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An Assessment of Eastern Scotian Shelf Haddock for 1992

by

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Abstract

This fishery has been restricted to by-catches since 1987. The nominal catch in 1991 totalled approximately 5000 t. Most of these landings are now taken by long-liners (63%). Division 4W accounts for approximately 80% of all landings. Landings from 4Vs are sporadic, while landings from 4Vn and 4T are presently negligible. Landings of age 3 fish in 1991 were higher than in the previous four years reflecting the abundance of the 1988 year-class. Maximum age in the 1991 landings is 8 years, continuing a decline in the age span of the landings which started in the early 1980's. Mean weights of fish at ages 4+ have increased since 1985.

Survey results indicate that the 1988 year-class is the largest to enter the population since 1970. They also indicate that this stock is presently abundant only in subarea 4W and especially in and around the closed area. Post 1988 year-classes appear to be below average abundance.

Fishing mortality is presently on the order of 1.0 indicating an exploitation rate of about 58%. Using a relationship between cumulative survey abundance of cohorts at ages 0-3 and their cumulative landings at ages 4 and 5 indicate that the $F_{0.1}$ yield in 1992 should be in the range of 3900 to 6400 t. Due to the presence of the strong 1988 year-class, maintaining the present level of landings will result in some reduction in F; however if it is desirable to allow stock rebuilding more restrictive measures should be considered. Since fisxed gear catches in and around the closed area now represent the largest proposrtion of the landings, it is recommended that a minimum hook-size regulation be established to ensure the protection of young fish.

Résumé

La pêche dans la zone considérée se limite aux prises accidentelles depuis 1987. En 1991 les prises nominales ont atteint environ 5 000 t, provenant la plupart des palangriers (63 p. 100). Les prises en provenance de la division 4W représentent une proportion d'environ 80 p. 100 de tous les débarquements. Les débarquements provenant de 4Vs sont sporadiques, tandis que ceux de 4Vn et de 4T sont actuellement négligeables. En 1991, les poissons de trois ans ont été plus abondants parmi les prises qu'au cours des quatre années précédentes, ce qui reflète l'abondance de la classe d'âge de 1988. L'âge maximal dans ces prises était de huit ans, marquant une diminution de la fourchette d'âges parmi les captures qui s'est amorcée au début des années 80. Les poids moyens des poissons d'âge 4 + ont augmenté depuis 1985.

Les résultats des campagnes d'évaluation révèlent que la classe d'âge de 1988 est la plus importante à se joindre à la population depuis 1970. Ils indiquent aussi que ce stock n'est actuellement abondant que dans la sous-zone 4W, en particulier à l'intérieur de la zone fermée et dans ses environs. L'abondance des classes d'âge postérieures à 1988 semble inférieure à la moyenne.

La mortalité due à la pêche est actuellement de l'ordre de 1,0, dénotant un taux d'exploitation d'environ 58 p. 100. Un rapport entre les données cumulées d'abondance des cohortes aux âges 0-3 et les débarquements cumulés aux âges 4 et 5 indique qu'en 1992 le rendement à $F_{0.1}$ devrait être de l'ordre de 3 900 t à 6 400 t. La présence de la forte classe d'âge de 1988, qui maintient les débarquements à leur niveau actuel, se traduira par une certaine réduction de F; toutefois, si l'on désire assurer le rétablissement du stock, des mesures plus restrictives doivent être envisagées. Puisque dans la zone fermée et dans ses environs les engins fixes capturent la plus grosse proportion des prises, on recommande l'adoption d'une grosseur minimale d'hameçon pour protéger le jeune poisson.

Description of the Fishery to 1992

Landings have averaged 26,500 t per year from 1950 to 1969, 5,000 t from 1970 to 1979 and ranged between 8,000 and 20,000 t until 1987 (Table 1). The nominal catches for 1987 through 1991 have been taken exclusively as by-catch in other groundfish fisheries operating in divisions 4T, 4V and 4W, and totalled approximately 5,000 t in 1991.

In 1987, the combination of reduced recruitment over several successive years (1983-1985), low levels of spawning stock biomass, and the concentration of the fishery on the only two remaining year-classes of any appreciable size (1981, 1982), resulted in the restriction of the fishery to a 5% by-catch. In 1988 this was increased to 15% which remained in effect through 1990. In 1991, catches continued to be managed through a combination of by-catches and trip limits (Table 2) ranging from 450 kg per trip to 15% of landings by >65' mobile gear vessels. Management also imposed a year-round ban on mobile gear fisheries in areas identified as nursery grounds (mainly Western and Emerald banks). The year-round nursery ground closure, imposed in 1987, remains in effect to the present.

Until 1984, most of the catch from this stock was taken from Division 4W by large OTBs (TC4 and TC5) fishing in the spring. From 1984 to 1986 Subdivision 4Vs accounted for 40-60% of the total catch. Since 1987, landings from 4W have increased four-fold (Table 3). Landings in 4Vs doubled from 1987 to 1989, but have since declined by 60%. Landings in 4T and 4Vn are presently negligible. From 1987 to 1991 the proportion of landings contributed by OTBs has decreased from approximately 60% to 35% of annual landings while the by longliners portion has increased from 21% to 63% (Table 4). Longline landings in 1991 are the highest observed since 1960. Seine landings presently represent about 2% of the annual total. The largest proportion of the annual landings are presently recorded during the second and third quarters (Table 5). Trawler landings in 4Vs in 1991 decreased in all quarters from 1990, with a small increase in 4W (Table 6). Longline landings were similar to those in 1990 for both 4Vs and 4W, with a similar distribution by quarter.

Age Composition and Weight-at-Age of the Catch

The age composition of the 1990 small mesh gear catch in the foreign fishery was estimated by applying the July RV age-length key to the length frequency distribution of the haddock by-catch. The age composition of Canadian landings in 1991 was based on age-length keys for half-year catches by Division, and Subdivision where sampling was adequate. The components of the 1991 catch at age are given in tables 7 and 8. Weights at age for each component are given in Table 8a.

The catch at age in 1991 was composed primarily of the 1986-1988 year-classes, representing 87% of the total numbers caught (31%, 36% and 20% respectively). By weight these three year classes accounted for 86% of the total landings (12%, 33% and 41% respectively for the 1988, 1987 and 1986 year-classes). The landings of age 3 fish in 1991 were higher than they have been in the past four years consistent with a relatively large 1988 year class as

observed in the past two years (Table 9). The proportional age composition of fixed and mobile gear catches have been similar since 1986.

Since 1984 the maximum age in the landings has diminished to the point where in 1991 the oldest fish was 8 years old. Mean weights at age estimated from commercial landings are given on Table 10 and Figure 1. Mean weights of fish aged 4 and older have increased since 1985. The increases are particularly notable at ages 7 and 8 although these fish are relatively scarce in the catch and the estimates are variable. Mean weights of younger fish have remained relatively stable over this same period. Fish older than 7 presently represent 1% of the total numbers landed.

Commercial Catch Rates

The by-catch nature of this fishery since 1987 does not allow for a comparison of present catch rates to those of earlier years from directed fisheries. By-catch catch rates are not considered to be representative of the abundance of this stock.

Research Vessel Index

The research survey catch rates at age in 4VW show a decline in overall abundance from 1983 to 1987 (Figure 2). Since 1987 the catch rate has increased. Estimates of the 1988 year-class at ages 1, 2, and 3 indicate that this is one of the largest year-classes to enter the population since 1970 (Table 11). The associated CVs of between 27 and 40% of the mean catch per tow of the 1988 year-class at ages 0 through 2 show that this is a relatively reliable estimate (Table 12).

Disaggregation of the research vessel survey series into area and age components shows that the population in Subdivision 4Vn is composed mainly of fish aged 4+ (Figure 3a). Age 0 fish have never been observed in the survey of this area, while fish at ages 1-3 have occurred in less than 50% of the surveys. This probably indicates limited spawning activity in the area. Research vessel catch rates show clearly the influx and subsequent decline of the 1981 and 1982 year-classes beginning in 1984. Since these two large year-classes, there has been no significant recruitment to this part of the population (Table 13).

Contrary to the observations from 4Vn, age 1 fish have been observed in 4Vs in 18 of the past 22 years. Age 0 fish are observed only rarely. Overall catch rates in 4Vs increased rapidly in 1982 (Figure 3b) as a result of the abundant 1981 year-class. These catch rates declined to pre-1982 values by 1989. The 1988 year-class caused a slight increase in 1990, but this has again declined in 1991 (Table 14).

Division 4W has traditionally been the centre of distribution of this resource as evidenced by the significantly higher catch rates observed there (Figure 3c). Age 0 fish have been observed in 18 of the past 22 years while age 1 fish are present in all years. Catches of fish aged 0-3 increased after 1977, following the exclusion of the foreign fleet. The peak in recent catch rates occurred in 1983 due to the presence of the 1980-1982 year-classes. Catch rates at these younger

ages declined from 1983 to 1987 as these year-classes aged and were followed by less abundant ones. The post-1987 catch rates at ages 0-3 increased due to the abundance of the 1988 year-class. Catch rates at ages 4+, which peaked in 1984, continue to decline to the present, to a point where they now equal catch rates of the late 1970s and early 1980s (Table 15).

Survey estimates of haddock biomass at age give the same general impression of the resource (Figure 4a). Biomass in Subdivision 4Vn peaked in the mid-1980s as a result of the incursion of the early 1980's year-classes. The proportion of total biomass represented by fish aged 0-3 in this area has been very small since 1970 (Figure 4b). Total biomass in 4Vs increased rapidly in 1982 and has since declined to pre-1982 values (Figure 4c) with little evidence of significant new recruitment. Division 4W is clearly the centre of distribution for this resource. Biomass reached a recent maximum in 1980 and was comprised mainly of fish aged 4+ (Figure 4d). Since then total biomass fluctuated to a low in 1987. Since 1987, 4+ biomass appears to have continued a decline while biomass in the younger ages (0-3) has increased sharply. Presently age 0-3 biomass exceeds 4+ biomass.

The maximum age observed in the survey has been declining since the early 1980s. Since 1989 the oldest fish in the survey is 7 while in the early 1980s fish at ages 10 and 11 were observed with some as old as age 15.

The view of the resource derived from the groundfish surveys is consistent with that put forth by much of the industry prosecuting this resource. Catches of haddock in 4T and 4Vn are presently negligible, while catches in 4Vs are low and fish are generally hard to find. Catches have increased significantly in 4W since 1987 to the point where they are classified as good. Reports from fixed gear fishermen fishing inside the closed area indicate that fish there are relatively plentiful. Early reports for 1992 indicate that catches of haddock on Sable Island Bank, adjacent to the closed area, are good and that large trawlers (TC 5) have begun to fish the area more intensely than has been the case in the recent past.

In addition to the age based analysis of the survey data, catch rates at length were also examined. Figure 5 shows the mean catch per tow at length for all 22 years of survey data available. Two points are noteworthy; the first is the clarity of the modes for ages 0 through 2+ at 8.5 cm, 20.5 cm, 32.5 cm, and the second is the relative size of the 1988 year-class at a modal length of 34.5 cm. This year-class is evident as an above average mode in Division 4W (Figure 6c). Although it was above average at age 2 (28.5 cm) in 4Vs in 1990, the estimate at age 3 falls below the average (Figure 6b). There is no evidence of this year class in 4Vn (Figure 6a).

Mean weights at age estimated from surveys are presented in Figure 7 and roughly parallel those estimated from commercial data (Figure 1).

Estimation of Stock Parameters

The results of a number of formulations of the adaptive framework resulted in retrospective estimates of F far in excess of what had been estimated in that year (see below). These results led us to question the validity of the estimates of F in the current year. In the absence of a

satisfactory explanation for the increase in retrospective F, the results of the adaptive framework were considered to be unreliable.

Fully recruited F in current and retrospective year.

	Fishing Mortality		
Year	1989	1990	1991
1989	0.323	1.537	1.730
1990		0.809	1.915
1991			0.414

Assessment Results

Fishing Mortality, Stock Abundance, and Recruitment

Total mortality estimates from survey catch rates at age indicate an F in recent years well above $F_{0.1}$ = 0.25; however, these estimates are extremely variable and can be interpreted only as indicating trends and magnitudes of fishing mortality. Fishing mortalities estimated from survey catch rates at ages 4-6 versus ages 5-7 show an increase over the time series with present estimates at approximately 1.0 (Figure 9). Estimates of F (at ages 4-5) by cohort, from an illustrative run of ADAPT indicate a similar trend with F's on the 1983 cohort in the vicinity of 1.0 (Figure 10). The mean weight of a fish in the commercial catch corroborates, to some extent, the high mortalities estimated from surveys in that is indicates exploitation rates well in excess of F_{max} (Figure 8).

Results of the 1991 survey continue to indicate that the 1988 year class is large relative to other year-classes observed since 1970. Although previous surveys indicated that this year class was large in both 4W and 4Vs, present observations show that it remains well above average only in 4W (Figure 3). Whether or not this is due to a an artifact of sampling in 4Vs at present, will only be determined by subsequent surveys. It is; however, clear that this year class presently predominates in Division 4W. Anecdotal information from the fishery in 1991 and early in 1992 tend to corroborate this view. Fishermen indicate that "small" haddock are relatively abundant particularly in the closed area and adjacent Sable Island Bank. Research vessel catch rates inside the closed area and in adjacent strata tend to agree with industries observations. These show that abundance inside the closed area has increased at younger ages (0-3) since 1987 (Figure 11a) and decreased for ages 4+ since 1986. In waters adjacent to the closed area, abundance has also increased at younger ages (Figure 11b). Increases in both areas are due mainly to the presence of the 1988 year class. Estimates of the post-1988 year-classes do not indicate that these will be above average in abundance.

Prognosis

Research vessel catch rates at ages 0-3 and subsequent landings in the commercial fishery have shown a significant correlation for the 1970-1986 cohorts (Figures 12 and 13). This was

used to derive an estimated landing of approximately 13.5 million individuals from the 1988 year-class at ages 4-5 in combined over next two years. The average proportion of catches at ages 4 and 5 of the total caught at those ages was 0.49 and 0.51 for the 1970 through 1986 cohorts, not significantly different from 50:50. If present F's are approximately 1.0 then fishing at $F_{0.1}$ = 0.25 should yield about 4.6 million fish over the next two years with about equal numbers caught in each year. Using weights at ages 4 and 5 averaged from 1989-91 of 0.94 and 1.29 kg, we expect landings of 2200 and 3000 t respectively from this cohort over the next two years.

Using this approach was can also estimate the catch at age 5 from the 1987 cohort in 1992. At $F_{0.1}$ = 0.25 the catch of age 5 fish in 1992 should be approximately 1.0 million fish with a total weight of about 1200 t. Since landings of at ages 4 and 5 can be expected to account for 50 to 87% of the total landings, the total landings at $F_{0.1}$ = 0.25 in 1992 should be in the range of 3900 and 6400 t.

Although we are unable to estimate F precisely in 1990 there are a number of indicators which show that this stock has experienced heavy exploitation in the recent past and probably continues to be exploited at high rates even under present by-catch restrictions. There are indications that F's are presently on the order of 1.0 or above. The reduction in the overall age span of the sock to the point where fish older than age 7 are relatively rare also indicates heavy exploitation over a long period. The increases in allowable by-catch rates for 1988 through 1991 will not result in a reduction of this exploitation. Although the presence of the strong 1988 year-class is encouraging the early indications of post-1988 year-classes are that these will not be large. Due to the strong 1988 year-class, maintaining the present catch (approx. 5000 t) will result in some reduction of fishing mortality; however, if it is desirable to allow stock rebuilding, more restrictive measures should be considered.

The relatively large 1988 year-class, could be interpreted as a sign of stock rebuilding. The clearest signs of this potential rebuilding are seen in Division 4W, particularly in and around the closed area. The connection between establishment of the closed area and subsequent increases in haddock abundance cannot be proven; however, the observations presented are consistent with this hypothesis. Given that fishing mortalities remain high the Subcommittee recommends that the closed area remain in effect. The Subcommittee notes that fixed gear catches inside the closed area now represent the largest proportion of the catch. To ensure the protection of young haddock in closed area, the Subcommittee recommends the establishment of a minimum hook size requirement for this area.

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	87					423					3104					3497		**683			7794	6700
*1990	32					108					2419					4050		266		97	6972	6000
*1991	2					45					951					3722		106		45	4871	0

+ -- Between 1954 and 1958 catches for 4Vn and 4Vs were combined as 4V.
* -- Provisional data
** -- From Observer data (USSR and CUBA combined)

Table 2. Management framework for 1991 4TVW haddock.

Haddock 4VW; Fixed Gear <45'; Scotia-Fundy Based			
A_1, A_3	January 1	Lic C	1500 kg/30% by-catch
A_1, A_3	January 15	Lic C	2500 kg/30% by-catch
A_4 (HL) Cod/Had/Pol 4VWX5	March 1	Lic Cond	450 kg
A_4 (HL) Cod/Had/Pol 4VWX5Y	June 1	Lic Cond	2270 kg cod 1500 kg haddock
A_4 (HL) Cod/Had/Pol 4VWX5Y	November 21	Lic Cond *1991-129 (4X cod)	1500 kg each cod & haddock
A_4 (HL) all groundfish 4VWX5	May 1	Lic Cond	2000 kg
Fixed Gear <45'; Gulf Based			
FG <45'	January 1	Lic Cond	1500 kg/30% by-catch
FG <45'	January 15	Lic Cond	2500 kg/30% by-catch
Fixed Gear 45-65'; Scotia-Fundy Based			
A_2	January 1	Lic Cond	1500 kg/30% by-catch
A_2	January 15	Lic Cond	2500 kg/30% by-catch
A_4 (HL) Cod/Had/Pol 4VWX5	March 1	Lic Cond	450 kg
A_4 (HL) Cod/Had/Pol 4VWX5Y	June 1	Lic Cond	2270 kg cod 1500 kg haddock
A_4 (HL) Cod/Had/Pol 4VWX5Y	November 21	Lic Cond *1991-129 (4X cod only)	1500kg each cod & haddock
4VWX5 all groundfish	May 1	Lic Cond	2000 kg
Mobile Gear <45'; Scotia-Fundy Based			
C_3 (ENS competitive)	January 1	Lic Cond	1500 kg
C_3 (ENS competitive)	March 1	Lic Cond	closed until further notice
Mobile Gear <45'; Gulf Based			
C_{50}-C_{149}	January 1	Lic Cond	1500 kg
C_{50}-C_{149} C_{2100}-C_{2899}	July 1	Lic Cond	10% by-catch only
C_{50}-C_{149} C_{2100}-C_{2899}	September 1	Lic Cond	0kg/0% by-catch

Table 2. (Continued)

Mobile Gear 45-65′; Gulf Based			
C_{350}-C_{600}	January 1	1991-012	10% by-catch only
C_{350}-C_{600}	May 1	1991-060	revokes 1991-012 as per lic cond 1500 kg/10% by-catch
Mobile Gear >65′; Gulf Based			
B_1-B_{20} D_1-D_{20}	January 1	1991-005	10% by-catch only
B_1-B_{20} D_1-D_{20}	January 23	1991-016	revokes 1991-005 15% by-catch only

Table 3 . 4TVW haddock landings (t) by division and subdivision (Canadian catches only from inter-regional data).

Area	1986	1987	1988	1989	1990	1991
4T	553	453	383	79	30	12
4Vn	899	491	506	421	108	52
4Vs	8719	1547	2041	3114	2427	975
4W	6170	991	1150	3580	4078	3999
TOTAL	16341	3481	4080	7194	6643	5038

Table 4. Canadian nominal catches (t) of eastern Scotian Shelf haddock (4TVW) by gear. (From IS files for 86-88.)

Year	Otter Trawler	Longliner	Danish/Scottish Seiner	Misc.	Total
1960	20835	1077	23	696	22631
1961	22060	448	52	1377	23937
1962	16453	665	76	705	17899
1963	11943	511	147	526	13127
1964	10679	70	62	874	11685
1965	8033	352	66	160	8611
1966	10222	233	19	130	10604
1967	7855	126	25	573	8579
1968	8819	296	16	364	9495
1969	8603	289	30	341	9263
1970	5056	479	20	262	5817
1971	8709	538	77	179	9503
1972	2141	528	76	138	2883
1973	2459	628	28	232	3347
1974	543	493	17	162	1215
1975	593	873	10	82	1558
1976	383	657	10	75	1125
1977	2198	729	26	170	3123
1978	4009	1069	67	340	5485
1979	1745	1232	66	147	3190
1980	13063	933	229	270	14495
1981	17859	1253	464	113	19689
1982	12346	1567	890	249	15052
1983	6969	1254	541	235	8997
1984	6188	908	451	112	7659
1985	9548	822	830	50	11249
1986	13952	1105	1179	106	16341
1987	2077	736	585	83	3481
1988	2341	1134	424	180	4080
1989*	4333	2322	475	64	7194
1990*	2971	3149	417	106	6643
1991*	1725	3154	106	54	5038

* - Provisional Statistics

Table 5. 4TVW haddock landings by quarter and major gear type 1986-1989 (Canadian landings only). (From IS files)

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 5 . (Continued)

Gear	1990					1991				
	Q1	Q2	Q3	Q4	TOTAL	Q1	Q2	Q3	Q4	TOTAL
OTB	1092	957	664	258	2971	339	574	402	410	1725
LL	838	474	1341	497	3149	439	666	1412	636	3154
SNU	15	168	223	11	417	3	78	18	6	106
Other	0	7	64	35	106	1	17	33	4	54
TOTAL	1945	1606	2292	800	6643	782	1335	1865	1055	5038

Table 6. 4TVW haddock landings by area, quarter and gear type (Canadian landings only).

Year	4T					
	Gear	Q1	Q2	Q3	Q4	Total
1986	OTB	9	71	85	4	169
	LL	0	2	6	5	12
	SNU	0	261	83	16	359
	Other	0	1	10	1	13
	TOTAL	9	336	184	25	554
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	0	0
	SNU	0	7	1	0	9
	Other	0	0	0	0	1
	TOTAL	0	11	2	0	12

Table 6. (Continued)

Year	4Vn					
	Gear	Q1	Q2	Q3	Q4	Total
1986	OTB	67	139	180	18	405
	LL	0	27	87	47	161
	SNU	0	190	134	4	328
	Other	0	1	3	1	6
	TOTAL	67	356	405	71	899
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	424
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	9	4	2	23
	LL	0	2	14	3	19
	SNU	0	5	2	0	7
	Other	0	0	3	0	3
	TOTAL	8	15	23	6	52

Table 6. (Continued)

Year	4Vs					
	Gear	Q1	Q2	Q3	Q4	Total
1986	OTB	810	3666	3093	917	8485
	LL	4	93	115	0	212
	SNU	0	17	3	0	19
	Other	0	0	2	0	2
	TOTAL	814	3775	3212	917	8719
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	187	255	103	131	676
	LL	3	120	133	10	267
	SNU	1	28	2	1	32
	Other	0	0	0	0	0
	TOTAL	191	404	238	142	974

Table 6. (Continued)

Year	4W					
	Gear	Q1	Q2	Q3	Q4	Total
1986	OTB	2186	282	302	2122	4893
	LL	82	81	328	229	719
	SNU	121	16	130	206	472
	Other	1	12	50	23	86
	TOTAL	2391	391	810	2579	6170
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	144	307	295	277	1023
	LL	436	544	1266	622	2868
	SNU	3	39	12	5	58
	Other	1	16	30	4	50
	TOTAL	583	906	1603	907	3999

Table 7. Composition of age-length keys for 1991.

	1st Half		2nd Half	
	OTB	LL*	OTB	LL*
4TV				
# Sampled	9	12	5	12
# Measured	1923	2129	863	2567
# Aged	207	118	106	121
Catch	503	1105	247	2052
4W				
# Sampled	8		3	
# Measured	1691		497	
# Aged	169		33	
Catch	492		589	

* = 4TVW combined

Table 8a. Composition of the 1992 4TVW haddock catch at age (000s of fish).

Age	4TV		4W		4TVW		SMG	Total
	Trawlers 1st Half	Trawlers 2nd Half	Trawlers 1st Half	Trawlers 2nd Half	Longliner 1st Half	Longliner 2nd Half		
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	12	12
2	0	0	0	0	0	0	133	133
3	2	12	117	188	47	371	298	1035
4	35	52	159	339	362	814	85	1846
5	147	74	162	133	481	542	54	1593
6	133	31	59	2	82	129	31	467
7	24	2	12	0	4	5	0	47
8	0	0	1	0	0	1	0	2
Total	341	171	510	662	976	1862	613	5105

Table 8h Weights at age (kg) for 1992 commercial catch.

Age	4TV		4W		4TVW		SMG	Total
	Trawlers 1st Half	Trawlers 2nd Half	Trawlers 1st Half	Trawlers 2nd Half	Longliner 1st Half	Longliner 2nd Half		
0	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	0.17	0.17
2	-	0.34	-	-	-	-	0.29	0.29
3	0.67	0.68	0.40	0.66	0.58	0.70	0.46	0.58
4	0.93	1.09	0.71	0.90	0.90	0.96	0.94	0.91
5	1.33	1.50	1.23	1.17	1.25	1.34	1.32	1.29
6	1.66	2.14	1.79	1.67	1.73	2.03	1.71	1.83
7	2.25	3.06	2.20	-	2.22	3.45	-	2.40
8	4.35	5.12	2.54	-	-	4.37	-	3.46

Table 9. Commercial catch at age 4TVW haddock (000s of fish).

Year	Age										
	1	2	3	4	5	6	7	8	9	10	11
1948	0	0	177	2194	3269	1297	1412	1088	556	433	253
1949	0	10	855	1126	4330	3090	483	357	303	228	142
1950	0	0	83	2389	2823	5018	3227	293	575	230	358
1951	50	0	765	4967	6056	2216	1794	1306	98	66	79
1952	0	6	449	1915	6626	4654	1831	1079	405	96	65
1953	0	3	349	2324	4113	4445	1407	457	247	25	18
1954	0	12	211	2881	10071	2159	2466	1318	431	265	68
1955	0	0	504	1021	2592	5132	1765	1642	620	313	51
1956	0	213	1926	11209	2400	2539	2866	963	1334	340	89
1957	0	0	647	3634	13199	2045	1538	1233	341	244	92
1958	0	63	2115	3817	2504	8128	1076	777	788	276	164
1959	0	8	2938	6803	5559	3388	7071	809	528	534	213
1960	0	0	455	6408	7580	3339	2164	1964	372	157	161
1961	2	31	409	4901	8501	4298	1362	1062	727	193	61
1962	205	436	1491	2039	7794	6190	1957	839	317	223	59
1963	1287	924	511	3471	3673	6594	3190	1243	287	126	113
1964	2591	3073	4074	2368	6023	2069	2906	1562	403	81	45
1965	53595	32161	24140	15192	7775	4057	1282	1234	402	72	54
1966	2127	9696	9638	8887	4645	1217	1637	499	272	89	12
1967	89	181	1006	2622	2836	1113	441	597	212	174	55
1968	5	13	398	1806	2926	2494	793	379	406	116	78
1969	31	42	438	1408	2039	1955	939	279	131	118	39
1970	306	129	679	1743	1400	1365	1163	389	88	38	19
1971	268	667	888	2189	2740	1208	944	1177	277	39	21
1972	306	288	671	751	924	668	345	191	159	9	18
1973	487	1178	646	1467	811	723	342	159	60	99	2
1974	59	233	975	254	464	298	114	47	8	17	16
1975	279	61	470	805	282	185	63	30	8	4	1
1976	431	676	157	249	323	189	132	36	8	10	3
1977	213	283	965	335	513	283	117	80	19	15	6
1978	714	433	811	2412	436	715	203	61	23	8	2
1979	1	268	423	1120	675	159	149	16	5	6	2
1980	332	376	2372	4334	3238	1702	249	129	39	9	7
1981	870	318	262	5072	5081	3010	1178	139	105	30	10
1982	530	433	1520	764	5629	1957	1220	214	48	28	5
1983	497	470	1084	3207	2040	1677	530	235	29	18	19
1984	10	360	1514	4158	2225	821	410	90	30	5	2
1985	133	69	411	8006	4162	881	232	47	14	2	1
1986	12	50	1289	10064	5954	767	100	13	1	1	1
1987	30	76	160	983	1686	377	24	6	1	0	1
1988	56	68	129	1584	1726	390	39	4	4	1	0
1989	1590	774	519	2220	2949	699	63	2	1	0	0
1990	126	527	372	1251	3220	533	41	2	3	0	0
1991	12	133	1035	1846	1593	467	47	2	0	0	0

Table 10. Commercial weights at age for 4TVW haddock.

Year	Age										
	1	2	3	4	5	6	7	8	9	10	11
1948	.08	.31	1.13	1.19	1.61	2.25	2.69	3.02	3.10	3.38	3.49
1949	.08	.68	.84	1.19	1.39	1.82	2.47	2.93	2.99	3.16	3.32
1950	.08	.31	.82	1.03	1.38	1.86	2.17	2.63	2.56	2.84	3.59
1951	.68	.31	1.00	1.07	1.29	1.63	2.08	2.33	1.61	1.39	2.32
1952	.08	.68	.89	1.09	1.35	1.66	2.11	2.62	2.99	2.51	2.46
1953	.08	.58	.95	1.13	1.52	1.82	2.25	2.76	3.18	3.87	3.54
1954	.08	.68	.87	1.08	1.14	1.57	1.95	2.13	2.44	2.69	3.06
1955	.08	.31	.79	1.04	1.30	1.48	1.81	2.15	2.39	2.60	2.78
1956	.08	.50	.75	.89	1.25	1.53	1.72	2.13	2.23	2.28	2.81
1957	.08	.31	.76	.99	1.19	1.56	1.82	2.07	2.37	2.39	2.79
1958	.08	.53	.70	.98	1.26	1.47	1.75	2.10	2.09	2.46	2.41
1959	.08	.80	.68	.89	1.17	1.48	1.79	2.17	2.41	2.74	2.95
1960	.08	.31	.67	.91	1.10	1.41	1.83	2.19	2.46	2.70	2.68
1961	.06	.19	.79	.90	1.15	1.53	1.87	2.22	2.41	2.76	3.30
1962	.05	.20	.45	.83	1.02	1.35	1.74	2.18	2.73	2.60	3.45
1963	.10	.14	.36	.94	1.15	1.36	1.75	2.01	2.36	2.55	2.44
1964	.10	.28	.45	.71	1.10	1.35	1.64	1.92	2.34	2.72	2.39
1965	.10	.25	.42	.71	1.11	1.30	1.93	2.23	2.42	2.79	3.12
1966	.09	.27	.36	.70	1.03	1.33	1.55	2.18	2.30	2.67	3.04
1967	.12	.38	.53	.78	1.15	1.48	1.77	2.17	2.55	2.82	3.06
1968	.11	.17	.43	.80	1.12	1.59	2.16	2.19	2.57	3.10	3.34
1969	.10	.22	.65	.88	1.26	1.62	2.28	2.77	3.31	3.32	3.21
1970	.11	.33	.64	.91	1.29	1.56	2.07	2.59	3.14	4.04	3.55
1971	.12	.34	.63	.92	1.30	1.63	1.93	2.30	2.87	3.43	3.75
1972	.10	.28	.59	.96	1.34	1.83	2.19	2.41	2.97	3.86	3.83
1973	.12	.35	.65	.98	1.37	1.87	2.22	2.59	3.25	3.17	3.63
1974	.12	.41	.64	1.12	1.66	1.98	2.47	2.79	2.84	3.43	3.40
1975	.16	.25	.85	1.20	1.57	2.14	2.45	2.80	3.04	3.13	4.12
1976	.09	.37	.53	1.22	1.61	2.03	2.27	2.33	3.19	2.61	3.10
1977	.14	.51	.93	1.23	1.51	1.90	2.35	2.51	2.81	3.33	3.20
1978	.08	.35	.67	1.07	1.51	1.97	2.58	2.69	3.28	3.50	3.85
1979	.09	.33	.71	1.17	1.55	2.02	2.44	2.96	3.27	3.44	4.21
1980	.08	.23	.72	1.03	1.36	1.85	2.32	2.66	3.13	3.40	3.65
1981	.08	.38	.69	.95	1.27	1.68	2.19	2.71	3.08	3.41	3.66
1982	.06	.26	.63	.96	1.20	1.61	2.15	2.78	3.14	3.51	4.50
1983	.07	.19	.53	.82	1.16	1.43	1.72	1.90	2.80	2.06	1.82
1984	.09	.26	.58	.74	1.04	1.46	1.79	2.15	2.66	3.24	3.18
1985	.12	.20	.46	.70	.99	1.43	1.93	2.35	2.96	2.20	5.59
1986	.10	.27	.63	.82	1.05	1.57	2.41	2.28	2.58	3.76	4.47
1987	.10	.21	.51	.93	1.22	1.67	2.25	2.52	2.74	3.07	4.73
1988	.11	.30	.65	.91	1.21	1.59	2.19	2.31	2.57	2.69	4.61
1989	.08	.28	.66	.95	1.25	1.66	2.36	3.11	4.70	2.99	4.52
1990	.14	.25	.60	.96	1.33	1.94	3.04	3.53	4.06	2.99	4.51
1991	.17	.29	.58	.92	1.29	1.83	2.40	3.46	.00	.00	.00

Table 11. RV mean catch rates at age for 4TVW haddock.

Year	Age															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1970	.10	2.74	1.00	1.84	2.04	.99	.62	.70	.35	.14	.04	.04	.03	.00	.01	.00
1971	.06	1.72	3.63	1.20	1.58	.63	.36	.16	.25	.01	.00	.00	.00	.00	.00	.00
1972	.00	1.32	.89	1.30	.59	.49	.37	.15	.07	.04	.02	.00	.00	.00	.00	.00
1973	.00	.53	1.73	.54	.47	.17	.35	.07	.10	.02	.05	.00	.00	.00	.00	.00
1974	.23	.37	2.15	2.90	.53	.54	.27	.20	.08	.05	.03	.04	.00	.00	.00	.00
1975	.07	5.07	.72	1.94	1.73	.46	.83	.22	.09	.05	.05	.00	.02	.00	.00	.00
1976	.30	2.76	3.13	.48	.95	.93	.21	.23	.05	.02	.02	.02	.06	.00	.00	.00
1977	.20	6.07	11.38	8.97	1.22	1.94	.72	.20	.11	.00	.05	.01	.00	.02	.00	.00
1978	.00	9.90	11.07	14.81	8.32	.51	.49	.12	.02	.00	.01	.01	.00	.00	.00	.00
1979	.49	.09	9.13	9.94	10.33	2.90	.37	.29	.10	.00	.04	.02	.00	.00	.01	.00
1980	.44	3.51	.28	14.88	13.92	8.65	2.09	.33	.12	.02	.00	.00	.00	.00	.00	.00
1981	22.35	15.61	9.38	.99	7.37	4.68	2.01	.31	.09	.10	.03	.00	.00	.00	.00	.00
1982	.77	18.19	15.75	14.21	2.05	7.21	3.05	.97	.23	.02	.02	.00	.00	.00	.00	.02
1983	.15	21.80	14.49	30.22	11.63	3.08	2.74	.95	.24	.07	.06	.00	.04	.00	.02	.00
1984	.28	.30	10.84	16.89	29.11	5.25	2.57	1.36	.30	.11	.02	.01	.00	.00	.00	.00
1985	.00	4.22	1.04	11.08	21.68	4.73	1.26	.30	.06	.00	.00	.00	.00	.00	.00	.00
1986	.14	.60	2.25	7.78	26.06	11.88	1.30	.40	.07	.00	.00	.00	.00	.00	.00	.00
1987	.08	1.93	1.73	4.67	15.57	6.17	.55	.09	.00	.05	.00	.00	.00	.00	.00	.00
1988	1.04	4.70	13.43	10.20	16.16	9.26	1.13	.11	.03	.00	.00	.00	.00	.00	.00	.00
1989	.10	13.86	7.07	3.21	10.79	6.01	.46	.03	.00	.00	.00	.00	.00	.00	.00	.00
1990	.05	1.02	16.83	11.51	7.87	4.76	.33	.03	.00	.00	.00	.00	.00	.00	.00	.00
1991	.02	.25	6.45	39.98	12.52	3.63	.14	.02	.00	.00	.00	.00	.00	.00	.00	.00

Table 12. CVs for RV mean catch rates at age for 4TVW haddock.

Year	Age															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1970	.65	.47	.32	.30	.18	.20	.23	.31	.20	.24	.80	.24	.32	.00	.00	.00
1971	.72	.36	.39	.33	.30	.25	.26	.26	.40	.56	.00	.00	.00	.00	.00	.00
1972	.00	.34	.48	.35	.24	.23	.29	.29	.49	.49	.71	.00	.00	.00	.00	.00
1973	.00	.28	.50	.35	.33	.39	.50	.46	.53	1.00	.80	.00	.00	.00	.00	.00
1974	.00	.24	.01	.01	.04	.02	.00	.05	.24	.00	.33	.13	.00	.00	.00	.00
1975	.51	.56	.51	.40	.42	.31	.35	.35	.35	.38	.34	.00	.86	.00	.00	.00
1976	.67	.42	.32	.37	.49	.40	.34	.31	.34	.52	.45	.52	.00	.00	.00	.00
1977	.46	.33	.38	.36	.32	.27	.26	.33	.33	.00	.78	1.00	.00	1.00	.00	.00
1978	.00	.28	.49	.46	.40	.28	.23	.43	.35	.00	1.00	1.00	.00	.00	.00	.00
1979	.39	.82	.30	.41	.34	.28	.26	.33	.50	.00	.71	.74	.00	.00	1.00	.00
1980	.63	.22	.32	.31	.40	.38	.27	.27	.30	.40	.00	.00	.00	.00	.00	.00
1981	.51	.24	.46	.31	.24	.24	.21	.24	.32	.35	.66	.00	.00	.00	.00	.00
1982	.24	.26	.23	.14	.19	.21	.20	.18	.12	.92	.38	.00	.00	.00	.00	1.00
1983	.61	.32	.25	.49	.32	.15	.20	.22	.21	.18	.74	.00	.83	.00	.00	.00
1984	.45	.44	.26	.21	.21	.17	.15	.20	.37	.54	.69	1.00	.00	1.00	.00	.00
1985	.00	.57	.35	.24	.14	.18	.25	.28	.53	.00	1.00	.00	.00	.00	.00	.00
1986	.63	.36	.27	.21	.20	.15	.21	.23	.36	.00	.00	.00	.00	.00	.00	.00
1987	.56	.38	.37	.20	.21	.24	.19	.28	.00	.56	.00	.00	.00	.00	.00	.00
1988	.27	.34	.91	.69	.38	.20	.20	.30	1.00	.00	.00	.00	.00	.00	.00	.00
1989	.38	.30	.48	.28	.18	.14	.27	.60	.00	.00	.00	.00	.00	.00	.00	.00
1990	.47	.29	.40	.30	.19	.19	.25	.35	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1991	.56	.41	.27	.38	.45	.38	.19	.00	.00	.00	.00	.00	.00	.00	.00	.00

Table 13. RV mean catch rates at age for 4Vn haddock.

Year	Age															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1970	.00	.00	.00	.00	.33	.67	.00	.09	.00	.00	.33	.00	.00	.00	.00	.00
1971	.00	.21	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1972	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1973	.00	.00	.00	.00	.12	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1974	.00	.39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1975	.00	.12	.88	.11	.11	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1976	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.56	.00	.00	.00
1977	.00	.00	.00	.00	.00	.00	.00	.00	.18	.00	.35	.00	.00	.00	.00	.00
1978	.00	.00	.00	.00	.26	.00	.13	.00	.00	.00	.00	.13	.00	.00	.00	.00
1979	.00	.00	.26	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1980	.00	.43	.00	.12	.00	.37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1981	.00	.00	.27	.00	.32	.26	1.06	.10	.21	.00	.00	.00	.00	.00	.00	.00
1982	.00	.73	.00	.34	.55	.29	.50	.93	.00	.00	.00	.00	.00	.00	.00	.00
1983	.00	.00	.00	.10	.45	.00	.23	.23	.19	.10	.00	.00	.00	.00	.00	.00
1984	.00	.13	.27	.56	2.00	.81	.30	.66	.00	.00	.00	.00	.00	.00	.00	.00
1985	.00	.00	.00	.00	3.90	3.46	1.38	.10	.00	.00	.00	.00	.00	.00	.00	.00
1986	.00	.31	.09	1.35	1.72	6.20	1.10	.06	.06	.00	.00	.00	.00	.00	.00	.00
1987	.00	.00	.00	.00	.57	1.57	.42	.07	.00	.07	.00	.00	.00	.00	.00	.00
1988	.00	.00	.00	.00	.06	.85	1.33	.38	.00	.00	.00	.00	.00	.00	.00	.00
1989	.00	.00	.07	.00	.14	1.25	.22	.22	.00	.00	.00	.00	.00	.00	.00	.00
1990	.00	.00	.00	.11	.10	.20	.44	.00	.05	.00	.00	.00	.00	.00	.00	.00
1991	.00	.00	.00	.00	.13	.19	.06	.00	.00	.00	.00	.00	.00	.00	.00	.00

Table 14. RV mean catch rates at age for 4Vs haddock.

Year	Age															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1970	.00	.05	.09	.08	1.80	.84	.49	.24	.52	.16	.03	.05	.03	.00	.03	.00
1971	.00	.33	.01	.05	.02	.06	.10	.07	.07	.00	.00	.00	.00	.00	.00	.00
1972	.00	.21	1.81	1.60	.35	.16	.38	.07	.00	.00	.00	.00	.00	.00	.00	.00
1973	.00	.05	.01	.18	.13	.00	.00	.05	.00	.00	.03	.00	.00	.00	.00	.00
1974	.00	.23	.07	.08	.06	.03	.00	.03	.06	.00	.04	.01	.00	.00	.00	.00
1975	.00	.14	.14	.04	.02	.08	.22	.04	.00	.00	.04	.00	.00	.00	.00	.00
1976	.00	.03	1.96	.26	.00	.04	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1977	.00	.06	.10	1.13	.56	.55	.10	.06	.00	.00	.00	.00	.00	.06	.00	.00
1978	.00	.00	.00	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1979	.00	.03	.33	.21	.08	.04	.00	.02	.00	.00	.00	.00	.00	.00	.02	.00
1980	.00	2.31	.17	.15	.22	.20	.08	.03	.07	.00	.00	.00	.00	.00	.00	.00
1981	.00	1.59	.21	.03	.07	.07	.15	.14	.00	.01	.00	.00	.00	.00	.00	.00
1982	.11	24.85	2.47	13.80	.81	3.07	.83	.27	.35	.00	.00	.00	.00	.00	.00	.00
1983	.00	3.09	9.85	4.85	3.99	1.92	.48	.19	.05	.10	.00	.00	.01	.00	.07	.00
1984	.00	.00	3.88	13.47	8.03	1.26	.29	.35	.03	.00	.00	.02	.00	.01	.00	.00
1985	.00	.00	.00	1.65	13.19	2.99	.39	.37	.00	.00	.01	.00	.00	.00	.00	.00
1986	.00	.02	.03	1.22	8.88	4.12	1.01	.15	.07	.00	.00	.00	.00	.00	.00	.00
1987	.00	.00	.41	1.47	6.11	6.30	.47	.06	.00	.13	.00	.00	.00	.00	.00	.00
1988	.00	.16	.01	.49	2.66	4.45	.77	.00	.09	.00	.00	.00	.00	.00	.00	.00
1989	.00	.32	.70	.04	.18	.44	.23	.02	.00	.00	.00	.00	.00	.00	.00	.00
1990	.05	.97	2.54	.61	.13	.47	.21	.01	.00	.00	.00	.00	.00	.00	.00	.00
1991	.00	.01	.02	.94	.44	.54	.15	.05	.00	.00	.00	.00	.00	.00	.00	.00

Table 15. RV mean catch rates at age for 4W haddock.

Year	Age															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1970	.19	4.95	1.78	3.30	2.53	1.15	.83	1.10	.31	.16	.00	.04	.04	.00	.00	.00
1971	.11	2.90	6.61	2.15	2.86	1.10	.58	.25	.42	.02	.00	.00	.00	.00	.00	.00
1972	.00	2.27	.48	1.36	.85	.79	.43	.23	.13	.08	.03	.00	.00	.00	.00	.00
1973	.00	.93	3.15	.87	.75	.31	.64	.10	.17	.04	.06	.00	.00	.00	.00	.00
1974	.42	.46	3.87	5.24	.92	.97	.49	.35	.11	.08	.03	.06	.00	.00	.00	.00
1975	.13	9.13	1.06	3.49	3.13	.79	1.38	.38	.16	.09	.07	.00	.03	.00	.00	.00
1976	.54	5.01	4.48	.71	1.73	1.67	.38	.42	.09	.03	.03	.03	.00	.00	.00	.00
1977	.36	11.03	20.67	15.63	1.86	3.19	1.25	.33	.16	.00	.02	.02	.00	.00	.00	.00
1978	.00	18.04	20.17	26.97	15.11	.93	.86	.23	.03	.00	.02	.00	.00	.00	.00	.00
1979	2.71	.14	16.38	17.97	18.77	5.25	.68	.51	.18	.00	.07	.03	.00	.00	.00	.00
1980	2.63	4.87	.39	27.00	25.23	15.56	3.76	.59	.17	.03	.00	.00	.00	.00	.00	.00
1981	40.73	27.45	16.90	1.79	13.33	8.43	3.37	.45	.12	.17	.05	.00	.00	.00	.00	.00
1982	1.34	17.40	27.15	17.17	3.12	11.16	4.95	1.41	.19	.03	.03	.00	.00	.00	.00	.04
1983	.27	37.79	20.22	52.01	18.60	4.40	4.65	1.56	.36	.05	.11	.00	.08	.00	.00	.00
1984	.50	.53	17.26	22.22	47.62	8.61	4.44	2.13	.53	.20	.05	.00	.00	.00	.00	.00
1985	.00	7.70	1.89	19.16	30.48	6.07	1.78	.30	.11	.00	.00	.00	.00	.00	.00	.00
1986	.25	1.03	4.06	13.14	41.57	17.85	1.52	.63	.07	.00	.00	.00	.00	.00	.00	.00
1987	.15	3.51	2.90	7.59	24.42	6.99	.63	.12	.00	.00	.00	.00	.00	.00	.00	.00
1988	1.90	8.45	24.47	18.28	27.77	13.91	1.31	.12	.00	.00	.00	.00	.00	.00	.00	.00
1989	.18	25.06	12.43	5.82	19.52	10.43	.65	.00	.00	.00	.00	.00	.00	.00	.00	.00
1990	.07	1.25	29.08	20.57	14.25	8.34	.39	.05	.00	.00	.00	.00	.00	.00	.00	.00
1991	.04	.45	11.74	72.27	22.51	6.24	.15	.00	.00	.00	.00	.00	.00	.00	.00	.00

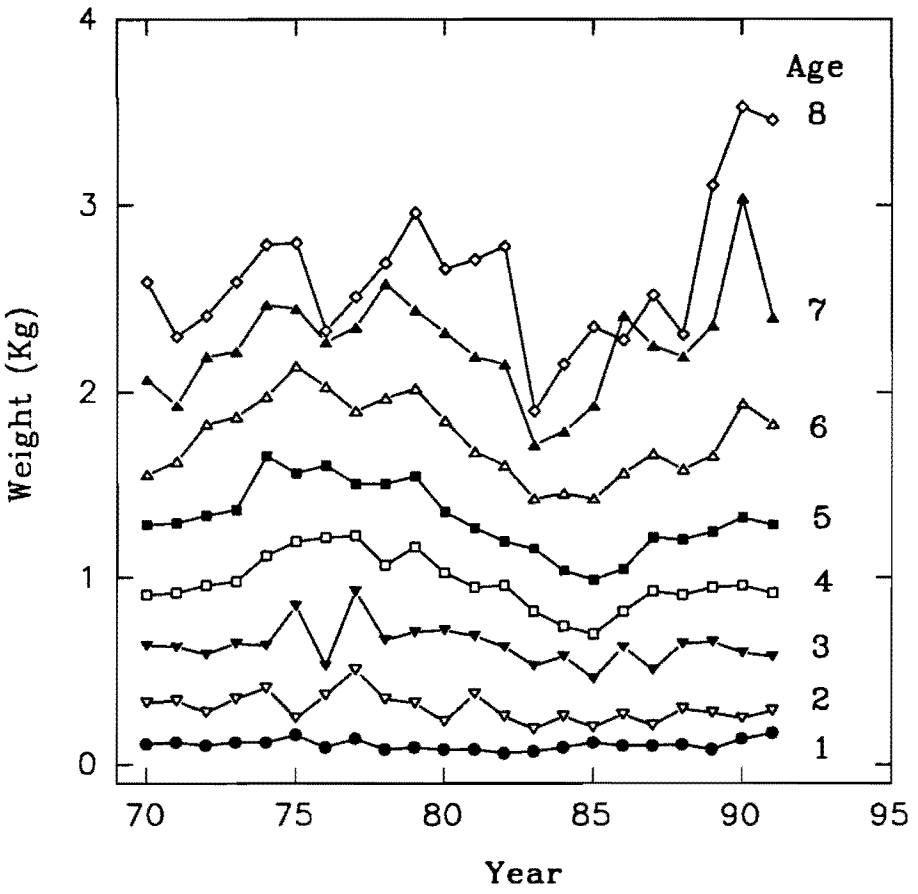

Figure 1. Commercial mean weights at age 4TVW haddock.

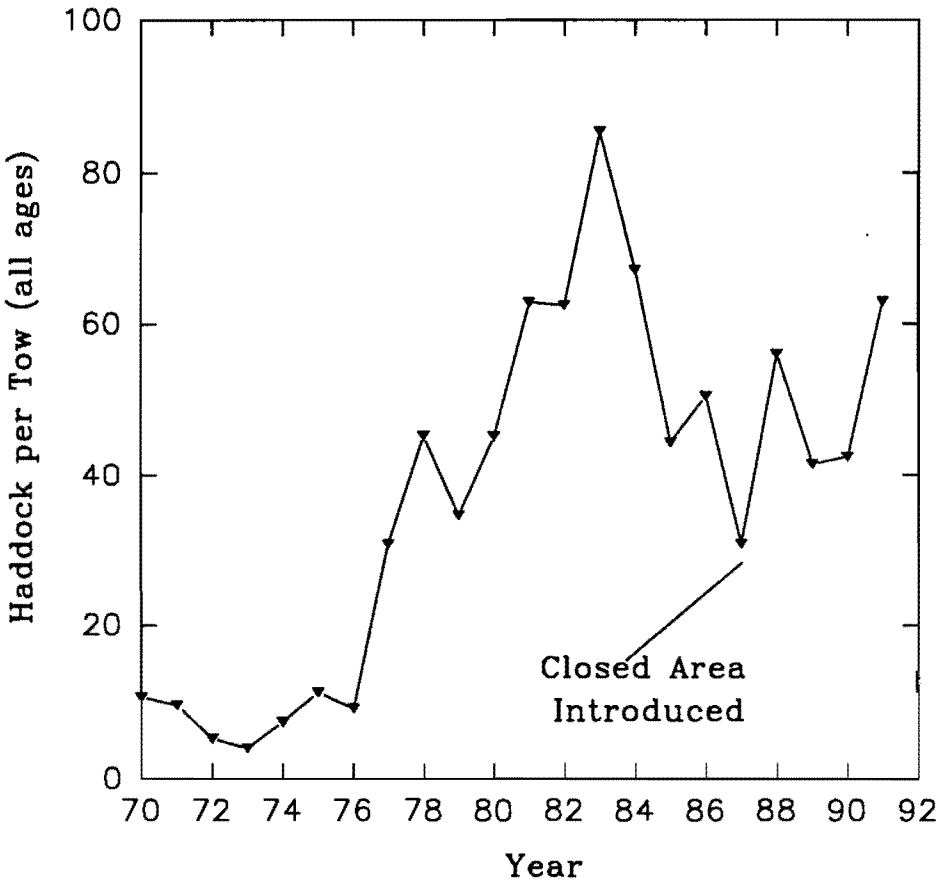

Figure 2. Research vessel mean catch of haddock per tow in 4VW, 1970-1991.

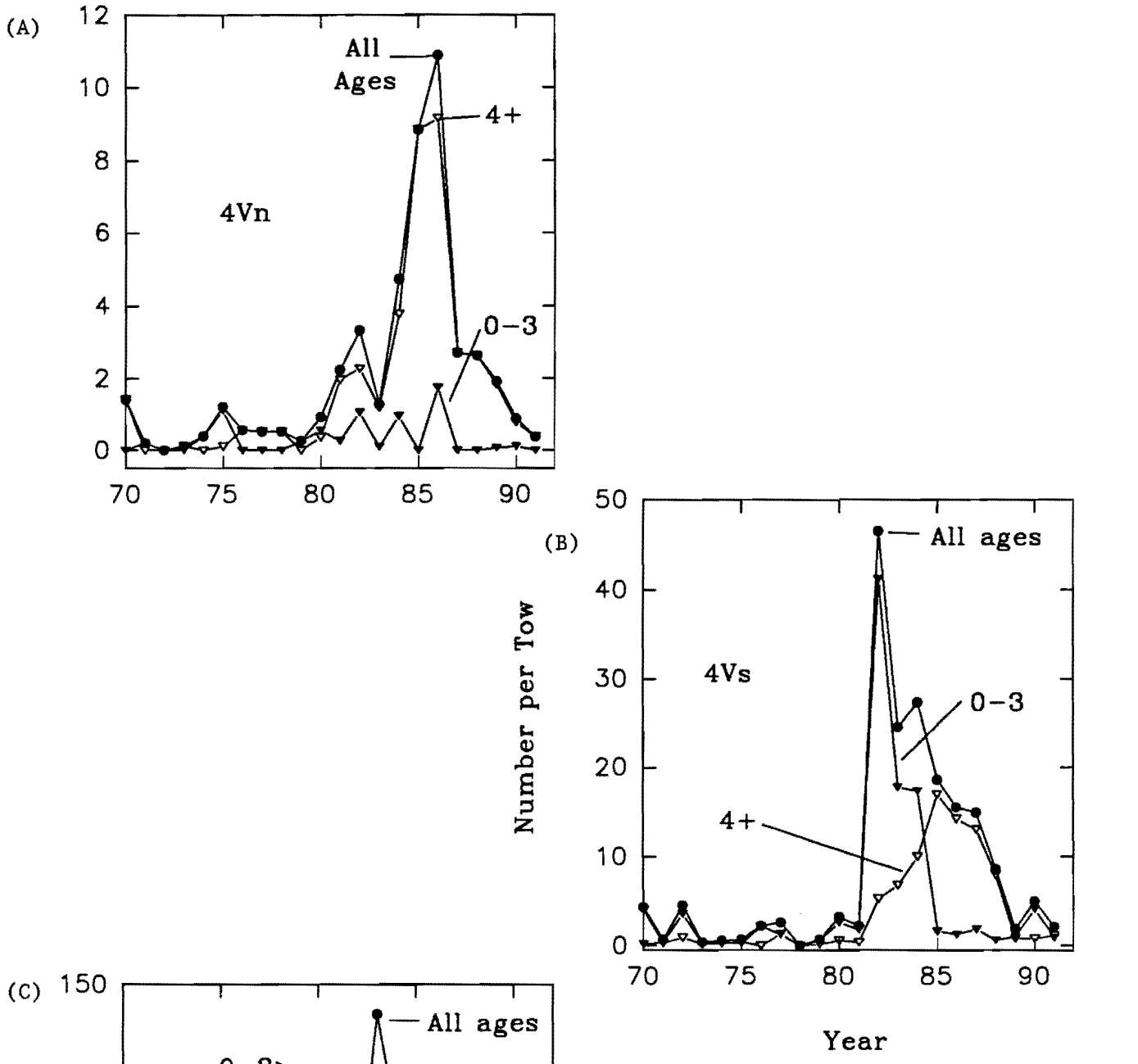

Figure 3. Research vessel mean catch rates of haddock per tow in Subdivision 4Vn (A), 4VS (B), and 4W (C).

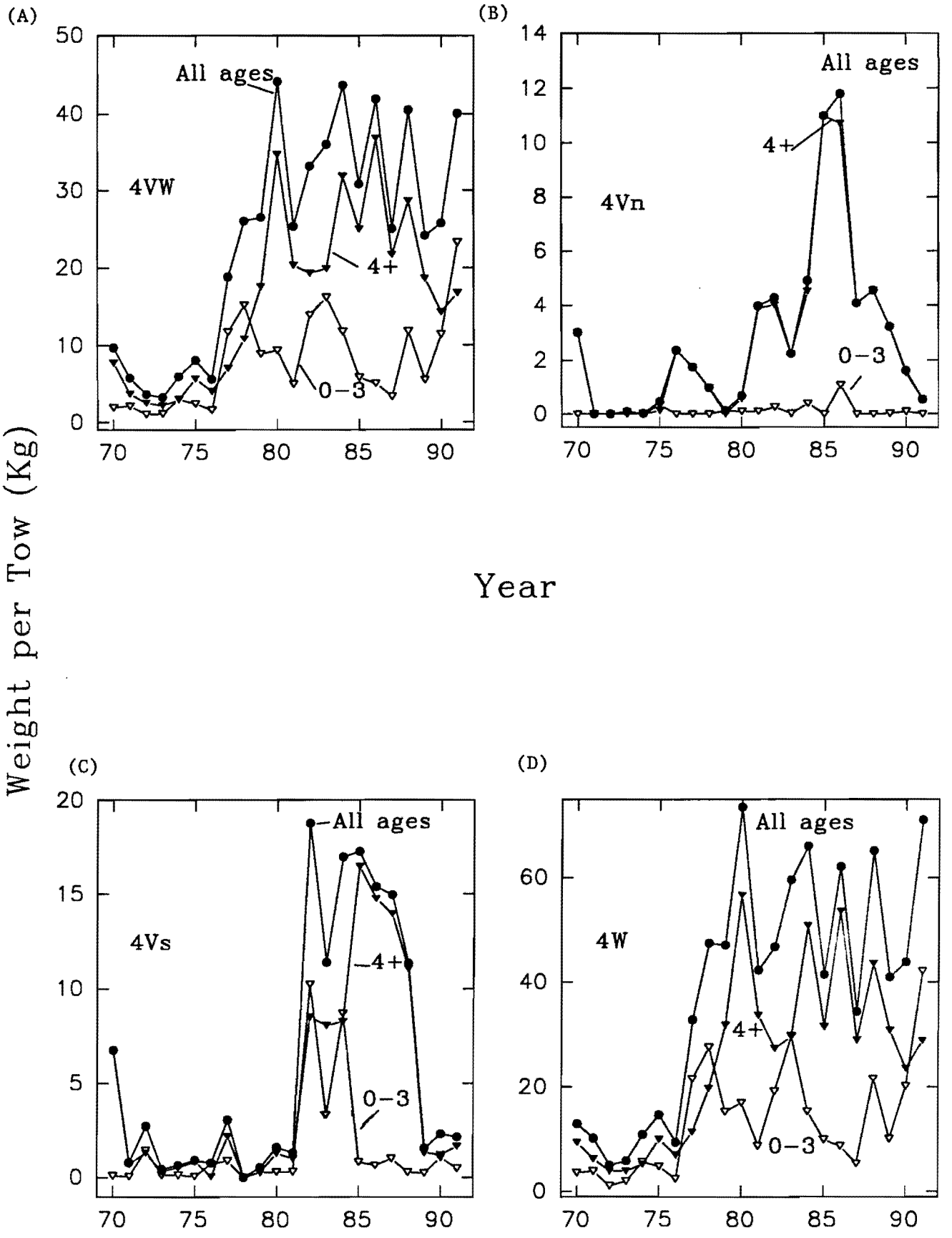

Figure 4. Biomass of haddock per tow for Divisions 4VW combined (A), Subdivision 4Vn (B) and 4Vs (C), and Division 4W (D).

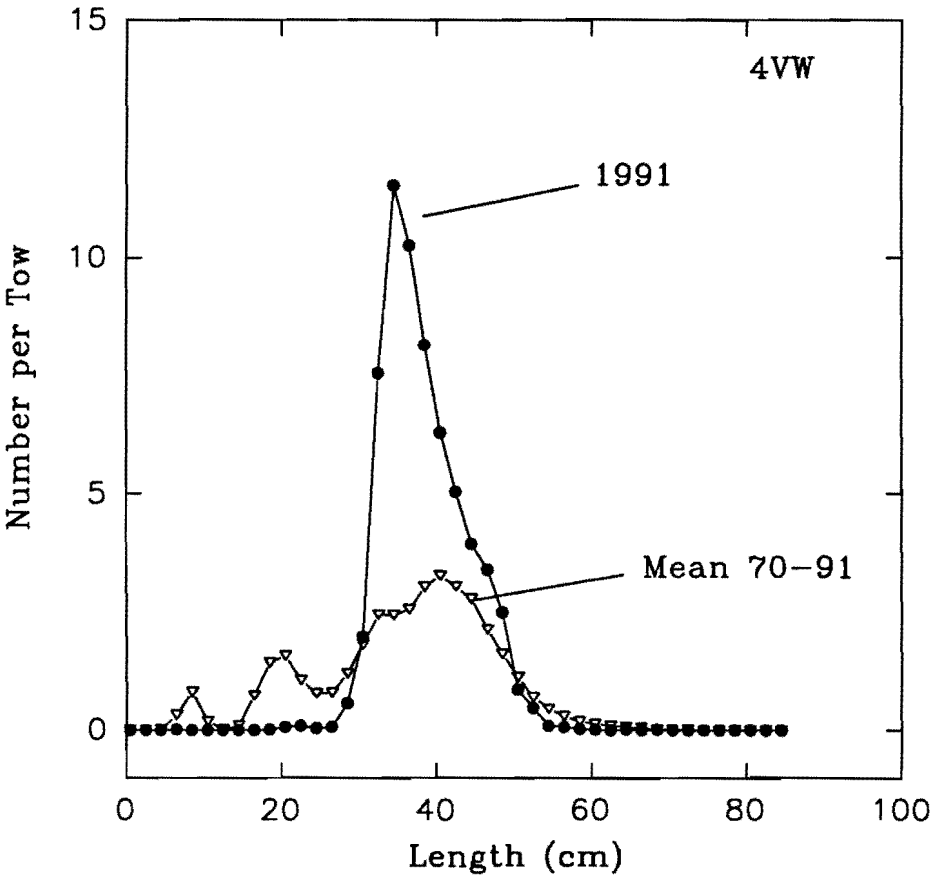

Figure 5. Length frequency of haddock from RV surveys showing both the long-term average and 1991 for 4VW combined.

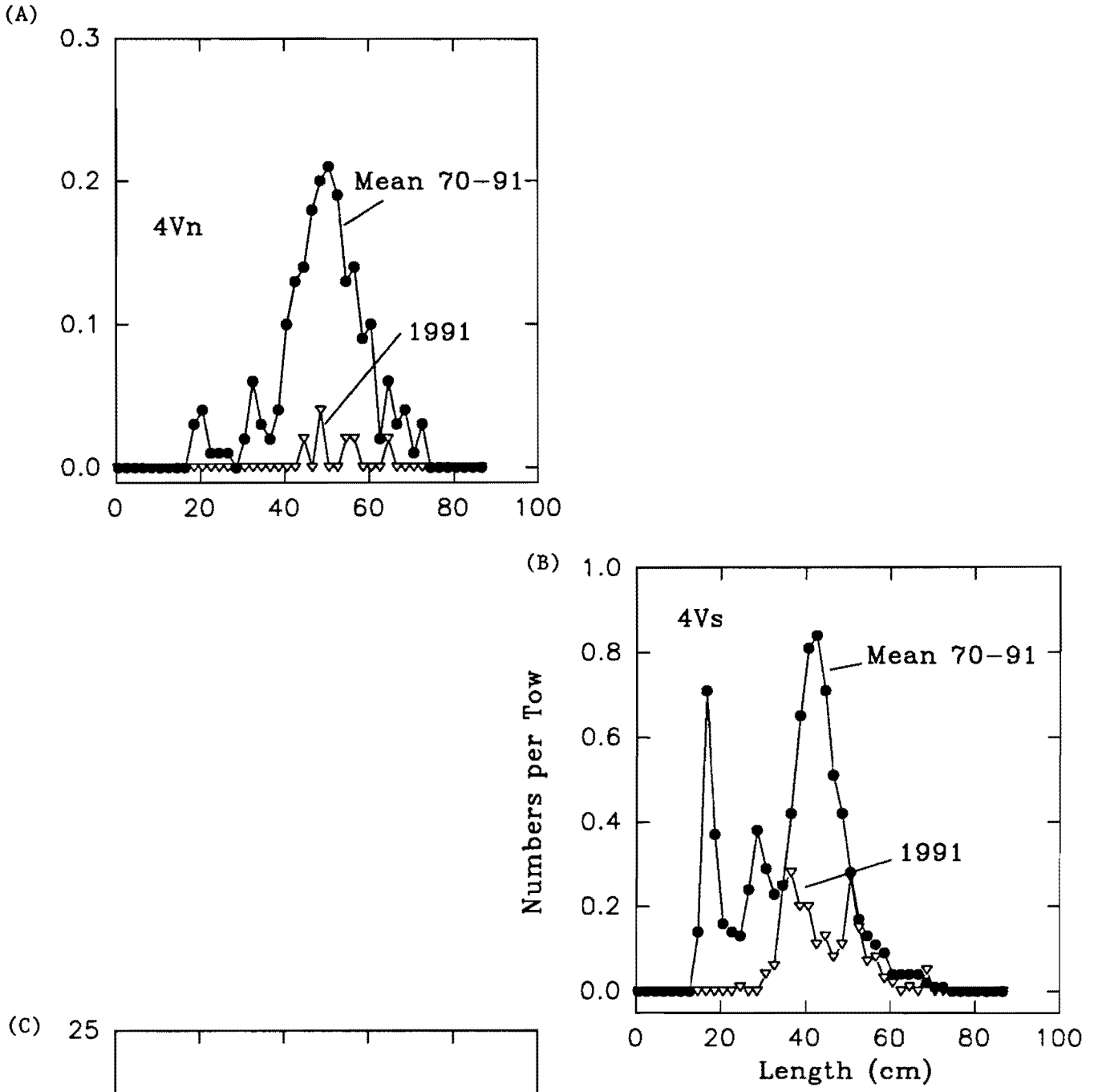

Figure 6. Length frequency of haddock from RV surveys showing both the long-term averages and estimates for 1991 for Subdivision 4Vn (A), 4Vs (B), and Division 4W (C).

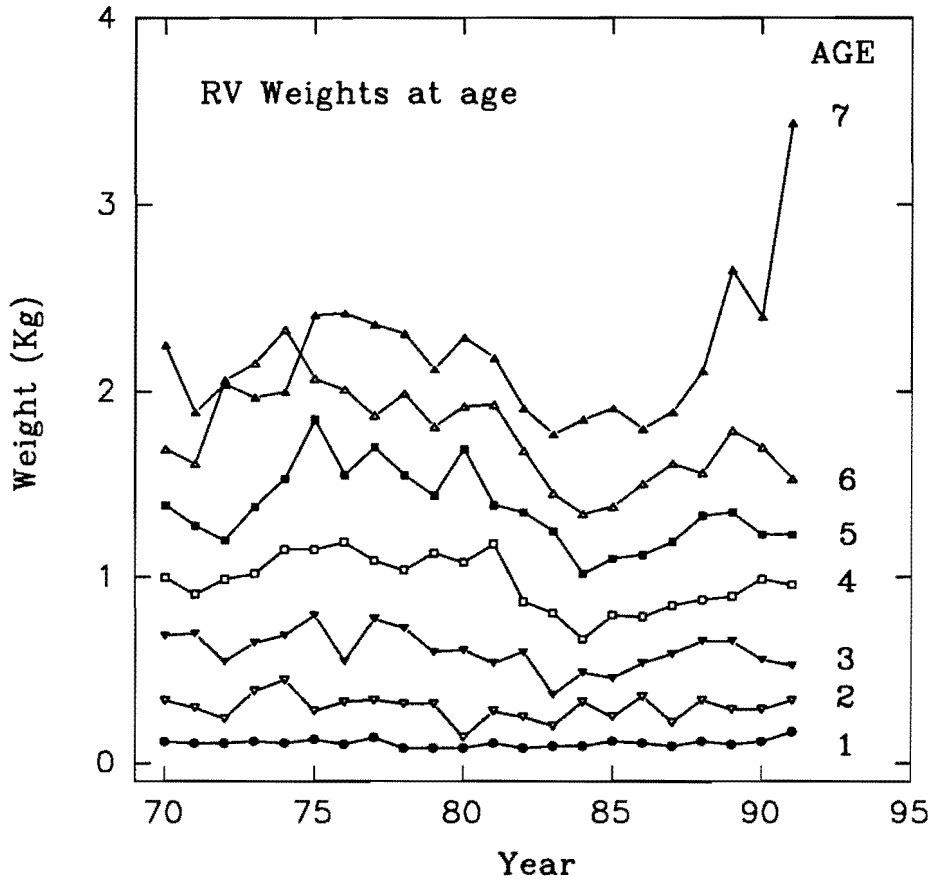

Figure 7. Average weights of haddock observed in RV surveys.

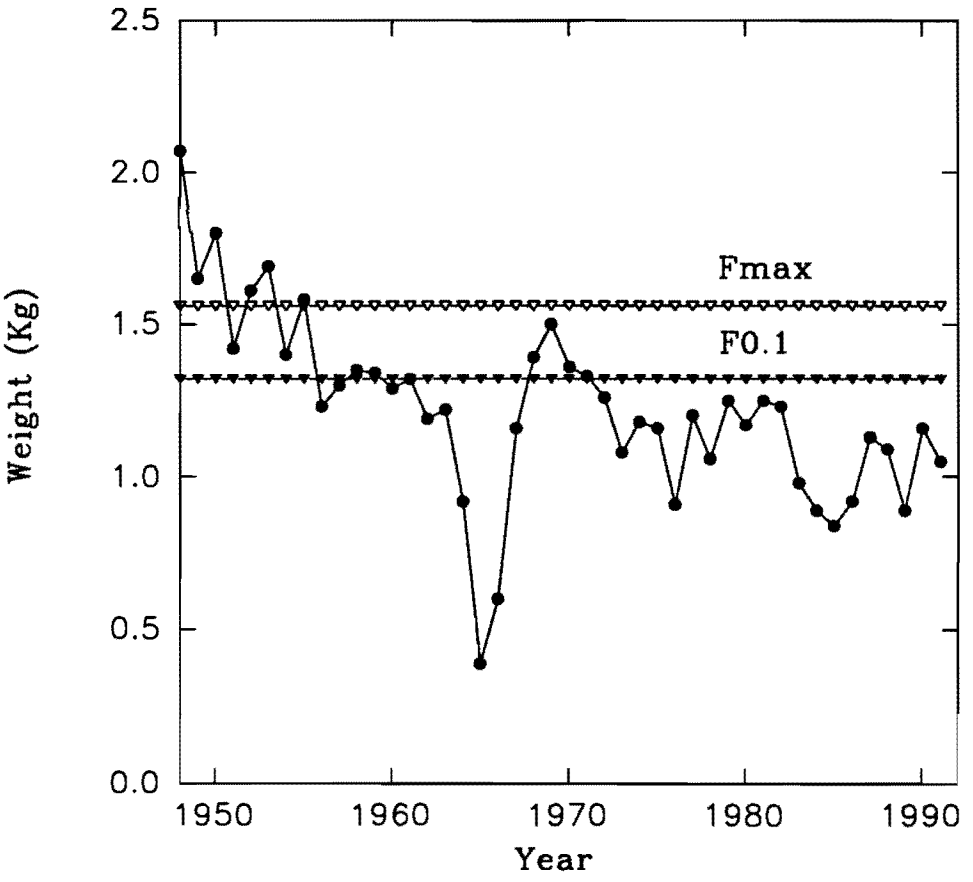

Figure 8. Mean weight of a fish in the catch relative to $F_{0.1}$ and F_{MAX}.

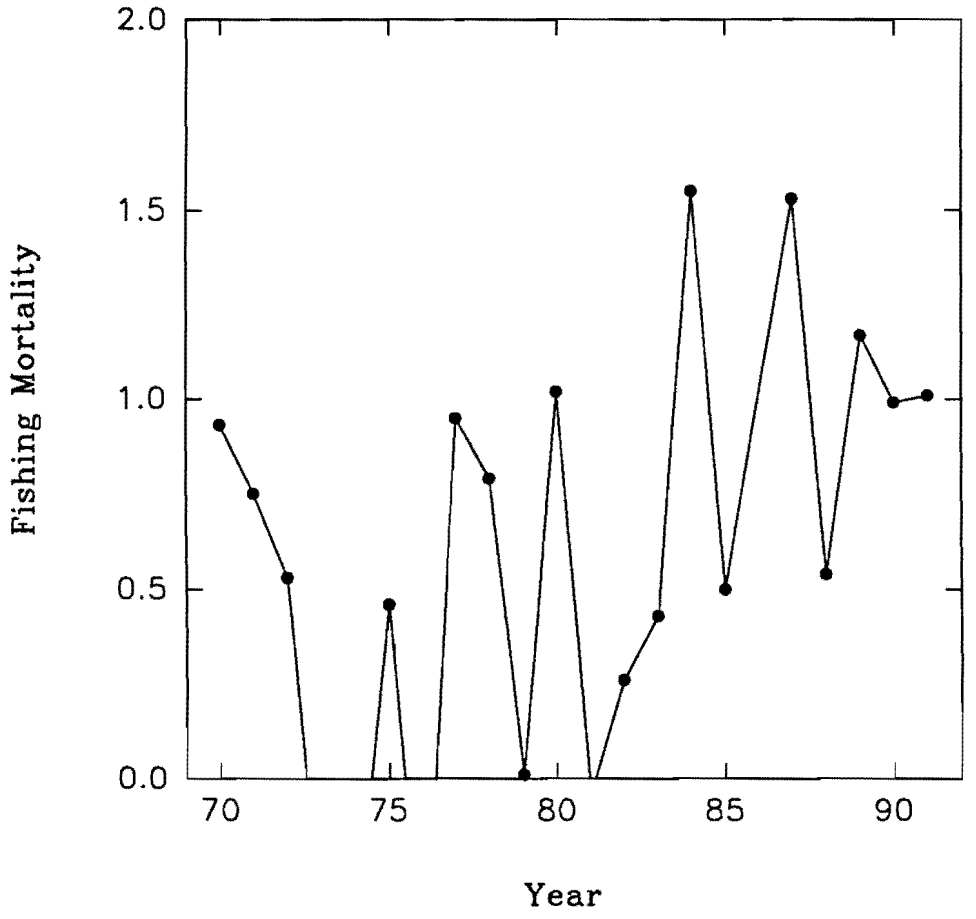

Figure 9. Fishing mortality (ages 4-6/5-7) estimated from research vessel mean catch rates per tow at age.

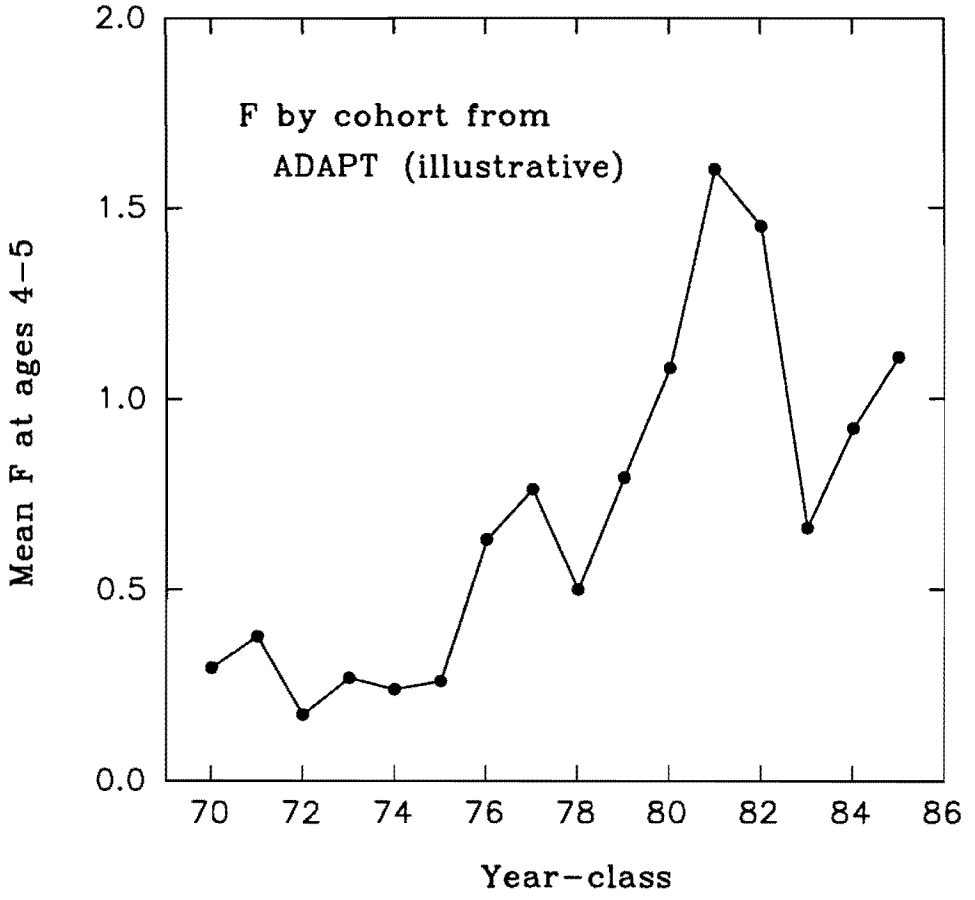

Figure 10. Fishing mortality by cohort averaged over ages 4 and 5 from an illustrative run of the adaptive framework.

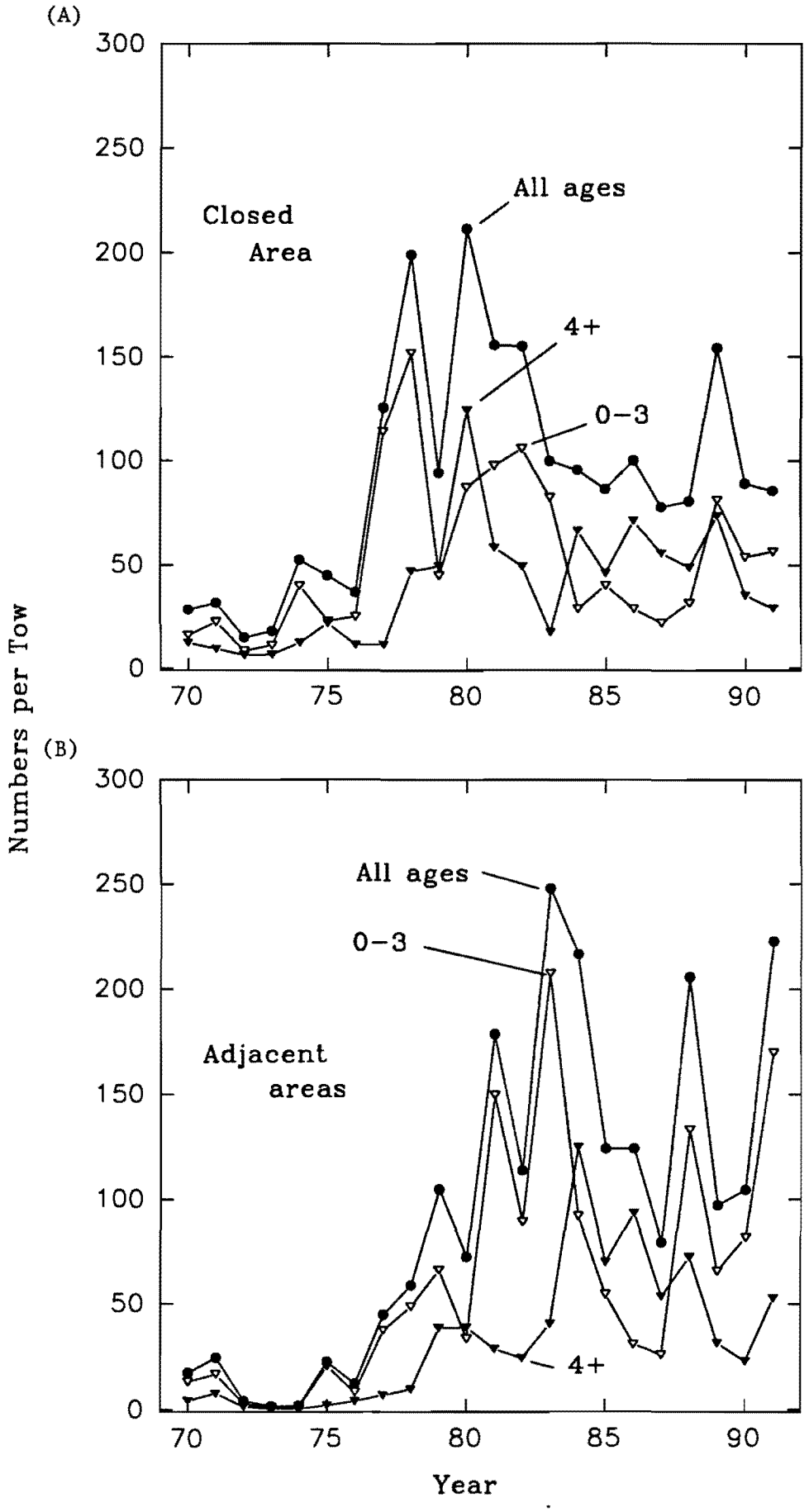

Figure 11 (A&B). Research vessel mean catch rates of haddock per tow inside the closed area (A) and in adjacent waters (B).

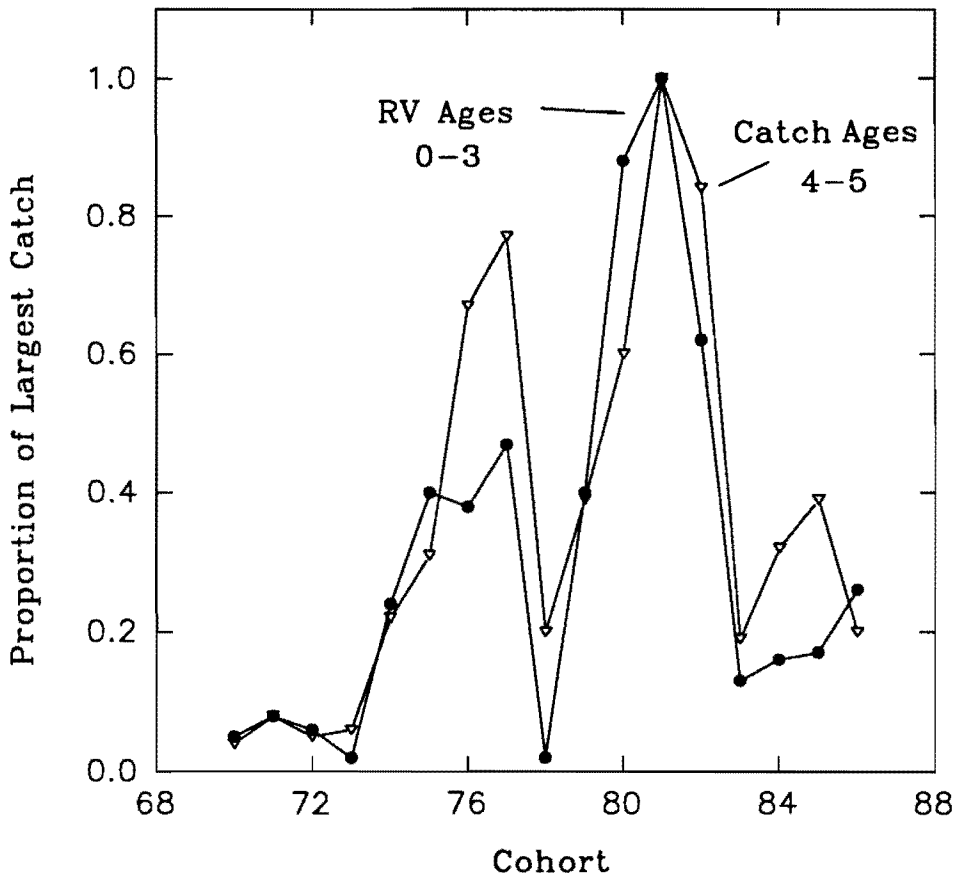

Figure 12. Normalized abundance of cohorts at ages 0-3 as estimated from RV surveys and those same cohorts at ages 4-5 from commercial catches.

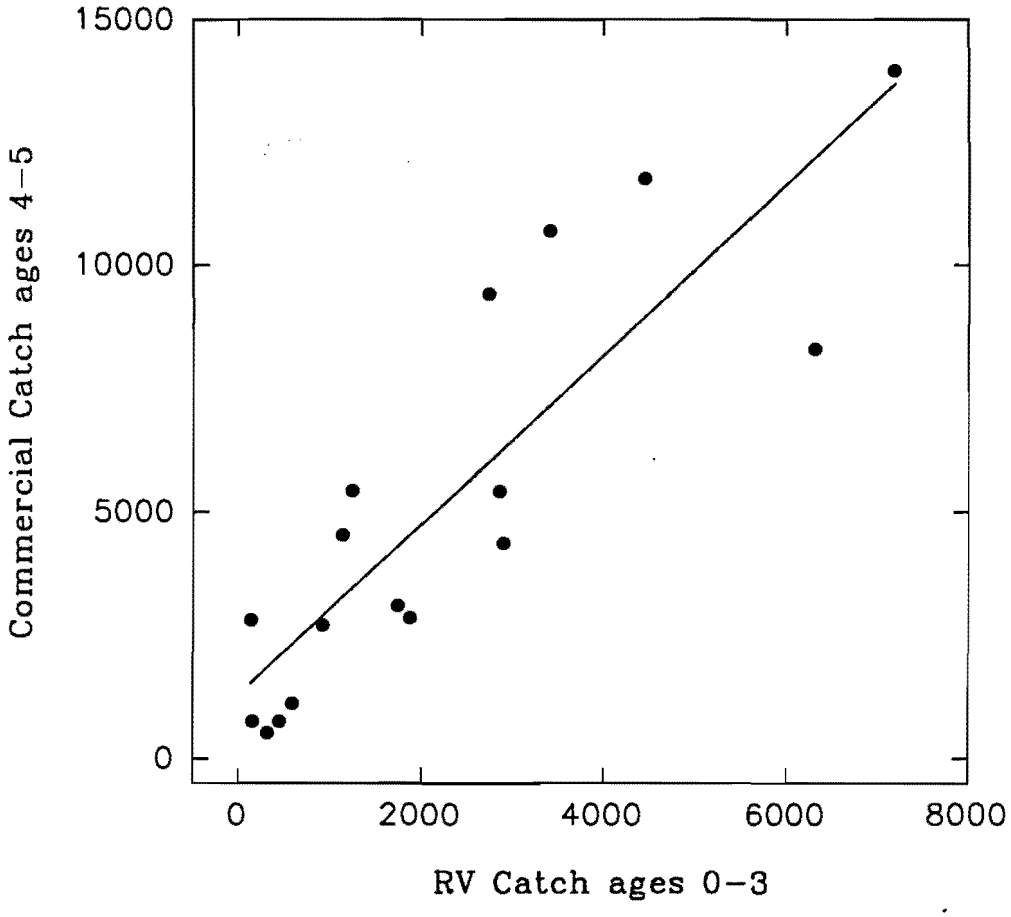

Figure 13. Relationship between RV catch rates at ages 0-3 and commercial catches of the same cohort at ages 4-5 (R^2 = 0.74).