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Biological Update for Haddock in Division 4TVW in 1995

by

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ABSTRACT

From reported historical annual landings of as high as 55,000t (1965) and up to 20,000t from 1979 to 1987, this fishery was essentially closed in 1995 with reported total landings of just under 120t. Most of these landings were from Divisions 4VW by longline and otter trawl. The current size composition of this stock shows a relatively narrow range of length-classes.

With the removal of all fishing activity from the closed area in 1993 and a virtual closure of the fishery in 1994, exploitation has fallen to the lowest observed since 1970.

Under the assumption that the maturity schedules have not shifted, the present spawning stock biomass may be as low as 13,000t.

There are indications that the 1993 and 1994 year-classes maybe of above average abundance. These year-classes must be protected to promote stock rebuilding. The reduced exploitation which has been achieved over the past two years, if maintained in the near future, may aid in this rebuilding process.

RÉSUMÉ

De débarquements annuels historiques allant jusqu'à 20 000 t entre 1979 et 1987 et pouvant atteindre 55 000 t (1965), cette pêche a essentiellement été fermée en 1995, le total des débarquements signalés n'ayant pas atteint 120 t. La plus grande partie des prises ont été récoltées à la palangre et au chalut à panneaux dans les divisions 4VW. La distribution courante des longueurs chez le stock indique une plage relativement étroite de classes d'âge.

Suite à l'arrêt complet des activités de pêche dans ces divisions en 1993 et la fermeture en fait de la pêche en 1994, l'exploitation de ce stock a chuté au plus faible niveau observé depuis 1970.

Si l'on s'en tient à l'hypothèse que les régimes de maturité n'ont pas varié, la biomasse actuelle de géniteurs pourrait n'atteindre que 13 000 t.

Des indices portent à croire que l'abondance des classes d'âge de 1993 et 1994 pourrait être supérieure à la moyenne. Il faudrait les protéger pour favoriser le rétablissement du stock. La quasi-fermeture de la pêche pendant les deux dernières années, si elle se poursuit dans un proche avenir, pourrait étayer ce processus de rétablissement.

Description of the Fishery to 1995

Landings averaged 26,500t per year from 1950 to 1969, 5,000t from 1970 to 1979: since then landings have ranged between 8,000 and 20,000t until 1987. The nominal catches for 1987 through 1994, have been taken almost exclusively as by-catch in other groundfish fisheries operating in divisions 4T, 4V, and 4W, and totaled just 120t in 1995 (Table 1). The 1989 nominal catch has been left as provisional due to a large discrepancy between the haddock by-catches reported to NAFO by the former USSR and those reported by the International Observer Program (Zwanenburg, et al. 1994).

The year-round nursery ground closure (mainly Emerald and Western banks) imposed in 1987 still remains in effect. Throughout the 1987 and 1992 period fixed gear vessels were allowed to fish inside the closed area. In 1993 the closed area was closed to all fishing. Since 1987 the fishery has been regulated through a combination of by-catch restrictions and trip limits. In 1995, the fishery was severely restricted and limited to 10% by-catches in hake, cusk, and pollock fisheries, and to 200 lb trip limits in the restricted fixed gear 4Vn cod fishery.

Until 1984, most of the catch from this stock was taken from Division 4W by large otter trawlers (OTBs, TC4 and TC5) in the spring. In 1984, Division 4W was closed to trawlers from May to December to prevent the capture of the abundant early 1980s year-classes. This caused a shift in the fishery to 4Vs. From 1984 to 1986, favourable catch rats resulted in an increase in 4Vs landings to the point where they represented 40-60% of total landings. Following the exclusion of mobile gear from much of Division 4W (as a result of the imposition of the closed area in 1987) landings in 4Vs ranged from 1,500 to 2,500t annually, however landings in this area have declined to just 35t in 1994. Since 1987, landings in 4W increased five-fold (from 991 to 5,261t) due mainly to the development of the fixed gear fishery inside the closed area. In 1993, following the exclusion of all gears from the closed area, landings declined and totaled only 60t in 1995. Landings in Division 4T and Subdivision 4Vn have been negligible since 1989 (Tables 1 and 2).

Given the severely restricted nature of the fishery in the last two years, it is difficult to compare the distribution of landings by gear type with those of previous years. From 1987 to 1993 the proportion of landings taken by trawlers has decreased from 60 to about 50%. In 1995 trawler landings represent about one-third of the total. Longline landings have ranged from 21 to 63% over the period 1987 to 1993 and in 1995 they accounted for 61% of total landings. Seiner landings represented approximately 3% of the total landings in 1994 (Table 3). Most of the fishery occurred in the third and fourth quarters of 1995 (Table 4).

Consultation with inshore fishermen in 4W indicated that the inshore haddock landings have declined significantly in recent years. Although a steady decline in landings has bee noted over the past 15 to 25 years, declines in the past 3-7 years have been relatively precipitous. In addition to this decline in landings, many independent sources report a change in the 'migratory pattern' of the inshore haddock. In past years the haddock would 'come ashore' in waters westward of Country Harbour, Nova Scotia. These fish would then 'migrate' westward throughout the remainder of the summer and fall until the fishermen in the area stopped fishing when the fishery reached Halifax Harbour and approaches. More recently it is reported that the haddock are coming onshore further westward each year, and that the numbers caught has declined substantially. All respondents indicated that these 'inshore haddock' are different from offshore haddock by virtue of colour, shape, taste, and general size composition (larger). We presently have no information by which to judge these observations, but it illustrates our general lack of understanding of inshore resources in general. Plans for cooperative work with the inshore industry to determine the relationship between inshore and offshore haddock are being developed.

The foregoing discussion was not based on recorded information, but rather comes from the memories of the fishermen participants.

Sources of Uncertainty

The preceding estimates of landings do not incorporate estimates of misreporting by area, or non-reporting of catches as a result of dumping or discarding. Unquantified, anecdotal information suggests that such practices have been significant sources of error at a number of times in the past. some of these reports indicate that the amount of dumping and discarding has represented a significant portion of the total reported landings. The effects of these potential errors on catch estimates for the assessment of the status of this resource cannot presently be evaluated.

Composition of the Catch

The age composition of the 1995 landings is not available. Serious concerns have been raised about the accuracy of the ages determined for haddock. A significant bias in the ageing of haddock appears to have been introduced in the early 1980s resulting in over-ageing of young fish in the early 1980s and a subsequent under-ageing of older fish in the late 180s and early 1990s. Resolution of this problem is presently underway through an age validation study and the establishment and implementation of verified and consistent ageing criteria. These studies have progressed to the point where agers are being trained using the newly established and verified ageing criteria. The bias introduced through the historical ageing process will require the re-examination of historical otoliths to revise previous estimates of catch-at-age. A schedule or re-ageing and of ageing backlogged materials from 1989 through to the present has been established, and it is projected that age structured analysis of this resource will recommence during the first half of 1997.

The sampling information available for the 1994 landings is given in Table 5. Landings at length for the haddock by-catch from the foreign small mesh gear fishery were estimated from International Observer Program (IOP) data. For landings prior to 1977 no IOP estimates of length-frequencies were available. In the absence of these data it was assumed that the length frequencies of these landings were similar to those observed in the July research surveys conducted in 4W in the same years (Zwanenburg, et al. 1994).

Estimates of landings at length for 1970-1995 are given in Table 6. Landings at length by the domestic fisheries were estimated using commercial groundfish samples stratified as for the estimation of landings at age outlined in previous documents (see Zwanenburg 1989). The length composition of domestic landings from 1970 to 1978 were estimated as outlined in Mahon et al. (1984).

The landings at length for 1995 shows modes at 22.5, 30.5, 46.5, and 52.5cm (Figure 1). The modes at 22.5 and 30.5cm were the result of catches by the silver hake fishery and likely represent fish from the 1994 and 1993 year-classes, respectively. Landings in all length classes were well below the long-term average (1970-1994).

Sources of Uncertainty

These estimates of length composition of domestic landings do not take into account any at-sea modification to the size composition. There have been reports of discarding and high-grading that cannot be quantified with presently available information. Dumping would tend to result in underestimation of total landings while selective discarding is likely to result in underestimation of removals at the smaller length classes. The overall effects of these potential sources of error cannot at present be quantified.

The estimation of lengths at age and, therefore, the conversion of the landings at length to landings at age depend on the accuracy of the lengths at age used and the distribution of the sizes at any given age. The present estimates are taken from ageing data whose reliability is still being investigated.

Commercial Catch Rates

The restrictive nature of this fishery since 1987 does not allow for a comparison of present catch rates to those of earlier years from directed fisheries. We do not consider that by-catch catch rates are representative of the abundance of this stock.

Research Vessel Survey Results

Catch rates at length for the fall July Research Vessel (RV) survey time series (1970-1995) are given in Table 7.

Summer Surveys

Survey catch rates for 1970-1994 (Figure 2) indicated that overall catch rates declined from 1983-1987 and then fluctuated. Since 1992, survey catch rates have been low and stable. Catch rates in the recruited size groups (36cm and larger) have declined since 1984 (Figure 3). Catch rates of the size-classes representing new pre-recruits (less than 36cm) show peaks in the early 1980s and again from 1988 to 1991 with the incoming 1988 year-class. Catch rates of pre-recruits again increased in 1994 with the incoming 1993 year-class. This resource is centred in Division 4W with much lower catch rates in subdivisions 4Vn and 4Vs (Figure 4).

The long-term average length composition (1990-1994) of Subdivision 4Vn shows modes at 20.5, 32.5, and 50.5cm (Figure 5). Subdivision 4Vn also has the largest mean modal length of the three areas comprising the stock area. It is likely that the 20.5cm mode represents age 1 fish although we cannot rule out a significantly different growth rate for the haddock in 4Vn relative to other parts of the stock area. If growth rates are similar throughout the stock areas, the interpretation of these fish being age 1 would be consistent with the age structured analysis presented in previous assessments. This indicated that the 4Vn population is composed mainly of fish aged 4+ and the age 0 fish have never been observed in the survey of this area. There are anecdotal reports of haddock spawning in inshore areas of 4Vn in years past, however, we have no observations with which to judge these reports. There is no evidence of the large 1988 year-class in 4Vn. The overall catch rates at length in 4Vn in 1995 remain well below the long-term mean.

The long-term mean 91970-1994) catch at length in 4Vs shows modes at 16.5, 28.5, and 42.5cm (Figure 6). These modes are smaller in all cases than those observed in 4Vn. The modes at 16.5 and 28.5cm probably represent fish aged 1 and 2, respectively. Overall catch rates at age were below the long-term average in 1995, however, these were above average catches at model lengths of 22.5cm and 30.5cm. Above average catch rates were also observed at lengths over 54cm.

An above average catch rate at 24.5cm was also noted in the 1994 survey of this area. This differs significantly from the historical average and probably represent the fish observed at 10.5cm in 1993, likely the 1993 year-class. The above average catch rate at 30.5cm in 1995 again represents the 1993 year-class.

Division 4W has traditionally been the centre of distribution of this resource as evidenced by the significantly higher catch rates observed there. Analysis of the long-term catch at length for 4W shows clear modes at 8.5, 20.5, and 32.5cm (Figure 7). The 1995 catch rate at length shows slightly above average modes at 22.5cm and at 30.5cm which are likely the 1994 and 1993 year-classes, respectively. Again we note a shift in the modal length of these cohorts relative to the historical patterns. At 24.5cm in 1994, the 1993 year-class would have been growing relatively faster than the historical average (20.5cm at age 1), while in 1995 it is near the long-term mean modal length of 32.5cm. At 22.5cm in 1995, the 1994 year-class is again showing increased growth rates relative to historical values. Both the 1993 and the 1994 year-classes are of somewhat above average abundance.

The distribution of catch rates at length for 4VW as a whole (Figure 8) shows the relative abundance of the 1993 and 1994 year-classes relative to the long-term average.

Sentinel Survey Results

A sentinel survey was carried out in October of 1995. The survey was a cooperative venture between DFO, Department of Human Resources Development, and the Fishermen and Scientists

Research Society who acted as the sponsor of the survey and whose members participated in the survey. A total of about 220 standardized long-line sets of a planned total of 300 were completed in the course of the survey. Sets were distributed throughout 4VW and stratified on the same basis used for the 4VsW spring survey (Figure 9) with the addition of three inshore strata shoreward of the 50 meter isobath. The survey caught a total of just over 6t of haddock (Table 8). The distribution of these catches was consistent with the distributional patterns of haddock determined from DFO trawl surveys (Figure 10).

The sentinel survey haddock length composition shows that the gear employed (Mustad #12 circle hooks) retained less than 5% of haddock under 36cm while the modal catch was at 42cm (Figure 11). This indicates a very steep selection curve. It also shows that that survey will not provide estimates of incoming year-classes until they reach marketable size-classes.

The results of this single survey are insufficient to allow for conclusions regarding overall stock abundance.

We examined the relationship between bottom temperature and haddock catches for both the sentinel survey and the DFO July trawl survey. Two-way area analysis of haddock catch (numbers) and temperature (SPANS GIS) shows both the proportion of bottom area available at any given temperature and the proportion of that area that is occupied by haddock at any predetermined density. Results for the sentinel survey (Figure 12) show that haddock are being caught over increasing proportions of the area available at temperatures to a maximum of 7°C. It also showed that haddock appeared to be caught at bottom temperatures that were least available in terms of the overall study area. Spatial analysis of the July survey gave qualitatively similar results (Figure 13) except that the July survey caught haddock more frequently at colder temperatures than did the sentinel survey. This may indicate that haddock do occupy a small proportion of these colder bottom waters, but that they do not feed and are therefore no vulnerable to long-line gear.

Analysis of these same data using the temperature weighted cumulative catch method developed by Perry and Smith (1994) show that for the sentinel survey haddock tend to fall below the ambient environmental temperature curve until 6.5-7.0°C and that the rate of accumulation of haddock catches is greater than the rate of temperature accumulation for temperatures of 4-8°C (Figure 14). For the July survey the rate of haddock catch accumulation is roughly similar to the temperature accumulation curve until about 5°C when haddock catches accumulate more rapidly (Figure 15).

These results indicate that haddock prefer to inhabit waters above about 4°C and that although they do occupy small proportions of colder bottom areas, as shown by the July survey results, they do not appear to feed there as evidenced by the results of the sentinel long-line survey.

Biological Indicators

The size ranges of haddock in both commercial landings and surveys have narrowed since 1970 indicating small range of sizes (ages) in the population in recent years relative to the documented history of this resource. A reduction in size range can be indicative of reduced growth rate or of high exploitation rates.

The condition of haddock (plumpness) expressed as the average weight of a fish at 45cm, has decreased by about 10-15% since 1970 (Figure 16). The decline has been most gradual in Subdivision 4Vs, while in Division 4W it declined rapidly during the early 1980s and recovered somewhat before continuing its decline through the early 1990s. Condition factor increases in both 4Vs and 4W in 1995. Long-term declines in condition factor can be indicative of a population under stress from either exploitation or a gradually degrading environment.

Recruitment

The 1995 summer survey indicated that both the 1993 and 1994 year-classes were caught at rates above the 1970-1994 average (Figure 8). Catch rates of these size classes remained above average when compared to the more recent (1970-1994) average (Figure 17). Survey results also indicated that the 1993 year-class in particular was also of above average abundance in Subdivision 4Vs (Figure 6). The occurrence of a year-class in above average numbers in 4Vs is usually indicative of an abundant year-class.

It has been demonstrated that abundant year-classes are more widely distributed than weak ones. Spatial analysis of the 1993 and 1994 year-classes show that, at age 1 (18-24cm) and moderate densities (greater than 50 fish per standard survey tow), they occupy a total area which ranks them well below the area occupied by the early 1980s year-classes, but that they are the most widely distributed year-classes since the large 1988 year-class (Figure 18). Spatial analysis of the 1993 year-class at age 2 (28-32cm) shows that it occupied a larger area moderate densities then the 1988 year-class at the same lengths (Figure 19). These analyses indicate that the distributional patterns of the 1993 cohort in particular is consistent with that of a relatively abundant year-class.

Catches of haddock in the foreign small-mesh gear fisheries give another indication of incoming recruitment in that they catch fish at lengths which are not yet recruited to the domestic fishery (Figure 20). Comparison of both the 1994 and 1995 small mesh gear haddock catch rates at length to the long-term (1978-1993) catch rates in these fisheries indicate that the 1993 year-class was caught at slightly below average rates (Figure 21). It is somewhat problematic to compare the long-term catch rates to more recent catch rates since there has been both a gear change (introduction of the Nordmor grate in 1993) and the seaward relocation of the landward boundary of the small mesh gear box in 1995. Although it seems clear that these measures have had a significant impact on catch rates of haddock greater than 34cm, their effect on catch rates of small haddock are as yet undefined.

Spawning Stock Biomass

Earlier assessments of this resource indicated that the probability of producing a large year-class is related to the general level of spawning stock biomass (Mahon, et al. 1985). At a spawning stock biomass below 16,000t the probability of producing an above average year-class is considered low. At present spawning stock biomass estimated from surveys is on the order of 13,000t (Figure 22). This estimate was derived from survey catch rates at length converted to weight and assumed knife-edged maturity at 43cm. If the maturity schedule of this stock has shifted to maturing at younger ages, these would obviously be underestimates of overall SSB.

Prognosis

The overall abundance of this resource remains below the long-term average as indicated by the results of survey data. Spawning stock biomass, as indicated by the biomass of 43cm and larger fish is presently low, however there are signs that moderate year-classes have been produced in recent years (1992-1994). These year-classes must be protected to promote stock rebuilding. The reduced exploitation which has been achieved over the past three years, if maintained in the near future may aid this rebuilding process by allowing fish to realize their full growth and reproductive potentials.

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Table 1. Nominal catches (t) of eastern Scotian Shelf haddock (4TVW) by NAFO Division and country as reported to NAFO (from NAFO Statistical Bulletin).

	4T					4Vn*					4Vs					4W						
Year	Can.	USA	USSR	Spain	Other	Can.	USA	USSR	Spain	Other	Can.	USA	USSR	Spain	Other	Can.	USA	USSR	Spain	Other	Total	TAC
1954	5918	1044			40	5549	405		1058	24						12323	1956		17		28334	
1955	3101	31				3339	450		1183	13						12777	1217				22111	
1956	2861					4899	147		1350	12						18273	1661		354		29557	
1957	1740	1				5869	120		747	9						19960	1533		132		30111	
1958	2599			151		3166	71		1343	6						17572	427		1593		26928	
1959	2996	1		64		1594	159		69		3456	111		2870		21156	4804		640		37920	
1960	2041					1317	6		97		1187	18		3926	1	20093	127		1024		29837	
1961	1297			273	2	1055	1		47	1	846			1526	7	22277	23	151	1441	16	28963	
1962	1132			10		1097	1		5	2	1235			1076		15566	51	2567	3224		25966	
1963	1019			46		1213	1	6	64		1061	1		2828	195	11002	60	3295	4915	866	26572	
1964	461			1		958			59	52	677	11		2057	2	9810	42	4391	2884	1889	23294	
1965	432			3	3	402			53	84	1201			1806	47	7007	8	42876	1500	96	55518	
1966	149			1		311		516	30		1494			940	9	8259	19	9985	1885	51	23649	
1967	112			9		203		95	26	31	898			839	9	7180	5	459	1046		10912	
1968	144				4	127			70	6	1128		59	1702	23	8392		195	1458	10	13318	
1969	167				3	245				112	726			631	66	8270		235	864	1	11320	
1970	160					395	2		75	1	620		34	830	16	4754	574	636	1332		9429	
1971	151					466			215	1	1133		11	1114		7940	497	464	1477		13469	
1972	60					362	3		136	19	421		3	599	37	2096	70	103	737	102	4748	
1973	21				2	286			76	164	233			431	9	2830	173	76	95	18	4414	
1974	17				14	161			3	1	147		30	174	196	907	6	102	521	78	2357	0
1975	35				2	67			15	4	107	1		48	3	1393	20	52	63	59	1868	0
1976	12					40				1	52	1	9		1	1198	31	15			1360	2000
1977	8					189				8	144				1	2845	1	14		38	3248	2000
1978	18					119				3	441		3		38	4949	82	139		109	5901	2000
1979	59					194				11	650				2	2339		104		73	3433	2000

Table 1. (Continued)

	4T					4Vn+					4Vs					4W						
Year	Can.	USA	USSR	Spain	Other	Can.	USA	USSR	Spain	Other	Can.	USA	USSR	Spain	Other	Can.	USA	USSR	Spain	Other	Total	TAC
1980	81					188				42	1841					12448		209		31	14840	15000
1981	177					119				25	1796					17684		187		21	20009	23000
1982	47					183				23	2373					12498		53		49	15226	23000
1983	30					206				17	1542					7302		149		166	9412	15000
1984	120					299				11	3195		2		1	3992		168		233	8021	15000
1985	498					598				59	7291				2	2862		275		79	11664	15000
1986	531					904				17	8798				4	6277		312		78	16921	17000
1987	438					484				13	1587					994		207		154	3877	0
1988	369					507					2057					1176		332		99	4540	0
1989	80					425				2	3108					3582		1754		177	9128	6700
1990	33					108					2429					4077		265		97	7009	6000
1991	18					51					984				1	3824		292		59	5229	0
1992	9					27					778					5154		42		116	6126	0
*1993	4					9					434					730		27		55	1259	0
*1994	1					9					35					41				12	98	0
*1995	0					1					57					35				26	119	0

+ = Between 1954 and 1958 catches for 4Vn and 4Vs were combined as 4V.
* = Provisional data.

Table 2. 4TVW haddock landings (t) by division and subdivision (Canadian catches only from inter-regional data).

Area	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
4T	553	453	383	79	30	12	9	4	0	0
4Vn	899	491	506	421	108	52	27	11	9	1
4Vs	8719	1547	2041	3114	2427	975	776	435	35	57
4W	6170	991	1150	3580	4078	3999	5261	824	48	35
TOTAL	16341	3481	4080	7194	6643	5038	6074	1275	92	94

Table 3. 4TVW haddock landings by quarter and major gear type 1986-1995 (Canadian landings only).

Gear	1986					1987				
	Q1	Q2	Q3	Q4	TOTAL	Q1	Q2	Q3	Q4	TOTAL
OTB	3072	4158	3661	3060	13952	356	680	608	433	2077
LL	86	203	535	281	1105	34	135	377	190	736
SNU	121	483	349	226	1179	5	370	175	34	585
Other	1	14	65	26	106	0	19	40	24	83
TOTAL	3280	4858	4611	3592	16341	396	1203	1200	682	3481

Gear	1988					1989				
	Q1	Q2	Q3	Q4	TOTAL	Q1	Q2	Q3	Q4	TOTAL
OTB	266	852	777	447	2341	763	2022	1062	487	4332
LL	33	177	721	204	1134	285	522	858	657	2322
SNU	11	199	197	17	424	14	283	150	28	475
Other	7	63	53	57	180	0	16	34	14	64
TOTAL	317	1291	1747	725	4080	1062	2842	2104	1186	7194

Table 3. (Continued)

Gear	1990					1991				
	Q1	Q2	Q3	Q4	TOTAL	Q1	Q2	Q3	Q4	TOTAL
OTB	1092	957	664	258	2971	338	569	396	410	1713
LL	838	474	1341	497	3149	439	668	1413	651	3171
SNU	15	168	223	11	417	3	78	16	6	104
Other	0	7	64	35	106	1	17	34	4	55
TOTAL	1945	1606	2292	800	6643	782	1332	1859	1071	5043

Gear	1992					1993				
	Q1	Q2	Q3	Q4	TOTAL	Q1	Q2	Q3	Q4	TOTAL
OTB	1323	514	217	218	2272	95	140	121	18	374
LL	615	660	1400	855	3530	27	171	597	45	841
SNU	1	123	85	37	246	0	27	20	7	53
Other	0	1	14	12	26	0	0	6	1	7
TOTAL	1939	1299	1716	1121	6074	123	337	743	72	1275

Table 3. (Continued)

Gear	1994					1995				
	Q1	Q2	Q3	Q4	TOTAL	Q1	Q2	Q3	Q4	TOTAL
OTB	15	6	18	6	45	11	4	5	11	31
LL	2	8	25	4	39	2	8	37	11	58
SNU	0	2	2	0	4	0	1	2	0	3
Other	0	4	0	0	4	0	1	1	0	2
TOTAL	17	20	46	10	93	13	14	45	22	94

Table 4. 4TVW haddock landings by area, quarter and gear type (Canadian landings only).

	4T					
Year	**Gear**	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
1987	OTB	4	78	43	9	134
	LL	0	2	6	4	13
	SNU	0	208	75	5	289
	Other	0	11	6	0	17
	TOTAL	4	300	130	19	453
1988	OTB	1	18	199	5	224
	LL	0	1	2	4	8
	SNU	0	57	69	7	132
	Other	0	9	9	2	20
	TOTAL	1	85	279	18	383
1989	OTB	0	9	2	0	11
	LL	0	0	1	2	3
	SNU	0	39	20	1	60
	Other	0	4	1	0	6
	TOTAL	0	52	24	3	79
1990	OTB	1	2	0	1	5
	LL	0	0	1	0	1
	SNU	0	19	3	0	22
	Other	0	1	1	0	2
	TOTAL	1	22	5	2	30
1991	OTB	0	3	0	0	3
	LL	0	0	0	1	2
	SNU	0	10	2	0	12
	Other	0	0	1	0	1
	TOTAL	0	14	3	2	18
1992	OTB	0	0	0	0	1
	LL	0	0	0	2	2
	SNU	0	5	1	0	6
	Other	0	0	0	0	0
	TOTAL	0	6	1	2	9
1993	OTB	0	0	0	0	0
	LL	0	0	0	1	2
	SNU	0	1	0	0	1
	Other	0	0	0	1	1
	Total	0	1	1	3	4
1994	OTB	0	0	0	0	0
	LL	0	0	0	0	0
	SNU	0	0	0	0	0
	Other	0	0	0	0	0
	Total	0	0	0	0	0
1995	OTB	0	0	0	0	0
	LL	0	0	0	0	0
	SNU	0	0	0	0	0
	Other	0	0	0	0	0
	Total	0	0	0	0	0

Table 4. (Continued)

Year	Gear	4Vn Q1	Q2	Q3	Q4	Total
1987	OTB	28	84	32	20	164
	LL	7	28	54	26	115
	SNU	0	142	47	18	207
	Other	0	1	2	3	5
	TOTAL	35	254	135	66	491
1988	OTB	26	113	14	11	164
	LL	0	21	113	52	186
	SNU	0	102	48	3	153
	Other	0	0	2	0	2
	TOTAL	26	236	177	66	506
1989	OTB	24	178	46	1	249
	LL	0	13	32	8	53
	SNU	0	96	17	1	114
	Other	0	1	2	1	4
	TOTAL	25	287	97	12	421
1990	OTB	17	32	12	6	67
	LL	0	6	14	1	21
	SNU	0	15	5	0	20
	Other	0	0	0	0	1
	TOTAL	17	53	31	7	108
1991	OTB	8	8	4	2	21
	LL	0	2	14	3	19
	SNU	0	5	2	0	7
	Other	0	0	3	0	3
	TOTAL	8	14	23	5	50
1992	OTB	8	2	1	1	12
	LL	0	0	10	3	13
	SNU	0	1	0	0	2
	Other	0	0	0	0	0
	TOTAL	8	4	12	4	27
1993	OTB	1	2	0	0	3
	LL	0	2	5	1	8
	SNU	0	0	0	0	0
	Other	0	0	0	0	0
	TOTAL	1	4	5	1	11
1994	OTB	0	0	4	1	5
	LL	1	0	0	0	1
	SNU	0	1	0	0	1
	Other	0	3	0	0	3
	TOTAL	1	3	4	1	9
1995	OTB	0	0	1	1	1
	LL	0	0	0	0	0
	SNU	0	0	0	0	0
	Other	0	0	0	0	0
	TOTAL	0	0	1	1	1

Table 4. (Continued)

Year	Gear	4Vs Q1	Q2	Q3	Q4	Total
1987	OTB	252	398	412	291	1353
	LL	2	58	98	16	174
	SNU	0	11	7	1	19
	Other	0	0	0	0	0
	TOTAL	254	468	517	308	1547
1988	OTB	188	596	448	385	1617
	LL	14	67	211	27	319
	SNU	0	24	16	0	40
	Other	7	45	11	2	65
	TOTAL	209	732	685	414	2041
1989	OTB	592	1255	538	209	2594
	LL	11	100	193	95	399
	SNU	5	76	34	2	118
	Other	0	3	0	0	4
	TOTAL	608	1434	765	307	3114
1990	OTB	830	639	370	184	2023
	LL	132	84	54	6	276
	SNU	0	64	62	0	126
	Other	0	3	0	0	3
	TOTAL	961	789	486	190	2427
1991	OTB	185	257	104	129	675
	LL	3	120	133	10	267
	SNU	1	28	2	1	31
	Other	0	0	0	0	0
	TOTAL	189	405	239	140	973
1992	OTB	204	195	60	97	555
	LL	1	67	64	5	137
	SNU	0	79	2	2	84
	Other	0	0	0	0	0
	TOTAL	204	342	127	104	776
1993	OTB	81	126	32	5	244
	LL	8	57	84	0	150
	SNU	0	25	10	7	42
	Other	0	0	0	0	0
	TOTAL	90	208	126	12	435
1994	OTB	6	6	7	3	22
	LL	1	3	5	1	10
	SNU	0	1	2	0	3
	Other	0	0	0	0	0
	TOTAL	7	9	15	4	35
1995	OTB	7	4	4	10	26
	LL	2	5	19	2	28
	SNU	0	0	2	0	3
	Other	0	0	0	0	0
	TOTAL	9	10	26	13	57

Table 4 . (Continued)

	4W					
Year	**Gear**	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
1987	OTB	72	120	121	113	427
	LL	26	45	219	144	434
	SNU	5	8	47	10	70
	Other	0	7	32	21	60
	TOTAL	103	181	419	288	991
1988	OTB	51	125	116	45	336
	LL	19	88	394	121	622
	SNU	11	16	64	8	99
	Other	0	9	31	53	93
	TOTAL	81	238	605	226	1150
1989	OTB	146	581	476	276	1479
	LL	274	409	633	551	1867
	SNU	9	72	79	24	184
	Other	0	8	31	12	51
	TOTAL	429	1070	1218	863	3580
1990	OTB	245	284	282	66	877
	LL	706	384	1272	489	2851
	SNU	15	70	153	11	249
	Other	0	3	62	34	100
	TOTAL	966	742	1769	601	4078
1991	OTB	145	301	288	280	1064
	LL	436	546	1266	636	2883
	SNU	3	36	11	5	54
	Other	1	16	30	4	50
	TOTAL	584	900	1594	923	4001
1992	OTB	1112	317	155	120	1704
	LL	615	593	1326	845	3378
	SNU	0	37	82	35	154
	Other	0	1	14	12	26
	TOTAL	1727	947	1576	1011	5261
1993	OTB	13	12	89	13	127
	LL	19	112	509	42	682
	SNU	0	1	10	0	10
	Other	0	0	5	0	5
	TOTAL	32	125	612	55	824
1994	OTB	9	0	7	2	18
	LL	0	5	20	3	28
	SNU	0	0	0	0	0
	Other	0	1	0	0	1
	TOTAL	10	7	27	5	48
1995	OTB	3	0	0	0	4
	LL	0	3	18	9	30
	SNU	0	0	0	0	0
	Other	0	1	0	0	2
	TOTAL	4	4	18	9	35

Table 5. Catch at length for 1995 landings based on shore-based (trawlers, long-liners) and foreign removals.

(thousands of fish)

lengths	t1d	t2d	ll	for	all
8.5				0.002	0.005
10.5				0.005	0.011
12.5				0.004	0.009
14.5				0.018	0.042
16.5				0.044	0.103
18.5				1.345	3.175
20.5				5.908	13.948
22.5				8.262	19.505
24.5				4.565	10.777
26.5	0.007	0.005		6.392	15.104
28.5	0.025	0.005		15.234	36.003
30.5	0.076	0	0.207	15.624	37.063
32.5	0.014	0.06	0.267	9.095	21.643
34.5	0.013	0.075	0.614	6.125	14.762
36.5	0.02	0.131	1.439	4.007	10.106
38.5	0.048	0.075	3.493	2.962	8.298
40.5	0.156	0.152	7.797	2.183	8.118
42.5	0.735	0.217	11.452	1.856	9.46
44.5	0.734	0.506	10.987	1.212	8.102
46.5	1.172	0.745	8.793	0.788	7.275
48.5	1.161	0.974	5.307	0.365	5.351
50.5	1.226	1.017	2.589	0.143	4.066
52.5	1.153	1.432	1.989	0.064	4.045
54.5	0.981	1.002	1.491	0.031	3.126
56.5	1.053	0.974	0.901	0.014	2.954
58.5	0.522	0.772	0.572	0.006	1.834
60.5	0.504	0.712	0.524	0.006	1.731
62.5	0.41	0.409	0.51	0	1.221
64.5	0.153	0.35	0.131	0	0.647
66.5	0.039	0.157	0.156	0	0.278
68.5	0.02	0.056	0.122	0	0.13
70.5	0.032	0.069	0.058	0	0.141
72.5	0.01	0.004	0	0	0.019
74.5	0.003	0.004	0	0	0.01
76.5	0.003	0.004	0		0.01
78.5	0	0.004	0.015		0.01
80.5	0				0
82.5	0.003				0.005
TOTAL	10.276	9.913	59.413	86.259	249.086

		tr 1st half	tr 2nd half	ll	foreign	allsamples
(hundreds of fish)	T catch	15	16	58	26	120
	#measur	1662	1117	3141	32512	38494
	Sampled Catch	4.48	3.58	3.97	12.72	24.88

Table 6. Commercial catch at length.

Length (c	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	94	95
0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.50	2.89	8.45	0.00	0.00	0.00	5.11	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.50	8.67	2.82	0.00	0.00	0.00	1.70	27.77	1.57	0.00	0.00	6.33	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.50	0.00	0.00	0.00	0.00	12.73	1.70	9.26	0.78	0.00	0.00	4.84	2.33	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
12.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.22	0.16	0.95	0.51	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	0.00	0.01	0.00	0.00
14.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.28	0.00	0.78	3.71	62.54	10.25	0.00	0.34	0.01	0.00	0.00	8.73	0.40	0.01	0.00	0.01	0.00	0.02
16.50	2.89	5.64	8.61	0.00	0.00	0.00	11.57	0.39	27.99	0.12	163.26	44.74	239.55	88.44	0.00	51.47	0.01	0.20	0.18	119.51	0.62	0.01	0.03	0.01	0.00	0.04
18.50	37.57	14.09	55.99	21.60	0.00	5.11	25.46	1.96	141.77	0.19	286.10	219.37	340.05	498.55	0.00	175.71	0.35	2.96	3.96	467.26	4.82	0.08	0.26	0.20	0.13	1.35
20.50	127.17	53.54	189.52	75.61	0.00	17.03	164.33	9.03	249.31	0.80	168.19	452.83	204.01	352.55	17.97	354.29	2.90	16.21	33.37	584.73	17.85	0.63	0.53	1.18	1.95	5.91
22.50	222.54	70.45	167.98	216.04	15.27	37.47	143.50	16.48	157.60	1.75	130.96	286.12	69.26	233.97	796.30	229.68	5.05	25.02	45.84	297.17	36.94	2.24	0.67	1.82	6.34	8.26
24.50	72.25	39.45	43.07	162.03	10.18	98.80	50.92	14.52	63.03	3.60	97.01	85.82	19.69	141.05	161.14	66.46	5.47	16.53	20.78	74.61	61.80	5.69	0.74	2.44	7.37	4.57
26.50	34.68	25.36	21.54	86.41	10.18	85.17	20.83	9.03	20.06	13.62	36.54	12.32	61.24	98.28	137.55	20.94	4.65	11.39	9.08	101.31	148.22	16.14	0.84	1.66	3.15	6.39
28.50	14.45	47.90	21.54	140.42	5.09	28.96	30.09	10.56	45.32	18.43	4.74	14.98	35.28	51.54	62.00	3.50	7.35	20.37	17.33	233.49	189.54	39.15	1.25	4.16	2.86	15.23
30.50	66.47	159.76	54.87	195.56	17.82	5.11	44.01	12.92	80.41	28.74	2.88	15.69	14.83	17.48	29.96	15.34	22.81	41.94	25.53	277.77	118.31	68.84	2.37	6.75	5.27	15.62
32.50	76.38	185.79	47.65	413.51	43.27	3.41	148.37	12.56	131.63	35.73	7.34	17.74	19.94	31.06	39.48	2.38	47.45	47.06	22.72	164.42	58.34	118.04	6.69	6.35	4.22	9.15
34.50	98.85	129.70	64.81	264.85	129.91	6.24	256.56	13.95	126.61	24.75	35.39	25.10	96.56	109.25	160.89	30.30	99.85	40.38	16.56	60.22	70.71	149.47	43.11	7.16	2.26	6.34
36.50	262.38	173.18	101.08	235.32	157.99	50.23	147.42	33.09	107.65	23.28	153.80	77.12	206.26	189.96	526.78	207.45	271.03	32.99	14.70	52.69	67.77	151.13	169.64	22.03	1.87	4.49
38.50	322.64	268.91	100.10	287.79	325.44	53.82	40.74	56.72	171.12	63.85	400.55	287.16	452.70	349.67	1101.85	783.47	1060.93	51.27	48.36	122.69	47.46	257.29	448.88	58.31	1.54	3.77
40.50	473.07	431.08	175.97	277.51	225.14	105.36	16.35	113.88	273.33	100.52	751.09	802.64	511.47	742.28	1296.59	1748.80	2605.06	124.52	147.23	283.98	129.41	416.70	650.51	125.24	2.31	6.14
42.50	479.32	668.11	210.00	297.49	138.00	123.56	29.63	245.70	387.72	163.33	1227.49	1248.79	639.18	964.17	1169.66	2230.47	3858.84	253.29	384.91	644.38	239.89	504.55	721.56	171.34	3.86	10.32
44.50	610.96	732.11	248.97	383.84	84.70	161.71	20.70	283.65	502.38	215.20	1440.72	1690.66	990.02	862.88	951.70	1982.97	3983.36	382.48	723.51	939.35	528.63	676.64	772.23	159.07	4.25	11.78
46.50	629.71	920.49	310.39	469.03	132.03	161.16	62.22	324.75	598.71	257.27	1470.65	2130.75	1313.02	842.35	714.08	1567.21	2821.27	610.41	870.84	1175.58	824.68	727.82	757.68	152.26	4.53	13.05
48.50	669.66	983.74	326.94	351.91	100.70	217.38	108.16	308.11	547.97	321.59	1565.11	2128.57	1629.10	890.70	661.93	1049.08	1511.18	611.55	654.15	1105.70	930.06	596.93	693.09	125.40	4.23	12.18
50.50	709.20	931.33	332.04	355.23	125.87	170.54	112.31	227.37	470.37	341.81	1266.23	1822.71	1485.96	866.12	421.46	597.13	848.62	458.28	440.97	799.54	907.78	473.58	478.59	95.82	4.62	6.82
52.50	710.34	950.26	387.75	342.78	158.49	185.31	111.73	186.52	379.23	323.90	1070.79	1533.81	1142.35	653.20	312.00	421.00	460.22	297.29	263.33	539.76	650.55	318.21	314.56	81.46	3.85	6.74
54.50	480.73	783.43	299.87	313.36	169.91	164.97	133.79	164.61	288.49	181.35	818.33	1143.45	838.48	484.16	275.96	277.00	258.27	161.02	149.99	321.25	476.16	219.77	209.14	54.57	2.94	5.49
56.50	420.21	724.90	299.01	242.54	127.59	105.60	99.36	151.18	246.95	151.67	578.21	844.11	637.02	317.54	189.73	216.00	144.61	96.50	75.34	195.06	241.19	148.07	156.45	38.34	2.13	2.97
58.50	343.90	552.90	225.39	268.59	128.18	100.06	84.69	115.57	198.84	98.35	378.13	637.03	459.54	206.24	120.73	136.00	90.43	46.15	40.67	104.92	136.54	85.18	101.35	29.93	1.69	2.12
60.50	219.43	401.08	178.41	219.25	94.39	68.78	86.19	92.55	169.39	78.82	263.07	376.17	356.00	131.20	81.00	87.00	67.92	33.08	26.90	66.45	70.01	65.53	69.85	27.53	1.11	2.12
62.50	241.66	381.14	153.45	173.57	85.81	73.06	71.10	55.42	101.40	48.00	167.01	262.69	216.00	93.08	46.00	54.00	32.82	16.62	17.43	27.64	33.68	31.41	45.62	14.68	0.59	1.26
64.50	132.78	230.20	101.21	87.01	57.11	28.49	46.11	32.13	73.58	31.00	106.00	125.15	124.00	42.28	29.00	41.00	24.21	8.36	12.41	18.61	25.32	20.13	31.06	10.98	0.29	0.46
66.50	94.76	158.62	55.83	72.57	28.61	24.37	31.66	28.81	33.34	13.01	67.00	93.15	100.00	27.00	19.23	24.00	13.23	2.15	5.23	9.00	15.16	7.05	20.50	5.08	0.21	0.17
68.50	59.04	85.70	43.83	23.83	25.27	8.53	6.81	16.66	28.94	11.00	19.00	43.05	45.00	11.08	11.00	13.00	2.03	0.01	4.15	7.00	11.10	4.05	5.32	1.61	0.07	0.03
70.50	26.56	51.59	8.24	20.69	11.67	5.28	4.11	15.93	5.26	3.00	28.00	26.04	44.00	14.16	10.00	10.00	4.03	1.03	2.02	3.00	8.01	2.02	1.82	1.26	0.04	0.13
72.50	22.88	19.53	13.23	20.42	3.33	5.17	6.42	3.92	3.11	3.00	6.00	10.01	20.00	5.00	3.00	4.00	1.02	1.05	1.06	0.00	3.00	1.00	6.61	0.14	0.05	0.00
74.50	20.80	14.43	2.45	14.86	2.59	0.00	0.48	2.19	2.17	1.00	4.00	8.01	5.00	5.00	2.00	4.00	1.03	0.00	0.02	1.00	0.00	0.00	0.29	0.04	0.02	0.00
76.50	7.84	18.66	1.68	1.49	0.74	0.00	0.34	1.52	3.23	1.00	1.00	2.00	5.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	0.01	1.00	0.34	0.03	0.00	0.00
78.50	4.19	1.98	2.92	1.13	0.00	0.94	0.00	0.39	0.17	0.00	1.00	2.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.16	0.00	0.00
80.50	0.00	0.48	2.92	0.00	0.00	0.00	0.00	1.60	0.00	0.00	0.00	1.00	2.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
82.50	3.90	1.72	0.00	1.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84.50	0.53	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00
Sum	7711	10229	4257	6038	2428	2110	2153	2566	5637	2560	12729	16477	12387	9333	9349	12406	18256	3411	4079	8807	6055	5108	5712	1207	74	163

Table 7. Research vessel (RV) catch at length (summer).

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.026	0	0	0	0	0	0	0	0
4.5	0	0	0.0108	0	0	0	0.006	0	0	0.0516	0.0432	0.0132	0.075	0.015	0	0	0	0	0	0	0	0	0	0.012	0	0.01
6.5	0.03	0.0372	0.0264	0	0	0.024	0.3192	0.06	0	0.516	0.8856	4.4976	0.319	0.1	0.018	0	0.086	0.017	0.063	0	0	0.022	0	0.282	0.31	0.03
8.5	0.0744	0.0252	0.0108	0	0.1416	0.0228	0.2508	0.1296	0	0.8664	0.42	14.3148	0.28	0.031	0.258	0.011	0.051	0.061	0.692	0.057	0	0	0	1.13	0.69	0.2
10.5	0	0	0	0	0.0864	0.0264	0.0444	0.0672	0	0.0528	0.1248	3.3396	0.1	0	0	0	0	0.004	0.28	0.043	0	0	0	1.006	0.35	0.03
12.5	0	0	0	0	0	0	0	0	0	0	0.012	0.1884	0.03	0.016	0	0	0	0	0.008	0	0	0	0	0.063	0.01	0
14.5	0	0	0	0	0	0	0	0.024	0.036	0	0.0216	0.312	1.361	0.286	0.005	0	0	0	0	0	0.018	0	0	0	0	0
16.5	0.0264	0.018	0.036	0	0	0.0348	0.096	0.024	0.5256	0	0.036	2.31	7.78	4.163	0	0.023	0	0.174	0	0.741	0.014	0	0.02	0.007	0	0.08
18.5	0.2292	0.15	0.2172	0.0132	0.0276	0.096	0.1404	0.0852	2.9172	0.024	0.5928	5.238	5.809	9.825	0.04	0.155	0.061	0.487	0.075	5.296	0.049	0.017	0.008	0.053	0.06	0.19
20.5	0.792	0.3204	0.5376	0.0792	0.024	0.2196	1.2636	0.8328	4.0608	0.0348	1.476	4.7808	2.548	8.22	0.258	1.286	0.179	0.941	1.043	5.627	0.249	0.061	0.323	0.34	0.75	1.15
22.5	1.2288	0.6696	0.4932	0.2076	0.1392	0.3816	1.014	2.2416	1.7112	0.0228	1.1064	2.0916	0.745	3.071	0.339	2.346	0.45	0.871	2.081	1.632	0.387	0.091	0.299	1.06	2.48	1.95
24.5	0.3408	0.4776	0.1368	0.1848	0.1008	1.9296	0.39	2.2164	0.9084	0.1788	0.3936	1.0956	1.547	2.256	0.951	0.677	0.483	0.31	1.306	0.574	0.424	0.035	0.137	0.925	3.24	0.82
26.5	0.15	0.3396	0.198	0.1548	0.0804	2.3844	0.4452	1.1016	0.4872	0.5112	0.03	0.5868	3.612	2.65	1.839	0.226	0.178	0.131	0.27	0.217	1.652	0.068	0.049	0.422	1.01	0.43
28.5	0.042	0.3204	0.1512	0.2592	0.0384	0.5028	0.3516	1.116	0.3192	1.6212	0.0648	1.7688	4.593	4.014	3.119	0.307	0.187	0.211	0.356	0.512	5.874	0.564	0.16	0.217	1.7	1.59
30.5	0.366	0.9528	0.372	0.2448	0.1308	0.1224	0.2556	2.0184	1.5552	2.3904	0.018	2.724	3.806	4.201	5.183	0.834	0.912	0.5	2.704	1.735	7.123	1.969	0.435	0.705	1.94	2.77
32.5	0.3936	1.1928	0.36	0.5592	0.4584	0.0252	0.546	3.1224	3.4404	2.9352	0.1044	2.5908	2.329	5.154	4.54	1.803	1.567	0.874	8.208	3.2	2.976	7.544	1.248	0.618	0.94	2.44
34.5	0.1932	0.8316	0.264	0.3732	0.9096	0.0432	0.7008	2.9544	4.2552	2.538	0.7716	1.656	0.962	5.174	4.238	3.366	2.026	0.888	6.178	1.718	2.035	11.525	4.519	0.981	0.75	2
36.5	0.4212	0.39	0.2376	0.2232	0.7524	0.0888	0.69	2.0832	3.456	1.4832	1.8828	0.5604	1.919	7.836	7.143	4.235	4.271	1.542	2.738	0.943	3.184	10.256	6.059	2.949	1.32	1.46
38.5	0.4704	0.2148	0.222	0.2052	0.6456	0.1056	0.2964	1.3608	3.2088	2.0712	4.3992	0.3144	3.427	9.099	9.916	4.598	7.598	2.535	3.639	1.053	3.369	8.137	4.78	5.136	2.95	2.1
40.5	0.7044	0.372	0.2868	0.1656	0.504	0.4476	0.0816	1.6692	4.7424	3.3876	5.214	0.6972	3.8	5.085	10.563	6.282	9.06	4.557	4.268	1.567	2.489	6.279	3.746	4.535	3.94	2.84
42.5	0.6756	0.6288	0.2004	0.0636	0.6888	0.4848	0.1848	2.4528	3.7956	3.6348	4.4376	1.8192	2.891	3.309	6.792	6.288	7.812	5.432	5.336	2.945	2.12	5.037	2.364	3.28	2.79	2.59
44.5	0.7872	0.5484	0.1524	0.1728	0.642	0.9324	0.1164	2.1756	2.9484	3.4656	5.5668	2.3952	3.269	2.615	3.945	4.122	5.611	4.808	6.121	3.965	2.99	3.945	1.478	1.763	1.52	1.51
46.5	0.5328	0.4164	0.2508	0.15	0.4788	0.5496	0.2568	1.4028	2.274	3.0252	4.8	2.4732	2.37	2.152	2.184	2.748	3.655	2.913	4.7	3.694	2.72	3.408	1.111	1.045	0.65	0.67
48.5	0.4524	0.378	0.1344	0.0468	0.2304	0.4476	0.4008	0.534	2.0508	2.2212	4.698	2.4288	2.196	1.809	1.686	1.595	2.239	1.83	3.012	2.706	1.974	2.487	0.775	0.448	0.37	0.23
50.5	0.5868	0.378	0.3384	0.1632	0.1428	0.438	0.3696	0.6984	1.2696	1.5228	3.6984	1.77	2.039	1.348	1.039	1.335	1.559	0.769	1.451	1.504	1.438	0.865	0.528	0.432	0.16	0.08
52.5	0.498	0.252	0.144	0.1692	0.2412	0.2544	0.3132	0.7128	0.5184	0.828	1.7424	1.0428	1.65	1.177	1.066	0.83	0.76	0.515	0.726	0.827	0.597	0.467	0.306	0.167	0.07	0.06
54.5	0.2112	0.1596	0.1332	0.1524	0.2724	0.4644	0.3204	0.492	0.1632	0.6252	1.3368	0.5952	1.173	0.836	0.545	0.425	0.652	0.188	0.318	0.441	0.298	0.095	0.099	0.07	0.03	0.1
56.5	0.3324	0.1776	0.0864	0.0324	0.2136	0.2508	0.2076	0.4368	0.1656	0.1728	0.432	0.5424	0.645	0.323	0.464	0.373	0.498	0.167	0.193	0.275	0.254	0.072	0.107	0.03	0.02	0.11
58.5	0.2448	0.0864	0.0552	0.15	0.1704	0.2964	0.0708	0.312	0.1152	0.0924	0.3468	0.288	0.476	0.258	0.302	0.242	0.305	0.07	0.115	0.07	0.065	0.034	0.011	0.023	0	0.07
60.5	0.1068	0.0564	0.0672	0.048	0.0648	0.2496	0.0252	0.3228	0.1116	0.1548	0.2376	0.2448	0.185	0.091	0.238	0.093	0.155	0.032	0.13	0.102	0.093	0.007	0.015	0.008	0.01	0.09
62.5	0.1692	0.048	0.0912	0.0936	0.0684	0.132	0.1008	0.1128	0.1068	0.096	0.186	0.09	0.287	0.121	0.126	0.073	0.066	0.002	0.056	0.043	0.016	0	0.015	0	0	0.04
64.5	0.2436	0.0204	0.036	0	0.0888	0.1272	0.0792	0.084	0.0744	0.0516	0.1056	0.1332	0.175	0.083	0.102	0.031	0.038	0.013	0.067	0.019	0.005	0.009	0	0.002	0	0.03
66.5	0.1956	0.1032	0	0.0588	0.0096	0.0792	0.0444	0.0168	0	0.0612	0.0492	0.0324	0.076	0.099	0.066	0.093	0.02	0.01	0.016	0.008	0.007	0	0.007	0	0	0.01
68.5	0.0312	0.0084	0.0468	0	0.0216	0.03	0.0216	0.0624	0.0312	0.036	0.0528	0.0324	0	0.042	0.066	0.028	0.007	0.002	0	0.008	0	0.016	0.007	0	0	0
70.5	0.0444	0.0252	0	0	0.0048	0.0468	0	0	0.03	0.0192	0	0	0.018	0.002	0	0.024	0.007	0	0	0	0	0	0	0	0	0
72.5	0.0432	0	0	0.0228	0.0156	0.036	0.06	0.0324	0.0108	0	0	0	0	0.024	0.014	0.004	0	0	0	0	0.005	0	0	0	0.01	0
74.5	0.0084	0	0	0.0348	0	0	0.0036	0	0	0	0	0	0.022	0	0.006	0	0	0	0	0	0	0	0	0	0	0
76.5	0.0084	0	0	0	0	0	0	0	0	0	0	0	0	0	0.026	0	0	0	0	0	0	0	0	0	0	0
78.5	0.0084	0	0	0	0	0	0	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.003	0.002	0	0.008	0	0	0	0	0	0	0	0
82.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
84.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUM	10.6428	9.5988	5.2968	4.0284	7.3932	11.274	9.4668	30.9852	45.2892	34.692	45.2868	62.9676	62.514	85.485	67.08	44.455	50.493	30.888	56.15	41.522	42.425	63.01	28.606	27.709	28.07	25.68

Table 8. Summary of catches from the 1995 4VsW sentinel survey (weights are in kilograms).

Species	Total # Caught	Total Wt. Caught	Total # Measured	Total # Otoliths	Total # Stomachs	Total # Gonads
Cod	6631	6656.0	5565	288	73	71
Haddock	7274	6229.0	4262	172	51	50
Hake	2685	2828.0	1837	216	26	51
Cusk	383	804.0	156	0	0	0
Halibut	70	702.0	25	2	2	2
Dogfish	3134	5813.0	11	0	0	0
Blue Shark	31	861.0	0	0	0	0
Sculpin	150	56.0	1	0	0	0
Monkfish	653	155.0	0	0	0	0
Skate	3399	4772.0	0	0	0	0
Wolfish	189	273.0	0	0	0	0
Flounder	136	105.0	0	0	0	0
Am.Plaice	597	420.0	0	0	0	0
Turbot	5	9.0	0	0	0	0
Red Hake	192	52.0	0	0	0	0
Silver Hake	53	40.0	53	0	0	0
Pollock	109	170.0	0	0	0	0
Redfish	228	158.0	0	0	0	0

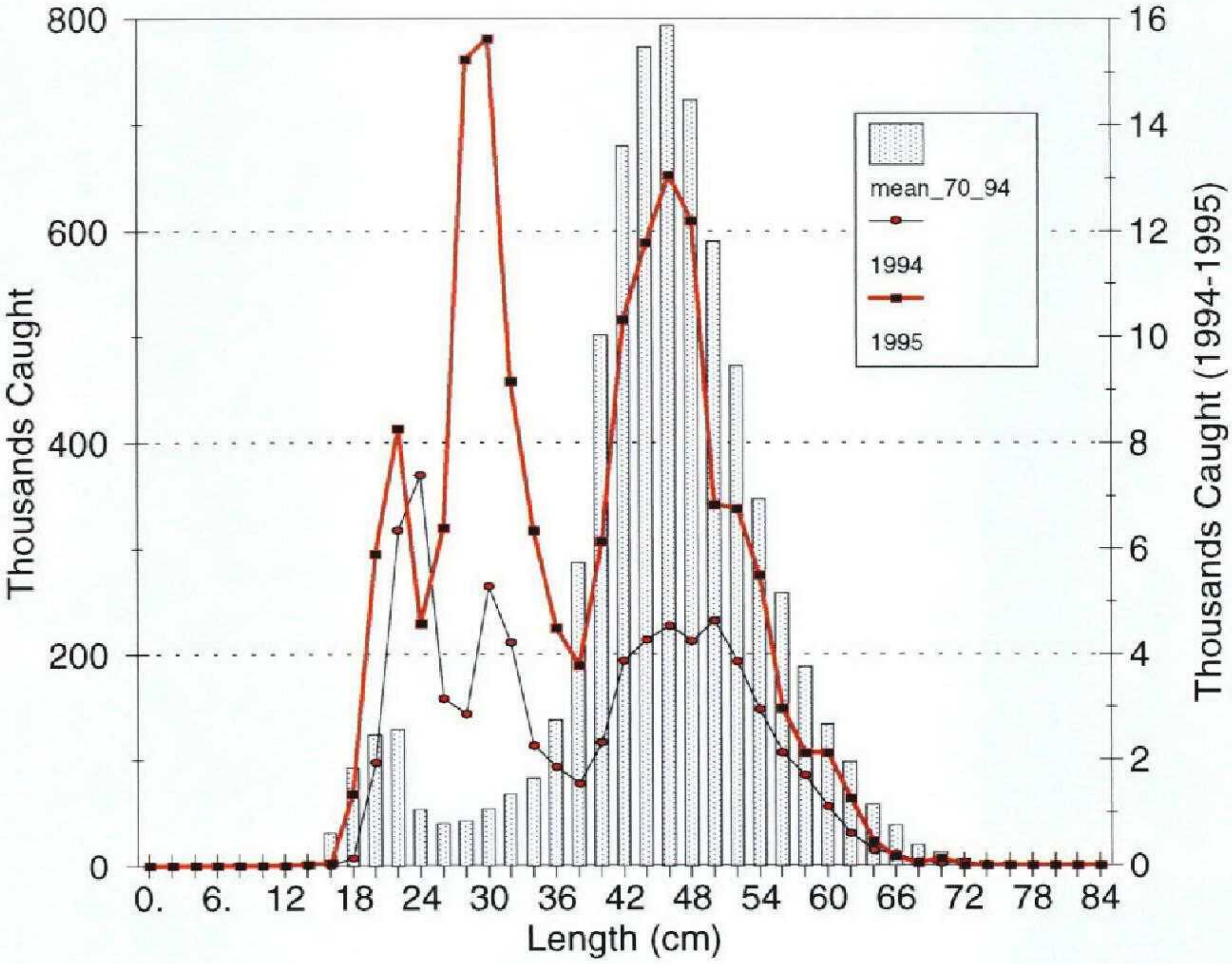

Figure 1. Length composition of 4TVW haddock landings for the long-term (1970-1994) and for the two most recent years. Note the change in scale for 1994/95.

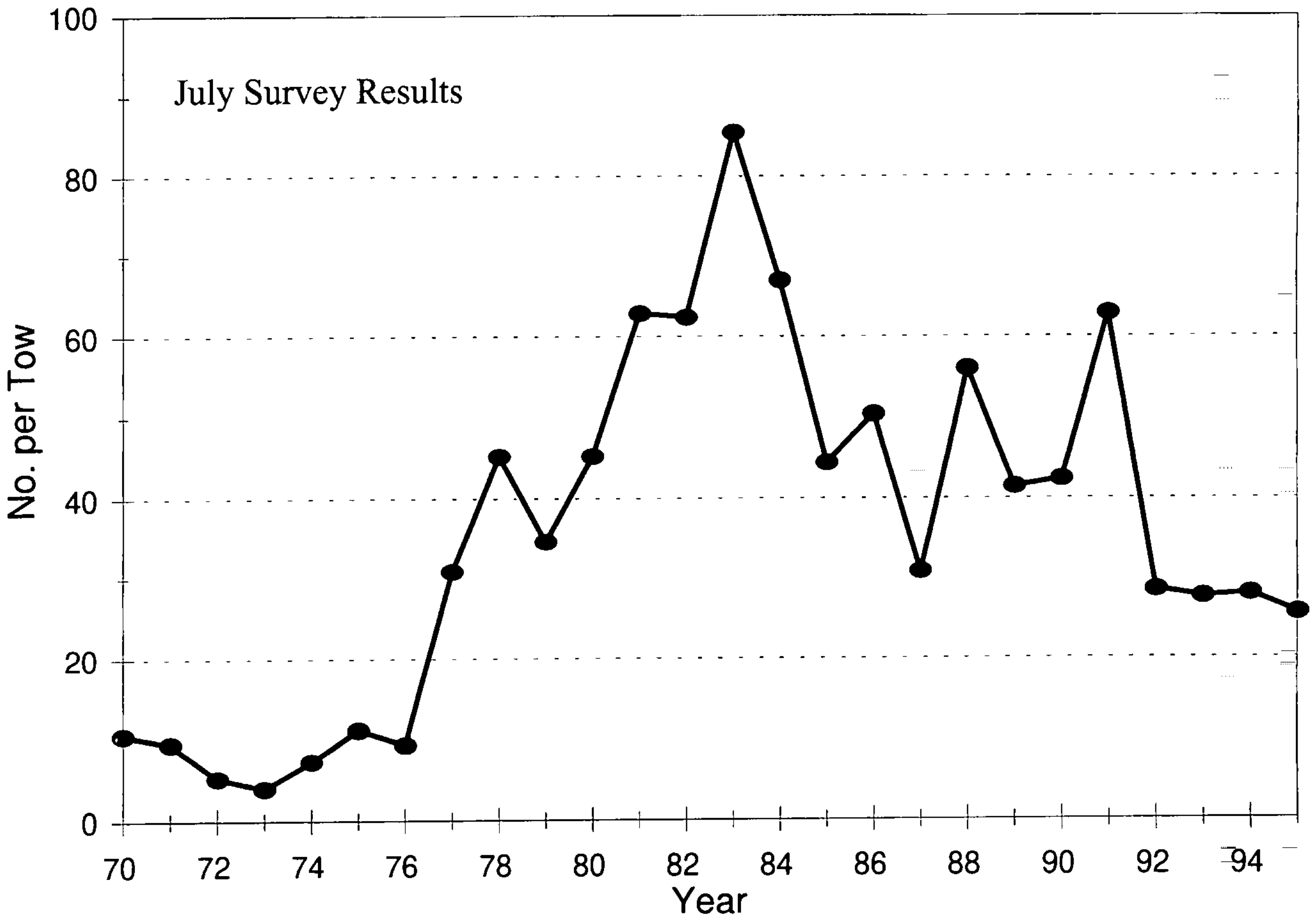

Figure 2. Mean catch per tow for haddock of all sizes in the July survey of NAFO areas 4VsW.

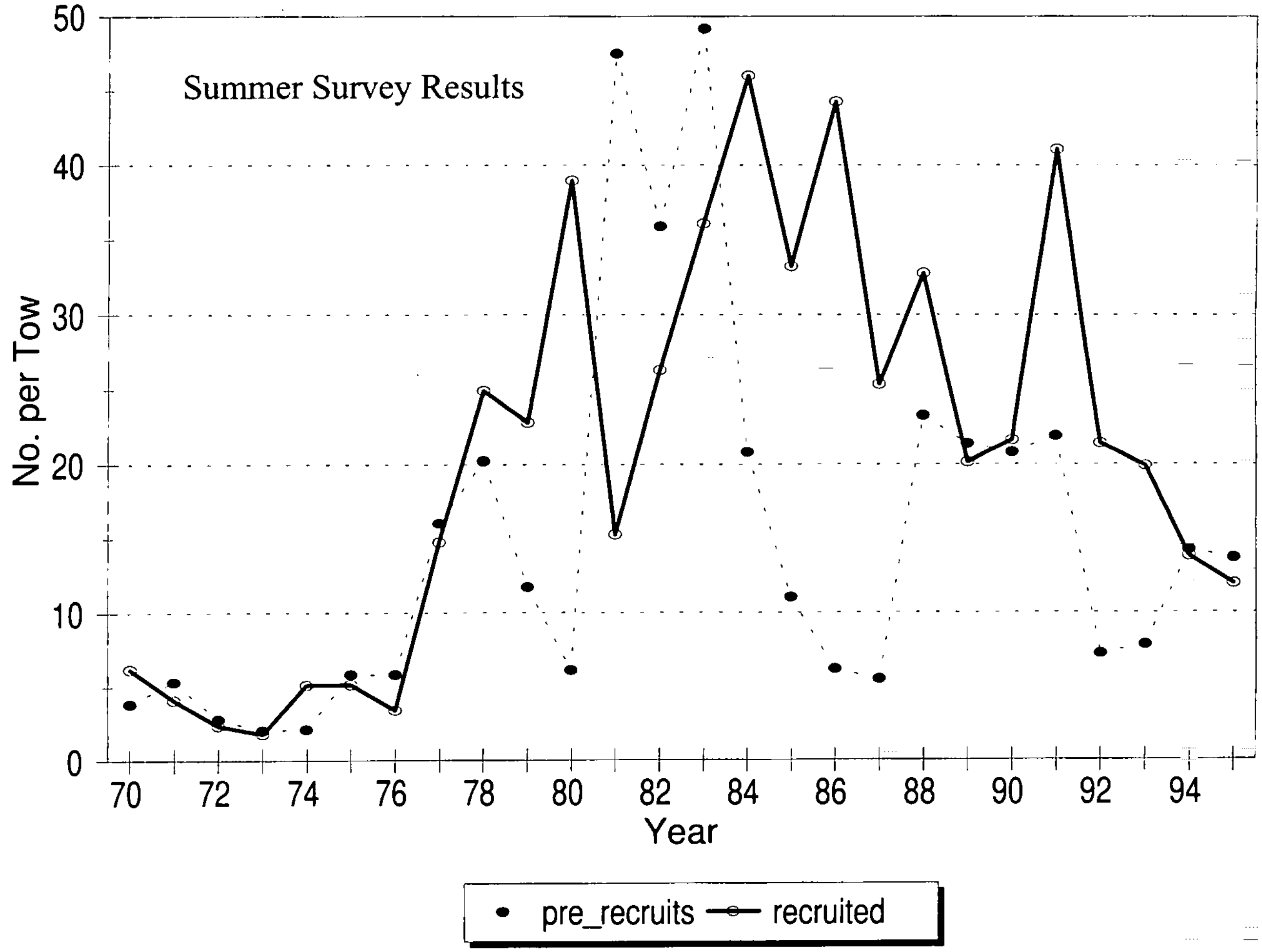

Figure 3. Mean catch per tow for pre-recruits (less than 36cm) and recruited (greater than 36cm) size classes of 4TVW haddock.

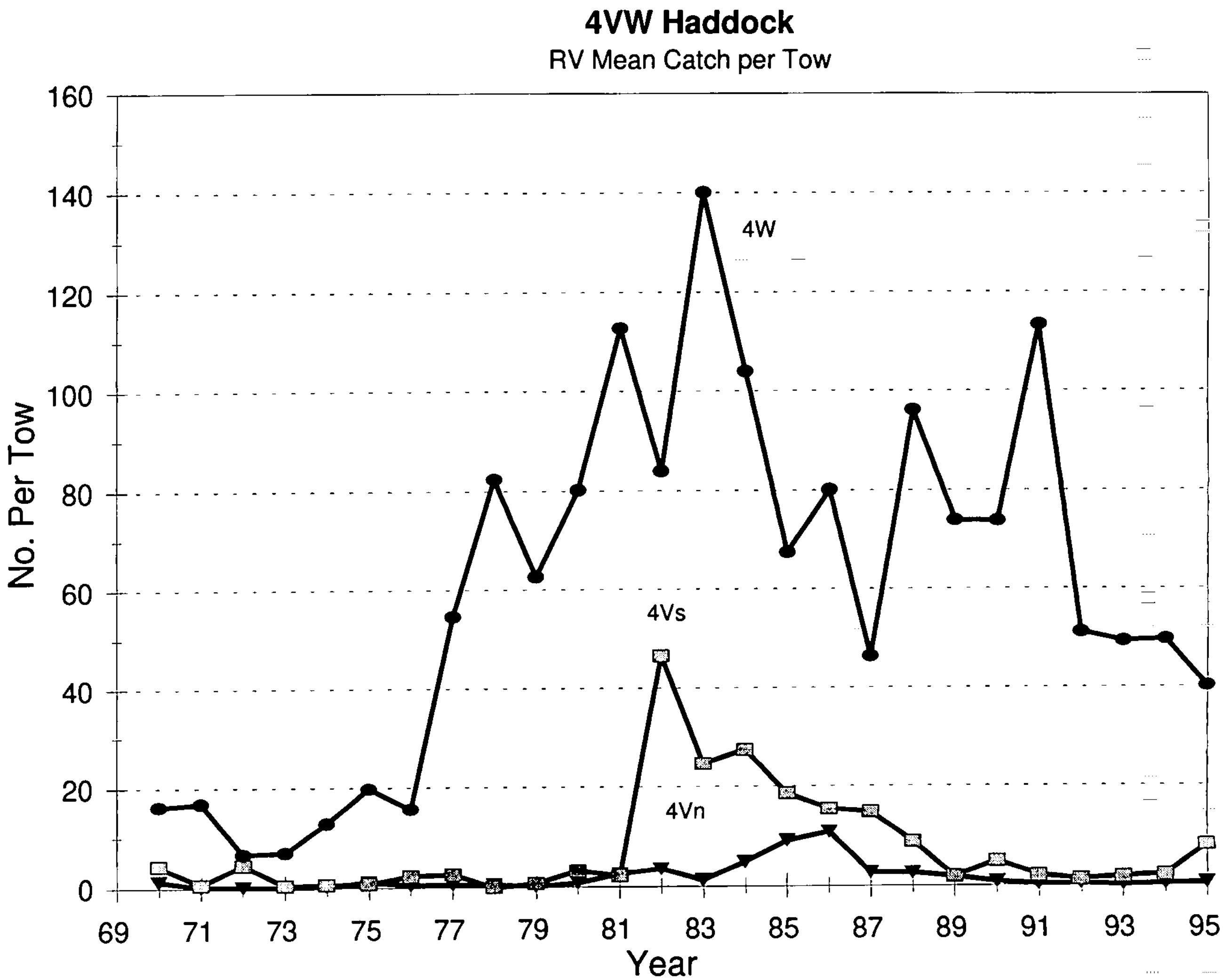

Figure 4. Mean catch per tow for 4TVW haddock (all sizes) by NAFO Division and Subdivision from summer research vessel surveys.

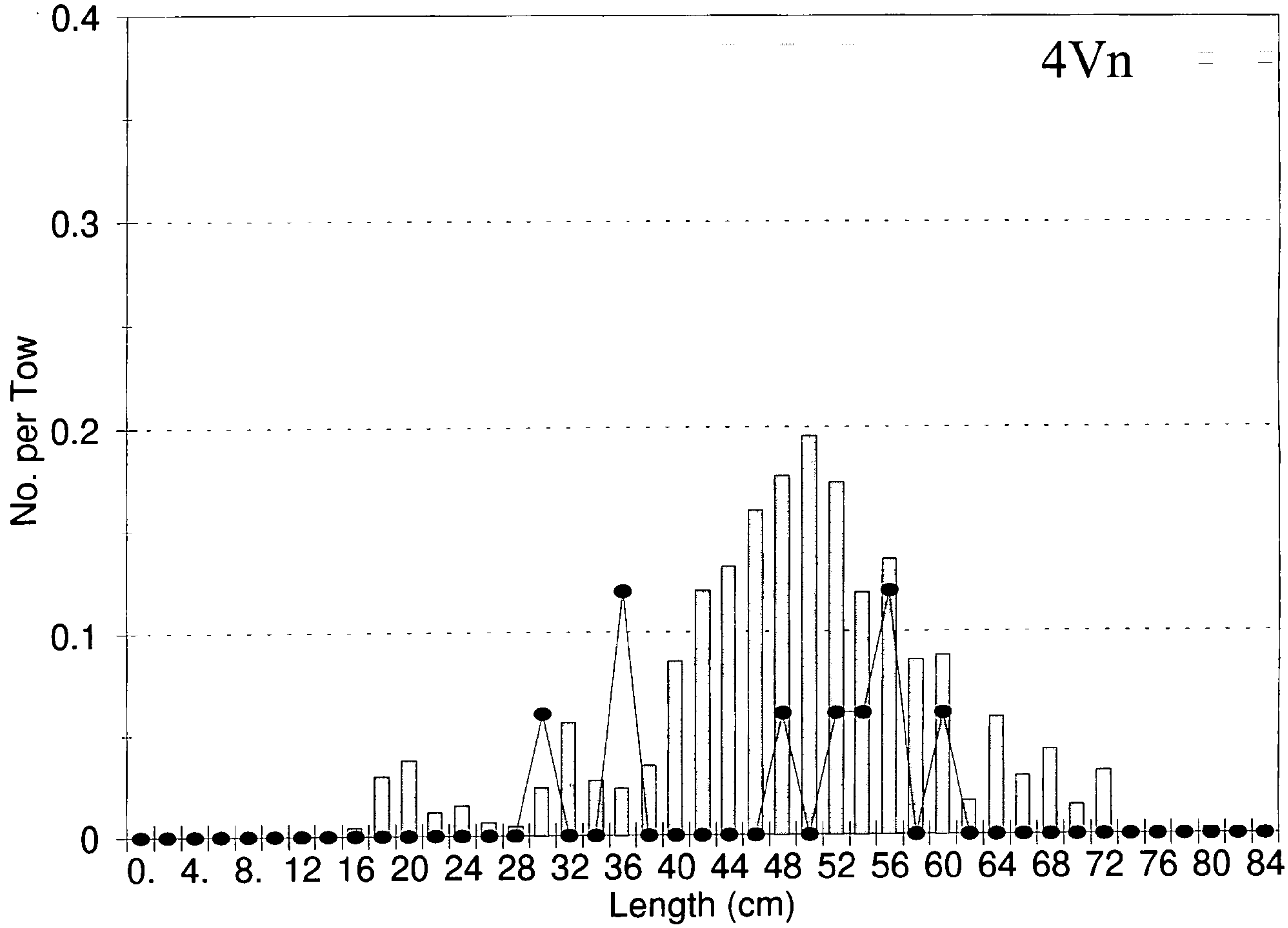

Figure 5. Long-term (1980-1994; bars) and recent (1995; line) catch at length for haddock in Subdivision 4Vn. Results are from the summer (July) surveys.

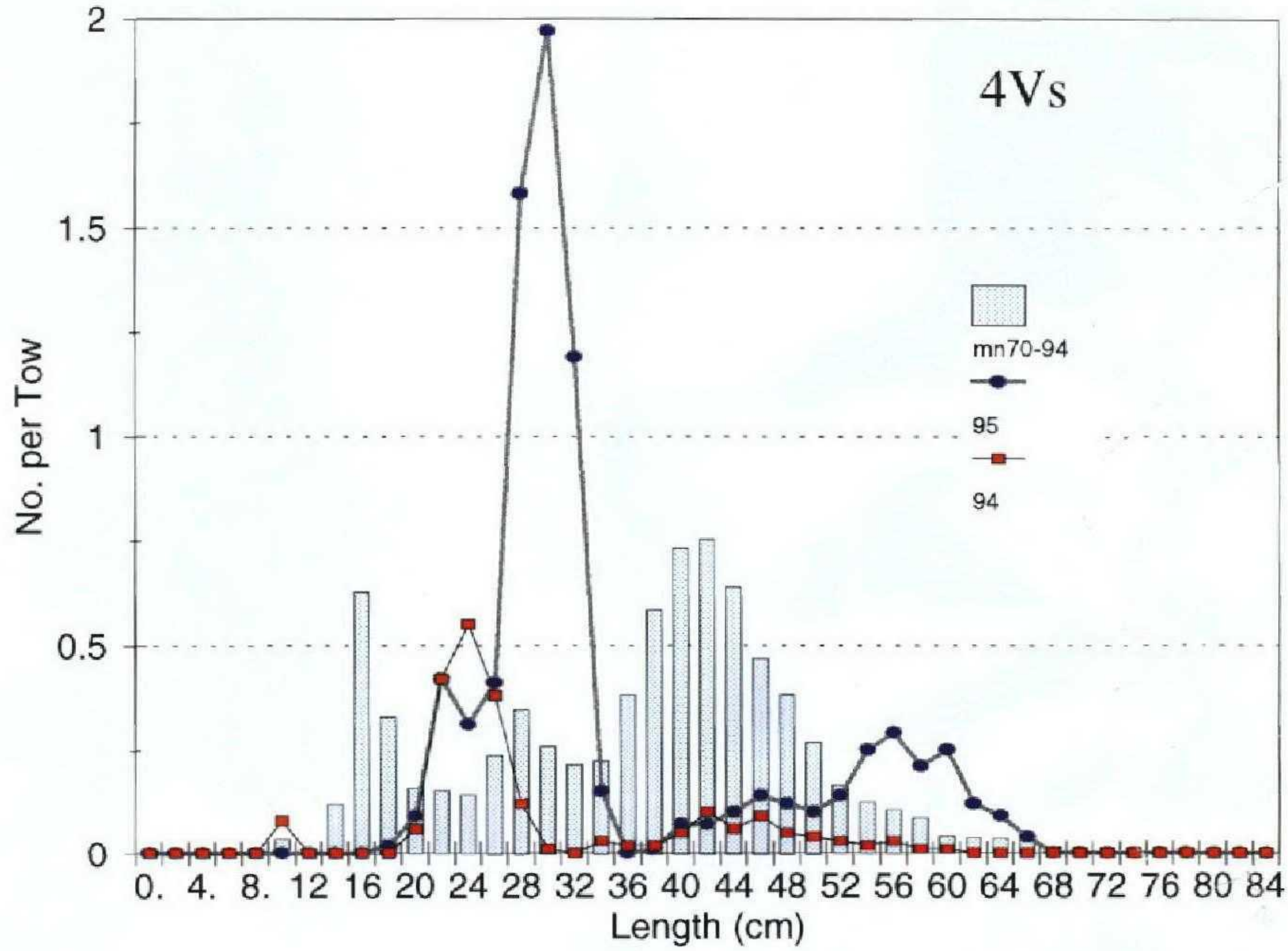

Figure 6. Long-term (1970-1994; bars) and recent (1994 and 1995; lines) catch at length for haddock in Subdivision 4Vs. Results are from the summer (July) surveys.

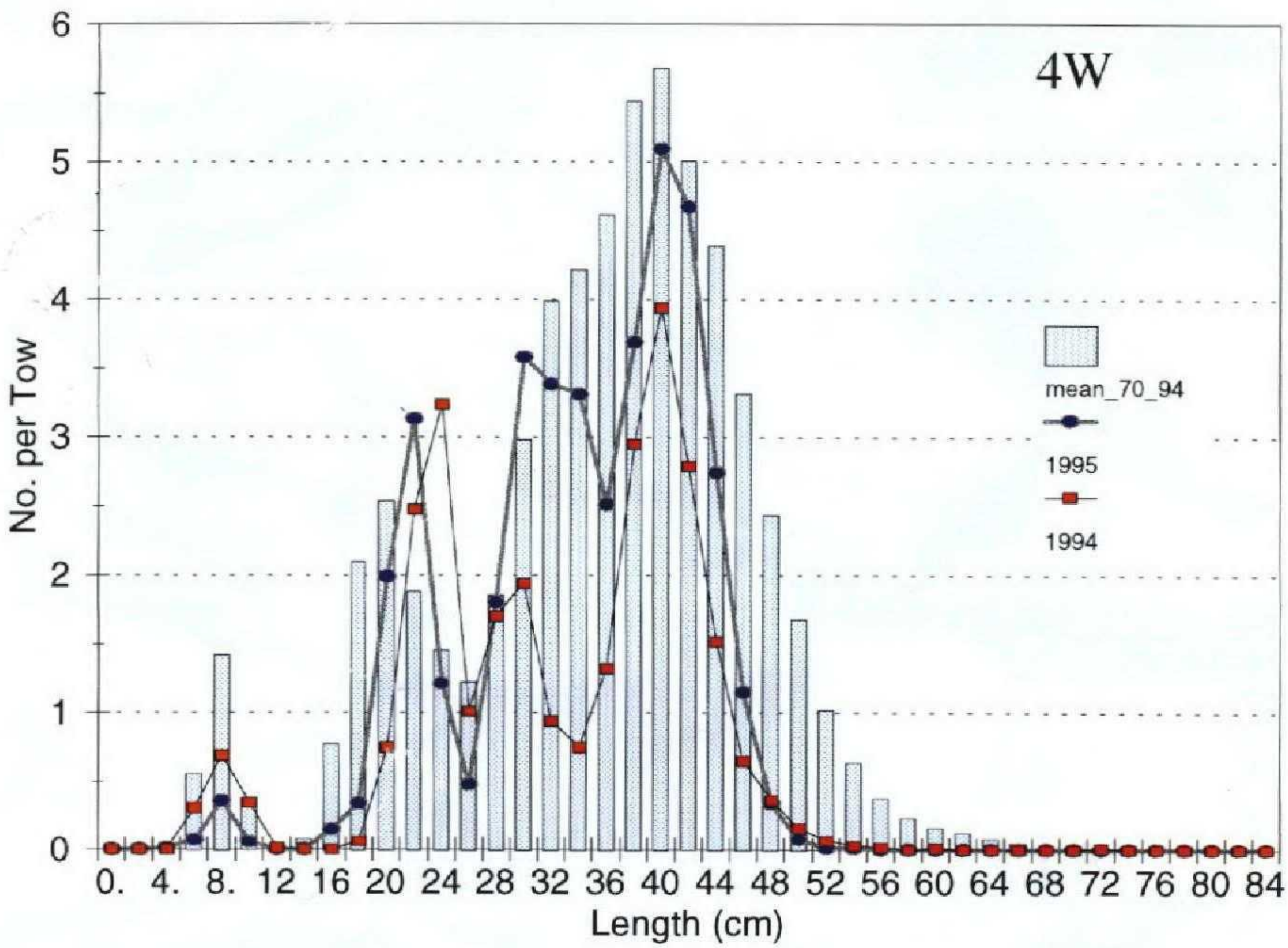

Figure 7. Long-term (1970-1994; bars) and recent (1994 and 1995; lines) catch at length for haddock in Division 4W. Results are from the summer (July) surveys.

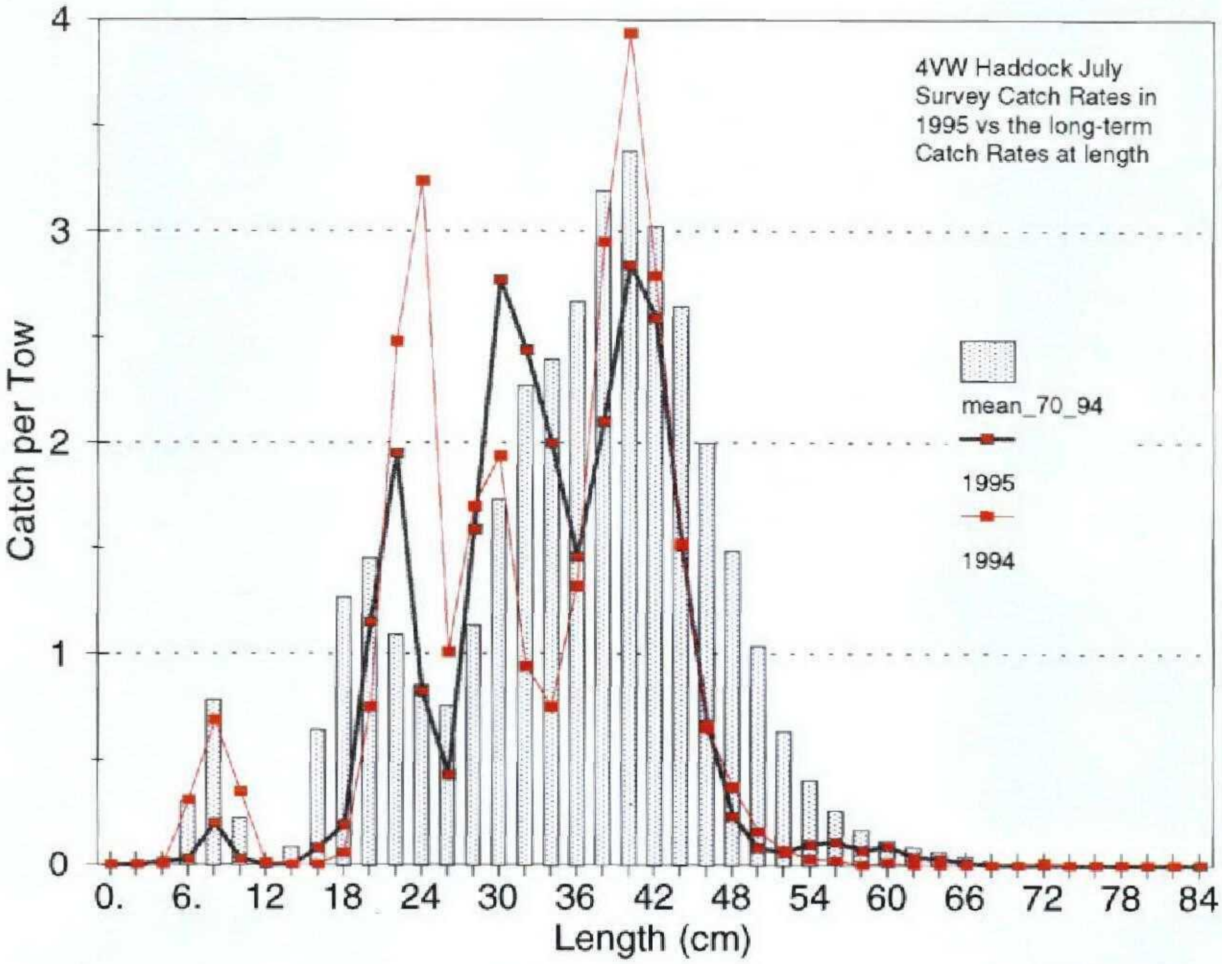

Figure 8. Long-term (1970-1994; bars) and recent (1994 and 1995; lines) catch at length for haddock in Divisions 4VW. Results are from the summer (July) surveys.

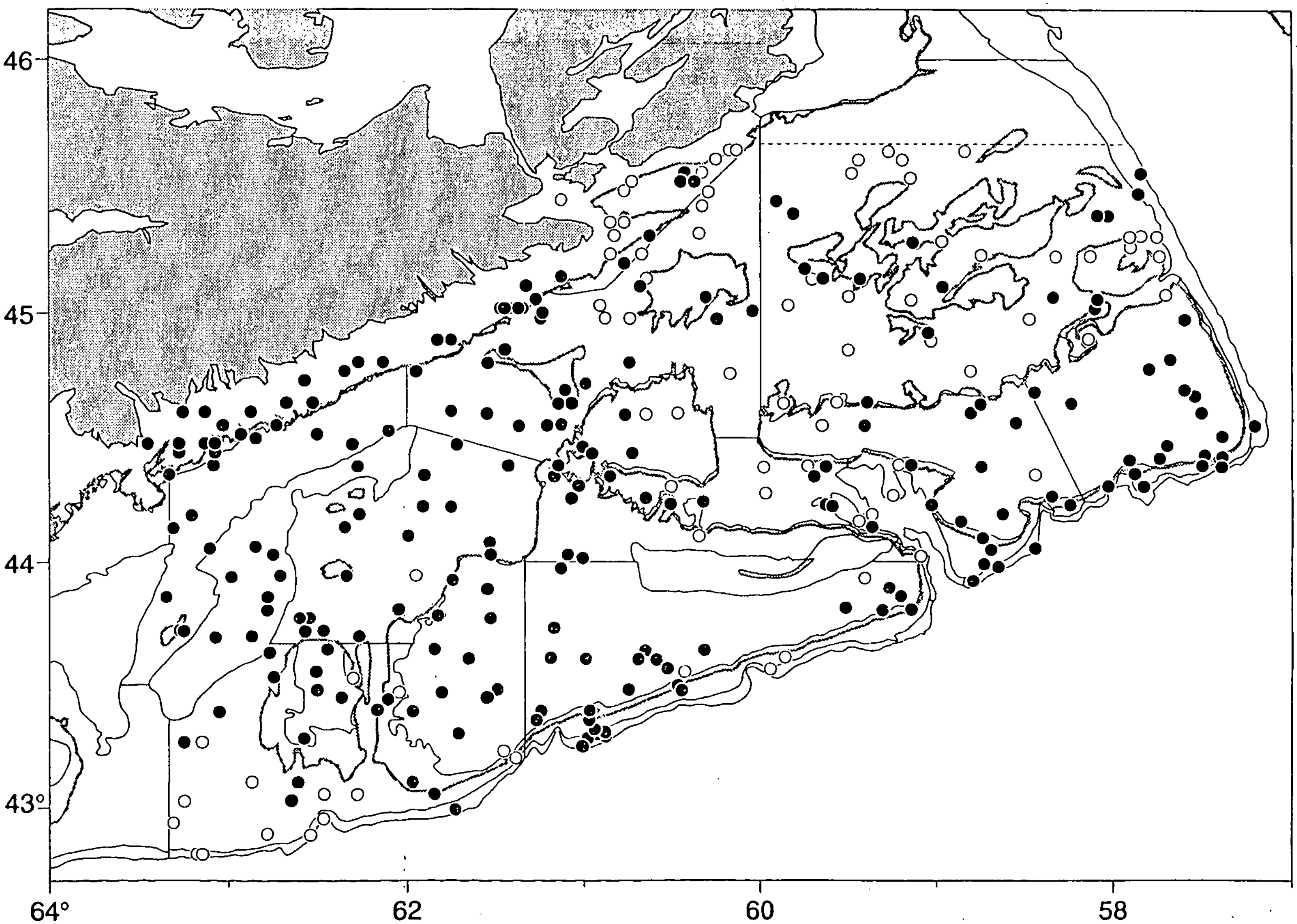

Figure 9. Set locations for the 1995 4VsW Sentinel Survey. Stratification scheme was identical to the summer groundfish stratification with the addition of three inshore strata (less than 50 fm).

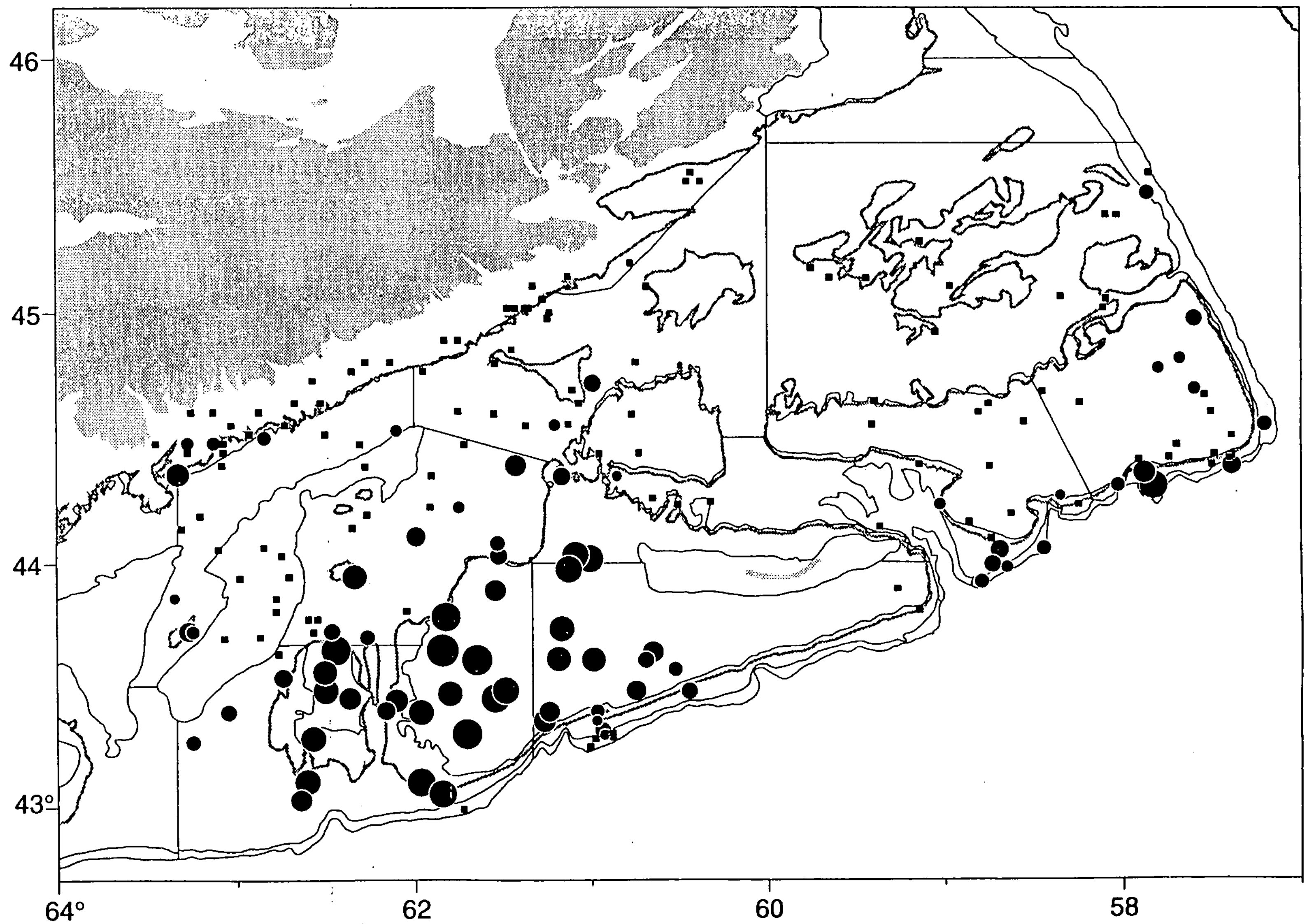

Figure 10. Haddock catches (kg per set) realized during the 1995 sentinel survey.

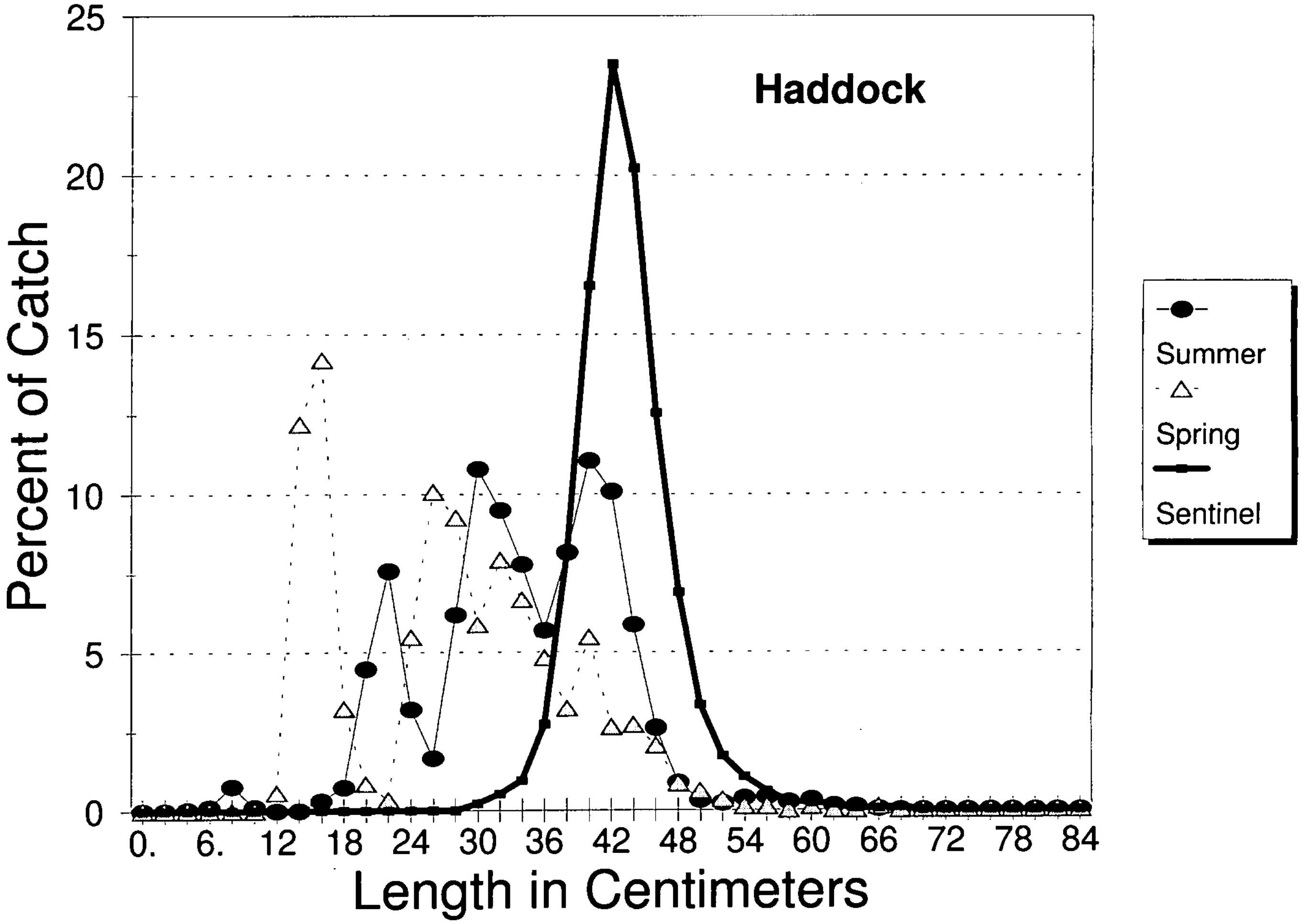

Figure 11. Size frequencies of 4TVW haddock caught by the 1995 sentinel survey relative to the size frequency of haddock caught in the standard spring and summer trawl surveys conducted by DFO.

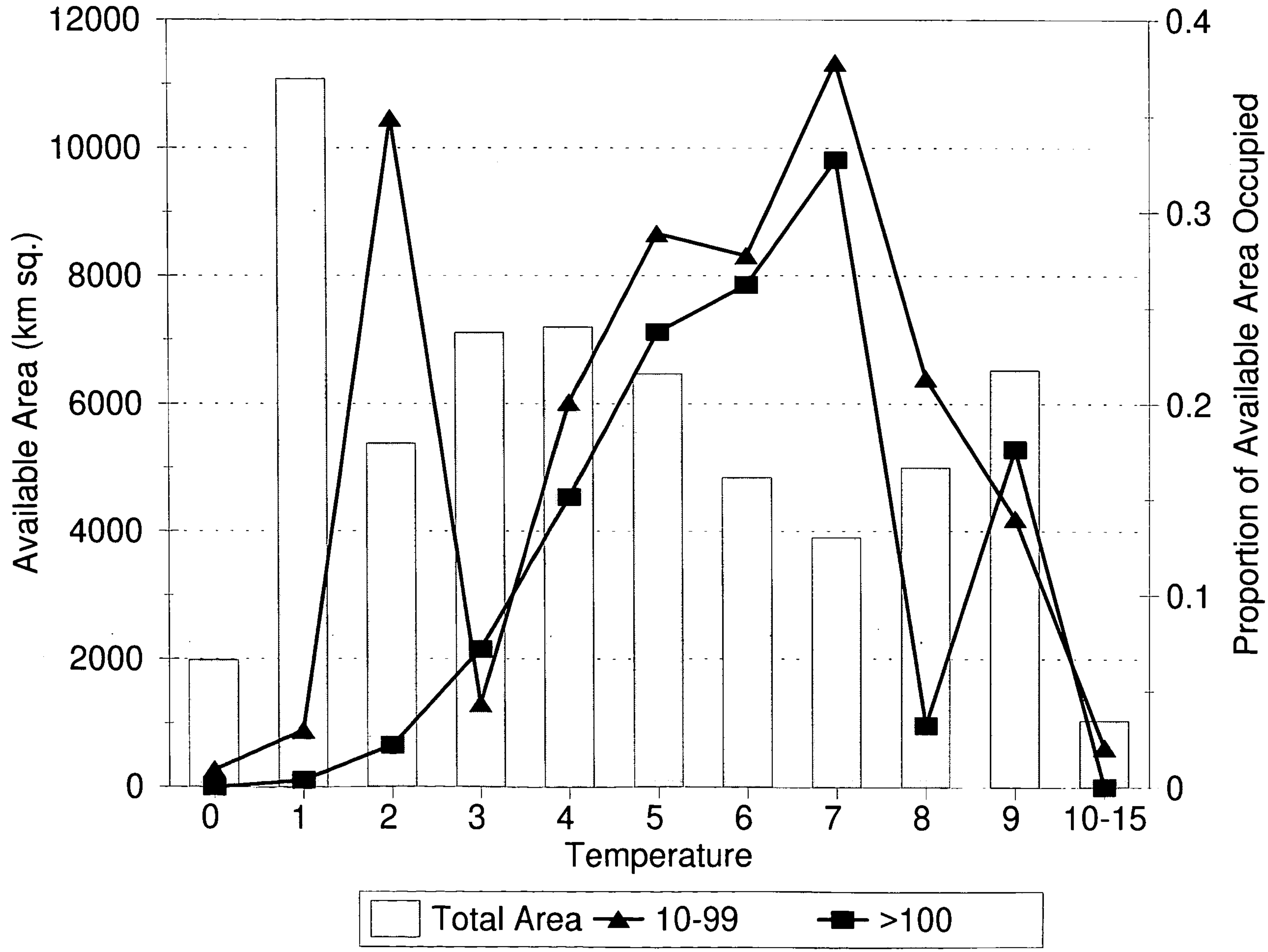

Figure 12. Temperatures occupied by 4VW haddock during the 1995 sentinel survey. The bars represent the total bottom area (square km) available in the survey area at the water temperature indicated. The lines represent the proportion of that available bottom area and temperature occupied by haddock at densities of less than 100 fish per standard set, and densities greater than 100 fish per set.

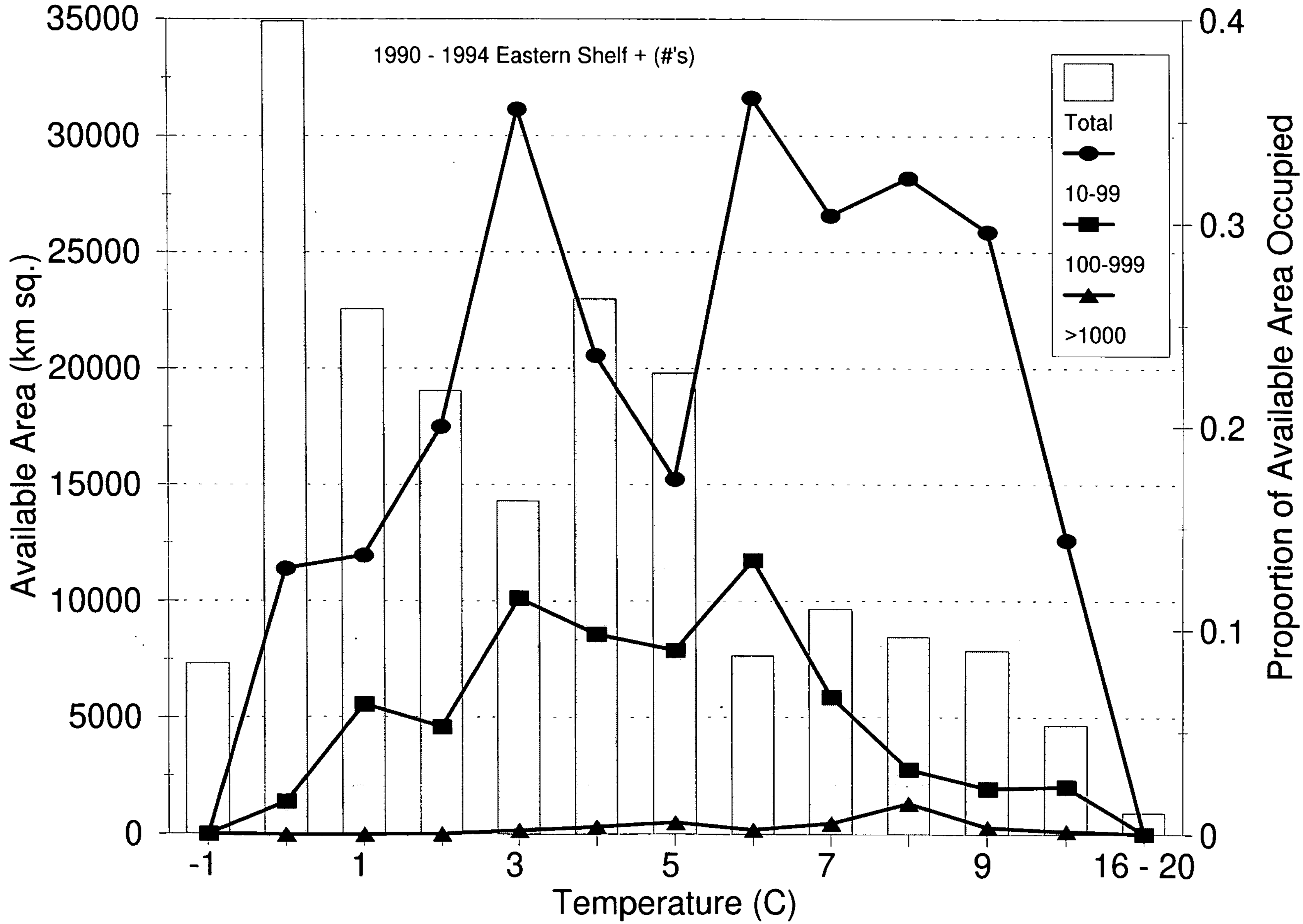

Figure 13. Temperatures occupied by 4VW haddock during the summer trawl surveys of 1990 through 1994. The bars represent the total bottom area (square km) available in the survey area at the water temperature indicated. THe lines represent the proportion of that available bottom area and temperature occupied by haddock at densities of less than 100 fish per standard set, and densities greater than 100 fish per set.

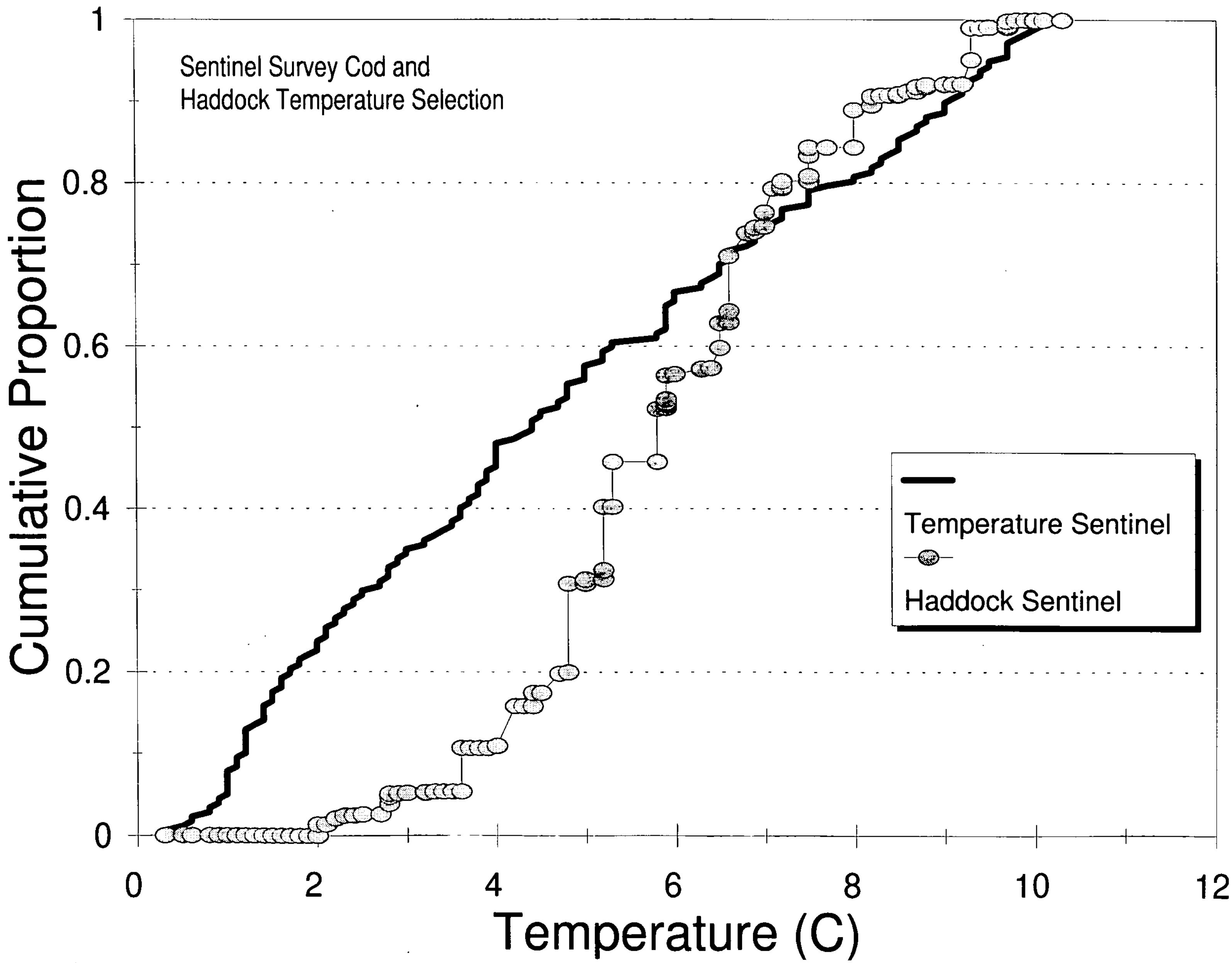

Figure 14. Cumulative Distribution Functions for bottom temperature and haddock catch weighted temperature for the 1995 4VsW Sentinel Survey. The results show that haddock were caught in lower then expected numbers at temperatures below about 4 degrees C and then accumulated relatively rapidly in temperatures between 4 and 8 degrees C.

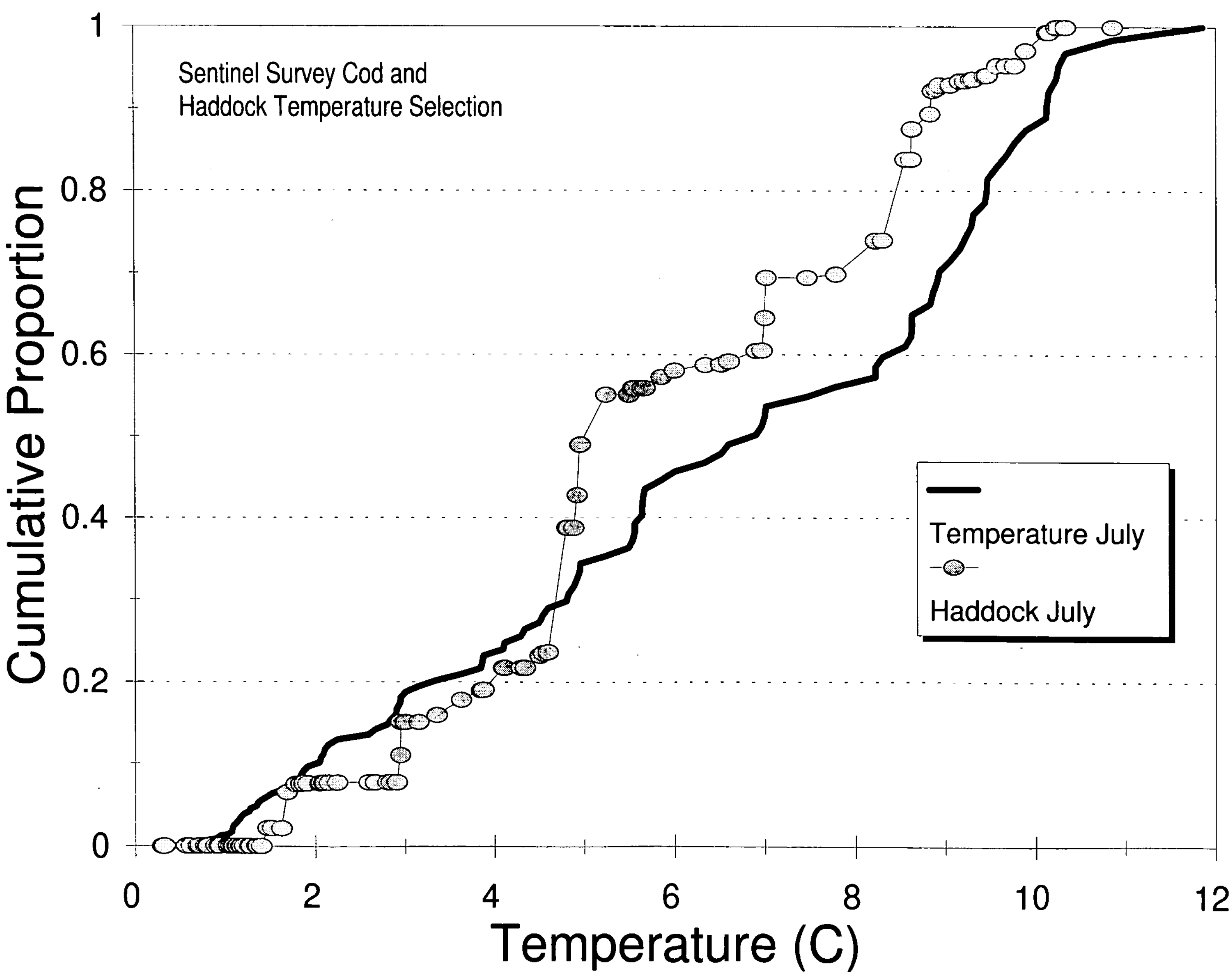

Figure 15. Cumulative Distribution Functions for bottom temperature and haddock catch weighted temperature for the 1995 July trawl survey. The results show that haddock catches accumulated at approximately the same rate as ambient temperature until about 5 degrees C.

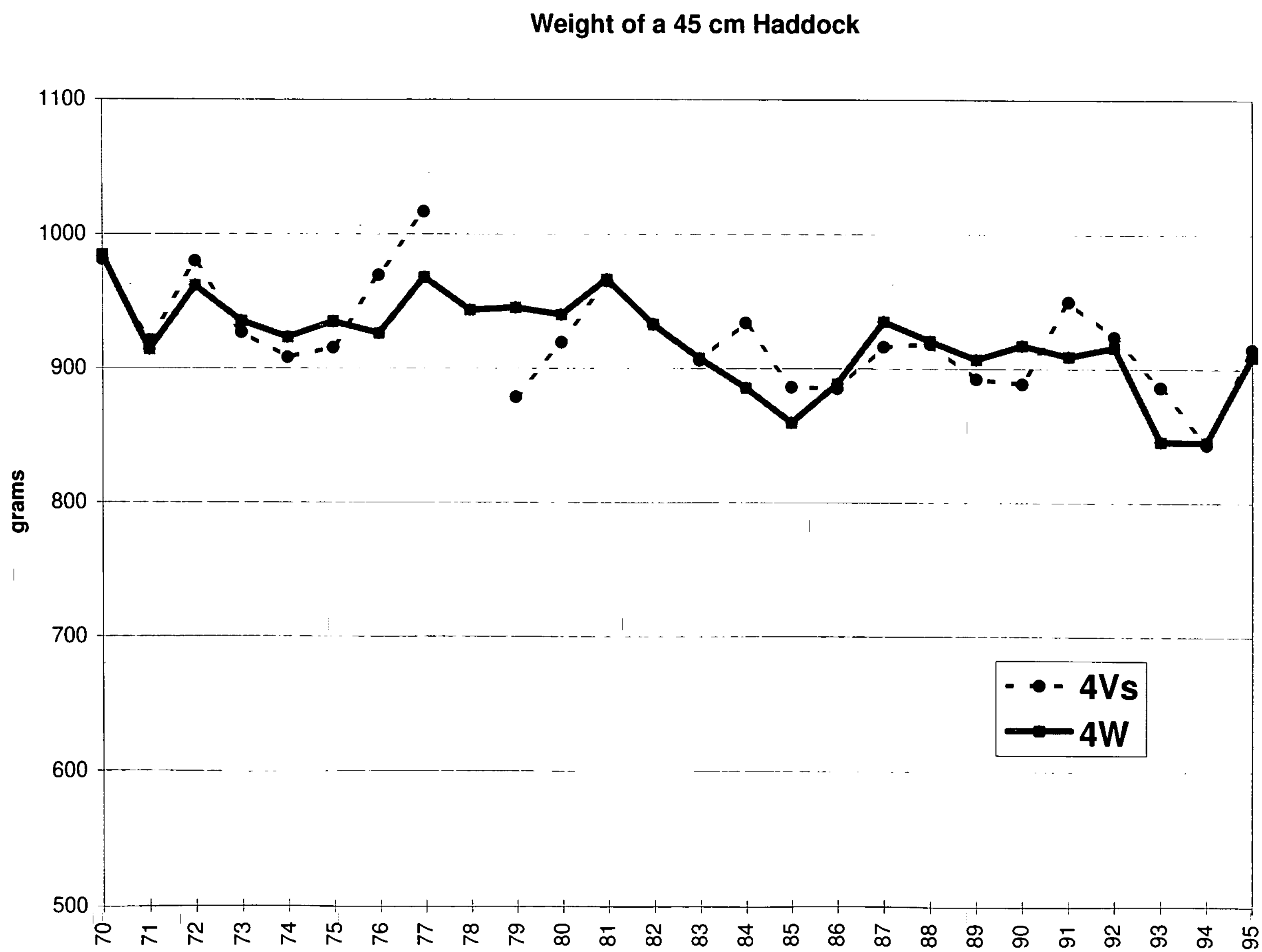

Figure 16. Weight (g) of a haddock at a length of 45cm for Subdivision 4Vs and Division 4W from 1970-1995 as estimated from July research survey catches.

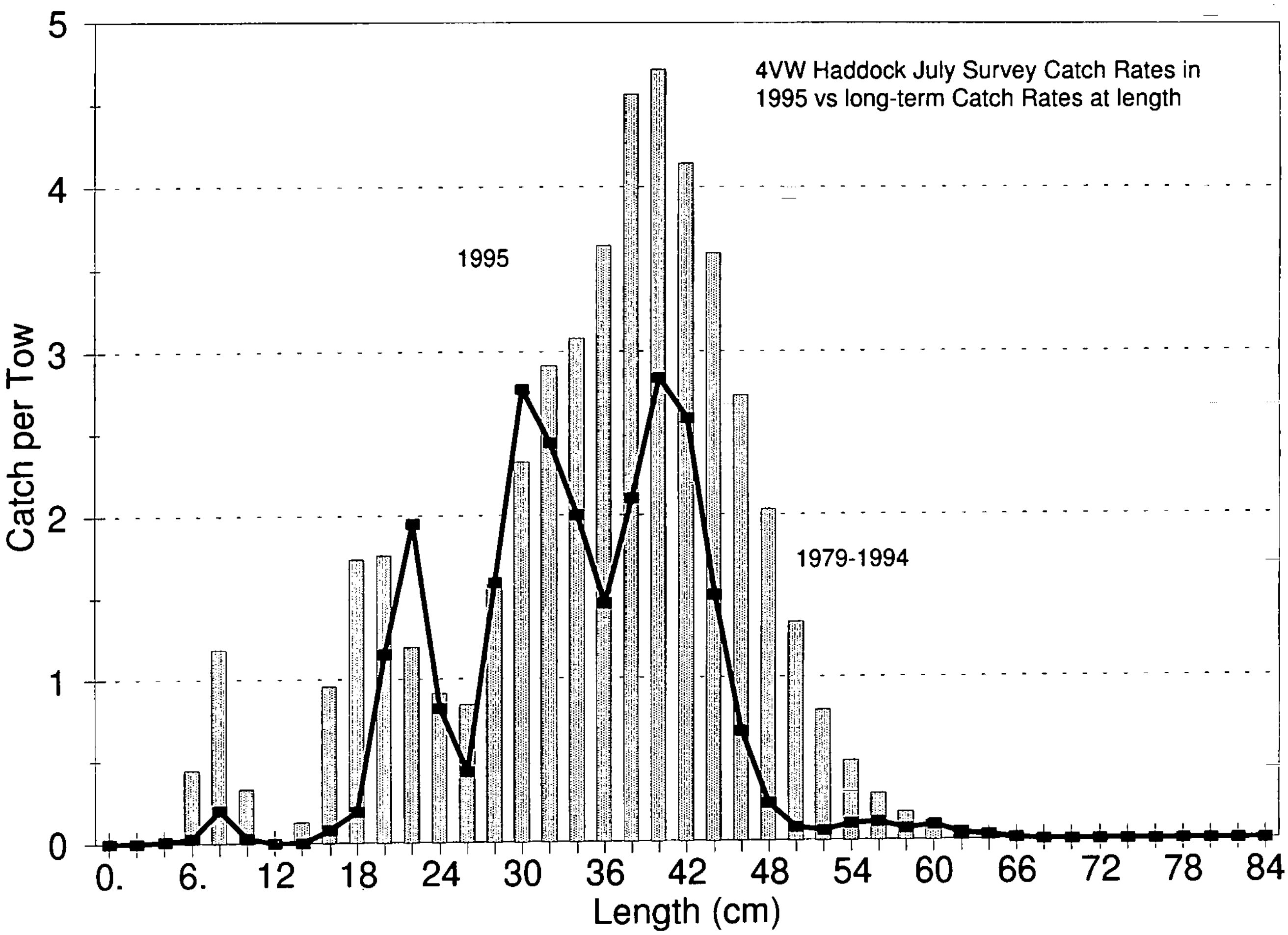

Figure 17. Long-term (1970-1994; bars) and recent (1995; line) catch at length for haddock in Divisions 4VW. Results are from the summer (July) surveys.

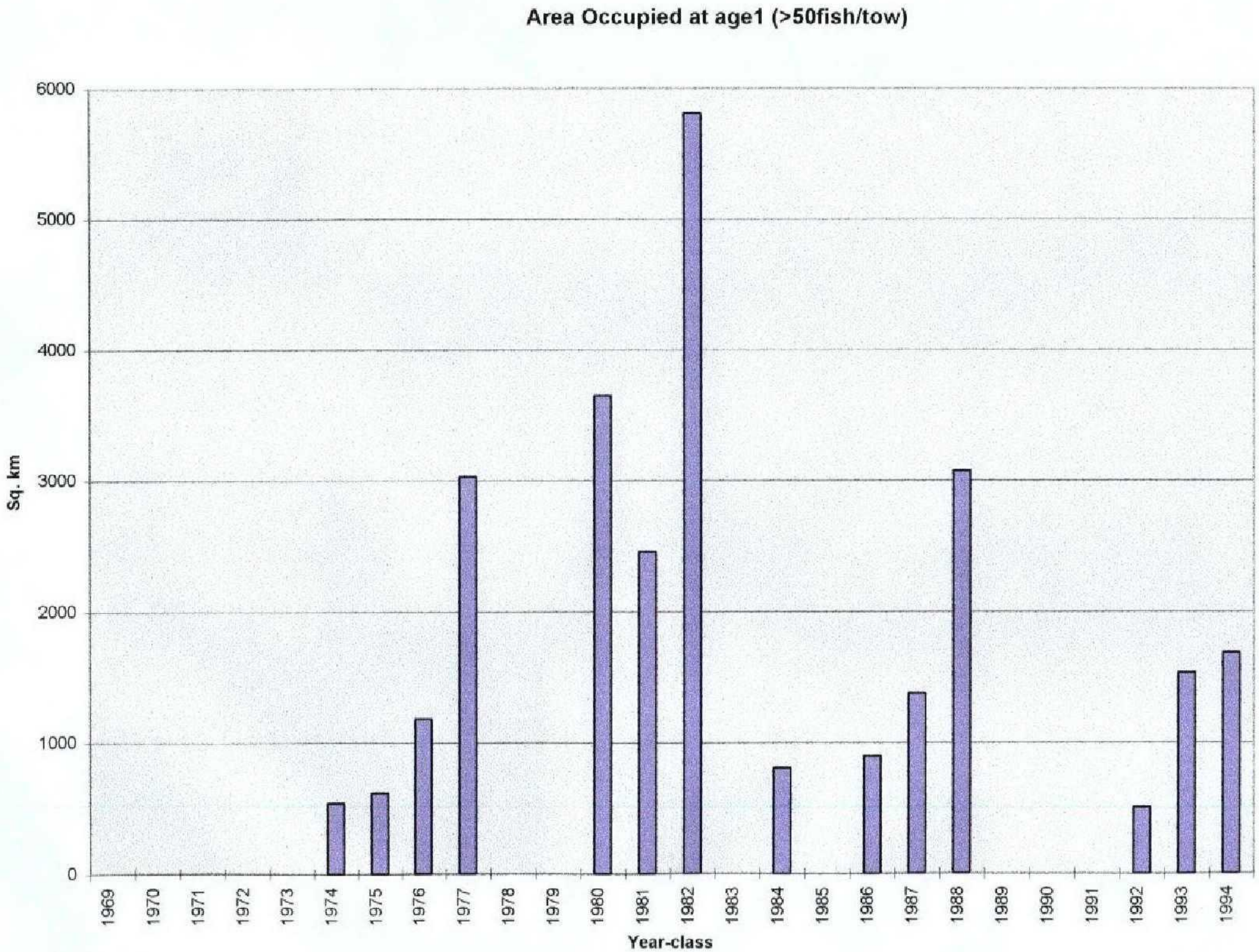

Figure 18. Area occupied (squre km) by 4TVW haddock cohorts at lengths equivalent to age 1 and densities greater than 50 fish per standard tow during the July surveys (1970 to 1995).

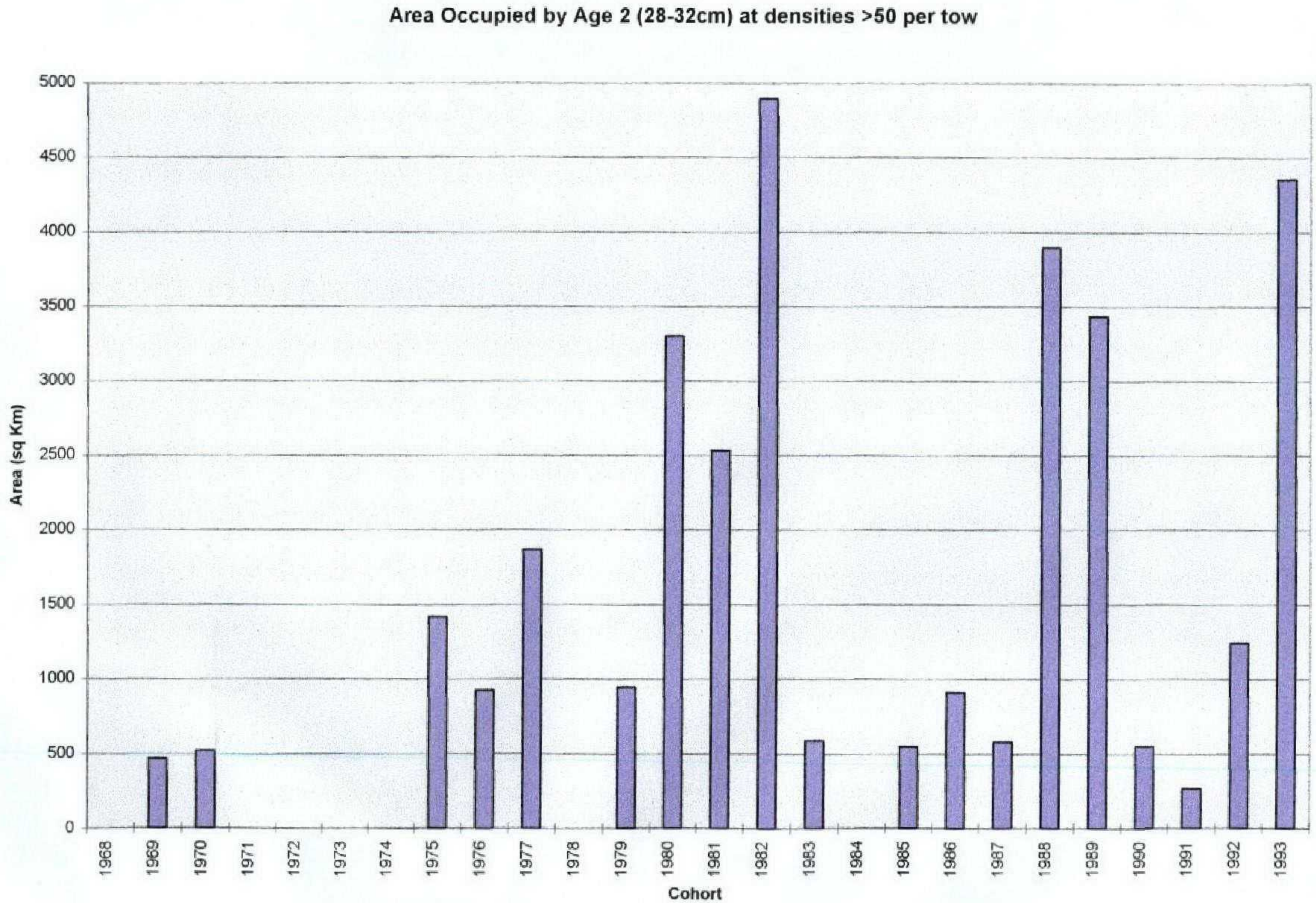

Figure 19. Area occupied (square km) by 4TVW haddock cohorts at lengths equivalent to age 2 and densities greater than 50 fish per standard tow during the July surveys (1970 to 1995).

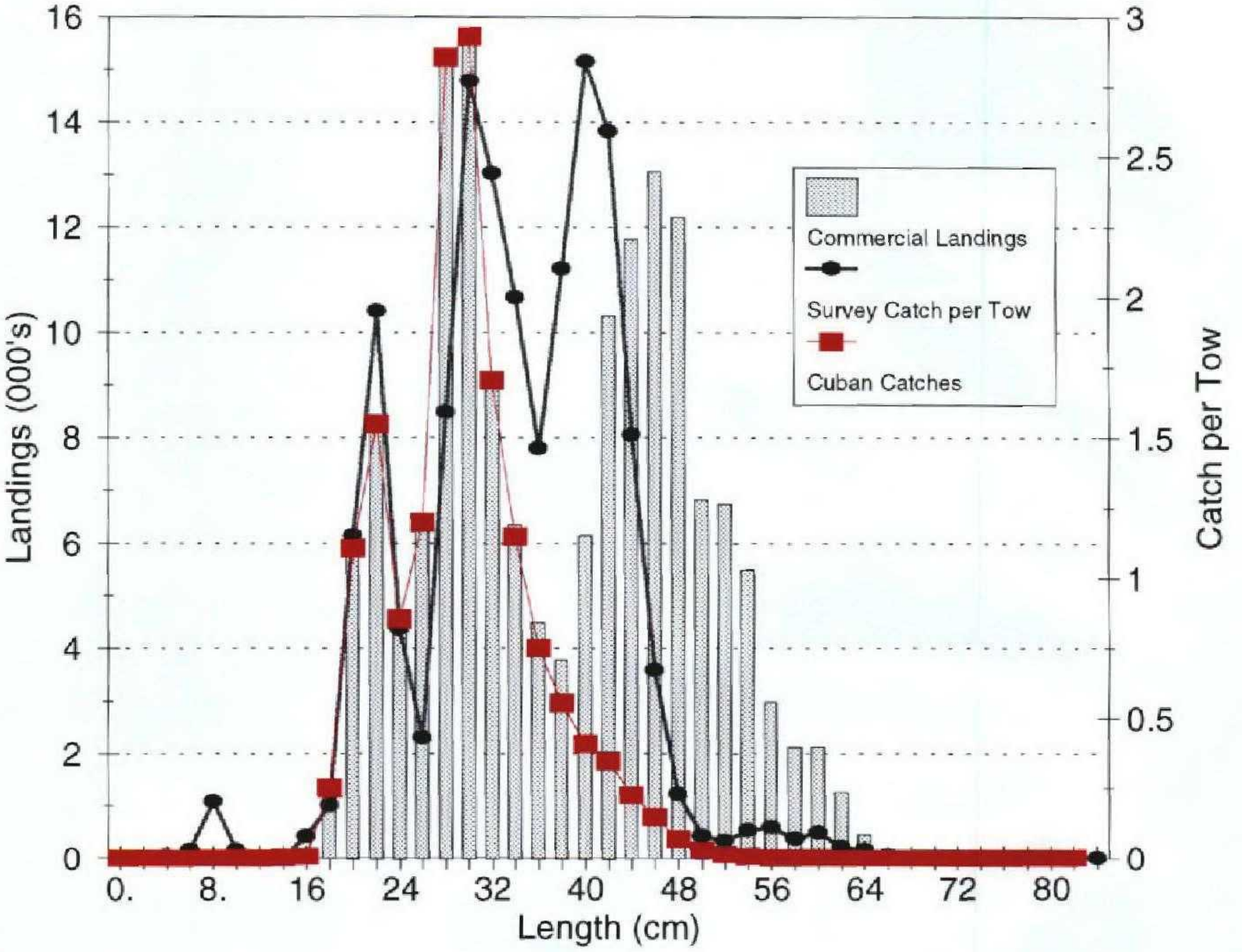

Figure 20. Size grequencies of 4TVW haddock caught by the Cuban small-meshed gear silver hake fishery relative to the size-frequencies of haddock caught by the commercial fleets as a whole and relative to that observed for the summer research vessel surveys. All data are for 1995.

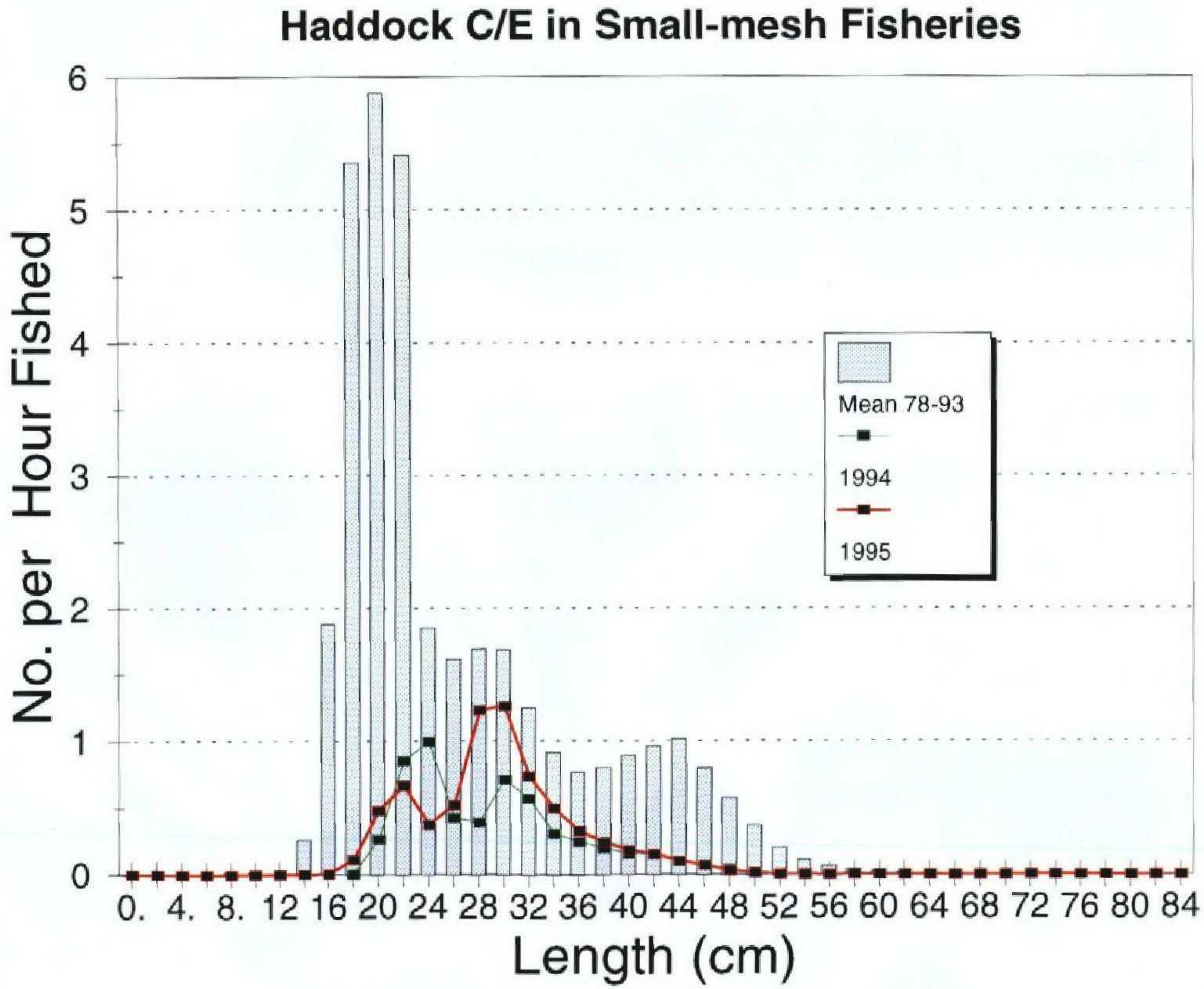

Figure 21. Catch rates at length for 4TVW haddock in the small-meshed gear fishery; long-term (1978-1993) and recent years (1993, 1994).

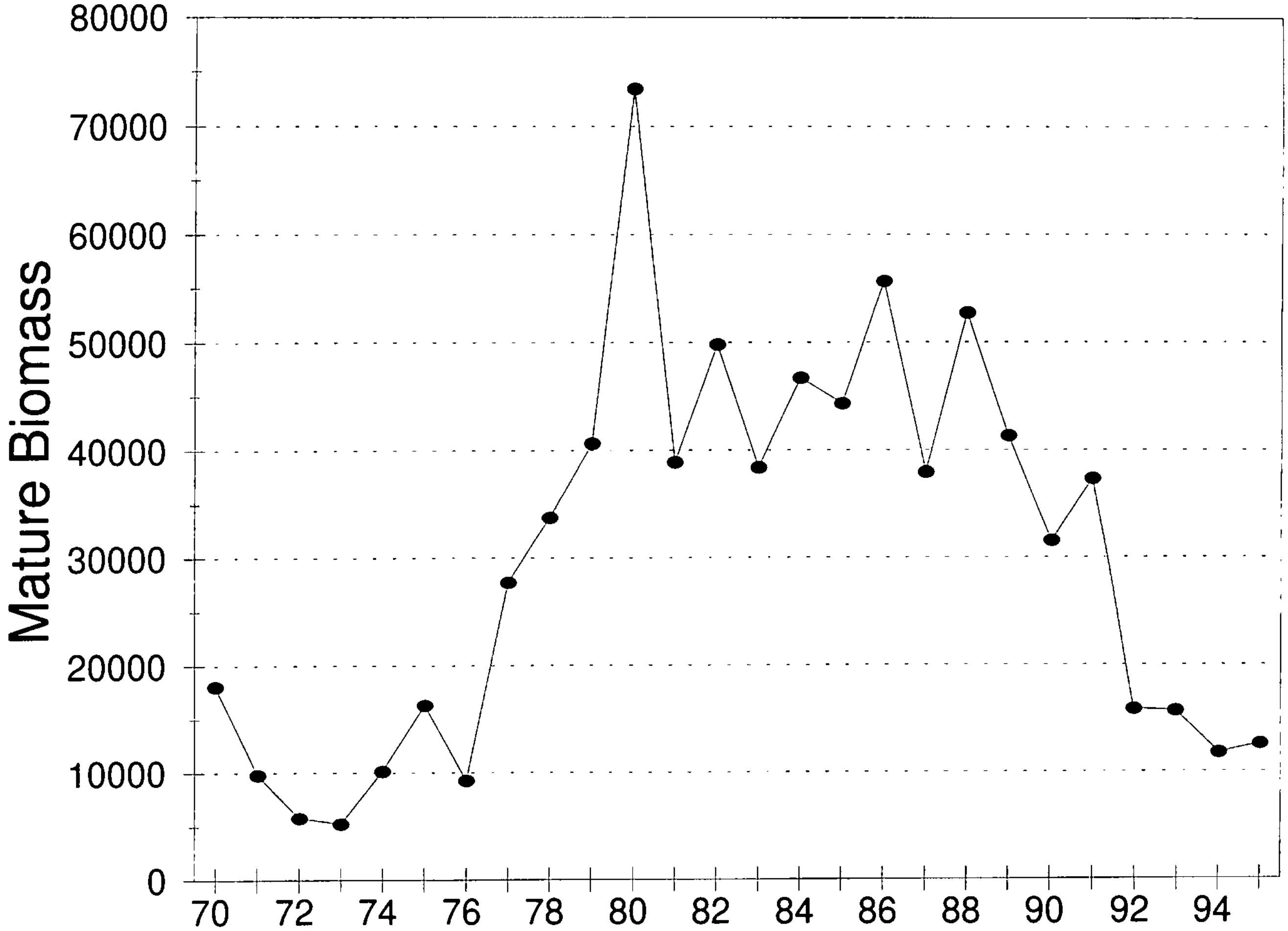

Figure 22. Mature trawlable biomass as estimated from July research vessel surveys.