Table B1. Butterfish USA landings (tonnes), USA discards, Foreign landings, and total catch during 1965-2002

Year	USA landings	USA discards	Foreign landings	Total catch
1965	3340	833	749	4922
1966	2615	846	3865	7326
1967	2452	991	2316	5759
1968	1804	770	5437	8011
1969	2438	968	15378	18784
1970	1869	569	12450	14888
1971	1570	866	8913	11349
1972	819	293	12221	13333
1973	1557	1030	31679	34266
1974	2528	1409	15465	19402
1975	2088	1478	12764	16330
1976	1528	969	14309	16806
1977	1448	1172	4607	7228
1978	3676	5237	1906	10819
1979	2831	3452	1207	7491
1980	5356	7802	1264	14422
1981	4855	7412	1345	13612
1982	9060	12906	907	22873
1983	4905	6421	906	12231
1984	11972	18959	617	31547
1985	4739	7134	1156	13029
1986	4418	7249	236	11902
1987	4508	7168		11676
1988	2001	3224		5225
1989	3203	4442		7645
1990	2295	3020		5315
1991	2149	3451		5600
1992	2752	5698		8450
1993	4604	8478		13082
1994	3631	3701		7332
1995	2080	8599		10679
1996	3547	6823		10370
1997	2784	3852		6636
1998	1956	3274		5230
1999	2103	4115		6218
2000	1422	2427		3849
2001	4396	7262		11658
2002	867	1809		2676

Table B2. Observed tows with butterfish catch for target species or groups including target, number of trips, percent trips, cumulative frequency of trips, and cumulative percent of trips from the USA observer program database during 1989-2003.

Target	Frequency	Percent	Cumulative F	Cumulative P
None	206	3.7	206	3.7
Scup	83	1.5	289	5.2
Fluke	818	14.6	1107	19.8
Other	971	17.3	2078	37.1
Squid	2120	37.9	4198	75.0
Butter	233	4.2	4431	79.1
Finfish	136	2.4	4567	81.6
Mix Flnd	21	0.4	4588	81.9
Mix Grnd	391	7.0	4979	88.9
Silver Hake	620	11.1	5599	100.0

Table B3. Target species or group, number of trips, landings (kg), and discards (kg) during 1989-1993.

Year	Target	Trips	Landings	Discard
1989	None	7	8996	8333
	Scup	2	640	315
	Fluke	12	294	679
	Other	12	3996	6316
	Squid	11	6016	10691
	Finfish	2	75	625
	Mix groundfish	13	10592	1387
	Silver hake	20	8960	21660
1990	None	1	53	565
	Fluke	11	1096	684
	Other	15	1209	2139
	Squid	11	9561	3750
	Finfish	8	4251	3861
	Mix flounder	2	2	2
	Mix groundfish	5	1870	2716
	Silver hake	11	618	239
1991	None	9	3832	13052
	Fluke	11	77	3623
	Other	24	34277	21549
	Squid	25	6432	45113
	Butter	6	45622	8574
	Finfish	6	806	9389
	Mix flounder	3	51	176
	Mix groundfish	17	10142	19043
	Silver hake	21	3308	5708
1992	None	1	1149	4502
	Fluke	23	1491	7795
	Other	9	267	5602
	Squid	11	7133	31467
	Finfish	2	15	22
	Mix groundfish	20	10429	58545
	Silver hake	13	1661	1208
1993	Fluke	8	1274	4000
	Other	7	2731	19417
	Squid	7	2617	30910
	Butter	3	108738	19436
	Finfish	1	370	17
	Mix flounder	1	0	1
	Mix groundfish	5	7404	15417
	Silver hake	17	1289	6770

Table B3. Continued; 1994-1998

Year	Target	Trips	Landings	Discard
1994	None	2	250	336
	Scup	2	515	3407
	Fluke	14	179	812
	Other	7	2183	10787
	Squid	9	3965	7155
	Butter	2	94957	1682
	Finfish	1	7	7
	Mix groundfish	5	4115	3773
	Silver hake	2	27	178
1995	Scup	1	330	365
	Fluke	21	192	3280
	Other	10	10965	14730
	Squid	7	127	3734
	Mix groundfish	3	52	22
	Silver hake	21	1581	324
1996	Fluke	11	1443	3172
	Other	25	37852	4331
	Squid	9	3041	21874
	Butter	1	2351	1591
	Mix groundfish	1	0	1
	Silver hake	26	74	73
1997	Scup	2	20	210
	Fluke	5	2385	1597
	Other	13	14040	34947
	Squid	24	7755	6781
	Butter	5	33088	9691
	Finfish	2	0	71
	Mix flounder	1	2	4
	Mix groundfish	1	0	1
	Silver hake	4	554	68
1998	None	3	1026	1694
	Fluke	5	1245	1619
	Other	6	1433	15381
	Squid	14	6273	5301
	Mix flounder	1	0	1
	Silver hake	4	781	2821

Table B3. Continued; 1999-2003

Year	Target	Trips	Landings	Discard
1999	None	3	91	42
	Scup	1	200	118
	Fluke	1	398	7050
	Other	10	18133	59380
	Squid	33	3296	121022
	Butter	1	3850	2050
	Mix groundfish	1	0	1
	Silver hake	11	61	131
2000	Scup	3	25	59
	Fluke	4	0	12
	Other	22	38237	120912
	Squid	26	5310	46843
	Mix flounder	1	0	13
	Mix groundfish	4	36	20
	Silver hake	6	280	18
2001	Scup	4	205	135
	Fluke	7	5	59
	Other	14	245	7360
	Squid	40	15508	80234
	Butter	1	0	160
	Silver hake	9	2169	3351
2002	Scup	4	15	2
	Fluke	21	115	75
	Other	18	420	745
	Squid	36	6731	23726
	Butter	1	67	96
	Silver hake	10	529	160
2003	Scup	5	126	11
	Fluke	17	115	85
	Other	6	278	7517
	Squid	12	812	5693
	Silver hake	3	123	508

Table B4. Landings, discards, discard ratios, and sample size (N) during 1994-2002 from the NMFS VTR database (for half year intervals and trips 600 lbs or less and greater than 600 lbs) using an aggregate approach (summed discards/ summed landings) with all trips included.

Year	Half	600				>600			
		Landings	Discard	Dratio	N	Landings	Discard	Dratio	N
1994	1	42.0	15.4	.367	756	64.7	100.1	1.547	1028
	2	56.1	8.0	.143	83	281.9	60.4	.214	217
1995	1	32.7	49.4	1.511	580	40.1	43.8	1.092	819
	2	200.0	88.4	.442	155	118.9	50.1	.421	89
1996	1	35.0	69.5	1.985	552	52.3	22.7	.434	1048
	2	930.3	99.6	.107	147	142.0	33.5	.236	165
1997	1	37.2	17.5	.471	556	57.3	21.7	.378	1116
	2	317.2	37.7	.119	154	101.2	11.4	.113	103
1998	1	31.5	22.6	.716	502	36.1	17.4	.481	853
	2	313.6	41.6	.132	127	43.1	5.5	.127	54
1999	1	33.2	9.7	.293	534	33.1	37.8	1.142	821
	2	133.8	5.1	.038	73	83.2	6.9	.082	101
2000	1	30.2	20.0	.663	607	39.0	13.8	.354	855
	2	26.6	4.9	.185	43	111.5	19.0	.170	87
2001	1	34.0	10.2	.301	528	36.3	13.5	.371	757
	2	1464.1	39.4	.027	162	69.4	8.7	.126	119
2002	1	24.3	22.7	.932	491	22.4	30.8	1.374	597
	2	119.3	5.3	.044	62	26.2	2.2	.085	38

Table B5. Landings, discards, discard ratios, and sample size (N) during 1989-2002 from observed tows in the NMFS observer program (for half year intervals and trips 600 lbs or less and greater than 600 lbs) using an aggregate approach (summed discards/ summed landings) with all trips included.

Year	Half	600				>600			
		Land	Discard	Dratio	N	Land	Discard	Dratio	N
1989	1	1642	5066	3.08526	26	15621	962	0.06158	3
	2	1584	8254	5.21086	39	20257	34192	1.68791	12
1990	1	808	3337	4.12995	22	13262	4419	0.33321	9
	2	1514	4178	2.75958	31	3058	1978	0.64683	3
1991	1	3332	23654	7.12041	45	43992	2183	0.04962	3
	2	4650	41101	8.83892	70	52583	59313	1.12799	9
1992	1	1816	10539	5.8034	52	14213	36990	2.6025	7
	2	2365	19342	8.1784	36	3936	42307	10.7487	4
1993	1	1996	6304	3.1583	22	13986	16496	1.1795	3
	2	1718	21208	12.3446	20	106723	51958	0.4868	5
1994	1	56	11.5	0.2054	4	na	na	na	Na
	2	1594	7055	4.4268	17	4426	13837	3.1263	2
1995	1	3336	11263	33.5012	42	10668	12005	1.1253	1
	2	3532	6281	1.7785	91	na	na	na	Na
1996	1	2526	11939	4.7257	37	4494	16041	3.56982	3
	2	3343	5203	1.55647	92	41216	7934	0.19251	8
1997	1	1458	3109	2.13317	37	51919	45294	0.87241	11
	2	1188	3265	2.7484	17	3599	1759	0.48875	2
1998	1	2363	4081	1.72704	18	6584	18465	2.80453	5
	2	1311	3336	2.54424	21	2292	1510	0.65881	2
1999	1	3231	33517	10.372	27	8151	17152	2.104	4
	2	780	132355	169.687	34	13870	6790	0.490	2
2000	1	1400	39346	28.105	33	4684	8458	1.806	3
	2	386	85939	222.639	31	37460	34175	0.912	2
2001	1	1530	44277	28.9392	38	16117	32360	2.0078	6
	2	632	15075	23.853	34	na	na	na	Na
2002	1	153	1301	8.5318	29	6318	10625	1.6817	1
	2	1609	13005	8.08272	65	1460	1651	1.13082	1

Table B6. Discard ratios , and sample size (N) during 1989-2002 from observed tows in the NMFS observer program (for half year intervals and trips 600 lbs or less and greater than 600 lbs) using a geometric mean discard ratio (retransformed, mean D/L by trip) for matched trips with landings and discards only.

Year	Half	600	N	>600	N
1989	1	2.531255	17	0.989597	3
	2	4.347187	20	1.593124	12
1990	1	2.681034	12	1.240319	8
	2	3.62086	15	1.478619	3
1991	1	3.795113	32	1.231818	3
	2	4.607233	42	1.806282	9
1992	1	3.142323	15	2.025193	7
	2	2.29842	15	2.49667	4
1993	1	2.793747	16	1.441397	3
	2	3.222019	13	2.011631	5
1994	1	0.471726	3	na	na
	2	2.702608	9	2.082737	2
1995	1	39.94192	18	1.753105	1
	2	2.793871	32	na	Na
1996	1	2.51086	18	2.208343	3
	2	3.403395	29	1.204729	7
1997	1	1.814747	16	1.504132	11
	2	2.220992	7	1.404974	2
1998	1	1.938916	12	1.723983	5
	2	3.548073	8	1.181671	2
1999	1	3.048545	16	2.090695	3
	2	3.636889	10	1.512366	2
2000	1	3.036537	14	1.926607	3
	2	1.660259	7	1.807028	2
2001	1	2.132316	19	1.734414	6
	2	1.418301	5	na	na
2002	1	4.240989	9	1.884612	1
	2	2.924087	13	1.764504	1

Table B7. Discard ratios (retransformed), otter trawl landings (tonnes), discard by otter trawls (tonnes) for half year and landings category (<600, >600), and total otter trawl discards (tonnes) during 1989-2002.

Year	Half	Dratio		Landings		Discard		Total Discard
		600	>600	600	>600	600	>600	
1989	1	2.531	0.989	63.9	1097.9	161.7	1086.5	4441.9
	2	4.347	1.593	97.0	1740.0	421.7	2772.0	
1990	1	2.681	1.240	86.8	978.4	232.7	1213.5	3019.7
	2	3.621	1.479	98.6	822.7	357.0	1216.5	
1991	1	3.795	1.232	72.6	1092.3	275.5	1345.5	3451.5
	2	4.607	1.806	87.3	790.7	402.2	1428.2	
1992	1	3.142	2.025	70.2	1692.2	220.6	3427.0	5697.9
	2	2.298	2.497	93.3	735.3	214.4	1835.8	
1993	1	2.794	1.441	83.0	824.1	231.9	1187.9	8477.8
	2	3.222	2.012	95.1	3356.3	306.4	6751.6	
1994	1	0.472	0.472	102.6	2082.2	48.4	982.2	3700.7
	2	2.703	2.083	107.2	1142.9	289.7	2380.4	
1995	1	39.942	1.753	119.8	1065.0	4785.0	1867.1	8599.1
	2	2.794	2.794	182.2	514.7	509.0	1438.0	
1996	1	2.511	2.208	167.2	2222.7	419.8	4908.5	6822.8
	2	3.403	1.205	198.0	681.2	673.9	820.7	
1997	1	1.815	1.504	172.5	1435.2	313.0	2158.7	3852.2
	2	2.221	1.405	227.1	623.5	504.4	876.0	
1998	1	1.939	1.724	179.6	1140.9	348.2	1966.9	3274.4
	2	3.548	1.182	176.5	281.8	626.2	333.0	
1999	1	3.049	2.091	190.1	1023.2	579.5	2139.2	4115.4
	2	3.637	1.512	154.2	552.7	560.8	835.9	
2000	1	3.037	1.927	131.6	227.3	399.6	437.9	2427.0
	2	1.660	1.807	151.5	740.4	251.5	1337.9	
2001	1	2.132	1.734	156.1	3562.8	332.9	6179.4	7261.7
	2	1.418	1.418	147.6	380.8	209.3	540.1	
2002	1	4.240	1.885	123.8	371.3	525.0	699.8	1809.2
	2	2.924	1.765	114.6	141.3	335.1	249.3	

Table B8. NEFSC indices in number and weight per tow (kg) for the Spring 1968-2002, Winter 1992-2002, and Autumn 1968-2002.

	Spring		Winter		Fall	
Year	# Spr	wt Spr	#Win	wt Win	#Fall	wt Fall
1968	33.139	1.956			90.838	7.86
1969	30.771	3.082			55.986	3.936
1970	9.871	0.515			35.235	2.282
1971	21.721	0.762			180.352	4.313
1972	228.075	6.643			68.976	2.767
1973	68.697	5.354			128.94	6.161
1974	25.258	1.72			86.845	4.06
1975	121.071	3.997			41.939	2.56
1976	31.148	1.308			122.304	5.671
1977	7.013	0.559			78.6	5.088
1978	4.654	0.25			78.272	3.614
1979	12.855	1.047			312.721	12.703
1980	58.182	3.197			313.711	15.06
1981	43.805	2.474			249.5	9.259
1982	49.188	2.549			88.393	4.134
1983	64.743	3.897			398.308	12.454
1984	15.837	0.711			332.506	11.243
1985	37.842	1.601			402.648	15.77
1986	66.206	2.784			162.941	5.967
1987	15.619	0.574			119.979	5.106
1988	13.353	0.478			268.748	7.277
1989	32.311	0.761			383.507	11.783
1990	8.928	0.36			406.732	9.899
1991	27.836	1.009			127.086	4.045
1992	17.949	0.607	20.099	0.769	263.224	4.917
1993	26.684	0.807	117.86	2.623	269.281	10.821
1994	36.294	1.45	169.513	6.255	542.882	13.81
1995	42.105	2.205	139.746	3.516	114.738	5.843
1996	11.47	0.512	67.663	1.351	72.479	2.867
1997	112.867	3.414	38.056	1.8	123.46	2.756
1998	41.07	2.144	40.123	0.975	231.036	7.097
1999	76.227	2.457	42.732	1.433	257.115	4.93
2000	36.773	0.99	153.673	5.07	181.611	7.515
2001	61.21	1.888	69.338	3.403	59.671	2.541
2002	46.572	1.705	44.859	1.925	36.411	1.29
2003	47.697	1.394				

Table B9. Catch per tow in number for NEFSC Spring surveys during 1982-2002 for ages 1-4.

Year	1	2	3	4
1982	36.0963	10.3065	2.3095	0.376
1983	33.815	22.9983	7.0392	0.8807
1984	10.8769	3.9009	0.9936	0.0658
1985	30.1886	4.9152	2.2178	0.464
1986	53.0479	12.0466	1.0129	0.0986
1987	13.9306	1.4298	0.2285	0.0228
1988	11.2921	1.8751	0.175	0.0113
1989	25.6435	5.7061	0.955	0.0059
1990	7.2205	1.3561	0.322	0.0297
1991	25.6657	1.4995	0.6257	0.0189
1992	16.0983	1.6132	0.2277	0.0098
1993	23.5588	2.7051	0.4205	0
1994	29.5594	5.6517	1.0395	0.0439
1995	26.5474	12.9457	2.6121	0
1996	7.7336	2.4142	1.2748	0.0477
1997	107.6083	4.6109	0.6476	0
1998	18.3203	21.5421	1.2072	0
1999	64.9677	9.2975	1.9621	0
2000	34.7082	1.6964	0.3287	0.0399
2001	49.2793	11.1395	0.7916	0
2002	38.1848	6.0295	2.1145	0.2429

Table B10. Catch per tow in number for NEFSC Autumn surveys during 1982-2002 for ages 0-3.

1982	57.752	24.9283	5.449	0.263
1983	303.883	82.9381	12.5132	1.4906
1984	282.965	39.0889	9.4107	1.0415
1985	319.562	74.7958	7.0782	1.1762
1986	126.467	24.8369	10.718	0.7787
1987	80.054	32.4701	7.1747	0.2803
1988	227.351	26.9924	14.2919	0.1126
1989	329.203	43.8711	10.2556	0.1772
1990	374.130	28.7001	3.4882	0.4142
1991	107.044	17.7069	2.0452	0.0194
1992	248.296	11.1541	3.7618	0.0117
1993	214.428	49.0602	5.4212	0.365
1994	504.598	26.917	10.6311	0.7043
1995	28.798	55.9273	29.9941	0.0189
1996	55.105	12.653	4.522	0.1984
1997	106.028	15.1555	2.0254	0.2516
1998	184.755	39.9448	5.3688	0.9673
1999	252.689	2.944	1.4821	0
2000	120.217	54.662	6.4658	0.2662
2001	29.317	18.3819	11.7222	0.2503
2002	28.921	4.6756	2.7507	0.0638

Table B11. Catch per tow in weight (kg) at age for NEFSC Autumn survey during 1982-2002 and for age 0 and 1+ during 1968-2002.

Year	0	1	2	3	0	1+
1968					0.2721	7.5879
1969					0.5397	3.3963
1970					0.8697	1.4123
1971					3.5352	0.7778
1972					2.2240	0.5430
1973					2.1216	4.0394
1974					1.9627	2.0973
1975					0.4952	2.0648
1976					1.9865	3.6845
1977					0.6372	4.4508
1978					2.4720	1.1420
1979					8.4353	4.2677
1980					4.5015	10.5585
1981					5.4677	3.7913
1982	1.5889	1.9977	0.5113	0.0364	1.5889	2.5454
1983	6.0358	5.1317	1.1389	0.1413	6.0358	6.4119
1984	7.3119	2.9419	0.8813	0.1083	7.3119	3.9315
1985	9.9567	4.9959	0.6987	0.1106	9.9567	5.8135
1986	3.1965	1.6832	0.9635	0.1093	3.1965	2.7702
1987	2.4951	2.056	0.5186	0.0362	2.4951	2.6108
1988	4.8221	1.4363	1.0035	0.0156	4.8221	2.4554
1989	8.3915	2.5959	0.7731	0.0222	8.3915	3.3912
1990	7.8038	1.7182	0.3318	0.0453	7.8038	2.0953
1991	2.6807	1.205	0.1565	0.0025	2.6807	1.3640
1992	3.9053	0.7087	0.3017	0.0019	3.9053	1.0123
1993	7.0499	3.2878	0.4401	0.0433	7.0499	3.7712
1994	11.0023	1.7917	0.9472	0.0647	11.0023	2.8080
1995	0.6757	3.3177	1.8463	0.003	0.6757	5.1670
1996	1.8175	0.6851	0.3494	0.0155	1.8175	1.0500
1997	1.5989	0.9855	0.1527	0.0185	1.5989	1.1567
1998	3.7522	2.7767	0.4712	0.0971	3.7522	3.3450
1999	4.676	0.1557	0.0978		4.6760	0.2535
2000	2.8136	4.1282	0.542	0.0311	2.8136	4.7013
2001	0.8906	0.9876	0.6409	0.0233	0.8906	1.6518
2002	0.8257	0.2412	0.2149	0.0082	0.8257	0.4643

Table B12. Indices in weight-per-tow for Rhode Island (1981-2002), Massachusetts (1982-2002), Connecticut (1984-2002) and the Virginia Institute of Marine Science (1988-2001).

Year	RI	MA	CT	VIMS
1981	1.200			
1982	1.200	2.790		
1983	1.200	2.787		
1984	3.000	1.787	8.639	
1985	1.100	1.433	16.770	
1986	4.200	4.414	10.978	
1987	2.500	0.688	7.856	
1988	12.300	11.684	15.412	0.008
1989	2.900	2.523	17.760	0.037
1990	5.500	2.552	13.318	0.025
1991	2.000	3.174	15.011	0.029
1992	3.500	8.874	22.623	0.010
1993	5.300	10.306	22.304	0.026
1994	5.600	7.286	11.130	0.008
1995	4.600	5.328	41.030	0.004
1996	2.800	6.605	23.016	0.025
1997	9.300	7.904	16.559	0.005
1998	4.600	14.479	51.376	0.015
1999	3.300	7.788	44.908	0.009
2000	0.880	3.175	27.605	0.016
2001	2.200	1.771	22.128	0.019
2002	2.000	3.844	26.520	na

Table B13 Estimates of instantaneous total mortality rates from spring survey catch per tow (number) at age (age 1-3) during 1982-2002.

Year	Age-1	Age-2	Age-3
1982-1983	0.451	0.381	.0964
1983-1984	2.160	3.142	4.673
1984-1985	0.794	0.565	0.761
1985-1986	0.919	1.580	3.113
1986-1987	3.614	3.965	3.794
1987-1988	2.005	2.101	3.007
1988-1989	0.683	0.675	3.390
1989-1990	2.940	2.875	3.471
1991-1992	1.572	0.773	2.835
1992-1993	2.767	1.885	4.156
1993-1994	1.784	1.345	Na
1994-1995	1.428	0.956	2.260
1995-1996	0.826	0.772	Na
1996-1997	2.398	2.318	4.003
1997-1998	0.517	1.316	Na
1998-1999	1.608	1.340	Na
1999-2000	0.678	2.396	Na
2000-2001	3.645	3.342	3.895
2001-2002	1.136	0.762	Na
	2.101	1.662	1.181
Average 1982-2001	1.701	1.707	2.965

Table B14. Estimates of instantaneous total mortality rates from autumn surveys catch per tow (number) at age (age 0-2) during 1982-2002.

Year	Age-0	Age-1	Age-2
1982-1983	-0.362	0.689	1.296
1983-1984	2.051	2.176	2.486
1984-1985	1.331	1.709	2.080
1985-1986	2.555	1.943	2.207
1986-1987	1.360	1.242	3.644
1987-1988	1.087	0.821	4.154
1988-1989	1.645	0.968	4.390
1989-1990	2.440	2.532	3.209
1990-1991	3.051	2.641	5.192
1991-1992	2.261	1.549	5.164
1992-1993	1.622	0.721	2.333
1993-1994	2.075	1.529	2.041
1994-1995	2.200	-0.108	6.332
1995-1996	0.822	2.515	5.018
1996-1997	1.291	1.832	2.889
1997-1998	0.976	1.038	0.739
1998-1999	4.139	3.294	Na
1999-2000	1.531	-0.787	1.717
2000-2001	1.878	1.540	3.252
2001-2002	1.836	1.900	5.213
Average 1982-2001	1.789	1.487	3.335

Table B15. Table of Lamdas used in profile and model runs to decide on final FPA model for butterfish.

	Profile over M	Profile over S	Estimate Catch	NO Constraints
NEFSC Surveys	1	1	1	1
Catch Deviations	10000	10000	1	10000
Natural Mortality	10000	0	0	0
Survey Survival Rates	0	10000	0	0
Minimum Swept Area Biomass	0	0	0	0
Constraint on C/B *	10000	10000	10000	10000
Constraint on IGR **	10000	10000	10000	10000
Fox Surplus Production	0.0001	0.0001	0.0001	0.0001

* Catch/ Biomass
** Initial Growth Rate

Table B16. Profile table for values of natural mortality (M) from 0.6-1.4

	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	
OBJ Function Major components									
Surveys-All	157.2683	155.2894	154.4288	153.4335	152.645977	152.1255	151.7644	151.5903	151.4414
Fit to recruitment model	4.338488	3.730925	2.417835	1.355338	0.380699673	-0.55549	-1.47755	-2.43697	-3.3003
Estimate some catches	2065.235	2065.235	2065.235	2065.235	2065.235267	2065.235	2065.235	2065.235	2065.235
Prior Q min swept biomass	0	0	0	0	0	0	0	0	0
Prior on log(variance recruit residuals)	0	0	0	0	0	0	0	0	0
Prior Q on Survey Z's	0	0	0	0	0	0	0	0	0
--Not used--	0	0	0	0	0	0	0	0	0
--Not used--	0	0	0	0	0	0	0	0	0
--Not used--	0	0	0	0	0	0	0	0	0
Constrain initial IGR values	2.861435	2.898323	2.416549	2.115867	1.81203703	1.535867	1.297357	1.07773	0.879218
--Not used--	0	0	0	0	0	0	0	0	0
Constrain B-zero	3.57E-05	4.04E-07	5.37E-09	2.15E-05	1.51284E-07	3.82E-06	2.28E-06	2.07E-10	5.22E-07
--Not used--	0	0	0	0	0	0	0	0	0
--Not used--	0	0	0	0	0	0	0	0	0
--Not used--	0	0	0	0	0	0	0	0	0
Pella and Tomlinson Production Model	0	0	0	0	0	0	0	0	0
Shaeffer Production Model	0.002271	0.004296	0.006613	0.009453	0.01315071	0.017264	0.021574	0.02537	0.029099
--Not used--	0	0	0	0	0	0	0	0	0
Max C/B	0	0	0	0	0	0	0	0	0
--Not used--	0	0	0	0	0	0	0	0	0
Total Log Likelihood (weighted sum)	164.4718	161.9187	159.2632	156.9069	154.838742	153.1063	151.5844	150.231	149.0204
Schaefer model parameters									
External or internal?	Internal	Internal	Internal	Internal	Internal	Internal	Internal	Internal	Internal
Alpha	0.627703	0.591564	0.618506	0.627018	0.628474389	0.63078	0.631489	0.629397	0.629407
Beta	-8.84157	-7.54804	-7.35774	-6.80587	-6.22094039	-5.7597	-5.35834	-5.04647	-4.83736
Log Likelihood	0.002271	0.004296	0.006613	0.009453	0.01315071	0.017264	0.021574	0.02537	0.029099
RMS Residuals	0.011232	0.015448	0.019167	0.022917	0.027029521	0.030969	0.03462	0.037543	0.040207
Carrying Capacity (K)	0.070994	0.078373	0.084062	0.092129	0.101025625	0.109516	0.117852	0.12472	0.130114
Bmsy (units=1000)	0.035497	0.039187	0.042031	0.046065	0.050512812	0.054758	0.058926	0.06236	0.065057
MSY (units=1000)	0.011141	0.011591	0.012998	0.014442	0.015873004	0.01727	0.018606	0.019625	0.020474
Fmsy	0.313851	0.295782	0.309253	0.313509	0.314237194	0.31539	0.315744	0.314699	0.314703
Recent Mean F / Fmsy	1.393003	0.883073	0.673704	0.58118	0.520863075	0.484367	0.462432	0.455616	0.452324
Recent Mean B / Bmsy	23.40385	38.21355	49.58598	59.36334	69.35057221	78.09034	85.77665	91.52304	96.51873
Recent Mean C/ MSY	0.659315	0.97517	1.179747	1.288699	1.372930333	1.426098	1.455671	1.467652	1.483606

Table B17. Values for profile of q on survey survival rates (S) for q=.2-1.0.

	q=.2	q=.3	q=.4	q=.5	q=.6	q=.7	q=.8	q=.9	q=1.0
Survey_trends	155.07	155.028	150.843	152.475	154.966	157.494	159.925	162.274	164.548
Fox_surplus_production	287.7	284.828	-56.5606	-76.7152	-82.3336	-84.832	-87.0526	-89.4808	-91.4909
Catch	1.7224E-12	1.6371E-12	2.46252E-08	1.25464E-07	2.22628E-07	2.9364E-07	3.46571E-07	3.91211E-07	4.31633E-07
Trend_Winter.Survey.Age.1+	7.21195	7.21216	6.72445	6.3539	6.41156	6.53163	6.69042	6.89332	7.12136
Trend_Spring.Survey.Age.1+	62.5476	62.528	57.3501	55.1018	54.2918	54.1205	54.1257	54.1949	54.3097
Trend_Fall.Survey.Age.0	20.8195	20.8042	27.2192	35.4202	40.375	43.6616	46.1282	48.1598	49.9286
Trend_Fall.Survey.Age.1+	64.4899	64.4823	59.5485	55.5977	53.8863	53.1789	52.9795	53.0243	53.1873
Trend_Fall.Survey.Min.Biomass.0+	43.5104	43.5036	51.8364	59.4435	64.918	68.9716	72.2249	74.9924	77.3955
Trend_Murawski.and.Waring.1979	15.6572	15.6484	28.5482	35.0743	37.7288	39.307	40.3508	41.0771	41.5941
Trend_Fall.survey.RI.1+	239.301	240.134	236.282	288.535	326.214	357.559	385.793	411.427	434.427
Trend_Fall.Survey.MA.1+	281.521	282.132	281.287	317.833	343.918	365.473	385.032	403.037	419.401
Trend_Fall.Survey.CT.1+	141.598	141.91	145.325	169.407	186.547	200.342	212.293	222.88	232.264
Trend_Fall.survey.VIMS.age.0	196.815	196.842	189.725	177.992	167.992	160.834	156.649	154.271	152.861
Trend_Survey.Survival.Ratio	21.6794	21.6794	22.62	24.3249	25.6297	26.668	27.5499	28.3375	29.0614
Total_LogLikelihood	3554.78	437.043	159.233	159.498	161.26	163.286	165.344	167.4	169.433
Target	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Residual	0.150941	0.0509412	0.000183598	-0.00014306	-0.00026006	-0.00033764	-0.00040197	-0.00045819	-0.00050401
Weight	10000	10000	10000	10000	10000	10000	10000	10000	10000
Q_for_adj_biomass	0.00014424	0.000141783	1.81411	5.23293	8.42295	11.4491	14.3475	17.1416	19.8508
Q_for_adj_biomass	0.350941	0.350941	0.400184	0.499857	0.59974	0.699662	0.799598	0.899542	0.999496
Bmsy=	8.17936E+25	421.368	0.046822	0.0288417	0.0250699	0.0232438	0.0222597	0.0216458	0.0211955
MSY=	9.89103E-34	150.466	0.0238747	0.0149227	0.0133047	0.0125389	0.0120472	0.0118163	0.0116405
Fmsy=	1.20927E-59	0.35709	0.509903	0.517399	0.530705	0.539452	0.541213	0.545892	0.549195
Recent_F/Fmsy=	7.21418E+53	2.60087E-05	0.239964	0.687924	1.04468	1.33497	1.59235	1.80553	1.99476
Recent_B/Bmsy=	1.14387E-23	2.25819	1.66893	1.06632	0.857803	0.748092	0.675702	0.625452	0.589705
AveBiomass	400413	407198	28.5609	8.5467	4.97495	3.58286	2.85392	2.40857	2.11068
av biomass last 3 yrs	703668.6667	715637	56.35876667	20.6328	13.59465	10.42220333	8.59135	7.40651	6.57822
av F last 3 yrs	9.44528E-06	9.28746E-06	0.122358733	0.355931333	0.554416667	0.720154	0.861802333	0.985623667	1.095515667

Table B18. Profile table of sensitivity of model results to changes in the CV (0.1-0.5) of catch (catches estimated with error) for the FPA model.

	catch cov on cv=0.1	catch cov on cv=0.2	catch cov on cv=0.3	catch cov on cv=0.4	catch cov on cv=0.5
Time	10/27/03 9:39	10/27/03 9:38	10/27/03 9:36	10/27/03 9:35	10/27/03 9:34
Survey_trends	150.768	148.617	138.098	129.411	123.695
Fox_surplus_production	-69.6275	-79.8233	-93.8058	-94.0182	-92.62
Catch	0.259454	2.16052	9.97362	11.8942	12.0244
Trend_Winter.Survey.Age.1+	6.43476	6.0129	5.57008	5.11559	4.82419
Trend_Spring.Survey.Age.1+	56.1161	54.9585	54.4983	54.8833	55.0064
Trend_Fall.Survey.Age.0	30.9963	33.9404	32.6911	28.2863	25.309
Trend_Fall.Survey.Age.1+	57.2196	53.7041	45.337	41.1251	38.5546
Trend_Fall.Survey.Min.Biomass.0+	55.4735	60.3136	67.2707	67.3579	67.0014
Trend_Murawski.and.Waring.1979	32.2986	35.019	35.9879	34.4148	33.2191
Trend_Fall.survey.RI.1+	259.516	279.896	291.11	314.179	317.262
Trend_Fall.Survey.MA.1+	297.593	311.755	324.056	341.34	342.446
Trend_Fall.Survey.CT.1+	156.275	167.007	180.568	187.51	187.508
Trend_Fall.survey.VIMS.age.0	184.218	174.745	155.835	149.603	145.231
Trend_Survey.Survival.Ratio	23.2842	23.3919	21.0917	17.8768	15.8297
Total_LogLikelihood	158.658	157.52	153.231	146.708	141.352
Q_Scaled_For_Calcs	NA	NA	NA	NA	NA
Target	NA	NA	NA	NA	NA
GOF	NA	NA	NA	NA	NA
Q_for_adj_biomass	3.31625	5.79431	12.3871	14.3822	14.4204
Q_for_adj_biomass	0.442758	0.514011	0.691449	0.702151	0.664409
Bmsy=	0.0340772	0.0272124	0.0227296	0.0228949	0.024381
MSY=	0.0175955	0.0137463	0.00991316	0.00975001	0.00968692
Fmsy=	0.516342	0.505148	0.436134	0.425859	0.397315
Recent_F/Fmsy=	0.437924	0.755526	1.53507	1.6421	1.72614
Recent_B/Bmsy=	1.32094	1.02484	0.633107	0.53394	0.49644
AveBiomass	14.491	7.68074	3.48882	3.13679	3.21028
av biomass last 3 yrs	31.41143333	18.60518	8.921896667	7.585903333	7.599196667
av F last 3 yrs	0.226118367	0.381652	0.669496	0.699302	0.68582

Table B19. Values for Goodness of Fit values for final set of model runs and final model chosen by the Working Group.

Final Run				
covariates on				
covariates on				
covariates on				
covariates on				
Son=.4 No Cv on catch				
noS noCV on catch				
Son=.6 No CV on catch				
noS Cv on catch=.1				
Time				
				11/13/03 14:10
				11/13/03 14:02
				11/13/03 14:16
				11/13/03 14:23
Survey_trends				
				152.949
				153.043
				155.516
				152.488
Fox_surplus_production				
				-63.9732
				-80.0318
				-91.3943
				-83.2247
Catch				
				1.11635E-11
				3.52805E-11
				9.45914E-11
				0.443018
Trend_Winter.Survey.Age.1+				
				7.00817
				6.60443
				6.48451
				6.45534
Trend_Spring.Survey.Age.1+				
				58.0204
				56.2417
				54.3275
				55.7888
Trend_Fall.Survey.Age.0				
				27.3662
				32.6738
				40.5746
				33.8033
Trend_Fall.Survey.Age.1+				
				60.5531
				57.5225

	54.1283
	56.4399
Trend_Fall.Survey.Min.Biomass.0+	
	63.5605
	77.547
	106.233
	81.8751
Trend_Murawski.and.Waring.1979	
	51.6593
	57.4801
	62.8181
	58.5762
Trend_Fall.survey.RI.1+	
	228.49
	259.753
	312.097
	266.092
Trend_Fall.Survey.MA.1+	
	274.961
	296.725
	332.926
	300.989
Trend_Fall.Survey.CT.1+	
	141.38
	155.989
	180.549
	159.254
Trend_Fall.survey.VIMS.age.0	
	191.81
	184.591
	170.106
	181.776
Trend_Survey.Survival.Ratio	
	22.6327
	23.723
	25.729
	23.8611
Total_LogLikelihood	
	162.351
	161.513
	162.838
	161.118
Q_Scaled_For_Calcs	
	0.4
NA	
	0.6
NA	
Target	
	0.000285961
NA	
	-0.000193041
NA	
GOF	
	10000
NA	
	10000

NA

Q_for_adj_biomass

0.689267
1.29052
2.41649
1.49401

Q for Survival S

0.400286
0.458972
0.599807
0.480088

Bmsy=

0.0442258
0.0315659
0.0265243
0.0299606

MSY=

0.0193932
0.0137439
0.0114972
0.0128212

Fmsy*0.71=

0.438503
0.435403
0.433458
0.427937

Recent_F/Fmsy=

0.267727
0.583193
1.24839
0.70419

Recent_B/Bmsy=

1.73588
1.21776
0.779495
1.10563

av biomass last 3 yrs

57.32266667
27.5442
13.68610667
23.4252

Av F last 3 yrs

0.1173994
0.2539237
0.541126667
0.301348833

Table B20. Table of emphasis coefficients used in the final model for butterfish.

Likelihood Term	Emphasis Coefficient
NEFSC Surveys	1
Catch	10000
Constraint C/B	10000
Constraint IGR	10000
Fox Surplus Production	0.0001

Table B21. Parameters estimated in the final model for butterfish.

index	name	point est	STD	CV
1	log_escapement_fyear	3.21	1.0959	0.341402
2	log_total_biom_prior_fyear	3.8105	0.94801	0.248789
3	log_mean_recr	2.9126	0.16296	0.05595
4	recruit_devs	0.059098	0.88869	15.03756
5	recruit_devs	1.3582	0.3287	0.242011
6	recruit_devs	-1.4008	0.74111	-0.52906
7	recruit_devs	-0.45544	0.24054	-0.52815
8	recruit_devs	-0.063293	0.19722	-3.11598
9	recruit_devs	0.48946	0.18373	0.375373
10	recruit_devs	0.99078	0.22346	0.225539
11	recruit_devs	0.69755	0.25023	0.358727
12	recruit_devs	0.95444	0.13958	0.146243
13	recruit_devs	-0.030495	0.20942	-6.86736
14	recruit_devs	0.36343	0.1504	0.413835
15	recruit_devs	-1.1016	0.22435	-0.20366
16	recruit_devs	0.48848	0.12249	0.250757
17	recruit_devs	1.1992	0.19574	0.163225
18	recruit_devs	0.27621	0.32175	1.164875
19	recruit_devs	0.81819	0.22257	0.272027
20	recruit_devs	0.38571	0.24297	0.629929
21	recruit_devs	0.75779	0.16815	0.221895
22	recruit_devs	1.0741	0.14009	0.130425
23	recruit_devs	0.37073	0.16984	0.458123
24	recruit_devs	-0.40332	0.18793	-0.46596
25	recruit_devs	-0.25577	0.19725	-0.7712
26	recruit_devs	-0.08615	0.15187	-1.76286
27	recruit_devs	-0.20331	0.1734	-0.85288
28	recruit_devs	-0.11532	0.15347	-1.33082
29	recruit_devs	-1.3695	0.27641	-0.20183
30	recruit_devs	0.28039	0.13957	0.497771
31	recruit_devs	0.48256	0.15242	0.315857
32	recruit_devs	0.52908	0.16039	0.303149
33	recruit_devs	-1.8786	0.27804	-0.148
34	recruit_devs	-0.14247	0.16866	-1.18383
35	recruit_devs	-0.67568	0.18474	-0.27341
36	recruit_devs	-0.65381	0.17138	-0.26213
37	recruit_devs	0.56656	0.24952	0.440412
38	recruit_devs	-0.12354	0.24039	-1.94585
39	recruit_devs	-1.3599	0.36529	-0.26862
40	recruit_devs	-1.8229	0.28466	-0.15616
41	fox_production_log_msy	-4.4084	27.287	-6.18977
42	fox_production_log_bmax	-2.7814	17.194	-6.18178
43	logmeanf	-1.0642	0.32497	-0.30537
44	fdevs	-0.71112	0.83749	-1.17771
45	fdevs	-0.30284	0.97281	-3.21229
46	fdevs	-1.3726	0.15061	-0.10973
47	fdevs	-0.64979	0.14017	-0.21572

Table B21. Cont.

48	fdevs	0.80285	0.11128	0.138606
49	fdevs	0.99409	0.13491	0.135712
50	fdevs	0.28979	0.17815	0.614756
51	fdevs	-0.25261	0.18506	-0.73259
52	fdevs	0.85729	0.1505	0.175553
53	fdevs	0.20487	0.11111	0.542344
54	fdevs	0.46813	0.11939	0.255036
55	fdevs	0.58046	0.12266	0.211315
56	fdevs	0.3421	0.10352	0.302602
57	fdevs	0.11903	0.11511	0.967067
58	fdevs	-1.1009	0.13277	-0.1206
59	fdevs	-0.28058	0.13335	-0.47527
60	fdevs	-0.41052	0.13732	-0.3345
61	fdevs	0.37596	0.11591	0.308304
62	fdevs	-0.3387	0.12312	-0.36351
63	fdevs	0.43158	0.11401	0.264169
64	fdevs	-0.19048	0.10146	-0.53265
65	fdevs	0.16412	0.1083	0.659883
66	fdevs	0.49783	0.10263	0.206155
67	fdevs	-0.35178	0.11395	-0.32392
68	fdevs	0.028659	0.11251	3.925817
69	fdevs	-0.40229	0.10581	-0.26302
70	fdevs	0.12839	0.11432	0.890412
71	fdevs	0.018151	0.12125	6.680073
72	fdevs	0.14334	0.12374	0.863262
73	fdevs	-0.66283	0.11006	-0.16605
74	fdevs	0.36937	0.12667	0.342935
75	fdevs	0.51154	0.10862	0.212339
76	fdevs	0.37879	0.11638	0.307241
77	fdevs	0.2296	0.1271	0.553571
78	fdevs	-0.56275	0.16484	-0.29292
79	fdevs	-1.0407	0.097159	-0.09336
80	fdevs	0.70227	0.097423	0.138726
81	fdevs	-0.0077181	0.17762	-23.0134
82	survey_covariate_pars[1]	0.13958	0.15552	1.1142
83	survey_covariate_pars[4]	-1.0566	0.1188	-0.11244
84	f	0.16944	0.17188	1.0144
85	f	0.25487	0.29001	1.137874
86	f	0.087445	0.022912	0.262016
87	f	0.18015	0.047374	0.26297
88	f	0.77004	0.22384	0.290686
89	f	0.93233	0.25208	0.270376
90	f	0.46099	0.1593	0.345561
91	f	0.268	0.086857	0.324093
92	f	0.81313	0.23371	0.28742
93	f	0.42346	0.11596	0.273839
94	F	0.551	0.16589	0.301071
95	F	0.61649	0.15816	0.256549

Table B21. Continued

96	F	0.48575	0.16343	0.336449
97	F	0.38863	0.12221	0.314464
98	F	0.11474	0.038463	0.335219
99	F	0.26061	0.095212	0.365343
100	F	0.22885	0.082895	0.362224
101	F	0.50248	0.16912	0.336571
102	F	0.24589	0.082366	0.334971
103	F	0.53122	0.16616	0.312789
104	F	0.28518	0.096322	0.337759
105	F	0.40655	0.14778	0.363498
106	F	0.56761	0.18944	0.33375
107	F	0.2427	0.078441	0.323201
108	F	0.35505	0.1196	0.336854
109	F	0.23074	0.075035	0.325193
110	F	0.39229	0.14596	0.372072
111	F	0.35134	0.1148	0.326749
112	F	0.39819	0.1267	0.31819
113	F	0.17782	0.052209	0.293606
114	F	0.49918	0.18532	0.371249
115	F	0.57544	0.17391	0.302221
116	F	0.5039	0.15614	0.309863
117	F	0.43407	0.1492	0.343723
118	F	0.19654	0.081109	0.412684
119	F	0.12186	0.037325	0.306294
120	F	0.69636	0.23541	0.338058
121	F	0.34236	0.15302	0.446956
122	average_biom	33.962	34.451	1.014398
123	average_biom	32.062	36.483	1.137889
124	average_biom	77.183	20.223	0.262014
125	average_biom	48.744	12.818	0.262966
126	average_biom	25.651	7.4563	0.290683
127	average_biom	16.578	4.4824	0.270382
128	average_biom	26.499	9.1566	0.345545
129	average_biom	50.844	16.478	0.324089
130	average_biom	43.406	12.476	0.287426
131	average_biom	49.147	13.458	0.273832
132	average_biom	32.319	9.7307	0.301083
133	average_biom	28.833	7.3971	0.25655
134	average_biom	14.879	5.006	0.336447
135	average_biom	27.839	8.7542	0.314458
136	average_biom	65.284	21.885	0.335228
137	average_biom	55.34	20.218	0.365342
138	average_biom	59.481	21.545	0.362217
139	average_biom	45.52	15.321	0.336577
140	average_biom	49.743	16.662	0.334962
141	average_biom	59.387	18.575	0.312779
142	average_biom	45.686	15.431	0.337762
143	average_biom	29.277	10.642	0.363494

Table B21. Continued

144	average_biom	20.57	6.8653	0.333753
145	average_biom	21.527	6.9576	0.323203
146	average_biom	21.532	7.2533	0.336861
147	average_biom	23.033	7.4901	0.32519
148	average_biom	14.277	5.3121	0.372074
149	average_biom	24.051	7.8587	0.326751
150	average_biom	32.853	10.453	0.318175
151	average_biom	41.232	12.106	0.293607
152	average_biom	21.393	7.9424	0.371262
153	average_biom	18.021	5.4461	0.302209
154	average_biom	13.17	4.0807	0.309848
155	average_biom	12.05	4.1418	0.343718
156	average_biom	31.64	13.057	0.412674
157	average_biom	31.585	9.674	0.306285
158	average_biom	16.741	5.6593	0.33805
159	average_biom	7.8169	3.4937	0.446942
160	spawning_biom	24.78	27.157	1.095924
161	spawning_biom	22.613	29.211	1.291779
162	spawning_biom	62.914	16.405	0.260753
163	spawning_biom	33.956	9.6241	0.283429
164	spawning_biom	12.75	5.2643	0.412886
165	spawning_biom	8.0333	3.2638	0.406284
166	spawning_biom	17.686	7.6615	0.433196
167	spawning_biom	37.61	13.942	0.370699
168	spawning_biom	22.649	9.488	0.418915
169	spawning_biom	32.963	10.958	0.332433
170	spawning_biom	19.154	7.4136	0.387052
171	spawning_biom	16.986	5.7037	0.335788
172	spawning_biom	8.9683	3.7709	0.42047
173	spawning_biom	19.248	7.2716	0.377785
174	spawning_biom	52.617	18.673	0.354885
175	spawning_biom	38.586	16.114	0.417613
176	spawning_biom	43.181	17.422	0.403464
177	spawning_biom	27.734	11.694	0.421649
178	spawning_biom	36.19	13.502	0.373086
179	spawning_biom	37.009	14.849	0.401227
180	spawning_biom	31.796	12.154	0.382249
181	spawning_biom	18.417	8.0321	0.436124
182	spawning_biom	12.083	5.1372	0.425159
183	spawning_biom	15.681	5.6008	0.357171
184	spawning_biom	14.566	5.806	0.398599
185	spawning_biom	16.784	6.0351	0.359575
186	spawning_biom	8.9826	4.0245	0.448033
187	spawning_biom	16.859	6.4827	0.384525
188	spawning_biom	22.272	8.5654	0.384582
189	spawning_biom	31.302	9.9205	0.316929
190	spawning_biom	12.357	5.8554	0.473853
191	spawning_biom	10.76	4.1491	0.385604

Table B21. Continued

192	spawning_biom	8.1352	3.1472	0.386862
193	spawning_biom	7.8433	3.3032	0.421149
194	spawning_biom	24.504	11.182	0.456334
195	spawning_biom	24.114	7.589	0.314713
196	spawning_biom	8.6812	4.0326	0.464521