



## Updates on Selected Scotian Shelf Groundfish Stocks in 2002

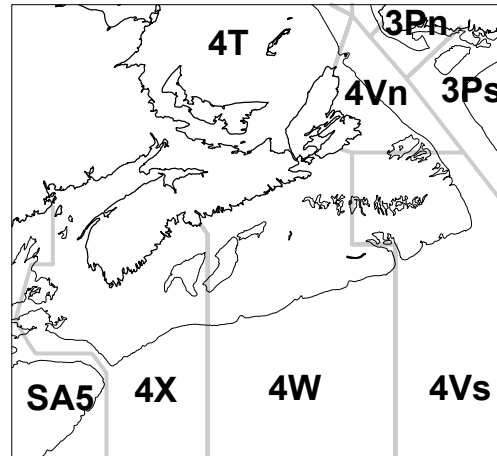
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## Updates on Selected Scotian Shelf Groundfish Stocks in 2002

### Background

*This report provides an update of stock status based on recent fishery and survey data of the following stocks: cod on the eastern Scotian Shelf (Div. 4VsW), pollock in Divs. 4VWX+5Zc, silver hake on the Scotian Shelf (Div. 4VWX), Unit 3 redfish, witch flounder on the Scotian Shelf (Div. 4VWX), American plaice, yellowtail flounder, and winter flounder on the western Scotian Shelf (Div. 4X), and cusk on the Scotian Shelf (Div. 4VWX). The SSR reference for the last full assessment of each stock is listed under the "Background" section of each update.*

*In 2002, assessments of the following stocks; 4Vn cod (SSR A3-02), 4X cod (SSR A3-05), 4TVW haddock (SSR A3-06), 4X haddock (SSR A3-07) 4VW American plaice, yellowtail flounder and winter flounder (SSR A3-34), 4VWX white hake (SSR A3-10), 4VsW winter skate (SSR A3-29), 4VWX monkfish (SSR A3-30), and 4VWX wolffish (SSR A3-31) were also conducted.*

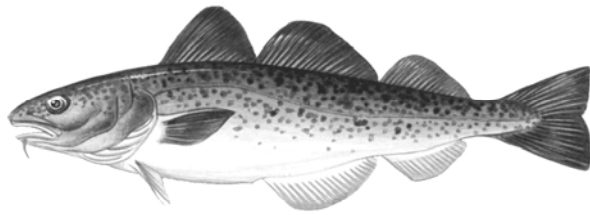


### Summary

- For **4VsW cod**, the three survey series all indicate continuing low and declining 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.
- For **4VWX5Zc pollock**, the 1997 year-class is stronger than the recent average and that there are preliminary indications that the 1998 and 1999 year-classes may also be above the recent average. However, the fishery remains spatially constricted, and the abundance of large fish remains low. The rapid increase in catch rates from 2001 to 2002 is probably due, in part, to increased availability. Catches up to the level of the 2002 TAC will likely permit rebuilding of the resource, and should result in a reduction in exploitation rate.
- For **4VWX silver hake**, the resource status continues to be poor and may be worsening.
- **Unit 3 redfish** population biomass estimates, although variable, have not changed much and should result in fishing and stock conditions in 2003/04 being much the

same as in recent years. However, there is evidence that the period of improved recruitment may be over, which would have consequences for yield in the medium term.

- For **witch flounder**, biomass remains low. However, the strong year-classes (<15cm) from 1994-1999 have produced good signs of improved recruitment coming into the fishable population (>35cm) in the near future.
- The lack of adequate information regarding species identification of landings covered by the generic 4X flatfish TAC is a major constraint to conducting assessments of the three separate stocks within the single management unit. Current survey information on **Western Scotian Shelf flatfish** indicates a very mixed set of stock status scenarios - a worsening situation for American plaice, an improving situation for yellowtail flounder, and relative stability in stock status of winter flounder.
- For **cusck**, despite the recent introduction of catch controls, this is a stock which shows no signs of improvement. While the factors affecting the population abundance of cusck are not well understood, it is possible 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.



## 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 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 assessment of this stock was conducted in spring 1998 (DFO 1998). Annual updates have been conducted since, the most recent being DFO (2001). More recent information from the fishery, research vessel and sentinel surveys is presented in this update.

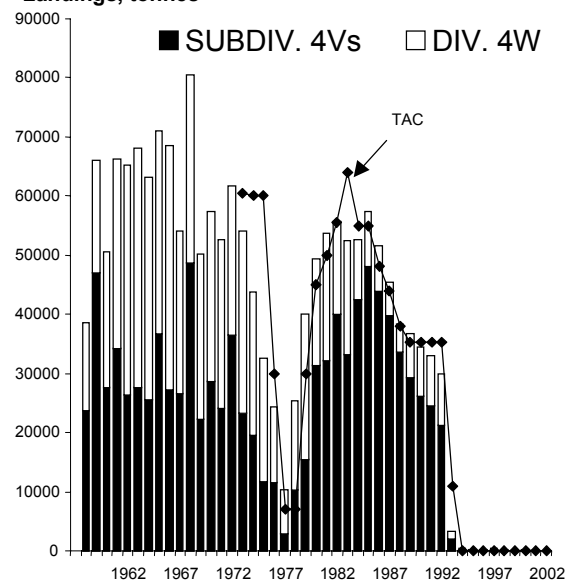
## The Fishery

### Landings (000s t)

Year	1970-79	1980-89	1990-96	1997	1998	1999	2000	2001	2002
	Avg.	Avg.	Avg.						
TAC	43.5	43.9	16.7	0 <sup>1</sup>	0 <sup>1</sup>	0 <sup>1</sup>	0 <sup>1</sup>	0 <sup>1</sup>	0 <sup>1</sup>
4Vs	19.8	33.3	10.7	0.1	0.1	0.3	0.1	0.1	
4W	22.3	13.2	3.8	0.2	0.2	0.1	0.1	0.1	
Total	42.1	46.6	14.5	0.3 <sup>2</sup>	0.3 <sup>2</sup>	0.4 <sup>2</sup>	0.1 <sup>2</sup>	0.1 <sup>2</sup>	

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.
4. Commencing in 2000, fishing year, landings and TAC refer to the period April 1<sup>st</sup> of the current year to March 31<sup>st</sup> of the following year.

### Landings, tonnes

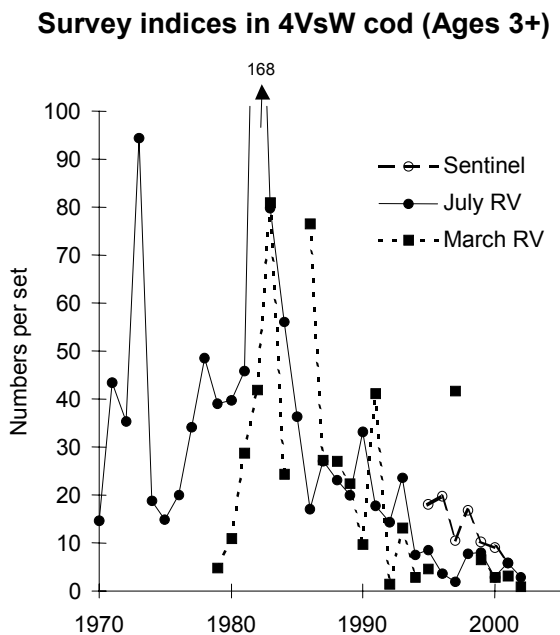


The 4VsW cod fishery remains closed to directed fishing, as it has been since the fall of 1993. Catches have been taken as by-catch in other groundfish fisheries and since 1996 in the Sentinel Program commercial index. The 2002 fishing year landings, to October 7<sup>th</sup>, are 71t. Detailed historical information on the cod fishery is available in Mohn et al. (1998).

## Resource Status

Information on the annual spatial distribution and size composition from the July research vessel surveys is contained in Branton and Black (2002).

The abundance indicators from 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. From 1999 to 2002, the March and July survey results for each year are virtually indistinguishable. The Sentinel survey has declined steadily from 1998 to 2001 (the most recent available data).



## Outlook

The three survey series all indicate continuing low and declining 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 Report for this stock, based on assessment of the stock (DFO 1998, 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 now suggests that the spawning stock biomass has been declining since 1998.

## For More Information

Contact:

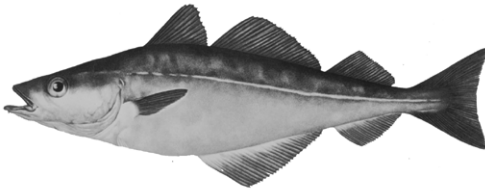
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## References

- Branton, R., and G. Black. 2002. 2002 Summer groundfish survey update for selected Scotia-Fundy groundfish stocks. DFO Canadian Science Advisory Secretariat Research Document 2002/089.
- DFO, 2001. Updates on Selected Scotian Shelf Groundfish Stocks in 2001. DFO Sci. Stock Status Report A3-35(2001).
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Mohn R.K., L.P. Fanning, and W.J. MacEachern. 1998. Assessment of 4VsW cod in 1997 incorporating additional sources of mortality. DFO. Atlantic Fisheries Research Document 98/78.



## Pollock in Divs. 4VWX and 5Zc

### 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 by-catch in cod and haddock fisheries and in the small-mesh silver hake and redfish fisheries.

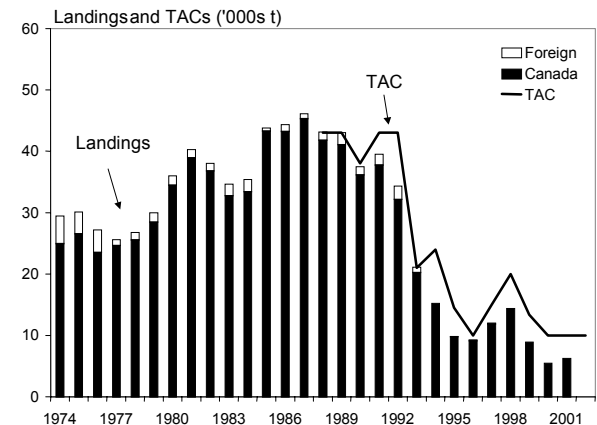
The most recent full assessment of this stock was conducted in fall 1999 (Neilson et al. 1999, DFO 1999). Annual updates have been conducted since, the most recent being DFO (2001). More recent information from the fishery, commercial port samples, the research vessel and ITQ surveys is presented in this update.

### The Fishery

#### Landings (000s t)

Year	1980-89 Avg.	1990-97 Avg.	1998	1999 <sup>1</sup>	2000 <sup>2</sup>	2001	2002
TAC	-	27.6	20.0	13.4	10.0	10.0	10.0
TOTAL	40.5	23.8	14.4	8.9	5.5	6.2	

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 refers to the period April 1<sup>st</sup> of the current year to March 31<sup>st</sup> of the following year.

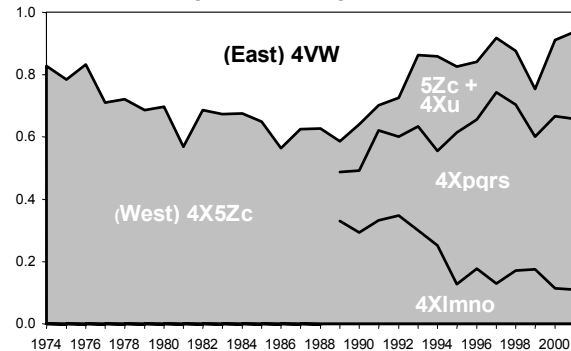


Landings for the fishing year April 1, 2001, to March 31, 2002, were 6203t. Landings in the current fishing year are 4499t (includes those landings from April 1<sup>st</sup> through Aug. 22<sup>nd</sup>).

The pollock fishery continues to undergo significant changes in both area fished and in dominant gear type. The western (4X5Zc) half of the management unit usually contributes the largest proportion to total landings. The eastern (4VW) contribution has been following a declining trend, and was 6% in 2001. Within 4X5Zc, the proportion of landings from the western half (Unit Areas 4Xpqrs) has increased from 29% in 1991 to 55% in 2000 and 2001. The changes in the distribution of the fishery were thought to reflect both the population dynamics of the stock and fishery management measures. During periods of lower landings (early 1970s and the present period), the contribution from the east is lower, suggesting

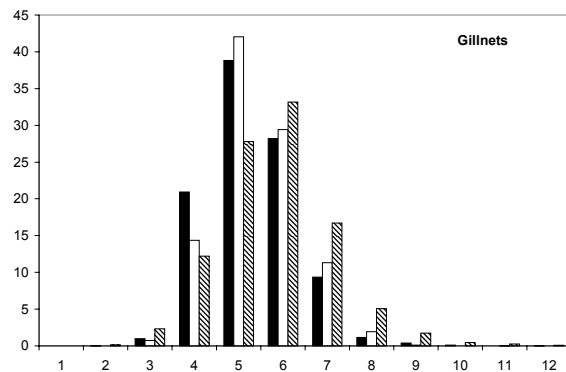
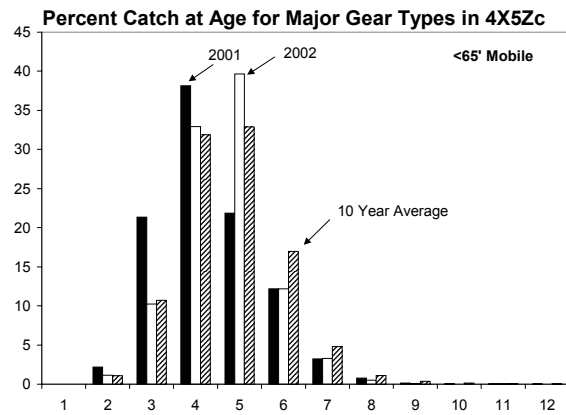
greater reductions in abundance. In the present period, the east is closed to cod-directed fishing, which further reduces pollock landings from that area.

Proportional Landings Within Management Unit Components



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 11% of total removals in 2001. 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 50 and 39% of the total landings, respectively.

The landings in the small (<65') mobile gear fishery in 2001 and 2002 typically consisted of ages 3-6, and ages comprising most of the gillnet fishery landings are 4-7. The 1997 year-class was identified as noteworthy at age 4 in the 2001 SSR, and continues to comprise a larger than average share of the catch at age 5. The 1998 year-class contribution is slightly above average. Ages 8 and 9 comprise a smaller proportion of the gillnet landings in 2001 and 2002 compared with the average from 1990 to 1999.



### Industry Perspective

During **industry consultations** in 2001, fishermen reported a varied experience with the fishery depending on what gear sector they belonged to. In 2002, more uniformly positive reports were received from mobile gear fishermen. One representative of the large mobile gear operators noted a slightly better fishery than in 2001, and commented on an improved market for pollock. Operators of small mobile gear report having experienced a strong fishery in 2002, with some groups running out of quota. All representatives of the mobile gear fishery noted a good range of sizes in the catch.

Reports from fixed gear fishermen were more mixed. Gillnet fishermen reported an average (Georges Bank) to poor (Bay of Fundy) fishery in 2002, compared with recent years. Gillnet

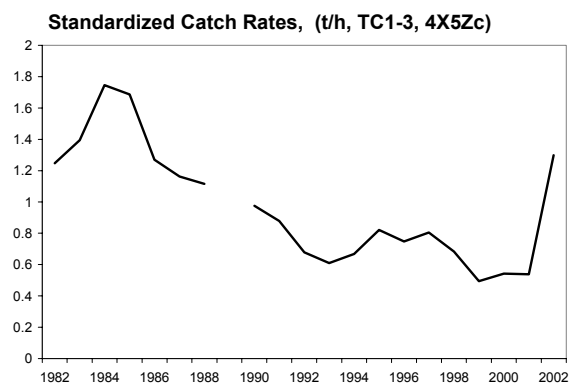


fishermen noted that by-catches of white hake have negatively affected the pollock fishery. Longline fishermen report similar experience with the fishery in 2002 compared with 2001. Handline fishermen generally reported poor pollock fishing compared with 2001. Most fixed gear fishermen reported that the size range in the fishery was broader than in recent years.

## Resource Status

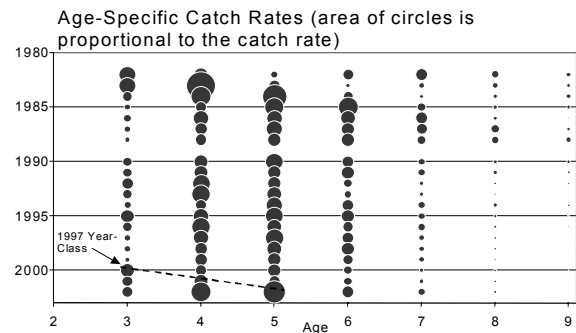
The indicator of abundance used in this assessment is a **standardized catch rate series** that uses data from directed pollock trips of TC 1-3 otter trawlers operating in 4X5Zc. The standardized catch rate series accounts for differences in catch rate by vessel tonnage class, mesh type, unit area, month and year.

The catch rate series peaked in 1984 as the strong 1979 year-class became fully recruited, and declined thereafter. Landings during that period were at their highest level historically. After a slight increase from 1993 to 1995, the catch rate series decreased and remained at a low level from 1999 to 2001. Catch rates in 2002 (as of Aug. 31) increased markedly from 2001.



When the catch rate series is examined on an age by age basis, the 1997 year-class is confirmed as being above average. The 1998 year-class (age 4 in

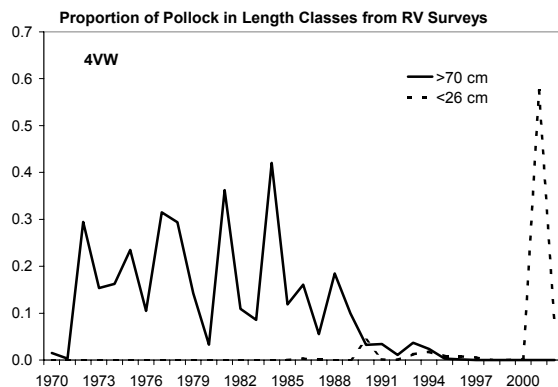
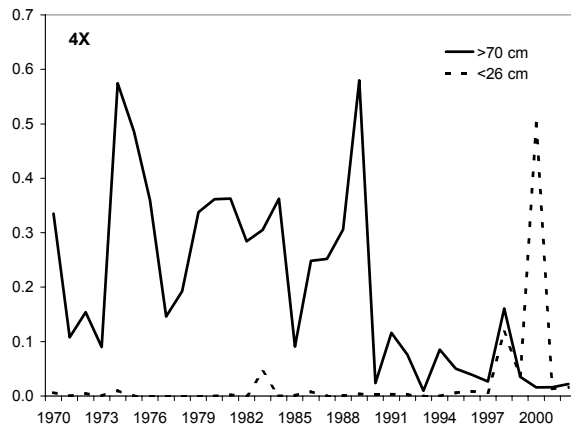
2002) is also above the recent average. However, the abundance (numbers) of some year-classes does not decline in the expected fashion from 2001 to 2002, indicating that the large increase in catch rates from 2001 to 2002 is reflecting not only increased abundance, but also changes in availability.



Information on the annual spatial distribution and size composition from the **July research vessel surveys** is provided in Branton and Black (2002). Such 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 (>70 cm) fish in the surveys since 1990, for both the eastern (4VW) and western (4X) halves. The absence of larger fish is probably attributable to relatively high exploitation rates during the early 1990s (Neilson et al. 1999).

Recent surveys (1998 to 2000) have caught more small pollock (<26cm) in 4X than in previous years. This was particularly noteworthy in 2000. Those fish are one year old (1999 year-class). The 1999 year-class was also apparent in the 2001 and 2002 as ages 2 and 3, respectively.

The 2001 survey in 4VW also caught many more small (<26cm) pollock than in previous years. In contrast to the 2000 survey, where most of the fish <26cm were found widely distributed in the Bay of Fundy, the small fish were found on the Eastern Scotian Shelf in 2001, mainly in a single large set. Small fish were relatively abundant in the 2002 survey, but again were caught at only two stations.



A joint industry/DFO Science survey conducted by the **ITQ fleet** in 4X also indicated fewer fish >70 cm in 1999 to 2001 compared with 1995 to 1998. In 2000, large numbers of 20-25 cm (age 1, 1999 year-class) fish were seen compared with previous years, and appeared in 2001 as 30-35 cm fish. However, that mode did not track through to the 2002 survey.

## Outlook

The Outlook from the 1999 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.”

In the 2000 review, it was noted that while there were preliminary indications of improved recruitment from the fishery, catch rates remained comparatively low, large fish were rare in the catch and the surveys, and the fishery remained spatially constricted. The 2001 review indicated that the 1997 year-class was moderately strong and was recruiting to the fishery. The 1999 year-class was also thought to be stronger than recent year-classes. However, catch rates and the abundance of larger fish remained low.

The current review confirms that the 1997 year-class is stronger than the recent average and that there are preliminary indications that the 1998 and 1999 year-classes may also be above the recent average. However, the fishery remains spatially constricted, and the abundance of large fish remains low. The rapid increase in catch rates from 2001 to 2002 is probably due, in part, to increased availability.

Catches up to the level of the 2002 TAC will likely permit rebuilding of the resource, and should result in a reduction in exploitation rate.

***For More Information***

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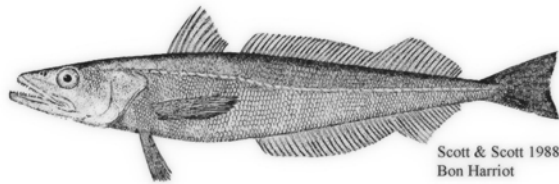
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Neilson, J., P. Perley, and C. Nelson. 1999. The 1999 assessment of pollock (*Pollachius virens*) in NAFO Divisions 4VWX and Subdivision 5Zc. DFO Canadian Stock Assessment Secretariat Research Document 99/160.



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

### Background

Silver hake (*Merluccius 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° 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 age is 12 years. Maturity is relatively early, with a majority of males maturing at age 2, and females at 3.

Historically, silver hake had been harvested on the Scotian Shelf by foreign nations. Prior to 1977, the fishery was unrestricted in terms of area and mesh size. From 1977 onwards, fishing for this species was limited to slope waters on the seaward side of the Small Mesh Gear Line (SMGL), with a minimum mesh size of 60mm diamond. In the 1990s, foreign allocations were phased out by 1998. Starting in the mid-1990s, a Canadian fleet has harvested silver hake in Emerald and LaHave basins. The proportion of the total catch by this fleet has increased over time, and since 1997, accounts for the majority of the landings. In 2001, the distribution of effort by this fleet expanded, with many vessels fishing on the slope area as well as in the basins. Given silver hake is harvested with small mesh gear, separator grates have been mandatory to control by-catch since 1993.

The most recent assessment of this stock was conducted in fall 1999 (DFO 1999). Annual updates have been conducted since then, the most recent being DFO (2001). More recent landings data and information from the 2001 and 2002 4VWX summer research vessel survey are presented in this update.

### The Fishery

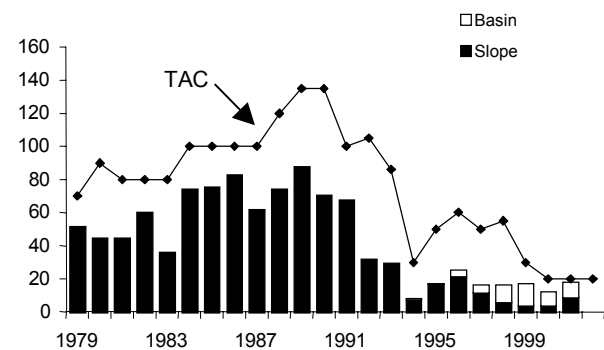
#### Landings (000s t)

Year	1970-79	1980-89	1990-97	1998	1999	2000 <sup>2</sup>	2001	2002
TAC	90.2 <sup>3</sup>	98.5	55.7	55	33	20	20	20
Canada <sup>1</sup>	0	0	0.6	16.1	16.7	12.9	18.0	
Foreign	115.6	64.2	34.8	0	0	0	0	
Total	115.6	64.2	35.4	16.2	16.7	12.9	18.0	

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 from April 1<sup>st</sup> of the current year to March 31<sup>st</sup> of the following year.
3. Average TAC for 1974-79 period.

Landings for the 2002 fishing year (to October 7<sup>th</sup>) are 6700t, for which the slope portion is 4600t.

#### Landings, tonnes ('000)

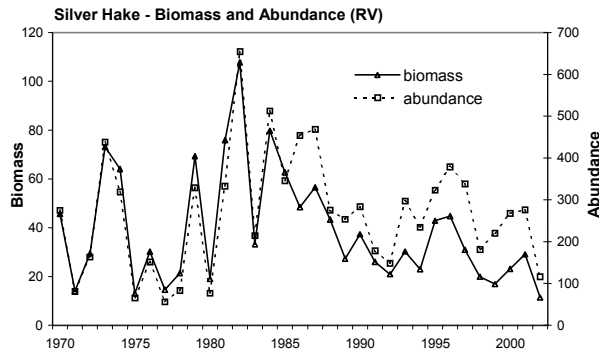


### Resource Status

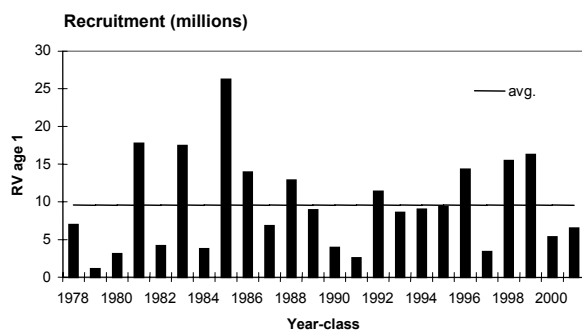
Information on the annual spatial distribution and size composition from the July research vessel surveys is contained in Branton and Black (2002).

Abundance and biomass from the DFO summer research vessel (RV) survey increased slightly from 1998 to 2001, but dropped sharply in 2002, and are

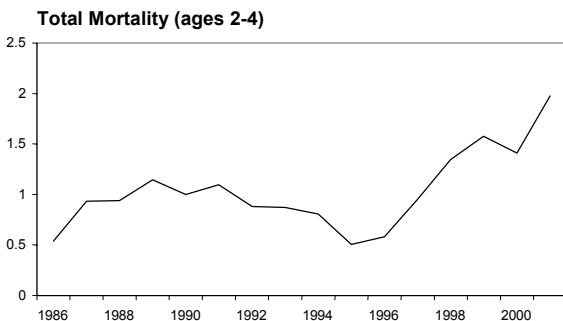
now at the lowest levels seen since 1980.



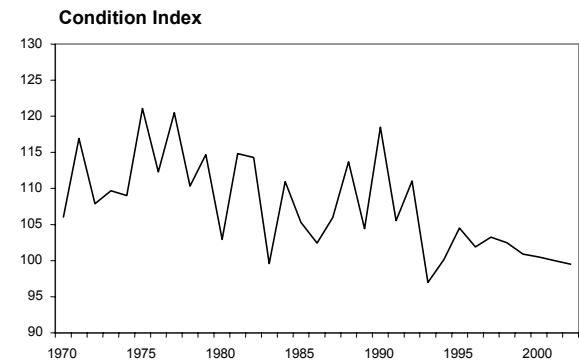
The RV age 1 **recruitment** indicator shows that the 2000 and 2001 year-classes are below average. The fishery will be dependent on these year-classes in 2002-03.



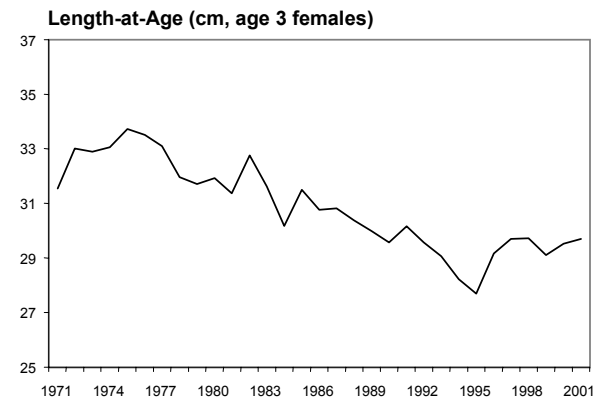
**Total mortality** over ages 2-4 from the summer survey shows an increasing trend since 1995. Total mortality for ages important to the fishery is above that expected with  $F_{0.1} = 0.7$  (assuming natural mortality = 0.4), suggesting either exploitation is relatively high (despite moderate catches)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



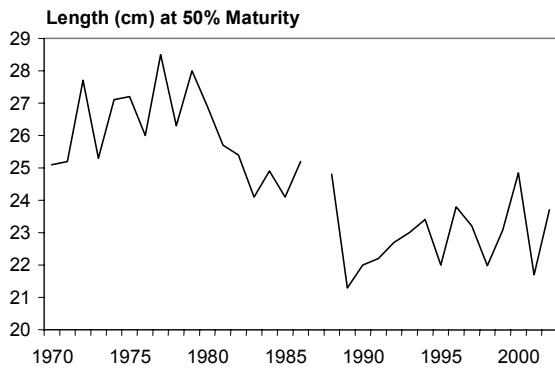
There are long-term declining trends in biological indicators. **Condition** (weight at 25cm), shows a general decline from 1975 to 1993. An increase was seen in 1995, but condition has declined subsequently to a low level relative to the long-term average.



**Length-at-age** has also shown a decline, from high levels in the early 1970s to a low in 1995. Length-at-age increased from 1995 to 1998, but declined subsequently and remains just below the long-term mean.

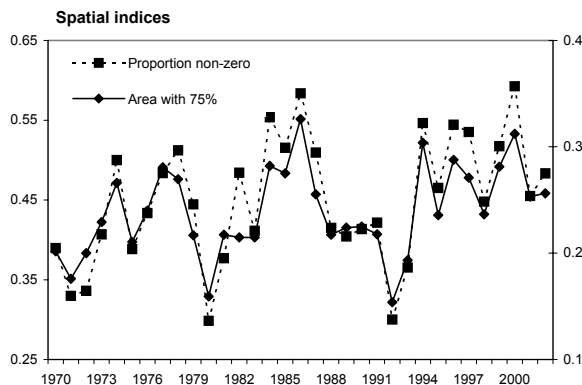


**Length at 50% maturity** was highest in the 1970's but declined subsequently. Since 1993, it has remained stable at a lower level.



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 been stable at a high level since 1994, indicating that the resource is widely distributed.

The proportion of annual survey sets where the species occurs (non-zero sets) is a measure of the **area occupied** by the species. This indicator has been stable at a high level since 1994, indicating that the resource is widely distributed.



### Summary of Indicators of Stock Status

Indicator	Recent Trend	Current Status
Biomass RV age 1+ (1970-2002)	Decreasing since 1996	At low level
Recruitment RV age 1 (1979-2002)	None	2000 and 2001 year classes below average
Total mortality RV ages 2-4 (1983-2000)	Increasing since 1995	F is above $F_{0.1}$ if $M=0.4$
Condition (1970-2002)	Declining since 1995	Low relative to long-term average
Length at age (1971-2001)	Stable	Low relative to long-term average
Length at maturity (1970-2002)	Stable	Low relative to long-term average
Resource concentration (1970-2002)	Stable	Widely distributed
Area occupied (1970-2002)	Stable	Widely distributed

### Outlook

The outlook from the last full assessment 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 are poor, with the both the 2000 and 2001 year-classes weak.

Resource concentration and distribution through the geographical range exhibit positive trends.

The information added in the current update indicates that the resource

status continues to be poor and may be worsening.

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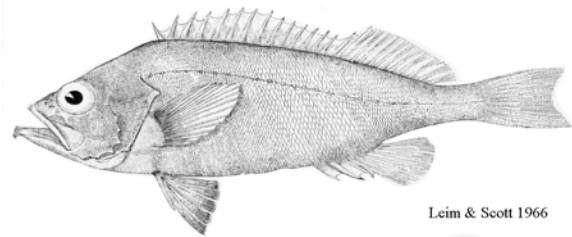
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Leim & Scott 1966

## 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. 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.

The Unit 3 management area (4WdehkIX) 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 by-catch in NAFO division 4X of other groundfish species to 10 % by weight of redfish caught and the by-catch in NAFO divisions 4VW to 2 % by weight each of cod and haddock.

The most recent assessment of this stock was conducted in fall 1999 (DFO 1999). Annual updates have been conducted since, the most recent being DFO (2002). The most recent

information for the fishery and summer research vessel survey is presented in this update.

### The Fishery

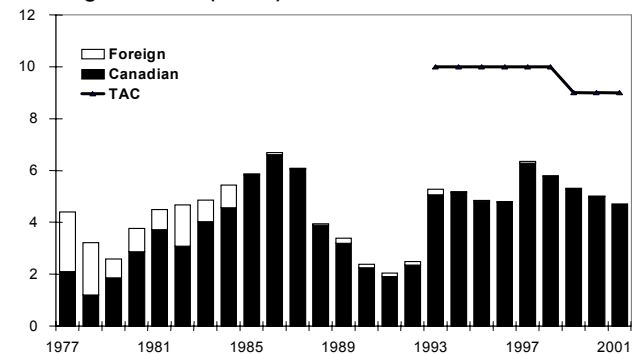
#### Landings (000s t)

Year	1980-89	1990-96	1997	1998	1999 <sup>1</sup>	2000 <sup>2</sup>	2001 <sup>2</sup>	2002 <sup>2</sup>
	Avg.	Avg.						
TAC	--	--	10.0	10.0	9.4	9.0	9.0	9.0
Total	5.4	4.2	6.4	5.8	5.3	5.0	4.7	

- 1 1999 TAC and landings 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<sup>st</sup> of the current year to March 31<sup>st</sup> of the following year.

Redfish landings gradually increased from the late 1970s, peaking at almost 7000t in 1986 followed by a decline to about 2000t in 1991. Landings peaked again in 1997 at about 6000t. Total landings for the 12 month period April 2001 to March 2002 was 4700t. Landings in 2002 (April 1<sup>st</sup> to September 11<sup>th</sup>) are 2850t.

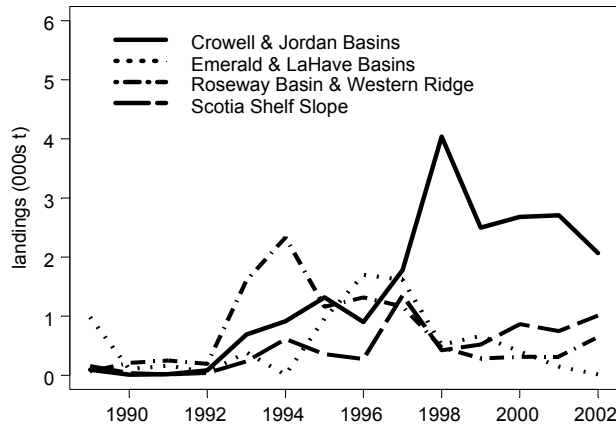
#### Landings and TAC (000s t)



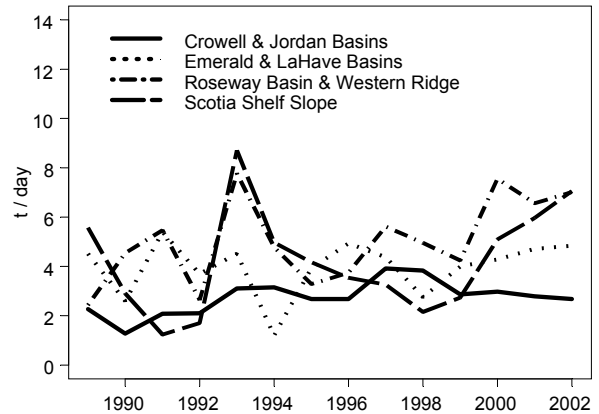
Since 1998, otter trawlers (<65ft), fishing almost entirely in the Crowell and Jordan basin portions of the Gulf of Maine, accounted for the largest portion of reported landings in Unit 3.



Otter Trawler (<65') Landings by Fishing Location



Otter Trawler Catch Rates by Fishing Location



The increase in **landings** after 1992, resulting from an increase in fishing effort by 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 otter trawlers directing for redfish (main species caught) has expanded since 1990 with some stabilization in the most recent years.

**Fishing success**, as measured by otter trawler catch rates, in Crowell and Jordan basins, has not changed much through most of the 1990s. The continued high catches from this area have mainly resulted from the sustained concentration of fishing effort there. Success for small trawlers in Emerald and LaHave basins, has fluctuated over time as new fishing locations are found and exploited. Fishing success in the Roseway Basin and Western Ridge for 2002, although higher than in other areas of Unit 3, were mainly the result of limited catches of small fish in that area.

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

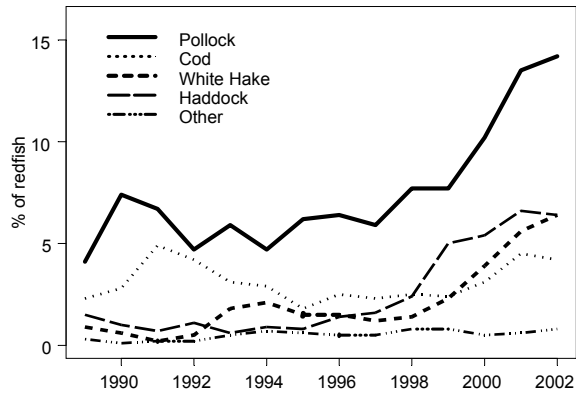
1993	1994	1995	1996	1997	1998	1999	2000	2001	2002 (to Sept)
4	15	15	10	6	7	11	9	13	11

Following an FRCC recommendation, the **protection area for small redfish** located north of Browns 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 2002 (less than 10% of total landings).

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

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

Reported Landings of By-catch Species



Observer data for 1998-2002 indicate a much higher by-catch rate for pollock and spiny dogfish (legally discarded) than do reported landings but the observer data are too limited to allow extrapolation to the fleet as a whole.

### Industry Perspective

Interviews with otter trawler operators during 2001-02 indicated concerns over the large by-catch of pollock. They commented that a lot of the pollock by-catch is undersize, particularly in the Crowell and Jordan Basins and expressed considerable interest in fishing north of 43°30'. Some are also concerned that redfish are being overexploited and have commented on seeing more small redfish in their catches.

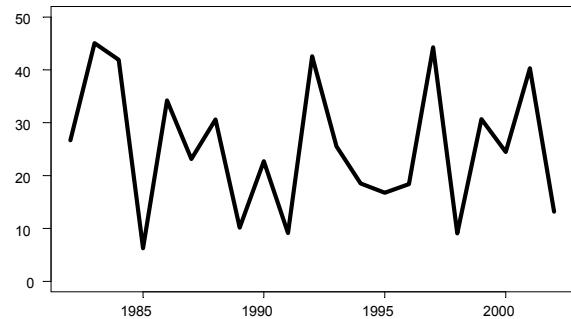
### Resource Status

Information on the annual spatial distribution and size composition from the July DFO research vessel surveys (RV) is contained in Branton and Black (2002).

RV estimates of **biomass** (< 200fm) 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).

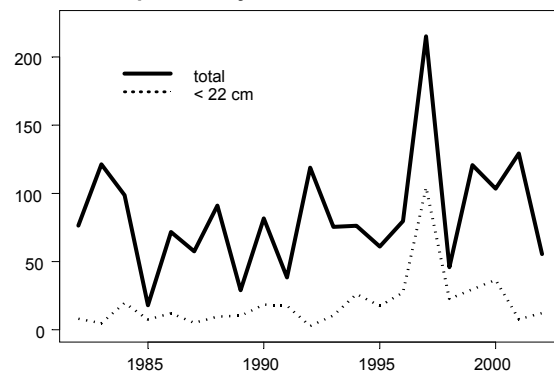
RV Kilograms per Tow



The joint DFO Science/Industry (ITQ) survey in Division 4X provides biomass estimates similar to the research vessel survey for that area, but the estimates are less variable. The ITQ surveys indicate abundance in 2002 similar to previous years.

With regards to **recruitment**, the RV survey shows considerably more small fish (< 22cm) in the late 1990s, particularly in the area north and east of Browns Bank, but a decline more recently.

RV Numbers per Tow by Size Class



The U.S. research vessel surveys in the Gulf of Maine, which surveys part of the Canadian fishing grounds, indicate that the biomass of redfish appears to have increased during the mid-1990s through combined effects of growth and survival of fish from a period of relatively successful reproduction in the early 1990s (Clark 2000).

Historically,  $F_{0.1}$  for redfish stocks has been estimated to be an exploitation rate of approximately 12% (DFO 2000). However it has not been possible to estimate this in absolute terms. The ratio of recent catches compared to DFO survey biomass estimates is used as a proxy which indicates that **exploitation** is low and probably does not exceed  $F_{0.1}$ .

### **Outlook**

The outlook from the last assessment 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."

Population biomass estimates, although variable, have not changed much and should result in fishing and stock conditions in 2003-04 being much the same as in recent years. However, there is evidence that the period of improved recruitment may be over, which would have consequences for yield in the medium term.

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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 6°C. but they have been recorded between 18 and 1570m and at -1 to 11°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 suggests some affinities among 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 assessment of this stock was conducted in 1997 (DFO 1997). Annual updates have been conducted since, the most recent being DFO (2001). More recent information from the fishery and the summer

research vessel survey is presented in this update.

### The Fishery

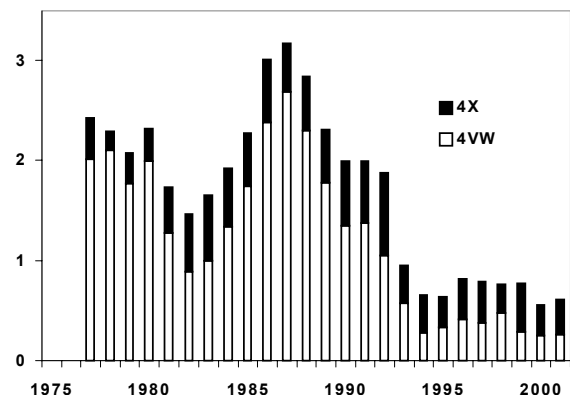
Landings (tonnes)

Year	1977-79 Avg.	1980-89 Avg.	1990-97 Avg.	1998	1999 <sup>1</sup>	2000 <sup>2</sup>	2001	2002
Total	2264	2259	1217	766	775	561	609	

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<sup>st</sup> of the current year to March 31<sup>st</sup> of the following year.

The 2002 landings are 323t for the period April 1<sup>st</sup> to September 30<sup>th</sup>. 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.

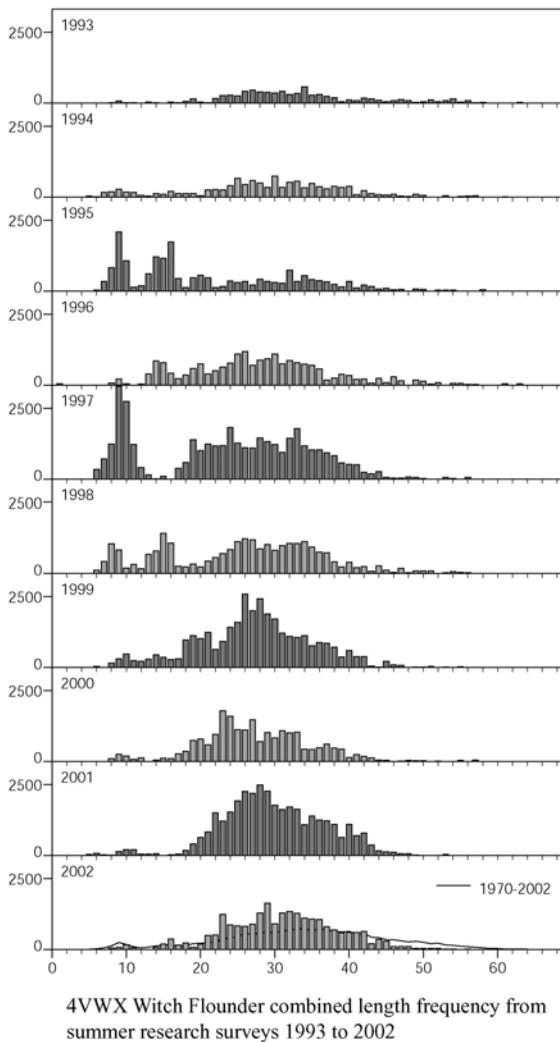
Landings (000s t)



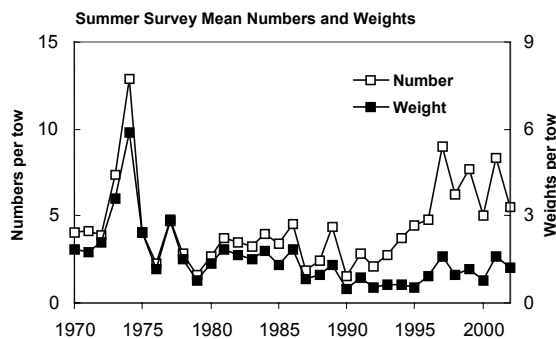
### Resource Status

Information on the annual spatial distributions and size composition from the July research vessel surveys is contained in Branton and Black (2002).

There were signs of improved **recruitment** (<20cm), to the stocks from 1994-1999. More recent recruitment has been close to the long0term average.



Survey weight per tow increased from a low in 1995, but is still low relative to the long-term. However, over the same period the survey numbers-per-tow have increased and are above the long-term average.



**Outlook**

Biomass remains low. However, the strong year-classes (<15cm) from 1994-99 have produced good signs of improved recruitment coming into the fishable population (>35cm) in the near future.

Although the new information continues to support a positive view of recovery, the short-term outlook for the stock from the 1997 assessment remains unchanged, as does the conclusion that "...The proportion of flatfish landings attributable to witch flounder should be maintained close to the status quo".

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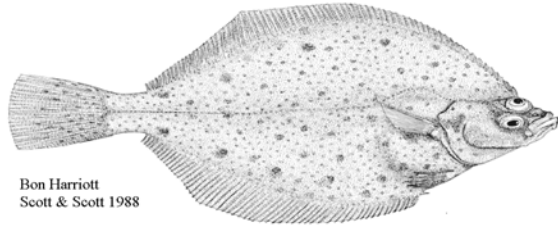
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Bon Harriott  
Scott & Scott 1988

## 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 assessment of this stock was conducted in 1997 (DFO 1997). Annual updates have been conducted since 1999, the most recent being DFO (2001). More recent information from the fishery and the summer research vessel survey is presented in this update.

### The Fishery

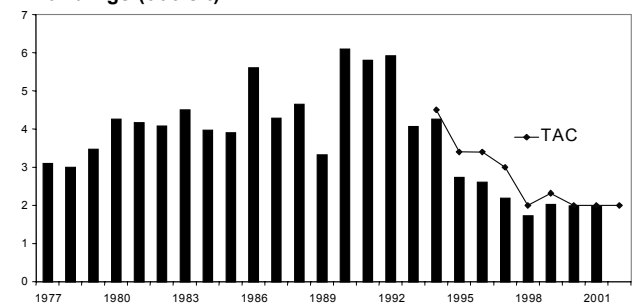
#### Landings (000s t)

Year	1977-1980	1980-1990	1990-1997	1997	1998	1999 <sup>2</sup>	2000 <sup>3</sup>	2001	2002
	79 Avg.	89 Avg.	96 Avg.						
TAC <sup>1</sup>				3.0	2.0	2.3	2.0	2.0	2.0
Total	3.2	4.3	4.5	2.2	1.7	2.0	2.0	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<sup>st</sup> of the current year to March 31<sup>st</sup> of the following year.

Total flatfish landings in the 2001 fishing year were 1997t. Landings of flatfish in 4X+5 for the 2002 fishing year to September 5, 2002, are 1025t (including witch flounder, but excluding 5Z yellowtail flounder).

#### Landings (000's t)



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 overall quotas were applied to combined fisheries. In 1999, the Fishing Log database was used to substitute species identifications where

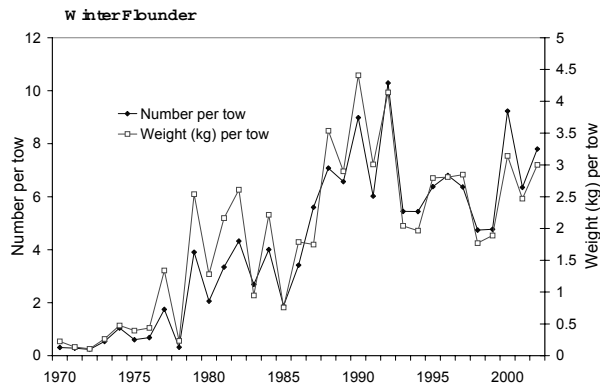
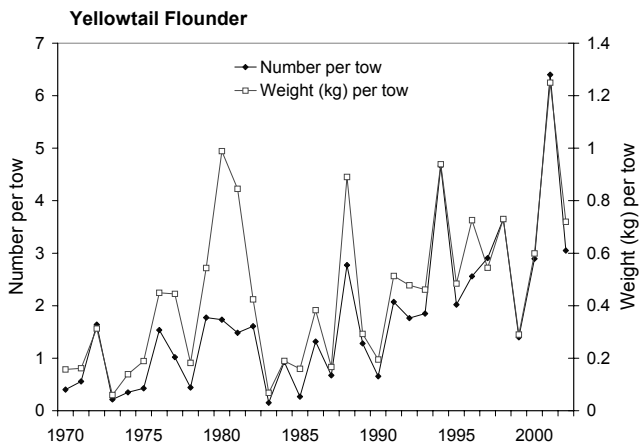
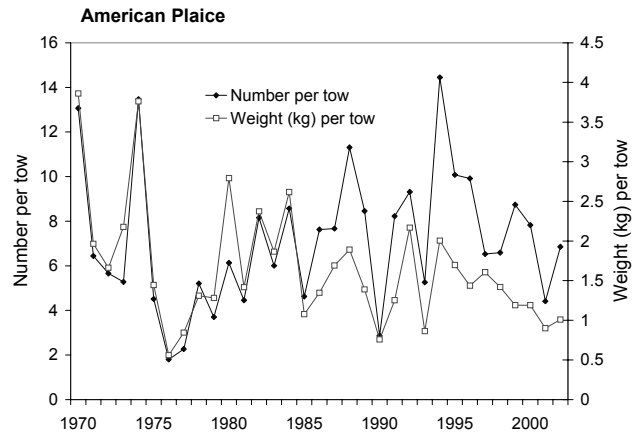


unspecified flounder was entered in the Commercial Landings database (Fowler and Stobo, 1999). These revised landings would indicate a much larger, but declining, fishery for American plaice in 4X/5 than previously thought.

**Resource Status**

Information on the annual spatial distributions and size composition from the July research vessel survey is contained in Branton and Black (2002).

Summer **research vessel (RV) survey** information indicates that the abundance of winter flounder has varied considerably in recent years, but is currently well above average. A large pulse of young American plaice in 1999 was not sustained in the population, abundance dropping to a very low level by 2001. In 2002, plaice abundance increased to a near-average level, although weight per tow remains very low. Yellowtail flounder abundance dropped from a record high in 2001, but the 2002 estimate is still above average for the time series.



**Outlook**

The lack of adequate information regarding species identification of landings covered by the generic 4X flatfish TAC is a major constraint to conducting assessments of the three separate stocks within the single management unit. Current information indicates a very mixed set of stock status scenarios -- a worsening situation for American plaice, an improving situation for yellowtail flounder, and relative stability in stock status of winter flounder.

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***References***

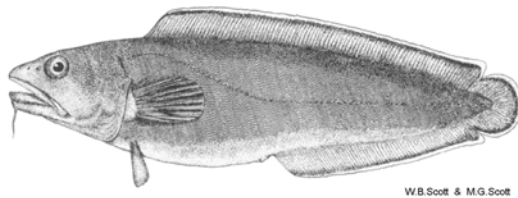
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W.B.Scott & M.G.Scott

## 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°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 August, 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 evert 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 reveal 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 assessment of this stock was conducted in 1998 (DFO 1998). Annual updates have been conducted since then, the most recent being DFO (2001). More recent information from the fishery and the summer research vessel surveys is presented in this update.

## The Fishery

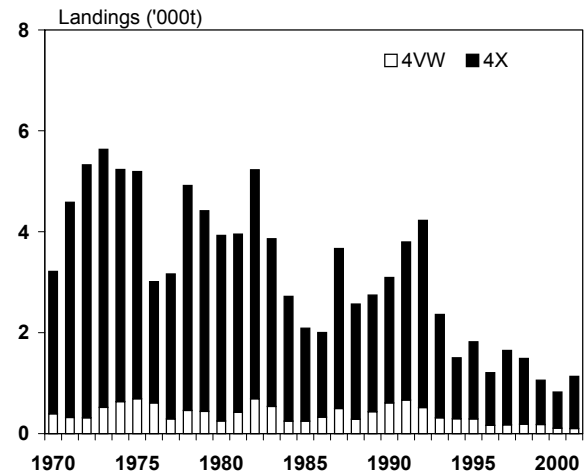
### Landings (tonnes)

Year	1970-79	1980-89	1990-96	1997	1998	1999 <sup>1</sup>	2000 <sup>2</sup>	2001
	Avg.	Avg.	Avg.					
4VW	468	395	408	174	186	179	109	101
4X	4001	2882	2165	1475	1304	879	717	1037
TOTAL	4469	3277	2573	1649	1490	1058	826	1138

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

Cusk was placed under by-catch limitations for the first time in 1999. A cap of 1000t was placed on the combined landings of all fleets. The 2002 fishing year landings, April 1<sup>st</sup> to September 11<sup>th</sup>, are 668t. The total landings for the 2002 fishing year will likely be within 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 717t in 2000. 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.



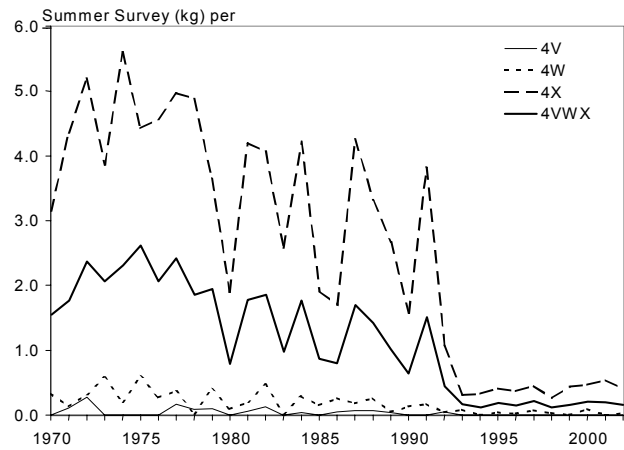
The most common (modal) size in commercial length frequency samples of

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.

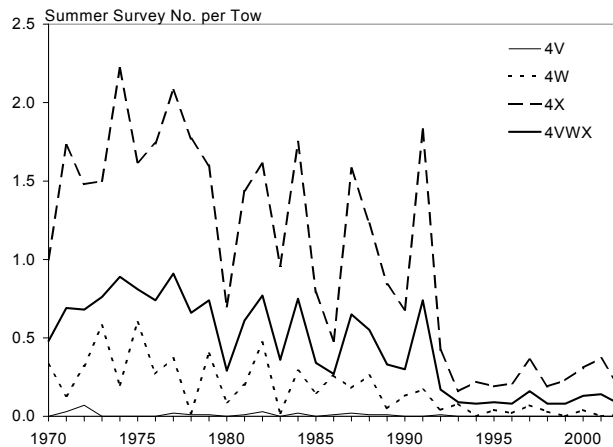
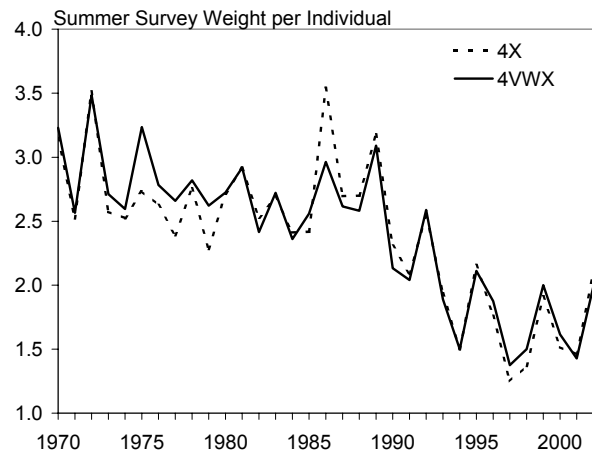
**Resource Status**

Information on the annual spatial distribution and size composition from the July research vessel surveys is contained in Branton and Black (2002).

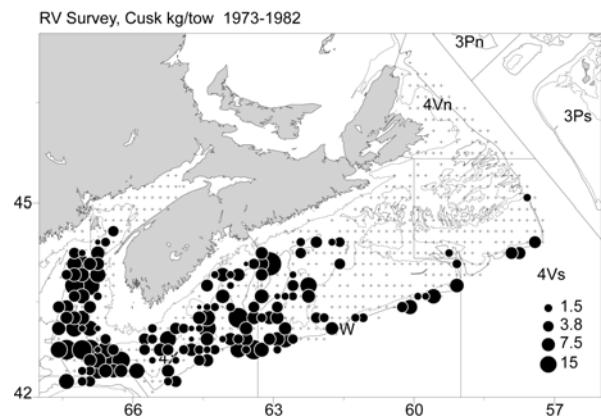
**Research vessel (RV) survey indicators** in 4W show a gradual decline in both numbers and weight-per-tow since the surveys started in 1970. In 4X (the centre of the historical distribution), these indicators show a gradual decline in both numbers and weight-per-tow since the 1970s with a collapse during 1991-93.

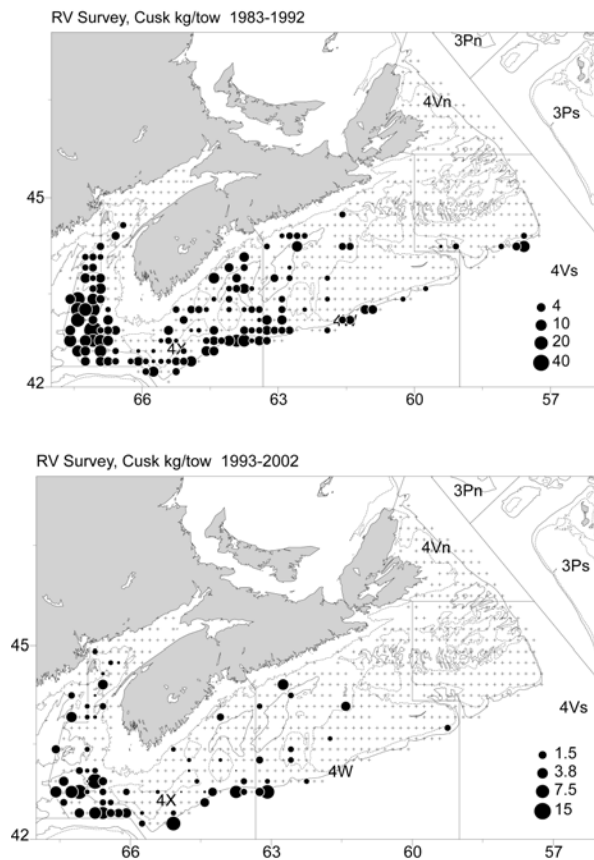


Mean weight per individual from the RV survey has declined since 1989.

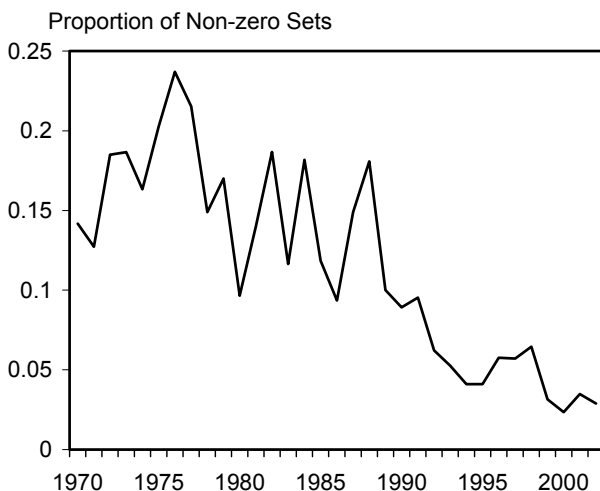


A comparison of the **geographic distribution** from summer RV surveys indicates a significant contraction of cusk distribution in recent years.





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, indicating concentration of the resource.



### Outlook

The outlook from the 1998 assessment (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 by-catch 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. While the factors affecting the population abundance of cusk are not well understood, it is possible 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.

### For More Information

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