

Appendix 2.

Biomass Dynamics Analysis of Subarea 5 Redfish (ASPIC - REDFISH3)

ASPIC -- A Surplus-Production Model Including Covariates (Ver. 3.74)

Author: Michael H. Prager
National Marine Fisheries Service
Southwest Fisheries Science Center
3150 Paradise Drive
Tiburon, California 94920 USA

ASPIC User's Manual
is available gratis
from the author

CONTROL PARAMETERS USED (FROM INPUT FILE)

```

-----
Number of years analyzed:          67          Number of bootstrap trials:          1000
Number of data series:            3          Lower bound on MSY:                  6.667E-01
Objective function computed:      in effort Upper bound on MSY:                  1.000E+02
Relative conv. criterion (simplex): 1.000E-08 Lower bound on r:                    1.000E-02
Relative conv. criterion (restart): 3.000E-08 Upper bound on r:                    1.000E+01
Relative conv. criterion (effort): 1.000E-04 Random number seed:                  4952310
Maximum F allowed in fitting:     5.000    Monte Carlo search trials:           50000
    
```

PROGRAM STATUS INFORMATION (NON-BOOTSTRAPPED ANALYSIS)

code 0

Normal convergence.

CORRELATION AMONG INPUT SERIES EXPRESSED AS CPUE (NUMBER OF PAIRWISE OBSERVATIONS BELOW)

```

-----
1 Std. CPUE          | 1.000
                    | 38
2 Fall Survey       | 0.633  1.000
                    | 27     38
3 Spring Survey     | 0.421  0.431  1.000
                    | 22     33     33
-----
                    | 1     2     3
    
```

GOODNESS-OF-FIT AND WEIGHTING FOR NON-BOOTSTRAPPED ANALYSIS

Loss component number and title	Weighted SSE	N	Weighted MSE	Current weight	Suggested weight	R-squared in CPUE
Loss(-1) SSE in yield	0.000E+00					
Loss(0) Penalty for B1R > 2	0.000E+00	1	N/A	1.000E+00	N/A	
Loss(1) Std. CPUE	1.911E+00	38	5.307E-02	1.000E+00	2.025E+00	0.707
Loss(2) Fall Survey	6.249E+00	38	1.736E-01	1.000E+00	6.192E-01	0.585
Loss(3) Spring Survey	1.290E+01	33	4.162E-01	1.000E+00	2.582E-01	0.371
TOTAL OBJECTIVE FUNCTION:	2.10613812E+01					

Number of restarts required for convergence: 16
 Est. B-ratio coverage index (0 worst, 2 best): 1.9474
 Est. B-ratio nearness index (0 worst, 1 best): 1.0000
 < These two measures are defined in Prager et al. (1996), Trans. A.F.S. 125:729

MODEL PARAMETER ESTIMATES (NON-BOOTSTRAPPED)

Parameter	Estimate	Starting guess	Estimated	User guess
B1R Starting biomass ratio, year 1934	2.000E+00	2.000E+00	0	1
MSY Maximum sustainable yield	2.026E+01	2.000E+01	1	1
r Intrinsic rate of increase	1.789E-01	2.000E-01	1	1
..... Catchability coefficients by fishery:				
q(1) Std. CPUE	4.922E-02	4.000E-01	1	1
q(2) Fall Survey	3.842E-01	4.000E-01	1	1
q(3) Spring Survey	3.593E-01	4.000E-02	1	1

MANAGEMENT PARAMETER ESTIMATES (NON-BOOTSTRAPPED)

Parameter	Estimate	Formula	Related quantity
MSY Maximum sustainable yield	2.026E+01	Kr/4	
K Maximum stock biomass	4.528E+02		
Bmsy Stock biomass at MSY	2.264E+02	K/2	
Fmsy Fishing mortality at MSY	8.946E-02	r/2	
F(0.1) Management benchmark	8.051E-02	0.9*Fmsy	
Y(0.1) Equilibrium yield at F(0.1)	2.005E+01	0.99*MSY	
B-ratio Ratio of B(2001) to Bmsy	3.292E-01		
F-ratio Ratio of F(2000) to Fmsy	5.143E-02		
F01-mult Ratio of F(0.1) to F(2000)	1.750E+01		
Y-ratio Proportion of MSY avail in 2001	5.500E-01	2*Br-Br^2	Ye(2001) = 1.114E+01
..... Fishing effort at MSY in units of each fishery:			
fmsy(1) Std. CPUE	1.817E+00	r/2q(1)	f(0.1) = 1.636E+00

ESTIMATED POPULATION TRAJECTORY (NON-BOOTSTRAPPED)

Obs	Year or ID	Estimated total F mort	Estimated starting biomass	Estimated average biomass	Observed total yield	Model total yield	Estimated surplus production	Ratio of F mort to Fmsy	Ratio of biomass to Bmsy
1	1934	0.001	4.528E+02	4.535E+02	5.190E-01	5.190E-01	4.475E-02	1.279E-02	2.000E+00
2	1935	0.017	4.524E+02	4.488E+02	7.549E+00	7.549E+00	7.086E-01	1.880E-01	1.998E+00
3	1936	0.053	4.455E+02	4.351E+02	2.316E+01	2.316E+01	3.037E+00	5.951E-01	1.968E+00
4	1937	0.035	4.254E+02	4.205E+02	1.482E+01	1.482E+01	5.367E+00	3.940E-01	1.879E+00
5	1938	0.050	4.159E+02	4.089E+02	2.064E+01	2.064E+01	7.086E+00	5.642E-01	1.837E+00
6	1939	0.064	4.024E+02	3.940E+02	2.541E+01	2.541E+01	9.152E+00	7.208E-01	1.777E+00
7	1940	0.071	3.861E+02	3.781E+02	2.676E+01	2.676E+01	1.116E+01	7.912E-01	1.705E+00
8	1941	0.145	3.705E+02	3.514E+02	5.080E+01	5.080E+01	1.404E+01	1.616E+00	1.636E+00
9	1942	0.178	3.338E+02	3.136E+02	5.589E+01	5.589E+01	1.720E+01	1.992E+00	1.474E+00
10	1943	0.173	2.951E+02	2.799E+02	4.835E+01	4.835E+01	1.910E+01	1.931E+00	1.303E+00
11	1944	0.202	2.658E+02	2.501E+02	5.044E+01	5.044E+01	2.000E+01	2.255E+00	1.174E+00
12	1945	0.168	2.354E+02	2.263E+02	3.791E+01	3.791E+01	2.025E+01	1.873E+00	1.040E+00
13	1946	0.206	2.177E+02	2.062E+02	4.242E+01	4.242E+01	2.008E+01	2.300E+00	9.616E-01
14	1947	0.217	1.954E+02	1.848E+02	4.016E+01	4.016E+01	1.956E+01	2.430E+00	8.629E-01
15	1948	0.270	1.748E+02	1.618E+02	4.363E+01	4.363E+01	1.859E+01	3.014E+00	7.719E-01
16	1949	0.215	1.497E+02	1.430E+02	3.074E+01	3.074E+01	1.750E+01	2.404E+00	6.613E-01
17	1950	0.270	1.365E+02	1.272E+02	3.431E+01	3.431E+01	1.636E+01	3.014E+00	6.028E-01
18	1951	0.272	1.185E+02	1.108E+02	3.008E+01	3.008E+01	1.496E+01	3.035E+00	5.236E-01
19	1952	0.215	1.034E+02	9.962E+01	2.138E+01	2.138E+01	1.390E+01	2.399E+00	4.568E-01
20	1953	0.178	9.596E+01	9.422E+01	1.679E+01	1.679E+01	1.335E+01	1.992E+00	4.238E-01
21	1954	0.140	9.252E+01	9.261E+01	1.299E+01	1.299E+01	1.318E+01	1.568E+00	4.086E-01
22	1955	0.151	9.271E+01	9.233E+01	1.391E+01	1.391E+01	1.315E+01	1.685E+00	4.095E-01
23	1956	0.158	9.195E+01	9.127E+01	1.439E+01	1.439E+01	1.304E+01	1.762E+00	4.061E-01
24	1957	0.211	9.060E+01	8.762E+01	1.849E+01	1.849E+01	1.264E+01	2.359E+00	4.001E-01
25	1958	0.194	8.475E+01	8.275E+01	1.605E+01	1.605E+01	1.210E+01	2.168E+00	3.743E-01
26	1959	0.197	8.080E+01	7.884E+01	1.552E+01	1.552E+01	1.165E+01	2.201E+00	3.569E-01
27	1960	0.148	7.693E+01	7.696E+01	1.138E+01	1.138E+01	1.143E+01	1.652E+00	3.398E-01
28	1961	0.187	7.699E+01	7.555E+01	1.410E+01	1.410E+01	1.126E+01	2.086E+00	3.400E-01
29	1962	0.195	7.415E+01	7.251E+01	1.413E+01	1.413E+01	1.090E+01	2.179E+00	3.275E-01
30	1963	0.141	7.091E+01	7.126E+01	1.005E+01	1.005E+01	1.074E+01	1.576E+00	3.132E-01
31	1964	0.114	7.161E+01	7.292E+01	8.313E+00	8.313E+00	1.095E+01	1.274E+00	3.162E-01
32	1965	0.106	7.424E+01	7.586E+01	8.057E+00	8.057E+00	1.130E+01	1.187E+00	3.279E-01
33	1966	0.108	7.748E+01	7.903E+01	8.569E+00	8.569E+00	1.167E+01	1.212E+00	3.422E-01
34	1967	0.134	8.058E+01	8.111E+01	1.086E+01	1.086E+01	1.191E+01	1.497E+00	3.559E-01
35	1968	0.080	8.163E+01	8.437E+01	6.777E+00	6.777E+00	1.228E+01	8.979E-01	3.605E-01
36	1969	0.143	8.714E+01	8.721E+01	1.246E+01	1.246E+01	1.260E+01	1.596E+00	3.848E-01
37	1970	0.197	8.728E+01	8.506E+01	1.674E+01	1.674E+01	1.236E+01	2.200E+00	3.855E-01
38	1971	0.255	8.290E+01	7.859E+01	2.003E+01	2.003E+01	1.162E+01	2.849E+00	3.661E-01
39	1972	0.272	7.449E+01	7.013E+01	1.909E+01	1.909E+01	1.060E+01	3.043E+00	3.290E-01
40	1973	0.280	6.599E+01	6.200E+01	1.736E+01	1.736E+01	9.573E+00	3.130E+00	2.915E-01
41	1974	0.182	5.821E+01	5.745E+01	1.047E+01	1.047E+01	8.975E+00	2.037E+00	2.571E-01
42	1975	0.189	5.671E+01	5.579E+01	1.057E+01	1.057E+01	8.752E+00	2.118E+00	2.505E-01
43	1976	0.199	5.489E+01	5.377E+01	1.070E+01	1.070E+01	8.478E+00	2.224E+00	2.424E-01
44	1977	0.265	5.267E+01	4.998E+01	1.322E+01	1.322E+01	7.955E+00	2.957E+00	2.326E-01
45	1978	0.322	4.740E+01	4.380E+01	1.408E+01	1.408E+01	7.077E+00	3.594E+00	2.094E-01
46	1979	0.412	4.040E+01	3.577E+01	1.476E+01	1.476E+01	5.892E+00	4.611E+00	1.784E-01
47	1980	0.354	3.153E+01	2.876E+01	1.018E+01	1.018E+01	4.819E+00	3.957E+00	1.393E-01
48	1981	0.327	2.617E+01	2.421E+01	7.915E+00	7.915E+00	4.100E+00	3.655E+00	1.156E-01
49	1982	0.335	2.236E+01	2.061E+01	6.903E+00	6.903E+00	3.520E+00	3.743E+00	9.873E-02
50	1983	0.299	1.897E+01	1.781E+01	5.328E+00	5.328E+00	3.062E+00	3.343E+00	8.379E-02
51	1984	0.307	1.671E+01	1.564E+01	4.793E+00	4.793E+00	2.701E+00	3.427E+00	7.378E-02
52	1985	0.314	1.461E+01	1.363E+01	4.282E+00	4.282E+00	2.366E+00	3.511E+00	6.454E-02
53	1986	0.238	1.270E+01	1.230E+01	2.929E+00	2.929E+00	2.141E+00	2.662E+00	5.608E-02
54	1987	0.158	1.191E+01	1.201E+01	1.894E+00	1.894E+00	2.091E+00	1.763E+00	5.260E-02
55	1988	0.093	1.211E+01	1.261E+01	1.177E+00	1.177E+00	2.193E+00	1.044E+00	5.347E-02
56	1989	0.046	1.312E+01	1.400E+01	6.370E-01	6.370E-01	2.427E+00	5.086E-01	5.795E-02
57	1990	0.038	1.491E+01	1.597E+01	6.010E-01	6.010E-01	2.756E+00	4.208E-01	6.586E-02
58	1991	0.029	1.707E+01	1.835E+01	5.250E-01	5.250E-01	3.150E+00	3.198E-01	7.538E-02
59	1992	0.040	1.969E+01	2.103E+01	8.490E-01	8.490E-01	3.588E+00	4.512E-01	8.697E-02
60	1993	0.033	2.243E+01	2.403E+01	8.000E-01	8.000E-01	4.071E+00	3.721E-01	9.907E-02
61	1994	0.016	2.570E+01	2.776E+01	4.400E-01	4.400E-01	4.663E+00	1.771E-01	1.135E-01
62	1995	0.014	2.993E+01	3.233E+01	4.400E-01	4.400E-01	5.371E+00	1.521E-01	1.322E-01
63	1996	0.009	3.486E+01	3.772E+01	3.220E-01	3.220E-01	6.186E+00	9.542E-02	1.539E-01
64	1997	0.006	4.072E+01	4.407E+01	2.510E-01	2.510E-01	7.117E+00	6.366E-02	1.798E-01
65	1998	0.006	4.759E+01	5.142E+01	3.200E-01	3.200E-01	8.153E+00	6.957E-02	2.102E-01
66	1999	0.006	5.542E+01	5.979E+01	3.530E-01	3.530E-01	9.283E+00	6.599E-02	2.448E-01
67	2000	0.005	6.435E+01	6.934E+01	3.190E-01	3.190E-01	1.050E+01	5.143E-02	2.842E-01
68	2001		7.453E+01						3.292E-01

RESULTS FOR DATA SERIES # 1 (NON-BOOTSTRAPPED)

Std. CPUE

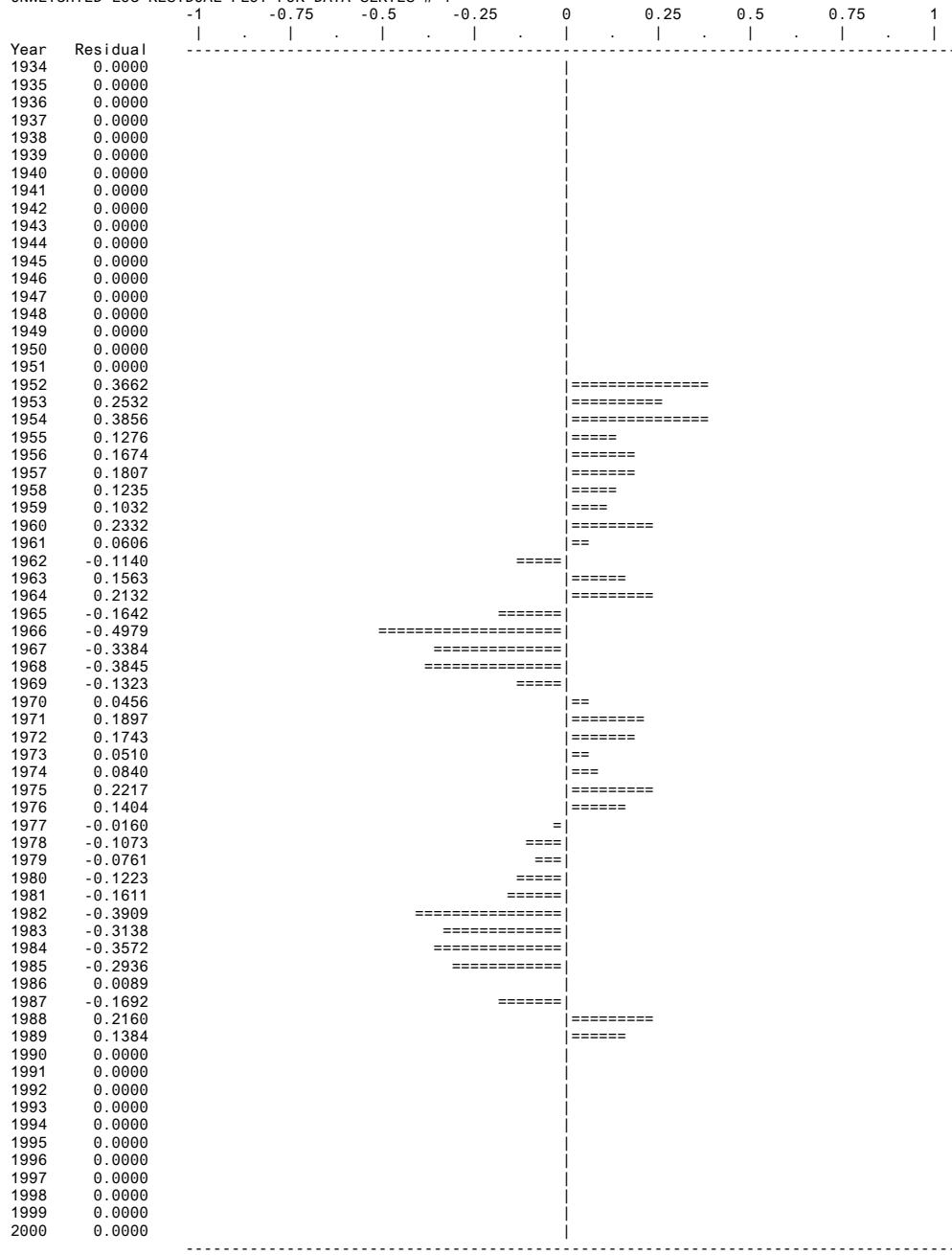
Data type CC: CPUE-catch series

Series weight: 1.000

Obs	Year	Observed CPUE	Estimated CPUE	Estim F	Observed yield	Model yield	Resid in log scale	Resid in yield
1	1934	*	2.232E+01	0.0011	5.190E-01	5.190E-01	0.00000	0.000E+00
2	1935	*	2.209E+01	0.0168	7.549E+00	7.549E+00	0.00000	0.000E+00
3	1936	*	2.142E+01	0.0532	2.316E+01	2.316E+01	0.00000	0.000E+00
4	1937	*	2.070E+01	0.0352	1.482E+01	1.482E+01	0.00000	0.000E+00
5	1938	*	2.013E+01	0.0505	2.064E+01	2.064E+01	0.00000	0.000E+00
6	1939	*	1.939E+01	0.0645	2.541E+01	2.541E+01	0.00000	0.000E+00
7	1940	*	1.861E+01	0.0708	2.676E+01	2.676E+01	0.00000	0.000E+00
8	1941	*	1.730E+01	0.1445	5.080E+01	5.080E+01	0.00000	0.000E+00
9	1942	*	1.544E+01	0.1782	5.589E+01	5.589E+01	0.00000	0.000E+00
10	1943	*	1.378E+01	0.1727	4.835E+01	4.835E+01	0.00000	0.000E+00
11	1944	*	1.231E+01	0.2017	5.044E+01	5.044E+01	0.00000	0.000E+00
12	1945	*	1.114E+01	0.1675	3.791E+01	3.791E+01	0.00000	0.000E+00
13	1946	*	1.015E+01	0.2057	4.242E+01	4.242E+01	0.00000	0.000E+00
14	1947	*	9.095E+00	0.2173	4.016E+01	4.016E+01	0.00000	0.000E+00
15	1948	*	7.964E+00	0.2696	4.363E+01	4.363E+01	0.00000	0.000E+00
16	1949	*	7.036E+00	0.2151	3.074E+01	3.074E+01	0.00000	0.000E+00
17	1950	*	6.263E+00	0.2696	3.431E+01	3.431E+01	0.00000	0.000E+00
18	1951	*	5.452E+00	0.2715	3.008E+01	3.008E+01	0.00000	0.000E+00
19	1952	3.400E+00	4.904E+00	0.2146	2.138E+01	2.138E+01	0.36620	0.000E+00
20	1953	3.600E+00	4.637E+00	0.1782	1.679E+01	1.679E+01	0.25323	0.000E+00
21	1954	3.100E+00	4.559E+00	0.1402	1.299E+01	1.299E+01	0.38560	0.000E+00
22	1955	4.000E+00	4.544E+00	0.1507	1.391E+01	1.391E+01	0.12760	0.000E+00
23	1956	3.800E+00	4.492E+00	0.1576	1.439E+01	1.439E+01	0.16735	0.000E+00
24	1957	3.600E+00	4.313E+00	0.2110	1.849E+01	1.849E+01	0.18069	0.000E+00
25	1958	3.600E+00	4.073E+00	0.1939	1.605E+01	1.605E+01	0.12346	0.000E+00
26	1959	3.500E+00	3.881E+00	0.1969	1.552E+01	1.552E+01	0.10325	0.000E+00
27	1960	3.000E+00	3.788E+00	0.1478	1.138E+01	1.138E+01	0.23323	0.000E+00
28	1961	3.500E+00	3.719E+00	0.1866	1.410E+01	1.410E+01	0.06062	0.000E+00
29	1962	4.000E+00	3.569E+00	0.1949	1.413E+01	1.413E+01	-0.11402	0.000E+00
30	1963	3.000E+00	3.507E+00	0.1410	1.005E+01	1.005E+01	0.15628	0.000E+00
31	1964	2.900E+00	3.589E+00	0.1140	8.313E+00	8.313E+00	0.21324	0.000E+00
32	1965	4.400E+00	3.734E+00	0.1062	8.057E+00	8.057E+00	-0.16419	0.000E+00
33	1966	6.400E+00	3.890E+00	0.1084	8.569E+00	8.569E+00	-0.49789	0.000E+00
34	1967	5.600E+00	3.992E+00	0.1339	1.086E+01	1.086E+01	-0.33839	0.000E+00
35	1968	6.100E+00	4.153E+00	0.0803	6.777E+00	6.777E+00	-0.38449	0.000E+00
36	1969	4.900E+00	4.293E+00	0.1428	1.246E+01	1.246E+01	-0.13234	0.000E+00
37	1970	4.000E+00	4.187E+00	0.1968	1.674E+01	1.674E+01	0.04564	0.000E+00
38	1971	3.200E+00	3.869E+00	0.2549	2.003E+01	2.003E+01	0.18974	0.000E+00
39	1972	2.900E+00	3.452E+00	0.2723	1.909E+01	1.909E+01	0.17427	0.000E+00
40	1973	2.900E+00	3.052E+00	0.2800	1.736E+01	1.736E+01	0.05103	0.000E+00
41	1974	2.600E+00	2.828E+00	0.1823	1.047E+01	1.047E+01	0.08401	0.000E+00
42	1975	2.200E+00	2.746E+00	0.1895	1.057E+01	1.057E+01	0.22174	0.000E+00
43	1976	2.300E+00	2.647E+00	0.1989	1.070E+01	1.070E+01	0.14037	0.000E+00
44	1977	2.500E+00	2.460E+00	0.2646	1.322E+01	1.322E+01	-0.01604	0.000E+00
45	1978	2.400E+00	2.156E+00	0.3216	1.408E+01	1.408E+01	-0.10732	0.000E+00
46	1979	1.900E+00	1.761E+00	0.4125	1.476E+01	1.476E+01	-0.07610	0.000E+00
47	1980	1.600E+00	1.416E+00	0.3540	1.018E+01	1.018E+01	-0.12230	0.000E+00
48	1981	1.400E+00	1.192E+00	0.3269	7.915E+00	7.915E+00	-0.16115	0.000E+00
49	1982	1.500E+00	1.015E+00	0.3349	6.903E+00	6.903E+00	-0.39087	0.000E+00
50	1983	1.200E+00	8.768E-01	0.2991	5.328E+00	5.328E+00	-0.31378	0.000E+00
51	1984	1.100E+00	7.696E-01	0.3065	4.793E+00	4.793E+00	-0.35720	0.000E+00
52	1985	9.000E-01	6.710E-01	0.3141	4.282E+00	4.282E+00	-0.29364	0.000E+00
53	1986	6.000E-01	6.053E-01	0.2382	2.929E+00	2.929E+00	0.00887	0.000E+00
54	1987	7.000E-01	5.910E-01	0.1577	1.894E+00	1.894E+00	-0.16923	0.000E+00
55	1988	5.000E-01	6.206E-01	0.0934	1.177E+00	1.177E+00	0.21604	0.000E+00
56	1989	6.000E-01	6.891E-01	0.0455	6.370E-01	6.370E-01	0.13840	0.000E+00
57	1990	*	7.859E-01	0.0376	6.010E-01	6.010E-01	0.00000	0.000E+00
58	1991	*	9.032E-01	0.0286	5.250E-01	5.250E-01	0.00000	0.000E+00
59	1992	*	1.035E+00	0.0404	8.490E-01	8.490E-01	0.00000	0.000E+00
60	1993	*	1.183E+00	0.0333	8.000E-01	8.000E-01	0.00000	0.000E+00
61	1994	*	1.367E+00	0.0158	4.400E-01	4.400E-01	0.00000	0.000E+00
62	1995	*	1.592E+00	0.0136	4.400E-01	4.400E-01	0.00000	0.000E+00
63	1996	*	1.857E+00	0.0085	3.220E-01	3.220E-01	0.00000	0.000E+00
64	1997	*	2.169E+00	0.0057	2.510E-01	2.510E-01	0.00000	0.000E+00
65	1998	*	2.531E+00	0.0062	3.200E-01	3.200E-01	0.00000	0.000E+00
66	1999	*	2.943E+00	0.0059	3.530E-01	3.530E-01	0.00000	0.000E+00
67	2000	*	3.413E+00	0.0046	3.190E-01	3.190E-01	0.00000	0.000E+00

* Asterisk indicates missing value(s).

UNWEIGHTED LOG RESIDUAL PLOT FOR DATA SERIES # 1



RESULTS FOR DATA SERIES # 2 (NON-BOOTSTRAPPED)

Fall Survey

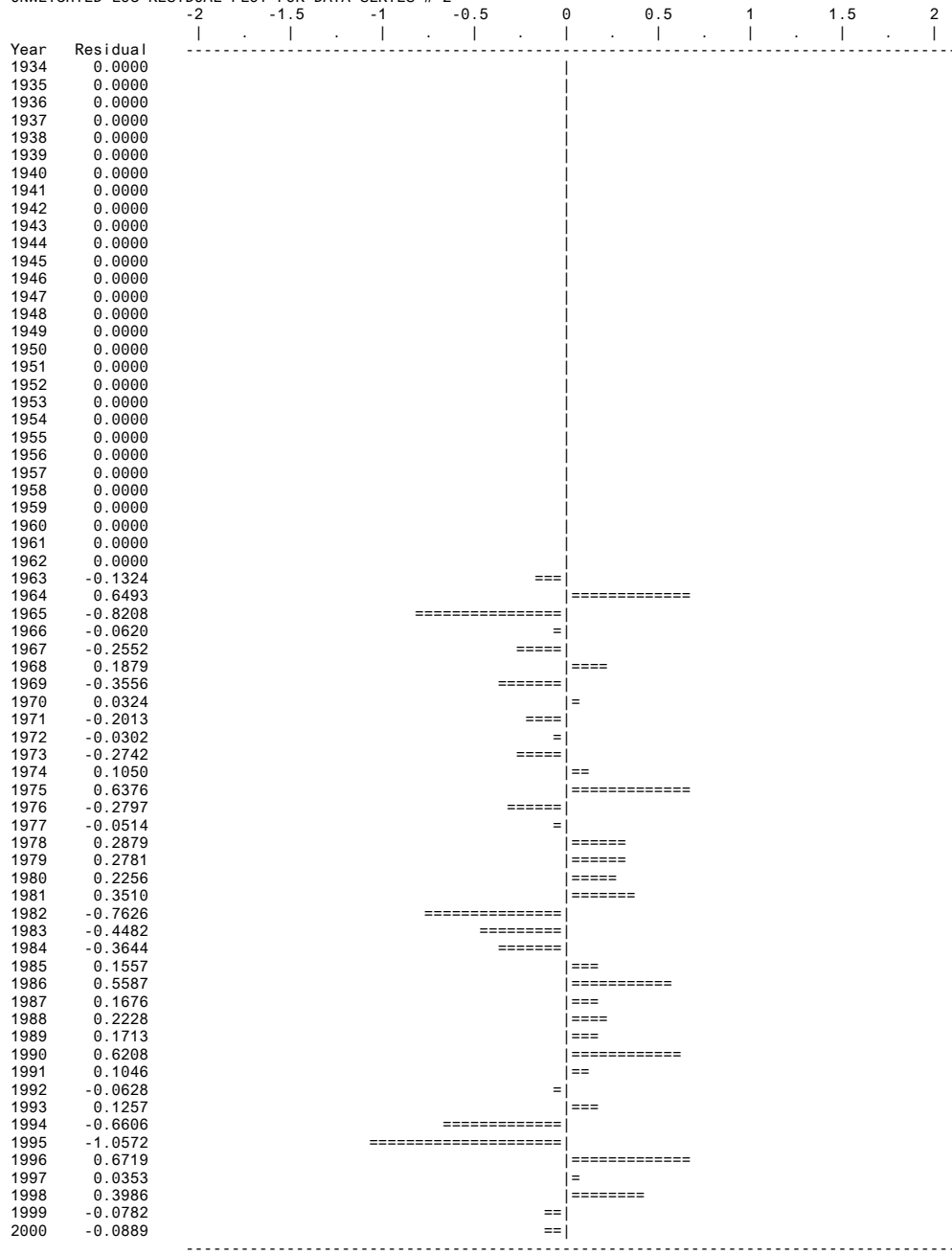
Data type I2: End-of-year biomass index

Series weight: 1.000

Obs	Year	Observed effort	Estimated effort	Estim F	Observed index	Model index	Resid in log index	Resid in index
1	1934	0.000E+00	0.000E+00	0.0	*	1.738E+02	0.00000	0.0
2	1935	0.000E+00	0.000E+00	0.0	*	1.712E+02	0.00000	0.0
3	1936	0.000E+00	0.000E+00	0.0	*	1.634E+02	0.00000	0.0
4	1937	0.000E+00	0.000E+00	0.0	*	1.598E+02	0.00000	0.0
5	1938	0.000E+00	0.000E+00	0.0	*	1.546E+02	0.00000	0.0
6	1939	0.000E+00	0.000E+00	0.0	*	1.484E+02	0.00000	0.0
7	1940	0.000E+00	0.000E+00	0.0	*	1.424E+02	0.00000	0.0
8	1941	0.000E+00	0.000E+00	0.0	*	1.282E+02	0.00000	0.0
9	1942	0.000E+00	0.000E+00	0.0	*	1.134E+02	0.00000	0.0
10	1943	0.000E+00	0.000E+00	0.0	*	1.021E+02	0.00000	0.0
11	1944	0.000E+00	0.000E+00	0.0	*	9.044E+01	0.00000	0.0
12	1945	0.000E+00	0.000E+00	0.0	*	8.366E+01	0.00000	0.0
13	1946	0.000E+00	0.000E+00	0.0	*	7.507E+01	0.00000	0.0
14	1947	0.000E+00	0.000E+00	0.0	*	6.715E+01	0.00000	0.0
15	1948	0.000E+00	0.000E+00	0.0	*	5.753E+01	0.00000	0.0
16	1949	0.000E+00	0.000E+00	0.0	*	5.244E+01	0.00000	0.0
17	1950	0.000E+00	0.000E+00	0.0	*	4.555E+01	0.00000	0.0
18	1951	0.000E+00	0.000E+00	0.0	*	3.974E+01	0.00000	0.0
19	1952	0.000E+00	0.000E+00	0.0	*	3.687E+01	0.00000	0.0
20	1953	0.000E+00	0.000E+00	0.0	*	3.555E+01	0.00000	0.0
21	1954	0.000E+00	0.000E+00	0.0	*	3.562E+01	0.00000	0.0
22	1955	0.000E+00	0.000E+00	0.0	*	3.533E+01	0.00000	0.0
23	1956	0.000E+00	0.000E+00	0.0	*	3.481E+01	0.00000	0.0
24	1957	0.000E+00	0.000E+00	0.0	*	3.256E+01	0.00000	0.0
25	1958	0.000E+00	0.000E+00	0.0	*	3.104E+01	0.00000	0.0
26	1959	0.000E+00	0.000E+00	0.0	*	2.956E+01	0.00000	0.0
27	1960	0.000E+00	0.000E+00	0.0	*	2.958E+01	0.00000	0.0
28	1961	0.000E+00	0.000E+00	0.0	*	2.849E+01	0.00000	0.0
29	1962	0.000E+00	0.000E+00	0.0	*	2.724E+01	0.00000	0.0
30	1963	1.000E+00	1.000E+00	0.0	2.410E+01	2.751E+01	-0.13240	-3.412E+00
31	1964	1.000E+00	1.000E+00	0.0	5.460E+01	2.852E+01	0.64931	2.608E+01
32	1965	1.000E+00	1.000E+00	0.0	1.310E+01	2.977E+01	-0.82085	-1.667E+01
33	1966	1.000E+00	1.000E+00	0.0	2.910E+01	3.096E+01	-0.06199	-1.861E+00
34	1967	1.000E+00	1.000E+00	0.0	2.430E+01	3.136E+01	-0.25518	-7.064E+00
35	1968	1.000E+00	1.000E+00	0.0	4.040E+01	3.348E+01	0.18791	6.921E+00
36	1969	1.000E+00	1.000E+00	0.0	2.350E+01	3.353E+01	-0.35557	-1.003E+01
37	1970	1.000E+00	1.000E+00	0.0	3.290E+01	3.185E+01	0.03240	1.049E+00
38	1971	1.000E+00	1.000E+00	0.0	2.340E+01	2.862E+01	-0.20130	-5.218E+00
39	1972	1.000E+00	1.000E+00	0.0	2.460E+01	2.536E+01	-0.03023	-7.551E-01
40	1973	1.000E+00	1.000E+00	0.0	1.700E+01	2.236E+01	-0.27420	-5.363E+00
41	1974	1.000E+00	1.000E+00	0.0	2.420E+01	2.179E+01	0.10498	2.412E+00
42	1975	1.000E+00	1.000E+00	0.0	3.990E+01	2.109E+01	0.63761	1.881E+01
43	1976	1.000E+00	1.000E+00	0.0	1.530E+01	2.024E+01	-0.27967	-4.937E+00
44	1977	1.000E+00	1.000E+00	0.0	1.730E+01	1.821E+01	-0.05143	-9.131E-01
45	1978	1.000E+00	1.000E+00	0.0	2.070E+01	1.552E+01	0.28793	5.179E+00
46	1979	1.000E+00	1.000E+00	0.0	1.600E+01	1.212E+01	0.27806	3.884E+00
47	1980	1.000E+00	1.000E+00	0.0	1.260E+01	1.005E+01	0.22563	2.545E+00
48	1981	1.000E+00	1.000E+00	0.0	1.220E+01	8.589E+00	0.35095	3.611E+00
49	1982	1.000E+00	1.000E+00	0.0	3.400E+00	7.289E+00	-0.76263	-3.889E+00
50	1983	1.000E+00	1.000E+00	0.0	4.100E+00	6.419E+00	-0.44821	-2.319E+00
51	1984	1.000E+00	1.000E+00	0.0	3.900E+00	5.615E+00	-0.36441	-1.715E+00
52	1985	1.000E+00	1.000E+00	0.0	5.700E+00	4.878E+00	0.15565	8.216E-01
53	1986	1.000E+00	1.000E+00	0.0	8.000E+00	4.575E+00	0.55873	3.425E+00
54	1987	1.000E+00	1.000E+00	0.0	5.500E+00	4.651E+00	0.16759	8.487E-01
55	1988	1.000E+00	1.000E+00	0.0	6.300E+00	5.042E+00	0.22281	1.258E+00
56	1989	1.000E+00	1.000E+00	0.0	6.800E+00	5.729E+00	0.17129	1.071E+00
57	1990	1.000E+00	1.000E+00	0.0	1.220E+01	6.557E+00	0.62083	5.643E+00
58	1991	1.000E+00	1.000E+00	0.0	8.400E+00	7.566E+00	0.10457	8.340E-01
59	1992	1.000E+00	1.000E+00	0.0	8.094E+00	8.619E+00	-0.06279	-5.245E-01
60	1993	1.000E+00	1.000E+00	0.0	1.120E+01	9.875E+00	0.12568	1.323E+00
61	1994	1.000E+00	1.000E+00	0.0	5.939E+00	1.150E+01	-0.66061	-5.559E+00
62	1995	1.000E+00	1.000E+00	0.0	4.653E+00	1.339E+01	-1.05718	-8.739E+00
63	1996	1.000E+00	1.000E+00	0.0	3.063E+01	1.565E+01	0.67190	1.499E+01
64	1997	1.000E+00	1.000E+00	0.0	1.894E+01	1.828E+01	0.03529	6.567E-01
65	1998	1.000E+00	1.000E+00	0.0	3.172E+01	2.129E+01	0.39857	1.043E+01
66	1999	1.000E+00	1.000E+00	0.0	2.286E+01	2.472E+01	-0.07820	-1.860E+00
67	2000	1.000E+00	1.000E+00	0.0	2.620E+01	2.864E+01	-0.08893	-2.437E+00

* Asterisk indicates missing value(s).

UNWEIGHTED LOG RESIDUAL PLOT FOR DATA SERIES # 2



RESULTS FOR DATA SERIES # 3 (NON-BOOTSTRAPPED)

Spring Survey

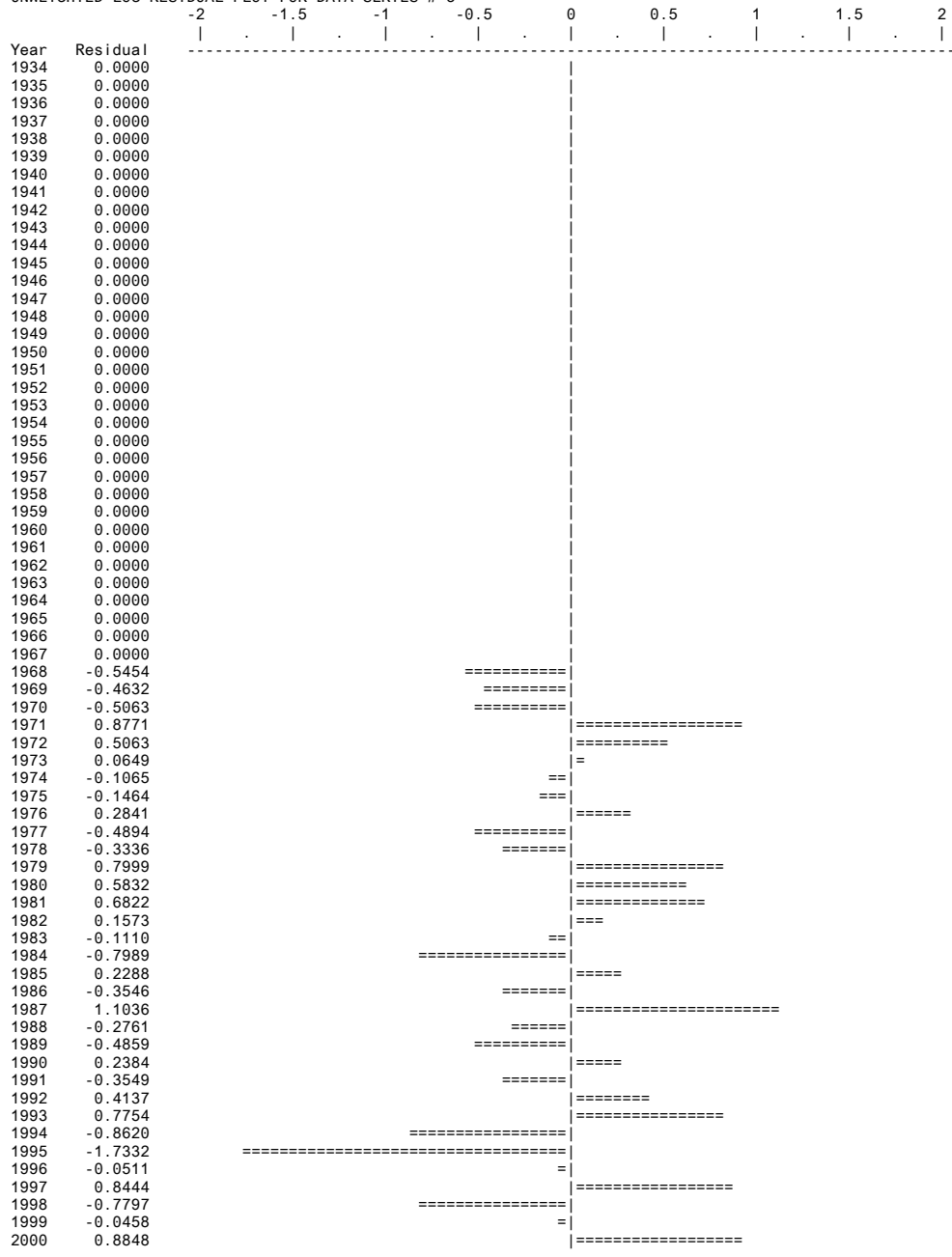
Data type I0: Start-of-year biomass index

Series weight: 1.000

Obs	Year	Observed effort	Estimated effort	Estim F	Observed index	Model index	Resid in log index	Resid in index
1	1934	0.000E+00	0.000E+00	0.0	*	1.627E+02	0.00000	0.0
2	1935	0.000E+00	0.000E+00	0.0	*	1.625E+02	0.00000	0.0
3	1936	0.000E+00	0.000E+00	0.0	*	1.601E+02	0.00000	0.0
4	1937	0.000E+00	0.000E+00	0.0	*	1.528E+02	0.00000	0.0
5	1938	0.000E+00	0.000E+00	0.0	*	1.494E+02	0.00000	0.0
6	1939	0.000E+00	0.000E+00	0.0	*	1.446E+02	0.00000	0.0
7	1940	0.000E+00	0.000E+00	0.0	*	1.387E+02	0.00000	0.0
8	1941	0.000E+00	0.000E+00	0.0	*	1.331E+02	0.00000	0.0
9	1942	0.000E+00	0.000E+00	0.0	*	1.199E+02	0.00000	0.0
10	1943	0.000E+00	0.000E+00	0.0	*	1.060E+02	0.00000	0.0
11	1944	0.000E+00	0.000E+00	0.0	*	9.551E+01	0.00000	0.0
12	1945	0.000E+00	0.000E+00	0.0	*	8.457E+01	0.00000	0.0
13	1946	0.000E+00	0.000E+00	0.0	*	7.823E+01	0.00000	0.0
14	1947	0.000E+00	0.000E+00	0.0	*	7.020E+01	0.00000	0.0
15	1948	0.000E+00	0.000E+00	0.0	*	6.280E+01	0.00000	0.0
16	1949	0.000E+00	0.000E+00	0.0	*	5.380E+01	0.00000	0.0
17	1950	0.000E+00	0.000E+00	0.0	*	4.904E+01	0.00000	0.0
18	1951	0.000E+00	0.000E+00	0.0	*	4.259E+01	0.00000	0.0
19	1952	0.000E+00	0.000E+00	0.0	*	3.716E+01	0.00000	0.0
20	1953	0.000E+00	0.000E+00	0.0	*	3.448E+01	0.00000	0.0
21	1954	0.000E+00	0.000E+00	0.0	*	3.324E+01	0.00000	0.0
22	1955	0.000E+00	0.000E+00	0.0	*	3.331E+01	0.00000	0.0
23	1956	0.000E+00	0.000E+00	0.0	*	3.303E+01	0.00000	0.0
24	1957	0.000E+00	0.000E+00	0.0	*	3.255E+01	0.00000	0.0
25	1958	0.000E+00	0.000E+00	0.0	*	3.045E+01	0.00000	0.0
26	1959	0.000E+00	0.000E+00	0.0	*	2.903E+01	0.00000	0.0
27	1960	0.000E+00	0.000E+00	0.0	*	2.764E+01	0.00000	0.0
28	1961	0.000E+00	0.000E+00	0.0	*	2.766E+01	0.00000	0.0
29	1962	0.000E+00	0.000E+00	0.0	*	2.664E+01	0.00000	0.0
30	1963	0.000E+00	0.000E+00	0.0	*	2.548E+01	0.00000	0.0
31	1964	0.000E+00	0.000E+00	0.0	*	2.573E+01	0.00000	0.0
32	1965	0.000E+00	0.000E+00	0.0	*	2.667E+01	0.00000	0.0
33	1966	0.000E+00	0.000E+00	0.0	*	2.784E+01	0.00000	0.0
34	1967	0.000E+00	0.000E+00	0.0	*	2.895E+01	0.00000	0.0
35	1968	1.000E+00	1.000E+00	0.0	1.700E+01	2.933E+01	-0.54536	-1.233E+01
36	1969	1.000E+00	1.000E+00	0.0	1.970E+01	3.131E+01	-0.46322	-1.161E+01
37	1970	1.000E+00	1.000E+00	0.0	1.890E+01	3.136E+01	-0.50632	-1.246E+01
38	1971	1.000E+00	1.000E+00	0.0	7.160E+01	2.978E+01	0.87711	4.182E+01
39	1972	1.000E+00	1.000E+00	0.0	4.440E+01	2.676E+01	0.50629	1.764E+01
40	1973	1.000E+00	1.000E+00	0.0	2.530E+01	2.371E+01	0.06491	1.590E+00
41	1974	1.000E+00	1.000E+00	0.0	1.880E+01	2.091E+01	-0.10647	-2.112E+00
42	1975	1.000E+00	1.000E+00	0.0	1.760E+01	2.037E+01	-0.14639	-2.775E+00
43	1976	1.000E+00	1.000E+00	0.0	2.620E+01	1.972E+01	0.28408	6.479E+00
44	1977	1.000E+00	1.000E+00	0.0	1.160E+01	1.892E+01	-0.48943	-7.324E+00
45	1978	1.000E+00	1.000E+00	0.0	1.220E+01	1.703E+01	-0.33362	-4.831E+00
46	1979	1.000E+00	1.000E+00	0.0	3.230E+01	1.451E+01	0.79995	1.779E+01
47	1980	1.000E+00	1.000E+00	0.0	2.030E+01	1.133E+01	0.58318	8.970E+00
48	1981	1.000E+00	1.000E+00	0.0	1.860E+01	9.403E+00	0.68218	9.197E+00
49	1982	1.000E+00	1.000E+00	0.0	9.400E+00	8.032E+00	0.15731	1.368E+00
50	1983	1.000E+00	1.000E+00	0.0	6.100E+00	6.816E+00	-0.11103	-7.163E-01
51	1984	1.000E+00	1.000E+00	0.0	2.700E+00	6.002E+00	-0.79886	-3.302E+00
52	1985	1.000E+00	1.000E+00	0.0	6.600E+00	5.250E+00	0.22877	1.350E+00
53	1986	1.000E+00	1.000E+00	0.0	3.200E+00	4.562E+00	-0.35457	-1.362E+00
54	1987	1.000E+00	1.000E+00	0.0	1.290E+01	4.279E+00	1.10360	8.621E+00
55	1988	1.000E+00	1.000E+00	0.0	3.300E+00	4.350E+00	-0.27615	-1.050E+00
56	1989	1.000E+00	1.000E+00	0.0	2.900E+00	4.715E+00	-0.48594	-1.815E+00
57	1990	1.000E+00	1.000E+00	0.0	6.800E+00	5.358E+00	0.23838	1.442E+00
58	1991	1.000E+00	1.000E+00	0.0	4.300E+00	6.132E+00	-0.35490	-1.832E+00
59	1992	1.000E+00	1.000E+00	0.0	1.070E+01	7.075E+00	0.41367	3.625E+00
60	1993	1.000E+00	1.000E+00	0.0	1.750E+01	8.059E+00	0.77538	9.441E+00
61	1994	1.000E+00	1.000E+00	0.0	3.900E+00	9.235E+00	-0.86199	-5.335E+00
62	1995	1.000E+00	1.000E+00	0.0	1.900E+00	1.075E+01	-1.73322	-8.852E+00
63	1996	1.000E+00	1.000E+00	0.0	1.190E+01	1.252E+01	-0.05107	-6.235E-01
64	1997	1.000E+00	1.000E+00	0.0	3.404E+01	1.463E+01	0.84445	1.941E+01
65	1998	1.000E+00	1.000E+00	0.0	7.840E+00	1.710E+01	-0.77966	-9.257E+00
66	1999	1.000E+00	1.000E+00	0.0	1.902E+01	1.991E+01	-0.04580	-8.913E-01
67	2000	1.000E+00	1.000E+00	0.0	5.601E+01	2.312E+01	0.88485	3.289E+01

* Asterisk indicates missing value(s).

UNWEIGHTED LOG RESIDUAL PLOT FOR DATA SERIES # 3



RESULTS OF BOOTSTRAPPED ANALYSIS

Param name	Bias-corrected estimate	Ordinary estimate	Relative bias	Approx 80% lower CL	Approx 80% upper CL	Approx 50% lower CL	Approx 50% upper CL	Inter-quartile range	Relative IQ range
B1ratio	2.000E+00	2.000E+00	0.00%	2.000E+00	2.000E+00	2.000E+00	2.000E+00	5.931E-09	0.000
K	4.544E+02	4.528E+02	-0.35%	4.229E+02	4.888E+02	4.370E+02	4.718E+02	3.472E+01	0.076
r	1.776E-01	1.789E-01	0.74%	1.520E-01	2.058E-01	1.641E-01	1.926E-01	2.849E-02	0.160
q(1)	4.890E-02	4.922E-02	0.66%	4.142E-02	5.687E-02	4.486E-02	5.313E-02	8.264E-03	0.169
q(2)	3.811E-01	3.842E-01	0.81%	3.260E-01	4.428E-01	3.526E-01	4.108E-01	5.813E-02	0.153
q(3)	3.577E-01	3.593E-01	0.44%	3.041E-01	4.166E-01	3.293E-01	3.899E-01	6.058E-02	0.169
MSY	2.018E+01	2.026E+01	0.39%	1.857E+01	2.176E+01	1.935E+01	2.104E+01	1.689E+00	0.084
Ye(2001)	1.109E+01	1.114E+01	0.49%	8.774E+00	1.353E+01	9.804E+00	1.228E+01	2.472E+00	0.223
Bmsy	2.272E+02	2.264E+02	-0.35%	2.115E+02	2.444E+02	2.185E+02	2.359E+02	1.736E+01	0.076
Fmsy	8.880E-02	8.946E-02	0.74%	7.600E-02	1.029E-01	8.204E-02	9.629E-02	1.425E-02	0.160
fmsy(1)	1.814E+00	1.817E+00	0.22%	1.641E+00	1.990E+00	1.721E+00	1.904E+00	1.833E-01	0.101
fmsy(2)	2.341E-01	2.328E-01	-0.53%	2.070E-01	2.659E-01	2.203E-01	2.500E-01	2.962E-02	0.127
fmsy(3)	2.493E-01	2.490E-01	-0.12%	2.184E-01	2.851E-01	2.315E-01	2.675E-01	3.594E-02	0.144
F(0.1)	7.992E-02	8.051E-02	0.67%	6.840E-02	9.263E-02	7.384E-02	8.666E-02	1.282E-02	0.160
Y(0.1)	1.998E+01	2.005E+01	0.38%	1.839E+01	2.155E+01	1.916E+01	2.083E+01	1.672E+00	0.084
B-ratio	3.289E-01	3.292E-01	0.09%	2.708E-01	3.985E-01	2.978E-01	3.652E-01	6.747E-02	0.205
F-ratio	5.167E-02	5.143E-02	-0.47%	4.062E-02	6.640E-02	4.562E-02	5.895E-02	1.333E-02	0.258
Y-ratio	5.496E-01	5.500E-01	0.07%	4.683E-01	6.382E-01	5.069E-01	5.971E-01	9.021E-02	0.164
f0.1(1)	1.632E+00	1.636E+00	0.19%	* * * * *	0.101				
f0.1(2)	2.107E-01	2.095E-01	-0.48%	* * * * *	0.127				
f0.1(3)	2.244E-01	2.241E-01	-0.11%	* * * * *	0.144				
q2/q1	7.748E+00	7.806E+00	0.75%	6.742E+00	8.899E+00	7.203E+00	8.324E+00	1.121E+00	0.145
q3/q1	7.292E+00	7.299E+00	0.10%	6.299E+00	8.445E+00	6.733E+00	7.904E+00	1.170E+00	0.160

NOTES ON BOOTSTRAPPED ESTIMATES:

- The bootstrapped results shown were computed from 1000 trials.
- These results are conditional on the constraints placed upon MSY and r in the input file (ASPIC.INP).
- All bootstrapped intervals are approximate. The statistical literature recommends using at least 1000 trials for accurate 95% intervals. The 80% intervals used by ASPIC should require fewer trials for equivalent accuracy. Using at least 500 trials is recommended.
- The bias corrections used here are based on medians. This is an accepted statistical procedure, but may estimate nonzero bias for unbiased, skewed estimators.

Trials replaced for lack of convergence: 0
Trials replaced for MSY out-of-bounds: 0
Trials replaced for r out-of-bounds: 0
Residual-adjustment factor: 1.0238