Northwest Atlantic Fisheries Organization

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Canadian Research Report for 2003

Part I – Newfoundland and Labrador Region – submitted by D. Richards
Part II – Central and Arctic Region – submitted by M. Treble, T. Siferd and S. Cosens

# PART I. Newfoundland and Labrador Region

By

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## SUBAREAS 0 AND 1

## A. Status of the Fisheries

Nominal landings from 1993 to 2003 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

*a) Shrimp*-Div. 0AB

Between 1991 and 1996, the *Pandalus borealis* quota in Division 0A was set at 8500 t. Between 1997 and 2001 the quota varied between 7,650 and 9,350 t. The quota increased to 12,040 t and then 14,167 t during 2002 and 2003 respectively. The 2003 quota will be maintained during 2004. Annual catches of 4,800-7,500 t were made between 1991 and 1994, but have since fluctuated between 500 and 6,250 t.

Catches of *Pandalus borealis* in Div. 0B increased from about 2,800 t in 1988 to 3,000 t in 1989 but subsequently declined to 100 t in 1993. The 1994, catch was less than 500 t; however, catches increased substantially to about 3,600 and 3,200 t in 1995 and 1996, respectively and to more than 5,000 t each year from 1997 to 1999. Approximately 5,800 t and 5,500 t were caught during 2001 and 2002 respectively while preliminary data indicate that about 4,400 t were taken in 2003.

Recent catches for the species have been estimated, in part, from the mixed fishery data for *P. borealis/ montagui* in the area east of Resolution Island but their accuracy is questionable. *Pandalus borealis* taken in the immediately adjacent areas of Hudson Strait, Ungava Bay and NAFO Div. 2G were included in the catches reported for Div. 0B. TAC's remained at 3,500 t from 1989 to 1996 but were increased experimentally to 5,250 t for 1997 and 1998. In 1999, an additional 3,500 t were provided for the area north of 63°N as an incentive for the offshore fleet to return to grounds not fished extensively since 1995. However, just over 100 t were taken within this area in 1999. In 2000, the additional 3,500 t were not included in the quota report, and accordingly the catch was not counted against the TAC for the south (5,383 t). In 2001, the additional 3,500 t were included in the quota report as an exploratory quota east of 63°W. This quota for *Pandalus borealis* was maintained in 2003 and 2004 while a new exploratory quota of 2,000 t was allotted for *P. montagui*. The exploratory quota for *P. montagui* was to be fished within the Nunavut Settlement Area (NSA).

The standardized annual CPUE showed an overall decline from 1988 to 1993. Catch rates increased sharply from 1993 to 1998. The model was standardized for year, month and vessel effects with effort weighting and accounted for 77% of the variance in data. The 1998 and 2000-2002 indices were statistically similar ($P>0.05$) to the 2003 estimate while others were significantly lower than the 2003 estimate ($P<0.05$). Even though the commercial CPUE has been stable at a high level since 1998, it may not be reflective of stock status due to fishing constraints associated with the overlapping distributions of *Pandalus borealis* and *P. montagui*.

The Greenland halibut resource within Subarea 0+1 is considered to be part of a common stock distributed in Davis Strait and south to Subarea 3. The resource within the area, with the exception of Div. 1A inshore, is managed jointly by Canada and Denmark (Greenland), with the TAC being split equally. Since 2000, NAFO Scientific Council has provided separate TAC advice for offshore areas of Div. 0A+1A based on the unresolved relationship with the remaining areas. In 2002, the Scientific Council advised a catch in 2003 of 8,000 t for 0A+1A offshore and 11,000 t for 0B+1B-1F. Canada (NL) catches for 2003 were approximately 4,200 t with 2,400 t taken by otter trawls, 1,200 t with gillnets and 600 t by longline. Recent scientific information on this stock is limited. The most recent surveys were completed in Div. 0A and 0B in 2001 and Div. 1C and 1D in 2002. In 2003, the Scientific Council recommended that Div. 1B be included in the management area with Div. 0A and Div. 1A with a TAC of 8,000 t. The Council also recommended, based on relative stability in biomass and CPUE indices that for Div. 0B and Div. 1C-1F the TAC should not exceed 11,000 t for 2004.

## SUBAREA 2

### A. Status of the Fisheries

Nominal landings from 1993 to 2003 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

a) *Atlantic salmon*

The commercial fishery remained closed for 2003. Approximately 9,700 salmon were retained or hooked and released in the recreational fishery. Preliminary information on food fishery catches indicated that about 23 t of salmon were harvested in 2003.

b) *Arctic charr*

Commercial landings of Arctic charr from north Labrador in 2003 were 19 t, 7% less than landings in 2002. Catch rates remained moderately high in the three primary stock complex areas. Over the past 30 years (1974-2003), more than 2,700 t of charr have been harvested from a limited section of the north Labrador coast, and attests to the capacity of this area to produce fish. Preliminary information on the amount of charr harvested for subsistence (food) purposes in 2001, 2002, and 2003 are: 6 t, 13.3 t, and 9.6 t, respectively.

c) *Shrimp*

The shrimp fishery in Subarea 2 and the northern portion of Subarea 3 is divided into three management areas – 2G, Hopedale and Cartwright Channels (2HJ), and Hawke Channel (2J) + 3K.

Between 1998 and 2002, annual catches of approximately 8,000 t were taken in 2G from 8,320 t TACs. The 2003 TAC was increased to 10,320 t and included a 1,125 t allocation for northern shrimp research. Preliminary data indicate that about 10,000 t were taken during 2003. The TAC will be maintained at 10,320 t during 2004. Standardized catch per unit effort indices have fluctuated without trend since 1991, reflecting stability in the resource. Historically, the fishery has been concentrated north of 60°N in an area noted for producing high catch rates of large, high-quality shrimp. During 1998, a separate quota was created for the area south of 60°N to reflect the existence of high concentrations of shrimp along the shelf slope. The new quota resulted in a southward shift in fishing effort. Overall, the stock remains healthy as evidenced in continued high catch rates for female shrimp and expansion of the resource.

TACs in Hopedale and Cartwright Channels (2HJ) doubled form 7,650 t during 1994-1996 to 15,300 t over the 1997-2002 period. TACs have been taken in most years. In 2003, the TAC increased to 23,300 t and included a 2,500 t allocation for northern shrimp science research. Preliminary data indicate that about 17,000 t were taken during 2003. The 2003 TAC will be maintained during 2004. Standardized catch rates, within Hopedale and Cartwright Channels were relatively stable between 1986 and the early-1990's, increased from 1993 through to 1998 and then stabilized at a high level. The 1999-2002 catch rates were statistically similar ($P>0.05$) to 2003 while all others were lower than the 2003 index ($P<0.05$). High CPUEs are being maintained over a relatively broad area indicating that the stock is healthy.

The 2001 multispecies research trawl survey biomass and abundance indices for Hopedale Channel were substantially higher than those observed over the 1997-1999 period. The 2002 and 2003 surveys covered only Cartwright Channel where biomass and abundance indices have fluctuated without trend over the time series.

The fishery in Hawke Channel (southern Div. 2J) + 3K began in 1987 with landings of approximately 1,800 t. Catches increased to more than 7,800 t in 1988 and ranged between 5,500 and 8,000 t throughout 1989-1993. The first multi-year management plan for 1994-1996 set the annual TAC at 11,050 t for the Hawke Channel, St. Anthony Basin, east St. Anthony, Funk Island Deep, and three exploratory areas on the seaward slope of the shelf. Catches increased to 11,000 t in each of these years. TACs were increased to 23,100 t in 1997 as a first step toward increasing the exploitation of an abundant resource within the 1997-1999 Management Plan. Most of the increase was reserved for development of the small vessel fleet (<500 t vessels). TACs more than doubled between 1997 and 1999, increased slightly to 2002 and further increased to 77,932 t in 2003. This TAC will be maintained during 2004. The TACs have been reached in most years, however, due to market constraints, small vessels have not taken their entire allocations since 2000.

Autumn research surveys have been conducted since 1995 and indices of biomass/ abundance have been increasing since 1997. The lower 95% confidence intervals for the biomass indices averaged 483,100 t (about 122 billion animals) during the 1998-2003 period. The resource in this area remains healthy with high biomass/ abundance of male and female components. The biomass and abundance of males should be maintained over the next few years, by recent strong year-classes (13–17 mm), while the female component should be maintained, over the next 2-3 years, as relatively strong year-classes (15–19 mm males) change sex. Exploitation rate indices (ratio of nominal catch/ lower 95% confidence interval of biomass index) have remained below 15% over the past 6 years and the fishery continues to cover a broad area. Therefore, fishery related impacts could not be detected from the logbook, observer or the research data. The fact that catch per unit effort for the large vessels has been maintained at a high level, and the fishing fleets are able to take their quotas over broad geographic areas, throughout the year further suggest that the stock is healthy.

The mandatory use of sorting grates, low groundfish abundance and avoidance of problem locations have minimized by-catch. Recent studies estimated that low numbers of redfish and Greenland halibut have been caught by the shrimp fishing fleets.

d) *Cod* – 2GH, 2J3KL

The cod stock in NAFO Div. 2GH has been under a moratorium with respect to directed fishing since 1986. Canada (NL) by-catch has been extremely low (<1 t) since 1992.

The northern (NAFO Div. 2J+3KL) cod stock was closed to directed commercial fishing in 1992. A directed commercial fishery was reopened in the inshore only during 1998-2002. In April 2003 the whole stock area was closed indefinitely to directed commercial and recreational fishing. Sentinel surveys continue. Reported landings during 2003 were 939 t from the commercial fishery and 90 t from sentinel surveys, for a total of 1,029 t. Most of the commercial “catch” came from a mass mortality of cod in Smith Sound, Trinity Bay, during April 2003. The exact cause of this event remains uncertain, but it was clearly associated with unusually cold water within the sound. The rest of the reported catch was by-catch in fisheries directed at other species, mainly winter flounder.

The most recent full assessment of this stock was conducted in February 2003. An update of major indices was reported in March 2004. Prospects for recovery in the offshore remain very poor because of very low spawner biomass and extremely high mortality. Prospects for the small inshore populations are unclear. Their biomass appeared to decline by about half from 1998 to 2003 as a result of fishing mortality, high natural mortality on adults, and weak recruitment. It is hoped that a recent improvement in recruitment will result in an increase in spawner biomass in the inshore during the next few years.

e) *American plaice* – 2+3K

The stock of American plaice in NAFO Subarea 2 plus Div. 3K remains at a very low level. There was no directed fishery on this stock in 2003. Catches have increased since 1999, due mainly to by-catch in the Greenland halibut fishery. The composition of the A. plaice by-catch in this fishery is composed mainly of sexually mature females. Research vessel surveys indicate that the stock size is currently about 3-5% of the values measured in the early-1980s. Stock size has remained at this low level for several years following the closure of the directed fishery. Changes in the distribution of the fish were observed in the mid- to-1980s, and size and age at maturity declined through the mid-1990s but has stablized since then. Since the stock did not recover when catch levels were very low (mid to late-1990s), commercial catches do not appear to be a major contributor to the high mortality estimated in this stock. This is supported by recent catch/biomass ratios of less than 1%. Further, with no strong year-classes present in the population, and relatively high mortality rates, the prospects for stock rebuilding continue to be extremely poor.

f) *Redfish* – 2+3K

This stock has been under moratorium to directed fishing since 1997. Prior to this, there had not been a persistent directed effort on this stock since 1990 when 2,400 t were landed. Landings declined to 280 t in 1991, and were less than 19 t in each year from 1992-1997. Catch increased rapidly to 1,600 t in 2001, with further increases to 3,200 t in 2002 and to 4,400 t in 2003. The increases beginning in 2001 were from non-Canadian directed fisheries outside the 200-mile limit utilizing large midwater trawls. It is likely these catches were from the pelagic stock of redfish that resides primarily in the Irminger Sea between Greenland and Iceland. In recent years mid-summer trawl-acoustic surveys of this Irminger Sea population have measured a portion of the concentration within the 2J3K boundary. Canadian landings since the moratorium are by-catch from Greenland halibut fisheries and have been less than 40 t annually. Estimates of redfish by-catch discarded from shrimp fisheries in the Div. 2G to Div. 3K area since 1980 have ranged from 14 t in 1983 to 665 t in 1990. Since 2000 estimates have ranged from 60 t to 135 t. Results from research vessel surveys in Div. 2J and 3K suggest the resource was at an historically low level in 1994. Although the survey biomass index increased by a factor of six from 1994 to 1998 then remained stable, the average from 2000-2002 was only 4% of the index averaged from 1978-1990. Recruitment has been very poor since the year-classes of the early-1970s. Most of the abundance in the 2002 survey is composed of fish less than 25 cm (10 inches). There are no indications that the status of the stock will change in a positive way in the foreseeable future.

g) *Snow crab* – 2J3KLNO

Catches increased by about 1% to 50,650 t in 2003 from 49,900 t in 2002, due to slight increases in TAC in 2003 primarily in Div. 3KLNO. Fishery performance is monitored in through analyses of commercial logbook data, observer program data, and dockside monitoring. Offshore CPUE from logbook data, had been declining in the north (Div. 2J3K) between 1998 and 2001, remained unchanged in 3K during 2001-2003, but continued to decline to 2003 in 2J. It generally remained at a high level in 3LNO, although it did decrease in 2003. The exploitable biomass index, which is estimated from the fall multispecies bottom trawl survey, declined between 1998 and 2003. The pre-recruit index for greater than 94 mm new-shelled males also declined during 1996-2002 and remained low in 2003. Recruitment is expected to remain relatively low in the short term and longer-term prospects are unknown.

h) *Iceland scallop*-2HJ

Inshore aggregations here were again fished in 2003 with nominal catches estimated at 376 t, round. The fishery is prosecuted by inshore vessels, typically under 45 ft (14 m), L.O.A. Except for exploratory surveys for presence/absence, there have been no directed scientific missions into scallop aggregations along the Labrador coast.

i) *Greenland halibut*-SA 2 + Div. 3KLMNO

The Canadian catch of Greenland halibut in 2002 in NAFO Subarea 2 and Div. 3KLMNO was reported to be almost 6,300 t. This was down by 2,100 t from the catch in 2001, and about 4300 t lower than the catch in 2000. Reduced catches in the gillnet sector, primarily in Div. 3KL, were responsible for the decline, although gillnet was still the predominant gear type. The otter trawl catch of just under 1800 t was similar to the 2001 level, which was the highest by this fleet sector in ten years. The catch at age in 2002 was dominated by the 1995 year-class, which accounted for 42% of the catch numbers and 29% of the catch weight. TACs in 2002 and 2003 have been set above scientific advice and appear not to have been reached.

Improved recruitment lead to an increase in this stock up to 1999, after which it appears to have declined again. The most recent (2003) estimates of stock size from 3 independent survey series all indicate that the resource is similar to the low levels observed in 2002. The 2003 assessment estimate of biomass (ages 5+) is the lowest value in the time series.

j) *Witch flounder*-Div 2J3KL

There has been no directed fishing on this stock since 1994. By-catch in other fisheries from the Newfoundland region amounted to 111 t. Canadian fall surveys since the late-1970s indicated that witch flounder were widely distributed throughout the shelf area in deeper channels around the fishing banks primarily in Div. 3K. By the mid-1980s they were rapidly disappearing and by the early-1990s had virtually disappeared from the area entirely except for some very small catches along the slope in Div. 3L. The fall 1998-2003 surveys indicate no change in this distribution pattern. For the three Div. combined, the biomass index declined from about 65,000 t in 1984 to 1,100 t in 1995, the lowest in the time series. Mean weight per tow decreased from a maximum of near 6 kg/tow in 1984 to a low of 0.23 kg/tow in 1995. The small increase in biomass index and mean weight per tow observed between 1995 and 1996 was almost exclusively a result of inclusion of the deeper strata surveyed in Div. 3L. The estimates have remained the same since then. The stock size remains extremely low.

## B. Special Research Studies

1. Biological Studies

a) *Groundfish and Shellfish*

Biological and oceanographic data from fall multi-species research vessel surveys were collected from Div. 2GHJ to conduct distribution and abundance studies and detailed biological sampling. Stomach analysis is usually conducted from specimens of Greenland halibut caught during the fall surveys. A food and feeding study on Greenland halibut is being conducted based on annual stomach collections from trawl surveys in Subarea 2 and 3.

Analysis of sexual maturity data is conducted annually on American plaice, yellowtail flounder, Greenland halibut and other species.

b) *Arctic charr*

Samples were obtained for food and feeding, age, sex, and length distributions from commercial landings from seven north Labrador Subareas. Following a long term decline in mean weight of charr harvested in north Labrador, analyses of recent data show that mean weight has increased, or generally stabilized in

each of the three primary stock complex areas during the past five years (1998-2002). Besides the long term effects of fishing on stock characteristics, recent analyses have identified a possible environmental component contributing to some of the variation in stock characteristics. In addition, analyses of food and feeding patterns have demonstrated major diet shifts occurring over an 18-year interval and have been related, in part, to changes in the size of charr in some areas. Diet studies continued in 2003 with samples obtained from seven separate Subareas while an analysis of latitudinal variation in fecundity was also initiated.

## SUBAREA 3

### A. Status of Fisheries

Nominal landings from 1993 to 2003 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

*a)* *Squid* – Subarea 2+3.

Following a peak catch in 1979 of about 88,800 t, the Subarea 3 catch declined regularly to 5 t in 1983. Catches remained lower than 5,000 t during the thirteen-year period 1983 to 1995. They increased since 1995 to about 12,700 t in 1997 before declining sharply to about 800 t in 1998 and about 20 t in 1999. They remained low, at about 300 t, in 2000, decreased to only about 20 t in 2001, and increased to about 600 t in 2003. Increases in catches in 1996 and 1997 were associated with environmental warming and increase in squid abundance at the northern extreme of their range. The recent very low catches during 1998-2003 reflect low squid abundance in Canadian waters.

b) *Atlantic salmon*-Subarea 3

A moratorium on the Canadian commercial fishery has been in place since 1992. Landings at St. Pierre (Div. 3Ps) totalled 3.6 t in 2002. The 2003 recreational harvest, including both retained and hooked-and-released, was approximately 38,000 fish in insular Newfoundland.

c) *Shrimp* – 3LMNO

Subarea 3 has been divided into two shrimp management areas – 3LNO and 3M. The 3LNO shrimp stock is distributed along the edge of the Grand Banks mainly in Div. 3L. The fishery began in 1993 and catches were approximately 1800 t. Exploratory fishing from 1996-1999 resulted in catches ranging from 179 to 795 t. In 2000, the NAFO Fisheries Commission implemented a TAC of 6000 t, and fishing was restricted to Div. 3L. The catch in 2000 increased to 4,900 t, 4,300 t of which was caught by Canada. The remainder of the catch was taken by vessels from 7 other countries.

STACFIS estimated that the 2001 fishery took approximately 10,600 t, with Canada taking just over 5,100 t. However, reliable catch reports were not available for all countries in 2001. Similarly, estimates of catch in 2002 were not available for all countries. However, STACFIS noted that the total catch in 2002 was likely to be lower than that estimated for 2001, but that there was considerable uncertainty with estimates of catch in both years. Canadian vessels caught 5,400 t of shrimp in 3L during 2002.

During November 2002, Scientific Council (SC) noted that there had been a significant increase in biomass and recruitment in Div. 3LNO shrimp since 1999. Applying a 15% exploitation rate to the lower 95% confidence interval of biomass estimates, averaged over the autumn 2000-2001 and spring 2001-2002 surveys, resulted in a catch of approximately 13,000 t. Accordingly, SC recommended that the TAC for shrimp in Div. 3LNO in 2003 and 2004 should not exceed 13,000 t. Preliminary data indicate that ~12,000 t of shrimp were taken from 3L during 2003. Preliminary data indicate that the total catch for 2003 was ~12,000 t of shrimp, of which Canadian vessels took ~10,700 t.

Catch and effort data were available from fishing records from Canadian vessels in Div. 3L from 2000 to 2002. Unstandardized catch rates (both single and double trawl) for large vessels increased in 2001 and again in 2002.

The fishery for northern shrimp at Flemish Cap began in the spring of 1993 and has since continued with estimated annual catches (as estimated by STACFIS) of approximately 27,000, 25,000, 33,000, 48,000, 25,000, 30,000 and 43,000 t from 1993 to 1999, respectively. The 2000 catch was 50,000 t, the highest in the series. In 2002, 48,000 t of shrimp were caught in 3M. Vessels from as many as 16 nations have participated in this fishery since its beginning.

The use of a sorting grid to reduce by-catches of fish is mandatory for all fleets in the 3LNO and 3M fisheries. By-catch of groundfish has been quantified, and consists primarily of redfish and Greenland halibut.

d) *Iceland scallop.*

In the Newfoundland area, Iceland scallops are fished in Div. 3LN and Div. 3Ps and to a lesser extent along inshore waters off Labrador.

The 3LN scallop fishery commenced in 1992. Aggregations over the eastern Grand Bank (3L) were first commercialized. In 1994 the fishery expanded into the Lilly and Carson Canyons (LCC) and subsequently (1995) into the northeast of LCC between 45°30' N and 46°30' N. In 1996 a new aggregation was located and rapidly fished down. Nominal landings have declined throughout, partially because of effort diversion into shrimp and crab.

There was no directed fishery for Iceland scallops from the LCC box in 2003, the second consecutive year since aggregations were first exploited in 1994. Elsewhere, over the Grand Bank (Div. 3LN), there has been no commercial activity since 2000.

The Iceland scallop fishery on 3Ps commenced in 1989. It encompasses the trans-boundary stock, along the northern edge of St. Pierre Bank, co-managed by France (70% of annual TAC) and Canada (30% of TAC), and the remainder of 3Ps that remains entirely under Canadian jurisdiction.

Total removals from the Canadian zone in 2003 increased from the previous year (735 t *versus* 478 t). Off-shore aggregations on the St. Pierre Bank accounted the total removals from this area. There has been no directed effort for Iceland scallops in the trans-boundary area since 1998.

e) *Capelin* – Subarea 2 + Div. 3KL

Inshore capelin catches in Subarea 2 + Div. 3KL are taken during the inshore spawning migration. Catches increased from 10,200 t in 2002 to about 18,100 t in 2003, which was similar to the 2001 catch of 18,700 t. Resource status has not been determined since 2000.

f) *Snow crab* – 3Ps.

Catches in 3Ps in 2003 (6,110 t) were 20% lower than those of 2002 (7,635 t). Inshore and offshore CPUE declined between 1999 and 2003 by 40% and 67% respectively, due to an apparent reduction of commercial-sized males. Bottom trawl surveys are unreliable for indicating resource status because they are carried out in spring when mating and molting occur and the population is incompletely available to the survey trawl. Recruitment appears to have been stable in recent years and is expected to change little in the short term. Longer-term prospects are unknown.

g) *Cod* – 3NO and 3Ps.

The cod stock in NAFO Div. 3NO has been under moratorium to all directed fishing both inside and outside the Regulatory Area since February 1994. In the last assessment of this stock (2003) fishing mortality

averaged over 2000 to 2002 for ages 4 to 6 is 0.32. This level of fishing mortality is comparable to that in earlier time periods during which substantial fisheries existed. Estimates of recent year-class size indicate that recruitment has been very low since the 1990 year-class. Low spawner biomass, low recruitment and high fishing mortality point to poor prospects for this stock in the future. Recovery will require a number of relatively strong year-classes that survive to maturity, rebuilding the spawner biomass. Recent Canadian spring and fall research bottom trawl surveys confirm that the stock size remains at an extremely low level.

The cod stock NAFO Subdiv. 3Ps was placed under moratorium in August 1993. Stock assessments estimated a growing spawner biomass and the fishery reopened in 1997 with a TAC of 10,000 t, which was increased to 20,000 t in 1998 and to 30,000 t in 1999. From 2000 onwards the TAC has covered the period 1 April to 31 March. Although the 2000/2001 TAC was reduced to 20,000 t based on stock assessment results which indicated that spawner biomass was declining, the transition in the TAC year resulted in a calendar year catch of 25,100 t in 2000. The TAC has remained constant at 15,000 t for the 2001/2002-2003/2004 fishing seasons. The Canada (NL) share of the TAC is 84.5%, the remainder is allocated to France (SPM). A preliminary estimate of Canada (NL) catch in 2003 is 12,400 t. The most recent assessment (October 2003) indicated considerable uncertainty in the absolute size of the stock, but estimated that spawner biomass should increase under this TAC level. The outlook about the short-term productivity of the stock is less optimistic than in recent assessments. Concern continues regarding the low age at maturity in this stock and the very high exploitation rates in a portion of the stock area (Placentia Bay).

h) *American plaice*-3Ps

The last assessment of this stock was carried out in October 2002. This stock has been under moratorium since September 1993. By-catches in recent years have increased from 90 t in 1995 to about 650 t in 1999 and 2000 and to over 1,000 t in 2001 and 2002. Preliminary estimates for 2003 are 850 t. This by-catch is mainly taken in the cod and witch flounder fisheries.

Research vessel survey results indicate that this stock has remained at a low level since 1992. Biomass and abundance in the last 5 to 6 years are somewhat higher than those seen in the mid-1990s. However, the average biomass in 2000-2003 is only 20% of the 1983-1987 average and abundance is 26% of the 1983-1987 average.

In the short to medium term there appears to be little prospect of significant rebuilding of this stock. Any removals from this stock will further delay recovery.

i) *Witch flounder*-3Ps

Landings from this stock over the last 20 years have fluctuated between 300 t and 1,000 t annually. The main directed fishery is prosecuted by offshore otter trawlers complemented by a nearshore Danish seine fishery. However, in recent years it appears to be a mixed American plaice and witch flounder fishery by otter trawlers. During 2000-2003 the American plaice by-catch rates in the otter trawl directed witch flounder fishery ranged from 90-150% compared to Danish seiners which is only marginal. Although survey stock size indices since 1983 have been highly variable, the survey biomass index during recent years suggests that the biomass is on average about 75% of the 1983-90 average when catches were around 800 t. The age and size structure observed in this stock since the early-1980s also appear to have remained stable with little change in growth pattern. Geographic distribution has not changed appreciably since 1983 except during the early to mid-1990s when fish disappeared from the 51-100 fath. depth zone coincident with extremely cold sea bottom water temperatures. In recent years the distribution appears to be returning to a more normal pattern. No measurable change in recruitment has been observed over the past 20 years.

j) *Yellowtail flounder* – 3LNO

Since the fishery for this stock reopened in 1998, stock size has continued to increase and the TAC's recommended for 2003 and 2004 were 14,500 t in each year, In addition to the annual spring stratified-random survey in 3LNO and the fall multispecies bottom trawl survey, joint DFO-Industry surveys have been conducted since July of 1996. Two such surveys were conducted in 2003. The objective of these Fisheries

Products International-DFO surveys is to develop a commercial-type index of abundance and to determine distribution of yellowtail flounder within a zone traditionally fished by commercial fleets. Evidence from the commercial fishery and various surveys indicates that the range of this stock has increased along with stock size since the mid-1990s. Fishing mortality is estimated to be relatively low and the stock biomass relatively high.

k) *American plaice* – 3LNO

VPA analyses indicates that population abundance and biomass declined fairly steadily from the mid-1970s. Biomass has been relatively stable over the last number of years. F increased fairly steadily from 1995 to 2000. Average F on ages 11-14 in 2002 was 0.17, lower than in 2001, consistent with the decline in catch. SSB remains at a very low level at just over 20,000 t. This is only 10% of the level in the mid-1960s and 16% of the level in the mid-1980s. Recruitment has been steadily declining since the 1986 year-class and there have been no good year-classes since then. No good recruitment is seen below an SSB of 50,000 t, the $B_{lim}$ for this stock. Projections indicate that the stock will experience 5 times greater growth over the next 5 years at F=0 compared to current levels of F. However, even at F=0 the stock will not reach $B_{lim}$ within 5 years.

l) *Redfish* – Unit 2 (3Ps4Vs, 3Pn4Vn-June to December, 4Wfgi) and 3O.

Redfish in the Canadian Atlantic within NAFO Div. 3P4RSTVWX were redefined into three management units in 1993. Redfish in UNIT2 was last reviewed in November 2001 and updated in 2004.

Unit 2 Canadian landings in 2003 totalled approximately 9,600 t and approximately 3000 t was caught by Canada (NL). Total Canadian catches have declined steadily from 27,000 t in 1993 matching reductions in TACs. Current management regulations include a closure related to peak spawning in May and June, and a minimum size restriction at 22 cm. The current stock status was determined from stratified random surveys and sampling of the commercial fishery. The 2003 fishery was dominated by exploitable year-classes born after 1980, most notably the 1988 year-class. Current information suggests the 1988 year-class is not as strong as the 1980 that has already produced about 13 years of yield. There appears to be improved recruitment to the stock from the 1994 and 1998 year-classes but their absolute size is unknown. Biological characteristics suggest the 1988, 1994 and 1998 year-classes are predominantly *S. fasciatus*, a shallower water species and the strong 1980 year-class is predominantly *S. mentella*, a deeper water species. The strength of year-classes of *S. mentella* since the 1980 year-class are apparently very weak, yet it continues to be a significant portion of the fishery.

Canada has had limited interest in a fishery in Div. 3O because of small sizes of redfish encountered in areas suitable for trawling. Canadian landings were less than 200 t annually from 1983-1991. In 1994, Canada took 1,600 t due to improved markets related to lobster bait, but declined to about 200 t in 1995. Between 1996 and 1999 Canadian catches have alternated between levels of about 8,000 t and 2,500 tons based on market acceptability for redfish near the 22cm size limit. Since 2000 Canada has averaged about 3,300 t with Canada (NL) accounting for more than 80% of the catch. Assessment of this stock has been primarily based on research vessel (RV) data due to variable commercial indices and fleets prosecuting different areas of the stock. Generally, the spring Canadian survey biomass index suggests the stock may have increased since the early-1990s, fluctuated over 100,000 t from 1994 to 1999 and declined to 2002. The autumn Canadian survey, while more stable in the early-1990s, generally supports this pattern. RV surveys do not adequately sample fish greater than 25 cm which up to 1997 have generally comprised the main portion of the fishery. This makes it is difficult to interpret survey estimates in relation to what is happening to the stock as a whole. The fishery since 1998 appeared to target the relatively strong 1988 year-class that has grown sufficiently to exceed the small fish protocol of 22 cm. There is concern that there has been little sign in recent surveys of size groups smaller than 17 cm despite using a shrimp trawl, which is very effective at catching small fish.

m) *Witch flounder* – 3NO

There has been no directed fishing on this stock since 1994. By-catch in 2003 (Newfoundland region) was 52 t. The data for Div. 3NO combined suggest an overall declining trend in stock size with the estimates for the spring 1998 survey at the lowest level observed since 1984. Since then, all indices have generally increased

but remain variable. The 2003 spring survey estimates show an increase from 2002 (driven by one large set in Div. 3O), with wide confidence limits.

## B. Special Research Studies

1. Environmental Studies

Physical oceanographic observations are routinely collected during fish assessment and research surveys in the Newfoundland and Labrador Region. The enhanced Atlantic Zonal monitoring program (AZMP) initiated in 1998 continued during 2003. This program was established to include biological and chemical oceanographic sampling at a fixed coastal site (Station 27) at biweekly intervals and along offshore sections at seasonal time scales. The Newfoundland and Labrador Region conducted three annual physical/biological oceanographic surveys during 2003 along several cross-shelf NAFO and AZMP sections from the Southeast Grand Bank to Nain Bank on the mid-Labrador Shelf. These surveys were conducted during mid-spring, summer and during the fall. The main objectives were to establish the seasonal temporal and spatial distribution and abundance of plant pigments, nutrients, microzooplankton and mesozooplankton in relation to the physical environment. Physical, biological and chemical variables being monitored include temperature, salinity, dissolved oxygen, ocean currents as well as measures of primary and secondary production and biomass, species composition of phytoplankton and zooplankton and nutrients. The oceanographic monitoring program currently conducted on the Newfoundland and Labrador Shelf should allow an understanding of changes in ecosystem productivity and changes in ecosystem structure over time. Data from this effort are used to produce annual physical, chemical and biological state of the ocean reports and in studies relating environmental conditions to marine resources.

*a) Plankton studies*

The enhanced Atlantic Zonal Monitoring Program activities in the Newfoundland and Labrador Region have permitted a number of general observations concerning the chemical and biological conditions in the Newfoundland and Labrador Region. As previous workers have suggested, there is a south-to-north progression in the onset of the spring bloom. The concentration of all nutrients at depths of 100 m or more tends to show an increase during the summer and into the fall period, preceding the fall increase in the surface layer that is associated with the breakdown of stratification. Phosphate and silicate concentrations in the surface layer show a seasonal cycle similar to that of nitrate but the former rarely appear to reach depleted levels (near zero concentrations), with the exception of silicate concentrations on the Grand Banks. Finally, the inshore and offshore arms of the Labrador current are generally marked with shallow nutricline and relatively high concentrations of chlorophyll relative to other areas of the shelf, suggesting that variations in current speed and shear may influence the flux of nutrients into surface layers during the summer months.

Overall, the seasonality of chemical and biological variables at Station 27 and along the major AZMP sections in 2003 was similar to previous years (1999-2002). The timing of events on the Newfoundland Shelf (south of Seal Island) was once again similar to conditions observed in the early part of the program but in contrast to 2001 when the onset of the Spring phytoplankton bloom was delayed. However, satellite information indicates that the relative delay in the onset of the Spring Bloom remained as one moved further north.

It is becoming clear that interannual variations in the seasonality of vertical mixing and water column structure plays an important role in the seasonal phytoplankton cycle along the Newfoundland Shelf. In 2001, the delay in the onset of the Spring Bloom was associated with persistent deep mixing of the water column. Although wind stress remained high in 2002, the overall impact on the water column may have been somewhat lessened by the relative timing and intensity of wind events such that the mixed layer depth shoaled more progressively in 2002, thus allowing an earlier Spring Bloom.

Variations in the physical environment since the inception of the Atlantic Zone Monitoring Program may also be contributing to a gradual increase in the magnitude of the Spring phytoplankton bloom. Since 2000, there has been a gradual intensification in the overall productivity and standing stock of phytoplankton during the Spring. The gradual rather than abrupt shoaling of the mixed layer may have provided sufficient light and high nutrient availability to permit the development of denser phytoplankton population, mainly composed of

diatoms, than in previous years. However, in addition to the factors that regulate the vertical structure of the water column, there is a preliminary indication that interannual variations in incident light may also have contributed to the increase in the overall intensity of the Spring phytoplankton bloom. Although intercalibration of observations from the Northwest Atlantic Fisheries Centre with those collected by the Canadian Meteorological Service has yet to be completed, the first indications are that incident radiation during the spring and summer months in 2001-03 are at the upper extreme of light levels observed in the past three decades at St. John's Airport.

In 2001, the deep nutrient inventories (> 50m) observed at Station 27 showed a 30-50% decrease over conditions in previous years but the change was not observed along any of the standard sections. The condition at Station 27 persisted in 2002 but there are some indications that the depletion of the deep nutrient pool may have expanded onto the inshore and mid-Shelf portions of the Bonavista section, where a notable decrease in deep nutrient levels were observed in 2002, but the magnitude is considerably less than has been observed at Station 27. Further depletion in the deep nutrient inventories was evident at Station 27 in 2003 throughout the different seasonal periods. This trend was reversed for the shallow silicate inventories where large positive changes occurred and was consistent with observations along all seasonal occupations on sections across the Newfoundland and Labrador Shelf.

The relationship between silicate and nitrate concentrations in the upper layer (0-50 m) indicates that during much of the year, nitrate appears to have a greater potential to limit phytoplankton production. However, there is also an indication that replenishment of silicate is more extensive than that of nitrate throughout much of the year, and this was particularly evident in 2003 at both Station 27 and on the Newfoundland Shelf.

The overall standing stock of phytoplankton on the NE Newfoundland Shelf was generally less during the spring and summer, but higher during the fall survey's than in previous years. Although stratification was less intense over much of the Grand Banks, which suggests that nutrient replenishment may have occurred more readily, the integrated temperature was also lower, suggesting that decreases in temperature may play an important role in limiting production on the Shelf. This trend was reversed for the Labrador sections occupied during the summer. Alternatively, higher grazing pressure from a slight increase in the density of large calanoid copepods may have maintained standing stocks at low levels.

The decline in abundance of major phytoplankton taxa observed in recent years appears to have persisted into 2003. The cell densities of Diatoms, Dinoflagellates, and Flagellates have continued to decrease. Although Flagellates do not make up a substantial portion of the overall phytoplankton biomass compared to larger Diatom and Dinoflagellate cells, the decrease in the abundance of all taxa may suggest a change in the dynamics of the microbial food web dynamics in the area. Further investigation is required.

The overall abundance of zooplankton at both Station 27 was generally in keeping with previous observations. The notable change in the zooplankton community structure at the fixed station has been in the increase in the abundance of cold water species of copepods observed in 2002 did not appear to persist into 2003. The abundance of copepodites of *Metridia* sp., *C. glacialis*, *C. hyperboreus* and *Microcalanus* sp. which had become more frequent members of the community although the overall increase in their abundance has been modest returned to levels consistent with conditions at the start of the monitoring program. The warm water species, *T. longicornis*, whose abundance peaks during the fall, has shown an increase in overall abundance and in relative frequency of occurrence at Station 27.

The somewhat reduced occurrence and abundance of large species of copepods such as *Calanus* and *Metridia* may have lead to a decrease in the relative abundance of large calanoid nauplii on the mid- and outer shelf areas. Small species of copepods, such as *Oithona* sp. and *Pseudocalanus* sp. generally dominate the copepod community across much of the NE Newfoundland Shelf, and their dominance appears to have increased over 2002.

b) *Oceanographic studies Subareas 2 and 3*

Physical oceanographic studies were conducted on the Newfoundland and Labrador Shelf during 2003 in NAFO Div. 2J and 3KLNO. These studies were based on observations from Nain Bank on the mid Labrador

Shelf to the Southern Grand Bank on the Newfoundland Shelf. The annual water-column averaged temperature at Station 27 for 2003 remained above the long-term mean and increased over 2002 values at all depth ranges. The annual surface temperature at Station 27 was 0.7 above normal, while the annual bottom temperature remained similar to 2002 at 0.2°C above normal. . Bottom temperatures were above normal during January and February, below normal during spring and above normal during the remainder of the year. Water-column averaged annual salinities at Station 27 remained above normal similar to 2002 values the highest in over a decade. Surface salinities at Station 27 were above normal for 11 of 12 months, while bottom salinities were generally below normal, particularly during the period April to July. The cross-sectional area of <0°C (CIL) water on the Newfoundland and Labrador Shelf during the summer of 2003 increased slightly over 2002 values but remained below the long-term mean for the ninth consecutive year in some areas. In general, the cold temperatures observed along standard sections off the east coast of Newfoundland during the spring moderated by summer and were generally above normal by fall. Bottom temperature anomalies on the Grand Bank during the spring of 2003 were highly variable mostly positive in the northern areas of 3LNO during both spring and fall. However, fall bottom temperatures for the shallow waters of the southeast Grand Bank where similar to 2002, up to 2°C below normal. Fall bottom temperatures in Div. 2J and 3K were also above normal, up to 2°C on Hamilton Bank and up to 1°C on Funk Island Bank. In summary, 2003 was a year of extremes in many areas, with below normal temperatures in early spring but increased to above normal values through the year. In general both 2002 and 2003 were cooler than 1999-2000 values, but remained above normal over most areas continuing the trend established in 1996.

A study was conducted in NAFO Subdiv. 3Pn and 3Ps during 2003 relating possible influences of oceanographic conditions on the distribution and abundance of Atlantic cod (*Gadus morhua*). Temperature measurements on St. Pierre Bank show anomalous cold periods in the mid-1970s and from the mid-1980s to mid-1990s. Beginning in 1996 however, temperatures started to moderate, decreased again during the spring of 1997 and returned to more normal like values during 1998. During 1999 and 2000 temperatures continued to increase, reaching the highest values observed since the late-1970s in some regions. During the past 3 years however, temperatures have cooled significantly to values observed during the mid-1990s by the spring of 2003. In fact, the average temperature for NAFO Div. 3P during the spring of 2003 was the coldest observed in about 13 years. The areal extent of <0°C bottom water increased significantly from the mid-1980s to mid-1990s, but decreased to very low values during 1998-2000. During 2001 to 2003 however, this area increased to values observed during the cold years of the early-1990s. In general, temperatures during the spring of 2003 decreased significantly over values observed during the past several years. The most evident trend in the numbers of cod caught per set during the multi-species surveys was the high number of zero catches in the <0°C water on St. Pierre Bank and regions to the east of the Bank, mainly from 1985 to 1998 but also from 2001 to 2003. During 1999 and 2000 larger catches became more wide spread over St. Pierre Bank as cold (<0°C) water disappeared from the area. In general, during all surveys most of the larger catches occurred in the warmer waters (2°-6°C) along the slopes and areas to the west of St. Pierre Bank. In addition, variations in the estimated abundance and biomass of cod from the RV surveys in strata with water depths <92 m are significantly correlated with bottom temperatures for that depth range.

An oceanographic assessment study was also conducted during the summer of 2003 on the Flemish Cap in NAFO Div. 3M. The cold near-surface temperatures (0.5° to 2°C below normal) experienced over the Cap from 1993-1996 had warmed to 0.5°-1.5°C above normal by July of 1997, which increased further to 2°C above normal by the summer of 1999. Upper layer temperatures over the Flemish Cap during the spring of 2001 and the summer of 2002 generally showed a downward trend with temperatures decreasing to below normal values. During the summer of 2003, temperatures directly over the Cap were highly variable while adjacent areas showed significant positive anomalies. Near bottom temperatures over the Cap were generally around 3.5°C, which was below normal in some areas particularly on the western side of the Cap. Salinities over most of the upper water column during the summer of 2002 and 2003 were generally saltier-than-normal (0.25-1.0). In the deeper water (>100-m depth) salinities were about normal. In general the colder than normal temperatures experienced over the continental shelf and on the Flemish Cap from the late-1980s up to the mid-1990s moderated by the summer of 1996 and continued to warm until 1999. During the summer of 2000 and into the spring of 2001 the observations indicate a reversal in the recent warm trend in some areas of the water column with near normal temperatures in most areas. During the summers of 2002 and 2003 most areas of the water column experienced highly variably conditions with near-surface values below normal in

2002 and above normal in 2003. During 2003 and throughout most of the 1990s summer chlorophyll levels in the upper 100-m of the water column over the Cap were higher compared to the adjacent Grand Bank. Dissolved oxygen levels were about normal for the region with super-saturated values in the near surface layers reaching 105%. Both the measured currents and the geostrophic estimates, while showing considerable differences and variability between years, confirm the existence of a general anticyclonic circulation around the Flemish Cap during the summer.

A review of the distribution and abundance of northern shrimp (*Pandalus borealis*) in relation to bottom temperatures in NAFO Div. 3LNO based on Multi-Species Surveys from 1995-2003 was also completed in 2003. The highest numbers of shrimp were caught in the $2^{o}$-$4^{o}$C-temperature range during the spring surveys with lower numbers in the $1^{o}$-$2^{o}$C and $4^{o}$-$5^{o}$C temperature ranges. During the fall surveys most shrimp were caught in the $1^{o}$-$3^{o}$C temperature range. Cumulative frequency distribution of the number of shrimp caught and temperature indicates that <5% of the catches are associated with temperatures $<1^{o}$C in the spring and about 20-30% on average are associated with temperatures $<1^{o}$C in the fall. About 80-90% of the shrimp were caught in the $2^{o}$-$4^{o}$C temperature range during the spring, while only about half that number appeared in this temperature range during the fall. In terms of available thermal habitat, about 30% of the surveyed region was covered with water in the $2^{o}$-$4^{o}$C-temperature range during the spring, while about 40% was covered by water in this temperature range in the fall. An apparent shift in the shrimp distribution towards colder temperatures further upon the Grand Bank and towards the inshore regions occurred during the fall and as a result, a greater proportion (30%) of the catch shifted into the $0^{o}$-$1^{o}$C-temperature range. Very low numbers of shrimp were found in temperatures $<0^{o}$C and $>4^{o}$C during both spring and fall. Shrimp catches were mostly zero in all surveys in the swallow waters (<100 m) of the southeast Grand Bank, where temperatures generally range from $2^{o}$-$7^{o}$C. In general, during the spring most of the large catches were found in the warmer water along the slopes of Div. 3LN, while in the fall, larger catches were found in most areas of Div. 3L including the inshore areas of the bays along the east coast of Newfoundland.

c) *Hydrographic Surveys Subareas 3 and 4*

The hydrographic priorities for 2002-2003 in Newfoundland and Labrador were in Notre Dame Bay, White Bay and Labrador. In Notre Dame Bay, hydrographic surveys were completed in the Springdale and Fogo Island areas as required for hydrographic charting. In White Bay, new hydrographic information was gathered to fill in previously uncharted areas of the chart for this site. In northern Labrador new coastal shipping corridor surveys started last year were extended from Okak Bay northwards to Cape Mugford using a combination of single and multibeam acoustic technologies. A hydrographic survey was also completed at Cartwright Harbour as part of the revision of this port. An additional multibeam survey was completed for the Royal Military College at Saglek Bay. This survey was designed to detect areas of sedimentation at that site and was a component of a program to remove PCB contamination.

All hydrographic surveys were conducted from the CCG Vessel Matthew and its survey launches equipped with multibeam and single beam acoustic systems.

A Sailing Directions revisory survey was also completed throughout Newfoundland and Labrador. Information from this project was used to update the five Sailing Directions publications for the Region.

2. Biological Studies

a) *Flatfish*

A food and feeding study on Greenland halibut is being conducted based on annual stomach collections from autumn trawl surveys in Subarea 2 and 3.

Analysis of sexual maturity data is conducted annually on American plaice, yellowtail flounder, Greenland halibut and other species. The most recent studies on Greenland halibut were presented to NAFO SC in 2001. The yellowtail and American plaice analyses are presented to NAFO during the biannual assessment of Div. 3LNO American plaice and yellowtail flounder. Research on yellowtail age and growth is ongoing, using a

variety of methods. The most recent analysis of age validation studies was presented to NAFO SC in June 2001.

A tagging program was begun on yellowtail flounder in Div. 3LNO in 2000. This is a co-operative project between DFO and Fishery Products International Ltd. This program is designed to run in May –June of each year from 2000 to 2004 inclusive. The objectives are to obtain estimates of exploitation and population size to improve the assessment of this stock; and to study movements and migrations, age and growth, mortality, and longevity of this species. These objectives will be accomplished by using two different tagging methods. In 2003, data storage tags were again used, for the third year, along with the Petersen discs used in 2000-2002.

Studies are ongoing into the factors affecting the maturation of American plaice including the reasons for changes in maturity at age and size in American plaice Subarea 2 + 3K, Div. 3LNO, and Subdiv. 3Ps. In addition there are studies on seasonal and interannual changes in condition in American plaice.

b) *Seals*

Multi-disciplinary studies on harp, hooded, and grey seal population dynamics and seal-fish interactions continued in 2003. A two year project, the Atlantic Seal Research Program (ASRP) was initiated in 2003. The objectives of the ASRP are to: 1) conduct surveys to estimate the abundance of the three seal species believed to be important groundfish predators; 2) determine seal distribution in relation to fish resource and provide current estimates of the diet of each species; and 3) evaluate the utility and test seal management tools, which might aid the recovery of Atlantic cod stocks (e.g. Seal Exclusion Zone, immuno-contraception). In addition, research is continuing on other aspects of seal biology and ecology (e.g. interannual changes in growth and reproductive status) in order to determine their role in the ecosystem of the Northwest Atlantic.

Consumption of prey by harp seals in NAFO Div. 2J3KL is estimated by integrating information on individual energy requirements, population size, distribution, and diet composition. New information on the diet of harp seals in nearshore areas of NAFO Div. 2J3KL was collected during 2003. The proportion of cod in nearshore diets continued to vary significantly among years and seasons. The few samples obtained from offshore areas did not contain Atlantic cod. Further sampling of diets, particularly in offshore areas will take place in 2004 in order to improve estimates of consumption. However, estimates will likely remain highly variable owing to the strong temporal and spatial variation observed in diet composition.

c) *Capelin*

Studies to determine factors governing capelin survival during egg development and larval emergence from beach sediments continued at one beach site in 2003. In the same area, studies were initiated to assess and determine factors causing the high mortality of capelin eggs deposited at demersal spawning sites in 2001. An ongoing acoustic survey initiated in the spring of 2000 examined capelin distribution, behavior, and feeding habits in Div. 3KL. Inshore surveys were conducted in the fall of 2003 to map the dispersal and distribution of larval capelin in Trinity Bay, Div. 3L.

d) *Salmon*

A method was derived by which numbers of adult Atlantic salmon returning to fishways or fish counting fences could be combined into separate regional indices (e.g. northeast coast, south coast, southwest coast, northwest coast), or a composite index of all Newfoundland. The approach uses data from all counting facilities in constructing the indices, even those where projects have now been terminated. Owing to the sequence of specific management measures, such as the 1984 salmon management plan followed by the closure of the commercial fishery in 1992, data can be analyzed with planned contrasts to evaluate the impact of the 1992 fishery closure on returns of salmon to Newfoundland rivers.

A comparative analysis of proximate body composition (e.g. protein, lipid, ash, moisture) of Atlantic salmon parr rearing in fluvial (stream) versus lacustrine (lake) habitats was completed for one river system. In

general, crude fat, protein, and overall energy content of parr rearing in lake habitats was greater than parr utilizing fluvial habitat for rearing.

3. Miscellaneous Studies

a) *Fish Habitat Compensation Studies*

*Scallop Habitat Creation*

Petro Canada, on behalf of the Terra Nova Offshore Oil Development Project, has undertaken a multi-year fish habitat compensation program associated with the creation of habitat for and increase in productive capacity of Iceland scallops in Paradise Sound, Placentia Bay. Scallop shell habitat was created in 2001 and 2002 in three locations, utilizing discarded scallop shells. The habitat was created at depths ranging between 7 to 20 m with 1-3 inches thickness of shells and it was seeded with scallop spat in order to boost natural productivity. Monitoring studies conducted in 2003 found that juvenile sea scallops were abundant however, no Iceland scallops were observed.

*Artificial Reefs and Eelgrass Transplants*

Husky Oil Operations Ltd., on behalf of the White Rose Offshore Oil Development Project, has undertaken a multi-year fish habitat compensation program associated with the creation of a multi-species artificial reef and eelgrass transplants. Compensation works undertaken in 2003 included the restoration of a 3,600 $m^2$ eelgrass bed in Rocky Cove within the East Arm of Bonne Bay and a test eelgrass transplant (<1,000 $m^2$) in Caplin Cove, Placentia Bay.

*Lobster Habitat Creation*

Newfoundland Transshipment Ltd., on behalf of the Newfoundland Transshipment Terminal Project, has undertaken a multi-year fish habitat compensation program associated with the creation of habitat for both the early benthic phase and adult lobsters. Lobster habitat was created in 1997, including the construction of two cobble artificial reefs for the early benthic phase and construction of a causeway composed of solid rock and rubble fill for adults. The artificial reefs were placed at depths of approximately 10 m, and had elevations of approximately 1 m off the seafloor. The causeway armour stone extended from above the low water mark to a depth of 15 m. Monitoring conducted during 2003 indicated that the habitat is functioning as designed. For example, many suitable features for various lobster life stages are present, including voids of different sizes, cover provided by coralline algae, kelp and sessile invertebrates, and food sources such as crabs, mussels, urchins, scallops, brittle stars, etc. In addition, adolescent and adult lobsters were found throughout the created habitat and many lobster dens/feeding areas were observed.

b) *Environmental Effects Monitoring Studies (EEM)*

*Hibernia Offshore Oil Project*

Hibernia is located near the northeast corner of the Grand Banks, approximately 315 km east-southeast of St. John's. Hibernia uses a gravity-based structure (GBS) to complete drilling of up to 83 development wells that will be required throughout the lifetime of the project.

The Hibernia Environmental Effects Monitoring (EEM) Program has been ongoing since 1998 and DFO has contributed to the program since its inception. In the fall 2003, DFO received for review and comment the Hibernia 2002 EEM (Year 5) Report. As all future EEM programs are scheduled to be conducted only every second year, the next sampling program will occur in the spring/summer of 2004, with reporting in summer/fall 2005.

*Terra Nova Offshore Oil Project*

The Terra Nova offshore oil field is situated on the Grand Banks, approximately 350 km east-southeast of St. John's and 35 km southeast of the Hibernia Oilfield. The Terra Nova Oilfield is being developed using a floating production, storage and offloading (FPSO) facility and a semi-submersible drilling rig. A total of 24 wells will be drilled through seven sub-sea templates, located in five glory holes to protect them from iceberg scour. Trenched and bermed flowlines connected to flexible risers will link the sub-sea installations to the FPSO.

An EEM program was designed, with input from DFO. A Baseline Characterization program was conducted in 1997 and the first year of the operational EEM program was conducted in 2000. The third year of the EEM program was conducted in the summer of 2002, the results of which were submitted to DFO and reviewed in 2003. As environmental effects at Terra Nova remain limited and fully within the range predicted by the Environmental Impact Statement, future EEM sampling will occur only every second year, the next in the spring/summer of 2004, with reporting in spring 2005.

*White Rose Offshore Oil Project*

Husky Energy (Husky) and its co-venturer, Petro-Canada, have been sanctioned to develop the White Rose offshore oilfield located approximately 350 km east-southeast of St. John's and 50 km from both the Hibernia and Terra Nova oilfields. Similar to The Terra Nova Development, the White Rose development will use a FPSO vessel to provide production facilities and a semi-submersible drill rig will be employed to drill up to 25 wells from up to four well heads.

In the fall of 2000 Husky undertook a Baseline Characterization Data Program to collect data to describe the baseline conditions prior to the drilling and production phases. The Baseline Characterization Data Report was submitted in October 2001 and a thorough review was conducted by DFO. In December 2003, the White Rose EEM Program Design Report was submitted for review and comment by DFO. A draft White Rose EEM Program document is anticipated in spring 2004 and DFO will continue to contribute to the development and review of this Program.

*Newfoundland Transshipment Terminal*

The Newfoundland Transshipment Terminal (NTT) was constructed to serve as a temporary storage and transshipment facility for crude oil from the Newfoundland offshore. The marine facilities for this project include a causeway, tug basin, approach trestle, jetty with berthing and two loading platforms with marine topside facilities (crude transfer and control system).

The first operational EEM field program was conducted in August 2000. After submission of the 2000 EEM report, it was determined that the second and third years of the post-operational EEM Program would be postponed until 2002 and 2003 respectively, based upon the actual and projected reduction in vessel traffic to the terminal in 2001. It was agreed by all regulatory agencies that information gained from the 2002 and 2003 monitoring seasons would be more reflective of routine facility operations. Results from the 2002 monitoring was submitted to DFO and reviewed in 2003. Results from the 2003 monitoring season are anticipated for review and comment in spring/summer 2004.

c) *Marine Classification (Subareas 2 and 3)*

Marine Environment and Habitat Management (MEHM) Division has been developing a marine habitat classification system that will provide a standardized approach for conducting environmental assessments on projects having potential impacts on fish and fish habitat. A literature review and compilation of information on the habitat requirements of a variety of marine species (finfish, shellfish and invertebrates) occurring in Newfoundland and Labrador has been undertaken, with major emphasis on those species supporting commercial, recreational and/or aboriginal fisheries or providing important food sources for such species. Following this, methodologies and descriptions to characterize the biophysical environment of coastal areas

were formulated. Most recently, a field ground-truthing program was conducted to determine the effectiveness of these habitat description procedures for the NL Region.

*d) Seismic (Subareas 2 and 3)*

Building on a literature review conducted by MEHM in 2001, an Environmental Studies Research Fund (ESRF) project was conducted in 2003 in DFO Newfoundland and Labrador Region, to identify and map key spawning and nursery areas for 12 commercial finfish species on the Newfoundland Grand Banks (specifically NAFO areas 3LMNO and 3Ps). Spawning times will also be identified. This initiative stems from increased petroleum exploration activity in the Newfoundland offshore area. For environmental assessment processes and ocean planning in general, the atlas will be useful to scientists, habitat managers, regulators, industry, consultants and fishers. The work was completed in winter 2003 and has been published in the DFO Technical Report series (No. 2522).

Currently, there is scientific uncertainty associated with potential impacts of seismic testing on the marine environment. Habitat managers are lacking a nationally consistent scientific basis for evaluating the potential environmental consequences of seismic surveys. To help address this point, a DFO National Science Advisory Meeting was held in March 2003, to develop a science-based decision framework for assessing seismic survey referrals. A national list of factors to be considered was developed for the seismic referral review process however; more work is required before the decision framework is operable. An additional meeting will be held in May 2004 to review working papers which provide overviews of the primary and secondary literature on the possible effects of seismic testing on various components of aquatic ecosystems. In addition, it will review reports on standards used by other jurisdictions internationally for regulating seismic activities in marine ecosystems, and on sound propagation models for marine environments. On the basis of these reviews, scientific advice on potential components of a regulatory or management framework for seismic testing in Canadian waters will be developed.

Priority research attention needs to be given to addressing the question of exposure distance relationships and potential for producing damaging effects (serious pathologies leading for instance to potential for delayed mortality and morbidity, adverse reproductive outcomes or predator susceptibility) in representative fish and shellfish and probably other species. Pilot studies carried out by DFO NL Region with a small seismic gun, have also reinforced the need for research in this area. The Region is also presently assisting with a project on snow crab from a seismic survey carried out off Cape Breton in the fall of 2003. Overall, the lack of information in the general area precludes providing Marine Environment and Habitat Management with informed prediction on whether delayed mortality or morbidity could be problematic when carrying out seismic surveys and thus whether or not remedial measures are required.

e) *Aquaculture*

A series of *National Aquaculture Site Application Guides*, including i) Interim Guide to the Application of Section 35 of the *Fisheries Act* to Salmonid Cage Aquaculture Developments; ii) Interim Guide to Information Requirements for Environmental Assessment of Marine Finfish Aquaculture Projects; and iii) Interim Guide to Information Requirements for Environmental Assessment of Marine Shellfish Aquaculture Projects were presented across the country in February 2002. To facilitate the adoption and use of the *National Aquaculture Site Application Guides* introduced in 2002, information requirements for these guides were integrated into the provincial aquaculture application system in 2003. Subsequent to this, a series of training sessions were held for growers, consultants, and provincial government staff on the collection of site baseline data. Also, a shellfish aquaculture site monitoring protocol and a finfish aquaculture site monitoring protocol was developed in 2003.

## SUBAREA 4

### A. Status of the Fisheries

Nominal landings from 1993 to 2003 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

a) *Snow Crab* – 4R

Catches in 4R in 2003 (1,570 t) decreased by 10% from those of from 2002 (1750 t). The commercial catch rate has remained at a lower level than in other Divisions. There are no research data available from this Div.. It is not possible to infer trends in exploitable biomass from commercial CPUE data because of recent changes in the spatial distribution of fishing effort. Recruitment prospects are unknown.

b) *Iceland scallops* – 4R

The nominal catch from the Strait of Belle Isle (4R) in 2003 is estimated at 268 t (round) against a TAC of 1,000 t. CPUE in 2003 increased by 3 % from the previous year. The fishery here continues to be driven by the exploitation of an accumulated biomass consisting largely of cohorts of old, possibly well separated year-classes with little potential for further growth. No significant larval settlement or recruitment has been detected in recent years. Fishing activity in high density scallop aggregations causes high collateral mortality to scallop spat and appears to have had a significant effect on recruitment dynamics in the area.

## SUBAREAS 2 + 3 + 4

### A. Status of the Fisheries

Nominal landings from 1993 to 2003 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

a) *Lobster*

Landings declined through the 1990s to 1,756 t in 2000 from a long-term high of 3,207 t in 1992. Preliminary figures indicate increases in the past two years to 2,275 t in 2002 and 2,334 t in 2003. These increases occur primarily in 4R LFAs and LFA 11 in 3Ps, while in most LFAs around the island landings remain low, following the recent downward trend. The fishery is monitored at a few localized sites through co-operative arrangements with harvesters to complete logbooks and conduct at-sea sampling of commercial catches. The fishery is characterized by high exploitation rates and a size limit that is small in relation to growth rate and size at maturity. Yield per recruit analysis demonstrates growth overfishing with potential substantial increases in yield through reduction in exploitation rate or an increase in size limit. Egg per recruit analysis indicates a sufficiently low level of egg production under the current management regime to suggest a high risk of recruitment failure under unfavourable environmental-ecological conditions. While egg per recruit has been increased substantially as a result of the 1.5 mm carapace length size limit increase implemented in 1998, the doubling objective of the 1998-2002 Management Plan has not been achieved. The limited at-sea sampling indicates that v-notching has not been practiced in the fishery overall to the extent expected in the plan. With a strong environmental-ecological influence on recruitment and a system limited by low egg production, fluctuations in annual landings will be especially subject to environmental variability. Future landings can be expected to be lower, on average, and less stable than under a management regime with a lower level of exploitation.

### B. Special Research Studies

1. Sentinel Surveys

The Sentinel Surveys, initiated in October 1994, were continued in 2003. Data collected were tabled at regional stock assessments in the autumn of 2003 for 3Ps. There was no assessment for 2J3KL cod. Sites in 2J3K3L, 3Ps and 3Pn4Rs were sampled by inshore fish harvesters using traditional fishing gears based on historic fishing patterns. The objectives of the program are: to develop a reliable inshore catch rate, length frequencies, sex, maturity, and otolith series for use in resource assessment; to incorporate the knowledge of inshore fish harvesters in the process of resource assessment, to describe temporal and spatial inshore distributions; to establish a long-term physical oceanographic and environmental monitoring program of the

inshore area; and to provide a source of biological material for other researchers for genetic, physiological, food and feeding, and toxicological analyses.

2. Gear and Selectivity Studies

a) *Herding efficiency of the Canadian Campelen survey trawl*

A second year of experimental fishing trials were carried out in 2003 to measure the herding (bridle) efficiency of the Campelen 1800 shrimp trawl which is used during the annual bottom trawl surveys of the Grand Bank. At each of 9 stations in Subdiv. 3Ps three fishing tows were made over the same ground with the trawl rigged with varying bridle lengths (20 m, 40 m and 80 m in a randomized fashion) using the alternate haul method. Only cod was present in sufficient quantities. Preliminary analysis shows that there is no difference in the catch rates with either rigging, although it should be kept in mind that the number of sets are small. Further trials will be carried out in 2004.

**OTHER RESEARCH INFORMATION NOT SPECIFICALLY DELINEATED BY SUBAREA**

**A. <u>Oceans Management</u>**

In 1997, the federal government adopted the *Oceans Act*, which committed the Department of Fisheries and Oceans to prepare an Oceans Management Strategy. The Government of Canada publicly released Canada's Oceans Strategy on July 12, 2002. Based on the authority and direction set out in the *Oceans Act*, Canada's Oceans Strategy sets out the policy direction for modern oceans management in Canada. The strategy is based on the principles of sustainable development, integrated and collaborative management, and the precautionary approach and is supported by three main programs-Marine Protected Areas, Integrated Management, and Marine Environmental Quality.

a) Marine Protected Areas Program

Currently three sites in the region have been identified as Areas of Interest (AOIs), or candidate sites, in the Marine Protected Areas (MPA) Program.

*i) Proposed Eastport Marine Protected Area (Subarea 3)*

The waters surrounding Round Island and Duck Islands (approximately 2.1 $km^2$) off the Eastport Peninsula in Bonavista Bay were proposed as potential MPA sites by the Eastport Peninsula Lobster Protection Committee and were collectively announced by the Minister as an AOI in October 2000.

In 2002 multilateral consultations were held with stakeholder groups including local municipalities, the Kittiwake Economic Development Association, FFAW, Provincial Department of Fisheries and Aquaculture, and Parks Canada. A Steering Committee was formed to work with DFO in the further evaluation of the merits of this site as potential MPA under Canada's *Oceans Act*.

A Seabed Imaging and Mapping System survey was conducted to identify and quantify critical habitat, and existing biophysical and socio-economic information was compiled for review. Lobster research is ongoing including at-sea sampling, closed areas research, and monitoring increases in local egg production.

Following a technical assessment, a Recommendation was prepared with the support of the Steering Committee suggesting that a MPA under the *Oceans Act* was the most suitable management option. The Minister approved the Recommendation in March 2003, and DFO in collaboration with the Steering Committee began regulatory management planning as per Step 4 of the National Framework for Establishing and Managing MPAs (1999).

The Joint Project Agreement between the Department and local fishers remains in place and ensures continued interim protection for commercial and recreational species through area closures while the MPA management plan and regulations are being developed.

During the winter 2004, the Newfoundland and Labrador Legacy Nature Trust, in partnership with DFO and Memorial University, was successful in soliciting funds to continue existing lobster research in Eastport as well as introduce a juvenile lobster assessment. In addition, conservation and research methodology model utilized on the Eastport Peninsula will be replicated in 5 other areas around Newfoundland, including the proposed Tickles MPA. This work will commence in the spring.

*ii) Proposed Leading Tickles Marine Protected Area (Subarea 3)*

The Leading Tickles – Glovers Harbour Fisherperson's Committee and the Town of Leading Tickles proposed that the surrounding area in Notre Dame Bay (approximately 50 $km^2$) on the northeast coast be considered in the MPA Program.

In June 2001, the site was officially announced as an AOI. A Steering Committee was formed following consultations with potential stakeholders including the Exploits Valley Economic Development Corporation, Provincial Department of Fisheries and Aquaculture, and the Lewisporte Yacht Club. This committee is co-chaired by DFO and a fisher, and will further evaluate the site's potential as a MPA under the *Oceans Act*.

Oceans staff conducted groundtruthing of QTC View 4 substrate data collected previously during a multibeam bathymetric survey in partnership with the Canadian Hydrographic Service (CHS). Clusters of sites from various acoustic classes were sampled for similarities using underwater video, aquascope, and benthic grab samples. This information is being used to classify and map habitat within the proposed MPA and identify critical habitats and species associations.

In addition, a beach seining program has been developed to collect pre-treatment baseline information on the types and abundance of juvenile fish utilizing local eel grass beds. Sites will be monitored annually for changes in the types and/ or densities of juvenile fish to determine if conservation measures are proving effective and quantify impacts resulting from fishery closures and gear restrictions.

Biophysical and socio-economic overviews were completed to compile existing related information for use in management planning, identifying information gaps, and determining research priorities.

In March 2003, the Steering Committee held a Strategic Planning Session to develop the framework for a management plan. Several species were identified for protection, including lobster (*Homarus americanus*), Atlantic herring (*Clupea harengus harengus*), capelin (*Mallotus villosus*), and winter flounder (*Pleuronectes americanus*), as well as various species specific conservation options.

In 2004, the Department closed two areas to commercial lobster harvesting within the proposed MPA boundary at the request of the Steering Committee. The Steering Committee supports the use of the *Fisheries Act* in providing interim protection to local species, and is developing an implementation strategy for proposed herring conservation. Conservation strategies for other species identified at the March 2003 Strategic Planning Session will be developed as appropriate.

Following a technical assessment, the Region submitted a Recommendation to the Minister suggesting that an MPA under the *Oceans Act* was the most appropriate management tool for the area. If approved, regulatory management planning will commence.

*iii) Proposed Gilbert Bay Marine Protected Area (Subarea 2)*

Gilbert Bay is located on Labrador's southeast coast, approximately 300 km from the town of Happy Vally-Goose Bay. The geophysical configuration of the bay contributes to its unique character through semi-isolation from the Labrador Sea. Gilbert Bay is approximately 60 $km^2$ in area.

Since 1996, scientists from Memorial University of Newfoundland have been studying the cod (*Gadus morhua)* found in Gilbert Bay. They discovered a resident population of Northern cod that are genetically distinct from other Labrador cod. Tagging and tracking of this reddish-brown cod has been used to identify spawning and rearing areas of the cod confirming the population remain in the bay year round.

The communities of Port Hope Simpson and Williams Harbour (with the support of local fisheries committees) submitted a proposal asking DFO to establish a MPA in Gilbert Bay, and following a favourable review, the site was identified as an Area of Interest (AOI) in October 2000. In 2001, the Gilbert Bay Steering Committee was established, representing all interested and impacted parties.

In 2002, the Gilbert Bay Steering Committee completed analysis of the biophysical and socio-economic assessments and concluded that a MPA was the best management option for the site. A Recommendation to the Minister was prepared suggesting that the project move ahead with management planning and proceed to Step 4 of the National Framework for Establishing and Managing MPAs (1999). The Minster subsequently approved the recommendation in March 2003, and the Steering Committee began drafting a management plan including a regulatory package. DFO partnered with the Labrador Métis Nation to hire a community coordinator in February-May 2003. The coordinator will provide assistance to the Steering Committee and develop a public awareness program for the area. From February-March 2004, a coordinator was re-hired to assist the Steering Committee and develop public awareness products.

Scientific research conducted in Gilbert Bay during 2003 was a continuation of research initiated in 1998. Primary research activities involved conducting a tag/recapture program, collection of cod eggs, larva and pelagic juveniles, and the collection and analysis of zooplankton. Based on this research scientists from DFO and Memorial University of Newfoundland were able to estimate the population of Gilbert Bay cod (~70 metric tones). The results of this analysis are published as a Canadian Science Advisory Secretariat document. In October 2002, a multi beam survey was completed in Gilbert Bay through a partnership with the Canadian Hydrographic Service.

In March 2004, the Committee completed a regulatory package for Gilbert Bay.

b) *Integrated Management Program*

The *Oceans Act* calls for the Minister of Fisheries and Oceans to lead and facilitate the development and implementation of plans for the Integrated Management (IM) of all activities or measures affecting estuaries, coastal and marine waters. IM is a proactive approach towards sound ocean management. It is an ongoing and collaborative planning process that brings together interested parties, stakeholders, and regulators to reach general agreement on the best mix of conservation, sustainable use, and economic development of coastal and marine areas for the benefit of all Canadians.

Considerable work has been done in relation to IM in the Region. In Conception Bay South, biophysical and socioeconomic overviews have been compiled, based on existing knowledge. A visual environmental profile has been drafted. Issues and potential conflicts have been identified and meetings with stakeholders have been conducted.

In the Bay D'Espoir/Connaigre Peninsula area, consultations with stakeholders have identified issues and concerns, which have been documented in a report as a basis for pursing IM planning on the area. The sponsor group, Coast of Bays Corporation, has developed a strategic plan to proceed with Integrated Management in the area.

In the Gulf of St. Lawrence, NL Region personnel continued to work collaboratively with colleagues in the Gulf and Quebec Regions to research and develop an Ecosystem Overview Report and associated ecological assessment for the Gulf of St. Lawrence. This report is being undertaken using direction provided in national draft guidelines for ecosystem overview reporting in order to describe existing aspects of the physical, biological and socio-economic aspects of the Gulf of St. Lawrence ecosystem.

In the Placentia Bay area, a Federal/Provincial working group has been established to coordinate the development of IM planning in Placentia Bay. To date, joint efforts have concentrated on gathering existing biophysical and socio-economic information and a database of references has been created. In addition, three Community Coastal Resource Inventories (CCRIs) have been compiled and mapped for the entire bay. These inventories were completed in co-operation with local sponsoring groups.

A CSAS document entitled Integrating Scientific and Local Ecological Knowledge to Identify Potential Critical Habitats: A Case Study in Placentia Bay, Newfoundland was published. The initiative documented the local ecological knowledge of fishers and community members regarding marine mammals, pelagic fish and the location of environmentally sensitive areas/habitats in Placentia Bay.

A multi-medium interactive CD-ROM and a visual profile of Placentia Bay have been developed that highlights the major biophysical and socio-economic components of bay. Both the CD-ROM and the visual profile were created as an additional reference tool for consultations, and to build upon the education and awareness of IM planning in Placentia Bay.

A comprehensive scoping exercise was completed in late-2003/early-2004 where bilateral meetings with groups, agencies, and individuals were held to determine issues and concerns and/or opportunities and the need for IM planning in Placentia Bay.

Future focus for IM planning in Placentia Bay will be to move towards the establishment of a multi-stakeholder IM Planning Committee. This will involve the continued consultation with key stakeholders who have expressed an interest in IM planning in Placentia Bay.

*i) Community Coastal Resource Inventories*

DFO has been working with community groups throughout coastal Newfoundland and Labrador to document and map coastal resources since 1996. Information documented in these Community-Based Coastal Resource Inventories (CCRIs) is largely traditional ecological knowledge collected through an interview process with local community members who have knowledge of coastal resources based on their long-term interaction with these resources. The entire coastline of the island of Newfoundland has now been inventoried under this program as well as the coast of Labrador from the Quebec border to Smokey, including Lake Melville. Typically, information collected includes, but is not limited to, resource distribution (groundfish, pelagics, shellfish, aquatic plants, marine mammals and birds), infrastructure, culture, tourism and recreation, aquaculture and shoreline classification.

All information is maintained in a Geographic Information System (GIS) with associated databases. A project in collaboration with CHS will provide for the dissemination of the information on the internet via DFO's Geoportal.

*ii) Coastal Management Areas (CMA) – Bay of Islands and Northern Peninsula*

*Bay of Islands*

Oceans Management continued to foster the development of coastal management plans within western Newfoundland. Stakeholder consultations and information exchange have been used to identify issues and concerns with respect to integrated coastal management particularly within the Bay of Islands and the western half of the Northern Peninsula.

Within the Bay of Islands a productive partnership with the Atlantic Coastal Action Plan (ACAP) group located within the Humber Arm / Bay of Islands area continued. Since 1991, DFO has worked with ACAP Humber Arm Inc. and member stakeholders to develop the concept of integrated management planning. This has included development of an ecosystem overview, completion of a community coastal resource inventory, identification of coastal management concerns and opportunities, development and revision of a Comprehensive Environmental Management Plan, and the development and implementation

of coastal zone management education and information sharing initiatives. Activity within 2003/04 included: working with ACAP and its member stakeholders to continue the development and implementation of community education and information sharing initiatives, initiation of consultations with stakeholders to determine how to revise the Comprehensive Environmental Management Plan (CEMP), and to initiate revision of the CEMP based on stakeholder consultations and in keeping with the provisions of the "National Policy and Framework for the Integrated Management of Estuarine, Coastal and Ocean Areas".

*Northern Peninsula*

This is a community based coastal planning initiative which involves a partnership between the Department of Fisheries and Oceans, local economic development agencies, and their associated stakeholder groups. This initiative covers the western portion of the Northern Peninsula from Cape St. Gregory to Cape Bauld including communities from Trout River to Lanse aux Meadows located within subDiv. 4Ra and 4Rb of NAFO Div. 4R.

The long term objective of this cooperative initiative is to encourage proactive, integrated management planning with key stakeholders to deal with issues related to coastal infrastructure requirements, fishing activity, increased coastal development, and multiple uses of coastal resources identify stakeholders and key coastal issues, and avoid potential conflict.

To date progress has been made with respect to the development of a community based coastal resources inventory of the area and a comprehensive list of stakeholders, and bilateral meetings/interviews with selected stakeholders to identify and discuss coastal planning issues and potential conflicts.

During 2003/04 work on this initiative included the collection, review and compilation of data and information which may be used to describe the physical, biological and socio-economic aspects of the coastal environment within this planning area, the formation of an interim coastal planning committee and the development and delivery of a presentation on Integrated Management to encourage the continued participation of stakeholders in coastal planning activities. The interim steering committee includes representatives from DFO, local stakeholders, interested parties, coastal communities and other government departments. The role of this committee will be to educate and inform local groups as to the objectives and process of Integrated Management and to further guide the development of an integrated management plan for coastal activities within this portion of western Newfoundland.

*iii) Sensitive and Significant Areas Identification and Mapping*

*Inshore*

Investigations into sensitive and significant areas have been conducted in Placentia Bay and the Gulf of St. Lawrence to deal with concerns and issues for specific areas in Newfoundland and Labrador and to provide management options. Considerations for such undertakings include critical habitats such as spawning or juvenile rearing areas, feeding sites, important migration corridors, both the shoreline, nearshore and offshore areas, various fish and shellfish species, marine plants, marine mammals, and seabirds. The information collected has been compiled and stored in a format that will facilitate ready retrieval and display in a spatial or mapping format, and will complement the information that has already been collected through the CCRI program.

The information collected through the CCRIs and the investigations into sensitive and critical areas provides a basis for integrated management of coastal areas by identifying priority areas and engaging stakeholders in the communities. Additionally, the information is valuable for environmental assessment, sensitivity mapping for emergency response planning, and is used by coastal communities for sustainable economic planning.

Within western Newfoundland (i.e. NAFO Div. 4R) Oceans staff, in collaboration with personnel from Quebec and Gulf regions, continue the evaluation, validation and review of available information on

sensitive areas to identify and describe ecologically and biologically significant areas within the coastal and offshore areas of the Gulf of St. Lawrence. These ecologically and biologically significant areas represent marine spaces which through their physical, chemical, biological and geological characteristics offer habitat important for one or more species of aquatic animals and that they appear to provide or represent:

- Areas of important /significant biodiversity and/or biological productivity;
- Particular ecological communities;
- Conditions suitable for the development, maintenance or general survival (e.g. spawning, feeding, nursery, etc.) of individuals in a population or species;
- Contain/support endangered species; and
- Contain/provide particular oceanographic conditions/mechanisms (e.g. underwater coastal shelves, coastal upwellings, etc…).

It is anticipated that the Ecologically and Biologically Significant Areas (EBSA) listing will provide information for use in the integrated management of coastal and offshore areas within the Gulf of St. Lawrence. In addition, the EBSA information will be used in the future identification of potential Marine Protected Areas within western Newfoundland and the Gulf of St. Lawrence.

*Offshore*

Under the *Oceans Act*, DFO is responsible for the conservation and protection of marine areas with high biodiversity and biological productivity. In the offshore, the Grand Banks were selected as a study area due to the increasing activity related to hydrocarbon exploration and development. Leases held by oil and gas industry have been overlaid on DFO data from the Newfoundland Fishery Observer Program and Groundfish Scientific Surveys. Eighteen commercially significant groundfish species are identified using data from 1980-2000. The extracted data will be spatially represented using SPANS GIS Software. Upon completion, resulting maps would be stored in several mediums including CD and web-based applications. Identifying these areas is an important step toward effective oceans planning and management in the offshore area.

*c) Marine Environmental Quality Program*

The overall objective of the MEQ program is to provide sound advice to decision-makers for ecosystem-based planning and management. Initially the program focused on building an ecosystem knowledge base, and GIS tools, to assist in identifying relationships between the human activities we plan to manage, and environmental conditions that affect existing or intended uses of the marine environment. Work now focuses increasingly on developing the role of MEQ within for areas of interest to the IM and MPA programs, including the development of ecosystem objectives.

*i) Marine Environmental Quality Profiles*

A generic MEQ profile has been developed for the region, providing background information on major issues, and a summary of the existing data that has been compiled for the region. This profile is updated regularly as new issues or activities arise and is used by Oceans Management Section to guide the production of MEQ profiles for areas of interest to the IM and MPA programs, and contribute to Ecosystem Overview reports.

*ii) Contaminant Database*

The identification and characterization of marine sewage outfalls in the region has been given a high priority and a detailed database has been developed for the region, including photos and map coordinates for all municipal sewage outfall within Placentia Bay, Bay of Islands, Conception Bay, Coast of Bays, and the areas surrounding Leading Tickles and Eastport Considerable effort has also been focused on compiling an electronic database of chemical contaminants in marine sediments from hard

copy reports collected by various government departments over the past 30 years, largely in association with harbour dredging programs. This database provides information on more than 38 chemical parameters in 119 harbours around Newfoundland and Labrador, and will be updated annually as new data is collected. The development of a database of potential point sources of contaminants has also been given priority, particularly for the IM and MPA sites. DFO has partnered with the Provincial Department of Environment (DOE) to combine data collected by both departments and initiate the development of an on-line system to display these databases.

GIS tools are under development to display MEQ data, and help to assess possible linkages between the condition of the environment (i.e. contaminant levels), potential threats (i.e. point sources of contaminants) and possible effects (i.e. shellfish closures or algal blooms) by superimposing relevant map layers. An MEQ atlas prototype has been developed on a shared drive using Map-Info to display all the data collected for the MEQ profile as well as other relevant data such as fish resources and sensitive areas. Hard copy Atlases have been developed for Bay of Islands, St. George's Bay and the Northern Peninsula West. A draft CD has also been developed in partnership with Environment Canada using a simulated GIS software package (Toolbook) to display MEQ data for the region. This CD consolidates all of the data and information collected by the regional MEQ Program, providing a valuable and versatile tool for oceans managers.

*ii) Marine Environmental Quality Demonstration Project*

The *Oceans Act* initiated a new integrated approach to management of Canada's oceans, calling for consideration of the impacts of all human activities on marine ecosystems, and the establishment of guidelines, and objectives in relation to marine environmental quality (MEQ). The Bay of Islands was chosen as one of several *MEQ Demonstration Projects* initiated during 2002 within the Gulf of St. Lawrence, to demonstrate the role of MEQ within integrated management planning. Within 2003, this project continued to focus on water quality issues in York Harbour and Lark Harbour and on the following objectives:

- Engage stakeholders and establish MEQ Objectives in relation to water quality issues.
- Identify and map specific *areas of concern* in relation to water quality within the Bay.
- Identify, characterise, and map sources contributing to water quality degradation, for each of the *areas of concern* identified within the Bay.
- Undertake a water/sediment quality monitoring program at *areas of concern* impacted by bacterial contamination, to assess the level of contamination, and differentiate sources.

Also within 2003/04 efforts continued towards the following long-term objectives of the demonstration project:

- For each a*rea of concern*, develop indicators and associated reference points which reflect existing and desired conditions in the local area.
- Identify specific management actions required to meet these objectives, which can be implemented if reference points (limit/targets) are exceeded.
- Establish a monitoring program to measure the performance of each indicator.
- Undertake the required management actions, drawing upon the relevant regulatory regime and stakeholders. Approach funding agencies for support, if necessary.

This is a collaborative project which intends to demonstrate how government agencies, community groups, and other interested individuals can work together-in an Integrated Management framework-to plan how to improve marine water quality in this case within Lark Harbour and York Harbour. The project was successful in the initiation of a project under the direction of the York Harbour Town Council, the NL Conservation Corp, Fisheries and Oceans, ACAP Humber Arm, Environment Canada, and NL Department of Tourism (Inland Fish and Wildlife) to improve water quality within a small lagoon/barachois in York Harbour through the planting of vegetation and household education on septic system maintenance.

Table 1. Summary of preliminary catches for stocks within the DFO, Newfoundland and Labrador Region, 1993-2003. Note that unless otherwise specified this table presents Newfoundland and Labrador landings only.

| | | | Catch (t) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Subarea** | **Species** | **Division** | **2003** | **2002** | **2001** | **2000** | **1999** | **1998** | **1997** | **1996** | **1995** | **1994** | **1993** |
| 0+1 | Greenland halibut | SA 0 + 1A(offshore)+ 1B-F | 4,204 | 2,561 | 3,181 | 2,615 | 3,876 | 3,300 | 1,700 | 1,453 | 5,852 | 3,723 | 2,561 |
| | Shrimp* | 0A | 6,652 | 6,247 | 3,625 | 1,588 | 2,046 | 933 | 517 | 2,623 | 2,361 | 4,727 | 5,501 |
| | | 0B | 4,399 | 5,597 | 5,829 | 4,805 | 5,132 | 5,204 | 5,670 | 3,220 | 3,564 | 476 | 106 |
| 2 | Cod | 2GH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| | Shrimp* | 2G (SFA 4) | 12,823 | 8,393 | 8,116 | 7,529 | 7,884 | 8,051 | 5,217 | 5,160 | 5,104 | 3,982 | 2,723 |
| | | 2HJ (SFA 5) | 26,750 | 15,332 | 15,116 | 14,729 | 15,109 | 15,170 | 15,103 | 7,383 | 7,616 | 7,499 | 5,719 |
| | | 2HJ3K (SFA 6) | 64,391 | 60,198 | 52,656 | 63,796 | 51,202 | 46,337 | 21,246 | 10,923 | 10,914 | 10,978 | 8,035 |
| | Crab | 2J | 2532 | 3,522 | 3,756 | 3,794 | 5,448 | 4,061 | 3,166 | 3,090 | 3,178 | 2,978 | 2,275 |
| | Iceland scallop | 2HJ | 376 | 259 | 218 | 230 | 685 | 1,295 | 1,027 | 360 | 167 | 340 | 401 |
| | Arctic Charr | 2J3KLPs+4R | 19 | 21 | 33 | 47 | 41 | 38 | 38 | 16 | 30 | 31 | 38 |
| 2+3 | Redfish | 2+3K | 21 | 35 | 41 | 28 | 3 | 3 | 4 | 2 | 1 | | 2 |
| | Greenland halibut | 2+3KLMNO | 6,960 | 6,292 | 8,235 | 10,637 | 4,124 | 4,081 | 5,877 | 5,891 | 3,229 | 2,928 | 4,899 |
| | American plaice | 2+3K | 34 | 100 | 132 | 67 | 6 | 6 | 2 | 16 | 28 | 16 | 77 |
| | Witch | 2J+3KL | 111 | 166 | 151 | 92 | 2 | 1 | 6 | 4 | 10 | 11 | 343 |
| | Cod | 2J3KL | 1,029 | 4,193 | 6,887 | 5,354 | 8,472 | 4,501 | 501 | 1,500 | 332 | 1,309 | 3,938 |
| | Grenadier | 2+3 | 185 | 272 | 212 | 234 | 145 | 209 | 98 | 225 | 125 | 130 | 614 |
| | Capelin | 2J3KL (offshore) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Squid | 2+3 | 622 | 228 | 23 | 328 | 19 | 815 | 12,748 | 8,285 | 48 | 1,954 | 276 |
| 3 | Redfish | 3LN | 9 | 48 | 24 | 32 | 5 | 7 | 19 | 0 | 0 | 0 | 46 |
| | | 3M | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 3O | 3,093 | 2,988 | 4,532 | 880 | 2,027 | 6,121 | 1,895 | 128 | 24 | 1,192 | 677 |
| | Yellowtail | 3LNO | 12,702 | 9,958 | 12,240 | 9,425 | 5,540 | 3,536 | 1 | | | | 6,265 |
| | American plaice | 3LNO | 1,606 | 1,377 | 1594 | 622 | 269 | 204 | 71 | 47 | 65 | 59 | 7,454 |
| | | 3Ps | 881 | 1,011 | 877 | 607 | 542 | 405 | 213 | 112 | 80 | 112 | 723 |
| | Witch flounder | 3NO | 52 | 26 | 12 | 4 | 3 | 3 | 18 | 26 | 0 | 0 | 3,971 |
| | | 3Ps | 530 | 518 | 450 | 332 | 507 | 452 | 259 | 250 | 273 | 429 | 956 |
| | Atlantic halibut | 3 | 398 | 365 | 317 | 183 | 124 | 165 | 152 | 101 | 107 | 36 | 138 |
| | Cod | 3NO | 714 | 424 | 506 | 172 | 485 | 306 | 289 | 54 | 31 | 3 | 3,719 |
| | | 3Ps | 12,440 | 12,118 | 13,339 | 19,683 | 24,328 | 15,690 | 7,327 | 767 | 581 | 575 | 13,865 |
| | Haddock | 3LNO | 69 | 183 | 88 | 70 | 50 | 14 | 190 | 28 | 9 | 0 | 675 |
| | | 3Ps | 137 | 109 | 99 | 163 | 98 | 191 | 69 | 118 | 48 | 20 | 86 |
| | Pollock | 3Ps | 332 | 492 | 808 | 710 | 729 | 428 | 592 | 435 | 248 | 59 | 113 |
| | Capelin | 3L | 13,870 | 8,617 | 13,898 | 12,041 | 11,403 | 19,809 | 3,560 | 16,840 | 100 | 890 | 23,480 |
| | | 3K | 4,242 | 1,553 | 5,022 | 4,066 | 7,254 | 10,225 | 9,230 | 8,920 | 30 | 70 | 13,525 |
| | Shrimp* | 3M | 0 | 8 | 293 | 618 | 490 | 469 | 785 | 906 | 970 | 1,041 | 3,724 |
| | | 3L | 10,685 | 5,417 | 4,986 | 4,111 | | | | | | | |
| | Sea scallop | 3KLNO | 0 | 0 | 0 | 0 | 0 | 6 | 20 | 27 | 9 | 10 | 9 |
| | | 3Ps | 31 | 48 | 338 | 85 | 70 | 266 | 9 | 8 | 418 | 534 | 483 |
| | Iceland scallop | 3LNO | 0 | 0 | 39 | 336 | 141 | 1,300 | 3,986 | 9,454 | 6,501 | 3,941 | 817 |
| | | 3Ps | 735 | 478 | 498 | 1,148 | 1,197 | 2,792 | 5,367 | 608 | 1,061 | 440 | 667 |
| | Crab | 3K | 16,493 | 16,352 | 15,288 | 15,390 | 21,470 | 16,788 | 14,830 | 14,190 | 12,245 | 11,039 | 9,760 |
| | | 3LNO | 31,627 | 30,032 | 28,172 | 26,773 | 32,725 | 23,533 | 22,185 | 16,656 | 13,790 | 12,237 | 8,979 |
| | | 3Ps | 6,110 | 7,637 | 7,843 | 7,917 | 7,909 | 6,615 | 4,753 | 3,047 | 1,853 | 1,590 | 704 |
| | Lobster | 3K | 206 | 206 | 275 | 231 | 251 | 295 | | | | | |
| | | 3L | 118 | 128 | 124 | 126 | 158 | 146 | | | | | |
| | | 3Ps | 787 | 762 | 709 | 637 | 612 | 683 | | | | | |
| | | 3Pn | 22 | 12 | 25 | 18 | 25 | 26 | | | | | |
| | Atlantic salmon** | 2J3KLPs+4R | 36 | 39 | 39 | 30 | 38 | 45 | 82 | 114 | 95 | 133 | 126 |
| 3+4 | Redfish | 3P+4V | 3,040 | 3,289 | 2,506 | 4,439 | 4,726 | 4,101 | 3,825 | 4,566 | 3,978 | 7,594 | 9,350 |
| 4 | Iceland scallop | 4R | 268 | 249 | 638 | 1,083 | 1,058 | 1,348 | 1,205 | 1,204 | 1,497 | 2,294 | 2,122 |
| | Sea scallop | 4R | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 37 | 0 |
| | Lobster | 4R | 1201 | 950 | 985 | 747 | 766 | 885 | | | | | |
| | Crab | 4R | 1,565 | 1,750 | 1,675 | 1,640 | 1,612 | 1,064 | 969 | 833 | 920 | 655 | |

*Shrimp catches are for Eastern Canada (i.e. taken by vessels from Newfoundland and Labrador, Quebec, and Nova Scotia).
**Recreational catch.

## Part II – Central and Arctic Region

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### SUBAREA 0

A. Status of the Fisheries

*a) Shrimp*

See report by Newfoundland (Part B).

*b) Shellfish*

In 2003 DFO did not issue an exploratory license to Qikiqtarjuaq because of concerns of possible health risks associated with uninspected shellfish. At a workshop in Iqaluit an interim plan was put forward to test product for contaminants on a lot by lot basis to ensure the product was safe for human consumption. The acceptance of this plan by all involved parties allowed DFO to reissue the license for the community in January 2004. The Nunavut Department of Sustainable Development funded a pilot project to run a proper fishery in Qikiqtarjuaq. The Aboriginal Business Quest of BC was contracted to manage and provide diving supervision for the fishery. The project began January 2004 and began harvesting clams in February. In eight weeks of diving 11 divers collected 4,672 kgs of clams, all *Mya* sp.

c) *Arctic Charr*

Subsistence and commercial Arctic charr fisheries in the Baffin region are conducted in inshore lakes and rivers not in marine waters. Information on these fisheries can be found in the "Annual Summary of Fish and Marine Mammal Harvest Data for the Northwest Territories" published by Fisheries and Oceans Canada, Central and Arctic Region.

d) Greenland Halibut – Div. 0B

Nunavut companies have a 1,000 ton inshore allocation for Greenland halibut in Subarea 0. The Cumberland Sound fishery began in 1987 and is the only inshore fishery that has operated on an annual basis. The total allowable catch (TAC) for the Cumberland Sound fishery has been set at 500 tons since 1994 but in recent years the TAC has not been reached. The fishery is exclusively a winter fishery (January to May) and the fishermen use long-lines set through holes cut in the land-fast sea ice. In 2002 exploratory fishing was conducted in the summer, open water season but was not successful in locating aggregations of Greenland halibut. Fishermen have experienced unstable ice conditions on the sea ice platform in previous years and effort had decreased since the early-1990s. In 2003 ice conditions were good and there was greater participation, approx. 35 fishermen up from approx. 20 in previous years. The fish plant also began selling squid for bait in 2002 and this has continued in 2003. Fishermen have reported that the squid bait improved catches. The fishery produced 244 tons in 2003 up from 106 in 2002 (Table 1).

Nunavut companies have a 500 ton quota in the Div. 0B offshore commercial fishery. In recent years they have also been allowed to transfer any surplus inshore quota to the offshore fishery. In 2003, Nunavut license holders in Div. 0B offshore harvested approx. 1,016 tons for a total of 1,260 t (Table 1).

e) *Greenland Halibut* – Div. 0A

Since 1996 Nunavut companies have had exclusive access to an exploratory fishery license to harvest Greenland halibut in NAFO Div. 0A. Between 1996 and 2000 catches were less than 330 t. Catches began to increase in 2001 (2,625 t) and in 2003 they were approx.4,278 t (Table 1). There is 100% observer coverage for this fishery. In 2003 approximately 40 species or families of fish were listed as caught by the observers but most were discarded. Skate species dominated with approx. 212 t recorded, the majority of which came from the long-line gear (Table 3). Greenland shark (107 t) was caught in 144 of 503 trawl sets and 95 of 675 long-line sets. Considerably fewer Broadhead or Northern wolfish were caught in 2003 (2 t from 147 of 675 long-line sets) as compared to 2002 (11 t). There were 28.9 t of unspecified Grenadier caught and an additional 2.6 t of Roughhead Grenadier (*Macrourus berglax*). No Atlantic halibut (*Hippoglossus hippoglossus*) or Atlantic cod (*Gadus morhua*) were recorded.

B. Special Research Studies

1. Environmental Studies

No environmental studies were conducted.

2. Biological Studies

a) Age Validation for Greenland halibut

The $C^{14}$ method of age validation is being examined for its applicability in the case of Greenland halibut. This work is being undertaken in collaboration with Dr. Steven Campana at the Bedford Institute and in cooperation with scientists from DFO Newfoundland and the Greenland Institute of Natural Resources. In 2001 analysis of $C^{14}$ in the core of otoliths from 4 Greenland halibut collected in Cumberland Sound in 1986 showed that whole otolith ages may be under-aging these fish. However, since the $C^{14}$ signal recorded in deep-sea environments is different (delayed) from that of the surface marine waters, reference $C^{14}$ values appropriate to the environment experienced during the period of otolith core formation must be used.

In 2003 work focused on strengthening the reference curve by expanding the number of samples analyzed (0-2 year old Greenland halibut collected between 1959 and 1987). Samples of Atlantic cod collected from the same area and over the same time frame were also analyzed to compare to the Greenland halibut and confirm the shape of the reference curve. 37 samples have been assayed to determine $C^{14}$ levels and to create a reference curve for Greenland halibut and 33 have been done for Atlantic cod. The validation samples have been aged whole and in cross section and are being prepared for assay analysis. The results should be available in summer or fall 2004.

A tagging program for Greenland halibut from Cumberland Sound was conducted from 1997 to 2000 during the winter long-line fishery. In 2003 4 tagged fish were returned for a total of 13 recaptures out of 1,674 tagged (Treble, 2003). Another aspect of this tagging program was the marking of the otoliths using an injection of oxytetracyline (OTC). We now have three marked otoliths that have been returned, one 2 years, one 3 years and one 4 years since marking. The mark is visible on the sections of all otoliths as well as on the whole otolith for the one that has been at large for 4 years. Assessment of growth and determination of annuli is in progress. It is anticipated that these results will be presented together with the $C^{14}$ results in 2005.

b) Marine Mammal Studies

Our lab has been studying the beluga and narwhal stocks within Cumberland Sound (NAFO Div. 0B) for a number of years. There is an important subsistence harvest for these whales by hunters in the community of Pangnirtung. In June, 2003, an unsuccessful attempt was made to tag belugas at the head of Cumberland Sound. In August 2003, we also had an unsuccessful attempt to obtain skin biopsies from

belugas on the west side of Cumberland Sound for genetic analysis. Also, aerial surveys of narwhal and bowhead whales were conducted in August of 2003 along the east coast of Baffin Island.

c) Shellfish

Stock Assessment photographic survey of Clam Fishing Zone 3 was conducted in 2003. Most of the area that currently can be fished has been sampled. The results will provide a good estimate of the standing stock of clams in the area. Samples were collected by divers for ageing and biomass estimates.

## REFERENCES

Treble, M. A. 2003. Results of a Greenland Halibut (*Reinhardtius hippoglossoides* ) tagging project in Cumberland Sound, NAFO Div. 0B, 1997-2000. NAFO SCR Doc. 03/41, 7p.

Table 1. Summary of catch estimates (t) for Greenland halibut by Central and Arctic licensed vessels, landed catch only.

| **Div.** | **2003** | **2002** | **2001** | **2000** | **1999** | **1998** | **1997** | **1996** | **1995** | **1994** | **1993** | **1992** | **1991** | **1990** | **1989** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0A offshore | 4278 | 3561 | 2610 | 211 | 0 | 42 | 203 | 295 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0B inshore | 244 | 106 | 77 | 45 | 34 | 63 | 66 | 60 | 285 | 400 | 425 | 430 | 147 | 255 | 180 |
| 0B offshore | 1016 | 812 | 1013 | 1341 | 1568 | 1720 | 1446 | 1417 | 407 | 0 | 20 | 1020 | 0 | 0 | 0 |
| Total 0B | 1260 | 918 | 1090 | 1386 | 1602 | 1783 | 1512 | 1477 | 692 | 400 | 445 | 1450 | 147 | 255 | 180 |

Table 2. Total weight (t) by gear of the by-catch species recorded as caught by observers (100% coverage) in the Central and Arctic Region, Div. 0A Greenland halibut fishery in 2003.

| **Species** | **Trawl** | | **Long-line** | | **Total** |
|---|---|---|---|---|---|
| | Catch | Discard | Catch | Discard | |
| Greenland shark (*Somniosus microcephalus*) | .005 | 67.905 | | 39.100 | 107.010 |
| Skate unspecified | | 2.385 | | 197.742 | 200.127 |
| Jensen's skate (Amblyr*aja jenseni*) | | 2.658 | | | 2.658 |
| Arctic skate (*Amblyraja hyperborea*) | | .040 | | 8.955 | 8.995 |
| Grenadier unspecified | .142 | .325 | 6.830 | 21.610 | 28.907 |
| Roughhead grenadier (*Macrourus berglax*) | .037 | .700 | .101 | 1.759 | 2.597 |
| Broadhead wolffish (*Anarhichas denticulatus*) | | .014 | | 1.970 | 1.984 |
| Spotted wolffish (*Anarhichas minor*) | | | | .026 | .026 |
| Striped wolfish (*Anarhichas lupus*) | .005 | .022 | | .004 | .031 |