NEW ENGLAND FISHERY MANAGEMENT COUNCIL

Herring PDT/TC Report

May 5, 2004
Holiday Inn, Mansfield, MA

The Herring Plan Development Team (PDT) met jointly with the ASMFC Herring Technical Committee (TC) on May 5, 2004 in Mansfield, MA to update stock and fishery information and develop recommendations regarding the specifications for the 2005 fishing year (January 1 – December 31, 2005). This Report includes the Herring PDT and TC's recommendations regarding the 2005 fishery specifications as well as updated stock/fishery information and supporting analyses.

PDT/TC Attendance: Lori Steele, NEFMC Staff, Herring PDT Chair; Megan Gamble, ASMFC Staff; Drew Kitts, Phil Logan, Patricia Pinto da Silva, Bill Overholtz, NEFSC; Clare McBane, NH FG; Myles Raizen, NMFS NERO; Matt Cieri, ME DMR and ASMFC Herring TC Chair; Kohl Kanwit, ME DMR; Madeleine Hall-Arber, MIT Sea Grant; Steve Correia, MA DMF.

Others Present: Lew Flagg, NEFMC Herring Committee and ASMFC Herring Section Chair; Leslie-Ann McGee, Pat Fiorelli, NEFMC Staff; Sarah Gurtman, Dave Tomey, Chad Demarest, David Stevenson, NMFS NERO; Mary Beth Tooley, ECPA; Dave Ellenton, Cape Seafoods, Herring Advisory Panel Chair; Richard Allen, ED; Jim Kendall, NBSC/NORPEL; Peter Moore, NORPEL.

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1.0 UPDATED STOCK INFORMATION

Research trawl surveys are conducted region-wide by the National Marine Fisheries Service (NMFS) and in inshore areas by the Massachusetts Division of Marine Fisheries (MA DMF) as well as the Maine Department of Marine Resources (ME DMR).

The Herring PDT and TC reviewed updated information related to the status of the Atlantic herring stock complex, including the inshore (GOM) and offshore (GB/NS) components of the resource. Available sources of information have been updated through 2003 and are presented in the subsections below.

1.1 NMFS TRAWL SURVEY – ALL STRATA

Table 1 summarizes spring and autumn data (mean weight per tow and mean number per tow) from the NMFS bottom trawl survey from 2000 – 2003. Both surveys have been quite variable over the time series. No trends are apparent from the most recent survey years, but the 2003 spring survey declined in both number and weight per tow. The autumn survey number per tow has increased significantly in the last two years, and while the weight per tow is somewhat variable, the decrease in weight per tow in 2003 suggests that the survey picked up a significant amount of smaller fish.

Table 1 NMFS Trawl Survey – Herring Catch Per Tow (Mean Number and Weight in kg), 1990-2003

YEAR	SPRING SURVEY		AUTUMN SURVEY	
	number/tow	kg/tow	number/tow	kg/tow
1990	8.98	0.92	13.98	1.64
1991	25.40	2.29	20.74	2.95
1992	39.30	2.76	56.48	9.25
1993	68.52	7.68	16.81	2.51
1994	35.40	3.88	13.56	2.15
1995	27.57	3.14	69.76	13.10
1996	58.58	3.81	37.53	4.64
1997	64.66	4.66	36.86	4.87
1998	50.62	4.72	20.63	2.84
1999	84.52	9.45	13.48	1.84
2000	33.34	2.92	20.65	3.18
2001	35.07	3.35	25.33	3.69
2002	42.09	2.70	77.99	10.74
2003	19.71	1.87	94.76	6.23

1.2 NMFS, MA DMF, AND ME DMR TRAWL SURVEYS – INSHORE ONLY (FISHERY-INDEPENDENT)

Since Fall 2000, Maine DMR, in conjunction with the Gulf of Maine Research Institute and the State of New Hampshire, have been conducting an inshore bottom trawl survey. While this survey targets principal groundfish species from the NH/MA boarder to Canada, it has regularly sampled herring. Data collected from the ME DMR survey is presented in Section 1.2.4 of this document.

A selected subset of NMFS and MA DMF trawl survey strata were chosen to represent trends in the inshore herring component during 1963-2003. NMFS strata 26-27,38-40 and Mass DMF strata 31-36 were used during spring and autumn (Figure 1 and Figure 2). In addition, the number of positive (non-zero) tows was also calculated for the NMFS spring and autumn surveys.

Figure 1 NMFS Trawl Survey Strata

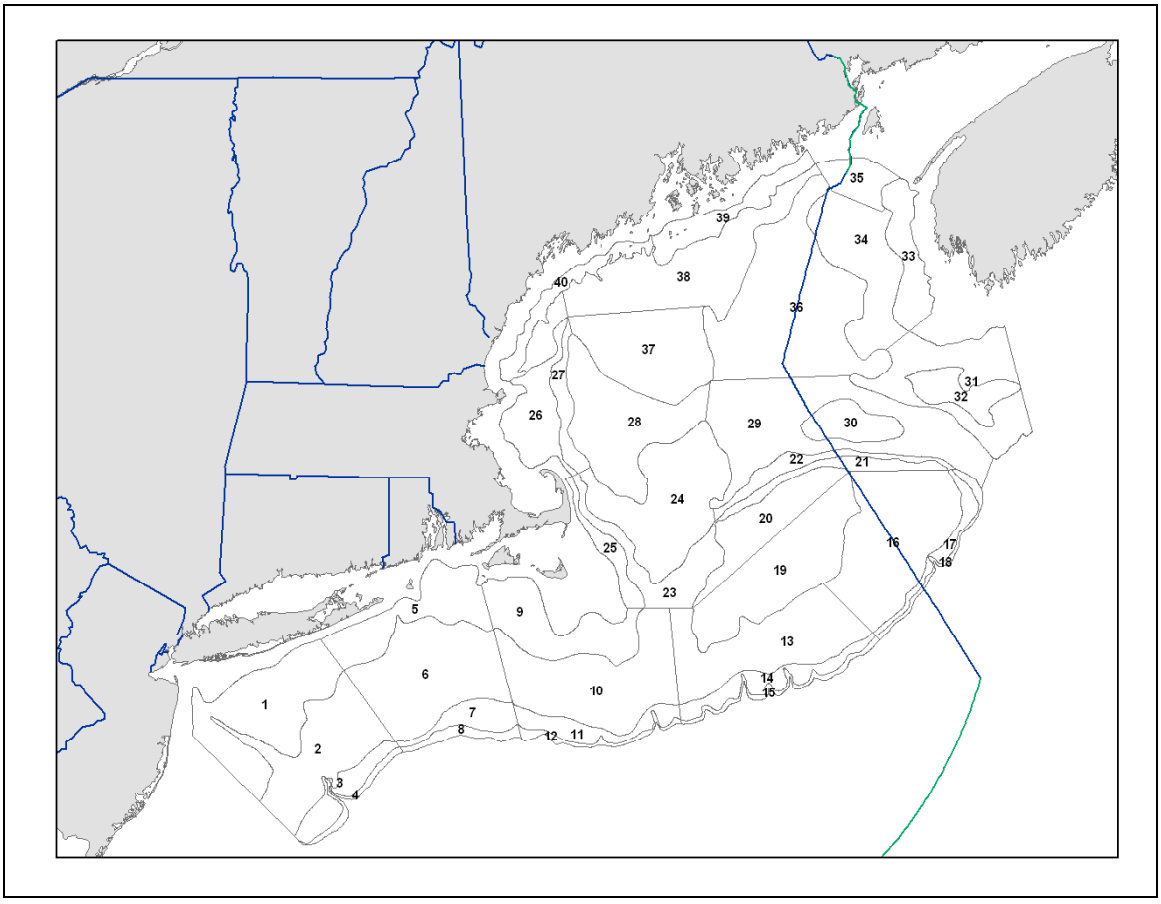
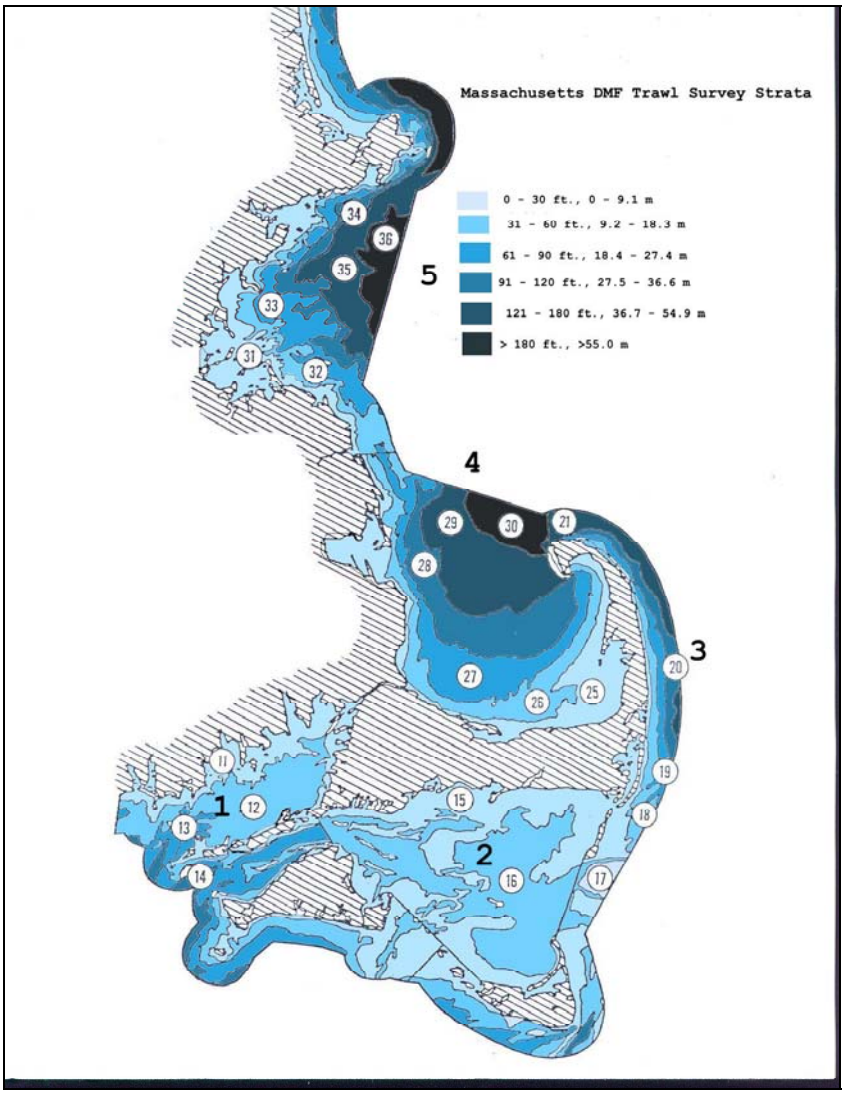


Figure 2 MA DMF Inshore Trawl Survey Strata



1.2.1 Encounter Rate in NMFS Trawl Survey

The encounter rate for herring in the spring NMFS research bottom trawl survey has increased during 1968-2003, as measured by an increase in the number of tows that encountered herring (called non-zero tows). The trend has increased linearly since 1968 and appears to be about three times higher now than during the late 1960s and early 1970s (Figure 3). In the autumn survey, the trend in non-zero tows was relatively flat during the 1960s and early 1970s and has increased by a factor of two since that time (Figure 4). Such an increase in encounter rate may suggest increased abundance. However, because herring is a schooling pelagic fish, it should be noted that an increase in the number of non-zero tows may reflect an increase in the number of schools of herring encountered during the survey and may not represent an increase in overall abundance.

Figure 3 Non-Zero Tows for NMFS Spring Survey for Herring in Strata 26-27, 38-40 (inshore), 1968-2003

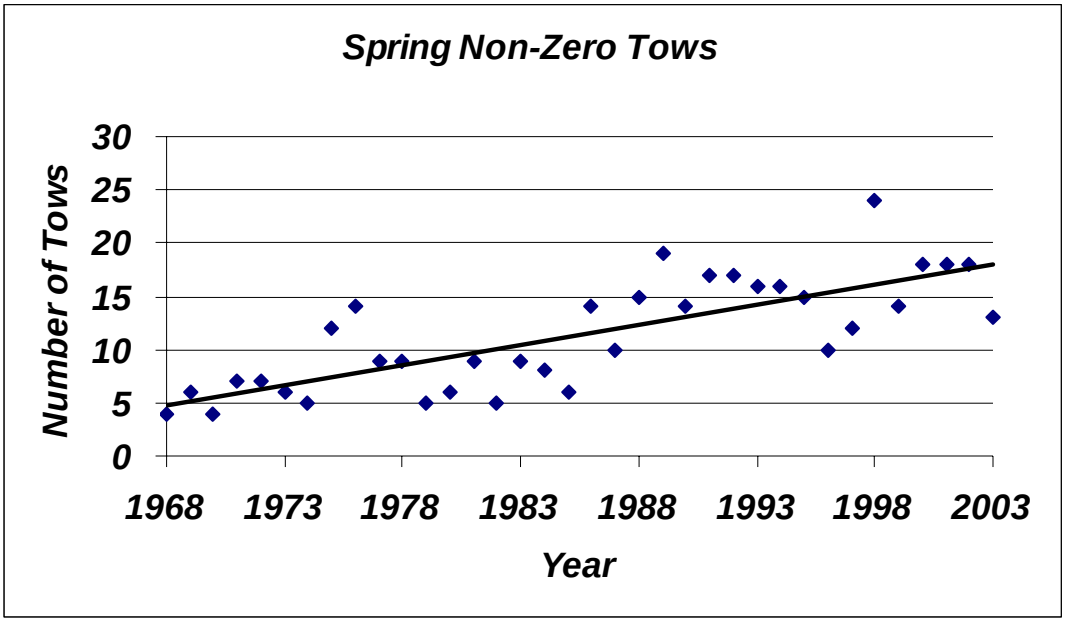
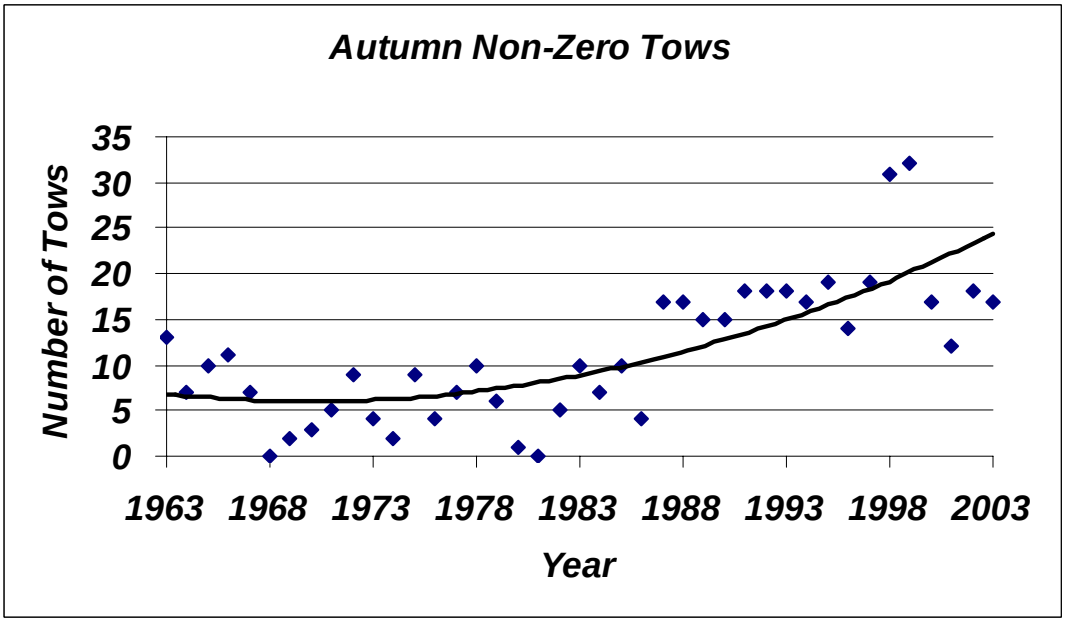


Figure 4 Non-Zero Tows for NMFS Autumn Survey for Herring in Strata 26-27,38-40 (inshore), 1963-2003



1.2.2 Catch Per Tow for the NMFS Trawl Survey

The NMFS spring survey was relatively flat, averaging a few fish per tow, during the late 1960s through the early 1980s (Figure 5). In the late 1980s, the index increased significantly, and although variable, has remained relatively high, averaging 40-50 fish per tow, since that time. The autumn survey time series for the inshore area was very low from 1963 to the mid-1980s (Figure 6). Since that time, the autumn survey index has increased to about an average of 50 fish per tow (2002 data excluded) and has remained relatively high (Figure 6). An increase in the number of fish per tow, when combined with an increase in the encounter rate (Section 1.2.1), is suggestive of increased relative abundance when compared to the 1980s. However, survey catch in number per tow from the time series is noisy and should be interpreted with caution.

Figure 5 Herring Catch/Tow (Number) Indices from the NMFS Spring Bottom Trawl Survey Strata 26-27,38-40 (inshore), 1968-2003

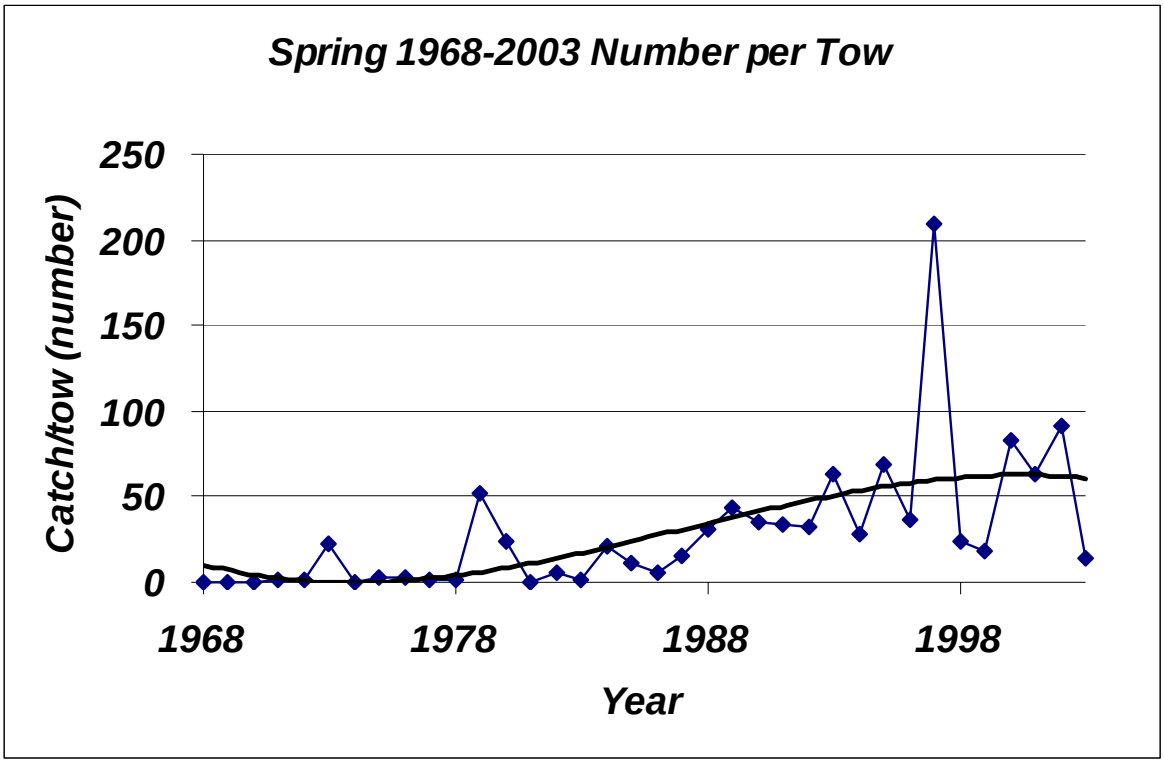
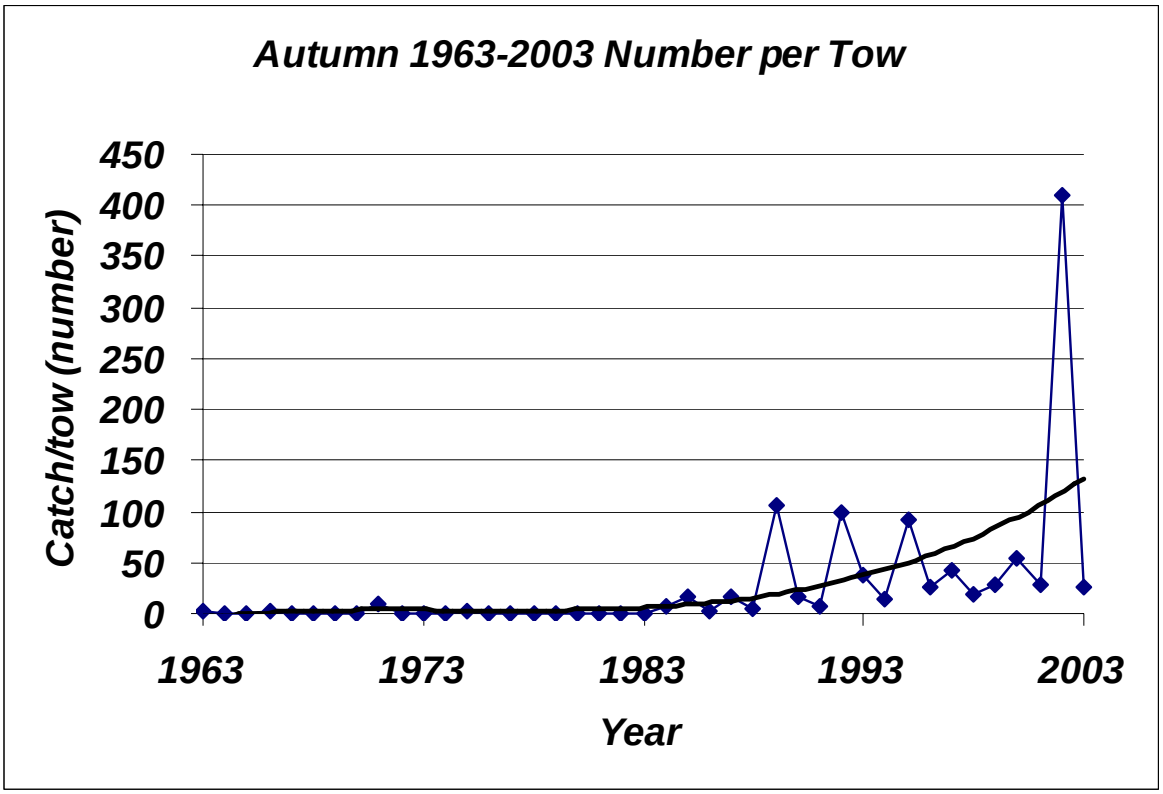


Figure 6 Herring Catch/Tow (Number) Indices from the NMFS Autumn Bottom Trawl Survey Strata 26-27,38-40 (inshore), 1968-2003



1.2.3 Catch Per Tow for the MA DMF Inshore Trawl Survey

The MA DMF research bottom trawl surveys for spring and autumn were also examined for trends in the inshore herring component. Both series are highly variable with no apparent trend (Figure 7, Figure 8). This suggests that this survey is not capturing any trend in adult herring abundance. These indices, however, may be useful as a measure of recruitment to the inshore component of the resource.

Figure 7 Herring Catch/Tow (Number) Indices from the MA DMF Spring Inshore Trawl Survey Strata 31-36, 1978-2002

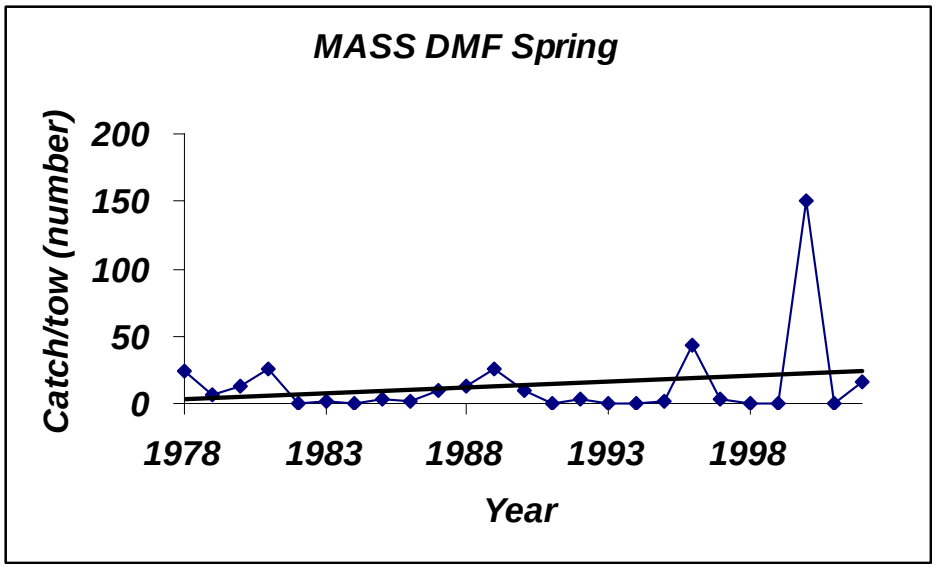
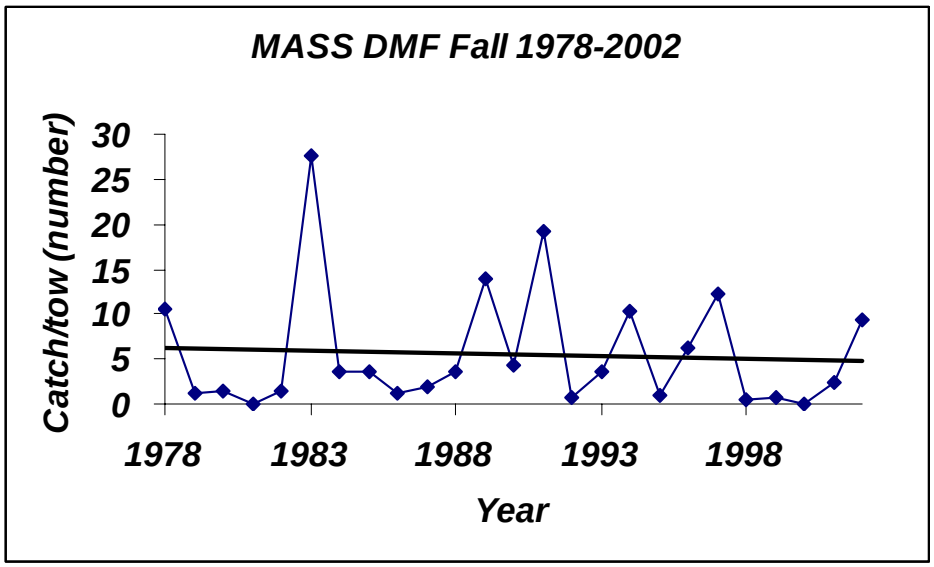


Figure 8 Herring Catch/Tow (Number) Indices from the MA DMF Autumn Inshore Trawl Survey Strata 31-36, 1978-2002



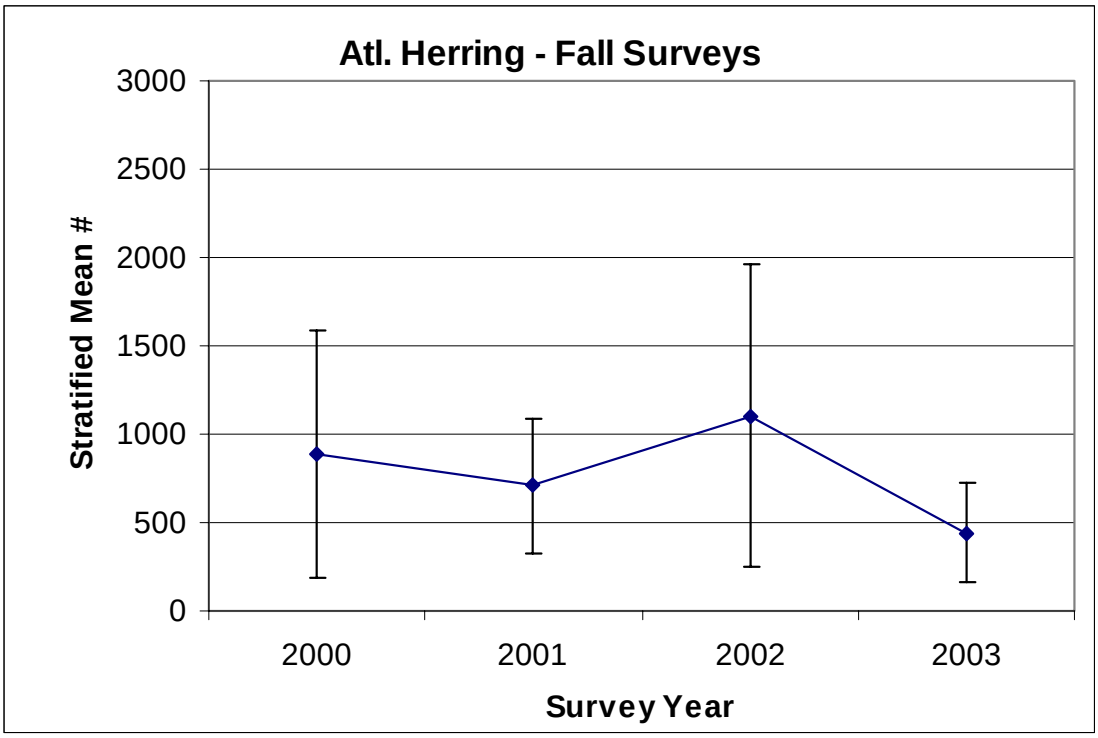
1.2.4 ME DMR Inshore Trawl Survey

Since Fall 2000, Maine DMR, in conjunction with the Gulf of Maine Research Institute and the State of New Hampshire, have been conducting an inshore bottom trawl survey. While this survey targets principal groundfish species from the NH/MA boarder to Canada, it has regularly sampled herring.

Results from this survey (Figure 9) indicate that the mean number per tow observed by the survey is at its lowest point since inception. However, if error is applied, this reduction is within the observed error of other years, and no trend is apparent. Based on the fish sampled in this survey, there is no clear indication of an overall reduction in the abundance of the inshore component of the herring resource.

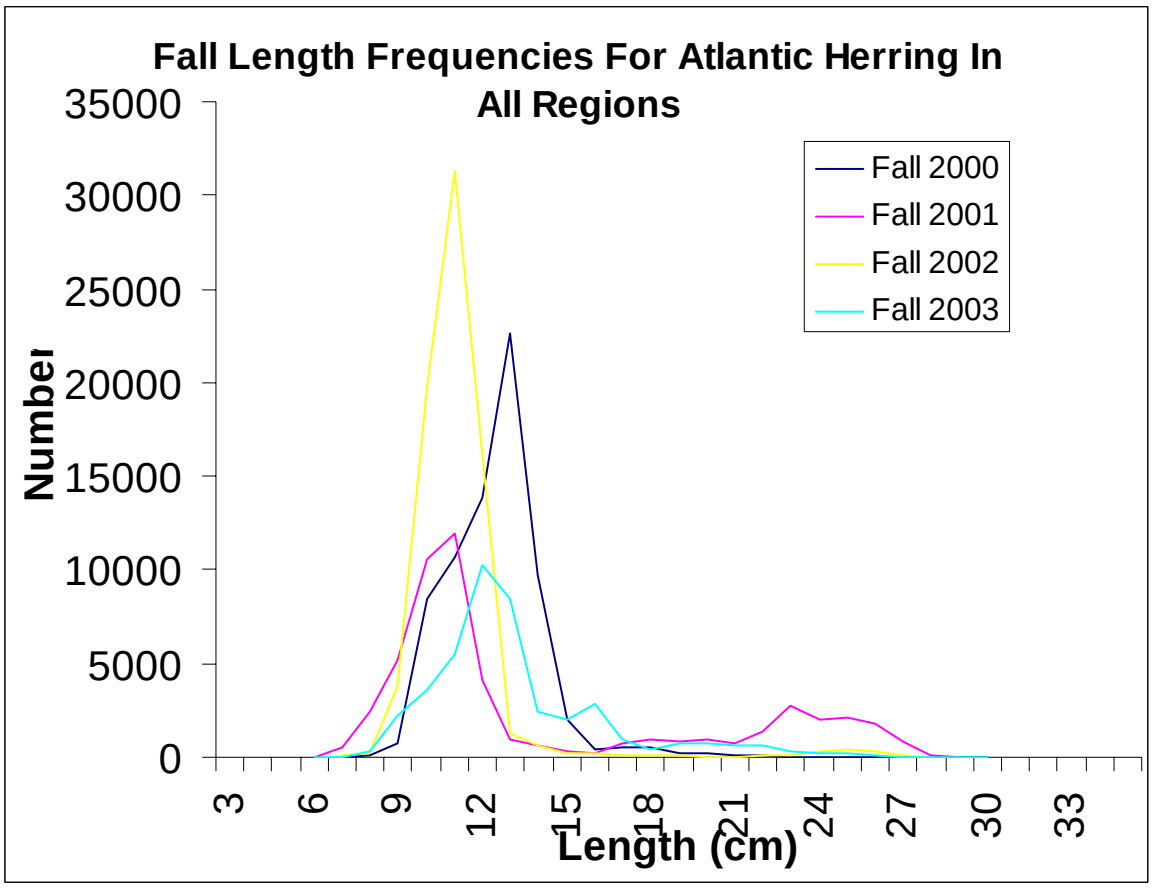
However, the ME/NH inshore bottom trawl survey samples mostly juvenile fish (less than 23 cm); which may or may not be a part of the inshore spawning component in future years (Figure 10). This is a ME/NH coast-wide bottom trawl survey, the results of which should not be viewed as an index of spawning stock biomass (SSB) for the inshore component of the herring resource. In fact, most of the fish sampled by this survey are age 1 fish. Similar to the MA DMF survey, this bottom trawl survey may provide an indication of pre-recruitment year class strength.

Figure 9 ME DMR Inshore Bottom Trawl Survey catch (in #) per tow



Note: Error is stratified error.

Figure 10 Length Frequencies for Herring Sampled by the Inshore Bottom Trawl Survey



1.3 NMFS OFFSHORE ACOUSTIC SURVEY (FISHERY-INDEPENDENT)

Offshore hydroacoustic surveys of Atlantic herring have been conducted by the National Marine Fisheries Service (NMFS) since 1999. From 1999-2001, three different surveys were conducted; in 2002, one larger survey was conducted. In 2002, 40-50% of the fish that were sampled during the survey were "spent," suggesting that spawning occurred earlier last year, and the survey may have missed the fish when they were most concentrated. Echo-intensities were therefore lower in 2002, resulting in a lower total biomass estimate, but not affecting overall distribution (Table 2). **Data from the 2003 NMFS acoustic survey are not yet available.**

Table 2 Geostatistical Estimates of Biomass, Coefficients of Variation (CV), CV inverse, Weighted Biomass (W), and Weighted CV (W) for Acoustic Surveys on Georges Bank from 1999-2002

Year Survey Design	Biomass	CV	1/CV	W Biomass	W CV
1999					
Zigzag1	1.4173	18.74	0.0534		
Zigzag2	1.0409	20.86	0.0479	1.19E+06	10.712
Parallel	1.1467	9.79	0.1021		
2000					
Parallel	1.5025	11.49	0.087		
Zigzag	1.268	10	0.1	1.43E+06	7.222
S random	1.596	16.89	0.0592		
2001					
Parallel	2.1484	9.89	0.1011		
Zigzag	1.6172	10.8	0.0926	1.82E+06	6.604
S random	1.596	15.3	0.0654		
2002					
Parallel	0.7628	13.56		7.63E+05	13.56

1.4 ME DMR INSHORE ACOUSTIC SURVEY (FISHERY-INDEPENDENT)

Since 1999, the Maine Department of Marine Resources (ME DMR), in partnership with the Gulf of Maine Aquarium (now the Gulf of Maine Research Institute), has been surveying the inshore spawning component in the Gulf of Maine during Autumn (September – November). This project is funded by the Northeast Consortium, and uses groundfish and herring vessels to conduct fishery-independent hydroacoustic surveys. This survey compliments the offshore hydroacoustic survey conducted by NMFS (discussed in Section 1.3).

Current estimates of biomass of the inshore spawning component sampled by this survey are unavailable at this time. This is due, in part, to questions surrounding survey timing, coverage, and methodology. A full peer review of this project is scheduled to be completed next year. After a thorough review and any accompanying advice, further data analysis may allow for the use of this survey as an index of inshore spawning component.

1.5 COMMERCIAL CATCH SAMPLING (FISHERY-DEPENDENT)

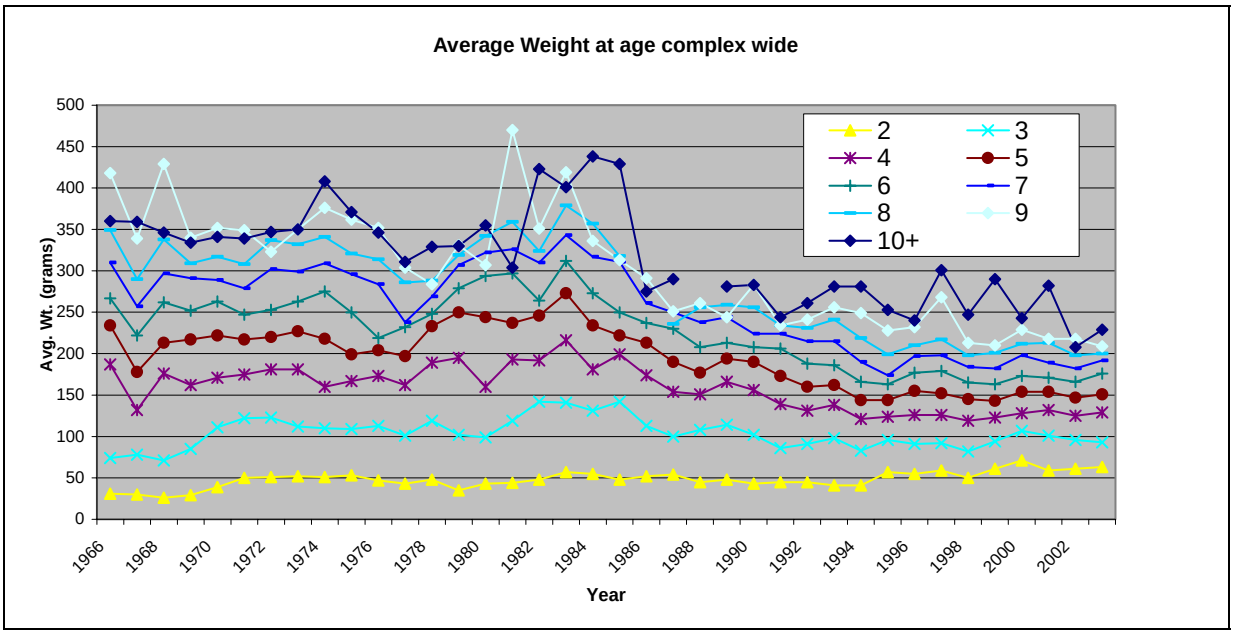
Samples of herring collected from the commercial catch are processed at the Maine Department of Marine Resources (ME DMR). Historically, samples were obtained from sardine canning plants, some of which transported fish from other states. NMFS port agents, fishery biologists in other states, and the Canadian Department of Fisheries and Oceans would also provide samples or data to the State of Maine. Recently, ME DMR has been given a grant from the Atlantic Coastal Cooperative Statistic Program (ACCSP) for a dedicated herring sampler. Normally, 4-8 samples are collected each month by statistical area harvested. However, more extensive sampling has occurred during foreign fishing or processing operations. Current sampling ratio is approximately one 50-fish sample per 500 mt.

Usually, between 175 and 250 samples are processed by ME DMR each year. Samples of 50 fish are processed for length (mm total length), weight (grams), sex, and, where applicable, sexual maturity and gonad stage, using standard procedures and criteria. From each sample, the sagittal otoliths are removed from two fish per centimeter group and embedded in plastic blocks for ageing. Periodic calibration of ageing procedure is conducted with NMFS' scientists.

Atlantic Herring Stock Complex

Resulting data for the Atlantic herring stock complex as a whole suggest a large reduction in weight at age, evident since the early 1980s (Figure 11). Such reduction in both weight at age and length at age may have implication to the partial recruitment vector for this complex. While the reason for this reduction in weight at age is unknown, density dependent factors may be involved (i.e., slower growth at higher stock sizes). However, these data should not be interpreted as a result of a reduction in available food or that the complex is in danger of overpopulation.

Figure 11 Total Weight at Age for the Atlantic Herring Stock Complex

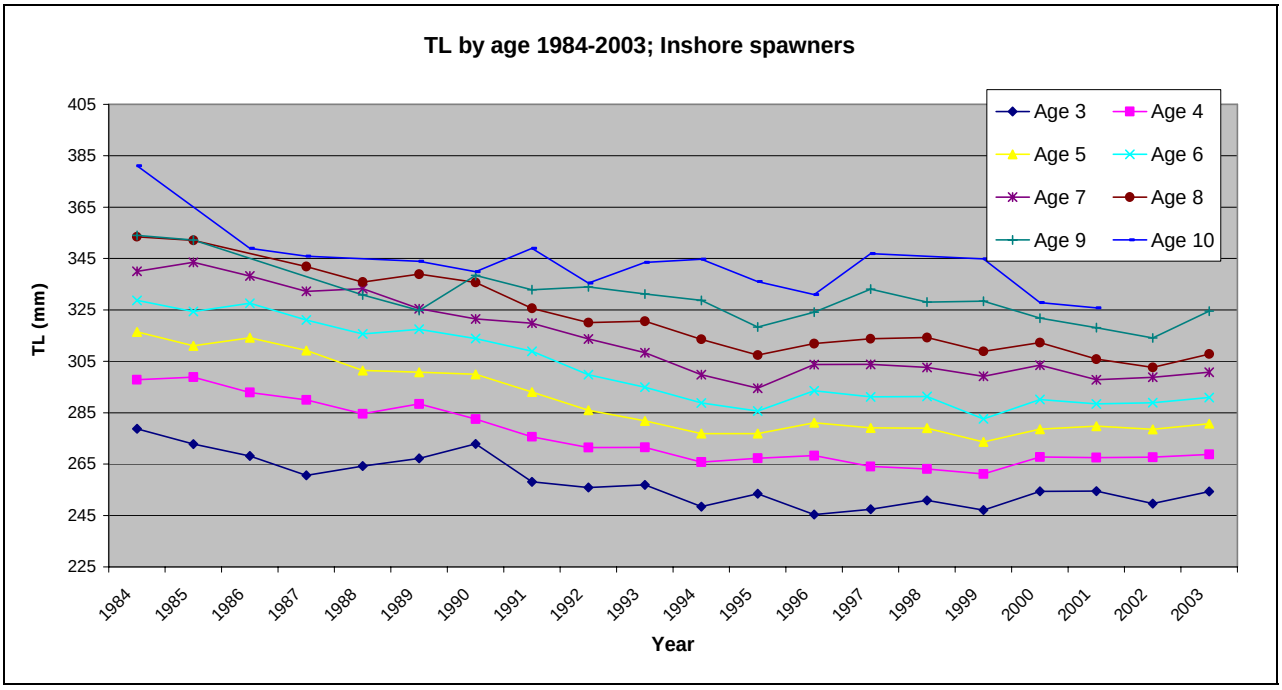


Inshore Spawning Component

Samples from the inshore spawning stock (adult sized fish, GSI > 0.10) are available for 2003 (Figure 12). Since 1984, a rather large drop in size (total length at age) is apparent. This is consistent with trends observed for the overall stock complex (see above). The biggest change in length at age for the inshore component occurred from 1984 – 1994, and since that time, the trend has been rather flat.

A decline in growth over time may indicate that density-dependent factors are at work for the inshore component. As such, it also suggests that a larger stock exists than was apparent during the mid-late 1980s. It should be noted that slower growth for individuals from the inshore component might be the result of increased stock size for the complex overall, or a change in environmental conditions affecting feed and/or growth of the different year classes. However, the declines over time that have been observed, especially from 1984-1994, are not necessarily consistent with changes in environmental conditions. In this case, the downward trend in length at age may be more suggestive of density-dependent factors at work, especially because the trend is also consistent with the overall upward trend in abundance apparent from the survey data.

Figure 12 Total Length at Age for Inshore Spawners (> 230 mm & > GSI 0.10)



2.0 UPDATED FISHERY INFORMATION

The Herring PDT and ASMFC TC reviewed available fishery and landings information through the 2003 fishing year. Updated fishery information is summarized in the following subsections.

2.1 2003 HERRING CATCH AND LANDINGS STATISTICS

The annual catch numbers and landings for the Atlantic Herring fishery are monitored using two harvester-based reporting systems and mandatory dealer reporting.

Harvesters record trip level information using Vessel Trip Report (VTR) forms and submit them on a monthly basis. This reporting system provides detailed catch information including, set time and duration, the coordinates where fishing activity occurs, incidental catches and any observed bycatch. VTR data are useful for stock assessment and effort information.

Harvesters are also required to submit catch reports using the Interactive Voice Response (IVR) system. These reports are made using a call-in system that records the total weekly catch by federal management area. This reporting system is useful for near real-time quota monitoring. IVR data are not generally useful for stock assessment, or management questions that require trip level information.

Federal Atlantic herring dealers submit trip-level landings reports on a monthly basis. These data include the vessel name, gear type, general catch area and amount purchased. The information from this reporting system is generally not useful for stock assessment but does contribute to economic analyses.

The catch-at-age (CAA) matrix is developed by applying the commercial harvest data (from VTRs) to samples of fish taken from the commercial fleet using a program called BIOSTAT. This matrix is developed for each area by month. The results by area are then summed fishery wide from which they can be utilized in an age structured population model, or analyzed for other fishery dependent statistics.

2.1.1 VTR – Preliminary Data as of May 1, 2004

As reported by the National Marine Fisheries Service (NMFS) and the Maine Department of Marine Resources (ME DMR), and as of May 1, 2004, a total of 100,676 metric tons (mt), of herring were caught during the 2003 fishing year (Table 3). This amount represents a fishery wide increase of 8,084 mt from the previous year. The catch from Management Area 1A (59,451 mt) accounted for approximately 59% of the total landings, followed by Area 3 which accounted for 20% (20,226 mt).

Within Area 1A, purse seines accounted for approximately 30% of the catch, but only accounted for 18% of the annual catch for the entire stock complex (Figure 13 and Figure 14). Single boat mid-water trawlers accounted for 13% of the Area 1A catch, while pair trawlers accounted for 57%.

Maine had the highest reported landings (46%) in 2003, followed by Massachusetts (38%), New Hampshire (8%), and Rhode Island (7%) (Figure 15).

Table 3 Atlantic Herring Catch (mt) by Management Area and Month, 1999 – 2003*

1999	Month												
MGMT AREA	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
1A	805	120	93	3,945	4,995	8,432	13,371	11,731	10,759	6,057	9,863	5,414	75,585
1B	311		41		181	57		35	113	731	106	57	1,632
2X	7,335	9,488	4,504	559	15	8	79	158	0	1	4	560	22,712
3X		143	272	1,007	160	1,460	289	96	1,297	994			5,718
TOTAL	**8,451**	**9,751**	**4,910**	**5,512**	**5,352**	**9,956**	**13,738**	**12,020**	**12,169**	**7,783**	**9,973**	**6,031**	**105,647**
2000													
MGMT AREA	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**TOTAL**
1A	3	99	76	1,525	7,398	9,946	14,997	12,259	4,777	9,081	631		60,793
1B		0	127	82	128	234	489	73	209	0	6,126		7,468
2X	9,340	9,838	2,358	203	19	0	0	2	23	2	860	4,552	27,198
3X	54		537	87	38		743	3,006	6,686	2,048		0	13,199
TOTAL	**9,397**	**9,937**	**3,098**	**1,896**	**7,582**	**10,181**	**16,230**	**15,341**	**11,694**	**11,132**	**7,617**	**4,552**	**108,658**
2001													
MGMT AREA	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**TOTAL**
1A	3	1,767	1,273	2,814	6,526	8,701	7,884	7,254	5,046	9,741	2,662	57	53,728
1B	18	1	68	45	195	110		1,302	2,192	237	6,198	6,336	16,704
2X	9,129	4,376	447	869	56	100	55	2	96	3	64	623	15,821
3X						755	7,675	7,807	12,146	6,328	314	53	35,079
TOTAL	**9,150**	**6,144**	**1,788**	**3,728**	**6,778**	**9,666**	**15,615**	**16,366**	**19,480**	**16,310**	**9,237**	**7,069**	**121,332**
2002													
MGMT AREA	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**TOTAL**
1A	1,653	1,223	933	3,087	249	9,755	13,269	7,453	7,801	5,897	8,621	103	60,044
1B	1,701	753	355	126	1,062	412	665	159	293	31	14	1,766	7,335
2X	5,232	4,237	593	79	187	0	1	1	138	1	125	445	11,038
3X	589	0		43	805	792	3,211	2,041	3,953	2,739	4		14,177
TOTAL	**9,175**	**6,212**	**1,881**	**3,335**	**2,302**	**10,959**	**17,146**	**9,653**	**12,185**	**8,668**	**8,764**	**2,314**	**92,594**
2003													
MGMT AREA	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**TOTAL**
1A	185	11	14	260	4,151	8,998	6,581	11,714	12,559	7,653	7,326	0	59,452
1B	0	0	0	122	9	194	689	178	71	1	540	3,113	4,917
2X	4,670	3,101	1,901	378	353	1	1	2	419	37	277	4,939	16,079
3X	0	0	12	149	122	673	9,977	3,967	1,719	3,592	13	2	20,226
TOTAL	**4,855**	**3,112**	**1,927**	**909**	**4,635**	**9,866**	**17,248**	**15,861**	**14,768**	**11,283**	**8,156**	**8,054**	**100,674**

**2003 data are preliminary.*

Figure 13 2003 Landings of Atlantic Herring by Gear Type

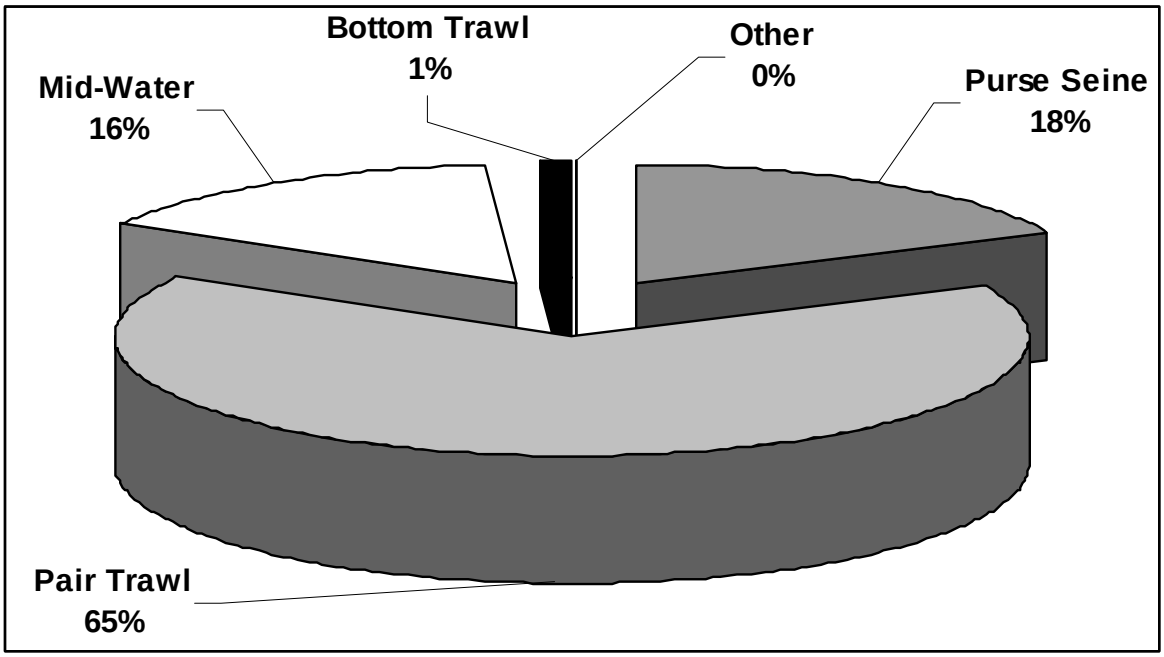


Figure 14 2003 Landings of Atlantic Herring by Gear in Management Area 1A

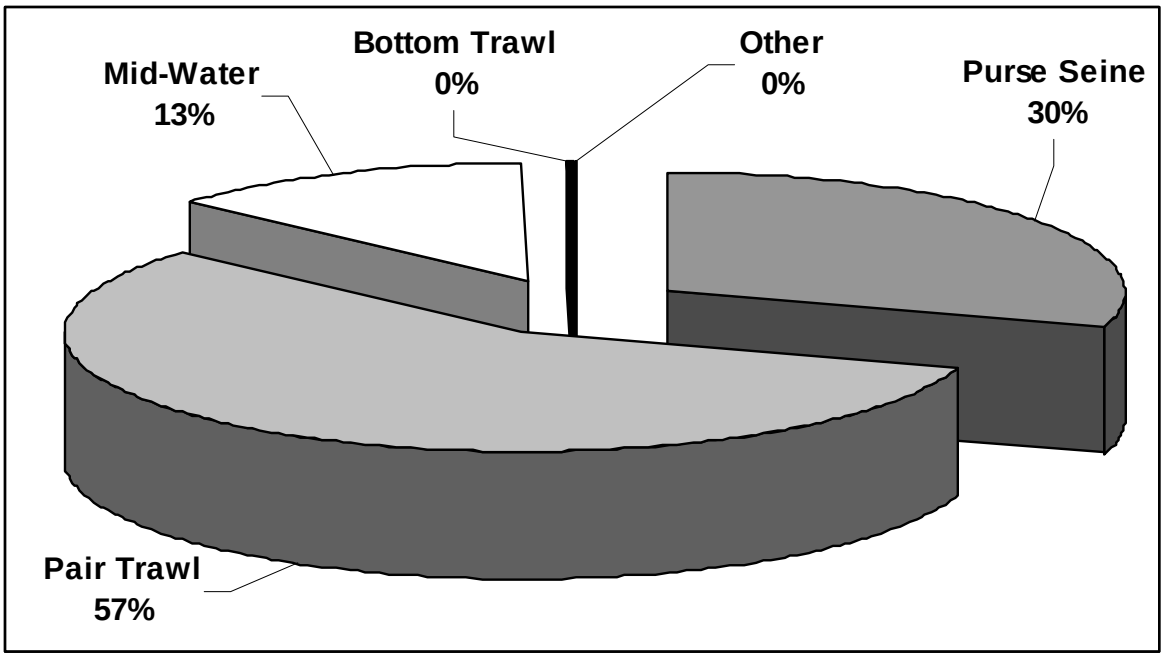
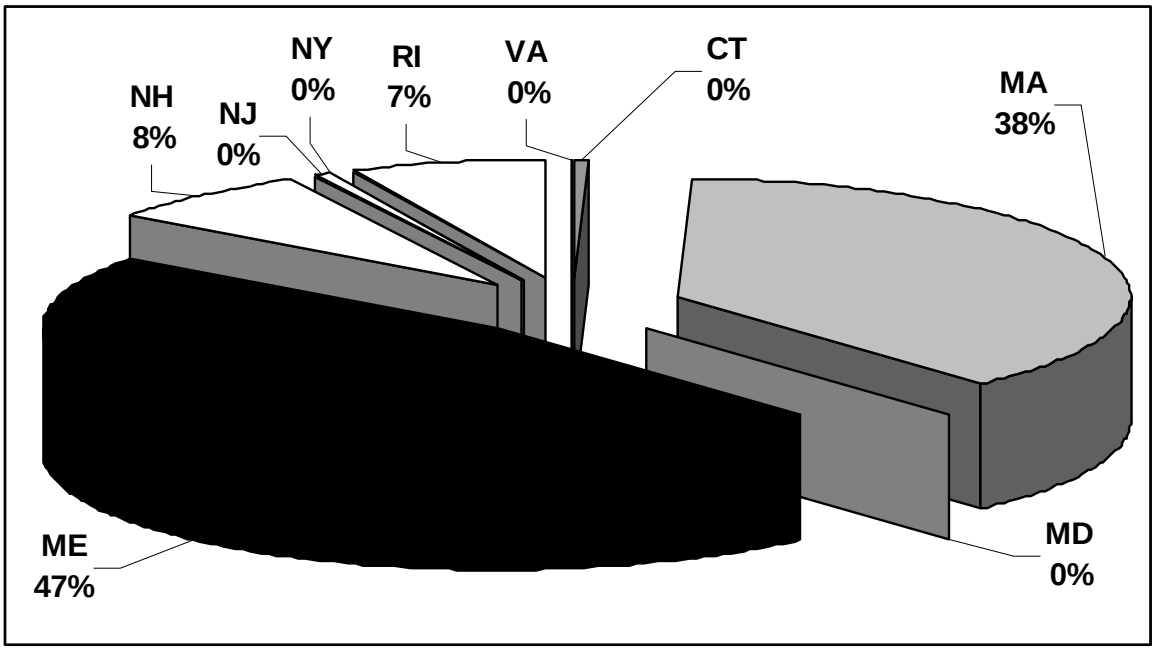


Figure 15 Percentage of 2003 Herring Landings by State



Note: Figure 15 reflects where herring were landed, not necessarily where they were caught.

2.1.2 IVR Landings

The Interactive Voice Response (IVR) call-in system is also a harvester report. Harvesters report combined catches by management area on weekly schedule. While both trip level information and precise location are not reported, this system is useful for near real-time quota monitoring. IVR data are not generally useful for stock assessment, or management questions that require information by sub-area or gear. Both IVR and VTR data incorporate landings to foreign vessels by domestic harvesters (JV or IWP, but not TALFF).

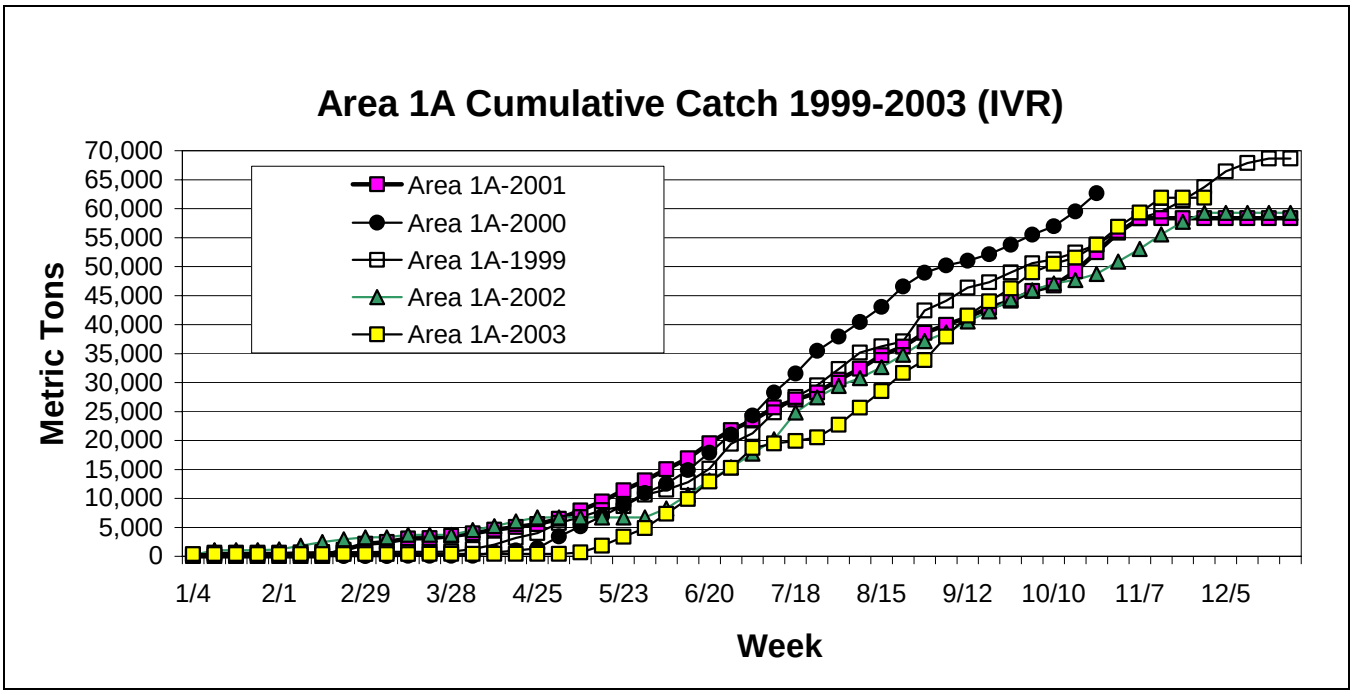
A total of 105 vessels had a Category 1 permit in 2003 (up from 96 in 2002). Of those vessels, 64 made positive reports using the IVR system. Although IVR reporting compliance among Category 1 herring permit holders was about 61%, the dedicated herring fleet (about 25 in number) had a compliance level approaching 100%.

The total IVR catch in 2003 reached 100,544 mt, a 9% increase from 2002. The Area 1A harvest accounted for approximately 62% of the total catch, followed by Area 3 with 21%, Area 2 with 12% and Area 1B with 5%. The fishery in Area 1A started very slowly in 2003, with virtually no landings prior to the middle of May (Figure 16). This resulted in almost all of the Period 1 TAC rolling over into the Period 2 fishery. By early July, the Area 1A fishery caught up to the 2002 catch levels, and in late September, the Area 1A catch almost exactly matched that of 2002 and 2001. The final catch in Area 1A was slightly over the TAC of 60,000 mt. However, it is important to note that IVR data are based on hail weights and generally are overestimated in comparison to the VTR data. Preliminary VTR data (as of May 1, 2004) indicate that the total

Area 1A catch in 2003 was 59,451 mt and the total catch for all management areas was 100,676 mt (Table 3, p. 14).

Note: Direct comparisons among years are difficult because of changes in the "days out" effort controls and spawning closures.

Figure 16 IVR Reports for Area 1A 1999-2003



2.1.3 Catch at Age

Examination of the catch at age matrix for the entire herring fishery reveals interesting trends within the data. Strong year classes are noticeable particularly for 1994, 1996, and 1998 (Table 4). The 1994 and 1998 year classes seem particularly strong on a complex-wide basis. The 2001 year class appears to be very strong and may be the cause for increased catches of two-year olds in 2003 and one-year olds in 2002. Other strong year classes (notably from 1994 and 1998) were similarly observed as increased juvenile catch during recent years.

Overall, the age structure of Atlantic herring catch has shifted to older individuals in recent years. This trend may be attributable to many factors, including the abundance of older age classes due to increased recruitment and low fishing mortality, and industry/market trends towards landing larger fish.

The apparent large increase in juvenile (ages 1-2) catch over the last five years is most likely the result of strong recruitment to the herring complex and may not be the result of a deliberate shift in the target fish size for the fishery. Similar catches of juvenile fish have heralded other large year classes and their entry into the fishery (e.g. 1994 & 1998).

Table 4 Herring Catch at Age in Weight and Numbers*

Weight (mt) Harvested at age

	1	2	3	4	5	6	7	8	9	10	11 +	Total
1998	0	10,589	9,016	38,530	8,090	4,790	5,776	3,141	1,197	397	76	**81,601**
1999	20	6,065	25,751	9,651	29,594	12,698	6,203	3,832	886	103	0	**94,803**
2000	0	14,093	4,688	15,947	24,270	30,445	8,762	3,278	638	250	87	**102,459**
2001	5	4,544	38,144	6,775	15,035	21,531	25,152	5,604	1,081	131	24	**118,028**
2002	289	5,454	9,998	31,558	12,293	11,313	12,709	6,547	778	87	0	**91,026**
2003	23	15,936	14,533	9,048	30,249	11,269	11,664	6,289	1,449	207	0	**100,667**

Numbers (X 1000) Harvested at age

	1	2	3	4	5	6	7	8	9	10	11 +	Total
1998	0	240,609	109,839	321,663	56,069	29,267	31,640	16,064	5,764	1,618	281	**812,814**
1999	667	103,606	285,314	82,967	216,579	79,553	35,158	19,554	4,527	357	0	**828,282**
2000	0	195,108	41,892	121,107	155,341	175,833	44,078	15,388	2,832	1,037	319	**752,937**
2001	117	74,760	379,858	51,299	98,063	127,478	135,847	26,771	5,153	484	91	**899,921**
2002	11,888	93,418	100,940	247,386	80,615	67,731	70,482	32,992	3,628	416	47	**709,543**
2003	927	249,179	149,704	65,795	192,313	62,797	59,476	30,593	6,742	875	0	**818,401**

**2003 data are preliminary*

2.2 ECONOMIC FACTORS

This section summarizes the economic aspects of the herring fishery, including vessel, dealer and processor activities, as well as revenues from and utilization of herring.

2.2.1 Landings and Revenues

In 2003, the gear type that brought the largest amount of herring to market was the midwater pair trawl at 65,901 mt. This is a 40% increase from 2002 levels. Seventeen vessels pair trawled in 2003, which is three more than 2002. Single vessel midwater trawls accounted for 15,841 metric tons of herring, which is 32% lower than 2002. Purse seine landings totaled 17,870 metric tons; a 9% decline from 2002. Bottom trawl gear accounted for 1,037 metric tons. Landings by U.S. weirs in 2003 amounted to one metric ton.

The total number of vessels landing herring in 2003 (Table 6) increased to 154, which is 14 more than in 2002. However, most of this is attributed to movement in and out of the bottom trawl and "other" (non-traditional herring gear) gear sectors. There was some movement among traditional herring gear sectors with the pair trawl fleet gaining three vessels and the single midwater trawl fleet losing nine vessels. The purse seine fleet remained at six vessels.

Most herring sold in 2003 was taken from Area 1A (59,451 mt) – just 905 mt more than 2002. Area 1B landings (4,919 mt) were 34% lower than they were in 2002. The Area 2 landings were 16,081 metric tons (up from 10,868 in 2002). Area 3 landings were 20,227 metric tons, up from 14,203 mt in 2002. Table 5 shows landings from the various gears used in 2003 and the activities of each in the herring management areas.

Table 6 differs from Table 5 in that instead of listing herring landings by gear used, each vessel was assigned a principal gear based on the gear it used that landed the most herring. Since some vessels used multiple gears to catch herring, this principal gear designation was necessary to describe herring fishery activity by vessel. For example, some vessels which primarily used midwater trawl gear landed herring with other gears; the actual gear used is shown in Table 5, while Table 6 lists all landings under the primary gear used by the vessel.

Table 6 lists number of trips and days at sea by principal gear and management area. For pair trawl gear, trips and days are counted for each participating vessel. For example, if two vessels make a two day pair trawl trip, the total number of trips would equal two and the total number of days at sea would equal four.

The Herring FMP distinguishes between vessels catching herring incidentally while pursuing other species and those targeting herring by defining vessels that average less than 2,000 pounds of herring caught per trip (in all areas) as incidental herring vessels. Table 7 provides the same information as Table 6 except it excludes the incidental herring vessels. In the 2003 fishing year, there were 38 vessels, defined as directed herring vessels, which sold 100,598 metric tons of herring.

Since Area 1A is the management area in which the TAC is most likely to be reached, it is important to summarize the activity of vessels targeting herring in Area 1A. Table 8 provides information for the 25 vessels that averaged more than 2,000 pounds per trip in Area 1A in 2003. Those vessels landed 59,400 mt of herring from Area 1A.

Prices for herring ranged from a low of $0.054 per pound in July to a high of $0.16 per pound in October. The average yearly price was $0.08 per pound in 2003, which is a 23% increase over the average 2002 price. Using the average monthly price of herring sold in 2003 the total value of all herring sold was $17,065,417.

Table 9 reports the average dependence on herring by state of landing and principal gear. Vessels principally using purse seine gear are the most dependent on herring in that 82% of the value of their catch is derived from herring. For pair and single mid-water trawl vessels, 59% and 32% of their revenue is from herring, respectively. The highest state level dependency rates of 82% for both pair trawl and purse seine gear occurs in Maine.

Table 10 shows the breakdown of quantity and value of landings by state landed and gear used. The state of Maine lands 46,795 mt of herring at a value of $7.4 million. Massachusetts follows next in the ranking with landings of 38,213 mt and a value of $6.5 million. Rhode Island and New Hampshire have significantly less landings of herring. Each of these states has landings in the range of 7,000 to 7,700 mt at a value of $1.3 to $1.65 million.

Table 11 and Table 12 provide information on the number of crew members employed in the herring fishery. Table 11 reports the average, minimum, and maximum number of crew members (including the captain) per trip as reported on logbooks. Table 12 defines fleet sectors by a vessel's principal gear and the state in which the vessel made the majority of its landings.

Then, using the average crew size per vessel, the number of vessels and total number of crew they employ are reported by fleet sector.

Table 5 Metric Tons of Herring Sold by Gear and Management Area in 2003

	1A	1B	2	3	Total
Midwater Pair Trawl	33,765	3,784	10,967	17,385	65,901
Midwater Trawl	7,846	1,001	4,238	2,756	15,841
Purse Seine	17,738	132	0	0	17,870
Bottom Trawl	88	1	862	86	1037
Weir	0	0	1	0	1
Other	14	1	13	0	28
Total	59,452	4,920	16,081	20,227	100,680

Table 6 Number of Vessels, Herring Trips and Days, and Herring Sold (mt) by Management Area and Principal Herring Gear for 2003

		1A	1B	2	3	Total
Midwater Pair Trawl 16 vessels	**Number of trips**	396	37	105	131	669
	Days at Sea	907	98	343	561	1909
	Landings (mt)	32,804	3,784	11,286	17,576	65,450
Midwater Trawl 9 vessels	**Number of trips**	179	11	55	10	255
	Days at Sea	313	25	152	49	539
	Landings (mt)	7,352	980	3,001	2,565	13,898
Purse Seine 6 vessels	**Number of trips**	324	5	12	0	341
	Days at Sea	625	10	14	0	649
	Landings (mt)	19,193	153	810	0	20,156
Bottom Trawl 63 vessels	**Number of trips**	273	8	152	39	472
	Days at Sea	279	12	287	238	816
	Landings (mt)	88	1	970	86	1145
Weir	**Landings (mt)**	0	0	1	0	1
Other Gear 60 vessels	**Number of trips**	120	4	406	0	530
	Days at Sea	125	4	418	0	547
	Landings (mt)	14	1	12	0	27
Total 154 vessels	**Number of trips**	1292	65	730	180	2267
	Days at Sea	2249	149	1214	848	4460
	Landings (mt)	59,451	4,919	16,080	20,227	100,677

Table 7 Number of Vessels, Herring Trips and Days, and Herring Sold (mt) by Management Area and Principal Herring Gear for Vessels Averaging more than 2,000 pounds of Herring per Trip in All Areas During 2003

		1A	1B	2	3	Total
Midwater Pair Trawl 16 vessels	**Number of trips**	396	37	105	131	669
	Days at Sea	907	98	343	561	1909
	Landings (mt)	32,804	3,784	11,286	17,576	65,450
Midwater Trawl 7 vessels	**Number of trips**	156	11	55	10	232
	Days at Sea	290	25	152	49	516
	Landings (mt)	7,337	980	3,001	2,565	13,883
Purse Seine 5 vessels	**Number of trips**	323	5	12	0	340
	Days at Sea	623	10	14	0	647
	Landings (mt)	19,193	153	810	0	20,156
Bottom Trawl 10 vessels	**Number of trips**	17	0	43	36	96
	Days at Sea	17	0	147	215	379
	Landings (mt)	66	0	958	85	1109
Total 38 vessels	**Number of trips**	892	53	215	177	1337
	Days at Sea	1837	133	656	825	3451
	Landings (mt)	59,400	4,917	16,055	20,226	100,598

Table 8 Number of Vessels, Herring Trips and Days, and Herring Sold (mt) by Management Area and Principal Herring Gear for Vessels Averaging more than 2,000 Pounds of Herring per Trip in Area 1A During 2003

		1A	1B	2	3	Total
Midwater Pair Trawl 12 vessels	**Number of trips**	396	34	99	118	647
	Days at Sea	907	88	315	511	1,821
	Landings (mt)	32,804	3,484	10,785	15,559	62,632
Midwater Trawl 5 vessels	**Number of trips**	156	11	48	9	224
	Days at Sea	290	25	103	38	456
	Landings (mt)	7,337	980	2,520	2,447	13,284
Purse Seine 5 vessels	**Number of trips**	323	5	12	0	340
	Days at Sea	623	10	14	0	647
	Landings (mt)	19,193	153	810	0	20,156
Bottom Trawl 3 vessels	**Number of trips**	17	0	0	0	17
	Days at Sea	17	0	0	0	17
	Landings (mt)	66	0	0	0	66
Total 25 vessels	**Number of trips**	892	50	159	127	1228
	Days at Sea	1837	123	432	549	2941
	Landings (mt)	59,400	4,617	14,115	18,006	96,138

Table 9 Average Herring Value as a Percentage of Total Revenue by Principal Herring Gear and Principal State for 2003

	MA	ME	NH	RI	Average for all States
Midwater Pair Trawl	60%	82%	36%	5%	59%
Midwater Trawl		36%		4%	32%
Purse Seine		82%			82%
Bottom Trawl				3%	<1%

Table 10 Landings and Value by Gear Used and State

		MA	ME	NH	RI	Other Mid-Atlantic	Other New England	Total
Midwater Pair Trawl	**MT**	35,375	20,764	5,883	3,228	407	242	65,899
	Value	5,989,225	3,200,748	1,048,157	774,929	63,553	40,898	11,117,510
Midwater Trawl	**MT**	2,353	9,784	558	3,021	0	126	15,842
	Value	455,850	1,528,183	91,985	625,165	0	21,277	2,722,460
Purse Seine	**MT**	456	16,232	1,183	0	0	0	17,871
	Value	59,824	2,706,408	177,515	0	0	0	2,943,747
Bottom Trawl	**MT**	18	9	62	819	23	105	1036
	Value	3,576	1,759	8,162	239,264	3,606	20,148	276,515
Weir	**MT**	1	0	0	0	0	0	1
	Value	71	0	0	0	0	0	71
Other	**MT**	10	6	0	0	12	0	28
	Value	1,686	1,005	0	0	2,416	0	5,107
Total	**MT**	38,213	46,795	7,686	7,068	442	473	100,677
	Value	6,510,232	7,438,103	1,325,819	1,639,358	69,575	82,323	17,065,410

Table 11 Average Crew Size (including captain) by Gear Used

	Average	Minimum	Maximum
Midwater Pair Trawl	4.6	1	7
Midwater Trawl	3.7	1	12
Purse Seine	5.4	1	6
Bottom Trawl	3.3	1	13

Table 12 Total Number of Vessels and Crew (including captain) Employed per Fleet Sector

		MA	ME	NH	RI	Total
Midwater Pair Trawl	Number of Vessels	9	4	2	1	16
	Total # of Crew	44	18	8	3	73
Midwater Trawl	Number of Vessels		6		3	9
	Total # of Crew		15		20	35
Purse Seine	Number of Vessels		6			6
	Total # of Crew		31			31
Total	Number of Vessels	9	16	2	4	31
	Total # of Crew	44	64	8	23	139

2.2.2 Domestic Annual Processing (DAP) and Domestic Annual Harvest (DAH)

The Herring FMP specifies that domestic annual harvest (DAH) will be composed of domestic annual processing (DAP), the total amount allocated to processing by foreign ships (JVPt), and the amount of herring that can be taken in U.S. waters and transferred to Canadian herring carriers for transshipment to Canada (BT).

DAH = DAP + JVPt + BT

Allocation to BT has remained at 4,000 mt since the implementation of the Herring FMP, and there does not appear to be a need to change this allocation for the 2005 fishing year. The next step towards estimating DAH is to estimate DAP so that the Council can consider whether an allocation to JVPt is appropriate for 2005. The Herring FMP specifies that because JVP is derived from DAH, DAH must be determined first before establishing an allocation for JVP.

2.2.2.1 Estimate of Domestic Annual Processing (DAP)

DAP is defined in the Herring FMP as the amount of U.S. harvest that domestic processors will use, combined with the amount of the resource that will be sold as fresh fish. The ability to estimate DAP is complicated by poor information about the amount of herring being sold as bait and a lack of detailed information on current and future capacity of domestic processors, as well as any plans for new processing plants to be established.

The Herring PDT estimated DAP for 2005 based primarily on past fishery performance (landings) and personal communication with shoreside processing facilities. Some Herring PDT members visited most processing facilities and interviewed individuals at those facilities as part of ongoing research related to Amendment 1 to the Herring FMP. The production estimates provided by the processing facilities were used to estimate DAP. The Herring PDT applied a 20% increase in production to account for any expansion of the fishery and markets that would

allow for increased shoreside production. The resulting estimate of potential production (DAP) during 2005 is presented in Table 13.

Processing, with respect to the Atlantic herring fishery, is defined in the regulations as *the preparation of Atlantic herring to render it suitable for human consumption, bait, commercial uses, industrial uses, or long-term storage, including but not limited to cooking, canning, roe extraction, smoking, salting, drying, freezing, or rendering into meat or oil.* The definition of processing does not include trucking and/or transporting fish; therefore, production estimates provided in Table 13 do not include any fish that may be landed in the U.S. and trucked to Canada for processing at the sardine canneries in Canada. The estimate provided in Table 13 for the U.S. sardine canneries, however, does include any fish that may be landed in the U.S. and trucked to the two canneries in the U.S. for domestic processing.

The Herring PDT notes that the DAP estimate provided in Table 13 may overestimate production likely to occur during the 2005 fishing year for several reasons. First, the PDT applied a 20% increase to production estimates provided by the processing facilities to account for any expansion of the fishery or markets that may occur during the 2005 fishing year; it is unclear whether or not this increase will be realized. Second, the current 20,000 mt allocation for U.S. at-sea processing (USAP) has not been utilized and may not be necessary in 2005, as there is no information to indicate that any at-sea domestic processing vessels will operate in this fishery during 2005. Third, to cross-check the production estimates in Table 13, the Herring PDT queried the 2002 dealer data (2003 data are incomplete) and found that landings to some of the processing facilities were reported to be significantly less than the estimates provided in Table 13. However, it appears that the dealer data may not reflect true landings, since only 68,400 metric tons of herring landings are recorded in the 2002 dealer database versus 92,600 mt recorded in the logbook data.

Table 13 Estimate of Domestic Annual Processing (DAP) for 2005

DOMESTIC PROCESSOR	ESTIMATED HERRING PRODUCTION	SOURCE OF INFORMATION AND ADDITIONAL COMMENTS
Lobster Bait	60,000 mt	• Approximately 60% of 2003 herring landings
Sardine Canneries	36,000 mt	• Personal communication –based on production estimate of 30,000 mt for two U.S. canneries provided by Connors Bros. • Added 20% to account for potential increase in production during 2005 • Includes fish trucked to the two U.S. canneries, but not fish trucked to Canadian canneries
Cape Seafoods, Gloucester MA	27,600 mt	• Personal communication – based on total 42,000 mt current production estimate provided by Cape Seafoods, of which herring is 20,000 – 26,000 mt (mean 23,000 mt) • Added 20% to account for potential increase in production during 2005
NORPEL, New Bedford MA	30,000 mt	• Personal communication – based on 20,000-30,000 mt production estimate provided by NORPEL (mean 25,000 mt) • Added 20% to account for potential increase in production during 2005
Lund's Fisheries, Cape May NJ	2,300 mt	• Personal communication – based on highest year of herring production from 2000-2003 (2000: 1,900 mt) • Added 20% to account for potential increase in production during 2005
U.S. At-Sea Processing (USAP)	20,000 mt	• Current allocation for USAP – domestic processing vessels that exceed vessel size limits • Allocation does not appear to be utilized, may not be necessary
Other	20,000 mt	• Accounts for potential increase in demand for herring as lobster bait • Accounts for domestic processing outside of USAP, including at-sea freezing by domestic catcher/processor vessels
TOTAL	**195,900 mt**	• **May overestimate DAP – USAP allocation may not be necessary, 2002 dealer data reflect much lower amounts, and 20% expansion of fishery/markets may not occur in 2005**

2.2.2.2 Harvesting Capacity and Considerations Related to DAH

Although DAH generally results from applying a formula based on DAP, JVPt, and BT, some important considerations relate to the actual and potential capacity of the U.S. harvesting fleet. In preparation for Amendment 1 to the Herring FMP, which is considering limited access for the herring fishery, the Herring PDT conducted a preliminary assessment of harvesting capacity in the herring fishery based on a relatively common analytical approach called "data envelopment analysis." This approach is described below and should be considered by the Council relative to discussions about DAP and JVPt.

There are some caveats to this analysis which should be clarified:

- The purse seine fleet primarily concentrates on Area 1 and is typically unable to fish the offshore areas.
- Freezer plants require that herring be stored in refrigerated sea water (RSW) tanks prior to pumping. Since all herring vessels do not use RSW tanks, all of the capacity estimated in this preliminary assessment is not available to the freezer plants.
- Some capacity may not be physically available (the vessel either sunk or moved to another fishery). However, since there was landings history and a permit was maintained in 2002, their capacity was counted.
- The analysis is based on the market, stock, and weather conditions that existed during 1999 - 2002. Large variations from those conditions are not accounted for in the analysis.
- Vessels that entered the fishery after the control date are included in the analysis.

The caveats identified above will be addressed to the extent possible in the analyses for Amendment 1, and the following analysis will likely be updated with 2003 data in the Amendment 1 DSEIS.

Capacity measures for the single midwater trawl and purse seine fleets were estimated using data envelopment analysis (DEA). DEA is one of three methods identified by the National Marine Fisheries Service to measure capacity, which provides a per vessel estimate of capacity based on similarly configured vessels. DEA compares the catch of all vessels using the same gear type, and estimates the vessel's catch capacity based on vessels with similar length, horse power, tonnage, and crew size, given current market conditions, herring stock conditions, and regulations.

For this analysis, vessels were separated into bins according to major gear. The capacity of bottom trawl vessels was not estimated since they account for 5% or less of the landings. Landings and effort data from 1999 – 2002 were used to estimate capacity for mid-water trawl and purse seine fleets. Not all vessels were active in all four years, but all had a herring permit in 2002. Some vessels are not active (sunk) but permit and history exists so capacity is counted.

Before running the DEA model, the upper 5% and lower 5% of herring landings were removed from the data. A moving average of landings per trip for each vessel in each month was

constructed, where the landings equaled the current trip plus the previous trip divided by two. This smoothed out some of the data. Vessel capacity was then estimated for each quarter. The DEA output provided average herring catch capacity per trip for each quarter by vessel, and the total number of trips in each quarter for each vessel. Yearly catch capacity was then calculated by multiplying the average number of observed trips per quarter by the average trip capacity for the same quarter.

Using DEA to measure capacity in the pair trawl fleet is problematic. Therefore, pair trawl capacity was assumed to equal the highest level of landings recorded for each vessel during 1999–2002 time period. This approach does not assume any changes in effort so the capacity estimates remain the same for both scenarios. This approach estimates that actual capacity is at least as high as the amount of herring each vessel caught in its most productive year. Actual capacity is likely higher.

Two resulting aggregate capacity measures are reported in Table 14. One measure, a total of 180,000 mt, represents catch capacity at current levels of effort. The second measure is at an increased level of effort. For this measure, all effort in the midwater trawl and purse seine fleet was increased to at least half the number of trips of the most active vessel within a particular gear sector and quarter. As noted above, the pair trawl estimate remained the same as in the first scenario. The total capacity estimate using this measure is 234,700 mt.

Table 14 Preliminary Estimates of Harvesting Capacity Based on Data Envelopment Analysis

	Total capacity per year in metric tons CURRENT EFFORT	**Total capacity per year in metric tons INCREASED EFFORT**
Mid-water trawl (27 vessels)	69,200	119,900
Purse seine (9 vessels)	26,300	30,200
Pair trawl (15 vessels)	84,600	84,600
Total	**180,100**	**234,700**

2.3 CANADA – NEW BRUNSWICK WEIR FISHERY

Catch of the Atlantic herring stock complex in Canadian waters consists primarily of fish caught in the New Brunswick weir fishery. Currently, the Herring FMP assumes that 20,000 mt of fish from the inshore component of the Atlantic herring resource will be taken annually in the NB weir fishery. This assumed catch is subtracted from the available yield from the inshore component of the resource before TACs are determined for management areas in the U.S. Exclusive Economic Zone (EEZ).

Table 15 summarizes landings from the New Brunswick (NB) weir fishery by month from 1978-2003 (2003 estimates are preliminary). The fishery is predominantly a late summer/fall fishery, with approximately 10% of the landings occurring during October, November, and December (based on 2000-2003 activity). Historical catches in the NB weir fishery were much higher and exceeded the current 20,000 mt assumption in most years prior to 1995. Preliminary catch estimates for 2003 suggest a significant decline in this fishery and are the lowest of the time series since 1984. Total landings in the NB weir fishery averaged 22,909 mt for the entire time series (1978-2003), 17,087 mt for the most recent ten-year time period (1994-2003), and 15,263 mt for the most recent five-year time period (1999-2003).

Table 15 Herring Landings from the New Brunswick Weir Fishery by Month, 1978-2003*

YEAR	NB WEIR LANDINGS BY MONTH (METRIC TONS)												GRAND TOTAL
	1	2	3	4	5	6	7	8	9	10	11	12	
1978	3				512	802	5,499	10,275	10,877	4,972	528	132	**33,599**
1979	535	96			25	1,120	7,321	9,846	4,939	5,985	2,638	74	**32,579**
1980					36	119	1,755	5,572	2,352	1,016	216		**11,066**
1981					70	199	4,431	3,911	2,044	2,435	1,686	192	**14,968**
1982		17			132	30	2,871	7,311	7,681	3,204	849	87	**22,181**
1983					65	29	299	2,474	5,382	3,945	375		**12,568**
1984					6	3	230	2,344	2,581	3,045	145		**8,353**
1985					22	89	4,217	8,450	6,910	4,814	2,078	138	**26,718**
1986	43				17		2,480	10,114	5,997	6,233	2,564	67	**27,516**
1987	39	21	6	12	10	168	2,575	10,893	6,711	5,362	703	122	**26,621**
1988		12	1	90	657	287	5,993	11,975	8,375	8,457	2,343	43	**38,235**
1989		24		95	37	385	8,315	15,093	10,156	7,258	2,158		**43,520**
1990					93	20	4,915	14,664	12,207	7,741	168		**39,808**
1991					57	180	4,649	10,319	6,392	2,028	93		**23,717**
1992				15	50	774	5,477	10,989	9,597	4,395	684		**31,981**
1993					14	168	5,561	14,085	8,614	2,406	470	10	**31,328**
1994				18		55	4,529	10,592	3,805	1,589	30		**20,618**
1995					15	244	4,517	8,590	3,956	896	10		**18,228**
1996					19	676	4,819	7,767	1,917	518	65		**15,781**
1997				8	153	1,017	6,506	7,396	5,316				**20,396**
1998					560	713	3,832	8,295	5,604	525			**19,529**
1999					690	805	5,155	9,895	2,469	48			**19,063**
2000					10	7	2,105	7,533	4,940	1,713	69		**16,376**
2001					35	478	3,931	8,627	5,514	1,479			**20,064**
2002					84	20	1,099	6,446	2,878	1,260	20		**11,807**
2003					257	250	1,423	3,554	3,166	344	10		**9,003**

Source: Canadian Department of Fisheries and Oceans. 2003 estimates are preliminary.

Recent declines in catch in the NB weir fishery appear to be consistent with a reduced number of active weirs operating in the fishery (Table 16). The average number of active weirs in the NB weir fishery was 88 from 1999-2003, down from an average of 109 from 1994-1998. Canadian fishermen attribute declines in this fishery to several factors, including pollution, changes in fish behavior (fish not coming as close to shore), market conditions, conflicts with other resource user groups, expansion of the U.S. herring fishery, and expansion of the aquaculture industry and consequent loss of inshore fishing grounds for weirs to utilize. However, it should be noted that the number of active weirs and subsequent landings from this fishery have been highly variable over the time series.

Table 16 Number of Active Weirs in New Brunswick Weir Fishery, 1978-2003*

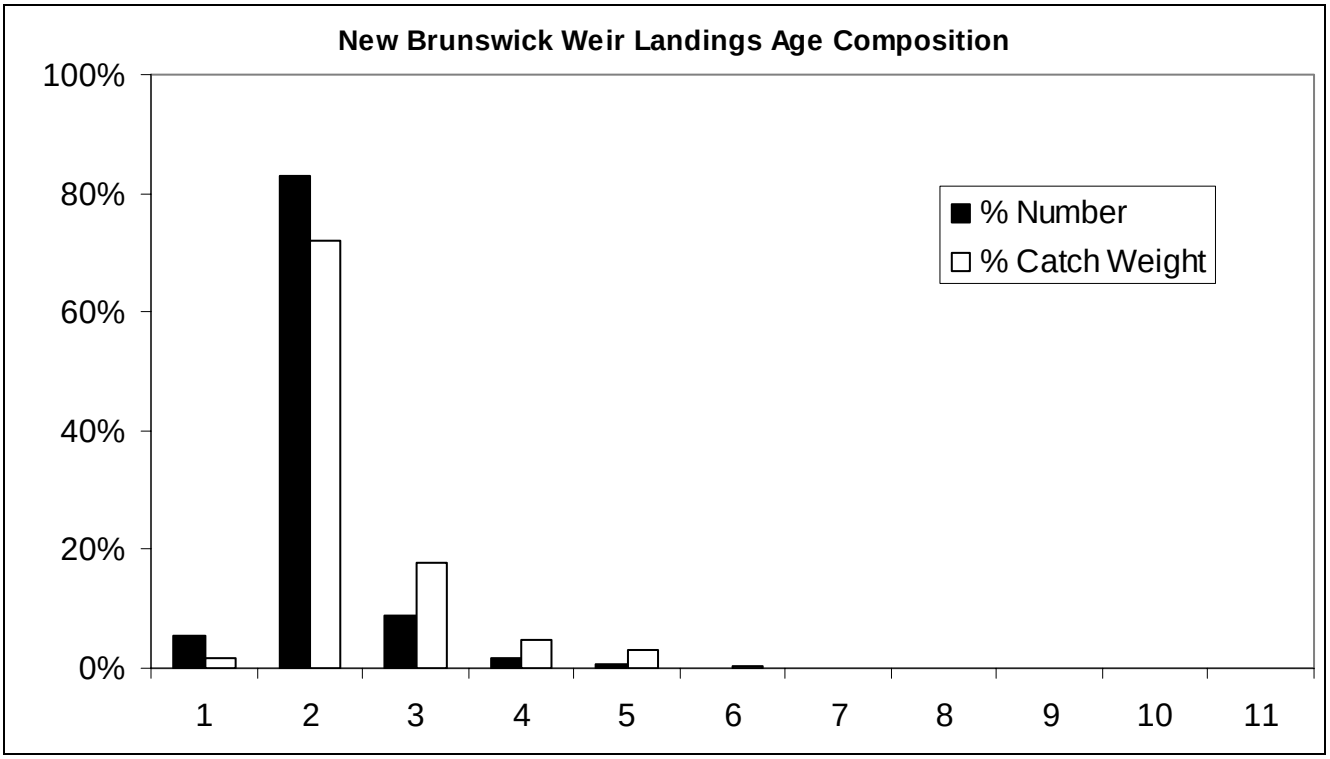
Year	No. Active Weirs in NB
1978	208
1979	210
1980	120
1981	147
1982	159
1983	143
1984	116
1985	156
1986	105
1987	123
1988	191
1989	171
1990	154
1991	143
1992	151
1993	145
1994	129
1995	106
1996	101
1997	102
1998	108
1999	100
2000	77
2001	101
2002	83
2003	78

Source: Canadian Department of Fisheries and Oceans.

**2003 estimates are preliminary.*

It is assumed that juvenile fish (age 1 and 2) caught in the NB weir fishery are from the inshore (GOM) component of the Atlantic herring stock complex, while adult fish (age 3+) caught in the NB weir fishery are from the SW Nova Scotia stock complex (4WX). Figure 17 illustrates the age composition of herring caught in the NB weir fishery during 2003. Based on numbers of fish (older fish are heavier, so characterizing catch composition by weight can be misleading), it appears that over 90% of the landings in the NB weir fishery in 2003 were juvenile fish, ages 1 and 2. Some age 3+ fish were caught in the NB weir fishery (almost 20% by weight, but about 5% by number), but very few adult and older fish were landed. The age composition of the 2003 catch in the NB weir fishery is consistent with that from previous years (1990 onward) and does not suggest that a shift towards younger/smaller fish has just recently occurred in this fishery.

Figure 17 Age Composition of Landings from the NB Weir Fishery, 2003



3.0 HERRING PDT/TC CONCLUSIONS AND RECOMMENDATIONS

In general:

- Available trawl survey data do not indicate that a significant drop in herring biomass is occurring. In terms of the Atlantic herring stock complex as a whole, available data suggest that biomass is stable and increasing over time.
- Available survey data suggest that the inshore component of the resource has remained relatively stable in recent years. It is important to note that data specific to the inshore component of the resource are limited – inshore hydroacoustic data are not considered reliable enough at this time to identify trends (see Section 1.4), so the available data are generally limited to those from bottom trawl surveys and commercial catch sampling.
- Assessment of the Atlantic herring resource remains complex-wide; data are not available at this time to generate a biomass estimate, apply a target fishing mortality rate, and estimate an appropriate level of yield specifically from the inshore component of the resource. Herring PDT biologists are working on developing a separate stock assessment for the inshore component of the resource. If a separate assessment of the inshore component can be conducted, it should be peer-reviewed through a benchmark stock assessment for herring (TRAC or SARC) prior to use in the management arena.

3.1 ABC, OY, AND OTHER FISHERY SPECIFICATIONS

Regulations governing annual specifications for the Atlantic herring fishery include, but are not limited to the following:

> (1) Optimum yield (OY) must be equal to or less than the allowable biological catch (ABC) minus an estimate of the expected Canadian NB fixed gear and GB herring catch, which shall not exceed 20,000 mt for the NB fixed gear harvest and 10,000 mt for the Canadian GB harvest.
>
> (2) OY shall not exceed maximum sustainable yield (MSY), unless an OY that exceeds MSY in a specific year is consistent with a control rule that ensures the achievement of MSY and OY on a continuing basis; however, OY shall not exceed MSY prior to the 2001 fishing year.
>
> (3)…
>
> (4) Adjustments to the total allowable level of foreign fishing (TALFF), if any, will be made based on updated information relating to status of stocks, estimated and actual performance of domestic and foreign fleets, and other relevant factors.

Therefore:

The Herring PDT/TC recommends that the Council/Section consider specifying ABC for 2005 consistent with the MSY proxy alternative that is proposed in Amendment 1 (220,000 mt). MSY itself is not a fishery specification and will be addressed in Amendment 1. According to projections from the forward projection model (FPM) presented at the TRAC

Meeting in February 2003, the impacts of total removals under an ABC of 220,000 mt are not expected to be significant enough to compromise the health of the herring resource as a whole. Additional information is provided in the TRAC Assessment Report (*Stock Assessment of the Gulf of Maine-Georges Bank Atlantic Herring Complex, 2003*, Northeast Fisheries Science Center Reference Document 04-06, February 2004).

However, it may not be appropriate to allow total removals from the fishery to be equivalent to ABC; total removals from the fishery should be based on optimum yield (OY) and should minimize the risk of overfishing the individual spawning components of the stock. According to the regulations, OY for the U.S. fishery could be set at least 30,000 mt lower than ABC to account for Canadian fisheries. In addition, the Herring PDT/TC recommends that OY be specified at a level lower than ABC for biological and ecological reasons. Recognizing that proposed value for ABC is conservative, a buffer between ABC and OY still may be appropriate because of scientific uncertainty, the importance of recruitment and ensuring strong year classes in the future, the importance of herring as a forage species, and the potential impact of any increase in the NB weir fishery.

OY also should be based, in part, on the U.S. expected utilization of the resource during the upcoming fishing year. The Council may need to address issues related to specifying JVP/IWP and TALFF depending on what it selects for ABC and OY as well as what it anticipates that the U.S. industry will actually harvest in the next fishing year. The "gap" between expected U.S. catch and OY affects discussions about allocating TALFF. Ultimately, the selection of the area-specific TACs (and consequently OY) will require choices to be made about the relative risk associated with overfishing the Gulf of Maine spawning component of the stock. In terms of risk, the Gulf of Maine (inshore) stock component is considered to be the limiting factor (versus the Georges Bank/Nantucket Shoals offshore component).

The Herring PDT/TC also recommends that the Council consider eliminating the allocation for U.S. at-sea processing (USAP) because it does not appear to have been utilized in recent years, and there is no information to indicate that domestic processing vessels which exceed current vessel size limits wish to enter the fishery. For the 2005 fishery specifications, USAP could be set at zero; eliminating the USAP allocation altogether could be accomplished through Amendment 1 if the Council supports this recommendation.

3.2 AREA-SPECIFIC TACS FOR THE 2005 FISHING YEAR

Available information does not provide a clear answer to the question of whether or not harvest at current levels will jeopardize the inshore component of the resource. However, harvest levels for the Atlantic herring fishery have been relatively consistent for many years, and available data suggest that the inshore component of the stock is stable and has not experienced significant declines in biomass under these harvest levels. Without any biological targets or benchmarks specifically for the inshore component of the resource, the PDT/TC cannot with certainty that maintaining harvest of this stock component at or near current levels will not cause a decline in biomass. **Nevertheless, given a long time series of relatively consistent catch and stable surveys, the PDT/TC is comfortable concluding that no significant declines in the**

inshore component of the resource should be expected under harvest levels in 2005 similar to those observed in recent years.

Note that current harvest levels refer to actual landings and not TAC allocations. This is important because some of the inshore component is caught in the Area 2 fishery, and the Area 2 TAC has not yet been fully utilized. The risk assessment presented in Section 3.3 below suggests that the current TACs may not be the most risk-averse to the inshore component of the resource, ***if*** *all of the TACs are fully utilized in all management areas. See below for additional discussion.*

Reviewing the risk assessment developed during Amendment 1 provides an opportunity to take advantage of the most recent years of fishery data to characterize the impacts of various TAC distributions relative to historical catch (historical = most recent 5-year and 10-year time periods). **The Herring PDT/TC recommends that further expansion of the fishery occur primarily in Area 3** because it is highly likely that there is little occurrence of the Gulf of Maine (inshore) spawning component in this area.

The Herring PDT/TC also recommends that the Committee/Council consider eliminating the Area 2 TAC reserve. The Area 2 TAC has never been fully utilized to date, and uncertainties about stock component mixing in Area 2 suggest that the reserve would not likely be released should the entire Area 2 TAC be taken during the fishing year. In addition, the PDT/TC notes that further expansion of fishery should be encouraged in Area 3, not in Area 2. The TAC options presented in the risk assessment below do not include a reserve for Area 2 or any other management area.

3.3 UPDATED RISK ASSESSMENT AND TAC OPTIONS PROPOSED DURING THE DEVELOPMENT OF AMENDMENT 1

The Herring PDT/TC conducted a relative risk assessment of the TAC options that were considered during the development of Amendment 1 to the Herring FMP as a starting point for discussion by the Committee/Section at the June 15, 2004 meeting. **The Herring PDT/TC recommends that the Committee/Section identify 3-4 TAC options for further analysis during the specification process for the 2005 fishing year.** If the Committee/Section identifies options that are not currently included in the following risk assessment, the PDT/TC will conduct a risk assessment on these options as part of the additional analyses that will be provided to the Council/Section when selecting the final specifications for 2005 at the July 2004 meeting. The no action alternative – current TACs plus the Area 2 reserve – will form the basis of comparison for further analysis once the Herring Committee/Section identify the TAC options that will be considered during the specification process.

Risk Assessment Background

While the Atlantic herring stock is assessed as one meta-complex, most scientists recognize two sub-components; the inshore Gulf of Maine (GOM) and offshore Georges Bank/Nantucket Shoals component. Both of these components are separated during spawning; however, both mix while on feeding (Area 1A and 1B) and over-wintering grounds (Area 2). There is no evidence of mixing either in Area 3 or during spawning season in any location other than 1B (August- November).

At the June 19, 2003 SSC meeting, the SSC expressed concern that the recent distribution of landings, while not jeopardizing the overall stock complex, could overexploit a stock component, particularly the inshore (Gulf of Maine) component. Therefore, the SSC recommended that the Herring PDT conduct a risk analysis of current, historic, and projected landing distributions, given a range of possible mixing regimes.

Factors that the PDT considered when developing a "risk assessment approach" to determining specifications and options for area-specific TACs/OY include:

- the current seasonal mixing formula in the Herring FMP;
- other possible mixing formulas;
- the recent 10-year and 5-year average landings for the stock complex (1994-2003 and 1999-2003);
- landings from the New Brunswick (NB) weir fishery;
- all other relevant biological and fishery information; and
- the June 19, 2003 SSC recommendation to evaluate the risk of overfishing individual stock components under different TAC options so that areas can be identified where expansion of the fishery is appropriate.

Risk Assessment Methodology

The methodology for the risk assessment can be summarized generally as follows:

1. The PDT estimated average historical removals (five years and ten years) of the inshore component based on a range of mixing scenarios (described below). These average historical removals form the basis of comparison for the TAC options under consideration.
2. The PDT evaluated a range of options for TAC distributions (including the current TACs minus the Area 2 reserve):
    - The assessment evaluates the relative risk associated with the TAC options by producing estimates of removals from the inshore component under a range of mixing scenarios, which should be compared to average historical removals under the same range of mixing scenarios. More risk is associated with TAC options that project removals of the inshore component that are higher than average historical (5-year and 10-year) removals.

This analysis was conducted by averaging monthly landings by management area over a five-year (1999-2003) and ten-year period (1994-2003) as a basis for comparison of TAC distributions. This time frame was chosen instead of a 15-year average (as suggested by the SSC) because 15 years encompassed some years when the Georges Bank/Nantucket Shoals component of the stock was still recovering from a crash after heavy foreign fishing in the 1970s.

The Herring PDT identified three uncertainties associated with the mixing ratios to determine the distribution of the two stock components by season and management area:

1. the mix of catch in the New Brunswick weir fishery (assumed to be from the inshore component);
2. the mix of catch from Area 1A in the summer; and

3. the seasonal mix of catch from Area 2.

Because of the uncertainties associated with the mixing formulas, five different mixing regimes were applied to the landings data by quarter for the relative risk assessment. The PDT agreed that winter and summer mixing ratios (instead of all quarters) would be adequate to illustrate the range of relative risk under different catch and mixing scenarios. Mixing scenarios are based on the quarter approach as outlined in the original FMP (Winter: December-March, Summer: April through July). The mixing scenarios considered in this risk assessment are:

1. **0.5 Summer/0.2 Winter –** In the summer, 50% of the catch from Areas 1A and 2 comes from the inshore component. In the winter, 80% of the catch in Area 1A and 20% of the catch in Area 2 comes from the inshore component (Herring FMP).
2. **0.6 Summer/0.2 Winter –** In the summer, 60% of the catch in Area 1A is from the inshore component and 40% from the offshore component. In the winter Area 2 fishery, 20% of the catch comes from the inshore component and 80% from the offshore component.
3. **0.5 Summer/0.5 Winter –** In the summer, 50% of the catch from Areas 1A and 2 comes from the inshore component. In the winter, 50% of the catch from Areas 1A and 2 comes from the inshore component (summer ratio from Herring FMP; winter ratio from Armstrong & Cadrin, 2001).
4. **0.3 Summer/0.3 Winter –** In the summer, 30% of the catch from Areas 1A and 2 comes from the inshore component. In the winter, 30% of the catch from Areas 1A and 2 comes from the inshore component (Armstrong & Cadrin, 2001).
5. **0.3 Summer/0.15 Winter –** In the summer, 30 % of the catch in Area 1A is from the inshore component and 70% from the offshore component. In the winter Area 2 fishery, 15% of the catch comes from the inshore component and 85% from the offshore component. This ratio is based on information from the TRAC Assessment.

Using this range of mixing scenarios, removals from the inshore component were estimated for the historical (ten-year and five-year) time series and a range of options considered for area-specific TACs.

In all scenarios, the following applies:

- Area 1B mixing rates are assumed to be 0.3 (30% GOM and 70% GB/NS) throughout the year;
- All catch from Area 3 is assumed to come from the offshore component of the stock;
- Catch from the New Brunswick weir fishery is assumed to be 20,000 mt and come from the inshore stock component.
- **Each projection option accounts for seasonal and yearly TACs for each management area as currently implemented and assumes that the TACs are fully utilized in all areas.**

TAC Options and Relative Risk Assessment Results

The risk assessment evaluates relative risk associated with the TAC options by producing estimates of removals from the inshore component under a range of mixing scenarios, which should be compared to historical removals under the same range of mixing scenarios. **More risk is associated with TAC options that project removals of the inshore component that are higher than historical removals.**

Comparing removals of the inshore component over the most recent five-year and ten-year time period illustrate the impacts of the Atlantic herring management program and the area-specific TACs that were implemented in the Herring FMP. The Herring FMP became effective for the 2000 fishing year and implemented quotas by management area in a previously un-regulated fishery. Five-year historical removals are consequently lower than ten-year historical removals because the five-year average includes three years of management under area-specific TACs, which appear to have reduced the harvest of the inshore component of the resource when compared to the historical ten-year average.

The Council should select TACs for Areas 1A, 1B, 2, and 3 based on choices regarding both the risk of overfishing the inshore component (relative to historical removals) and issues/tradeoffs associated with allocating the catch of the inshore component of the resource between Areas 1 (primarily 1A) and 2. The following TAC options (Table 17) were proposed for consideration during the development of Amendment 1.

At the June 15, 2004 meeting, the Herring Committee/Section should review these options and recommend a total of 3-4 options for further consideration during this specification process. If the options that the Committee/Section recommends differ from those presented below, an updated risk assessment will be provided in addition to other required analyses.

Table 17 Summary of TAC Options Considered During the Development of Amendment 1 to the Herring FMP

TAC Options Proposed in Amendment 1											
#1	1A	60,000		**#4**	1A	45,000		**#7**	1A	55,000	
	1B	10,000			1B	10,000			1B	5,000	
	2	20,000			2	35,000			2	30,000	
	3	60,000			3	60,000			3	60,000	
	NB	20,000	**US (OY)**		NB	20,000	**US (OY)**		NB	20,000	**US (OY)**
	Total	**170,000**	**150,000**		**Total**	**170,000**	**150,000**		**Total**	**170,000**	**150,000**
#2 (SQ)	1A	60,000		**#5**	1A	60,000					
	1B	10,000			1B	10,000					
	2	50,000			2	35,000					
	3	60,000			3	60,000					
	nb	20,000	**US (OY)**		NB	20,000	**US (OY)**				
	Total	**200,000**	**180,000**		**Total**	**185,000**	**165,000**				
#3	1A	45,000		**#6**	1A	60,000					
	1B	10,000			1B	10,000					
	2	20,000			2	30,000					
	3	75,000			3	60,000					
	NB	20,000	**US (OY)**		NB	20,000	**US (OY)**				
	Total	**170,000**	**150,000**		**Total**	**180,000**	**160,000**				

Table 18 presents the results of the relative risk assessment based on the TAC options that were considered during the development of Amendment 1 to the Herring FMP and based on the five mixing scenarios described in the previous discussion. More risk is associated with TAC options that project removals of the inshore component that are higher than historical removals. **Again, it is important to note that the risk assessment assumes that 20,000 mt of the inshore component is removed by the NB weir fishery and that all of the area-specific TACs are fully utilized.**

- The TAC distribution in Option 1 closely represents current harvest levels in the fishery (60,000 mt in Area 1A and 20,000 mt in Area 2) with the exception of Area 3 (catches in Area 3 do not impact this analysis, as no inshore fish are assumed to be caught in Area 3 at any time of the year). The projected removals of the inshore component under Option 2 illustrate the potential impacts of the current TACs, should all of the TACs be fully utilized in all management areas where inshore fish are caught. **Therefore, the results for Option 2 reflect the impacts of the current TAC allocation, while the results for Option 1 reflect the impacts of the current TAC utilization.**
- In a relative sense, options with projected removals that are less than the five-year average removals are the most risk-averse of the options that were analyzed. Options with projected removals that are between the five-year and ten-year average removals are relatively less risk-averse. Options with projected removals above the ten-year average are the most risk-prone of the options that were analyzed.
- Options 3, 4, and 7 are projected to result in removals of the inshore component that are less than both the five-year and ten-year historical removals under all of the mixing scenarios.

- Options 2 and 5 project removals of the inshore component that are higher than the ten-year historical average under some of the mixing scenarios.
- Options 1 and 6 are projected to result in removals of the inshore component that are higher than the five-year historical average but lower than the ten-year historical average under all of the mixing scenarios. Option 5 also falls within the range of the five-year and ten-year historical averages under most mixing scenarios.
- The risk assessment does not account for changes in ASMFC's "days out" management. Postponing landings until later in the year for Area 1A may result in increased removals from the inshore component. Additional analysis of the impacts of days out may be provided after the Committee/Section identify a range of 3-4 TAC options for further consideration.
- The large variability of some TAC options is the result of uncertainties associated with mixing of the different stock components, should removals be increased during the winter fishery in Area 2.

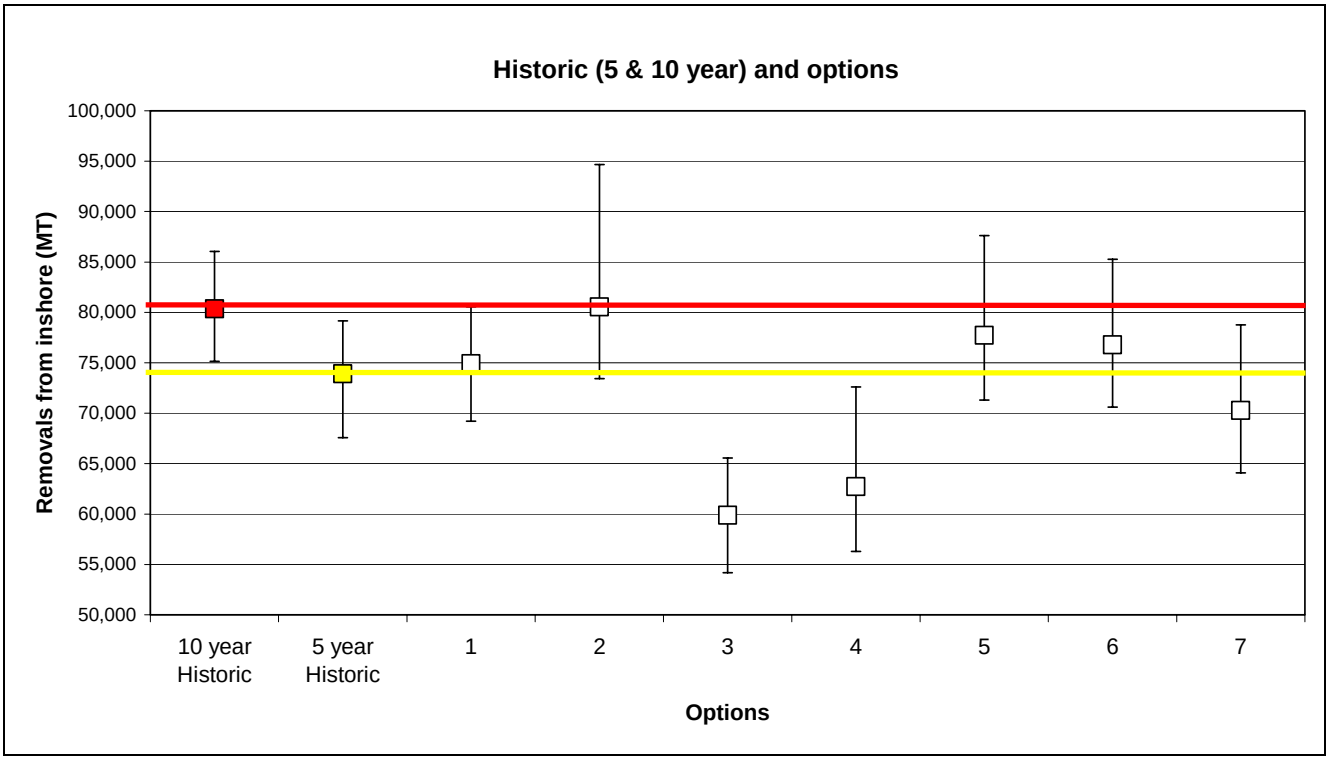
The results of the risk assessment relative to five-year and ten-year removals of the inshore component of the resource are also illustrated in Figure 18.

Table 18 Results of Relative Risk Assessment of TAC Options Considered During the Development of Amendment 1

Mixing Ratios	Summer	0.5	0.6	0.5	0.3	0.3	Median
	Winter	0.2	0.2	0.5	0.3	0.15	
Removals of Inshore Component	10-year Historical	80,357	83,902	86,043	77,539	75,142	80,357
	5-year Historical	73,906	76,639	79,164	70,193	67,564	73,906
Options	1	74,906	77,289	80,571	72,030	69,198	74,906
	2	80,543	82,926	94,663	80,485	73,425	80,543
	3	59,894	62,276	65,558	57,017	54,185	59,894
	4	62,715	65,098	72,611	61,249	56,301	62,715
	5	77,728	80,110	87,624	76,261	71,313	77,728
	6	76,785	79,168	85,268	74,848	70,607	76,785
	7	70,271	72,654	78,754	68,334	64,093	70,271

Note: This is a relative risk assessment for the purposes of comparing TAC options and only considers the inshore component of the resource. The assessment assumes that all TACs are fully utilized in all management areas, in addition to removals of 20,000 mt of inshore fish from the NB weir fishery.

Figure 18 Results of Risk Assessment Relative to Five-Year and Ten-Year Removals of the Inshore Component



Note: The error bars on the figure above represent the range of mixing scenarios considered in the relative risk assessment.

Note: This is a relative risk assessment for the purposes of comparing TAC options and only considers the inshore component of the resource. The assessment assumes that all TACs are fully utilized in all management areas, in addition to removals of 20,000 mt of inshore fish from the NB weir fishery.