

Table A1. Longfin squid landings during 1963-2001 (thousand mt). U.S. landings through 2000 include prorated unspecified squid landings. Landings for January-April 2001 are preliminary and possibly incomplete. Landings for July-December 2001 are preliminary and assumed equal to quarterly quota allocations.

Year	U.S.	Foreign	Total
1963	1.294	0.000	1.294
1964	0.576	0.002	0.578
1965	0.709	0.099	0.808
1966	0.772	0.226	0.998
1967	0.547	1.130	1.677
1968	1.084	2.327	3.411
1969	0.899	8.643	9.542
1970	0.653	16.732	17.385
1971	0.727	17.442	18.169
1972	0.725	29.009	29.734
1973	1.105	36.508	37.613
1974	2.274	32.576	34.850
1975	1.621	32.180	33.801
1976	3.602	21.682	25.284
1977	1.088	15.586	16.674
1978	1.291	9.355	10.646
1979	4.252	13.068	17.320
1980	3.996	19.750	23.746
1981	2.316	20.212	22.528
1982	2.848	15.805	18.653
1983	10.867	11.720	22.587
1984	7.689	11.031	18.720
1985	6.899	6.549	13.448
1986	11.525	4.598	16.123
1987	10.367	0.002	10.369
1988	18.593	0.003	18.596
1989	23.733	0.005	23.738
1990	15.399	0.000	15.399
1991	20.299	0.000	20.299
1992	19.018	0.000	19.018
1993	23.020	0.000	23.020
1994	23.480	0.000	23.480
1995	18.880	0.000	18.880
1996	12.026	0.000	12.026
1997	16.308	0.000	16.308
1998	19.151	0.000	19.151
1999	19.386	0.000	19.386
2000	17.034	0.000	17.034
2001	14.603	0.000	14.603

Table A2. Longfin squid landings data (thousand mt) by quarter during 1987-2001.  
 Data for January-June 2001 are preliminary and probably incomplete.  
 Data for July-December 2001 are preliminary and assumed equal to  
 quarterly quota allocations. Landings for 1987-2000 include prorated  
 unspecified squid landings.

Year	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Nov	Total
1987	2.505	4.265	1.815	1.782	10.367
1988	3.404	7.589	3.451	4.149	18.593
1989	9.838	6.919	1.164	5.812	23.733
1990	4.538	3.847	2.933	4.081	15.399
1991	2.877	6.297	3.443	7.682	20.299
1992	7.211	3.531	2.061	6.214	19.018
1993	11.438	4.736	1.725	5.121	23.020
1994	4.762	2.285	6.603	9.830	23.480
1995	5.815	3.820	3.933	5.312	18.880
1996	5.201	4.648	1.019	1.158	12.026
1997	3.347	2.961	2.753	7.248	16.308
1998	10.692	2.128	1.128	5.204	19.151
1999	4.927	3.152	5.001	6.307	19.387
2000	6.408	3.345	3.884	3.397	17.034
2001	3.817	2.429	2.941	5.416	14.603
<b>Average %</b>					
1987-2000	32%	23%	16%	29%	100%

Table A3. Discard rate (weight longfin squid discarded / weight target species landed) and discard estimates (mt) for longfin squid in trips targeting key species during 1997-2000. Landings data for Loligo includes prorated unspecified squid. Landings data for herring includes "Herring NK" (herring species not known). No adjustments were made to landings data for any other species. Landings data from the commercial fisheries database (CFDETS1994-CFDETS2000). Discard rate estimates from NMFS observer data during 1997 to mid-2000 and Rutgers University personnel aboard 13 trips targeting black seabass and scup. All available discard data were used.

Year	Black Seabass	Butterfish	Herring	Loligo	Mackerel	Scup	Silver hake	Totals
<i>Landings</i>								
1997	1,203	2,798	97,055	16,308	9,539	1,659	15,534	144,097
1998	1,184	1,967	82,597	19,151	11,599	1,179	14,691	132,368
1999	1,337	2,112	79,652	19,386	8,774	1,056	13,443	125,760
2000	1,213	1,435	75,605	17,034	4,475	742	12,145	112,649
<i>Average Landings</i>	1,234	2,078	83,727	17,970	8,597	1,159	13,953	128,719
<i>Observer Trips</i>	5	3	0	111	15	18	32	184
<i>Observer Tows</i>	16	21	0	1,115	97	78	147	1,474
<i>Discard Rate</i>	0	0.0095	0.0004	0.0277	0.0004	0.0125	0.0018	0.0046
<i>Average Discards (MT)</i>	0	20	34	498	4	14	25	596

Table A4. Standard landings per unit fishing effort (LPUE, mt /days fished) for longfin squid in the domestic squid fishery from NEFSC (1996). "Winter" is October-March (e.g. "1982" means October 1982-March 1983). Summer is April-September (e.g. "1982" means April-September 1982).

Year	Winter	Summer
1982	3.66	3.82
1983	6.17	7.18
1984	4.61	5.09
1985	2.18	4.62
1986	3.99	4.38
1987	4.63	4.27
1988	8.45	4.95
1989	6.13	3.54
1990	4.64	3.63
1991	7.96	4.38
1992	8.52	2.90
1993		2.59

Table A5. Summary of NEFSC autumn bottom trawl survey data for longfin squid. The autumn survey started in 1964 but longfin squid were first identified in 1967. "Mean date (Julian)" is for tows in strata used for longfin squid. In a non-leap year, the earliest mean Julian date (264) corresponds to September 21 and the latest mean Julian date (303) corresponds to October 30. The NEFSC standard Yankee No. 36 bottom trawl ([www.nefsc.nmfs.gov/esb/survey%20gear.htm](http://www.nefsc.nmfs.gov/esb/survey%20gear.htm).) was used in all years.

Year	Mean Date (Julian)	Original Cruise Code	Cruise Code Assigned	Research Vessels	Type Trawl Doors
1967	303	721	6721	Albatross IV	BMV
1968	293	817	6817	Albatross IV	BMV
1969	291	911	6911	Albatross IV	BMV
1970	277	706	7006	Albatross IV, Delaware II	BMV
1971	285	716	7106	Albatross IV	BMV
1972	284	728	7208	Albatross IV	BMV
1973	281	738	7308	Albatross IV	BMV
1974	277	748	7411	Albatross IV	BMV
1975	294	758	7512	Albatross IV, Delaware II	BMV
1976	289	767	7609	Albatross IV	BMV
1977	283	778	7712	Delaware II	BMV
1978	284	789	7806	Delaware II	BMV
1979	287	799	7910	Albatross IV, Delaware II	BMV
1980	283	809	8007	Delaware II	BMV
1981	280	816	8106	Albatross IV, Delaware II	BMV
1982	278	NA	8206	Albatross IV	BMV
1983	276	NA	8306	Albatross IV	BMV
1984	274	NA	8405	Albatross IV	BMV
1985	283	NA	8508	Albatross IV, Delaware II	Polyvalent
1986	275	NA	8606	Albatross IV, Delaware II	Polyvalent
1987	269	NA	8705	Albatross IV	Polyvalent
1988	270	NA	8803	Albatross IV, Delaware II	Polyvalent
1989	271	NA	8904	Delaware II	Polyvalent
1990	267	NA	9004	Delaware II	Polyvalent
1991	267	NA	9105	Delaware II	Polyvalent
1992	270	NA	9206	Albatross IV	Polyvalent
1993	266	NA	9306	Delaware II	Polyvalent
1994	270	NA	9406	Albatross IV	Polyvalent
1995	266	NA	9507	Albatross IV	Polyvalent
1996	266	NA	9604	Albatross IV	Polyvalent
1997	267	NA	9706	Albatross IV	Polyvalent
1998	278	NA	9804	Albatross IV	Polyvalent
1999	280	NA	9908	Albatross IV	Polyvalent
2000	264	NA	2005	Albatross IV	Polyvalent
2001	264	NA	200109	Albatross IV	Polyvalent

Table A6. Summary of NEFSC spring bottom trawl survey data for longfin squid. "Mean date (Julian)" is for tows in strata used for longfin squid. In a non-leap year, the earliest mean Julian date (69) is 10 March and the latest mean Julian date (109) is 19 April. The standard Yankee No. 36 and No. 41 bottom trawls are described in <http://www.nefsc.nmfs.gov/esb/survey%20gear.htm>.

Year	Mean Date (Julian)	Original Inshore Cruise Code	Original Offshore Cruise Code	Cruise Code Assigned	Research Vessels	Type Survey Trawl	Type Trawl Doors
1968	76	NA	NA	6803	Albatross IV	Yankee No. 36	BMV
1969	76	NA	NA	6902	Albatross IV	Yankee No. 36	BMV
1970	109	NA	NA	7003	Albatross IV	Yankee No. 36	BMV
1971	87	NA	NA	7101	Albatross IV	Yankee No. 36	BMV
1972	81	NA	NA	7202	Albatross IV	Yankee No. 36	BMV
1973	89	NA	NA	7303	Albatross IV, Delaware II	Yankee No. 36	BMV
1974	83	274	744	7404	Albatross IV	Yankee No. 41	BMV
1975	78	753	NA	7503	Albatross IV	Yankee No. 41	BMV
1976	77	450	762	7602	Albatross IV, Delaware II	Yankee No. 41	BMV
1977	95	467	771	7702	Albatross IV, Delaware II	Yankee No. 41	BMV
1978	89	782	783	7804	Albatross IV	Yankee No. 41	BMV
1979	102	792	793	7904	Albatross IV, Delaware II	Yankee No. 41	BMV
1980	98	801	802	8002	Albatross IV, Delaware II	Yankee No. 41, Yankee No. 36	BMV
1981	101	811	812	8102	Delaware II	Yankee No. 41, Yankee No. 36	BMV
1982	91	NA	NA	8202	Delaware II	Yankee No. 36	BMV
1983	85	NA	NA	8303	Albatross IV	Yankee No. 36	BMV
1984	79	NA	NA	8402	Albatross IV	Yankee No. 36	BMV
1985	72	NA	NA	8502	Albatross IV	Yankee No. 36	Polyvalent
1986	80	NA	NA	8603	Albatross IV	Yankee No. 36	Polyvalent
1987	97	NA	NA	8702	Albatross IV, Delaware II	Yankee No. 36	Polyvalent
1988	77	NA	NA	8801	Albatross IV	Yankee No. 36	Polyvalent
1989	69	NA	NA	8901	Delaware II	Yankee No. 36	Polyvalent
1990	74	NA	NA	9002	Delaware II	Yankee No. 36	Polyvalent
1991	74	NA	NA	9102	Delaware II	Yankee No. 36	Polyvalent
1992	72	NA	NA	9202	Albatross IV	Yankee No. 36	Polyvalent
1993	83	NA	NA	9302	Albatross IV	Yankee No. 36	Polyvalent
1994	77	NA	NA	9402	Delaware II	Yankee No. 36	Polyvalent
1995	85	NA	NA	9503	Albatross IV	Yankee No. 36	Polyvalent
1996	84	NA	NA	9602	Albatross IV	Yankee No. 36	Polyvalent
1997	74	NA	NA	9702	Albatross IV	Yankee No. 36	Polyvalent
1998	70	NA	NA	9802	Albatross IV	Yankee No. 36	Polyvalent
1999	75	NA	NA	9902	Albatross IV	Yankee No. 36	Polyvalent
2000	88	NA	NA	2002	Albatross IV	Yankee No. 36	Polyvalent
2001	76	NA	NA	200102	Albatross IV	Yankee No. 36	Polyvalent

Table A7. Summary of NEFSC winter bottom trawl survey data for longfin squid. Longfin squid were identified in all years. "Mean date (Julian)" is for tows in strata used for longfin squid. In a non-leap year, the earliest mean Julian date (38) is 7 February and the latest mean Julian date (49) is 18 February. The standard 60-80 bottom trawl used in winter surveys is described in [http://www.nefsc.nmfs.gov/esb/adobe/flat\\_net.pdf](http://www.nefsc.nmfs.gov/esb/adobe/flat_net.pdf).

<b>Year</b>	<b>Mean Date (Julian)</b>	<b>Cruise Code</b>	<b>Research Vessels</b>
1992	49	9202	Albatross IV
1993	44	9302	Albatross IV
1994	38	9402	Delaware II
1995	48	9503	Albatross IV
1996	44	9602	Albatross IV
1997	43	9702	Albatross IV
1998	44	9802	Albatross IV
1999	40	9902	Albatross IV
2000	49	2002	Albatross IV
2001	39	2101	Albatross IV

Table A8. Summary of Massachusetts spring bottom trawl survey data for longfin squid. Longfin squid were identified in all years. "Mean date (Julian)" is for tows in strata used for longfin squid. In a non-leap year, the earliest mean Julian date (132) is 11 May and the latest mean Julian date (147) is 26 May. The standard 60-80 bottom trawl used in winter surveys is described in the text.

<b>Year</b>	<b>Mean Date (Julian)</b>	<b>Cruise Code</b>	<b>Research Vessels</b>
1978	147	921	Francis Elizabeth
1979	134	923	Francis Elizabeth
1980	139	925	Francis Elizabeth
1981	136	927	Francis Elizabeth
1982	135	8291	Gloria Michelle
1983	139	8391	Gloria Michelle
1984	137	8491	Gloria Michelle
1985	136	8591	Gloria Michelle
1986	135	8691	Gloria Michelle
1987	132	8791	Gloria Michelle
1988	141	8891	Gloria Michelle
1989	137	8991	Gloria Michelle
1990	138	9091	Gloria Michelle
1991	136	9191	Gloria Michelle
1992	134	9291	Gloria Michelle
1993	134	9391	Gloria Michelle
1994	139	9491	Gloria Michelle
1995	139	9591	Gloria Michelle
1996	137	9691	Gloria Michelle
1997	135	9791	Gloria Michelle
1998	133	9891	Gloria Michelle
1999	140	9991	Gloria Michelle
2000	140	2091	Gloria Michelle
2001	137	2191	Gloria Michelle

Table A9. NEFSC fall bottom trawl survey data for longfin squid. Data are mean KG per standard tow for all squid and mean number per tow for "pre-recruits"  $\leq 8.9$  cm DML (both adjusted to daytime equivalents using diel correction factors in Hatfield and Cadrin, in press). "Survey Area" and "Survey Strata" give the number of strata and total area of strata sampled in each year. Average temperatures are from survey records at each tow location used for longfin squid.

Year	Average Surface Temp. (°C)	Average Bottom Temp. (°C)	KG/Tow	CV	Pre-Recruit N/Tow	CV	N Tows	Survey Strata Sampled	Survey Area
1967	15.3	11.8	5.2	0.28	184	0.25	187	40	40,586
1968	17.5	13.0	8.7	0.24	199	0.25	187	40	40,586
1969	14.5	13.6	11.2	0.14	270	0.18	186	40	40,586
1970	18.9	11.5	5.2	0.20	124	0.23	184	40	40,586
1971	18.3	12.6	3.6	0.18	193	0.23	191	40	40,586
1972	17.5	14.4	10.0	0.22	444	0.25	181	40	40,586
1973	18.3	13.7	15.0	0.12	463	0.24	177	40	40,586
1974	18.5	13.7	12.6	0.14	411	0.36	176	40	40,586
1975	16.0	12.9	17.9	0.22	895	0.30	181	40	40,586
1976	17.1	13.5	16.0	0.19	641	0.17	185	40	40,586
1977	17.5	13.1	12.8	0.18	601	0.20	208	40	40,586
1978	17.0	11.6	6.4	0.14	194	0.17	266	40	40,586
1979	16.5	12.7	6.4	0.11	357	0.18	258	40	40,586
1980	18.3	12.9	12.0	0.18	1,325	0.36	189	39	40,526
1981	16.5	12.4	7.9	0.15	307	0.16	170	40	40,586
1982	18.7	12.5	9.8	0.18	446	0.32	166	40	40,586
1983	19.1	12.4	15.3	0.14	472	0.17	169	40	40,586
1984	18.8	12.4	17.1	0.12	319	0.16	167	39	40,500
1985	19.0	14.3	17.0	0.20	649	0.23	167	40	40,586
1986	18.6	13.6	13.0	0.12	616	0.17	167	40	40,586
1987	19.3	12.3	3.2	0.24	81	0.21	154	39	40,534
1988	19.0	11.6	11.7	0.16	637	0.23	152	40	40,586
1989	18.9	13.1	15.6	0.12	531	0.21	151	40	40,586
1990	21.0	14.0	13.8	0.14	548	0.20	159	39	40,481
1991	20.0	12.7	13.2	0.12	430	0.22	152	40	40,586
1992	18.5	12.5	10.7	0.17	1,252	0.21	150	38	40,429
1993	19.9	12.3	6.4	0.13	177	0.23	151	39	40,526
1994	18.1	13.7	19.8	0.16	607	0.21	158	40	40,586
1995	19.6	14.8	8.2	0.14	440	0.27	151	40	40,586
1996	18.1	12.0	4.4	0.15	219	0.23	153	40	40,586
1997	19.8	13.6	8.9	0.28	386	0.26	155	40	40,586
1998	18.5	12.2	6.2	0.19	267	0.18	154	40	40,586
1999	18.7	14.9	15.6	0.11	1,018	0.15	153	40	40,586
2000	19.6	14.1	17.2	0.12	843	0.15	153	40	40,586
2001	na	na	18.3	0.18	1,578	0.37	154	40	40,586
Average	18.3	13.0	11.3	0.17	518	0.23	173	40	40,571
Min	14.5	11.5	3.2	0.11	81	0.15	150	38	40,429
Max	21.0	14.9	19.8	0.28	1,578	0.37	266	40	40,586



Table A10. NEFSC spring bottom trawl survey data for longfin squid. Data are mean KG per standard tow for all squid and mean number per tow for "pre-recruits"  $\leq 8.9$  cm DML (both adjusted to daytime equivalents using diel correction factors in Hatfield and Cadrin, in press). "Survey Area" and "Survey Strata" give the number of strata and total area of strata sampled in each year. Average temperatures are from survey records at each tow location used for longfin squid.

Year	Average Surface Temp. (°C)	Average Bottom Temp. (°C)	KG/Tow	CV	Pre-Recruit N/Tow	CV	N Tows	Survey Strata Sampled	Survey Area
1968	5.6	8.7	1.6	0.75	10	0.57	174	40	40,586
1969	6.4	9.2	1.1	0.54	3	0.57	178	40	40,586
1970	7.1	9.9	0.9	0.69	20	0.88	188	40	40,586
1971	6.1	9.5	1.7	0.38	23	0.33	183	40	40,586
1972	7.5	10.2	3.1	0.32	43	0.47	189	40	40,586
1973	7.1	10.4	2.9	0.39	22	0.70	210	40	40,586
1974	8.7	10.6	4.3	0.30	219	0.43	153	40	40,586
1975	6.7	9.4	4.6	0.42	147	0.54	157	36	38,879
1976	7.9	9.8	5.7	0.22	187	0.42	185	40	40,586
1977	9.1	8.8	0.9	0.75	11	0.53	183	40	40,586
1978	6.6	8.4	1.4	0.71	44	0.92	185	40	40,586
1979	7.2	9.0	2.4	0.44	103	0.63	239	40	40,586
1980	8.7	9.7	1.9	0.41	45	0.52	225	40	40,586
1981	7.6	9.7	1.9	1.01	34	1.19	163	39	40,414
1982	6.4	9.2	2.2	0.47	58	0.93	174	40	40,586
1983	8.0	9.7	2.6	0.52	23	0.52	169	40	40,586
1984	7.6	10.0	2.9	0.52	61	0.64	172	40	40,586
1985	8.2	10.2	2.4	0.57	76	0.58	167	40	40,586
1986	8.9	10.4	3.2	0.38	83	0.44	172	40	40,586
1987	7.4	9.6	2.1	0.41	15	1.18	173	40	40,586
1988	6.0	9.1	3.9	0.39	106	0.66	154	39	40,481
1989	8.1	9.5	5.3	0.43	104	0.60	149	40	40,586
1990	8.0	9.6	3.8	0.56	119	0.40	151	39	40,414
1991	9.4	10.8	4.7	0.30	156	0.40	154	40	40,586
1992	6.9	9.5	2.5	0.55	78	0.59	150	38	40,350
1993	6.3	8.7	2.0	0.54	33	0.56	151	38	40,350
1994	7.3	10.0	1.2	0.49	28	0.58	152	39	40,410
1995	8.7	10.5	2.2	0.31	55	0.37	150	40	40,586
1996	7.5	9.6	0.6	0.47	23	0.50	163	40	40,586
1997	7.2	10.2	2.2	0.59	67	0.49	152	38	40,305
1998	6.5	8.1	1.5	0.50	53	0.49	154	39	40,526
1999	8.1	10.8	3.6	0.43	216	0.42	154	40	40,586
2000	9.0	10.3	2.9	0.38	115	0.49	154	40	40,586
2001	7.2	9.8	2.1	0.40	106	0.38	154	40	40,586
Average	7.5	9.7	2.6	0.49	73	0.59	170	40	40,494
Min	5.6	8.1	0.6	0.22	3	0.33	149	36	38,879
Max	9.4	10.8	5.7	1.01	219	1.19	239	40	40,586

Table A11. NEFSC winter bottom trawl survey data for longfin squid. Data are mean KG per standard tow for all squid and mean number per tow for "pre-recruits"  $\leq 8.9$  cm DML (both adjusted to daytime equivalents using diel correction factors in Hatfield and Cadrin, in press). "Survey Area" and "Survey Strata" give the number of strata and total area of strata sampled in each year. Average temperatures are from survey records at each tow location used for longfin squid.

Average Surface Temp. (°C)	Average Winter Temp. (°C)	KG/Tow	CV	Pre-Recruit		N Tows	Survey Strata Sampled	Survey Area
				N/Tow	CV			
7.0	9.2	2.2	0.33	44	0.49	105	24	32,994
6.7	8.4	4.9	0.33	100	0.46	109	23	29,988
7.5	9.4	2.2	0.35	45	0.53	78	24	32,994
15.6	9.5	3.7	0.31	67	0.37	118	27	33,772
6.5	9.1	2.7	0.52	45	0.55	123	25	33,354
7.1	9.7	1.9	0.26	38	0.33	119	31	34,343
7.0	8.7	1.7	0.35	25	0.38	134	32	34,267
8.5	10.8	2.9	0.20	107	0.33	134	33	34,455
9.4	10.3	7.2	0.24	295	0.38	123	28	30,479
7.6	10.0	4.1	0.30	150	0.32	166	33	34,455
8.3	9.5	3.4	0.32	92	0.42	121	28	33,110
6.5	8.4	1.7	0.20	25	0.32	78	23	29,988
15.6	10.8	7.2	0.52	295	0.55	166	33	34,455

Table A12. Massachusetts inshore spring bottom trawl survey data for longfin squid. Data are mean KG per standard tow for all squid and mean number per tow for "pre-recruits"  $\leq 8.9$  cm DML (both adjusted to daytime equivalents using diel correction factors in Hatfield and Cadrin, in press). "Survey Area" and "Survey Strata" give the number of strata and total area of strata sampled in each year. Average temperatures are from survey records at each tow location used for longfin squid.

Year	Average Surface Temp. (°C)	Average Bottom Temp. (°C)	KG/Tow	CV	Pre-Recruit N/Tow	CV	N Tows	Survey Strata Sampled	Survey Area
1978	14.1	13.5	1.3	0.31	2	0.23	56	11	1,044
1979	13.9	13.3	4.1	0.30	7	0.41	51	11	1,044
1980	11.4	12.1	6.1	0.47	3	0.25	53	11	1,044
1981	11.3	10.8	1.2	0.42	5	0.43	55	11	1,044
1982	11.6	11.2	1.5	0.50	5	0.36	51	11	1,044
1983	12.2	11.8	8.1	0.43	38	0.21	53	11	1,044
1984	12.4	11.8	4.6	0.31	14	0.17	54	11	1,044
1985	12.4	11.7	7.0	0.28	38	0.31	52	11	1,044
1986	10.8	10.2	7.4	0.37	2	0.32	56	11	1,044
1987	11.7	11.4	6.7	0.36	3	0.32	51	11	1,044
1988	11.7	10.9	17.7	0.31	79	0.24	49	11	1,044
1989	10.7	9.4	6.0	0.22	12	0.33	49	11	1,044
1990	11.4	11.0	9.6	0.26	54	0.17	53	11	1,044
1991	13.6	13.0	4.7	0.28	3	0.29	51	11	1,044
1992	10.6	10.4	1.3	0.39	1	0.28	51	11	1,044
1993	12.5	11.8	3.2	0.31	1	0.38	54	11	1,044
1994	10.5	9.9	1.8	0.35	4	0.34	53	11	1,044
1995	10.8	10.5	5.0	0.28	64	0.24	53	11	1,044
1996	12.3	11.5	3.7	0.47	6	0.26	56	11	1,044
1997	11.1	10.7	1.5	0.20	15	0.40	55	11	1,044
1998	10.9	10.5	0.9	0.19	40	0.28	52	11	1,044
1999	14.1	13.9	2.6	0.27	9	0.31	52	11	1,044
2000	12.5	12.3	5.7	0.35	173	0.30	53	11	1,044
2001	12.6	12.3	1.6	0.33	1	0.32	54	11	1,044
Average	12.0	11.5	4.7	0.33	24	0.30	53	11	1,044
Min	10.5	9.4	0.9	0.19	1	0.17	49	11	1,044
Max	14.1	13.9	17.7	0.50	173	0.43	56	11	1,044

Table A13. Time in length group ( $Dt_L$ ) and assumed natural mortality rates ( $M_L$ ) used in length based virtual population analyses (LVPA) for longfin squid.

Length Groups (cm)	Summer fishery / Winter Hatch $M_L$ (quarter <sup>-1</sup> )	Winter Fishery / Summer Hatch $M_L$ (quarter <sup>-1</sup> )	Summer Fishery / Winter Hatch Age at Lower Bound of Length Group (months)	$Dt_L$ (months)	Winter Fishery / Summer Hatch Age at Lower Bound of Length Group (months)	$Dt_L$ (months)
31+	NA	NA	10.276	NA	8.351	NA
29 to 30.9	1.5	1.98	10.006	0.271	8.179	0.172
27 to 28.9	0.75	0.99	9.716	0.290	7.995	0.184
25 to 26.9	0.75	0.99	9.403	0.312	7.797	0.198
23 to 24.9	0.75	0.99	9.065	0.338	7.583	0.215
21 to 22.9	0.75	0.99	8.696	0.369	7.349	0.234
19 to 20.9	0.75	0.99	8.290	0.406	7.091	0.258
17 to 18.9	0.75	0.99	7.839	0.451	6.805	0.286
15 to 16.9	0.75	0.99	7.331	0.508	6.483	0.322
13 to 14.9	0.75	0.99	6.751	0.581	6.114	0.368
11 to 12.9	0.75	0.99	6.073	0.678	5.685	0.430
9 to 10.9	0.75	0.99	5.259	0.814	5.168	0.516

Table A14. Summary of bounds for factors affecting catchability of longfin squid in the NEFSC fall bottom trawl survey (survey data adjusted for diel catchability patterns).

Factor	Lower Bound	Upper Bound	Comment
Tow distance ( $d$ )	5% smaller than the nominal value (0.95 x 3.52 km/tow = 3.3450)	10% larger than the nominal value (1.1 x 3.52 km/tow = 3.8732)	Units km/tow, based on information from clam and scallop studies
Effective survey bottom trawl width ( $w$ )	Mean wing spread (0.01164 km)	Mean door spread (0.02380 km)	Units km, based on field measurements
Survey bottom trawl efficiency $e$	0.1	0.9	Dimensionless; choices close to minimum and maximum possible values ( $0 < e \leq 1$ )
Effective stock area ( $A$ )	5% larger than area surveyed (1.1 $S$ = 1.1 x 139,357 = 146,324 km <sup>2</sup> )	30% larger than area surveyed (1.3 $S$ = 1.5 x 139,357 = 181,163 km <sup>2</sup> )	Units km <sup>2</sup> , for fall NEFSC survey with diel catchability adjustments
Weight units ( $u$ )	106	106	Survey data in kg/tow, stock biomass in 1000 MT
Fall survey daytime catchability ( $Q$ )	$Q^{min} = [d_{min} w_{min} e_{min}] / A_{max} = (3.3450 \times 0.01164 \times 0.1 \times 106) / 181,163 = 0.02149$	$Q^{max} = [d_{max} w_{max} e_{max}] / A_{min} = (3.8732 \times 0.02380 \times 0.9 \times 106) / 146,324 = 0.5569$	Units km <sup>-1</sup> , lower bound is minimum/maximum factor values; upper bound is maximum/minimum factor values

Table A15. Scaled autumn catch-survey biomass and fishing mortality ( $F$ ) estimates for longfin squid.  $F$  estimates not calculated prior to 1987 because quarterly catch data not available.

Minimum "most likely" $Q_{Fall}$	0.050
Maximum "most likely" $Q_{Fall}$	0.220
Upper feasible bound for $Q_{Fall}$	0.547
Discard rate	6%

Year	Adjusted (daytime) KG/Tow	Minimum	Maximum	Lowest Feasible Biomass (1000 mt)	October- December Catch (1000 mt)	October- December Catch + Discard (1000 mt)	Minimum	Maximum	Maximum Feasible $F$ (quarter <sup>-1</sup> )
		"Most Likely" Biomass (1000 mt)	"Most Likely" Biomass (1000 mt)				"Most Likely" $F$ (quarter <sup>-1</sup> )	"Most Likely" $F$ (quarter <sup>-1</sup> )	
1967	5.15	23	103	9					
1968	8.66	39	173	16					
1969	11.22	51	224	21					
1970	5.22	24	104	10					
1971	3.64	17	73	7					
1972	10.05	46	201	18					
1973	14.99	68	300	27					
1974	12.62	57	252	23					
1975	17.90	81	358	33					
1976	15.98	73	320	29					
1977	12.85	58	257	23					
1978	6.36	29	127	12					
1979	6.44	29	129	12					
1980	12.02	55	240	22					
1981	7.87	36	157	14					
1982	9.80	45	196	18					
1983	15.29	70	306	28					
1984	17.13	78	343	31					
1985	17.04	77	341	31					
1986	12.97	59	259	24					
1987	3.15	14	63	6	1.78	1.89	0.03	0.13	0.33
1988	11.75	53	235	21	4.15	4.40	0.02	0.08	0.20
1989	15.59	71	312	28	5.81	6.16	0.02	0.09	0.22
1990	13.81	63	276	25	4.08	4.33	0.02	0.07	0.17
1991	13.21	60	264	24	7.68	8.14	0.03	0.14	0.34
1992	10.68	49	214	20	6.21	6.59	0.03	0.14	0.34
1993	6.39	29	128	12	5.12	5.43	0.04	0.19	0.46
1994	19.82	90	396	36	9.83	10.42	0.03	0.12	0.29
1995	8.15	37	163	15	5.31	5.63	0.03	0.15	0.38
1996	4.43	20	89	8	1.16	1.23	0.01	0.06	0.15
1997	8.90	40	178	16	7.25	7.68	0.04	0.19	0.47
1998	6.15	28	123	11	5.20	5.52	0.04	0.20	0.49
1999	15.59	71	312	29	6.31	6.69	0.02	0.09	0.23
2000	17.18	78	344	31	3.40	3.60	0.01	0.05	0.11
2001	18.33	83	367	34	5.42	5.74	0.02	0.07	0.17
Min	3.15	14	63	6	1.16	1.23	0.01	0.05	0.11
Max	19.82	90	396	36	9.83	10.42	0.04	0.20	0.49
Mean All Years	11.32	51	226	21	5.24	5.55	0.03	0.12	0.30

Table A16. Unscaled relative catch-survey  $F$  estimates for longfin squid from winter survey and catch data, and from spring survey and catch data.

Year	Spring Survey (KG/Tow)	April-June Catch	Unscaled Relative Spring F	Winter Survey (KG/Tow)	January-March Catch	Relative Winter F
1987	2.60	4.265	1.64			
1988	3.77	7.589	2.02			
1989	5.29	6.919	1.31			
1990	3.67	3.847	1.05			
1991	4.42	6.297	1.42			
1992	2.53	3.531	1.40	3.14	7.211	2.29
1993	2.27	4.736	2.09	5.85	11.438	1.95
1994	1.24	2.285	1.85	2.68	4.762	1.78
1995	2.10	3.820	1.82	4.38	5.815	1.33
1996	0.74	4.648	6.31	3.25	5.201	1.60
1997	2.27	2.961	1.31	2.26	3.347	1.48
1998	1.39	2.128	1.53	2.08	10.692	5.14
1999	3.63	3.152	0.87	3.23	4.927	1.52
2000	2.78	3.345	1.20	8.03	6.408	0.80
2001	2.35	3.024	1.29	4.82	3.391	0.70

Table A17. CV's for longfin squid abundance data with assumed CV's for catchability process errors and goodness of fit CV's from the basecase PDQ model run.

<b>Abundance Index</b>	<b>Minimum Data CV</b>	<b>Mean Data CV</b>	<b>Maximum Data CV</b>	<b>Assumed CV for Catchability Process Errors</b>	<b>Goodness of Fit CV for Basecase Run</b>
NEFSC autumn bottom trawl survey (1987-2001)	0.11	0.16	0.28	0.15	0.26
NEFSC spring bottom trawl survey (1987-2001)	0.3	0.45	0.6	0.05	0.51
NEFSC winter bottom trawl survey (1987-2001)	0.2	0.32	0.52	0.1	0.37
Massachusetts spring bottom trawl survey (1987-2001)	0.19	0.3	0.47	0.35	0.36
Standardized winter LPUE	0.2	0.2	0.2*	0	0.21
Standardized summer LPUE	0.2	0.2	0.2*	0	0.24
Winter LVPA biomass trend	0.3	0.3	0.3*	0.15	0.34
Summer LVPA biomass trend	0.3	0.3	0.3*	0.05	0.37

\* Assumed constant value



Table A18. Basecase run and likelihood profile analysis for the simple PDQ model with catchability process errors. The likelihood profile analysis was carried out by fixing  $Q_{FALL}$  at a series of values that spanned the feasible range and with process error CV's as in the basecase run (see Table A17). Goodness of fit (GOF) is measured by negative log likelihood. Smaller negative log likelihood values mean better fit. The smallest negative log likelihood value in each row is identified by *large-bold-italic-outline* font.

	Profile Q=0.02	Profile Q=0.05	Profile Q=0.11	Profile Q=0.2	Profile Q=0.22	Profile Q=0.29	Profile Q=0.39	Best Fit, Basecase	Profile Q=0.48	Profile Q=0.56
<b>NEFSC Fall Survey Catchability</b>	0.02	0.05	0.11	0.20	0.22	0.29	0.39	0.45	0.48	0.56
<b>Goodness of fit (GOF) for surveys:</b>										
GOF NEFSC Fall Survey	21.78	21.78	19.84	20.18	17.22	15.89	14.91	14.48	14.36	<b>14.06</b>
GOF NEFSC Spring Survey	12.23	11.10	11.15	12.42	10.26	10.04	9.85	9.71	9.65	<b>9.44</b>
GOF NEFSC Winter Survey	9.59	9.98	9.34	8.08	8.49	8.17	<b>8.10</b>	8.19	8.24	8.46
GOF Mass. Spring Survey	9.82	<b>9.16</b>	10.45	10.95	9.94	10.13	10.23	10.24	10.22	10.13
GOF Winter LPUE	6.40	7.47	6.60	5.22	5.52	4.80	4.09	3.68	3.55	<b>3.15</b>
GOF Summer LPUE	4.79	<b>3.68</b>	3.99	4.47	3.98	4.28	4.66	4.92	5.01	5.33
GOF Winter LVPA Biom. Trend	9.74	10.05	10.12	11.20	10.03	9.77	9.36	9.04	8.93	<b>8.51</b>
GOF Summer LVPA Biom. Trend	<b>11.01</b>	9.61	10.73	13.91	10.61	10.63	10.59	10.61	10.63	10.82
<b>GOF all surveys:</b>	85.35	82.83	82.22	86.42	76.06	73.72	71.78	70.86	70.59	<b>69.90</b>
<b>Prior GOF Qfall:</b>	4.31	1.96	<b>1.54</b>	1.60	1.67	2.02	2.77	3.71	4.22	11.68
<b>Survey Q process errors:</b>	38.61	38.28	37.44	38.19	35.29	34.17	33.18	32.67	32.50	<b>32.02</b>
<b>Production process errors:</b>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Catch:</b>	0.00	1.00	0.03	0.17	0.00	0.00	0.00	0.00	0.00	0.00
<b>Catch/Biomass Constraint:</b>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>GOF everything</b>	128.27	124.07	121.24	126.38	113.02	109.92	107.74	<b>107.23</b>	107.32	113.60
<b>Biomass and F:</b>										
Average biomass in 2001	500.00	205.98	104.04	91.37	61.30	50.26	41.38	36.43	34.80	<b>29.70</b>
Average F 2000	<b>0.01</b>	0.02	0.05	0.06	0.09	0.12	0.16	0.20	0.21	0.26
Average catch in 2000	4.78	4.79	4.94	4.72	4.78	4.78	4.78	4.79	4.79	4.79
<b>Production model:</b>										
Geom. Mean surplus production rate	<b>0.02</b>	0.02	0.06	0.10	0.12	0.16	0.21	0.25	0.26	0.31

Table A19. Longfin squid biomass, surplus production and fishing mortality rates for basecase PDQ model with catchability process errors. CV's for biomass and fishing mortality estimates calculated by the delta method with asymptotic variances for parameters, and by bootstrapping (500 bootstrap iterations). Estimates for 2001 not reliable.

Year	Biomass (1000 MT)		Surplus Production (Thousand MT per quarter)		Fishing Mortality ( <i>F</i> ) per quarter		Bootstrap CV	
	Asymptotic CV	Bootstrap CV	Asymptotic CV	Bootstrap CV	Asymptotic CV	Bootstrap CV	Asymptotic CV	Bootstrap CV
1987.00	16.42	0.17	0.20	4.58	0.16	0.17	0.18	
1987.25	17.82	0.17	0.19	4.97	0.27	0.17	0.18	
1987.50	17.35	0.18	0.20	4.83	0.11	0.17	0.18	
1987.75	19.87	0.16	0.18	5.54	0.09	0.15	0.16	
1988.00	23.15	0.14	0.16	6.45	0.16	0.13	0.14	
1988.25	25.28	0.13	0.15	7.04	0.36	0.13	0.14	
1988.50	22.63	0.14	0.16	6.31	0.16	0.13	0.14	
1988.75	24.55	0.13	0.15	6.84	0.18	0.12	0.13	
1989.00	26.12	0.11	0.14	7.28	0.47	0.13	0.14	
1989.25	20.80	0.14	0.17	5.80	0.40	0.15	0.16	
1989.50	17.75	0.17	0.19	4.95	0.07	0.15	0.16	
1989.75	21.22	0.14	0.17	5.91	0.32	0.15	0.16	
1990.00	19.72	0.16	0.18	5.50	0.26	0.16	0.17	
1990.25	19.43	0.16	0.19	5.41	0.22	0.16	0.17	
1990.50	19.94	0.16	0.19	5.56	0.16	0.16	0.17	
1990.75	21.77	0.15	0.18	6.07	0.21	0.15	0.16	
1991.00	22.63	0.15	0.17	6.31	0.14	0.14	0.15	
1991.25	25.29	0.14	0.16	7.05	0.29	0.14	0.15	
1991.50	24.30	0.14	0.16	6.77	0.15	0.13	0.14	
1991.75	26.70	0.13	0.15	7.44	0.34	0.13	0.14	
1992.00	24.33	0.14	0.16	6.78	0.35	0.14	0.15	
1992.25	21.90	0.15	0.17	6.10	0.17	0.15	0.15	
1992.50	23.51	0.14	0.16	6.55	0.09	0.13	0.14	
1992.75	27.44	0.12	0.14	7.65	0.26	0.12	0.13	
1993.00	27.18	0.11	0.13	7.57	0.55	0.13	0.14	
1993.25	20.09	0.15	0.17	5.60	0.27	0.15	0.16	
1993.50	19.65	0.16	0.18	5.48	0.09	0.15	0.15	
1993.75	22.93	0.14	0.16	6.39	0.25	0.14	0.14	
1994.00	22.80	0.14	0.16	6.36	0.23	0.14	0.14	
1994.25	23.10	0.13	0.15	6.44	0.10	0.12	0.13	
1994.50	26.63	0.11	0.13	7.42	0.28	0.11	0.12	
1994.75	25.64	0.11	CV	7.15	0.48	0.12	0.13	
1995.00	20.21	0.13	0.13	5.63	0.34	0.14	0.15	
1995.25	18.42	0.14	0.16	5.13	0.23	0.14	0.15	
1995.50	18.69	0.14	0.17	5.21	0.24	0.14	0.15	
1995.75	18.88	0.14	0.17	5.26	0.33	0.14	0.16	
1996.00	17.37	0.15	0.17	4.84	0.36	0.16	0.17	
1996.25	15.57	0.17	0.18	4.34	0.35	0.19	0.20	
1996.50	13.97	0.20	0.20	3.89	0.08	0.19	0.20	
1996.75	16.57	0.18	0.23	4.62	0.07	0.17	0.18	
1997.00	19.72	0.16	0.21	5.50	0.19	0.16	0.17	
1997.25	20.96	0.15	0.19	5.84	0.15	0.15	0.16	
1997.50	22.99	0.14	0.18	6.41	0.13	0.13	0.15	
1997.75	25.90	0.12	0.17	7.22	0.33	0.12	0.14	
1998.00	23.88	0.13	0.15	6.65	0.60	0.15	0.17	
1998.25	16.83	0.18	0.16	4.69	0.13	0.18	0.20	
1998.50	18.81	0.17	0.22	5.24	0.06	0.16	0.19	
1998.75	22.63	0.15	0.21	6.31	0.26	0.15	0.18	
1999.00	22.31	0.15	0.19	6.22	0.25	0.16	0.19	
1999.25	22.25	0.16	0.20	6.20	0.15	0.15	0.20	
1999.50	24.45	0.15	0.20	6.81	0.23	0.15	0.21	
1999.75	24.90	0.15	0.20	6.94	0.29	0.15	0.24	
2000.00	23.80	0.16	0.21	6.63	0.31	0.17	0.31	
2000.25	22.26	0.18	0.23	6.20	0.16	0.18	0.39	
2000.50	24.20	0.18	0.28	6.75	0.17	0.18	0.47	
2000.75	26.01	0.18	0.29	7.25	0.14	0.18	0.59	
Minimum	13.97	0.11	0.13	3.89	0.06	0.11	0.12	
Average	21.78	0.15	0.18	6.07	0.24	0.15	0.18	
Maximum	27.44	0.20	0.29	7.65	0.60	0.19	0.59	

Table A20. Per recruit model data for longfin squid.

Age	Fishery Selectivity	Natural Mortality (quarter-1)	Maturity	Body Weight (KG)
<i>Winter hatch (summer fishery)</i>				
1	0.008	0.750	0.006	0.004
2	0.011	0.750	0.008	0.007
3	0.017	0.750	0.012	0.011
4	0.029	0.750	0.019	0.019
5	0.057	0.750	0.035	0.033
6	0.132	0.750	0.076	0.056
7	0.328	0.750	0.189	0.095
8	0.686	0.750	0.468	0.162
9	0.937	0.750	0.828	0.275
10	0.994	0.750	0.977	0.468
11	1.000	1.500	0.999	0.795
12	1.000	1.500	1.000	1.351
<i>Summer hatch (winter fishery)</i>				
1	0.005	1.000	0.004	0.001
2	0.007	1.000	0.005	0.003
3	0.011	1.000	0.008	0.007
4	0.024	1.000	0.016	0.017
5	0.071	1.000	0.043	0.038
6	0.289	1.000	0.165	0.088
7	0.826	1.000	0.636	0.204
8	0.994	1.000	0.977	0.471
9	1.000	2.000	1.000	1.086
10	1.000	2.000	1.000	2.506

Table A21. Per recruit model results for longfin squid.

Biological Reference Point	Yield Per Recruit (Proportion of Maximum)	Spawning Biomass Per Recruit (Proportion of Maximum)	Fully Recruited Fishing Mortality (quarter <sup>-1</sup> )	Biomass Weighted Fishing Mortality (quarter <sup>-1</sup> )
<i>Winter hatch / summer fishery</i>				
$F_{MAX}$	0.029	0.052	1.392	0.767
$F_{0.1}$	0.027	0.076	0.940	0.581
$F_{SPR\%}$ :				
5%	0.021	0.010	4.421	1.256
10%	0.025	0.019	2.886	1.103
15%	0.027	0.029	2.207	0.989
20%	0.028	0.038	1.790	0.890
25%	0.028	0.047	1.495	0.802
30%	0.028	0.057	1.268	0.721
35%	0.028	0.066	1.086	0.647
40%	0.027	0.076	0.934	0.578
45%	0.026	0.085	0.803	0.514
50%	0.025	0.095	0.690	0.453
55%	0.023	0.104	0.590	0.397
60%	0.021	0.114	0.500	0.343
65%	0.019	0.123	0.419	0.293
70%	0.017	0.133	0.344	0.245
75%	0.014	0.142	0.276	0.199
80%	0.012	0.152	0.213	0.156
85%	0.009	0.161	0.155	0.115
90%	0.006	0.171	0.100	0.075
95%	0.003	0.180	0.049	0.037
<i>Summer hatch / winter fishery</i>				
$F_{MAX}$	0.030	0.050	1.560	1.095
$F_{0.1}$	0.029	0.071	1.084	0.816
$F_{SPR\%}$ :				
5%	0.021	0.009	4.955	2.095
10%	0.025	0.017	3.328	1.768
15%	0.027	0.026	2.574	1.540
20%	0.029	0.035	2.101	1.356
25%	0.030	0.044	1.761	1.199
30%	0.030	0.052	1.499	1.063
35%	0.029	0.061	1.286	0.941
40%	0.029	0.070	1.108	0.832
45%	0.028	0.078	0.955	0.732
50%	0.026	0.087	0.821	0.641
55%	0.024	0.096	0.702	0.557
60%	0.023	0.104	0.596	0.479
65%	0.020	0.113	0.499	0.406
70%	0.018	0.122	0.411	0.338
75%	0.015	0.131	0.329	0.273
80%	0.013	0.139	0.254	0.213
85%	0.010	0.148	0.185	0.155
90%	0.007	0.157	0.119	0.101
95%	0.003	0.165	0.058	0.049