3.0 Biological Environment

This section presents an overview of the Study Area ecosystem with emphasis on valued ecosystem components (VECs). Typical VECs include fish and fish habitat, fisheries, marine birds, marine mammals, sea turtles, and Species at Risk (SAR) as listed in legislation.

Not only are shallow water areas included in the Study Area (depth range intertidal to >500 m), but three of the four Bid Parcels (4, 6 and 7) and four existing ELs (1069, 1070, 1071 and 1072) impinge on the west coast of Newfoundland. Parcel 4 contacts the western tip of the Port au Port Peninsula (Cape St. George) in Unit Area 4Rc, Parcel 6 contacts the coast within and north of Bay of Islands (Unit Areas 4Rb and 4Rc), and Parcel 7 contacts the section of coast extending from north of Bay of Islands to just north of Bonne Bay (Unit Area 4Rb) (see Figure 1.1). Consequently, it is important in this SEA to consider the biological environment occurring from the intertidal area to the offshore areas where depth exceeds 500 m.

3.1 Coastal Algal Communities

3.1.1 Non-estuarine Areas

Warm summer seawater temperatures, due primarily to the existence of an inshore, northerly flowing water current, characterize the west coast of Newfoundland. The intertidal and shallow subtidal of the open coast is scoured by ice driven ashore by prevailing westerly winds, resulting in these zones being dominated by annual algal species. Luxuriant growth of perennials (e.g., *Fucus*, *Ascophyllum*, *Chondrus*) occurs only locally in more sheltered sites where there is periodic removal by ice (South 1983). Table 3.1 indicates the algal distribution between the high water mark and the shallow subtidal zone at coastline types differentiated by degree of exposure.

3.1.2 Estuarine Areas

There is limited variability in estuarine communities occurring around the island of Newfoundland. Substrate type tends to be the major factor affecting community differences (Table 3.2).

Table 3.1. Generalized Algal Zonation and Associated Invertebrates in Intertidal and Shallow Subtidal Areas in the Western Newfoundland and Labrador Offshore Area.

Wave Exposure	Typical Algal/Invertebrate Species		
	HW to 5 m	**5 to 20 m**	**> 20 m[1]**
Low	Maritime lichens Cyanophyta *Bangia atropurpurea* *Fucus vesiculosus* *Balanus balanoides* *Ascophyllum nodosum* *Mytilus edulis* *Bonnemaisonia hamifera*	*Laminaria longicruris* *Phyllophora* sp. *Agarum cribosum* *Laminaria solidungula*	*Phyllophora* sp. *Agarum cribosum* *Lithothamnium tophiforme* *Phymatolithon laevigatum* *Laminaria longicruris* *Laminaria solidungula*
Moderate	Maritime lichens *Pilayella littoralis* *Bangia atropurpurea* *Chordaria flagelliformis* *Chorda filum* *Phyllophora* sp. *Alaria esculenta* *Saccorhiza dermatodea*	*Lithothamnium glaciale* *Desmarestia* sp. *Agarum cribosum* *Laminaria longicruris* *Phyllophora* sp.	*Phyllophora* sp. *Lithothamnium glaciale*
High	Cyanophyta *Porphyra* sp. *Bangia atropurpurea* *Pilayella littoralis* *Chordaria flagelliformis* *Alaria esculenta* *Saccorhiza dermatodea* *Lithothamnium glaciale*	*Clathromorphum circumscriptum* *Lithothamnium glaciale* *Laminaria longicruris* *Agarum cribosum* *Phyllophora* sp.	*Ptilota serrata* *Phyllophora* sp.

[1] 20-40 m for low exposure; 20-25 m for moderate and high exposure; HW denotes high water mark
Source: South (1983).

Table 3.2. Estuarine Algal Communities by Substrate Type.

Substrate Type	Typical Algal Species	
	HW to 5 m	**5 to 10 m**
Hard (including pebbles and boulders)	Maritime lichens *Cyanophyta* *Enteropmorpha* sp. *Fucus vesiculosus* *Ascophyllum nodosum* *Ahnfeltia plicata* *Chorda filum* *Phymatolithon laevigatum*	*Laminaria longicruris* *Phymatolithon laevigatum* *Clathromorphum circumscriptum* *Lithothamnium glaciale*
Sand/mud	*Spartina* sp. *Plantago* sp. *Cyanophyta* *Enteropmorpha* sp *Zostera marina* *Ascophyllum nodosum* *Fucus vesiculosus* *Ahnfeltia plicata* Benthic diatoms *Chaetomorpha*	*Zostera marina* *Laminaria longicruris* *Ahnfeltia plicata*

3.1.3 Planning Implications for Marine Algae

Algae associated with some of the more sensitive coastal areas (e.g., saltmarshes, eelgrass beds) are probably of most concern considering the low proportion of these types of habitats along the west coast of Newfoundland. At the same time, algae associated with the more common habitat types (i.e., coarser substrate areas) are also important as primary producers and in their interactions with animal biota. Operators would be required to ensure safe operating practices to minimize the probability of accidental events and to be well prepared to react to an accidental event.

3.1.4 Data Gaps for Marine Algae

More data on oil characteristics, spill trajectories, and oil fate and behaviour is required for the Study Area. Considering the proximity of the Bid Parcels to shore, the primary potential negative effect on marine algae would be accidental spills and blowouts. Continuing collection of physical environment data (e.g., oceanographic, climate) would also help to predict aspects of spills and blowouts.

3.2 Plankton

Plankton refers to free-floating organisms that form the basis of the pelagic ecosystem. Members of this group of organisms include bacteria, fungi, phytoplankton (plants), zooplankton (small invertebrates), macro invertebrate eggs and larvae, and ichthyoplankton (eggs and larvae of fish). In simplest terms, the phytoplankton (e.g., diatoms) produces carbon through the utilization of sunlight and nutrients (e.g., nitrogen, phosphorus, silicon). This process is called primary production. Herbaceous zooplankton (e.g., calanoid copepods, the dominant component of Northwest Atlantic zooplankton) feed on phytoplankton. This growth process is called secondary production. The herbivores are eaten by predators (i.e., tertiary production) such as predacious zooplankton (e.g., chaetognaths, jellyfish) which in turn are consumed by higher predators such as fish, seabirds, and marine mammals. This food web also links to the ecosystem on the seabed (the benthos, see below) through bacterial degradation processes, dissolved and particulate carbon, and direct predation.

Plankton production is important because areas of enhanced production and/or biomass tend to be congregation areas for fish, seabirds, marine mammals, and possibly sea turtles. Production is enhanced in areas of bottom upwelling where nutrient-rich bottom water is brought to the surface by a combination of bottom topography, wind and currents. An example of a well-known area of bottom upwelling is the anchovy fishery off the west coast of South America. Frontal areas are where two dissimilar water masses meet to create lines of convergence and often concentrate plankton and predators alike. A well-known example of this phenomenon is the semi-permanent front between waters of Gulf Stream origin and waters of Labrador Current origin. The two physical processes (upwelling and fronts) may be found together in varying degrees, particularly in coastal areas.

3.2.1 Gulf of St. Lawrence

The northeastern Gulf of St. Lawrence has a very low phytoplankton biomass between April and October compared to the other parts of the Gulf (see literature review by de Lafontaine et al. 1991). A decreasing production rate between April and May led the authors to surmise that the phytoplankton bloom in this area might typically occur in late March/early April, immediately following ice melt.

There is evidence that the surface waters overlying the Laurentian and Esquiman Channels (see Figure 1.1) in the northcentral Gulf of St. Lawrence resemble the *Calanus*-*Sebastes*-dominated system occurring in the Northwest Atlantic Ocean. Two *Calanus* species (*C. finmarchicus* and *C. hyperboreus*) dominate the mesoplankton composition in the Laurentian Channel. At the same time (late June), larval redfish (*Sebastes* spp.) appear to dominate the ichthyoplankton, particularly over deeper waters. Interestingly, the phytoplankton regime in this region in late spring/early summer is more typical of a stratified, nutrient-depleted temperate ocean than of a weakly stratified coastal environment supporting high phytoplankton biomass traditionally thought to be essential for spawning of *Calanus*. Therefore, there are suggestions that the strong link between variability in phytoplankton biomass and *Calanus* production does not exist in early summer in the north-central Gulf (Runge and de Lafontaine 1996).

Larvae of cod, herring and American plaice have been encountered primarily in relatively shallow coastal waters of the northeastern Gulf region (de Lafontaine et al. 1991). These authors also indicated redfish larvae as the dominant ichthyoplankton, occurring primarily at deep water areas.

June sampling performed on a transect running perpendicular to the Laurentian Channel and located outside of the Study Area indicated a thermocline at 10-30 m, low nutrient levels in surface waters, and low chlorophyll *a* concentrations that were maximal at 20-25 m depth at the base of the thermocline. Copepods dominated the mesoplankton (90%). Other common zooplankters included medusae, euphausiids (*Meganyctiphanes norvegica*, *Thysanoessa inermis*, *Thysanoessa raschii*), chaetognaths, larvaceans and ostracods. At stations where depth exceeded 200 m, copepodite stages of *Calanus* (*C. finmarchicus*, *C. glacialis*, and *C. hyperboreus*) made up about 80% by number of the catch. Icthyoplankton composition was dominated by redfish larvae (>96% of all fish larvae) at the deep stations (>200 m). Most redfish larvae were *Sebastes mentella* and were recently spawned, based on size. At the shallower stations, redfish larvae were less abundant and replaced by two species of shanny. Species richness was greater at shallow stations but the larvae density was about two orders of magnitude lower (Runge and de Lafontaine 1996).

The majority of *Calanus* females and redfish larvae were found in the upper 25 m of the water column (i.e., above the base of the thermocline) during both day and night. Within this surface layer, both the *Calanus* females and the redfish larvae were deeper during the day (10-25 m) than at night (0-10 m). Egg production rates by *Calanus finmarchicus* approached the known maximal level known for the species, indicating no or little food limitation. The principal stomach contents of redfish larvae collected during daylight hours were copepod eggs. Larger redfish larvae also appeared to feed on nauplii and copepodites (Runge and de Lafontaine 1996).

The *Calanus*-larval *Sebastes* interaction in the northern Gulf probably commences in late April/early May and continues throughout the summer. Larval extrusion in this area occurs primarily in May, with a minimal occurrence in early June. Available data indicate that the *Calanus-Sebastes* interaction characterizes large areas of the Laurentian and Esquiman Channels in the north-central Gulf. The authors concluded that *C. finmarchicus* in the area studied were utilizing heterotrophic microplankton (i.e., dinoflagellates, midroflagellates, diatoms) as the primary source of nutrition (Runge and de Lafontaine 1996).

Krill is one of the key species of the food web in the Gulf of St. Lawrence. One of the primary retention areas of krill occurs in the Northeastern Gulf within the Study Area (UAs 4Ra and 4Rb). Sourisseau et al. (2004) indicated upper water column krill concentration “hotspots” during February in the vicinity of Bay of Islands (UA 4Rbc; Parcels 6 and 7) and in the northern part of the Study Area near Port au Choix. Moderate concentrations were indicated along the remaining west coast of Newfoundland. Sourisseau et al. (2004) also indicated deep-dwelling krill concentrations north of Bonne Bay between May and August, and along the shelf edge in UA 4Rc during January and February.

Anecdotal information collected from fishers during SEA consultations in July 2005 (Appendix 1) confirmed this hotspot off Port au Choix indicated by Sourisseau et al. (2004). This area, known locally as “The Hole,” occurs over a steep slope area at the northern end of the Esquiman Channel (more information on the Hole will be provided in later sections) (Figure 3.1). Fishers believe that small invertebrate animals, perhaps zooplankton and ichthyoplankton, are concentrated at this location. Other areas highlighted by fishers which are likely important from an ichthyoplankton perspective include ‘Bad Bay’ area at the mouth of River of Ponds (~ 15 km south of Hawkes Bay; northern 4Rb) where there is substantial spawning (particularly capelin) activity in June and July, Port au Port Bay area (lobster larvae) during the summer (southern 4Rc), and an area west of Port au Port Peninsula (Cape St. George Cod Spawning Area off Port au Port) where 4RS+3Pn cod spawn in the spring (straddles 4Rc and 4Rd boundary; overlaps with Parcel 4). Herring are known to spawn in St. George’s Bay (4Rd) in the spring and in St. John Bay (4Ra) in the fall. More detail on these areas will be provided in later sections.

3.2.2 Planning Implications for Plankton

There are no specific planning issues associated with plankton alone, although there may be areas of enhanced production being utilized by higher trophic levels (e.g., The Hole, the Cape St. George Cod Spawning Area, nearshore area south of Hawkes Bay). This SEA does not consider plankton to be a VEC *per se* but has examined plankton production from the perspective that known or recognizable areas of enhanced production may be indicative of potentially important areas for fish, marine birds, marine mammals and sea turtles. These issues would be discussed in more detail in site-specific EAs.

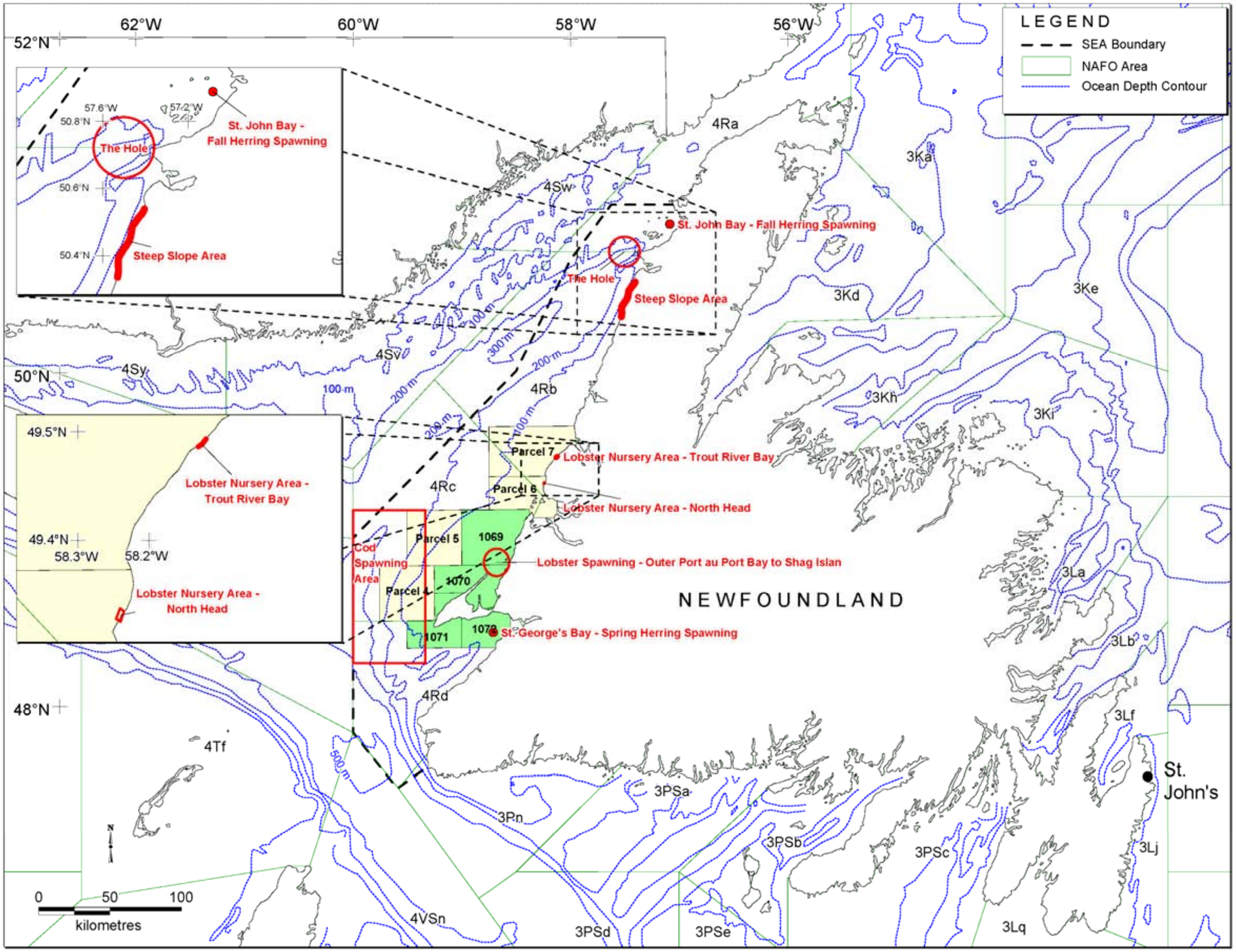


Figure 3.1. Potential Fish/Fisheries Related Sensitive Areas in the Study Area.

3.2.3 Data Gaps for Plankton

The most obvious data gap with respect to plankton concerns the spatial and temporal distributions of ichthyoplankton in the Study Area. Some spawning areas have been identified but little work has been done on the passive movements of planktonic fish and invertebrate eggs and larvae. This type of research would help to identify the plankton drift routes and, subsequently, more fish and invertebrate nursery areas.

Studies of phytoplankton and zooplankton distributions and their associations with ichthyoplankton (e.g., redfish-*Calanus* link) and higher trophic levels should continue.

3.3 Benthic Invertebrates

Benthic invertebrates are an important consideration because they are potentially most affected by disturbances to the seabed. They form an important link to higher trophic levels such as fish, birds and mammals.

Several literature reviews of coastal benthic resources of Newfoundland and Labrador are available (MacLaren 1977; South et al. 1979; Barrie et al. 1980; Campbell and Sutterlin 1981; Thompson and Aggett 1981; LeDrew 1984; Hardy 1985; Gilkinson 1986). In a literature review for marine benthic molluscs in the Newfoundland and Labrador waters, Gilkinson (1986) cites 147 references, noting that while several species have been studied rather intensively, most species have received only very cursory attention. These reviews highlight large gaps in the current knowledge of benthic ecosystems of coastal and offshore waters in the Newfoundland-Labrador region (Coady and Maidment 1984; Gilkinson 1986), with the exception of commercially important species such as the Atlantic sea scallop *Placopecten magellanicus* and the common blue mussel *Mytilus edulis*. A number of zoobenthic inventories have been compiled such as the Offshore Labrador Biological Studies program (OLABS) (Barrie et al. 1980; Barrie and Browne 1980) and others (Denbeste and McCart 1979; Gilbert et al. 1982), with studies targeted at specific coastal areas in Labrador.

For coastal Newfoundland waters, the majority of benthic community composition data exist as a result of EIS-support studies associated with offshore exploration for oil and gas (Barrie et al. 1980; Hutcheson et al. 1981; Hardy 1984) or data associated with research conducted at Memorial University or DFO. While benthic research in many cases has been intensive, the studies tend to be targeted to specific coastal areas or are concentrated in restricted time periods. In general, much of the coastline fauna of Newfoundland and Labrador remains to be inventoried (Gilkinson 1986) and there are considerable data gaps for certain geographic regions and deep-sea environments such as the continental margin and slope environments. Surveys that assess benthic community composition rather than species-specific studies are limited for this region.

Desrosiers et al. (2000) reported on a location in Cabot Strait (47º 40.3’N, 60º 00.0’W) (near offshore limit of UA 4Rd) which was sampled in November/December 1993 and June 1994. The depth of the station was 525 m. The dominant single sediment fraction was silt-clay. The intention was to examine the trophic structure of macrobenthic communities in the Gulf of St. Lawrence in relation to abiotic and biotic characteristics of the sampling sites. Both plankton and sediment were sampled at this station. Levels of both chlorophyll *a* and bacterial levels in sediments were higher in summer than in winter.

Macrofauna appeared to be distributed deeper in the sediment during winter than in summer. Most of the macrofauna individuals were found in the upper 10 cm of sediment during the winter. Approximately half of the macrofauna were surface deposit feeders while another 34% were subsurface deposit feeders. Omnivores and carnivores made up the remainder of individuals found. Summer sampling found a similar scenario. Surface deposit feeders at the Cabot Strait sampling site included Spionidae (*Laonice* sp.), Paraonidae (*Paraonis* sp.), and the Gammaridae (*Harpinia propinqua*). Subsurface deposit feeders at Cabot Strait included scaphopods (*Antalis occidentale*), bivalves (*Nuculana* sp.; *Nucula* sp.), and the mollusc Aplacophora (*Chaetoderma* sp.) (Desrosiers et al. 2000).

Deeper stations had lower macrofaunal biomasses, due mainly to smaller organisms and less food compared to the shallower benthic communities. Deep-water stations also had higher proportions of mobile and semi-mobile small organisms (Desrosiers et al. 2000).

Desrosiers et al. (2000) concluded that geomorphological characteristics (e.g., bathymetry, topography, substratum) influenced the trophic structure and composition of benthic assemblages at the Cabot Strait location. They also suggested that regular albeit relatively low-level inputs of particulate matter favour the development of benthic communities dominated by surface deposit feeders.

3.3.1 Intertidal Communities

Catto et al. (1999) presented intertidal biological shoreline units that were based on a scheme developed for the West Coast Newfoundland Oil Spill Sensitivity Atlas (Dempsey et al. 1995). These shoreline units have been designated on the basis of key biological indicators. They are as follow:

- Saltmarsh (fine substrate)
- Eelgrass (*Zostera*) (fine substrate)
- *Fucus anceps* Surf Zone (coarse substrate)
- Seabird-dominated Shores (coarse substrate)
- *Ascophyllum* Rockweed Shores (coarse substrate)
- Capelin Spawning Beaches (coarse substrate)
- Temporary Intertidal Communities (coarse substrate)
- Barachois Estuaries (fine substrate)

- Vertical Biological Zones (coarse substrate)
- Rockweed Platforms (coarse substrate)
- Periwinkle Shores (coarse substrate)

All of these shore unit types occur within the Study Area but the predominant types are beaches of coarse substrates such as pebble-cobble, sand-gravel, boulders and bedrock. Relatively few areas with finer substrates occur.

3.3.1.1 Periwinkle Shores

Periwinkle shores are similar to the rockweed platform shores except the substrate can include boulders, cobbles and fine gravel. The diversity of both plants and animals is lower. Typical animals on periwinkle shores include periwinkles, green sea urchins, polychaetes, nemerteans, amphipods, oligochaetes, nematodes, and even clams if there are patches of suitable sediment (Catto et al. 1999).

3.3.1.2 *Fucus anceps* Surf Zone

Fucus anceps surf zone shores are typical of extremely exposed bedrock shores subject to essentially continuous surf and pervasive fog (i.e., much of the northern part of the Study Area). Marine plants and animals colonize the rock faces well above the tidal zone. Pack ice can damage these communities by damping wave energy, thereby preventing the raised communities from receiving sea spray. Barnacles are typical animals observed in this type of habitat (Catto et al. 1999).

3.3.1.3 Seabird-dominated Shores

Seabird-dominated shores are typified by green to yellow-orange rock faces, coloured this way by nitrogen loving algae and lichens which thrive in seabird excrement (Catto et al. 1999).

3.3.1.4 Vertical Biological Zones

Vertical biological zones cover sheltered bedrock vertical cliff faces. Horizontal bands of lichens, seaweeds, and invertebrates form well-defined zones, commonly defined as characteristic in the biological literature. These vertical zones are most prominent along glaciated fjord walls (e.g., Bonne Bay in 4Rb). Typical fauna include periwinkles and mussels (Catto et al. 1999).

3.3.1.5 Rockweed Platforms

Rockweed platform exposed shores have an irregular rocky substrate which usually includes frequent tidepools. Some typical fauna include periwinkles, mussels, and barnacles (Catto et al. 1999).

3.3.1.6 Temporary Intertidal Communities

These communities form on rounded boulders that are stable in calm weather but less so under storm conditions. Pocket beaches backed by steep cliffs often develop a biota of rapidly growing, ephemeral seaweeds and invertebrates that are removed by every storm event. Typical animals found in these communities include copepods and amphipods. Species diversity tends to be low with very few species dominating (Catto et al. 1999). Boulder beaches occur throughout the Study Area.

3.3.1.7 Capelin Spawning Beaches

Capelin appear to prefer to spawn on wave-dominated, exposed fine gravel shorelines. Although these beaches might appear to be barren, they are distinguished by microscopic species of algae and invertebrates. In early summer, capelin eggs and dead capelin form the main food supply in this habitat. Numerous animals typically move into this habitat to feed during capelin spawning and incubation season in June/July. Although the biological assemblage of capelin beaches has been poorly studied to date, it is known to include nematodes and burrowing crustaceans (Catto et al. 1999). During SEA consultation meetings in July 2005, fishermen from western Newfoundland indicated that the coastal region immediately south of Port au Choix (4Rb) is a location of substantial capelin spawning activity.

3.3.1.8 *Ascophyllum* Rockweed Shores

These shores are dominated by carpets of yellow-brown fucoid seaweeds growing on bedrock and stable boulder substrata. Since these beds require several years of biological succession to develop, they cannot occur in areas that are regularly scoured by severe storms and sea ice. Common benthic invertebrates on *Ascophyllum* rockweed shores include periwinkles (*Littorina* spp.), polychaetes, hydroids, and bryozoans (Catto et al. 1999).

3.3.1.9 Saltmarsh

Saltmarsh shores are high intertidal areas dominated by vascular vegetation, especially grasses and sedges. Marsh vegetation entraps sediment, thereby stabilizing the shore. Saltmarsh habitats within the Study Area occur at St. Paul’s Bay (4Rb) and in parts of Bonne Bay (4Rb) (A. Laflamme, Environment Canada, pers. comm.). Typical Placentia Bay saltmarsh fauna are described in Catto et al. (1999) and include snails and amphipods.

3.3.1.10 Eelgrass (*Zostera*)

Zostera is normally found in sandy, relatively sheltered lowshore locations such as areas at the head of St. George’s Bay (4Rd; EL 1072). These areas tend to be quite productive and shelter many important commercial species. The sand surrounding the eelgrass roots typically contains a wide range of burrowing invertebrates, including softshell clams (*Mya arenaria*), lugworms (polychaetes), and sand shrimp (*Crangon septemspinosus*). Other fauna typically occurring in eelgrass habitats include hydroids, bryozoans and serpulids which attach themselves to seaweeds (Catto et al. 1999).

Eelgrass beds are generally important areas for salmon, trout and other fish. They not only serve as feeding zones but also as resting areas where fish can acclimatize physiologically between life in freshwater and life at sea. Eelgrass stabilizes sediment, often as much as 30 to 50 cm (Catto et al. 1999).

3.3.1.11 Barachois Estuaries

Barachois estuaries, as is present at the mouth of Grand Codroy River in 4Rd, are characterized by sedimentary bars that isolate lagoon-like water bodies with fresh water at surface and higher salinity waters below. These estuaries are biologically stressful sites, with low biological diversity and low productivity. Many estuaries shelter sea-run trout and/or salmon (Catto et al. 1999).

3.3.2 Subtidal Communities

Characteristic faunal species in the near shore on the shallowest parts of the Newfoundland continental shelf include green sea urchins, horse mussels, sea stars, lobsters and sometimes sea scallops. From the shallow subtidal (~10 m) to about 100 m depth where sand is the predominant substrate type, the dominant faunal species is typically the sand dollar. Snow crab is also abundant at this depth range, particularly if the substrate is coarser than sand (Steele 1983).

The following sections describe macrobenthos found at other subtidal locations on the Newfoundland and Labrador continental shelf at depths comparable to those in the Study Area. It is important to point out that the physical features of the marine environment of the Study Area and the restricted exchange of marine waters with the North Atlantic through the Cabot Strait and Strait of Belle Isle have created a environment different than that of the Atlantic offshore.

3.3.3 Grand Banks Continental Shelf (50 to 185 m)

Benthic data from the Grand Banks are of some relevance to those parts of the Study Area with similar physical conditions (e.g., substrate depth, etc.). In order to provide quantitative baseline data of macrobenthic community composition for the Grand Banks area, specifically the Hibernia region, Mobil Oil conducted a survey in 1980 (Hutcheson et al. 1981). Van Veen samples were collected and analyzed to assess sediment characteristics (grain size, organic content) and benthic community composition. The diversity recorded across all four major sampling stations was high with 343 different taxa in total. Polychaete worms were numerically dominant, however, molluscs and echinoderms accounted for the highest biomass. Small-scale variations in species distributions with changing sediment type were observed. The prevalent sediment types were sand and gravel with wide variations in the proportions of different grain size.

The dominant species and species assemblages in relation to grain size were also identified for the Grand Banks region from the Hibernia surveys. Polychaetes and infaunal bivalves were the dominant species. Sand dollars occurred at almost all stations and were considered to be a characteristic species of the Grand Banks benthos. Interestingly, five assemblages of benthic organisms were identified that varied with changing grain size. Species assemblages that were dominant in sandy habitats included the suspension feeding bivalve *Mesodesma deauratum*, amphipods, polychaetes, and sea cucumbers (notably *Stereoderma unisemita*). Polychaete worms dominated coarse sand habitats and included species such as *Exogone hebes*, *Glycera capitata*, *Parapionosyllis longicirrata* and *Laphania boecki*. A unique species assemblage was identified for habitats comprised of fine silt/clay particles. The crustacean *Harpinia plumosa*, unidentified tanaids, polychaetes *Prionospio steenstrupi* and *Onuphis conchylega*, and the cumacean *Eudorellopsis integra* dominated these sites.

Epibenthic megafauna have been assessed at a higher spatial resolution using photographic transects obtained using sled-mounted cameras (Schneider et al. 1987). Data collected from higher resolutions such as photographic data can provide information of epibenthic communities (benthic animals that live on or just above the sea floor). Photographic transects were taken on the northeastern edge of the Grand Banks in the Hibernia area (Schneider et al. 1987). An investigation of the distribution of megafauna relative to small and large-scale variation in substrate was assessed. Echinoderms (sea cucumbers, sand dollars, asteroids) were the most frequently encountered phylum. The next most abundant phyla were molluscs, annelids, and cnideria. Schneider et al (1987) identified correlations between megafauna and habitat variability (as determined by substrate type). Specifically they found that highly mobile swimming megafauna were less frequently correlated with local variability than non-swimming more sessile megafauna. Large-scale processes influencing the sedimentary cover on the Grand Banks include the hydrodynamic regime and physical forces such as tidal mixing, and reworking of the sediment due to seasonal storms (Barrie et al. 1984).

DFO conducted a 3-year otter trawling experiment on a sandy bottom ecosystem on the Grand Banks of Newfoundland (120 to146 m depths) from 1993 to 1995. The area was selected as it had not experienced trawling for at least 12 years and benthic fauna were sampled before and after trawling as well as in a reference area, hence information of non-disturbed benthic assemblages can be extracted from the before and reference data. Two hundred benthic samples were collected using a new grab-sampling device (0.5 m^2) equipped with a high-resolution video camera system. Samples contained 246 taxa, primarily polychaetes, crustaceans, echinoderms, and molluscs. Bivalves and sand dollars dominated in terms of biomass while abundance was dominated by polychaetes and bivalves (Kenchington et al. 2001). Prena et al. (1999) also report on data collected as part of the same experimental study to assess effects of otter trawling. Dominant species included, in decreasing order of mean biomass, echinoderns, crustaceans, molluscs and soft coral.

Data from all of the above studies conducted on the continental shelf of the Grand Banks suggest the diversity of benthic communities in this area is high. Polychaetes, crustaceans, echinoderms and molluscs were the dominant biota of these communities. Small-scale variations in species distributions with changing sediment type were also observed.

While the results of these studies may not closely reflect the biota comprising the subtidal communities in the Study Area, the community variability as it relates to substrate type and depth is likely similar in the Study Area.

3.3.4 Sensitive Species/Communities

Consistent responses of soft-sediment macrofaunal communities to anthropogenic disturbances in general include structural and functional changes, loss of habitat complexity, reduced diversity and productivity, and changes in the community composition to favour opportunistic species (Ellis et al. 2000). These consistent macrofaunal responses to stress can be used to identify species that are sensitive to anthropogenic disturbances and also investigate subsequent recovery dynamics of species at risk. In this respect, information that has been generated to determine responses of benthic communities in Atlantic coastal waters to fishing impacts can also be used to identify likely species that would be sensitive to other anthropogenic disturbances.

Experimental work conducted by DFO to assess impacts of trawling on benthic communities documented significant immediate declines associated with trawling activities in the abundance and biomass of a number of species (Prena et al. 1999; Kenchington et al. 2001). Benthic biomass of organisms in trawled corridors was on average 24% lower than for reference corridors (Prena et al. 1999). At the species level this biomass difference was significant for snow crabs *Chionoecetes opilio*, sand dollars *Echinarachnius parma*, brittle stars *Ophiura sarsi*, sea urchins *Strongylocentrotus pallidus* and soft corals *Gersemia* sp. The reduced biomass of epibenthic organisms in trawled corridors was hypothesized to be due to several integrating factors including direct removal by the trawl, mortality, damage, predation and migration. This research highlights the potential for detectable changes on both benthic habitat and communities due to otter trawling on sandy bottom ecosystems in the Grand Banks, in particular with significant reduction in the biomass of large epibenthic fauna.

As part of the same experimental trawling impact study, Kenchington et al. (2001) found 12 taxa representing eight families and five orders of the Polychaeta, which appeared to have dynamic population responses to physical disturbance. They included *Chaetozone setosa* and four other sedentary filter- or deposit-feeding spionids, which tend to be small and short-lived (<2 years), with possibility more than one recruitment period per year (Fauchald and Jumars 1979). Four were errant burrowers of the families Opheliidae, Paraonidae, and Phyllodocidae, plus juveniles of the equally motile polynoids and two capitellid deposit feeders, one of which is a tube-building species. Dynamic changes in polychaete populations in response to disturbance are well documented. Their rapid recoveries are attributed to the opportunistic nature of the mobile, scavenging species and the ability of surface tube dwellers to reproduce and in some cases regenerate rapidly. While many polychaetes have the potential for rapid recovery, Kenchington et al. (2001) note that the presence of bioturbators such as sand dollars and some polychaetes, opens the potential for substantial changes in community structure associated with trawling-induced changes in their abundance. The actions of bioturbators provide a habitat complexity that can be critical to the maintenance of species diversity in unconsolidated sediments (Thistle and Eckman 1990). Sand dollars in particular are considered to be critical in structuring sandy-bottom benthic communities. Their movement and burrowing activity particularly affect tube-dwelling polychaetes and the meiofauna (Brenchley 1981). While polychaetes have the potential for rapid recovery following disturbance events, sand dollars have an average life span of eight years and are unable to survive damage to their tests requiring careful consideration of impacts to such key species.

In summary, consistent responses of benthic communities to anthropogenic disturbances such as trawling (and potentially oil production activities such as glory hole excavation or pipeline construction) include reductions in the abundance and biomass of large long-lived epifaunal species and sessile organisms. These types of responses are likely exhibited by benthic communities occurring in the Study Area. The most vulnerable seabed habitats are those with a high degree of structural complexity with an abundance of surface-dwelling flora and fauna such as soft or hard corals and sponges, which could sustain long-term damage through even limited disturbance. Vulnerable species such as sand dollars have key roles in the functioning and structure of benthic communities.

3.3.5 Existing Disturbances in the Western Newfoundland Offshore Area

The main identifiable anthropogenic disturbance presently occurring in Canadian Atlantic waters is due to commercial fishing activities. The effects of these activities range from removal of target and bycatch species to alteration of the proximate benthic habitat and communities. Mobile fishing gear is a widespread cause of physical disturbance to the global continental shelf benthos (Dayton et al. 1995), where large bag or semi-rigid box structures are dragged across the ocean floor. While a number of studies have been conducted on the impacts of fixed gear (gillnets, longlines, traps, etc.) on seabed habitat and communities, the effect of non-mobile gears are expected to be substantially less than those of mobile gears, namely trawls (Kulka and Pitcher 2001). Numerous studies worldwide have documented damage to benthic habitats as a result of trawling (MacDonald et al. 1996; Jennings and Kaiser 1998; Lindeboom and de Groot 1998; Watling and Norse 1998; Hall 1999; Auster and Langton 1999; Collie et al. 2000; WGECO 2000; Thrush et al. 2001). While the results of specific experiments are dependent on the conditions under which they were conducted, it is clear from recent literature that among other conclusions, effects of otter trawling on seabed habitat and communities can be detected and are dependent upon at least three factors: (1) fishing history (intensity and frequency of trawling), (2) type of habitat, and (3) the kinds of organisms present (Kulka and Pitcher 2001).

Trawling occurs in the Study Area where Atlantic cod and redfish are harvested with otter trawls and shrimp trawls are employed to catch northern shrimp. DFO has analysed trawling in Canadian Atlantic and Pacific waters as part of a program to assess the effect of trawling on benthic habitats of the Atlantic and Pacific using a Geographic Information System (GIS) (Kulka and Pitcher 2001). Data from the Fisheries Observer Program for the period 1980-2000 (Atlantic) and 1994-2000 (Pacific) in the form of geo-referenced fishing set locations were used to spatially describe trawl effort location. The primary output are maps depicting the area scoured at varying levels of intensity, hence providing information of bottom disturbance due to trawling. Maps of the extent and intensity of trawling over 21 years for|

Atlantic waters indicate a patchy and complex pattern of trawling for a wide range of groundfish species and shrimp. Although patterns of trawling changed quite dramatically over the time sequence analysed, locations of high intensity trawling were fairly similar from one year to the next. Throughout the 1980s there were numerous persistent core areas of trawling spread mainly along the shelf edge and between the banks. In the early 1990s, fishing patterns changed dramatically in most areas. As the groundfish stocks collapsed and fisheries were closed, the extent of area fished diminished. The only place on the Grand Banks where fishing was sustained over the entire period was along the southwest slope. Trawling was moderately persistent (9 of 21 years) on the central part of the Grand Bank, along the shelf edge centered at Lat 49º and in a few small areas to the north on the outer shelf. Trawling activity was concentrated on the outer shelf and in the trenches between the banks for two reasons: (1) because this is where the fish and invertebrates of commercial size concentrate and (2) because the grounds in these areas are sufficiently smooth (even bottom and free of snags that can damage the gear) (Kulka and Pitcher 2001).

The research on trawling provides an excellent source of knowledge of historical disturbance due to fishing activities as well as information of undisturbed benthic habitats. In order to assess the effects of anthropogenic disturbances such as trawling on benthic habitats one must be able to differentiate gear effects from physical stresses imposed by storm waves, tidal currents, ice scour, sediment transport, as well as biological influences from predation and bioturbation activities. By obtaining information of undisturbed environments, natural variation (both spatial and temporal) can be assessed relative to changes caused by human activities such as fishing and oil exploration and production.

3.3.6 Deep-water Corals

Tropical shallow-water corals have been well studied and are noted for their high diversity. It is less well known, however, that corals (e.g., scleractinians and gorgonians) are widespread in cold temperate waters (Buhl-Mortensen and Mortensen 2003), and have similarly high faunal assemblages associated with coral reefs constituting high biodiversity habitats (Jensen and Frederiksen 1992; Mortensen 2001). Deep-water gorgonian corals are found in oceans around the world most commonly at depths on the order of 200-1,500-m (Genin et al. 1986; Mistri and Ceccherelli 1994) and are considered to be important components of deep-water ecosystems (Rogers 1999; Krieger and Wing 2002). In general, there is limited knowledge of the distribution, habitat, age composition and biological aspects of these deep-water coral habitats (Mortensen et al. 2002). The development of remotely operated vehicles (ROV) or submersibles has provided the ability to sample deep-water habitats although investigations are still limited due to the expense of sampling.

There is growing concern that fishing and oil and gas exploration activities that are moving into deeper waters may damage these coral habitats (Probert et al. 1997; Reed 2002). While there is limited research on the effects of oil exploration activities, evidence of physical damage to coral reefs where sea-fans and coral ‘trees’ are broken or removed due to trawling and longline fishing activities have been documented for Atlantic Canadian waters (Mortensen et al. 2002). Documented anthropogenic impacts include the immediate consequences of physical damage to coral fans with subsequent slow recovery rates, as well as the potential for secondary effects due to alterations in associated benthic and fish communities. Visual surveys can be used to assess areas where coral communities occur at relatively high abundances. For example, in June 2002 DFO established a “Coral Conservation Area” in the Northeast Channel off Nova Scotia after reviewing preliminary results from video records and photographic transects taken using an ROV. Currently finer scale visual information is limited for the Grand Banks and offshore continental slope area. However, it is known that deep-water gorgonians occur off Atlantic Canada on the continental slope, in submarine canyons, and in channels between offshore banks (Verrill 1922; Deichman 1936; Breeze et al. 1997; MacIssac et al. 2001; Mortensen et al. 2002)

Within these habitats they are locally abundant on hard substratum including cobbles and large boulders and in high current areas (Tendal 1992). These environments are therefore the habitats in the Western Newfoundland and Labrador Offshore Area where the highest abundances of these vulnerable coral-assemblage communities may occur.

3.3.7 Planning Implications for Benthic Invertebrates

Benthos is relevant to offshore planning because benthic communities are relatively immobile, are directly affected by drilling discharges and accidental spills (particularly in shallow areas), are an important link to commercial fisheries, and generally exhibit some level of zonation in their distribution. Macrobenthos in the Study Area that are particularly important to fishermen on the west coast of Newfoundland include lobster and snow crab. These are presently the two most valuable commercial species in the Study Area. There is also potential for suitable habitat to support corals. In most coastal and slope areas of North America such as the West Coast, Gulf of Mexico, and U.S. East Coast, there is sufficient information linking specific benthic assemblages to specific depth ranges. It is known that benthic invertebrate community characteristics are directly linked to the physical characteristics of an area. There are a variety of shore types (Sections 2.1.3 and 3.3.1) in the Study Area, indicating a variety of benthic community types. Different shoretypes also have varying levels of sensitivity to the various potential effects of oil and gas activities. Operators may have to collect baseline benthic data in support of exploratory drilling applications.

3.3.8 Data Gaps for Benthic Invertebrates

Because of the commercial importance of macrobenthic invertebrates, more is known about these species compared to non-commercial infauna and epifauna. Overall, however, intertidal and subtidal benthic invertebrate communities in the Study Area are not well understood. Obvious data gaps for benthic invertebrates in the Study Area relate to distributional and biological aspects of corals. The interactions between benthic invertebrates and both lower and higher trophic organisms are also not well understood.

3.4 Fish and Fisheries

3.4.1 Important Commercial Invertebrate Species

3.4.1.1 Lobster

Lobsters (*Homarus americanus*) are distributed nearshore around the island of Newfoundland, including the west coast of Newfoundland. Lobster populations tend to be very localized in nature. The major lobster life history events (i.e., molting, spawning, larval hatching) typically occur between mid-summer and early fall, following the spring fishery (DFO 2003).

Mating between male and female American lobsters usually occurs immediately following the female's shedding of her old shell (molting or ecdysis) during the summer months (Aiken and Waddy 1980). The sperm is stored in a receptacle on the underside of the female's body and carried by the female until she spawns the following year. At that time, the eggs are pushed from the ovaries and fertilized as they pass through the sperm receptacle. The fertilized eggs are extruded and attached to long hairs on the female's pleopods.

The female carries the embryos until the following summer when the pre-larvae hatch and remain attached until they molt into the first larval stage within 24 hours of hatching (Charmantier et al. 1991). Hatching can occur over a wide range of temperatures during the May to July period on the Atlantic coast of North America (Ennis 1995). Hatching generally begins around 10 to 15 ºC and is most intense at 20 ºC (Hughes and Matthiessen 1962). The female then releases the first stage larvae by fanning her pleopods. The larvae may be released over a period of time from a few days to a few weeks. There is normally a two-year period between mating and pre-larval hatch (i.e., a two-year reproductive cycle) (Ennis 1995).

The three distinct larval stages are planktonic, generally found in the upper two to three m of the water column during a two to eight-week period (Hudon et al. 1986). Field studies have suggested that the maximum depth of decapod larval vertical migration is related to the depth of the thermocline (Harding et al. 1987). During this time, lobster larvae are passive drifters so their gross movements are largely controlled by the direction of the wind and water currents. Both are generally onshore during the regular time of larval release. Hudon and Fradette (1993) described the wind-induced advection of larval decapods, including lobster, into a bay of the Magdalen Islands in the southern Gulf of St. Lawrence.

Settling postlarval lobster typically prefer inshore habitat with gravel/cobble substrate (Palma et al. 1999) and kelp cover. During their study in the Gulf of Maine, Palma et al. (1999) observed a conspicuous lack of newly settled lobsters on adjacent finer-sediment substrata. However, lobsters more than 1 year old were found on the finer-sediment substrata. In terms of settlement depth, newly settled lobsters were found on collectors at five and 10 m but not at 20 m.

During SEA consultations with fishermen in July 2005 (Appendix 1), the inshore area between the outer portion of Port au Port Bay and Shag Island to the north (4Rc) was identified as prime lobster spawning area (Figure 3.1). Fishermen indicated that that lobster fishing grounds in the area between Long Point (outer Port au Port Bay) and Shag Island generally yield very large females. Fishers also noted lobster nursery areas near Shoal Point, Outer Bay of Islands located just above North Head (LFA 13B; Parcel 6), and at an area further north known as Trout River Bay (LFA 14A; Parcel 7). These two areas are presently closed to the lobster fishery as a means of conservation. The areas are defined as follow:

Corner coordinates of area in LFA 13B/ Bid Parcel 6

49º 19’ 25’’ N, 58º 14’ 23” W
49º 19’ 35’’ N, 58º 14’ 45” W
49º 20’ 10’’ N, 58º 14’ 25” W
49º 20’ 00’’ N, 58º 14’ 05” W

Headland to headland coordinates of area in LFA 14A/Bid Parcel 7

49º 29’ 30’’ N, 58º 07’ 12” W
49º 28’ 56’’ N, 58º 07’ 24” W

Increases in lobster landings were reported in west coast LFAs 13A (4Rd), 13B (4Rc) and 14A (part of 4Rb) in 2001 and 2002. However, these landings are still low compared to those of the early 1990s. Fishermen consulted in July 2005 identified the Port au Port Bay region as having both male and female lobsters larger than those in other areas along the coast. The lobster is an important commercial species throughout the nearshore area in the Study Area, including the section of coastline in Parcels 6 and 7.

3.4.1.2 Snow Crab

Snow crab (*Chionoecetes opilio*) is a decapod crustacean that occurs over a broad depth range (50 to 1,300 m) in the Northwest Atlantic. The distribution of this decapod in waters off Newfoundland and southern Labrador is widespread but the stock structure remains unclear. Snow crabs have a tendency to prefer water temperatures ranging between –1.0 and 4.0ºC. Large snow crabs (≥95-mm carapace width or CW) occur primarily on soft bottoms (mud or mud-sand) (DFO 2005a), particularly in water depths of 200 to 500 m. Small snow crabs appear to be most common on relatively hard substrates (DFO 2005a). Mating generally occurs during the early spring and the females subsequently carry the fertilized eggs for about two years. Large numbers of sexually paired snow crabs have been observed in relatively shallow water (10 to 40 m) during late April/early May at Bonne Bay, Newfoundland (Taylor et al. 1985; Hooper 1986; Ennis et al. 1990). The pairs were found in algal covered boulder slopes less than one kilometre away from areas of depth >100 m. Level sand or mud substrates supported lower densities of paired snow crab but were the main sites where feeding was observed. The larvae hatch in late spring or early summer, and then remain in the water column for 12 to 15 weeks before settling on the bottom (DFO 2005a).

Comeau et al. (1998) studied a relatively unexploited stock in Bonne Bay, Newfoundland. In that study, relative abundance of early benthic to commercial-size individuals suggested that small immature crabs migrate from shallow rocky areas to deep muddy bottom areas. The patchy spatial distribution observed for the snow crab in Bonne Bay appeared to be determined more by substrate and intraspecific factors than by depth. Seasonal movements to shallow waters by larger crabs were related to density- and temperature-dependent factors associated with the reproductive and growth cycle.

Snow crab typically feed on fish, clams, polychaete worms, brittle stars, shrimp and crustaceans, including smaller snow crab. Hooper (1986) observed the feeding behaviour of sexually paired snow crabs in shallow water at Bonne Bay, Newfoundland during April and May. The most favoured natural prey types of the snow crab were polychaetes, ophiuroids and bivalves although the most frequently eaten food was fish used as lobster bait.

During recent years, most of the snow crab catches have occurred in Unit Area 4Rc, the northern part of 4Rd and southern 4Rb. There has been a pronounced change in the distribution of effort from north to south in recent years (DFO 2005a). In 2004, snow crab catches were made inside all four Bid Parcels.

The snow crab fishery in the area that overlaps with the 4Ra and northern 4Rb portions of the SEA Study Area was placed under moratorium in 2003 (DFO 2004a). Recent trap survey results give no indication that the critical state of the snow crab resource will improve appreciably in the short term (DFO 2005a).

3.4.1.3 Northern shrimp

Northern shrimp (*Pandalus borealis*) mating takes place in the fall and the females carry the fertilized eggs for about eight months (September to April). Larvae are pelagic upon hatching in the spring but eventually settle to the bottom by late summer. Shrimp migrations tend to be associated with breeding (berried females move into shallower waters in winter) and feeding (upward movement in water column at night to get to plankton). Northern shrimp are generally found in areas with water depths ranging between 150 and 350 m (DFO 2004b).

Most of the shrimp catches in the Study Area are made in Unit Area 4Rb, followed by 4Rc. Essentially all of the recent northern shrimp catches have occurred outside of all four Bid Parcels. Division 4R falls within the Gulf of St. Lawrence shrimp fishing area 8, otherwise known as Esquiman. Research survey indices in Esquiman were very high in 2003, well above the 1990-1999 mean.

3.4.2 Important Commercial Fish Species

3.4.2.1 Atlantic Cod

Northern Gulf of St. Lawrence cod (*Gadus morhua*) (NAFO Divisions 3Pn and 4RS) undertake extensive migrations. In winter, they aggregate off southwestern and southern Newfoundland at depths of more than 400 m (4Rd) (Castonguay et al. 1999). In April/May, they move towards the Port au Port Peninsula (UA 4Rcd) near Parcels 4 and 5 where spawning commences (DFO 2005b; Ouellet et al. 1997). In 2002, a new zone was established just off the Cape St. George Cod Spawning Area that is closed to all groundfish fishing between April 1st and June 15th (see Figure 3.1). Cod spawn in the area during this period. The Cape St. George Cod Spawning Area is presently defined by the following corner coordinates:

48º 15’ N, 59º 20’ W
49º 10’ N, 59º 20’ W
49º 10’ N, 60º 00’ W
48º 15’ N, 60º 00’ W

During summer, the cod continue their migration and disperse towards the coastal zones along the west coast of Newfoundland (4R) and towards Quebec’s Middle and Lower North Shore (4S). This migration towards the coastal regions appears to be associated with warmer water and the presence of capelin, the primary prey of the cod (DFO 2005b).

According to DFO, the abundance and spawning stock biomass of the northern Gulf stock remain low despite that since 1997, the commercial fishery has been conducted by fixed gears only (longlines, gill nets and handlines) (Fréchet et al. (2003). The spawning stock biomass increased between 1994 and 1999 but subsequently declined between 2000 and 2002. The cod fishery was under moratorium in 2003 and then re-opened under small quotas in 2004. The 2004 cod catches were distributed primarily in the northern part of the Study Area, from nearshore to the extreme offshore. With respect to the Parcels up for bids, Parcel 7 reported the most cod catches, followed by Parcel 6. Catches tended to be in the nearshore areas of these Parcels. Few catches were reported in Parcels 4 and 5.

3.4.2.2 Mackerel

The Atlantic mackerel (*Scomber scombrus*) is a pelagic fish common to temperate waters of the open sea and is one of the most active and migratory of fishes. They winter outside of the Gulf of St. Lawrence but migrate to the Gulf of St. Lawrence in spring to spawn in the Magdalen Shallows (outside of the Study Area). Spawning typically occurs between mid-June and mid-July in open water, resulting in a concentration of fertilized eggs in the upper 10 m of the water column. Larval hatching generally occurs within five to seven days at water temperatures of 11 to 14ºC (Scott and Scott 1988).

The purse seine fishery for mackerel in 4R has grown substantially during recent years. In 2003 and 2004, landings of 4R catches have been 3 to 4 times the 1990 to 2003 average (DFO 2005c). Highest catches of mackerel in the Study Area typically occur in Unit Areas 4Rc and 4Rd during September and October. Mackerel catches commonly occur in the nearshore areas of Parcels 6 and 7.

3.4.2.3 Herring

Atlantic herring (*Clupea harengus harengus*) is primarily pelagic and often schools, particularly just prior to spawning. Along the Canadian coast, Atlantic herring may spawn in any month between April and October, but spawning is concentrated in May (spring spawners) and September (fall spawners) (Ahrens 1993).

Atlantic herring are demersal spawners depositing their adhesive eggs on stable bottom substrates (Scott and Scott 1988; Reid et al. 1999). Spawning may occur in offshore waters (e.g., Georges Bank) at depths of 40 to 80 m; however, most Atlantic herring stocks spawn in shallow (<20 m) coastal waters, and it appears that in the Newfoundland region Atlantic herring spawn in coastal waters only. In the case of coastal spawning, spring spawning generally takes place in shallower waters than fall spawning. For example, in coastal waters in the Gulf of St. Lawrence, Tibbo et al. (1963) suggested that spring spawning largely takes place in waters four to six m deep while fall spawning takes place at depths of 18 to 22 metres. Tibbo (1956) also adds that the main spawning areas are located at the heads of the various bays and deepwater inlets around insular Newfoundland. In their review of Atlantic herring spawning grounds in the Northwest Atlantic Reid et al. (1999) report that spawning on stable substrates in shallow waters close to shore insures that the eggs will be exposed to well-mixed water, and tidal currents averaging .75 to 1.5 m/sec have been recorded in the area of Atlantic herring spawning beds. These high-energy environments provide aeration and reduce siltation and accumulation of metabolites (Reid et al. 1999).

Recently hatched Atlantic herring larvae are pelagic. The duration of the larval stage of fall spawned herring is more extensive (i.e., lasts through the winter months) than spring spawned herring. Some larvae are retained in tidally energetic areas near the spawning site for several months after hatching, while other larvae are dispersed soon after hatching and drift with residual currents.

Important spring (May to June) herring spawning grounds exist in St. George's Bay (4Rd) (see Figure 3.1). There are also indications of spring spawning in 4Ra. Fall spawning occurs mainly in 4Ra from mid-July to mid-September. Important feeding areas for herring occur in St. George's Bay (4Rd) in the spring, in southern 4Ra in the summer, and in north 4Ra in the fall. These Gulf herring overwinter in Esquiman Channel (DFO 2004c).

Large herring catches are made on the west coast of Newfoundland in all of Division 4R, primarily with purse seiners. Gill nets are also used after the seine fishery. Between 1990 and 2002, the highest average annual landings of herring occurred in 4Rc (5,052 mt), 4Rd (4,332 mt), 4Rb (4,127 mt) and finally 4Ra (1,786 mt) (DFO 2004c). Most of the 2004 herring catches in 4Rc and 4Rd occurred in October and November. Herring catches commonly occur in the nearshore areas of Parcels 6 and 7.

3.4.2.4 Capelin

Capelin (*Mallotus villosus*) overwinter in offshore waters, move shoreward in early spring to spawn on beaches throughout the region in the spring-summer, and return to offshore waters in autumn. A combination of factors determine beach suitability as well as when and where beach spawning will occur, these include temperature, substrate type, tidal phase, and light conditions (Templeman 1948). Generally, where substrate conditions are suitable (see below) spawning beaches may be found in exposed, moderately exposed, and sheltered locations throughout the region. Beach spawning is demersal with the eggs being deposited in the intertidal zone. However, occurrence of egg masses indicate that subtidal spawning occurs to depths ranging from approximately one to 37 m and up to approximately 400 m from shore in years and areas where water temperatures on the beaches exceeds the preferred spawning temperatures (Templeman 1948). In the Newfoundland region beach spawning may occur over a wide range of temperatures from 2.5 to 10.8° C (Frank and Leggett 1981). Subtidal spawning is assumed to be variable from year-to-year.

The size of the substrate on the beach will determine the suitability of the beach for spawning with capelin usually preferring gravel five to 15 mm in diameter (Templeman 1948). When the most favoured substrate is occupied, or not available because of tidal conditions beach spawning capelin may spawn on sand less than 2 mm in diameter or on larger gravel up to 25 mm in diameter (Templeman 1948). Capelin do not spawn on larger substrates or mud (Templeman 1948). However, it appears that eggs may incidentally adhere to rocks, large boulders, and macroalgae when they are present among preferred substrates (Templeman 1948). Subtidal spawning inshore appears to be predominantly on sand (Templeman 1948).

Spawning occurs with one or two males accompanying a female as they are carried onto the beach by an incoming wave. They swim up the beach as far as possible, where they are temporarily stranded as the wave recedes. Eggs and sperm are shed on the beach surface, then the fish return to the water on the next series of waves. Fertilized eggs adhere to the substrate while wave and tidal action distributes the eggs over the breadth of the intertidal zone to depths of 15 cm or more below the beach surface. The eggs develop and hatch in the beach substrate. Juvenile capelin are found in bays surrounding insular Newfoundland; however, most larvae are rapidly carried out of the bays and inshore areas by surface currents.

Unit Areas 4abc account for much of the capelin landings in 4RST. Capelin on the west coast of Newfoundland have shown a recent size increase but are still smaller than those observed in 1980s. The capelin fishery is primarily a purse seine fishery (76% in 4R in 2004), along with some catches by trap (24%). The most intensive capelin fishery in 4R occurs in June and July. The purse seine fishery typically occurs near the stretch of coast between Bonne Bay and Port au Port (i.e., 4Rbc, including nearshore areas of Parcels 6 and 7). Between 2000 and 2004, the most highly concentrated capelin catches occurred in Port au Port Bay (4Rd), and between Bay of Islands and Bonne Bay (4Rc; Parcels 6 and 7) (DFO 2005d). SEA consultations in July 2005 noted remarks by fishermen that capelin are particularly plentiful along a section of coast south of Port au Choix. The slope in this area is relatively steep compared to areas further south.

3.4.2.5 Redfish

Redfish typically occur in cool waters (3.0 to 8.0ºC) along the slopes of fishing banks and deep channels in depths of 100 to 700 m. In the western Atlantic, redfish species range from Baffin Island in the north to the waters off New Jersey in the south. The three redfish species that occur in the Northwest Atlantic include *Sebastes mentella*, *S. fasciatus*, and *S. marinus*. The latter species is relatively uncommon except in the area of the Flemish Cap so for the purposes of this assessment, only *S. mentella* and *S. fasciatus* will be considered. *S. mentella* is typically distributed deeper than *S. fasciatus* (Gascon 2003).

Redfish are described as lecithotrophic viviparous with internal fertilization. Mating occurs in the fall months and the larvae subsequently hatch from the eggs inside the female. The larvae feed exclusively on energy stored in the yolk, develop inside the female and eventually are released as young fish sometime between April and July (Gascon 2003; Ollerhead et al. 2004). Based on DFO research vessel survey data collected from 1995 to 2002, Ollerhead et al. (2004) indicated the peak of redfish spawning to be in April. Release of the young occurs in NAFO Subdivisions 3Ps and 4Vn, particularly along the western slope of the St. Pierre Bank, in the deeper waters of the Laurentian Channel, and along the slope region of southern St. Pierre Bank to south of Green Bank (JWEL 2003; Ollerhead et al. 2004). DFO research survey data collected in May between 1998 and 2002 indicated the occurrence of relatively intense redfish spawning along the slope region of southern St. Pierre Bank, southern Halibut Channel and southern Green Bank (Ollerhead et al. 2004). Research survey data collected in July, 1998 to 2002, also indicated spawning activity, albeit at less intense levels. The July spawning was occurring in locations similar to the May spawning (Ollerhead et al. 2004).

The live young aggregate in the surface waters at night but during the day they are found in or below the thermocline at a depth of 10 to 20-m (Fortier and Villeneuve 1996 *in* JWEL 2003). Smaller redfish often inhabit shallower waters while the larger redfish occur at greater depths (McKone and LeGrow 1984 *in* JWEL 2003). Redfish are pelagic predators, feeding primarily on copepods, amphipods, and shrimp (Rodriguez-Marin et al. 1994 *in* JWEL 2003), and sometimes on capelin (Frank et al. 1996 *in* JWEL 2003).

Redfish have large swimbladders and exhibit semi-pelagic shoaling behaviour. Gauthier and Rose (*in* Gascon 2003) reported that redfish perform regular diel vertical migrations. They exhibited consistent patterns of vertical migration in winter, spring and summer that appeared to be limited by hydrostatic pressure. Gauthier and Rose (*in* Gascon 2003) found that the hydrostatic pressure at the upper range of the vertical migration was never less than 67% of the pressure at the bottom. This vertical migration seemed to be a foraging strategy used to follow the movement of their euphausiid prey. The authors reported that redfish were on or near bottom during the day and higher up in the water column at night. Gascon (2003) indicated that the migration and movement patterns of redfish in the Laurentian Channel are poorly understood.

One of the currently identified concentrations of Gulf redfish is located in the Cabot Strait area in 4R (i.e., southern 4Rd) (DFO 2004d).

3.4.2.6 Greenland Halibut

The Greenland halibut (turbot) (*Reinhardtius hippoglossoides*) is a deepwater flatfish species that occurs in water temperatures ranging between –0.5 to 6.0ºC but appears to have a preference for temperatures of 0 to 4.5ºC. In the Northwest Atlantic off northeastern Newfoundland and southern Labrador, these fish are normally caught at depths exceeding 450 m. Reported depths of capture range from 90 to 1,600 m. The larger individuals tend to occur in the deeper parts of its vertical distribution. Unlike many flatfishes, the Greenland halibut spends considerable time in the pelagic zone (Scott and Scott 1988).

These halibut are believed to spawn in Davis Strait during the winter and early spring at depths ranging from 650 to 1,000 m. They are also thought to spawn in the Laurentian Channel and the Gulf of St. Lawrence during the winter. The large fertilized eggs of this species (4.0 to 5.0-mm diameter) are benthic but the hatched young move upwards in the water column and remain at about 30 m below surface until they attain an approximate length of 70 mm. As they grow, the young fish move downward in the water column and are transported by the currents in the Davis Strait southward to the continental shelf and slopes of Labrador and Newfoundland (Scott and Scott 1988).

Greenland halibut are voracious bathypelagic predators that feed on a wide variety of prey. Summer and fall appear to be the seasons of most intense feeding. Prey items include capelin, Atlantic cod, polar cod, young Greenland halibut, grenadier, redfishes, sand lance, barracudinas, crustaceans (e.g., northern shrimp), cephalopods and various benthic invertebrates. Major predators of Greenland halibut include the Greenland shark, various whales, hooded seals, cod, salmon and Greenland halibut (Scott and Scott 1988).

This flatfish is typically found in the channels of the Gulf of St. Lawrence at depths ranging from 130 to 500 m. Based on genetic research, there are indications that the Gulf of St. Lawrence stock of Greenland halibut may complete its entire life cycle within the Gulf (DFO 2005e). Spawning takes place primarily in winter, between January and March.

Newfoundland-landed catch distributions in 2004 indicated that most of the Greenland halibut caught within the Study Area were taken in Unit Area 4Rb beyond the 100 m isobath. Some were also caught in St. George’s Bay and along the southwest coast in 4Rd. Catches within the Parcels between 1999 and 2004 have been minimal. Most catches in 2004 were made between May and July.

3.4.2.7 Atlantic Halibut

Atlantic halibut (*Hippoglossus hippoglossus*), the largest of the flatfishes, is typically found along the slopes of the continental shelf. Atlantic halibut move seasonally between deep and shallow waters, apparently avoiding temperatures below 2.5ºC (Scott and Scott 1988). The spawning grounds of the Atlantic halibut are not clearly defined. The fertilized eggs are slightly positively buoyant so that they naturally disperse and only gradually float toward the ocean's surface. Once hatched, the developing larvae live off their yolk for the next six to eight weeks while their digestive system develops so they can begin feeding on natural zooplankton. After a few weeks of feeding, they metamorphose from a bilaterally symmetrical larva to an asymmetrical flatfish, and are ready to assume a bottom-living habit. At this point they are approximately 20-mm long. As juveniles, Atlantic halibut feed mainly on invertebrates, including annelid worms, crabs, shrimps, and euphausiids. Young adults (between 30 to 80-cm in length) consume both invertebrates and fish, while mature adults (greater than 80-cm) feed entirely on fishes (Scott and Scott 1988).

Atlantic halibut in the northern Gulf of St. Lawrence are most abundant in the Esquiman, Laurentian and Anticosti Channels at depths >200 m. Based on observations made during scientific trawl surveys, these halibut are able to spawn in January and May (timing of surveys). Tagging studies have indicated that Atlantic halibut of this stock do not move far from their home range (DFO 2005f).

Most of the Atlantic halibut caught within the Study Area and landed at Newfoundland ports in 2004 were taken in the offshore areas of 4Rb, primarily beyond the 200 m isobath. Scattered catches were reported in all four Parcels as well as in 4Rd. Most Atlantic halibut catches within the Study Area occurred between May and July.

Overall, the 4RST Atlantic halibut stock remains at a very low level. Although recent commercial fishery landings have been increasing, the average of the landings over the last five years remains well below those in the 1960s (DFO 2005f).

3.4.2.8 Witch flounder

Landings of witch flounder (*Glyptocephalus cynoglossus*) in 4R during the mid 1990s were low but they recovered in 1998. Most of the recent 4R witch flounder fishing has occurred in 4Rd between May and October in St. George's Bay. Witch flounder are known to spawn in St. George's Bay. The biomass index for witch flounder in 4R remains below that seen in 1980s (DFO 2004e).

3.4.2.9 American plaice

American plaice (*Hippoglossoides platessoides*) occur primarily in the southern Gulf of St. Lawrence (DFO 2004f) but some are taken as bycatch in the 4R fisheries.

3.4.2.10 White hake

The white hake (*Urophycis tenuis*) Gulf stock occurs primarily in the southern Gulf of St. Lawrence (DFO 2004g) but some are taken in 4R fisheries.

3.4.3 Important Non-commercial Fish Species

3.4.3.1 Atlantic Salmon

Within the SEA Study Area, there are more than 30 scheduled Atlantic salmon (*Salmo salar*) rivers distributed somewhat evenly throughout the area. While the commercial fishery for this species is under moratorium, Atlantic salmon remains an important recreational fishery species in Newfoundland and Labrador. This anadromous fish spends time in both freshwater (spawning) and at sea (feeding, growth), and therefore, could potentially be impacted by oil and gas activities in the Study Area during their migrations between the two systems. Atlantic salmon were raised as an issue during consultations with Parks Canada in June 2005 (Appendix 1).

The two Atlantic salmon management areas (salmon fishing areas or SFAs) in the Study Area are SFA13 (Cape Ray to Cape St. Gregory; 4Rd and small portion of 4Rc) and SFA 14A (Cape St. Gregory to Cape Bauld (remainder of Study Area) (DFO 2003). In these SFAs, there are important large salmon components that contain a mixture of maiden fish (never spawned before) which have spent two or more years at sea, and repeat spawners which are returning to the rivers for a second or subsequent spawning. The large component in most other Newfoundland rivers consists primarily of repeat spawners.

Conservation requirements for Atlantic salmon rivers are considered to be threshold reference points. The status of salmon stocks is assessed on the basis of the proportion of the conservation egg deposition achieved in a given year and trends in abundance of various life stages. These requirements are established for individual rivers in Newfoundland, including the following ones that occur within the Study Area.

- Torrent River (SFA 14A; 4Rb)
- Lomond River (SFA 14A; 4Rb)
- Harrys River (SFA 13; 4Rd)
- Flat Bay Brook (SFA 13; 4Rd)
- Fischells River (SFA 13; 4Rd)
- Robinsons River (SFA 13; 4Rd)
- Middle Barachois River (SFA 13; 4Rd)
- Crabbes River (SFA 13; 4Rd)
- Highlands River (SFA 13; 4Rd)

Improvements were observed in most of the monitored rivers in SFA 13 in 2003 compared to 2002 (DFO 2003) but populations sizes remained low. In SFA 14A in 2003, there was not any increase in adult salmon recruitment. Two of the seven SFA 13 rivers and both SFA 14A rivers exceeded conservation requirements in 2003.

Based on fishway and counting fence data, counts of small and large salmon for the two monitored SAF 14A rivers in 2002 were 3,965 and 397, respectively, for the Torrent River, and 548 and 62, respectively, for the Lomond River. Small and large salmon counts for the Highlands River in 2002 were 169 and 87, respectively.

DFO states that particular concern should be given to the conservation of salmon populations in St. George's Bay (DFO 2003). Rivers that flow into this bay experience dramatic fluctuations in salmon abundance.

The Humber River, a large high profile salmon river, empties into Humber Arm, located off Bay of Islands (i.e., Bid Parcel 6). Based on fishway and counting fence data, 27,000+ small salmon and 4,400+ large salmon were counted in the Humber River in 1999 (O'Connell et al. 2003)

3.4.3.2 Wolffishes

Two wolffish species, spotted (*Anarhichas minor*) and northern (*Anarhichas denticulatus*) are presently listed as *threatened* on Schedule 1 of *SARA*. The Atlantic or striped wolffish (*Anarhichas lupus*) is listed as a species of *special concern* on Schedule 1 of *SARA*.

The northern wolffish typically occurs at intermediate depths of 90 to 200 m but have been found to depths of 600 m. Tagging studies have shown that northern wolffish do not migrate long distances, and do not form large schools. The northern wolffish is a benthic and bathypelagic predator, preying upon jellyfish, comb jellies, crabs, brittle stars, seastars, and sea urchins. Predators of the northern wolffish include redfish and Atlantic cod.

The spotted wolffish typically occurs at depths of 475 m or more. Tagging studies have shown that spotted wolffish only migrate locally, and do not form schools. Spatial analysis of DFO research vessel catch data from the Grand Banks indicated that spotted wolffish abundance declined from the late 1980s to the mid-1990s, with an increase in abundance during both survey seasons since the mid-1990s (Kulka et al. 2003). Its prey includes hard-shelled invertebrates such as crustaceans, molluscs, and echinoderms, and fish, primarily those discarded by trawlers. The species has few predators, although remains have been found in the stomachs of Atlantic cod, pollock and Greenland sharks (Scott and Scott 1988).

Atlantic or striped wolffish is typically found further south than either northern or spotted wolffish. It has been found at depths of up to 350 m (Scott and Scott 1988). There is no evidence that Atlantic wolffish migrates long distances, or form schools in Newfoundland waters (DFO 2004h). In the Northwest Atlantic, Atlantic wolffish feeds primarily on benthic invertebrates such as echinoderms, molluscs and crustaceans, as well as small amounts of fish. No predators of adult Atlantic wolffish have been identified, but juveniles have been found in the stomachs of Atlantic cod (Scott and Scott 1988).

It is not known with certainty if any of these three wolffish species spawn in the Study Area, although it is probable given the limited migration of the species. If spawning does occur in the Study Area, it would most likely take place along the slope region. During the late fall fertilized eggs are deposited on either a hard bottom or underwater ledge (Scott and Scott 1988), producing larvae which are large (2-cm long upon hatching) and semipelagic (DFO 2004h). The spotted wolffish and striped wolffish are regarded as commercial species in Newfoundland waters while the northern wolffish is not (Simpson and Kulka 2002, 2003). While the decline in abundance and biomass estimates of all three species has occurred throughout much of Newfoundland's waters, it seems that the decline has been greater in the more northern areas (Divisions 2J, 3K and northern 3L) than in the southern areas (southern 3L, 3N, 3O) for all three species (Simpson and Kulka 2002, 2003). DFO is presently preparing a 'Wolffish Recovery Plan' but this document has not yet been published (J. Simms, DFO, pers. comm.).

However, fishers consulted for this SEA in July 2005 reported that bycatch for all three wolffish species remains high at certain locations within the Study Area. According to DFO Newfoundland-landed commercial catch statistics, 1,462 wolffish (species breakdown unknown) were caught in NAFO Division 4R between 1999 and 2004. Most wolffish were caught in 4Rb and 4Rd. Little scientific information is available for the wolffish populations inhabiting the waters off western Newfoundland.

3.4.4 Commercial Fisheries

This section provides a description (qualification and quantification) of the commercial fisheries within and adjacent to the SEA Study Area. In particular, it presents a historical overview of past (1985-2004) harvesting activities, a more detailed analysis of harvesting data for the 2002-2004 fishing seasons, and describes expected fish harvesting activities in the Areas in the foreseeable future. Figure 3.2 shows the Study Area in relation to regional fisheries management areas. As this map indicates, the Area falls within North Atlantic Fisheries Organization (NAFO) Division 4R.

3.4.4.1 Information Sources and Data Areas

The fisheries data analyses use Department of Fisheries and Ocean's (DFO) Newfoundland Region (Newfoundland and Labrador), Maritimes Region (New Brunswick and Nova Scotia Atlantic coasts), Gulf Region (Prince Edward Island, and New Brunswick and Nova Scotia Gulf coasts) and Quebec (Gulf and St. Lawrence River) georeferenced catch and effort datasets for 2002 – 2004 (accessed in 2003 for 2002, and 2005 for 2003 and 2004) and other historical DFO datasets for Newfoundland Region (1985-2004). The DFO datasets record domestic harvest and foreign harvest landed in Canada.

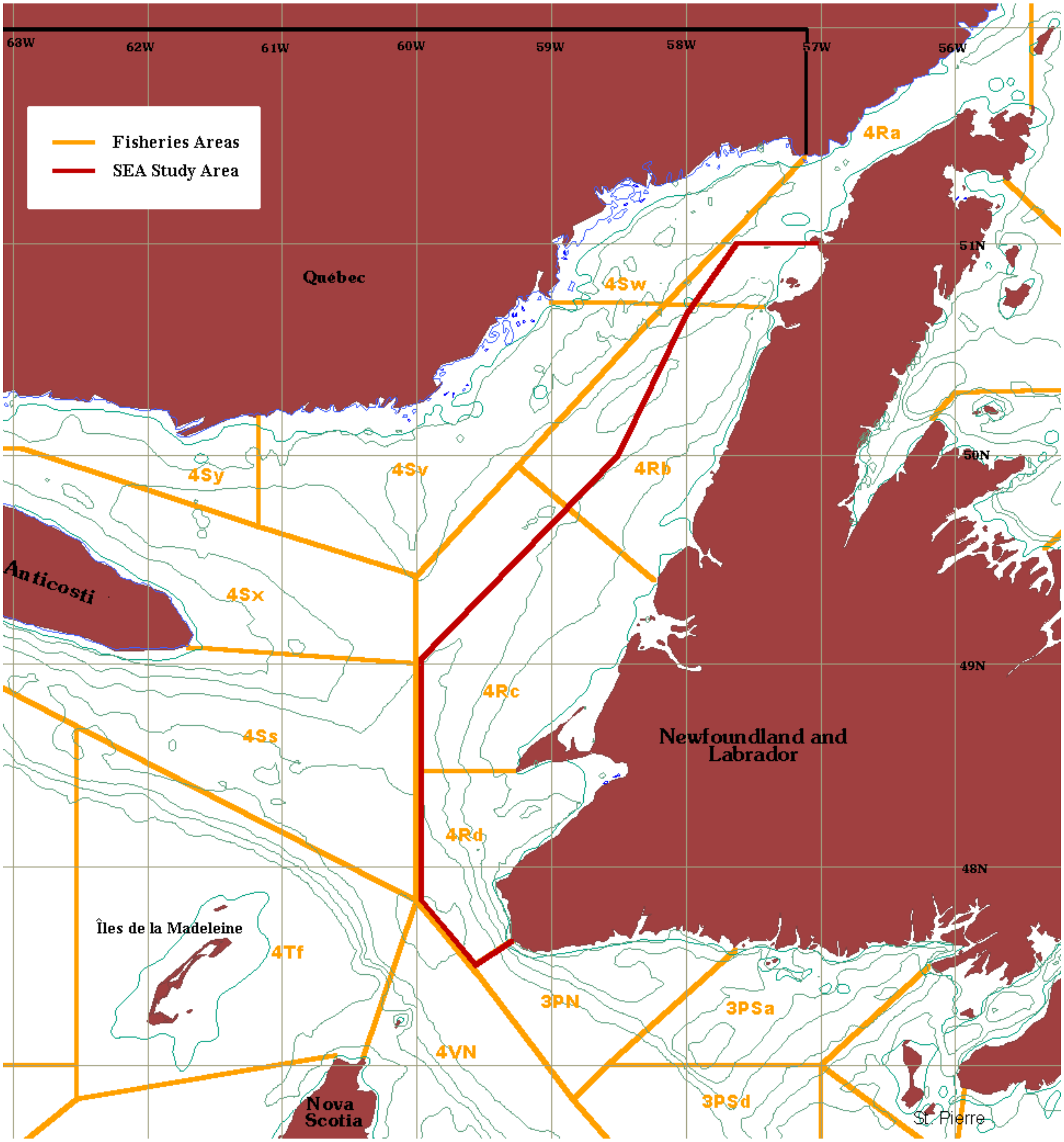


Figure 3.2. **SEA Study Area in Relation to Regional Fisheries Management Areas.**

The DFO data are georeferenced in two ways: by latitude and longitude (degrees and minutes) of the gear set location, and by the Unit Area in which the catch was harvested. While much of the harvest carries the latitude and longitude information (76% by weight for all of 4R in 2004), virtually all the data carries a Unit Area designation.

Georeferencing by latitude and longitude allows the mapping of specific harvesting locations. Areas farther from shore, fished generally by larger boats, tend to have a greater proportion of their catch georeferenced, while those closer to shore have less. Also, certain inshore species (e.g., lobster) are not thus georeferenced, while the deeper water species (e.g., shrimp) are. For example, in 2004 in 4R, 0% of lobster harvest was so referenced while 44% of groundfish and 84% of the shrimp harvest was (by weight).

The Unit Area designation allows all the harvesting data to be tabulated according to these fisheries management sub-zones. The Unit Areas that most closely approximate the Study Area are Unit Areas 4Rb, 4Rc and 4Rd (see map). These are used in the Study Area Unit Area analysis for this report.[4]

In 2004, approximately 95% of the harvest taken within 4R was landed in Newfoundland and Labrador, and is thus recorded in the Newfoundland Region DFO database.

The maps in the sections that follow show harvesting locations, based on the latitude and longitude (lat/long) data, as dark points. The points are not "weighted" by quantity of harvest, but show where fishing effort was recorded. Such location information data has been groundtruthed with fishers in many consultations and has proven, in past assessments, to be particularly useful for petroleum industry operators in understanding the likely location of gear concentrations and timing of fisheries in order to eliminate or minimize potential mutual interference. Similar maps were also presented to area fishers during the consultations for this SEA and were found to be a good representation of fishing areas and patterns.

In most instances, the information used to characterize the fisheries in this SEA presents quantities of harvest rather than harvest values. Quantities are directly comparable from year to year, while values (for the same quantity of harvest) may vary annually with negotiated prices, changes in exchange rates and fluctuating market conditions. Prices paid may also vary from month to month and from area to area. Although some species vary greatly in price (e.g., snow crab vs. herring), in terms of interference between exploration activities and fisheries, it is the level of fishing effort and gear utilized (better represented by quantities of harvest) that is more important. Values are important in the case of a gear damage incident, and would be carefully evaluated at that time, based on then-current numbers, to calculate compensation (an impact mitigation during an exploration project).

[4] A small part of southern 4Ra, which extends north to Belle Isle, also occurs within the SEA Study Area, but is not used in the Unit Area analysis.

Fisheries consultations were conducted with representatives of the Fish, Food and Allied Workers Union (FFAWU), DFO and individual fishers living within the SEA Study Area. The consultations were to gather information about area fisheries and to determine any issues or concerns to be considered in the SEA.

Fisheries-related information and issues raised during consultations are presented in Appendix 1.

Other sources consulted for this assessment include DFO species management plans and stock status reports.

3.4.4.2 Commercial Fisheries Overview

This section provides an overview of the commercial fisheries within and/or adjacent to the Study Area (depending on the datasets used). The first part provides the historical context, based on DFO data for NAFO 4R, for the 20-year period 1985-2004. The next section focuses on recent harvests (2002-2004) in 4R Unit Areas b, c and d (the Study Area Unit Areas), and the final part of this fisheries overview section provides similar recent information for the georeferenced (lat/long) data specifically recorded within the SEA Study Area, and maps the locations of these fisheries for that period.

The section following these (Principal Species) provides more detailed information on the important regional fisheries.

<u>Historical Fisheries in NAFO 4R</u>

This section describes the historical fisheries within NAFO Division 4R, which includes the full SEA Study Area (see Figure 3.1), for the 20-year period 1985-2004. Over the past decade and a half, the fisheries in 4R have undergone significant changes, owing largely to the collapse of groundfisheries (mainly cod) after 1991 and consequent fisheries moratoria and reductions within the area (after 1993).

DFO's most recent cod Science Advisory Report (2005/003) describes the series of steps that have been taken to manage the northern Gulf (4RS,3PN) cod fisheries since the early 1990s: "The fishery was under moratorium from 1994 to 1996. A reduced fishery was authorized in 1997 … . In 2003, the cod fishery faced a second moratorium, so there was no commercial fishery. The 2004 TAC was set at 3,500 t, as recommended by the FRCC. Reported landings in January 2005 were 3,112 t. Sentinel fisheries were introduced in 1994 in order to develop a partnership between the industry and the Department of Fisheries and Oceans (DFO). Sentinel fisheries are carried out within a well-defined framework and provide, among other things, abundance indices of the resource. Three types of fisheries are carried out each year: the gillnet sentinel fishery on the Lower North Shore (Division 4S) and on the west coast of Newfoundland (Division 4R), the longline sentinel fishery and the trawl sentinel fishery on the entire territory (3Pn, 4RS). All catches made by sentinel fisheries are included in the TAC."

The following graphs (based on DFO Maritimes and Newfoundland Region data) show the overall (all species) harvest for the last 20 years (Figure 3.3), the same for groundfish species (Figure 3.4), and then for shrimp and snow crab (Figure 3.5), the two species which increased the most during this period. These two high-value fisheries now make up a substantial proportion of the commercial fisheries in the Gulf of St. Lawrence, and have largely replaced the groundfisheries for many participants in the region.

The most recent scientific advice does not indicate that the groundfisheries are likely to increase in the foreseeable future.

Additional historical information on principal fisheries is provided in following sections.

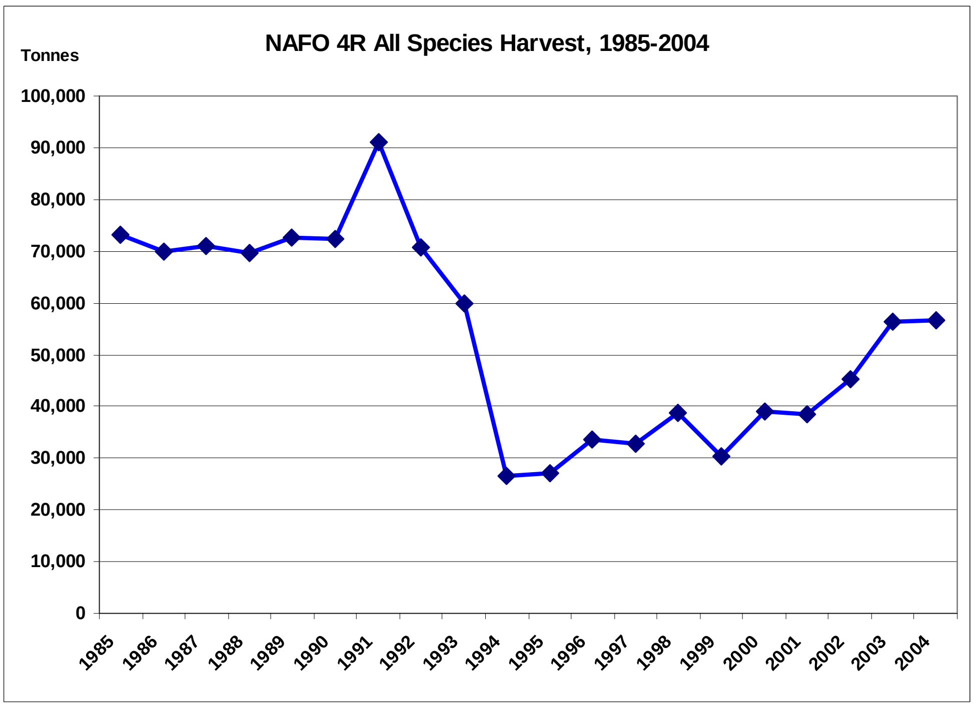


Figure 3.3. 1985-2004 Commercial Harvest from 4R, All Species.

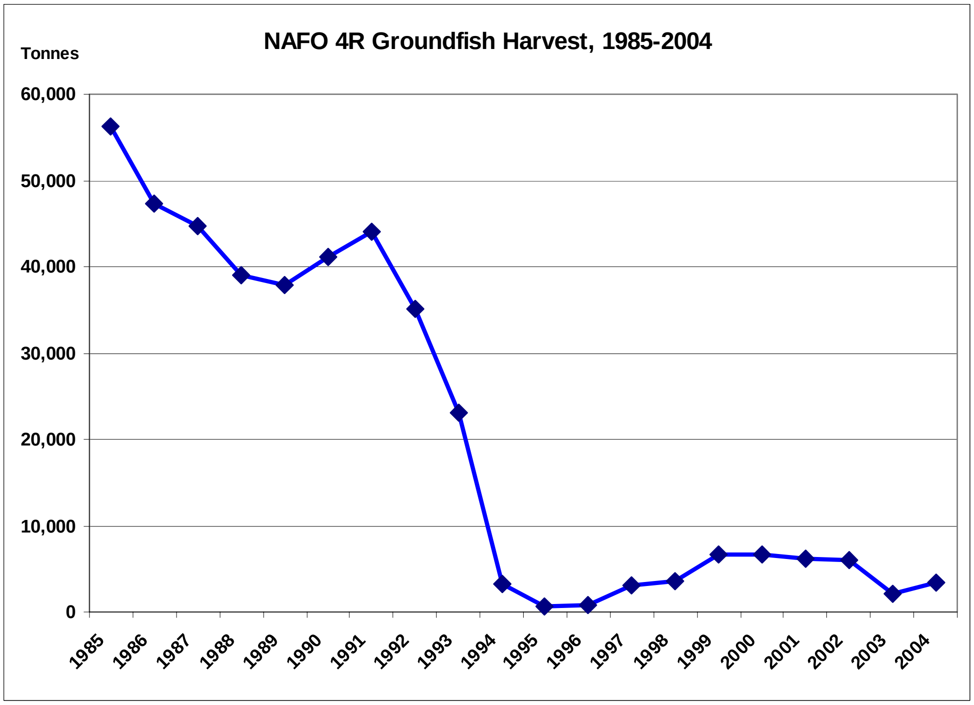


Figure 3.4. 1985-2004 Commercial Harvest from 4R, All Groundfish Species.

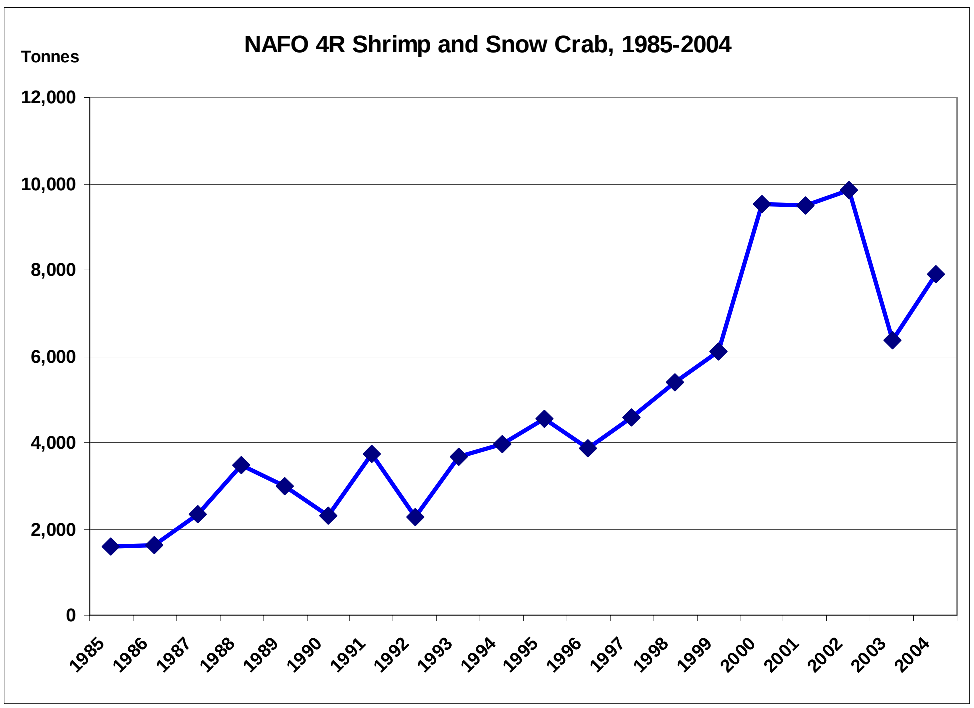


Figure 3.5. 1985-2004 Commercial Harvest from 4R, Shrimp and Snow Crab.

The following graph shows the composition of the harvest in 1985 and in 2004, indicating the changes in the make-up of the 4R harvest (Figure 3.6).

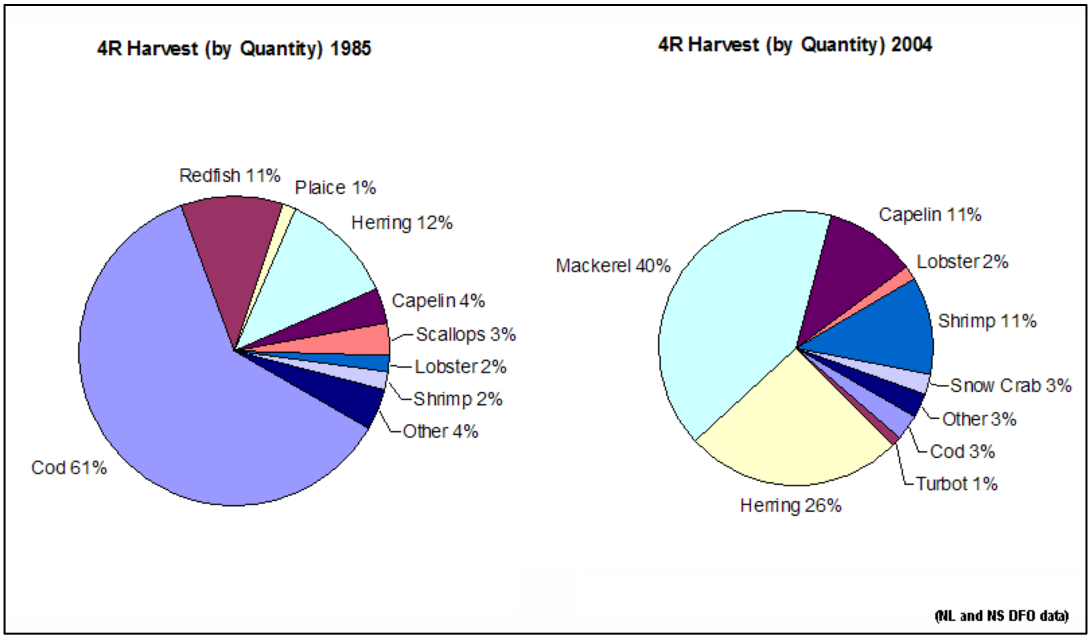


Figure 3.6. Composition of the Harvest (4R), 1985 *vs.* 2004

<u>Study Area Unit Areas (4Rb,c,d) Harvest, 2002-2004</u>

Table 3.3 shows the quantity of the domestic harvest recorded within 4R Unit Areas b, c and d during 2002, 2003 and 2004 (all DFO regions data). As Table 3.3 indicates, the harvest was primarily composed of two pelagic species, herring and mackerel, during 2002 - 2004. Overall, in these years, these two species made up nearly 72% of the harvest by quantity. Other principal species during these years have been northern shrimp, capelin, cod and snow crab. The lobster fisheries – though comparatively low in quantity – are of high economic and social value, and are particularly important to local Study Area-based fishers who typically harvest this species in waters near their home ports.

Table 3.3. 2002-2004 Harvest in Study Area Unit Areas (4Rb,c,d).

Species	Tonnes	% of Total
2002		
Atlantic Cod	2,751.1	6.9%
Redfish (Sp.)	689.3	1.7%
Halibut	84.3	0.2%
Plaice	123.7	0.3%
Greysole/witch flounder	440.0	1.1%
Winter flounder	11.9	0.0%
Turbot/Greenland halibut	510.0	1.3%
Skate (sp.)	70.3	0.2%

Table 3.3 Continued.

White hake	9.6	0.0%
Wolffish/catfish	74.8	0.2%
Monkfish	7.2	0.0%
Herring	11,499.1	28.7%
Mackerel	11,027.9	27.5%
Eels	16.1	0.0%
Capelin	3,187.9	8.0%
Mako shark	1.3	0.0%
Icelandic scallops	3.4	0.0%
American lobster	763.7	1.9%
Spider/toad crab	11.4	0.0%
Northern shrimp	7,004.7	17.5%
Rock crab	20.9	0.1%
Snow crab	1,725.2	4.3%
All other	3.5	0.0%
Total	40,036.9	100.0%
2003		
Atlantic Cod	146.8	0.3%
Redfish (Sp.)	482.9	0.9%
Halibut	132.4	0.2%
Plaice	146.1	0.3%
Greysole/witch flounder	274.1	0.5%
Turbot/Greenland halibut	947.9	1.7%
Skate (sp.)	61.0	0.1%
Pollock	2.8	0.0%
White hake	11.8	0.0%
Wolffish/catfish	7.6	0.0%
Monkfish	15.5	0.0%
Herring	13,887.9	25.3%
Mackerel	25,209.9	45.8%
Eels	26.2	0.0%
Capelin	4,520.0	8.2%
American lobster	987.4	1.8%
Spider/toad crab	18.9	0.0%
Northern shrimp	6,481.2	11.8%
Snow crab	1,556.1	2.8%
Seal parts	49.3	0.1%
Lumpfish roe	25.5	0.0%
All other	6.4	0.0%
Total	54,997.5	100.0%
2004		
Atlantic Cod	1,230.1	2.3%
Haddock	2.8	0.0%
Redfish (Sp.)	484.8	0.9%
Halibut	123.9	0.2%
Plaice	74.9	0.1%
Greysole/witch flounder	407.0	0.8%

Table 3.3 Concluded.

Turbot/Greenland halibut	834.0	1.5%
Skate (sp.)	14.4	0.0%
White hake	28.3	0.1%
Wolffish/catfish	6.3	0.0%
Herring	14,258.3	26.4%
Mackerel	23,300.7	43.2%
Capelin	2,873.9	5.3%
Mako shark	2.4	0.0%
American lobster	756.8	1.4%
Northern shrimp	7,993.1	14.8%
Snow crab	1,427.2	2.6%
Seal parts	62.8	0.1%
Lumpfish roe	26.7	0.0%
All other	3.3	0.0%
Total	53,911.6	100.0%

Seasonality. The timing of the harvest is dictated by weather and ice conditions, the availability of the resource, fisheries management plans and other resource conservation considerations (e.g., the closure of the cod spawning area from 1 April to mid June), as well as individual fishers' harvesting plans (e.g., harvesting lobster before turning to snow crab. The following graph (Figure 3.7) shows the 2002-2004 4Rb,c,d harvest by month. As the graph shows, little or no harvesting occurs before May. This is primarily due to ice in the Gulf, and in some years this can delay the start of particular fisheries. Figures 3.13 to 3.24 show the location of the Study Area harvest by month for 2004, based on the georeferenced (lat/long) data. More information on the timing and other aspects of principal fisheries is provided in following sections.

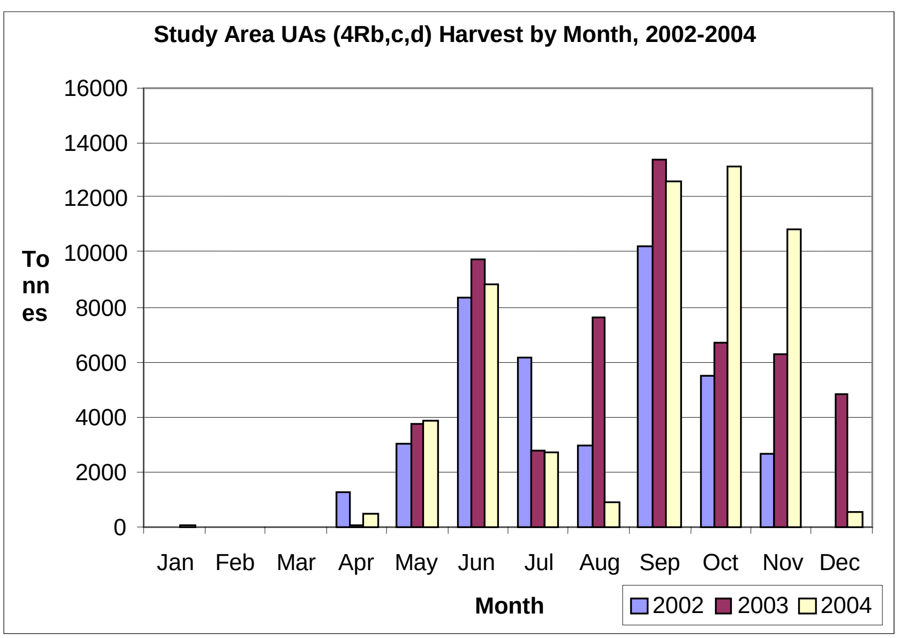


Figure 3.7. 4Rb, c, d Harvest by Month, 2002, 2003 and 2004.

Fishing Gear. The area's fisheries use both fixed (e.g., crab and lobster pots) and mobile (e.g., seines and shrimp trawls) fishing gears. The following table shows the breakdown of the harvest (quantities) by gear type (Table 3.4). Figures 3.8 and 3.9 show the location of the Study Area harvest by principal gear type for 2004, based on the georeferenced (lat/long) data.

In general, fixed gear poses a much greater potential for conflicts with exploration activities (particularly seismic surveys) 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 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. For example, a survey ship and fishing vessels should be able to communicate with each other and exchange information about their operating areas and activities.

Table 3.4. 4Rb,c,d Harvest by Gear Type, All Months, 2004.

Gear Type	Tonnes	% of Total
Stern otter trawl (bottom)	413.2	0.8%
Stern trawl (midwater)	61.1	0.1%
Shrimp trawl	7,993.3	14.8%
Danish seine	509.4	0.9%
Purse seine	39,845.1	73.9%
Gill net*	1,823.9	3.4%
Longline*	616.5	1.1%
Baited handline*	184.6	0.3%
Trap*	217.4	0.4%
Pot*	2,183.9	4.1%
Seal hunting	62.8	0.1%
Total	53,911.3	100.0%

*fixed gear

3.4.4.3 Study Area Unit Areas (4Rb,c,d) Landed Value

Table 3.5 shows the landed value of the domestic harvest recorded within 4R Unit Areas b, c and d during 2004 (all DFO regions data). This includes all recorded harvest from these waters whether or not it was landed by fishers based in Study Area ports.

These values are based on Newfoundland Region average prices for 2004 derived from DFO statistical reports (see http://www.nfl.dfo-mpo.gc.ca/publications/reports_rapports/ Land_All_2004.htm). They are thus an approximation of the landed value, since prices for some species may vary slightly from area to area within Newfoundland Region, and from province to province, depending on where the harvest was actually landed and sold. Prices for some species vary throughout the fishing season, as well, so that the value of the same quantity of a species landed at the being of its harvesting season may be higher or lower than that landed at the end.

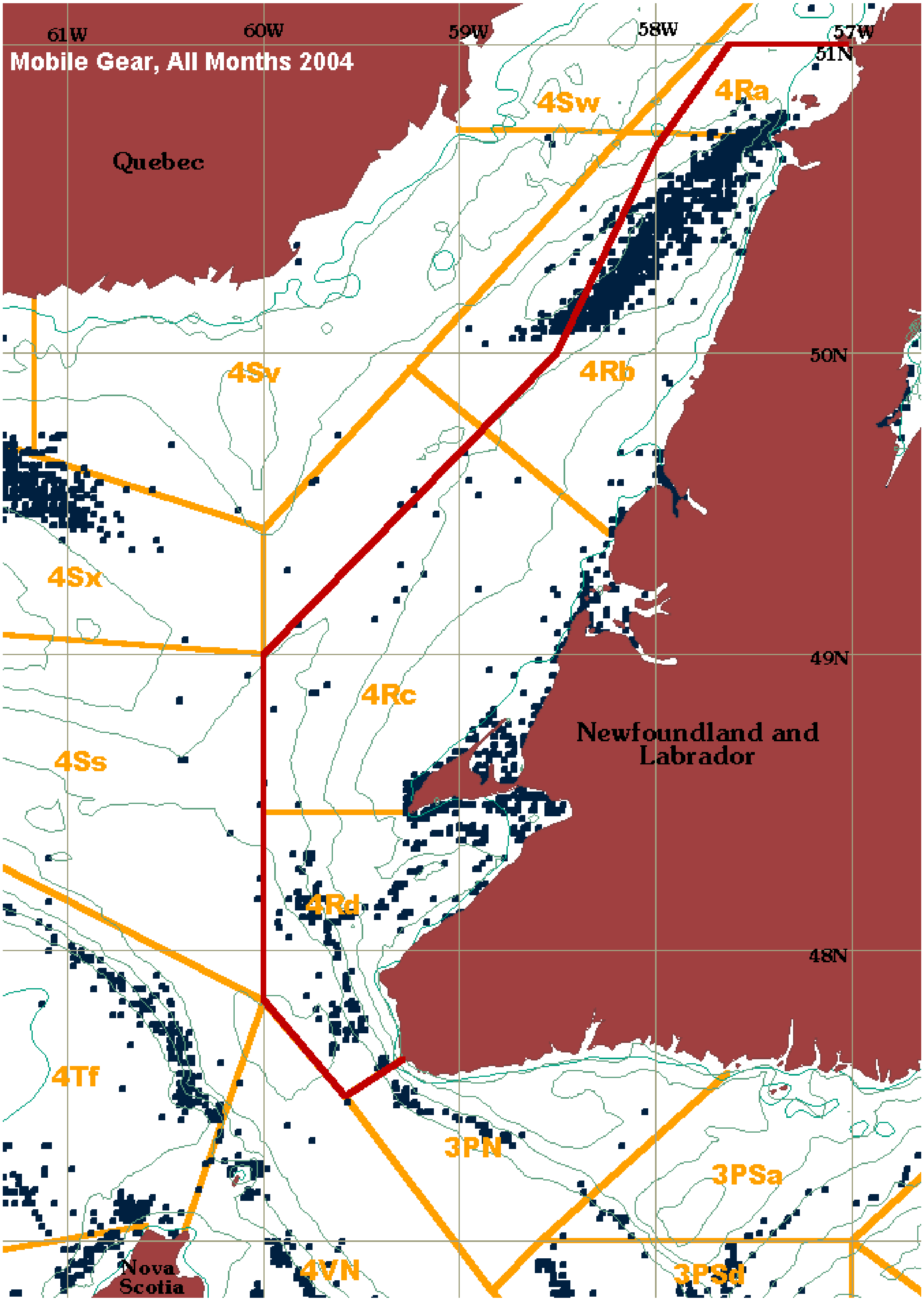


Figure 3.8 . Mobile Gear Harvesting Locations, Study Area and Adjacent Waters, All Species, All Months, 2004.

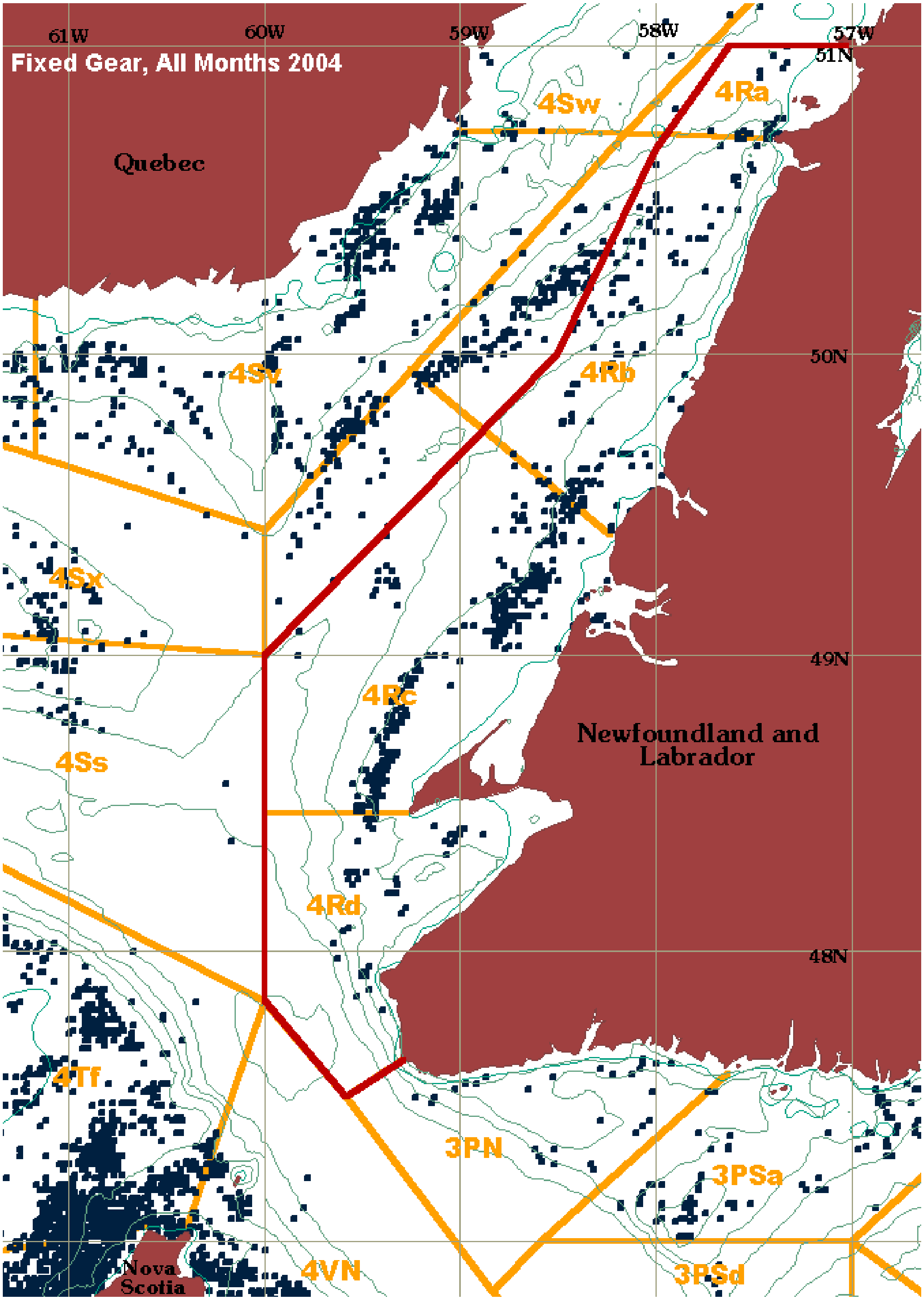


Figure 3.9 . Fixed Gear Harvesting Locations, Study Area and Adjacent Waters, All Species, All Months, 2004.

Table 3.5. Landed Value, Study Area Unit Areas (4Rb,c,d) 2004.

Species	Kgs	$/Kg	Landed Value
Atlantic Cod	1,230,100	$1.25	$1,532,211
Haddock	2,800	$1.01	$2,827
Redfish (Sp.)	484,800	$0.49	$236,203
Halibut	123,900	$6.61	$818,904
Plaice	74,900	$0.77	$57,628
Greysole/witch flounder	407,000	$0.87	$354,423
Turbot/Greenland halibut	834,000	$1.32	$1,097,666
Skate (sp.)	14,400	$0.24	$3,429
White hake	28,300	$0.53	$14,974
Wolffish (sp.)/catfish	6,300	$0.28	$1,736
Herring	14,258,300	$0.16	$2,263,237
Mackerel	23,300,700	$0.27	$6,215,616
Capelin	2,873,900	$0.27	$779,303
Mako shark	2,400	$1.03	$2,471
American lobster	756,800	$11.03	$8,347,212
Northern shrimp	7,993,100	$1.39	$11,083,979
Snow crab	1,427,200	$5.40	$7,708,693
Seal parts (1)	62,800	$0.26	$16,328
Lumpfish roe	26,700	$5.36	$143,112
All other (2)	3,300	$1.80	$5,940
Total	53,911,700		$40,685,890

Notes:

1. The value for seal parts is based on parts reported by weight (meat, fat);
2. The value for “all other” species is based on the average 2004 price for all Newfoundland region species reported by weight.

The landed value is the value of the catch “at the wharf”, generally the price paid to the harvesting sector. It does not show, for instance, the “downstream” indirect or induced economic benefits of the harvest, during or after processing or value-added manufacturing of fish-based products.

As discussed previously, total values (and the amount paid per Kg) for many species vary annually with negotiated prices, changes in exchange rates and fluctuating market conditions. For instance, the average Newfoundland Region price per Kg of snow crab, as of the beginning of September 2005, was $3.19 (vs. $5.40 in 2004) (http://www.nfl.dfo-mpo.gc.ca/publications/reports_rapports/Land_All_2005.htm accessed 1 September 2005).

3.4.4.4 Fishing Enterprises and Licences (4R)

Table 3.6 shows the numbers of Core and non-Core / Recreational fishing licences by species for NAFO 4R for 2003, the most recent year for which these data are published. However, DFO notes (D. Ball pers. comm. September 2005) that the 2004 Report (available late September 2005) will be very similar.

Table 3.6. Licences held by 4R Fishers, Vessels < 65', NAFO Division 4R.

Species	Core	Non-Core and Recreational	Total
Bait	619	139	758
Capelin (Fixed Gear)	203	44	247
Capelin (Mobile Gear)	12	1	13
Capelin (Mobile Gear) - Exploratory	8	0	8
Eels	36	15	51
Groundfish (Fixed Gear)	638	171	809
Groundfish (Mobile Gear)	61	1	62
Herring (Fixed Gear)	554	77	631
Herring (Mobile Gear)	15	1	16
Lobster	622	140	762
Mackerel (Fixed Gear)	414	21	435
Mackerel (Mobile Gear)	12	0	12
Mackerel (Mobile Gear) - Exploratory	8	1	9
Scallop	115	17	132
Scallop - Recreational	17	170	187
Seal - Assistant	65	1,070	1,135
Seal - Personal Use	1	105	106
Seal - Professional	598	869	1,467
Shark	0	3	3
Shrimp - Gulf	45	0	45
Shrimp SFA 06 - Temporary	63	0	63
Shrimp SFA 08/Gulf - Temporary	10	0	10
Snow Crab - Commercial	17	0	17
Snow Crab - Inshore	17	0	17
Snow Crab - Inshore	44	0	44
Snow Crab - Inshore Commercial	322	0	322
Squid	80	9	89
Tuna, bluefin	1	0	1
Whelk	110	0	110
Total	4,707	2,854	7,561

Source: DFO 2003, Tables 1a,b,c.

Table 3.7 shows fishing enterprises by category for 2003.

Table 3.7. Enterprises, 4R, by Category, Vessels <65'.

Category	< 25'	25' – 34'	35' – 44'	45' – 54'	55' – 64'	Total
Core	293	356	45	25	62	781
Non-Core	183	50	4			237
Total	476	406	49	25	62	1,018

Source: DFO 2003, Tables 12a,b,c.

Study Area Georeferenced Harvest, 2002-2004

This section provides data and maps for the components of the 2002-2004 DFO datasets that are georeferenced by latitude and longitude (as described above). As noted, more than 75% (by weight) of the 4R harvest was so referenced in 2002 - 2004. However, some species harvested in 4R (e.g., lobster and scallops) are not included, or have only a small proportion of the actual harvest represented (e.g., cod and halibut).

The georeferenced data for the SEA Study Area similar to the data for 4R as a whole indicate that herring and mackerel make up the greatest part of the Study Area harvest by quantity, representing between 60% and 76% of the harvest in recent years (Table 3.8). Various groundfish, capelin, northern shrimp and snow crab account for nearly all the remainder.

Of the groundfish species, cod, redfish and greysole (witch flounder) make up the great majority of the georeferenced harvest, though, as noted, other groundfish species not georeferenced, are harvested in greater quantities than indicated, most notably halibut and turbot.

Table 3.8. Georeferenced Harvest Within the Study Area, 2002-2004.

Species	Tonnes	% of Total
2002		
Atlantic Cod	575.7	2.4%
Redfish (Sp.)	626.8	2.7%
Halibut	22.4	0.1%
Plaice	37.3	0.2%
Greysole flounder	403.3	1.7%
Turbot/Greenland halibut	53.2	0.2%
Skate (sp.)	5.4	0.0%
White hake	5.3	0.0%
Wolffish/catfish	21.0	0.1%
Herring	6,435.0	27.3%
Mackerel	7,809.0	33.2%
Capelin	2,500.5	10.6%
Northern shrimp	4,365.6	18.5%

Table 3.8 Concluded.

Snow crab	676.6	2.9%
All other	1.77	0.0%
Total	23,537.2	100.0%
2003		
Atlantic Cod	32.2	0.1%
Haddock	1.6	0.0%
Redfish (Sp.)	395.8	1.1%
Halibut	39.5	0.1%
Plaice	31.1	0.1%
Greysole flounder	253.7	0.7%
Turbot/Greenland halibut	133.2	0.4%
Skate (sp.)	1.4	0.0%
Pollock	2.3	0.0%
White hake	4.2	0.0%
Wolffish/catfish	1.3	0.0%
Herring	11,162.8	32.4%
Mackerel	15,278.7	44.3%
Capelin	3,298.4	9.6%
Northern shrimp	3,369.1	9.8%
Snow crab	498.1	1.4%
All other	6.34	0.0%
Total	34,503.5	100.0%
2004		
Atlantic Cod	148.2	0.4%
Haddock	2.8	0.0%
Redfish (Sp.)	478.5	1.3%
Halibut	28.7	0.1%
Plaice	32.7	0.1%
Greysole flounder	372.7	1.0%
Turbot/Greenland halibut	72.9	0.2%
White hake	18.4	0.1%
Herring	10,688.2	29.6%
Mackerel	16,285.1	45.1%
Capelin	1,103.9	3.1%
Northern shrimp	6,394.4	17.7%
Snow crab	500.0	1.4%
All other	2.0	0.0%
Total	36,128.5	100.0%

The following maps (Figures 3.10 to 3.12) show the location of the georeferenced harvest within the Study Area and adjacent waters for the years 2002 to 2004, summarized for all months and species.

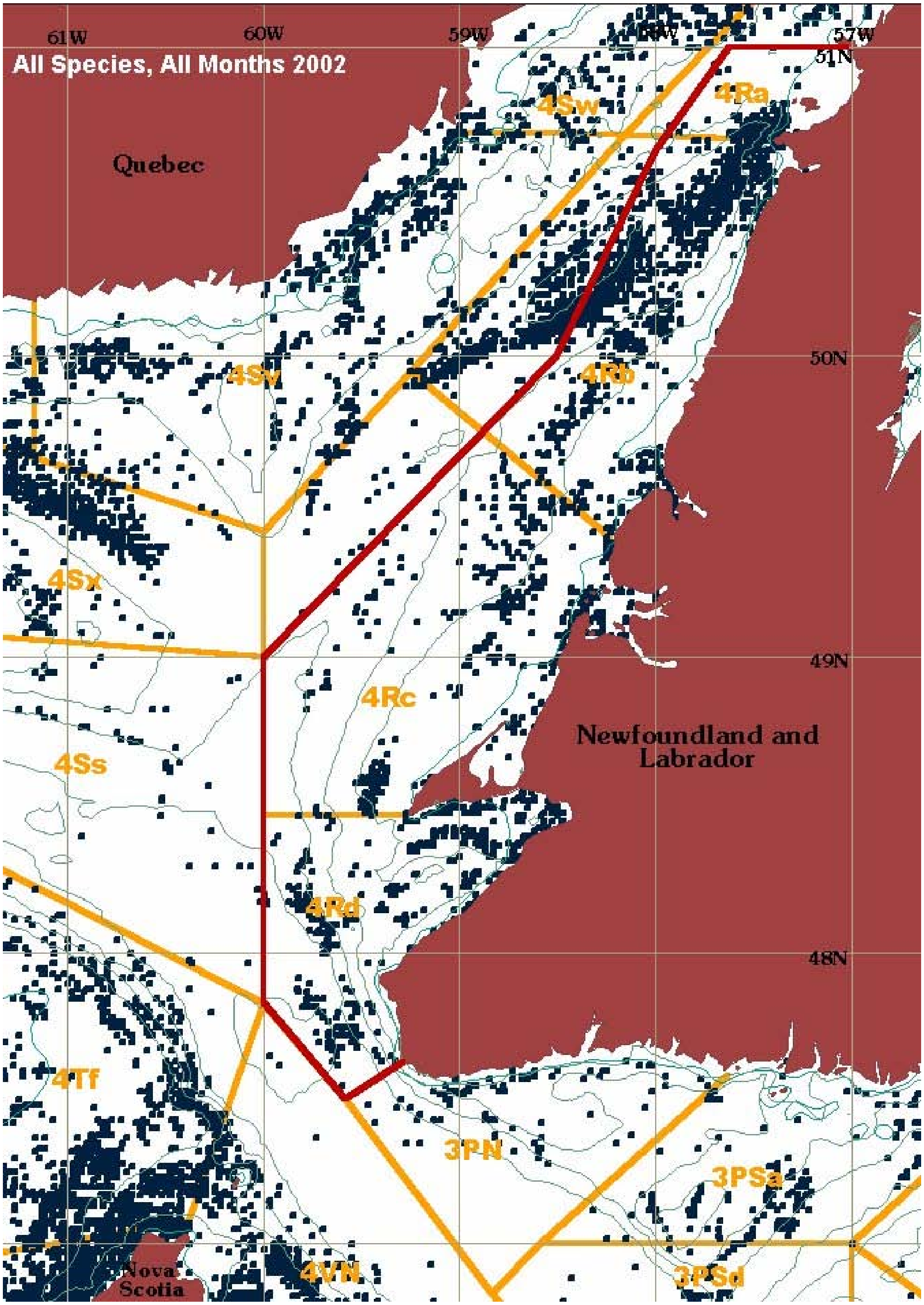


Figure 3.10. Harvesting Locations, Study Area and Adjacent Waters, All Species, All Months, 2002.

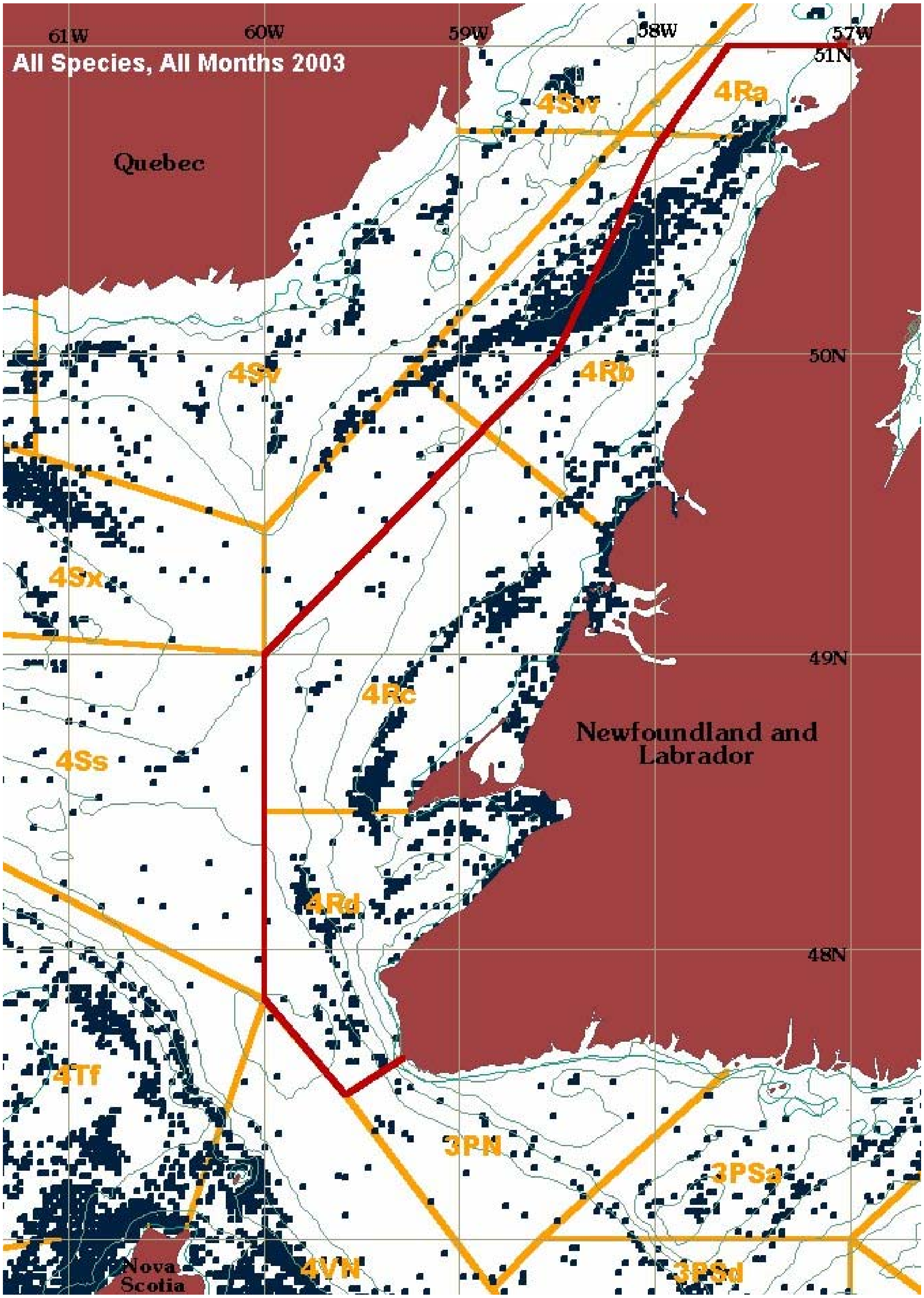


Figure 3.11. Harvesting Locations, Study Area and Adjacent Waters, All Species, All Months, 2003.

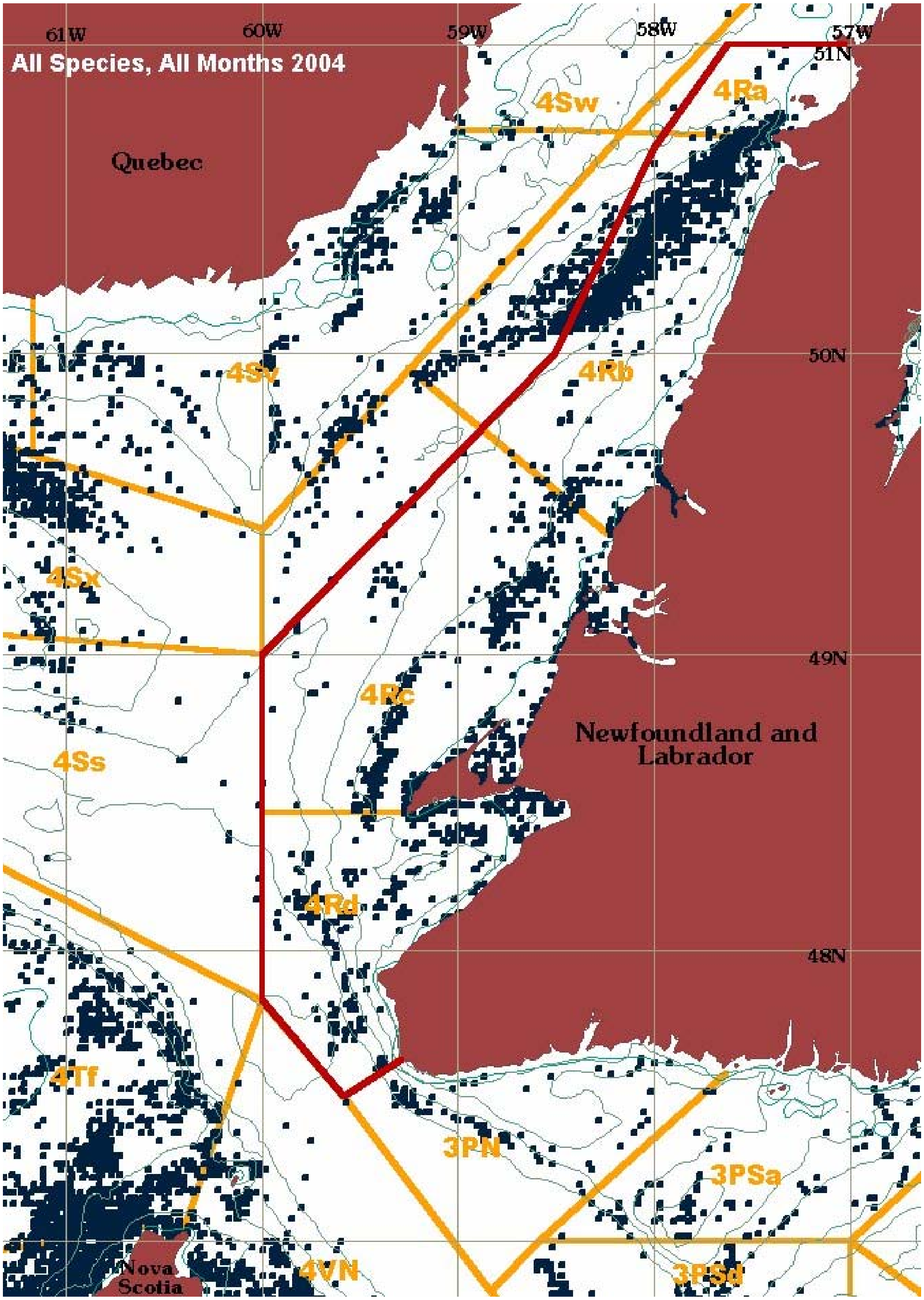


Figure 3.12 . Harvesting Locations, Study Area and Adjacent Waters, All Species, All Months, 2004.

The following maps (Figures 3-13 to 3.24) show the annual harvest in the region by month for 2004 using these data.

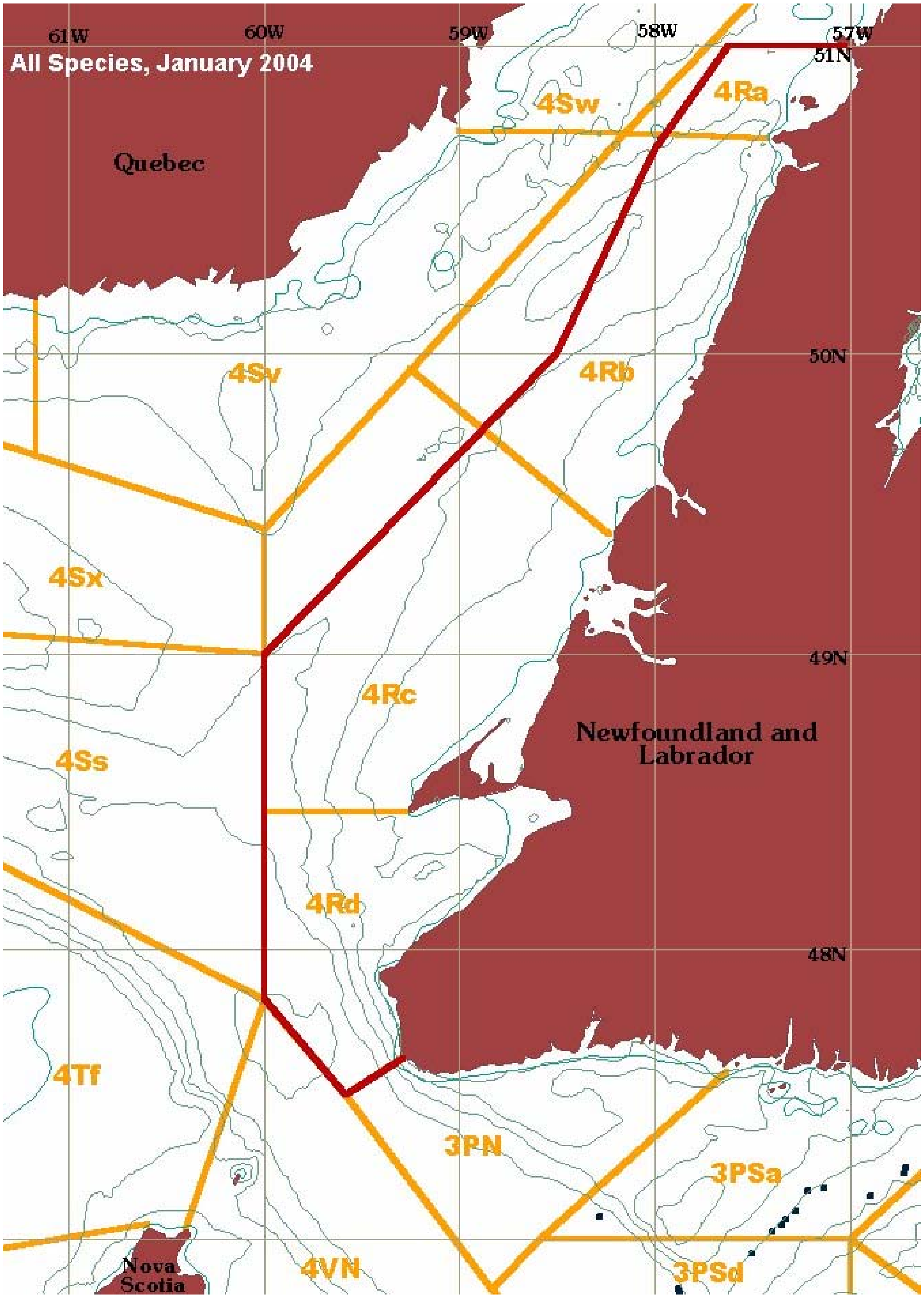


Figure 3.13. Harvesting Locations, Study Area and Adjacent Waters, All Species, January 2004.

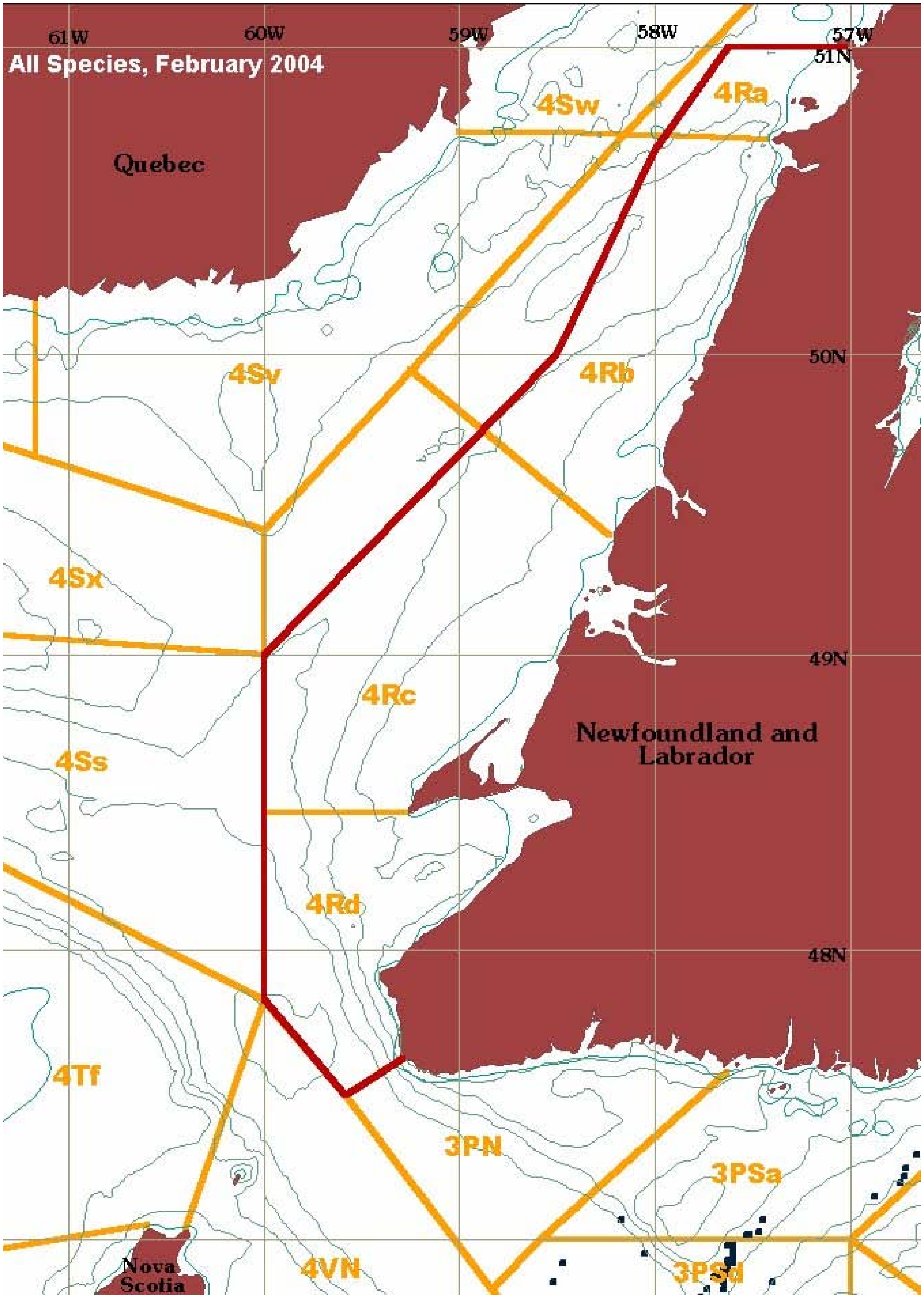


Figure 3.14. Harvesting Locations, Study Area and Adjacent Waters, All Species, February 2004.

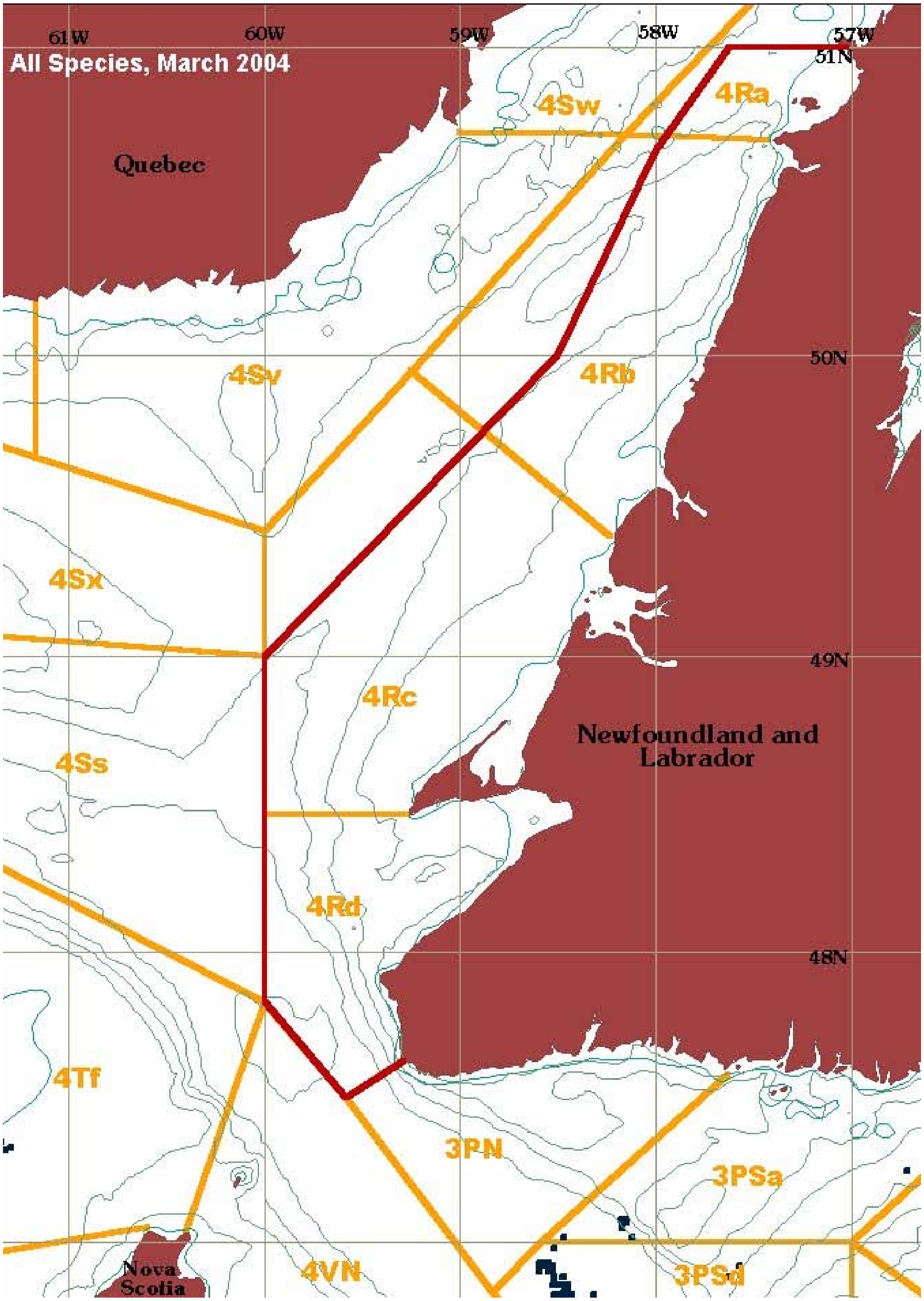


Figure 3.15. Harvesting Locations, Study Area and Adjacent Waters, All Species, March 2004.

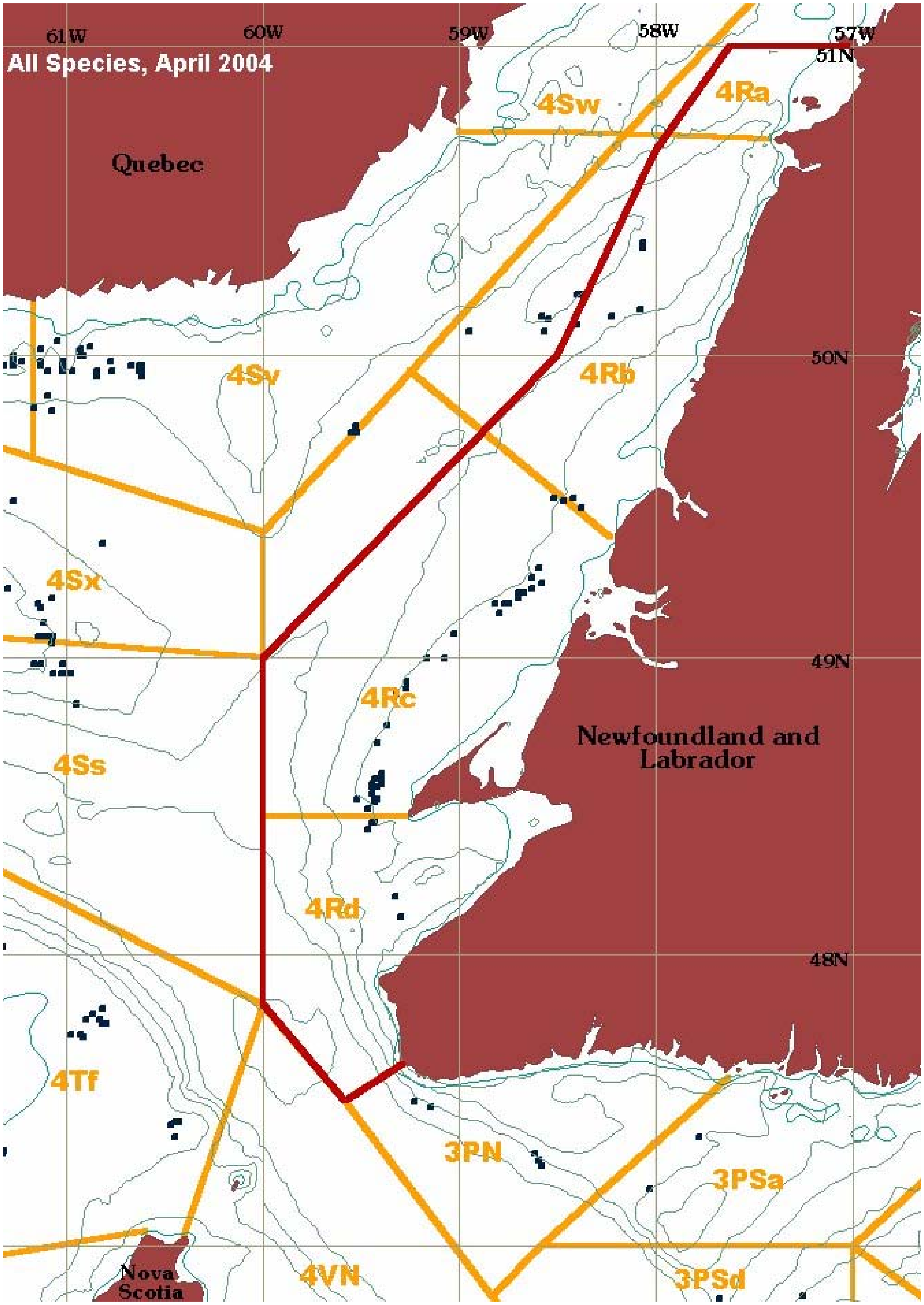


Figure 3.16. Harvesting Locations, Study Area and Adjacent Waters, All Species, April 2004.

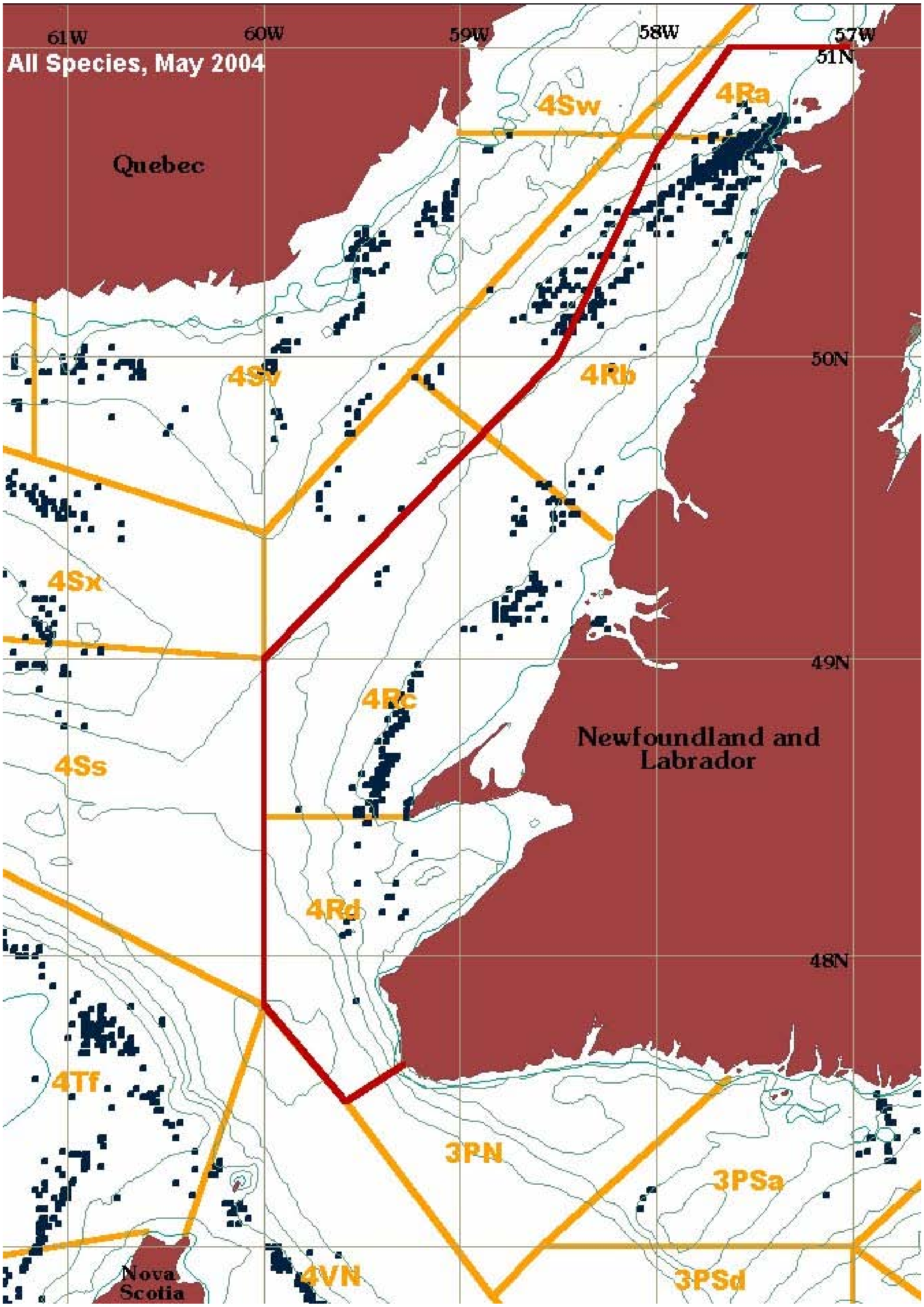


Figure 3.17. Harvesting Locations, Study Area and Adjacent Waters, All Species, May 2004.

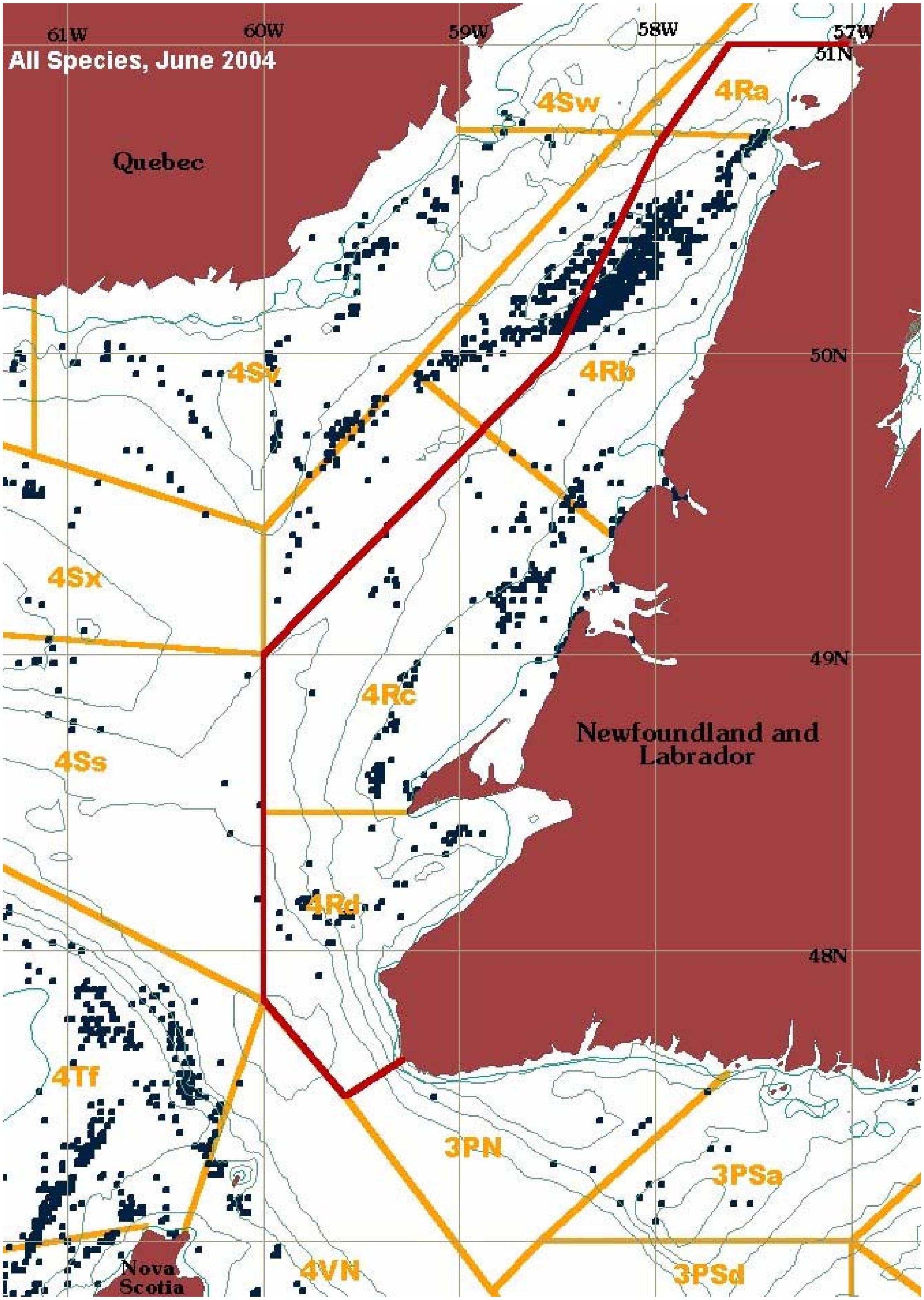


Figure 3.18. Harvesting Locations, Study Area and Adjacent Waters, All Species, June 2004.

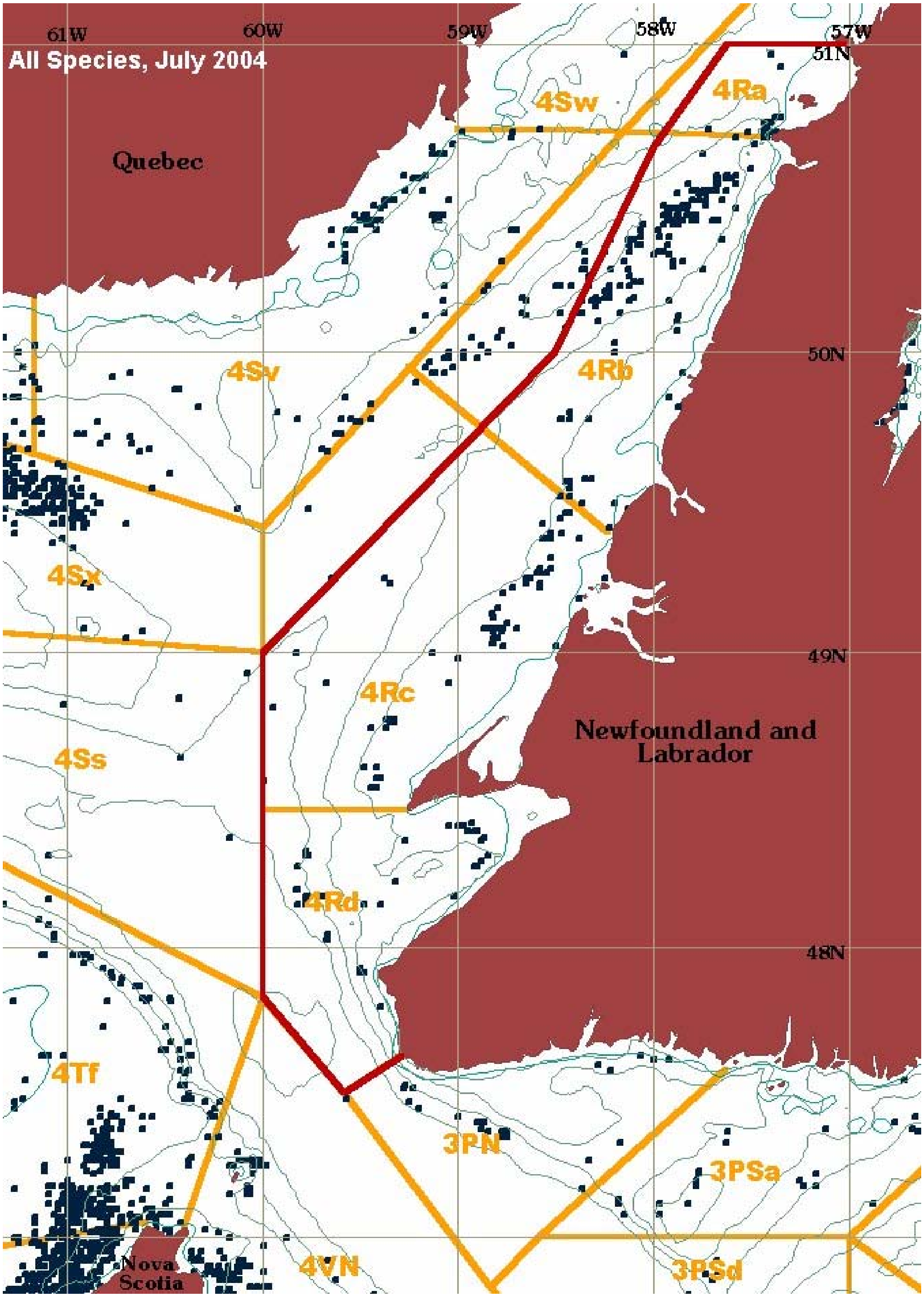


Figure 3.19. Harvesting Locations, Study Area and Adjacent Waters, All Species, July 2004.

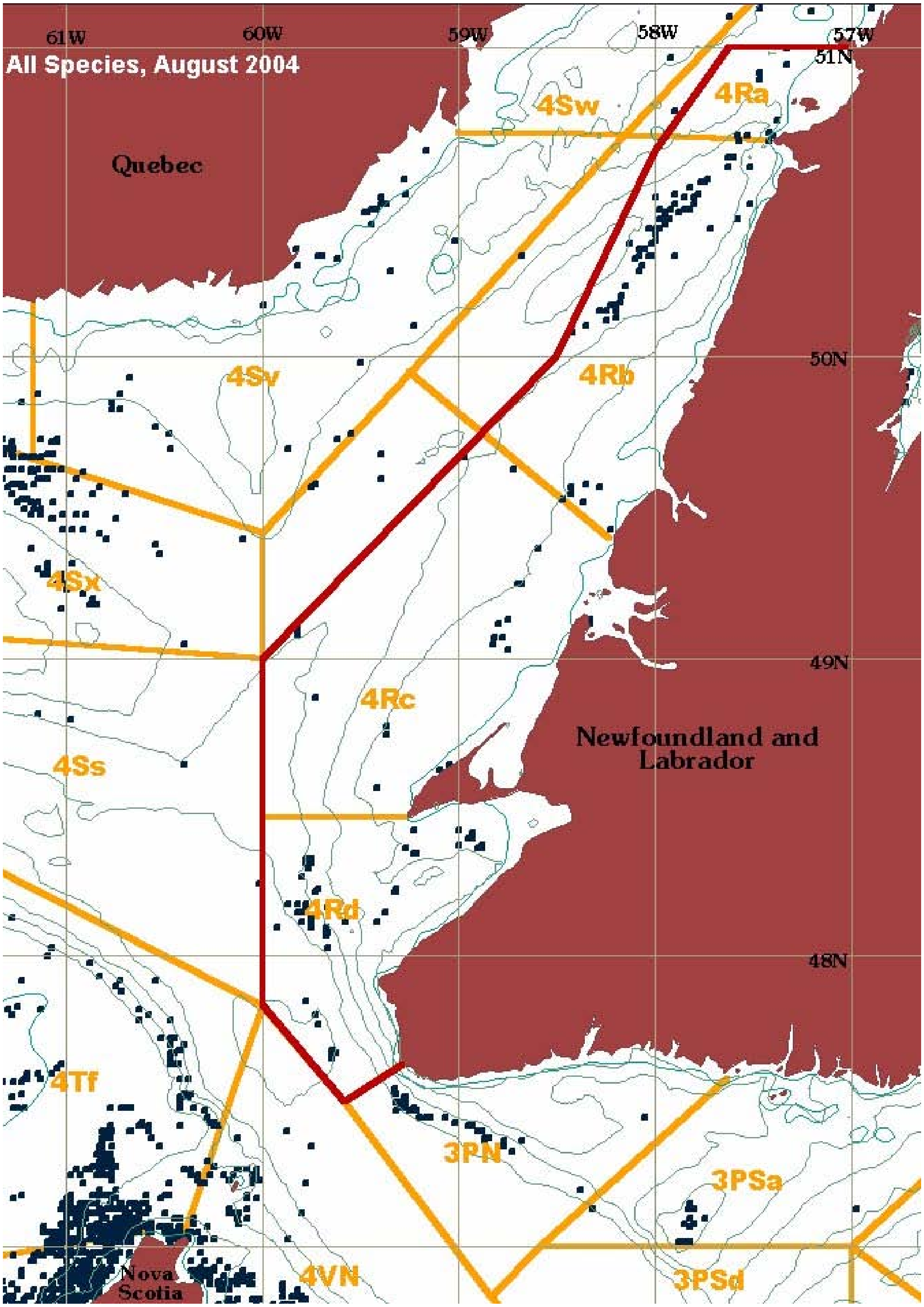


Figure 3.20. Harvesting Locations, Study Area and Adjacent Waters, All Species, August 2004.

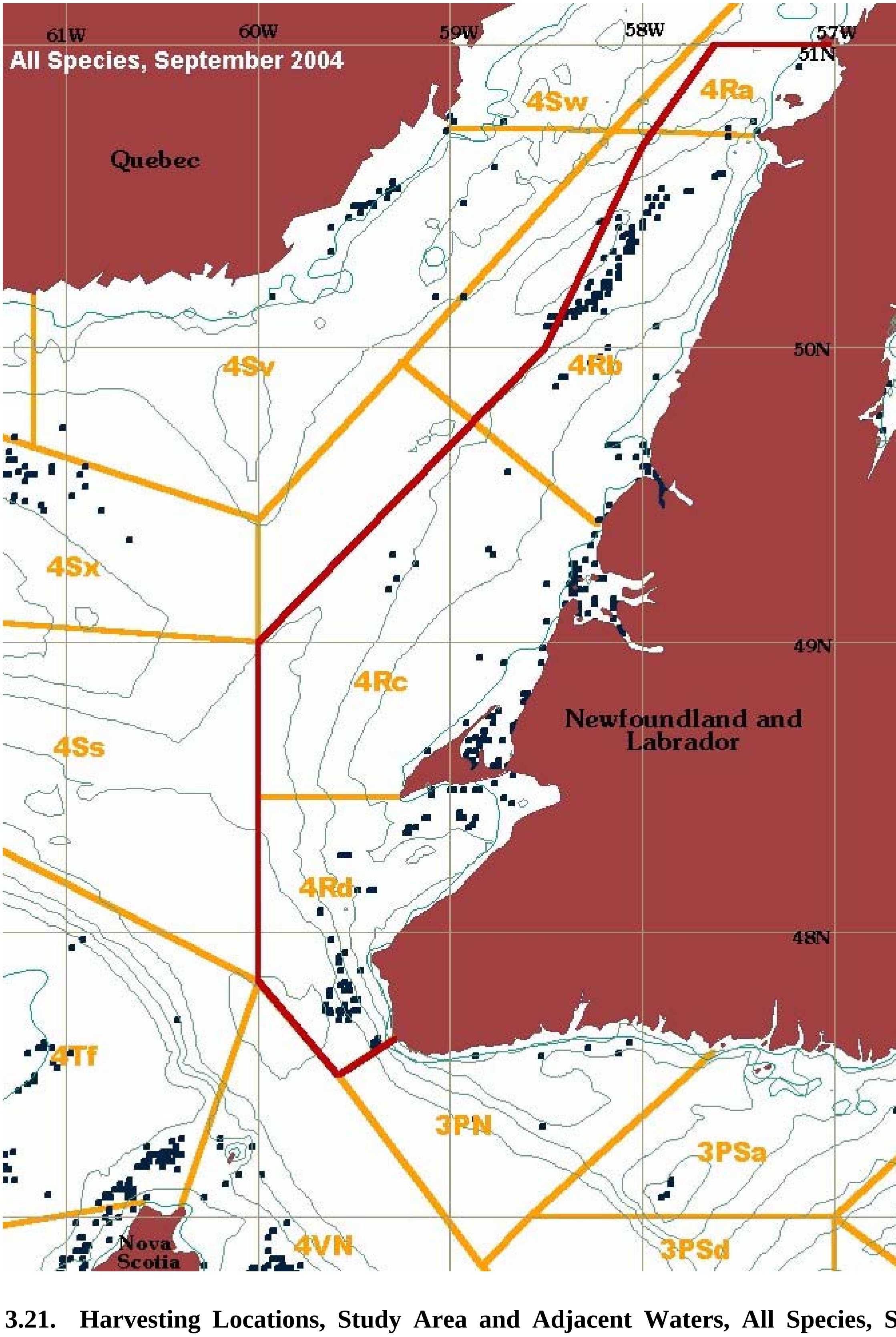


Figure 3.21. Harvesting Locations, Study Area and Adjacent Waters, All Species, September 2004.

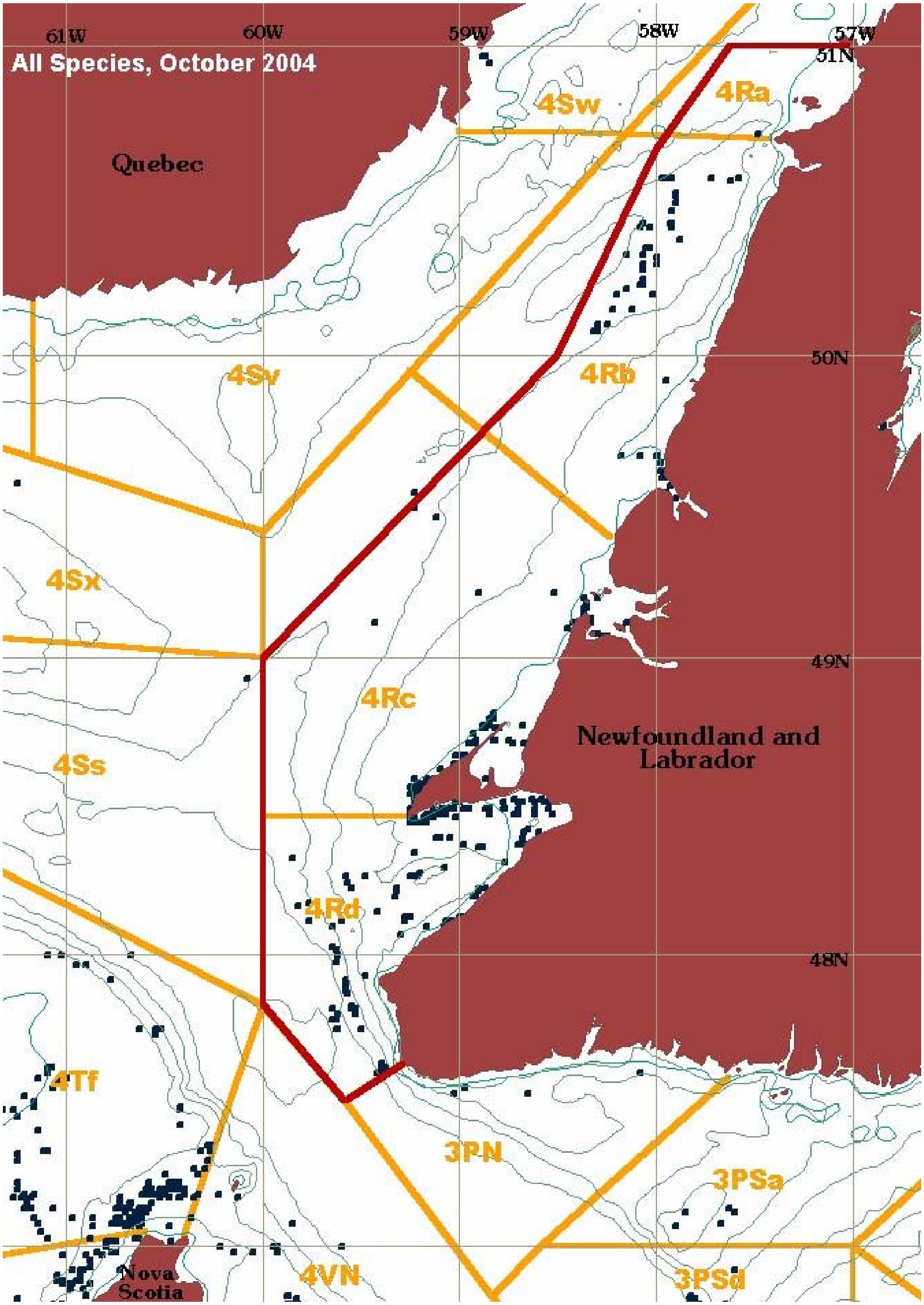


Figure 3.22. Harvesting Locations, Study Area and Adjacent Waters, All Species, October 2004.

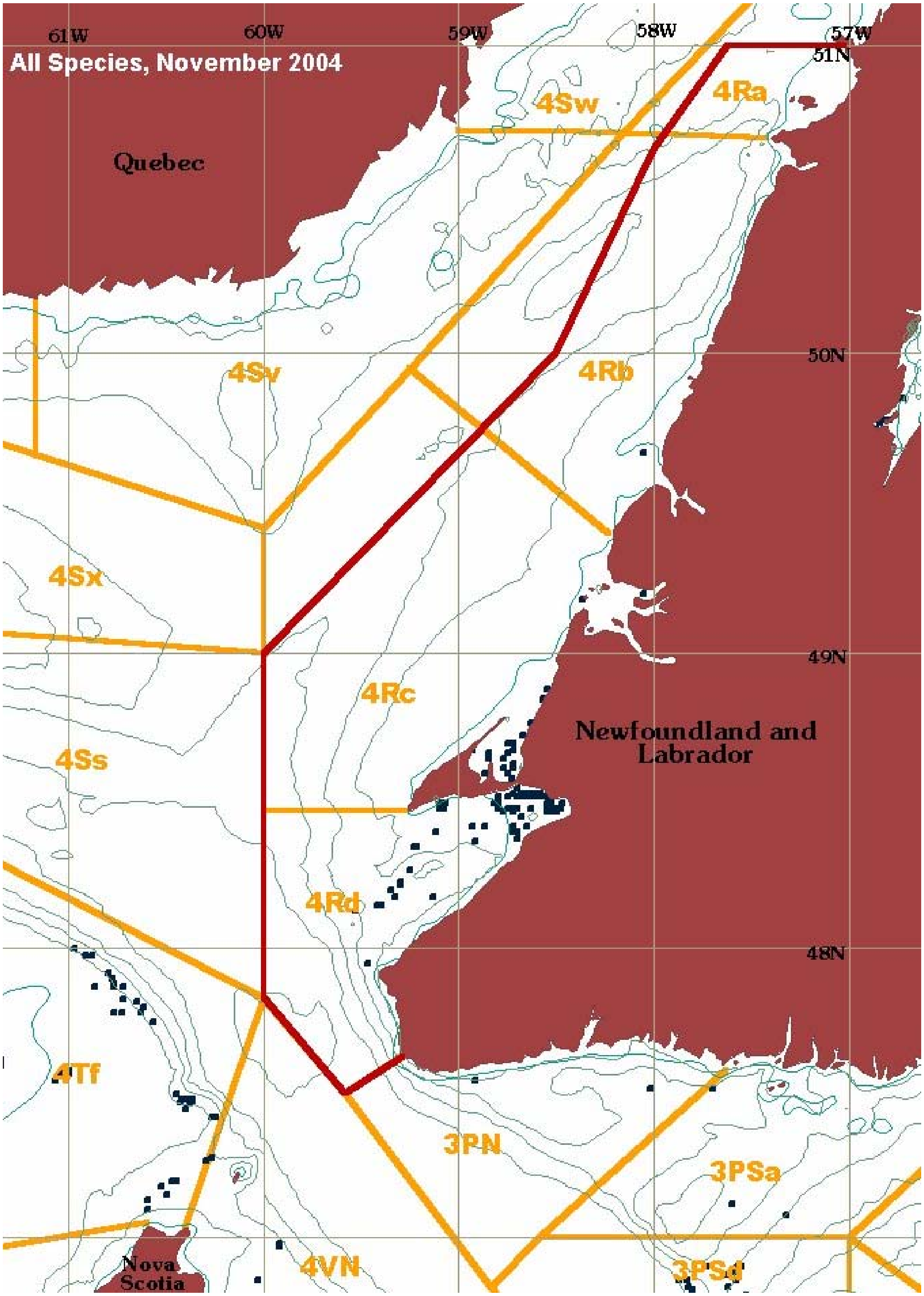


Figure 3.23. Harvesting Locations, Study Area and Adjacent Waters, All species, November 2004.

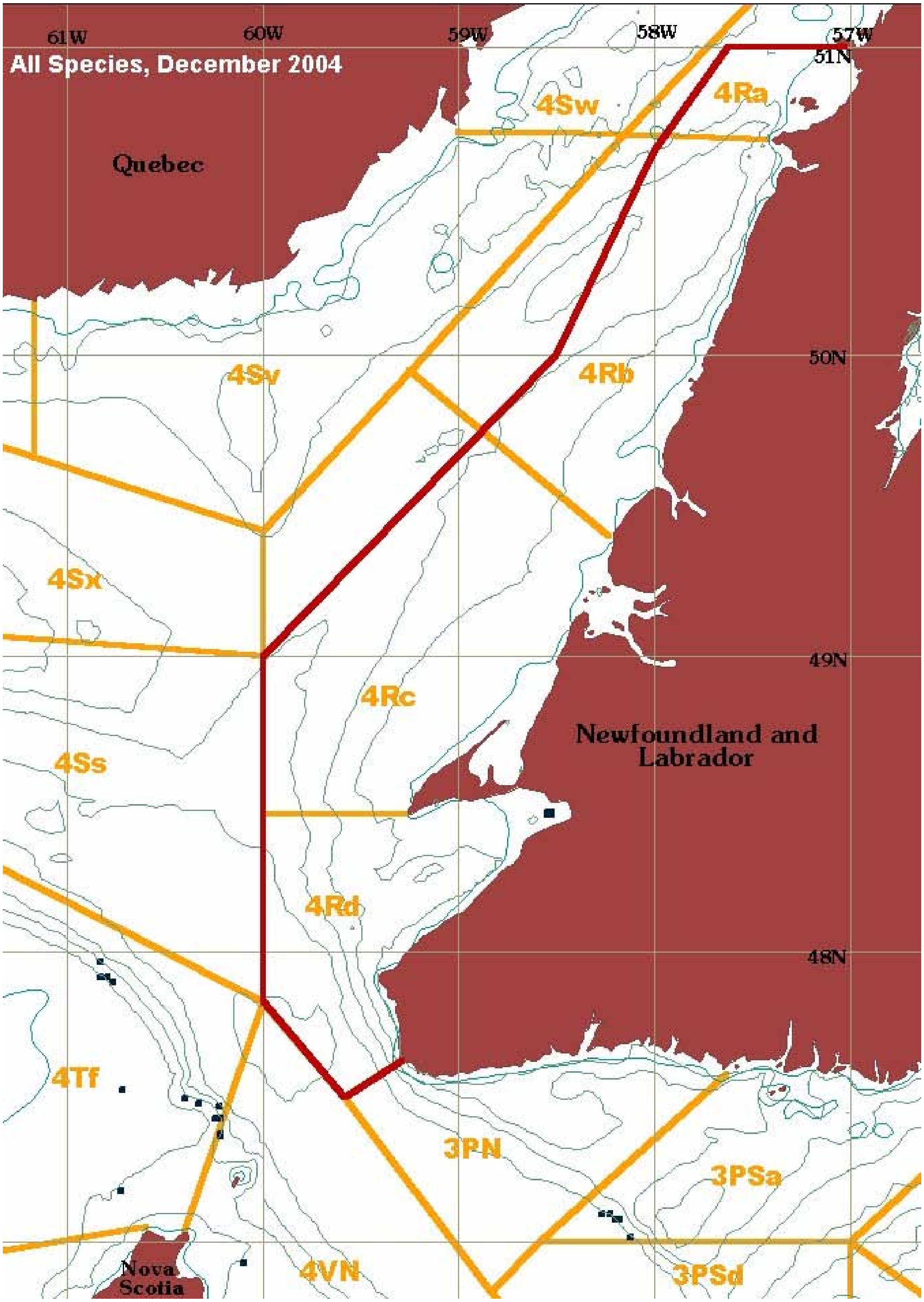


Figure 3.24. Harvesting Locations, Study Area and Adjacent Waters, All Species, December 2004.

3.4.4.5 Principal Species Fisheries

As discussed, groundfish (primarily cod, redfish and greysole flounder), herring, mackerel, capelin, lobster, shrimp and snow crab make up more than 99% of the 4Rb,c,d harvest in recent years. This section provides more detailed information on these fisheries. Maps presented are based on the georeferenced (lat/long) data for 2002 - 2004.

<u>Groundfish</u>

As discussed previously, the groundfish harvest has been drastically reduced in Division 4R (NL and NS data) over the last two decades, owing largely to changes in the cod fisheries (Figure 3.25). Although still important socially and economically, in 2004 the groundfisheries were only about 5% of what they had been two decades earlier (Figures 3.25 to 3.28). Rather similar declines occurred in some other groundfish harvests, such as redfish, while halibut and greysole (witch) flounder harvests have not followed these same trends, as indicated in the following graphs of key groundfish harvests.

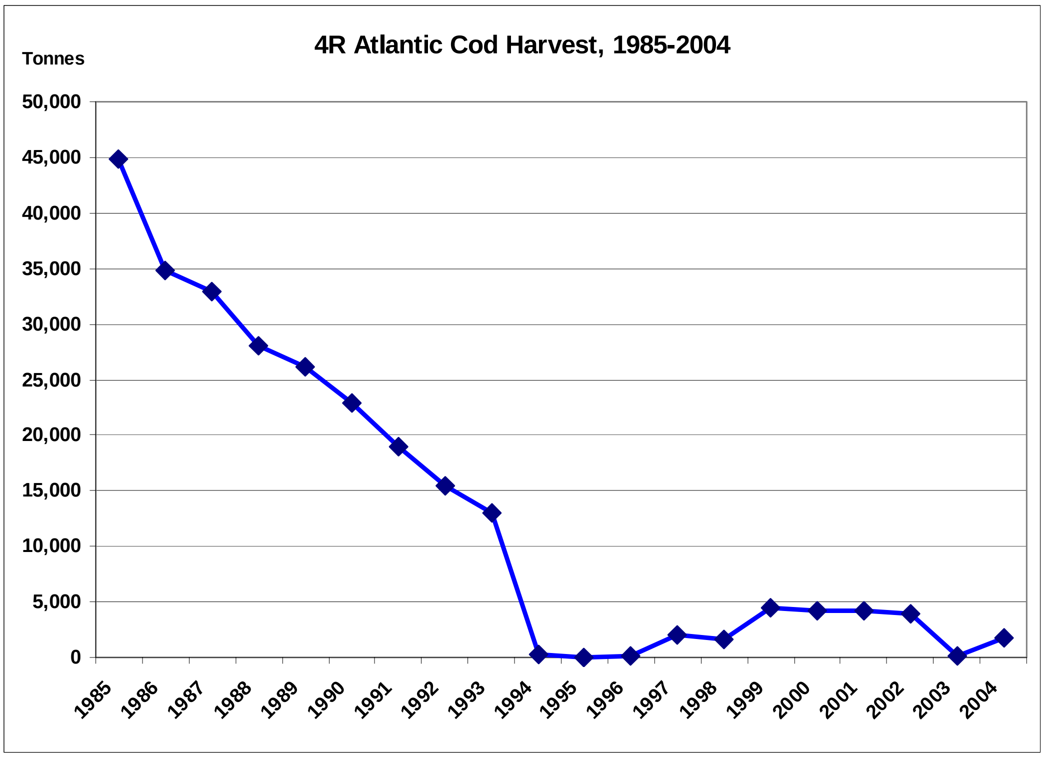


Figure 3.25. Cod Harvest in 4R, 1985-2004.

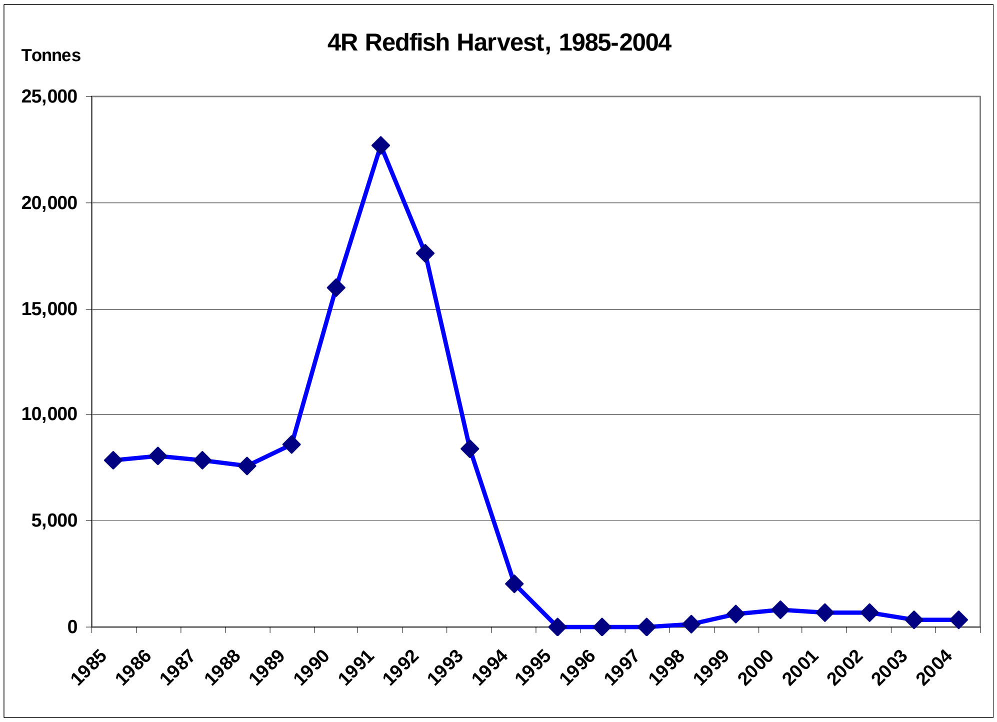


Figure 3.26. Redfish harvest in 4R, 1985-2004

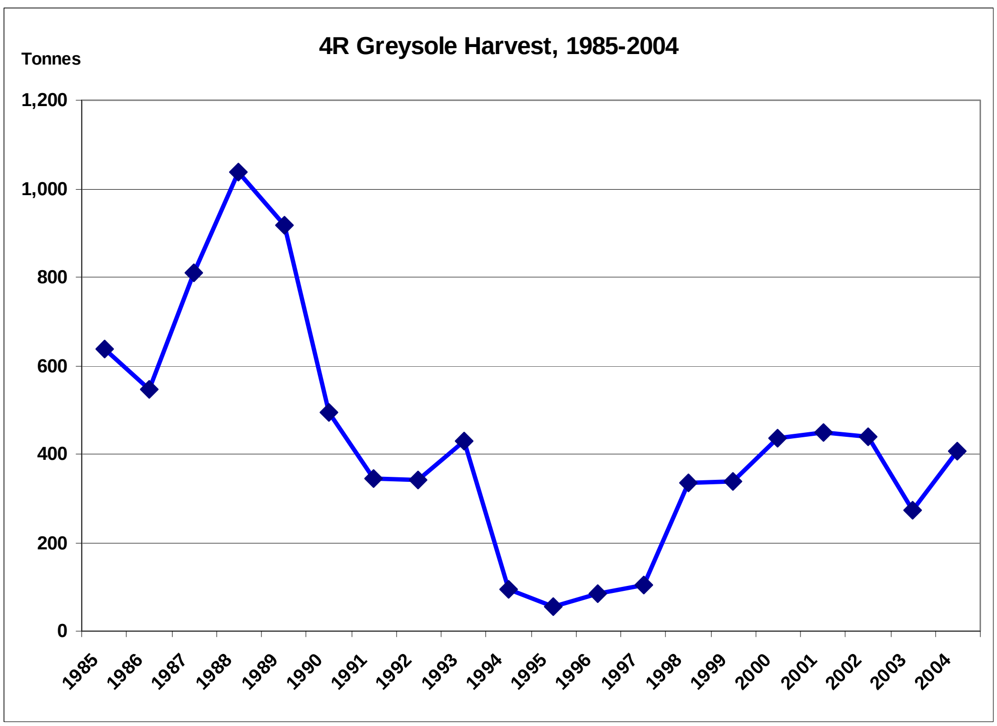


Figure 3.27. Greysole Flounder Harvest in 4R, 1985-2004

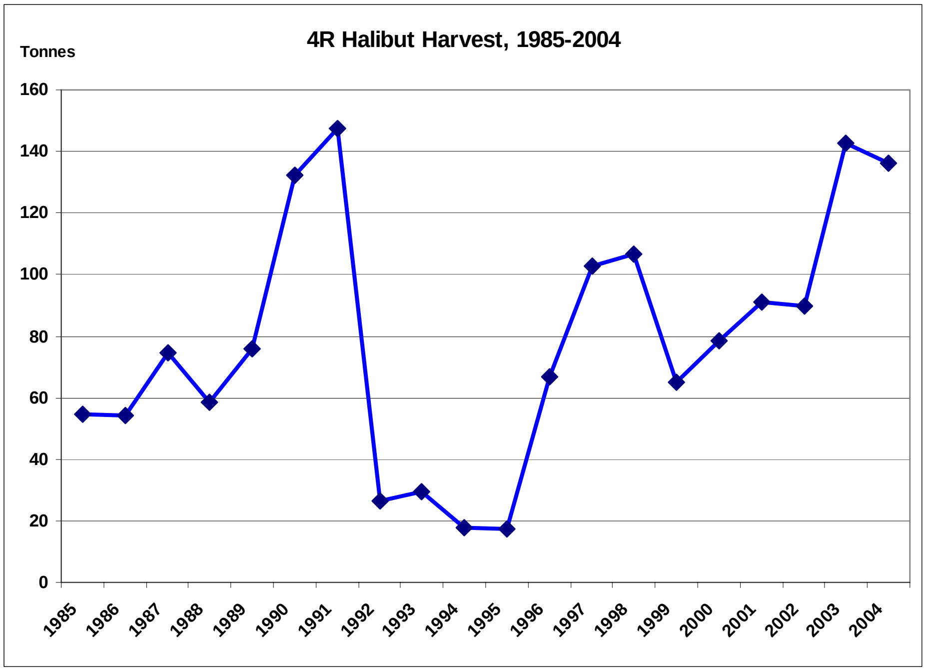


Figure 3.28. Atlantic Halibut Harvest in 4R, 1985-2004

Cod are harvested in the area mainly with gillnets, longlines and handlines. Redfish are taken almost entirely with stern otter trawls. Greysole are caught using midwater trawls. Halibut are harvested primarily using longlines, though small quantities are also harvested using gillnets and otter trawls.

Figures 3.29 to 3.35 show the timing of the groundfish harvest in 4Rb,c,d during 2002 – 2004, and - show the locations of the georeferenced harvest for groundfish (2002-2004), and then for key groundfish species during 2004.

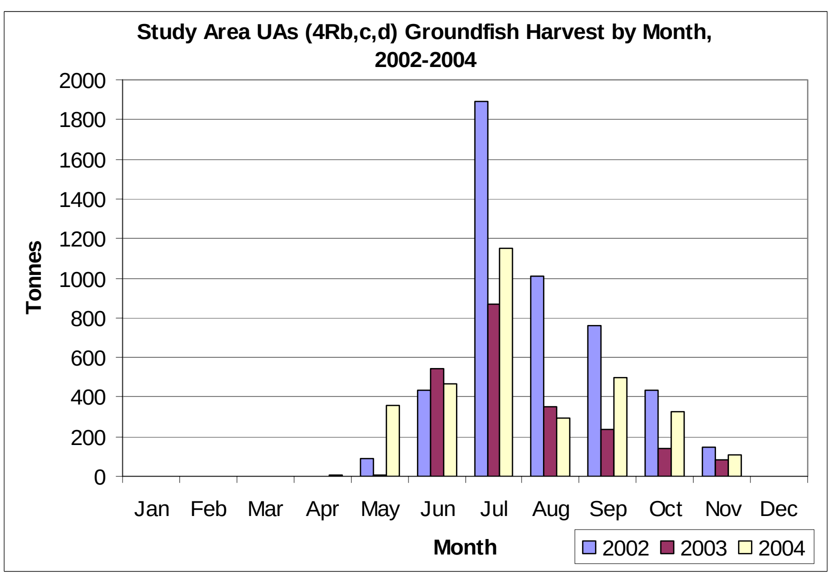


Figure 3.29. 4Rb,c,d Groundfish Harvest by Month, 2002, 2003 and 2004.

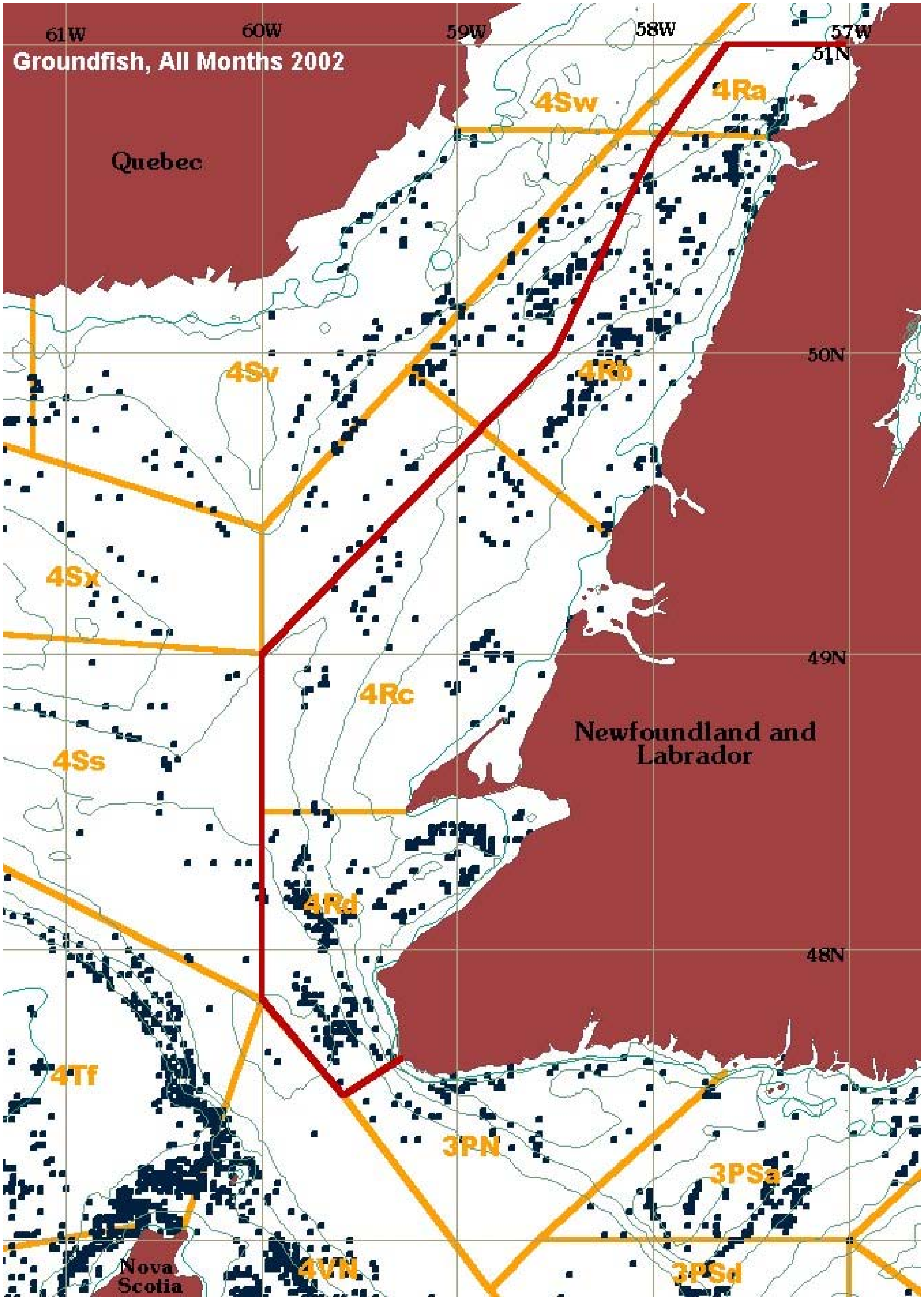


Figure 3.30. Harvesting Locations, Groundfish Species, All Months 2002.

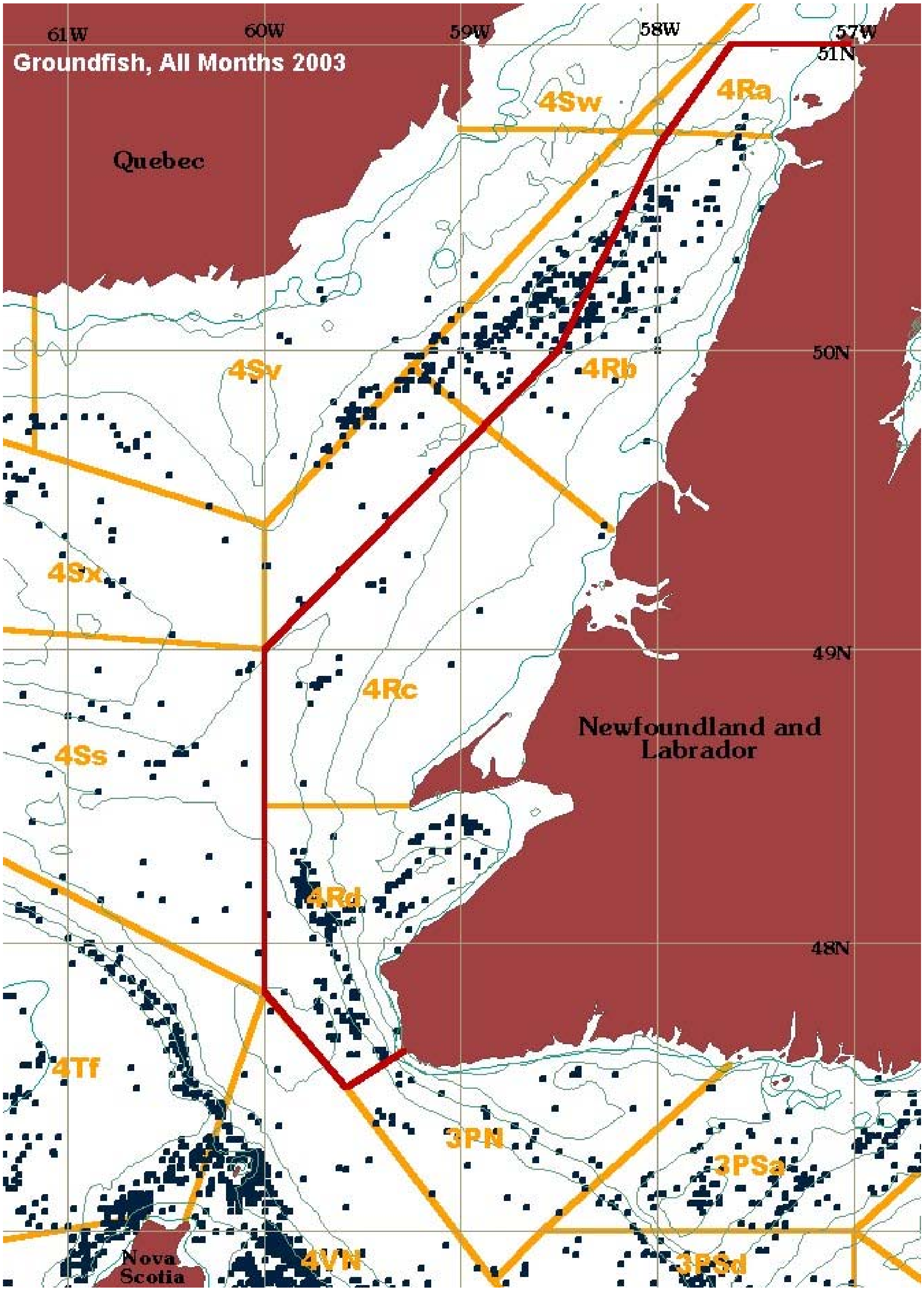


Figure 3.31. Harvesting Locations, Groundfish Species, All Months 2003.

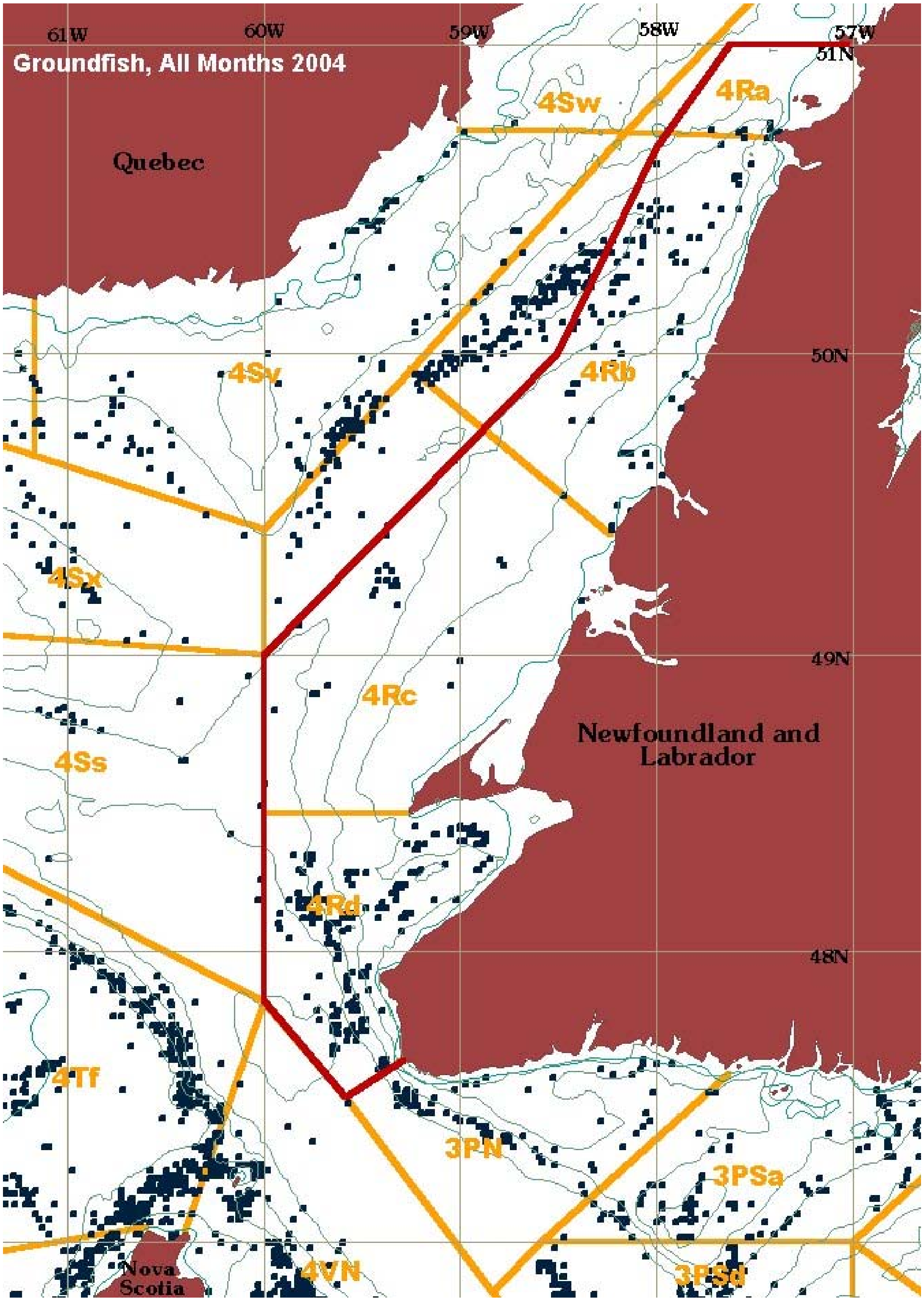


Figure 3.32. Harvesting Locations, Groundfish Species, All Months 2004.

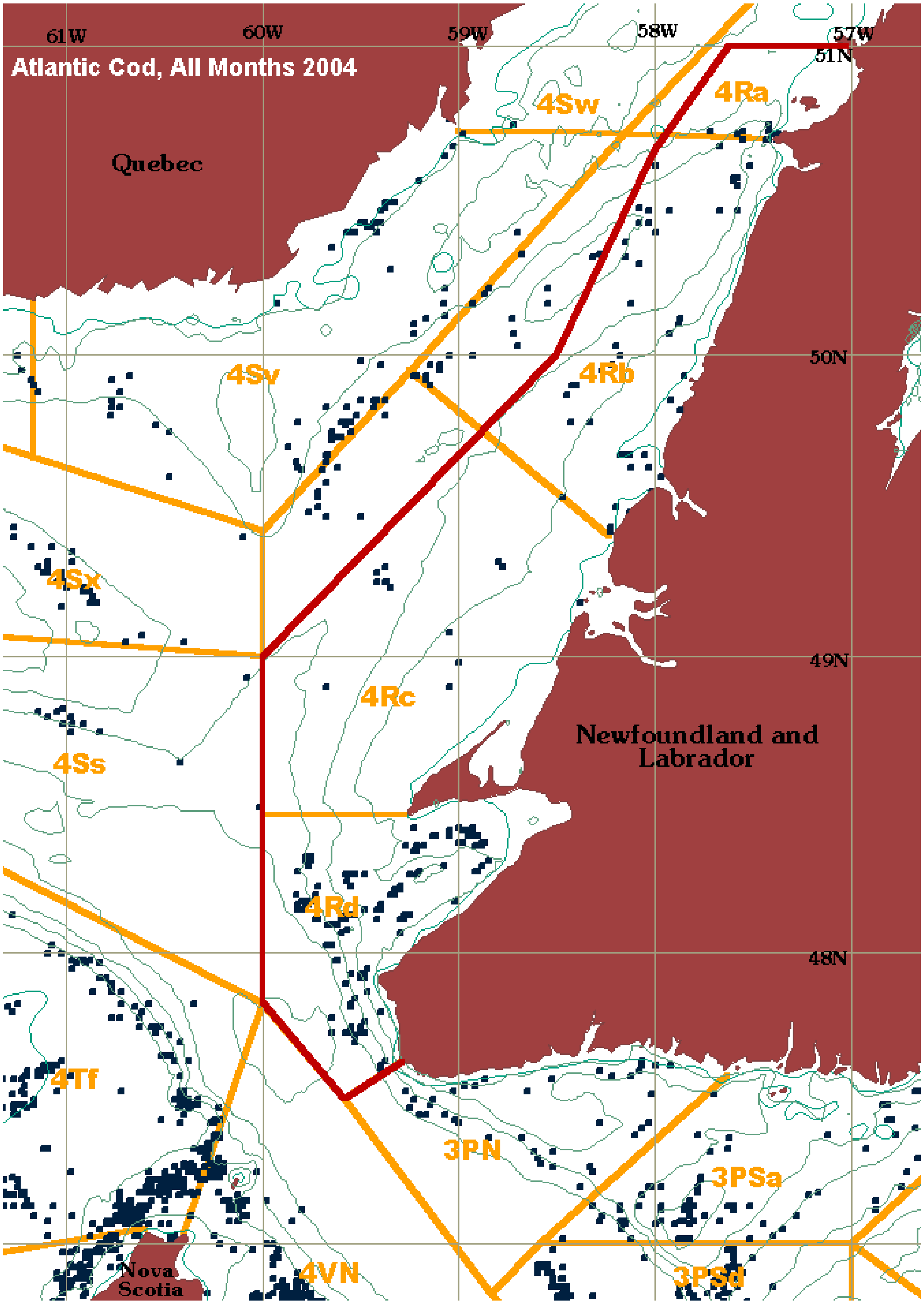


Figure 3.33. Harvesting Locations, Atlantic Cod, All Months 2004.

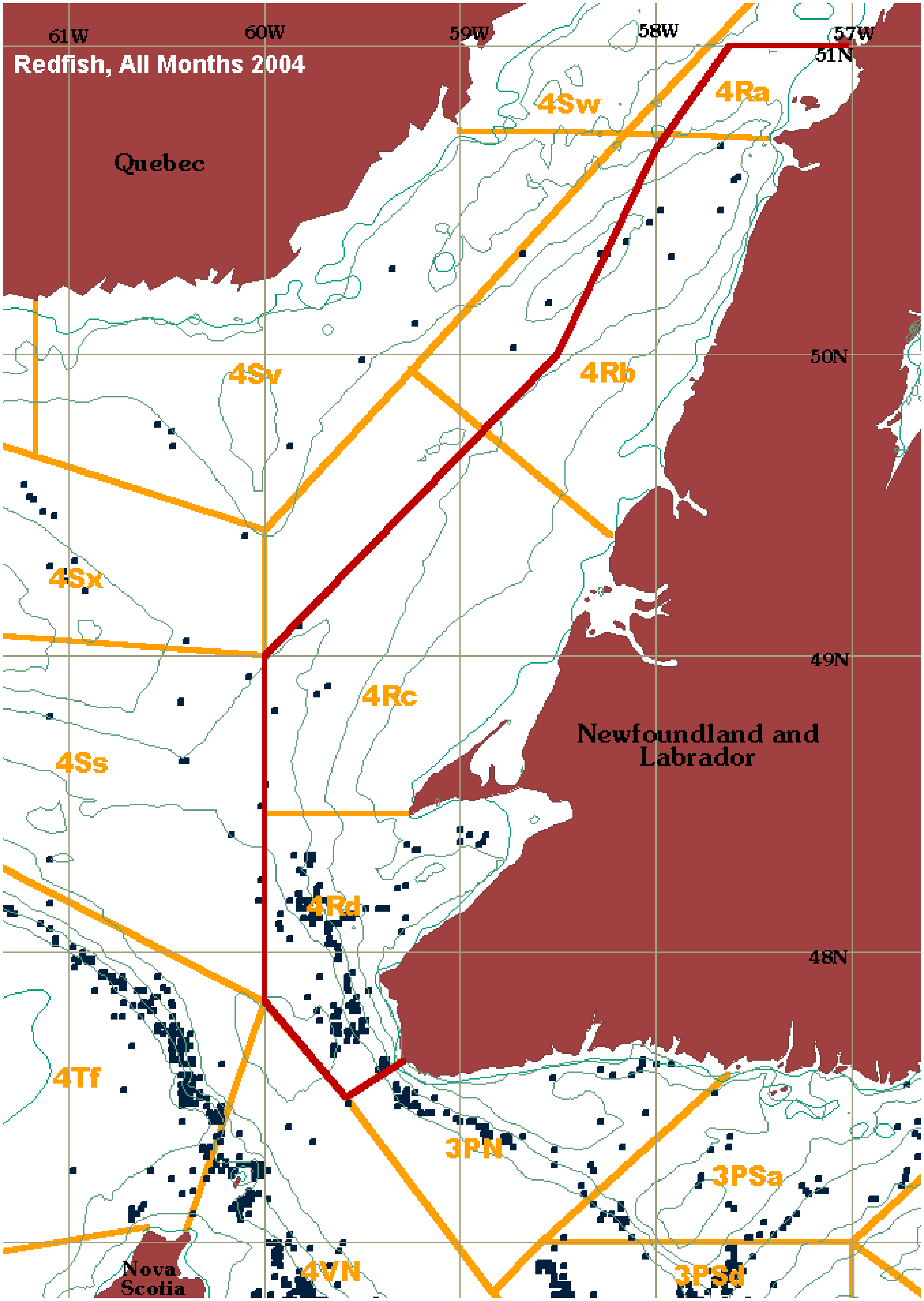


Figure 3.34. Harvesting Locations, Redfish, All Months 2004.

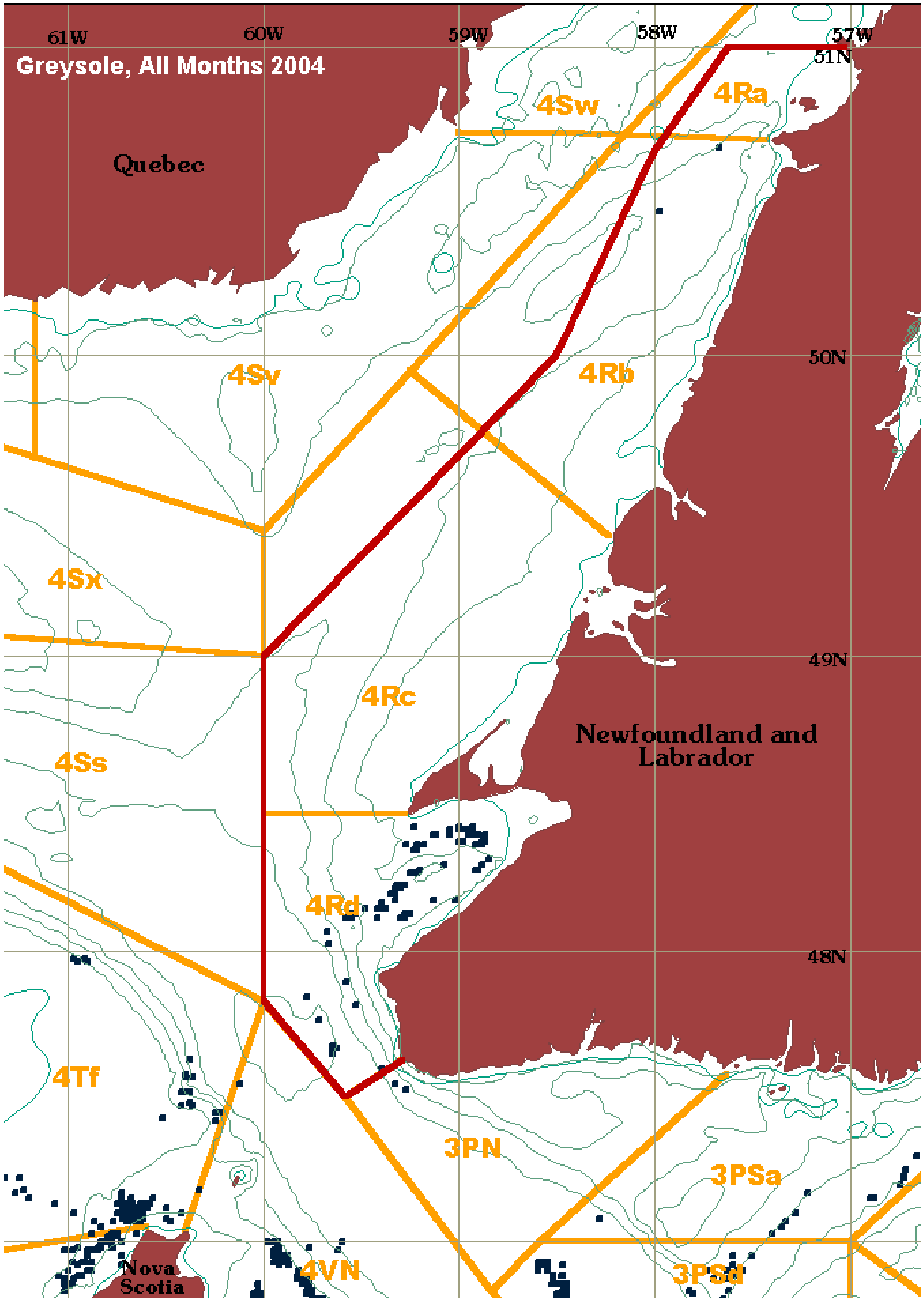


Figure 3.35. Harvesting Locations, Greysole Flounder Species, All Months 2004.

Herring

The herring fishery in the area now accounts for the second largest part of the harvest, by quantity, after mackerel. Figure 3.36 shows commercial landings for 1985 to 2004. As the data indicate, the herring harvest over the past decade or so has been fairly stable in the area, accounting for about 15,000 tonnes of the harvest annually. However, in addition to the landings recorded in the DFO datasets, there is also a substantial bait fishery for herring which is not recorded. As DFO notes, "These catches are not accounted for and could be substantial, especially since the crab (*Chionoecetes opilio*) and lobster (*Homarus americanus*) fisheries have recently shown record highs" (DFO 2005g).

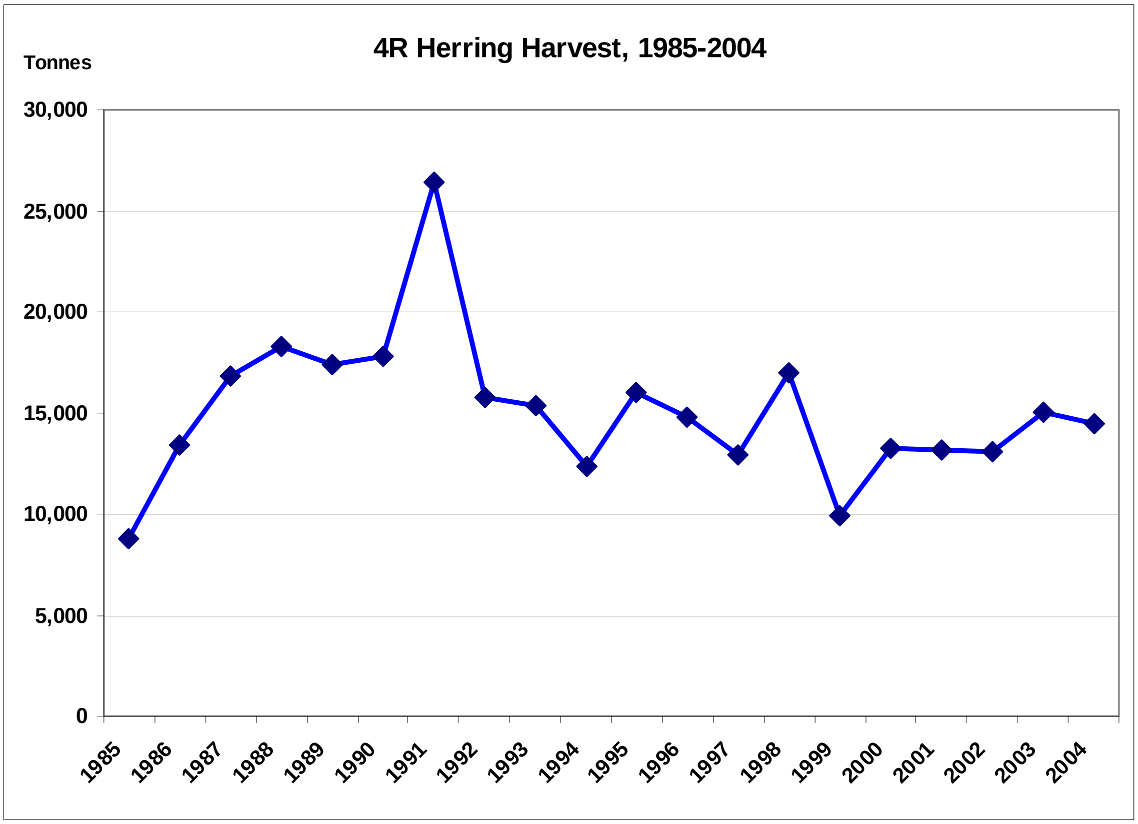


Figure 3.36. 4R Herring Harvest, 1985-2004.

The herring are harvested primarily with purse seines, though there is also a smaller gillnet fishery. DFO notes, "The two herring stocks of the west coast of Newfoundland are harvested separately during spawning gatherings or collectively when the stocks are mixed between April and December. These stocks are mainly harvested by a fleet of large (>65') and small (<65') seiners, and by many gillnet fishermen. From 1990 to 2003, landings made using the three types of gear averaged 15,285 t per year. The average annual landings were 10,859 t for large seiners, 2,915 t for small seiners, and 1,368 t for gillnetters."

The following graph (Figure 3.37) shows the timing of the harvest in 4Rb,c,d during 2002 – 2004, and the following maps (Figures 3.38 to 3.40) show the locations of the georeferenced harvest for herring (2002-2004). As the graph indicates, the herring fishery is conducted in two phases during the year: a spring fishery (May-July) and a more substantial fall harvest (October-December).

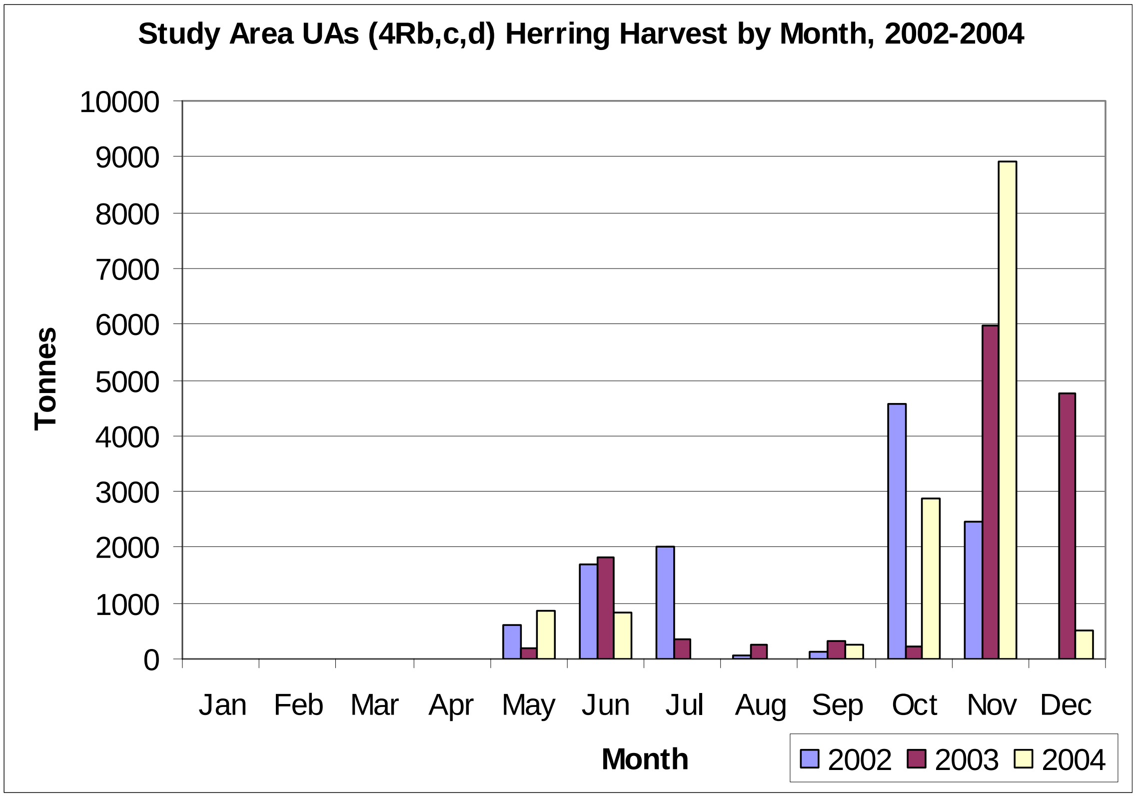


Figure 3.37. 4Rb,c,d Herring Harvest by Month, 2002, 2003 and 2004.

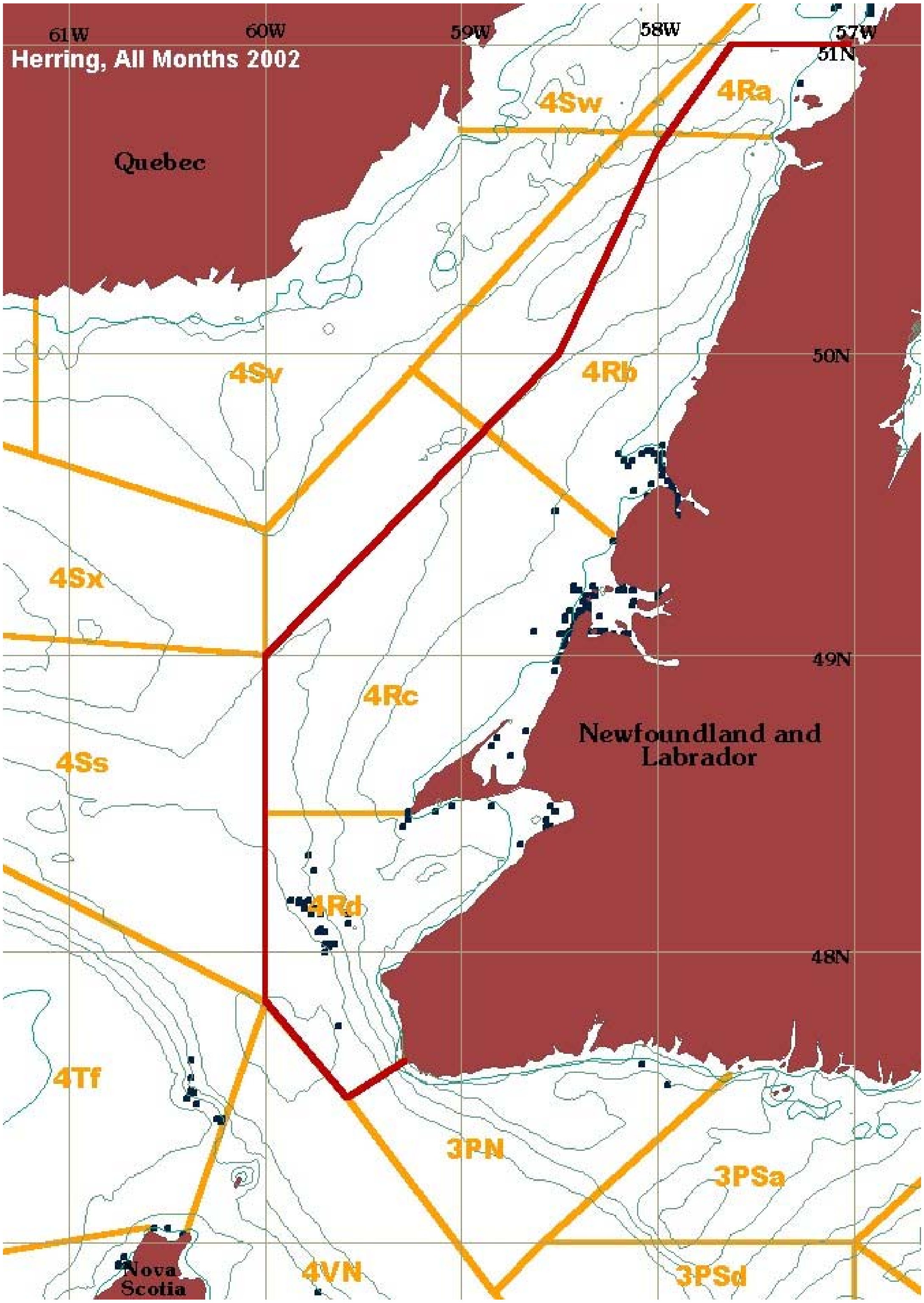


Figure 3.38. Harvesting Locations, Herring, All Months 2002.

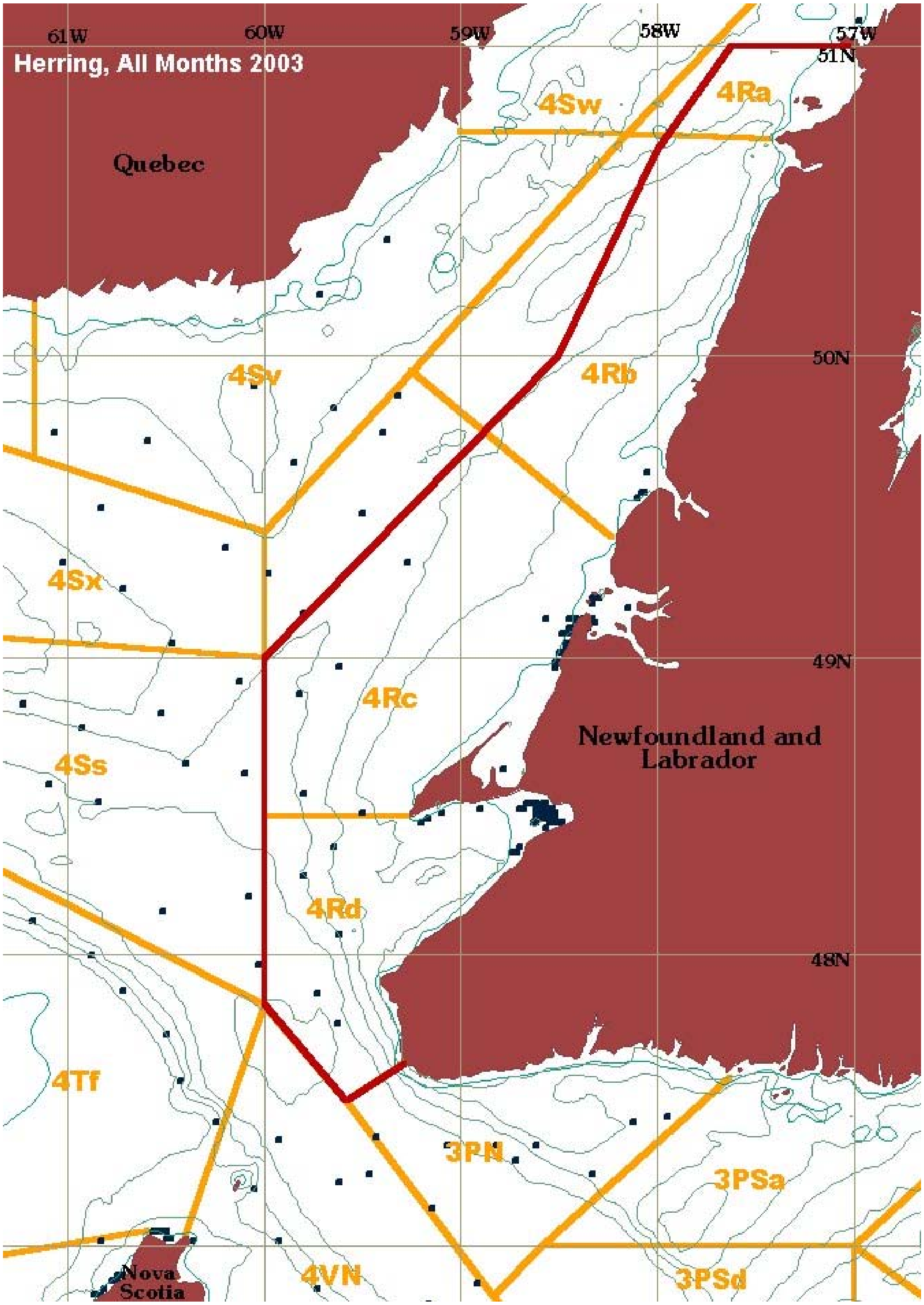


Figure 3.39. Harvesting Locations, Herring, All Months 2003.

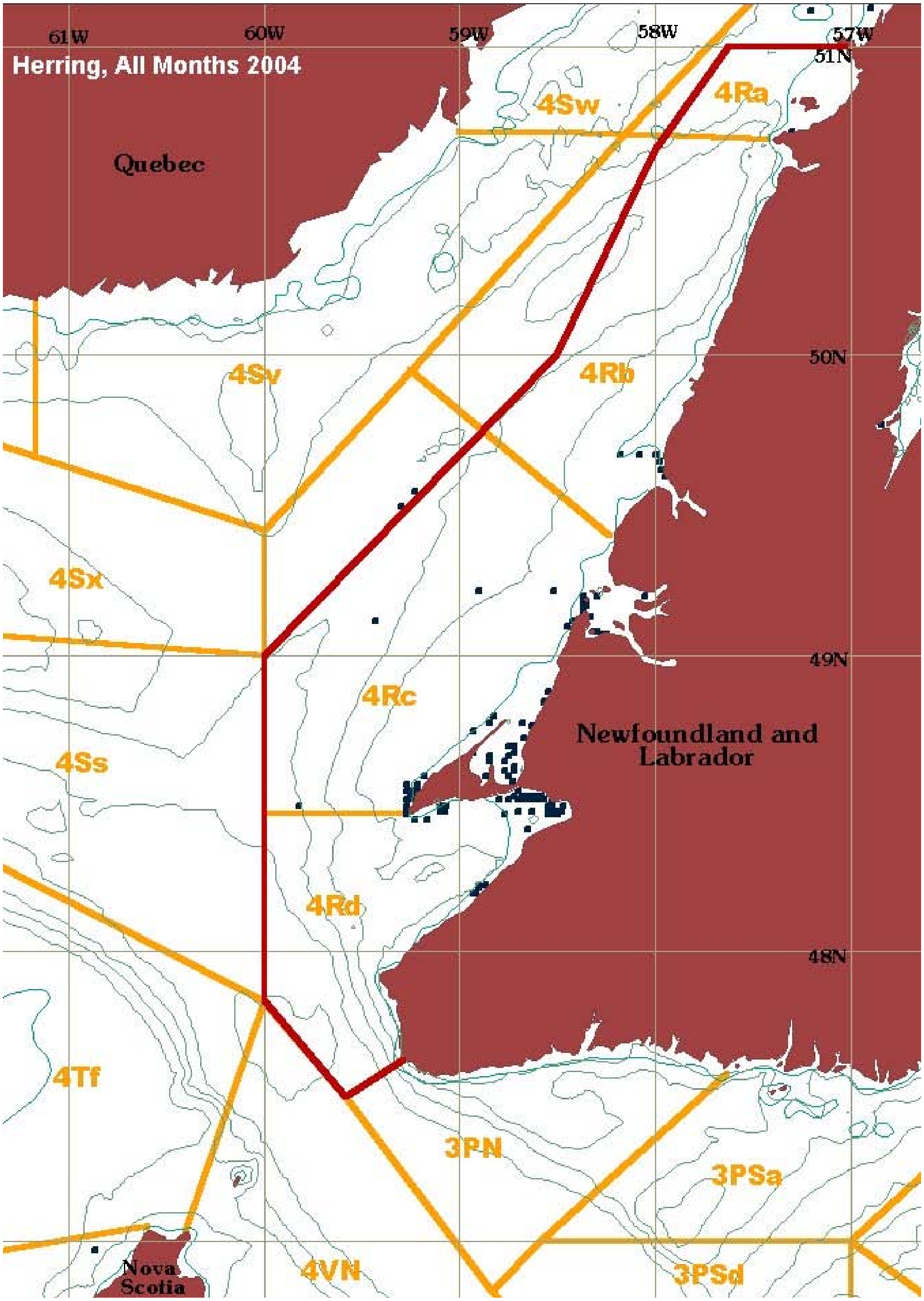


Figure 3.40. Harvesting Locations, Herring, All Months 2004.

Mackerel

The mackerel fisheries typically accounts for the most significant harvest, by quantity in the area, though its low price (relative to shellfish species, for example) means that it is less significant economically. Figure 3.41 shows commercial landings for mackerel for 1985 to 2004. As it indicates, since 2000 the harvests have risen dramatically, though they declined slightly in 2004. However, as DFO notes, of the eastern Canadian/U.S. mackerel fishery, "The mackerel that are caught and then used for bait do not appear in the Department's official statistics, which are based on purchase slips from sales to processing plants. Recreational fishing is very popular in summer, and these statistics aren't recorded either. Since these activities are carried out throughout Eastern Canada, the actual total number of mackerel caught is largely underestimated" (DFO 2005c).

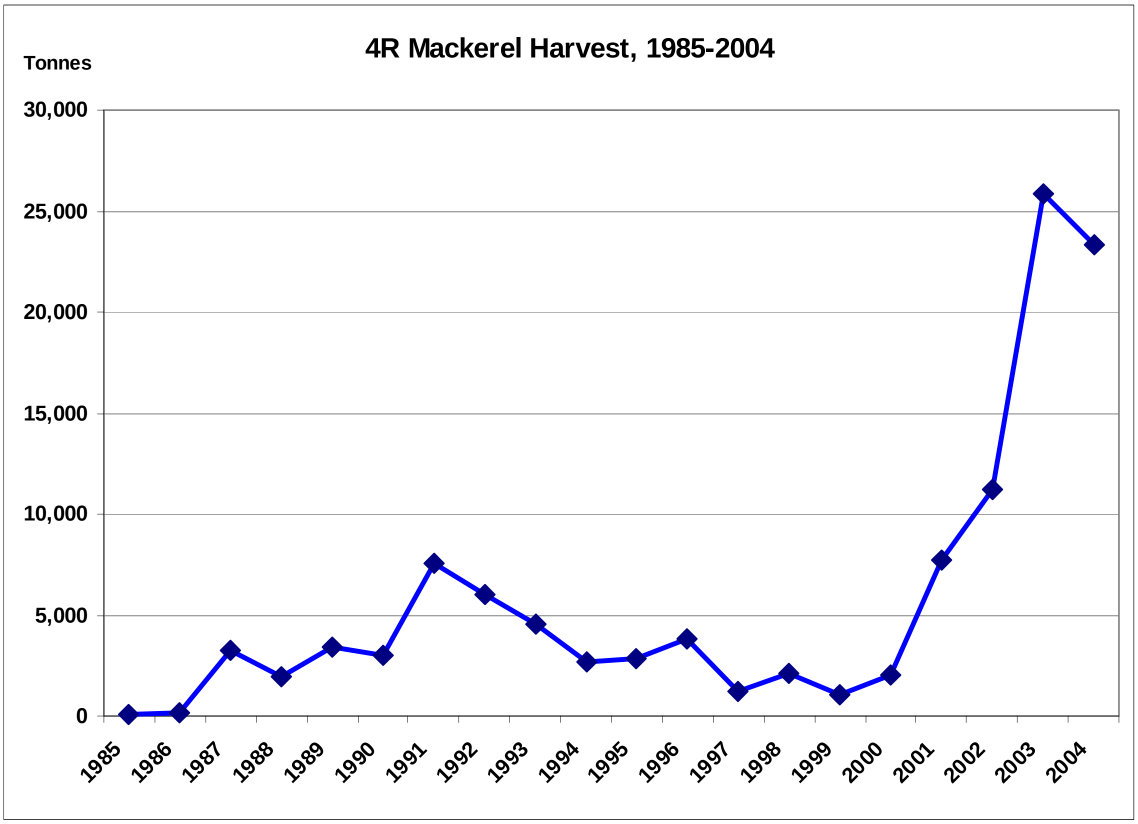


Figure 3.41. 4R Mackerel Harvest, 1985-2004.

The mackerel fishery, like herring, is mainly pursued using purse seines in this area. However, DFO reports, "For several years, 40% of the TAC has been allocated to mobile gear over 65' (19.8 m), and 60% to mobile gear under 65' and to coastal fixed gear such as traps, gillnets, lines and weirs. In the first case, nearly 50% and 35% of the quota was reached in 2003 and 2004 respectively. These values were the highest of all historical landing series. In the second case, 66% and 55% of the quota was reached over the last two years."

The following graph of the timing of the mackerel harvest in the area indicates that it is primarily a late summer – early fall fishery (Figure 3.42).

The maps that follow show georeferenced harvesting locations for 2002 – 2004 (Figures 3.43 to 3.45).

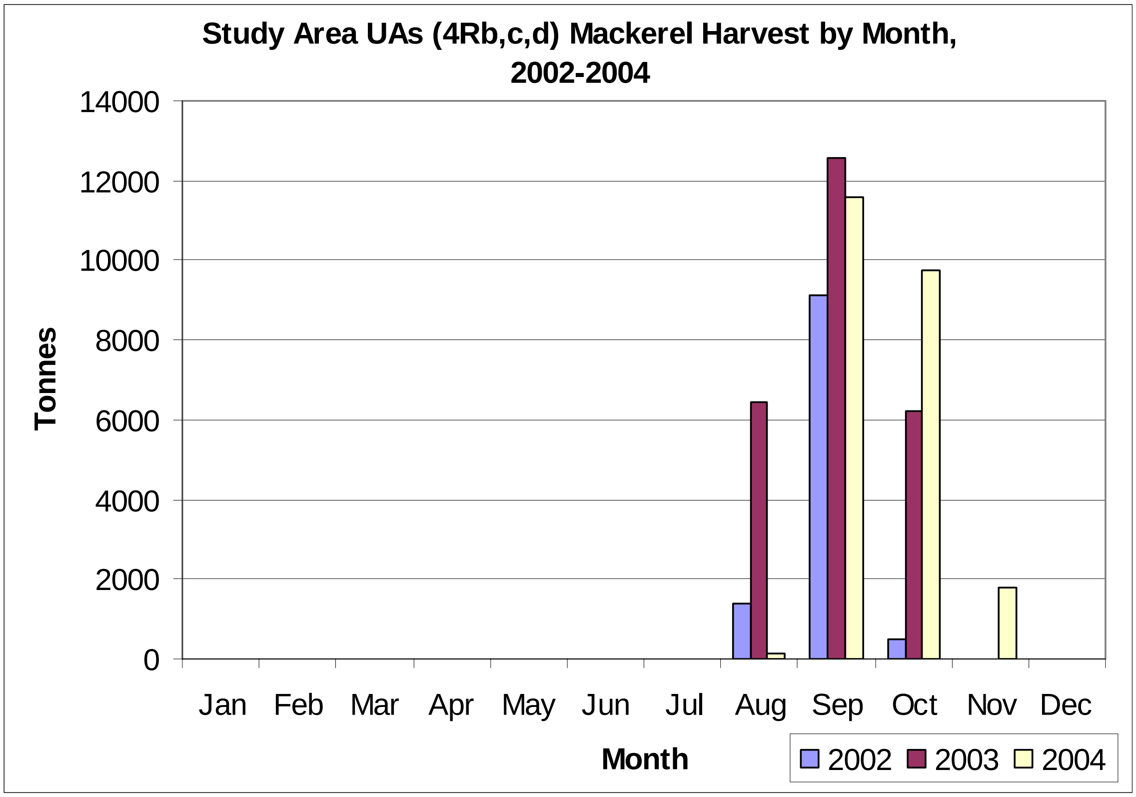


Figure 3.42. 4Rb,c,d Mackerel Harvest by Month, 2002, 2003 and 2004.

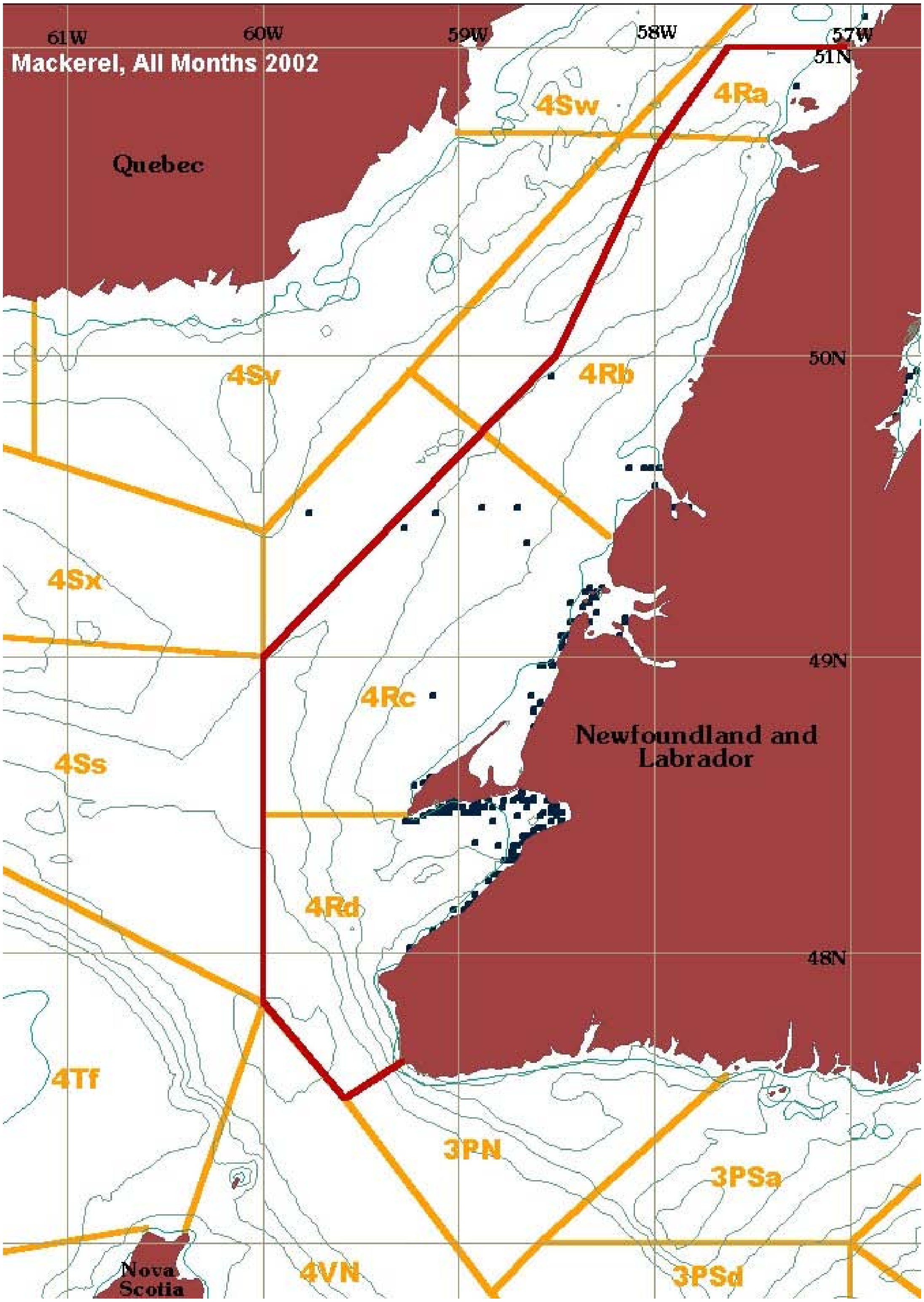


Figure 3.43. Harvesting Locations, Mackerel, All Months 2002.

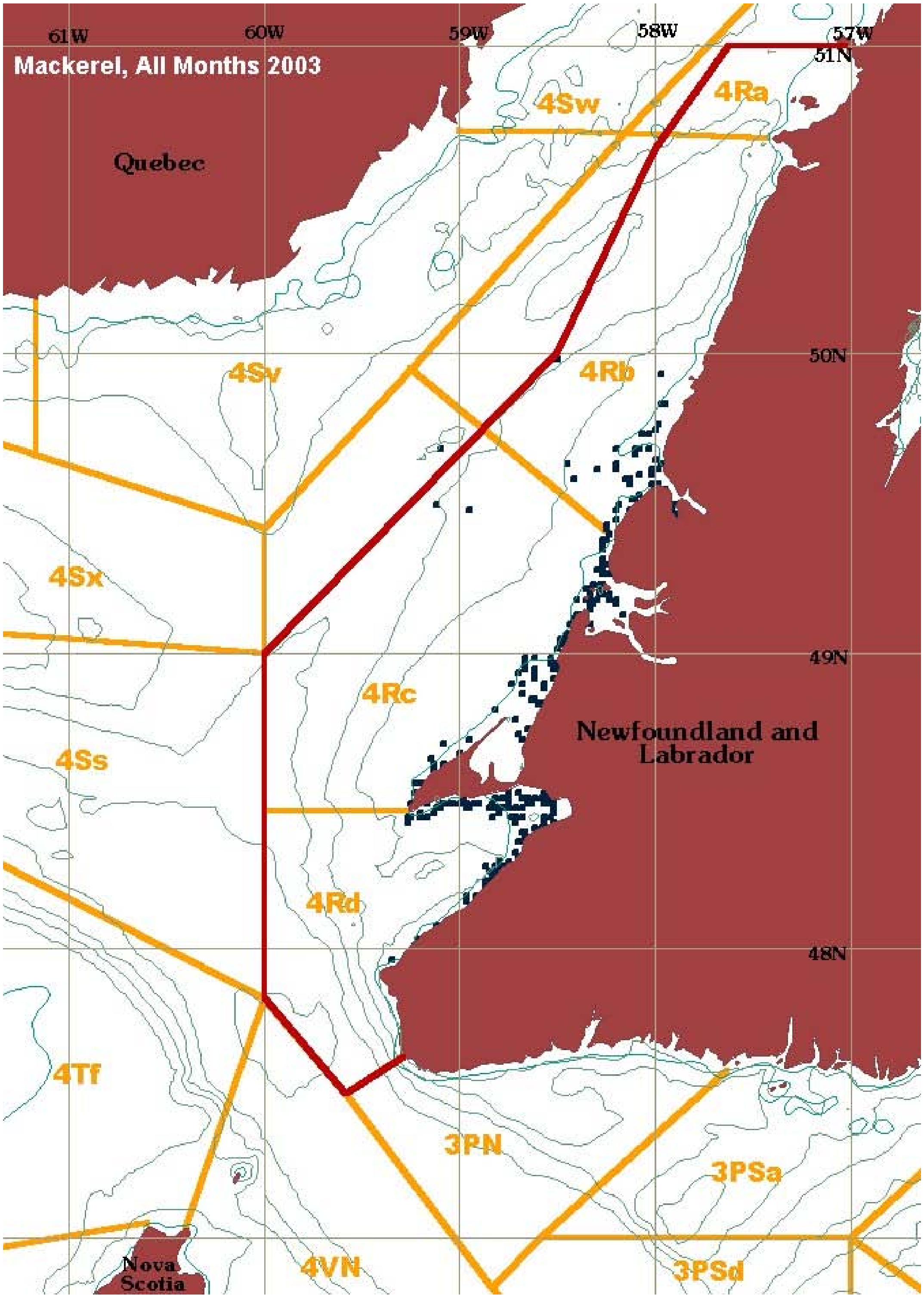


Figure 3.44. Harvesting Locations, Mackerel, All Months 2003.

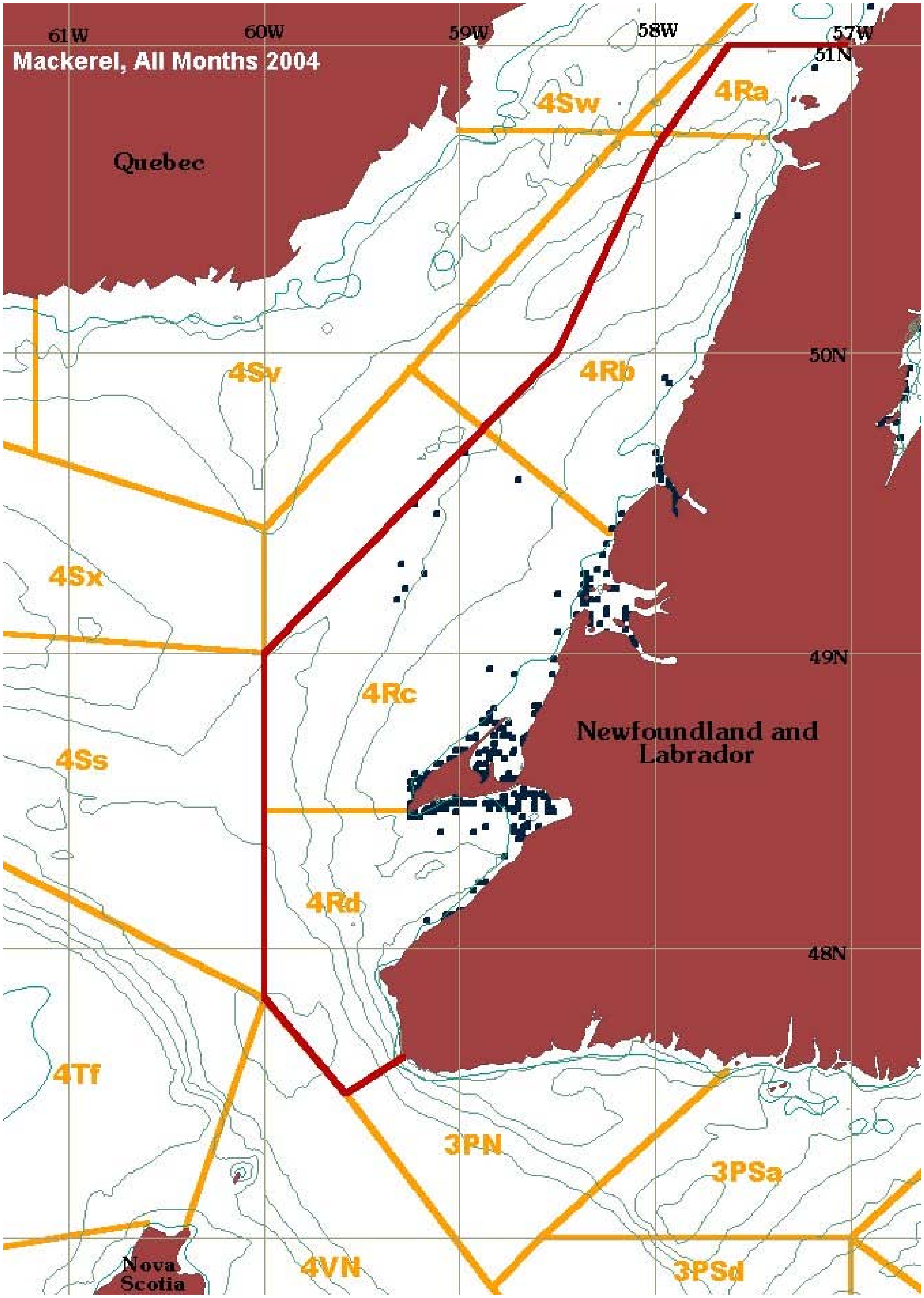


Figure 3.45. Harvesting Locations, Mackerel, All Months 2004.

Capelin

The capelin fishery in the area is quite important to some fishers, though, as the following graph indicates, the fishery has fluctuated markedly over the past several years (Figure 3.46). The fishery is primarily pursued using purse seines in this area.

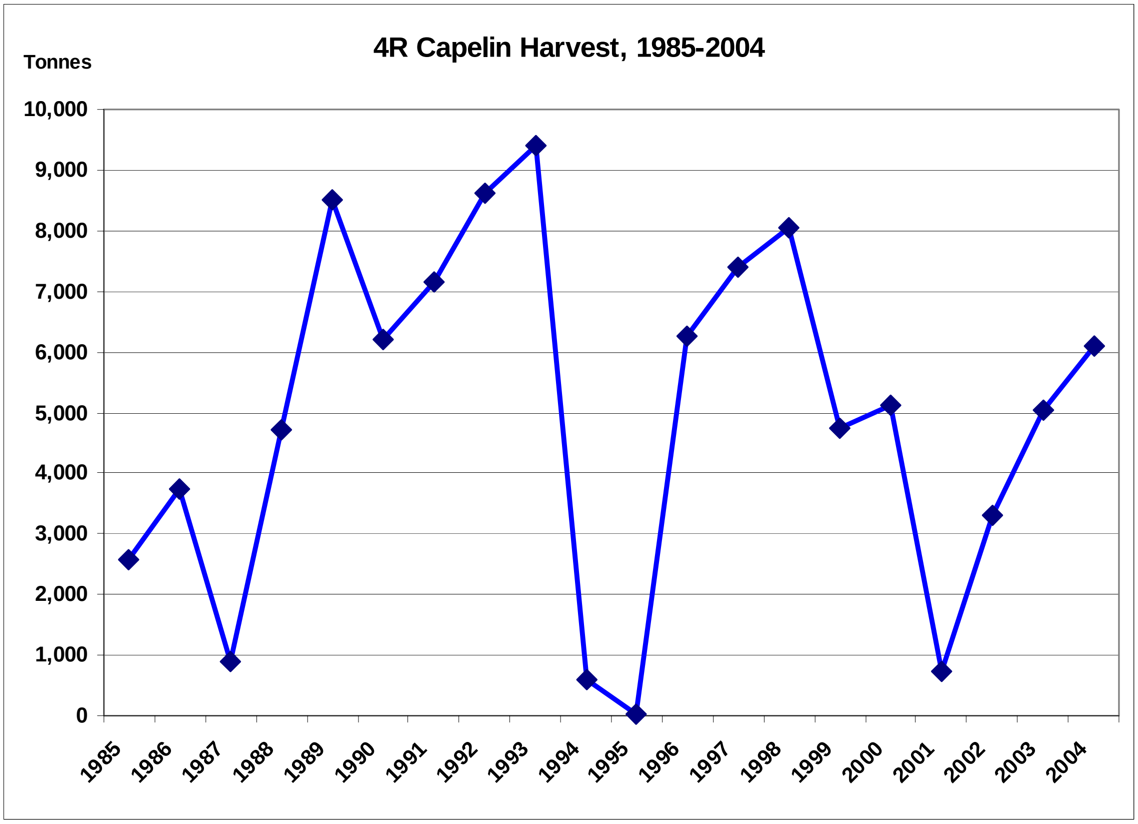


Figure 3.46. 4R Capelin Harvest, 1985-2004.

As the following graph showing the capelin harvest by month for 2002 to 2004 shows, the fishery is quite focused in June and the beginning of July, when the fish aggregate to spawn (Figure 3.47). The purse seine fishery focuses on pre-spawning aggregations and a trap fishery occurs during the spawning period. Both target mature females fish for the Japanese roe market. DFO observes, "Compared to the 1980s, capelin fishing and spawning seasons began later in the 1990s. A relative stability in fishing periods has been observed since 2001. However, median fishing dates are still later than those observed during the 1980s" (DFO 2005d).

Georeferenced harvesting locations are mapped on Figures 3.48 to 3.50. DFO notes that "The largest landings for the entire Gulf of St. Lawrence are made on the west coast of Newfoundland".

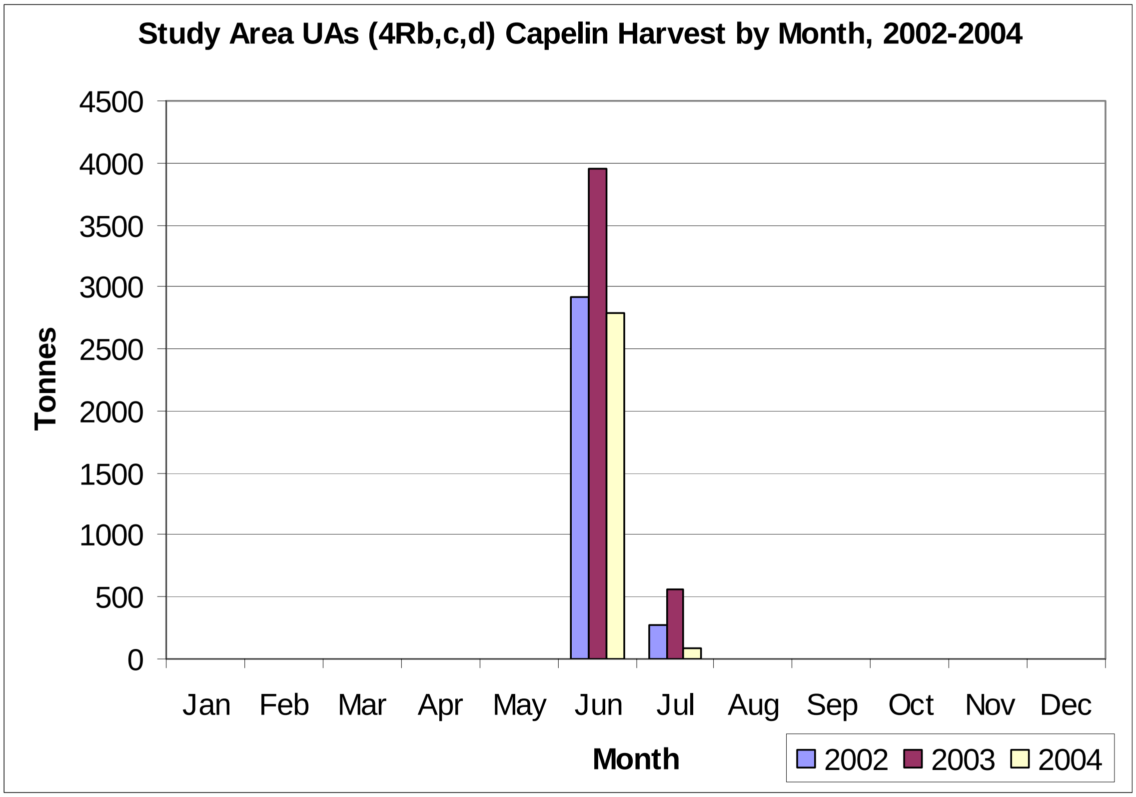


Figure 3.47. 4Rb,c,d Capelin Harvest by Month, 2002, 2003 and 2004.

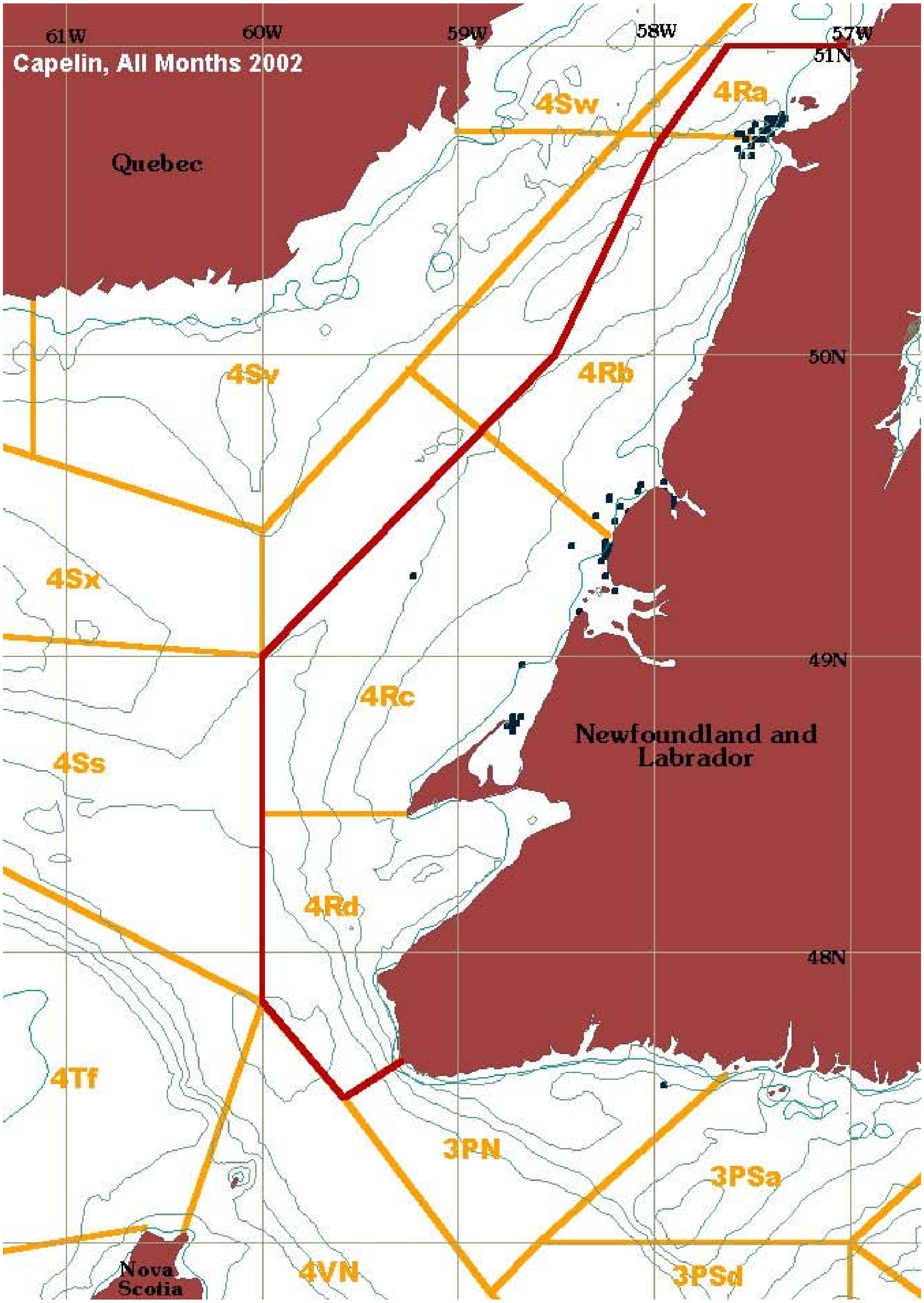


Figure 3.48. Harvesting Locations, Capelin, All Months 2002.

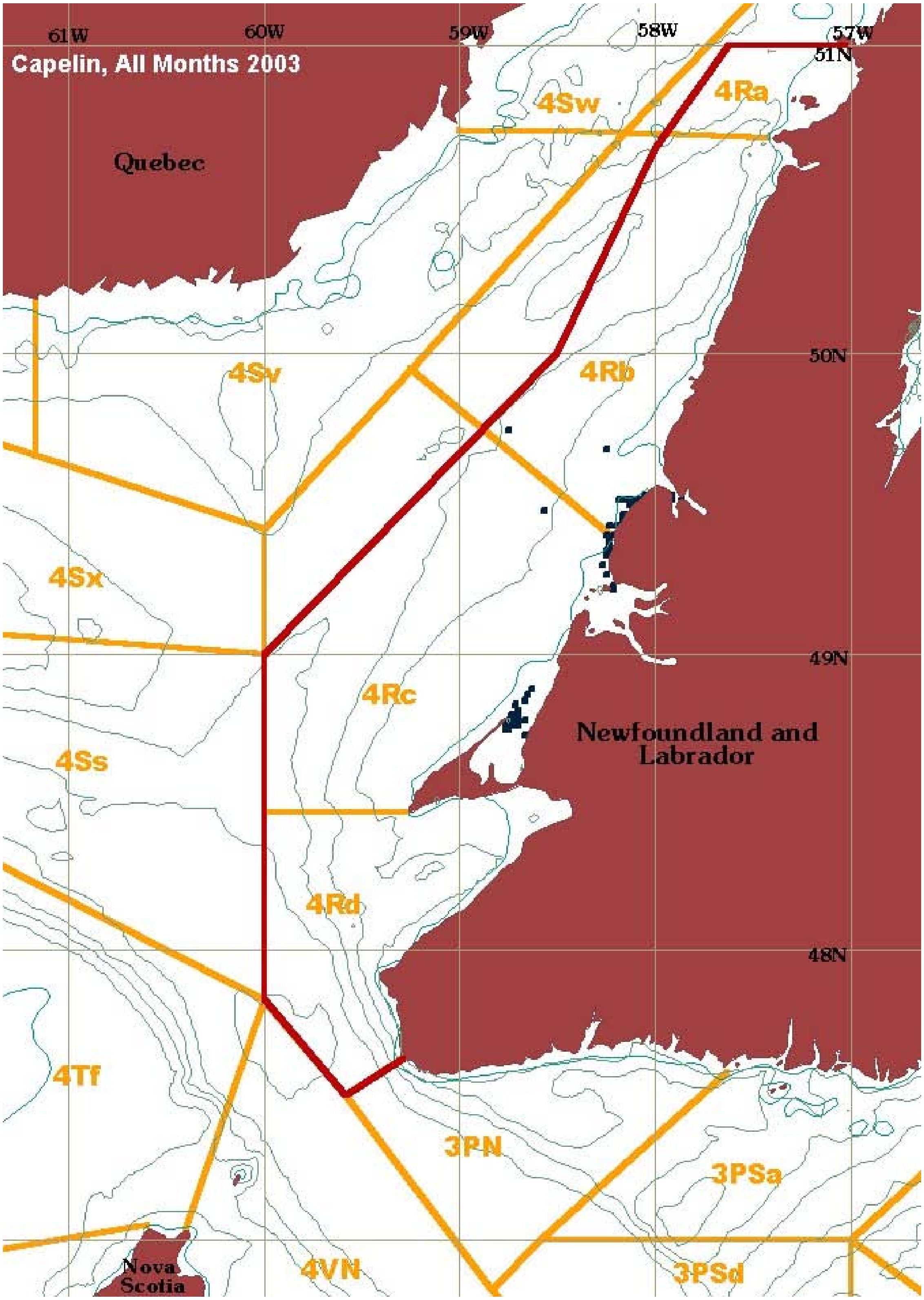


Figure 3.49. Harvesting Locations, Capelin, All Months 2003.

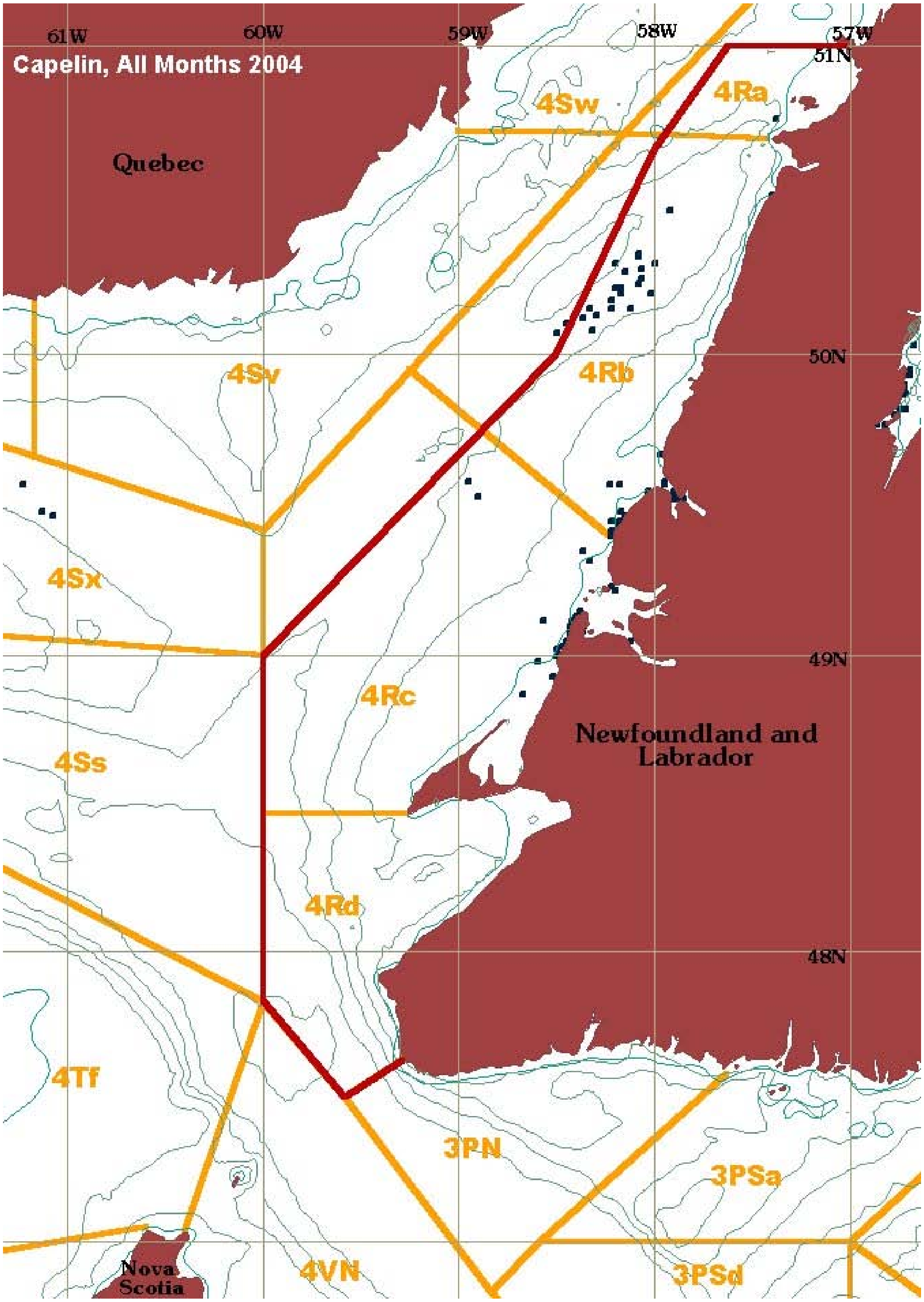


Figure 3.50. Harvesting Locations, Capelin, All Months 2004.

Lobster

The lobster fishery, although it typically makes up under 2% of the harvest by quantity, is a high-value fishery and are very important to many local Study Area-based fishers who typically harvest this species in waters near their home ports. As Figure 3.51 illustrates, the lobster fishery has been relatively stable, compared to the fluctuations in other fisheries, it experienced a decline in the late 1990s and early years of this decade, though the harvest has been closer to historical levels in the past two years.

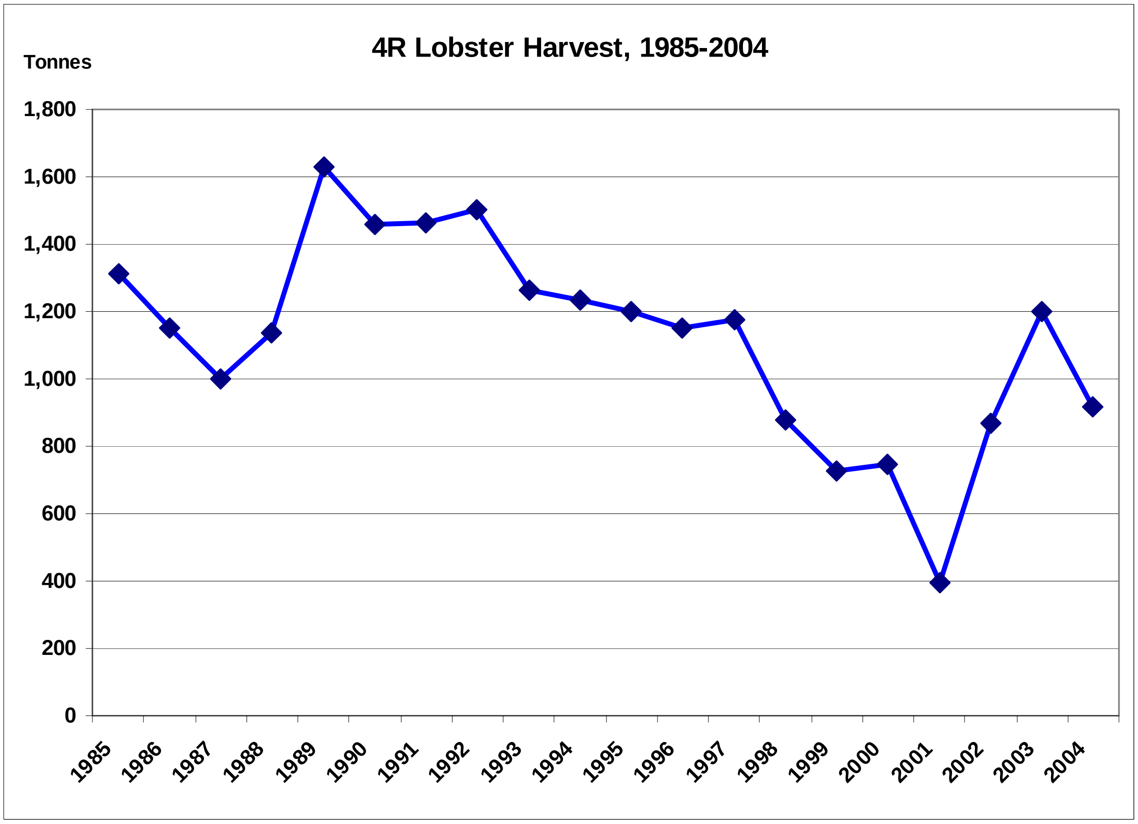


Figure 3.51. 4R Lobster Harvest, 1985-2004.

The lobster season in this area is focused in the spring, from ice out (April) to June–early July (Figure 3.52).

The lobster fishery uses lobster traps (or “pots”) weighted to the bottom typically in rocky areas near to shore or around offshore islands, in depths generally less than 20 m. In Newfoundland, trap limits vary between lobster fishing areas (LFAs) from 100 to 425 traps. The Study Area includes LFAs 13A, 13B and 14A.

Although no maps of these locations are available, the gear is typically set in waters adjacent to or near the fisher’s home port.

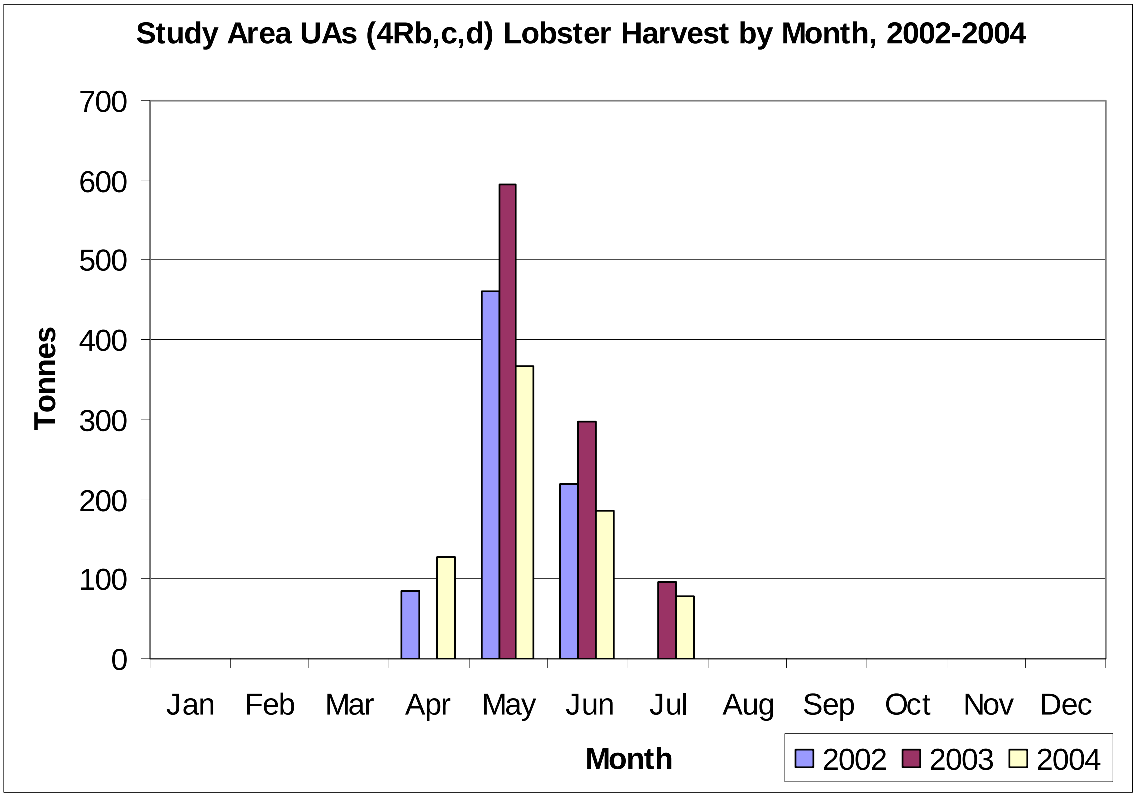


Figure 3.52. 4Rbcd Lobster Harvest by Month, 2002, 2003 and 2004.

Northern Shrimp

In terms of quantity and value, the northern shrimp fishery is very important to the region. In many respects it has come to replace much of the value of the fishery lost through the declines in most groundfisheries. A high value (price per quantity) fishery, it has had a fairly steady increase since the early 1980s, though in recent years the resource has shown some measure of variability, and quotas and catches have fluctuated (Figure 3.53). For example, in 2003 the 4R shrimp quota was reduced by about 14%, to 6,674 tonnes, but was increased to 8,520 tonnes the following year (2004). For 2005, it was again reduced to 6,909 tonnes.

Within the Gulf of St. Lawrence, three fleets of trawlers based in Quebec, New Brunswick and Newfoundland harvest shrimp in four areas: Sept-Îles (Area 10), Anticosti (Area 9), Esquiman (Area 8) – which includes 4R - and the Estuary (Area 12). DFO notes, “Shrimp fishing is controlled by a number of management measures, including total allowable catches (TAC) in the four areas. In 2002, there were 112 permanent shrimp licences. In addition, since 1997, temporary allocations have been granted to shrimpers without permanent licences” (DFO 2004b)

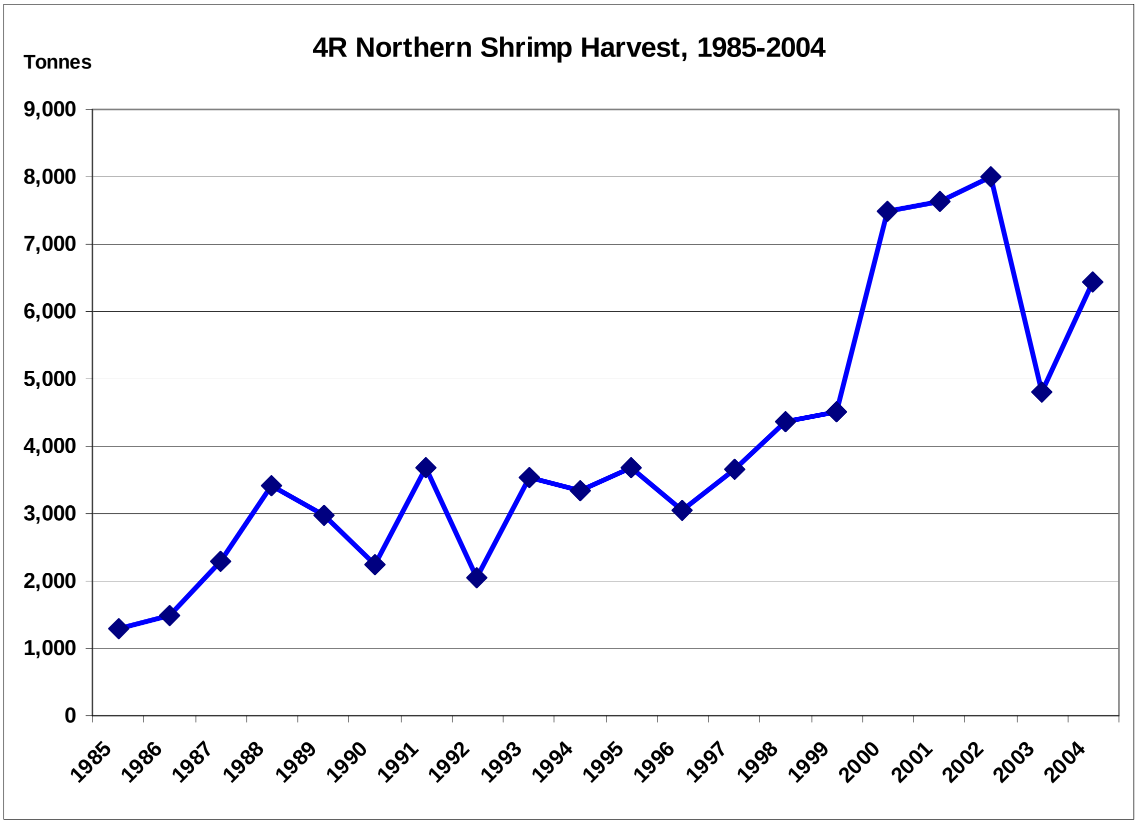


Figure 3.53. 4R Northern Shrimp Harvest, 1985-2004.

As Figure 3.54 illustrates, the great majority of the catch is typically taken between May and July, though the fishery is open from April 1 to December 31.

The gear used to harvest the shrimp is a specially designed shrimp trawl.

As Figures 3.55 to 3.57 indicate, the location of the shrimp fishery is highly consistent from year to year. Effort is focused on the deeper waters (and “holes”) of the Gulf, typically in depths greater than 200 m.

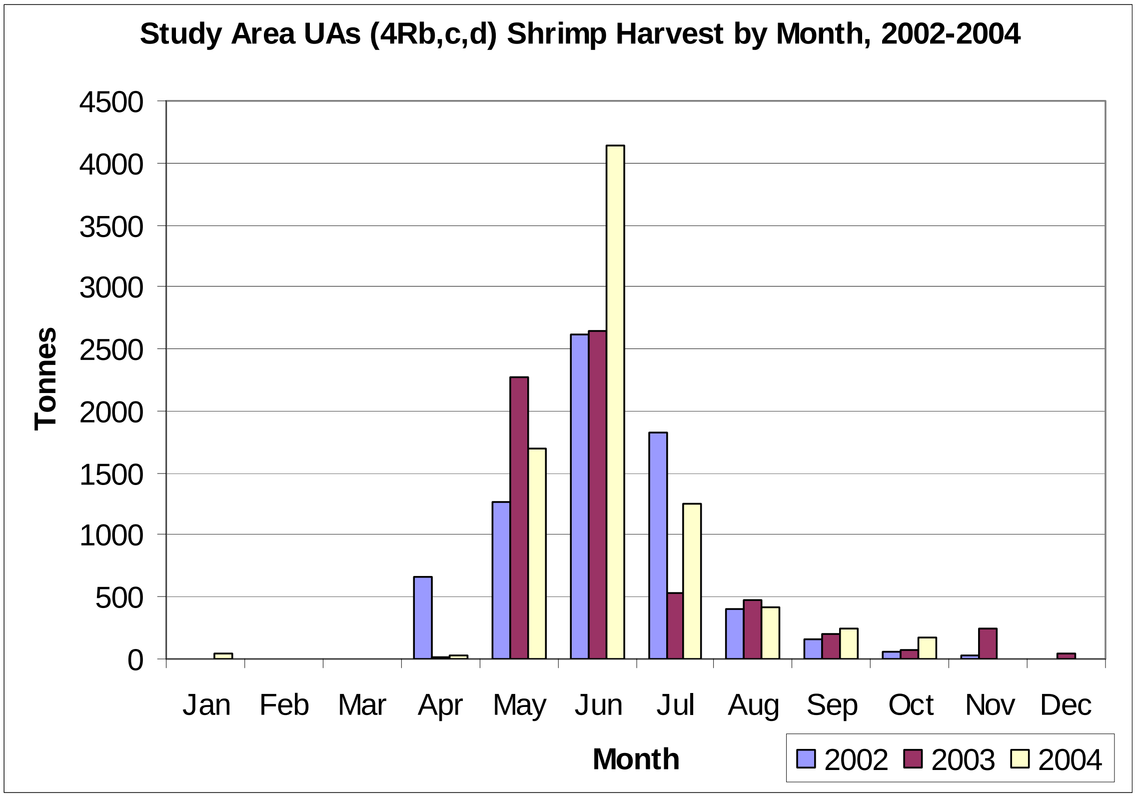


Figure 3.54. The 4Rbcd Northern Shrimp Harvest by Month, 2002, 2003 and 2004.

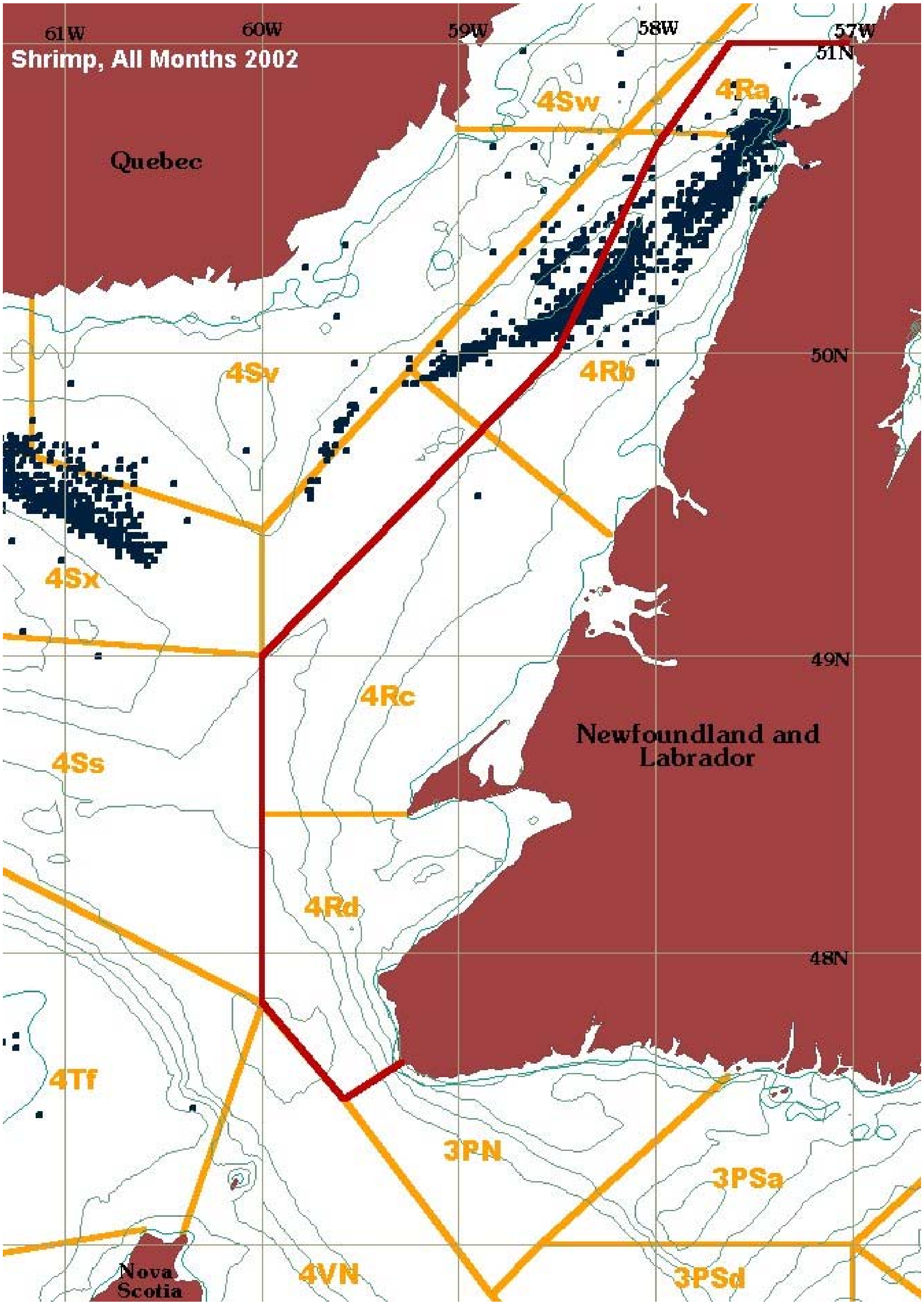


Figure 3.55. Harvesting Locations of Northern Shrimp, All Months 2002.

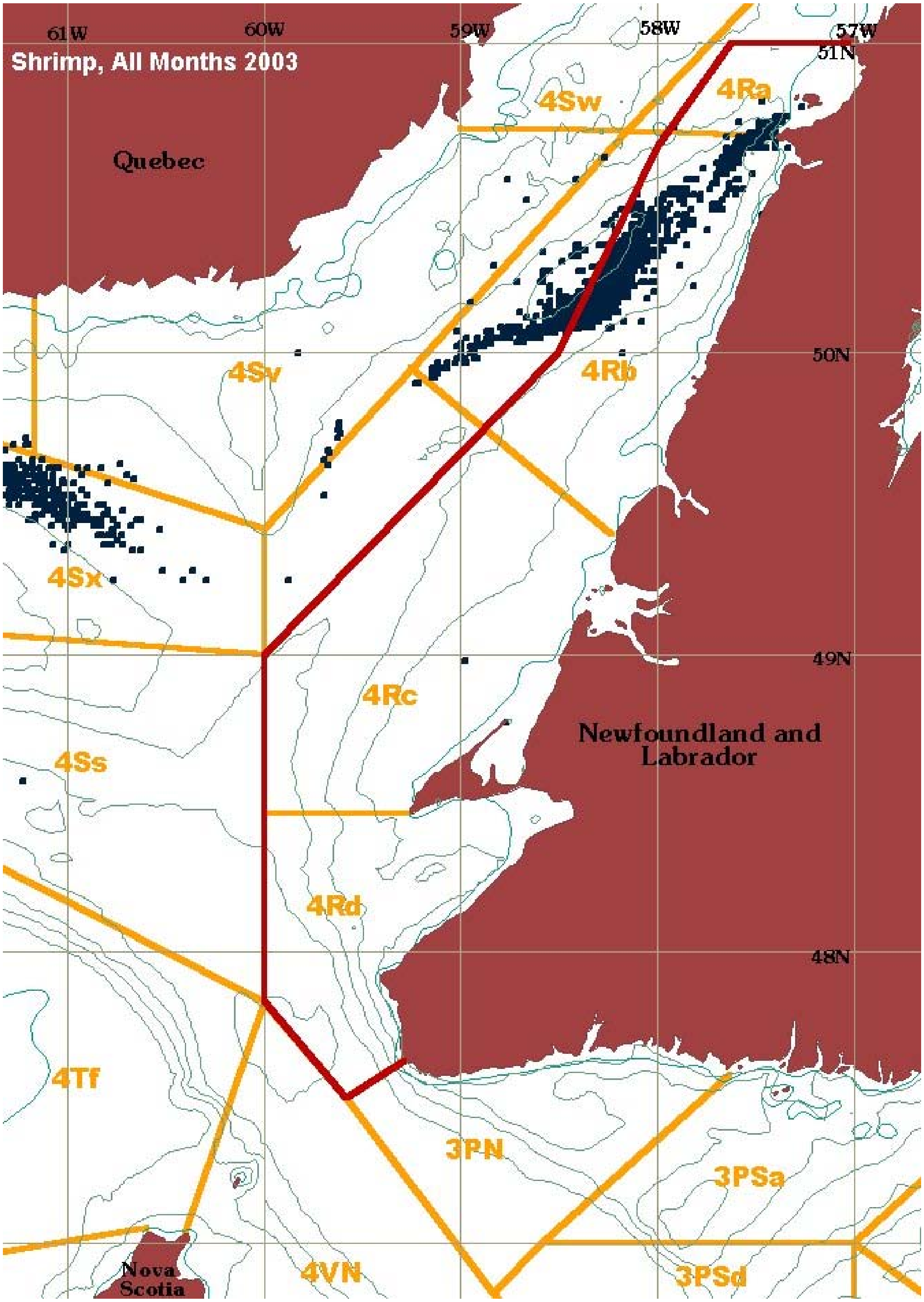


Figure 3.56. Harvesting Locations of Northern Shrimp, All Months 2003.

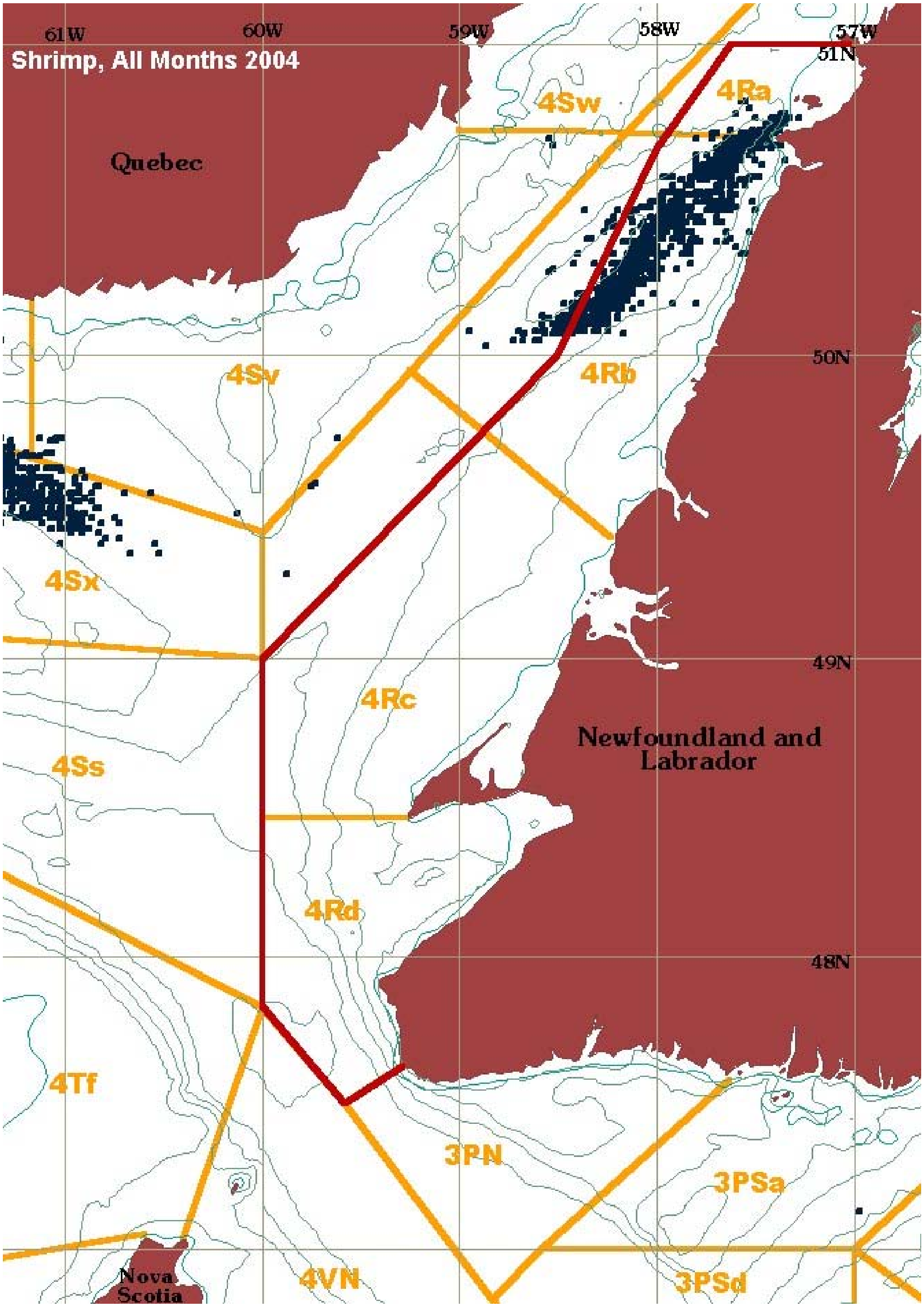


Figure 3.57. Harvesting Locations of Northern Shrimp, All Months 2004.

Snow Crab

Similar to the shrimp fishery, snow crab has increased dramatically in the area over the past two decades, and has become a very important high-value fishery, taking the place of groundfish for many local fishers (Figure 3.58). As has been the case for shrimp, the snow crab fishery has experienced a decline in recent years (since 2000), following a very rapid rise after the groundfish closures. Between 2002 and 2003 there was a significant reduction in the Area 12 (Figure 3.59) quotas, and smaller reductions since then.

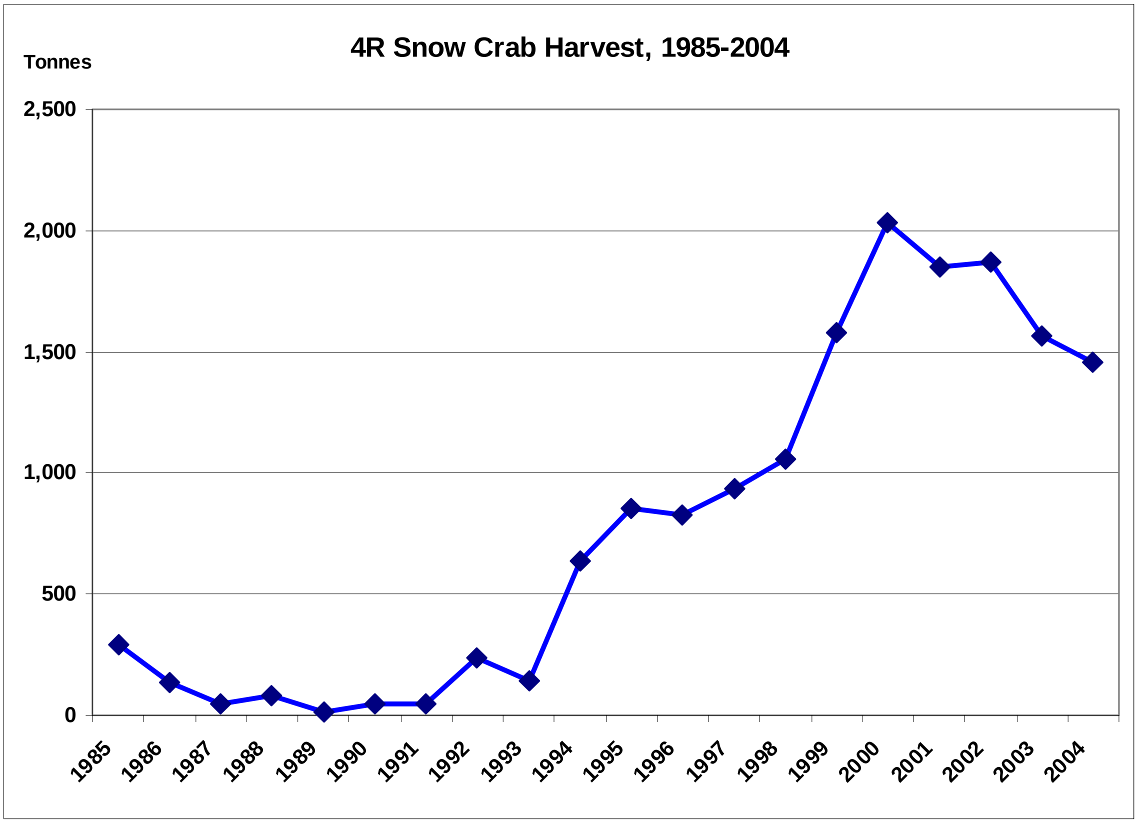


Figure 3.58. The 4R Snow Crab Harvest, 1985-2004.

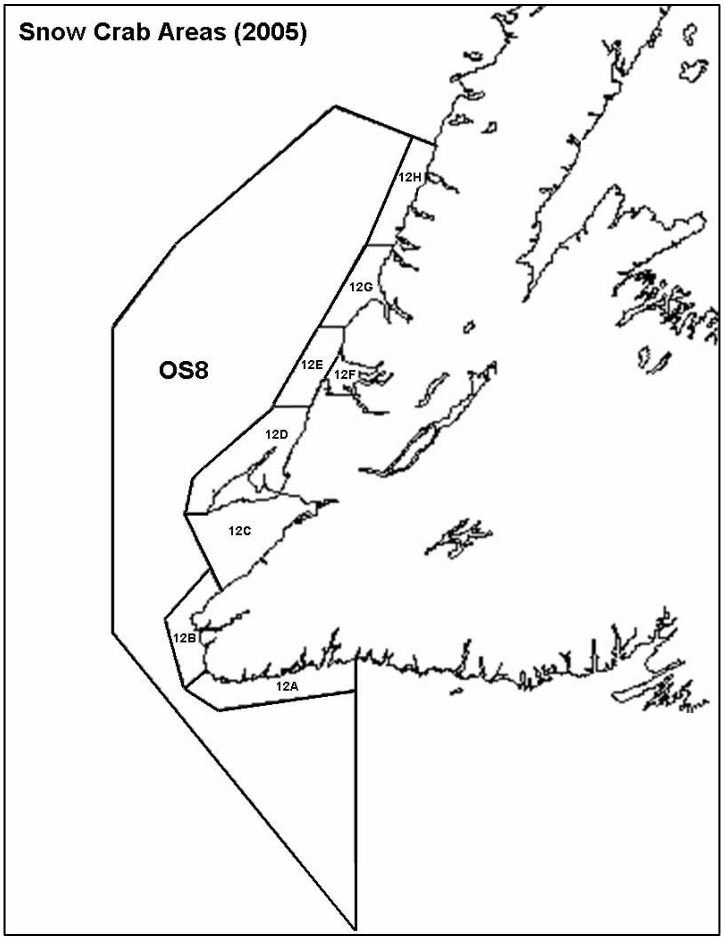


Figure 3.59. West Coast Crab Fishing Areas (Zone 12/Offshore 8).

Figure 3.60 shows the timing of the snow crab harvest in the area. It occurs throughout the spring and summer, though is most focused in the spring months. Closing dates can vary, depending on resource conditions (e.g., occurrence of “soft shell”, and quotas). In 2004 the Area 12 fishery continued until mid-August, but closed mid-July in 2005.

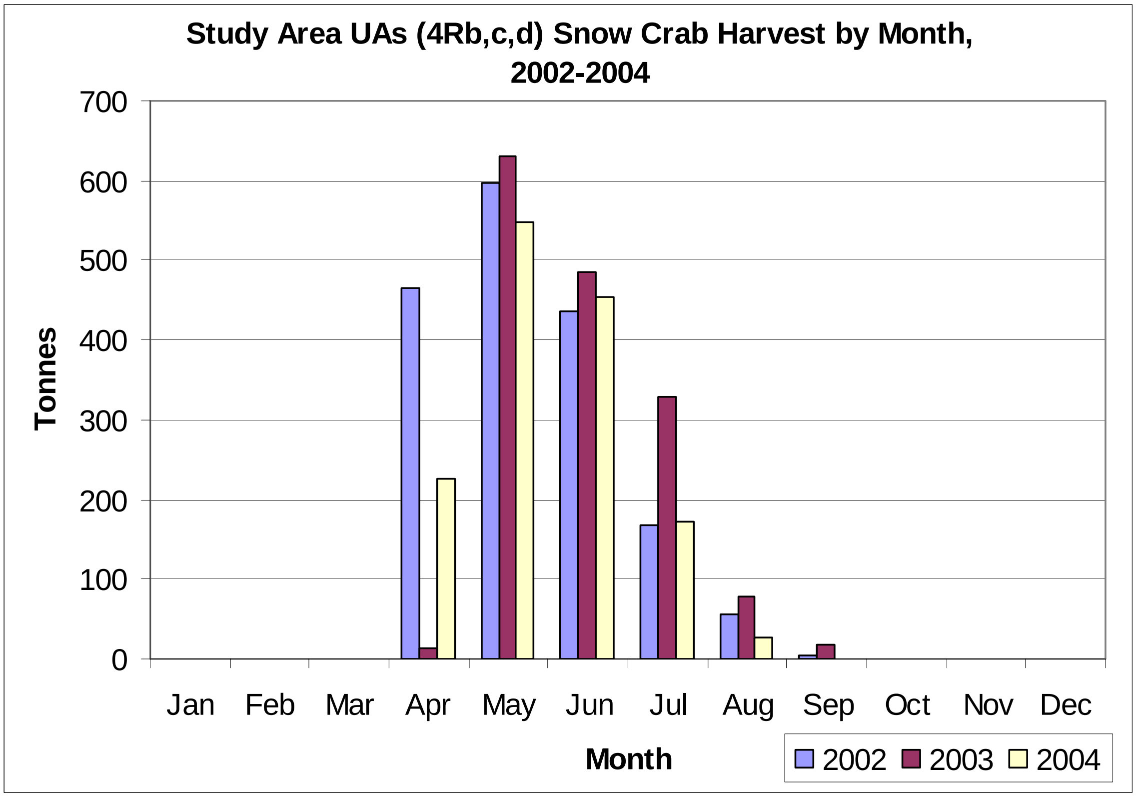


Figure 3.60. The 4Rbcd Snow Crab Harvest by Month, 2002, 2003 and 2004.

The following maps (Figures 3.61 to 3.63) show the recorded harvesting locations of the georeferenced portion of the snow crab harvest for 2002, 2003 and 2004. As with shrimp, snow crab harvest locations were relatively consistent between 2002 and 2004. However, if one considers the distribution of harvesting locations since 1999, there has been a progressively increasing concentration of effort in the southern and inshore regions of the Study Area, particularly in the vicinities of Bay of Islands and Bonne Bay.

Snow crab is harvested using bottom set crab pots, marked at the surface with buoys and often highflyers.

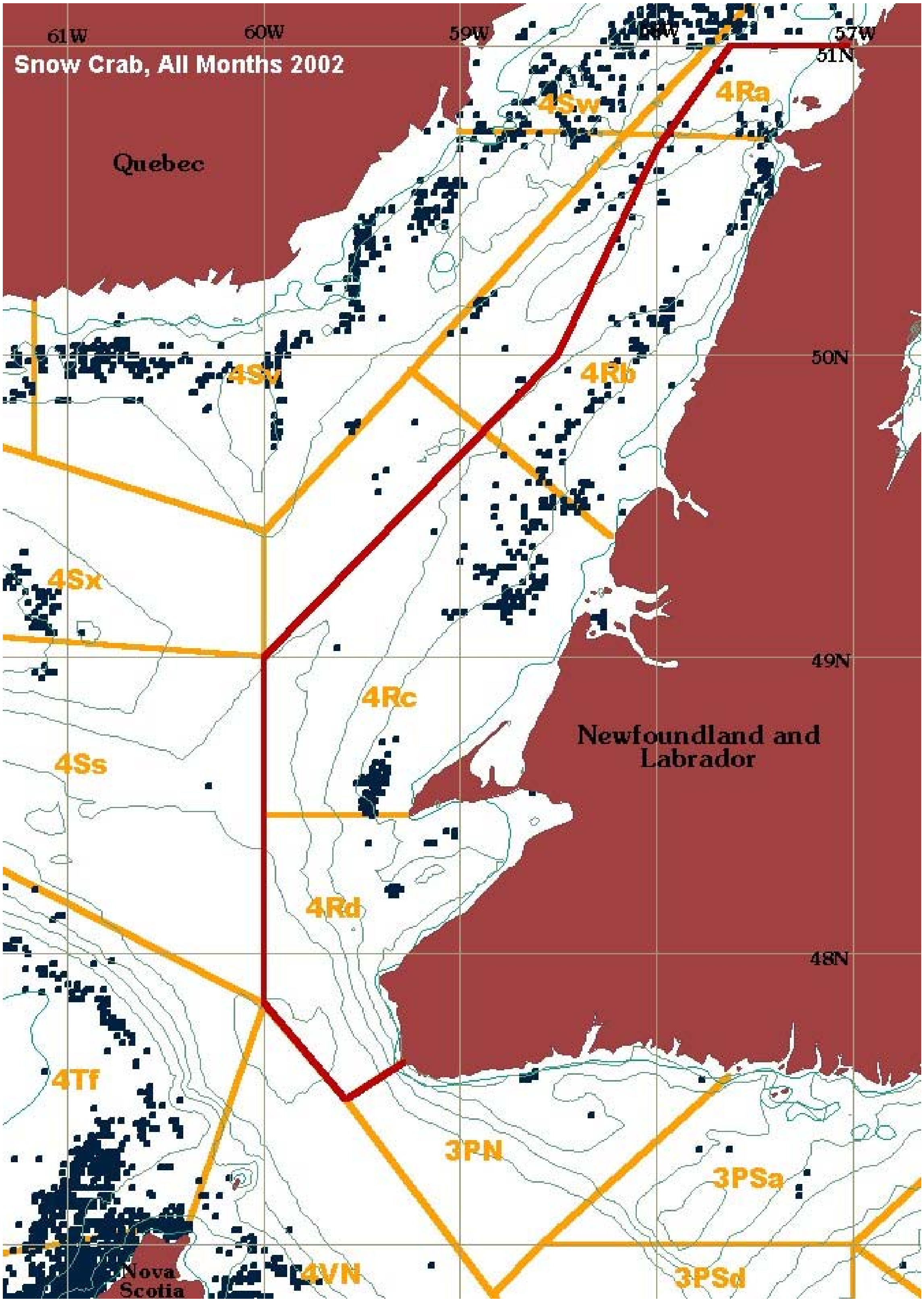


Figure 3.61. Harvesting Locations of Snow Crab, All Months 2002.

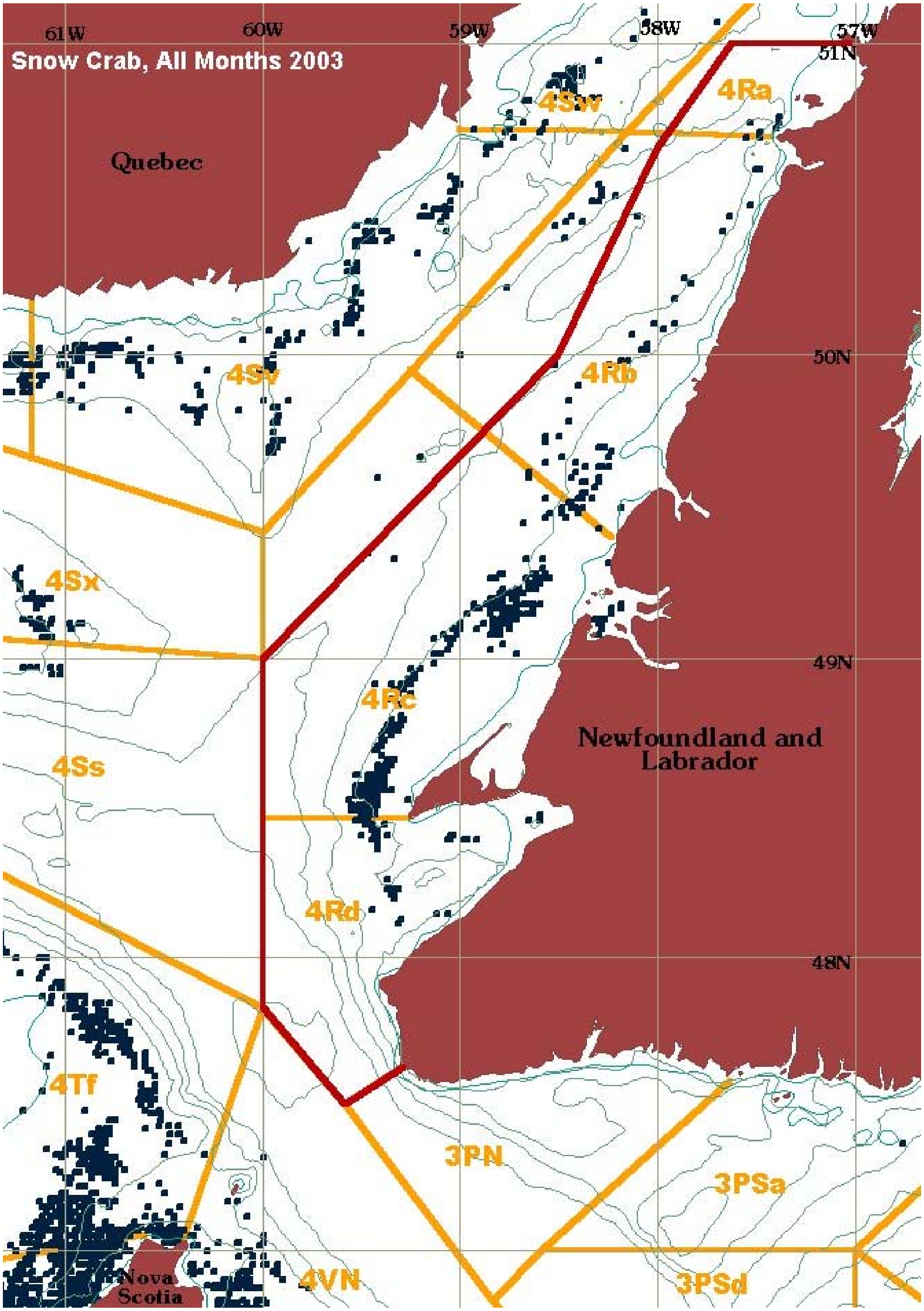


Figure 3.62. Harvesting Locations of Snow Crab , All Months 2003.

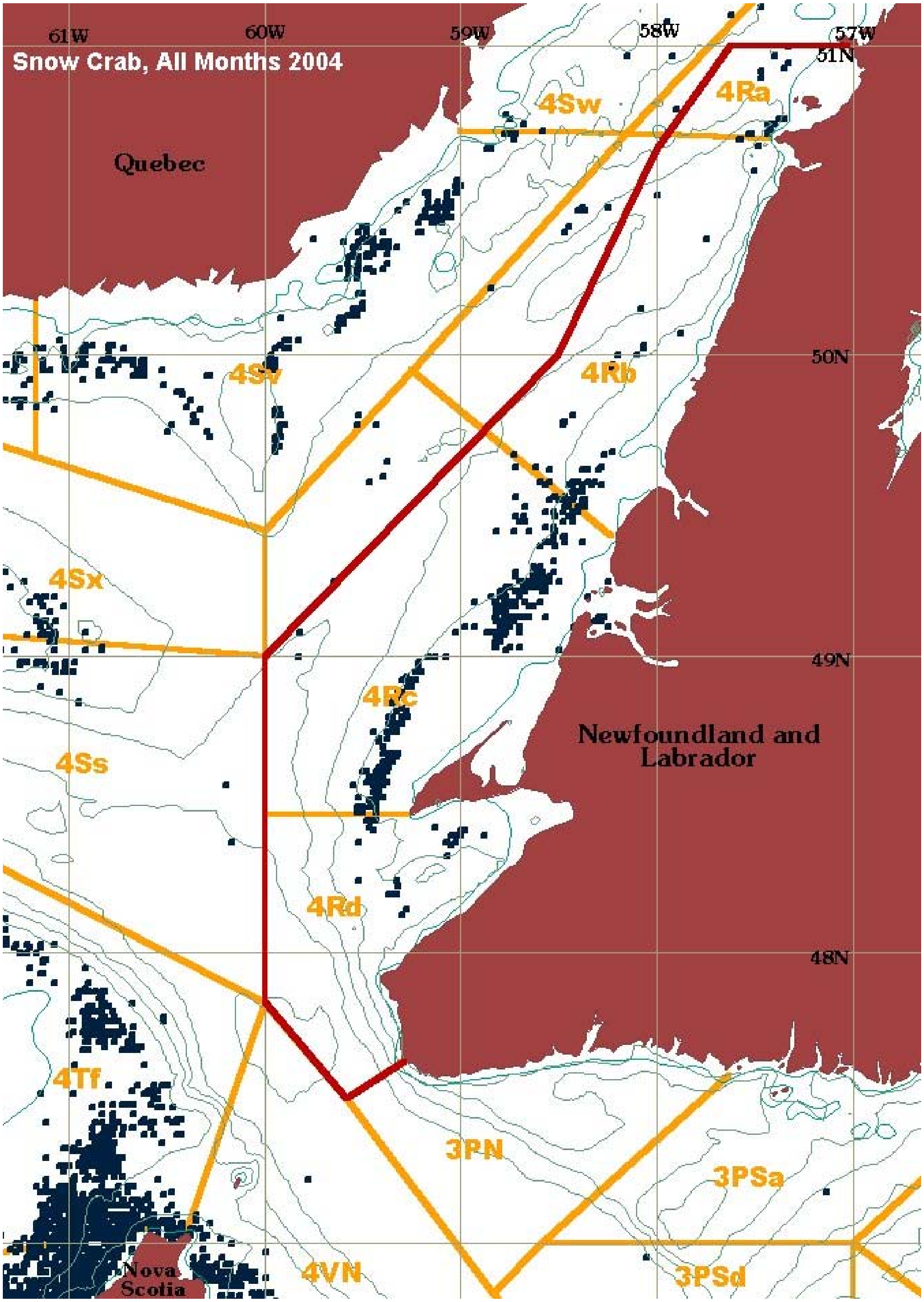


Figure 3.63. Harvesting Locations of Snow crab, All Months 2004.

3.4.4.6 Planning Implications Regarding the Commercial Fishery

The Study Area fisheries are conducted primarily in the May – November period, owing in large part to ice and weather conditions. This is also when offshore exploration is likely to be active for the same reasons. As a consequence, there is very likely to be temporal overlap between exploration activities and commercial fisheries. Depending on locations chosen by the petroleum industry, there may also be spatial overlap.

While exploration drilling activities would be site-specific and thus affect a very small geographical area (except in the event of an accident), seismic surveys (particularly 2-D surveys) typically range over a relatively broad area, and thus have the greater potential for interference with concurrent fisheries. The project-specific EAs will need to consider this potential depending on the locations of specific project activities.

Physical impacts on eggs, larvae and juveniles, potential scaring of fish (preventing them from being harvested, diverting migrations, interrupting spawning behaviour) and physical interference with harvesting (gear conflicts, particularly with fixed gear, which might become entangled with seismic streamers) are of concern to fish harvesters, as they might affect their fisheries in both the short and longer term.

The implications of potential impacts of exploration and production activities on the commercial fishery as well as the mitigations typically employed in Atlantic Canada and elsewhere to avoid or mitigate interference with active fishing are discussed in the relevant sub-sections of Section 4.0.

3.4.5 Aquaculture

Aquaculture activity in the Western Newfoundland and Labrador Offshore Area Study Area is limited compared to the rest of the Gulf of St. Lawrence. Less than 1% of Newfoundland and Labrador's aquaculture production occurs in the Gulf of St. Lawrence. According to Alexander et al. (2005), there were seven shellfish and ten finfish aquaculture operations along the west coast of Newfoundland in 2003, located between Robinsons on the southwest coast and Pistolet Bay on the Northern Peninsula (Table 3.9; Figure 3.64). Of these seventeen sites, four occur outside of the Study Area. Of the thirteen aquaculture sites that occur within the Study Area, five shellfish (six blue mussel and one sea scallop) and five Atlantic cod grow-out sites are located in the marine system. The remaining three finfish sites (two Atlantic salmon/rainbow trout and one eel) are land-based. All thirteen aquaculture sites occur in either Unit Area 4Rb or 4Rc.

Table 3.9. Marine-based Aquaculture Sites Occurring within the Study Area.

Location	Species	Number of Sites
Port Saunders (Keppel Harbour)	Atlantic cod	1
Port Saunders (Northeast side of Keppel Island)	Atlantic cod	1
Bonne Bay (Stores Cove)	Atlantic cod	1
Bonne Bay (Gadd's Harbour)	Atlantic cod	1
Bonne Bay (Rocky Harbour)	Atlantic cod	1
Bay of Islands (Outer Goose Arm)	Blue mussels	1
Bay of Islands (Goose Arm)	Blue mussels	1
Port au Port Peninsula (Piccadilly Bay)	Blue mussels	2
Port au Port Peninsula (Piccadilly Bay)	Sea scallop	1

Source: Alexander et al. 2005.

Following a four-year Atlantic cod moratorium (1993-1996) in the Gulf of St. Lawrence, commercial fishers were permitted to fish cod on a limited basis. Fishers on the west coast of Newfoundland began to hold and feed cod in grow-out traps for a period of a few months, and subsequently harvest them during the fall and early winter when prices tend to be higher. Blue mussels and sea scallops are grown in suspension in Newfoundland and Labrador as opposed to being grown on the ocean bottom (Alexander et al. 2005)

Location and type of licensed aquaculture activity in the Study Area, as well as production and value data, are available at the following address for AquaGIS on the Government of Newfoundland and Labrador website: www.aquagis.com (Alexander et al. 2005).

3.4.6 Planning Implications for Fish and Fisheries

Several sensitive areas directly associated with fish and invertebrates occur within the Study Area. These include The Hole (off Port au Choix, straddling boundary between 4Ra and 4Rb) which appears to be a steep slope area of high productivity. Some fishers who were consulted claimed that high biological activity continued year-round at The Hole. The nearshore area (relatively steep slope) immediately south of Port au Choix was also identified as an area of high biological activity. Other areas highlighted by fishers included Bonne Bay, the Bay of Islands area (lobster nursery), Port au Port Bay (lobster spawning), cod spawning area (Cape St. George Spawning Area) off Cape St. George, Port au Port Peninsula, and herring spawning within St. George's Bay. These examples represent essentially the whole of the nearshore within the Study Area. Specific mitigative measures would likely be established during site-specific EAs.

3.4.7 Data Gaps for Fish and Fisheries

The distribution of invertebrate and fish eggs and larvae is poorly understood in the Study Area. Specific areas have been identified as spawning areas for various species but little information related to the passive movements of these ichthyoplankton exists.

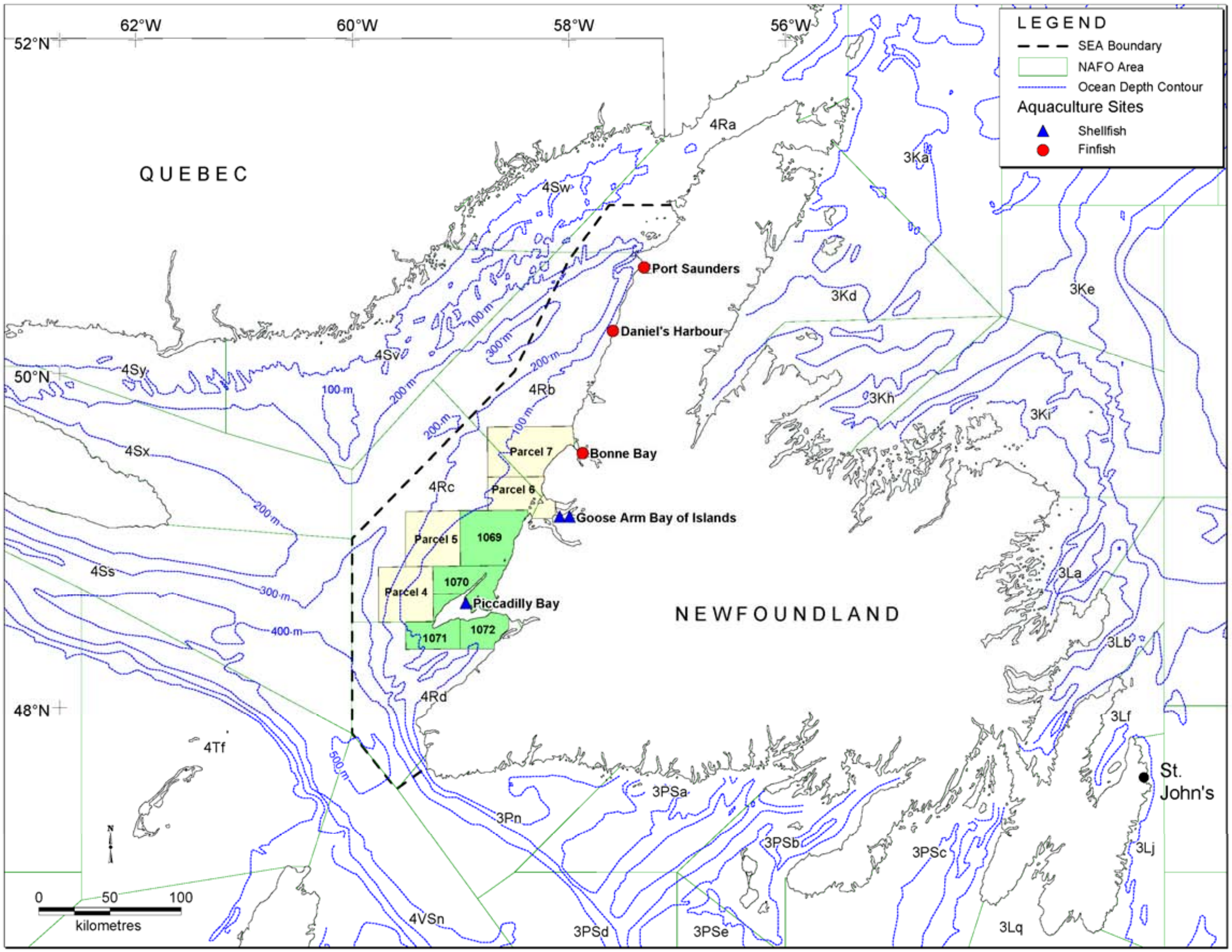


Figure 3.64. Locations of Recent Aquaculture Activity within the Study Area.

There are still considerable data gaps related to the movements of fish within the Study Area. Most of what is known comes from commercial fishery data. A telemetry study is presently being conducted off the southwest coast of Newfoundland (J. Spingle, FFAW, pers. comm.). The study will provide information on the movement of cod across the 4Rd-3Pn boundary, and the 3Pn-3Ps boundary.

3.5 Marine-associated Birds

Marine-associated birds are considered in three categories: (1) seabirds, (2) coastal waterfowl, and (3) shorebirds.

3.5.1 Seabirds

The marine coast and waters of western Newfoundland have lower abundances of seabirds than other coastal areas of Newfoundland (Lock et al. 1994) likely because they are less influenced by the major oceanic currents. This also may be due to a lack of breeding habitat along the west coast and the lower productivity of the adjacent waters compared to the east coast (Lock et al. 1994). Nevertheless the general area has received relatively little survey coverage and numerous oversights are apparent, such as the awareness of unique migratory bird concentrations at Flat Bay Islands (UA 4Rd). Seabirds in the area include shearwaters, fulmars, petrels, jaegars, skuas, phalaropes, gannets, cormorants, alcids, kittiwakes and gulls. Some relatively large seabird colonies occur along the Quebec North Shore, for example Bonaventure Island (Rail and Chapdelaine 2002), and notably, Northern Gannets, Razorbills, Common Murres, and lesser numbers of Atlantic Puffins that breed along the Quebec North Shore occur pelagically in the Study Area. Only the large gulls and terns and gannets are reported common in the Study Area. Foraging strategies of these seabird groups vary from plunge diving (gannets) and pursuit diving (alcids), through surface feeding (phalaropes) to kleptoparasitism (jaegars and skuas) (Table 3.10).

The period of peak vulnerability to perturbations (in terms of concentrations) of seabirds in the Study Area is between January and March. The highest abundance of seabirds during this period occurs at the southern part of the Study Area (i.e., UA 4Rcd), particularly in the vicinity of Parcels 5 and 6. Seabirds are least abundant in the Study Area during the October to December. Greater than 10 birds per km are vulnerable to perturbations in coastal areas adjacent to the southwest coast of Newfoundland from January to September and less than 10 birds per km are vulnerable from October to December (Lock et al. 1994).

3.5.1.1 Nesting Populations and Breeding Biology

Common Terns, Arctic Terns, Great Black-backed Gulls, Herring Gulls, Ring-billed Gulls and Black-legged Kittiwakes nest in small colonies scattered along the coast (Table 3.10; Figure 3.65). Black-headed Gulls nest at Stephenville Crossing (discovered in 1977, Lock et al. 1994) and intermittently at Sandy Point (UA 4Rd). There are a few pairs also nesting in the area of Plum Point (UA 4Ra). The largest colony in Newfoundland is located at Ladle Cove Island off the Northeast Coast.

Table 3.10. General Distributions, Seasonal Abundances, and Foraging Strategies of Seabirds that Occur in the Study Area.

Common Name	Scientific Name	General Area of Distribution	Abundance Summer (June-Sept)	Autumn (Oct-Dec)	Winter (Jan-Mar)	Spring (Apr-May)	Foraging Strategy
Fulmars and Shearwaters							
Northern Fulmar	*Fulmarus glacialis*	Offshore, coastal	Uncommon	Uncommon	Rare	Uncommon	SF
Greater Shearwater	*Puffinus gravis*	Offshore, coastal	Uncommon	Uncommon	Absent	Scarce	PP
Sooty Shearwater	*Puffinus griseus*	Offshore, coastal	Scarce	Scarce	Absent	Rare	PP
Manx Shearwater	*Puffinus puffinus*	Offshore, coastal	Rare	Rare	Absent	Rare	PP
Jaegers and Skuas							
Pomarine Jaeger	*Stercorarius pomarinus*	Offshore	Scarce	Scarce	Absent	Scarce	K
Parasitic Jaeger	*Stercorarius parasiticus*	Offshore	Scarce	Scarce	Absent	Scarce	K
Long-tailed Jaeger	*Stercorarius longicaudus*	Offshore	Rare	Rare	Absent	Rare	K
Great Skua	*Catharacta skua*	Offshore	Rare	Rare	Absent	Absent	K
Gannets and Cormorants							
Northern Gannet	*Sula bassanus*	Offshore, coastal	Common	Uncommon	Absent	Uncommon	DP
Double-crested Cormorant	*Phalacrocorax auritus**	Coastal	Common	Common	Absent	Common	PD
Great Cormorant	*Phalacrocorax carbo**	Coastal	Common	Common	Uncommon	Common	PD
Storm Petrels							
Wilson's Storm-Petrel	*Oceanites oceanicus*	Offshore	Scarce	Absent	Absent	Absent	SF
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	Offshore	Uncommon	Uncommon	Absent	Uncommon	SF
Red Pharalope	*Phalaropus fulicaria*	Offshore	Scarce	Scarce	Absent	Scarce	SF
Red-necked Pharalope	*Phalaropus lobatus*	Offshore	Scarce	Scarce	Absent	Scarce	SF
Gulls and Kittiwakes							
Herring Gull	*Larus argentatus**	Coastal, offshore	Common	Common	Uncommon	Common	SF
Iceland Gull	*Larus glaucoides*	Coastal, offshore	Absent	Common	Common	Common	SF
Glaucous Gull	*Larus hyperboreus*	Coastal, offshore	Absent	Uncommon	Uncommon	Uncommon	SF
Great Black-backed Gull	*Larus marinus**	Coastal, offshore	Common	Common	Common	Common	SF
Sabine's Gull	*Xema sabini*	Offshore	Absent	Rare	Absent	Absent	SF
Ivory Gull	*Pagophila eburnea*	Offshore	Absent	Rare	Rare	Rare	SF
Black-legged Kittiwake	*Rissa tridactyla **	Offshore, coastal	Uncommon	Uncommon	Scarce	Uncommon	SF
Common Tern	*Sterna hirundo**	Coastal, offshore	Common	Scarce	Absent	Common	SF, PP
Arctic Tern	*Sterna paradisaea**	Coastal, offshore	Common	Scarce	Absent	Common	SF, PP
Alcids (Auks)							
Dovekie	*Alle alle*	Offshore, coastal	Absent	Uncommon	Uncommon	Uncommon	PD
Common Murre	*Uria aalge*	Offshore, coastal	Uncommon	Uncommon	Rare	Uncommon	PD
Thick-billed Murre	*Uria lomvia*	Offshore, coastal	Scarce	Uncommon	Uncommon	Uncommon	PD
Razorbill	*Alca torda*	Offshore, coastal	Scarce	Scarce	Rare	Scarce	PD
Black Guillemot	*Cepphus grille **	Coastal	Uncommon	Uncommon	Scarce	Scarce	PD
Atlantic Puffin	*Fratercula arctica **	Offshore, coastal	Scarce	Scarce	Absent	Scarce	PD

Source: Modified from Husky (2000). *'*' indicates species that are known to nest along the western coast of Newfoundland*

'SF' : surface feeding; 'PP' : pursuit plunging; 'DP' : deep plunging; 'K' : kleptoparasitism; 'PD' : pursuit diving

In cases with two 'general area of distribution' designations, the species occurs primarily in the first area and secondarily in the second.

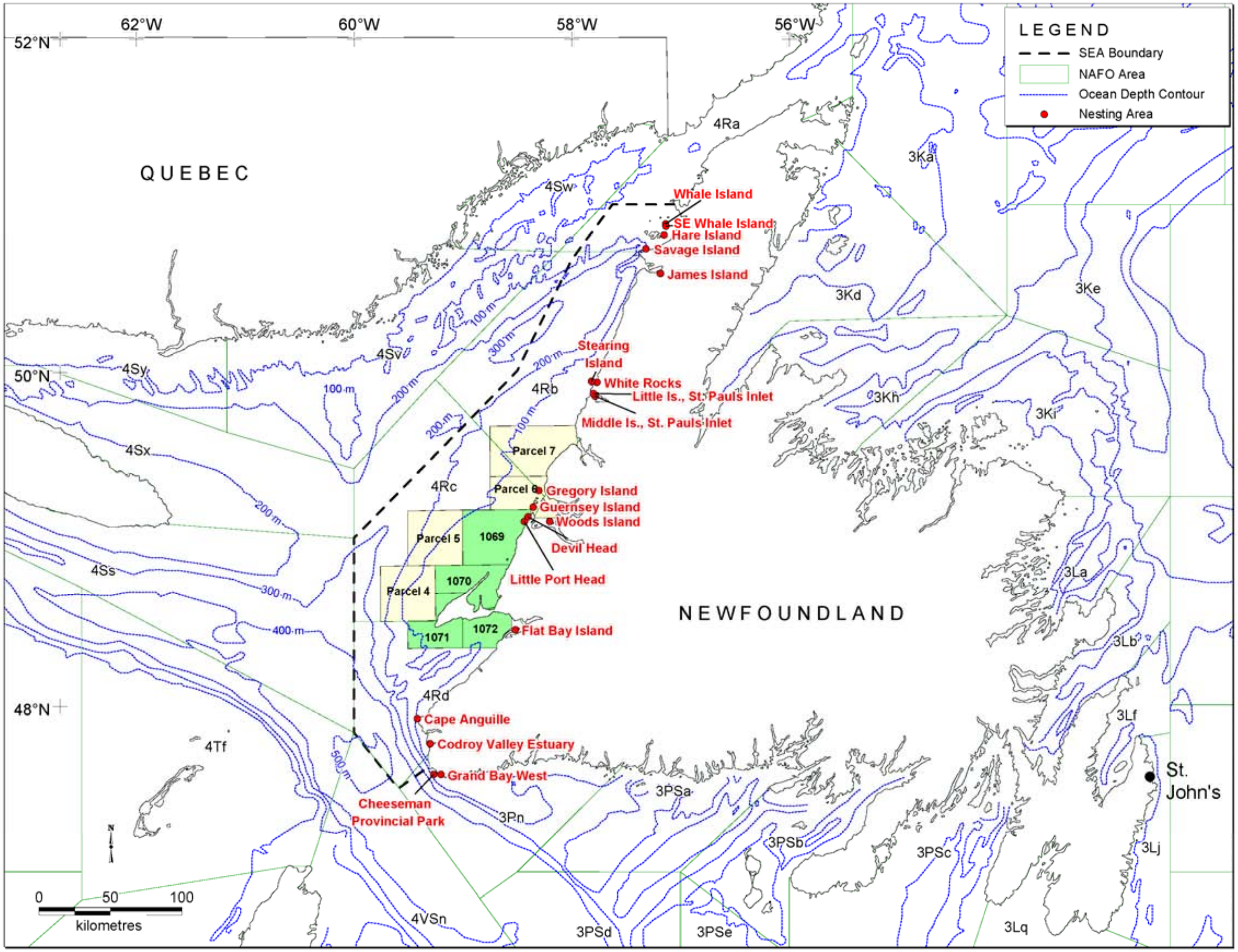


Figure 3.65. Areas used by Nesting Seabirds within the Study Area.

Caspian Terns, currently listed as *species of concern* by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), have been observed in the Study Area and nest in incidental numbers, e.g., Plum Point and likely Stephenville Crossing and Robinsons-Jeffreys area. This species frequently nests in single pairs and therefore it can be difficult to confirm nesting. At Stephenville Crossing, groups of 20 or more are regularly observed during migration (P. Linegar, pers. comm.).

Aerial surveys in mid June 2001 and 2002 conducted by the Canadian Wildlife Service (CWS) indicated relatively larger concentrations of terns (total individuals) at Bay of Islands in UA 4Rc (off McIvers - 425), St. John Bay in UA 4Ra (Horn Bay – 1,000) and St. Paul's Inlet in UA 4Rb (mostly Little Island, also Middle Island and Western Island – 2,300). Black-legged Kittiwakes nest on the Port au Port Peninsula in UA 4Rd (Cape St. George –1 to 2,000) (Appendix 2). Lock et al. 1994 did not identify any colonies in the Study Area that were vulnerable to oil pollution but this reflects the lack of information for this geographic area. There are high reported frequencies of oil spills in the Stephenville – Stephenville Crossing area, i.e., >100 and, the unique concentrations of migratory birds in that area, for example Flat Bay Islands and Port au Port Peninsula would be vulnerable to toxic spills.

There are small colonies of Double-crested Cormorant and Great Cormorant near Cape Anguille, Bay of Islands (UA 4Rc) and the northern portion of Gros Morne National Park (UA 4Rb). Other seabird species nesting along this coast include a few small colonies of Black Guillemots (Lock et al. 1994) and Atlantic Puffins (Cairns et al. 1989). Several islands in the Bay of Islands are used from April to October for egg laying and brood rearing by these species. Nesting colonies in Bay of Islands are distributed across NAFO Unit Areas 4Rabcd (Table 3.11, Figure 3.65).

Seabirds nesting near the Study Area are long-lived with low rates of population growth (Table 3.12). Egg-laying commences in mid to late May and into June, and most species are fledged by July – August with Northern Gannets fledging into October and November (Table 3.13). Most nesting is on coastal islands, and Terns and gulls also nest at many of the sandy beaches, and peninsulas in the Study Area (e.g., Flat Bay - Sandy Point).

3.5.1.2 Prey and Foraging Habits

Seabirds in the Study Area feed on a variety of prey species including capelin, sandlance, copepods, amphipods and short-finned squid. Some species such as terns and phalaropes specialize in foraging in shallow depths at the surface, while species such as alcids and loons may dive to great depths (20 to 50m). Fish, crustaceans, cephalopods, and offal comprise the main prey, and foraging strategies of seabirds vary by species (Table 3.14).

Table 3.11. Estimated Numbers of Pairs of Colonial, Marine-associated Birds and Bird Species of Conservation Concern Nesting in Coastal Western Newfoundland in the Study Area.

	Sites in or near Study Area		Nesting Areas and Important Bird Areas																	
Species	# of Nesting Sites	# of Nesting Pairs	Grand Bay West to Cheese-man Prov. Pk.[1]	Codroy Valley Estuary[1]	Cape Anguille	Flat Bay Island	Little Port Head	Devil Head	Woods Is. & unnamed is.	Guernsey Is.	Gregory Is.	Middle Is., St. Paul's Inlet	Little Is., St. Paul's Inlet	White Rocks & Stear-ing Is.[2]	James Is.	Savage Is.	Hare Is.	SE Whale Is.	Whale Is.
Cormorants																			
Great Cormorant	2	39			20					19									
Double-crested Cormorant	2	2			1				1										
Shorebirds																			
Piping Plover[3]	3	12	8	1		3													
Gulls, Kittiwakes and Terns																			
Black-headed Gull[4]	1	3				3[7]													
Ring-billed Gull	3	181				100								6					75
Herring Gull	5	650				10	250		200	165					25				
Great Black-backed Gull	3	235				100			60						75				
Black-legged Kittiwake	2	800						300			500								
Arctic Tern[5]	4	435				100[6]						15[6]	20[6]					300	
Common Tern[5]	7	795		25		200			30[6]			135[6]	180[6]			25			
Unidentified Tern[5]	1	200												200[6]	200[6]				
Alcids (Auks)																			
Black Guillemot	2	20							10					10					
Atlantic Puffin	1	10															10		
TOTALS	33	3380	8	26	20	516	250	300	300	184	500	150	200	216	300	25	10	300	75

Source: Cairns et al. 1989, Lock et al. 1994, except where noted.

[1] Important Bird Area.

[2] Gros Morne National Park Important Bird Area.

[3] Endangered, *Species at Risk Act*, Schedule 1.

[4] Rare.

[5] Provincially Sensitive.

[6] P. Thomas, Canadian Wildlife Service, unpublished.

[7] Currently relocated to Stephenville Crossing

Table 3.12. Marine-associated Birds Nesting in or near the Study Area and Demographic Parameters Reported for Other Sites.

Species	Mean Adult Survival Rate	Age of First Breeding (yr)	Clutch Size	Breeding Success [1]	Sources
Seabirds					
Northern Gannet	0.95	4-7	1	0.81	Nelson (1966), Montevecchi and Porter (1980)
Herring Gull	0.80-0.85	3-7	2-3	1.03-1.58	Pierotti and Good (1994), Haycock and Threlfall (1975), Kadlec (1976)
Great Black-backed Gull	-	4-5	3	0.50-2.11	Good (1998), Butler and Trivelpiece (1981)
Black-legged Kittiwake	0.81-0.86	3-7	2	0.54-0.58	Baird (1994), Maunder and Threlfall (1972
Common and Arctic Terns	0.86	2-4	1-3	0.59-0.77	Cullen (1956), Kirkham (1980)
Black Guillemot	0.77-0.89	2	1-2	0.12-0.78	Asbirk (1979), Cairns (1981)
Coastal Waterfowl					
Common Eider	0.90	2-5	3-5	0.5-0.93	Goudie et al. (2000)

[1] Numbers of chicks fledged per breeding pair of adults.

Table 3.13. Marine-associated Birds Nesting, Hatching and Fledging in or near the Study Area, and Demographic Parameters Reported for Other Sites.

Species	Egg Laying	Incubation	Hatching	Nesting	Fledging	Comments
Seabirds						
Northern Gannet[1]	mid - late May[(1,2)]	42 days [(1,2)]	late June to early July	91 days[(1,2)]	Late Sept. to early Oct.[(1,3)]	NF breeding population represents 17% of the eastern Canadian population. NF's population is stable and increasing
Herring Gull[2]; Great Black-backed Gull[3]	mid - late May[(4,5,6)]	26-29days [4,5,6)]	mid-late June	45 days[(12)] 50-55 days [(4,6)]	late July - early August	Nest singly or in colonies at many locations along NF East Coast[(7)]. Study area breeding population is only a small proportion of total Canadian[(8)] population.
Black-legged Kittiwake[4]	late May - early June[(9)]	27 days[(9)]	late June[(9)]	42 days[(9)]	early Aug.[(9)]	Three major colonies along Avalon Peninsula[(10)]. NF group represents approx. 33% total Canadian breeding population.
Common Tern[5]; Arctic Tern[6]	first half June[(11)]	22 days [(11)]	mid July	21 - 26 days[(11)]	late July-early Aug.[(11)]	Occur singly or in small colonies along the Avalon Peninsula[(10)]
Black Guillemot[7]	Mid May - early June[(12)]	28 - 33 days[(12)]	mid June - mid July[(12)]	34 -39 days[(12)]	early - late August[(12)]	No estimate of the number of breeding birds in the Study Area, but considered to be low[(8,13)].
Coastal Waterfowl						
Common Eider[8]	Early May -mid June	26 days	mid June - mid July	35 - 40 days	mid August – late September	Nest in high densities, sometimes in large colonies

[1]Mowbray (2002)
[2]Pierotti and Good (1994)
[3]Good (1998)
[4]Baird (1994)
[5]Nisbet (2002)
[6]Hatch (2002)
[7]Butler and Buckley (2002)
[(8)]Goudie et al. (2000)

[(1)] Kirkham (1980)
[(2)] Montevecchi and Porter (1980)
[(3)] Pitocchelli. et al. (1981)
[(4)] Haycock and Threlfall (1975)
[(5)] Pierotti (1982)
[(6)] Butler and Trivelpiece (1981)
[(7)] Erwin (1971)
[(8)] Nettleship (1980)
[(10)] Brown et al. (1975)
[(9)] Maunder and Threlfall (1972)
[(11)] Hawksley (1950)
[(12)] Cairns (1981)
[(13)] Nettleship (1972)

Table 3.14. Foraging Strategy and Types of Prey for Seabirds that Frequent the Study Area.

Species (Group)	Foraging Strategy	Prey	Source
Procellaridae			
Northern Fulmar	Surface feeding	Fish, cephalopods, crustaceans, offal	Brown (1970)
Greater Shearwater	Pursuit plunging	Capelin, squid, crustaceans, offal	Brown.et al. (1981)
Sooty Shearwater	Pursuit plunging	Capelin, squid, crustaceans, offal	Brown et al. (1981)
Storm-Petrels	Surface feeding	Myctophid fish, amphipods	Linton (1978)
Pelecaniformes			
Northern Gannet	Deep plunging	Mackerel, capelin, squid	Kirkham (1980)
Cormorants	Pursuit Diving	Mackerel, capelin, squid	Brown et al. (1981)
Charadriformes			
Phalaropes	Surface feeding	Copepods	Brown (1980)
Jaegers and skuas	Kleptoparasitism	Fish	Hoffman et al. (1981)
Herring Gull [1]	Surface feeding	Fish, crustaceans, cephalopods, offal	Threlfall (1968)
Iceland Gull	Surface feeding	Fish, crustaceans, cephalopods, offal	Cramp and Simmons (1977)
Glaucous Gull	Surface feeding	Fish, crustaceans, cephalopods, offal	Cramp and Simmons (1977)
Great Black-backed Gull [1]	Surface feeding	Fish, crustaceans, cephalopods, offal	Threlfall (1968)
Black-legged Kittiwake	Surface feeding	Fish, crustaceans, cephalopods, offal	Threlfall (1968)
Terns	Surface and pursuit plunging	Fish, crustaceans	Braune and Gaskin (1982)
Alcidae			
Dovekie	Pursuit diving	Amphipods, copepods	Bradstreet (1982a)
Common Murre	Pursuit diving	Fish, invertebrates	Bradstreet (1982b)
Thick-billed Murre	Pursuit diving	Fish, invertebrates	Tuck (1961)
Black Guillemot	Pursuit diving	Fish, invertebrates	Cairns (1981)
Razorbill	Pursuit diving	Fish, invertebrates	Bradstreet (1982b)
Atlantic Puffin	Pursuit diving	Fish, invertebrates	Bradstreet (1982b)

[1] These species feed on eggs and chicks of seabirds, and occasionally adults (Rodway et al. 1996; Stenhouse and Montevecchi 1999a).

Foraging strategies of seabirds affects their breeding success during periods of limited food availability (Bryant et al. 1999; Regehr and Rodway 1999). In 1992 and 1993, Black-legged Kittiwakes, Herring and Great Black-backed Gulls, had lower hatching, fledging and breeding success than in previous years, and this was attributed to reductions in food availability for seabirds in the Study Area because the inshore spawning migration of capelin (a major prey species) was delayed by one month in the Northwest Atlantic. As well, the ground fisheries moratorium eliminated the production of fish offal, an important alternative food source for large gulls and kittiwakes. Other species, such as Atlantic Puffins and Common Murres were not negatively affected, and offshore surface feeders such as the Leach's Storm Petrel had high breeding success (Regehr and Rodway 1999). Depredation by large gull species on seabird adults, chicks and eggs increased in 1992 and 1993 (Rodway et al. 1996; Stenhouse and Montevecchi 1999b), and seabirds shifted their diets coinciding with changes in sea surface temperature on the Newfoundland Shelf (Montevecchi and Myers 1997). The significance of gull depredation on other seabirds and sea ducks is a matter of considerable debate as some researchers have demonstrated such mortality to be compensatory to starvation or mediated by human disturbance Swennen 1989, Goudie 1991a)

3.5.1.3 Geographic and Seasonal Distribution

During the nesting season, numbers of seabirds in the Study Area are greatest in the immediate vicinity of the larger nesting colonies (Lock et al. 1994). Most seabird species mature slowly and some do not begin breeding until four to five years of age (e.g. alcids), and the immature cohorts are present offshore and in adjacent waters. Sub-populations may mix at these times (e.g., individuals from colonies in Newfoundland with individuals from the Québec north shore), and species such as the large auks may aggregate in very large numbers. Some relatively large seabird colonies occur along the Québec North Shore (Rail and Chapdelaine 2002), and notably, Northern Gannets, Razorbills, Common Murres, and lesser numbers of Atlantic Puffins that breed in this political unit, occur in the Study Area.

Species such as Greater Shearwater, Sooty Shearwater and Wilson's Storm Petrel nest in the South Atlantic during the northern hemisphere winter and are present in waters of Newfoundland and Labrador during the summer (June to October). It is only a small proportion of the millions of these birds (especially Greater Shearwaters) that occur off the west coast of Newfoundland.

During the winter, Northern Fulmars, Glaucous Gulls, Black-legged Kittiwakes, Thick-billed Murres and Dovekies from breeding colonies in the Arctic spend the winter in offshore waters south of the ice edge (Lock et al.1994). The geographic and seasonal numbers of these seabirds varies (Figure 3.66). Further north, the Strait of Belle Isle (not in the Study Area) is an important migration route for some marine-associated birds, alcids and sea ducks in particular (Tuck 1967; B. Mactavish, LGL Limited, pers. comm.).

3.5.2 Coastal Waterfowl

The west coast of Newfoundland has not been systematically surveyed for coastal waterfowl. Lock et al. (1994) reported a small wintering population of Common Eiders, and these and scoters (notably Black Scoter) aggregate off the Port au Port Peninsula and possibly Cape Ray (UA 4Rd). Cairns et al. (1989) did not report any sites in the Study Area for nesting Common Eiders, and significant sites such as St. John Bay were also omitted in Lock et al. (1994). The Strait of Belle Isle was historically reported to be an important migration route for Common and King Eiders (Tuck 1967; B. Mactavish, pers. comm.). Some component of eiders migrating during fall-winter from breeding colonies in coastal Labrador and the eastern Canadian Arctic are thought to migrate through the Strait of Belle Isle, with some over-wintering along the Quebec North Shore and southwest coast of Newfoundland (Gillespie and Learning 1974; Goudie et al. 2000).

The islands of St. John Bay (immediately north of Port aux Choix in UA 4Ra) have hundreds of nesting Common Eiders; the archipelago is one of the larger sites in coastal Newfoundland (Goudie 1986) where current estimates are between 500 and 1000 nesting pairs (CWS, unpublished). Smaller numbers of eiders nest in St. Margaret's Bay in UA 4Ra (~200 pairs), on Stearin Island in UA 4Rb (<100 pairs), and in Bay of Islands (<50 pairs) (CWS, unpublished). Eider broods frequent the coastline of the Strait Shore from Eddies Cove West south to Hawkes Bay (UAs 4Rab) during late summer (Figure 3.67). Tables 3.12 and 3.13 present some nesting, hatching and fledging data relevant to the Common Eider.

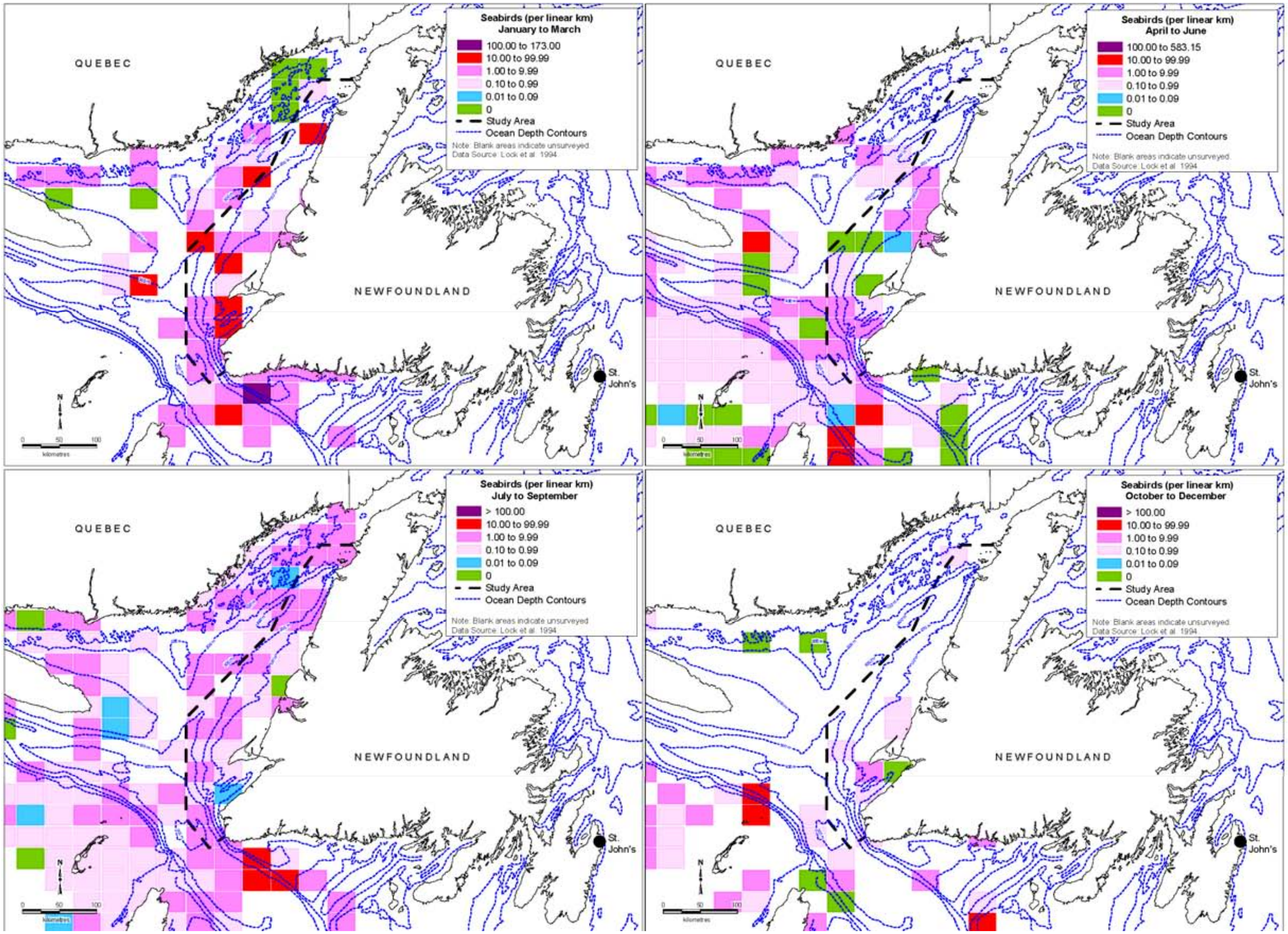
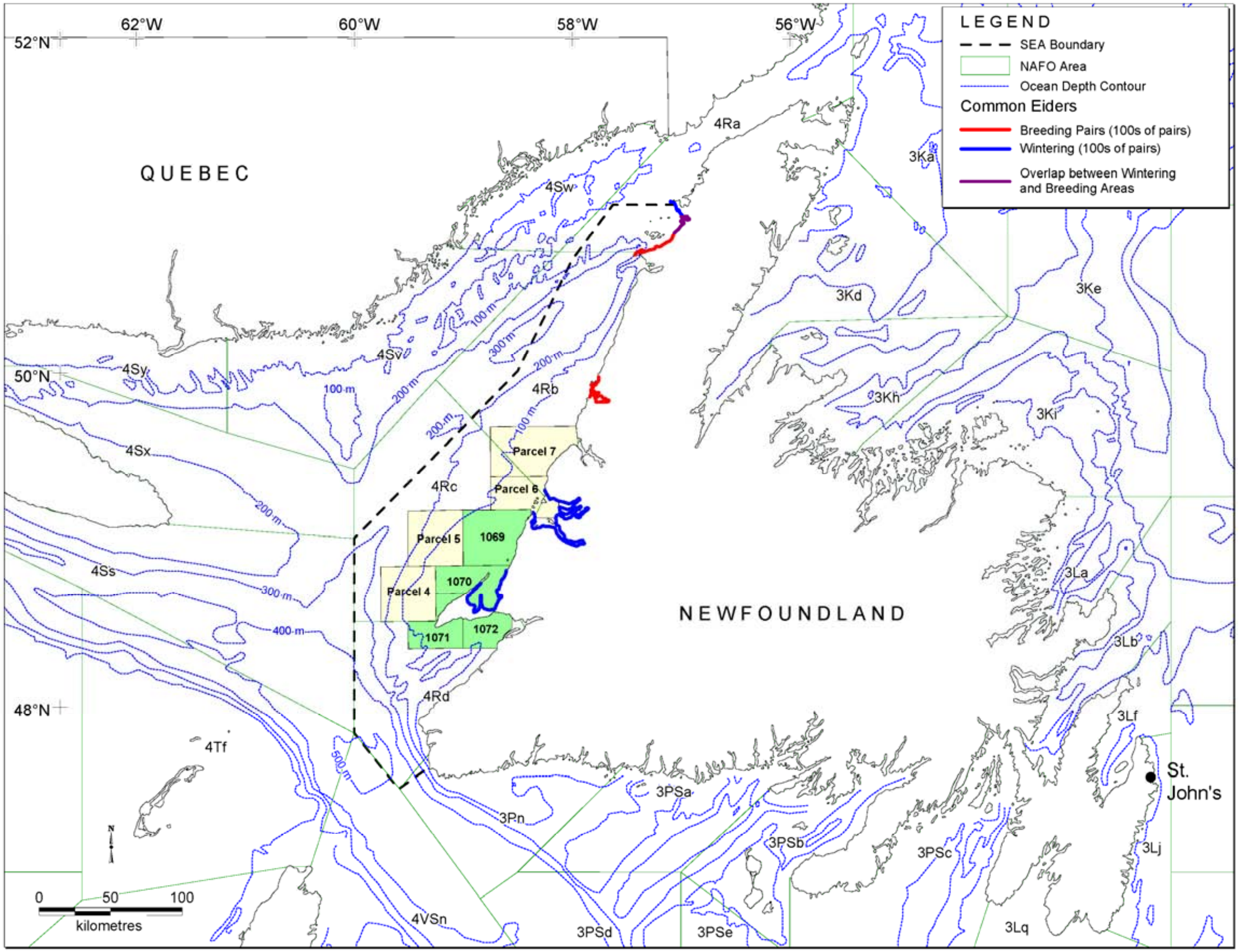


Figure 3.66. Geographic and Seasonal Distributions and Abundances of Vulnerable Seabirds within the Study Area.



Source: Conservation Data Centre.

Figure 3.67. Breeding and Wintering Locations of Common Eiders within the Study Area.

The eastern population of Harlequin Duck was listed as *endangered* in 1990 (Goudie 1991b), and are currently listed by *SARA* as a *species of concern*. Rivers and streams used for breeding (Robertson and Goudie 1999) occur in watersheds draining the Long Range Mountains in UAs 4Rabc (Thomas and Robert 2001). The only coastal aggregation identified in the Study Area is a small concentration of Harlequin Ducks (<100) that moults in late summer-early fall at Stearin Island off Cow Head (Figure 3.68). Few moulting areas have been identified for the eastern population and the current status of this site is unknown, and information on temporal distribution and male-female composition is lacking. Some broods of Harlequin Ducks are known to descend the natal rivers to coastal marine habitats in the Study Area (e.g., Doctors Brook near Eddies Cove West). The extent to which this occurs for other watersheds is unknown although likely for rivers such as Western Brook where breeding occurs relatively close to the estuary. For other watershed such as Torrent River it is clear that broods fledge inland and fly to marine habitats in late summer-early fall (Goudie and Gilliland 2005, in press).

Some relatively large concentrations of breeding and staging waterfowl occur in the Codroy River estuary (UA 4Rd) that has been designated a wetland of international importance under the international Ramsar Convention. Some of the largest provincial and regional aggregations of Canada Geese occur there in spring, late summer and early fall. The rich estuarine marshes support wetland species that are rare on insular Newfoundland, such as breeding American Wigeon and likely Great Blue Herons, and the only provincial breeding records for Pie-billed Grebes. Other notable sites include nesting records for Sora in Stephenville south to Codroy (P. Linegar, pers. comm.). Coastal concentrations of staging waterfowl, especially Canada Geese and Black Ducks occur in migration at Flat Bay Island/Sandy Point, and Stephenville Crossing in UA 4Rd, St. Pauls Inlet in UA 4Rb and Parsons Pond in UA 4Rb. These sites may support diving ducks (family Athyini) such as Greater Scaup that are uncommon in Newfoundland. Common Goldeneye and Mergansers of the sea duck group are common throughout.

Common Loons occur in the Study Area and winter in coastal areas that remain ice-free. Species such as Red-throated Loon and grebes are relatively uncommon. American Coots are rare and occur in the Codroy estuary.

3.5.3 Shorebirds

Migrant shorebirds that occur within the SEA Study Area include multiple species of Sandpipers, Yellowlegs, Plovers, and Phalaropes also based on Lock et al. (1994), Cairns et al. (1989), Brown (1986), and recent surveys from Gros Morne National Park and CWS (Conservation Data Centre). The most abundant shorebird species in the Study Area are White-rumped Sandpipers, Semipalmated Sandpipers, Greater Yellowlegs, Semipalmated Plovers, Black-bellied Plovers with lesser numbers of Least Sandpipers, Ruddy Turnstones and Sanderlings. Maximum abundance and diversity occurs in the mid-late August to early September period, and 10 to 14 species have regularly been recorded at Sandy Point, Flat Bay Spit, Stephenville Crossing, St. Paul's Inlet, and Eddies Cove East. Flat Bay Island/Sandy Point supports the highest recorded abundance and diversity of migrating shorebirds, and abundance and diversity is highest in the July-September period (Appendix 3).

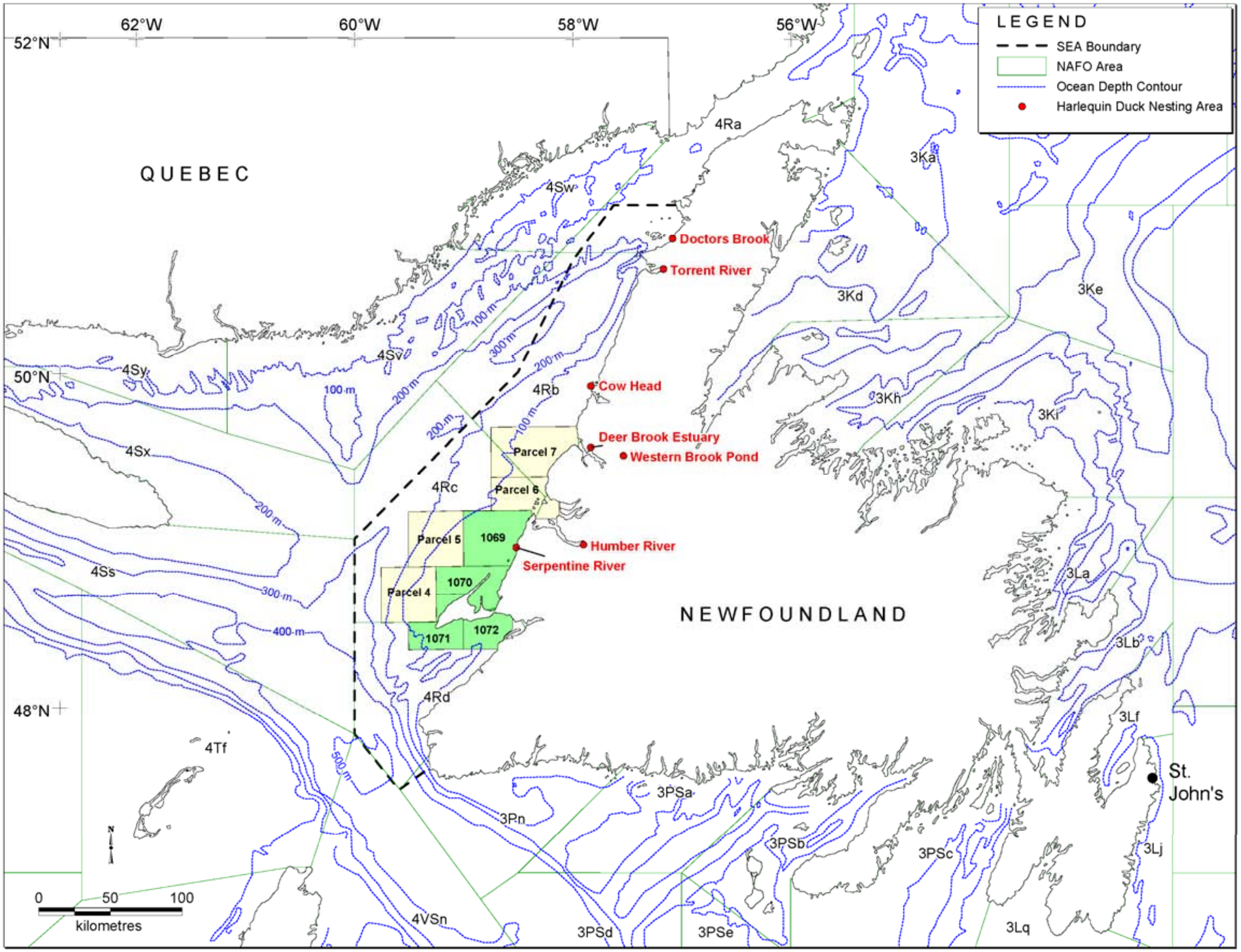


Figure 3.68. Some Locations of Harlequin Duck Nesting Areas within the Study Area.

Migrating shorebirds (sandpipers and plovers) concentrate at various beaches and tidal flats in the SEA Study Area. There is limited published information on shorebirds in western Newfoundland (B. Mactavish, LGL, pers. comm.). The largest concentrations of shorebirds in the Study Area identified by Lock et al. (1994) occur in UA 4Rb (Bonne Bay and immediately to the north notably St. Pauls Inlet and Parsons Pond), followed by UAs 4Rd (Cape Anguille, St. George's Bay) and 4Rc (Port au Port Bay) (Figure 3.69) (Lock et al. 1994).

Important shorebird areas for western Newfoundland identified by P. Thomas of CWS (pers. comm.), P. Linegar (pers. comm.) and B. Mactavish (pers. comm.) include the following:

- Eddies Cove East (north of Study Area),
- Parson's Pond (UA 4Rb),
- St. Paul's Inlet (UA 4Rb),
- Point au Mal (Port au Port Bay, UA 4Rc),
- Piccadilly Lagoon (Port au Port Bay, UA 4Rc),
- West Bay (Port au Port Bay, UA 4Rc),
- Black Duck Brook (Port au Port Bay, UA 4Rc),
- Stephenville Crossing (St. George's Bay, UA 4Rd),
- Sandy Point (St. George's Bay, UA 4Rd),
- Flat Bay (St. George's Bay, UA 4Rd),
- J.T. Cheeseman Park (just outside southern limit of the Study Area)
- Grand Bay West area (just outside southern limit of the Study Area).

3.5.4 Important Bird Areas

The Important Bird Area (IBA) program identifies habitat important to the survival of bird species. The program is coordinated by BirdLife International and administered in Canada by the Canadian Nature Federation and Bird Studies Canada (www.ibacanada.com). The criteria used to identify important habitat are internationally standardized and are based on the presence of *threatened* and *endangered* species, endemic species, species representative of a biome (keystone species), or a significant proportion of a species' population. These criteria focus on sites of national and international importance and it is important to recognize that areas of regional and provincial significance can be over-looked if assessment of important habitat is limited to this approach.

Three coastal sites in the west-southwest Newfoundland have been afforded the IBA designation. They are as follows:

1) Codroy Valley Estuary (NF041) (UA 4Rd) that is a wetland of international importance under the RAMSAR convention.
2) Grand Bay West to Cheeseman Provincial Park (NF038) (UA 4Rd).
3) Gros Morne National Park (NF045) (UA 4Rb; Parcel 7).

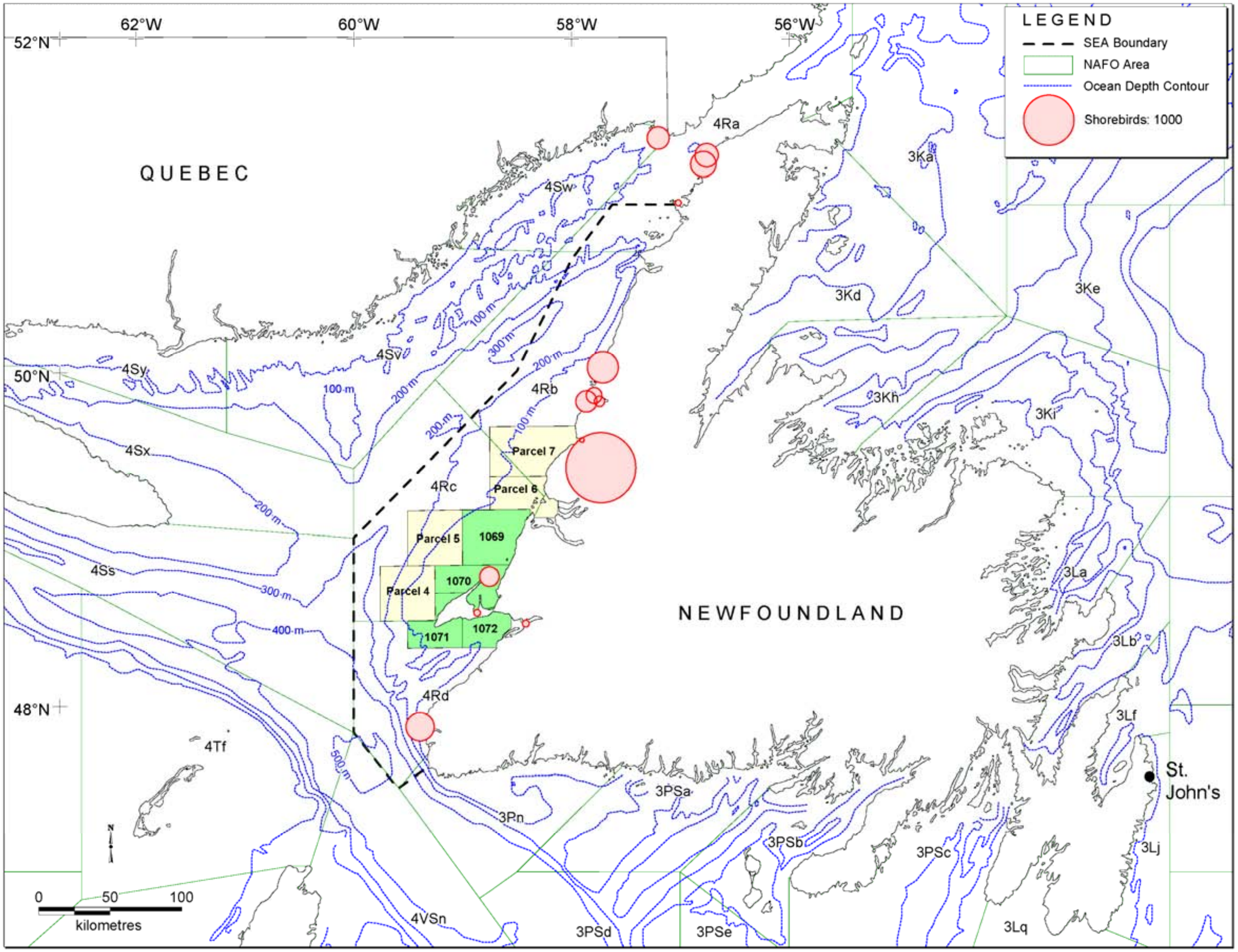


Figure 3.69. Locations of Important Migrant Shorebird Areas within the Study Area.

These three IBAs rank low in 'IBA Population Threshold' score compared with other Newfoundland IBAs (www.ibacanada.com) such as alcid colonies that support massive numbers of birds.

3.5.4.1 Codroy Valley Estuary

Located at the mouth of the Grand Codroy River, this IBA site supports a high diversity of breeding and staging site waterfowl species, and is a wetland of international importance (Ramsar Convention 1971). At least 20 waterfowl species have been identified in the estuary including Wood Duck, Green-winged Teal, American Black Duck, Northern Pintail, American Wigeon, Gadwall, Lesser and Greater Scaup, and Common and Red-breasted Mergansers. Rare ducks such as Eurasian Wigeon and Tufted Duck have also been seen at this IBA. In addition, thousands of Canada Geese staging during migration has been recorded here in continentally significant numbers. This IBA also has the first Newfoundland breeding record for Northern Shoveler, American Wigeon and Blue-winged Teal. The adjacent upland habitats support an array of provincially-rare breeding passerine birds (e.g., Boblink) and Ruby-throated Hummingbird.

The Piping Plover nests on Grand Codroy beach (Searston Beach and historically north beach). This species is globally vulnerable and is listed as *endangered* on Schedule 1 of *SARA*. A pair successfully bred on the beach at the mouth of the estuary from 1992 to 1998.

3.5.4.2 Grand Bay West to Cheeseman Provincial Park

This area consists an extensive eight kilometres of sand beach and small sections of rocky coastline stretching east from J.T. Cheeseman Provincial Park near Port aux Basques. The site is important nesting habitat for the Piping Plover, and supported an average of 17 adults during the period 1995 to 1998. The 18 individuals counted in 1996 comprised 4.2% of the Atlantic Canada population of the species.

3.5.4.3 Gros Morne National Park

At least 207 bird species have been recorded in the park, of which Common Tern and Arctic Tern occur along the coast (Lamberton 1976). Terns nest on two offshore islands in Gros Morne National Park, namely, Stearin Island and the White Rocks (Lock et al. 1994). Both species are designated *sensitive* by the provincial government. The eastern Canadian population of the Harlequin Duck is listed as a *species of concern* on Schedule 1 of *SARA*, and occurs here on turbulent rivers and streams in the park. Before and after the nesting season some broods congregate where the breeding streams drain into coastal waters and a small concentration (<100) moults at Stearin Island (Thomas and Robert 2001; Lock et al. 1994). Relatively large aggregations of shorebirds and waterfowl occur during migration in St. Paul's Inlet, and Piping Plover likely breed there up to recent times.

3.5.4.4 Other Significant Habitat Areas

Sandy Point/Flat Bay Islands (UA 4Rd) is under consideration for special protection due to its unique migratory bird fauna, notably breeding Willets and Piping Plovers (CWS files). The greatest average abundance and diversity of shorebirds has been recorded there (Appendix 3). The nesting concentration of Common Eiders in St. John Bay is one of the largest in coastal Newfoundland. Stephenville Crossing supports a relatively rich intertidal flats and marshes that are little studied and likely unique for insular Newfoundland. The area supports some of the largest concentrations of migrating shorebirds (Appendix 3). Breeding Piping Plovers, Black-headed Gulls and likely Caspian Terns attest to its significance. Rare birds are frequently observed there and the recent presence of a Western Reef Heron (natural range being West Africa) has raised a lot of international interest in the bird watching community.

3.5.5 Bird Species at Risk

Bird species in the Study Area considered *at risk* include the Piping Plover and Harlequin Duck. The Piping Plover is listed as *endangered* on Schedule 1 of *SARA* and designated *endangered* by the Government of Newfoundland and Labrador. It currently nests on an array of beaches along the southern and southwestern part of the Study Area (Table 3.11; Figure 3.65). A Proposed Recovery Strategy for the Piping Plover is outlined in Goossen (2002). Recommendations for protection of critical habitat under the Endangered Species Act of Newfoundland Labrador have been forwarded to the responsible provincial minister by the Newfoundland Piping Plover Working Group (J. Brazil, pers. comm.) (see Section 3.8).

Piping Plovers are listed as *endangered* (COSEWIC and *Endangered Species Act of Newfoundland and Labrador, 2001*), and are present on sandy beaches from April to September. Ten to 12 pairs breed on 14 km of sand-beach habitat from Cheeseman Provincial Park (Cape Ray Beach) to Grand Bay West in Unit Area 3Pn. Sandy beach habitat is extensive in this area of the province and beaches known to support breeding pairs include Osmond Beach (1 to 2 pairs), Short Sand Beach (1 to 2 pairs), Big Barasway Beach and Sand Banks Park Beach (2 to 6 pairs), Bottles Beach (Rocky Barasway Beach) (1 to 2 pairs), and Second Beach (Rocky Barasway Bight) (1 to 2 pairs).

Further north, breeding pairs have been recorded at Little Codroy (1 to 2 pairs), Grand Codroy (1 pair) and Flat Bay Spit/Sandy Point (3 pairs) and, Stephenville Crossing (1 pair). There was a recent sighting at Piccadilly Beach on Port au Port Peninsula (2005), and there were regular sightings and suspected breeding at St. Paul's Inlet through the 1980's although there have been no recent observations (Area UA 4Rd, Table 3.11; Figure 3.65) (Lock et al. 1994).

Critical habitat is defined as habitat that is critical to survival of a species (*Endangered Species Act of Newfoundland and Labrador, 2001*). The act also defines 'recovery habitat' as habitat that is necessary for the recovery of a species. A person may not destroy or disturb the residence of an individual of a designated species where residence is defined as a specific dwelling place habitually occupied by one or individuals during all or part of their life cycles. Critical habitat for Piping Plovers has been delineated by the Newfoundland Piping Plover Working Group, comprised of Government and non-government interest representatives, that has made recommendations to the national Piping Plover Recovery Team and the provincial responsible Minister for the Government of Newfoundland and Labrador. Options for conservation and management of identified critical habitat areas are presented to the responsible minister by the Newfoundland Piping Plover Working Group. These options can include things such as the Provincial Park Act, Wildlife Reserves, Ecological Reserves and others (J. Brazil, pers. comm.). Most beach areas known to support breeding habitat for Piping Plovers are likely to be identified as critical habitat. Approaches to conservation and/or protection are dependent on area-specific management plans that can vary. The responsible minister may issue permits to permit economic related activities in areas of critical habitat if the actions are considered sustainable. The Accord between the Governments of Canada and Newfoundland and Labrador generally favour the responsible protection of critical habitat by the provincial jurisdiction. The federal Minister of Environment may in special circumstances invoke additional protection of critical habitat.

The Strait of Belle Isle is also thought to be an important migration route for shorebirds such as Whimbrels (B. Mactavish, pers. comm.) and may have been the migration route of the Eskimo Curlew (listed by COSEWIC as *endangered* but likely extinct) (Todd 1967). Other breeding shorebirds in the Study Area that are rare include the only provincial breeding records of Willet at Sandy Point.

The eastern population of the Harlequin Duck is presently listed as a *species of concern* on Schedule 1 of *SARA* and designated *vulnerable* by the Government of Newfoundland and Labrador. It breeds along streams and rivers draining the Long Range Mountains (Figure 3.66). It may be found in coastal waters during both spring and fall staging at the mouths of nesting streams occurring in UAs 4Rabc. A small late summer – fall moulting concentration occurs at Stearin Island. Terns are regarded as *sensitive* in the province. Arctic and Common Terns nest at nine coastal locations scattered throughout the Study Area (Table 3.11; Figure 3.65). The Caspian Tern is designated as vulnerable by COSEWIC and breeds infrequently as single pairs in sections of the Study Area (see above).

3.5.6 Rare Species

There are only a few sites for breeding Black-headed Gull in North America as this European species has expanded its range to North America in recent decades. A few pairs of this species have nested at Flat Bay Island/Sandy Point and maybe relocating from the original site at Stephenville Crossing. The movement between Sandy Point and Stephenville Crossing may reflect more frequent disturbance at Sandy Point (P. Linegar, pers. comm.).

The breeding range of Willets is south of Newfoundland, and this large shorebird species is only known to nest at Flat Island/Sandy Point, and more recently Stephenville Crossing. Rare birds infrequently occur at these enriched coastal locations, such as the Western Reef Heron (from West Africa) recently observed at the latter site that created a lot of international bird watching interest and tourism. Other species, such as the Sora and Great Blue Heron may breed in the province only in these enriched marshes of southwestern coast.

3.5.7 Planning Implications for Migratory Birds

Marine-associated bird abundance is low in the Study Area compared to other parts of Newfoundland and Labrador. Their peak vulnerability occurs between January and March. Common Eiders, Harlequin Ducks, Black Ducks and Canada Geese are the highest profile coastal waterfowl occurring in the Study Area. Common Eiders are most abundant in St. John Bay (4Ra, north of Port au Choix) and Harlequin Ducks occur at various locations in Unit Areas 4Ra, 4Rb, and 4Rc, and notably a moulting concentration at Stearin Island in Gros Morne National Park. Harlequin Ducks are listed on Schedule 1 of *SARA* as a *species of concern* and are considered vulnerable by the Government of Newfoundland and Labrador.

Nationally significant concentrations of Canada Geese occur at Codroy estuary, and the wetlands that also support an abundance of breeding and staging Black Ducks, Pintail, Wigeon and other waterfowl are designated as internationally significant (RAMSAR Convention).

Shorebirds are common at various locations within the Study Area. They are most abundant at Sandy Point-Flat Bay in St. George's Bay (4Rb) and in the Port au Port area in UA 4Rc, Stephenville Crossing and St. Paul's Inlet,. The Piping Plover is the highest profile shorebird. This species is listed as *endangered* on both Schedule 1 of *SARA* and by the Government of Newfoundland and Labrador. It occurs at different locations in Unit Area 4Rd between April and September.

Nearshore shallow water areas are obviously very important to most marine birds at some time of the year. Appropriate mitigations will have to be developed to minimize any impact of oil and gas activities on the shore area.

For most exploration, delineation and production drilling programs in recent years, the C-NLOPB has required that the operator undertake seabird monitoring from drilling rigs during the drilling program. For seismic programs, mitigation includes seabird monitoring a stranded bird release program in the Newfoundland and Labrador offshore area. Therefore, it is anticipated that the Board will require similar monitoring programs during this exploration, seismic and drilling programs in the Western Newfoundland and Labrador Offshore Area. A recent Environmental studies Research Fund (ESRF) study developed protocols for seabird monitoring programs for the offshore (Moulton and Mactavish 2004).

3.5.8 Data Gaps for Marine-associated Birds

There is relatively little information on seabirds for this area of coastal Newfoundland. Data on seabirds off coastal Newfoundland rely mainly on Brown et al. (1975) and Brown (1986), and are therefore historical in context. These ship-based data are now two to three decades old, and may not be representative of current abundance and distribution (Lock et al. 1994). Additional temporal and spatial data on marine-associated birds on the West coast of Newfoundland are desirable as they are the most sensitive group to oil spills. Operators will be encouraged to utilize suitable qualified personnel to collect marine-associated bird data during exploratory and production activity.

3.6 Marine Mammals and Sea Turtles

Thirteen species of cetacean, including dolphins, small and large toothed whales, and baleen whales occur in the western Newfoundland offshore region. These are presented in Table 3.15. Some of the cetacean species outlined in Table 3.15 have been afforded special status under *SARA*. The North Atlantic right whale and the blue whale are listed under Schedule 1 of *SARA* as *endangered*. The fin whale and the Scotian Shelf population of the northern bottlenose whale are listed under Schedule 3 of *SARA* as species of *special concern*. Further, the northern bottlenose whale is currently under consideration for listing under Schedule 1. The St. Lawrence Estuary population of beluga whales is currently listed under Schedule 1 of *SARA* as *threatened*. The harbour porpoise is currently listed under Schedule 2 of *SARA* as *threatened* and is under consideration for listing under Schedule 1.

Four species of pinniped are known to occur regularly in the western Newfoundland offshore region (Table 3.15). None of these species is listed under *SARA*. Hooded seals and grey seals are considered by COSEWIC to be *not at risk*, and the harbour seal is considered as *data deficient*. Two other species of pinniped could potentially occur in the western Newfoundland offshore region. These are the ringed seal (*Phoca hispida*) and the bearded seal (*Erignathus barbatus*). However, although they are known to occur in the Gulf of St. Lawrence, including the western Newfoundland offshore region (Environment Canada, n.d.), they are likely to be rare visitors to the area, as their usual distributions are thought to be much further north.

The other species of "marine mammal" that could occur in the western Newfoundland offshore region is the North American river otter (*Lontra canadensis*). North American river otters occur in rivers and streams throughout much of North America; in the northern portion of their range, they occur in coastal marine areas as well (Estes and Bodkin 2002). The breeding season of this species is from December to April and pups are born between February and April (Larivière and Walton 1998). The abundance of this species along the Atlantic coast of North America is unknown (Estes and Bodkin 2002), but they are thought to be relatively common in most of Canada where suitable habitat exists (Melquist et al. 2003). Preferred habitat consists of rugged coastal areas with irregular shorelines that have short intertidal lengths (Melquist et al. 2003). Otters in Newfoundland belong to a distinct subspecies, *L. canadensis degener* (Parks Canada n.d.). Their abundance is unknown. The status of the North American river otter has not been assessed by COSEWIC.

Table 3.15. The Habitat, Occurrence, and Conservation Status of Marine Mammals Occurring in the Study Area.

Species	Habitat	Occurrence in area	*SARA* status*
Mysticetes			
North Atlantic right whale (*Eubalaena glacialis*)	Coastal and shelf waters	Rare	Schedule 1: *Endangered*
Humpback whale (*Megaptera novaeangliae*)	Mainly nearshore waters and banks	Common	*Not at Risk*
Blue whale (*Balaenoptera musculus*)	Coastal and pelagic	Uncommon	Schedule 1: *Endangered*
Fin whale (*Balaenoptera physalus*)	Continental slope, pelagic	Common	Schedule 3: *Special Concern*
Minke whale (*Balaenoptera acutorostrata*)	Continental shelf, coastal	Common	Not Assessed
Odontocetes			
Sperm whale (*Physeter macrocephalus*)	Usually pelagic and deep seas	Common	Not Assessed
Northern bottlenose whale (*Hyperoodon ampullatus*)	Pelagic	Uncommon	Schedule 3: *Special Concern*[1]
Killer whale (*Orcinus orca*)	Widely distributed	Uncommon	Not Assessed
Long-finned pilot whale (*Globicephala melas*)	Mostly pelagic	Common	Not Assessed
Beluga whale (*Delphinapterus leucas*)	Estuarine	Rare	Schedule 1: *Threatened*[2]
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	Continental shelf and slope	Common	Not Assessed
White-beaked dolphin (*Lagenorhynchus albirostris*)	Continental shelf	Uncommon	Not Assessed
Harbour porpoise (*Phocoena phocoena*)	Continental shelf	Common	Schedule 2: *Threatened*[3]
Pinnipeds			
Harbour seal (*Phoca vitulina*)	Coastal	Common	Not Assessed
Harp seal (*Phoca groenlandica*)	Ice	Common	Not Assessed
Hooded seal (*Cystophora cristata*)	Ice	Common	Not Assessed
Grey seal (*Halichoerus grypus*)	Coastal	Common	Not Assessed

*Species designation under *SARA* (Government of Canada 2005).
[1] Scotian Shelf population; currently under consideration for listing under Schedule 1.
[2] St. Lawrence Estuary population.
[3] Currently under consideration for listing under Schedule 1.

3.6.1 Mysticetes

3.6.1.1 North Atlantic right whale (*Eubalaena glacialis*)

The North Atlantic right whale is the most *endangered* large whale in the world. In spite of being the first whale to receive total protection from hunting over 60 years ago, its population size remains low. The western North Atlantic population is estimated to be on the order of about 300 individuals (IWC 2001a; Kraus et al. 2001) and appears to be declining (Caswell et al. 1999). The North Atlantic right whale is listed under Schedule 1 of *SARA* as *endangered* (Government of Canada 2005).

Right whales are generally found in waters with surface temperatures ranging from 8-15°C in areas that are 100-200 m deep (Winn et al. 1986). In the lower Bay of Fundy, they are generally distributed in areas where the bottom topography is relatively flat and the water column is stratified (Woodley and Gaskin 1996). In the Great South Channel, the average right whale dive depth was found to be only 7.3 m and few dives were deeper than 30 m (Winn et al. 1994). The primary prey item of the North Atlantic right whale is the copepod *C. finmarchicus*, and shifts in the distribution and abundance of this species can dramatically affect right whale distribution (Kenney 2001). North Atlantic right whales produce low-frequency moans of <400 Hz that are used in communication (reviewed by Thomson and Richardson 1995).

Right whales are known to aggregate in five seasonal habitat areas along the east coast of North America (IWC 2001b). In Canada, they can be found in the Bay of Fundy from June-November, with a peak of abundance in August to early October, and in the Roseway basin, south of Nova Scotia, from July-November, with a peak in abundance in August-September, although their use of this area seems to be declining in recent years (IWC 2001b). Although there has been a great deal of effort put into identifying their distribution, on average, only about 25% of the known right whale population can be accounted for in any month except August (IWC 2001b). Right whales are only occasionally sighted in the Gulf of St. Lawrence (Lien et al. 1989), and sightings are likely to be rare in the western Newfoundland offshore region.

3.6.1.2 Humpback whale (*Megaptera novaeangliae*)

The humpback whale has a cosmopolitan distribution. Although considered to be mainly a coastal species, it often traverses deep pelagic areas while migrating. Its migrations between high-latitude summering grounds and low-latitude wintering grounds are reasonably well known (Winn and Reichley 1985). In the North Atlantic, there are five areas where humpback whales aggregate in the summer to feed—Iceland–Denmark Strait, western Greenland, Newfoundland (including Labrador), the Gulf of St. Lawrence, and the Gulf of Maine–Scotian Shelf (Katona and Beard 1990). Genetic studies have revealed matrilineally determined distinctiveness between feeding aggregations of humpback whales in the western North Atlantic and off Iceland, but no genetic differences among humpback whales of the four western North Atlantic feeding areas (Palsbøll et al. 1995). The North Atlantic population of humpback whales likely numbers >11,500 individuals, approaching pre-exploitation levels, and although an abundance estimate is not available for Canadian waters, COSEWIC considers this species to be *not at risk* (COSEWIC 2003).

Humpback whales are often sighted singly or in groups of two or three; however, while in their breeding and feeding ranges, they may occur in groups of up to 15 individuals (Leatherwood and Reeves 1983). Whitehead et al. (1998) reported a mean group size of 1.47 for humpback whales seen off Nova Scotia.

Humpback whales produce sounds in the frequency range of 20 Hz to 8.2 kHz, although the songs sung by males on the wintering grounds have dominant frequencies of 120-4000 Hz (reviewed by Thomson and Richardson 1995).

Humpback whales aggregate in the Gulf of St. Lawrence in the summer to feed (Katona and Beard 1990). Although there were too few sightings to provide a reliable estimate, sightings data collected during aerial surveys in the Gulf from late August to early September of 1995 and from late July to early August of 1996 suggest that there were about 100 humpback whales in Gulf during those times (Kingsley and Reeves 1998). Most humpback whale sightings occurred in the northeast portion of the Gulf, north of the western Newfoundland offshore region. Humpbacks are occasionally observed in the St. Lawrence Estuary (Edds and Macfarlane 1987).

Humpback whales are much less common off the west and southwest coasts of Newfoundland than elsewhere off Newfoundland. Lynch (1987) provided summer (June-September) sighting frequencies that ranged from zero to 0.29 humpback whale sightings per week of land-based observations in survey blocks encompassing the western Newfoundland offshore region in 1979-1982. All sightings occurred in the northern portion of this region. She also reported no sightings of humpback whales during 865 nautical miles of shipboard survey effort in the western Newfoundland offshore region between 48°N and 50°N in 1976-1983. However, these data should be viewed with caution, given the often limited visibility in the area. Similar to the Kingsley and Reeves (1998) study, humpback sightings in the shipboard portion of her survey in the Gulf of St. Lawrence occurred off the northwest coast of Newfoundland.

3.6.1.3 Blue whale (*Balaenoptera musculus*)

The blue whale is widely distributed throughout the world's oceans and occurs in coastal, shelf, and oceanic waters. All populations of blue whales have been exploited commercially, and many have been severely depleted as a result. Recent estimates suggest a mere 400-1,400 blue whales remain in the Southern Hemisphere (IWC 2005). The North Atlantic population has been estimated to be 1,400 (NMFS 1998), while that of the western North Atlantic is probably on the order of a few hundred individuals (Sears and Calambokidis 2002). The blue whale is listed as *endangered* by COSEWIC (Sears and Calambokidis 2002) and by *SARA*.

The distribution of blue whales during the times of year when feeding is a major activity is specific to areas that provide large seasonal concentrations of euphausiids, which are the whale's main prey (Yochem and Leatherwood 1985). Generally, blue whales are seasonal migrants between high latitudes in the summer, where they feed, and low latitudes in the winter, where they mate and give birth (Lockyer and Brown 1981). In the western North Atlantic, blue whales occur in the Gulf of St. Lawrence and east of Nova Scotia in spring, summer, and fall, in the Davis Strait in summer, and off southern Newfoundland in winter; movement between the Gulf of St. Lawrence and western Greenland has been demonstrated (summarized by Waring et al. 2002). Blue whales usually occur alone or in small groups (Leatherwood and Reeves 1983). Whitehead et al. (1998) noted an average group size of 1.38 for blue whales sighted off the coast of Nova Scotia. The best-known sounds of blue whales consist of low-frequency moans and long pulses that range from 12.5 Hz to 200 Hz and can have source levels up to 188 dB re 1 µPa (Cummings and Thompson 1971).

Blue whales can be found in the Gulf of St. Lawrence from January through November, but are most abundant from August to October (Sears et al. 1990). Sightings of this species in the Gulf occur predominantly along the north shore between the Saguenay River and the Strait of Belle Isle (Sears et al. 1990). Three hundred seventy-two blue whales were photographically identified during 21 years of research, primarily in the Gulf of St. Lawrence, but these data could not be used to produce an abundance estimate for this region (COSEWIC 2002a). There were only five sightings of blue whales during aerial surveys in the Gulf from late August to early September of 1995 and from late July to early August of 1996 (Kingsley and Reeves 1998). The western North Atlantic population of blue whales was severely depleted by whaling, and sightings of this species anywhere within its range, including the western Newfoundland offshore region, are uncommon.

3.6.1.4 Fin whale (*Balaenoptera physalus*)

Fin whales are widely distributed in all the world's oceans (Gambell 1985), but typically occur in temperate and polar regions. They appear to have complex seasonal movements and are likely seasonal migrants (Gambell 1985). Fin whales mate and calve in temperate waters during the winter, but migrate to northern latitudes during the summer to feed (Mackintosh 1965). Genetic analyses suggest several different populations of fin whales in the North Atlantic (Berubé et al. 1998). In that study, fin whales from the western North Atlantic (Gulf of St. Lawrence and Gulf of Maine) were found to be genetically different from fin whales off Iceland and from those in the eastern North Atlantic. The entire North Atlantic population of fin whales is estimated at 47,300 (IWC 2005). Fin whales are considered as a species of *special concern* by COSEWIC (Table 3.15).

Fin whales occur in coastal and shelf waters, as well as in oceanic waters. Sergeant (1977) proposed that fin whales tend to follow steep slope contours, either because they detect them readily or because biological productivity is high along steep contours due to tidal mixing and perhaps current mixing. Fin whales in the Bay of Fundy, Canada, were distributed in shallow areas with high topographic variation (Woodley and Gaskin 1996). Fin whales are sometimes observed alone or in pairs, but on feeding grounds, groups of up to 20 individuals are more common (Gambell 1985). Whitehead et al. (1998)

reported a mean group size of 1.31 for fin whales sighted off the Nova Scotian shelf. Fin whales are seen in the St. Lawrence Estuary in groups of two to six; adult–calf pairs are observed occasionally (Edds and Macfarlane 1987). The distinctive 20-Hz pulses of fin whales, with source levels as high as 180 dB re 1 µPa, can be heard reliably to distances of several tens of kilometres (Watkins 1981; Watkins et al. 1987). These sounds are presumably used for communication while swimming slowly near the surface or traveling rapidly (Watkins 1981).

Aerial surveys of the Gulf of St. Lawrence from late August to early September of 1995 and from late July to early August of 1996 found fin whales located predominantly along the margins of the Laurentian channel (Kingsley and Reeves 1998). Although there were too few sightings to provide a reliable estimate, sightings data from those surveys suggest that there were a few hundred fin whales in the Gulf during those times (Kingsley and Reeves 1998). Fin whales from the Gulf of St. Lawrence migrate to the Laurentian Channel and probably to northern Nova Scotia in the winter (Sergeant 1977).

Finback whales are less common off the west and southwest coasts of Newfoundland than elsewhere off Newfoundland. Lynch (1987) provided summer (June-September) sighting frequencies that ranged from zero to 0.18 finback whale sightings per week of land-based observations in survey blocks encompassing the western Newfoundland offshore region in 1979-1982. All sightings occurred in the northern portion of this region. She also reported no sightings of finback whales during 865 nautical miles of shipboard survey effort in the western Newfoundland offshore region between 48°N and 50°N in 1976-1983. Finback sightings in the shipboard portion of her survey occurred off the northwest coast of Newfoundland in the Gulf of St. Lawrence.

3.6.1.5 Minke whale (*Balaenoptera acutorostrata*)

Minke whales have a cosmopolitan distribution that spans ice-free latitudes (Stewart and Leatherwood 1985). In the Northern Hemisphere, they migrate northward during spring and summer and can be seen in pelagic waters at that time. Genetic analyses have revealed evidence of four distinct subpopulations in the North Atlantic: west Greenland, central North Atlantic–east Greenland–Jan Mayen, northeast Atlantic, and North Sea (Andersen et al. 2003). Minke whales off the east coast of North America are considered to belong to a separate stock, but their relationship to the other North Atlantic stocks in unknown (Waring et al. 2004). The status of the minke whale has not been evaluated by COSEWIC, but their populations are generally considered to be much healthier than those of the other baleen whales.

Minke whales are generally sighted in waters <200 m deep (Hooker et al. 1999; Hamazaki 2002), and this species is believed, in general, to prefer shallow water. In fact, Whitehead et al. (1998) found the minke whale to be the only cetacean species sighted less often in the waters around a deep biologically significant submarine canyon on the Scotian Shelf than in the other Shelf waters. In the northern Gulf of St. Lawrence, although minke whales were most often found in areas with steep bottom topography and depths between 20 m and 40 m, their distribution was most closely linked to the presence of underwater sand dunes, which are thought to be important habitats for sand lance and capelin, their preferred prey in the area (Naud et al. 2003).

Minke whales are relatively solitary, usually seen individually or in groups of two or three, but they can occur in large aggregations of up to 100 animals at high latitudes where food resources are concentrated (Perrin and Brownell 2002). Minke whales are most often sighted alone in the Gulf of St. Lawrence Estuary and are occasionally sighted in pairs (Edds and Macfarlane 1987). A large variety of sounds, ranging in frequency from 60 Hz to 12 kHz, have been attributed to minke whales (Stewart and Leatherwood 1985; Mellinger et al. 2000). The minke whale call recorded most often in the St. Lawrence estuary consisted of a 0.4-second downsweep in frequency that began at 100-200 Hz and ended below 90 Hz; this call may function to maintain spacing in this feeding area (Edds-Walton 2000).

Minke whales are widespread throughout the Gulf of St. Lawrence, but are encountered more frequently in northern portions of the Gulf (Kingsley and Reeves 1998). Using sighting information collected during aerial surveys in the Gulf from late August to early September of 1995, one thousand minke whales were estimated to be present in the entire Gulf; aerial surveys in late July to early August of 1996 provided an abundance estimate of 600 minke whales for the northern portion of the Gulf alone (Kingsley and Reeves 1998).

As with the other baleen whale species, minke whales are less common off the west and southwest coasts of Newfoundland than elsewhere off Newfoundland. Lynch (1987) provided summer (June-September) sighting frequencies that ranged from zero to 0.64 minke whale sightings per week of land-based observations in survey blocks encompassing the western Newfoundland offshore region in 1979-1982. The highest reported frequency (0.64 sightings per week) in this region was for St. George's Bay in the southern portion of the region. A sighting rate of 0.35 per week was reported for a survey block that included the northern portion of the Newfoundland offshore region, while no minkes were sighted in the central portion of the region. Lynch (1987) also reported sightings rates of zero and 0.01 minke whale sightings per track line surveyed during 470 nautical miles of shipboard survey effort in the 1° × 1° square from 48°N to 49°N and 60°W to 59°W and during 395 nautical miles of shipboard survey effort in the 1° × 1° square from 49°N to 50°N and 59°W to 58°W, respectively, in 1976-1983.

3.6.2 Odontocetes

3.6.2.1 Sperm whale (*Physeter macrocephalus*)

Sperm whales are the largest of the toothed whales, with an extensive worldwide distribution (Rice 1989). They range as far north and south as the edges of the polar pack ice, although they are most abundant in tropical and temperate waters where temperatures are higher than 59ºF or 15ºC (Rice 1989). Sperm whale distribution is linked to their social structure; adult females and juveniles generally occur in tropical and subtropical waters, whereas adult males are commonly alone or in same-sex aggregations, often occurring in higher latitudes outside of the breeding season (Best 1979; Watkins and Moore 1982; Arnbom and Whitehead 1989; Whitehead and Waters 1990). In the North Atlantic, female sperm whales range only as far as about 45-50°N (Rice 1989), so most sperm whales encountered in the western Newfoundland offshore region are likely to be solitary, older males. There currently are no valid estimates for the size of any sperm whale population (Whitehead 2002); however, COSEWIC considers sperm whales to be *not at risk*.

Sperm whales are generally distributed over large areas that have high secondary productivity and steep underwater topography (Jaquet and Whitehead 1996); their distribution and relative abundance can vary in response to prey availability (Jaquet and Gendron 2002). Sperm whales routinely dive to depths of hundreds of meters and may occasionally dive as deep as 3000 m (Rice 1989). Presumed feeding events have been shown to occur at depths >1200 m (Wahlberg 2002). Sperm whales are capable of remaining submerged for longer than two hours, but most dives probably last a half hour or less (Rice 1989).

Whitehead et al. (1998) reported an average group size of 1.09 for 92 sightings of sperm whales off Nova Scotia.

Sperm whales produce acoustic clicks that are used for both echolocation and communication (Backus and Schevill 1966; Møhl et al 2000; Madsen et al. 2002b, 2002c; Wahlberg 2002; Whitehead 2003). During foraging dives sperm whales produce "usual clicks" in the frequency range of 5-24 kHz (Madsen et al. 2002b). Patterns of clicks, known as "codas" are used by socializing groups of female sperm whales (Weilgart and Whitehead 1992; Rendell and Whitehead 2003; Whitehead 2003). On their breeding grounds in the Galápagos Islands, mature males produce "slow clicks" that are likely related to mating (Whitehead 1993, 2003).

Sperm whales are known to occur in the Gulf of St. Lawrence, including the western Newfoundland offshore region (Environment Canada, n.d.). This species is generally seen only sporadically in the Gulf of St. Lawrence; however, a few individuals can be seen there on a regular basis (Reeves and Whitehead 1997). Sperm whale sightings are common in the western Newfoundland offshore region.

3.6.2.2 Northern bottlenose whale (*Hyperoodon ampullatus*)

Northern bottlenose whales live in deep water areas of the North Atlantic and are rarely found in waters less than 500 m deep (Gowans 2002). They range as far south as Nova Scotia and as far north and east as Spitzbergen, at about 80°N, 20°E; their range extends to 70°N in the Davis Strait (Mead 1989). In the western North Atlantic, there are two areas of abundance of northern bottlenose whales, one off northern Labrador and the other in a submarine canyon known as "the Gully" on the Scotian Shelf. The northern bottlenose whale is listed as *endangered* by COSEWIC (COSEWIC 2002b) and as a species of *special concern* under Schedule 3 of *SARA*; it is currently under review for listing under Schedule 1 as *endangered*.

Northern bottlenose whales routinely dive to depths greater than 800 m and are capable of remaining submerged for over an hour. Their primary prey is deep water squid (Gowans 2002). Northern bottlenose whales can be found in groups ranging in size from one to 20 individuals (Gowans 2002). Whitehead et al. (1998) reported a mean group size of 3.29 in the Gully. There is evidence that males form long-term bonds with other males that last for years, while females have a loose network of associates (Gowans 2002). Northern bottlenose whales produce whistles with a frequency range of 3-16 kHz and clicks that range in frequency from 0.5 kHz to >26 kHz (reviewed by Thomson and Richardson 1995).

Northern bottlenose whales are known to occur in the Gulf of St. Lawrence, including the western Newfoundland offshore region (Environment Canada, n.d.). However, they are likely to be uncommon in the western Newfoundland offshore region as it is not within the known areas of concentration of this species. Reeves et al. (1993) reported that there were only two known occurrences of this species in the Gulf of St. Lawrence and Wimmer and Whitehead (2004) show four stranding records from the region.

3.6.2.3 Killer whale (*Orcinus orca*)

Killer whales are cosmopolitan and globally fairly abundant; they have been observed in all oceans of the world (Ford 2002). Although they prefer cold waters, they have been reported from tropical waters as well (Heyning and Dahlheim 1988). High densities of this species occur at high latitudes, especially in areas where prey is abundant. Killer whales prey on a diverse variety of items, including marine mammals, fish, and squid. They are known to have preyed upon 20 different species of cetacean, including sperm whales and the large baleen whales, and 14 different species of pinniped (Jefferson et al. 1991). The greatest abundance of killer whales is found within 800 km of major continents (Mitchell 1975), although they also have been reported in offshore waters (Heyning and Dahlheim 1988).

Killer whales are large and conspicuous, often traveling in close-knit matrilineal groups of a few to tens of individuals (Dahlheim and Heyning 1999). Killer whales are capable of hearing high-frequency sounds, which is related to their use of these sound frequencies for echolocation (Richardson 1995). They produce whistles and calls in the frequency range of 0.5-25 kHz (reviewed by Thomson and Richardson 1995), and their hearing ranges from below 500 Hz to 120 kHz (Hall and Johnson 1972; Bain et al. 1993; Szymanski et al. 1999). The displacement of killer whales from one location to another as a result of the introduction of noise (in the form of acoustic harassment devices intended to deter harbour seal predation on fish pens) into their environment has been documented (Morton and Symonds 2002). Killer whale occurrence was re-established beginning six months after the noise source was removed.

Killer whales are known to occur throughout the Gulf of St. Lawrence, including the western Newfoundland offshore region (Environment Canada, n.d.). Their occurrence is somewhat regular near the Mingan Islands and at the western end of the Strait of Belle Isle (Baird 2001). Lien et al. (1988) reported occasional sightings of this species over a 12-year period off western Newfoundland and suggest that the population of this species in all Newfoundland waters is quite small. Based on the available information, this species is likely to be uncommon in the western Newfoundland offshore region.

3.6.2.4 Long-finned pilot whale (*Globicephala melas*)

Pilot whales are widely distributed throughout the world's oceans. There are two species of pilot whales, long-finned pilot whales and short-finned pilot whales (*Globicephala macrorhynchus*), distinguished most easily by their disparate distributions, with short-finned pilot whales being primarily tropical while long-finned pilot whales are mostly distributed antitropically (Olson and Reilly 2002). Long-finned pilot whales are abundant throughout the North Atlantic ocean to as far north as 70°N (Bernard and Reilly 1999), with some evidence of segregation between the western and eastern North Atlantic (Bloch and Lastein 1993).

Pilot whales exhibit great sexual dimorphism; males are longer than females and have more pronounced melons and larger dorsal fins (Olson and Reilly 2002). Molecular evidence suggests that pilot whale pods are composed of related individuals with little or no dispersal of either males or females from their natal group (Amos et al. 1993). Pilot whales pods are known to strand frequently en masse. Whitehead et al. (1998) reported an average group size of 11.44 for 54 sightings of long-finned pilot whales off Nova Scotia. Long-finned pilot whales produce whistles with dominant frequencies in the range of 1-8 kHz and echolocate using clicks with frequencies ranging from 6-11 kHz (reviewed by Thomson and Richardson 1995).

During an aerial survey from late August to early September of 1995, long-finned pilot whales were seen in the southeastern portion of the Gulf of St. Lawrence, near Cape Breton Island and southwestern Newfoundland (Kingsley and Reeves 1998). This species occurs regularly in that region and can be considered common in the western Newfoundland offshore region. Sightings in the region occurred in deep water with steep bottom topography (Kingsley and Reeves 1998).

Lynch (1987) provided summer (June-September) sighting frequencies that ranged from zero to 1.07 pilot whale sightings per week of land-based observations in survey blocks encompassing the western Newfoundland offshore region in 1979-1982. The highest rate (1.07 sightings per week) was reported for the central portion of the region, while no pilot whales were sighted in the St. George's Bay area. An intermediate rate of 0.35 sightings per week was reported for the northern portion of the western Newfoundland offshore region. Lynch (1987) also reported sighting rates of 0.08 and 0.15 pilot whale sightings per track line surveyed during 470 nautical miles of shipboard survey effort in the 1° × 1° square from 48°N to 49°N and 60°W to 59°W and 395 nautical miles of shipboard survey effort in the 1° × 1° square from 49°N to 50°N and 59°W to 58°W, respectively, in 1976-1983.

3.6.2.5 Beluga whale (*Delphinapterus leucas*)

The beluga whale, or white whale, is generally limited to seasonally ice-covered Arctic and sub-Arctic waters (Lesage and Kingsley 1998). The St. Lawrence population of beluga whales is at the southern limit of distribution of this species worldwide and seems to be isolated from its more northern conspecifics (Lesage and Kingsley 1998). This population has been estimated at 900-1,000 individuals and is considered *threatened* by COSEWIC (COSEWIC 2004) and *SARA*.

Beluga whales (*Delphinapterus leucas*) could potentially occur in the western Newfoundland and Labrador offshore region, but their presence is likely to be rare. They are thought to be confined, for the most part, to the St. Lawrence Estuary and Saguenay Fjord within the St. Lawrence region (Environment Canada n.d.); however, they occasionally range much further (e.g., Brown Gladden et al. 1999). Curren and Lien (1998) report only three sightings of live beluga whales, including one mother and calf pair, and two beluga whale strandings off western Newfoundland from 1979-1992.

3.6.2.6 Atlantic white-sided dolphin (*Lagenorhynchus acutus*)

Atlantic white-sided dolphins occur in temperate and sub-Arctic portions of the North Atlantic, where they are quite abundant (Reeves et al. 1999a). The total population of Atlantic white-sided dolphins in the North Atlantic may be as high as a few hundred thousand (Reeves et al 1999a). Evidence suggests that there may be three distinct populations of Atlantic white-sided dolphins in the western North Atlantic—Gulf of Maine, Gulf of St. Lawrence, and Labrador Sea (Palka et al. 1997).

Atlantic white-sided dolphins are fairly gregarious, commonly seen in groups of 50-60 and occasionally seen in groups numbering hundreds of individuals (Reeves et al. 1999a). Whitehead et al. (1998) reported a mean group size of 8.8 for this species off Nova Scotia. Atlantic white-sided dolphins produce whistles with dominant frequencies between 6 and 15 kHz (reviewed by Thomson and Richardson 1995).

Atlantic white-sided dolphins can be seen throughout the Gulf of St. Lawrence; however, most sightings of this species occur in areas with steep bottom topography along the margins of the Gulf (Kingsley and Reeves 1998). This species was seen frequently during aerial surveys from late August to early September of 1995, which provided an abundance estimate of 12,000 animals for the entire Gulf; however, surveys from the following year suggest that the number of these animals that visits the Gulf varies greatly from year to year (Kingsley and Reeves 1998). Atlantic white-sided dolphins were sighted often off southwest Newfoundland during those surveys, and this species is likely to be common in the western Newfoundland offshore region.

3.6.2.7 White-beaked dolphin (*Lagenorhynchus albirostris*)

White-beaked dolphins are found in cold temperate and sub-Arctic waters in the North Atlantic (Reeves et al. 1999b). Populations in the eastern and western North Atlantic appear to be distinct (Kinze 2002). White-beaked dolphins are less abundant in the western North Atlantic than in the eastern portion of their range, with the greatest abundances occurring in this region off Labrador and southwest Greenland (Kinze 2002). White-beaked dolphins occur in schools up to several hundreds or thousands in number, although groups of 30 animals or so are most common (Kinze 2002). White-beaked dolphins produce squeals with a dominant frequency range of 8-12 kHz and echolocate at frequencies up to 325 kHz (reviewed by Thomson and Richardson 1995).

Within the Gulf of St. Lawrence, white-beaked dolphins are seen almost exclusively in shallow waters (<100 m deep) in the northeast corner of the Gulf near the Strait of Belle Isle (Kingsley and Reeves 1998). Aerial surveys from late August to early September of 1995 and from late July to early August of 1996 provided an abundance estimate of approximately 2500 of these animals for the entire Gulf (Kingsley and Reeves 1998). However, white-beaked dolphins are likely to be uncommon in the western Newfoundland offshore region. Hai et al. (1996) reported one stranding of three white-beaked dolphins in St. George's Bay during 1979-1990.

3.6.2.8 Harbour porpoise (*Phocoena phocoena*)

The harbour porpoise is found in shelf waters throughout the northern hemisphere, usually in waters colder than 17°C (Read 1999). The northernmost limit of their range is 70°N, but they are present in northern coastal waters only during the summer months (IWC 1996). Harbour porpoises in the western North Atlantic have been divided into three different subpopulations—Bay of Fundy–Gulf of Maine, Gulf of St. Lawrence, and Newfoundland—on the basis of mtDNA genetic differences (Wang et al. 1996) and pollutant burden (Westgate and Tolley 1999). The boundaries between these populations are not well defined as there is some genetic overlap. The Northwest Atlantic harbour porpoise is listed under Schedule 2 of *SARA* as *threatened* and is currently under consideration for listing under Schedule 1.

Harbour porpoises are usually seen in small groups of one to three animals, often including at least one calf; occasionally they form much larger groups (Bjørge and Tolley 2002). Harbour porpoises feed independently on small schooling fishes (Read 1999) and echolocate using frequencies in the range of 110-150 kHz (reviewed by Thomson and Richardson 1995). The range of their most sensitive hearing is from 8-32 kHz (Read 1999).

Harbour porpoises were seen throughout the Gulf of St. Lawrence during aerial surveys from late August to early September of 1995 and from late July to early August of 1996 (Kingsley and Reeves 1998). They were most numerous in the northern portion of the Gulf but were also widely distributed in the southern and central Gulf. Sightings data collected during those surveys provided estimates of 12,000 and 21,000 harbour porpoises, respectively, for the entire Gulf during those two years (Kingsley and Reeves 1998). This species was seen frequently during those surveys in waters off central and southwestern Newfoundland and is likely to be common in the western Newfoundland offshore region.

3.6.3 Pinnipeds

3.6.3.1 Harbour seal (*Phoca vitulina*)

Harbour seals have one of the largest distributions of any pinniped. They can be found in most coastal waters of the North Atlantic and North Pacific to as far north as about 80°N off Spitzbergen (Bigg 1981). This species has been divided into five different subspecies (Burns 2002). Western North Atlantic harbour seals belong to the subspecies *P. vitulina concolor*. The population of harbour seals in eastern Canadian waters was estimated at 30,000-40,000 in 1993 (Burns 2002). Harbour seals are present throughout the Gulf of St. Lawrence and are the only year-round residents of the St. Lawrence Estuary (MLI 1999). Harbour seal distribution is continuous throughout the Gulf of St. Lawrence (Burns 2002), and this species is likely to be common in the western Newfoundland offshore region. The harbour seal is considered *data deficient* by COSEWIC (Table 3.15).

3.6.3.2 Harp seal (*Phoca groenlandica*)

Harp seals range throughout the North Atlantic and Arctic Oceans from the Gulf of St. Lawrence to Russia (Lavigne 2002). They are one of the most abundant pinniped species, with an estimated population size in 2000 of 5.2 million (95% C.I. = 4.0-6.4 million) in the Northwest Atlantic (Healey and Stenson 2000). This population size appears to have been stable since 1996. Harp seals that whelp in the Northwest Atlantic (in the Gulf of St. Lawrence and off southern Labrador/northern Newfoundland) are genetically distinct from those that whelp in the northeast Atlantic (Perry et al. 2000).

The Northwest Atlantic harp seal population summers in the Canadian Arctic and Greenland, migrating south to the Gulf of St. Lawrence or off southern Labrador and northern Newfoundland where pups are born on the ice in late February or March (DFO 2000). Females nurse their pups for about 12 days, then mate and disperse. Older seals aggregate to moult off northeastern Newfoundland and in the northern Gulf of St. Lawrence in April and May. After that time, they disperse and migrate northward (DFO 2000). Harp seals dive to a maximum of about 370 m, and dives can last for up to 16 minutes (reviewed by Schreer and Kovacs 1997). Harp seals produce sounds in the frequency range of <0.1 to >10 kHz (reviewed by Thomson and Richardson 1995).

Pupping in the Gulf of St. Lawrence occurs in the southern portion of the Gulf, north of Prince Edward Island, in late February or March, and moulting occurs in northern portions of the Gulf in April and May (DFO 2000; Lavigne 2002). Harp seals are likely to be common in the western Newfoundland offshore region in the late fall to early spring and rare during other times of the year.

3.6.3.3 Hooded seal (*Cystophora cristata*)

The range of the hooded seal encompasses a large portion of the North Atlantic from as far south as Nova Scotia to as far north as north of Svalbard in the Barents Sea (Kovacs 2002). It is not uncommon for hooded seals, particularly young animals, to be found outside their normal range. Hooded seals are migratory, congregating to breed in spring in the Gulf of St. Lawrence, north of Newfoundland, in the Davis Strait, and east of Greenland (Kovacs 2002). After breeding, hooded seals move to moulting areas on the southeast and northeast coasts of Greenland. Hooded seals disperse widely in the summer and fall (Kovacs 2002). There are no good estimates of the hooded seal population size because this species is difficult to survey, but the total population probably numbers on the order of half a million (Kovacs 2002).

The hooded seal breeding season lasts only 2-3 weeks in each area. Females give birth in loose pack ice areas and nurse their pups for a mere four days, during which time the pups consume up to 10 litres of milk per day (Kovacs 2002). Mating occurs in the water after weaning. Hooded seals are quite solitary outside the breeding season and, as a result, their vocal repertoire is quite simple (Kovacs 2002). They produce sounds in the frequency range of 0.1-1.2 kHz (reviewed by Thomson and Richardson 1995).

Hooded seals gather in the Gulf of St. Lawrence in the spring to breed, then migrate toward Greenland to moult several weeks later and are dispersed widely during the rest of the year (Kovacs 2002). Whelping occurs in the southern portion of the Gulf near the Magdalen Islands, Prince Edward Island, and Cape Breton Island (Hammill 1993). Only a small proportion of the hooded seal population visits the Gulf, with the bulk of the population whelping off northeast Newfoundland and in the Davis Strait (Hammill 1993). Hooded seals are likely to be common in the Newfoundland offshore region in the spring and rare during other times of the year.

3.6.3.4 Grey seal (*Halichoerus grypus*)

Grey seals are distributed in coastal areas of the North Atlantic, off eastern Canada, Iceland, the United Kingdom, and Norway during the breeding season from September to December (Bonner 1981). Outside the breeding season, they range farther. Large-scale movements up to 2,100 km have been demonstrated (NAMMCO 1997). The Northwest Atlantic stock of grey seals occurs in the Gulf of St. Lawrence and around Nova Scotia and Newfoundland and Labrador. The largest breeding colony in the North Atlantic is on Sable Island, east of Nova Scotia, with about 85,000 individuals (Hall 2002). Stocks of grey seals in the northeastern and Northwestern Atlantic are thought to be genetically distinct (NAMMCO 1997).

Female grey seals give birth between September and March (Hall 2002). In Canada, the peak pupping season occurs in January (Hall 2002). Pups are nursed for approximately 18 days and the female mates again near the end of the lactation period either on land or in the water (Hall 2002). Grey seals from Sable Island disperse after the breeding period, moult during May-June, and move northward during July-September, returning to Sable Island to breed in October-December (Stobo and Zwanenburg 1990). Most grey seals likely return to breed in the same area where they were born (Bonner 1981). Grey seal dives last, on average, from 4-10 minutes, with a maximum duration of 30 minutes (Hall 2002). Grey seals produce sounds in the frequency range of 0.1-16 kHz (reviewed by Thomson and Richardson 1995).

Grey seals gather in breeding colonies from October to December; in the Gulf of St. Lawrence, these are located between the eastern end of Prince Edward Island and Cape Breton Island, mainly on Amet Island, and on the ice in St. George's Bay (Stobo and Zwanenburg 1990). They disperse following the breeding season, from January to April, but during the moulting season in May and throughout the summer, grey seals are also seen on Anticosti Island (Stobo and Zwanenburg 1990). The Gulf of St. Lawrence population of grey seals has been estimated at 69,000 animals (Hall 2002). This species is likely to be common in the Newfoundland offshore region.

3.6.4 Sea Turtles

Three species of sea turtle could potentially occur in the Western Newfoundland and Labrador Offshore Area (Table 3.16). In order of decreasing abundance in North American waters, these are as follow: (1) the loggerhead turtle (*Caretta caretta*), (2) the leatherback turtle (*Dermochelys coriacea*), and (3) the Kemp's ridley turtle (*Lepidochelys kempii*). Both loggerheads and leatherbacks are common in the waters off Newfoundland during the summer and fall (Goff and Lien 1988; Marquez 1990; Witzell 1999). Less is known about the distribution of Kemp's ridley turtles in eastern Canada, although they are thought to be rare (Breeze et al. 2002). Adults of this species are rarely found beyond the Gulf of Mexico; however, juvenile animals range as far north as Newfoundland (Ernst et al. 1994).

Table 3.16. The Habitat, Abundance, and Conservation Status of Sea Turtles Found in the Western Newfoundland and Labrador Offshore Area.

Species	**Occurrence in Study Area**	***SARA* status***
Leatherback turtle (*Dermochelys coriacea*)	Seasonally common	Schedule 1: *Endangered*
Loggerhead turtle (*Caretta caretta*)	Uncommon	Not Listed
Kemp's ridley turtle (*Lepidochelys kempii*)	Very rare, only juveniles	Not Listed

*Species designation under *SARA* (Government of Canada 2005).

3.6.4.1 Leatherback Turtle (*Dermochelys coriacea*)

The leatherback is the largest living turtle, attaining up to 219 cm in length and over 900 kg. It also may be the most widely distributed reptile, ranging throughout the Atlantic, Pacific, and Indian Oceans and into the Mediterranean Sea (Ernst et al. 1994). Leatherbacks are predominantly pelagic and are highly carnivorous, consuming mostly invertebrates. Although they occasionally ingest algae or vertebrates, their preferred prey is jellyfish.

The worldwide population of leatherbacks was recently censused at between 26,000 and 43,000 (Dutton et al. 1999). This number, not far from the evolutionary effective population size, is estimated to be between 45,700 and 60,000 calculated from observed genetic diversity (Dutton et al. 1999). The current population is thought to be declining, as major nesting colonies have declined in the last 20 years, although Dutton et al. (1999) report an increase in leatherbacks nesting in Florida over the last few years. There are no estimates of the population size in Canada; however, adult leatherbacks are thought to be a regular part of the Newfoundland marine fauna in the summer and fall (Goff and Lien 1988; Witzell 1999). The leatherback turtle is listed under Schedule 1 of *SARA* as *endangered*.

Data from the U.S. Pelagic longline fishery observer program have added to the knowledge of leatherback distribution off Newfoundland (Witzell 1999). Nearly half of the leatherbacks (593 captures) caught incidentally by this fishery between 1992 and 1995 from the Caribbean to Labrador were captured in waters on and east of the 200-m isobath off the Grand Banks (Witzell 1999). Animals were caught in this region during all months from June to November, with the bulk of captures from July to September. Not surprisingly, leatherback captures within these waters corresponded closely with fishing effort, both clustered near the 200-m isobath. Two leatherback turtles were sighted during a shipboard survey east of the Scotian Shelf out to the Laurentian Channel in 2002 (Clapham and Wenzel 2002). Breeze et al. (2002) state that adult leatherback turtles are regularly observed on the Scotian Shelf from June to October. Goff and Lien (1988) report three captures of leatherback turtles off west and southwest Newfoundland from 1976-1985. This species is occasionally sighted off Quebec in the Gulf of St. Lawrence (James 2001). Although there are no estimates available for the number of leatherback turtles in the western Newfoundland offshore region, they are likely a regular part of the marine fauna in the area.

3.6.4.2 Loggerhead Turtle (*Caretta caretta*)

The loggerhead is the largest hard-shelled turtle in the world (typically 85–100 cm) and also the most abundant sea turtle in North American waters (Ernst et al. 1994). They wander widely throughout their range, found in coastal areas or sometimes more than 200 km out to sea. Loggerheads are omnivorous, predominantly consuming many types of invertebrates but also algae and vascular plants (Ernst et al. 1994). The North American population, which is thought to be declining, has been estimated to number between 9,000 and 50,000 adults (Ernst et al. 1994). This species is classified as *threatened* under the U.S. ESA.

Loggerheads found in Canadian waters tend to be smaller than their counterparts in coastal U.S. waters (Witzell 1999), so are likely younger animals. Ninety percent of females nesting in the Atlantic do so in the southeastern U.S. in what appear to be demographically independent groups based on mitochondrial DNA haplotype distributions (Encalada et al. 1998). How genetic distinctions in nesting areas may relate to genetic structure elsewhere in their range has not been investigated.

Data from the U.S. Pelagic longline fishery observer program have added to the knowledge of loggerhead distribution off Newfoundland (Witzell 1999). Seventy percent of loggerheads (936 captures) caught incidentally by this fishery between 1992 and 1995 from the Caribbean to Labrador were captured in waters on and east of the 200-m isobath off the Grand Banks. Animals were caught in this region during all months from June to November with a peak in captures during September. Within these waters, loggerhead captures corresponded closely with fishing effort, both being clustered near the 200-m isobath where oceanographic features lead to the concentration of prey species for both the turtles and the swordfish and tuna that are the targets of the longline fishers.

Loggerheads are not observed as frequently as leatherbacks on the Scotian Shelf (Breeze et al. 2002). Although there are no estimates available for the density of loggerhead turtles in the western Newfoundland offshore region, they are likely to be rare.

3.6.4.3 Kemp's Ridley Turtle (*Lepidochelys kempii*)

Adult Kemp's ridley turtles rarely range beyond the Gulf of Mexico, but juveniles can be found as far north as Newfoundland on the east coast of North America (Ernst et al. 1994). There are no estimates on the number of Kemp's ridley turtles occurring in Canadian waters. Breeze et al. (2002) list them as accidental visitors to eastern Canada and state that the Scotian Shelf is not believed to an important habitat for them. Almost all nesting of Kemp's ridleys occurs along a single beach in Rancho Nuevo, Mexico. The number of females nesting there dropped from as many as 40,000 over 50 years ago to a low of around 700 in the late 1980s, but saw a steady increase in the 1990s as a result of conservation measures (Marquez et al. 1999). The number of Kemp's ridleys that visit the western Newfoundland offshore region is unknown, but this species is likely to be extremely rare. Kemp's ridley turtles are considered *endangered* under the U.S. ESA.

3.6.5 Planning Implications for Marine Mammals and Sea Turtles

For most exploration, delineation and production drilling operations, the C-NLOPB has required that the operator undertake whale monitoring from drilling rigs during the drilling program. For seismic programs, it has been a standard mitigative measure in recent years to conduct marine mammal monitoring for all seismic programs in the Newfoundland and Labrador offshore area. Observational data on sea turtles in conjunction with any marine mammal monitoring will be required.

Marine mammal and sea turtle species with special consideration under *SARA* are the blue whale, North Atlantic right whale, fin whale, northern bottlenose whale, beluga whale and harbor porpoise. Of greatest concern are the blue whale, the North Atlantic right whale, the St. Lawrence Estuary population of the beluga whale, and the leatherback sea turtle, which are all listed under Schedule 1 of *SARA*. Blue whales, North Atlantic right whales and leatherback sea turtles are all listed as *endangered*. The St. Lawrence Estuary population of the beluga is listed as *threatened*.

3.7 Species at Risk

All of the following *SARA*, COSEWIC, and Government of Newfoundland and Labrador “species at risk” designations are current as of 30 August 2005.

3.7.1 *SARA*

Schedule 1 of *SARA* is the official list of wildlife species in Canada that have legal protection and conservation requirements. Once a species is listed, measures to protect it and help its recovery are implemented.

Species that are legally protected under *SARA* (i.e., Schedule 1 *threatened* or *endangered*) and that may occur in the Study Area include the following:

- Blue whale (*Balaenoptera musculus*) (Atlantic population) – *endangered*
- North Atlantic right whale (*Eubalaena glacialis*) – *endangered*
- Piping Plover (*Charadrius melodus melodus*) – *endangered*
- Leatherback sea turtle (*Dermochelys coriacea*) – *endangered*
- Northern wolffish (*Anarhichas denticulatus*) – *threatened*
- Spotted wolffish (*Anarhichas minor*) – *threatened*
- Beluga whale (*Delphinapterus leucas*) (St. Lawrence Estuary population) – *threatened*

Atlantic wolffish (*Anarhichas lupus*) and the Ivory gull (*Pagophila eburnea*) are presently listed as *special concern* on Schedule 1 of *SARA*. Schedules 2 and 3 of *SARA* identify species that were designated 'at risk' by COSEWIC prior to October 1999 and must be reassessed using revised criteria before they can be considered for addition to Schedule 1.

Under *SARA* Schedule 1, a 'recovery strategy' and corresponding 'action plan' must be prepared for *endangered*, *threatened* and extirpated species, and a management plan must be prepared for species listed as *special concern*. Currently, there are no recovery strategies, action plans, or management plans in place for species listed under Schedule 1 and are known to occur in the Study Area. It is possible that a Recovery Strategy will soon be in place for blue whales (J. Lawson, DFO, pers. comm.).

3.7.2 COSEWIC

COSEWIC have also designated some species as either *endangered* or *threatened* that do not occur on the *SARA* listing as either *endangered* or *threatened*. These COSEWIC-listed species that may occur in the Study Area include the following:

- Porbeagle shark (*Lamna nasus*) – *endangered*
- Winter skate (*Leucoraja ocellata*) (Southern Gulf of St. Lawrence population) – *endangered*
- Striped bass (*Morone saxitilis*) (Southern Gulf of St. Lawrence population) – *threatened*
- Atlantic cod (*Gadus morhua*) – *threatened*
- Cusk (*Brosme brosme*) – *threatened*

3.7.3 Government of Newfoundland and Labrador

Species that are listed as "at risk" by the Government of Newfoundland and Labrador and that may occur in the Study Area include the following:

- Banded killifish (*Fundulus diaphanus*) – vulnerable
- Ivory Gull (*Pagophila eburnea*) – vulnerable
- Harlequin Duck (*Histrionucus histrionucus*) – vulnerable
- Piping Plover (*Charadrius melodus melodus*) – *endangered*

The Newfoundland and Labrador population of the banded killifish is presently listed as a species of *special concern* on Schedule 1 of *SARA*. It is found in seven locations in Newfoundland and Labrador, including the west coast of the island. This small fish mostly occurs in freshwater, rarely in estuarine or marine areas.

3.7.4 Planning Implications for Species at Risk

Operators are required to be *SARA*-compliant over the lifespan of a project. Mitigations currently being employed include delayed ramp-up of seismic arrays when a marine mammal or sea turtle designated as either *endangered* or *threatened* under *SARA* Schedule 1 is within either 500 or 1,000 m of the seismic array, and shutdown of operating seismic arrays when a marine mammal or sea turtle designated as either *endangered* or *threatened* under *SARA* Schedule 1 is within either 500 or 1,000 m of the seismic array. The radius of the monitoring safety zone is project-specific. Any marine mammals or sea turtles that become listed on *SARA* Schedule 1 as *endangered* or *threatened* during an ongoing project immediately qualify as species requiring the above mitigations.

It is also important that operators use spatial and temporal scheduling mitigations to avoid critical life stages of Species at Risk. This mitigation applies to invertebrate, fish and bird species as well as to marine mammals and sea turtles.

Critical habitat of Species at Risk is also protected under *SARA*. The protection of critical habitats is a major aspect of *SARA* Recovery Strategies (e.g., identified Piping Plover critical habitat sites in the southern part of the Study Area). Mitigations to protect critical habitat in such areas will have to be employed and monitored.

3.7.5 Data Gaps for Species at Risk

As is the case with most marine biota, much of the basic biological information related to species identified as being at risk is lacking (e.g., critical habitat, movement patterns, inter-relationships with other species, critical life stage behaviours). More scientific research is required to address knowledge gaps which deter the effective implementation of recovery strategies. Collaborative efforts involving industry and government could potentially fill some of the data gaps for Species at Risk and introduce GIS or web-based information tools, thereby providing more of an ecosystem perspective rather than data for individual species only.

3.8 Potentially Sensitive Areas

Key areas of highest potential sensitivity have been identified within the Study Area. The locations of the potentially sensitive areas discussed in the following sections are indicated in Figure 3.70.

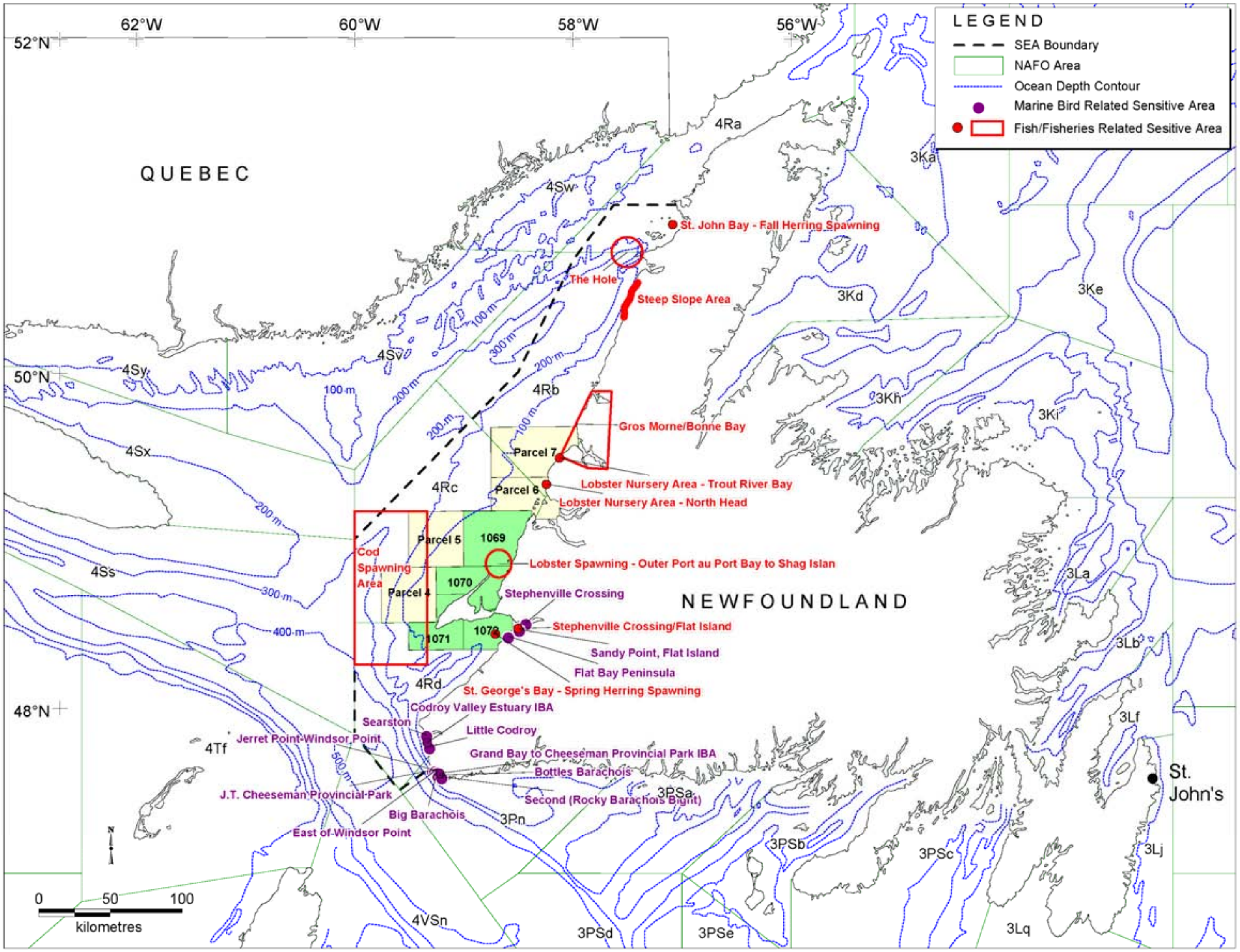


Figure 3.70. Potentially Sensitive Areas within the Study Area.

3.8.1 Fish and Invertebrates

3.8.1.1 Slope Region (4Ra/4Rb)

A steep slope area at the northern end of the Esquiman Channel and just offshore from Port au Choix (4Rab) is known locally as 'The Hole'. This area is considered by local fishers to be quite productive and, therefore, a very sensitive fisheries resource zone throughout the year. Various life stages of numerous species (e.g., cod, capelin, shrimp) occur at The Hole, including juveniles, adults, and likely eggs and larvae. According to fishers, DFO has been considering this area as a candidate for a Marine Protected Area.

Another relatively steep slope area which occurs close to shore between Bellburns and River of Ponds (~ 15 km south of Port au Choix) is also considered special by local fishers. As with The Hole, there is likely upwelling in the area, resulting in the occurrence of various life stages of numerous species.

Another steep slope area within the Study Area occurs in the southern portion of 4Rd.

3.8.1.2 4Rc/4Rd Cod Spawning Area off Cape St. George

The region defined by the following corner coordinates is closed to groundfish fishing between 1 April and 23 June because of the occurrence of spawning by 4RS/3Pn cod. The area was established in 2002 and has been resized since that time. Corner coordinates of the Cape St. George Spawning Area are as follow:

48º 00' N, 59º 20' W
49º 10' N, 59º 20' W
49º 10' N, 60º 00' W
48º 00' N, 60º 00' W

Depths within the area range from just under 100 m to more than 300 m. The Cape St. George Spawning Area overlaps with portions of Bid Parcels 4 and 5 and EL 1071.

St. George's Bay (4Rd)

Spring spawning by herring typically occurs in this bay in May/June

St. John Bay (4Ra)

Fall spawning by herring typically occurs in this bay between mid-July and mid-September.

Lobster Spawning/Nursery Areas (4Rbc)

Although lobster essentially spawn along the entire west coast of Newfoundland, particular areas have been designated as special spawning and nursery locations. The area between outer Port au Port Bay and Shag Island was identified as a location with very large female lobsters carrying sizeable egg clutches. Two other areas along the coast north of Bay of Islands are now closed to fishing because of their roles as lobster nursery areas.

3.8.2 Marine-associated Birds

3.8.2.1 Critical Habitat of Piping Plover (UA 4Rd)

In the proposed draft recovery strategy for Piping Plover, Amirault (2005) identified numerous sites within or proximate to the Study Area that meet Piping Plover critical habitat criteria. All are located in Unit Area 4Rd. They are as follow:

- Stephenville Crossing (48.50ºN, 58.43ºW)
- Sandy Point, Flat Island (48.46ºN, 58.49ºW)
- Flat Bay Peninsula (48.42ºN, 58.59ºW)
- Searston (47.83ºN, 59.34ºW)
- Little Codroy (47.76ºN, 59.31ºW)
- East of Windsor Point (47.62ºN, 59.25ºW)
- J.T. Cheeseman Provincial Park (47.62ºN, 59.28ºW)
- Jerret Point-Windsor Point (47.62ºN, 59.26ºW)
- Big Barachois (47.61ºN, 59.24ºW)
- Bottles Barachois (47.59ºN, 59.23ºW)
- Second (Rocky Barachois Bight) (47.58ºN, 59.20ºW)

Amirault (2005) also describes Action Plans that include the identification of sites presently not occupied by Piping Plover but which may eventually be identified as Piping Plover critical habitat.

3.8.2.2 Sandy Point, St. George's Bay (UA 4Rd)

Four hectares (10 acres) of property on Sandy Point were acquired by the Nature Conservancy of Canada in 2005. Sandy Point has tidal sand flats, sand beaches, and dunes, habitats that are relatively uncommon in Newfoundland and Labrador. One of eastern North America's largest and most northerly *Spartina* salt marshes also occurs on this property. Approximately 30% of the nationally *endangered* Piping Plover population in Newfoundland occurs in this area. Sandy Point is also important habitat for migrating birds, including American Widgeon, American Black Duck, Green-winged Teal, Red-breasted Merganser, Northern Pintail, Greater Scaup, White-winged Scoter and Common Goldeneye. Until July

2005, Sandy Point was the only known nesting location of the Willet (*Catoptrophorus semipalmatus*) in Newfoundland. Twelve rare species of plants also occur in this area, including seabeach sedge and saltwater cordgrass (Georgian, 12-18 July 2005).

3.8.2.3 Grand Codroy Estuary (UA 4Rd)

The Grand Codroy Estuary is on the Ramsar List which acknowledges wetlands of international importance. It is the only Newfoundland and Labrador wetland among the 37 Canadian wetlands listed by Ramsar (http://www.ramsar.org/index_list.htm).

Grand Codroy is one of the most productive of Newfoundland's few estuarine wetland sites. Portions of the intertidal area are heavily vegetated with eelgrass (*Zostera marina*), an important food source for up to 3,000 Canada Geese (*Branta canadensis*) during fall and early winter, and for up to 1,000 American Black Ducks (*Anas rubripes*) in late September. Small concentrations of shorebirds use the intertidal bars and flats in late summer.

On either side of the Grand Codroy River lies shallow brackish wetland with mudflats and sandbars exposed at low tide. The mouth of the estuary is separated from the open ocean (Searston Bay) by a one kilometre long sand spit which is vegetated by dune grass (*Ammophila* sp.). Other notable bird species occurring here include Northern Pintails (*Anas acuta*), Green-winged Teal (*A. crecca*), American Widgeon (*A. americanus*), and Greater Scaup (*Aythya marila*). Piping plover (*Charadrius melodus*) were reported to be nesting on the sandbar at the mouth of the estuary in 1992 but none have been sighted since.

3.8.2.4 Stephenville Crossing (UA 4Rd)

Stephenville Crossing is the most significant North American breeding location of the Black-headed Gull (5 to 15 breeding pairs as of July). Nineteen juveniles were sighted on 13 July 2005 (B. Mactavish, pers. comm.). It was determined in July 2005 that the tidal marsh at Stephenville Crossing is now a nesting location for Willets. Two breeding pairs, one with four downy young, were sighted (B. Mactavish, pers. comm.).

Other significant bird sightings at the Stephenville Crossing tidal marsh in June/July 2005 include the Western Reef Heron (first Canadian and second North American sighting of this African/Middle Eastern bird), the Little Egret (fifth Newfoundland sighting of this European bird) which is rare in North America, and the Bar-tailed Godwit (second Newfoundland sighting of this primarily Eurasian bird) which is rare in Canada and breeds in Alaska (B. Mactavish, pers. comm.).

According to the Natural History Society of Newfoundland and Labrador Inc., 195 bird species are listed for Stephenville Crossing, not all directly associated with the estuarine and marine environment.

3.8.2.4 IBAs

Three coastal sites in the west-southwest Newfoundland have been designated IBAs: (1) Codroy Valley Estuary (NF041) (Unit Area 4Rd), (2) Grand Bay West to Cheeseman Provincial Park (NF038) (Unit Area 4Rd), and (3) NF045 – Gros Morne National Park (Unit Area 4Rb; Parcel 7). These three IBAs on the west-southwest coast of Newfoundland rank low in 'IBA Population Threshold' score compared with other Newfoundland IBAs (see www.ibacanada.com). See Section 3.5.4 for more details.

3.8.3 Gros Morne National Park (UA 4Rb)

Gros Morne National Park was declared a UNESCO World Heritage Site in 1987 (http://whc.unesco.org/). Some of the unique areas within and adjacent to Gros Morne include Bonne Bay, Western Brook Pond and St. Paul's Bay (http://www.grosmorne.ca/). Bonne Bay and the area immediately north of it are considered 'hotspots' for various shorebirds.

3.8.4 Planning Implications for Potentially Sensitive Areas

Operators should be aware of the potentially sensitive areas within the Study Area. The Bid Parcels overlap with only some of the identified sensitive areas (i.e., Cod Spawning Area, the lobster spawning/nursery areas and Gros Morne/Bonne Bay. However, future Parcels out for bids may be located at or near other sensitive areas, particularly those identified for marine-associated birds. Depending on the sensitive area, various mitigations would be employed to minimize impact on the area. These mitigations have been discussed in the relevant sections.

3.8.5 Data Gaps for Potentially Sensitive Areas

As discussed in the previous sections, data gaps relating to both the physical and biological environment are numerous. Later sections of the SEA discuss the knowledge gaps relating to the potential effects of oil and gas exploratory and production activities on the environment. All of these data gaps apply to the potentially sensitive areas.