

Atlantic Herring
Stock Assessment and Fishery Evaluation Report
for the
2001 Fishing Year
(January 1 – December 31, 2001)

Prepared by the
New England Fishery Management Council
Atlantic States Marine Fisheries Commission
National Marine Fisheries Service

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1.0 Executive Summary

This Atlantic Herring 2001 Stock Assessment and Fishery Evaluation Report (SAFE) summarizes the 2001 fishing year and Plan Development Team (PDT) recommendations for annual specifications of optimum yield, domestic and foreign fishing, and domestic and joint venture processing for the 2003 fishing year.

The last scientific assessment of herring stock status was done in 1998. For this Report, the PDT examined landings and NMFS trawl survey data to formulate its recommendations. The PDT did not, however, conduct formal projections to estimate stock size or fishing mortality rates in 2001. The PDT has concluded based on available information, however, that fishing mortality remains low on this stock complex, and current biomass is very large. A new herring assessment will be completed in 2003 under the Trans-boundary Resource Assessment Committee (TRAC) in cooperation with Canadian scientists.

Landings of Atlantic herring increased in 2001 by 14 percent from the previous year, to approximately 118,000 metric tons (mt). This is the highest level of landings observed in more than two decades. As in last year, landings in the inshore Gulf of Maine (Area 1A) declined modestly (about 11 percent) but still accounted for the largest portion, approximately 45 percent, of the total catch of the four management zones. Landings from Area 1B and Area 3 increased by 168 percent and 114 percent, respectively, while landings in Area 2, Southern New England, declined 35 percent.

In accordance with the fishery management plans (federal and state plans), Area 1A was closed before the end of the year because reported landings were at the 60,000 mt quota. Subsequent compilation of vessel logbook reports shows Area 1A landings were about 7,000 mt, or 12 percent, below the quota, suggesting that IVR reports overestimated landings in that area. In contrast, final landings data for Area 1B exceeded the 10,000 mt quota for that area by 50 percent. This overage was due to the incorrect assignment in the IVR reports of landings to Area 3 when they were reported in the VTR as coming from Area 1B.

In 2001, 5,000 mt was allocated to directed foreign fishing (TALFF), of which 1,241 mt was caught. In addition, U.S. vessels sold 13,462 mt to foreign processing ships under the joint venture and internal waters processing allocations. This amount of fish is slightly less than the increase in total landings from 2000 to 2001, suggesting that domestic processing and usage remained essentially flat from the previous year.

The total number of vessels landing herring in 2001 (146) declined 14 percent, having also declined 21 percent in the previous year, and the total number of vessels averaging over 2,000 pounds per trip (32) declined 24 percent. The number of vessels using purse seines, mid-water trawls, bottom trawls and other gear all declined, while the number of vessels using mid-water pair trawls increased from 2 to 12. Despite the decline in numbers of vessels landing herring, the number of trips on which herring was landed increased slightly

The number of dealers purchasing herring increased significantly in 2001, however this may reflect the permit and reporting requirements under the federal FMP (implemented in December, 2000).

The PDT recommends no change to the annual specifications, Table 1, and management area TACs, Table 2, for the 2003 fishing year as outlined below. The management area TACs include the January-June seasonal quota as implemented under Framework 1 in 2002.

Specification	PDT Recommendation (mt)
ABC	300,000
OY	250,000
DAH	250,000
TALFF	0
DAP	226,000
USAP	20,000
BT	4,000
JVPt	20,000
JVP (Area 2 & 3)	10,000
IWP	10,000
Reserve	0

Table 1 PDT recommendations for 2003 annual specifications (carry forward 2002 specifications).

Area	Metric Tons	
1A	60,000	6,000 Jan.-June 54,000 June-Dec.
1B	10,000	
2	50,000 (TAC reserve: 80,000)	
3	50,000	

Table 2 Proposed management area TACs for fishing year 2003.

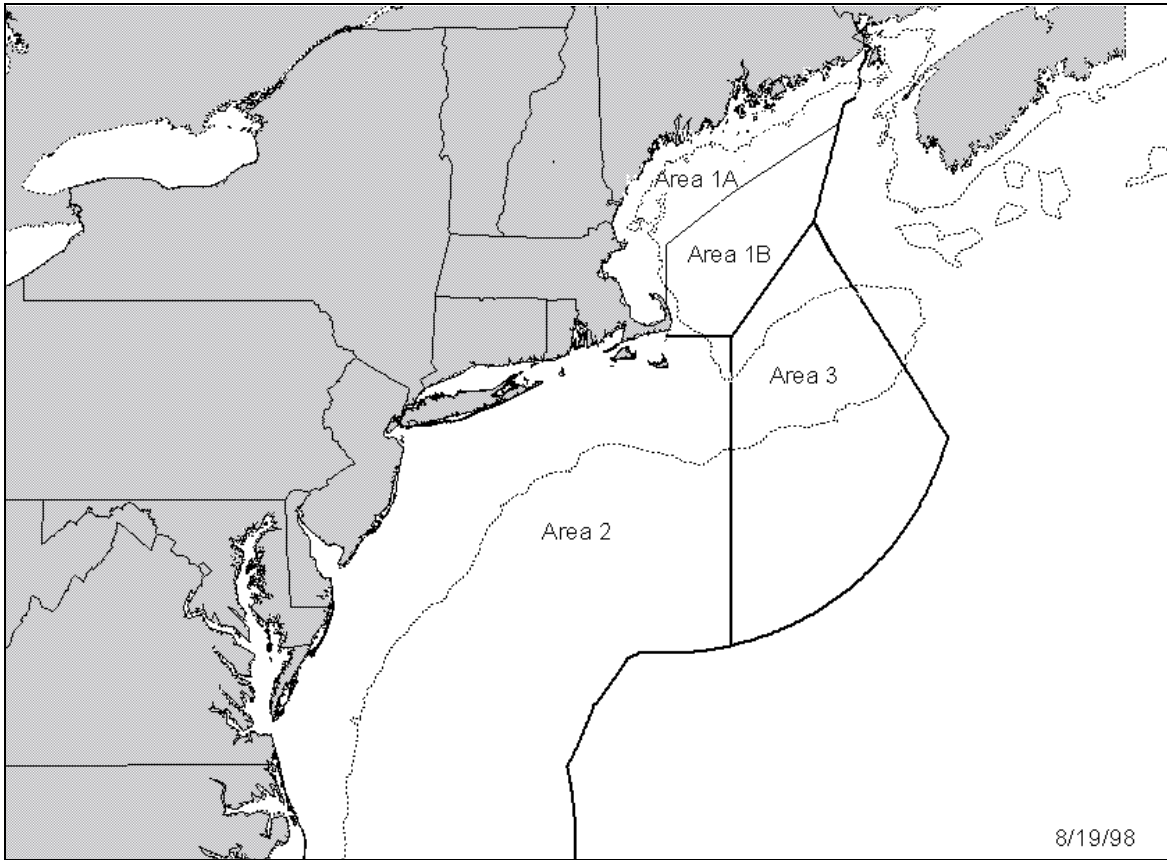


Figure 1 Atlantic herring management areas

2.0 Stock Assessment and Fishery Evaluation

The following section describes the catch, stock status and economic aspects of the herring fishery in 2000. Figure 1, above, shows the herring management areas.

2.1 Biological factors

2.1.1 2000 Herring catch statistics

Catch and landings for the Atlantic Herring fishery is monitored using three separate reporting systems: Vessel Trip Reports (VTR), Interactive Voice Reporting (IVR), and Dealer reports.

Harvesters report VTR data on a monthly basis. Because harvesters give precise location (coordinates or Loran) on a per trip basis, this reporting system allows for detailed catch information from specific areas. VTR data are useful for stock assessment and effort information, but because they are reported on a monthly basis, this system is not useful for quota monitoring. [NOTE: While NMFS monitors vessel locations in real-time through the electronic Vessel Monitoring System (VMS), the information is used for enforcement purposes and not for plotting catch data by area. All herring vessels catching more than 500 mt of herring in any year are required to use a VMS.]

The 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 is not generally useful for stock assessment, or management questions that require information by sub-area or gear.

Dealer Reporting is a monthly reporting system for all federally licensed dealers of Atlantic Herring. While this system does not give specific catch by area information, detailed information on amount landed, price paid, and utilization of landings is gathered.

Both IVR and VTR data incorporates landing to foreign vessels by domestic harvesters (JV or IWP but not TALFF). Dealer data accounts for only landings made to domestic dealers (no JV, IWP, or TALFF). NMFS observers collect data on landings to JVs and TALFF. Individual states collect data on landings to the IWPs

2.1.1.1 VTR

[NOTE: Maine Department of Marine Resources (DMR) is contracted by NMFS to process VTR data for the herring fishery.] As reported by DMR, 118,028 metric tons (mt), (preliminary as of May 2001) of herring were caught during the 2001 fishing year (Table 3). This amount is the highest domestic catch in the history of the series and a 14,850 mt increase from the previous year. Management Area 1A (53,167 mt) accounted for approximately 45 % of the over all landings, followed by Management Area 3 with 29 % (Figure 2). Area 3 and Area 1B experienced a dramatic increase in harvest levels compared to the previous years, while Area 2 saw a decline. Area 1B saw a large increase in catches, approximately 50% above the TAC of this Area. The fact that Area 1A was closed but ended up about 7,000 mt below the TAC, while

Area 1B was not closed but ended up well over the TAC illustrates well the discrepancy between IVR and VTR data discussed in the previous section.

Within Area 1A, purse seines accounted for approximately 38% of the catches, but only accounted for 17 % of the catches for the entire stock complex (Table 4 & Figure 3). Both types of Mid-water trawler gear (single and pair) accounted for the bulk of the catches in 1A and stock-wide.

Of all of the states (Table 5 & Figure 4), Maine had the highest landings (55%), followed by Massachusetts (22%), Rhode Island (14%), and New Hampshire (7%). Comparing 2000 and 2001 landings, Maine and Rhode Island saw reductions in landings, while Massachusetts, New Hampshire, and New Jersey increased in landings

2.1.1.2 IVR

IVR data indicates that a total of 121,569 mt were harvested from the domestic fishery (Table 6 & Figure 5). Comparing 2000 and 2001 catch rates in Area 1A reveals that 2001 catches were lower than the previous year. While the TAC was harvested in this area during both years, the fishery ended approximately two weeks later in 2001. The cause for this reduced catch rates is unknown, but availability of fish inshore, management actions to increase days out of the fishery, and JV operations in Area 3 probably were contributing factors.

Discrepancies exist between IVR and VTR reporting by Area (Table 6). The discrepancy between the two systems is more pronounced in Area 1B and responsible for the TAC overrun noted above. While it may appear that this is the result of over reporting on the IVR system for Area 1A (and a under reporting for Area 1B), trip level analysis indicates otherwise. In many cases a harvester would report a particular catch as coming from Area 3 using IVR, while the coordinates given the VTR system placed that catch just over the line in Area 1B (in an area called Franklin Swell). As many of those fish caught were Georges Bank fish gathering for spawning, these fish are likely not part of the Area 1 spawning component (Figure 6). The PDT will investigate this issue following next year's stock assessment.

2.1.1.3 Catch at Age

The catch at age matrix is developed by applying the commercial harvest data (from VTR) 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 and used in an age structured population model.

Preliminary results (Table 8 & Figure 7& Figure 8) indicate that the 1998 year class is particularly strong for this complex. The 1996 and 1994 year classes were also very strong. Overall, the age structure of this complex has shifted to older individuals since 1997.

Since 1960, Maine DMR has been processing commercial caught samples of Atlantic Herring. Total length, weight, maturity, sex, and age, are generally recorded throughout the entire range of the fishery. Examination of average weight at age for the entire time series suggests a noticeable reduction since the 1980's across most age classes (Figure 9). Further, a reduction in the total length of inshore spawners has also been seen since the 1980's (Figure 10). Overall, it

appears that both inshore and offshore herring are getting smaller at age when compared to the 1980's rebuilding phase of the fishery. While the exact cause maybe unknown, ecosystem effects and increased competition for food may play a role in this trend. Interestingly, there has been a slight increase in weight at age over the entire fishery since 1999.

2.1.1.4 Bycatch and Discards

In addition to the data provided in the 2000 SAFE report, NMFS observers recorded incidents of bycatch during JV & TALFF operations (Table 9). In all a total of 9,182 mt of herring were landed to the JVs over 302 trips. The most significant bycatch was silver hake, but amounted to only 91 mt (< 1 %). Incidents of marine mammal catches were also observed. Given this data, and the data provided previously, significant bycatch of other regulated species is not likely to be occurring. However, the PDT recommends that observer coverage in the inshore areas for all gear types (Single Mid-water Trawl, Pair Mid-water Trawl, and Purse Seine) be increased.

Discards in the domestic herring fishery totaled 545 mt (as reported through VTR), less than 0.05%.

2.1.1.5 Total Removals

Total removals from the stock complex including: Domestic Harvest, TALFF, New Brunswick Weir, and Canadian Purse seine catches on Georges Bank, totaled 142,796 mt (Table 10). Domestic harvest was by far the largest removal source (~ 83 %), followed distantly by the New Brunswick Weir fishery (~ 14 %).

2001*															
Mgt Area	1	2	3	4	5	6	7	8	9	10	11	12	Total	TAC	
1A		3 1,716	1,292	2,476	6,596	8,605	6,978	7,920	4,682	8,954	3,888	57	53,167	60,000	
1B		18	1 68	45	195	110		1,266	1,302	1,128	4,382	6,447	14,963	10,000	
2		8,582	4,900	430	828	56	100	0	2	96	3	64	327	15,388	50,000
3							755	7,636	7,826	10,701	7,310	193	89	34,510	50,000
Total		8,604	6,617	1,789	3,349	6,847	9,571	14,614	17,015	16,781	17,394	8,527	6,920	118,028	170,000

* uncompleted catch data

2000														
Mgt Area	1	2	3	4	5	6	7	8	9	10	11	12	Total	
1A		3	3	76	1,339	7,076	10,390	14,355	12,818	4,334	8,525	812	0	59,730
1B			87	127		76	234	276	73	166	0	5,836	110	6,985
2		7,802	7,902	2,391	212	18	1	0	2	23	2	860	4,364	23,578
3		125		537	87	38		418	3,107	5,893	2,679			12,884
Total		7,929	7,992	3,132	1,638	7,208	10,624	15,049	16,001	10,415	11,207	7,508	4,474	103,178

1999														
Mgt Area	1	2	3	4	5	6	7	8	9	10	11	12	Total	
1A		628	120	93	3,264	4,975	8,055	12,939	9,415	9,497	5,907	8,644	5,110	68,648
1B		272		41		181	57		35	113	731	106	57	1,593
2		7,179	7,516	2,928	511	9	4	34	136	0	1	4	555	18,878
3			143	272	999	154	1,460	290	92	1,280	994			5,685
Total		8,080	7,779	3,334	4,775	5,320	9,575	13,263	9,678	10,890	7,633	8,754	5,722	94,803

1998														
Mgt Area	1	2	3	4	5	6	7	8	9	10	11	12	Total	
1A			193		2,705	3,831	4,014	7,200	4,092	5,101	5,973	6,004	4,473	43,586
1B				392		166	154	112	186	535	1,399	871		3,815
2		5,965	6,568	2,167	160	187	202	161		237	246	222	126	16,242
3				523	487	3,630	3,988	3,845	3,267	1,610	465	144		17,959
Total		5,965	6,761	2,167	3,779	4,505	8,012	11,503	8,049	8,792	8,364	8,091	5,614	81,601

1997														
Mgt Area	1	2	3	4	5	6	7	8	9	10	11	12	Total	
1A			6		2,801	3,302	5,885	10,311	12,530	12,841	11,647	7,303	983	67,608
1B				118	295	500	556	1,091		3	94	316		2,972
2		7,229	4,713	3,841	615	5					500	102	4,443	21,448
3				34		839	948	2,581		213	778			5,393
Total		7,229	4,719	3,875	3,534	4,441	7,333	13,448	13,621	13,057	13,018	7,721	5,426	97,422

1996														
Mgt Area	1	2	3	4	5	6	7	8	9	10	11	12	Total	
1A			19		1,613	6,785	8,155	10,675	10,037	14,383	11,597	9,684	238	73,186
1B				195	1,897	2,405	192	3,536		30	16	477		8,746
2		8,088	3,798	3,791	1,257	345	21				50	1,790	4,748	23,888
3				29						612	1,047			1,688
Total		8,088	3,817	3,820	3,065	9,027	10,581	10,867	13,573	15,025	12,709	11,951	4,986	107,508

Table 3 – Summary of 1996 – 2001 Atlantic herring catches (mt), (Maine DMR).

Management Area	Hand Line Rod & Reel	Bottom Trawl	Gill Net	Purse Seine	Pair Trawl	Mid-Water Trawl	Weir	Total	TAC
1A	0	45	0	20,164	23,018	9,940	10	53,177	60,000
1B	0	4	0	444	8,563	5,951	0	14,963	10,000
2X	1	285	7	0	7,455	7,629	0	15,378	50,000
3X	0	204	0	0	18,645	15,661	0	34,510	50,000
Total	1	539	7	20,609	57,680	39,181	10	118,028	170,000

Table 4– Summary of 1999 herring catch by Management Areas and gear type (Maine DMR).

STATE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
ME	2	0	101	1,588	5,596	8,092	11,009	12,433	12,319	11,734	2,116	43	65,035
MA	39	1,716	1,345	962	539	499	1,867	3,452	3,359	3,548	5,450	3,779	26,555
RI	7,466	4,680	286	789					203	272	338	2,249	16,284
NH	833	123	0	0	710	980	1,738	1,127	898	983	622		8,013
NJ	218	93	25	9	0	0	0	1	1	857	0	829	2,033
NY	42	3	1	1	2	0	0	1	0	1	1	7	59
VA	4	1	31										36
CT												12	12
MD		0	0	0									1
Total	8,604	6,617	1,789	3,349	6,847	9,571	14,614	17,015	16,781	17,394	8,527	6,920	118,028

Table 5– 2001 domestic landings (mt) of Atlantic herring by state and month (Maine DMR)

Month	IVR	VTR	US and Foreign Processing
Jan	7,085	8,604	9,065
Feb	6,551	6,617	6,439
Mar	2,856	1,789	1,570
Apr	2,527	3,349	2,374
May	5,991	6,847	10,499
Jun	11,021	9,571	8,725
Jul	13,573	14,614	13,905
Aug	14,111	17,015	15,019
Sep	19,175	16,781	17,473
Oct	20,639	17,394	16,022
Nov	8,629	8,527	8,109
Dec	9,410	6,920	6,953
Total	121,569	118,028	116,153

Area	IVR	VTR	TAC
1A	58,370	53,167	60,000
1B	8,866	14,963	10,000
2	17,160	15,388	50,000
3	37,174	34,510	50,000
Total	121,569	118,028	170,000

Table 6 - 2001 IVR and VTR landings, and Dealer data (plus foreign processing)

MT													
State	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
ME			88	1,088	7,910	7,317	10,777	11,638	10,885	9,330	2,110	34	61,178
MA		1,520	1,275	1,052	389	497	1,448	2,774	2,461	3,250	4,881	3,606	23,153
RI	9,065	4,830	207	234							36	155	14,527
NH		89			2,200	912	1,681	68	85	39			5,074
Foreign								539	4,230	4,167	1,360	3,166	13,462
Total	9,065	6,439	1,570	2,374	10,499	8,725	13,905	15,019	17,661	16,786	8,388	6,962	117,394

\$													
State	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
ME			11,513	158,023	1,082,516	996,287	1,546,613	1,618,090	1,493,520	1,233,841	312,484	9,096	8,461,983
MA		166,024	151,371	135,219	47,228	158,948	261,878	311,104	282,207	369,083	573,435	433,656	2,890,153
RI	1,034,886	542,270	25,211	28,263							4,800	20,534	1,655,964
NH		10,463			267,584	113,856	211,468	9,000	11,220	5,160			628,751
Foreign								78,518	617,593	579,613	187,469	427,066	1,890,259
Total	1,034,886	718,757	188,095	321,505	1,397,328	1,269,091	2,019,959	2,016,712	2,404,540	2,187,697	1,078,188	890,352	15,527,110

Table 7 US Domestic Landings and Landings to IWP and JV operations (Maine DMR)

Weight (mt) Harvested at age

	1	2	3	4	5	6	7	8	9	10	11 +	Total
1997	22	5,738	47,181	9,508	6,546	10,708	13,228	3,600	637	8	32	97,208
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

Numbers (X 1000) Harvested at age

	1	2	3	4	5	6	7	8	9	10	11 +	Total
1997	1,442	101,286	523,940	77,892	45,343	63,572	71,456	16,970	2,506	24	92	904,522
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

Table 8 Catch at Age in Weight and Numbers: 1997 - 2001 (Maine DMR)

JV																
Month	Trips	Herring Frozen	Herring Mealed	Herring Discarded	Herring total	Mackerel Frozen	Mackerel Discarded	Mackerel Total	Dogfish	Redfish	Sliver Hake	Red Hake	Haddock	Other Fish	White Sided Dolphin	Pilot Whale
8	35	529	0	10	539	0	0	0	0	0	36	4	0	0	0	0
9	102	3,914	123	4	4,041	0	0	0	0	0	45	0	0	0	2	1
10	125	3,306	96	0	3,402	0	0	0	0	0	1	2	0	0	0	2
11	30	355	20	0	375	0	0	0	8	0	10	0	0	0	0	0
12	10	726	100	0	825	46	0	46	0	0	0	0	0	0	0	0
Total	302	8,830	338	15	9,182	47	0	47	8	0	91	7	0	1	2	3

TALFF																
Month	Trips	Herring Frozen	Herring Mealed	Herring Discarded	Herring total	Mackerel Frozen	Mackerel Discarded	Mackerel Total	Dogfish	Redfish	Sliver Hake	Red Hake	Haddock	Other Fish	White Sided Dolphin	Pilot Whale
9	3	175	14	0	189	0	0	0	0	0	9	1	3	0	0	0
10	25	732	33	0	765	0	0	0	0	0	3	4	0	0	0	1
11	31	263	14	2	279	0	0	0	7	3	48	0	5	0	0	0
12	1	9	0	0	9	0	0	0	0	0	0	0	0	0	0	0
Total	60	1,179	61	2	1,241	0	0	0	7	3	60	5	8	1	0	1

* All data in MT except for Marine Mammals

Table 9 NMFS observer data for 2001 JVs (Maine DMR)

	Month													Total	% of Total
	January	February	March	April	May	June	July	August	September	October	November	December			
Domestic*	8,604	6,617	1,789	3,349	6,847	9,571	14,614	17,015	16,781	17,394	8,527	6,920	118,028	82.7	
TALFF	0	0	0	0	0	0	0	0	189	765	279	9	1,241	0.9	
N.B. Weir	0	0	0	0	35	478	3,964	8,648	5,606	1,479	0	0	20,210	14.2	
Canadian Purse Seine: GB	0	0	0	0	0	0	653	949	1,146	569	0	0	3,317	2.3	
Total	8,604	6,617	1,789	3,349	6,882	10,049	19,231	26,612	23,722	20,207	8,806	6,929	142,796		

* Includes landings to JV and IWP using VTR

Table 10 Total Removals from Stock Complex by Month for 2001 (Maine DMR)

Landings by Area: 2001

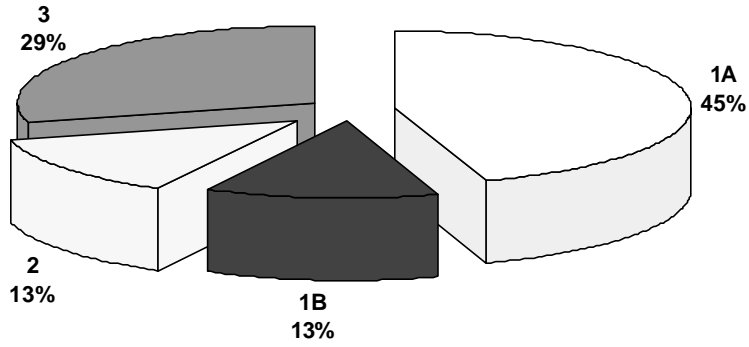


Figure 2 – Herring landings by management area in 2001

Landings by Gear Type: 2001

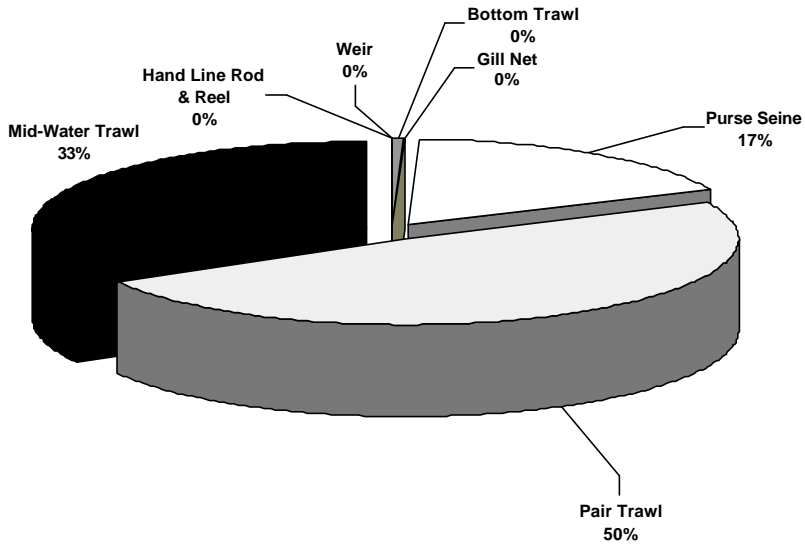


Figure 3 – Herring landings by gear type in 2001

Domestic Landings by State

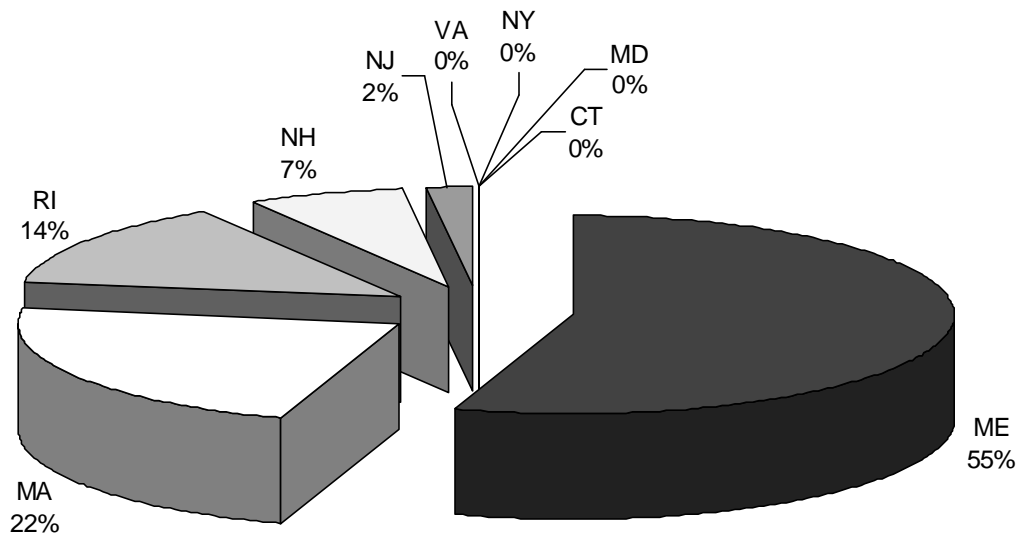


Figure 4 2001 Domestic Landings of Atlantic Herring by State (Maine DMR)

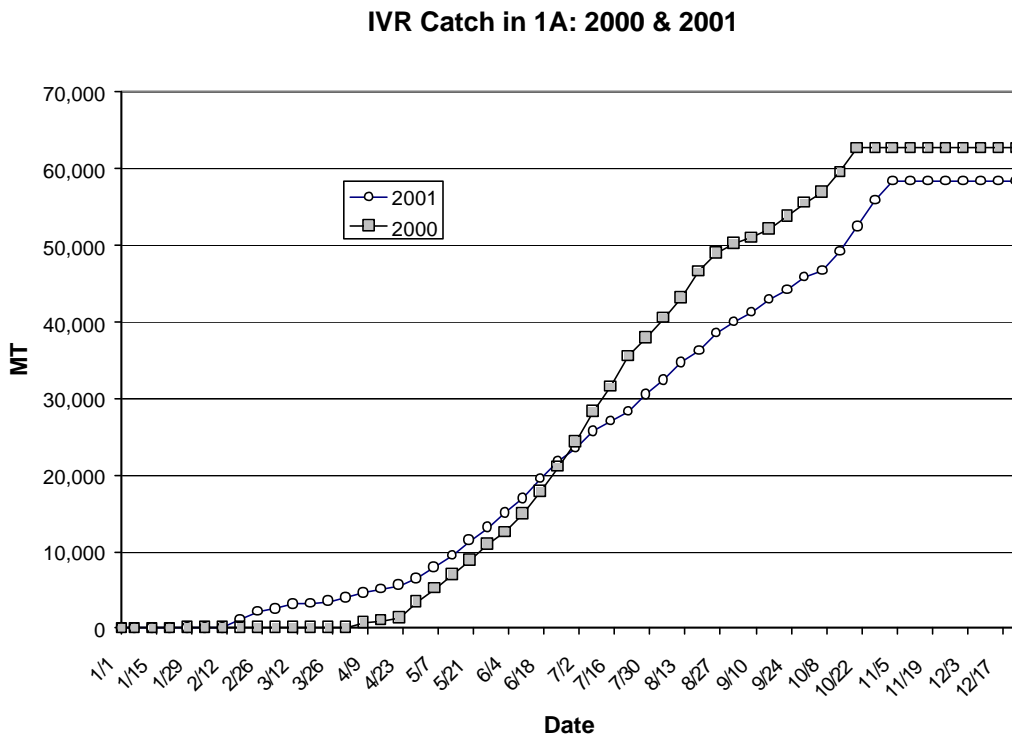
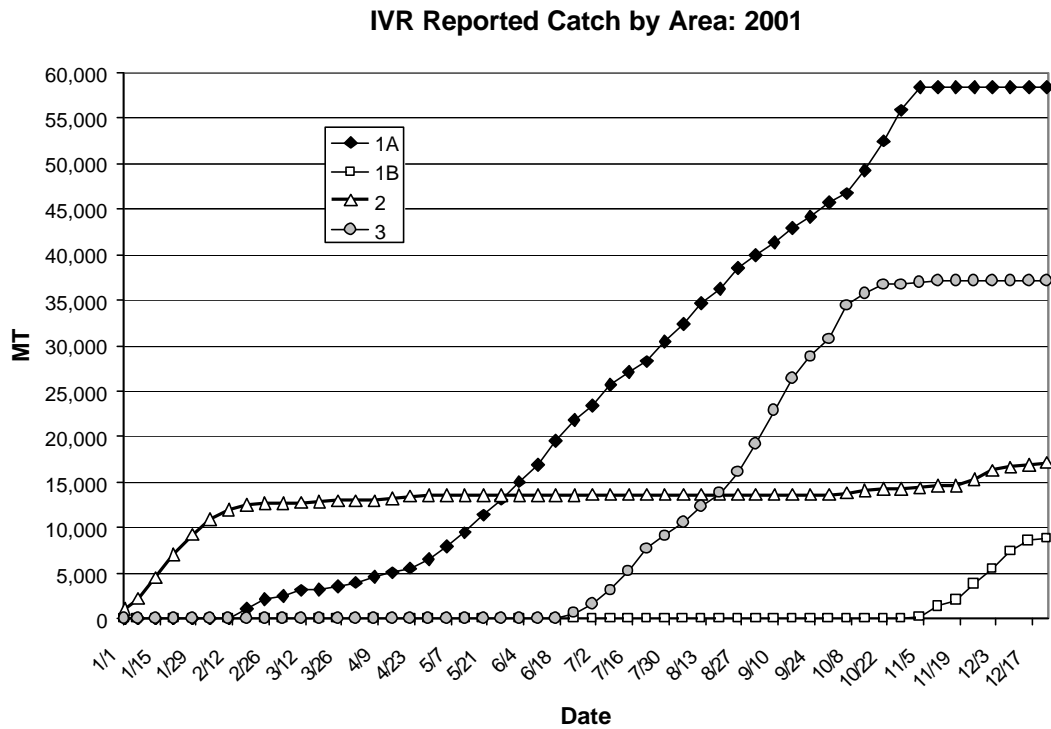


Figure 5 2001 IVR system Catch by Management Area (Maine DMR)

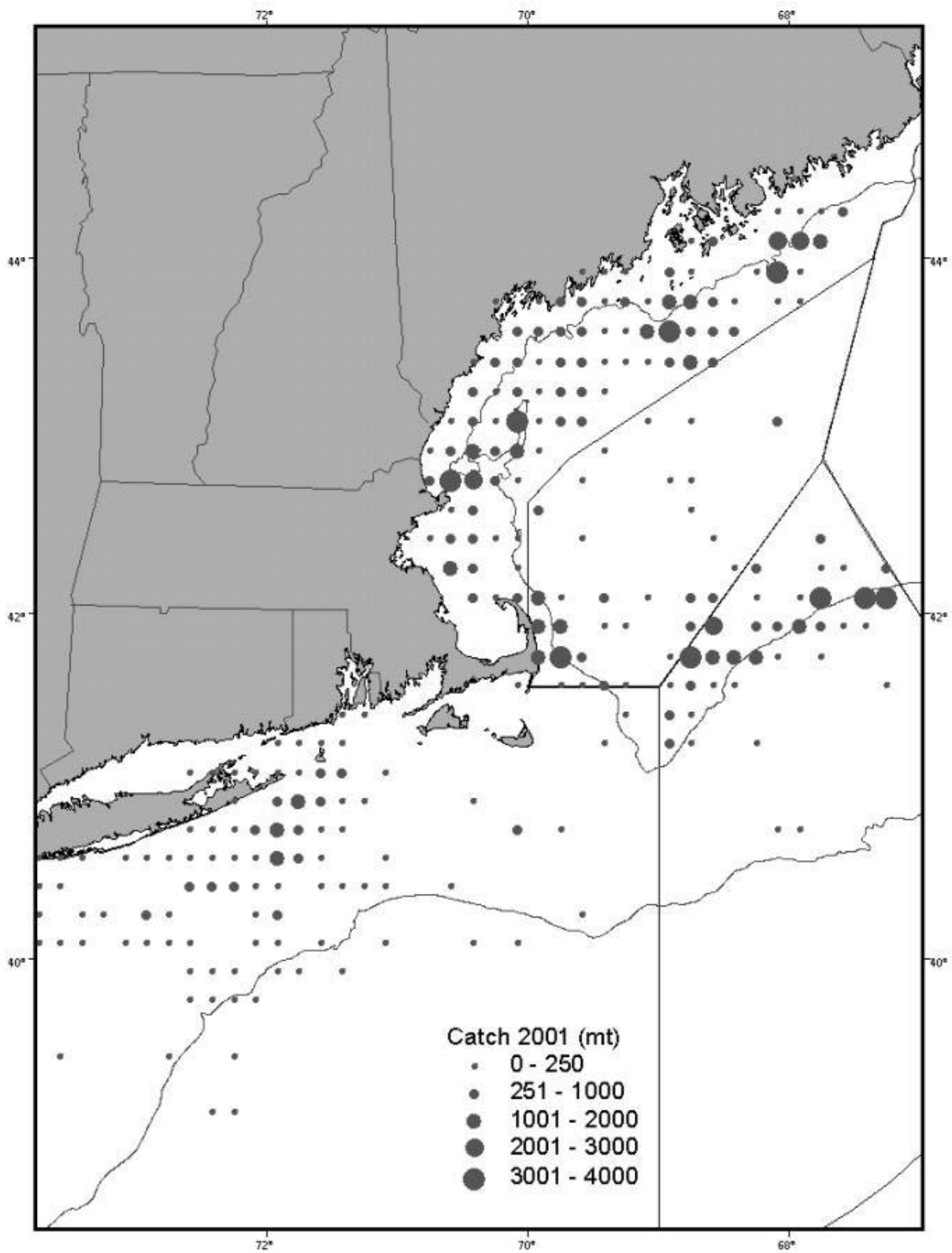


Figure 6 – 2001 Atlantic Herring Catch by 10 minute square (Maine DMR).

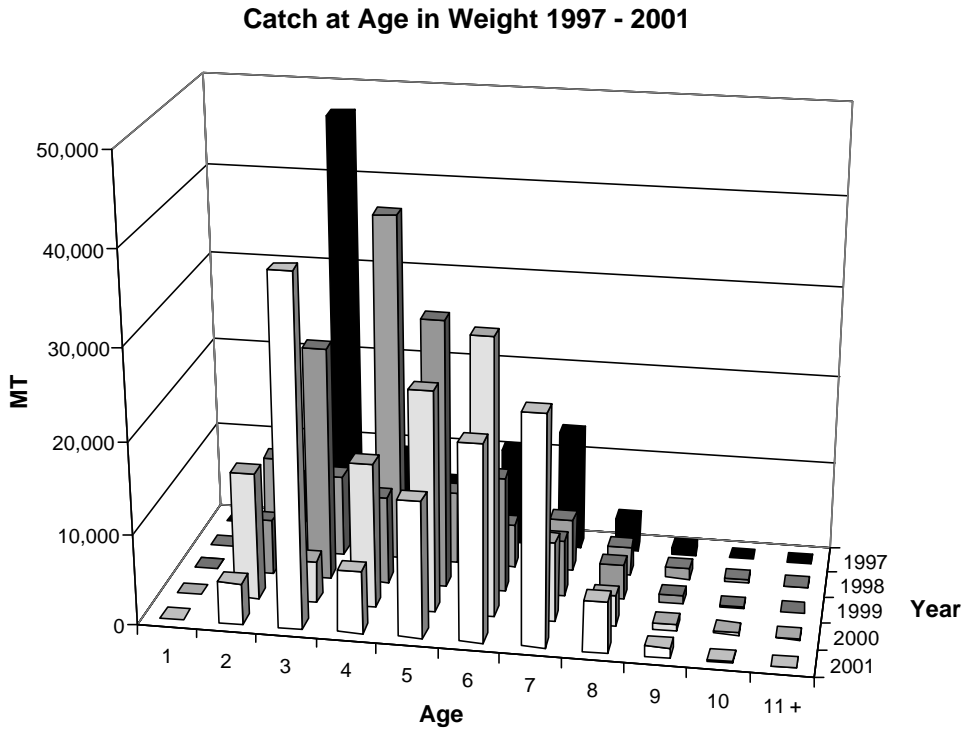


Figure 7 Catch at Age by Weight 1997 - 2001 (Maine DMR)

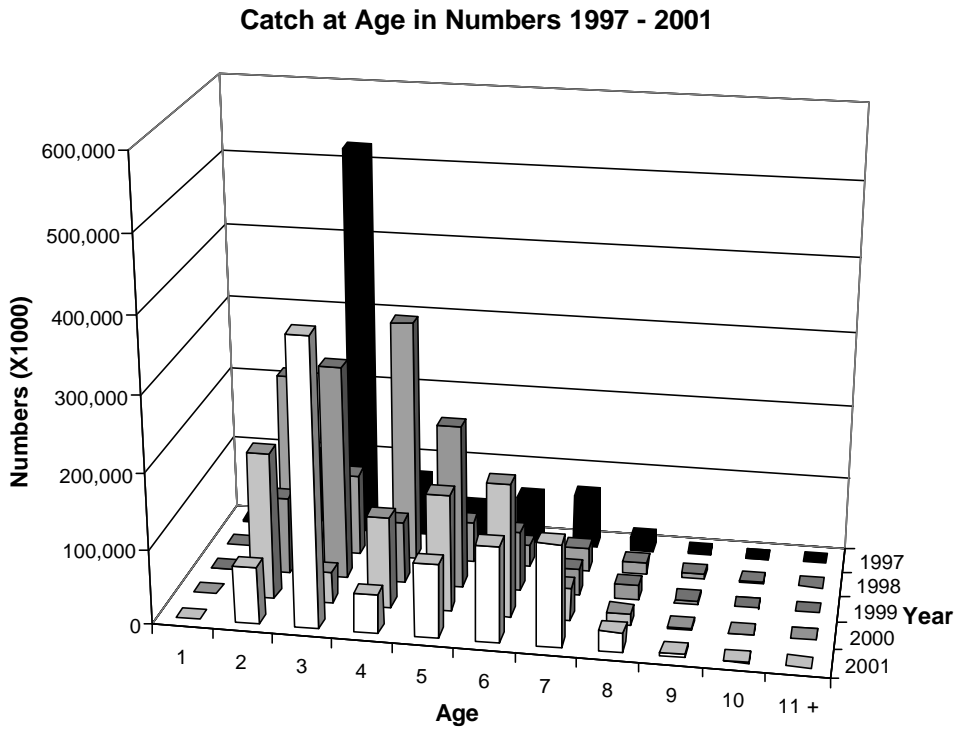


Figure 8 Catch at Age by Numbers 1997 - 2001 (Maine DMR)

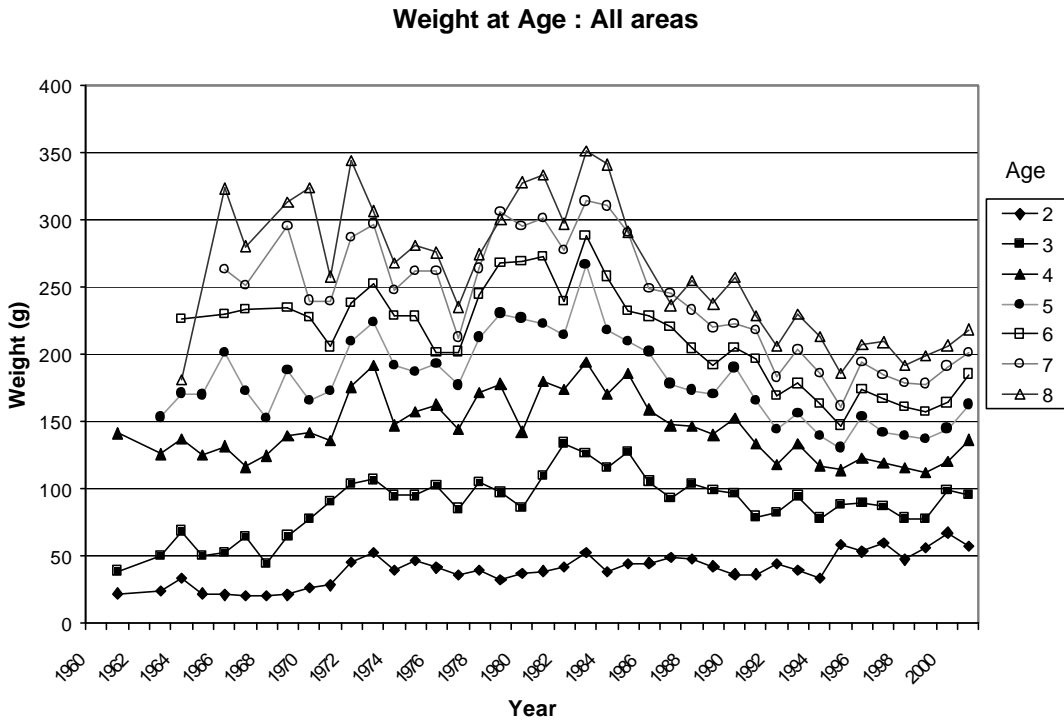


Figure 9 Fishery-wide Average Weight at Age by age class: 1960 - 2001 (Maine DMR)

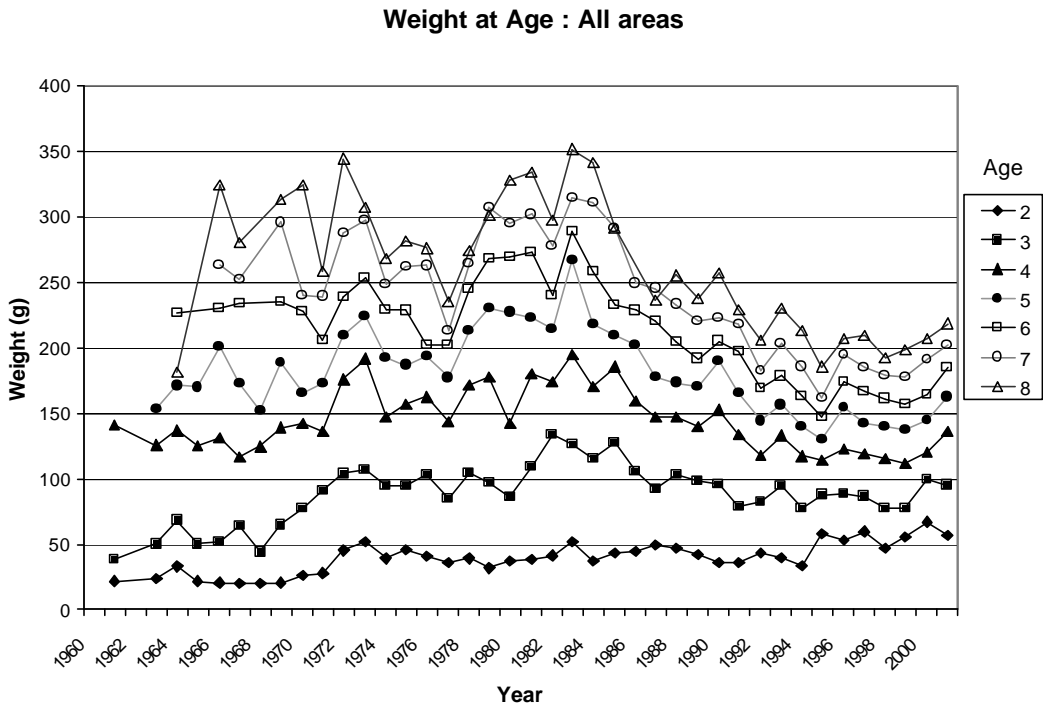


Figure 10 Average Total Length for Inshore Spawners (Maturity Stage > 4) Maine DMR)

2.1.2 Status of the resource

A peer-reviewed assessment of the Atlantic herring coastal stock complex was last conducted in 1998 (NEFSC 1998). This assessment indicated that the stock complex was at a high biomass level and was under-exploited in 1997. Fishing mortality and biomass were estimated using virtual population analysis (VPA). Fishing mortality was at a record low ($F = 0.05$) and spawning stock biomass (SSB) had increased to a record high 1.8 million mt. The SARC noted that estimates of F and SSB had low precision, in part, due to the low fishing mortality on the stock. They also noted that a retrospective analysis indicated that the VPA tended to over-estimate SSB and under-estimate F in the terminal years. The cause of this retrospective pattern has not been determined.

No projections were made for 2003 because too much time has elapsed since the last assessment. Nevertheless, it is the consensus of the PDT that fishing mortality remains low on this stock complex, and current biomass is large. A new herring assessment will be completed in 2003.

The biomass indices for herring from the NMFS Groundfish surveys during winter, spring and autumn all increased in 2001 (Figure 11 & Table 11). Smoothed indices from the spring survey indicate that the stock has continued to increase and remain at high abundance throughout the 1990s (Figure 12). Hydroacoustic surveys during autumn 1998-2001 indicate that a very large biomass of spawning herring is present offshore. The extent of the distribution of these spawning concentrations is very large and the density of herring at many of the surveyed sites was high again in 2001 (Figure 13). The Plan Development Team (PDT) concluded that the biomass of the stock complex remains high.

Since 1999 Maine DMR, in partnership with the Gulf of Maine Aquarium, 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.

The estimate of spawning herring biomass surveyed in the Gulf of Maine in 2001 is approximately 30,000 metric tons. This value is considerably lower than estimates from prior years (226,000 metric tons in 1999 and 256,000 metric tons in 2000, Figure 14). However when the biomass of spawning and “spent” herring are combined, 2001 survey results indicate nearly 340,000 metric tons of herring, compared with 235,000 metric tons of spent plus spawning herring in 1999 and 280,000 metric tons in 2000. Most likely, the large amount of spent herring surveyed in November 2001 in the Jeffreys Ledge / Southwestern Gulf of Maine region represents individuals who spawned in coastal Gulf of Maine, but were missed during earlier surveys. While there appears to be a trend toward increasing biomass for inshore herring, the error estimates are quite high and there is not a statistically significant increase in this spawning component.

In recent years both the NMFS and the inshore Gulf of Maine hydroacoustic surveys have not documented spawning activity on Jeffreys Ledge proper despite numerous sampling trips. While large aggregations of post spawning individuals have been seen, “ripe and running” adults have not been found. This observation suggests that either this component has been routinely missed or that spawning no longer occurs there.

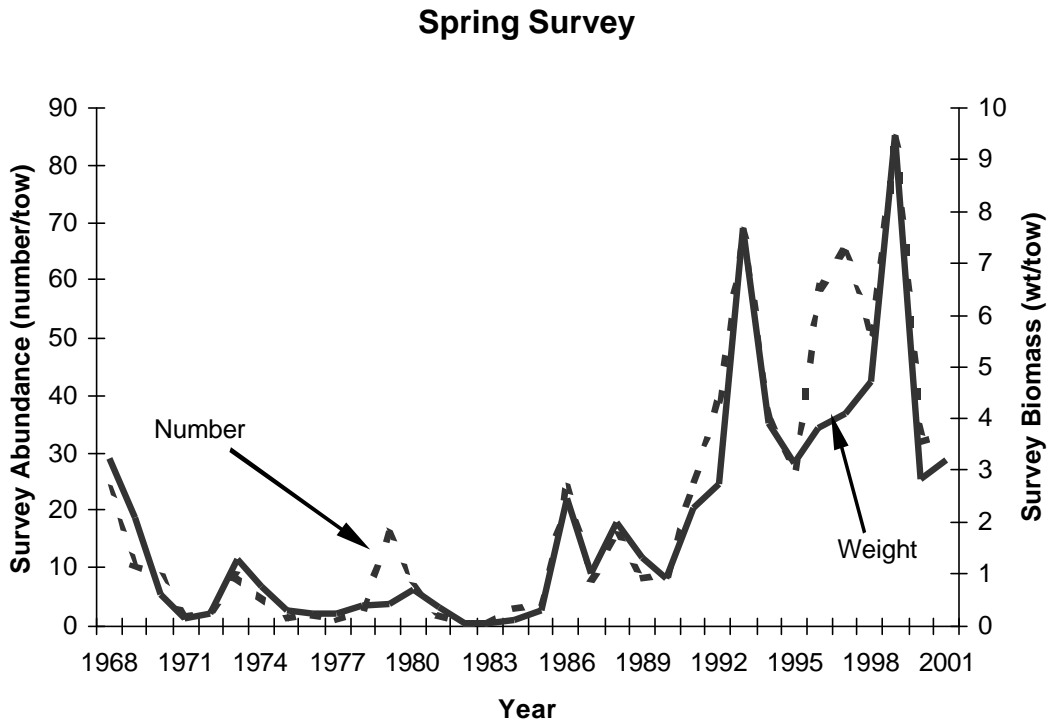


Figure 11 NMFS Spring bottom trawl survey indices, 1968-2001.

spring survey catch/tow

yr	number	wt	ret num	ret wt
1968	23.472	3.236	9.961	1.437
1969	10.701	2.083	2876	0.616
1970	8.416	0.615	3.132	0.406
1971	1.682	0.169	1.071	0.143
1972	2.65	0.219	1.568	0.16
1973	8.76	1.263	3.178	0.552
1974	5.363	0.767	2.412	0.485
1975	1.521	0.322	0.832	0.202
1976	1.993	0.216	0.899	0.184
1977	1.199	0.226	0.553	0.114
1978	3.252	0.399	1.103	0.231
1979	16.137	0.419	0.818	0.225
1980	6.466	0.7	2.164	0.404
1981	2.176	0.358	0.921	0.243
1982	0.573	0.037	0.243	0.036
1983	0.459	0.055	0.05	0.301
1984	3.096	0.134	0.861	0.104
1985	3.872	0.299	2.04	0.207
1986	24.039	2.479	4.177	0.813
1987	7.843	1.012	3.684	0.683
1988	15.557	1.995	4.397	0.867
1989	8.354	1.318	4.225	0.605
1990	8.976	0.917	5.731	0.645
1991	25.397	2.292	21.151	1.537
1992	39.296	2.755	21.717	1.615
1993	68.515	7.683	52.381	3.939
1994	35.396	3.881	27.57	2.33
1995	27.565	3.143	17.47	1.993
1996	58.577	3.809	32.157	2.129
1997	64.663	4.084	42.543	2.696
1998	50.619	4.726	35.438	2.519
1999	84.523	9.447	67.608	5.336
2000	32.024	2.803	22.744	1.887
2001	33.717	3.221	22.946	2.101

Table 11 NMFS spring bottom trawl survey indices for herring, 1968-2001.

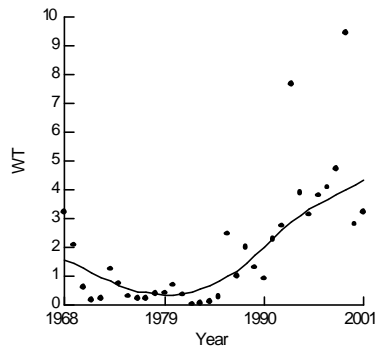
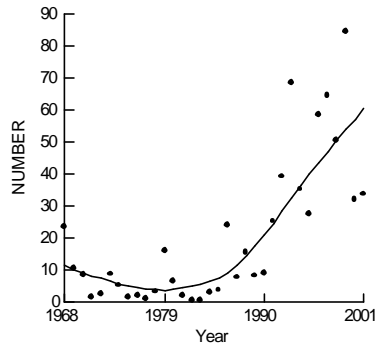


Figure 12 NMFS Spring bottom trawl smoothed indices, 1968-2001.

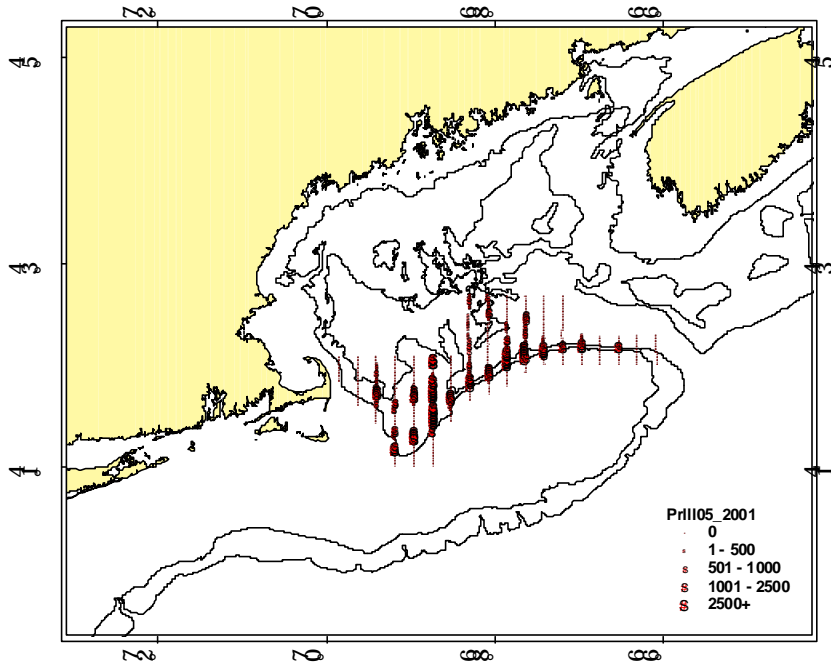


Figure 13 NMFS herring acoustic survey (zigzag design) during autumn, 2001 (size of circles indicates relative density of herring)

Combined Spawning and Late Spent

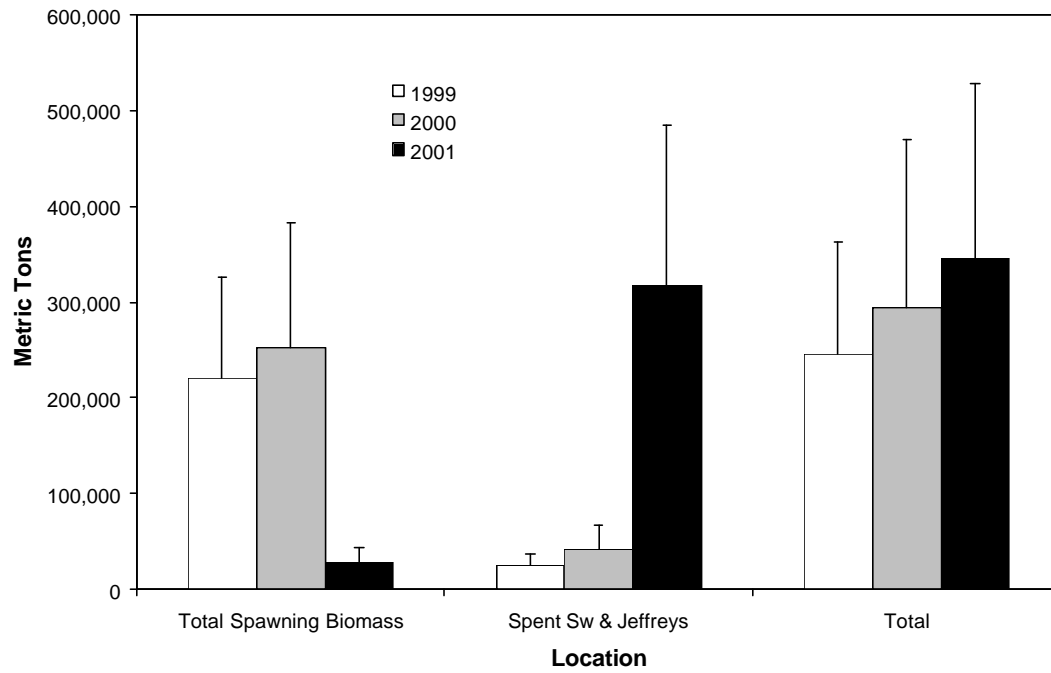


Figure 14 Data from Inshore Acoustic Surveys 1999- 2001 (Maine DMR)

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 Vessels

[NOTE, some discrepancy exists between the data in this section and in Section 2.1.1. This is due to the updating of the catch statistics after the data had been compiled for analysis in this section. The differences are not significant, however.]

In 2001 the gear type that brought the largest amount of herring to market was the mid-water pair trawl at 57,681 metric tons which is a 50% increase over 2000 landings. Thirteen vessels pair trawled in 2001 which is substantially more than the two vessels that used this fishing method in 1999 and three more than was used in 2000. Single vessel mid-water trawling accounted for 37,503 metric tons which is 12% higher than 2000 landings. Purse seine landings totaled 20,609 metric tons; a 28% decline from 2000. Bottom trawl gear accounted for 2,215 metric tons. Landings by weirs in 2001 was 10 metric tons. The change from purse seining to mid-water trawling (single or pair) observed in 2000 continued in 2001.

Most herring sold in 2001 was taken from Area 1A (52,594 mt). Area 1B landings (15,023 mt) were higher than in 2000 (6,986 mt) due, most likely, to the 60,000 mt Area 1A cap being reached by November 10, 2001 (10,829 mt landed from Area 1B in November and December). The 10,000 mt TAC was exceeded because of area discrepancies in the quota monitoring system. The Area 2 landings were 15,389 metric tons (down from 23,070 in 2000). Area 3 landings were 34,511 metric tons, up significantly from 5,549 mt in 1999 and 12,070 in 2000. Table 12 shows the landings of the various gears used in 2001 and the activities of each in the management areas.

Table 13 differs from Table 12 in that instead of listing herring landings by gear used, each vessel was assigned a principal gear based on the gear 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 mid-water trawl gear landed herring with other gears; the actual gear used is shown in Table 12, while Table 13 lists all landings under the primary gear used by the vessel.

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 14 provides the same information as Table 13 except it excludes the incidental herring vessels. In 2001 there were 32 vessels, defined as directed herring vessels, which sold 117,940 metric tons of herring. In 2001 there were 8 less bottom trawl vessels and 2 less purse seine vessels directing on herring than in 2000.

Since Area 1A is the 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 15 provides information for the 22 vessels that averaged more than 2,000 pounds per trip in Area 1A in 2001. Those

vessels landed 114,005 mt of herring from all areas (up from 102,393 in 2000) and 52,546 mt, or more than 99 percent of the herring from Area 1A. In Section **3.4.3**, below, the PDT discusses several issues related to the potential impact on vessels of the quota management of Area 1A.

Fluctuations in the ex-vessel price for herring are minor and the average price was \$0.06 per pound in 2001. At this price the total value of herring sold in 2001 was \$15,615,237.

The landings summarized in Table 12 through Table 15 are based on data provided by the State of Maine (for herring landings in all Northeast states). Most of the Maine data is from federal logbooks. Table 16 compares the value of herring to the value of all landed species, expressed as a percentage of revenues, by principal herring gear as well as average crew sizes on herring trips. Since the data provided by the State of Maine does not include information on non-herring landings or crew size, this information must be drawn from logbooks. Table 16 was constructed by only using information where the herring landings provided by the State of Maine closely matched the herring landings in the federal logbooks.

The total number of vessels landing herring in 2001, Table 13, declined to 146 from 214 in 1999 and 169 in 2000, and the total number of vessels averaging over 2,000 pounds per trip, Table 14, declined to 32 from 55 in 1999 and 42 in 2000. Since 1999 the number of vessels with primary gear of mid-water pair trawl went from 2 to 12 vessels. Single mid-water trawls went from 25 to 9. Clearly, some vessels switched from single MWT to pair MWT since 1999. However, there was a net decline of 6 vessels in the total MWT group (single and pair). Purse seine vessels declined by three (8 to 5). The most significant decline was bottom trawl vessels which declined from 131 to 80 vessels (38.9%). Other gear declined by 8 (48 to 40).

Despite the overall decrease in numbers of vessels, total number of trips in 2001 (2,195) increased slightly from 2000 levels (2,058) and total landings increased from 102,461 mt to 118,029 mt, or about fifteen percent. Area 1A trips were up but the landings were capped at 52,594 due to the November 10 closure. Effort and catch appear to have shifted from area 1A to 1B during the closure. Some effort and catch also shifted out of area 2. There was also a marked increase in area 3 effort and catch in 2001.

	1A	1B	2	3	Unknown	Total
Mid-water pair	22,815	8,563	7,456	18,645	202	57,681
Mid-water trawl	9,940	5,301	7,629	14,633	0	37,503
Purse Seine	19,794	505	0	0	310	20,609
Bottom trawl	44	654	284	1,233	0	2,215
Weir	0	0	10	0	0	10
Other	1	0	10	0	0	11
Total	52,594	15,023	15,389	34,511	512	118,029

Table 12 Metric tons of herring sold by gear used and management area in 2001

		1A	1B	2	3	Un- known	Total
Mid-water pair trawl	Number of trips	329	123	106	168	5	731
12 vessels	Landings (mt)	24,297	10,549	9,362	18,305	203	62,716
Mid-water trawl	Number of trips	125	22	92	92	0	331
9 vessels	Landings (mt)	8,540	3,964	5,722	15,623	0	33,849
Purse seine	Number of trips	309	5	0	0	7	321
5 vessels	Landings (mt)	19,647	505	0	0	311	20,463
Bottom trawl	Number of trips	388	7	161	6	0	562
80 vessels	Landings (mt)	109	4	284	583	0	980
Weir	Landings (mt)	0	0	10	0	0	10
Other gear	Number of trips	6	0	244	0	0	250
40 vessels	Landings (mt)	1	0	10	0	0	11
Total	Number of trips	1,157	157	603	266	12	2,195
146 vessels	Landings (mt)	52,594	15,022	15,388	34,511	514	118,029

Table 13 Number of vessels, herring trips, and herring sold (mt) by management areas and principal herring gear for 2001

		1A	1B	2	3	Un- known	Total
Mid-water pair trawl 12 vessels	Number of trips	329	123	106	168	5	731
	Landings (mt)	24,297	10,549	9,362	18,305	204	62,717
Mid-water trawl 7 vessels	Number of trips	117	22	92	92	0	323
	Landings (mt)	8,538	3,964	5,722	15,623	0	33,847
Purse seine 5 vessels	Number of trips	309	5	0	0	7	321
	Landings (mt)	19,647	505	0	0	311	20,463
Bottom trawl 8 vessels	Number of trips	4	0	38	5	0	47
	Landings (mt)	64	0	266	583	0	913
Total 32 vessels	Number of trips	759	150	236	265	12	1,422
	Landings (mt)	52,546	15,018	15,350	34,511	515	117,940

Table 14 Number of vessels, herring trips, 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 2001

		1A	1B	2	3	Un-known	Total
Mid-water pair trawl	Number of trips	329	123	106	168	5	731
	Landings (mt)	24,297	10,549	9,362	18,305	204	62,717
12 vessels							
Mid-water trawl	Number of trips	117	20	69	88	0	294
	Landings (mt)	8,538	3,001	4,867	13,977	0	30,383
4 vessels							
Purse seine	Number of trips	309	5	0	0	7	321
	Landings (mt)	19,647	505	0	0	311	20,463
5 vessels							
Bottom trawl	Number of trips	4	0	0	3	0	7
	Landings (mt)	64	0	0	378	0	442
1 vessels							
Total	Number of trips	759	148	175	259	12	1,353
	Landings (mt)	52,546	14,055	14,229	32,660	515	114,005
22 vessels							

Table 15 Number of vessels, herring trips, and herring sold (mt) by management areas and principal herring gear for vessels averaging more than 2,000 pounds of herring per trip in Area 1A during 2001

	Percent of revenue from herring	Average crew size on herring trips
Mid-water pair trawl	60%	4.4
Mid-water trawl	61%	3.4
Purse seine	98%	5.0
Bottom trawl	0.7%	2.6

Table 16 Value of herring compared to value of all species (as a percent of revenue) and crew size by principal herring gear for 2001

Among other measures, the final rule implementing the Atlantic Herring FMP, published on December 11, 2000, established permitting requirements for the Atlantic herring fishery. Effective January 10, 2001, all commercial U.S. vessels fishing for, catching, possessing, or landing herring in or from the EEZ were required to obtain a Federal Atlantic herring vessel permit. There are two types of Federal Atlantic herring vessel permits:

- Category 1 Permit: requires any eligible vessel that caught more than 500 metric tons (mt) of Atlantic herring during the calendar year 2000, or intends to catch more than 500 mt of Atlantic herring during calendar year 2001, to install a NMFS-approved Vessel Monitoring System (VMS) no later than March 12, 2001. NMFS issued 125 Category 1 permits in 2000 and 141 in 2001 (Figure 15, showing 2001 Category 1 permits by state).
- Category 2 Permit: requires any eligible vessel that did not catch more than 500 mt of Atlantic herring during fishing year 2000, or did not intend to catch more than 500 mt of Atlantic herring during calendar year 2001, to obtain a Category 2 Permit. NMFS issued 1,526 Category 2 permits in 2000 and 1868 in 2001 (Figure 16, showing 2001 Category 2 permits by state).

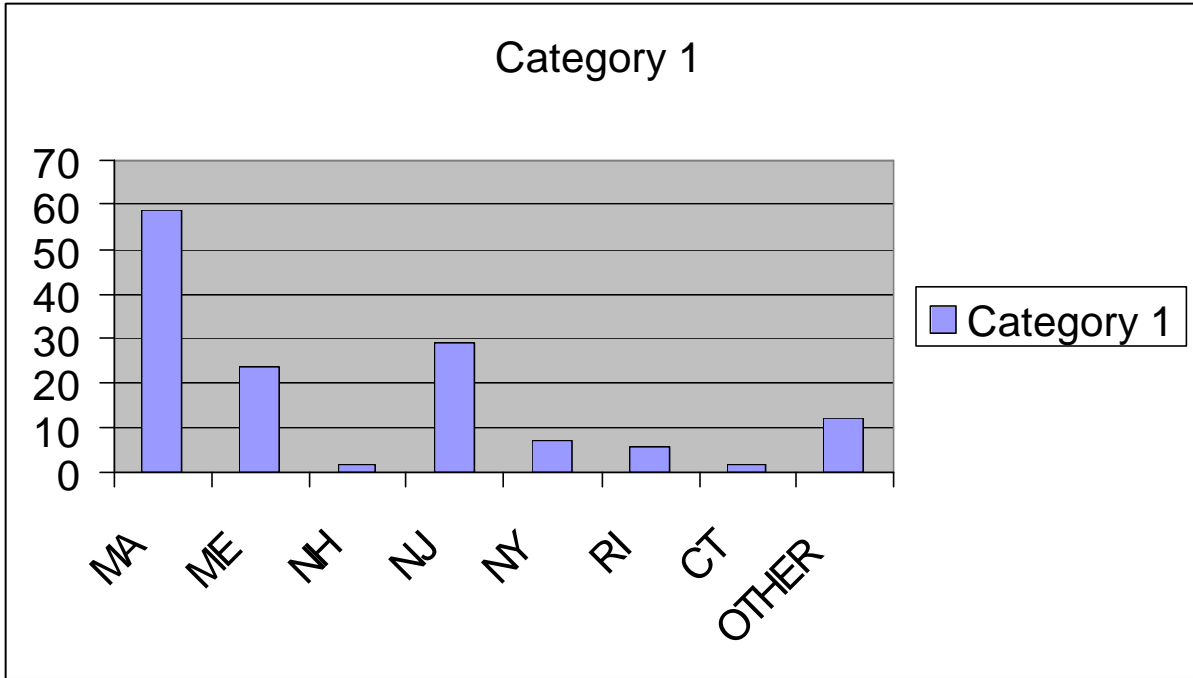


Figure 15 Atlantic herring Category 1 permits, 2001

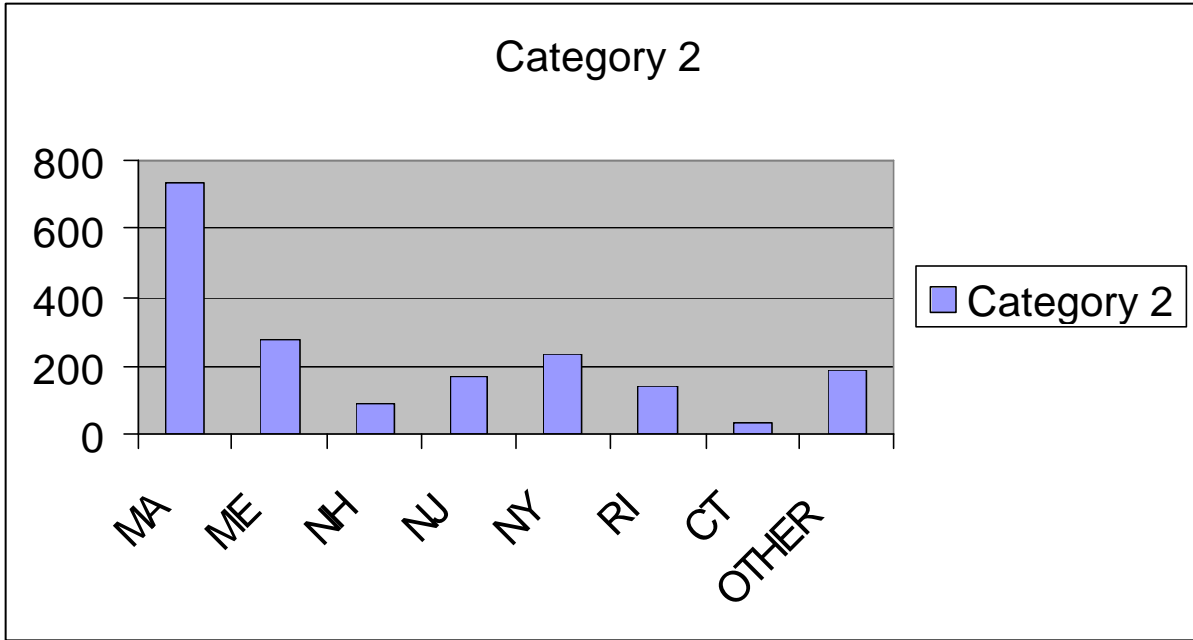


Figure 16 Atlantic herring Category 2 permits, 2001

2.2.2 Dealers

[NOTE, some discrepancy exists between the data in this section and in Section 2.1.1. This is due to the updating of the catch statistics after the data had been compiled for analysis in this section. The differences are not significant, however.]

Table 17 characterizes the number of dealers purchasing various quantities of herring. Estimates of bait do not include bait that came out of the canneries or bait imported from Canada due to resource shortages. Depending on yields, approximately 30-40 percent of the weight of herring purchased by the canneries goes into the bait market. Table 17 does not reflect this additional bait herring. Furthermore, the figures in Table 17 are preliminary because, as of May 2002, only 97,043 mt are reported in the dealer database.

Number of dealers	Total metric tons of herring purchased	Metric tons purchased for bait market
Unknown dealers	2,426	219
18 dealers each receiving over 1,000 metric tons	80,355	41,076
32 dealers each receiving 100 to 1,000 metric tons	14,053	11,250
13 dealers each receiving 1 to 100 metric tons	205	177
17 dealers each receiving less than 1 metric ton	4	0.5
Total	97,043	52,722.5

Table 17 Dealers purchasing herring, based on 2001 dealer data. NOTE: dealer data does not account for the full amount of landings reported on the VTR.

Data as reported to Maine DMR shows domestic landings of 103,932 mt, worth \$13,636,851 (Table 18). If foreign processed landings (IWP and JV) are included, the total amount reported increases to 117,394 mt and value increases to \$15,527,110 (Table 7). Food accounted for approximately 40% of the landings and value. Bait accounted for the rest of the landings and value. If foreign processing is again included, food accounts for approximately 47 % of landings and value. Overall value of this fishery has increased by approximately \$4,000,000 over 2000 levels.

FOOD			BAIT			OTHER			TOTAL		
MONTH	MT	VALUE	MONTH	MT	VALUE	MONTH	MT	VALUE	MONTH	MT	VALUE
JAN	6,899	\$ 777,614	JAN	2,112	\$257,272	JAN	54	0	JAN	9,065	\$1,034,886
FEB	4,945	\$ 556,450	FEB	1,373	\$162,307	FEB	120	0	FEB	6,439	\$718,757
MAR	682	\$ 77,869	MAR	889	\$110,226	MAR	0	0	MAR	1,570	\$188,095
APR	67	\$ 7,732	APR	2,307	\$313,773	APR	0	0	APR	2,374	\$321,505
MAY	3,318	\$ 380,012	MAY	7,154	\$1,017,316	MAY	27	0	MAY	10,499	\$1,397,328
JUN	3,044	\$ 492,095	JUN	5,681	\$776,996	JUN	0	0	JUN	8,725	\$1,269,091
JUL	3,433	\$ 534,265	JUL	10,439	\$1,485,694	JUL	34	0	JUL	13,905	\$2,019,959
AUG	4,459	\$ 553,206	AUG	9,983	\$1,383,788	AUG	39	1,200	AUG	14,480	\$1,938,194
SEP	3,811	\$ 462,876	SEP	9,621	\$1,324,071	SEP	0	0	SEP	13,432	\$1,786,947
OCT	4,919	\$ 555,241	OCT	7,666	\$1,052,843	OCT	34	0	OCT	12,619	\$1,608,084
NOV	3,996	\$ 449,194	NOV	3,031	\$441,525	NOV	0	0	NOV	7,027	\$890,719
DEC	2,339	\$ 260,966	DEC	1,457	\$202,320	DEC	0	0	DEC	3,796	\$463,286
TOTAL	41,911	\$5,107,520	TOTAL	61,714	\$8,528,131	TOTAL	307	1,200	TOTAL	103,932	\$13,636,851

Table 18 Domestic dealer reports of 2001 herring landings, value and utilization by month (Maine DMR)

2.2.3 Processors

Effective January 10, 2001, any person who purchases or receives Atlantic herring for a commercial purpose other than solely for transport, or pumping operations, or for the purchaser's own bait must obtain a Federal Atlantic herring dealer permit. Also, any person who receives unprocessed Atlantic herring either from a fishing vessel issued a Federal Atlantic herring permit or from an Atlantic herring dealer for the purposes of processing must obtain a Federal Atlantic herring processor permit. Because the Federal dealer and/or processor permit requirements became effective after the 2000 quota period, no Federal Atlantic herring dealer and/or processor permits were issued for fishing year 2000. In 2001, NMFS issued 190 Federal Atlantic herring dealer permits and 20 Federal Atlantic herring processor permits. The distribution of processor and dealer permits by state as of May, 2001 are shown in Figure 17 and Figure 18, respectively.

In 2001, Dr. John Gates, URI, in consultation with the DPT developed a prototype processor survey to collect information about the plans of processors for the upcoming year that could be used to estimate DAP. Upon review of the survey responses, the PDT concluded that some sectors were not well enough covered by the survey for the information to be used at this time. The PDT recommended that a follow-up, revised survey be conducted for use in next year's report.

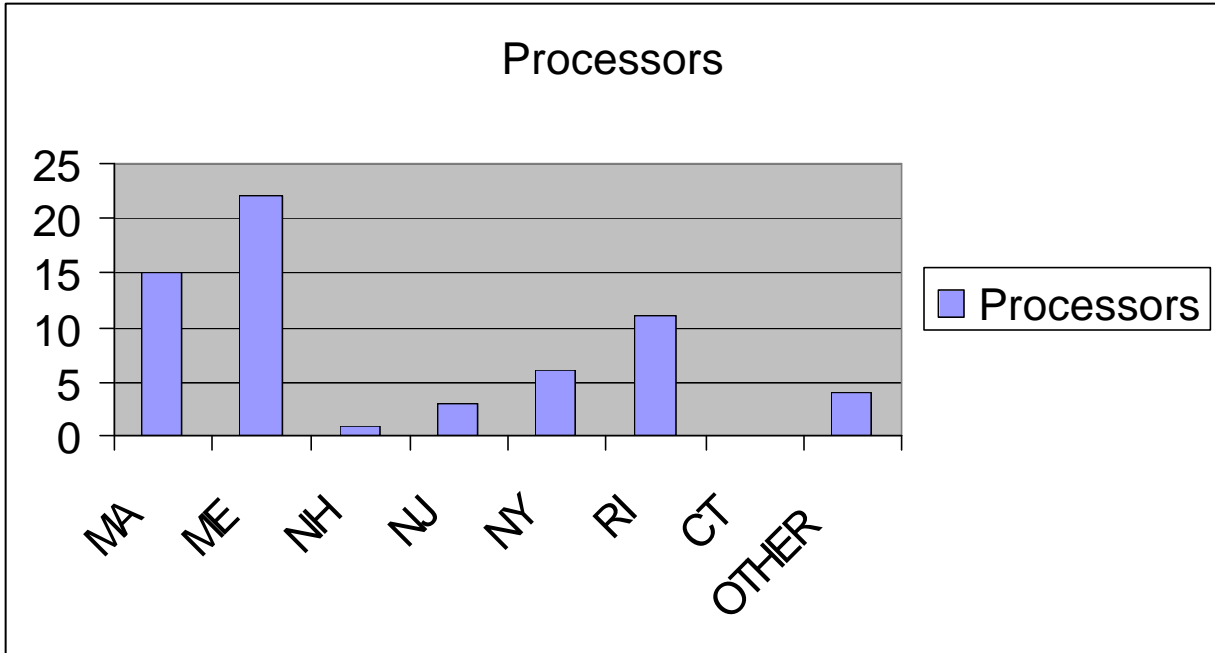


Figure 17 Herring processor permits by state, May, 2001

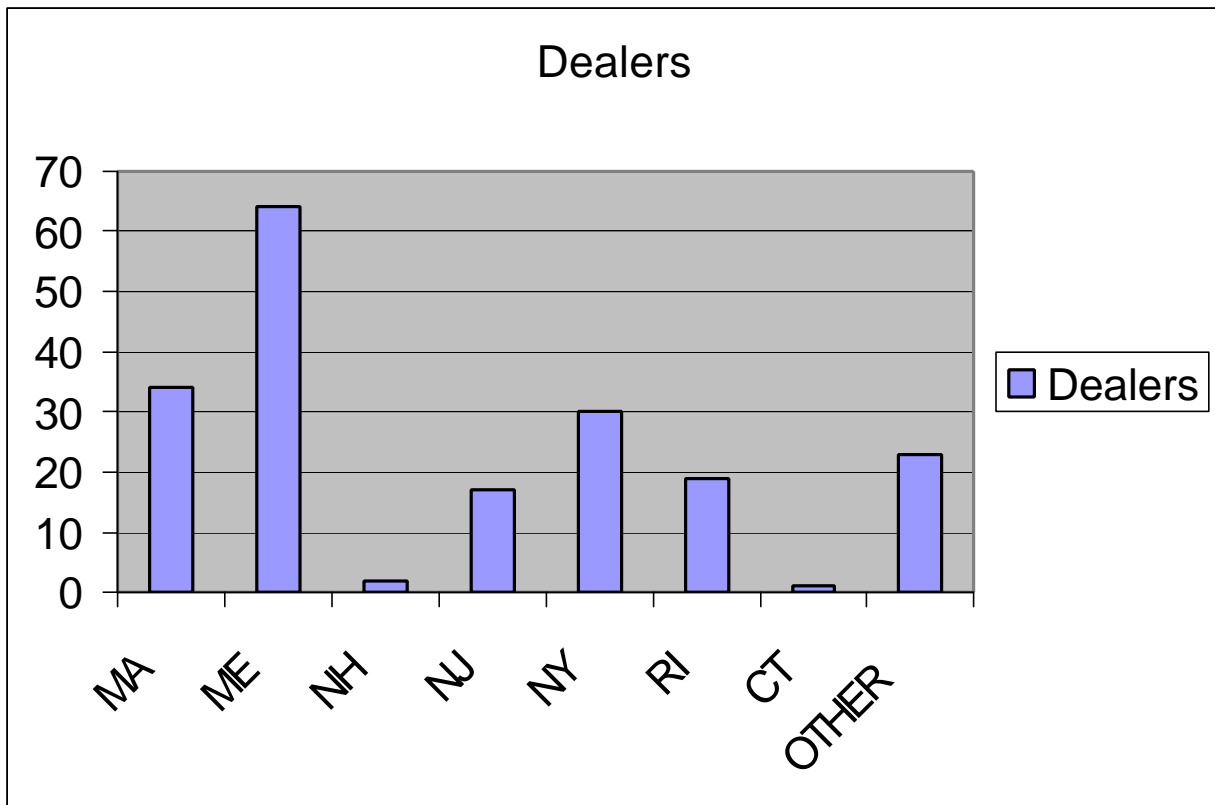


Figure 18 Herring dealer permits by state, May, 2001

2.2.4 Trade in Atlantic Herring

Exports of frozen Atlantic herring substantially increased in 2001 (Table 19). In 2000, Canada and Bermuda bought US frozen herring in relatively small amounts, 99 mt and 8 mt, respectively. However, in 2001, major markets for US frozen herring were developed with Egypt, Nigeria, and Australia being the major importers of US frozen herring receiving 8888 mt, 379 mt, and 300 mt, respectively. This represents a major shift in the direction of trade in frozen herring. At present, the US exports only minimal amounts of processed herring products.

In previous years the US was only a buyer in the international herring market and even though frozen herring exports have risen dramatically, the US remains a relatively small but growing participant in the world market for herring. Canada is clearly its major trading partner in herring. Canada has exported relatively large amounts of both frozen and fresh herring to the US (Table 20). Other exporters of fresh and frozen herring to the US in 2001 include Norway and Sweden.

Aside from fresh and frozen herring, substantial amounts of processed herring products are imported into the US including herring oil from the Netherlands, kippered herring and herring packed in oil from Canada and Germany, pickled herring from Canada, Finland, and Germany, frozen herring roe from the Netherlands, and salted and smoked herring from Canada, Iceland, and Russia.

DESTINATION	2000 (metric tons)	2000 VALUE (\$1,000)	2001 (metric tons)	2001 VALUE (\$1,000)
AUSTRALIA	0.0	0.0	379.1	197.1
BERMUDA	8.4	65.3	44.1	17.2
CANADA	99.4	113.9	14.4	17.9
DENMARK	0.0	0.0	36.0	20.5
EGYPT	0.0	0.0	8888.9	3012.5
FIJI	0.0	0.0	92.2	66.6
GREECE	0.0	0.0	9.1	3.0
ICELAND	0.0	0.0	61.8	112.0
LATVIA	0.0	0.0	46.4	26.6
MALAYSIA	0.0	0.0	24.5	9.7
NIGERIA	0.0	0.0	300.0	97.5
RUSSIA	0.0	0.0	74.4	41.2
SINGAPORE	0.0	0.0	23.5	14.3
SOUTH AFRICA	0.0	0.0	112.0	13.9
SOUTH KOREA	0.0	0.0	25.5	15.8

(U.S. Customs Service Database)

Table 19 U.S. Exports of frozen Atlantic herring 2000-2001

SOURCE	2000 (metric tons)	2000 VALUE (\$1,000)	2001 (metric tons)	2001 VALUE (\$1,000)
FROZEN				
CANADA	3537.9	2631.6	4573.2	4161.9
FAROE IS.	0.0	0.0	12.3	17.7
ICELAND	29.9	23.1	13.0	10.4
NETHERLANDS	16.8	58.5	33.9	81.7
NORWAY	138.9	100.5	530.7	469.0
RUSSIA	112.2	46.5	0.0	0.0
SWEDEN	0.0	0.0	453.3	256.4
FRESH				
CANADA	4537.4	3634.5	1822.5	671.3
	0	0	18.8	10.4

(U.S. Customs Service Database)

Table 20 U.S. Imports of fresh and frozen Atlantic herring 2000-2001

2.3 Social factors

Social factors in the herring fishery are described in the Atlantic herring FMP (NEFMC 1999). Little additional information has been collected since submission of the FMP. Section 2.2 includes summaries of the number of vessels, dealers, processors, and fishermen in the fishery. Port/community profiles funded through the Marine Fisheries Initiative (MARFIN) are complete and provide additional information about the communities involved in and dependent on the herring fishery. For example, the MARFIN profiles present updated socio-cultural and demographic data and characterize fisheries dependence for communities like Rockland, ME and Gloucester, MA, among several others. These profiles will form the basis for evaluating the impacts of the FMP and any proposed adjustments when the Council initiates a plan amendment or framework adjustment.

2.4 Ecological factors

2.4.1 Predator-prey relationships

2.4.1.1 Influence of pelagic fishes on the recovery of groundfish stocks

Atlantic mackerel and Atlantic herring stocks recovered to historic levels of abundance in the 1990s. Both of these fishes are planktivores that will feed on fish larvae (Oiestad 1985; Michaels 1991). With pelagic fishes at high abundance, can groundfish also recover when pelagic fish may be predators of their eggs and larvae? There are no simple answers to this question; however, in over 30 years of monitoring the diets of pelagic fishes the only larval/juvenile fish that has been consistently found in any abundance in fish stomachs is sand lance. On numerous occasions, especially during the late 1970s and early 1980s, sand lance was found in measurable quantities in herring and mackerel stomachs (Maurer 1976; Bowman et al. 1984; Michaels 1991).

Garrison et al. (2000) suggest that mackerel are not very important predators of cod and haddock larvae because the prospects for spatial overlap between this species and the larvae on Georges Bank is relatively low during April and May, the critical time. Cod larvae are generally not available to adult herring predation in the region, because they inhabit the well-mixed zone on Georges Bank; herring are usually found in the stratified area along the southern edge of the bank at this time of the year (Garrison et al 2000). Herring and haddock larvae were spatially and temporally coincident on Georges Bank during cruises conducted by the NEFSC in 1990, 1994 and 1995; herring may have fed on haddock larvae (Garrison et al 2000). However, Atlantic herring predation is probably not a dominant influence on haddock year class strength because during the 1990s, a period when herring reached historic high abundance, haddock recruitment improved steadily as haddock spawning biomass increased (Brown and Munroe 2000).

High biomass of mackerel and herring might also lead to a depletion of their food resources (zooplankton) as the abundance of these two species increased through the 1990s. However, over a long time-series of monitoring zooplankton abundance, there is no consistent decline in

any of the important planktonic prey of these two species (Link and Brodziak 2002; Sherman et al. 2002).

References:

Bowman, R., J. Warzocha, and T. Morris. 1984. Trophic relationships between Atlantic mackerel and American sand lance. ICES CM 1984/H:H27.

Brown, R.W., and N.J. Munroe. 2000. Stock assessment of the Georges Bank haddock, 1931-1999. NEFSC Reference Document 00-12.

Garrison, L.P., W.L. Michaels, J.S. Link, and M.J. Fogarty. 2000. Predation risk on larval gadids by pelagic fish in the Georges Bank ecosystem. 1. Spatial overlap associated with hydrographic features. Canadian Journal of Fisheries and Aquatic Sciences. 57: 2455-2469.

Link, J.S. and J.K.T. Brodziak, editors. 2002. Report on the status of the Northeastern US Continental shelf ecosystem. NEFSC Reference Document xx-xx. In review.

Maurer, R. 1976. A preliminary analysis of inter-specific trophic relationships between the sea herring and the Atlantic mackerel. ICNAF Research Document. 76/VI/121.

Michaels, W.M. 1991. The impact of mackerel predation on the survival of pelagic age-0 sand lance, cod, and haddock on Georges Bank during the spring of 1986. MS thesis, Southeastern Massachusetts University, North Dartmouth.

Oiestad, V. 1985. Predation on fish larvae as a regulatory force, illustrated in mesocosm studies with large groups of larvae. Northwest Atlantic Fishery Organization Scientific Counsel Studies. 8:25-32.

2.4.1.2 Herring as prey/forage species

Atlantic herring in the Gulf of Maine-Georges Bank region serve as a key forage species for predatory fishes, marine mammals, and seabirds (Overholtz et al 1991). Recent analysis of over 20 years of data from the NEFSC fish diet program indicate that predatory fish consumed more herring than the fishery removed in the early 1990s, however, with the decline of several important predators such as spiny dogfish, white hake, and cod, fish consumption and fishery removals are about equal now (Overholtz et al 2000).

References:

Overholtz, W.J., S.A. Murawski, and k.L. Foster. 1991. Impact of predatory fish, marine mammals, and seabirds on the pelagic fish ecosystem of the Northeastern USA. International Council for the Exploration of the Sea Marine Science Symposium. 193:198-208.

Overholtz, W.J., J.S. Link, and L.E. Suslowicz. 2000. Consumption of important pelagic fish and squid by predatory fish in the northeastern USA shelf ecosystem with some fishery comparisons. ICES Journal of Marine Science. 57:1147-1159.

2.4.2 Habitat

The Atlantic herring FMP incorporates, by reference, habitat descriptions, assessments and information contained in the Council's Omnibus Essential Fish Habitat FMP Amendment (NEFMC 1998). Most years, the Council's Essential Fish Habitat Technical Team prepares a "Habitat Annual Review Report" (HARR) which serves as the habitat component to all annual Stock Assessment and Fishery Evaluation (SAFE) reports. The intent of the HARR is to provide the Council with all new relevant habitat-related information and to assist the Council in meeting the habitat-related provisions of the Magnuson-Stevens Act. Although a HARR was not prepared in either 2001 or 2002, and is not being prepared for 2003, the 2000 HARR contained no new information directly related to Atlantic herring. The Council is aware of no new information on the habitat requirements of Atlantic herring, the adverse impacts of fishing and non-fishing related activities on the essential fish habitat (EFH) of Atlantic herring, or any adverse impacts on the EFH of other species related to the herring fishery. The information contained in the Omnibus EFH Amendment remains current and should be used to address all habitat-related questions that result from the Atlantic herring SAFE report (NEFMC 1998).

2.4.3 Marine mammals and protected species

The herring mid-water trawl fishery was listed as a Category II fishery under NMFS' 1999 List of Fisheries, prepared pursuant to section 118 of the Marine Mammal Protection Act (Federal Register/Vol.64, No. 36/Wednesday, February 24, 1999. 9067-9088) . This classification authorized NMFS to place marine mammal observers on these vessels, because the gear type is considered to have an occasional likelihood of causing incidental mortality and/or serious injury to marine mammals.

NMFS confirmed no reported takes of marine mammals in the U.S. herring fishery in 1999 and 2000. In 2001, the only observed takes were on vessels engaged in the foreign joint ventures as reported in Table 9. Observer coverage of the herring fishery is low: in 1999, two days in October and four days in January; in 2000, 17 trips targeting herring, including 11 mid-water trawl and one mid-water pair trawl trip; in 2001, six trips landing herring.

3.0 Fishery Management Measures and Preliminary 2003 Specifications

3.1 Summary

This section provides a summary report on the status of management actions, including FMP implementation, outstanding issues and recommended actions to be implemented through a plan amendment or framework adjustment. This section also includes the recommended specifications and TACs for the 2003 fishing year. Under the terms of the FMP, the NMFS Regional Administrator implements the specifications and TACs after receiving public comment.

3.2 Fishery Management Plan

3.2.1 FMP Implementation

- NEFMC submitted the FMP to NMFS on March 8, 1999
- NMFS partially approved the FMP on October 27, 1999. Disapproved measures include: mandatory days out of the fishery, spawning area closures, prohibition on TALFF, and TAC adjustment for Area 1A (inshore Gulf of Maine) based on Canadian catches.
- NMFS published the proposed rule for the FMP on March 7, 2000. The public comment period ended on April 21.
- Final rule published and effective on December 11, 2000, except the requirement for permit Category 1 vessels to install Vessel Monitoring Systems (VMS) which was delayed until March 12, 2001. In accordance with a Presidential Memorandum, "Regulatory Review Plan", NMFS delayed the effectiveness of the VMS requirement until May 11, 2001.

3.2.2 FMP Summary

The FMP contains the following provisions:

- Directed Fishery Quota- when 95 percent of the area TAC is caught, the directed fishery would be closed, with remaining 5 percent to allow for incidental harvest under a 2,000 lb possession limit
- Transfers at-sea are not restricted unless an area is closed to directed fishing, wherein the transfer is limited to 2,000 lb per day, or, in the case of transfer to Canadian carrier vessels, if the BT specification is reached
- Vessel size limit- vessels greater than 165 feet, 750 GRT, or 3,000 horsepower are not permitted to fish for herring, and are limited in receiving fish for processing to the specification for USAP
- Roe fishery is allowed, provided the carcasses are not discarded
- Electronic Vessel Monitoring Systems (VMS)- required on vessels catching >500 mt in any year
- Permitting- all commercial vessels must be permitted, operators, processors and dealers must also be permitted

- Reporting- mandatory Vessel Trip Reports (VTR, logbooks) submitted monthly, plus weekly reporting through VMS and/or Interactive Voice Reporting (IVR)
- Annual monitoring and plan adjustment through a framework process

3.3 ASMFC Herring plan

Amendment 1 to the Atlantic States Marine Fisheries Commission (ASMFC) Interstate Fisheries Management Plan for Atlantic Herring was approved and adopted by the Commission on October 22, 1998. Amendment 1 contained many of the same provisions as the Council's Herring FMP in addition to addressing such issues as spawning closures and a mechanism for implementing effort controls (days out of the fishery). All states subject to the provisions of Amendment 1 (Maine thru New Jersey) are in compliance with the plan.

Addendum I to Amendment 1 was approved by the Commission's Herring Section on July 12, 2000. Addendum I modified the spawning closure regulations, allowing a bycatch of spawn herring of up to 20% of a vessel's catch to be landed from an area under a spawning closure during 2000. This allowance has been termed the "tolerance provision". Addendum I further stipulated that the tolerance provision be replaced by a bycatch limit of 2,000 pounds for the 2001 and subsequent fishing seasons. All spawning closure regulations implemented through Addendum I are mandatory compliance measures as stipulated under Amendment 1. The Commission's Atlantic Herring Section subsequently allowed the tolerance provision to be implemented each year provided that the State of Maine submit an annual report on enforcement and compliance.

Amendment 1 contained a provision to implement controls on effort in the herring fishery by mandating days out of the fishery when a certain percentage of the TAC has been attained in each management area (ASMFC Amendment 1, Section 4.2.8). This measure is intended to slow catch rates, extending the season and ensuring a supply of herring to the industry. The Council originally included this provision in the federal herring FMP, with monitoring of the TAC by the NMFS, and the days out of the fishery set by the Regional Administrator.

However, NMFS disapproved that portion of the federal plan along with the spawning closures. In response, to the disapproval, the Commission's Atlantic Herring Section delegated authority to the states bordering on Area 1A (Maine, New Hampshire and Massachusetts) to implement the effort controls for Area 1A. As a result, the states agreed to implement the effort controls through their state regulatory authorities. A three-day closure (Friday, Saturday, and Sunday) was implemented during 2000 when 50% of the TAC in Area 1A was caught, or projected to be caught by August 1, and a four-day closure (Thursday, Friday, Saturday, and Sunday) was implemented when 75% of the TAC in a management area was caught, or projected to be caught by September 1.

In response to concerns raised by herring fishermen about the impacts of an extensive four-day closure, the State of Maine modified the four-day closure by designating two mandatory days out (Saturday and Sunday), and allowing fishermen to declare another two days during each week that they would not land herring during 2001. The same states agreed to implement a two-day closure for Area 1A starting on June 1, 2002, for the entire 2002 fishing season, in the hopes of avoiding more stringent effort controls during the latter part of the 2002 season.

Addendum II to the Commission's FMP, approved on February 28, 2002, implements a split quota for Area 1A that complements the Council's Framework 1. Addendum II also specifies deadlines and application procedures for IWP requests.

3.4 Outstanding management issues

3.4.1 Limited entry/controlled access

The Council held scoping hearings on a limited entry/controlled access program for the herring fishery during February, 2000. Due to work-load considerations, however, it has postponed further action to develop alternatives. Meanwhile, a group of industry members have met independently to continue discussions on issues and possible alternatives. Work on this issue continued in 2000 and 2001. The Herring Committee will recommend a course of action to the Council in September, 2002.

3.4.2 U.S./Canada herring management

Industry representatives continued their semi-annual meetings to discuss each other's management programs and issues in 2000. The meetings were suspended because of diverging policies on directed foreign fishing permits, recommended by the Council for approval. The parties have since expressed an interest in resuming talks. Both sides have agreed that coordinated management is in their best interests, and have identified a need for a common scientific basis to enable any future coordination in management. To this end, the group sent a request to NMFS and DFO to include herring in the Trans-boundary Resource Assessment Committee (TRAC). A TRAC assessment is scheduled for January 2003.

3.4.3 Impacts of quota closure

Area 1A closed on October 28 in 2000 and on November 10, 2001. Framework 1, which is being implemented in 2002, split the 60,000 mt area 1A TAC into two periods. The period one TAC which goes from January 1 to May 31, is 6,000 mt. The remaining 54,000 mt of TAC is reserved for June 1 to December 31. The period one TAC was reached by April 26, 2002.

While area 1A landings in February and March were much higher than they have been in recent years, area 1A landings from April through October were 12,000 to 13,000 mt less than they were in 2000. Area 1B landings in 2001 were more than double the 2000 landings. There is a 10,000 mt TAC for Area 1B but the area was not closed due to discrepancies in the quota monitoring system (misreporting of location of catch on the IVR, but not the VTR). Had the catch been recorded accurately, Area 1B would have been closed sometime in December. Area 3 landings also increased significantly in July through October. Possible reasons for catch shifting from the near-shore areas of 1A and 2 to offshore Areas of 1B and 3 could include:

- availability and abundance of fish
- the switch from purse seining, which is better suited to inshore fishing, to mid-water trawling
- higher catch rates in off-shore areas that offset the increased cost of fishing off-shore
- the existence of offshore JV operations buying herring from US catcher vessels
- the mandatory three days out of the fishery, implemented by the states, began on July 6th

- the quantities needed by canneries were lower in 2001 because they sold down inventory and closed plants while upgrading

Open access fisheries managed by TACs historically have led to races to fish and shortening seasons. There may be short term influences that slow the race to fish, such as market conditions, but the long term trend is to progressively take the available TAC in shorter periods of time. This may be done with more harvest capacity and/or increased effort early in the season. If conditions in 2002 are similar to 2001, there is likely to be two closures in area 1A; a period one closure and a period two closure. There is also likely to be a closure in area 1B. Area 3 currently serves as a relief valve for areas 1A and 1B. However, if the upward trend in area 3 landings continues and the TAC is approached, 1A and 1B fishing seasons may also be affected.

The economic impacts resulting from area 1A closures are described qualitatively below. These impacts are likely under any system where the total catch from an area is limited to less than the demand, regardless of how the quota is distributed, however, some of these will be exacerbated by having shortened 1A seasons and an area 1B closure. If effort controls and spawning closures under the ASMFC plan do not slow effort sufficiently during the season, or the closure problem is not otherwise addressed, open seasons may become shorter each year and these impacts will become ever more significant.

- Closing Area 1A, or otherwise limiting the catch from Area 1A, forces the vessels that are able to move offshore to fish farther from port. This increases the cost of a fishing trip and negatively impacts profits. Some of the increased cost may be offset by higher catch rates. Recent acoustic surveys show higher abundance on Georges Bank. However, higher catch rates are not guaranteed and, under normal circumstances, the vessel owner would have to weigh the odds of getting higher catch rates against the increase in cost. Clearly, some vessels make the choice to fish offshore while inshore areas are still available. However, generally it is more economically efficient to be able to choose an area than have the choice limited by closure.
- For vessels unable to move offshore, the Area 1A closure means a shortened fishing season or a relocation to a port near Area 2. A vessel's choice or ability to move offshore is an individual one, but gear type and vessel size or condition are important factors.
- Since purse seine gear is not as effective as mid-water trawl gear in offshore areas, purse seine owners may decide to switch to mid-water trawl gear if they think Area 1A will continue to close early. Changing gear types is costly. However, even prior to the implementation of the FMP the number of purse seine vessels was declining, with some of those vessels converting to mid-water trawl gear.
- Closing an area, or otherwise limiting the catch from the area may disrupt the flow of product to markets. The level of the disruption depends on the availability of alternative product, such as frozen herring or fresh herring transported from other areas, and herring caught in other areas and delivered by vessel, as well as alternative products, such as groundfish racks (skeletons left after processing). For vessels fishing in other areas and delivering herring to ports in Area 1A, those vessels must travel farther to obtain product

and may not be able to make deliveries according to their normal schedule. Remote communities, e.g., island communities in Maine, may be negatively impacted by a closure of Area 1A because they may not have freezer space and/or transportation of herring from other regions is cost prohibitive.

- As the flow of product, particularly to the bait market, is interrupted by a closure, lobster fishermen must seek bait substitutes. Options include other species such as menhaden, racks (backbones from filleted flounders or redfish), other animal products, or artificial bait. If these substitutes are at a higher cost or inferior in quality to herring, then there would be negative impacts on the lobster industry. Some comments suggest, however, that some of these alternatives are actually more desirable than herring, particularly during some seasons or as a matter of local preference.
- Another result of disrupted product flow to markets is the incentive to build freezer capacity. If the building of freezer capacity is in response to the closure rather than the development of new markets, then net national benefits are reduced because these excess productive resources could be applied elsewhere in the economy. On the other hand, if the building of freezer capacity facilitates the entry into new markets, and at the same time mitigates the impact of disruptions in the local availability of fresh bait, then net national benefits are increased.
- One of the results, common in other fisheries where there is a race to fish, is referred to as “input or capital stuffing”. In this situation, as vessel owners strategize to get to the fish before competitors, they spend money on vessel, gear, electronic, and other improvements to increase throughput. From the perspective of net national benefits, excess productive resources are diverted to fishing rather than being used for other more productive purposes.

3.5 Specifications for the 2003 fishing year

The Atlantic Herring FMP requires the Council, in consultation with the ASMFC Herring Section, to recommend specifications to the Regional Administrator for the Atlantic herring fishery. Section 3.2 of the FMP lists the issues that must be considered when determining the specifications. The PDT recommends that the 2002 specifications be retained for 2003. The Council indicated in setting its work priorities for 2002 that barring any unforeseen situation, it would not be revising the specifications this year. The PDT notes that until a new stock assessment is completed, scheduled for January, 2003, there is no technical basis for revising the specification of allowable biological catch and the distribution of the TAC among the different management areas.

3.5.1 ABC

The PDT did not run new stock size projections for the coastal stock complex of Atlantic herring. In the 2000 SAFE Report, the PDT provided three projections based upon three different levels of assumed catch for the 2000 fishing year. In all three projections, stock size was estimated to remain well above B_{MSY} . Actual landings in 2000 were below the lowest projected, resulting in a fishing mortality rate that is likely below $F=0.03$. Using the overfishing definition in the FMP, the target fishing mortality for 2002 is $F_{Target}=0.28$.

The PDT recommends retaining ABC at 300,000 mt.

This option sets ABC at the level calculated when the biomass is at B_{MSY} , based on a target fishing mortality rate, $F_{target}=0.28$, as specified in the overfishing definition, or 300,000 mt. This is the current ABC.

The PDT recommends continuing a conservative approach to setting the allowable biological catch, ABC, in the herring fishery because of uncertainty about current stock size, which may be overestimated (NEFSC 1998), and to retain stability in the year-to-year estimate of ABC in the event of a sudden shift in the terminal year estimate of biomass. In addition, herring is a key forage resource for a number of species, so it is critical that allowable catch levels be set conservatively. Because the management program has only recently been implemented, the impact of the management measures – including mandatory reporting requirements – are uncertain.

3.5.2 OY

The PDT recommends retaining OY at the current level of 250,000 mt.

This OY is set at a conservative level that is less than the maximum available under the current ABC. This OY allows for considerable growth in the herring fishery, more than double the landings in any of the previous five years. It also considers the uncertainty of scientific information, including year-to-year variation in stock status indicators.

3.5.3 DAH/TALFF

The PDT recommends setting DAH at the current level of 250,000 mt.

This option would set DAH at 250,000 mt, equal to OY, and set TALFF at 0. Estimates of domestic harvesting capacity in the FMP indicate there is sufficient domestic harvesting capacity

to harvest the resource, although landings remain below this level due to market constraints. Setting DAH=OY provides opportunity for U.S. harvesters to increase production to accommodate changes in markets for herring. As of this writing, several new processing facilities are in development that may increase the utilization of DAH in 2003. U.S. vessels would have to increase their harvest by nearly 150 percent to fully utilize this allocation.

3.5.4 DAP

The PDT recommends setting DAP at the current level of 226,000 mt.

DAP is defined as the amount of the U.S. harvest that domestic processors (both ashore and at sea) will process, combined with the amount that will be sold as fresh fish. The ability to estimate DAP continues to be complicated by poor information on the amount of herring sold as bait and incomplete information on the plans of domestic processors. There is also limited information on alternative sources of bait herring. Some herring is reportedly imported from Canada to bridge shortfalls from U.S. harvesters, but the amount and value is not readily available. Information on the amount of herring sold as bait should improve as the processed products survey is implemented in the herring fishery, following implementation of the FMP in 2000.

The PDT recommendation is based on the current allocation of 20,000 mt to foreign joint venture processing and 4,000 mt to over-the-side sales to vessels transporting herring to Canadian processors.

3.5.5 USAP

The FMP limits at-sea processing by domestic vessels over 165 feet in length, or more than 750 GRT, to the amount specified in the U.S. at-sea processing specification (USAP). This specification provides a method to control the introduction of additional at-sea processing capacity into the fishery. Since the regulations require the Council to set USAP annually, uncertainty about USAP allocations beyond one year increases the investment risk and, therefore, limits the potential for utilization of USAP.

The PDT recommends retaining the USAP at 20,000 mt for the 2002 fishing year. There is a broad gap between OY and the current herring harvest, in part due to a lack of markets. Herring continues to be used primarily for bait and to supply the sardine canneries, although several new facilities designed to process herring for the overseas food market have begun operation or are in development. The recommended level will allow a cautious introduction of at-sea processing capacity into the fishery, should a vessel seek to begin such activity in 2003.

3.5.6 Border Transfer (BT)

The transfer of U.S.-caught herring to Canada by Canadian herring carriers continues to decline from a high of 3,690 mt in 1996. Average transfers for the last five years were less than 2,000 mt, and amounted to 318 mt in 2001

The PDT recommends BT be retained at 4,000 mt for the 2002 fishing year. This level will provide flexibility for the canneries and potentially provide additional markets for U.S. fishermen. This is the figure incorporated into the DAP specification.

3.5.7 JVpt, JVP, IWP

Joint Venture Processing Total (JVpt) is the amount of fish available for joint venture processing in internal waters (IWP) and in the EEZ (JVP). In 1998, only two vessels requested a herring JV allocation. No herring were processed by IWPs in 1998. No permits were requested for herring JV's in 1999 and 2000, perhaps in part because several Governing International Fishery Agreements (GIFAs) were not renewed. In 2001, 13,462 mt of herring were sold to JV and IWP facilities.

The PDT recommends that JVpt for 2003 be set at the current level of 20,000 mt, split evenly between JV and IWP allocations. As in last year's specifications, vessels harvesting for JVs are limited to fishing in Areas 2 and 3. The Commission's Atlantic Herring Section has specified that IWP operations be limited to harvesting herring from Area 2 in 2002.

Specification	PDT Recommendation (mt)
ABC	300,000
OY	250,000
DAH	250,000
TALFF	0
DAP	226,000
USAP	20,000
BT	4,000
JVPt	20,000
JVP (Area 2 & 3)	10,000
IWP	10,000
Reserve	0

Table 21 – PDT recommendations for 2003 annual specifications (carry forward 2002 specifications).

3.6 Management area TACs

The PDT recommends retaining the 2002 management area TACs for 2003.

The rationale for the distribution of Management Area TACs is described in the management plan documents (NEFMC 1999; ASMFC 1999). There is no new information on the distribution or relative size of spawning components that warrants a revision to this distribution. For 2001, the Council recommended increasing OY from 224,000 mt to 250,000 mt, with all of the increase going to the Area 2 TAC reserve. In Framework 1, effective starting 2002, the Council added a seasonal quota (for January through May) for Area 1A, and set the 2002 specification at 6,000 mt. The PDT makes no recommendation to change this quota.

Area	Metric Tons	
1A	60,000	6,000 Jan.-June 54,000 June-Dec.
1B	10,000	
2	50,000 (TAC reserve: 80,000)	
3	50,000	

Table 22 – PDT recommendation for 2003 management area TACs.

3.7 Annual or Multi-year specifications

In last year's SAFE Report, the PDT considered two options for setting specifications and management area TACs. One option is the status quo, where the Council sets specifications and TACs annually after considering PDT, Herring Committee and Advisory Panel recommendations. Under the second option the Council would recommend specifications and TACs for two or three years. This option would primarily address NMFS', Council staff, and PDT members' workload issues but would also provide a longer horizon for business planning, for both domestic and foreign ventures. **The PDT recommends deferring action on this proposal until completion of the stock assessment in 2003.**

Option 1 (status quo)

This option would retain the current specifications setting system where PDT, Committee and Advisors meet annually to develop recommendations to the Council. The Council then decides on specifications and TACs to be forwarded to NMFS. NMFS publishes the proposed specifications in the *Federal Register* and takes public comment. This process has resulted in delays in the setting of the specifications, for example, NMFS published final 2001 specifications on May 25, 2001.

Option 2

This option would enable the Council, after receiving PDT, Committee and Advisory Panel recommendations, as well as public comment, to recommend specifications and management area TACs for two or three years. As noted above, this option would primarily address the

Council staff, NMFS' and PDT members' work load issues but would also provide a longer horizon for business planning, particularly with respect to JVs and TALFF. The Council would still have the option, as under the current regulations, of making in-season adjustments should the need arise.

4.0 Research needs and data considerations

4.1 Research needs and recommendations

The PDT makes the following research recommendations. Some of these recommendations on previous lists and are currently being addressed. Their appearance on this list indicates continued PDT support.

4.1.1 Biological research

1. Develop a long-term strategy for assessing individual spawning stocks as a basis for more effective management of any heavily exploited portions of the stock complex. Evaluate the merits of acoustic surveys, tagging and other techniques to achieve sub-stock complex monitoring.
2. Pursue the development of a dedicated pelagic survey technique utilizing hydro-acoustic and trawling methods to provide another direct and independent means of estimating stock size.
3. Reinvestigate the natural mortality rate assumed for all ages, the use of catch-per-unit-effort tuning indices, and the use of NEFSC fall bottom trawl survey tuning indices in the analytical assessment of herring.
4. Conduct a retrospective analysis of herring larval and assessment data to determine the role larval data plays in anticipating stock collapse and as a tuning index in the age-structured assessment.
5. Investigate alternative methods of estimating mean weight at age of U.S. and Canadian landings from the coastal stock complex.
6. Investigate the effects of averaging maturity rates over blocks of years to help smooth some of the inter-annual variability in the calculation of spawning stock biomass.
7. Consider potential discards if fishing mortality increases in the future.
8. Continue annual U.S.-Canada workshops to coordinate stock assessment activities and optimize cooperation in management approaches between the two countries.
9. Determine the extent of bycatch in the fishery and its impact on the use of TACs in managing the fishery. Increase levels of observer coverage on vessels catching herring.

4.1.2 Economic research

1. Conduct processor survey annually to determine processor intent in upcoming year (to improve estimates of DAP)
2. Investigate disposition of herring by specific market uses, including seasonality, prices and other factors
3. Obtain improved access, on an annual basis, to U.S. Census Import/Export database, and develop a methodology for extracting and analyzing relevant data.

4.1.3 Social factors research

1. Conduct a pilot project to institutionalize social science data collection using the MARFIN profiles as a baseline. This may include establishment of community panels to participate in collection and verification of social science data.
2. Establish a long-term social science database using the MARFIN port profiles as a starting point and adding information for Mid-Atlantic communities.