Atlantic Mackerel of the Northwest Atlantic - Update (2001)

Background

*This document is a supplement to Stock Status Report (SSR) B4-04 (2001) published in the spring of 2001. It provides updated data on landings, biology and abundance of Atlantic mackerel (*Scomber scombrus *L.) in NAFO subareas 3 and 4. A full report will be published again in 2003 following the June 2002 egg-sampling survey. For the time being, no changes have been made to the most recent scientific advice.*

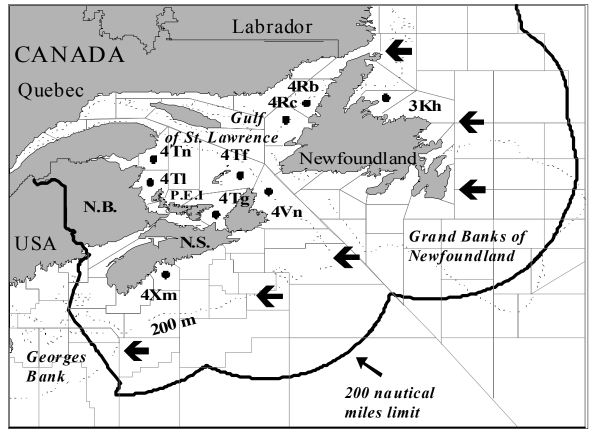


Figure 1. Distribution (🡐) of Atlantic mackerel (Scomber scombrus L.) in the northwest Atlantic and main fishing unit areas (●).

Summary

- In 2001, for a second consecutive year, the most noticeable feature of the commercial mackerel fishery was the very large number of small fish found in catches. These small fish, from the 1999 year-class, with an average length of approximately 30 cm, accounted for 68% of all catches in terms of number of fish caught. This is a record-high value for two-year-old fish for all year-classes sampled since 1973.
- In Canadian waters, commercial landings of mackerel rose from 9,837 t in 2000 to 15,301 t in 2001. Nearly half of all these landings, or 7,647 t, were made solely on the west coast of Newfoundland. During the same period, landings by American commercial fishermen more than doubled, from 5,645 t to 11,521 t.
- Annual variations in the condition of mackerel during spawning in the Gulf of St Lawrence follow a pattern similar to fluctuations in the average water temperature of the **C**old **I**ntermediate **L**ayer (**CIL**). Over the years, this similarity has been observed in different age groups and in all the year-classes that have dominated commercial catches.
- The mackerel spawning biomass is currently estimated from data collected during a biennial egg-sampling survey and from a theoretical model describing daily egg production during spawning. In 2001, a new model was calculated based on daily gonadosomatic index values.
- The new spawning biomass estimates are now very similar to those calculated in 1996, 1998 and 2000 using the **D**aily **F**ecundity **R**eduction **M**ethod (**DFRM**), whose calculations are based on different data. These estimates do not significantly alter our interpretation of the current status of the stock, but provide a much more accurate description of the recruitment episodes that have occurred in the Gulf since 1982.
- Although the mackerel spawning biomass is now more accurately

estimated by the egg index, its accuracy for the stock as whole could be affected by interannual variations in the proportion of fish that enter the Gulf to spawn.

Biology

Growth

In 2001, the mean lengths at age were similar to those calculated the previous year and during the 1980s (Figure 2A). However, the mean weights at age observed were the highest recorded since the early 1970s (Figure 2B). In addition to displaying interannual variations, growth of mackerel was even slower in the 1967, 1974, 1982 and 1988 year-classes (Figure 3). It is these year-classes that have dominated commercial catches for several years.

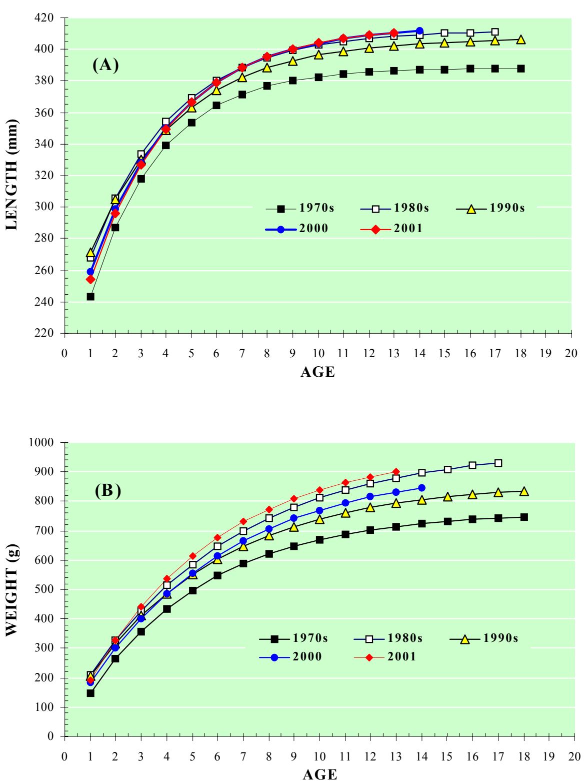
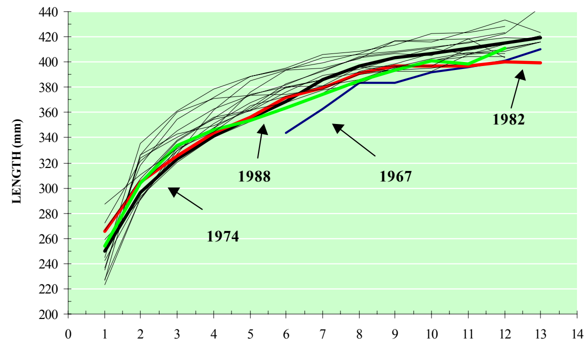


Figure 2. Mean length (A) (mm) and weight (B) (g) at age calculated for mackerel sampled in Canadian coastal waters since 1973.

Gonadosomatic index



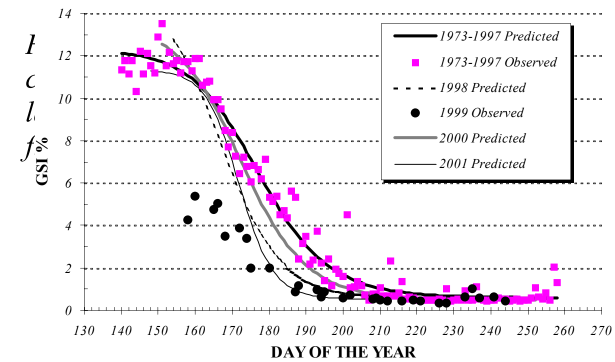


Figure 4. Mean daily gonadosomatic index (GSI) values observed and predicted during the 1973-2001 period (a logistical model was used to calculate the predicted values).

A study of the mean daily gonadosomatic index values reveals that spawning in 2001 occurred slightly earlier than in the years from 1973 to 1997 and in 1998 and 2000 (Figure 4). The earliest spawning observed occurred in 1999, when the maximum gonadosomatic index values were only about 5% in early June (day 160 of the year) compared to 12% for the other years.

Condition

Over the years, fluctuations in the condition of mackerel during spawning in the Gulf of St Lawrence in June have followed a pattern similar to fluctuations in average temperature (ºC) of the upper layer of the **CIL** (Figure 5A). This similarity has also been observed in different age groups

(Figure 5B) and in the year-classes that have dominated commercial catches (Figure 5C).

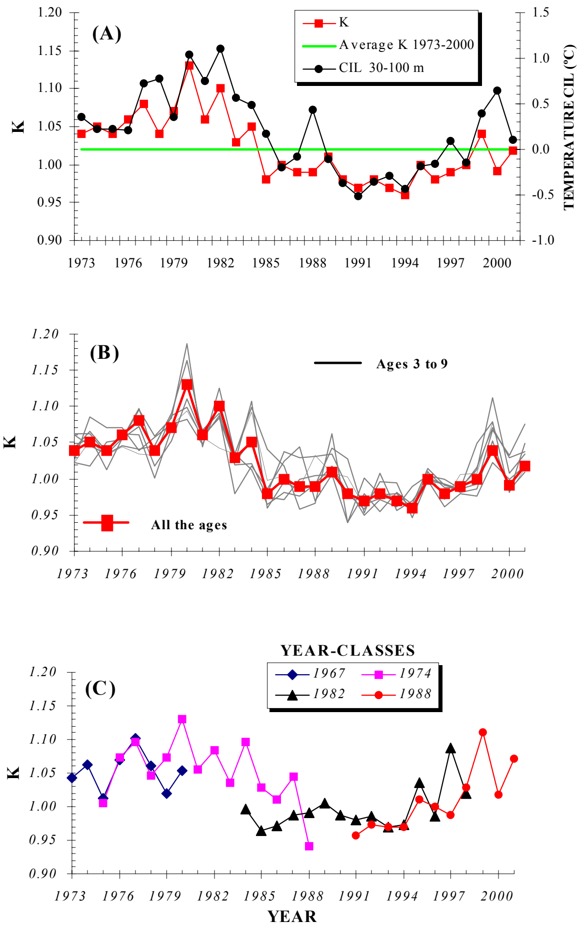


Figure 5. Mean condition factor (Fulton) calculated in June, and mean temperature (ºC) of the 30 to 100 m layer associated with the CIL (Cold Intermediate Layer) (A) (Dr. Denis Gilbert, Maurice Lamontagne Institute, Mont-Joli, pers. comm.), for various age groups (B) and for the year-classes (C) that have dominated the mackerel fishery since the late 1960s.

The fishery

Landings

In 2001, reported landings of mackerel in eastern Canada were 15,301 t, which represents an increase of 5,464 t or 36% over 2000 (Table 1). However, these landings are still below the average of recent years, and with the exception of 1999, they represent the lowest value observed since 1990. American commercial landings were 11,521 t in 2001, which represents an increase of 5,876 t or 51% over 2000. Their recreational landings were 1,229 t compared to 1,381 t for 2000, and no foreign vessels have reportedly fished in U.S. waters since 1992. For the entire northwest Atlantic, 28,051 t of mackerel were landed in 2001, which is well below the annual averages of recent years (Table 1).

Nearly 50% of all landings in 2001, or 7,647 t, were made solely on the west coast of Newfoundland (Table 2) using purse seines (Table 3). This was followed by jiggers, gillnets and traps, with respective landings of 2,846 t, 2,533 t and 2,222 t.

Description of landings

For a second consecutive year, mackerel landings were characterized by the presence of a very large number of small fish. These small fish were associated with the 1999 year-class (Figure 6). To date, at ages 1 and 2, these fish accounted for 63% and 68% of all catches in terms of number of fish caught in 2000 and 2001 respectively. This is a record-high value for all year-classes sampled since 1973.

In 2001, the average length of mackerel from the 1999 year-class was approximately 300 mm. These fish were observed in the annual length frequencies from samples from the line fishery in Division 4T and the purse seine fishery in Division 4R (Figure 7). Because of the high selectivity of

Table 1. Annual landings (t) of mackerel between 1990 and 2001 in NAFO Subareas 2 to 6.

YEAR	CANADA		USA			TOTAL
	Canadian vessels	Foreign vessels	Commercial	Recreational	Other countries	
1990	19 190	3 854	31 261	1 908	30 678	**86 891**
1991	24 914	1 281	26 961	2 439	15 714	**71 309**
1992	24 307	2 417	11 775	344	0	**38 843**
1993	26 158	591	4 666	540	0	**31 955**
1994	20 564	49	8 877	1 705	0	**31 195**
1995	17 650	-	8 479	1 249	0	**27 378**
1996	20 364	-	16 137	1 416	0	**37 917**
1997	21 309	-	15 400	1 735	0	**38 444**
1998	19 334	-	14 523	690	0	**34 547**
1999	16 561	-	12 026	1 335	0	**29 922**
2000	9 837	-	5 645	1 381	0	**16 863**
2001*	**15 301**	-	**11 521**	**1 229**	**0**	**28 051**
AVERAGE:						
1960-2000	**17 852**	**3 982**	**6 682**	**2 848**	**65 767**	**95 506**
1970-2000	**20 587**	**4 889**	**8 078**	**2 803**	**80 138**	**114 915**
1980-2000	**21 316**	**836**	**10 948**	**2 022**	**12 149**	**47 032**
1990-2000	**20 017**	**1 638**	**14 159**	**1 340**	**4 217**	**40 479**

* Preliminary data

Table 2. Annual landings (t) of mackerel by Canadian province since 1995.

PROVINCE	YEAR							AVERAGE	
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001***	(1995-2000)	(1990-2000)
Nova Scotia	6 681	5 517	5 669	4 562	4 797	2 710	2 707	**4 989**	**6 397**
New Brunswick	2 206	2 683	1 990	1 682	1 373	223	394	**1 693**	**1 950**
Prince Edward Island	2 518	4 017	6 693	6 784	3 842	1 459	1 660	**4 219**	**3 909**
Quebec	3 382	4 317	5 769	4 066	5 104	1 711	2 892	**4 058**	**3 596**
Newfoundland	2 862	3 830	1 188	2 149	1 445	3 734	7 647	**2 535**	**4 133**
Not known	0	0	0	91	0	0	0	**15**	**8**
TOTAL	**17 650**	**20 364**	**21 309**	**19 334**	**16 561**	**9 837**	**15 301**		

* Preliminary data

Table 3. Annual landings (t) of mackerel by fishing gear since 1995.

GEAR	YEAR							AVERAGE	
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001***	(1995-2000)	(1990-2000)
Trawl	59	68	92	9	12	5	0	**41**	**535**
Purse seine	2 720	3 607	1 116	1 572	1 348	3 730	7 647	**2 349**	**4 134**
Other seines	0	0	9	0	0	0	0	**2**	**20**
Gillnet	4 442	6 419	6 657	7 638	5 128	2 016	2 533	**5 383**	**6 097**
Trap	4 719	3 821	3 889	3 999	4 057	2 454	2 222	**3 823**	**3 667**
Longline	0	0	0	7	3	0	2	**2**	**8**
Handline	899	1 231	3 029	1 998	569	17	9	**1 291**	**904**
Jigger	3 821	4 705	6 204	3 651	5 435	1 616	2 846	**4 239**	**4 323**
Weir	177	0	1	141	8	0	42	**54**	**60**
Other	812	510	313	320	0	0	0	**326**	**245**

* Preliminary data

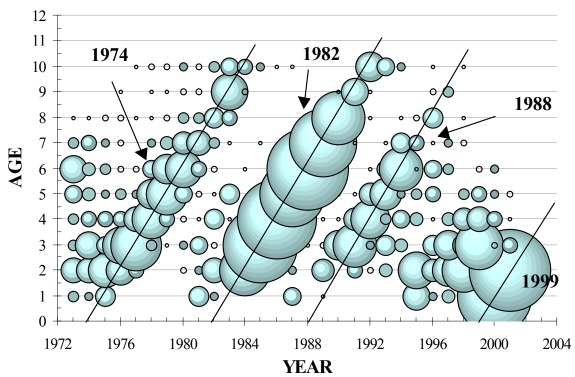


Figure 6. Canadian catch at age (%) for mackerel during the 1973-2001 period (the year-classes that have dominated the fishery for several years are indicated; age group 10 represents all fish aged 10 or over).

gillnets, the 1999 year-class has not yet been observed in the length frequencies obtained in 2001 from commercial sampling.

Industry comments

Despite variations between different regions and fishing sectors, the comments received from the industry for the past two years have centred on the abundance and growth of the 1999 year-class. More and more fishermen are also paying particular attention to possible links between catch levels and certain environmental variables, such as water temperature. Some fishermen even use satellite maps of surface water temperatures as a tool to help them locate

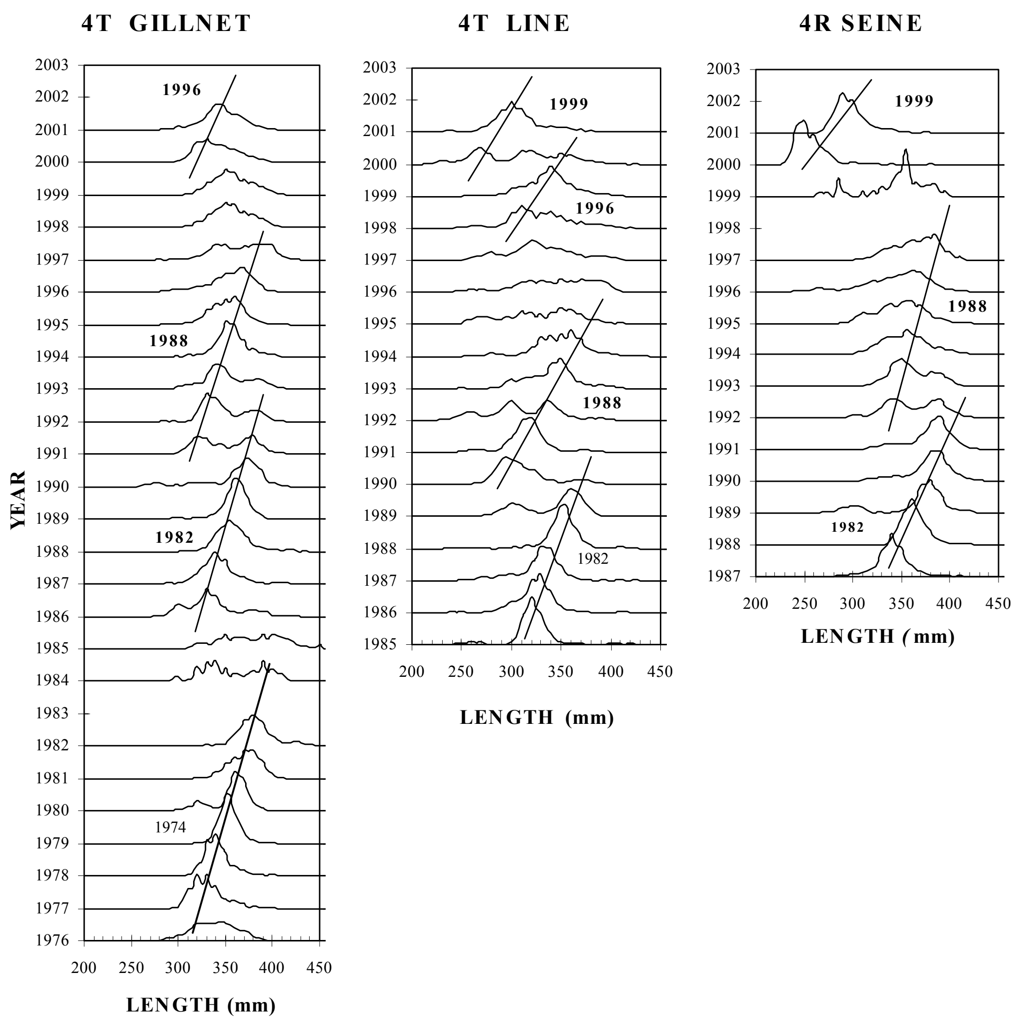


Figure 7. Annual length frequencies (mm) of mackerel caught with gillnets and lines in Division 4T and with purse seines in Division 4R (the age-classes that have dominated these fisheries are indicated).

masses of warm water so that they can set their fishing nets in these areas. Other comments made in 2001 dealt specifically with the following points: (1) changes in migration patterns, which mean that mackerel arrive later in some regions in the spring and remain longer in the fall in other regions, (2) the absence of large individuals in the spring, which has been observed for several years, (3) the larger numbers of seals found around fishing gear such as gillnets and traps, (4) the presence of very cold water and problems associated with clogging of nets ("slub"), (5) catches of very small fish by certain types of fishing gear, (6) the delay in enforcing requirements that all fishermen, including bait fishermen, keep logbooks and (7) recreational catches which are quite large, but not officially recorded.

Resource status

Changes to the abundance index

Efforts have been made on a regular basis to improve mackerel biomass estimates. To this end, in recent years changes have been made in the number of stations sampled during the survey, in egg and plankton sampling techniques, and in calculations of mean egg densities for the entire sampling area. In addition, deficiencies associated with the theoretical model used to calculate the proportion of eggs laid daily and over the entire spawning season have been corrected since 1996 by using the **D**aily **F**ecundity **R**eduction **M**ethod **(DFRM).** The basic calculations used with this method do not take into account the theoretical model which describes spawning. Furthermore, with this method, it is no longer necessary to know the total or annual egg production, the calculations of which are also based on the same theoretical model. However, using the **DFRM** is resource-intensive, and for the moment, the series comprises only three years.

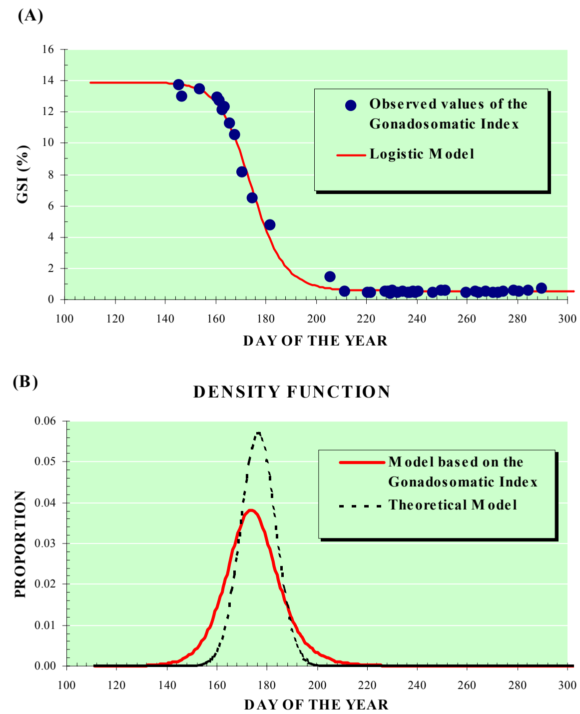


Figure 8. Mean daily gonadosomatic index (GSI) values (A) for the first pass of an egg survey and models (B) describing the proportion of eggs laid daily during the corresponding spawning season.

In 2001, a new model describing daily egg production was used based on mean daily gonadosomatic index values (Figure 8A). For each year in which a survey was conducted, a logistical curve was adjusted to the index values and new annual models were constructed from those curves (Figure 8B). In addition to these changes, and in contrast to past years, new temperature data were used to calculate egg incubation time, a variable used in calculating daily egg production.

New biomass estimates

The new biomass estimates are different from those derived from the theoretical model (Figure 9A), but very similar to those calculated in 1996, 1998 and 2000 using the **DFRM** (Figure 9B). These estimates provide a much more accurate description of

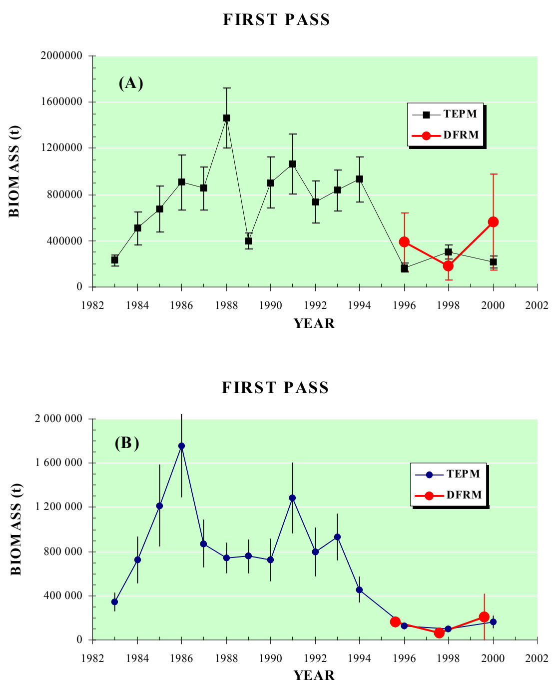


Figure 9. Spawning biomasses (t) of mackerel calculated according to two different approaches (TEPM: Total Egg Production Method; DFRM: Daily Fecundity Reduction Method) and two models that describe the proportion of eggs laid daily: (A) Theoretical model, see text, and (B) Model calculated from the daily gonadosomatic index values. Daily egg production was calculated from the mean egg density (stratified) per square metre and a new equation measuring egg incubation time.

the recruitment episodes that have occurred in the Gulf since 1982. However, there are still major biomass differences between certain years and it is difficult to explain these differences from the current catch level. For example, between 1993 and 1996 inclusive, the spawning biomass of mackerel in the Gulf apparently dropped from 936,000 t to 126,000 t, a difference of 810,000 t. During the same period, reported landings for eastern Canada were only 85,376 t (Table 1). Although the spawning biomasses of mackerel are now accurately estimated by the egg index, the accuracy of this figure for the stock as whole appears to be influenced by one or more mechanisms other than the fishery. For example, the proportion of fish entering the Gulf of St Lawrence to spawn may vary from year to year. This hypothesis could be verified by extending the egg-sampling survey outside the Gulf.

Abundance of plankton

During the 1990s, a reduction in the quantity of plankton was observed in the samples collected during the egg-sampling survey. To quantify this reduction, a plankton abundance index was developed, defined as the ratio of the settled volume of plankton to the volume of water filtered. This index was calculated for each station and an average for the entire area sampled was determined by geostatistics. These averages do in fact reveal a decline during the 1990s (Figure 10). In addition, and with the exception of 2000, the highest averages are associated with the 1982 and 1988 year-classes, which have dominated the commercial fishery for a number of years.

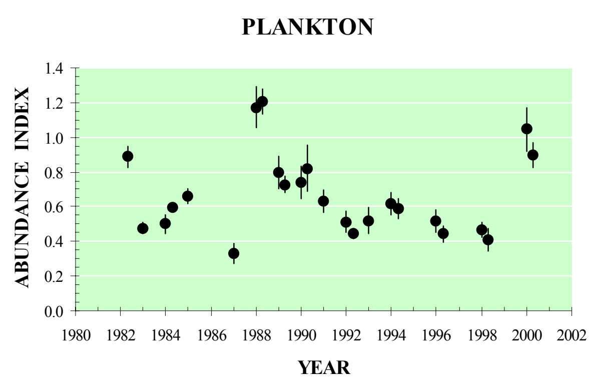


Figure 10. Annual abundance index of plankton collected during the egg surveys conducted in June between 1982 and 2000 (the vertical bars represent the confidence intervals; the missing years and passes represent data that require special processing or for which geostatistics cannot be used).

Outlook

In light of the foregoing results, no change will be made to the scientific advice issued last year. However, it is important to note the delay in enforcing the requirement of mandatory logbooks for fishermen with mackerel licences. Once this system is in place, it will be important for all fishermen to properly document their catches, since proper monitoring of a stock can only be achieved through an accurate recording of all catches.

References:

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