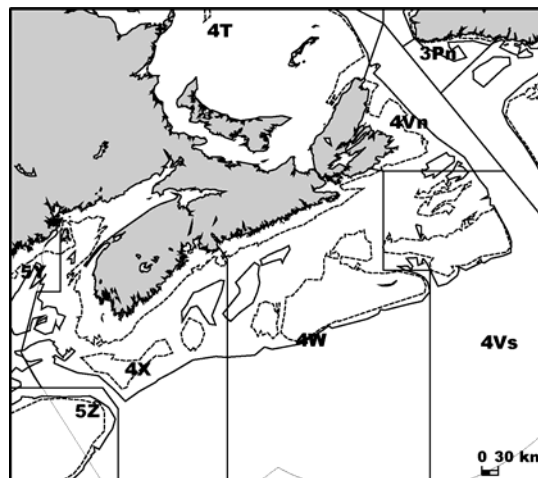




W.B.Scott & M.G.Scott

Wolffish on the Scotian Shelf, Georges Bank and in the Bay of Fundy (4VWX and 5YZe)



Background

The Atlantic wolffish (*Anarhichas lupus*) occurs on both sides of the North Atlantic. In the Northwest Atlantic their range is from off southern Labrador to Cape Hatteras on the continental shelf and in the deeper slope waters. In the Maritimes, wolffish are most prevalent in the approaches to the Bay of Fundy, Browns, Roseway and LaHave banks, the northeastern portion of the Scotian Shelf adjacent to the Laurentian Channel and in the waters off western Newfoundland. They are a demersal species usually found between 50 and 150m and 0.4°C to 6.0°C but they have been recorded between 1 and 550m and tolerating temperature from -1.0°C to 10°C. Wolffish are solitary by nature. Migration is limited but seasonal inshore migrations may occur in the spring, when mature fish are found in shallow waters of 0 to 15m.

In Newfoundland, wolffish spawn in September, in the White Sea in July and in Iceland in January-February. Powles (1967) reported egg masses in abundance south of LaHave Bank in March 1966 and empty egg cases were found near Sable Island in February. The precise spawning time of wolffish in the Maritimes is unknown. The large cohesive eggs range from 5.5 to 6.5mm, are demersal and are laid in clusters. An adult male may guard the egg clusters. Larvae are 17-18mm in length on hatching. The larvae remain close to the bottom until the yolk sac is absorbed. The entire larval stage is spent near the area where the eggs were laid (Bigelow and Schroeder, 1953). Growth may be rapid for the first year, and then slows; in sub-arctic water, fish at five years of age were only 24cm.

Wolffish feed on rocky bottoms on welks, sea urchins, brittle stars, crabs, scallops (shells are crushed) and occasional redfish (Templeman, 1985). Cod have been reported as predators of small wolffish.

Summary

- Landings have declined and are presently low.
- The number of immature fish has been above average since 1985, while the number of mature fish declined through the period and are presently near the lowest observed in the series.
- Fishing mortality has decreased, but there are indications that natural mortality has increased.
- Until the relatively high abundance of small fish are translated into mature biomass, care must be taken not to increase fishing mortality.

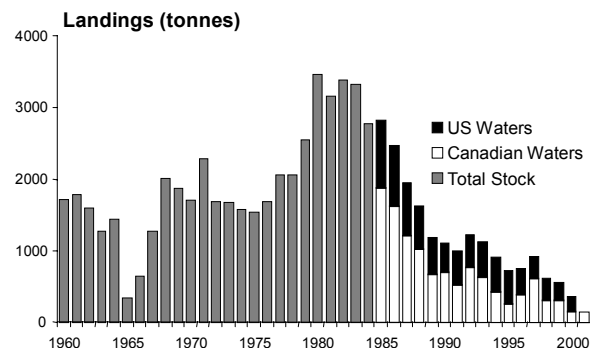
The Fishery

Landings (tonnes)

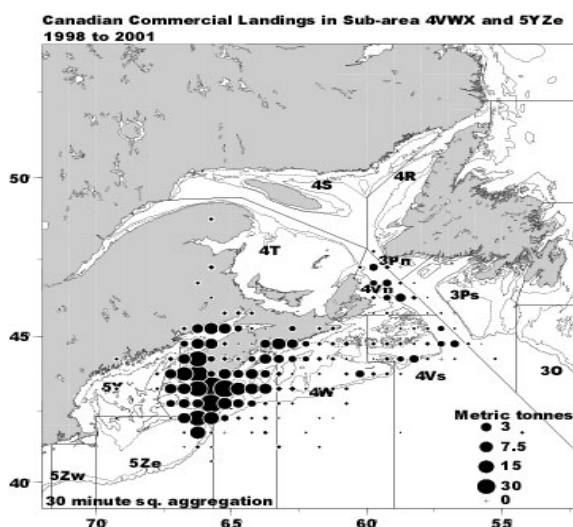
Year	1970- 79	1980- 89	1990- 97	1998	1999 ¹	2000 ²	2001
4VWX	1430	1672	489	291	281	144	112
5YZe							
Canada ³	67	106	49	20	18	13	21
Other ³	381	835	432	296	258	202	
Total	1878	2613	970	608	557	359	133

1. Landings refer to the 15 month period from January 1, 1999, to March 31, 2000
2. Commencing in 2000, fishing year and landings refer to the period April 1st of the current year to March 31st of the following year.
3. Corresponds to landings from Canadian and USA jurisdictional zones, respectively after 1984

Wolffish **landings** from NAFO Divisions 4VWX, 5Y and 5Ze were between 1500 and 2000 tonnes through most of the 1960s and 1970s. Landings increased in the late 1970s, reaching a peak in 1980 of almost 3500t. Landings dropped steadily after 1985 to 1000t in the early 1990s and have been recently about 400t. In 2002, landings up to October 24th were 163t. Canadian landings represent approximately 55% of this total with the remainder consisting mostly of US landings from 5Y and 5Ze. There is no TAC for this resource and it is generally fished as a bycatch with fleet landings regulated not to exceed historical levels. Under the Conservation Harvesting Plan, there is a 20% wolffish bycatch regulation for the mobile fleet in 4X from April 1st to September 1, 2002 and 10% during the remainder of the year to March 31, 2003.



Canadian wolffish landings from divisions 4VWX and 5YZc since 1986, are primarily from 4X and comprise 89% of the total. Low landings in 4VW reflect the low level of fishing effort since 1992. Although this is a bycatch fishery, about 25% of the landings are from sub-trips where the main species caught is wolffish. Otter trawlers account for most of the wolffish landed in 4X and 5YZc, while in 4Vs, landings are by both otter trawlers and longliners.

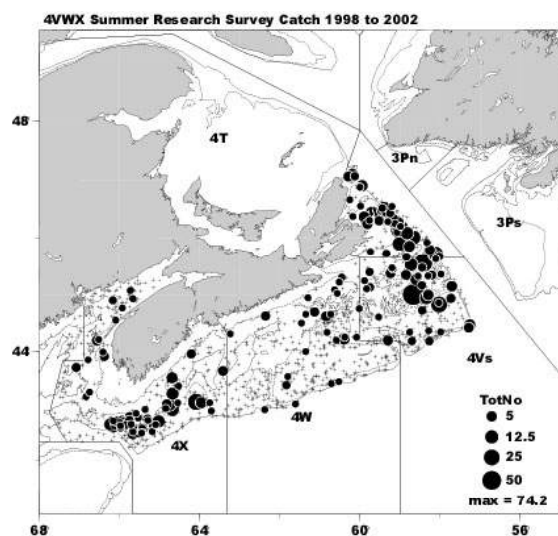


Sampling of commercial landings for this species has been limited and the few samples available do not provide reliable estimates for sizes landed.

Resource Status

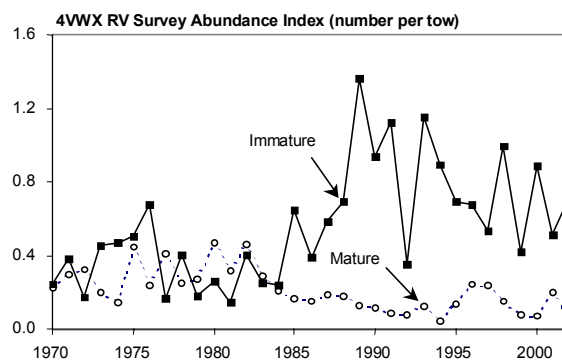
Research vessel (RV) surveys on the Scotian Shelf show wolffish distributed throughout the area, but in recent years there has been reduced numbers in the mid-shelf regions (4W) and greater numbers along the Laurentian Channel and in Subdiv. 4Vs. There are also concentrations in the approaches to the Bay of Fundy and around Browns, Roseway and LaHave banks (4X).

The NAFO Div. 4X **ITQ** and 4VsW **Sentinel surveys**, show a similar distribution to the RV survey in recent years. However, the 4VsW Sentinel survey has found relatively large numbers of wolffish close to shore in the late summer and fall in areas where the RV surveys do not sample. Industry also reports that wolffish are common nearshore in 4X.

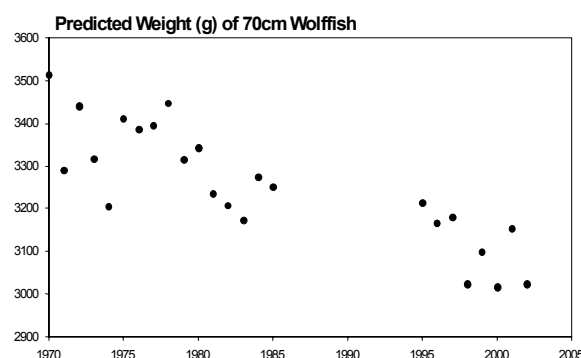


Mean number per tow from the summer RV surveys in 4VWX, were highly variable from year to year, and were without apparent trend until the latter half of the 1980s. They increased to the highest values in the series in the early 1990s and have remained above

the 1990-2002 average since. **Mean weight per tow** declined over the same period and is presently close to the lowest in the series. **Length frequency** data from the 4VWX summer RV survey reveal that the increased abundance since 1986 was due to smaller fish. The number of immature fish ($\leq 55\text{cm}$) since 1985 has been above average, while the number of mature fish ($>55\text{cm}$) declined through the period and are presently near the lowest observed in the series.

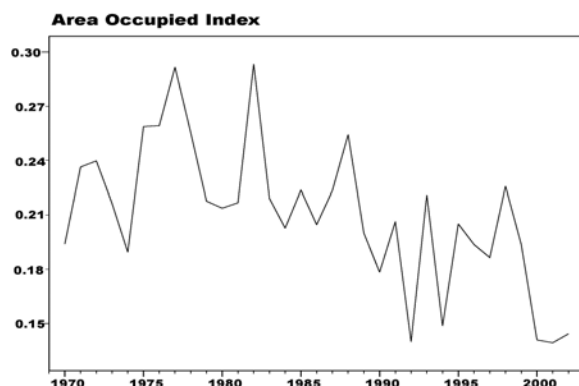


The **condition** of large wolffish (70cm) in 4VWX is also presently lower than the average values.

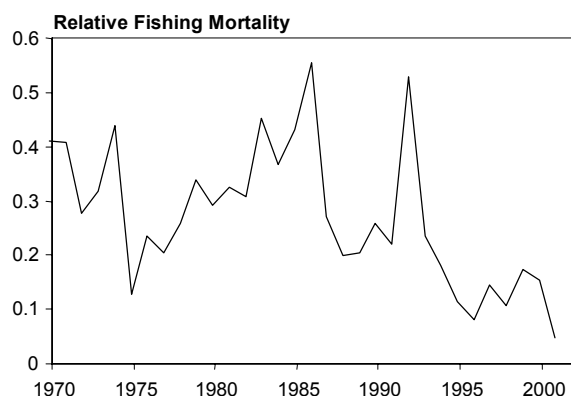


The proportion of annual survey sets where a species occurs is a measure of the **area occupied**. This index for 4VWX wolffish has been lower in the 1990s following a decline in the 1980s

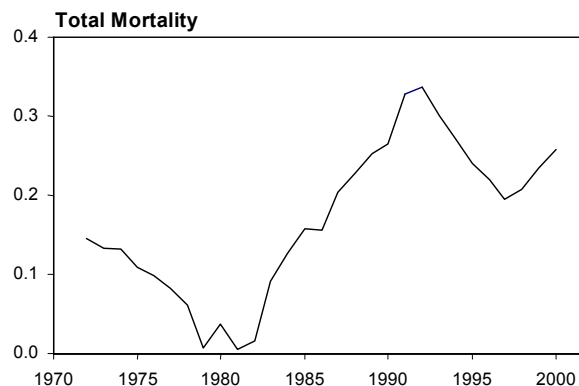
and has been at the lowest values in the series since 2000.



Relative fishing mortality using the catch in 4VWX, increased steadily from 1975 to 1986 and then dropped quickly to low levels and has remained low.



An index of **total mortality (Z)** derived from the summer RV survey in 4VWX shows a period of increasing mortality from 1982 to 1992 and a generally decreasing trend since.



The patterns of Zs available from catch curve analysis are based on the assumption of a stable age distribution. The recent strong abundance of young fish makes this assumption suspect and there will likely be biases associated with that. While accepting the trends in Z at face value is difficult, it is reasonable to interpret these estimates as indicating that the proportions of older fish declined in the 1980s and since 1992 have increased.

There are inconsistencies between the relative fishing mortality and the total fishing mortality, in some years, but these could not be resolved.

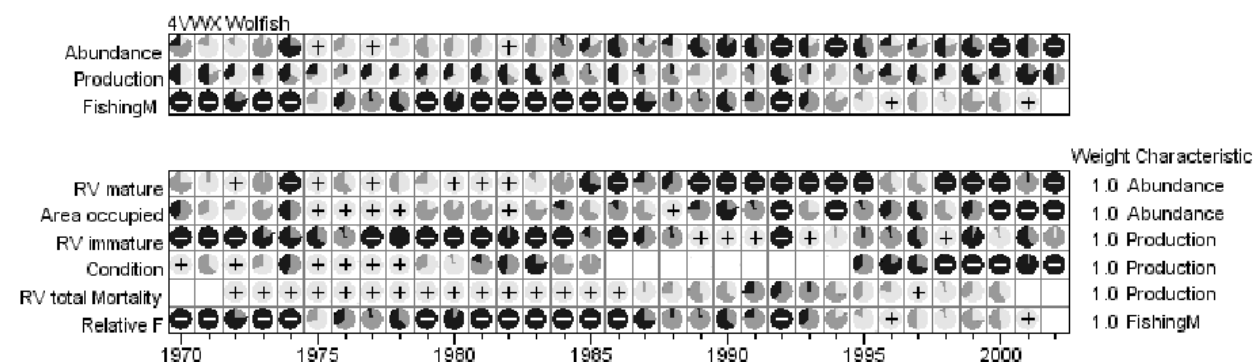
Traffic Light Analysis

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.



* See Appendix 1 for description of traffic light indicators, boundary points, weights and rationale for 4VWX wolffish.

Outlook

Indices of **abundance** (RV mature, Area occupied) in 4VWX have declined since the early 1980s and remain low.

There is evidence that **production** (RV immature, RV Total Mortality, Condition) has been mixed through the 1990s. There are large numbers of small fish in 4VWX. The RV total mortality was increasing until 1992 and has remained high since. Fish condition is lower now in 4VWX than earlier in the series.

Landings were high in the early 1980s and declined to low values in the 1990s.

Fishing mortality (Relative F) is presently low.

In summary, low abundance of mature fish in 4VWX is a concern. Fishing mortality has decreased to less than half and indications are that natural mortality has increased. Until the relatively high abundance of immature wolffish translates into increased mature biomass, care must be taken not to increase fishing mortality.

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Appendix 1. Description of traffic light indicators, boundary points, weights and rationale for 4VWX wolffish.

The traffic light approach provides a framework that allows us to incorporate multiple indices of stock status and other relevant indicators. Colour boundaries corresponding to good and bad periods can be established qualitatively for some indicators, but remain problematic for others. For most indicators, the history of the index is short relative to the ecological and evolutionary history of the fish populations or of the ecosystems within which they occur. In the absence of quantitative information to specify colour boundaries they have been established by a process of deliberation, where the weight of expert opinion is used to determine the most reasonable estimates. These represent the best available estimates; however all are subject to improvement through ongoing research.

Indicators	Green (+) Boundary	Red (-) Boundary	Characteristic	Weight
RV mature	0.3: This value cuts the highs observed in the late 1980s and in the 1990s	0.15: This value represents the lows observed in the 1970s and early 1980s	Abundance	1
Area occupied	0.25: This value cuts the highs observed in the mid 1970s and early 1980s	0.17: This value represents the lows observed in the 1990s	Abundance	1
RV immature	0.9: This value represents the highs observed in the 1970s	0.4: This value represents the lows observed in the 1990s	Production	1
Condition	3350: This value represents the highs observed in the 1970s	3150: This value represents the lows observed in the late 1990s	Production	1
RV Total Mortality	0.2: This value based on a natural mortality of 0.2	0.4: This value based on a natural mortality of 0.2	Production	1
Relative F	0.1: This value represents the highs observed in the 1970s and early 1980s	0.3: This value represents the lows observed in the 1990s	Fishing M	1