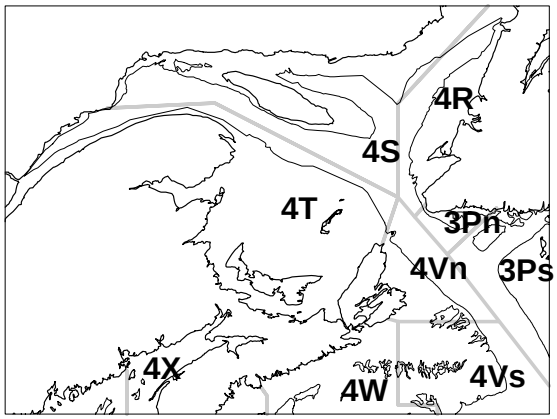
Witch Flounder (Divs. 4RST)

Background

Witch flounder are found in the deeper waters of the North Atlantic. In the Northwest Atlantic, witch range from the lower Labrador coast to Cape Hatteras, North Carolina. Relative to other flounders, witch are slow-growing and long-lived. Spawning occurs from spring to late summer, depending on the region, and in the Gulf of St. Lawrence (NAFO Division 4RST), spawners aggregate in channel waters in January and February. Spawning in the Gulf is believed to occur in deep water in late spring or early summer. The females are highly fertile, releasing as many as 500,000 eggs in a single spawn. In the late 1970s and early 1980s, 50% of females reached maturity at lengths of 40-45 cm (9-14 years of age) and 50% of males matured at lengths of 30-34 cm (5-8 years of age, Bowering and Brodie 1984). The fertilized eggs float and hatching occurs after several days, followed by a lengthy pelagic stage that may last a year. Juveniles eventually settle to the bottom in deep waters. In northern areas of their range, including the Gulf of St. Lawrence, witch flounder move into deep water during winter months and cease feeding. Witch grow faster in the Gulf of Maine and Georges Bank, where water temperature is higher and feeding occurs year-round.

Commercial fisheries for witch flounder developed significantly with the introduction of otter trawling to Newfoundland in the 1940s. Stocks in the Gulf of St. Lawrence became exploited in the 1950s when declining stocks caused Danish seiners in Fortune Bay, Newfoundland (NAFO Division 3Ps) to move to St. George's Bay in 4R. A small directed fishery for witch developed in St. George's Bay during the summertime, with offshore, winter catches of witch gaining in importance as bycatch in cod- and redfish-directed fisheries. The witch fishery expanded in the Gulf from St. George's Bay during the 1970s to the Esquiman Channel and the northern shores of Cape Breton Island.

Witch flounder in the northern Gulf of St. Lawrence (NAFO Division 4RS) came under quota management in 1977, with a precautionary quota of 3500 t. The first detailed assessment of 4RS witch was conducted in 1978 and continued yearly until 1981. During the 1980s, 4T landings increasingly dominated Gulf witch landings; however, the management unit remained as 4RS. In 1979, the TAC on 4RS was increased to 5000 t to remove an old and slow-growing component of the stock. This measure succeeded in reducing the age composition of the stock; however, landings declined and by 1982, the TAC was reduced to 3500 t. Stock assessments resumed in 1991 and following the recommendation of the Fisheries Resource Conservation Council in 1994, the management unit was extended to 4RST in 1995.



The most recent full assessment of the status of this stock was conducted in February 2001 (Swain and Poirier, 2001; SSR A3-20 (2001)). This report updates fishery and survey data on this stock up to 2003.

Summary

- In 2003, the TAC remained at 1000 t. Total landings were 660 t. Seine fleets directing for witch flounder caught most of their quota in 4T but not in 4R.

- The research vessel (RV) survey biomass index for commercial sizes (30+ cm) decreased to low values in the mid 1990s. The index increased to an intermediate level in the 1999-2002 period.

- The biomass index for the southern Gulf portion of the stock area cannot be updated for 2003. The regular survey vessel, the CCGS *Alfred Needler*, was disabled shortly before the September survey and was replaced by the CCGS *Wilfred Templeman*. The relative fishing efficiency of the two vessels is unknown. Furthermore, portions of the survey area were either unsampled or under-sampled in 2003.

- In contrast to other areas of the Gulf, the biomass index for eastern 4T has been at a high level since the mid 1990s (though no estimate is available for this area in 2003).

- In contrast to the RV surveys, sentinel surveys of the northern Gulf (primarily 4R and 4S) provide no indication of an increase in biomass since the mid 1990s.

- Two strong year-classes have been observed in the research vessel survey of the northern Gulf since 1997. If this persists, the resource should improve.

- Stock structure is a major source of uncertainty for this resource.

The Fishery

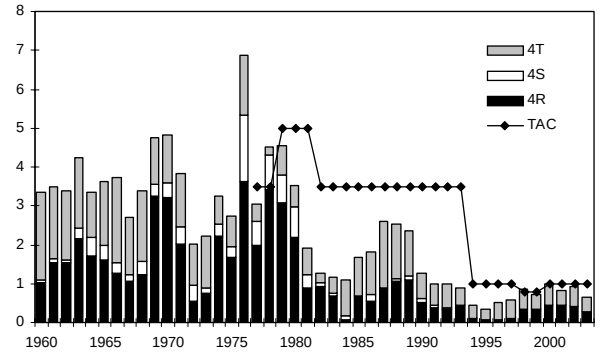
Landings and TAC's (thousand tonnes)

Year	Average 1981-90	Average 1991-95	Average 1996-00	2001	2002	2003*
TAC	3.7	2.5	0.9	1.0	1.0	1.0
Landing	1.8	0.7	0.7	0.8	0.9	0.7

*Preliminary statistics
(TAC in 2000-2003 for May 15 to May 14 of the following year)

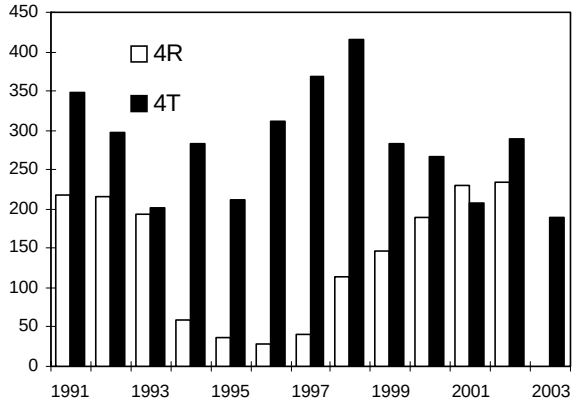
Landings of witch flounder in NAFO Divs. 4RST exceeded 3000 t in most years from 1960 to 1980. Landings declined to 1100 t in the early 1980s but increased to near 2500 t in the late 1980s. Landings declined in the 1990s, reaching very low levels in 1994 to 1997. This decline reflected very low landings from 4R in the mid 1990s. Landings from 4R recovered in 1998, and total landings increased to the level of the TAC in 1998 to 2000. Landings remained near the TAC in 2001 and 2002 but declined to 65% of the TAC in 2003. Total landings in 2003 were 660 t. Seine fleets directing for witch flounder caught nearly 90% of their quota in 4T but only 66% of their quota in 4R.

Landings (000s of tonnes)



Since the mid-1980s, landings have been mostly by seiners directing for witch flounder between May and October in St. George's Bay, Newfoundland (4Rd) and off the west coast of Cape Breton Island (4Tf and 4Tg). The drop in landings in the 4R area in 1994-1997 reflected a sharp decline in fishing effort in this area. In this period, a high incidence of crab gear interfered with the fishery for witch flounder in 4R in early summer, a period when fishing effort was traditionally high. Fishing effort in 4R increased again in 1998, as did the landings. The seine fleet in 4R caught its quota each year from 1998 to 2002, but failed to catch its quota in 2003. Effort data are not yet available for this fleet for 2003.

Directed effort (days)



(data unavailable for 4R in 2003)

Since the mid 1990s, the fishery for witch flounder in 4T has opened later than usual. This has prevented fishing during spring periods when catch rates have traditionally been high. In 2001, fishing for witch flounder

in 4T was limited before May 15 because most fishers had caught their cod quota for the 15 May 2000 – 14 May 2001 management cycle. This contributed to the failure of the 4T fleet to catch its quota in 2001. Despite late openings, this fleet caught all or most of its quota in 2002 and 2003.

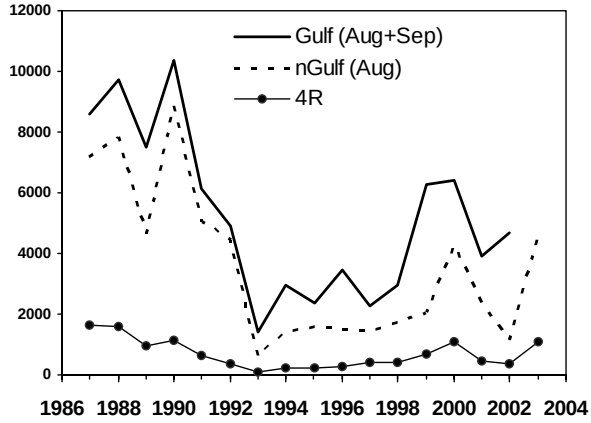
Resource Status

A biomass index for commercial sizes (30+ cm) of witch flounder in 4RST is calculated for 1987-2002 by combining data from annual **research vessel (RV) surveys** conducted in the southern Gulf each September and in the northern Gulf each August. Adjustments are made for changes in vessel or gear based on comparative fishing experiments (1990 in the August survey and 1992 in the September survey). The adjusted index (the catch per tow expanded to the area surveyed) should reflect changes in witch flounder biomass over time but should not be taken as a measure of the actual biomass present in the area.

The biomass index for the southern Gulf portion of the stock area cannot be updated for 2003. The regular survey vessel, the CCGS *Alfred Needler*, was disabled shortly before the September survey and was replaced by the CCGS *Wilfred Templeman*. The relative fishing efficiency of the two vessels is unknown. Furthermore, portions of the survey area, including important witch flounder habitat, were either unsampled or under-sampled in 2003. The mean catch rate of witch flounder in the 2003 September survey was 0.49 kg/tow, only 17% of the 1995-2002 average for a comparable survey area. The extent to which this decline reflects a difference in fishing efficiency between the two vessels is unknown. Data from the September survey are used here only to examine geographic distribution and size composition of witch flounder in 2003.

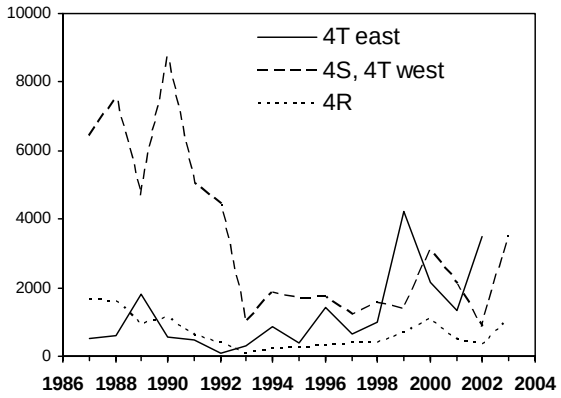
A sharp decline in witch flounder biomass occurred in the Gulf (4RST) from 1990 to 1993. The index of biomass remained at a low but steady level from 1993 to 1998. It increased to an intermediate level in 1999 and 2000 but returned to a lower level in 2001 and 2002. Biomass in the area covered by the August survey (primarily the northern Gulf) was at an intermediate level in 2003. This reflected increases in the index in both 4R and portions of 4ST (primarily the St. Lawrence Estuary).

Biomass index (30+ cm) from the August and September research vessel surveys



Changes in biomass have not occurred uniformly throughout the stock area. The decline in biomass in the early 1990s occurred primarily in 4R, 4S and western 4T. Although biomass has recovered somewhat in these areas in recent years, particularly in 4R, it remains below the levels seen in the late 1980s. In contrast, biomass has been relatively high in eastern 4T in recent years, averaging over twice the 1987-1990 level. The biomass index cannot be determined for eastern 4T in 2003, though sentinel survey catch rates (see sentinel survey section) indicate that witch flounder biomass was relatively high in this area compared to other areas of the Gulf in 2003.

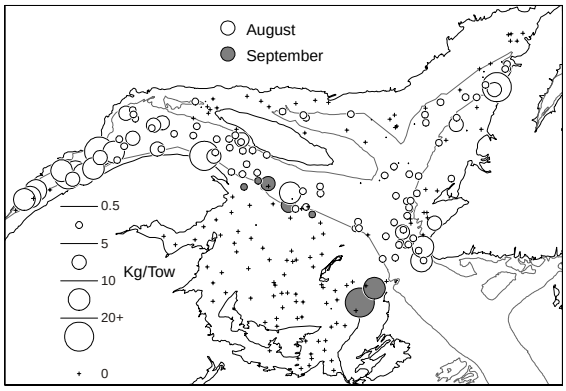
Research survey biomass index (30+ cm) by area



(part of 4S, 4T west missing in 2003)

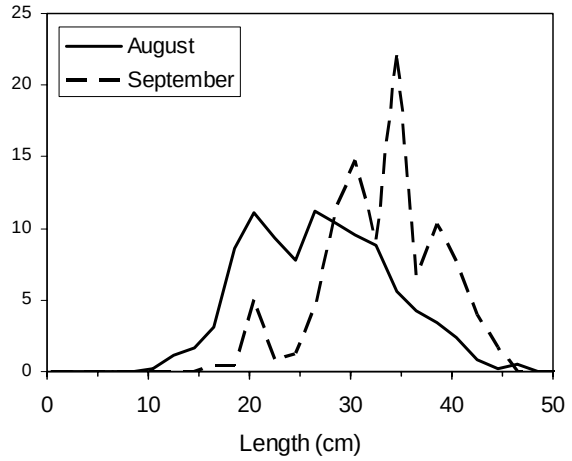
Catch rates of witch flounder in the RV surveys in 2003 tended to be highest in the Estuary, along the southern slope of the Laurentian Channel, in the Cape Breton Trough and along the west coast of Newfoundland.

Catches of witch flounder in the 2003 research vessel surveys



Juvenile witch flounder occur in the deep channels in the Gulf. Adults also occupy deep waters in winter but move into shallower areas to feed in summer. The August survey covers the deep areas of the Gulf while the Magdalen Shallows comprises most of the area covered by the September survey. Juveniles comprise a high proportion of catches in the August survey. In contrast, catches in the September survey consist primarily of adults of commercial size (30 cm).

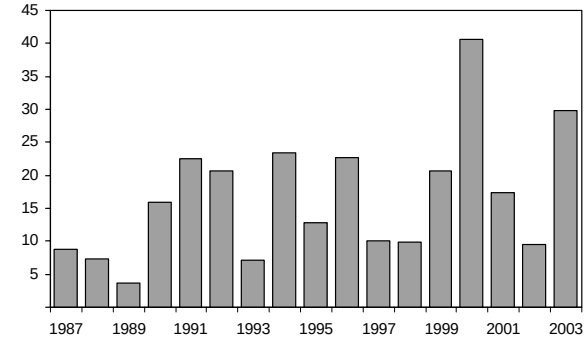
Length distributions (%) of witch flounder caught in the 2003 research vessel surveys



(August data adjusted to size selectivity of gear used in September)

Pre-recruit abundance (fish 16-29 cm in length) in the August RV survey fluctuated without trend between 1990 and 2003, with particularly high values in 2000 and 2003. Pre-recruit abundance has tended to be high since 1990 relative to the late 1980s. However, the trawl used in the August survey changed in 1990 to one that is more efficient at catching small witch flounder. Although adjustments for this change in efficiency have been included in these analyses, based on the results of comparative fishing experiments, it is possible that these adjustments have not been entirely effective. Moreover, the time series of pre-recruit abundance is short, and it is unknown how recent values compare to the longterm average.

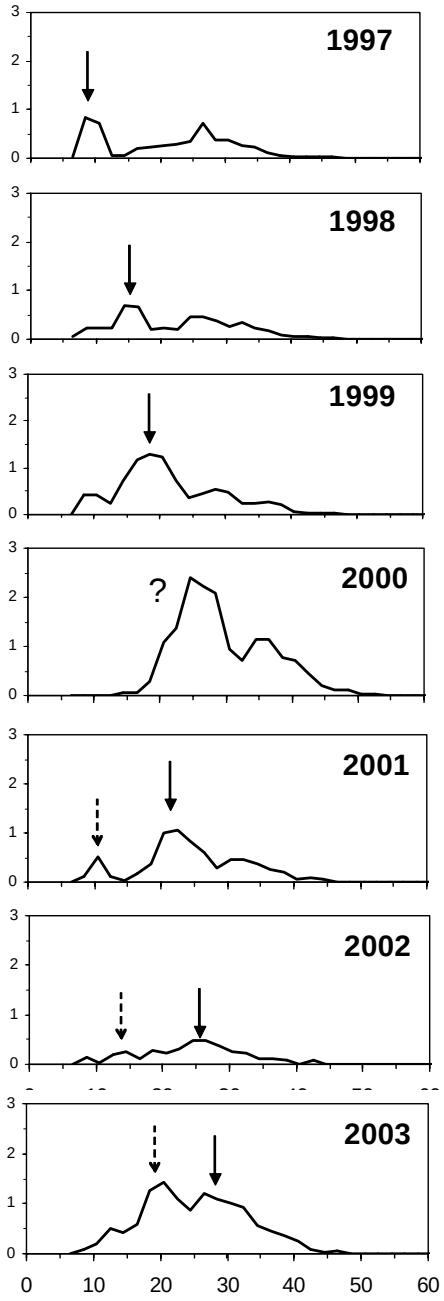
Pre-recruit abundance index



Catches in the August RV survey suggest the appearance of a strong year-class in the

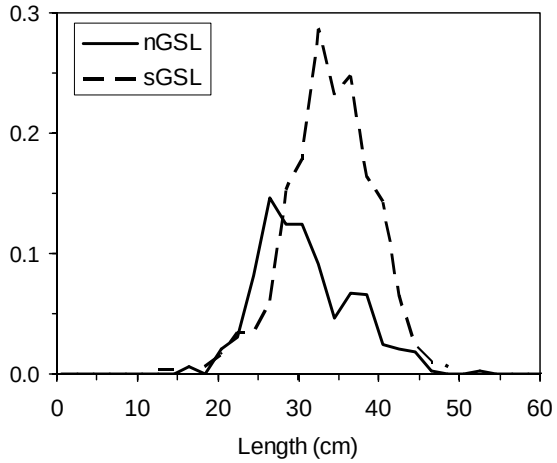
late 1990s. This year-class has been appearing at progressively larger sizes in the survey in most years since 1997 and may now be recruiting to commercial sizes. Length frequencies in the August survey also suggest a second strong year-class, first evident in 2001.

Length composition (mean number / tow) of witch flounder catches in the August research vessel survey (arrows track strong year-classes)



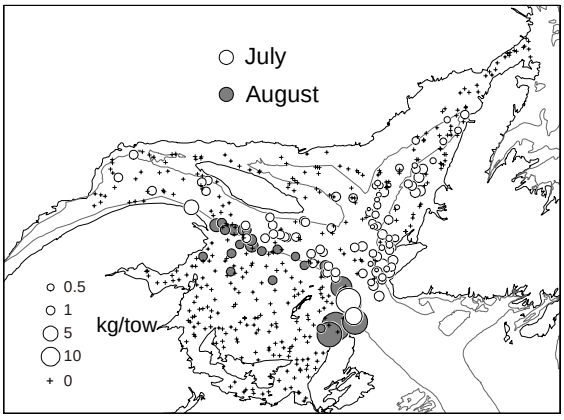
Sentinel surveys have been conducted in the northern Gulf of St. Lawrence in July since 1995 and in the southern Gulf in August beginning in 2003. These surveys provide a second view of witch flounder distribution over much of the management unit, though they do not cover the Estuary west of about 67°W, an area where RV catch rates are often high. As in the RV surveys, juveniles comprise a higher proportion of catches in the northern Gulf sentinel survey than in the southern Gulf survey, reflecting its greater coverage of juvenile habitats. However, vulnerability of small fish is lower to the sentinel survey gear than to the RV survey gears, and few fish smaller than 20 cm are caught in the sentinel surveys.

Length distributions (number/tow) of witch flounder caught in the 2003 sentinel surveys



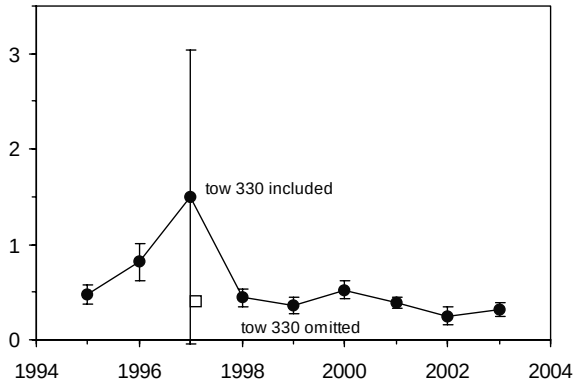
In the 2003 sentinel surveys, the largest catches of witch flounder occurred in the Cape Breton Trough and along the southern slope of the Laurentian Channel off northwestern Cape Breton.

Catches of witch flounder in the 2003 sentinel surveys of the northern (July) and southern (August) Gulf of St. Lawrence



Catch rates in the July sentinel survey reveal no clear trends in witch flounder biomass in the northern Gulf between 1995 and 2003. The high catch rate in the 1997 survey is due to a single tow. The increase in biomass suggested by including this tow in the index is not supported by the mean catch rates in subsequent years. In contrast to the August RV survey, catch rates in the July sentinel survey provide no indication of an increase in biomass since the mid 1990s, though this may reflect differences in the area covered or in the lengths included in the index.

Catch rates (kg/tow, ±1SE) of witch flounder in the July sentinel survey of the northern Gulf of St. Lawrence



Catch rates in the October sentinel survey of the northern Gulf, conducted from 1995 to 2002, have also fluctuated without trend between 1995 and 2002. The mean catch rate in this survey was relatively high in 2000 and low in 2002. This survey was discontinued after 2002.

Sources of Uncertainty

Stock structure is a major source of uncertainty for this resource, affecting the interpretation of the regional differences observed in biomass trends in the Gulf. Biomass declines in the early 1990s were restricted to 4R, 4S and western 4T. Survey catch rates in eastern 4T (primarily in the Cape Breton Trough) have tended to be high since the mid 1990s. If witch flounder comprise a single stock over the 4RST area, these high catch rates in the Cape Breton Trough reflect a shift in distribution, with an increased proportion of the stock concentrated in this part of their range. On the other hand, witch flounder in the Cape Breton Trough may be linked to those in NAFO div. 4VW. A number of exceptionally strong year-classes have been produced on the Scotian Shelf in the 1990s, perhaps contributing to the increase in abundance of larger witch flounder in the Cape Breton Trough.

The lack of a biomass index for the southern Gulf portion of the stock area is a major source of uncertainty in 2003. The increase in biomass in the northern Gulf in 2003 could reflect a shift in distribution from the southern Gulf rather than an overall increase in stock biomass. The witch flounder catch rate was low in the southern Gulf RV survey in 2003, but this may reflect the change in vessel or a year effect associated with the low sampling intensity in 2003. Sentinel survey catches indicated that witch flounder biomass in eastern 4T was high in 2003 relative to other areas of the Gulf.

The subsequent declines in RV survey catch rates suggest that the large increase in the survey biomass index for eastern 4T in 1999 and for the northern Gulf in 2000 may reflect changes in catchability. Contradictory results between the July sentinel survey and the August RV survey, with biomass increasing since the mid 1990s in the RV survey but not

in the sentinel survey, are an additional source of uncertainty.

The apparent increase in pre-recruit abundance in the 1990s relative to the late 1980s is uncertain because the trawl used in the northern Gulf RV survey changed in 1990. Adjustments for the differences in fishing efficiency between the trawls used before and since 1990 may not have been entirely effective.

Outlook

The RV survey biomass index for 4RST witch flounder increased from a low level in the mid 1990s to an intermediate level in recent years. Most of this improvement reflected a high biomass in the Cape Breton Trough area of eastern 4T. A biomass index for the whole stock area could not be calculated for 2003 due to difficulties with the southern Gulf survey, though the index from the northern Gulf survey suggests that biomass remains at an intermediate level or higher in 2003. The interpretation of the high biomass in eastern 4T in recent years depends on stock structure, which is uncertain. Nonetheless, two strong year-classes have been observed in the northern Gulf research survey since 1997. The older of these year-classes appears to be recruiting to commercial sizes now. If this indication of strong incoming recruitment persists, the witch flounder resource in 4RST should soon improve.

For More Information

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References

Bowering, W.R., and W.B. Brodie. 1984. Distribution of witch flounder in the northern Gulf of St. Lawrence and changes in its growth and maturity patterns. North Am. J. Fish. Manag. 4: 399-413.

DFO, 2001. Witch Flounder (Divs. 4RST). DFO Science Stock Status Report A3-20 (2001).

DFO, 2003. Witch Flounder (Divs. 4RST). DFO Science Stock Status Report A3-20 (2003).

Poirier, G. A., and L. Currie. 2004. Results from the August 2003 Sentinel Mobile Survey of the Southern Gulf of St. Lawrence. DFO Can. Science Advisory Sec. Res. Doc. 2004/014.

Poirier, G.A., T. Hurlbut, D.P. Swain, G.A. Chouinard, H.P. Benoît, C. LeBlanc, and L. Currie. 2003. Preliminary results from the September 2003 bottom-trawl survey of the Southern Gulf of St. Lawrence. DFO Can. Science Advisory Sec. Res. Doc. 2003/112.

Swain, D.P., and G.A. Poirier. 2001. Status of witch flounder in NAFO Divisions 4RST, February 2001. DFO Can. Stock Assess. Sec. Res. Doc. 2001/021.

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