K and September 1 in 3Ps. Fishermen in 2J fared poorly in the inshore areas and had low catch rates of commercial crab combined with a high proportion of soft shelled animals which were not accepted by the processor in the area.

Effort by the supplementary licences in 3K was evenly distributed over the area. Catch per vessel varied greatly although most fishermen claimed that the crab they landed "saved" their season. Although resource management instructed supplementary licencees not to fish in Area 36, this edict appears to have been ignored.

Most of the landings in 3Ps were from Placentia Bay, an area that had been fished by full time crab fishermen until 1976. Here too, fishermen reported large numbers of soft shelled animals, however, it is not known whether these animals were accepted by processors.

Resource management was advised by the senior author that given the high exploitation rates already experienced in all areas of 3K, supplementary licences should not be issued unless landings by the traditional fleet were reduced to offset the negative effects that increased fishing pressure would have on the stocks. Unfortunately this advice was ignored. Further, it is regrettable that log books were not issued to the supplementary licencees as it is impossible to determine where their effort was concentrated for purposes of Leslie analyses.

Experimental Fishery - Labrador

In August two large Southern Zone vessels were subsidized by DFO Development Branch to encourage fishing of a newly discovered snow crab concentration approximately 70 miles off the Labrador coast. Fishing was conducted from August 19 to October 1 with encouraging results. Each vessel made 16 trips to the fishing grounds and landed 311 t between them averaging 15.2 kg/trap haul (Table 3). The outlook for this area is

quite promising. One of the fishermen conservatively estimates the available fishing grounds at 500 sq. n mile.

As a result of their success, there is considerable pressure from Southern Zone fishermen attempting to presuade DFO to allow them to fish off Labrador in 1986.

Summary

The crab fishery in almost all management areas of Newfoundland continued to decline during 1986 particularly in the southern zone where traditional fishing grounds were abandoned because of reduced catch rates (Table 4). Landings, CPUE and effort were markedly reduced in the Northern Zone and with the introduction of 97 supplementary licences in August 1985, the prognosis for this zone is not good.

The discovery of large quantities of commercial sized crab in Labrador and the reopening of the fishery in Placentia Bay are promising aspects of an otherwise dismal year.

References

Taylor, D. M. and P. G. O'Keefe. 1985. Analysis of the snow crab (Chionoecetes opilio), fishery in Newfoundland for 1984. CAFSAC Res. Doc. 85/93.

Table 1. Landings of snow crab by supplementary crab licensed vessels.

Area	Licensed Vessels	Landings (t)
3K	97	853
2J	5	10
3Ps	64	602
TOTAL		1465

Table 2. Summary of statistics for the Newfoundland Snow Crab fishery, 1979-85.

Area	Year	Effort (trap hauls)	Landings (t)	CPUE kg/trap haul)	Estimated biomass (t) (confidence limits)	Exploitation rate (%)
8	1979	1,260	8	6.7	-	-
	1980	-	-	-	-	-
	1981	11,150	168	15.0	-	-
	1982	48,350	506	10.5	551 (500-646)	92
	1983	37,780	274	7.3	341 (306-409)	80
	1984	35,400	264	7.5	-	-
	1985	23,300	164	7.1	-	-
10	1983	3,080	43	13.9	-	-
	1984	18,700	175	9.4	-	-
	1985	44,890	385	8.6	-	-
12	1980	13,825	292	21.1	377 (311-728)	78
	1981	45,455	854	18.9	1291 (1114-1639)	66
	1982	49,975	732	14.7	974 (938-1017)	75
	1983	99,280	955	9.6	1045 (948-1316)	91
	1984	135,883	1068	7.9	-	-
	1985	86,937	627	7.2	-	-
13	1982	7,295	114	15.6	-	-
	1983	61,089	733	12.0	-	-
	1984	41,080	397	9.7	592 (501-790)	67
	1985	-	-	-	-	-
14	1979	37,950	762	20.1	1095 (891-1681)	70
	1980	5,860	121	20.6	-	-
	1981	27,113	434	16.0	614 (506-1043)	71
	1982	32,320	465	14.4	-	-
	1983	23,165	190	8.2	209 (181-260)	91
	1984	17,340	93	5.4	119 (96-275)	79
	1985	12,710	64	5.0	-	-
15	1981	18,128	404	22.3	-	-
	1982	66,949	1056	15.8	1861 (1465-3024)	56
	1983	1,320	138	10.5	-	-
	1984	-	-	-	-	-
	1985	1,140	6	5.7	-	-
16	1979	28,845	464	16.1	1351 (951-3204)	34
	1980	56,393	869	15.4	1571 (1214-2890)	55
	1981	43,546	502	11.2	689 (619-747)	73
	1982	60,753	694	11.4	1073 (951-1255)	65
	1983	64,175	564	8.8	-	-
	1984	52,330	333	6.4	-	-
	1985	26,060	139	5.3	-	-

Table 2. (Cont'd.)

Area	Year	Effort (trap hauls)	Landings (t)	CPUE kg/trap haul)	Estimated biomass (t) (confidence limits)	Exploitation rate (%)
18	1979	398,939	6870	17.2	14359 (11,778-19,792)	44
	1980	236,417	4944	20.9	14166 (9348-59867)	46
	1981	413,815	6769	16.4	11289 (910-17067)	60
	1982	153,238	1847	12.1	-	-
	1983	71,905	473	6.7	-	-
	1984	38,690	219	5.7	310 (265-402)	70
	1985	10,580	43	4.0	-	-
19	1981	65,978	1840	28.0	-	-
	1982	218,356	4194	19.2	7744 (5983-12022)	54
	1983	150,432	1662	11.0	2016 (1684-2739)	82
	1984	47,845	431	9.0	588 (504-811)	73
	1985	5,955	31	5.2	-	-
20	1979	4,165	67	16.0	-	-
	1980	4,550	59	12.9	-	-
	1981	14,970	110	7.4	-	-
	1982	10,535	65	6.1	-	-
	1983	12,120	72	6.0	-	-
	1984	2,180	17	6.9	-	-
	1985	4,980	19	3.8	-	-
22	1979	56,887	569	9.9	1467 (1011-3233)	39
	1980	58,160	494	8.5	912 (788-1103)	54
	1981	24,782	178	7.2	-	-
	1982	13,755	95	6.9	-	-
	1983	20,065	107	5.3	-	-
	1984	38,240	202	5.3	260 (213-366)	78
	1985	27,560	113	4.1	-	-
25	1979	173,305	1586	9.2	-	-
	1980	191,754	1905	9.9	-	-
	1981	171,685	1376	8.0	-	-
	1982	96,330	905	9.4	1391 (1054-2445)	65
	1983	205,353	1101	5.4	1802 (1434-2914)	61
	1984	248,962	1327	5.3	1434 (1220-1903)	93
	[a]1985	251,720	728	2.9	959 (909-1018)	76

[a]Landings do not include 287 t of soft shelled crab taken after July 28, 1985.

Table 3. Summary of statistics for the Newfoundland Snow Crab fishery (Northern Zone), 1979-85. Data for effort and landings do not include supplementary crab vessels.

Area	Year	Effort (trap hauls)	Landings (t)	CPUE kg/trap haul)	Estimated biomass (t) (confidence limits)	Exploitation rate (%)
28	1983	28,169	387	13.7	-	-
	1984	43,583	444	10.2	583 (498-779)	76
	1985	52,615	433	8.2	-	-
30	1983	163,138	1470	9.0	-	-
	1984	120,628	1019	8.4	2426 (1876-3765)	42
	1985	88,661	630	7.1	-	-
32	1979	46,183	491	10.6	882 (76-1077)	56
	1980	33,261	374	9.9	787 (583-1229)	43
	1981	54,416	650	11.9	1845 (1193-6615)	35
	1982	130,305	1352	10.4	2213 (1605-4284)	42
	1983	88,288	537	6.1	1097 (845-1874)	49
	1984	76,491	502	6.6	1037 (821-1526)	48
	1985	81,139	476	5.9	808 (691-1022)	59
34	1979	11,830	141	11.9	-	-
	1980	7,330	96	14.3	106 (74-273)	91
	1981	19,250	322	16.7	604 (502-792)	53
	1982	51,347	735	14.3	1016 (839-7423)	68
	1983	105,756	1210	11.5	2023 (1632-3023)	60
	1984	173,038	1576	9.1	3092 (2354-5457)	51
	1985	81,655	478	5.9	757 (665-908)	63
36	1979	21,298	156	7.3	383 (265-887)	41
	1980	17,864	158	8.8	276 (218-412)	57
	1981	19,840	230	11.6	504 (403-710)	46
	1982	32,917	418	12.7	-	-
	1983	68,497	583	8.5	1619 (1099-4692)	36
	1984	79,401	524	6.6	-	-
	1985	84,153	386	4.6	685 (533-1114)	56
38	1983	66,123	681	10.3	-	-
	1984	102,102	948	9.3	-	-
	1985	96,796	472	4.9	719 (575-1099)	66
40	1984	11,035	67	6.1	-	-
	1985	40,420	225	5.6	-	-
41	1985	20,419	311	15.2	-	-

Table 4. Summary of performance of Newfoundland snow crab fishery, 1979-84.

Year	Southern Zone Catch (t)	Southern Zone Effort ('000 trap hauls)	Northern Zone Catch (t)	Northern Zone Effort ('000 trap hauls)	Total Newfoundland Catch (t)	Total Newfoundland Effort ('000 trap hauls)
1979	9,426	666	788	79	10,214	745
1980	8,190	527	628	58	8,818	585
1981	12,636	808	1,202	94	13,838	902
1982	10,673	762	2,505	215	13,178	977
1983	9,182	745	4,868	520	14,050	1,265
1984	4,526	679	5,080	606	9,606	1,285
1985	2,673	496	3,411[a]	546	6,084[b]	1,042

[a]Includes Labrador.

[b]Figure does not include landings by supplementary licensed vessels indicated in Fig. 1.

Table 5. Summary of reproductive status of female snow crab, Chionoecetes opilio, in three management areas in Newfoundland, 1984-85.

Area	Year	Month	# in sample	% berried females	Spermataphore type		
					% Old	% New	% Both
16	1984	October	57	99	14	-	86
	1985	November	45	98	7	40	53
18	1984	May	37	100	97	-	3
	1985	June	55	89	42	4	55
25	1984	August	131	99	22	1	77
	1985	August	106	100	8	22	70

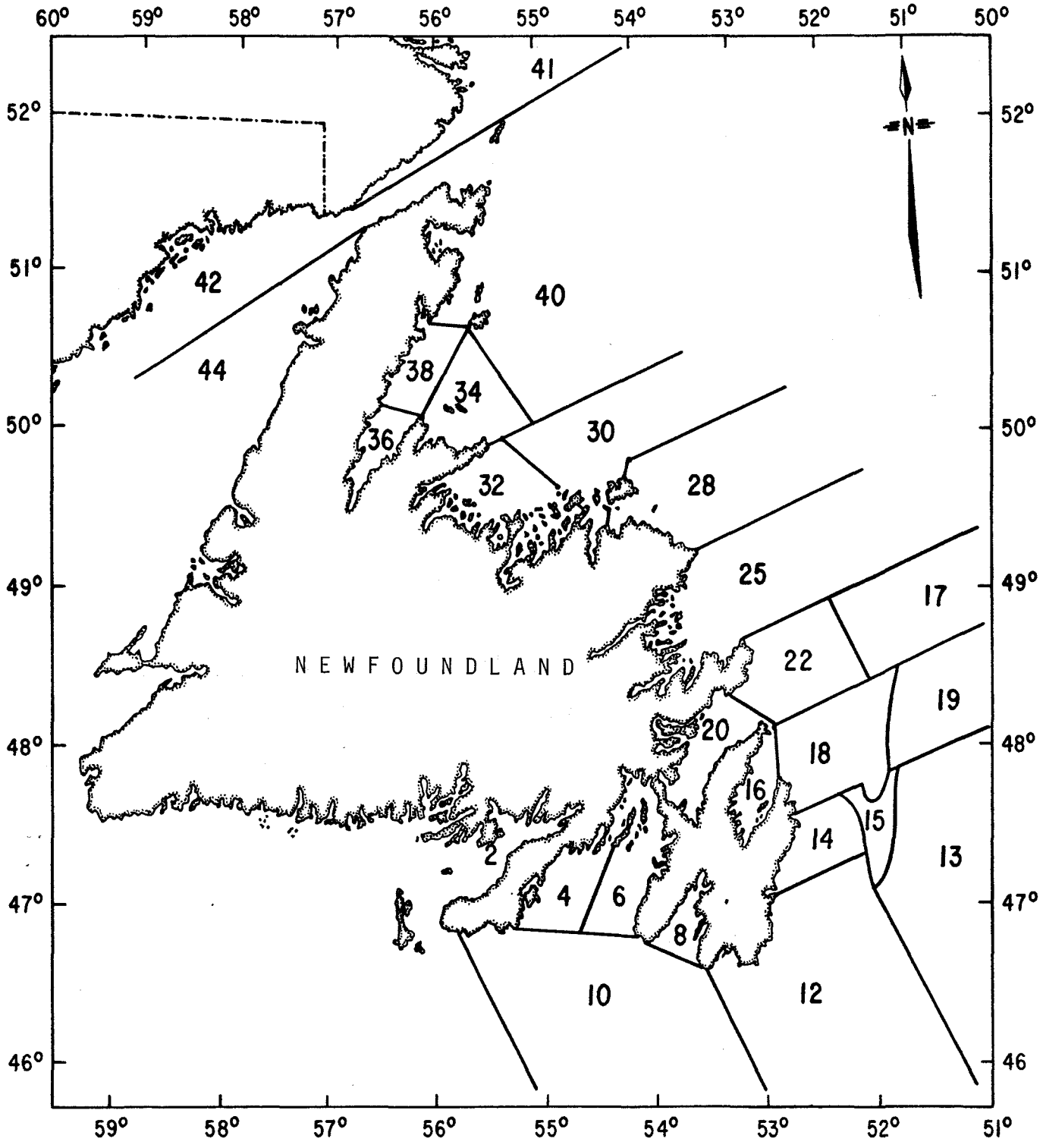

Figure 1. Newfoundland snow crab management areas.

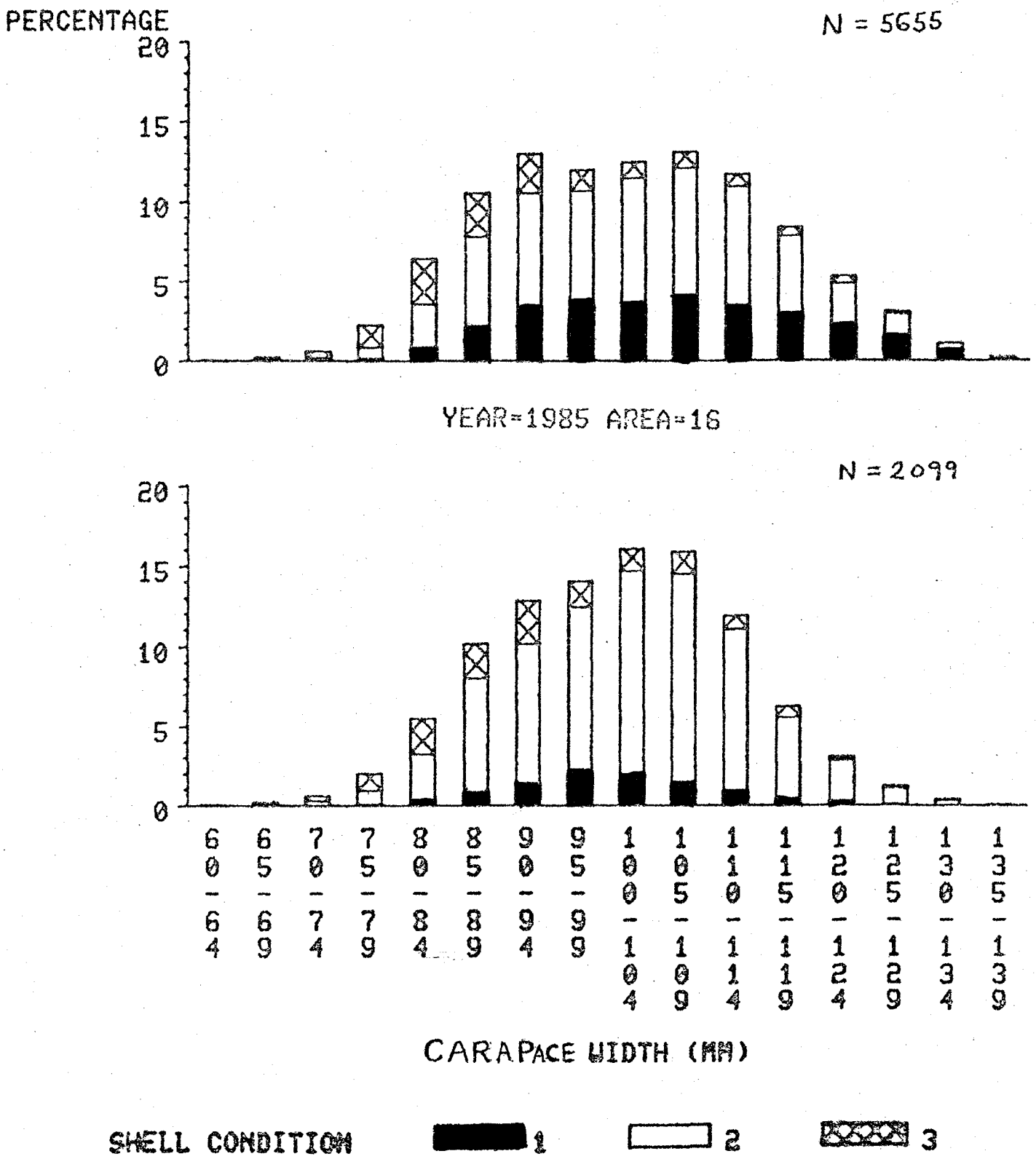

Figure 2. Comparison of size frequency/shell conditions for Area 16, 1984-1985 research sample.

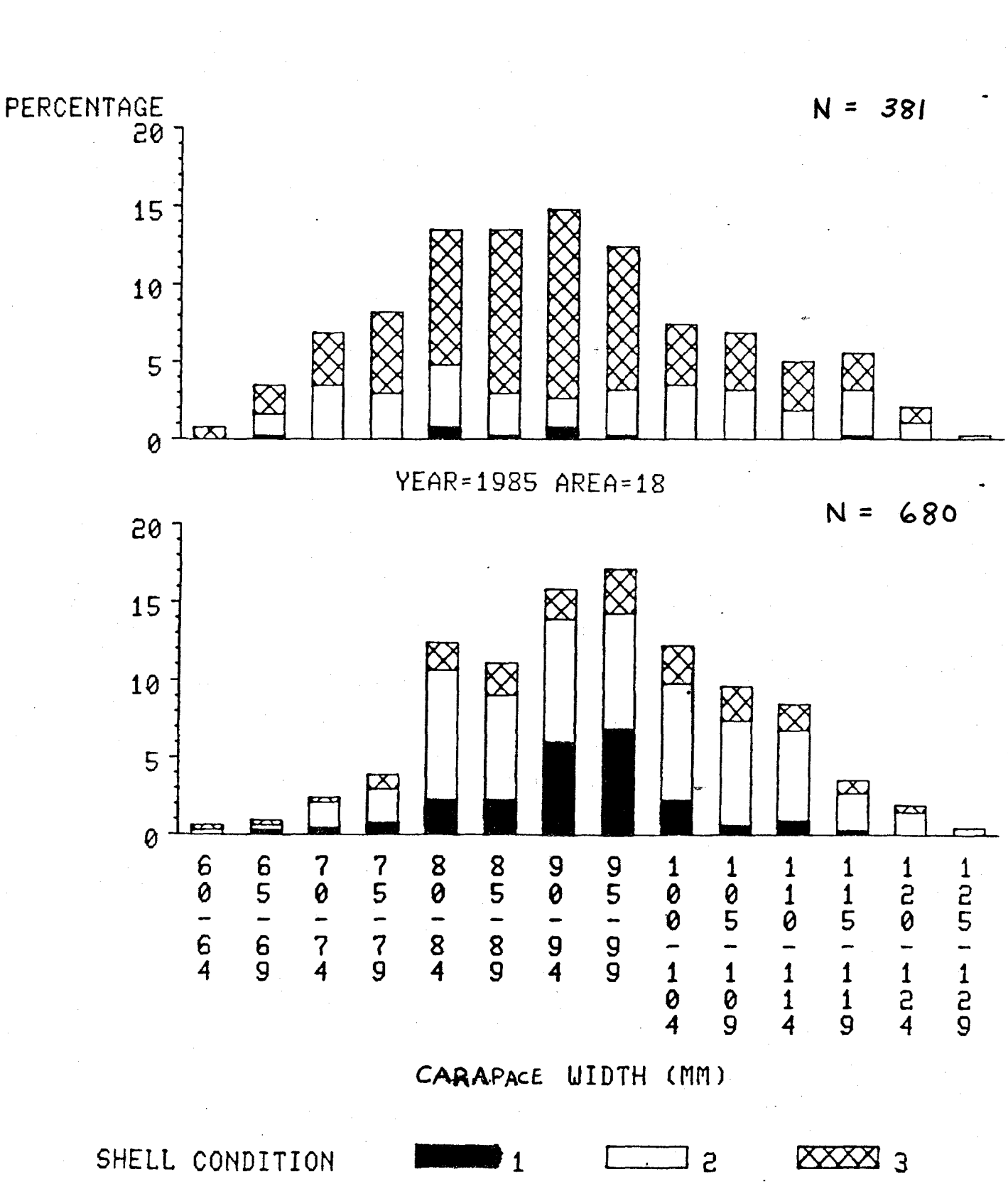

Figure 3. Comparison of size frequency/shell conditions for Area 18, 1984-1985 research sample.

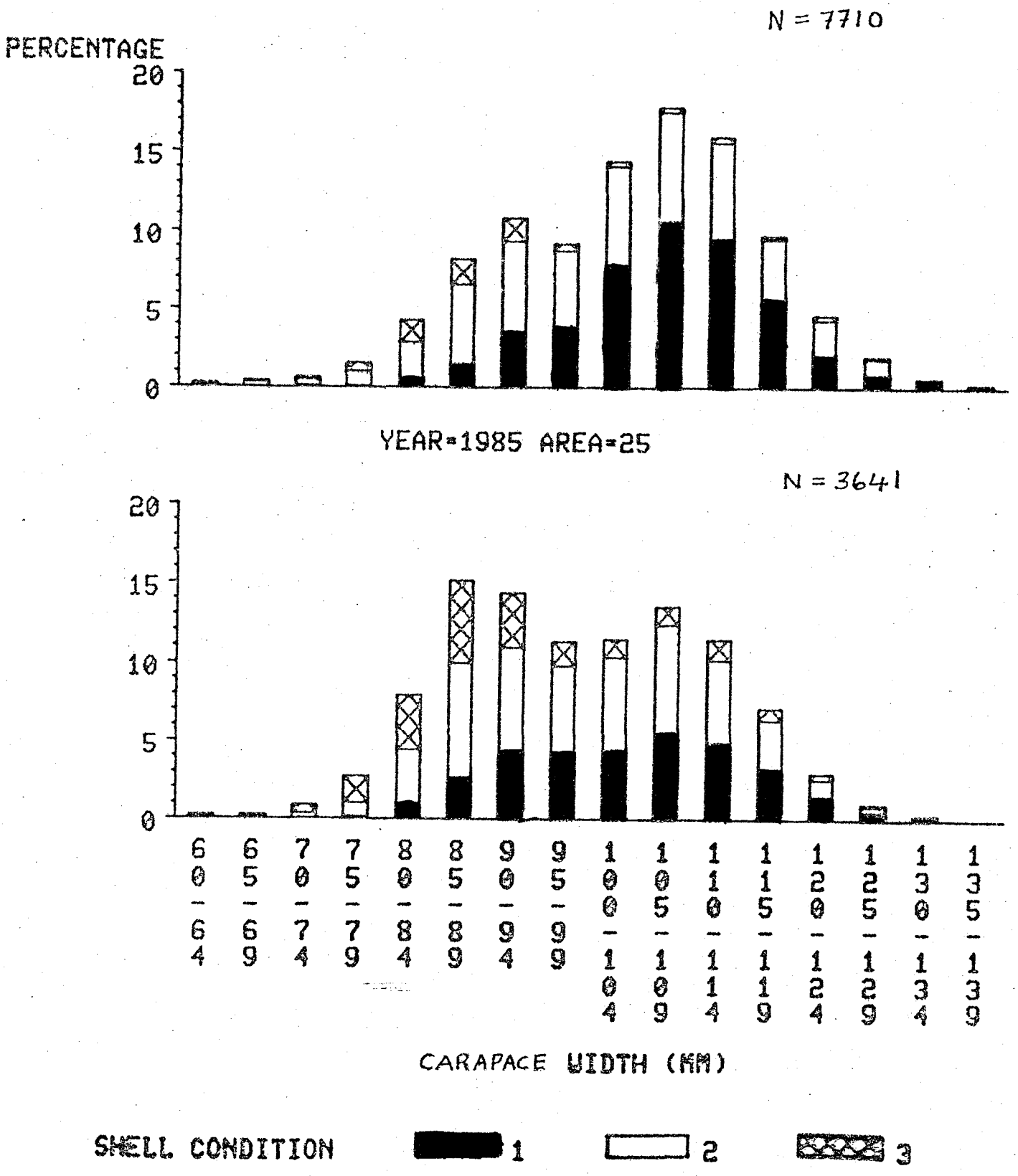

Figure 4. Comparison of size frequency/shell conditions for Area 25, 1984-1985 research sample.

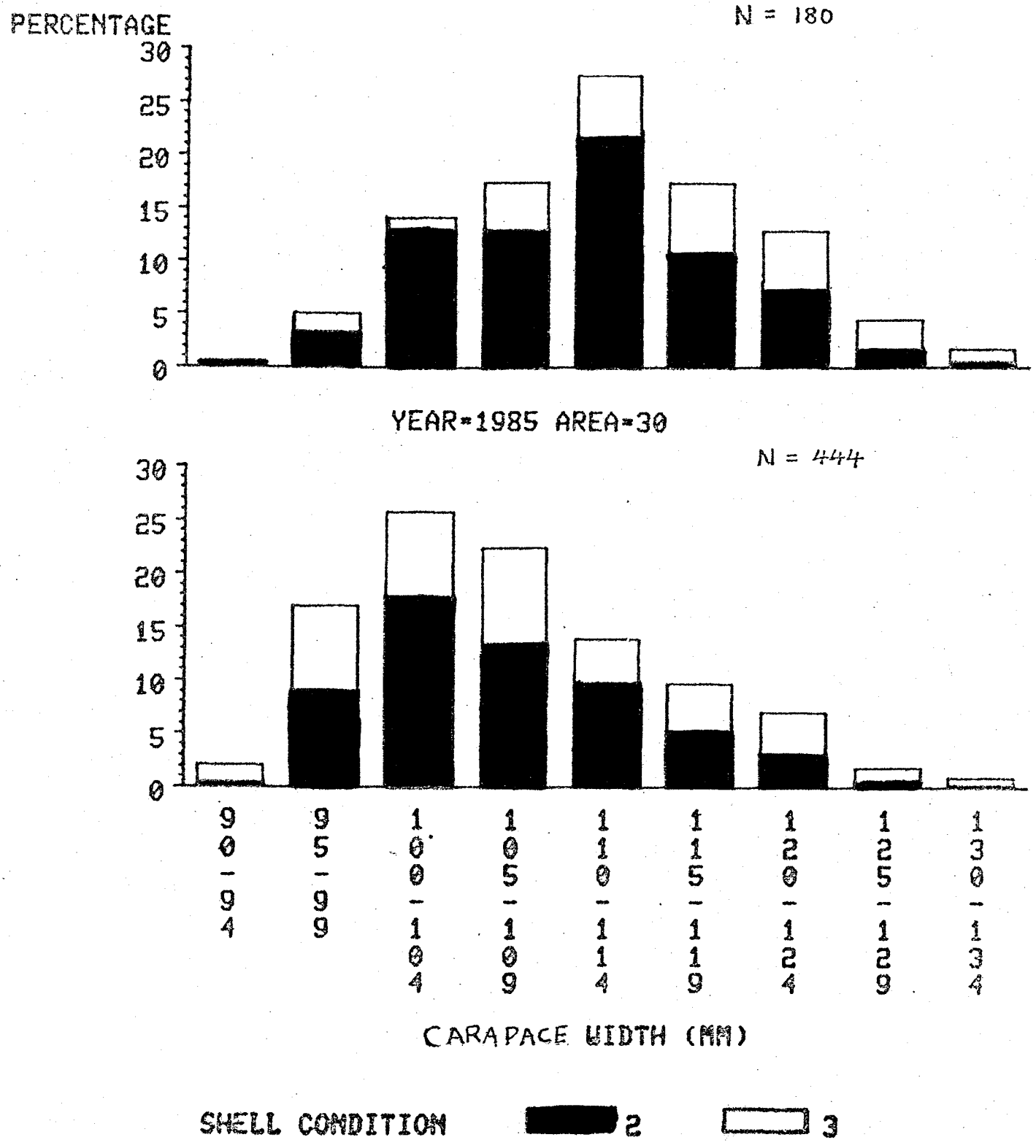

Figure 5. Comparison of size frequency/shell conditions for Area 30, 1984-1985 commercial sample.

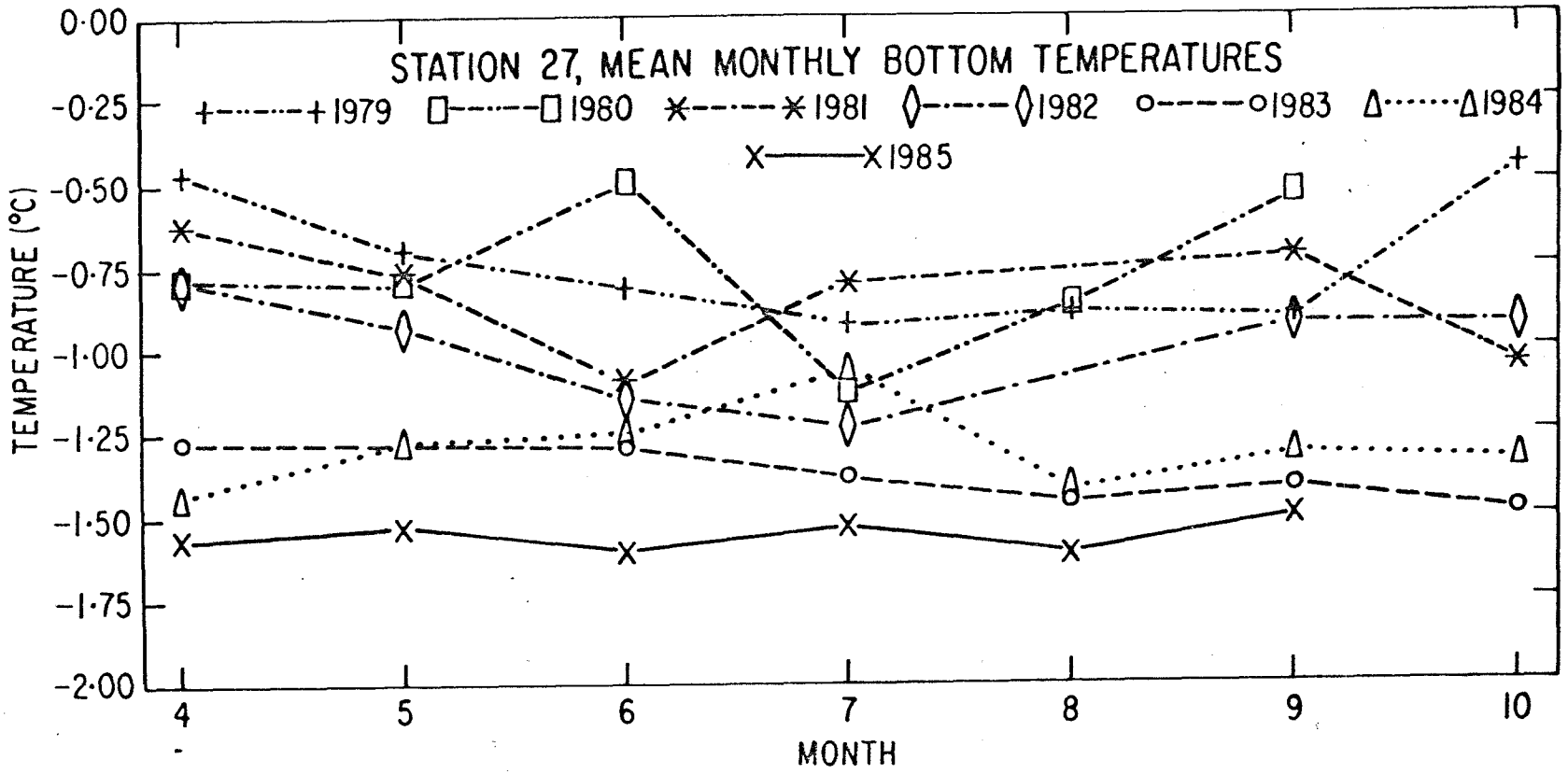

Figure 6. Mean Monthly Bottom Temperatures off St. John's (Area 18) 1979-1985

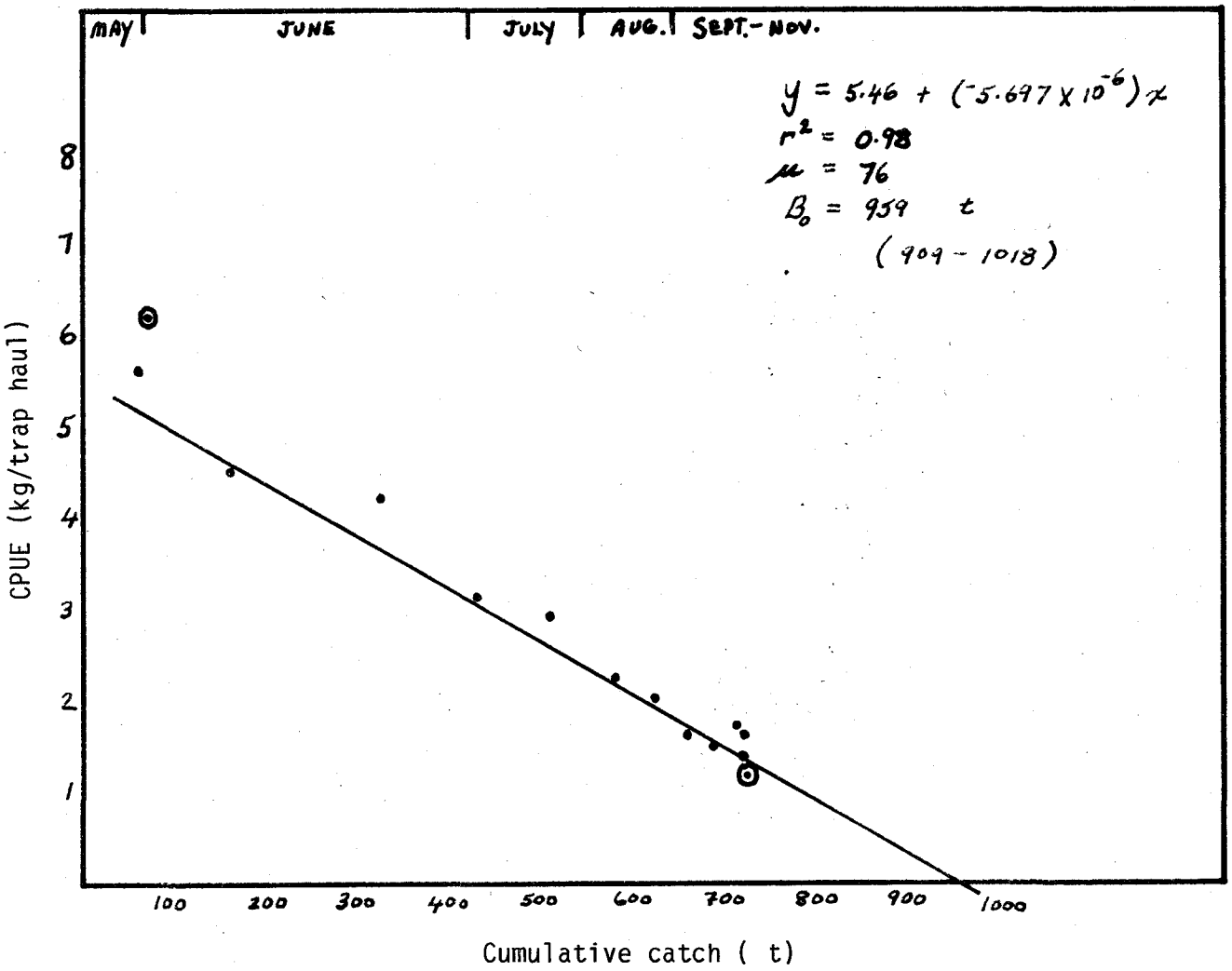

Fig. 7. Leslie graph of biweekly catches of snow crab from Bonavista Bay (Area 25), Newfoundland, 1985.

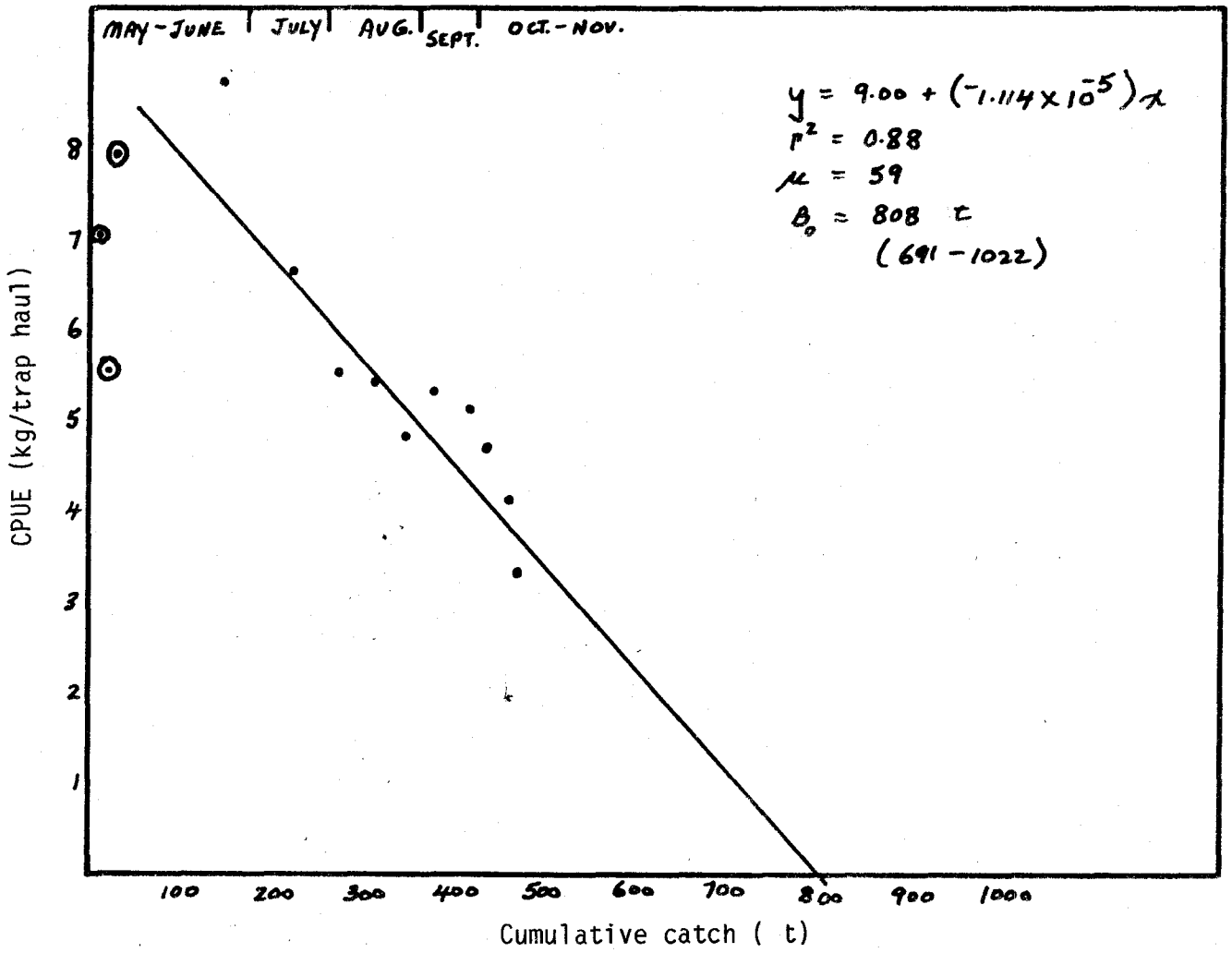

Fig. 8. Leslie graph of biweekly catches of snow crab from Notre Dame Bay (Area 32), Newfoundland, 1985.

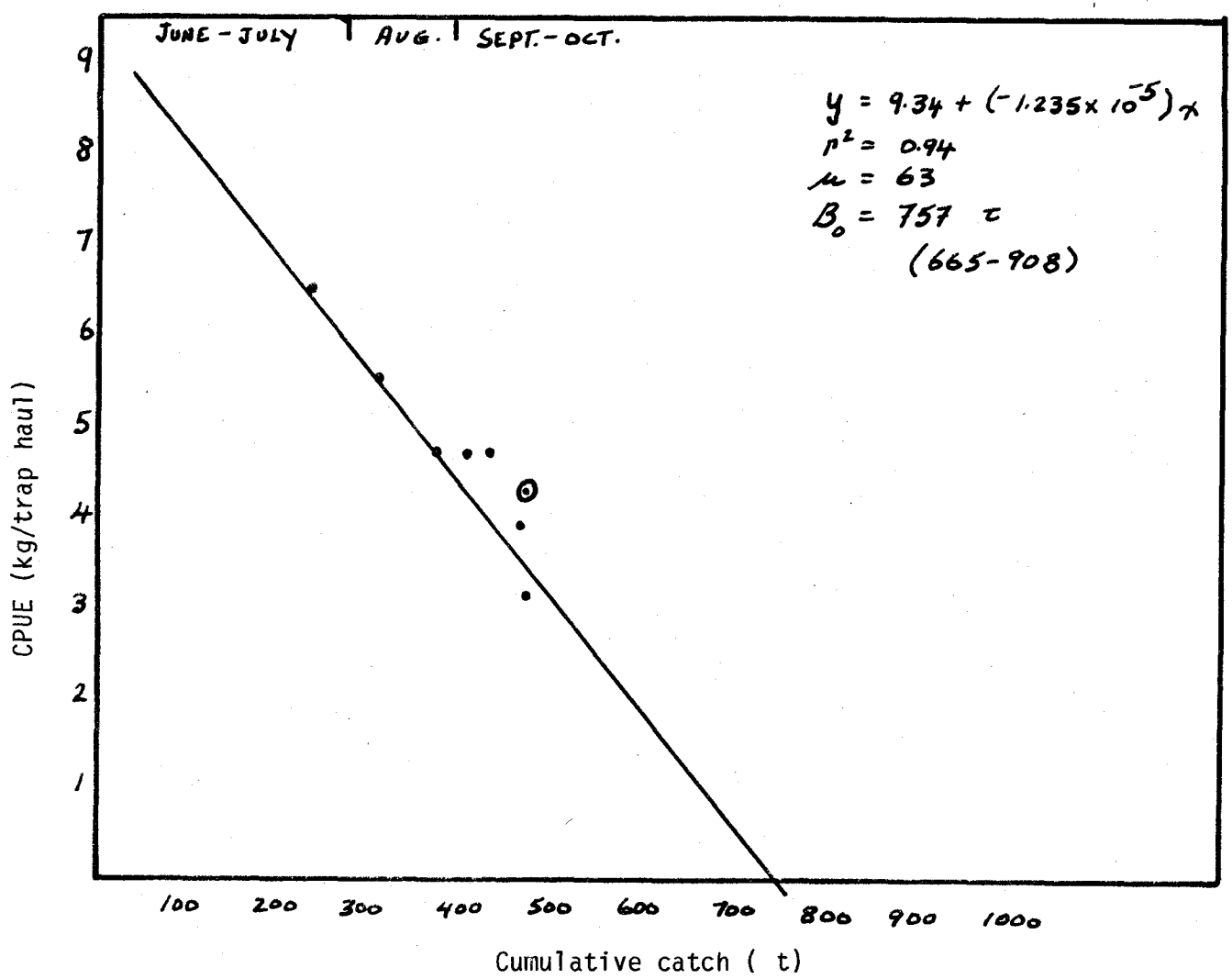

Fig. 9. Leslie graph of biweekly catches of snow crab from Horse Islands (Area 34), Newfoundland, 1985.

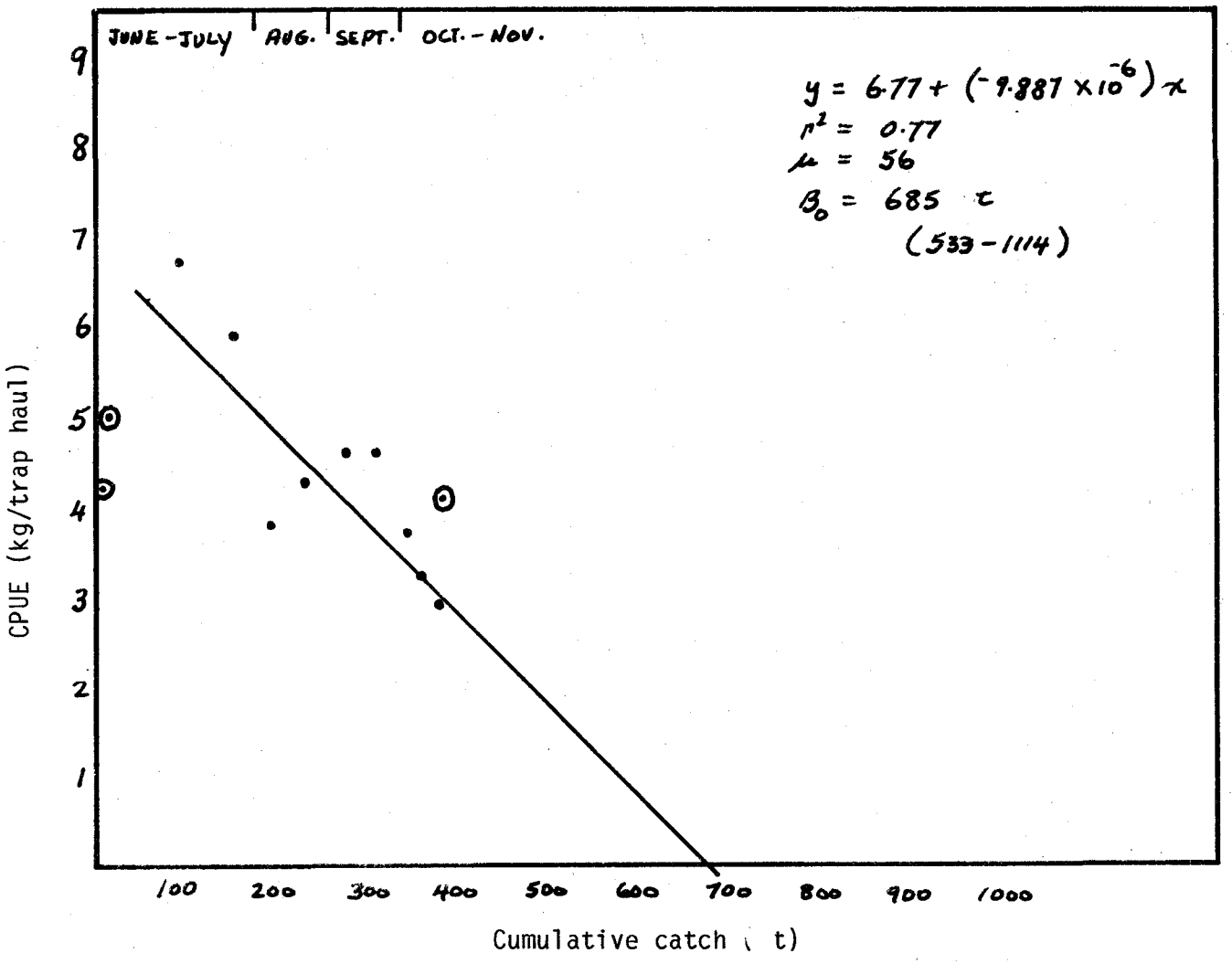

Fig. 10. Leslie graph of biweekly catches of snow crab from White Bay (Area 36), Newfoundland, 1985.

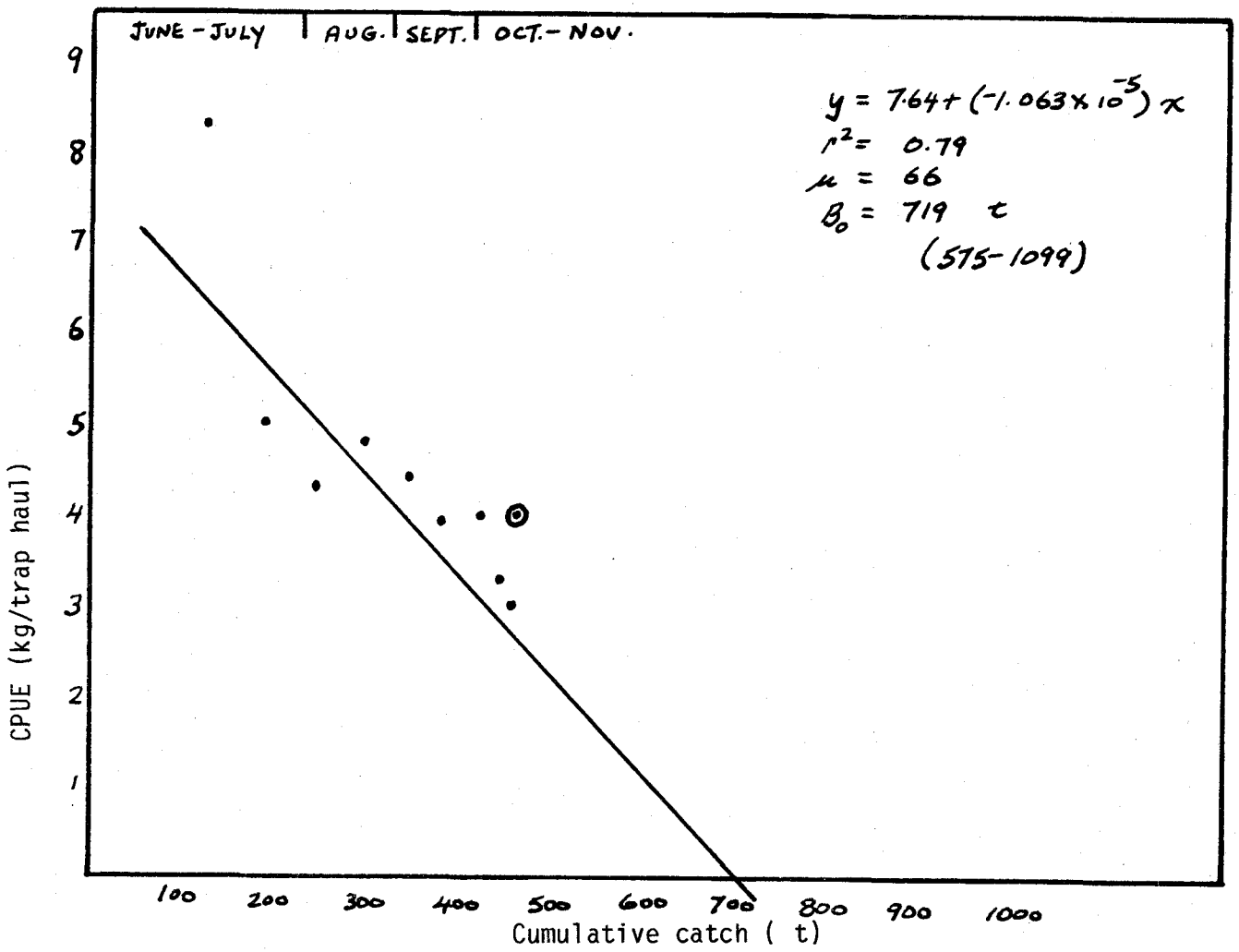

Fig. 11. Leslie graph of biweekly catches of snow crab from Canada Bay (Area 38), Newfoundland, 1985.