G. Witch Flounder by S. E. Wigley

1.0 Background

Witch flounder, *Glyptocephalus cynoglossus*, are assessed as a unit stock from the Gulf of Maine southward. An analytical assessment was conducted on this species in 1999 (Wigley et al. 1999) and reviewed at SAW 29 (NEFSC 1999).   At that time, average fishing mortality (ages 7-9, unweighted) increased from 0.21 in 1982 to 0.59 in 1985, declined to 0.24 in 1990, increased to 0.86 in 1996, then declined to 0.37 (F on 3+ biomass was 0.13) in 1998.   Mean 3+ biomass declined steadily from 27,930 mt in 1982 to 7,742 mt in 1994, then sharply increased to 18,934 mt by 1998. Spawning stock biomass declined from 18,000 tons in 1982 to about 4,000 tons in 1993 and then increased sharply to 8,600 mt in 1998. However, spawning stock biomass was at a low level relative to the long-term survey biomass indices. Since 1982, recruitment at age 3 has ranged from approximately 3 million fish (1984 year class) to 38 million fish (1996 year class) with a mean of 14 million fish. Recent recruitment had been above average, and the 1995 and 1996 year classes were estimated to be among the highest in the time series.

Assuming 1999 catches will equal 1998 catches, the 1999 fully recruited fishing mortality rate was estimated to be 0.20, and the target fishing mortality (F on biomass) prescribed by the control rule for the 1999 stock size was 0.096, which was approximately equivalent to 0.19 on fully recruited ages assuming the current age structure of the population (NEFSC 1999). The estimated mean 3+ biomass in 1999 was projected to be 26,048 mt (above the overfishing threshold and near Bmsy) and the F on 3+ biomass was estimated to be 0.096 (slightly lower that the overfishing threshold and near F target). Based in the 1999 estimates, the stock was considered to be near target biomass and fishing mortality levels (NEFSC 1999).

2.0 The Fishery

Historically, significant proportions of the U.S. nominal catch have been taken both on Georges Bank and in the Gulf of Maine; but in recent years most of the U.S. catch has come from the Gulf of Maine area. Canadian landings from both areas have been minor (never more than 68 mt annually). Distant-water fleet catches averaged 2,700 mt in 1971-1972, but subsequently declined sharply and have been negligible since 1976. Total landings peaked at more than 6,000 mt in 1971, declined to an annual average of 2,800 mt during 1973-1981, and then increased sharply to 6,700 mt in 1984. Landings then declined steadily to only 1,500 mt in 1990, the lowest value since 1964. Landings for 1991-1998 averaged 2,200 mt annually. Total landings in 1999 were 2,123 mt (Table G1, Figure G1), 15% higher than the estimated landings used in the 1999 assessment. Based upon the 1998 percentage of discard/landings (18%), discard weight in 1999 was estimated to be 382 mt.

3.0 Research Vessel Survey Indices

The NEFSC autumn bottom trawl survey biomass index declined from an average of 3.6 kg per tow in 1966-1970 to 0.9 kg per tow in 1976 following heavy exploitation by distant-water fleets. The index increased in 1977-78 but then declined to 0.2 kg per tow in 1992, the lowest level on record. Since 1993, the survey biomass index has remained at low levels, averaging 0.7 kg per tow. The 1999 biomass index was 0.9 kg per tow (Table G2, Figure G1). The maximum age of witch flounder observed in the 1999 research vessel surveys was age 10, the lowest maximum age in the 20 year time series, indicating the age structure of the population remains truncated. The low number of older fish may adversely impact the stock's reproductive potential output.

4.0 Assessment Results

Results of the projection analysis indicate that the 1999 fully recruited F was 0.23 (0.18 - 0.30 with 80% confidence) and that F on 3+ biomass was 0.109. The 1999 assumed fully recruited F (0.2) from the previous assessment was slightly lower, but falls within the confidence band of the current analysis. The 1999 mean 3+ biomass was 25,509 mt (19,235 - 34,631 mt with 80% confidence), slightly lower than the estimate from the previous assessment (26,048 mt), but within the confidence band of the current analysis (Table G3, Figure G2). The index assessment presented above reveals that landings and survey trends have remained stable indicating that no substantial change in stock status has occurred since the last analytical assessment.

5.0 Harvest Control Rule

The harvest control rule for witch flounder states that when the stock biomass exceeds B_{msy}, the overfishing threshold is F_{msy}, and target F is the lower 80th percentile (or 10th percentile) of F_{msy}. When stock biomass is less than B_{msy}, the overfishing threshold is based on maximum F that would allow rebuilding to B_{msy} in five years. When biomass is less than the biomass threshold, F = 0. The biomass threshold is defined by the minimum stock size that is projected to rebuild to B_{msy} in 5 years at F=0. The harvest control rule was updated during the 1999 analytical assessment with revised estimates of F_{msy} (0.106), B_{msy} (25,000 mt), biomass threshold (13,200 mt) and the tenth percentile of F_{msy} (0.090). MSY is estimated as 2,684 mt (Figure G2).

6.0 Sources of Uncertainty

- VPA results indicate the mean biomass 3+ trend has increased in recent years and is near Bmsy, however, the survey biomass indices have remained low. This inconsistency may be due to the variability in age at full recruitment to the survey sampling gear, and/or Bmsy may not be well estimated.

- The sources of uncertainty associated with the 1999 assessment identified by the SARC/SAW 29 are still unsolved, and are listed in NDWG 2000.

7.0 References

Burnett, J. and S.H. Clark. 1983. Status of witch flounder in the Gulf of Maine - 1983. NMFS/NEFC, Woods Hole Laboratory Ref. Doc. No. 83-36, 31 p.

Lange, A.M.T. and F.E. Lux. 1978. Review of the other flounder stocks (winter flounder, American plaice, witch flounder, and windowpane flounder) off the northeast United States. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 78-44, 53 pp.

NDWG [Northern Demersal Working Group, Northeast Regional Stock Assessment Workshop]. 2000. Assessment of 1 Northeast groundfish stocks through 1999: Report to the New England Fishery Management Council's Multispecies Monitoring Committee. Northeast Fish. Sci. Cent. Ref. Doc. 00-05; 175 p.

NEFSC [Northeast Fisheries Science Center]. 1999. Report of the 29th Northeast Regional Stock Assessment Workshop (29th SAW), Stock Assessment Review Committee (SARC) consensus summary of assessments. Northeast Fish. Sci. Cent. Ref. Doc. 99-14, 347 p.

Wigley, S.E., J. K.T. Brodziak, and S.X. Cadrin. 1999. Assessment of the witch flounder stock in Subareas 5 and 6 for 1999. Northeast Fish. Sci. Cent. Ref. Doc. 99-16, 153 p.

Table G1. Witch flounder landings, discards and catch (metric tons, live) from Subareas 5 and 6, by country, 1960-1999 [1960-1963 reported to ICNAF/NAFO (Burnett and Clark, 1983)].

Year	Canada	USA[2]	Other[1]	Total	Discards	Total USA Catch (used in VPA)
1960	-	1255	-	1255		
1961	2	1022	-	1024		
1962	1	976	-	977		
1963	27	1226	121	1374		
1964	37	1381	-	1418		
1965	22	2140	502	2664		
1966	68	2935	311	3314		
1967	63	3370	249	3682		
1968	56	2807	191	3054		
1969	-	2542	1310	3852		
1970	19	3112	130	3261		
1971	35	3220	2860	6115		
1972	13	2934	2568	5515		
1973	10	2523	629	3162		
1974	9	1839	292	2140		
1975	13	2127	217	2357		
1976	5	1871	6	1882		
1977	11	2469	13	2493		
1978	18	3501	6	3525		
1979	17	2878	-	2895		
1980	18	3128	1	3147		
1981	7	3442	-	3449		
1982	9	4906	-	4915	48	4953
1983	45	6000	-	6045	162	6162
1984	15	6660	-	6675	100	6760
1985	46	6130	-	6176	61	6191
1986	67	4610	-	4677	25	4635
1987	23	3450	-	3473	47	3497
1988	45	3262	-	3307	60	3322
1989	13	2074	-	2087	133	2207
1990	12	1478	-	1490	184	1662
1991	7	1798	-	1805	95	1893
1992	7	2246	-	2253	171	2417
1993	10	2605	-	2615	376	2981
1994	34	2670	-	2704	422	3092
1995	11	2212	-	2223	265	2477
1996	10	2088	-	2098	454	2542
1997	7	1775	-	1782	393	2168
1998	*	1849	-	1849	334	2184
1999	*	2123	-	2123	*382*[3]	*2505*[3]

[1] Includes West Germany, East Germany, Poland, Spain, Japan, & the former USSR.
[2] excluding landings from Grand Banks (subarea 3).
* 1998 and 1999 Canadian landings not available.
[3] 1999 USA discards estimated by applying the 1998 percentage of discards/landings (18%).

Table G2.   Stratified mean number, weight (kg) and length (cm) per tow of witch flounder in NEFSC offshore spring
and autumn bottom trawl surveys in Gulf of Maine-Georges Bank region (strata 22-30,36-40), 1963-1999.

| YEAR | SPRING | | | AUTUMN | | |
	Number per tow	Weight per tow	Length per tow	Number per tow	Weight per tow	Length per tow
1963	-	-	-	5.52	3.46	39.7
1964	-	-	-	2.89	2.00	44.2
1965	-	-	-	3.94	2.27	40.6
1966	-	-	-	7.80	4.56	41.2
1967	-	-	-	3.01	2.02	43.6
1968	4.76	3.34	42.5	4.82	3.49	44.8
1969	3.74	2.53	45.3	5.81	4.40	43.9
1970	6.39	4.49	44.7	4.89	3.71	45.0
1971	2.74	2.06	46.5	4.32	2.95	42.1
1972	5.35	4.01	45.8	3.24	2.42	43.9
1973	8.20	6.21	44.8	3.18	2.05	43.6
1974	6.23	3.62	39.3	2.34	1.54	40.9
1975	3.72	2.75	43.9	1.66	1.03	39.8
1976	5.50	3.70	42.3	1.34	0.94	41.9
1977	4.20	1.96	37.2	5.06	3.38	42.0
1978	3.87	2.56	41.7	4.04	2.94	42.9
1979	3.01	1.77	38.3	1.94	1.62	45.2
1980	8.46	3.89	36.0	2.62	2.04	43.6
1981	8.40	4.18	38.1	3.66	2.19	40.4
1982	3.64	1.87	37.2	0.99	0.83	44.7
1983	6.41	2.74	36.3	4.72	2.12	36.7
1984	3.00	1.66	39.9	4.37	2.34	39.7
1985	5.18	2.75	40.3	2.76	1.59	42.0
1986	2.07	1.35	44.1	1.59	1.09	43.3
1987	1.01	0.65	43.4	0.48	0.37	44.0
1988	1.43	0.85	42.3	1.38	0.57	35.2
1989	1.95	0.74	35.8	0.89	0.38	31.3
1990	0.63	0.24	35.2	2.00	0.40	24.8
1991	1.68	0.57	31.5	2.08	0.54	29.3
1992	1.26	0.50	34.8	0.94	0.24	29.5
1993	1.47	0.36	30.3	5.15	0.54	17.0
1994	3.13	0.53	27.4	2.21	0.42	24.9
1995	1.88	0.47	30.7	4.47	0.62	25.7
1996	1.36	0.28	30.5	5.38	1.02	29.7
1997	2.22	0.43	31.0	5.10	0.77	24.9
1998	4.27	0.77	29.0	3.70	0.47	24.2
1999	3.15	0.48	28.1	5.92	0.88	26.3
2000	3.45	0.52	27.3			

Note: During 1963-1984, BMV oval doors were used in the spring and autumn surveys; since 1985, Portuguese polyvalent doors have been used in both surveys. No significant differences in catchability were found for witch flounder, therefore no adjustments have been made (Byrne and Forrester, MS 1991). No significant differences were found between research vessels, and no adjustment have been made (Byrne and Forrester, MS 1991). Spring surveys during 1973-1981 were accomplished with a 41 Yankee trawl; in all other years, a 36 Yankee trawl was used. No adjustments have been made.

Table G3.   Input data and results of 1999 projection for witch flounder.

```
Input:
July2000 Witch fld
      1999
        11
       100
     12345
         0
         1
         1
         0
         0
         0
         0
         1
         0
         0
         0
         1
         0
         1
         1
         9 1 9
    0.150000
    0.056      0.140   0.247   0.357   0.484   0.615   0.764   0.908   1.319
    0.094      0.199   0.299   0.419   0.549   0.677   0.846   0.973   1.319
    0.030      0.078   0.149   0.189   0.235   0.235   0.235   0.235   0.235
    0.00       0.08    0.45    0.85    1.00    1.00    1.00    1.00    1.00
    0.16670
         3
        16
      15434000   17862000   15866000   7326000   4876000   2950000   9502000
    6359000  6871000    8949000  15279000  10906000  13869000  27833000
    26142000  20549000
       1000
boot54n.txt
      1000.000
 18124000 25000000 0.09
    0.013  0.073    0.233  0.473  1.00  1.00  1.00  1.00  1.00
    1.00  0.89     0.62  0.12   0      0       0      0      0
    1 0 0 0 0 0 0 0 0 0 0
    2505000 0 0 0 0 0 0 0 0 0 0
    0 0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11
```

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Results:

MIXTURE OF F AND QUOTA BASED CATCHES
YEAR   F       QUOTA (THOUSAND MT)
1999           2.505

SPAWNING STOCK BIOMASS (THOUSAND MT)
YEAR    AVG SSB (000 MT)     STD
1999         14.725          2.639
```

PERCENTILES OF SPAWNING STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1999	9.477	10.678	11.498	12.903	14.599	16.214	18.192	19.338	21.828

ANNUAL PROBABILITY THAT SSB EXCEEDS THRESHOLD: 18.124 THOUSAND MT

YEAR	Pr(SSB > Threshold Value)
1999	0.109

MEAN BIOMASS (THOUSAND MT) FOR AGES: 3 TO 9

YEAR	AVG MEAN B (000 MT)	STD
1999	26.539	6.820

PERCENTILES OF MEAN STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1999	14.783	17.531	19.235	22.092	25.509	29.601	34.631	39.870	48.923

ANNUAL PROBABILITY THAT MEAN BIOMASS EXCEEDS THRESHOLD: 25.000 THOUSAND MT

YEAR	Pr(MEAN B > Threshold Value)
1999	0.540

F WEIGHTED BY MEAN BIOMASS FOR AGES: 3 TO 9

YEAR	AVG F_WT_B	STD
1999	0.112	0.026

PERCENTILES OF F WEIGHTED BY MEAN BIOMASS FOR AGES: 3 TO 9

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1999	0.061	0.072	0.082	0.094	0.109	0.126	0.144	0.158	0.183

ANNUAL PROBABILITY THAT F WEIGHTED BY MEAN BIOMASS EXCEEDS THRESHOLD: 0.090

YEAR	Pr(F_WT_B > Threshold Value)
1999	0.814

RECRUITMENT UNITS ARE:1000. FISH

BIRTH YEAR	AVG RECRUITMENT	STD
1999	13157.602	7098.799

PERCENTILES OF RECRUITMENT UNITS ARE:1000. FISH

BIRTH YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1999	2950.000	2950.000	4876.000	7326.000	13869.000	15866.000	26142.000	27833.000	27833.000

LANDINGS FOR F-BASED PROJECTIONS

YEAR	AVG LANDINGS (000 MT)	STD
1999	2.505	0.000

PERCENTILES OF LANDINGS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1999	2.505	2.505	2.505	2.505	2.505	2.505	2.505	2.505	2.505

DISCARDS FOR F-BASED PROJECTIONS

YEAR	AVG DISCARDS (000 MT)	STD
1999	0.135	0.039

PERCENTILES OF DISCARDS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1999	0.069	0.080	0.090	0.107	0.129	0.158	0.185	0.206	0.248

REALIZED F SERIES FOR QUOTA-BASED PROJECTIONS

YEAR	AVG F	STD
1999	0.237	0.050

PERCENTILES OF REALIZED F SERIES

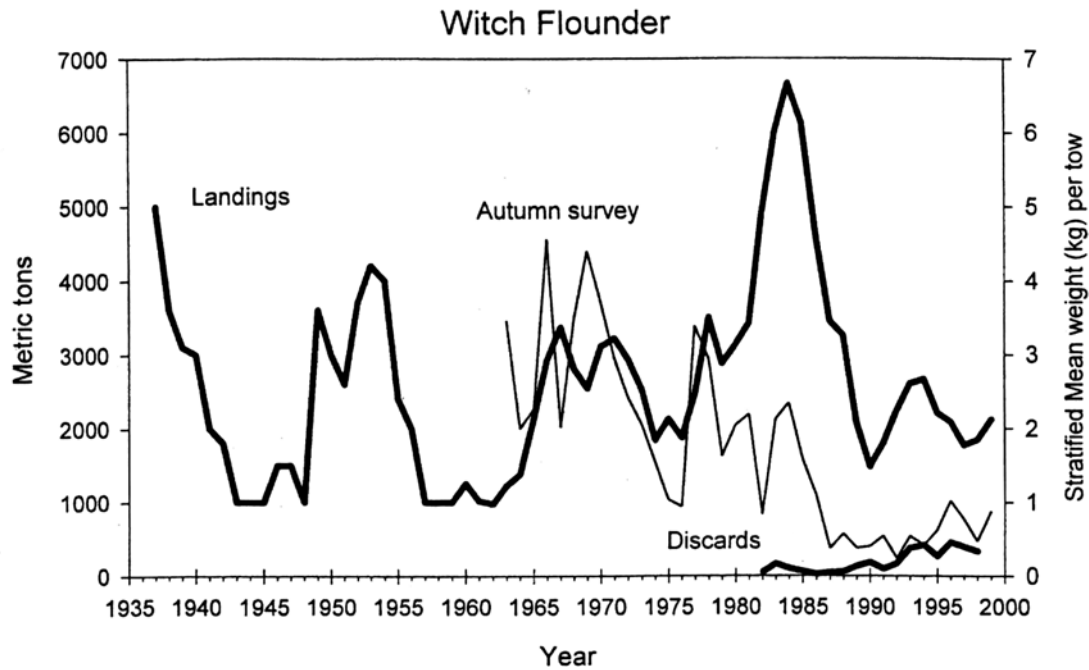| YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1999	0.143	0.166	0.178	0.202	0.229	0.267	0.300	0.327	0.379

Witch Flounder

Figure G1.   Trends in total landings and NEFSC autumn survey biomass indices for witch flounder (Note: USA landings from the Grand Banks have been excluded; landings prior to 1960 are provisional landings taken from Lange and Lux (1978).
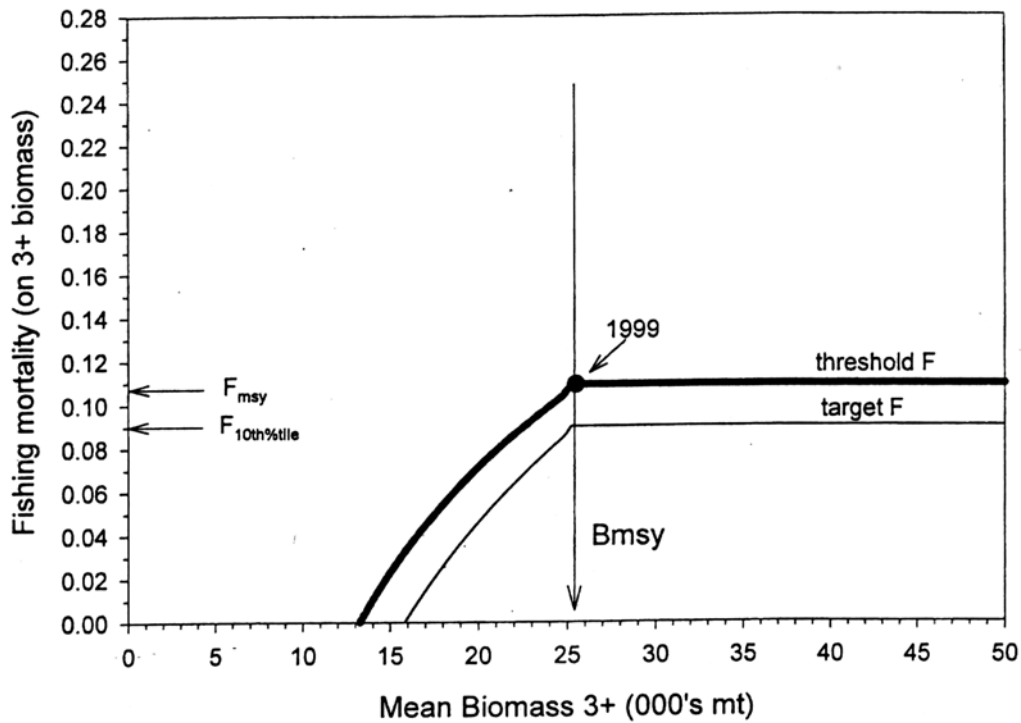

Figure G2.   Harvest control rule for witch flounder.