

OCEAN QUAHOG TABLES

Table A1. Landings (1,000 mt meats) for ocean quahog during 1967-2005 from dealer data (state + EEZ waters) and logbooks (EEZ only). Landings from state waters are calculated approximately by subtracting logbook landings from dealer landings. The EEZ quota and ratio of EEZ landings and EEZ quota are shown for comparison. Data for 2005 are preliminary and may be incomplete.

Year	Dealer Database	EEZ (Logbook)	State Waters (Logbook - Dealer)	Percent Landings in EEZ	EEZ Quota	EEZ Landings / Quota (%)
1967 ^a	0.020	0.000	0.020	0.000		
1968	0.102	0.000	0.102	0.000		
1969	0.290	0.000	0.290	0.000		
1970	0.792	0.000	0.792	0.000		
1971	0.921	0.000	0.921	0.000		
1972	0.634	0.000	0.634	0.000		
1973	0.661	0.000	0.661	0.000		
1974	0.365	0.000	0.365	0.000		
1975	0.569	0.000	0.569	0.000		
1976	2.510	1.854	0.656	0.739		
1977	8.411	7.293	1.118	0.867		
1978	10.415	9.197	1.218	0.883		
1979	15.748	14.344	1.404	0.911	13.608	105%
1980 ^{b,c}	11.623	13.407	-1.784	1.153	15.876	84%
1981	11.202	13.101	-1.899	1.170	18.144	72%
1982	16.478	14.234	2.244	0.864	18.144	78%
1983	16.200	14.586	1.615	0.900	18.144	80%
1984	17.939	17.974	-0.035	1.002	18.144	99%
1985	22.035	20.726	1.310	0.941	22.226	93%
1986	20.585	18.902	1.683	0.918	27.215	69%
1987	22.709	21.514	1.195	0.947	27.215	79%
1988	21.007	20.273	0.734	0.965	27.215	74%
1989	23.147	22.359	0.788	0.966	23.587	95%
1990	21.235	20.965	0.270	0.987	24.040	87%
1991	22.119	22.063	0.056	0.997	24.040	92%
1992	22.871	22.476	0.395	0.983	24.040	93%
1993	24.843	21.876	2.968	0.881	24.494	89%
1994	21.159	20.985	0.174	0.992	24.494	86%
1995	23.253	21.107	2.145	0.908	22.226	95%
1996	21.122	20.061	1.062	0.950	20.185	99%
1997	19.930	19.628	0.302	0.985	19.581	100%
1998	18.098	17.896	0.201	0.989	18.144	99%
1999	17.557	17.381	0.175	0.990	20.412	85%
2000	14.899	14.722	0.176	0.988	20.412	72%
2001	17.234	17.068	0.165	0.990	20.412	84%
2002	18.144	17.947	0.198	0.989	20.412	88%
2003	18.997	18.815	0.182	0.990	20.412	92%
2004	17.788	17.650	0.138	0.992	22.680	78%
2005		13.629	-13.629		24.190	56%

^a Landings for 1967-1979 are from NEFSC (1990)

^b Landings for 1980-1993 from NEFSC (2003).

^c For 1980-2005, "Dealer Database Total" landings are from commercial landings databases (CFDETS or CFDEERS), EEZ landings are from logbooks (Maine included), and "State Waters (Dealer-Logbook)" landings are the difference. Logbook landings are more accurate. In some years, logbook landings exceeded dealer database totals slightly.

Table A2. Ocean quahog landings (mt meats) by stock assessment region reported in logbooks for the US EEZ. Data for 1980-2003 are from logbooks and differ from the previous assessment (NEFSC 2004) because additional landings from other/unknown regions (“UNK”) were allocated to regions in this assessment and because NEFSC (2004) treated Maine landings as other/unknown. Landings for 1978-1979 are not from logbooks and less reliable. Data for 2005 are preliminary and may be incomplete. Based on Maine reports, UNK amounts during 2002 were probably from Maine waters.

YEAR	SVA	DMV	NJ	LI	SNE	GBK	MNE	UNK	Grand Total
1978		1,290	6,350					2,775	10,415
1979		5,450	6,030					4,268	15,748
1980	0	4,230	7,750	6	0			1,421	13,407
1981	56	3,637	8,402	3	0			1,003	13,101
1982	6	4,598	8,538	0	0			1,092	14,234
1983	0	5,396	8,249	21	629	0	0	291	14,586
1984	6	7,164	8,857	0	822	0	0	1,125	17,974
1985	160	7,200	10,676	40	693	0	0	1,956	20,726
1986	0	8,236	9,053	396	568	0	0	649	18,902
1987	0	10,533	9,077	1,180	696	0	0	27	21,514
1988	42	11,715	7,014	640	841	0	0	20	20,273
1989	0	6,439	14,100	605	1,196	0	0	20	22,359
1990	14	3,685	15,590	739	934	0	3	0	20,965
1991	0	4,839	14,575	1,674	865	0	110	0	22,063
1992	0	2,378	6,942	11,939	1,143	0	75	0	22,476
1993	0	1,953	10,205	8,642	1,020	0	56	0	21,876
1994	0	992	6,938	12,014	954	0	65	22	20,985
1995	0	699	5,356	9,526	5,412	0	114	0	21,107
1996	0	736	4,864	5,943	8,350	0	142	26	20,061
1997	0	1,072	4,229	5,141	8,968	0	218	0	19,628
1998	0	1,365	2,684	6,856	6,736	0	218	39	17,896
1999	0	1,090	3,038	6,329	6,618	0	279	27	17,381
2000	0	1,048	3,318	4,745	5,083	49	357	123	14,722
2001	0	894	4,560	5,692	4,694	13	326	889	17,068
2002	0	1,732	2,781	9,113	3,884	0	387	51	17,947
2003	0	896	3,692	11,617	2,177	0	359	73	18,815
2004	0	634	2,795	10,631	3,283	0	307	0	17,650
2005	0	932	664	9,688	2,015	0	294	35	13,629

Table A3. Ocean quahog landings by stock assessment region as reported in logbooks for the US EEZ. Figures are 1000 ITQ bushels except for Maine, which are reported as both ITQ and Maine bushels. Data for 2005 are preliminary and may be incomplete. Based on Maine reports, UNK amounts during 2002 were probably from Maine waters.

YEAR	SVA	DMV	NJ	LI	SNE	GBK	MNE	MNE (Maine bushels)	UNK	Grand Total
1980	0	933	1,709	1	0	0	0		313	2,956
1981	12	802	1,852	1	0	0	0		221	2,888
1982	1	1,014	1,882	0	0	0	0		241	3,138
1983	0	1,190	1,819	5	139	64	0	0	64	3,280
1984	1	1,580	1,953	0	181	248	0	0	248	4,211
1985	35	1,587	2,354	9	153	431	0	0	431	5,001
1986	0	1,816	1,996	87	125	143	0	0	143	4,310
1987	0	2,322	2,001	260	153	6	0	0	6	4,749
1988	9	2,583	1,546	141	185	4	0	0	4	4,474
1989	0	1,420	3,108	133	264	4	0	0	4	4,934
1990	3	812	3,437	163	206	0	1	1	0	4,623
1991	0	1,067	3,213	369	191	0	24	37	0	4,901
1992	0	524	1,530	2,632	252	0	16	25	0	4,980
1993	0	431	2,250	1,905	225	0	12	19	0	4,841
1994	0	219	1,530	2,649	210	5	14	21	5	4,653
1995	0	154	1,181	2,100	1,193	0	25	38	0	4,691
1996	0	162	1,072	1,310	1,841	6	31	47	6	4,476
1997	0	236	932	1,133	1,977	0	48	73	0	4,400
1998	0	301	592	1,511	1,485	9	48	72	9	4,026
1999	0	240	670	1,395	1,459	6	62	93	6	3,931
2000	0	231	732	1,046	1,121	27	79	119	27	3,381
2001	0	197	1,005	1,255	1,035	196	72	109	196	4,065
2002	0	382	613	2,009	856	11	85	129	11	4,097
2003	0	198	814	2,561	480	16	79	120	16	4,284
2004	0	140	616	2,344	724	0	68	102	0	3,993
2005	0	206	146	2,136	444	8	65	98	8	3,110

Table A4. Real and nominal prices (dollars per ITQ bushel) for ocean quahogs landed by ITQ and Maine vessels. Real prices are 1991 dollars. Information for ITQ vessels from dealer data. Information for Maine vessels from MAFMC (2005). Price data for Maine vessels (originally prices for Maine bushel) were converted to prices per ITQ bushel). Adjustments for inflation from the US Bureau of Labor Statistics for unprocessed shellfish.^a

Year	ITQ		Maine	
	Nominal	Real	Nominal	Real
1994	\$4.44	\$4.20		
1995	\$4.30	\$3.56		
1996	\$4.12	\$3.40		
1997	\$4.13	\$2.39		
1998	\$4.23	\$2.41		
1999	\$4.24	\$2.53		
2000	\$4.35	\$2.55		
2001	\$5.54	\$3.23		
2002	\$5.47	\$3.33		
2003	\$5.37	\$3.08	\$61.73	\$35.43
2004	\$5.26	\$3.02	\$59.55	\$34.17

Table A5. Ocean quahog fishing effort (hours fished) by stock assessment region in the US EEZ based on logbook data. Figures for 1983-2003 differ from NEFSC (2003) because additional other/unknown (“UNK”) trips were allocated to region and because data for subtrips (deliveries from the same trip to different dealers) were counted only once. Data for 2005 are preliminary and may be incomplete. Based on Maine reports, UNK amounts during 2002 were probably from Maine waters.

YEAR	SVA	DMV	NJ	LI	SNE	GBK	MNE	UNK	Grand Total
1983	0	7,131	13,932	50	1,535	0	0	56	22,704
1984	15	11,096	15,488	0	2,523	0	0	1,231	30,353
1985	204	10,058	17,890	87	2,066	0	0	2,955	33,260
1986	0	12,260	14,350	361	1,145	0	0	1,012	29,127
1987	0	15,812	14,704	806	1,340	0	0	49	32,711
1988	64	19,100	11,598	615	1,639	0	0	64	33,079
1989	0	12,124	24,262	797	2,327	0	0	50	39,560
1990	25	8,166	29,327	1,283	1,838	0	286	0	40,924
1991	0	12,048	30,397	1,844	1,433	0	17,110	0	62,832
1992	0	5,513	15,998	13,148	1,964	0	13,424	0	50,047
1993	0	4,622	25,457	12,883	1,783	0	5,720	0	50,465
1994	0	2,260	20,543	19,165	2,082	0	5,056	57	49,162
1995	0	1,621	13,598	16,015	8,561	0	5,731	0	45,526
1996	0	1,521	9,340	10,238	11,866	0	8,404	54	41,422
1997	0	2,742	9,382	8,295	13,515	0	11,734	0	45,669
1998	0	3,225	6,983	10,509	10,639	0	11,631	79	43,066
1999	0	2,595	7,623	9,132	12,258	0	10,821	90	42,518
2000	0	2,517	7,966	7,071	10,542	63	12,215	612	40,986
2001	0	2,170	10,844	7,813	11,404	22	13,113	1,454	46,820
2002	0	4,290	6,683	11,605	7,797	0	16,779	85	47,240
2003	0	2,617	10,764	16,099	4,596	0	17,832	108	52,016
2004	0	2,476	7,953	14,478	6,665	0	19,013	0	50,586
2005	0	3,500	1,935	12,437	4,019	0	16,572	129	38,591

Table A6. Commercial landings per unit effort (LPUE) for ocean quahog by region. Figures for Maine are for vessels in ton class groups 1-2 (1-50 GRT). Figures for all other regions are for vessels in ton class groups 3-4 (51-500 GRT). "Nominal Mean LPUE" is the simple average of LPUE for each trip in the region during the year. "Total Bushels / Total Hours" is total landings divided by total hours fished. "Standardized Index" is back-transformed year effects from a general linear model with year, month and vessel effects. The standardized indices are adjusted to the LPUE level of a single randomly chosen vessel (ton class 4 for the EEZ and ton class 1 for Maine) during June of each year. Data for 2005 are preliminary and may be incomplete.

Year	DMV				NJ			
	Nominal Mean LPUE	Total Bushels / Total Hours	Standardized Index	CV	Nominal Mean LPUE	Total Bushels / Total Hours	Standardized Index	CV
1980	153	139	165	0.15	119	118	113	0.19
1981	149	140	159	0.15	122	118	113	0.19
1982	151	143	176	0.15	135	130	120	0.19
1983	175	167	201	0.15	138	131	124	0.19
1984	154	142	181	0.15	133	126	119	0.19
1985	167	158	192	0.15	140	132	124	0.19
1986	157	148	169	0.15	144	139	125	0.19
1987	159	147	158	0.15	136	136	116	0.19
1988	144	135	141	0.15	137	133	110	0.19
1989	127	117	131	0.15	133	128	105	0.19
1990	106	99	118	0.15	123	117	95	0.19
1991	94	89	102	0.15	110	106	82	0.19
1992	100	95	104	0.15	101	96	84	0.19
1993	105	93	105	0.15	95	88	75	0.19
1994	104	97	97	0.15	80	74	68	0.19
1995	102	95	91	0.16	93	87	79	0.19
1996	119	107	101	0.16	121	115	100	0.19
1997	93	86	90	0.15	105	99	86	0.19
1998	100	93	92	0.15	109	85	75	0.19
1999	96	93	88	0.15	95	88	80	0.19
2000	98	92	86	0.15	96	92	82	0.19
2001	90	91	76	0.16	98	93	80	0.19
2002	93	88	83	0.15	94	91	77	0.19
2003	77	74	68	0.15	79	74	63	0.19
2004	66	56	60	0.16	88	77	67	0.19
2005	61	59	56	0.15	80	76	64	0.18

Table A6 (continued).

Year	Nominal Mean LPUE	LI			SNE			
		Total Bushels / Total Hours	Standardized Index	CV	Nominal Mean LPUE	Total Bushels / Total Hours	Standardized Index	CV
1980								
1981	123	123						
1982								
1983	91	93			91	90		
1984					73	72	73	0.17
1985	106	102			75	74	79	0.18
1986	262	242	267	0.23	115	109	114	0.17
1987	322	323	319	0.20	122	115	117	0.17
1988	232	230	210	0.22	114	113	113	0.17
1989	176	167	190	0.21	127	113	118	0.17
1990	180	127	221	0.23	129	112	136	0.17
1991	205	200	212	0.18	135	133	134	0.17
1992	207	200	227	0.15	119	128	164	0.17
1993	159	148	174	0.15	115	126	179	0.17
1994	152	138	161	0.15	100	101	142	0.17
1995	145	131	159	0.15	145	139	119	0.17
1996	136	128	149	0.16	164	155	137	0.17
1997	144	137	157	0.16	156	146	126	0.17
1998	155	144	160	0.16	147	140	120	0.17
1999	165	153	172	0.16	126	119	106	0.17
2000	156	148	163	0.16	109	106	99	0.17
2001	165	161	177	0.16	93	91	88	0.17
2002	182	173	178	0.15	122	110	122	0.17
2003	169	160	168	0.15	116	104	106	0.17
2004	179	162	166	0.15	115	109	106	0.17
2005	177	172	151	0.06	113	111	108	0.17

Table A6 (continued).

Year	Nominal Mean LPUE	MNE		CV
		Total Bushels / Total Hours	Standardized Index	
1980				
1981				
1982				
1983				
1984				
1985				
1986				
1987				
1988				
1989				
1990	3.50	3.56		
1991	2.06	2.15	2.09	0.031
1992	1.89	1.85	1.89	0.031
1993	3.18	3.00	2.52	0.033
1994	4.95	4.25	3.95	0.032
1995	6.98	6.62	6.18	0.032
1996	5.92	5.61	5.55	0.031
1997	6.64	6.20	5.86	0.030
1998	6.73	6.23	5.55	0.030
1999	9.66	8.60	7.58	0.030
2000	10.05	9.73	8.30	0.030
2001	8.45	8.28	7.28	0.030
2002	8.02	7.67	7.14	0.030
2003	7.06	6.71	6.01	0.029
2004	5.58	5.37	4.76	0.029
2005	6.14	5.91	5.03	0.027

Table A7. Trends in survey, stock and fishable abundance and biomass for ocean quahog ≥ 50 mm SL during 1982-2005 based on NEFSC clam survey data. Mean numbers per tow (N/Tow) and mean meat weight per tow (KG/Tow) are for a standard 0.15 nm tow with adjustments for tow distance based on Doppler data. Figures include original plus borrowed tows. For example, "Number Strata" for a particular year includes strata sampled by the survey during the same year plus strata sampled by tows borrowed from the previous and subsequent surveys. Survey data for 1994 are excluded because of gear problems that artificially boosted sampling efficiency. Survey coverage was incomplete on GBK prior to 1986 and GBK was not sampled during 2005.

Region	Year	Survey			Stock			Fishable			Number Tows	Number Positive Tows	Number Strata With Data			
		N/Tow	CV	KG/Tow	CV	N/Tow	CV	KG/Tow	CV	N/Tow				CV	KG/Tow	CV
SVA	1982	0.039	0.00	0.002	0.00	0.039	0.00	0.002	0.00	0.038	0.00	0.002	0.00	5	1	2
SVA	1983	1.892	0.58	0.099	0.58	1.917	0.58	0.101	0.58	1.854	0.58	0.097	0.58	10	3	2
SVA	1984	0.189	0.85	0.010	0.87	0.191	0.84	0.010	0.87	0.185	0.85	0.010	0.87	14	2	2
SVA	1986	0.285	0.00	0.013	0.00	0.294	0.00	0.013	0.00	0.275	0.00	0.012	0.00	9	1	2
SVA	1989	0.392	0.00	0.018	0.00	0.401	0.00	0.019	0.00	0.380	0.00	0.018	0.00	9	1	2
SVA	1992	0.000	.	0.000	.	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	9	0	2
SVA	1997	0.154	0.00	0.004	0.00	0.282	0.00	0.006	0.00	0.132	0.00	0.003	0.00	9	1	2
SVA	1999	0.081	0.55	0.002	0.61	0.182	0.50	0.003	0.54	0.069	0.56	0.002	0.61	19	2	2
SVA	2002	0.045	1.00	0.001	1.00	0.133	1.00	0.002	1.00	0.037	1.00	0.001	1.00	10	1	2
SVA	2005	0.000	.	0.000	.	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	9	0	2
DMV	1982	79.162	0.32	2.956	0.34	86.645	0.31	3.156	0.33	73.837	0.32	2.786	0.34	59	24	6
DMV	1983	86.228	0.49	2.549	0.42	106.611	0.52	2.988	0.45	76.158	0.48	2.301	0.41	54	28	6
DMV	1984	52.011	0.35	1.667	0.30	63.193	0.36	1.904	0.31	46.650	0.34	1.530	0.30	78	34	6
DMV	1986	75.681	0.23	2.532	0.22	86.737	0.24	2.800	0.22	68.939	0.23	2.342	0.22	61	28	6
DMV	1989	64.366	0.58	1.801	0.46	82.482	0.62	2.179	0.51	55.961	0.55	1.606	0.44	69	31	6
DMV	1992	71.982	0.36	2.285	0.31	85.405	0.40	2.589	0.33	64.676	0.35	2.093	0.30	69	25	6
DMV	1997	47.743	0.21	1.669	0.21	56.440	0.22	1.847	0.21	43.721	0.21	1.557	0.21	73	28	6
DMV	1999	28.359	0.29	0.948	0.27	33.388	0.29	1.056	0.27	25.821	0.29	0.878	0.26	70	23	6
DMV	2002	31.814	0.25	1.106	0.23	38.774	0.26	1.232	0.23	29.139	0.24	1.032	0.22	71	19	6
DMV	2005	19.407	0.49	0.694	0.53	24.842	0.45	0.776	0.50	17.906	0.50	0.652	0.53	66	21	6

Table A7 (cont.)

Region	Year	Survey			Stock			Fishable			Number Tows	Number Positive Tows	Number Strata With Data			
		N/Tow	CV	KG/Tow	CV	N/Tow	CV	KG/Tow	N/Tow	CV				KG/Tow		
NJ	1982	112.339	0.20	3.555	0.20	129.333	0.20	3.918	0.20	102.545	0.20	3.302	0.20	100	50	13
NJ	1983	86.092	0.21	2.832	0.21	98.417	0.21	3.090	0.21	79.201	0.21	2.649	0.21	98	55	13
NJ	1984	143.533	0.24	4.531	0.24	165.861	0.24	4.998	0.24	131.075	0.24	4.208	0.24	153	80	13
NJ	1986	142.520	0.23	4.847	0.23	158.243	0.24	5.213	0.23	132.170	0.23	4.555	0.22	103	52	13
NJ	1989	73.510	0.22	2.193	0.21	90.578	0.21	2.491	0.21	66.320	0.22	2.020	0.21	110	52	13
NJ	1992	88.043	0.18	3.023	0.17	97.822	0.18	3.246	0.17	81.725	0.18	2.843	0.17	110	52	13
NJ	1997	122.262	0.15	4.273	0.15	135.780	0.16	4.576	0.15	113.720	0.15	4.028	0.15	124	59	13
NJ	1999	59.480	0.15	2.019	0.14	72.266	0.15	2.221	0.14	54.889	0.15	1.900	0.14	132	61	13
NJ	2002	89.793	0.23	3.229	0.24	101.123	0.22	3.456	0.23	83.825	0.24	3.059	0.24	127	60	13
NJ	2005	47.076	0.16	1.568	0.15	62.364	0.15	1.769	0.15	43.117	0.15	1.473	0.14	103	54	13
LI	1982	278.856	0.15	7.021	0.16	434.976	0.16	9.325	0.15	239.652	0.15	6.258	0.16	43	37	9
LI	1983	185.877	0.21	5.232	0.21	253.508	0.22	6.355	0.21	163.619	0.21	4.742	0.21	38	36	9
LI	1984	235.154	0.17	6.536	0.16	318.987	0.18	7.967	0.17	206.330	0.17	5.906	0.16	71	63	9
LI	1986	311.430	0.22	8.625	0.21	416.390	0.23	10.480	0.21	273.066	0.22	7.782	0.21	36	31	9
LI	1989	226.213	0.34	5.062	0.29	367.492	0.38	7.152	0.33	190.104	0.33	4.384	0.28	40	36	9
LI	1992	323.335	0.18	8.313	0.16	465.234	0.20	10.625	0.17	279.032	0.17	7.401	0.16	42	36	9
LI	1997	401.643	0.16	11.156	0.16	518.847	0.17	13.351	0.16	353.149	0.16	10.049	0.16	42	35	9
LI	1999	232.273	0.17	6.280	0.15	310.519	0.19	7.671	0.16	202.716	0.17	5.628	0.14	45	41	9
LI	2002	253.059	0.21	6.969	0.20	330.414	0.21	8.385	0.20	222.209	0.21	6.268	0.20	43	40	9
LI	2005	151.233	0.18	4.122	0.19	218.396	0.19	5.121	0.18	132.758	0.18	3.717	0.19	45	39	9

Table A7 (cont.)

Region	Year	Survey			Stock			Fishable			Number Tows	Number Positive Tows	Number Strata With Data			
		N/Tow	CV	KG/Tow	CV	N/Tow	CV	KG/Tow	N/Tow	CV				KG/Tow	CV	
SNE	1982	277.607	0.27	6.981	0.25	345.845	0.28	8.222	0.26	245.458	0.27	6.283	0.25	48	30	10
SNE	1983	173.213	0.29	4.163	0.30	237.689	0.31	5.149	0.29	151.399	0.29	3.727	0.30	58	37	10
SNE	1984	188.458	0.27	4.753	0.29	234.355	0.26	5.588	0.28	166.802	0.27	4.280	0.29	69	38	10
SNE	1986	289.151	0.31	6.961	0.31	394.360	0.35	8.561	0.32	253.117	0.31	6.226	0.31	27	23	9
SNE	1989	274.664	0.19	6.707	0.18	353.181	0.21	8.050	0.19	241.358	0.19	6.003	0.18	34	29	10
SNE	1992	333.079	0.19	8.634	0.19	400.104	0.19	9.947	0.19	297.003	0.19	7.814	0.20	36	31	10
SNE	1997	292.893	0.54	6.128	0.45	447.963	0.61	8.405	0.52	246.944	0.52	5.335	0.43	39	27	10
SNE	1999	252.431	0.54	6.169	0.48	312.910	0.56	7.316	0.51	221.840	0.53	5.510	0.47	39	30	10
SNE	2002	180.674	0.22	5.103	0.22	206.737	0.22	5.663	0.22	164.245	0.22	4.697	0.22	29	28	9
SNE	2005	178.281	0.28	3.944	0.24	395.499	0.44	5.882	0.29	154.795	0.27	3.547	0.24	29	25	7
GBK	1986	276.488	0.19	6.207	0.18	427.632	0.23	8.633	0.20	232.206	0.19	5.313	0.18	48	21	16
GBK	1989	90.805	0.26	2.371	0.26	124.548	0.25	2.950	0.25	78.933	0.26	2.098	0.26	79	38	16
GBK	1992	346.253	0.21	9.225	0.21	485.713	0.19	11.427	0.20	302.841	0.21	8.208	0.21	74	41	16
GBK	1997	269.762	0.19	7.058	0.19	389.377	0.19	8.969	0.18	234.251	0.19	6.274	0.19	83	44	18
GBK	1999	273.398	0.17	7.806	0.19	365.971	0.16	9.391	0.18	241.903	0.17	7.060	0.19	77	47	18
GBK	2002	328.367	0.18	9.059	0.19	478.136	0.15	11.247	0.18	288.963	0.18	8.149	0.19	61	38	15

Table A8. Number of random and nearly random NEFSC survey tows used to estimate trends in abundance of ocean quahog. Figures in each cell are the number of tows in calculations for each combination of stratum and cruise. Figures in plain text are the number of original tows (without borrowing). Bold and outlined figures are for cells with zero tows originally that were filled by borrowing tows from the same strata during previous and/or subsequent cruises. Black cells are for cells with zero tows that could not be filled by borrowing. Note that there were too few tows in GBK during 1982-1984 and 2005 to calculate abundance indices for GBK during these years.

Region	Stratum	Survey Year										
		1982	1983	1984	1986	1989	1992	1994	1997	1999	2002	2005
SVA	5	4	9	13	8	8	8	8	8	16	8	8
	6	1	1	1	1	1	1	1	1	3	2	2
DMV	9	30	26	35	29	37	37	39	39	38	39	39
	10	2	2	3	3	3	3	3	3	3	3	3
	11	2	2	4	2	2	2	2	2	2	2	2
	13	19	18	25	20	20	20	21	22	19	20	20
	14	2	2	3	3	3	3	5	3	3	3	3
	15	4	4	8	4	4	4	5	4	5	4	4
NJ	17	11	11	18	12	12	12	12	14	12	12	12
	18	3	3	6	3	3	3	3	3	3	3	3
	19	3	3	6	3	3	3	3	3	3	3	3
	21	18	18	22	19	20	20	23	26	39	29	29
	22	3	3	6	3	3	3	5	3	3	3	3
	23	7	6	11	5	4	5	5	5	5	5	5
	25	9	9	13	8	9	9	9	12	8	9	9
	26	2	2	5	3	3	3	3	3	3	3	3
	27	4	4	8	4	4	4	4	4	4	4	4
	87	8	7	10	9	9	9	9	9	9	16	16
	88	15	15	24	17	20	20	20	21	22	20	20
	89	15	15	21	15	18	17	17	19	18	18	18
90	2	2	3	2	2	2	2	2	2	2	2	
LI	29	11	10	20	10	10	10	10	10	11	10	10
	30	7	8	14	6	6	6	6	6	7	6	6
	31	9	7	12	5	7	8	8	8	9	8	8
	33	4	4	8	4	4	4	5	4	4	4	4
	34	2	2	4	2	2	2	5	2	2	2	2
	35	4	2	4	2	5	6	6	6	6	6	6
	91	3	2	4	4	3	3	3	3	3	3	3
	92	2	2	3	2	2	2	2	2	2	2	2
	93	1	1	2	1	1	1	1	1	1	2	2

Table A8 (continued).

Region	Stratum	Survey Year										
		1982	1983	1984	1986	1989	1992	1994	1997	1999	2002	2005
SNE	37	7	4	7	3	6	3	5	4	4	3	3
	38	3	2	5	3	3	3	5	3	3	3	3
	39	6	4	6	2	5	5	5	5	5	5	5
	41	6	5	7	5	6	6	6	6	5	6	6
	45	3	7	9	4	4	4	4	4	4	3	3
	46	2	5	5	3	2	3	5	3	3	2	2
	47	4	3	4	2	2	4	5	4	3	1	1
	94	1	2	2		1	1	2	2	4	2	2
	95	4	14	11	4	4	4	4	4	4	4	4
	96	12	12	13	1	1	3	2	4	4		
GBK	54		3	3	3	6	3	3	3	3	0	0
	55	3	3	3	3	1	3	3	3	2	2	2
	56								4	4	4	
	57			2	2	1	2	5	2	2	2	2
	58								5	5	5	
	59	1	4	5	1	2	6	5	5	4	5	5
	60			2	2	2	4	2	5	5	5	5
	61	8	1	6	5	12	7	6	6	6	6	6
	62			1	1	1	4	4	4	4	4	4
	65			3	3	5	2	2	3	4	1	1
	67		5	5	5	7	7	7	7	7		
	68	1	8	7	3	6	6	5	5	5		
	69	2	5	11	6	6	6	7	6	7	7	
	70	1	2	6	4	8	4	4	4	3	2	2
	71		2	2	3	1	2	3	3	1	2	2
	72	2	10	8	1	8	8	8	8	6	6	
73	1	1	4	3	6	6	6	6	5	6	6	
74	3	4	1	3	7	4	4	4	3	3	3	

Table A9. Parameter estimates for the relationship between shell length (L , mm) and drained (fresh, not frozen) meat weight (W , g) in ocean quahog (NEFSC 2004). The equation for the relationship is $W=e^{\alpha}L^{\beta}$.

Region	Alpha	Beta
SVA	-9.042313	2.787987
DMV	-9.042313	2.787987
NJ	-9.847183	2.949540
LI	-9.233646	2.822474
SNE	-9.124283	2.774989
GBK	-8.969073	2.767282

Table A10. Clam survey database parameters used to extract survey data for ocean quahog in this assessment. Parameters were the same for all regions. Negative parameter values are ignored in database calculations.

Database Parameter	Survey length composition	Trends < 70 mm SL	Trends in survey, stock and fishable biomass	Efficiency corrected swept-area biomass
DISTANCE_TYPE	TREND	TREND	TREND	SENSORS
USEINCHESDOWN	1	1	1	1
LENGTH_BIN_SIZE_MM	10	1000	1000	1000
FIRST_LENGTH_MM	1	0	50	50
FIRST_BIN_IS_PLUSGROUP	-1	-1	-1	-1
LAST_LENGTH_MM	250	69	250	250
LAST_BIN_IS_PLUSGROUP	-1	-1	-1	-1
SVSPP_TO_USE	409	409	409	409
AREAKIND	GIS	GIS	GIS	GIS
REV_DATE_FOR_AREAS	2002	2002	2002	2002
REV_DATE_FOR_LW	2000	2000	2000	2000
FIRST_JWSTCODE	-1	-1	-1	-1
LAST_JWSTCODE	-1	-1	-1	-1
FIRST_RANDLIKE	1	1	1	1
LAST_RANDLIKE	2	2	2	2
FIRST_STATION	-1	-1	-1	-1
LAST_STATION	-1	-1	-1	-1
FIRST_HAUL	1	1	1	1
LAST_HAUL	3	3	3	3
FIRST_GEARCOND	1	1	1	1
LAST_GEARCOND	6	6	6	6
FIRST_STRATUM	-1	-1	-1	-1
LAST_STRATUM	-96	-96	-96	-96
FIRST_REGION_CODE	1	1	1	1
LAST_REGION_CODE	6	6	6	6
WRITE_TOW_DATA	1	1	1	1
WRITE_STRATUM_DATA	1	1	1	1
FIRST_CRUISE	-199700	-199700	-199700	199700
LAST_CRUISE	-200509	-200509	-200509	200509
SurvSelxAlpha	8.122	8.122	8.122	8.122
SurvSelxBeta		-0.119	-0.119	-0.119
FisherySelxAlpha		7.63	7.63	7.63
FisherySelxBeta		-0.105	-0.105	-0.105
NOMINAL_TOW_DISTANCE_NM		0.15	0.15	0.15
MINVALIDDOPPLER		0.04	0.04	0.04
MAXVALIDDOPPLER		0.3	0.3	0.3
FILLHOLZ		1	1	1

Table A11. Patch model estimates of efficiency for commercial and NEFSC survey clam dredges based on depletion experiments during 1997-2005. "NA" means not available.

Experiment	Study area			Depletion Tows				Patch Model					Setup Tows (if applicable)		NEFSC Dredge Efficiency	Footnotes								
	Region	Latitude (decimal degrees)	Longitude (decimal degrees)	Depth (m)	Mean Sediment Size (microns)	Depletion Study Vessel	Depletion Date	Ship Position Data (source / nominal accuracy / time interval)	N Bushel Counts / Length samples	N tows used	Depletion Vessel Blade Width (ft)	Cell Size (ft)	Density (N ft ⁻³)	Depletion Vessel Efficiency			k	γ	Neg. Log likelihood	Fit to Catch Data (R ² s)	Setup Date	Setup or RV Depletion Stations	Density (N ft ⁻³)	
OO2005-1	LI	40.5190	72.0762	57	536	FV/Lisa Kim	Sep-05	GPS / 6 ft / 6 sec	20	4 / 4	10	20	0.073	0.183	1.97	0.50	127.0	Ok	Jun-05	165, 231-234	0.0120	0.165	1	
OO2005-2	LI	40.3896	72.3895	53	438	FV/Lisa Kim	Sep-05	GPS / 6 ft / 6 sec	21	4 / 4	10	20	0.047	0.402	8.57	0.50	131.8	Ok	Jun-05	162, 235-238	0.0080	0.169	1	
OO2005-3	LI	40.6422	72.6517	35	267	FV/Lisa Kim	Sep-05	GPS / 6 ft / 6 sec	20	4 / 4	10	20	0.085	0.733	9.57	0.50	125.9	Ok	Jun-05	3, 239-242	0.0101	0.119	1	
OO2005-4	LI	40.6882	72.1815	46	308	FV/Lisa Kim	Sep-05	GPS / 6 ft / 6 sec	17	4 / 4	10	20	0.027	0.815	12.31	0.50	89.4	Ok	Jun-05	168, 243-246	0.0042	0.154	1	
OO2005-6	LI	40.0555	72.4167	65	554	FV/Lisa Kim	Sep-05	GPS / 6 ft / 6 sec	20	4 / 4	10	20	0.137	0.660	2.55	0.50	146.3	Ok	Jun-05	252-256	0.0210	0.153	1	
Mean				51	421				19.6			20	0.074	0.559	6.99	29%					0.0110	0.152		
CV for Mean				10%	14%				3%				25%	21%	29%						25%	6%		
OO2002-1 (LK-1)	LI	40.7276	71.7373	60	331	FV/Lisa Kim	Mar-02	GPS / 1 ft / 6 sec	24	5 / 5	10	20	0.295	0.489	6.56	0.50	173.1	Ok	Jun-02	5 - 9	0.0290	0.098	1, 2, 5	
OO2002-2 (LK-2)	LI	40.1031	73.1911	48	277	FV/Lisa Kim	Mar-02	GPS / 1 ft / 6 sec	22	4 / 4	10	20	0.165	0.785	10.57	0.50	149.7	Ok	Jun-02	25 - 29	0.0245	0.149	1, 2	
OO2002-3 (LK-3)	NJ	38.8149	73.8133	50	195	FV/Lisa Kim	Mar-02	GPS / 1 ft / 6 sec	20	4 / 4	10	20	0.081	0.777	11.57	0.50	133.4	Ok	Jun-02	213 - 217	0.0239	0.297	1, 2	
OO2002-4 (LK-4)	DMV	37.8876	74.6449	48	135	FV/Lisa Kim	Mar-02	GPS / 1 ft / 6 sec	24	5 / 5	10	20	0.073	0.254	12.46	0.50	136.0	Ok	Jun-02	272 - 276	0.0210	0.287	1, 2, 9, 16	
Mean				52	235				22.5			20	0.153	0.576	10.29	13%					0.0704	0.178		
CV for Mean				6%	18%				4%				34%	22%	13%						65%	0.274		
OO2000-1 (JN-1)	LI	40.6022	71.9875	58	N/A	FV/John N	Mar-00	GPS / 1 ft / 30 sec	22	5 / 5	12.5	25	0.100	0.730	5.55	0.50	157.4	Ok	Jun-99	194 - 199	NA	NA	1, 2, 6	
OO2000-2 (JN-2)	LI	40.3945	72.5430	48	N/A	FV/John N	Mar-00	GPS / 1 ft / 30 sec	16	4 / 3	12.5	25	0.062	0.554	15.10	0.50	98.1	Ok	Jun-99	178 - 180	0.0145	0.234	1, 2, 7, 11, 12, 17	
OO2000-3 (DM-1)	LI	40.5830	72.7968	40	N/A	FV/Danielle Maria	May-00	GPS / 1 ft / 30 sec	27	6 / 6	10	20	0.089	0.560	4.57	0.50	184.2	Ok	Jun-99	3 - 8	0.0147	0.165	1, 2, 8, 10, 12, 18	
Mean									21.7				0.084	0.615	8.405	40%					0.0146	0.199		
CV for Mean									15%				14%	9%	40%						1%	17%		
OO1999-01 DE2	LI	40.6023	71.9848	57	N/A	RV/Delaware II	Jun-99	GPS / 36 ft / 1 sec	60	8 / 8	5	10	0.007	0.990	4.05	0.25	253.1	Poor		N/A		0.990	14, 15	
OO1998-1 (SH-3)	LI (Shinnecock)	40.7665	72.1795	41	N/A	FV/Cape Fear	3/1/11998	Loran / 40 ft / 30 sec	14	3 / 3	10	20	0.017	1.000	3.48	0.50	76.5	Poor					1, 13	
OO1998-2 (SH-2)	LI (Shinnecock)	40.7220	72.0075	45	N/A	FV/Cape Fear	Mar-98	Loran / 40 ft / 30 sec	23	5 / 5	10	20	0.067	0.869	10.57	0.50	140.3	Ok		NA		NA	15	
OO1998-3 (NS-1) (Shoals)	SNE (Nantucket Shoals)	40.4670	69.4830	63	N/A	FV/Cape Fear	Apr-98	Loran / 40 ft / 30 sec	24	5 / 5	10	20	0.255	0.710	7.56	0.50	195.5	Ok					15	
Mean									20.3				0.113	0.860	7.204	29%						0.0146	0.199	
CV for Mean									16%				64%	10%	29%							1%	17%	
OO1997-1 (SH-1)	LI (Shinnecock)	40.2695	72.2985	58	N/A	FV/Laura Ann	Jul-97	Loran / 40 ft / 30 sec	28	7 / 7	7.75	20	0.083	0.458	10.57	0.39	164.2	Ok					1, 3	
OO1997-2 (WW-1) (Wildwood)	NJ	38.5095	74.1115	49	N/A	FV/Agitator	Aug-97	Loran / 40 ft / 30 sec	28	13 / 6	10	20	0.084	0.150	2.37	0.50	176.0	Ok		NA		NA	1, 4	
Mean				51					19.6				0.180	0.592	6.01	25%						0.0146	0.199	
CV for Mean				8%					19%				45%	23%	25%							1%	17%	

SEE FOOTNOTES ON NEXT PAGE

- ¹ NA
- ² NA
- ³ Depletion tows 1, 2, 12 & 18 omitted per NEFSC 1998, Figure E18
- ⁴ Depletion tows 1, 19, 23 & 27 omitted per NEFSC 1998, Figure E21
- ⁵ Setup station 5 dropped because sensor tow distance < 0.04 nm
- ⁶ Length composition data collected at setup tow 194 only for OQ2000-1 (indicated 6% of catch \geq 90 mm SL), setup data not useable.
- ⁷ Length composition data collected at setup tow 178 only for OQ2000-2 (indicated 28% of catch \geq 90 mm SL), used for all setup tows.
- ⁸ Length composition data collected at setup tows 3 and 6 only for OQ2000-3 (average 33% and 28% of catch \geq 90 mm SL), used for all setup tows.
- ⁹ Length composition data collected at setup tow 272 only for OQ2000-4 (33% of catch \geq 90 mm SL), used for all setup tows.
- ¹⁰ Sensor tow distance missing for setup station 4, average tow distance at stations 3, 5, 6, 7, 8 used instead.
- ¹¹ Depletion tow 1 omitted because it was outside the study area.
- ¹² Adjustments for apparent trends in numbers per bushel during depletion experiment.
- ¹³ Original estimates appear to have used incorrect mean number per bushel in depletion tows
- ¹⁴ Missing GPS location data at survey stations 198 and 216 (depletion tows 5 and 23) replaced by approximate start/stop locations and interpolation.
- ¹⁵ Anomalously high bushel count and length data at station 200 not used.
- ¹⁶ One setup tow with length data for OQ2002-4.
- ¹⁷ One setup tow with length data for OQ2000-2.
- ¹⁸ Two setup tows with length data for OQ2000-3.

Table A12. Summary of new and revised density, commercial dredge efficiency, and survey dredge efficiency estimates for ocean quahog 90+ mm SL from the Patch model and setup tows.

Statistic	Density (N ft ⁻²)	Commercial Vessel Efficiency	NEFSC Dredge Efficiency
N experiments	18	17	12
Minimum	0.007	0.150	0.098
Maximum	0.295	1.000	0.990
Median	0.082	0.660	0.165
Mean	0.097	0.596	0.248
<i>Distribution of point estimates¹</i>			
sd	0.141	0.267	0.241
CV (sd/mean)	1.453	0.448	0.972
Lo 95%	0.000	0.073	0.000
Hi 95%	0.373	1.000	0.722
<i>Distribution of average estimates¹</i>			
se	0.033	0.065	0.070
CV (se/mean)	0.236	0.243	0.289
Lo 95%	0.032	0.469	0.112
Hi 95%	0.162	0.723	0.385
<i>Distribution of median estimates²</i>			
se	0.011	0.091	0.029
Robust CV (se/median)	0.132	0.138	0.177
Lo 95%	0.047	0.402	0.136
Hi 95%	0.089	0.733	0.261

¹ Parametric statistics.

² Bootstrap statistics (15,000 iterations).

Table A13. Original (used in the last assessment, NEFSC 2004) and revised ocean quahog density and efficiency estimates from the Patch model based on depletion experiments during 1997-2002. Percent change is (Revised-Previous).Previous x 100. "NA" means not available. Previous and revised density estimates are shown but are not directly comparable because they are based on different size groups.

Experiment	Density ($D, n \text{ ft}^{-2}$) ^a		Commercial efficiency (E)		Setup Density ($d, n \text{ ft}^{-2}$)		Survey efficiency (e)					
	Previous	Revised	% Change ^c	Previous	Revised	% Change ^c	Previous	Revised	% Change ^c			
OQ2002-1	0.550	0.295	-46%	0.653	0.489	-25%	0.068	0.029	-57%	0.081	0.098	21%
OQ2002-2	0.345	0.165	-52%	0.810	0.785	-3%	0.067	0.024	-64%	0.158	0.149	-6%
OQ2002-3	0.111	0.081	-27%	0.816	0.777	-5%	0.037	0.024	-36%	0.275	0.297	8%
OQ2002-4	0.101	0.073	-27%	0.599	0.254	-58%	0.080	0.021	-74%	0.474	0.287	-39%
OQ2000-1 ^b	0.413	0.100	-76%	0.950	0.730	-23%	0.169	NA	NA	0.389	NA	NA
OQ2000-2 ^b	0.095	0.062	-35%	0.922	0.554	-40%	0.054	0.015	-73%	0.524	0.234	-55%
OQ2000-3 ^b	0.180	0.089	-51%	0.734	0.560	-24%	0.053	0.015	-72%	0.216	0.165	-24%
OQ1999-01 DE2	0.306	0.007	NA	NA	NA	NA	NA	NA	NA	0.470	0.990	111%
OQ1998-1	0.105	0.017	-84%	0.950	1.000	5%	NA	NA	NA	NA	NA	NA
OQ1998-2	0.242	0.067	-73%	0.401	0.869	117%	NA	NA	NA	NA	NA	NA
OQ1998-3	0.570	0.255	-55%	0.950	0.710	-25%	NA	NA	NA	NA	NA	NA
OQ1997-1	0.440	0.083	-81%	0.488	0.458	-6%	NA	NA	NA	NA	NA	NA
OQ1997-2	0.060	0.084	39%	0.256	0.150	-41%	NA	NA	NA	NA	NA	NA

^a Previous and revised density estimates are shown for completeness but are not comparable because they are based on different size groups.

^b Survey efficiencies calculated based on information in NEFSC (2000, Tables C12 and C13) using $e=d/D \times E$.

^c Percent change is (Revised - Previous) / Previous.

Table A14. Effects of new data and methods on efficiency and density estimates for ocean quahog from the Patch model and setup tows (where available).

Data and methods	Density (D, n/ft²)	Commercial Efficiency (E)	Setup Tow Density (d, n/ft²)	Survey Efficiency (e)
<i>OQ1998-2</i>				
Original ¹	0.242	0.401		
Step 1 ²	0.253	0.383		
Step 2 ³	NA	NA		NA
Step 3 ⁴	0.109	0.489		
New ⁵	0.067	0.869		
<i>OQ2002-1</i>				
Original ⁶	0.550	0.653	0.068	0.081
Step 1 ²	0.550	0.653	0.068	0.081
Step 2 ³	0.550	0.653	0.068	0.124
Step 3 ⁴	0.255	0.553	0.029	0.114
New ⁵	0.295	0.489	0.029	0.098

¹ From Table A10 in NEFSC (2004)

² Step 1 uses new programs and original data

³ Step 2 is like step 1 but with correct formula for survey dredge efficiency

⁴ Step 3 is like step 2 but with new catch data for 90+ mm SL

⁵ New estimates are the current best estimates and like step 3 but with revised position data

⁶ From Tables C11-C12 in NEFSC (2000)

Table A15. Efficiency corrected swept-area biomass estimates (1,000 mt) and CVs for the fishable stock of ocean quahog during 1997, 2000, 2002 and 2005 by stock assessment region. Figures for SVA and GBK during 2005 were taken from 2003 because no data were available for 2005.

	Estimate	CV
INPUT: Nominal tow distance (d_n , nm)	0.15	
INPUT: Dredge width (nm)	0.0008225	
Area swept per standard tow (a , nm ²)	1.23375E-04	10%

Area of assessment region (A , nm ²) - no correction for stations with unsuitable clam habitat		
S. Virginia and N. Carolina (SVA)	712	10%
Delmarva (DMV)	4,071	10%
New Jersey (NJ)	6,510	10%
Long Island (LI)	4,463	10%
Southern New England (SNE)	4,922	10%
Georges Bank (GBK)	7,821	10%
Total	28,499	

INPUT: Fraction suitable habitat (u)		
S. Virginia and N. Carolina (SVA)	100%	10%
Delmarva (DMV)	100%	10%
New Jersey (NJ)	100%	10%
Long Island (LI)	100%	10%
Southern New England (SNE)	96%	10%
Georges Bank (GBK)	90%	10%

Habitat area in assessment region (A' , nm ²)		
S. Virginia and N. Carolina (SVA)	712	14%
Delmarva (DMV)	4,071	14%
New Jersey (NJ)	6,510	14%
Long Island (LI)	4,463	14%
Southern New England (SNE)	4,714	14%
Georges Bank (GBK)	7,039	14%

INPUT: Biomass fraction in unsurveyed deep water		
S. Virginia and N. Carolina (SVA)	0%	10%
Delmarva (DMV)	0%	10%
New Jersey (NJ)	0%	10%
Long Island (LI)	0%	10%
Southern New England (SNE)	2%	10%
Georges Bank (GBK)	13%	10%

INPUT: Original survey mean catch from fishable stock (kg/tow, for tows adjusted to nominal tow distance using sensors)								
	Estimates for 1997		Estimates for 1999		Estimates for 2002		Estimates for 2005	
	CV		CV		CV		CV	
S. Virginia and N. Carolina (SVA)	0.0013	100%	0.0007	55%	0.0004	100%	0.0004	100%
Delmarva (DMV)	0.6528	23%	0.4449	26%	0.6863	24%	0.4221	48%
New Jersey (NJ)	1.7341	15%	0.9728	14%	1.8614	23%	1.0441	14%
Long Island (LI)	4.5648	17%	3.0065	14%	3.4414	17%	2.1812	16%
Southern New England (SNE)	2.2252	37%	2.6964	45%	3.2654	26%	2.2555	24%
Georges Bank (GBK)	2.6710	16%	3.1454	18%	3.8760	17%	3.8760	17%

Swept-area biomass without efficiency correction (B' , 1000 mt)								
S. Virginia and N. Carolina (SVA)	0.0076	102%	0.0040	59%	0.0022	102%	0.0022	102%
Delmarva (DMV)	21.5388	30%	14.6803	33%	22.6452	31%	13.9280	52%
New Jersey (NJ)	91.4993	25%	51.3297	24%	98.2159	30%	55.0929	24%
Long Island (LI)	165.1265	26%	108.7572	24%	124.4894	26%	78.9022	26%
Southern New England (SNE)	86.7210	42%	105.0878	49%	127.2624	33%	87.9046	31%
Georges Bank (GBK)	172.2007	26%	202.7813	27%	249.8861	26%	249.8861	26%
Total fishable biomass less GBK	365	17%	280	21%	373	16%	236	16%
Total fishable biomass	537	14%	483	17%	623	14%	486	16%

INPUT: Survey dredge efficiency (e)								
	0.165	18%	0.165	18%	0.165	18%	0.165	18%

Efficiency adjusted swept area fishable biomass (B , 1000 mt)								
S. Virginia and N. Carolina (SVA)	0.046	104%	0.024	61%	0.013	104%	0.013	104%
Delmarva (DMV)	131	35%	89	37%	137	36%	84	55%
New Jersey (NJ)	555	31%	311	30%	596	35%	334	30%
Long Island (LI)	1,002	32%	660	30%	755	32%	479	31%
Southern New England (SNE)	526	46%	638	52%	772	37%	533	36%
Georges Bank (GBK)	1,045	31%	1,230	32%	1,516	32%	1,516	32%
Total fishable biomass less GBK	2,214	24%	1,698	28%	2,261	24%	1,431	24%
Total fishable biomass	3,258	23%	2,928	24%	3,776	23%	2,947	24%

Lower bound for 80% confidence intervals on fishable biomass (1000 mt, for lognormal distribution with no bias correction)				
	Estimates for 1997	Estimates for 1999	Estimates for 2002	Estimates for 2005
S. Virginia and N. Carolina (SVA)	0.015	0.012	0.004	0.004
Delmarva (DMV)	84	56	88	44
New Jersey (NJ)	378	213	385	229
Long Island (LI)	675	452	509	324
Southern New England (SNE)	302	340	487	342
Georges Bank (GBK)	708	823	1,021	1,021
Total fishable biomass less GBK	1,627	1,199	1,667	1,060
Total fishable biomass	2,448	2,153	2,830	2,189

Upperbound for 80% confidence intervals on fishable biomass (1000 mt, for lognormal distribution with no bias correction)				
S. Virginia and N. Carolina (SVA)	0.137	0.050	0.040	0.040
Delmarva (DMV)	202	141	215	163
New Jersey (NJ)	814	454	923	488
Long Island (LI)	1,488	962	1,122	706
Southern New England (SNE)	918	1,197	1,225	833
Georges Bank (GBK)	1,542	1,839	2,251	2,251
Total fishable biomass less GBK	3,012	2,405	3,066	1,931
Total fishable biomass	4,336	3,982	5,039	3,967

Table A16. Ocean quahog fishing mortality estimates based on catch and efficiency corrected swept-area biomass for fishable ocean quahog during 1997, 1999, 2002 and 2005. CV's are based on analytical variance calculations assuming log normality, and include uncertainty in catch, survey data, swept-area, amount of suitable habitat, and survey dredge efficiency.

INPUT: Upper bound incidental mortality allowance	5%							
INPUT: Assumed CV for catch	10%							
INPUT: Landings (1000 mt, discard ~ 0)	Estimates for 1997	Estimates for 1999	Estimates for 2002	Estimates for 2005				
S. Virginia and N. Carolina (SVA)	0.000	0.000	0.000	0.000				
Delmarva (DMV)	1.072	1.092	1.737	0.935				
New Jersey (NJ)	4.229	3.043	2.788	0.665				
Long Island (LI)	5.141	6.338	9.139	9.713				
Southern New England (SNE)	8.968	6.628	3.895	2.021				
Georges Bank (GBK)	0.000	0.000	0.000	0.000				
Total	19.409	17.102	17.559	13.334				
Catch (1000 mt, landings + upper bound incidental mortality allowance)								
S. Virginia and N. Carolina (SVA)	0.000	0.000	0.000	0.000				
Delmarva (DMV)	1.126	1.146	1.824	0.981				
New Jersey (NJ)	4.441	3.195	2.928	0.699				
Long Island (LI)	5.398	6.655	9.596	10.199				
Southern New England (SNE)	9.416	6.960	4.090	2.122				
Georges Bank (GBK)	0.000	0.000	0.000	0.000				
Total	20.380	17.957	18.437	14.001				
INPUT: Efficiency Corrected Swept Area Biomass for Fishable Stock (1000 mt)	Estimates for 1997	CV	Estimates for 1999	CV	Estimates for 2002	CV	Estimates for 2005	CV
S. Virginia and N. Carolina (SVA)	0	104%	0	61%	0	104%	0	104%
Delmarva (DMV)	131	35%	89	37%	137	36%	84	55%
New Jersey (NJ)	555	31%	311	30%	596	35%	334	30%
Long Island (LI)	1,002	32%	660	30%	755	32%	479	31%
Southern New England (SNE)	526	46%	638	52%	772	37%	533	36%
Georges Bank (GBK)	1,045	31%	1,230	32%	1,516	32%	1,516	32%
Total fishable biomass less GBK	2,214	24%	1,698	28%	2,261	24%	1,431	24%
Total fishable biomass	3,258	23%	2,928	24%	3,776	23%	2,947	24%
Fishing mortality (y ⁻¹)								
S. Virginia and N. Carolina (SVA)	0.000	104%	0.000	62%	0.000	104%	0.000	104%
Delmarva (DMV)	0.009	37%	0.013	39%	0.013	37%	0.012	56%
New Jersey (NJ)	0.008	32%	0.010	32%	0.005	37%	0.002	32%
Long Island (LI)	0.005	NA	0.010	NA	0.013	33%	0.021	33%
Southern New England (SNE)	0.018	47%	0.011	53%	0.005	39%	0.004	37%
Georges Bank (GBK)	0.000	NA	0.000	NA	0.000	NA	0.000	NA
Total fishable biomass less GBK	0.009	26%	0.011	29%	0.008	26%	0.010	26%
Total fishable biomass	0.006	25%	0.006	26%	0.005	25%	0.005	26%
Lower bound for 80% confidence intervals for fishing mortality (y ⁻¹ , for lognormal distribution with no bias correction)	Estimates for 1997	Estimates for 1999	Estimates for 2002	Estimates for 2005				
S. Virginia and N. Carolina (SVA)	NA	NA	NA	NA				
Delmarva (DMV)	0.005	0.008	0.008	0.006				
New Jersey (NJ)	0.005	0.007	0.003	0.001				
Long Island (LI)	NA	NA	0.008	0.014				
Southern New England (SNE)	0.010	0.006	0.003	0.003				
Georges Bank (GBK)	NA	NA	NA	NA				
Total fishable biomass less GBK	0.007	0.007	0.006	0.007				
Total fishable biomass	0.005	0.004	0.004	0.003				
Upper bound for 80% confidence intervals for fishing mortality (y ⁻¹ , for lognormal distribution with no bias correction)								
S. Virginia and N. Carolina (SVA)	NA	NA	NA	NA				
Delmarva (DMV)	0.014	0.021	0.021	0.023				
New Jersey (NJ)	0.012	0.015	0.008	0.003				
Long Island (LI)	NA	NA	0.019	0.032				
Southern New England (SNE)	0.032	0.021	0.009	0.006				
Georges Bank (GBK)	NA	NA	NA	NA				
Total fishable biomass less GBK	0.013	0.015	0.011	0.014				
Total fishable biomass	0.009	0.009	0.007	0.007				

Table A17. Proportions of total fishable ocean quahog biomass during 1980-2005 at a range of survey biomass density levels, by region.

Years	Fishable biomass density levels (kg/tow) from survey data						Sum of Proportions (check)	Total Number of Tows	Total Number of Surveys
	0 to 4	5 to 9	10 to 14	15 to 19	20 to 24	25+			
Proportions of tows (and stock area) at each survey catch rate level:									
<i>Southern Virginia (SVA)</i>									
1980-1989	1.00						1.00	47	5
1990-1999	1.00						1.00	37	3
2000-2005	1.00						1.00	19	2
<i>Delmarva (DMV)</i>									
1980-1989	0.90	0.04	0.03	0.01	0.01	0.02	1.00	317	5
1990-1999	0.92	0.05	0.01	0.01	0.00		1.00	207	3
2000-2005	0.96	0.02	0.01	0.01			1.00	131	2
<i>New Jersey (NJ)</i>									
1980-1989	0.84	0.07	0.03	0.02	0.02	0.03	1.00	458	5
1990-1999	0.82	0.11	0.04	0.02	0.01		1.00	307	3
2000-2005	0.92	0.05	0.02			0.01	1.00	183	2
<i>Long Island (LI)</i>									
1980-1989	0.57	0.21	0.12	0.06	0.01	0.04	1.00	218	5
1990-1999	0.49	0.19	0.12	0.10	0.02	0.07	1.00	121	3
2000-2005	0.64	0.24	0.06	0.02	0.01	0.02	1.00	84	2
<i>Southern New England (SNE)</i>									
1980-1989	0.75	0.09	0.08	0.03	0.02	0.03	1.00	245	5
1990-1999	0.67	0.16	0.08	0.04	0.01	0.04	1.00	114	3
2000-2005	0.65	0.23	0.07	0.04	0.02		1.00	57	2
<i>Georges Bank (GBK)</i>									
1986-1992	0.82	0.06	0.03	0.01	0.01	0.06	1.00	201	3
1997-2002	0.68	0.10	0.07	0.03	0.05	0.07	1.00	219	3
All years	0.75	0.08	0.05	0.02	0.03	0.07	1.00	420	6
Mean survey catch rate (kg/tow) at each survey catch rate level (μ_L):									
<i>Southern Virginia (SVA)</i>									
1980-1989	0.054								
1990-1999	0.007								
2000-2005	0.002								
<i>Delmarva (DMV)</i>									
1980-1989	0.490	5.856	11.604	18.761	21.994	31.082			
1990-1999	0.413	7.133	13.556	17.734	21.847				
2000-2005	0.307	7.888	11.960	15.524					
<i>New Jersey (NJ)</i>									
1980-1989	0.848	7.115	12.577	17.033	20.956	35.668			
1990-1999	0.647	6.845	11.748	17.546	23.198				
2000-2005	0.938	6.166	12.707			29.972			
<i>Long Island (LI)</i>									
1980-1989	1.703	7.100	12.281	17.431	20.781	38.945			
1990-1999	1.252	7.523	12.508	16.974	22.793	30.846			
2000-2005	1.779	6.894	12.780	16.666	20.087	39.638			
<i>Southern New England (SNE)</i>									
1980-1989	1.002	7.084	12.200	17.286	21.627	33.942			
1990-1999	1.001	7.461	11.993	17.384	20.904	36.563			
2000-2005	1.387	7.238	12.077	16.226	21.845				
<i>Georges Bank (GBK)</i>									
1986-1992	0.627	6.874	12.945	16.049	23.225	44.962			
1997-2002	0.626	7.681	12.370	16.595	23.386	40.787			
All years	0.627	7.381	12.535	16.413	23.349	42.576			
Proportions of stock biomass at each survey catch rate level (X_L):									
<i>Southern Virginia (SVA)</i>									
1980-1989	1.00						1.00		
1990-1999	1.00						1.00		
2000-2005	1.00						1.00		
<i>Delmarva (DMV)</i>									
1980-1989	0.23	0.12	0.15	0.12	0.07	0.31	1.00		
1990-1999	0.30	0.27	0.15	0.20	0.08		1.00		
2000-2005	0.43	0.26	0.13	0.17			1.00		
<i>New Jersey (NJ)</i>									
1980-1989	0.22	0.15	0.14	0.09	0.10	0.29	1.00		
1990-1999	0.23	0.34	0.20	0.17	0.07		1.00		
2000-2005	0.49	0.17	0.16			0.19	1.00		
<i>Long Island (LI)</i>									
1980-1989	0.15	0.22	0.23	0.15	0.03	0.22	1.00		
1990-1999	0.08	0.18	0.19	0.21	0.07	0.28	1.00		
2000-2005	0.22	0.32	0.15	0.08	0.05	0.18	1.00		
<i>Southern New England (SNE)</i>									
1980-1989	0.18	0.16	0.22	0.13	0.08	0.23	1.00		
1990-1999	0.12	0.22	0.18	0.14	0.03	0.30	1.00		
2000-2005	0.21	0.38	0.19	0.13	0.09	0.00	1.00		
<i>Georges Bank (GBK)</i>									
1986-1992	0.11	0.10	0.08	0.05	0.08	0.58	1.00		
1997-2002	0.07	0.12	0.13	0.07	0.16	0.45	1.00		
All years	0.08	0.11	0.11	0.06	0.13	0.50	1.00		

Table A18. Proportions of total 2005 stock biomass at a range of survey density levels, by region.

Region	Survey catch rate level (kg/tow)						Total
	0 to 4	5 to 9	10 to 14	15 to 19	20 to 24	25+	
<i>Total 2005 biomass (mt meats)</i>							
Southern Virginia (SVA)	17	0	0	0	0	0	17
Delmarva (DMV)	43,532	26,628	13,459	17,470	0	0	101,089
New Jersey (NJ)	195,400	68,833	63,047	0	0	74,354	401,634
Long Island (LI)	151,198	217,001	100,560	52,457	31,612	124,762	677,590
Southern New England (SNE)	123,098	225,647	115,846	77,824	52,388	0	594,802
Georges Bank (GBK)	82,714	148,850	163,456	87,709	206,009	574,872	1,263,610
Total	595,959	686,960	456,369	235,460	290,008	773,987	3,038,741
<i>Total 2005 biomass (bushels)</i>							
Southern Virginia (SVA)	3,731	0	0	0	0	0	3,731
Delmarva (DMV)	9,597,036	5,870,504	2,967,208	3,851,373	0	0	22,286,120
New Jersey (NJ)	43,077,930	15,174,947	13,899,368	0	0	16,391,987	88,544,232
Long Island (LI)	33,333,071	47,840,106	22,169,510	11,564,629	6,969,113	27,504,966	149,381,395
Southern New England (SNE)	27,138,182	49,746,067	25,539,371	17,157,064	11,549,366	0	131,130,049
Georges Bank (GBK)	18,235,073	32,815,497	36,035,560	19,336,384	45,416,674	126,736,217	278,575,405
Total	131,385,021	151,447,120	100,611,016	51,909,450	63,935,154	170,633,170	669,920,932
<i>Percent of total 2005 biomass</i>							
Southern Virginia (SVA)	0.001%	0.000%	0.000%	0.000%	0.000%	0.000%	0.001%
Delmarva (DMV)	1.43%	0.88%	0.44%	0.57%	0.00%	0.00%	3.33%
New Jersey (NJ)	6.43%	2.27%	2.07%	0.00%	0.00%	2.45%	13.22%
Long Island (LI)	4.98%	7.14%	3.31%	1.73%	1.04%	4.11%	22.30%
Southern New England (SNE)	4.05%	7.43%	3.81%	2.56%	1.72%	0.00%	19.57%
Georges Bank (GBK)	2.72%	4.90%	5.38%	2.89%	6.78%	18.92%	41.58%
Total	19.61%	22.61%	15.02%	7.75%	9.54%	25.47%	100.00%

Table A19. Calculations to build a bridge between efficiency corrected swept area biomass estimates for ocean quahog during 2002 in NEFSC (2004) and new estimates in this assessment. Columns show cumulative effects from each change in data and methods starting with NEFSC's (2004) estimates on the left and ending with the new estimates on the right.

Region	NEFSC (2004)	Step 1 (New spread sheet)	Step 2 (Correct survey data)	Step 3 (Add biomass in deep water)	Step 4 (Use fishable biomass)	This assessment (New efficiency estimate)	Ratio (New / NEFSC(2004))
Data and configuration							
Efficiency	0.269	0.269	0.269	0.269	0.269	0.165	0.61
Size groups in Patch model	70+	70+	70+	70+	Fishable	Fishable	NA
Deep water percentage	0%	0%	0%	13%	13%	13%	NA
Survey data	Erroneous	Erroneous	Correct	Correct	Correct	Correct	NA
2002 efficiency corrected swept-area biomass estimates (1000 mt)							
SVA	0.01	0.01	0.01	0.01	0.01	0.01	1.93
DMV	71	71	89	89	84	137	1.93
NJ	330	330	383	383	365	596	1.81
LI	454	454	498	498	463	755	1.66
SNE	428	437	511	511	473	772	1.80
GBK	833	833	875	989	929	1,516	1.82
Total less GBK	1,283	1,292	1,481	1,481	1,385	2,261	1.76
Total	2,116	2,125	2,356	2,470	2,314	3,776	1.78

Table A20. "Best" fishable biomass and fishing mortality estimates for ocean quahog during 1978-2005, by stock assessment region and for the entire EEZ stock (with and without GBK).

Model	SVA		DMV		NJ		LI		SNE		GBK		Entire stock less GBK		Entire Stock	
	VPA	Estimate	KLAMZ	CV	KLAMZ	CV	KLAMZ	CV	KLAMZ	CV	Estimate	CV	Estimate	CV	NA	Estimate
Scaling parameter for swept area biomass	1 (assumed)	0.99	NA	NA	1.00	NA	0.99	NA	1	NA (assumed)	15,199 (excludes SVA & GBK)	NA	NA	NA	NA	NA
Recruitment (1000 mt)	NA	0 (assumed)	0.541	0.43	9.860	0.34	4.799	1.06	NA	NA	15,199 (excludes SVA)	NA	15,199 (excludes SVA & GBK)	NA	NA	NA
Fishable Stock Biomass (1000 mt)																
1978	0.338	299	0.10	0.22	718	0.26	788	0.32	1,264	0.19	2,710	0.19	3,973	0.19	2,710	3,973
1979	0.338	292	0.10	0.22	721	0.25	782	0.31	1,264	0.19	2,674	0.19	3,938	0.19	2,674	3,938
1980	0.338	280	0.10	0.21	723	0.24	777	0.30	1,264	0.19	2,636	0.19	3,900	0.19	2,636	3,900
1981	0.338	270	0.11	0.21	726	0.24	771	0.29	1,264	0.19	2,599	0.19	3,862	0.19	2,599	3,862
1982	0.275	261	0.11	0.21	729	0.23	765	0.28	1,264	0.19	2,562	0.19	3,826	0.19	2,562	3,826
1983	0.268	251	0.11	0.21	732	0.22	759	0.27	1,264	0.19	2,525	0.19	3,789	0.19	2,525	3,789
1984	0.268	240	0.11	0.20	734	0.22	753	0.26	1,264	0.19	2,489	0.19	3,753	0.19	2,489	3,753
1985	0.261	228	0.12	0.20	737	0.21	747	0.25	1,264	0.19	2,450	0.19	3,714	0.19	2,450	3,714
1986	0.075	216	0.12	0.20	739	0.20	741	0.24	1,264	0.19	2,409	0.19	3,672	0.19	2,409	3,672
1987	0.075	203	0.12	0.19	742	0.20	735	0.24	1,264	0.19	2,370	0.19	3,634	0.19	2,370	3,634
1988	0.075	189	0.13	0.19	743	0.20	729	0.23	1,264	0.19	2,330	0.19	3,594	0.19	2,330	3,594
1989	0.031	173	0.14	0.19	745	0.19	723	0.22	1,264	0.19	2,291	0.19	3,555	0.19	2,291	3,555
1990	0.031	163	0.15	0.19	747	0.19	717	0.21	1,264	0.19	2,252	0.19	3,515	0.19	2,252	3,515
1991	0.017	157	0.15	0.19	749	0.18	711	0.21	1,264	0.19	2,214	0.19	3,478	0.19	2,214	3,478
1992	0.017	149	0.15	0.19	749	0.18	705	0.20	1,264	0.19	2,176	0.19	3,440	0.19	2,176	3,440
1993	0.017	143	0.16	0.18	740	0.18	699	0.20	1,264	0.19	2,139	0.19	3,402	0.19	2,139	3,402
1994	0.017	139	0.16	0.18	734	0.18	693	0.19	1,264	0.19	2,102	0.19	3,366	0.19	2,102	3,366
1995	0.017	135	0.16	0.18	724	0.18	688	0.18	1,264	0.19	2,067	0.19	3,331	0.19	2,067	3,331
1996	0.017	131	0.16	0.18	718	0.18	678	0.18	1,264	0.19	2,033	0.19	3,296	0.19	2,033	3,296
1997	0.017	128	0.16	0.18	714	0.18	665	0.18	1,264	0.19	2,000	0.19	3,263	0.19	2,000	3,263
1998	0.017	125	0.16	0.18	712	0.18	652	0.18	1,264	0.19	1,968	0.19	3,231	0.19	1,968	3,231
1999	0.017	121	0.17	0.17	708	0.18	642	0.18	1,264	0.19	1,938	0.19	3,202	0.19	1,938	3,202
2000	0.017	117	0.17	0.17	705	0.18	631	0.18	1,264	0.19	1,910	0.19	3,173	0.19	1,910	3,173
2001	0.017	114	0.17	0.17	703	0.18	622	0.18	1,264	0.19	1,884	0.19	3,148	0.19	1,884	3,148
2002	0.017	111	0.17	0.17	700	0.18	614	0.18	1,264	0.19	1,857	0.19	3,121	0.19	1,857	3,121
2003	0.017	107	0.17	0.17	694	0.18	607	0.18	1,264	0.19	1,830	0.19	3,093	0.19	1,830	3,093
2004	0.017	104	0.17	0.17	685	0.18	601	0.18	1,264	0.19	1,802	0.19	3,065	0.19	1,802	3,065
2005	0.017	101	0.18	0.17	678	0.18	595	0.18	1,264	0.19	1,775	0.19	3,039	0.19	1,775	3,039

Table A20 (continued).

Fishing mortality rate	0.0000	0.0044	0.10	0.0097	0.22	0.00000	NA	0.0000	NA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0039	0.0026
1978	0.0000	0.0044	0.10	0.0097	0.22	0.00000	NA	0.0000	NA	0.0000	0.0000	0.0000	0.0000	0.0039	0.0026	
1979	0.0000	0.0191	0.10	0.0095	0.22	0.00000	NA	0.0000	NA	0.0000	0.0000	0.0000	0.0000	0.0059	0.0040	
1980	0.0000	0.0172	0.10	0.0103	0.21	0.00001	0.24	0.0000	0.24	0.0000	0.0000	0.0000	0.0000	0.0051	0.0034	
1981	0.2085	0.0148	0.11	0.0111	0.21	0.00000	0.24	0.0000	0.24	0.0000	0.0000	0.0000	0.0000	0.0051	0.0034	
1982	0.0252	0.0195	0.11	0.0116	0.21	0.00000	NA	0.0000	NA	0.0000	0.0000	0.0000	0.0000	0.0056	0.0037	
1983	0.0000	0.0224	0.11	0.0109	0.20	0.00003	0.22	0.0009	0.22	0.0009	0.0000	0.0000	0.0000	0.0058	0.0039	
1984	0.0257	0.0326	0.11	0.0126	0.20	0.00000	NA	0.0012	0.26	0.0012	0.0000	0.0000	0.0000	0.0072	0.0048	
1985	1.2454	0.0358	0.12	0.0163	0.20	0.0001	0.21	0.0010	0.25	0.0010	0.0000	0.0000	0.0000	0.0085	0.0056	
1986	0.0000	0.0407	0.12	0.0134	0.20	0.0006	0.20	0.0008	0.24	0.0008	0.0000	0.0000	0.0000	0.0079	0.0052	
1987	0.0000	0.0539	0.13	0.0134	0.19	0.0016	0.20	0.0010	0.24	0.0010	0.0000	0.0000	0.0000	0.0091	0.0059	
1988	0.8817	0.0649	0.14	0.0106	0.19	0.0009	0.20	0.0012	0.23	0.0012	0.0000	0.0000	0.0000	0.0087	0.0057	
1989	0.0000	0.0383	0.14	0.0221	0.19	0.0008	0.19	0.0017	0.22	0.0017	0.0000	0.0000	0.0000	0.0098	0.0063	
1990	0.6092	0.0230	0.15	0.0255	0.19	0.0010	0.19	0.0013	0.21	0.0013	0.0000	0.0000	0.0000	0.0094	0.0060	
1991	0.0000	0.0317	0.15	0.0249	0.19	0.0023	0.18	0.0012	0.21	0.0012	0.0000	0.0000	0.0000	0.0100	0.0064	
1992	0.0000	0.0163	0.16	0.0123	0.19	0.0161	0.18	0.0016	0.20	0.0016	0.0000	0.0000	0.0000	0.0104	0.0066	
1993	0.0000	0.0139	0.16	0.0187	0.19	0.0118	0.18	0.0015	0.20	0.0015	0.0000	0.0000	0.0000	0.0103	0.0065	
1994	0.0000	0.0073	0.16	0.0132	0.18	0.0166	0.18	0.0014	0.19	0.0014	0.0000	0.0000	0.0000	0.0100	0.0063	
1995	0.0000	0.0053	0.16	0.0105	0.18	0.0133	0.18	0.0080	0.19	0.0080	0.0000	0.0000	0.0000	0.0103	0.0064	
1996	0.0000	0.0057	0.16	0.0098	0.18	0.0084	0.18	0.0125	0.18	0.0125	0.0000	0.0000	0.0000	0.0099	0.0061	
1997	0.0000	0.0085	0.16	0.0087	0.18	0.0073	0.18	0.0137	0.18	0.0137	0.0000	0.0000	0.0000	0.0099	0.0060	
1998	0.0000	0.0112	0.16	0.0057	0.18	0.0097	0.18	0.0105	0.18	0.0105	0.0000	0.0000	0.0000	0.0091	0.0056	
1999	0.0000	0.0092	0.17	0.0066	0.17	0.0090	0.18	0.0105	0.18	0.0105	0.0000	0.0000	0.0000	0.0090	0.0054	
2000	0.0000	0.0091	0.17	0.0074	0.17	0.0068	0.18	0.0082	0.18	0.0082	0.0000	0.0000	0.0000	0.0077	0.0047	
2001	0.0000	0.0084	0.17	0.0110	0.17	0.0086	0.18	0.0080	0.18	0.0080	0.0000	0.0000	0.0000	0.0091	0.0054	
2002	0.0000	0.0160	0.17	0.0065	0.17	0.0132	0.18	0.0064	0.18	0.0064	0.0000	0.0000	0.0000	0.0097	0.0058	
2003	0.0000	0.0085	0.17	0.0089	0.17	0.0170	0.18	0.0036	0.18	0.0036	0.0000	0.0000	0.0000	0.0103	0.0061	
2004	0.0000	0.0062	0.17	0.0069	0.17	0.0157	0.18	0.0055	0.18	0.0055	0.0000	0.0000	0.0000	0.0098	0.0058	
2005	0.0000	0.0094	0.18	0.0017	0.17	0.0145	0.18	0.0034	0.18	0.0034	0.0000	0.0000	0.0000	0.0077	0.0045	

Table A21. Ocean quahog biomass in 2005 as a percentage of biomass in 1978, based on best estimates.

SVA	DMV	NJ	LI	SNE	GBK	Entire stock less GBK	Entire Stock
5%	34%	44%	94%	75%	100%	66%	76%

Table A22. Comparison of best estimates for ocean quahog biomass during 2004 from the previous (NEFSC 2004) and current assessments.

Assessment	SVA	DMV	NJ	LI	SNE	GBK	Entire stock less GBK	Entire Stock
<i>1978 Biomass Estimates (Virgin Biomass)</i>								
This assessment	0.338	299	904	718	788	1,264	2,710	3,973
NEFSC (2004)	0.297	298	455	534	386	655	1,674	2,329
Ratio (new/old)	1.1	1.0	2.0	1.3	2.0	1.9	1.6	1.7
<i>2004 Biomass Estimates</i>								
This assessment	0.0169	103.8	411.5	685	601.3	1264	1801.603121	3065
NEFSC (2004)	0.013	91	284	478	349	655	1,201	1,856
Ratio (new/old)	1.3	1.1	1.5	1.4	1.7	1.9	1.5	1.7

Table A23. Mean numbers per tow for ocean quahog < 70 mm SL and mean weight per tow for ocean quahog 70+ mm SL in NEFSC clam surveys on GBK during 1986-2002 (1994 omitted due to high pump voltage).

Year	< 70 mm SL		70+ mm SL	
	(N tow ⁻¹)	CV	(KG tow ⁻¹)	CV
1986	40.5	0.60	5.7	0.17
1989	7.0	0.32	2.3	0.26
1992	31.7	0.35	9.0	0.21
1997	62.0	0.35	6.6	0.19
1999	35.3	0.34	7.5	0.19
2002	39.7	0.18	8.7	0.20

Table A24. Biological reference points for ocean quahog from a length based per-recruit model with sensitivity analyses. Biological reference points from an age based per-recruit model in the last assessment (NEFSC 2004) are shown for comparison.

Reference Point	Natural Mortality (M)			Fishery selectivity L50%		Growth parameter K		Maturity L50%		
	Old (SARC-38)	New basecase ^A (M _{LO} =0.01 y ⁻¹)	Half basecase (M _{HI} =0.04 y ⁻¹)	Double basecase (M _{HI} =0.04 y ⁻¹)	Basecase - 5 mm (L50 _{LO} = 73 - 5 = 67 mm)	Basecase - 5 mm (L50 _{HI} = 73 + 5 = 78 mm)	Basecase - 30% (K _{LO} = 0.0311 * 0.7 = 0.0218 y ⁻¹)	Basecase + 30% (K = 0.0311 * 1.3 = 0.0404 y ⁻¹)	Basecase - 5 mm (L50 _{LO} = 64 - 5 = 59 mm)	Basecase + 5 mm (L50 _{HI} = 64 + 5 = 69 mm)
F _{0.1} (target)	0.0275	0.0278	0.0160	0.0618	0.0254	0.0300	0.0288	0.0277	0.0278	0.0278
F _{MAX}	0.1810	0.0760	0.0361	0.2300	0.0632	0.0896	0.0882	0.0722	0.0760	0.0760
F _{25%} (threshold)	0.0800	0.0517	0.0291	0.1249	0.0429	0.0617	0.0564	0.0501	0.0561	0.0478
F _{50%}	0.0200	0.0180	0.0110	0.0402	0.0158	0.0205	0.0192	0.0177	0.0190	0.0171

^A In the basecase run: $M=0.02\text{ y}^{-1}$, growth parameters ($L_{max}=97.28\text{ mm}$; $K=0.0311\text{ y}^{-1}$) are from NEFSC (2002); maturity ($a=-5.92$; $b=0.0927$) and fishery selectivity ($a=-7.63$; $b=0.1054$) parameters are from Thorarindottir and Jacobson (2005); and length-weight parameters ($\ln a=-9.242$; $b=2.821$) are from an average length-weight curve for all stock assessment areas.

Table A25. Percentage of ocean quahog biomass in each stock assessment region during 1978 and 2005. Percentages for SVA, DMV, NJ, LI, SNE and GBK in the same row sum to 100%.

Year	SVA	DMV	NJ	LI	SNE	GBK	Entire stock less GBK
1978	0.009%	8%	23%	18%	20%	32%	68%
2005	0.001%	3%	13%	22%	20%	42%	58%

Table A26. Input data for ocean quahog projections.

Year	SVA	DMV	NJ	LI	SNE	GBK	Total Less GBK	Total
Somatic growth rate ($G y^{-1}$)								
2005	0.0045	1.0600E-07	0.0013	0.0101	0.0066	0	0.0064	0.0037
Recruitment rate ($r = \text{Recruitment} / \text{Average Biomass in 2005 } y^{-1}$)								
2005	0.0060	1.0038E-08	0.0014	0.0146	0.0081	0.0000	0.0086	0.0050
Natural mortality ($M y^{-1}$)								
2005	0.0200	0.0200	0.0200	0.0200	0.0200	0	0.0200	0.0117
Initial Biomass								
2005	0.017	101	402	678	595	1,264	1,775	3,039
Landings ($mt y^{-1}$)								
2005	0.000	0.890	0.634	9.251	1.924	0	12.6990	12.6990
Catch (landings + 5% allowance for incidental mortality, $mt y^{-1}$)								
2005	0.000	0.935	0.665	9.713	2.021	0	13.3340	13.3340
Fishing mortality ($F y^{-1}$)								
2005	0.0000	0.0094	0.0017	0.0145	0.0034	0	0.0077	0.0045

Table A27. Projected biomass and fishing mortality for ocean quahog during 2005-2010 based on a 4 million bushel (18,144 mt meats) annual quota during 2007-2010. Landings during 2006 are assumed the same as in 2005. Proportions of total catch in each year for each region are the same as in 2005.

Year	SVA	DMV	NJ	LI	SNE	GBK	Total Less GBK	Total
Somatic growth rate ($G y^{-1}$)								
2005	0.0045	0.0000	0.0013	0.0101	0.0066	0.0000	0.0064	0.0037
Recruitment rate ($r = \text{Recruitment} / \text{Average Biomass in 2002 } y^{-1}$)								
2005	0.0060	0.0000	0.0014	0.0146	0.0081	0.0000	0.0086	0.0050
Natural mortality ($M y^{-1}$)								
2005	0.0200	0.0200	0.0200	0.0200	0.0200	0.0000	0.0200	0.0117
Net instantaneous rate of change, less fishing ($X - F = G + r - M y^{-1}$)								
2005	-0.0095	-0.0200	-0.0174	0.0047	0.0052	0.0000	-0.0050	0.0029
Fishing mortality first year ($F y^{-1}$)								
2005	0.0000	0.0094	0.0017	0.0145	0.0034	0.0000	0.0077	0.0045
Landings (mt meats y^{-1})								
2005-2006	0	1	1	9	2	0	13	13
2007-2010	0	1	1	13	3	0	18	18
Catch (mt meats y^{-1}, landings+ 5% allowance for incidental mortality)								
2005-2006	0	1	1	10	2	0	13	13
2007-2010	0	1	1	14	3	0	19	19
Initial Biomass								
2005-2006	0	101	402	678	595	1,264	1,775	3,039
Projected biomass (mt meats)								
2006	0	98	394	671	590	1,264	1,753	3,016
2007	0	95	387	664	585	1,264	1,731	2,995
2008	0	92	379	654	579	1,264	1,703	2,967
2009	0	89	372	643	573	1,264	1,676	2,940
2010	0	86	364	632	567	1,264	1,649	2,912
Projected fishing mortality rate ($F y^{-1}$)								
2006	0.000	0.010	0.002	0.015	0.003	0.000	0.008	0.004
2007	0.000	0.014	0.002	0.021	0.005	0.000	0.011	0.006
2008	0.000	0.015	0.003	0.021	0.005	0.000	0.011	0.006
2009	0.000	0.015	0.003	0.022	0.005	0.000	0.011	0.007
2010	0.000	0.016	0.003	0.022	0.005	0.000	0.012	0.007

Table A28. Projected biomass and fishing mortality for ocean quahog during 2005-2010 based on a 5.333 million bushel (24,189 mt meats) annual quota during 2007-2010. Landings during 2006 are assumed the same as in 2005. Proportions of total catch in each year for each region are the same as in 2005.

Year	SVA	DMV	NJ	LI	SNE	GBK	Total Less GBK	Total
Somatic growth rate ($G y^{-1}$)								
2005	0.0045	0.0000	0.0013	0.0101	0.0066	0.0000	0.0064	0.0037
Recruitment rate ($r = \text{Recruitment} / \text{Average Biomass in 2002 } y^{-1}$)								
2005	0.0060	0.0000	0.0014	0.0146	0.0081	0.0000	0.0086	0.0050
Natural mortality ($M y^{-1}$)								
2005	0.0200	0.0200	0.0200	0.0200	0.0200	0.0000	0.0200	0.0117
Net instantaneous rate of change, less fishing ($X - F = G + r - M y^{-1}$)								
2005	-0.0095	-0.0200	-0.0174	0.0047	-0.0052	0.0000	-0.0050	-0.0029
Fishing mortality first year ($F y^{-1}$)								
2005	0.0000	0.0094	0.0017	0.0145	0.0034	0.0000	0.0077	0.0045
Landings (mt meats y^{-1})								
2005-2006	0	1	1	9	2	0	13	13
2007-2010	0	2	1	18	4	0	24	24
Catch (mt meats y^{-1}, landings+ 5% allowance for incidental mortality)								
2005-2006	0	1	1	10	2	0	13	13
2007-2010	0	2	1	19	4	0	25	25
Initial Biomass								
2005-2006	0	101	402	678	595	1,264	1,775	3,039
Projected biomass (mt meats)								
2006	0	98	394	671	590	1,264	1,753	3,016
2007	0	95	387	664	585	1,264	1,731	2,995
2008	0	92	379	649	578	1,264	1,697	2,961
2009	0	88	371	633	571	1,264	1,663	2,927
2010	0	85	363	618	564	1,264	1,630	2,893
Projected fishing mortality rate ($F y^{-1}$)								
2006	0.000	0.010	0.002	0.015	0.003	0.000	0.008	0.004
2007	0.000	0.019	0.003	0.028	0.007	0.000	0.015	0.009
2008	0.000	0.020	0.003	0.029	0.007	0.000	0.015	0.009
2009	0.000	0.021	0.003	0.030	0.007	0.000	0.015	0.009
2010	0.000	0.021	0.004	0.030	0.007	0.000	0.016	0.009

Table A29. Projected biomass and fishing mortality for ocean quahog during 2005-2010 based on a 6 million bushel (27,215 mt meats) annual quota during 2007-2010. Landings during 2006 are assumed the same as in 2005. Proportions of total catch in each year for each region are the same as in 2005.

Year	SVA	DMV	NJ	LI	SNE	GBK	Total Less GBK	Total
Somatic growth rate ($G y^{-1}$)								
2005	0.0045	0.0000	0.0013	0.0101	0.0066	0.0000	0.0064	0.0037
Recruitment rate ($r = \text{Recruitment} / \text{Average Biomass in 2002 } y^{-1}$)								
2005	0.0060	0.0000	0.0014	0.0146	0.0081	0.0000	0.0086	0.0050
Natural mortality ($M y^{-1}$)								
2005	0.0200	0.0200	0.0200	0.0200	0.0200	0.0000	0.0200	0.0117
Net instantaneous rate of change, less fishing ($X - F = G + r - M y^{-1}$)								
2005	-0.0095	-0.0200	-0.0174	0.0047	-0.0052	0.0000	-0.0050	-0.0029
Fishing mortality first year ($F y^{-1}$)								
2005	0.0000	0.0094	0.0017	0.0145	0.0034	0.0000	0.0077	0.0045
Landings (mt meats y^{-1})								
2005-2006	0	1	1	9	2	0	13	13
2007-2010	0	2	1	20	4	0	27	27
Catch (mt meats y^{-1}, landings+ 5% allowance for incidental mortality)								
2005-2006	0	1	1	10	2	0	13	13
2007-2010	0	2	1	21	4	0	29	29
Initial Biomass								
2005-2006	0	101	402	678	595	1,264	1,775	3,039
Projected biomass (mt meats)								
2006	0	98	394	671	590	1,264	1,753	3,016
2007	0	95	387	664	585	1,264	1,731	2,995
2008	0	91	379	647	577	1,264	1,694	2,957
2009	0	88	371	629	570	1,264	1,657	2,921
2010	0	84	363	611	563	1,264	1,620	2,884
Projected fishing mortality rate ($F y^{-1}$)								
2006	0.000	0.010	0.002	0.015	0.003	0.000	0.008	0.004
2007	0.000	0.021	0.004	0.032	0.007	0.000	0.017	0.010
2008	0.000	0.022	0.004	0.033	0.008	0.000	0.017	0.010
2009	0.000	0.023	0.004	0.034	0.008	0.000	0.017	0.010
2010	0.000	0.024	0.004	0.035	0.008	0.000	0.018	0.010

Table A30. Projected biomass and fishing mortality for ocean quahog during 2005-2010 based on $F=F_{0.1}=0.0278 \text{ y}^{-1}$ for exploitable region (total area less GBK) during 2007-2010. Landings during 2006 are assumed the same as in 2005. Proportions of total catch in each year for each region are the same as in 2005.

Year	SVA	DMV	NJ	LI	SNE	GBK	Total Less GBK	Total
Somatic growth rate ($G \text{ y}^{-1}$)								
2005	0.0045	0.0000	0.0013	0.0101	0.0066	0.0000	0.0064	0.0037
Recruitment rate ($r = \text{Recruitment} / \text{Average Biomass in 2002 } \text{y}^{-1}$)								
2005	0.0060	0.0000	0.0014	0.0146	0.0081	0.0000	0.0086	0.0050
Natural mortality ($M \text{ y}^{-1}$)								
2005	0.0200	0.0200	0.0200	0.0200	0.0200	0.0000	0.0200	0.0117
Fishing mortality ($F \text{ y}^{-1}$)								
2005-2006	0.0000	0.0094	0.0017	0.0145	0.0034	0.0000	0.0077	0.0045
2007-2010	0.0278	0.0278	0.0278	0.0278	0.0278	0.0000	NA	NA
Net instantaneous rate of change $X = G + r - F - M \text{ y}^{-1}$)								
2005-2006	-0.0095	-0.0294	-0.0190	-0.0098	-0.0086	0.0000	-0.0127	-0.0074
2007-2010	-0.0373	-0.0478	-0.0452	-0.0231	-0.0330	0.0000	NA	NA
Initial Biomass								
2005	0.017	101	402	678	595	1,264	1,775	3,039
Projected biomass (mt meats)								
2006	0.017	98	394	671	590	1,264	1,753	3,016
2007	0.016	94	377	656	571	1,264	1,696	2,960
2008	0.016	89	360	641	552	1,264	1,642	2,905
2009	0.015	85	344	626	534	1,264	1,589	2,853
2010	0.014	81	329	612	517	1,264	1,538	2,802
Catch (landings + 5% allowance for incidental mortality, mt y^{-1})								
2006	0.0	0.9	0.7	9.7	2.0	0.0	13.3	13.3
2007	0.0	3.2	2.3	33.8	7.0	0.0	46.4	46.4
2008	0.0	3.1	2.2	32.1	6.7	0.0	44.1	44.1
2009	0.0	3.0	2.1	30.8	6.4	0.0	42.3	42.3
2010	0.0	2.9	2.0	29.7	6.2	0.0	40.8	40.8
Landings (95% of catch, mt y^{-1})								
2006	0.0	0.9	0.6	9.2	1.9	0.0	12.7	12.7
2007	0.0	3.1	2.2	32.1	6.7	0.0	44.0	44.0
2008	0.0	2.9	2.1	30.5	6.4	0.0	41.9	41.9
2009	0.0	2.8	2.0	29.2	6.1	0.0	40.1	40.1
2010	0.0	2.7	1.9	28.2	5.9	0.0	38.7	38.7
Projected fishing mortality rate ($F \text{ y}^{-1}$)								
2006	0.000	0.009	0.002	0.014	0.003	0.000	0.008	0.004
2007	0.000	0.035	0.006	0.052	0.012	0.000	0.027	0.016
2008	0.000	0.035	0.006	0.051	0.012	0.000	0.027	0.015
2009	0.000	0.035	0.006	0.050	0.012	0.000	0.027	0.015
2010	0.000	0.036	0.006	0.049	0.012	0.000	0.027	0.015

Table A31. Summary of example projections.

Year	Biomass All Regions (1000 mt)	Biomass less GBK (1000 mt)	Landings (1000 mt)	F All Regions (y^{-1})	F less GBK (y^{-1})
Quota = 4 million bushels (18,144 mt meats)					
2006	3,016	1,753	13	0.004	0.008
2007	2,995	1,731	18	0.006	0.011
2008	2,967	1,703	18	0.006	0.011
2009	2,940	1,676	18	0.007	0.011
2010	2,912	1,649	18	0.007	0.012
Quota = 5.333 million bushels (24,189 mt meats)					
2006	3,016	1,753	13	0.004	0.008
2007	2,995	1,731	24	0.009	0.015
2008	2,961	1,697	24	0.009	0.015
2009	2,927	1,663	24	0.009	0.015
2010	2,893	1,630	24	0.009	0.016
Quota = 6 million bushels (27,215 mt meats)					
2006	3,016	1,753	13	0.004	0.008
2007	2,995	1,731	27	0.010	0.017
2008	2,957	1,694	27	0.010	0.017
2009	2,921	1,657	27	0.010	0.017
2010	2,884	1,620	27	0.010	0.018
$F = F_{0.1} = 0.028 y^{-1}$ in exploited regions ($F=0$ for GBK)					
2006	3,016	1,753	13	0.004	0.028
2007	2,960	1,696	44	0.016	0.028
2008	2,905	1,642	42	0.015	0.028
2009	2,853	1,589	40	0.015	0.028
2010	2,802	1,538	39	0.015	0.028