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Assessment of northern shrimp stocks in the Estuary and Gulf of St. Lawrence in 2017: commercial fishery data

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Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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ABSTRACT

The Estuary and Gulf of St. Lawrence northern shrimp (*Pandalus borealis*) stock status is determined every year by examining a main indicator from the commercial fishery and the research survey. This document presents the data and methods that are used to produce the commercial fishery statistics (catches, effort, catch rates, number at length, bycatches) for 1982 to 2017 for each of the four fishing areas.

INTRODUCTION

The northern shrimp (*Pandalus borealis*) fishery began in the Gulf of St. Lawrence in 1965 (Table 1). The exploitation is conducted by trawlers in four shrimp fishing areas (SFA): Estuary (SFA 12), Sept-Iles (SFA 10), Anticosti (SFA 9) and Esquiman (SFA 8) (Figure 1). The number of active licences for northern shrimp fishing in the Estuary and Gulf was 111 in 2017. Operators are from five provinces and seven First Nations communities. Shrimpers must also keep a log book, have their catches weighed at dockside, and agree to have an observer on board at the Department's request (5% coverage). The season begins on April 1 and ends on December 31. The fishery has been managed by TAC (total allowable catches) since 1982, and the traditional fishers have had individual quotas since the mid-1990s. The fishery management measures include the imposition of a minimum mesh size (40 mm) and, since 1993, the compulsory use of the Nordmore grate, which significantly reduces groundfish bycatches and a protocol to limit small fish bycatch is in place since 2014 for the small groundfish (cod (*Gadus morhua*), redfish (*Sebastes sp.*) and Greenland halibut (*Reinhardtius hippoglossoides*)). Use of the Vessel Monitoring System (VMS) has been mandatory since 2012.

This document presents the data and methods that are used to produce the commercial fishery statistics from 1982 to 2017 for each of the four fishing areas. This is an update of the research document produced by Bourdages and Marquis (2014) on fishery statistics, the distribution of fishing effort, catches per unit of effort, numbers at length from the commercial fishing and bycatch. Numbers per unit effort of the commercial fishery in summer for males and females will be used to project harvest according to the guidelines of the precautionary approach (Savard 2012).

BIOLOGY

BEHAVIOUR

Shrimp start being caught by commercial trawls when they are males and reach a carapace length (CL) of about 15 mm. The probability of trawl capture increases with size, and individuals are fully recruited to the fishery at about 22 mm (LC). Therefore, the proportion of male and female individuals caught by fishers varies according to the catch period and location. Indeed, shrimp migratory movements are well known to fishers, who have adapted their fishing patterns to their benefit. Fishers typically try to maintain high catch rates and maximize catches of large shrimp while minimizing bycatch of other species.

Every year, shrimp migrate to reproduce. In late fall and early winter, berried females (females carrying eggs under the abdomen) begin to migrate to the shallower areas of their distribution range. In spring, they gather at sites suitable for releasing the larvae while the males are still scattered throughout the distribution range. Fishers take full advantage of this spring gathering of berried females to obtain high yields. Once the larvae have been released, the females molt and then disperse to deeper areas (200 to 300 meters) of the distribution range. Shrimp are also distributed differently according to the age of individuals. Typically, young shrimp are found in shallower areas, often at the heads of channels, whereas older individuals, females, are found in deeper waters. Young shrimp concentrations in shallower water are also denser than large shrimp concentrations in deep water. The composition of spring commercial catches often closely reflects this distribution pattern. Because spring catches occur in shallower water, they often consist of 2 groups of individuals: berried females and very small males.

Shrimp also migrate vertically. They leave the bottom at night to rise in the water column to feed on plankton, and then return to the bottom during the day. The scale of vertical migrations varies

depending on the individual's developmental stage and local conditions. For example, small shrimp appear to leave the bottom earlier and rise higher in the water column than do larger females. Although yields may be lower at night, the mean catch size should be higher because of the lower proportion of males in catches. What's more, it may be advantageous to fish at night to avoid bycatch of capelin, which also leaves the bottom at night.

The variations in female sizes follow an east-west gradient, the smallest being observed in the Esquiman Channel and the largest, in the Estuary. It is worth noting that, as individual fecundity increases with size, egg production by an equal number of females will theoretically be lower in the east. The number of individuals for a single unit of weight also varies by area. The number of shrimp per kg depends on 2 factors: the fishing pattern influencing the proportion of males in catches; and, the mean size of females. The number of shrimp per kg is increasing from west to east because the proportion of males in commercial catches is increasing while the size of females is decreasing.

METHOD

FISHERY STATISTICS

The shrimp fishing licence holders have to describe their fishing operations in a logbook. Information on the estimated catch, the number of hours of trawling, and the location of the fishing tows are noted for each day at sea. The catch data are validated with the processing plant purchase slips or with the dock side monitoring program. The dock side monitoring program has been running since 1991; all fishermen have to have their landings weighted by observers who are based in designated ports.

The resolution of the information noted in the logbook and recorded in a zonal file (ZIFF, *Zonal Interchange File Format*) corresponds to one fishing day at a given location. Every day, the fisherman has to note the total of the estimated catches and the total of hours of trawling for each location. The official landing (coming from the dock side weighting), that happens often after many days at sea, is then attributed proportionally to the daily catches.

DFO official statistics on landings by fishing area are derived from the Canadian Atlantic Quota Report (CAQR) and are available in the Gulf Quota Report (Table 1, Figures 2 to 4).

COMMERCIAL CATCH SAMPLING

Samples from commercial catches have been collected at landing since 1982 (Table 2). The samples are brought back to the laboratory where the individuals are sexed and measured (cephalothorax length, CL) to the closest 0.1 mm. The individuals are sexed according to the characteristic of the endopod of the first pleopod (Rasmussen 1953) and the maturity stage is determined by the presence or absence of sternal spines (McCrary 1971) and by the presence or absence of eggs.

CATCH AND FISHING EFFORT COMPILATION

An observation given by fishermen in their logbook corresponds to a catch and an effort realised by a vessel for a fishing day in a given location. A first validation of the observations is done in eliminating missing or improbable data for essential variables (fishing vessel, catch, effort, date of the catch, shrimp fishing area).

Table 3 presents the catches and effort corresponding to the validated observations, by fishing area and by year. An annual catch per unit of effort is estimated from these data for each fishing area (Table 3, Figure 5).

The sum of catches does not represent the total of the landings given that some observations had to be removed from the analyses because they were missing or incomplete. The sum of the effort corresponding to the same observations neither represents the total effort put by the fleets to catch the total landing. However, it is possible to estimate the total fishing effort corresponding to the total landing by using the catch per unit of effort estimated from the validated observation subset (Table 3, Figure 5). Similarly, it is possible to estimate the monthly catch and effort by fishing area and by year (Tables 4 and 5). The total effort of fishing by year for shrimpers is presented at figure 6.

DISTRIBUTION OF FISHING EFFORT

The harvest site position that the fisher notes in the logbook is used to identify the shrimp fishing area in which fishing operations are conducted. Depending on the type of form issued to the fisher's fleet, the position is expressed either as latitude and longitude or by identifying the fishing square (a square measuring 10 minutes by 10 minutes, Figure 7). The harvest site may, on occasion, be missing. In such a case, it possible to identify the shrimp fishing area by NAFO subdivision of (Figure 8) find in the logbook.

The spatial distributions of catches, effort and catch per unit of effort (CPUE) by grid square are shown in figures 9, 10 and 11. They are shown by decade and grid square mean, or for 2014 to 2017.

Use of the Vessel Monitoring System (VMS) has been a licence condition since 2012. During shrimp fishing trips, vessels were positioned by satellite at a 60-minute frequency and, since 2016, every 30 minutes. The information collected consisted of the vessel number (CFVN), position (latitude and longitude), date and time. There is no information on whether a vessel was in a shrimp fishing situation or when the trawl was set. In order to distinguish non-directed shrimp fishery activities, we compared the dates and CFVN in the VMS data with the logbook data. We retained all positions that more or less corresponded to a day when a shrimp catch was recorded in logbooks. It was impossible for another directed-species activity to be conducted in that time interval. Next, we eliminated positions that a vessel travelled through towards the harvest site, and positions where a vessel was stationary (at sea or dockside). To accomplish this, we calculated vessel speed starting from the positions and the time interval between two positions. We retained speeds between 1.8 and 2.6 knots as shrimp trawling speeds and validated this information with fishers. Shrimp fishing positions were aggregated annually in grid squares of 1 minute longitude by 1 minute latitude for charting.

The spatial distribution of the fishing effort by 1-minute square is shown in Figure 12 for logbook data, and in Figures 13 and 14 for Vessel Monitoring System data. The fishing footprint, based on fishing effort or surface area trawled, is shown in Table 6 according to various fishing intensities.

CATCH PER UNIT OF EFFORT STANDARDIZATION

The annual catches per unit of effort (CPUE) are standardized to take into account the changes in the fishing capacity and in the seasonal fishing patterns (Gavaris 1980). Multiple linear regressions were performed between the logarithm of CPUE and the variables vessel length and propulsion power (to reflect changes in fishing power), month (to take account changes in the fishing season) and year (to isolate the annual effect without any effect from the other variables). The analyses were performed with the GLM procedure of the SAS software (SAS 1996). The analyses were done separately for each fishing area.

The important variables were first examined to determine if the number of observations in each category was sufficient to be representative of the fleet behaviour. The length and the

propulsion power of the vessels were grouped into classes. The lengths were grouped into 6 classes of 10 feet, from 30 to 89 feet, identified by the middle of the class. The powers were grouped into 9 classes of 100 hp, from 100 to 999 hp, identified also by the middle of the class. Given that one observation corresponds to one (or less) fishing day, it is considered that the fishing effort in a given category is representative when many observations (and thus many fishing days) are associated with it.

The conditions for which the fishing effort is considered representative have already been presented in Savard (2011) (Table 7). They are the following:

- a vessel had to be active during at least 3 years and had to have at least 7 observations per year;
- a length or power class had to be present during at least 3 years and had to have at least 7 observations per year;
- the months that were kept were those during which there were activities for at least 3 years and for which there are at least 7 observations (5 observations for the Estuary area) per year and per fishing area;
- an observation would be considered as significant if it corresponds to an effort greater than one hour and a catch greater than 50 kg;
- the sub-categories representing less than 1% of the total observations were not used in the analyses because it was considered that they were little representative of the behaviour of the fleets.

The validation of these models is done by analyzing the residuals against the predicted values and categories of factors studied. The analyses of variance are all significant ($p<0.0001$) as well as the contribution of the categories to the regression ($p<0.0001$) except for the length category ($p=0.0197$) in the Estuary area (Tables 8 to 11). The model explains 60% of the variance for Esquiman area, 60% for Anticosti, 52% for Sept-Iles and 54% for Estuary.

The standardized catch rates are shown in table 12 and figure 15. The CPUEs correspond to a standard vessel with a length class of 60-69 ft and a propulsion power class of 500-599 hp. The standard month is June.

NUMBER AT LENGTH COMPILATION

Commercial catch samples are combined by area and by month. The monthly length frequency distributions are weighted by the month landing (Table 13) and the numbers at length are calculated by applying the weight-length relationships estimated from the survey (Bourdages and Marquis 2018b). The annual commercial catches are estimated by summing the monthly numbers at length (Table 14). The numbers per unit of effort are calculated by dividing the numbers at length by the fishing effort (Figure 16).

The main indicator of the stock status is estimated using data from the commercial fishery and research survey. Indices used from commercial fishing are numbers per unit of effort (NPUE) during the summer for the male and female components. These indices have been restricted to the summer (June, July and August) due to seasonal variations in catchability (Figure 17). The male and female NPUE are estimated from length frequency of summer months by fishing area (Table 15 and Figures 18 and 19).

Mean lengths of female carapace shrimps harvested in the summer by fishing area and year are presented in figure 20.

REPRODUCTIVE CYCLE

Monitoring of the reproductive cycle in the area of Sept-Iles is made from samples collected during fishing (see section commercial catch sampling). The proportion of egg-bearing females (females carrying eggs under the abdomen), the number of egg-bearing females on the total number of females, is determined for each sample (Figure 21). As the proportion of females in maturation is determined by comparing the number of female with green head compared to the number of females excluding egg-bearing females (Figure 22). Spring day when 50% of females released their eggs is determined, and the autumn day when 50% of females carrying eggs. In addition, the day of the year where 50% of females are in maturation is determined. These days of the year for these three events, extrusion, maturation and spawning are presented annually in figure 23.

BYCATCHES

Harvesters are obliged to have an at-sea observer on board at the Department's request. The At-Sea Observer Program aims at 5% coverage of all shrimper fishing trips. These observers record detailed information on tows (position, duration, and catch per species or taxon and, for some species, specimen length). Data from the At-Sea Observer Program that were used for this study were collected between 2000 and 2017 during the northern shrimp fishing in the Estuary and Gulf of St. Lawrence with the goal to estimate the bycatches.

The methodology for data processing of bycatches is presented in Savard et al. (2013). Since 2000, 20746 tows were sampled. The positions of the observed tows from 2015 to 2017 are presented in figure 24. Weighting factors (∑shrimper effort/∑observer effort) were calculated and used to scale the bycatch results to the total effort deployed by the fleet (Tables 16 and 17).

Bycatches for all species combined are estimated by fishing area and year (Table 18, Figure 25). The bycatch estimate is compared to the shrimp catch to obtain a ratio of bycatch on the total shrimp catch (Table 18, Figure 26). The results, in occurrence and in weight, are also presented for 98 taxa (Tables 19 and 20 and Figure 27).

Bycatches in the shrimp fishery were compared with biomass and population number estimates from the annual DFO trawl survey in the Estuary and northern Gulf of St. Lawrence between 2000 and 2017 (Bourdages et al. 2018a) (Table 21 and Figure 28).

The geographical distributions of bycatches during fishing activities directed on shrimp in presence of an at-sea observer are presented for Atlantic cod, redfishes, Atlantic halibut, Greenland halibut, American plaice, witch flounder and capelin. The average of catches (kg/tow) of all tows in a same square of 5 minutes is made annually (2016 and 2017) or for the period of 2000 to 2015 (Figures 29 to 35).

Length frequencies are available for Atlantic cod, redfishes, Atlantic halibut, Greenland halibut, American plaice and witch flounder (Figures 36 to 41).

RESULTS

Northern shrimp landings in the Estuary and Gulf of St. Lawrence have risen gradually since the fishery began. Landings increased from about 1,000 t in the early 1970s to more than 35,000 t by the end of 2010 (Figure 2). Landings decreased thereafter to 22,431 t in 2017. The preliminary statistics indicate 2017 landings of 889 t in the Estuary, 7,236 t in Sept-Iles, 7,292 t in Anticosti, and 7,004 t in Esquiman (Figure 3).

In 2017, TACs decreased by 15% in the Estuary, Sept-Iles and Anticosti, and remained the same in the Esquiman area (Table 1). The TAC was reached at more than 97% in the Estuary,

and at nearly 100% in Esquiman on January 9, 2018. The TAC was not reached in Sept-Iles or Anticosti, where landings reached only 68% and 90% of the TAC, respectively. The proportion of fishing effort between spring, summer and fall seems consistent over the years (Figure 4).

Annual CPUEs were standardized to factor in changes in fishing power and in seasonal fishing patterns. The CPUE has varied widely over time and has followed the same trends since 1982 in all 4 areas. From 1983 to 1995, CPUEs were low; they increased as of 1995, peaked around 2005, and then remained high for a few years. Since 2014, CPUEs have decreased in the 4 areas and reached values comparable to those observed in the early 2000s (Figure 15).

The use of fishing activity positions in logbooks and the VMS helped delineate fishing activities in the Gulf of St. Lawrence. The sectors that sustain fishing in the 4 areas have barely changed in recent years and correspond to the spots where high concentrations of shrimp were observed during the research survey (Figures 12 and13). In recent years, certain traditional fishing grounds have been abandoned because of the low abundance of shrimp: for example, the area east of the Manicouagan Peninsula in the Estuary, the northeastern tip of the Gaspé Peninsula, the southeast of Anticosti Island, and the southwest of the Esquiman Channel.

Use of the VMS since 2012 has made it possible to pinpoint the locations of fishing grounds (Figures 12 and 13). Fishing effort increased in 2016 and 2017 (Figure 6). Since 2012, the total annual fishing effort has been about 100,000 hours and corresponds annually to a maximum footprint on the seabed of about 7,200 km^2, assuming no overlapping of tows (Table 6). This effort is concentrated in an area of 13,800 km^2 where fishing intensity is variable (Figure 14). The fishing area where activity is most intense corresponds to an area of 2,250 km^2 where 54% of the fishing effort is deployed. The fishing footprint overlaps 14% of the shrimp's distribution range.

Bycatches of small fish in the shrimp fishery between 2000 and 2017 were examined using at-sea observer data. Fish bycatches were predominantly in the range of 1 kg or less per species and per sampled tow. Since 2013, bycatches in the shrimp fishery have risen well above the average, reaching a historic peak of over 1,500 t in 2016 (Figure 25). On average, from 2000 to 2015, bycatches accounted for 1.83% of the biomass of northern shrimp catch; in 2016 and 2017, they represented 5% (Figure 26). This increase is mainly due to a significant rise in small redfish catches (Figure 27). The main species in the 2017 catches were, in order of importance, redfish, herring, Greenland halibut, capelin, white shrimp, witch flounder, white barracudina, and American plaice (Table 20). Total catches estimated per species in these bycatches nonetheless represent less than 1% of biomass estimates in the DFO survey for each species (Table 21 and Figure 28).

Catches of other shrimp species during commercial fishing activities are very low compared to northern shrimp catches. Two shrimp species are common in catches: white shrimp (*Pasiphaea multidentata*) and Aesop shrimp (*Pandalus montagui*). From 2000 to 2017, the percentage in the total *P. multidentata* catch observed at sea was 0.09% and in landings, 0.82% (Table 22); for *P. montagui*, the percentages observed were 0.02% at sea and 0.21% in landings.

CONCLUSION

In 2017, preliminary landings were 22,431 t from a TAC of 26,732 t, a decrease of 26% in 2 years. TACs were not reached in the Sept-Iles and Anticosti areas.

In 2 years, fishing effort has increased in the 4 fishing areas and total fishing effort in the Gulf of St. Lawrence is comparable to the historical average.

The fishery's standardized CPUEs have decreased in the 4 areas and reached values comparable to those observed in the early 2000s.

Bycatches in the shrimp fishery have increased because of a significant rise in small redfish. Bycatches represented 5% of the biomass of northern shrimp catch in 2016 and 2017. However, the estimated total catch for each bycatch species represents less than 1% of its biomass as estimated in the DFO survey.

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TABLES

Table 1. Landing (L) and total of allowable catch (TAC) by shrimp fishing areas: Estuary (SFA 12); Sept-Iles (SFA 10), Anticosti (SFA 9) and Esquiman (SFA 8).

Year	Estuary		Sept-Iles		Anticosti		Esquiman		Total	
	L	TAC	L	TAC	L	TAC	L	TAC	L	TAC
1965	-	-	11	-	-	-	-	-	11	-
1966	-	-	95	-	-	-	-	-	95	-
1967	-	-	278	-	-	-	-	-	278	-
1968	-	-	271	-	-	-	-	-	271	-
1969	-	-	273	-	-	-	-	-	273	-
1970	-	-	413	-	-	-	159	-	572	-
1971	-	-	393	-	-	-	691	-	1084	-
1972	-	-	481	-	-	-	184	-	665	-
1973	-	-	1273	-	-	-	520	-	1793	-
1974	-	-	1743	-	980	-	594	-	3317	-
1975	-	-	2135	-	1025	-	1368	-	4528	-
1976	-	-	1841	-	1310	-	1494	-	4645	-
1977	-	-	2746	-	1185	-	1249	-	5180	-
1978	-	-	2526	-	1460	-	2166	-	6152	-
1979	-	-	3207	-	1108	-	3226	-	7541	-
1980	539	-	2978	-	1454	-	2441	-	7412	-
1981	27	-	3680	-	1385	-	3014	-	8106	-
1982	152	**500**	3774	**3800**	2464	**4400**	2111	**4200**	8501	**12900**
1983	158	**500**	3647	**3800**	2925	**5000**	2242	**6000**	8972	**15300**
1984	248	**500**	4383	**4800**	1336	**5000**	1578	**6000**	7545	**16300**
1985	164	**500**	4399	**4600**	2786	**3400**	1421	**6000**	8770	**14500**
1986	262	**500**	4216	**4600**	3340	**3500**	1592	**3500**	9410	**12100**
1987	523	**500**	5411	**5600**	3422	**3500**	2685	**3500**	12041	**13100**
1988	551	**500**	6047	**5600**	2844	**3500**	4335	**3500**	13777	**13100**
1989	629	**500**	6254	**5700**	4253	**4200**	4614	**4500**	15750	**14900**
1990	507	**500**	6839	**6400**	4723	**4200**	3303	**4700**	15372	**15800**
1991	505	**500**	6411	**6400**	4590	**5000**	4773	**4700**	16279	**16600**
1992	489	**500**	4957	**6400**	4162	**5000**	3149	**4700**	12757	**16600**
1993	496	**500**	5485	**6400**	4791	**5000**	4683	**4700**	15455	**16600**
1994	502	**500**	6165	**6400**	4854	**5000**	4689	**4700**	16210	**16600**
1995	486	**500**	6386	**6400**	4962	**5000**	4800	**4700**	16634	**16600**
1996	505	**500**	7014	**7040**	5469	**5500**	5123	**5170**	18111	**18210**
1997	549	**550**	7737	**7744**	6058	**6050**	5957	**5687**	20301	**20031**
1998	634	**633**	8981	**8966**	6932	**7004**	6554	**6584**	23101	**23187**
1999	646	**633**	9239	**8966**	7022	**7004**	6732	**6584**	23639	**23187**
2000	739	**709**	10160	**10042**	7941	**7844**	7396	**7374**	26236	**25969**
2001	832	**786**	10965	**11136**	5399	**8700**	7815	**8178**	25011	**28800**
2002	799	**786**	11493	**11136**	8638	**8700**	8250	**8178**	29180	**28800**
2003	796	**802**	11357	**11360**	8742	**8874**	6773	**6674**	27668	**27710**
2004	1033	**995**	15932	**15611**	10429	**10226**	8593	**8502**	35987	**35334**
2005	1001	**995**	12793	**15611**	8047	**10226**	8867	**9351**	30708	**36183**
2006	1029	**995**	15312	**15611**	8754	**10226**	8957	**9351**	34052	**36183**
2007	1022	**995**	15645	**15611**	10180	**10226**	9208	**9352**	36055	**36184**
2008	1017	**1020**	15972	**15995**	9635	**10478**	9110	**9409**	35734	**36902**
2009	993	**1018**	15873	**15970**	9644	**10461**	9473	**9567**	35983	**37016**
2010	906	**917**	15756	**15969**	10099	**10461**	9541	**9567**	36302	**36914**
2011	880	**916**	14376	**15172**	9831	**9938**	9177	**9091**	34264	**35117**
2012	956	**1053**	12516	**12896**	8267	**8447**	10244	**10452**	31983	**32848**
2013	1117	**1211**	14217	**14830**	7681	**7676**	9149	**9395**	32164	**33112**
2014	984	**1029**	12416	**12606**	8738	**8827**	8408	**8249**	30546	**30711**
2015	1093	**1183**	12601	**12606**	8762	**9511**	7911	**8249**	30367	**31549**
2016	1025	**1084**	11810	**12606**	8153	**9511**	7022	**7012**	28010	**30213**
2017	899	**921**	7236	**10715**	7292	**8084**	7004	**7012**	22431	**26732**

2017 : as in January 9, 2018

Table 2. Number of samples of the commercial catches and number of samples per 1,000 tons of landing, by fishing area (SFA) and by year.

Year	Number of samples					N. samples / 1,000 tons			
	SFA					SFA			
	12	10	9	8	*Total*	12	10	9	8
1982	1	29	21	15	66	6.6	7.7	8.5	7.1
1983	7	27	49	27	110	44.3	7.4	16.8	12.0
1984	-	43	16	29	88	-	9.8	12.0	18.4
1985	-	56	52	40	148	-	12.7	18.7	28.1
1986	2	28	35	29	94	7.6	6.6	10.5	18.2
1987	1	21	28	39	89	1.9	3.9	8.2	14.5
1988	2	42	16	38	98	3.6	6.9	5.6	8.8
1989	-	39	25	39	103	-	6.2	5.9	8.5
1990	3	32	11	28	74	5.9	4.7	2.3	8.5
1991	-	26	16	26	68	-	4.1	3.5	5.4
1992	3	30	12	23	68	6.1	6.1	2.9	7.3
1993	4	34	21	29	88	8.1	6.2	4.4	6.2
1994	7	31	10	42	90	13.9	5.0	2.1	9.0
1995	11	50	36	46	143	22.6	7.8	7.3	9.6
1996	10	33	52	50	145	19.8	4.7	9.5	9.8
1997	9	38	49	44	140	16.4	4.9	8.1	7.4
1998	15	46	47	56	164	23.7	5.1	6.8	8.5
1999	16	39	36	49	140	24.8	4.2	5.1	7.3
2000	12	57	34	49	152	16.2	5.6	4.3	6.6
2001	11	60	37	37	145	13.2	5.5	6.9	4.7
2002	14	69	38	45	166	17.5	6.0	4.4	5.5
2003	14	74	36	48	172	17.6	6.5	4.1	7.1
2004	19	73	40	34	166	18.4	4.6	3.8	4.0
2005	16	66	34	48	164	16.0	5.2	4.2	5.4
2006	18	71	36	58	183	17.5	4.6	4.1	6.5
2007	23	64	36	56	179	22.5	4.1	3.5	6.1
2008	22	65	27	50	164	21.6	4.1	2.8	5.5
2009	22	56	33	26	137	22.2	3.5	3.4	2.7
2010	17	67	32	37	153	18.8	4.3	3.2	3.9
2011	21	61	33	40	155	23.9	4.2	3.4	4.4
2012	18	59	38	37	152	18.8	4.7	4.6	3.6
2013	26	64	30	50	170	23.3	4.5	3.9	5.5
2014	18	59	27	59	163	18.3	4.8	3.1	7.0
2015	28	55	39	52	174	25.6	4.4	4.5	6.6
2016	20	68	40	55	183	19.5	5.8	4.9	7.8
2017	25	41	32	49	147	27.8	5.8	4.8	7.0

Table 3. Number of observations, catch (kg), effort (h), catch per unit of effort (kg/h) and its standard error (SE), percentage (%) of the landing corresponding to the observations, landing (t) and nominal effort (h) by fishing area (SFA) and by year.

SFA	Year	n obs	∑catch	∑effort	CPUE	SE	%	Landing	Nominal effort
8	1982	1281	1617	13095	123.5	1.93	76.6	2111	17093
8	1983	2038	1929	20289	95.1	1.64	86.0	2242	23584
8	1984	742	846	7902	107.1	3.14	53.6	1578	14733
8	1985	164	231	2796	82.7	1.78	16.3	1421	17189
8	1986	952	1060	10412	101.8	2.04	66.6	1592	15643
8	1987	948	1139	11312	100.7	1.41	42.4	2685	26665
8	1988	1029	1656	13405	123.5	2.04	38.2	4335	35101
8	1989	1468	2659	16708	159.1	2.52	57.6	4614	28997
8	1990	1918	3465	22220	155.9	2.40	104.9	3303	21184
8	1991	2440	4630	29256	158.3	1.83	97.0	4773	30158
8	1992	1775	3063	24622	124.4	1.36	97.3	3149	25314
8	1993	2307	4256	31074	137.0	1.18	90.9	4683	34190
8	1994	1764	4264	26917	158.4	1.77	90.9	4689	29601
8	1995	2198	4548	30429	149.5	1.42	94.8	4800	32114
8	1996	1647	4964	22288	222.7	2.92	96.9	5123	23003
8	1997	1558	5273	20994	251.2	3.02	88.5	5957	23716
8	1998	2088	6345	25383	250.0	2.55	96.8	6554	26218
8	1999	2107	6249	24804	252.0	2.81	92.8	6732	26719
8	2000	2189	6980	23690	294.6	3.62	94.4	7396	25101
8	2001	1937	6888	23970	287.4	2.95	88.1	7815	27196
8	2002	2336	7621	27017	282.1	2.34	92.4	8250	29248
8	2003	1817	6018	18111	332.3	3.32	88.9	6773	20382
8	2004	1858	7806	17232	453.0	4.62	90.8	8593	18969
8	2005	1681	7830	17152	456.5	5.38	88.3	8867	19424
8	2006	1608	8155	17062	478.0	6.18	91.0	8957	18740
8	2007	2068	8035	21910	366.7	3.97	87.3	9208	25110
8	2008	1783	8307	20972	396.1	4.91	91.2	9110	22998
8	2009	3263	9022	20344	443.5	4.34	95.2	9473	21362
8	2010	2952	8715	17872	487.6	5.15	91.3	9541	19566
8	2011	2951	8822	16139	546.7	5.84	96.1	9177	16788
8	2012	3086	9637	16950	568.5	5.88	94.1	10244	18018
8	2013	2911	9169	19008	482.4	5.46	100.2	9149	18966
8	2014	2382	7793	14849	524.8	5.18	92.7	8408	16020
8	2015	2597	7540	17159	439.4	4.04	95.3	7911	18003
8	2016	2698	6520	16247	401.3	4.23	92.9	7022	17497
8	2017	2351	5304	16044	330.6	3.97	75.9	6989	21143
9	1982	1725	2259	24987	90.4	0.95	91.7	2464	27252
9	1983	1890	2252	25894	87.0	1.06	77.0	2925	33626
9	1984	1482	1243	20206	61.5	0.85	93.1	1336	21710

SFA	Year	n obs	∑catch	∑effort	CPUE	SE	%	Landing	Nominal effort
9	1985	2292	2570	30665	83.8	0.76	92.2	2786	33243
9	1986	2980	3181	40802	78.0	0.70	95.2	3340	42841
9	1987	2354	3051	36176	84.3	0.85	89.1	3422	40580
9	1988	1624	2367	24137	98.1	1.14	83.2	2844	28999
9	1989	1901	3662	27630	132.5	1.51	86.1	4253	32089
9	1990	1983	4244	30474	139.3	1.80	89.9	4723	33917
9	1991	2280	4611	37598	122.7	1.09	100.5	4590	37425
9	1992	2416	4113	40742	101.0	0.79	98.8	4162	41226
9	1993	2460	4554	44786	101.7	0.63	95.0	4791	47121
9	1994	2295	4897	41169	119.0	0.88	100.9	4854	40804
9	1995	1874	5024	34810	144.3	1.08	101.3	4962	34379
9	1996	2039	5480	38038	144.1	1.32	100.2	5469	37958
9	1997	1923	6052	37455	161.6	1.55	99.9	6058	37491
9	1998	2128	6991	40955	170.7	1.26	100.9	6932	40609
9	1999	2355	6880	44971	153.0	1.19	98.0	7022	45899
9	2000	2181	7680	41171	186.5	1.40	96.7	7941	42571
9	2001	1579	5155	30727	167.8	1.89	95.5	5399	32184
9	2002	2129	8476	40843	207.5	1.89	98.1	8638	41625
9	2003	1693	8442	32173	262.4	2.53	96.6	8742	33317
9	2004	2077	10058	39541	254.4	2.27	96.4	10429	40999
9	2005	1277	7551	23618	319.7	4.69	93.8	8047	25170
9	2006	1377	7830	24554	318.9	4.67	89.4	8754	27452
9	2007	1721	9496	32155	295.3	2.93	93.3	10180	34472
9	2008	1480	8999	27803	323.7	3.25	93.4	9635	29767
9	2009	1529	9591	28114	341.2	3.73	99.5	9644	28268
9	2010	1713	9720	32106	302.8	3.09	96.2	10099	33358
9	2011	1575	9603	29598	324.4	3.37	97.7	9831	30302
9	2012	1492	8012	28011	286.0	3.15	96.9	8267	28901
9	2013	1129	7480	20496	364.9	4.48	97.4	7681	21048
9	2014	1195	8473	21590	392.4	5.05	97.0	8738	22266
9	2015	1501	8809	26863	327.9	3.38	100.5	8762	26720
9	2016	2058	8628	37820	228.1	2.08	105.8	8153	35737
9	2017	1755	6696	33238	201.5	2.21	100.5	6661	33065
10	1982	2247	2554	31755	80.4	1.50	67.7	3774	46932
10	1983	1532	2058	21767	94.6	1.73	56.4	3647	38573
10	1984	3593	4011	51114	78.5	1.12	91.5	4383	55860
10	1985	3297	4305	50343	85.5	0.99	97.9	4399	51444
10	1986	2888	4179	43386	96.3	1.43	99.1	4216	43775
10	1987	3540	5151	56227	91.6	1.09	95.2	5411	59070
10	1988	4079	5401	65130	82.9	0.95	89.3	6047	72918
10	1989	3477	5326	55785	95.5	1.05	85.2	6254	65501
10	1990	2784	6043	45941	131.5	1.62	88.4	6839	51994
10	1991	3336	6206	53084	116.9	1.46	96.8	6411	54842

SFA	Year	n obs	∑catch	∑effort	CPUE	SE	%	Landing	Nominal effort
10	1992	3921	4923	65510	75.2	0.96	99.3	4957	65961
10	1993	4066	5295	72394	73.1	0.81	96.5	5485	74995
10	1994	3841	6212	73030	85.1	0.92	100.8	6165	72472
10	1995	2303	6457	44583	144.8	2.11	101.1	6386	44094
10	1996	2120	7105	40423	175.8	2.51	101.3	7014	39908
10	1997	2275	7819	41477	188.5	2.56	101.1	7737	41040
10	1998	2427	9102	43620	208.7	2.76	101.3	8981	43042
10	1999	2589	9228	46399	198.9	2.50	99.9	9239	46457
10	2000	2819	10075	51683	194.9	2.06	99.2	10160	52118
10	2001	3486	10829	66553	162.7	1.75	98.8	10965	67389
10	2002	3068	11433	57315	199.5	1.86	99.5	11493	57616
10	2003	2156	11226	37844	296.6	3.84	98.8	11357	38285
10	2004	2928	15803	51634	306.1	3.11	99.2	15932	52054
10	2005	2353	12605	40791	309.0	2.91	98.5	12793	41400
10	2006	2951	15576	50950	305.7	2.79	101.7	15312	50087
10	2007	2240	14242	39794	357.9	3.76	91.0	15645	43715
10	2008	2543	15669	44761	350.1	4.11	98.1	15972	45626
10	2009	2785	15540	48891	317.8	3.28	97.9	15873	49940
10	2010	2932	15662	54879	285.4	2.65	99.4	15756	55207
10	2011	2964	14920	54696	272.8	2.60	103.8	14376	52703
10	2012	2474	12523	44402	282.0	2.89	100.1	12516	44376
10	2013	3172	14564	56533	257.6	2.34	102.4	14217	55186
10	2014	2439	12172	42496	286.4	2.83	98.0	12416	43350
10	2015	2310	12250	41253	296.9	2.76	97.2	12601	42436
10	2016	3250	11940	59815	199.6	1.76	101.1	11810	59162
10	2017	2858	7030	52863	133.0	1.15	100.1	7023	52811
12	1982	108	120	1628	73.9	4.34	79.1	152	2058
12	1983	59	57	1093	52.0	4.18	36.0	158	3039
12	1984	217	207	3254	63.7	3.75	83.6	248	3895
12	1985	46	51	705	73.0	6.35	31.4	164	2246
12	1986	182	154	3058	50.5	2.43	58.9	262	5189
12	1987	268	319	5097	62.5	2.42	60.9	523	8369
12	1988	264	457	4327	105.5	6.49	82.9	551	5222
12	1989	314	506	5576	90.8	3.27	80.5	629	6929
12	1990	229	450	3592	125.3	5.88	88.7	507	4048
12	1991	161	495	2144	230.9	23.31	98.0	505	2187
12	1992	300	486	4463	108.9	7.41	99.4	489	4491
12	1993	183	486	3092	157.1	9.47	97.9	496	3158
12	1994	166	490	2247	217.9	21.10	97.6	502	2303
12	1995	144	478	1718	278.2	20.39	98.3	486	1748
12	1996	129	490	1528	320.7	26.38	97.0	505	1575
12	1997	163	535	1903	280.9	13.90	97.4	549	1954
12	1998	164	646	1760	366.8	22.24	101.8	634	1729

SFA	Year	n obs	∑catch	∑effort	CPUE	SE	%	Landing	Nominal effort
12	1999	143	647	1708	378.6	25.63	100.1	646	1707
12	2000	188	728	2022	360.2	18.90	98.5	739	2052
12	2001	246	822	3253	252.6	9.40	98.7	832	3294
12	2002	260	803	3667	219.1	8.21	100.6	799	3647
12	2003	197	797	1939	411.3	20.65	100.2	796	1935
12	2004	215	1033	2627	393.2	15.60	100.0	1033	2627
12	2005	225	1009	2498	404.0	13.15	100.8	1001	2478
12	2006	209	1036	2293	451.6	17.40	100.6	1029	2278
12	2007	232	1022	2745	372.2	13.43	100.0	1022	2746
12	2008	210	1016	2829	359.2	12.68	99.9	1017	2831
12	2009	257	994	3485	285.3	10.81	100.1	993	3481
12	2010	255	914	3563	256.5	9.34	100.9	906	3532
12	2011	277	879	4405	199.6	4.76	99.9	880	4408
12	2012	253	956	4240	225.4	6.40	100.0	956	4242
12	2013	333	1117	6269	178.2	3.72	100.0	1117	6268
12	2014	236	984	4293	229.1	5.98	100.0	984	4294
12	2015	235	1091	4254	256.3	9.13	99.8	1093	4263
12	2016	267	1027	5084	201.9	4.27	100.2	1025	5076
12	2017	274	899	5288	170.0	3.75	100.0	899	5288

Table 4. Catch (t) per month by fishing area (SFA) and by year.

SFA	Year	J	F	M	A	M	J	J	A	S	O	N	D
8	1982	0	0	0	242	832	138	193	277	129	299	0	0
8	1983	0	142	345	696	187	382	159	111	149	59	12	0
8	1984	0	8	9	572	273	244	84	122	101	140	24	0
8	1985	0	0	0	5	236	378	176	419	208	0	0	0
8	1986	0	0	0	527	203	97	296	215	147	98	9	0
8	1987	0	0	78	213	344	753	219	539	204	238	76	22
8	1988	0	0	0	379	1203	960	881	445	0	300	123	45
8	1989	0	0	0	121	1292	1178	377	624	424	253	331	15
8	1990	0	0	0	0	860	532	1048	339	308	215	0	0
8	1991	0	0	0	720	1498	1283	875	240	101	28	29	0
8	1992	0	0	0	0	634	1615	686	72	102	40	1	0
8	1993	0	0	0	2	1338	1172	1334	621	171	36	10	0
8	1994	0	0	0	0	455	1660	1896	411	200	68	0	0
8	1995	4	0	0	9	2651	1460	38	114	316	206	3	0
8	1996	0	0	0	0	1834	2073	815	263	91	48	0	0
8	1997	0	0	0	3	1448	2596	1133	322	170	204	64	17
8	1998	0	0	0	1023	2433	1080	567	204	548	360	201	137
8	1999	0	0	0	1761	2393	1578	412	99	213	82	130	64
8	2000	0	0	0	2427	1875	1136	815	890	199	53	1	0
8	2001	0	0	0	1810	1629	1828	839	218	592	900	0	0
8	2002	0	0	0	1595	1488	2637	1772	478	182	68	31	0
8	2003	0	0	0	6	2495	2807	441	534	218	84	182	7
8	2004	0	0	6	39	2398	4296	1050	348	285	171	0	0
8	2005	0	0	0	1	2289	2608	639	1534	1113	675	8	0
8	2006	0	0	0	505	2344	1938	944	1261	1248	653	65	0
8	2007	0	0	3	870	4231	1053	855	618	899	434	225	22
8	2008	0	0	0	1093	3452	1931	2107	430	41	7	50	0
8	2009	0	0	0	874	3727	1344	2610	418	402	88	10	0
8	2010	0	0	0	304	4426	3548	557	535	106	18	47	0
8	2011	0	0	0	125	6666	1996	172	113	7	58	40	0
8	2012	0	0	0	123	5631	2914	802	389	306	80	0	0
8	2013	0	0	0	66	3716	2947	1398	404	255	307	51	6
8	2014	0	0	0	0	4141	2179	811	877	336	57	6	0
8	2015	0	0	0	0	3556	2311	980	900	165	0	0	0
8	2016	0	0	0	277	1223	3861	1335	69	88	63	98	8
8	2017	0	0	0	272	1319	1149	2837	882	365	154	12	0
9	1982	0	0	0	14	185	680	524	505	469	84	5	0
9	1983	0	0	0	45	108	912	592	365	543	327	33	0
9	1984	0	0	0	15	283	249	307	99	179	185	19	0
9	1985	0	0	0	15	100	490	791	577	607	206	0	0
9	1986	0	0	0	8	101	800	770	1027	418	216	0	0

SFA	Year	J	F	M	A	M	J	J	A	S	O	N	D
9	1987	0	0	0	13	584	602	1047	827	236	113	0	0
9	1988	0	0	0	27	84	484	393	1065	354	425	12	0
9	1989	0	0	0	1	187	1173	827	544	380	1083	59	0
9	1990	0	0	0	6	22	965	1372	1919	439	0	0	0
9	1991	0	0	0	24	373	1055	1537	762	495	306	39	1
9	1992	0	0	0	1	152	1336	1375	777	479	41	3	0
9	1993	0	0	0	0	269	1908	1676	689	189	45	14	0
9	1994	0	0	0	12	95	891	2305	1141	305	99	6	0
9	1995	0	0	0	4	310	1085	2515	841	165	41	1	0
9	1996	0	0	0	30	349	1934	1902	773	348	98	37	0
9	1997	0	0	0	309	560	2007	2659	419	104	0	0	0
9	1998	0	0	0	153	1141	2494	1867	1052	181	43	0	0
9	1999	0	0	0	42	540	1546	3117	1206	396	74	62	40
9	2000	0	0	0	11	647	2547	3217	1081	369	50	19	0
9	2001	0	0	0	2	215	737	1448	2021	870	75	29	2
9	2002	0	0	0	15	892	1590	3344	2155	541	88	0	15
9	2003	0	0	0	368	834	2351	3669	1165	235	73	44	3
9	2004	0	0	0	94	699	2121	4824	1866	683	128	15	0
9	2005	0	0	0	120	1428	3486	1704	420	647	236	7	0
9	2006	0	0	0	40	1119	2348	2483	1536	925	274	30	0
9	2007	0	0	0	0	1153	1953	3254	2293	1309	108	47	63
9	2008	0	0	0	0	1216	2734	3248	1861	498	80	0	0
9	2009	0	0	0	69	1378	4463	2552	824	133	84	143	0
9	2010	0	0	0	1	930	4748	3329	1019	47	24	0	0
9	2011	0	0	0	22	1240	5359	2474	549	162	22	5	0
9	2012	0	0	0	23	1855	3983	1602	442	211	73	78	0
9	2013	0	0	0	93	1678	4652	670	294	228	50	17	0
9	2014	0	0	0	63	2283	4658	1173	307	132	122	0	0
9	2015	0	0	0	188	1434	3714	2115	771	381	92	20	48
9	2016	0	0	0	34	608	2937	2360	1593	543	79	0	0
9	2017	0	0	0	0	628	2870	1612	1010	463	54	24	0
10	1982	0	0	87	834	1015	422	451	433	209	250	73	0
10	1983	0	0	0	698	1484	536	60	595	237	37	0	0
10	1984	0	0	17	776	1040	760	232	886	432	129	93	19
10	1985	0	0	143	1174	671	865	829	643	45	24	3	2
10	1986	0	0	92	1588	1093	633	684	22	86	20	0	0
10	1987	0	0	93	1329	1342	1028	25	54	1085	456	0	1
10	1988	0	0	79	999	1404	968	1321	349	728	199	0	0
10	1989	0	0	221	1555	1541	935	899	0	1103	0	0	0
10	1990	0	0	0	1310	1881	1676	1023	0	949	0	0	0
10	1991	0	0	0	1651	1435	891	655	771	595	373	40	1
10	1992	0	0	0	903	771	460	400	625	891	718	175	16
10	1993	0	0	0	931	964	283	733	844	1063	452	179	38

SFA	Year	J	F	M	A	M	J	J	A	S	O	N	D
10	1994	0	0	181	888	1346	891	520	757	1037	392	113	41
10	1995	0	0	0	2018	1806	1216	325	650	269	84	16	2
10	1996	0	0	0	3151	2161	814	310	428	112	26	9	4
10	1997	0	0	0	3097	1897	1310	765	588	71	6	0	4
10	1998	0	0	0	2797	2242	677	1229	985	756	244	51	2
10	1999	0	0	0	3641	2175	1671	666	603	359	74	31	19
10	2000	0	0	0	2970	2410	1281	1103	1483	437	348	127	2
10	2001	0	0	0	3513	1182	395	277	1141	1913	1214	1163	167
10	2002	0	0	0	2047	2759	2979	1170	1042	1012	268	178	39
10	2003	0	0	0	4076	2828	1154	830	1450	864	92	39	25
10	2004	0	0	0	5375	3595	1784	896	2254	1735	275	19	0
10	2005	0	0	0	4760	3508	1439	1305	504	449	721	107	0
10	2006	0	0	0	1967	3665	2700	1300	1138	2745	1301	362	134
10	2007	0	0	0	2196	4533	4045	2521	781	476	546	473	75
10	2008	0	0	25	4719	3958	2952	1463	1234	1032	303	204	82
10	2009	0	0	0	4021	3868	1211	1002	2569	2755	438	8	0
10	2010	0	0	0	4405	4052	762	1516	2081	1783	899	257	2
10	2011	0	0	0	4151	3167	618	1811	2194	1531	737	167	0
10	2012	0	0	0	4484	2250	674	2067	1681	995	310	55	0
10	2013	0	0	0	4069	2239	847	2342	2601	1364	698	53	4
10	2014	0	0	0	4171	1720	539	2067	2203	1274	362	20	61
10	2015	0	0	0	3802	2601	746	1356	2053	1346	490	207	0
10	2016	0	0	0	2651	2001	612	641	1608	1954	1564	688	91
10	2017	0	0	0	660	629	421	793	848	1840	1340	492	0
12	1982	0	0	0	50	19	3	24	3	51	2	0	0
12	1983	0	0	0	14	7	45	85	7	0	0	0	0
12	1984	0	0	0	18	36	47	51	5	20	58	10	3
12	1985	0	0	0	50	21	0	5	18	42	28	0	0
12	1986	0	0	18	17	18	5	28	62	70	45	0	0
12	1987	0	0	0	14	80	58	189	181	0	0	0	0
12	1988	0	0	0	347	80	86	39	0	0	0	0	0
12	1989	0	0	205	133	35	49	141	66	0	0	0	0
12	1990	0	0	212	125	171	0	0	0	0	0	0	0
12	1991	0	0	0	386	45	3	5	13	40	11	1	0
12	1992	0	0	0	314	99	17	7	15	14	10	14	0
12	1993	0	0	0	264	146	2	2	3	2	69	7	0
12	1994	0	0	50	390	34	2	2	3	6	8	7	0
12	1995	0	0	0	340	40	6	7	71	11	0	12	0
12	1996	0	0	0	404	20	6	6	15	40	11	3	0
12	1997	0	0	0	333	95	4	30	73	6	3	5	2
12	1998	0	0	0	265	151	23	72	40	38	43	2	0
12	1999	0	0	0	373	77	3	41	105	41	5	1	0
12	2000	0	0	0	448	79	6	1	77	71	54	3	0

SFA	Year	J	F	M	A	M	J	J	A	S	O	N	D
12	2001	0	0	0	220	377	0	3	5	46	127	54	0
12	2002	0	0	0	188	278	0	2	86	208	27	11	0
12	2003	0	0	0	314	138	44	0	93	168	31	8	0
12	2004	0	0	0	213	299	52	0	90	237	129	13	0
12	2005	0	0	0	363	240	168	48	85	13	67	18	0
12	2006	0	0	0	418	128	209	12	49	150	18	46	0
12	2007	0	0	0	261	100	79	0	270	265	19	29	0
12	2008	0	0	0	106	475	57	100	100	114	30	37	0
12	2009	0	0	0	322	200	0	0	183	221	51	16	0
12	2010	0	0	0	497	118	0	0	78	117	80	16	0
12	2011	0	0	0	107	96	0	0	263	314	81	20	0
12	2012	0	0	0	15	304	61	215	79	160	103	18	0
12	2013	0	0	0	26	84	13	227	257	273	148	90	0
12	2014	0	0	0	0	270	133	23	224	248	76	11	0
12	2015	0	0	0	62	438	173	57	82	237	28	16	0
12	2016	0	0	0	37	276	89	99	119	166	197	43	0
12	2017	0	0	0	107	72	55	63	259	104	213	25	0

Table 5. Effort (h) per month by fishing area (SFA) and by year.

SFA	Year	J	F	M	A	M	J	J	A	S	O	N	D
8	1982	0	0	0	1509	5781	1487	1557	2608	1382	2767	0	0
8	1983	0	835	2237	6240	1665	4107	2065	2124	2762	1277	272	0
8	1984	0	60	52	3558	2651	2386	781	1334	1455	2098	359	0
8	1985	0	0	0	105	2976	4583	2007	5140	2380	0	0	0
8	1986	0	0	0	2981	2307	1060	3368	2702	1901	1184	141	0
8	1987	0	0	685	2324	2926	6898	2671	5273	2413	2557	668	253
8	1988	0	0	0	2323	9413	8124	7428	3639	0	2831	914	429
8	1989	0	0	0	350	7698	6783	2616	3968	3185	1910	2392	96
8	1990	0	0	0	0	5311	2843	5389	2818	2846	1977	0	0
8	1991	0	0	0	2659	9839	7467	7021	1802	907	240	223	0
8	1992	0	0	0	0	4648	11777	6316	884	1192	488	8	0
8	1993	0	0	0	13	10057	7553	8839	5487	1746	359	134	0
8	1994	0	0	0	0	3589	9781	11505	2392	1699	635	0	0
8	1995	29	0	0	34	16989	9255	241	822	2573	2132	40	0
8	1996	0	0	0	0	6933	9020	4504	1830	428	288	0	0
8	1997	0	0	0	10	6003	9920	4078	1408	707	1118	404	67
8	1998	0	0	0	3810	9685	3552	2227	697	2286	1941	1371	650
8	1999	0	0	0	5994	10597	5343	1277	431	1262	511	910	394
8	2000	0	0	0	7610	7399	2701	2580	3577	985	239	11	0
8	2001	0	0	0	5715	6214	4734	2629	1009	2579	4316	0	0
8	2002	0	0	0	5088	5392	8005	7236	2192	792	433	110	0
8	2003	0	0	0	7	6961	8458	1438	1869	718	297	615	19
8	2004	0	0	15	159	5437	9416	1996	896	693	357	0	0
8	2005	0	0	0	1	4327	4641	1767	3549	3007	2111	22	0
8	2006	0	0	0	865	4385	2890	1650	3168	3695	1903	183	0
8	2007	0	0	3	1769	11775	2469	1579	1591	3108	1591	1047	180
8	2008	0	0	0	3173	9777	3277	4857	1396	240	36	242	0
8	2009	0	0	0	1799	8209	2762	5888	1202	1173	295	34	0
8	2010	0	0	0	905	8720	6426	1334	1623	419	42	97	0
8	2011	0	0	0	407	12450	2761	508	365	44	144	110	0
8	2012	0	0	0	367	9434	5006	1584	894	566	168	0	0
8	2013	0	0	0	243	6029	6014	3615	1378	599	905	166	19
8	2014	0	0	0	0	7910	3547	1365	2042	910	210	38	0
8	2015	0	0	0	0	7109	5348	2415	2641	490	0	0	0
8	2016	0	0	0	751	2566	9133	3644	217	277	270	579	60
8	2017	0	0	0	621	3551	2837	8170	3630	1546	711	76	0
9	1982	0	0	0	96	1712	7053	5827	5324	5852	1333	56	0
9	1983	0	0	0	297	854	8374	7357	4696	6462	4874	712	0
9	1984	0	0	0	114	3096	3198	5188	1913	3276	4403	523	0
9	1985	0	0	0	178	1543	5685	8043	6771	7752	3272	0	0
9	1986	0	0	0	43	788	8150	8962	12658	7032	5209	0	0

SFA	Year	J	F	M	A	M	J	J	A	S	O	N	D
9	1987	0	0	0	237	5778	6675	13167	10103	3135	1485	0	0
9	1988	0	0	0	248	969	4756	3665	11186	3662	4294	218	0
9	1989	0	0	0	43	1364	7771	5939	4734	3180	8490	570	0
9	1990	0	0	0	3	162	4131	10263	15492	3865	0	0	0
9	1991	0	0	0	97	2417	7393	12883	7208	4184	2857	379	7
9	1992	0	0	0	11	1645	12063	13909	8080	4909	565	44	0
9	1993	0	0	0	0	2605	17805	16191	7780	1919	643	179	0
9	1994	0	0	0	158	1081	7464	18731	9976	2393	921	79	0
9	1995	0	0	0	34	2753	7377	16147	6459	1141	444	22	0
9	1996	0	0	0	170	2794	10794	13540	6447	3043	811	358	0
9	1997	0	0	0	1612	4761	12891	14924	2516	786	0	0	0
9	1998	0	0	0	818	5801	13953	11332	6822	1386	497	0	0
9	1999	0	0	0	236	3749	9160	18387	8630	3998	737	705	298
9	2000	0	0	0	62	3795	13629	16300	5939	2342	371	132	0
9	2001	0	0	0	17	1445	3342	6295	12708	7472	674	216	16
9	2002	0	0	0	90	4110	6259	14975	11610	3862	597	0	121
9	2003	0	0	0	1467	2766	10081	13890	3868	734	319	168	25
9	2004	0	0	0	434	2370	7929	18566	7808	3170	630	91	0
9	2005	0	0	0	295	3826	9264	6440	1554	2771	999	21	0
9	2006	0	0	0	141	3701	5063	6956	5535	4631	1221	204	0
9	2007	0	0	0	0	3331	5380	11669	9096	4178	476	147	195
9	2008	0	0	0	0	3377	6579	9640	7503	2178	490	0	0
9	2009	0	0	0	282	3843	11510	9008	2964	295	218	150	0
9	2010	0	0	0	7	2083	14995	11976	3962	220	114	0	0
9	2011	0	0	0	97	3003	14947	9773	2025	281	108	68	0
9	2012	0	0	0	100	5639	13161	6177	1928	958	369	570	0
9	2013	0	0	0	481	4314	11419	2410	1187	972	197	69	0
9	2014	0	0	0	226	6336	11491	2483	924	439	367	0	0
9	2015	0	0	0	398	3797	9877	7428	2916	1265	561	158	319
9	2016	0	0	0	177	2593	10232	11188	8343	2920	285	0	0
9	2017	0	0	0	0	2213	12205	8820	6660	2514	445	208	0
10	1982	0	0	286	4463	11798	6931	6455	7815	3712	4036	1437	0
10	1983	0	0	0	4232	13263	6619	1331	7963	4290	875	0	0
10	1984	0	0	20	4796	10256	10622	4614	13360	7420	2845	1579	348
10	1985	0	0	675	8552	11779	11199	10197	7432	920	577	101	12
10	1986	0	0	496	9100	13371	8793	9394	481	1639	503	0	0
10	1987	0	0	1098	11281	13818	11303	760	940	12941	6919	0	11
10	1988	0	0	710	8988	16241	13148	15584	4830	10116	3302	0	0
10	1989	0	0	1480	13855	16688	12002	10585	0	10892	0	0	0
10	1990	0	0	0	7846	14371	14732	6620	0	8426	0	0	0
10	1991	0	0	0	8627	14533	9253	6294	6367	5495	3852	407	15
10	1992	0	0	0	5533	10946	6752	5598	9830	12584	10535	3907	277
10	1993	0	0	0	7117	14800	3907	8837	11330	14416	10305	3869	415

SFA	Year	J	F	M	A	M	J	J	A	S	O	N	D
10	1994	0	0	338	9482	18330	11207	5914	9101	10538	5276	1820	466
10	1995	0	0	0	10587	16141	9248	2146	3618	1694	514	126	21
10	1996	0	0	0	16102	13612	4582	1795	2587	769	193	138	131
10	1997	0	0	0	13644	12577	7978	3568	2785	385	81	0	22
10	1998	0	0	0	10287	9397	3430	6796	6367	4644	1795	316	10
10	1999	0	0	0	13598	13069	9021	2907	3734	3072	640	246	170
10	2000	0	0	0	12742	13636	7109	4735	7518	2797	2621	950	9
10	2001	0	0	0	13816	7547	2587	1259	6058	14404	11011	9742	964
10	2002	0	0	0	10989	15878	14503	4502	5187	4455	1187	740	175
10	2003	0	0	0	10113	9973	5175	3183	5459	3669	438	178	99
10	2004	0	0	0	12923	14212	7215	3163	7167	6375	919	81	0
10	2005	0	0	0	13928	12540	4536	3944	1758	1373	2876	445	0
10	2006	0	0	0	4823	12427	9411	4070	3310	9136	5315	1324	273
10	2007	0	0	0	4135	13444	12285	6180	1961	1700	2342	1537	132
10	2008	0	0	73	7123	13043	9716	5017	4453	4241	1337	455	167
10	2009	0	0	0	7524	14878	5097	2991	8968	9026	1417	37	0
10	2010	0	0	0	11974	13988	2975	5276	7808	7714	4371	1087	17
10	2011	0	0	0	12017	12519	2464	7249	9010	6360	2641	443	0
10	2012	0	0	0	13697	9421	2395	7185	5696	4141	1668	173	0
10	2013	0	0	0	13113	10195	3538	8917	9952	6622	2689	111	48
10	2014	0	0	0	12580	7225	2317	7659	7073	4905	1393	76	120
10	2015	0	0	0	9910	9088	3037	5015	7177	5655	1997	557	0
10	2016	0	0	0	9529	9949	3340	3496	7986	10837	9145	4342	539
10	2017	0	0	0	3665	4262	3000	6110	6608	12704	11332	5128	0
12	1982	0	0	0	423	284	54	334	39	876	47	0	0
12	1983	0	0	0	200	78	473	2010	278	0	0	0	0
12	1984	0	0	0	57	266	598	1036	117	430	1064	279	48
12	1985	0	0	0	331	323	0	67	341	672	512	0	0
12	1986	0	0	239	149	188	48	507	1051	1339	1668	0	0
12	1987	0	0	0	188	920	663	3290	3309	0	0	0	0
12	1988	0	0	5	2631	957	943	687	0	0	0	0	0
12	1989	0	0	1982	1669	587	512	1420	761	0	0	0	0
12	1990	0	0	1640	715	1693	0	0	0	0	0	0	0
12	1991	0	0	0	1097	262	51	125	173	308	157	14	0
12	1992	0	0	0	1716	1015	333	202	224	349	329	322	0
12	1993	0	0	0	1086	1110	14	29	86	47	692	94	0
12	1994	0	0	492	1035	364	57	50	110	42	93	61	0
12	1995	0	0	0	875	286	69	53	351	71	0	42	0
12	1996	0	0	0	959	80	69	63	127	222	45	10	0
12	1997	0	0	0	1056	317	42	114	348	43	11	16	6
12	1998	0	0	0	485	370	105	265	175	140	170	20	0
12	1999	0	0	0	604	269	32	227	360	180	26	9	0
12	2000	0	0	0	875	336	43	7	295	282	183	30	0

SFA	Year	J	F	M	A	M	J	J	A	S	O	N	D
12	2001	0	0	0	731	1526	0	31	22	181	529	274	0
12	2002	0	0	0	892	1587	22	8	319	709	75	36	0
12	2003	0	0	0	524	319	146	0	308	498	120	21	0
12	2004	0	0	0	340	749	306	8	233	628	330	33	0
12	2005	0	0	0	819	547	334	158	273	51	243	54	0
12	2006	0	0	0	632	310	548	48	130	446	49	115	0
12	2007	0	0	0	371	290	248	0	757	889	103	88	0
12	2008	0	0	0	221	1299	109	227	335	465	88	88	0
12	2009	0	0	0	591	684	8	0	817	1062	259	59	0
12	2010	0	0	0	1500	686	0	0	274	640	358	73	0
12	2011	0	0	0	483	497	0	0	1321	1505	458	143	0
12	2012	0	0	0	74	1174	168	672	387	933	680	155	0
12	2013	0	0	0	138	506	88	1266	1465	1647	689	468	0
12	2014	0	0	0	0	916	567	143	937	1291	355	85	0
12	2015	0	0	0	198	1301	533	258	417	1253	181	122	0
12	2016	0	0	0	142	1421	566	441	451	841	1019	195	0
12	2017	0	0	0	426	395	308	433	1668	661	1222	176	0

Table 6. Spatial distribution of fishing effort in hours and trawl surface according to VMS data according to the trawl footprint of the northern shrimp fishery.

Year	Footprint					
	Low		Medium		High	
	> 0 %	> 10 %	> 25 %	> 50 %	> 100 %	> 200 %
Fishing effort (hour)						
2012	82253	79975	73978	60924	35382	10896
2013	88311	85972	80739	70492	49650	19154
2014	72403	70231	64674	53821	33209	10759
2015	79748	77717	72357	59458	36327	10114
2016	105260	102945	99104	90348	67740	34608
2017	106626	104703	101215	92316	68228	31368
Average	89100	86924	82011	71227	48423	19483
Trawl surface (km^2)						
2012	6601	6417	5935	4884	2829	867
2013	7069	6882	6463	5643	3974	1533
2014	5820	5646	5200	4328	2672	866
2015	6493	6328	5891	4839	2953	822
2016	8636	8446	8129	7407	5549	2835
2017	8759	8601	8313	7580	5604	2578
Average	7230	7053	6655	5780	3930	1584
Surface of the area (km^2)						
2012	14305	10437	7532	4666	1762	321
2013	13560	9413	6850	4611	2305	571
2014	12759	9036	6353	3962	1645	325
2015	13822	10070	7460	4567	1890	321
2016	14451	9319	7390	5421	2863	930
2017	13892	9511	7786	5784	3063	857
Average	13798	9631	7229	4835	2255	554

Table 7. Frequency of observations used for the multiple regression between the logarithm of catch rates and the different categories (year, month, length and power of the vessels) by fishing area.

	ESQUIMAN		ANTICOSTI		SEPT-ILES		ESTUARY	
	n	%	n	%	n	%	n	%
Year								
1982	1073	1.58	1566	2.38	1801	1.80	84	1.19
1983	1401	2.07	1790	2.72	1378	1.38	54	0.76
1984	622	0.92	1408	2.14	3425	3.43	203	2.88
1985	162	0.24	2272	3.45	3229	3.23	43	0.61
1986	943	1.39	2965	4.50	2835	2.84	175	2.48
1987	843	1.25	2319	3.52	3433	3.44	243	3.44
1988	970	1.43	1579	2.40	3908	3.91	226	3.20
1989	1382	2.04	1842	2.80	3372	3.38	252	3.57
1990	1881	2.78	1982	3.01	2773	2.78	194	2.75
1991	2403	3.55	2224	3.38	3323	3.33	149	2.11
1992	1751	2.59	2408	3.66	3877	3.88	261	3.70
1993	2270	3.35	2445	3.71	3982	3.99	153	2.17
1994	1621	2.39	2252	3.42	3670	3.67	134	1.90
1995	2003	2.96	1864	2.83	2267	2.27	120	1.70
1996	1623	2.40	1993	3.03	2066	2.07	112	1.59
1997	1507	2.23	1794	2.72	2159	2.16	140	1.98
1998	2006	2.96	2070	3.14	2320	2.32	143	2.03
1999	2034	3.00	2286	3.47	2518	2.52	125	1.77
2000	2144	3.17	2093	3.18	2643	2.65	177	2.51
2001	1864	2.75	1559	2.37	3333	3.34	224	3.17
2002	2283	3.37	2115	3.21	2952	2.95	241	3.41
2003	1720	2.54	1592	2.42	2087	2.09	186	2.63
2004	1814	2.68	2038	3.10	2797	2.80	208	2.95
2005	1620	2.39	1249	1.90	2258	2.26	213	3.02
2006	1570	2.32	1350	2.05	2766	2.77	208	2.95
2007	2020	2.98	1676	2.55	2126	2.13	232	3.29
2008	1746	2.58	1465	2.23	2460	2.46	210	2.97
2009	3178	4.69	1495	2.27	2674	2.68	256	3.63
2010	2919	4.31	1709	2.60	2804	2.81	252	3.57
2011	2916	4.31	1555	2.36	2845	2.85	276	3.91
2012	3000	4.43	1452	2.21	2419	2.42	253	3.58
2013	2796	4.13	1099	1.67	3087	3.09	332	4.70
2014	2281	3.37	1182	1.80	2344	2.35	236	3.34
2015	2538	3.75	1442	2.19	2233	2.24	229	3.24
2016	2601	3.84	2043	3.10	3075	3.08	242	3.43
2017	2193	3.24	1664	2.53	2661	2.66	274	3.88
Month								
3	-	-	-	-	-	-	231	3.27
4	5758	8.51	-	-	20698	20.72	1756	24.87
5	24409	36.06	5529	8.40	23621	23.64	1333	18.88
6	16768	24.77	17404	26.43	13472	13.49	388	5.50
7	9189	13.57	20120	30.56	10584	10.59	566	8.02
8	4498	6.64	13040	19.81	11054	11.07	850	12.04
9	3586	5.30	6650	10.10	12225	12.24	949	13.44
10	2669	3.94	3094	4.70	6209	6.22	703	9.96
11	821	1.21	-	-	2037	2.04	284	4.02
Vessel length class								
45	2912	4.30	1772	2.69	2877	2.88	184	2.61
55	31767	46.92	18237	27.70	38141	38.18	1482	20.99
65	26812	39.61	24617	37.39	39070	39.11	4264	60.40
75	4136	6.11	14028	21.31	13610	13.62	1130	16.01
85	2071	3.06	7183	10.91	6202	6.21	-	-
Engin power class								
150	3329	4.92	1252	1.90	1519	1.52	-	-
250	6595	9.74	1855	2.82	2415	2.42	-	-
350	12050	17.80	9977	15.15	18810	18.83	1082	15.33
450	13014	19.22	12079	18.35	24155	24.18	1689	23.92
550	16766	24.77	28086	42.66	41487	41.53	3769	53.39
650	9667	14.28	7623	11.58	8481	8.49	520	7.37
750	4757	7.03	2901	4.41	3033	3.04	-	-
850	1520	2.25	2064	3.14	-	-	-	-

Table 8. Results of the multiple regression between the logarithm of catch rates and the different categories (year, month, length and power of the vessels) for Esquiman fishing area.

	DF	Sum of squares	Mean square	F	Pr > F
Model	53	23573.89	444.79	1940.81	<.0001
Error	67644	15502.53	0.23	-	-
Corrected total	67697	39076.42	-	-	-

R^2 = 0.60 CV = 8.54 Root MSE = 0.48 Ln CPUE mean = 5.61

Source	DF	Type III SS	Mean square	F	Pr > F
Month	7	1074.70	153.53	669.91	<.0001
Length	4	125.77	31.44	137.20	<.0001
Power	7	520.25	74.32	324.30	<.0001
Year	35	14294.87	408.42	1782.13	<.0001

Parameter		Estimate	Standard error	t	Pr > |t|
Intercept		5.319	0.027	198.22	<.0001
Month	4	0.568	0.018	30.80	<.0001
Month	5	0.433	0.018	24.77	<.0001
Month	6	0.509	0.018	28.94	<.0001
Month	7	0.397	0.018	22.07	<.0001
Month	8	0.212	0.019	11.35	<.0001
Month	9	0.142	0.019	7.49	<.0001
Month	10	0.072	0.019	3.68	0.0002
Month	11	0.000	-	-	-
Length class	45	0.185	0.015	12.15	<.0001
Length class	55	0.180	0.012	14.84	<.0001
Length class	65	0.166	0.012	14.14	<.0001
Length class	75	0.005	0.013	0.34	0.7335
Length class	85	0.000	-	-	-
Power class	150	-0.515	0.016	-31.88	<.0001
Power class	250	-0.146	0.015	-10.04	<.0001
Power class	350	-0.198	0.014	-14.16	<.0001
Power class	450	-0.116	0.013	-8.62	<.0001
Power class	550	-0.062	0.013	-4.75	<.0001
Power class	650	-0.029	0.013	-2.16	0.0310
Power class	750	-0.065	0.014	-4.49	<.0001
Power class	850	0.000	-	-	-
Year	1982	-0.885	0.018	-48.31	<.0001
Year	1983	-1.405	0.017	-83.09	<.0001
Year	1984	-1.237	0.022	-55.93	<.0001

Parameter			Estimate	Standard error	t	Pr > |t|
	Year	1985	-1.185	0.040	-29.96	<.0001
	Year	1986	-1.143	0.019	-60.53	<.0001
	Year	1987	-1.096	0.020	-55.46	<.0001
	Year	1988	-0.907	0.019	-47.85	<.0001
	Year	1989	-0.579	0.017	-33.86	<.0001
	Year	1990	-0.726	0.015	-47.38	<.0001
	Year	1991	-0.775	0.014	-53.71	<.0001
	Year	1992	-0.994	0.016	-63.58	<.0001
	Year	1993	-0.809	0.015	-55.56	<.0001
	Year	1994	-0.645	0.016	-40.74	<.0001
	Year	1995	-0.700	0.015	-45.78	<.0001
	Year	1996	-0.367	0.016	-22.96	<.0001
	Year	1997	-0.234	0.016	-14.35	<.0001
	Year	1998	-0.226	0.015	-14.83	<.0001
	Year	1999	-0.303	0.015	-19.89	<.0001
	Year	2000	-0.168	0.015	-11.11	<.0001
	Year	2001	-0.149	0.016	-9.57	<.0001
	Year	2002	-0.173	0.015	-11.78	<.0001
	Year	2003	0.031	0.016	1.99	0.0461
	Year	2004	0.327	0.016	21.06	<.0001
	Year	2005	0.443	0.016	27.75	<.0001
	Year	2006	0.479	0.016	29.80	<.0001
	Year	2007	0.124	0.015	8.19	<.0001
	Year	2008	0.069	0.016	4.37	<.0001
	Year	2009	0.221	0.014	16.33	<.0001
	Year	2010	0.316	0.014	22.81	<.0001
	Year	2011	0.398	0.014	28.24	<.0001
	Year	2012	0.465	0.014	33.42	<.0001
	Year	2013	0.300	0.014	21.47	<.0001
	Year	2014	0.379	0.015	25.78	<.0001
	Year	2015	0.216	0.014	15.14	<.0001
	Year	2016	0.058	0.014	4.12	<.0001
	Year	2017	0.000	-	-	-

Table 9. Results of the multiple regression between the logarithm of catch rates and the different categories (year, month, length and power of the vessels) for Anticosti fishing area.

	DF	Sum of squares	Mean square	F	Pr > F
Model	51	19158.11	375.65	1969.65	<.0001
Error	65785	12546.46	0.19	-	-
Corrected total	65836	31704.57	-	-	-

R^2 = 0.60 CV = 8.68 Root MSE = 0.44 Ln CPUE mean = 5.03

Source	DF	Type III SS	Mean square	F	Pr > F
Month	5	763.87	152.77	801.04	<.0001
Length	4	38.09	9.52	49.93	<.0001
Power	7	423.98	60.57	317.58	<.0001
Year	35	10411.08	297.46	1559.67	<.0001

Parameter		Estimate	Standard error	t	Pr > |t|
Intercept		5.217	0.018	295.51	<.0001
Month	5	0.359	0.010	34.90	<.0001
Month	6	0.435	0.009	48.34	<.0001
Month	7	0.336	0.009	37.84	<.0001
Month	8	0.228	0.009	25.00	<.0001
Month	9	0.133	0.010	13.66	<.0001
Month	10	0.000	-	-	-
Length class	45	-0.168	0.013	-12.71	<.0001
Length class	55	-0.047	0.007	-6.46	<.0001
Length class	65	-0.028	0.007	-4.09	<.0001
Length class	75	-0.050	0.007	-7.34	<.0001
Length class	85	0.000	-	-	-
Power class	150	-0.608	0.016	-37.04	<.0001
Power class	250	-0.486	0.016	-31.27	<.0001
Power class	350	-0.407	0.011	-36.66	<.0001
Power class	450	-0.385	0.011	-34.95	<.0001
Power class	550	-0.315	0.011	-29.77	<.0001
Power class	650	-0.234	0.011	-21.10	<.0001
Power class	750	-0.209	0.013	-16.13	<.0001
Power class	850	0.000	-	-	-
Year	1982	-0.658	0.016	-41.37	<.0001
Year	1983	-0.688	0.015	-44.54	<.0001
Year	1984	-1.035	0.016	-63.23	<.0001
Year	1985	-0.730	0.015	-50.17	<.0001
Year	1986	-0.803	0.014	-57.97	<.0001

Parameter			Estimate	Standard error	t	Pr > |t|
	Year	1987	-0.729	0.014	-50.52	<.0001
	Year	1988	-0.483	0.016	-30.82	<.0001
	Year	1989	-0.211	0.015	-13.96	<.0001
	Year	1990	-0.270	0.015	-18.34	<.0001
	Year	1991	-0.387	0.014	-27.05	<.0001
	Year	1992	-0.606	0.014	-43.09	<.0001
	Year	1993	-0.607	0.014	-43.43	<.0001
	Year	1994	-0.420	0.014	-29.48	<.0001
	Year	1995	-0.235	0.015	-15.85	<.0001
	Year	1996	-0.269	0.015	-18.40	<.0001
	Year	1997	-0.177	0.015	-11.80	<.0001
	Year	1998	-0.101	0.014	-7.01	<.0001
	Year	1999	-0.198	0.014	-14.01	<.0001
	Year	2000	0.008	0.014	0.53	0.5940
	Year	2001	-0.065	0.016	-4.19	<.0001
	Year	2002	0.127	0.014	8.86	<.0001
	Year	2003	0.318	0.015	20.69	<.0001
	Year	2004	0.306	0.014	21.12	<.0001
	Year	2005	0.494	0.016	30.13	<.0001
	Year	2006	0.540	0.016	33.61	<.0001
	Year	2007	0.465	0.015	30.64	<.0001
	Year	2008	0.537	0.016	34.21	<.0001
	Year	2009	0.544	0.016	34.89	<.0001
	Year	2010	0.421	0.015	27.97	<.0001
	Year	2011	0.484	0.015	31.38	<.0001
	Year	2012	0.362	0.016	23.00	<.0001
	Year	2013	0.586	0.017	34.42	<.0001
	Year	2014	0.671	0.017	40.22	<.0001
	Year	2015	0.521	0.016	33.07	<.0001
	Year	2016	0.182	0.014	12.61	<.0001
	Year	2017	0.000	-	-	-

Table 10. Results of the multiple regression between the logarithm of catch rates and the different categories (year, month, length and power of the vessels) for Sept-Iles fishing area.

	DF	Sum of squares	Mean square	F	Pr > F
Model	52	35714.93	686.83	2071.74	<.0001
Error	99847	33101.36	0.33	-	-
Corrected total	99899	68816.29	-	-	-

R^2 = 0.52 CV = 11.62 Root MSE = 0.58 Ln CPUE mean = 4.95

Source	DF	Type III SS	Mean square	F	Pr > F
Month	7	2095.65	299.38	903.05	<.0001
Length	4	219.96	54.99	165.87	<.0001
Power	6	654.54	109.09	329.06	<.0001
Year	35	25429.94	726.57	2191.63	<.0001

Parameter		Estimate	Standard error	t	Pr > |t|
Intercept		4.655	0.021	221.13	<.0001
Month	4	0.631	0.014	45.78	<.0001
Month	5	0.325	0.014	23.72	<.0001
Month	6	0.314	0.014	22.22	<.0001
Month	7	0.392	0.014	27.27	<.0001
Month	8	0.355	0.014	24.98	<.0001
Month	9	0.286	0.014	20.39	<.0001
Month	10	0.117	0.015	7.87	<.0001
Month	11	0.000	-	-	-
Length class	45	-0.294	0.014	-20.45	<.0001
Length class	55	-0.107	0.009	-12.03	<.0001
Length class	65	-0.061	0.008	-7.24	<.0001
Length class	75	-0.143	0.009	-15.59	<.0001
Length class	85	0.000	-	-	-
Power class	150	-0.549	0.019	-28.72	<.0001
Power class	250	-0.188	0.017	-11.06	<.0001
Power class	350	-0.147	0.012	-12.63	<.0001
Power class	450	-0.119	0.011	-10.49	<.0001
Power class	550	-0.013	0.011	-1.19	0.2341
Power class	650	0.074	0.012	6.01	<.0001
Power class	750	0.000	-	-	-
Year	1982	-0.553	0.018	-30.68	<.0001
Year	1983	-0.356	0.020	-18.07	<.0001
Year	1984	-0.572	0.015	-37.21	<.0001
Year	1985	-0.569	0.016	-36.56	<.0001

Parameter			Estimate	Standard error	t	Pr > |t|
	Year	1986	-0.463	0.016	-28.89	<.0001
	Year	1987	-0.455	0.015	-29.83	<.0001
	Year	1988	-0.567	0.015	-38.18	<.0001
	Year	1989	-0.472	0.015	-30.97	<.0001
	Year	1990	-0.089	0.016	-5.57	<.0001
	Year	1991	-0.253	0.015	-16.67	<.0001
	Year	1992	-0.659	0.015	-45.22	<.0001
	Year	1993	-0.692	0.014	-47.83	<.0001
	Year	1994	-0.551	0.015	-37.30	<.0001
	Year	1995	-0.101	0.017	-6.05	<.0001
	Year	1996	0.044	0.017	2.55	0.0109
	Year	1997	0.149	0.017	8.83	<.0001
	Year	1998	0.283	0.016	17.16	<.0001
	Year	1999	0.234	0.016	14.45	<.0001
	Year	2000	0.277	0.016	17.31	<.0001
	Year	2001	0.154	0.015	10.23	<.0001
	Year	2002	0.323	0.016	20.68	<.0001
	Year	2003	0.712	0.017	41.84	<.0001
	Year	2004	0.742	0.016	46.98	<.0001
	Year	2005	0.774	0.017	46.41	<.0001
	Year	2006	0.845	0.016	53.62	<.0001
	Year	2007	0.984	0.017	58.04	<.0001
	Year	2008	0.920	0.016	56.44	<.0001
	Year	2009	0.822	0.016	51.64	<.0001
	Year	2010	0.701	0.016	44.63	<.0001
	Year	2011	0.644	0.016	41.12	<.0001
	Year	2012	0.623	0.016	38.15	<.0001
	Year	2013	0.551	0.015	35.85	<.0001
	Year	2014	0.655	0.016	39.79	<.0001
	Year	2015	0.735	0.017	44.14	<.0001
	Year	2016	0.393	0.015	25.70	<.0001
	Year	2017	0.000	-	-	-

Table 11. Results of the multiple regression between the logarithm of catch rates and the different categories (year, month, length and power of the vessels) for Estuary fishing area.

	DF	Sum of squares	Mean square	F	Pr > F
Model	49	3296.69	67.28	170.29	<.0001
Error	7010	2769.57	0.40	-	-
Corrected total	7059	6066.25	-	-	-

R^2 = 0.54 CV = 12.18 Root MSE = 0.63 Ln CPUE mean = 5.16

Source	DF	Type III SS	Mean square	F	Pr > F
Month	8	333.82	41.73	105.61	<.0001
Length	3	3.90	1.30	3.29	0.0197
Power	3	27.15	9.05	22.91	<.0001
Year	35	2319.39	66.27	167.73	<.0001

Parameter		Estimate	Standard error	t	Pr > |t|
Intercept		5.224	0.064	81.39	<.0001
Month	3	0.160	0.067	2.40	0.0164
Month	4	0.657	0.042	15.70	<.0001
Month	5	0.242	0.042	5.72	<.0001
Month	6	0.218	0.051	4.28	<.0001
Month	7	0.108	0.048	2.23	0.0256
Month	8	0.150	0.045	3.35	0.0008
Month	9	0.048	0.044	1.10	0.2711
Month	10	-0.026	0.045	-0.58	0.5589
Month	11	0.000	-	-	-
Length class	45	-0.134	0.054	-2.50	0.0123
Length class	55	-0.075	0.030	-2.52	0.0117
Length class	65	-0.037	0.024	-1.55	0.1217
Length class	75	0.000	-	-	-
Power class	350	-0.287	0.035	-8.07	<.0001
Power class	450	-0.247	0.036	-6.92	<.0001
Power class	550	-0.200	0.031	-6.38	<.0001
Power class	650	0.000	-	-	-
Year	1982	-1.104	0.081	-13.56	<.0001
Year	1983	-1.386	0.097	-14.28	<.0001
Year	1984	-1.165	0.060	-19.29	<.0001
Year	1985	-1.112	0.104	-10.65	<.0001
Year	1986	-1.321	0.062	-21.39	<.0001
Year	1987	-1.161	0.058	-19.97	<.0001
Year	1988	-0.918	0.059	-15.67	<.0001

Parameter			Estimate	Standard error	t	Pr > |t|
	Year	1989	-0.928	0.060	-15.54	<.0001
	Year	1990	-0.488	0.067	-7.27	<.0001
	Year	1991	-0.467	0.065	-7.17	<.0001
	Year	1992	-1.090	0.056	-19.58	<.0001
	Year	1993	-0.416	0.065	-6.42	<.0001
	Year	1994	-0.541	0.068	-7.93	<.0001
	Year	1995	-0.102	0.070	-1.46	0.1430
	Year	1996	-0.015	0.072	-0.20	0.8382
	Year	1997	0.067	0.067	1.00	0.3152
	Year	1998	0.554	0.066	8.40	<.0001
	Year	1999	0.535	0.069	7.76	<.0001
	Year	2000	0.424	0.062	6.85	<.0001
	Year	2001	0.194	0.058	3.35	0.0008
	Year	2002	-0.047	0.057	-0.82	0.4113
	Year	2003	0.618	0.061	10.16	<.0001
	Year	2004	0.690	0.059	11.62	<.0001
	Year	2005	0.622	0.059	10.57	<.0001
	Year	2006	0.779	0.059	13.12	<.0001
	Year	2007	0.722	0.057	12.66	<.0001
	Year	2008	0.643	0.059	10.94	<.0001
	Year	2009	0.375	0.056	6.72	<.0001
	Year	2010	0.123	0.056	2.19	0.0282
	Year	2011	0.053	0.054	0.98	0.3271
	Year	2012	0.255	0.055	4.60	<.0001
	Year	2013	0.044	0.052	0.86	0.3920
	Year	2014	0.323	0.057	5.72	<.0001
	Year	2015	0.323	0.057	5.64	<.0001
	Year	2016	0.168	0.056	2.99	0.0028
	Year	2017	0.000	-	-	-

Table 12. Standardised catch per unit of effort and its standard error, landing and standardised effort, by fishing area and by year.

SFA	Year	CPUE std	SE	Landing (t)	Effort std
8	1982	174.25	2.80	2111	12115
8	1983	103.68	1.48	2242	21624
8	1984	122.61	2.48	1578	12870
8	1985	129.01	4.96	1421	11015
8	1986	134.64	2.26	1592	11824
8	1987	141.20	2.48	2685	19016
8	1988	170.51	2.83	4335	25424
8	1989	236.84	3.42	4614	19482
8	1990	204.44	2.57	3303	16156
8	1991	194.58	2.18	4773	24530
8	1992	156.35	1.96	3149	20140
8	1993	188.13	2.17	4683	24893
8	1994	221.59	2.90	4689	21161
8	1995	209.77	2.52	4800	22882
8	1996	292.76	3.79	5123	17499
8	1997	334.31	4.46	5957	17819
8	1998	337.03	4.09	6554	19447
8	1999	312.10	3.75	6732	21570
8	2000	357.27	4.32	7396	20702
8	2001	363.97	4.56	7815	21472
8	2002	355.42	4.06	8250	23212
8	2003	435.94	5.46	6773	15537
8	2004	586.07	7.13	8593	14662
8	2005	657.70	8.58	8867	13482
8	2006	682.07	9.10	8957	13132
8	2007	478.35	5.80	9208	19250
8	2008	452.40	5.75	9110	20137
8	2009	526.95	5.35	9473	17977
8	2010	579.61	5.80	9541	16461
8	2011	628.62	6.56	9177	14599
8	2012	672.63	6.91	10244	15230
8	2013	570.03	5.84	9149	16050
8	2014	616.91	6.94	8408	13629
8	2015	524.43	5.60	7911	15085
8	2016	447.80	4.61	7022	15681
8	2017	422.43	4.99	6989	16545
9	1982	115.21	1.44	2464	21387

SFA	Year	CPUE std	SE	Landing (t)	Effort std
9	1983	111.80	1.33	2925	26162
9	1984	78.99	1.04	1336	16913
9	1985	107.23	1.15	2786	25982
9	1986	99.68	0.97	3340	33509
9	1987	107.28	1.14	3422	31899
9	1988	137.18	1.68	2844	20731
9	1989	180.12	2.04	4253	23612
9	1990	169.84	1.89	4723	27809
9	1991	150.98	1.58	4590	30402
9	1992	121.40	1.21	4162	34284
9	1993	121.26	1.19	4791	39512
9	1994	146.15	1.52	4854	33213
9	1995	175.78	1.96	4962	28228
9	1996	170.01	1.84	5469	32169
9	1997	186.43	2.08	6058	32495
9	1998	201.00	2.12	6932	34488
9	1999	182.40	1.87	7022	38499
9	2000	224.14	2.37	7941	35428
9	2001	208.44	2.56	5399	25902
9	2002	252.66	2.70	8638	34189
9	2003	305.64	3.62	8742	28602
9	2004	302.03	3.27	10429	34529
9	2005	364.41	4.81	8047	22082
9	2006	381.52	4.92	8754	22945
9	2007	354.09	4.19	10180	28750
9	2008	380.39	4.74	9635	25329
9	2009	383.24	4.67	9644	25165
9	2010	338.95	3.89	10099	29795
9	2011	361.05	4.31	9831	27229
9	2012	319.32	3.92	8267	25889
9	2013	399.75	5.56	7681	19214
9	2014	435.22	5.86	8738	20077
9	2015	374.32	4.62	8762	23408
9	2016	266.85	2.88	8153	30552
9	2017	222.43	2.59	6661	29947
10	1982	90.76	1.37	3774	41584
10	1983	110.49	1.87	3647	33007
10	1984	89.03	1.05	4383	49231
10	1985	89.28	1.05	4399	49270
10	1986	99.29	1.22	4216	42464

SFA	Year	CPUE std	SE	Landing (t)	Effort std
10	1987	100.16	1.15	5411	54022
10	1988	89.54	0.98	6047	67531
10	1989	98.46	1.12	6254	63519
10	1990	144.41	1.75	6839	47357
10	1991	122.54	1.40	6411	52316
10	1992	81.65	0.90	4957	60709
10	1993	78.95	0.87	5485	69474
10	1994	90.98	1.01	6165	67766
10	1995	142.63	1.89	6386	44774
10	1996	164.83	2.29	7014	42552
10	1997	183.24	2.48	7737	42224
10	1998	209.43	2.80	8981	42883
10	1999	199.47	2.53	9239	46317
10	2000	208.09	2.61	10160	48824
10	2001	184.04	2.19	10965	59579
10	2002	217.85	2.57	11493	52756
10	2003	321.62	4.47	11357	35312
10	2004	331.31	4.10	15932	48087
10	2005	342.15	4.64	12793	37390
10	2006	367.25	4.55	15312	41694
10	2007	422.27	5.73	15645	37050
10	2008	395.94	5.11	15972	40339
10	2009	359.14	4.55	15873	44197
10	2010	317.92	3.98	15756	49559
10	2011	300.55	3.74	14376	47833
10	2012	294.29	3.90	12516	42530
10	2013	273.78	3.30	14217	51928
10	2014	303.87	4.07	12416	40860
10	2015	329.05	4.47	12601	38295
10	2016	233.66	2.82	11810	50544
10	2017	157.79	2.03	7023	44507
12	1982	73.31	5.76	152	2073
12	1983	55.21	5.12	158	2862
12	1984	69.08	3.86	248	3590
12	1985	72.52	7.49	164	2262
12	1986	59.09	3.53	262	4434
12	1987	69.37	3.73	523	7539
12	1988	88.41	4.55	551	6232
12	1989	87.54	4.82	629	7185
12	1990	135.86	8.68	507	3732

SFA	Year	CPUE std	SE	Landing (t)	Effort std
12	1991	138.75	8.58	505	3640
12	1992	74.43	3.81	489	6570
12	1993	146.00	9.06	496	3397
12	1994	128.81	8.30	502	3897
12	1995	199.74	13.21	486	2433
12	1996	218.02	14.92	505	2316
12	1997	236.70	15.06	549	2319
12	1998	385.08	23.86	634	1646
12	1999	377.78	25.02	646	1710
12	2000	338.30	19.86	739	2184
12	2001	268.95	14.83	832	3094
12	2002	211.34	11.34	799	3781
12	2003	410.67	23.45	796	1938
12	2004	441.54	24.20	1033	2340
12	2005	412.29	22.40	1001	2428
12	2006	482.61	25.63	1029	2132
12	2007	455.68	24.19	1022	2243
12	2008	421.11	23.27	1017	2415
12	2009	322.16	17.02	993	3082
12	2010	250.53	13.35	906	3616
12	2011	233.57	12.21	880	3768
12	2012	285.92	15.02	956	3344
12	2013	231.56	11.56	1117	4824
12	2014	305.96	15.95	984	3216
12	2015	305.79	15.86	1093	3574
12	2016	261.88	13.51	1025	3914
12	2017	221.47	11.30	899	4059

Table 13. Weighting factors used to estimate the numbers at length by fishing area (SFA), by year and by month. The catch corresponds to the landing that is adjusted for the proportion (ratio) of P. borealis in the samples. The origin (month, year) of the samples used for the estimated is also indicated.

SFA	Year	Month	Landing (t)	Samples		Catch estimate (t)	From :		SFA	Year	Month	Landing (t)	Samples		Catch estimate (t)	From :	
				N individuals	Ratio *P. borealis*		Month	Year					N individuals	Ratio *P. borealis*		Month	Year
8	2015	1	0.0	-	-	-	-	-	9	2015	1	0.0	-	-	-	-	-
8	2015	2	0.0	-	-	-	-	-	9	2015	2	0.0	-	-	-	-	-
8	2015	3	0.0	-	-	-	-	-	9	2015	3	0.0	-	-	-	-	-
8	2015	4	0.0	-	-	-	-	-	9	2015	4	188.4	267	0.992	187.0	4	2015
8	2015	5	3556.2	3440	0.991	3525.0	5	2015	9	2015	5	1433.5	2925	0.989	1418.1	5	2015
8	2015	6	2310.6	5826	0.991	2290.7	6	2015	9	2015	6	3713.5	2639	0.970	3602.5	6	2015
8	2015	7	979.8	2384	0.981	961.3	7	2015	9	2015	7	2114.5	2388	0.938	1983.8	7	2015
8	2015	8	899.5	220	1.000	899.5	8	2015	9	2015	8	771.4	1368	0.983	758.4	8	2015
8	2015	9	164.8	1057	0.995	164.0	9	2015	9	2015	9	380.6	754	0.999	380.2	9	2015
8	2015	10	0.0	798	0.994	0.0	10	2015	9	2015	10	92.3	-	-	92.2	9	2015
8	2015	11	0.0	-	-	-	-	-	9	2015	11	20.0	-	-	20.0	9	2015
8	2015	12	0.0	-	-	-	-	-	9	2015	12	47.7	-	-	47.7	9	2015
8	2016	1	0.0	-	-	-	-	-	9	2016	1	0.0	-	-	-	-	-
8	2016	2	0.0	-	-	-	-	-	9	2016	2	0.0	-	-	-	-	-
8	2016	3	0.0	-	-	-	-	-	9	2016	3	0.0	-	-	-	-	-
8	2016	4	276.7	253	0.980	271.3	4	2016	9	2016	4	33.8	-	-	32.7	5	2016
8	2016	5	1223.2	783	0.995	1216.9	5	2016	9	2016	5	608.0	1560	0.966	587.5	5	2016
8	2016	6	3861.2	4451	0.992	3832.0	6	2016	9	2016	6	2936.9	3164	0.956	2806.3	6	2016
8	2016	7	1335.3	4457	0.987	1318.4	7	2016	9	2016	7	2359.7	2870	0.980	2312.3	7	2016
8	2016	8	68.9	-	-	68.0	7	2016	9	2016	8	1592.8	1819	0.968	1541.4	8	2016
8	2016	9	88.4	1029	0.989	87.4	9	2016	9	2016	9	542.5	796	0.992	538.0	9	2016
8	2016	10	62.5	1558	0.992	62.0	10	2016	9	2016	10	79.3	267	0.990	78.5	10	2016
8	2016	11	98.0	1624	0.976	95.6	11	2016	9	2016	11	0.0	-	-	-	-	-
8	2016	12	7.8	263	0.998	7.8	12	2016	9	2016	12	0.0	-	-	-	-	-
8	2017	1	0.0	-	-	-	-	-	9	2017	1	0.0	-	-	-	-	-
8	2017	2	0.0	-	-	-	-	-	9	2017	2	0.0	-	-	-	-	-
8	2017	3	0.0	-	-	-	-	-	9	2017	3	0.0	-	-	-	-	-
8	2017	4	271.7	453	0.996	270.7	4	2017	9	2017	4	0.0	-	-	-	-	-
8	2017	5	1318.9	1567	0.990	1306.1	5	2017	9	2017	5	628.1	1260	0.976	613.0	5	2017
8	2017	6	1148.5	1504	0.964	1107.4	6	2017	9	2017	6	2870.0	3178	0.968	2776.8	6	2017
8	2017	7	2836.8	3709	0.997	2827.7	7	2017	9	2017	7	1611.9	2341	0.938	1512.4	7	2017
8	2017	8	882.2	3764	0.990	873.7	8	2017	9	2017	8	1009.6	1587	0.953	962.5	8	2017
8	2017	9	364.7	1315	0.990	361.0	9	2017	9	2017	9	463.2	-	-	441.6	8	2017
8	2017	10	154.3	524	0.999	154.2	10	2017	9	2017	10	54.3	-	-	51.8	8	2017
8	2017	11	11.8	-	-	11.8	10	2017	9	2017	11	23.8	-	-	22.7	8	2017
8	2017	12	0.0	-	-	-	-	-	9	2017	12	0.0	-	-	-	-	-
10	2015	1	0.0	-	-	-	-	-	12	2015	1	0.0	-	-	-	-	-
10	2015	2	0.0	-	-	-	-	-	12	2015	2	0.0	-	-	-	-	-

SFA	Year	Month	Landing (t)	Samples		Catch estimate (t)	From :	
				N individuals	Ratio *P. borealis*		Month	Year
10	2015	3	0.0	282	1.000	0.0	3	2015
10	2015	4	3801.9	3093	0.987	3751.7	4	2015
10	2015	5	2600.5	2824	0.993	2581.6	5	2015
10	2015	6	746.3	1615	0.996	743.1	6	2015
10	2015	7	1355.5	1329	0.995	1348.1	7	2015
10	2015	8	2052.9	2560	0.994	2041.5	8	2015
10	2015	9	1346.3	1316	0.988	1330.0	9	2015
10	2015	10	490.2	1080	0.977	479.1	10	2015
10	2015	11	207.4	-	-	202.7	10	2015
10	2015	12	0.0	-	-	-	-	-
10	2016	1	0.0	-	-	-	-	-
10	2016	2	0.0	-	-	-	-	-
10	2016	3	0.0	-	-	-	-	-
10	2016	4	2650.7	3373	0.997	2641.5	4	2016
10	2016	5	2000.5	2808	0.996	1993.3	5	2016
10	2016	6	611.9	1708	0.996	609.6	6	2016
10	2016	7	641.4	1775	0.989	634.2	7	2016
10	2016	8	1608.2	2238	0.991	1593.1	8	2016
10	2016	9	1954.0	1836	0.997	1948.7	9	2016
10	2016	10	1563.6	1740	0.994	1554.2	10	2016
10	2016	11	688.3	1302	0.985	678.2	11	2016
10	2016	12	91.3	530	0.992	90.6	12	2016
10	2017	1	0.0	-	-	-	-	-
10	2017	2	0.0	-	-	-	-	-
10	2017	3	0.0	-	-	-	-	-
10	2017	4	660.3	2354	0.992	655.3	4	2017
10	2017	5	628.9	1535	0.989	621.9	5	2017
10	2017	6	420.6	1312	0.998	419.9	6	2017
10	2017	7	793.2	1989	0.973	772.1	7	2017
10	2017	8	848.0	2089	0.989	838.9	8	2017
10	2017	9	1839.8	448	0.994	1829.0	9	2017
10	2017	10	1339.9	522	0.988	1324.2	10	2017
10	2017	11	492.3	262	0.981	482.8	11	2017
10	2017	12	0.0	-	-	-	-	-

SFA	Year	Month	Landing (t)	Samples		Catch estimate (t)	From :	
				N individuals	Ratio *P. borealis*		Month	Year
12	2015	3	0.0	-	-	-	-	-
12	2015	4	61.9	661	0.995	61.6	4	2015
12	2015	5	437.9	1440	0.996	436.4	5	2015
12	2015	6	173.3	1092	0.994	172.2	6	2015
12	2015	7	57.3	767	0.991	56.8	7	2015
12	2015	8	81.9	624	0.991	81.2	8	2015
12	2015	9	236.9	1261	0.994	235.5	9	2015
12	2015	10	28.2	464	0.997	28.1	10	2015
12	2015	11	15.7	-	-	15.7	10	2015
12	2015	12	0.0	-	-	-	-	-
12	2016	1	0.0	-	-	-	-	-
12	2016	2	0.0	-	-	-	-	-
12	2016	3	0.0	-	-	-	-	-
12	2016	4	37.3	271	0.991	37.0	4	2016
12	2016	5	275.7	1334	0.998	275.1	5	2016
12	2016	6	89.0	1293	0.984	87.5	6	2016
12	2016	7	98.8	799	0.979	96.7	7	2016
12	2016	8	119.4	260	0.992	118.5	8	2016
12	2016	9	165.6	533	0.989	163.7	9	2016
12	2016	10	196.5	531	0.999	196.3	10	2016
12	2016	11	42.8	260	0.981	42.0	11	2016
12	2016	12	0.0	-	-	-	-	-
12	2017	1	0.0	-	-	-	-	-
12	2017	2	0.0	-	-	-	-	-
12	2017	3	0.0	-	-	-	-	-
12	2017	4	106.7	512	0.994	106.1	4	2017
12	2017	5	72.3	237	1.000	72.3	5	2017
12	2017	6	55.3	548	1.000	55.3	6	2017
12	2017	7	63.4	1049	0.996	63.2	7	2017
12	2017	8	258.8	2092	0.979	253.3	8	2017
12	2017	9	104.3	526	0.975	101.7	9	2017
12	2017	10	212.9	1574	0.974	207.4	10	2017
12	2017	11	25.2	-	-	24.5	10	2017
12	2017	12	0.0	-	-	-	-	-

Table 14. Commercial catches (in million) by fishing area and by year. M: males, Fp: primiparous females, Fm: multiparous females.

ESQUIMAN	M	Fp	Fm	Total	ANTICOSTI	M	Fp	Fm	Total
1982	215.494	49.492	91.256	356.242	1982	354.331	55.094	61.002	470.427
1983	211.819	37.740	91.560	341.119	1983	375.077	54.539	78.453	508.069
1984	145.040	15.549	85.196	245.785	1984	151.252	36.732	38.081	226.065
1985	151.231	37.706	46.987	235.924	1985	320.703	78.089	76.269	475.061
1986	120.045	31.901	89.999	241.945	1986	442.183	114.163	89.859	646.205
1987	493.459	42.252	68.386	604.097	1987	518.113	125.330	59.129	702.572
1988	656.047	119.061	102.194	877.302	1988	381.706	98.655	75.004	555.365
1989	577.444	124.477	156.915	858.836	1989	637.523	105.404	118.282	861.209
1990	387.893	86.160	98.431	572.484	1990	497.342	196.956	73.961	768.259
1991	566.111	76.143	201.893	844.147	1991	556.637	112.013	107.116	775.766
1992	420.714	102.085	73.063	595.862	1992	406.097	197.015	17.839	620.951
1993	698.498	165.563	86.800	950.861	1993	597.755	222.650	16.018	836.423
1994	619.205	252.483	37.162	908.850	1994	634.086	203.387	22.730	860.203
1995	667.039	241.633	130.037	1038.709	1995	660.898	193.718	21.759	876.375
1996	721.922	250.670	75.166	1047.758	1996	534.054	252.672	48.925	835.651
1997	707.747	323.717	80.080	1111.544	1997	578.694	239.342	73.004	891.040
1998	724.994	192.660	287.530	1205.184	1998	576.832	324.173	92.946	993.951
1999	708.681	284.961	292.935	1286.577	1999	794.582	306.487	52.019	1153.088
2000	886.107	301.021	277.073	1464.201	2000	808.052	367.987	102.416	1278.455
2001	1060.451	350.249	272.424	1683.124	2001	693.367	256.858	31.371	981.596
2002	1123.099	374.999	267.882	1765.980	2002	983.521	494.299	53.328	1531.148
2003	828.602	407.706	150.114	1386.422	2003	830.157	444.364	131.779	1406.300
2004	1032.410	373.656	329.239	1735.305	2004	820.917	529.865	252.313	1603.095
2005	1296.424	406.123	305.434	2007.981	2005	787.549	364.186	194.474	1346.209
2006	1412.634	290.951	441.742	2145.327	2006	887.003	309.751	232.736	1429.490
2007	1428.017	391.336	510.623	2329.976	2007	1011.710	571.822	269.490	1853.022
2008	1432.250	596.220	261.960	2290.430	2008	1193.729	507.026	188.343	1889.098
2009	1552.270	575.361	223.377	2351.008	2009	1141.609	574.811	180.627	1897.047
2010	1363.004	438.653	217.868	2019.525	2010	1396.917	492.835	182.825	2072.577
2011	1089.972	440.064	352.035	1882.071	2011	1169.269	521.825	133.595	1824.689
2012	1454.742	464.186	310.682	2229.610	2012	1143.131	370.874	134.592	1648.597
2013	1010.397	509.913	272.635	1792.945	2013	804.858	443.428	112.650	1360.936
2014	942.368	241.082	357.338	1540.788	2014	1005.601	282.055	245.113	1532.769
2015	817.992	456.613	253.172	1527.777	2015	1231.074	430.438	157.328	1818.840
2016	840.123	221.479	325.938	1387.540	2016	1037.161	428.942	169.480	1635.583
2017	795.996	297.349	271.500	1364.845	2017	722.547	302.192	150.448	1175.187

Table 14. Continued.

SEPT-ILES	M	Fp	Fm	Total	ESTUARY	M	Fp	Fm	Total
1982	375.282	53.857	170.848	599.987	1982	13.810	2.877	3.781	20.468
1983	485.454	58.186	138.521	682.161	1983	26.289	3.431	2.544	32.264
1984	390.134	48.936	192.620	631.690	1984	0.000	0.000	0.000	0.000
1985	315.398	84.758	207.568	607.724	1985	0.000	0.000	0.000	0.000
1986	293.776	70.364	267.590	631.730	1986	21.947	8.923	5.832	36.702
1987	538.326	88.080	290.142	916.548	1987	44.606	18.122	10.868	73.596
1988	611.767	108.888	266.561	987.216	1988	32.501	5.390	38.175	76.066
1989	410.861	154.875	311.362	877.098	1989	0.000	0.000	0.000	0.000
1990	489.744	111.135	360.979	961.858	1990	42.153	3.426	27.542	73.121
1991	476.345	73.968	323.239	873.552	1991	0.000	0.000	0.000	0.000
1992	505.295	117.119	160.793	783.207	1992	9.026	3.216	43.162	55.404
1993	514.300	175.244	156.151	845.695	1993	10.958	1.634	39.891	52.483
1994	632.719	195.742	156.810	985.271	1994	7.262	1.315	42.146	50.723
1995	535.856	237.542	196.221	969.619	1995	8.841	4.545	40.014	53.400
1996	608.578	287.066	173.234	1068.878	1996	3.998	5.703	42.644	52.345
1997	510.236	198.577	337.013	1045.826	1997	14.492	8.706	39.940	63.138
1998	515.923	211.279	395.123	1122.325	1998	12.334	9.810	45.413	67.557
1999	541.918	269.191	405.233	1216.342	1999	16.843	12.260	43.412	72.515
2000	738.989	348.368	387.798	1475.155	2000	15.806	11.172	55.032	82.010
2001	661.354	299.342	578.698	1539.394	2001	39.214	20.743	52.503	112.460
2002	787.058	653.214	318.475	1758.747	2002	47.265	24.545	43.310	115.120
2003	530.773	282.130	720.734	1533.637	2003	26.301	15.553	55.642	97.496
2004	764.002	465.282	953.292	2182.576	2004	40.626	15.917	74.884	131.427
2005	696.846	335.327	790.340	1822.513	2005	28.446	20.274	77.983	126.703
2006	859.492	471.118	835.223	2165.833	2006	37.700	15.053	80.898	133.651
2007	806.439	364.161	855.166	2025.766	2007	35.852	18.826	69.653	124.331
2008	895.364	395.833	935.740	2226.937	2008	38.022	18.765	65.636	122.423
2009	958.749	468.496	854.031	2281.276	2009	60.346	20.336	57.901	138.583
2010	1326.559	338.655	943.957	2609.171	2010	43.176	11.771	68.848	123.795
2011	1143.480	488.737	802.924	2435.141	2011	121.495	22.225	32.463	176.183
2012	918.065	389.976	648.460	1956.501	2012	131.421	26.400	27.511	185.332
2013	808.862	546.955	624.876	1980.693	2013	99.101	45.315	28.464	172.880
2014	802.315	262.678	674.389	1739.382	2014	96.012	21.016	36.053	153.081
2015	840.493	326.000	621.355	1787.848	2015	96.598	24.639	45.870	167.107
2016	786.647	289.504	652.356	1728.507	2016	114.915	17.613	38.848	171.376
2017	640.399	261.750	216.024	1118.173	2017	94.512	21.618	29.918	146.048

Table 15. Number per unit of effort by fishing area and by year for the summer season (months of June, July and August). M: males, Fp: primiparous females, Fm: multiparous females.

ESQUIMAN	M	Fp	Fm	Total	ANTICOSTI	M	Fp	Fm	Total
1982	12845	3109	2785	18739	1982	12448	2336	2423	17207
1983	7388	1212	3290	11890	1983	11304	2082	2187	15573
1984	10046	1241	4306	15594	1984	7215	1936	1847	10999
1985	8216	2521	2599	13337	1985	9881	2858	2372	15112
1986	6013	2566	4022	12601	1986	11746	2935	2292	16973
1987	18988	1741	1938	22667	1987	13311	2975	1153	17440
1988	18766	2993	2238	23996	1988	11465	4238	1991	17694
1989	18650	6186	3793	28628	1989	15232	5124	3246	23601
1990	20201	4240	5913	30353	1990	14924	5914	2262	23099
1991	19909	2325	4616	26850	1991	13039	3674	2512	19225
1992	19400	5080	970	25450	1992	9235	5243	157	14635
1993	24667	5944	587	31198	1993	12824	4845	254	17923
1994	21693	9218	1190	32101	1994	15577	5283	346	21206
1995	23299	9163	1844	34305	1995	19813	5720	610	26143
1996	30285	10395	1656	42336	1996	15377	6929	1018	23324
1997	31723	15112	1996	48831	1997	17070	7210	915	25194
1998	39532	13661	1393	54586	1998	14271	8853	915	24038
1999	31478	19599	2607	53684	1999	19195	7293	630	27118
2000	43491	16741	3256	63488	2000	19433	8993	2212	30638
2001	50206	20202	3349	73757	2001	25007	8770	940	34717
2002	40244	18016	1033	59292	2002	24207	12776	665	37648
2003	41526	20380	3342	65247	2003	25963	13545	2663	42170
2004	54096	23890	12614	90600	2004	19862	13586	5731	39179
2005	59383	32072	8299	99754	2005	34693	17068	3695	55456
2006	78243	26079	16361	120683	2006	37762	14506	7190	59457
2007	69907	26955	11435	108297	2007	28765	15828	7128	51721
2008	70932	32166	10507	113605	2008	38572	18139	6536	63247
2009	70258	26883	6299	103440	2009	41083	20515	4628	66225
2010	74142	20590	11163	105896	2010	40380	14448	5500	60328
2011	88551	33294	12418	134263	2011	36740	16992	3839	57571
2012	82286	28248	9209	119744	2012	40257	12878	3619	56754
2013	43104	28621	8329	80054	2013	39695	20823	5302	65820
2014	55346	16728	22699	94773	2014	50890	11516	12117	74522
2015	41181	21345	13320	75846	2015	47909	14413	5649	67971
2016	49116	12525	18153	79794	2016	29955	12089	4714	46758
2017	37015	13919	13131	64065	2017	21709	8753	4618	35080

Table 15. Continued.

SEPT-ILES	M	Fp	Fm	Total	ESTUARY	M	Fp	Fm	Total
1982	6275	1417	1743	9435	1982	6465	1347	1770	9583
1983	9649	1796	2264	13708	1983	8435	991	857	10284
1984	7100	979	2193	10272	1984				
1985	7744	2306	2246	12297	1985				
1986	10652	2301	2016	14969	1986	5470	2313	793	8576
1987	13195	1592	2713	17500	1987	5484	2320	795	8599
1988	9917	1612	2725	14255	1988	7115	3009	1032	11156
1989	7485	2007	2860	12352	1989				
1990	13117	3048	3482	19647	1990				
1991	10696	1952	3787	16435	1991				
1992	6995	3359	399	10753	1992	3098	670	3083	6851
1993	6247	4017	468	10732	1993	3735	808	3717	8260
1994	8657	3990	458	13104	1994	2721	1038	1283	5042
1995	12601	7250	1368	21220	1995	12903	7825	4440	25168
1996	14788	8670	1673	25131	1996	3796	4645	3863	12304
1997	16246	7931	2136	26313	1997	5604	11664	6747	24015
1998	14161	8296	1197	23654	1998	12660	12423	5316	30398
1999	17787	9366	873	28026	1999	9080	15353	2912	27346
2000	19615	9240	2883	31738	2000	20801	11217	5935	37953
2001	14256	9250	3027	26533	2001	20153	3901	3771	27824
2002	18087	16085	502	34673	2002	17055	16888	1254	35197
2003	20197	12708	3442	36348	2003	11332	17082	7439	35852
2004	19842	15694	5170	40707	2004	14925	14730	5850	35505
2005	25579	17658	3608	46844	2005	20553	18474	14103	53130
2006	21576	13349	9776	44700	2006	27826	10207	16060	54093
2007	25084	12255	10899	48239	2007	20957	9713	15123	45793
2008	29816	13617	4563	47995	2008	28113	17973	6243	52330
2009	23531	14322	5137	42990	2009	15330	12757	3832	31919
2010	35723	11764	3693	51180	2010	10830	17148	7349	35328
2011	23800	15000	3157	41957	2011	38310	6002	1791	46103
2012	33134	13308	3376	49818	2012	47641	9304	3037	59982
2013	20547	14899	2022	37468	2013	12601	13200	648	26449
2014	27574	8134	6911	42619	2014	19738	6898	7573	34209
2015	27621	9730	5306	42657	2015	20883	7624	8741	37248
2016	17468	6809	6129	30406	2016	27044	5762	4753	37559
2017	10625	6431	3348	20405	2017	15802	6280	3036	25119

Tableau 16. Sum of the duration (hours) of fishing tows realised with an observer on board and total fishing effort (hours) of shrimpers by fishing area and by NAFO unit area for 2016 and 2017.

Fishing Area	NAFO Unit Area	2016 Hour (h)		2017 Hour (h)	
		Observer	Fishery	Observer	Fishery
Estuary	4TP	20	2840	61	2713
Estuary	4TQ	97	2236	43	2575
Total Estuary		**117**	**5076**	**104**	**5288**
Sept-Iles	4SI	947	19376	440	16372
Sept-Iles	4SS	216	443	9	311
Sept-Iles	4SZ	1413	33730	442	29158
Sept-Iles	4TK				
Sept-Iles	4TN				
Sept-Iles	4TO	965	5613	538	6948
Sept-Iles	4TQ				22
Total Sept-Iles		**3541**	**59162**	**1429**	**52810**
Anticosti	4SS		13		51
Anticosti	4SV	100	858	38	441
Anticosti	4SX	2344	33923	1684	31705
Anticosti	4SY	79	943	111	868
Anticosti	4TF				
Anticosti	4TK				
Total Anticosti		**2523**	**35737**	**1833**	**33065**
Esquiman	4R	293		309	
Esquiman	4RA		91		674
Esquiman	4RB	548	17369	328	20421
Esquiman	4RC				
Esquiman	4SV		37		46
Total Esquiman		**841**	**17497**	**637**	**21141**

Table 17. Weighting factor (fleet fishing effort / fishing effort with an observer) by cell (combination of shrimp fishing area (SFA) and NAFO subdivisions) used to scale the at-sea observer results to the total fishing effort of the shrimper fleet.

SFA	Estuary	Sept-Iles				Anticosti			Esquiman
	12	10	10	10	10	9	9	9	8
NAFO	4Tp 4Tq	4To 4Tn 4Tk	4Tq 4Sz	4Si 4Sy	4Ss	4Tf 4Tk	4Ss	4Sx 4Sy 4Sv	4Sv 4Ra 4Rb 4Rc 4R
Year									
2000	21.17	15.45	26.98	17.97	11.56	12.21	14.11	39.28	29.55
2001	16.97	23.73	28.01	18.46	22.22	82.75	15.36	25.75	29.33
2002	12.38	14.05	10.72	50.50	43.30	5.88	16.73	23.06	26.54
2003	54.00	14.36	12.20	19.96	14.77	79.10	22.24	25.83	19.37
2004	19.69	24.38	23.86	8.14	14.02	29.34	24.20	23.82	36.28
2005	9.18	14.29	12.83	21.18	21.72	1.72	22.73	20.15	44.65
2006	18.94	12.21	16.06	14.25	27.41	28.96	16.22	30.55	26.08
2007	8.95	11.03	23.84	20.28	44.99	9.96	13.59	20.12	27.96
2008	9.13	15.43	20.18	16.88	28.37	3.50	19.95	17.48	34.87
2009	12.00	11.72	29.47	21.77	28.91	1.28	23.40	11.94	68.48
2010	12.59	18.20	16.45	15.10	27.97	-	11.77	16.23	24.23
2011	6.85	37.42	26.91	19.08	28.51	-	9.56	13.46	24.51
2012	15.24	11.08	19.22	39.18	23.65	0.41	14.49	20.49	16.79
2013	10.00	16.11	22.90	15.20	23.36	1.66	11.79	24.61	20.14
2014	14.83	7.39	22.42	18.88	21.38	-	-	24.40	30.96
2015	82.34	11.29	22.21	8.20	9.68	-	-	19.79	24.73
2016	43.27	5.82	23.87	20.46	2.05	-	-	14.16	20.80
2017	50.89	12.92	66.03	37.17	34.02	-	-	18.01	33.20

Table 18. Bycatch (t) and ratio (%) of the bycatch on the northern shrimp catch by year and by fishing area for all species combined.

SFA	Bycatch (t)					Ratio (%)				
	8	9	10	12	Total	8	9	10	12	Total
Year										
2000	80	168	227	20	495	1.08	2.12	2.24	2.71	1.89
2001	125	70	152	6	353	1.60	1.29	1.39	0.69	1.41
2002	316	107	225	9	657	3.83	1.24	1.96	1.19	2.25
2003	85	85	276	11	457	1.25	0.97	2.43	1.42	1.65
2004	165	105	324	8	601	1.92	1.01	2.03	0.73	1.67
2005	175	60	158	17	410	1.98	0.75	1.23	1.66	1.34
2006	42	108	187	8	345	0.47	1.24	1.22	0.82	1.01
2007	94	124	145	10	373	1.02	1.21	0.93	1.02	1.04
2008	86	113	206	43	448	0.95	1.17	1.29	4.18	1.25
2009	283	124	169	25	599	2.98	1.28	1.06	2.49	1.67
2010	111	176	176	41	505	1.16	1.75	1.12	4.53	1.39
2011	66	137	329	23	555	0.72	1.40	2.29	2.60	1.62
2012	69	147	260	12	488	0.68	1.78	2.08	1.25	1.53
2013	144	89	539	74	845	1.57	1.16	3.79	6.60	2.63
2014	192	307	588	22	1109	2.28	3.52	4.73	2.28	3.63
2015	200	337	433	52	1022	2.53	3.85	3.44	4.72	3.37
2016	291	272	886	55	1504	4.15	3.34	7.50	5.35	5.37
2017	198	257	553	67	1075	2.84	3.86	7.87	7.43	4.98
Mean 2000-2015	140	141	275	24	579	1.63	1.61	2.08	2.43	1.83

Table 19. Occurrence and total catch of sampled tows by observers (16,545 tows) for 98 taxa for the 2000-2017 period.

	Occurrence		Catch (kg)
Taxa	n tows	%	
Crevette nordique / Northern shrimp	20720	99.875	27259673
Flétan du Groenland / Greenland halibut	18746	90.360	89917
Capelan / Capelin	17342	83.592	121805
Sébastes / Redfishes	15853	76.415	186324
Hareng atlantique / Atlantic herring	14364	69.237	46551
Plie canadienne / American plaice	11924	57.476	24082
Plie grise / Witch flounder	10282	49.561	18762
Lussion blanc / White barracudina	10052	48.453	18866
Raie épineuse / Thorny skate	7837	37.776	11593
Myxine du nord / Atlantic hagfish	6557	31.606	7263
Grenadier du Grand Banc / Marlin-spike	5195	25.041	5450
Morue franche / Atlantic cod	4727	22.785	11820
Lycodes / Eelpouts	4665	22.486	6158
Motelle à quatre barbillons / Fourbeard rockling	2803	13.511	3209
Lançons / Sand lances	2057	9.915	3089
Sivade rose / Pink glass shrimp	1823	8.787	23933
Calmars / Squids	1718	8.281	2005
Merluche blanche / White hake	1717	8.276	1874
Merlu argenté / Silver hake	1589	7.659	1651
Agonidés / Poachers	1502	7.240	1549
Mollasse atlantique / Atlantic soft pout	1288	6.208	1304
Raie lisse / Smooth skate	1035	4.989	1178
Octopodes / Octopoda	1008	4.859	1017
Anthozoaires / Anthozoan	907	4.372	957
Saida / Arctic cod	755	3.639	1177
Étoiles de mer / Sea stars	703	3.389	724
Scyphozoaires / Scyphozoans	586	2.825	1123
Crabe des neiges / Snow crab	567	2.733	595
Limaces / Seasnails	489	2.357	489
Flétan Atlantique / Atlantic halibut	469	2.261	4167
Raie à queue épineuse / Spinytail skate	464	2.237	562
Terrassier tacheté / Wrymouth	401	1.933	468
Chaboisseaux / Sculpins	393	1.894	394
Lompénies / Eelpouts	352	1.697	562
Poules de mer / Lumpfishes	317	1.528	324
Poissons-lanternes / Lantern-fishes	311	1.499	316
Grosse poule de mer / Lumpfish	307	1.480	325
Pennatula borealis / Sea pen	306	1.475	311
Plie rouge / Winter flounder	276	1.330	451
Hameçons / Hookear sculpins	266	1.282	276
Mustèles / Rocklings	251	1.210	341
Sépioles / Bobtails	229	1.104	230
Échinoides / Sea urchins	196	0.945	220
Haches d'argent / Hatchetfishes	177	0.853	177
Faux-trigles / Sculpins	168	0.810	169
Quatre-lignes atlantique / Fourline snakeblenny	156	0.752	184
Crevettes / Shrimp-Like	137	0.660	2993
Loup atlantique / Atlantic wolffish	135	0.651	147
Merluche à longues nageoires / Longfin hake	130	0.627	133
Raie tachetée / Winter skate	123	0.593	211
Aiguillat noir / Black dogfish	112	0.540	2007

Taxa	Occurrence		Catch (kg)
	n tows	%	
Ogac / Greenland cod	101	0.487	168
Maquereau bleu / Atlantic mackerel	98	0.472	123
Éperlan / Rainbow smelt	95	0.458	2247
Loquette d'Amérique / Ocean pout	91	0.439	95
Crabes lyre / Toad crabs	80	0.386	80
Avocette ruban / Slender snipe eel	67	0.323	67
Crevette ésope / Striped pink shrimp	67	0.323	4719
Aiguillat commun / Spiny dogfish	66	0.318	111
Gastérostéidés / Sticklebacks	66	0.318	66
Porifères / Sponges	57	0.275	58
Loup tacheté / Spotted wolffish	56	0.270	62
Baudroie d'Amérique / Monkfish	52	0.251	57
Bivalves / Bivalves	43	0.207	43
Ophiuridés / Brittle stars	40	0.193	40
Limande à queue jaune / Yellowtail flounder	37	0.178	42
Aiglefin / Haddock	33	0.159	33
Concombres de mer / Sea cucumbers	25	0.121	41
Grande lamproie marine / Sea lamprey	24	0.116	24
Goberge / Pollock	22	0.106	33
Cyclothones / Lightfishes	21	0.101	21
Poulamon atlantique / Atlantic tomcod	19	0.092	36
Poutassou / Blue whiting	17	0.082	17
Tricorne arctique / Arctic staghorn sculpin	17	0.082	17
Gorgonocéphales / Basket stars	17	0.082	17
Serrivomer trapu / Stout sawpalate	16	0.077	16
Crabe épineux du nord / Norway king crab	14	0.067	14
Grande argentine / Atlantic argentine	13	0.063	2618
Anguille américaine / American eel	10	0.048	10
Alose savoureuse / American shad	9	0.043	11
Chauliode très-lumineux / Manylight viperfish	8	0.039	8
Loup à tête large / Northern wolffish	7	0.034	9
Dragon-boa / Boa dragonfish	6	0.029	6
Anguille égorgée bécue / Slatjaw cutthroat eel	6	0.029	6
Sigouine de roche / Rock gunnel	5	0.024	5
Saumon atlantique / Atlantic salmon	4	0.019	5
Hémitriptère atlantique / Sea raven	4	0.019	4
Dragons-brochets / Scaleless dragonfishes	4	0.019	8
Balaou / Atlantic saury	4	0.019	4
Crabe tourteau commun / Atlantic rock crab	4	0.019	5
Baudroies / Anglers	3	0.014	3
Cotte polaire / Polar sculpin	3	0.014	3
Unernak caméléon / Fish doctor	3	0.014	3
Bar d'amérique / Striped bass	2	0.010	3
Raie ronde / Round skate	1	0.005	1
Icèles / Sculpins	1	0.005	1
Stromatée à fossettes / Butterfish	1	0.005	1
Choquemort / Mummichog	1	0.005	1

Table 20. Occurrence and bycatch means for the 2000-2015 period and for the years 2016 and 2017.

Taxa	Occurrence (%)			Bycatch (kg)		
	2000-2015	2016	2017	2000-2015	2016	2017
Flétan du Groenland / Greenland halibut	90.116	91.860	94.452	90009	129758	97440
Capelan / Capelin	83.090	89.470	85.290	158890	82773	64987
Sébastes / Redfishes	74.264	98.656	97.677	130688	994732	490383
Hareng atlantique / Atlantic herring	67.632	78.118	87.355	44344	60786	115964
Plie canadienne / American plaice	57.184	58.476	65.032	22345	16072	16695
Plie grise / Witch flounder	47.232	73.637	66.065	15547	24679	32853
Lussion blanc / White barracudina	45.710	82.524	66.452	14003	37130	19410
Raie épineuse / Thorny skate	36.454	46.004	56.129	7443	10468	11759
Myxine du nord / Atlantic hagfish	31.120	39.283	33.290	3261	3339	5516
Grenadier du Grand Banc / Marlin-spike	24.502	27.857	33.032	1529	2222	2579
Lycodes / Eelpouts	23.589	13.592	9.032	4647	1956	3550
Morue franche / Atlantic cod	23.545	13.368	26.452	10279	1670	8900
Motelle à quatre barbillons / Fourbeard rockling	12.912	18.372	21.677	940	1922	2019
Lançons / Sand lances	10.097	3.883	13.806	3950	1700	3423
Calmars / Squids	8.487	1.195	12.903	2199	187	2100
Merlu argenté / Silver hake	7.739	3.286	12.774	484	185	439
Agonidés / Poachers	7.722	1.643	3.613	1679	719	917
Sivade rose / Pink glass shrimp	7.674	17.625	17.677	19271	87323	40309
Merluche blanche / White hake	7.664	13.592	15.871	743	1280	1320
Mollasse atlantique / Atlantic soft pout	5.863	12.248	7.226	124	226	82
Raie lisse / Smooth skate	4.783	7.991	5.806	455	557	181
Octopodes / Octopoda	4.141	9.335	14.968	53	73	124
Saida / Arctic cod	3.721	0.971	4.258	883	106	255
Anthozoaires / Anthozoan	3.685	12.472	7.613	173	503	264
Étoiles de mer / Sea stars	2.800	11.426	4.645	35	420	27
Crabe des neiges / Snow crab	2.689	3.286	2.968	99	134	85
Limaces / Seasnails	2.469	1.195	1.548	417	615	416
Flétan Atlantique / Atlantic halibut	2.259	0.971	2.968	3838	6946	10806
Scyphozoaires / Scyphozoans	2.114	10.157	7.355	874	333	214
Raie à queue épineuse / Spinytail skate	2.111	3.062	3.613	365	330	538
Chaboisseaux / Sculpins	2.004	0.672	0.258	409	215	69
Lompénies / Eelpouts	1.798	0.747	1.032	824	173	337
Terrassier tacheté / Wrymouth	1.700	3.883	4.258	116	72	353
Poules de mer / Lumpfishes	1.607	0.747	0.774	353	304	142
Grosse poule de mer / Lumpfish	1.469	2.315	0.774	53	116	13
Poissons-lanternes / Lantern-fishes	1.368	1.718	4.516	294	403	914
Hameçons / Hookear sculpins	1.306	1.120	1.032	271	508	324
Mustèles / Rocklings	1.302	0.000	0.129	382	0	13
Plie rouge / Winter flounder	1.157	1.419	5.419	352	200	5312
Faux-trigles / Sculpins	0.908	0.224	0.000	162	88	0
Haches d'argent / Hatchetfishes	0.875	0.971	0.129	185	217	37
Quatre-lignes atlantique / Fourline snakeblenny	0.758	0.822	0.258	248	424	36
Sépioles / Bobtails	0.757	4.630	3.226	179	1025	632
Pennatula borealis / Sea pen	0.705	9.709	6.194	153	1833	1445
Loup atlantique / Atlantic wolffish	0.685	0.000	0.000	113	0	0
Échinoides / Sea urchins	0.650	5.078	1.290	140	1040	129
Merluche à longues nageoires / Longfin hake	0.641	0.224	1.161	140	47	177
Raie tachetée / Winter skate	0.630	0.224	0.000	88	10	0
Crevettes / Shrimp-Like	0.576	0.896	2.581	608	496	117493
Maquereau bleu / Atlantic mackerel	0.497	0.448	0.129	100	233	34
Ogac / Greenland cod	0.479	0.149	0.387	126	23	30
Éperlan / Rainbow smelt	0.461	0.373	0.129	2270	93	66

Taxa	Occurrence (%)			Bycatch (kg)		
	2000-2015	2016	2017	2000-2015	2016	2017
Loquette d'Amérique / Ocean pout	0.422	0.672	0.000	19	35	0
Aiguillat noir / Black dogfish	0.386	1.568	2.710	2787	147	281
Gastérostéidés / Sticklebacks	0.353	0.075	0.000	75	24	0
Crevette ésope / Striped pink shrimp	0.338	0.373	0.000	3941	583	0
Aiguillat commun / Spiny dogfish	0.337	0.149	0.129	112	3	5
Loup tacheté / Spotted wolffish	0.318	0.075	0.000	66	21	0
Avocette ruban / Slender snipe eel	0.318	0.523	0.387	70	95	83
Crabes lyre / Toad crabs	0.318	1.120	0.645	52	312	70
Porifères / Sponges	0.271	0.373	0.000	67	78	0
Bivalves / Bivalves	0.199	0.224	0.387	40	63	84
Limande à queue jaune / Yellowtail flounder	0.197	0.000	0.129	51	0	66
Ophiuridés / Brittle stars	0.175	0.448	0.258	35	35	26
Aiglefin / Haddock	0.162	0.000	0.129	31	0	33
Baudroie d'Amérique / Monkfish	0.144	1.792	0.258	41	415	99
Grande lamproie marine / Sea lamprey	0.126	0.075	0.000	30	43	0
Concombres de mer / Sea cucumbers	0.118	0.075	0.258	24	14	1189
Poutassou / Blue whiting	0.103	0.000	0.000	19	0	0
Cyclothones / Lightfishes	0.100	0.149	0.000	20	12	0
Goberge / Pollock	0.098	0.000	0.387	20	0	49
Tricorne arctique / Arctic staghorn sculpin	0.084	0.000	0.258	18	0	102
Poulamon atlantique / Atlantic tomcod	0.080	0.373	0.000	28	27	0
Serrivomer trapu / Stout sawpalate	0.080	0.000	0.000	18	0	0
Crabe épineux du nord / Norway king crab	0.066	0.000	0.258	13	0	69
Anguille américaine / American eel	0.050	0.000	0.000	11	0	0
Gorgonocéphales / Basket stars	0.050	0.597	0.000	9	309	0
Grande argentine / Atlantic argentine	0.047	0.075	0.387	4335	21	69
Alose savoureuse / American shad	0.043	0.000	0.129	12	0	37
Loup à tête large / Northern wolffish	0.032	0.000	0.129	18	0	26
Anguille égorgée bécue / Slatjaw cutthroat eel	0.032	0.000	0.000	4	0	0
Dragon-boa / Boa dragonfish	0.027	0.075	0.000	6	24	0
Sigouine de roche / Rock gunnel	0.027	0.000	0.000	4	0	0
Chauliode très-lumineux / Manylight viperfish	0.026	0.224	0.000	7	61	0
Saumon atlantique / Atlantic salmon	0.022	0.000	0.000	7	0	0
Dragons-brochets / Scaleless dragonfishes	0.022	0.000	0.000	10	0	0
Hémitriptère atlantique / Sea raven	0.021	0.000	0.000	2	0	0
Crabe tourteau commun / Atlantic rock crab	0.021	0.000	0.000	7	0	0
Unernak caméléon / Fish doctor	0.018	0.000	0.000	3	0	0
Cotte polaire / Polar sculpin	0.017	0.000	0.000	7	0	0
Balaou / Atlantic saury	0.017	0.000	0.129	4	0	18
Baudroies / Anglers	0.016	0.000	0.000	4	0	0
Choquemort / Mummichog	0.006	0.000	0.000	2	0	0
Bar d'amérique / Striped bass	0.005	0.000	0.129	1	0	26
Raie ronde / Round skate	0.005	0.000	0.000	1	0	0
Icèles / Sculpins	0.005	0.000	0.000	0	0	0
Stromatée à fossettes / Butterfish	0.005	0.000	0.000	1	0	0

Table 21. Survey abundance and biomass estimates, bycatches in number and biomass and ratio of the bycatch on the survey estimate.

Year	Survey		Bycatch		Ratio (%)	
	N (x1000)	Biomass (t)	N (x1000)	Biomass (t)	N (x1000)	Biomass (t)
Morue franche / Atlantic cod (< 30 cm)						
2000-2015	74138	9196	130.63	10.28	0.161	0.118
2016	70708	10677	5.84	1.67	0.008	0.016
2017	55496	6116	62.49	8.90	0.113	0.146
Sébastes / Redfishes (< 20 cm)						
2000-2015	2369087	72215	8145.51	130.58	0.202	0.211
2016	21371562	1540517	27496.26	994.73	0.129	0.065
2017	17184085	1485965	10398.68	490.38	0.061	0.033
Flétan du Groenland / Greenland halibut (< 31 cm)						
2000-2015	278803	27577	1585.43	88.47	0.578	0.360
2016	237130	30755	2339.44	129.76	0.987	0.422
2017	160799	22335	1396.75	97.44	0.869	0.436
Plie canadienne / American plaice (< 30 cm)						
2000-2015	300370	16242	361.58	22.33	0.164	0.174
2016	336467	18654	88.51	16.07	0.026	0.086
2017	295987	18941	103.46	16.70	0.035	0.088
Plie grise / Witch flounder (< 30 cm)						
2000-2015	64843	4067	192.73	15.55	0.292	0.394
2016	38067	2536	238.84	24.68	0.627	0.973
2017	55646	3518	328.53	32.85	0.590	0.934
Merluche blanche / White hake (< 30 cm)						
2000-2015	-	462	-	0.74	-	0.260
2016	-	657	-	1.28	-	0.195
2017	-	445	-	1.32	-	0.297
Flétan Atlantique / Atlantic halibut						
2000-2015	-	9105	-	3.84	-	0.088
2016	-	25007	-	6.95	-	0.028
2017	-	22288	-	10.81	-	0.048
Motelle à quatre barbillons / Fourbeard rockling						
2000-2015	-	1842	-	0.94	-	0.057
2016	-	1295	-	1.92	-	0.148
2017	-	1272	-	2.02	-	0.159
Raie épineuse / Thorny skate (< 30 cm)						
2000-2015	-	1932	-	7.44	-	0.420
2016	-	1587	-	10.47	-	0.660
2017	-	2075	-	11.76	-	0.567
Raie lisse / Smooth skate (< 30 cm)						
2000-2015	-	421	-	0.45	-	0.143
2016	-	254	-	0.56	-	0.219
2017	-	251	-	0.18	-	0.072

Year	Survey		Bycatch		Ratio (%)	
	N (x1000)	Biomass (t)	N (x1000)	Biomass (t)	N (x1000)	Biomass (t)
Myxine du nord / Atlantic hagfish						
2000-2015	-	5954	-	3.26	-	0.064
2016	-	4435	-	3.34	-	0.075
2017	-	5181	-	5.52	-	0.106
Grenadier du Grand Banc / Marlin-spike						
2000-2015	-	2863	-	1.53	-	0.061
2016	-	2382	-	2.22	-	0.093
2017	-	2350	-	2.58	-	0.110
Grosse poule de mer / Lumpfish						
2000-2015	-	627	-	0.05	-	0.015
2016	-	2016	-	0.12	-	0.006
2017	-	1807	-	0.01	-	0.001
Mollasse atlantique / Atlantic soft pout						
2000-2015	-	146	-	0.12	-	0.090
2016	-	30	-	0.23	-	0.765
2017	-	22	-	0.08	-	0.364
Merlu argenté / Silver hake						
2000-2015	-	1030	-	0.70	-	0.163
2016	-	415	-	0.18	-	0.045
2017	-	833	-	0.44	-	0.053
Loup atlantique / Atlantic wolffish						
2000-2015	-	2622	-	0.12	-	0.005
2016	-	2598	-	0.00	-	0.000
2017	-	5928	-	0.00	-	0.000
Loup tacheté / Spotted wolffish						
2000-2015	-	790	-	0.04	-	0.005
2016	-	201	-	0.02	-	0.010
2017	-	1	-	0.00	-	0.000
Saida / Arctic cod						
2000-2015	-	34	-	0.84	-	10.266
2016	-	27	-	0.11	-	0.394
2017	-	58	-	0.26	-	0.442
Merluche à longues nageoires / Longfin hake						
2000-2015	-	1570	-	0.18	-	0.012
2016	-	1440	-	0.05	-	0.003
2017	-	2179	-	0.18	-	0.008
Mustèles / Rocklings						
2000-2015	-	3	-	0.31	-	362.483
2016	-	0	-	0.00	-	-
2017	-	0	-	0.01	-	-
Faux-trigles / Sculpins						
2000-2015	-	732	-	0.16	-	0.021
2016	-	205	-	0.09	-	0.043
2017	-	762	-	0.00	-	0.000

Year	Survey		Bycatch		Ratio (%)	
	N (x1000)	Biomass (t)	N (x1000)	Biomass (t)	N (x1000)	Biomass (t)
Chaboisseaux / Sculpins						
2000-2015	-	2859	-	0.33	-	0.015
2016	-	6706	-	0.21	-	0.003
2017	-	2639	-	0.07	-	0.003
Hameçons / Hookear sculpins						
2000-2015	-	44	-	0.38	-	0.899
2016	-	18	-	0.51	-	2.751
2017	-	31	-	0.32	-	1.047
Agonidés / Poachers						
2000-2015	-	170	-	1.94	-	1.329
2016	-	70	-	0.72	-	1.023
2017	-	71	-	0.92	-	1.299
Limaces / Seasnails						
2000-2015	-	254	-	0.51	-	0.734
2016	-	47	-	0.61	-	1.295
2017	-	44	-	0.42	-	0.936
Poules de mer / Lumpfishes						
2000-2015	-	160	-	0.30	-	0.238
2016	-	128	-	0.30	-	0.237
2017	-	118	-	0.14	-	0.121
Lompénies / Eelpouts						
2000-2015	-	616	-	1.23	-	0.171
2016	-	90	-	0.17	-	0.191
2017	-	258	-	0.34	-	0.131
Terrassier tacheté / Wrymouth						
2000-2015	-	204	-	0.14	-	0.057
2016	-	233	-	0.07	-	0.031
2017	-	336	-	0.35	-	0.105
Lycodes / Eelpouts						
2000-2015	-	2015	-	5.13	-	0.267
2016	-	945	-	1.96	-	0.207
2017	-	1175	-	3.55	-	0.302

Table 22. Percentage (Pct) of Pandalus montagui and Pasiphaea multidentata in the shrimp samples at landing.

Year	Number of samples	Pct *P. montagui* (%)	Pct *P. multidentata* (%)
2000	152	0.130	1.001
2001	145	0.080	0.962
2002	166	0.098	0.380
2003	172	0.035	0.448
2004	166	0.046	0.414
2005	164	0.152	0.172
2006	183	0.248	0.461
2007	179	0.139	0.406
2008	164	0.267	0.932
2009	137	0.724	1.365
2010	153	0.276	1.397
2011	155	0.350	0.813
2012	152	0.380	0.770
2013	170	0.390	0.668
2014	163	0.078	0.943
2015	174	0.009	1.113
2016	183	0.092	1.070
2017	147	0.225	1.463

FIGURES

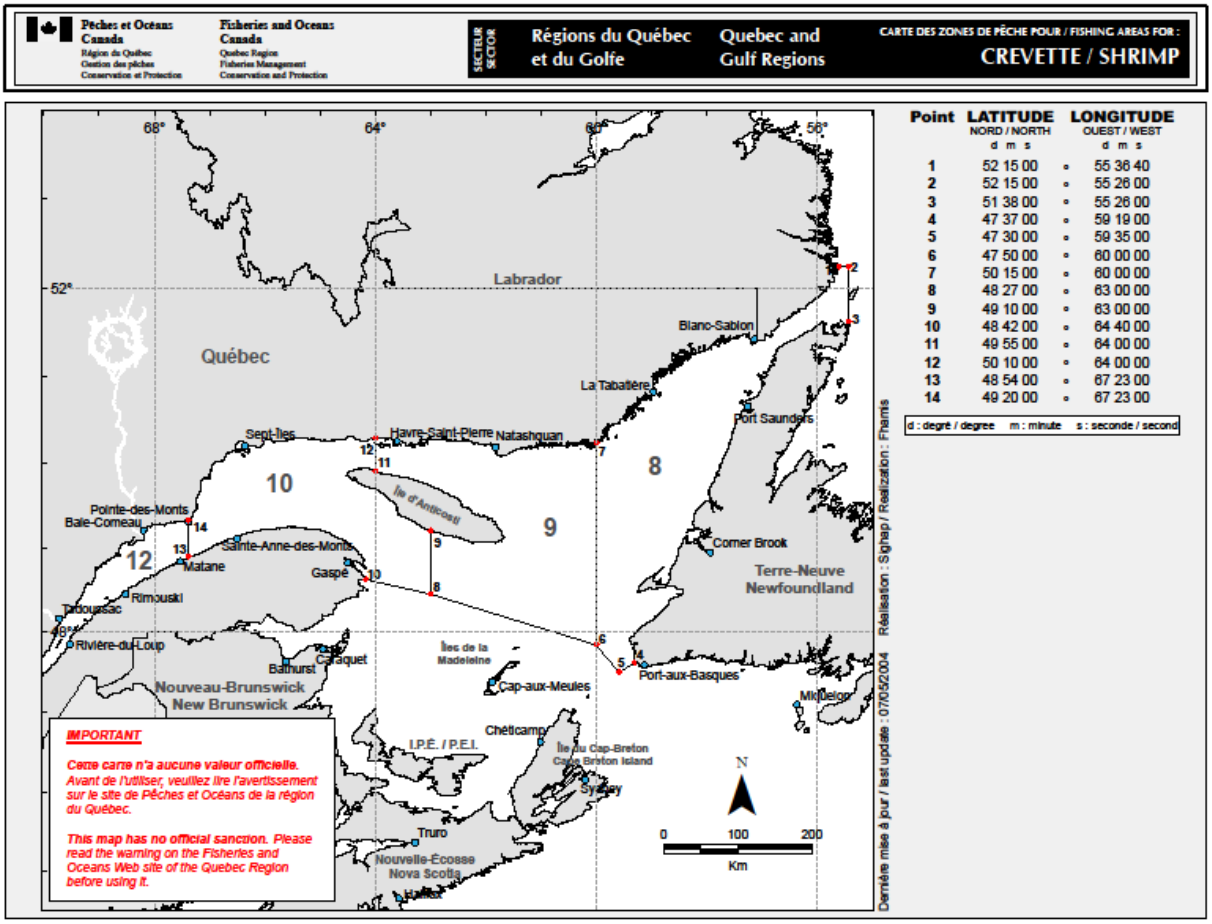

Figure 1. Shrimp fishing areas (SFA) in the northern Gulf of St. Lawrence: Estuary (SFA 12); Sept-Iles (SFA 10); Anticosti (SFA 9); Esquiman (SFA 8).

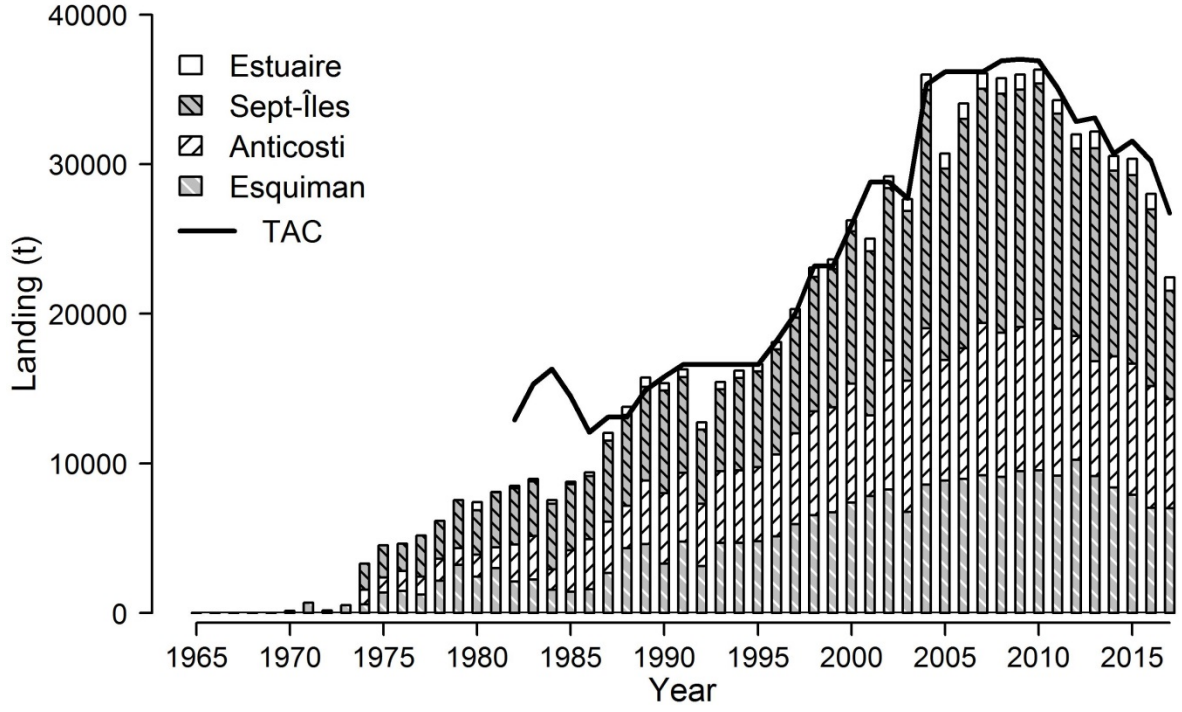

Figure 2. Landing and total allowable catches (TAC) in the Estuary and Gulf of St. Lawrence.

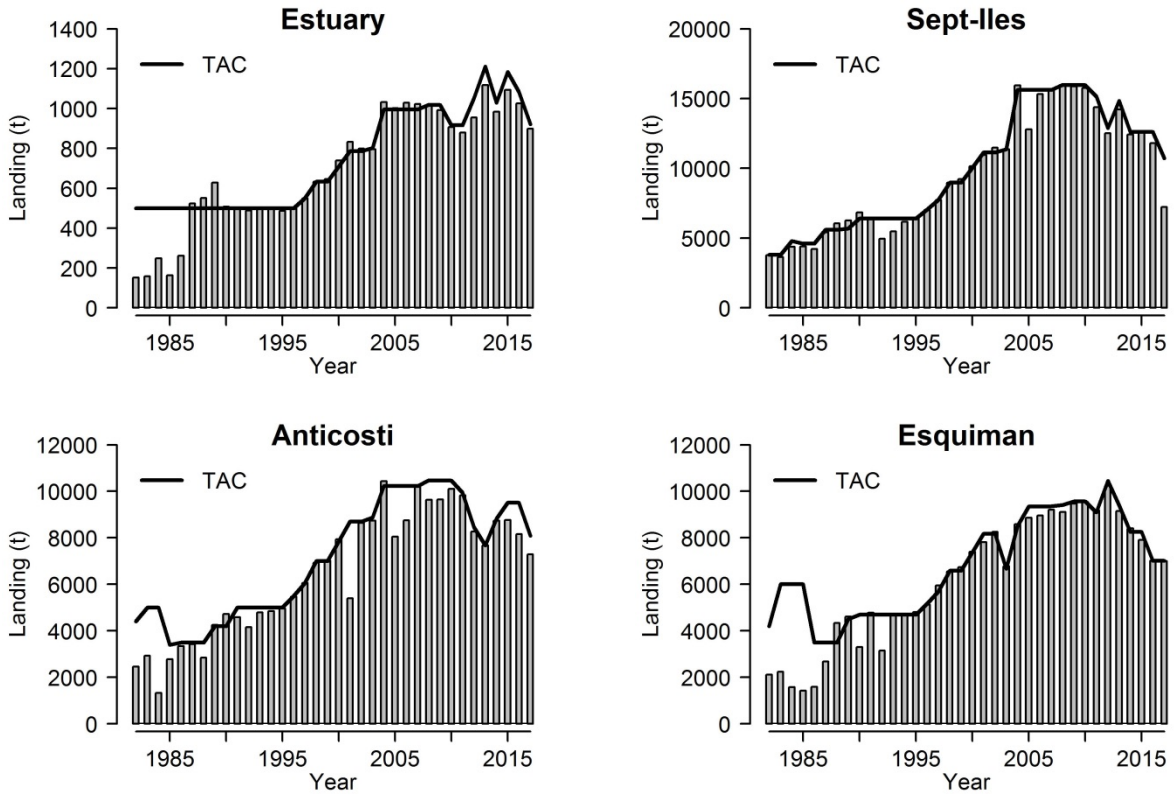

Figure 3. Landing and total allowable catches (TAC) by shrimp fishing area.

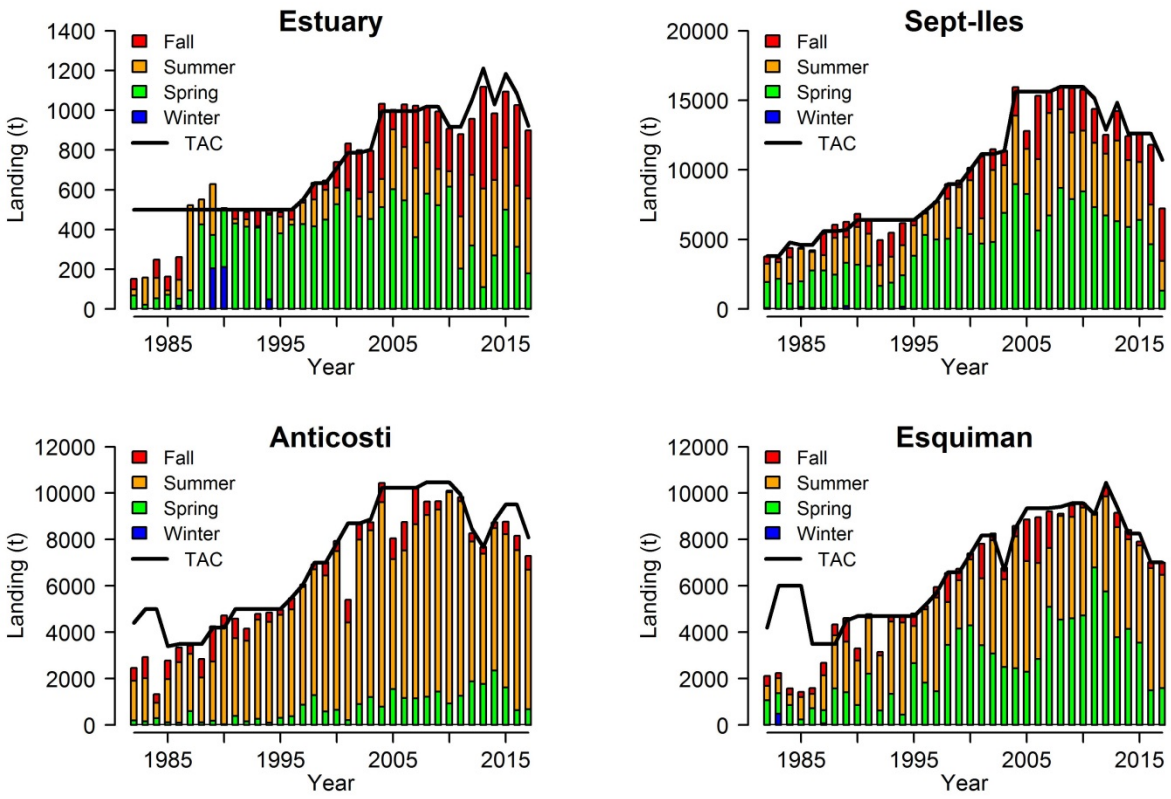

Figure 4. Seasonal landing and total allowable catches (TAC) by shrimp fishing area.

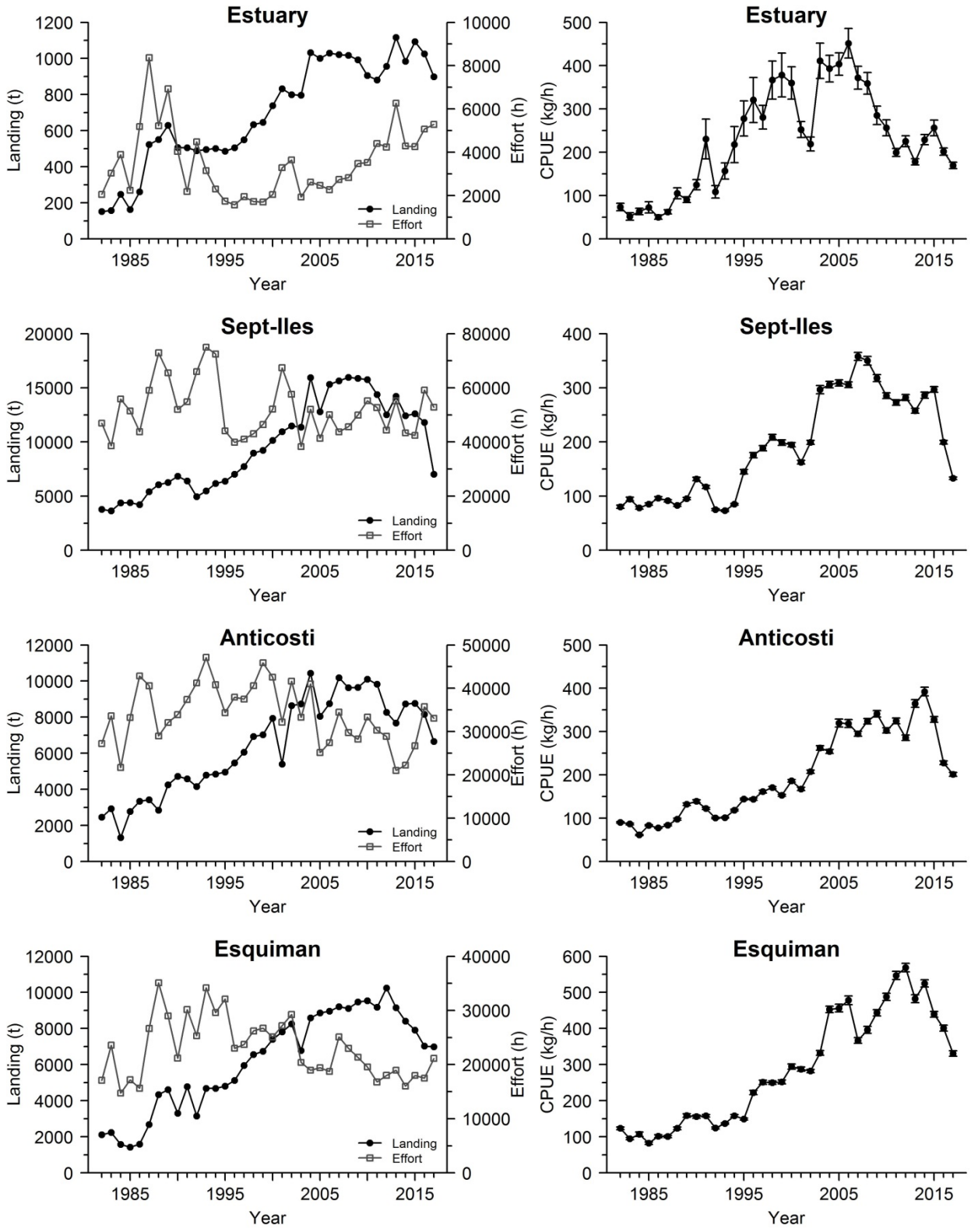

Figure 5. Landing, nominal effort and catch per unit of effort ± confidence interval (95%), by year and by fishing area.

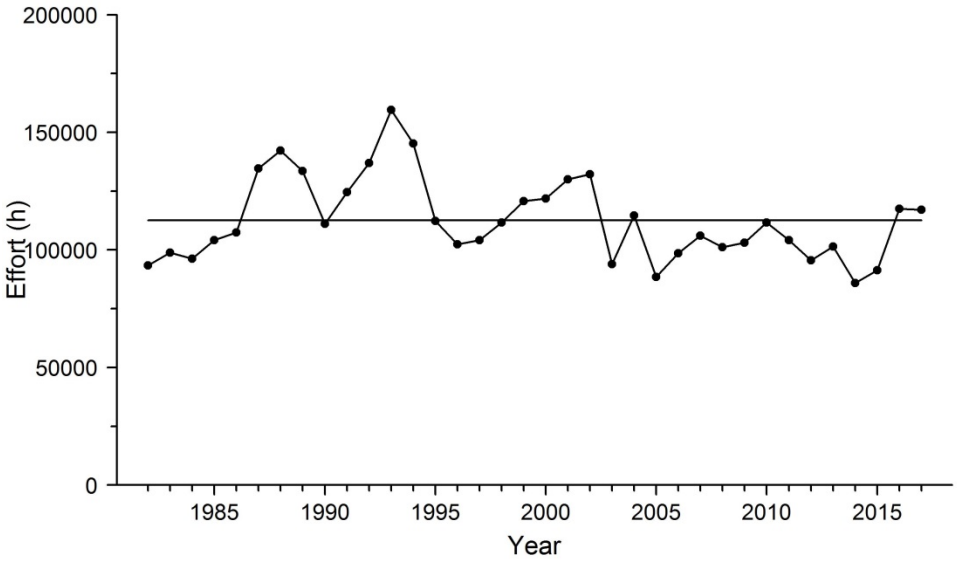

Figure 6. Total effort of fishing by year for the Estuary and Gulf of St. Lawrence. The full line indicates the mean of the series.

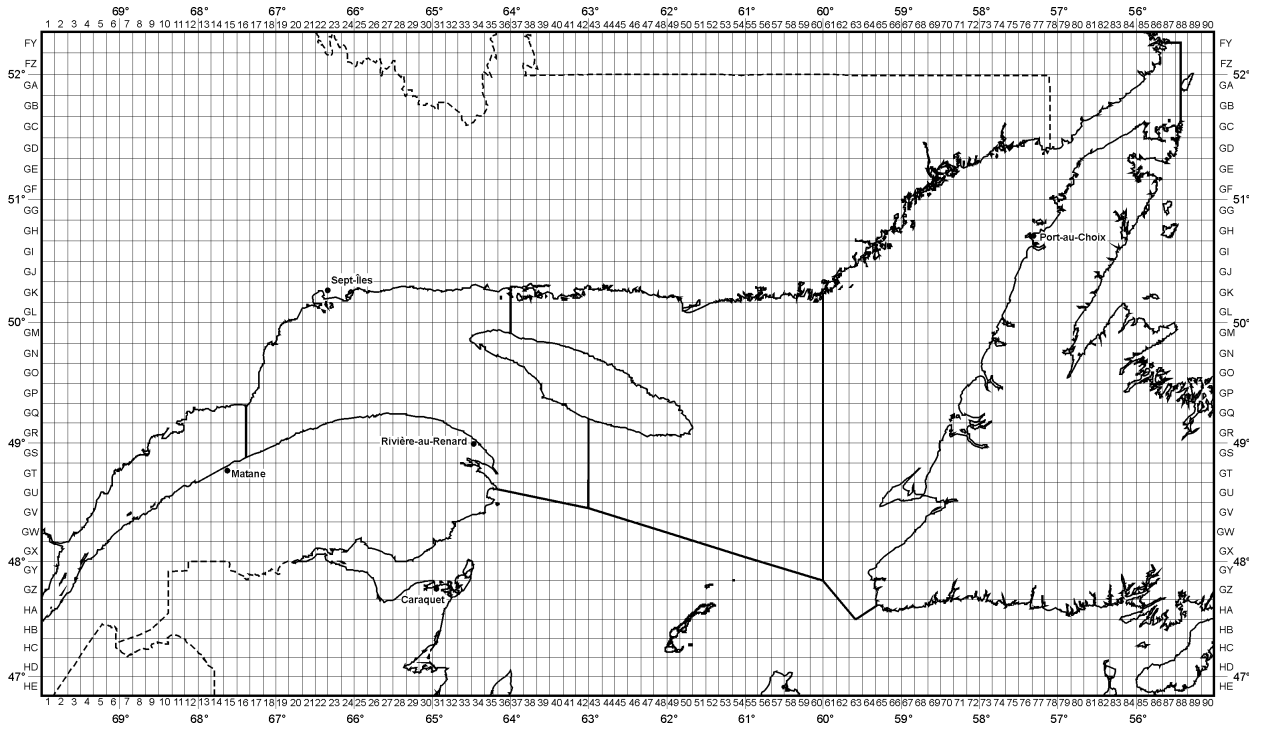

Figure 7. Statistical squares used to list the fishing effort and shrimp fishing areas (SFA) in the Estuary and Gulf of St. Lawrence. Estuary, ZFA 12; Sept-Iles, ZFA 10; Anticosti, ZFA 9; Esquiman, ZFA 8.

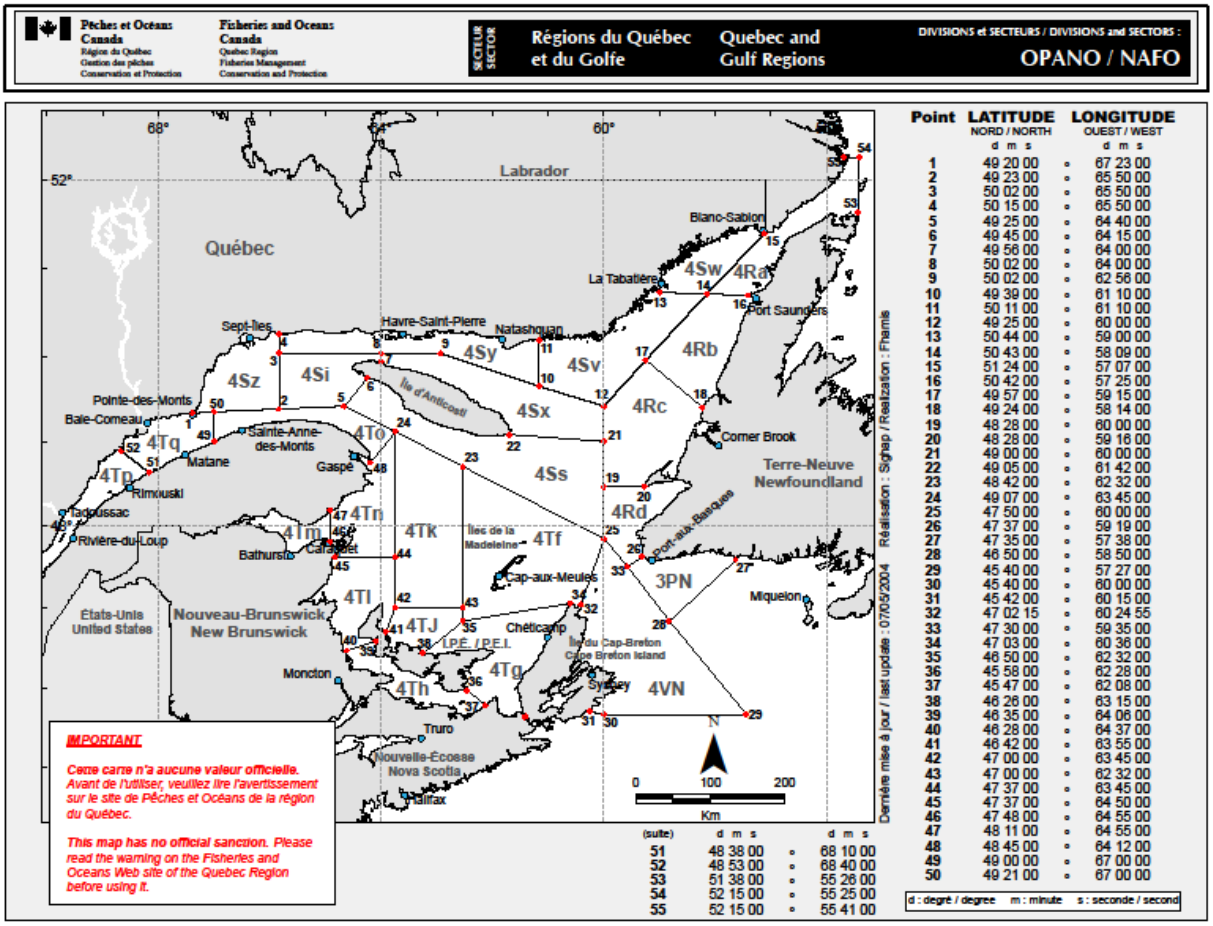

Figure 8. NAFO unit areas in the Estuary and Gulf of St. Lawrence.

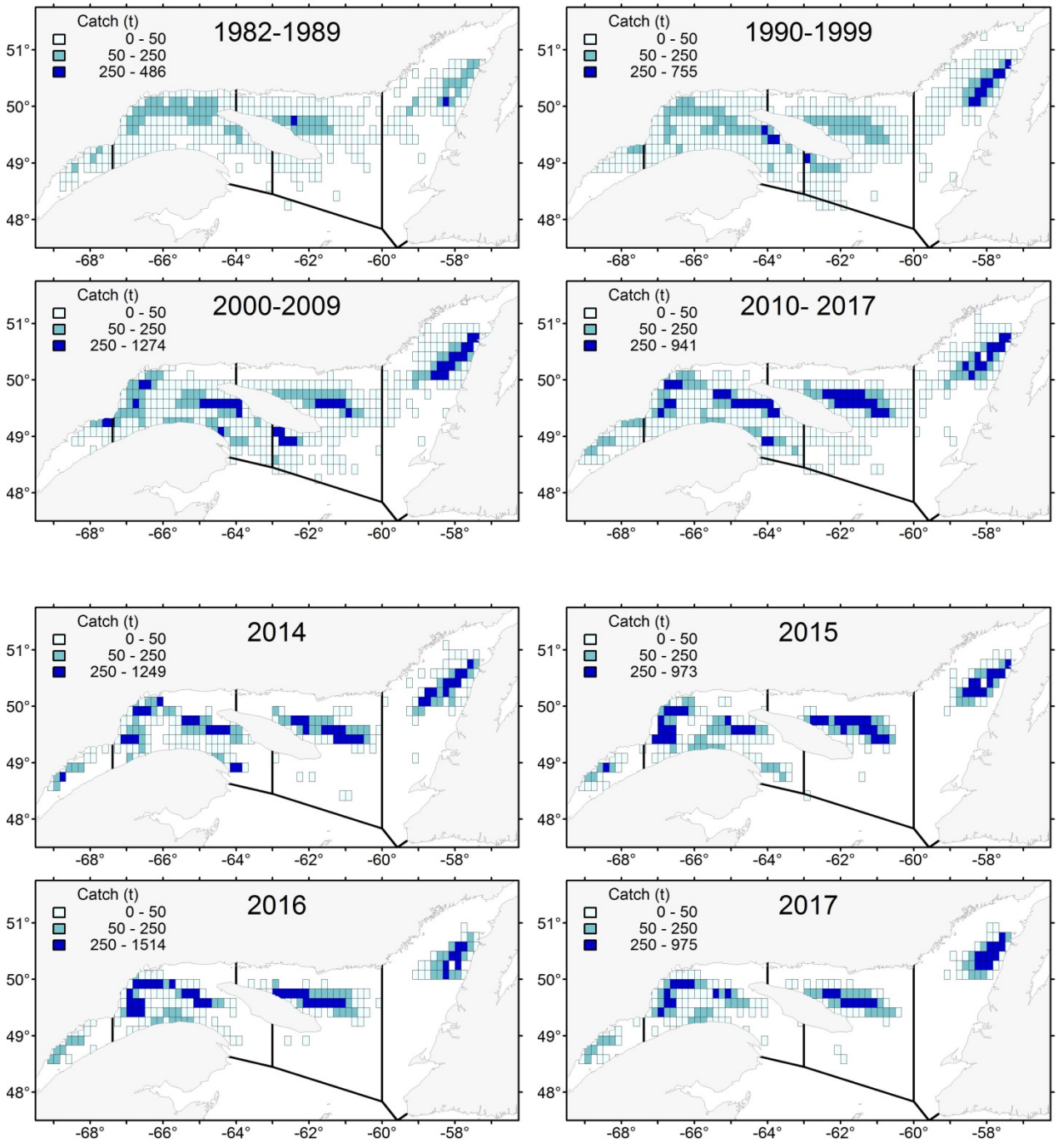

Figure 9. Catches (t) by statistical square by decade (annual mean) and from 2014 to 2017.

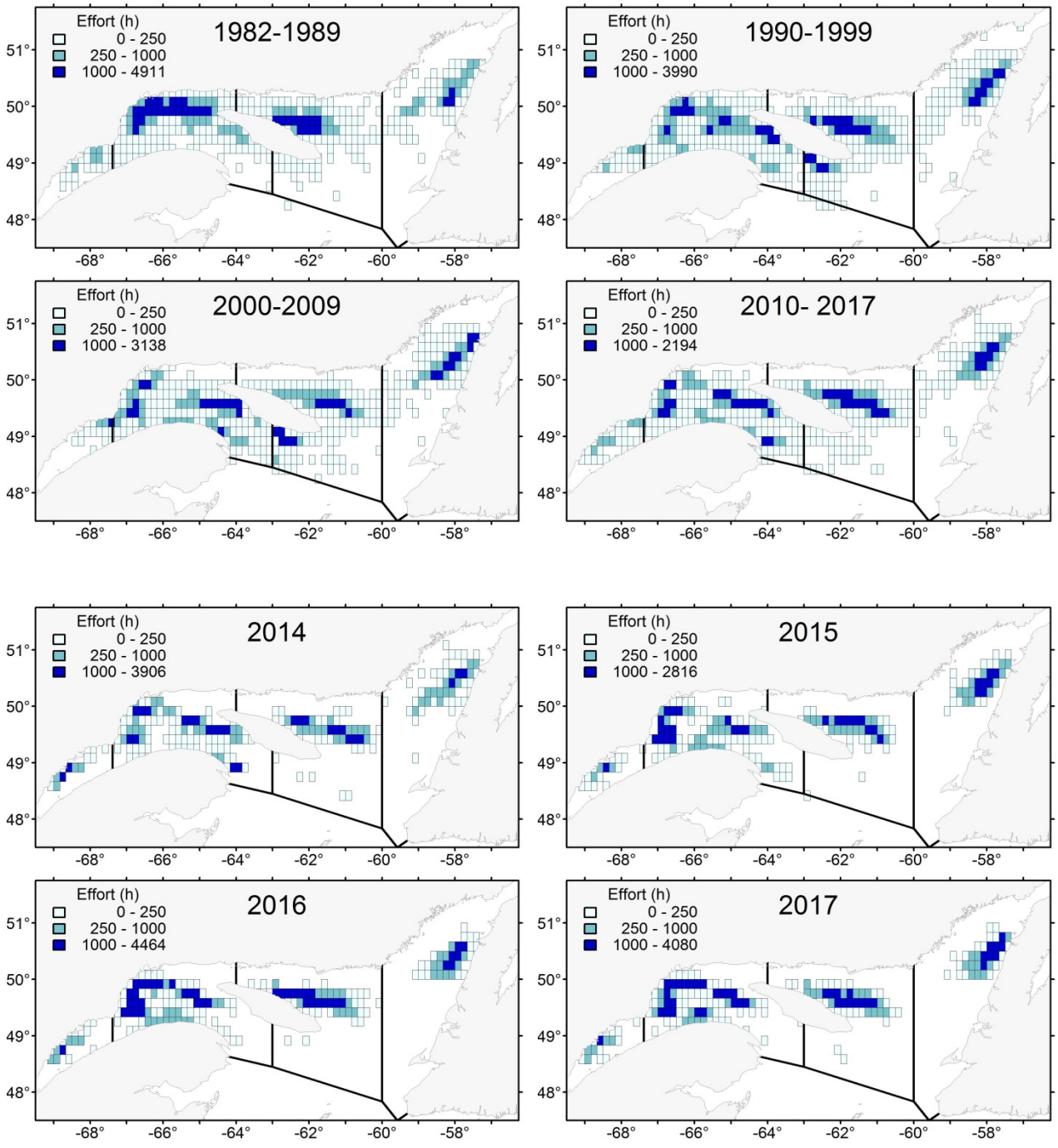

Figure 10. Fishing effort (t) by statistical square by decade (annual mean) and from 2014 to 2017.

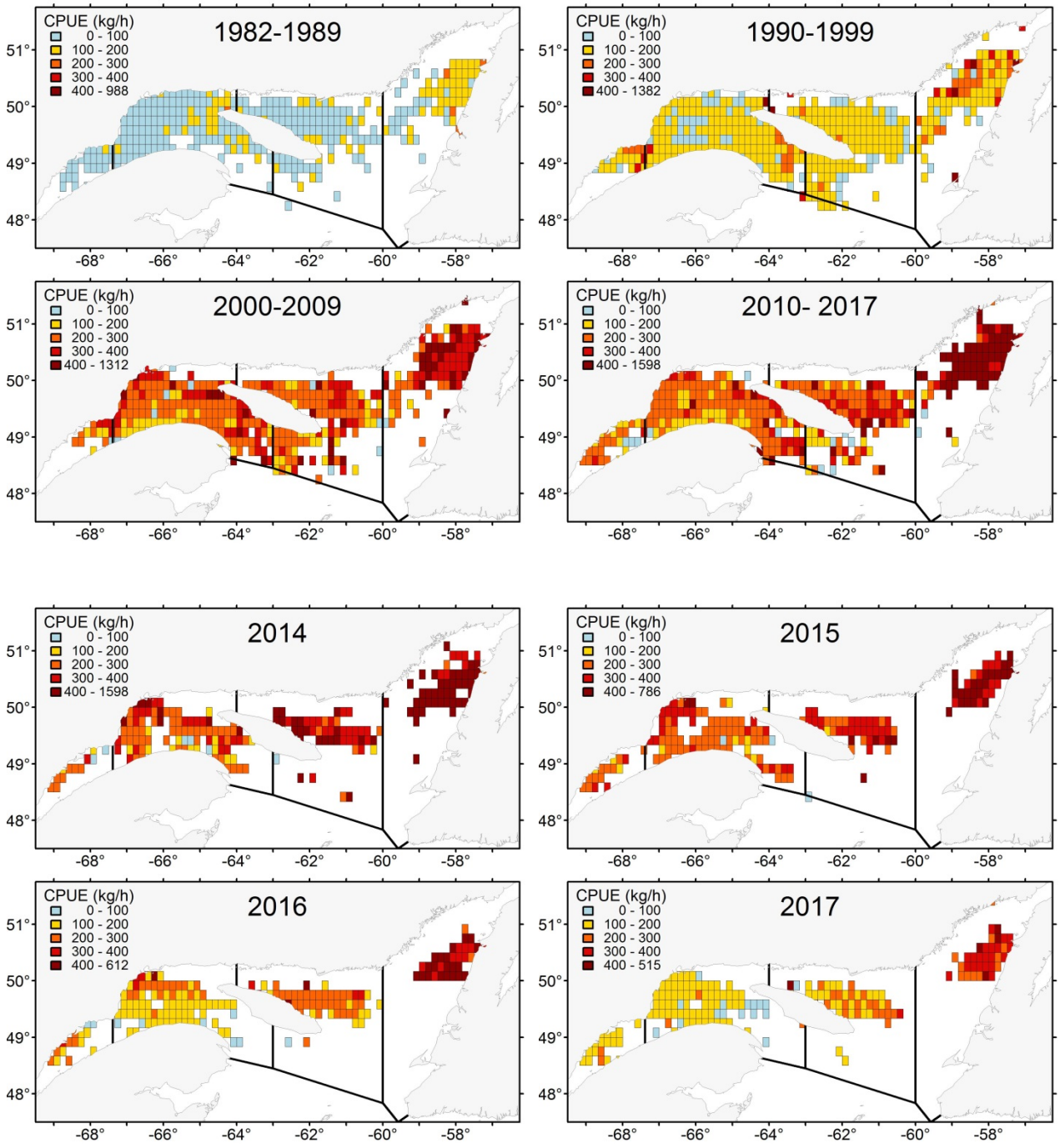

Figure 11. Catch per unit of effort by statistical square by decade (annual mean) and from 2014 to 2017.

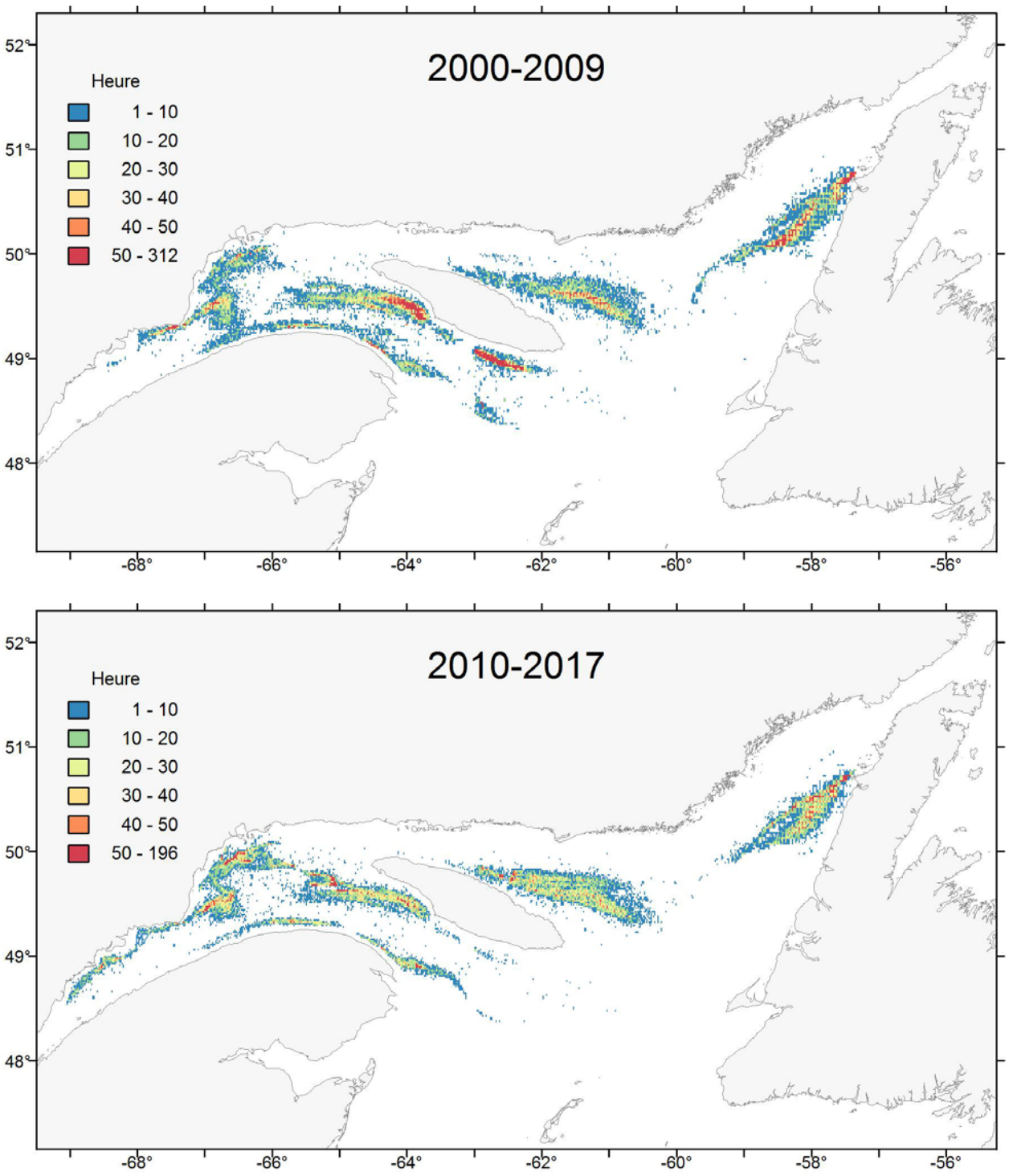

Figure 12. Average distribution of annual shrimp fishing effort in the Gulf of St. Lawrence for the periods 2000 to 2009 and 2010 to 2017 (number of hours per square of 1 minute) from logbook data.

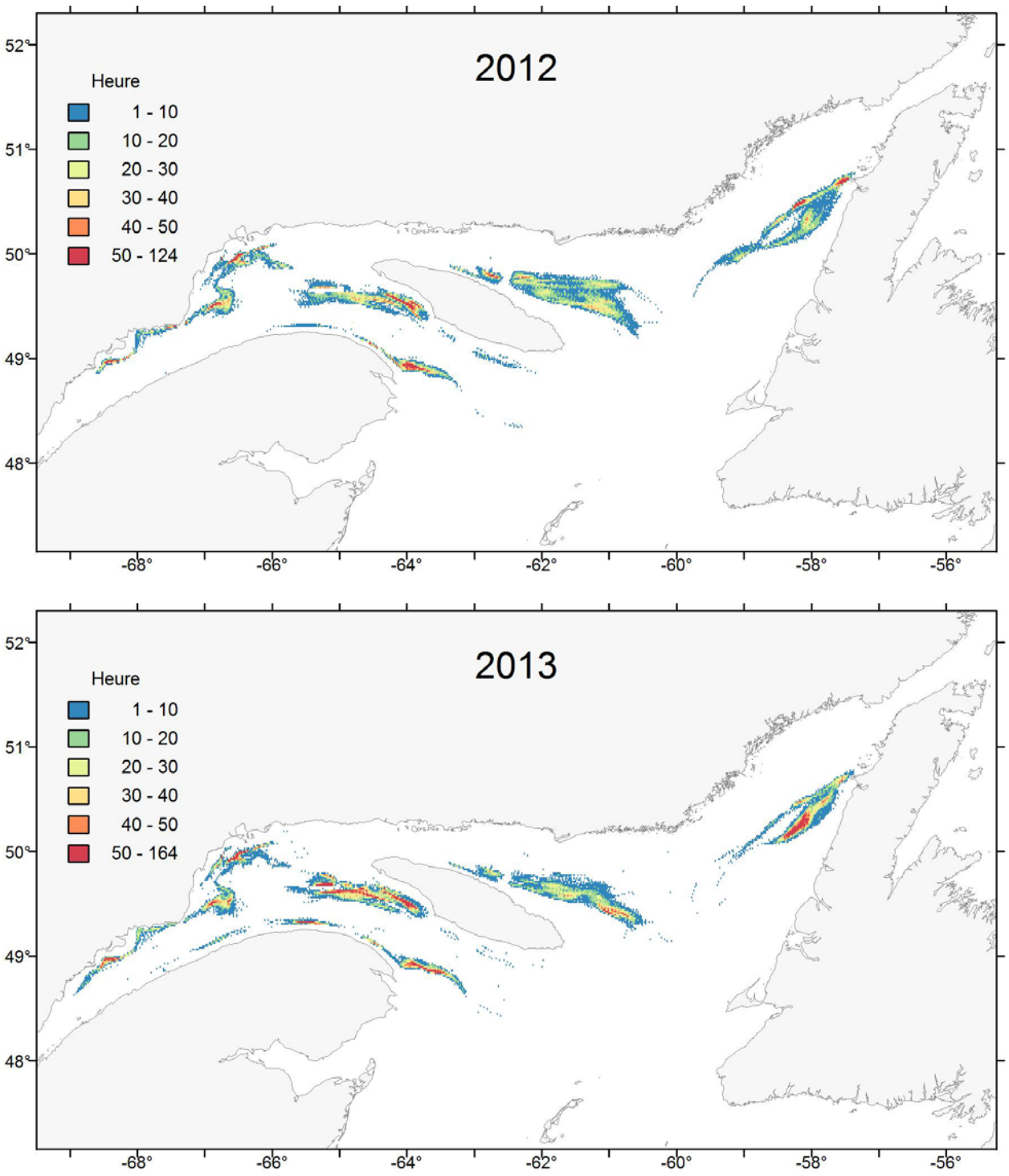

Figure 13. Distribution of shrimp fishing effort in the Gulf of St. Lawrence from 2012 to 2017 based on Vessel Monitoring System (VMS) data, number of hours in a directed shrimp fishery per 1 minute square.

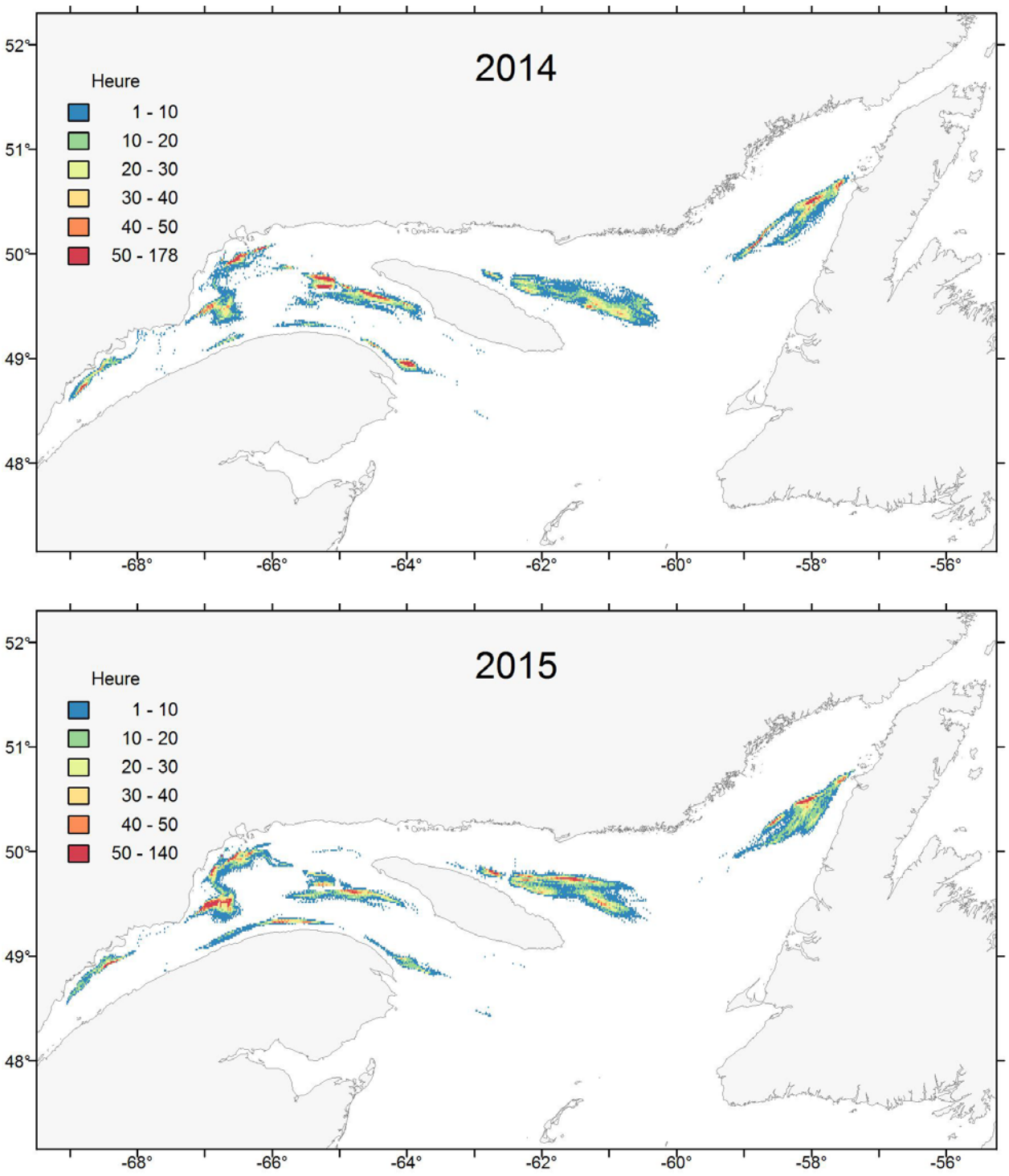

Figure 13. Continued.

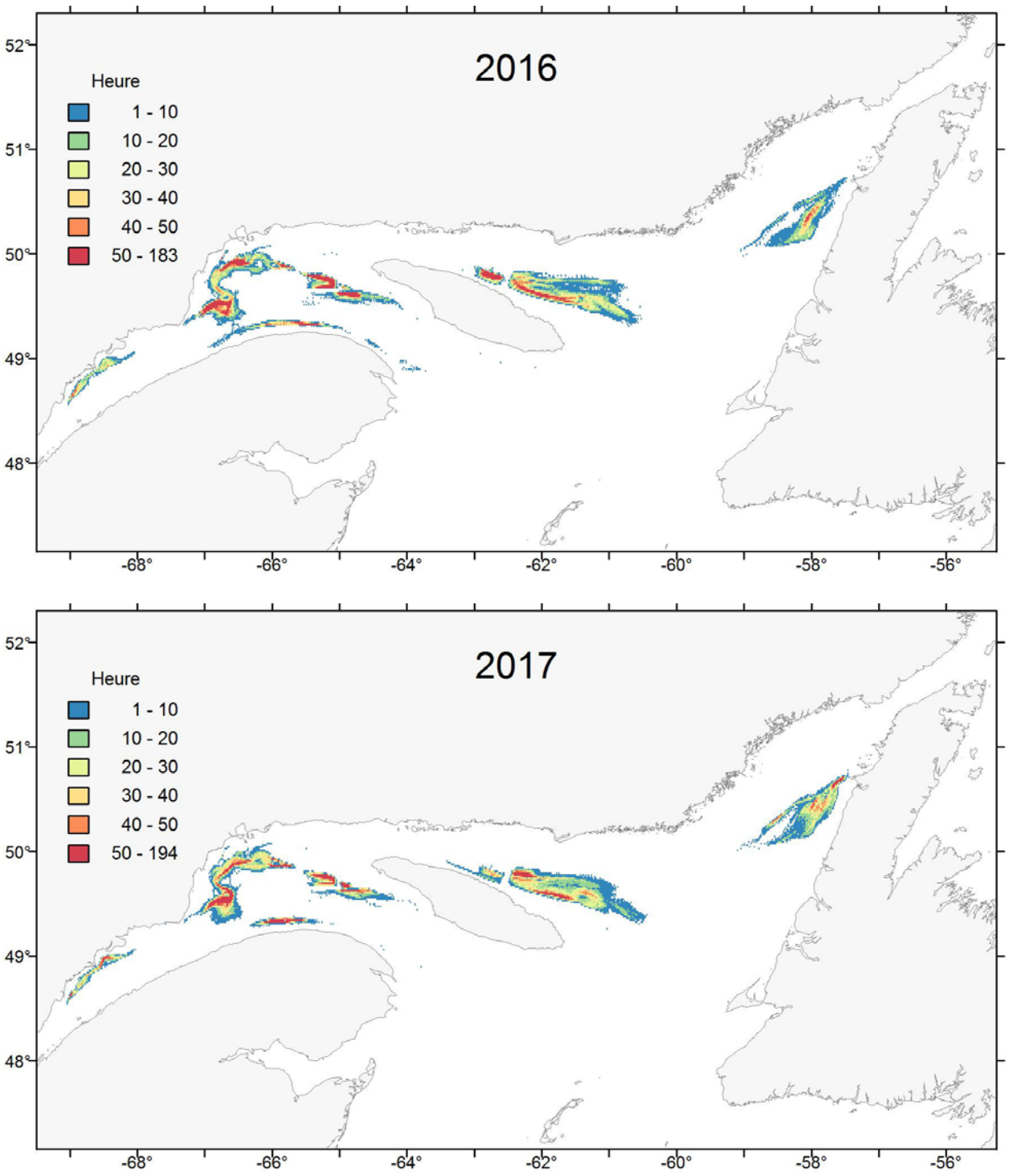

Figure 13. Continued.

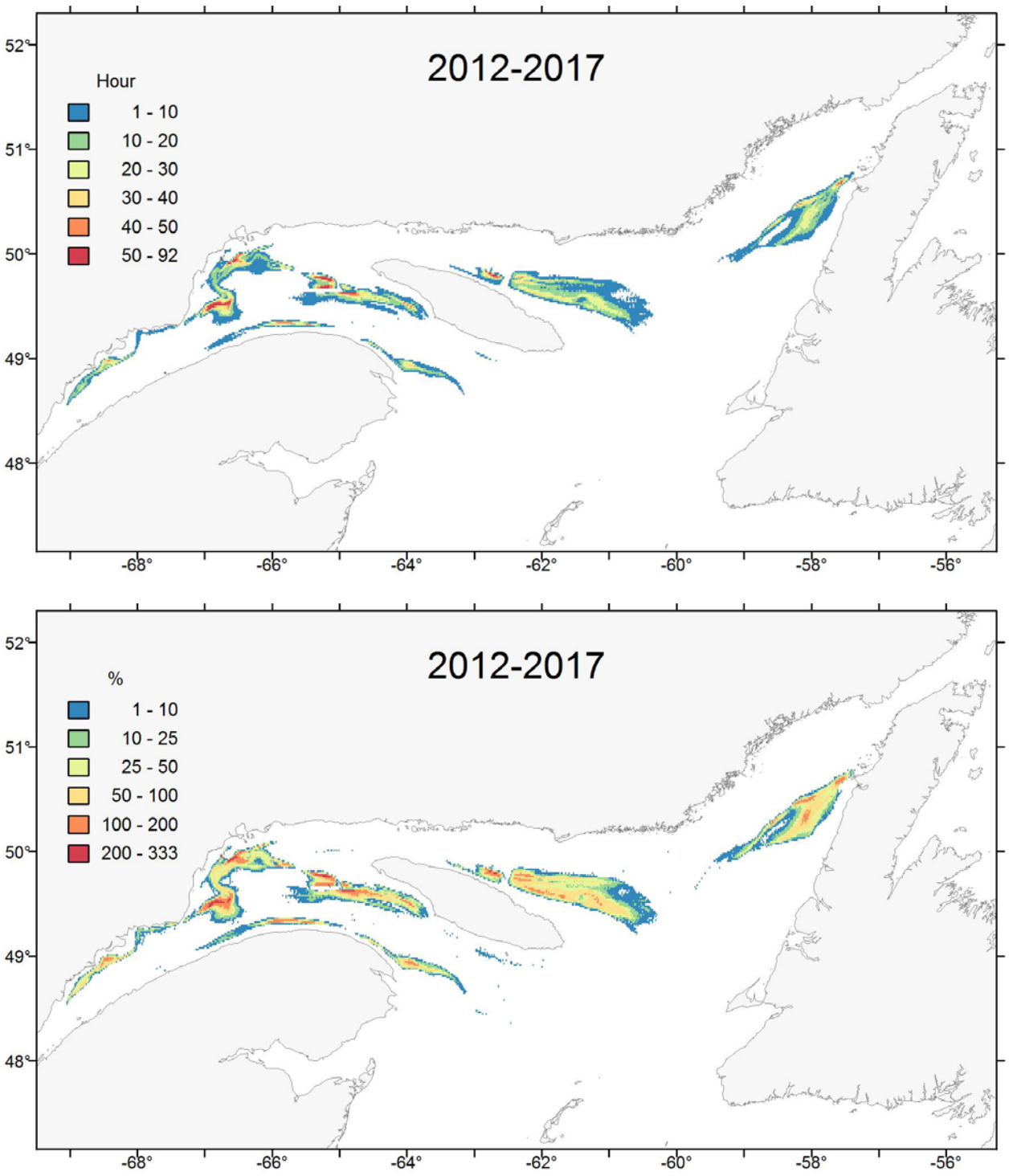

Figure 14. Average annual fishing effort distribution for shrimp boats in the Gulf of St. Lawrence from 2012 to 2017 (number of hours per square of 1 minute) and bottom trawl footprint (percent recovery) according to system data Vessel Monitoring System (VMS).

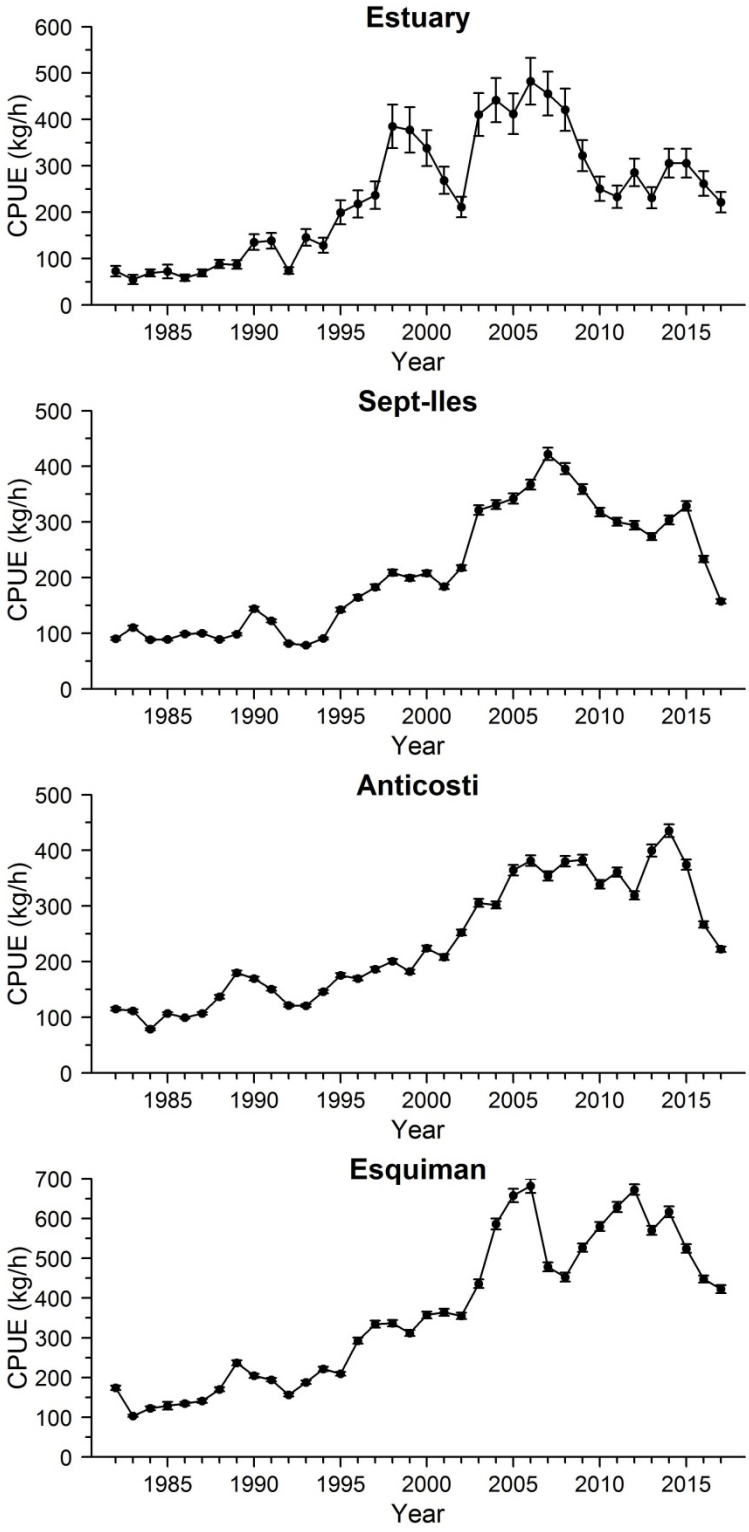

Figure 15. Standardized catch per unit of effort ± confidence interval (95 %) by fishing area and by year.

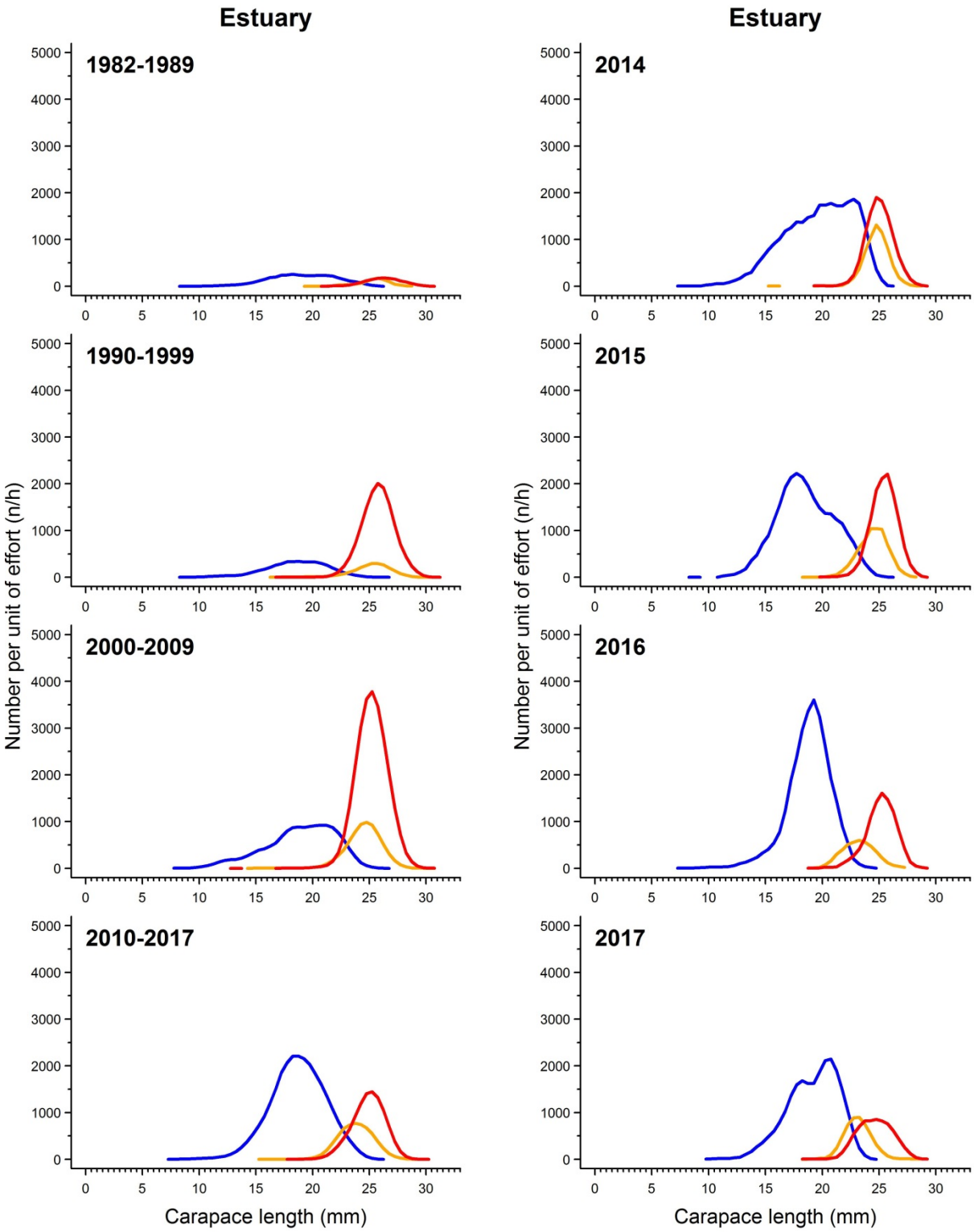

Figure 16. Number per unit of effort by carapace length class (0.5 mm) by fishing area for the fishing season by decade and for 2014 to 2017. Males in blue, primiparous females in orange and multiparous females in red.

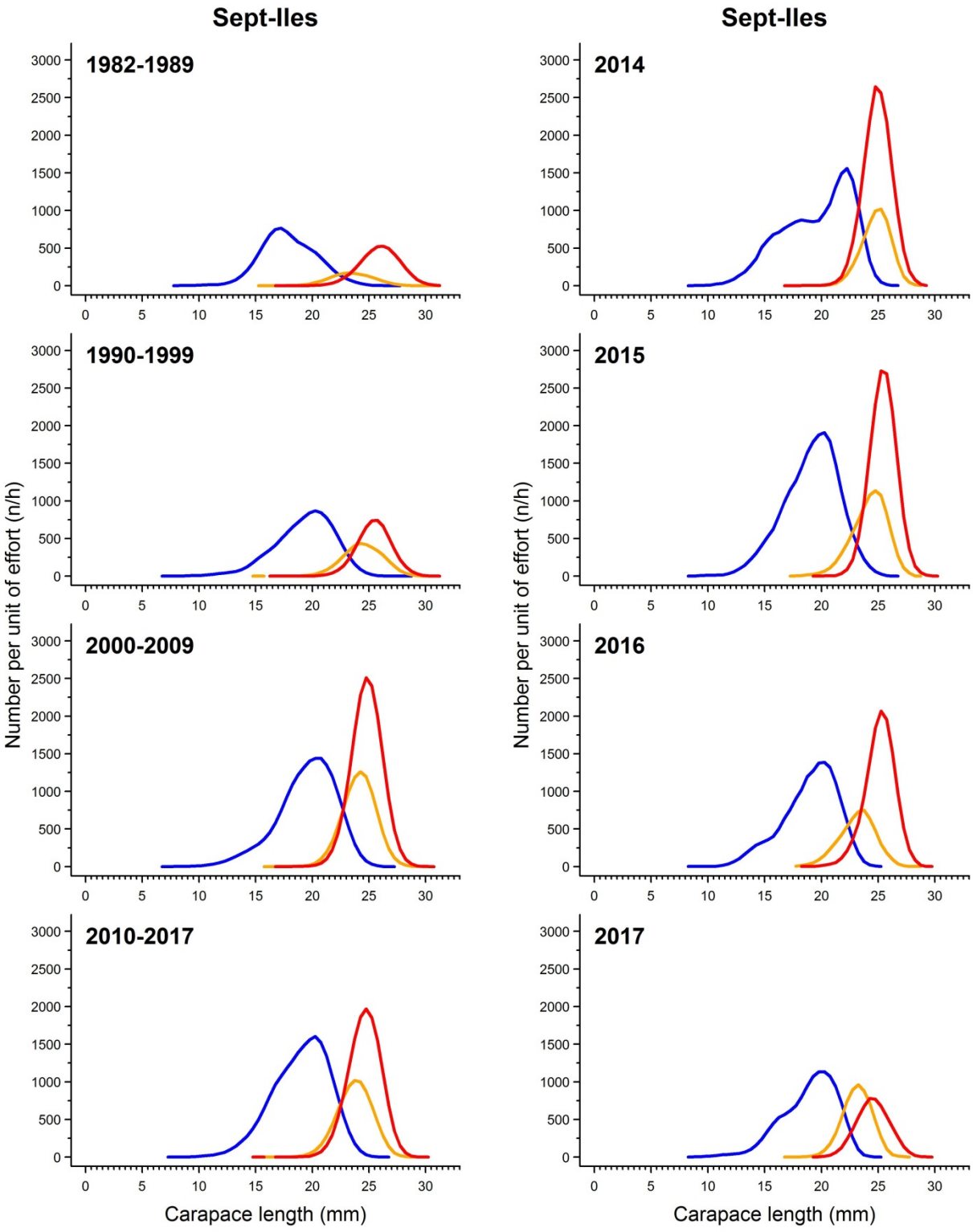

Figure 16. Continued.

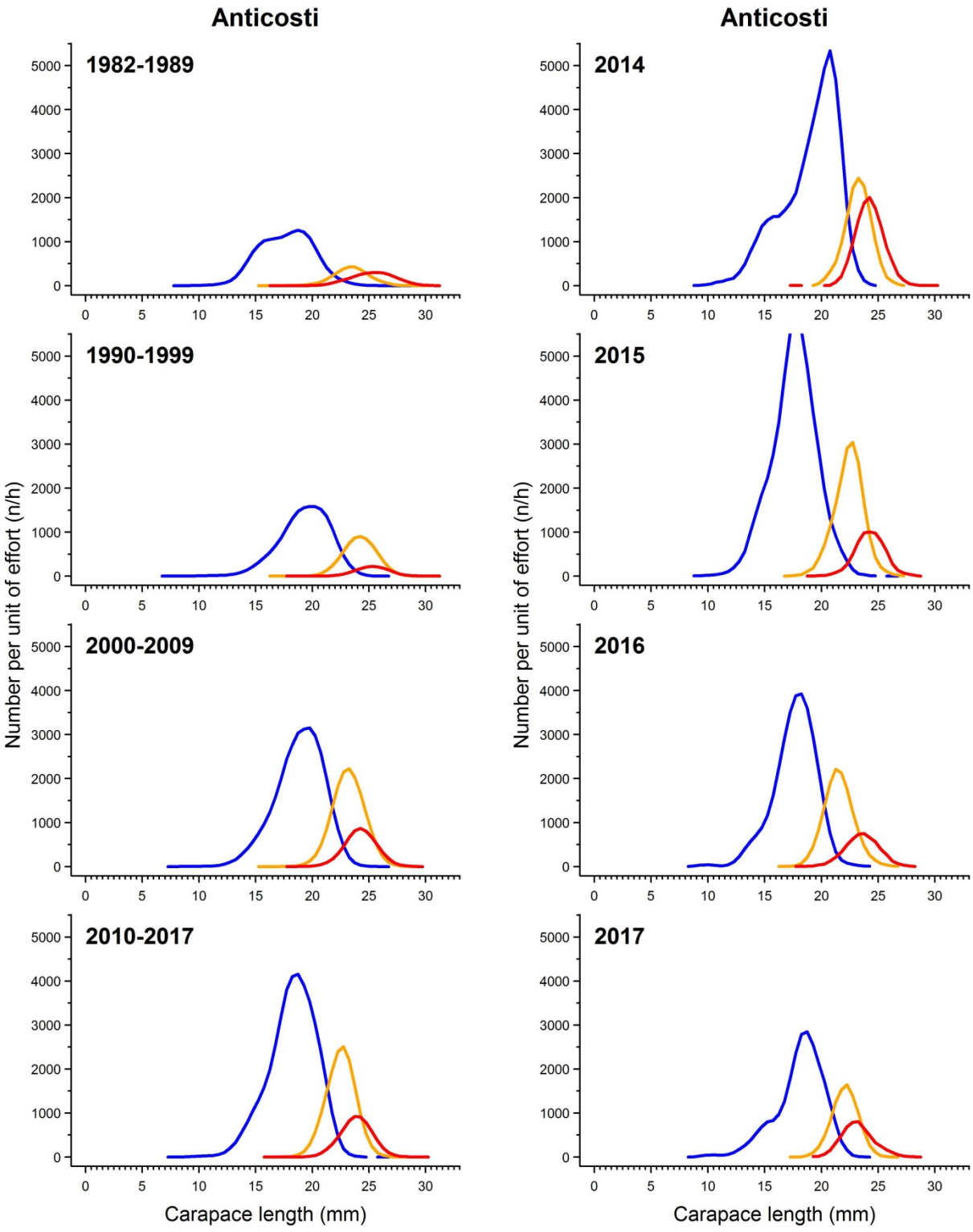

Figure 16. Continued.

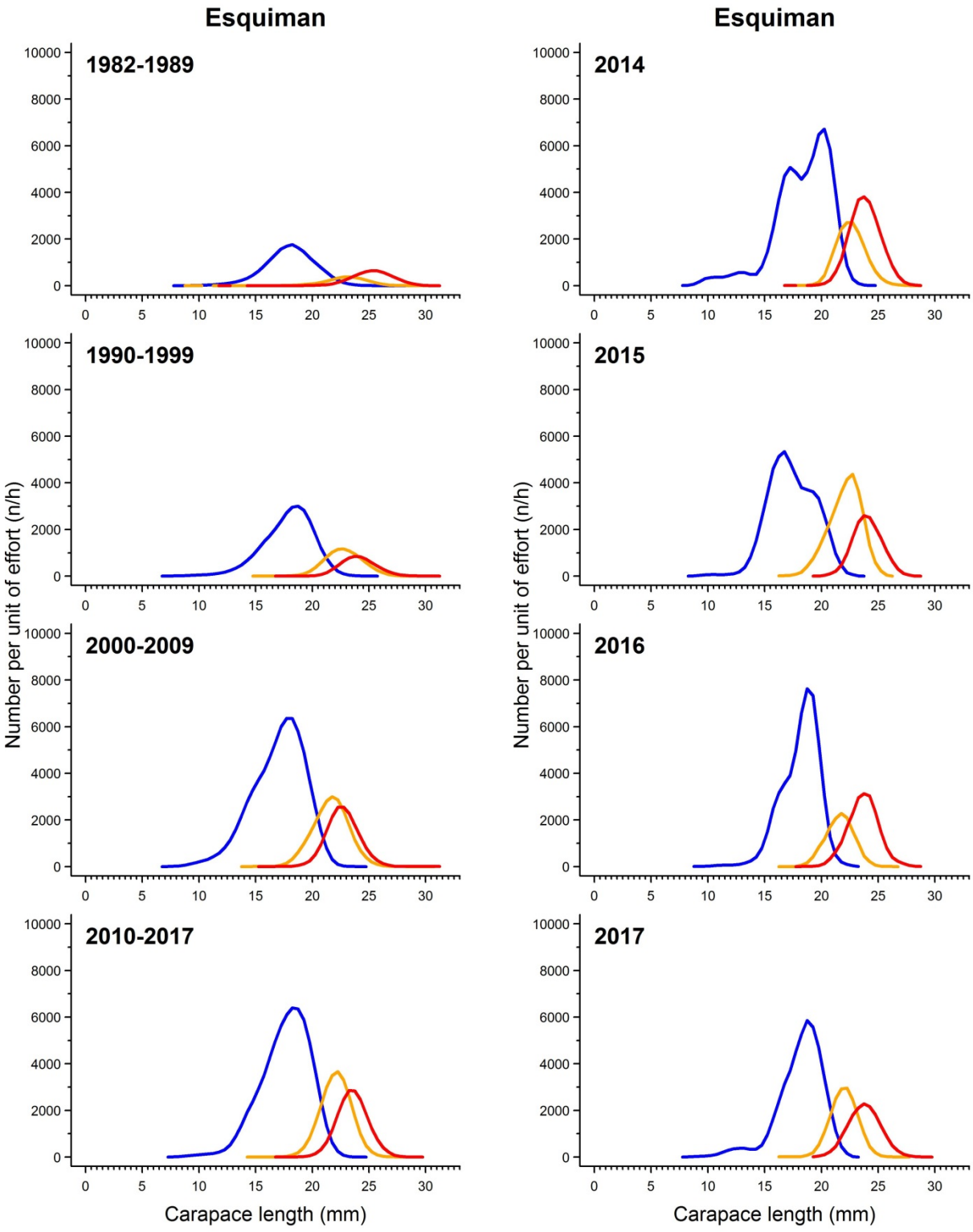

Figure 16. Continued.

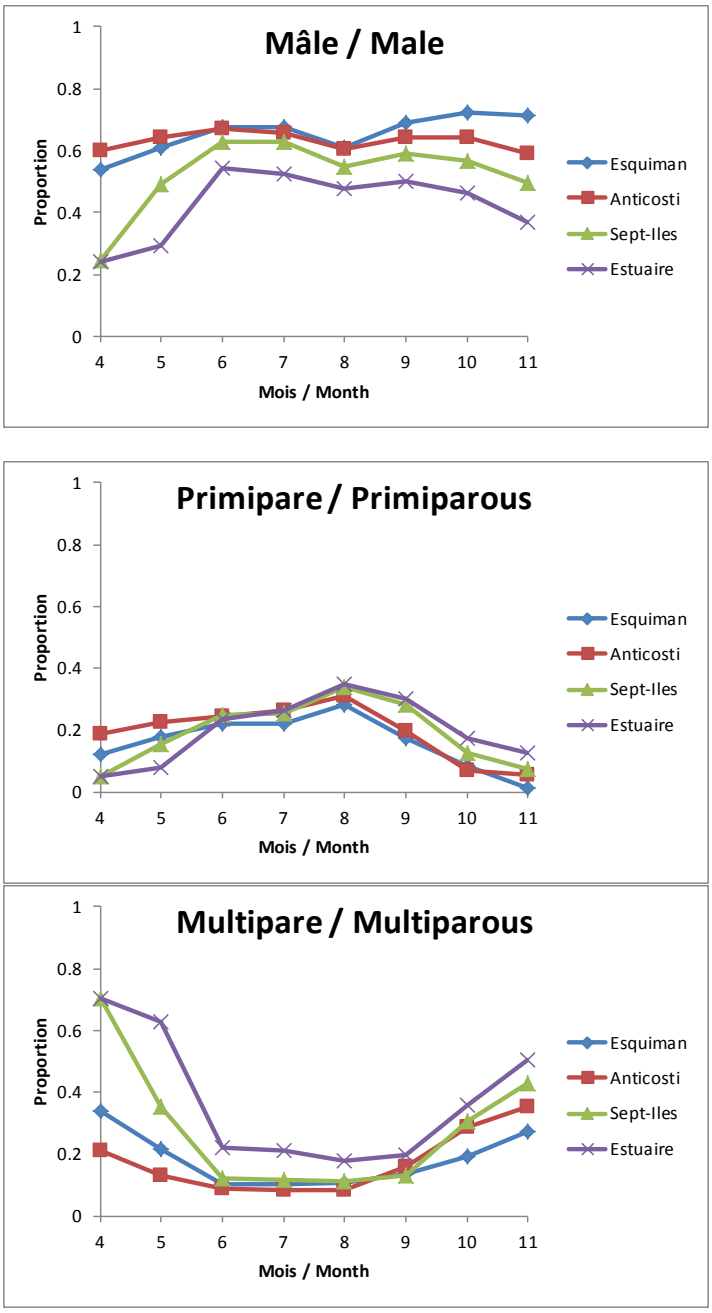

Figure 17. Proportion of males, primiparous and multiparous females in the fishery. Average per month from 1982 to 2013.

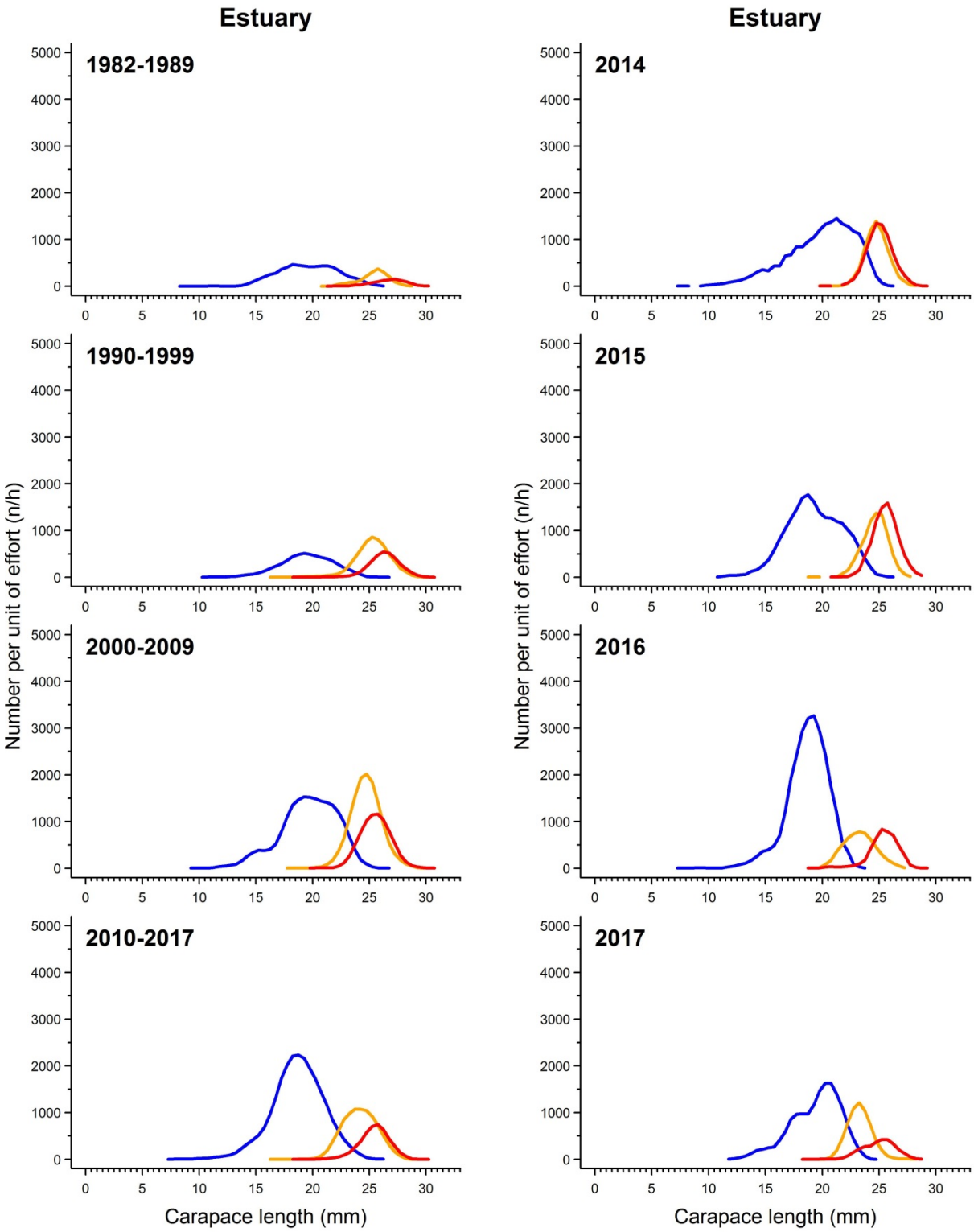

Figure 18. Number per unit of effort by carapace length class (0.5 mm) by fishing area for the summer season (June, July and August) by decade and for 2014 to 2017. Males in blue, primiparous females in orange and multiparous females in red.

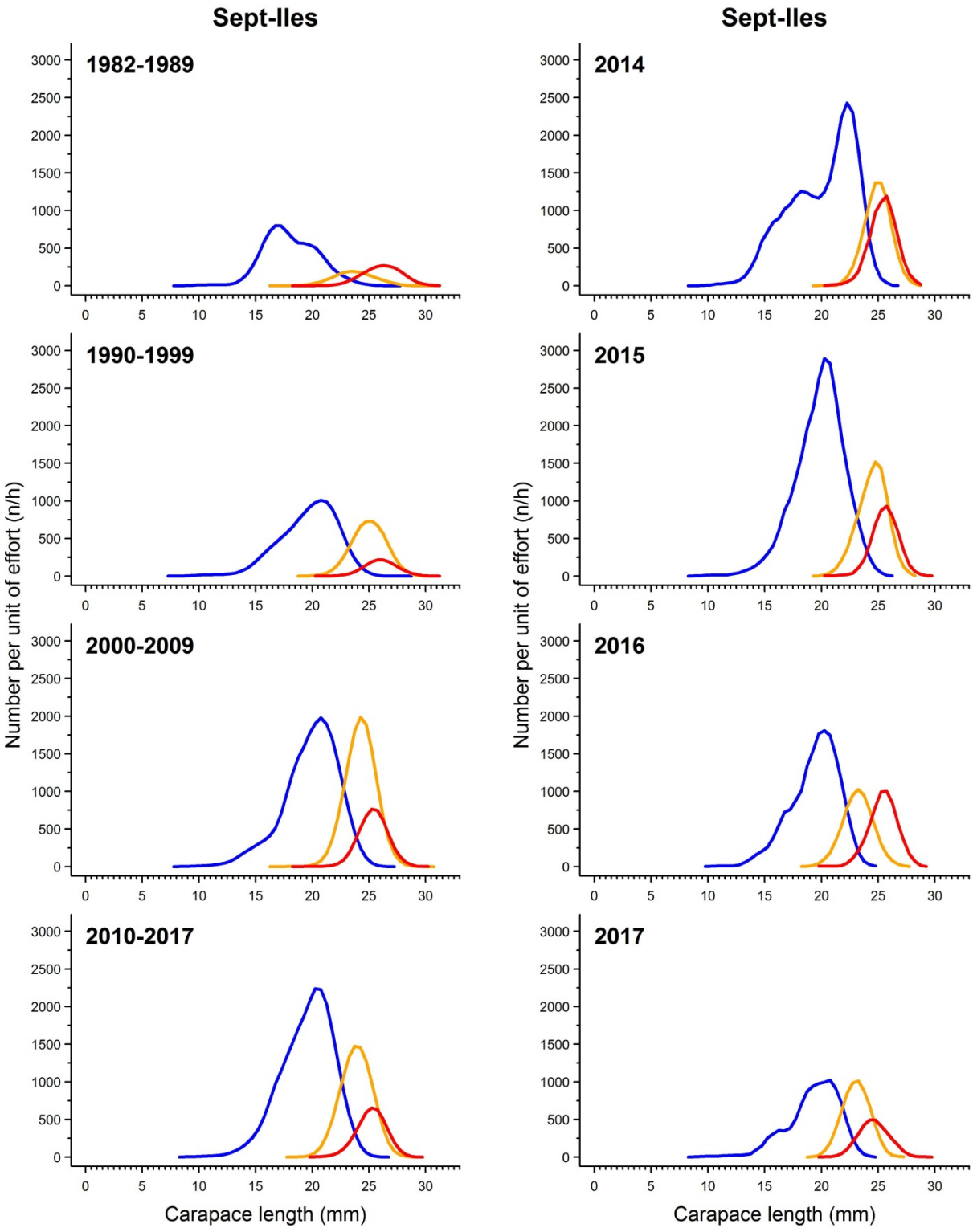

Figure 18. Continued.

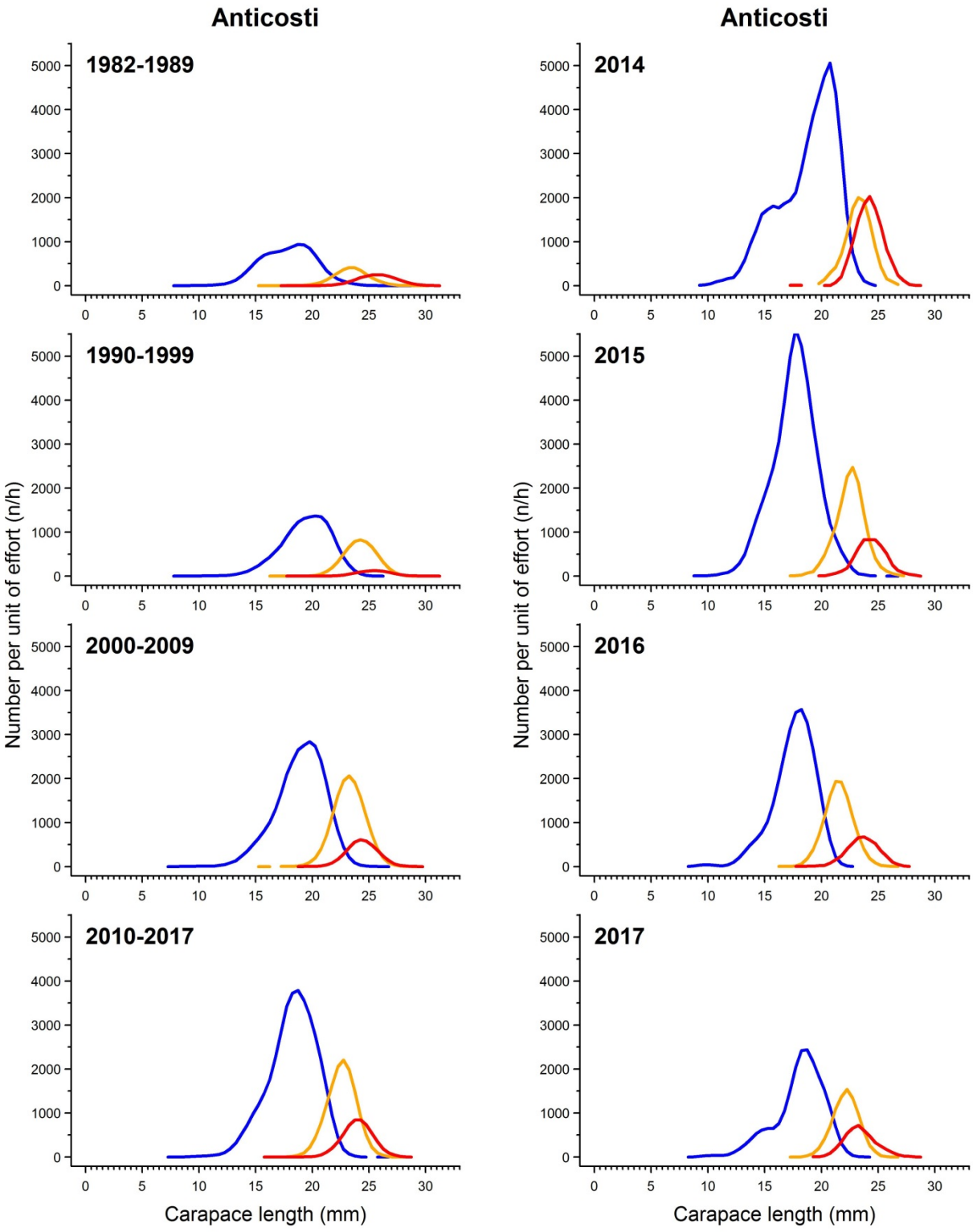

Figure 18. Continued.

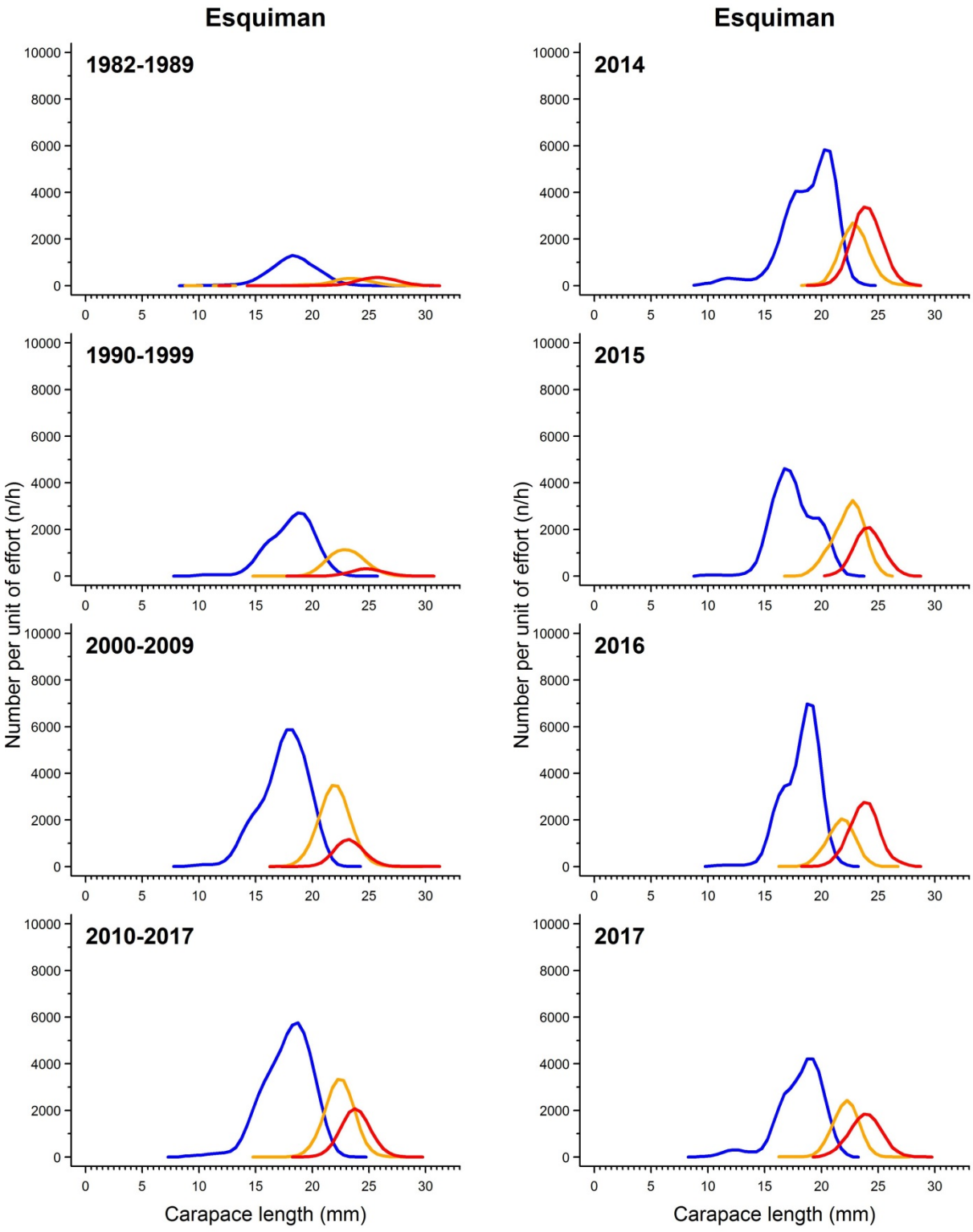

Figure 18. Continued.

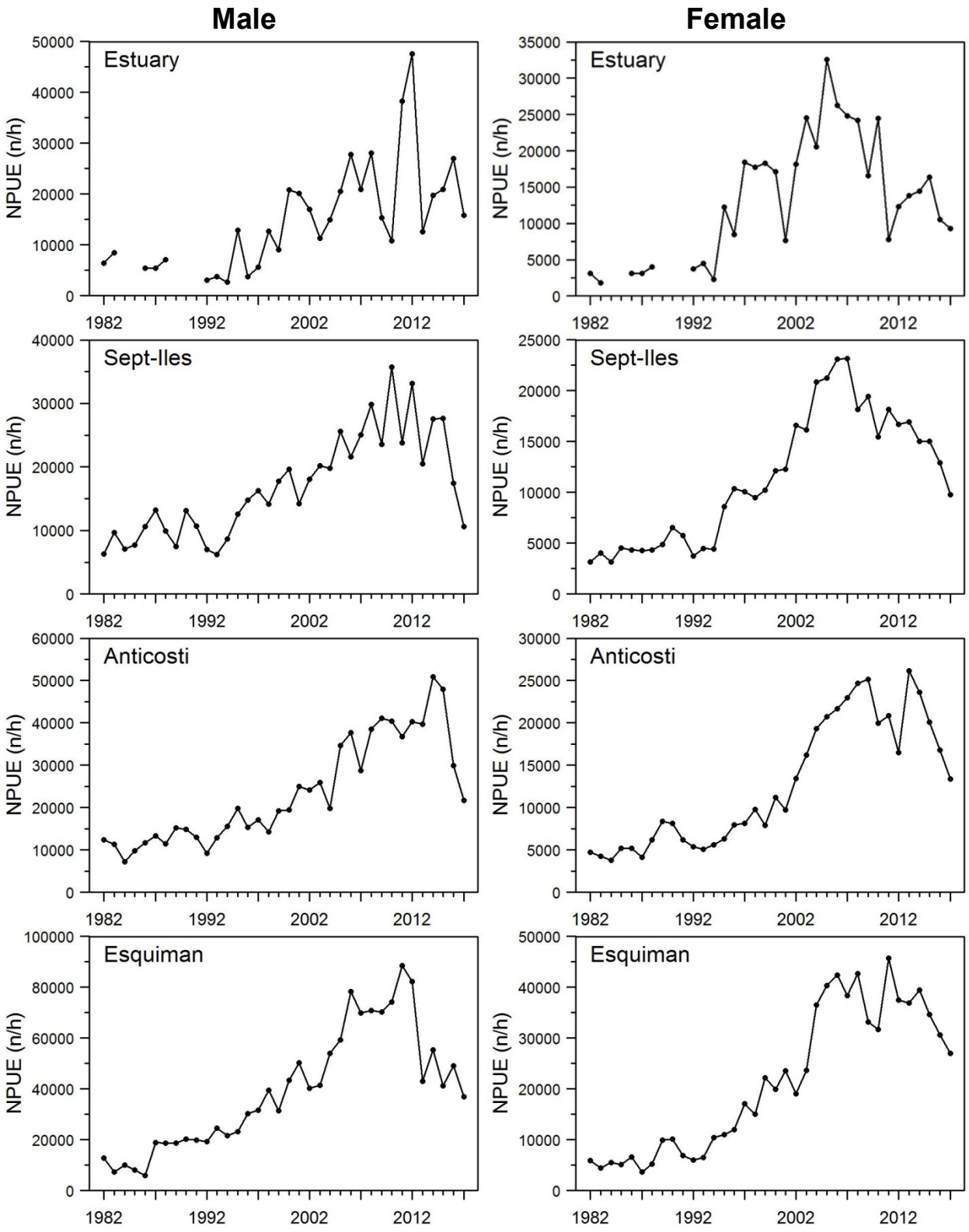

Figure 19. Number per unit of effort for the summer months (June, July and August) for the male and female shrimps, by fishing area and by year.

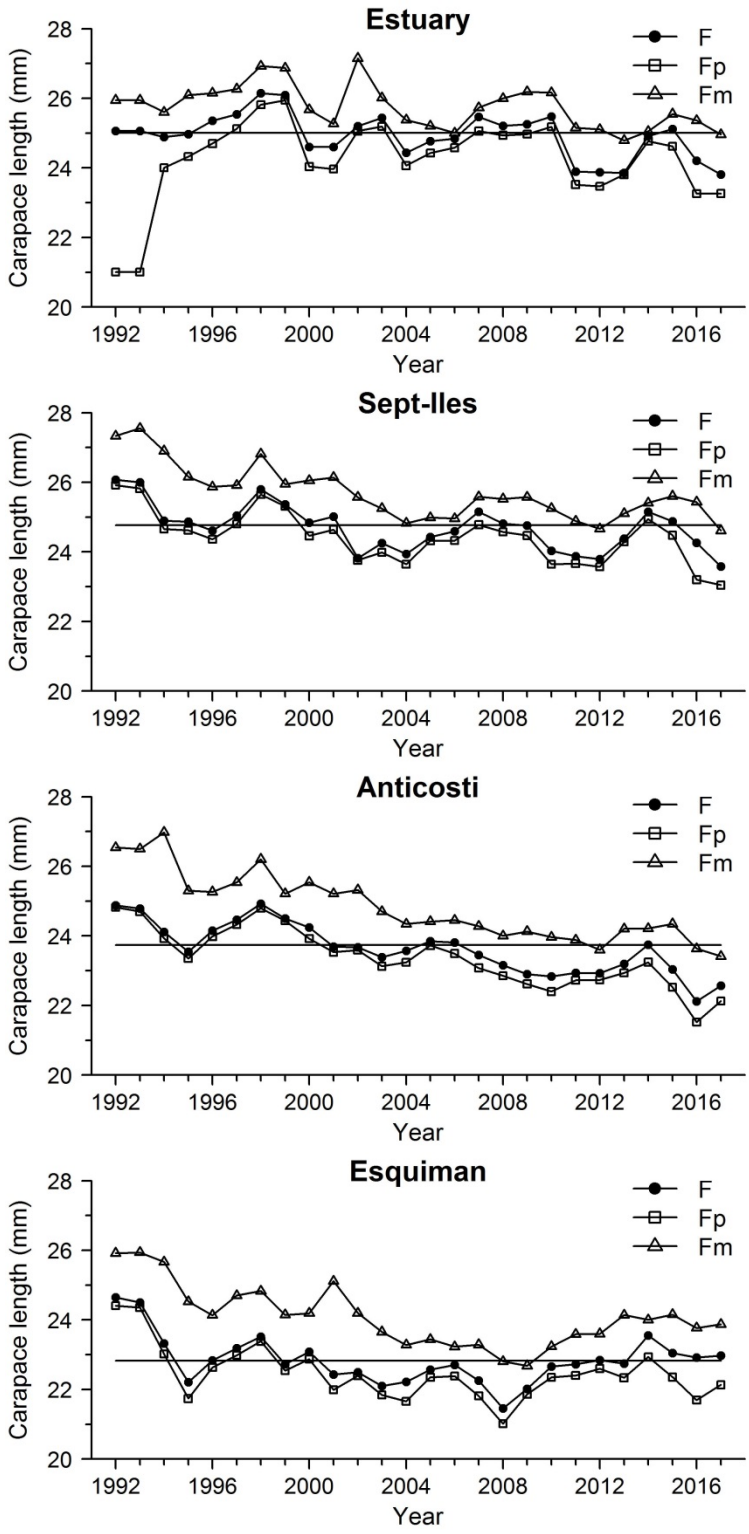

Figure 20. Average carapace length of female shrimps harvested in the summer by fishing area and year (F: female, Fp: primiparous female and Fm: female multiparous). The solid horizontal line represents the 1992-2015 mean.

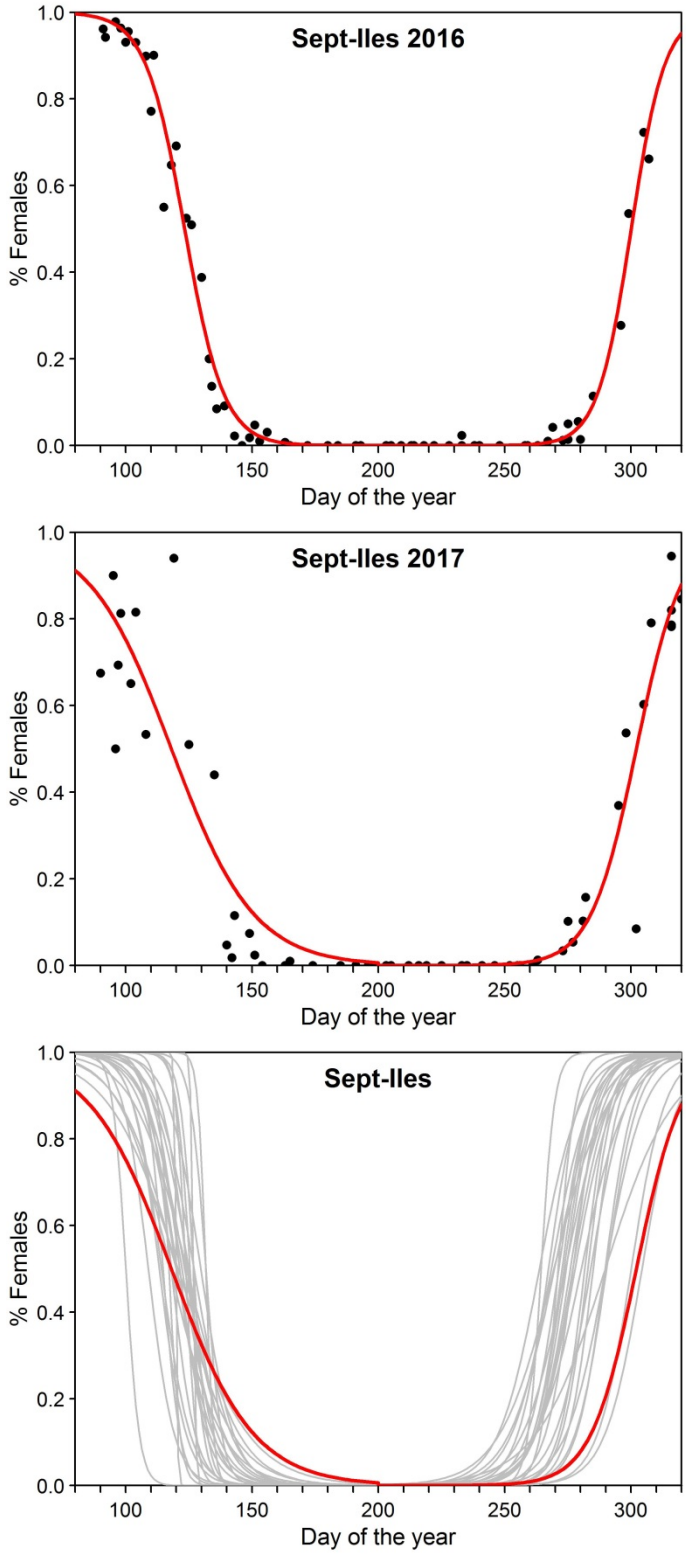

Figure 21. Proportion of egg-bearing females in the catch of females depending on the day of the year for the samples collected in 2016 and 2017 in the area of Sept-Iles. The bottom panel shows the years 1990-2016 in gray and 2017 in red.

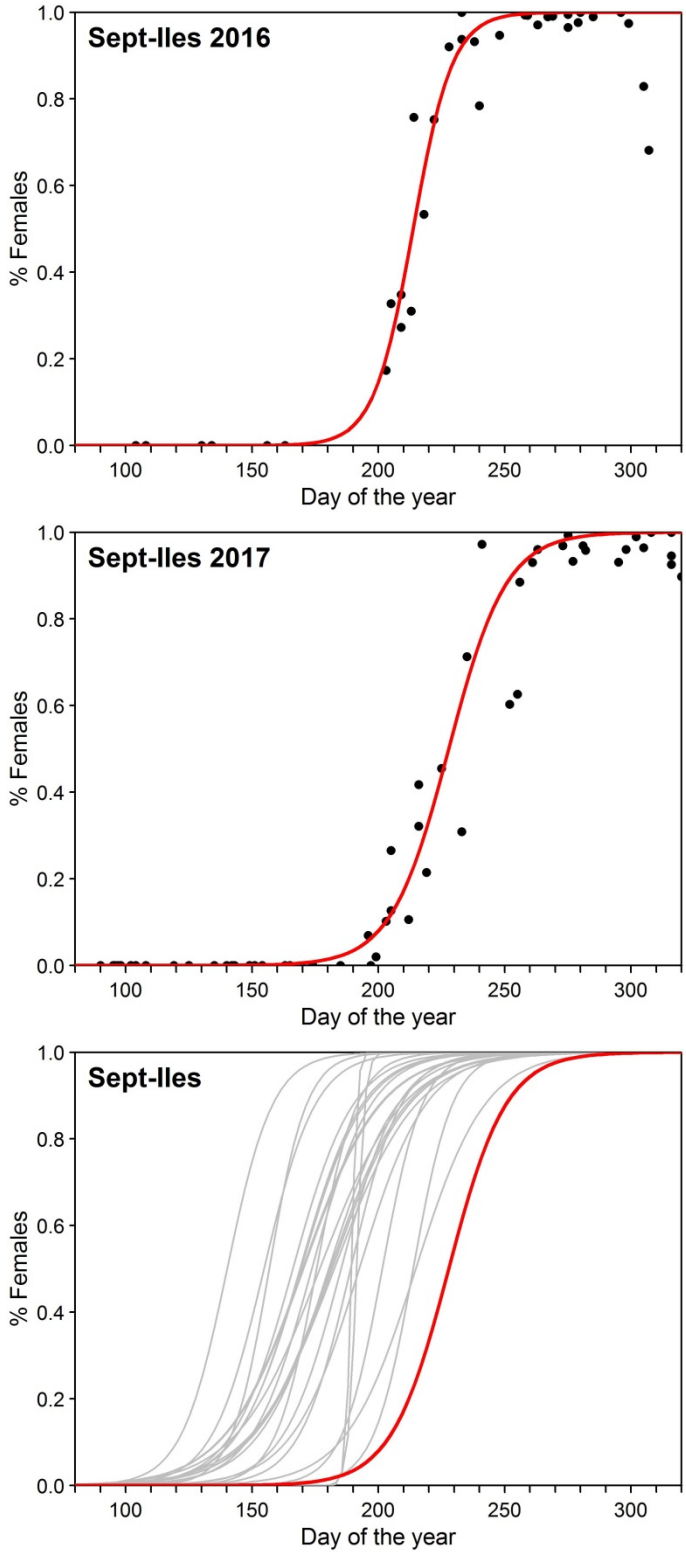

Figure 22. Proportion of females in maturation depending on the day of the year for the samples collected in 2016 and 2017 in the area of Sept-Iles. The bottom panel shows the years 1990-2016 in gray and 2017 in red.

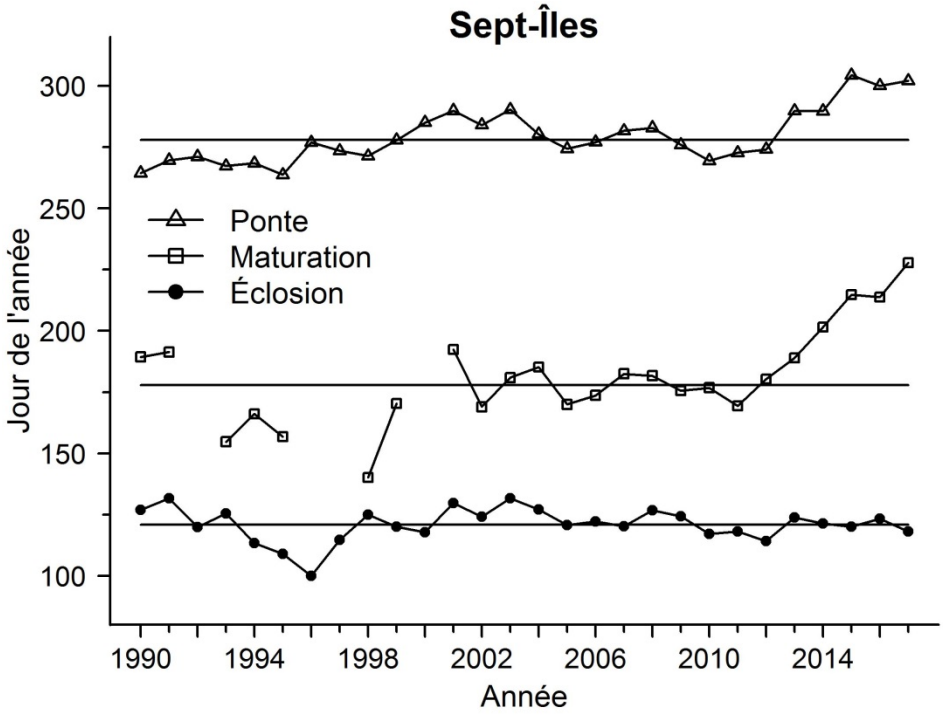

Figure 23. Days of the year where 50% of female shrimp were maturing (maturation), where 50% had spawn there eggs (spawning) and where 50% of females had released larvae (extrusion) depending on the day of the year for samples collected in the area of Sept-Iles from 1990 to 2017.

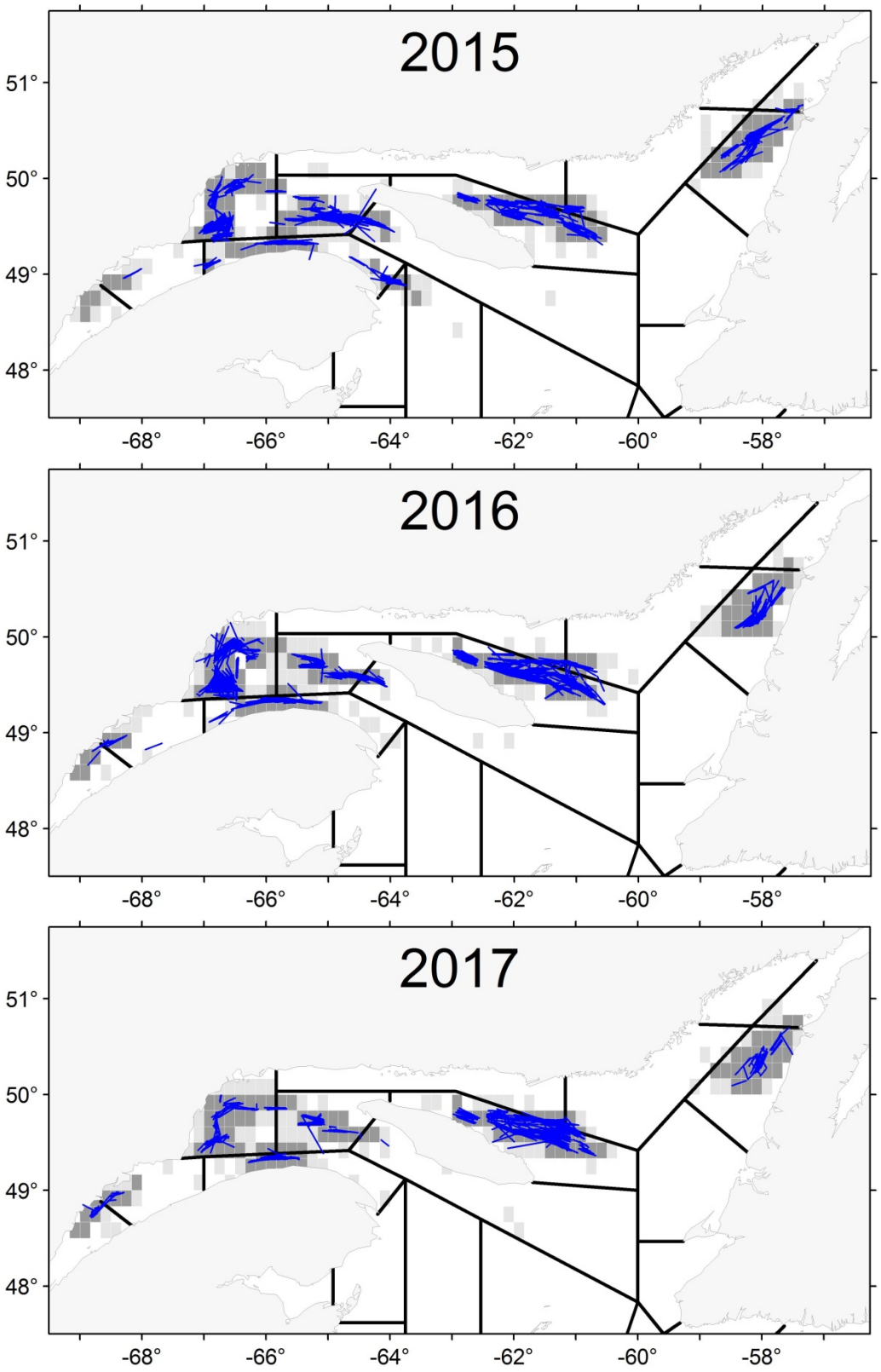

Figure 24. Geographic distribution of annual fishing effort by statistical square (gray squares: pale < 100h, dark > 100h) and fishing tows (blue lines) realised with an observer on board. The NAFO unit areas are also shown.

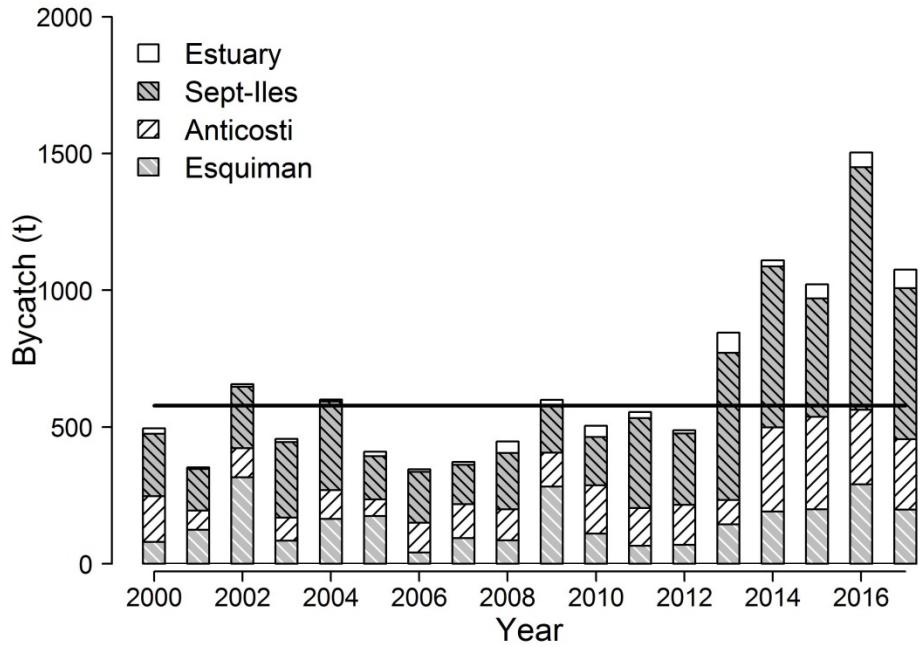

Figure 25. Bycatches for all species by year and by fishing area estimate by at-sea observers. Solid line indicates the average for the years 2000-2015.

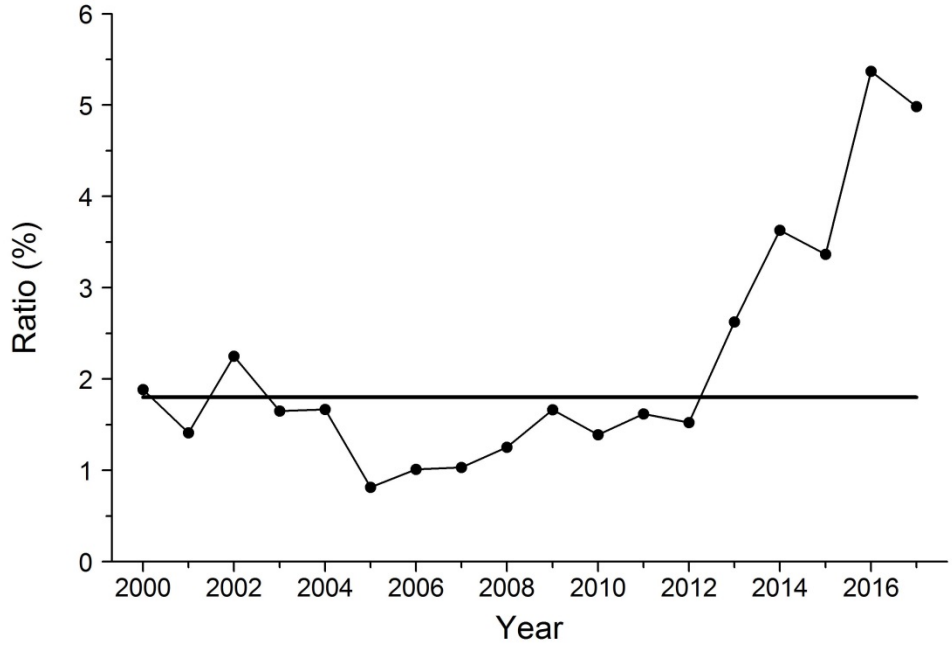

Figure 26. Ratio (%) of the bycatch of all species on the northern shrimp catch by year and by fishing area. Solid line indicates the average for the years 2000-2015.

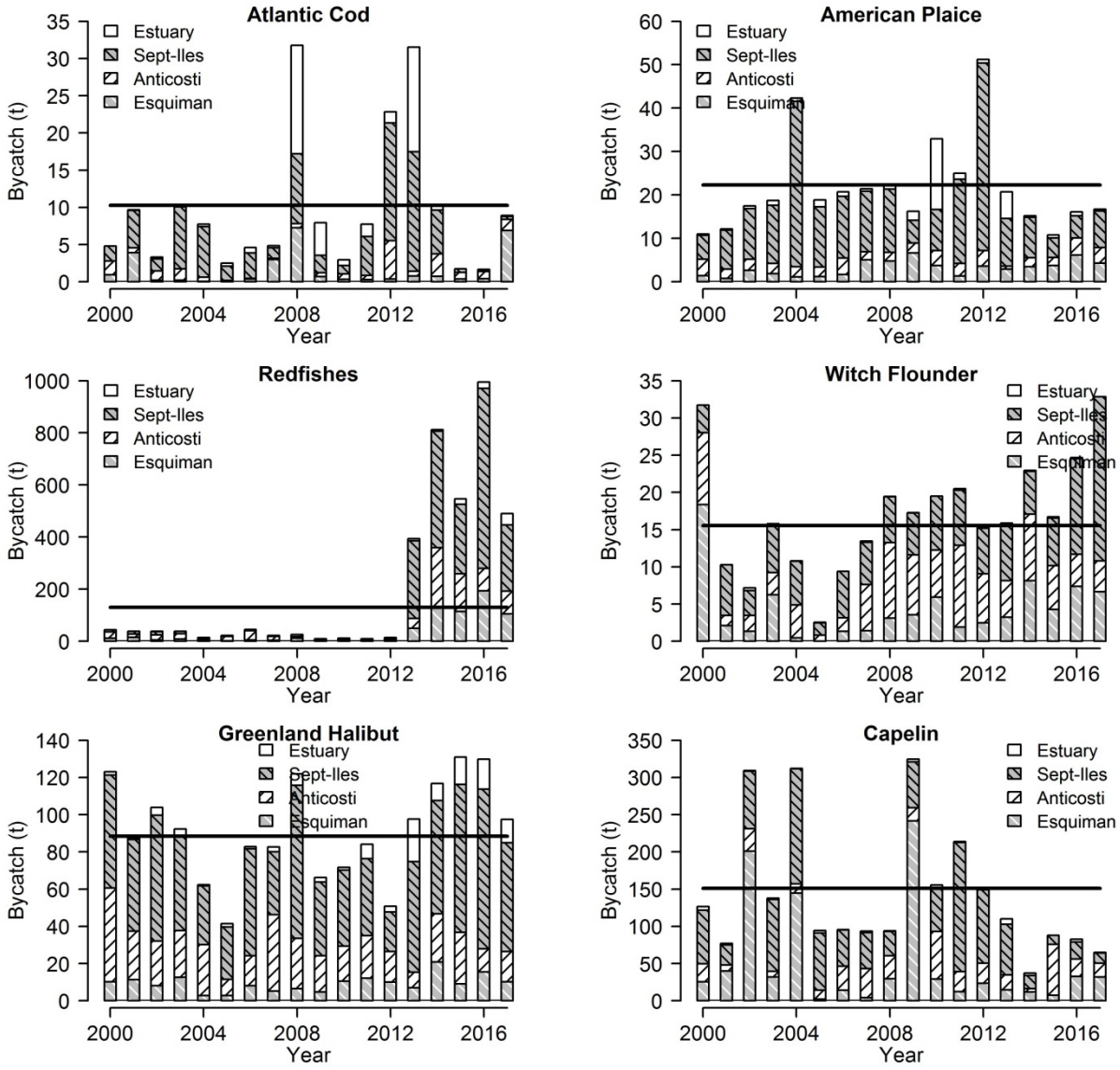

Figure 27. Bycatches by year and by fishing area estimate by at-sea observers for six species. Solid line indicates the average for the years 2000-2015.

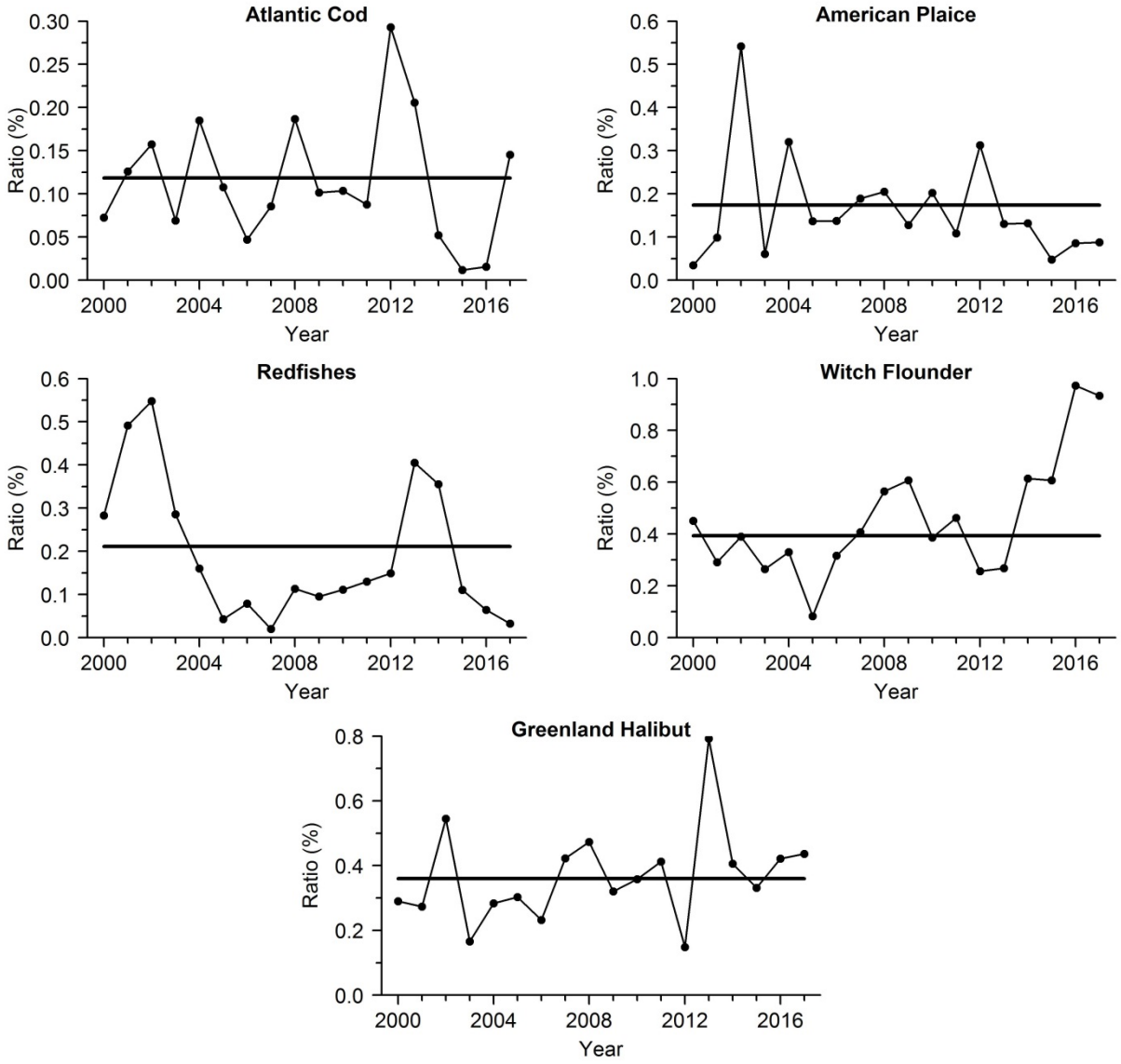

Figure 28. Ratio (%) of the bycatch on the biomass estimate from the groundfish survey in the northern Gulf of St. Lawrence for five species. Solid line indicates the average for the years 2000-2015.

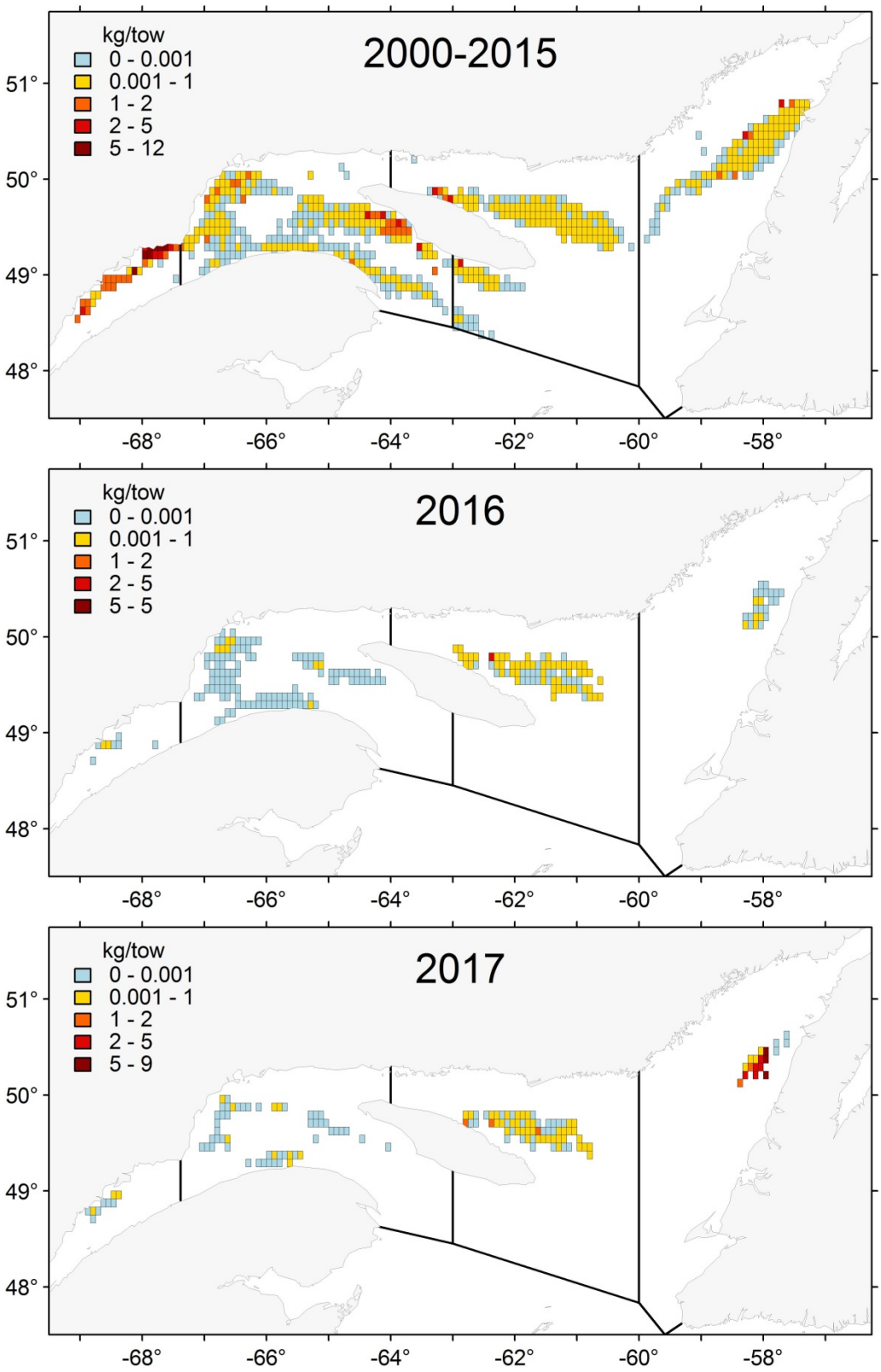

Figure 29. Geographical distribution of catches of cod per averaged by statistical squares of 5 minutes during fishing activities directed on shrimp in the presence of an at-sea observer.

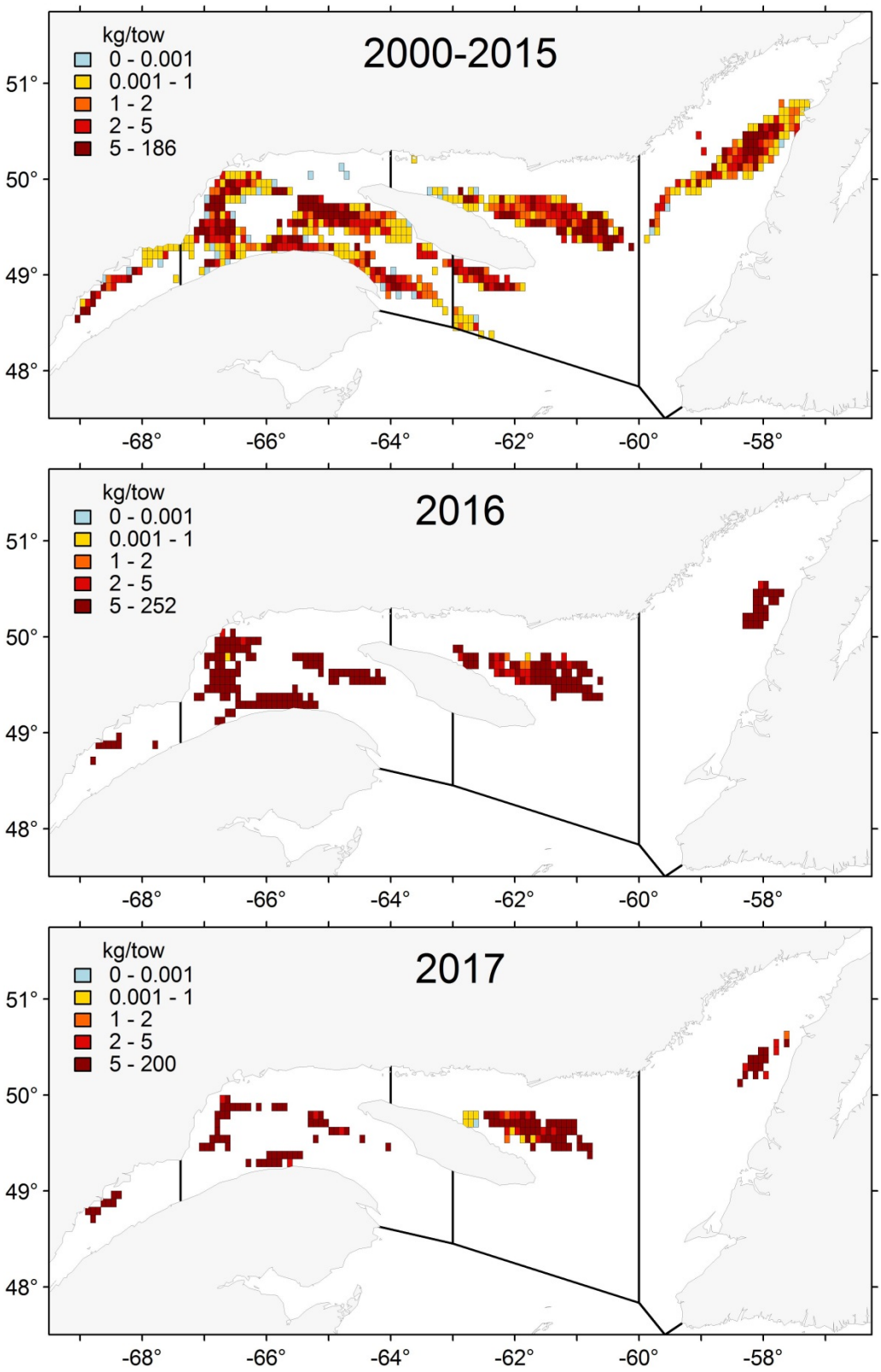

Figure 30. Geographical distribution of catches of redfish per averaged by statistical squares of 5 minutes during fishing activities directed on shrimp in the presence of an at-sea observer.

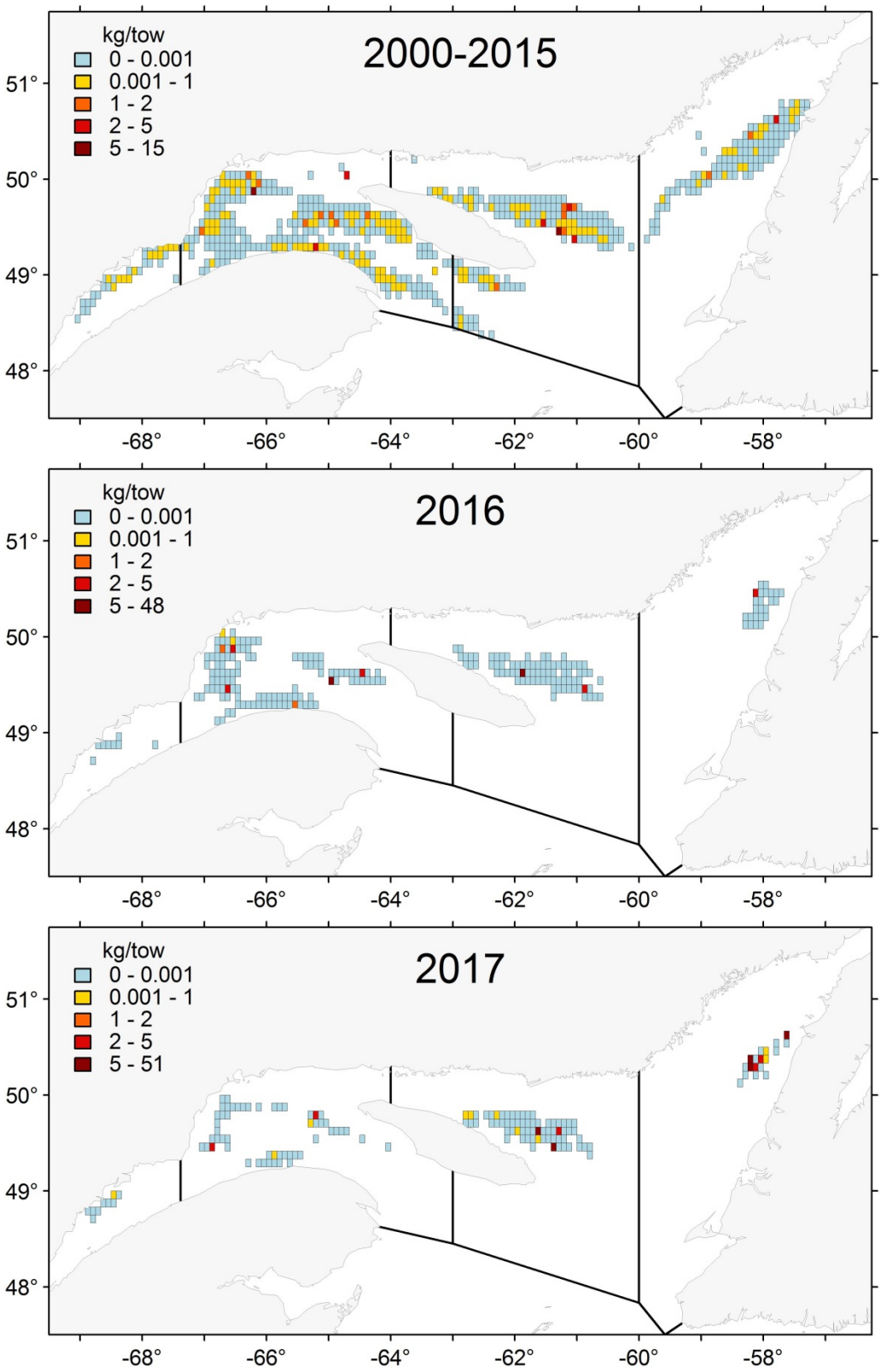

Figure 31. Geographical distribution of catches of Atlantic halibut per averaged by statistical squares of 5 minutes during fishing activities directed on shrimp in the presence of an at-sea observer.

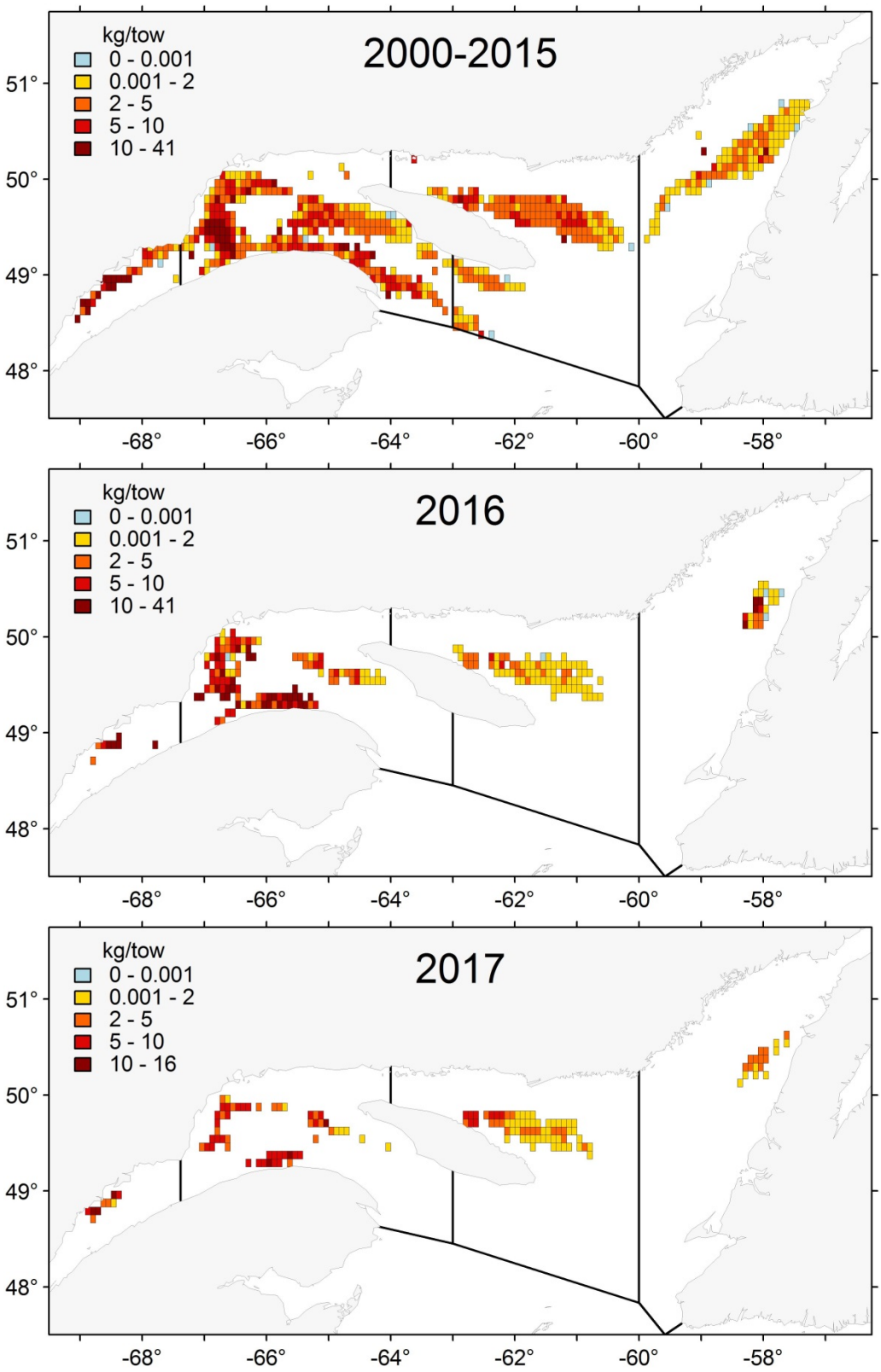

Figure 32. Geographical distribution of catches of Greenland halibut per averaged by statistical squares of 5 minutes during fishing activities directed on shrimp in the presence of an at-sea observer.

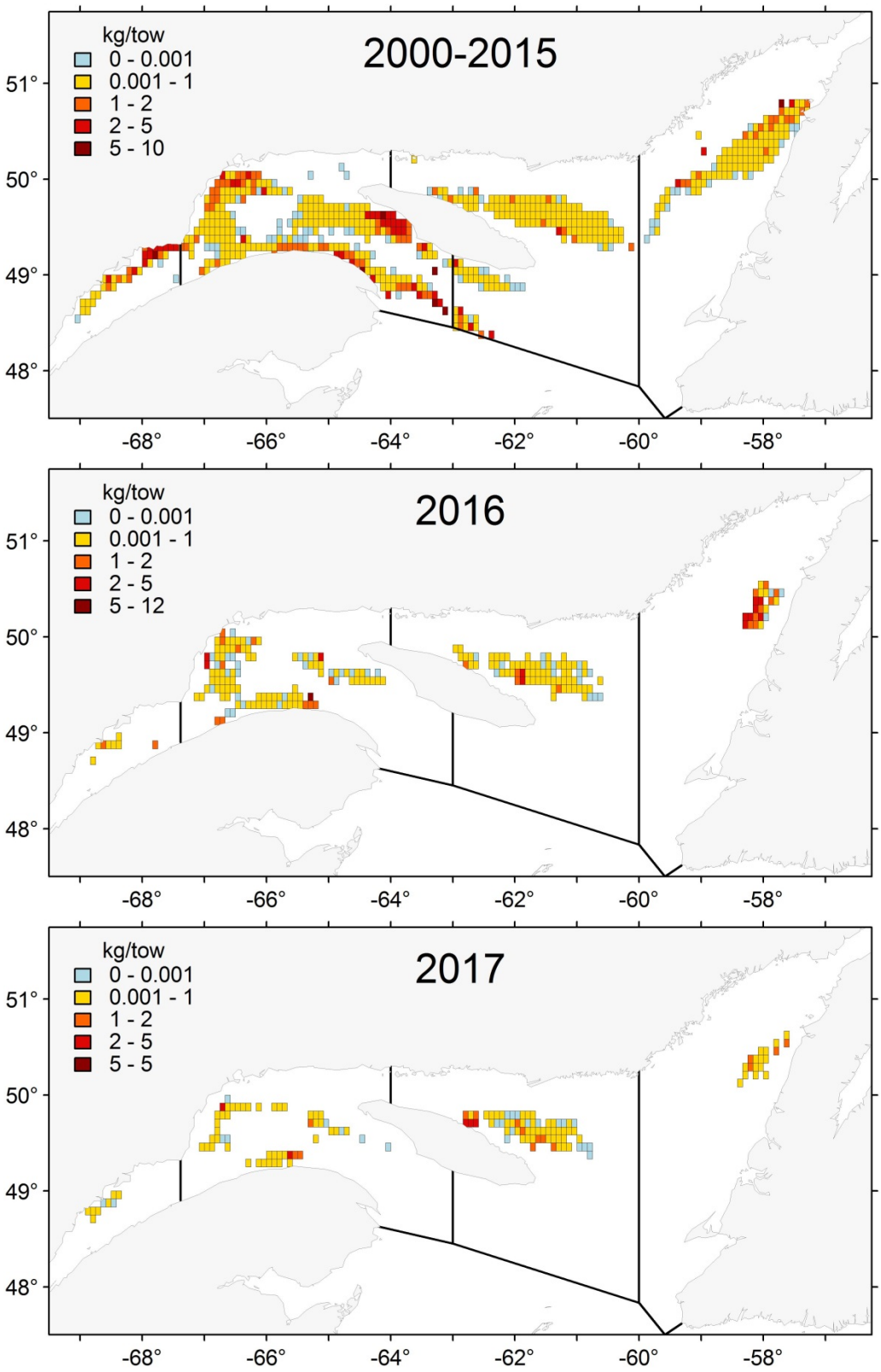

Figure 33. Geographical distribution of catches of American plaice per averaged by statistical squares of 5 minutes during fishing activities directed on shrimp in the presence of an at-sea observer.

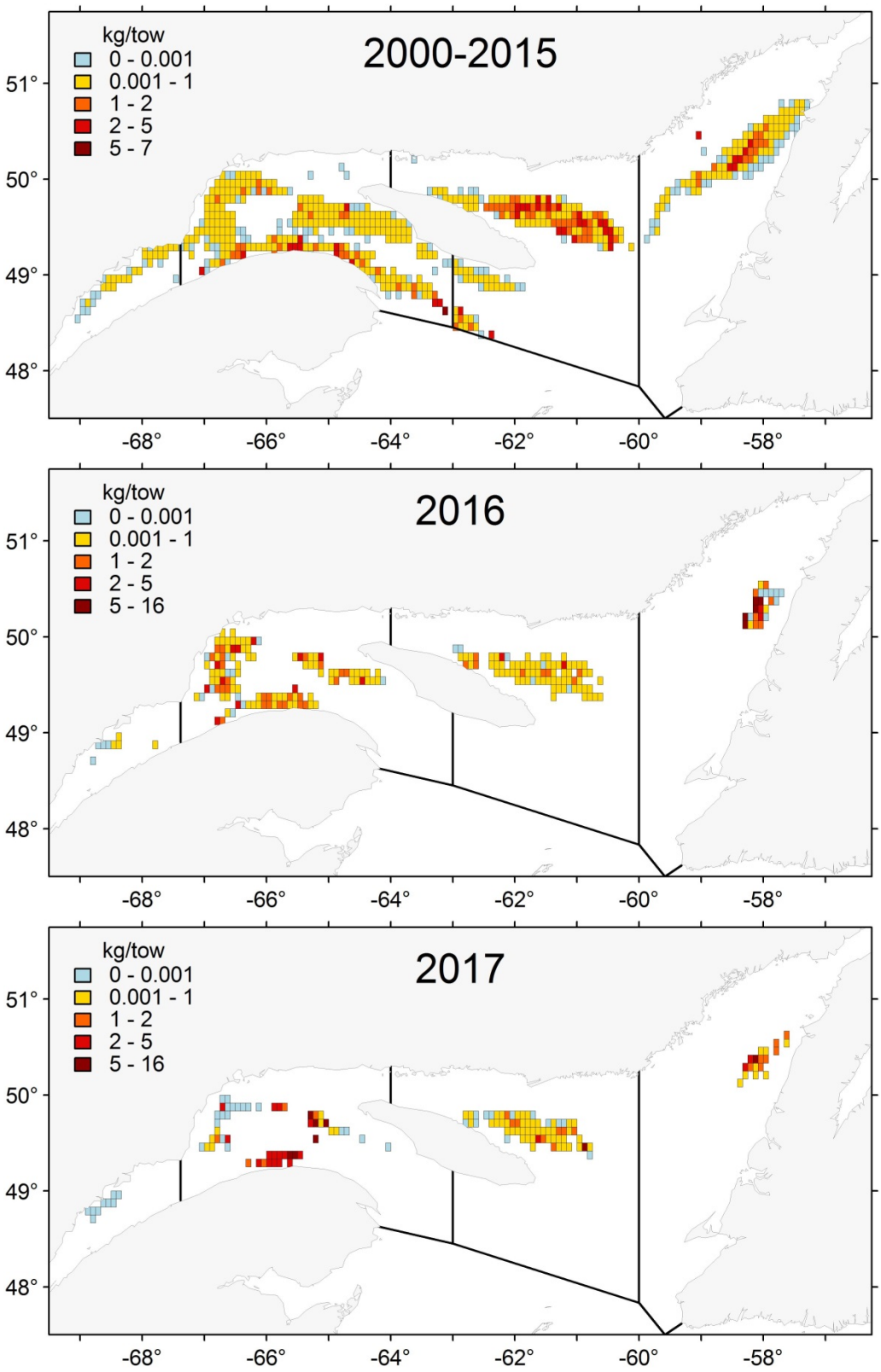

Figure 34. Geographical distribution of catches of witch flounder per averaged by statistical squares of 5 minutes during fishing activities directed on shrimp in the presence of an at-sea observer.

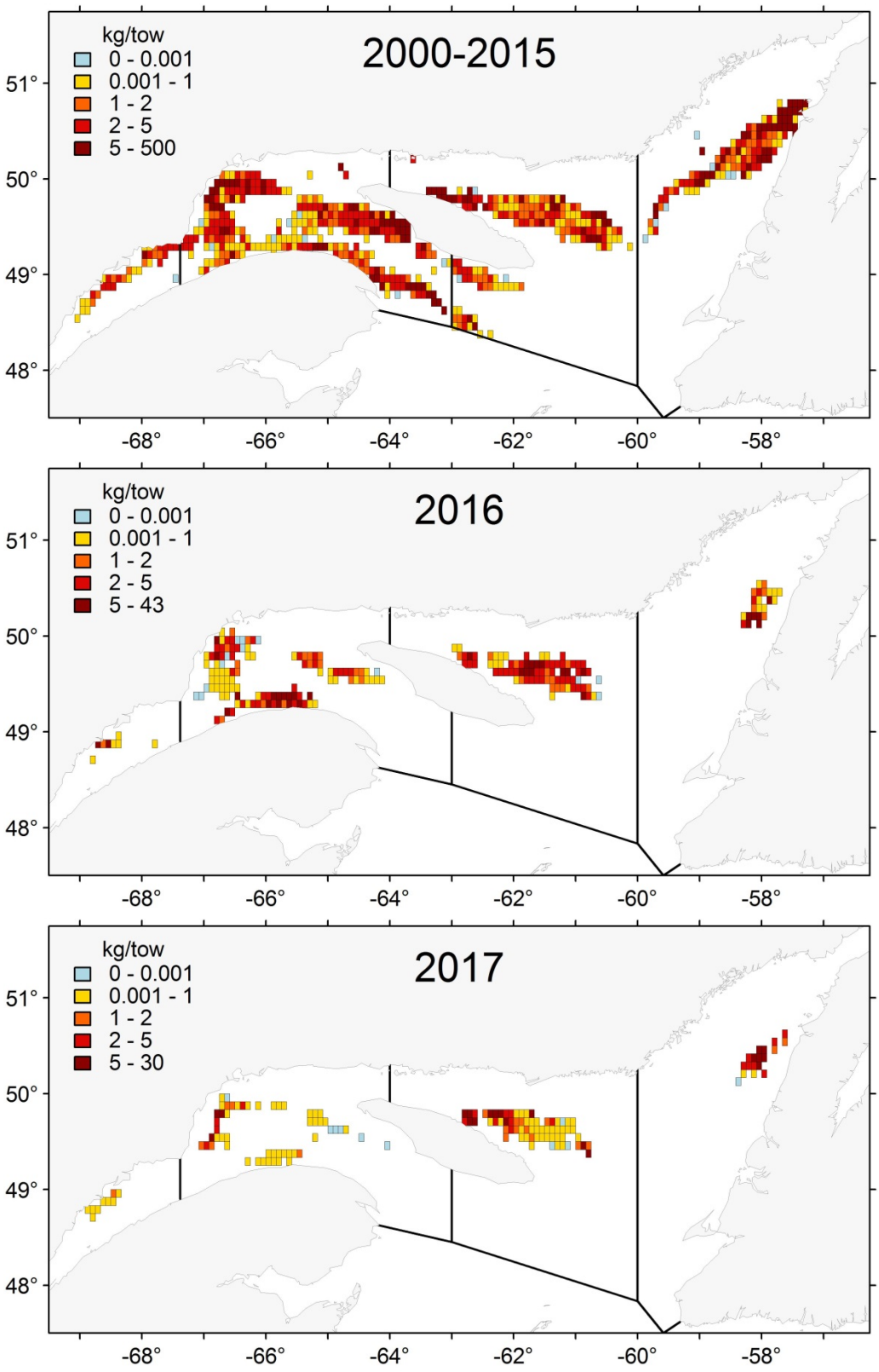

Figure 35. Geographical distribution of catches of capelin per averaged by statistical squares of 5 minutes during fishing activities directed on shrimp in the presence of an at-sea observer.

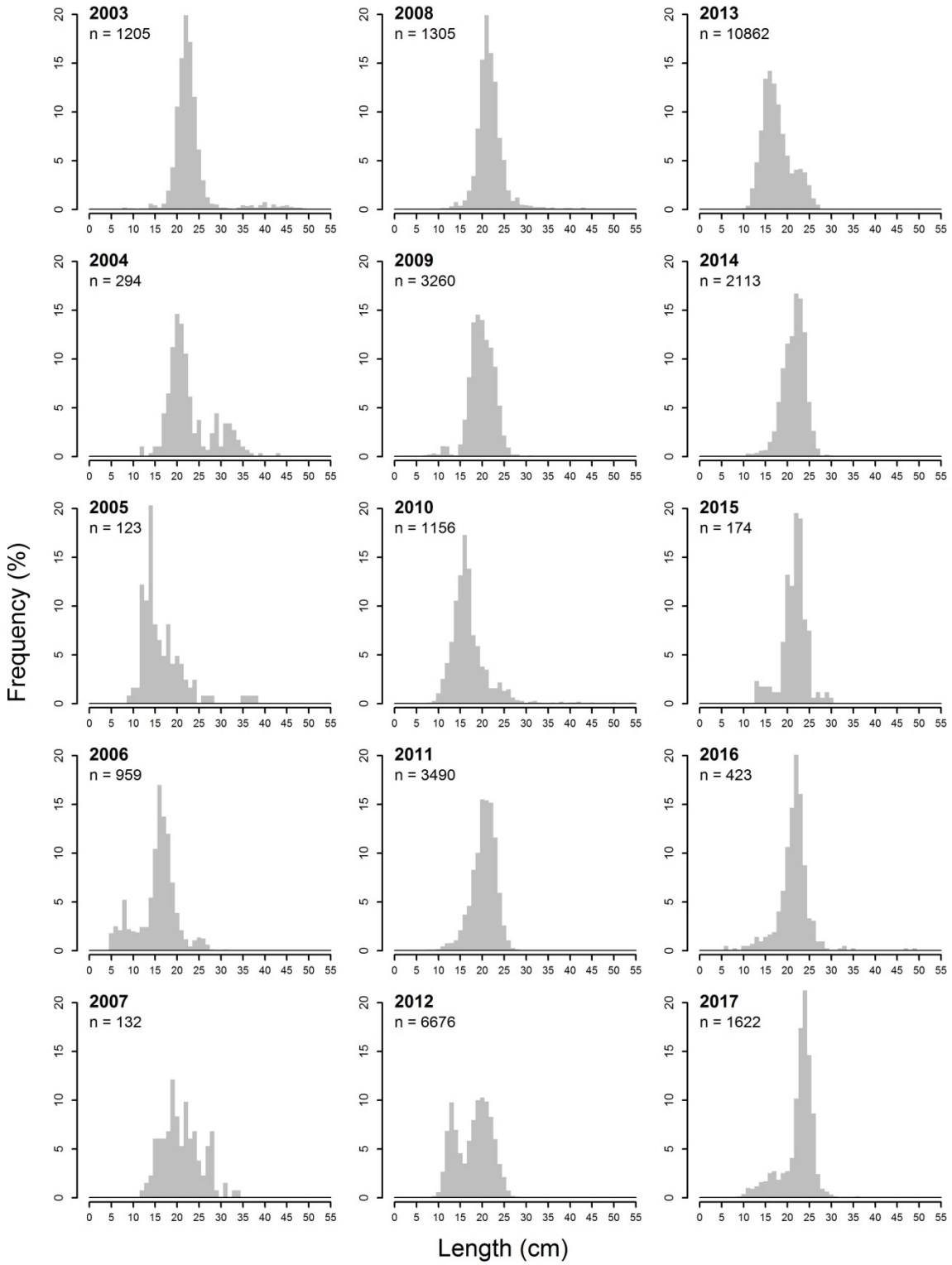

Figure 36. Atlantic cod length frequency distributions sampled by at-sea observers from 2003 to 2017. The number (n) of specimens that were measured is shown.

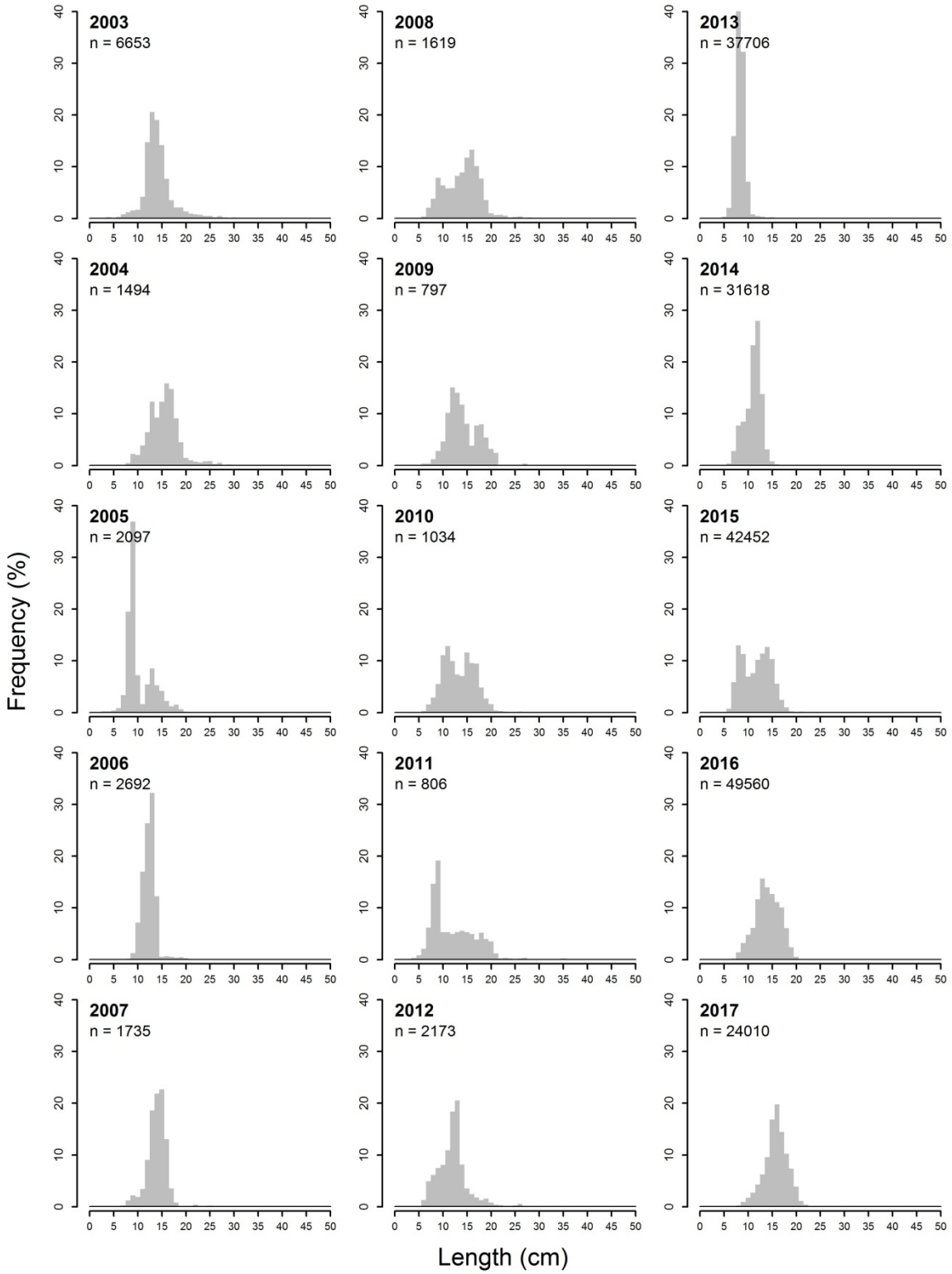

Figure 37. Redfish length frequency distributions sampled by at-sea observers from 2003 to 2017. The number (n) of specimens that were measured is shown.

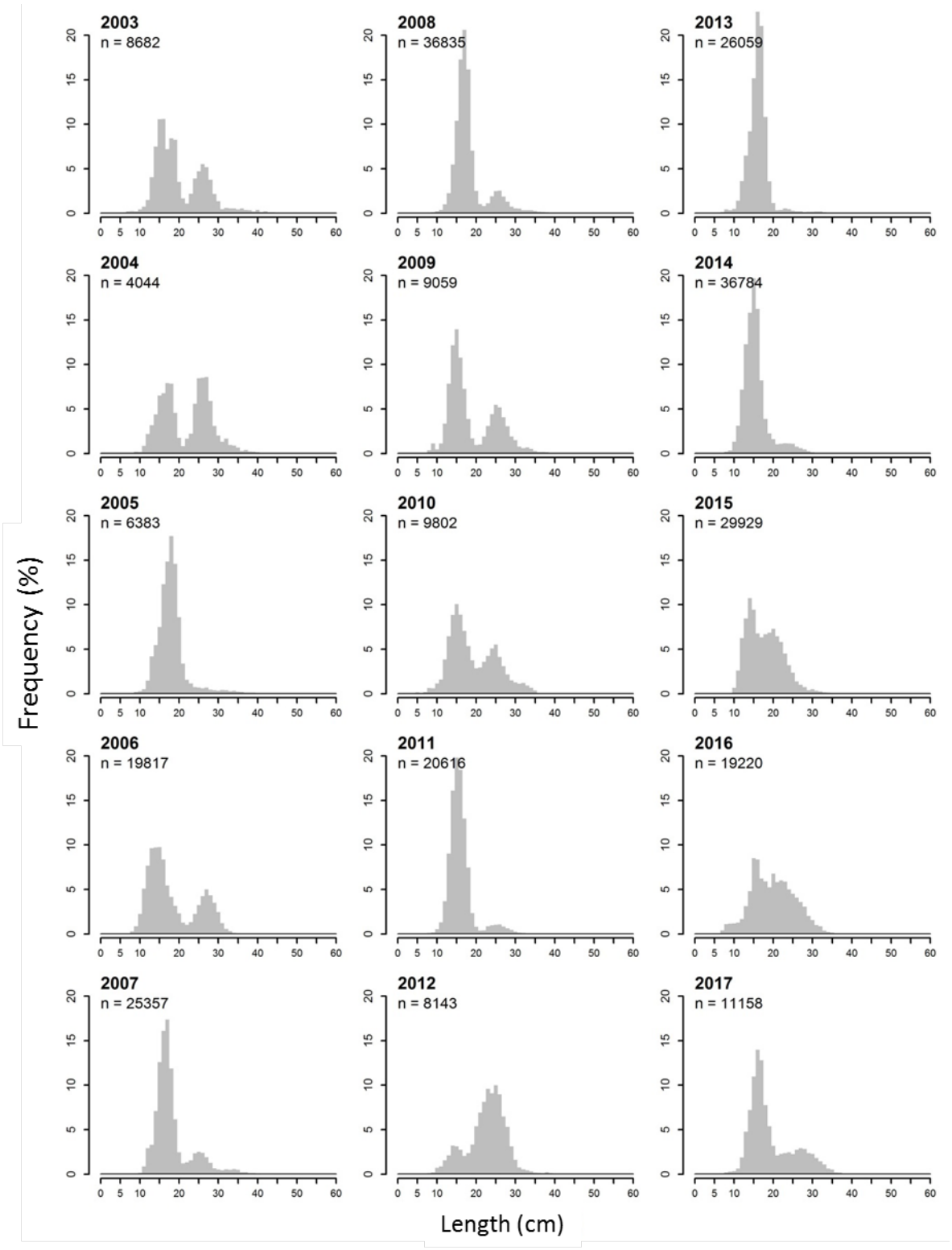

Figure 38. Atlantic halibut length frequency distributions sampled by at-sea observers from 2003 to 2017. The number (n) of specimens that were measured is shown.

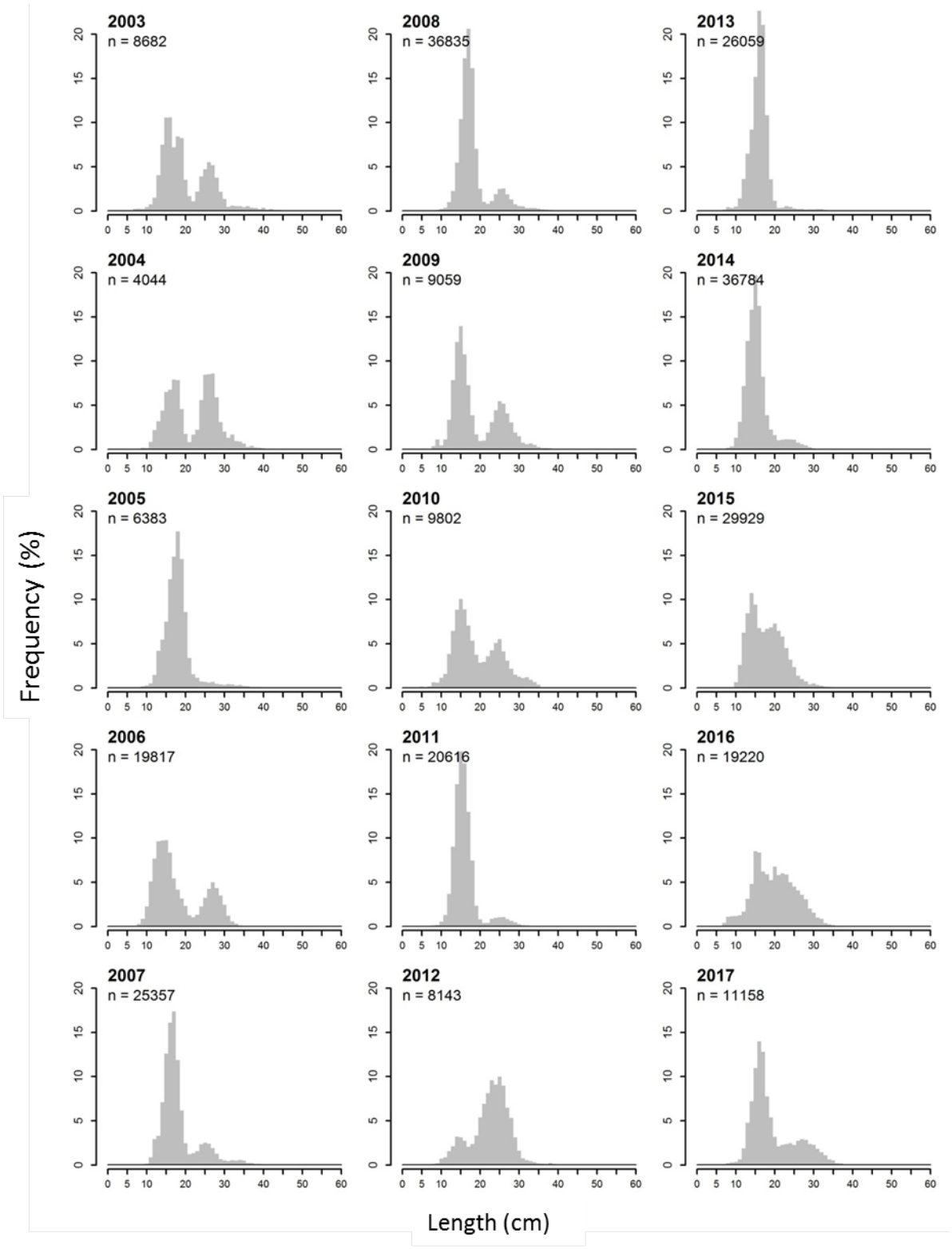

Figure 39. Greenland halibut length frequency distributions sampled by at-sea observers from 2003 to 2017. The number (n) of specimens that were measured is shown.

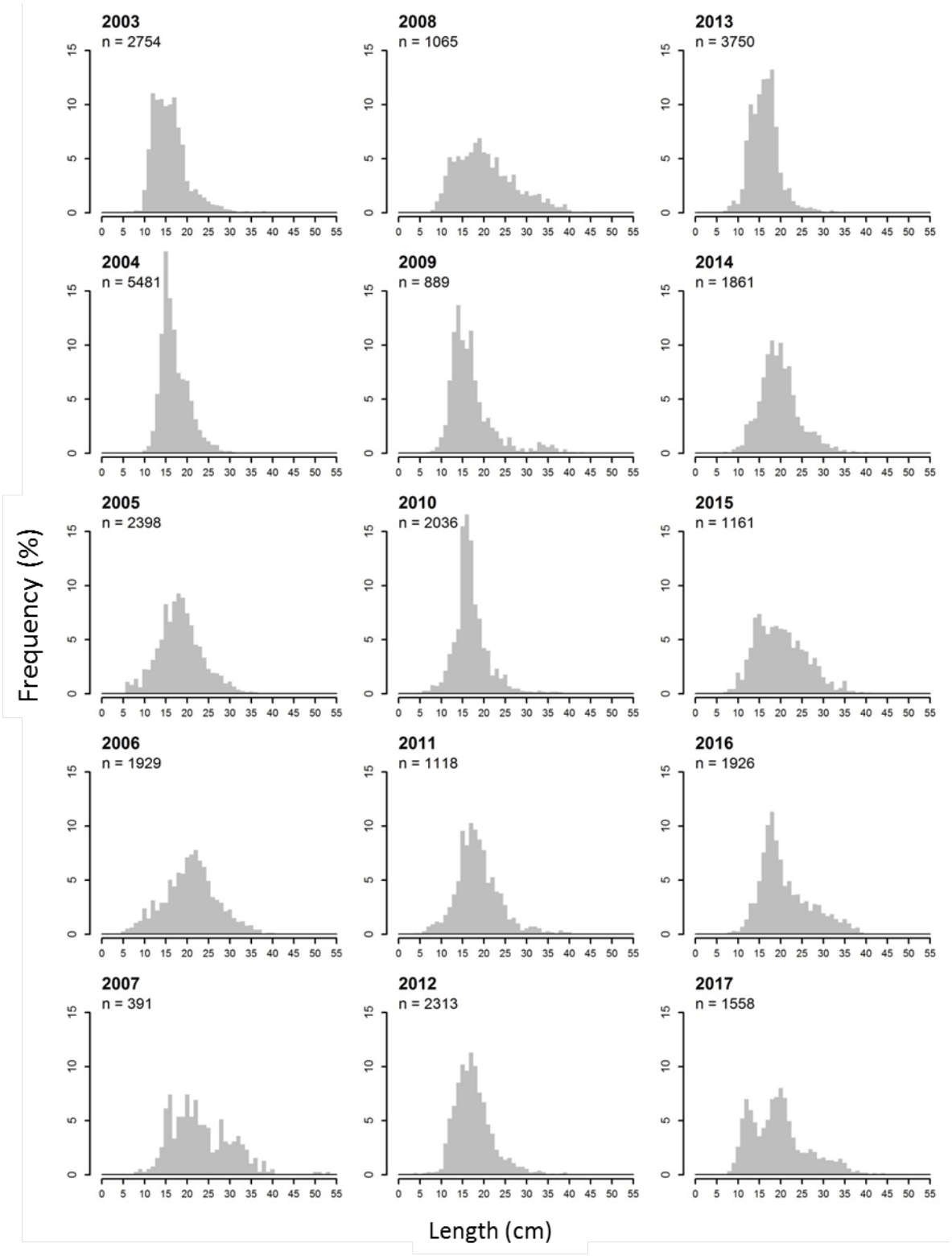

Figure 40. American plaice length frequency distributions sampled by at-sea observers from 2003 to 2017. The number (n) of specimens that were measured is shown.

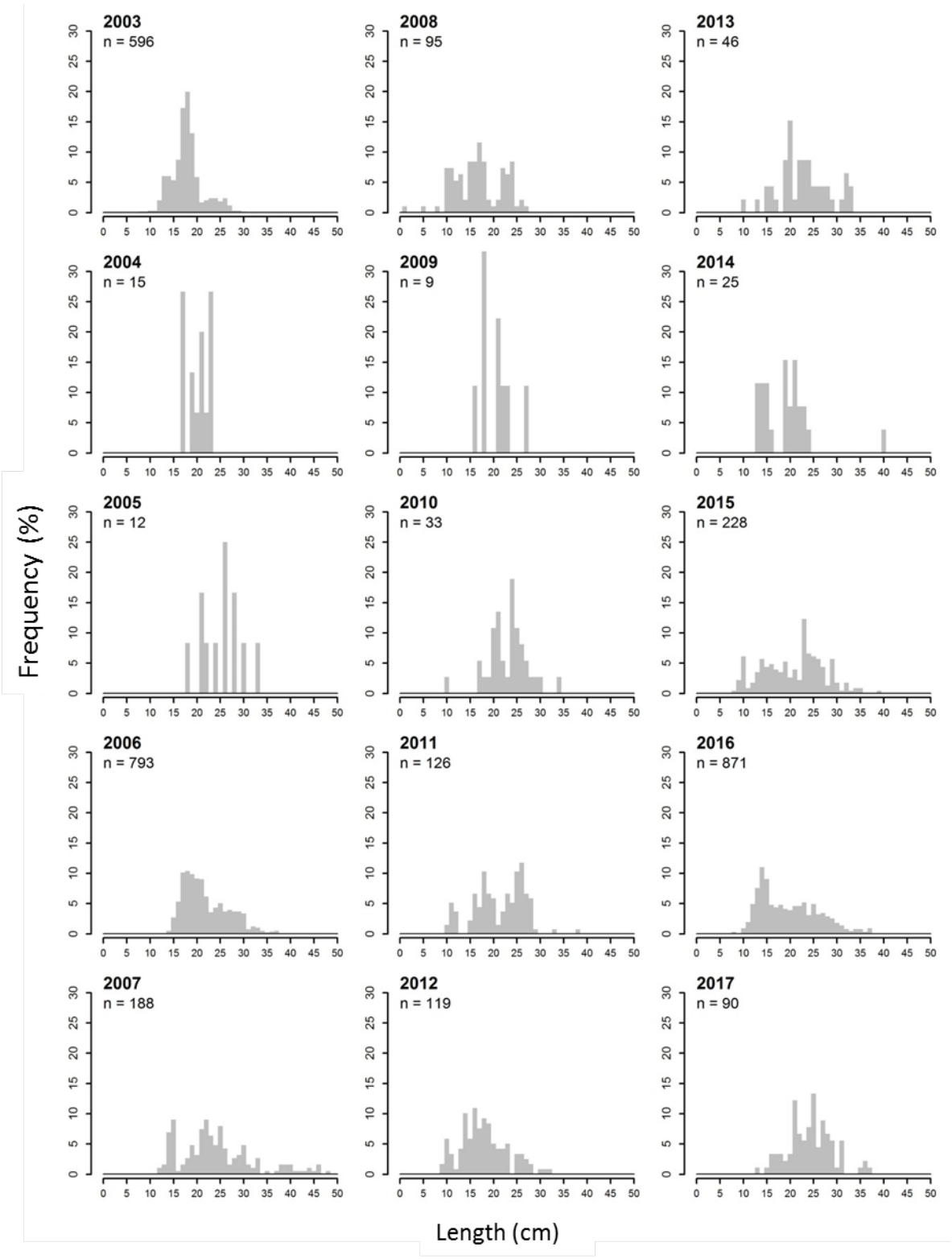

Figure 41. Witch flounder length frequency distributions sampled by at-sea observers from 2003 to 2017. The number (n) of specimens that were measured is shown.