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Haddock on the Eastern Scotian Shelf 1990

by

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Abstract

The nominal catch of 4TVW haddock totalled 7750 t in 1989, representing a 30% overrun of the advised TAC. This fishery has been restricted to by-catches and a year around closed area since 1987. The closed area applies only to the mobile gear components of the fishery. Research vessel catch rates are consistently highest in and around the closed area. Haddock become more widely distributed as overall abundance increases. As abundance declines haddock become less dispersed, retreating to spatiotemporally persistent centers of concentration. The closed area appears to encompass the center of distribution for haddock ages 0-8, making it potentially very effective as a refugium for stock rebuilding. There are a number of indicators which show that this stock has been and continues to be heavily exploited even under present by-catch regulations. Research vessel catch rates at age give F's on the order of 1.0 or above, the average weight of a fish in the catch is low, and the age span of the catch has been reduced to the point where fish over the age of 7 are rare. However; catches from both research vessel surveys and the foreign small mesh gear fishery indicate that the 1988 year-class at age 1 shows an abundance not inconsistent with that of the above average 1981 or 1982 year-classes. If this cohort does not experience high mortalities in the intervening period it may contribute significantly to the fishery as fish reach the legal size in 1991/1992.

Résumé

Les prises nominales d'aiglefin dans les divisions 4TVW se sont élevées à 7 750 t en 1989, représentant un dépassement de 30 p. 100 du TPA conseillé. Depuis janvier 1987, on a imposé une zone de clôture permanente pour cette pêche; en outre, seules les prises accidentelles sont autorisées. La zone en question n'est close qu'aux pêcheurs aux engins mobiles. Les taux de prises des navires scientifiques demeurent plus élevés dans la zone fermée et aux alentours de celle-ci. Quand l'aiglefin se fait plus abondant, sa distribution s'élargit, tandis qu'elle se restreint quand le poisson est moins abondant. Il se regroupe alors en certains endroits, suivant toujours les mêmes caractéristiques spatiotemporelles de concentration. Il semble que la zone de fermeture englobe le centre de distribution de l'aiglefin de 0 à 8 ans, ce qui est susceptible d'en faire un refuge très efficace pour le rétablissement du stock. Un certain nombe d'indices révèlent que ce stock a été et continue d'être très exploité, même dans le cadre des restrictions actuelles concernant les prises accidentelles. Selon les prises des navires scientifiques, F est égal ou supérieur à 1,0, le poids moyen du poisson capturé est bas et la fourchette d'âges des prises a été réduite à tel point qu'on y trouve rarement du poisson de plus de sept ans. Il n'en demeure pas moins que d'après les résultats des campagnes d'évaluation et de la pêche au engins à petites mailles pratiquée par les navires étrangers, la classe d'âge de 1988 à un an présente des signes d'abondance qui ne sont pas sans rappeler ceux des classes d'âge de 1981 ou de 1982, lesquelles se sont avérées supérieures à la moyenne. Si d'ici là cette cohorte ne connaît pas une forte mortalité, elle pourrait contribuer de façon importante à la pêche quand elle aura atteint la taille réglementaire, soit en 1991-1992.

Description of the Fishery to 1990

Catches 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 from 1980 to 1987 (Table 1). The nominal catches for 1987 through 1989 have been taken exclusively as by-catch in other groundfish fisheries operating in divisions 4T, 4V, and 4W, and totalled 7750 t in 1989. This represents a 30% overrun of the advised TAC of 6,000 t for 1989.

In 1986, the combination of poor recruitment over four consecutive 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 by-catches. In 1987 the maximum by-catch was 5%, in 1988 this was increased to 10%, and 15% in 1989. Management also imposed a year-round ban on mobile gear fisheries in areas identified as nursery grounds (mainly Western and Emerald Banks). These nursery ground closures remain in effect to the present.

Until 1984 most of the catch from this stock was taken in Division 4W by large OTBs (TC4 and TC5) fishing in the spring. From 1984 to 1986 Sub-Division 4Vs accounted for an increasing proportion of the total catch (Table 2). Since the restriction of the fishery in 1987 landings in 4Vs have about doubled while landings in 4W have increased approximately four-fold. Since 1987 OTBs have landed approximately 60% of the landings each year while longliners have increased their share from about 20 to 50% (Table 3) mainly as a result of increased catches in 4W. Long-line landings in 4W in 1989 exceed long-line landings observed there in 1986, prior to the restriction of the fishery. Seine catches have declined from 15 to 6% of the annual total. The major proportion of annual landings are recorded during the second and third quarters (Table 4) a pattern which is relatively consistent across all components of the stock area (Table 5).

In 1989 there were some indications that haddock reported as caught in 4W may actually have been caught in 4X. This was the result of an early closure of the 4X fishery prompting some fishermen to obtain conditions of licence allowing them access to 4W, but continuing to fish in 4X. Early in 1990 there have also been reports of haddock caught in Sub-Division 4Vs being reported from Sub-Area 3. None of these reports indicate the quantities of fish involved.

Age Composition and Weight at Age of the Catch

The age composition of the 1989 small mesh gear catch in the foreign fishery was estimated in a manner consistent with recent practices (Zwanenburg 1989). A listing of the sampling data used to construct the 1989 catch at age is given in Table 6, while the age composition of each gear/area/time component is given on Table 7. The mean weights at age in each component of the commercial catch is presented on Table 8. The Canadian catch at age in 1989 was composed primarily of the 1984 and 1985 year-classes (33.4% and 25.1% by

numbers respectively) which made up 58.5% of the total numbers caught. By weight these year-classes accounted for 74.7% of the total catch (1984 = 47.6% and 1985 = 27.2%).

The foreign small mesh gear fishery caught 683 t in 1989, approximately twice the catch in 1988. This catch contained large numbers of fish at age 1 and 2 (Table 7). Since this fishery is restricted to the small mesh gear box this catch of small fish is not the result of a change in its location. Furthermore, catches of haddock are usually avoided since the entire silver hake fishery is restricted to a 1% aggregate by-catch and the fishery is closed once this limit has been reached. This indicates that these catches may have been unavoidable as a result of the overall abundance of the 1987 and 1988 year-classes. The 1988 year-class accounted for 20% of the 1989 catch by numbers and 1.6% of the catch by weight, while the 1987 year-class represented 9% by numbers and 2.8% by weight.

A time series of mean weights at age in the commercial catch is shown on Figure 1 (Table 9). This indicates that there are distinct temporal trends, but that present weights at age at about average levels. Mean weights at ages 8 and 9 are far above average levels, but this is most likely due to the small numbers of fish caught at these ages making the estimates unreliable.

A comparison of the observed and projected catch at age for 1989 (Figure 2) reveals discrepancies at ages 1 and 2 as a result of the small mesh gear catches. Catches at ages 3 to 5 are in relatively close agreement, while those at ages 6 and 7 show that significantly fewer fish were caught than were projected from last years assessment.

Since 1984 the maximum age in the catch has diminished to the point where in 1989 the oldest fish in the catch was 9 years old (Table 10).

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 rates are not considered to be representative of the abundance of this stock.

Research Vessel Index

The research survey catch rates from 1970 to 1988 show a decline in overall abundance from 1983 to 1987 with a subsequent increase in 1988 and a slight decline to 1989 (Figure 3). The sharp increase in 1988 is due mainly to a large catch of 2 year old fish (1986 year-class) in a single stratum resulting in a very high CV for this estimate as was noted in the last assessment (Zwanenburg 1989). The 1989 estimate of this year class shows it to be much smaller (Table 11). The 1989 catch rate is still higher than that of 1987. The estimates of the 1988 year-class at age 1 shows an abundance which is comparable to the abundant

1981 or 1982 year-classes and is associated with a CV of 30% which is relatively low (Table 12).

Division 4W has traditionally been the centre of distribution of this resource as evidenced by the significantly higher catch rates observed there (Figure 4). Age 0 fish have been observed in 13 of the past 20 years while age 1 fish are present in all years (Table 13). 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 large 1980-1982 year-classes. Catch rates at these younger ages declined from 1983 to 1987 as a result of lower recruitment and have shown an unsteady increase over the past two years. Catch rates at ages 4+, which peaked in 1984 continue to decline to the present.

The age composition in Sub-divisions 4Vn is skewed towards ages 4+ (Figure 5). Age 0 fish have not been observed in the survey of this area, while fish at ages 1-3 have occurred in less than 50% of the surveys (Table 14). Catch rates show clearly the influx and subsequent decline of the 1980-1982 year classes beginning in 1984. Since these three large year-classes there has been no significant recruitment to this part of the population. It should be noted that catch rates in 4Vn have been higher since the influx of the 1977 year-class in 1981 than for the preceding ten years. This year-class would have been the first one to benefit from the exclusion of the foreign fleets from the Scotian Shelf.

Sub-division 4Vs shows the presence of age 0 fish in only a single year since 1970 when some fish belonging to the large 1982 cohort were found there. Age 1 fish have been observed in 16 of the past 20 years (Table 15). Catch rates increased rapidly in 1982 as a result of the incursion of fish belonging mainly to the 1981 year-class (Figure 6). These high catch rates have declined to pre-1982 values by 1989. As was the case in 4Vn the presence of post 1977 year-classes became evident in the early 1980s. Since 1987 catch rates at ages 4+ have declined rapidly to the present.

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

Environmental Variables

Closed Area

A haddock nursery area has been closed year-round to mobile gear fisheries since 1987. The objective of the closed area is to protect incoming recruits from fishing to allow this stock to rebuild. Areas identified for closure were those which showed persistent and relatively large aggregations of young fish in the July RV survey series (Fanning et al. 1987). The area encompasses all of Western and Emerald banks and extends seaward to the small

mesh gear line. Fixed gear fisheries are permitted to fish inside this closed area (subject to all other regulations in effect) since these gears catch relatively older fish than mobile gears.

It is too early to establish a direct cause and effect relationship between the closed area and a subsequent change in resource status; however, catch rates at ages 1 and 2 of fish belonging to the 1987 and 1988 year-classes were higher than the 1983 through 1986 year-classes at these ages (Table 11). Catch rates inside the closed area are far higher than in Division 4W in general (compare Table 16 and Table 17) and have shown a continuous increase since 1987 (Figure 7) whereas catch rates in 4W in general showed a slight decline in 1989. These two year-classes are the first which may have benefitted from the effects of the closed area. An age structured analysis of the spatial distribution of haddock shows that the closed area may also encompass the centre of distribution of age classes 0 to 8. This is based on the observation that the mean catch per tow at age in this area is above the grand mean catch per tow at age (1970-1989) more frequently than elsewhere in the stock area for all of these ages (Table 17). The grand mean catch per tow at age was calculated across all strata and years of the survey. These analyses also indicated that haddock become more widely distributed with age and abundance. Abundant cohorts were also found to be more widely distributed than small cohorts. If this area is the centre of distribution for haddock on the eastern shelf, then this could make the closed area a very effective management initiative. As haddock become less abundant, their spatial dispersion would shrink to the point where most of the fish are inside the closed area and would become protected from most fishing effort. As abundance increases and fish become dispersed, they would again become available to the fishery. An examination of the 1987 and 1988 cohorts at ages 1 and 2 show them to be more widely distributed than the 1983 through 1986 cohorts.

These results are preliminary and apply only to the summer. However; a similar analysis for 4X haddock indicates that centres of distribution are consistent between seasons.

Estimation of Stock Parameters

As was the case in the previous assessment we were not able to estimate fishing mortality in the current year. At that time it was thought that the half year formulation of the adaptive framework, allowing for the incorporation of current year survey estimates, may have been responsible for the anomalous retrospective estimates of F observed. This year, the results of a number of formulations of the adaptive framework were examined. Each of these resulted in retrospective estimates of F far in excess of what had been estimated in that year.

Fully recruited F in current and Retrospective Year.

	1987	1988	1989
1987	.031	.131	.697
1988		.053	.298
1989			.127

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 analysis were considered to be unreliable.

It is clear that the survivorship of ages 4 and older haddock have been extremely low. The inconsistencies encountered when attempting to calibrate the SPA suggest that fish are dying faster than can be accounted for by the landings at age. Several factors could account for this observation. It has been suggested that larger, older haddock migrate out of the stock area. Alternatively, larger, older haddock could be experiencing higher natural mortality. Examination of tagging results and our present understanding of haddock life history is not consistent with these two possibilities, however they cannot be ruled out. A more parsimonious interpretation of the observations would be to assume that greater numbers of haddock are caught than what is reported in the landings statistics. This could be due to discarding, misreporting or non-reporting. Unfortunately, the uncertainties about the statistics does not permit a definitive interpretation at this time.

Assessment Results

Fishing Mortality and Stock Abundance

Total mortalities estimated from survey catch rates at age indicate that F in recent years is well above $F_{0.1}$=0.25 (Figure 9) and has been increasing since the early to mid 1980s. Given the variability in survey catch rates these estimates, while indicating the overall trend in F, should be viewed as approximate. The mean weight of a fish in the catch in 1989 also points to an exploitation rate well in excess of $F_{0.1}$ (Figure 10).

Recruitment

Results of the 1989 July RV survey indicate that the 1988 year-class appears to be relatively large. This estimate is associated with a relatively low CV. Its distribution over the stock area is consistent with that of previously observed large year-classes. The 1987 year-class does not appear to be as large as that of 1988, but may be larger than the 1983 through 1986 year-classes. The 1987 and 1988 year-classes also appeared strong in the small mesh gear fishery.

Prognosis

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. Research vessel catch rates at age indicate that Fs are presently on the order of 1.0 or above. This is consistent with the relatively small average weight of a fish in the catch which indicates an exploitation rate well in excess of F_{max}. The reduction in the overall age span of the stock to the point where fish older than age 7 are relatively rare also indicates poor survivorship over a long period.

References

Fanning, F.P., and K. Zwanenburg, and M. Showell. 1987. Haddock nursery closed areas: Delineation and impact. CAFSAC Research Document 87/59.

Zwanenburg, K. 1989. Assessment of 4TVW haddock with catch projections to 1990. CAFSAC Research Document 89/64.

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	459					488				13	1587				1	994		207		154	3903	0
*1988	381					506					2055					1156		332		98	4528	0
1989	79					411					3112					3465		**683			7750	0

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

Table 2. 4TVW haddock landings (t) by division and subdivision (Canadian catches only).

Area	1986	1987	1988	1989
4T	553	453	383	79
4Vn	899	491	506	411
4Vs	8719	1547	2041	3112
4W	6170	991	1150	3465
TOTAL	16341	3481	4080	7067

Table 3. Canadian (M, Q, & Nfld.) 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	14155	1098	1149	108	16510
1987*	2084	734	580	82	3480
1988*	2341	1134	424	180	4079
1989*	4311	2223	475	58	70674

* - Provisional Statitics

Table 4. 4TVW haddock landings by quarter and major gear type 1986-1989 (Canadian landings only. Key: OTB - otter trawler; LL - longliner; SNU - seiner)

	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

	1988					1989				
	Q1	Q2	Q3	Q4	TOTAL	Q1	Q2	Q3	Q4	TOTAL
OTB	266	852	777	447	2341	762	2021	1059	469	4311
LL	33	177	721	204	1134	285	522	811	605	2223
SNU	11	199	197	17	424	14	283	150	28	475
Other	7	63	53	57	180	0	16	28	13	58
TOTAL	317	1291	1747	725	4080	1062	2842	2049	1115	7067

Table 5. 4TVW haddock landings by area, quarter and gear type (Canadian landings only).

4T

	1986					1987				
	Q1	Q2	Q3	Q4	TOTAL	Q1	Q2	Q3	Q4	TOTAL
OTB	9	71	85	4	169	4	78	43	9	134
LL	0	2	6	5	12	0	2	7	4	13
SNU	0	261	83	16	359	0	208	75	5	289
Other	0	1	10	1	13	0	11	6	0	17
TOTAL	9	336	184	25	554	4	300	130	19	453

	1988					1989				
	Q1	Q2	Q3	Q4	TOTAL	Q1	Q2	Q3	Q4	TOTAL
OTB	1	18	199	5	224	0	9	2	0	11
LL	0	1	2	4	8	0	0	1	2	3
SNU	0	57	69	7	132	0	39	20	1	60
Other	0	9	9	2	20	0	4	1	0	6
TOTAL	1	85	279	18	383	0	52	24	3	79

4Vn

	1986					1987				
	Q1	Q2	Q3	Q4	TOTAL	Q1	Q2	Q3	Q4	TOTAL
OTB	67	139	180	18	405	28	84	32	20	164
LL	0	27	87	47	161	7	28	54	26	115
SNU	0	190	134	4	328	0	142	47	18	207
Other	0	1	3	1	6	0	1	2	3	5
TOTAL	67	356	405	71	899	35	254	135	66	491

	1988					1989				
	Q1	Q2	Q3	Q4	TOTAL	Q1	Q2	Q3	Q4	TOTAL
OTB	26	113	14	11	164	24	178	46	1	249
LL	0	21	113	52	186	0	13	27	5	44
SNU	0	102	48	3	153	0	96	17	1	114
Other	0	0	2	0	2	0	1	2	1	4
TOTAL	26	236	177	66	506	24	287	91	9	411

Table 5. (Continued)

4Vs										
	1986					1987				
	Q1	Q2	Q3	Q4	TOTAL	Q1	Q2	Q3	Q4	TOTAL
OTB	810	3666	3093	917	8485	252	398	412	291	1353
LL	4	93	115	0	212	2	58	98	16	174
SNU	0	17	3	0	19	0	11	7	1	19
Other	0	0	2	0	2	0	0	0	0	0
TOTAL	814	3775	3212	917	8719	254	468	517	308	1547
	1988					1989				
	Q1	Q2	Q3	Q3	TOTAL	Q1	Q2	Q3	Q4	TOTAL
OTB	188	596	448	385	1617	592	1254	538	209	2593
LL	14	67	211	27	319	11	100	192	95	398
SNU	0	24	16	0	40	5	76	34	2	118
Other	7	45	11	2	65	0	3	0	0	4
TOTAL	209	732	685	414	2041	608	1433	764	307	3112

4W										
	1986					1987				
	Q1	Q2	Q3	Q4	TOTAL	Q1	Q2	Q3	Q4	TOTAL
OTB	2186	282	302	2122	4893	72	120	121	113	427
LL	82	81	328	229	719	26	45	219	144	434
SNU	121	16	130	206	472	5	8	47	10	70
Other	1	12	50	23	86	0	7	32	21	60
TOTAL	2391	391	810	2579	6170	103	181	419	288	991
	1988					1989				
	Q1	Q2	Q3	Q4	TOTAL	Q1	Q2	Q3	Q4	TOTAL
OTB	51	125	116	45	336	146	581	473	258	1458
LL	19	88	394	121	622	274	409	592	503	1778
SNU	11	16	64	8	99	9	72	79	24	184
Other	0	9	31	53	93	0	8	25	12	45
TOTAL	81	238	605	226	1150	429	1070	1169	797	3465

Table 6. Composition of age length keys for 1989.

	Trawlers						
	1st Quarter	2nd Quarter	1st Half	3rd Quarter	4th Quarter	2nd Half	Longline Full Year
4TV							
# Samples	10	11		9	8		5
# Measured	1945	2385		1653	1552		1043
# Aged	209	230		152	145		114
Catch	621	1651		657	216		458
4W							
# Samples			8			4	7
# Measured			1816			838	1337
# Aged			178			62	107
Catch			808			834	1823

Table 7. Composition of 1989 4TVW haddock catch at age.
(Numbers in brackets are numbers of otoliths in the key.)

	4Vs					4W				
	OTB				LL	OTB		LL	SMG	Σ
	Q1 (209)	Q2 (230)	Q3 (152)	Q4 (145)	All (114)	Q1/2 (178)	Q3/4 (62)	All (107)	All (528)	
1	0	0	0	0	0	0	0	0	1590	1590
2	0	0	0	0	0	4	0	0	770	774
3	0	13	0	9	5	57	257	62	116	519
4	22	358	114	49	76	321	449	626	204	2220
5	219	725	255	64	173	335	178	894	109	2949
6	193	184	88	14	62	26	12	111	9	699
7	31	15	5	1	6	3	0	2	0	63
8	1	0	0	0	1	0	0	0	0	2
9	0	0	0	0	1	0	0	0	0	1

OTB - Otter trawlers
LL - Longliners
SMG - Small meshed gear (USSR, Cuba)

Table 8. Composite weights at age for 1989 catch (wt in kg 1989).

	4Vs					4W				
	OTB				LL	OTB		LL		
Age	Q1	Q2	Q3	Q4	All	Q1/2	Q3/4	All	SMG	Σ
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08
2	0.00	0.00	0.00	0.49	0.00	0.24	0.00	0.00	0.28	0.28
3	0.00	0.81	0.00	0.94	0.78	0.63	0.70	0.71	0.53	0.66
4	0.83	1.04	1.07	1.25	0.89	0.92	0.92	0.94	0.87	0.95
5	1.15	1.30	1.40	1.69	1.34	1.25	1.24	1.14	1.28	1.25
6	1.47	1.60	1.86	2.53	2.07	2.03	1.58	1.50	1.99	1.66
7	2.06	2.45	2.50	3.69	3.17	2.61	0.00	2.40	0.00	2.36
8	2.75	0.00	0.00	4.01	3.47	0.00	0.00	0.00	0.00	3.11
9	2.80	0.00	0.00	0.00	4.70	0.00	0.00	0.00	0.00	4.70

Table 9. Commercial weight at age 4TVW haddock.

	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
1	.08	.08	.08	.68	.08	.08	.08	.08	.08	.08	.08	.08
2	.31	.68	.31	.31	.68	.58	.68	.31	.50	.31	.53	.80
3	1.13	.84	.82	1.00	.89	.95	.87	.79	.75	.76	.70	.68
4	1.19	1.19	1.03	1.07	1.09	1.13	1.08	1.04	.89	.99	.98	.89
5	1.61	1.39	1.38	1.29	1.35	1.52	1.14	1.30	1.25	1.19	1.26	1.17
6	2.25	1.82	1.86	1.63	1.66	1.82	1.57	1.48	1.53	1.56	1.47	1.48
7	2.69	2.47	2.17	2.08	2.11	2.25	1.95	1.81	1.72	1.82	1.75	1.79
8	3.02	2.93	2.63	2.33	2.62	2.76	2.13	2.15	2.13	2.07	2.10	2.17
9	3.10	2.99	2.56	1.61	2.99	3.18	2.44	2.39	2.23	2.37	2.09	2.41
10	3.38	3.16	2.84	1.39	2.51	3.87	2.69	2.60	2.28	2.39	2.46	2.74
11	3.49	3.32	3.59	2.32	2.46	3.54	3.06	2.78	2.81	2.79	2.41	2.95

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
1	.08	.06	.05	.10	.10	.10	.09	.12	.11	.10	.11	.12
2	.31	.19	.20	.14	.28	.25	.27	.38	.17	.22	.33	.34
3	.67	.79	.45	.36	.45	.42	.36	.53	.43	.65	.64	.63
4	.91	.90	.83	.94	.71	.71	.70	.78	.80	.88	.91	.92
5	1.10	1.15	1.02	1.15	1.10	1.11	1.03	1.15	1.12	1.26	1.29	1.30
6	1.41	1.53	1.35	1.36	1.35	1.30	1.33	1.48	1.59	1.62	1.56	1.63
7	1.83	1.87	1.74	1.75	1.64	1.93	1.55	1.77	2.16	2.28	2.07	1.93
8	2.19	2.22	2.18	2.01	1.92	2.23	2.18	2.17	2.19	2.77	2.59	2.30
9	2.46	2.41	2.73	2.36	2.34	2.42	2.30	2.55	2.57	3.31	3.14	2.87
10	2.70	2.76	2.60	2.55	2.72	2.79	2.67	2.82	3.10	3.32	4.04	3.43
11	2.68	3.30	3.45	2.44	2.39	3.12	3.04	3.06	3.34	3.21	3.55	3.75

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	.10	.12	.12	.16	.09	.14	.08	.09	.08	.08	.06	.07
2	.28	.35	.41	.25	.37	.51	.35	.33	.23	.38	.26	.19
3	.59	.65	.64	.85	.53	.93	.67	.71	.72	.69	.63	.53
4	.96	.98	1.12	1.20	1.22	1.23	1.07	1.17	1.03	.95	.96	.82
5	1.34	1.37	1.66	1.57	1.61	1.51	1.51	1.55	1.36	1.27	1.20	1.16
6	1.83	1.87	1.98	2.14	2.03	1.90	1.97	2.02	1.85	1.68	1.61	1.43
7	2.19	2.22	2.47	2.45	2.27	2.35	2.58	2.44	2.32	2.19	2.15	1.72
8	2.41	2.59	2.79	2.80	2.33	2.51	2.69	2.96	2.66	2.71	2.78	1.90
9	2.97	3.25	2.84	3.04	3.19	2.81	3.28	3.27	3.13	3.08	3.14	2.80
10	3.86	3.17	3.43	3.13	2.61	3.33	3.50	3.44	3.40	3.41	3.51	2.06
11	3.83	3.63	3.40	4.12	3.10	3.20	3.85	4.21	3.65	3.66	4.50	1.82

	1984	1985	1986	1987	1988	1989
1	.09	.12	.10	.10	.11	.08
2	.26	.20	.27	.21	.30	.28
3	.58	.46	.63	.51	.65	.66
4	.74	.70	.82	.93	.91	.95
5	1.04	.99	1.05	1.22	1.21	1.25
6	1.46	1.43	1.57	1.67	1.59	1.66
7	1.79	1.93	2.41	2.25	2.19	2.36
8	2.15	2.35	2.28	2.52	2.31	3.11
9	2.66	2.96	2.58	2.74	2.57	4.70
10	3.24	2.20	3.76	3.07	2.69	2.99
11	3.18	5.59	4.47	4.73	4.61	4.52

Table 10. Commercial catch at age 4TVW haddock.

	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
1	0	0	0	50	0	0	0	0	0	0	0	0
2	0	10	0	0	6	3	12	0	213	0	63	8
3	177	855	83	765	449	349	211	504	1926	647	2115	2938
4	2194	1126	2389	4967	1915	2324	2881	1021	11209	3634	3817	6803
5	3269	4330	2823	6056	6626	4113	10071	2592	2400	13199	2504	5559
6	1297	3090	5018	2216	4654	4445	2159	5132	2539	2045	8128	3388
7	1412	483	3227	1794	1831	1407	2466	1765	2866	1538	1076	7071
8	1088	357	293	1306	1079	457	1318	1642	963	1233	777	809
9	556	303	575	98	405	247	431	620	1334	341	788	528
10	433	228	230	66	96	25	265	313	340	244	276	534
11	253	142	358	79	65	18	68	51	89	92	164	213

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
1	0	2	205	1287	2591	53595	2127	89	5	31	306	268
2	0	31	436	924	3073	32161	9696	181	13	42	129	667
3	455	409	1491	511	4074	24140	9638	1006	398	438	679	888
4	6408	4901	2039	3471	2368	15192	8887	2622	1806	1408	1743	2189
5	7580	8501	7794	3673	6023	7775	4645	2836	2926	2039	1400	2740
6	3339	4298	6190	6594	2069	4057	1217	1113	2494	1955	1365	1208
7	2164	1362	1957	3190	2906	1282	1637	441	793	939	1163	944
8	1964	1062	839	1243	1562	1234	499	597	379	279	389	1177
9	372	727	317	287	403	402	272	212	406	131	88	277
10	157	193	223	126	81	72	89	174	116	118	38	39
11	161	61	59	113	45	54	12	55	78	39	19	21

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	306	487	59	279	431	213	714	1	332	870	530	497	10
2	288	1178	233	61	676	283	433	268	376	318	433	470	360
3	671	646	975	470	157	965	811	423	2372	262	1520	1084	1514
4	751	1467	254	805	249	335	2412	1120	4334	5072	764	3207	4158
5	924	811	464	282	323	513	436	675	3238	5081	5629	2040	2225
6	668	723	298	185	189	283	715	159	1702	3010	1957	1677	821
7	345	342	114	63	132	117	203	149	249	1178	1220	530	410
8	191	159	47	30	36	80	61	16	129	139	214	235	90
9	159	60	8	8	8	19	23	5	39	105	48	29	30
10	9	99	17	4	10	15	8	6	9	30	28	18	5
11	18	2	16	1	3	6	2	2	7	10	5	19	2

	1985	1986	1987	1988	1989
1	133	12	30	56	1590
2	69	50	76	68	774
3	411	1289	160	129	519
4	8006	10064	983	1584	2220
5	4162	5954	1686	1726	2949
6	881	767	377	390	699
7	232	100	24	39	63
8	47	13	6	4	2
9	14	1	1	4	1
10	2	1	0	1	0
11	1	1	1	0	0

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

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
0	.10	.06	.00	.00	.23	.07	.30	.20	.00	1.49	1.44
1	2.74	1.72	1.32	.53	.37	5.07	2.76	6.07	9.90	.09	3.51
2	1.00	3.63	.89	1.73	2.15	.72	3.13	11.38	11.07	9.13	.28
3	1.84	1.20	1.30	.54	2.90	1.94	.48	8.97	14.81	9.94	14.88
4	2.04	1.58	.59	.47	.53	1.73	.95	1.22	8.32	10.33	13.92
5	.99	.63	.49	.17	.54	.46	.93	1.94	.51	2.90	8.65
6	.62	.36	.37	.35	.27	.83	.21	.72	.49	.37	2.09
7	.70	.16	.15	.07	.20	.22	.23	.20	.12	.29	.33
8	.35	.25	.07	.10	.08	.09	.05	.11	.02	.10	.12
9	.14	.01	.04	.02	.05	.05	.02	.00	.00	.00	.02
10	.04	.00	.02	.05	.03	.05	.02	.05	.01	.04	.00
11	.04	.00	.00	.00	.04	.00	.02	.01	.01	.02	.00
12	.03	.00	.00	.00	.00	.02	.06	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.02	.00	.00	.00
14	.01	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00
15	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	22.35	.77	.15	.28	.00	.14	.08	1.04	.10
1	15.61	18.19	21.80	.30	4.22	.60	1.93	4.70	13.86
2	9.38	15.75	14.49	10.84	1.04	2.25	1.73	13.43	7.07
3	.99	14.21	30.22	16.89	11.08	7.78	4.67	10.20	3.21
4	7.37	2.05	11.63	29.11	21.68	26.06	15.57	16.16	10.79
5	4.68	7.21	3.08	5.25	4.73	11.88	6.17	9.26	6.01
6	2.01	3.05	2.74	2.57	1.26	1.30	.55	1.13	.46
7	.31	.97	.95	1.36	.30	.40	.09	.11	.03
8	.09	.23	.24	.30	.06	.07	.00	.03	.00
9	.10	.02	.07	.11	.00	.00	.05	.00	.00
10	.03	.02	.06	.02	.00	.00	.00	.00	.00
11	.00	.00	.00	.01	.00	.00	.00	.00	.00
12	.00	.00	.04	.00	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.02	.00	.00	.00	.00	.00	.00
15	.00	.02	.00	.00	.00	.00	.00	.00	.00

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

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

	1985	1986	1987	1988	1989
0	.00	.63	.56	.27	.38
1	.57	.36	.38	.34	.30
2	.35	.27	.37	.91	.48
3	.24	.21	.20	.69	.28
4	.14	.20	.21	.38	.18
5	.18	.15	.24	.20	.14
6	.25	.21	.19	.20	.27
7	.28	.23	.28	.30	.60
8	.53	.36	.00	1.00	.00
9	.00	.00	.56	.00	.00
10	1.00	.00	.00	.00	.00
11	.00	.00	.00	.00	.00
12	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00
15	.00	.00	.00	.00	.00

Table 13. Mean catch per tow (Strata 53-66).

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
0	.19	.11	.00	.00	.42	.13	.54	.36	.00	2.71	2.63
1	4.95	2.90	2.27	.93	.46	9.13	5.01	11.03	18.04	.14	4.87
2	1.78	6.61	.48	3.15	3.87	1.06	4.48	20.67	20.17	16.38	.39
3	3.30	2.15	1.36	.87	5.24	3.49	.71	15.63	26.97	17.97	27.00
4	2.53	2.86	.85	.75	.92	3.13	1.73	1.86	15.11	18.77	25.23
5	1.15	1.10	.79	.31	.97	.79	1.67	3.19	.93	5.25	15.56
6	.83	.58	.43	.64	.49	1.38	.38	1.25	.86	.68	3.76
7	1.10	.25	.23	.10	.35	.38	.42	.33	.23	.51	.59
8	.31	.42	.13	.17	.11	.16	.09	.16	.03	.18	.17
9	.16	.02	.08	.04	.08	.09	.03	.00	.00	.00	.03
10	.00	.00	.03	.06	.03	.07	.03	.02	.02	.07	.00
11	.04	.00	.00	.00	.06	.00	.03	.02	.00	.03	.00
12	.04	.00	.00	.00	.00	.03	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	40.73	1.34	.27	.50	.00	.25	.15	1.90	.18
1	27.45	17.40	37.79	.53	7.70	1.03	3.51	8.45	25.06
2	16.90	27.15	20.22	17.26	1.89	4.06	2.90	24.47	12.43
3	1.79	17.17	52.01	22.22	19.16	13.14	7.59	18.28	5.82
4	13.33	3.12	18.60	47.62	30.48	41.57	24.42	27.77	19.52
5	8.43	11.16	4.40	8.61	6.07	17.85	6.99	13.91	10.43
6	3.37	4.95	4.65	4.44	1.78	1.52	.63	1.31	.65
7	.45	1.41	1.56	2.13	.30	.63	.12	.12	.00
8	.12	.19	.36	.53	.11	.07	.00	.00	.00
9	.17	.03	.05	.20	.00	.00	.00	.00	.00
10	.05	.03	.11	.05	.00	.00	.00	.00	.00
11	.00	.00	.00	.00	.00	.00	.00	.00	.00
12	.00	.00	.08	.00	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	.00	.04	.00	.00	.00	.00	.00	.00	.00

Table 14. **Mean catch rates per tow 4Vn** (Strata 40-42).

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1	.00	.21	.00	.00	.39	.12	.00	.00	.00	.00	.43	.00	.73	.00
2	.00	.00	.00	.00	.00	.88	.00	.00	.00	.26	.00	.27	.00	.00
3	.00	.00	.00	.00	.00	.11	.00	.00	.00	.00	.12	.00	.34	.10
4	.33	.00	.00	.12	.00	.11	.00	.00	.26	.00	.00	.32	.55	.45
5	.67	.00	.00	.00	.00	.00	.00	.00	.00	.00	.37	.26	.29	.00
6	.00	.00	.00	.00	.00	.00	.00	.00	.13	.00	.00	1.06	.50	.23
7	.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.10	.93	.23
8	.00	.00	.00	.00	.00	.00	.00	.18	.00	.00	.00	.21	.00	.19
9	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.10
10	.33	.00	.00	.00	.00	.00	.00	.35	.00	.00	.00	.00	.00	.00
11	.00	.00	.00	.00	.00	.00	.00	.00	.13	.00	.00	.00	.00	.00
12	.00	.00	.00	.00	.00	.00	.56	.00	.00	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

	1984	1985	1986	1987	1988	1989
0	.00	.00	.00	.00	.00	.00
1	.13	.00	.31	.00	.00	.00
2	.27	.00	.09	.00	.00	.07
3	.56	.00	1.35	.00	.00	.00
4	2.00	3.90	1.72	.57	.06	.14
5	.81	3.46	6.20	1.57	.85	1.25
6	.30	1.38	1.10	.42	1.33	.22
7	.66	.10	.06	.07	.38	.22
8	.00	.00	.06	.00	.00	.00
9	.00	.00	.00	.07	.00	.00
10	.00	.00	.00	.00	.00	.00
11	.00	.00	.00	.00	.00	.00
12	.00	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00	.00
15	.00	.00	.00	.00	.00	.00

Table 15. **Mean Catch rates per tow 4Vs** (Strata 43-52).

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.11
1	.05	.33	.21	.05	.23	.14	.03	.06	.00	.03	2.31	1.59	24.85
2	.09	.01	1.81	.01	.07	.14	1.96	.10	.00	.33	.17	.21	2.47
3	.08	.05	1.60	.18	.08	.04	.26	1.13	.01	.21	.15	.03	13.80
4	1.80	.02	.35	.13	.06	.02	.00	.56	.00	.08	.22	.07	.81
5	.84	.06	.16	.00	.03	.08	.04	.55	.00	.04	.20	.07	3.07
6	.49	.10	.38	.00	.00	.22	.00	.10	.00	.00	.08	.15	.83
7	.24	.07	.07	.05	.03	.04	.00	.06	.00	.02	.03	.14	.27
8	.52	.07	.00	.00	.06	.00	.00	.00	.00	.00	.07	.00	.35
9	.16	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00
10	.03	.00	.00	.03	.04	.04	.00	.00	.00	.00	.00	.00	.00
11	.05	.00	.00	.00	.01	.00	.00	.00	.00	.00	.00	.00	.00
12	.03	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.06	.00	.00	.00	.00	.00
14	.03	.00	.00	.00	.00	.00	.00	.00	.00	.02	.00	.00	.00
15	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

	1983	1984	1985	1986	1987	1988	1989
0	.00	.00	.00	.00	.00	.00	.00
1	3.09	.00	.00	.02	.00	.16	.32
2	9.85	3.88	.00	.03	.41	.01	.70
3	4.85	13.47	1.65	1.22	1.47	.49	.04
4	3.99	8.03	13.19	8.88	6.11	2.66	.18
5	1.92	1.26	2.99	4.12	6.30	4.45	.44
6	.48	.29	.39	1.01	.47	.77	.23
7	.19	.35	.37	.15	.06	.00	.02
8	.05	.03	.00	.07	.00	.09	.00
9	.10	.00	.00	.00	.13	.00	.00
10	.00	.00	.01	.00	.00	.00	.00
11	.00	.02	.00	.00	.00	.00	.00
12	.01	.00	.00	.00	.00	.00	.00
13	.00	.01	.00	.00	.00	.00	.00
14	.07	.00	.00	.00	.00	.00	.00
15	.00	.00	.00	.00	.00	.00	.00

Table 16. **Mean catch per tow in Closed area**

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
0	.14	.00	.00	.00	1.63	.58	2.33	.48	.00	8.72	7.91
1	6.46	5.34	5.84	3.43	1.84	8.28	11.92	27.49	25.27	.56	7.52
2	3.09	12.94	.71	6.07	15.96	1.23	9.09	46.83	53.65	11.20	.34
3	6.46	4.17	2.03	1.82	20.60	12.86	1.84	39.24	73.07	24.35	71.43
4	5.49	5.21	2.06	2.43	3.68	11.94	5.13	4.14	42.66	35.53	73.35
5	2.34	2.14	2.22	1.05	3.99	2.78	4.42	5.03	2.13	11.17	42.85
6	1.80	1.05	.92	2.30	2.10	5.11	.92	1.79	1.56	1.50	7.05
7	1.90	.54	.60	.43	1.47	1.28	.84	.23	.65	1.02	.80
8	.52	.51	.33	.37	.47	.42	.15	.16	.04	.15	.15
9	.30	.03	.24	.18	.36	.23	.01	.00	.00	.00	.05
10	.00	.00	.07	.00	.13	.13	.08	.04	.00	.00	.00
11	.07	.00	.00	.00	.23	.00	.01	.00	.00	.05	.00
12	.07	.00	.00	.00	.00	.02	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	15.87	.34	.87	2.18	.00	.10	.00	3.42	.08
1	68.98	18.35	52.52	.83	10.31	2.53	5.81	12.09	53.81
2	10.15	52.77	14.70	10.98	4.43	7.78	4.21	3.73	15.07
3	2.60	34.49	14.20	14.95	25.41	18.50	12.02	12.50	12.01
4	35.46	7.62	8.48	51.01	38.36	50.40	42.03	31.58	46.92
5	15.91	29.33	4.38	9.72	6.21	20.00	12.39	15.97	25.37
6	5.79	9.96	3.63	4.02	1.38	.65	1.14	1.19	1.16
7	.82	2.35	.92	1.55	.14	.23	.27	.10	.00
8	.17	.17	.13	.20	.02	.03	.00	.00	.00
9	.17	.00	.01	.09	.00	.00	.00	.00	.00
10	.03	.01	.02	.03	.00	.00	.00	.00	.00
11	.00	.00	.00	.00	.00	.00	.00	.00	.00
12	.00	.00	.00	.00	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	.00	.00	.00	.00	.00	.00	.00	.00	.00

Table 17. Stratum rankings by age. Highest rank (1) is that stratum where mean catch per tow at age most often exceeds the grand mean catch per tow at that age.

	AGE									
Rank	0	1	2	3	4	5	6	7	8	9
1	64	63	65	63	64,64	63	63	63	59	62
2	65,56	65	64	64	55	64	64	64	63,64	64
3	55,62,63	56	56	55,56	56	55,56	65	65	60	60,63,65
4	58	64,62,64	55,63	65	65	65	55,56	62	62	59
5	54,59,60,61	55	50,62	58	58	58	60,62	55	55,56	55,56
6		50,57	54,58,59	62	47	47,62	41,58,59	60,52	65	41,47,48 50,51,58
7		47,48,51,58, 59,60	47,57	50,54,47	54	49,54	47,49,51	49,50,56	49	43,44,49
8		52	60	49,57,59	48,50,62	50,60	50	41,54,58	41,44,47,50 51,52,54	54,57
9			48,49,51	48,51,60	49,52,57	41,48	52,54,57	47,51	58,48	
10					41,51	51,52,59	44,48	44,48,67	42,43,57,66	
11						44,57				

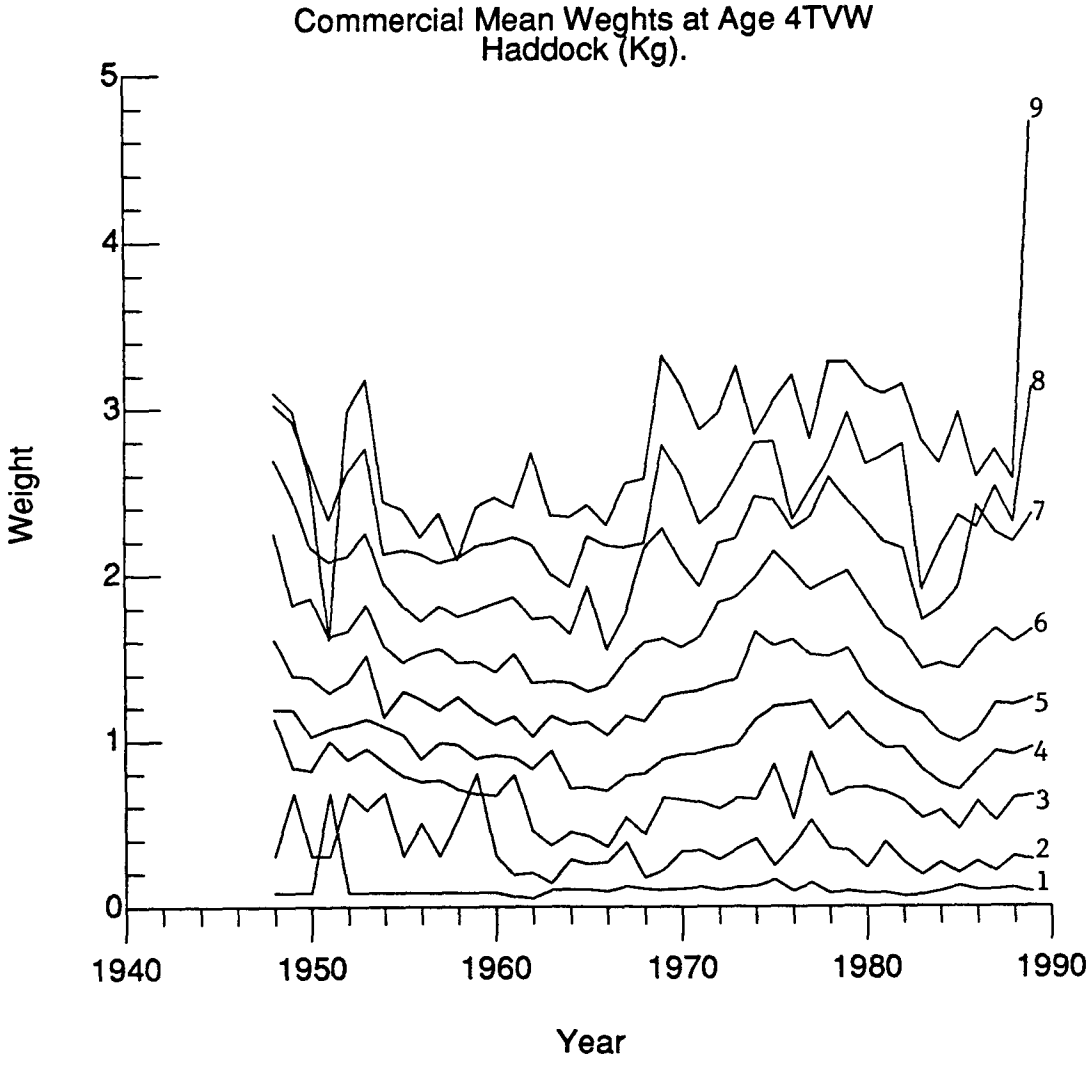
Commercial Mean Weghts at Age 4TVW
Haddock (Kg).
Weight
Year
0
1
2
3
4
5
1940
1950
1960
1970
1980
1990
9
8
7
6
5
4
3
2
1

Figure 1.

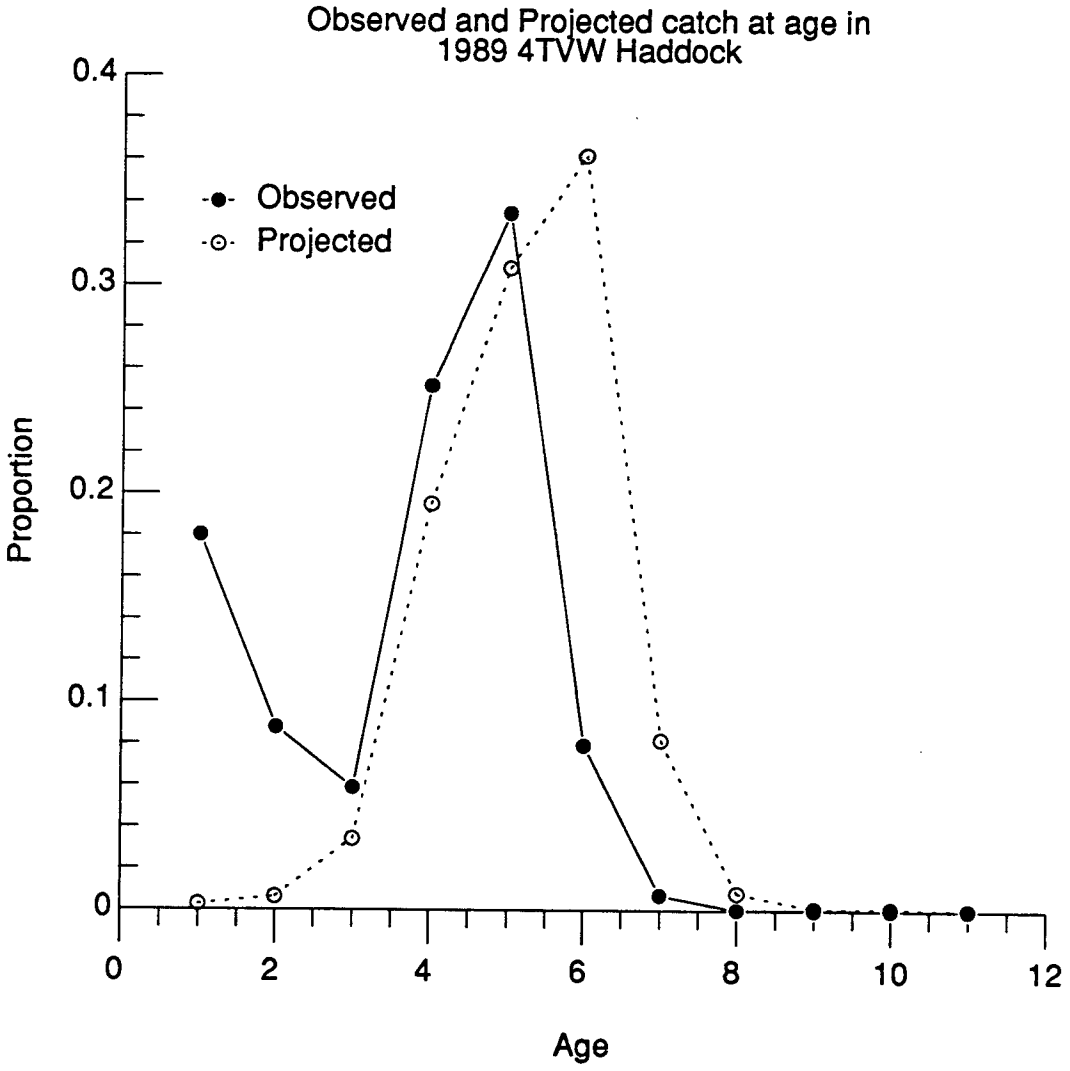
Observed and Projected catch at age in
1989 4TVW Haddock
Observed
Projected
Proportion
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
12
Age

Figure 2.

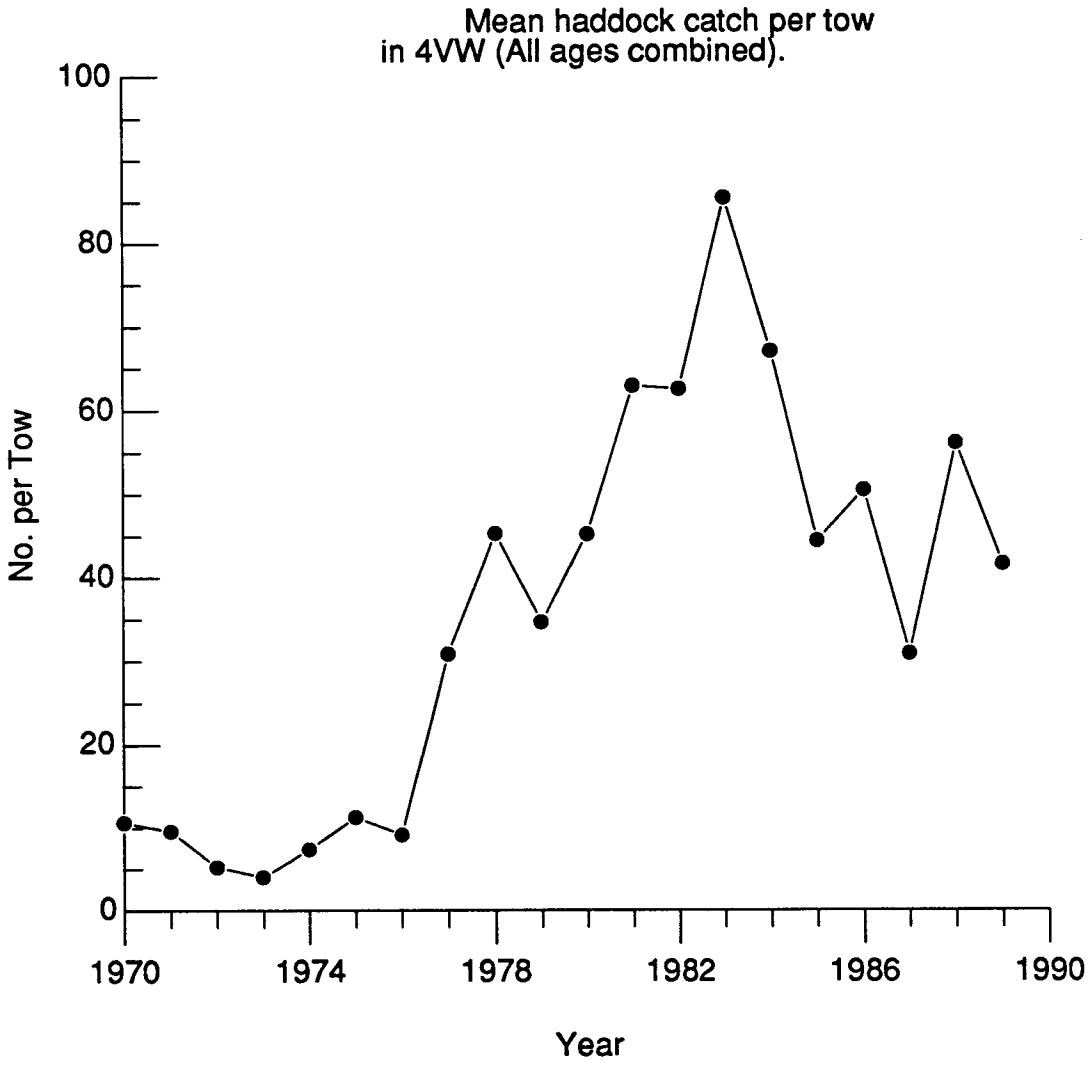
Mean haddock catch per tow
in 4VW (All ages combined).
No. per Tow
100
80
60
40
20
0
1970
1974
1978
1982
1986
1990
Year

Figure 3.

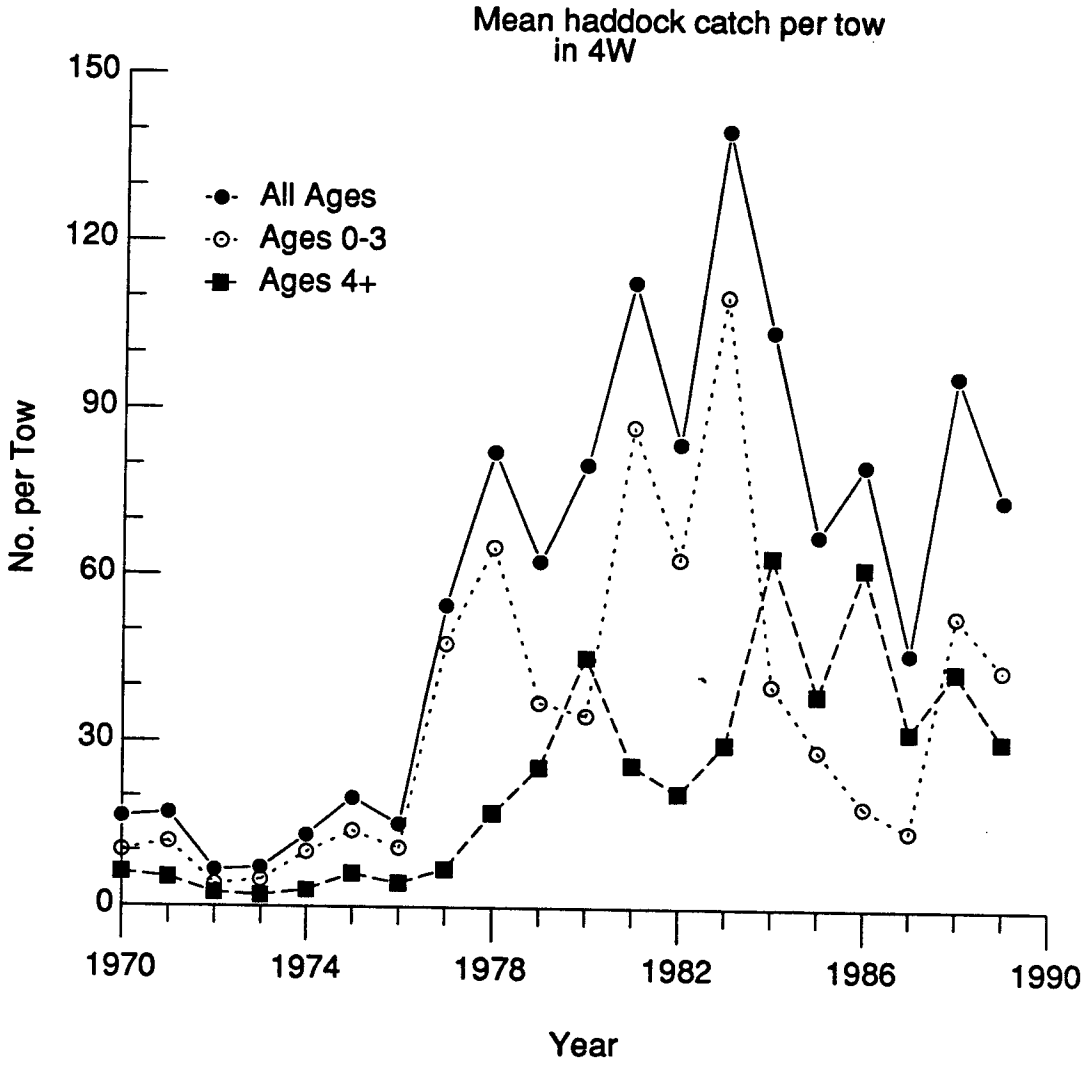
Mean haddock catch per tow
in 4W
All Ages
Ages 0-3
Ages 4+
No. per Tow
150
120
90
60
30
0
1970
1974
1978
1982
1986
1990
Year

Figure 4.

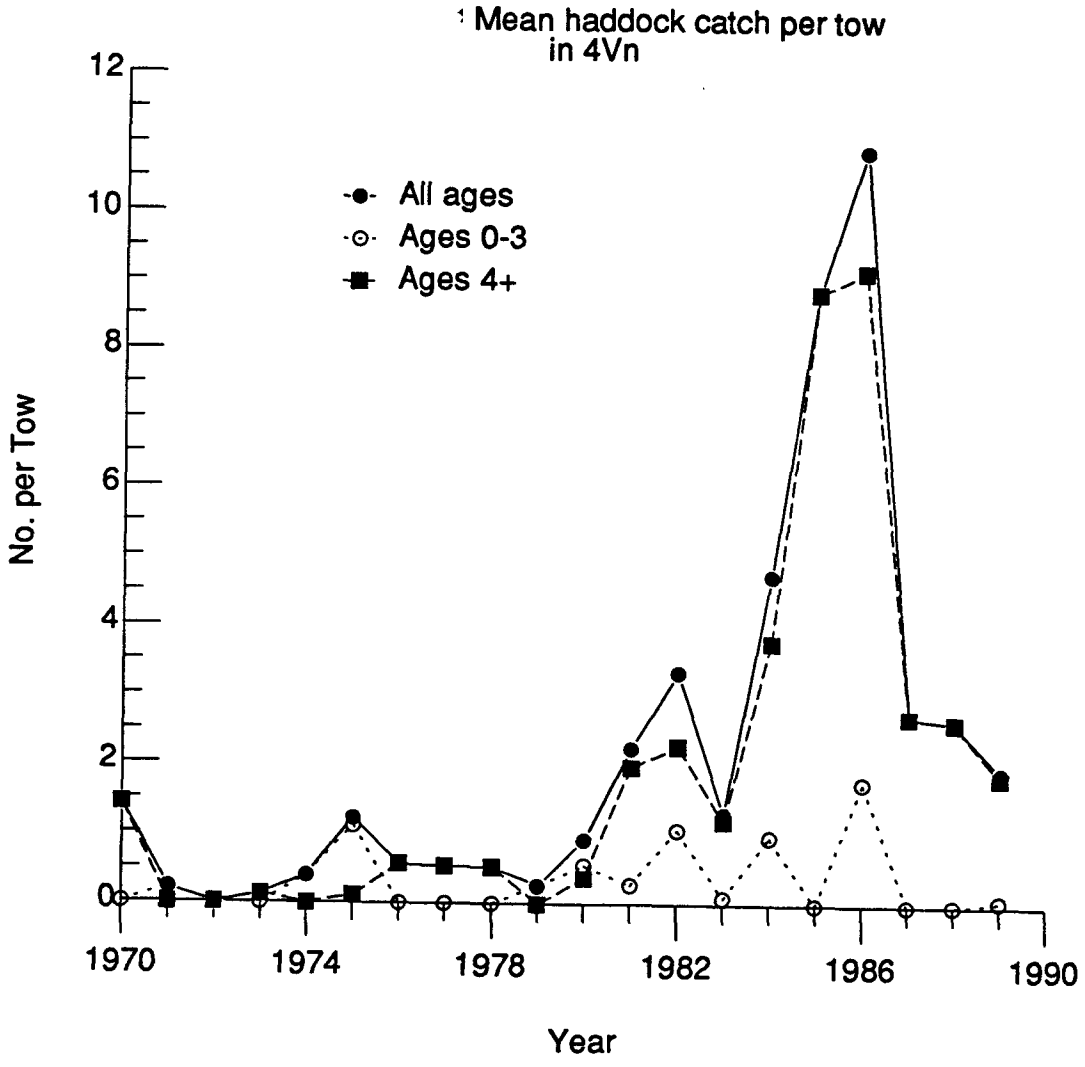
Mean haddock catch per tow
in 4Vn
All ages
Ages 0-3
Ages 4+
No. per Tow
Year
0
2
4
6
8
10
12
1970
1974
1978
1982
1986
1990

Figure 5.

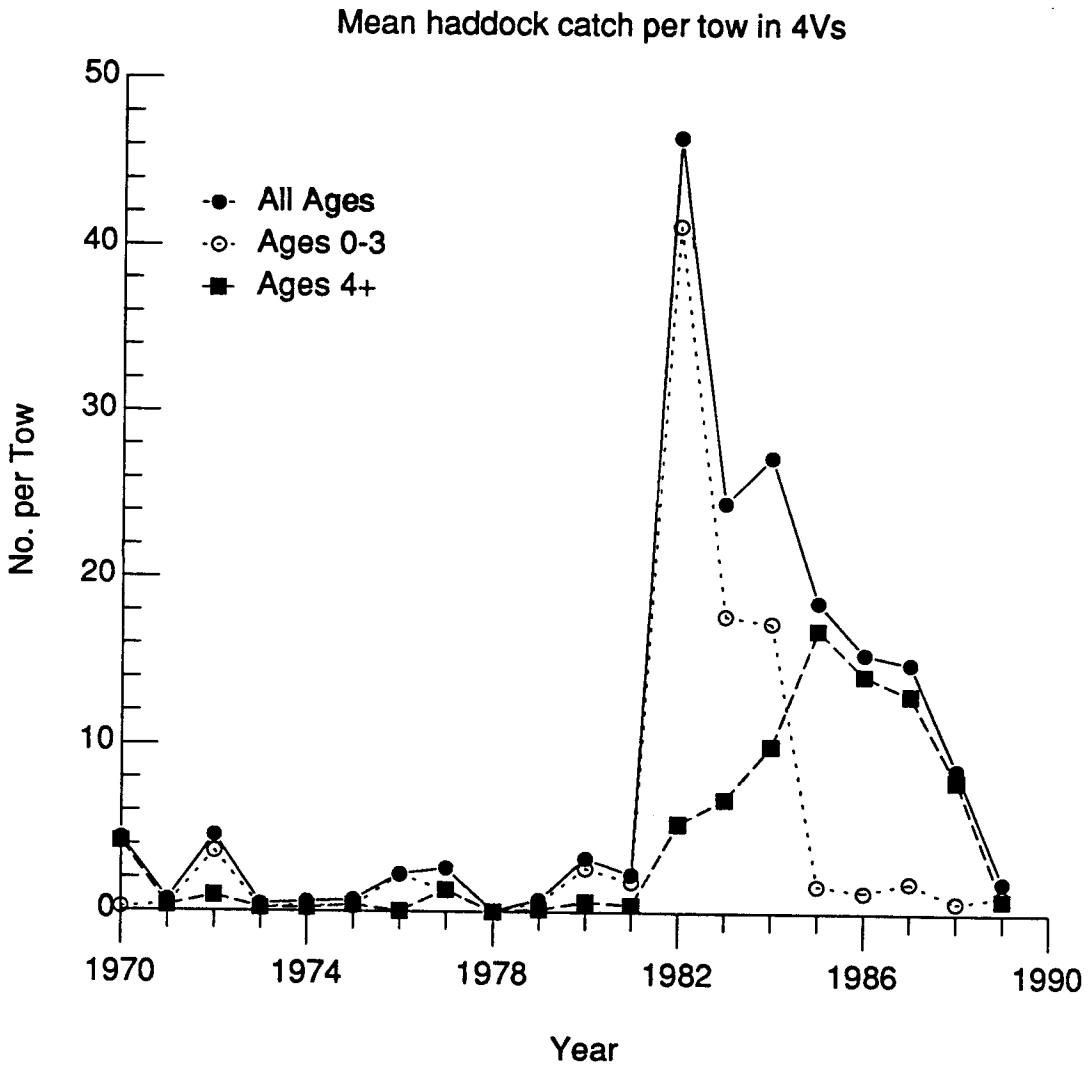
Mean haddock catch per tow in 4Vs
All Ages
Ages 0-3
Ages 4+
No. per Tow
50
40
30
20
10
0
1970
1974
1978
1982
1986
1990
Year

Figure 6.

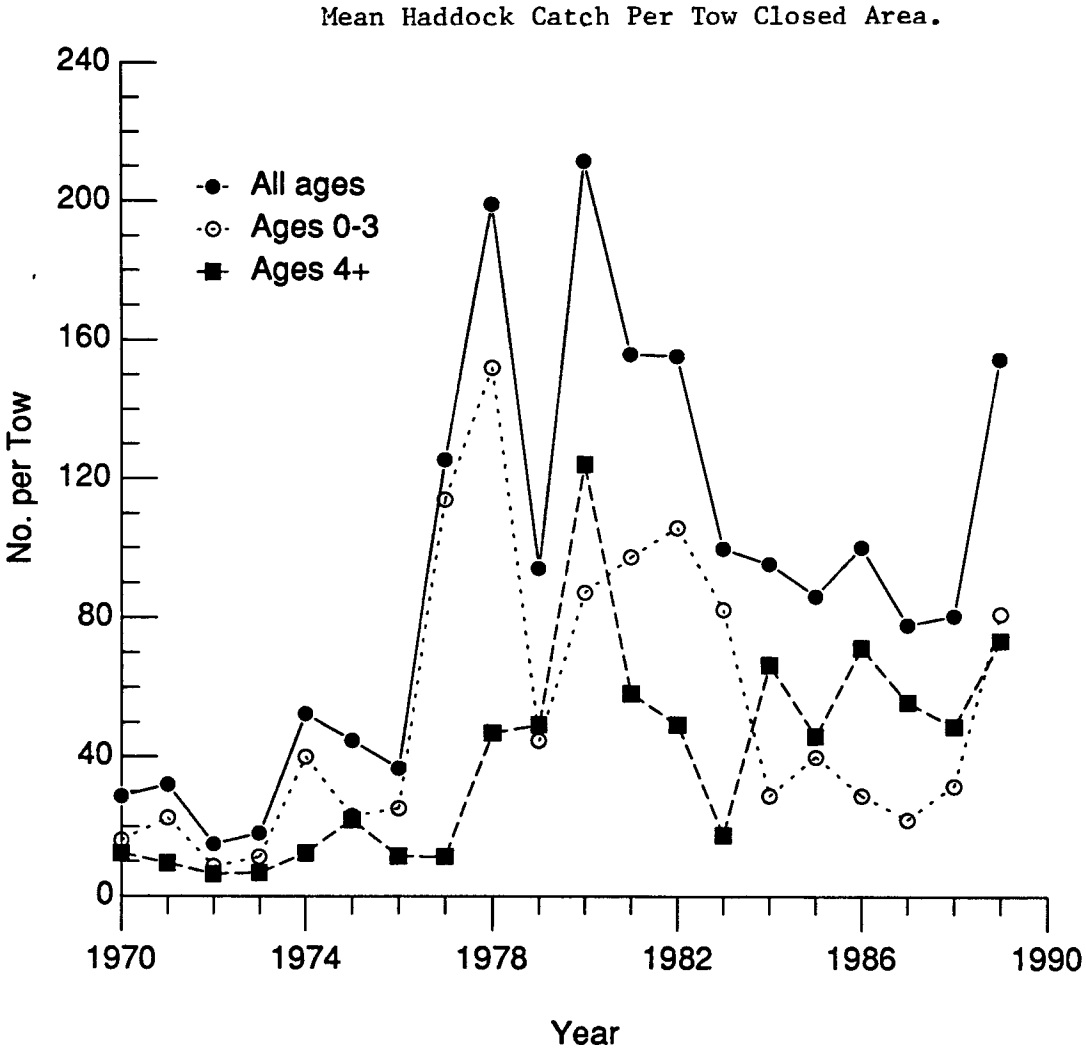
Mean Haddock Catch Per Tow Closed Area.
240
200
160
120
80
40
0
No. per Tow
All ages
Ages 0-3
Ages 4+
1970
1974
1978
1982
1986
1990
Year

Figure 7.

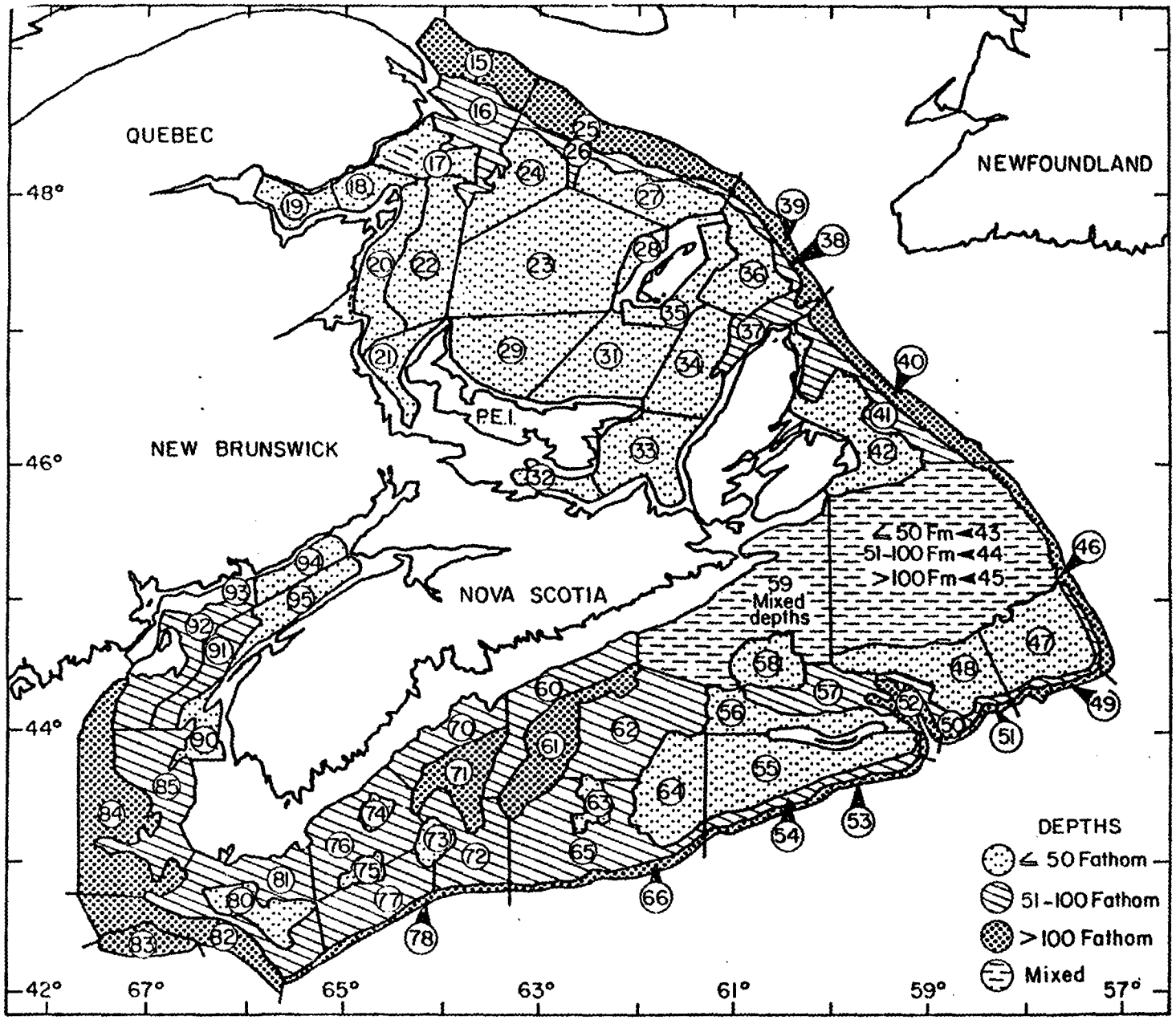
QUEBEC
NEWFOUNDLAND
NEW BRUNSWICK
P.E.I.
NOVA SCOTIA
48°
46°
44°
42°
67°
65°
63°
61°
59°
57°
≤ 50 Fm ◄ 43
51-100 Fm ◄ 44
>100 Fm ◄ 45
59
Mixed depths
DEPTHS
≤ 50 Fathom
51-100 Fathom
>100 Fathom
Mixed

Figure 8.

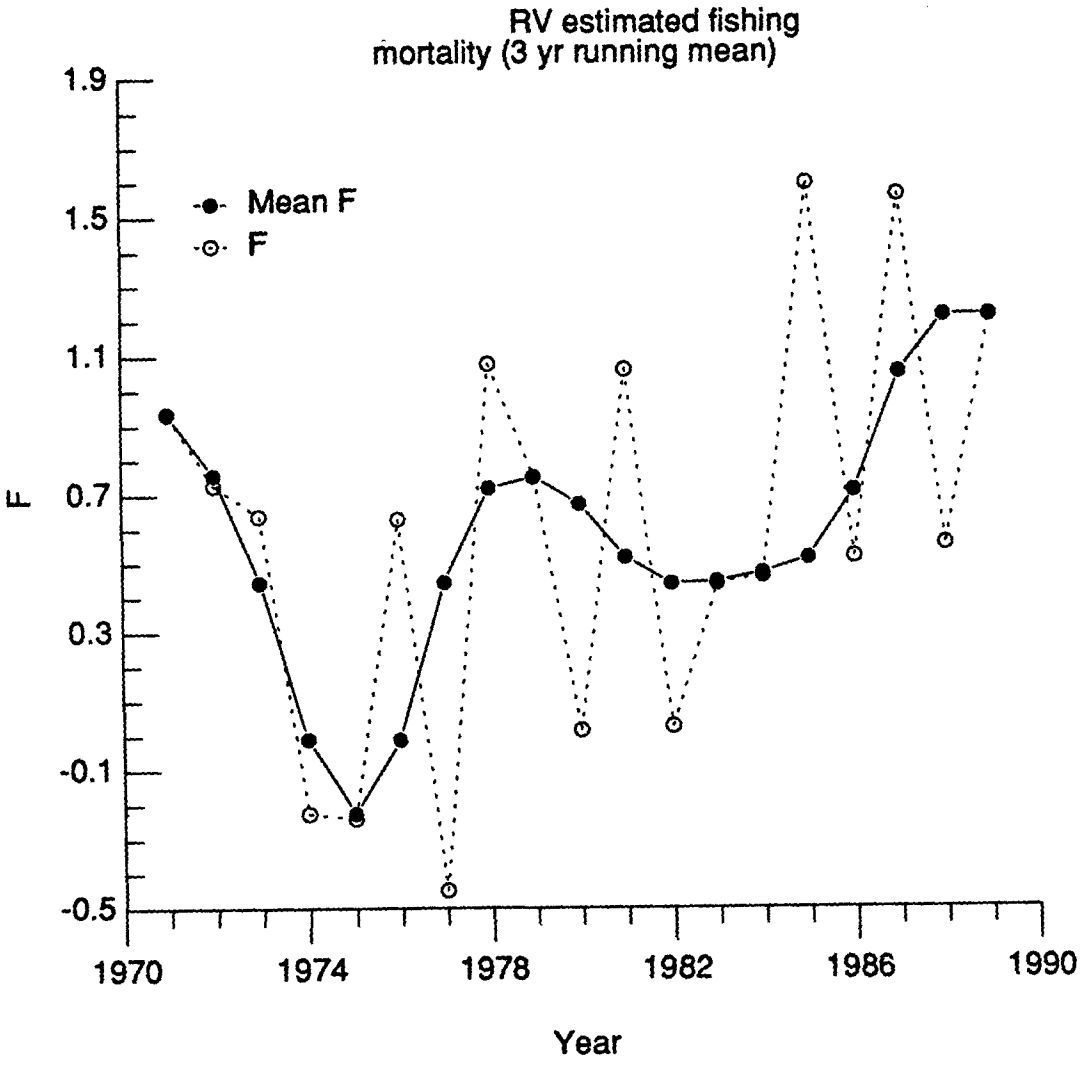
RV estimated fishing
mortality (3 yr running mean)
Mean F
F
1.9
1.5
1.1
0.7
0.3
-0.1
-0.5
F
1970
1974
1978
1982
1986
1990
Year

Figure 9.

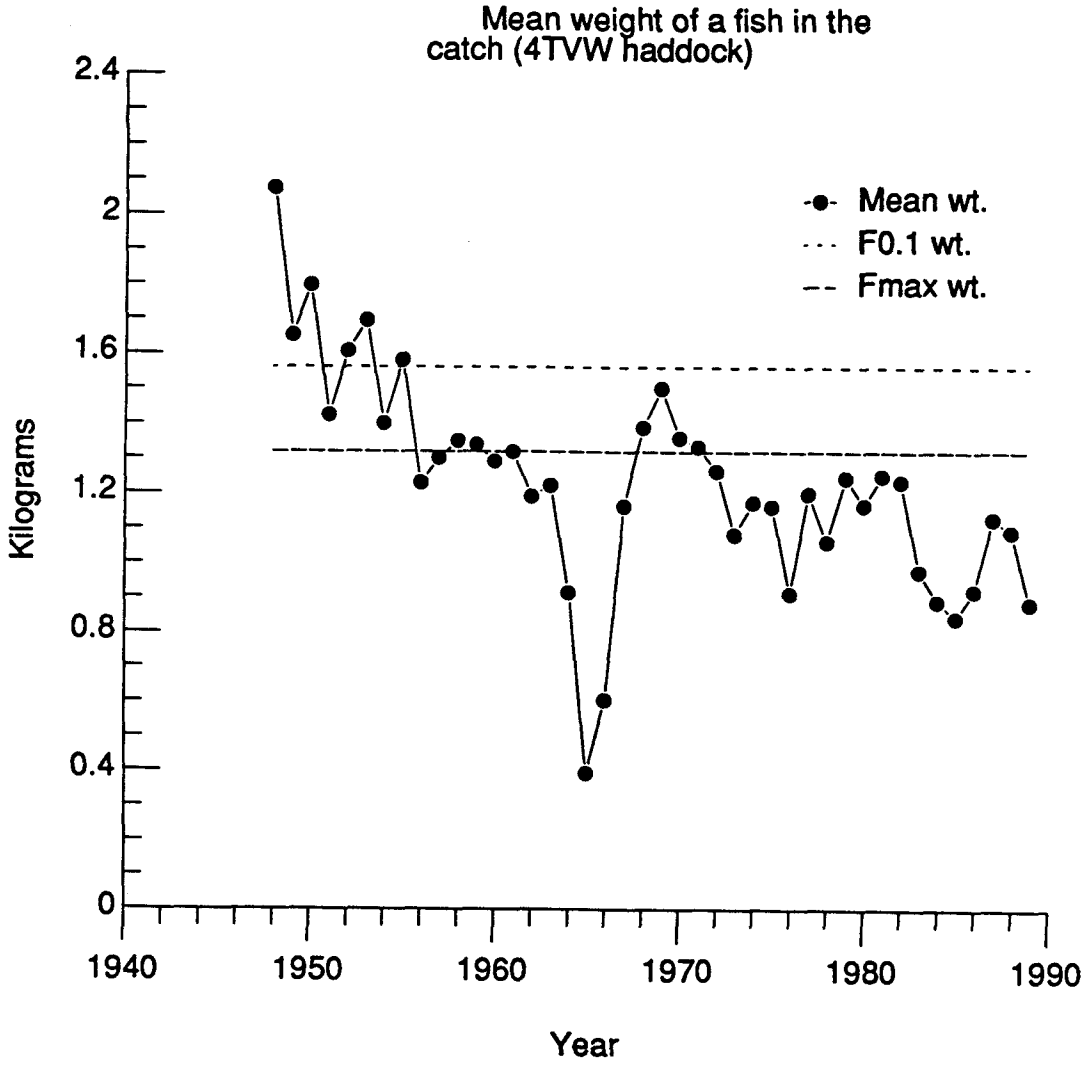
Mean weight of a fish in the catch (4TVW haddock)
Mean wt.
F0.1 wt.
Fmax wt.
Kilograms
2.4
2
1.6
1.2
0.8
0.4
0
1940
1950
1960
1970
1980
1990
Year

Figure 10.