Updates on Selected Scotian Shelf Groundfish Stocks in 2000

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Canada

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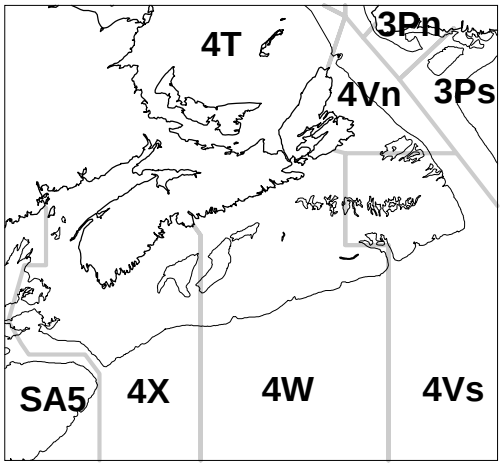
Background

The most recent full assessments of the following Maritimes Region stocks are summarized in stock status reports from 1996 to 1999: 4Vn cod, 4VsW cod, 4X/5Y haddock, 4TVW haddock, 4VWX5Zc pollock, 4VWX silver hake, 4VWX+5Zc white hake, 4VWX cusk, Unit 3 redfish, 4VWX witch flounder, 4X flatfish, and 4VWX3NOPs Atlantic halibut. The SSR reference for the last complete assessment is listed under the "Background" section of each update. This report provides a brief update of stock status based on recent fishery and survey data.



Summary

- Stock biomass for **4Vn cod** remains low with little recruitment, thus no recovery is evident and no change in outlook.

- The two research vessel survey series for **4VsW cod** indicate continuing low abundance and have not indicated any major recruitment events in recent years. Until recruitment of several large year-classes is seen, there does not appear to be any basis to expect stock growth.

- Recruitment for the **4TVW haddock** stock has been improving, but adult biomass has remained low. Slow growth has delayed the entry of new year-classes into fishable sizes.

- Recent recruitment for **4X haddock** has been good. Spawning stock biomass has recovered to near average levels and will likely increase slightly in 2001.

- For **4VWX5Zc pollock**, catch rates remain comparatively low, large fish are rare in the catch and the surveys, and the fishery remains spatially constricted.

- Survey biomass for **silver hake** remains very low and total mortality is high. Recruitment prospects appear good, with two above average year-classes entering the fishery. The outlook for this resource remains the same – catches should not increase from those in 1997-1999.

- The downward trends in abundance indices for **white hake** in 4X/5 suggest that this portion of the stock may be at risk of collapse. Abundance indices of the 4V and 4W components of the stock have remained near record lows.

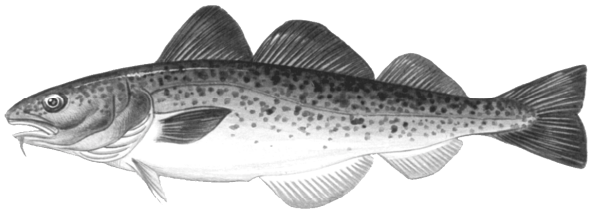
- The Scotian Shelf **cusk** stock appears to have collapsed since 1992 and remains very low.

- **Unit 3 redfish** recruitment, although promising, has not yet resulted in a detectable increase in the population biomass, but combined with the low exploitation rates which currently prevail, should result in fishing and stock conditions in 2001/2002 being very much the same as in recent years

- Recruitment (<35cm) for **witch flounder** in 4VWX since 1993 continues to show an improvement over earlier periods. Survey weight per tow modestly increased from a low in 1995, but is still low relative to the long-term.

- Current information on **western Scotian Shelf flatfish** indicates stability in stock status in recent years at about the long-term mean.

- **Atlantic halibut** abundance, as estimated from the results of research vessel surveys in the management unit, is presently low relative to the available time series. There is no indication that effort on this resource should be increased but rather that the present restrictive measures should be continued.



Cod in Sydney Bight (Subdiv. 4Vn) May- October

Background

The 4Vn region is known to represent a mixing ground between the resident 4Vn cod (Gadus morhua) stock and larger neighbouring stocks, the 4TVn stock to the west and the 4VsW stock to the south. In addition, 4TVn cod overwinter along the shelf edge from Sydney Bight as far as Banquereau Bank region, leaving the Gulf in the late autumn and returning in the spring. During this period, the catch of cod in 4Vn would be comprised of both Gulf and resident cod, although 4TVn cod would make up the bulk, being a much larger stock. Thus, unknown quantities of 4Vn cod have been caught during the overwintering period. Mixing of Gulf of St. Lawrence (4TVn) cod with the resident stock and inability to apportion landings according to stock have complicated the assessment and management of the 4Vn stock.

Cod in 4Vn grow more slowly than the 4VsW stock to the south but more quickly than 4TVn cod. They are assumed to be fully mature at age 5, at a length of 48 cm. Tagging studies suggest that they overwinter in deeper water. 4Vn cod spawn in Sydney Bight in May.

The most recent full assessment of this stock was conducted in spring 1998 (SSR A3-02 (1998)). Updates were conducted in the fall of 1998 (SSR A3-35 (1998)) and 1999 (SSR A3-35 (1999)). More recent information from the fishery, the DFO Summer and Inshore Surveys for 2000, and the Sentinel Survey for 1999 is presented.

The Fishery

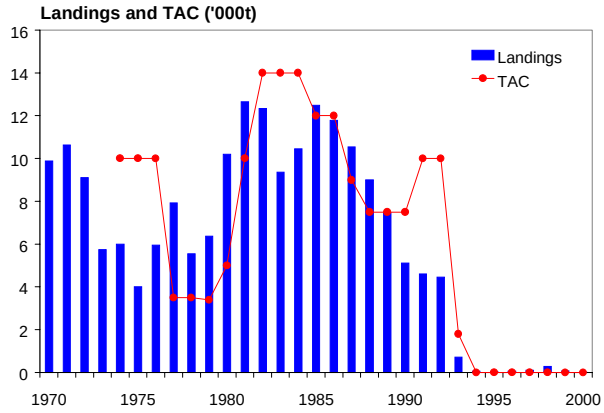
Landings (tonnes)

	1993	1994	1995	1996	1997	1998	1999	2000
TAC	1800	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
Landings[2]	715	57	46	58	106	277	69	

1. Bycatch only
2. Landings since 1994 include Sentinel Survey landings

The 4Vn cod fishery remains closed to directed fishing, as it has been since the fall of 1993.

Landings data from 1999 represent additional information since the last update (DFO, 1999). Less than 300 tonnes of cod landings per year have been reported since 1994, most of which were taken annually in the Sentinel Survey and the remainder as bycatch. The 2000 landings to October 15th, are 31t.

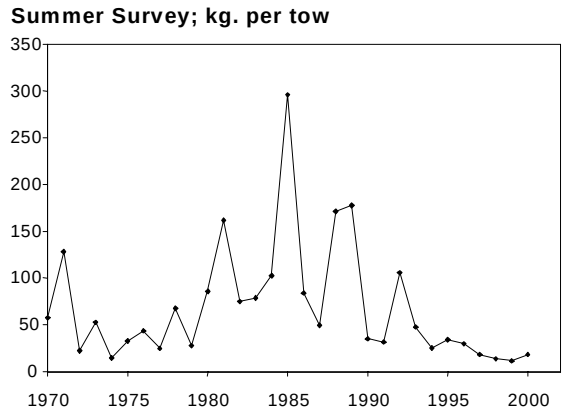


Resource Status

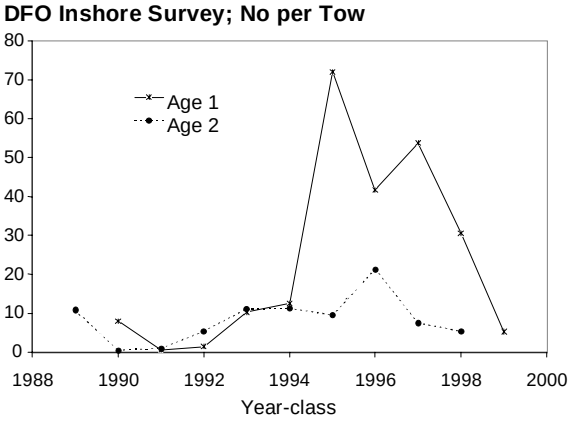
Information on the annual spatial distribution and length frequency from the July research vessel surveys from 1995 to 2000 is contained in Branton and Black (2000).

The 2000 **Summer Survey** shows a similar biomass to recent years at a very low level

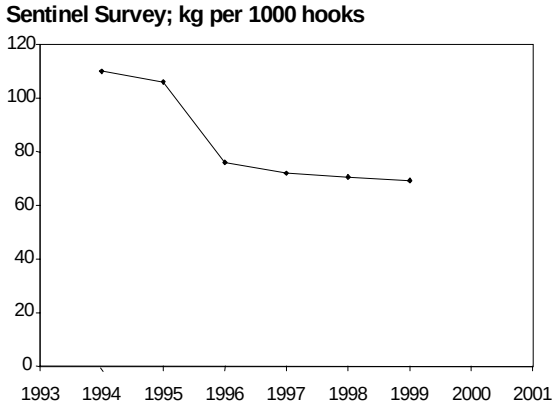
compared to the historic average of 68 kg per tow.



The DFO **Inshore Survey** catches more small cod than the Summer Survey. Indices of age one and two cod showed an improvement in the mid-1990s then fell in recent years. These fish must survive and recruit to the spawning population before a recovery of the stocks can take place.



A **Sentinel Survey** has been carried out since 1994 using commercial vessels. This survey has shown a declining trend in catch rates since its inception.



Outlook

Excerpts from the Outlook of the last Stock Status Report (A3-02 (1998)) for this stock, based on an assessment (Mohn et al. 1998) are as follows:

> "The 1993 and 1994 year-classes are the first good year-classes to enter the fishable population since that of 1987. However, spawning biomass is very low and has not shown any recovery, although the 1997 biomass is slightly larger than the low seen in 1996. This increase is due to the growth of fish in the population and not due to recruitment."

The new information available since the last assessment does not suggest that the above outlook needs to be revised.

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References

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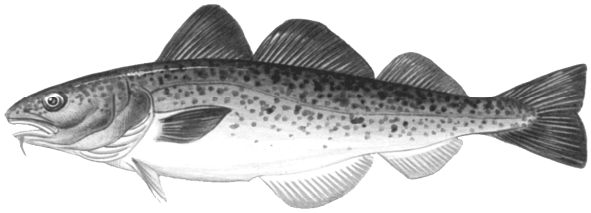
Mohn, R., T. Lambert, S. Wilson, and G. Black. 1998. Update of the Status of 4Vn cod: 1997. DFO Canadian Stock Assessment Secretariat Research Document 98/09.



Cod on the Eastern Scotian Shelf (Div. 4VsW)

Background

The cod (Gadus morhua) resource on the Eastern Scotian Shelf is a complex of spawning components including at least two major offshore groups (Western/Sable and Banquereau), smaller offshore groups (Middle Bank, Canso Bank) and a chain of smaller coastal spawning groups. The situation is complicated by the presence of both spring and fall spawning in several of the spawning components (Sable/Western offshore and various inshore areas).

Growth rates differ between 4Vs and 4W so that in the 1970s fish in 4Vs fish reached 68cm at age 7 while in 4W reached 72cm. In the mid-1980s growth declined in both areas and the average length at age 7 dropped to 59 and 54 cm respectively from 1985 to 1995.

The fishery for 4VsW cod was prosecuted primarily by foreign vessels until the extension of jurisdiction in 1977. Since that time, the Canadian offshore trawler fleet accounted for 70-75% of the landings and longliners most of the rest. Catches from 1958-79 were about 40-50% from 4Vs, however, as the stocks rebuilt in the early 1980s, the fishery shifted more to the east each year and 4Vs accounted for 60-80% of the landings from 1980-93.

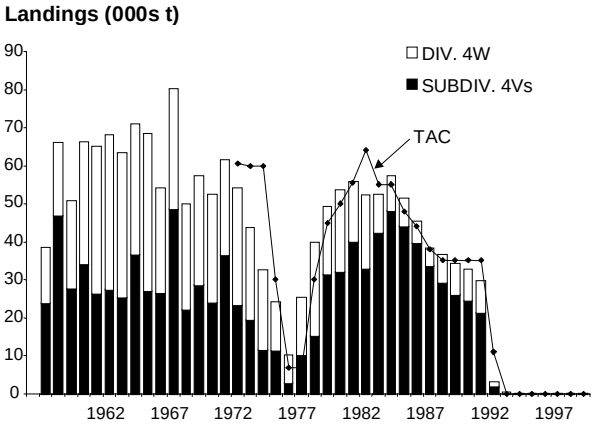
The most recent full assessment of this stock was in spring 1998 (SSR A3-03 (1998)). Updates were conducted in the fall of 1998 (SSR A3-35 (1998)) and 1999 (SSR A3-35 (1999)). More recent information from the fishery, 1999-2000 research vessel and 1997-1999 sentinel surveys is presented.

The Fishery

Landings (tonnes)

Year	1994	1995	1996	1997	1998	1999[3]	2000
TAC	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]
4Vs	180	180	160	104	110	192	
4W	190	90	150	127	152	90	
TOTAL	370	270	310[2]	231[2]	262[2]	281[2]	

1. by-catch only
2. by-catch and commercial index
3. Fishing year, landings and TAC refer to the 15-month period from January 1, 1999 to March 31, 2000.



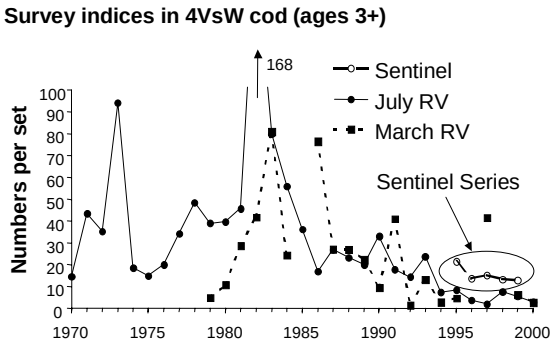
The 4VsW cod fishery remains closed to directed fishing, as it has been since the fall of 1993. Catches have been taken as bycatch in other groundfish fisheries and since 1996, in the Sentinel Program commercial index. The 2000 fishing year landings, to October 16th, are 78t. Detailed historical information on the cod fishery is available in Mohn et al. (1998).

Resource Status

Information on the annual spatial distribution and length frequency from the July research vessel surveys from 1995 to 2000 is contained in Branton and Black (2000).

The most recent surveys all remain low with respect to their series. In particular, the large 1997 estimate from the March survey stands out as an anomaly, not representative of abundance. In 1999 and 2000, the March and

July survey results for each year are virtually indistinguishable.



Outlook

The two research vessel survey series indicate continuing low abundance and have not indicated any major recruitment events in recent years. Until recruitment of several large year-classes is seen, there does not appear to be any basis to expect stock growth.

The outlook from the last Stock Status Reports (DFO, 1998a and 1999) for this stock, based on assessment of the stock (Mohn et al., 1998) included the following:

> "The short-term prospects for this fishery remain dismal. The productivity of the stock is very low, there are several factors causing increased mortality overall as well as seal predation on the younger age groups. The spawning stock biomass, while not declining, has not rebuilt since the closure of the fishery."

The new information available since then does not suggest that the above outlook need be revised.

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Haddock on the Southern Scotian Shelf and Bay of Fundy (Div. 4X/5Y)

Background

Haddock (Melanogrammus aeglefinus) are found on both sides of the North Atlantic. In the west Atlantic, they occur from southwest Greenland to Cape Hatteras. A major stock exists in the southern Scotian Shelf and Bay of Fundy area. This bottom-dwelling species is a member of the cod family and feeds mainly on small invertebrates. It is most common at depths ranging from 25-75 fathoms (46-137 m) and in bottom temperatures above 2°C. Although seasonal migrations are evident within the stock area, there is relatively little exchange between adjacent haddock stocks.

Young haddock in this stock are relatively fast growing, reaching 17 inches (43 cm) and 1.7 pounds (0.8 kg) by age 3 on average. Growth slows thereafter and haddock reach only about 26 inches (66 cm) in length by age 10. Haddock in the Bay of Fundy grow more rapidly than those on the southern Scotian Shelf. Approximately 50% of female haddock are mature by age 3; however the number of eggs produced by a female of this age is low and increases dramatically with age. Browns Bank is the major spawning area for the stock and peak spawning may occur from April to June

Reported annual landings have been as high as 43,000t and the long-term average is about 18,000t. Landings have been below 11,000t since 1988. Historically this fishery has been dominated by mobile gear except during 1990-93 when the proportion of landings taken by fixed gear was greater. Quotas for this stock were introduced in 1970 and a spawning season/area closure has been in place since that time.

The most recent full assessment of this stock was conducted in fall 1999 (SSR A3-07(1999)). More recent information from the fishery, commercial port samples, and the 2000 research vessel and ITQ surveys is presented.

The Fishery

Landings (thousands of tonnes)

Year	1994	1995	1996	1997	1998	1999[1]	2000[2]
TAC	4.5	6.0	6.5	6.7	8.1	9.8	8.1
TOTAL	4.4	5.7	6.2	6.5	7.8	9.2	

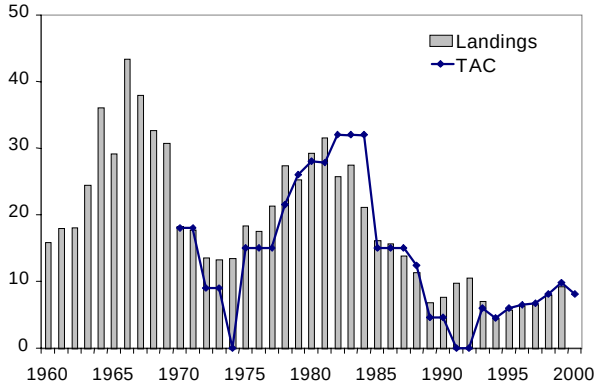
1. Fishing year, landings and TAC refer to the 15-month period from January 1, 1999 to March 31, 2000.
2. Commencing in 2000, fishing year, landings and TAC refer to the period April 1 of the current year to March 31 of the following year.

The 4X haddock quota of 8,100t for the 1999 calendar year was prorated to a 15-month quota of 9,800t, to allow a change to a 12-month fishing year starting April 1, 2000.

Reported **landings** of 4X haddock in the 15-month period were 9,215t. The majority of the shortfall occurred in the fixed gear sector, and reports indicate this was related to restrictive cod quotas. This also happened in the 2000/01 fishing year. Haddock landings for the current fishing year to September 30, 2000, were 3,144t. At that point, 63% of the overall cod quota had been landed while only 40% of the haddock quota had been landed.

Haddock landings during the first quarter of 2000 were the highest since 1992. Both the fixed gear and mobile gear sectors indicated this was due primarily to the ability to direct for haddock with a minimal bycatch of cod at that time of year.

Landings and TAC ('000 t)



Reports from industry indicate that haddock abundance was good throughout most of the stock area in 1999 and 2000. Catches of small fish were prevalent, particularly in eastern 4X. Industry reports indicated they felt that discarding of small haddock was low in 1999 and 2000 due to improved prices for small fish.

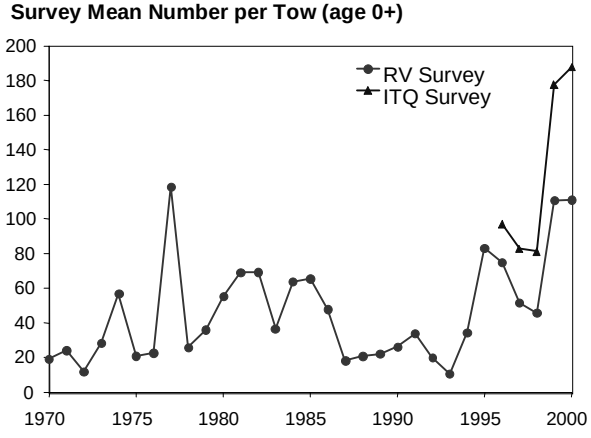
The 1993 and 1994 year-classes dominated the **age composition** of the 1999 landings. These two year-classes made up 48% of the landings.

Mean weights-at-age in the commercial landings have been decreasing since the early to mid 1990s and in 1998 were the lowest observed since the early 1970s. The 1999 values have not been examined.

Resource Status

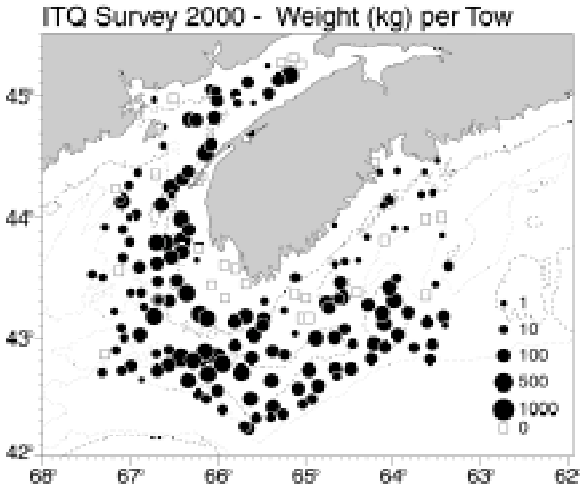
Information on the annual spatial distribution and length frequency from the July research vessel surveys from 1995 to 2000 is contained in Branton and Black (2000).

Abundance in the **summer DFO research vessel survey** was high in 1999 and was again in 2000, due largely to record catches of age 0 and 2 haddock and near record catches of age 1 haddock. Catches of these age groups were widespread in the survey area.



Catches of commercial-size (>43cm) haddock were below the long-term mean in the research vessel survey.

A **joint industry/DFO Science resource survey** of 4X was conducted in summer 1995-2000 by the ITQ fleet. Survey coverage has increased to 187 standardized fishing sets and now covers most of the 4X area. In addition to providing extensive coverage of the traditional research vessel survey strata, this survey provides coverage inshore of the traditional strata in an area where a substantial portion of the mobile gear fishery occurs. Haddock were widespread throughout the survey area again in 2000 and abundance was high. It was decided that the 1995 survey point would not be used as an index of abundance, due to a number of differences in the survey in that developmental year.

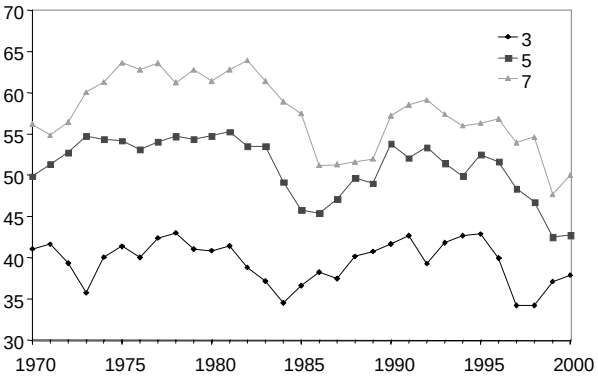


Total mortality estimated for ages 5-7 from the summer research vessel surveys were relatively stable in recent years and implied fishing mortality of about $F_{0.1}$.

Mean lengths-at-age in the research vessel survey have been decreasing since the mid 1990s, particularly at older ages. Mean weights-at-age show similar trends. Many ages are below the long-term mean length and weight and some are at the smallest size

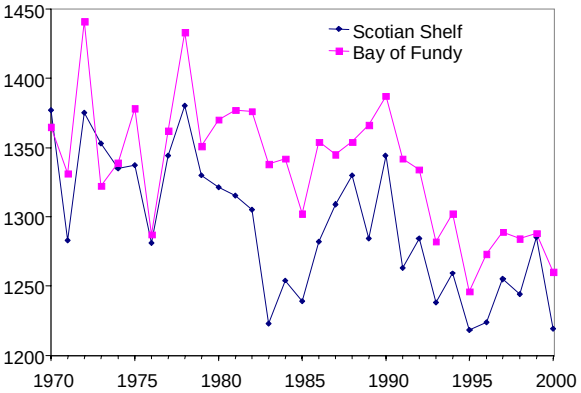
observed in the research vessel survey series.

Mean Length-at-age (cm)



Condition is the relative weight of the fish for their length (i.e. their plumpness). An index of condition, developed from the summer research vessel surveys, was variable but indicated that condition decreased since the late 1980s and reached a minimum in 1995. This index had increased since but decreased to near record low levels in 2000. The attributes, condition and fish size, are believed to be related to spawning potential for cod. This could also be true for haddock.

Condition Index – Predicted Weight (g) at 50cm



A measure of **resource concentration** is the proportion of the historical stock area encompassing 75% of the annually estimated survey biomass. This index has been increasing since 1989.

The proportion of annual survey sets where a species occurs (non-zero sets) is a measure of the **area occupied** by the species. This index has been increasing since 1989 and is presently at a high level.

The research vessel survey and the ITQ survey indicate that the 1997 year-class is above average and that the 1998 and 1999 year-classes are strong.

Summary of Attributes of Stock Status

Attribute	Recent trend	Current Status
Biomass SPA 4+ 1970-99	Increasing since 1994	Above average
Abundance RV number/tow 1970-00	Increasing	Above average
Recruitment SPA age 1 1970-99	Increasing	Above average in 4 of last 5 years
Exploitation SPA ages 5-7 1970-99	Stable	Near $F_{0.1}$
Total mortality RV ages 5-7 1970-00	Stable	Near average
Mean Length RV age 5 1970-00	Decreasing	Near lowest observed
Condition RV 1970-00	Variable	Below average
Resource concentration	Increasing	Evenly distributed
Area occupied	Stable	Widest observed

Outlook

The outlook from the last Stock Status Report for this stock (DFO, 1999) indicated that the resource is rebuilding, due to a number of strong year-classes and recent exploitation levels at or slightly below the target level. Spawning stock biomass is near average levels but was projected to decrease unless further strong recruitment occurs.

There are indications of good recruitment in 1999 and 2000 as evidenced by the widespread occurrence of age 0, 1 and 2 year old haddock in the surveys. All age classes are widely distributed, a condition usually associated with high abundance in this resource. Fish condition and mean fish size are currently low.

Exploitation in 1999 was likely near the target and will likely be again in 2000/2001 if the quota is not exceeded.

Therefore our view of current stock status is unchanged. The projections of yield and spawning stock biomass made in the last assessment are still applicable.

The assessment last year indicated that the $F_{0.1}$ yield in the fishing years commencing April 1st in 2000, 2001 and 2002 would be 8,200t, 8,600t and 8,600t. Spawning stock biomass would increase to 39,000t in 2001 and decrease slightly to 37,000t in 2002 at those exploitation levels.

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Hurley, P.C.F., G.A.P. Black, P.A. Comeau, and R.K. Mohn. 1999. Assessment of 4X haddock in 1998 and the first half of 1999. DFO Canadian Stock Assessment Secretariat Res. Doc. 99/147.

Haddock on the Eastern Scotian Shelf (Div. 4TVW)

Background

The haddock (Melanogrammus aeglefinus) resource on the eastern Scotian Shelf and southern Gulf of St. Lawrence is considered a single management unit distinct from the adjacent stock in 4X. The majority of 4TVW haddock occur on the offshore banks of the Scotian Shelf ranging from Emerald Bank in the west to Banquereau Bank in the east.

Haddock prefer hard sand or gravel bottoms at depths ranging from less than 50 m to about 350 m, and temperatures ranging from 4 - 8^{o} C. During summer haddock are distributed on the tops of banks while in winter months they move to deeper waters to avoid cold temperatures. Spawning occurs in spring and the principal spawning areas are the complex of banks in 4W including Emerald, Western and Sable Island banks. In the past, these spawning aggregations were the target of intense fisheries until the imposition of a closed area, which encompasses Emerald and part of Western banks in 1987.

A large female haddock (about 60 cm or 24 inches) can produce several hundred thousand eggs which are liberated near the bottom and rise to the surface during an average incubation period of two weeks. During the first year of life, young haddock actively feed on plankton in the surface waters and gradually descend to the bottom as juveniles in mid-summer. Thereafter, they remain on bottom, feeding and growing at a rate of about 5-10 cm (2-4 inches) in length per year. When sexual maturity is reached after 3-5 years, growth rates diminish. Haddock are relatively long-lived (>10 years) and age is determined from the pattern of rings in their otoliths (earbones). The 4TVW haddock otoliths have been particularly difficult to interpret in the past. However, completion of a recent age validation study has resolved this problem.

Since 1987, the haddock fishery has been regulated through a combination of by-catch restrictions and trip limits. The year-round nursery ground closure established in 1987 (initially exempt to fixed gear) remains in effect. In the fall of 1993 the area was closed to all groundfish fishing.

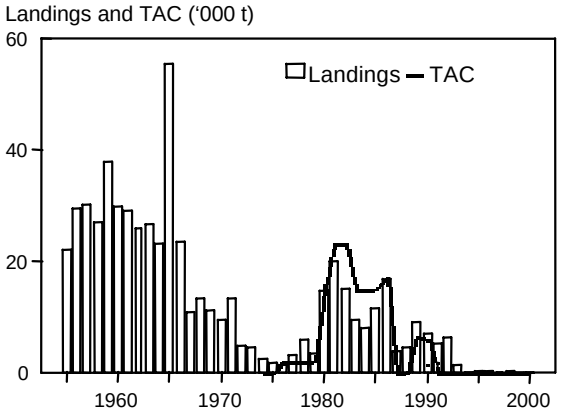
The most recent full assessment of this stock was conducted in 1997 (SSR A3-06). An update was conducted in 1999 (SSR A3-35(1999)). More recent information from the fishery and summer survey is presented.

The Fishery

Landings, tonnes

Year	1994	1995	1996	1997	1998	1999[2]	2000
TAC	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]
Total	92	109	200	127	162	83	

1. by-catch only
2. Fishing year, landings and TAC refer to the 15-month period from January 1, 1999 to March 31, 2000.



In the 2000 fishing year (to September 30th), reported bycatch of haddock in other fisheries amounted to 56t.

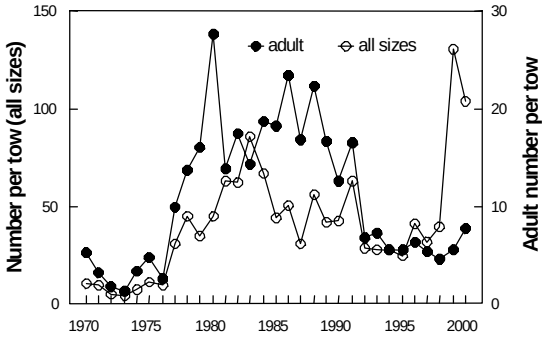
Resource Status

DFO research vessel summer **survey data** from 2000 represents new information available since the last SSR. Information on the annual spatial distributions and length frequencies from 1997 to 2000 are contained in Branton and Black (2000).

A dramatic increase in the number per tow was evident in 1999, due to an extraordinary abundance of 0-group (~10cm haddock). The 1999 year-class has remained extremely abundant in the 2000 survey. 0-group abundance in the 2000 survey also appears to be high. In addition, the 1995, 1996 and

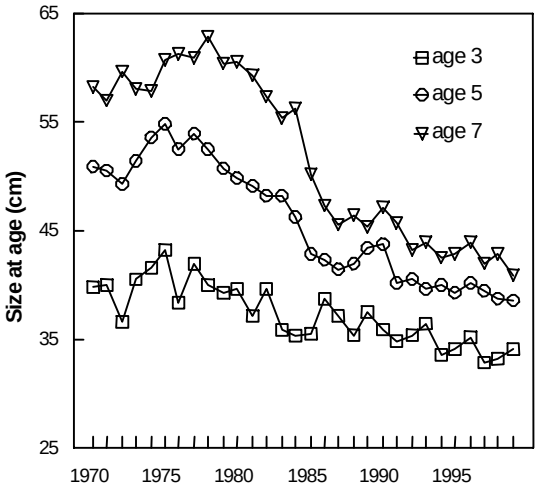
1997 year-classes are near the long-term average. Despite this situation, the adult or fishable component (haddock > 42 cm) of the population has remained below average since 1992.

Summer Survey Number per Tow



Recent growth rates of haddock have been extremely low, delaying the entry of new year-classes into the fishable stock. For example, the mean size-at-age of a 5 year-old haddock is currently 39cm. When compared to the size of a 5 year-old in the mid-1970s of 53cm, it is obvious that a tremendous reduction in growth has occurred. Other age groups show similar large reductions in mean size at age. Note that the size at age data series extends to 1999.

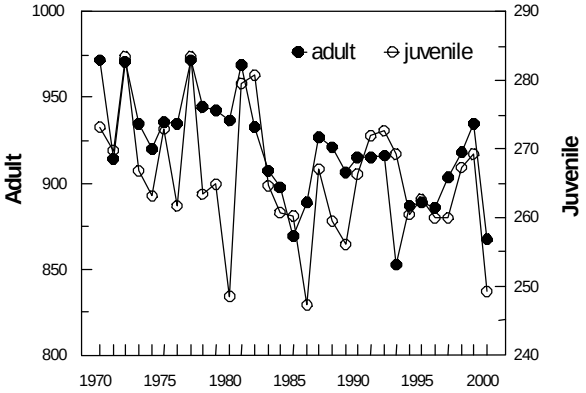
Size at age from Summer Survey



Currently the stock is concentrated on Emerald, Western and Sable Island Banks. This pattern was observed during the RV surveys as well as the fall industry/science survey. In general, haddock distribution is confined to the haddock closed area in Div. 4W. It is notable that the 1999 year-class was widely distributed throughout the Scotian Shelf.

Condition of adult haddock had been steadily improving since 1993, when record lows were recorded. Above average adult condition was observed for the first time in over a decade in 1999. Adult condition in 2000 has once again fallen to below average levels. Somewhat similar patterns have been noted for the condition of juveniles.

Condition factor from Summer Survey



Outlook

The outlook from the last Stock Status Report (A3-35 (1999)) for this stock indicated that the short-term prospects for this stock were not encouraging. However, the longer term prospects are better.

Improvement in recruitment has been noted with the 1995-1997 year-classes approaching long-term average values. The 1999 year-class, as 0-group, was widely distributed, consistent with previous large year-classes. This year-class has remained strong and widely distributed at age 1 and

may have the potential to become the strongest ever observed. Its development will be closely monitored.

Current growth has been well-below average, delaying the entry of new year-classes into fishable sizes. Condition had been steadily improving and was above average for both juvenile and adult haddock in 1999. The condition index dropped to below-average in 2000. Until 2000, improvement in the condition of adults may have contributed to the succession of average to above-average year-classes seen in the last five years.

While some of the indicators show improvement, they are not sufficient to change the view of the status of the stock. If the current slow growth regime does not change, the recent, strong incoming recruitment will not enter into fishable sizes for several years.

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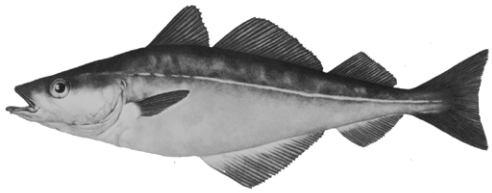


Pollock in Div. 4VWX and SA 5

Background

Pollock (Pollachius virens) in the western Atlantic range from southern Labrador to about Cape Hatteras. The main fishable concentrations occur in the Georges Bank, Gulf of Maine, and Scotian Shelf areas.

Young pollock are closely associated with nearshore habitats, recruiting to the offshore populations at around age 2. Based on observations by fishermen and acoustic studies, pollock spend the least time on the bottom of all the cod-like fish. Pollock show strong schooling behaviour. Food of adult pollock include euphausiids and fish such as herring, sand lance and silver hake.

Pollock are mature at ages 3 to 5 depending on the area. Pollock also show marked differences in growth rate by area, with fish in the Bay of Fundy area growing faster than those on the eastern Scotian Shelf.

The management unit includes the Canadian portion of Georges Bank and the Gulf of Maine, and the Scotian Shelf. A variety of fishing gear is used to fish pollock, primarily otter trawls and gillnets, but also includes handlines and longlines. The otter trawl and gillnet fisheries are often directed. Pollock can also be taken as bycatch in cod and haddock fisheries and in the small-mesh silver hake and redfish fisheries.

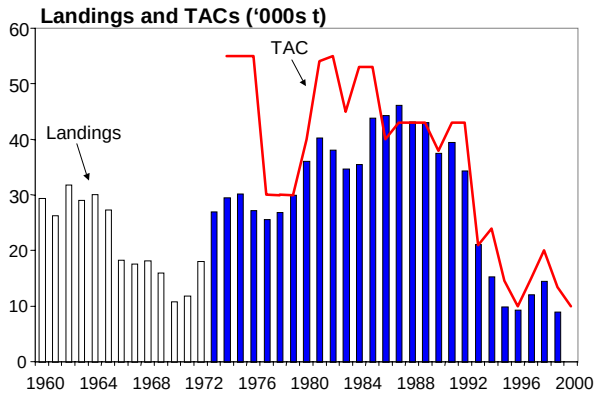
The most recent full assessment of this stock was conducted in fall 1999 (Neilson et al. 1999, SSR A3-13 (1999)). More recent information from the fishery, commercial port samples, and the 2000 research vessel and ITQ surveys is presented.

The Fishery

Landings (thousand tonnes)

Year	1994	1995	1996	1997	1998	1999[1]	2000[2]
TAC	24.0	14.5	10.0	15.0	20.0	13.4	10.0
TOTAL	15.2	9.8	9.3	12.0	14.4	8.9	

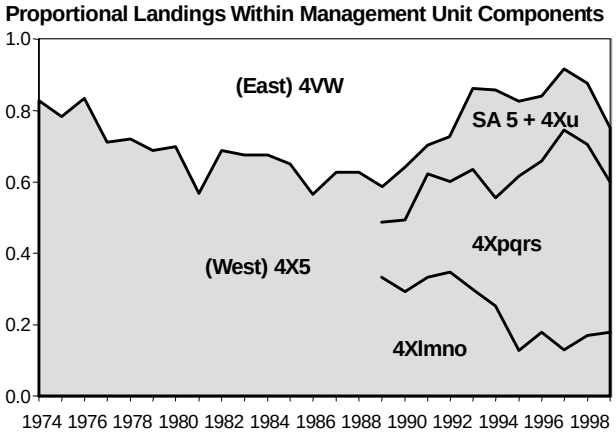
1. Fishing year, landings and TAC refer to the 15-month period from January 1 1999 to March 31, 2000.
2. Commencing in 2000, fishing year, landings and TAC refers to the period April 1 of the current year to March 31 of the following year.



1. Landings before 1973 included Canadian removals only.

Landings in 2000 are 2973t (includes those landings from April 1st through Aug. 31st).

The recent pollock fishery continues to undergo significant changes in both area fished and in dominant gear type. During the 1980s, landings from 4VW accounted for about 36% of landings from the management unit. In 1999, they accounted for about 25% of total landings. The changes in the distribution of the fishery were thought to reflect both the population dynamics of the stock and fishery management measures. Within 4X5, the proportion of landings from the western half (Unit Areas 4Xpqrs) has increased from 29% in 1991 to 42% in 1999.



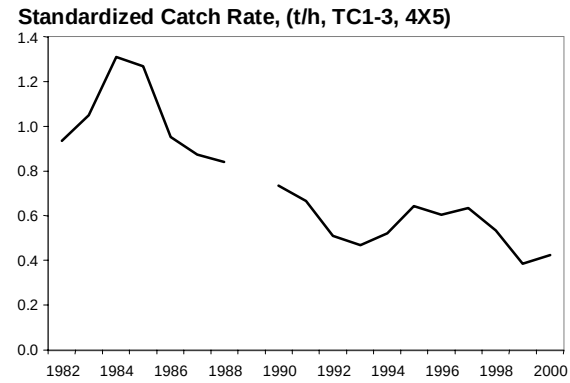
The contribution of larger trawlers to total landings (Tonnage Class (TC) 4+), once the dominant gear type in the fishery, has been steadily declining since 1981 and accounted for 24% of total removals in 1999. In contrast, the contributions of TC 1-3 trawlers and fixed gear vessels (gillnet, longline) have been increasing over the same period and now account for 45 and 31% of the total landings, respectively.

During **industry consultations** in October of 2000, fishermen reported that low catches to date have not reflected low availability to the fishery. Instead, the low catches were related to reduced market prices for pollock. In addition, fishermen noted that white hake and cod bycatch restrictions have limited the pollock fishery. Finally, it was noted that unusually high numbers of small (20cm) pollock were caught in lobster traps in 2000.

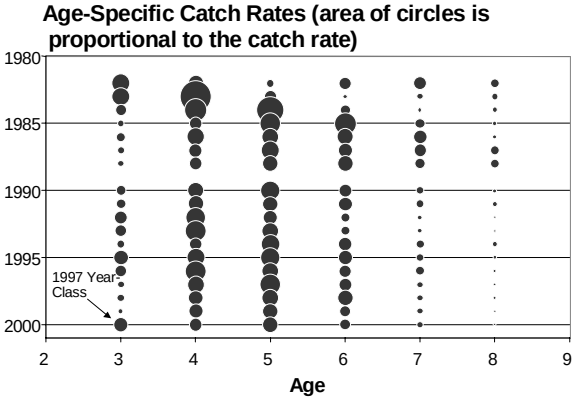
Resource Status

The index of abundance used in this assessment is a **standardized catch rate series** that uses data from directed pollock trips of TC 1-3 otter trawlers operating in 4X5. The standardized catch rate series accounts for differences in catch rate by vessel tonnage class, mesh type, unit area, month and year.

The catch rate series peaked in 1984 as the strong 1979 year-class became fully recruited, and declined thereafter. After a slight increase from 1994 to 1996, the catch rate series decreased.

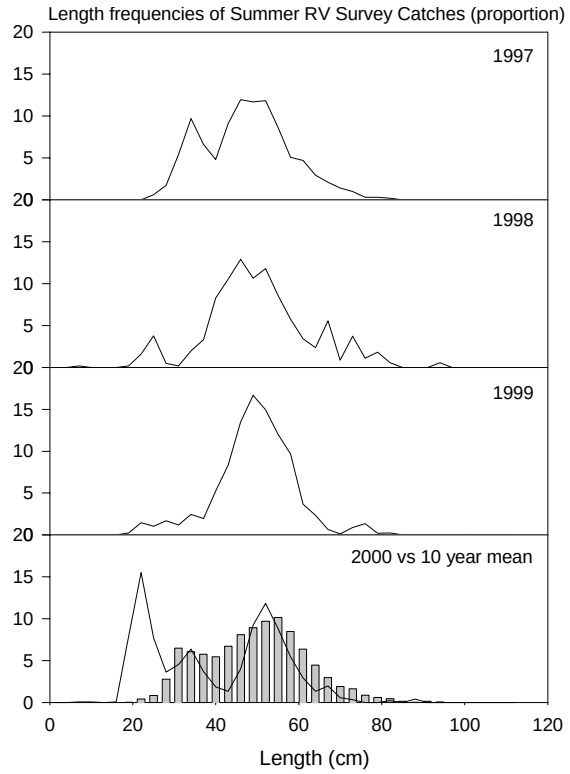


There has been a slight improvement in catch rate from 1999 to 2000, due to higher catch rates for age-3 fish (1997 year-class).



Summer research vessel survey data are not currently used as an index of abundance in this assessment, because there is considerable unexplained interannual variation of many year-classes, which is inconsistent with our knowledge of fisheries dynamics. However, the research survey information on **size structure** indicates fewer larger fish in the surveys since 1990. The 2000 survey caught many more small pollock (<25cm) compared with the 10-year average. These fish are two years old, and represent the 1998 year class. It is unprecedented in the summer survey series to have caught such large numbers of small fish. However, previous strong year-

classes have not been detected at that early stage.



A joint industry/DFO Science survey conducted by the ITQ fleet in 4X also showed a comparative absence of fish larger than 40 cm in 1998 to 2000 compared with the two earlier years of the survey. In 2000, large numbers of 20-30 cm (age 2, 1998 year-class) fish were seen compared with previous years.

Outlook

The Outlook from the previous Stock Status Report noted:

> "In summary, the pollock resource remains depleted,….biomass is less than average, recent recruitment has been poor, there is an absence of older fish in the population, and there are spatial changes in the resource and in the fishery distributions that are worrisome. Caution in establishing harvest levels is required."

Excepting preliminary indications of improved recruitment from the fishery and surveys, the new information available since the last assessment does not suggest that the above outlook needs to be revised. Catch rates remain comparatively low, large fish are rare in the catch and the surveys, and the fishery remains spatially constricted. It is noted that the TAC for the 2000-2001 fishery of 10,000t exceeded the $F_{0.1}$ level of 7,000t (SSR A3-13 (1999)).

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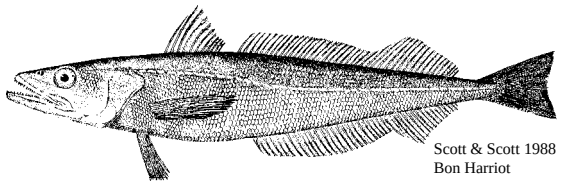


Scott & Scott 1988
Bon Harriot

Silver Hake on the Scotian Shelf (Div. 4VWX)

Background

Silver hake (Merlucius bilinearis) is a bottom dwelling member of the gadoid family, found from Cape Hatteras to the Grand Banks and the Gulf of St. Lawrence. A major concentration of silver hake occurs on the Scotian Shelf.

Scotian Shelf silver hake are generally found between 7 and 10^o C, in deeper water on the shelf edge and in the Emerald and LaHave basins. Seasonal movements occur during the summer, as silver hake move into shallow water on Sable and Western banks to spawn. Scotian Shelf silver hake feed primarily on invertebrates, with krill the predominant prey item. Older fish are piscivorous and exhibit a high degree of cannibalism.

Silver hake exhibit relatively rapid growth with females growing faster than males. Maximum longevity is 12 years. Maturity is relatively early, with a majority of males maturing at age 2, and females at 3.

Prior to 1977, fishing on the Scotian Shelf was unrestricted in terms of area, mesh size and season. During this period fishing was conducted over the entire shelf, and the use of trawl mesh as small as 40 mm was common. In 1977, fishing for this species was restricted to the seaward side of the Small Mesh Gear Line (SMGL), west of 60^o W longitude, with a minimum mesh size of 60 mm. In 1994, further restrictions were introduced to minimise incidental catches of cod, haddock and pollock in the silver hake fishery. These included a repositioning of the SMGL to prevent fishing in depths less than 190 m and the mandatory use of a separator grate in the lengthening piece of the trawl.

The most recent assessment of this stock was conducted in fall 1999 (SSR A3-09 (1999). More recent landings data and information from the 4VWX summer research vessel survey are presented.

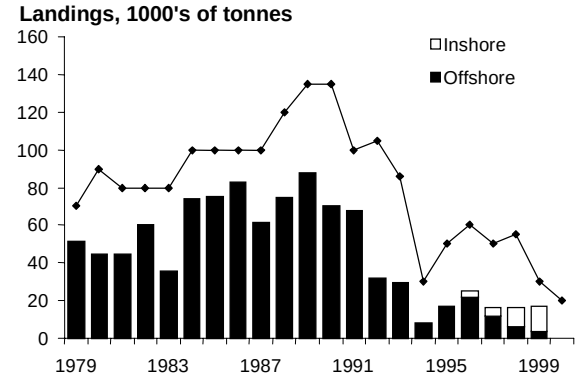
The Fishery

Landings ('000t)

Year	1994	1995	1996	1997	1998	1999[2]	2000[3]
TAC	30	60	60	50	55	33	20
Canada[1]	7.3	15.0	24.4	16.3	16.1	16.7	
Foreign	0.9	2.2	1.4	0.7	0	0	
Total	8.2	17.2	25.8	17.0	16.1	16.7	

1. Includes developmental allocations.
2. Fishing year, landings and TAC refer to the 15-month period from January 1, 1999 to March 31, 2000.
3. Commencing in 2000, fishing year, landings and TAC refer to the period from April 1 of the current year to March 31 of the following year.

Landings for the 2000 fishing year (to October 15th) are 6,200t, for which the offshore developmental portion is 1,200t.

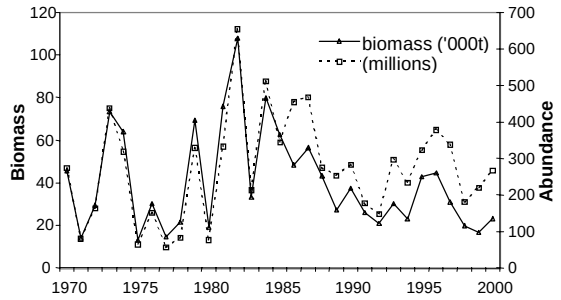


Resource Status

Information on the annual spatial distribution and length frequency from the July research vessel surveys from 1995 to 2000 is contained in Branton and Black (2000).

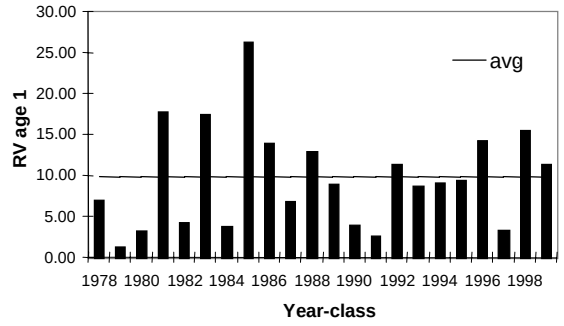
Abundance and biomass from the DFO **summer research vessel (RV) survey** show a slight increase over 1999 levels, but remain low relative to the long term mean.

Silver Hake - Biomass and Abundance (RV)



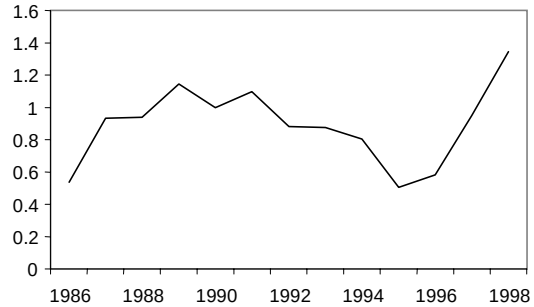
Recruitment to the fishery will be from the 1998 and 1999 year-classes, which are estimated to be above average in abundance, based on recent survey data.

Recruitment (millions)



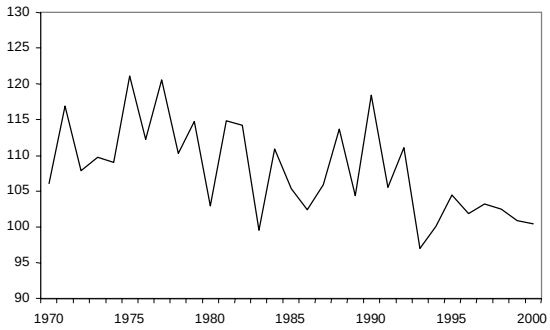
Total mortality over ages 2-4 from the summer survey shows an increasing trend since 1995. Total mortality for ages important to the fishery is above that expected with $F_{0.1}$ = 0.7 (assuming natural mortality = 0.4), suggesting exploitation is relatively high despite moderate catches.

Total Mortality (ages 2-40)



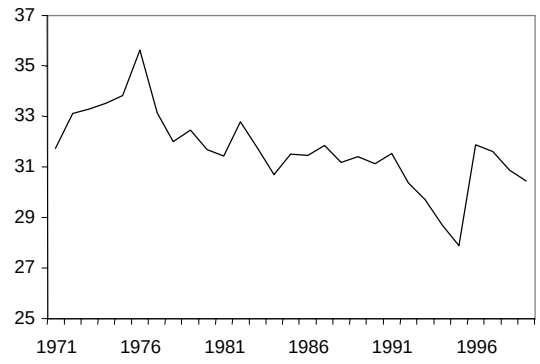
There are long-term declining trends in biological indicators. **Condition** (weight at 25cm), shows a general decline from 1975 to 1993. An increase was seen in 1995, but condition has declined subsequently to a low level relative to the long-term average.

Condition Index

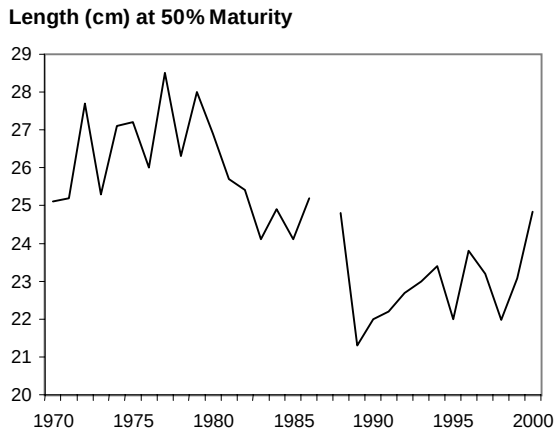


Length-at-age has also shown declines, from high levels in the early 1970s to a low in 1995. Length-at-age increased from 1995 to 1996, but has declined subsequently and remains just below the long-term mean.

Length-at-age (cm, age 3 females)



Length at 50% maturity has declined since the late 1970's. While there has been some increase since the late 1980's, it remains low.



A measure of **resource concentration** is the proportion of the historical stock area encompassing 75% of the annually estimated survey biomass. For silver hake this index has increased since 1992.

The proportion of annual survey sets where the species occurs (non-zero sets) is a measure of the **area occupied** by the species. This index has been increasing since 1992 and is presently at a high level.

Summary of Attributes of Stock Status

Attribute	Recent Trend	Current Status
Biomass RV age 1+ (1970-2000)	Decreasing since 1996; small increase in 2000.	At low level.
Recruitment RV age 1 (1979-2000)	Stable	1998 & 1999 year-classes above average
Total mortality RV ages 2-4 (1983-99)	Increasing since 1995.	F is above $F_{0.1}$ if M=0.4.
Condition (1970-2000)	Declining since 1995	Low relative to long-term average.
Length at age (1971-1999)	Declining since 1996.	Low relative to long-term average.
Length at maturity (1970-2000)	Stable.	Low relative to long-term average.
Resource concentration (1970-2000)	Increasing	Evenly dispersed.
Area occupied (1970-2000)	Increasing	Widely distributed.

Outlook

The outlook from the last SSR for this resource indicated that catches should not be allowed to increase from 1997-99 levels.

Survey biomass remains very low and total mortality is high. The extreme values of these important indicators cause substantial concern. In addition, condition, length-at-age, and size at maturity are below long-term averages.

Recruitment prospects appear good, with two above average year-classes entering the fishery, and resource concentration and distribution through the geographical range exhibit positive trends.

Given the inconsistency of available attributes of stock status for this resource,

the outlook remains the same – catches should not increase from those in 1997-1999.

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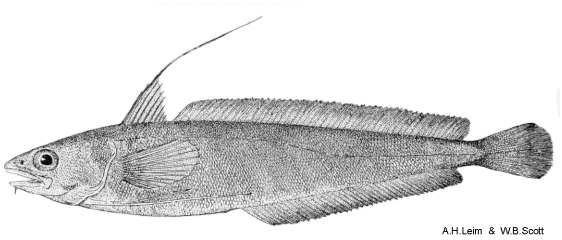


White Hake on the Scotian Shelf and Northeastern Geroges Bank (Div. 4VWX and 5Zc)

Background

White hake (Urophycis tenuis) are bottom dwelling fish found in areas with a mud bottom from the southern Grand Banks to the mid-Atlantic Bight. Their depth range varies with life history stage, with age 2 and older fish occurring predominantly at depths between 50 to 200m. They favour temperatures between 3° and 10°C.

The spawning areas and times on the Scotian Shelf and in the Bay of Fundy are not well understood. There appear to be two spawning components – late spring/early summer and late summer/early autumn. White hake are highly fecund, having several million eggs per female. They are pelagic spawners, with the eggs and larvae drifting in the upper 50 meters for about a month. The larvae change shape into juveniles in the pelagic zone and subsequently migrate into the shallow coastal zone. At an age of about 2 months the small pelagic juveniles (approximately 4cm) move to the bottom in shallow water. They appear to stay in shallow water for a year and then migrate to the offshore adult distributional area at some time during their second year. In the Bay of Fundy they are about 10cm in length in August of the first year, and 30cm in length at age 1 (August). Growth rate varies with area. In the Gulf of Maine area, white hake begin maturation and reproduction at ages two and three, at lengths between 35 and 45cm. The age span is about 20 years, with fish potentially growing to lengths as large as 189cm.

The stock structure in 4VWX and 5Zc may be complex, with several self-sustaining components. White hake in the 4Vn Laurentian Channel slope waters are contiguous with 4T. Those in the Bay of Fundy and approaches are contiguous with 5Z and 5Y (i.e. the Gulf of Maine area). The central Scotian Shelf (parts of 4X and 4W) may be separate from those to the east and west. The present management units (4T, 4VWX, 5Zc, and USA 5+6), do not reflect discontinuities in adult distributions. About two thirds of the white hake landed in 4VWX and 5Zc are from 4X and 5Zc.

The landings from all areas have declined in recent years. Canadian fishing effort for this species was unregulated in 4VWX and 5 until 1996. It has become increasingly a directed fishery. Longliners and gillnets take about 40% of the catch each, with small draggers (less than 65') taking most of the rest. The landed value in 1997 was about $2 million.

The most recent full assessment of this stock was conducted in 1998 (SSR A3-10 (1998)). More recent information from the fishery and the summer 1999-2000 research vessel surveys is also presented.

The Fishery

Landings (tonnes)

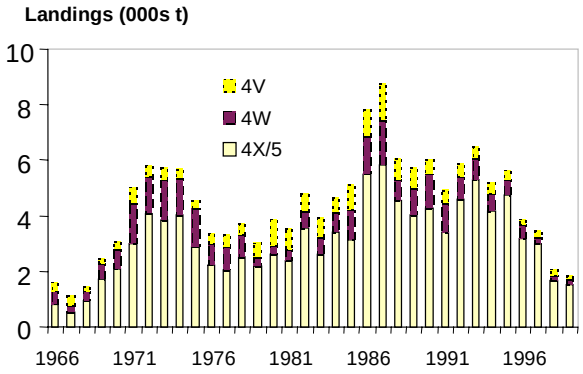
Year	1994	1995	1996	1997	1998	1999[1]	2000
TAC			3420	3100	3500		
Landings	5224	5635	3892	3453	2017	2145	

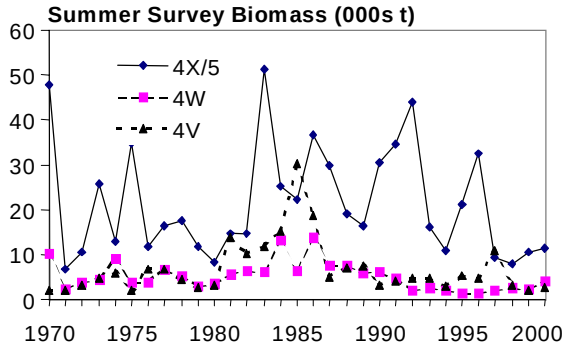
1. Fishing year and landings refer to the 15-month period from January 1, 1999 to March 31, 2000.

Landings from 1998-2000 represent additional data since the last assessment.

Reported landings in 4VWX/5 during the 1999 calendar year were the lowest reported since 1968. Landings for the 2000 fishing year to October 15th are 1733t for 4VWX/5.

Until 1996, there were no restrictions on fishing effort for white hake in 4VWX/5, when the first catch limit (TAC) was introduced and solely allocated to the fixed gear sector (< 65ft). In addition, other fleet sectors are regulated through bycatch restrictions (20% for the ITQ fleet, 10% for large trawlers). The TAC was restrictive to fishing until 1998, when it could not be reached. In 1999, the fishery was put on a by-catch, however, a CAP was introduced to the fixed gear fleet (<65ft) which was 50% of the previous year's TAC. Transfers between Community Management Boards were not permitted. The CAP was reduced in 2000 to 1429t, 1062t of which had been caught by the end of August. Recently, industry has reported difficulties staying within white hake catch restrictions while fishing for other species in 4X.



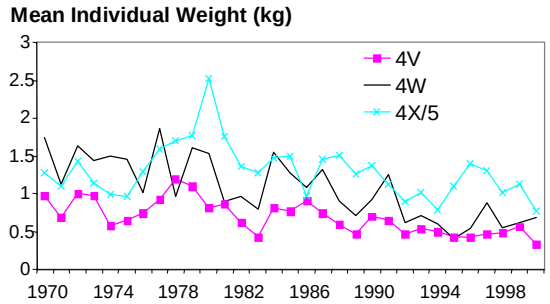


Resource Status

Information on the annual spatial distribution and length frequency from the July research vessel surveys from 1995 to 2000 is contained in Branton and Black (2000).

Summer **research vessel (RV) survey** biomass estimates for 4X, which typically contains about 75% of the biomass for the 4VWX/5 stock unit, dropped sharply in 1996, and have remained low since. The size composition has shifted towards smaller fish since 1995. Summer RV survey biomass estimates for 4W declined from 1986 to a record low in 1995, rising slightly in subsequent years. Summer RV estimates for 4V dropped sharply from 1985 to 1987, and have since remained low but relatively stable. An increase in 1997 was not maintained in 1998, and 1999 represented a new record low for the 4V component. The 2000 estimate for 4V was only a slight increase over 1999.

Mean individual weights of white hake in RV surveys in general declined through the 1980s, bottomed out in the early 1990s, and have since remained low. The 2000 weights are new record lows for both 4X/5 and 4V.



Outlook

The outlook from the last Stock Status Report (DFO, 1998), based on the 1998 assessment (Fowler, 1998) was as follows:

> "The downward trends in abundance indices for 4X/5 suggest that this portion of the stock may be at risk of collapse. Abundance indices of the 4W and 4V components of the stock have remained near record lows. … Present management has not been effective in protecting white hake."

Marginal increases in RV biomass estimates are not sufficient to alter recent perceptions of this stock. The reduced CAPs have not yet proven adequate to rebuild the stock.

None of the new information shows any clear signs of improvement in this stock, and the outlook should not be revised. The fisheries in both management units should be restricted to bycatch only, with the lowest possible landings.

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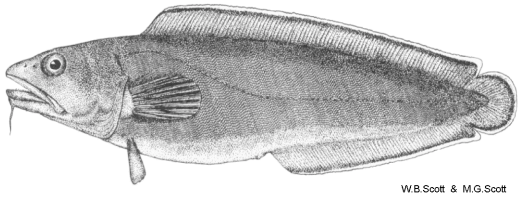


Cusk on the Scotian Shelf (Div. 4VWX)

Background

Cusk (Brosme brosme) is a solitary, slow swimming species, found primarily on the southwestern Scotian Shelf and Slope and in the Fundian Channel, that seldom moves from bank to bank. Based on July research surveys, cusk occur in temperatures ranging from 3 to 11°C with most being caught in the 6-10 ^{0} C range, at depths of 75-150 m.. They also prefer a rocky bottom, or gravel and occasional mud but seldom sand.

Spawning on the Scotian Shelf is believed to occur from May to Aug., peaking in June. The buoyant eggs are 1.3-1.5 mm in diameter with a pinkish oil globule. The pelagic larvae are about 4 mm when hatched, migrating to the bottom when they have grown to approximately 50 mm in length. Males appear to grow slightly faster than females, (reaching 45 cm at five years of age) and appear to mature more rapidly.

The diet of cusk on the Scotian Shelf is unknown, as their stomachs invert when they are brought to the surface. In European waters, cusk feed primarily on crabs and molluscs, along with the occasional starfish. Observations on this side of the Atlantic revealed cusk feeding on crabs and the occasional mollusc off the coast of Maine. The only known predation record was by a hooded seal off Greenland. There is no record of cusk occurring in seal stomachs on the Scotian Shelf.

The most recent full assessment of this stock was conducted in 1998 (DFO, 1998). More recent information from the fishery and the summer 1999-2000 research vessel surveys is presented.

The Fishery

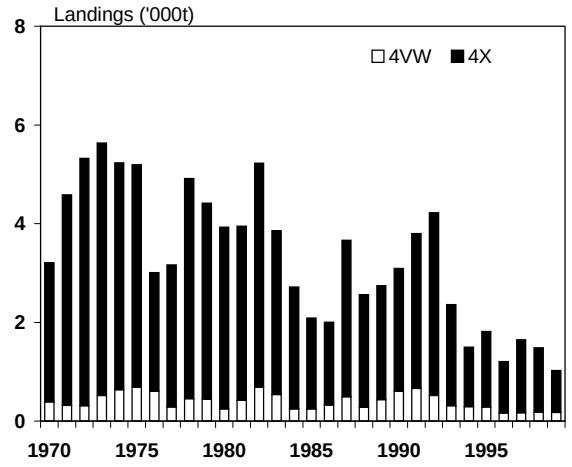
Landings (tonnes)

Year	1994	1995	1996	1997	1998	1999[1]	2000
4VW	294	290	164	174	186	177	-
4X	1209	1531	1044	1475	1304	851	-
TOTAL	1502	1820	1208	1649	1490	1028	-

1. Fishing year and landings refer to the 15-month period from January 1 1999 to March 31, 2000.

Cusk was placed under bycatch limitations for the first time in 1999. A CAP of 1000t was placed on the combined landings of all fleets. The 2000 fishing year landings, to September 30, are 622t. It is predicted that if the fishery continues at the current rate the total landings for the 2000 fishing year will be below the 1000t CAP.

Cusk are primarily caught by longline (95%), with over 80% of the landings coming from 4X. In 4X, landings have varied from a maximum of 5,130t in 1973 to a low of 908t in 1999. The general pattern of landings is one of a gradual decrease from the early 1970s to the present. Landings in Division 4W have rarely exceeded 500t, while landings in Division 4V have been negligible.



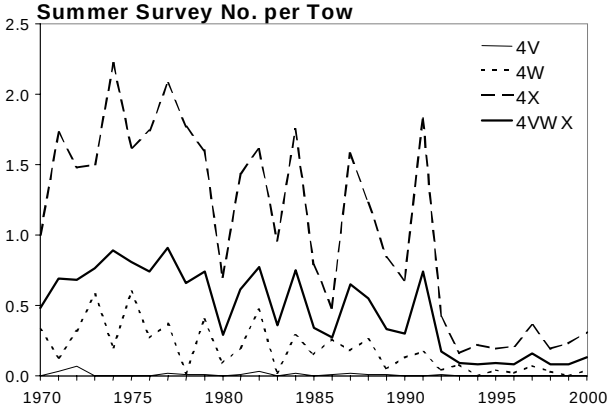
The most common (modal) size in commercial length frequency samples of cusk from the early 1970s and early 1980s was between 64 to 67cm, similar to modal size in the research vessel survey over the same

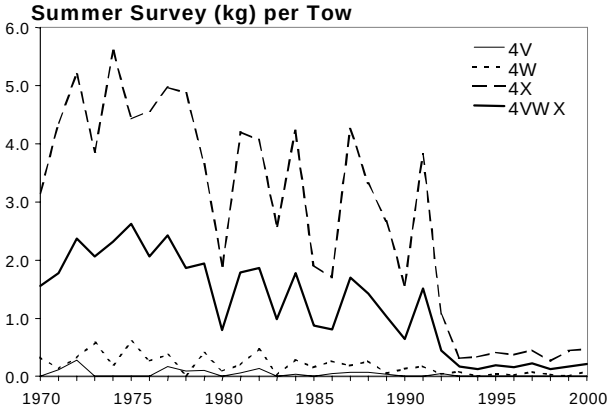
period. These are consistent with modal sizes reported by Oldham (1972) from LaHave Bank in the mid 1960s. The size composition from commercial samples since 1988 has shown no consistent pattern with modes ranging from 52-61 cm.

Resource Status

Information on the annual spatial distribution and length frequency from the July research vessel surveys from 1995 to 2000 is contained in Branton and Black (2000).

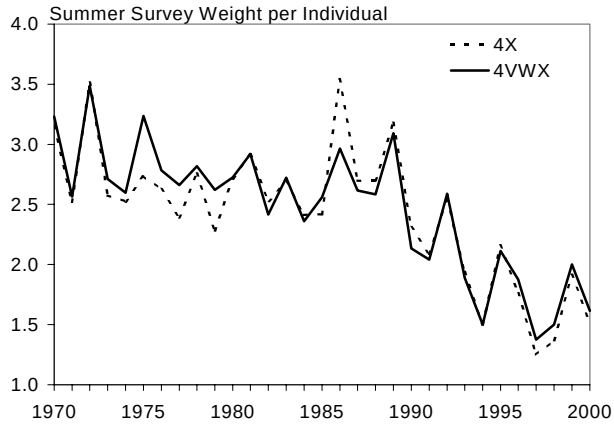
Cusk **biomass** in both 4W and 4X (the centre of the historic distribution) has shown a gradual decline since the start of groundfish **research vessel (RV)** surveys in 1970. Research survey indices show a gradual decrease in both numbers per tow and weight per tow since the late 1970s with an apparent collapse in 1992.



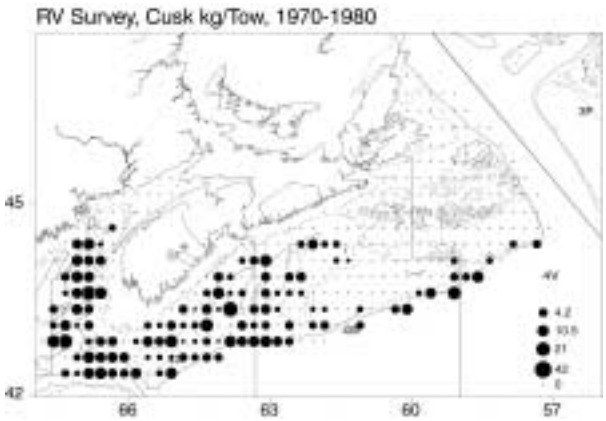


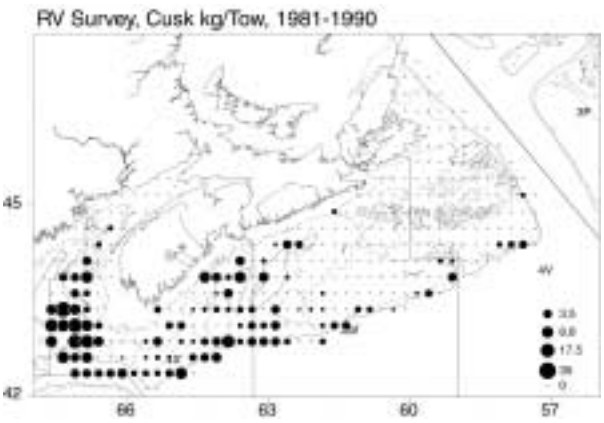
Summer research vessel surveys also show a decrease in abundance of cusk greater than 50 cm.

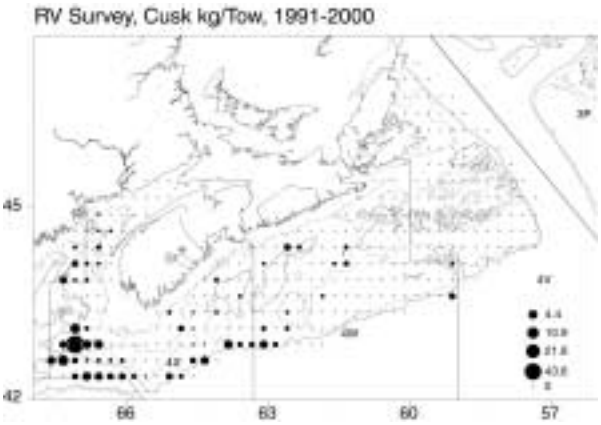
Mean weight per individual from the research vessel survey has declined since 1989.



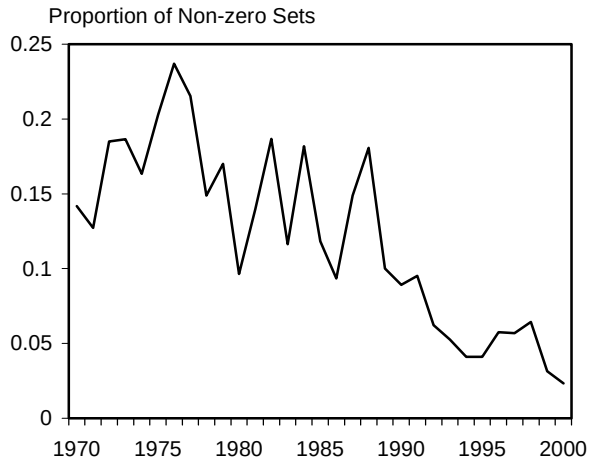
A comparison of the **geographic distribution** from summer research vessel surveys indicates a significant contraction of cusk distribution in recent years. Since 1991, few cusk are distributed along the seaward edges of Western/Emerald/Sable Island and Banquereau banks.







The proportion of annual survey sets where the species occurs (non-zero sets) is a measure of the area occupied within its historical geographic range. For cusk, this index has shown a steady decline since the late 1980s.



Outlook

The outlook from the last Stock Status Report (DFO, 1998) for this stock included the following:

> "Given the apparent collapse of the cusk population since 1992, immediate and substantial restrictions on cusk landings are required. Elimination of the directed fishery is necessary. Rebuilding of the stock will probably require a combination of both traditional and innovative measures. A restrictive bycatch would aid in rebuilding efforts, but may be difficult to implement without discarding."

Despite the recent introduction of catch controls, this is a stock which shows no signs of improvement. It is likely that the 1000t cap placed on this stock is not providing adequate restrictions on catches to allow for the stock to rebuild and more restrictive measures may be required. A more comprehensive review of this resource will be undertaken in 2001.

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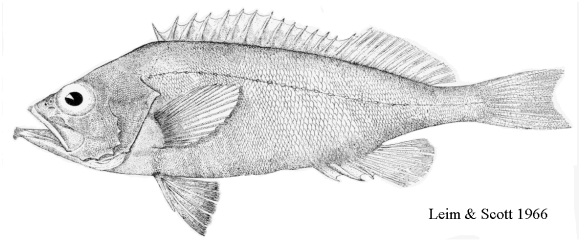
Scott, W.B., and M.G. Scott. 1988. Atlantic Fishes of Canada. Can. Bull. Fish. Aquat. Sci. 219: 731 p.



Unit 3 Redfish

Background

Redfish, also known as ocean perch occur on both sides of the Atlantic Ocean. They are normally found along the slopes of fishing banks and deep channels usually at 100 - 700 m in water of 3 to 8 ° C. In the northwest Atlantic, redfish range from Baffin Island in the north to New Jersey in the south. The predominant species on the Scotian Shelf are Sebastes fasciatus (Acadian redfish), occurring in the deep basins and at the edge of the continental shelf, and S. mentella (beaked redfish) occurring in the deeper waters off the continental shelf. Differences between these two species are not readily apparent, therefore commercial and research catch are not routinely separated by species.

The Unit 3 management area (4WdehklX) for redfish was first implemented in the 1993 Groundfish Management Plan with a quota of 10,000 t. Redfish in this area were previously managed as part of a larger 4VWX management area. Redfish in Unit 3 are primarily caught by otter trawlers using 90 mm mesh. Regulations limit the bycatch in NAFO division 4X of other groundfish species to 10 % by weight of redfish caught and the bycatch in NAFO divisions 4VW to 2 % by weight each of cod and haddock.

The most recent full assessment of this stock was conducted at the fall 1999 Atlantic Zone assessment for redfish Units 1, 2, and 3, and in Division 3O (SSR A1-01). The present document includes fishery and survey data acquired since then.

The Fishery

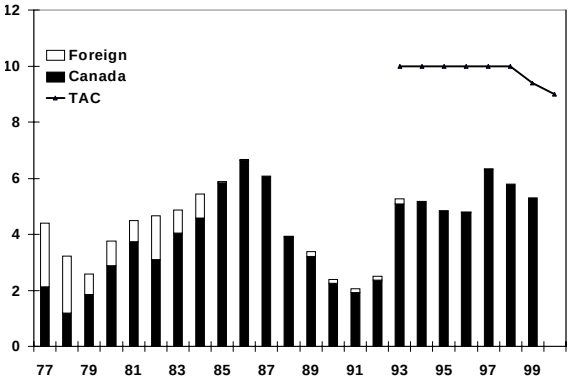
Landings (000s t)

Year	1994	1995	1996	1997	1998	1999[1]	2000[2]
TAC	10.0	10.0	10.0	10.0	10.0	9.4	9.0
Total	3.6	4.9	4.8	6.4	5.8	5.3	

1. 1999 TAC and landings refer to the 15 month period from Jan 1, 1999 to March 31, 2000.
2. 2000 TAC refers to the 12 month period commencing April 1, 2000.

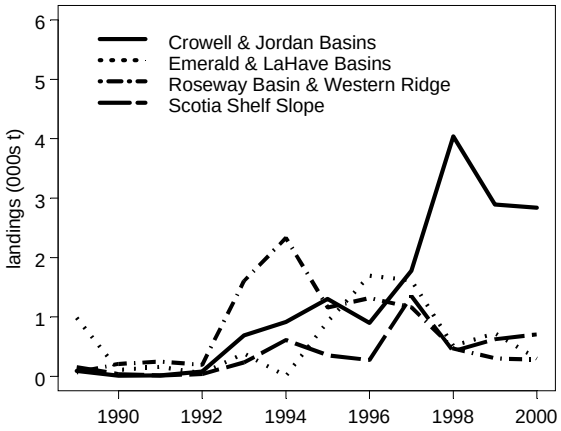
Redfish landings gradually increased from the late 1970s, peaking at almost 7,000t in 1986 followed by a decline to about 2,000t in 1991. Landings peaked again in 1997 at about 6,000t. Landings for 1998 were about 5,800t, well below the 10,000t TAC. In 1999, the TAC although reduced to 9,000t, was subsequently prorated to a 15-month TAC of 9,400t, to allow for transition to a 12 month fishing year starting April 1, 2000. The total catch for this 15 month 1999 period was 5,300t, with 700t being taken in first quarter 2000 (January to March). The 2000 catch (April to October) was 3,400t.

Landings and TAC (000s t)



Since 1998, small otter trawlers (<65'), fishing almost entirely in the Crowell and Jordan basin portions of the Gulf of Maine, took most of the reported landings.

Small otter trawler landings by fishing location



Since 1996, 22cm has been used as the **minimum size** in Conservation Harvesting Plans. Percentages by number of redfish landings under this size were:

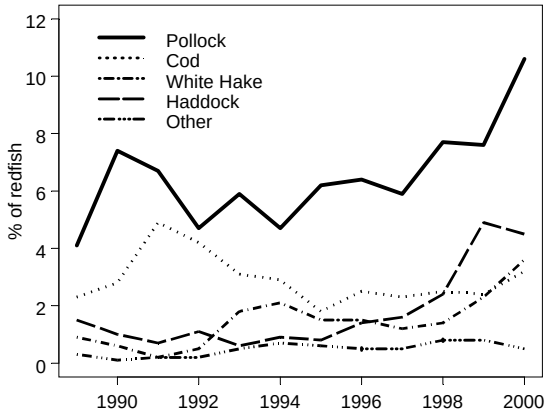
1993	1994	1995	1996	1997	1998	1999 (to July)
4	15	15	10	6	7	6

Following an FRCC recommendation, the **protection area for small redfish** located north of Brown's bank (known as the 'Bowtie') was redefined in early 1998. Landings from that general area (4Xo) were very low through all of 1998 and into 2000.

A number of areas have been closed to redfish fishing to avoid **by-catches** of other species, in addition to limits on percentage bycatch. Pollock as a percent of the redfish catch accounts for most of the reported bycatch in Unit 3 and has increased steadily since 1994.

The highest bycatch rates for pollock were in Crowell and Jordan basins, but generally neither industry nor management has considered the situation there to be a problem because most of this bycatch consisted of legal sized fish and was counted towards the vessel quotas.

Reported landings of bycatch species



Observer data for 1998-99 indicate a much higher bycatch rate for pollock than do reported landings but the observer data are too limited to allow extrapolation to the fleet as a whole. An observer program project into the discarding of non target species and/or small redfish was initiated in April, 2000. Data collection phase of the project was completed by August, 2000, but results are not yet available.

Industry Perspective

Several captains who had successfully fished for redfish in recent years were no longer doing so because of reduced demand at the processing plants for small redfish commonly found in Unit 3 and increased fuel costs. Most captains of small otter trawlers remain concerned over the continued concentration of fishing effort in Crowell and Jordan basins.

Resource Status

Information on the annual spatial distribution and size composition from the July DFO research **vessel surveys (RV)** for 1997 to 2000 is contained in Branton and Black (2000).

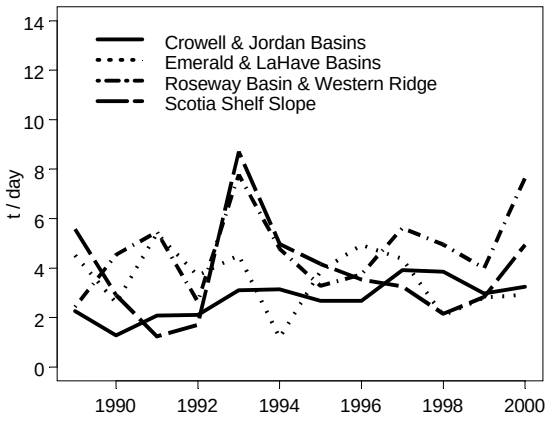
The increase in **landings** after 1992, resulting from an increase in fishing effort by small otter trawlers, reflected decreased

fishing opportunities for more valuable species, and not an increase in redfish abundance. The decrease in catches since 1996, resulted from a decrease in effort by these same vessels, reflecting decreased demand at the processing plants for the smaller fish and not a decrease in redfish abundance.

The **extent of area** occupied by small otter trawlers directing for redfish (main species caught) has expanded since 1990 with some stabilization in the most recent years.

Fishing success of small otter trawlers to the westward (Crowell and Jordan basins) although somewhat lower in 1999 and 2000, has been generally improving throughout the 1990s. The continued high catches from this area have mainly resulted from the sustained concentration of fishing effort there. Success for small trawlers to the eastward (Emerald and LaHave basins) in 1999 and 2000 did improve over 1998, mainly due to the discovery of some new fishing locations. Fishing success in the Roseway Basin and Western Ridge and the Scotian Shelf for 2000 although higher than 1999, were mainly the result of limited catches of small fish in the first quarter 2000. These catches did not persist into second quarter 2000.

Small otter trawler catch rates by fishing location

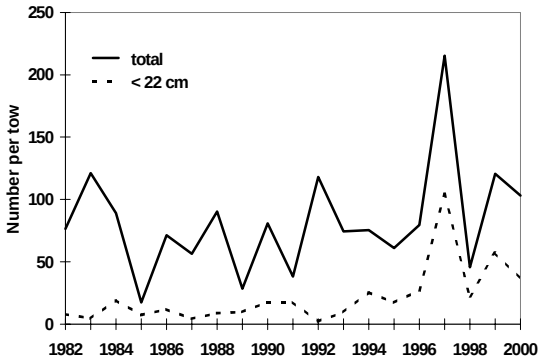


Recent **genetic research results** confirm that Unit 3 redfish are almost exclusively *S. fasciatus* and belong to a separate stock from *S. fasciatus* in Units 1 and 2. There is also an indication of a genetic separation between Scotian Shelf and Gulf of Maine populations. While this genetic information provides important insights on stock structure, additional research is required, before its full implications are understood.

RV estimates of **population biomass** (< 200 fm) in the management unit, although highly variable between years, show no trend over time. Redfish smaller than commercial size do not contribute greatly to this biomass estimate, so survey biomass can be taken as an indicator for the size classes fished commercially. However, survey biomass underestimates the actual biomass on which the commercial fishery is based, as not all of the commercial sized fish are available to the survey gear, and some are outside the survey area (deeper than 200 fm). The joint DFO Science/Industry survey in Division 4X provides biomass estimates similar to the research vessel survey for that area, but the estimates are less variable. The Industry surveys indicate abundance in 2000 similar to previous years.

With regards to **recruitment**, these surveys show considerably more small fish (< 22 cm) in recent years, particularly in the area north and east of Brown's Bank.

RV numbers per tow by size class



The U.S. research vessel surveys in the Gulf of Maine indicate that the biomass of redfish

appears to have increased during the mid-1990s through the combined effects of growth and survival of fish from a period of relatively successful reproduction in the early 1990s (USA 2000).

The ratio of recent catches compared to DFO survey biomass estimates indicates that **exploitation** is low and probably does not exceed $F_{0.1}$.

Outlook

The Outlook from the last stock status report (DFO 1999) stated:

> "DFO research vessel surveys indicate stability in the population biomass within the management unit and improved recruitment particularly in and around Roseway Basin and Western Ridge. This recruitment, although promising, has not yet resulted in a detectable increase in the population biomass, but combined with the low exploitation rates which currently prevail, should result in fishing and stock conditions in 2000/01 being very much the same as in recent years.
>
> There is no biological or fishery basis to suggest a need for change in the management of the resource at this time."

The new information presented in this document provides no basis for changing that advice.

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Witch Flounder on the Scotian Shelf (Div. 4VWX)

Background

Witch flounder(Glyptocephalus cynoglossus) occur in the Northwest Atlantic from off southern Labrador to Cape Hatteras, usually at 50 - 300m in water of 2 to 6º C. but they have been recorded between 18 and 1570m and at -1 to 11º C. They occur most commonly in deep holes and channels and along the shelf slope on muddy bottom. There is no evidence that witch undertake extensive migrations but there are seasonal changes in concentration associated with spawning. The spawning period is protracted, and on the Scotian Shelf is thought to occur from May to October with a peak in July-August. The post-larval, pelagic phase is unusually long, lasting up to one year, and it is thought that the first few years of demersal life are spent in much deeper water than adults. Food consists of primarily of worms supplemented by other benthic invertebrates such as small crustaceans and bivalve molluscs. Witch is a long-lived, slow growing species; a maximum age of about 30 years and a maximum size of 78 cm (weight of about 5 kg) have been recorded.

Stock structure of witch flounder is not known and Div. 4VWX is a management unit based on administrative, rather than biological considerations. There is continuity in distribution of witch between Div. 4V and Div. 4RST and Div. 3P that suggest some affinities between these populations. Similarly, concentrations of witch in western Div. 4X are continuous with those in the rest of the Gulf of Maine.

The most recent full assessment of this stock was conducted in 1997 (SSR A3-19). Updates were conducted in 1998 (SSR A3-35(1998)) and 1999 (SSR A3-35(1999)). More recent landings data and information from the summer 2000 research vessel survey is also presented.

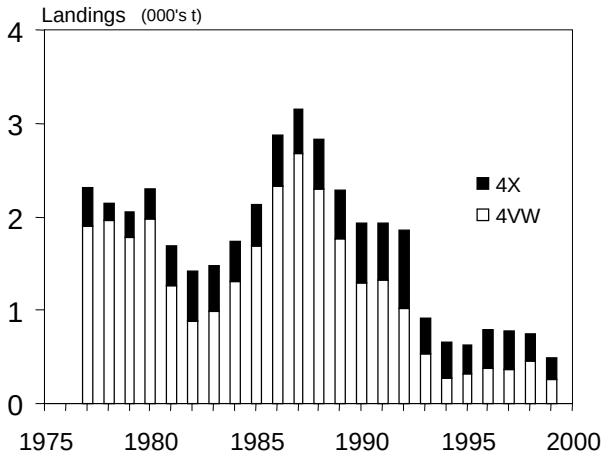
The Fishery

Landings (in tonnes)

Year	1994	1995	1996	1997	1998	1999[1]	2000
Total	661	637	812	797	765	752	

1. Fishing year, landings and TAC refer to the 15-month period from January 1 1999 to March 31, 2000.

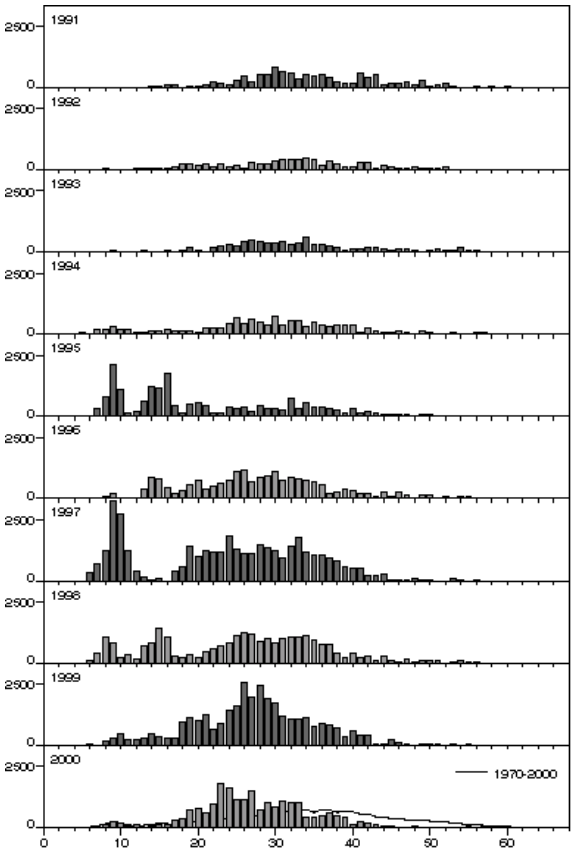
The 2000 landings are 251t to September 30th. Historical information on the witch flounder fishery is contained in McRuer et al. (1997). Witch flounder is managed as part of the flatfish TAC for 4X and 4VW.



Resource Status

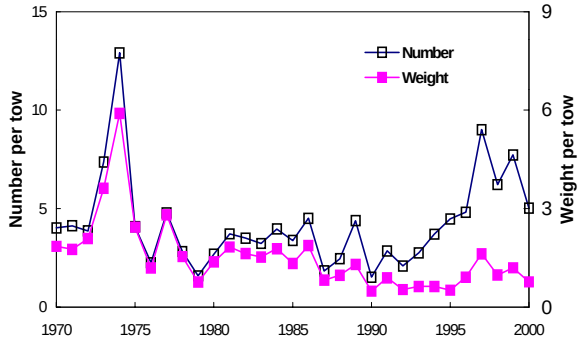
Information on the annual spatial distributions and length frequencies from 1997 to 2000 are contained in Branton and Black (2000).

Since 1993, there are signs of improved recruitment (<35cm).



4VWX Witchflounder combined length frequency from summer research surveys 1991 to 2000

Survey weight per tow modestly increased from a low in 1995, but is still low relative to the long-term.



Outlook

The outlook from the last Stock Status Reports (DFO, 1997) included:

> "It is not known to what extent this recruitment will contribute to the populations presently being fished in Subdiv. 4Vn and in Div. 4X. In any case, witch year classes can be expected to progressively contribute to the fishery over a substantial number of years beginning at about age 6. Any concentration of fishing on recruiting age groups at this time would be detrimental to potential future yields, as well as result in the opportunity being missed to rebuild the population of commercial-sized fish.
>
> Given the multi-species character of the flatfish TAC, there is substantial opportunity to direct increased effort towards witch flounder, which would be undesirable under present circumstances. Furthermore, the present flatfish TAC has not been limiting on catches from the species complex as a whole. Thus, the proportion of flatfish landings attributable to witch flounder should be maintained close to the status quo."

Both numbers and weight per tow declined in the 2000 research survey compared to 1999. Recruitment remains stronger than in the 1980s and early 1990s and its contribution to the population is becoming evident in the size composition.

Although the new information continues to support a positive view of recovery, the short-term outlook for the stock remains unchanged.

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American Plaice, Yellowtail Flounder, and Winter Flounder on the Western Scotian Shelf (Div. 4X)

Background

Flatfish are bottom dwelling fishes primarily associated with soft substrate (mud and sand bottom). They are unique among other fish in being asymmetrical, both eyes lying on one side of the highly flattened body. Early in life they start swimming on one side, and the eye on the underside migrates to the upper side. Flatfishes lie on the bottom on the blind side. Principal food items include crustaceans, molluscs, polychaete worms and small fishes.

Prior to 1994, yellowtail flounder (Limanda ferruginea), witch flounder (Glyptocephalus cynoglossus) and American plaice (Hippoglossoides platessoides) were managed as one stock complex (4VWX); winter flounder (Pseudopleuronectes americanus) was excluded from management considerations. In 1994, the management area was divided into an eastern (4VW) and western (4X) component, winter flounder was included, and the overall Total Allowable Catch (TAC) partitioned between the two areas based on catch history. The flounder fishery in 4X was placed under the Individual Transferable Quotas (ITQ) program in August 1994.

Management of the four species together under one TAC reflected the fact that it has been impossible to obtain reliable statistics on landings separated by species. The reported witch flounder landings are generally considered to be reliable, due to the higher price paid for this species. But the unreliability of the catch data for the other three species, coupled with the reports from the fishing industry of serious mis-reporting of other species as flatfish prior to 1991 eliminates the value of that information in determining resource exploitation. Initiation of ITQ logs and dockside monitoring of landings has had limited success in separating catch to individual species because landings were not separated at weighout or were misidentified by the weighmaster. It was decided to assess witch flounder separately from the other three species in 1997, but it is still managed as part of the general flounder TAC.

The most recent full assessment of this stock was conducted in 1997 (SSR A3-21 (1997)). An update was conducted in 1999 (SSR A3-35 (1999)). More recent information from the fishery and the summer research vessel survey is presented.

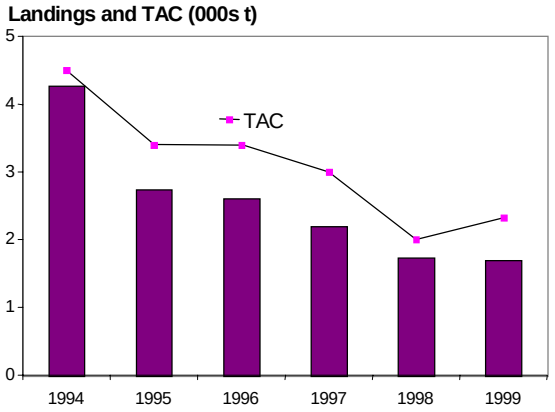
The Fishery

Landings (000s t)

Year	1994	1995	1996	1997	1998	1999[2]	2000[3]
TAC[1]	4.5	3.4	3.4	3.0	2.0	2.3	2.0
Total	4.3	2.7	2.6	2.2	1.7	2.0	

1. The TAC and landings include witch flounder and unidentified flatfish.
2. Fishing year, landings and TAC refer to the 15-month period from January 1 1999 to March 31, 2000.
3. Commencing in 2000, fishing year, landings and TAC refer to the period April 1 of the current year to March 31 of the following year.

To accommodate transition from a calendar fishing year to one running from April to March, a 15 month fishing year occurred in 1999/2000. As a result, the landings for the 1999/2000 fishing year include the 15 month period from January 1999 to March 2000. **Total flatfish landings** in 1999/2000 were 2026t. The 2000 fishing year landings of flatfish in 4X+5 to October 15, 2000, are 1554t (including witch flounder, but excluding 5Z yellowtail flounder).



Historical information on winter flounder, yellowtail flounder and American plaice is contained in Stobo et al. (1997). The biggest problem for managing flatfish stocks has been inability to segregate the fisheries by species, and consequently single quotas were applied to combined fisheries. In 1999, the Fishing Log database was used to substitute species identifications where unspecified flounder was entered in the

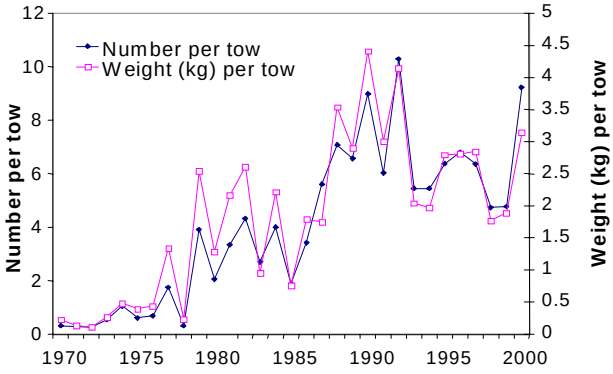
Commercial Landings database (Fowler and Stobo, 1999). These revised landings would indicate a much larger, but declining, fishery for American plaice in 4X/5 than previously thought.

Resource Status

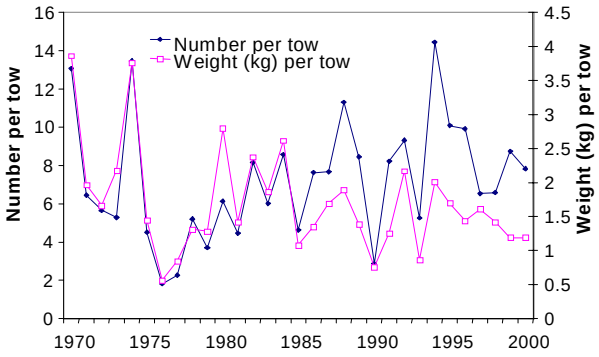
Information on the annual spatial distributions and length frequencies from 1997 to 2000 are contained in Branton and Black (2000).

Summer **research vessel (RV) survey** information indicates that the declining trend in abundance of winter flounder, evident in 1998-99, was reversed in 2000 with a high abundance estimate. A large pulse of young fish in 1999 remains a hopeful sign of future recruitment to the American plaice population. A large decline in the yellowtail flounder survey index for 1999 was not maintained in 2000. Thus the abundance of yellowtail flounder may have remained above the long-term mean since 1991.

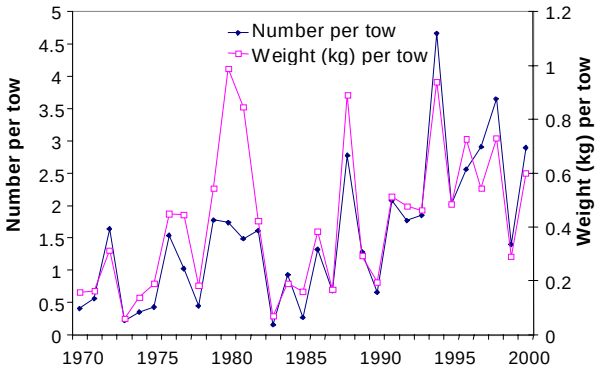
Winter Flounder



American Plaice



Yellowtail Flounder



Outlook

In the past, industry has expressed concern over the depleted state of these resources. Current information indicates stability in stock status in recent years at about the long-term mean.

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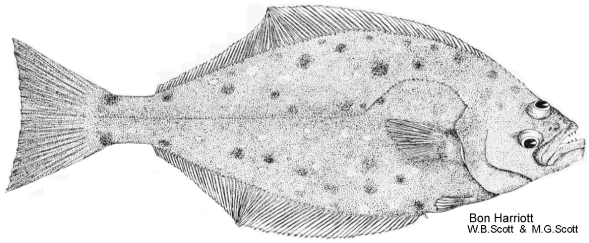


Atlantic Halibut on the Scotian Shelf and Southern Grand Bank (Div. 4VWX 3NOPs)

Background

Atlantic halibut (Hippoglossus hippoglossus), the largest of the flatfishes, ranges widely over Canada's Atlantic fishing grounds. Halibut are demersal living on or near the bottom at temperatures within a few degrees of 5°C. Atlantic halibut are most abundant at depths of 200-500 m in the deep-water channels running between the banks and along the edge of the continental shelf, with larger individuals moving into deeper water in winter. The management unit definition (4VWX3NOPs) was based largely on tagging results which indicated that Atlantic halibut move extensively throughout the Canadian North Atlantic with smaller fish moving further than larger fish. Migrations of larger fish were thought to be related to spawning. Studies have shown that the Brown's Bank area may be an important rearing area for juvenile halibut and that there is a north-eastward movement of fish as they grow. The geographic range of Atlantic halibut in the Northwest Atlantic extends from the coast of Virginia in the south to the waters off Disko Bay, Greenland in the north. Since the early 1990s, there appears to have been a significant reduction in the numbers of halibut in the northern portion of this range, especially along Labrador Shelf.

Although the growth and maturity cycles of Atlantic halibut require further study, it appears that females grow faster than males, and attain a much larger maximum size. Females reach 50% maturity at about 115 cm, while males 50% reach maturity at about 75 cm. In the absence of reliable growth information age at maturity remains uncertain. Present fishing regulations require that all halibut less than 82cm in length be released. Halibut are voracious feeders and up to a length of 30 cm, food consists almost exclusively of invertebrates. Between 30 cm and 66 cm both invertebrates and fish are eaten while halibut over this size eat fish almost exclusively.

The most recent full assessment of this stock was conducted in 1997 (SSR A3-23 (1997)). An update was conducted in 1999 (SSR A3-35 (1999)). More recent information from the fishery and the summer survey is also presented.

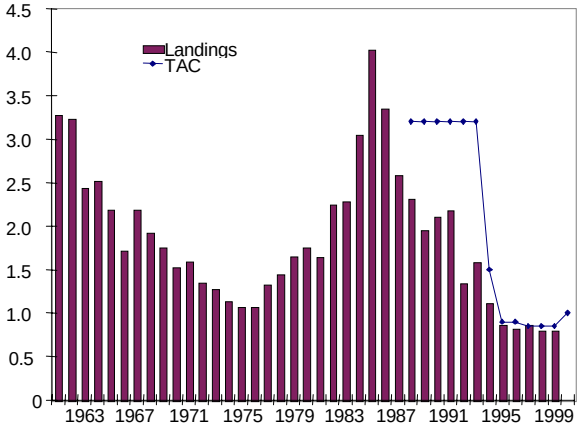
The Fishery

Landings (000's t)

Year	1994	1995	1996	1997	1998	1999[1]	2000[2]
TAC	1.5	0.90	0.90	0.85	0.85	1.0	1.0
4VWX							
Canada	1.0	0.6	0.6	0.6	0.5	0.7	
3NOPs							
Canada	0.2	0.2	0.2	0.3	0.3	0.2	
Foreign	0.1	0.1					
Total							
4VWX	1.0	0.6	0.6	0.6	0.5	0.7	
3NOPs	0.3	0.3	0.2	0.3	0.3	0.2	
TOTAL	1.3	0.9	0.8	0.9	0.8	1.0	

1. Fishing year, landings and TAC refer to the 15-month period from January 1, 1999 to March 31, 2000. Landings in 2000 are for Scotia-Fundy only.
2. Commencing in 2000, fishing year, landings and TAC refer to the period from April 1 of the current year to March 31 of the following year..

Landings and TACs ('000t)

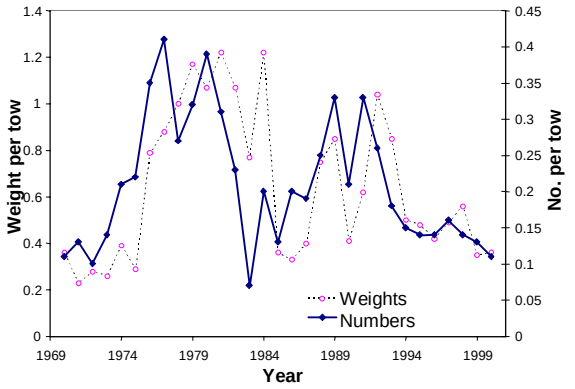


Landings in the 2000 fishing year to October 18 total 480t. Detailed historical information on the halibut fishery is contained in Zwanenburg et al. (1997).

Resource Status

Information on the annual spatial distributions and length frequencies from 1995 to 2000 are contained in Branton and Black (2000).

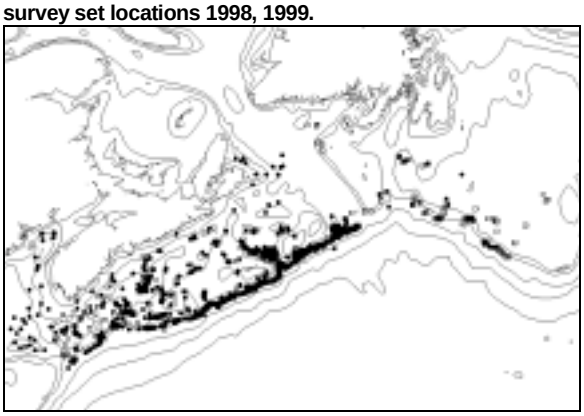
Summer survey weights and number per tow



Research vessel (RV) summer survey results show that both weight and numbers per tow remain below the long-term average for this series. Halibut are not well sampled by this survey.

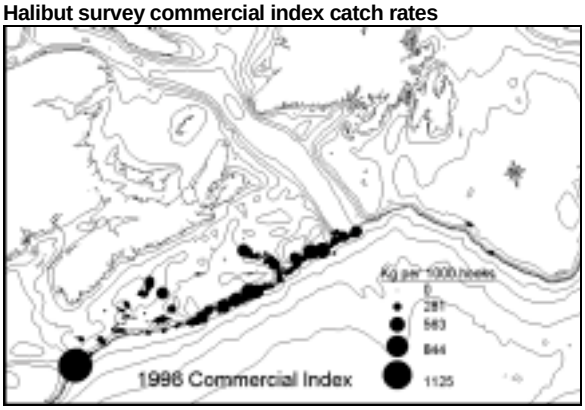
An **industry / DFO longline halibut survey** on the Scotian Shelf and Southern Grand Banks was initiated in 1998. Three years of this survey have now been completed. The survey was designed to consist of two phases, a stratified random phase and a commercial index phase. During the stratified random phase, pre-selected locations are fished with survey fishing protocols, while during the commercial index phase, participants fish with their standard fishing protocols at locations of their choosing. A total of about 600 random stratified sets and about 1800 commercial index-fishing sets, distributed throughout the stock area, have been completed. Catch rates estimated from both the stratified survey and commercial index phases for 1998 and 1999 are consistent and comparable between years.

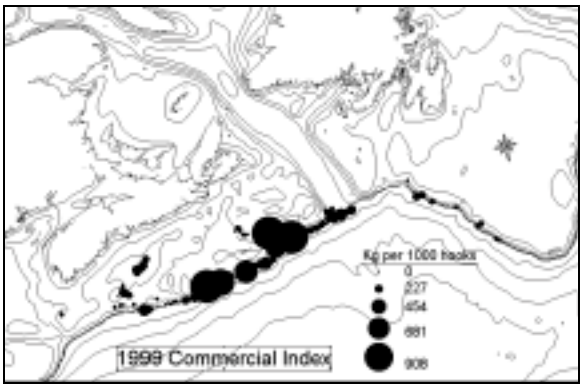
Halibut stratified random and commercial index industry survey set locations 1998, 1999.



Catch rates from surveys should become a meaningful indicator of population size over the next several years.

Halibut survey commercial index catch rates





These data will augment the results of the summer surveys and improve annual estimates of halibut abundance and distribution. Estimates of abundance from

surveys will become more valuable as the survey time series lengthens.

The halibut survey has also collected large numbers of biological observations. Over 15,000 halibut have been measured (length), and nearly 8,000 have been examined in detail (sex, weight, otoliths, and diet information). In conjunction with an age validation study initiated in 1998, this information will allow us to refine the estimates of total mortality for this population.

Sex-specific length compositions from the halibut surveys in 1998 and 1999 suggest significantly different growth rates in males and females. This emphasizes the need for completion of the age validation study to refine estimates of population mortality rates.

Outlook

The outlook from the last Stock Status Report (DFO, 1997) for this stock, based on assessment of the stock (Zwanenburg et al. 1997) included:

> "…halibut **abundance**, as estimated from the results of research vessel surveys in the management unit, is presently low relative to the available time series. Present landings are also low relative to the long-term (1883 - 1996) history of this resource. Survey results for the geographic range of halibut suggest that declines in abundance have been more evident for the southern Grand Banks than for the Scotian Shelf.
>
> There is no indication that effort on this resource should be increased but rather that the present restrictive measures should be continued".

Loss rates [total mortalities + emigration] from the Scotian Shelf, based on RV survey data, have increased from 1971 through 1996 (Zwanenburg et al., 1997). The observed increase is likely due to increased mortality since halibut abundance in the northern part of the management unit (3NOPs), where migrating fish are predicted to go, has declined since the early 1980s. Length frequency data collected from all parts of the stock area, by the halibut longline survey, will help to improve the estimates of loss rates. Conversion of these improved length frequency estimates to estimates of age composition will allow us to determine population mortality rates.

Halibut size compositions from RV surveys show a reduced range of sizes (1971 – 1996) relative to that for 1960; however, estimates of population size frequency used in the previous assessment did not include size information for 3NOPs while the 1960s size composition included data for this area. Data collected by the halibut longline survey will help determine whether or not such a reduction in size range has actually taken place over the entire stock area.

The new information presented here does not suggest that the previous outlook needs be revised.

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