

11 CAPELIN IN THE ICELAND-EAST GREENLAND-JAN MAYEN AREA

11.1 The Fishery

11.1.1 Regulation of the fishery

The fishery is based on maturing capelin, i.e. that part of each year class which spawns at age 3 as well as those fish at age 4, that did not mature and spawn at age 3. The abundance of the immature component is difficult to assess before their recruitment to the adult stock at ages 2 and 3. This is especially true of the age 3 immatures.

The fishery of the Icelandic capelin has, therefore, been regulated by preliminary catch quotas set prior to each fishing season (July–March). Predictions of TACs have been computed from autumn survey data the year before on the abundance of 1 and 2 year old capelin. The process includes historical relationships between such data and the back-calculated abundance of the same year classes, growth rate and stock in numbers, natural mortality and the provision of a remaining spawning stock biomass of 400 000 t. Final catch quotas for each season have then been set according to the results of acoustic surveys of the maturing, fishable stock, carried out in autumn (October–November) and/or winter (January/February) in that fishing season. For a more detailed description of the method and its past performance see e.g. Gudmundsdottir and Vilhjalmsón 2002; ICES 2004. A summary of the results of this catch regulation procedure is given in Table 11.1.1.

Over the years the fishery has been closed during April - late June and the season has started in July/August or later, depending on the state of the stock. Due to very low stock abundance there was a fishing ban lasting from December 1981 to November 1983. In addition, areas with high abundances of juvenile age 1 and 2 capelin (in the shelf region off NW-, N- and NE-Iceland) have usually been closed to the summer and autumn fishery.

11.1.2 The fishery in the 2004/05 season

In November 2003, an attempt to locate juvenile age 1 and 2 capelin (year classes 2002 and 2001 respectively) failed completely, as did a survey carried out in April 2005. Consequently the WGNPBW had no data at its 2004 spring meeting with which to predict fishable/spawning stock abundance in the 2004/05 season. Therefore, the Working Group recommended that the fishery should not be opened until further surveys had shown large enough numbers of maturing capelin to enable a fishery leaving at least 400 000 t to spawn in spring 2005. ACFM concurred with this advice which was accepted by all parties concerned.

Yet another survey was carried out in mid-May, but recorded very small numbers of capelin of ages 2 and 3. In fact it was not until during a survey during late June/early July that enough capelin were located and measured to start a summer fishery in 2004. Details of these and later surveys in 2004 and 2005 are given in Section 11.3 and Tables 11.3.2.1-4 .

The fishery began in late June and in early July capelin schools were being fished in deep waters north of the Vestfirðir peninsula. The fishing grounds then shifted to the north and north-west and in the latter half of July most of the catch was taken in the Greenlandic EEZ. Catch rates were high in the beginning but began to drop off around 20 July and the summer fishery ended in late July. At that time the total international catch amounted to about 85 000 t.

In the last week of November a small fishery started off Vestfirðir and from then until about 20 December a few Icelandic vessels took about 7 000 t at the shelf edge north of the Vestfirðir peninsula. Most of this catch was frozen onboard and sold for human consumption.

The total international catch in the 2004 summer and autumn season was about 92 000 t (Table 11.2.1).

In the first days of January 2005, nine scouting vessels searched the area from west and northwest of Vestfirðir, north of Iceland to 68°20'N and off the northern east coast to 9°W. This operation took no more than 3 days and located dense capelin schools near and some way off the shelf edge off the eastern north coast of Iceland. The scouting vessels found no capelin elsewhere. The winter fishery in 2005 started in early January in this area where there were large, dense schools of capelin and high catch rates.

In the first 2-3 weeks of January, the capelin migrated quickly east and southeast along the Icelandic shelf edge and were followed by the fishing fleet. On arriving in the area near the cold-warm boundary area off the southern east coast of Iceland in late January, the southward migration stopped and the schools tended to disperse and reassemble in tune but out of phase with the fishing intensity.

The first spawning migration did not enter the warm Atlantic waters off the southeast coast until mid-February, which is unusually late in view of their relatively early arrival in the area east of Iceland. From there, the capelin migrated slowly westward in near-shore waters. As usual, catch rates were high in the shallow water area throughout February, but from consultations with the fishing skippers it seems obvious that the abundance of capelin migrating west along the coast was nowhere nearly as large as expected from what had been recorded by a research vessel and later observed by the fishing fleet northeast and east of Iceland. Furthermore, maturing was rapid and none of the capelin arriving from the east seemed to round the Reykjanes promontory to spawn off the west coast.

In early March, schools of mature capelin were found migrating south off the Vestfirðir peninsula. Since capelin, that had entered the south coast spawning grounds from the east were already spawning, the fishery shifted to the western area. Good catches were taken in this area for about two weeks. Furthermore, a few loads were taken in Isafjardardjup, the northernmost fjord system on the Vestfirðir peninsula, as well as in the outer reaches of Eyjafjörður on the central north coast. Such occurrences are highly unusual but not previously unknown.

The total international catch during the 2005 winter season was 692 000 t (Table 11.2.1). Due to the abrupt end of the fishery around mid-March, all of the TAC set for the 2003/04 season was not taken.

11.2 Catch Statistics

The total annual catch of capelin in the Iceland-East Greenland-Jan Mayen area since 1964 is given by weight, season, and fleet in Table 11.2.1.

The total catch in numbers during the summer/autumn 1982–2004 and winter 1983–2005 seasons is given by age and years in Tables 11.2.2 and 11.2.3.

The distribution of the catch during the summer-autumn 2004 and winter 2005 seasons is given by length groups at age in Tables 11.2.4 and 11.2.11.

11.3 Surveys of Stock Abundance

11.3.1 0-group surveys

The distribution and abundance of 0-group capelin in the Iceland-East Greenland-Jan Mayen area has been recorded during surveys carried out in August since 1970. The survey methods and computations of abundance indices were described by Vilhjálmsson and Fríðgeirsson (1976). These surveys have been discontinued, the last being conducted in 2003. The abun-

dance indices of 0-group capelin until 2003, divided according to areas, are given in Table 11.3.1.1.

It is of interest that since 2000 0-group capelin have been distributed progressively further west and in 2003 there were practically no 0-group capelin in Icelandic waters except far to the north off the Vestfirðir peninsula.

Acoustic estimates of the abundance of 1-group capelin have also been obtained during the August 0-group surveys (e.g. Vilhjálmsson 1994). However, due to the large variability of this time series, the August abundance indices have not been used for stock projections for more than a decade. Directed collection of data on juvenile age 1 and 2 capelin in August has been discontinued. The abundance of 1-group capelin by number, mean length and weight for 1983–2003 is given in Table 11.3.1.2.

11.3.2 Stock abundance in summer/autumn 2004 and winter 2005

11.3.2.1 The adult fishable stock

As described earlier, the autumn 2003 survey located but very small numbers of capelin of the 2001 and 2002 year classes. For that reason, ICES advised that the summer 2004 fishery not be opened until later surveys had located these capelin and assessed them in high enough numbers to justify a fishery with traditional conditions of a remaining spawning stock of 400 000 t.

Attempts were made to establish the whereabouts and assess the abundance of capelin of the above year classes, first during 13-20 April and, second, during 16-22 May 2005. There were severe limitations on area coverage due to drift ice, especially in April, and both of these surveys were dismal failures.

During 25 June – 6 July the area from 31°W to the east of Iceland was thoroughly searched by 6 scouting vessels. No capelin were found east of 20°W and the research vessel could therefore concentrate its effort on the region west of that. Capelin were distributed over a wide area between 20°W and 31°W and it was believed that the survey had not covered all of the possible distribution area. The details of the June/July survey results are given in Table 11.3.2.1.1.

Despite assistance of 6 scouting vessels, the autumn 2004 acoustic assessment survey recorded very few adult capelin of the 2002 and 2001 year classes (Table 11.3.2.1.2). According to this result the remainder of the preliminary TAC should have been revoked. However, this was not done since there was no ongoing fishery and drift ice precluded surveying parts of the E-Greenland shelf where adult capelin have occasionally been found at this time of year. Due to difficult weather and limited ship time an area east and northeast of Scoresby Sound, often rich in capelin in previous years, was not surveyed.

Due to the unusually large uncertainty associated with the prediction of the fishable stock size in the 2004/05 season, nine fishing vessels were recruited to carry out a coordinated pilot survey off NW- N- and E-Iceland in the beginning of January 2005. Although capelin were only recorded in a fairly restricted areas off the eastern north coast and northeast of Iceland, densities were extremely high in places. On the basis of the findings by the scouting vessels, a research vessel completed an acoustic survey of these areas during 6-10 January. The total adult stock biomass came to 1 270 000 t. Details of this assessment are given in Table 11.3.2.1.3.

Due to the high variability inherent in surveys where there are large variations of density within relatively small areas, it would have been preferable to repeat the assessment. This was not done since the capelin were beginning to migrate east and south at high but variable speed and another estimate would therefore have had to wait for at least 2 weeks, i.e. until all of the capelin had assembled north of the warm water front east of Iceland. However, the January

assessment survey was run against the direction of migration and it was not attempted to correct for this possible negative bias.

As mentioned earlier, a capelin migration was found heading southward off the Vestfirðir peninsula in the beginning of March. The abundance of these capelin was assessed in early March at about 165 000 t. These proved to be mature capelin with a somewhat higher proportion of the older year class (2001) than observed among the eastern migration.

Thus, the total biomass of adult capelin, assessed northeast and later west of Iceland in January and March 2005 amounted to a total of 1 435 000 t, assuming that the western migration had not been part of the January assessment.

However, the possibility that part of the westernmost capelin recorded north of Iceland in January at about 16°-17°W cannot be excluded. Such a case was observed in winter 1980 when the main migration, having reached longitude 19°W off central N-Iceland, did an about turn and finally arrived on the spawning grounds off the Icelandic west coast in February/March (Vilhjálmsón 1994). In this connection it may also be noted that during the warm years in the late 1920s and early 1930s it was noted that capelin ceased to spawn south of Iceland, but spawned in stead in the lagoon of Hornafjörður (SE-Iceland as well as off the north coast (Sæmundsson, 1934)

Details of the January and March 2005 acoustic estimates of adult capelin are given in Tables 11.3.2.1.3 - 11.3.2.1.4.

11.3.2.2 Estimates of immature capelin

As stated earlier the acoustic survey, carried out in November 2004, only recorded very few capelin, both adults and juveniles. These capelin were extremely scattered and the total estimate was only $16 \cdot 10^9$ fish representing a biomass of 192 thousand t. The winter (January-March) 2005 assessment surveys of the mature fishable stock hardly recorded any immature capelin at all. A survey of the Denmark Strait and the Greenland plateau west of there had been planned to take place after the assessment of the adult fishable/spawning stock in January. This plan had to be abandoned because of stormy weather and drift ice.

At present (late April 2005) ice covers the Greenland half of the Denmark Strait. Although the ice cover appears to be diminishing, experience shows that such ice will take several weeks to recede sufficiently for effectively surveying that area for capelin. A survey, aimed at locating and assessing the fishable stock for 2005/06 (year classes 2002 and 2003, is scheduled by the MRI to begin on 20 June. A participation of 4-6 scouting vessels will be arranged.

While the autumn 2004 survey results may correctly reflect an extremely low abundance of the 2003 year class, there may be environmental factors at play, affecting i.a. the geographic distribution of the juvenile stock (see Section 11.7) and therefore its availability to the survey as it was run.

11.4 Historical Stock Abundance

The historical estimates of stock abundance are based on the “best” acoustic estimates of the abundance of maturing capelin in autumn and/or winter surveys, the “best” in each case being defined as that estimate on which the final decision of TAC was based. Taking account of the catch in number and a monthly natural mortality rate of $M = 0.035$ (ICES 1991/Assess:17; Gudmundsdóttir and Vilhjálmsón 2002), abundance estimates of each age group are then projected to the appropriate point in time. Since natural mortality rates of juvenile capelin are not known, their abundance by number has been projected using the same natural mortality rate.

The annual abundance by number and weight at age for mature and immature capelin in the Iceland-East Greenland-Jan Mayen area has been calculated with reference to 1 August and 1 January of the following year for the 1978/79–2004/05 seasons. The results are given in Tables 11.4.1 and 11.4.2 (1 August and 1 January, respectively). Table 11.4.2 also gives the remaining spawning stock by number and biomass in March/April 1979–2005.

The observed annual mean weight at age, obtained from catch and survey data from January, was used to calculate the stock biomass on 1 January. The observed average weight at age of adult capelin in autumn (Table 11.5.1.2) is used to calculate stock biomass of the maturing components in summer. Because there is a small weight increase among mature capelin in February and March, the remaining spawning stock biomass is underestimated.

11.5 Management of capelin in the Iceland-East Greenland-Jan Mayen area

The fishable stock consists of 2 age groups (2 and 3 year olds, spawning at ages 3 and 4). The fishing season usually begins in June/July and ends in March of the following year when the remainder of the fishable stock spawns and dies. The fishable stock, which is also the maturing stock, is thus renewed annually and its exploitation must of necessity be cautious. Due to the short life span and high spawning mortality, stock abundance can only be assessed by acoustic surveys.

Since 1992, the key elements in the management of capelin in the Iceland-East Greenland-Jan Mayen area have been as follows:

Acoustic survey estimates of juvenile capelin abundance have been used to predict fishable stock abundance in the following year (fishing season) using the historical comparisons shown in Figure 11.5.2.1. Historical average mean weight at age (in later years the relationship between numerical stock abundance and growth shown in Fig. 11.5.2.2), growth rates and natural mortality have been used for calculations and projections of maturing and fishable stock biomass.

Based on the data described above, a TAC is predicted in the spring of the year in which the season begins, allowing for 400 000 t to spawn at the end of the season. For precautionary purposes, a preliminary TAC, corresponding to 2/3 of the predicted total TAC for the season, has then been allocated to the period July–December. With regard to a precautionary approach, the Working Group stresses the importance of the continued setting of a preliminary TAC for the first half of the season.

The final decision on a TAC for each fishing season has been based on the results of acoustic stock abundance surveys in late autumn or in January/February of the following year, in both cases during the ongoing fishing season.

The procedure just described has worked well in the past for ‘normal’ ranges of stock abundance. However, it is clear that extra care should be taken when dealing with stock abundance below or above the norm, corresponding to TACs lower than 500 000 t or greater than 1 600 000 t.

11.6 Precautionary Approach to Fisheries Management

Due to the short life span of capelin and their high spawning mortality, the main management objective is to maintain enough spawners for the propagation of the stock. Since 1979 the targeted remaining spawning stock for capelin in the Iceland-East Greenland Jan Mayen area has been 400 000 t. Although there have been large fluctuations in stock abundance during this period, these appear to be environmentally induced and not due to excessive fishing. There-

fore, the criterion of maintaining a remaining spawning stock may be defined as Blim, i.e. stock abundance below which no fishery should be permitted.

The definition of other precautionary reference points is more problematic. However, due to uncertainties inherent in predicting the abundance of short-lived species and the importance of capelin as forage fish for predators such as cod, saithe, Greenland halibut, baleen whales and sea birds, extra precaution should be taken when stock biomass projections indicate TACs lower than 500 000 t and greater than 1 600 000 t. In the former case, the fishery should not be opened until after the completion of a stock assessment survey in autumn/winter in that season. The latter simply represents a scenario where projected stock abundance is beyond the highest historical abundance on record. In such cases the preliminary TAC should not exceed 1 100 000 t.

11.7 Special Comments

The autumn surveys of 2002 and 2003 failed to locate age 1 and 2 immature capelin, i.e. the age groups on which the fishery in the 2003/04 and 2004/05 seasons would be based.

A survey, lasting for one week, was conducted in the area west off Vestfirðir, between 66°N and 68°N and reaching west to 30-31°W during 12-18 April 2003. Considerable and, in places, very dense capelin concentrations were recorded during this survey, mostly on either side of the deep Iceland-Greenland Channel, around 66°N where practically no capelin were seen about two weeks earlier. West of there, the capelin were much more scattered and in places difficult to separate from echoes of other life forms in the area. These recordings consisted exclusively of age groups 2 and 3 and translated into a total of 61.5*10⁹ individuals. This estimate was then projected with an M=0.035/month back in time to November 2002 and then used to predict adult fishable/spawning stock abundance in the 2003/04 season. This gave a preliminary TAC of 835 000 t for the 2003/004 season corresponding to a precautionary TAC of 555 000 t, which subsequently was set.

Like in November 2002, the autumn survey of 2003 also failed to locate immature age 1 and 2 capelin, except in very small numbers. Attempts in April and May 2004 to search for and assess these age groups of the 2004/05 season were unsuccessful, i.a. because of drift ice in the Denmark Strait and westward over the E-Greenland shelf. During 25 June -6 July 2004, these capelin were located and assessed in the area from north of the Vestfirðir peninsula of Iceland (about 20°W) westward to about 31°W. Following this abundance estimate, a small precautionary quota of 335 000 t was set for the period June-November 2004. However, the final quota could not be determined until early January 2005 and amounted to just under 900 000 t.

From this, and the unusual westerly distribution of the 2001 and 2002 year classes at the 0-group stage, it seems clear that the warming of Icelandic water, observed in the last few years and possibly associated with changes in surface ocean currents, has displaced the drift routes of 0-group capelin westward. From this it has followed naturally that the young capelin have not grown in the waters north of Iceland as they did for the most part in the 1980s and 1990s, but instead on the Greenland plateau much farther west. Naturally, this means that a 'normal' autumn survey coverage was inadequate for detecting and assessing juvenile capelin of ages 1 and 2. Fortunately, growth conditions must have been good in these new juvenile areas. This statement is supported, both by the fact that the 2001 and 2002 year classes appear to be of a good average size, and the relatively high mean weight of these fish as adults.

Furthermore, the adult spawning stock has arrived later in autumn/winter than usual, has also tended to keep to deeper waters while migrating towards the spawning grounds in the coastal areas off S- and W-Iceland. Adult capelin have thus also been less available to fish predators such as cod probably explaining, at least in part, the observed reduced mean weight at age in the Icelandic cod in recent years. Whether this situation will prevail for any length of time

cannot be predicted, but if it does it will negatively affect bioproduction of Icelandic waters at the higher trophic levels.

Finally, unless the juvenile 1- and 2-group capelin can be located and assessed in late autumn on a regular basis, the established model of predicting the abundance of mature capelin will obviously become obsolete..

An overview of stock developments during 1978–2004 is given in Table 11.7.1.

11.8 Sampling

INVESTIGATION	NO. OF SAMPLES	LENGTH MEAS. INDIVIDUALS	AGED INDIVIDUALS
Fishery 2004	15	1500	1575
Survey 2004	23	2300	2270
Fishery 2005	28	2800	2785
Survey 2005	15	1500	1485

Table 11.2.2 The total international catch of capelin in the Iceland-East Greenland-Jan Mayen area by age group in numbers (billions) and the total catch by numbers and weight (thousand tonnes) in the autumn season (August-December) 1983–2004.

Age	YEAR										
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	0.6	0.5	0.8	+	+	0.3	1.7	0.8	0.3	1.7	0.2
2	7.2	9.8	25.6	10.0	27.7	13.6	6.0	5.9	2.7	14.0	24.9
3	0.8	7.8	15.4	23.3	6.7	5.4	1.5	1.0	0.4	2.1	5.4
4	-	0.1	0.2	0.5	+	+	+	+	+	+	0.2
Total number	8.6	18.2	42.0	33.8	34.4	19.3	9.2	7.7	3.4	17.8	30.7
Total weight	133.4	548.5	919.7	772.9	458.6	371.4	121.0	111.2	56.0	298.1	611.6

Age	Year										
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	0.6	1.5	0.2	1.8	0.9	0.3	0.2	+	+	0.3	+
2	15.0	9.7	25.2	33.4	25.1	4.7	12.9	17.6	18.3	11.8	5.3
3	2.8	1.1	12.7	10.2	2.9	0.7	3.3	1.2	2.5	1.0	0.5
4	+	+	0.2	0.4	+	+	0.1	+	+	+	-
Total number	18.4	12.3	38.4	45.8	28.9	5.7	16.5	18.8	20.8	14.3	5.8
Total weight	324.1	205.7	773.7	763.6	440.5	102.4	265.1	294.0	339.7	199.5	92

Table 11.2.3 The total international catch of capelin in the Iceland-East Greenland-Jan Mayen area by age group in numbers (billions) and the total catch by numbers and weight (thousand tonnes) in the winter season (January-March) 1984–2005.

Age	YEAR										
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
2	2.1	0.4	0.1	+	+	0.1	1.4	0.5	2.7	0.2	0.6
3	18.1	9.1	9.8	6.9	23.4	22.9	24.8	7.4	29.4	20.1	22.7
4	3.4	5.4	6.9	15.5	7.2	7.8	9.6	1.5	2.8	2.5	3.9
5	-	-	0.2	-	0.3	+	0.1	+	+	+	+
Total number	23.6	14.5	17.0	22.4	30.9	30.8	35.9	9.4	34.9	22.8	27.2
Total weight	439.6	348.5	391.8	560.5	657.2	665.1	686.8	202.4	621.1	489.6	567.1

Age	Year										
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
2	1.3	0.6	0.9	0.3	0.5	0.3	0.4	0.1	0.1	0.6	0.1
3	17.6	27.4	29.1	20.4	31.2	36.3	27.9	33.1	32.2	24.6	31.5
4	5.9	7.7	11.0	5.4	7.5	5.4	6.7	4.2	1.9	3.0	3.1
5	+	+	+	+	+	+	+	+	+	+	-
Total number	24.8	35.7	41.0	26.1	39.2	42.0	35.0	37.4	34.4	28.3	34.7
Total weight	539.8	723.6	797.6	481.3	658.9	830.3	787.2	955.0	648.0	542.9	692

Table 11.2.4 The total international catch in numbers (millions) of capelin in the Iceland-East Greenland-Jan Mayen area in the summer/autumn season of 2004 by age and length, and the catch in weight (thousand tonnes) by age group.

TOTAL LENGTH (CM)	AGE 1	AGE 2	AGE 3	AGE 4	TOTAL	PERCENTAGE
12	+	49	0	0	49	0.8
12.5	+	396	0	0	396	6.5
13	+	1126	12	0	1138	18.7
13.5	0	1312	25	0	1336	21.9
14	0	1126	111	0	1237	20.3
14.5	0	903	124	0	1027	16.8
15	0	495	74	0	569	9.3
15.5	0	124	99	0	223	3.7
16	0	37	49	0	87	1.4
16.5	0	12	12	+	25	0.4
17		0	12	+	12	0.2
Total number	+	5580	520	+	6100	
Percentage	+	91.5	8.5	+	100.0	100.0
Total weight	0.1	82.0	9.8	0.1	92.0	

Table 11.2.5 The total international catch in numbers (millions) of capelin in the Iceland-East Greenland-Jan Mayen area in the winter season of 2005 by age and length, and the catch in weight (thousand tonnes) by age group.

TOTAL LENGTH (CM)	AGE 2	AGE 3	AGE 4	AGE 5	TOTAL	PERCENTAGE
12	83	0	0	0	83	0.2
12.5	189	0	0	0	189	0.5
13	177	28	0	0	205	0.6
13.5	173	331	0	0	505	1.5
14	39	1536	12	0	1587	4.6
14.5	12	3262	132	0	3406	9.8
15	28	6092	148	0	6268	18.1
15.5	0	6798	436	0	6634	19.1
16	0	5949	474	+	6823	19.7
16.5	0	5384	842	0	5326	15.3
17	0	2035	578	+	2614	7.5
17.5	0	568	312	0	880	2.5
18	0	24	140	0	164	0.5
18.5	0	0	28	0	28	0.1
Total number	701	32006	3102	+	34709	
Percentage	2.0	92.2	8.9	0.0	100.0	100.0
Total weight	7.8	611.3	72.9	0.1	692.1	

Table 11.3.1.1 Abundance indices of 0-group capelin 1970-2003 and their division by areas.

Area	YEAR												
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
NW-Irminger Sea	1	+	+	14	26	3	2	2	+	4	3	10	+
W-Iceland	8	7	30	39	44	37	5	19	2	19	18	13	8
N-Iceland	2	12	52	46	57	46	10	19	29	25	19	6	5
East Iceland	-	+	7	17	7	3	15	3	+	1	+	-	+
Total	11	19	89	116	134	89	32	43	31	49	40	29	13

Area	Year												
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
NW-Irminger Sea	+	+	1	+	1	3	1	+	8	3	2	3	+
W-Iceland	3	2	8	16	6	22	13	7	2	11	21	12	6
N-Iceland	18	17	19	17	6	26	24	12	43	20	13	69	10
East Iceland	1	9	3	4	1	1	2	2	1	+	15	10	8
Total	22	28	31	37	14	52	40	21	54	34	51	94	24

	YEAR							
	1996	1997	1998	1999	2000	2001	2002	2003
NW-Irminger Sea	2	5	+	NA	NA	NA	NA	+
W-Iceland	17	14	7	25	1	25	17	+
N-Iceland	57	30	34	51	7	53	8	4
East Iceland	6	12	5	7	4	4	1	+
Total	82	61	46	83	12	82	26	5

Table 11.3.1.2 Estimated numbers, mean length and weight of age 1 capelin in the August surveys for 1983-2001.

	YEAR													
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Number (10 ⁹)	155	286	31	71	101	147	111	36	50	87	33	85	189	138
Mean length (cm)	10.4	9.7	10.2	9.5	9.1	8.8	10.1	10.4	10.7	9.7	9.4	9.0	9.8	9.3
Mean weight (g)	4.2	3.6	3.8	3.3	3.0	2.6	3.4	4.0	5.1	3.4	3.0	2.8	3.4	2.9

	YEAR							
	1997	1998	1999	2000	2001	2002	2003	2004
	No survey							
Number (10 ⁹)	143	87	55	94	99			
Mean length (cm)	9.3	9.0	9.5	9.5	10.0			
Mean weight (g)	2.8	2.9	3.2	3.1	3.7			

Table 11.3.2.1.1 Assessment of capelin in the Iceland/Grenland/Jan Mayen area, 25/6-6/7 2004.
(Numbers in billions, biomass in thousand tonnes)

Length (cm)	AGE			NUMBER (10 ⁹)	AVERAGE weight (g)	BIOMASS (‘000 t)
	1	2	3			
7.5	0.031	0.000	0.000	0.031	1.4	0.1
8	0.249	0.000	0.000	0.249	1.7	0.4
8.5	0.257	0.000	0.000	0.257	2.4	0.6
9	1.042	0.000	0.000	1.042	2.8	2.9
9.5	1.880	0.000	0.000	1.880	3.5	6.6
10	4.307	0.150	0.000	4.457	4.1	18.2
10.5	3.620	0.928	0.000	4.548	4.7	21.3
11	2.053	1.150	0.000	3.203	5.3	17.1
11.5	0.460	1.246	0.000	1.705	5.9	10.1
12	0.000	0.761	0.000	0.761	7.0	5.3
12.5	0.000	1.647	0.000	1.647	7.8	12.9
13	0.000	3.958	0.041	3.999	8.7	34.8
13.5	0.000	5.659	0.044	5.703	10.0	57.3
14	0.000	7.733	0.099	7.832	11.2	87.8
14.5	0.000	8.139	0.370	8.509	12.7	107.9
15	0.000	6.095	0.526	6.621	14.6	96.7
15.5	0.000	5.096	0.444	5.540	16.2	90.0
16	0.000	1.995	0.228	2.223	18.4	40.9
16.5	0.000	0.377	0.062	0.439	20.7	9.1
17	0.000	0.122	0.003	0.126	23.2	2.9
17.5	0.000	0.000	0.022	0.022	25.0	0.6
Total number	13.899	45.056	1.839	60.794	10.3	623.6
Total biomass (‘000 t)	58.8	537.1	27.6	623.5		
Average weight (g)	4.2	11.9	15.0	10.3		
Average length (cm)	10.1	14.0	15.1	13.2		
Age ratio by number	0.23.	0.74.	0.03	1		
Ratio of ages 2 and 3		0.96	0.04	1		

Table 11.3.2.1.2 Acoustic abundance estimate of mature and immature capelin, November 2004.
Numbers are in millions and biomass in thousand tonnes

Length (cm)	AGE				TOTAL numbers	AVERAGE weight (g)	Biomass
	1	2	3	4			
9.5	22	0	0	0	22	3.2	0.1
10	229	0	0	0	229	3.2	0.7
10.5	243	0	0	0	243	4.2	1.0
11	1111	0	0	0	1111	4.9	5.5
11.5	1737	0	0	0	1737	5.7	9.9
12	394	0	0	0	394	6.6	2.6
12.5	1286	67	0	0	1353	7.2	9.8
13	1165	45	0	0	1210	8.1	9.8
13.5	730	319	0	0	1050	9.7	10.2
14	249	448	0	0	697	11.2	7.8
14.5	282	1255	45	0	1583	12.8	20.2
15	212	1445	192	11	1860	14.5	27.0
15.5	120	1435	169	0	1724	16.6	28.5
16	64	1285	135	0	1485	18.9	28.1
16.5	11	644	80	0	735	20.6	15.1
17	0	373	102	0	475	23.4	11.1
17.5	0	102	11	0	113	26.4	3.0
18	0	22	22	0	45	26.9	1.2
Total number	7858	7440	757	11	16067	11.9	191.6
Total biomass	58.5	119.3	13.7	0.2			
Mean weight (g)	7.4	16.0	18.0	14.5			
Mean length	12.3	15.3	15.8	15.0			
Percent number	48.9	46.3	4.7	0.1			

Table 11.3.2.1.3 Acoustic abundance estimate of capelin by numbers and weight, 6-10 January 2005.

Numbers (N) are billions and (B) is thousand tonnes

Length (cm)	Age			Total N	Mean weight (g)	Total B
	2	3	4			
14	0.3	0.4	0.0	0.6	11.0	7.1
14.5	0.0	1.6	0.0	1.6	12.7	19.8
15	0.0	4.2	0.1	4.3	14.4	61.9
15.5	0.0	11.1	0.1	11.2	16.0	179.1
16	0.0	12.0	0.4	12.4	18.1	223.8
16.5	0.0	12.0	1.0	13.0	20.4	266.4
17	0.0	10.1	0.9	11.0	23.0	253.6
17.5	0.0	5.7	0.7	6.4	25.9	166.4
18	0.0	2.1	1.0	3.1	28.2	87.9
18.5	0.0	0.1	0.1	0.2	31.5	5.8
Total	0.3	59.3	4.3	63.9	19.9	1271.6
Mean length (cm)	14.0	16.3	17.1	16.3		
Mean weight (g)	11.0	19.7	23.5	19.9		

Table 11.3.2.1.4 Abundance estimate of capelin by numbers and weight, 6.-9. March 2005.
Numbers (N) are billions and (B) is thousand tonnes

Length (cm)	AGE			Total N	MEAN	
	2	3	4		weighth (g)	Total B
12	0.0	0.0	0.0	0.0	7.3	0.1
12.5	0.1	0.0	0.0	0.1	8.5	0.6
13	0.2	0.1	0.0	0.3	9.1	2.8
13.5	0.2	0.2	0.0	0.3	10.1	3.2
14	0.1	0.3	0.0	0.5	11.6	5.3
14.5	0.0	0.6	0.0	0.6	12.8	8.0
15	0.0	0.6	0.0	0.6	14.3	8.7
15.5	0.0	1.6	0.0	1.6	15.6	25.4
16	0.0	1.2	0.1	1.4	18.6	25.2
16.5	0.0	0.9	0.2	1.1	21.1	22.8
17	0.0	0.8	0.3	1.1	24.9	26.9
17.5	0.0	0.5	0.3	0.9	28.1	24.8
18	0.0	0.2	0.1	0.3	30.5	10.2
18.5	0.0	0.0	0.1	0.1	33.3	2.5
Total	0.7	7.0	1.2	8.8	18.9	166.5
Mean length (cm)	13.50	15.84	17.11	15.8		
Mean weight (g)	10.3	18.5	25.8	18.9		

Table 11.4.1 The estimated number (billions) of capelin on 1 August 1978–2004 by age and maturity groups. The total number (billions) and weight (thousand tonnes) of the immature and maturing (fishable) stock components are also given.

Age/maturity	YEAR									
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1 juvenile	163.8	60.3	66.1	48.9	146.4	124.2	250.5	98.9	156.2	144.0
2 immature	15.3	16.4	4.2	3.7	15.0	42.5	40.9	100.0	29.4	37.2
2 mature	81.9	91.3	35.4	39.7	17.1	53.7	40.7	64.6	35.6	65.4
3 mature	29.1	10.1	10.8	2.8	2.3	9.8	27.9	27.0	65.8	20.1
4 mature	0.4	0.3	+	+	+	0.1	0.4	0.4	0.7	0.1
Number immat.	179.2	76.7	70.3	52.6	161.4	166.7	291.4	198.9	185.6	181.2
Number mature	111.4	101.7	46.2	42.5	19.4	63.6	69.0	92.0	102.1	85.6
Weight immat	751	366	283	209	683	985	1067	1168	876	950
Weight mature	2081	1769	847	829	355	1085	1340	1643	2260	1689

Age/maturity	Year									
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1 juvenile	80.8	63.9	117.5	132.9	162.9	144.3	224.1	197.3	191.2	165.4
2 immature	24.0	10.3	10.1	9.7	16.6	20.1	35.2	45.1	28.7	35.2
2 mature	70.3	42.8	31.9	67.7	70.7	86.9	59.8	102.2	100.7	90.3
3 mature	24.5	15.8	6.8	6.7	6.4	10.9	13.2	23.0	29.6	19.0
4 mature	0.4	+	+	+	+	0.2	-	+	+	+
Number immat.	104.8	74.2	127.6	142.6	179.5	164.7	259.2	242.4	219.9	200.6
Number mature	95.2	58.6	38.7	74.4	77.1	98.0	73.0	125.1	130.3	109.3
Weight immat	438	309	542	702	747	702	1019	1188	985	758
Weight mature	1663	1173	751	1273	1311	1585	1268	1819	1900	1590

Age/maturity	Year						
	1998	1999	2000	2001	2002	2003	2004
1 juvenile	167.9	138.0	145.6	139.7	142.3	131.8*	NA
2 immature	19.2	24.4	25.0	9.0	23.9	11.4	NA
2 mature	89.5	85.9	65.7	86.7	68.0	82.1	86.6 NA
3 mature	23.2	12.6	16.0	16.9	5.9	15.7	7.5 NA
4 mature	+	+				+	
Number immat.	187.1	162.4	170.6	148.7	166.2	143.2*	NA
Number mature	112.7	98.5	81.7	103.6	73.9	97.8	91.4
Weight immat	621	612	645	615	713	596*	NA
Weight mature	1576	1703	1519	1817	1280	1544	1392

* Preliminary

NA: Not available

Table 11.4.2 The estimated number (billions) of capelin on 1 January 1979–2005 by age and maturity groups. The total number (billions) and weight (thousand tonnes) of the immature and maturing (fishable) stock components and the remaining spawning stock by number and weight are also given.

Age/maturity	YEAR									
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
2 juvenile	137.6	50.6	55.3	41.2	123.7	105.0	211.6	83.2	131.9	120.5
3 immature	12.8	13.8	3.5	3.0	12.6	35.7	34.3	83.9	25.6	31.2
3 mature	51.8	53.4	16.3	8.0	14.3	39.8	25.2	34.5	22.1	34.1
4 mature	14.8	3.6	4.9	0.5	2.0	7.6	15.6	10.5	37.0	11.7
5 mature	0.3	0.2	+	+	+	0.1	0.3	0.2	0.2	+
Number immat.	150.4	64.4	58.8	44.2	136.3	140.7	245.9	167.1	157.5	151.3
Number mature	66.9	57.2	21.2	8.5	16.3	47.5	41.1	45.2	59.1	45.8
Weight immat.	1028	502	527	292	685	984	1467	1414	1003	1083
Weight mature	1358	980	471	171	315	966	913	1059	1355	993
Number sp.st.	29.0	17.5	7.7	6.8	13.5	21.6	20.7	19.6	18.3	18.5
Weight sp. st	600	300	170	140	260	440	460	460	420	400

Age/maturity	Year									
	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2 juvenile	67.8	53.9	98.9	111.6	124.6	121.3	188.1	165.2	160.0	138.8
3 immature	20.1	8.6	8.6	8.1	13.9	16.9	29.5	37.9	24.1	29.5
3 mature	48.8	31.2	22.3	54.8	46.5	50.5	35.1	75.5	72.4	50.1
4 mature	16.0	12.1	4.5	5.3	3.5	4.6	8.7	20.1	24.8	7.9
5 mature	0.3	+	+	+	+	+	+	+	+	+
Number immat.	87.9	62.5	107.5	119.7	138.5	138.2	217.6	203.1	184.1	168.3
Number mature	64.8	43.3	26.8	60.1	50.0	55.1	43.8	95.6	97.2	58.0
Weight immat.	434	291	501	487	622	573	696	800	672	621
Weight mature	1298	904	544	1106	1017	1063	914	1820	1881	1106
Number sp.st.	22.0	5.5	16.3	25.8	23.6	24.8	19.2	42.8	21.8	27.6
Weight sp. st.	440	115	330	475	499	460	420	830	430	492

Age/maturity	Year							
	1999	2000	2001	2002	2003	2004	2005	
2 juvenile	140.9	115.8	122.2	117.3	109.4	110.6*	NA	
3 immature	16.1	20.5	21.0	7.6	9.4	11.4	NA	
3 mature	53.2	68.2	46.3	59.3	58.4	54.2	86.6	
4 mature	16.0	10.0	10.5	10.5	2.9	6.2	7.5	
5 mature	+	+	+	+		+	+	
Number immat.	157.0	136.3	161.2	126.6	105.1	143.5*	NA	
Number mature	69.3	78.2	56.8	69.8	61.3	60.4	72.5	
Weight immat.	585	535	655	510	487	511*	NA	
Weight mature	1171	1485	1197	1445	1214	1204	1450	
Number sp.st.	29.5	34.2	21.3	22.9	20.7	28.2	36.3	
Weight sp. st.	500	650	450	475	410	535	765	

* Preliminary/Predicted

NA: Not available

Table 11.5.1.1 Data used in the comparisons between abundance of age groups (numbers) when predicting fishable stock abundance for the calculation of preliminary TACS

Year class	AGE 1	AGE 2	AGE 2	AGE 2	AGE 3
	Acoustics	Back-calc. Mature	Acoustics Immature	Back-calc. Total	Back-calc. Mature
	N ₁	N _{2mat}	N _{2imm}	N _{2tot}	N _{3tot}
1980	23.7	17.1	1.7	32.1	9.8
1981	68.0	53.7	8.2	96.2	27.9
1982	44.1	40.7	4.6	81.6	27.0
1983	73.8	64.6	12.6	164.6	65.8
1984	33.8	35.6	1.4	65.0	20.1
1985	58.0	65.4	5.4	102.6	24.5
1986	70.2	70.3	6.7	94.6	15.8
1987	43.9	42.8	1.8	53.1	6.8
1988	29.2	31.9	1.3	42.0	6.7
1989	*39.2	67.7	5.2	77.2	6.4
1990	60.0	70.7	2.3	87.3	10.9
1991	104.6	86.9	10.8	107.0	13.2
1992	100.4	59.8	6.9	95.0	24.0
1993	119.0	102.2	46.3	147.2	29.6
1994	165.0	100.7	16.4	129.4	19.0
1995	111.9	90.3	30.8	125.5	23.2
1996	128.5	89.5	6.3	108.7	12.6
1997	121.0	85.9	5.0	110.3	16.0
1998	89.8	65.7	11.0	84.1	16.9
1999	103.0	86.7	2.4	95.8	5.9
2000	100.3	68.0	3.7	89.8	15.7
2001	**74.4	82.1	NA	93.5	7.5
2002	NA	86.6	NA		

* Invalid due to ice conditions.

** Projected from assessment in April 2003

NA: Not available

Table 11.5.1.2 Mean weight (g) of maturing capelin in autumn.

	YEARS							
	1981	1982	1983	1984	1985	1986	1987	1988
Age 2	19.2	16.5	16.1	15.8	15.5	18.1	17.9	15.5
Age 3	24.0	24.1	22.5	25.7	23.8	24.1	25.8	23.4

	Years							
	1989	1990	1991	1992	1993	1994	1995	1996
Age 2	18.0	18.1	16.3	16.5	16.2	16.0	15.3	15.8
Age 3	25.5	25.5	25.4	22.6	23.3	23.6	20.5	20.6

	Years							
	1997	1998	1999	2000	2001	2002	2003	2004
Age 2	14.3	14.1	16.8	17.1	16.3	No data	No data	No data
Age 3	20.3	18.1	20.6	24.7	23.9	No data	No data	No data

Table 11.5.1.3 Predictions of fishable stock abundance and TACs for the 1987/88–2004/05 seasons.

The last row gives contemporary advice on TACs for comparison.

Age 2 and age 3 = Numbers in billions in age groups at the beginning of season.

Fishable stock = calculated weight of maturing capelin in thousand tonnes (ref. August).

TAC calc = predicted in thousand tonnes.

SEASON	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96
Year classes	85-84	86-85	87-86	88-87	89-88	90-89	91-90	92-91	93-92
Age 2	55.5	64.8	43.2	31.1	39.4	56.4	93.1	89.6	92.5
Age 3	13.7	29.0	25.5	8.2	3.7	18.3	22.6	27.0	14.9
Fishable stock	1268	1800	1350	724	755	1398	2123	2170	1916
Calculated TAC	642	1105	713	170	197	755	1385	1427	1200
Advised TAC	1115	1036	550	265	740	*900	1250	850	1390
Season	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05
Year classes	94-93	95-94	96-95	97/96	98 /97	99/98	00/99	01/02	02/03
Age 2	90.0	83.8	94.4	89.2	70.9	77.1	77.2	63.0	45.1
Age 3	35.0	30.9	30.8	23.3	19.2	16.9	17.3	15.6	1.9
Fishable stock	2352	2019	2088	1885	1584	1620	1642	1424	710
Calculated TAC	1635	1265	1420	1285	975	1050	1040	835	335
Advised TAC	1600	1265	1200	1000	**1090	1350	1005	875	985

***In January 1993, 80 000 t were added to the 820 000 t recommended after the October 1992 survey due to an unexpected large increase in mean weights.**

**** In March 2001, 100 000 t were added to the 990 000 t recommended after the January/February 2001 survey due to much higher mean weights in the catch during 1 February-10 March than measured during the survey.**

Table 11.7.1 Capelin in the Iceland-East Greenland-Jan Mayen area 1978-2004. Recruitment of 1 year old fish (unit 10^9) and total stock biomass ('000 t) are given for 1 August Spawning stock biomass ('000 t) is given at the time of spawning (March next year). Landings ('000 t) are the sum of the total landings in the season starting in the summer/autumn of the year indicated and ending in March of the following year.

YEAR	RECRUITMENT	TOTAL STOCK BIOMASS	LANDINGS	SPAWNING STOCK BIOMASS
1978	164	2832	1195	600
1979	60	2135	980	300
1980	66	1130	684	170
1981	49	1038	626	140
1982	146	1020	0	260
1983	124	2070	573	440
1984	251	2427	897	460
1985	99	2811	1312	460
1986	156	3106	1333	420
1987	144	2639	1116	400
1988	81	2101	1037	440
1989	64	1482	808	115
1990	118	1293	314	330
1991	133	1975	677	475
1992	163	2058	788	499
1993	144	2287	1179	460
1994	224	2287	864	420
1995	197	3007	929	830
1996	191	2885	1571	430
1997	165	2348	1245	492
1998	168	2197	1100	500
1999	138	2315	933	650
2000	146	2164	1071	450
2001	140	2432	1249	475
2002	142	1993	988	410
2003	*132	*2140	741	535
2004	NA	NA	784	765

*Preliminary

NA: Not available

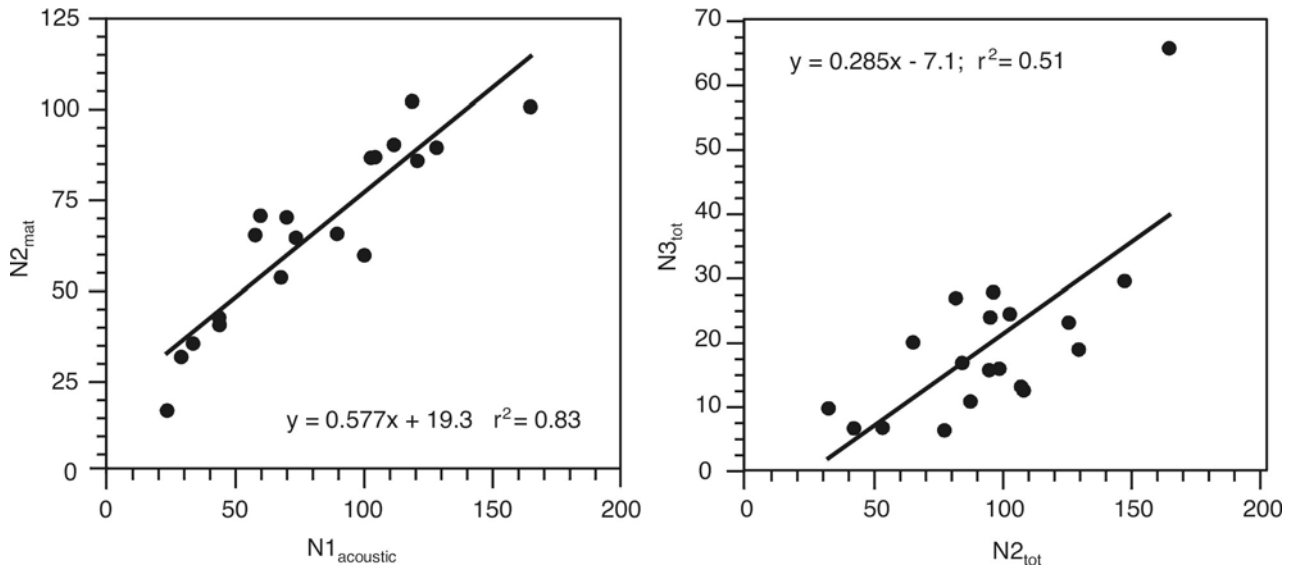


Figure 11.5.2.1. The relationship between the measured numbers of immature 1-group capelin in autumn acoustic surveys and the numbers of maturing capelin in 1 August of the following year (left hand figure) and between measured total numbers of 2-group capelin and the maturing 3-group capelin in the following year (right hand figure).

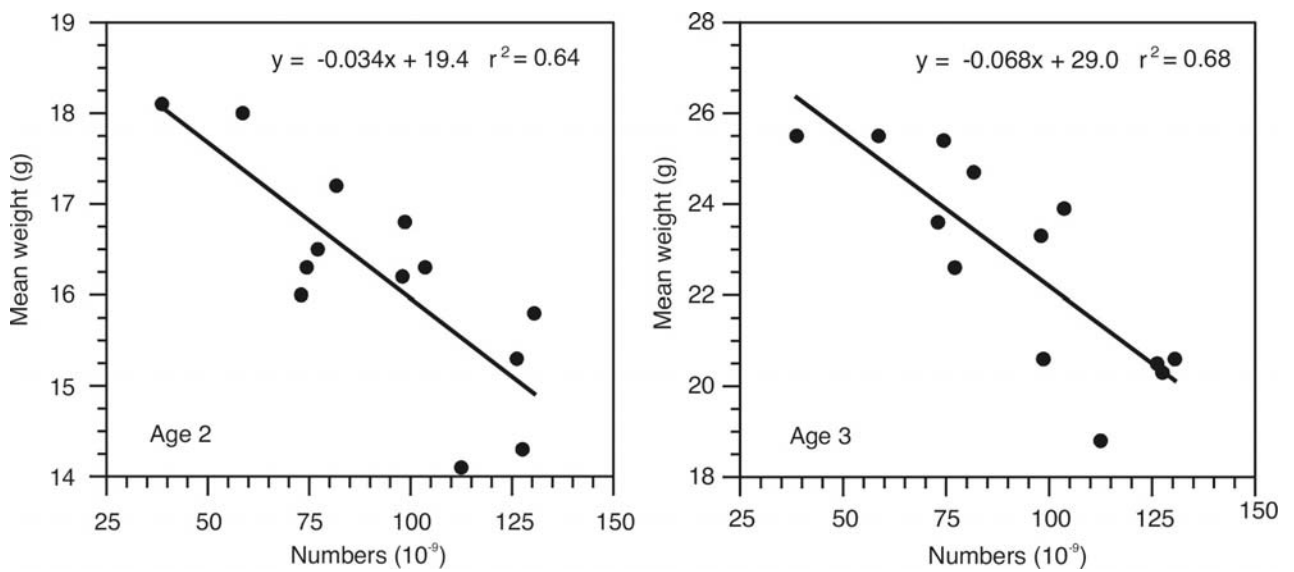


Figure 11.5.2.2. The relationship between the total numbers in the maturing stock and the mean weight of maturing 2-group (left hand figure) and 3-group (right hand figure) in autumn 1989-2001.