4.4.2.3 Redfish

Redfish are benthic fishes, inhabiting areas with rocky or clay-silt substrates along the slopes of banks and in deep channels at depths of 100 to 700 m and temperatures of 3 to 8°C. They remain on or near the seabed during the day, rising into the water column at night to feed and are stratified by size, with smaller fish in shallow waters and larger fish deeper (Scott and Scott 1988; McKone and LeGrow 1984). The three species of redfish found in the Northwest Atlantic are *Sebastes fasciatus*, *S. marinus* and *S. mentella*. The three species are similar, nearly impossible to distinguish by appearance and are managed as a single fishery (Power and Mowbray 2000; Gascon 2003). *S. marinus* may be found in 3Ps, the Gulf of St. Lawrence, SA2 and 3R with the largest population occurring on the Flemish cap.

Populations of redfish are allopatric (separated geographically) for *S. mentella* and *S. fasciatus*. *S. mentella* is the northern range species off Labrador and Greenland. *S. fasciatus* is the southern range species on the scotian shelf and the Gulf of Maine (Scott and Scott 1988; Gascon 2003). The ranges for *S. mentella* and *S. fasciatus* overlap in the Laurentian Channel and the Grand Banks (Gascon 2003). Redfish distribution for *S. mentella* and *S. fasciatus* is presented in Figure 4.13. In areas where *S. mentella* and *S. fasciatus* intermix, *S. mentella* is generally distributed deeper than *S. fasciatus* (Power and Morbray 2000; Gascon 2003). The exception to this trend occurs in the Gulf of St. Lawrence where *S. mentella* dominates.

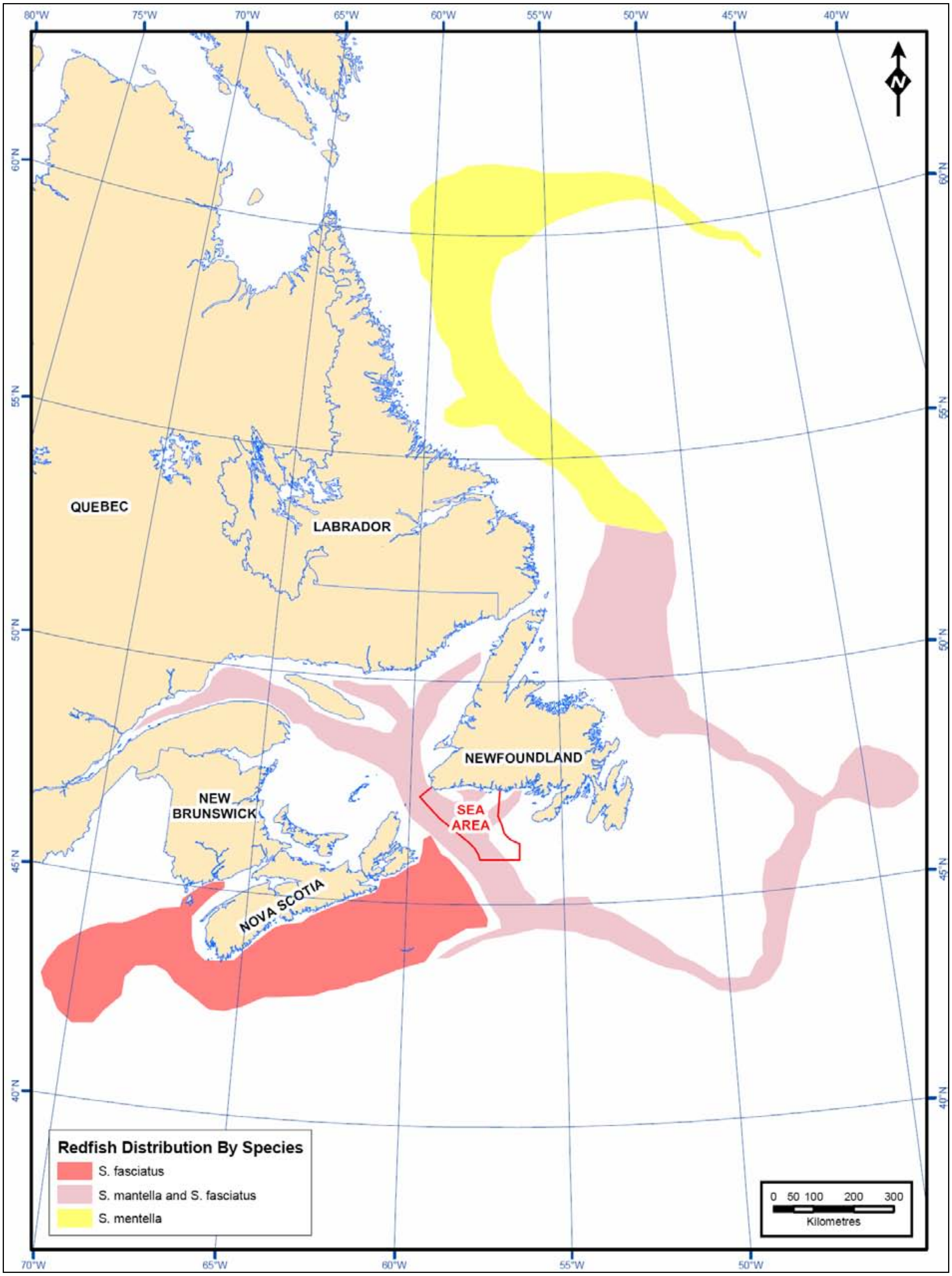
The genetic differentiation between redfish species in the Gulf of St. Lawrence and waters south of Newfoundland and Labrador is complicated by the presence of introgressive hybridization (incorporation of genes of one species into the gene pool of another) individuals between *S. fasciatus* and *S. mentella* (Morin et al. 2004). The Gulf of St. Lawrence, the Laurentian Channel, Grand Banks, southern Labrador Sea and Flemish Cap comprised an area of symmetry separating the two allopatric zones. The introgression between the two species (*S. fasciatus* and *S. mentella*) is geographical limited to Unit 1, Unit 2 and the Flemish Cap where introgressed individuals persist with non-introgressed individuals of the two redfish species.

Redfish are a slow growing and long lived species with specimens having been aged at least to 75 years (Campana et al. 1990). *S. fasciatus* grows slower than *S. mentella* with females of the species growing faster than males. Growth is usually faster in southern areas as compared to northern areas (Branton et al. 2003).

Redfish are icethotropic viviparous with internal fertilization, which means that the fertilized eggs hatch inside the females and they give birth to live young (Scott and Scott 1988; Gascon 2003). Mating likely occurs during the late fall and early winter. Females carry developing embryos until spring. Larvae hatch internally and are extruded during the late spring and early summer (St. Pierre and de Lafontaine 1995; Gascon 2003; Morin et al. 2004).

In all areas studies, *S. mentella* release their young a month earlier than *S. fasciatus* (Gascon 2003). Recruitment success is variable with significant year classes observed from 5- to more than 12-year intervals (Gascon 2003). The differences between strong and weak-year classes appear to be less in the southern range of redfish (Morin et al. 2004) with studies suggesting larval survival may be greatest at medium prey densities (Laurel et al. 2001).

Figure 4.13 Redfish Species Distribution in Atlantic Canada



Adapted from: Gascon 2003.

Based on DFO survey data collected from 1995 to 2002, Ollerhead et al. (2004) have determined a peak in redfish spawning in April in NAFO subdivisions 3Ps and 4VN, although spawning occurs elsewhere, at lower intensity, from April through July. Intense spawning is concentrated within the SEA Area during April along the western slope of the St. Pierre Bank and the Laurentian Channel, and in the Halibut Channel (Figure 4.14). The live young congregate in surface waters at night but migrate below the thermocline during the day to depths of 10 to 20 m (Fortier and Villeneuve 1996).

Redfish are pelagic or bathypelagic feeders, feeding primarily on zooplankton, including copepods, amphipods and euphausiids. Fishes and crustaceans become more important in the diet as redfish increase in size. Feeding is believed to occur at night, when redfish rise off the bottom and feed on pelagic organisms in the water column (Scott and Scott 1988). Although this diel vertical migration is well documented, it is poorly understood in the Laurentian Channel (Gascon 2003). Redfish larvae feed almost exclusively on calanoid copepods (Runge and de Lafontaine 1996). Variability in the annual production cycle of these copepods can be an important factor in interannual differences in growth and survival of redfish larvae (Anderson 1994).

Redfish stock structure and resulting management strategies are complex due to the recognition of three species as well as the occurrence of introgressive hybridization individuals (Morin et al. 2004). A detailed review of available data resulted in the implementation of modified management units for redfish in 1993 (Morin et al. 2004). Unit 1 represents redfish in the Gulf of St. Lawrence comprised of redfish from Division 4RST, 3PN and 4Vn (January to May). Unit 2 is comprised of redfish from 3Ps, 4Vs, 4Wfgi and 3Pn, 4Vnl (June to December).

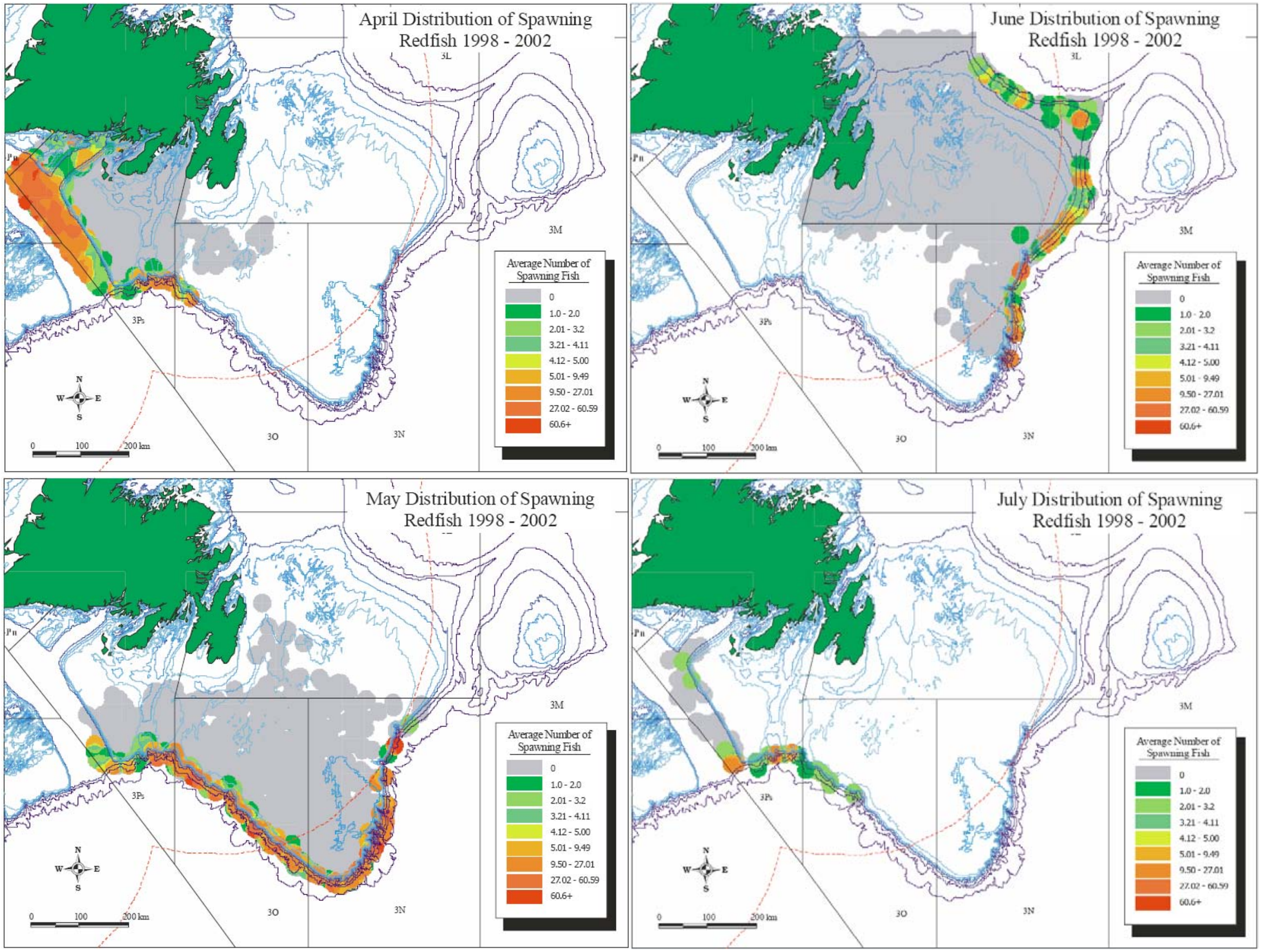
The stock structure of redfish has recently been examined via parasite tagging and genetic analyses. The parasite tagging studies confirmed distinct redfish stocks occurred off Labrador and on the Flemish Cap (Morin et al. 2004; Marcogliese et al. 2003). These studies also suggested that redfish from Unit 1 and Unit 2 may belong to distinct stocks. The results of the parasite tagging studies are only partly supported by population genetic studies (Morin et al. 2004). These studies indicate the population structure of redfish may be determined by the importance of introgressive hybridization between *S. fasciatus* and *S. mentella* which occurs in the Gulf of St. Lawrence and the Laurentian Channel.

Redfish species *S. mentella* has been placed on the Prioritized Candidate List by COSEWIC in October 2006 (COSEWIC 2006a).

4.4.2.4 Atlantic Halibut

Atlantic halibut is the largest of the flatfishes and is typically found along the slopes of offshore banks. Atlantic halibut migrates seasonally between shallow and deep waters, avoiding water temperatures below 2.5°C. Within the SEA Area, Atlantic halibut distribution includes the deep waters bordering the Laurentian Channel during the spring (Figures 4.15 and 4.16) (Scott and Scott 1988; Kulka et al. 2003).

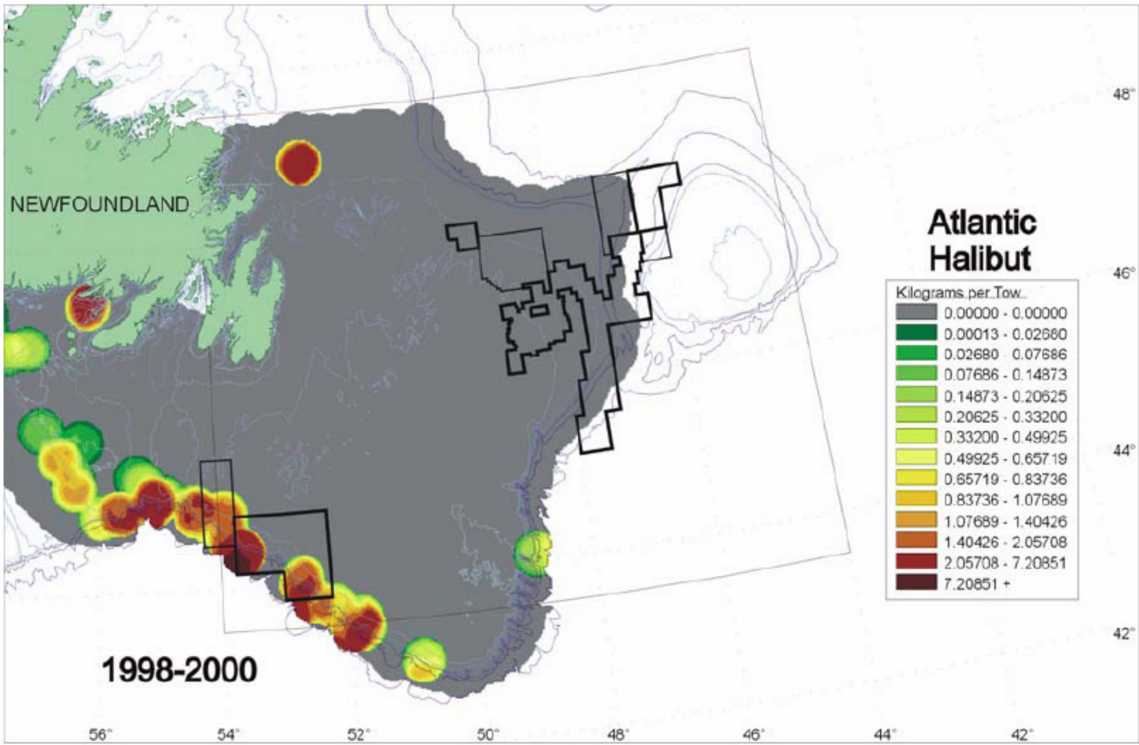
Figure 4.14 Distribution of Spawning Redfish (1998 to 2002)



Source: Ollerhead et al. 2004.

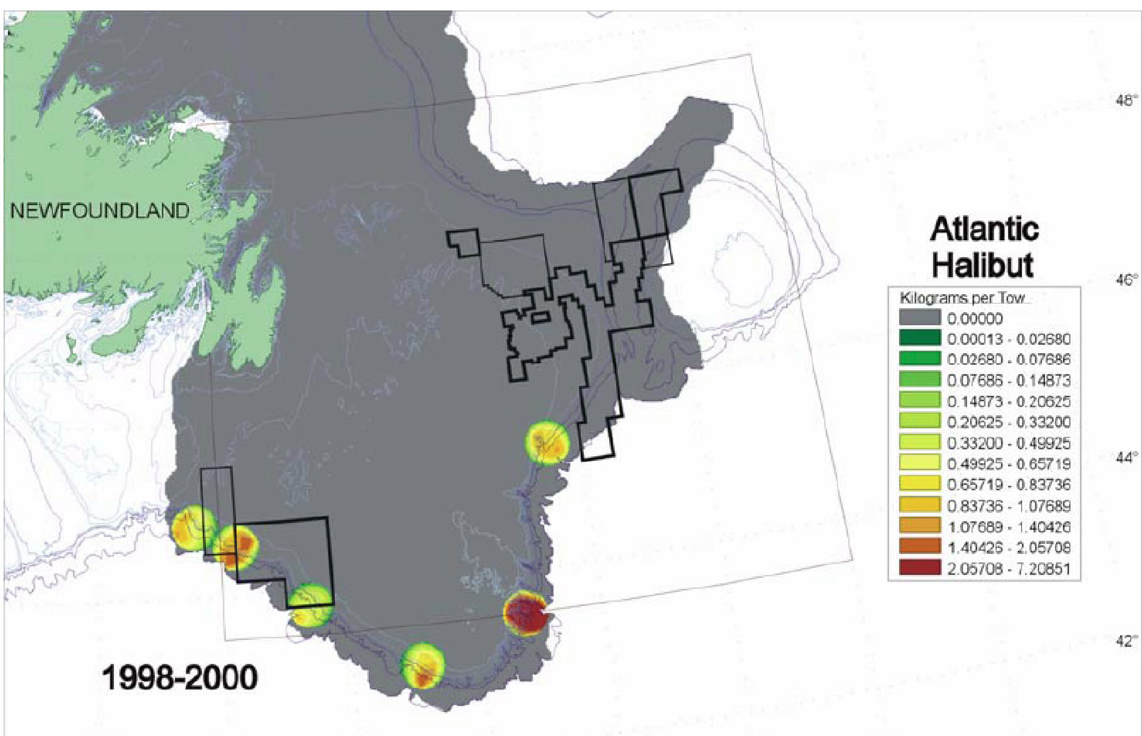
Note: The 0 class represents survey sets where no fish were caught.

Figure 4.15 Atlantic Halibut Distribution Based on Spring Research Surveys, 1998 to 2000



Source: Kulka et al. 2003.
Note: Grey represents areas sampled with no catch data.

Figure 4.16 Atlantic Halibut Distribution Based on Fall Research Surveys, 1998 to 2000



Source: Kulka et al. 2003.
Note: Grey represents areas sampled with no catch data.

The spawning grounds of Atlantic halibut are not clearly defined; however, it is known that they spawn between February and April at depths of 1,000 m or more, in most of their Canadian range. Their eggs are neutrally buoyant and float at depths of 300 to 400 m. As they develop, they sink to the seabed. Once hatched, the larvae rely on their stored yolk for food for four to five weeks while their mouth and digestive tract develops. After a few weeks of feeding on planktonic invertebrates, they metamorphose from bilaterally symmetrical larvae to asymmetrical flatfish and take up residence on the seabed. As juveniles (less than 30 mm in length) on the seabed, Atlantic halibut consume mainly benthic invertebrates including annelid worms, crabs, shrimps and euphausiids. Young adults (30 to 80 mm) feed on both invertebrates and small fishes, while mature adults (greater than 80 mm in length) feed only on fishes (Scott and Scott 1988; DFO 2006d).

Atlantic halibut movements have been monitored since the late 1990s through the Gulf Atlantic Halibut Tagging Program. Its purpose is to study the movements of Atlantic halibut in and out of the Gulf and determine links between the Atlantic halibut of NAFO subdivision 3Pn and adjacent stocks of 4RST and 4VWX3NOPs. The results of the study indicate that individuals are mainly recaptured in the fishing division in which the tagging took place. Only one individual tagged in 3Pn (of 137 tagged) was recaptured outside the subdivision (in 4R). A few individuals from 4R were found in 4S (nine individuals) and 3Pn (two individuals). Only one individual from 4T was found in 3Pn (DFO 2005c).

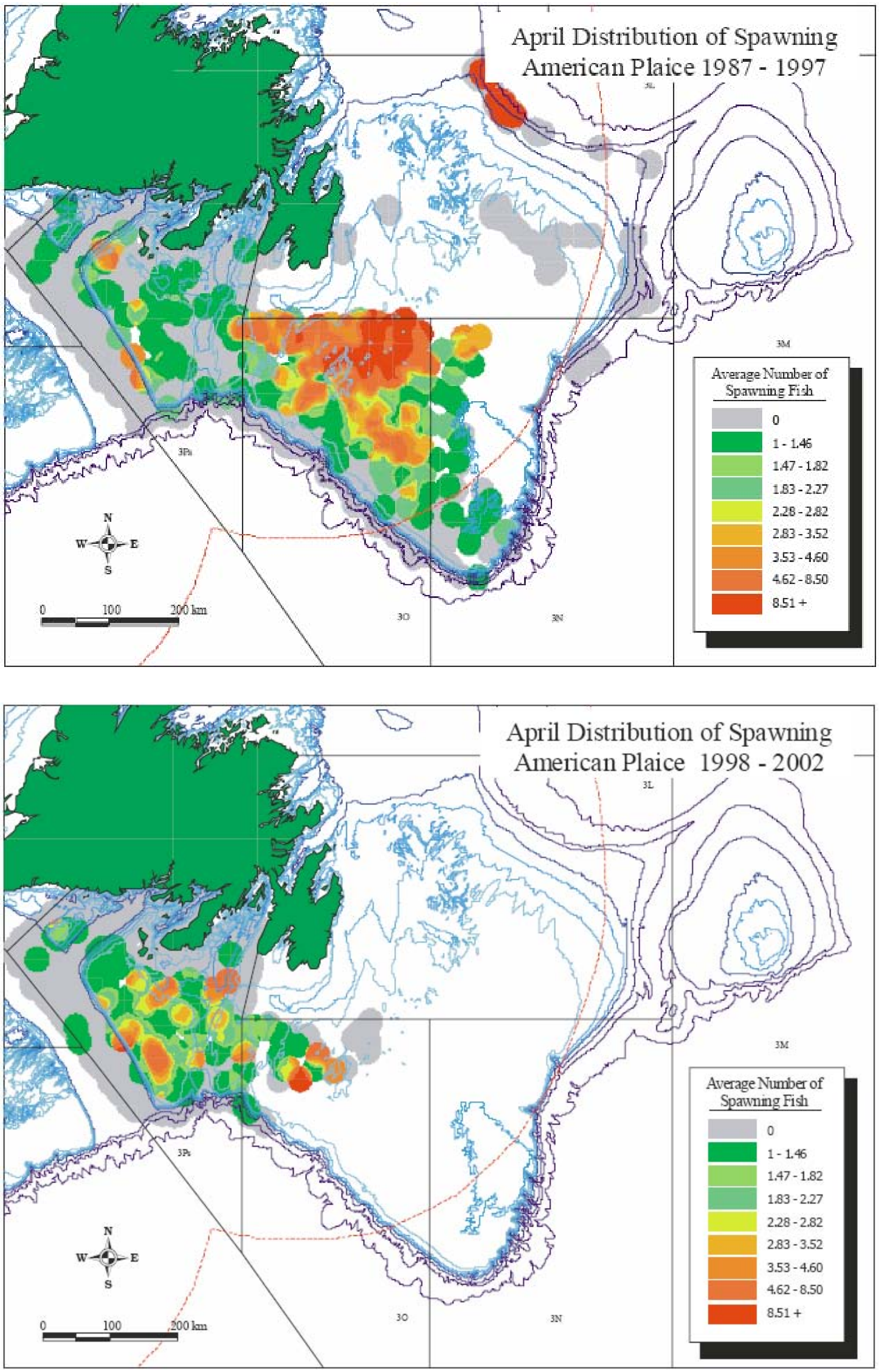
Atlantic halibut has been placed on the Prioritized Candidate List by COSEWIC in October 2006 (COSEWIC 2006a).

4.4.2.5 American Plaice

American plaice (*Hippoglossoides platessoides*) is a bottom dwelling flatfish that resides on both sides of the Atlantic (DFO 2006e). American plaice that reside in the western Atlantic region range from the deep waters off Baffin Island and western Hudson’s Bay southward to the Gulf of Maine and Rhode Island (Scott and Scott 1988). In Newfoundland waters, plaice occurs both inshore and offshore over a wide variety of bottom types (Morgan 2000). They are tolerant of a wide range of salinities and have been observed in estuaries (Scott and Scott 1988; Jury et al. 1994). Plaice are typically found at depths of approximately 90 to 250 m, but have been found as deep as 713 m. Most commercially harvested plaice are taken at depths of 125 to 200 m. They are a coldwater species, preferring water temperatures of 0°C to 1.5°C (Scott and Scott 1988). Tagging studies conducted on juvenile and adult plaice on the Grand Banks and in St. Mary’s Bay showed that the species is sedentary, with most recaptures occurring within 48 km of release (Pitt 1969). However, older plaice have been known to move up to 160 km (Powles 1965). Migrations have been observed in Canadian waters to deeper offshore waters in the winter, returning to shallower water in the spring (Hebert and Wearing-Wilde 2002, in Johnson 2004).

In Newfoundland waters, American plaice spawn during the spring. Within the SEA Area, there is limited data with respect to the actual spawning times. However, the limited data indicates that spawning does occur in April (and possibly other months) on Burgeo Bank, St. Pierre Bank and along the slopes of the Laurentian Channel and Hermitage Channel (Ollerhead et al. 2004) (Figure 4.17). Spawning on the St. Pierre Bank typically occurs in water temperatures of 2.7°C (Scott and Scott 1988). Large quantities of eggs are released and fertilized over a period of days on the seabed (Johnson 2004). Eggs are buoyant and drift into the upper water column, where they are widely dispersed, allowing for some intermingling of stocks. Intermingling of adults is minimal. Hatching time is temperature dependant, occurring in 11 to 14 days at temperatures of 5°C (Scott and Scott 1988). Larvae are 4 to 6 mm in length when they hatch and begin to settle to the seabed when they reach 18 to 34 mm in length and their body flattens (Fahay 1983).

Figure 4.17 April Distribution of Spawning American Plaice, 1980 to 2002



Source: Ollerhead et al. 2004.
Note: The 0 class represents survey sets where no fish were caught.

Larval plaice feed on phytoplankton and zooplankton while in the upper water column (Pitt 1989). When they have settled to the seabed, their diet changes as they grow, ingesting larger and larger benthic organisms, and is dependant on their location. On the Grand Banks, small plaice (less than 30 cm) consume crustaceans and small echinoderms (Pitt 1973). Adult plaice generally consume large quantities of fish. Adult plaice on the southern Grand Banks exhibit a diurnal feeding pattern. They consume large amounts of brittle stars and capelin in the afternoon, and switch to sand lance later in the day (Zamarro 1992). This may be linked to periods of increased availability of prey at these times of day. Feeding intensity is highest during the spring and summer, likely to replenish energy stores lost during gonadal development during the winter (Zamarro 1992).

American plaice is managed as seven stocks in the Northwest Atlantic (DFO 2006e). Only 3Ps falls within the SEA Area. Catches from this stock were highest in the late 1960s and early 1970s, averaging 10,000 tonnes. The stock size has declined since this time reaching its lowest point in 1992. In 1993, the stock was placed under moratorium and currently remains under moratoria (Morgan et al. 2005). There has been a slight increase in stock biomass and abundance from 1992 to 2005 but the stock is currently only 20 percent of the 1983 to 1987 biomass. Since 1993, catches of American plaice have been mainly as by-catch in the Atlantic cod and witch flounder directed fisheries (Morgan et al. 2005). Catches (primarily by-catches of Atlantic cod and witch flounder fisheries) at current levels (over 1,000 tonnes for 2001 through 2003) may be contributing to the lack of recovery of 3Ps American plaice (DFO 2005d).

As cod and plaice occupy the same habitats, DFO contracted two vessels to carry out 15-day trials of new gear on Burgeo Bank in the fall of 2001. The new gear consisted of various circle-hook sizes. The study found that the use of larger hooks and hooks floated off the bottom did not significantly reduce the by-catch of American plaice in the longline cod fishery on Burgeo Bank (Brothers 2002).

American Plaice has been placed on the Prioritized Candidate List by COSEWIC in October 2006 (COSEWIC 2006a).

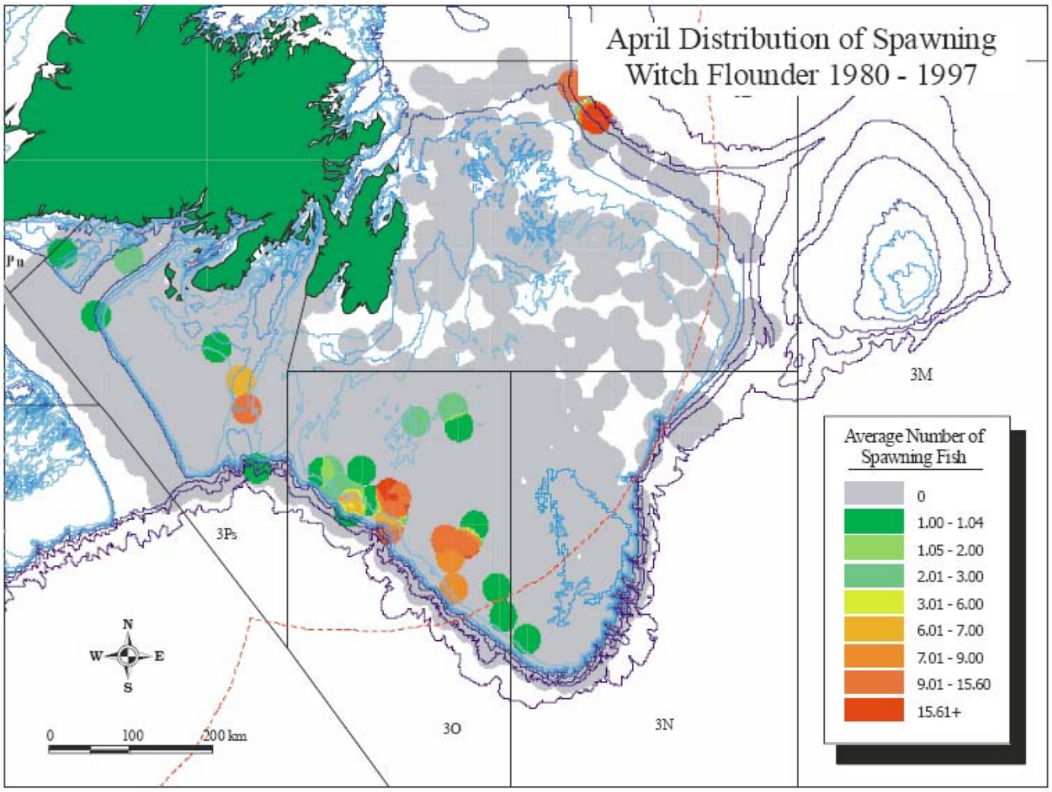
4.4.2.6 Witch Flounder

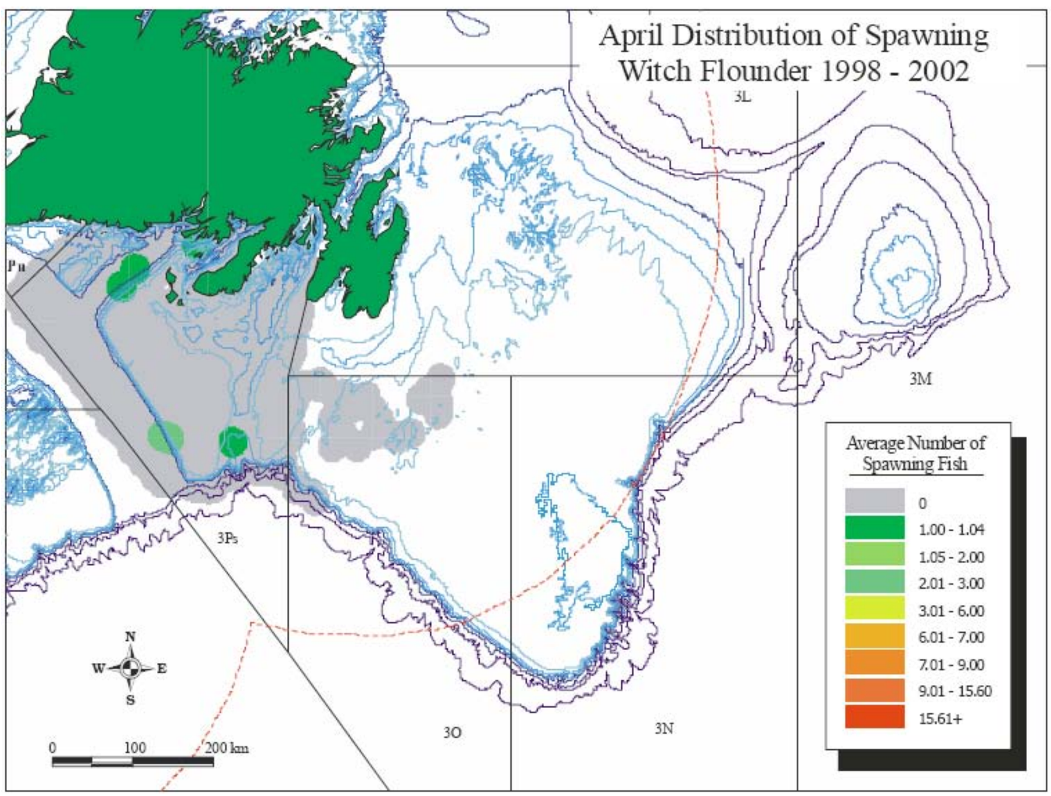
Witch flounder (*Glyptocephalus cynoglossus*) are a deep water flatfish, also known as greysole, occur in the Northwest Atlantic from Hamilton Inlet in Labrador south to Cape Hatteras. They are usually found offshore, in moderately deep water, mainly at depths of 45 to 275 m, preferring mud or sand-mud substrates, water temperatures of 2°C to 6°C and do not migrate (Scott and Scott 1988; Cargnelli et al. 1999). In 3Ps, witch flounder are primarily distributed along the slope around St. Pierre Bank, and in the Hermitage Channel (Maddock-Parsons 2005a).

Witch flounder are a slow growing, long lived species that have been aged over 20 years old (Maddock-Parsons 2005a). However, witch flounder age groups in 3Ps have been substantially reduced and fish older than 13 years are rarely observed in commercial or survey catches since the early 1999s (Maddock-Parsons 2005a).

In the Northwest Atlantic, spawning occurs over a prolonged period extending from March through September (Figure 4.18). Spawning for witch flounder in 3Ps is early by comparison with the highest intensity observed in January through March (Maddoc-Parsons 2005a). During winter and spring, witch flounder can be found in spawning concentrations along the continental shelf of the St. Pierre Bank and particularly in the Halibut Channel. The offshore commercial fisheries have focussed their effort on spatial and temporal to coincide with the above note spawning concentrations.

Figure 4.18 April Distribution of Spawning Witch Flounder, 1980 to 2002





Source: Ollerhead et al. 2004.
Note: The 0 class represents survey sets where no fish were caught.

Spawning occurs at the seabed but the buoyant eggs are pelagic and float to the surface, hatching approximately one week after spawning, at 8°C. Young fish can remain pelagic for a year before settling to the seabed (Cargnelli et al. 1999). This is the longest pelagic stage of any flatfish in Newfoundland waters (Scott and Scott 1988; Cargnelli et al. 1999).

Witch flounder's diet consists of benthic polychaetes and crustaceans, although small fishes, molluscs and echinoderms are also consumed (Scott and Scott 1988; Cargnelli et al. 1999).

4.4.2.7 Greenland Halibut

Greenland halibut (*Reinhardtius hippoglossoides*), commonly known as turbot, is a deepwater flatfish preferring temperatures of 0°C to 4.5°C. In the Northwest Atlantic, their range extends from Greenland to the Scotian Shelf and most are taken from depths greater than 450 m. Their depth range is from 90 to 1,600 m, with larger individuals occurring in deeper waters. Unlike most flatfishes, the Greenland halibut spends much of its time off the bottom, behaving as a pelagic fish (Scott and Scott 1988).

It is thought that turbot spawn in the Laurentian Channel and Gulf of St. Lawrence during the winter (Scott and Scott 1988). The eggs are benthic, but upon hatching the young move up into the water column and remain at depths of 30 m until they are approximately 70 mm in length. As they grow, the young halibut move downward in the water column and are transported by the currents (Scott and Scott 1988).

Greenland halibut is typically found in the channels of the Gulf of St. Lawrence and there are indications that the Gulf of St. Lawrence stock may spend its entire life within the Gulf (DFO 2005e). In winter, these fish migrate towards the entrance of the Gulf (Morin et al. 1996, in Archambault et al. 2001).

4.4.2.8 Skate

Five species of skate (Family Rajidae) are commonly found to occur on the Grand Banks (including the Grand, Whale, Green and St. Pierre Banks) of Newfoundland and Labrador (Kulka et al. 2006). The five species are the thorny skate (*Amblyraja radiata*), smooth skate (*Malacoraja senta*), spinytail skate (*Bathyraja spinicaudata*), winter skate (*Leucoraja ocellata*) and Barndoor skate (*Dipturus laevis*). The thorny and smooth skate account for approximately 95 percent of skate landings and are described in greater detail below.

Thorny Skate

Thorny skate are the most common skate species, making up 90 percent of all skate caught during DFO surveys (DFO 2003b). Thorny skate are commercially harvested in the SEA Area (Canning & Pitt 2006).

Thorny skate are a temperate to arctic species widely distributed in the North Atlantic distribution ranging from Greenland to South Carolina (Kulka et al. 2006). Thorny skate have been observed over a wide range of depths from nearshore to 1,700 m with most of its biomass noted to occur between 50 to 150 m (Kulka and Miri 2003a). Thorny skate are observed on both hard and soft substrates (Kulka et al. 1996) and are primarily associated with muddy, sandy and pebble substrates typical of Grand Banks sediment (Kulka and Miri 2003a).

The migration patterns of the thorny skate are not fully understood, but evidence suggests a seasonal migration concentrating toward the edge from December to June, and on the Banks for the remainder of the year (Kulka and Mowbray 1998). In part, thorny skate distributions may be influenced by temperature with thorny skate preferentially distributed in warmer waters on the Grand Banks, particularly in spring. Thorny skate have been observed to aggregate in waters with bottom temperatures of 4.5 to 5.2°C, which represent near maximum temperatures for the Grand Banks. The most common temperature where skate are found is in the 3°C to 4°C range (Colbourne and Kulka 2004).

Observations from the managed thorny skate areas (3LNO and 3Ps) indicate a relatively continuous distribution and lack of physical barriers suggest that the thorny skate concentrating on the shallow edge of the Grand Banks and extending from the tail of the Grand Banks to the southern edge of the St. Pierre Bank constitute a singe reproductive unit (Kulka and Miri 2003a). There is information that suggests thorny skate on the northern section of the Grand Banks and northeast Newfoundland shelf are becoming increasingly separated from those to the south.

The life span of the thorny skate has not been studied, but data from tagging studies indicate they may live for 20 years or more (DFO 2003b; Kulka and Miri 2003a). Males have been found to mature at smaller sizes than females with size at maturity increasing from north to south. Ovaries of sexually mature females hold 10 to 12 pairs of eggs in various developmental stages (Kulka and Miri 2003a). Thorny skate deposit between 6 to 40 egg cases per year (DFO 2003b). Larger thorny skate produce larger egg cases, but it is not known if egg case size is related to survival rates (Kulka and Miri 2003a).

Thorny skate feed on a variety of invertebrates and fish including polychaetes, crabs and whelks (Kulka and Miri 2003a). The diets of larger skates include fish prey such as sculpins, redfish, sand launce and small haddock. Significant amounts of fish offal have been found in skate stomach and this coupled with the ventral mouth location suggests that thorny skate are opportunistic bottom feeders. There is limited information regarding thorny skate predation suggesting they are prey to large predators such as seals, sharks and Atlantic halibut.

Thorny skate abundances increased from the early 1970s through the mid 1980s (DFO 2003c), followed by a decline to its lowest levels in the mid-1990s. The population of thorny skate has remained stable at the lower abundance. Thorny skate have become concentrated in approximately 20 percent of their former range, primarily the edge of southwest Grand Banks. Concurrent with abundance decreases, a reduction in average weight was observed until the mid-1990s. Since 1994, the average weight has increased to approximately 1.5 kg compared to 0.5 kg in the mid-1990s. Small thorny skates are largely absent from the northern Grand Banks with the largest abundance of small thorny skates occurring in 3Ps.

Thorny skate is currently under review by COSEWIC (D. Kulka, pers. comm.).

Smooth Skate

Smooth skate is found along the Atlantic coast of North America ranging from the Gulf of St. Lawrence and Labrador shelf to South Caroline (Packer et al. 2003). Smooth skate live on soft mud and clay bottom, often in deep troughs and basins (Scott and Scott 1988). It is found at depths ranging from 46 to 457 m with greatest abundances noted below 110 m. Smooth skate are found in the deep waters along the slope of the Laurentian Channel (Swain and Benoit 2001), though may be occasionally captured in shallow areas.

There is limited knowledge available on the life history of the smooth skate. The diet of smooth skate is comprised of amphipods, mysids, decopods, euphausids and fish species including yellow tail, hake, witch flounder and sand launce (Packer et al. 2003).

Smooth skate is currently under review by COSEWIC (P. Shelton, pers. comm.) with the species schedule to be assessed in May 2008.

4.4.2.9 Pollock

Pollock (*Pollachius virens*) is a cod-like fish, but spends more of its time moving through the water column than its bottom-dwelling relatives. They prefer depths between 110 to 181 m and water temperatures of 0°C to 10°C (Scott and Scott 1988; DFO 2006f). They are at the northern extent of their range in Newfoundland waters (DFO 2006f), so are not widely distributed. Pollock distribution in NAFO subzone 3Ps is mainly restricted to the slope waters of the Burgeo and St. Pierre Banks and inshore waters. Mature pollock occur on the slopes of St. Pierre and Burgeo Bank (Figure 4.19). In the summer months, schools of young pollock are sometimes found in harbors along the south coast of Newfoundland. DFO RV surveys indicate that they are restricted to these slopes and inshore waters (Murphy 2003; DFO 2006f).

There is limited life history information on the pollock of 3Ps, and much of that information is inferred from studies on more southernly stocks (Murphy 2003). 3Ps pollock may represent the northern boundary for 4VWX5Zc stock rather than separate stock (Murphy 2003, DFO 2006f).

Pollock has been placed on the Prioritized Candidate List by COSEWIC in October 2006 (COSEWIC 2006a).

Young pollock feed almost entirely on small fishes, including herring (*Clupea harengus*), sand lance (*Ammodytes* spp.) and redfish. Adults eat the same species, as well as crustaceans. They have relatively few natural predators, although they are known to fall victim to cannibalism and harbour seals (Scott and Scott 1988).

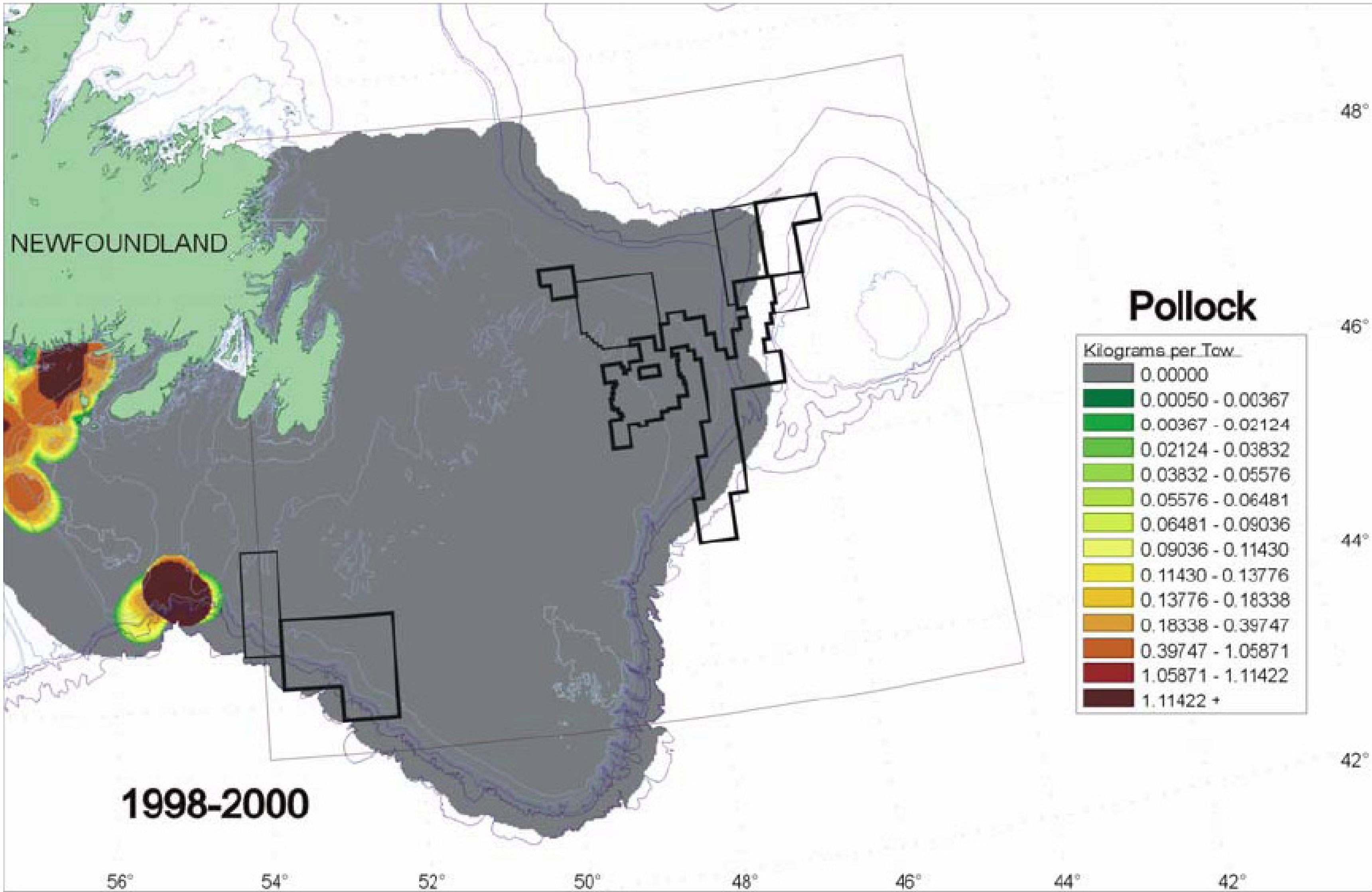
4.4.2.10 White Hake

White hake (*Urophycis tenuis*) is a highly found, bottom dwelling species that ranges from Cape Halteras to Southern Labrador (Kukla et al. 2006; Kulka et al. 2005a). They prefer mud bottoms with temperatures ranging from 5°C to 11°C (Scott and Scott 1988; Kulka et al. 2005a). White hake occur over a wide range of depths from less than 50 m to approximately 1,000 m (Kulka et al. 2004). White hake are a temperate species at the limit of their temperature range and as a result are spatially restricted to the south western Grand Banks (Kulka et al. 2005a).

White hake occur continuously along the southwest portion of the Grand Bank, into the Laurentian Channel, western edge of the St. Pierre Bank, Burgeo Channel, Hermitage Channel and nearshore as far east as Hermitage Bay (Figure 4.20). White hake are rarely encountered west of Hermitage Bay in the areas of Fortune Bay, Placentia Bay or waters south of these areas. This pattern of distribution has been consistent for all years examined from 1971 to 2004 (Kulka et al. 2004).

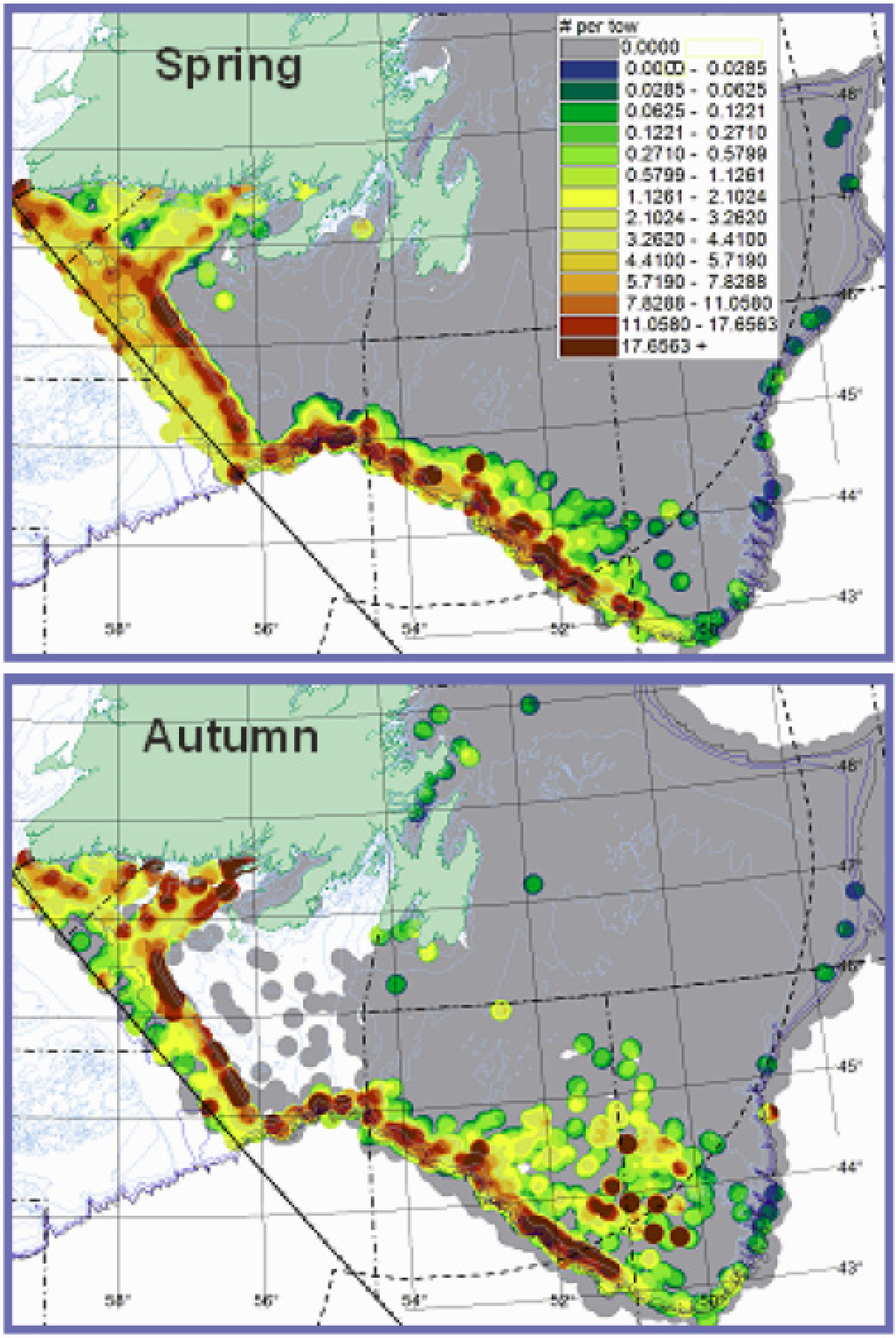
White hake concentrate at warmest locations with its main concentrations occurring on the western slope of the Grand Banks and St. Pierre Bank (Kulka et al. 2005a). This has resulted in the restricted distribution of white hake to occupy approximately 20 percent of available habitat on the Grand Banks because a vast majority of the Grand Banks has water temperatures less than 5°C year round. Although there have been abundance and biomass fluctuations over the years, the habitat occupied by white hake has remained stable. A subtle shift in distribution occurred during the 1989 to 1995 period and was attributed to colder bottom temperature that further restricted white hake distributions.

Figure 4.19 Pollock Distribution Based on Spring Research Surveys, 1998 to 2000



Source: Kulka et al. 2003.
Note: Grey represents areas sampled with no catch data.

Figure 4.20 Seasonal Distribution of White Hake in the Waters of Newfoundland (Northwest Atlantic Fisheries Organization Divisions 3LNPO and Subdivisions 3Ps and 3Pn)



Source: Kulka et al. 2005a.

Note: Based on seasonal RV surveys, 1971 to 2004. Grey areas are locations surveyed but without catches of white hake.

Examination of length frequency data indicate that white hake distribute differentially by size between NAFO Divisions (Kulka et al. 2005a). White hake less than 30 cm are rarely observed in 3Ps (<2 years old fish). The Grand Banks spawning ground is located in a narrow band along the continental slope (females >56 cm in length). Mature fish (>56 cm) do not tent to distribute into the Laurentian Channel, shallow areas or coastal areas. First year fish dominate shallow southern regions of the Grand Banks and nearshore locations and are largely absent from the southern tip of the Grand Banks to the Laurentian Channel. White hake ranging in length from 26 to 66 cm dominate the Laurentian Channel (fish aged 2 plus) with the majority of them juveniles (18 to 56 cm).

There are data gaps associated with fish maturity and spawning cycles to the timing of the fishery surveys (Kulka et al. 2005a). Spawning is known to occur along the south western slope of the Grand Banks in April and May. Fishery observer reports indicate spawning was complete prior to the July to August period.

White hake eggs and larvae are pelagic with young of the year observed in August to September over the Grand Banks, with densest concentrations occurring on the shallow areas of the southern Bank (Kulka et al. 2005a). White hake juveniles are typically found offshore on the southern Grand Banks in autumn at bottom depths between 50 to 80 m and corresponding to the warmest areas within the 100 m Bank contour. Newly settled juveniles are geographically separated from larger white hakes and this is a beneficial adaptation as large white hake are known to prey on younger ones.

As the juveniles grow, they increasingly mix with larger white hake and by the following spring year one fish are fully integrated along the outer Grand Banks (Kulka et al. 2005X). Older juveniles (18 to 56 cm) occupy the greatest range of the white hake life stages extending from the southwest coast of Labrador, into Laurentian Channel and along the southwest slope of the Grand Banks.

White hake from various stocks mix in the Laurentian Channel, with the primary stock an extension of the Grand Banks stock that mix with Scotian Shelf and Gulf of St. Lawrence stocks.

White hake prey heavily on other fishes. In Newfoundland waters they prey upon silver (*Merluccius bilinearis*), red (*Urophycis chuss*) and longfin (*Phyois chesteri*) hake, Atlantic cod, herring and flatfishes (Kulka and Simpson 2002).

White hake is currently under review by COSEWIC (P. Shelton, pers. comm.) with the species scheduled to be assessed in November 2007 or May 2008.

4.4.2.11 Monkfish

Monkfish (*Lophius americanus*) are a bottom dwelling species that range from its northern limit on the Labrador shelf and south to Florida (DFO 2003c). It is more commonly found on southern Grand Banks, Scotian Shelf, Bay of Fundy, southern Gulf of St. Lawrence, Georges Bank and in the shelf waters of the mid-Atlantic Bight (Kulka and Miri 2003b). Its Grand Banks range is limited to southwest slope of the Grand Banks, western slope of the St. Pierre Bank and the Laurentian Channel.

The stock structure of the monkfish is largely unknown and the degree of mixing is also unknown (Kulka and Miri 2003b). The discontinuous distribution between the Scotian Shelf, Gulf of St. Lawrence and the Grand Banks is suggestive of distinct populations. Fisheries management considers the Scotia Shelf a unit and the Grand Banks stock is managed as 3LNO and 3Ps.

Monkfish inhabit a variety of depths from the shoreline out to 800 m (Kulka and Miri 2003b). Monkfish are found in a wide range of temperature from 0°C to 21°C, with their preferred temperature in the range of 6°C to 10°C. As a result, the monkfish distribution is restrictive, occurring in areas of the Grand Banks and Laurentian Channel that exceed 3°C. The highest densities are observed where bottom waters exceed 4°C. The geographical distribution of monkfish on the Grand Banks has changed little over the past 50 years. The centre of distribution has had subtle shifts over the years, attributed to cooler waters that were observed in the mid-1980s to early 1990s. A shift to deeper waters could reflect an avoidance of colder water in those years. Monkfish spread into the Grand Banks in autumn, when bottom temperatures are warmer; however, this seasonal expansion is limited.

Monkfish biomass exhibits a bimodal distribution (Spring), suggestive of a population segregated by size or sex (Kulka and Miri 2003b). There is limited data or information with respect to spawning and their reproductive cycle for the Grand Banks. Monkfish are a short-lived species, with a maximum age of approximately 11 years.

Monkfish in the southwest Grand Banks may be comprised of a single biological unit but are managed as two units (3LNO and 3Ps) for licensing.

Survey biomass and abundance show considerable fluctuations with peaks in 1977 and 1988. After declines to their lowest levels, the biomass and abundance indices have increased, with 2003 representing a peak year for abundance.

4.4.2.12 Porbeagle

Porbeagle (*Lamna nasus*) is a large cold-water pelagic shark distributed in the western Atlantic from Greenland to Bermuda (COSEWIC 2004). Its distribution includes all the waters off Newfoundland. In the SEA Area, porbeagle are specifically found on the St. Pierre Bank and in the Laurentian Channel in the spring and summer months (Scott and Scott 1988). Mating occurs annually from September through November and live birth occurs eight to nine months later with an average litter size of four (Jensen et al. 2002). Porbeagle has an estimated lifespan of 25 to 46 years and a generation time, the mean age of female parents, of 18 years (Campana et al. 1999; Natanson et al. 2002, in COSEWIC 2004).

Abundance of porbeagle has declined greatly since it was targeted commercially in the 1990s after an earlier collapse and partial recovery (COSEWIC 2004). Its life history characteristics, including late maturity and low fecundity, make this species vulnerable to overexploitation (COSEWIC 2004). Prior to 1991, the most abundant age-class off southern Newfoundland in the fall months was 10 to 15 years old. This is consistent with the use of the area as a mating ground. Between 1998 and 2000, the most abundant age classes in this area were less than age 3 (Campana et al. 2002).

Porbeagle were assessed as endangered by COSEWIC in 2004 (COSEWIC 2006a) and are pending public consultation for addition to SARA Schedule 1.

4.4.2.13 Herring

Herring is a pelagic, schooling fish usually occurring in shallow inshore waters. It also occurs offshore from the surface to depths of 200 m. There are a number of separate herring populations in the Northwest Atlantic and each has preferred spawning, feeding and wintering grounds.

The time and location of spawning depends of the herring stock. Most stocks spawn in spring or fall (Scott and Scott 1988). Herring are demersal spawners, depositing their eggs on stable substrates in high energy environments with strong tidal currents (Iles and Sinclair 1982, in Stevenson and Scott 2005). Spawning can occur on offshore banks at depths of 40 to 80 m; however, most herring stocks spawn in shallow coastal waters at depths of less than 20 m. In Newfoundland waters, it appears that herring spawn in coastal waters only. For coastal spawning stocks spring spawning usually occurs in shallower waters than fall spawning (LGL 2005b). Tibbo (1956) found that the main spawning locations in Newfoundland waters are found at the heads of bays and deepwater inlets.

Herring larvae are pelagic. The larval stage of fall-spawned herring is much longer than spring-spawned herring, lasting through the winter months. Larvae are very light sensitive, seeking deeper waters on bright days (Scott and Scott 1988).

During the public consultation meetings conducted for this SEA, local fishermen reported that herring spawn off Port aux Basques (Canning & Pitt 2006).

A herring reconnaissance survey was conducted in the late winter and spring of 2006 along the south coast of Newfoundland. The purpose of this study was to determine if herring were present along the south coast and to tag 20,000 individuals to determine if they were from the Southern Gulf population. A total of 14 days at sea, surveying the inshore waters from Cape Ray, near Port Aux Basques, to Pass Island, near Hermitage Bay, resulted in a total of 96 herring caught, all in LaPoile Bay indicating that there are few herring in the area. The data are insufficient to determine whether these herring are part of the Southern Gulf population. The survey was conducted at a time when herring were expected to be aggregated along this coast. To date, no decision has been made to proceed with a detailed acoustic survey to further assess the biomass (J. Wheeler, pers. comm.).

4.4.2.14 Capelin

Capelin (*Mallotus uillosus*) is a small pelagic species that has a circumpolar distribution in the Northern hemisphere (DFO 2006g). Capelin are members of the smelt family (*Osmeridae*), olive in color with an elongated body and exhibit pronounced sexual dimorphism during spawning. Capelin are found along the coasts of Newfoundland and Labrador and on the Grand Banks.

Migration towards the coast precedes spawning on beaches or in deeper waters (DFO 2006g). Capelin role on sandy or fine gravel beaches in water temperatures in the range of 6°C to 10°C. Beach spawning is more prevalent at night. Capelin are able to spawn at the age of two and males usually die following spawning.

Spawning commences in early June and may continue through July depending upon tides, winds and water temperatures (Scott and Scott 1988).

Eggs are red in color, 1 mm diameter and are attached to the substrate. Incubation varies with ambient temperature and lasts approximately 15 days at 10°C. Larval capelin are plankton and remain near the surface until the onset of winter.

Capelin prey consists of planktonic organisms comprised of primarily of euphausiids and copepods. Capelin feeding is seasonal with intense feeding late winter and early spring leading up to the spawning cycle when feed ceases. Feed recommences several weeks after cessation of spawning.

Capelin are major component in marine ecosystem dynamics as they facilitate the transfer of energy between trophic levels, principally between primary and secondary producers to higher trophic levels (DFO 2006g). Capelin predators comprise most major fish species including Atlantic cod, haddock, herring, flatfish species, dogfish and others. Several marine mammal species including minke whales, fin whales, harp and ringed seals as well as a variety of seabirds also prey on capelin.

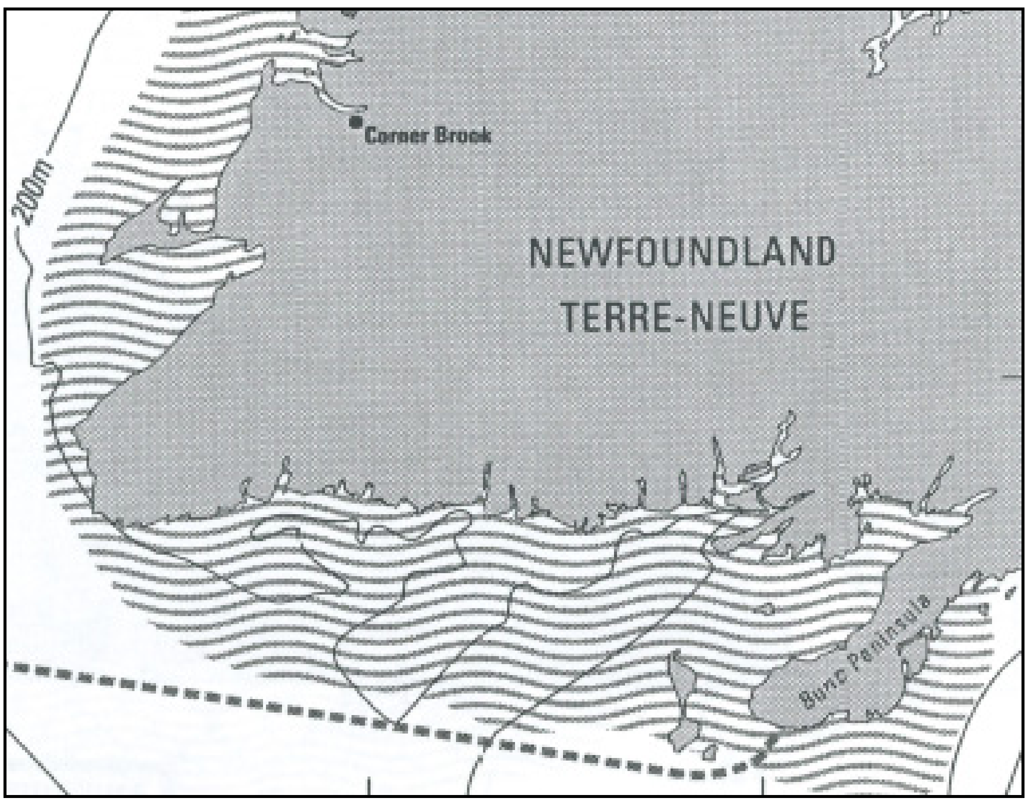
The primary cause of capelin mortality is associated with predation and as such variations in capelin abundances are directly linked to natural causes (DFO 2006g). Capelin have a short life span (usually five years or less), abundances are linked to a few age classes. Management of capelin fisheries tends to be conservative as a result of the prominent role of capelin in the marine ecosystem.

4.4.2.15 Lumpfish

Lumpfish (*Cyclopterus lumpus*) are considered as groundfish that range on both sides of the North Atlantic. In the northwest Atlantic, lumpfish range from Greenland south to Cheasapeak Bay (DFO 2006h). Meltzer (1996) indicates that Lumpfish are found throughout the SEA area, on Rose Blanche Bank, Burgeo Bank, St. Pierre Bank and in the Hermitage Channel. Lumpfish are present in high concentrations on St. Pierre Bank in the spring (D. Mercer, pers. comm.) and local fisher have commented that lumpfish are abundant on the St. Pierre Bank (Canning & Pitt 2006). Lumpfish distribution in water adjacent to the coast of Newfoundland and Labrador is illustrated in Figure 4.24).

During early life stages lumpfish attach to rocks, lobster traps and other solid objects with their pelvic adhesive disc (DFO 2006h).

Figure 4.21 Lumpfish Distribution in Southern Newfoundland Waters



Source: Meltzer 1996.

Lumpfish undergo a coastal migration for spawning which takes place in May and June (DFO 2006h). Lumpfish feature sexual dimorphism with male lumpfish significantly smaller than the females. Males arrive on the spawning grounds several weeks in advance of the females to establish their territories.

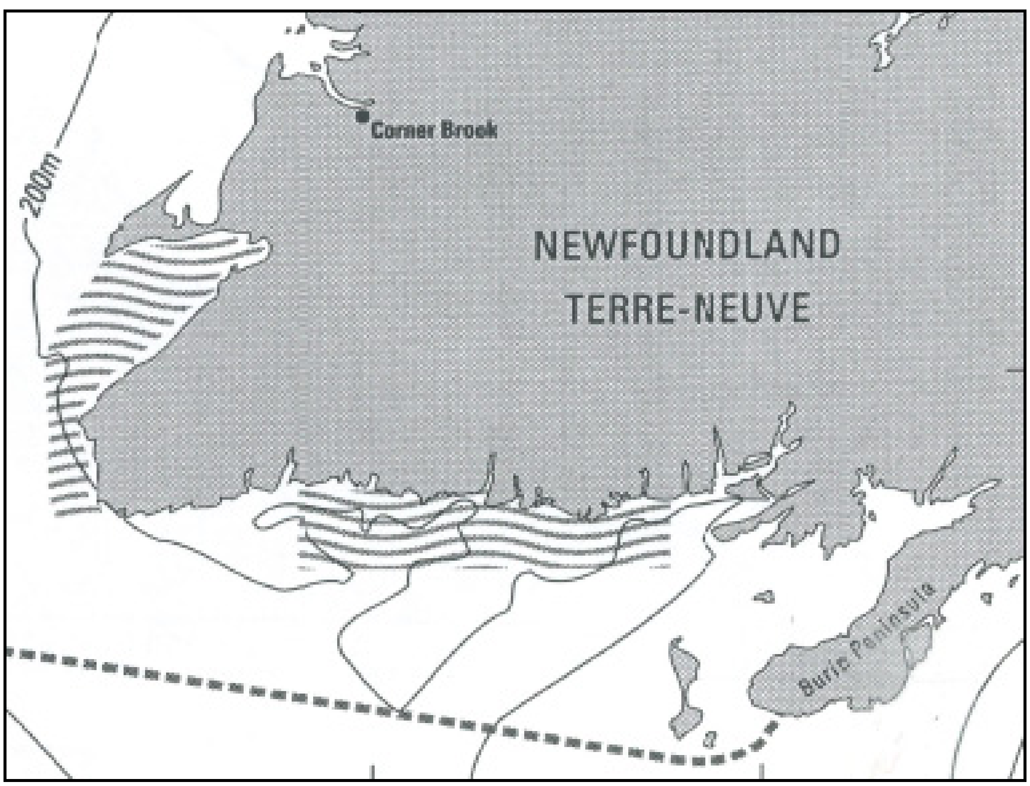
The females lay two to three egg mass at intervals ranging from 8 to 14 days. Once the eggs are deposited, females migrate back to deeper water leaving the males to guard the egg masses (DFO 2002d; 2006h). Egg mass may contain more than 100,000 to 130,000 eggs measuring 2 mm in diameter with one oil globule and light green to yellowish in colour. Males guard and fan the egg masses for the duration of incubation (Scott and Scott 1988). Larval are approximately 5 mm at release after six to eight weeks of incubation. Juveniles are semi-pelagic, remaining in the top meter of the water column for their first year during which they are often associated with floating algae.

A tagging study conducted in May to June of 2004 and 2005 has yield limited data due in part to the seasonal and short duration of the fishery (DFO 2006h). The longest distance covered by a lumpfish was 300 km with the lumpfish having traveled from 3Pn to Fortune Bay over a three month period. Only 37 of 914 lumpfish tagged in 2004 were recaptured in 2005 and these data are insufficient to determine exploitation rates.

4.4.2.16 Sand Lance

Sand lance is a small planktivorous fish found on sandy seabeds. It lives partially buried in the sand and occasionally rising into the water column to feed. It is found in the North Atlantic from Greenland to the Gulf of St. Lawrence and is typically found at depths of less than 91 m. Sand lance distribution in the SEA Area is shown in Figure 4.22. The species of sand lance present in the SEA Area is the northern sand lance (*Ammodytes dubius*). It co-occurs over much of its range with the American sand lance (*A. americanus*) (Scott and Scott 1988). On the Scotian Shelf, both species of sand lance spawn in the winter, from December to February (Scott and Scott 1988). There is no information available regarding the time of spawning in the SEA Area.

Figure 4.22 Sandlance Distribution in Southern and Western Newfoundland Waters



Source: Meltzer 1996.

This species is not commercially fished, but is an important part of the marine food-web as it is a food source for marine mammals and several species of fish including cod.

4.4.2.17 Demersal Sharks

Six species of small dogfish are resident in Canadian waters with the spiny dogfish (*Squalus acanthius*) and black dogfish (*Centroscyllum fabricii*) being the most abundant. Other demersal sharks in Canadian waters included the smooth dogfish (*Mustelus canis*), Portuguese shark (*Centroscymnus coelolepis*), deepsea cat shark (*Apristurus profundorum*) and great lantern shark (*Etmorpterus princes*)

Spiny Dogfish

The spiny dogfish is a widely distributed boreal to warm temperate species distributed over continental and insular shelves and upper slopes of the Pacific and Atlantic oceans (Kulka 2006). Their western Atlantic distribution ranges from Labrador to Florida, with their centre of abundance located between the southern Scotian Shelf and Cap Hatteras. Spiny dogfish concentrate at bottom depth of 10 to 200 m in water ranging between 7°C to 15°C. Thus, the spiny dogfish are at the northern limit of their distribution in Newfoundland and Labrador waters. Spiny dogfish concentrate on the Western portion of the St. Pierre Bank adjacent to the Laurentian Channel and onto the Hermitage Channel in water depths of 100 to 250 m. They congregate in the warmest available water (>5°C) and the population are comprised of mature adults.

Data from commercial catches observed spiny dogfish catches year-round, with the highest catches in winter and spring months (Kulka 2006). The winter catches were concentrated along the western edge of the St. Pierre Bank, which has the highest Grand Banks bottom temperatures (approximately 60°C year-round). This would indicate that a portion of the spiny dogfish distributed over the St. Pierre Bank is resident year-round and the St. Pierre Bank is a winter ground for spiny dogfish. The data suggest there is a local in shore/offshore migration pattern.

Spiny dogfish distributions are patchy and they form dense aggregations, causing high variability in survey indices. The absence of young juveniles coupled with survey abundance variability suggests that the early life history stages (pupping and juveniles) occur elsewhere and, as such, the spiny dogfish on the Grand Banks are not independent stock.

Spiny dogfish exploitation has averaged 14+ annually between 1996 and 2005 and is a by-catch of redfish, monkfish and crab fisheries in 3Ps. Exploitation mortality on the Grand Banks is small compared to the Grand Banks biomass index.

Spiny dogfish is currently under review by COSEWIC (P. Shelton, pers. comm.).

Black Dogfish

Black dogfish is distributed along the slopes of the Atlantic Ocean Basin ranging from Greenland down to Cape Hatteras, possibly Florida and into the Gulf of Mexico (Kulka 2006). Black dogfish are a bathydemersal species resident in waters as shallow as 300 m but generally found in water deeper than 500 m. Black dogfish are concentrated in the Laurentian Channel, into Hermitage Channel and near the St. Pierre Bank. Black dogfish reside in the warmest available bottom temperatures (73.8°C).

Relative abundance estimates are problematic as a significant portion of the black dogfish occupy depth that exceed the range surveys (pre-1995), as well as only spring surveys are conducted in 3Ps where the largest concentrations of black dogfish reside (Kulka 2006). Within the Laurentian Channel, the relative abundance fluctuated at low levels during the 1970s and 1980s, increased rapidly stabilizing through the mid-1990s, after which it has declined possibly becoming stable over resident in the Laurentian Channel are primarily juveniles as well as a substantial portion of mature females in the shallow areas of the Channel. This indicates that the Laurentian Channel appears to be a pupping ground for this species. Black dogfish exhibit a highly structured distribution with a degree of separation by life stage. Large pregnant females migrate to shallow waters in the Laurentian Channel where pupping occurs. The young migrate in to deeper waters of the channel where as they mature, they migrate out of the Laurentian Channel in to the slope waters. They may migrate significant distances to the Labrador shelf. As they continue to grow, they continue to move into deeper waters.

Exploitation in Canadian waters averaged 68+ annually between 1996 and 2005. Black dogfish are primarily by-catch in Greenland halibut, crab, redfish, monkfish and witch flounder fisheries.

4.4.2.18 Atlantic Salmon

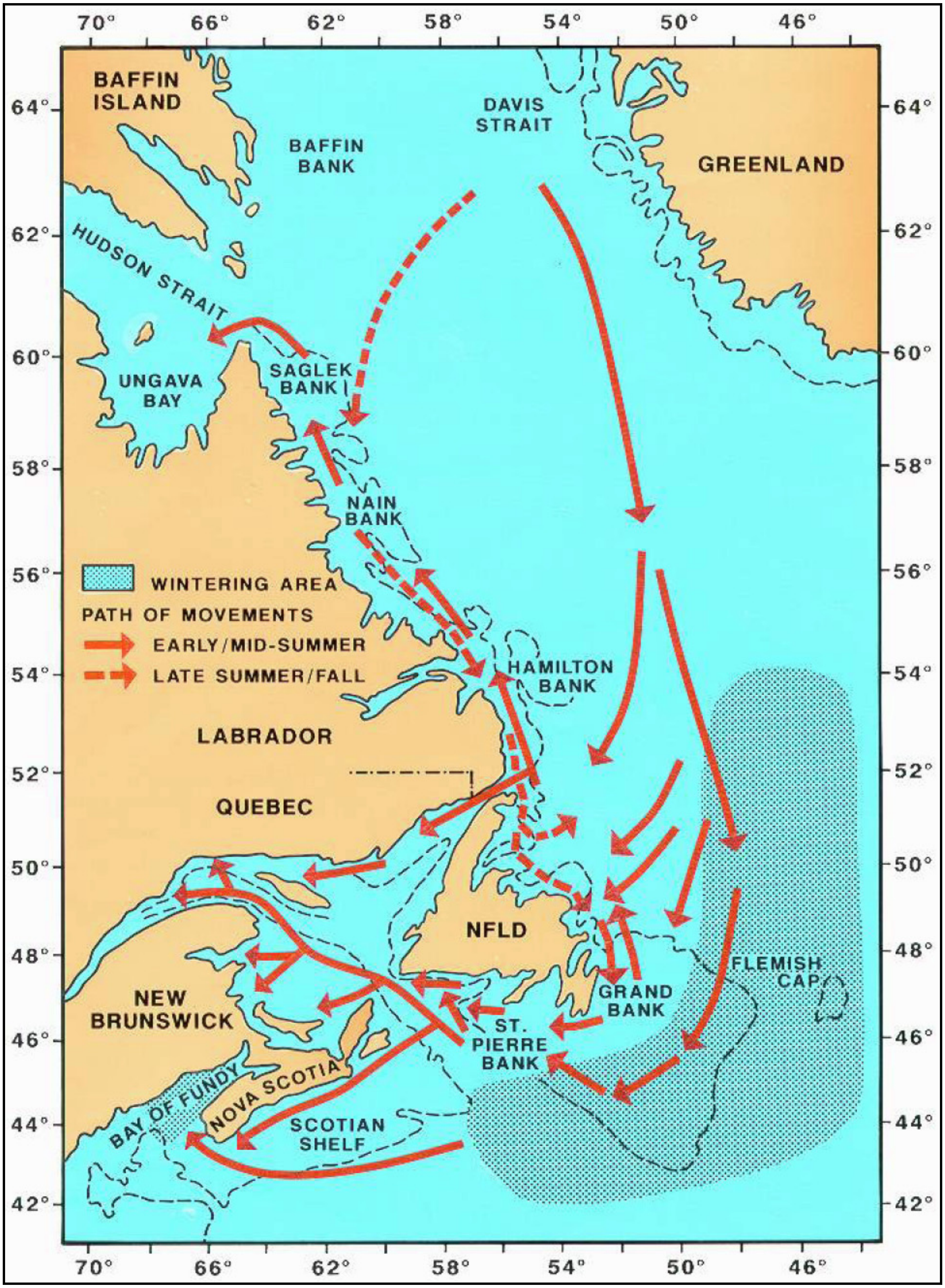
Atlantic salmon (*Salmo salar*) are anadromous fish, living in freshwater rivers for the first two years of life before migrating to sea. It is an iteroparous species, meaning it can spawn repeatedly, as opposed to most species of Pacific salmon (*Onchorhynchus* spp.), which are semelparous and die after one spawning (Schaffer 1974, in O'Connell et al. 2006; Flemming and Reynolds 2004, in O'Connell et al. 2006).

Atlantic salmon return annually to their natal river or tributary for spawning. Both post-smolt (juvenile) and adult salmon migrate from northeastern North America in the spring and summer to waters off Labrador to overwinter (Figure 4.23). They return to coastal North American in the fall, passing through the Laurentian Channel and St. Pierre Bank in the SEA Area (Reddin 2006). While at sea, adult salmon were found spending a considerable amount of time in the upper portion of the water column (Reddin 2006). Tagging studies of post-smolts also showed them spending most of their time near the surface, but undergo deep dives, likely in search of prey (Reddin et al. 2006).

While still in the river, post-smolts mainly eat aquatic insect larvae including caddisflies and blackflies. Adults at sea consume euphausiids, amphipods and fishes such as herring, capelin, small mackerel, sand lance and small cod. When salmon return to freshwater to spawn they do not eat (Scott and Scott 1988). Mortality sources of salmon while at sea are poorly known (Reddin 2006), but it is known that they are prey for seals, sharks, pollock and tuna (Scott and Scott 1988). The commercial net fishing of Atlantic salmon in Newfoundland waters was placed under moratoria in 1992 in an effort to increase the number of salmon spawning in freshwater, resulting in higher production in future years. From 1992 to 1996, salmon stocks on the south coast declined. Small salmon declined by 20 percent, adults by 11 percent (DFO 1997).

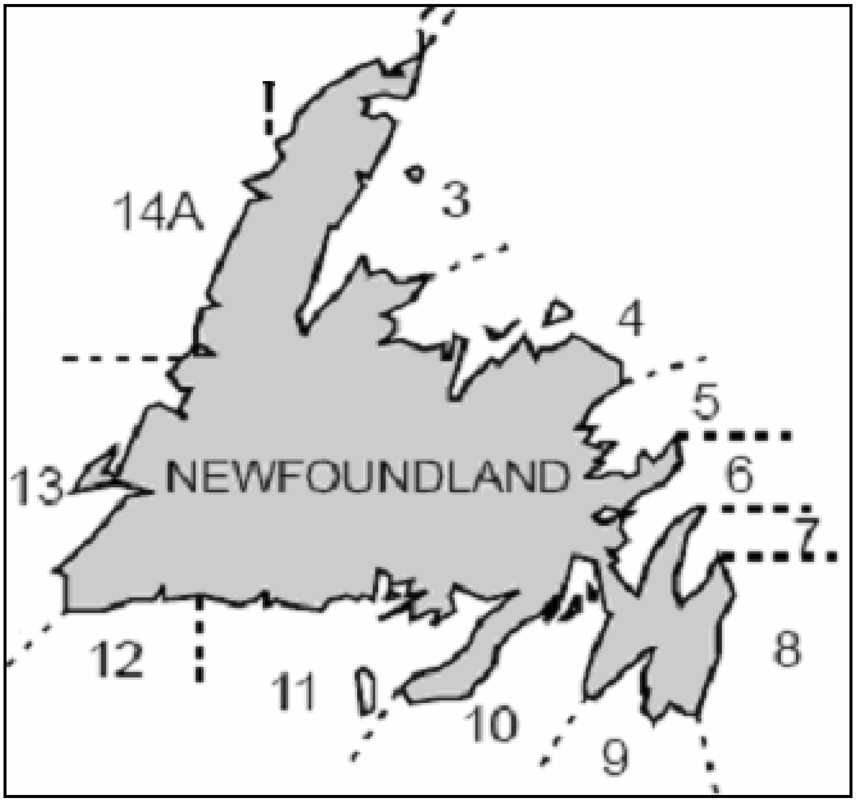
The two Atlantic salmon management areas (salmon fishing areas or SFAs) in the SEA Area are SFA11 and SFA12 (Figure 4.24). There are 15 salmon rivers in these two SFAs, as numbered in Figure 4.25. Those Included in the SEA Area are: 41. Northwest Brook; 42. Grand Bay River; 43. Isle aux Morts River; 44. Grandy's Brook (Burnt Island River); 45. Northwest River (Garia Bay); 46. Garia Brook (River); 47. Farmer's Brook (Farmer's Arm); 48. LaPoile River; 49. East Bay Brook (LaPoile); 50. Cinq Serf Brook; 51. Brandy Brook; 52. Kings Harbour Brook; 53. Bay du Loup Brook; 54. White Bear River; and, 55. Grey River.

Figure 4.23 Migration of Adult Atlantic Salmon Between Eastern North America and Labrador



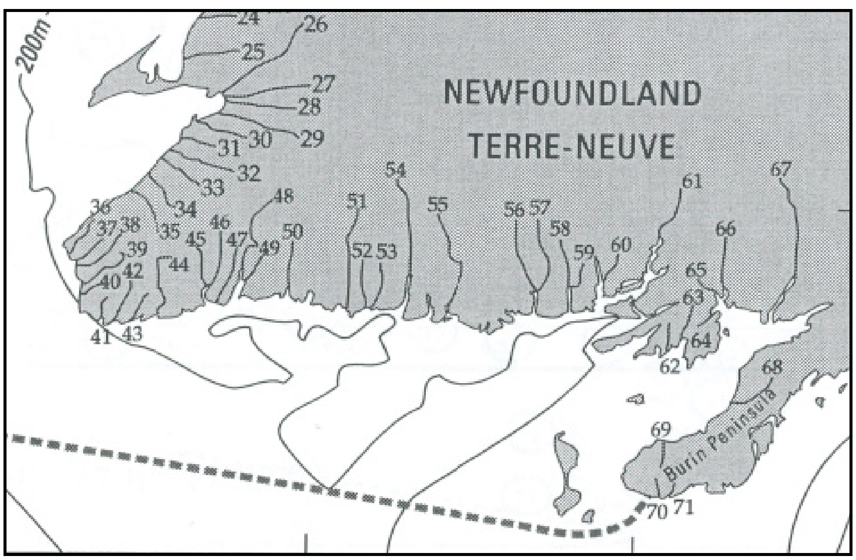
Source: Reddin 1988, in Reddin 2006.

Figure 4.24 Salmon Fishing Areas of Newfoundland



Source: O'Connell et al. 2006.

Figure 4.25 Salmon Rivers on the South Coast of Newfoundland



Source: Department of Energy, Mines and Resources 1975, in Meltzer 1996.

Grey River is the productive river in SFA11. Grandy River and LaPoile River are the most productive rivers in SFA12 (Burgeo Diversification Development Board (BDDB) 2003; DFO 2002e). Although there have been recent surveys of the salmon rivers on the west coast of Newfoundland, there has not been a recent assessment of the stocks of the rivers in SFA11 and SFA12, which occur in the SEA Area. A 2004 assessment of SFA 11 examined Conne River only, which is east of the SEA Area. The assessment determined that returns of small adult salmon had increased by 95 percent from 2003 to 2004, and returns of large adults had increased by more than 200 percent in the same time (DFO 2004c). Assessment of salmon in SFA12 rivers could not be found.

4.4.3 Commercial Fisheries

The biological characteristics and status of the main commercial and other marine species were described in Sections 4.4.1 and 4.4.2.

The principal focus for the fisheries description is the domestic Canadian harvest, for which good datasets (described below) are available. For these fisheries, the period 1986 to 2005 is used for a historical retrospective, while more detailed analysis of the SEA Area is based on recent harvesting, 2003 to 2005, since fishing activities in the region have changed in recent years.

This section describes the species harvested, locations, seasonality of the harvest and harvesting methods used, with a particular focus on the principal species fisheries.

4.4.3.1 Data and Information Sources

In this discussion of commercial fishing activities, a number of fisheries management data areas are referenced. In addition to the SEA Area, this section also uses data for fisheries management Unit Areas 3Psa, 3Pse and 3Psd and Subdivision 3Pn (refer to Figure 4.4). These are the management areas that most closely approximate the SEA Area boundaries. These areas are used since much of the catch data available from DFO is not georeferenced by latitude and longitude in these areas, so the Unit Area designation, indicating the Unit Area (or Subdivision, in the case of 3Pn) where the catch occurred, which is attached to all the catch data, provides the best and most accurate means for quantifying and qualifying the relevant area fisheries (Figure 4.26).

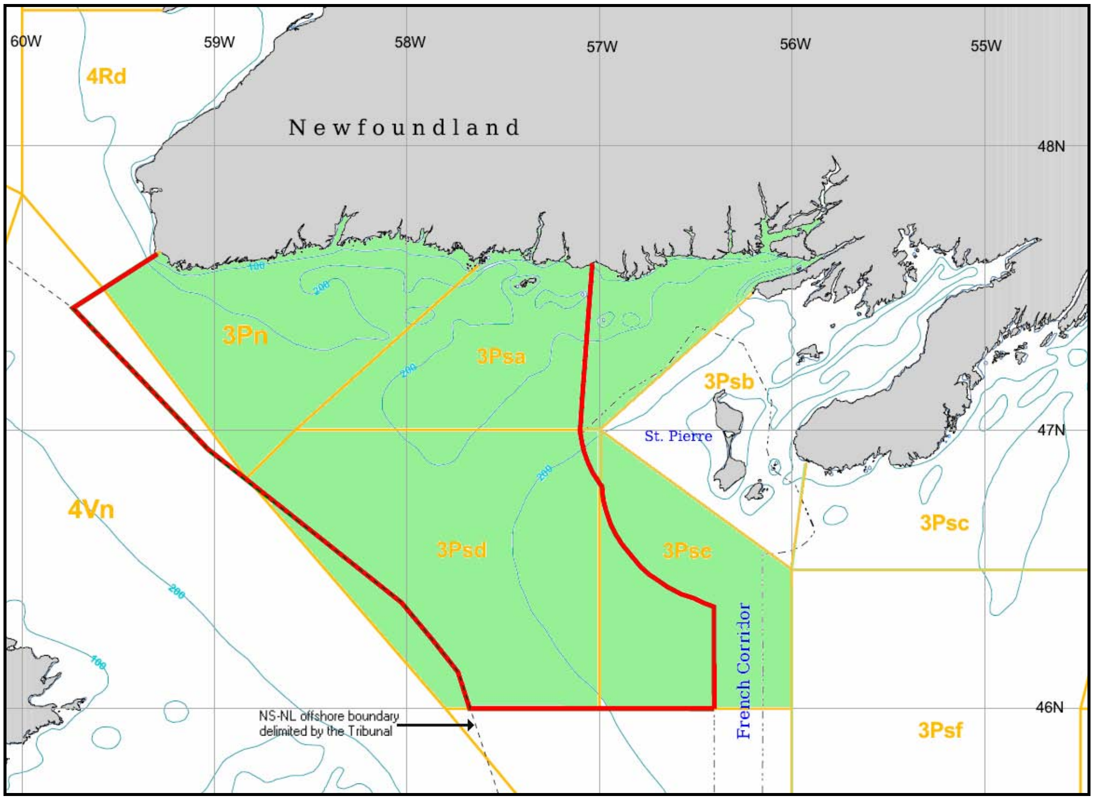
To provide broader historical context that includes past foreign fishing effort in the general area, NAFO datasets for Subdivision 3Ps and 3Pn are used.

Most of the analysis of commercial fisheries data in this report is based on federal DFO catch data. Catch data derived from DFO Newfoundland and Labrador and Maritimes Regions (Nova Scotia) for the period 1986 to 2005[2] are used to characterize the historical domestic fisheries in the SEA Area and adjacent waters. Foreign catches not landed in Canadian ports are not captured in the DFO data; therefore, NAFO datasets (1982 to 2001) are used to quantify harvesting by foreign (as well as domestic) fishers for certain fisheries.

[2] The DFO data used in the report represent all catch landed within DFO Maritimes Region and for all Newfoundland and Labrador landed catch. Foreign catches landed outside these areas are not included in the DFO data sets, but most are captured in the NAFO data. Data for 2003 to 2005 are still classified by DFO as preliminary, though the species data used in this report are not likely to change to any measurable extent when the data are finalized. The most recent Maritimes Region and Newfoundland Region data were accessed in February 2006.

Maritimes Region DFO data are included because a portion of the harvest within the SEA Area is typically landed in Nova Scotia.

Figure 4.26 Strategic Environmental Assessment Area Unit Areas (green) and Strategic Environmental Assessment Area Boundaries (red)



Note: dotted line represents the Newfoundland and Labrador-Nova Scotia offshore boundary line as delimited by the Tribunal.

A portion of the past domestic harvesting locations are shown in relation to the SEA Area in the fisheries maps in this section. These maps are based on the DFO datasets, which are georeferenced. However, the maps capture a relatively small proportion of the domestic harvest in the relevant areas for most species. Within 3Pn, just 5 percent of the harvest, by quantity, is georeferenced in the 2005 dataset. For 3Psa, 37 percent is georeferenced for that year, 28 percent in 3Pse, and 67 percent in 3Psd. Nevertheless, the maps are useful for showing known areas of concentrated fishing. In general, the areas farther from shore have a larger proportion of the catch georeferenced (as noted above, to capture the full area harvest, an analysis based on Unit Areas is also incorporated within this section).

For the georeferenced data, the location given in the datasets is that recorded in the vessel's fishing log, and is reported in the database by degree and minute of latitude and longitude; thus, the position is accurate within approximately 0.9 km (0.5 nautical miles) of the reported coordinates. It should be noted that for some gear, such as mobile gear towed over an extensive area, or for extended gear, such as longlines, the reference point does not represent the full distribution of the gear or activity on the water. However, over many data entries, the reported locations create a fairly accurate indication of where such fishing activities occur and these kinds of database locations have been groundtruthed by Canning & Pitt Inc. with fishers in Nova Scotia, Newfoundland and Labrador and elsewhere over many years.

Where the harvests are quantified, the weight of the harvest (in tonnes) is given rather than its value, since these quantities are directly comparable from year to year. Values (for the same quantity of harvest) may vary annually with species, negotiated prices, changes in exchange rates and fluctuating market conditions. However, value would be very important, and carefully evaluated according to the current prices, if there were a compensation incident.

The maps in the following sections show the harvesting locations as dark points. The points are not "weighted" by quantity of harvest, but show where at least some fishing effort was reported.

Other sources consulted for this section include fisheries management plans, quota reports and other related DFO documents. Representatives of fisheries organizations (including those in the Nova Scotia fishing industry - see Appendix B) and DFO were also consulted. These consultations were undertaken to inform stakeholders about the SEA process, to gather information about expected future fishing activities, and to determine any issues or concerns.

A list of the fisheries agencies and industry stakeholders consulted is provided in Appendix B.

4.4.3.2 Historical Overview

Commercial fish harvesting on many parts of the Newfoundland Grand Banks has changed considerably over the last two decades, shifting from a groundfish-based industry to primarily crustacean harvesting. In 1992 and 1993, with the acknowledgement of the collapse of several groundfish stocks, a harvesting moratorium was declared and directed fisheries for Atlantic cod and some other groundfish were no longer permitted in most areas.

However, Subdivisions 3Ps and 3Pn have been an exception and are now the only remaining Grand Banks areas with a directed (though reduced) Atlantic cod fishery. After large catches in these Divisions in the 1970s and 1980s, the fishery was considerably curtailed in the mid-1990s at the time of the moratoria. Since then, much lower quotas have been allowed, varying over the years based on scientific advice and other considerations. These changes in NAFO Subdivisions 3Pn and 3Ps, from 1982 to 2001, are illustrated in Figure 4.27. Catches for NAFO-regulated species by foreign and domestic harvesters, based on NAFO statistics are shown in Figure 4.27. The harvest over these years was predominantly groundfish harvesting, largely Atlantic cod, but also included lesser though important quantities of American plaice and redfish. Snow crab, presently another principal species harvested in some parts of 3P, is not managed by NAFO and thus not included in these data. Only small quantities of snow crab are harvested within the SEA Area, as most of the important grounds are to the east, in 3Psf. The relatively small amount of crab harvesting within the SEA Area occurs near the 200-m contour in 3Psd.

Other than Canadian harvesters, those fishing in these Divisions are French vessels (based in St. Pierre et Miquelon). Since 1992, their effort, associated with the French Corridor, has been confined to 3Ps.

Within Unit Areas 3Psa, 3Pse and 3Psd, and Subdivision 3Pn (the SEA Area Unit Areas, see Figure 4.4), which contain the SEA Area, the domestic fisheries over the past 20 years (1986 to 2005) followed a similar pattern, with a greatly reduced groundfish fishery but an increase in the number of other species harvested (Figure 4.28). Specifically, the SEA Area's harvest is now more diverse than it was two decades ago. The composition of the SEA Area Unit Areas harvest in 1986 and 2005 is compared in Figure 4.29.

Figure 4.27 Northwest Atlantic Fisheries Organization 3Pn and 3Ps Harvest, 1982 to 2001, Foreign and Domestic

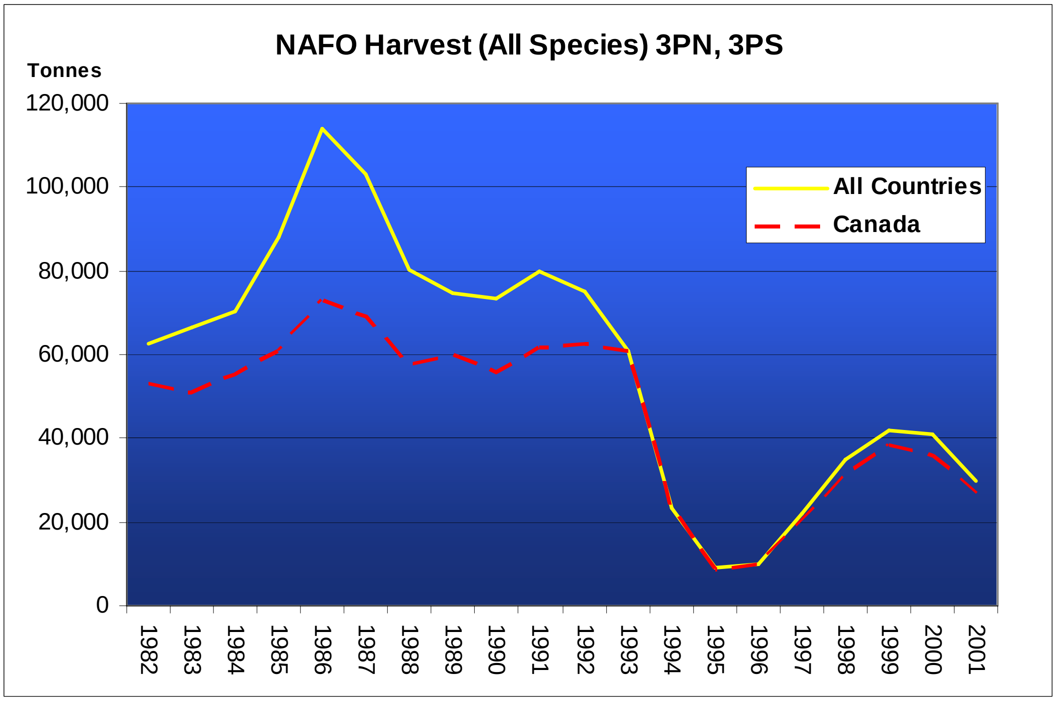


Figure 4.28 Strategic Environmental Assessment Area Unit Area Harvest, All Species, 1986 to 2005

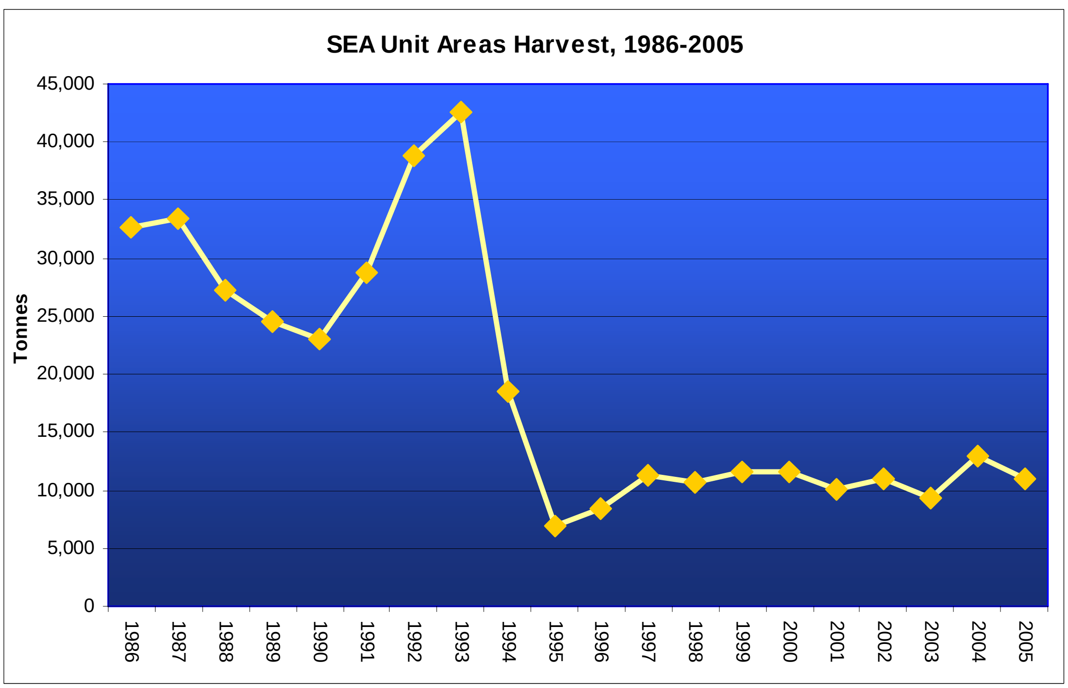
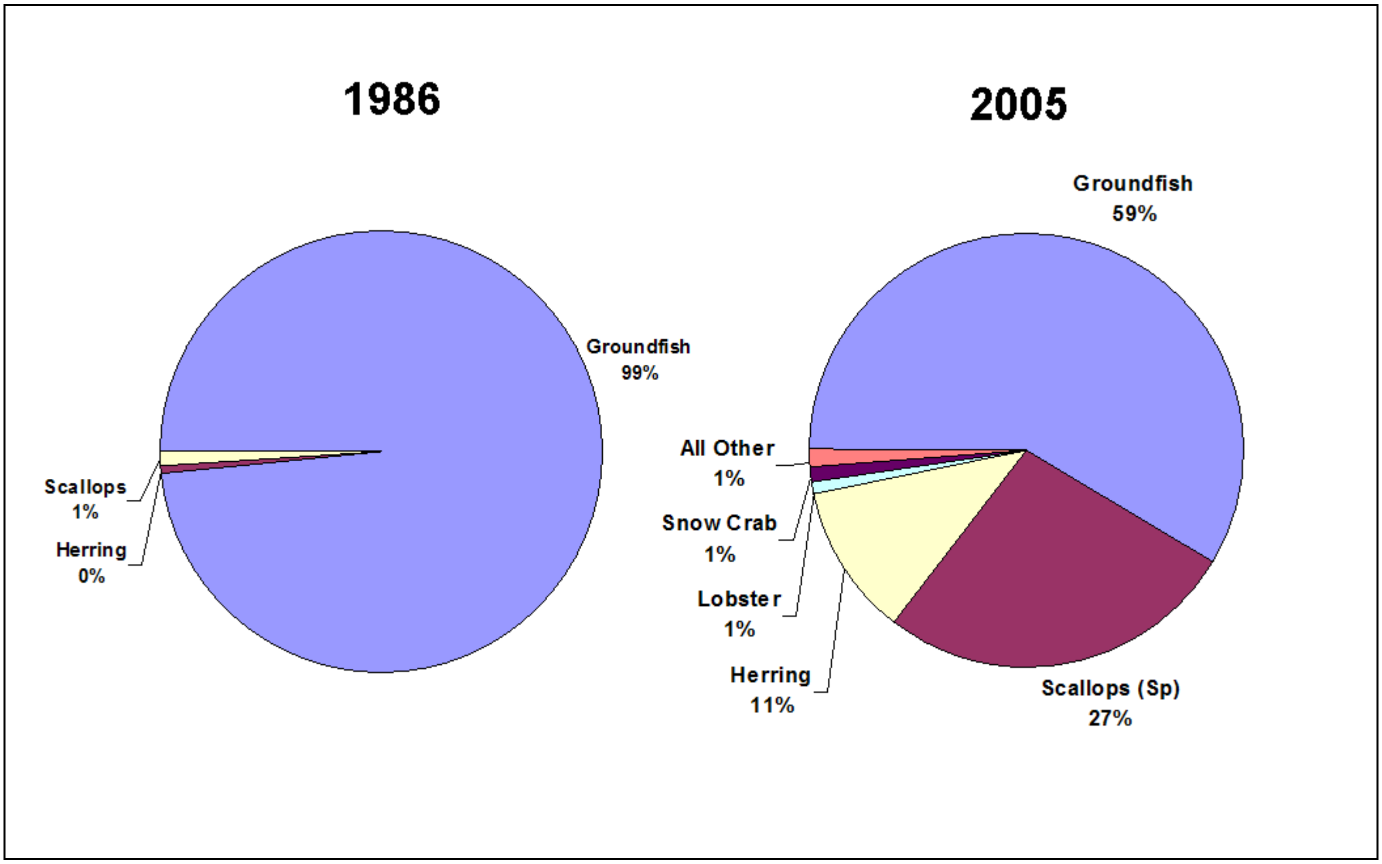


Figure 4.29 Strategic Environmental Assessment Area Unit Areas Composition of Harvest, 1986 and 2005



4.4.3.3 Strategic Environmental Assessment Area Domestic Fisheries (Current)

Composition and Location

As in the past, the SEA Area fisheries are presently dominated by the harvest of groundfish species. Today, a much larger part of the catch is made up of other species, some of which were not caught commercially in the area a decade or two ago.

The composition of the SEA Area Unit Areas harvest based on the 2003 to 2005 average catch from these waters is shown in Table 4.3. As these data indicate, domestic commercial fisheries in the area are approximately 64 percent groundfish species; primarily redfish and cod, with lesser amounts of several other species, most notably white hake and monkfish. Of the non-groundfish species that now make up more than 33 percent of the harvest, most are shellfish, with scallops the largest harvest by quantity. Herring makes up most of the balance of the harvest.

In addition to these fisheries, there has been some experimental fishing for sea cucumbers within the southern part of the SEA Area. This is described in more detail in Section 4.4.3.5.

Table 4.3 Domestic Harvest by Species, Strategic Environmental Assessment Area Unit Areas, 2003 to 2005 Average

Species	Tonnes	% of Total
Cod	2,495.8	22.5
Haddock	28.6	0.3
Redfish	3,075.3	27.7
Halibut	80.9	0.7
Plaice	166.3	1.5
Greysole	85.5	0.8
Turbot	83.8	0.8
Skate	187.9	1.7
Pollock	136.1	1.2
White Hake	439.0	4.0
Catfish (Wolffish)	43.7	0.4
Monkfish	221.8	2.0
Herring	966.4	8.7
Iceland Scallops	442.3	4.0
Sea Scallops	2,103.1	19.0
Whelk	29.9	0.3
Lobster	94.0	0.8
Snow Crab	216.2	1.9
All Other	192.6	1.7
Total	11,089.2	100.0

The relative distribution of the harvest over the 2003 to 2005 period among each of the four SEA Area Unit Areas is shown in Figure 4.30, and more detailed information on the composition of the catch in each of these Unit Areas for the same period is provided in Table 4.4. This gives an indication of the difference in relative importance of certain species in these different geographical areas. For instance, in 3Pn, the harvest is more than 70 percent groundfish, mainly cod; in 3Psa cod and redfish are equally important; in 3Psd the harvest is nearly 60 percent redfish and 20 percent scallops; and the 3Pse harvest during this period was nearly 75 percent scallops.

Figure 4.30 Strategic Environmental Assessment Area Unit Areas, Relative Quantity of Harvest

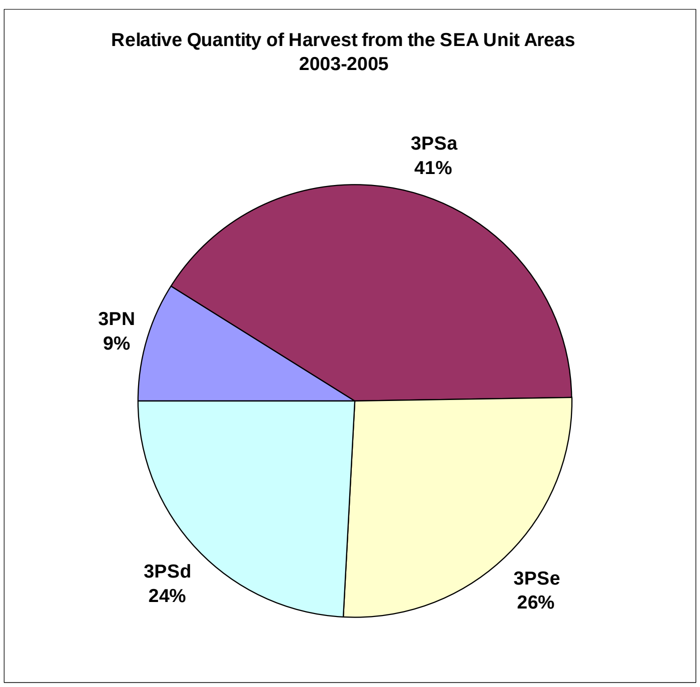


Table 4.4 Domestic Harvest by Unit Area by Species, 2003 to 2005 Average

Species	Tonnes (Average)	% of Unit Area Total
3Pn		
Atlantic Cod	531.7	53.6
Redfish (sp)	121.9	12.3
Halibut	25.1	2.5
American Plaice	7.3	0.7
Skate	15.2	1.5
Pollock	2.6	0.3
Hake White	113.3	11.4
Catfish (Wolffish)	4.9	0.5
Monkfish	2.1	0.2
Herring	43.5	4.4
Mackerel	24.1	2.4
Lobster	21.1	2.1
Snow Crab	2.2	0.2
Seal Meat/Fat	9.4	0.9
Lumpfish roe	65.1	6.6
All other	2.0	0.2
Total	991.3	100.0
3Psa		
Atlantic Cod	1,265.8	28.0
Haddock	20.6	0.5
Redfish (sp)	1,239.6	27.4
Halibut	44.1	1.0
American Plaice	136.5	3.0
Yellowtail Flounder	1.5	0.0
Greysole Flounder	68.9	1.5
Winter Flounder	17.1	0.4
Turbot (Greenland Halibut)	29.2	0.6
Skate	92.0	2.0
Pollock	112.2	2.5
Hake White	280.6	6.2
Catfish (Wolffish)	36.5	0.8
Monkfish	134.5	3.0
Herring	870.9	19.3
Scallops, Sea	1.7	0.0
Whelks	12.3	0.3
Sea Urchins	2.5	0.1
Lobster	72.9	1.6
Snow Crab	20.6	0.5
Lumpfish roe	58.6	1.3
All other	2.4	0.1
Total	4,521.0	100.0
3Psd		
Atlantic Cod	268.7	9.3
Haddock	7.8	0.3
Redfish (sp)	1,713.5	59.3
Halibut	10.6	0.4
American Plaice	7.4	0.3
Yellowtail Flounder	1.5	0.1
Greysole Flounder	16.3	0.6
Turbot (Greenland Halibut)	53.7	1.9
Skate	73.4	2.5
Pollock	20.6	0.7
Hake White	43.0	1.5
Catfish (Wolffish)	2.2	0.1
Monkfish	82.6	2.9
Swordfish	3.7	0.1

Species	Tonnes (Average)	% of Unit Area Total
Scallops, Sea	319.3	11.1
Scallops, Icelandic	227.0	7.9
Whelks	11.0	0.4
Snow Crab	24.9	0.9
All other	1.1	0.0
Total	2,888.4	100.0
3Pse		
Atlantic Cod	429.6	16.0
Halibut	1.1	0.0
American Plaice	15.1	0.6
Yellowtail Flounder	3.9	0.1
Skate	7.3	0.3
Hake White	2.1	0.1
Monkfish	2.6	0.1
Herring	52.0	1.9
Scallops, Sea	1,782.2	66.3
Scallops, Icelandic	215.4	8.0
Whelks	6.6	0.2
Snow Crab	168.5	6.3
All other	2.2	0.1
Total	2,688.6	100.0

The location of harvesting activities as recorded in the georeferenced DFO data are shown in Figures 4.31 to 4.33. This information represents only a small percentage of the total harvest in the SEA Area, but is still useful for indicating areas of relatively intensive fishing. The georeferenced data are more complete for areas father away from shore than for the areas closer to shore.

Figure 4.31 Strategic Environmental Assessment Area and Georeferenced Harvest Locations, 2003

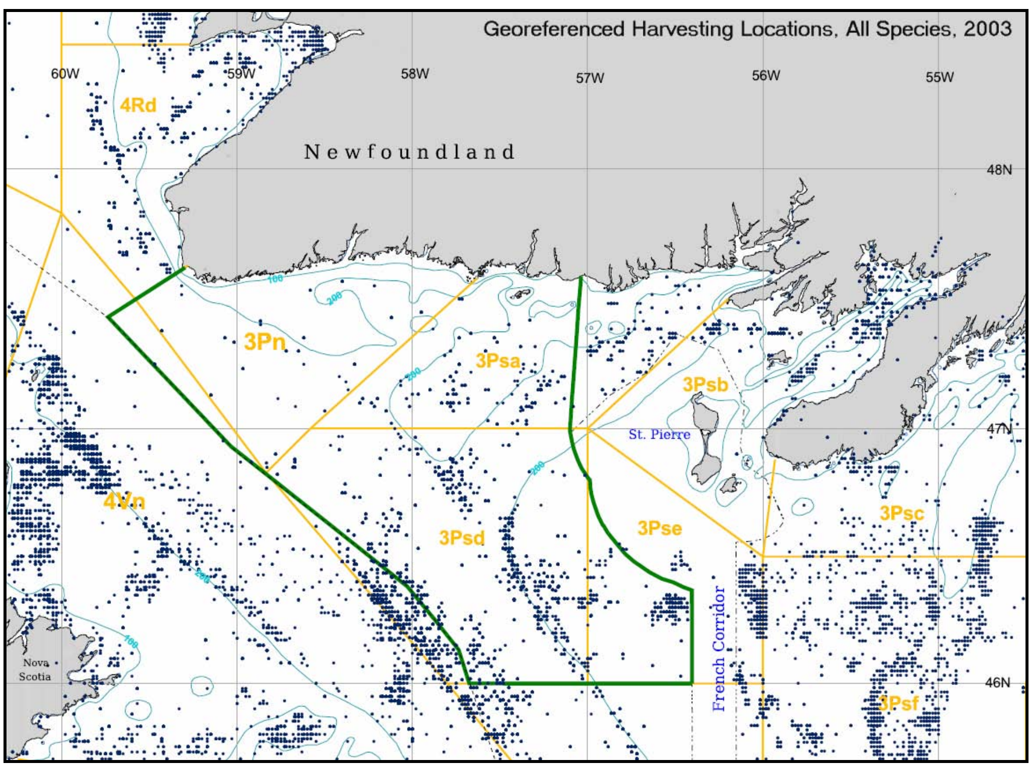


Figure 4.32 Strategic Environmental Assessment Area and Georeferenced Harvest Locations, 2004

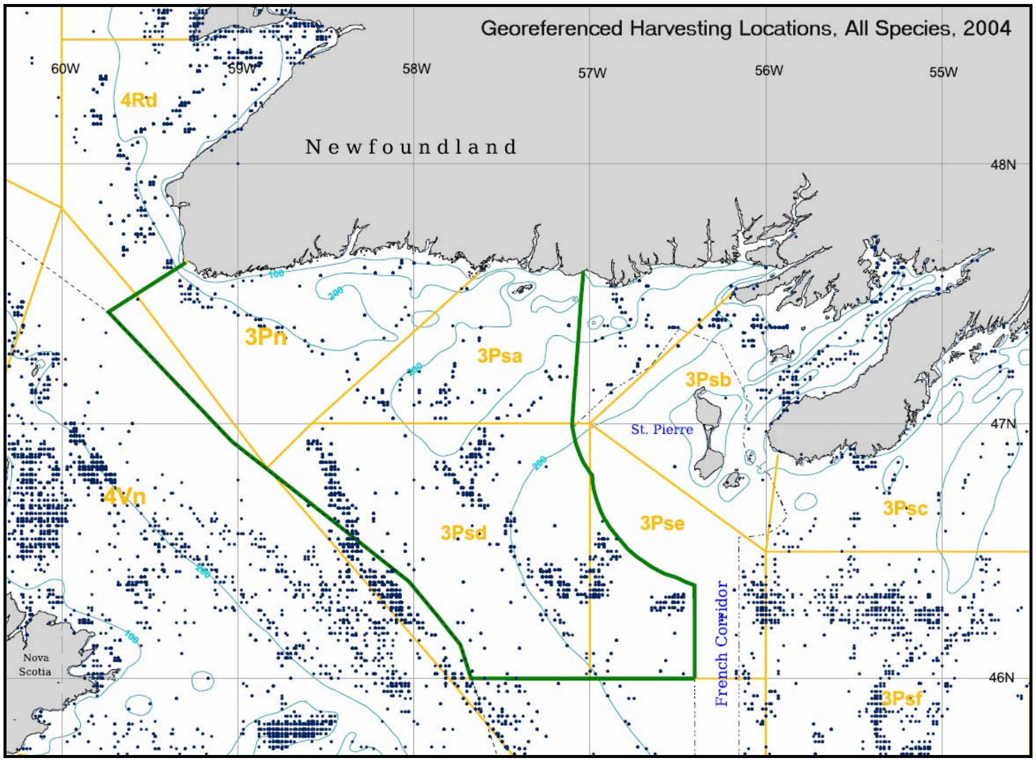
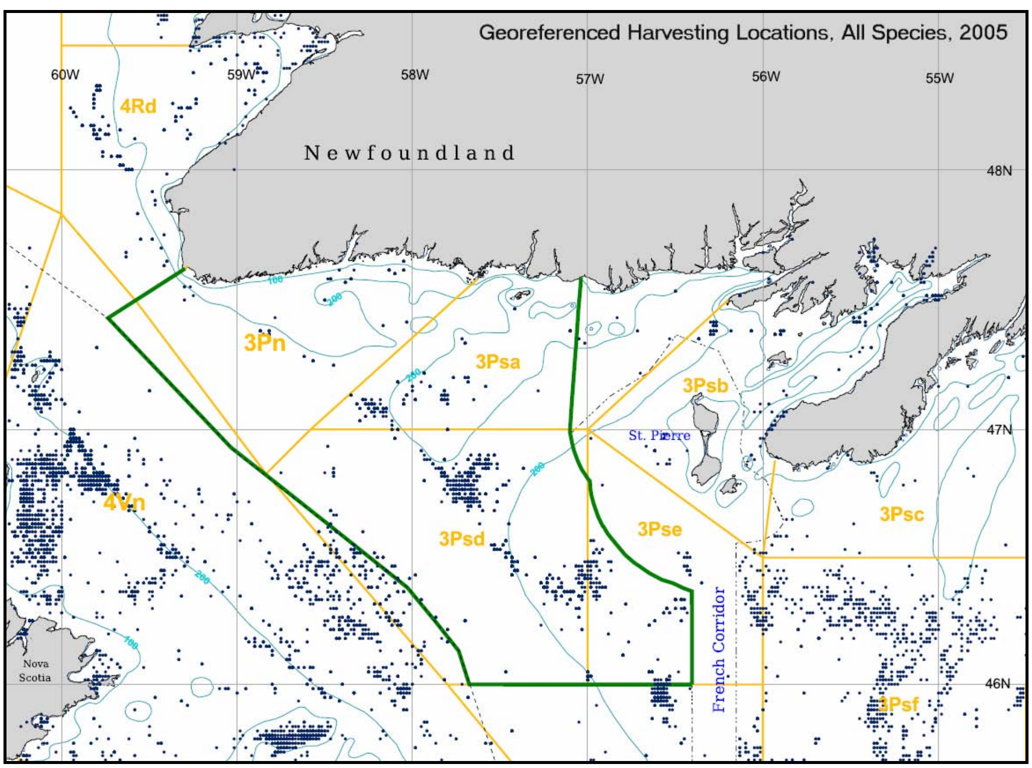


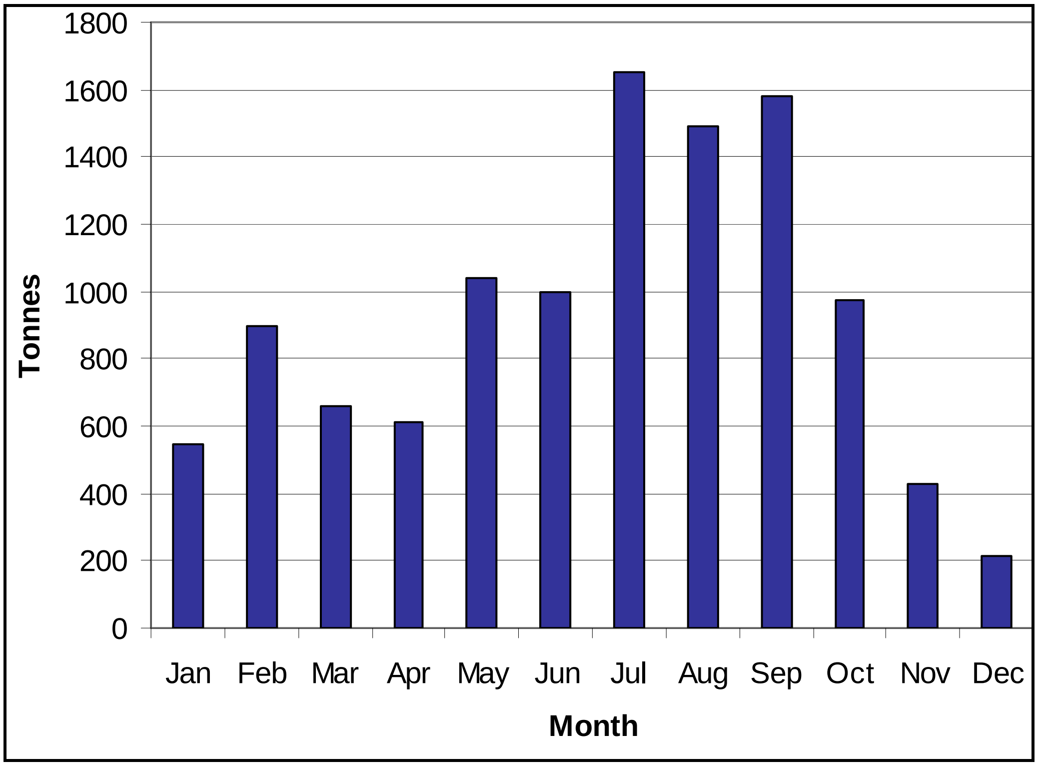
Figure 4.33 Strategic Environmental Assessment Area and Georeferenced Harvest Locations, 2005



Seasonality

Harvesting times may change from year to year, depending on seasons and regulations set by DFO, the harvesting strategies of fishing enterprises, or on the availability of the resource itself. The 2003 to 2005 average catch by month (all species) from the SEA Area Unit Areas is shown in Figure 4.34.

Figure 4.34 Strategic Environmental Assessment Area Unit Areas Harvest by Month, 2003 to 2005 Average



The Unit Area harvest occurs year-round, but has been highest during July to September over the past three years (Figure 4.34). Timing of the harvest of the main commercial species is described in Section 4.4.3.4.

Fishing Vessels

Harvesting within the SEA Area Unit Areas is pursued mainly (>70 percent) by smaller vessels, under 45 feet in length, and more than half of the harvest by quantity is taken by vessels under 35 feet (Table 4.5). Just 13 percent is harvested by vessels over 100 feet (based on 2003 to 2005 records).

Table 4.5 Domestic Harvest by Vessel Size, 2003 to 2005 Average

Vessel Size (feet)	Tonnes Harvested (Average)	% of Total
Under 35	6,472.6	58.4
35 - 44	1,507.9	13.6
45 - 54	296.4	2.7
55 - 64	1,009.6	9.1
65 - 74	125.7	1.1
75 - 99	250.6	2.3
100 - 124	949.3	8.6
125 - 149	473.3	4.3
150 - 199	3.8	0.0
Total	11,089.2	100.0

Within the SEA Area Unit Areas, the harvest is mainly by Newfoundland-based vessels, landing their catch in Newfoundland ports. In 2005, for example, 83 percent of the harvest by quantity from these waters was Newfoundland-landed and approximately 17 percent Nova Scotian, from vessels fishing primarily in 3Psd, in which Nova Scotian landings made up more than half the harvest.

The Newfoundland harvesters (based on the home port of the fishing vessel) came from ports in many areas, but most (of those where homeport information was available) were from ports on coasts adjacent to the SEA Area, from Statistical Sections 36 to 39 (roughly from Hermitage to Channel-Port aux Basques). The majority of the Nova Scotia-based harvesting was by vessels from ports in and southwest of Halifax County (Statistical Districts 21, 26 and 28). The breakdown of the harvest (annual average, 2003 to 2005) by fishing vessel home statistical area is shown in Table 4.6.

Table 4.6 Domestic Harvest by Home Port Vessel, 2003 to 2005 Average

Home Port Area	Tonnes	% of Total
Not Specified		
No Port Given	6,616.2	59.7
Newfoundland and Labrador Statistical Section (SS)		
1	1.4	0.0
6	0.1	0.0
10	8.2	0.1
11	5.3	0.0
12	3.6	0.0
21	0.1	0.0
24	8.8	0.1
30	1.1	0.0
31	1.6	0.0
32	10.0	0.1
33	50.0	0.5
34	26.3	0.2
35	57.4	0.5
36	1,382.5	12.5
37	1,155.3	10.4
38	330.8	3.0
39	557.0	5.0
40	3.6	0.0
41	3.5	0.0
48	1.2	0.0
49	4.3	0.0
NL Total	3,611.9	32.6
Nova Scotia Statistical Division (SD)		
6	9.7	0.1
7	3.3	0.0
15	1.2	0.0
20	0.2	0.0
21	262.9	2.4
22	0.4	0.0
26	238.3	2.1
27	0.2	0.0
28	301.8	2.7
30	0.3	0.0
32	8.7	0.1
33	3.3	0.0
34	26.4	0.2
37	4.6	0.0
NS Total	861.1	7.8
SEA Area Unit Areas Total	11,089.2	100.0

Fishing Gear

Several gear types are used to harvest commercial species taken in the SEA Area Unit Areas. These include both fixed and mobile gears. Some fisheries are associated with specific gear types (e.g. scallops using dredges) while some other species fisheries employ multiple harvesting methods (e.g. cod, using both stern otter trawls and gillnets). The harvest by type of fishing gear for the SEA Area Unit Areas in recent years is shown in Table 4.7.

Table 4.7 Harvest by Gear Type, 2003 to 2005 Average

Gear Type	Tonnes	% of Total
Stern Otter Trawl (bottom)	2,551.5	23.0
Midwater Trawl	187.1	1.7
Danish Seine	65.4	0.6
Beach/Bar Seine	470.9	4.2
Gillnet*	2,657.0	24.0
Longline*	1,794.0	16.2
Hand Line	35.5	0.3
Trap Net*	428.8	3.9
Trap/Pot*	339.7	3.1
Dredges	2,547.5	23.0
Diving	2.5	0.0
Hunting (Seals)	9.4	0.1
Total	11,089.2	100.0
* fixed gear.		

In general, fixed gear poses a much greater potential for conflicts with seismic survey activities, since it is often hard to detect when there is no fishing vessel near by, and it may be set out over long distances in the water. Because most mobile gears are towed behind a vessel, they pose less risk of conflict because the activity can be more easily observed and located on the water. The survey ship and the fishing vessels should be able to communicate with each other and exchange information about their operating areas and activities. The following describes the principal gear types recorded in the SEA Area.

Stern Otter Trawls. This mobile gear is used for a variety of groundfish species in the area. It consists of a large cone-shaped net towed along the ocean bottom. Large rectangular "doors" (otterboards) are attached to cables between the ship and the net to keep the net open (horizontally) while being towed. Floats on top and weights at the bottom maintain the vertical opening in the otter trawl. The net is pulled along the seabed on wheel-like "bobbins". Fish enter through the large opening and are funneled to the end of the net, a bag-like section called the "cod end". The size of the mesh in the net allows smaller fish to escape.

Gillnets. This fishing gear is used for several groundfish species in the area. Fixed or set gillnets are anchored to the seabed to keep the gear stationary, and have buoys on each end which float on the surface. The net itself is kept open or full through the use of weights attached to the bottom of the net. A highflyer buoy usually marks one end of the set gillnet (typically the north end), though not always. There may be 50 nets in a fleet; each net is approximately 91 m (300 feet) long, for a length of 4,572 m (15,000 feet) per fleet. Fishers may fish 8 to 10 fleets at once. The nets are constructed of monofilament netting. The gear poses a higher risk of conflict with seismic survey tows than some other gear types, since in deeper water the nets are left set and may be hard to detect, although the use of chase or support vessels and as Fisheries Liaison Officer may reduce the likelihood of gear conflicts during seismic surveys.

Longlines (baited trawl). Groundfish longlines (also known as baited trawls) consist of a buoyed line from which a series of fishhooks are suspended. Larger buoys are generally attached to each end of the longline. Longlines may be anchored and buoyed. The gear is set out behind the vessel and left to fish. It is then hauled in to retrieve the catch, re-baited and set again. However, in some cases, longlines are not anchored but simply set to drift for a time and are suspended by buoys at either end (when longlines are set in this way, it is referred to by some fishers as "fly and set"). The length of the longline will vary according to the fisher's preference or other factors.

Halibut longlines consist of a heavy bottom groundline with sidelines (gangings) attached to it at intervals of several metres. Each ganging has a large baited halibut hook at its end. The longline, consisting of several sections, may be a mile or longer and is typically anchored to the bottom at both ends, with a marker buoy at one end. The line may be left to fish for several hours or up to a few days (depending on weather).

Large pelagic longlines used for swordfish consist of very long main lines floating at or near the sea surface. Weighted leader lines descend at intervals from the main lines along its full length. The main line, which is usually marked with buoys, highfliers and often radio beacons, can extend up to 92.6 km (50 nautical miles) behind the fishing vessel. The smaller shark vessels (which might be active in the area) use 18.5 to 27.8 km (10 to 15 nautical miles) long main lines. The porbeagle shark fishery uses longlines that are usually set weighted to the bottom in the middle, in a "V" formation. The gear is usually marked with highfliers approximately every 3.7 km (2 nautical miles), and with floats at the surface about every 0.5 km (0.25 nautical miles).

These gears also pose a high risk of interaction with survey vessels.

Scallop Dredges. Scallop rakes or drags (dredges) are typically operated by mid-sized vessels with powerful engines, designed to pull the heavy equipment along the sea floor (i.e., on scallop beds). The dredges have a frame mouth which leads to a large bag or net made of metal rings or mesh. Scallop draggers may pull one or more dredges behind the vessel and/or from side-rigged booms.

Crab Pots. Because it is a fixed gear, crab pots pose a considerable potential for conflict if seismic survey vessels encounter them. The amount of gear fishers are permitted to use varies by license category, and also by the area in which a license holder may be fishing. Crab pots are set on the seabed in strings buoyed at the surface. Crab gear generally has a highflyer (radar reflector) at one end and a large buoy at the other. Some fishers use highflyers at both ends. Depending on weather, they may be left unattended for several days at a time, or frequently longer.

Fishers typically try to leave approximately 36.5 m (20 fathoms (120 feet)) on the seabed between each pot, thus, allowing slack for the anchor ropes on either end of the string to extend upwards at an angle. The distance between the typical highflyer and end-buoy of, for example, a 50 to 60 pot string of crab gear, would be 6,000 feet to 7,500 feet, or approximately 1.8 to 2.3 km.

4.4.3.4 Principal Species Fisheries

As indicated in Tables 4.3 and 4.4, the domestic harvest within the SEA Area Unit Areas consists largely of groundfish, though other species (particularly scallops and herring) are important in some Unit Areas. This section describes the principal SEA Area fisheries in more detail. A report on consultations provides additional information on key species and fish harvesters' perspectives about these activities (Appendix B).