

**Preliminary Status of Gag Grouper  
in the Gulf of Mexico: continuity run VPA, SEDAR-10  
(Not to Be Distributed Without Panel Report)**

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## Introduction

The status of gag grouper (*Mycteroperca microlepis*) in the Gulf of Mexico was reviewed using information on landings and discards, relative indices of abundance, size and age sampling, and updated biological information from 1963 through 2004. The report document from the Data Workshop (SEDAR-10 DW 2006) and Document SEDAR-10 AW-# (Ortiz 2006) present detailed information on the input data and procedures for estimation of catch at size, catch at age, and maturity/fecundity vectors. The present document describes the procedures and results of an evaluation of gag GOM using the same protocols and programs as in the last assessment conducted in 2001 (Turner et al 2001). By definition this evaluation is so-called a “continuity” case.

In 2001, the assessment panel used a virtual population analysis (VPA) model implemented with VPA-2BOX program (Porch 2002) with data from 1986 through 1999 (Turner et al 2001). The updated VPA model used also the VPA-2BOX program but extended the data from 1984 through 2004.

## VPA model inputs and settings

VPA models assess the abundance and mortality of fish populations by fitting age-structured population equations to catch, effort and abundance data. VPA-2BOX uses backwards recursions to fit age-structured models for one or two intermixing populations, in the case of gag GOM only a single close stock/population is assumed with no intermixing. VPA-2Box is part of the ‘toolbox’, fisheries assessment set of programs created and distributed by National Marine Fisheries Service (NMFS) (Ref), it can be download it from (Ref). The manual (Porch 2002) have full description of the model population equation dynamics and user options for evaluation. VPA-2BOX ver 3.1 was used for the present evaluation, in 2001 VPA-2BOX ver ##.# was used. Initial runs with the same inputs used in 2001 stock assessment produce exactly the same results with both program versions.

As mention in the introduction, full description of the basic input files for the continuity case can be found in the document SEDAR-10 AW-# (Ortiz 2006), in particular with regards to the protocols for estimating catch-at size (CAS) and catch at age (CAA) for landed and dead discards of gag GOM from 1984 to 2004 data. For the current evaluation, two methods were used to estimate dead-discards; a) using a fixed proportion of discards as in the 2001 assessment (20% in recreational fisheries, 30% in commercial fisheries) and, b) using a depth-dependent function (catch-at depth distribution) (Ortiz 2006). These two methods generated two CAA inputs, for the VPA continuity run, only the CAA based on mortality as fixed proportion of discards was used, as that was the method in 2001 SA.

Table 1 presents the input CAA used with VPA-2Box (Fig 1). First, in 2001 assessment, age 10 was defined as the plus group, with CAA estimated for age0 to age10+. In the 2006 evaluation it was decided extend the age structure and use age 12 a plus group, thus the CAA was estimated for age 0 to age 12+. Second, comparison of 2001 CAA and 2006 CAA shows differences in the proportion of catch by ages, particularly for age 0 and 1. In 2001 about 40% of the catch was from ages 0 -1, while in 2006 there were not catch of age 0 and few (less than 1%) of age 1. These differences in age composition were related to the update of the von Bertalanffy growth function (see Ortiz 2006 for complete details).

Indices of abundance available in 2006 are shown in Table 2. Because of changes in minimum size restrictions for commercial and recreational fisheries in 1989 and 2000, it was recommended by the data working group to use fisheries-dependent indices estimated for those years with a consistent regulations in cases when the index standardization did not accounted for these changes of regulations. Therefore, for the VPA continuity run, the following indices were selected:

1. Handline commercial index from 1990 to 2000 and the handline index 2000-2004.
2. Longline commercial index from 1990 to 2000 and the longline index 2000-2004.
3. MRFSS index from 1981 to 2004. In all cases the index was used as a continuous series as the index reflects total catch retained and discarded and considered not influenced by minimum size restrictions.
4. Headboat index split as 1986-1989, 1990-2000, and 2000-2004 series.
5. SEAMAP RF Video survey index 1993 to 2004 with some missing years, and the corresponding "Copper Belly" Video index same years.
6. FMRI Otter trawl survey index 1996 to 2004. This index is for juveniles or age 0 class.

Selectivity associated with the fishery dependent indices of abundance was assumed to be constant through out the index time series. Partial catch at age for Handline, Longline, Headboat and MRFSS fishery-dependent indices were specified. For the fishery independent indices, the following selectivities were defined; for the SEAMAP video survey and Copper Belly indices it was assumed the same selectivity at age as the longline fishery 1990-2004 years. For the FMRI trawl survey it was assumed to represent an index of age 0 class. Indices from Handline and longline fisheries were in biomass units, all other indices represent numbers of fish. Weights at age were inferred from updated growth function and the size-weight relationships (Ortiz 2006). For all indices it was assumed that they represent the average abundance during the year. It was assumed that recreational fisheries indices represented relative abundance of ages 1 through 12+ (MRFSS and Headboat), commercial fisheries indices represented relative abundance of ages 2 through 12+ (Handline and Longline), the SEAMAP Video Survey represented ages 2 to 12+, the Copper Belly index represented ages 6 to 12+, and the FMRI was and index for age 0 exclusively.

Relative indices of abundance included estimates of error (as Coefficient of variation), however as in 2001 evaluation, for the VPA continuity run it was assumed a equal weighting for all indices in the analysis. The maturity and fecundity vectors at age

were calculated from size-based maturity functions provided by the life history group at the SEDAR-10 data workshop (SEDAR10 2006), and converted to age specific values using the updated von Bertalanffy growth function. Fecundity is expressed in terms of weight (gutted weight in pounds) of mature females, for the plus group fecundity and maturity was estimated as a weighted average of predicted-survivals from age 12 up to age 20. Natural mortality was assumed constant by age and year, a value of 0.15 was used as in 2001 evaluation.

Fishing mortality rates on ages 0, 1, 2, 4, 6, 8, and 10 in the terminal year were estimated in the VPA model. As in the prior assessment, the fishing mortality rates for other ages were based on assumed relationship to estimated values; age 3 = age 4, age 5 = age 6, age 7 = age 8, age 9 and 11 = age 10, the ratio of the plus group was set to 1 in reference to age 11. Appendix 1 presents the input files for VPA-2BOX continuity run.

## VPA Continuity run results

Deterministic VPA run results are presented in Tables 2 and 3 for estimated abundance at age for the gag GOM stock (numbers of fish) and estimated fishing mortality rates by year and age, respectively (Fig 2 and Fig 3). Spawning stock biomass (SSB females only) expressed as gutted weight of mature females (pounds) and recruits (age 0 class) estimates are shown in Figure 4 and table 4. Figure 5 shows the relationship between SSB and recruits, larger recruitment was estimated for 2002 (over 16 million fish) and 2003 (10.7 million). For other years recruitment ranged from 0.8 to 5.4 millions fish. Recruitment in recent years is poorly estimated and the high peak in 2002 likely represent the fit to the FMRI index value for 2002. Figure 7 presents the observed and fitted indices of abundance for the VPA continuity run. Finally, Figure 6 shows the estimated selectivity patterns by fishery from the continuity run. These patterns indicate that both recreational fisheries (MRFSS and Headboat) have increased selectivity towards younger age classes (3-6) compared to the commercial fisheries (longline ages 8-10, handline ages 6-10). Shifts of selectivity patterns within fisheries, were as expected in reference to the increase of minimum size regulations, i.e. move towards older fish as the minimum size increased.

As in 2001 assessment, management reference points were estimated based on the VPA continuity run. Based on 2001 assumptions about stock-recruitment, for the present evaluation it was assumed a hockey-stick stock-recruitment relationship. It basically, assumes an average recruitment value over the range of the spawning stock size observed (maximum recruitment in the hockey stick function), and a linear decrease of recruitment for SSB below the lower value observed. For the stock-recruitment it was considered only recruits and spawners from 1984 to 2001, has having sufficient cohort information in the model.

Bootstrapping was used to estimate the uncertainty about the deterministic results, and to provide an indication of the bias in the estimates. Figure 8 shows the results of 1000 bootstraps and the deterministic run for the VPA continuity run expressed as the

ratios of the current fishing mortality (2004) over  $F_{30\%SPR}$  plot against the ratio of the current spawning biomass ( $SSB_{2005}$ ) to the  $SSB$  expected for a 30% SPR. This plot, also called “phase plot” indicates that overall current fishing mortality rates exceed those expected to in the long term equilibrium bring the stock to a level corresponding with a 30% SPR. Also, that in the beginning of 2005 the spawning stock biomass was about 85% of that expected for 30% SPR, respectively. The spread of bootstrapped results gives an idea of the uncertainty of the run, however in almost all runs; it was conclude that mortality rates were above  $F_{30\%SPR}$ .

Following, Figure 9 presents histograms and cumulative function distributions for several benchmark estimates based on the 1000 boots from the VPA continuity run. Including,  $F_{MSY}$ ,  $MSY$ ,  $F_{max}$ ,  $SSB_{max}$ ,  $F_{30\%SPR}$  and  $SSB_{30\%SPR}$ . Similar values are presented in Table 6.

## Literature Cited

- SEDAR10. 2006. South Atlantic and Gulf of Mexico Gag grouper Data Workshop Report. Charleston, NC Jan 23-27 2006.
- Turner, S.C., C.E. Porch, D. Heinemann, G.P. Scott, and M. Ortiz. 2001. Status of gag in the Gulf of Mexico, Assessment 3.0. NMFS, Southeast Fisheries Science Center, Miami, FL. Sustainable Fisheries Division Contribution: SFD 01/02–134. 32 p. plus Tables and Figures.
- Ortiz, M. 2006 SEDAR-10 AW - ## Preliminary status on gag grouper in the Gulf of Mexico.

Table 1. Estimated Catch at age gag GOM 1984-2004 based on mortality of discards as fixed proportion by fishery (20% recreational, 30% commercial).

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12+
1984	0	2644	75347	44067	128354	71353	34478	21965	17229	7242	236	3300	18315
1985	0	4440	114708	151924	221437	358564	48894	51678	18795	10254	2990	1391	38729
1986	0	4849	138147	174684	207537	159534	59240	19658	22878	10077	1032	673	18697
1987	0	4634	101585	88116	142954	92142	47380	27965	18667	10350	1978	3090	12974
1988	0	9542	182064	64457	224702	108499	42540	26940	20005	7391	3590	245	22715
1989	0	3716	106134	93416	129661	103101	50953	21497	28522	11466	10104	2460	13698
1990	0	3540	62250	21767	92518	46628	43347	25554	20636	20644	5827	1081	13389
1991	0	4819	115147	18999	111361	39957	125924	36376	17778	23636	6739	4433	35587
1992	0	4146	36525	188220	39468	95393	38825	45492	10286	2795	2398	6108	28348
1993	0	757	32641	105897	402512	61846	52167	28549	32172	10521	2666	798	11501
1994	0	3418	20311	132604	139343	368815	65613	18276	12632	9015	3620	7783	4052
1995	0	0	73794	247974	202327	122839	226974	24713	6228	6202	5466	431	8312
1996	0	0	2769	291310	258558	81887	36199	51817	3121	6044	4812	593	8823
1997	0	0	8378	64884	646620	73764	47713	22224	24250	0	1806	1480	6446
1998	0	10823	21703	212883	369771	454321	56285	17148	20143	3640	10172	1216	16956
1999	0	0	26225	320750	206973	243640	168788	21527	13083	8029	2908	3225	9252
2000	0	11333	156811	149730	598850	53448	136038	56926	12069	2885	9668	3345	6532
2001	0	3078	15546	87012	224397	523772	84130	91576	38439	6516	9146	2750	16142
2002	0	3563	36948	440319	132724	276367	233673	37798	19060	26807	3216	1889	18434
2003	0	40	22928	344287	596123	83781	149108	115261	17323	14659	5841	6503	16322
2004	0	107	28900	366904	432982	526478	86142	64569	50306	8051	6302	4973	10948

Table 2. Indices of abundance from commercial, recreational and independent fisheries for gag GOM.

RECOMMENDED FD INDICES												
COMMERCIAL												
Index Name	CMHL:1990-2004		CMHL:1990-2000		CMHL:2000-2004		CMLL:1990-2004		CMLL:1990-2000		CMLL:2000-2004	
Size Range	>508 mm		>508 mm		>610 mm		>508 mm		>508 mm		>610 mm	
Relative (Scaled to 1)?	No		No		No		No		No		No	
Weight/Numbers	Weight		Weight		Weight		Weight		Weight		Weight	
Units	Lbs/Hook_Hour		Lbs/Hook_Hour		Lbs/Hook_Hour		lbs/hook		lbs/hook		lbs/hook	
YEAR	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV
1981	-	-	-	-	-	-	-	-	-	-	-	-
1982	-	-	-	-	-	-	-	-	-	-	-	-
1983	-	-	-	-	-	-	-	-	-	-	-	-
1984	-	-	-	-	-	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-	-	-	-	-	-
1986	-	-	-	-	-	-	-	-	-	-	-	-
1987	-	-	-	-	-	-	-	-	-	-	-	-
1988	-	-	-	-	-	-	-	-	-	-	-	-
1989	-	-	-	-	-	-	-	-	-	-	-	-
1990	0.537535449	0.117	0.653040367	0.138	-	-	0.849883366	0.450	1.263523789	0.332	-	-
1991	0.379607251	0.110	0.465700281	0.134	-	-	0.562190283	0.463	0.850069446	0.331	-	-
1992	0.476513861	0.099	0.576358326	0.122	-	-	0.452355835	0.606	0.706373501	0.417	-	-
1993	0.761432621	0.062	0.925583908	0.078	-	-	0.624425122	0.251	0.976023949	0.180	-	-
1994	0.594985256	0.064	0.730907076	0.084	-	-	0.355157008	0.326	0.54109724	0.232	-	-
1995	0.741422183	0.061	0.890967986	0.078	-	-	0.498558244	0.278	0.74390762	0.202	-	-
1996	0.867145119	0.053	1.041221859	0.069	-	-	0.585552052	0.208	0.877762052	0.154	-	-
1997	0.927312489	0.052	1.129424344	0.067	-	-	0.585366928	0.210	0.874673239	0.154	-	-
1998	1.524325644	0.047	1.831293273	0.061	-	-	1.028643485	0.157	1.529127814	0.120	-	-
1999	1.063982128	0.048	1.289458048	0.063	-	-	0.779554532	0.181	1.183686171	0.136	-	-
2000	1.129660624	0.049	1.466044532	0.070	0.740800882	0.083	1.014401186	0.160	1.45375518	0.170	0.591896952	0.329
2001	1.543227123	0.047	-	-	1.087781028	0.075	1.832232763	0.110	-	-	1.045528638	0.154
2002	1.510135631	0.048	-	-	1.071871086	0.075	1.752185995	0.112	-	-	0.994197328	0.161
2003	1.256533041	0.048	-	-	0.893393319	0.076	1.951392003	0.104	-	-	1.113879909	0.148
2004	1.686181579	0.048	-	-	1.206153685	0.075	2.128101198	0.097	-	-	1.254497174	0.134

Index Name	MRFSS		Headboat:1986-2004		Headboat:1986-1989		Headboat:1990-2000		Headboat:2000-2004	
Size Range	Pending		Pending		Pending		Pending		Pending	
Relative (Scaled to 1)?	No		No		No		No		No	
Weight/Numbers	Numbers		Numbers		Numbers		Numbers		Numbers	
Units	Fish/1000 angler hours									
YEAR	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV
1981	12.152	0.414	-	-	-	-	-	-	-	-
1982	5.358	0.456	-	-	-	-	-	-	-	-
1983	10.275	0.471	-	-	-	-	-	-	-	-
1984	3.728	0.599	-	-	-	-	-	-	-	-
1985	14.555	0.392	-	-	-	-	-	-	-	-
1986	13.070	0.342	1.14	0.156	0.978	0.293	-	-	-	-
1987	3.500	0.376	1.317	0.119	1.205	0.219	-	-	-	-
1988	3.966	0.388	1.057	0.147	0.95	0.284	-	-	-	-
1989	5.401	0.385	0.993	0.157	0.866	0.315	-	-	-	-
1990	8.524	0.397	0.72	0.177	-	-	0.691	0.33	-	-
1991	6.460	0.372	0.597	0.218	-	-	0.606	0.36	-	-
1992	5.737	0.340	0.718	0.214	-	-	0.705	0.354	-	-
1993	14.556	0.324	0.826	0.179	-	-	0.836	0.297	-	-
1994	19.389	0.319	0.836	0.187	-	-	0.868	0.303	-	-
1995	18.521	0.313	0.853	0.2	-	-	0.866	0.307	-	-
1996	16.038	0.322	1.35	0.113	-	-	1.331	0.182	-	-
1997	11.972	0.315	1.327	0.11	-	-	1.339	0.176	-	-
1998	24.210	0.303	1.26	0.121	-	-	1.262	0.197	-	-
1999	20.283	0.301	1.237	0.115	-	-	1.258	0.185	-	-
2000	11.554	0.307	1.048	0.151	-	-	1.239	0.23	0.915	0.386
2001	9.109	0.310	0.778	0.208	-	-	-	-	0.88	0.327
2002	17.938	0.299	0.825	0.209	-	-	-	-	0.94	0.326
2003	19.630	0.299	1.039	0.155	-	-	-	-	1.102	0.273
2004	19.559	0.301	1.078	0.144	-	-	-	-	1.163	0.27

Index Name	SeaMAP R.F. Video		SeaMAP R.F. Video (Copper Belly)		FMRI Otter Trawl	
Comment	Table 12 SEDAR10-DW-12		Table 15 SEDAR10-DW-12		Table 3 SEDAR-10-30	
Size Range	425-975 mm		425-975 mm		50-400 mm	
Relative (Scaled to 1)?	No		No		No	
Weight/Numbers	Presence/Absence		Presence/Absence		Numbers	
Units	Proportion Positive Trips		Proportion Positive Trips		Number/Haul	
YEAR						
1981	-	-	-	-	-	-
1982	-	-	-	-	-	-
1983	-	-	-	-	-	-
1984	-	-	-	-	-	-
1985	-	-	-	-	-	-
1986	-	-	-	-	-	-
1987	-	-	-	-	-	-
1988	-	-	-	-	-	-
1989	-	-	-	-	-	-
1990	-	-	-	-	-	-
1991	-	-	-	-	-	-
1992	-	-	-	-	-	-
1993	0.663	0.424467	1.244	0.403	-	-
1994	0.513	0.528376	0.844	0.586	-	-
1995	0.446	0.360877	0.670	0.497	-	-
1996	0.879	0.28771	0.758	0.457	1.13399	0.6656
1997	0.932	0.30967	0.544	0.574	0.31773	1.07858
1998	-	-	-	-	0.2317	1.28399
1999	-	-	-	-	0.61968	0.7432
2000	-	-	-	-	0.44081	0.84245
2001	-	-	-	-	0.70821	0.78985
2002	1.587	0.189639	0.964	0.371	3.29081	0.40103
2003	-	-	-	-	1.79145	0.49632
2004	1.980	0.186472	1.977	0.297	0.46561	0.94286

Table 3. Estimated abundance at the beginning of the year for gag GOM 1984-04.

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12+
1984	1397577	1765184	1017153	912530	852632	272362	235708	69671	127888	26342	16291	71718	398037
1985	1323723	1202899	1516853	805709	744606	615160	168560	170987	39711	94136	15989	13803	384324
1986	1142125	1139332	1031232	1199362	553062	436624	201053	99973	99504	16910	71534	10998	305548
1987	935098	983031	976135	759795	870733	284886	228847	118399	67881	64513	5329	60614	254499
1988	847267	804841	841805	746152	572425	617269	160251	153193	76081	41199	45957	2765	256325
1989	3280397	729245	683891	556350	582547	285822	430985	98664	106950	47018	28628	36231	201746
1990	1224907	2823449	624220	490483	392486	381631	151025	323806	65062	65727	29881	15330	189878
1991	1200823	1054281	2426884	479654	402001	252375	285332	89994	255043	36971	37535	20334	163234
1992	1617138	1033552	902965	1982186	395241	243239	180273	129789	43979	203056	10215	26077	121026
1993	4008046	1391876	885744	743353	1531861	303657	121536	119295	69791	28353	172181	6577	94792
1994	2188595	3449740	1197297	732132	541861	946942	204213	56621	76314	30499	14713	145728	75869
1995	1561553	1883731	2966058	1011700	507575	337750	475474	115270	31883	54005	17935	9321	179767
1996	5332600	1344034	1621334	2484536	641811	250631	177544	200711	76383	21687	40743	10395	154666
1997	3345915	4589788	1156814	1392932	1868907	314432	140227	119365	124919	62852	13089	30616	133344
1998	1219315	2879842	3950448	987916	1138810	1012692	202511	76719	82197	85107	54096	9595	133791
1999	4024740	1049468	2468682	3380083	653636	639268	453919	122363	50193	52149	69881	37159	106604
2000	4129549	3464108	903281	2100515	2612360	371740	325864	235230	85417	31125	37460	57453	112192
2001	2584448	3554318	2971089	632489	1669289	1695364	270524	155304	149898	62356	24119	23317	136866
2002	16452196	2224444	3056375	2542829	463899	1229188	976170	155256	49812	93533	47640	12337	120387
2003	10765589	14160468	1911293	2596417	1781558	276823	802699	624413	98728	25323	55771	38026	95443
2004	2813335	9265983	12187933	1623822	1916266	983908	160986	553071	430900	68961	8367	42597	93776
2005		2421459	7975206	10463466	1058738	1249413	363926	59545	416285	324330	51906	1470	102645

Table 4. Estimated fishing mortality rate for gag grouper GOM 1984-04.

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12+
1984	0	0.002	0.083	0.053	0.176	0.33	0.171	0.412	0.156	0.349	0.016	0.051	0.051
1985	0	0.004	0.085	0.226	0.384	0.968	0.372	0.391	0.704	0.125	0.224	0.115	0.115
1986	0	0.005	0.155	0.17	0.513	0.496	0.38	0.237	0.283	1.005	0.016	0.068	0.068
1987	0	0.005	0.119	0.133	0.194	0.425	0.251	0.292	0.349	0.189	0.506	0.056	0.056
1988	0	0.013	0.264	0.098	0.545	0.209	0.335	0.209	0.331	0.214	0.088	0.1	0.1
1989	0	0.006	0.182	0.199	0.273	0.488	0.136	0.266	0.337	0.303	0.475	0.076	0.076
1990	0	0.001	0.113	0.049	0.292	0.141	0.368	0.089	0.415	0.41	0.235	0.079	0.079
1991	0	0.005	0.052	0.044	0.352	0.186	0.638	0.566	0.078	1.136	0.214	0.267	0.267
1992	0	0.004	0.045	0.108	0.114	0.544	0.263	0.47	0.289	0.015	0.29	0.289	0.289
1993	0	0.001	0.04	0.166	0.331	0.247	0.614	0.297	0.678	0.506	0.017	0.14	0.14
1994	0	0.001	0.018	0.216	0.323	0.539	0.422	0.424	0.196	0.381	0.306	0.059	0.059
1995	0	0	0.027	0.305	0.556	0.493	0.712	0.262	0.235	0.132	0.395	0.051	0.051
1996	0	0	0.002	0.135	0.564	0.431	0.247	0.324	0.045	0.355	0.136	0.063	0.063
1997	0	0	0.008	0.051	0.463	0.29	0.453	0.223	0.234	0	0.161	0.053	0.053
1998	0	0.004	0.006	0.263	0.427	0.652	0.354	0.274	0.305	0.047	0.226	0.146	0.146
1999	0	0	0.012	0.108	0.414	0.524	0.507	0.209	0.328	0.181	0.046	0.098	0.098
2000	0	0.004	0.206	0.08	0.282	0.168	0.591	0.301	0.165	0.105	0.324	0.065	0.065
2001	0	0.001	0.006	0.16	0.156	0.402	0.405	0.987	0.322	0.119	0.52	0.136	0.136
2002	0	0.002	0.013	0.206	0.366	0.276	0.297	0.303	0.527	0.367	0.075	0.18	0.18
2003	0	0	0.013	0.154	0.444	0.392	0.222	0.221	0.209	0.957	0.119	0.203	0.203
2004	0	0	0.003	0.278	0.278	0.845	0.845	0.134	0.134	0.134	1.589	0.134	0.134

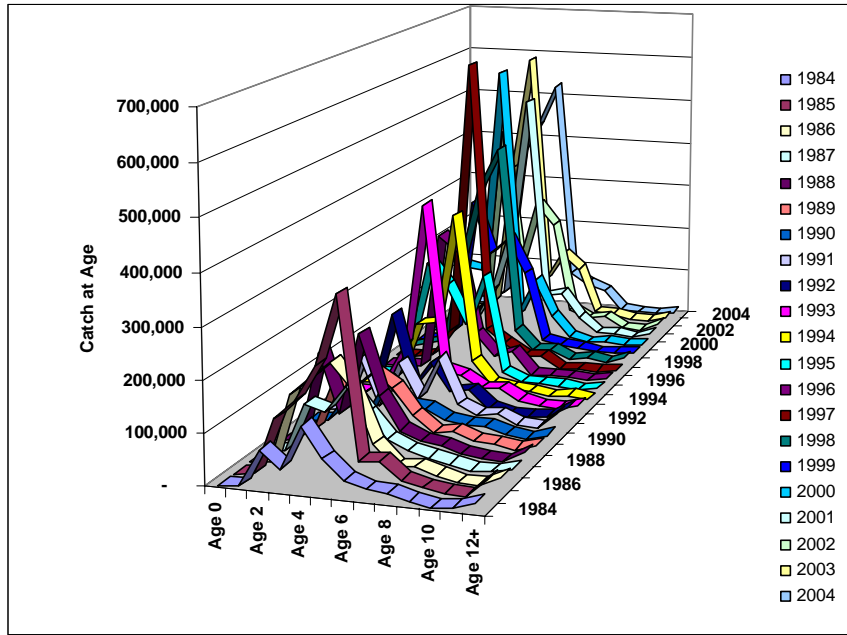
Table 5. Spawning stock fecundity and recruitment of gag GOM

Year	spawning recruits	
	biomass	from VPA
1984	18551	1397577
1985	18742	1323723
1986	16613	1142125
1987	16955	935098
1988	17418	847267
1989	17476	3280397
1990	16835	1224907
1991	16106	1200823
1992	15335	1617138
1993	18519	4008046
1994	18773	2188595
1995	15661	1561553
1996	15230	5332600
1997	19809	3345915
1998	21705	1219315
1999	21388	4024740
2000	27290	4129549
2001	31823	2584448
2002	31736	16452196
2003	34482	10765589
2004	36829	2813335

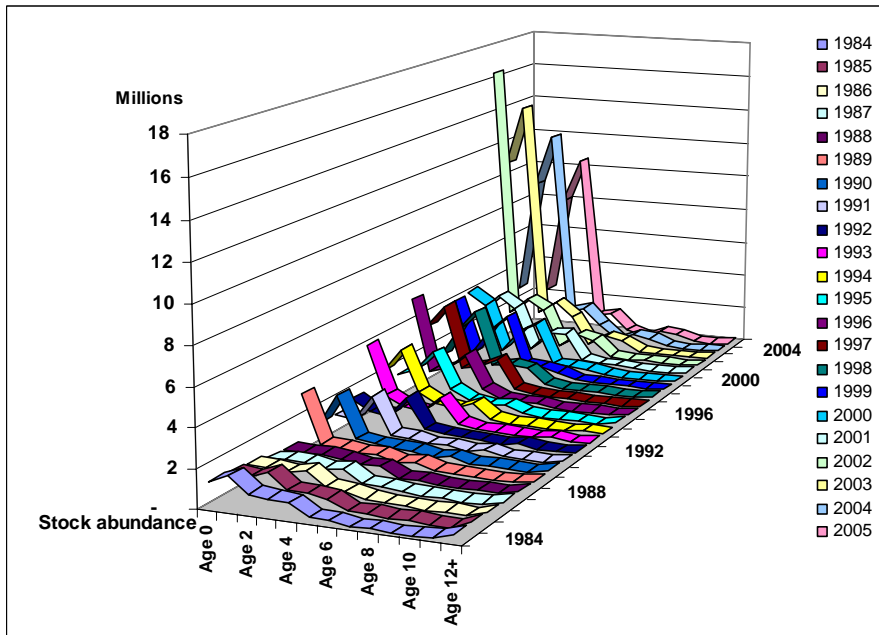


Table 6. Estimates for several benchmark based on the 1000 boots from the VPA continuity run. Low and upper CI represent 10% and 90% percentiles from bootstraps.

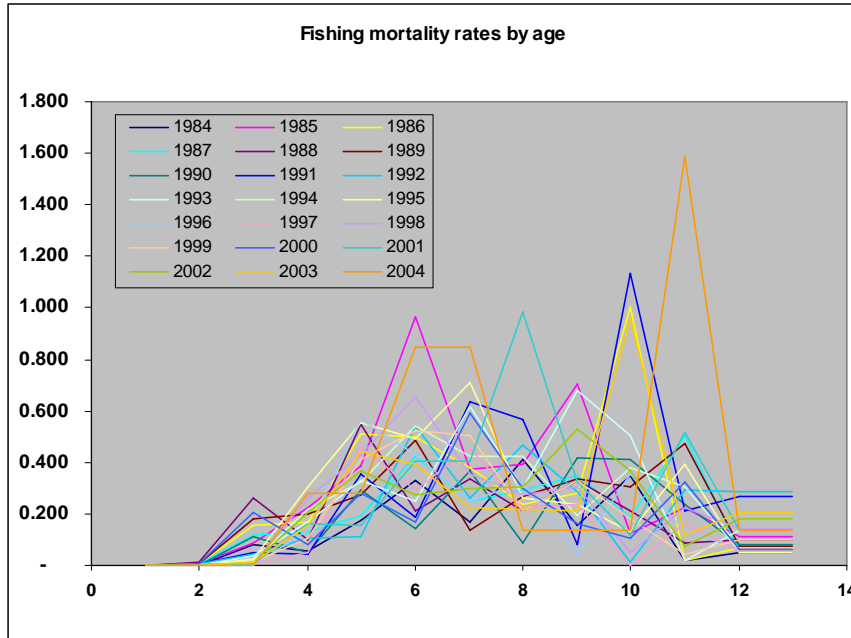
	<b>Estimate</b>	<b>Median</b>	<b>Low CI</b>	<b>Upp CI</b>
F at MSY	0.2565	0.2569	0.2186	0.3096
MSY	5,184	5,191	4,789	5,688
Y/R at MSY	2.66	2.64	2.47	2.82
S/R at MSY	29.00	29.05	28.21	29.87
SPR AT MSY	0.2884	0.2889	0.2805	0.2970
SSB AT MSY	56,571	57,063	54,063	60,943
F at max. Y/R	0.2565	0.2569	0.2186	0.3096
Y/R maximum	2.66	2.64	2.47	2.82
S/R at Fmax	29.00	29.05	28.21	29.87
SPR at Fmax	0.2884	0.2889	0.2805	0.2970
SSB at Fmax	56,571	57,063	54,063	60,943
F 30% SPR	0.2445	0.2465	0.2136	0.2887
Y/R at F30	2.66	2.64	2.47	2.82
S/R at F30	30.31	30.33	30.28	30.37
SSB at F30	59,118	59,531	56,816	63,135
F 40% SPR	0.1735	0.1741	0.1495	0.2061
Y/R at F40	2.54	2.52	2.36	2.70
S/R at F40	40.34	40.42	40.34	40.48
SSB at F40	78,688	79,324	75,739	84,145
F 75% of Fmax	0.1924	0.1927	0.1639	0.2322
Y 75% of Fmax	5,056	5,065	4,668	5,556
Y/R at 75% Fmax	2.59	2.57	2.41	2.76
S/R at 75% Fmax	37.22	37.27	36.59	37.87
SSB at 75% Fmax	72,606	73,171	69,746	77,907



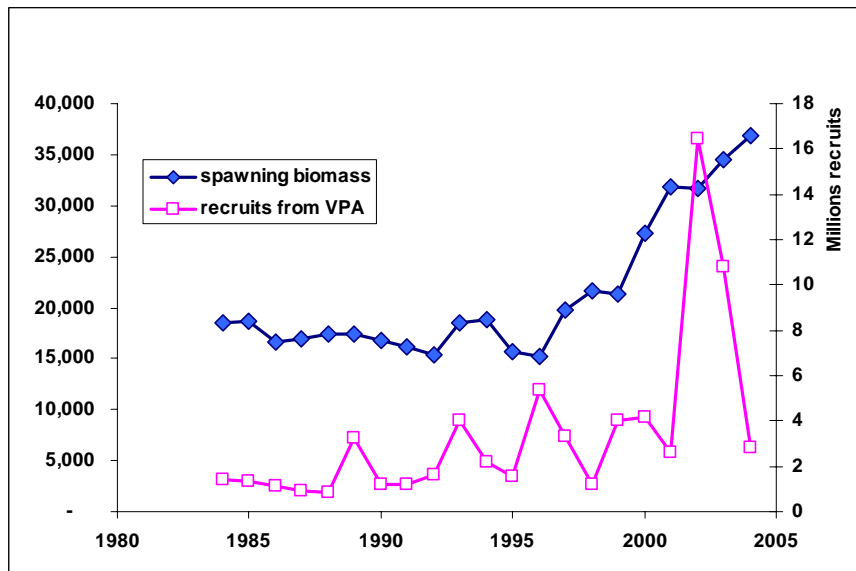
**Figure 1.** Catch at Age input for VPA run Gag GOM 1984-2004 ages 0 -12+.



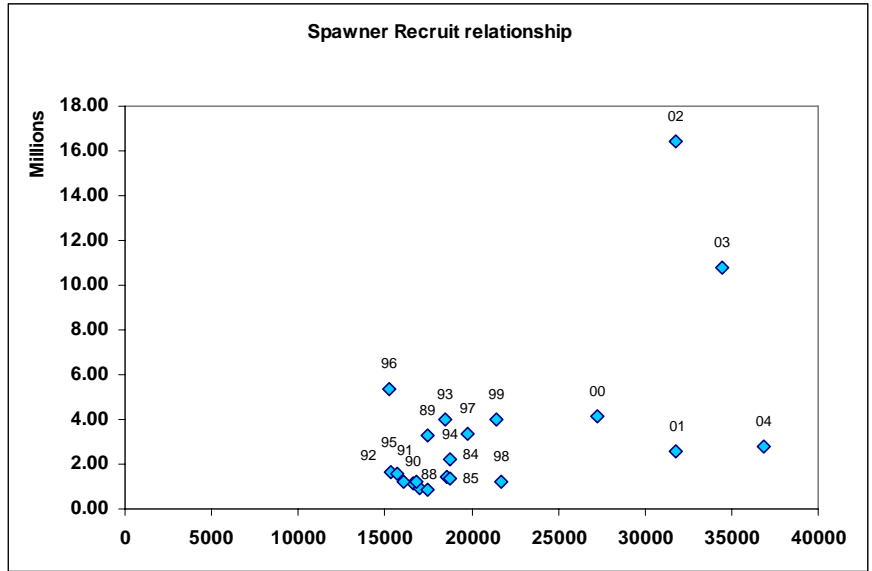
**Figure 2.** Estimated stock abundance (millions of fish) from VPA run Gag GOM 1984-2004 ages 0-12+.



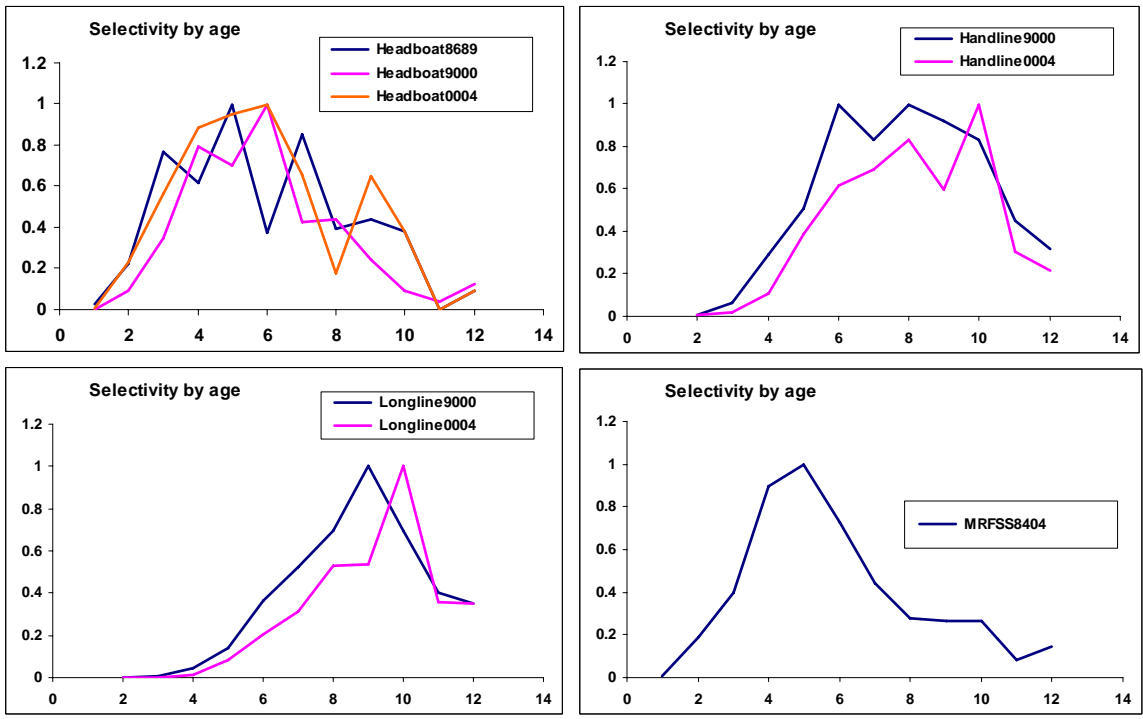
**Figure 3.** Estimated fishing mortality rates by age from VPA run Gag GOM 1984-04



**Figure 4.** Annual trends of gag GOM recruits and spawning stock biomass from VPA run.



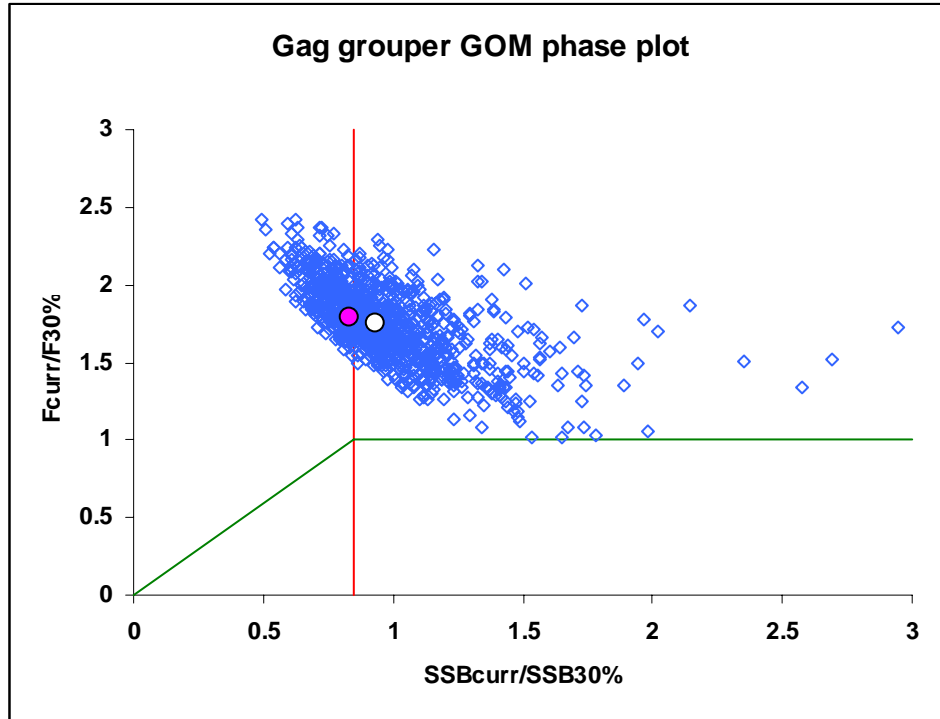
**Figure 5.** Spawner recruit plot for gag GOM from the VPA run 1984-04.



**Figure 6.** Selectivity at age (partial CAA) by fishery in the VPA run gag GOM 1984-2004.

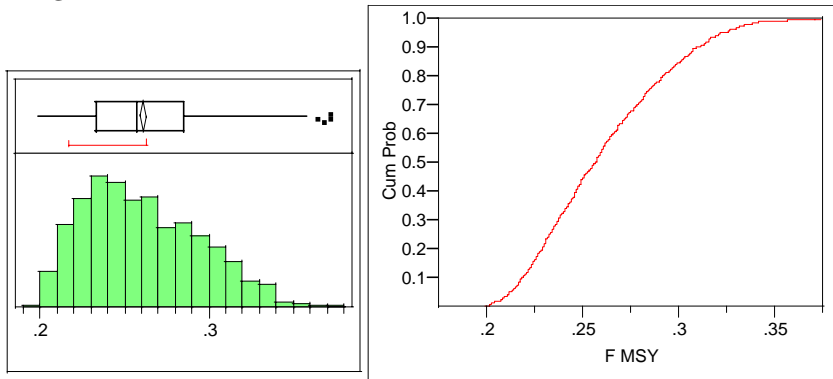


**Figure 7.** Fits to indices of abundance from the VPA run Gag GOM



**Figure 8.** Individual bootstrap estimates of spawning stock biomass (SSB) females and fishing mortality rate (F) relative to SSB and F at F30% SPR from the VPA run gag GOM 1984-04.

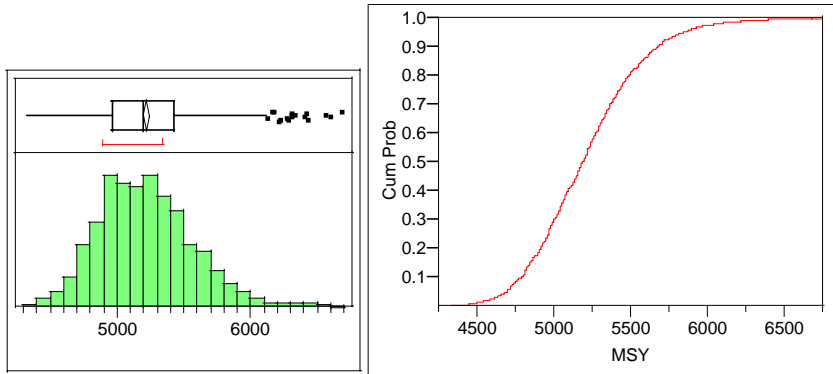
### F MSY



### Moments

Mean	0.2609679
Std Dev	0.0345425
Std Err Mean	0.0010918
upper 95% Mean	0.2631104
lower 95% Mean	0.2588255
N	1001

### MSY

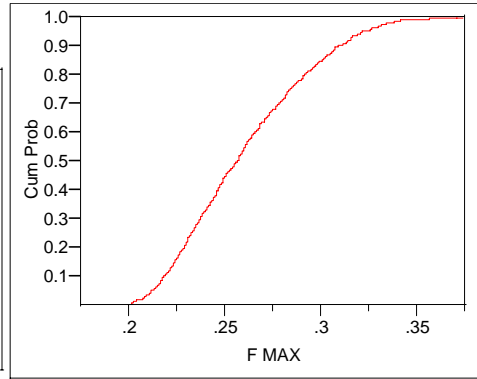
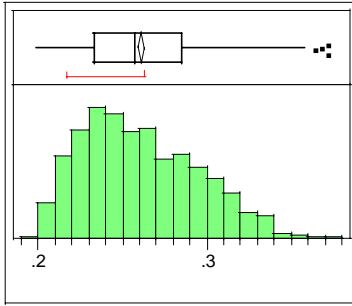


### Moments

Mean	5217.8691
Std Dev	358.38051
Std Err Mean	11.327324
upper 95% Mean	5240.0972
lower 95% Mean	5195.6411
N	1001

**Figure 9.** Histograms and cumulative frequency distributions for various reference statistics from bootstrapped estimates VPA run Gag GOM .

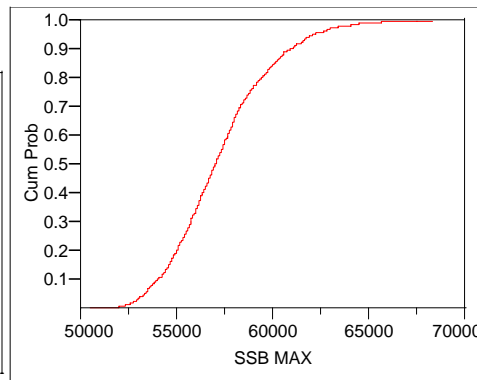
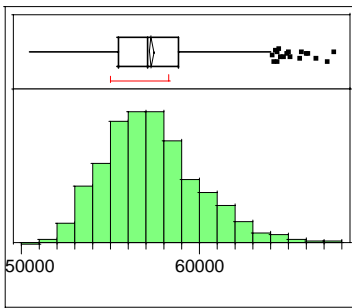
### F MAX



### Moments

Mean	0.2609679
Std Dev	0.0345425
Std Err Mean	0.0010918
upper 95% Mean	0.2631104
lower 95% Mean	0.2588255
N	1001

### SSB MAX

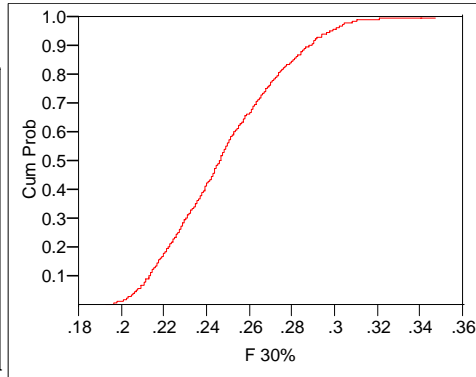
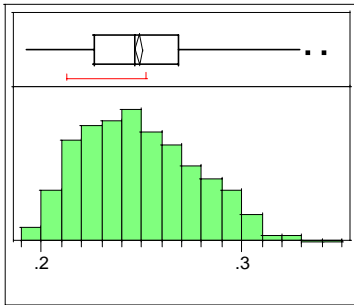


### Moments

Mean	57314.486
Std Dev	2671.3487
Std Err Mean	84.433256
upper 95% Mean	57480.172
lower 95% Mean	57148.799
N	1001



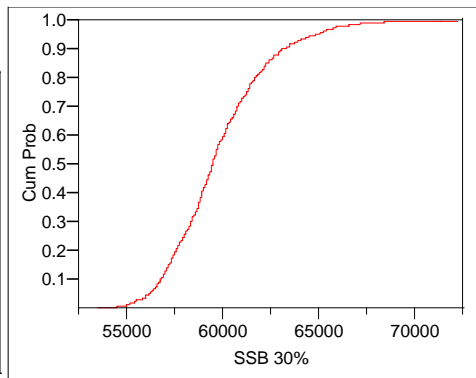
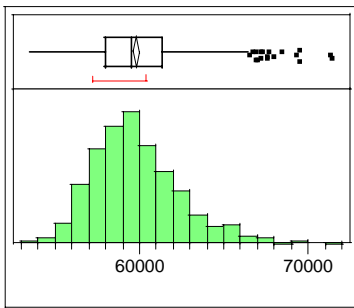
### F 30%



### Moments

Mean	0.2486662
Std Dev	0.0279577
Std Err Mean	0.0008837
upper 95% Mean	0.2504003
lower 95% Mean	0.2469322
N	1001

### SSB 30%



### Moments

Mean	59826.823
Std Dev	2613.0109
Std Err Mean	82.589375
upper 95% Mean	59988.892
lower 95% Mean	59664.755
N	1001

# Appendix 1

Input files for VPA-2BOX continuity run 2006 gag GOM assessment.

## 1. gag.dat file

```
#
# Catch Data File Generated by VPA-2BOX GUI - Version 3.02
#
# 1st Year - Last Year
1984 2004
# 1st Age - Last Age - Plus Group
0 12 12
#
# *** Zone 1 ***
#
# Number of Indices
14
# Spawntime
3
# Maturity
1 1 1 1 1 1 1 1 1 1 1 1 1 1
# Zone Name
'Gag grouper GOM-06 1984-2004' 0 0
# Catch At Age
1984 0 2644 75347 44067 128354 71353 34478 21965 17229 7242 236 3300 18315
1985 0 4440 114708 151924 221437 358564 48894 51678 18795 10254 2990 1391 38729
1986 0 4849 138147 174684 207537 159534 59240 19658 22878 10077 1032 673 18697
1987 0 4634 101585 88116 142954 92142 47380 27965 18667 10350 1978 3090 12974
1988 0 9542 182064 64457 224702 108499 42540 26940 20005 7391 3590 245 22715
1989 0 3716 106134 93416 129661 103101 50953 21497 28522 11466 10104 2460 13698
1990 0 3540 62250 21767 92518 46628 43347 25554 20636 20644 5827 1081 13389
1991 0 4819 115147 18999 111361 39957 125924 36376 17778 23636 6739 4433 35587
1992 0 4146 36525 188220 39468 95393 38825 45492 10286 2795 2398 6108 28348
1993 0 757 32641 105897 402512 61846 52167 28549 32172 10521 2666 798 11501
1994 0 3418 20311 132604 139343 368815 65613 18276 12632 9015 3620 7783 4052
1995 0 0 73794 247974 202327 122839 226974 24713 6228 6202 5466 431 8312
1996 0 0 2769 291310 258558 81887 36199 51817 3121 6044 4812 593 8823
1997 0 0 8378 64884 646620 73764 47713 22224 24250 0 1806 1480 6446
1998 0 10823 21703 212883 369771 454321 56285 17148 20143 3640 10172 1216 16956
1999 0 0 26225 320750 206973 243640 168788 21527 13083 8029 2908 3225 9252
2000 0 11333 156811 149730 598850 53448 136038 56926 12069 2885 9668 3345 6532
2001 0 3078 15546 87012 224397 523772 84130 91576 38439 6516 9146 2750 16142
2002 0 3563 36948 440319 132724 276367 233673 37798 19060 26807 3216 1889 18434
2003 0 40 22928 344287 596123 83781 149108 115261 17323 14659 5841 6503 16322
```

2004      0      107      28900      366904      432982      526478      86142      64569      50306      8051      6302      4973      10948

-1

# Index Specification

1	0	1	4	-1	1	12	'Headboat8604'
2	1	1	4	-1	1	12	'Headboat8689'
3	1	1	4	-1	1	12	'Headboat9000'
4	1	1	4	-1	1	12	'Headboat0004'
5	0	2	4	-1	2	12	'Handline9004'
6	1	2	4	-1	2	12	'Handline9000'
7	1	2	4	-1	2	12	'Handline0004'
8	0	2	4	-1	2	12	'Longline9004'
9	1	2	4	-1	2	12	'Longline9000'
10	1	2	4	-1	2	12	'Longline0004'
11	1	1	4	-1	1	12	'MRFSS8404'
12	1	1	4	-1	2	12	'Video9304'
13	1	1	4	-1	6	12	'CooperBelly9304'
14	1	1	1	-1	0	0	'FMRI9604'

-1

# Index Data

1	1986	1.1400	0.1560
1	1987	1.3170	0.1190
1	1988	1.0570	0.1470
1	1989	0.9930	0.1570
1	1990	0.7200	0.1770
1	1991	0.5970	0.2180
1	1992	0.7180	0.2140
1	1993	0.8260	0.1790
1	1994	0.8360	0.1870
1	1995	0.8530	0.2000
1	1996	1.3500	0.1130
1	1997	1.3270	0.1100
1	1998	1.2600	0.1210
1	1999	1.2370	0.1150
1	2000	1.0480	0.1510
1	2001	0.7780	0.2080
1	2002	0.8250	0.2090
1	2003	1.0390	0.1550
1	2004	1.0780	0.1440
2	1986	0.9780	0.2930
2	1987	1.2050	0.2190
2	1988	0.9500	0.2840
2	1989	0.8660	0.3150
3	1990	0.6910	0.3300
3	1991	0.6060	0.3600
3	1992	0.7050	0.3540
3	1993	0.8360	0.2970
3	1994	0.8680	0.3030

3	1995	0.8660	0.3070
3	1996	1.3310	0.1820
3	1997	1.3390	0.1760
3	1998	1.2620	0.1970
3	1999	1.2580	0.1850
3	2000	1.2390	0.2300
4	2000	0.9150	0.3860
4	2001	0.8800	0.3270
4	2002	0.9400	0.3260
4	2003	1.1020	0.2730
4	2004	1.1630	0.2700
5	1990	0.537535449	0.116657863
5	1991	0.379607251	0.110118609
5	1992	0.476513861	0.098972363
5	1993	0.761432621	0.061532352
5	1994	0.594985256	0.064418946
5	1995	0.741422183	0.060743194
5	1996	0.867145119	0.053345885
5	1997	0.927312489	0.051667329
5	1998	1.524325644	0.047189276
5	1999	1.063982128	0.048192468
5	2000	1.129660624	0.048608123
5	2001	1.543227123	0.047121544
5	2002	1.510135631	0.047585983
5	2003	1.256533041	0.048358512
5	2004	1.686181579	0.047619676
6	1990	0.653040367	0.138228873
6	1991	0.465700281	0.134045403
6	1992	0.576358326	0.121542572
6	1993	0.925583908	0.078409618
6	1994	0.730907076	0.083501792
6	1995	0.890967986	0.078355429
6	1996	1.041221859	0.069454544
6	1997	1.129424344	0.067145927
6	1998	1.831293273	0.061439209
6	1999	1.289458048	0.063274254
6	2000	1.466044532	0.07013881
7	2000	0.740800882	0.082890852
7	2001	1.087781028	0.074606822
7	2002	1.071871086	0.075114496
7	2003	0.893393319	0.076166876
7	2004	1.206153685	0.074679519
8	1990	0.849883366	0.45
8	1991	0.562190283	0.463
8	1992	0.452355835	0.606
8	1993	0.624425122	0.251
8	1994	0.355157008	0.326

8	1995	0.498558244	0.278
8	1996	0.585552052	0.208
8	1997	0.585366928	0.21
8	1998	1.028643485	0.157
8	1999	0.779554532	0.181
8	2000	1.014401186	0.16
8	2001	1.832232763	0.11
8	2002	1.752185995	0.112
8	2003	1.951392003	0.104
8	2004	2.128101198	0.097
9	1990	1.263523789	0.332
9	1991	0.850069446	0.331
9	1992	0.706373501	0.417
9	1993	0.976023949	0.18
9	1994	0.54109724	0.232
9	1995	0.74390762	0.202
9	1996	0.877762052	0.154
9	1997	0.874673239	0.154
9	1998	1.529127814	0.12
9	1999	1.183686171	0.136
9	2000	1.45375518	0.17
10	2000	0.591896952	0.329
10	2001	1.045528638	0.154
10	2002	0.994197328	0.161
10	2003	1.113879909	0.148
10	2004	1.254497174	0.134
11	1984	0.292	0.599
11	1985	1.142	0.392
11	1986	1.025	0.342
11	1987	0.275	0.376
11	1988	0.311	0.388
11	1989	0.424	0.385
11	1990	0.669	0.397
11	1991	0.507	0.372
11	1992	0.450	0.340
11	1993	1.142	0.324
11	1994	1.521	0.319
11	1995	1.453	0.313
11	1996	1.258	0.322
11	1997	0.939	0.315
11	1998	1.899	0.303
11	1999	1.591	0.301
11	2000	0.906	0.307
11	2001	0.715	0.310
11	2002	1.407	0.299
11	2003	1.540	0.299
11	2004	1.534	0.301

12	1993	0.662867	0.424467
12	1994	0.512612	0.528376
12	1995	0.445969	0.360877
12	1996	0.879396	0.28771
12	1997	0.932022	0.30967
12	1998	-999	-999
12	1999	-999	-999
12	2000	-999	-999
12	2001	-999	-999
12	2002	1.58665	0.189639
12	2003	-999	-999
12	2004	1.980485	0.186472
13	1993	1.24373	0.40344727
13	1994	0.843636	0.5859226
13	1995	0.670346	0.49734794
13	1996	0.757523	0.45720844
13	1997	0.54385	0.573801
13	1998	-999	-999
13	1999	-999	-999
13	2000	-999	-999
13	2001	-999	-999
13	2002	0.963539	0.37100684
13	2003	-999	-999
13	2004	1.977376	0.29729623
14	1996	1.13399	0.6656
14	1997	0.31773	1.07858
14	1998	0.2317	1.28399
14	1999	0.61968	0.7432
14	2000	0.44081	0.84245
14	2001	0.70821	0.78985
14	2002	3.29081	0.40103
14	2003	1.79145	0.49632
14	2004	0.46561	0.94286

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# Index Vulnerability

1	1986	0	306	3773	19379	1850	15191	378	2332	567	240	1004	0	197
1	1987	0	481	3915	11816	11677	3129	2312	1197	0	624	8	0	366
1	1988	0	0	3028	7549	14022	0	644	2113	0	0	0	0	216
1	1989	0	1181	4572	11721	2141	7140	5987	1961	2609	245	409	2	957
1	1990	0	0	993	2479	8291	4318	8216	2361	1913	563	0	0	103
1	1991	0	145	2908	841	2279	834	3185	606	273	356	0	34	376
1	1992	0	117	1317	7400	1283	2958	1236	1505	91	31	16	0	615
1	1993	0	67	1358	2994	12610	2095	1424	639	1001	158	27	0	442
1	1994	0	42	645	6269	6004	15044	3165	630	484	54	0	410	262
1	1995	0	0	2739	7614	5095	2713	5118	381	83	282	62	23	0
1	1996	0	0	97	10130	8483	1918	795	703	4	0	13	0	32
1	1997	0	0	370	1196	17465	1716	249	464	77	0	0	0	0

1	1998	0	432	1285	12310	17570	17832	2055	232	460	0	0	0	194
1	1999	0	0	1932	21175	8235	7214	3260	429	88	103	0	0	83
1	2000	0	482	6121	4972	18976	624	3271	1097	0	0	332	0	167
1	2001	0	51	418	1600	4195	9116	1384	1185	357	0	62	0	0
1	2002	0	0	562	9121	2426	3070	1573	120	12	36	0	0	24
1	2003	0	0	586	8125	12591	1472	1479	1435	67	374	0	0	135
1	2004	0	51	1251	10952	9404	10973	1370	1457	962	0	0	0	0
2	1986	0	306	3773	19379	1850	15191	378	2332	567	240	1004	0	197
2	1987	0	481	3915	11816	11677	3129	2312	1197	0	624	8	0	366
2	1988	0	0	3028	7549	14022	0	644	2113	0	0	0	0	216
2	1989	0	1181	4572	11721	2141	7140	5987	1961	2609	245	409	2	957
3	1990	0	0	993	2479	8291	4318	8216	2361	1913	563	0	0	103
3	1991	0	145	2908	841	2279	834	3185	606	273	356	0	34	376
3	1992	0	117	1317	7400	1283	2958	1236	1505	91	31	16	0	615
3	1993	0	67	1358	2994	12610	2095	1424	639	1001	158	27	0	442
3	1994	0	42	645	6269	6004	15044	3165	630	484	54	0	410	262
3	1995	0	0	2739	7614	5095	2713	5118	381	83	282	62	23	0
3	1996	0	0	97	10130	8483	1918	795	703	4	0	13	0	32
3	1997	0	0	370	1196	17465	1716	249	464	77	0	0	0	0
3	1998	0	432	1285	12310	17570	17832	2055	232	460	0	0	0	194
3	1999	0	0	1932	21175	8235	7214	3260	429	88	103	0	0	83
3	2000	0	482	6121	4972	18976	624	3271	1097	0	0	332	0	167
4	2000	0	482	6121	4972	18976	624	3271	1097	0	0	332	0	167
4	2001	0	51	418	1600	4195	9116	1384	1185	357	0	62	0	0
4	2002	0	0	562	9121	2426	3070	1573	120	12	36	0	0	24
4	2003	0	0	586	8125	12591	1472	1479	1435	67	374	0	0	135
4	2004	0	51	1251	10952	9404	10973	1370	1457	962	0	0	0	0
5	1990	0	0	1473	322	448	4590	10457	14717	9978	7218	5680	1050	4788
5	1991	0	0	0	0	5475	5238	29102	4837	7056	2629	3716	402	5191
5	1992	0	0	793	10189	5429	12275	9625	12387	4641	858	883	3072	5299
5	1993	0	0	208	5357	37170	6362	12872	8820	11933	4763	842	462	5488
5	1994	0	0	0	3154	10640	49251	7546	6481	3705	5304	2276	2424	2391
5	1995	0	0	0	15726	17937	10565	23680	8180	4040	3832	3260	157	5395
5	1996	0	0	22	15083	42715	22476	11460	15218	2006	3745	74	138	2252
5	1997	0	0	0	24600	44138	2754	29269	7196	11498	0	860	673	2204
5	1998	0	0	2624	10187	43103	88802	16416	8388	5518	2102	1510	936	6301
5	1999	0	0	2744	1864	16485	39422	49359	8555	5113	3057	1600	802	3472
5	2000	0	0	2103	9284	57168	19265	20360	18355	7555	1497	1092	1752	2576
5	2001	0	0	56	3006	13199	86240	18267	22139	16621	3641	3758	1276	3804
5	2002	0	0	439	4667	8798	33381	64507	12890	10416	6277	1304	842	3756
5	2003	0	0	52	1500	19084	13545	33682	28318	5700	2847	2469	827	3231
5	2004	0	0	133	3471	16590	50242	17227	22504	18454	4374	1774	1356	2736
6	1990	0	0	1473	322	448	4590	10457	14717	9978	7218	5680	1050	4788
6	1991	0	0	0	0	5475	5238	29102	4837	7056	2629	3716	402	5191
6	1992	0	0	793	10189	5429	12275	9625	12387	4641	858	883	3072	5299
6	1993	0	0	208	5357	37170	6362	12872	8820	11933	4763	842	462	5488
6	1994	0	0	0	3154	10640	49251	7546	6481	3705	5304	2276	2424	2391

6	1995	0	0	0	15726	17937	10565	23680	8180	4040	3832	3260	157	5395
6	1996	0	0	22	15083	42715	22476	11460	15218	2006	3745	74	138	2252
6	1997	0	0	0	24600	44138	2754	29269	7196	11498	0	860	673	2204
6	1998	0	0	2624	10187	43103	88802	16416	8388	5518	2102	1510	936	6301
6	1999	0	0	2744	1864	16485	39422	49359	8555	5113	3057	1600	802	3472
6	2000	0	0	2103	9284	57168	19265	20360	18355	7555	1497	1092	1752	2576
7	2000	0	0	2103	9284	57168	19265	20360	18355	7555	1497	1092	1752	2576
7	2001	0	0	56	3006	13199	86240	18267	22139	16621	3641	3758	1276	3804
7	2002	0	0	439	4667	8798	33381	64507	12890	10416	6277	1304	842	3756
7	2003	0	0	52	1500	19084	13545	33682	28318	5700	2847	2469	827	3231
7	2004	0	0	133	3471	16590	50242	17227	22504	18454	4374	1774	1356	2736
8	1990	0	0	157	152	304	349	4098	6766	2799	12478	144	0	3227
8	1991	0	0	0	0	406	1305	8462	2516	4136	1760	2657	289	4167
8	1992	0	0	46	489	632	4294	4675	6424	2886	475	716	2991	4732
8	1993	0	0	18	554	3351	1319	3123	3694	5163	2939	625	325	2876
8	1994	0	0	0	284	1333	7878	1628	2410	1890	2583	1249	1161	775
8	1995	0	0	0	770	2775	2263	5780	2426	1905	1912	2045	60	2701
8	1996	0	0	0	776	3295	4667	3526	7023	880	2199	53	139	1329
8	1997	0	0	0	1511	4300	778	4520	3498	6145	0	941	790	2372
8	1998	0	0	97	820	4480	10555	3817	3949	3132	1486	1263	234	5303
8	1999	0	0	32	165	1451	4395	10481	3179	2598	2169	1284	620	3259
8	2000	0	0	110	334	3793	3781	4578	6878	4351	1354	1175	1559	3357
8	2001	0	0	13	404	1697	12665	5905	9671	10349	2781	3245	1441	5906
8	2002	0	0	23	344	1170	6775	18832	7234	6907	5071	1641	1042	6313
8	2003	0	0	33	320	3460	4246	16206	18032	5801	3303	3349	1350	5465
8	2004	0	0	21	739	3587	12933	7649	11820	12014	3539	1973	1912	6379
9	1990	0	0	157	152	304	349	4098	6766	2799	12478	144	0	3227
9	1991	0	0	0	0	406	1305	8462	2516	4136	1760	2657	289	4167
9	1992	0	0	46	489	632	4294	4675	6424	2886	475	716	2991	4732
9	1993	0	0	18	554	3351	1319	3123	3694	5163	2939	625	325	2876
9	1994	0	0	0	284	1333	7878	1628	2410	1890	2583	1249	1161	775
9	1995	0	0	0	770	2775	2263	5780	2426	1905	1912	2045	60	2701
9	1996	0	0	0	776	3295	4667	3526	7023	880	2199	53	139	1329
9	1997	0	0	0	1511	4300	778	4520	3498	6145	0	941	790	2372
9	1998	0	0	97	820	4480	10555	3817	3949	3132	1486	1263	234	5303
9	1999	0	0	32	165	1451	4395	10481	3179	2598	2169	1284	620	3259
9	2000	0	0	110	334	3793	3781	4578	6878	4351	1354	1175	1559	3357
10	2000	0	0	110	334	3793	3781	4578	6878	4351	1354	1175	1559	3357
10	2001	0	0	13	404	1697	12665	5905	9671	10349	2781	3245	1441	5906
10	2002	0	0	23	344	1170	6775	18832	7234	6907	5071	1641	1042	6313
10	2003	0	0	33	320	3460	4246	16206	18032	5801	3303	3349	1350	5465
10	2004	0	0	21	739	3587	12933	7649	11820	12014	3539	1973	1912	6379
11	1984	0	2644	72390	42695	118670	53871	13854	5840	6726	5	4	138	7346
11	1985	0	4440	112812	149745	202069	341326	16086	41999	6669	169	912	110	27042
11	1986	0	4543	133392	151564	187330	121020	36518	3	12389	3	0	173	8356
11	1987	0	4153	97045	73107	128258	76398	26854	2	7995	3	1240	130	6422
11	1988	0	9542	176788	54551	207425	102098	27359	12187	5780	1695	0	105	16243



11	1989	0	2535	98602	80443	124260	88666	27468	2	10527	4	3459	166	5461
11	1990	0	3540	59616	18168	81933	35713	19978	1521	5844	383	0	29	5227
11	1991	0	4674	112239	18158	100232	31557	82404	28160	6149	18851	313	3705	25758
11	1992	0	4029	33873	167587	29937	74522	22766	24202	2623	1408	771	0	17636
11	1993	0	690	30976	95744	341687	51340	33482	14931	13403	2593	1155	0	2509
11	1994	0	3376	19661	121682	118528	289681	52259	8156	6349	788	0	3649	456
11	1995	0	0	71055	221686	172881	105479	189380	13017	0	0	0	187	0
11	1996	0	0	2650	264305	200579	50448	19503	28119	143	0	4671	315	5164
11	1997	0	0	8008	35467	576328	68283	10832	10555	5885	0	0	0	1795
11	1998	0	10391	17445	188805	302010	332472	33223	4285	10874	0	7367	0	5003
11	1999	0	0	21325	297330	179210	189085	103234	9112	5167	2642	0	1788	2351
11	2000	0	10851	148064	133511	513485	28897	106978	29996	0	0	7032	0	348
11	2001	0	3027	15042	81206	203518	408603	57712	57861	10669	0	1994	0	6272
11	2002	0	3563	35724	425009	118895	230939	146256	17354	1601	15361	260	0	8274
11	2003	0	40	22180	333811	556823	63328	96144	66476	5669	8086	0	4319	7425
11	2004	0	56	27353	350887	401002	448125	59132	28114	18493	84	2534	1691	1763
12	1993	0	0	18	554	3351	1319	3123	3694	5163	2939	625	325	2876
12	1994	0	0	0	284	1333	7878	1628	2410	1890	2583	1249	1161	775
12	1995	0	0	0	770	2775	2263	5780	2426	1905	1912	2045	60	2701
12	1996	0	0	0	776	3295	4667	3526	7023	880	2199	53	139	1329
12	1997	0	0	0	1511	4300	778	4520	3498	6145	0	941	790	2372
12	1998	0	0	97	820	4480	10555	3817	3949	3132	1486	1263	234	5303
12	1999	0	0	32	165	1451	4395	10481	3179	2598	2169	1284	620	3259
12	2000	0	0	110	334	3793	3781	4578	6878	4351	1354	1175	1559	3357
12	2001	0	0	13	404	1697	12665	5905	9671	10349	2781	3245	1441	5906
12	2002	0	0	23	344	1170	6775	18832	7234	6907	5071	1641	1042	6313
12	2003	0	0	33	320	3460	4246	16206	18032	5801	3303	3349	1350	5465
12	2004	0	0	21	739	3587	12933	7649	11820	12014	3539	1973	1912	6379
13	1993	0	0	18	554	3351	1319	3123	3694	5163	2939	625	325	2876
13	1994	0	0	0	284	1333	7878	1628	2410	1890	2583	1249	1161	775
13	1995	0	0	0	770	2775	2263	5780	2426	1905	1912	2045	60	2701
13	1996	0	0	0	776	3295	4667	3526	7023	880	2199	53	139	1329
13	1997	0	0	0	1511	4300	778	4520	3498	6145	0	941	790	2372
13	1998	0	0	97	820	4480	10555	3817	3949	3132	1486	1263	234	5303
13	1999	0	0	32	165	1451	4395	10481	3179	2598	2169	1284	620	3259
13	2000	0	0	110	334	3793	3781	4578	6878	4351	1354	1175	1559	3357
13	2001	0	0	13	404	1697	12665	5905	9671	10349	2781	3245	1441	5906
13	2002	0	0	23	344	1170	6775	18832	7234	6907	5071	1641	1042	6313
13	2003	0	0	33	320	3460	4246	16206	18032	5801	3303	3349	1350	5465
13	2004	0	0	21	739	3587	12933	7649	11820	12014	3539	1973	1912	6379

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# Index Weight at Age

5	1990	0.094	0.748	2.200	4.421	7.266	10.556	14.114	17.788	21.457	25.027	28.434	31.636	34.606
5	1991	0.094	0.748	2.200	4.421	7.266	10.556	14.114	17.788	21.457	25.027	28.434	31.636	34.606
5	1992	0.094	0.748	2.200	4.421	7.266	10.556	14.114	17.788	21.457	25.027	28.434	31.636	34.606
5	1993	0.094	0.748	2.200	4.421	7.266	10.556	14.114	17.788	21.457	25.027	28.434	31.636	34.606
5	1994	0.094	0.748	2.200	4.421	7.266	10.556	14.114	17.788	21.457	25.027	28.434	31.636	34.606



9	1996	0.094	0.748	2.200	4.421	7.266	10.556	14.114	17.788	21.457	25.027	28.434	31.636	34.606
9	1997	0.094	0.748	2.200	4.421	7.266	10.556	14.114	17.788	21.457	25.027	28.434	31.636	34.606
9	1998	0.094	0.748	2.200	4.421	7.266	10.556	14.114	17.788	21.457	25.027	28.434	31.636	34.606
9	1999	0.094	0.748	2.200	4.421	7.266	10.556	14.114	17.788	21.457	25.027	28.434	31.636	34.606
9	2000	0.094	0.748	2.200	4.421	7.266	10.556	14.114	17.788	21.457	25.027	28.434	31.636	34.606
10	2000	0.094	0.748	2.200	4.421	7.266	10.556	14.114	17.788	21.457	25.027	28.434	31.636	34.606
10	2001	0.094	0.748	2.200	4.421	7.266	10.556	14.114	17.788	21.457	25.027	28.434	31.636	34.606
10	2002	0.094	0.748	2.200	4.421	7.266	10.556	14.114	17.788	21.457	25.027	28.434	31.636	34.606
10	2003	0.094	0.748	2.200	4.421	7.266	10.556	14.114	17.788	21.457	25.027	28.434	31.636	34.606
10	2004	0.094	0.748	2.200	4.421	7.266	10.556	14.114	17.788	21.457	25.027	28.434	31.636	34.606

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# Fecundity

1984	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
1985	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
1986	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
1987	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
1988	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
1989	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
1990	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
1991	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
1992	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
1993	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
1994	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
1995	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
1996	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
1997	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
1998	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
1999	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
2000	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
2001	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
2002	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
2003	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516
2004	0	0	0	0.633735331	4.661830216	9.013509882	12.87342989	16.34616762	19.24788082	21.21953167	21.89076605	21.05686292	10.08813516

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@

2. Gag GOM Control file

```
#
# Control File Generated by VPA-2BOX GUI - Version 3.02
#
'Gag GOM 84-04 equal wgt index'
'J:\CONTINUITY\VPA2006\RUN1\GAG.D06'
'J:\CONTINUITY\VPA2006\RUN1\GAG.P06'
'J:\CONTINUITY\VPA2006\RUN1\GAG.REP'
'J:\CONTINUITY\VPA2006\RUN1\GAG.EST'
'J:\CONTINUITY\VPA2006\RUN1\GAG.SPD'
'NONE FOR GAG'
```

```

# Model Options
1
1
# Tagging Control
0
# Search Algorithm Controls
-911
20
3
0.4
# Index Weighting Controls
0
1
0
# Constraints on Vulnerability
0
# Constraints on Recruitment
0
0
# Constraints on Spawner-Recruit Relationship
0
# Terminal Year Option
1
# Catchability Option
0
# Bootstrapping
0
# Retrospective
8
# No Print
-1
@

```

### 3. Parameter file gag GOM

```

#
# Parameter Data File Generated by VPA-2BOX GUI - Version 3.02
#
#
# *** Zone 1 ***
#
# Terminal Year Parameters
      0      0.001      2      1      2
      0      0.1      2      1      2
      0      0.2      2      1      0.1
      0      1      2      0      4
      0      0.25      2      1      0.1
      0      1      2      0      6

```

0	0.25	2	1	0.1
0	1	2	0	8
0	0.25	2	1	0.1
0	1	2	0	8
0	0.25	2	1	0.1
0	1	2	0	8
# F-Ratio Parameters				
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
0.1	1	5	0	0.2
# Natural Mortality Parameters				
0	0.15	1	0	0.1
0	0.15	1	0	0.1
0	0.15	1	0	0.1
0	0.15	1	0	0.1
0	0.15	1	0	0.1
0	0.15	1	0	0.1
0	0.15	1	0	0.1
0	0.15	1	0	0.1
0	0.15	1	0	0.1
0	0.15	1	0	0.1
0	0.15	1	0	0.1
0	0.15	1	0	0.1
0	0.15	1	0	0.1
0	0.15	1	0	0.1
# Mixing Parameters				
0	0	1	0	0.1
0	0	1	0	0.1
0	0	1	0	0.1
0	0	1	0	0.1

0	0	1	0	0.1
0	0	1	0	0.1
0	0	1	0	0.1
0	0	1	0	0.1
0	0	1	0	0.1
0	0	1	0	0.1
0	0	1	0	0.1
0	0	1	0	0.1
0	0	1	0	0.1
0	0	1	0	0.1
# Stock Recruitment Parameters				
0	.1137d+08	1.D20	0	0.4
0	.8559d+04	1.D20	0	0
0	0	0.9	0	0
0	0	1	0	0
0	0.4	2	0	0
# Variance Scaling Parameters				
0	0.4	1	0	0.1
0	0.4	1	1	0.1
0	0.4	1	-0.1	0.1
0	0.4	1	-0.1	0.1
0	0.4	1	0	0.1
0	0.4	1	-0.1	0.1
0	0.4	1	-0.1	0.1
0	0.4	1	0	0.1
0	0.4	1	-0.1	0.1
0	0.4	1	-0.1	0.1
0	0.4	1	-0.1	0.1
0	0.4	1	-0.1	0.1
0	0.4	1	-0.1	0.1
0	0.4	1	-0.1	0.1
0	0.4	1	1	0.1