

Scott & Scott 1988
Bon Harriot

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

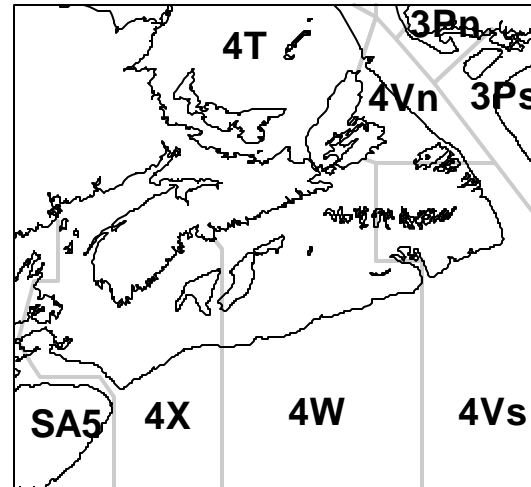
Background

Silver hake 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 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° 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.



Summary

- Landings by Canadian vessels from Emerald and La Have basins are continuing to increase relative to catches from the offshore fishery.
- Changes in mesh type and size by the Canadian fleet appear to be reducing catches of small fish.
- Survey estimates of abundance and biomass show declines since the early 1980s.
- Independent estimates of total mortality for ages important in the fishery are above $F_{0.1}$.
- There are long-term declining trends in biological indices, with condition, mean length-at-age, and length of 50% maturity all at low levels relative to the long term mean.
- The 1998 year-class is above average in size, while the 1997 is below average.
- It would be prudent not to allow catches to increase from 1997-99 levels.

Summary of Attributes of Stock Status

This year, the stock assessment includes a compilation of attributes of stock status. While the attributes are generally those traditionally included in an assessment, other more novel indicators are also included. Summarizing these attributes in tabular form facilitates comparison and should be an aid for decision makers.

Attribute	Recent Trend	Current Status
Biomass RV age 1+ (1970-99)	Decreasing since 1996.	At lowest level since 1977.
Recruitment RV age 1 (1979-99)	Variable	Above average for 1998 year-class
Total mortality RV ages 2-4 (1983-98)	Increasing since 1995.	F is above $F_{0.1}$ if $M=0.4$.
Condition (1970-99)	Declining slightly since 1995	Low relative to long-term average.
Length at age (1971-98)	Increasing since 1995.	Low relative to long-term average.
Length at maturity (1970-99)	Stable.	Low relative to long-term average.
Resource concentration (1970-99)	Stable	Evenly dispersed.
Geographical range (1970-99)	Stable	Widely distributed.

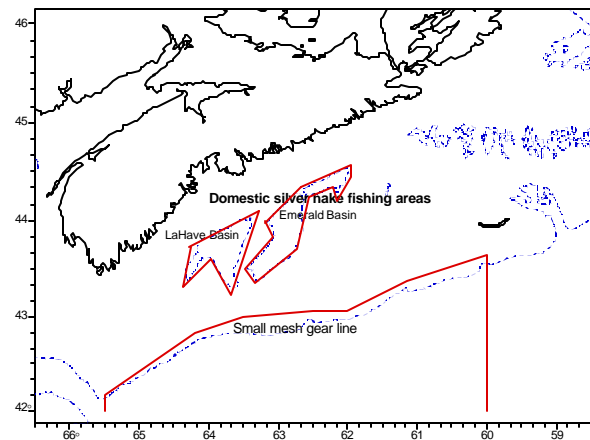
The Fishery

Landings ('000t)

Year	1993	1994	1995	1996	1997	1998	1999
TAC	86	30	60	60	50	55	30
Canada ¹	26	7	15	25	16	16	
Foreign	4	1	2	1	1	0	
Total	30	8	17	26	17	16	

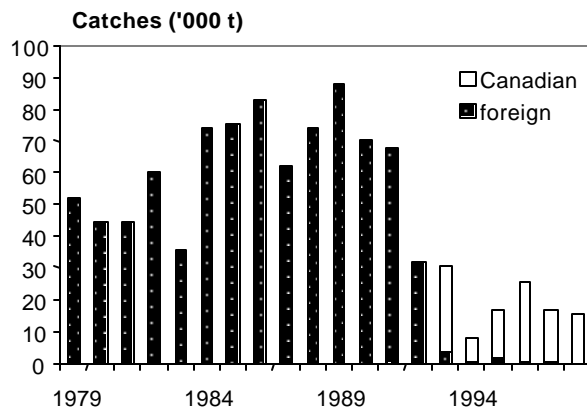
¹ Includes developmental allocations.

The silver hake fishery has been conducted on the Scotian Shelf since the early 1960's, primarily by the distant water fleets of Russia/USSR, Cuba and Japan. Since 1977, fishing for silver hake has been restricted by Canadian regulations to deeper water on the shelf edge. In recent years, the Canadian mobile gear fleet has conducted a year round fishery for this species in Emerald and LaHave basins.



Nominal catches range from a high of 300,000t in 1973 to a low of 8,000t in 1994. Catches by the foreign fleet were generally high during the mid to late 1980's, with catches in recent years much lower.

The proportion of the catches made by Canadian vessels in the basins has increased in recent years, and since 1998 has been more than half the catch. The 1999 TAC of 30,000t was prorated to a 15 month fishing year ending March 31, 2000 (33,000t). The 1999 catch to October is 11,000t, for which the offshore developmental portion is less than 4,000t.



The **size composition** of the catch differed between the inshore and offshore fisheries, with almost half the inshore fishery catch composed of age 2 fish in 1998, while the offshore fishery caught primarily age 3 and 4 fish. The introduction of square mesh and other associated gear changes for the fishery in the basins in 1999 has reduced catches of small silver hake.

Commercial **mean weight-at-age** for this stock has declined since 1979. While weights were relatively stable from 1985 to 1992, they declined sharply in 1993 and have remained at this lower level subsequently.

A sampling program conducted by **industry** has greatly enhanced understanding of the size distribution of the landings in light of gear changes intended to reduce the catch of small fish.

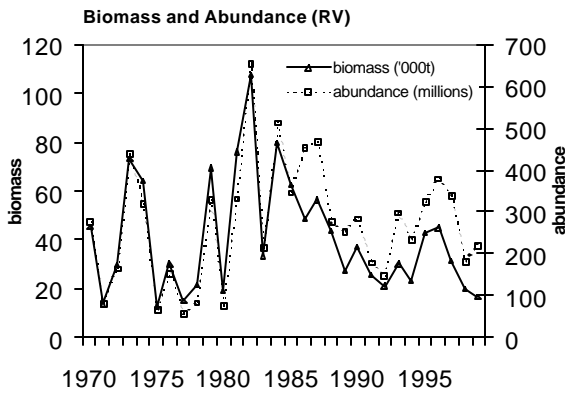
Resource Status

The age based **sequential population analysis** used in last year's stock assessment showed considerable uncertainty in the recent estimates of exploitation rate and biomass. A major contributor to this uncertainty is a severe **retrospective pattern** in the population model, with successive estimates of year-class size often becoming considerably smaller as more data become available. This year the effect was much larger than that seen in previous years for this resource, and as a consequence the results of the model were rejected.

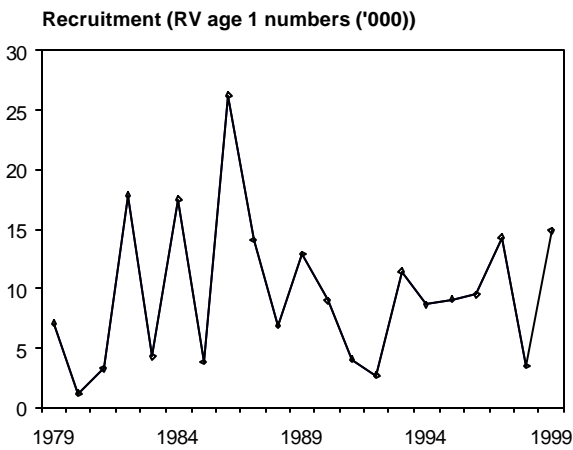
Catch rates of foreign vessels showed an increasing trend from 1979 to 1989, but then dropped sharply in 1990 through 1992. Catch rates for this fleet declined further in 1999, to the lowest level observed since 1977. Factors such as avoidance of traditionally good fishing areas due to gear conflict, decreased scouting capability, and general mechanical condition of the fleet have been proposed as explanations for these declines. Catch rates for the Canadian fleet increased from 1995 to 1996, but declined subsequently. Several reasons for catch rate variability were identified for this relatively new fishery, including changes in timing due to a year round fishery, learning, vessel power, and market considerations. For these reasons neither series is considered indicative of resource abundance.

The DFO **summer research vessel (RV) survey** results, adjusted prior to 1982 for vessel change, show relatively high abundance and biomass in the early to mid-1980's, followed by a decline to relatively low levels over the period 1988-94. Abundance and

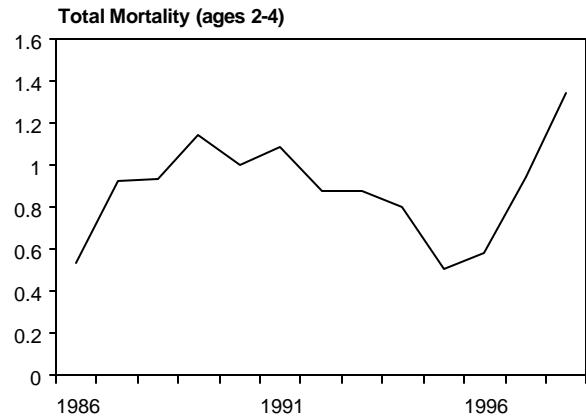
biomass increased in 1995 and 1996, subsequently declined, and remain low in 1999.



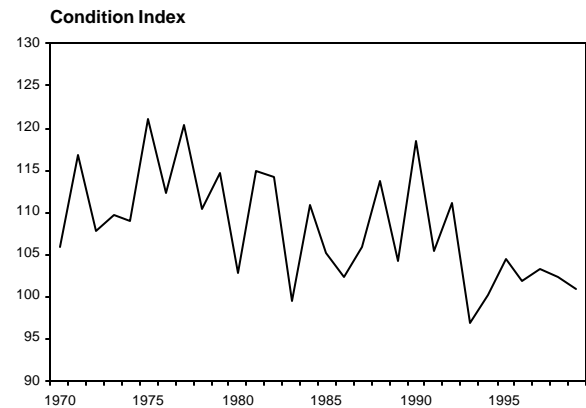
Recruitment to the fishery will be from the 1998 year-class, which is estimated to be above average in abundance, based on recent survey data.



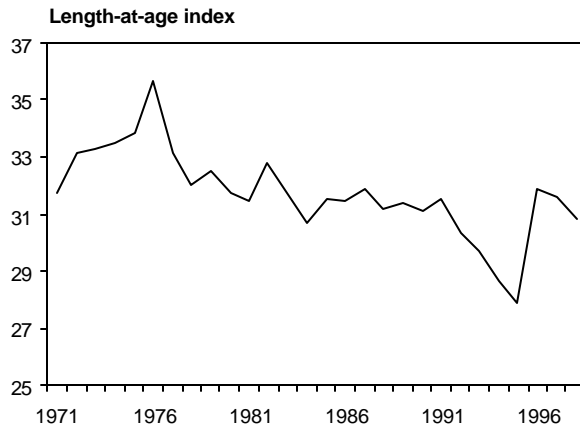
Total mortality over ages 2-4 from the summer survey shows an increasing trend since 1995. Total mortality for ages important to the fishery is above that expected (assuming natural mortality and fishing at $F_{0.1}$), suggesting exploitation is relatively high despite moderate catches.



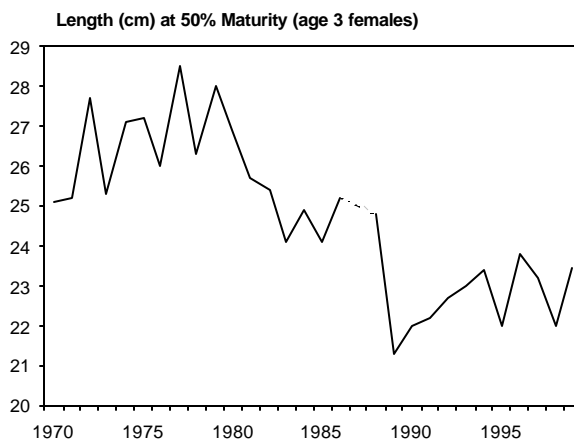
There are long-term declining trends in biological indicators. **Condition** (size at given length), shows a general decline from 1975 to 1993. An increase has been seen subsequently, but condition remains low relative to the long-term average.



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



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 shows the resource is evenly dispersed.

The proportion of annual survey sets where the species occurs (non-zero sets) is a measure of the distribution of a stock within its historical **geographic range**. At present silver hake are widely distributed. This is also clear from the distribution plots in Branton and Black (1999).

Outlook

There is a high degree of uncertainty as to the status of this resource, and available attributes of stock status are not consistent. Recruitment will likely be above average, and resource concentration and distribution through the geographical range exhibit positive trends. However, survey biomass is very low and total mortality is high. The extreme values of these important indicators cause substantial concern. Condition, length-at-age, and size at maturity, while below long-term averages, are not near lowest levels. Under these circumstances, catches should not be allowed to increase from 1997-99 levels.

For More Information

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References

- Branton, R. & J. Black 1999: Survey update for selected Scotia-Fundy groundfish stocks. DFO Can. Stock Assess. Sec. Res. Doc. 99/151.
- Showell, M.A. & L.P. Fanning 1999: Assessment of the Scotian Shelf silver hake population in 1998. DFO. Can. Stock Assess. Sec. Res. Doc. 99/148.

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