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Newfoundland and Labrador Region

Canadian Science Advisory Secretariat
Science Advisory Report 2014/043

STOCK ASSESSMENT OF NAFO DIVISIONS 3LNO HADDOCK

Divisions 3LNO Haddock

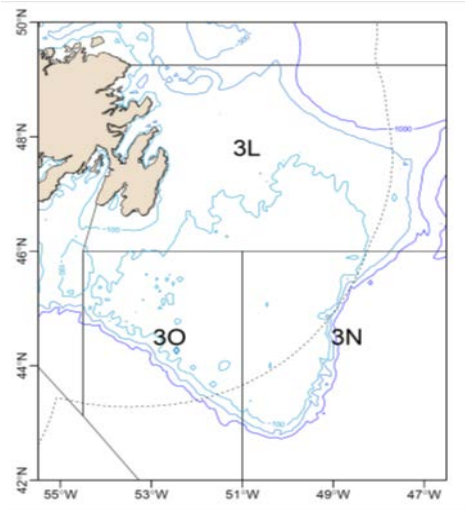

Figure 1. Stock area of NAFO Divisions 3LNO Haddock. The dashed line indicates Canada's 200 nautical mile Exclusive Economic Zone (EEZ).

Context:

Haddock occurs on both sides of the North Atlantic. Along the North American coast it occurs from the Straits of Belle Isle south to Cape Hatteras being more abundant in its southern range.

Haddock are primarily bottom feeders and food varies with size. Those less than 50 cm eat crustaceans, in particular amphipods, pandalid Shrimp and Hermit Crabs. Also a part of the diet are echinoderms (Brittle Stars, Sea Urchins and Sand Dollars), Mollusks, (snails and clams) and annelid worms. In Haddock greater than 50 cm small fish make up about 30 % of the diet with Sand Lance, Capelin and Silver hake, Herring and Argentines being consumed. When available large numbers of Herring and Capelin eggs are eaten.

Haddock larvae are pelagic, settling when 50 mm. Males and females attain sexual maturity at ages 3-5; males usually at a slightly younger age than females. Growth rates vary and are generally slower in northern stocks.

Prior to 1945 catches on the Grand Bank (NAFO Divisions 3LNO) were low but increased rapidly in the late 1940s and remained high until the early 1960s. There is evidence to suggest that Haddock were abundant earlier but were not a desired species in the saltfish trade and catch was either not kept or not recorded separately. The high catches of the 1950s and early 1960 were the result of several strong year-classes. The fishery of this era was characterized by high discard rates (30-40 % by weight and 50-70 % by numbers). This was a result of small mesh size (70-100 mm) and a requirement by fish plants that landed catch must be at least 45 cm. Catches since the 1960s have declined to very low levels, but there was a small increase in the mid to late 1980s which did not exceed 10,000 t in any one year. This stock has been under moratorium since 1993. Landings during the period 1993 to 2012 averaged 136 t annually.

The current evaluation of the stock was conducted through a Regional Advisory Process (RAP) that also evaluated Subdivision 3Ps Haddock, Pollock and American Plaice. The meeting was held January 29-30, 2014 in St. John's, NL. Participants included DFO scientists, fisheries managers, and individuals from provincial governments, non-government organizations, the fishing industry, and academia.

Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

Canada

SUMMARY

- This stock has been under moratorium since 1993. From 1973 to 1992, landings averaged 2378 t annually. Since 1993, landings averaged 136 t annually.
- The fall Research Vessel (RV) survey biomass and abundance indices have varied without trend although the last two years have been above average. These results are generally consistent with those in the spring survey.
- A recruitment index based on fish less than 20 cm in the fall RV surveys was higher in 2011 and 2012 than the 1995-2012 average.
- In the absence of a model of population dynamics and the lack of trend in the current RV survey indices at very low catch levels, advice could not be provided on whether to maintain a moratorium on fishing. Any planned increases in catches should be adaptive, accompanied by monitoring of stock indices.

INTRODUCTION

History of the Fishery

The post war fishery was prosecuted mainly by Canada with significant landings reported by Spain and USSR in some years. Landings were highest during the 1950s and early 1960s with a peak of 76,000 t in 1961 (Figure 2). The presence of the strong 1949 and 1955 year-classes supported these catches. Landings remained low from the mid-1960s to mid-1980s because of poor recruitment. In 1988 landings increased to 8200 t, the highest since 1967, but catches subsequently declined through the early 1990s (Figure 2). This stock has been under moratorium since 1993. From 1973 to 1992, landings averaged 2378 t annually. During the period 1993 to 2012, landings from bycatch averaged 136 t annually. Since 2009, Haddock landings were mostly from bycatch in the Yellowtail Flounder, Atlantic Halibut, Skate and White Hake fisheries.

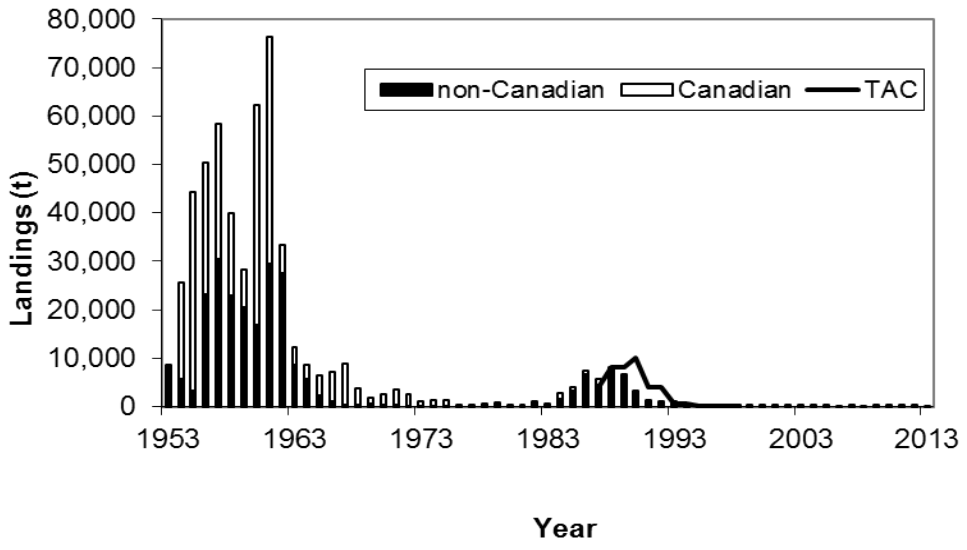

Figure 2. NAFO Divisions 3LNO Haddock landings and TACs from 1953 to 2013.

ASSESSMENT

This assessment considered information from total landings from all countries (1953-2012) and Canada (2013) in conjunction with analyses of data from research vessel (RV) trawl surveys conducted during spring (1972-2013) and autumn (1990-2012). There is no population dynamics model for this stock.

Sources of data

The main sources of data for this assessment are as follows: Indices of abundance and biomass are obtained from multi-species RV bottom-trawl surveys conducted by DFO in Divisions 3LNO during the spring and autumn. These surveys also provided distributional data and information on the size composition of the population. A recruitment index is based on the abundance of fish less than 20 cm in the fall RV survey. Additionally, indices of biomass and information on the size of fish sampled were available (unpublished data) from an EU-Spain bottom trawl survey of a portion of Divisions 3NO located outside Canada's EEZ (200 nautical miles).

Stock Trends

Bottom-trawl surveys

Research vessel surveys of Divisions 3LNO have been conducted by Canada in the spring since 1972 and in the fall since 1990. Three different bottom trawls have been used in the surveys over time. A Yankee 41.5 trawl was used from 1972 to 1982, then the Engel 145 otter trawl was used during the periods 1984 to 1995 (spring) or 1990 to 1994 (fall).There was no survey in 1983. The Engel trawl was switched to the Campelen shrimp trawl, which is currently used in surveys. The Campelen trawl has improved survey catchability for young fish, but there are no conversion factors to convert the pre-Campelen data for Haddock. Therefore, direct comparisons cannot be made between periods with different trawl types.

Spring surveys

The biomass index for Haddock was low from 1972 to 1981 compared to the values from 1982 to 1988 (Figure 3). In 1984, the biomass index peaked due to the relatively strong 1981 year-class. The 1982 and 1983 year-classes were moderately successful and supported the fishery up to the late 1980s, but they were caught mostly as immature and maturing fish (< 45 cm) during the mid-1980s and contributed little to the spawning stock biomass. Subsequently, year-classes were weak until 1998.

In 1997, the survey biomass index increased sharply due to one large catch of pre-spawning fish, accounting for 98 % of the biomass. The 1998 survey located few Haddock. High biomass and abundance (Figure 4) indices were observed in 1999 and 2000 due to the strong 1998 and 1999 year-classes, but only low levels of recruitment were observed from 2000 to 2005 and the biomass and abundance (Figure 4) indices generally declined during that period. The biomass index has been relatively high since 2007 with all annual indices near or above the time-series (1996-2013) average. This relative stability is due to frequent annual recruitment events and the progression of year-classes through to mature fish, neither of which was seen in the 1980s or early 1990s. Abundance indices have been less stable than biomass indices since 2007. The abundance index was particularly low (5445 fish) in 2011 as little recruitment was observed in 2010 and the 2009 year-class was diminished. In 2013, the abundance index was slightly higher than the 1996 to 2013 average of 14.7×10^6.

During spring, Haddock tend to be concentrated in the warmer slope water and this may increase the variance in the surveys because coverage is minimal in the narrow strata where the warmer water masses typically exist. Concentrations of Haddock were found in the slope waters during 2013, but they were also found on the bank, more broadly distributed than in most years.

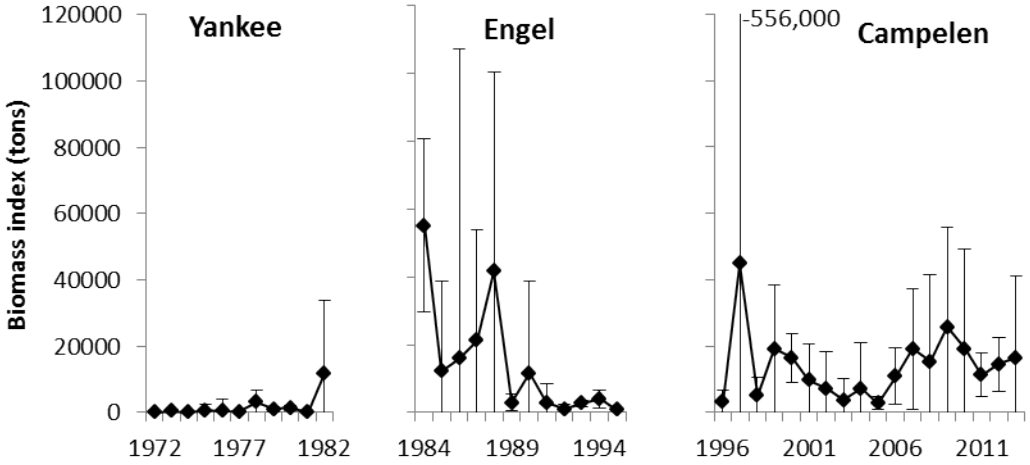

Figure 3. Biomass index for Haddock in the spring research vessel survey from 1972 to 2013.

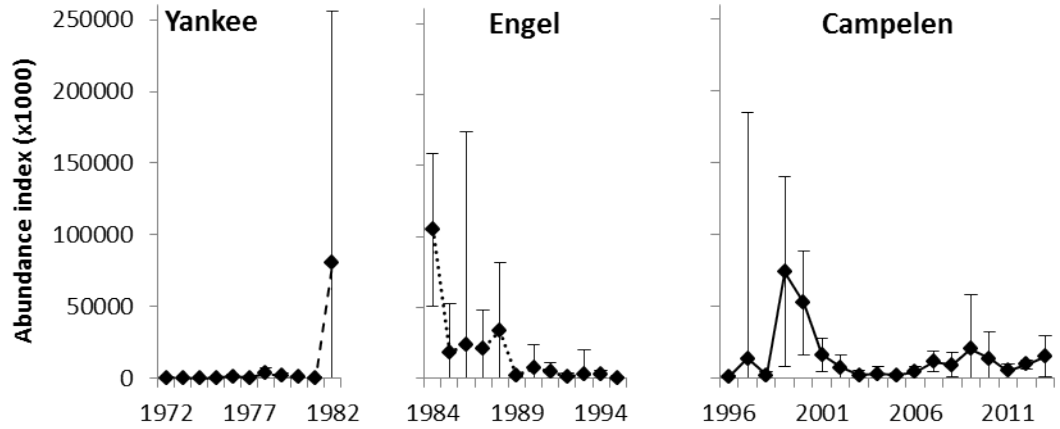

Figure 4. Abundance index for Haddock in the spring research vessel survey from 1972 to 2013.

Fall surveys

The fall RV survey is valuable for the assessment of Haddock because fish are dispersed over the bank and in the slope waters during fall when water temperatures are similar in both areas. Haddock tend to congregate in the warmer slope waters during winter and early spring. During the period 1996 to 2002, the fall biomass index increased from low values to the highest in the time series (Figure 5). However, the high 2002 value was the consequence of two large catches of fish with a broad size distribution in the western portion of Division 3O.

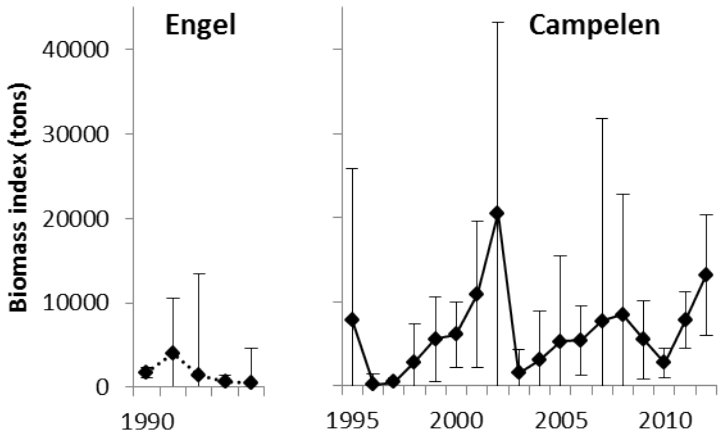

Figure 5. Biomass index for Haddock in the fall research vessel survey from 1990 to 2012.

The fall abundance index (Figure 6) was relatively high through the period 1998 to 2002 as the 1998 and 1999 year-classes remained prominent in the survey catch. Subsequently, annual recruitment, defined as the abundance of fish < 20 cm in the fall survey (Figure 7), was low up to 2006 and this was reflected in low abundance indices (< 2700 fish) during 2003 to 2005.

Moderate and stronger year-classes were observed more frequently since 2005 than earlier in the Campelen time-series from the fall. The abundance index peaked in 2007, with most fish sampled in that year from the relatively strong 2006 year-class. A moderately strong 2009 year-class was prominent in the survey catch in 2010, but biomass and abundance indices were quite low in that year because few larger (> 31 cm) fish were sampled. The pre-recruit index for both 2011 and 2012 is higher than the 1995 to 2012 average. Most fish sampled by the survey during the last two years were small (< 41 cm) and during 2012 in particular, they were concentrated on the southeast shoal where the Yellowtail Flounder fishery is centred.

The fall biomass and abundance indices have varied without trend over time but the last two years have been above average. Generally, results are consistent between spring and fall surveys.

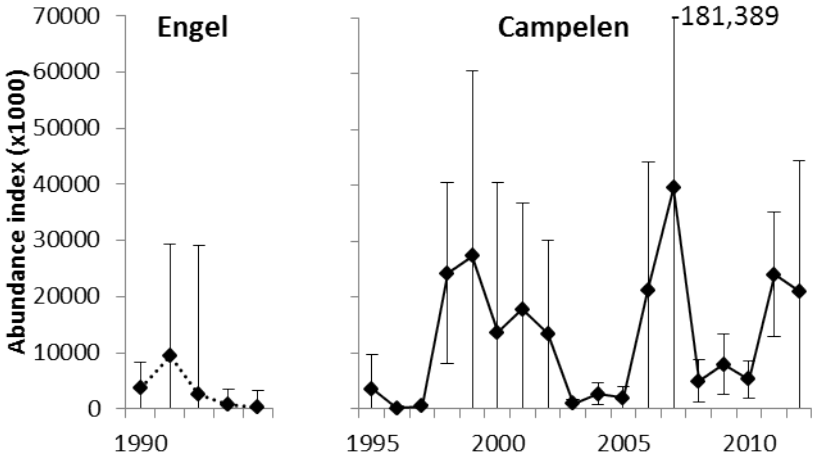

Figure 6. Abundance index for Haddock in the fall research vessel survey from 1990 to 2012.

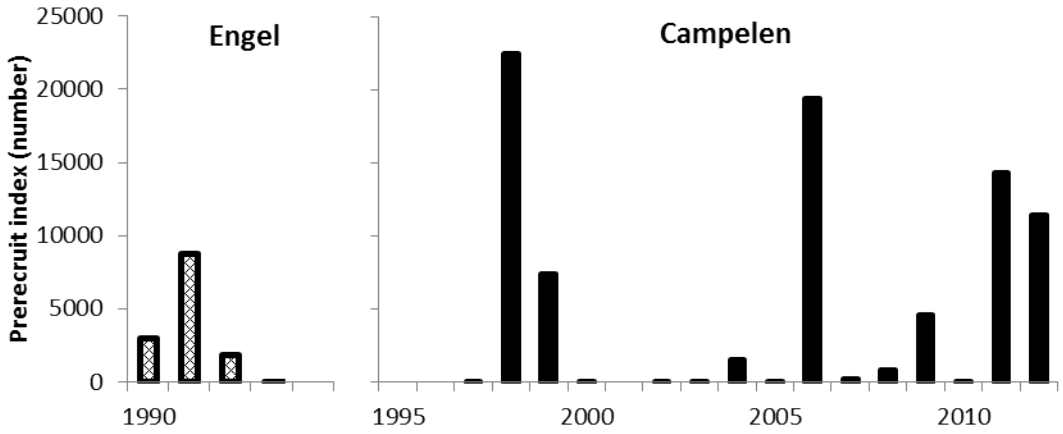

Figure 7. Prerecruit index for Haddock in the fall research vessel survey from 1990 to 2012.

Environment and Ecosystem

A key indicator of ocean climate conditions on the Newfoundland and Labrador (NL) Shelf, the North Atlantic Oscillation (NAO) index, returned to a negative phase in 2013 and as a result arctic air outflow to the Northwest Atlantic during the winter decreased over the previous year. This appears to have resulted in an increase in winter air temperatures over much of the Labrador Sea area causing a continuation of less sea-ice than normal on the NL Shelf. As a result of these and other factors, local water temperatures remained above normal in most areas in 2013 but show a decrease over 2011-12 values. In general, all environmental indices indicate a continuation of the warmer than normal trend throughout the area since the mid-1990s. During the past 2 years however temperatures have decreased compared to the record warm conditions of 2011.

The fish community in Divisions 3LNO declined during the mid-1980s and early 1990s. This decline was also accompanied by a decrease in the average fish size. Since the mid 1990s the biomass of the fish community has shown a positive trend. The only exception is shellfish (mainly Shrimp), which peaked around 2007 and declined since then; this increasing pattern is observed in all fish functional groups with plankpiscivores (mainly Redfish) showing the largest increases in recent years. Average fish size has shown high variability, with a clear increase since the lowest levels observed in early 2000s. These changes in biomass/abundance (BA) ratio at the fish community level can be explained by a reduction in the abundance of Shrimp in recent times. Among large benthivores, Haddock biomass levels have fluctuated comparatively little since the mid 1990s. This functional group has been dominated by American Plaice and Thorny Skate.

Sources of Uncertainty

The current age structure of Divisions 3LNO Haddock is unknown. Assignment of fish to year-classes in this report was based on historical age at length data. Length-frequencies of Haddock from recent RV surveys do not consistently track size-modes that indicate year-class strength.

Recent information on growth rates and age at maturity are not available.

No age determinations are available from the commercial catch and biological data have been reported infrequently, with no data in most years.

It is not possible to develop a population dynamics model at this time.

The sources of natural mortality for Haddock are not known. In the absence of fishing, abundance indices fell to low levels during the period 2008-2010, despite evidence that the 2006 year-class was strong and prominent in the RV surveys during both 2006 and 2007.

Distribution of Haddock in the spring survey is highly variable with fish aggregated only in slope waters during some years and dispersed over both the slope and bank in others. There is no information on how temporal variability in the degree of fish aggregation influences abundance and biomass indices for Divisions 3LNO Haddock.

The degree of mixing between Haddock in Divisions 3LNO and Subdivision 3Ps is not known. Mixing is thought to most likely occur in the slope waters along the boundary of Division 3O and Subdivision 3Ps and less likely between Grand Bank and the Halibut Channel or St. Pierre Bank as water temperatures between these locations are usually unfavourably cool for Haddock.

There is uncertainty in the landing statistics. The amount of unreported catches due to discarding at sea is unknown.

Conversion factors are not available to convert among the three gear types that were used in the surveys during various periods.

CONCLUSIONS AND ADVICE

There has been a moratorium on Haddock in Divisions 3LNO since 1993. From 1973 to 1992, landings averaged 2378 t annually. Since 1993, landings averaged 136 t annually.

Since 2009, Haddock landings were mostly from the Yellowtail Flounder and Skate fisheries.

The fall RV survey biomass and abundance indices have varied without trend although the last two years have been above average. Generally, these results are consistent with those in the spring survey.

Recruitment to this stock is episodic. A recruitment index based on fish less than 20 cm in the fall RV surveys was higher in 2011 and 2012 than the 1995-2012 average.

In the absence of a model of population dynamics and the lack of trend in the current RV survey indices at very low catch levels, advice could not be provided on whether to maintain a moratorium on fishing. Any planned increases in catches should be adaptive, accompanied by monitoring of stock indices.

SOURCES OF INFORMATION

This Science Advisory Report is from the St. John's NL, January 29-30, 2014 Regional Peer Review; 3Ps and 3LNO Haddock, 3Ps Pollock, and 3Ps American Plaice Stock Assessment. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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