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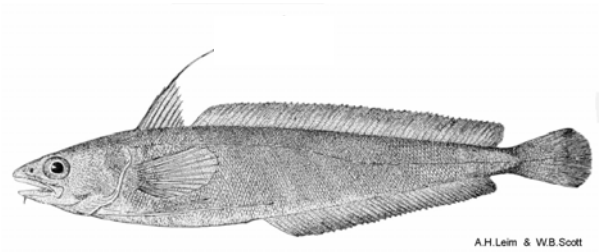
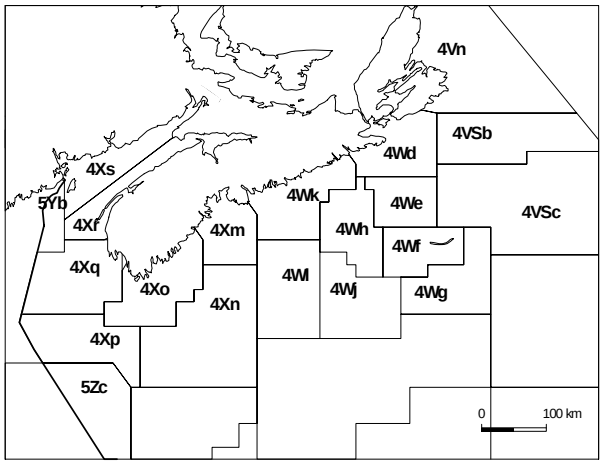
Maritimes Region
Canadian Science Advisory Secretariat
Science Advisory Report 2005/058

WHITE HAKE IN 4VWX AND 5





Context

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 400 m. They favour temperatures between 3°C 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 pelagic spawners, having several million eggs per female. The eggs and larvae drift in the upper 50 meters for about a month, then the larvae change 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 20-25 cm in length at age 1 (August). Growth rate varies with area. White hake mature around 42-45 cm (age 4). The age span is about 20 years, with fish potentially growing to lengths as large as 135 cm.

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) in the NW Atlantic, do not reflect clear discontinuities in adult distributions. On the Scotian Shelf white hake is assessed as three components, 4Vn, 4VsW and 4X/5. About 90 % of the white hake landed in 4VWX and 5Zc are currently 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. In the 2000s, longliners take 41 % of the catch, gillnets 33 % and small otter trawlers (less than 65') 26 % of the catch.

SUMMARY

- Landings throughout 4VWX/5 have declined from a peak of 8,700 t in 1987; since 2003 landings have been below 2000 t, reflecting quota caps.
- White hake is managed as a by-catch in longline, gillnet and otter trawl fisheries targeting halibut, redfish, cod, pollock and other groundfish. This has implications for quota management in a mixed groundfish fishery.
- There are very few large white hake on the Scotian Shelf (4VW) now compared to the 1980s, despite reduced catches in all areas and indications of good recruitment.
- In 4X5, there has been a general decrease in the abundance of white hake since the early 1990s.
- Fishing mortality is relatively low in all areas since the introduction of catch limits in 1996.
- Total mortality on the Scotian Shelf is high and its causes are unknown. Total mortality of white hake in the Bay of Fundy is variable without trend.
- The status of white hake in 4Vn and 4VsW is poor and requires rebuilding. Unless there is good recruitment in 4X over the next few years, catches at the current level may lead to further decreases in abundance.

DESCRIPTION OF THE ISSUE

Rationale for the Assessment

Advice was requested by Fisheries Management on the stock status of white hake in order to determine a quota cap that would be consistent with the management plan. Specifically:
- Report on all current removals, including surveys and commercial by-catch
- Report on abundance and distribution trends from the DFO summer bottom trawl survey

The Fishery

Landings (000's tonnes)

Year	1970-79 Avg	1980-89 Avg	1990-99[1] Avg	2000[2]	2001[3]	2002[3]	2003[3]	2004[4]	2005[4]
TAC[2]			3.5						
Quota Cap[2]				1.4	2.8	2.8	2.8	2.8	2.8
Landings[2]	4.7	6.2	4.5	2.5	2.4	2.5	1.5	1.6	

[1] Catch limit allocated to the fixed gear sector <45 ft in 1996.
[2] Commencing in 2000, fishing year, landings and TAC refer to the period April 1st of the current year to March 31st of the following year.
[3] Quota cap includes 2168 t for the fixed gear sector <45 ft., and 650 t. for the mobile fleet and fixed gear >45 ft.
[4] Quota cap includes 1768t for the fixed gear sector <45 ft., and 555t for the mobile fleet and fixed gear >45 ft.

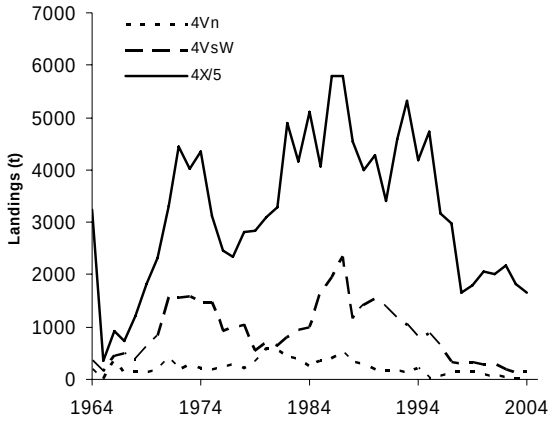


Figure 1. Landings[2] of white hake by NAFO area.

Reported landings throughout 4VWX/5 have been declining since 1987 and this trend continues in 4Vn and 4VsW (Figure 1). Since 2003, landings have been below 2000 t; in 4X/5, landings have plateaued since a low in 1999, reflecting quota caps. Landings as of October 27, 2005 in 4VWX/5 were 1532 t.

The fishery for white hake is Canadian, with no foreign fishing activity since the early 1990s. Until 1996, there were no restrictions on fishing effort for white hake in 4VWX/5, when the first catch limit (TAC) was introduced and allocated to the fixed gear sector. In addition, other fleet sectors were regulated through by-catch restrictions (20% for the ITQ fleet, 10% for large trawlers). The TAC was restrictive to fishing until 1998, when the TAC was not reached. In 1999, the FRCC recommended that white hake be caught as by-catch only, and a quota cap was put in place. In recent years, the fixed gear industry has reported difficulties staying within white hake catch restrictions while fishing for other species and in 2002, the otter trawl fleet in 4X reported similar difficulties. This appears to be less of a problem this year (2005).

The white hake fishery has had significant changes in both area fished and dominant gear type. Until the early 1990s, about 70% of the catch was taken from 4X/5; since then, as total catch has decreased, a greater proportion of the catch has been taken from 4X/5 and now amounts to 90% of the total catch. White hake is caught with longline, gillnet and otter trawl < 65 ft gear. The distribution of catch by gear has changed over time, with a decrease in the use of longline and an increase in gillnets and otter trawl.

White hake is managed as a by-catch in longline, gillnet and otter trawl fisheries targeting halibut, redfish, cod, pollock and other groundfish. This has implications for quota management in a mixed groundfish fishery. It also has management implications in an ecosystem context; any changes in these fisheries will have consequences for mortality on white hake.

RESOURCE ASSESSMENT

Resource Distribution

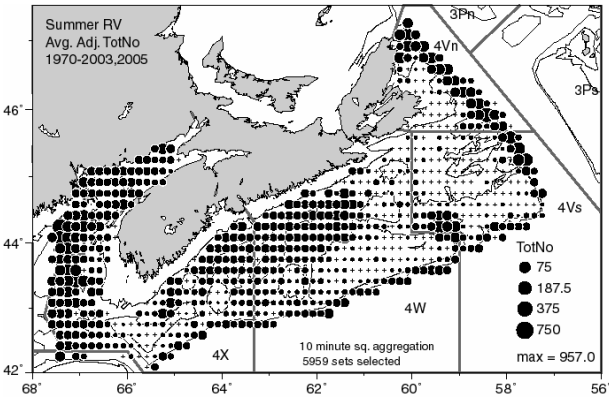


Figure 2. Map showing distribution of white hake in 4VWX/5 based on RV Survey data.

NAFO Area	Mean Nos/tow	Mean Wt/tow (Kg)	Mean proportion of biomass in 4VWX	Mean Wt of fish (Kg)	Mean length of fish (cm)
4Vn	16.0	10.6	0.09	0.69	42.1
4VsW	4.4	3.5	0.26	0.87	42.5
4X	10.9	13.1	0.65	1.28	48.6

Table 1. Indices averaged over the summer RV survey time series, 1970-2005.

The Research Vessel (RV) survey shows that white hake are distributed over the entire management area, but are concentrated along the Laurentian Channel, the shelf edge, around Emerald and LaHave Basins and the Bay of Fundy (Figure 2). There are differences between these areas in several key indices such as catch rate and size of white hake estimated from the summer RV survey (Table 1). The largest fish are found in 4X, the highest mean number per tow is in 4Vn, whilst the highest mean weight per tow is in 4X. Area occupied by white hake > 45 cm has decreased since the mid-1980s in 4VsW and is below the long-term mean in 4X.

Resource Status

The stock status is based on evaluation of abundance estimates from groundfish RV surveys and Industry surveys (4Vn Sentinel Survey (1994 to 2004), 4VsW Sentinel Survey (1996 to 2004), Halibut Survey (1998 to present), ITQ Survey in 4X (1996 to present), and the Longline Survey on Georges Bank (5Z) (1995 to 2004), and mortality estimates from the summer RV surveys and the commercial fishery.

Summer research vessel (RV) survey **abundance** estimates have been low throughout the 1990s (Figure 3). Trends for small fish (< 45 cm) and large fish (45+) vary in the three areas. The trends in small fish are used as proxies for **recruitment** estimates. In 4Vn, abundance of small fish has been variable, with a peak in 2001 due to fish between 30-45 cm. This high abundance may have been due to white hake from 4T, but they have not been seen since. In 4VsW, the number of small fish has been low since 2001. Although small fish greatly outnumbered large fish in the 1990s and 2000s, the number of large fish is very low. There are several reasons why this may be occurring:

(a) small fish are not surviving,

(b) the distribution of large fish has changed,

(c) growth rate has decreased and thus fish are smaller at age (this has been seen in 4TVW Haddock, 4Vn cod, 4VsW cod). However, there has only been a small decrease in the growth rate of white hake in 4VW.

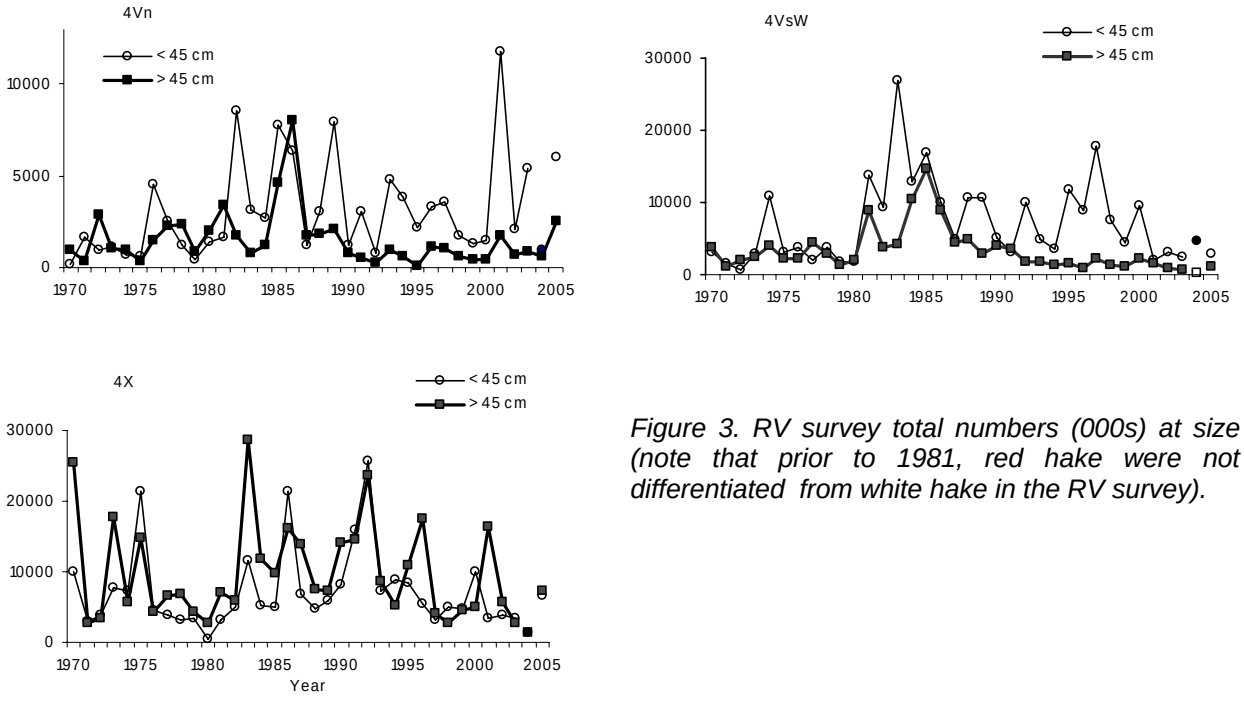


Figure 3. RV survey total numbers (000s) at size (note that prior to 1981, red hake were not differentiated from white hake in the RV survey).

In 4X, the small and large fish track each other well. On average, there are more large fish than small fish. There has been an overall decrease in abundance since the 1980s and the average abundance is less in the 2000s than in earlier decades. There has been no good recruitment of small fish since 2001. Both large and small fish increased in 2005.

In general there is good consistency between the RV survey trends and Industry survey trends.

In 4Vn and 4VsW, the **proportion of large fish in the population** decreased from the 1970s to the mid-1990s. Since then the proportion has remained below the long-term mean**,** indicating that

there has been a sustained loss of large fish in the population. In 4Vn the proportion of large fish in the survey declined from 49% in the 1970s to 20% in the 2000s, and from 44% to 22% in 4VsW. In 4X, there is no trend, but since 1990, most points have been below the long-term mean. In 4X, large fish comprise around 50% of the surveyed population. Over the time series, there is a higher proportion of large fish in 4X than in 4VW.

The **condition factor**, the predicted weight at size 45 cm has varied over time but has shown no pattern. There is a cline in **growth** rate from east to west; growth is slower in 4VW than in 4X. Turning south, growth on Georges Bank is faster than in 4VWX. There is an indication of a temporal decline in growth on the Scotian Shelf, but not in the Bay of Fundy.

Total mortality of white hake on the Scotian Shelf has increased through time (Figure 4a). Total mortality of white hake in the Bay of Fundy is variable without trend (Figure 4b); this variability could be indicative of migration in and out of the area by white hake from the Gulf of Maine Total mortality of white hake is higher on the Scotian Shelf than in the Bay of Fundy; average total mortality in the Bay of Fundy (1970-2004) is about 0.3 yr^{-1}, whereas on the Scotian Shelf it is 0.6 yr^{-1}.

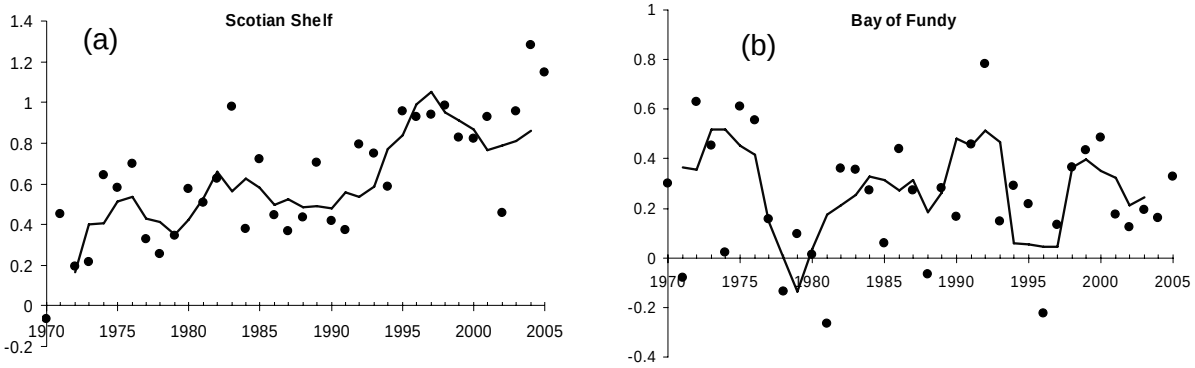


Figure 4. Estimates of total mortality for (a) Scotian Shelf and (b) Bay of Fundy (thick line is the 4 year moving window, points are annual estimates).

Relative fishing mortality (commercial catch divided by the fishable biomass) estimated from the summer RV survey, is here defined as large fish > 45+ cm (Figure 5). Fishing mortality is relatively low in all areas since the introduction of catch limits in 1996.

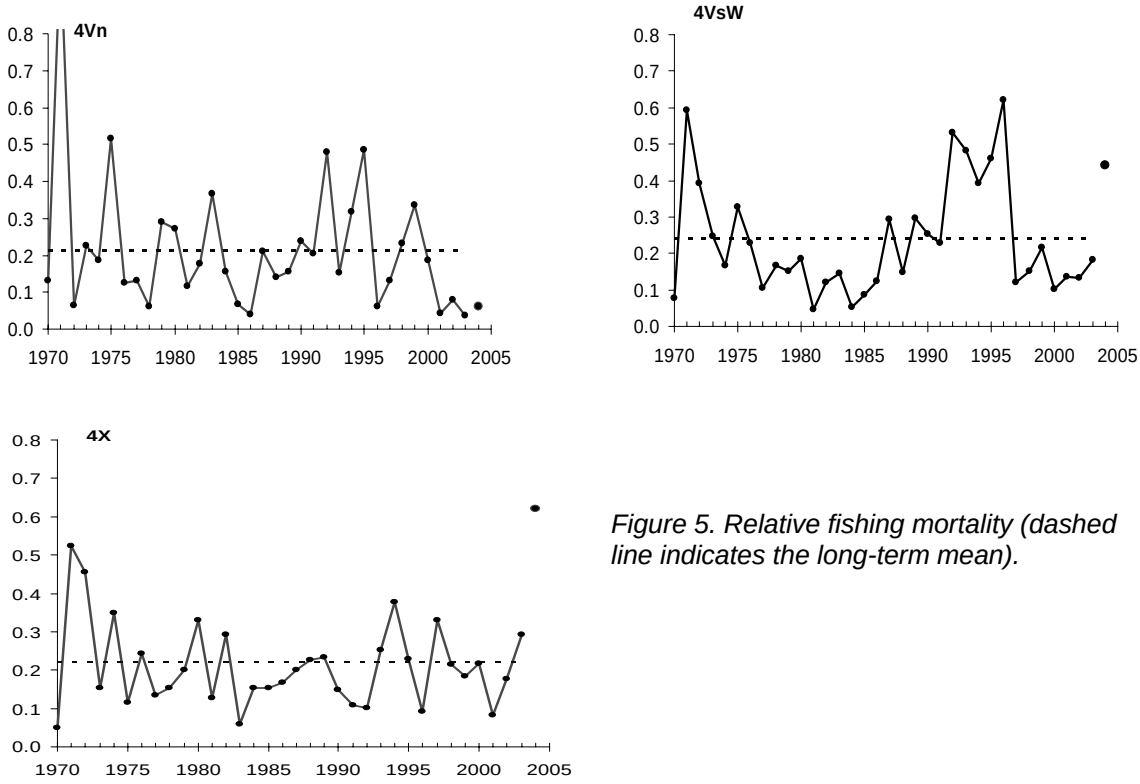


Figure 5. Relative fishing mortality (dashed line indicates the long-term mean).

In the 1980s on the Scotian Shelf (Figure 6), total mortality fluctuated around 0.6, whereas fishing mortality increased to levels comparable to total mortality in 1992, indicating that most of the mortality of white hake was caused by fishing. Since 1992, fishing mortality decreased, while total mortality remained high. Total mortality on the Scotian Shelf is high and its causes are unknown.

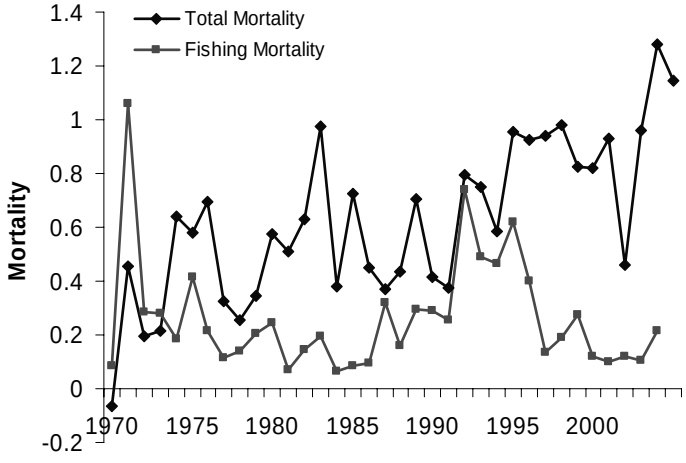


Figure 6. Comparison of annual total and fishing mortality on the Scotian Shelf.

Sources of Uncertainty

There are several sources of uncertainty for this assessment, including uncertainty over stock or sub-stock definition. The RV surveys do not cover the full depth range of white hake distribution, possibly inflating estimates of total mortality, and catchability to the RV survey within the sampled range is not well understood. While total mortality is high, the source of the increase in mortality is unknown. Landings prior to 1993 may be inaccurately reported, due to misreporting as other species. Survey data prior to 1981 included red hake as white hake as these were not differentiated.

ADDITIONAL STAKEHOLDER PERSPECTIVES

Industry raised questions about the accuracy of the landings data due to the inconsistent species identification in the earlier part of the time series. This refers to both misreporting of other gadids as white hake during the 1980s and to the separation of the red and white hake data in the commercial catch and in the RV survey data.

CONCLUSIONS AND ADVICE

There are very few large white hake on the Scotian Shelf (4VW) now compared to the 1980s, despite reduced catches in all areas and indications of good recruitment. Area occupied by large fish has decreased, total mortality is high and fishing mortality has decreased in recent years. The status of white hake in 4Vn and 4VsW is poor and requires rebuilding.

In 4X, there has been a general decrease in the abundance of white hake since the early 1990s, the area occupied by large fish is below the long-term mean, total mortality and fishing mortality have had little trend over time. Growth is faster than on the Scotian Shelf, fish are larger and biomass is higher. Unless there is good recruitment in 4X over the next few years, catches at the current level may lead to further decreases in abundance.

OTHER CONSIDERATIONS

Genetic research is currently being undertaken to determine the stock structure of white hake in the northwest Atlantic and may inform future management of white hake in 4VWX5.

Of the total removals of white hake from 4VWX5, at least 98% have been removed annually by the commercial fishery.

SOURCES OF INFORMATION

Bundy, A., and J. Simon. 2005 Assessment of the Status of 4VWX5 White Hake, 2005. DFO Can. Sci. Advis. Sec. Res. Doc. 2005/081.

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