

## **R. Gulf of Maine Haddock** by Jon Brodziak and Michele Thompson

### **1.0 Background**

The Gulf of Maine haddock stock was last assessed in 2001 by the Northern Demersal Working Group (NEFSC 2001). Research survey indices indicated that stock biomass was increasing. In this report, we update the Gulf of Maine haddock assessment using fishery data for 2001 and available survey data for 2001-2002. Updated survey biomass and exploitation rate indices are used for stock status determination.

### **2.0 Assessment for 2002**

#### 2.1 2001 Landings

US haddock landings were prorated into Georges Bank and Gulf of Maine stock components using a standard algorithm. US Gulf of Maine haddock commercial fishery landings totaled 1,190 mt in 2001, a 72% increase over 2000 (Table R1, Figure R1) and over 2.5 times the 1992-2000 average (451 mt). Despite the substantial increase, commercial landings in 2001 were still less than half of average landings during 1982-1991 (2,564 mt).

Provisional US recreational landings of Gulf of Maine haddock were extracted from MRFSS databases in 2001 (Scott Steinback, NEFSC, personal communication). Recreational landings totaled 203 mt in 2001, a 7% increase over 2000 landings and over three times average recreational landings since 1992 (Figure R1).

#### 2.2 Survey Indices

US spring survey indices were computed for 2001-2002 (Table B2, Figure B2) and US autumn survey indices were computed for 2001 (Table B2, Figure B2) using standardized data.

### **3.0 Assessment Results**

#### 3.1 Index-Based Results

An updated index-based assessment was conducted. The 3-year average of the NEFSC autumn survey biomass constituted the stock biomass index, except for 1963-1964 where one- and two-year averages were used (Table R3). Commercial fishery landings were used as the catch (Table R3). Observed exploitation rate indices were computed as the catch divided by the observed survey biomass index in each year. Smoothed exploitation rate indices used for stock status determination were computed as the catch divided by the 3-year average stock biomass index (Table R3, Figure R3). The smoothed exploitation rate index in 2001 was 0.115, an increase of roughly 20% over the 2000 index (0.095) and one-half of the  $F_{MSY}$  proxy (0.23).

#### 3.2 Sensitivity to Potential Trawl Warp Inconsistencies during 2000-2002

Measurements of NEFSC survey trawl warps in autumn 2002 suggested that right and left warps may have been offset by up to several feet during winter 2000 through spring 2002 surveys. To evaluate the sensitivity of index-based results to potential undercapture of fish, NEFSC autumn survey indices were arbitrarily adjusted upwards by 10%, 25%, and 100% for autumn 2000 and 2001. Results are summarized in Section 5.2 (Summary of Assessment Advice).

#### 4.0 Sources of Uncertainty

- Recruitment dynamics of the Gulf of Maine and Georges Bank haddock stocks may be linked. The amount of interchange between stocks is a source of uncertainty.

#### 5.0 Summary Stock Status

##### Biological Reference Points

For Gulf of Maine haddock, the stock biomass index ( $B_{MSY}$ ) and the proxy exploitation rate index ( $F_{MSY}$ ) to produce MSY are  $B_{MSY} = 22.17$  kg/tow and  $F_{MSY} = 0.23$  (NEFSC 2002). The overfished threshold ( $B_{THRESHOLD}$ ) for Gulf of Maine haddock is  $B_{THRESHOLD} = \frac{1}{2} B_{MSY} = 11.08$  kg/tow. The overfishing threshold ( $F_{THRESHOLD}$ ) for Gulf of Maine haddock is  $F_{THRESHOLD} = F_{MSY} = 0.23$ .

##### Stock Status in 2001

In 2001, the stock biomass index was 10.31 kg/tow (93% of  $B_{THRESHOLD}$  and 47% of  $B_{MSY}$ ) with a standard error of 4.08 kg/tow. Based on the point estimate of the biomass index, the Gulf of Maine haddock stock was overfished in 2001. In 2001, the exploitation rate index was 0.115 (50% of  $F_{THRESHOLD}$ ). Therefore, overfishing was not occurring on the Gulf of Maine haddock stock in 2001.

##### Projections

Projected catches to rebuild the Gulf of Maine stock were evaluated in spring 2002 (NEFSC 2002, Table 4.1.2). Projected catches for 2002-2009 were updated assuming a 10% annual increase in biomass from 2001 onwards with a constant exploitation rate index. Projected catches (rounded to the nearest 100 mt) were: 1,500 mt in 2002 and 2003; 1,700 mt in 2004; 1,800 mt in 2005; 2,000 mt in 2006; 2,200 mt in 2007; 2,500 mt in 2008; and 2,700 mt in 2009.

#### 6.0 References

Northeast Fisheries Science Center. 2001. Assessment of 19 Northeast groundfish stocks through 2000. NEFSC Reference Document 01-20, Woods Hole, MA, 02543.

Northeast Fisheries Science Center. 2002. Final Report of the Working Group on Re-Evaluation of Biological Reference Points for New England Groundfish. NEFSC Reference Document 02-04, Woods Hole, MA, 02543.

Table R1. Commercial landings (mt, live weight) of haddock from the Gulf of Maine (NAFO Division 5Y; U.S. statistical areas 511-515) from 1956-2001.

Year	United States	Canada	USSR	Other	Total
1956	7278	29	--	--	7307
1957	6141	25	--	--	6166
1958	7082	285	--	--	7367
1959	4497	163	--	--	4660
1960	4541	383	--	--	4924
1961	5297	112	--	--	5409
1962	5003	107	--	--	5110
1963	4742	3	44	--	4789
1964	5383	70	--	--	5453
1965	4204	159	--	--	4363
1966	4579	1125	--	--	5704
1967	4907	589	--	--	5496
1968	3437	120	--	--	3557
1969	2423	59	--	231	2713
1970	1457	38	--	67	1562
1971	1194	85	--	27	1306
1972	909	23	4	--	936
1973	509	49	--	--	558
1974	622	198	--	9	829
1975	1180	79	--	4	1263
1976	1865	91	--	--	1956
1977	3296	26	--	--	3322
1978	4538	641	--	--	5179
1979	4622	257	--	--	4879
1980	7270	203	--	--	7473
1981	5726	513	--	--	6239
1982	5645	1278	--	--	6923
1983	5594	2003	--	--	7597
1984	2793	1245	--	--	4038
1985	2234	781	--	--	3015
1986	1443	225	--	--	1668
1987	829	--	--	--	829
1988	436	--	--	--	436
1989	264	--	--	--	264
1990	433	--	--	--	433
1991	431	--	--	--	431
1992	312	--	--	--	312
1993	193	--	--	--	193
1994 <sup>1</sup>	112	--	--	--	112
1995 <sup>1</sup>	192	--	--	--	192
1996 <sup>1</sup>	257	--	--	--	257
1997 <sup>1</sup>	616	--	--	--	616
1998 <sup>1</sup>	1018	--	--	--	1018
1999 <sup>1</sup>	668	--	--	--	668
2000 <sup>1</sup>	691	--	--	--	691
2001 <sup>1</sup>	1190	--	--	--	1190

<sup>1</sup> U.S. landings from 1994-2001 are provisional.

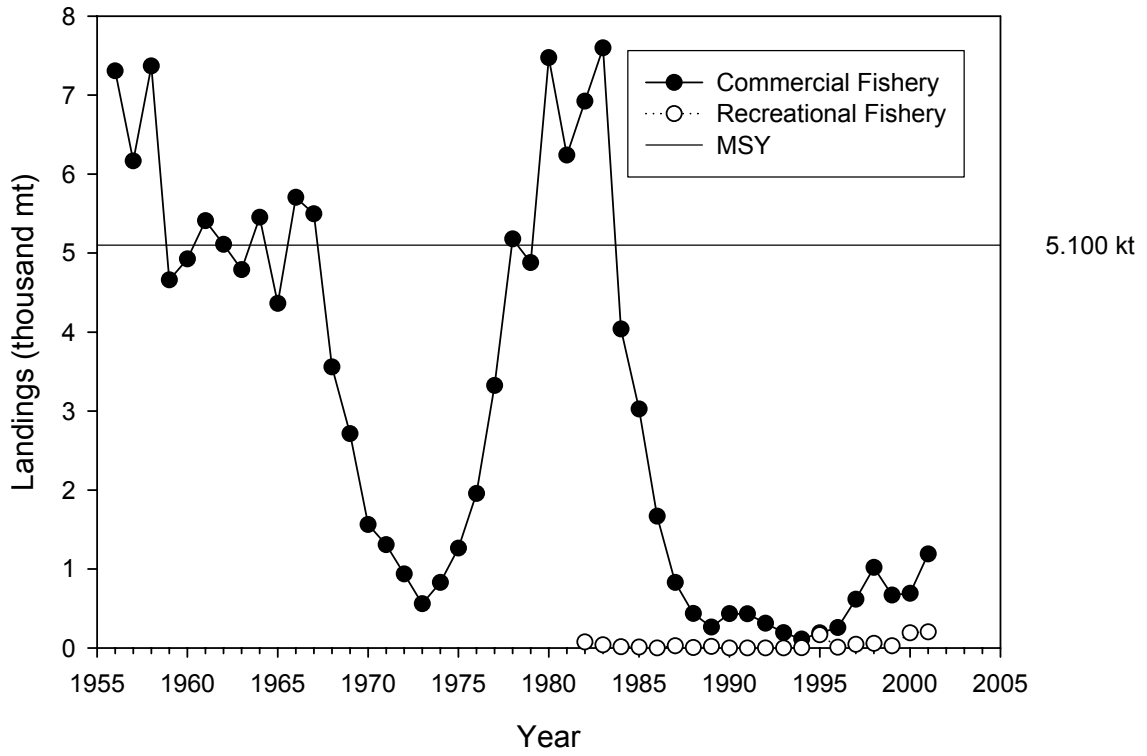
Table R2. Stratified mean catch number and weight (kg) per tow for haddock in NEFSC offshore spring and autumn research vessel bottom trawl surveys in the Gulf of Maine (Strata 01260-01280, 01360-01400), 1963-2002.

Year	Spring Number per Tow	Spring Weight per Tow	Autumn Number per Tow	Autumn Weight per Tow
1963			69.549	50.697
1964			14.176	18.829
1965			17.434	17.644
1966			11.652	13.859
1967			12.186	16.853
1968	6.008	7.887	7.648	15.484
1969	3.783	7.376	5.451	12.854
1970	0.906	1.725	2.918	7.354
1971	0.878	2.523	2.879	8.137
1972	0.862	0.867	1.984	3.036
1973	1.204	1.578	4.165	8.583
1974	1.437	1.059	2.687	3.347
1975	2.770	3.482	5.533	8.616
1976	8.326	6.350	6.035	8.040
1977	6.799	6.725	8.296	8.752
1978	1.356	1.434	9.163	20.932
1979	3.330	4.633	5.528	13.723
1980	2.697	3.383	7.152	9.835
1981	4.405	4.488	3.869	9.344
1982	2.047	2.555	2.627	4.164
1983	3.678	3.567	2.598	5.219
1984	1.095	1.144	1.696	3.893
1985	1.773	1.882	4.079	6.149
1986	0.707	1.284	0.623	1.392
1987	0.092	0.062	1.035	2.645
1988	0.187	0.301	0.335	1.476
1989	0.083	0.124	0.283	0.631
1990	0.024	0.000	0.145	0.432
1991	0.074	0.066	0.142	0.120
1992	0.193	0.271	0.211	0.091
1993	0.450	0.200	0.866	0.472
1994	0.402	0.253	0.325	0.217
1995	0.806	0.350	0.977	1.099
1996	0.305	0.338	2.407	3.543
1997	1.935	1.222	2.688	2.424
1998	0.197	0.112	3.130	2.917
1999	4.267	1.108	6.730	4.910
2000	3.610	1.815	16.589	14.032
2001	2.364	3.215	9.960	11.983
2002	5.704	2.794		

Table R3. Exploitation rate index for Gulf of Maine haddock based on autumn NEFSC survey biomass index and (3-year average, except for 1963-1964) and annual commercial landings, 1963-2001.

<b>Year</b>	<b>Landings</b>	<b>Survey Index</b>	<b>3-Year Average Survey Index</b>	<b>Annual Exploitation Rate Index Based on 3-Year Survey Index</b>
1963	4.789	50.697	50.697	0.094
1964	5.453	18.829	34.763	0.157
1965	4.363	17.644	29.057	0.150
1966	5.704	13.859	16.777	0.340
1967	5.496	16.853	16.119	0.341
1968	3.557	15.484	15.399	0.231
1969	2.713	12.854	15.064	0.180
1970	1.562	7.354	11.897	0.131
1971	1.306	8.137	9.448	0.138
1972	0.936	3.036	6.176	0.152
1973	0.558	8.583	6.585	0.085
1974	0.829	3.347	4.989	0.166
1975	1.263	8.616	6.849	0.184
1976	1.956	8.04	6.668	0.293
1977	3.322	8.752	8.469	0.392
1978	5.179	20.932	12.575	0.412
1979	4.879	13.723	14.469	0.337
1980	7.473	9.835	14.830	0.504
1981	6.239	9.344	10.967	0.569
1982	6.923	4.164	7.781	0.890
1983	7.597	5.219	6.242	1.217
1984	4.038	3.893	4.425	0.912
1985	3.025	6.149	5.087	0.595
1986	1.668	1.392	3.811	0.438
1987	0.829	2.645	3.395	0.244
1988	0.436	1.476	1.838	0.237
1989	0.264	0.631	1.584	0.167
1990	0.433	0.432	0.846	0.512
1991	0.431	0.12	0.394	1.093
1992	0.312	0.091	0.214	1.456
1993	0.193	0.472	0.228	0.848
1994	0.112	0.217	0.260	0.431
1995	0.192	1.099	0.596	0.322
1996	0.257	3.543	1.620	0.159
1997	0.616	2.424	2.355	0.262
1998	1.018	2.917	2.961	0.344
1999	0.668	4.910	3.417	0.195
2000	0.691	14.032	7.286	0.095
2001	1.190	11.983	10.308	0.115
Average 1963-2001	2.525	8.301	9.140	0.395

Figure R1. Gulf of Maine haddock commercial landings during 1956-2001 and provisional recreational landings during 1982-2001.



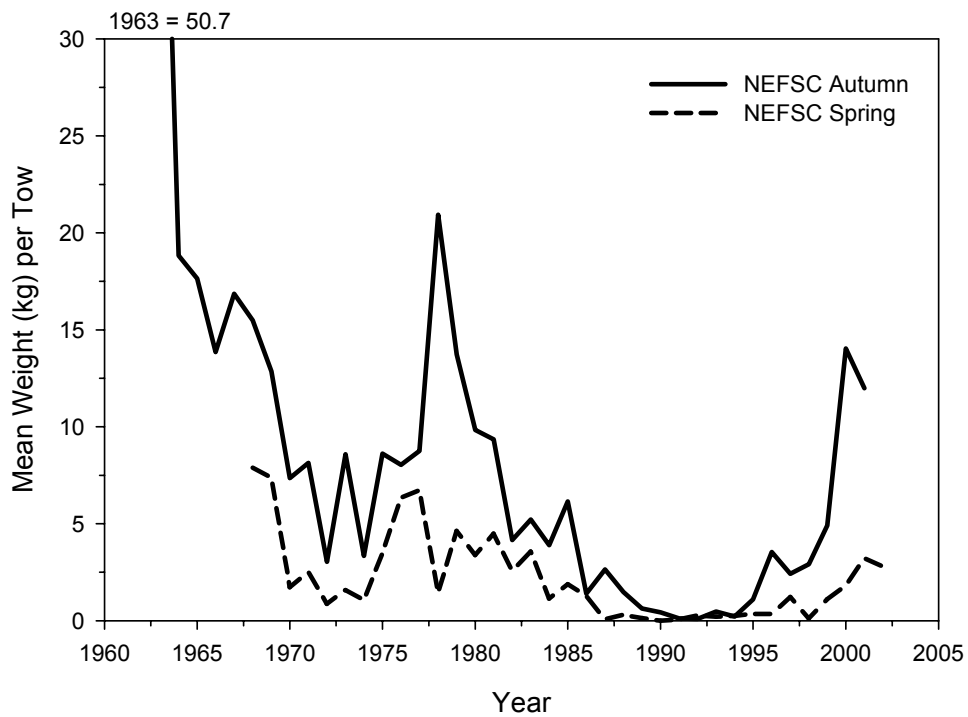
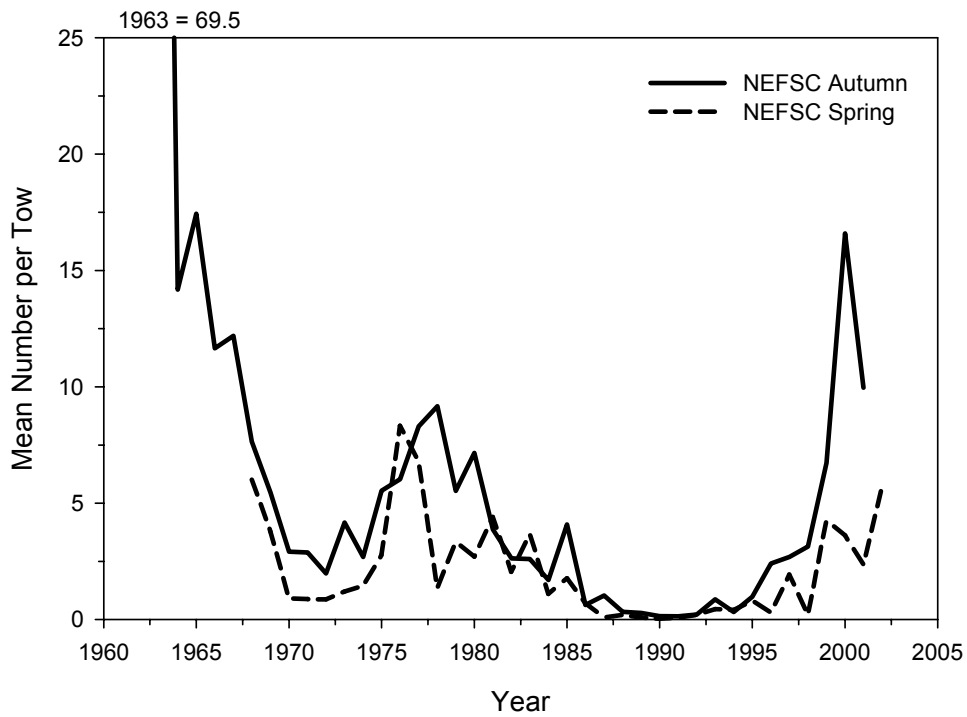


Figure R2. Northeast Fisheries Science Center research standardized and stratified survey abundance (mean number per tow; top panel) and biomass (kg per tow; bottom panel) indices for Gulf of Maine haddock from 1963-2002. U.S. survey includes strata 01260-01280 and 01360-01400.

Figure R3. Observed and smoothed exploitation rate indices for Gulf of Maine haddock, 1963-2001.

