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# Results of the Atlantic mackerel (*Scomber scombrus* L.) egg surveys conducted in the southern Gulf of St. Lawrence from 2008 to 2011

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## ABSTRACT

This document presents the results of the Atlantic mackerel (*Scomber scombrus* L.) egg surveys conducted in the southern Gulf of St. Lawrence from 2008 to 2011. For each of these surveys, very low abundances of eggs of less than 10 eggs/$m^2$ were measured at more than 40% of the sampled stations. Abundances ranged from 0.0 to 785.1 eggs/$m^2$ for respective averages of 95.3 and 56.1 eggs/$m^2$ in 2008 and 2009 and of 20.0 and 30.0 eggs/$m^2$ in 2010 and 2011. The highest egg abundances were measured at the stations between Îles-de-la-Madeleine, baie des Chaleurs, and the northeast coast of New Brunswick. It is also at these stations that water temperatures were the highest. In 2008 and 2009, total egg productions were evaluated at $4.18 \times 10^{12}$ and $1.90 \times 10^{12}$ eggs and in 2010 and 2011, at $6.48 \times 10^{11}$ and $9.58 \times 10^{11}$ eggs. These egg productions are associated with an index of the spawning stock biomass ranging from 25,960 t to 99,631 t. This index has significantly decline from the mid-1990s and the values calculated since 2005 are among the lowest of the historical series. In order to verify if these low values were associated with a displacement of the main spawning activities outside the Gulf of St. Lawrence, an additional egg survey was conducted on the Scotian Shelf and on a portion of the southern coast of Newfoundland in 2009. The low egg abundances measured during this survey suggest that the spawning biomass was not important and that the low values measured in the southern Gulf of St. Lawrence represent a real decline in abundance. All the results presented in this document suggest a reduction of the Total Allowable Catch (TAC).

## RÉSUMÉ

Ce document présente les résultats des relevés des œufs de maquereau bleu (*Scomber scombrus* L.) réalisés dans le sud du golfe du Saint-Laurent de 2008 à 2011. Pour chacun de ces relevés, de très faibles abondances d'œufs de moins de 10 œufs/$m^2$ ont été mesurées à plus de 40 % des stations échantillonnées. Les abondances ont varié de 0,0 à 785,1 œufs/$m^2$ pour des moyennes respectives de 95,3 et 56,1 œufs/$m^2$ en 2008 et 2009 et de 20,0 et 30,0 œufs/$m^2$ en 2010 et 2011. Les abondances d'œufs les plus élevées ont été mesurées aux stations situées entre les Îles-de-la-Madeleine, la baie des Chaleurs et la côte nord-est du Nouveau-Brunswick. C'est aussi à ces stations que les températures de l'eau étaient les plus élevées. En 2008 et 2009, les productions totales d'œufs ont été évaluées à 4,18 x $10^{12}$ et 1,90 x $10^{12}$ œufs et en 2010 et 2011, à 6,48 x $10^{11}$ et 9,58 x $10^{11}$ œufs. À ces productions d'œufs sont associées un indice de la biomasse reproductrice variant de 25 960 t à 99 631 t. Cet indice a connu une chute importante à partir du milieu des années 1990 et les valeurs calculées depuis 2005 sont parmi les plus faibles de toute la série historique. Afin de vérifier si ces faibles valeurs étaient associées à un déplacement des principales activités de ponte à l'extérieur du golfe du Saint-Laurent, un relevé additionnel des œufs a été réalisé sur le plateau néo-écossais et une portion de la côte sud de Terre-Neuve en 2009. Les faibles abondances d'œufs mesurées lors de ce relevé suggèrent que la biomasse reproductrice était peu abondante et que les faibles valeurs mesurées dans le sud du golfe du Saint-Laurent représentent une baisse réelle d'abondance. Tous les résultats présentés dans ce document suggèrent une réduction du Total Admissible des Captures (TAC).

# 1. INTRODUCTION

The calculation of a biomass index for the Atlantic mackerel (*Scomber scombrus* L.) stock that spawns in the southern Gulf of St. Lawrence is realised using an egg survey. This index is used since 1983 to follow the evolution of the abundance of the Atlantic mackerel in NAFO Subareas 3-4. In 2012, the index was also used to calibrate a Sequential Population Analysis (SPA).

The last Canadian assessment of the Atlantic mackerel dates back to 2008 and was based on the results of the 2007 egg survey (Grégoire *et al*. 2008). The preliminary results of the 2008 survey were presented in 2009 at the joint Canada / United States assessment. This document presents the complete results of the surveys conducted in 2008, 2009, 2010, and 2011.

# 2. MATERIAL AND METHODS

## 2.1 SAMPLING AT SEA

As requested by industry, the at-sea sampling plan for the 2008 and 2009 surveys was modified in order to include (as in 2006 and 2007) five stations in the Northumberland Strait (Figure 1). Plankton was collected using a Bongo sampler (Posgay and Marak 1980) equipped with two 333-micron mesh Nitex nets with a 61 cm opening. A General Oceanics$^{TM}$ flowmeter was attached near the opening of each net in order to measure the volume of filtered water. The tows, which lasted a minimum of 10 minutes, were made following a saw-tooth pattern (Hempel 1973) between the surface and a maximum depth of 50 m, or up to 5 m from the bottom for shallower stations. The tow patterns and positioning of the nets in the water column were monitored in real time using electronic equipment (BIONET$^{TM}$) attached to the sampler's frame. A CTD (Sea-Bird SBE-19) probe, also attached to the sampler's frame, provided temperature and salinity patterns in the sampled portion of the water column.

Back on the deck, the nets were hung and washed with salt water. Plankton samples from one of the two nets were kept in a diluted solution (4-5%) of formaldehyde (Hunter 1985) and the samples from the other net, in concentrated ethanol (100%).

## 2.2 LABORATORY ANALYSES

Plankton sorting (formaldehyde) was carried out at the Maurice Lamontagne Institute laboratory (Fisheries and Oceans, Mont-Joli) in the fall following each survey. Each sample was fractionated based on the Van Guelpen beaker split method (Van Guelpen *et al*. 1982). The mackerel egg and larvae identification criteria were taken from the work conducted by Fritzsche (1978), Elliott and Jimenez (1981), and by Fahay (1983).

## 2.3 CALCULATION OF THE EGG ABUNDANCE (N/M$^2$) BY STATION

The egg counts by stage of development (Girard 2000) were recorded, validated and standardized according to the volume of filtered water ($m^3$) and converted in abundance (number) by $m^2$ considering the maximum sampled depth (m). These abundances were analyzed according to the water temperature based on the approach proposed by Perry and Smith (1994).

## 2.4 CALCULATION OF THE INCUBATION TIMES (HR)

The egg incubation times of stages one and five (stage 1 broken or dead) were calculated according to the Lockwood *et al*. (1977) model for Northeast Atlantic mackerel. This model is defined as follows:

$$I = (e^{\,[-1.61 \cdot Ln(T) + 7.76]})$$

where T is the mean temperature (°C) for the first 10 meters of water (area in the southern Gulf of St. Lawrence at the time of the survey that is usually above the thermocline).

## 2.5 CALCULATION OF THE DAILY EGG PRODUCTION (N/M$^2$) BY STATION

The daily egg production (n/m$^2$) per station is defined as follows:

$$\frac{\text{Abundance (stages 1 and 5) (n/m}^2)}{\text{Incubation time (hr)}} \bullet 24\ hr$$

## 2.6 CALCULATION OF THE DAILY EGG PRODUCTION (N/M$^2$) FOR THE ENTIRE SAMPLED AREA

The sampled area has three adjoining stratums that were defined by Ouellet (1987) based on the statistical approach proposed by Dalenius and Hodges (1959). The surface of each of these stratums was used as a weighting factor based on the equations from a random stratified sampling plan (Cochran 1977). The daily egg production for the entire sampled area corresponds to the weighted mean from the daily productions (n/m$^2$) calculated for each station.

The daily egg production for the entire sampled area was also calculated using kriging. The choice of the variogram, the calculation of the semivariance and the ordinary point kriging were realised with the GS$^+$ software (Robertson 1998). A correction factor was applied for variograms constructed without extreme values. The number of points to be added to the research neighbourhood was set at 16, and there were no restrictions applied to the search radius. Kriging averages and variances were calculated using the EVA II software (Petitgas and Lafont 1997).

## 2.7 CALCULATION OF THE PROPORTION OF EGGS SPAWNED DAILY

The proportion of eggs spawned at the median date of the surveys was calculated using a density curve taken from a logistic model describing the daily changes of the gonadosomatic index (GSI). This approach was preferred to the normal density curve (of the same range and with a maximum occurring always at the same date) that was used in the past (Grégoire *et al*. 2008). The logistic model is described as follows:

$$y = y_0 + \frac{a}{\left[1 + \left(\frac{x}{x_0}\right)^b\right]}$$

where:

y= daily average of the gonadosomatic index

x= day of the year

and $y_0$, a, $x_0$ and b, the parameters to be fitted

The same logistic model was used over the years. However, a correction was applied to the 1991 model in order to force the presence of a plateau for the values measured at the beginning of the season.

## 2.8 CALCULATION OF THE TOTAL ANNUAL EGG PRODUCTION

Total annual egg production was calculated by dividing the product of the mean daily egg production and the surface of the area sampled by the proportion of eggs spawned at the median date of the surveys.

## 2.9 CALCULATION OF THE SPAWNING BIOMASS INDEX

The spawning biomass index (t) was calculated according to the basic model proposed by Saville (1977). The Total Egg Production Method (TEPM), which is an application of this model, is defined as follows:

$$B = \frac{P \cdot A \cdot W}{S \cdot F \cdot R \cdot 10^6}$$

where:

B = Spawning biomass index (t)

P = Mean daily egg production (nb/$m^2$) per station (stratified or kriging average)

A = Area ($m^2$) of the zone sampled (6.945 x $10^{10}$ $m^2$)

W = Mean weight (g) of a fish

S = Proportion of eggs spawned at the median date of a survey

F = Fecundity of females (Pelletier 1986)

R = Sex ratio (proportion of females in the biological samples)

$10^6$ = Factor for converting grams into tonnes

## 2.10 ATLANTIC MACKEREL LARVAE ABUNDANCE

The abundances of mackerel larvae were calculated in numbers per $m^2$ and their distribution are presented for the surveys conducted since 1983.

# 3. RESULTS

## 3.1 SAMPLING PLAN

The 2008 survey was conducted between 21 and 29 June, the surveys of 2009 and 2010 between 13 and 21 June, and the 2011 survey between 11 and 19 June (Figure 2). Surveys of 2008 and 2010 started at stations 4.5, the 2009 survey at station 2.2 and the 2011 survey at station 9.5. In 2008, 12 stations could not be sampled because of the poor weather conditions. All stations were sampled in 2009, 2010 and 2011, but problems with the CTD probe were met at two stations (8.6 and 8.7) in 2009 and at one station (1.1) in 2011.

## 3.2 EGG ABUNDANCE (N/$M^2$) BY STATION

Very low egg abundances, less than 10 eggs/$m^2$, have been measured at 42% of the stations sampled in 2008 compared to 66% and more for following surveys. Abundances have ranged from 0.0 to 785.1 eggs/$m^2$ for respective averages of 95.3 and 56.1 eggs/$m^2$ in 2008 and 2009, and of 20.0 and 30.0 eggs/$m^2$ in 2010 and 2011 (Table 1). The highest abundances were measured at the stations located between the Magdalen Islands and Baie des Chaleurs in 2008 and 2009, at the entrance of Baie des Chaleurs in 2010 and in the estuary of the Miramichi River in 2011 (Figure 3). Warmer temperatures are associated with these stations. Very few eggs were found in the Northumberland Strait in 2008 and 2009. Overall, the egg abundances of the 2008-2011 surveys are much lower than those of the surveys realised from the 1980s to the mid-1990s (Appendix 1).

During the 2008-2011 surveys, water temperatures in the 0-10 m layer varied from 6.0 to 15.6°C for respective averages of 12.5 and 10.8°C in 2008 and 2009 and of 9.3 and 9.5 °C in 2010 and 2011 (Table 2).

In 2008 and 2009, the egg abundances of 300 eggs/$m^2$ and more were measured at the stations where water temperatures ranged between 10.0 and 13.0 °C (Figures 4A and 4B). Almost 50% of the abundances were associated with temperatures below 12.0 °C (Figures 4C and 4D). In 2010 and 2011, the highest abundances, of 265 and 776 eggs/$m^2$, were associated with temperatures of 10.9 and 11.3 °C (Figures 5A and 5B). For these two surveys, the egg abundances were strongly related to temperatures above 11.0 °C (Figures 5C and 5D).

More than 50% of the abundances consisted of eggs from stages of development 1 and 5 (Figure 6A). Eggs of the other stages accounted for less than 20%. Stages 1 and 5 abundance has been increasing since 2008 contrary to those of stage 4. An opposite relationship ($p<0.0001$) has been determined between the annual proportion (%) of eggs from stages 1 and 5 and the average temperature of the 0-10 m layer of water (Figure 6B).

## 3.3 INCUBATION TIMES (HR)

Incubation times varied from 28.1 to 130.7 hr for respective averages of 42.1 and 52.2 hr in 2008 and 2009, and of 69.0 and 65.8 hr in 2010 and 2011 (Table 3). The higher incubation times of 2010 and 2011 were caused by colder temperatures (Table 2).

## 3.4 DAILY EGG PRODUCTION (N/M$^2$) BY STATION AND FOR THE ENTIRE SAMPLED AREA

The daily egg productions by station calculated between 2008 and 2011 ranged from 0 to 392.2 eggs/m$^2$ for respective averages of 54.1 and 27.6 eggs/m$^2$ in 2008 and 2009 and 9.2 and 14.5 eggs/m$^2$ in 2010 and 2011 (Table 4). Similar averages were obtained taking into account the three strata of the sampling area (Table 5).

The parameters of the variograms used to calculate the daily egg productions by kriging are presented in Table 6. The spherical model has been used in most of the cases and the coefficients of determination of each model ranged from 0.827 to 0.993. The daily egg productions calculated by kriging (Table 7) are similar to those calculated for all the strata (Table 5). However, the variances calculated by kriging are lower.

## 3.5 GONADOSOMATIC INDEX AND PROPORTION OF EGGS SPAWNED DAILY

The maximum values of the gonadosomatic index were observed June 12$^{th}$ (day of the year 164) in 2008 (Figure 7A), June 13$^{th}$ (day 164) in 2009 (Figure 8A) and June 9$^{th}$ (day 160) in 2010, and 2011 (Figures 9A and 10A). Values of less than 2% (end of the spawning) were measured from July 1$^{st}$ (day 182).

Based on the logistic model, the proportions of eggs spawned at the survey's median dates and used to calculate the total egg productions were 0.0543 and 0.0361 in 2008 and 2009 compared to 0.0321 and 0.0339 in 2010 and 2011 (Table 8; Figures 7B, 8B, 9B, and 10B). Median dates of the 2008, 2010, and 2011 surveys correspond to the peaks of the spawning while the 2009 peak occurred a few days after the median date of the survey. The spawning durations were 22 and 30 days in 2008 and 2009 compared to 32 and 31 days in 2010 and 2011 (Table 9).

## 3.6 TOTAL ANNUAL EGG PRODUCTION AND INDEX OF THE SPAWNING BIOMASS

The total egg productions of 2008 and 2009 were evaluated respectively at $4.18 \times 10^{12}$ and $1.90 \times 10^{12}$ eggs (Table 10). Lower productions, of $6.48 \times 10^{11}$ and $9.58 \times 10^{11}$ eggs, were measured in 2010 and 2011. Between 2008 and 2011, the proportions of females in the biological samples ranged from 0.5084 to 0.5144 and the mean weights of a fish, from 335.5 to 350.4 g (Table 11). Mean female fecundities calculated from the same samples ranged from 481,941 to 530,018 eggs.

The spawning biomass indices were evaluated at less than 100,000 t since 2005. The historic minimum was measured in 2010 with 25,960 t (Table 12; Figure 11). These indices are similar to those calculated from the kriged daily egg productions (Figure 11).

## 3.7 LARVAE DISTRIBUTION AND ABUNDANCE

In 2008 and 2009, mackerel larvae were found at several stations in the south of the area sampled. However, very few larvae were found during the 2010 and 2011 surveys (Figure 12) as well as for the surveys conducted in the 1990s and between 2000 and 2005 (Appendix 2).

# 4. CONCLUSION

Since the beginning of the survey series in 1983 (and including the 1979 survey), the mackerel spawning biomass index increased significantly on three occasions. These increases were linked to the arrival of the dominant 1982, 1988, and 1999 year-classes. A large decrease of the spawning biomass index was measured in the mid-1990s. This index also reached historical minimum values since 2005.

The low egg abundances measured in 2009 during the Scotian Shelf and the southern coast of Newfoundland survey (Grégoire *et al*. 2012) exclude the possibility that a significant portion of the Canadian contingent of Atlantic mackerel spawns outside the Gulf of St. Lawrence. The low values of the spawning biomass index measured in the southern Gulf of St. Lawrence suggest a real decline in abundance. Pending the arrival of a strong recruitment, these results suggest also that the catches should be reduced over the next years.

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# TABLES

*Table 1. Egg abundance (developmental stages 1 and 5) ($n/m^2$) of Atlantic mackerel for the stations of the research surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2011.*

| | STATIONS | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1.1** | **1.2** | **1.3** | **1.4** | **1.5** | **2.1** | **2.2** | **2.3** | **2.4** | **2.5** | **2.6** | **3.1** | **3.2** | **3.3** | **3.4** | **3.5** | **3.6** | **3.7** | **3.8** |
| **STRATE / *STRATUM*** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 |
| **LONGITUDE** | -60.92 | -60.75 | -60.75 | -60.75 | -60.75 | -61.25 | -61.25 | -61.25 | -61.25 | -61.25 | -61.25 | -61.77 | -61.75 | -61.75 | -61.75 | -61.75 | -61.83 | -61.75 | -61.75 |
| **LATITUDE** | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 46.50 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 45.83 | 46.17 | 46.50 | 46.83 | 47.17 | 47.58 | 47.83 | 48.17 |
| **1979** | 8.4 | 87.9 | 0.0 | 0.0 | 1.1 | 86.2 | 38.4 | 15.1 | 105.1 | 59.7 | 0.1 | 122.1 | 7.5 | 84.3 | 136.6 | 49.6 | 306.1 | 65.4 | 0.3 |
| **1983** | 2.4 | 4.4 | 60.8 | 23.9 | 0.5 | 37.5 | 2.7 | 30.7 | 87.2 | 132.9 | 8.2 | 76.4 | 58.2 | 78.5 | 12.8 | 164.2 | 61.9 | --- | 2.7 |
| **1984** | 40.6 | 79.9 | 0.0 | 2.2 | 0.0 | 67.9 | 35.8 | 16.8 | 14.1 | 1.7 | 6.9 | 82.9 | 31.7 | 87.1 | 60.1 | 7.8 | 313.1 | 10.0 | 0.9 |
| **1985** | 8.9 | 29.5 | 0.0 | 0.0 | 0.8 | 74.6 | 19.5 | 104.8 | 7.7 | 0.0 | 0.0 | 63.6 | 97.1 | 176.5 | 186.8 | 229.7 | 129.4 | 186.9 | 302.9 |
| **1986** | --- | --- | 0.0 | 0.0 | 0.0 | --- | --- | --- | 284.3 | 666.3 | 0.0 | --- | 48.4 | 609.6 | 183.4 | 271.7 | 1248.7 | 960.3 | 0.0 |
| **1987** | 39.9 | 158.1 | 40.5 | 1.3 | 3.7 | 172.5 | 246.0 | 213.5 | 121.6 | 228.1 | 28.5 | 104.8 | 209.4 | 372.2 | 174.5 | 194.6 | 148.2 | 93.2 | 93.7 |
| **1988** | 378.3 | 56.6 | 0.0 | 0.0 | 0.0 | 221.5 | 227.3 | 117.0 | 4.0 | 0.0 | 0.5 | 508.5 | 121.6 | 108.4 | 167.6 | 528.0 | 65.5 | 0.0 | 0.0 |
| **1989** | 0.4 | 23.9 | 2.8 | 0.0 | 0.0 | 31.0 | 10.0 | 43.8 | 4.5 | 1.4 | 7.5 | 124.8 | 128.5 | 46.6 | 37.8 | 43.1 | 112.7 | 2.3 | 0.0 |
| **1990** | 44.9 | 15.0 | 0.0 | 0.0 | 0.0 | 171.2 | 8.2 | 11.4 | 3.4 | 0.0 | 0.0 | 99.5 | 65.9 | 52.7 | 15.6 | 24.8 | 0.0 | 4.9 | 0.0 |
| **1991** | 61.5 | 4.7 | 0.0 | 0.0 | 0.0 | 110.2 | 14.3 | 0.0 | 2.3 | --- | 0.0 | 135.0 | 125.0 | 135.0 | 8.8 | 16.7 | 4.4 | 450.7 | 0.0 |
| **1992** | 4.0 | 28.6 | 23.7 | 0.0 | 0.0 | 32.2 | 6.1 | 48.3 | 5.1 | 1.7 | 0.0 | 27.4 | 184.9 | 93.6 | 45.0 | 23.6 | 0.9 | 14.0 | 0.6 |
| **1993** | 85.8 | 23.6 | 0.0 | 0.0 | 0.0 | 59.7 | 11.2 | 11.0 | 0.9 | 0.5 | 0.0 | 185.2 | 50.3 | 20.4 | 16.2 | 40.0 | 6.7 | 1.2 | 0.0 |
| **1994** | 3.0 | 27.2 | 0.0 | 0.0 | 0.0 | 8.2 | 6.0 | 4.8 | 0.0 | 0.0 | 0.0 | 56.8 | 1.9 | 22.4 | 9.5 | 0.6 | 0.2 | 0.0 | 0.0 |
| **1996** | 25.6 | 59.2 | 0.2 | 0.0 | 0.0 | 9.7 | 27.4 | 20.3 | 54.4 | 0.0 | 0.0 | 18.3 | 9.5 | 95.4 | 30.4 | 64.2 | 5.0 | 1.1 | 0.0 |
| **1998** | 14.3 | 24.9 | 22.6 | 0.0 | 0.0 | 7.3 | 24.1 | 181.1 | 1.5 | 0.3 | 0.2 | 22.5 | 46.9 | 18.0 | 61.3 | 54.8 | 0.0 | --- | 0.0 |
| **2000** | 2.6 | 3.5 | 0.0 | 0.0 | 0.0 | 5.5 | 4.6 | 0.0 | 0.0 | 0.0 | 0.0 | 40.9 | 8.2 | 37.2 | --- | 1.3 | 0.3 | 0.0 | 0.0 |
| **2002** | 18.4 | 10.4 | 0.9 | 0.0 | 0.0 | 20.8 | 17.7 | 5.4 | 0.2 | 0.0 | 0.0 | 59.9 | 104.9 | 123.0 | 66.0 | 9.2 | 0.8 | 0.0 | 0.0 |
| **2003** | 20.4 | 29.8 | 0.4 | 0.2 | 0.0 | 166.7 | 92.2 | 0.0 | 0.0 | 0.0 | 0.0 | 49.8 | 180.9 | 106.3 | 60.3 | 1.3 | 0.0 | 0.0 | 0.0 |
| **2004** | 36.7 | 7.2 | 0.0 | 0.0 | 0.0 | 4.2 | 18.8 | 1.4 | 0.0 | 0.0 | 0.0 | 154.5 | 13.0 | 20.5 | 9.2 | 0.4 | 0.0 | 0.0 | 0.0 |
| **2005** | 91.0 | 24.2 | 0.6 | --- | --- | 14.9 | 11.2 | 81.2 | 6.3 | 0.2 | 0.0 | 1.5 | 14.1 | 39.4 | 35.3 | 68.6 | 0.0 | 0.0 | 0.0 |
| **2006** | 0.0 | 0.0 | 2.9 | 0.0 | 0.2 | 0.4 | 1.0 | 0.2 | 1.7 | 8.7 | 0.6 | 5.9 | 0.3 | 0.0 | 0.0 | 2.9 | 1.2 | 0.6 | 0.0 |
| **2007** | 2.3 | 1.4 | 5.9 | 0.0 | 0.0 | 2.4 | 1.4 | 0.0 | 0.0 | 0.0 | 0.0 | 69.7 | 0.2 | 20.5 | 11.8 | 8.3 | 0.0 | 0.0 | 0.0 |
| **2008** | 1.3 | --- | --- | --- | --- | 1.9 | 1.1 | 2.2 | 0.0 | 0.2 | 0.0 | 1.0 | 0.2 | 0.7 | 0.0 | 14.9 | 0.1 | 67.8 | 0.0 |
| **2009** | 2.8 | 2.1 | 0.0 | 0.0 | 0.0 | 0.0 | 9.0 | 2.7 | 0.8 | 0.0 | 0.0 | 3.3 | 1.2 | 1.7 | 3.0 | 0.8 | 2.3 | 351.8 | 1.3 |
| **2010** | 3.3 | 3.3 | 0.0 | 0.0 | 0.0 | 1.1 | 7.2 | 0.0 | 0.0 | 0.0 | 0.0 | 3.7 | 0.4 | 4.2 | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 |
| **2011** | --- | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 2.2 | 0.8 | 2.4 | 2.0 | 0.4 | 0.0 | 0.0 | 0.7 |

*Table 1. (Continued).*

| | STATIONS | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **3.9** | **4.1** | **4.2** | **4.3** | **4.4** | **4.5** | **4.6** | **4.7** | **4.8** | **4.9** | **5.1** | **5.2** | **5.3** | **5.4** | **5.5** | **5.6** | **5.7** | **6.1** | **6.2** |
| **STRATE / *STRATUM*** | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 2 |
| **LONGITUDE** | -61.75 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.75 | -62.75 | -62.75 | -62.75 | -62.75 | -62.75 | -62.75 | -63.25 | -63.25 |
| **LATITUDE** | 48.33 | 45.83 | 46.17 | 46.57 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 48.33 | 46.50 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 48.33 | 46.50 | 46.83 |
| **1979** | --- | 22.3 | 16.9 | 132.0 | 130.7 | 188.1 | 938.7 | 1239.3 | 43.3 | --- | 136.1 | 133.8 | 160.0 | 526.6 | 214.9 | 27.3 | 2.8 | 188.7 | 291.7 |
| **1983** | 0.3 | 119.9 | 29.9 | 92.4 | 6.8 | 41.5 | 635.6 | 585.3 | 632.7 | 17.7 | 56.1 | 16.7 | 153.6 | 508.2 | 1493.2 | 74.6 | 24.3 | 10.3 | 133.2 |
| **1984** | 0.0 | 165.8 | 173.6 | 74.8 | 353.0 | 113.2 | 204.4 | 154.6 | 0.0 | 0.4 | 44.0 | 92.5 | 1850.2 | 1224.6 | 1129.7 | 569.9 | 36.6 | 69.9 | 127.2 |
| **1985** | 5.4 | 64.3 | 149.9 | 74.7 | 257.5 | 863.6 | 244.9 | 384.4 | 901.9 | 4.7 | 230.5 | 504.4 | 339.4 | 699.7 | 439.8 | 891.3 | 231.6 | 28.9 | 212.6 |
| **1986** | 0.0 | 264.4 | --- | 505.8 | 453.0 | 404.2 | 689.0 | 1988.1 | 70.3 | 0.0 | 1418.8 | 438.5 | 388.4 | 1159.4 | 2645.8 | 418.9 | 618.9 | 182.0 | 578.6 |
| **1987** | 3.8 | 146.5 | 20.9 | 322.2 | 142.6 | 29.6 | 165.8 | 381.5 | 15.4 | 15.9 | 1.0 | 154.6 | 781.7 | 793.1 | 1928.3 | 239.1 | 46.4 | 3.7 | 205.6 |
| **1988** | 0.0 | --- | --- | 407.6 | --- | 1106.7 | 559.5 | 215.1 | 0.0 | 0.0 | 1385.3 | 1119.0 | 449.1 | 766.3 | 286.2 | 0.5 | 0.6 | 50.0 | 706.4 |
| **1989** | 0.0 | 237.8 | 19.6 | 59.8 | 34.8 | 228.0 | 1418.2 | 5.5 | 6.0 | 0.0 | 16.1 | 38.9 | 203.7 | 1796.5 | 186.9 | 0.0 | 1.1 | 66.0 | 60.6 |
| **1990** | 0.0 | 64.3 | 25.7 | 141.6 | 25.9 | 57.4 | 3.9 | 255.1 | 0.0 | 0.0 | 177.9 | 249.1 | 114.0 | 611.3 | 344.8 | 0.2 | 0.0 | 6.5 | 179.4 |
| **1991** | 0.0 | 106.5 | 299.6 | 595.6 | 23.3 | 24.3 | 329.2 | 1697.4 | 542.2 | 0.0 | 53.2 | 508.4 | 397.7 | 486.0 | 2579.5 | 42.5 | 6.9 | 189.1 | 306.5 |
| **1992** | 0.0 | 2.3 | 7.6 | 664.9 | 149.7 | 187.3 | 277.5 | 88.9 | 22.7 | 0.0 | 1.1 | 189.6 | 288.9 | 174.1 | 363.9 | 1569.5 | 133.8 | 0.0 | 119.4 |
| **1993** | 0.0 | 16.6 | 9.7 | 127.5 | 10.4 | 6.7 | 610.1 | 0.0 | 0.0 | 0.0 | 18.9 | 152.1 | 238.6 | 66.7 | 149.2 | 358.4 | 6.4 | 178.9 | 234.2 |
| **1994** | 0.0 | 7.7 | 18.9 | 77.1 | 9.1 | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 | 75.1 | 138.3 | 3.9 | 1.4 | 321.4 | 0.0 | 0.0 | 129.8 | 937.3 |
| **1996** | 0.0 | 0.8 | 9.0 | 47.6 | 48.4 | 180.7 | 6.7 | 1.1 | 0.0 | 0.0 | 3.1 | 100.0 | 402.6 | 268.3 | 108.8 | 0.0 | 0.0 | 1.3 | 82.0 |
| **1998** | 0.0 | 0.8 | 51.0 | 1.5 | 67.7 | 351.5 | 161.5 | 14.7 | 0.0 | 0.0 | 0.6 | 37.8 | 253.1 | 99.0 | 248.5 | 0.6 | 0.0 | 2.8 | 37.8 |
| **2000** | 0.0 | 3.7 | 9.5 | 40.7 | 0.0 | 2.4 | 0.2 | 0.0 | 0.0 | 0.0 | 23.6 | 28.9 | 334.8 | 0.0 | 0.0 | 0.0 | 0.0 | 24.5 | 74.9 |
| **2002** | 0.0 | 28.9 | 38.7 | 89.0 | 36.0 | 50.1 | 18.9 | 0.2 | 0.0 | 0.0 | 19.2 | 275.6 | 952.9 | 895.6 | 28.1 | --- | 0.0 | 3.2 | 355.6 |
| **2003** | 0.0 | 6.8 | 1077.3 | 413.7 | 205.2 | 1.4 | 0.0 | 0.0 | 0.0 | 0.0 | 209.5 | 456.8 | 36.9 | 0.0 | 0.0 | 0.0 | 0.0 | 677.6 | 601.2 |
| **2004** | 0.0 | 97.7 | 152.2 | 806.2 | 4.3 | 0.3 | 0.0 | 0.0 | 0.2 | 0.0 | 1067.1 | 117.3 | 15.2 | 119.2 | 391.6 | 0.0 | 0.0 | 1009.4 | 928.9 |
| **2005** | 0.0 | 1.0 | 219.4 | 16.0 | 60.6 | 10.8 | 38.5 | 0.5 | 0.0 | 0.0 | 11.1 | 208.8 | 13.5 | 0.1 | 0.0 | 0.2 | 0.0 | 18.3 | 828.9 |
| **2006** | 0.0 | 0.4 | 0.0 | 0.0 | 0.3 | 14.0 | 11.3 | 0.0 | 2.1 | 0.0 | 2.0 | 0.0 | 3.6 | 4.0 | 6.3 | 5.6 | 0.0 | 0.5 | 0.5 |
| **2007** | 0.0 | 0.0 | 2.9 | 95.0 | 1.1 | 0.7 | 20.7 | 0.0 | 35.9 | 0.0 | 2.5 | 135.1 | 34.0 | 479.5 | 465.4 | 28.5 | 0.0 | 108.9 | 54.9 |
| **2008** | --- | 0.5 | 1.2 | 2.7 | 10.3 | 0.4 | 107.5 | 276.1 | 35.0 | --- | 12.4 | 49.3 | 285.5 | 112.0 | --- | 48.6 | --- | 12.3 | 14.7 |
| **2009** | 0.5 | 0.3 | 4.7 | 16.3 | 5.6 | 13.3 | 0.3 | 64.2 | 1.4 | 0.6 | 2.6 | 28.4 | 9.0 | 71.4 | 61.7 | 39.3 | 0.8 | 2.6 | 5.2 |
| **2010** | 0.0 | 1.6 | 15.3 | 29.8 | 3.3 | 0.5 | 121.3 | 0.0 | 0.0 | 0.0 | 30.7 | 8.7 | 8.0 | 2.6 | 98.1 | 1.0 | 0.0 | 13.1 | 11.0 |
| **2011** | 0.0 | 2.6 | 2.4 | 57.7 | 1.2 | 1.6 | 2.2 | 0.0 | 0.0 | 0.0 | 2.6 | 8.1 | 3.2 | 1.5 | 0.9 | 0.4 | 0.0 | 56.9 | 15.4 |

*Table 1. (Continued).*

| | STATIONS | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **6.3** | **6.4** | **6.5** | **6.6** | **6.7** | **7.1** | **7.2** | **7.3** | **7.4** | **7.5** | **7.6** | **7.7** | **8.1** | **8.2** | **8.3** | **8.4** | **8.5** | **8.6** | **8.7** |
| **STRATE / *STRATUM*** | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 3 | 2 | 1 |
| **LONGITUDE** | -63.25 | -63.25 | -63.25 | -63.25 | -63.25 | -63.75 | -63.75 | -63.75 | -63.75 | -63.75 | -63.75 | -63.75 | -64.37 | -64.25 | -64.25 | -64.25 | -64.25 | -64.08 | -64.08 |
| **LATITUDE** | 47.17 | 47.50 | 47.83 | 48.17 | 48.50 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 48.50 | 48.83 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 48.50 | 48.75 |
| **1979** | 333.8 | 143.7 | 87.7 | 17.2 | 9.4 | 418.4 | 400.0 | 326.5 | 36.0 | 18.0 | 12.9 | --- | --- | 637.4 | 617.1 | 314.3 | 42.3 | 34.3 | --- |
| **1983** | 132.6 | 125.0 | 488.0 | 163.6 | 20.3 | 66.3 | 14.9 | 142.5 | 141.7 | 118.1 | 36.7 | 87.2 | 10.3 | 112.7 | 102.2 | 61.6 | 18.2 | 29.7 | 18.3 |
| **1984** | 519.3 | 935.1 | 959.5 | 511.6 | 4.9 | 89.7 | 82.4 | 244.3 | 446.3 | 632.7 | 676.5 | 160.7 | 23.1 | 41.3 | 433.7 | 705.8 | 827.4 | 331.9 | 75.8 |
| **1985** | 228.0 | 1275.4 | 534.3 | 1556.3 | 86.8 | 709.2 | 685.4 | 1243.0 | 1545.1 | 773.5 | 404.2 | 33.6 | 70.3 | --- | 716.1 | 958.1 | 372.6 | 83.8 | 308.3 |
| **1986** | 572.1 | 1040.5 | 1726.2 | 2262.0 | 677.6 | 2834.6 | 1896.4 | 477.0 | 364.0 | 1972.2 | 1508.7 | 20.4 | 147.5 | 716.3 | 1416.9 | 2714.4 | 910.4 | 924.9 | 133.7 |
| **1987** | 126.4 | 584.5 | 898.6 | 642.4 | 342.7 | 27.1 | 226.3 | 673.6 | 1357.2 | 583.1 | 0.8 | 5.5 | 2.8 | 213.4 | 414.7 | 4558.1 | 207.0 | 272.8 | 31.2 |
| **1988** | 1044.6 | 555.4 | 2233.0 | 96.1 | 1.2 | 209.6 | 803.8 | 1726.3 | 351.4 | 610.5 | 297.2 | 0.4 | 14.7 | 1442.9 | 1121.6 | 1414.4 | 3176.1 | 1609.9 | 147.2 |
| **1989** | 124.0 | 561.4 | 29.6 | 65.2 | 54.6 | 49.1 | 208.9 | 673.6 | 661.3 | 1342.5 | 217.2 | 3.9 | 0.0 | 121.9 | 754.6 | 528.4 | 212.5 | 23.6 | 9.2 |
| **1990** | 153.7 | 551.7 | 323.4 | 694.4 | 1.0 | 178.3 | 1231.5 | 404.5 | 647.8 | 157.1 | 2.9 | 13.2 | 2.4 | 524.8 | 501.7 | 1821.9 | 814.3 | 94.2 | 19.5 |
| **1991** | 103.1 | 2684.3 | 2348.0 | 8.9 | 0.0 | 407.4 | 559.5 | 249.5 | 540.1 | 515.3 | 0.0 | 2.1 | 16.7 | 377.6 | 1158.3 | 596.8 | 2284.5 | 94.1 | 431.1 |
| **1992** | 147.7 | 453.6 | 2168.3 | 1271.1 | 0.0 | 239.0 | 151.9 | 1045.7 | 232.5 | 1315.0 | 40.1 | 0.0 | 2.1 | 91.6 | 431.6 | 2183.6 | 1194.2 | 24.9 | 115.1 |
| **1993** | 605.3 | 1261.6 | 2002.5 | 545.3 | 47.1 | 820.6 | 2101.0 | 1208.8 | 344.6 | 159.0 | 2.6 | --- | 157.0 | 2822.2 | 2945.7 | 217.7 | 659.9 | 39.3 | --- |
| **1994** | 96.3 | 2004.5 | 170.8 | 83.0 | 0.0 | 810.0 | 297.8 | 2450.5 | 298.6 | 456.3 | 10.8 | 0.5 | 72.7 | 723.1 | 637.4 | 421.1 | 184.7 | 256.6 | 5.1 |
| **1996** | 422.7 | 114.8 | 27.8 | 0.5 | 0.0 | 88.7 | 31.0 | 38.7 | 79.8 | 154.1 | --- | 0.0 | 1.5 | 11.5 | 397.8 | 54.7 | 247.5 | 35.6 | 0.9 |
| **1998** | 89.9 | 99.2 | 99.3 | 16.2 | 22.5 | 34.5 | 125.5 | 11.6 | 186.2 | 26.4 | 0.0 | 0.0 | 2.6 | 55.3 | 66.1 | 62.2 | 76.5 | 0.3 | 0.0 |
| **2000** | 37.9 | 47.3 | 201.3 | 0.0 | 0.6 | 381.2 | 79.9 | 137.5 | 2093.4 | 23.1 | 0.0 | 0.0 | 0.7 | 45.3 | 40.2 | 79.3 | 150.1 | 0.8 | 0.0 |
| **2002** | 765.4 | 600.0 | 32.7 | 0.0 | 0.0 | 522.7 | 659.0 | 425.6 | 2100.3 | 112.7 | 1.4 | 0.0 | 27.2 | 207.2 | 250.0 | 173.1 | 774.5 | 0.0 | 0.0 |
| **2003** | 896.4 | 115.0 | 0.0 | 0.0 | 0.0 | 674.7 | 1785.6 | 1413.2 | 3.3 | 0.2 | 0.0 | 0.0 | 95.0 | 508.1 | 676.5 | 581.2 | 195.5 | 0.0 | 0.0 |
| **2004** | 300.2 | 0.0 | 130.1 | 2.2 | 0.2 | 1436.4 | 535.3 | 2.5 | 0.0 | 0.0 | 0.0 | 0.1 | --- | 341.3 | 13.6 | 125.9 | 8.4 | 0.0 | 0.2 |
| **2005** | 638.9 | 0.4 | 0.0 | 0.2 | 0.0 | 1205.2 | 433.9 | 36.8 | 12.3 | 0.0 | 0.2 | --- | 24.1 | 26.0 | 711.0 | 126.2 | 8.7 | 0.1 | 0.0 |
| **2006** | 0.6 | 80.3 | 72.9 | 15.3 | 25.6 | 0.1 | 2.1 | 4.4 | 9.5 | 15.2 | 3.5 | 4.6 | 0.7 | 23.9 | 153.8 | 14.5 | 10.1 | 21.4 | 7.9 |
| **2007** | 100.3 | 35.1 | 420.4 | 262.8 | 14.7 | 45.9 | 71.1 | 232.2 | 57.3 | 30.2 | 61.0 | 8.2 | 0.0 | 54.9 | 179.7 | 184.5 | 211.4 | 246.8 | 97.6 |
| **2008** | 199.9 | 93.7 | --- | 513.8 | --- | 45.7 | 113.4 | 397.2 | --- | 86.9 | 11.9 | 0.4 | 5.9 | 85.1 | 314.8 | 723.4 | 109.7 | 7.8 | 4.1 |
| **2009** | 66.4 | 136.8 | 5.7 | 6.7 | 0.0 | 17.5 | 45.8 | 204.8 | 112.8 | 19.8 | 438.2 | 0.7 | 39.3 | 40.2 | 94.9 | 779.1 | 84.3 | --- | --- |
| **2010** | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 29.6 | 8.5 | 90.2 | 2.2 | 5.9 | 0.2 | 0.0 | 58.6 | 39.0 | 66.3 | 1.7 | 0.4 | 127.3 | 3.2 |
| **2011** | 16.3 | 0.8 | 0.7 | 4.1 | 0.3 | 47.1 | 5.6 | 1.7 | 85.3 | 25.7 | 28.2 | 19.7 | 1.9 | 135.4 | 209.2 | 53.8 | 6.9 | 42.3 | 37.2 |

*Table 1. (Continued).*

| | STATIONS | | | | | | | | STATISTIQUES / *STATISTICS* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **9.1** | **9.2** | **9.3** | **9.4** | **9.5** | **10.1** | **11.1** | **12.1** | | | | | | |
| **STRATE / *STRATUM*** | 1 | 1 | 2 | 2 | 3 | 2 | 3 | 3 | **Moyenne / *Mean*** | **É.-T. / *STD*** | **Min.** | **Max.** | **Étendue / *Range*** | **n** |
| **LONGITUDE** | -64.67 | -64.75 | -64.67 | -64.75 | -64.75 | -65.25 | -65.75 | -66.13 | | | | | | |
| **LATITUDE** | 46.83 | 47.17 | 47.50 | 47.93 | 48.17 | 47.93 | 48.00 | 48.05 | | | | | | |
| **1979** | --- | 13.3 | 344.5 | 151.5 | 172.7 | 193.3 | 604.7 | 1736.0 | 207.3 | 313.3 | 0.0 | 1736.0 | 1736.0 | 59 |
| **1983** | 76.6 | 22.7 | 49.2 | 25.7 | 40.4 | 8.5 | 111.8 | 1.2 | 120.4 | 228.2 | 0.3 | 1493.2 | 1492.9 | 64 |
| **1984** | 161.6 | 144.7 | 292.4 | 780.9 | 128.6 | 923.5 | 334.3 | 241.1 | 276.2 | 369.8 | 0.0 | 1850.2 | 1850.2 | 65 |
| **1985** | 11.7 | 6.3 | 522.0 | 684.3 | 1458.0 | 676.7 | 1261.6 | 493.2 | 388.2 | 425.6 | 0.0 | 1556.3 | 1556.3 | 64 |
| **1986** | 196.6 | 237.4 | 1105.0 | 771.4 | 1041.1 | 425.8 | 622.9 | 1181.9 | 765.4 | 737.0 | 0.0 | 2834.6 | 2834.6 | 58 |
| **1987** | 39.9 | 17.9 | 151.1 | 1120.1 | 1154.3 | 182.9 | 1175.7 | 632.6 | 364.4 | 652.3 | 0.8 | 4558.1 | 4557.3 | 65 |
| **1988** | 20.4 | 574.6 | 433.5 | 972.0 | 1261.5 | 159.0 | 858.4 | 25.2 | 495.4 | 633.0 | 0.0 | 3176.1 | 3176.1 | 62 |
| **1989** | 0.0 | 48.7 | 648.5 | 53.3 | 451.4 | 221.9 | 1054.8 | 4.6 | 201.9 | 368.0 | 0.0 | 1796.5 | 1796.5 | 65 |
| **1990** | 128.6 | 355.7 | 722.5 | 35.2 | 2411.7 | 683.1 | 1069.6 | 160.3 | 253.5 | 438.5 | 0.0 | 2411.7 | 2411.7 | 65 |
| **1991** | 248.3 | 695.2 | 1089.5 | 222.0 | 1990.8 | 95.0 | 866.1 | 54.3 | 420.2 | 663.6 | 0.0 | 2684.3 | 2684.3 | 64 |
| **1992** | 21.3 | 74.7 | 441.1 | 331.3 | 1834.5 | 1537.5 | 1314.7 | 77.8 | 331.1 | 558.6 | 0.0 | 2183.6 | 2183.6 | 65 |
| **1993** | 692.8 | 669.6 | 1399.4 | 362.6 | 950.1 | 212.1 | 395.3 | 236.1 | 373.9 | 650.6 | 0.0 | 2945.7 | 2945.7 | 63 |
| **1994** | 307.7 | 114.1 | 128.6 | 24.8 | 366.6 | 160.3 | 176.9 | 539.6 | 194.8 | 423.9 | 0.0 | 2450.5 | 2450.5 | 65 |
| **1996** | 2.1 | 0.9 | 49.5 | 1.3 | 132.2 | 98.3 | 52.8 | 1.9 | 58.2 | 97.2 | 0.0 | 422.7 | 422.7 | 64 |
| **1998** | 1.8 | 2.2 | 199.2 | 1.5 | 38.2 | 1.3 | 119.0 | 21.8 | 49.5 | 73.2 | 0.0 | 351.5 | 351.5 | 64 |
| **2000** | 82.7 | 12.4 | 153.2 | 21.0 | 50.9 | 30.8 | 100.4 | 1.4 | 69.0 | 267.1 | 0.0 | 2093.4 | 2093.4 | 64 |
| **2002** | 32.1 | 245.5 | 352.7 | 0.0 | 50.2 | 8.3 | 37.8 | 1.4 | 165.8 | 342.5 | 0.0 | 2100.3 | 2100.3 | 64 |
| **2003** | 225.8 | 140.1 | 593.2 | 134.1 | 10.6 | 7.6 | 375.8 | 23.2 | 197.7 | 356.6 | 0.0 | 1785.6 | 1785.6 | 65 |
| **2004** | 1215.7 | 539.1 | 1117.4 | 68.7 | 0.8 | 2.0 | 214.1 | 4.7 | 172.4 | 348.8 | 0.0 | 1436.4 | 1436.4 | 64 |
| **2005** | 254.3 | 429.8 | 765.9 | 0.4 | 0.0 | 1.8 | 15.0 | --- | 106.7 | 242.3 | 0.0 | 1205.2 | 1205.2 | 61 |
| **2006** | 20.7 | 11.3 | 17.8 | 13.1 | 2.6 | 11.4 | 9.6 | --- | 9.8 | 23.1 | 0.0 | 153.8 | 153.8 | 64 |
| **2007** | 1.4 | 6.5 | 38.2 | 22.6 | 1165.3 | 550.2 | 35.9 | 2.1 | 88.1 | 184.1 | 0.0 | 1165.3 | 1165.3 | 65 |
| **2008** | 87.2 | 75.1 | 151.5 | 0.5 | 785.1 | 113.3 | 63.3 | --- | 95.3 | 170.8 | 0.0 | 785.1 | 785.1 | 53 |
| **2009** | 83.1 | 74.7 | 407.7 | 75.3 | 13.0 | 49.2 | 22.4 | 2.1 | 56.1 | 128.8 | 0.0 | 779.1 | 779.1 | 63 |
| **2010** | 1.0 | 79.4 | 71.2 | 2.4 | 265.3 | 10.4 | 62.4 | 2.5 | 20.0 | 43.6 | 0.0 | 265.3 | 265.3 | 65 |
| **2011** | 1.5 | 197.2 | 775.8 | 1.3 | 31.4 | 24.3 | 25.0 | 2.6 | 30.0 | 102.4 | 0.0 | 775.8 | 775.8 | 65 |

*Table 2. Mean temperature (°C) of the first 10 meters of water for the stations of the egg surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2011.*

| | STATIONS | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1.1** | **1.2** | **1.3** | **1.4** | **1.5** | **2.1** | **2.2** | **2.3** | **2.4** | **2.5** | **2.6** | **3.1** | **3.2** | **3.3** | **3.4** | **3.5** | **3.6** | **3.7** | **3.8** |
| **STRATE / *STRATUM*** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 |
| **LONGITUDE** | -60.92 | -60.75 | -60.75 | -60.75 | -60.75 | -61.25 | -61.25 | -61.25 | -61.25 | -61.25 | -61.25 | -61.77 | -61.75 | -61.75 | -61.75 | -61.75 | -61.83 | -61.75 | -61.75 |
| **LATITUDE** | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 46.50 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 45.83 | 46.17 | 46.50 | 46.83 | 47.17 | 47.58 | 47.83 | 48.17 |
| **1979** | 12.4 | 11.5 | 10.2 | 9.0 | 8.8 | 12.2 | 12.2 | 10.2 | 10.9 | 9.8 | 9.6 | 11.5 | 12.7 | 11.8 | 11.5 | 9.8 | 10.9 | 10.6 | 10.6 |
| **1983** | 16.8 | 14.2 | 12.5 | 11.6 | 11.0 | 15.1 | 14.8 | 13.8 | 12.6 | 13.0 | 12.4 | 15.8 | 15.2 | 16.0 | 16.3 | 14.4 | 14.3 | --- | 13.1 |
| **1984** | 10.4 | 11.0 | 7.8 | 7.5 | 7.0 | 10.5 | 10.5 | 13.0 | 11.6 | 8.0 | 6.5 | 12.0 | 12.0 | 11.9 | 10.7 | 9.0 | 8.3 | 7.4 | 10.3 |
| **1985** | 9.8 | 9.7 | 6.1 | 7.9 | 8.0 | 13.0 | 9.6 | 10.3 | 8.1 | 6.6 | 8.3 | 12.3 | 12.4 | 11.3 | 11.9 | 9.1 | 10.0 | 10.1 | 10.7 |
| **1986** | --- | --- | --- | 9.0 | 9.0 | --- | --- | --- | 10.5 | 9.0 | 9.0 | --- | 13.5 | 12.0 | 12.0 | 10.5 | 9.5 | 10.0 | 9.0 |
| **1987** | 11.7 | 11.0 | 11.3 | 11.2 | 10.7 | 11.9 | 11.6 | 12.4 | 11.8 | 13.2 | 11.6 | 12.4 | 12.0 | 12.3 | 11.1 | 11.5 | 10.1 | 10.3 | 9.7 |
| **1988** | 10.7 | 8.7 | 7.3 | 6.9 | 6.4 | 11.1 | 9.0 | 8.2 | 7.8 | 6.1 | 6.8 | 12.8 | 10.4 | 10.8 | 9.3 | 9.0 | 8.7 | 8.1 | 7.0 |
| **1989** | 10.9 | 10.9 | 10.3 | 8.7 | 8.3 | 11.8 | 11.0 | 11.5 | 10.5 | 7.3 | 8.8 | 13.6 | 12.9 | 11.7 | 12.2 | 11.3 | 10.9 | 9.4 | 9.6 |
| **1990** | 11.0 | 9.0 | 7.2 | 7.1 | 6.9 | 11.0 | 9.9 | 9.7 | 7.6 | 8.5 | 8.5 | 12.9 | 12.5 | 10.8 | 10.3 | 9.8 | 8.6 | 8.7 | 8.2 |
| **1991** | 10.1 | 8.3 | 7.7 | 6.7 | 6.7 | 10.5 | 7.8 | 8.0 | 8.2 | --- | 6.3 | 10.7 | 10.6 | 9.1 | 7.6 | 9.3 | 9.1 | 9.3 | 5.5 |
| **1992** | 11.8 | 8.0 | 8.7 | 8.3 | 7.4 | 12.2 | 10.4 | 9.3 | 8.4 | 7.6 | 8.2 | 12.6 | 11.8 | 11.2 | 10.8 | 10.5 | 10.3 | 9.6 | 8.7 |
| **1993** | 10.7 | 8.3 | 7.1 | 5.8 | 5.8 | 11.3 | 9.2 | 7.5 | 6.8 | 5.1 | 5.6 | 12.5 | 10.3 | 11.3 | 9.8 | 8.9 | 8.9 | 7.4 | 8.7 |
| **1994** | 10.2 | 6.9 | 6.0 | 5.6 | 5.4 | 8.5 | 6.7 | 6.5 | 7.4 | 6.3 | 5.3 | 11.0 | 8.6 | 9.3 | 7.1 | 5.9 | 7.3 | 5.9 | 5.5 |
| **1996** | 12.9 | 11.0 | 8.3 | 7.9 | 7.4 | 12.7 | 11.5 | 9.7 | 9.9 | 9.1 | 9.3 | 13.2 | 12.4 | 12.2 | 10.5 | 10.6 | 11.3 | 10.8 | 9.4 |
| **1998** | 11.7 | 10.2 | 9.2 | 8.5 | 7.8 | 10.8 | 10.1 | 10.5 | 8.4 | 8.3 | 9.1 | 11.2 | 11.1 | 10.7 | 11.5 | 11.0 | 11.2 | 10.6 | 9.1 |
| **2000** | 10.9 | 7.7 | 7.3 | 7.4 | 7.6 | 11.6 | 10.1 | 8.9 | 8.0 | 7.9 | 7.9 | 12.8 | 12.3 | 11.1 | 9.8 | 10.1 | 10.5 | 10.1 | 7.8 |
| **2002** | 9.2 | 8.5 | 6.5 | 6.6 | 6.0 | 10.7 | 9.9 | 8.6 | 8.0 | 6.6 | 6.9 | 11.4 | 11.0 | 10.6 | 10.5 | 8.2 | 7.2 | 7.3 | 7.4 |
| **2003** | 10.4 | 8.0 | 7.0 | 5.8 | 7.1 | 9.9 | 9.3 | 7.3 | 7.7 | 7.0 | 6.8 | 11.0 | 11.2 | 9.7 | 9.5 | 7.4 | 8.2 | 7.8 | 6.9 |
| **2004** | 9.2 | 7.1 | 7.0 | 7.0 | 6.7 | 9.6 | 6.7 | 7.7 | 7.0 | 7.0 | 6.6 | 11.1 | 9.8 | 9.1 | 7.9 | 7.6 | 8.4 | 7.5 | 6.6 |
| **2005** | 9.7 | 7.5 | 7.7 | --- | --- | 10.2 | 8.6 | 7.5 | 7.3 | 6.9 | 7.7 | 10.4 | 9.7 | 9.8 | 9.2 | 7.3 | 8.7 | 8.5 | 7.7 |
| **2006** | 15.7 | 13.2 | 13.1 | 12.3 | 12.1 | 15.6 | --- | 14.1 | 14.9 | 14.1 | 12.9 | 15.9 | 15.0 | 15.8 | 15.1 | 14.8 | 15.3 | 14.5 | 14.5 |
| **2007** | 12.6 | 12.4 | 9.9 | 9.6 | 11.1 | 13.4 | 13.1 | 10.3 | 9.8 | 9.0 | 10.4 | 13.3 | 12.1 | 13.2 | 10.8 | 12.5 | 11.0 | 9.5 | 12.4 |
| **2008** | 14.3 | --- | --- | --- | --- | 15.3 | 13.2 | 11.2 | 9.5 | 9.7 | 10.8 | 14.7 | 14.4 | 14.3 | 12.9 | 11.3 | 11.4 | 11.8 | 10.3 |
| **2009** | 11.5 | 10.0 | 9.4 | 8.9 | 9.4 | 12.1 | 9.7 | 9.7 | 9.5 | 10.0 | 8.9 | 12.4 | 12.1 | 10.5 | 11.8 | 10.4 | 11.5 | 11.5 | 11.2 |
| **2010** | 10.8 | 8.6 | 6.3 | 7.1 | 6.6 | 10.7 | 9.9 | 7.9 | 7.0 | 7.9 | 7.2 | 12.4 | 11.1 | 10.6 | 8.6 | 7.7 | 8.5 | 8.2 | 6.9 |
| **2011** | --- | 6.0 | 7.7 | 8.2 | 8.0 | 9.9 | 9.3 | 8.0 | 7.8 | 6.1 | 8.6 | 10.4 | 10.2 | 9.1 | 8.5 | 8.4 | 8.2 | 9.0 | 10.1 |

*Table 2. (Continued).*

| | STATIONS | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **3.9** | **4.1** | **4.2** | **4.3** | **4.4** | **4.5** | **4.6** | **4.7** | **4.8** | **4.9** | **5.1** | **5.2** | **5.3** | **5.4** | **5.5** | **5.6** | **5.7** | **6.1** | **6.2** |
| **STRATE / *STRATUM*** | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 2 |
| **LONGITUDE** | -61.75 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.75 | -62.75 | -62.75 | -62.75 | -62.75 | -62.75 | -62.75 | -63.25 | -63.25 |
| **LATITUDE** | 48.33 | 45.83 | 46.17 | 46.57 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 48.33 | 46.50 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 48.33 | 46.50 | 46.83 |
| **1979** | --- | 11.9 | 11.9 | 13.5 | 13.0 | 11.4 | 12.0 | 12.4 | 11.4 | --- | 14.1 | 13.2 | 12.1 | 11.9 | 12.2 | 11.4 | 10.6 | 14.0 | 15.0 |
| **1983** | 11.1 | 17.3 | 16.3 | 15.8 | 16.6 | 14.6 | 14.6 | 14.2 | 15.4 | 12.8 | 15.5 | 15.9 | 15.0 | 15.2 | 13.4 | 11.0 | 11.4 | 15.3 | 14.1 |
| **1984** | 10.3 | 12.2 | 11.7 | 11.6 | 9.9 | 9.0 | 8.2 | 6.3 | 9.0 | 9.6 | 13.0 | 11.0 | 10.5 | 9.5 | 9.0 | 11.0 | 10.3 | 12.5 | 11.9 |
| **1985** | 10.8 | 12.7 | 10.8 | 12.9 | 11.5 | 10.5 | 9.5 | 10.2 | 11.0 | 11.6 | 12.6 | 10.9 | 10.3 | 10.4 | 11.5 | 12.7 | 12.0 | 11.5 | 10.1 |
| **1986** | 9.0 | 13.5 | --- | 13.0 | 12.0 | 11.0 | 11.0 | 11.0 | 9.0 | 9.0 | 13.0 | 12.0 | 12.5 | 11.0 | 11.0 | 11.0 | 11.0 | 12.5 | 12.5 |
| **1987** | 9.4 | 12.1 | 12.4 | 13.1 | 12.8 | 8.6 | 10.7 | 10.8 | 10.0 | 9.7 | 13.4 | 13.3 | 11.8 | 11.8 | 11.6 | 9.8 | 9.2 | 13.1 | 13.1 |
| **1988** | 7.0 | 12.1 | 9.8 | 11.5 | 9.9 | 9.4 | 9.2 | 8.7 | 7.5 | 7.3 | 12.1 | 10.9 | 9.5 | 8.8 | 9.3 | 7.4 | 7.9 | 12.4 | 10.7 |
| **1989** | 9.5 | 11.7 | 11.5 | 13.7 | 9.9 | 11.6 | 10.4 | 9.9 | 9.5 | 9.9 | 13.3 | 12.6 | 12.5 | 12.4 | 10.3 | 10.3 | 9.1 | 13.6 | 14.3 |
| **1990** | 8.8 | 12.2 | 11.4 | 12.3 | 10.3 | 9.0 | 8.6 | 9.6 | 8.7 | 9.0 | 12.8 | 11.0 | 9.4 | 10.6 | 9.5 | 9.5 | 8.3 | 10.9 | 11.1 |
| **1991** | 6.0 | 11.9 | 10.7 | 12.3 | 8.2 | 8.1 | 8.1 | 10.3 | 8.6 | 5.4 | 12.1 | 9.5 | 9.5 | 9.8 | 11.3 | 7.6 | 5.8 | 11.6 | 9.8 |
| **1992** | 7.3 | 9.7 | 11.8 | 13.7 | 13.1 | 10.7 | 11.0 | 9.3 | 8.6 | 8.4 | 13.7 | 12.4 | 11.5 | 12.1 | 9.9 | 11.1 | 10.5 | 13.0 | 12.8 |
| **1993** | 7.1 | 11.4 | 10.2 | 10.9 | 10.0 | 9.5 | 9.8 | 9.1 | 8.6 | 7.9 | 12.5 | 10.3 | 10.0 | 8.2 | 9.1 | 8.1 | 9.0 | 12.4 | 11.6 |
| **1994** | 5.2 | 10.6 | 9.1 | 10.0 | 8.4 | 7.7 | 6.9 | 6.8 | 7.0 | 7.2 | 10.8 | 9.8 | 8.1 | 7.9 | 9.2 | 9.8 | 9.1 | 11.1 | 9.8 |
| **1996** | 9.4 | 11.9 | 12.5 | 13.4 | 11.0 | 10.4 | 10.8 | 11.1 | 9.2 | 8.1 | 14.8 | 12.1 | 11.0 | 11.4 | 11.4 | 11.0 | 10.7 | 14.9 | 12.5 |
| **1998** | 8.8 | 11.0 | 11.0 | 10.4 | 12.3 | 12.3 | 11.8 | 10.8 | 10.4 | 9.8 | 9.0 | 11.9 | 12.1 | 11.2 | 11.8 | 11.1 | 10.4 | 9.8 | 10.1 |
| **2000** | 8.6 | 13.9 | 12.8 | 12.5 | 11.0 | 10.9 | 11.3 | 9.9 | 8.7 | 8.0 | 13.0 | 11.3 | 12.6 | 11.3 | 11.1 | 10.0 | 9.3 | 13.5 | 12.5 |
| **2002** | 6.6 | 10.4 | 10.2 | 11.2 | 10.2 | 9.2 | 8.6 | 8.2 | 7.7 | 6.3 | 10.5 | 11.6 | 9.5 | 9.1 | 8.7 | --- | 6.9 | 11.3 | 11.8 |
| **2003** | 6.3 | 10.4 | 10.9 | 10.6 | 9.1 | 8.1 | 8.1 | 7.9 | 7.7 | 7.6 | 11.4 | 11.1 | 8.1 | 8.6 | 9.2 | 9.1 | 6.9 | 11.9 | 12.7 |
| **2004** | 6.6 | 9.2 | 9.7 | 10.0 | 8.8 | 7.0 | 8.1 | 8.2 | 7.4 | 7.0 | 10.1 | 9.4 | 8.6 | 9.1 | 8.5 | 7.9 | 7.9 | 9.9 | 9.5 |
| **2005** | 8.0 | 7.7 | 10.1 | 7.0 | 10.0 | 7.5 | 8.3 | 8.3 | 8.5 | 8.8 | 6.3 | 9.5 | 7.9 | 6.7 | 8.3 | 8.9 | 9.3 | 6.4 | 9.7 |
| **2006** | 14.3 | 14.9 | 15.5 | 16.4 | 15.7 | 13.1 | 13.1 | 14.1 | 14.9 | 14.7 | 16.7 | 14.9 | 13.4 | 14.2 | 13.0 | 13.7 | 14.8 | 15.7 | 15.0 |
| **2007** | 10.0 | 12.3 | 12.4 | 12.2 | 10.2 | 9.6 | 9.1 | 11.2 | 11.6 | 11.2 | 13.2 | 10.7 | 10.7 | 11.2 | 12.1 | 11.0 | 11.1 | 13.7 | 11.3 |
| **2008** | --- | 13.9 | 14.1 | 14.6 | 12.0 | 8.9 | 11.9 | 12.1 | 11.4 | --- | 14.6 | 12.8 | 12.9 | 12.2 | --- | 11.9 | --- | 15.2 | 13.7 |
| **2009** | 11.5 | 12.2 | 12.7 | 11.4 | 11.6 | 9.0 | 9.1 | 11.1 | 10.8 | 9.6 | 11.4 | 10.5 | 9.7 | 9.4 | 11.4 | 9.9 | 10.7 | 11.3 | 11.6 |
| **2010** | 7.3 | 11.8 | 11.8 | 11.3 | 9.7 | 7.8 | 9.4 | 7.0 | 7.2 | 7.7 | 11.5 | 10.3 | 8.9 | 9.1 | 9.2 | 7.2 | 8.0 | 10.3 | 9.2 |
| **2011** | 9.1 | 10.3 | 9.3 | 11.0 | 8.4 | 8.5 | 8.2 | 9.7 | 10.2 | 7.5 | 10.7 | 9.2 | 9.1 | 9.4 | 10.5 | 9.8 | 10.4 | 11.0 | 9.7 |

*Table 2. (Continued).*

| | STATIONS | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **6.3** | **6.4** | **6.5** | **6.6** | **6.7** | **7.1** | **7.2** | **7.3** | **7.4** | **7.5** | **7.6** | **7.7** | **8.1** | **8.2** | **8.3** | **8.4** | **8.5** | **8.6** | **8.7** |
| **STRATE / *STRATUM*** | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 3 | 2 | 1 |
| **LONGITUDE** | -63.25 | -63.25 | -63.25 | -63.25 | -63.25 | -63.75 | -63.75 | -63.75 | -63.75 | -63.75 | -63.75 | -63.75 | -64.37 | -64.25 | -64.25 | -64.25 | -64.25 | -64.08 | -64.08 |
| **LATITUDE** | 47.17 | 47.50 | 47.83 | 48.17 | 48.50 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 48.50 | 48.83 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 48.50 | 48.75 |
| **1979** | 13.2 | 15.0 | 12.2 | 10.5 | 10.5 | 15.0 | 13.9 | 15.2 | 13.4 | 10.7 | 11.1 | --- | --- | 14.7 | 12.0 | 11.9 | 9.6 | 10.5 | --- |
| **1983** | 14.0 | 15.0 | 12.5 | 13.0 | 11.2 | 13.8 | 14.4 | 13.1 | 12.0 | 12.3 | 11.5 | 12.3 | 15.1 | 13.7 | 13.2 | 12.4 | 13.4 | 11.6 | 13.8 |
| **1984** | 12.0 | 10.1 | 9.0 | 10.2 | 10.8 | 12.8 | 12.3 | 11.2 | 11.7 | 11.1 | 11.9 | 10.5 | 13.2 | 13.6 | 11.0 | 11.5 | 12.9 | 11.2 | 11.5 |
| **1985** | 10.6 | 11.9 | 11.5 | 11.7 | 12.5 | 12.6 | 12.3 | 12.0 | 11.2 | 11.8 | 14.7 | 9.9 | 13.3 | --- | 11.6 | 10.9 | 10.7 | 12.1 | 10.3 |
| **1986** | 12.0 | 12.0 | 12.0 | 11.0 | 10.0 | 13.5 | 12.5 | 12.5 | 12.0 | 11.5 | 8.5 | 9.0 | 14.0 | 13.0 | 13.0 | 13.0 | 11.0 | 11.0 | 9.0 |
| **1987** | 12.3 | 12.5 | 12.4 | 10.3 | 10.2 | 12.9 | 12.6 | 12.5 | 11.6 | 10.6 | 9.6 | 9.0 | 12.1 | 13.1 | 11.8 | 11.7 | 9.9 | 9.9 | 9.2 |
| **1988** | 10.6 | 10.1 | 9.7 | 8.0 | 7.9 | 11.1 | 11.9 | 9.9 | 12.5 | 7.6 | 8.7 | 7.8 | 12.9 | 11.4 | 12.2 | 10.9 | 10.5 | 9.4 | 8.7 |
| **1989** | 12.9 | 11.3 | 11.7 | 10.1 | 10.2 | 14.0 | 13.9 | 12.8 | 10.8 | 12.3 | 8.5 | 9.4 | 12.7 | 14.0 | 12.7 | 13.3 | 12.3 | 7.3 | 9.8 |
| **1990** | 10.3 | 10.3 | 9.1 | 9.6 | 8.6 | 13.0 | 12.2 | 10.8 | 10.2 | 8.0 | 9.1 | 7.5 | 12.1 | 12.4 | 10.7 | 9.2 | 9.1 | 9.2 | 9.5 |
| **1991** | 9.7 | 10.4 | 11.1 | 7.8 | 5.7 | --- | 11.0 | 11.2 | 10.8 | 10.9 | 6.4 | 7.4 | 13.4 | 12.3 | 11.4 | 11.1 | 12.2 | 11.9 | 13.0 |
| **1992** | 12.4 | 11.7 | 11.5 | 9.8 | 7.4 | 12.8 | 13.5 | 13.3 | 13.3 | 12.2 | 9.9 | 9.4 | 14.3 | 13.8 | 13.5 | 12.0 | 13.0 | 9.5 | 10.2 |
| **1993** | 10.7 | 8.9 | 10.9 | 10.3 | 9.0 | 12.5 | 10.6 | 11.2 | 10.0 | 10.5 | 8.0 | --- | 13.5 | 12.1 | 10.5 | 9.8 | 9.4 | 9.0 | --- |
| **1994** | 9.7 | 9.6 | 9.3 | 10.2 | 10.3 | 10.9 | 10.6 | 10.7 | 9.7 | 10.2 | 9.7 | 9.5 | 10.6 | 11.0 | 10.3 | 9.8 | 10.7 | 12.0 | 11.4 |
| **1996** | 13.1 | 11.5 | 11.3 | 10.4 | 10.7 | 14.0 | 13.3 | 11.8 | 11.8 | 11.2 | 10.4 | 8.7 | 12.6 | 13.4 | 13.4 | 11.6 | 10.8 | 10.1 | 10.5 |
| **1998** | 11.7 | 11.8 | 11.6 | 10.5 | 11.4 | 11.2 | 11.8 | 11.6 | 11.8 | 10.5 | 10.5 | 9.5 | 12.3 | 11.0 | 10.9 | 10.3 | 10.8 | 8.3 | 6.8 |
| **2000** | 12.2 | 11.1 | 11.0 | 10.5 | 10.1 | 11.7 | 11.9 | 11.4 | 11.8 | 11.0 | 10.2 | 10.9 | 13.2 | 12.7 | 11.8 | 13.7 | 12.6 | 10.9 | 10.7 |
| **2002** | 9.6 | 9.7 | 8.9 | 7.7 | 7.7 | 12.1 | 10.8 | 11.5 | 11.2 | 10.2 | 8.4 | 6.5 | 12.3 | 11.0 | 11.5 | 10.8 | 10.2 | 7.8 | 8.2 |
| **2003** | 8.8 | 10.1 | 8.8 | 9.8 | 8.7 | 12.1 | 12.0 | 12.1 | 11.4 | 10.9 | 8.8 | 7.8 | 13.0 | 12.5 | 11.6 | 11.3 | 11.0 | 8.1 | 9.0 |
| **2004** | 8.9 | 8.5 | 9.0 | 8.6 | 7.6 | 10.1 | 9.3 | 9.2 | 7.8 | 7.4 | 7.6 | 8.5 | --- | 9.7 | 9.0 | 8.6 | 8.3 | 7.6 | 7.5 |
| **2005** | 9.8 | 7.6 | 8.3 | 8.6 | 9.1 | 10.1 | 9.2 | 7.7 | 9.3 | 9.3 | 9.8 | --- | 10.7 | 9.0 | 9.5 | 9.2 | 10.1 | 7.6 | 8.7 |
| **2006** | 15.2 | 14.6 | 12.4 | 13.5 | 13.3 | 14.9 | 15.2 | 15.1 | 14.3 | 12.4 | 14.7 | 14.1 | 14.8 | 13.5 | 14.8 | 12.4 | 9.6 | 14.0 | 12.6 |
| **2007** | 10.7 | 10.4 | 11.5 | 11.7 | 11.5 | 12.2 | 12.1 | 11.3 | 13.1 | 11.4 | 11.7 | 12.3 | 14.2 | 13.3 | 11.7 | 10.7 | 11.0 | 11.7 | 10.3 |
| **2008** | 13.3 | 11.8 | --- | 12.4 | --- | 13.2 | 14.4 | 12.6 | --- | 11.6 | 11.2 | 11.0 | 15.6 | 15.1 | 11.1 | 11.5 | 10.6 | 10.9 | 10.5 |
| **2009** | 10.3 | 12.2 | 12.2 | 10.1 | 10.0 | 12.4 | 11.9 | 11.0 | 11.8 | 11.4 | 11.8 | 8.8 | 12.4 | 11.6 | 10.1 | 10.2 | 9.4 | --- | --- |
| **2010** | 8.2 | 9.5 | 7.1 | 8.3 | 7.9 | 11.2 | 10.6 | 10.5 | 9.8 | 7.5 | 7.6 | 7.9 | 11.7 | 11.2 | 10.2 | 9.7 | 8.5 | 10.7 | 9.7 |
| **2011** | 9.1 | 9.0 | 10.4 | 9.8 | 9.7 | 9.7 | 9.4 | 8.8 | 11.3 | 9.2 | 9.7 | 7.3 | 10.4 | 11.4 | 11.1 | 9.6 | 8.8 | 9.4 | 7.9 |

*Table 2. (Continued).*

| | STATIONS | | | | | | | | STATISTIQUES / *STATISTICS* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **9.1** | **9.2** | **9.3** | **9.4** | **9.5** | **10.1** | **11.1** | **12.1** | | | | | | |
| **STRATE / *STRATUM*** | 1 | 1 | 2 | 2 | 3 | 2 | 3 | 3 | **Moyenne / *Mean*** | **É.-T. / *STD*** | **Min.** | **Max.** | **Étendue / *Range*** | **n** |
| **LONGITUDE** | -64.67 | -64.75 | -64.67 | -64.75 | -64.75 | -65.25 | -65.75 | -66.13 | | | | | | |
| **LATITUDE** | 46.83 | 47.17 | 47.50 | 47.93 | 48.17 | 47.93 | 48.00 | 48.05 | | | | | | |
| **1979** | --- | 12.6 | 12.2 | 12.7 | 12.5 | 11.9 | 12.5 | 14.2 | 12.0 | 1.5 | 8.8 | 15.2 | 6.4 | 59 |
| **1983** | 16.2 | 14.3 | 14.2 | 15.6 | 14.6 | 15.0 | 14.3 | 13.9 | 14.0 | 1.6 | 11.0 | 17.3 | 6.3 | 64 |
| **1984** | 13.0 | 12.0 | 12.0 | 13.3 | 13.0 | 13.7 | 12.0 | 13.3 | 10.8 | 1.8 | 6.3 | 13.7 | 7.4 | 65 |
| **1985** | 12.1 | 11.9 | 12.3 | 11.9 | 11.6 | 12.8 | 12.4 | 13.8 | 11.1 | 1.6 | 6.1 | 14.7 | 8.6 | 64 |
| **1986** | 14.5 | 14.5 | 14.0 | 12.0 | 13.0 | 12.0 | 14.0 | 14.0 | 11.5 | 1.7 | 8.5 | 14.5 | 6.0 | 57 |
| **1987** | 14.1 | 13.4 | 12.0 | 12.0 | 10.3 | 11.1 | 11.4 | 11.5 | 11.5 | 1.3 | 8.6 | 14.1 | 5.5 | 65 |
| **1988** | 12.1 | 12.3 | 10.6 | 13.6 | 10.7 | 10.6 | 11.7 | 10.5 | 9.7 | 1.9 | 6.1 | 13.6 | 7.5 | 65 |
| **1989** | 15.6 | 12.9 | 11.7 | 15.0 | 12.4 | 11.4 | 11.3 | 10.2 | 11.3 | 1.8 | 7.3 | 15.6 | 8.3 | 65 |
| **1990** | 11.8 | 11.7 | 10.9 | 7.3 | 8.2 | 11.2 | 13.1 | 12.8 | 10.0 | 1.6 | 6.9 | 13.1 | 6.2 | 65 |
| **1991** | 15.1 | 13.8 | 12.5 | 15.9 | 12.3 | 9.5 | 12.5 | 12.1 | 9.8 | 2.4 | 5.4 | 15.9 | 10.5 | 63 |
| **1992** | 14.0 | 14.6 | 12.5 | 13.1 | 11.9 | 13.5 | 12.9 | 13.3 | 11.2 | 2.0 | 7.3 | 14.6 | 7.3 | 65 |
| **1993** | 13.5 | 11.1 | 10.5 | 12.7 | 9.3 | 9.2 | 12.4 | 10.7 | 9.7 | 1.9 | 5.1 | 13.5 | 8.4 | 63 |
| **1994** | 11.9 | 11.7 | 12.1 | 10.3 | 10.1 | 11.2 | 10.5 | 10.6 | 9.0 | 2.0 | 5.2 | 12.1 | 6.9 | 65 |
| **1996** | 13.9 | 14.2 | 12.5 | 8.9 | 9.4 | 9.7 | 10.5 | 10.4 | 11.2 | 1.7 | 7.4 | 14.9 | 7.5 | 65 |
| **1998** | 12.4 | 10.9 | 11.1 | 9.1 | 12.0 | 9.0 | 12.4 | 12.0 | 10.6 | 1.3 | 6.8 | 12.4 | 5.7 | 65 |
| **2000** | 13.8 | 12.9 | 13.5 | 13.1 | 12.6 | 10.0 | 12.2 | 11.5 | 10.9 | 1.8 | 7.3 | 13.9 | 6.7 | 65 |
| **2002** | 12.6 | 13.1 | 12.0 | 11.5 | 10.5 | 10.8 | 11.8 | 12.2 | 9.5 | 1.9 | 6.0 | 13.1 | 7.1 | 64 |
| **2003** | 12.8 | 12.8 | 12.0 | 14.2 | 11.8 | 10.4 | 14.0 | 10.8 | 9.7 | 2.1 | 5.8 | 14.2 | 8.4 | 65 |
| **2004** | 11.2 | 9.3 | 8.9 | 9.9 | 9.1 | 8.6 | 9.3 | 8.9 | 8.5 | 1.1 | 6.6 | 11.2 | 4.6 | 64 |
| **2005** | 9.6 | 10.3 | 9.2 | 9.4 | 9.5 | 9.9 | 11.9 | --- | 8.8 | 1.2 | 6.3 | 11.9 | 5.6 | 61 |
| **2006** | 13.5 | 9.4 | 11.2 | 15.4 | 9.3 | 10.9 | 12.3 | --- | 14.0 | 1.6 | 9.3 | 16.7 | 7.4 | 63 |
| **2007** | 14.4 | 14.2 | 13.3 | 13.9 | 11.9 | 12.2 | 14.0 | 14.0 | 11.7 | 1.4 | 9.0 | 14.4 | 5.4 | 65 |
| **2008** | 13.5 | 13.9 | 13.2 | 9.4 | 10.8 | 12.0 | 13.2 | --- | 12.5 | 1.7 | 8.9 | 15.6 | 6.7 | 53 |
| **2009** | 12.8 | 13.0 | 11.6 | 9.7 | 9.5 | 10.0 | 10.7 | 10.0 | 10.8 | 1.1 | 8.8 | 13.0 | 4.2 | 63 |
| **2010** | 12.3 | 10.9 | 10.4 | 10.9 | 10.9 | 11.0 | 12.4 | 11.9 | 9.3 | 1.7 | 6.3 | 12.4 | 6.2 | 65 |
| **2011** | 11.9 | 11.5 | 11.3 | 12.4 | 9.7 | 9.3 | 12.3 | 10.2 | 9.5 | 1.3 | 6.0 | 12.4 | 6.4 | 64 |

*Table 3. Incubation time (hr) of the Atlantic mackerel eggs for the stations of the research surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2011 according to the Lockwood et al. model (1977).*

| | STATIONS | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1.1** | **1.2** | **1.3** | **1.4** | **1.5** | **2.1** | **2.2** | **2.3** | **2.4** | **2.5** | **2.6** | **3.1** | **3.2** | **3.3** | **3.4** | **3.5** | **3.6** | **3.7** | **3.8** |
| **STRATE / *STRATUM*** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 |
| **LONGITUDE** | -60.92 | -60.75 | -60.75 | -60.75 | -60.75 | -61.25 | -61.25 | -61.25 | -61.25 | -61.25 | -61.25 | -61.77 | -61.75 | -61.75 | -61.75 | -61.75 | -61.83 | -61.75 | -61.75 |
| **LATITUDE** | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 46.50 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 45.83 | 46.17 | 46.50 | 46.83 | 47.17 | 47.58 | 47.83 | 48.17 |
| **1979** | 40.7 | 46.0 | 55.8 | 68.2 | 70.7 | 41.8 | 41.8 | 55.8 | 50.1 | 59.5 | 61.5 | 46.0 | 39.2 | 44.1 | 46.0 | 59.5 | 50.1 | 52.4 | 52.4 |
| **1983** | 25.0 | 32.7 | 40.2 | 45.3 | 49.4 | 29.6 | 30.6 | 34.3 | 39.7 | 37.7 | 40.7 | 27.6 | 29.3 | 27.0 | 26.2 | 32.0 | 32.4 | --- | 37.3 |
| **1984** | 54.0 | 49.4 | 85.9 | 91.5 | 102.2 | 53.2 | 53.2 | 37.7 | 45.3 | 82.4 | 115.2 | 42.9 | 42.9 | 43.5 | 51.6 | 68.2 | 77.7 | 93.5 | 54.9 |
| **1985** | 59.5 | 60.5 | 127.6 | 84.1 | 82.4 | 37.7 | 61.5 | 54.9 | 80.8 | 112.4 | 77.7 | 41.2 | 40.7 | 47.3 | 43.5 | 67.0 | 57.6 | 56.6 | 51.6 |
| **1986** | --- | --- | --- | 68.2 | 68.2 | --- | --- | --- | 53.2 | 68.2 | 68.2 | --- | 35.5 | 42.9 | 42.9 | 53.2 | 62.5 | 57.6 | 68.2 |
| **1987** | 44.7 | 49.4 | 47.3 | 48.0 | 51.6 | 43.5 | 45.3 | 40.7 | 44.1 | 36.8 | 45.3 | 40.7 | 42.9 | 41.2 | 48.7 | 46.0 | 56.6 | 54.9 | 60.5 |
| **1988** | 52.0 | 72.0 | 96.4 | 105.6 | 118.1 | 48.4 | 68.4 | 78.6 | 85.9 | 126.2 | 106.6 | 38.5 | 53.8 | 51.2 | 64.9 | 68.4 | 72.3 | 80.8 | 102.9 |
| **1989** | 50.0 | 50.5 | 54.7 | 72.0 | 77.8 | 44.4 | 49.7 | 46.1 | 53.1 | 94.9 | 70.8 | 35.2 | 38.2 | 45.0 | 42.1 | 47.3 | 50.5 | 63.3 | 61.2 |
| **1990** | 49.4 | 68.1 | 97.2 | 100.4 | 104.9 | 49.7 | 59.0 | 61.0 | 90.5 | 75.2 | 75.5 | 38.1 | 40.4 | 51.2 | 55.2 | 59.8 | 73.2 | 72.2 | 78.8 |
| **1991** | 57.0 | 78.5 | 88.6 | 109.2 | 108.6 | 53.6 | 86.2 | 83.3 | 79.1 | --- | 120.2 | 51.3 | 52.1 | 66.6 | 88.8 | 64.2 | 66.8 | 64.2 | 149.8 |
| **1992** | 43.9 | 82.8 | 72.4 | 78.3 | 93.3 | 42.1 | 54.2 | 65.0 | 76.8 | 89.0 | 78.6 | 39.6 | 44.2 | 48.0 | 50.8 | 53.5 | 54.9 | 61.6 | 72.4 |
| **1993** | 51.4 | 77.4 | 100.8 | 138.0 | 138.7 | 47.0 | 65.7 | 92.5 | 106.6 | 170.7 | 147.7 | 40.2 | 54.5 | 47.2 | 59.6 | 68.9 | 69.1 | 94.1 | 71.6 |
| **1994** | 55.9 | 104.6 | 132.1 | 146.8 | 157.6 | 74.8 | 110.7 | 114.3 | 93.9 | 122.4 | 160.9 | 49.7 | 73.2 | 64.9 | 101.1 | 134.6 | 95.5 | 135.7 | 152.0 |
| **1996** | 38.3 | 49.4 | 77.1 | 84.3 | 94.5 | 39.1 | 46.0 | 60.4 | 58.1 | 67.5 | 65.3 | 36.9 | 40.7 | 42.0 | 53.5 | 52.8 | 47.0 | 50.6 | 63.4 |
| **1998** | 44.5 | 56.1 | 65.6 | 74.6 | 86.6 | 50.9 | 56.7 | 53.0 | 76.8 | 78.3 | 67.5 | 48.0 | 48.7 | 51.5 | 46.0 | 49.2 | 47.7 | 52.2 | 67.5 |
| **2000** | 50.2 | 87.2 | 96.1 | 93.7 | 89.3 | 45.5 | 57.0 | 69.9 | 83.2 | 84.3 | 84.7 | 38.6 | 41.4 | 48.5 | 59.8 | 56.3 | 52.9 | 56.4 | 85.9 |
| **2002** | 66.1 | 75.0 | 115.0 | 111.0 | 131.8 | 51.9 | 59.0 | 73.7 | 81.9 | 111.6 | 105.0 | 46.7 | 49.7 | 52.5 | 53.1 | 79.1 | 97.6 | 96.2 | 93.3 |
| **2003** | 53.8 | 83.3 | 102.7 | 138.0 | 99.0 | 58.1 | 65.0 | 96.2 | 87.7 | 101.7 | 107.9 | 49.5 | 48.2 | 60.7 | 62.5 | 93.1 | 79.5 | 85.2 | 104.4 |
| **2004** | 65.4 | 101.0 | 102.6 | 102.0 | 108.9 | 61.6 | 109.7 | 88.4 | 101.3 | 102.1 | 113.0 | 48.4 | 59.1 | 66.4 | 83.9 | 88.9 | 76.6 | 91.7 | 111.5 |
| **2005** | 60.5 | 91.5 | 87.7 | --- | --- | 55.8 | 74.1 | 91.5 | 95.5 | 104.6 | 87.7 | 54.0 | 60.5 | 59.5 | 65.8 | 95.5 | 72.0 | 74.8 | 87.7 |
| **2006** | 27.9 | 37.0 | 37.1 | 41.1 | 42.6 | 28.0 | --- | 33.0 | 30.2 | 33.1 | 38.1 | 27.3 | 29.8 | 27.6 | 29.6 | 30.6 | 29.1 | 31.8 | 31.6 |
| **2007** | 39.7 | 40.7 | 58.1 | 61.4 | 48.9 | 35.8 | 37.4 | 54.6 | 59.0 | 68.1 | 54.0 | 36.4 | 42.5 | 37.0 | 50.9 | 40.3 | 49.2 | 62.6 | 40.6 |
| **2008** | 32.5 | --- | --- | --- | --- | 29.1 | 36.7 | 48.2 | 62.4 | 60.5 | 51.0 | 31.1 | 31.9 | 32.5 | 38.3 | 47.6 | 46.9 | 44.2 | 55.3 |
| **2009** | 46.2 | 57.3 | 63.8 | 69.6 | 64.0 | 42.5 | 60.2 | 60.6 | 62.5 | 57.9 | 70.1 | 40.9 | 42.5 | 53.6 | 44.2 | 54.3 | 46.3 | 45.8 | 48.0 |
| **2010** | 51.2 | 73.1 | 122.4 | 100.1 | 111.3 | 51.3 | 58.8 | 83.4 | 102.2 | 84.3 | 97.7 | 40.8 | 48.4 | 52.5 | 73.5 | 86.9 | 74.9 | 80.0 | 104.4 |
| **2011** | --- | 130.7 | 88.4 | 79.5 | 81.9 | 58.9 | 65.1 | 81.9 | 85.3 | 126.6 | 73.1 | 53.8 | 56.0 | 66.6 | 75.1 | 76.5 | 79.5 | 68.4 | 57.0 |

*Table 3. (Continued).*

| | STATIONS | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **3.9** | **4.1** | **4.2** | **4.3** | **4.4** | **4.5** | **4.6** | **4.7** | **4.8** | **4.9** | **5.1** | **5.2** | **5.3** | **5.4** | **5.5** | **5.6** | **5.7** | **6.1** | **6.2** |
| **STRATE / *STRATUM*** | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 2 |
| **LONGITUDE** | -61.75 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.75 | -62.75 | -62.75 | -62.75 | -62.75 | -62.75 | -62.75 | -63.25 | -63.25 |
| **LATITUDE** | 48.33 | 45.83 | 46.17 | 46.57 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 48.33 | 46.50 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 48.33 | 46.50 | 46.83 |
| **1979** | --- | 43.3 | 43.3 | 35.5 | 37.7 | 46.6 | 42.9 | 40.7 | 46.6 | --- | 33.1 | 36.8 | 42.3 | 43.5 | 41.8 | 46.6 | 52.4 | 33.5 | 30.0 |
| **1983** | 48.7 | 23.8 | 26.2 | 27.6 | 25.5 | 31.3 | 31.3 | 32.7 | 28.7 | 38.7 | 28.4 | 27.3 | 30.0 | 29.3 | 35.9 | 49.4 | 46.6 | 29.0 | 33.1 |
| **1984** | 54.9 | 41.8 | 44.7 | 45.3 | 58.5 | 68.2 | 79.2 | 121.1 | 68.2 | 61.5 | 37.7 | 49.4 | 53.2 | 62.5 | 68.2 | 49.4 | 54.9 | 40.2 | 43.5 |
| **1985** | 50.9 | 39.2 | 50.9 | 38.2 | 46.0 | 53.2 | 62.5 | 55.8 | 49.4 | 45.3 | 39.7 | 50.1 | 54.9 | 54.0 | 46.0 | 39.2 | 42.9 | 46.0 | 56.6 |
| **1986** | 68.2 | 35.5 | --- | 37.7 | 42.9 | 49.4 | 49.4 | 49.4 | 68.2 | 68.2 | 37.7 | 42.9 | 40.2 | 49.4 | 49.4 | 49.4 | 49.4 | 40.2 | 40.2 |
| **1987** | 63.6 | 42.3 | 40.7 | 37.3 | 38.7 | 73.4 | 51.6 | 50.9 | 57.6 | 60.5 | 35.9 | 36.4 | 44.1 | 44.1 | 45.3 | 59.5 | 65.8 | 37.3 | 37.3 |
| **1988** | 102.9 | 42.2 | 59.3 | 45.8 | 58.1 | 63.8 | 65.4 | 71.9 | 91.7 | 95.1 | 42.6 | 50.0 | 63.0 | 70.2 | 65.0 | 93.1 | 84.3 | 40.6 | 51.9 |
| **1989** | 62.7 | 44.5 | 46.1 | 34.6 | 58.4 | 45.3 | 54.1 | 59.0 | 62.3 | 58.5 | 36.5 | 39.9 | 40.2 | 40.8 | 54.8 | 55.3 | 66.9 | 35.0 | 32.3 |
| **1990** | 70.3 | 41.6 | 46.7 | 41.5 | 54.5 | 68.7 | 72.8 | 61.2 | 71.6 | 67.8 | 38.8 | 49.2 | 63.2 | 52.6 | 62.3 | 62.2 | 78.0 | 50.3 | 48.9 |
| **1991** | 131.4 | 43.4 | 51.5 | 41.3 | 79.9 | 81.1 | 80.3 | 55.1 | 73.9 | 154.8 | 42.6 | 62.5 | 62.7 | 59.5 | 47.3 | 90.3 | 138.0 | 45.3 | 59.1 |
| **1992** | 95.7 | 60.8 | 44.2 | 34.8 | 37.5 | 51.8 | 49.2 | 64.4 | 72.8 | 76.7 | 34.7 | 40.7 | 45.8 | 42.2 | 58.2 | 48.7 | 53.5 | 37.6 | 38.5 |
| **1993** | 99.9 | 46.9 | 55.6 | 50.0 | 57.8 | 62.5 | 59.9 | 66.8 | 73.5 | 84.1 | 40.2 | 55.0 | 57.8 | 79.2 | 67.5 | 80.6 | 68.4 | 40.8 | 45.4 |
| **1994** | 165.5 | 52.2 | 66.6 | 57.7 | 77.0 | 87.5 | 104.1 | 107.9 | 103.2 | 97.9 | 50.9 | 59.9 | 81.6 | 84.0 | 66.3 | 60.0 | 67.1 | 48.4 | 59.8 |
| **1996** | 63.3 | 43.4 | 40.0 | 35.9 | 49.7 | 54.2 | 50.7 | 48.4 | 65.9 | 81.5 | 30.6 | 42.2 | 49.3 | 46.8 | 46.4 | 49.2 | 51.6 | 30.3 | 40.4 |
| **1998** | 71.1 | 49.4 | 49.4 | 53.8 | 41.4 | 41.2 | 44.3 | 50.7 | 54.0 | 59.7 | 68.3 | 43.6 | 42.4 | 48.2 | 44.1 | 48.5 | 54.0 | 59.4 | 56.5 |
| **2000** | 73.3 | 33.8 | 38.7 | 40.4 | 49.6 | 49.8 | 47.3 | 58.2 | 72.3 | 82.6 | 37.5 | 47.4 | 39.5 | 47.0 | 48.5 | 57.8 | 64.8 | 35.4 | 40.4 |
| **2002** | 111.5 | 54.1 | 55.8 | 47.8 | 55.3 | 65.5 | 73.5 | 79.4 | 86.8 | 120.4 | 53.0 | 45.3 | 63.0 | 66.6 | 72.5 | --- | 103.8 | 47.5 | 44.1 |
| **2003** | 122.7 | 54.0 | 50.2 | 52.7 | 67.5 | 81.6 | 80.2 | 84.3 | 86.9 | 88.8 | 46.5 | 49.0 | 80.5 | 73.8 | 66.4 | 67.0 | 104.6 | 43.3 | 39.1 |
| **2004** | 111.1 | 65.6 | 60.8 | 57.9 | 70.7 | 103.3 | 80.2 | 79.1 | 93.4 | 102.4 | 56.5 | 63.2 | 72.9 | 67.2 | 74.2 | 84.1 | 84.1 | 58.1 | 62.0 |
| **2005** | 82.4 | 87.7 | 56.6 | 102.2 | 57.6 | 91.5 | 77.7 | 77.7 | 74.8 | 70.7 | 121.1 | 62.5 | 84.1 | 109.7 | 77.7 | 69.4 | 64.7 | 118.1 | 60.5 |
| **2006** | 32.2 | 30.4 | 28.6 | 25.9 | 28.0 | 37.5 | 37.5 | 33.1 | 30.2 | 31.1 | 25.3 | 30.3 | 35.9 | 32.8 | 37.6 | 34.6 | 30.6 | 27.8 | 29.9 |
| **2007** | 57.5 | 41.4 | 40.6 | 42.0 | 56.1 | 61.5 | 67.2 | 47.8 | 45.2 | 48.2 | 36.6 | 51.9 | 51.8 | 48.1 | 42.3 | 49.3 | 48.3 | 34.8 | 47.1 |
| **2008** | --- | 33.8 | 33.1 | 31.4 | 42.7 | 69.1 | 43.6 | 42.6 | 46.5 | --- | 31.2 | 38.7 | 38.3 | 41.6 | --- | 43.6 | --- | 29.2 | 34.6 |
| **2009** | 46.2 | 41.8 | 39.4 | 46.6 | 45.5 | 68.8 | 66.9 | 48.4 | 50.6 | 61.1 | 46.5 | 53.0 | 60.5 | 64.0 | 46.4 | 58.1 | 51.3 | 47.4 | 45.5 |
| **2010** | 94.9 | 44.2 | 44.2 | 47.0 | 60.6 | 85.2 | 64.0 | 101.5 | 97.0 | 87.1 | 46.2 | 55.3 | 69.1 | 67.5 | 65.8 | 97.7 | 82.6 | 54.6 | 65.5 |
| **2011** | 66.8 | 54.5 | 65.3 | 49.2 | 76.2 | 74.4 | 78.6 | 60.1 | 55.8 | 92.3 | 52.0 | 65.9 | 66.8 | 63.5 | 53.5 | 59.3 | 53.9 | 49.2 | 60.3 |

*Table 3. (Continued).*

| | STATIONS | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **6.3** | **6.4** | **6.5** | **6.6** | **6.7** | **7.1** | **7.2** | **7.3** | **7.4** | **7.5** | **7.6** | **7.7** | **8.1** | **8.2** | **8.3** | **8.4** | **8.5** | **8.6** | **8.7** |
| **STRATE / *STRATUM*** | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 3 | 2 | 1 |
| **LONGITUDE** | -63.25 | -63.25 | -63.25 | -63.25 | -63.25 | -63.75 | -63.75 | -63.75 | -63.75 | -63.75 | -63.75 | -63.75 | -64.37 | -64.25 | -64.25 | -64.25 | -64.25 | -64.08 | -64.08 |
| **LATITUDE** | 47.17 | 47.50 | 47.83 | 48.17 | 48.50 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 48.50 | 48.83 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 48.50 | 48.75 |
| **1979** | 36.8 | 30.0 | 41.8 | 53.2 | 53.2 | 30.0 | 33.9 | 29.3 | 35.9 | 51.6 | 48.7 | --- | --- | 31.0 | 42.9 | 43.5 | 61.5 | 53.2 | --- |
| **1983** | 33.5 | 30.0 | 40.2 | 37.7 | 48.0 | 34.3 | 32.0 | 37.3 | 42.9 | 41.2 | 46.0 | 41.2 | 29.6 | 34.7 | 36.8 | 40.7 | 35.9 | 45.3 | 34.3 |
| **1984** | 42.9 | 56.6 | 68.2 | 55.8 | 50.9 | 38.7 | 41.2 | 48.0 | 44.7 | 48.7 | 43.5 | 53.2 | 36.8 | 35.1 | 49.4 | 46.0 | 38.2 | 48.0 | 46.0 |
| **1985** | 52.4 | 43.5 | 46.0 | 44.7 | 40.2 | 39.7 | 41.2 | 42.9 | 48.0 | 44.1 | 31.0 | 58.5 | 36.4 | --- | 45.3 | 50.1 | 51.6 | 42.3 | 54.9 |
| **1986** | 42.9 | 42.9 | 42.9 | 49.4 | 57.6 | 35.5 | 40.2 | 40.2 | 42.9 | 46.0 | 74.8 | 68.2 | 33.5 | 37.7 | 37.7 | 37.7 | 49.4 | 49.4 | 68.2 |
| **1987** | 41.2 | 40.2 | 40.7 | 54.9 | 55.8 | 38.2 | 39.7 | 40.2 | 45.3 | 52.4 | 61.5 | 68.2 | 42.3 | 37.3 | 44.1 | 44.7 | 58.5 | 58.5 | 65.8 |
| **1988** | 52.6 | 56.8 | 60.3 | 82.3 | 84.8 | 48.7 | 43.3 | 58.8 | 40.2 | 88.8 | 72.4 | 86.8 | 38.0 | 46.8 | 42.1 | 50.2 | 53.1 | 63.6 | 71.5 |
| **1989** | 38.3 | 47.2 | 44.8 | 57.1 | 55.9 | 33.7 | 34.0 | 38.9 | 50.9 | 41.1 | 74.8 | 63.8 | 39.0 | 33.5 | 39.2 | 36.5 | 41.2 | 96.4 | 59.1 |
| **1990** | 54.8 | 54.8 | 67.6 | 61.6 | 73.4 | 38.0 | 41.6 | 50.9 | 55.9 | 83.1 | 66.8 | 90.9 | 42.6 | 41.0 | 51.5 | 66.4 | 67.1 | 65.8 | 62.4 |
| **1991** | 60.1 | 53.7 | 48.7 | 86.2 | 141.1 | --- | 49.3 | 48.3 | 51.1 | 49.8 | 118.7 | 94.1 | 35.8 | 41.4 | 46.4 | 48.4 | 41.6 | 43.3 | 37.7 |
| **1992** | 41.0 | 44.5 | 45.7 | 59.4 | 93.1 | 38.7 | 35.5 | 36.5 | 36.2 | 42.0 | 58.4 | 63.3 | 32.3 | 34.2 | 35.6 | 43.1 | 37.9 | 62.2 | 55.8 |
| **1993** | 52.0 | 69.7 | 50.3 | 55.2 | 68.1 | 40.2 | 52.1 | 48.0 | 57.5 | 53.1 | 81.9 | --- | 35.7 | 42.6 | 53.1 | 60.0 | 63.7 | 68.6 | --- |
| **1994** | 60.9 | 61.9 | 65.0 | 56.0 | 55.3 | 50.3 | 52.6 | 51.3 | 60.3 | 55.6 | 60.9 | 62.6 | 52.6 | 49.6 | 54.6 | 59.7 | 51.5 | 42.7 | 46.9 |
| **1996** | 37.2 | 45.7 | 47.5 | 54.5 | 52.0 | 33.5 | 36.3 | 44.4 | 44.2 | 47.7 | 54.0 | 72.3 | 39.9 | 36.1 | 36.1 | 45.4 | 50.6 | 56.6 | 53.2 |
| **1998** | 44.9 | 44.0 | 45.1 | 53.0 | 46.4 | 48.0 | 43.9 | 45.6 | 44.0 | 53.5 | 53.5 | 62.6 | 41.5 | 49.6 | 50.0 | 55.0 | 50.9 | 78.2 | 107.9 |
| **2000** | 41.7 | 48.6 | 49.1 | 53.3 | 56.8 | 44.8 | 43.3 | 46.7 | 44.2 | 49.1 | 55.6 | 49.9 | 36.8 | 39.2 | 43.8 | 34.8 | 39.6 | 49.8 | 51.7 |
| **2002** | 61.9 | 60.4 | 70.1 | 87.2 | 87.2 | 42.1 | 50.5 | 46.2 | 48.2 | 55.9 | 75.9 | 116.1 | 41.1 | 49.4 | 46.1 | 51.1 | 55.5 | 85.5 | 79.1 |
| **2003** | 71.0 | 56.4 | 70.8 | 59.6 | 71.9 | 42.4 | 43.0 | 42.2 | 46.4 | 50.5 | 70.3 | 85.3 | 38.0 | 40.1 | 45.3 | 47.3 | 49.3 | 81.6 | 68.4 |
| **2004** | 69.3 | 75.0 | 68.1 | 74.0 | 90.1 | 56.9 | 64.9 | 66.1 | 86.1 | 93.5 | 89.0 | 74.5 | --- | 60.3 | 68.5 | 73.7 | 77.6 | 90.0 | 91.2 |
| **2005** | 59.5 | 89.5 | 77.7 | 73.4 | 67.0 | 56.6 | 65.8 | 87.7 | 64.7 | 64.7 | 59.5 | --- | 51.6 | 68.2 | 62.5 | 65.8 | 56.6 | 89.5 | 72.0 |
| **2006** | 29.5 | 31.3 | 40.8 | 35.7 | 36.5 | 30.4 | 29.4 | 29.6 | 32.3 | 40.7 | 30.9 | 33.3 | 30.6 | 35.5 | 30.5 | 40.8 | 62.0 | 33.6 | 39.5 |
| **2007** | 51.7 | 54.5 | 46.0 | 44.7 | 46.1 | 41.9 | 42.6 | 47.1 | 37.4 | 46.3 | 44.9 | 41.3 | 32.9 | 36.5 | 44.8 | 51.7 | 49.7 | 44.7 | 55.3 |
| **2008** | 36.3 | 43.9 | --- | 40.7 | --- | 36.7 | 31.9 | 39.5 | --- | 45.3 | 48.0 | 49.1 | 28.1 | 29.7 | 48.7 | 46.2 | 52.2 | 50.3 | 53.5 |
| **2009** | 55.0 | 42.0 | 42.0 | 56.6 | 57.7 | 40.8 | 43.3 | 49.2 | 44.3 | 46.9 | 44.1 | 71.4 | 40.6 | 45.3 | 56.6 | 55.7 | 64.0 | --- | --- |
| **2010** | 79.4 | 62.1 | 99.9 | 77.8 | 84.3 | 48.2 | 52.3 | 53.5 | 59.8 | 92.5 | 89.9 | 84.3 | 45.0 | 47.8 | 55.8 | 61.0 | 75.1 | 51.4 | 60.1 |
| **2011** | 67.4 | 68.0 | 54.4 | 59.2 | 60.4 | 60.3 | 64.1 | 70.8 | 47.5 | 66.1 | 60.9 | 96.0 | 54.5 | 46.8 | 48.9 | 61.6 | 71.1 | 64.0 | 84.6 |

*Table 3. (Continued).*

| | STATIONS | | | | | | | | STATISTIQUES / *STATISTICS* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **9.1** | **9.2** | **9.3** | **9.4** | **9.5** | **10.1** | **11.1** | **12.1** | | | | | | |
| **STRATE / *STRATUM*** | 1 | 1 | 2 | 2 | 3 | 2 | 3 | 3 | **Moyenne / *Mean*** | **É.-T. / *STD*** | **Min.** | **Max.** | **Étendue / *Range*** | **n** |
| **LONGITUDE** | -64.67 | -64.75 | -64.67 | -64.75 | -64.75 | -65.25 | -65.75 | -66.13 | | | | | | |
| **LATITUDE** | 46.83 | 47.17 | 47.50 | 47.93 | 48.17 | 47.93 | 48.00 | 48.05 | | | | | | |
| **1979** | --- | 39.7 | 41.8 | 39.2 | 40.2 | 43.5 | 40.2 | 32.7 | 44.6 | 9.4 | 29.3 | 70.7 | 41.4 | 59 |
| **1983** | 26.5 | 32.4 | 32.7 | 28.1 | 31.3 | 30.0 | 32.4 | 33.9 | 34.5 | 6.7 | 23.8 | 49.4 | 25.6 | 64 |
| **1984** | 37.7 | 42.9 | 42.9 | 36.4 | 37.7 | 34.7 | 42.9 | 36.4 | 54.6 | 19.0 | 34.7 | 121.1 | 86.4 | 65 |
| **1985** | 42.3 | 43.5 | 41.2 | 43.5 | 45.3 | 38.7 | 40.7 | 34.3 | 51.7 | 16.7 | 31.0 | 127.6 | 96.6 | 64 |
| **1986** | 31.6 | 31.6 | 33.5 | 42.9 | 37.7 | 42.9 | 33.5 | 33.5 | 48.1 | 12.2 | 31.6 | 74.8 | 43.1 | 57 |
| **1987** | 33.1 | 35.9 | 42.9 | 42.9 | 54.9 | 48.7 | 46.6 | 46.0 | 47.6 | 9.2 | 33.1 | 73.4 | 40.3 | 65 |
| **1988** | 42.1 | 41.4 | 52.7 | 34.9 | 51.6 | 52.1 | 44.7 | 52.9 | 65.6 | 21.7 | 34.9 | 126.2 | 91.3 | 65 |
| **1989** | 28.1 | 38.3 | 44.6 | 30.1 | 40.6 | 46.9 | 47.5 | 55.5 | 49.7 | 14.1 | 28.1 | 96.4 | 68.3 | 65 |
| **1990** | 44.2 | 44.5 | 50.3 | 95.1 | 79.2 | 47.8 | 37.5 | 38.6 | 61.2 | 16.7 | 37.5 | 104.9 | 67.4 | 65 |
| **1991** | 29.7 | 34.2 | 40.2 | 27.3 | 41.2 | 62.6 | 40.4 | 42.2 | 68.0 | 30.9 | 27.3 | 154.8 | 127.4 | 63 |
| **1992** | 33.4 | 31.3 | 40.2 | 37.4 | 43.6 | 35.5 | 38.0 | 36.3 | 52.0 | 17.1 | 31.3 | 95.7 | 64.5 | 65 |
| **1993** | 35.7 | 48.7 | 53.2 | 39.1 | 64.7 | 66.1 | 40.5 | 51.3 | 66.4 | 27.2 | 35.7 | 170.7 | 135.1 | 63 |
| **1994** | 43.5 | 44.6 | 42.3 | 54.8 | 57.1 | 48.2 | 53.0 | 52.3 | 77.3 | 33.6 | 42.3 | 165.5 | 123.2 | 65 |
| **1996** | 33.9 | 32.8 | 40.2 | 69.2 | 64.0 | 60.3 | 53.0 | 53.8 | 50.5 | 13.3 | 30.3 | 94.5 | 64.2 | 65 |
| **1998** | 40.7 | 50.0 | 48.8 | 66.5 | 43.0 | 68.7 | 40.6 | 43.0 | 54.2 | 12.7 | 40.6 | 107.9 | 67.3 | 65 |
| **2000** | 34.2 | 38.0 | 35.6 | 37.3 | 39.6 | 57.6 | 41.7 | 45.7 | 53.1 | 16.5 | 33.8 | 96.1 | 62.3 | 65 |
| **2002** | 39.7 | 37.4 | 42.7 | 45.8 | 53.2 | 51.1 | 43.9 | 42.0 | 68.1 | 24.3 | 37.4 | 131.8 | 94.5 | 64 |
| **2003** | 38.7 | 38.6 | 43.0 | 32.6 | 43.9 | 53.7 | 33.5 | 51.2 | 66.6 | 23.6 | 32.6 | 138.0 | 105.4 | 65 |
| **2004** | 47.8 | 64.4 | 69.6 | 58.8 | 67.5 | 73.2 | 64.8 | 69.2 | 78.3 | 17.2 | 47.8 | 113.0 | 65.3 | 64 |
| **2005** | 61.5 | 54.9 | 65.8 | 63.6 | 62.5 | 58.5 | 43.5 | --- | 73.9 | 16.9 | 43.5 | 121.1 | 77.6 | 61 |
| **2006** | 35.3 | 63.2 | 47.9 | 28.7 | 64.6 | 50.1 | 41.5 | --- | 34.7 | 8.2 | 25.3 | 64.6 | 39.3 | 63 |
| **2007** | 32.0 | 32.7 | 36.3 | 33.9 | 43.5 | 41.6 | 33.4 | 33.5 | 45.9 | 8.7 | 32.0 | 68.1 | 36.1 | 65 |
| **2008** | 35.5 | 33.7 | 36.9 | 64.0 | 50.7 | 43.0 | 36.6 | --- | 42.1 | 9.6 | 28.1 | 69.1 | 41.0 | 53 |
| **2009** | 38.8 | 37.9 | 45.5 | 60.5 | 63.0 | 58.0 | 52.0 | 57.2 | 52.2 | 9.1 | 37.9 | 71.4 | 33.5 | 63 |
| **2010** | 41.4 | 49.8 | 54.4 | 50.3 | 50.3 | 49.7 | 40.6 | 43.3 | 69.0 | 21.0 | 40.6 | 122.4 | 81.8 | 65 |
| **2011** | 43.4 | 46.2 | 47.5 | 40.7 | 61.0 | 64.5 | 41.1 | 56.2 | 65.8 | 16.9 | 40.7 | 130.7 | 90.0 | 64 |

*Table 4. Daily egg production (developmental stages 1 and 5) (n/m$^2$) of the Atlantic mackerel for the stations of the research surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2011.*

| | STATIONS | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1.1** | **1.2** | **1.3** | **1.4** | **1.5** | **2.1** | **2.2** | **2.3** | **2.4** | **2.5** | **2.6** | **3.1** | **3.2** | **3.3** | **3.4** | **3.5** | **3.6** | **3.7** | **3.8** |
| **STRATE / *STRATUM*** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 |
| **LONGITUDE** | -60.92 | -60.75 | -60.75 | -60.75 | -60.75 | -61.25 | -61.25 | -61.25 | -61.25 | -61.25 | -61.25 | -61.77 | -61.75 | -61.75 | -61.75 | -61.75 | -61.83 | -61.75 | -61.75 |
| **LATITUDE** | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 46.50 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 45.83 | 46.17 | 46.50 | 46.83 | 47.17 | 47.58 | 47.83 | 48.17 |
| **1979** | 5.0 | 45.9 | 0.0 | 0.0 | 0.4 | 49.5 | 22.1 | 6.5 | 50.4 | 24.1 | 0.1 | 63.8 | 4.6 | 45.9 | 71.3 | 20.0 | 146.6 | 29.9 | 0.1 |
| **1983** | 2.3 | 3.2 | 36.3 | 12.6 | 0.2 | 30.3 | 2.1 | 21.5 | 52.7 | 84.5 | 4.8 | 66.5 | 47.6 | 69.7 | 11.7 | 123.1 | 45.9 | --- | 1.8 |
| **1984** | 18.0 | 38.8 | 0.0 | 0.6 | 0.0 | 30.6 | 16.1 | 10.7 | 7.4 | 0.5 | 1.4 | 46.4 | 17.7 | 48.0 | 27.9 | 2.7 | 96.7 | 2.6 | 0.4 |
| **1985** | 3.6 | 11.7 | 0.0 | 0.0 | 0.2 | 47.4 | 7.6 | 45.8 | 2.3 | 0.0 | 0.0 | 37.0 | 57.2 | 89.6 | 103.0 | 82.3 | 54.0 | 79.2 | 140.8 |
| **1986** | --- | --- | --- | 0.0 | 0.0 | --- | --- | --- | 128.2 | 234.5 | 0.0 | --- | 32.7 | 340.9 | 102.6 | 122.6 | 479.4 | 400.4 | 0.0 |
| **1987** | 21.4 | 76.8 | 20.6 | 0.6 | 1.7 | 95.1 | 130.3 | 125.9 | 66.2 | 148.7 | 15.1 | 61.8 | 117.1 | 216.6 | 86.1 | 101.6 | 62.8 | 40.7 | 37.2 |
| **1988** | 174.6 | 18.9 | 0.0 | 0.0 | 0.0 | 109.9 | 79.7 | 35.7 | 1.1 | 0.0 | 0.1 | 316.7 | 54.2 | 50.8 | 62.0 | 185.1 | 21.7 | 0.0 | 0.0 |
| **1989** | 0.2 | 11.4 | 1.2 | 0.0 | 0.0 | 16.8 | 4.8 | 22.8 | 2.0 | 0.3 | 2.5 | 85.1 | 80.8 | 24.9 | 21.6 | 21.8 | 53.6 | 0.9 | 0.0 |
| **1990** | 21.8 | 5.3 | 0.0 | 0.0 | 0.0 | 82.6 | 3.3 | 4.5 | 0.9 | 0.0 | 0.0 | 62.7 | 39.1 | 24.7 | 6.8 | 10.0 | 0.0 | 1.6 | 0.0 |
| **1991** | 25.9 | 1.4 | 0.0 | 0.0 | 0.0 | 49.3 | 4.0 | 0.0 | 0.7 | --- | 0.0 | 63.1 | 57.6 | 48.6 | 2.4 | 6.2 | 1.6 | 168.3 | 0.0 |
| **1992** | 2.2 | 8.3 | 7.8 | 0.0 | 0.0 | 18.4 | 2.7 | 17.8 | 1.6 | 0.5 | 0.0 | 16.6 | 100.3 | 46.8 | 21.3 | 10.6 | 0.4 | 5.5 | 0.2 |
| **1993** | 40.1 | 7.3 | 0.0 | 0.0 | 0.0 | 30.5 | 4.1 | 2.9 | 0.2 | 0.1 | 0.0 | 110.5 | 22.1 | 10.3 | 6.5 | 13.9 | 2.3 | 0.3 | 0.0 |
| **1994** | 1.3 | 6.2 | 0.0 | 0.0 | 0.0 | 2.6 | 1.3 | 1.0 | 0.0 | 0.0 | 0.0 | 27.4 | 0.6 | 8.3 | 2.3 | 0.1 | 0.1 | 0.0 | 0.0 |
| **1996** | 16.0 | 28.8 | 0.1 | 0.0 | 0.0 | 6.0 | 14.3 | 8.1 | 22.5 | 0.0 | 0.0 | 11.9 | 5.6 | 54.6 | 13.6 | 29.2 | 2.6 | 0.5 | 0.0 |
| **1998** | 7.7 | 10.6 | 8.3 | 0.0 | 0.0 | 3.4 | 10.2 | 81.9 | 0.5 | 0.1 | 0.1 | 11.3 | 23.1 | 8.4 | 32.0 | 26.7 | 0.0 | --- | 0.0 |
| **2000** | 1.3 | 1.0 | 0.0 | 0.0 | 0.0 | 2.9 | 1.9 | 0.0 | 0.0 | 0.0 | 0.0 | 25.4 | 4.7 | 18.4 | --- | 0.5 | 0.1 | 0.0 | 0.0 |
| **2002** | 6.7 | 3.3 | 0.2 | 0.0 | 0.0 | 9.6 | 7.2 | 1.8 | 0.1 | 0.0 | 0.0 | 30.8 | 50.6 | 56.2 | 29.8 | 2.8 | 0.2 | 0.0 | 0.0 |
| **2003** | 9.1 | 8.6 | 0.1 | 0.0 | 0.0 | 68.8 | 34.0 | 0.0 | 0.0 | 0.0 | 0.0 | 24.1 | 90.0 | 42.1 | 23.2 | 0.3 | 0.0 | 0.0 | 0.0 |
| **2004** | 13.5 | 1.7 | 0.0 | 0.0 | 0.0 | 1.6 | 4.1 | 0.4 | 0.0 | 0.0 | 0.0 | 76.6 | 5.3 | 7.4 | 2.6 | 0.1 | 0.0 | 0.0 | 0.0 |
| **2005** | 36.1 | 6.4 | 0.2 | --- | --- | 6.4 | 3.6 | 21.3 | 1.6 | 0.0 | 0.0 | 0.7 | 5.6 | 15.9 | 12.9 | 17.2 | 0.0 | 0.0 | 0.0 |
| **2006** | 0.0 | 0.0 | 1.9 | 0.0 | 0.1 | 0.4 | --- | 0.2 | 1.3 | 6.3 | 0.4 | 5.2 | 0.2 | 0.0 | 0.0 | 2.3 | 1.0 | 0.5 | 0.0 |
| **2007** | 1.4 | 0.8 | 2.4 | 0.0 | 0.0 | 1.6 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 45.9 | 0.1 | 13.3 | 5.5 | 4.9 | 0.0 | 0.0 | 0.0 |
| **2008** | 1.0 | --- | --- | --- | --- | 1.6 | 0.7 | 1.1 | 0.0 | 0.1 | 0.0 | 0.7 | 0.1 | 0.5 | 0.0 | 7.5 | 0.1 | 36.8 | 0.0 |
| **2009** | 1.5 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 3.6 | 1.1 | 0.3 | 0.0 | 0.0 | 1.9 | 0.7 | 0.7 | 1.6 | 0.3 | 1.2 | 184.5 | 0.7 |
| **2010** | 1.5 | 1.1 | 0.0 | 0.0 | 0.0 | 0.5 | 2.9 | 0.0 | 0.0 | 0.0 | 0.0 | 2.2 | 0.2 | 1.9 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 |
| **2011** | --- | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 1.0 | 0.3 | 0.8 | 0.6 | 0.1 | 0.0 | 0.0 | 0.3 |

*Table 4. (Continued).*

| | STATIONS | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **3.9** | **4.1** | **4.2** | **4.3** | **4.4** | **4.5** | **4.6** | **4.7** | **4.8** | **4.9** | **5.1** | **5.2** | **5.3** | **5.4** | **5.5** | **5.6** | **5.7** | **6.1** | **6.2** |
| **STRATE / *STRATUM*** | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 2 |
| **LONGITUDE** | -61.75 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.25 | -62.75 | -62.75 | -62.75 | -62.75 | -62.75 | -62.75 | -62.75 | -63.25 | -63.25 |
| **LATITUDE** | 48.33 | 45.83 | 46.17 | 46.57 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 48.33 | 46.50 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 48.33 | 46.50 | 46.83 |
| **1979** | --- | 12.3 | 9.3 | 89.2 | 83.1 | 96.8 | 524.9 | 730.6 | 22.3 | --- | 98.7 | 87.2 | 90.7 | 290.5 | 123.4 | 14.0 | 1.3 | 135.3 | 233.6 |
| **1983** | 0.2 | 120.8 | 27.4 | 80.5 | 6.4 | 31.8 | 487.4 | 429.2 | 528.6 | 11.0 | 47.4 | 14.6 | 123.0 | 415.8 | 997.3 | 36.3 | 12.5 | 8.5 | 96.5 |
| **1984** | 0.0 | 95.2 | 93.2 | 39.6 | 144.8 | 39.8 | 61.9 | 30.6 | 0.0 | 0.2 | 28.0 | 45.0 | 834.5 | 470.1 | 397.6 | 277.0 | 16.0 | 41.7 | 70.2 |
| **1985** | 2.5 | 39.4 | 70.7 | 46.9 | 134.4 | 389.5 | 94.0 | 165.5 | 438.4 | 2.5 | 139.4 | 241.6 | 148.4 | 310.8 | 229.6 | 546.1 | 129.5 | 15.1 | 90.1 |
| **1986** | 0.0 | 178.7 | --- | 321.8 | 253.3 | 196.5 | 334.9 | 966.4 | 24.7 | 0.0 | 902.5 | 245.2 | 231.9 | 563.6 | 1 286.1 | 203.6 | 300.8 | 108.7 | 345.5 |
| **1987** | 1.4 | 83.0 | 12.3 | 207.5 | 88.5 | 9.7 | 77.1 | 180.1 | 6.4 | 6.3 | 0.7 | 102.0 | 425.5 | 431.7 | 1 021.0 | 96.5 | 16.9 | 2.4 | 132.4 |
| **1988** | 0.0 | --- | --- | 213.4 | --- | 416.3 | 205.4 | 71.8 | 0.0 | 0.0 | 779.9 | 537.6 | 171.0 | 262.0 | 105.6 | 0.1 | 0.2 | 29.6 | 326.9 |
| **1989** | 0.0 | 128.4 | 10.2 | 41.4 | 14.3 | 120.9 | 628.9 | 2.2 | 2.3 | 0.0 | 10.6 | 23.4 | 121.7 | 1 056.3 | 81.9 | 0.0 | 0.4 | 45.3 | 45.1 |
| **1990** | 0.0 | 37.1 | 13.2 | 81.9 | 11.4 | 20.0 | 1.3 | 100.1 | 0.0 | 0.0 | 110.1 | 121.4 | 43.3 | 279.1 | 132.8 | 0.1 | 0.0 | 3.1 | 88.0 |
| **1991** | 0.0 | 58.9 | 139.5 | 346.1 | 7.0 | 7.2 | 98.4 | 738.8 | 176.0 | 0.0 | 29.9 | 195.2 | 152.2 | 196.2 | 1 307.5 | 11.3 | 1.2 | 100.3 | 124.5 |
| **1992** | 0.0 | 0.9 | 4.1 | 458.6 | 95.8 | 86.8 | 135.3 | 33.1 | 7.5 | 0.0 | 0.8 | 111.8 | 151.3 | 98.9 | 150.0 | 773.0 | 60.0 | 0.0 | 74.4 |
| **1993** | 0.0 | 8.5 | 4.2 | 61.2 | 4.3 | 2.6 | 244.6 | 0.0 | 0.0 | 0.0 | 11.3 | 66.4 | 99.0 | 20.2 | 53.1 | 106.7 | 2.2 | 105.2 | 123.8 |
| **1994** | 0.0 | 3.6 | 6.8 | 32.1 | 2.8 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 35.4 | 55.5 | 1.1 | 0.4 | 116.4 | 0.0 | 0.0 | 64.4 | 376.4 |
| **1996** | 0.0 | 0.4 | 5.4 | 31.8 | 23.4 | 80.0 | 3.2 | 0.5 | 0.0 | 0.0 | 2.4 | 56.9 | 196.0 | 137.5 | 56.2 | 0.0 | 0.0 | 1.0 | 48.7 |
| **1998** | 0.0 | 0.4 | 24.8 | 0.6 | 39.2 | 204.5 | 87.5 | 7.0 | 0.0 | 0.0 | 0.2 | 20.8 | 143.2 | 49.2 | 135.2 | 0.3 | 0.0 | 1.1 | 16.1 |
| **2000** | 0.0 | 2.7 | 5.9 | 24.2 | 0.0 | 1.2 | 0.1 | 0.0 | 0.0 | 0.0 | 15.1 | 14.6 | 203.7 | 0.0 | 0.0 | 0.0 | 0.0 | 16.6 | 44.4 |
| **2002** | 0.0 | 12.8 | 16.7 | 44.7 | 15.6 | 18.4 | 6.2 | 0.0 | 0.0 | 0.0 | 8.7 | 146.1 | 363.0 | 322.6 | 9.3 | --- | 0.0 | 1.6 | 193.6 |
| **2003** | 0.0 | 3.0 | 515.3 | 188.3 | 73.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 108.0 | 223.7 | 11.0 | 0.0 | 0.0 | 0.0 | 0.0 | 375.9 | 369.3 |
| **2004** | 0.0 | 35.7 | 60.1 | 334.2 | 1.5 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 453.3 | 44.5 | 5.0 | 42.6 | 126.7 | 0.0 | 0.0 | 417.2 | 359.4 |
| **2005** | 0.0 | 0.3 | 93.0 | 3.8 | 25.3 | 2.8 | 11.9 | 0.2 | 0.0 | 0.0 | 2.2 | 80.1 | 3.8 | 0.0 | 0.0 | 0.1 | 0.0 | 3.7 | 329.1 |
| **2006** | 0.0 | 0.4 | 0.0 | 0.0 | 0.3 | 9.0 | 7.2 | 0.0 | 1.7 | 0.0 | 1.9 | 0.0 | 2.4 | 3.0 | 4.0 | 3.9 | 0.0 | 0.5 | 0.4 |
| **2007** | 0.0 | 0.0 | 1.7 | 54.4 | 0.5 | 0.3 | 7.4 | 0.0 | 19.0 | 0.0 | 1.7 | 62.5 | 15.8 | 239.2 | 264.1 | 13.9 | 0.0 | 75.1 | 28.0 |
| **2008** | --- | 0.3 | 0.9 | 2.1 | 5.8 | 0.1 | 59.2 | 155.4 | 18.0 | --- | 9.6 | 30.6 | 178.9 | 64.6 | --- | 26.8 | --- | 10.1 | 10.2 |
| **2009** | 0.3 | 0.1 | 2.9 | 8.4 | 2.9 | 4.6 | 0.1 | 31.8 | 0.7 | 0.2 | 1.4 | 12.8 | 3.6 | 26.8 | 32.0 | 16.2 | 0.4 | 1.3 | 2.7 |
| **2010** | 0.0 | 0.9 | 8.3 | 15.2 | 1.3 | 0.1 | 45.5 | 0.0 | 0.0 | 0.0 | 16.0 | 3.8 | 2.8 | 0.9 | 35.8 | 0.2 | 0.0 | 5.7 | 4.0 |
| **2011** | 0.0 | 1.1 | 0.9 | 28.1 | 0.4 | 0.5 | 0.7 | 0.0 | 0.0 | 0.0 | 1.2 | 2.9 | 1.2 | 0.6 | 0.4 | 0.2 | 0.0 | 27.7 | 6.1 |

*Table 4. (Continued).*

| | STATIONS | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **6.3** | **6.4** | **6.5** | **6.6** | **6.7** | **7.1** | **7.2** | **7.3** | **7.4** | **7.5** | **7.6** | **7.7** | **8.1** | **8.2** | **8.3** | **8.4** | **8.5** | **8.6** | **8.7** |
| **STRATE / *STRATUM*** | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 3 | 2 | 1 |
| **LONGITUDE** | -63.25 | -63.25 | -63.25 | -63.25 | -63.25 | -63.75 | -63.75 | -63.75 | -63.75 | -63.75 | -63.75 | -63.75 | -64.37 | -64.25 | -64.25 | -64.25 | -64.25 | -64.08 | -64.08 |
| **LATITUDE** | 47.17 | 47.50 | 47.83 | 48.17 | 48.50 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 48.50 | 48.83 | 46.83 | 47.17 | 47.50 | 47.83 | 48.17 | 48.50 | 48.75 |
| **1979** | 217.6 | 115.1 | 50.4 | 7.8 | 4.2 | 335.1 | 283.4 | 267.2 | 24.0 | 8.4 | 6.4 | --- | --- | 494.2 | 345.1 | 173.4 | 16.5 | 15.5 | --- |
| **1983** | 95.0 | 100.1 | 291.4 | 104.0 | 10.2 | 46.5 | 11.2 | 91.8 | 79.2 | 68.7 | 19.2 | 50.7 | 8.3 | 78.0 | 66.6 | 36.3 | 12.2 | 15.7 | 12.8 |
| **1984** | 290.4 | 396.2 | 337.7 | 220.2 | 2.3 | 55.6 | 48.0 | 122.3 | 239.6 | 312.1 | 373.2 | 72.5 | 15.1 | 28.2 | 210.8 | 368.5 | 519.8 | 166.1 | 39.6 |
| **1985** | 104.4 | 703.6 | 279.0 | 835.5 | 51.8 | 429.0 | 398.8 | 695.1 | 773.2 | 421.0 | 313.4 | 13.8 | 46.4 | --- | 379.2 | 458.9 | 173.3 | 47.5 | 134.8 |
| **1986** | 319.9 | 581.9 | 965.3 | 1 099.5 | 282.5 | 1 916.1 | 1 132.5 | 284.9 | 203.5 | 1 029.8 | 484.2 | 7.2 | 105.7 | 455.6 | 901.3 | 1 726.7 | 442.6 | 449.6 | 47.0 |
| **1987** | 73.6 | 349.0 | 529.7 | 280.9 | 147.5 | 17.0 | 136.9 | 402.3 | 718.6 | 267.0 | 0.3 | 1.9 | 1.6 | 137.4 | 225.7 | 2 447.1 | 84.9 | 111.9 | 11.4 |
| **1988** | 477.0 | 234.5 | 889.5 | 28.0 | 0.3 | 103.4 | 445.3 | 704.8 | 209.6 | 165.0 | 98.5 | 0.1 | 9.3 | 739.8 | 639.9 | 676.5 | 1 434.7 | 607.6 | 49.4 |
| **1989** | 77.6 | 285.4 | 15.8 | 27.4 | 23.4 | 35.0 | 147.5 | 415.8 | 312.1 | 783.2 | 69.7 | 1.5 | 0.0 | 87.4 | 462.3 | 347.9 | 123.7 | 5.9 | 3.7 |
| **1990** | 67.3 | 241.6 | 114.8 | 270.7 | 0.3 | 112.7 | 711.0 | 190.6 | 278.0 | 45.4 | 1.0 | 3.5 | 1.3 | 307.4 | 233.6 | 658.4 | 291.2 | 34.4 | 7.5 |
| **1991** | 41.2 | 1 199.6 | 1 156.4 | 2.5 | 0.0 | --- | 272.3 | 123.9 | 253.8 | 248.3 | 0.0 | 0.5 | 11.2 | 219.1 | 598.9 | 295.7 | 1 317.2 | 52.2 | 274.2 |
| **1992** | 86.5 | 244.9 | 1 138.6 | 513.9 | 0.0 | 148.1 | 102.6 | 687.6 | 154.0 | 752.2 | 16.5 | 0.0 | 1.5 | 64.4 | 290.7 | 1 216.1 | 755.9 | 9.6 | 49.5 |
| **1993** | 279.3 | 434.5 | 956.4 | 237.0 | 16.6 | 489.4 | 968.0 | 604.0 | 143.9 | 71.8 | 0.8 | --- | 105.5 | 1 590.9 | 1 330.6 | 87.1 | 248.6 | 13.7 | --- |
| **1994** | 38.0 | 777.4 | 63.0 | 35.6 | 0.0 | 386.3 | 136.0 | 1 146.2 | 118.9 | 197.0 | 4.3 | 0.2 | 33.2 | 349.9 | 280.0 | 169.4 | 86.0 | 144.3 | 2.6 |
| **1996** | 272.9 | 60.3 | 14.1 | 0.2 | 0.0 | 63.5 | 20.5 | 20.9 | 43.4 | 77.6 | --- | 0.0 | 0.9 | 7.7 | 264.1 | 28.9 | 117.5 | 15.1 | 0.4 |
| **1998** | 48.1 | 54.0 | 52.8 | 7.3 | 11.6 | 17.3 | 68.7 | 6.1 | 101.5 | 11.9 | 0.0 | 0.0 | 1.5 | 26.8 | 31.7 | 27.2 | 36.1 | 0.1 | 0.0 |
| **2000** | 21.8 | 23.4 | 98.4 | 0.0 | 0.3 | 204.3 | 44.3 | 70.6 | 1 136.3 | 11.3 | 0.0 | 0.0 | 0.4 | 27.7 | 22.0 | 54.6 | 91.0 | 0.4 | 0.0 |
| **2002** | 296.7 | 238.6 | 11.2 | 0.0 | 0.0 | 298.0 | 313.0 | 221.1 | 1 046.8 | 48.4 | 0.4 | 0.0 | 15.9 | 100.6 | 130.3 | 81.4 | 334.8 | 0.0 | 0.0 |
| **2003** | 303.1 | 49.0 | 0.0 | 0.0 | 0.0 | 381.9 | 995.8 | 804.1 | 1.7 | 0.1 | 0.0 | 0.0 | 60.0 | 303.8 | 358.7 | 294.6 | 95.2 | 0.0 | 0.0 |
| **2004** | 103.9 | 0.0 | 45.9 | 0.7 | 0.1 | 605.6 | 198.0 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | --- | 135.7 | 4.8 | 41.0 | 2.6 | 0.0 | 0.0 |
| **2005** | 257.9 | 0.1 | 0.0 | 0.1 | 0.0 | 510.6 | 158.2 | 10.1 | 4.6 | 0.0 | 0.1 | --- | 11.2 | 9.1 | 273.0 | 46.0 | 3.7 | 0.0 | 0.0 |
| **2006** | 0.5 | 61.6 | 42.9 | 10.3 | 16.8 | 0.1 | 1.7 | 3.6 | 7.0 | 9.0 | 2.7 | 3.3 | 0.5 | 16.2 | 121.1 | 8.5 | 3.9 | 15.3 | 4.8 |
| **2007** | 46.6 | 15.5 | 219.6 | 141.2 | 7.7 | 26.3 | 40.0 | 118.3 | 36.8 | 15.7 | 32.6 | 4.8 | 0.0 | 36.1 | 96.2 | 85.6 | 102.1 | 132.6 | 42.4 |
| **2008** | 132.1 | 51.3 | --- | 302.9 | --- | 29.9 | 85.3 | 241.2 | --- | 46.0 | 5.9 | 0.2 | 5.1 | 68.7 | 155.1 | 376.1 | 50.5 | 3.7 | 1.8 |
| **2009** | 29.0 | 78.2 | 3.2 | 2.9 | 0.0 | 10.3 | 25.4 | 100.0 | 61.1 | 10.1 | 238.5 | 0.2 | 23.2 | 21.3 | 40.2 | 335.9 | 31.6 | --- | --- |
| **2010** | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 14.7 | 3.9 | 40.4 | 0.9 | 1.5 | 0.0 | 0.0 | 31.3 | 19.6 | 28.5 | 0.7 | 0.1 | 59.5 | 1.3 |
| **2011** | 5.8 | 0.3 | 0.3 | 1.7 | 0.1 | 18.8 | 2.1 | 0.6 | 43.0 | 9.3 | 11.1 | 4.9 | 0.8 | 69.4 | 102.8 | 21.0 | 2.3 | 15.9 | 10.5 |

*Table 4. (Continued).*

| | STATIONS | | | | | | | | STATISTIQUES / *STATISTICS* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **9.1** | **9.2** | **9.3** | **9.4** | **9.5** | **10.1** | **11.1** | **12.1** | | | | | | |
| **STRATE / *STRATUM*** | 1 | 1 | 2 | 2 | 3 | 2 | 3 | 3 | **Moyenne / *Mean*** | **É.-T. / *STD*** | **Min.** | **Max.** | **Étendue / *Range*** | **n** |
| **LONGITUDE** | -64.67 | -64.75 | -64.67 | -64.75 | -64.75 | -65.25 | -65.75 | -66.13 | | | | | | |
| **LATITUDE** | 46.83 | 47.17 | 47.50 | 47.93 | 48.17 | 47.93 | 48.00 | 48.05 | | | | | | |
| **1979** | --- | 8.1 | 197.8 | 92.8 | 103.2 | 106.7 | 361.1 | 1 273.0 | 131.1 | 211.8 | 0.0 | 1273.0 | 1273.0 | 59 |
| **1983** | 69.4 | 16.8 | 36.1 | 21.9 | 31.0 | 6.8 | 82.9 | 0.8 | 86.8 | 161.7 | 0.2 | 997.3 | 997.2 | 64 |
| **1984** | 102.8 | 80.9 | 163.5 | 515.3 | 81.8 | 639.2 | 186.9 | 159.1 | 135.4 | 177.9 | 0.0 | 834.5 | 834.5 | 65 |
| **1985** | 6.6 | 3.5 | 303.7 | 377.5 | 772.0 | 419.8 | 743.7 | 345.4 | 206.7 | 231.6 | 0.0 | 835.5 | 835.5 | 64 |
| **1986** | 149.1 | 180.0 | 792.0 | 431.4 | 662.3 | 238.1 | 446.5 | 847.1 | 429.6 | 428.0 | 0.0 | 1916.1 | 1916.1 | 57 |
| **1987** | 28.9 | 11.9 | 84.5 | 626.4 | 504.7 | 90.2 | 605.3 | 330.3 | 193.1 | 348.6 | 0.3 | 2447.1 | 2446.8 | 65 |
| **1988** | 11.6 | 333.1 | 197.3 | 668.0 | 586.5 | 73.3 | 460.9 | 11.4 | 227.2 | 293.1 | 0.0 | 1434.7 | 1434.7 | 62 |
| **1989** | 0.0 | 30.5 | 348.6 | 42.5 | 267.1 | 113.4 | 533.1 | 2.0 | 111.5 | 202.8 | 0.0 | 1056.3 | 1056.3 | 65 |
| **1990** | 69.8 | 192.0 | 345.1 | 8.9 | 730.5 | 342.8 | 685.4 | 99.6 | 113.1 | 180.1 | 0.0 | 730.5 | 730.5 | 65 |
| **1991** | 200.4 | 488.0 | 650.6 | 194.9 | 1 158.4 | 36.4 | 513.9 | 30.8 | 213.6 | 345.0 | 0.0 | 1317.2 | 1317.2 | 63 |
| **1992** | 15.3 | 57.3 | 263.1 | 212.6 | 1 010.7 | 1 038.0 | 830.1 | 51.4 | 187.9 | 316.5 | 0.0 | 1216.1 | 1216.1 | 65 |
| **1993** | 466.0 | 329.8 | 631.2 | 222.4 | 352.5 | 77.1 | 234.2 | 110.4 | 177.2 | 319.1 | 0.0 | 1590.9 | 1590.9 | 63 |
| **1994** | 169.8 | 61.4 | 73.0 | 10.8 | 154.1 | 79.8 | 80.2 | 247.5 | 86.0 | 186.4 | 0.0 | 1146.2 | 1146.2 | 65 |
| **1996** | 1.5 | 0.7 | 29.6 | 0.5 | 49.6 | 39.2 | 23.9 | 0.8 | 31.4 | 56.1 | 0.0 | 272.9 | 272.9 | 64 |
| **1998** | 1.1 | 1.1 | 98.0 | 0.5 | 21.3 | 0.5 | 70.3 | 12.1 | 26.0 | 40.4 | 0.0 | 204.5 | 204.5 | 64 |
| **2000** | 58.0 | 7.8 | 103.2 | 13.5 | 30.8 | 12.8 | 57.7 | 0.7 | 38.7 | 145.4 | 0.0 | 1136.3 | 1136.3 | 64 |
| **2002** | 19.4 | 157.6 | 198.0 | 0.0 | 22.6 | 3.9 | 20.6 | 0.8 | 76.9 | 160.3 | 0.0 | 1046.8 | 1046.8 | 64 |
| **2003** | 139.9 | 87.0 | 330.8 | 98.7 | 5.8 | 3.4 | 269.1 | 10.9 | 104.0 | 192.7 | 0.0 | 995.8 | 995.8 | 65 |
| **2004** | 610.4 | 200.8 | 385.4 | 28.0 | 0.3 | 0.7 | 79.3 | 1.6 | 69.4 | 146.4 | 0.0 | 610.4 | 610.4 | 64 |
| **2005** | 99.3 | 187.9 | 279.2 | 0.2 | 0.0 | 0.7 | 8.3 | --- | 41.7 | 97.7 | 0.0 | 510.6 | 510.6 | 61 |
| **2006** | 14.0 | 4.3 | 8.9 | 11.0 | 1.0 | 5.4 | 5.5 | --- | 6.9 | 17.6 | 0.0 | 121.1 | 121.1 | 63 |
| **2007** | 1.0 | 4.7 | 25.3 | 16.0 | 642.9 | 317.1 | 25.8 | 1.5 | 47.6 | 100.7 | 0.0 | 642.9 | 642.9 | 65 |
| **2008** | 59.0 | 53.4 | 98.7 | 0.2 | 371.6 | 63.2 | 41.5 | --- | 54.1 | 90.5 | 0.0 | 376.1 | 376.1 | 53 |
| **2009** | 51.5 | 47.4 | 215.3 | 29.9 | 5.0 | 20.3 | 10.3 | 0.9 | 27.6 | 61.8 | 0.0 | 335.9 | 335.9 | 63 |
| **2010** | 0.6 | 38.2 | 31.4 | 1.1 | 126.7 | 5.0 | 36.9 | 1.4 | 9.2 | 20.2 | 0.0 | 126.7 | 126.7 | 65 |
| **2011** | 0.8 | 102.4 | 392.2 | 0.8 | 12.4 | 9.1 | 14.6 | 1.1 | 14.5 | 52.2 | 0.0 | 392.2 | 392.2 | 64 |

*Table 5. Daily egg production (stratified mean) ($n/m^2$) of Atlantic mackerel for the entire sampled area by the research surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2011.*

| ANNÉE / *YEAR* | RELEVÉ / *SURVEY** | NOMBRE DE STATIONS / *NUMBER OF STATIONS* Strate / *Stratum* | | | PRODUCTION QUOTIDIENNE D'ŒUFS / *DAILY EGG PRODUCTION* ($n/m^2$) Moyenne / *Average* Strate / *Stratum* | | | Variance Strate / *Stratum* | | | Moyenne stratifiée / *Stratified mean* | Variance de la moyenne / *Variance of the mean* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | $m_1$ | $m_2$ | $m_3$ | $v_1$ | $v_2$ | $v_3$ | | |
| **1979** | P-221 | 21 | 23 | 15 | 21.0 | 144.5 | 264.8 | 548 | 21 655 | 113 473 | 122.9 | 603 |
| **1983** | P-353 | 27 | 22 | 15 | 33.4 | 81.5 | 190.8 | 1 275 | 19 920 | 68 226 | 89.2 | 402 |
| **1984** | N-030 | 27 | 23 | 15 | 29.0 | 149.6 | 305.0 | 1 086 | 30 198 | 42 126 | 138.3 | 325 |
| **1985** | P-324 | 27 | 22 | 15 | 39.9 | 233.4 | 467.5 | 2 126 | 29 195 | 66 041 | 211.4 | 440 |
| **1986** | P-337 | 19 | 23 | 15 | 101.6 | 493.4 | 747.3 | 11 593 | 175 825 | 180 688 | 391.9 | 1 675 |
| **1987** | P-353 | 27 | 23 | 15 | 55.5 | 109.5 | 569.1 | 3 240 | 17 290 | 322 857 | 205.1 | 1 531 |
| **1988** | P-369 | 25 | 22 | 15 | 59.7 | 277.6 | 432.4 | 9 123 | 69 142 | 155 619 | 224.7 | 1 071 |
| **1989** | P-386 | 27 | 23 | 15 | 17.4 | 118.3 | 270.3 | 985 | 40 432 | 78 550 | 114.5 | 531 |
| **1990** | P-400 | 27 | 23 | 15 | 21.7 | 105.0 | 290.0 | 1 701 | 29 333 | 49 342 | 117.2 | 358 |
| **1991** | P-415 | 26 | 22 | 15 | 55.1 | 135.5 | 603.0 | 12 414 | 23 836 | 250 438 | 221.9 | 1 307 |
| **1992** | P-430 | 27 | 23 | 15 | 16.4 | 193.2 | 488.5 | 623 | 82 033 | 174 440 | 194.1 | 1 134 |
| **1993** | P-445 | 25 | 23 | 15 | 46.6 | 221.3 | 327.4 | 12 441 | 146 570 | 141 518 | 174.2 | 1 354 |
| **1994** | N-209 | 27 | 23 | 15 | 12.2 | 86.4 | 218.4 | 1 178 | 15 577 | 102 952 | 88.8 | 533 |
| **1996** | GE-001 | 27 | 22 | 15 | 8.1 | 35.3 | 67.6 | 166 | 3 514 | 6 109 | 32.1 | 44 |
| **1998** | N-223 | 27 | 22 | 15 | 9.4 | 29.7 | 50.3 | 299 | 2 391 | 1 996 | 26.4 | 22 |
| **2000** | MB | 26 | 23 | 15 | 5.0 | 24.2 | 119.3 | 153 | 2 087 | 82 170 | 40.6 | 375 |
| **2002** | MB | 27 | 22 | 15 | 15.6 | 77.0 | 186.9 | 1 043 | 12 266 | 75 032 | 79.2 | 396 |
| **2003** | Coriolis II | 27 | 23 | 15 | 41.0 | 163.3 | 126.7 | 10 310 | 54 890 | 50 392 | 101.7 | 531 |
| **2004** | Teleost | 26 | 23 | 15 | 39.2 | 133.4 | 23.4 | 15 356 | 36 262 | 1 412 | 64.9 | 271 |
| **2005** | Teleost | 24 | 23 | 14 | 21.6 | 72.8 | 25.0 | 1 970 | 19 265 | 5 239 | 38.7 | 123 |
| **2006** | Coriolis II | 26 | 23 | 14 | 1.8 | 5.0 | 19.6 | 10 | 31 | 1 171 | 7.4 | 6 |
| **2007** | Teleost | 27 | 23 | 15 | 4.9 | 41.7 | 133.6 | 137 | 4 550 | 27 436 | 49.7 | 143 |
| **2008** | Teleost | 20 | 22 | 11 | 6.7 | 33.8 | 180.8 | 291 | 1 348 | 16 111 | 60.2 | 106 |
| **2009** | Teleost | 26 | 27 | 26 | 5.4 | 3.4 | 4.8 | 189 | 86 | 401 | 27.4 | 56 |
| **2010** | Teleost | 22 | 22 | 23 | 38.0 | 10.0 | 26.2 | 5 210 | 250 | 6 608 | 9.3 | 7 |
| **2011** | Teleost | 15 | 16 | 15 | 50.9 | 18.3 | 13.5 | 7 096 | 1 151 | 750 | 13.8 | 35 |

* P=E.E. Prince; N=Alfred Needler; GE=Grande-Entrée; MB=Martha L. Black

*Table 6. Parameters of the variograms used for kriging the daily egg productions of the research surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2011.*

| ANNÉE / *YEAR* | MODÈLE* / *MODEL** | Pépite / *Nugget* ($C_0$) | Plateau / *Sill* ($C_0 + C$) | Étendue / *Range* ($A_0$) | $R^2$ | RSS ** |
|---|---|---|---|---|---|---|
| **1979** | Sphérique / *Spherical* | 13150 | 42840 | 249.6 | 0.993 | 2.91E+06 |
| **1983** | Sphérique / *Spherical* | 10 | 7872 | 144.4 | 0.988 | 1.34E+06 |
| **1984** | Sphérique / *Spherical* | 8970 | 23700 | 256.8 | 0.935 | 9.34E+06 |
| **1985** | Sphérique / *Spherical* | 15200 | 59290 | 194.1 | 0.970 | 3.29E+07 |
| **1986** | Sphérique / *Spherical* | 6700 | 194700 | 79.0 | 0.924 | 3.07E+08 |
| **1987** | Sphérique / *Spherical* | 4200 | 130000 | 74.0 | 0.891 | 1.89E+08 |
| **1988** | Exponentiel / *Exponential* | 12800 | 101300 | 68.5 | 0.973 | 1.01E+08 |
| **1989** | Sphérique / *Spherical* | 1790 | 15690 | 143.4 | 0.960 | 2.73E+07 |
| **1990** | Sphérique / *Spherical* | 8340 | 24700 | 256.2 | 0.918 | 1.32E+07 |
| **1991** | Sphérique / *Spherical* | 10 | 28200 | 67.3 | 0.912 | 6.34E+07 |
| **1992** | Sphérique / *Spherical* | 50700 | 101500 | 182.3 | 0.910 | 1.46E+08 |
| **1993** | Exponentiel / *Exponential* | 17100 | 127800 | 201.1 | 0.973 | 2.46E+08 |
| **1994** | Sphérique / *Spherical* | 10 | 20890 | 110.1 | 0.974 | 5.72E+06 |
| **1996** | Sphérique / *Spherical* | 1 | 1930 | 119.6 | 0.942 | 2.31E+05 |
| **1998** | Sphérique / *Spherical* | 1 | 844.1 | 99.3 | 0.955 | 1.33E+04 |
| **2000** | Sphérique / *Spherical* | 351 | 702 | 189.8 | 0.938 | 3.42E+03 |
| **2002** | Sphérique / *Spherical* | 810 | 11340 | 188.9 | 0.989 | 5.47E+05 |
| **2003** | Sphérique / *Spherical* | 10 | 22910 | 231.7 | 0.974 | 8.76E+06 |
| **2004** | Sphérique / *Spherical* | 1510 | 4712 | 216.1 | 0.939 | 3.76E+05 |
| **2005** | Sphérique / *Spherical* | 10 | 4875 | 121.5 | 0.905 | 1.90E+06 |
| **2007** | Sphérique / *Spherical* | 10 | 9924 | 105.6 | 0.947 | 7.54E-06 |
| **2008** | Sphérique / *Spherical* | 10 | 7849 | 90.4 | 0.827 | 6.89E-06 |
| **2009** | Sphérique / *Spherical* | 10 | 3540 | 53.9 | 0.934 | 1.81E+05 |
| **2010** | Sphérique / *Spherical* | 1 | 347 | 60.4 | 0.864 | 6.88E+03 |
| **2011** | Sphérique / *Spherical* | 1 | 434 | 127.0 | 0.900 | 1.33E+03 |

* Sphérique / *Spherical* $\gamma(h) = \begin{cases} C0 + C\left[1.5\left(\frac{h}{A_0}\right) - 0.5\left(\frac{h}{A_0}\right)^3\right] & \text{if } h \le A_0, \text{ et/and } C0+C \text{ autrement/otherwise} \end{cases}$

Exponentiel / *Exponential* $\gamma(h) = C0 + C\left[1 - \exp\left(-\frac{h}{A_0}\right)\right]$

** Somme des carrés des résidus / *Residual sum of squares*

*Table 7. Daily egg production (kriged mean) (n/m$^2$) of Atlantic mackerel for the entire sampled area by the research surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2011.*

| **ANNÉE / *YEAR*** | **NOMBRE-*NUMBER* / m$^2$** | | | **INTERVALLE CONFIANCE 95 % *95% CONFIDENCE INTERVAL*** | |
|---|---|---|---|---|---|
| | Moyenne / Average | Variance | CV | Limite inférieure / *Lower limit* | Limite supérieure / *Upper Limit* |
| **1979** | 121.51 | 260.82 | 0.13 | 89.86 | 153.17 |
| **1983** | 90.33 | 2.23 | 0.02 | 87.41 | 93.26 |
| **1984** | 135.91 | 102.07 | 0.07 | 116.11 | 155.72 |
| **1985** | 203.77 | 284.18 | 0.08 | 170.72 | 236.81 |
| **1986** | 428.27 | 1144.24 | 0.08 | 361.97 | 494.57 |
| **1987** | 200.98 | 468.67 | 0.11 | 158.55 | 243.41 |
| **1988** | 232.81 | 774.82 | 0.12 | 178.26 | 287.37 |
| **1989** | 114.26 | 18.39 | 0.04 | 105.86 | 122.67 |
| **1990** | 112.13 | 95.74 | 0.09 | 92.95 | 131.30 |
| **1991** | 219.46 | 30.75 | 0.03 | 208.59 | 230.33 |
| **1992** | 183.57 | 838.72 | 0.16 | 126.81 | 240.34 |
| **1993** | 178.37 | 547.21 | 0.13 | 132.52 | 224.21 |
| **1994** | 89.01 | 21.59 | 0.05 | 79.90 | 98.12 |
| **1996** | 32.83 | 1.45 | 0.04 | 30.47 | 35.19 |
| **1998** | 27.17 | 0.87 | 0.03 | 25.34 | 28.99 |
| **2000** | 73.13 | 0.18 | 0.01 | 72.30 | 73.97 |
| **2002** | 82.48 | 7.84 | 0.03 | 76.99 | 87.97 |
| **2003** | 108.62 | 8.44 | 0.03 | 102.93 | 114.32 |
| **2004** | 77.26 | 4.75 | 0.03 | 72.99 | 81.53 |
| **2005** | 44.46 | 5.35 | 0.05 | 39.93 | 49.00 |
| **2007** | 46.26 | 21.94 | 0.10 | 37.08 | 55.44 |
| **2008** | 59.12 | 37.19 | 0.10 | 47.17 | 71.07 |
| **2009** | 29.25 | 14.04 | 0.13 | 21.91 | 36.60 |
| **2010** | 8.53 | 1.26 | 0.13 | 6.33 | 10.73 |
| **2011** | 15.16 | 4.67 | 0.14 | 10.92 | 19.39 |

*Table 8. Parameters of the logistic model used to describe the daily changes in the mean gonadosomatic index values of the spawning seasons of 1979 and from 1983 to 2011.*

| ANNÉE / *YEAR* | PARAMÈTRES MODÈLE LOGISTIQUE* / *PARAMETERS LOGISTIC MODEL** | | | | Date médiane des relevés / *Median date of the surveys* | S** |
|---|---|---|---|---|---|---|
| | a | b | x0 | y0 | | |
| **1979** | 13.0575 | 14.4975 | 177.8867 | 0.0284 | 166.5 | 0.0177 |
| **1983** | 11.5863 | 33.1683 | 172.4413 | 0.6522 | 177.5 | 0.0357 |
| **1984** | 13.0000 | 19.6315 | 174.0580 | 0.5018 | 176.0 | 0.0270 |
| **1985** | 13.9005 | 16.2356 | 175.2628 | 0.3617 | 176.5 | 0.0228 |
| **1986** | 14.4193 | 15.3273 | 174.1798 | 0.3934 | 172.5 | 0.0221 |
| **1987** | 12.0224 | 20.1395 | 172.4082 | 0.5056 | 172.5 | 0.0291 |
| **1988** | 13.3372 | 26.6142 | 174.2490 | 0.5521 | 172.5 | 0.0381 |
| **1989** | 17.0650 | 11.4019 | 170.7835 | 0.2361 | 174.5 | 0.0161 |
| **1990** | 13.3555 | 14.3253 | 178.2834 | 0.4319 | 170.0 | 0.0192 |
| **1991*** ** | 18.1154 | 12.2182 | 167.6766 | 0.5171 | 172.0 | 0.0232 |
| **1992** | 12.6668 | 19.0768 | 176.9768 | 0.5655 | 172.0 | 0.0263 |
| **1993** | 12.8226 | 17.6929 | 180.0840 | 0.6077 | 170.0 | 0.0211 |
| **1994** | 11.6671 | 23.9986 | 175.9399 | 0.6016 | 168.5 | 0.0284 |
| **1996** | 14.4765 | 21.7761 | 172.6301 | 0.4623 | 172.5 | 0.0314 |
| **1998** | 14.0552 | 22.0477 | 167.9536 | 0.5520 | 167.0 | 0.0328 |
| **2000** | 13.0333 | 19.7498 | 173.2550 | 0.3784 | 174.0 | 0.0279 |
| **2002** | 14.3553 | 16.4767 | 169.6161 | 0.4487 | 171.5 | 0.0237 |
| **2003** | 14.4720 | 23.5582 | 170.7031 | 0.4759 | 171.5 | 0.0340 |
| **2004** | 10.5535 | 29.0933 | 175.5954 | 0.5096 | 169.5 | 0.0345 |
| **2005** | 16.0325 | 26.6581 | 173.7021 | 0.4628 | 170.0 | 0.0373 |
| **2006** | 14.9748 | 21.7965 | 167.4634 | 0.4492 | 184.0 | 0.0108 |
| **2007** | 12.3435 | 38.2537 | 176.9876 | 0.5289 | 176.0 | 0.0539 |
| **2008** | 10.3455 | 39.5329 | 176.6838 | 0.5034 | 176.5 | 0.0543 |
| **2009** | 11.4965 | 29.1543 | 174.0404 | 0.4101 | 168.5 | 0.0361 |
| **2010** | 13.0345 | 21.8685 | 170.4039 | 0.4374 | 168.0 | 0.0321 |
| **2011** | 18.2367 | 22.6462 | 166.6338 | 0.4072 | 166.0 | 0.0339 |

* $$y = y_0 + \frac{a}{\left[1+\left(\frac{x}{x_0}\right)^b\right]}$$

** Proportion journalière de la production d'œufs associée à la date médiane des relevés / *Daily proportion of the egg production associated with the median date of the surveys*

*** Une correction a été apportée pour forcer la présence d'un plateau aux valeurs les plus élevées de l'indice gonado-somatique / *A correction was applied to force the presence of a plateau for the highest gonadosomatic index values*

*Table 9. Characteristics of the Atlantic mackerel spawning seasons according to the model describing the proportion of eggs spawned daily.*

| ANNÉE / *YEAR* | JOUR DE L'ANNÉE / *DAY OF THE YEAR* | | | |
|---|---|---|---|---|
| | $f(x_1)$=2.5% | f(xi) Max. | $f(x_2)$=97.5% | Durée Ponte (D)* / *Spawning Duration (D)* * |
| **1979** | 138 | 176 | 229 | 91 |
| **1983** | 154 | 172 | 192 | 38 |
| **1984** | 144 | 173 | 209 | 65 |
| **1985** | 140 | 174 | 219 | 79 |
| **1986** | 137 | 173 | 221 | 84 |
| **1987** | 163 | 172 | 206 | 43 |
| **1988** | 152 | 174 | 200 | 48 |
| **1989** | 155 | 168 | 235 | 80 |
| **1990** | 165 | 177 | 230 | 65 |
| **1991** | 153 | 166 | 226 | 73 |
| **1992** | 146 | 176 | 214 | 68 |
| **1993** | 146 | 179 | 221 | 75 |
| **1994** | 168 | 175 | 205 | 37 |
| **1996** | 164 | 172 | 204 | 40 |
| **1998** | 159 | 167 | 198 | 39 |
| **2000** | 163 | 172 | 208 | 45 |
| **2002** | 158 | 168 | 211 | 53 |
| **2003** | 163 | 170 | 199 | 36 |
| **2004** | 169 | 175 | 199 | 30 |
| **2005** | 166 | 173 | 199 | 33 |
| **2006** | 159 | 167 | 198 | 39 |
| **2007** | 171 | 177 | 194 | 23 |
| **2008** | 171 | 176 | 193 | 22 |
| **2009** | 167 | 174 | 197 | 30 |
| **2010** | 162 | 170 | 194 | 32 |
| **2011** | 158 | 166 | 189 | 31 |
| **Min.** | 137 | 166 | 189 | 22 |
| **Moyenne / *Ave rage*** | 157 | 172 | 207 | 50 |
| **Max.** | 171 | 179 | 235 | 91 |

* Durée de la ponte (D) / *Spawning duration* (D): $X_{i=97.5} - X_{i=2.5}$

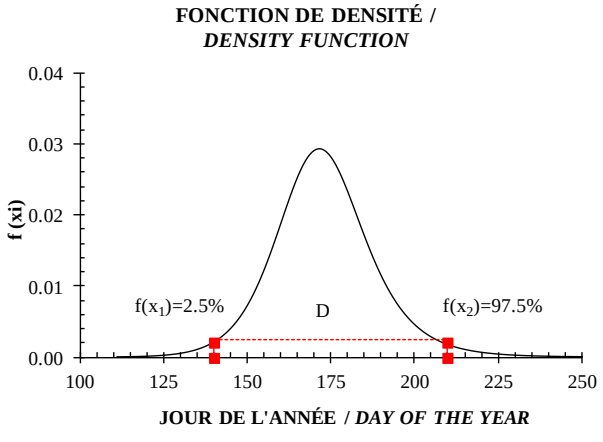


*Table 10. Total daily egg production (n) of the Atlantic mackerel for the research surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2011.*

| ANNÉE / *YEAR* | RELEVÉ / *SURVEY** | PRODUCTION TOTALE D'ŒUFS / *TOTAL EGG PRODUCTION* | | | | |
|---|---|---|---|---|---|---|
| | | | | INTERVALLE CONFIANCE (95 %) / *CONFIDENCE INTERVAL (95%)* | | |
| | | n | Variance | L. Inf. / *Lower L.* | L. Sup. / *Upper L.* | CV |
| **1979** | P-221 | 8.54E+12 | 2.91E+24 | 5.19E+12 | 1.19E+13 | 19.98 |
| **1983** | P-353 | 6.19E+12 | 1.94E+24 | 3.47E+12 | 8.92E+12 | 22.47 |
| **1984** | N-030 | 9.61E+12 | 1.57E+24 | 7.15E+12 | 1.21E+13 | 13.04 |
| **1985** | P-324 | 1.47E+13 | 2.12E+24 | 1.18E+13 | 1.75E+13 | 9.92 |
| **1986** | P-337 | 2.72E+13 | 8.08E+24 | 2.16E+13 | 3.28E+13 | 10.44 |
| **1987** | P-353 | 1.42E+13 | 7.39E+24 | 8.92E+12 | 1.96E+13 | 19.07 |
| **1988** | P-369 | 1.56E+13 | 5.16E+24 | 1.11E+13 | 2.01E+13 | 14.56 |
| **1989** | P-386 | 7.96E+12 | 2.56E+24 | 4.82E+12 | 1.11E+13 | 20.11 |
| **1990** | P-400 | 8.14E+12 | 1.72E+24 | 5.57E+12 | 1.07E+13 | 16.13 |
| **1991** | P-415 | 1.54E+13 | 6.31E+24 | 1.05E+13 | 2.03E+13 | 16.29 |
| **1992** | P-430 | 1.35E+13 | 5.47E+24 | 8.89E+12 | 1.81E+13 | 17.35 |
| **1993** | P-445 | 1.21E+13 | 6.53E+24 | 7.09E+12 | 1.71E+13 | 21.12 |
| **1994** | N-209 | 6.17E+12 | 2.57E+24 | 3.03E+12 | 9.31E+12 | 25.99 |
| **1996** | GE-001 | 2.23E+12 | 2.13E+23 | 1.32E+12 | 3.13E+12 | 20.73 |
| **1998** | N-223 | 1.83E+12 | 1.05E+23 | 1.20E+12 | 2.47E+12 | 17.67 |
| **2000** | MB | 2.82E+12 | 1.81E+24 | 1.81E+11 | 5.45E+12 | 47.75 |
| **2002** | MB | 5.50E+12 | 1.91E+24 | 2.79E+12 | 8.21E+12 | 25.12 |
| **2003** | Coriolis II | 7.06E+12 | 2.56E+24 | 3.93E+12 | 1.02E+13 | 22.66 |
| **2004** | Teleost | 4.50E+12 | 1.30E+24 | 2.27E+12 | 6.74E+12 | 25.36 |
| **2005** | Teleost | 2.68E+12 | 5.94E+23 | 1.17E+12 | 4.20E+12 | 28.72 |
| **2006** | Coriolis II | 5.12E+11 | 2.79E+22 | 1.85E+11 | 8.40E+11 | 32.58 |
| **2007** | Teleost | 3.45E+12 | 6.87E+23 | 1.83E+12 | 5.08E+12 | 24.01 |
| **2008** | Teleost | 4.18E+12 | 5.13E+23 | 2.78E+12 | 5.58E+12 | 17.13 |
| **2009** | Teleost | 1.90E+12 | 2.72E+23 | 8.82E+11 | 2.93E+12 | 27.39 |
| **2010** | Teleost | 6.48E+11 | 3.14E+22 | 3.01E+11 | 9.95E+11 | 27.34 |
| **2011** | Teleost | 9.58E+11 | 1.68E+23 | 1.56E+11 | 1.76E+12 | 42.71 |

* P=E.E. Prince; N=Alfred Needler; GE=Grande-Entrée; MB=Martha L. Black

*Table 11. Proportion of females, mean weight (g) of a fish, and mean fecundity used for the calculation of the Atlantic mackerel spawning biomass index.*

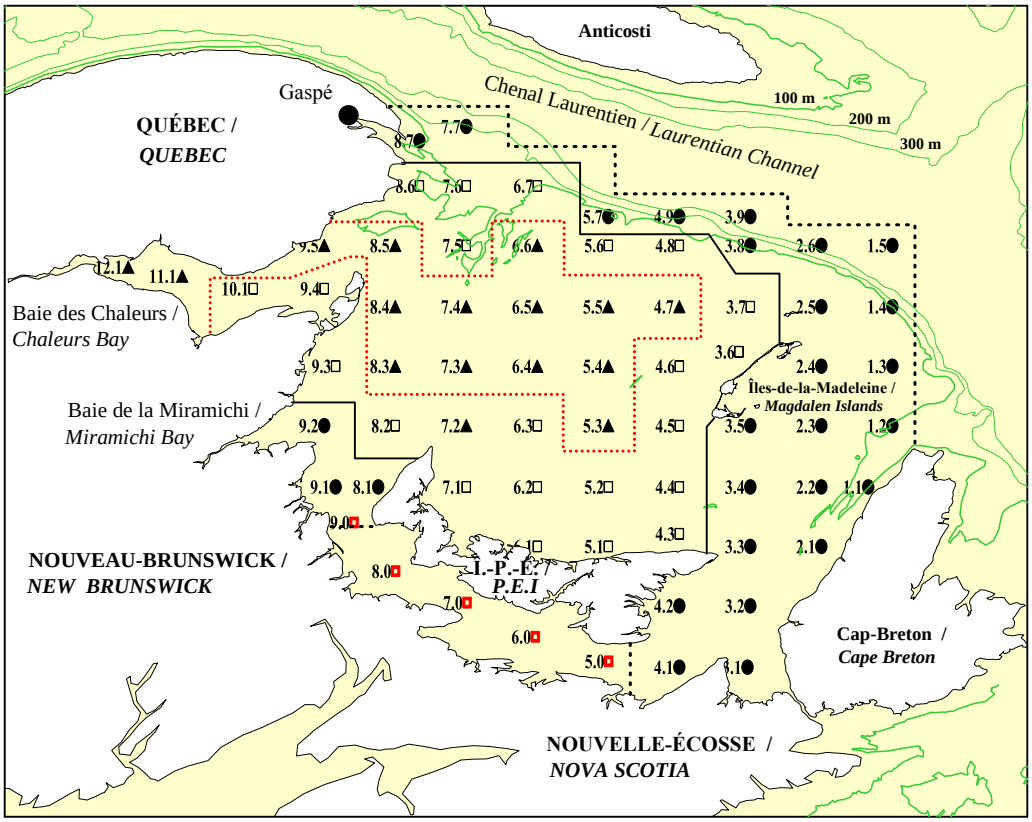
| ANNÉE / *YEAR* | PROPORTION | | POIDS / *WEIGHT* (g) | | FÉCONDITÉ / *FECUNDITY* | |
|---|---|---|---|---|---|---|
| | Femelle / *Female* | Variance | Moyenne / *Average* | Variance | Moyenne / *Average* | Variance |
| **1979** | 0.5171 | 0.0004 | 559.3 | 3 339 | 634 155 | 2.82E+10 |
| **1983** | 0.5183 | 0.0005 | 473.6 | 22 419 | 462 421 | 1.19E+10 |
| **1984** | 0.5124 | 0.0011 | 523.7 | 28 454 | 501 014 | 4.76E+10 |
| **1985** | 0.5115 | 0.0009 | 526.2 | 47 179 | 544 311 | 4.90E+10 |
| **1986** | 0.5120 | 0.0006 | 433.2 | 13 851 | 593 853 | 6.14E+10 |
| **1987** | 0.5150 | 0.0007 | 458.1 | 9 992 | 499 572 | 3.17E+10 |
| **1988** | 0.5193 | 0.0005 | 561.0 | 10 753 | 598 637 | 2.29E+10 |
| **1989** | 0.5155 | 0.0010 | 560.4 | 13 097 | 703 542 | 2.81E+10 |
| **1990** | 0.5108 | 0.0007 | 487.7 | 26 437 | 553 083 | 3.34E+10 |
| **1991** | 0.5207 | 0.0008 | 456.8 | 17 467 | 462 272 | 2.53E+10 |
| **1992** | 0.5072 | 0.0004 | 404.0 | 21 204 | 499 101 | 2.39E+10 |
| **1993** | 0.5096 | 0.0005 | 480.7 | 13 495 | 580 252 | 3.09E+10 |
| **1994** | 0.5013 | 0.0008 | 514.1 | 11 014 | 469 731 | 2.83E+10 |
| **1996** | 0.5203 | 0.0005 | 528.0 | 24 221 | 582 107 | 2.51E+10 |
| **1998** | 0.5077 | 0.0008 | 471.3 | 21 565 | 489 902 | 1.08E+10 |
| **2000** | 0.5185 | 0.0012 | 466.1 | 20 430 | 561 074 | 2.18E+10 |
| **2002** | 0.5053 | 0.0009 | 380.5 | 14 275 | 450 159 | 1.43E+10 |
| **2003** | 0.5179 | 0.0007 | 423.1 | 7 275 | 553 256 | 1.60E+10 |
| **2004** | 0.5176 | 0.0009 | 352.7 | 3 524 | 546 061 | 1.63E+10 |
| **2005** | 0.5089 | 0.0012 | 354.3 | 10 519 | 569 694 | 1.43E+05 |
| **2006** | 0.5106 | 0.0011 | 348.8 | 13 224 | 598 761 | 1.97E+05 |
| **2007** | 0.5142 | 0.0006 | 341.3 | 10 642 | 554 931 | 1.97E+10 |
| **2008** | 0.5144 | 0.0008 | 338.9 | 10 821 | 511 405 | 1.26E+05 |
| **2009** | 0.5084 | 0.0008 | 342.2 | 7 065 | 481 941 | 1.22E+05 |
| **2010** | 0.5142 | 0.0007 | 350.4 | 7 889 | 530 018 | 1.28E+05 |
| **2011** | 0.5109 | 0.0007 | 335.5 | 8 840 | 520 156 | 1.60E+05 |

*Table 12. Spawning biomass index (t) of Atlantic mackerel according to two different approaches (TEPM: Total Egg Production Method; DFRM: Daily Fecundity Reduction Method).*

| ANNÉE / *YEAR* | RELEVÉ / *SURVEY** | MÉTHODE DE LA PRODUCTION TOTALE D'ŒUFS (MPTO) / *TOTAL EGG PRODUCTION METHOD (TEPM)* | | | MÉTHODE DE LA RÉDUCTION JOURNALIÈRE DE LA FÉCONDITÉ (MRJF) / *DAILY FECUNDITY REDUCTION METHOD (DFRM)* | | |
|---|---|---|---|---|---|---|---|
| | | BIOMASSE REPRODUCTRICE (t) / *SPAWNING BIOMASS (t)* | INTERVALLE CONFIANCE (95 %) / *CONFIDENCE INTERVAL (95%)* L. Inf. / *Lower L.* | L. Sup. / *Upper L.* | BIOMASSE REPRODUCTRICE (t) / *SPAWNING BIOMASS (t)* | INTERVALLE CONFIANCE (95 %) / *CONFIDENCE INTERVAL (95%)* L. Inf. / *Lower L.* | L. Sup. / *Upper L.* |
| **1979** | P-221 | 820 554 | 670 391 | 970 718 | | | |
| **1983** | P-353 | 342 591 | 260 329 | 424 853 | | | |
| **1984** | N-030 | 726 183 | 516 577 | 935 790 | | | |
| **1985** | P-324 | 1 217 178 | 848 625 | 1 585 732 | | | |
| **1986** | P-337 | 1 754 052 | 1 293 813 | 2 214 290 | | | |
| **1987** | P-353 | 872 703 | 662 915 | 1 082 490 | | | |
| **1988** | P-369 | 739 208 | 603 293 | 875 123 | | | |
| **1989** | P-386 | 757 877 | 607 657 | 908 098 | | | |
| **1990** | P-400 | 725 415 | 536 492 | 914 337 | | | |
| **1991** | P-415 | 1 284 928 | 969 028 | 1 600 829 | | | |
| **1992** | P-430 | 796 459 | 581 190 | 1 011 727 | | | |
| **1993** | P-445 | 935 545 | 726 633 | 1 144 456 | | | |
| **1994** | N-209 | 467 261 | 350 826 | 583 696 | | | |
| **1996** | GE-001 | 128 149 | 99 446 | 156 852 | 166 903 | 43 384 | 290 423 |
| **1998** | N-223 | 103 242 | 80 323 | 126 161 | 66 768 | 18 387 | 115 148 |
| **2000** | MB | 165 017 | 112 662 | 217 373 | 207 302 | 0 | 441 429 |
| **2002** | MB | 379 070 | 281 852 | 476 288 | 359 330 | 64 642 | 654 017 |
| **2003** | Coriolis II | 314 752 | 254 150 | 375 355 | | | |
| **2004** | Teleost | 162 714 | 129 616 | 195 812 | | | |
| **2005** | Teleost | 86 487 | 67 790 | 105 183 | | | |
| **2006** | Coriolis II | 54 133 | 41 263 | 67 004 | | | |
| **2007** | Teleost | 76 532 | 18 345 | 18 345 | | | |
| **2008** | Teleost | 99 631 | 22 235 | 22 235 | | | |
| **2009** | Teleost | 73 743 | 14 050 | 14 050 | | | |
| **2010** | Teleost | 25 960 | 5 016 | 5 016 | | | |
| **2011** | Teleost | 35 714 | 9 441 | 9 441 | | | |

* P=E.E. Prince; N=Alfred Needler; GE=Grande-Entrée; MB=Martha L. Black

# FIGURES




**LÉGENDE / *LEGEND:***

● Strate / *Stratum 1*

□ Strate / *Stratum 2*

▲ Strate / *Stratum 3*

*Figure 1. Map of the stations and strata of the Atlantic mackerel egg survey conducted in the southern Gulf of St. Lawrence (stations sampled in the Northumberland Strait between 2006 and 2009 are indicated by ◘ ).*

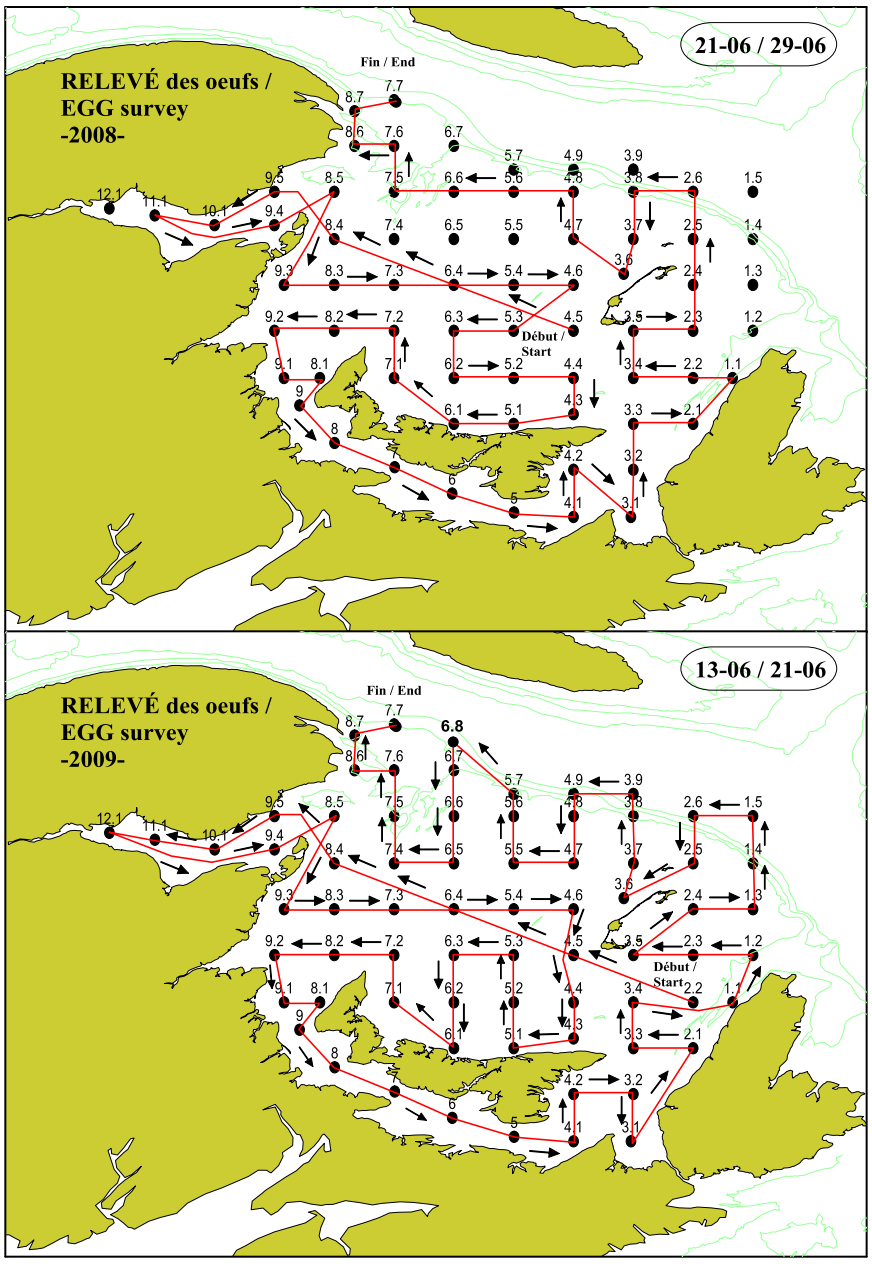



*Figure 2. Sampling patterns of the Atlantic mackerel egg surveys conducted in the southern Gulf of St. Lawrence from 2008 to 2011.*

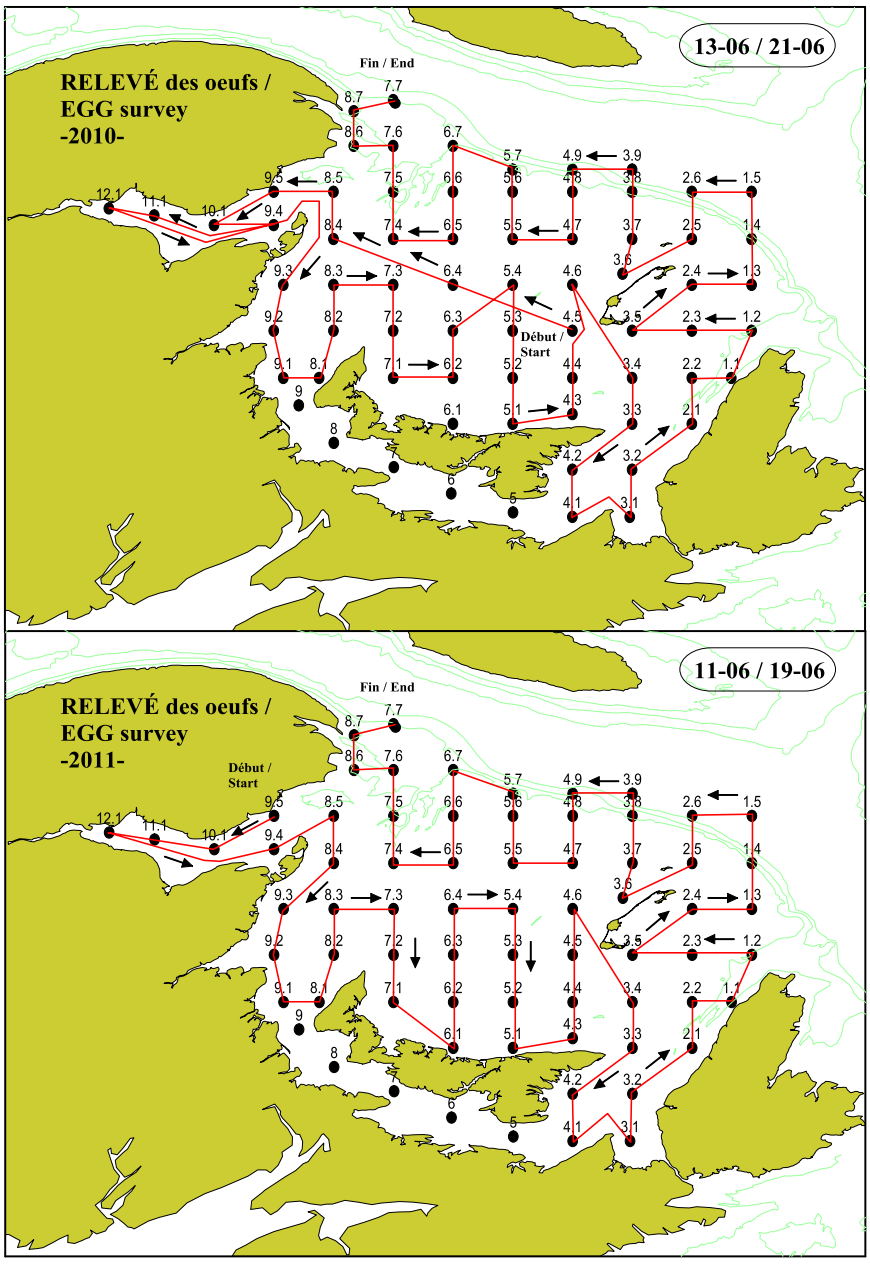



*Figure 2. (Continued).*

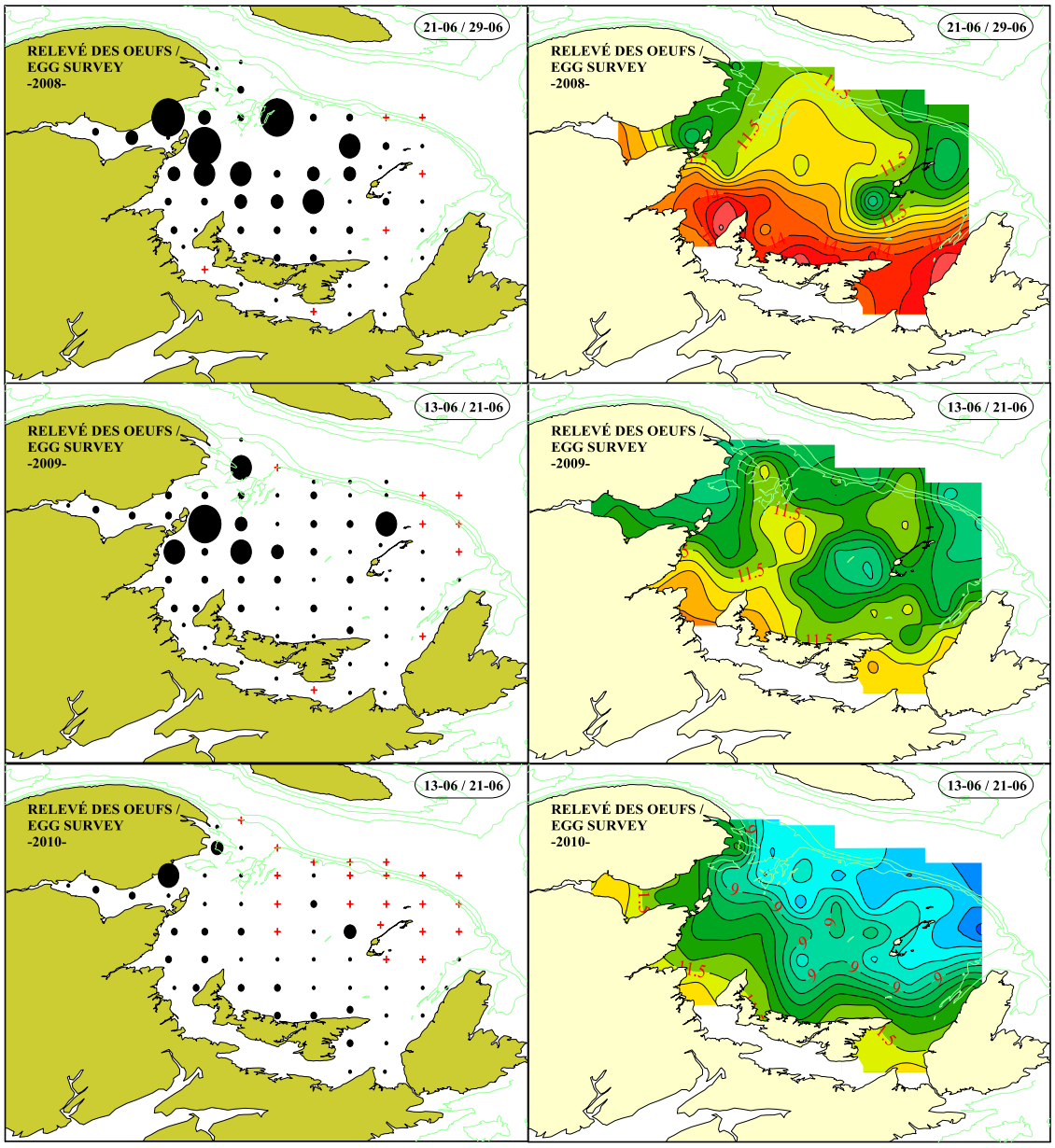
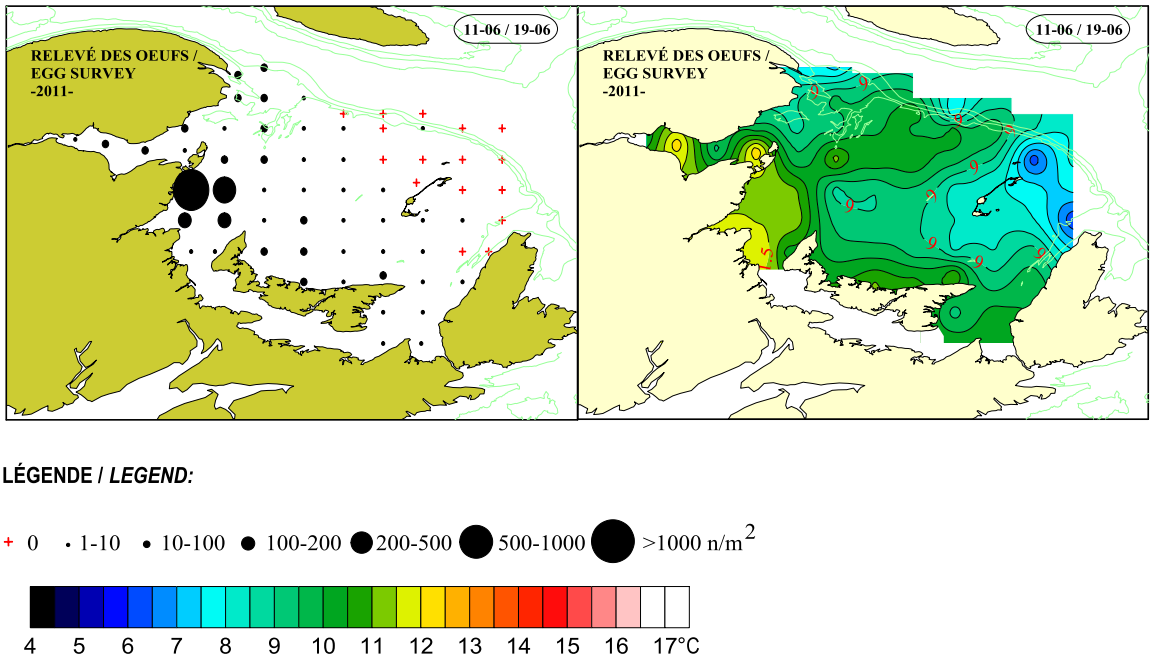



*Figure 3. Distribution of the Atlantic mackerel egg abundances (n/m$^2$) and water temperatures (°C) (mean 0-10 m) for the research surveys conducted in the southern Gulf of St. Lawrence from 2008 to 2011.*




**LÉGENDE / *LEGEND:***




*Figure 3. (Continued).*

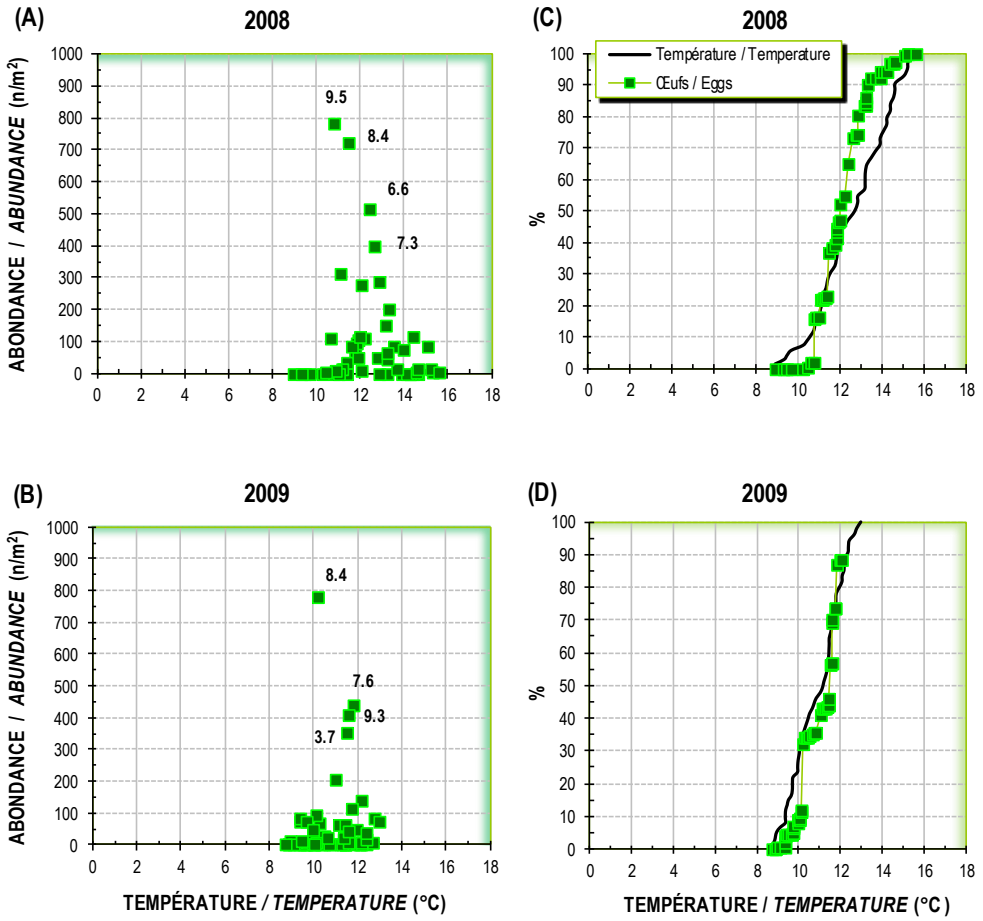



*Figure 4. Relationships between egg abundance (n/m$^2$) and water temperature (°C) (mean 0-10 m) (the stations with the highest abundances are indicated) (A = 2008; B = 2009) and cumulative curves of the abundance data in relation to water temperature (C and D) for the research surveys conducted in the southern Gulf of St. Lawrence in 2008 and 2009.*

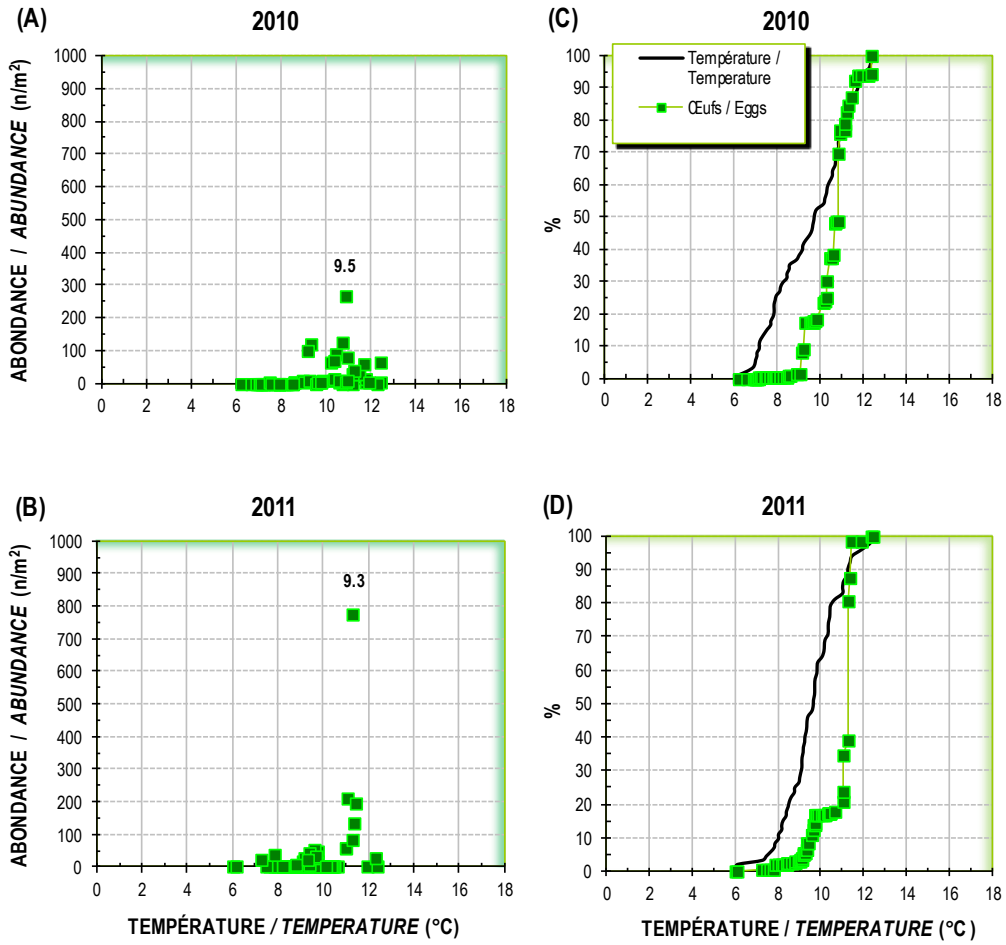



*Figure 5. Relationships between egg abundance (n/m$^2$) and water temperature (°C) (mean 0-10 m) (the stations with the highest abundances are indicated) (A = 2010; B = 2011) and cumulative curves of the abundance data in relation to water temperature (C and D) for the research surveys conducted in the southern Gulf of St. Lawrence in 2010 and 2011.*

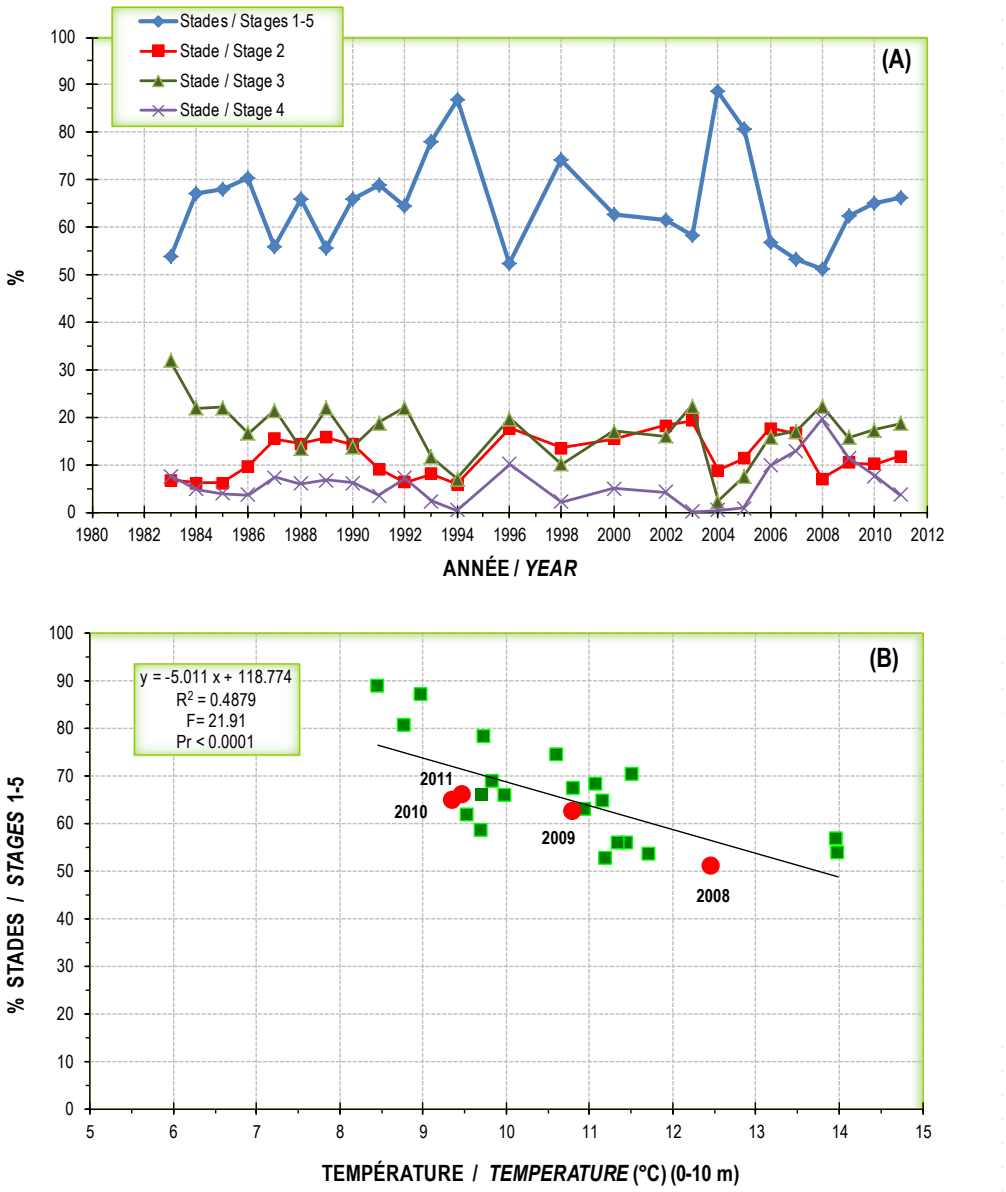



*Figure 6. Mean annual percentages of Atlantic mackerel egg abundances (n/m$^2$) by stage of development (A) and relationship with the mean water temperature (°C) (0-10 m) (B) for the research surveys conducted from 1983 to 2011 (surveys from 2008 to 2011 are indicated).*

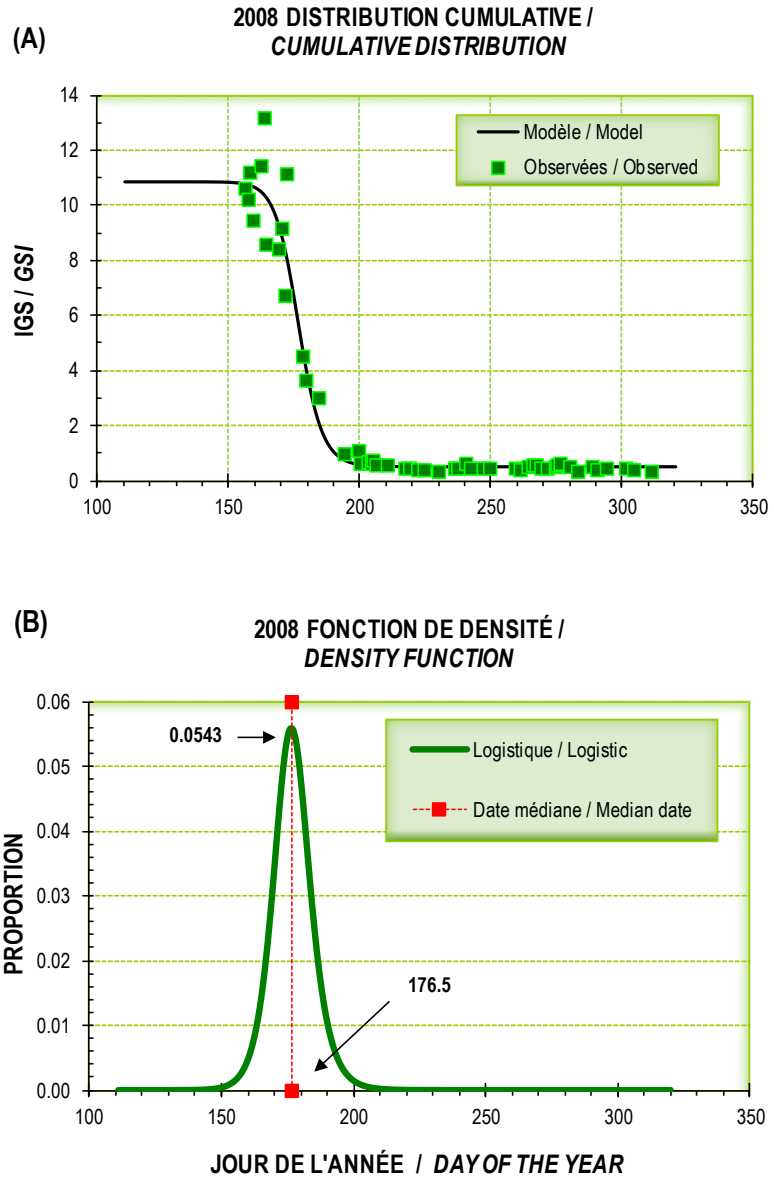



*Figure 7. Gonadosomatic index (GSI) (observed and expected values) (A) and density curve (B) describing the proportion of eggs spawned daily in 2008 (the median date of the egg survey and the proportion associated to this date are indicated).*

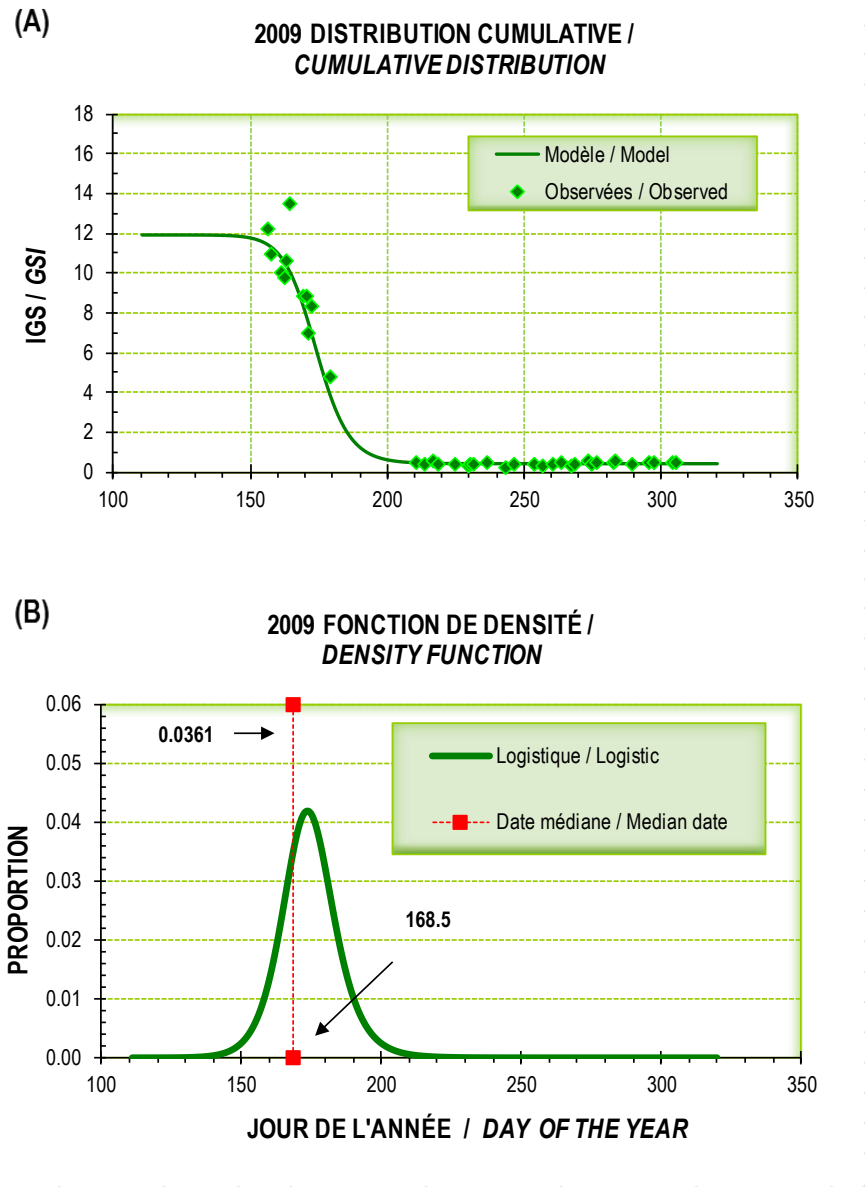



*Figure 8. Gonadosomatic index (GSI) (observed and expected values) (A) and density curve (B) describing the proportion of eggs spawned daily in 2009 (the median date of the egg survey and the proportion associated to this date are indicated)*

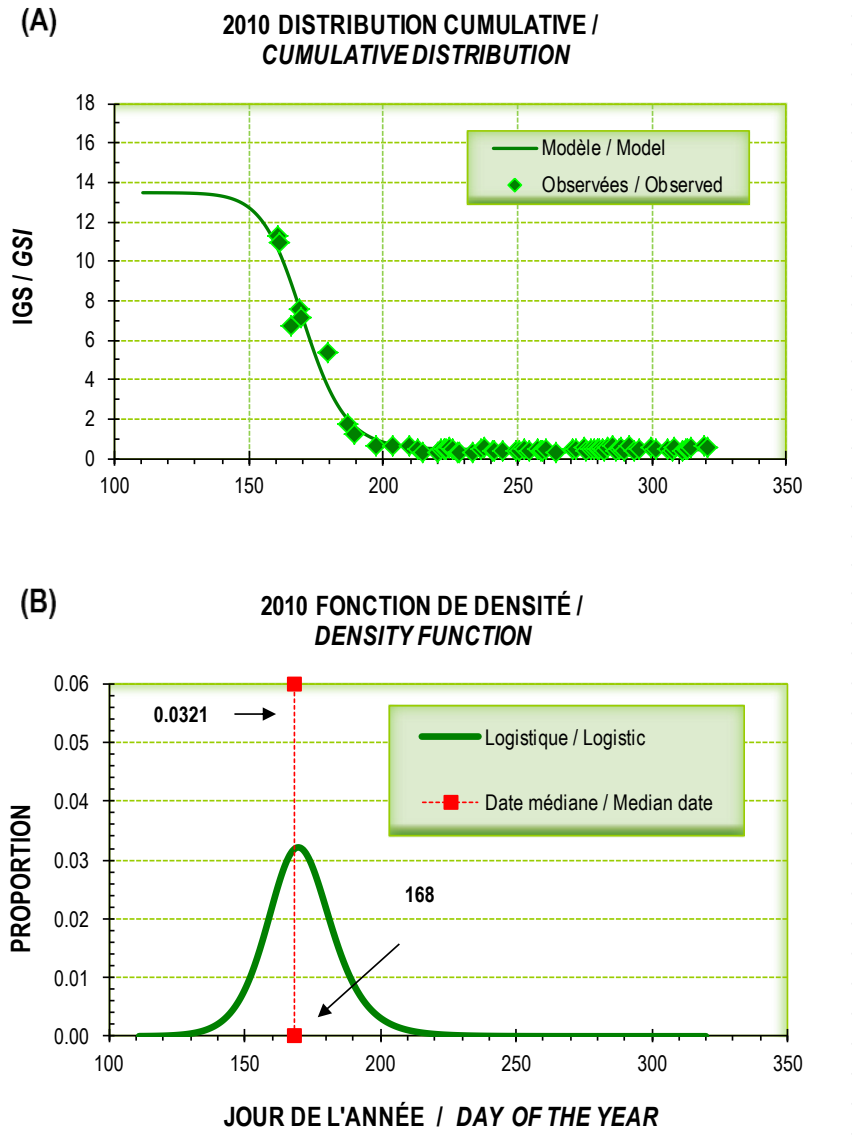



*Figure 9. Gonadosomatic index (GSI) (observed and expected values) (A) and density curve (B) describing the proportion of eggs spawned daily in 2010 (the median date of the egg survey and the proportion associated to this date are indicated).*

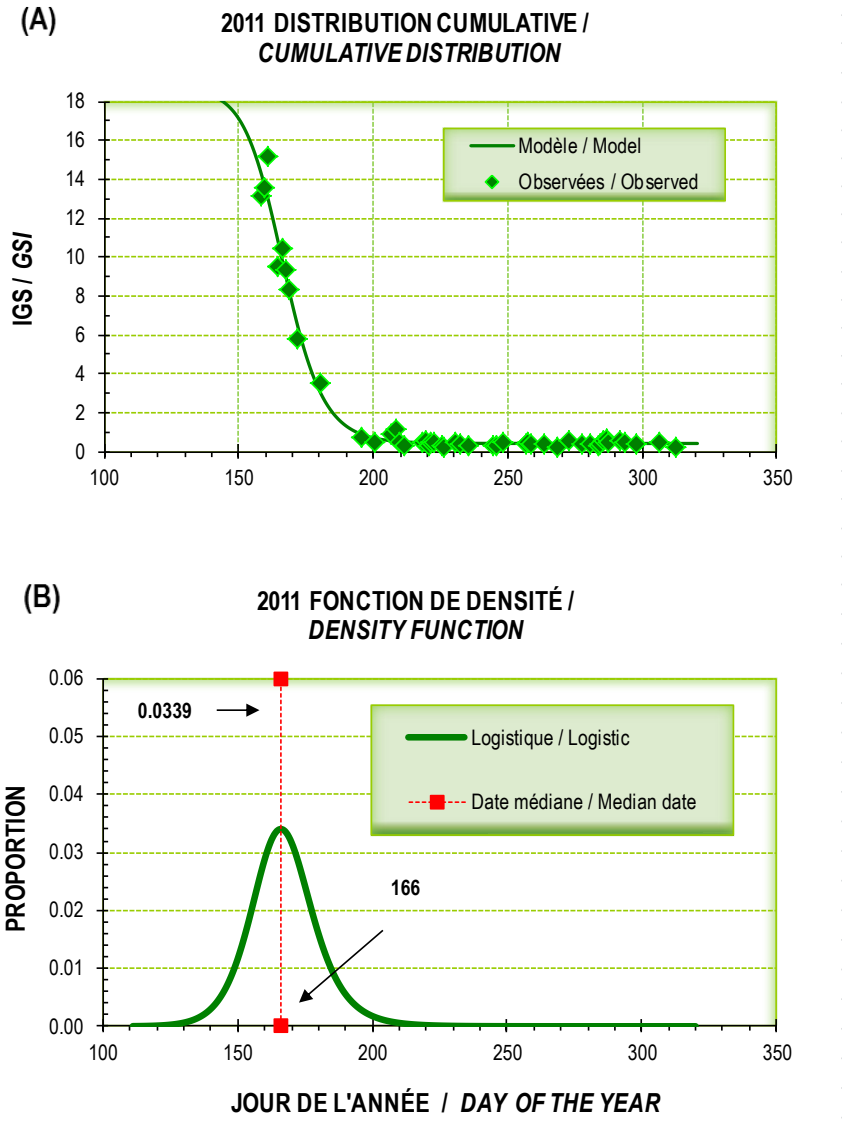



*Figure 10. Gonadosomatic index (GSI) (observed and expected values) (A) and density curve (B) describing the proportion of eggs spawned daily in 2011 (the median date of the egg survey and the proportion associated to this date are indicated).*

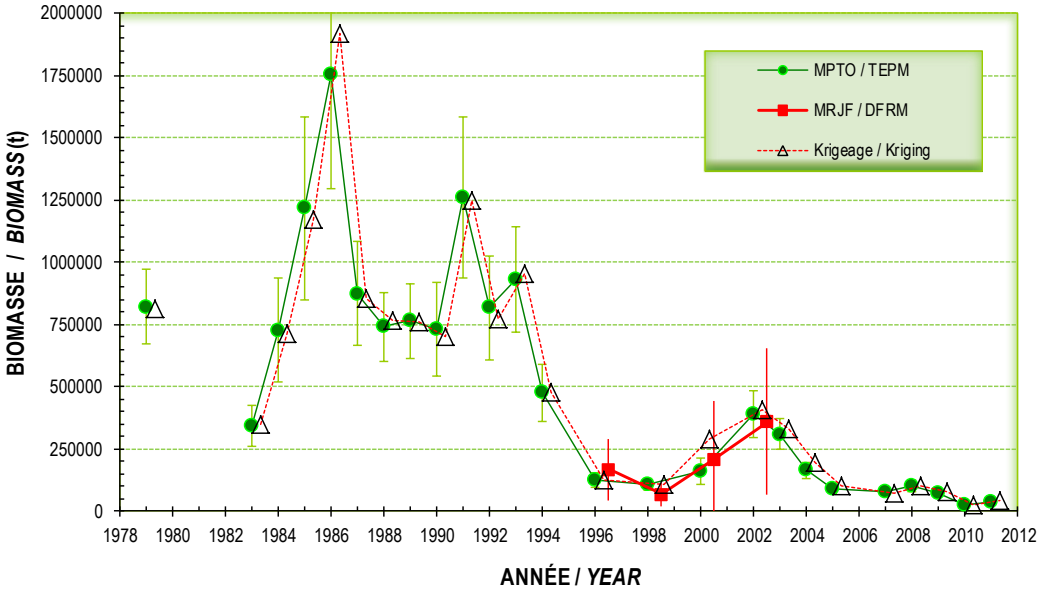



*Figure 11. Index of the spawning biomass (t) of Atlantic mackerel calculated from the data of the egg surveys conducted in the southern Gulf of St. Lawrence according to two different approaches (TEPM: Total Egg Production Method; DFRM: Daily Fecundity Reduction Method) and technics (stratified and kriged averages of the daily egg productions).*

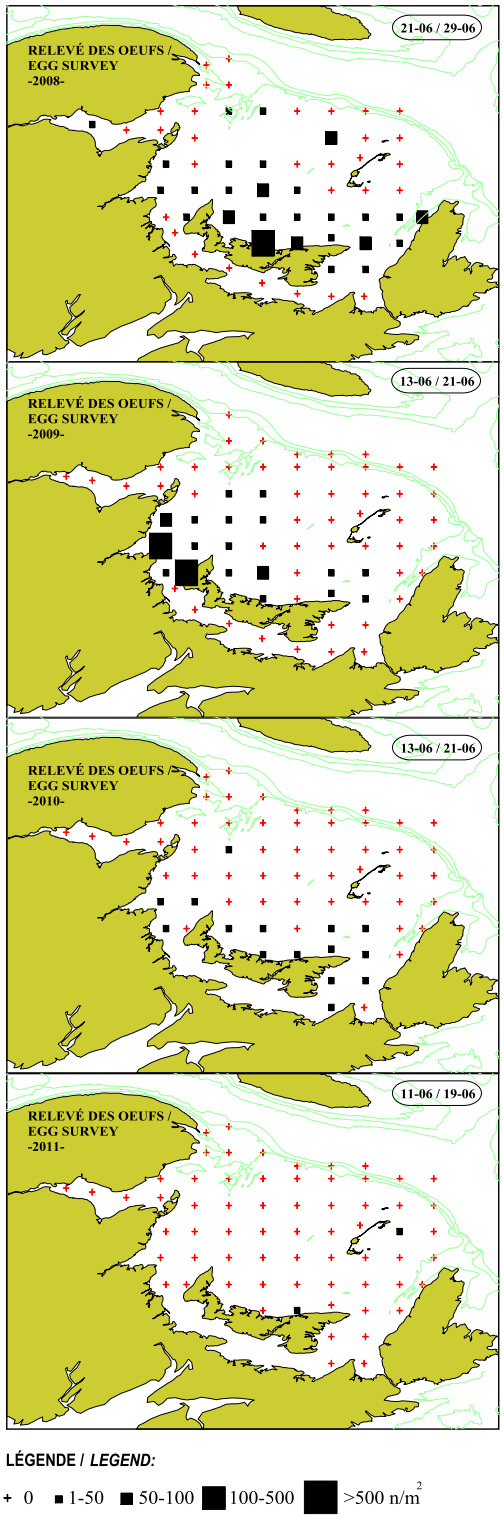
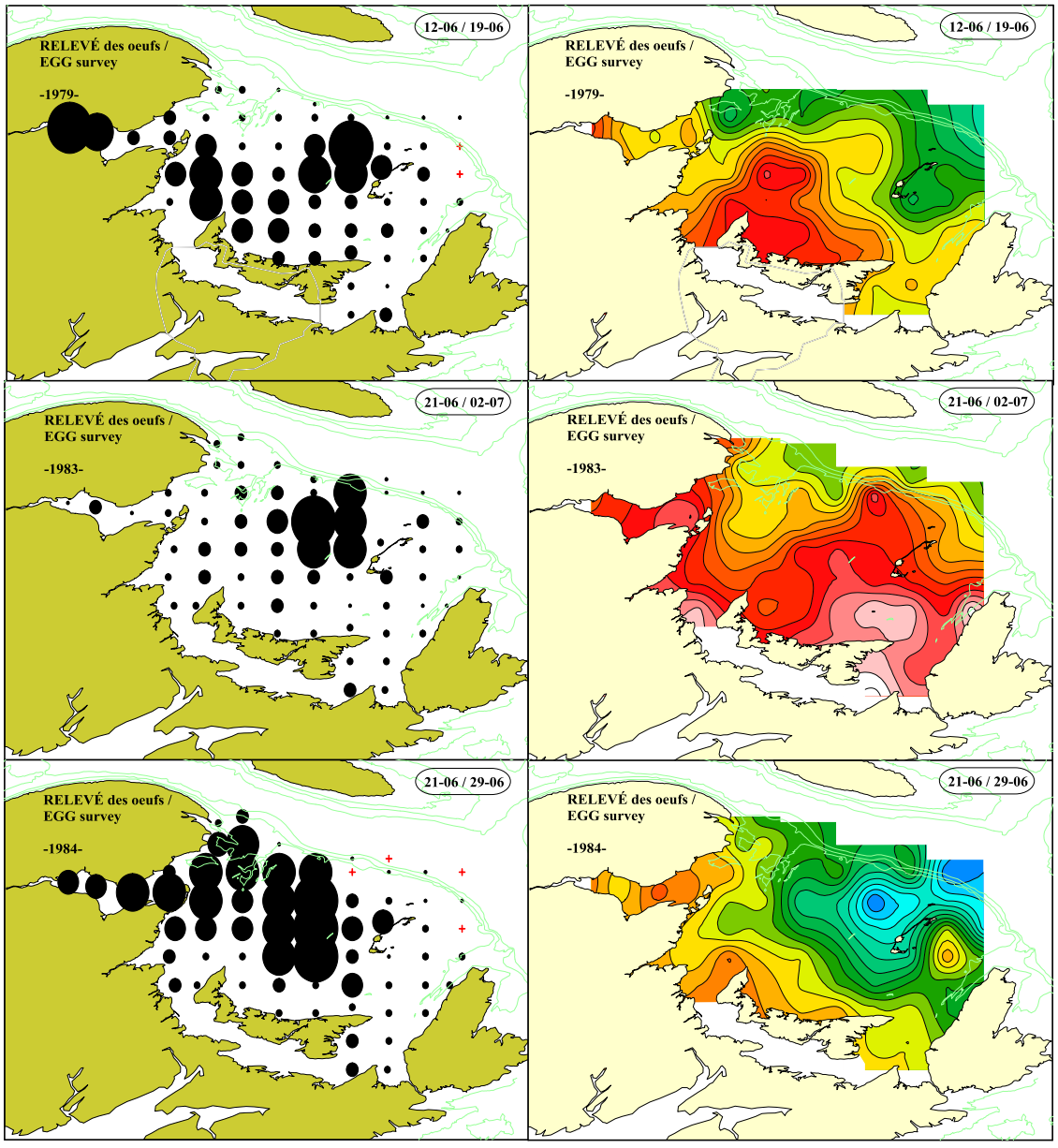


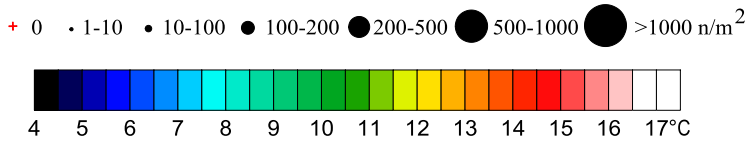

*Figure 12. Distribution of the Atlantic mackerel larvae abundances (n/m$^2$) for the research surveys conducted in the southern Gulf of St. Lawrence from 2008 to 2011.*

# APPENDICES

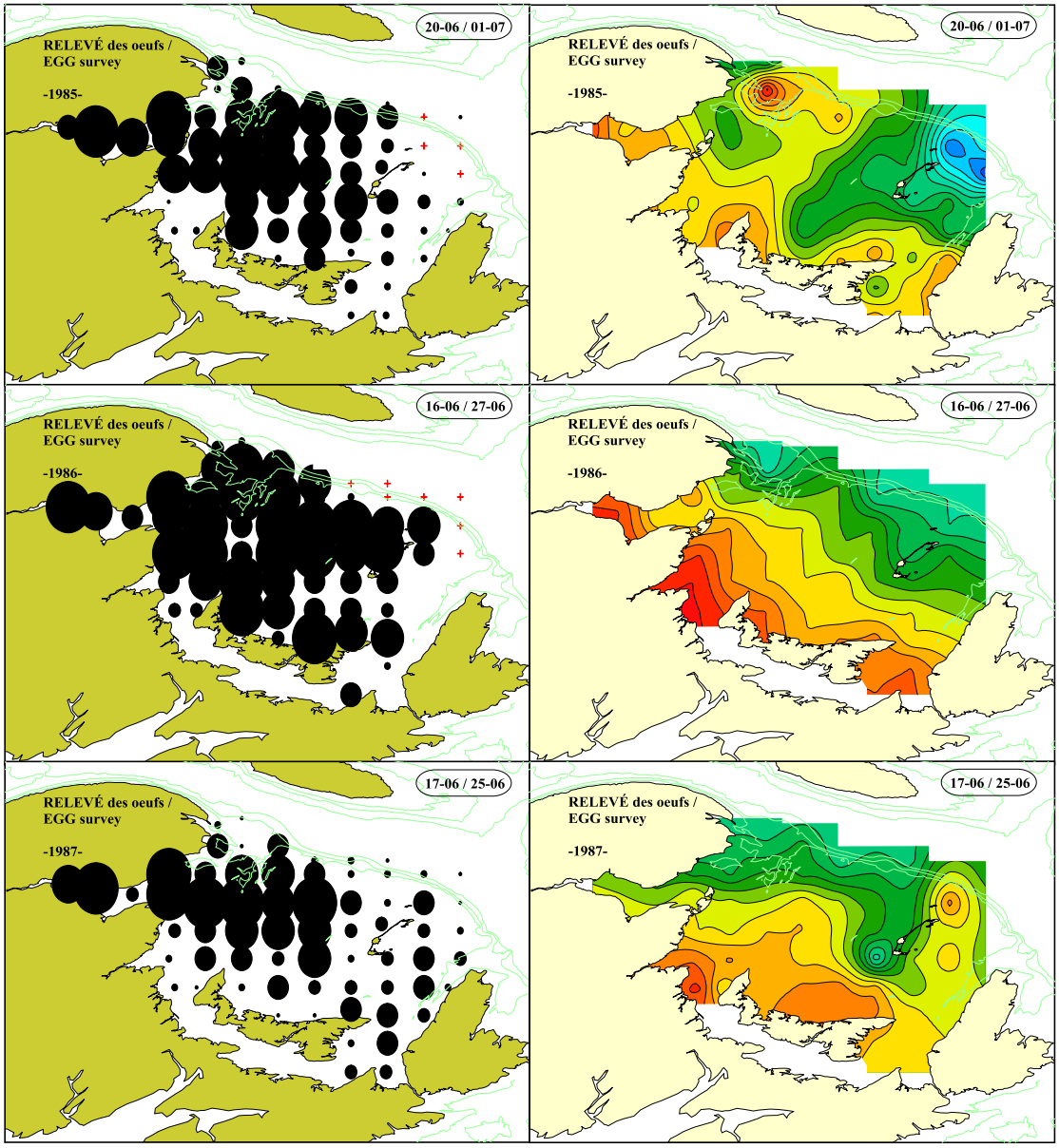
*Appendix 1.* *Distribution of the Atlantic mackerel egg abundances (n/m$^2$) and water temperature (°C) (mean 0-10 m) for the research surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2007.*




**LÉGENDE / *LEGEND:***



*Appendix 1.* *(Continued).*

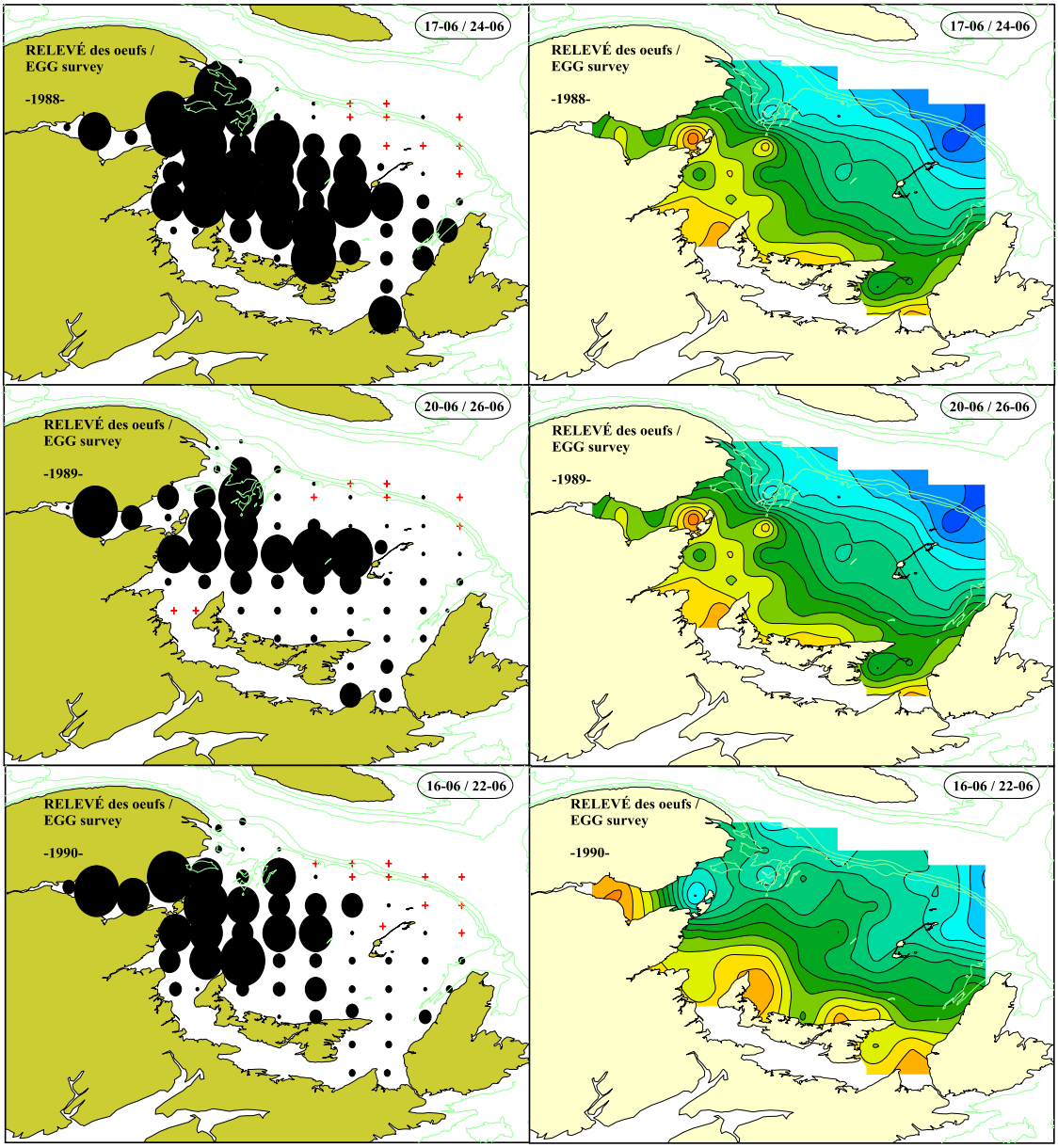



**LÉGENDE / *LEGEND:***

\+ 0 · 1-10 • 10-100 ● 100-200 ⬤ 200-500 ⬤ 500-1000 ⬤ >1000 n/m$^2$

4 5 6 7 8 9 10 11 12 13 14 15 16 17°C

*Appendix 1. (Continued).*

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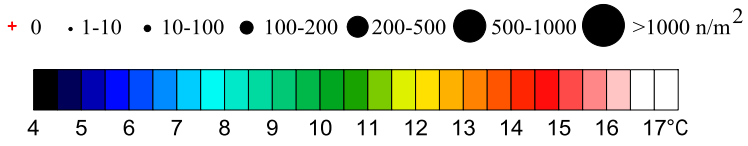
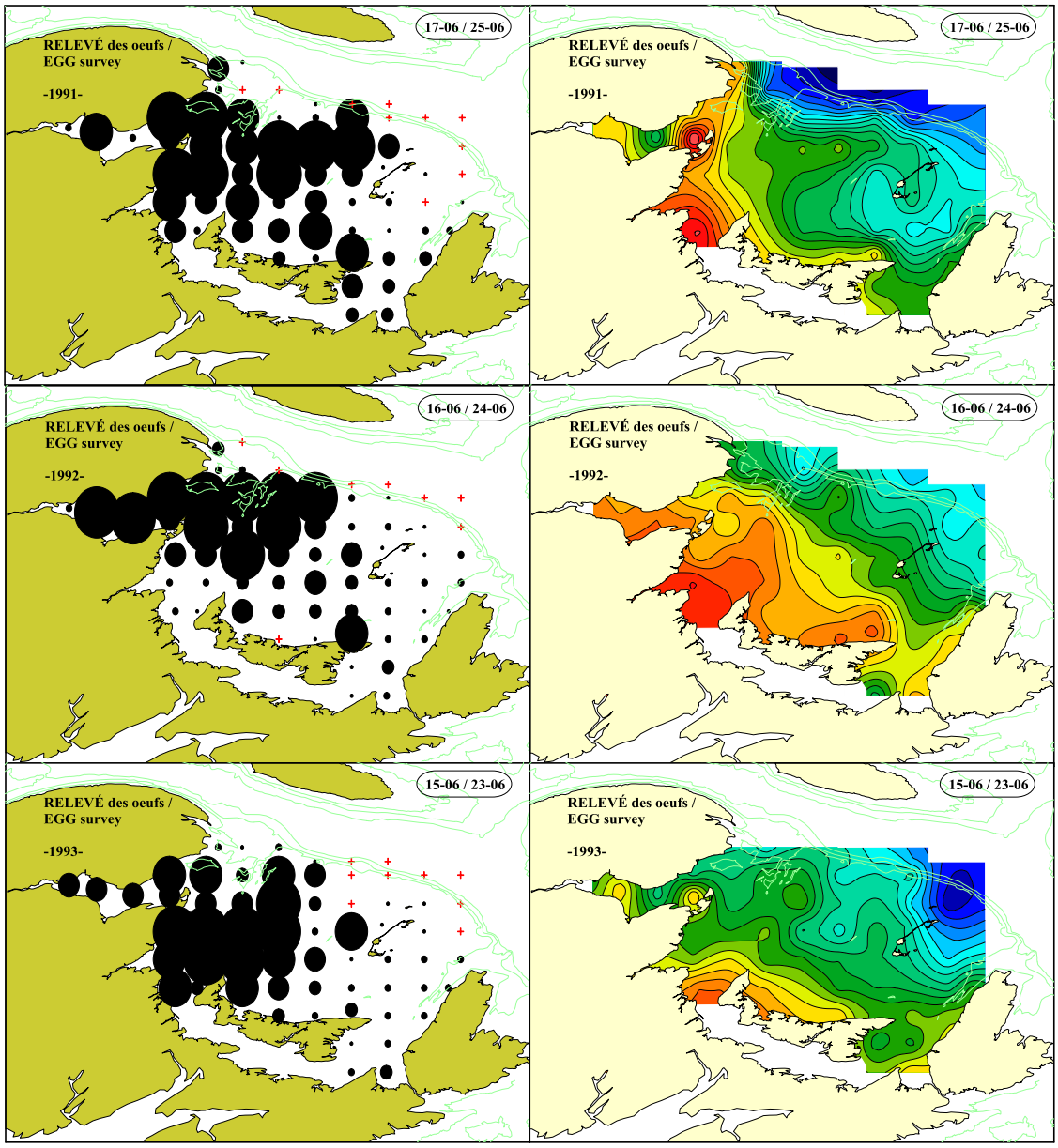


*Appendix 1. (Continued).*

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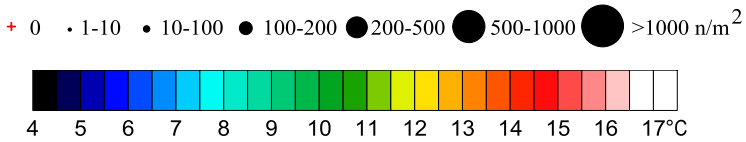
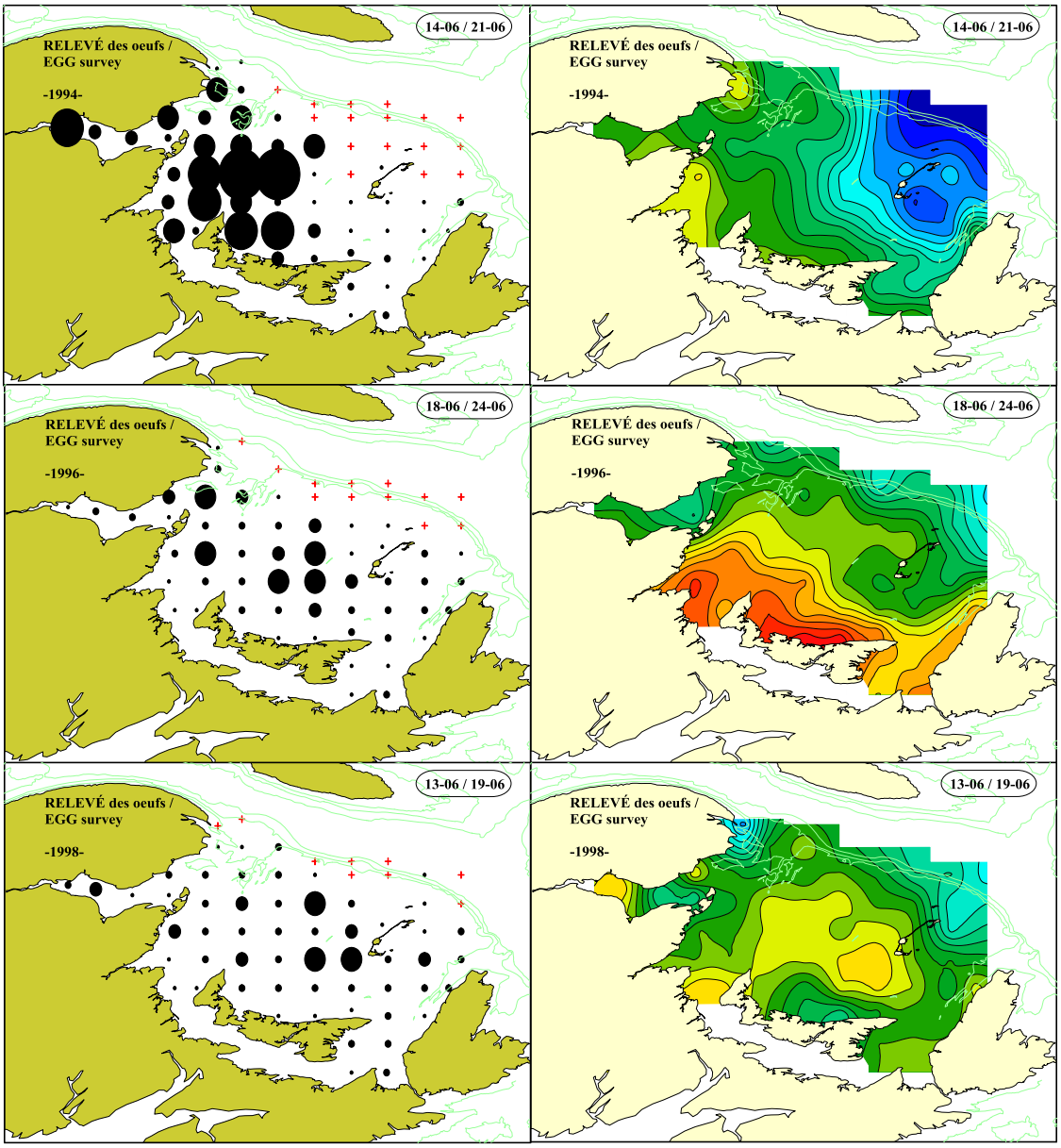


*Appendix 1. (Continued).*

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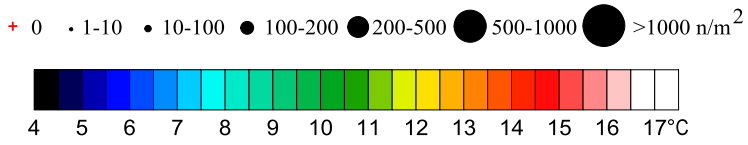
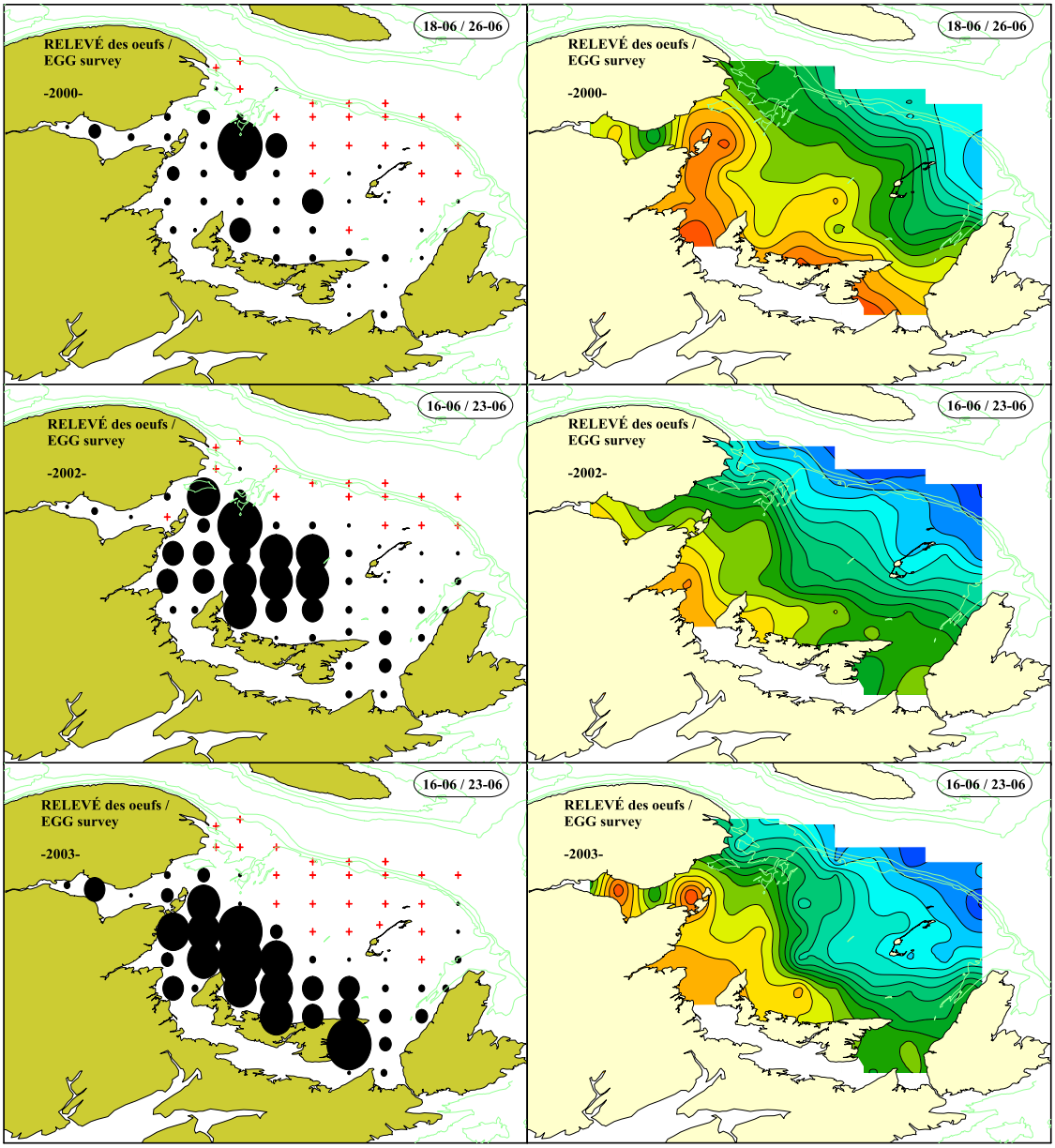
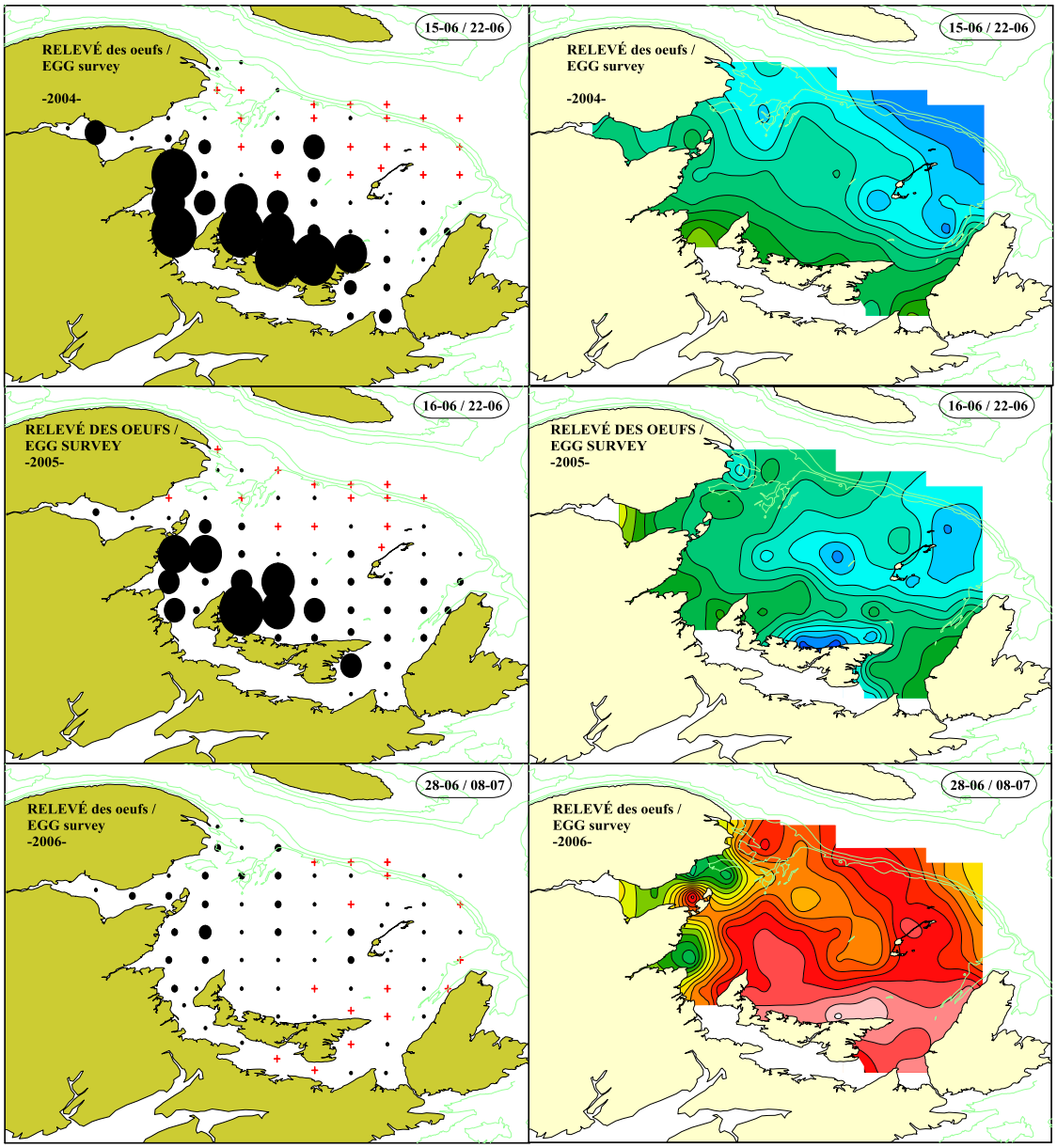


*Appendix 1. (Continued).*



*Appendix 1.* *(Continued).*

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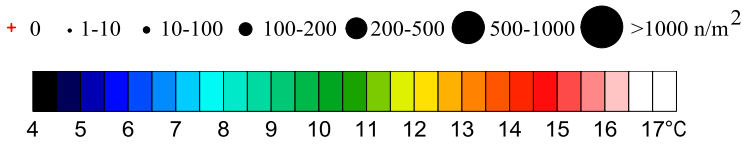
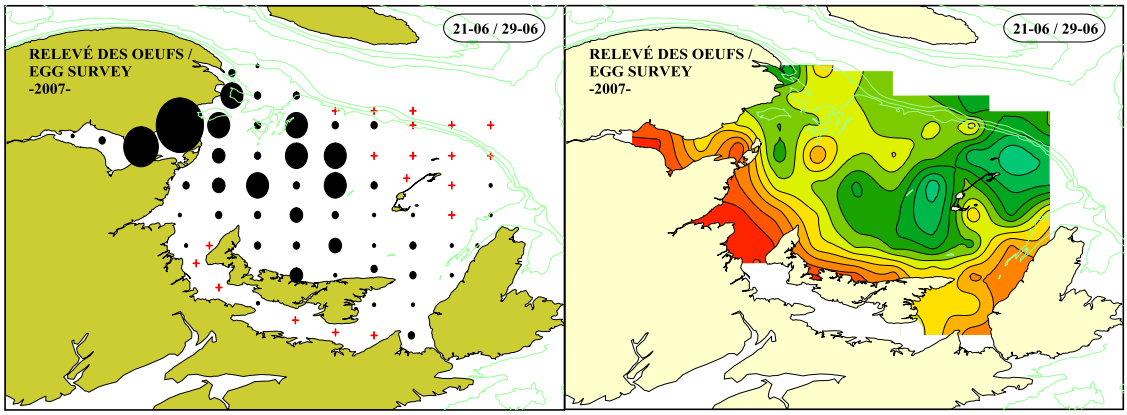


*Appendix 1. (Continued).*

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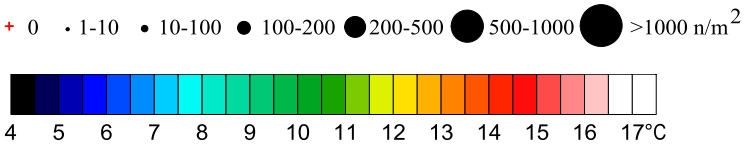
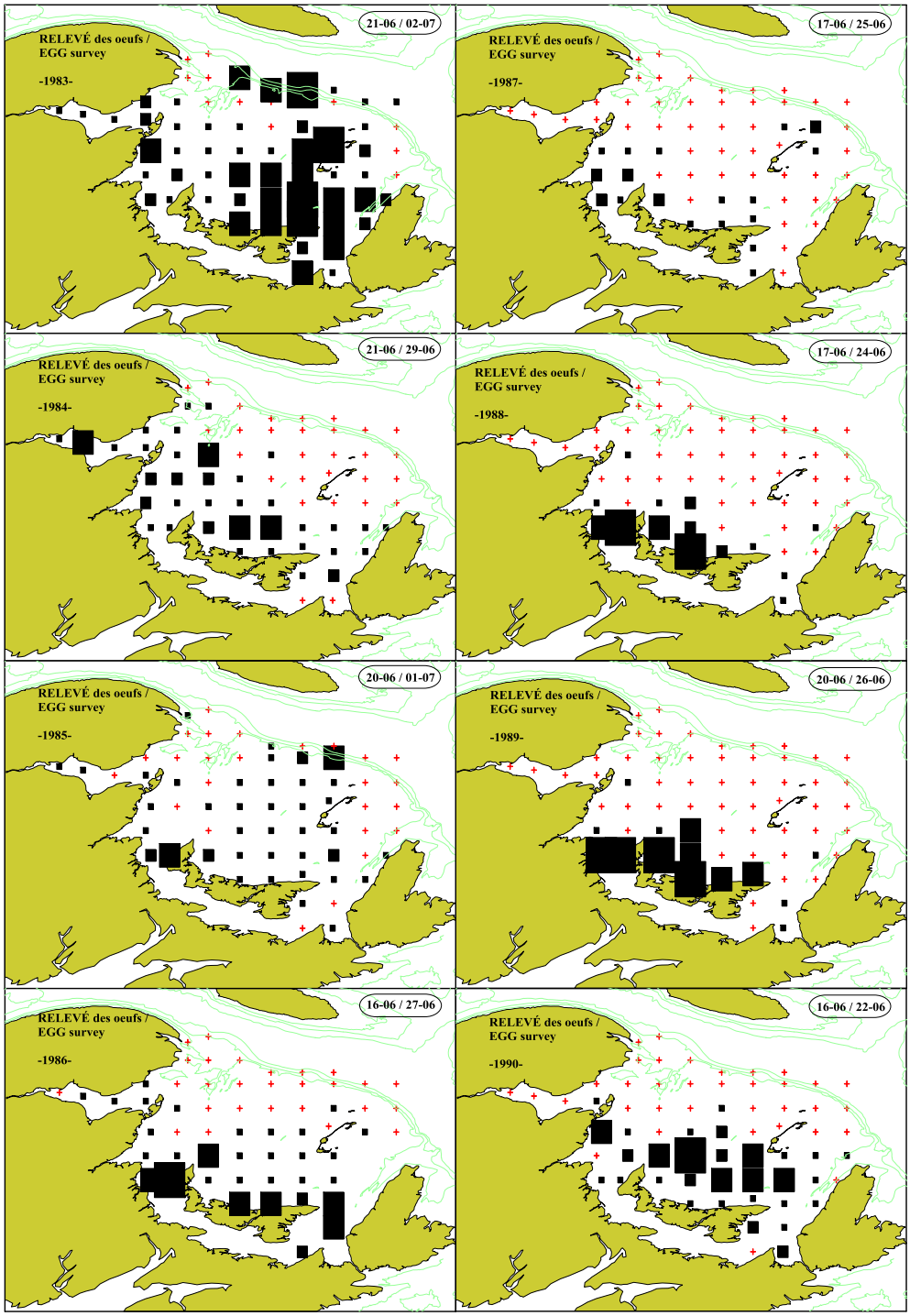


*Appendix 2.* *Distribution of the Atlantic mackerel larvae abundances (n/m$^2$) for the research surveys conducted in the southern Gulf of St. Lawrence between 1983 and 2007.*



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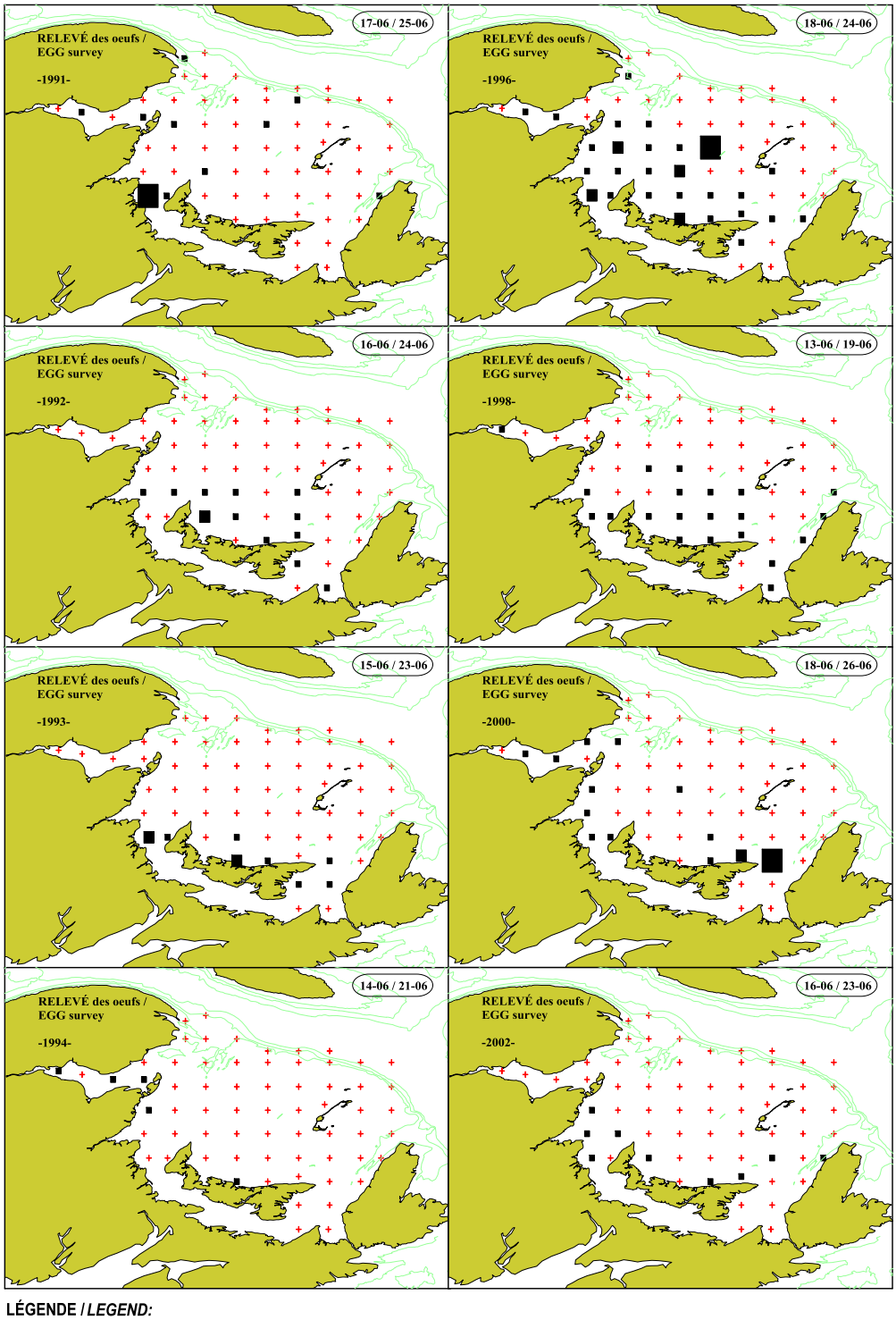
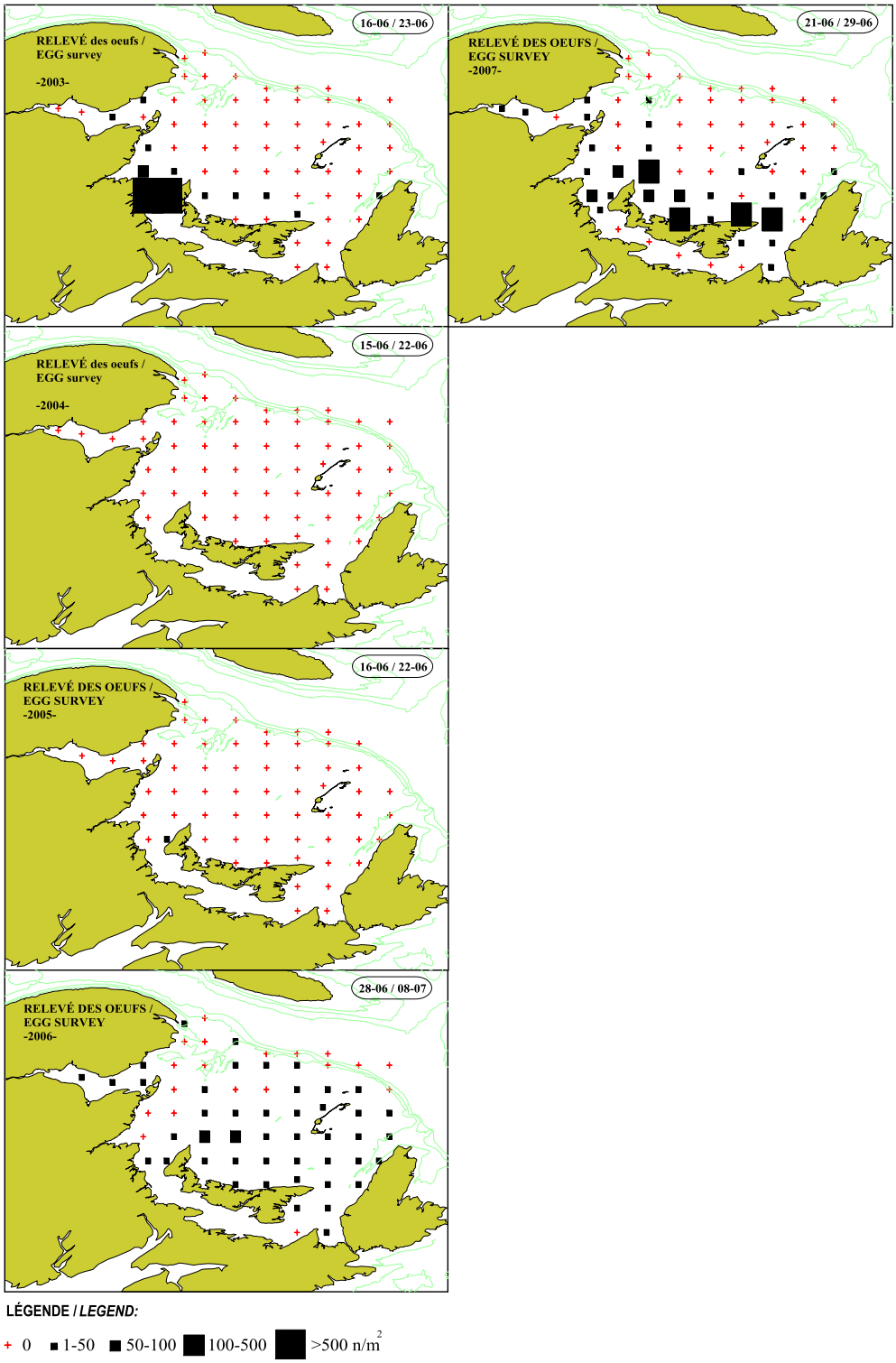
*Appendix 2. (Continued).*