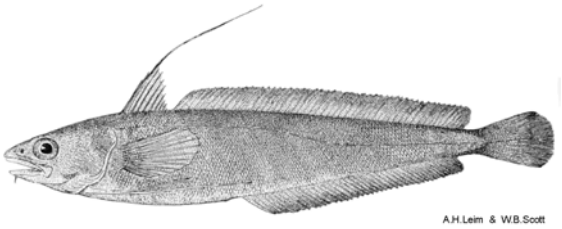



# White Hake in 4VWX and 5

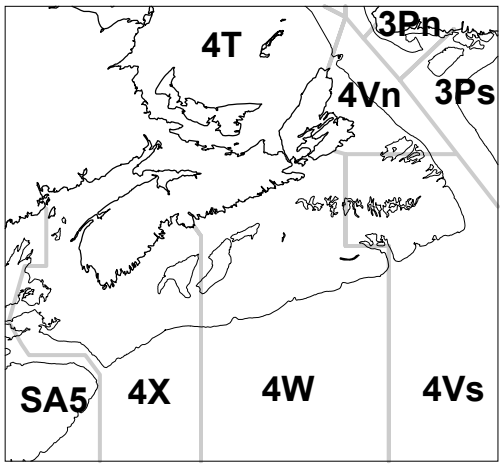
***Background***

*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. Longliners take about 55% of the catch, gillnets take about 29% of the catch each, and small otter trawlers (less than 65') taking most of the rest.*




## *Summary*


- Total landings have declined since 1987.
- 4VWX/5 white hake has been assessed as three components, 4Vn, 4VsW and 4X/5 in keeping with current management areas.
- White hake is caught as by-catch in longline, gillnet and otter trawl fisheries targetting halibut, cusk and other groundfish. This has management implications in an ecosystem context.
- Fishing mortality is low in all areas since the introduction of TACs.
- Total mortality is high, implying high natural mortality.
- The status of white hake in 4Vn and 4VsW is poor and requires rebuilding.
- The status of white hake in 4X has been poor but shows signs of recovery.
- Any increase in catch could jeopardise rebuilding or recovery of white hake.

## *The Fishery*

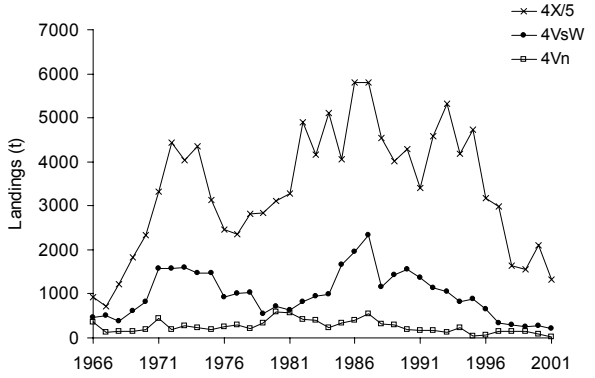
Landings (tonnes)

| Year | 1970-79 Avg | 1980-89 Avg | 1990-96 Avg | 1997 | 1998 | 1999[1] | 2000 | 2001 |
|---|---|---|---|---|---|---|---|---|
| TAC[2] | | | | 3100 | 3500 | | | |
| Quota Cap[2] | | | | | | 1692 | 1429 | 2861[3] |
| Landings | 4665 | 6150 | 5443 | 3418 | 2072 | 1927 | 2432 | |

[1] Fishing year and landings refer to the 15-month period from January 1, 1999 to March 31, 2000.
[2] Catch limit allocated to the fixed gear sector <45 ft.
[3] Quota cap in 2001 includes 2224 t for the fixed gear sector <45 ft., and 637 t. for the mobile fleet and fixed gear >45 ft.

**Reported landings** throughout 4VWX/5 have been declining since 1987. This trend continues in 4Vn and 4Vs, whilst in 4W and 4X/5, landings reached an all time low in 1999, then increased slightly in 2000. Landings as of October 24 in 4VWX/5 were 1884 t.

**Nominal Landings, 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 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 placed on the catch of the fixed gear fleet < 45 ft. In 1999, the quota cap was half of the 1998 TAC, and transfers between Community Management Boards were not permitted. The quota cap was reduced again in 2000 to 1429 t, whilst in 2001, it was increased to 2224 t, of which 1374 t has been caught, as of October 24, 2001. In addition, the mobile fleet and fixed gear > 45 ft is also being managed on a quota cap basis in 2001. The quota cap in 2001 is 637 t, and as of October 24, 2001, 510 t has been caught. In 2000, the fixed gear industry reported difficulties staying within white hake catch restrictions while fishing for other species.

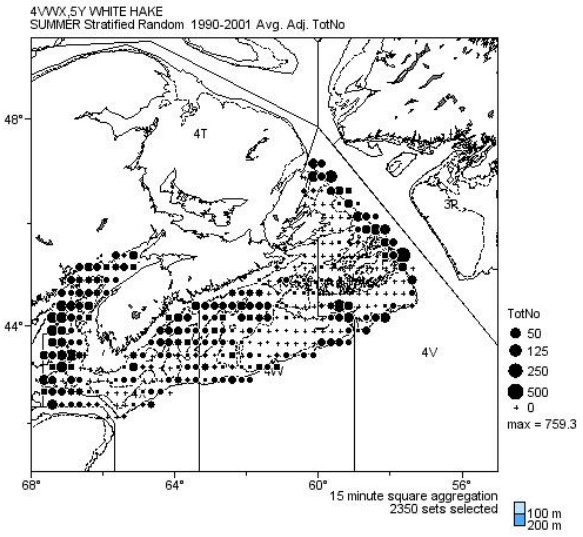
An **analysis of the species composition** white hake landings indicates that longliners in all areas of 4VWX/5 are landing between 50 and 90 % of white hake as the main species and not as by-catch. In the 4X gillnet fishery since 1998, between 21 and 43 % of white hake was landed as main species, whilst the remainder was landed as by-catch, mainly in the pollock and cod directed fisheries. In the otter trawl fishery since 1998, over 90 % of white hake is a by-catch of groundfish fisheries, predominately haddock and redfish. Overall, around 67 % of white hake was landed as by-catch in 1999 and 2000. This has increased from a low of 36 % in 1994.

The **size composition** of catches by longline, gillnet and otter trawl gears are variable through time, with no overall trend. However, fish caught in 4VW are on average 10 cm smaller than fish caught in 4X/5.

Commercial **catch rates** of index white hake fishermen in 4X/5 have increased across all fleets since a low in 1998. This is compatible with observations by Industry of recent increases in white hake catch rates in 4X/5. In 4VsW, there has been a decline in longline catch rates since the early 1990s, with the most recent years near record lows. The available 4Vn longline data series indicates a sharp increase in catch rates between 1996 and 1998, since which time they have only declined slightly. Only the 4VsW longline

catch rate analysis was used as an index of abundance (see Resource Status below) because it has a consistent time series and 73 % of white hake was landed as main species from 1990 to 2000. The 4X/5 catch rates were not used as indices of abundance as only 33 % of white hake is landed as main species in 4X/5, catch rates are likely to be affected by varying management conditions, predicted catch rates were inconsistent between gears, and were incomplete, over the time period. The 4Vn catch rates were not used as an index of abundance because there is a likelihood that some of their catch is 4T white hake.

## *Resource Distribution*



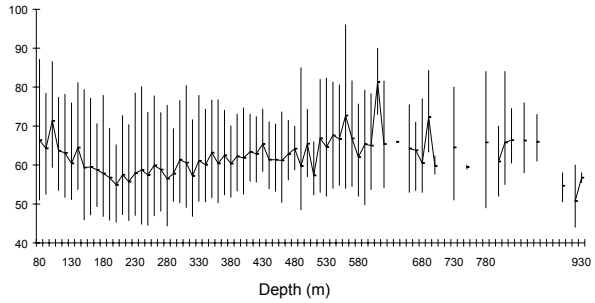

White hake are distributed over the entire management area, but are concentrated along the Laurentian Channel, the shelf edge, around Emerald and LaHave Basins and the Bay of Fundy. There are differences between these areas in several key indices such as abundance, catch per tow and size of white hake estimated from the summer RV survey. 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. On average, 64 % of the biomass is in 4X, 15 % in 4W, 11 % in 4Vs and 9 % in 4Vn.

Indices averaged over the Summer RV survey time series, 1970-2001

| NAFO Area | Mean Nos/tow | Mean Wt/tow (Kg) | Proportion of biomass in 4VWX | Mean Wt of fish (Kg) | Mean length of fish (cm) |
|---|---|---|---|---|---|
| 4Vn | 15.8 | 10.7 | 0.09 | 0.71 | 42.4 |
| 4Vs | 6.7 | 4.1 | 0.11 | 0.71 | 40.8 |
| 4W | 3.3 | 3.5 | 0.15 | 1.05 | 44.9 |
| 4X | 11.4 | 13.6 | 0.64 | 1.29 | 48.8 |

The depth distribution of white hake as a function of size was available from two industry surveys (4VsW Sentinel and Halibut). Both surveys show that size decreases with depth down to about 180-200 metres and then begins to increase again. This is shown below for data from the Halibut Survey in all areas. However, these data do not address the distribution of the very young white hake since small fish are not observed in these surveys.

**Length Distribution at Depth**



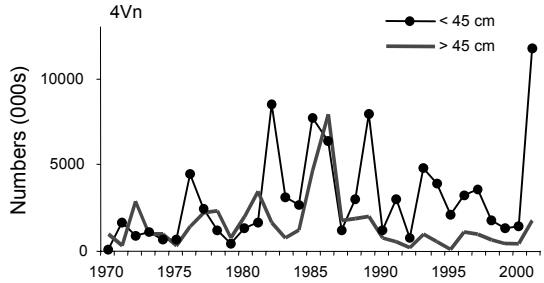

## *Resource Status*

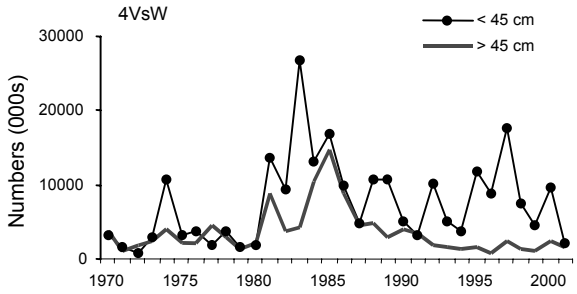
The stock status is based on evaluation of abundance estimates from groundfish research vessel and industry surveys, commercial catch rates of fishermen who have been consistently directing for white hake since 1990, and mortality estimates from the summer groundfish research vessel survey and the commercial fishery.

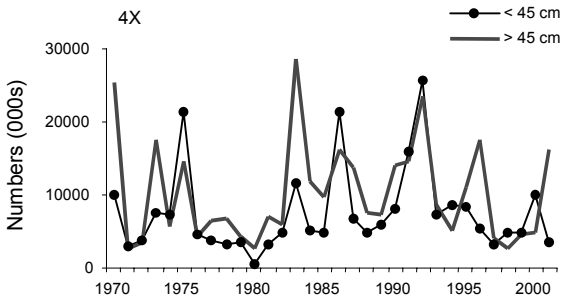
**Summer research vessel (RV) survey** abundance estimates have been low throughout the 1990s. Trends for small fish (< 45 cm) and

large fish (45+) vary in the three areas. The trends in small fish are used as proxies for direct 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 be due to white hake from 4T. In 2000, four very large sets of small white hake (30-45 cm) were made in the Cape Breton Trough in 4T. In 2001, these fish were not observed in the 4T survey and may be the fish that are seen in 4Vn in 2001. Abundance of large fish has remained low throughout the 1990s. In 4VsW, after a high peak of abundance in the 1980s, abundance of large fish dropped and has remained low. The abundance of small fish has been higher during the 1990s, but these small fish are not surviving to become large fish. In 4X, which typically contains about 64 % of the biomass for the 4VWX/5 stock unit, there has also been an overall decrease in abundance of large and small fish since the 1980s. Since a low point in 1998, abundance of large fish has increased to 2001.

**RV Survey Total Numbers at Size**



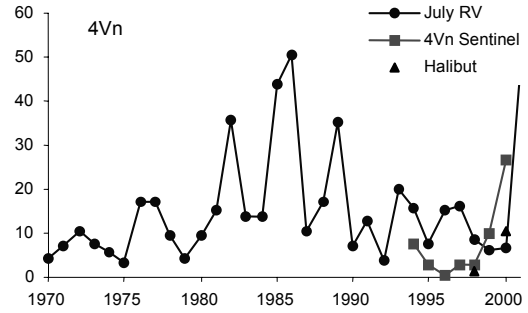



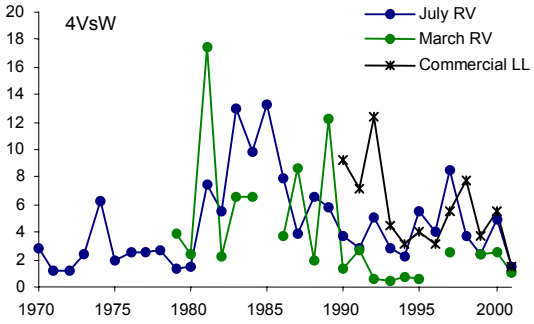

A **spring RV survey** is available for 4VsW only. It is consistent with the summer RV index of abundance for 4VsW. Abundance reached an all time low in 1993, and began to rise back in 1999, and again in 2001.

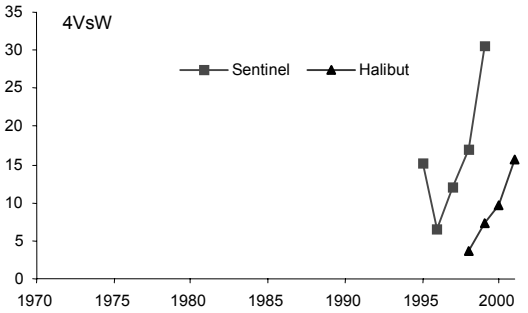
Several **industry surveys** provide additional abundance indices for white hake, the 4Vn Sentinel Survey (1994 to present), the 4VsW Sentinel Survey (1996 to present), the Halibut Survey (1998 to present), the ITQ Survey in 4X (1996 to present), and the Longline Survey on Georges Bank (5Z) (1995 to present). In all areas other than 4VsW, there is good agreement between the industry survey and the RV survey. However, in 4VsW, the industry surveys (Sentinel and Halibut) show an increase in abundance, whereas the two RV surveys (summer and spring) show no increase.

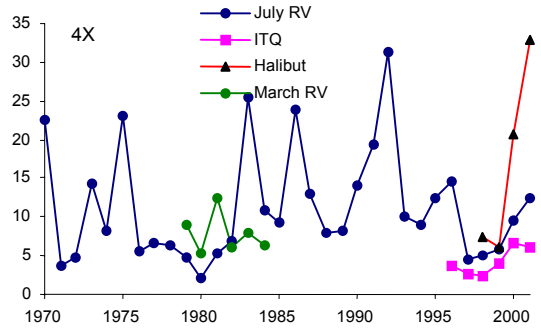
The commercial **catch rate** for index longline fishers decreased slightly during the 1990s and is similar to the two RV surveys.

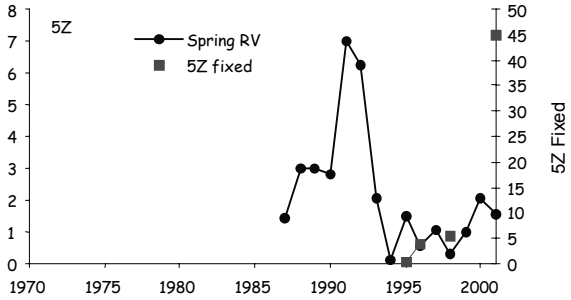
### RV Surveys, Industry Surveys and Commercial Catch Rate Abundance Indices



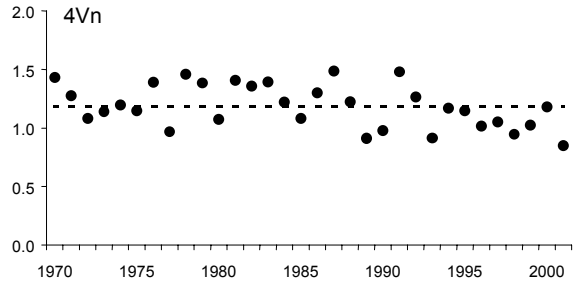



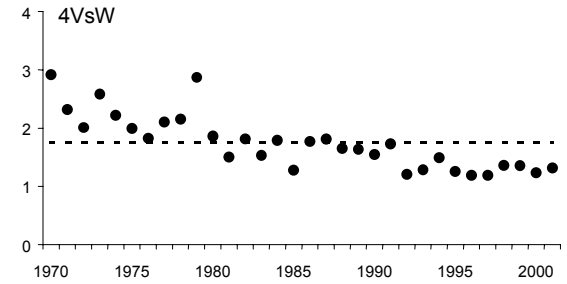



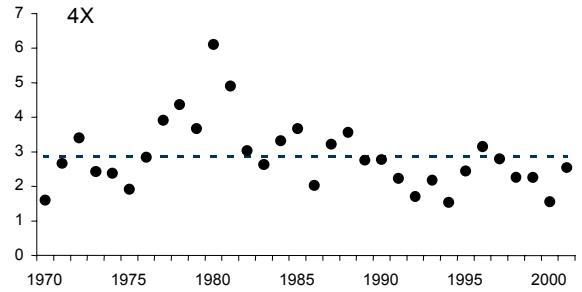




The **mean length and mean weight** of large fish (45+ cm) in 4Vn are below the long-term average in the 1990s. In 4VsW mean length and weight have declined throughout the time series. There is no trend in mean length in 4X/5, but mean weight has been below the long-term mean in 12 of the last 13 years. These data indicate that there has been a loss of larger fish in all areas, particularly in 4VsW.

### Mean Weight of Large Fish

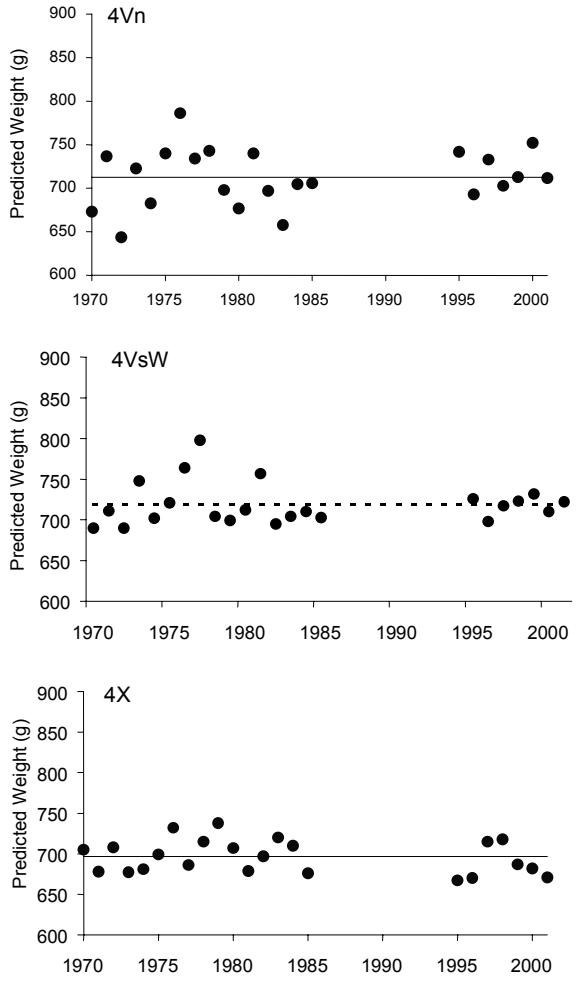




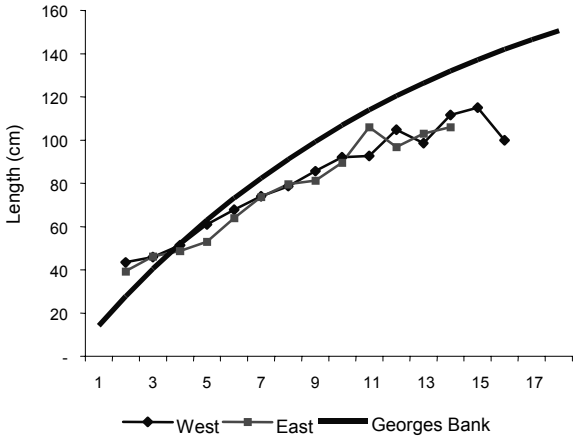

The **condition factor,** the predicted weight at size 45 cm has varied over time but has shown no pattern.

**Condition Factor**



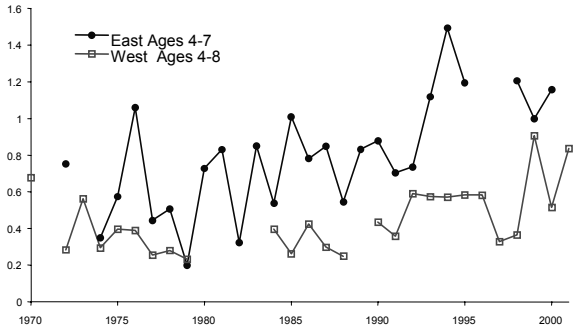

**Growth curves**, estimated from commercial age at length data for 1998-2000 indicate that there is a small difference in growth rate between east (4VWXmn) and west (4Xopqrs5Zc). Growth is faster in the west, although white hake tend to be the same size at older ages. Growth in both areas is slightly greater than in the Gulf of St. Lawrence (not shown), but lower than on Georges Bank.

**Mean Length at Age**



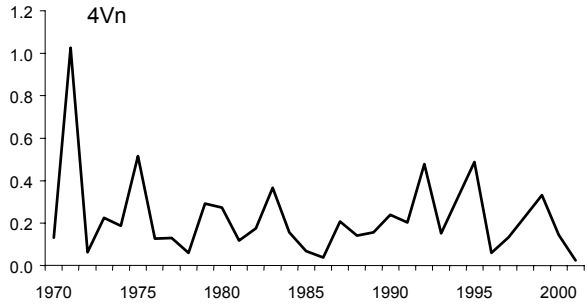

**Total mortality rates** were estimated from the summer RV numbers at length converted to numbers at age using the growth curves estimated for the eastern and western sections of the Scotian Shelf for 1998-2000. There is currently no age data for Scotian Shelf white hake for the 1970s or 1980s and thus it is not known if the growth rate has remained constant. If there have been growth rate changes, this will affect mortality estimates. Mortality was estimated in three ways and all show that on the western Scotian Shelf, total mortality remained stable until around the early 1980s, and has increased since. On the eastern Scotian Shelf, mortality has been increasing since the 1970s, and the magnitude and absolute value of total mortality is greater than on the western Scotian Shelf. Total mortality was similar in both areas in the 1970s, but they diverged in the early 1980s, as shown by the catch curves in the figure below.

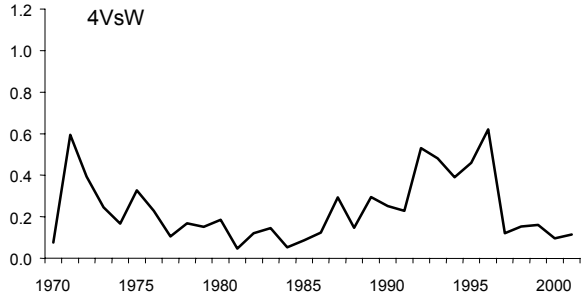
**Total Mortality**

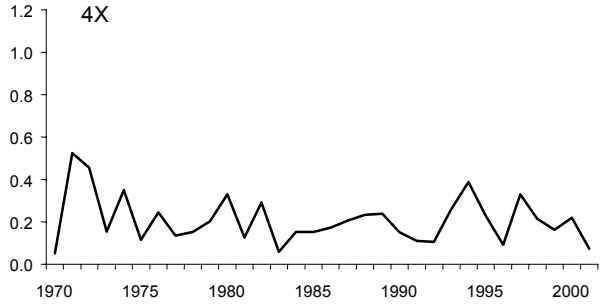



**Relative fishing mortality** was estimated as landings divided by fishable biomass (45+ cm) as estimated by the RV survey. No trends in relative F were evident in 4Vn and 4X. However, in 4VsW, relative F increased from the mid-1980s to a peak in 1996, then abruptly decreased in 1997. Relative F has remained low since then. The increase in relative F from the late 1980s to early 1990s could be due to redirected effort or improved reporting practices.

**Relative Fishing Mortality**



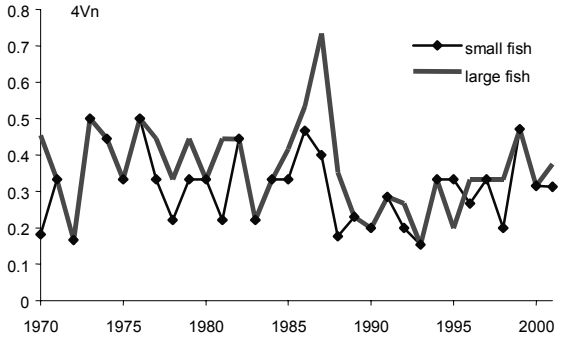

**Distributional indices** were estimated for each area. **Area occupied** is the proportion of summer RV sets that catch white hake and **density** is the catch rate in only sets where white hake are caught, i.e., non-zero sets. Density of white hake is highly correlated with abundance in each area, and was thus not considered further here since it provides no new information.

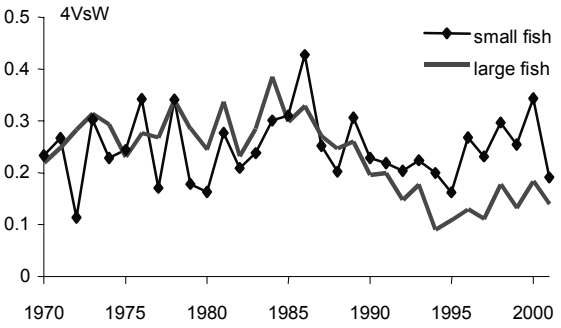
In 4Vn, little pattern is evident in the area occupied by large or small fish. The large interannual variation in abundance of small fish (see above) coupled with the relative consistency in area occupied, supports the view that 4T fish are mixing in with 4Vn fish.

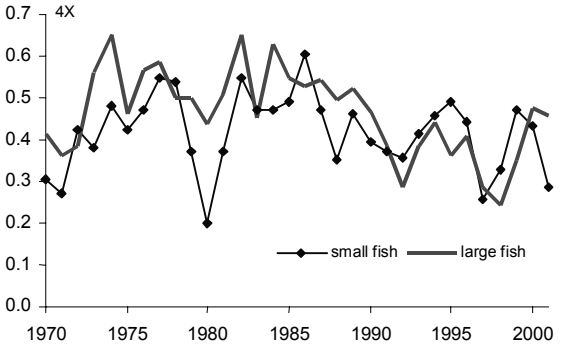
In 4VsW, the area occupied by small fish peaked in 1986, and fell below the long-term mean from 1990 to 1995. Area occupied by large fish was reasonably constant until 1984 and then declined consistently until 1994. This decrease may be due to mortality, distributional changes, or both.

In 4X, there was a decrease in the area occupied of both size classes from the early 1980s until the mid to late 1990s. This is more marked in the larger fish.

**Area Occupied**



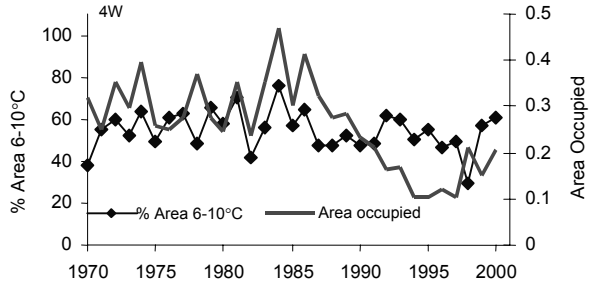



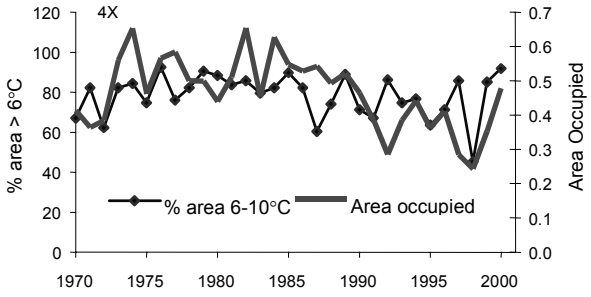




Many aspects of the **environment** can affect resource status and distribution. One index is the proportion of bottom that is 6-10°C, which reflects the temperature range occupied by white hake in 4W and 4X, as shown by the July RV survey. In 4W, the trends in the area occupied and temperature indicator for large white hake are similar from 1981 to 1989 and then diverge. A similar but weaker pattern is seen for small white hake. In 4X, there is some consistency between the area occupied and the temperature indicator throughout the time series for large white hake, although the correlation is low.

The divergence between the area occupied and the temperature indicator in 4W during the 1990s suggests that the decline in area occupied is not primarily caused by redistribution as a result of water cooling. It is more likely to be due to a reduction in abundance.

**Area Occupied and % area 6-10°C**




## *Sources of Uncertainty*

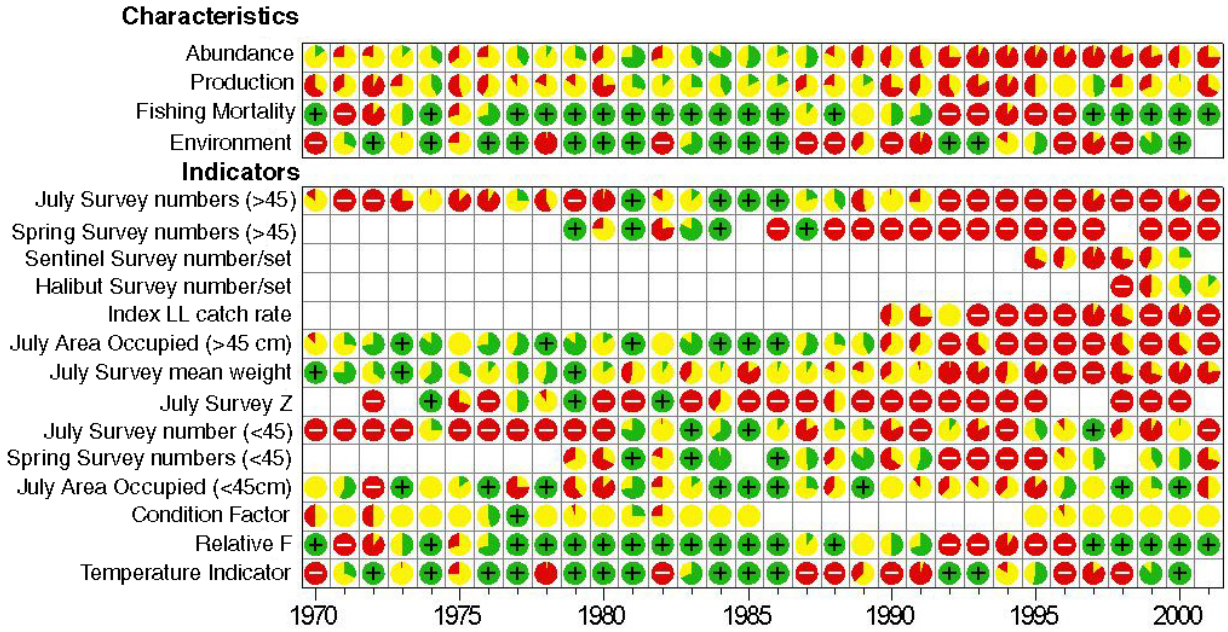
There are several sources of **uncertainty** for this assessment, including uncertainty over stock or sub-stock definition. The RV surveys do not cover the full depth range of white hake distribution and catchability to the RV survey within the sampled range is not well understood. Landings prior to 1993 may be inaccurately reported. Age and associated growth data have only been collected since 1998, providing no long-term perception of the population age composition or growth changes.

## *Traffic Light Analysis*

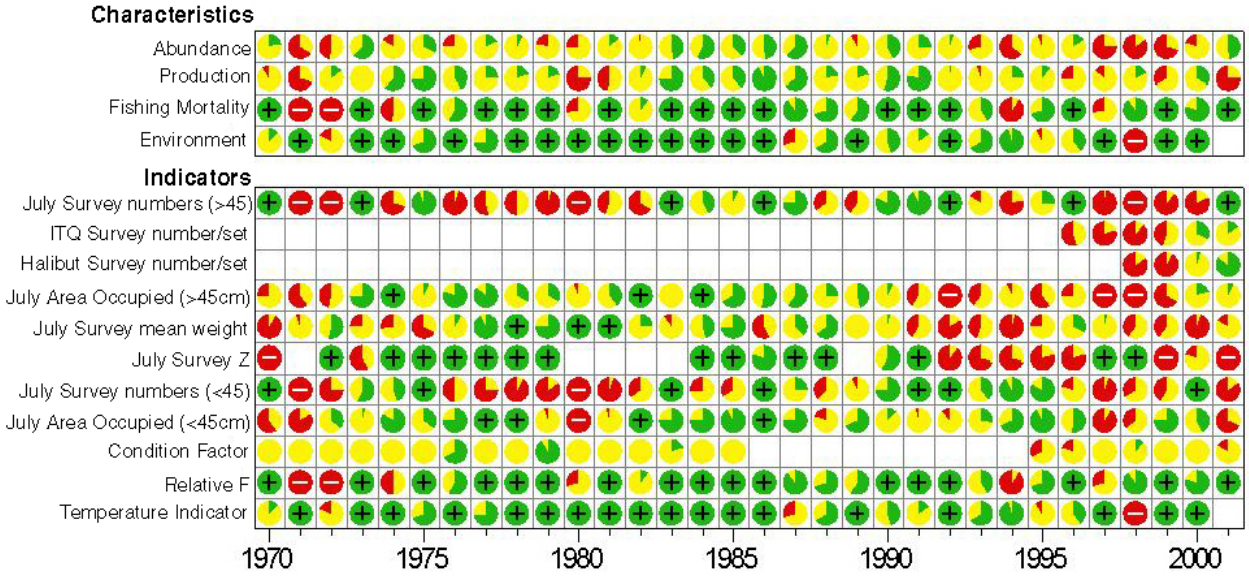
The **Traffic Light** table summarizes the indicators of stock status shown above. This table shows the annual values of each indicator as a combination of three lights depending on whether they are among the best values for that indicator, among the worst or in between. For indicators such as stock biomass and recruitment, high values are good and have a green light and low values are bad and have a red light. However, for indicators such as mortality, high values are bad and are assigned a red light whereas low values are good and receive a green light. Intermediate values (midpoint between red and green) are yellow. A value between red and yellow is expressed as a pie with increasing amounts of red in the pie as the value approaches the red threshold or cut point. Similarly, a value between the midpoint and the green cut point becomes increasingly green in the pie as the green cut point is approached. Empty cells in the table indicate no observation for that year. Uncertainties about the appropriate cut point resulted in a broad yellow zone.

In the traffic light analysis, indicators are summarised into groups which emphasise specific aspects of the resource. These groupings are called characteristics. The following outlook section is cast in terms of these characteristics and each is shown in bold.

**Traffic Light Table for 4VsW White Hake**



**Traffic Light Table for 4X White Hake**




## *Outlook*

### 4VsW

**Abundance** has remained very low since the early 1990s. Most indicators of abundance of 4VsW white hake have been poor since the early 1990s. However, the 4VsW Sentinel numbers per set and Halibut Survey numbers per set both show increasing trends over the last 3 to 4 years. The 4VsW Survey and Halibut Survey have a shorter time series than the RV Surveys and these different trends cannot be reconciled at this time.

**Production** has been poor since 1990, and after some improvement, 2001 is the worst year of production since 1994. Indicators of productivity have been variable over time. Total mortality has increased since the 1970s, implying high natural mortality. It is not clear what is causing this mortality.

Relative **fishing mortality** has been low since 1997 after the introduction of a TAC and by-catch quotas in 1996.

**Environment** as measured by the area of suitable bottom temperature has increased recently, possibly indicating favourable environment conditions for white hake in 4VsW.

There does not appear to be a recovery in 4VsW white hake, despite low fishing mortality in recent years. Small fish seen in the RV survey are not surviving and total mortality is increasing. Although it is possible that total mortality was overestimated in the 1980s due to changes in water temperature, this does not appear to be the case in the 1990s. Inconsistencies between relative fishing mortality and total mortality have preceded dramatic declines and collapses of other stocks. The status of white hake in 4VsW is poor and requires rebuilding.

### 4X

**Abundance** has been poor during most of the 1990s, but has increased recently and continues to improve. Indicators of abundance of 4X white hake show increases over the last 3 to 4 years, and particularly in 2001, except the mean weight of large fish in the survey which has not improved.

**Production** has declined since the 1980s and production in 2001 is the worst seen, suggesting that continued caution is required or the abundance recovery seen in 2001 may not be sustained. Indicators of productivity have been variable over time. Total mortality is higher in the 1990s than in the 1970s or 1980s, implying high natural mortality. It is not clear what is causing this mortality.

Relative **fishing mortality** has been low throughout most of the time series.

**Environment** as measured by the area of suitable bottom temperature has increased recently, possibly indicating favourable environment conditions for white hake in 4X.

White hake in 4X are showing signs of recovery. The improved abundance in 2001 follows good abundance of small fish in 2000. However production is poor in 2001. Total mortality is increasing while fishing mortality appears to be low. Similar inconsistencies have preceded dramatic declines and collapses of other stocks. The status of white hake in 4X has been poor but shows signs of recovery. Any increase in catches could jeopardise rebuilding.

**4Vn**

No traffic light analysis was conducted for 4Vn white hake. RV survey abundance of large 4Vn white hake has remained low during the 1990s and the mean weight of large fish is below the long-term mean. Small fish seen in the RV survey are not surviving. A peak of abundance of fish 30 – 45 cm seen in 2001 may be due to fish from 4T. Although the industry surveys indicate increased abundance since 1998, overall, there is little sign of recovery of 4Vn white hake.

**Summary**

There are signs of recovery in western stock area, ie., 4X/5 but the abundance of white hake in the eastern area, 4Vn and 4VsW continues to be very low despite reduced catches and warming water temperatures.

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This report is available from the:

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Internet address: www.dfo-mpo.gc.ca/csas
ISSN: 1480-4913

*La version française est disponible à l'adresse ci-dessus.*

***Correct citation for this publication***

DFO, 2001. White Hake in 4VWX and 5. DFO Sci. Stock Status Rep. A3-10 (2001).