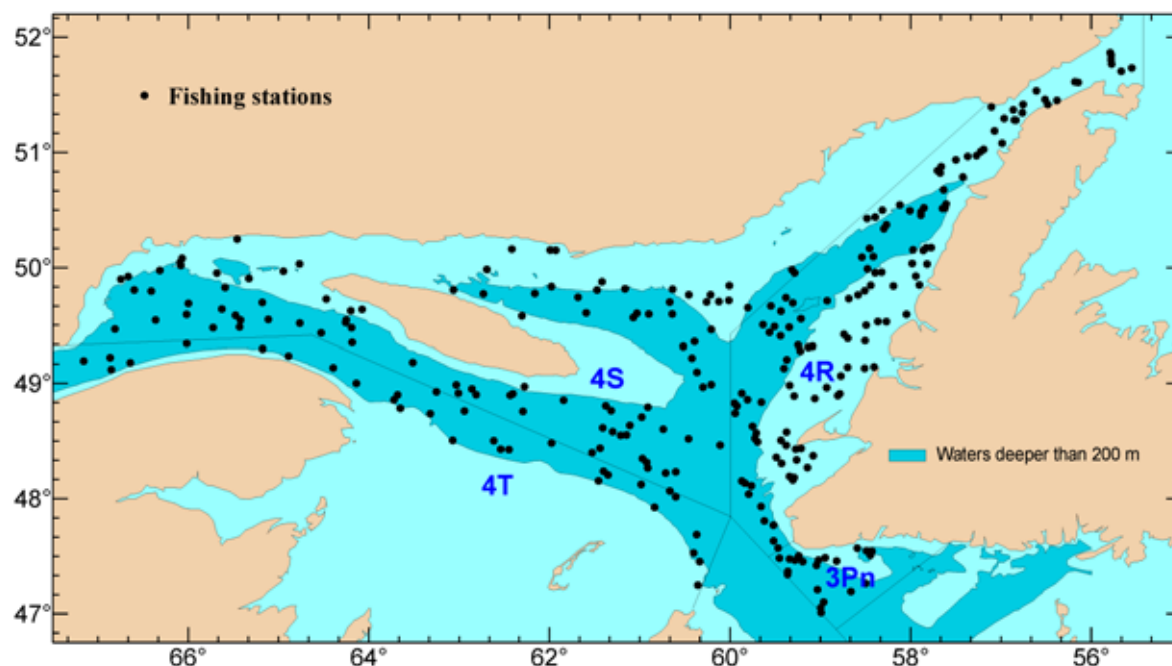


5.8.1.4 Sentinel Fisheries (Attachment C)

The mobile gear Sentinel Fisheries Program (St. Lawrence Global Observatory 2010) follows a depth-stratified random survey plan. The northern Gulf is divided into depth strata because depth is known to have an influence on the distribution of fish and invertebrate species. The mobile survey generally consists of 300 stations randomly selected within those strata with all strata sampled, because results from this survey are used for multiple species with different depth preferences (Figure 5.63).



Source: St. Lawrence Global Observatory 2010

Figure 5.63 Distribution of Stratified Random Tows Performed during the July 2010 Survey

Nine trawlers, five from Newfoundland and Labrador and four from Quebec, conduct the survey. At each pre-determined station, the vessel performs a standard 30 minutes tow at 2.5 knots. The boats participating in the survey use a 300 star balloon trawl mounted on a rock hopper footgear. The trawl mesh size is 145 mm, with a liner of 40 mm in the codend.

The 16th annual July sentinel survey was conducted in the northern Gulf between June 30 and July 19, 2010. A total of 280 fishing stations were successfully carried out (Figure 5.63), including 21 stations in 3Pn, 129 in 4R (including 10 tows in the 10 to 20 fathoms strata), 100 in 4S and 30 in 4T; this represented 93 percent of the sampling target.

Data collected per set of information included length, weight, sex and maturity for a certain number of fish for each species. In addition, samples of otoliths, liver, gonads and stomach may also be collected. Fish samples are also collected and frozen for diverse studies. Finally, water temperature and fishing depth data are collected using a Vemco sensor installed on the trawl.

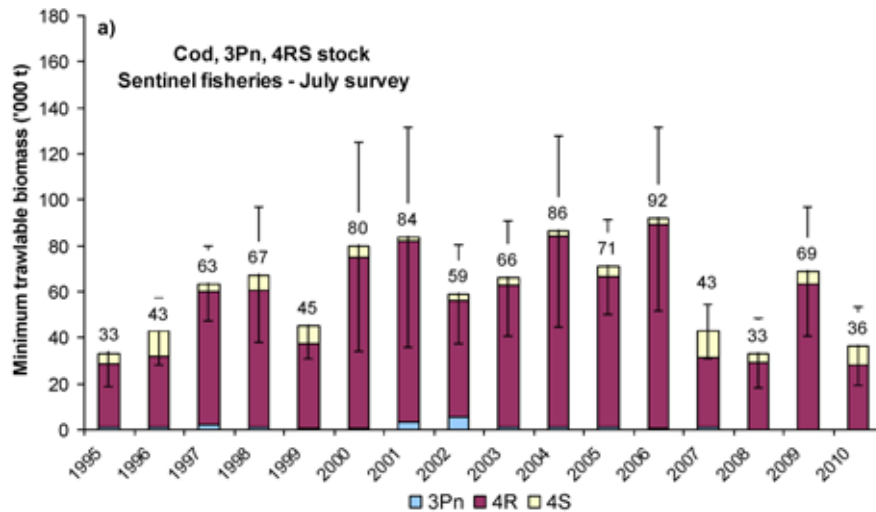
Cod, redfish, Greenland halibut (turbot) and Atlantic halibut catches for the 280 successful tows of the 2010 July survey are presented in Table 5.24. In 2010, American plaice, thorny skate and shorthorn sculpin were the other main fish caught.

Table 5.24 Cod, Redfish, Greenland Halibut and Atlantic Halibut Catches for the July 1995 to 2010 Surveys (3Pn, 4RST)

Year	Sets Survey	Survey Catches (kg)				Sets Total	Total Catches (kg)				
		Cod	Redfish	Turbot	Halibut		Cod	Redfish	Turbot	Halibut	Other
1995	311	6,477	11,457	649	84	326	6,598	11,662	675	84	4,716
1996	272	7,254	16,921	1,300	114	332	12,108	27,169	1,502	150	8,593
1997	285	8,642	12,358	1,206	27	313	11,271	13,582	1,397	80	5,848
1998	289	7,719	16,154	1,472	17	320	12,196	36,231	1,668	113	7,198
1999	294	5,487	12,623	1,703	42	335	19,396	17,177	2,079	129	4,031
2000	291	7,893	7,574	1,583	97	324	16,963	10,486	1,932	126	5,454
2001	275	10,238	7,603	1,342	120	317	16,476	14,421	1,814	208	4,194
2002	261	7,729	8,101	1,486	113	293	18,551	8,849	3,090	160	4,155
2003	296	13,741	6,400	1,693	44	326	14,040	6,616	3,512	72	3,590
2004	280	14,072	8,245	2,015	216	317	15,655	13,295	2,567	271	6,670
2005	285	9,662	6,785	2,977	226	303	10,023	7,802	3,649	402	8,652
2006	295	13,174	5,106	2,748	335	325	15,332	5,963	3,624	577	6,647
2007 ^A	291	6,431	6,797	2,976	382	297	6,435	6,836	2,977	399	3,905
2008 ^A	289	9,931	4,310	2,594	456	293	9,931	4,341	2,604	456	2,743
2009 ^A	282	8,939	3,605	1,701	521	285	8,940	3,605	1,716	521	3,921
2010 ^A	280	7,137	4,059	1,935	395	284	7,137	4,059	1,965	395	2,689
Source: St. Lawrence Global Observatory 2010											
A No discretionary tows.											

Cod

The July sentinel survey series for water deeper than 20 fathoms (1 fathom = 1.8 m) (1995 to 2009) suggests an increase in the minimum trawlable biomass for cod between 1995 and 2001, followed by stable period up to 2006 (Figure 5.64). Substantial decreases were observed in 2007 and 2008, followed by an increase in 2009. The estimate of 36,478 tons in 2010 is a marked decrease, bringing the index level close to the lowest values observed in the series (33,000 tons in 1995 and 2008).

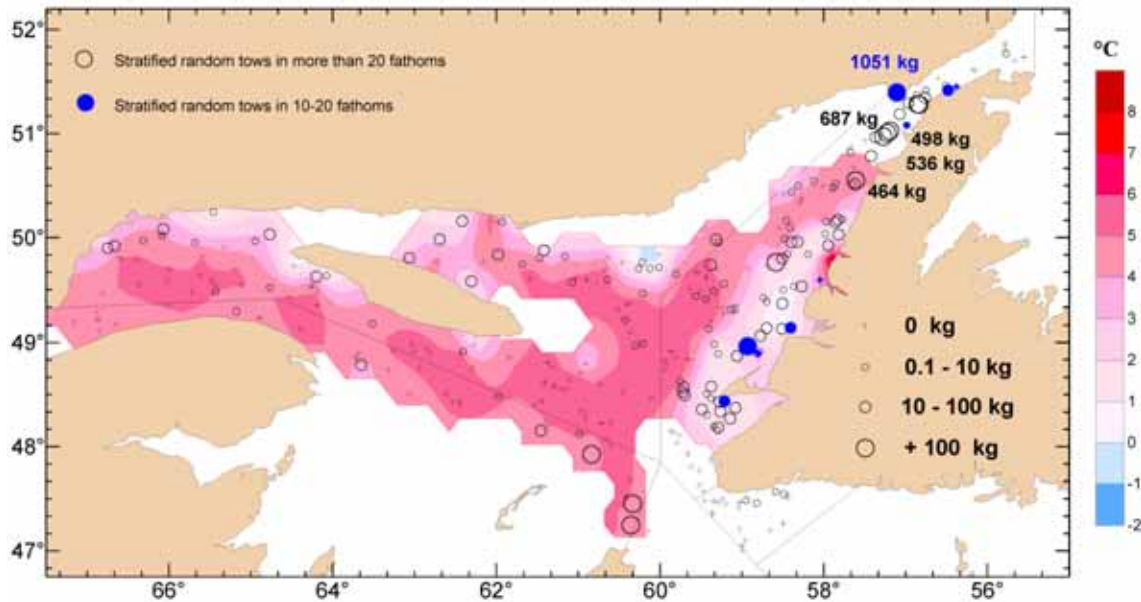


Source: St. Lawrence Global Observatory 2010

Figure 5.64 Minimum Trawlable Biomass Index for Cod (July sentinel mobile survey in Subdivision 3Pn and Divisions 4RS (1995 to 2010))

Three inshore strata with depths ranging from 10 to 20 fathoms were added in 2003 for 4R. These strata were added to examine cod outside the zone previously sampled by trawlers in the July mobile gear sentinel survey. Ten tows were done in these strata by four trawlers during the July 2010 survey. The cod catches varied between 0 and 1,051 kg for a 30-minute standard tow. Six of the ten tows reached the 30-minute duration, while the other four lasted less than 30 minutes because of bad bottom (trawl hooked at the bottom). The global biomass index (including the 10 to 20 fathoms strata) is 45,323 tons for 2010; this value is the lowest observed since sampling began in 2003.

The catch distribution shows that cod is located primarily in 4R along the west coast of Newfoundland (Figure 5.65). In 2010, the cod concentration remains low in 4S and 3Pn. Of the 280 tows performed as part of this survey in 2010, five had catches of cod of more than 400 kg and they were all located in 4R. Only one large catch occurred in the 10- to 20-fathom strata. The largest catches for 4S and 3Pn were 61 and 3 kg, respectively.



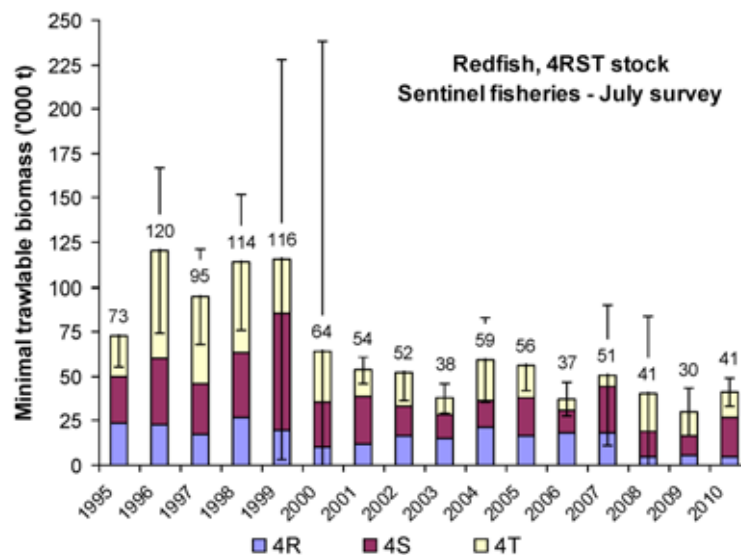
Source: St. Lawrence Global Observatory 2010

Note: Catches greater than 400 kg are noted on map.

**Figure 5.65 Bottom Temperature and Observed Catch Rate (kg/standard tow)
Distribution of Cod for the July 2010 Stratified Random Survey in 3Pn and 4RST**

Redfish

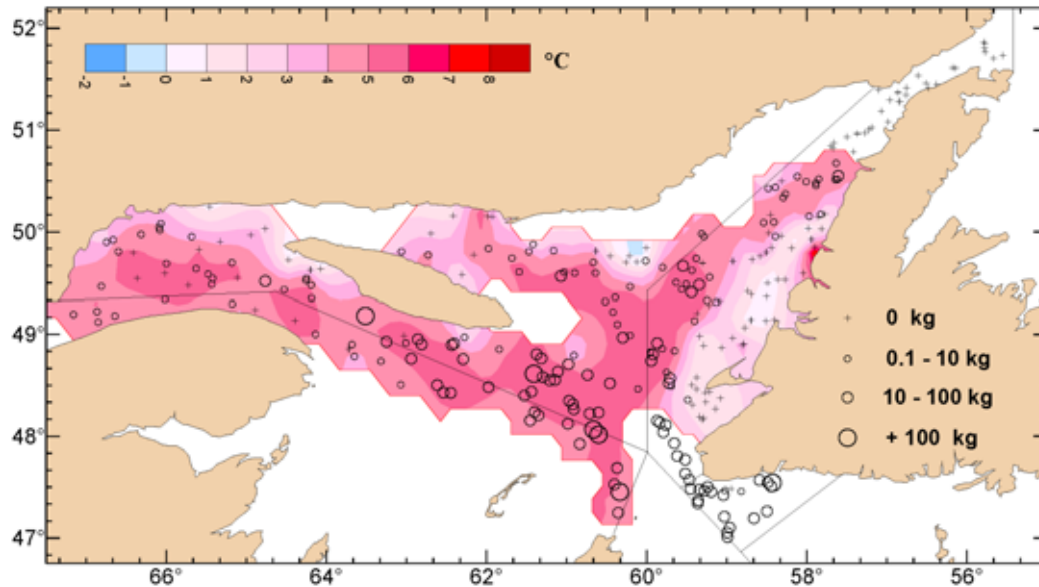
For Unit 1 redfish stock (4RST Divisions), the July sentinel survey series (1995 to 2010) shows a higher minimum trawlable biomass between 1996 and 1999, followed by decrease biomass from 2000 until 2009 (Figure 5.66). In 2010, the minimum trawlable biomass estimate increased (primarily in 4S) to 41,283 tons but remains among the lowest values of the series.



Source: St. Lawrence Global Observatory 2010

Figure 5.66 Minimum Trawlable Biomass Index for Redfish in 4RST Based on the July Stratified Random Survey (1995 to 2010)

Redfish were concentrated for the most part in the channels of the northern region of the Gulf (Figure 5.67). In July 2010, some concentrations of redfish were found in 3Pn. This area is not part of the redfish stock of Unit 1 management (4RST) between the months of June to December.

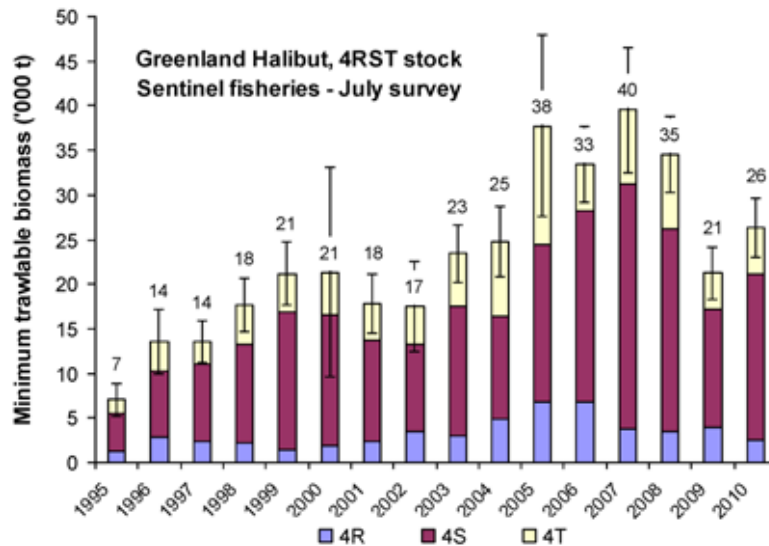


Source: St. Lawrence Global Observatory 2010

Figure 5.67 Bottom Temperature and Catch Rate (kg/standard tow) Distribution of Redfish for the July 2010 Stratified Random Survey in 3Pn and 4RST

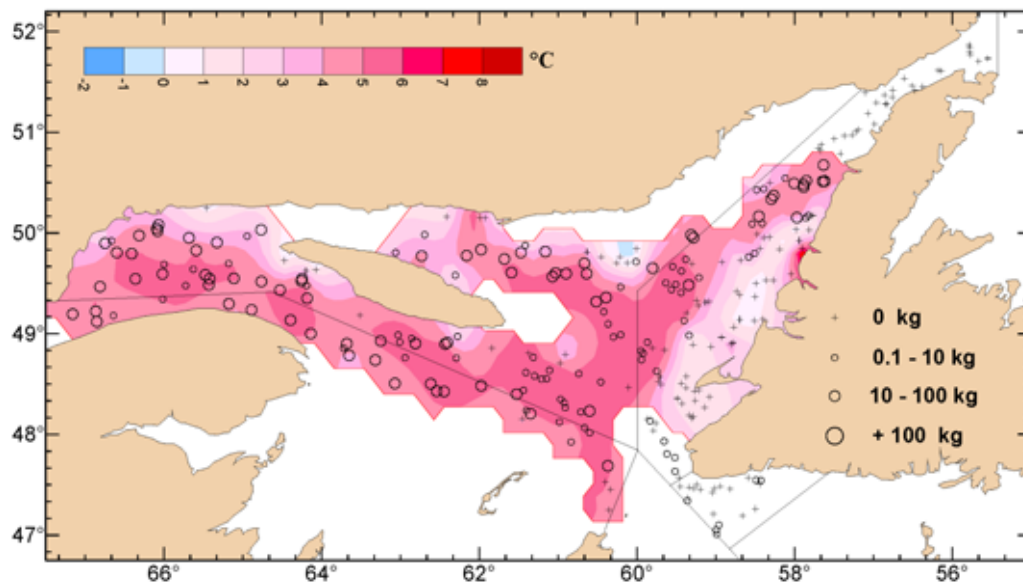
Greenland Halibut

The July sentinel survey series (1995 to 2010) showed a general increase in turbot biomass from 1995 to 2005 that remained relatively stability up to 2008, followed by a substantial decrease in 2009 and an increase in 2010 (Figure 5.68). The 2010 value compares to those observed in 2003 and 2004. Turbot was concentrated mostly in the Estuary and in the Laurentian Channel, around Anticosti Island and in the northern portion of the Esquiman Channel (Figure 5.69). The distribution of turbot is overall similar to those of earlier years.



Source: St. Lawrence Global Observatory 2010

Figure 5.68 Minimum Trawlable Biomass Index for Greenland Halibut Based on the July Stratified Random Survey (1995 to 2010)

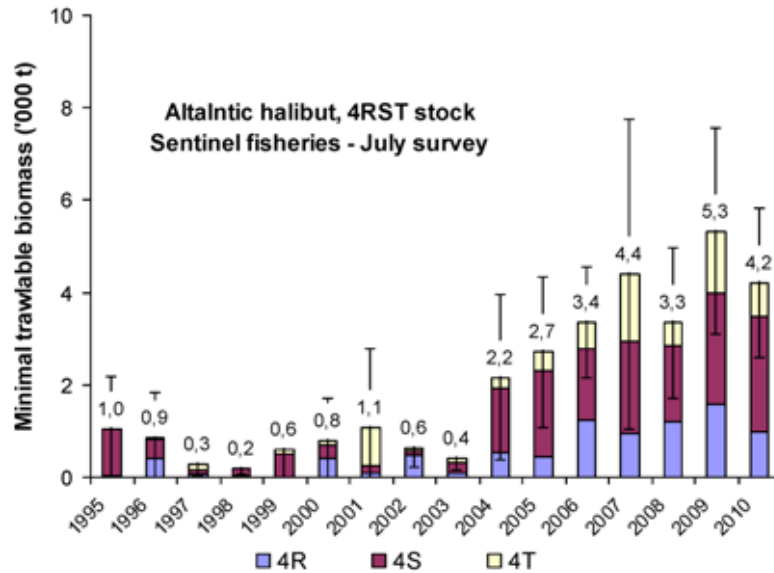


Source: St. Lawrence Global Observatory 2010

Figure 5.69 Bottom Temperature and Catch Rate (kg/standard tow) Distribution of Greenland Halibut for the July 2010 Stratified Random Survey in 3Pn and 4RST

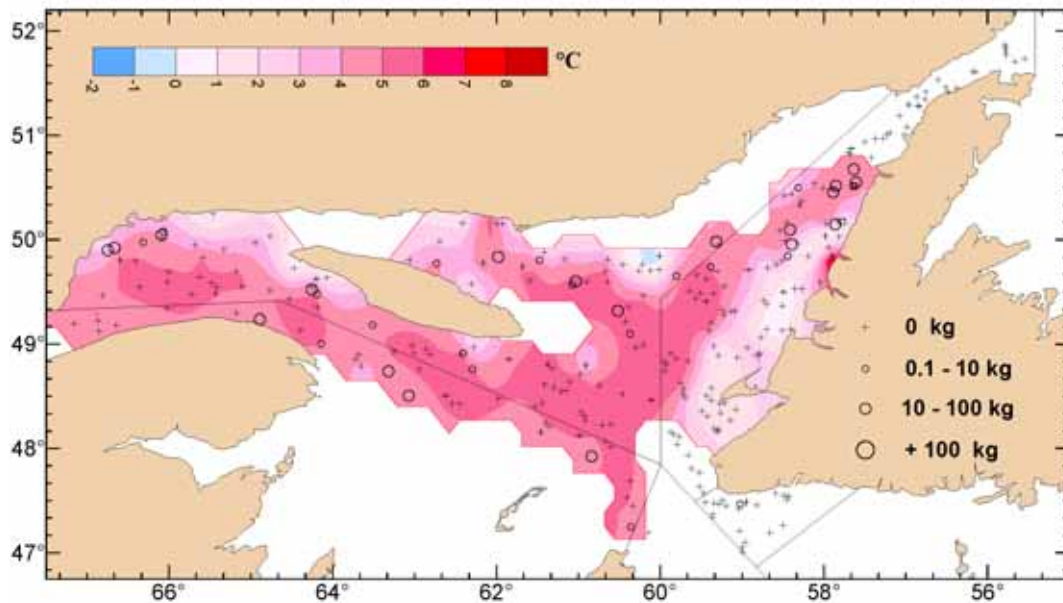
Atlantic Halibut

The July sentinel survey series (1995 to 2010) showed a substantial increase in biomass from 2004 to 2010 (Figure 5.70); biomass was low and stable between 1995 and 2003. The 2010 value compares to those observed in 2007. Atlantic halibut was concentrated mostly in the Esquiman Channel (Figure 5.71).



Source: St. Lawrence Global Observatory 2010

Figure 5.70 Minimum Trawlable Biomass Index for Atlantic Halibut Based on the July Stratified Random Survey (1995 to 2010)



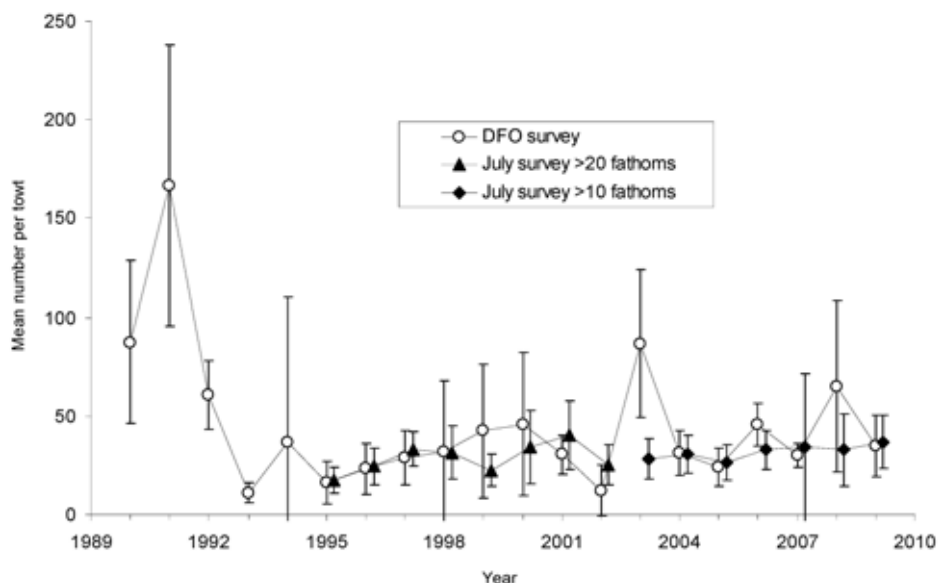
Source: St. Lawrence Global Observatory 2010

Figure 5.71 Bottom Temperature and Catch Rate (kg/standard tow) Distribution of Atlantic Halibut for the July 2010 Stratified Random Survey in 3Pn and 4RST

5.8.1.5 Research Vessel Survey Data

The trends in the main species caught in the northern Gulf DFO research vessel (RV) survey during 1990 to 2008 indicate that turbot, Atlantic halibut and shrimp increased during the last 10 years and are currently at relatively high abundance levels. Redfish remains at low abundance following intensive fishing in the 1980s and early 1990s. Herring and capelin abundance seems relatively healthy. Simulations using abundance data from RV surveys and diet data from various sources has suggested that intensive fishing during the 1980s and early 1990s removed most of the large piscivorous fish trophic level (i.e., cod and redfish), which has left marine mammals as the dominant top predators in the northern Gulf during the 2000s (DFO 2010a).

The DFO RV survey began in 1990 on the *CCGS Alfred Needler* and since 2004 has been carried out on the *CCGS Teleost* (DFO 2010a). The results of the RV survey indicate a sharp decline in cod abundance during 1991 to 1993, followed by an increase until 2000. The timing of the increase corresponded to the period of the first moratorium during 1994 to 1996 (Figure 5.72). Abundance then fluctuated with little trend from 2001 to 2009. An abnormal low value occurred in 2002 and a high value occurred in 2003.

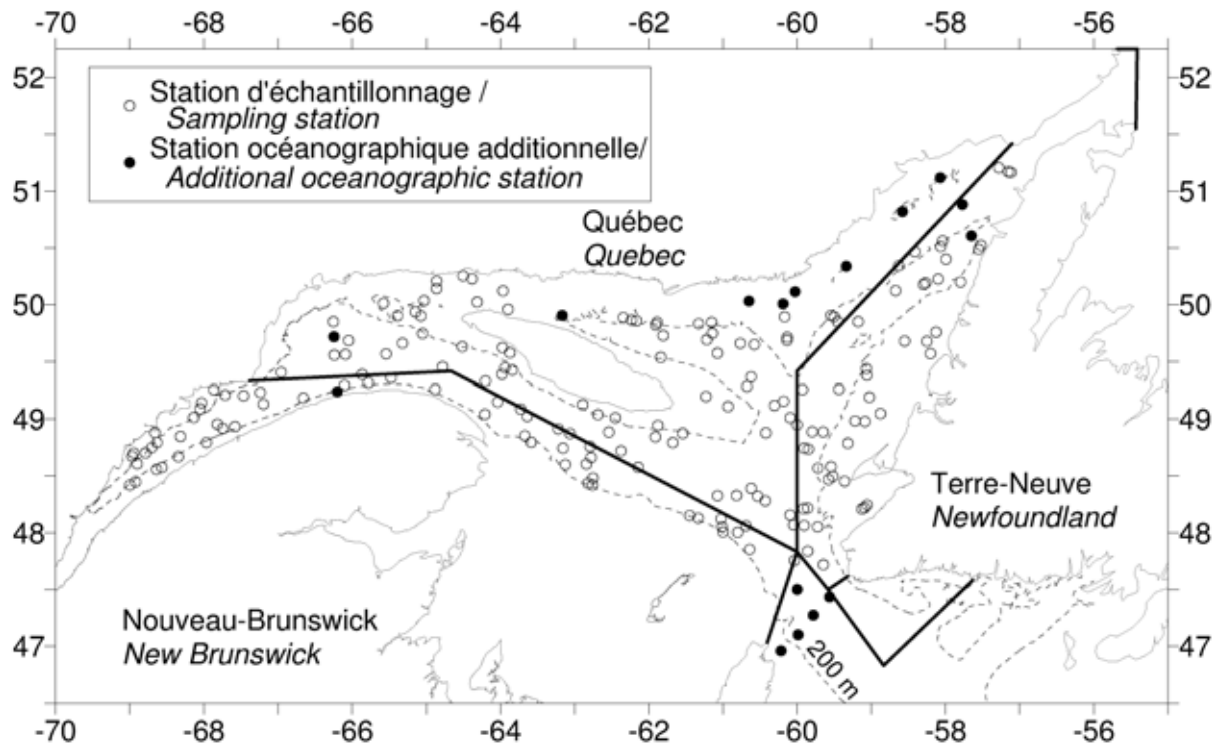


Source DFO 2010a

Figure 5.72 Mean Number per Tow for the August DFO RV and the July Sentinel Mobile Surveys

In 2009, the annual summer survey for the assessment of abundance and distribution of groundfish and shrimp in the northern Gulf was conducted from July 31 to August 31 onboard the *CCGS Teleost* (Bordages et al. 2010) (Figure 5.73). In 2009, the abundance and biomass indices of many species have decreased as compared to the previous years. Indices for redfish, black dogfish and longfin hake are among the lowest values. Greenland halibut indices are similar to the early 2000s, a decrease of approximately 30 percent. Meanwhile, indices for other species (cod, northern shrimp, Atlantic halibut, thorny skate, white hake, American plaice, witch

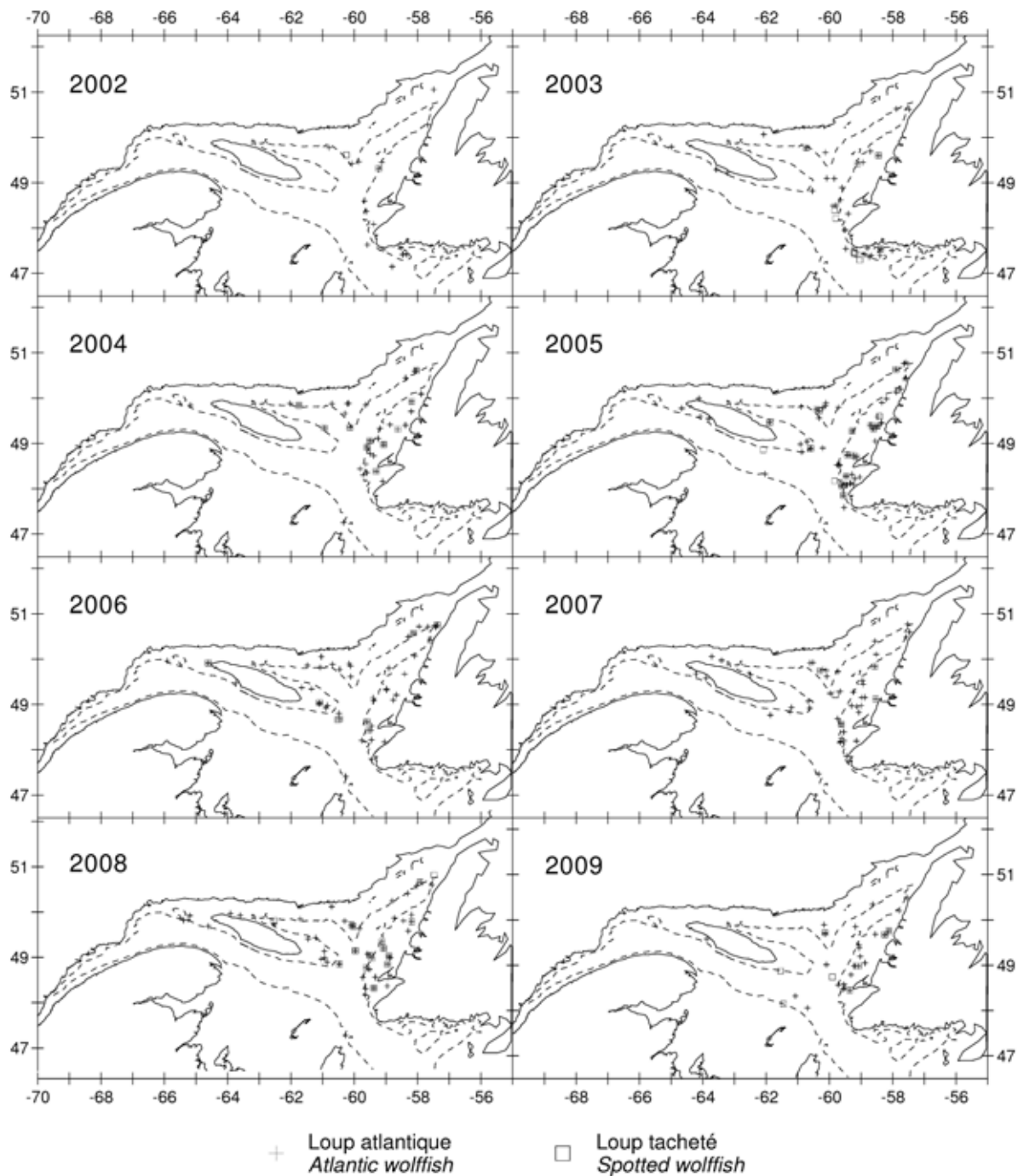
flounder and snow crab) in 2009 are comparable to the average of 2004 to 2008 years, even though a decrease was observed compared to 2008. The geographic distributions of catches recorded for the different species in 2009 show the same pattern as observed for the previous seven years.



Source: Bordages et al. 2010

Figure 5.73 Locations of Sampling Stations for the 2009 Survey

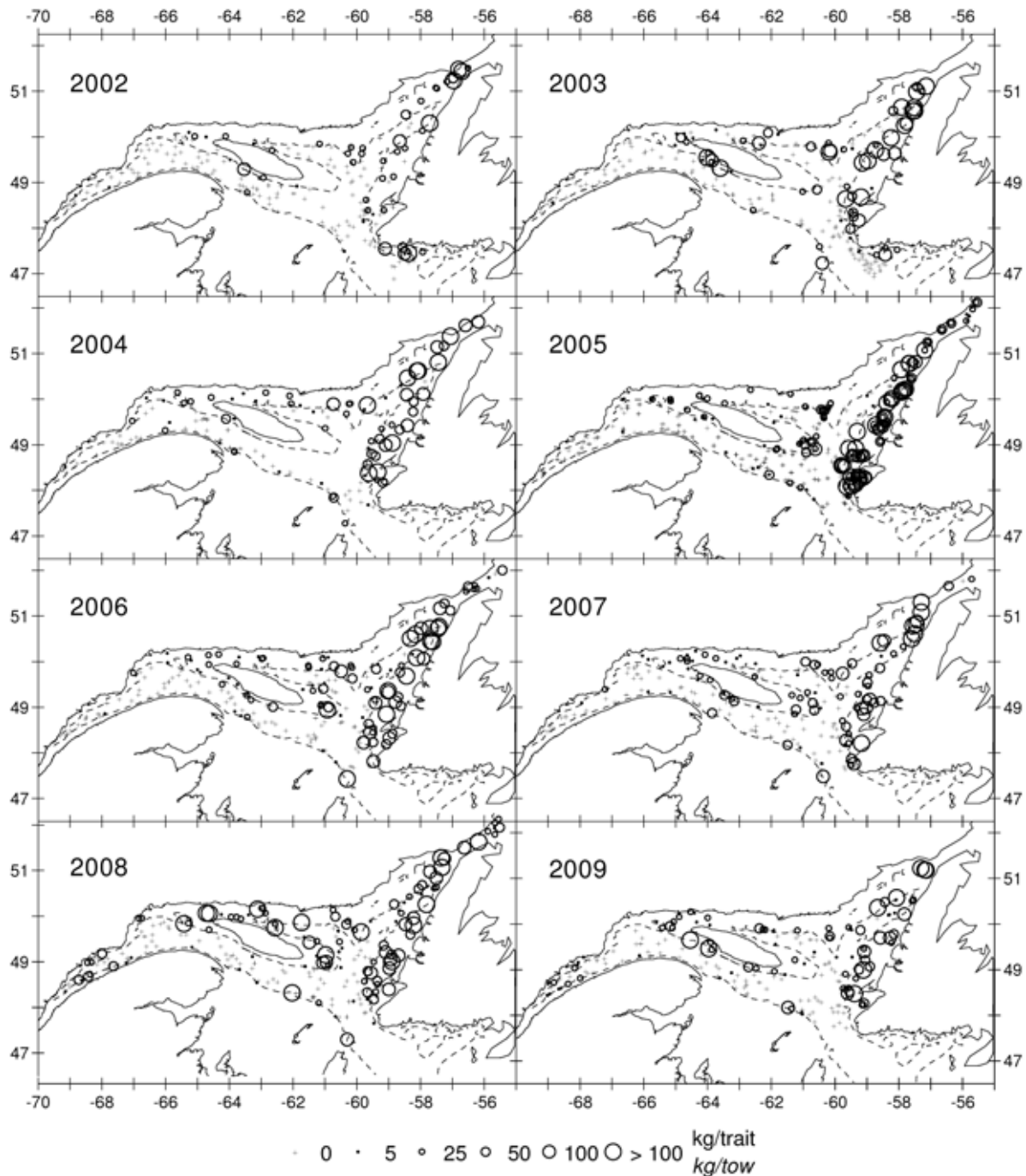
Atlantic and spotted wolffish, both SARA-listed species, are caught primarily at the 200 m isobaths off western Newfoundland, Beauge Bank, near Anticosti Island and in the southern Laurentian Channel (Figure 5.74). The number of wolffish per tow when caught was between a few individuals to a maximum of 20 (Bordages et al. 2010).



Source: Bordages et al. 2010

Figure 5.74 Atlantic Wolffish and Spotted Wolffish Catch Locations from the Survey for the 2002 to 2009 Period

The mean number and weight of cod (a COSEWIC designated species) per tow have remained low but stable since the fishery reopened in 1997 (Bordages et al. 2010). The most substantial cod catches in 2009 (and previous years) were mostly caught along the west coast of Newfoundland (NAFO Division 4R) (Figure 5.75).

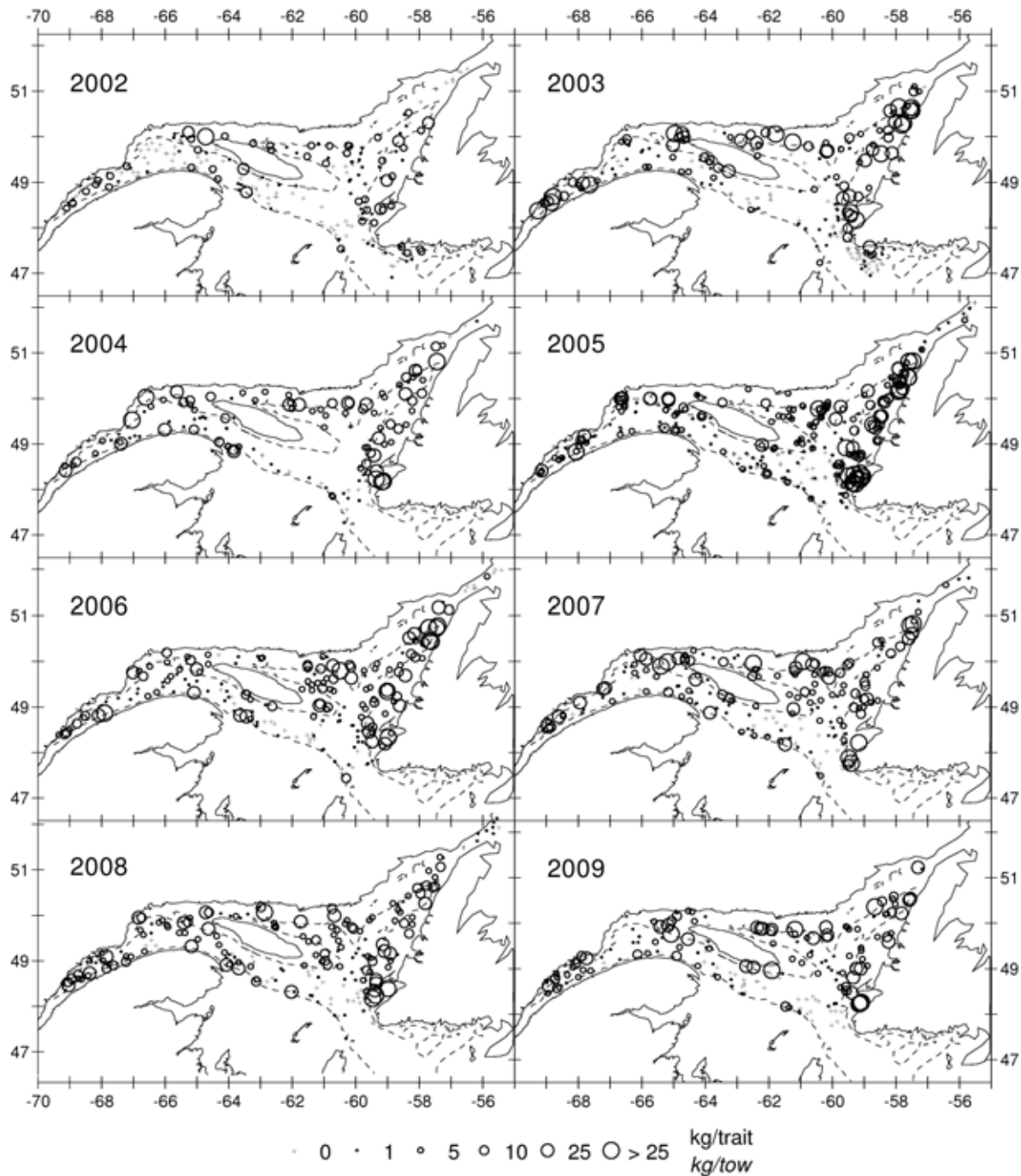


Source: Bordages et al. 2010

Note: The "+" symbol indicates a zero.

Figure 5.75 Cod Catch Rate (kg/tow) Distribution from the Survey for 2002 to 2009

American plaice (a COSEWIC designated species) fluctuated without notable trends in mean numbers and weights from 1990 to 2003 (Bordages et al. 2010). Numbers remained stable from 2004 to 2008, with the mean number per tow increasing slightly in 2009 (Figure 5.76). A shift towards smaller-sized individuals has been observed since 2007. American plaice are found throughout the Estuary and Northern Gulf.



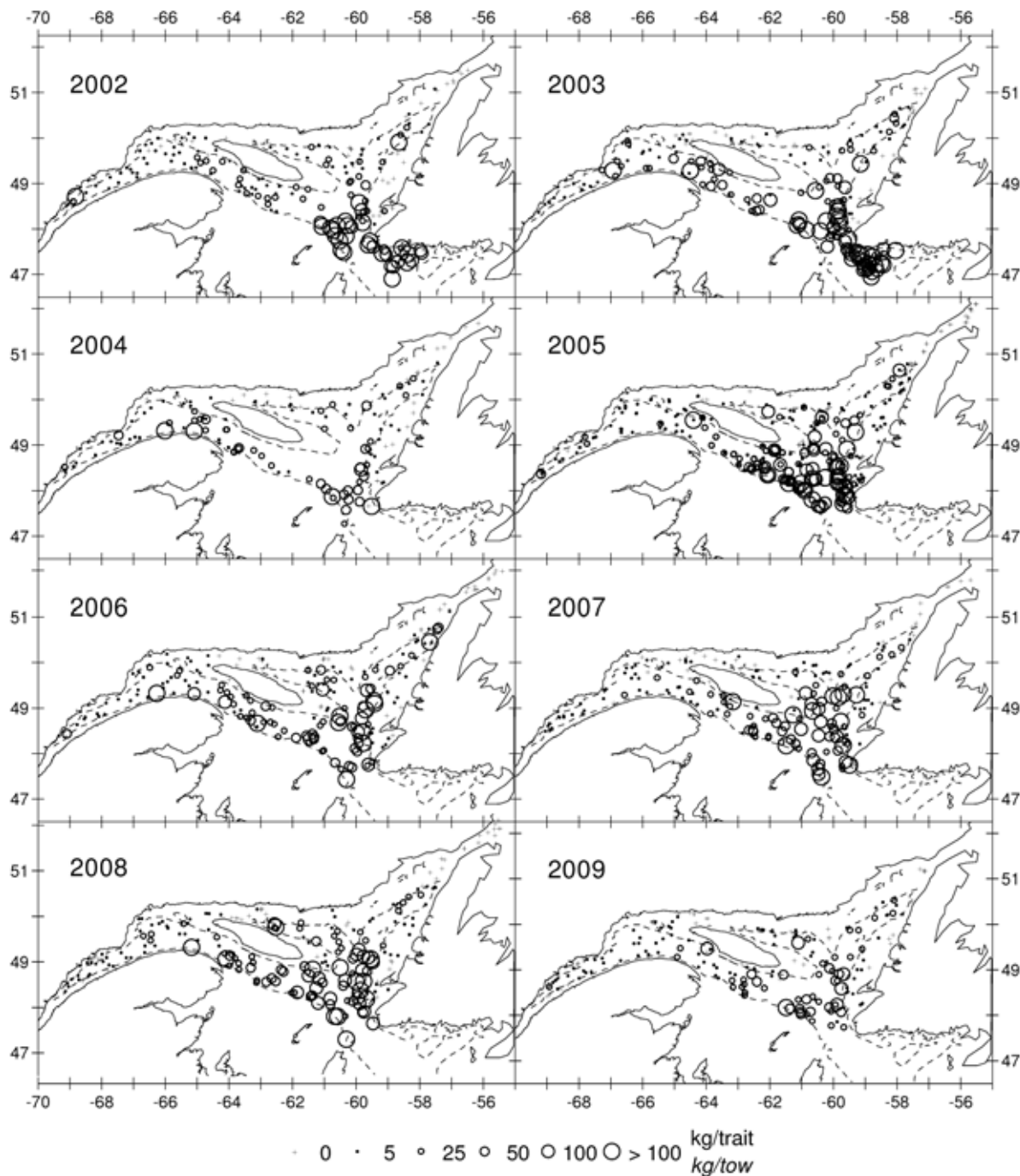
Source: Bordages et al. 2010

Note: The "+" symbol indicates a zero.

Figure 5.76 American Plaice Catch Rate (kg/tow) Distribution from the Survey for 2002 to 2009

Redfish (two COSEWIC designated species) mean number and weight per tow dropped between 1990 to 1996, after which the values have remained steady but low until 2005, when it increased due to good recruitment from the 2003 year class (Bordages et al. 2010). The 1988 and 2003 were strong year classes that were observed in 1990 to 1992 and 2005 to 2007, after

which they quickly declined. The main Gulf redfish concentrations are at the entry and north of Cabot Strait and South of Anticosti Island in the Laurentian Channel (Figure 5.77).



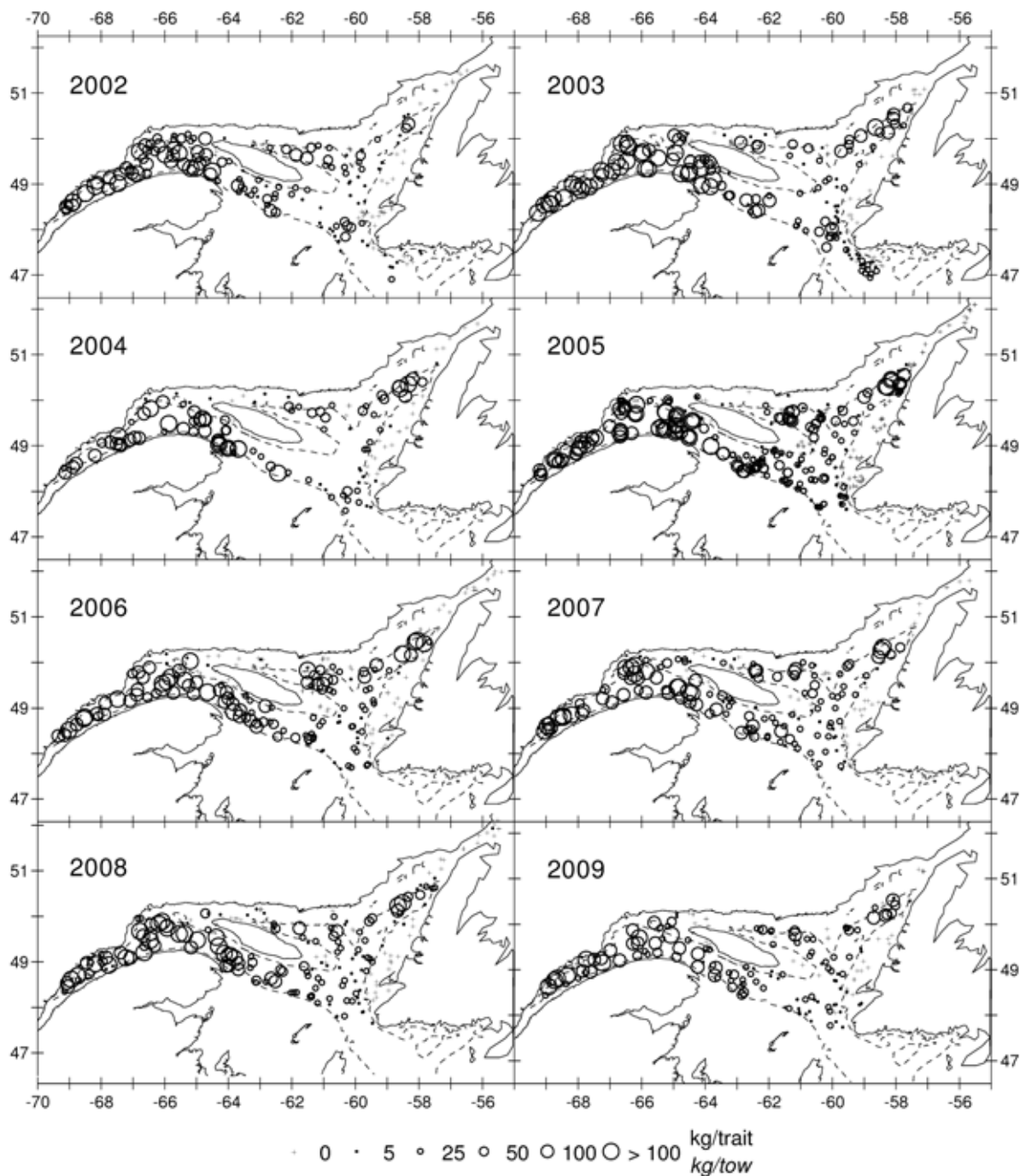
Source: Bordages et al. 2010

Note: The "+" symbol indicates a zero.

Figure 5.77 Redfish Catch Rate (kg/tow) Distribution from the Survey for 2002 to 2009

Mean number and weight of Greenland halibut per tow has shown an upward trend in the 1990s and since the early 2000s, this increase has been less pronounced (Bordages et al. 2010). The

2009 abundance and biomass are the lowest of the last 10 years. The main concentrations of Greenland halibut were mostly observed west, south and north of Anticosti Island and were also seen in the Esquiman Channel (Figure 5.78).

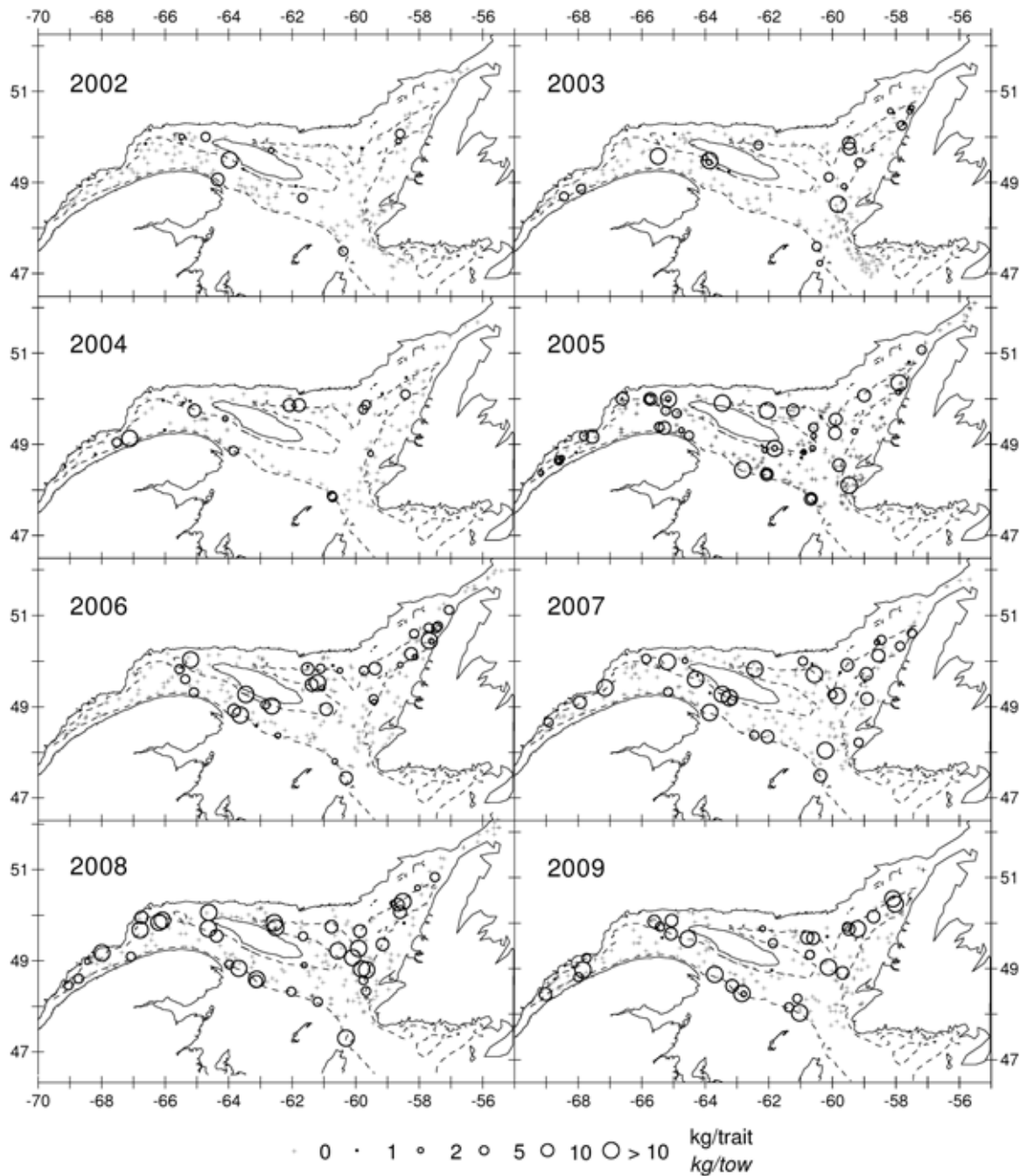


Source: Bordages et al. 2010

Note: The "*" symbol indicates a zero.

Figure 5.78 Greenland Halibut Catch Rate (kg/tow) Distribution from the Survey for 2002 to 2009

Atlantic Halibut mean weight and numbers were low during the 1990s and have steadily increased until 2008, followed by approximately 33 percent decrease in 2009 (Bordages et al. 2010). However, the Atlantic halibut abundances were the highest from 2006 to 2009. The largest catches are from the channel areas along the 200 m isobaths and in the Sept-Îles and estuary areas (Figure 5.79)

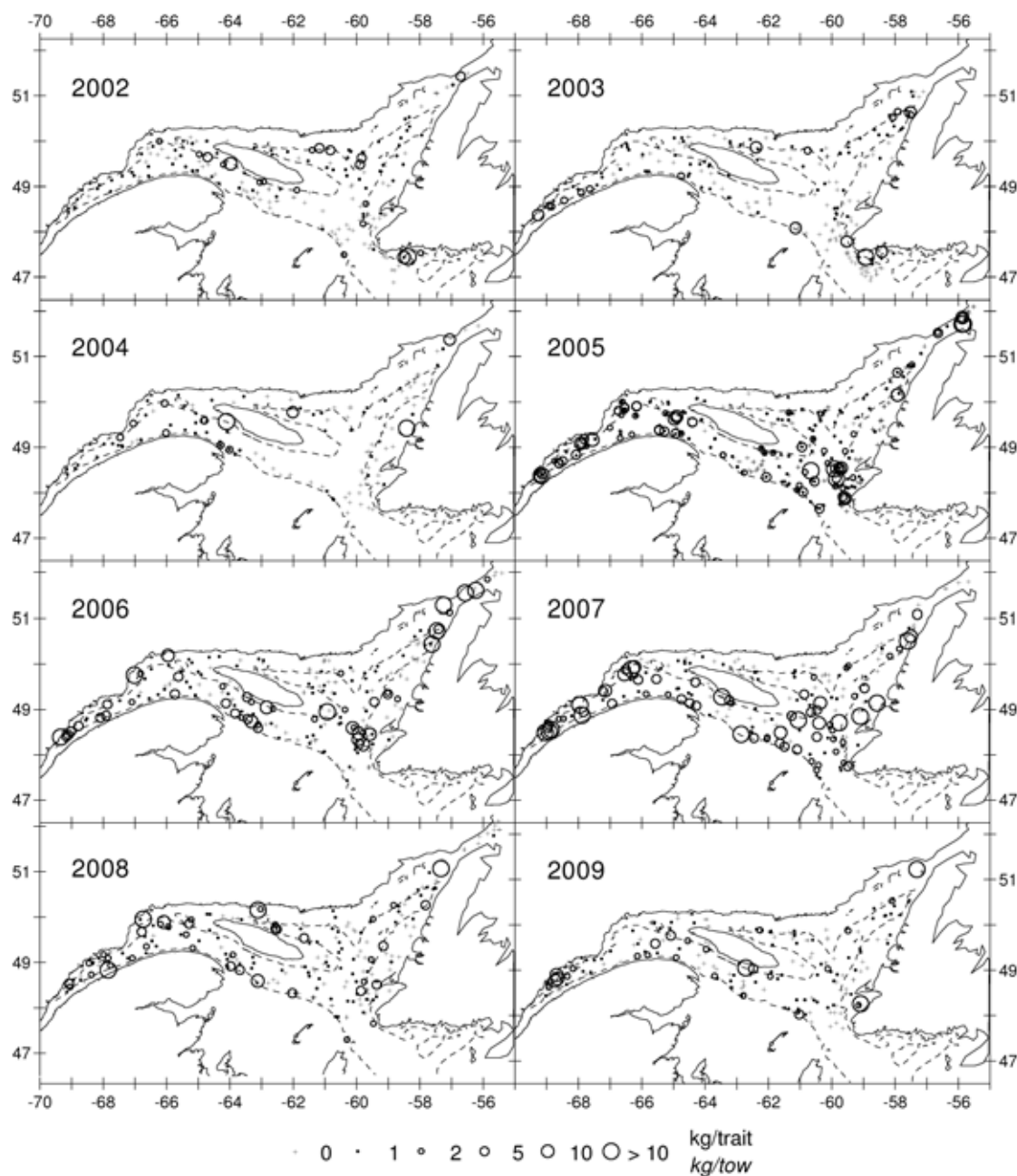


Source: Bordages et al. 2010

Note: The "+" symbol indicates a zero.

Figure 5.79 Atlantic Halibut Catch Rate (kg/tow) Distribution from the Survey for 2002 to 2009

Herring caught during the survey represent two spawning stocks and are found throughout the area (Bordages et al. 2010). The highest catches are from the St. Lawrence Estuary, along the Laurentian channel, between Anticosti Island and Newfoundland as well as in the Strait of Belle Isle (Figure 5.80). In 4R, the probability of finding herring varied for 1990 to 1998 (21 to 41 percent), and increased until 2001 (73 percent), then dropped again until 2004 (26 percent). Probabilities have increased reaching 50 percent in 2007 and remained steady since. The 4s annual variations in catch probabilities were similar to 4R.

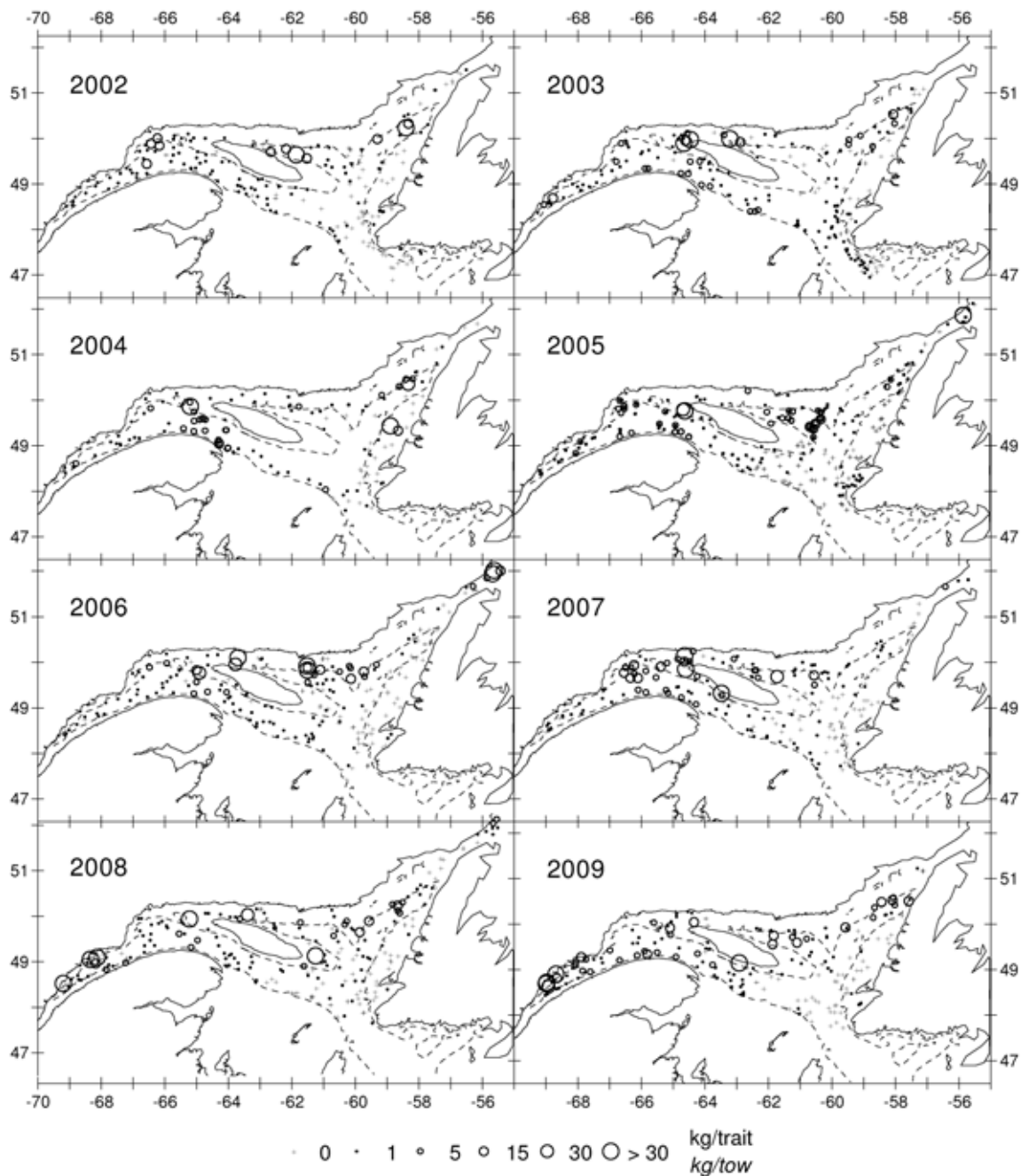


Source: Bordages et al. 2010

Note: The "+" symbol indicates a zero.

Figure 5.80 Herring Catch Rate (kg/tow) Distribution from the Survey for 2002 to 2009

Capelin catches are the highest in the St. Lawrence estuary, around Anticosti Island and in the Strait of Belle Isle (Figure 5.81). Catch probabilities have fluctuated substantially since 1990, reaching the lowest value in 2006 (23 percent) and have risen to 51 percent (2008) and 42 percent (2009). Catch probabilities for 4S are less variable, with an increasing trend observed between 1990 and 2000, decreasing slightly until 2003 and have remained between 70 to 80 percent since 2002 (Bordages et al. 2010).

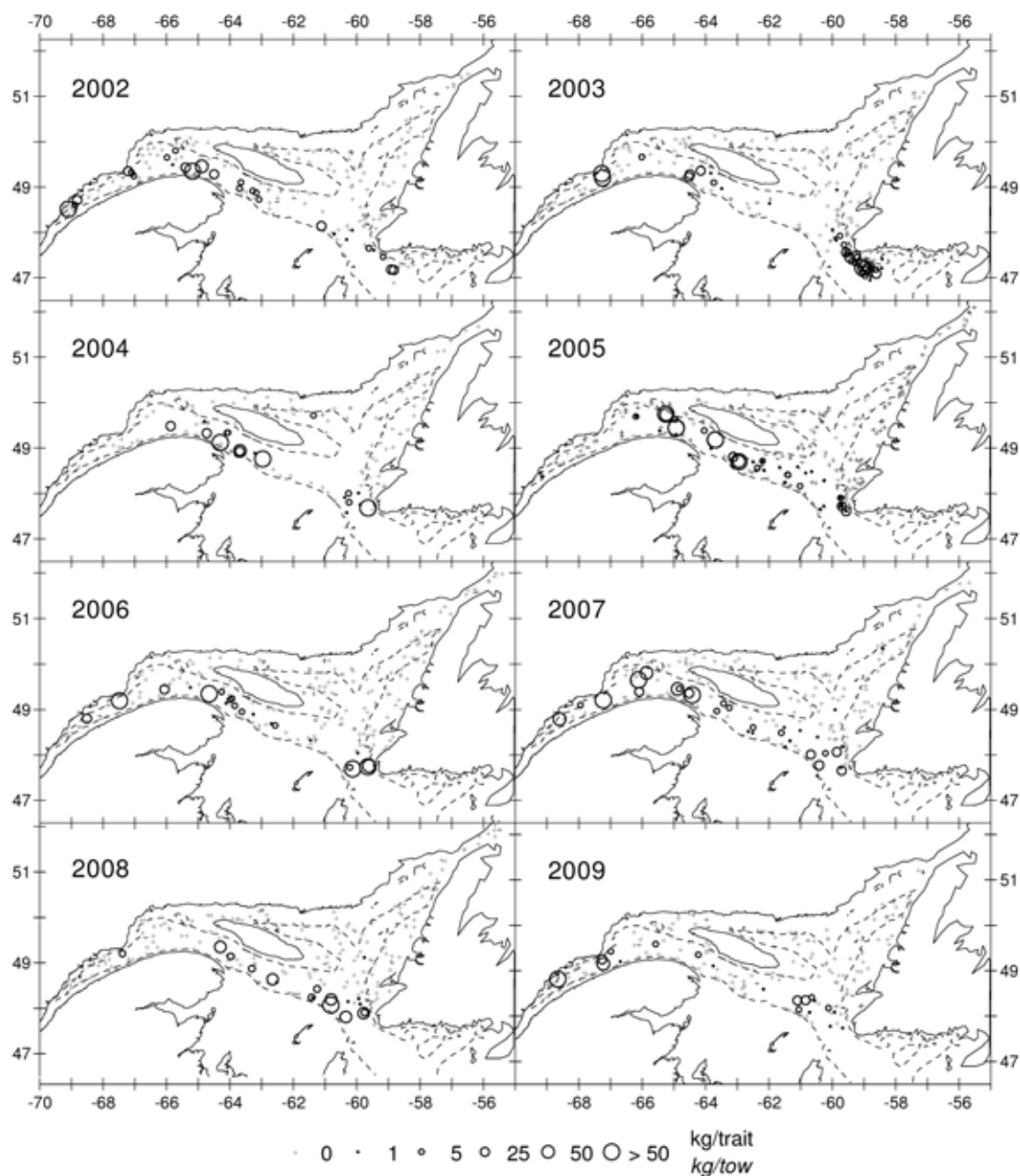


Source: Bordages et al. 2010

Note: The "+" symbol indicates a zero.

Figure 5.81 Capelin Catch Rate (kg/tow) Distribution from the Survey for 2002 to 2009

Black dogfish mean numbers and weights per tow have varied considerably over the years and large confidence intervals are often associated with the largest values as a result of the species gregarious nature and limited spatial distribution (Figure 5.82). The 2009 values are among the lowest of the data series. The largest dogfish concentrations were found in the deep upstream portion of the Laurentian Channel and in the St. Lawrence Estuary in 2002 to 2007. In 2009, the concentrations were limited to the Cabot Strait area and the southern part of the Laurentian Channel (Bordages et al. 2010).

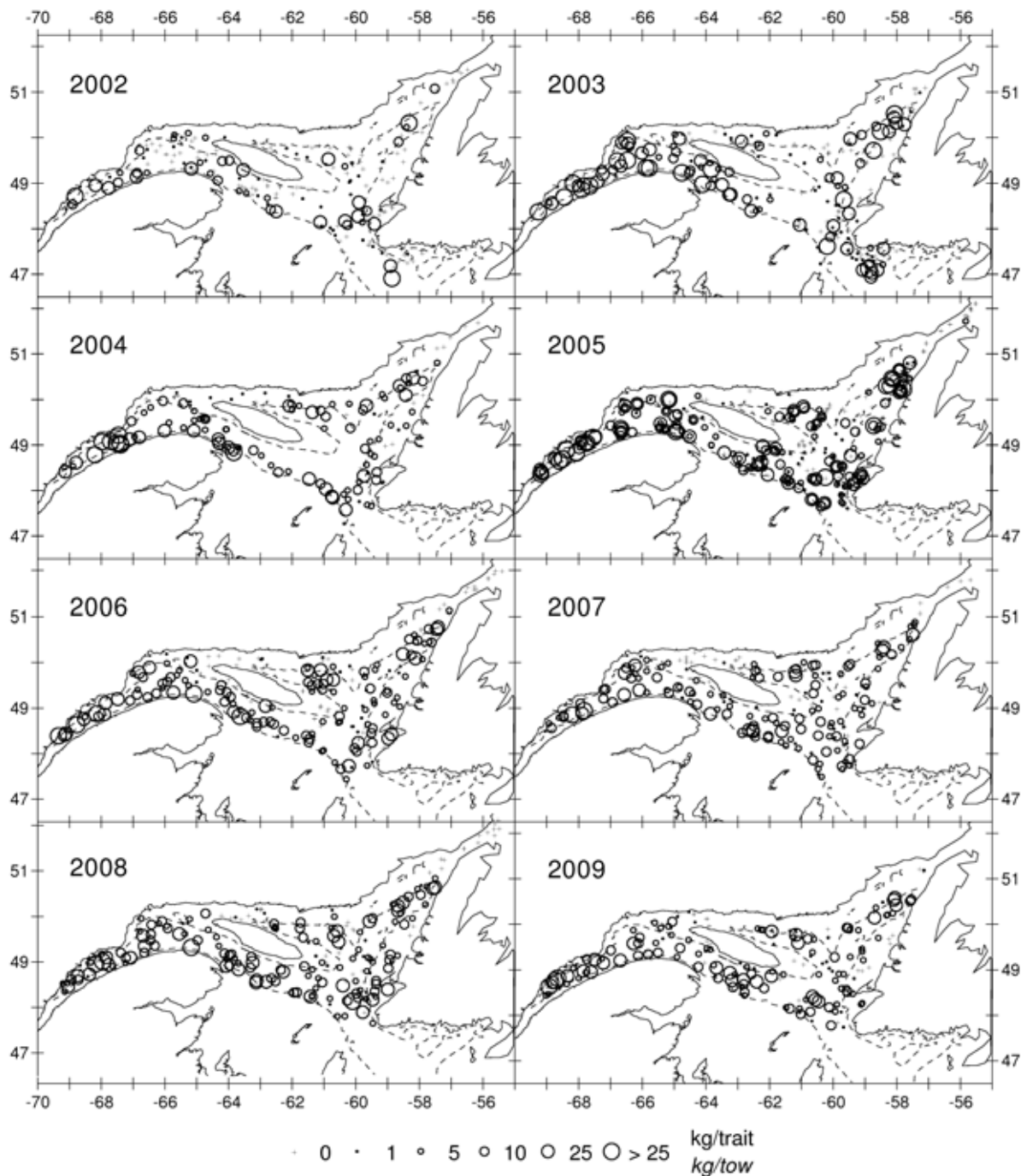


Source: Bordages et al. 2010

Note: The "+" symbol indicates a zero.

Figure 5.82 Black Dogfish Catch Rate (kg/tow) Distribution from the Survey for 2002 to 2009

Thorny skate mean number and weights exhibited fluctuations between 1990 to 2002, with the means numbers decreasing since 2003, but the mean weight has remained stable over the this timeframe (Figure 5.83) . Therefore, thorny skate are less abundant but larger (Bordages et al. 2010).

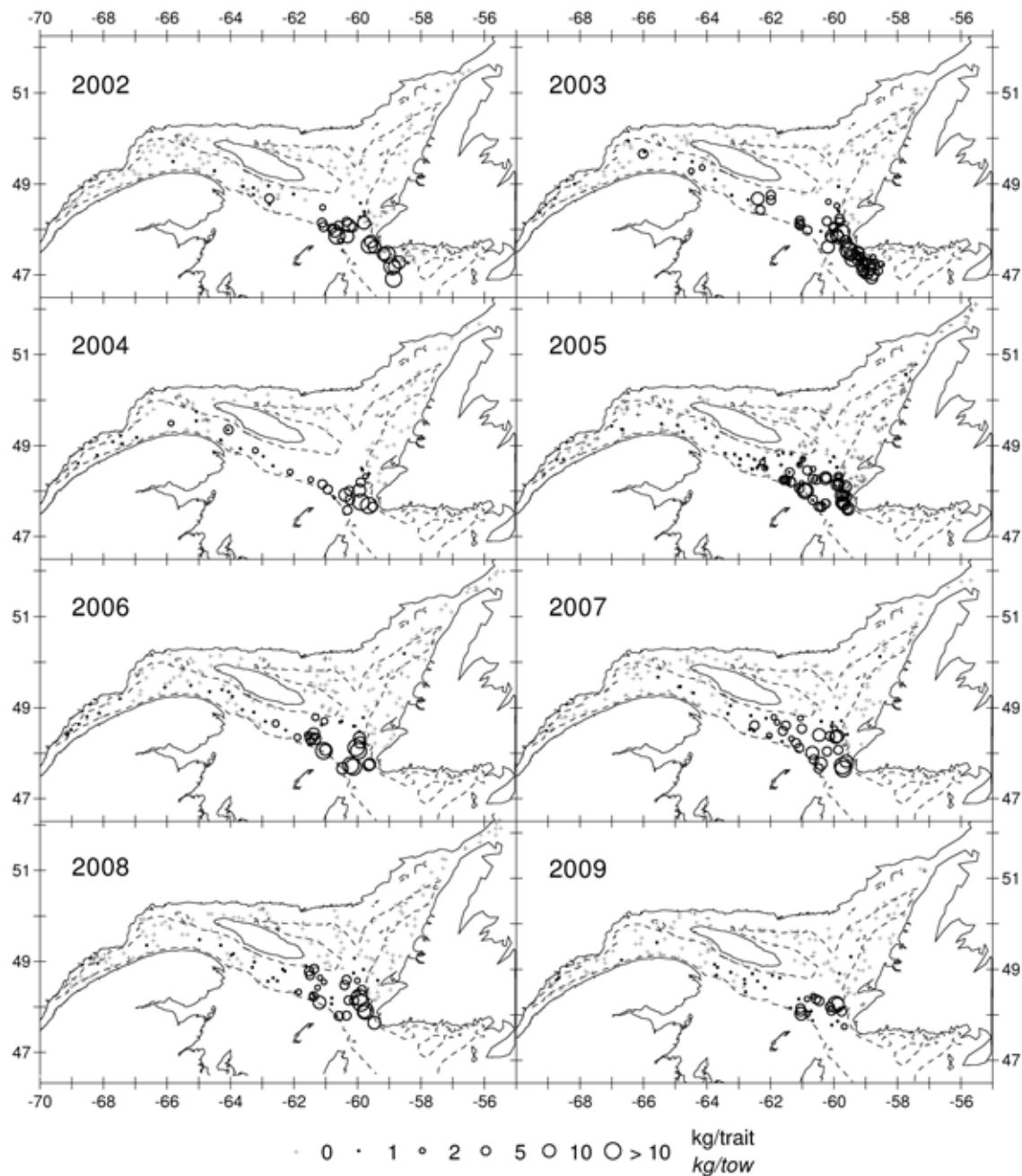


Source: Bordages et al. 2010

Note: The "+" symbol indicates a zero.

Figure 5.83 Thorny Skate Catch Rate (kg/tow) Distribution from the Survey for 2002 to 2009

Longfin hake exhibited a sharp drop in the mean number and weight between 1990 and 1993, and has fluctuated since this period (Bordages et al. 2010). There was a slight increase in the late 1990s but numbers have subsequently dropped sharply and have remained relatively stable since 2003. The 2009 values are the lowest for this survey (Figure 5.84). Longfin hake are found primarily in the southern portion of the Gulf, with highest catches in the southern Laurentian Channel and near Cabot Strait.

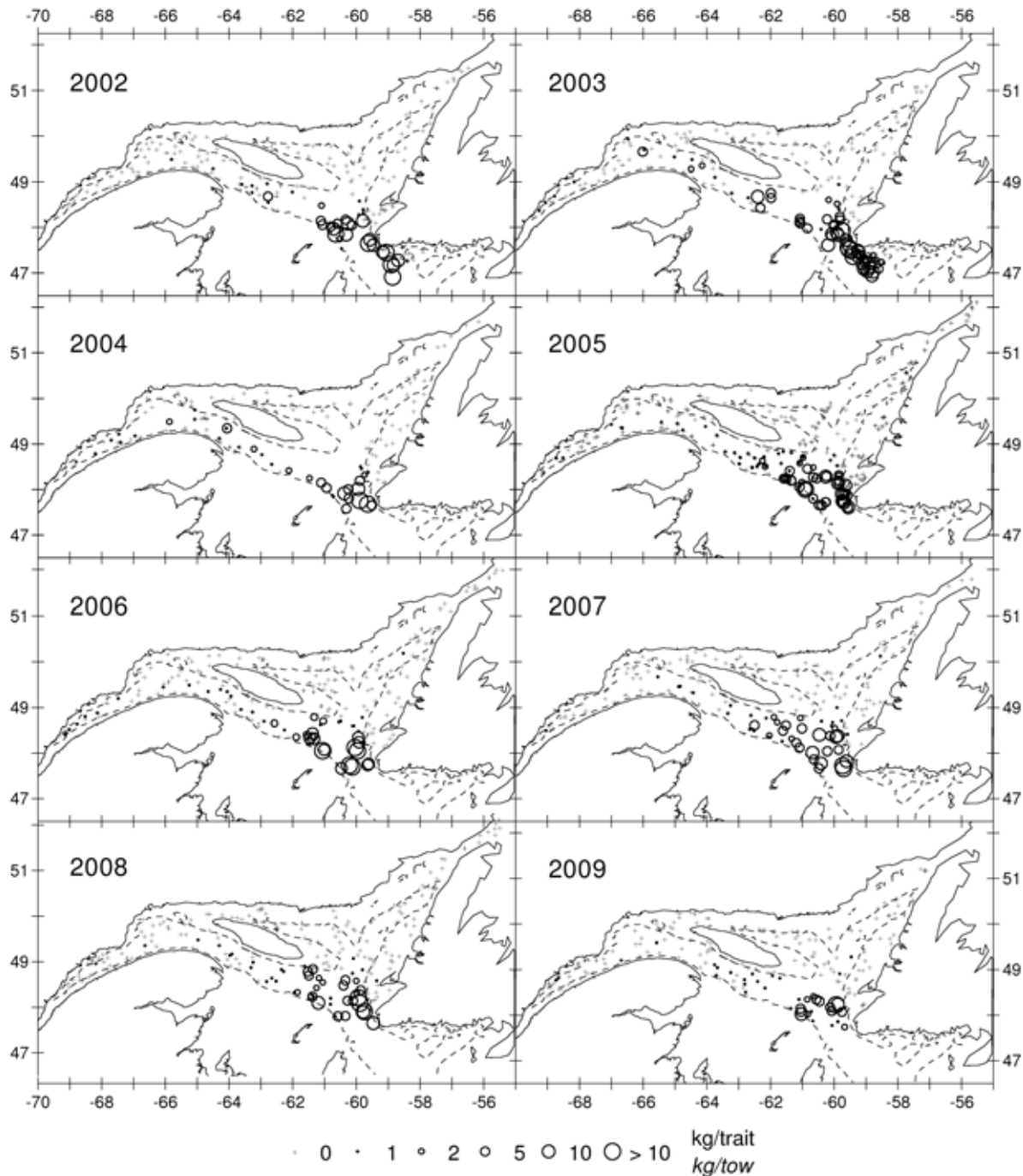


Source: Bordages et al. 2010

Note: The "+" symbol indicates a zero.

Figure 5.84 Longfin Hake Catch Rate (kg/tow) Distribution from the Survey for 2002 to 2009

White hake mean numbers and weights dropped sharply from 1990 to 1993 and have fluctuated thereafter (Bordages et al. 2010). The indices recorded between 2003 and 2009 were among the survey's lowest (Figure 5.85). Since 2003, the strongest concentrations are found along the 200 m isobaths in the southern flank of the Laurentian Channel and offshore St. Georges Bay.

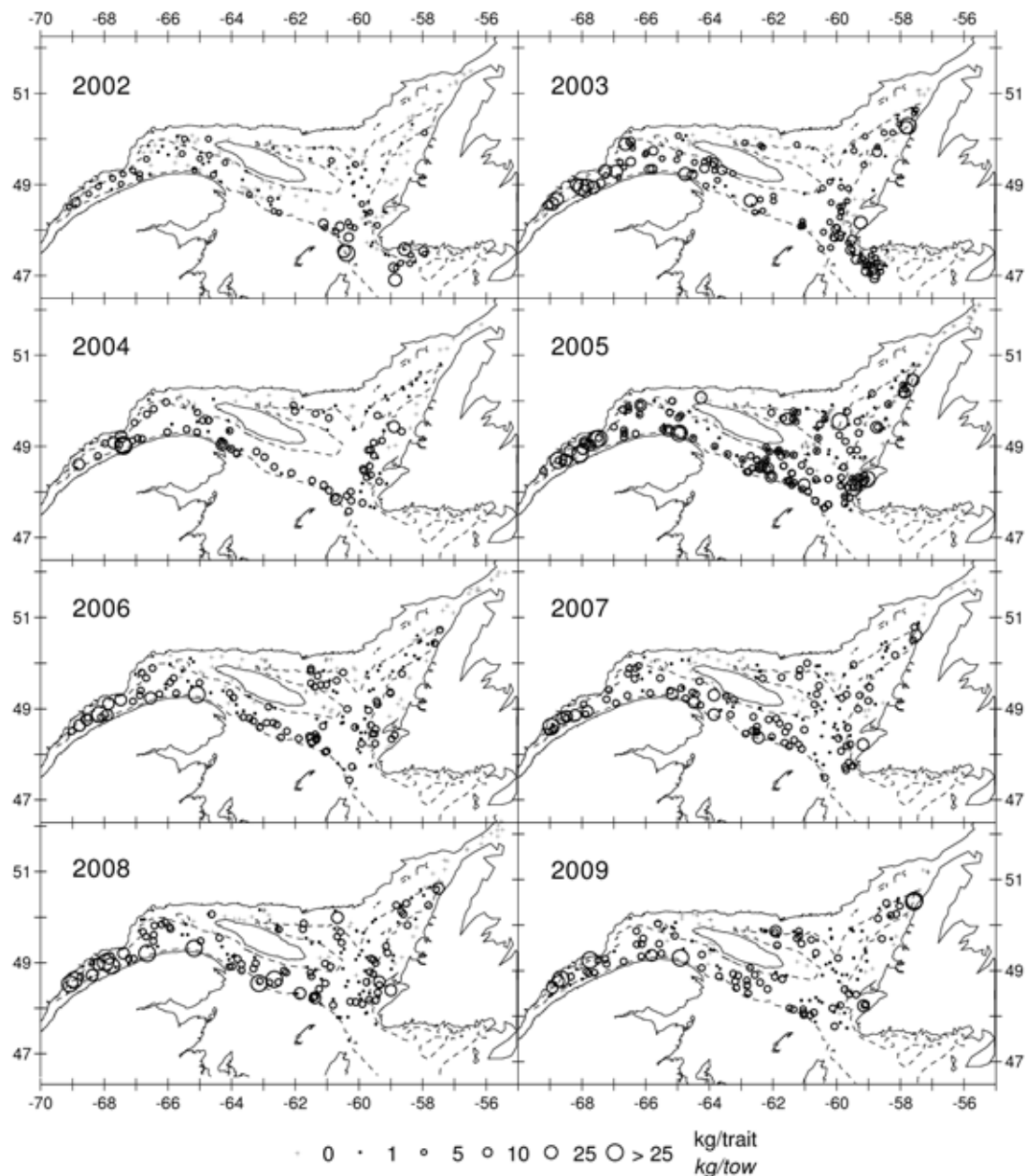


Source: Bordages et al. 2010

Note: The "+" symbol indicates a zero.

Figure 5.85 White Hake Catch Rate (kg/tow) Distribution from the Survey for 2002 to 2009

Witch flounder are relatively homogenous covering the northern Gulf, with mean number and weights having decreased between 1990 and 1993. These values remained stable until 1999, followed by two upward and downward waves between 2000 and 2003 and were again stable between 2004 and 2009 (levels comparable to 1994 to 1999 levels). Values in 2009 were below the 1990 to 2008 average. The largest concentrations are along the southern slope and the head of the Laurentian Channel (Figure 5.86). In 2009, good catches were noted at the Head of the Esquiman Channel which is seldom observed (Bordages et al. 2010).

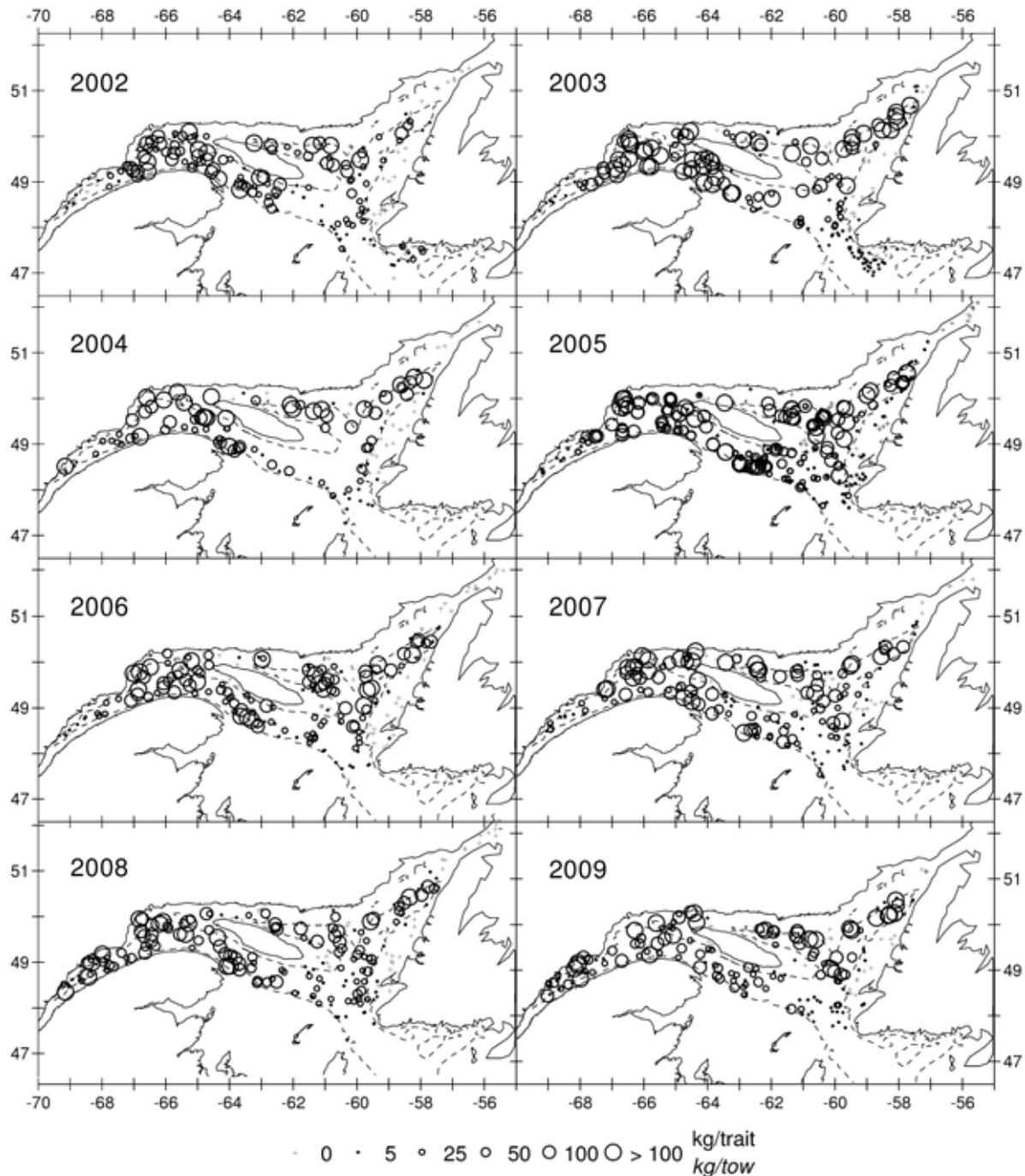


Source: Bordages et al. 2010

Note: The "+" symbol indicates a zero.

Figure 5.86 Witch Flounder Catch Rate (kg/tow) Distribution from the Survey for 2002 to 2009

Northern shrimp mean number and weights per tow are similar to 2006 and 2008 observations, with 2009 values lower than those observed in 2003 but higher than pre-2002 values (Bordages et al. 2010). The catches were highest along the channels and west of Anticosti Island (Figure 5.87).

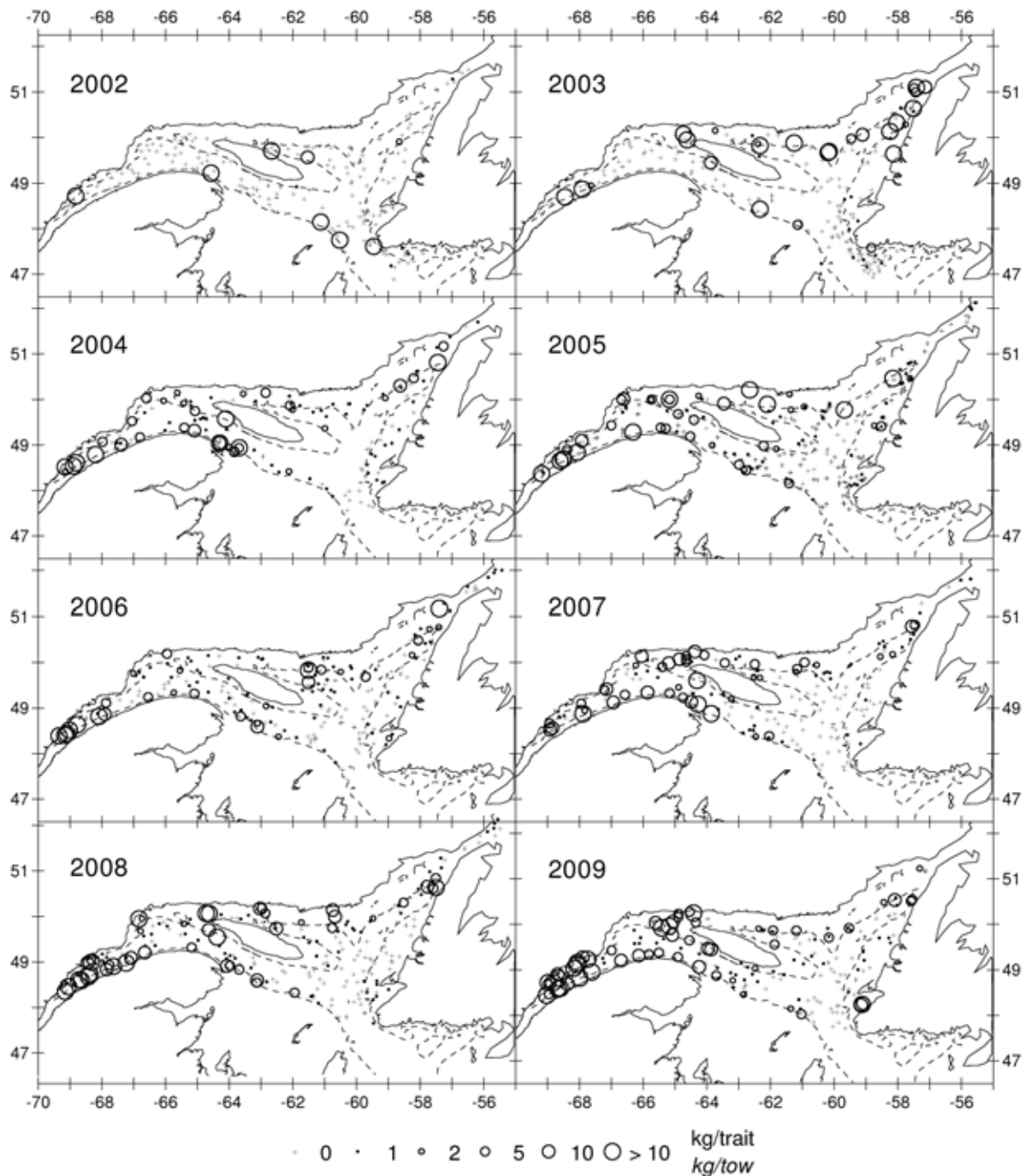


Source: Bordages et al. 2010

Note: The "+" symbol indicates a zero.

Figure 5.87 Shrimp Catch Rate (kg/tow) Distribution from the Survey for 2002 to 2009

The 2009 RV survey data indicates the presence of a large but stable biomass of snow crab (Figure 5.88.), with the 2002 to 2009 data catch distribution revealing that snow crab are not abundant at depths greater than 200 m. Catches were made for all stations less than 200 m in depth (Bordages et al. 2010).



Source: Bordages et al. 2010

Note: The "+" symbol indicates a zero.

Figure 5.88 Snow Crab Catch Rate (kg/tow) Distribution from the Survey for 2002 to 2009