

Gulf of Maine Atlantic Cod

2019 Assessment Update Report Supplemental Tables

**U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts**

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Overview

This supplemental report is intended to augment the condensed assessment report. It contains more detailed information on assessment data preparations and inputs. This report is not a substitute for the formal assessment report, but rather provides additional details that users of stock assessment information may find useful.

References

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Table 1. Estimates of Gulf of Maine Atlantic cod catch (mt) by fleet (commercial, recreational) and disposition (landed, discarded) from 1982 to 2018. *Discard amounts have been adjusted to account for mortality assumptions adopted at the SAW/SARC 55 assessment (NEFSC 2013; commercial longline = 33%, commercial trawl = 75%, commercial gillnet = 80%) as well as a revised estimate of recreational discards (15%, Capizzano et al. 2016).*

Year	Recreational discards (mt)	Recreational landings (mt)	Commercial discards (mt)	Commercial landings (mt)	Total catch (mt)
1982	5.5	3,206.1	856.8	13,465.9	17,534.2
1983	13.6	3,224.5	882.3	13,867.4	17,987.7
1984	21.1	2,797.5	913.4	10,725.3	14,457.3
1985	11.1	6,418.9	1,025.7	10,645.3	18,101.0
1986	12.0	3,978.2	1,025.9	9,669.6	14,685.8
1987	47.2	5,793.7	940.0	7,526.2	14,307.2
1988	12.1	3,458.0	724.4	7,948.2	12,142.6
1989	63.3	3,836.2	833.9	10,550.7	15,284.0
1990	62.5	4,770.1	1,659.6	15,439.7	21,931.9
1991	41.9	2,669.3	705.3	17,959.0	21,375.4
1992	38.9	1,255.2	709.9	11,019.4	13,023.4
1993	95.1	2,217.0	498.7	8,366.7	11,177.5
1994	98.2	1,430.9	216.1	8,030.2	9,775.4
1995	114.2	1,480.1	243.7	6,606.8	8,444.7
1996	58.4	777.0	158.7	7,019.8	8,014.0
1997	55.0	438.4	89.6	5,432.1	6,015.1
1998	70.0	670.3	79.0	4,074.3	4,893.6
1999	63.9	1,343.2	1,063.8	1,407.4	3,878.2
2000	112.7	1,710.5	985.6	3,771.8	6,580.5
2001	158.3	2,538.3	1,589.1	4,314.4	8,600.2
2002	211.5	1,919.1	1,373.4	3,638.3	7,142.2
2003	172.1	1,878.7	769.9	3,865.6	6,686.4
2004	170.2	2,394.1	658.0	3,782.3	7,004.6
2005	230.2	3,021.7	278.0	3,557.6	7,087.5
2006	115.9	759.0	359.3	3,029.4	4,263.6
2007	238.4	1,554.6	183.6	3,989.8	5,966.4
2008	248.2	2,244.4	366.6	5,443.5	8,302.8
2009	293.4	2,450.2	788.4	5,952.9	9,484.8
2010	419.2	3,144.9	179.1	5,356.4	9,099.7
2011	306.9	2,999.4	103.0	4,597.9	8,007.2
2012	103.1	1,244.7	97.3	2,759.0	4,204.1
2013	194.6	1,523.5	53.7	950.8	2,722.7
2014	151.3	795.6	27.1	831.8	1,805.9
2015	167.9	11.0	14.3	227.0	420.2
2016	333.8	187.0	8.3	320.4	849.6
2017	610.0	170.0	15.6	375.5	1171.0
2018	325.9	12.3	16.6	398.4	753.1

Table 2. Total numbers of Gulf of Maine Atlantic cod lengths sampled from commercial landings by market category and year between 1969 and 2018. Sampling intensity is expressed as metric tons landings per 100 lengths sampled (*200 metric tons per 100 lengths is an unofficial NAFO/ICNAF standard*). Cells shaded in grey indicate where lengths were aggregated semi-annually. Cells shaded orange indicate where lengths were aggregated annually. Aggregation occurred when length sampling was insufficient; a general criterion of 100 lengths/block was used to determine sufficiency.

Year	Scrod (0814)				Market (0813)				Large (0811)				Unclassified (0815)				Total lengths	Landing s (mt)	Metric tons/100 lengths
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4			
1969																	114	7,828	6,867.0
1970					100								287				387	7,512	1,941.0
1971																	0	7,193	
1972																	0	6,786	
1973																	0	6,061	
1974	102							101									203	7,425	3,657.8
1975		186															248	8,676	3,498.4
1976			62										101			56	157	9,878	6,291.5
1977	101	66	402	1,012		277	371	64		80	152						2,525	11,993	475.0
1978	407	455	65		370	304	500	100			55						2,256	11,890	527.0
1979	56		58	116		100	237	188									755	10,972	1,453.3
1980	213	100	51										212				576	12,515	2,172.7
1981	52	57	81	236			82	471			210						1,189	12,382	1,041.3
1982	401	488	484	308	418	309	665	345		208	64	158	97	102	122		4,169	13,466	323.0
1983	712	626	578	253	396	1,021	583	200		56	205	514	97	53			5,294	13,867	261.9
1984	344	271	342	378	396	264	443	551		75	552	204	105				4,019	10,725	266.9
1985	263	352	449	241	837	565	677	351		542	341	263	403				5,284	10,645	201.5
1986	229	264	319	160	520	608	834	329		75	279	269	183				4,069	9,670	237.6
1987	281	232	165	271	344	490	351	399		157	150	258	90				3,188	7,526	236.1
1988	298	99	215	249	59	539	291	481		59	194	135					2,619	7,948	303.5
1989	154	170	201	174	401	204	506	409		195	102	104	98				2,718	10,551	388.2
1990	156	362	165	260	409	715	370	300		136	108						2,981	15,440	517.9
1991	100	533	192	215	514	1,034	1,137	275		302	273	101					4,676	17,959	384.1
1992	118	443	320	180	633	725	592	263		297	142	75	298				4,086	11,019	269.7
1993	159	173	174	55	97	173	393	106		65	87	141	63	67			1,753	8,367	477.3
1994		102	107	181	97	576	324	567		184	322	198					2,658	8,030	302.1
1995	211	196	107	249	170	807	215	224		280		98					2,557	6,607	258.4
1996	278	275	491	691	596	961	1,165	1,178		68	200	303	280				6,486	7,020	108.2
1997	520	848	188	751	1,235	1,071	991	880		190	539	201	145				7,559	5,432	71.9
1998	295	383		101	911	951	1,103	436		99		175	82				4,536	4,074	89.8
1999	385				311	108	58			211							1,073	1,407	131.2
2000	694	304	294	426	1,588	1,167	409	924					115				5,921	3,772	63.7
2001	189	215	216	404	428	984	697	1,548		172	474	892	898				7,117	4,314	60.6
2002	106	80		39	1,365	260	411	395		1,192	397	524	494				5,263	3,638	69.1
2003	254	66	214	73	1,121	705	1,762	1,402		1,179	1,432	1,583	1,688				11,479	3,866	33.7
2004	361	299	233	73	1,384	1,887	1,288	994		2,049	1,419	283	940	25			11,235	3,782	33.7
2005	73	193	324	506	919	1,095	1,384	1,362		790	709	1,330	1,478		61	180	10,404	3,558	34.2
2006	494	167	294	125	1,291	1,412	1,075	753		1,552	871	1,348	1,388				10,770	3,029	28.1
2007	291	174	315	293	584	1,188	1,521	1,488		654	811	1,887	1,417			66	10,689	3,990	37.3
2008	536	251	203	85	969	1,403	1,196	927		712	1,314	1,753	1,573				10,922	5,443	49.8
2009	407		62	141	800	1,601	1,791	2,601		954	1,656	2,304	2,554				14,871	5,953	40.0
2010	150	53		199	2,679	1,762	2,788	1,741		1,428	2,106	2,561	1,984				17,451	5,356	30.7
2011	287	320	144	577	2,005	2,848	2,674	3,260		1,141	2,250	1,884	1,292				18,682	4,598	24.6
2012	458	63		322	1,417	2,346	1,605	833		1,374	855	826	908				11,007	2,759	25.1
2013	236	181	282	385	787	1,554	1,259	1,287		1,165	521	225	189				8,071	951	11.8
2014	292	421	262	480	740	1,233	1,111	1,540		805	578	410	574				8,446	832	9.8
2015	140	95	44	31	1,346	913	392	1,156		209	350	223	463				5,362	227	4.2
2016	156	320		119	1,754	998	828	1,581		378	316	470	650				7,570	320	4.2
2017	263	86	173	11	1,141	1,027	797	601		340	349	293	204				5,285	375	7.1
2018	200	133	58	151	742	1,029	334	582		365	473	156	336				4,559	398	8.7

Table 3. Total numbers of Gulf of Maine Atlantic cod aged otoliths sampled from commercial landings by quarter between 1977 and 2018.

Year	Quarter				Total	Landings (mt)	Metric tons/100
	1	2	3	4			
1977	20	114	229	205	568	11,993	2,111
1978	124	124	115	20	383	11,890	3,104
1979	10	20	48	52	130	10,972	8,440
1980	35	27	15		77	12,515	16,253
1981	12	15	67	170	264	12,382	4,690
1982	194	237	251	183	865	13,466	1,557
1983	277	513	400	158	1,348	13,867	1,029
1984	245	350	296	337	1,228	10,725	873
1985	446	377	397	323	1,543	10,645	690
1986	243	360	398	173	1,174	9,670	824
1987	252	229	226	228	935	7,526	805
1988	131	223	187	196	737	7,948	1,078
1989	206	129	203	165	703	10,551	1,501
1990	140	302	171	150	763	15,440	2,024
1991	126	447	385	152	1,110	17,959	1,618
1992	220	298	264	178	960	11,019	1,148
1993	72	130	186	49	437	8,367	1,915
1994	21	195	149	308	673	8,030	1,193
1995	144	311	101	126	682	6,607	969
1996	190	315	426	449	1,380	7,020	509
1997	395	632	331	285	1,643	5,432	331
1998	192	325	276	199	992	4,074	411
1999	227	27	11		265	1,407	531
2000	639	481	205	396	1,721	3,772	219
2001	280	574	674	950	2,478	4,314	174
2002	1,320	301	437	347	2,405	3,638	151
2003	1,046	1,111	1,948	1,525	5,630	3,866	69
2004	1,880	1,011	425	228	3,544	3,782	107
2005	494	644	1,117	1,287	3,542	3,558	100
2006	1,109	806	1,225	1,197	4,337	3,029	70
2007	719	1,020	1,138	1,030	3,907	3,990	102
2008	858	1,225	1,213	1,173	4,469	5,443	122
2009	947	1,407	1,684	2,222	6,260	5,953	95
2010	1,335	1,235	1,856	1,103	5,529	5,356	97
2011	735	1,867	1,555	1,412	5,569	4,598	83
2012	767	1,368	914	837	3,886	2,759	71
2013	1,070	1,390	1,143	834	4,437	951	21
2014	614	1,026	767	713	3,120	832	27
2015	962	711	289	1,088	3,050	227	7
2016	1,297	894	862	942	3,995	320	8
2017	742	765	677	438	2,622	375	14
2018	615	671	314	316	1,916	398	21

Table 4. Total Gulf of Maine Atlantic cod commercial landings-at-age (numbers) from 1982 to 2018.

Year	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
1982	0	27,609	1,335,509	1,634,173	1,116,072	619,571	51,241	69,146	59,375	43,415	32,683	6,285	898	0	0	0	0
1983	0	0	833,083	2,413,843	1,067,910	627,331	407,393	44,212	57,669	25,845	12,747	3,800	3,515	1,719	2,599	0	0
1984	0	2,782	425,538	1,227,232	1,504,575	396,710	195,918	96,402	9,105	16,794	14,229	11,957	2,335	3,863	1,235	0	0
1985	0	0	387,614	1,440,985	1,002,193	615,000	123,315	73,198	32,430	3,962	10,619	2,438	4,573	1,583	470	0	0
1986	0	0	85,363	2,187,322	818,717	239,742	161,736	38,700	27,497	19,813	4,745	1,497	3,940	2,434	306	0	0
1987	0	442	193,735	627,766	1,116,907	267,706	64,579	45,981	5,481	8,410	9,270	182	607	0	2,129	0	0
1988	0	0	167,468	1,356,369	907,960	400,942	58,792	21,864	20,247	3,257	2,438	1,213	0	0	606	0	0
1989	0	0	322,130	1,486,592	1,354,890	451,857	70,570	58,876	7,931	2,238	9,000	3,945	0	1,127	1,127	0	0
1990	0	0	210,618	3,403,626	2,227,578	452,797	151,887	25,246	24,675	7,680	16,034	11,764	2,353	3,597	0	0	0
1991	0	0	198,915	609,915	4,543,525	904,421	138,556	42,961	25,983	7,877	4,698	2,571	0	0	0	0	0
1992	0	0	302,552	527,720	432,280	1,969,905	213,021	77,420	5,837	4,488	1,042	0	0	0	0	0	0
1993	0	0	25,866	1,543,228	729,548	92,745	464,198	37,780	11,264	0	0	0	0	0	0	0	0
1994	0	0	29,014	1,055,313	1,170,244	240,940	63,586	69,917	28,114	6,108	384	1,008	0	0	0	0	0
1995	0	0	183,724	938,703	1,056,404	207,195	28,494	6,521	17,992	580	2,228	0	0	0	0	0	0
1996	0	0	55,763	507,349	1,763,068	375,559	35,144	3,903	413	845	0	0	0	0	0	0	0
1997	0	0	77,455	434,378	435,036	800,750	67,415	5,368	2,080	393	636	0	0	0	0	0	0
1998	0	0	87,919	391,916	544,744	139,369	187,088	27,507	4,853	1,495	762	0	0	0	0	0	0
1999	0	0	2,858	179,688	191,438	66,127	23,995	22,398	7,504	1,035	0	0	0	0	0	0	0
2000	0	0	102,341	258,469	501,545	124,105	66,295	9,007	6,465	0	0	0	0	0	0	0	0
2001	0	0	43,737	471,763	326,442	206,475	65,902	38,490	5,509	8,803	1,006	0	0	0	0	0	0
2002	0	0	1,439	111,287	433,957	170,415	102,971	41,667	12,019	3,750	4,055	434	80	0	40	0	0
2003	0	0	8,113	47,543	198,476	380,859	120,697	52,001	19,769	9,173	4,250	2,812	472	0	0	0	0
2004	0	0	492	142,749	130,172	220,142	170,502	52,305	26,442	13,941	6,789	1,414	620	0	0	0	0
2005	0	0	1,217	37,890	423,154	64,419	178,040	83,220	21,459	12,366	5,056	3,125	1,817	500	0	0	0
2006	0	0	777	115,306	181,958	300,653	21,412	62,692	29,111	10,477	5,994	2,537	1,242	953	180	0	0
2007	0	0	5,209	95,694	629,852	99,105	178,429	5,952	15,582	7,698	3,753	1,468	1,323	1,174	126	345	0
2008	0	0	4,142	283,069	465,757	600,316	53,944	82,494	2,490	6,652	3,224	986	473	367	234	104	21
2009	0	0	2,700	283,610	718,934	333,800	199,827	16,653	20,518	857	2,311	1,072	952	224	127	61	49
2010	0	0	1,683	121,449	578,192	463,641	114,076	59,845	8,069	2,947	446	476	162	112	17	28	0
2011	0	0	534	97,964	296,737	396,070	256,786	26,149	29,090	4,906	1,177	196	538	68	178	0	0
2012	0	0	10,688	128,853	288,100	174,639	109,225	53,408	7,150	2,173	1,149	31	0	93	0	0	0
2013	0	142	11,438	91,528	74,399	72,869	14,160	10,023	6,344	591	197	116	0	0	0	0	0
2014	0	0	11,474	109,780	113,811	36,559	17,115	5,273	1,416	647	48	21	5	0	5	0	0
2015	0	0	1,213	9,087	36,347	12,773	1,455	1,680	290	92	116	12	0	0	0	0	0
2016	0	0	452	21,504	26,618	36,862	3,841	1,236	604	141	42	47	0	0	0	0	0
2017	0	0	42	2893	53464	19128	16262	1706	274	218	26	11	11	0	0	0	0
2018	0	1112	2758	4047	21675	51463	8067	7556	202	64	107	0	0	0	0	0	0

Table 5. Coefficients of variation (CV) on the estimates of Gulf of Maine Atlantic cod commercial landings numbers-at-age from 1984 to 2018 (CVs greater than 0.3 are shaded grey). *Note that prior to 1984 CVs could not be calculated due to the inability to identify discrete sampling events.*

Year	Age0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
1984		0.74	0.12	0.04	0.02	0.04	0.06	0.06	0.17	0.16	0.22	0.20	0.39	0.29	0.69		
1985			0.08	0.06	0.04	0.03	0.05	0.05	0.10	0.25	0.14	0.27	0.35	0.48	0.76		
1986			0.18	0.05	0.04	0.06	0.08	0.14	0.13	0.20	0.44	0.56	0.37	0.65	0.89		
1987		1.35	0.19	0.07	0.04	0.07	0.09	0.15	0.29	0.28	0.43	0.90	0.44		0.68		
1988			0.29	0.06	0.05	0.06	0.09	0.15	0.24	0.48	0.81	0.81			1.32		
1989			0.38	0.08	0.09	0.07	0.14	0.24	0.33	0.56	0.23	0.34		0.68	0.69		
1990			0.26	0.07	0.08	0.13	0.24	0.47	0.36	0.41	0.26	0.28	0.67	0.70			
1991			0.23	0.15	0.04	0.11	0.12	0.23	0.31	0.27	1.02	0.64					
1992			0.18	0.20	0.13	0.06	0.11	0.18	0.62	0.56	0.88						
1993			0.89	0.09	0.18	0.29	0.11	0.34	0.41								
1994			0.49	0.10	0.07	0.27	0.25	0.21	0.22	0.64	1.02	0.89					
1995			0.25	0.12	0.09	0.10	0.35	0.23	0.21	1.05	0.61						
1996			0.27	0.10	0.04	0.14	0.20	0.28	0.95	0.69							
1997			0.20	0.09	0.07	0.06	0.14	0.32	0.27	0.62	0.60						
1998			0.16	0.11	0.07	0.15	0.15	0.27	0.37	0.49	0.99						
1999				0.19	0.12	0.31	0.36	0.23	0.17	0.58							
2000			0.14	0.08	0.06	0.12	0.23	0.49	0.55								
2001			0.24	0.06	0.07	0.08	0.11	0.14	0.30	0.28	0.59						
2002			1.11	0.22	0.05	0.09	0.07	0.11	0.15	0.29	0.26	0.48	1.21		1.38		
2003			0.35	0.17	0.05	0.03	0.06	0.07	0.10	0.17	0.19	0.23	0.46				
2004			1.38	0.11	0.07	0.07	0.06	0.09	0.13	0.21	0.23	0.49	0.75				
2005			0.66	0.15	0.05	0.08	0.09	0.08	0.12	0.12	0.15	0.21	0.26	0.42			
2006			1.02	0.17	0.06	0.04	0.14	0.09	0.09	0.14	0.11	0.17	0.22	0.27	0.56		
2007			0.49	0.13	0.04	0.08	0.10	0.27	0.19	0.12	0.15	0.25	0.23	0.27	0.69	0.46	
2008			0.72	0.10	0.05	0.05	0.13	0.08	0.39	0.16	0.17	0.29	0.38	0.44	0.56	0.80	1.43
2009			0.52	0.10	0.05	0.09	0.07	0.18	0.12	0.25	0.17	0.26	0.26	0.40	0.59	0.90	1.01
2010			0.50	0.12	0.04	0.04	0.08	0.10	0.13	0.16	0.38	0.34	0.66	0.67	1.38	1.42	
2011			0.28	0.04	0.02	0.01	0.01	0.02	0.02	0.07	0.14	0.34	0.26	0.72	0.45		
2012			0.35	0.09	0.05	0.07	0.07	0.10	0.29	0.35	0.23	0.95	0.62				
2013		1.31	0.17	0.05	0.06	0.06	0.11	0.10	0.14	0.24	0.35	0.41					
2014			0.19	0.05	0.04	0.09	0.12	0.21	0.21	0.20	0.49	0.67	1.38		1.32		
2015			0.38	0.10	0.04	0.07	0.18	0.17	0.27	0.38	0.57	0.98					
2016			0.54	0.10	0.05	0.04	0.09	0.19	0.20	0.32	0.62	0.48					
2017			0.23	0.11	0.02	0.01	0.01	0.05	0.13	0.16	1.01	1.35	1.02				
2018		0.78	0.49	0.17	0.09	0.03	0.10	0.11	0.45	0.79	0.47						
Average		1.05	0.41	0.11	0.06	0.09	0.13	0.18	0.26	0.35	0.45	0.51	0.55	0.50	0.86	0.90	1.22

Table 6. Mean weights-at-age (kg) of commercially landed Gulf of Maine Atlantic cod from 1982 to 2018.

Year	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
1982		0.831	1.177	1.669	2.790	5.006	7.097	9.580	9.945	12.789	19.365	16.480	22.443				
1983			1.172	1.621	2.428	3.812	6.058	5.982	10.480	11.548	11.138	18.890	12.669	24.552	22.224		
1984		0.569	1.179	1.656	2.679	3.568	5.563	8.541	10.290	13.711	14.485	14.318	15.430	17.886	19.285		
1985			1.312	1.740	2.820	4.528	5.610	8.436	11.238	12.479	14.280	13.394	16.112	16.739	22.012		
1986			1.392	1.819	2.905	4.691	6.272	7.994	9.826	13.592	13.496	15.888	15.808	20.232	16.834		
1987		0.998	1.369	1.719	3.252	4.805	6.912	9.318	10.769	14.810	16.101	13.418	8.066		22.379		
1988			1.293	1.943	2.448	5.282	5.315	6.374	9.951	10.434	17.787	9.857			21.886		
1989			1.314	1.763	3.055	4.242	5.943	9.379	13.425	16.500	20.410	22.606		27.911	27.896		
1990			1.247	1.660	2.238	4.380	7.816	11.229	12.270	15.999	16.344	22.690	23.134	22.138			
1991			1.489	1.834	2.412	4.031	7.164	9.689	12.261	15.093	6.203	24.937					
1992			1.608	1.941	2.899	3.070	5.699	10.984	10.766	13.418	19.072						
1993			1.356	1.930	2.350	4.595	5.802	9.649	13.673								
1994			1.434	1.955	3.186	3.349	6.350	7.787	12.422	10.012	22.008	22.643					
1995			1.588	1.774	2.838	5.187	7.054	11.466	13.223	19.756	23.143						
1996			1.746	2.258	2.337	3.532	7.523	11.759	14.795	16.331							
1997			1.846	2.291	3.093	3.162	4.829	9.027	12.177	15.625	17.749						
1998			1.396	2.020	2.726	4.025	4.376	7.235	12.111	17.500	15.060						
1999			1.545	1.741	2.539	3.390	5.049	7.563	10.220	12.279							
2000			1.736	2.608	3.635	4.678	6.158	5.600	8.939								
2001			1.937	2.556	3.400	5.036	6.544	7.684	9.213	8.945	17.660						
2002			1.326	2.706	3.378	4.269	6.300	7.072	8.965	10.167	10.786	15.353	17.249		18.746		
2003			1.871	2.475	3.279	4.321	5.544	7.584	8.892	10.909	12.121	13.709	14.362				
2004			1.648	2.689	3.686	4.261	5.976	7.590	9.902	12.654	14.059	11.423	22.553				
2005			1.926	2.274	3.118	4.584	4.793	6.447	8.066	11.054	13.942	14.901	15.362	19.605			
2006			2.671	2.540	3.437	3.877	4.905	5.673	7.605	9.709	12.724	16.000	15.761	20.480	20.326		
2007			2.090	2.616	3.317	4.053	5.014	6.518	7.182	10.140	12.199	13.344	14.213	17.126	21.784	21.757	
2008			1.848	2.768	3.145	3.811	4.777	6.036	6.106	8.583	11.258	13.800	16.189	19.251	19.918	18.735	25.984
2009			1.939	2.766	3.532	3.972	4.775	6.007	8.367	11.208	10.805	12.934	15.971	15.803	22.452	22.459	22.812
2010			2.228	2.731	3.528	4.268	4.874	5.550	8.478	10.152	11.016	13.209	12.519	16.891	20.103	16.834	
2011			1.746	2.724	3.389	4.094	4.988	5.934	6.076	11.750	12.190	17.376	17.827	23.845	19.502		
2012			1.903	2.927	3.146	3.593	4.300	5.337	5.407	7.951	12.770	21.458	18.259				
2013		1.295	1.615	2.636	3.182	3.856	4.184	5.782	7.227	10.357	10.854	15.982					
2014			1.857	2.121	3.089	3.179	4.206	4.083	6.718	8.69	14.405	16.552	19.247		17.299		
2015			1.420	2.310	3.404	4.571	4.857	5.725	8.295	11.228	16.038	14.739					
2016			1.718	2.223	3.421	3.967	5.632	5.123	6.923	9.602	10.479	13.019					
2017			2.062	2.444	3.409	4.425	5.213	6.890	8.097	9.039	13.239	12.270	20.803				
2018		0.351	1.053	2.214	3.322	4.363	5.216	5.781	9.549	10.869	11.583						

Table 7. Total number of Gulf of Maine trips observed from 1989 to 2018, summarized by gear type. *The 2010-14 numbers include trips observed by both at-sea monitors and observers. The Gulf of Maine region is defined by statistical areas 464, 465, 467, 511-515.*

Year	Longline	Otter trawl		Shrimp trawl	Sink Gillnet		Total
		Small mesh (< 5.5")	Large mesh (≥ 5.5")		Large mesh (5.5" - 7.99")	Extra large mesh (≥ 8.0")	
1989		23	44	40	84		191
1990		8	26	31	120		185
1991	2	29	53	52	801		937
1992	9	15	45	82	896		1,047
1993	2	6	17	81	560		666
1994			9	77	82	7	175
1995		30	29	73	62	14	208
1996		40	19	35	39	10	143
1997		3	7	16	31	5	62
1998			7		78	6	91
1999		11	25		70	8	114
2000			122		70	19	211
2001		4	136	3	39	21	203
2002		34	199		62	25	320
2003	14	19	278	15	254	95	675
2004	8	68	321	12	587	340	1,336
2005	58	69	534	17	505	251	1,434
2006	36	24	209	20	109	35	433
2007	36	16	234	14	92	46	438
2008	20	12	260	19	130	49	490
2009	35	22	428	12	271	30	798
2010	52	30	685	15	1,080	379	2,241
2011	80	25	1,098	1	1,382	264	2,850
2012	113	31	1,177	19	1,166	119	2,625
2013	33	63	670	24	495	96	1,381
2014	31	50	662		735	154	1,632
2015	3	66	407		269	166	911
2016	9	56	334		182	97	678
2017	17	103	302		94	105	621
2018	20	60	384		110	55	633

Table 8. Estimates of total Gulf of Maine Atlantic cod commercial discards (mt) by gear from 1982 to 2018 by gear. Discards from 1982 to 1988 were estimated using hindcast procedures and discards from 1989 to 2018 were estimated from observer data. See NEFSC (2013) for a full description of the discard estimation methodologies. *Discard amounts have been adjusted to account for mortality assumptions adopted at the SAW/SARC 55 assessment (NEFSC 2013; commercial longline = 33%, commercial trawl = 75%, commercial gillnet = 80%).*

Year	Longline	Otter trawl		Shrimp trawl	Sink Gillnet		Total
		Small mesh (< 5.5")	Large mesh (>= 5.5")		Large mesh (5.5" - 7.99")	Extra large mesh (>= 8.0")	
1982			662.1	108.0	86.7		856.8
1983			678.3	120.1	83.9		882.3
1984			646.0	171.4	96.0		913.4
1985			707.5	233.4	84.7		1,025.7
1986			640.1	285.5	100.4		1,025.9
1987			580.6	259.4	100.1		940.0
1988			459.0	162.5	102.8		724.4
1989		4.6	508.0	192.3	129.0		833.9
1990		0.7	1,175.7	308.0	175.2		1,659.6
1991	0.1	0.6	465.8	153.9	84.8		705.3
1992	2.6	0.0	584.0	36.7	86.6		709.9
1993	93.0	0.0	278.1	4.7	122.9		498.7
1994			122.8	5.7	84.1	3.5	216.1
1995		6.3	114.4	3.0	103.8	16.3	243.7
1996		2.5	18.9	2.3	116.2	19.0	158.7
1997		12.4	20.9	3.5	47.2	5.5	89.6
1998		0.0	8.7		66.0	4.4	79.0
1999		8.7	619.9		428.8	6.5	1,063.8
2000			591.8		379.0	14.8	985.6
2001		0.1	654.8	0.0	890.8	43.4	1,589.1
2002		12.3	651.5		662.9	46.7	1,373.4
2003	21.9	16.5	415.3	2.0	257.4	56.8	769.9
2004	2.6	2.2	399.3	0.7	185.4	67.7	658.0
2005	40.9	2.9	124.5	0.9	87.6	21.3	278.0
2006	15.7	1.9	253.3	0.2	75.5	12.7	359.3
2007	22.2	1.5	77.0	0.7	66.9	15.4	183.6
2008	19.3	4.6	257.3	0.1	67.9	17.4	366.6
2009	6.3	1.5	539.9	0.1	210.6	29.9	788.4
2010	3.8	4.8	119.7	0.2	42.1	8.5	179.1
2011	10.5	3.5	58.4	0.0	27.6	3.0	103.0
2012	12.1	2.0	56.7	0.0	25.6	0.8	97.3
2013	10.7	0.5	33.0	0.0	8.3	1.1	53.7
2014	2.1	0.5	11.1		12.6	1.0	27.1
2015	0.0	0.5	5.1		7.7	1.0	14.3
2016	0.1	1.3	2.4		2.7	1.8	8.3
2017	0.3	0.5	8.0		1.6	5.2	15.6
2018	0.3	0.2	6.0		7.5	2.6	16.6

Table 9. Coefficients of variation (CV) for the Gulf of Maine Atlantic cod commercial discard (mt) estimates from 1989 to 2018 by gear; CVs greater than 0.3 are shaded in grey. CVs are not available for hindcasted discards (pre-1989).

Year	Longline	Otter trawl		Shrimp trawl	Sink Gillnet	
		Small mesh (< 5.5")	Large mesh (>= 5.5")		Large mesh (5.5" - 7.99")	Extra large mesh (>= 8.0")
1989		0.67	0.34	0.25	0.29	
1990		0.79	0.37	0.42	0.23	
1991	0.40	0.60	0.37	0.32	0.10	
1992	0.64	3.72	0.33	0.24	0.07	
1993	0.20		0.44	0.13	0.09	
1994			0.63	0.15	0.32	0.75
1995		0.24	0.59	0.24	0.26	0.45
1996		2.84	0.91	0.34	0.30	0.28
1997		0.25	0.44	0.41	0.42	0.85
1998			0.55		0.28	0.95
1999		0.62	0.56		0.37	0.51
2000			0.28		0.27	0.31
2001		1.84	0.27		0.52	0.58
2002		0.55	0.34		0.24	0.59
2003	0.30	0.72	0.29	0.42	0.14	0.28
2004	0.48	0.44	0.34	0.37	0.13	0.12
2005	0.24	0.27	0.19	0.38	0.13	0.12
2006	0.29	0.27	0.39	0.44	0.38	0.32
2007	0.17	0.43	0.22	0.70	0.29	0.31
2008	0.42	0.37	0.21	0.55	0.18	0.49
2009	0.17	0.28	0.14	0.64	0.19	0.49
2010	0.33	0.28	0.19	0.90	0.11	0.17
2011	0.18	0.41	0.09		0.04	0.07
2012	0.20	0.44	0.08	1.02	0.04	0.06
2013	0.62	0.63	0.27	0.95	0.07	0.21
2014	0.49	0.36	0.29		0.07	0.08
2015		0.25	0.23		0.28	0.22
2016	1.09	0.38	0.16		0.15	0.28
2017	0.28	0.29	0.27		0.27	0.17
2018	0.28	0.52	0.20		0.54	0.22

Table 10. Total Gulf of Maine Atlantic cod commercial discards-at-age (numbers) from 1982 to 2018. *These estimates include gear-specific assumptions of discard survival.*

Year	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
1982	581	347,720	1,156,034	224,521	50,895	0	0	0	0	0	0	0	0	0	0	0	0
1983	13,645	562,544	1,281,940	158,839	5,416	0	0	0	0	0	0	0	0	0	0	0	0
1984	18,275	347,694	1,445,433	219,644	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	67,101	459,681	1,162,717	516,585	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	17,767	731,053	1,522,658	208,195	48,007	0	0	0	0	0	0	0	0	0	0	0	0
1987	100,702	252,248	1,375,956	406,263	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	3,446	405,259	1,149,396	275,330	23,306	0	0	0	0	0	0	0	0	0	0	0	0
1989	43	157,339	733,450	415,475	51,442	5,129	1,380	502	109	0	0	0	0	0	0	0	0
1990	0	61,442	539,508	1,619,321	185,562	1,188	216	0	0	0	0	0	0	0	0	0	0
1991	3,251	115,661	244,750	156,398	273,359	23,658	945	211	0	494	22	0	0	0	0	0	0
1992	23,803	364,755	481,485	278,021	32,164	91,688	2,805	119	14	0	0	0	0	0	0	0	0
1993	26,570	100,225	345,799	212,563	62,392	47	682	187	0	0	0	0	0	0	0	0	0
1994	11,734	119,195	93,081	140,124	14,606	816	234	270	0	0	0	0	0	0	0	0	0
1995	11,572	75,059	57,584	104,772	42,720	3,914	413	0	0	0	0	0	0	0	0	0	0
1996	22,067	31,719	22,411	24,451	38,147	6,928	657	102	78	542	0	0	0	0	0	0	0
1997	1,472	66,116	33,817	27,941	5,256	13,811	766	120	0	0	0	0	0	0	0	0	0
1998	699	2,565	36,073	20,996	13,651	1,615	1,536	82	0	0	0	0	0	0	0	0	0
1999	63	58,620	35,442	77,449	78,134	64,863	19,741	22,472	3,779	32	0	0	0	0	0	0	0
2000	0	10,977	192,879	122,257	137,216	26,040	8,080	1,471	315	0	0	0	0	0	0	0	0
2001	0	584	166,381	181,295	117,448	89,585	23,098	9,463	1,433	1,304	0	0	0	0	0	0	0
2002	0	10,379	26,625	95,299	150,797	58,039	36,422	15,103	9,627	3,784	3,221	270	220	0	0	0	0
2003	22,873	30,227	60,078	48,552	131,760	95,818	18,452	5,589	1,985	819	315	204	15	0	0	0	0
2004	187	130,674	71,594	234,041	42,241	41,615	19,027	4,267	1,900	569	231	88	11	0	0	0	0
2005	1,487	19,746	72,822	27,925	88,613	2,854	7,378	2,689	588	435	156	176	80	43	0	0	0
2006	204	10,521	29,696	159,504	38,366	53,974	2,405	2,150	1,902	93	34	5	0	1	0	0	0
2007	407	10,720	49,447	57,421	49,909	4,291	2,782	49	53	6	0	2	0	0	0	0	0
2008	305	7,598	58,021	104,763	59,668	40,918	1,629	1,361	75	17	27	26	0	0	0	0	0
2009	81	5,791	52,840	167,603	143,740	56,239	26,856	734	1,259	13	33	7	0	8	0	0	0
2010	213	4,607	23,503	52,319	27,322	15,926	3,289	989	20	2	0	0	0	0	0	0	0
2011	27	1,612	13,351	31,934	28,579	6,662	1,533	153	29	87	0	0	0	0	0	0	0
2012	5	2,866	23,763	32,839	19,192	8,527	999	291	1	0	0	0	0	0	0	0	0
2013	119	1,930	25,249	15,987	8,015	3,454	427	21	1	0	0	0	0	0	0	0	0
2014	0	1,710	4,680	8,986	9,394	1,003	185	45	2	0	0	0	0	0	0	0	0
2015	0	311	8,528	1,866	1,847	240	56	24	3	0	0	0	0	0	0	0	0
2016	0	39	2,465	4,455	438	319	13	1	1	0	0	0	0	0	0	0	0
2017	0	16	2,132	3,145	4,593	581	168	5	1	0	0	0	0	0	0	0	0
2018	0	2,107	8,223	2,640	2,547	1,280	53	8	0	0	0	0	0	0	0	0	0

Table 11. Mean weights-at-age (kg) of commercially discarded Gulf of Maine Atlantic cod from 1982 to 2018.

Year	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13
1989	0.046	0.224	0.490	0.753	1.784	4.111	5.544	9.336	6.408					
1990		0.195	0.645	0.702	0.845	4.341	4.565							
1991	0.014	0.238	0.859	0.918	0.998	1.428	6.758	8.389		18.191	3.705			
1992	0.023	0.053	0.680	0.773	1.096	1.170	1.656	5.239	2.425					
1993	0.021	0.074	0.668	0.931	0.919	1.953	4.309	7.342						
1994	0.022	0.049	0.627	0.830	1.830	3.879	12.083	9.439						
1995	0.027	0.094	0.808	0.929	1.663	4.965	4.684							
1996	0.033	0.068	0.676	1.133	1.856	3.771	6.751	11.559	12.656	17.406				
1997	0.017	0.058	0.588	0.928	2.009	1.805	4.415	8.571						
1998	0.007	0.200	0.602	1.096	1.695	3.316	3.287	3.285						
1999	0.052	0.201	0.599	1.955	3.371	4.637	6.590	6.600	9.627	12.279				
2000		0.292	0.962	1.856	3.063	3.904	4.907	4.312	6.123					
2001		0.316	0.669	2.041	3.798	4.915	5.919	6.604	7.205	8.800				
2002		0.203	0.922	1.417	3.008	4.243	6.253	7.006	9.420	12.283	10.892	10.504	14.222	
2003	0.038	0.132	0.803	1.379	1.722	2.859	4.215	6.930	9.830	8.652	11.636	10.112	12.786	
2004	0.025	0.105	0.456	1.131	1.900	2.837	4.866	6.767	8.779	11.615	11.876	10.706	11.700	
2005	0.027	0.109	0.553	1.189	1.474	3.583	3.876	5.887	7.497	11.334	15.812	16.473	9.759	23.098
2006	0.070	0.273	0.659	1.069	1.519	1.633	1.948	3.965	2.917	7.828	8.328	13.434		13.434
2007	0.025	0.228	0.659	1.084	1.437	1.766	2.331	4.433	5.178	7.784		7.837		
2008	0.073	0.214	0.792	1.296	1.599	1.784	3.144	6.373	6.143	5.869	10.399	10.660		
2009	0.026	0.354	0.913	1.520	2.024	2.126	2.423	3.974	3.317	8.235	8.748	7.218		10.510
2010	0.023	0.251	1.056	1.256	1.755	1.924	1.978	2.208	4.554	8.210				
2011	0.126	0.362	0.886	1.205	1.325	1.495	1.620	1.666	2.531	16.415				
2012	0.011	0.368	0.901	1.125	1.287	1.306	1.500	1.733	4.199					
2013	0.030	0.503	0.768	1.116	1.270	1.362	1.434	1.851	1.969					
2014		0.473	0.798	1.112	1.122	1.555	2.326	1.812	7.281					
2015		0.247	0.630	1.254	2.753	4.528	4.488	4.553	6.100					
2016		0.186	0.646	1.045	2.441	2.930	3.628	3.593	3.950					
2017		0.250	0.639	1.088	1.815	2.954	4.220	6.158	6.388					
2018		0.332	0.884	1.202	1.314	1.533	1.542	3.458						

Table 12. Estimates of Gulf of Maine Atlantic cod recreational catch in numbers (000's) and weight (mt) from 1981 to 2018. Recreational releases reflect an assumed post-release mortality of 15% (Capizzano et al. 2016). *Coefficients of variation (CVs) on the 2004-2018 harvest estimates ranged from 0.09-0.27 and 0.08-0.23 for the releases.*

Year	Numbers (000s)				Biomass (mt)				Released/ harvest ratio
	Harvest (AB1)	Released (B2) w/ 100% discard mortality	Released (B2) w/ 15% discard mortality	Total catch w/ 15% discard mortality	Harvest (AB1)	Released (B2) w/ 100% discard mortality	Released (B2) w/ 15% discard mortality	Total catch w/ 15% discard mortality	
1981	3230.8	403.8	60.6	3291.4	6,604.8	174.7	26.2	6,631.0	0.12
1982	1557.9	96.6	14.5	1572.4	3,206.1	36.6	5.5	3,211.6	0.06
1983	1704.5	269.3	40.4	1744.9	3,224.5	90.6	13.6	3,238.1	0.16
1984	1499.3	378.0	56.7	1556.0	2,797.5	140.5	21.1	2,818.5	0.25
1985	2813.9	199.1	29.9	2843.8	6,418.9	74.1	11.1	6,430.0	0.07
1986	1514.2	217.8	32.7	1546.9	3,978.2	79.8	12.0	3,990.2	0.14
1987	2457.4	843.2	126.5	2583.9	5,793.7	314.9	47.2	5,841.0	0.34
1988	1931.6	237.7	35.6	1967.3	3,458.0	80.5	12.1	3,470.1	0.12
1989	1750.7	719.9	108.0	1858.7	3,836.2	422.0	63.3	3,899.5	0.41
1990	1976.6	670.3	100.5	2077.1	4,770.1	416.9	62.5	4,832.7	0.34
1991	1193.9	382.0	57.3	1251.2	2,669.3	279.0	41.9	2,711.1	0.32
1992	479.9	396.2	59.4	539.4	1,255.2	259.1	38.9	1,294.0	0.83
1993	1245.2	1059.7	159.0	1404.2	2,217.0	634.0	95.1	2,312.1	0.85
1994	779.0	1061.7	159.3	938.3	1,430.9	654.9	98.2	1,529.1	1.36
1995	893.4	1226.0	183.9	1077.3	1,480.1	761.3	114.2	1,594.3	1.37
1996	405.2	491.5	73.7	478.9	777.0	389.5	58.4	835.4	1.21
1997	194.8	425.1	63.8	258.5	438.4	367.0	55.0	493.4	2.18
1998	273.8	561.2	84.2	358.0	670.3	466.7	70.0	740.3	2.05
1999	429.9	641.2	96.2	526.1	1,343.2	425.7	63.9	1,407.1	1.49
2000	687.1	1139.9	171.0	858.1	1,710.5	751.2	112.7	1,823.1	1.66
2001	974.8	1381.0	207.2	1182.0	2,538.3	1,055.6	158.3	2,696.6	1.42
2002	625.6	1214.0	182.1	807.7	1,919.1	1,409.7	211.5	2,130.5	1.94
2003	531.6	1021.3	153.2	684.8	1,878.7	1,147.6	172.1	2,050.8	1.92
2004	605.7	1251.5	187.7	793.4	2,394.1	1,135.0	170.2	2,564.3	2.07
2005	741.9	1802.3	270.3	1012.3	3,021.7	1,534.8	230.2	3,251.9	2.43
2006	212.0	847.3	127.1	339.1	759.0	772.6	115.9	874.9	4.00
2007	446.8	1453.8	218.1	664.8	1,554.6	1,589.0	238.4	1,792.9	3.25
2008	685.7	1502.6	225.4	911.0	2,244.4	1,654.8	248.2	2,492.6	2.19
2009	721.1	1662.1	249.3	970.4	2,450.2	1,956.1	293.4	2,743.6	2.30
2010	947.1	2302.6	345.4	1292.5	3,144.9	2,794.8	419.2	3,564.1	2.43
2011	960.0	1648.1	247.2	1207.2	2,999.4	2,046.0	306.9	3,306.3	1.72
2012	631.2	988.3	148.2	779.4	1,244.7	687.5	103.1	1,347.9	1.57
2013	840.9	1797.6	269.6	1110.5	1,523.5	1,297.1	194.6	1,718.1	2.14
2014	388.2	1160.2	174.0	562.2	795.6	1,008.5	151.3	946.9	2.99
2015	10.7	1040.8	156.1	166.8	11.0	1,119.5	167.9	178.9	97.63
2016	70.2	1716.5	257.5	327.7	187.0	2,225.4	333.8	520.9	24.46
2017	80.0	2195.9	329.4	409.4	170.0	4,066.5	610.0	780.0	27.45
2018	6.1	1121.6	168.2	174.3	12.3	2,172.6	325.9	338.2	184.98

Table 13. Number of lengths sampled from recreationally harvested (type A and B1) Gulf of Maine Atlantic cod by semester and year as estimated by the Marine Recreational Information Program from 1981 to 2018. Sampling intensity is expressed as metric tons of landings per 100 lengths sampled (*200 metric tons per 100 lengths is an unofficial NAFO/ICNAF standard*).

Year	Semester		Total	AB1 estimated numbers (000s)	AB1 Landings (mt)	Lengths per 1000 fish	mt per 100 lengths
	1	2					
1981	355	366	721	3,231	6,605	0.2	916.1
1982	320	276	596	1,558	3,206	0.4	537.9
1983	609	560	1,169	1,705	3,224	0.7	275.8
1984	394	391	785	1,499	2,797	0.5	356.4
1985	272	155	427	2,814	6,419	0.2	1503.3
1986	77	90	167	1,514	3,978	0.1	2382.2
1987	167	367	534	2,457	5,794	0.2	1085.0
1988	325	213	538	1,932	3,458	0.3	642.8
1989	208	352	560	1,751	3,836	0.3	685.0
1990	160	210	370	1,977	4,770	0.2	1289.2
1991	377	83	460	1,194	2,669	0.4	580.3
1992	710	268	978	480	1,255	2.0	128.3
1993	136	200	336	1,245	2,217	0.3	659.8
1994	333	485	818	779	1,431	1.1	174.9
1995	663	434	1,097	893	1,480	1.2	134.9
1996	585	515	1,100	405	777	2.7	70.6
1997	190	392	582	195	438	3.0	75.3
1998	447	215	662	274	670	2.4	101.3
1999	111	117	228	430	1,343	0.5	589.1
2000	70	77	147	687	1,710	0.2	1163.6
2001	124	121	245	975	2,538	0.3	1036.0
2002	181	196	377	626	1,919	0.6	509.0
2003	361	322	683	532	1,879	1.3	275.1
2004	1,203	1,137	2,340	606	2,394	3.9	102.3
2005	1,281	1,370	2,651	742	3,022	3.6	114.0
2006	948	628	1,576	212	759	7.4	48.2
2007	907	696	1,603	447	1,555	3.6	97.0
2008	1,632	724	2,356	686	2,244	3.4	95.3
2009	1,837	1,122	2,959	721	2,450	4.1	82.8
2010	1,736	1,220	2,956	947	3,145	3.1	106.4
2011	1,750	998	2,748	960	2,999	2.9	109.2
2012	1,098	1,364	2,462	631	1,245	3.9	50.6
2013	1,564	1,171	2,735	841	1,524	3.3	55.7
2014	805	522	1,327	388	796	3.4	60.0
2015	13	21	34	11	11	3.2	32.3
2016	47	279	326	70	187	4.6	57.4
2017	34	31	65	80	170	0.8	261.5
2018	15	14	29	6	12	4.8	42.3

Table 14. Number of lengths sampled from recreationally discarded (type B2) Gulf of Maine Atlantic cod by semester and year as estimated by the Marine Recreational Information Program from 2004 to 2018. Length samples of recreationally discarded (i9 samples) Atlantic cod were unavailable prior to 2004. Sampling intensity is expressed as metric tons landings per 100 lengths sampled (*200 metric tons per 100 lengths is an unofficial NAFO/ICNAF standard*). Reported release estimates have not been adjusted to account for post-release survival/mortality.

Year	Semester		Total	B2 releases (000s)	B2 releases (mt)	Lengths per thousand fish	Metric tons per 100 lengths
	1	2					
2004	520	456	976	606	1,135	1.6	116.3
2005	607	640	1,247	742	1,535	1.7	123.1
2006	965	606	1,571	212	773	7.4	49.2
2007	733	852	1,585	447	1,589	3.5	100.3
2008	1,275	717	1,992	686	1,655	2.9	83.1
2009	771	901	1,672	721	1,956	2.3	117.0
2010	732	1,035	1,767	947	2,795	1.9	158.2
2011	504	958	1,462	960	2,046	1.5	139.9
2012	392	952	1,344	631	688	2.1	51.2
2013	733	561	1,294	841	1,297	1.5	100.2
2014	578	202	780	388	1,009	2.0	129.3
2015	476	362	838	11	1,120	78.6	133.6
2016	811	644	1,455	70	2,225	20.7	153.0
2017	949	271	1220	80	4,066	15.2	333.3
2018	537	140	677	6	2,173	111.7	320.9

Table 15. Total Gulf of Maine Atlantic cod recreational landings-at-age (numbers) from 1981 to 2018.

Year	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
1981	0	256,903	1,002,396	999,342	685,243	112,371	68,453	11,875	47,173	0	40,329	0	6,721	0	0	0	0
1982	871	77,296	478,591	486,539	299,856	147,043	16,663	28,348	15,000	4,444	653	0	2,613	0	0	0	0
1983	0	27,145	574,204	617,744	233,300	139,469	82,371	10,568	8,863	3,232	2,528	1,459	3,645	0	0	0	0
1984	0	25,928	496,708	499,515	306,982	89,973	52,352	20,420	861	927	773	1,385	0	954	2,546	0	0
1985	0	81,604	855,617	1,017,446	347,233	285,673	88,297	78,891	36,967	5,120	12,785	733	2,332	1,235	0	0	0
1986	0	44,814	248,693	725,758	257,011	81,570	84,559	19,219	22,055	12,958	7,383	1,784	6,606	1,784	0	0	0
1987	0	27,568	569,632	845,839	747,407	126,825	40,566	57,250	14,664	13,805	10,354	3,067	461	0	0	0	0
1988	0	6,418	405,260	920,860	462,133	95,816	17,690	7,569	12,288	0	0	3,590	0	0	0	0	0
1989	0	7,093	228,662	855,205	476,097	125,684	29,787	21,386	2,605	4,169	0	0	0	0	0	0	0
1990	0	5,971	85,362	954,921	627,954	185,502	78,487	9,463	24,931	4,007	0	0	0	0	0	0	0
1991	0	4,218	41,223	178,207	818,750	123,903	13,035	14,434	0	0	167	0	0	0	0	0	0
1992	0	4,229	43,179	87,815	70,843	247,743	20,417	5,318	388	0	0	0	0	0	0	0	0
1993	0	4,191	93,788	753,242	292,383	23,084	70,630	7,874	0	0	0	0	0	0	0	0	0
1994	0	942	27,686	482,172	205,042	48,642	4,766	7,873	1,190	734	0	0	0	0	0	0	0
1995	0	59	83,760	441,491	341,751	23,516	2,416	0	453	0	0	0	0	0	0	0	0
1996	0	0	18,663	100,756	253,260	30,778	1,324	53	0	368	0	0	0	0	0	0	0
1997	0	145	9,417	59,072	39,522	79,458	6,737	65	356	0	0	0	0	0	0	0	0
1998	414	0	17,676	100,407	100,608	21,923	30,094	2,102	598	0	0	0	0	0	0	0	0
1999	0	1,285	12,338	124,575	142,014	90,860	22,460	33,782	2,572	0	0	0	0	0	0	0	0
2000	0	0	93,038	230,419	289,788	44,833	18,871	3,550	6,616	0	0	0	0	0	0	0	0
2001	0	0	54,607	498,608	276,387	108,781	22,159	11,971	1,703	599	0	0	0	0	0	0	0
2002	0	0	474	88,354	357,439	112,197	36,459	14,716	9,248	1,201	2,224	0	3,319	0	0	0	0
2003	0	0	5,707	43,457	174,533	219,741	48,043	21,155	8,729	5,928	1,367	2,015	955	0	0	0	0
2004	0	47	1,435	137,252	102,789	186,902	102,883	29,227	18,960	9,029	9,045	3,719	4,379	0	0	0	0
2005	0	1,052	10,817	54,295	365,959	40,349	131,756	92,695	28,014	11,264	3,118	1,412	1,128	66	0	0	0
2006	36	840	1,754	36,011	51,571	85,835	5,227	16,082	8,719	3,266	1,616	583	282	119	12	0	0
2007	0	89	4,852	56,843	257,173	38,817	69,619	3,182	6,136	4,278	2,061	1,519	519	1,336	124	209	0
2008	0	205	6,909	150,690	227,936	240,618	20,139	28,257	1,218	2,860	2,528	544	3,569	141	0	42	0
2009	0	515	4,197	182,132	305,651	123,648	80,515	6,893	11,179	1,125	1,677	916	1,663	876	0	53	41
2010	0	280	7,500	183,504	403,524	246,260	66,644	30,113	5,402	2,155	195	1,193	220	78	0	0	0
2011	116	2,700	12,207	141,269	337,961	284,269	147,804	15,030	15,839	1,518	679	393	89	0	98	0	0
2012	0	3,885	38,207	183,721	234,194	120,867	35,897	12,861	1,158	266	97	0	0	0	0	0	0
2013	922	3,383	144,280	358,384	213,977	96,124	17,092	5,440	1,274	22	3	5	0	0	0	0	0
2014	0	1,563	28,577	142,886	148,044	46,351	15,483	4,499	530	288	0	0	0	0	0	0	0
2015	0	810	5,620	2,323	1,594	233	46	20	9	5	0	0	0	0	0	0	0
2016	0	646	1,966	23,587	18,869	22,920	1,504	561	94	30	0	0	0	0	0	0	0
2017	0	821	5,357	16,121	43,758	8,661	5,127	117	49	0	0	0	0	0	0	0	0
2018	0	836	657	677	1,562	2,001	164	166	0	0	0	0	0	0	0	0	0

Table 16. Mean weights-at-age (kg) of recreationally landed Gulf of Maine Atlantic cod from 1981 to 2018.

Year	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
1981		0.341	0.995	1.524	2.915	4.715	5.645	5.863	8.359		12.339		18.100				
1982	0.022	0.372	0.848	1.401	2.209	5.362	6.955	9.732	8.990	11.008	11.547		21.416				
1983		0.378	0.791	1.398	2.401	3.772	6.032	6.745	8.393	9.627	15.175	19.306	19.182				
1984		0.372	0.775	1.365	2.668	4.005	5.349	6.559	6.583	8.955	11.743	13.474		17.780	27.103		
1985		0.346	0.752	1.281	2.810	5.310	6.771	8.645	11.257	11.854	12.252	8.049	9.297	8.332			
1986		0.375	0.668	1.589	2.770	5.308	7.418	8.584	11.185	11.839	14.266	14.560	22.376	14.560			
1987		0.243	0.900	1.472	2.696	4.196	8.162	10.978	11.301	12.673	13.141	13.835	8.332				
1988		0.170	0.787	1.528	2.188	4.550	4.414	5.123	10.614			10.175					
1989		0.539	0.989	1.500	2.700	4.579	6.191	8.715	7.616	17.137							
1990		0.132	0.916	1.439	2.261	4.965	7.351	8.502	10.658	13.166							
1991		0.180	1.088	1.499	2.025	3.388	6.933	13.033			3.838						
1992		0.106	1.360	1.715	2.541	2.923	4.437	9.324	2.516								
1993		0.184	0.805	1.566	1.827	2.890	3.791	11.707									
1994		0.136	1.169	1.514	2.262	2.270	5.374	5.751	18.165	2.156							
1995		0.509	1.432	1.514	1.769	3.381	2.479		4.244								
1996			1.483	1.809	1.863	2.502	9.632	8.622		13.434							
1997		0.307	1.626	1.924	2.389	2.396	2.964	6.038	11.932								
1998	0.010		1.600	2.071	2.435	3.491	3.179	4.591	12.220								
1999		0.290	1.296	1.943	2.951	3.687	5.490	5.561	7.637								
2000			1.561	1.961	2.718	3.199	5.103	5.023	10.277								
2001			1.709	2.199	2.659	3.732	5.019	6.259	10.560	5.813							
2002			1.275	2.135	2.581	3.048	5.265	6.429	7.919	8.984	10.569		21.420				
2003			1.954	2.237	2.525	3.225	4.822	8.064	9.802	11.167	11.115	15.401	21.534				
2004		0.241	0.762	2.031	2.629	3.004	4.681	7.304	10.222	13.028	14.042	15.955	20.498				
2005		0.153	0.743	1.993	2.602	4.440	5.226	7.455	8.066	9.105	10.495	12.003	13.376	15.589			
2006	0.104	0.140	0.684	2.114	2.936	3.267	4.767	5.541	8.047	9.862	11.816	13.681	13.742	17.763	19.820		
2007		0.246	1.504	2.307	2.906	3.611	4.718	5.801	7.967	11.293	12.525	14.839	14.738	16.691	15.964	19.820	
2008		0.377	1.303	2.518	2.795	3.309	4.046	6.071	5.712	10.730	13.338	13.944	24.555	15.675		15.522	
2009		0.237	1.335	2.568	3.075	3.467	4.494	6.803	9.098	12.648	11.875	14.271	18.424	20.778		13.434	19.820
2010		0.297	1.354	2.407	3.027	3.712	4.297	5.825	9.044	11.058	8.756	14.538	13.974	9.903			
2011	0.104	0.223	1.105	2.230	2.718	3.366	4.128	4.638	4.856	11.340	15.963	18.834	13.523		14.398		
2012		0.224	1.264	1.577	2.031	2.197	2.965	3.844	4.403	8.581	11.707						
2013	0.057	0.554	1.245	1.803	1.977	2.224	2.273	2.669	4.183	8.703	6.017	7.240					
2014		0.284	1.488	1.827	2.140	2.347	2.911	3.614	6.129	4.831							
2015		0.230	0.627	1.071	1.874	5.667	5.739	5.693	6.487	6.487							
2016		0.054	0.679	2.066	2.889	3.194	4.085	4.335	4.616	7.240							
2017		0.295	0.716	1.276	2.180	3.157	4.219	5.759	5.791								
2018		0.277	0.697	1.826	2.103	2.946	3.541	3.515									

Table 17. Total Gulf of Maine Atlantic cod recreational discards-at-age (numbers) from 1981 to 2018. *Estimates include assumptions of 15% discard survival.*

Year	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
1981	0	18,894	34,208	7,464	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	3,785	9,803	710	187	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	15,482	24,211	696	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	10,301	42,767	3,629	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	7,134	16,696	6,036	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	9,394	21,898	584	800	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	12,029	98,268	16,184	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	5,960	24,985	4,704	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	4,558	62,373	38,863	2,185	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	1,193	20,817	70,352	8,180	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	1,448	12,679	14,597	26,355	2,217	0	0	0	0	0	0	0	0	0	0	0
1992	0	3,776	27,021	19,940	2,680	5,794	217	0	0	0	0	0	0	0	0	0	0
1993	0	3,537	91,266	46,134	18,022	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	4,224	64,320	84,922	5,791	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	4,570	50,662	108,393	19,584	687	0	0	0	0	0	0	0	0	0	0	0
1996	0	4,194	15,442	22,518	28,940	2,626	0	0	0	0	0	0	0	0	0	0	0
1997	0	2,762	19,793	23,787	5,784	11,028	618	0	0	0	0	0	0	0	0	0	0
1998	0	3,271	36,586	25,679	17,008	280	1,355	0	0	0	0	0	0	0	0	0	0
1999	0	13,169	42,113	33,134	5,352	2,063	279	75	0	0	0	0	0	0	0	0	0
2000	0	11,283	112,342	37,273	9,062	937	91	0	0	0	0	0	0	0	0	0	0
2001	0	0	98,497	86,462	18,318	3,583	294	0	0	0	0	0	0	0	0	0	0
2002	0	4,756	9,743	81,520	69,414	16,203	180	0	291	0	0	0	0	0	0	0	0
2003	0	8,943	32,009	21,047	62,470	25,221	3,511	0	0	0	0	0	0	0	0	0	0
2004	0	3,047	30,283	126,129	15,108	11,721	1,422	17	3	0	0	0	0	0	0	0	0
2005	0	3,760	89,844	40,043	132,078	1,742	2,797	66	8	12	0	0	0	0	0	0	0
2006	16	5,474	17,187	72,705	13,289	16,957	811	330	325	5	1	0	0	0	0	0	0
2007	17	1,113	39,123	80,166	86,308	6,437	4,892	8	12	0	0	0	0	0	0	0	0
2008	86	3,620	49,351	91,655	47,045	32,260	873	472	18	5	0	0	0	0	0	0	0
2009	18	5,080	45,565	98,870	67,315	22,399	9,603	267	193	0	0	0	0	0	0	0	0
2010	0	3,991	51,131	160,636	77,772	39,878	9,082	2,894	2	0	0	0	0	0	0	0	0
2011	707	7,138	36,036	75,971	90,752	28,079	7,464	810	251	0	0	0	0	0	0	0	0
2012	110	13,023	57,598	54,162	16,849	6,212	213	68	5	0	0	0	0	0	0	0	0
2013	0	6,587	175,711	65,697	17,147	4,096	335	65	4	0	0	0	0	0	0	0	0
2014	0	21,330	25,553	56,691	61,859	7,062	1,287	242	0	0	0	0	0	0	0	0	0
2015	0	8,616	74,788	34,367	34,803	2,785	537	211	6	0	0	0	0	0	0	0	0
2016	177	4,424	41,424	153,426	30,511	26,328	947	210	32	0	0	0	0	0	0	0	0
2017	0	1,755	26,610	68,508	186,659	31,601	13,920	293	39	6	0	0	0	0	0	0	0
2018	0	12,733	31,504	20,169	45,829	49,052	4,882	4,052	13	0	0	0	0	0	0	0	0

Table 18. Mean weights-at-age (kg) of recreationally discarded Gulf of Maine Atlantic cod from 1981 to 2018.

Year	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10
1981		0.367	0.456	0.492							
1982		0.307	0.400	0.450	0.509						
1983		0.260	0.386	0.326							
1984		0.288	0.387	0.436							
1985		0.272	0.395	0.426							
1986		0.319	0.380	0.429	0.499						
1987		0.221	0.393	0.371							
1988		0.185	0.357	0.438							
1989		0.395	0.524	0.692	0.867						
1990		0.231	0.528	0.637	0.786						
1991		0.234	0.536	0.776	0.819	0.818					
1992		0.217	0.590	0.724	0.837	0.902	0.868				
1993		0.252	0.487	0.769	0.794						
1994		0.283	0.470	0.740	0.683						
1995		0.302	0.520	0.635	0.870	0.931					
1996		0.277	0.655	0.827	0.902	0.918					
1997		0.196	0.685	0.915	1.095	1.092	1.294				
1998		0.203	0.630	1.007	1.072	1.211	1.365				
1999		0.301	0.535	0.869	1.078	1.157	1.097	1.456			
2000		0.275	0.574	0.911	1.109	1.003	1.211				
2001			0.581	0.886	1.098	1.105	1.290				
2002		0.156	0.468	1.035	1.406	1.444	1.371		1.937		
2003		0.345	0.544	1.223	1.327	1.507	1.422				
2004		0.201	0.561	0.911	1.257	1.389	1.719	2.961	4.009		
2005		0.204	0.505	1.006	1.046	1.033	1.314	1.940	2.516	1.734	
2006	0.086	0.296	0.561	0.868	1.217	1.358	1.290	2.004	1.697	4.395	6.249
2007	0.048	0.170	0.639	1.052	1.284	1.580	1.586	3.048	3.896		
2008	0.105	0.321	0.772	1.116	1.316	1.303	1.669	2.476	2.374	6.003	
2009	0.057	0.311	0.807	1.207	1.325	1.407	1.476	2.007	1.714		
2010		0.283	0.902	1.148	1.437	1.464	1.401	1.639	3.203		
2011	0.084	0.307	0.760	1.245	1.368	1.566	1.685	1.797	2.155		
2012	0.000	0.290	0.583	0.790	0.946	0.990	2.749	3.936	5.370		
2013		0.346	0.627	0.883	1.082	1.196	1.460	1.631	2.098		
2014		0.357	0.792	0.998	0.915	1.168	1.298	1.384			
2015		0.237	0.599	1.337	1.867	2.842	2.810	3.325	5.888		
2016	0.010	0.148	0.584	1.223	1.950	2.208	2.900	3.457	4.555		
2017		0.212	0.655	1.228	2.061	2.494	3.085	4.331	6.032	6.983	
2018		0.310	0.778	1.515	2.062	2.868	3.442	3.660	7.240		

Table 19. Total catch-at-age (numbers) of Gulf of Maine Atlantic cod from 1982 to 2018 with an age 9⁺ group. *Only ages 1 through the 9⁺ group are used as assessment model inputs.*

Year	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9+
1982	1,452	456,410	2,979,937	2,345,942	1,467,010	766,614	67,904	97,494	74,375	90,991
1983	13,645	605,170	2,713,438	3,191,122	1,306,626	766,800	489,764	54,780	66,532	61,089
1984	18,275	386,705	2,410,446	1,950,020	1,811,557	486,683	248,270	116,822	9,966	56,998
1985	67,101	548,419	2,422,644	2,981,052	1,349,426	900,673	211,612	152,089	69,397	45,850
1986	17,767	785,260	1,878,612	3,121,859	1,124,535	321,312	246,295	57,919	49,552	63,250
1987	100,702	292,287	2,237,591	1,896,052	1,864,314	394,531	105,145	103,231	20,145	48,285
1988	3,446	417,637	1,747,109	2,557,263	1,393,399	496,758	76,482	29,433	32,535	11,104
1989	43	168,991	1,346,615	2,796,136	1,884,614	582,670	101,737	80,764	10,645	21,606
1990	0	68,605	856,306	6,048,219	3,049,274	639,487	230,590	34,709	49,606	45,435
1991	3,251	121,326	497,567	959,117	5,661,988	1,054,200	152,536	57,606	25,983	15,829
1992	23,803	372,760	854,237	913,497	537,967	2,315,130	236,460	82,857	6,239	5,530
1993	26,570	107,953	556,719	2,555,167	1,102,345	115,876	535,510	45,841	11,264	0
1994	11,734	124,361	214,101	1,762,531	1,395,684	290,398	68,586	78,060	29,304	8,234
1995	11,572	79,688	375,730	1,593,359	1,460,459	235,312	31,323	6,521	18,445	2,808
1996	22,067	35,913	112,279	655,074	2,083,415	415,891	37,125	4,058	491	1,755
1997	1,472	69,023	140,481	545,177	485,598	905,047	75,537	5,553	2,436	1,029
1998	1,113	5,836	178,254	538,998	676,011	163,186	220,073	29,691	5,451	2,257
1999	63	73,074	92,750	414,846	416,939	223,913	66,474	78,728	13,855	1,067
2000	0	22,260	500,600	648,417	937,612	195,915	93,337	14,028	13,396	0
2001	0	584	363,223	1,238,128	738,595	408,424	111,454	59,924	8,645	11,712
2002	0	15,135	38,281	376,460	1,011,608	356,854	176,032	71,486	31,185	22,597
2003	22,873	39,170	105,907	160,599	567,239	721,638	190,703	78,745	30,483	28,325
2004	187	133,768	103,804	640,171	290,310	460,380	293,834	85,816	47,305	49,835
2005	1,487	24,558	174,700	160,153	1,009,804	109,364	319,971	178,670	50,069	40,754
2006	256	16,835	49,414	383,526	285,184	457,419	29,855	81,254	40,057	27,400
2007	424	11,922	98,631	290,124	1,023,242	148,650	255,722	9,191	21,783	25,941
2008	391	11,423	118,423	630,177	800,406	914,112	76,585	112,584	3,801	21,820
2009	99	11,386	105,302	732,215	1,235,640	536,086	316,801	24,547	33,149	12,024
2010	213	8,878	83,817	517,908	1,086,810	765,705	193,091	93,841	13,493	8,031
2011	850	11,450	62,128	347,138	754,029	715,080	413,587	42,142	45,209	9,927
2012	115	19,774	130,256	399,575	558,335	310,245	146,334	66,628	8,314	3,809
2013	1,041	12,042	356,678	531,596	313,538	176,543	32,014	15,549	7,623	934
2014	0	24,603	70,284	318,343	333,108	90,975	34,070	10,059	1,948	1,014
2015	0	9,737	90,149	47,643	74,591	16,031	2,094	1,935	308	225
2016	177	5,109	46,307	202,972	76,436	86,429	6,305	2,008	731	260
2017	0	2,592	34,141	90,667	288,474	59,971	35,477	2,121	363	272
2018	0	16,788	43,142	27,533	71,613	103,796	13,166	11,782	215	171

Table 20. Mean weights-at-age (kg) of the total catch Gulf of Maine Atlantic cod from 1982 to 2018 with an age 9⁺ group. Mean catch weights-at-age in the 9⁺ group were estimated using a numbers weighted approach. Cells shaded grey were imputed using a 5-year centered moving average. *Only ages 1 through the 9⁺ group are used as assessment model inputs.*

Year	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9+
1982	0.013	0.356	0.859	1.511	2.597	5.074	7.062	9.624	9.752	15.653
1983	0.024	0.227	0.771	1.529	2.416	3.805	6.054	6.129	10.202	13.493
1984	0.001	0.239	0.666	1.461	2.677	3.649	5.518	8.195	9.970	15.062
1985	0.039	0.218	0.738	1.381	2.818	4.776	6.095	8.545	11.248	13.074
1986	0.005	0.280	0.512	1.685	2.773	4.848	6.666	8.190	10.431	14.740
1987	0.004	0.157	0.667	1.349	3.029	4.609	7.394	10.239	11.156	14.209
1988	0.003	0.122	0.603	1.641	2.331	5.141	5.107	6.052	10.202	12.527
1989	0.046	0.242	0.773	1.517	2.927	4.313	6.010	9.203	11.932	20.556
1990	0.021	0.190	0.817	1.357	2.154	4.550	7.655	10.485	11.460	18.459
1991	0.014	0.236	1.122	1.606	2.280	3.890	7.142	10.522	12.261	14.016
1992	0.023	0.055	1.040	1.537	2.733	2.973	5.537	10.869	10.234	14.483
1993	0.021	0.083	0.703	1.720	2.105	4.254	5.535	9.993	13.673	15.590
1994	0.022	0.058	0.760	1.686	3.025	3.170	6.302	7.587	12.655	11.418
1995	0.027	0.105	1.290	1.569	2.526	4.990	6.670	11.466	13.002	22.443
1996	0.033	0.092	1.339	2.097	2.250	3.443	7.585	11.713	14.455	16.056
1997	0.017	0.064	1.365	2.121	3.000	3.048	4.629	8.984	12.141	16.938
1998	0.008	0.202	1.099	1.945	2.620	3.941	4.186	7.037	12.123	16.676
1999	0.052	0.221	0.691	1.769	2.813	3.848	5.638	6.425	9.581	12.279
2000	0.030	0.283	1.145	2.136	3.240	4.216	5.829	5.315	9.534	12.757
2001	0.045	0.316	0.954	2.218	3.126	4.624	6.095	7.227	9.138	9.516
2002	0.032	0.188	0.827	1.883	2.903	3.749	6.072	6.931	8.740	12.558
2003	0.038	0.181	0.869	1.911	2.459	3.683	5.145	7.665	9.216	12.105
2004	0.025	0.108	0.496	1.627	2.923	3.545	5.428	7.450	9.984	14.169
2005	0.027	0.125	0.554	1.669	2.509	4.439	4.913	6.957	8.057	11.588
2006	0.075	0.276	0.661	1.570	2.981	3.401	4.538	5.584	7.426	11.970
2007	0.025	0.222	0.768	1.816	2.949	3.763	4.837	6.256	7.397	12.543
2008	0.084	0.244	0.840	2.220	2.821	3.498	4.512	6.033	5.960	13.384
2009	0.031	0.330	0.910	2.220	3.122	3.553	4.402	6.126	8.382	14.124
2010	0.023	0.267	1.010	1.976	3.147	3.894	4.462	5.482	8.698	11.530
2011	0.088	0.295	0.861	2.057	2.766	3.681	4.608	5.377	5.625	13.053
2012	0.001	0.290	0.951	1.869	2.548	2.934	3.951	5.032	5.267	9.906
2013	0.054	0.442	0.921	1.812	2.196	2.857	3.098	4.670	6.715	11.091
2014	0.022	0.361	1.249	1.760	2.207	2.580	3.497	3.798	6.558	8.122
2015	0.032	0.236	0.614	1.506	2.637	4.285	4.341	5.447	8.173	13.790
2016	0.010	0.136	0.602	1.423	2.697	3.222	4.848	4.728	6.518	10.089
2017	0.010	0.239	0.664	1.270	2.322	3.209	4.225	6.467	7.536	10.042
2018	0.010	0.313	0.814	1.597	2.421	3.593	4.530	5.022	9.408	11.307
Average 2016-2018	0.010	0.229	0.693	1.430	2.480	3.341	4.534	5.406	7.821	10.479

Table 21. Mean January 1/spawning stock weights-at-age (kg) of Gulf of Maine Atlantic cod from 1982 to 2018 an age 9⁺ group. Mean weights-at-age were estimated by applying a Rivard-type approach (see NEFSC 2013) to numbers-weighted catch weights without mortality assumptions applied (uses all fish encountered). Cells shaded grey were imputed using a 5-year centered moving average. *Only ages 1 through the 9⁺ group are used as assessment model inputs.*

Year	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9
1982	0.003	0.240	0.595	1.162	2.116	4.646	7.581	9.348	9.688	15.653
1983	0.008	0.052	0.500	1.109	1.892	3.129	5.542	6.579	9.909	13.493
1984	0.000	0.077	0.375	1.013	2.013	2.968	4.582	7.043	7.817	15.062
1985	0.015	0.015	0.412	0.905	2.001	3.576	4.716	6.867	9.601	13.074
1986	0.001	0.104	0.326	1.079	1.906	3.696	5.642	7.065	9.441	14.740
1987	0.001	0.028	0.409	0.786	2.243	3.550	5.987	8.261	9.559	14.209
1988	0.000	0.021	0.304	0.974	1.709	3.946	4.852	6.690	10.220	12.527
1989	0.022	0.027	0.295	0.895	2.151	3.165	5.558	6.856	8.493	20.556
1990	0.007	0.095	0.440	0.937	1.735	3.635	5.746	7.937	10.270	18.459
1991	0.007	0.071	0.446	1.073	1.678	2.845	5.700	8.973	11.339	14.045
1992	0.011	0.029	0.469	1.194	2.001	2.549	4.593	8.809	10.373	14.483
1993	0.011	0.049	0.194	1.219	1.648	3.358	4.021	7.412	12.190	15.597
1994	0.009	0.042	0.243	0.947	2.175	2.488	5.180	6.481	11.244	11.418
1995	0.011	0.056	0.284	0.869	1.880	3.823	4.596	8.504	9.934	22.443
1996	0.021	0.064	0.382	1.340	1.674	2.840	6.110	8.834	12.844	16.153
1997	0.005	0.052	0.397	1.387	2.328	2.505	3.879	8.252	11.925	16.938
1998	0.001	0.059	0.263	1.350	2.129	3.355	3.454	5.614	10.435	16.676
1999	0.023	0.045	0.343	1.125	2.179	3.028	4.689	5.122	8.211	12.279
2000	0.009	0.120	0.460	1.031	2.170	3.353	4.677	5.449	7.811	12.732
2001	0.023	0.097	0.449	1.240	2.311	3.743	4.981	6.452	6.917	9.496
2002	0.011	0.088	0.450	1.013	2.148	3.104	5.210	6.461	7.817	12.477
2003	0.022	0.090	0.339	1.012	1.684	2.873	3.975	6.807	8.001	12.071
2004	0.010	0.066	0.371	0.916	2.008	2.556	4.192	5.958	8.733	14.157
2005	0.008	0.062	0.246	0.822	1.524	3.232	3.928	6.077	7.737	11.584
2006	0.046	0.088	0.305	0.789	1.809	2.365	4.095	5.096	7.023	11.956
2007	0.009	0.126	0.442	0.896	1.691	2.916	3.672	5.022	6.367	12.543
2008	0.049	0.089	0.405	1.074	1.801	2.728	3.788	5.179	6.050	13.371
2009	0.016	0.171	0.486	1.183	2.136	2.748	3.500	5.042	6.947	14.114
2010	0.006	0.108	0.544	1.102	2.165	2.988	3.444	4.393	7.143	11.530
2011	0.045	0.084	0.467	1.219	1.779	2.951	3.800	4.373	5.201	13.063
2012	0.000	0.157	0.461	1.046	1.917	2.440	3.597	4.663	5.142	9.906
2013	0.020	0.014	0.453	0.995	1.638	2.469	2.854	4.251	5.800	11.091
2014	0.006	0.138	0.591	0.985	1.482	2.033	2.871	3.241	5.489	8.122
2015	0.015	0.071	0.464	1.135	1.691	2.346	2.716	3.796	5.275	13.790
2016	0.002	0.068	0.373	0.871	1.728	2.317	3.757	3.824	5.329	10.089
2017	0.002	0.047	0.310	0.852	1.634	2.414	2.979	4.679	5.446	9.730
2018	0.002	0.056	0.414	1.002	1.625	2.546	3.185	3.767	7.010	11.307
2016-2018 average		0.057	0.365	0.908	1.662	2.426	3.307	4.090	5.928	10.375

Table 22. Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl survey and Massachusetts Division of Marine Fisheries (MADMF) spring bottom trawl survey indices for Gulf of Maine Atlantic cod from 1963 to 2019. *Note: the NEFSC spring survey did not begin until 1968 and 1978 for the MADMF spring survey, the 2019 fall survey has not been conducted at the time of this report. Model inputs include only years 1982 to 2018.*

Year	Abundance (numbers/tow)		Biomass (kg/tow)			
	NMFS spring	NMFS fall	MADMF spring	NMFS spring	NMFS fall	MADMF spring
1963		5.914			17.950	
1964		4.015			22.799	
1965		4.500			12.089	
1966		3.720			12.838	
1967		2.603			9.313	
1968	5.329	4.374		17.480	19.437	
1969	3.215	2.758		13.100	15.154	
1970	2.191	4.905		11.089	16.442	
1971	1.429	4.361		6.996	16.528	
1972	2.057	9.301		8.029	12.988	
1973	7.525	4.452		18.807	8.758	
1974	2.902	4.328		7.418	8.959	
1975	2.512	6.143		6.039	8.619	
1976	2.782	2.148		7.556	6.740	
1977	3.872	3.073		8.541	10.199	
1978	2.050	5.773	48.993	7.697	12.899	11.015
1979	3.644	3.142	96.559	7.555	13.927	14.276
1980	2.155	7.035	65.979	6.232	14.202	14.508
1981	4.832	2.349	69.406	10.650	7.533	18.688
1982	3.763	7.769	25.842	8.616	15.919	12.161
1983	3.912	2.786	54.873	10.962	8.416	18.746
1984	3.667	2.449	10.330	6.143	8.735	7.240
1985	2.517	2.821	8.455	7.645	8.264	4.765
1986	1.957	1.950	24.089	3.476	4.715	7.841
1987	1.083	2.996	17.206	1.976	3.394	7.865
1988	3.127	5.903	22.242	3.603	6.616	7.703
1989	2.112	4.553	52.244	2.424	4.535	17.346
1990	2.362	2.986	32.409	3.077	4.912	15.879
1991	2.393	1.252	13.639	2.891	2.782	8.730
1992	2.435	1.434	16.924	8.626	2.448	8.766
1993	2.507	1.232	92.659	5.875	1.002	5.861
1994	1.271	2.130	16.358	2.427	2.737	4.334
1995	1.930	2.008	23.364	2.432	3.665	3.993
1996	2.465	1.327	12.961	5.427	2.351	3.152
1997	2.192	0.872	17.887	5.616	1.872	2.500
1998	1.710	0.843	27.570	4.180	1.500	3.250
1999	2.301	1.807	161.058	5.089	3.505	8.997
2000	3.083	2.604	50.771	3.211	4.652	20.604
2001	2.147	1.980	41.844	6.215	7.324	26.445
2002	3.724	5.328	24.338	10.934	24.659	11.158
2003	3.677	2.529	1120.371	9.495	5.988	10.984
2004	0.981	3.533	131.589	2.412	4.906	8.147
2005	1.765	1.338	193.262	2.701	2.897	10.402
2006	1.363	3.594	1077.030	2.702	4.229	9.177
2007	12.393	1.992	61.576	15.811	2.714	8.430
2008	7.990	3.460	482.100	10.823	5.307	12.229
2009	1.535	3.441	480.516	3.234	5.776	4.489
2010	3.540	0.719	8.075	5.700	1.985	5.645
2011	0.894	0.996	59.064	2.133	2.667	4.519
2012	1.061	0.452	11.465	1.930	1.024	2.276
2013	0.909	0.587	2.314	1.678	1.068	0.953
2014	0.582	1.269	19.857	1.323	2.662	1.302
2015	4.088	0.376	4.790	8.017	1.282	1.193
2016	1.864	1.527	5.062	3.364	4.389	0.458
2017	1.264	0.942	105.903	3.740	3.262	1.440
2018	0.498	0.623	9.382	1.682	1.399	0.917
2019	0.186		337.900	0.566		1.084
Avg	2.764	3.023	122.341	6.257	7.552	8.321
Min	0.186	0.376	2.314	0.566	1.002	0.458
Max	12.393	9.301	1120.371	18.807	24.659	26.445

Table 23. Coefficients of variation (CV) for the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl survey and Massachusetts Division of Marine Fisheries (MADMF) spring bottom trawl survey indices for Gulf of Maine Atlantic cod from 1963 to 2019. *Note: the NEFSC spring survey did not begin until 1968 and 1978 for the MADMF spring survey, the 2019 fall survey has not been conducted at the time of this report. Model inputs include only years 1982 to 2018.*

Year	Abundance (numbers/tow)			Biomass (kg/tow)		
	NMFS spring	NMFS fall	MADMF spring	NMFS spring	NMFS fall	MADMF spring
1963		0.25			0.40	
1964		0.42			0.50	
1965		0.27			0.26	
1966		0.22			0.23	
1967		0.23			0.23	
1968	0.13	0.18		0.15	0.20	
1969	0.32	0.15		0.32	0.22	
1970	0.22	0.31		0.24	0.24	
1971	0.19	0.20		0.22	0.31	
1972	0.21	0.53		0.22	0.21	
1973	0.33	0.15		0.40	0.27	
1974	0.19	0.25		0.20	0.20	
1975	0.22	0.22		0.25	0.16	
1976	0.18	0.20		0.16	0.23	
1977	0.26	0.12		0.20	0.12	
1978	0.20	0.19	0.15	0.21	0.15	0.14
1979	0.24	0.12	0.29	0.18	0.13	0.23
1980	0.16	0.26	0.12	0.18	0.15	0.13
1981	0.20	0.23	0.20	0.20	0.23	0.28
1982	0.22	0.65	0.22	0.22	0.63	0.18
1983	0.26	0.17	0.16	0.22	0.19	0.16
1984	0.47	0.22	0.28	0.34	0.32	0.25
1985	0.21	0.18	0.21	0.22	0.36	0.18
1986	0.31	0.23	0.52	0.20	0.22	0.36
1987	0.26	0.29	0.21	0.31	0.23	0.28
1988	0.21	0.34	0.20	0.28	0.23	0.24
1989	0.19	0.22	0.26	0.21	0.17	0.33
1990	0.24	0.19	0.29	0.26	0.20	0.34
1991	0.25	0.25	0.20	0.25	0.26	0.12
1992	0.31	0.21	0.27	0.38	0.25	0.31
1993	0.23	0.25	0.35	0.33	0.25	0.29
1994	0.23	0.31	0.22	0.22	0.29	0.24
1995	0.28	0.30	0.26	0.27	0.32	0.24
1996	0.25	0.26	0.22	0.28	0.27	0.31
1997	0.17	0.30	0.23	0.19	0.29	0.25
1998	0.34	0.35	0.26	0.32	0.28	0.46
1999	0.25	0.18	0.37	0.32	0.20	0.26
2000	0.21	0.31	0.39	0.15	0.34	0.45
2001	0.30	0.25	0.43	0.31	0.28	0.56
2002	0.20	0.58	0.09	0.22	0.68	0.39
2003	0.21	0.31	0.49	0.37	0.25	0.22
2004	0.24	0.32	0.45	0.28	0.22	0.27
2005	0.24	0.06	0.23	0.26	0.22	0.20
2006	0.19	0.30	0.33	0.25	0.18	0.18
2007	0.66	0.38	0.27	0.55	0.29	0.25
2008	0.70	0.38	0.20	0.60	0.27	0.22
2009	0.30	0.53	0.36	0.31	0.44	0.19
2010	0.64	0.28	0.23	0.43	0.35	0.45
2011	0.28	0.31	0.55	0.20	0.34	0.44
2012	0.22	0.21	0.26	0.22	0.23	0.40
2013	0.28	0.26	0.26	0.29	0.25	0.31
2014	0.23	0.47	0.15	0.24	0.45	0.44
2015	0.35	0.27	0.27	0.32	0.27	0.21
2016	0.55	0.53	0.31	0.51	0.51	0.36
2017	0.21	0.28	0.41	0.17	0.30	0.32
2018	0.26	0.34	0.24	0.29	0.31	0.42
2019	0.39		0.43	0.31		0.35
Avg	0.28	0.28	0.28	0.27	0.28	0.29
Min	0.13	0.06	0.09	0.15	0.12	0.12
Max	0.70	0.65	0.55	0.60	0.63	0.56

Table 24. Northeast Fisheries Science Center (NEFSC) spring survey abundance indices-at-age (numbers/tow) from 1970 to 2019 for Gulf of Maine Atlantic cod. *Note: age data are not available prior to 1970. Model inputs include only years 1982 to 2018.*

Year	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16	Age17	Age18
1970	0.000	0.159	0.124	0.053	0.089	0.314	0.453	0.601	0.058	0.054	0.083	0.130	0.053	0.000	0.020	0.000	0.000	0.000	0.000
1971	0.000	0.055	0.110	0.113	0.268	0.090	0.106	0.287	0.185	0.158	0.039	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1972	0.000	0.353	0.153	0.508	0.198	0.205	0.053	0.083	0.119	0.290	0.029	0.021	0.029	0.000	0.017	0.000	0.000	0.000	0.000
1973	0.000	0.000	4.326	0.942	0.615	0.344	0.162	0.116	0.172	0.274	0.190	0.072	0.113	0.112	0.089	0.000	0.000	0.000	0.000
1974	0.000	0.476	0.081	1.534	0.177	0.223	0.085	0.000	0.068	0.040	0.053	0.044	0.057	0.000	0.030	0.000	0.036	0.000	0.000
1975	0.006	0.086	0.674	0.121	1.206	0.193	0.066	0.000	0.010	0.025	0.028	0.035	0.062	0.000	0.000	0.000	0.000	0.000	0.000
1976	0.000	0.032	0.272	1.127	0.135	0.900	0.105	0.066	0.043	0.000	0.009	0.000	0.028	0.065	0.000	0.000	0.000	0.000	0.000
1977	0.000	0.029	0.274	0.475	1.984	0.146	0.800	0.000	0.126	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.006	0.000
1978	0.000	0.050	0.067	0.322	0.403	0.732	0.093	0.239	0.014	0.109	0.000	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1979	0.000	0.470	1.407	0.186	0.473	0.308	0.536	0.095	0.105	0.013	0.051	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1980	0.000	0.107	0.417	0.527	0.122	0.230	0.269	0.353	0.000	0.113	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1981	0.000	1.089	0.621	0.850	1.326	0.327	0.303	0.080	0.138	0.098	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1982	0.000	0.372	0.991	0.555	0.705	0.869	0.088	0.118	0.000	0.056	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1983	0.013	0.610	0.968	1.042	0.456	0.329	0.254	0.061	0.000	0.079	0.020	0.021	0.045	0.000	0.016	0.000	0.000	0.000	0.000
1984	0.000	0.151	1.263	1.012	0.850	0.244	0.052	0.097	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1985	0.000	0.029	0.248	0.665	0.613	0.707	0.108	0.092	0.053	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1986	0.000	0.537	0.259	0.768	0.203	0.082	0.051	0.039	0.000	0.000	0.000	0.000	0.018	0.000	0.000	0.000	0.000	0.000	0.000
1987	0.000	0.030	0.471	0.191	0.216	0.078	0.000	0.070	0.012	0.000	0.000	0.000	0.000	0.000	0.015	0.000	0.000	0.000	0.000
1988	0.000	0.781	0.893	0.796	0.266	0.229	0.088	0.045	0.000	0.030	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1989	0.000	0.017	0.618	0.710	0.632	0.061	0.076	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1990	0.000	0.000	0.237	1.335	0.666	0.071	0.024	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1991	0.000	0.027	0.078	0.236	1.747	0.243	0.043	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1992	0.000	0.050	0.247	0.225	0.254	1.360	0.214	0.074	0.000	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1993	0.000	0.191	0.521	0.809	0.354	0.088	0.444	0.056	0.045	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1994	0.000	0.016	0.316	0.406	0.203	0.085	0.054	0.136	0.011	0.028	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995	0.000	0.038	0.170	1.155	0.346	0.146	0.063	0.000	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996	0.000	0.057	0.022	0.586	1.355	0.385	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997	0.000	0.159	0.139	0.390	0.271	0.874	0.244	0.115	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1998	0.000	0.018	0.228	0.364	0.503	0.146	0.396	0.025	0.030	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1999	0.000	0.166	0.342	0.731	0.344	0.299	0.136	0.271	0.000	0.000	0.000	0.000	0.000	0.011	0.000	0.000	0.000	0.000	0.000
2000	0.026	1.173	0.737	0.438	0.485	0.099	0.092	0.011	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2001	0.000	0.029	0.340	0.683	0.522	0.345	0.065	0.097	0.055	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2002	0.000	0.340	0.045	0.559	1.571	0.608	0.342	0.185	0.057	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2003	0.000	0.075	0.825	0.059	0.719	1.082	0.397	0.308	0.087	0.086	0.031	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2004	0.000	0.136	0.045	0.230	0.116	0.209	0.213	0.011	0.011	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005	0.000	0.029	0.739	0.082	0.619	0.012	0.140	0.129	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006	0.000	0.212	0.237	0.434	0.049	0.197	0.024	0.126	0.069	0.000	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	0.000	0.099	3.423	3.077	4.452	0.443	0.782	0.076	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008	0.000	0.079	1.165	3.930	1.582	1.099	0.053	0.081	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	0.000	0.065	0.195	0.364	0.420	0.263	0.198	0.010	0.018	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2010	0.000	0.069	1.352	1.149	0.407	0.322	0.155	0.043	0.016	0.010	0.005	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000
2011	0.000	0.005	0.024	0.140	0.383	0.189	0.086	0.033	0.035	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2012	0.001	0.086	0.137	0.261	0.288	0.186	0.061	0.034	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2013	0.000	0.012	0.283	0.224	0.162	0.165	0.044	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2014	0.000	0.006	0.022	0.090	0.253	0.129	0.035	0.034	0.000	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2015	0.000	0.031	0.826	1.118	1.748	0.262	0.077	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2016	0.000	0.060	0.130	1.237	0.199	0.221	0.005	0.006	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2017	0.000	0.004	0.031	0.171	0.478	0.301	0.259	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2018	0.000	0.025	0.018	0.006	0.108	0.278	0.032	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2019	0.033	0.000	0.000	0.000	0.000	0.000	0.153	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 25. Northeast Fisheries Science Center (NEFSC) fall survey abundance indices-at-age (numbers/tow) from 1970 to 2018 for Gulf of Maine Atlantic cod. *Note: age data are not available prior to 1970. Model inputs include only years 1982 to 2018.*

Year	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16	Age17	Age18
1970	0.000	1.686	0.265	0.505	0.340	0.491	0.428	0.823	0.131	0.090	0.037	0.037	0.073	0.000	0.000	0.000	0.000	0.000	0.000
1971	1.322	0.210	0.223	0.189	0.614	0.428	0.510	0.214	0.294	0.202	0.061	0.041	0.054	0.000	0.000	0.000	0.000	0.000	0.000
1972	0.000	5.695	1.119	1.587	0.187	0.074	0.097	0.035	0.121	0.371	0.000	0.000	0.000	0.000	0.016	0.000	0.000	0.000	0.000
1973	0.766	0.196	2.147	0.184	0.532	0.189	0.060	0.021	0.042	0.167	0.133	0.000	0.000	0.017	0.000	0.000	0.000	0.000	0.000
1974	0.283	1.113	0.262	1.952	0.106	0.267	0.000	0.032	0.051	0.053	0.000	0.145	0.000	0.000	0.063	0.000	0.000	0.000	0.000
1975	0.000	0.199	3.066	0.136	2.348	0.252	0.106	0.020	0.000	0.000	0.000	0.006	0.009	0.000	0.000	0.000	0.000	0.000	0.000
1976	0.000	0.209	0.216	0.590	0.107	0.822	0.051	0.123	0.000	0.000	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1977	0.000	0.061	0.420	0.463	1.157	0.139	0.602	0.026	0.076	0.022	0.052	0.000	0.023	0.031	0.000	0.000	0.000	0.000	0.000
1978	0.241	1.411	0.360	1.148	0.662	1.445	0.105	0.261	0.008	0.094	0.000	0.022	0.000	0.017	0.000	0.000	0.000	0.000	0.000
1979	0.000	0.377	0.604	0.131	0.697	0.325	0.754	0.041	0.145	0.000	0.052	0.000	0.000	0.000	0.005	0.013	0.000	0.000	0.000
1980	0.027	1.329	2.536	1.680	0.514	0.273	0.355	0.206	0.026	0.013	0.000	0.040	0.000	0.014	0.000	0.000	0.022	0.000	0.000
1981	0.010	0.585	0.401	0.482	0.509	0.094	0.108	0.043	0.088	0.000	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1982	0.000	0.834	3.244	2.458	1.009	0.224	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1983	0.000	0.306	0.914	0.811	0.226	0.228	0.219	0.000	0.000	0.000	0.018	0.028	0.037	0.000	0.000	0.000	0.000	0.000	0.000
1984	0.000	0.513	0.418	0.586	0.400	0.196	0.173	0.067	0.000	0.016	0.000	0.000	0.045	0.035	0.000	0.000	0.000	0.000	0.000
1985	0.164	0.503	0.914	0.630	0.215	0.223	0.070	0.000	0.042	0.062	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1986	0.000	0.393	0.405	0.644	0.350	0.068	0.048	0.000	0.000	0.044	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1987	0.129	0.570	1.388	0.595	0.203	0.112	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1988	0.000	1.889	2.366	1.070	0.351	0.162	0.000	0.064	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1989	0.000	0.137	2.476	1.458	0.281	0.147	0.054	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1990	0.000	0.057	0.218	1.797	0.582	0.285	0.034	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1991	0.009	0.149	0.146	0.231	0.634	0.062	0.000	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1992	0.059	0.289	0.449	0.145	0.044	0.322	0.126	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1993	0.042	0.199	0.578	0.358	0.017	0.000	0.038	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1994	0.032	0.183	0.909	0.825	0.085	0.051	0.000	0.045	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995	0.009	0.067	0.308	1.226	0.304	0.082	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996	0.029	0.122	0.379	0.232	0.516	0.050	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997	0.000	0.297	0.096	0.159	0.169	0.151	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1998	0.050	0.092	0.335	0.110	0.185	0.041	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1999	0.025	0.432	0.375	0.590	0.244	0.127	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2000	0.008	0.540	0.981	0.399	0.490	0.142	0.012	0.000	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2001	0.018	0.000	0.143	0.767	0.489	0.333	0.127	0.080	0.000	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2002	0.000	0.269	0.104	0.319	2.696	1.084	0.724	0.087	0.046	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2003	0.542	0.461	0.186	0.217	0.512	0.455	0.071	0.062	0.000	0.011	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2004	1.369	0.659	0.166	0.570	0.264	0.255	0.162	0.056	0.013	0.010	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005	0.034	0.153	0.378	0.078	0.455	0.023	0.090	0.082	0.023	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006	0.064	1.240	0.599	1.008	0.254	0.290	0.037	0.053	0.034	0.000	0.000	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	0.016	0.131	0.863	0.395	0.497	0.023	0.067	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008	0.165	0.658	1.219	1.060	0.188	0.139	0.000	0.000	0.000	0.010	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	0.022	0.666	2.105	0.301	0.266	0.039	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2010	0.004	0.091	0.122	0.195	0.203	0.077	0.011	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.000	0.000	0.000	0.000
2011	0.036	0.060	0.093	0.210	0.304	0.179	0.078	0.005	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2012	0.000	0.079	0.087	0.135	0.092	0.032	0.011	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2013	0.011	0.020	0.243	0.221	0.064	0.014	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2014	0.000	0.385	0.344	0.331	0.177	0.016	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2015	0.000	0.004	0.123	0.060	0.128	0.055	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2016	0.003	0.000	0.059	1.007	0.199	0.224	0.031	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2017	0.000	0.000	0.058	0.170	0.574	0.092	0.048	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2018	0.000	0.186	0.085	0.102	0.107	0.136	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 26. Massachusetts Division of Marine Fisheries (MADMF) spring survey abundance indices-at-age (numbers/tow) from 1982 to 2019 for Gulf of Maine Atlantic cod. *Note that age data are not available prior to 1982. Model inputs include only years 1982 to 2018.*

Year	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16	Age17	Age18
1982	1.691	13.194	6.624	2.935	1.045	0.225	0.027	0.051	0.050	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1983	0.718	30.256	17.620	4.576	0.452	1.108	0.075	0.035	0.033	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1984	0.257	1.975	5.016	2.093	0.778	0.087	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1985	1.569	1.656	2.719	1.990	0.522	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1986	1.075	17.889	3.547	0.889	0.543	0.123	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1987	0.725	8.644	5.330	2.074	0.170	0.140	0.053	0.000	0.000	0.070	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1988	1.909	10.194	6.952	1.961	1.176	0.000	0.049	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1989	0.265	21.496	22.947	6.876	0.501	0.126	0.034	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1990	4.942	5.370	5.012	14.718	2.147	0.220	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1991	0.355	5.335	2.278	1.792	3.690	0.249	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1992	1.506	4.390	5.686	3.448	0.484	1.301	0.066	0.044	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1993	80.115	2.811	6.122	2.554	0.813	0.170	0.074	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1994	4.627	5.405	3.883	1.704	0.630	0.108	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995	12.000	5.955	2.447	2.407	0.520	0.034	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996	8.844	0.775	0.498	0.955	1.590	0.299	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997	12.445	2.896	1.035	0.920	0.190	0.384	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1998	23.481	1.492	0.919	0.779	0.637	0.034	0.211	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1999	143.000	11.832	2.407	2.275	0.735	0.631	0.036	0.127	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2000	2.151	35.360	6.995	2.371	2.319	0.789	0.643	0.063	0.082	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2001	25.987	0.084	4.998	4.717	3.464	1.868	0.356	0.252	0.117	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2002	0.924	19.340	0.220	1.379	1.146	0.561	0.319	0.111	0.253	0.025	0.049	0.000	0.012	0.000	0.000	0.000	0.000	0.000	0.000
2003	1094.143	17.060	5.507	0.439	1.943	0.923	0.226	0.077	0.015	0.025	0.000	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2004	116.149	8.914	1.881	2.631	0.375	1.028	0.488	0.080	0.030	0.000	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005	179.479	5.524	4.129	0.802	1.961	0.263	0.664	0.243	0.094	0.105	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006	1053.701	9.992	7.139	3.930	0.526	1.530	0.110	0.058	0.000	0.017	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	49.323	3.776	3.078	2.303	2.163	0.343	0.519	0.025	0.046	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008	456.954	7.275	10.336	3.242	2.288	1.695	0.155	0.155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	466.098	8.907	2.351	1.654	1.046	0.348	0.112	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2010	1.165	2.418	1.390	1.426	0.816	0.678	0.133	0.000	0.000	0.000	0.050	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2011	55.378	0.326	1.001	0.621	0.933	0.559	0.139	0.086	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2012	6.240	3.368	0.671	0.446	0.304	0.415	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2013	1.254	0.284	0.237	0.145	0.232	0.162	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2014	17.764	1.034	0.250	0.573	0.131	0.055	0.034	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2015	3.454	0.360	0.297	0.288	0.285	0.023	0.000	0.084	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2016	4.659	0.000	0.068	0.260	0.033	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2017	105.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2018	8.326	0.384	0.243	0.209	0.124	0.064	0.000	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2019	336.407	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 27. Maine-New Hampshire spring and fall inshore bottom trawl survey indices and coefficients of variation (CV) for Gulf of Maine Atlantic cod from 2000 to 2018. Includes regions 1 through 5 and depth strata 1 through 4. The fall 2000- 2002 and spring 2001-2002 indices were calculated using only three depth strata - a fourth depth stratum was added to the survey in 2003. Fixed stations have not been included in the calculation of the indices. *Data courtesy of R. Peters, ME DMR. Note that the ME NH survey is not used as an input to the assessment model.*

Year	Spring				Fall			
	Biomass (kg/tow)	CV	Abundance (numbers/tow)	CV	Biomass (kg/tow)	CV	Abundance (numbers/tow)	CV
2000					1.32	1.48	4.04	1.18
2001	0.32	0.63	2.19	0.51	0.18	0.57	2.86	0.59
2002	2.29	0.73	5.70	0.91	0.31	0.64	0.87	0.48
2003	0.94	0.53	1.23	0.43	1.63	0.32	3.54	0.40
2004	0.63	0.55	6.31	0.57	1.00	0.59	2.78	0.72
2005	2.21	1.29	5.51	0.90	2.16	1.23	3.88	0.81
2006	0.76	1.20	1.24	0.59	1.83	1.28	3.33	1.13
2007	1.01	0.37	2.26	0.64	1.77	1.26	2.33	1.23
2008	1.49	0.90	3.37	0.97	0.52	0.76	1.09	0.63
2009	2.24	0.74	2.52	0.58	0.50	0.17	1.16	0.48
2010	1.42	0.78	1.78	0.52	0.70	0.44	0.67	0.35
2011	0.56	0.56	1.63	1.11	0.44	0.76	1.06	0.37
2012	0.67	0.50	1.87	0.64	0.16	0.59	0.29	0.54
2013	0.13	0.75	0.24	0.96	0.11	0.80	0.13	0.55
2014	0.57	0.51	4.61	0.96	0.09	1.02	0.44	0.45
2015	0.08	0.64	0.94	0.57	0.07	0.67	1.27	0.21
2016	0.20	0.56	1.44	0.43	0.19	1.01	0.30	0.96
2017	0.89	1.96	1.00	1.24	0.61	1.77	1.19	0.80
2018	0.21	0.99	0.92	0.40	0.12	1.49	0.35	1.09

Table 28. Summary of Gulf of Maine Atlantic cod ASAP model diagnostics and terminal estimates from the M=0.2 and M-ramp models. See NEFSC (2013) for a full description of model configurations - no changes have been made to the model configurations as part of the 2019 Update.

Model		M=0.2	M-ramp
Description		M=0.2	M=0.2 (1982-1988), linear ramp (1989-2002), M=0.4 (2003-2018)
Maximum gradient (<i>conv. criteria < 1e-4</i>)		3.73E-04	1.87E-04
Number of parameters		107	107
Objective function		6716	6703
Components of objective function	Recruit devs	7	3
	Survey age comps	2261	2260
	Catch age comps	4557	4559
	Index fit	1	-9
	Catch fit	-110	-110
RMSE	Catch	0.23	0.16
	NEFSC spring	1.35	1.21
	NEFSC fall	1.07	1.06
	MADMF spring	1.37	1.33
	Index total	1.27	1.20
	Recruit devs	1.85	1.54
SSB ₁₉₈₂ (mt)		25,323	24,652
SSB ₂₀₁₈ (mt)		3,752	3,838
F _{mult, 2018}		0.188	0.198
Median recruitment ₁₉₈₂₋₂₀₁₆ (000s)		4,629	9,185
Geometric mean recruitment ₂₀₁₄₋₂₀₁₈ (000s)		1,654	2,978
Mohn's rho (7 year peel)	SSB	0.52	0.29
	F _{mult}	-0.29	-0.16
	Age 1 N	0.03	-0.18
Survey catchability (q)	NEFSC spring	0.98 (0.16)	0.86 (0.16)
	NEFSC fall	0.54 (0.22)	0.47 (0.14)
	MADMF spring	0.17 (0.11)	0.11 (0.10)

Table 29. Comparison of the fleet and index selectivity parameters and the corresponding coefficients of variation (CV) from the Gulf of Maine Atlantic cod M=0.2 and M-ramp models. *Ages where CV values are null are fixed parameters within the model (see NEFSC 2013 for a full description of selectivity assumptions).*

Block/survey	Parameter	M=0.2		M-ramp	
		Value	CV	Value	CV
Block 1 (1982-1988)	A ₅₀	2.32	0.04	2.33	0.04
	slope up	0.44	0.09	0.44	0.09
Block 2 (1989 - 2004)	A ₅₀	3.29	0.02	3.32	0.02
	slope up	0.53	0.05	0.51	0.05
Block 3 (2005-2018)	A ₅₀	3.60	0.03	3.65	0.03
	slope up	0.60	0.05	0.56	0.05
NEFSC spring	Age1	0.04	0.23	0.03	0.23
	Age2	0.13	0.18	0.11	0.18
	Age3	0.29	0.17	0.26	0.17
	Age4	0.53	0.17	0.51	0.17
	Age5	0.78	0.18	0.77	0.17
	Age6	1.00		1.00	
	Age7	1.00		1.00	
	Age8	1.00		1.00	
	Age9 ⁺	1.00		1.00	
NEFSC fall	Age1	0.16	0.24	0.12	0.17
	Age2	0.36	0.23	0.31	0.16
	Age3	0.60	0.23	0.56	0.16
	Age4	0.90	0.23	0.87	0.16
	Age5	1.00	0.25	1.00	0.01
	Age6	1.00		1.00	
	Age7	1.00		1.00	
	Age8	1.00		1.00	
	Age9 ⁺	1.00		1.00	
MADMF spring	Age1	1.00		1.00	
	Age2	0.72	0.14	0.81	0.14
	Age3	0.74	0.16	0.92	0.15
	Age4	0.77	0.20	1.00	0.01
	Age5	0.75	0.29	1.00	0.00
	Age6	0.56	0.56	0.77	0.56
Survey catchability (q)	NEFSC spring	0.98	0.16	0.86	0.16
	NEFSC fall	0.54	0.22	0.47	0.14
	MADMF spring	0.17	0.11	0.11	0.1

Table 30. Gulf of Maine Atlantic cod January 1 biomass and spawning stock biomass from 1982 to 2018 as estimated from the M=0.2 and M-ramp models.

Year	M=0.2		M-ramp	
	January 1 biomass (mt)	Spawning stock biomass (mt)	January 1 biomass (mt)	Spawning stock biomass (mt)
1982	41,669	25,323	41,131	24,652
1983	32,253	19,707	31,918	19,234
1984	26,892	16,703	26,708	16,353
1985	25,895	15,548	25,823	15,293
1986	23,824	14,134	23,801	13,940
1987	22,894	13,511	22,951	13,400
1988	22,771	13,819	23,094	13,900
1989	30,250	18,070	31,373	18,518
1990	36,660	22,925	38,647	23,921
1991	29,178	18,902	30,910	19,820
1992	20,231	12,117	21,798	12,835
1993	15,317	8,655	16,969	9,401
1994	13,740	7,859	15,845	8,932
1995	13,590	8,667	16,352	10,302
1996	13,595	8,915	17,073	11,038
1997	11,992	7,954	16,005	10,419
1998	10,826	7,260	15,352	10,062
1999	11,820	8,053	17,860	11,650
2000	16,453	10,506	25,574	15,381
2001	20,131	13,742	31,016	20,529
2002	18,704	13,921	28,749	20,660
2003	15,995	11,869	23,900	17,025
2004	15,085	10,886	22,102	15,268
2005	12,926	8,913	18,684	12,397
2006	11,855	8,114	17,944	11,479
2007	15,542	10,354	22,798	14,043
2008	17,627	11,824	24,345	15,440
2009	18,281	12,189	24,534	15,548
2010	15,273	10,262	19,568	12,606
2011	10,760	6,723	13,212	8,009
2012	6,119	3,524	7,733	4,221
2013	3,540	1,874	4,599	2,361
2014	2,676	1,263	4,063	1,809
2015	2,550	1,439	4,135	2,164
2016	3,329	2,258	4,714	3,023
2017	4,023	3,051	5,021	3,593
2018	4,915	3,752	5,497	3,838

Table 31. Gulf of Maine Atlantic cod fishing mortality-at-age from 1982 to 2018 as estimated from the $M = 0.2$ model.

Year	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9 ⁺	F _{fall}
1982	0.032	0.221	0.560	0.665	0.679	0.680	0.680	0.680	0.680	0.680
1983	0.039	0.270	0.685	0.813	0.829	0.831	0.831	0.831	0.831	0.831
1984	0.035	0.240	0.609	0.724	0.738	0.740	0.740	0.740	0.740	0.740
1985	0.046	0.314	0.797	0.946	0.965	0.967	0.967	0.967	0.967	0.967
1986	0.039	0.272	0.689	0.819	0.835	0.837	0.837	0.837	0.837	0.837
1987	0.040	0.277	0.702	0.835	0.851	0.853	0.853	0.853	0.853	0.853
1988	0.031	0.213	0.540	0.641	0.654	0.655	0.655	0.655	0.656	0.655
1989	0.013	0.079	0.353	0.757	0.919	0.950	0.955	0.956	0.956	0.956
1990	0.016	0.099	0.441	0.945	1.147	1.186	1.192	1.193	1.193	1.193
1991	0.017	0.100	0.447	0.959	1.164	1.204	1.210	1.211	1.211	1.211
1992	0.018	0.109	0.485	1.039	1.261	1.304	1.311	1.312	1.312	1.312
1993	0.022	0.133	0.591	1.268	1.539	1.591	1.600	1.601	1.601	1.601
1994	0.020	0.121	0.538	1.152	1.399	1.447	1.455	1.456	1.456	1.456
1995	0.014	0.087	0.390	0.835	1.014	1.049	1.054	1.055	1.055	1.055
1996	0.014	0.082	0.366	0.784	0.952	0.985	0.990	0.991	0.991	0.991
1997	0.012	0.071	0.319	0.683	0.829	0.858	0.862	0.863	0.863	0.863
1998	0.010	0.063	0.281	0.603	0.732	0.757	0.761	0.762	0.762	0.762
1999	0.007	0.043	0.194	0.415	0.504	0.521	0.524	0.524	0.524	0.524
2000	0.009	0.052	0.231	0.495	0.601	0.621	0.624	0.625	0.625	0.625
2001	0.009	0.055	0.246	0.528	0.640	0.662	0.666	0.666	0.666	0.666
2002	0.007	0.044	0.196	0.421	0.511	0.528	0.531	0.531	0.532	0.531
2003	0.008	0.046	0.206	0.442	0.537	0.555	0.558	0.559	0.559	0.559
2004	0.009	0.054	0.239	0.513	0.622	0.643	0.647	0.647	0.647	0.647
2005	0.012	0.058	0.238	0.583	0.802	0.864	0.876	0.879	0.879	0.879
2006	0.008	0.038	0.158	0.386	0.532	0.572	0.581	0.582	0.583	0.582
2007	0.008	0.041	0.167	0.409	0.563	0.606	0.615	0.617	0.617	0.617
2008	0.011	0.054	0.223	0.546	0.752	0.809	0.821	0.823	0.824	0.823
2009	0.012	0.061	0.253	0.619	0.852	0.917	0.931	0.934	0.934	0.934
2010	0.014	0.068	0.282	0.691	0.951	1.024	1.039	1.042	1.043	1.042
2011	0.020	0.099	0.407	0.997	1.373	1.478	1.500	1.504	1.505	1.504
2012	0.022	0.111	0.458	1.120	1.542	1.661	1.685	1.690	1.691	1.690
2013	0.029	0.143	0.590	1.444	1.988	2.140	2.172	2.178	2.179	2.178
2014	0.029	0.146	0.602	1.474	2.029	2.185	2.217	2.224	2.225	2.224
2015	0.005	0.024	0.100	0.245	0.338	0.364	0.369	0.370	0.370	0.370
2016	0.006	0.030	0.124	0.304	0.419	0.451	0.458	0.459	0.459	0.459
2017	0.006	0.028	0.114	0.278	0.383	0.412	0.418	0.419	0.419	0.419
2018	0.002	0.012	0.051	0.125	0.172	0.185	0.188	0.188	0.188	0.188

Table 32. Gulf of Maine Atlantic cod fishing mortality-at-age from 1982 to 2018 as estimated from the M-ramp model.

Model	Year	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9 ⁺	F _{full}
M-ramp	1982	0.032	0.224	0.576	0.685	0.698	0.700	0.700	0.700	0.700	0.700
M-ramp	1983	0.039	0.274	0.703	0.836	0.853	0.855	0.855	0.855	0.855	0.855
M-ramp	1984	0.035	0.244	0.626	0.744	0.759	0.760	0.760	0.761	0.761	0.761
M-ramp	1985	0.046	0.319	0.819	0.974	0.993	0.995	0.995	0.995	0.995	0.995
M-ramp	1986	0.039	0.275	0.705	0.838	0.854	0.856	0.856	0.856	0.856	0.856
M-ramp	1987	0.040	0.278	0.714	0.850	0.866	0.868	0.868	0.868	0.868	0.868
M-ramp	1988	0.030	0.210	0.539	0.641	0.653	0.655	0.655	0.655	0.655	0.655
M-ramp	1989	0.010	0.068	0.339	0.771	0.940	0.970	0.974	0.975	0.975	0.975
M-ramp	1990	0.013	0.084	0.417	0.948	1.156	1.192	1.198	1.198	1.199	1.198
M-ramp	1991	0.012	0.083	0.412	0.937	1.142	1.178	1.183	1.184	1.184	1.184
M-ramp	1992	0.013	0.090	0.446	1.013	1.234	1.273	1.279	1.280	1.280	1.280
M-ramp	1993	0.016	0.108	0.538	1.222	1.488	1.536	1.543	1.544	1.544	1.544
M-ramp	1994	0.014	0.093	0.464	1.055	1.285	1.326	1.332	1.333	1.333	1.333
M-ramp	1995	0.010	0.064	0.319	0.726	0.884	0.912	0.916	0.917	0.917	0.917
M-ramp	1996	0.009	0.057	0.284	0.646	0.787	0.812	0.816	0.816	0.816	0.816
M-ramp	1997	0.007	0.047	0.234	0.531	0.647	0.668	0.671	0.671	0.671	0.671
M-ramp	1998	0.006	0.039	0.195	0.443	0.540	0.557	0.559	0.560	0.560	0.560
M-ramp	1999	0.004	0.026	0.131	0.297	0.361	0.373	0.375	0.375	0.375	0.375
M-ramp	2000	0.005	0.031	0.154	0.351	0.427	0.441	0.443	0.443	0.443	0.443
M-ramp	2001	0.005	0.032	0.160	0.364	0.443	0.457	0.459	0.459	0.460	0.459
M-ramp	2002	0.004	0.025	0.126	0.287	0.350	0.361	0.362	0.363	0.363	0.363
M-ramp	2003	0.004	0.027	0.137	0.311	0.379	0.391	0.392	0.393	0.393	0.393
M-ramp	2004	0.005	0.033	0.164	0.372	0.453	0.468	0.470	0.470	0.470	0.470
M-ramp	2005	0.006	0.033	0.156	0.420	0.591	0.635	0.644	0.645	0.645	0.645
M-ramp	2006	0.004	0.022	0.105	0.284	0.399	0.429	0.435	0.435	0.436	0.435
M-ramp	2007	0.004	0.025	0.116	0.314	0.442	0.475	0.481	0.482	0.482	0.482
M-ramp	2008	0.006	0.034	0.160	0.433	0.610	0.656	0.664	0.665	0.666	0.665
M-ramp	2009	0.007	0.039	0.186	0.502	0.706	0.759	0.769	0.770	0.771	0.770
M-ramp	2010	0.008	0.045	0.214	0.578	0.813	0.874	0.885	0.887	0.887	0.887
M-ramp	2011	0.012	0.067	0.315	0.852	1.199	1.288	1.305	1.308	1.308	1.308
M-ramp	2012	0.013	0.076	0.357	0.965	1.359	1.460	1.478	1.482	1.482	1.482
M-ramp	2013	0.017	0.095	0.448	1.211	1.704	1.831	1.855	1.859	1.859	1.859
M-ramp	2014	0.015	0.086	0.402	1.087	1.530	1.644	1.665	1.669	1.669	1.669
M-ramp	2015	0.002	0.014	0.065	0.176	0.247	0.266	0.269	0.270	0.270	0.270
M-ramp	2016	0.003	0.019	0.090	0.244	0.343	0.369	0.373	0.374	0.374	0.374
M-ramp	2017	0.003	0.019	0.091	0.247	0.347	0.373	0.378	0.379	0.379	0.379
M-ramp	2018	0.002	0.010	0.048	0.129	0.182	0.195	0.198	0.198	0.198	0.198

Table 33. Gulf of Maine Atlantic cod January 1 numbers-at-age (000s) from 1982 to 2018 as estimated from the M = 0.2 model. Recruitment summary statistics reported (i.e., median and geometric mean) are provided for various time periods relevant to reference point determination and stock projections.

Year	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9+	Total
1982	12,110	13,265	5,474	3,156	1,870	173	233	159	263	36,702
1983	13,486	9,602	8,708	2,560	1,328	777	72	97	175	36,804
1984	13,651	10,617	6,002	3,596	929	475	277	26	97	35,669
1985	10,391	10,793	6,837	2,672	1,428	364	185	108	48	32,825
1986	16,226	8,128	6,455	2,524	849	445	113	58	49	34,847
1987	16,848	12,770	5,071	2,653	911	302	158	40	38	38,790
1988	30,234	13,250	7,926	2,057	943	318	105	55	27	54,915
1989	4,527	24,000	8,768	3,782	887	401	135	45	35	42,580
1990	4,629	3,658	18,152	5,043	1,453	290	127	43	25	33,418
1991	8,321	3,728	2,713	9,564	1,605	378	72	32	17	26,430
1992	8,306	6,700	2,761	1,420	3,002	410	93	18	12	22,723
1993	10,593	6,679	4,921	1,392	411	697	91	20	6	24,811
1994	3,499	8,484	4,789	2,230	321	72	116	15	4	19,531
1995	3,786	2,808	6,157	2,290	577	65	14	22	4	15,722
1996	3,111	3,055	2,107	3,414	813	171	19	4	7	12,701
1997	5,080	2,513	2,304	1,196	1,276	257	52	6	3	12,687
1998	4,474	4,110	1,915	1,371	495	456	89	18	3	12,932
1999	8,769	3,625	3,159	1,183	614	195	175	34	8	17,762
2000	5,106	7,128	2,841	2,131	640	304	95	85	20	18,350
2001	1,316	4,145	5,541	1,847	1,064	287	134	42	46	14,422
2002	5,761	1,068	3,211	3,547	892	459	121	56	37	15,152
2003	2,064	4,682	836	2,160	1,907	438	222	58	45	12,413
2004	6,695	1,677	3,660	557	1,137	913	206	104	48	14,997
2005	4,097	5,433	1,302	2,359	273	500	393	88	65	14,509
2006	6,912	3,316	4,198	840	1,079	100	172	134	52	16,804
2007	5,430	5,616	2,613	2,936	467	519	46	79	85	17,792
2008	4,118	4,410	4,415	1,810	1,596	218	232	20	72	16,893
2009	2,736	3,336	3,421	2,892	858	616	79	83	33	14,056
2010	1,711	2,213	2,568	2,175	1,275	300	202	26	38	10,507
2011	1,645	1,382	1,692	1,586	892	403	88	58	18	7,765
2012	1,682	1,321	1,025	922	479	185	75	16	14	5,718
2013	788	1,347	968	531	246	84	29	11	5	4,008
2014	2,702	627	956	439	103	28	8	3	1	4,866
2015	1,184	2,148	443	428	82	11	3	1	0	4,302
2016	758	965	1,717	328	274	48	6	1	1	4,099
2017	1,845	617	767	1,241	198	148	25	3	1	4,845
2018	2,767	1,503	491	560	770	111	80	14	2	6,298
1982-2016 median	4,629									
2014-2018 geomean	1,654									

Table 34. Gulf of Maine Atlantic cod January 1 numbers-at-age (000s) from 1982 to 2018 as estimated from the M-ramp model. Recruitment summary statistics reported (i.e., median and geometric mean) are provided for various time periods relevant to reference point determination and stock projections.

Year	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9+	Total
1982	12,519	13,460	5,509	3,133	1,822	167	221	150	245	37,227
1983	13,977	9,926	8,805	2,536	1,293	742	68	90	161	37,598
1984	14,055	11,003	6,178	3,568	900	451	258	24	87	36,525
1985	10,786	11,113	7,059	2,705	1,388	345	173	99	42	33,710
1986	16,632	8,437	6,612	2,548	836	421	104	52	43	35,686
1987	17,663	13,093	5,248	2,676	902	291	146	36	33	40,089
1988	32,593	13,897	8,114	2,104	937	311	100	50	24	58,129
1989	5,051	25,896	9,222	3,876	907	399	132	43	32	45,558
1990	5,418	4,053	19,607	5,324	1,453	287	123	40	23	36,327
1991	10,072	4,251	2,961	10,263	1,638	363	69	29	15	29,663
1992	10,662	7,825	3,078	1,542	3,163	412	88	17	11	26,798
1993	14,684	8,193	5,572	1,535	436	717	90	19	6	31,252
1994	5,258	11,030	5,614	2,485	345	75	118	15	4	24,943
1995	6,218	3,918	7,594	2,667	654	72	15	24	4	21,165
1996	5,585	4,608	2,750	4,129	966	202	22	5	8	18,274
1997	9,778	4,061	3,192	1,518	1,587	322	66	7	4	20,535
1998	9,105	7,050	2,814	1,835	648	603	120	24	4	22,204
1999	19,042	6,508	4,874	1,665	847	272	249	49	12	33,516
2000	11,456	13,366	4,467	3,014	872	416	132	120	30	33,873
2001	2,976	7,955	9,040	2,671	1,481	397	187	59	67	24,834
2002	13,175	2,046	5,321	5,321	1,283	657	174	81	55	28,113
2003	4,778	8,887	1,351	3,175	2,704	612	310	82	64	21,963
2004	15,418	3,190	5,795	790	1,560	1,241	278	140	66	28,478
2005	9,185	10,284	2,069	3,298	365	664	521	116	87	26,590
2006	15,170	6,121	6,670	1,187	1,452	135	236	184	71	31,226
2007	11,425	10,129	4,012	4,025	599	653	59	102	111	31,116
2008	8,282	7,625	6,624	2,395	1,971	258	272	24	88	27,541
2009	5,283	5,518	4,940	3,782	1,041	718	90	94	39	21,504
2010	3,214	3,516	3,556	2,750	1,535	344	225	28	41	15,210
2011	3,123	2,137	2,252	1,925	1,035	456	96	62	19	11,106
2012	3,451	2,069	1,340	1,101	550	209	84	18	15	8,837
2013	1,712	2,283	1,285	628	281	95	33	13	5	6,334
2014	5,727	1,128	1,391	550	125	34	10	3	2	8,972
2015	2,311	3,781	694	624	124	18	4	1	1	7,559
2016	1,355	1,545	2,500	436	351	65	9	2	1	6,265
2017	3,062	905	1,016	1,531	229	167	30	4	2	6,947
2018	4,261	2,045	595	622	802	108	77	14	3	8,527
1982-2016 median	9,185									
2014-2018 geomean	2,978									

Table 35. Inputs to the Gulf of Maine Atlantic cod yield per recruit (YPR) and projection calculations for the M=0.2 and M-ramp model scenarios. Weights are based on an average of the most recent three years (2016-2018).

Age	Natural mortality	Fraction mature	Jan1/SSB weights (kg)	Catch weights (kg)	Fishery selectivity (M = 0.2)	Fishery selectivity (M-ramp)
1	0.200	0.087	0.057	0.229	0.013	0.009
2	0.200	0.318	0.365	0.693	0.066	0.051
3	0.200	0.697	0.908	1.430	0.271	0.241
4	0.200	0.919	1.662	2.480	0.663	0.651
5	0.200	0.982	2.426	3.341	0.912	0.917
6	0.200	0.996	3.307	4.534	0.982	0.985
7	0.200	0.999	4.090	5.406	0.997	0.997
8	0.200	1.000	5.928	7.821	1.000	1.000
9+	0.200	1.000	10.375	10.479	1.000	1.000

Table 36. Target fishing mortality, yield per recruit, spawning biomass per recruit and mean age for a range of fishing mortality reference points.

Model	Reference point	F	YPR (kg)	SSB/R (kg)	Mean age (years)
M=0.2	F_0	0.000	0.000	17.020	5.52
	$F_{0.1}$	0.183	1.231	6.545	3.63
	F_{MAX}	0.352	1.336	3.810	3.06
	$F_{40\%}$	0.173	1.212	6.810	3.68
M-ramp (M=0.2)	F_0	0.000	0.000	17.020	5.52
	$F_{0.1}$	0.186	1.241	6.531	3.63
	F_{MAX}	0.361	1.348	3.791	3.06
	$F_{40\%}$	0.175	1.221	6.817	3.68

Table 37. Biological reference points and stock status for Gulf of Maine Atlantic cod based on the 2014 (Palmer 2014), 2015 (NEFSC 2015), and 2017 (NEFSC 2017) assessment updates and the current 2019 assessment update. Intervals shown are the 5th and 95th percentiles.

Assessment	Proxy reference points	M=0.2	M-ramp
2014 update	$F_{\text{full, 2013}}$	1.33 (0.89 - 1.92)	1.24 (0.84 - 1.78)
	F_{MSY}	0.18	0.18
	$F_{\text{full, 2013}}/F_{\text{MSY}}$	7.39	6.89
	Overfishing	Yes	Yes
	SSB_{2013} (mt)	2,063 (1,561 - 2,774)	2,432 (1,819 - 3,230)
	SSB_{MSY} (mt)	47,184 (32,903 - 67,045)	69,621 (53,349 - 89,302)
	$\text{SSB}_{2013}/\text{SSB}_{\text{MSY}}$	0.04	0.03
	Overfished	Yes	Yes
	MSY (mt)	7,753 (5,355 - 11,162)	11,388 (8,624 - 14,750)
2015 update	Median age1 recruitment (000s)	4,665 (1,414 - 14,649)	9,173 (2,682 - 16,262)
	$F_{\text{full, 2014}}$	0.956 (0.664 - 1.387)	0.932 (0.654 - 1.304)
	F_{MSY}	0.185	0.187
	$F_{\text{full, 2014}}/F_{\text{MSY}}$	5.11	4.98
	Overfishing	Yes	Yes
	SSB_{2014} (mt)	2,225 (1,713 - 2,892)	2,536 (1,942 - 3,298)
	SSB_{MSY} (mt)	40,187 (27,551 - 58,228)	59,045 (44,976 - 76,525)
	$\text{SSB}_{2014}/\text{SSB}_{\text{MSY}}$	0.06	0.04
	Overfished	Yes	Yes
2017 update	MSY (mt)	6,797 (4,608 - 9,990)	10,043 (7,560 - 13,130)
	Median age1 recruitment (000s)	4,406 (1,458 - 14,450)	8,965 (2,489 - 15,908)
	$F_{\text{full, 2016}}$	0.228 (0.165 - 0.316)	0.237 (0.169 - 0.331)
	F_{MSY}	0.174	0.177
	$F_{\text{full, 2016}}/F_{\text{MSY}}$	1.31	1.34
	Overfishing	Yes	Yes
	SSB_{2016} (mt)	3,046 (2,301 - 4,025)	3,262 (2,464 - 4,270)
	SSB_{MSY} (mt)	40,604 (27,631 - 58,553)	59,714 (44,732 - 77,611)
	$\text{SSB}_{2016}/\text{SSB}_{\text{MSY}}$	0.08	0.05
2019 update	Overfished	Yes	Yes
	MSY (mt)	7,049 (4,699 - 10,380)	10,502 (7,734 - 13,822)
	Median age1 recruitment (000s)	4,377 (1,161 - 14,434)	8,464 (2,353 - 15,934)
	$F_{\text{full, 2018}}$	0.188 (0.113 - 0.263)	0.198 (0.113 - 0.263)
	F_{MSY}	0.173	0.175
	$F_{\text{full, 2018}}/F_{\text{MSY}}$	1.09	1.13
	Overfishing	Yes	Yes
	SSB_{2018} (mt)	3,752 (2,432 - 5,071)	3,838 (2,582 - 5,094)
	SSB_{MSY} (mt)	42,692 (27,916 - 62,785)	63,867 (46,144 - 84,098)
2019 update	$\text{SSB}_{2018}/\text{SSB}_{\text{MSY}}$	0.09	0.06
	Overfished	Yes	Yes
	MSY (mt)	7,580 (4,853 - 11,366)	11,420 (8,149 - 15,268)
	Median age1 recruitment (000s)	4,677 (1,064 - 16,392)	9,249 (2,129 - 18,031)

Table 38. Short-term projections (2020-2022) of total fishery yield and spawning stock biomass for Gulf of Maine Atlantic cod based on a F_{MSY} -proxy ($F_{40\%}$) harvest strategy. These projections have assumed the geometric mean recruitment of the 2014-2018 period for estimating 2019 age-1 recruitment. For age-1 recruitment in 2020 and beyond the projections assume 1982-2016 median recruitment ($M=0.2 \sim 4.6$ million fish, M -ramp ~ 9.2 million fish) when spawning stock biomass is above 6,300 mt in the $M=0.2$ model and 7,900 mt in the M -ramp model. At spawning stock levels below these thresholds, recruitment declines linearly to zero. Catch in 2019 has been assumed to be 710 mt (*J Cournane, NEFMC PDT*). There are two sets of projections for both the $M=0.2$ and M -ramp models. For the $M=0.2$ model, the first projection assumes 2018 conditions as determined from the $M=0.2$ model with no adjustment for retrospective error, the second applies a retrospective adjustment based on $\rho=0.52$ ($((1/1+\rho)=0.66)$). The two M -ramp projections differ in the assumed natural mortality rate in subsequent years. One is set at $M=0.2$ while the other is set at $M=0.4$ to bracket the range of natural mortality rates used in the M -ramp model.

Harvest strategy	Year	Input	M=0.2 model						M-ramp model					
			No retro adjustment			Retrospective adjustment			M=0.2			M=0.4		
			Catch (mt)	Spawning stock biomass (mt)	F_{full}	Catch (mt)	Spawning stock biomass (mt)	F_{full}	Catch (mt)	Spawning stock biomass (mt)	F_{full}	Catch (mt)	Spawning stock biomass (mt)	F_{full}
F_{MSY}	2018	Model result	753	3,752	0.188	753	2,468	0.265	753	3,838	0.198	753	3,838	0.198
	2019	Assumed catch	710	4,732	0.148	710	4,080	0.225	710	4,326	0.171	710	4,103	0.189
	2020	Projection	1,102	6,276	0.173	689	5,083	0.173	1,027	6,112	0.175	758	4,719	0.175
	2021	Projection	1,440	8,064	0.173	912	6,707	0.173	1,469	8,547	0.175	893	5,461	0.175
	2022	Projection	1,813	10,673	0.173	1,160	9,052	0.173	1,995	11,927	0.175	1,010	6,415	0.175