



STOCK ASSESSMENT OF SUBDIVISION 3Ps COD, OCTOBER 2010

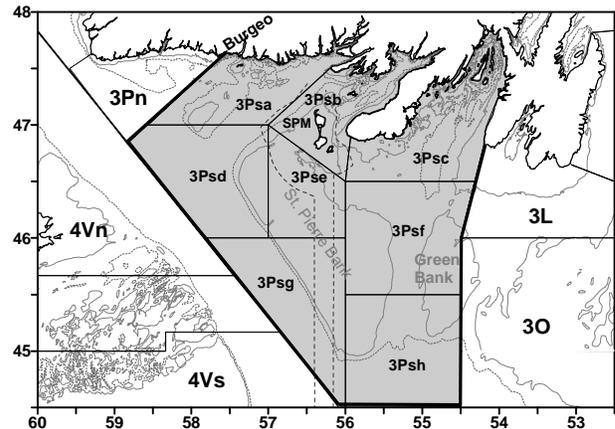
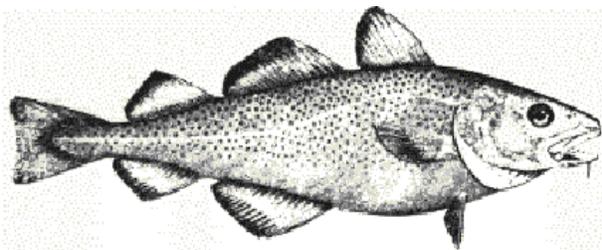


Fig. 1: 3Ps management area (shaded) unit areas (solid lines) and economic zone around the French islands of St. Pierre and Miquelon (SPM) (dashed line).

Context

In the Northwest Atlantic, cod are distributed from Greenland to Cape Hatteras and are managed as 12 stocks. The 3Ps stock off southern Newfoundland extends from Cape St. Mary's to just west of Burgeo Bank, and over St. Pierre Bank and most of Green Bank (Fig. 1).

The distribution of 3Ps cod does not conform well to management boundaries and the stock is considered a complex mixture of inshore and offshore sub-components. These may include fish that move seasonally between adjacent areas as well as fish that migrate seasonally between inshore and offshore. The extent to which the different components contribute to the fisheries is not fully understood.

Cod from this stock generally grow faster than those from areas further northward. Female cod from this stock are generally maturing at younger ages in recent years. For example, about 35% of the females are mature by age 5 (~47 cm) in recent cohorts, compared to only about 10% at age 5 (~55 cm) among cohorts present in the 1970s-early 1980s.

Catches from this stock have supported an inshore fixed gear fishery for centuries and are of vital importance to the area. Fish are caught offshore by mobile and fixed gear, and inshore by fixed gear only. Spanish and other non-Canadian fleets heavily exploited the stock in the 1960s and early 1970s. French catches increased in the offshore throughout the 1980s. A moratorium on fishing initiated in August 1993 ended in 1997 with a quota set at 10,000 t. Beginning in 2000, the management year was changed to begin on 1 April. The TAC for both the 2009/10 and 2010/11 management years was set at 11,500 t. Under the terms of a 1994 Canada-France agreement, the French (St. Pierre et Miquelon) share of the TAC is 15.6%.

The present assessment is the result of a request for science advice from the Fisheries and Aquaculture Management (FAM) Branch (NL Region). The main objectives were to evaluate the status of the stock and to provide scientific advice concerning conservation outcomes related to various fishery

management options.

Participants included DFO scientists, a scientist from IFREMER (France), fisheries managers, government officials from the province of Newfoundland and Labrador, fishing industry representatives, and World Wildlife Fund (Canada).

SUMMARY

- Information available to evaluate stock status consisted of commercial landings (1959 to 15 Oct 2010) and log-book data (1997-2009) in conjunction with information from Canadian research vessel (RV) trawl surveys (1972-2010), industry trawl surveys (1997-2005, 2007), sentinel surveys (1995-2010), and a telephone survey of Canadian fish harvesters pertaining to the 2009/10 fishery. Exploitation (harvest) rates were estimated from tagging experiments in Placentia Bay.
- Catch and commercial logbook data for the entire 2010/11 management year were not available to the current assessment as the 2010/11 fishery is ongoing. Tag return and sentinel survey data are also incomplete for 2010 and will be considered during the next assessment.
- The total allowable catch (TAC) for the 2010/11 management year is 11, 500 t.
- Tagging data and ancillary information indicated that there is a complex of stock components in 3Ps. However, the DFO RV survey covers most of the stock, and survey trends broadly reflect stock trends.
- The basis for a limit reference point (LRP) for this stock is B_{Recovery} , defined as the lowest observed SSB from which there has been a sustained recovery. The 1994 value of SSB has been identified as the limit reference level for this stock.
- Estimates of total mortality (ages 4-11) from a cohort model over 2005-09 were approximately 0.60 (45% mortality). This high level of mortality is a concern. Total mortality rates reflect mortality due to all causes, including fishing.
- In this assessment, SSB estimated from a survey based cohort model (SURBA) decreased in recent years and in 2008 and 2009 there was a probability of 0.59 and 0.75, respectively, that SSB was below the LRP. The SSB in 2010 is estimated to be above the LRP, although the probability of being below the LRP is 0.37.
- A one year projection to 2011 using the cohort model indicated that survey SSB will increase if total mortality rates are similar to current values (i.e. within $\pm 20\%$), and that the probability of being below the LRP in 2011 is low (0.04 to 0.17).
- The 2006 cohort is estimated to be relatively strong and is expected to recruit to the 2011 fishery. The 2007 and 2008 cohorts are estimated to be near the 1994-2008 average. Year-classes currently supporting the fishery are relatively weak in comparison to the strong 1997 and 1998 cohorts.
- The status of inshore components is uncertain, however catch rates from sentinel surveys and logbooks for vessels <35' suggest stability.

- Exploitation rates for cod tagged in Placentia Bay during 2008 and 2009 ranged from 10-14% and were lower than those observed in 1999-2005 (23-35%).
- The impacts of fishing at specific TAC levels on all stock components could not be quantified.
- Reported landings during the 2009/10 season totaled 77% of the TAC. This is atypical.
- Industry participants noted reduced catches during the 2009/10 season. Primary reasons were reduced effort and market conditions. Harvesters continue to see evidence of a strong 2006 year-class.

INTRODUCTION

History of the fishery

The stock was heavily exploited in the 1960s and early 1970s by non-Canadian fleets, mainly from Spain, with catches peaking at 84,000 t in 1961 (Fig. 2).

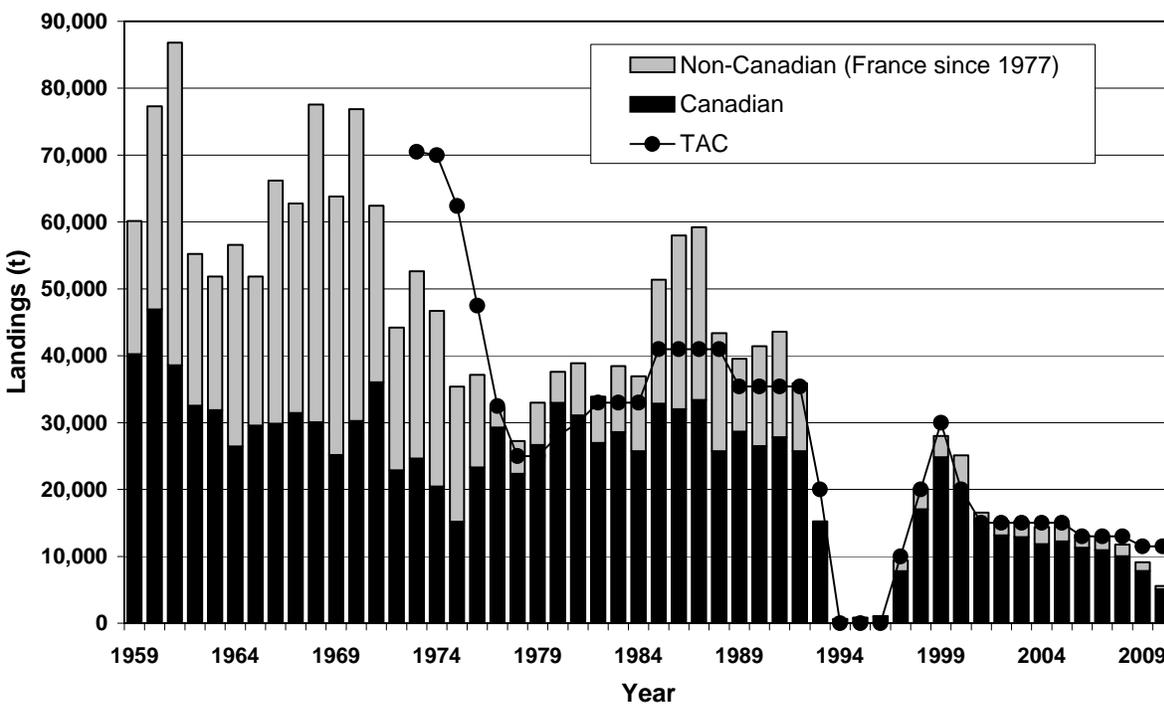


Fig. 2. Reported calendar year landings (t) of cod in 3Ps, 1959-2010 (2010/11 fishing season ongoing). Note that since 2000 TAC's are by management year (1 April-31 March).

After the extension of jurisdiction in 1977, catches averaged around 30,000 t until the mid-1980s when fishing effort by France increased and total landings reached about 59,000 t in 1987. Catches then declined gradually to 36,000 t in 1992.

A moratorium was imposed in August 1993 after only 15,000 t had been landed. Although offshore landings fluctuated, the inshore fixed gear fishery reported landings around 20,000 t each year up until the moratorium.

The fishery reopened in May 1997 with a TAC of 10,000 t. This was subsequently increased to 20,000 t for 1998 and to 30,000 t for 1999. In 2000 the management year was changed to begin on 1 April. An interim quota of 6,000 t was set for the first three months of 2000. Subsequent TACs are shown in Table 1. The TAC for the 2010/11 management year was set at 11,500 t.

Landings

Management Year	01-02	02-03	03-04	04-05	05-06	06-07	07-08 ¹	08-09 ¹	09-10 ¹	10-11 ^{1,2}
TAC³	15.0	15.0	15.0	15.0	15.0	13.0	13.0	13.0	11.5	11.5
Canada	13.2	12.5	12.6	12.1	11.7	11.3	10.8 ⁴	10.6 ⁴	7.5 ⁴	3.2 ⁴
France	2.3	2.3	2.4	2.4	2.2	1.9	2.0	2.0	1.5	0
Totals	15.5	14.8	15.0	14.5	13.9	13.2	12.8	12.6	9.0	3.2

Table 1: Landings by management year in NAFO Subdivision 3Ps (nearest thousand metric tons).

¹ Provisional.

² Approximate landings to October 2010.

³ TAC is shared between Canada (84.4%) and France (St. Pierre and Miquelon; 15.6%).

⁴ Does not include Canadian recreational fisheries.

In the 2009/10 management year, total reported landings were 8,900 t, or 77% of the TAC. The difference in TAC and landings is unusual; normally the entire TAC is utilized. Participants from industry and fisheries management indicated multiple reasons which contributed to this change: large reduction in prices and additional market considerations and a reduction in the availability of large fish offshore during winter 2010. The total 2009/10 landings includes French landings of 1,445 t, approximately 80% of which was caught by otter trawlers. Sentinel surveys removed a total of 19 t.

Provisional data (as of Oct 15 2010) indicate total landings during the ongoing 2010/11 management year were approximately 3,100 t, 170 t of which was landed by France. Sentinel surveys have landed 11 t to date.

The level of total removals is uncertain. It is likely that historical landings have been biased both upwards (e.g. due to misreporting of catch by area and/or species) and downwards (e.g. due to discarding). In addition, commercial catch accounting procedures pre- and post-moratorium are radically different, with current measures likely to provide improved estimates of removals. In assessing stock status, it would be useful to better understand the accuracy of total removals, especially in the post-moratorium. Estimates of recreational fishery landings have not been provided for 2009.

During the calendar year 2009, most of the catch was taken by gillnets and although a wide range of ages were captured, 80% of the landings comprised of ages 5-8 cod.

Species Biology

Stock structure and **migration patterns** of 3Ps cod are complex. Migration of offshore components of the stock to inshore areas during spring and summer, as well as the existence of inshore components that remain outside the DFO RV trawl survey areas throughout the year, complicate the assessment of stock status.

Tagging studies were initiated in spring 1997 in Placentia Bay but during 1998-2003 also included inner and outer Fortune Bay and two offshore areas (Burgeo/Hermitage Channel and Halibut Channel). In more recent years (2008-10) tagging has been restricted to Placentia Bay. Cod tagged inshore were mostly recaptured inshore, even 5-6 years after release. Some cod tagged offshore were recaptured in the inshore fixed gear fishery on the south coast during the summer and fall. Tagging indicated some **movement** of cod between 3Ps and neighbouring stock areas (3Pn4RS, 3KL, and 3NO). A telemetry study conducted from May 2004 to September 2005 to examine mixing of northern Gulf cod (3Pn4RS) into 3Ps showed that 61% of cod implanted with transmitters in the northern Gulf (3Pn4RS) crossed into 3Ps during winter. The peak of movement into 3Ps was in December and the peak of return into 3Pn was in the first two weeks of April.

Maturation in female cod was estimated by cohort. The proportion of female cod maturing at younger ages has been higher for all cohorts subsequent to the 1986 cohort. The reasons for the change toward earlier age at maturity are not fully understood but may have a genetic component that is partly a response to high levels of mortality including fishing. Males generally mature about one year younger than females but show a similar trend over time.

Spawning is spatially widespread in 3Ps, occurring close to shore as well as on Burgeo Bank, St. Pierre Bank, and in the Halibut Channel. Timing of spawning is variable and extremely protracted, with spawning fish present from March until August in Placentia Bay. A recent review of spawning time (DFO, 2009) found no indication of any shift in the timing of spawning compared to previous observations.

Growth, calculated from length-at-age in research trawl survey samples, has varied over time. From the mid-1980s to early-2000s, length-at-age tended to increase at young ages (2-3), and varied with no consistent trend at older ages. Length-at-age for fish sampled in the sentinel surveys, however, has declined since 1998 in fish older than age 4.

Comparison of post-1992 **condition** with that observed during 1985-1992 is difficult because survey timing has changed. Condition varies seasonally and tends to decline during winter and early spring. In general, the overall condition of cod in the surveys post-1992 shows no consistent trend although the values from 2010 are below average. Examination of the data across select size ranges indicated that the condition for cod from 36 to 62 cm over 2008-10 was very low relative to previous observations. Seasonally, fish and liver condition observed in sampling from the sentinel surveys were higher in the fall and declined over the winter and early spring. Annually, trends in condition have varied, but condition has declined each year since 2007 and in 2010 was the lowest in the series.

ASSESSMENT

Resource Status

Sources of information:

Stock status was updated using **commercial landings** to October 2010, log-book data (1997-2009), **abundance indices** from Canadian research vessel (RV) trawl surveys (1972-2010), industry trawl surveys (1997-2005, 2007), and sentinel surveys (1995-2010). Results of telephone surveys of inshore fish harvesters from Canada and exploitation (harvest) rates estimated from tagging experiments in Placentia Bay were also available.

Research vessel surveys:

Canadian DFO RV bottom **trawl surveys** have been conducted since 1972. Surveys from 1972-1982 had poor coverage. The surveyed area was increased by 12% during 1997 when inshore strata were added. The DFO RV survey was not completed in 2006 due to unforeseen operational difficulties with the vessels. Survey indices are presented for the expanded DFO survey area (inshore and offshore; denoted “Combined” in figures) as well as for the offshore strata (“Offshore” in figures). The DFO RV survey covers most of the stock, and survey trends broadly reflect stock trends. Any near-shore aggregations in April would not be measured by the DFO RV survey. The majority of the area shore-ward of the DFO RV survey lies within inner and western Placentia Bay. There is no recent evidence that a large fraction of the stock is shore-ward of the DFO RV survey in April.

Survey indices of cod in 3Ps are at times influenced by “year-effects”, an atypical survey result that can be caused by a number of factors (e.g., environmental conditions, movement, degree of aggregation, etc.) which may be unrelated to absolute stock size. For example, the high 1995 estimate was strongly influenced by a single large catch. Also, the 1997 survey was low and did not encounter aggregations of fish that were observed in surveys and commercial catches in subsequent years. In the 2009 DFO RV survey the estimated abundance at ages 2-8 increased compared to these cohorts at ages 1-7 as measured in the 2008 survey. This is unusual and indicates that one (or possibly both) of the 2008 and 2009 surveys may be influenced by a year-effect.

The **biomass index** from the offshore strata is variable but declined from the mid-1980s to the early 1990s (Fig. 3). Values for most of the post-moratorium period up to 2004 were higher than those of the early 1990s, but not as high as those of the 1980s. The survey index shows a general declining trend from 87,000 t in 2001 to 20,525 t in 2008. The biomass index was higher in both 2009 and 2010 (57,450 t) and in 2010 was dominated by catches on Burgeo Bank, the southern edge of the Hermitage Channel and the Halibut Channel. Survey biomass from the combined index (“All Strata <300 fms”) shows similar trends to the offshore only index.

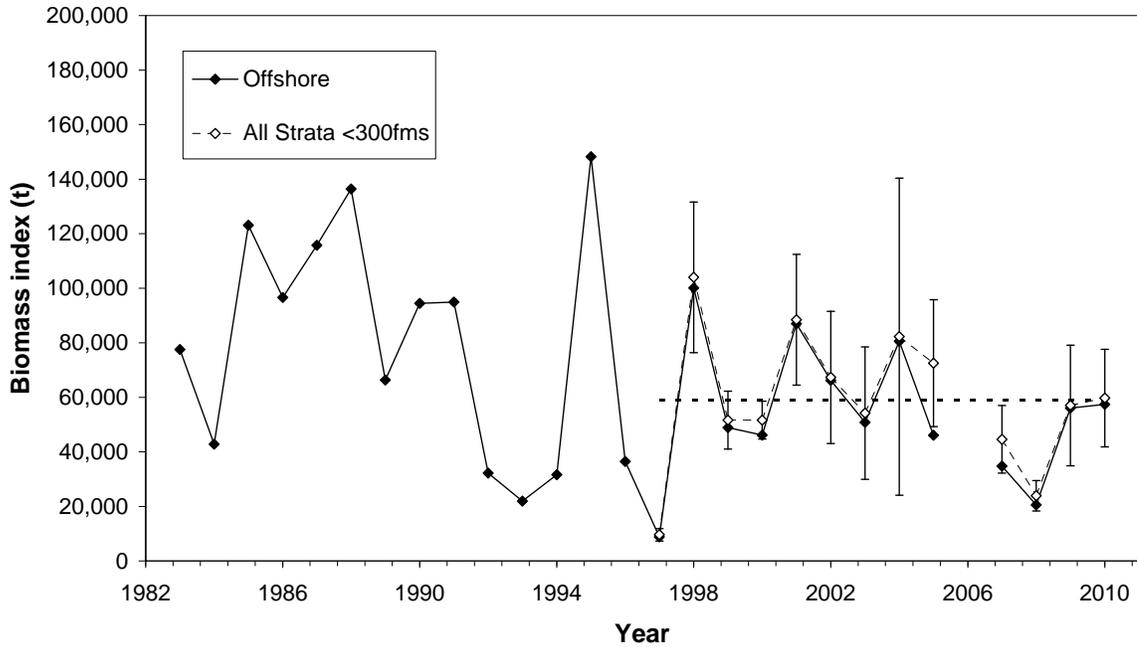


Fig. 3. Research vessel survey biomass indices (t)(error bars are 95% confidence intervals for combined survey index – dashed line is average of combined survey index).

An index of **mature (adult) biomass** was computed from the offshore survey (Fig. 4) and current values are slightly below the time-series average.

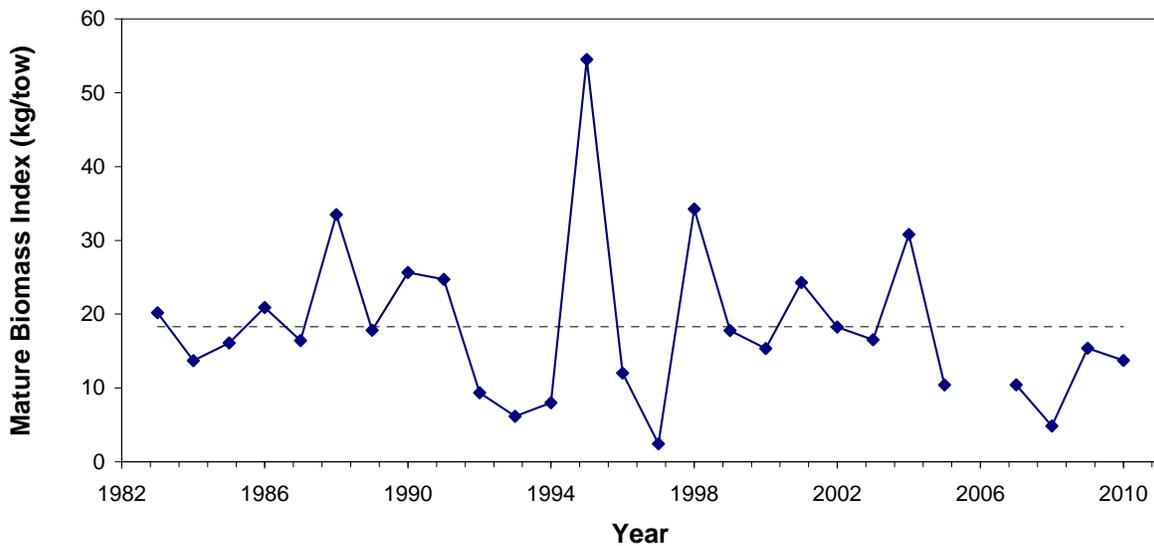


Fig. 4. Mature biomass index from DFO RV offshore survey. Dashed line is the time-series average.

The offshore DFO RV abundance index is variable, but values during the 1990s were generally lower than those from the 1980s (Fig. 5). The index generally declined from 88.25 million fish in 2001 to 38.65 million in 2008. Due to recruitment, the index has increased to 88.49 million fish in 2010. The combined DFO RV abundance index shows similar trends to the offshore index.

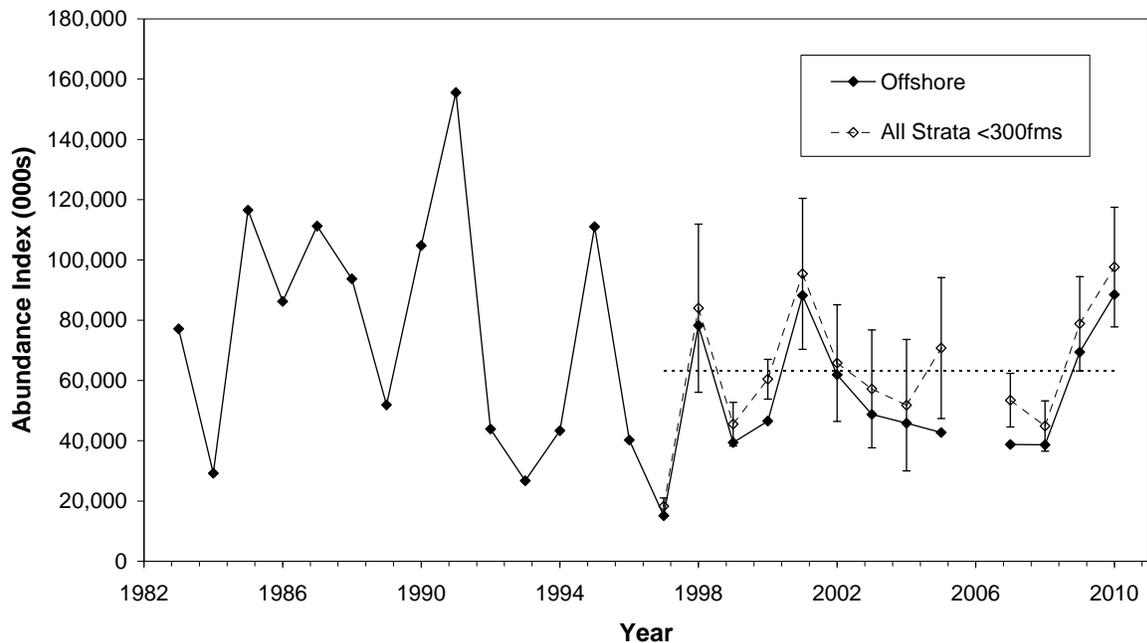


Fig. 5. Research vessel survey abundance indices (error bars are 95% confidence intervals for combined survey – dashed line is average of combined survey index).

Age composition:

Catches during the 2010 RV survey consisted mainly of cod aged 3-5 (75% of abundance index). The 2006 year-class, age 4 in 2010, was once again measured as above average compared to previous age 4 observations.

Cohort Analysis:

Spawning Biomass:

Cohort analyses (Cadigan, 2010) of the DFO RV data indicated that spawning stock biomass (SSB) declined by 12% per year over 2004-09 (Fig. 6). The basis for a limit reference point (LRP) for this stock is B_{Recovery} , defined as the lowest observed SSB from which there has been a sustained recovery. The 1994 value of SSB has been identified as the LRP for this stock (DFO, 2004). In this assessment, estimated survey SSB from a cohort model (SURBA) decreased in recent years and in 2008 and 2009 were below the limit reference point (LRP) with probability of 0.59 and 0.75, respectively. The survey SSB in 2010 is estimated to be above the LRP, although the probability of being below the LRP is 0.37.

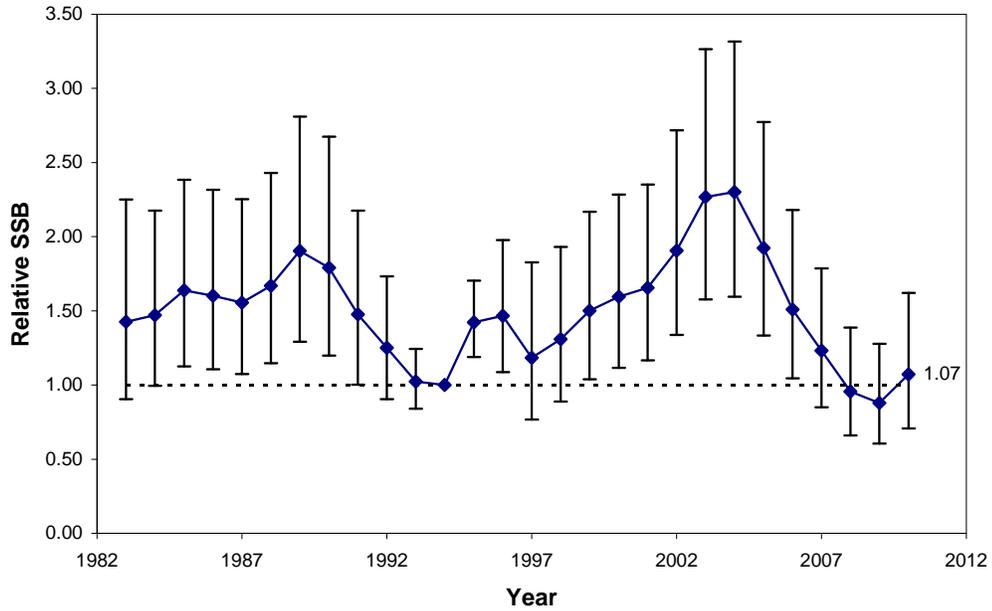


Fig. 6. Cohort analysis estimates of Survey Spawning Stock Biomass (SSB), relative to the 1994 value (with 95% confidence intervals). A horizontal dashed line at one (reference level) represents the SSB Limit Reference Point. Text label indicates the SSB relative to the LRP in 2010.

Mortality rates:

Estimates of total mortality from the cohort model (Fig. 7) over 2005-09 (ages 4-11) averaged 0.60 (45% mortality). This high level of mortality is a concern. Total mortality rates reflect mortality due to all causes, including fishing.

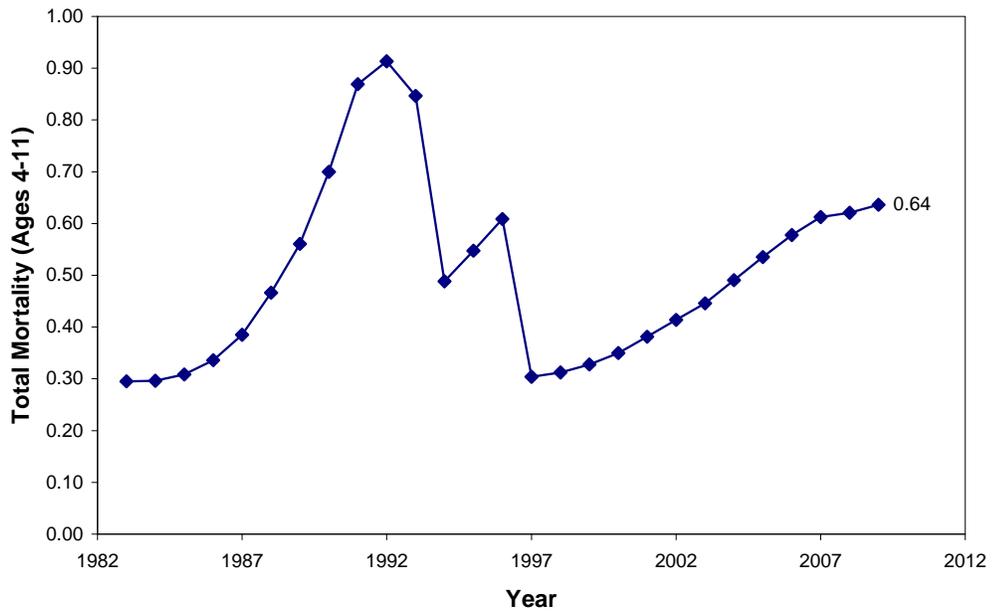


Fig. 7. Cohort analysis estimates of total mortality. Text label indicates the estimated total mortality for 2009.

This analysis assumes that age 4 and older fish are equally selected (flat-topped) by the RV survey. Alternate assumptions for the relative catchability (domed) of cod ages 4+ were also explored and gave similar trends (see DFO, 2009). Flat-topped selectivity is commonly assumed unless there is evidence otherwise.

Projection:

A one year projection to 2011 using the cohort model indicated that survey SSB will increase if total mortality rates are similar to current values (i.e. within $\pm 20\%$), and that the probability of being below the LRP in 2011 is low (0.04 to 0.17).

Sentinel survey:

Fixed gear **sentinel surveys** have been conducted at sites along the south coast of Newfoundland from St. Bride's to Burgeo from 1995 through 2009. Gillnet catch rates come mostly from sites in Placentia Bay whereas line-trawl catch rates come mostly from sites west of the Burin Peninsula. The sentinel survey for 2010 is still ongoing; hence, the data for 2010 were not included in the modeling reported below.

The sentinel survey data were standardized to remove site and seasonal effects to produce annual indices of the total and age-specific catch rates.

The standardized total annual **catch rate** for gillnets was high from 1995-97, but progressively lower in 1998 and 1999, and remained quite low from 2000 to 2009 (Fig. 8, upper panel). The line-trawl catch rates were high in 1995 with a steady decline to 1999, but have subsequently been fairly constant (Fig. 8, lower panel). Considerable declines have been measured by both gear types. Current gillnet estimates are about 10% of the 1995-97 average, whereas current line-trawl values are about 41% of the first two estimates.

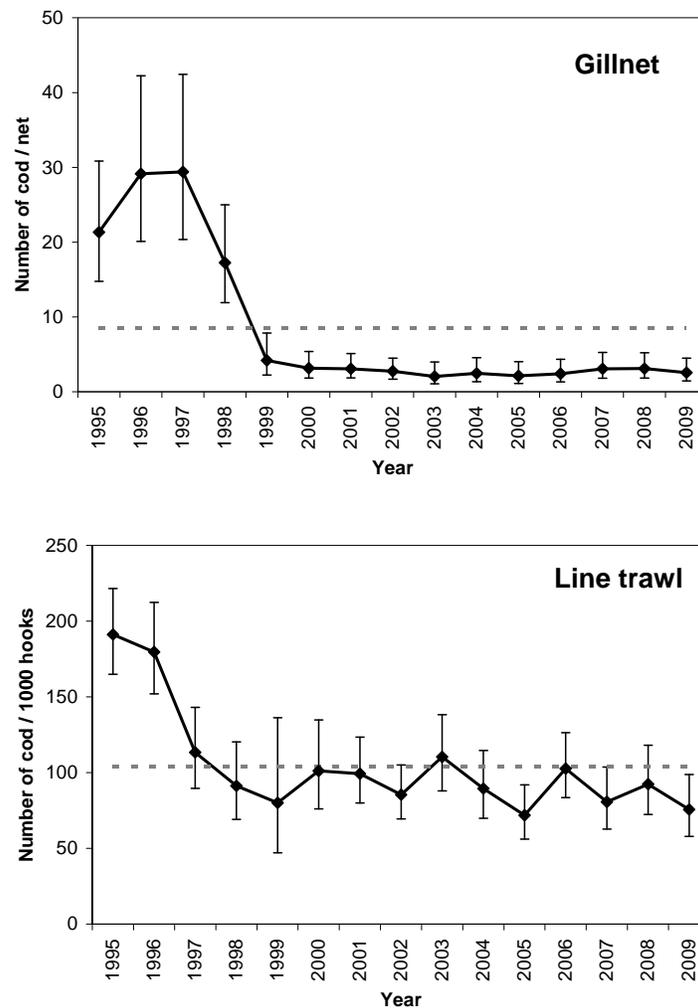


Fig. 8. Standardized sentinel catch rates for gillnets (upper panel) and line-trawls (lower panel). Error bars are 95% confidence intervals; dashed lines represent the time-series average.

Age composition:

The standardized age-specific catch-rates for gillnets and line-trawls show similar trends with the relatively strong 1989 and 1990 year-classes being replaced by subsequent weaker year-classes resulting in an overall decline in catch rates. Although the magnitude of the sentinel catch-rates has been constant for more than a decade, the 1997 and 1998 year-classes were consistently evident in both sentinel gears. In addition, the 2004 year-class appears to be well-represented only in line-trawl.

Log books:

There is considerable uncertainty in the interpretation of fishery catch rate data. These data may be more reflective of changes in the nature of the fishery than changes in population size.

<35' Vessels:

Standardized annual catch rates from science log books (<35' sector) for vessels fishing gillnets show a declining trend during 1998-2000, but have subsequently been fairly constant (Fig. 9, upper panel). A declining trend during 1997-99 was observed for line-trawls, followed by stable catch rates to 2002 and an increase in 2004-06 (Fig. 9, lower panel). Catch rates have since declined and the 2009 catch rate is approximately equal to

the time-series average. The commercial index is based on weight of fish caught whereas the sentinel index is based on numbers. As with the sentinel results, there is contrast between the two gear-types in current catch rates relative to the beginning of the time-series. Compared to the average CPUE in 1997 and 1998, current gillnet CPUE is 50% lower, whereas the 2009 linetrawl CPUE is only slightly (6%) less. Typically most gillnet effort is within the eastern part of the stock area; similarly linetrawl is the dominant gear in western 3Ps.

The percentage of the catch from the <35' sector that is accounted for in the standardized logbook indices has declined over time and now represents only about 30% of the catch as compared to approximately 70% at the start of the time series in 1997. This likely affects the quality, and comparability, of this index over time.

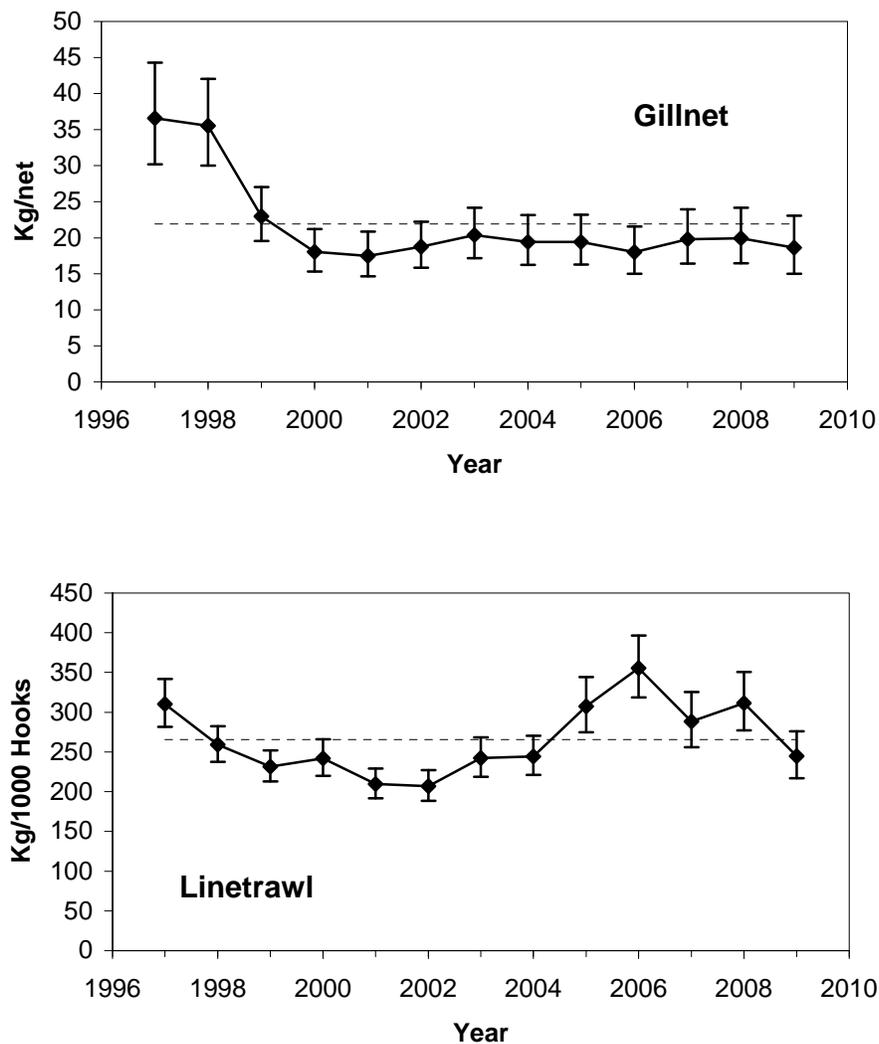


Fig. 9. Standardized catch rates for gillnets and line-trawls from science log books for vessels <35'. Error bars are 95% confidence intervals; dashed line is the average catch over 1997-2009.

>35' Vessels:

Median annual catch rates by gear sector and unit area from log books of larger vessels (>35' sector) were examined during the previous assessment. With the exception of 3Psd, the data for offshore line-trawl were too sparse for firm conclusions to be drawn. In unit

area 3Psd, linetrawl catch rates have declined considerably over the time-series. Otter trawl catch rates declined considerably over 2006-08. Catch rates increased in 2009, though the overall otter trawl effort was reduced. Gillnet catch rates in the recent period have generally decreased.

Tagging:

The number of tagged cod in 3Ps has been reduced in recent years, and tagging has been restricted to Placentia Bay. Hence, exploitation rates for cod tagged in the offshore, Burgeo Bank and Fortune Bay are no longer available, and those from Placentia Bay may not be applicable to other stock components or to the stock as a whole.

Information from recaptures of cod tagged in 3Ps since 1997 was used to estimate average annual exploitation (harvest) rates in specific unit areas. During 1999-2005, the mean exploitation rate was relatively high for cod tagged in Placentia Bay (3Psc, 23-35%). There was insufficient information to estimate exploitation rates in 2006 and 2007. During 2008 and 2009 exploitation rates for cod tagged in Placentia Bay were lower and ranged from 10-14%. All of these annual estimates are based on a broad size range of cod (>45 cm) and mean lengths at tagging were similar in each year.

The estimates can be influenced by the sizes of cod tagged due to selectivity of commercial fishing gear and larger cod (>65 cm) tend to be more readily selected than smaller ones. The exploitation rates for 2008 and 2009 based on cod >65 cm at tagging ranged from 14-21%.

Recruitment:

A recruitment index was derived from catch rates of juvenile cod during the DFO RV survey and the industry (GEAC) trawl survey (Fig. 10). The standardized index indicated that the 2006 cohort is estimated to be relatively strong and is expected to recruit to the 2011 fishery. The 2007 and 2008 cohorts are estimated to be near the 1994-2008 average. Year-classes currently supporting the fishery are relatively weak in comparison to the strong 1997 and 1998 cohorts.

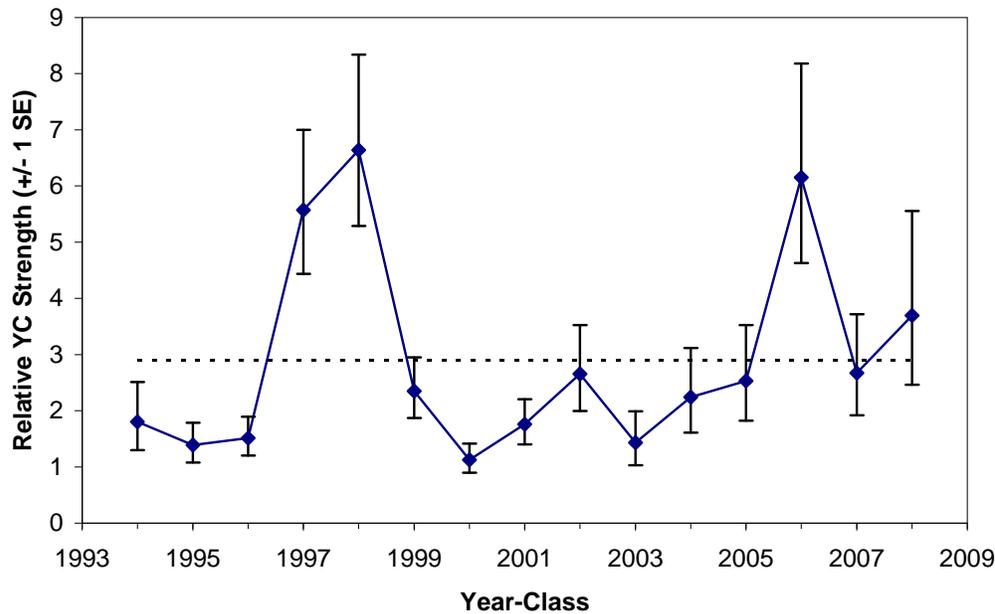


Fig. 10. Standardized year-class strength. Dashed line is average year-class strength.

Sources of Uncertainty

The level of total removals is uncertain. It is likely that historical landings have been biased both upwards (e.g. due to misreporting of catch by area and/or species) and downwards (e.g. due to discarding). In addition, commercial catch accounting procedures pre- and post-moratorium are radically different, with current measures likely to provide improved estimates of removals. In assessing stock status, it would be useful to better understand the accuracy of total removals, especially in the post-moratorium. Estimates of recreational fishery landings have not been provided for 2009.

There is uncertainty regarding the origins of fish found in 3Ps at various times of the year. Tagging and telemetry experiments show that there is mixing with adjacent stocks (southern 3L and 3Pn4RS) and this may vary over time. This may contribute to unusual year-to-year variability in survey indices.

Comparison of sentinel catch rates and the DFO RV index at times show inconsistent age-compositions. This may be indicative of differences in cohort strength between stock components. For example, the sentinel gillnet data consistently measured the 1992 cohort as being an above average fraction of the annual catch. This cohort was also important to the commercial gillnet catch, but was not notable in the DFO RV index. A similar phenomenon exists for the 2004 cohort (detected by sentinel linetrawl but not sentinel gillnet or DFO RV index).

The geographical coverage of tagging since 2007 is very limited; during 2008-10 cod have only been tagged in Placentia Bay. The lack of recent tagging in other areas adds uncertainty to our understanding of exploitation rates, stock structure, and movement patterns and how these influence survey and commercial catch rates in the recent period.

Trends in the level of natural mortality are difficult to measure and are uncertain.

The relative efficiency of the survey trawl at capturing different age groups is uncertain. Differing patterns of catchability were explored in this assessment and yielded similar outcome in terms of current status relative to the LRP. If the catchabilities differ from the assumed values, stock dynamics may differ from the results presented above.

Survey indices are at times influenced by “year-effects”, an atypical survey result that can be caused by a number of factors (e.g., environmental conditions, movement, degree of aggregation, etc.) which may be unrelated to absolute stock size. In the 2009 DFO RV survey the estimated abundance at ages 2-8 increased compared to these cohorts at ages 1-7 as measured in the 2008 survey. This is unusual and indicates that one (or possibly both) of the 2008 and 2009 surveys may be influenced by a year-effect. Year-effects are also evident in the 1995 and 1997 survey results.

The percentage of the catch from the <35' sector that is accounted for in the standardized logbook indices has declined over time and now represents only about 30% of the catch as compared to approximately 70% at the start of the time series in 1997. This likely affects the quality, and comparability of this index over time.

The DFO RV survey covers most of the stock, and survey trends broadly reflect stock trends. Any near-shore aggregations in April would not be measured by the DFO RV survey. The majority of the area shore-ward of the DFO RV survey lies within inner and western Placentia Bay. There is no recent evidence that a large fraction of the stock is shore-ward of the DFO RV survey in April.

Age at 50% maturity has been declining in recent years. The proportion of female cod maturing at younger ages has been higher for all cohorts subsequent to the 1986 cohort resulting in a significant proportion of SSB made up of younger fish. Questions exist as to whether or not these small, young fish are effective spawners. Given the lack of definitive data regarding size and age effects on spawner quality for this stock, the current practice of equally weighting all components of SSB (regardless of size and age) continues to be employed. However, if young spawners contribute disproportionately less to recruitment than older fish, the current reproductive potential of the stock would be lower than expected and would be reduced in comparison to the pre-1986 SSB, which was comprised of older fish.

ADDITIONAL STAKEHOLDER PERSPECTIVES

Fishing effort during the 2009/10 fishing season was reduced due to a substantial decrease in price (nearly 50% drop in one year) combined with a reduced price for summer gillnet fish. It is believed that these factors contributed to fishermen's decisions not to fish their quotas and why inshore cod landings were down in 2009. Similar market conditions have persisted to date during the 2010/11 fishery and as a result fishing effort has continued to be lower than normal.

To provide a fish harvester perspective on the results of the 2009 fishery, a telephone survey was conducted by the FFAW during February of 2010. Most fish harvesters felt that 2009 abundance was about the same or lower when compared to 2008. Fish harvesters were asked to rate their 2009 catch rates in comparison to his/her historical perspective. With 1 being the worst and 10 being the best, most responses were from 5 to 8. However, the number of participants reporting poor catch rates (response 1 – 3) relative to all prior experience was larger than in previous surveys. The size range of cod in 2009 was reported to be about the same or smaller than during 2008, and the condition of cod was reported as good. Fish harvesters felt that the 2009 abundance level of capelin and squid was low and declining.

During the 2010/11 season fish harvesters have commented that the 2006 year class appears very strong.

The St. Pierre et Miquelon quota is caught by a Canadian chartered vessel and was not fully taken in 2009/2010. The main reason for not catching the quota was lack of larger fish available to the vessel after Christmas. It was believed that a smaller biomass of larger fish and also less fishing grounds available to the vessel because of concurrent fishing activity by midshore fixed gear vessels were the contributing reasons. Further, the size of fish landed during the fishery from November to February was noticeably smaller than in previous years. More trips were made up of cod and other mixed groundfish species than in previous years. One company left a small amount of cod uncaught as they were unable to harvest it as a bycatch with their directed greyscale catch in March.

Fishermen reported that fish behaviour in the Gully Cove area (3Psh) was noticeably different after Christmas coincidental with test drilling for oil south of their fishing ground. The fish harvested appeared to be very agitated and it was thought that drilling may have reduced their catches during this period.

Fishermen reported that there were few if any reports of discarding at sea.

CONCLUSIONS AND ADVICE

The assessment concluded from tagging data and ancillary information that the complex of stock components exploited by fisheries in 3Ps does not comprise a single stock for which population biomass and abundance can be estimated from existing information. Therefore the impacts of fishing at specific TAC levels on all stock components could not be quantified. However, the DFO RV survey covers most of the stock, and survey trends broadly reflect stock trends. Indices based on the research vessel (RV) survey have been used to assess current status of the stock relative to historic observations and to evaluate growth and sustainability of the stock.

A limit reference point (LRP, B_{Recovery}) was identified for this stock during the 2004 assessment (DFO, 2004). It is defined as the lowest observed spawning stock biomass (SSB) from which there has been a sustained recovery; the 1994 value of SSB has been identified as the LRP. Estimated survey SSB from a cohort model (SURBA) decreased in recent years and in 2008 and 2009 were below the limit reference point (LRP) with probability of 0.59 and 0.75, respectively. The survey SSB in 2010 is estimated to be above the LRP, although the probability of being below the LRP is 0.37. A one year projection to 2011 using the cohort model indicated that survey SSB will increase if total mortality rates are similar to current values (i.e. within $\pm 20\%$), and that the probability of being below the LRP in 2011 is low (0.04 to 0.17). It was not possible at present to relate the level of catch to estimated total mortality.

The 2006 cohort is estimated to be relatively strong and is expected to recruit to the 2011 fishery. The 2007 and 2008 cohorts are estimated to be near the 1994-2008 average. Year-classes currently supporting the fishery are relatively weak in comparison to the strong 1997 and 1998 cohorts. Fish harvesters indicate the 2006 cohort is beginning to recruit to the fishery.

Estimates of total mortality (ages 4-11) from a cohort model over 2005-09 were approximately 0.60 (45% mortality). This high level of mortality is a concern. Total mortality rates reflect mortality due to all causes, including fishing.

The status of inshore components is uncertain. The inshore fishery exploits a mixture of inshore stock components and migrants from the offshore. Exploitation rates for cod tagged in Placentia Bay during 2008 and 2009 ranged from 10-14% and were lower than those observed in 1999-2005 (23-35%). The commercial gillnet catch rates for the <35' fleet and both sentinel catch rate series (gillnet and linetrawl) are stable. The commercial linetrawl catch rates for the <35' fleet have decreased in recent years.

Overall, the findings of the current assessment are consistent with those of previous assessments. The 3Ps cod SSB at the beginning of 2010 was estimated to be marginally above the LRP.

Management Considerations

The implementation of trip limits, price differentials based on size, and individual quotas (IQ's), are all potential incentives for discarding and high-grading of catches. Recent investigations into this problem have identified that high-grading has occurred, but the quantity has not been determined. Quantifying discards would improve the understanding of stock productivity. This is an unaccounted source of fishing mortality.

Management should recognize that cod which overwinter in 3Ps are also exploited in adjacent stock areas (Division 3L and Subdivision 3Pn). Hence management actions in these stock areas should consider potential impacts on 3Ps cod.

Recent results confirmed that closures to protect spawning or mixed-stock aggregations are appropriate.

Consequences of area/time closures should be carefully considered as these may result in higher exploitation rates on the components of the stock that remain open to fishing. The fishery should be managed such that catches are not concentrated in ways that result in high exploitation rates on any stock components.

Management should be aware of within-year variations in the individual weight of cod. Greatest yield can be gained when fish are in peak condition, typically in late fall/early winter, while minimizing the number of individuals removed from the stock.

The level of total removals is uncertain. In assessing stock status, it would be useful to better understand the accuracy of total removals, especially in the post-moratorium when commercial catches are more strictly monitored. Accurate estimates of recreational fishery landings are also required.

OTHER CONSIDERATIONS

Temperature

Oceanographic information collected during the spring DFO RV surveys indicated that near-bottom temperatures throughout NAFO subdivision 3Ps have warmed in both 2009 and 2010, increasing to above normal values. For example, the area of <0°C water has decreased to about 10%, compared to almost 30% in 2007 and 2008. Survey catches of cod are generally lower in years when there are relatively large incursions of cold/fresh water from the eastern NL shelf. The areal extent of bottom water with temperatures >3°C has remained relatively constant

at about 50% of the total 3P area, although actual temperature measurements show considerable inter-annual variability. The current conditions are comparable to those of the late 1970's and early 1980's when the stock was more productive.

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FOR MORE INFORMATION

Contact: Brian Healey
Fisheries and Oceans Canada
PO Box 5667
St. John's, NL
A1C 5X1
Tel: (709) 772-2001
Fax: (709) 772-4501
E-Mail: brian.healey@dfo-mpo.gc.ca

This report is available from the:

Centre for Science Advice
Newfoundland and Labrador Region
Fisheries and Oceans Canada
PO Box 5667
St. John's, NL
A1C 5X1

Telephone: (709) 772-8892
Fax: (709) 772-5315
E-Mail: vanessa.sutton-pande@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

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