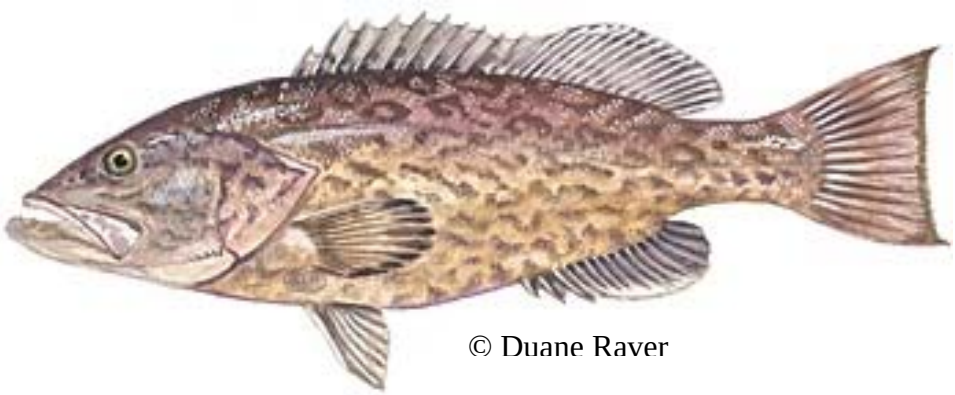
Appendix G
Potential Management Measures for Gag



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May 19, 2008

Summary

A benchmark assessment for gag completed in 2007 indicated the stock is experiencing overfishing and approaching an overfished condition as of 2005 (SEDAR 10 2007). The Council's Scientific and Statistical Committee (SSC) recommended the Council restrict harvest to the yield associated with Foy defined as 75% of Fmsy. This would correspond to a catch limit of 694,000 pounds gutted weight for all sectors in 2008, which is equivalent to a reduction of 36% in the average catch during 2004-2006.

The commercial quota depends on the allocation alternative and year (Table 1). Gag is not overfished if biomass is less than Bmsy.

Table 1. Commercial quotas and recreational allocations* for gag (pounds gutted weight) based on the TAC associated with the yield at 75% of F_{MSY}.

		Alternative 2 (preferred)		**Alternative 3**		**Alternative 4**	
Year	**Catch Level**	**Comm**	**Rec**	**Comm**	**Rec**	**Comm**	**Rec**
2009 Onwards	694,000	353,940	340,060	458,040	235,960	423,340	270,660

The combined effect of reducing the gag and black grouper bag limit to 1 fish, reducing the grouper aggregate bag limit to 3 fish, excluding captain and crew on for-hire vessels from possessing groupers, and a January through April spawning closure would provide reduction in recreational harvest of approximately 37%. These reductions take into consideration a 25% release mortality rate and continued non-compliance with the bag limit.

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1 Harvest levels recommended by Council's SSC

Table 2. Table 44 from SEDAR 10 (2007). Gag– Base run with constant catchability: Projection results under 75% of Fmsy (starting in 2008) (fishing mortality rate fixed at the current value in 2005-2007). SSB = spawning stock biomass, R = recruits in 1000s, F = fishing mortality rate, L = landings, Sum L = cumulative landings, and D = dead discards. For reference, relevant estimated benchmarks are SSBMSY = 7925 mt, RMSY = 500 recruits in 1000s, FMSY = 0.24/yr, and MSY = 1238 klb.

Year	SSB(klb)	R(1000s)	F(/yr)	L(mt)	L(klb)	Sum L(klb)	D(1000s)	D (klb)
2005	7,468	497	0.315	663	1462	1462	21.4	108
2006	6860	499	0.315	651	1436	2898	21.4	85
2007	6062	497	0.315	589	1299	4197	26	99
2008	5604	494	0.178	315	694	4891	17	70
2009	6096	491	0.178	325	716	5607	18	79
2010	6667	494	0.178	348	768	6,375	18.2	81
2011	7216	496	0.178	381	840	7,215	18.2	81
2012	7693	498	0.178	415	916	8,131	18.2	81
2013	8087	499	0.178	443	976	9,107	18.3	81
2014	8,413	501	–	–	–	–	–	–

2 Gag Landings and Allocation

2.1 Gag Landings

Table 3. Table 16 from SEDAR 10 2007 assessment. Constant catchability model estimated time series of landings in gutted weight (klb) for each fishery.

Year	C.HAL	C.Diving	Headboat	MRFSS	Total	Comm	Rec	% Comm	% Rec
1962	151	13	136	100	400	164	236	41.00%	59.00%
1963	137	13	124	91	365	150	215	41.10%	58.90%
1964	129	12	119	87	347	141	206	40.63%	59.37%
1965	130	12	127	93	362	142	220	39.23%	60.77%
1966	99	12	100	73	284	111	173	39.08%	60.92%
1967	211	12	218	160	601	223	378	37.10%	62.90%
1968	310	11	331	243	895	321	574	35.87%	64.13%
1969	217	9	219	161	606	226	380	37.29%	62.71%
1970	299	7	286	210	802	306	496	38.15%	61.85%
1971	307	5	281	206	799	312	487	39.05%	60.95%
1972	205	4	211	132	552	209	343	37.86%	62.14%
1973	292	5	123	84	504	297	207	58.93%	41.07%
1974	376	6	118	134	634	382	252	60.25%	39.75%
1975	427	8	117	244	796	435	361	54.65%	45.35%
1976	577	4	123	401	1105	581	524	52.58%	47.42%
1977	642	9	130	346	1127	651	476	57.76%	42.24%
1978	984	14	85	539	1622	998	624	61.53%	38.47%
1979	914	19	110	411	1454	933	521	64.17%	35.83%
1980	845	16	71	360	1292	861	431	66.64%	33.36%
1981	974	14	149	595	1732	988	744	57.04%	42.96%
1982	1004	16	124	185	1329	1020	309	76.75%	23.25%
1983	1040	9	158	649	1856	1049	807	56.52%	43.48%
1984	1082	19	186	1515	2802	1101	1701	39.29%	60.71%
1985	865	12	141	458	1476	877	599	59.42%	40.58%
1986	820	6	135	363	1324	826	498	62.39%	37.61%
1987	852	22	174	625	1673	874	799	52.24%	47.76%
1988	669	13	157	402	1241	682	559	54.96%	45.04%
1989	963	22	149	500	1634	985	649	60.28%	39.72%
1990	783	19	116	343	1261	802	459	63.60%	36.40%
1991	656	85	95	256	1092	741	351	67.86%	32.14%
1992	695	107	108	385	1295	802	493	61.93%	38.07%
1993	761	78	103	457	1399	839	560	59.97%	40.03%
1994	799	97	97	552	1545	896	649	57.99%	42.01%
1995	838	84	105	397	1424	922	502	64.75%	35.25%
1996	752	119	68	402	1341	871	470	64.95%	35.05%
1997	607	99	60	281	1047	706	341	67.43%	32.57%
1998	655	139	79	371	1244	794	450	63.83%	36.17%
1999	539	114	60	580	1293	653	640	50.50%	49.50%
2000	439	63	68	342	912	502	410	55.04%	44.96%
2001	450	82	58	477	1067	532	535	49.86%	50.14%
2002	448	85	51	265	849	533	316	62.78%	37.22%
2003	444	117	37	517	1115	561	554	50.31%	49.69%
2004	476	75	76	532	1159	551	608	47.54%	52.46%

Table 4. Commercial gag landings (pounds gutted weight) for gag taken with diving gear and all other gear types. Source: ALS. Commercial ALS data for 2006 are incomplete. Gear = 760, 941, 942, or 943 considered diving.

Year	Other	Diving
1986	697,737	2,583
1987	744,663	6,613
1988	506,193	6,439
1989	835,547	6,505
1990	693,939	0
1991	670,148	0
1992	701,453	6,961
1993	748,875	3,556
1994	863,968	10,660
1995	908,141	5,006
1996	843,300	1,209
1997	571,930	78,123
1998	669,441	99,121
1999	521,988	102,336
2000	434,852	52,960
2001	448,957	72,200
2002	459,369	55,093
2003	457,934	76,730
2004	482,912	53,459
2005	523,725	38,098
2006	471,977	41,395

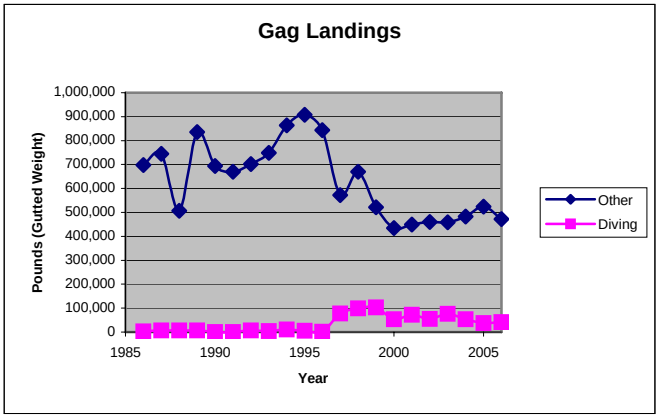


Table 5. Gag Landings – Pounds Gutted Weight. Source: ALS, MRFSS Web site; Headboat survey. Data do not include dead discards and MRFSS data are A+B1; weight not converted from numbers.

Year	comm	mrfss	hb	% comm	% rec
1986	700,785	38,199	113,665	82.19%	17.81%
1987	752,466	427,426	158,687	56.21%	43.79%
1988	513,791	188,438	170,518	58.87%	41.13%
1989	843,223	364,692	147,056	62.23%	37.77%
1990	693,939	296,116	117,536	62.65%	37.35%
1991	670,148	186,415	96,543	70.31%	29.69%
1992	709,667	403,603	105,496	58.23%	41.77%
1993	753,071	461,181	102,856	57.18%	42.82%
1994	876,547	475,081	80,428	61.21%	38.79%
1995	914,047	258,288	94,235	72.17%	27.83%
1996	844,727	240,483	56,221	74.01%	25.99%
1997	664,115	239,049	52,189	69.52%	30.48%
1998	786,403	177,101	60,064	76.83%	23.17%
1999	642,745	518,683	49,444	53.08%	46.92%
2000	497,345	382,843	51,617	53.37%	46.63%
2001	534,153	598,860	44,722	45.35%	54.65%
2002	524,379	327,670	42,845	58.60%	41.40%
2003	548,475	596,335	27,536	46.78%	53.22%

2004	545,994	459,162	82,474	50.20%	49.80%
2005	568,681	439,520	71,736	52.66%	47.34%
2006	520,824	425,071	46,537	52.48%	47.52%

2.2 Gag Landings Associated With 225 and Unlimited Permits

Table 6. Landings of gag (lbs gw) associated with 225 and unlimited permits.

Year	225 Permit	Unlimited Permit
1999	5,196	556,606
2000	3,401	418,173
2001	2,811	440,544
2002	1,923	449,515
2003	2,145	504,660
2004	3,392	448,125
2005	2,952	456,814
2006	2,214	402,171

2.3 Gag Landings by State

Table 7. Commercial landings by state, 1999-2005.

State	99-05	Avg ww	Avg GW	Percent
FL	1,347,665	192,524	163,156	29.6%
Monroe	38,137	5,448	4,617	0.8%
Georgia	288,232	41,176	34,895	6.3%
NC	1,435,185	205,026	173,751	31.5%
SC	1,447,671	206,810	175,263	31.8%

Table 8. Commercial landings by state, 1999-2006.

State	1999-2006	Avg ww	Avg GW	Percent
FL	1,461,135	182,642	154,781	28.3%
Monroe	42,734	5,342	4,527	0.8%
Georgia	311,807	38,976	33,030	6.0%
NC	1,676,135	209,517	177,557	32.4%
SC	1,679,651	209,956	177,929	32.5%

Table 9. Commercial landings by state, 2001-2006.

State	2001-2006	Avg ww	Avg GW	Percent
FL	974,204	162,367	137,599	25.5%
Monroe	31,386	5,231	4,433	0.8%
Georgia	202,824	33,804	28,647	5.3%
NC	1,331,478	221,913	188,062	34.8%
SC	1,286,264	214,377	181,676	33.6%

Table 10. Headboat landings by state, 1999-2005.

State	99-05	avg ww	avg gw	percent
GA AND NORTH F	116,885	16,698	14,151	26.7%
NORTH CAROLINA	121,028	17,290	14,652	27.7%
SOUTH CAROLINA	71,294	10,185	8,631	16.3%
SOUTH FLORIDA	127,834	18,262	15,476	29.2%

Table 11. Headboat landings by state, 2001-2006.

State	2001-2006	avg ww	avg gw	percent
GA AND NORTH FL	78,041	13,007	11,023	22.14%
NORTH CAROLINA	104,655	17,290	14,652	29.43%
SOUTH CAROLINA	62,377	10,185	8,631	17.34%
SOUTH FLORIDA	127,631	18,262	15,476	31.09%

Table 12. MRFSS landings (pounds) by state, 1999-2005.

MRFSS	99-05	avg ww	avg gw	percent
FL	3,065,904	510,984	433,037	83.3%
GA	27,082	4,514	3,825	0.7%
SC	188,079	31,347	26,565	5.1%
NC	399,106	66,518	56,371	10.8%

Table 13. MRFSS landings (pounds) by state, 2001-2006.

MRFSS	2001-2006	avg ww	avg gw	percent
FL	2,369,161	394,860	334,627	70.23%
GA	67,200	11,200	9,492	1.99%
SC	140,254	23,376	19,810	4.16%
NC	796,789	132,798	112,541	23.62%

Table 14. MRFFS landings (number A+B1) by state. 1999-2005.

MRFSS	99-05	avg	percent
FL	192,750	27,536	72.7%
GA	3,577	511	1.3%
SC	17,623	2,518	6.6%
NC	51,193	7,313	19.3%

Table 15. MRFFS landings (number A+B1) by state, 2001-2006.

MRFSS	2001-2006	avg	percent
FL	146,979	29,396	64.65%
GA	5,445	1,089	2.40%
SC	10,679	2,136	4.70%
NC	64,245	12,849	28.26%

Table 16. MRFSS number released alive (B2) among states, 1999-2005.

MRFSS	99-05	avg	percent
FL	693,383	115,564	91.0%
GA	4,670	778	0.6%
SC	29,186	4,864	3.8%
NC	34,881	5,814	4.6%

Table 17. MRFSS number released alive (B2) among states, 2001-2006.

MRFSS	2001-2006	avg	percent
FL	623,153	124,631	89.62%
GA	5,878	1,176	0.85%
SC	24,128	4,826	3.47%
NC	42,161	8,432	6.06%

Table 18. Percentage of MRFSS B2s by state. Average 1999-2005.

MRFSS	A+B1	B2	A+B1+B2	% B2
FL	27,536	99,055	126,590	78.2%
GA	511	667	1,178	56.6%
SC	2,518	4,169	6,687	62.4%
NC	7,313	4,983	12,296	40.5%
Total	37,878	108,874	146,752	74.2%

Table 19. Percentage of MRFSS B2s by state. Average 2001-2006.

MRFSS	A+B1	B2	A+B1+B2	% B2
FL	29,396	124,631	154,027	80.92%
GA	1,089	1,176	2,265	56.60%
SC	2,136	4,826	6,962	62.40%
NC	12,849	8,432	21,281	40.50%
Total	45,470	139,065	184,535	75.36%

2.4 Gag Landings by Month and State

2.4.1 Commercial

Table 20. Average gag commercial landings 1999-2005 (lbs gutted weight) by state and month. Includes Monroe County South Atlantic landings.

Month	Total	FL	GA	SC	NC
1	57,110	26,730	3,339	13,262	13,779
2	56,700	25,084	4,862	10,432	16,322
3	2,110	1,696	0	103	311
4	1,927	1,517	19	206	185
5	83,065	26,036	6,575	21,468	28,985
6	57,890	16,199	3,531	16,564	21,596
7	50,887	14,153	2,346	16,332	18,056
8	40,978	12,994	1,264	14,792	11,928
9	33,918	6,927	1,905	13,464	11,622
10	57,003	11,388	3,000	25,430	17,185
11	60,498	10,061	5,229	24,353	20,854
12	49,595	14,989	2,823	17,344	14,440
Total	551,682	167,773	34,895	173,751	175,263

Table 21. Percentage of gag (commercial) landed by month in FL, GA, SC, and NC during 1999-2005 (lbs gutted weight) by state and month.

Month	Total	FL	GA	SC	NC
1	10.35%	15.93%	9.57%	7.63%	7.86%
2	10.28%	14.95%	13.93%	6.00%	9.31%
3	0.38%	1.01%	0.00%	0.06%	0.18%
4	0.35%	0.90%	0.05%	0.12%	0.11%
5	15.06%	15.52%	18.84%	12.36%	16.54%
6	10.49%	9.66%	10.12%	9.53%	12.32%
7	9.22%	8.44%	6.72%	9.40%	10.30%
8	7.43%	7.74%	3.62%	8.51%	6.81%

9	6.15%	4.13%	5.46%	7.75%	6.63%
10	10.33%	6.79%	8.60%	14.64%	9.81%
11	10.97%	6.00%	14.99%	14.02%	11.90%
12	8.99%	8.93%	8.09%	9.98%	8.24%

Table 22. Average gag commercial landings 2001-2006 (lbs gutted weight) by state and month. Includes Monroe County South Atlantic landings.

Month	Total	FL	GA	SC	NC
1	58,389	25,148	2,515	15,020	15,706
2	52,953	21,642	3,816	10,675	16,821
3	1,274	897	0	81	296
4	2,106	1,650	0	238	218
5	79,875	20,011	6,483	21,959	31,422
6	60,435	13,296	3,421	19,089	24,630
7	51,177	12,776	1,815	17,003	19,583
8	44,313	12,673	1,343	16,090	14,208
9	34,226	5,177	1,153	17,076	10,820
10	51,963	8,249	1,675	27,686	14,353
11	55,521	7,524	4,075	24,681	19,242
12	48,185	12,991	2,353	18,465	14,376
Total	540,418	142,032	28,647	188,062	181,676

Table 23. Percentage of gag (commercial) landed by month in FL, GA, SC, and NC during 2001-2006 (lbs gutted weight) by state and month.

Month	Total	FL	GA	SC	NC
1	10.80%	17.71%	8.78%	7.99%	8.65%
2	9.80%	15.24%	13.32%	5.68%	9.26%
3	0.24%	0.63%	0.00%	0.04%	0.16%
4	0.39%	1.16%	0.00%	0.13%	0.12%
5	14.78%	14.09%	22.63%	11.68%	17.30%
6	11.18%	9.36%	11.94%	10.15%	13.56%
7	9.47%	9.00%	6.33%	9.04%	10.78%
8	8.20%	8.92%	4.69%	8.56%	7.82%
9	6.33%	3.64%	4.03%	9.08%	5.96%
10	9.62%	5.81%	5.85%	14.72%	7.90%
11	10.27%	5.30%	14.22%	13.12%	10.59%
12	8.92%	9.15%	8.21%	9.82%	7.91%

2.4.2 Headboat

Table 24. Average gag headboat landings 1999-2005 (lbs gutted weight) by state and month.

Month	Total	South FL	GA - NFL	SC	NC
1	3,508	2,089	1,311	81	27
2	3,680	2,437	1,159	11	73
3	6,750	4,503	1,483	400	363
4	5,739	1,649	1,934	862	1,294
5	6,854	1,297	2,114	1,120	2,323
6	7,556	1,214	1,648	1,235	3,459

7	7,233	954	1,388	1,418	3,473
8	5,067	784	1,142	1,080	2,061
9	3,055	373	523	1,186	973
10	5,316	876	1,243	1,245	1,951
11	4,415	949	1,271	1,183	1,013
12	2,555	929	1,292	249	85

Table 25. Average gag headboat landings 1999-2005 (percentage) by state and month.

Month	Total	FL	GA	SC	NC
1	5.68%	11.57%	7.94%	0.80%	0.16%
2	5.96%	13.50%	7.02%	0.11%	0.43%
3	10.93%	24.94%	8.98%	3.97%	2.12%
4	9.30%	9.14%	11.71%	8.56%	7.57%
5	11.10%	7.18%	12.81%	11.13%	13.59%
6	12.24%	6.73%	9.98%	12.27%	20.24%
7	11.72%	5.28%	8.41%	14.08%	20.32%
8	8.21%	4.34%	6.91%	10.72%	12.06%
9	4.95%	2.07%	3.17%	11.78%	5.69%
10	8.61%	4.85%	7.53%	12.37%	11.41%
11	7.15%	5.25%	7.70%	11.75%	5.92%
12	4.14%	5.15%	7.83%	2.47%	0.50%

Table 26. Average gag headboat landings 2001-2006 (lbs gutted weight) by state and month.

Month	Total	South FL	GA - NFL	SC	NC
1	2,832	1,937	779	69	48
2	3,395	2,402	928	3	62
3	6,419	4,573	1,096	383	366
4	5,219	1,759	1,452	848	1,160
5	5,817	1,259	1,464	1,040	2,054
6	5,884	1,180	1,082	1,201	2,419
7	6,464	1,182	796	1,262	3,223
8	4,040	859	619	740	1,823
9	2,712	433	274	808	1,198
10	4,308	661	951	1,049	1,647
11	3,612	929	829	1,133	722
12	1,940	853	753	274	61

Table 27. Average gag headboat landings 2001-2006 (percentage) by state and month.

Month	Total	South FL	GA - NFL	SC	NC
1	5.38%	10.74%	7.06%	0.78%	0.32%
2	6.45%	13.33%	8.42%	0.04%	0.42%
3	12.19%	25.37%	9.94%	4.35%	2.47%
4	9.91%	9.76%	13.17%	9.63%	7.85%
5	11.05%	6.99%	13.28%	11.80%	13.89%
6	11.18%	6.55%	9.82%	13.64%	16.37%
7	12.28%	6.56%	7.22%	14.32%	21.81%
8	7.67%	4.76%	5.62%	8.40%	12.33%
9	5.15%	2.40%	2.48%	9.17%	8.10%
10	8.18%	3.67%	8.63%	11.91%	11.15%

11	6.86%	5.15%	7.52%	12.86%	4.88%
12	3.69%	4.73%	6.83%	3.11%	0.41%

2.4.3 MRFSS

Table 28. Average gag MRFSS landings 1999-2005 (lbs gutted weight) by state and month.

Wave	Total	FL	GA	SC	NC
1	91,814	91,814	0	0	0
2	82,614	76,366	754	2,576	2,918
3	86,916	63,534	1,860	9,194	12,329
4	86,749	66,548	659	3,178	16,364
5	68,125	35,690	2,519	5,495	24,420
6	86,700	60,631	208	6,173	19,688

Table 29. Average gag MRFSS landings 1999-2005 (percent lbs gutted weight) by state and month.

Wave	Total	FL	GA	SC	NC
1	18.26%	23.27%	0.00%	0.00%	0.00%
2	16.43%	19.35%	12.56%	9.68%	3.85%
3	17.28%	16.10%	31.00%	34.54%	16.28%
4	17.25%	16.87%	10.99%	11.94%	21.61%
5	13.55%	9.05%	41.99%	20.65%	32.25%
6	17.24%	15.37%	3.46%	23.19%	26.00%

Table 30. Average gag MRFSS landings 2001-2006 (lbs gutted weight) by state and month.

Wave	Total	FL	GA	SC	NC
1	80,063	79,656	0	0	406
2	70,416	65,070	188	2,379	2,779
3	104,703	56,314	4,928	8,743	34,718
4	68,075	45,555	1,102	1,888	19,531
5	63,329	27,915	3,057	807	31,551
6	89,922	60,118	218	6,031	23,556

Table 31. Average gag MRFSS landings 2001-2006 (percent lbs gutted weight) by state and month.

Wave	Total	FL	GA	SC	NC
1	16.80%	23.80%	0.00%	0.00%	0.36%
2	14.78%	19.45%	1.98%	11.99%	2.47%
3	21.97%	16.83%	51.92%	44.05%	30.85%
4	14.29%	13.61%	11.61%	9.51%	17.35%
5	13.29%	8.34%	32.20%	4.06%	28.03%
6	18.87%	17.97%	2.29%	30.39%	20.93%

Table 32. Average gag MRFSS landings 1999-2005 (A+B1 Number) by state and month.

Wave	Total	FL	GA	SC	NC
1	5,865	5,865	0	0	0
2	4,792	4,356	73	202	161

Wave	Total	FL	GA	SC	NC
3	5,425	3,349	141	654	1,281
4	5,350	3,341	157	250	1,602
5	5,615	2,977	85	585	1,968
6	6,993	4,918	5	577	1,494

Table 33. Average gag MRFSS landings 1999-2005 (A+B1 Number, percent) by state and month.

Wave	Total	FL	GA	SC	NC
1	17.23%	23.64%	0.00%	0.00%	0.00%
2	14.08%	17.56%	15.86%	8.91%	2.47%
3	15.94%	13.50%	30.57%	28.82%	19.70%
4	15.72%	13.47%	34.18%	11.03%	24.62%
5	16.50%	12.00%	18.38%	25.80%	30.25%
6	20.54%	19.83%	1.01%	25.44%	22.96%

Table 34. Average gag MRFSS landings 2001-2006 (A+B1 Number) by state and month.

Wave	Total	FL	GA	SC	NC
1	5,170	5,134	0	0	37
2	4,480	4,103	9	194	174
3	6,853	2,955	398	637	2,863
4	3,702	1,602	80	132	1,888
5	5,078	2,342	267	86	2,382
6	6,827	4,624	14	459	1,730

Table 35. Average gag MRFSS landings 2001-2006 (A+B1 Number, percent) by state and month.

Wave	Total	FL	GA	SC	NC
1	16.10%	24.73%	0.00%	0.00%	0.40%
2	13.95%	19.76%	1.21%	12.88%	1.91%
3	21.34%	14.24%	51.78%	42.23%	31.55%
4	11.53%	7.71%	10.38%	8.76%	20.81%
5	15.81%	11.28%	34.79%	5.73%	26.26%
6	21.26%	22.28%	1.84%	30.41%	19.06%

Table 36. Average gag MRFSS landings 1999-2005 (B2 Number) by state and month.

Wave	Total	FL	GA	SC	NC
1	21,858	21,858	0	0	0
2	12,338	11,338	34	142	825
3	8,948	7,802	115	550	481
4	11,643	10,322	53	121	1,147
5	18,120	14,960	239	1,498	1,424
6	25,177	22,959	161	1,445	612

Table 37. Average gag MRFSS landings 1999-2005 (B2 Number, percent) by state and month.

Wave	Total	FL	GA	SC	NC
1	22.28%	24.49%	0.00%	0.00%	0.00%
2	12.58%	12.71%	5.59%	3.79%	18.37%

3	9.12%	8.74%	19.08%	14.64%	10.73%
4	11.87%	11.57%	8.76%	3.22%	25.55%
5	18.47%	16.76%	39.73%	39.89%	31.71%
6	25.67%	25.73%	26.84%	38.46%	13.64%

Table 38. Average gag MRFSS landings 2001-2006 (B2 Number) by state and month.

Wave	Total	FL	GA	SC	NC
1	15,750	15,712	0	0	38
2	12,067	11,006	0	128	933
3	9,732	8,109	325	603	695
4	12,029	11,151	58	44	775
5	18,958	14,688	273	1,155	2,842
6	29,673	27,349	175	1,477	672

Table 39. Average gag MRFSS landings 2001-2006 (B2 Number, percent) by state and month.

Wave	Total	FL	GA	SC	NC
1	16.04%	17.85%	0.00%	0.00%	0.64%
2	12.29%	12.50%	0.00%	3.76%	15.67%
3	9.91%	9.21%	39.11%	17.70%	11.67%
4	12.25%	12.67%	6.98%	1.29%	13.01%
5	19.30%	16.69%	32.85%	33.90%	47.72%
6	30.21%	31.07%	21.06%	43.35%	11.28%

2.5 Gag Commercial Percentage

Table 40. Gag % Commercial. Source ALS.

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1986	82.19%	66.32%	64.20%	63.60%	63.41%	64.42%	63.44%	62.53%	62.35%	63.41%	64.35%	64.71%	65.54%	64.60%	63.99%	62.78%	62.58%	61.67%	61.10%	60.61%	60.24%
1987		56.21%	57.26%	59.15%	59.98%	61.73%	61.11%	60.47%	60.58%	61.93%	63.08%	63.56%	64.53%	63.62%	63.02%	61.82%	61.66%	60.76%	60.22%	59.76%	59.41%
1988			58.87%	60.91%	61.49%	63.45%	62.30%	61.31%	61.29%	62.74%	63.94%	64.40%	65.41%	64.33%	63.64%	62.29%	62.09%	61.10%	60.50%	60.00%	59.61%
1989				62.23%	62.42%	64.62%	62.94%	61.67%	61.58%	63.13%	64.40%	64.85%	65.89%	64.70%	63.94%	62.49%	62.27%	61.21%	60.58%	60.05%	59.64%
1990					62.65%	66.20%	63.23%	61.50%	61.43%	63.29%	64.74%	65.23%	66.37%	64.98%	64.12%	62.51%	62.27%	61.13%	60.45%	59.88%	59.46%
1991						70.31%	63.53%	61.13%	61.15%	63.41%	65.06%	65.57%	66.81%	65.23%	64.27%	62.50%	62.24%	61.01%	60.29%	59.70%	59.26%
1992							58.23%	57.68%	58.95%	62.15%	64.27%	64.96%	66.41%	64.72%	63.72%	61.86%	61.63%	60.37%	59.65%	59.07%	58.64%
1993								57.18%	59.28%	63.34%	65.70%	66.30%	67.81%	65.67%	64.44%	62.29%	62.00%	60.57%	59.78%	59.14%	58.67%
1994									61.21%	66.35%	68.63%	68.80%	70.22%	67.26%	65.64%	63.02%	62.63%	60.97%	60.06%	59.33%	58.80%
1995										72.17%	73.04%	72.04%	73.16%	68.81%	66.61%	63.36%	62.87%	60.94%	59.90%	59.10%	58.54%
1996											74.01%	71.96%	73.56%	67.83%	65.27%	61.63%	61.26%	59.27%	58.28%	57.56%	57.06%
1997												69.52%	73.30%	65.62%	62.85%	58.97%	58.91%	56.98%	56.16%	55.59%	55.23%
1998													76.83%	63.96%	60.84%	56.64%	56.98%	55.11%	54.46%	54.04%	53.81%
1999														53.08%	53.21%	50.42%	52.16%	50.99%	50.91%	50.97%	51.07%
2000															53.37%	48.90%	51.79%	50.38%	50.42%	50.56%	50.74%
2001																45.35%	51.07%	49.52%	49.78%	50.08%	50.36%
2002																	58.60%	51.90%	51.43%	51.39%	51.47%
2003																		46.78%	48.59%	49.47%	50.02%
2004																			50.55%	50.91%	51.20%
2005																				51.27%	51.54%
2006																					51.83%

2.6 Gag Recreational Percentage

Table 42. Gag % Recreational. Source MRFSS Web site, NMFS Headboat survey.

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1986	17.81%	33.68%	35.80%	36.40%	36.59%	35.58%	36.56%	37.47%	37.65%	36.59%	35.65%	35.29%	34.46%	35.40%	36.01%	37.22%	37.42%	38.33%	38.90%	39.39%	39.76%
1987		43.79%	42.74%	40.85%	40.02%	38.27%	38.89%	39.53%	39.42%	38.07%	36.92%	36.44%	35.47%	36.38%	36.98%	38.18%	38.34%	39.24%	39.78%	40.24%	40.59%
1988			41.13%	39.09%	38.51%	36.55%	37.70%	38.69%	38.71%	37.26%	36.06%	35.60%	34.59%	35.67%	36.36%	37.71%	37.91%	38.90%	39.50%	40.00%	40.39%
1989				37.77%	37.58%	35.38%	37.06%	38.33%	38.42%	36.87%	35.60%	35.15%	34.11%	35.30%	36.06%	37.51%	37.73%	38.79%	39.42%	39.95%	40.36%
1990					37.35%	33.80%	36.77%	38.50%	38.57%	36.71%	35.26%	34.77%	33.63%	35.02%	35.88%	37.49%	37.73%	38.87%	39.55%	40.12%	40.54%
1991						29.69%	36.47%	38.87%	38.85%	36.59%	34.94%	34.43%	33.19%	34.77%	35.73%	37.50%	37.76%	38.99%	39.71%	40.30%	40.74%
1992							41.77%	42.32%	41.05%	37.85%	35.73%	35.04%	33.59%	35.28%	36.28%	38.14%	38.37%	39.63%	40.35%	40.93%	41.36%
1993								42.82%	40.72%	36.66%	34.30%	33.70%	32.19%	34.33%	35.56%	37.71%	38.00%	39.43%	40.22%	40.86%	41.33%
1994									38.79%	33.65%	31.37%	31.20%	29.78%	32.74%	34.36%	36.98%	37.37%	39.03%	39.94%	40.67%	41.20%
1995										27.83%	26.96%	27.96%	26.84%	31.19%	33.39%	36.64%	37.13%	39.06%	40.10%	40.90%	41.46%
1996											25.99%	28.04%	26.44%	32.17%	34.73%	38.37%	38.74%	40.73%	41.72%	42.44%	42.94%
1997												30.48%	26.70%	34.38%	37.15%	41.03%	41.09%	43.02%	43.84%	44.41%	44.77%
1998													23.17%	36.04%	39.16%	43.36%	43.02%	44.89%	45.54%	45.96%	46.19%
1999														46.92%	46.79%	49.58%	47.84%	49.01%	49.09%	49.03%	48.93%
2000															46.63%	51.10%	48.21%	49.62%	49.58%	49.44%	49.26%
2001																54.65%	48.93%	50.48%	50.22%	49.92%	49.64%
2002																	41.40%	48.10%	48.57%	48.61%	48.53%
2003																		53.22%	51.41%	50.53%	49.98%
2004																			49.45%	49.09%	48.80%
2005																				48.73%	48.46%
2006																					48.17%

2.7 Allocations

2.7.1 Recreational allocation and commercial quota

Allocations – the Council has chosen 1999-2003 allocation alternative as preferred for gag.

Years 1999-2003 = 51% commercial & 49% recreational
Years 1986-1998 = 66% commercial & 34% recreational
Years 1986-2005 = 61% commercial & 39% recreational

Applying these percentages to the annual catch limit in each year results in commercial and recreational proportions (pounds gutted weight) provided in Table 26.

Table 43. Commercial and recreation proportions of catch (pounds gutted weight) based on three allocation alternatives.

		Alternative 2 (51% comm/49% rec)		Alternative 3 (66% comm/34% rec)		Alternative 4 (61% comm/39% rec)	
Year	TAC	Comm	Rec	Comm	Rec	Comm	Rec
2009	694,000	353,940	340,060	458,040	235,960	423,340	270,660

Table 44. Landings data for 2001-2006. 2001-2004 landings data (gutted weight) are from SEDAR 10 (2007). 2005 and 2006 data are from ALS.

Gag Landings (gutted weight)				Total	Total
Year	Commercial	Headboat	MRFSS	Recreational	Landings
2001	532,000	53,000	455,000	508,000	1,040,000
2002	534,000	51,000	266,000	317,000	851,000
2003	560,000	32,000	519,000	551,000	1,111,000
2004	551,000	82,000	517,000	599,000	1,150,000
2005	568,681	71,736	468,814	540,550	1,109,231
2006	520,824	46,537	437,493	484,031	1,004,854
Avg 04-06	546,835	66,758	474,436	541,194	1,008,028

Allocation Alternative 2 results in a 35% commercial reduction and 37% recreational from the average of 2004-2006 landings. Allocation Alternative 3 results in a 16% commercial reduction and 56% recreational reduction from the average of 2004-2006 landings. Allocation Alternative 4 results in a 22% commercial reduction and 50% recreational reduction from the average of 2004-2006 landings. These would be initial reductions for 2009. As the allowable catch would increase after 2009, the amount of reduction in harvest compared to 2004-2006 landings would gradually decrease.

Alternative	Commercial Reduction	Recreational Reduction
2 (Preferred)	35%	37%
3	16%	56%
4	23%	50%

2.7.2 Regional Quotas

Table 45. Regional quotas by region for two allocation alternatives.

		Allocation Alternative 1. 51%C/49%R			Allocation Alternative 3. 66%C/34%R			Allocation Alternative 4. 61%C/39%R		
	Annual	Commercial	FL-GA	SC-NC	Commercial	FL-GA	SC-NC	Commercial	FL-GA	SC-NC
		Quota	36.70%	63.30%	Quota	36.70%	63.30%	Quota	36.70%	63.30%
Year	Catch Limit	(gutted weight)	(gutted weight)	(gutted weight)	(gutted weight)	(gutted weight)	(gutted weight)	(gutted weight)	(gutted weight)	(gutted weight)
2009	694,000	353,940	129,896	224,044	458,040	168,101	289,939	423,340	155,366	267,974

3 Monthly catch and reduction provided by seasonal closure

3.1 Commercial

Table 46. Monthly catch (pounds gutted weight) of gag during 1999-2005 (average), 1995, 2006, and 2001-2006. Data are from ALS.

Month	1999-2005	1995	2006	2001-2006
1	57,110	132,081	57,701	58,389
2	56,700	64,236	46,886	52,953
3	2,110	71,979	1,856	1,274
4	1,927	61,990	521	2,106
5	83,065	88,520	70,941	79,875
6	57,890	89,433	57,162	60,435
7	50,887	70,194	46,314	51,177
8	40,978	50,494	47,158	44,313
9	33,918	64,724	42,122	34,226
10	57,003	85,135	51,295	51,963
11	60,498	72,487	45,175	55,521
12	49,595	62,775	53,692	48,185
Total	551,682	914,047	520,824	540,418

3.2 Effectiveness of Commercial Closure

Seven steps were taken to determine the effectiveness of a commercial spawning season closure. Logbook data from 2001-2005 were used for analyses. The data set used also includes value for species and was provided by Dr. Jim Waters. Dr. Waters also provided a SAS program that calculates trip costs, which are adjusted based on changes in fuel prices, days per trip, crew size, total trip landings, and other variables. The SAS program was modified to include the effect of seasonal closures on gag. An opportunity cost of $50.00 per day was used. It was adjusted to account for inflation. Net revenue (total revenue – trip cost) for a trip was calculated. If the net revenue per trip was less than the opportunity cost of labor, then the trip was removed from the data set.

Logbook data were examined to identify the species most commonly caught on trips with gag by restricting trips to those that caught at least 1 lb of gag. Incidental catch during a seasonal closure was determined by identifying trips that targeted (caught at least 100 lbs) of co-occurring species; and calculating the catch of gag on those trips. Trips targeting gag during the proposed seasonal closures were removed from analyses. A trip would be considered to be targeting gag if greater than 75% of the landings on a trip included the species. In addition, trips, which employed diving gear, were not considered in analyses since fishermen can recognize a species before it is captured.

There is a possibility some trips would not be taken during a seasonal closure. Therefore, trips targeting co-occurring species during a closure were randomly selected to determine the effect of a 0 to 60% reduction in the number of trips on incidental catch of gag. These values were further adjusted by 0 to 60% to account for fishermen's ability to avoid gag by changing hook size, location, and fishing methods. Dead discards were determined by applying a 40% release mortality rate for gag. Effectiveness of closure was determined by comparing the magnitude of dead discards to actual landings.

STEP 1 - Determine landings of gag during 2001-2005

Table 47. Landings of gag during 2001-2005.

Month	Tot WW	Tot GW	Avg GW
1	309,020	261,881	52,376
2	265,912	225,349	45,070
3	4,883	4,138	828
4	11,809	10,008	2,002
5	430,727	365,023	73,005
6	315,686	267,530	53,506
7	262,087	222,108	44,422
8	211,835	179,521	35,904
9	157,179	133,202	26,640
10	254,353	215,553	43,111
11	263,565	223,360	44,672
12	229,434	194,436	38,887
		sum	460,422

STEP 2 - Drop trips if net revenue is less than opportunity cost.

Step in SAS program removed 1,830 of 18,544 trips because the net revenue was less than the opportunity cost.

Table 48. Landings of gag during 2001-2005 when trips removed because the net revenue per trip is less than opportunity cost of labor.

Month	Tot WW	Tot GW	Avg GW
1	302,820	256,627	51,325
2	260,160	220,475	44,095
3	4,700	3,983	797
4	11,610	9,839	1,968
5	423,860	359,203	71,841
6	310,400	263,051	52,610
7	255,990	216,941	43,388
8	207,960	176,237	35,247
9	154,260	130,729	26,146
10	251,730	213,331	42,666
11	260,440	220,712	44,142
12	225,720	191,288	38,258
		sum	452,483

STEP 3 - Identify most common species taken with gag

Table 49. Species most commonly taken on trips with gag.

COMMON	Mean	Sum	%	Cum
GROUPER,GAG	244	1,166,199	21.67%	21.67%
SNAPPER,VERMILION	481	1,091,995	20.29%	41.96%
SCAMP	182	420,633	7.82%	49.78%
AMBERJACK,GREATER	262	417,058	7.75%	57.53%
GROUPER,RED	175	397,988	7.40%	64.93%
TRIGGERFISH,GRAY	125	228,653	4.25%	69.18%
JACK,ALMACO	181	197,845	3.68%	72.85%
SNAPPER,RED	96	188,736	3.51%	76.36%

STEP 4 – Identify trips that target co-occurring species.
Identify trips that caught at least 100 lbs (directed catch) of co-occurring species during a seasonal closure.

STEP 5 - Determine incidental catch.
This step determines the incidental catch gag during a seasonal closure. Trips that use diving gear or target gag (where > 75% of the catch is gag) are dropped. This step does not take into consideration trips that will not be taken during a closure or ability of fishermen to avoid gag.

Table 50. Incidental catch of gag during a seasonal closure. Dead discards determined by applying 40% release mortality rate. Not adjusted for behavior.

Month	2001	2002	2003	2004	2005
1	30,136	27,703	13,610	27,669	32,203
2	26,780	23,712	15,898	26,890	28,797
3	93	34	653	195	178

4	3,093	508	1,331	1,305	314
Incidental catch	60,102	51,958	31,492	56,059	61,492
Dead Discards	24,041	20,783	12,597	22,424	24,597

STEP 6 – Determine incidental catch for reduced trips after quota.

Trips that target co-occurring species in STEP 3c were randomly selected to reduce the number of trips from 20% to 60%. This assumes fishermen may stop fishing for gag during a seasonal closure. Effectiveness of closure compares

Table 51. Incidental catch of during a seasonal closure (Average 2001-2005). Dead discards determined by applying 40% release mortality rate. Assumes some trips will not be made during a seasonal closure.

Trip reduction	0%	20%	40%	60%
Incidental catch	52,220	14,578	11,815	8,710
Dead Discards	20,888	5,831	4,726	3,484
Effectiveness	79.17%	94.18%	95.29%	96.53%

STEP 7 – Determine dead discards for reduced trips and behavior after quota.
This step assumes that some trips could be reduced and fishermen could have the ability to avoid gag by fishing differently.

Table 52. Incidental catch of gag assuming a range in trips (0 to 60%) during a seasonal closure and fishermen can avoid gag (range 0 to 60%) by changing fishing methods.

Trip reduction after quota	0%				20%				40%				60%			
Percent of discards avoided	0%	20%	40%	60%	0%	20%	40%	60%	0%	20%	40%	60%	0%	20%	40%	60%
Discards	52,220	41,776	25,066	10,026	14,578	11,662	6,997	2,799	11,815	9,452	5,671	2,269	8,710	6,968	4,181	1,672
Dead Discards	20,888	16,711	10,026	4,011	5,831	4,665	2,799	1,120	4,726	3,781	2,269	907	3,484	2,787	1,672	669
Effectiveness	79.17%	83.34%	90.00%	96.00%	94.18%	95.35%	97.21%	98.88%	95.29%	96.23%	97.74%	99.10%	96.53%	97.22%	98.33%	99.33%

Examination of the NMFS Logbook database (8/3/07) revealed the species most commonly taken on commercial trips with gag during 2003-2005 were vermilion snapper, scamp, greater amberjack, red grouper, and red snapper. If fishermen were to target these species during a closure and release mortality of gag is 40% (SEDAR 10 2007), it is anticipated a closure would be 79% effective (Table 30). However, if fishermen choose not to take trips or can avoid gag by using different fishing methods, the effectiveness of a closure could be greater. For the purposes here, it is assumed 20% of the trips would be reduced during a closure but 20% of the catch of gag can be avoided by changing fishing methodology or location of fishing. This scenario would result in a 95% effectiveness of a closure. The Snapper Grouper Advisory Panel is reviewing the methodology.

Examination of the discard logbook database revealed that the average number of discarded gag was less during March and April than during all other months except December through February. The data suggest fishermen can avoid gag to some degree during a closure but also indicates gag are still caught and discarded when targeting other species. The data also indicate that magnitude of gag discarded by commercial fishermen is small.

Table 53. Expanded number of discarded gag during 2002-2005. From NMFS discarded logbook.

month	2002	2003	2004	2005	Mean
1	171	140	153	10	118
2	191	100	111	5	102
3	361	222	89	0	168
4	491	186	0	0	169
5	93	412	272	128	226
6	97	297	234	685	328
7	32	97	170	271	143
8	300	129	289	67	196
9	739	254	868	43	476
10	1,989	261	902	48	800
11	658	193	489	461	450
12	292	18	140	43	123

The following two tables provide reduction from a seasonal closure considering 100% and 95% effectiveness of closure.

Table 54. Monthly reduction in take based on 1999-2005 data if a seasonal closure is 100% effective.

Month	1	2	3	4	5	6	7	8	9	10	11	12
1	10.4%	20.6%	21.0%	21.4%	36.4%	46.9%	56.1%	63.6%	69.7%	80.0%	91.0%	100.0%
2		10.3%	10.7%	11.0%	26.1%	36.6%	45.8%	53.2%	59.4%	69.7%	80.7%	89.6%
3			0.4%	0.7%	15.8%	26.3%	35.5%	42.9%	49.1%	59.4%	70.4%	79.4%
4				0.3%	15.4%	25.9%	35.1%	42.6%	48.7%	59.0%	70.0%	79.0%
5					15.1%	25.6%	34.8%	42.2%	48.4%	58.7%	69.6%	78.6%
6						10.5%	19.7%	27.1%	33.3%	43.6%	54.6%	63.6%
7							9.2%	16.7%	22.8%	33.1%	44.1%	53.1%
8								7.4%	13.6%	23.9%	34.9%	43.9%
9									6.1%	16.5%	27.4%	36.4%
10										10.3%	21.3%	30.3%

11											11.0%	20.0%
12												9.0%

Table 55. Monthly reduction in take based on 1999-2005 data if a seasonal closure is 95% effective.

Month	1	2	3	4	5	6	7	8	9	10	11	12
1	9.8%	19.6%	20.0%	20.3%	34.6%	44.6%	53.3%	60.4%	66.2%	76.0%	86.5%	95.0%
2		9.8%	10.1%	10.5%	24.8%	34.7%	43.5%	50.6%	56.4%	66.2%	76.6%	85.2%
3			0.4%	0.7%	15.0%	25.0%	33.7%	40.8%	46.6%	56.4%	66.9%	75.4%
4				0.3%	14.6%	24.6%	33.4%	40.4%	46.3%	56.1%	66.5%	75.0%
5					14.3%	24.3%	33.0%	40.1%	45.9%	55.7%	66.2%	74.7%
6						10.0%	18.7%	25.8%	31.6%	41.4%	51.9%	60.4%
7							8.8%	15.8%	21.7%	31.5%	41.9%	50.4%
8								7.1%	12.9%	22.7%	33.1%	41.7%
9									5.8%	15.7%	26.1%	34.6%
10										9.8%	20.2%	28.8%
11											10.4%	19.0%
12												8.5%

3.3 Recreational

Table 56. Average landings (pounds gutted weight) of gag taken by headboat and MRFSS during 1999-2005.

Month	HB	MRFSS	Total
1	3,007	43,183	46,191
2	3,154	43,183	46,338
3	5,785	38,857	44,642
4	4,919	38,857	43,776
5	5,875	40,880	46,755
6	6,477	40,880	47,357
7	6,200	41,622	47,822
8	4,343	41,622	45,965
9	2,619	32,042	34,661
10	4,556	32,042	36,598
11	3,785	40,779	44,563
12	2,190	40,779	42,968

Table 57. Average landings (pounds gutted weight) of gag taken by headboat and MRFSS during 2001-2006.

Month	HB	MRFSS	Total
1	2,832	40,031	42,863
2	3,395	40,031	43,426
3	6,419	35,208	41,627
4	5,219	35,208	40,427
5	5,817	52,352	58,169

6	5,884	52,352	58,236
7	6,464	34,038	40,502
8	4,040	34,038	38,078
9	2,712	31,665	34,377
10	4,308	31,665	35,973
11	3,612	44,962	48,574
12	1,940	44,962	46,902

3.4 Effectiveness of Recreational Closure

To determine the effectiveness of a recreational seasonal closure seven steps were taken. First, MRFSS data were examined to determine the most commonly species taken on trips with gag during the proposed January through April closure. Second, trips were identified that caught at least 1 individual of the most common species taken identified in step 1. Third, landings of gag on trips identified in step 2 that targeted co-occurring species were determined. This would be considered to be incidental catch of gag. Fourth, incidental catch was compared to actual catch to determine percentage that would still be caught during a closed season. Fifth, the portion of the gag incidental catch that would die when no retention was allowed was determined by applying a release mortality rate of 25% (SEDAR 10 2007). Sixth, the magnitude of incidental catch was estimated if the number of trips was reduced and if fishermen were able to avoid gag. Seven, determine effectiveness of closure by comparing the magnitude of dead discards to actual landings if a closure did not occur.

Table 58. Most common species taken on MRFSS trips during January – April that also caught gag. Landings are totals in number (A + B1) for 1999-2005. Represents sample not total expanded landings.

common	Obs	Mean	Sum	Percent	Cum %
vermilion snapper	43	13	559	14.52%	14.52%
black sea bass	62	6.887097	427	11.09%	25.60%
red snapper	81	3.728395	302	7.84%	33.45%
gag	407	0.732187	298	7.74%	41.18%
gray snapper	91	2.417582	220	5.71%	46.90%
lane snapper	35	5.228571	183	4.75%	51.65%
greater amberjack	45	3.311111	149	3.87%	55.52%
king mackerel	29	3.310345	96	2.49%	58.01%
white grunt	17	5.588235	95	2.47%	60.48%

Table 59. Incidental catch of during a seasonal closure (Average 1999-2005). Dead discards determined by applying 25% release mortality rate. Assumes some trips will not be made during a seasonal closure.

Trip reduction	0%	20%	40%	60%
Incidental catch	221	177	140	131
Dead Discards	55	44	35	33
Effectiveness	81.46%	85.15%	88.26%	89.01%

Table 60. Incidental catch of gag assuming a range in trips (0 to 60%) during a seasonal closure and fishermen can avoid gag (range 0 to 60%) by changing fishing methods.

Trip reduction after quota	0%			20%				40%				60%			
Percent of discards avoided	20%	40%	60%	0%	20%	40%	60%	0%	20%	40%	60%	0%	20%	40%	60%
Discards	177	106	42	177	142	85	34	140	112	67	27	131	105	63	25
Dead Discards	44	27	11	44	35	21	8	35	28	17	7	33	26	16	6
Effectiveness	85.17%	91.10%	96.44%	85.15%	88.12%	92.87%	97.15%	88.26%	90.60%	94.36%	97.74%	89.01%	91.21%	94.72%	97.89%

Examination of the MRFSS database indicated the species most commonly taken on recreational trips (MRFSS) during January – April with gag during 2001-2005 were vermilion snapper, black sea bass, red snapper, gray snapper, lane snapper, and gray triggerfish. If fishermen were to target these species during a closure and release mortality of gag is 25% (SEDAR 10 2007), it is anticipated that a closure would be 82% effective if effort remained the same and fishermen were unable to avoid gag. If 20% of the trips are not taken and fishermen can avoid 20% of gag by changing fishing methods and locations then the effectiveness would be 88%.

Table 61. Most common species taken on Headboat trips during January – April that also caught gag. Landings are for 1999-2005. Represents sample not total expanded landings.

species	specname	N	Mean	Sum	%	Cum %
10	Vermilion Snapper	3287	97.43809	320279	23.64%	23.64%
33	Black Sea Bass	4822	54.91373	264794	19.54%	43.18%
50	White Grunt	3505	53.34979	186991	13.80%	56.98%
15	Yellowtail Snapper	4011	32.00723	128381	9.47%	66.46%
51	Tomtate	1462	45.94391	67170	4.96%	71.41%
16	Lane Snapper	3937	11.31902	44563	3.29%	74.70%
77	Gray Triggerfish	3802	9.424513	35832	2.64%	77.35%

Table 62. Incidental catch of during a seasonal closure (Average 1999-2005). Dead discards determined by applying 25% release mortality rate. Assumes some trips will not be made during a seasonal closure.

Trip reduction	0%	20%	40%	60%
Incidental catch	7,220	3,980	3,200	2,341
Dead Discards	1,805	995	800	585
Effectiveness	75.51%	86.50%	89.14%	92.06%

Table 63. Incidental catch of gag on headboat trips assuming a range in trips (0 to 60%) during a seasonal closure and fishermen can avoid gag (range 0 to 60%) by changing fishing methods.

Trip reduction after quota	0%				20%				40%				60%			
Percent of discards avoided	0%	20%	40%	60%	0%	20%	40%	60%	0%	20%	40%	60%	0%	20%	40%	60%
Discards	7,220	5,776	3,466	1,386	3,980	3,184	1,910	764	3,200	2,560	1,536	614	2,341	1,873	1,124	449
Dead Discards	1,805	1,444	866	347	995	796	478	191	800	640	384	154	585	468	281	112
Effectiveness	75.51%	80.40%	88.24%	95.30%	86.50%	89.20%	93.52%	97.41%	89.14%	91.31%	94.79%	97.92%	92.06%	93.65%	96.19%	98.48%

Examination of the Headboat database indicated the species most commonly taken on recreational trips during January – April with gag during 2001-2005 were vermilion snapper, black sea bass, white grunt, and yellowtail snapper. If fishermen were to target these species during a closure and release mortality of gag is 25% (SEDAR 10 2007), it is anticipated that a closure would be 76% effective if effort remained the same and fishermen were unable to avoid gag. If 20% of the trips are not taken and fishermen can avoid 20% of gag by changing fishing methods and locations then the effectiveness would be 89%.

3.4.1 Headboat

Table 64. Average landings (pounds gutted weight) of gag taken by headboat during 1999-2005.

Month	Lbs gw	Percent
1	3,007	5.7%
2	3,154	6.0%
3	5,785	10.9%
4	4,919	9.3%
5	5,875	11.1%
6	6,477	12.2%
7	6,200	11.7%
8	4,343	8.2%
9	2,619	4.9%
10	4,556	8.6%
11	3,785	7.2%
12	2,190	4.1%

Table 65. Monthly reduction in Headboat take based on 1999-2005 data if a seasonal closure is 100% effective.

Month	1	2	3	4	5	6	7	8	9	10	11	12
1	5.7%	11.6%	22.6%	31.9%	43.0%	55.2%	66.9%	75.1%	80.1%	88.7%	95.9%	100.0%
2		6.0%	16.9%	26.2%	37.3%	49.5%	61.3%	69.5%	74.4%	83.0%	90.2%	94.3%
3			10.9%	20.2%	31.3%	43.6%	55.3%	63.5%	68.5%	77.1%	84.2%	88.4%
4				9.3%	20.4%	32.6%	44.4%	52.6%	57.5%	66.1%	73.3%	77.4%
5					11.1%	23.3%	35.1%	43.3%	48.2%	56.8%	64.0%	68.1%
6						12.2%	24.0%	32.2%	37.1%	45.7%	52.9%	57.0%
7							11.7%	19.9%	24.9%	33.5%	40.6%	44.8%
8								8.2%	13.2%	21.8%	28.9%	33.1%
9									4.9%	13.6%	20.7%	24.9%
10										8.6%	15.8%	19.9%
11											7.2%	11.3%
12												4.1%

Table 66. Monthly reduction in Headboat take based on 1999-2005 data if a seasonal closure is 89% effective.

Month	1	2	3	4	5	6	7	8	9	10	11	12
1	5.1%	10.4%	20.1%	28.4%	38.3%	49.1%	59.6%	66.9%	71.3%	79.0%	85.3%	89.0%
2		5.3%	15.0%	23.3%	33.2%	44.1%	54.5%	61.8%	66.2%	73.9%	80.3%	83.9%
3			9.7%	18.0%	27.9%	38.8%	49.2%	56.5%	60.9%	68.6%	75.0%	78.6%
4				8.3%	18.2%	29.1%	39.5%	46.8%	51.2%	58.9%	65.2%	68.9%
5					9.9%	20.8%	31.2%	38.5%	42.9%	50.6%	56.9%	60.6%
6						10.9%	21.3%	28.6%	33.0%	40.7%	47.1%	50.7%
7							10.4%	17.7%	22.1%	29.8%	36.2%	39.9%
8								7.3%	11.7%	19.4%	25.7%	29.4%
9									4.4%	12.1%	18.4%	22.1%
10										7.7%	14.0%	17.7%
11											6.4%	10.0%
12												3.7%

3.4.2 MRFSS Private

Table 67. Average landings (pounds gutted weight) of gag taken by private MRFSS during 1999-2005.

Month	Lbs gw	Percent
1	33,916	9.5%
2	33,916	9.5%
3	27,248	7.7%
4	27,248	7.7%
5	24,620	6.9%
6	24,620	6.9%
7	33,682	9.5%
8	33,682	9.5%
9	25,199	7.1%
10	25,199	7.1%
11	33,205	9.3%
12	33,205	9.3%

Table 68. Monthly reduction in private MRFSS take based on 1999-2005 data if a seasonal closure is 100% effective.

Month	1	2	3	4	5	6	7	8	9	10	11	12
1	9.5%	19.1%	26.7%	34.4%	41.3%	48.2%	57.7%	67.2%	74.2%	81.3%	90.7%	100.0%
2		9.5%	17.2%	24.9%	31.8%	38.7%	48.2%	57.6%	64.7%	71.8%	81.1%	90.5%
3			7.7%	15.3%	22.2%	29.2%	38.6%	48.1%	55.2%	62.3%	71.6%	80.9%
4				7.7%	14.6%	21.5%	31.0%	40.4%	47.5%	54.6%	63.9%	73.3%
5					6.9%	13.8%	23.3%	32.8%	39.9%	46.9%	56.3%	65.6%
6						6.9%	16.4%	25.9%	32.9%	40.0%	49.4%	58.7%
7							9.5%	18.9%	26.0%	33.1%	42.4%	51.8%
8								9.5%	16.6%	23.6%	33.0%	42.3%
9									7.1%	14.2%	23.5%	32.8%
10										7.1%	16.4%	25.8%
11											9.3%	18.7%
12												9.3%

Table 69. Monthly reduction in private MRFSS take based on 1999-2005 data if a seasonal closure is 89% effective.

Month	1	2	3	4	5	6	7	8	9	10	11	12
1	8.5%	17.0%	23.8%	30.6%	36.8%	42.9%	51.4%	59.8%	66.1%	72.4%	80.7%	89.0%
2		8.5%	15.3%	22.1%	28.3%	34.4%	42.9%	51.3%	57.6%	63.9%	72.2%	80.5%
3			6.8%	13.6%	19.8%	26.0%	34.4%	42.8%	49.1%	55.4%	63.7%	72.0%
4				6.8%	13.0%	19.1%	27.6%	36.0%	42.3%	48.6%	56.9%	65.2%
5					6.2%	12.3%	20.7%	29.2%	35.5%	41.8%	50.1%	58.4%
6						6.2%	14.6%	23.0%	29.3%	35.6%	43.9%	52.2%
7							8.4%	16.9%	23.2%	29.5%	37.8%	46.1%
8								8.4%	14.7%	21.0%	29.3%	37.6%
9									6.3%	12.6%	20.9%	29.2%
10										6.3%	14.6%	22.9%
11											8.3%	16.6%
12												8.3%

3.4.3 MRFSS Charter

Table 70. Average landings (pounds gutted weight) of gag taken by charter MRFSS during 1999-2005.

Month	Lbs gw	Percent
1	9,267	8.3%
2	9,267	8.3%
3	11,059	9.9%
4	11,059	9.9%
5	14,697	13.1%
6	14,697	13.1%
7	7,926	7.1%
8	7,926	7.1%
9	6,712	6.0%
10	6,712	6.0%
11	6,329	5.7%
12	6,329	5.7%

Table 71. Monthly reduction in charter MRFSS take based on 1999-2005 data if a seasonal closure is 100% effective.

Month	1	2	3	4	5	6	7	8	9	10	11	12
1	8.3%	16.6%	26.4%	36.3%	49.4%	62.6%	69.6%	76.7%	82.7%	88.7%	94.3%	100.0%
2		8.3%	18.2%	28.0%	41.2%	54.3%	61.4%	68.4%	74.4%	80.4%	86.1%	91.7%
3			9.9%	19.8%	32.9%	46.0%	53.1%	60.2%	66.2%	72.1%	77.8%	83.4%
4				9.9%	23.0%	36.1%	43.2%	50.3%	56.3%	62.3%	67.9%	73.6%
5					13.1%	26.2%	33.3%	40.4%	46.4%	52.4%	58.0%	63.7%
6						13.1%	20.2%	27.3%	33.3%	39.3%	44.9%	50.6%
7							7.1%	14.2%	20.2%	26.1%	31.8%	37.4%
8								7.1%	13.1%	19.1%	24.7%	30.4%
9									6.0%	12.0%	17.6%	23.3%
10										6.0%	11.6%	17.3%
11											5.7%	11.3%
12												5.7%

Table 72. Monthly reduction in charter MRFSS take based on 1999-2005 data if a seasonal closure is 89% effective.

Month	1	2	3	4	5	6	7	8	9	10	11	12
1	7.4%	14.7%	23.5%	32.3%	44.0%	55.7%	62.0%	68.3%	73.6%	78.9%	84.0%	89.0%
2		7.4%	16.2%	24.9%	36.6%	48.3%	54.6%	60.9%	66.2%	71.6%	76.6%	81.6%
3			8.8%	17.6%	29.3%	40.9%	47.2%	53.5%	58.9%	64.2%	69.2%	74.3%
4				8.8%	20.5%	32.2%	38.5%	44.8%	50.1%	55.4%	60.4%	65.5%
5					11.7%	23.4%	29.7%	36.0%	41.3%	46.6%	51.7%	56.7%
6						11.7%	18.0%	24.3%	29.6%	34.9%	40.0%	45.0%
7							6.3%	12.6%	17.9%	23.3%	28.3%	33.3%
8								6.3%	11.6%	17.0%	22.0%	27.0%
9									5.3%	10.7%	15.7%	20.7%
10										5.3%	10.4%	15.4%
11											5.0%	10.1%
12												5.0%

3.4.4 MRFSS All Modes

Table 73. Average landings (pounds gutted weight) of gag taken by MRFSS (all modes) during 1999-2005.

Month	Lbs gw	Percent
1	43,183	9.1%
2	43,183	9.1%
3	38,857	8.2%
4	38,857	8.2%
5	40,880	8.6%
6	40,880	8.6%
7	41,622	8.8%
8	41,622	8.8%
9	32,042	6.7%
10	32,042	6.7%
11	40,779	8.6%
12	40,779	8.6%

Table 74. Monthly reduction in MRFSS (all modes) take based on 1999-2005 data if a seasonal closure is 100% effective.

Month	1	2	3	4	5	6	7	8	9	10	11	12
1	9.1%	18.2%	26.4%	34.6%	43.2%	51.8%	60.6%	69.3%	76.1%	82.8%	91.4%	100.0%
2		9.1%	17.3%	25.5%	34.1%	42.7%	51.5%	60.2%	67.0%	73.7%	82.3%	90.9%
3			8.2%	16.4%	25.0%	33.6%	42.4%	51.1%	57.9%	64.6%	73.2%	81.8%
4				8.2%	16.8%	25.4%	34.2%	42.9%	49.7%	56.4%	65.0%	73.6%
5					8.6%	17.2%	26.0%	34.8%	41.5%	48.3%	56.8%	65.4%
6						8.6%	17.4%	26.1%	32.9%	39.6%	48.2%	56.8%
7							8.8%	17.5%	24.3%	31.0%	39.6%	48.2%
8								8.8%	15.5%	22.3%	30.9%	39.4%
9									6.7%	13.5%	22.1%	30.7%
10										6.7%	15.3%	23.9%
11											8.6%	17.2%
12												8.6%

Table 75. Monthly reduction in MRFSS (all modes) take based on 1999-2005 data if a seasonal closure is 89% effective.

Month	1	2	3	4	5	6	7	8	9	10	11	12
1	8.1%	16.2%	23.5%	30.8%	38.4%	46.1%	53.9%	61.7%	67.7%	73.7%	81.4%	89.0%
2		8.1%	15.4%	22.7%	30.3%	38.0%	45.8%	53.6%	59.6%	65.6%	73.3%	80.9%
3			7.3%	14.6%	22.2%	29.9%	37.7%	45.5%	51.5%	57.5%	65.2%	72.8%
4				7.3%	14.9%	22.6%	30.4%	38.2%	44.2%	50.2%	57.9%	65.5%
5					7.7%	15.3%	23.1%	30.9%	36.9%	42.9%	50.6%	58.2%
6						7.7%	15.5%	23.3%	29.3%	35.3%	42.9%	50.6%
7							7.8%	15.6%	21.6%	27.6%	35.3%	42.9%
8								7.8%	13.8%	19.8%	27.5%	35.1%
9									6.0%	12.0%	19.7%	27.3%
10										6.0%	13.7%	21.3%
11											7.6%	15.3%
12												7.6%

3.4.5 MRFSS/Headboat Combined

Table 76. Average landings (pounds gutted weight) of vermilion snapper taken by MRFSS/Headboat during 1999-2005.

Month	Lbs gw	Percent
1	46,191	8.8%
2	46,338	8.8%
3	44,642	8.5%
4	43,776	8.3%
5	46,755	8.9%
6	47,357	9.0%
7	47,822	9.1%
8	45,965	8.7%
9	34,661	6.6%
10	36,598	6.9%
11	44,563	8.4%
12	42,968	8.1%

Table 77. Monthly reduction in MRFSS/Headboat take based on 1999-2005 data if a seasonal closure is 100% effective.

Month	1	2	3	4	5	6	7	8	9	10	11	12
1	8.8%	17.5%	26.0%	34.3%	43.2%	52.1%	61.2%	69.9%	76.5%	83.4%	91.9%	100.0%
2		8.8%	17.2%	25.5%	34.4%	43.4%	52.4%	61.2%	67.7%	74.7%	83.1%	91.2%
3			8.5%	16.8%	25.6%	34.6%	43.7%	52.4%	58.9%	65.9%	74.3%	82.5%
4				8.3%	17.2%	26.1%	35.2%	43.9%	50.5%	57.4%	65.9%	74.0%
5					8.9%	17.8%	26.9%	35.6%	42.2%	49.1%	57.6%	65.7%
6						9.0%	18.0%	26.8%	33.3%	40.3%	48.7%	56.8%
7							9.1%	17.8%	24.3%	31.3%	39.7%	47.9%
8								8.7%	15.3%	22.2%	30.7%	38.8%
9									6.6%	13.5%	22.0%	30.1%
10										6.9%	15.4%	23.5%
11											8.4%	16.6%
12												8.1%

Table 78. Monthly reduction in MRFSS/Headboat take based on 1999-2005 data if a seasonal closure is 89% effective.

Month	1	2	3	4	5	6	7	8	9	10	11	12
1	7.8%	15.6%	23.1%	30.5%	38.4%	46.4%	54.5%	62.2%	68.1%	74.2%	81.8%	89.0%
2		7.8%	15.3%	22.7%	30.6%	38.6%	46.7%	54.4%	60.3%	66.4%	74.0%	81.2%
3			7.5%	14.9%	22.8%	30.8%	38.9%	46.6%	52.5%	58.6%	66.1%	73.4%
4				7.4%	15.3%	23.3%	31.3%	39.1%	44.9%	51.1%	58.6%	65.9%
5					7.9%	15.9%	23.9%	31.7%	37.5%	43.7%	51.2%	58.5%
6						8.0%	16.1%	23.8%	29.7%	35.8%	43.3%	50.6%
7							8.1%	15.8%	21.7%	27.8%	35.4%	42.6%
8								7.8%	13.6%	19.8%	27.3%	34.5%
9									5.8%	12.0%	19.5%	26.8%
10										6.2%	13.7%	20.9%
11											7.5%	14.8%
12												7.2%

Gag spawn from December through May with peak spawning during March and April. A January through April spawning season closure would provide a reduction of 34% if closure was 100% effective and a reduction of 31% if closure was 89% effective.

4 Quota and Seasonal Closure

Table 79. Monthly catch (pounds gutted weight) of gag during 1999-2005 (average). Cells highlighted in yellow represents when a 353,940 gutted weight quota would be met and cells highlighted in green represents when a 423,340 pound gutted weight quota would be met.

Month	1995-2005	Cumulative		
		No Action	March-May Closure	Jan-April Closure
1	57,110	57,110	57,110	0
2	56,700	113,810	113,810	0
3	2,110	115,920	115,920	2,110
4	1,927	117,847	117,847	4,037
5	83,065	200,912	117,847	87,101
6	57,890	258,802	175,737	144,992
7	50,887	309,689	226,625	195,879
8	40,978	350,667	267,603	236,857
9	33,918	384,586	301,521	270,775
10	57,003	441,589	358,524	327,778
11	60,498	502,086	419,022	388,276
12	49,595	551,682	468,617	437,871

Table 80. Monthly catch (pounds gutted weight) of gag during 2001-2006 (average). Cells highlighted in yellow represents when a 353,940 gutted weight quota would be met and cells highlighted in green represents when a 423,340 pound gutted weight quota would be met.

Month	2001-2006	Cumulative		
		No Action	March-May Closure	Jan-April Closure
1	58,389	58,389	58,389	0
2	52,953	111,342	111,342	0
3	1,274	112,616	112,616	1,274
4	2,106	114,722	114,722	3,380
5	79,875	194,597	114,722	83,255
6	60,435	255,033	175,157	143,691
7	51,177	306,210	226,334	194,868
8	44,313	350,523	270,648	239,181
9	34,226	384,749	304,874	273,407
10	51,963	436,712	356,836	325,370
11	55,521	492,233	412,357	380,891
12	48,185	540,418	460,542	429,075

Based on data from 1999-2005 and 2001-2006, a 353,940 pound gutted weight quota would be met in September with the current March-April closure, October with a March-May closure, and November with a January-April closure. A 423,340 pound gutted weight quota would be met in October with the current March-April closure and during December with a longer closure. This assumes no reduction in effort associated with management measures imposed on vermilion snapper,

5 Commercial Trip Limit Analysis

Table 81. Trip limit analysis for data from 1999-2005.

Trip Limit (pounds gutted weight)	Avg 1999-2005				
	Avg no. trips	Avg pounds gw over limit	Expected catch	% trips over limit	% reduction in catch from limit
0	2,538	469,922	0	100.0	100.0
212	641	195,143	274,780	25.2	41.5
254	522	170,615	299,308	20.6	36.3
424	275	106,537	363,385	10.8	22.7
508	211	86,036	383,886	8.3	18.3
593	165	70,264	399,658	6.5	15.0
678	130	57,703	412,219	5.1	12.3
763	104	47,710	422,212	4.1	10.2
847	84	39,765	430,158	3.3	8.5
932	71	33,218	436,704	2.8	7.1

1,017	58	27,775	442,148	2.3	5.9
1,102	48	23,286	446,637	1.9	5.0
1,186	40	19,539	450,383	1.6	4.2
1,271	31	16,547	453,375	1.2	3.5
1,356	26	14,167	455,756	1.0	3.0
1,441	21	12,187	457,735	0.8	2.6
1,525	17	10,605	459,318	0.7	2.3
1,610	15	9,255	460,668	0.6	2.0
1,695	12	8,141	461,781	0.5	1.7
1,907	8	6,059	463,863	0.3	1.3
2,119	6	4,546	465,376	0.2	1.0
2,331	4	3,467	466,455	0.2	0.7
2,542	3	2,614	467,308	0.1	0.6
2,754	3	1,976	467,946	0.1	0.4
2,966	2	1,516	468,407	0.1	0.3
3,178	1	1,204	468,718	0.1	0.3
3,390	1	941	468,981	0.0	0.2
3,602	1	722	469,200	0.0	0.2
3,814	1	551	469,371	0.0	0.1

Table 82. Trip limit analysis for data from 2006.

Trip Limit (pounds gutted weight)	2006				
	Avg no. trips	Avg pounds gw over limit	Expected catch	% trips over limit	% reduction in catch from limit
0	2,585	418,295	0	100.0	100.0
212	578	161,790	256,505	22.4	38.7
254	461	139,836	278,459	17.8	33.4
424	218	85,866	332,429	8.4	20.5
508	167	69,558	348,737	6.5	16.6
593	121	57,763	360,532	4.7	13.8
678	93	48,724	369,570	3.6	11.6
763	78	41,511	376,784	3.0	9.9
847	65	35,449	382,846	2.5	8.5
932	57	30,281	388,014	2.2	7.2
1,017	45	25,933	392,362	1.7	6.2
1,102	36	22,541	395,754	1.4	5.4
1,186	29	19,753	398,542	1.1	4.7
1,271	20	17,734	400,561	0.8	4.2
1,356	18	16,138	402,157	0.7	3.9
1,441	16	14,707	403,588	0.6	3.5
1,525	14	13,398	404,897	0.5	3.2
1,610	14	12,211	406,084	0.5	2.9
1,695	13	11,079	407,216	0.5	2.6
1,907	8	9,043	409,252	0.3	2.2
2,119	6	7,553	410,742	0.2	1.8
2,331	4	6,417	411,878	0.2	1.5
2,542	4	5,570	412,725	0.2	1.3
2,754	3	4,756	413,539	0.1	1.1
2,966	2	4,143	414,152	0.1	1.0
3,178	2	3,719	414,575	0.1	0.9
3,390	1	3,364	414,931	0.0	0.8
3,602	1	3,152	415,143	0.0	0.8
3,814	1	2,940	415,355	0.0	0.7
4,025	1	2,728	415,567	0.0	0.7
4,237	1	2,516	415,779	0.0	0.6
4,449	1	2,304	415,991	0.0	0.6
4,661	1	2,092	416,203	0.0	0.5
4,873	1	1,881	416,414	0.0	0.4
5,085	1	1,669	416,626	0.0	0.4

6 Recreational Bag Limit Analysis (gag, black grouper and gag, aggregate)

Table 83. Estimate of harvest reduction associated with reducing the aggregate bag limit from 5 to 3, gag and black grouper from 2 to 1, and gag from 2 to 1 using data from 1999-2005 for (1) headboat, (2) private MRFSS, (3) charter MRFSS, (4) private/charter MRFSS combined, and (5) all recreational sectors combined. Assumes a release mortality of 25% for gag, black grouper, red grouper, scamp, tiger grouper, yellowfin grouper, coney, sand tilefish, graysby, rock hind, red hind, and yellowmouth grouper. Assumes 100% release mortality for snowy grouper golden tilefish, blueline tilefish, yellowedge grouper, and misty grouper. **Assumes compliance with bag limit.**

	Estimated Harvest Reductions				
Species	Headboat	Private	Charter	MRFSS	Combined
Aggregate	0.8	1.9	3.2	2.2	1.9
Gag and Black	2.6	6.8	11.6	8.0	7.4
Gag	2.7	7.3	10.5	8.1	7.5
Gag w/ aggregate*	3.8	7.3	12.7	8.6	8.1
Gag w/ agg & black*	4.3	7.3	14.8	9.1	8.6

*Includes effect on gag of reducing aggregate bag limit to 3 fish and black grouper to 1 fish.

Table 84. Same as table 83 except **analyses exclude captain and crew** from retaining any grouper species. Adjustments not made to private sector of MRFSS. **Assumes compliance with bag limit.**

	Estimated Harvest Reductions				
Species	Headboat	Private	Charter	MRFSS	Combined
Aggregate	1.1	1.9	4.7	2.6	2.3
Gag and Black	3.6	6.8	17.8	9.4	8.8
Gag	3.8	7.3	11.9	8.4	8.0
Gag w/ aggregate*	4.7	7.3	13.9	8.9	8.5
Gag w/ agg & black*	5.2	7.3	16.2	9.5	9.0

*Includes effect on gag of reducing aggregate bag limit to 3 fish and black grouper to 1 fish.

To determine the reduction in harvest for MRFSS in Tables 83 and 84, reductions in the private and charter sectors of MRFSS were combined based on the proportion of landings represented by each sector. Similarly, reductions in harvest for all sectors (Headboat and MRFSS combined) was based on proportion of landings represented by each sector.

Table 85. Estimate of harvest reduction associated with reducing the bag limit from 2 to 1 gag using data from 1999-2005 for (1) headboat, (2) private MRFSS, (3) charter MRFSS, (4) private/charter MRFSS combined, and (5) all recreational sectors combined. Assumes a release mortality of 25% for gag, black grouper, red grouper, scamp, tiger grouper, yellowfin grouper, coney, sand tilefish, graysby, rock hind, red hind, and yellowmouth grouper. Assumes 100% release mortality for snowy grouper golden tilefish, blueline tilefish, yellowedge grouper, and misty grouper. **Takes into consideration non-compliance with bag limit.**

	Estimated Harvest Reductions				
Species	Headboat	Private	Charter	MRFSS	Combined
Aggregate	0.7	1.3	2.5	1.6	1.4
Gag and Black	2.1	3.1	6.6	4.0	3.8
Gag	2.3	5.4	6.1	5.6	5.3
Gag w/ aggregate*	3.3	5.4	8.4	6.1	5.9

Gag w/ agg & black*	3.8	5.4	10.7	6.7	6.4

*Includes effect on gag of reducing aggregate bag limit to 3 fish and black grouper to 1 fish.

Table 86. Same as Table 85 except analyses **exclude captain and crew** from retaining any grouper species. Adjustments not made to private sector of MRFSS. **Assumes non-compliance with bag limit.**

	Estimated Harvest Reductions				
Species	Headboat	Private	Charter	MRFSS	Combined
Aggregate	0.7	1.3	3.3	1.8	1.6
Gag and Black	2.4	3.1	9.2	4.6	4.4
Gag	2.6	5.4	6.5	5.7	5.4
Gag w/ aggregate*	3.6	5.4	8.7	6.2	5.9
Gag w/ agg & black*	4.1	5.4	11.1	6.8	6.5

*Includes effect on gag of reducing aggregate bag limit to 3 fish and black grouper to 1 fish.

To determine the reduction in harvest for MRFSS in Tables 85 and 86, reductions in the private and charter sectors of MRFSS were combined based on the proportion of landings represented by each sector. Similarly, reductions in harvest for all sectors (Headboat and MRFSS combined) was based on proportion of landings represented by each sector.

Four percent of the A+B1 MRFSS harvest occurred when fishermen landing three or more of the grouper aggregate species. Therefore, a reduction in the grouper aggregate from 5 to 3 fish for MRFSS could be expected to have some effect on reducing gag harvest. An estimate is provided but the exact amount is difficult to quantify.

7 Post Quota Bycatch Mortality

Regulations in Amendment 16 will initially decrease the allowable commercial catch of gag from 18 to 37%, depending on the allocation alternative selected. In addition, a 60% reduction in commercial harvest could occur for vermilion snapper based on a recent assessment update; however, this value could change since a new age based assessment is being conducted. A variety of management measures are available to end overfishing of these species, including a commercial quota. If a commercial quota is met for gag or vermilion snapper, it is expected there would still be some catch when fishermen target co-occurring species. These species would have to be released and a percentage of the incidentally caught gag and vermilion snapper would die, depending on depth of capture. The magnitude of incidentally caught gag and vermilion snapper that die after a quota is met is referred to as post quota bycatch mortality (PQBM). The range of management measures used, how fishermen will behave in response to reduced harvest levels, and ability to avoid a species after the quota is met will affect PQBM.

The Scientific and Statistical Committee (SSC) stated quotas should be adjusted for dead discards that could occur after a quota is. Furthermore, the SSC feels a seasonal closure would not be 100% effective in protecting a species since some incidental catch and mortality of the species would be expected.

At the December 2007 South Atlantic Council (Council) meeting, a methodology to estimate dead discards after a quota is met or during a seasonal closure was presented to the SSC and the Council. After discussions with the SSC and Council, two issues were unresolved. First, what is the percentage of trips that would not be made to target co-occurring snapper grouper species if the fishery for gag or vermilion snapper was closed? Second, what is percentage of gag or vermilion snapper that can be avoided by fishermen targeting co-occurring species during a closure if fishing methodology and or fishing location was changed? The SSC and Council indicated the Snapper Grouper Advisory Panel (AP) was best suited to answer these questions. The AP is currently reviewing the methodology.

<u>Assumptions</u>

- Trip based logbook data are used to estimate incidental catch of vermilion snapper and gag when fishermen target co-occurring species.
- Vermilion snapper and gag are taken by many fishermen on the same trip.
- If a fisherman cannot net at least $50.00/day, the trip is not included in analyses.
- In determining incidental catch of gag or vermilion snapper, a co-occurring species is targeted if at least 100 lbs whole weight is taken on a trip.
- If vermilion snapper or gag make up greater than 75% of the catch on a trip, it is not included in analyses.
- Fishermen will not use diving gear to target gag after a quota is met or during a seasonal closure.
- There will not be an increase in fishing effort before or after a seasonal closure.
- Some trips that target co-occurring species will not be taken after a quota is met. A range of 20 to 60% is used.
- Fishermen can avoid vermilion snapper and gag to some degree by changing hook size, method of fishing, and location. A range of 20 to 60% in reduction of catch is used.
- Dead discards are determined by applying release mortality rate of 40% for commercially caught vermilion snapper and gag.

7.1 Estimate of PQBM with Quota but no Gag Seasonal Closure

Table 87. Incidental catch of gag assuming a range in trips (0 to 60%) are not taken after quota is met and fishermen can avoid gag (range 0 to 60%) by changing fishing methods.

Trip reduction after quota	0%				20%				40%				60%			
Percent of discards avoided	0%	20%	40%	60%	0%	20%	40%	60%	0%	20%	40%	60%	0%	20%	40%	60%
Discards	319,206	255,365	153,219	61,287	177,554	142,043	85,226	34,090	143,839	115,071	69,043	27,617	105,598	84,478	50,687	20,275
Dead Discards	127,682	102,146	61,287	24,515	71,022	56,817	34,090	13,636	57,536	46,029	27,617	11,047	42,239	33,791	20,275	8,110

Table 88. Incidental catch of gag assuming a range in trips (0 to 60%) are not taken after 353,940 lb gutted weight quota is met and fishermen can avoid gag (range 0 to 60%) by changing fishing methods.

Trip reduction after quota	0%				20%				40%				60%			
Percent of discards avoided	0%	20%	40%	60%	0%	20%	40%	60%	0%	20%	40%	60%	0%	20%	40%	60%
Discards	34,798	27,838	16,703	6,681	20,456	16,365	9,819	3,928	15,244	12,195	7,317	2,927	11,733	9,386	5,632	2,253
Dead Discards	13,919	11,135	6,681	2,672	8,182	6,546	3,928	1,571	6,098	4,878	2,927	1,171	4,693	3,755	2,253	901

7.2 Estimate of PQBM With Quota and Seasonal Closure

Table 89. Incidental catch of gag assuming a range in trips (0 to 60%) are not taken after quota is met and fishermen can avoid gag (range 0 to 60%) by changing fishing methods.

Trip reduction after quota	0%				20%				40%				60%			
Percent of discards avoided	0%	20%	40%	60%	0%	20%	40%	60%	0%	20%	40%	60%	0%	20%	40%	60%
Discards	333,884	267,108	160,265	64,106	178,926	143,141	85,885	34,354	150,803	120,643	72,386	28,954	113,592	90,873	54,524	21,810
Dead Discards	133,554	106,843	64,106	25,642	71,571	57,256	34,354	13,742	60,321	48,257	28,954	11,582	45,437	36,349	21,810	8,724

Table 90. Incidental catch of gag assuming a range in trips (0 to 60%) are not taken after quota is met and fishermen can avoid gag (range 0 to 60%) by changing fishing methods.

Trip reduction after quota	0%				20%				40%				60%			
Percent of discards avoided	0%	20%	40%	60%	0%	20%	40%	60%	0%	20%	40%	60%	0%	20%	40%	60%
Discards	4,816	3,853	2,312	925	2,597	2,078	1,247	499	2,640	2,112	1,267	507	1,510	1,208	725	290
Dead Discards	1,927	1,541	925	370	1,039	831	499	199	1,056	845	507	203	604	483	290	116

8 Shallow Water Grouper Unit

8.1 Average landings of shallow water grouper species

Table 91. Average landings (pounds gutted weight) from 1999-2005 by sector for shallow water grouper species.

Species	Avg comm	Avg MRFSS	Avg Headboat	Avg rec	% Comm	% rec
Gag	551,682	474,726	52,911	527,637	51.11%	48.89%
Red Grouper	391,736	132,263	41,882	174,145	69.23%	30.77%
Scamp	277,122	75,906	60,522	136,429	67.01%	32.99%
Black Grouper	163,375	37,019	9,631	46,650	77.79%	22.21%
Rock Hind	19,291	2,695	5,346	8,041	70.58%	29.42%
Red Hind	15,960	2,400	798	3,198	83.31%	16.69%
Yellowfin Grouper	3,459	379	336	714	82.89%	17.11%
Graysby	3,117	4,125	5,167	9,292	25.12%	74.88%
Yellowmouth Grouper	104	764	723	1,487	6.56%	93.44%
Coney	24	612	55	667	3.47%	96.53%
Tiger Grouper	0	0	0	0		

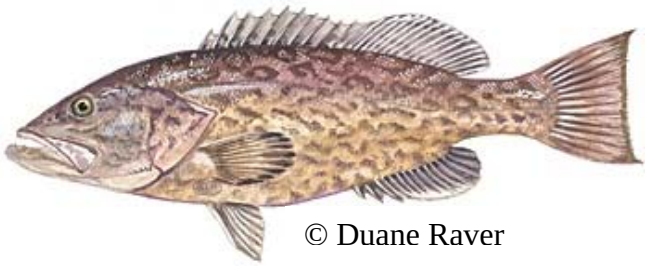
8.2 Spawning seasons of shallow water grouper species

Table 92. Spawning season information for groupers species taken in shallow water.

Species	Spawning Season	Peak
Gag	Dec-May	March-April
Black Grouper	All Year	Jan-March
Scamp	Feb-July	March-May
Red Grouper	Feb-June	April
Red Hind	May-Aug	Unknown
Rock Hind	May-Aug	Unknown
Yellowmouth Grouper	All Year	March-May
Tiger Grouper	Dec-April	Unknown
Yellowfin Grouper	March-August	Unknown
Graysby	May-Aug	Unknown
Coney	Jan-Feb	Unknown

8.3 Species descriptions of shallow water grouper species

8.3.1 Gag, *Mycteroperca microlepis*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Gag occurs in the Western Atlantic from North Carolina to the Yucatan Peninsula, and throughout the Gulf of Mexico. Juveniles are sometimes observed as far north as Massachusetts (Heemstra and Randall 1993). Gag commonly occur at depths of 39-152 m (131-498 ft) (Heemstra and Randall 1993) and prefer inshore-reef and shelf-break habitats (Hood and Schlieder 1992). Bullock and Smith (1991) indicated gag probably do not move seasonally between reefs in the Gulf of Mexico, but show a gradual shift toward deeper water with age. McGovern *et al.* (2005) reported extensive movement of gag along the Southeast United States. In a tagging study, 23% of the 435 recaptured gag moved distances greater that 185 km (100 nautical miles). Most of these individuals were tagged off South Carolina and were recaptured off Georgia, Florida, and in the Gulf of Mexico (McGovern *et al.* 2005).

Gag are probably estuarine dependent (Keener *et al.* 1988; Ross and Moser 1995; Koenig and Coleman 1998; Strelcheck *et al.* 2003). Juveniles (age 0) occur in shallow grass beds along Florida's east coast during the late spring and summer (Bullock and Smith 1991). Sea grass is also an important nursery habitat for juvenile gag in North Carolina (Ross and Moser 1995). Post-larval gag enter South Carolina estuaries when they are 13 mm (0.5 inches) TL and 40 days old during April and May each year (Keener *et al.* 1988), and utilize oyster shell rubble as nursery habitat. Juveniles remain in estuarine waters throughout the summer and move offshore as water temperatures cool during September and October. Adults are often seen in shallow water 5-15 m (16-49 ft) above the reef (Bullock and Smith 1991) and as far as 40-70 km (22-38 nautical miles) offshore.

Huntsman *et al.* (1999) indicated gag are vulnerable to overfishing since they are long-lived, late to mature, change sex, and aggregate to spawn. The estimated natural mortality rate is 0.14 (SEDAR 10 2007). Maximum reported size for gag is 145 cm (57.5 inches) TL and 36.5 kg (81 pounds) (Heemstra and Randall 1993), and maximum reported age is 26 years (Harris and Collins 2000). Gag is a sequential hermaphrodite, changing sex from female to male with increased size and age (Coleman *et al.* 1996; McGovern *et al.* 1998; Coleman *et al.* 2000). All individuals less than 87.5 cm (34.7 inches) TL are females. At 105.0 cm (41.6 inches) TL, 50% of fishes are males. Almost all gag are males at sizes greater than 120.0 cm (47.5 inches) TL (McGovern *et al.* 1998).

Along the southeastern United States (1994-1995), size at first maturity is 50.8 cm (20.2 inches) TL, and 50% of gag females are sexually mature at 62.2 cm (24.7 inches) (McGovern *et al.* 1998). According to Harris and Collins (2000), age-at-first-maturity is 2 years, and 50% of gag are mature at 3 years. For data collected during 1978-1982 off the southeastern United States, McGovern *et al.* (1998) reported the smallest mature females were 58.0 cm (22.9 inches) TL and 3 years old. Hood and Schlieder (1992) indicated most females reach sexual maturity at ages 5-7 in the Gulf of Mexico. Off the southeastern United States, gag spawn from December through May, with a peak

in March and April (McGovern *et al.* 1998). Duration of planktonic larvae is about 42 days (Keener *et al.* 1988; Koenig and Coleman 1998; Lindemen *et al.* 2000). McGovern *et al.* (1998) reported the percentage of male gag landed by commercial fishermen decreased from 20% during 1979-1981 to 6% during 1995-1996. This coincided with a decrease in the mean length of fish landed. A similar decrease in the percentage of males was reported in the Gulf of Mexico (Hood and Schleider 1992; Coleman *et al.* 1996).

Adults are sometimes solitary, and can occur in groups of 5 to 50 individuals. They feed primarily on fishes, crabs, shrimps, and cephalopods (Heemstra and Randall 1993), and often forage in small groups far from the reef ledge (Bullock and Smith 1991). Juveniles feed primarily on crustaceans, and begin to consume fishes when they reach about 25 mm (1 inch) in length (Bullock and Smith 1991; Mullaney 1994).

8.3.2 Red grouper, *Epinephelus morio*

Red grouper occur in the Western Atlantic, ranging as far north as Massachusetts to southeastern Brazil, including the eastern Gulf of Mexico (Robins and Ray 1986). The red grouper is uncommon around coral reefs; it generally occurs over flat rock perforated with solution holes (Bullock and Smith 1991), and is commonly found in the caverns and crevices of limestone reef in the Gulf of Mexico (Moe 1969). It also occurs over rocky reef bottoms (Moe 1969).


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Adult red grouper are sedentary fish that are usually found at depths of 5-300 m (16-984 ft). Fishermen off North Carolina commonly catch red grouper at depths of 27-76 m (88-249 ft) for an average of 34 m (111 ft). Fishermen off southeastern Florida also catch red grouper in depths ranging from 27-76 m (88-249 ft) with an average depth of 45 m (148 ft) (Burgos 2001; McGovern *et al.* 2002). Moe (1969) reported that juveniles live in shallow water nearshore reefs until they are 40.0 cm (16 inches) and 5 years of age, when they become sexually mature and move offshore. Spawning occurs during February-June, with a peak in April (Burgos 2001). In the eastern Gulf of Mexico, ripe females are found December through June, with a peak during April and May (Moe 1969). Based on the presence of ripe adults (Moe 1996) and larval red grouper (Johnson and Keener 1984) spawning probably occurs offshore. Coleman *et al*. (1996) found groups of spawning red grouper at depths between 21-110 m (70-360 feet). Red grouper do not appear to form spawning aggregation or spawn at specific sites (Coleman *et al.* 1996). They are reported to spawn in depths of 30-90 m (98-295 ft) off the Southeast Atlantic coast (Burgos 2001; McGovern *et al.* 2002).

Red grouper are protogynous, changing sex from female to male with increased size and age. Off North Carolina, red grouper first become males at 50.9 cm (20.1 inches) TL and males dominate size classes greater than 70.0 cm (27.8 inches) TL. Most females transform to males between ages 7 and 14. Burgos (2001) reported that 50% of the females caught off North Carolina are undergoing sexual transition at age 8. Maximum age reported by Heemstra and Randall (1993) was 25 years. Burgos (2001) and McGovern *et al.* (2002) indicated red grouper live for at least 20 years in the Southeast Atlantic and a maximum age of 26 years has been reported for red grouper in the Gulf of Mexico (L. Lombardi, NMFS Panama City, personal communication). Natural

mortality rate is estimated to be 0.20 (Potts and Brennan 2001). Maximum reported size is 125.0 cm (49.2 inches) TL (male) and 23.0 kg (51.1 pounds). For fish collected off North Carolina during the late 1990s, age at 50% maturity of females is 2.4 years and size at 50% maturity is 48.7 cm (19.3 inches) TL. Off southeastern Florida, age at 50% maturity was 2.1 years and size at 50% maturity was 52.9 cm (21.0 inches) TL (Burgos 2001; McGovern *et al.* 2002). These fish eat a wide variety of fishes, octopuses, and crustaceans, including shrimp, lobsters, and stomatopods (Bullock and Smith 1991, Heemstra and Randall 1993).

8.3.3 Scamp, *Mycteroperca phenax*


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Scamp occur in the Western Atlantic, from North Carolina to Key West, in the Gulf of Mexico, and in the southern portion of the Caribbean Sea. Juveniles are sometimes encountered as far north as Massachusetts (Heemstra and Randall 1993). Its reported depth range is 30-100 m (98-328 ft) (Heemstra and Randall 1993). Juveniles are found in estuarine and shallow coastal waters (Bullock and Smith 1991; Heemstra and Randall 1993).

Scamp are protogynous, with females dominating sizes less than 70.0 cm (27.8 in) (Harris *et al.* 2002). Scamp live for at least 30 years (Harris *et al.* 2002), and attain sizes as great as 107.0 cm (42.4 inches) TL and 14.2 kg (31.3 pounds) (Heemstra and Randall 1993, in Froese and Pauly 2003). Natural mortality rate is estimated to be 0.15 (Potts and Brennan 2001). Harris *et al.* (2002) report that the length and age at first spawning of females off North Carolina to southeast Florida was 30.0-35.0 cm (11.9-13.8 inches) TL and age 1. Length and age at 50% maturity was 35.3 cm (13.9 in) TL and 1.28 years, respectively (Harris *et al.* 2002). In a study conducted in the eastern Gulf of Mexico, all fish larger than 35.0 cm TL were sexually mature (M. Godcharles and L. Bullock, unpublished data).

Spawning occurs from February through July in the South Atlantic Bight and in the Gulf of Mexico, with a peak in March to mid-May (Harris *et al.* 2002). Hydration of eggs occurs primarily during the morning and late afternoon, which indicates scamp spawn during late afternoon and evening. Spawning individuals have been captured off South Carolina and St. Augustine, Florida at depths of 33 to 93 m (108-305 ft). Scamp aggregate to spawn. Spawning locations and time of spawning overlaps with gag (Gilmore and Jones 1992). Fish are the primary prey of this species (Matheson *et al.* 1986).

8.3.4 Black grouper, *Mycteroperca bonaci*


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The black grouper occurs in the Western Atlantic, from North Carolina to Florida, Bermuda, the Gulf of Mexico, West Indies, and from Central America to Southern Brazil (Crabtree and Bullock 1998). Adults are found over hard bottom such as coral reefs and rocky ledges. Black grouper occur at depths of 9 to 30 m (30 to 98 ft). Juveniles sometimes occur in estuarine

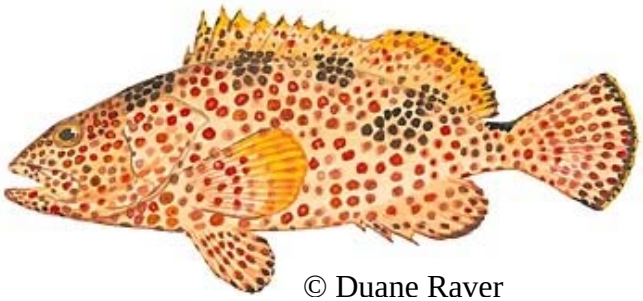
seagrass and oyster rubble habitat in North Carolina and South Carolina (Keener *et al.* 1988; Ross and Moser 1995). In the Florida Keys, juveniles settle on patch reefs (Sluka *et al.* 1994). Commercial landings of black grouper exceed landings of any other grouper in the Florida Keys.

Natural mortality (M) is estimated to be 0.15 (Potts and Brennan 2001). Crabtree and Bullock (1998) found black grouper live for at least 33 years and attain sizes as great as 151.8 cm (60.1 inches) TL. Females ranged in length from 15.5 to 131.0 cm (6.1-51.9 inches) TL and males range in length from 94.7 to 151.8 cm (38.3-60.1 in) TL. Black grouper are protogynous. Approximately 50% of females are sexually mature by 82.6 cm (32.7 inches) TL and 5.2 years of age. At a length of 121.4 cm (48.1 inches) TL and an age of 15.5 years, approximately 50% of the females have become males. Black grouper probably spawn throughout the year, however, peak spawning of females occurs from January to March.

Off Belize, black grouper are believed to spawn in aggregations at the same sites used by Nassau grouper (Carter and Perrine 1994). Eklund *et al.* (2000) describe a black grouper spawning aggregation discovered during winter 1997-1998, less than 100 m outside a newly designated marine reserve. Adults feed primarily on fishes.

8.3.5 Rock hind, *Epinephelus adscensionis*

Rock hind are found in the western Atlantic from Massachusetts to southern Brazil, Bermuda, the Gulf of Mexico, and the Caribbean, (Smith 1997). They also occur in the eastern Atlantic from Ascension Island and St. Helena Island (Smith 1997). The rock hind is a demersal species, inhabiting rocky reef habitat to depths of 120 m (394 ft). It is usually solitary.



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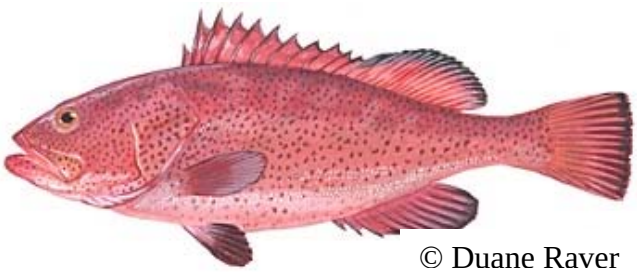
Maximum reported size is 61.0 cm (24.2 inches) TL (male) and 4.1 kg (9.1 pounds) (Heemstra and Randall 1993). Size at maturity and age at first maturity are estimated as 28.0 cm (11.1 inches) TL and 6.1 years, respectively. Maximum reported age is 12 years (Potts and Manooch 1995). The natural mortality rate is estimated as 0.25 (Ault *et al*. 1998).

Heemstra and Randall (1993) indicated that rock hind in the Gulf of Mexico are protogynous. This fish has been observed to spawn in aggregations near the shelf edge off the southwest coast of Puerto Rico in January at depths of 20-30 m (66 – 98 ft) (Rielinger 1999). Off Cuba, rock hind spawn during January through March (García-Cagide *et al.* 1994). Off South Carolina, females in spawning condition (hydrated oocytes or postovulatory follicles) have been collected during May through August (Unpublished MARMAP data)**.** Crabs comprise the majority of their diet, but rock hind have also been observed to feed on fishes and young sea turtles (Heemstra and Randall 1994).

8.3.6 Red hind, *Epinephelus guttatus*

Red hind is found in the Western Atlantic from North Carolina to Venezuela and is the most common species of *Epinephelus* in Bermuda and the West Indies (Smith



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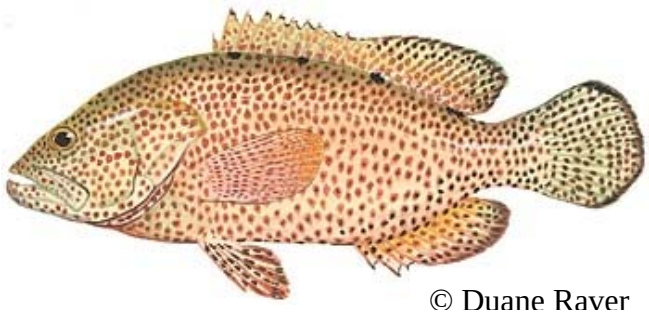
1997). The red hind is found in shallow reefs and rocky bottoms, at depths of 2-100 m (7 – 328 ft; Froese and Pauly 2003). It is usually solitary and territorial.

Maximum reported size is 76.0 cm (30.0 inches) TL (male) and 25.0 kg (55.5 pounds) (Heemstra and Randall 1993). Natural mortality rate is estimated to be 0.18 (Ault *et al.* 1998). Potts and Manooch (1995) examined 146 otoliths of red hind collected from North Carolina to the Dry Tortugas during 1980-1992 and report a maximum age of 11 years and maximum sizes of 49.0 cm (19.4 inches) TL. Sadovy *et al.* (1992) conducted an age and growth study of red hind from Puerto Rico (n = 624) and St. Thomas, USVI (n = 162) and report a maximum age of 18 and a maximum size of 47.5 cm (18.8 inches) TL. Luckhurst *et al.* (1992) captured a red hind off Bermuda that was 72.0 cm (28.5 in) TL and 22 years old.

Sadovy *et al.* (1994) found that red hind collected off Puerto Rico are protogynous. Females (n = 390) become sexually mature at 21.5 cm (9.7 in) TL, the size at 50% maturity is 28.5 cm (11.3 inches) TL, and they range in size from 11.0 to 48.0 cm (4.4 to 19.0 inches) TL. Males (n = 120) range in size from 27.3 to 51.0 cm (10.8 to 20.2 inches) TL and transitional individuals (n = 7) were from 27.5 to 34.5 cm (10.9 to 13.7 in) TL. Annual spawning aggregations occur during the full moon in January and February off the southwest coast of Puerto Rico, and during the summer in Bermuda with no relation to lunar periodicity (Shapiro *et al.* 1993; Sadovy *et al.* 1994). Spawning off Jamaica, Puerto Rico, and USVI occurs from December to February (Thompson and Munro 1978; Colin *et al.* 1987; Sadovy *et al.* 1992; Sadovy *et al.* 1994). Burnett-Herkes (1975) report that red hind spawn from April to July off Bermuda. Red hind spawn during the summer off the southeastern United States (MARMAP unpublished data).

This species aggregates in large numbers during the spawning season (Coleman *et al*. 2000; Sadovy *et al.* 1994). A number of spawning aggregation sites have been documented in the Caribbean. The timing of aggregations is somewhat variable. Aggregations off Puerto Rico generally occur from January through March in association with the full moon, while those off the USVI generally occur from December through March in association with the full moon (Rielinger 1999). The red hind feeds mainly on crabs and other crustaceans, fishes, such as labrids and haemulids, and octopus (Heemstra and Randall 1993).

8.3.7 Graysby, *Cephalopholis cruentata*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Graysby occurs from North Carolina to south Florida and in the Gulf of Mexico, Caribbean and Bermuda. The graysby inhabits seagrass (*Thalassia*) beds and coral reefs, and is found as deep as 170 m (557 ft). It is sedentary, solitary, and secretive, usually hiding during the day, and feeding at night. This small grouper is rare in landings off the southeast United States, and is more commonly seen in the Caribbean (Potts and Manooch 1999). Graysby are probably most often landed as unclassified grouper by commercial fishermen off the southeastern United States.

Maximum reported size is 42.6 cm (16.9 inches) TL (male) and 1.1 kg (2.4 pounds). In the northeastern Caribbean, individuals in spawning condition have been observed in March, and from May to July (Erdman 1976). Nagelkerken (1979) determined that graysby collected in the

Caribbean spawn from July through October. Graysby spawn during summer off the Southeastern United States (MARMAP unpublished data). Size at maturity and age at first maturity are estimated as 14.0 cm (5.5 inches) TL and 3.5 years (Nagelkerken 1979). The graysby is protogynous (Nagelkerken 1979). Sexual transition occurs at sizes ranging from 14.0 to 26.0 cm (5.5-10.3 inches) TL with most transitional individuals occurring between the sizes of 20.0-23.0 cm (7.9-9.1 inches) TL and ages 4-5.

Potts and Manooch (1999) examined otoliths from 118 graysby collected during 1979 to 1997. Maximum reported age is 13 years and maximum size is 40.5 cm (16.0 inches) TL. Juveniles feed on shrimp, while adults eat primarily fishes. Natural mortality rate is estimated as 0.20 (Ault *et al.* 1998). Adult graysby eat bony fish, shrimp, stomatopods, crabs, and gastropods (Randall 1967).

8.3.8 Yellowfin grouper, *Mycteroperca venenosa*

Yellowfin grouper occur in the Western Atlantic, ranging from Bermuda to Brazil and the Guianas, including the Gulf of Mexico and Caribbean Sea at depths of 2-137 m (7-449 ft). Juveniles are commonly found in shallow sea grass beds, while adults occur over rocky areas and coral reefs.

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Maximum reported size is 100.0 cm (39.6 inches) TL (male) and 18.5 kg (41.1 pounds) (Heemstra and Randall 1993). Thompson and Munro (1978) reported that yellowfin grouper off Jamaica are 4 years old between 46.0 and 57.0 cm (18.1-22.4 inches) TL, and by 80.0 cm (31.5 inches) TL, they are 10 years of age. Manooch (1987) reported a maximum age of 15 years for yellowfin grouper. Natural mortality rate is estimated to be 0.18 (Ault *et al.* 1998). This fish is believed to be protogynous. Yellowfin grouper aggregate at some of the same sites utilized by tiger grouper, Nassau grouper, and black grouper (Sadovy *et al.* 1994). Spawning occurs during March in the Florida Keys (Taylor and McMichael 1983), and from March and May to August in the Gulf of Mexico (Bullock and Smith 1991). Most spawning occurs in Jamaican waters between February and April (Thompson and Munro 1978), and during July off Bermuda (Smith 1971). Yellowfin grouper feed mainly on fishes (especially coral reef species) and squids (Heemstra and Randall 1993).

8.3.9 Coney, *Cephalopholis fulva*

Coney is a small grouper that occurs in the Western Atlantic, ranging from South Carolina (USA) and Bermuda to southern Brazil, including Atol das Rocas. The coney is a sedentary species. It prefers coral reefs and clear water, and can be found to depths as great as 150 m (492 ft). Coney are most commonly taken in the Caribbean, where they are found associated with patch reefs. Most commercial landings of coney are off southeast Florida and are often labeled as unclassified grouper.

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Maximum reported length is 41.0 cm (16.2 inches) TL (male). This species is protogynous (Heemstra and Randall 1993). Size at 50% maturity for females sampled off the west coast of Puerto Rico was 13.0 cm (5.1 inches) FL (Figuerola and Torrez Ruiz 2000). Heemstra and Randall (1993) report that females mature at 16.0 (6.3 inches) cm TL and transform to males at about 20.0 (7.9 inches) cm TL.

Potts and Manooch (1999) examined the otoliths from 55 coney collected during 1979-1997 from North Carolina to the Dry Tortugas, Florida. The maximum reported age is 11 years and maximum size is 39.7 cm (15.7 inches) TL. Natural mortality rate is estimated as 0.18 (Ault *et al.* 1998).

Spawning occurs in small groups composed of one male and multiple females. Although ripe ovaries are found from November to March off the west coast of Puerto Rico, spawning activity appears to be limited to several days around the last quarter and new moon phases during January and February (Figuerola *et al.* 1997). The diet is composed primarily of small fishes and crustaceans (Randall 1967).

8.3.10 Yellowmouth grouper, *Mycteroperca interstitialis*

Yellowmouth grouper occur along the eastern U.S. coast, Bermuda, Bahamas, Gulf of Mexico, and in the Caribbean south to Brazil (Smith 1971). Adults are found over rocky hard bottom and coral reefs near the shoreline as deep as 55 m (100 ft). Individuals have been found as deep as 150 m (275 ft). Young commonly occur in mangrove line lagoons.

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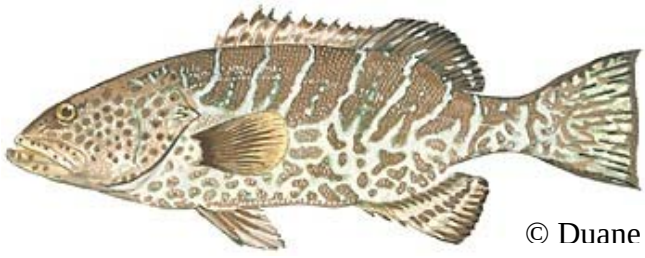
The maximum reported size of yellowmouth grouper is 84.0 cm (33.2 inches) TL (male) and 10.2 kg (22.6 pounds) (Froese and Pauly 2003). In the Gulf of Mexico, maximum reported age for yellowmouth grouper is 28 years (Bullock and Murphy 1994). Males (2-28 years) are generally older than females (2-17 years). Females become sexually mature between 40.0-45.0 cm (15.8-17.7 inches) TL and ages 2-4 years. Fifty percent are males at 60.0-64.9 cm (23.6-25.6 inches) TL. Fish undergo sexual transition from female to male at lengths from 50.3 to 64.3 cm (19.8-25.3 inches) TL, between the ages of 5 and 14 years. Yellowmouth grouper may spawn all year, but peak spawning of females in the Gulf of Mexico occurs during March to May (Bullock and Murphy 1994). Finfish constitute a large part of the diet of yellowmouth grouper (Randall 1967).

8.3.11 Tiger grouper, *Mycteroperca tigris*

Tiger grouper occur in the Western Atlantic, ranging from Bermuda and south Florida (USA) to Venezuela and, possibly Brazil, including the Gulf of Mexico and the Caribbean Sea. It inhabits coral reefs and rocky areas at depths of 10 to 40 m (33-131 ft). Approximate life span is 26 years, and M is estimated at 0.12 (Ault *et al.* 1998).



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The size-sex ratios described in a study conducted off Bermuda indicate this fish is probably protogynous (Heemstra and Randall 1993). It forms aggregations at specific times and locations each year, but only during the spawning season (Coleman *et al*. 2000; White *et al.* 2002). White *et al.* (2002) reported that spawning aggregations of tiger grouper occurred one week after the full moon during January through April off Puerto Rico. Tiger grouper spawn from December through April off southwest Cuba (García-Cagide *et al*. 1999). The tiger grouper preys on a variety of fishes, and frequents cleaning stations (Heemstra and Randall 1993).

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