Table A1. Annual landings of ocean quahog (metric tons, meats) from state waters and the Exclusive Economic Zone, and annual quotas.

Year	State Water	EEZ	Total	Percent EEZ	EEZ Quota[4]
1967[1]	20	-	20	0	-
1968	102	-	102	0	-
1969	290	-	290	0	-
1970	792	-	792	0	-
1971	921	-	921	0	-
1972	634	-	634	0	-
1973	661	-	661	0	-
1974	365	-	365	0	-
1975	569	-	569	0	-
1976	656	1,854	2,510	74	-
1977	1,118	7,293	8,411	87	-
1978	1,218	9,197	10,415	88	13,608
1979	1,404	14,344	15,748	91	13,608
1980[2]	-	13,407	11,623	-	15,876
1981	-	13,101	11,202	-	18,144
1982	2,244	14,234	16,478	86	18,144
1983	1,614	14,586	16,200	90	18,144
1984	-	17,974	17,939	100	18,144
1985	1,309	20,726	22,035	94	19,958
1986	1,683	18,902	20,585	92	27,215
1987	1,204	21,514	22,718	95	27,215
1988	734	20,273	21,006	96	27,215
1989	787	22,359	23,146	97	23,587
1990	268	20,966	21,234	99	24,040
1991	-	22,119	22,118	100	24,040
1992	357	22,514	22,871	98	24,040
1993	2,933	21,909	24,843	88	24,494
1994	140	21,017	21,158	99	24,494
1995	2,087	21,166	23,252	91	22,226
1996	990	20,132	21,122	95	20,185
1997	190	19,739	19,929	99	19,581
1998	90	18,007	18,097	100	18,140
1999	33	17,523	17556	100	20,411
2000	0	14,904	14,898	100	20,411
2001	0	17,234	17,234	100	20,411
2002	0	18,144	18,144	100	20,411
2003[3]	-	10,932	-	-	20,411

[1] Values from 1967-1979 are from NEFSC 90-07.
[2] From 1980-2003, “totals” are from the CFDETS database, EEZ landings are from logbooks (SFyyVR), and state landings are by taking the difference. Values assume 1 ”Industry” bushel OQ = 4.5359 kg meats. “Landings” reported in table do not take indirect mortality into account.
[3] 2003 has a partial year of data.
[4] An additional quota of 100,000 “Maine” bushels began in 1999. See Table A5 for those landings.

Table A2. Ocean quahog landings in metric tons of meats (calculated from number of bushels reported in logbooks) for the US EEZ, by stock assessment region. GBK not shown because landings were zero. 2003 is a partial year of data.

YEAR	SVA	DMV	NJ	LI	SNE	Other EEZ	EEZ Total
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	291	14,586
1984	6	7,164	8,858	0	822	1,124	17,974
1985	160	7,200	10,679	40	693	1,954	20,726
1986	0	8,231	9,061	396	562	652	18,902
1987	0	10,540	9,070	1,180	696	28	21,514
1988	42	11,715	7,014	640	841	21	20,273
1989	0	6,439	14,100	605	1,196	19	22,359
1990	14	3,691	15,583	739	934	5	20,966
1991	0	4,839	14,575	1,674	865	166	22,119
1992	0	2,378	6,942	11,939	1,143	112	22,514
1993	0	1,975	10,172	8,652	1,020	90	21,909
1994	0	992	6,970	11,983	954	118	21,017
1995	0	699	5,356	9,464	5,443	204	21,166
1996	0	736	4,864	5,905	8,319	308	20,132
1997	0	1,072	4,249	5,130	8,958	330	19,739
1998	0	1,365	2,664	6,570	6,433	975	18,007
1999	0	1,090	3,038	6,328	6,619	448	17,523
2000	0	1,048	3,318	4,745	5,083	710	14,904
2001	0	894	4,536	5,716	4,694	1,394	17,234
2002	0	1,732	2,781	9,113	3,884	634	18,144
2003	0	822	2,090	6,085	1,560	375	10,932

Table A3. Reported fishing effort (hours fished) for ocean quahog in the US EEZ, by stock assessment region, from logbooks. GBK not shown because fishing effort was zero.

YEAR	SVA	DMV	NJ	LI	SNE	Row Total
1980	0	6,942	16,039	32	0	23,014
1981	73	5,864	15,949	6	0	21,892
1982	7	7,241	14,737	0	0	21,985
1983	3,495	23,095	33,735	497	2,502	63,324
1984	2,351	19,434	34,499	24	3,657	59,965
1985	556	14,196	27,143	87	3,559	45,541
1986	223	13,984	24,785	397	3,587	42,975
1987	262	16,589	26,731	812	5,110	49,503
1988	386	19,861	24,898	615	6,990	52,750
1989	228	13,738	36,099	797	7,159	58,021
1990	1,175	10,258	42,018	1,283	4,870	59,603
1991	0	12,065	30,476	1,899	1,433	45,874
1992	0	5,513	16,150	13,501	1,976	37,141
1993	0	4,731	25,737	13,043	1,783	45,295
1994	0	2,260	20,674	19,282	2,088	44,303
1995	0	1,621	13,598	16,011	8,601	39,830
1996	0	2,450	9,382	10,206	11,843	33,882
1997	0	2,742	9,426	8,295	13,550	34,014
1998	0	3,225	6,960	10,171	10,289	30,646
1999	0	2,595	7,623	9,132	12,276	31,626
2000	0	2,517	8,013	7,071	10,562	28,163
2001	0	2,190	10,857	7,938	11,404	32,389
2002	0	4,303	6,733	11,686	7,829	30,551
2003	0	2,298	5,739	7,476	3,172	18,685

[1]2003 is a partial year.

Table A4.

Summary of annual, large vessel, commercial catch rates (kg meat/hr) of ocean quahogs, by region (assuming 1 bu = 10 lbs = 4.5359 kg).
A separate GLM on ln(LPUE) was run for each region. SVA was excluded due to small sample size.
GLM #1 models include year and subregion as explanatory variables. They include all trips.
GLM #2 models include vessel, year and subregion as explanatory variables. They omit annual data from fishery startup years and from vessels with <25 trips within a year.

	DMV					NJ					LI					SNE				
	Nominal	GLM #1		GLM #2		Nominal	GLM #1		GLM #2		Nominal	GLM #1		GLM #2		Nominal	GLM #1		GLM #2	
Year		GLM 1. (Yr, Subreg)	CV	GLM 2. (Yr, Vessel, Subreg)	CV		GLM 1. (Yr, Subreg)	CV	GLM 2. (Yr, Vessel, Subreg)	CV		GLM 1. (Yr, Subreg)	CV	GLM 2. (Yr, Vessel, Subreg)	CV		GLM 1. (Yr, Subreg)	CV	GLM 2. (Yr, Vessel, Subreg)	CV
1980	608.53	537.241	0.245	631.487	0.245	486.399	635.216	0.233	503.186	0.264	183.14	226.129	0.672							
1981	621.29	544.146	0.246	629.068	0.246	546.889	694.881	0.233	560.694	0.264	556.4	686.978	0.672							
1982	647.42	576.798	0.245	686.336	0.244	611.063	767.421	0.233	606.853	0.264										
1983	757.83	659.576	0.245	787.469	0.244	614.742	788.755	0.233	629.481	0.264	420.93	401.575	0.454			400.921	413.509	0.239		
1984	664.85	594.973	0.244	708.751	0.243	583.724	742.736	0.233	589.504	0.264						326.735	337.827	0.233		
1985	746.04	650.575	0.245	756.326	0.243	603.909	738.403	0.232	589.791	0.263	462.35	573.688	0.358			335.186	333.369	0.232		
1986	708.1	615.469	0.244	676.076	0.243	631.02	747.983	0.233	592.837	0.264	1159.11	1322.442	0.250			493.941	521.523	0.243		
1987	693.65	622.677	0.243	638.299	0.242	591.949	704.401	0.233	553.480	0.264	1453.74	1721.910	0.206			572.92	604.592	0.237		
1988	606.66	553.135	0.243	552.744	0.242	589.112	679.055	0.234	512.579	0.264	963.76	1191.574	0.240			552.675	560.008	0.238	752.993	0.237
1989	523.2	505.072	0.244	501.446	0.242	568.287	681.653	0.232	497.583	0.263	758.86	930.368	0.223			437.949	461.430	0.230	728.736	0.233
1990	463.51	426.080	0.247	471.437	0.244	532.868	643.898	0.232	465.043	0.263	576.5	860.130	0.225			497.907	551.271	0.234	800.716	0.236
1991	397.01	367.778	0.245	386.077	0.243	468.862	556.598	0.232	393.614	0.263	819.81	848.479	0.210	1001.963	0.219	598.657	596.864	0.231	784.662	0.232
1992	426.45	409.600	0.251	399.749	0.247	397.201	494.193	0.234	384.750	0.264	870.11	854.487	0.167	1028.605	0.191	712.962	736.070	0.227	963.822	0.227
1993	401.41	389.355	0.250	364.593	0.248	377.707	452.653	0.233	328.006	0.263	657.14	677.662	0.169	796.102	0.191	706.506	715.271	0.229	939.242	0.230
1994	440.88	399.591	0.258	396.544	0.253	329.983	387.131	0.234	300.717	0.264	615.01	648.662	0.167	733.556	0.189	593.141	603.831	0.231	793.167	0.231
1995	430.93	384.360	0.264	372.672	0.258	382.477	456.100	0.235	359.352	0.264	620.71	643.573	0.168	768.406	0.190	650.609	654.160	0.211	744.940	0.217
1996	300.42	417.895	0.264	401.844	0.258	519.089	640.699	0.238	495.504	0.266	605.06	617.973	0.170	733.239	0.191	709.095	712.088	0.210	791.508	0.215
1997	392.51	346.067	0.258	365.361	0.253	463.504	581.458	0.238	431.927	0.266	637.85	650.393	0.173	757.129	0.193	690.272	696.233	0.211	749.646	0.215
1998	431.95	383.297	0.258	381.972	0.253	380.099	508.365	0.242	382.202	0.268	693.91	702.060	0.175	796.318	0.193	642.66	650.164	0.212	709.184	0.216
1999	417.7	370.396	0.259	352.218	0.253	390.013	499.392	0.242	370.923	0.268	746.33	748.803	0.174	863.935	0.193	552.507	537.267	0.211	628.244	0.215
2000	416.22	380.240	0.258	347.104	0.253	414.076	520.799	0.239	386.338	0.266	688.19	682.587	0.179	775.917	0.196	491.894	472.576	0.212	591.276	0.216
2001	406.95	351.925	0.263	293.901	0.256	425.326	538.499	0.237	391.467	0.265	699.64	673.930	0.178	768.241	0.196	421.963	426.384	0.213	510.781	0.216
2002	398.41	379.475	0.254	322.193	0.248	433.116	532.641	0.245	379.214	0.269	797.56	780.584	0.172	814.961	0.189	517.175	556.111	0.213	754.344	0.218
2003	347.77	328.869		279.719		356.319	437.553		285.799		837.76	837.743		860.494		548.802	572.908		701.548	

Table A5.

Commercial logbook data about ocean quahogs from Maine. Landings are in units of "Maine bushels (1 Maine bushel = 1.2448 c. ft.).
Effort is in hours fished. LPUE = "Maine" bushels/hour fished.
Only records with both catch and effort > 0, were included. 2003 is a partial year of data.
Logbook data (sfYYvr tables) from Maine are included regardless of whether they came from state or federal waters.
Undertonnage: 0-5 gross tons, Small: 5-50 gross tons, Medium: 51-104 gross tons, Large: >104 gross tons.
The GLM of catch rate included factors: year, subregion, vessel. Only vessels with at least 25 trips in a year were included.

Year	Landings (Maine bushels), by vessel class:					Effort (hrs fished)	Nominal LPUE (ME bu / hr)	GLM: Catch rate	GLM: CV
	Undertonnage	Small	Med	Large	Small + Underton	Small + Underton	Small + Underton	Small + Underton	Small + Underton
1990	1,018		--	--	1,018	286	3.56	--	--
1991	17,778	16,533	49	--	34,360	17,107	2.01	4.96	0.230
1992	13,141	11,310	68	--	24,519	13,402	1.83	4.37	0.230
1993	10,052	7,092	1,568	--	18,712	5,748	3.26	4.78	0.241
1994	9,960	11,520	--	--	21,480	5,101	4.21	9.62	0.233
1995	20,339	17,573	--	7,840	45,752	5,747	7.96	13.71	0.230
1996	28,194	16,697	--	--	44,891	8,083	5.55	12.85	0.230
1997	45,158	27,489	--	--	72,647	11,829	6.14	12.96	0.226
1998	43,444	25,364	--	--	68,808	11,155	6.17	11.30	0.227
1999	64,464	27,750	--	--	92,214	11,136	8.28	17.01	0.227
2000	76,375	41,306	--	--	117,681	12,575	9.36	17.86	0.225
2001	68,309	39,273	--	--	107,582	13,309	8.08	14.99	0.225
2002	80,139	48,570	--	--	128,709	16,981	7.58	14.73	0.224

Table A6. Summary statistics on ocean quahog commercial length frequency data by year/area. Data were collected by port agents taking random samples from catches.

Area/Year	Mean Length (mm)	Min L	Max L	Number of Measured Clams
Delmarva				
1982	85.0	65	115	2611
1983	87.0	65	115	1716
1984	85.2	65	125	3116
1985	-	-	-	-
1986	-	-	-	-
1987	90.2	65	115	900
1988	90.1	55	115	780
1989	89.3	75	115	899
1990	92.4	75	125	900
1991	91.4	35	117	3331
1992	92.9	66	118	1668
1993	91.6	64	115	850
1994	92.5	65	115	120
1995	84.8	65	105	420
1996	84.0	65	115	635
1997	84.6	55	105	570
1998	86.9	65	125	480
1999	83.0	65	115	810
2000	83.1	37	111	605
2001	88.9	65	117	715
2002	89.1	66	109	300
2003	92.2	59	112	330
New Jersey				
1982	92.6	65	125	779
1983	93.9	75	115	1980
1984	-	-	-	-
1985	94.5	65	125	900
1986	94.5	75	125	870
1987	94.2	65	115	900
1988	92.6	65	115	933
1989	94.3	65	115	900
1990	95.5	55	115	870
1991	95.5	65	117	658
1992	90.4	77	108	90
1993	94.8	78	112	300
1994	96.9	85	115	90
1995	-	-	-	-
1996	92.0	75	105	60
1997	93.9	65	115	540
1998	88.4	45	115	240
1999	95.4	75	125	270
2000	91.7	65	115	510
2001	93.9	65	123	689
2002	89.8	62	117	390
2003	93.3	73	115	206
Long Island				
1992	87.3	70	98	30
1993	-	-	-	-
1994	89.7	75	105	30
1995	-	-	-	0
1996	83.1	65	105	79
1997	89.0	55	135	840
1998	89.9	55	125	660
1999	75.4	51	106	180
2000	77.6	48	105	366
2001	77.0	61	101	150
2002	81.5	63	108	270
2003	81.9	63	111	270

Table A6. (cont.)

Area/Year	Mean Length (mm)	Min L	Max L	Number of Measured Clams
S. New England				
1988	89.1	65	105	150
1989	87.3	75	115	240
1990	91.8	75	105	120
1991	90.5	70	109	121
1992	86.4	70	105	150
1993	85.3	72	99	30
1994	-	-	-	-
1995	-	-	-	-
1996	86.7	65	115	356
1997	78.7	55	105	310
1998	78.7	55	125	630
1999	81.2	57	104	90
2000	81.0	52	110	734
2001	85.3	52	111	766
2002	85.1	65	114	1011
2003	82.5	65	108	332

[1] Mean Length is the expected value from the length frequency distribution. Length frequency distributions were derived by weighting trips by their respective catches.
[2] Typically, 30 clams are measured per trip. The minimum and maximum lengths of measured clams are reported.
[3] Values for 1982-1983 are from NEFSC LDR 83-25. Values from 1985-1990 and 1994 are from subsamples of the data. Subsamples contain data from 30 randomly selected trips, when available.

Table A7. List of research clam surveys and gear changes from 1965-1981, and 1997-2002. Column entries are shifted to accentuate changes. Changes in the gear and survey season did not occur from August, 1980 to 1992. Sources of information for 1978 - 1981 are Smolovitz and Nulk 1982 and NEFSC Cruise Reports. Sources of information for 1965 - 1977 are NEFSC 1995a and NEFSC Survey Reports. “Sensors Used” : refers to the velocity, tilt and pump pressure sensors, used in computing tow distance and pump performance. These were used for the first time in 1997. "-" : undetermined.

Cruise	Date	Vessel	Season	Purpose	Pump Type	Dredge Width(cm)	Mesh Size (cm)	Doppler Measured	Sensor Used
65-	5/65	Undaunted	Spring	Survey	Surface	76	5.1 -		No
65-10	10/65	Undaunted	Fall	Survey	Surface	76	5.1	-	No
66-6,11	8/66	Albatross IV	Summer	Survey	Surface	76	5.1	-	No
69-1,7	6/69	Albatross IV	Summer	Survey	Surface	76	5.1	-	No
70-6	8/70	Delaware	Summer	Survey	Surface	122	3	-	No
SM742	6/74	Delaware	Summer	Survey	Surface	76	5.1	-	No
76-1	4/76	Delaware	Spring	Survey	Surface	122	3	-	No
77-2	1/77	Delaware	Winter	Survey	Surface	122	3	-	No
7801	1/78	Delaware	Winter	Survey	Surface	122	1.91	No	No
7807	12/78	Delaware	Winter	Survey	Surface	122	1.91	Yes	No
7901	1/79	Delaware	Winter	Survey	Submerse	152	2.54	Yes	No
7908	8/79	Delaware	Summer	Gear test	Submerse	152	2.54 & 5.08	Yes	No
8001	1/80	Delaware	Winter	Survey	Submerse	152	5.08	Yes	No
8006	8/80	Delaware	Summer	Survey	Submerse	152	5.08	Yes	No
8105	8/81	Delaware	Summer	Survey	Submerse	152	5.08	Yes	No
9704	7/97	Delaware	Summer	Survey	Submerse	152	5.08	Yes	Yes[1]
9903	7/99	Delaware	Summer	Survey	Submerse	152	5.08	Yes	Yes[2]
200206	6/02	Delaware	Summer	Survey	Submerse	152	5.08	Yes	Yes[3]

[1.] Individual sensors were used.
[2.] A protoptype integrated sensor package was used for the first 2/3 of the cruise. After that, individuals sensors were used.
[3.] First use of Survey Sensor Package (SSP) from Woods Hole Group. Used for entire cruise. Individ. sensors used as backup.

Table A8. Recent gear changes related to the NMFS Clam Survey, 1992-2002. Column entries were shifted to accentuate changes. Changes in the gear and survey season did not occur from August, 1980 to 1992, or from 1999 to 2002. Sources of information are NEFSC Cruise Meetings. "-" : undetermined.

Cruise	Date	Vessel	Ship Modified	Winch Changed	Winch Speed Out (met/min)	Winch Speed In (met/min)	Voltage to Pump
pre-92		Delaware II			60	60	460
9203	6/92	Delaware II		--	--	80	460
9404	8/94	Delaware II			Free spool	80	480
9704	7/97	Delaware II	1/97	1/97	20	20	460
9903	7/99	Delaware II		5/99	50-60	50-60	460
200206	7/02	Delaware II		5/99	50-60	50-60	460

Table A9. Historical estimates of efficiency of the DE-II dredge catching OQ.

Year	Eff of DE-II for OQ	Description/Source
1997	0.430	Value used in SARC27 (median of estimates from 5 OQ depletion exps using commercial dredges in 1997, 1998. **No** DE-II depl experiment or setup tows available.)
1997	0.346	Value used in 1999 for SARC31 (see below)
1999	0.346	Value used in SARC31 (Table C13. From OQ depletion exps with DE-II setup tows in 1999, 2000, and 1 DE-II depl. experiment.)

Table A10. Locations and depths of NMFS ocean quahog dredge calibration experiments and sediment samples during the 2002 Delaware-II clam survey.

Site	Latitude (dd)	Longitude (dd)	Depth (m)
OQ02-1	40.727620	71.737299	60
OQ02-2	40.103116	73.191079	48
OQ02-3	38.814912	73.813348	50
OQ02-4	37.887552	74.644855	48

Table A11. Summary of ***Delaware-II*** **dredge efficiency** for ocean quahogs in 2002 (Cruise 200206), inferred by comparing catches in DE-II S
Tows with Patch Model Estimates, assuming no indirect losses, from data collected with commercial clam vessel *F/V Lisa Kim*.
Formula used to compute DEL-II dredge efficiency (EFF) in experiments with the Lisa Kim (LK):

EFF(DEL) = [EFF(LK,model)*MinDensity(DEL)] / Density(LK,model)

Experiment	Region	Lisa Kim	Lisa Kim	Delaware	Delaware	Delaware	Delaware vs Lisa Kim
		Density (#/ft^2)	Efficiency	Station #	Density (#/ft^2)	Density (#/ft^2)	Relative Efficiency
		Model	Model		Setup Tows	Setup Tows	
OQ02-1	LI-E			5	0.0863		
				6	0.0337		
				7	0.0403		
				8	0.0295		
				9	0.0317		
		0.55	0.653		Average:	0.0443	0.081
					SD of samples:	0.0238	
OQ02-2	LI-W			25	0.0676		
				26	0.0341		
				27	0.0377		
				28	0.0482		
				29	0.0855		
		0.345	0.81		Average:	0.0546	0.158
					SD of samples:	0.0216	
OQ02-3	SNJ			213	0.0448		
				214	0.0272		
				215	0.0422		
				216	0.0052		
				217	0.0335		
		0.111	0.816		Average:	0.0305	0.275
					SD of samples:	0.0158	
OQ02-4	DMV			272	0.0440		
				273	0.0401		
				274	0.0507		
				275	0.0622		
				276	0.0425		
		0.101	0.599		Average:	0.0479	0.474
					SD of samples:	0.0089	
					Grand Mean		
					SD of 4 averages:		
					N		

For both Commercial Tows and the DE-II Dist. Calc. Is based on: Distance between Points program.
Survey setup tows: use neg1 inch, de2setuptows02_neg1in.xls. C:\depletion\2002dat\blade1in\GE130\ /deplresults_field2002.xls
Commercial tows: used 1inch, and were run 1/31/03. ~survey/surv_2002/comm…/oq…/sensors/. Positions use a blend of SSP data and Eric's
Vessels had approx. = selectivity, so all shell sizes were included.

Table A12 . Analysis of Repeated DE-II stations, by the DE-II.

Estimates of Relative Efficiency for the DE-II Dredge over time, based on OQ catches at DE-2 Repeat Stations on GBK (standardized to 0.15nmi with sensors; 70mm+ only)
Method 2: bootstrapped the 12 ratios, computed and saved the median, repeated for 100,000 trials.

		Method 1	Method 2		
	Sum of catches (12 tows)	Ratio of Sums of Catches (T/T-1)	Bootstrap Ratio Estimator T:T-1		
Time (T)			Median	5%LL	95%UL
1997	6381.6				
1999	5141.4	0.806	0.758	0.323	0.856
1999	5141.4				
2002	4279.4	0.832	0.845	0.56	1.878

9/11/2003
~sarc/sarc38oq/tabs/effsummary97_2002.xls

Table A13 .

Estimate of DE-II dredge efficiency for ocean quahogs in 1999 and 2002. Results were used in ESB model (Tables A17, A18) and in KLAMZ.		
Count	DE-II Eff.	Source
1	0.053	OQ02-1, 2002 depletion exp., setups
2	0.128	OQ02-2, 2002 depletion exp., setups
3	0.225	OQ02-3, 2002 depletion exp., setups
4	0.284	OQ02-4, 2002 depletion exp., setups
5	0.569	SARC31 (T. C13), 1999 DE-II depletion
6	0.227	SARC31 (T. C13), 2000 depletion exp., setups
7	0.313	SARC31 (T. C13), 2000 depletion exp., setups
8	0.239	SARC31 (T. C13), 2000 depletion exp., setups
9	0.384	SARC31 (T. C13), 2 boat, density ratio
Average:	**0.269**	
sd	0.149	
CV	0.552	

Table A14. Parameter estimates for the relationship between drained meat weight (gr) and shell length (mm) in **ocean quahogs**, by region and time. Samples collected in 1997 and 2002 include all fresh tissue minus shell, weighed at sea. Earlier samples were frozen before weighing. Weight = (e^alpha)*(L^beta).

REGION	ALPHA	BETA	Year Data Collected or Source of Data
DMV	-9.042313	2.787987	Murawski and Serchuk (1979)
NJ	-9.847183	2.94954	Murawski and Serchuk (1979)
LI	-9.124283	2.774989	Murawski and Serchuk (1979)
LI	-9.310191	2.860486	1997 Survey
GBK	-8.833807	2.761124	1997 Survey
NJ	-9.40911	2.93204	2002 Survey
SNE	-9.0439	2.82375	2002 Survey
GBK	-9.66701	2.95215	2002 Survey
SVA	-9.042313	2.787987	Values used in SARC-31 (NEFSC, 2000a)and SARC-38
DMV	-9.042313	2.787987	Values used in SARC-31 (NEFSC, 2000a)and SARC-38
NJ	-9.847183	2.94954	Values used in SARC-31 (NEFSC, 2000a)and SARC-38
LI	-9.233646317	2.822474034	Values used in SARC-31 (NEFSC, 2000a)and SARC-38
SNE	-9.124283	2.774989	Values used in SARC-31 (NEFSC, 2000a)and SARC-38
GBK	-8.969072506	2.767282187	Values used in SARC-31 (NEFSC, 2000a)and SARC-38

Table A15. NEFSC clam survey data for ocean quahog used in survey database trend calculations, by stock assessment area and cruise. 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 tow originally that were filled by borrowing tows from the same strata during previous or subsequent cruises. Black cells are cells zero with zero tows that could not be filled because there was no original data for previous or subsequent cruises. Borrowing was forward only (e.g. stratum 67 during the 9903 cruise), backward only (e.g. stratum 60 during the 8403 cruise), or both forward and backward (stratum 11 during the 8403 cruise). Tows originally in one cell may be borrowed forward and backward, but borrowed tows are never borrowed again in the same direction[1].

		Cruise															
Region	Stratum	7801	7807	7901	8001	8006	8105	8204	8305	8403	8604	8903	9203	9404	9704	9903	200206
DMV	9	20	20	22	32	21	21	30	26	35	29	37	37	39	39	38	39
	10	3	2	3	2	2	2	2	2	3	3	3	3	3	3	3	3
	11	5	2	1	**1**	**2**	2	2	2	**4**	2	2	2	2	2	2	2
	13	19	10	5	16	12	10	19	18	25	20	20	20	21	22	19	20
	14	2	2	1	2	2	2	2	2	3	3	3	3	5	3	3	3
	15	6	3	**3**	**4**	4	4	4	4	**8**	4	4	4	5	4	5	4
GBK	54								**3**	3	3	**6**	3	3	3	**3**	
	55							**3**	**3**	**3**	3	1	3	3	3	2	2
	56														**4**	4	**4**
	57				**1**	1	**1**			**2**	2	1	2	5	2	2	2
	58														**5**	5	**5**
	59				**5**	5	**6**	1	4	**5**	1	2	6	5	5	4	5
	60				**1**	1	**1**			**2**	2	2	**4**	2	5	5	5
	61				**3**	3	**11**	8	1	**6**	5	**12**	**7**	6	6	6	6
	62				**1**	1	**1**			**1**	1	**1**	**4**	4	4	4	4
	65									**3**	3	**5**	2	2	3	**4**	1
	67								**5**	5	5	7	7	7	7	**7**	
	68						**1**	1	**8**	7	3	6	6	5	5	**5**	
	69						**2**	2	5	**11**	6	6	6	7	6	7	**7**
	70						**1**	1	2	**6**	4	**8**	4	4	4	3	2
	71								**2**	2	3	1	2	3	3	1	2
	72						**2**	2	**10**	8	1	8	8	8	8	6	**6**
	73						**1**	1	1	**4**	3	6	6	6	6	5	6
	74						**3**	3	**4**	1	3	**7**	4	4	4	3	3
LI	29	16	7	13	8	11	10	11	10	**20**	10	10	10	10	10	11	10
	30	10	2	6	6	7	7	7	8	**14**	6	6	6	6	6	7	6
	31	10	**13**	3	2	9	9	9	7	**12**	5	7	8	8	8	9	8
	33	3	2	4	3	2	4	4	4	**8**	4	4	4	5	4	4	4
	34	3	2	1	2	**4**	2	2	2	**4**	2	2	2	5	2	2	2
	35	8	4	**4**			6	4	2	**4**	2	5	6	6	6	6	6
	91	4	5	4	3	3	3	3	2	4	4	3	3	3	3	3	3
	92	6	3	2	2	2	2	2	2	3	2	2	2	2	2	2	2
	93	4	2	3	2	1	1	1	1	2	1	1	1	1	1	1	2
NJ	17	16	5	5	12	12	10	11	11	18	12	12	12	12	14	12	12
	18	4	2	**5**	3	3	3	3	3	**6**	3	3	3	3	3	3	3
	19	5	1	**1**	**3**	3	3	3	3	**6**	3	3	3	3	3	3	3
	21	30	14	16	20	18	10	18	18	22	19	20	20	23	26	39	29
	22	5	4	1	3	3	3	3	3	**6**	3	3	3	5	3	3	3
	23	13	6	**6**	**6**	6	7	7	6	**11**	5	4	5	5	5	5	5
	25	12	6	8	12	9	9	9	9	13	8	9	9	9	12	8	9
	26	1	2	2	2	1	2	2	2	**5**	3	3	3	3	3	3	3
	27	5	2	**2**	**3**	3	4	4	4	**8**	4	4	4	4	4	4	4
	87	10	6	5	6	6	6	8	7	10	9	9	9	9	9	9	16
	88	12	8	6	12	11	10	15	15	24	17	20	20	20	21	22	20
	89	9	8	4	13	10	10	15	15	21	15	18	17	17	19	18	18
	90	4	4	2	2	2	2	2	2	3	2	2	2	2	2	2	2
SNE	37	5	**5**			**2**	2	7	4	**7**	3	**6**	3	5	4	4	3
	38	4	**5**	1	2	**5**	3	3	2	**5**	3	3	3	5	3	3	3
	39	14	**20**	6	1	**11**	10	6	4	**6**	2	5	5	5	5	5	5
	41	3	**4**	1	5	6	6	6	5	7	5	6	6	6	6	5	6
	45						**3**	3	7	9	4	4	4	4	4	4	3
	46						**2**	2	5	5	3	2	3	5	3	3	2
	47				**1**	*1*	**5**	4	3	4	2	2	4	5	4	3	1
	94	1	**1**	**1**	1	**1**	**2**	1	2	**2**		**1**	1	2	2	**4**	2
	95	2	**2**	**6**	6	4	4	4	14	11	4	4	4	4	4	4	4
	96							**12**	12	**13**	1	1	3	2	4	**4**	
SVA	5	11	**11**	**8**	8	**12**	4	4	9	13	8	8	8	8	8	**16**	8
	6					**1**	1	1	1	1	1	1	1	1	1	**3**	2

[1] For example, 1 tow originally in stratum 62 during the 8604 survey was borrowed both forward and backward. However the borrowed tow in stratum 62 during the 8403 cruise was not borrowed again to fill the zero for the 8305 cruise. Tows from the 810? cruise were not borrowed forward becauase data base codes (for the variables STATYPE, HAUL and GEARCOND) used to select records beginning with the 8204 cruise are not available for previous cruises. However, tows from the 8204 cruise were borrowed backwards because the 8204 cruise was included in database runs for previous cruises with criteria based on STATYPE, HAUL and GEARCOND turned off

Table A16. NEFSC clam survey trend data for ocean quahog. All columns reflect original plus borrowed tows. For example, "Number of Strata Sampled" includes strata not originally surveyed and included in calculations due to borrowing. Catches standardized to a 0.15 nm tow distance based on doppler distance measurements. Differences in SVA data for cruises 8305-9704 between this table and Table C14 in NEFSC (2000) are due to errors in the latter.

Cruise	KG Meats Per Tow	CV	Number Per Tow	CV	Number tows	Number Positive Tows	Number Strata Sampled
			SVA				
7801	0.000	0%	0.000	0%	11	0	1
7807	0.000	0%	0.000	0%	11	0	1
7901	0.000	0%	0.000	0%	8	0	1
8001	0.000	0%	0.000	0%	8	0	1
8006	0.040	0%	0.927	0%	13	1	2
8105	0.040	0%	0.927	0%	5	1	2
8204	0.002	0%	0.039	0%	5	1	2
8305	0.099	58%	1.892	58%	10	3	2
8403	0.010	87%	0.189	85%	14	2	2
8604	0.013	0%	0.285	0%	9	1	2
8903	0.018	0%	0.392	0%	9	1	2
9203	0.000	0%	0.000	0%	9	0	2
9404	0.202	79%	4.028	76%	9	2	2
9704	0.003	0%	0.116	0%	9	1	2
9903	0.002	64%	0.053	63%	19	2	2
200206	0.001	100%	0.022	100%	10	1	2
			DMV				
7801	1.456	46%	47.309	61%	55	30	6
7807	1.234	19%	35.659	23%	39	16	6
7901	1.277	41%	38.177	42%	35	12	6
8001	2.914	38%	82.480	40%	57	26	6
8006	1.957	54%	55.557	59%	43	21	6
8105	4.211	33%	138.269	32%	41	21	6
8204	2.946	34%	78.424	32%	59	24	6
8305	2.525	42%	84.486	49%	54	28	6
8403	1.649	30%	50.559	34%	78	34	6
8604	2.525	22%	75.139	23%	61	27	6
8903	1.814	45%	64.189	56%	69	31	6
9203	2.275	31%	71.214	36%	69	25	6
9404	1.359	22%	39.647	24%	75	28	6
9704	1.651	21%	46.269	21%	73	28	6
9903	0.936	27%	27.419	30%	70	23	6
200206	1.092	23%	30.621	25%	71	19	6

Table 16. Continued

NJ

Cruise	KG Meats Per Tow	CV	Number Per Tow	CV	Number tows	Number Positive Tows	Number Strata Sampled
7801	1.898	14%	57.581	15%	126	73	13
7807	6.707	74%	233.413	78%	68	32	13
7901	3.730	54%	122.955	60%	63	32	13
8001	3.096	19%	93.267	20%	97	52	13
8006	3.385	18%	107.930	19%	87	52	13
8105	7.253	29%	220.418	29%	79	43	13
8204	3.606	19%	112.557	20%	100	50	13
8305	2.807	21%	83.890	21%	98	55	13
8403	4.528	24%	141.127	24%	153	79	13
8604	4.896	22%	142.243	23%	103	52	13
8903	2.209	21%	72.384	22%	110	50	13
9203	3.015	17%	87.169	18%	110	52	13
9404	7.616	20%	232.844	22%	115	59	13
9704	4.260	15%	121.034	15%	124	59	13
9903	1.984	14%	56.179	15%	131	61	13
200206	3.206	24%	87.732	24%	127	59	13
			LI				
7801	4.099	14%	138.173	14%	64	53	9
7807	11.193	37%	382.081	38%	40	30	9
7901	7.231	20%	242.826	21%	40	29	9
8001	8.262	13%	277.090	14%	28	24	8
8006	6.547	23%	214.972	23%	45	38	9
8105	5.982	23%	200.219	22%	44	38	9
8204	6.149	16%	210.924	16%	43	36	9
8305	4.940	21%	163.753	20%	38	35	9
8403	6.320	16%	213.203	17%	71	62	9
8604	8.484	20%	289.641	22%	36	31	9
8903	4.450	26%	177.443	29%	40	36	9
9203	7.789	16%	282.678	17%	42	35	9
9404	14.571	16%	532.170	16%	46	44	9
9704	10.872	16%	380.161	16%	42	35	9
9903	6.100	14%	218.212	17%	45	41	9
200206	6.763	20%	237.190	21%	43	40	9

Table 16. Continued

SNE

Cruise	KG Meats Per Tow	CV	Number Per Tow	CV	Number tows	Number Positive Tows	Number Strata Sampled
7801	4.575	26%	185.849	25%	29	21	6
7807	5.104	19%	212.112	18%	37	26	6
7901	7.405	17%	327.322	19%	15	9	5
8001	11.704	8%	457.197	8%	16	11	6
8006	8.134	12%	326.935	13%	30	23	7
8105	8.263	19%	321.633	20%	37	32	9
8204	6.895	25%	269.090	27%	48	30	10
8305	3.994	30%	154.351	29%	58	36	10
8403	4.714	29%	182.628	26%	69	37	10
8604	6.703	29%	265.389	28%	27	23	9
8903	6.644	18%	264.888	18%	34	29	10
9203	8.566	20%	327.171	19%	36	31	10
9404	13.062	20%	498.326	21%	43	32	10
9704	5.411	41%	234.894	48%	39	27	10
9903	6.087	48%	245.663	53%	39	30	10
200206	5.076	22%	178.532	22%	29	28	9

GBK

8001	13.926	35%	574.585	35%	11	11	5
8006	13.926	35%	574.585	35%	11	11	5
8105	9.357	13%	349.304	15%	33	27	12
8204	7.390	11%	251.539	12%	22	16	9
8305	12.035	19%	458.844	19%	48	19	12
8403	5.635	26%	224.868	25%	69	30	16
8604	5.679	17%	236.060	16%	48	21	16
8903	2.308	26%	85.452	27%	79	38	16
9203	8.995	21%	325.218	22%	74	41	16
9404	10.564	21%	373.952	21%	74	38	16
9704	6.638	19%	236.570	19%	83	44	18
9903	7.471	19%	247.053	18%	76	47	18
200206	8.689	20%	296.141	20%	60	38	15

Table A17. Efficiency corrected swept-area biomass estimates (1000 mt) and CVs for ocean quahog (70+ mm) during 1997, 2000 and 2002, by stock assessment area. Data for deep strata in the Long Island, Southern New England and Georges Bank assessment areas first sampled in 2002 were "borrowed" for calculation of swept-area biomass during 1997 (NEFSC 2003). The CV for survey catch per tow in the S. Virginia and N. Carolina area during 1997 (originally 0%) was set to 100%. CV's are based on analytical variance calculations assuming log normality, and include uncertainty in survey data, swept-area amount of suitable habitat and survey dredge efficiency. The original CV for survey data in the SVA region (0%) was set to 100% in calculations.

	Estimate	CV
INPUT: Nominal tow distance (d_n, *nm*) and CV for Doppler tow distance	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', nm2)		
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: Original survey mean survey catch (kg/tow, for tows adjusted to nominal tow distance using sensors)	**Estimates for 1997**	**CV**	**Estimates for 1999**	**CV**	**Estimates for 2002**	**CV**
S. Virginia and N. Carolina (SVA)	0.0013	100%	0.0006	60%	0.0003	100%
Delmarva (DMV)	0.6847	22%	0.4692	27%	0.5784	24%
New Jersey (NJ)	1.8182	15%	0.9911	14%	1.6801	24%
Long Island (LI)	4.8327	17%	3.1377	14%	3.3762	18%
Southern New England (SNE)	2.2539	35%	2.9315	46%	3.0163	22%
Georges Bank (GBK)	2.7119	17%	3.2341	19%	3.9284	18%
INPUT: Survey dredge efficiency (e)	0.346	40%	0.269	55%	0.269	55%
Efficiency adjusted swept area biomass (B, 1000 mt)						
S. Virginia and N. Carolina (SVA)	0.021	109%	0.013	83%	0.006	115%
Delmarva (DMV)	65	49%	58	64%	71	62%
New Jersey (NJ)	277	46%	194	59%	330	62%
Long Island (LI)	505	47%	422	59%	454	60%
Southern New England (SNE)	249	56%	416	74%	428	62%
Georges Bank (GBK)	447	47%	686	61%	833	60%
Total fishable biomass less GBK	1,097	28%	1,090	38%	1,283	34%
Total fishable biomass	1,544	24%	1,776	33%	2,116	31%

Lower bound for 80% confidence intervals on biomass (1000 mt, for lognormal distribution with no bias correction)	**Estimates for 1997**	**Estimates for 1999**	**Estimates for 2002**
S. Virginia and N. Carolina (SVA)	0.007	0.005	0.002
Delmarva (DMV)	36	27	34
New Jersey (NJ)	158	96	158
Long Island (LI)	285	209	222
Southern New England (SNE)	127	179	207
Georges Bank (GBK)	253	335	408
Total fishable biomass less GBK	772	681	841
Total fishable biomass	1,140	1,176	1,429

Upperbound for 80% confidence intervals on biomass (1000 mt, for lognormal distribution with no bias correction)			
S. Virginia and N. Carolina (SVA)	0.066	0.033	0.020
Delmarva (DMV)	118	121	148
New Jersey (NJ)	488	393	687
Long Island (LI)	896	852	927
Southern New England (SNE)	487	969	887
Georges Bank (GBK)	792	1,404	1,701
Total fishable biomass less GBK	1,558	1,745	1,958
Total fishable biomass	2,091	2,683	3,135

Table A18.

Ocean quahog (70+ mm**) fishing mortality** estimates based on catch and efficiency corrected swept-area biomass estimates for 1997, 1999 and 2002. 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**
S. Virginia and N. Carolina (SVA)	0.000	0.000	0.000
Delmarva (DMV)	1.072	1.090	1.732
New Jersey (NJ)	4.249	3.038	2.781
Long Island (LI)	5.130	6.328	9.113
Southern New England (SNE)	8.958	6.619	3.884
Georges Bank (GBK)	0.000	0.000	0.000
Total	19.409	17.075	17.509

Catch (1000 mt, landings + upper bound incidental mortality allowance)			
S. Virginia and N. Carolina (SVA)	0.000	0.000	0.000
Delmarva (DMV)	1.126	1.145	1.818
New Jersey (NJ)	4.461	3.190	2.920
Long Island (LI)	5.387	6.644	9.569
Southern New England (SNE)	9.406	6.950	4.078
Georges Bank (GBK)	0.000	0.000	0.000
Total	20.380	17.929	18.384

INPUT: Efficiency Corrected Swept Area Biomass (1000 mt)	**Estimates for 1997**	**CV**	**Estimates for 1999**	**CV**	**Estimates for 2002**	**CV**
S. Virginia and N. Carolina (SVA)	0	109%	0	83%	0	115%
Delmarva (DMV)	65	49%	58	64%	71	62%
New Jersey (NJ)	277	46%	194	59%	330	62%
Long Island (LI)	505	47%	422	59%	454	60%
Southern New England (SNE)	249	56%	416	74%	428	62%
Georges Bank (GBK)	447	47%	686	61%	833	60%
Total fishable biomass less GBK	1,097	28%	1,090	38%	1,283	34%
Total fishable biomass	1,544	24%	1,776	33%	2,116	31%

Fishing mortality (y^{-1})						
S. Virginia and N. Carolina (SVA)	0.000	110%	0.000	84%	0.000	116%
Delmarva (DMV)	0.017	50%	0.020	64%	0.026	63%
New Jersey (NJ)	0.016	47%	0.016	60%	0.009	63%
Long Island (LI)	0.011	NA	0.016	NA	0.021	61%
Southern New England (SNE)	0.038	57%	0.017	75%	0.010	63%
Georges Bank (GBK)	0.000	NA	0.000	NA	0.000	NA
Total fishable biomass less GBK	0.019	30%	0.016	39%	0.014	35%
Total fishable biomass	0.013	26%	0.010	35%	0.009	33%

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**
S. Virginia and N. Carolina (SVA)	NA	NA	NA
Delmarva (DMV)	0.009	0.009	0.012
New Jersey (NJ)	0.009	0.008	0.004
Long Island (LI)	NA	NA	0.010
Southern New England (SNE)	0.019	0.007	0.005
Georges Bank (GBK)	NA	NA	NA
Total fishable biomass less GBK	0.013	0.010	0.009
Total fishable biomass	0.010	0.007	0.006

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
Delmarva (DMV)	0.032	0.042	0.054
New Jersey (NJ)	0.029	0.033	0.019
Long Island (LI)	NA	NA	0.043
Southern New England (SNE)	0.075	0.039	0.020
Georges Bank (GBK)	NA	NA	NA
Total fishable biomass less GBK	0.027	0.027	0.022
Total fishable biomass	0.018	0.016	0.013

Table A19.

Database parameters used in this assessment to extract NEFSC clam survey data for ocean quahog from the revised clam survey database. Database parameters for extracting data like those used in the last assessment (NEFSC 2000) are listed also. Parameters were the same for all regions. Negative parameter values are ignored in database calculations.

Database Parameter	For comparison to "KG/Tow" for 1978-1981 in SARC-31 (Table C14)	For comparison to "KG/Tow" for 1982-1999 in SARC-31 (Table C14)	Survey trends during 1978-1981 for this assessment	Survey trends during 1982-2002 for this assessment	Survey data for short efficiency corrected swept-area biomass (ESB)
DISTANCE_TYPE	TREND	TREND	TREND	TREND	SENDIST_NEG1
LENGTH_BIN_SIZE_MM	1000	1000	1000	1000	1000
FIRST_LENGTH_MM	70	70	70	70	70
FIRST_BIN_IS_PLUSGROUP	-1	-1	-1	-1	-1
LAST_LENGTH_MM	250	250	250	250	250
LAST_BIN_IS_PLUSGROUP	-1	-1	-1	-1	-1
SVSPP_TO_USE	409	409	409	409	409
AREAKIND	GIS	GIS	GIS	GIS	GIS
REV_DATE_FOR_AREAS	1998	1998	2002	2002	2002
REV_DATE_FOR_LW	2000	2000	2000	2000	2000
FIRST_JWSTCODE	1	1	-1	-1	-1
LAST_JWSTCODE	151	151	-1	-1	-1
FIRST_RANDLIKE	-1	-1	1	1	1
LAST_RANDLIKE	-2	-2	2	2	2
FIRST_STATION	-1	1	-1	-1	-1
LAST_STATION	-1	1	-1	-1	-1
FIRST_HAUL	-1	1	-1	1	1
LAST_HAUL	-3	3	-3	3	3
FIRST_GEARCOND	-1	1	-1	1	1
LAST_GEARCOND	-6	6	-6	6	6
FIRST_STRATUM	1	1	1	1	1
LAST_STRATUM	96	96	96	96	96
FIRST_REGION_CODE	1	1	1	1	1
LAST_REGION_CODE	7	7	6	6	6
WRITE_TOW_DATA	1	1	-1	-1	-1
WRITE_STRATUM_DATA	1	1	-1	-1	-1
FIRST_CRUISE	-9700	-9700	-7800	8200	9700
LAST_CRUISE	-9800	-9800	8200	-8200	-9800
NOMINAL_TOW_DISTANCE_NM	0.15	0.15	0.15	0.15	0.15
FILLHOLZ	-1	-1	1	1	1

Table A20.

Mean doppler distance, sensor distance and sensor/doppler ratio for tows in NEFSC clam surveys in quahog strata during 1997, 1999 and 2002. SD is the standard deviation for tow-by-tow sensor/ doppler ratios. The standard error (SE) and CV are for mean tow-by-tow sensor/doppler ratios.

Region	N Tows	Mean Sensor Distance (nm)	Mean Doppler Distance (nm)	Mean Sensor/ Doppler	SD	SE	CV
S. Virginia and N. Carolina (SVA)	218	0.23	0.12	1.97	0.50	0.030	2%
Delmarva (DMV)	173	0.27	0.13	2.15	0.42	0.030	2%
New Jersey (NJ)	130	0.25	0.13	2.02	0.43	0.040	2%
Long Island (LI)	381	0.23	0.12	1.93	1.17	0.060	3%
Southern New England (SNE)	104	0.26	0.13	1.98	0.46	0.050	2%
Georges Bank (GBK)	19	0.25	0.13	1.96	0.48	0.110	6%
All	1025	0.24	0.12	1.99	0.8	0.030	1%

Table A21.

Long times series of efficiency corrected swept-area biomass estimates ("Long ESB"), landings, fishing mortality and CVs. Data for 1978-1980 and 1994 omitted due to likely changes in NEFSC dredge efficiency. A 5% upper bound incidental mortality abundance was added to landings during computation of fishing mortality. A CV=10% was assumed for landings data. CV's for ESB in SVA during 1981-1982 were orignally zero but 80% was substituted in variance calculations.

Year	Long ESB (1000 mt)	CV	Landings (1000 mt)	Fishing Mortality (y-1)	CV
			DMV		
1981	237	33%	3.637	0.0161	35%
1982	166	34%	4.598	0.0292	36%
1983	142	42%	5.396	0.0399	43%
1984	93	30%	7.164	0.0811	32%
1986	142	22%	8.231	0.0609	24%
1989	102	45%	6.439	0.0663	46%
1992	128	31%	2.378	0.0195	32%
1997	93	21%	1.072	0.0121	23%
1999	53	27%	1.090	0.0218	29%
2002	61	23%	1.732	0.0296	25%
			LI		
1981	369	23%	0.003	0.0000	25%
1982	379	17%	0.000	0.0000	NA
1983	304	21%	0.021	0.0001	23%
1984	389	16%	0.000	0.0000	NA
1986	523	21%	0.396	0.0008	23%
1989	274	26%	0.605	0.0023	28%
1992	480	16%	11.939	0.0261	19%
1997	670	16%	5.130	0.0080	19%
1999	376	15%	6.328	0.0177	18%
2002	417	20%	9.113	0.0230	23%
			NJ		
1981	652	29%	8.402	0.0135	30%
1982	324	19%	8.538	0.0277	22%
1983	252	21%	8.249	0.0343	24%
1984	407	24%	8.858	0.0228	26%
1986	440	22%	9.061	0.0216	24%
1989	199	21%	14.100	0.0745	23%
1992	271	17%	6.942	0.0269	20%
1997	383	15%	4.249	0.0117	18%
1999	178	14%	3.038	0.0179	17%
2002	288	24%	2.781	0.0101	26%

Year	Long ESB (1000 mt)	CV	Landings (1000 mt)	Fishing Mortality (y-1)	CV
			SNE		
1981	538	19%	0.000	0.0000	NA
1982	449	25%	0.000	0.0000	NA
1983	260	30%	0.629	0.0025	32%
1984	307	29%	0.822	0.0028	30%
1986	436	30%	0.562	0.0014	31%
1989	433	18%	1.196	0.0029	21%
1992	558	20%	1.143	0.0022	22%
1997	352	41%	8.958	0.0267	42%
1999	396	48%	6.619	0.0175	49%
2002	330	22%	3.884	0.0123	24%
			SVA		
1981	0.391	80%	0.056	0.1495	81%
1982	0.023	80%	0.006	0.2626	81%
1983	0.976	59%	0.000	0.0000	NA
1984	0.097	88%	0.006	0.0655	88%
1986	0.125	0%	0.000	0.0000	NA
1989	0.181	0%	0.000	0.0000	NA
1994	1.990	79%	0.000	0.0000	NA
1997	0.034	0%	0.000	0.0000	NA
1999	0.015	65%	0.000	0.0000	NA
2002	0.006	101%	0.000	0.0000	NA
			GBK		
1981	909	26%	0.000	0.0000	NA
1982	718	25%	0.000	0.0000	NA
1983	1170	30%	0.000	0.0000	NA
1984	548	34%	0.000	0.0000	NA
1986	552	29%	0.000	0.0000	NA
1989	224	35%	0.000	0.0000	NA
1992	874	31%	0.000	0.0000	NA
1997	645	30%	0.000	0.0000	NA
1999	726	30%	0.000	0.0000	NA
2002	844	30%	0.000	0.0000	NA

Table A22.

KLAMZ model parameter estimates and standard errors for ocean quahog in the DMV, NJ and SNE regions. Arithmetic values and CVs for each log scale parameter are also shown. Log scale standard errors calculated by the delta method. Arithmetic CVs calculated assuming log-normal distributions.

Parameter	DMV (Scenario 5)	NJ (Scenario 3)	SNE (Scenario 3)
		Parameters	
Ln(Covariate Effect)	-0.8252	-0.2272	0.2358
Ln($Biomass_{1977}$)	12.6050	13.0280	12.8640
Ln($Escapement_{1978}$)	12.5750	13.0030	12.8540
Ln(Geom. Mean Recruitment)	NA	8.4585	8.4530
		Standard Errors for Parameters	
Ln(Covariate Effect)	0.2993	0.2031	0.1662
Ln(Biomass1977)	0.5198	0.5552	0.7884
Ln(Escapement1978)	0.5052	0.5589	0.7854
Ln(Geom. Mean Recruitment)	NA	0.5126	0.7061
		Arithmetic Estimates	
Covariate Effect	0.44	0.80	1.27
$Biomass_{1977}$ (mt)	298,045	454,976	386,157
$Escapement_{1978}$ (mt)	289,237	443,743	382,315
Geom. Mean Recruitment (mt)	NA	4,715	4,689
		Arithmetic CV	
Covariate Effect	31%	21%	17%
Biomass1977	56%	60%	93%
Escapement1978	54%	61%	92%
Geom. Mean Recruitment	NA	55%	80%

Table A23.

Calculations to estimate region specific scaling factors used to adjust survey trend data up to units of approximate stock biomass. CV's for the scaling factors do not include process errors calculated elsewhere.

Region Name	Available Habitat (A', nm^2)	CV	Average Efficiency (e)	CV	Area swept per standard tow (a, nm^2)	CV	Average Sensor/ Doppler Ratio	CV	Adjust KG to 1000 MT (u)	Scaling Factor (Ω, 1000 mt tow kg^{-1})	Survey Scaling Parameter in KLAMZ Model ($Q=1/\Omega$, kg tow ^{1} 10^{-3} mt^{-1})	CV
S. Virginia and N. Carolina (SVA)	712	14%	0.2947	15%	1.2338E-04	10%	1.992	1%	1.0E-06	9.832	0.10171	23%
Delmarva (DMV)	4,071	14%	0.2947	15%	1.2338E-04	10%	1.992	1%	1.0E-06	56.215	0.01779	23%
New Jersey (NJ)	6,510	14%	0.2947	15%	1.2338E-04	10%	1.992	1%	1.0E-06	89.894	0.01112	23%
Long Island (LI)	4,463	14%	0.2947	15%	1.2338E-04	10%	1.992	1%	1.0E-06	61.628	0.01623	23%
Southern New England (SNE)	4,714	14%	0.2947	15%	1.2338E-04	10%	1.992	1%	1.0E-06	65.094	0.01536	23%
Georges Bank (GBK)	7,039	14%	0.2947	15%	1.2338E-04	10%	1.992	1%	1.0E-06	97.197	0.01029	23%

Table A24. Summary of Biomass (mt) and fishing mortality (F) estimates from regional KLAMZ, and other, models.

Best biomass and fishing mortality estimates for ocean quahog during 1977-2003. "VPA" biomass estimates for 1999 are the average of efficiency corrected swept-area biomass (ESB) for 1997, 1999 and 2002; biomass estimates for other years computed by forward or backward VPA (see text). "VPA" fishing mortality estimates are the ratio of catch and average biomass during the same and subsequent years. For example, fishing mortality in SVA during 1977 is the catch during 1977 divided by the average biomass for 1977 and 1978. For 2002, fishing mortality in SVA is catch over 2002 biomass. "ESB" for Georges Bank is the average ESB estimate and the CV is the standard error for mean ESB.

Year	SVA	DMV	DMV CV	NJ	NJ CV	LI	SNE	SNE CV	GBK	GBK CV	Total less GBK	Total
						Model						
	VPA	KLAMZ Scenario 5		KLAMZ Scenario 3		VPA	KLAMZ Scenario 3		Average ESB		NA	NA
						Recruitment						
All	NA	0	NA	4,715	51%	NA	4,689	71%	NA	NA	NA	NA
						Total Biomass (mt)						
1977	297	297,990	52%	455,110	56%	534,059	386,310	79%	655,426	17%	1,673,766	2,329,192
1978	297	289,320	51%	448,410	55%	534,059	387,040	78%	655,426	17%	1,659,126	2,314,552
1979	297	280,620	49%	441,790	54%	534,059	387,760	77%	655,426	17%	1,644,526	2,299,952
1980	297	268,080	49%	435,560	54%	534,059	388,460	76%	655,426	17%	1,626,456	2,281,882
1981	297	257,070	48%	427,690	53%	534,054	389,150	75%	655,426	17%	1,608,260	2,263,687
1982	241	246,940	47%	419,260	53%	534,050	389,830	74%	655,426	17%	1,590,321	2,245,748
1983	235	236,150	46%	410,800	53%	534,050	390,500	73%	655,426	17%	1,571,736	2,227,162
1984	235	224,860	46%	402,730	53%	534,029	390,530	73%	655,426	17%	1,552,384	2,207,811
1985	229	212,140	46%	394,150	53%	534,029	390,370	72%	655,426	17%	1,530,918	2,186,345
1986	69	199,720	46%	383,860	53%	533,989	390,330	71%	655,426	17%	1,507,968	2,163,394
1987	69	186,610	47%	375,320	52%	533,593	390,420	71%	655,426	17%	1,486,012	2,141,438
1988	69	171,570	48%	366,870	52%	532,413	390,370	70%	655,426	17%	1,461,292	2,116,718
1989	27	155,770	50%	360,570	52%	531,773	390,170	70%	655,426	17%	1,438,310	2,093,736
1990	27	145,550	51%	347,310	53%	531,168	389,620	69%	655,426	17%	1,413,675	2,069,101
1991	13	138,300	51%	332,740	54%	530,429	389,330	69%	655,426	17%	1,390,812	2,046,238
1992	13	130,110	52%	319,350	55%	528,755	389,110	68%	655,426	17%	1,367,338	2,022,764
1993	13	124,550	52%	313,720	54%	516,815	388,620	68%	655,426	17%	1,343,719	1,999,145
1994	13	119,530	51%	304,960	54%	508,163	388,250	68%	655,426	17%	1,320,916	1,976,343
1995	13	115,600	51%	299,500	54%	496,180	387,940	67%	655,426	17%	1,299,234	1,954,660
1996	13	112,070	50%	295,730	54%	486,716	383,170	68%	655,426	17%	1,277,699	1,933,126
1997	13	108,600	49%	292,520	53%	480,810	375,590	69%	655,426	17%	1,257,534	1,912,960
1998	13	104,890	49%	289,970	52%	475,680	367,460	70%	655,426	17%	1,238,014	1,893,440
1999	13	100,980	48%	289,040	51%	469,110	361,920	70%	655,426	17%	1,221,064	1,876,490
2000	13	97,450	48%	287,780	50%	462,782	356,270	71%	655,426	17%	1,204,295	1,859,722
2001	13	94,051	48%	286,270	49%	468,498	352,200	72%	655,426	17%	1,201,032	1,856,458
2002	13	90,891	47%	283,580	49%	477,610	348,570	72%	655,426	17%	1,200,665	1,856,091
2003	13	NA	NA	NA	NA	468,498	NA	NA	655,426	17%	NA	NA
						Fishing mortality (y^{-1})						
1977	0.000	0.003	52%	0.014	56%	0.000	0.000	0%	0.000	0.000	0.004	0.003
1978	0.000	0.005	51%	0.014	55%	0.000	0.000	0%	0.000	0.000	0.005	0.003
1979	0.000	0.020	50%	0.014	55%	0.000	0.000	0%	0.000	0.000	0.007	0.005
1980	0.188	0.016	49%	0.018	54%	0.000	0.000	0%	0.000	0.000	0.008	0.005
1981	0.021	0.014	48%	0.020	54%	0.000	0.000	0%	0.000	0.000	0.008	0.005
1982	0.000	0.019	47%	0.021	54%	0.000	0.000	0%	0.000	0.000	0.008	0.006
1983	0.026	0.023	47%	0.020	54%	0.000	0.002	73%	0.000	0.000	0.009	0.007
1984	0.690	0.033	47%	0.022	53%	0.000	0.002	73%	0.000	0.000	0.011	0.008
1985	0.000	0.035	47%	0.028	53%	0.000	0.002	72%	0.000	0.000	0.012	0.009
1986	0.000	0.042	47%	0.024	53%	0.001	0.001	71%	0.000	0.000	0.012	0.009
1987	0.608	0.059	48%	0.025	53%	0.002	0.002	71%	0.000	0.000	0.015	0.010
1988	0.000	0.071	50%	0.019	53%	0.001	0.002	70%	0.000	0.000	0.014	0.010
1989	0.501	0.043	52%	0.040	53%	0.001	0.003	70%	0.000	0.000	0.016	0.011
1990	0.000	0.026	52%	0.046	54%	0.001	0.002	69%	0.000	0.000	0.015	0.010
1991	0.000	0.036	52%	0.045	55%	0.003	0.002	69%	0.000	0.000	0.016	0.011
1992	0.000	0.019	53%	0.022	55%	0.023	0.003	68%	0.000	0.000	0.017	0.011
1993	0.000	0.016	52%	0.033	55%	0.017	0.003	68%	0.000	0.000	0.016	0.011
1994	0.000	0.008	52%	0.023	55%	0.024	0.002	68%	0.000	0.000	0.016	0.011
1995	0.000	0.006	51%	0.018	55%	0.019	0.014	68%	0.000	0.000	0.016	0.011
1996	0.000	0.007	50%	0.017	54%	0.012	0.022	68%	0.000	0.000	0.016	0.010
1997	0.000	0.010	49%	0.015	53%	0.011	0.024	69%	0.000	0.000	0.016	0.010
1998	0.000	0.013	49%	0.009	52%	0.014	0.018	70%	0.000	0.000	0.014	0.009
1999	0.000	0.011	49%	0.011	51%	0.014	0.019	71%	0.000	0.000	0.014	0.009
2000	0.000	0.011	48%	0.012	50%	0.010	0.014	72%	0.000	0.000	0.012	0.008
2001	0.000	0.010	48%	0.016	50%	0.012	0.013	72%	0.000	0.000	0.013	0.009
2002	0.000	0.019	48%	0.010	49%	0.019	0.011	73%	0.000	0.000	0.015	0.009

Table A25. Inputs (shown up to age 28) to updated Yield per Recruit analysis for ocean quahog, with full recruitment at age 26 y and shell length approximately 70 mm. Growth parameters are from SARC-31 (NEFSC 2000a, p.198) and represent average growth across regions.

```
TITLE FOR RUN:
YPR-Quahog-like-delay-difference-for-SARC

TITLE FOR DATA:
Ocean-Quahog-Like-Delay-Difference

--------------------------------------------------------------------------------
 ***INPUT DATA***
NATURAL MORTALITY COEFFICIENT (M) =   0.02000

            PRICE PER UNIT WEIGHT =   1.00000

FIRST AGE GROUP:  LAST AGE GROUP:  LAST GROUP IS PLUS:
     1              150                  YES
PROPORTION F MORTALITY BEFORE SPAWNING SEASON:
   0.75
PROPORTION M MORTALITY BEFORE SPAWNING SEASON:
   0.75
                                      WEIGHT IN   WEIGHT IN    RELATIVE
AGE    FPATTERN  MPATTERN   MATURITY   THE CATCH   THE STOCK       VALUE
  1      0.0000     1.000     0.0000      1.2002      1.2002      1.0000
  2      0.0000     1.000     0.0000      1.9665      1.9665      1.0000
  3      0.0000     1.000     0.0000      2.7191      2.7191      1.0000
  4      0.0000     1.000     0.0000      3.4583      3.4583      1.0000
  5      0.0000     1.000     0.0300      4.1842      4.1842      1.0000
  6      0.0000     1.000     0.0300      4.8973      4.8973      1.0000
  7      0.0000     1.000     0.0300      5.5976      5.5976      1.0000
  8      0.0000     1.000     0.0300      6.2854      6.2854      1.0000
  9      0.0000     1.000     0.0300      6.9610      6.9610      1.0000
 10      0.0000     1.000     0.5000      7.6245      7.6245      1.0000
 11      0.0000     1.000     1.0000      8.2761      8.2761      1.0000
 12      0.0000     1.000     1.0000      8.9162      8.9162      1.0000
 13      0.0000     1.000     1.0000      9.5448      9.5448      1.0000
 14      0.0000     1.000     1.0000     10.1622     10.1622      1.0000
 15      0.0000     1.000     1.0000     10.7686     10.7686      1.0000
 16      0.0000     1.000     1.0000     11.3642     11.3642      1.0000
 17      0.0000     1.000     1.0000     11.9491     11.9491      1.0000
 18      0.0000     1.000     1.0000     12.5237     12.5237      1.0000
 19      0.0000     1.000     1.0000     13.0879     13.0879      1.0000
 20      0.0000     1.000     1.0000     13.6421     13.6421      1.0000
 21      0.0000     1.000     1.0000     14.1865     14.1865      1.0000
 22      0.0000     1.000     1.0000     14.7211     14.7211      1.0000
 23      0.0000     1.000     1.0000     15.2461     15.2461      1.0000
 24      0.0000     1.000     1.0000     15.7618     15.7618      1.0000
 25      0.0000     1.000     1.0000     16.2683     16.2683      1.0000
 26      1.0000     1.000     1.0000     16.7658     16.7658      1.0000
 27      1.0000     1.000     1.0000     17.2544     17.2544      1.0000
 28      1.0000     1.000     1.0000     17.7343     17.7343      1.0000
```

Table A26. Results of updated Yield per Recruit analysis for ocean quahog, with full recruitment at age 26 y and shell length approximately 70 mm. Growth parameters are from SARC-31 (NEFSC 2000a, p.198) and represent average growth across regions.

$F_{0.1}$	0.0275
F_{MAX}	0.1812

%MSP	F
15%	0.441
20%	0.138
25%	0.080
30%	0.055
35%	0.041
40%	0.032
45%	0.025
50%	0.020
55%	0.016
60%	0.013
65%	0.011
70%	0.008
75%	0.007
80%	0.005
85%	0.004
90%	0.002
95%	0.001
100%	0.000

Table A27. Projection of B and F assuming constant catches at 2002 levels.

Projected biomass and fishing mortality for ocean quahog during 2002-2007 based on best estimates for 2002 and **assuming constant regional catch at 2002 levels**. Projections use annual instantaneous rates of change for somatic growth in weight (G), recruitment biomass (r), natural mortality (M) and fishing (F) based on population dynamics equations givenin the text. Instantaneous rates for DMV, NJ, SNE are KLAMZ model estimates for 2002. Rates for other regions are averages of estimates for DMV, NJ and SNE except that G=0 for GBK because quahogs in GBK are unfished and assumed at carrying capacity. Projected biomass for the total area and for the total area less Georges Bank are sums of regional biomass levels. Similarly, projected fishing mortality rates are biomass weighted averages. Approximate 80% confidence intervals have endpoints that are half and double the projected values.

Year	SVA	DMV	NJ	LI	SNE	GBK	Total Less GBK	Total
Somatic growth rate (G y^{-1})								
2002	0.0080	0.0045	0.0099	0.0076	0.0096	0.0000	not used	not used
Recruitment rate (r = Recruitment / Average Biomass in 2002 y^{-1})								
2002	0.0101	0.0000	0.0168	0.0094	0.0136	0.0000	not used	not used
Natural mortality (M y^{-1})								
2002	0.0200	0.0200	0.0200	0.0200	0.0200	0.0200	not used	not used
Net instantaneous rate of change, less fishing (X - F = G + r - M y^{-1})								
2002	-0.0019	-0.0155	0.0067	-0.0030	0.0032	-0.0200	not used	not used
Landings (mt meats y^{-1})								
2002	0	1,732	2,781	9,113	3,884	0	17509 (not used)	17509 (not used)
Catch (mt meats y^{-1}, landings+ 5% allowance for incidental mortality)								
2002	0	1,818	2,920	9,569	4,078	0	18384 (not used)	18384 (not used)
Initial Biomass								
2002	13	90,891	283,580	477,610	348,570	655,426	1,200,665	1,856,091
Projected biomass (mt meats)								
2003	13	87,688	282,564	466,625	345,602	642,448	1,182,492	1,824,940
2004	13	84,534	281,540	455,673	342,625	629,727	1,164,385	1,794,112
2005	13	81,428	280,510	444,753	339,639	617,257	1,146,344	1,763,601
2006	13	78,371	279,473	433,866	336,643	605,035	1,128,366	1,733,400
2007	13	75,360	278,429	423,012	333,637	593,054	1,110,451	1,703,505
Projected fishing mortality rate (F y^{-1})								
2003	0.000	0.021	0.010	0.021	0.012	0.000	0.016	0.010
2004	0.000	0.022	0.010	0.021	0.012	0.000	0.016	0.010
2005	0.000	0.023	0.010	0.022	0.012	0.000	0.016	0.010
2006	0.000	0.023	0.010	0.022	0.012	0.000	0.016	0.011
2007	0.000	0.024	0.010	0.023	0.012	0.000	0.017	0.011

Table A28. Projection of B, F, and landings, assuming constant F's at 2002 levels.

Projected biomass and fishing mortality for ocean quahog during 2002-2007 based on best estimates for 2002 and **assuming constant regional fishing mortality at 2002 levels**. Projections use annual instantaneous rates of change for somatic growth in weight (G), recruitment biomass (r), natural mortality (M) and fishing (F) based on population dynamics equations given in the text. Instantaneous rates G, r and M for DMV, NJ, SNE are KLAMZ model estimates for 2002. Rates for other regions are averages of estimates for DMV, NJ and SNE except that G=0 for GBK because quahogs in GBK are unfished and assumed at carrying capacity. Projected biomass, catch and landings for the total area and for the total area less Georges Bank are sums of regional biomass levels. Approximate 80% confidence intervals have endpoints that are half and double the projected values.

Year	SVA	DMV	NJ	LI	SNE	GBK	Total Less GBK	Total
Somatic growth rate (G y^{-1})								
2002	0.0080	0.0045	0.0099	0.0076	0.0096	0.0000	not used	not used
Recruitment rate (r = Recruitment / Average Biomass in 2002 y^{-1})								
2002	0.0101	0.0000	0.0168	0.0094	0.0136	0.0000	not used	not used
Natural mortality (M y^{-1})								
2002	0.0200	0.0200	0.0200	0.0200	0.0200	0.0200	not used	not used
Fishing mortality (F y^{-1})								
2002	0.0000	0.0194	0.0099	0.0191	0.0113	0.0000	not used	not used
Net instantaneous rate of change X = G + r - F - M y^{-1})								
2002	-0.0019	-0.0349	-0.0032	-0.0221	-0.0081	-0.0200	not used	not used
Initial Biomass								
2002	13	90,891	283,580	477,610	348,570	655,426	1,200,665	1,856,091
Projected biomass (mt meats)								
2003	13	87,774	282,680	467,180	345,770	642,448	1,183,417	1,825,865
2004	13	84,764	281,782	456,977	342,993	629,727	1,166,529	1,796,256
2005	13	81,856	280,887	446,997	340,239	617,257	1,149,993	1,767,250
2006	13	79,049	279,995	437,235	337,506	605,035	1,133,799	1,738,833
2007	13	76,338	279,106	427,686	334,795	593,054	1,117,939	1,710,993
Catch (landings + 5% allowance for incidental mortality, mt y^{-1})								
2003	0	1,672	2,795	8,816	3,879	0	17,162	17,162
2004	0	1,615	2,786	8,624	3,848	0	16,872	16,872
2005	0	1,560	2,777	8,435	3,817	0	16,589	16,589
2006	0	1,506	2,769	8,251	3,786	0	16,312	16,312
2007	0	1,454	2,760	8,071	3,756	0	16,041	16,041
Landings (95% of catch, mt y^{-1})								
2003	0	1,589	2,655	8,375	3,685	0	16,304	16,304
2004	0	1,534	2,647	8,193	3,655	0	16,029	16,029
2005	0	1,482	2,638	8,014	3,626	0	15,760	15,760
2006	0	1,431	2,630	7,839	3,597	0	15,496	15,496
2007	0	1,382	2,622	7,667	3,568	0	15,239	15,239

Table A29. Projection of B and F assuming constant catches at the annual quotas.

Projected biomass and fishing mortality for ocean quahog during 2002-2007 based on best estimates for 2002 and **assuming constant regional catch at quota levels** (4.5 million bushels=20,412 mt during 2003 and 5.0 million bushels=22,680 mt during 2004-2007). Proportions of total catch in each year for each region are the same as in 2002. Projections use annual instantaneous rates of change for somatic growth in weight (G), recruitment biomass (r), natural mortality (M) and fishing (F) based on population dynamics equations given in the text. Instantaneous rates for DMV, NJ, SNE are KLAMZ model estimates for 2002. Rates for other regions are averages of estimates for DMV, NJ and SNE except that G=0 for GBK because quahogs in GBK are unfished and assumed at carrying capacity. Projected biomass for the total area and for the total area less Georges Bank are sums of regional biomass levels. Similarly, projected fishing mortality rates are biomass weighted averages. Approximate 80% confidence intervals have endpoints that are half and double the projected values.

Year	SVA	DMV	NJ	LI	SNE	GBK	Total Less GBK	Total
Somatic growth rate (G y^{-1})								
2002	0.0080	0.0045	0.0099	0.0076	0.0096	0.0000	not used	not used
Recruitment rate (r = Recruitment / Average Biomass in 2002 y^{-1})								
2002	0.0101	0.0000	0.0168	0.0094	0.0136	0.0000	not used	not used
Natural mortality (M y^{-1})								
2002	0.0200	0.0200	0.0200	0.0200	0.0200	0.0200	not used	not used
Net instantaneous rate of change, less fishing (X - F = G + r - M y^{-1})								
2002	-0.0019	-0.0155	0.0067	-0.0030	0.0032	-0.0200	not used	not used
Landings (mt meats y^{-1})								
2002	0	1,732	2,781	9,113	3,884	0	17,509	17,509
2003	0	2,019	3,242	10,624	4,528	0	20412 (Quota)	20412 (Quota)
2004-2007	0	2,243	3,602	11,804	5,031	0	22680 (Quota)	22680 (Quota)
Catch (mt meats y^{-1}, landings+ 5% allowance for incidental mortality)								
2002	0	1,818	2,920	9,569	4,078	0	18,384	18,384
2003	0	2,120	3,404	11,155	4,754	0	21,432	21,432
2004-2007	0	2,355	3,782	12,394	5,282	0	23,813	23,813
Initial Biomass								
2002	13	90,891	283,580	477,610	348,570	655,426	1,200,665	1,856,091
Projected biomass (mt meats)								
2003	13	87,688	282,564	466,625	345,602	642,448	1,182,492	1,824,940
2004	13	84,235	281,055	454,089	341,948	629,727	1,161,340	1,791,066
2005	13	80,601	279,156	440,352	337,753	617,257	1,137,876	1,755,134
2006	13	77,024	277,245	426,657	333,545	605,035	1,114,484	1,719,518
2007	13	73,501	275,320	413,003	329,323	593,054	1,091,161	1,684,215
Projected fishing mortality rate (F y^{-1})								
2003	0.000	0.021	0.010	0.021	0.012	0.000	0.016	0.010
2004	0.000	0.025	0.012	0.025	0.014	0.000	0.018	0.012
2005	0.000	0.029	0.014	0.028	0.016	0.000	0.021	0.014
2006	0.000	0.031	0.014	0.029	0.016	0.000	0.021	0.014
2007	0.000	0.032	0.014	0.030	0.016	0.000	0.022	0.014

Table A30. Projection of B, F and landings, assuming constant fishing at $F_{0.1}$.

Projected biomass and fishing mortality for ocean quahog during 2002-2007 based on best estimates for 2002 and **assuming constant regional fishing mortality $F_{0.1}$= 0.0275 y^{-1}** (except on GBK where fishing mortality is zero). Projections use annual instantaneous rates of change for somatic growth in weight (G), recruitment biomass (r), natural mortality (M) and fishing (F) based on population dynamics equations given in the text. Instantaneous rates G, r and M for DMV, NJ, SNE are KLAMZ model estimates for 2002. Rates for other regions are averages of estimates for DMV, NJ and SNE except that G=0 for GBK because quahogs in GBK are unfished and assumed at carrying capacity. Projected biomass, catch and landings for the total area and for the total area less Georges Bank are sums of regional biomass levels. Approximate 80% confidence intervals have endpoints that are half and double the projected values.

Year	SVA	DMV	NJ	LI	SNE	GBK	Total Less GBK	Total
Somatic growth rate (G y^{-1})								
2002	0.0080	0.0045	0.0099	0.0076	0.0096	0.0000	not used	not used
Recruitment rate (r = Recruitment / Average Biomass in 2002 y^{-1})								
2002	0.0101	0.0000	0.0168	0.0094	0.0136	0.0000	not used	not used
Natural mortality (M y^{-1})								
2002	0.0200	0.0200	0.0200	0.0200	0.0200	0.0200	not used	not used
Fishing mortality (F y^{-1})								
2002	0.0275	0.0275	0.0275	0.0275	0.0275	0.0000	not used	not used
Net instantaneous rate of change X = G + r - F - M y^{-1})								
2002	-0.0294	-0.0430	-0.0208	-0.0305	-0.0243	-0.0200	not used	not used
Initial Biomass								
2002	13	90,891	283,580	477,610	348,570	655,426	1,200,665	1,856,091
Projected biomass (mt meats)								
2003	13	87,065	277,749	463,263	340,202	642,448	1,168,291	1,810,739
2004	13	83,399	272,038	449,346	332,034	629,727	1,136,830	1,766,556
2005	12	79,888	266,444	435,847	324,062	617,257	1,106,254	1,723,512
2006	12	76,525	260,965	422,754	316,282	605,035	1,076,539	1,681,574
2007	12	73,303	255,599	410,055	308,689	593,054	1,047,658	1,640,712
Catch (landings + 5% allowance for incidental mortality, mt y^{-1})								
2003	0	2,344	7,559	12,547	9,243	0	31,693	31,693
2004	0	2,245	7,404	12,170	9,021	0	30,840	30,840
2005	0	2,150	7,252	11,805	8,804	0	30,011	30,011
2006	0	2,060	7,103	11,450	8,593	0	29,206	29,206
2007	0	1,973	6,956	11,106	8,387	0	28,423	28,423
Landings (95% of catch, mt y^{-1})								
2003	0	2,226	7,181	11,920	8,781	0	30,109	30,109
2004	0	2,133	7,034	11,562	8,570	0	29,298	29,298
2005	0	2,043	6,889	11,215	8,364	0	28,511	28,511
2006	0	1,957	6,747	10,878	8,163	0	27,746	27,746
2007	0	1,874	6,609	10,551	7,967	0	27,002	27,002