SEDAR10-DW- 23

Effect of Some Variations in Sampling Practices on the Length Frequency Distribution of Gag Groupers Caught by Commercial Fisheries in the Gulf of Mexico

by

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Introduction

Information extracted from the TIP database is often used to establish length and age frequency distributions for commercial landings. The Length/age distribution of individual trips is often combined under the assumption that the trips were randomly selected, and samples were randomly taken from individual landings. However, variations in sampling practices may sometimes influence the outcome of length or age frequence distributions. These sampling irregularities may include small sample sizes, non-proportional sampling of landings that had already been sorted, sampling from partial landings or combined landings, and non-random samplings for special purposes (for a detailed discussion of these sampling irregularities, see Chih, 2005). Also, these irregularities may not have been properly recorded in some cases due to the design of the TIP data structure. Because operating procedures for dealer sites or loading docks vary, sampling irregularities for each fishery may be different. Thus, it is important to consider sampling conditions before constructing a length or age frequency distribution for a species.

The present study aims to examine three issues that may influence the age/length frequency distributions of commercial landings of gag groupers extracted from the TIP database. These issues are (1) whether otolith samples collected for determination of age were randomly sampled, (2) whether a small sample size affects the length frequency distribution, and (3) whether weighting samples by landing weight significantly changes the length frequency distribution.

I. RANDOMNESS OF OTOLITH SAMPLES

Before 1991, no TIP otolith samples for gag groupers were taken from commercial landings (Table 1). Between 1991 to 2000, a relatively small number of otolith samples were taken, presumably for building an age-length key. Because the data structure of the old TIP database was not designed to record variations in sampling methods such as age-length key sampling and random age sampling, the randomness of these otolith samples was not clear. After 2001, a considerable number of gag grouper otolith samples were taken each year for the estimation of age frequency distributions. However, the size of otolith samples for a large percentage of gag grouper fishing trips in TIP was very small (Table 2). For example, the otolith sample size for more than 50% of trips was less than 5 during 2001-2004. These small size samples may also influence the length frequency distribution (also see Chih, 2004).

The randomness of otolith samples collected by TIP samplers was examined by comparing length frequency distributions from length samples and otolith samples taken from selected years. Figs. 1 & 2 show such comparisons for length and otolith samples taken in the handline and longline gag grouper fisheries in 1996 and 1998. For both years, the length frequency distributions were noticeably different between the

length and otolith samples. Although the total number of otolith samples in these two years was relatively small, which may have contributed to the differences in the length distributions between otolith and length samples, it is more likely that otolith samples in the years before 2000 were taken non-randomly for the purpose of building an age-length key. Thus, for years before 2000, the age length key method may have been a better method for making stock assessments.

Figs. 3 & 4 show comparisons of length frequency distributions from length and otolith samples taken in the handline and longline gag grouper fisheries in 2001 and 2003. Even though the total number of otolith samples increased considerably in those two years, there were still significant differences in the length distributions between length and otolith samples. These differences may have been due in part to the fact that a large percentage of trips had very small otolith sample sizes. Extraction of otoliths can be time consuming. This is particularly true if the fish are large. Because time for taking samples is limited, samplers may be forced to take small otolith samples even when landings are large. In some cases, samplers may take large length samples and small otolith samples for a single trip. Fig. 5 shows the length and otolith frequency distributions for three individual trips sampled in this way. The figures clearly shows that small otolith samples do not reflect the true distribution of the length sample, even though these two types of samples were from the same landings. Fig. 6 shows that, when eight such trips were pooled together, the difference between length and otolith samples persists. Figs. 7, and 8 show the difference between length and otolith samples collected by two agents in 2003 and 2001 respectively. In these two figures, the length and otolith samples were from the same landings. These figures show that small otolith samples lead to changes in the length frequency distribution. Thus, small otolith samples may need to be considered separately from large otolith samples.

II. RANDOMNESS OF SMALL SIZE SAMPLES

The issue of small sample sizes is not unique to otolith samples. For example, over 50% of length samples taken from 1991 to 1997 had sample sizes less than 5 when only a small number of otoliths was collected (Table 2). Figs. 9 & 10 show the length distributions for samples of different sizes collected from handline and longline gag grouper commercial landings in the Gulf of Mexico during 2003. For both handline and longline landings, there appears to be a larger proportion of bigger fish when sample sizes were small (less than 10). Fig. 11 shows length distributions for samples of different sizes collected from the Gulf of Mexico during 1998. The effect of small sample sizes (less than 10) is still evident even when longline and handline samples were combined.

Although small sample sizes are often due to limited sampling time, in some cases, small sample sizes may be due to small landings. The question remains whether length distributions obtained from small sized samples actually represent fisheries that usually have small gag grouper landings (Steve Turner, personal communication). This question was examined by comparing length distributions from

different sample sizes from trips where landing weights were less than 200 pounds. Figs. 12 & 13 show such comparisons in data from 1997 and 2003. Sample sizes for these trips were typically below 20. The length distributions from samples with sizes less than 5 are different from other length distributions even when total landings were less than 200 lb. Thus, length distributions from small-sized samples (n <=5) are not likely representative of fisheries with small landings.

As in the case of otolith samples, small-sized length samples may need to be considered separately. It should also be noted that the impact of small samples from larger landings on the over length distribution may be greater when the length distribution is weighted by landing weight (see below).

III. EFFECT OF WEIGHTING BY LANDING WEIGHT ON THE LENGTH FREQUENCY DISTRIBUTION

The size of gag grouper TIP samples varies greatly between individual trips. Typically, there is no correlation between landing weight and sample size (Fig. 14). If length distributions from individual trips were combined without weighting by landing weight, the length distributions from trips with small landings may be overemphasized. Also, because length distributions from individual trips can vary greatly even when the same gear was used, and because landings were from the same fishing areas, it is important to weight the length/age distribution by landing weight.

Fig. 15 shows the effect of weighting by landing weight on the length distributions of landings from the same grid areas in 2003. Although all samples were from landings caught by handline and from the same fishing areas, the length distributions of samples collected by different agents (also from different dealers) can be very different (Fig 15(A),(B)). When samples from the same agent were weighted by landing weight, the length distribution changed significantly. The effect of weighting on length distributions from local fishing areas is also significant (Fig 15(C)).

Figs. 16 & 17 show the effects of weighting by landing weight on length distributions from landings caught by handline and longline gag grouper commercial fisheries in the Gulf of Mexico during 2003 and 2001 respectively. In both years, weighting by landing weight significantly altered the length distribution, particularly for the handline fishery. Because most gag grouper sampling records in TIP have landing weights (Table 4), it may be feasible to weight the length distribution with the landing weight. It is also recommended that recordings of landing weights be mandatory for all sampling trips carried out by NMFS and state agents.

Another issue worth noting is the difference in length distributions between handline and longline gag grouper landings. Figs. 18-32 compare the length distributions for handline and longline gag grouper landings from 1990 to 2004.

Because the number of TIP samples collected for the two types of landings was not based on the proportion of landing quantity from handline and longline (Table 6), and because length distributions for the two types of landings are very different, it is important to weight the length distribution with the landing weight when combining samples from handline and longline fisheries to establish the overall distribution of landings.

Concluding Remarks

The above analysis indicates (1) that gag grouper otolith samples collected via the TIP program may not be random in some years, and that the age-length key method may be more appropriate for constructing age frequency distributions for commercial landings, (2) that samples with small sample sizes may need special consideration when constructing the length/age frequency distribution, and (3) that weighting the length distribution by landing weight can significantly alter the length distribution, and that such weighting should probably be considered when landing weight data for most trips are available.

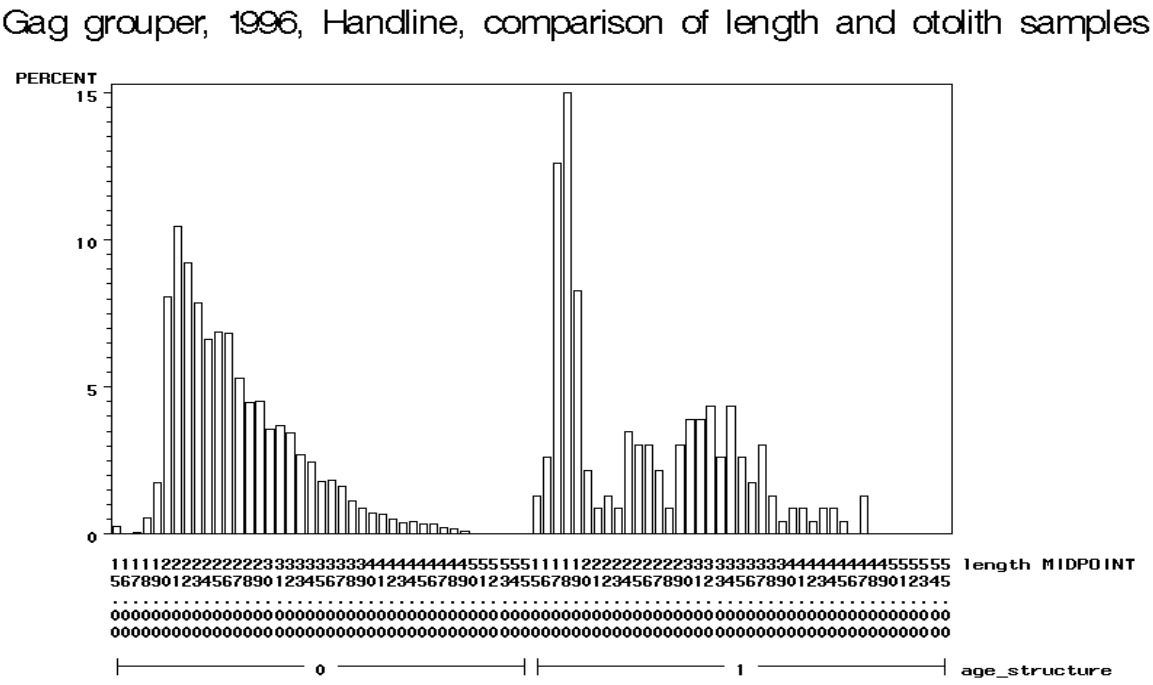
Other sampling conditions that can influence the randomness of samples, such as sorted landing, combined or split landings (see Chih, 05), are not commonly seen in the gag grouper commercial fishery and are not considered in this analysis.

Overall, the analysis presented here shows that information regarding trip and sampling conditions is important for determining length/age frequency distributions. It is recommended that the individual trip information typically collected in TIP should be collected by other sampling programs as well. It is also recommended that sampling conditions and trip information mentioned in this report be considered during subsampling procedures that sometimes take place during otolith processing.

References

1. C.P. Chih, 2005, Reevaluation of the Trip Interview Program (in the process of internal review)
2. C.P. Chih, 2004, Some observations concerning the sampling of commercial red snapper fisheries in the Gulf of Mexico (SEDAR7-DW-43)

Fig 1. Comparison of gag grouper length and otolith TIP samples from handline and longline landings taken in the Gulf of Mexico during 1996 (age_structure 0-length sample, 1-otolith sample, see Table 1 for number of samples).



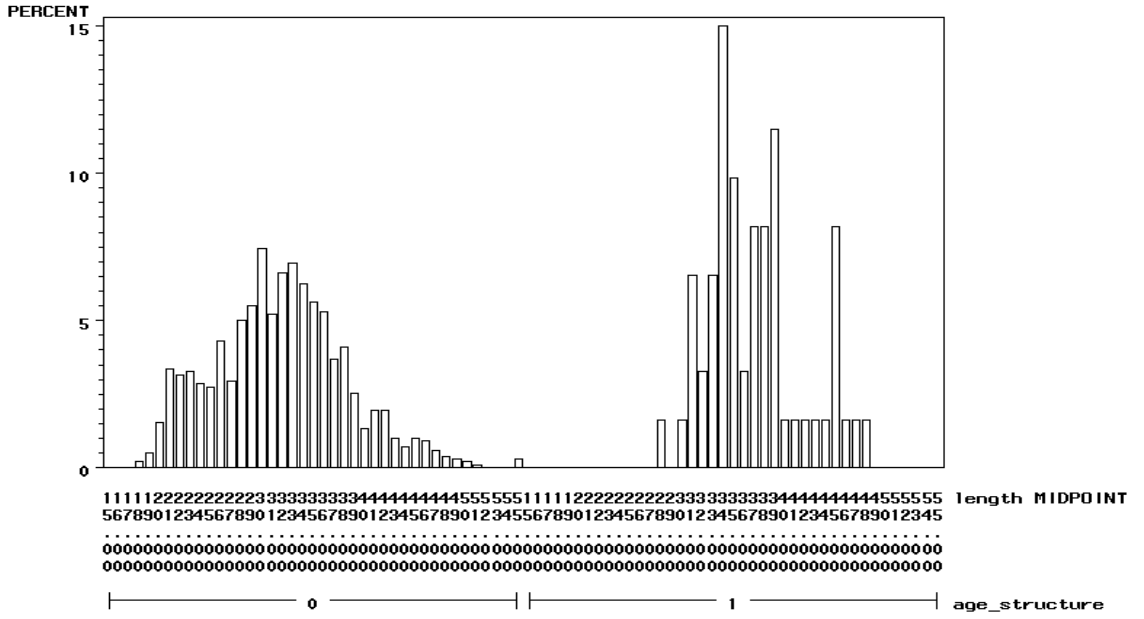
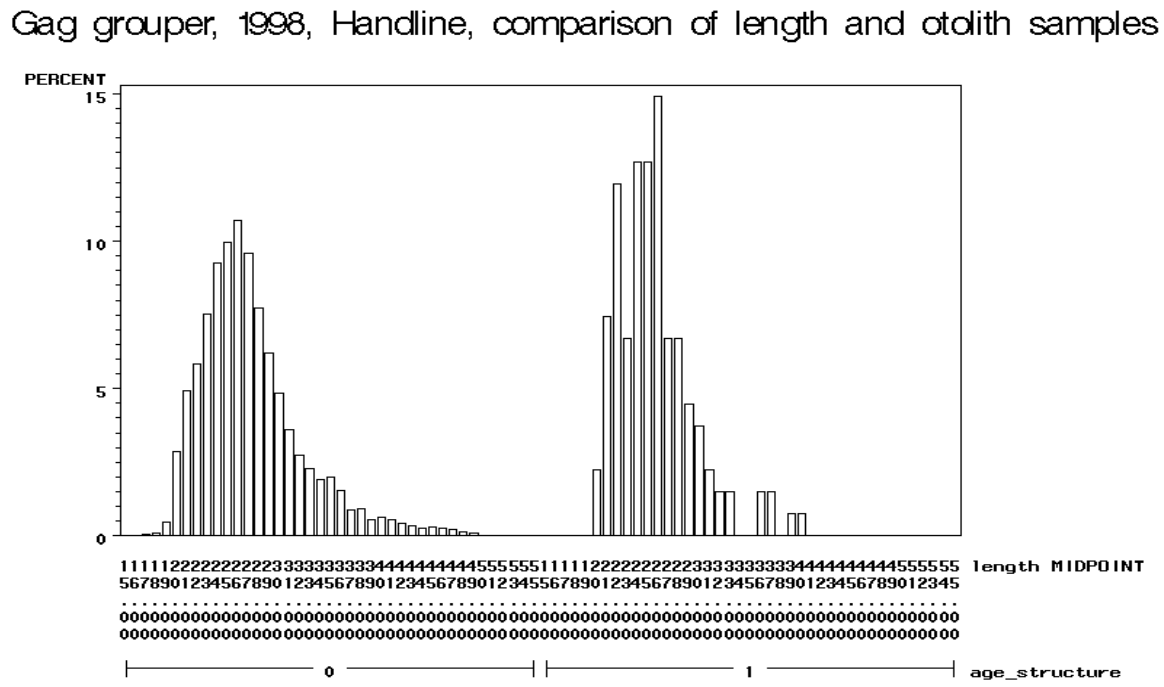


Fig 2. Comparison of gag grouper length and otolith TIP samples from handline and longline landings taken in the Gulf of Mexico during 1998 (age_structure 0-length sample, 1-otolith sample, see Table 1 for number of samples)



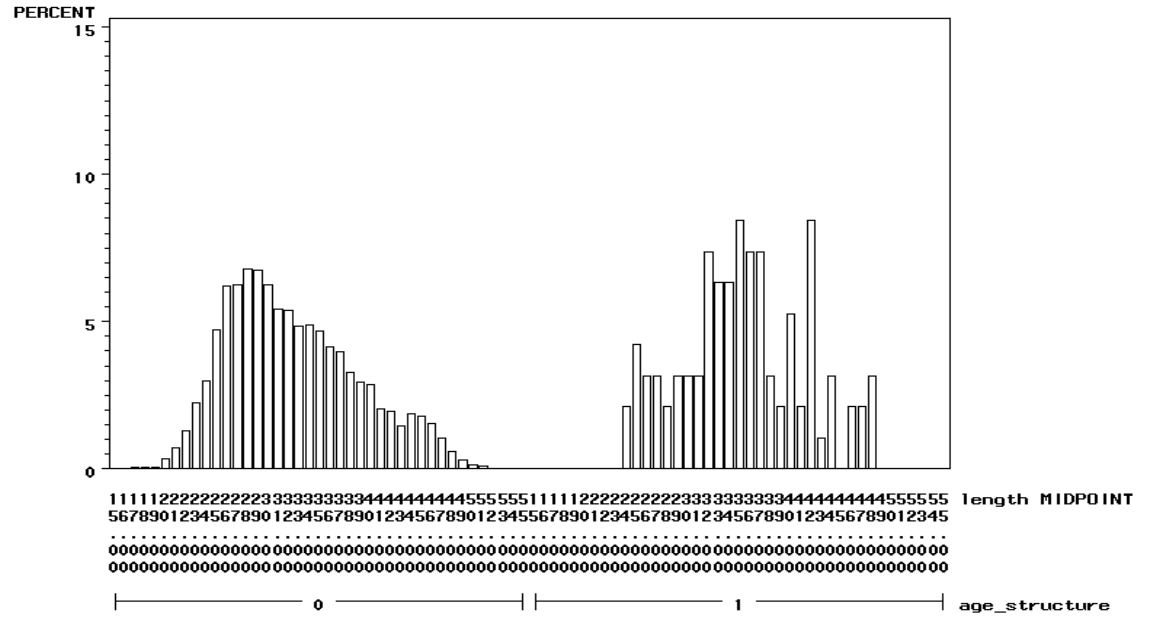
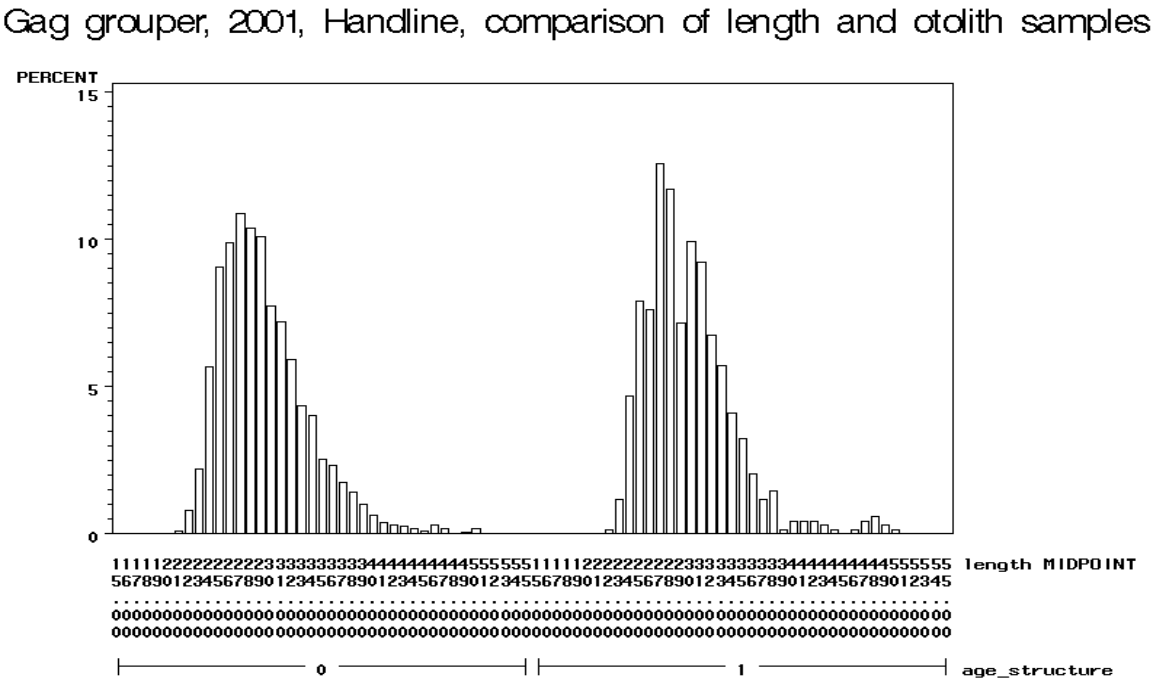


Fig 3. Comparison of gag grouper length and otolith TIP samples from handline and longline landings taken in the Gulf of Mexico during 2001 (age_structure 0-length sample, 1-otolith sample, see Table 1 for number of samples).



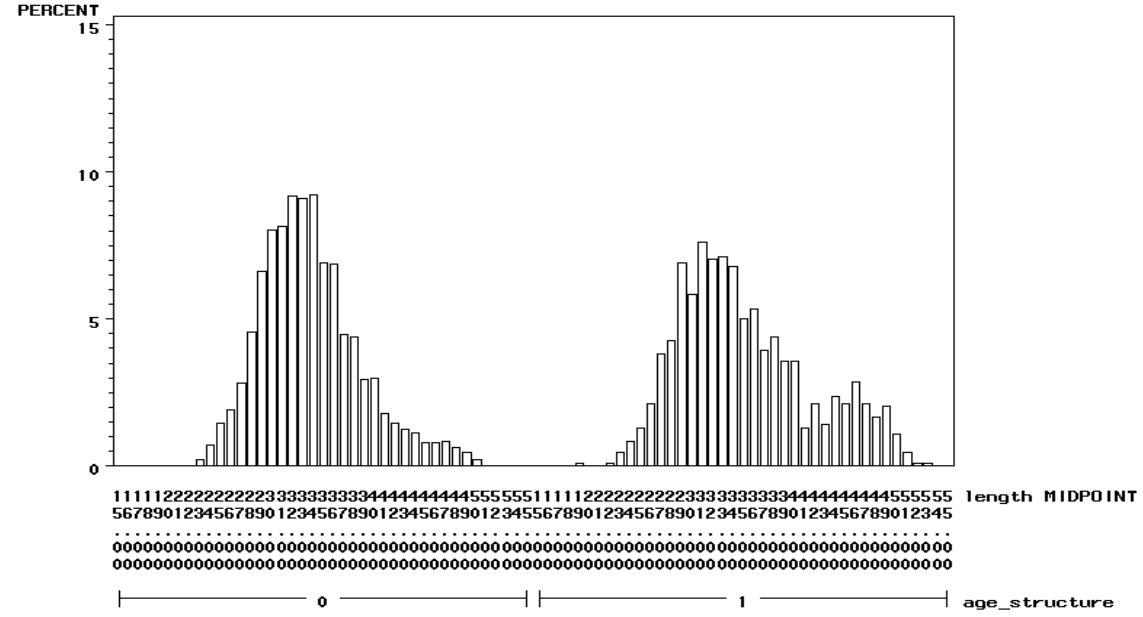
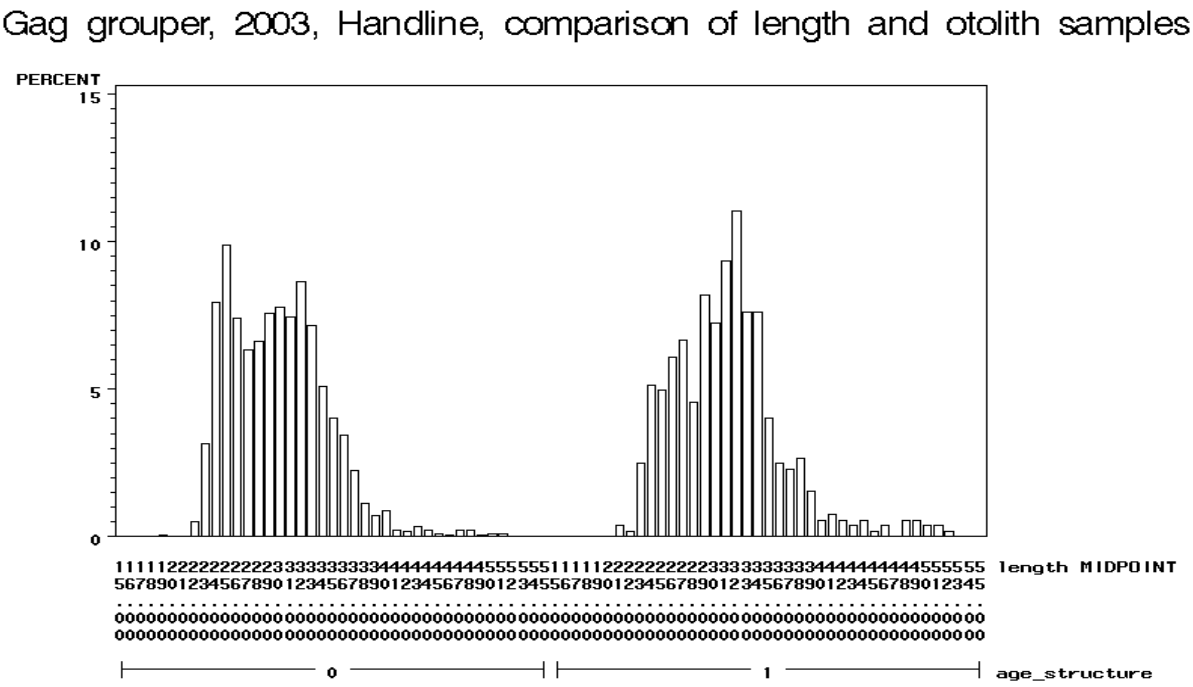


Fig 4.Comparison of gag grouper length and otolith TIP samples from handline and longline landings taken in the Gulf of Mexico during 2003 (age_structure 0-length sample, 1-otolith sample, see Table 1 for number of samples).



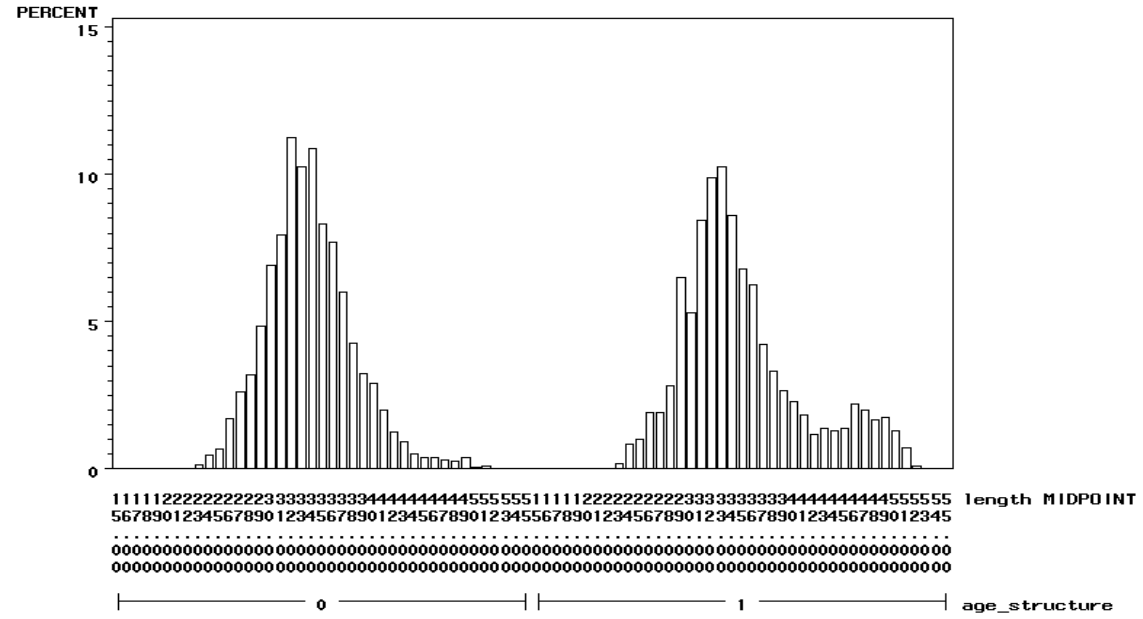
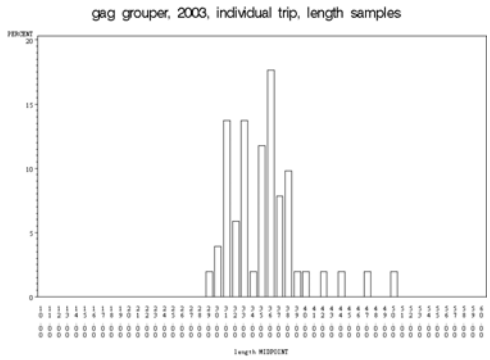
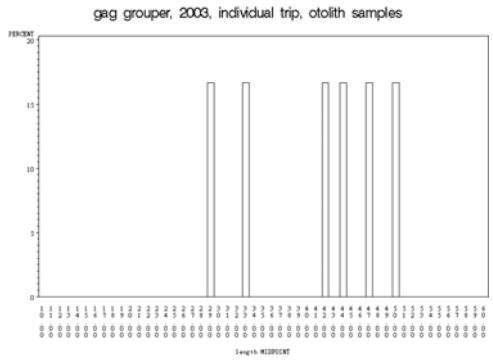


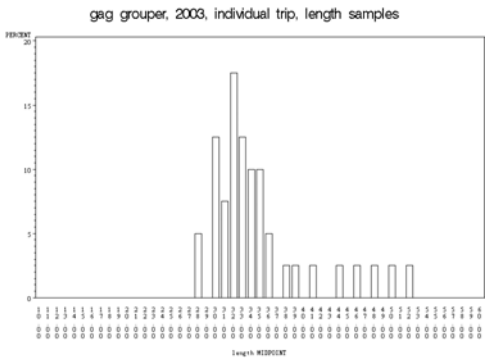
Fig 5. Comparison of the length distributions from individual trips where a larger length sample and a smaller otolith sample were taken from the same landings during 2003. (A) handline, n=40, no=6 (B) longline, n=51, no=6 (C) longline, n=60, no=4 (n-number of length samples, no-number of otolith samples).

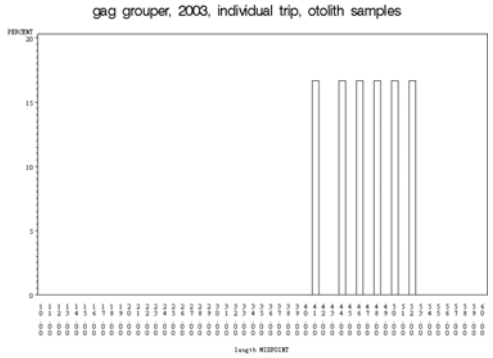
(A).



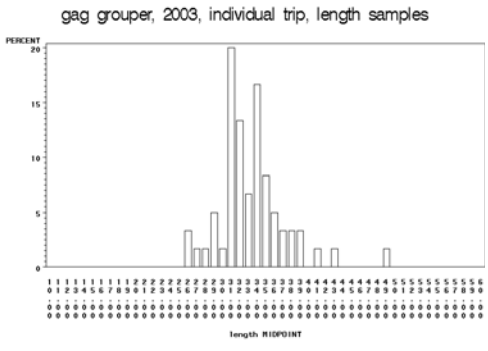


(B).





(C).



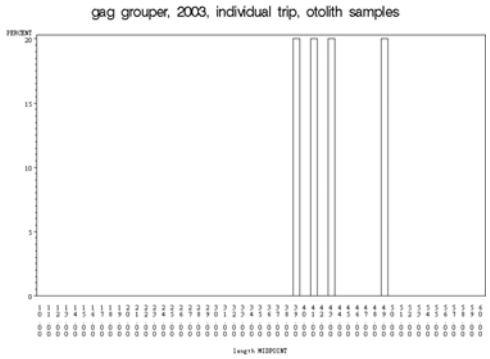
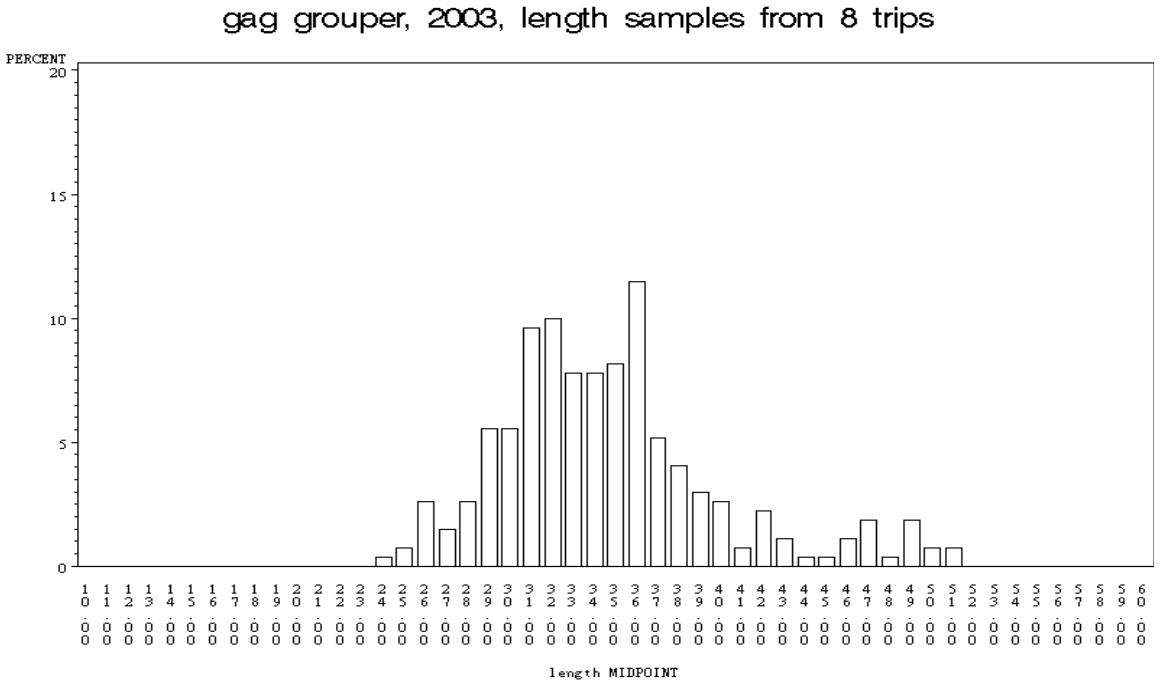


Fig 6. Comparison of the length distributions of length and otolith samples combined from 8 individual trips where a larger length sample and a smaller otolith sample were taken from the same landings during 2003. (total number of length sample=270, total number of otolith sample=33).



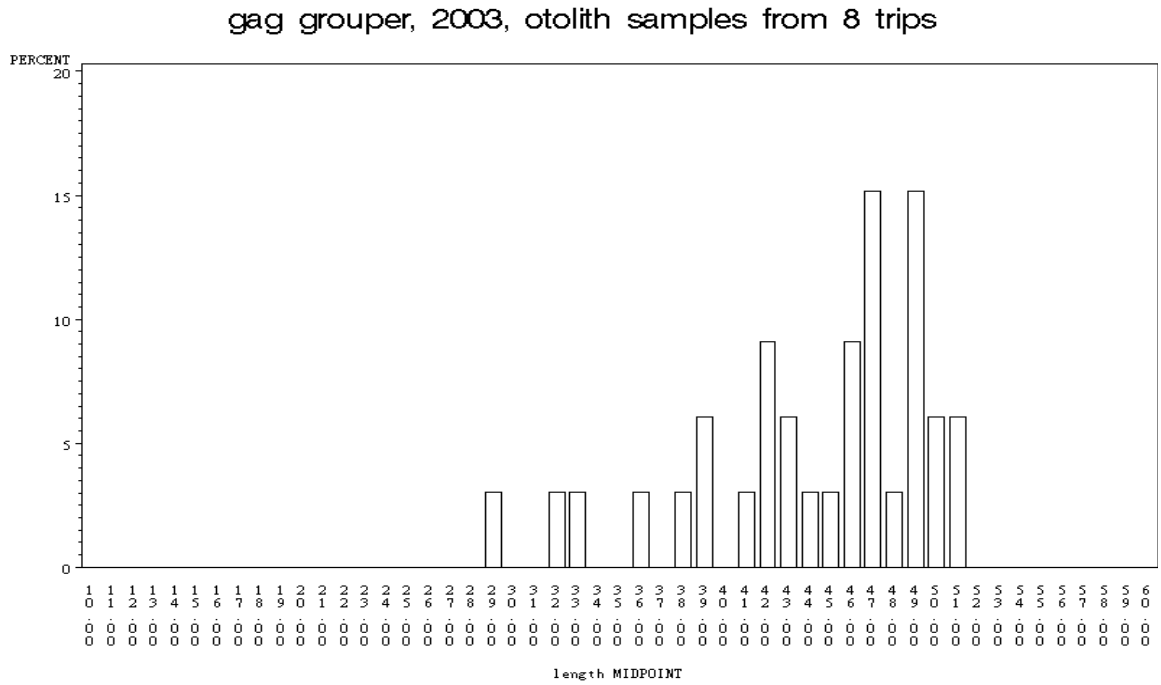
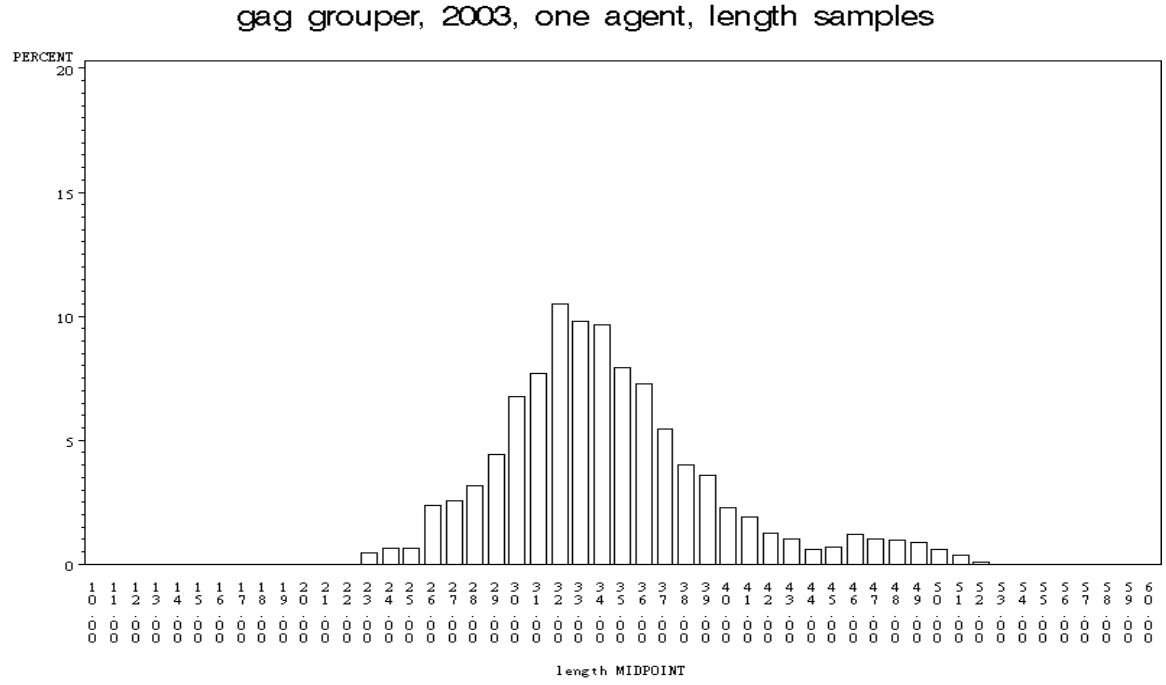


Fig 7. Comparison of length distributions for otolith and length samples collected by one TIP sampler in 2003 (total length number=1158, total otolith number=222). Note that otolith and length samples were from the same landings.



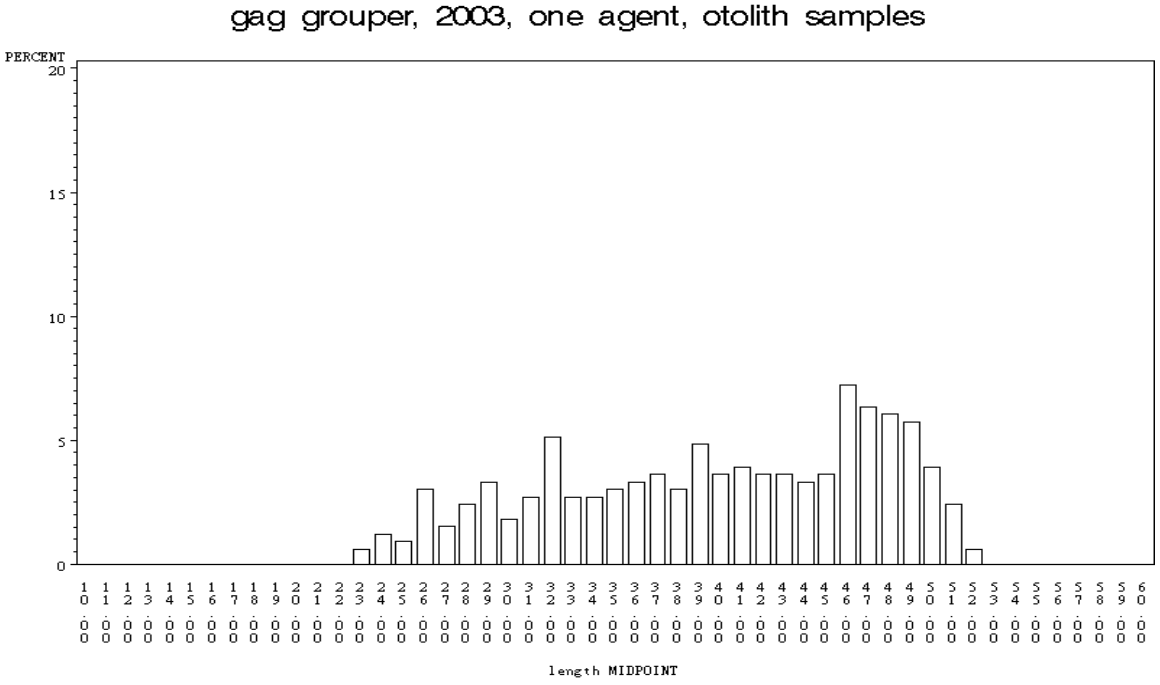


Fig 8. Comparison of length distributions for otolith and length samples collected by one TIP sampler in 2001 (total length number=759, total otolith number=106). Note that otolith and length samples were from the same landings.

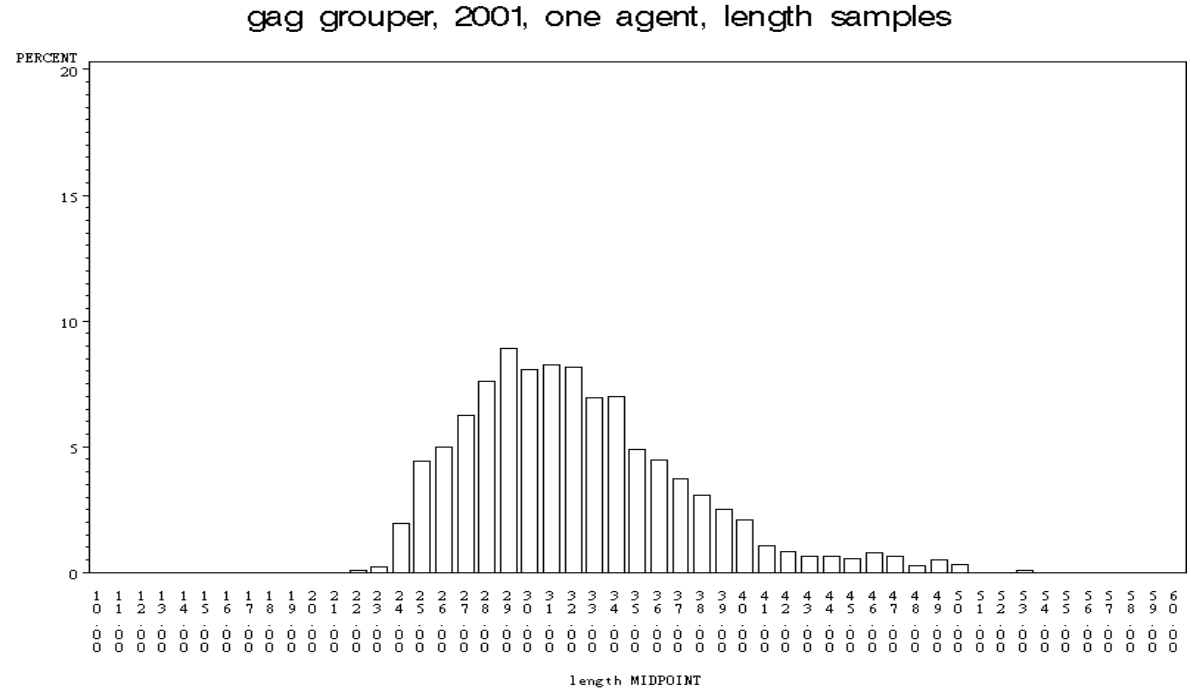


Fig 9 Comparison of length distributions for length samples with different sample sizes from handline landings in 2003.

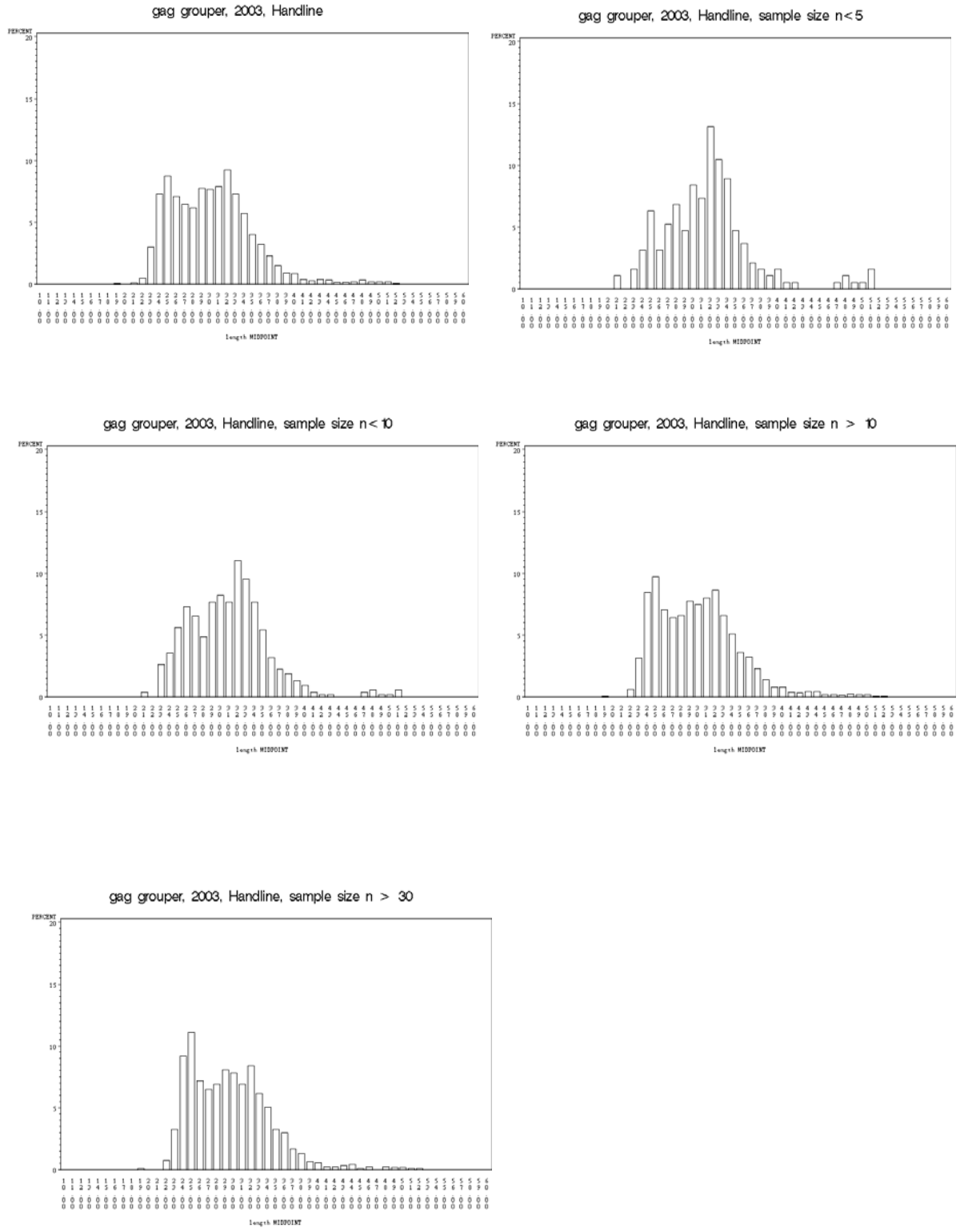
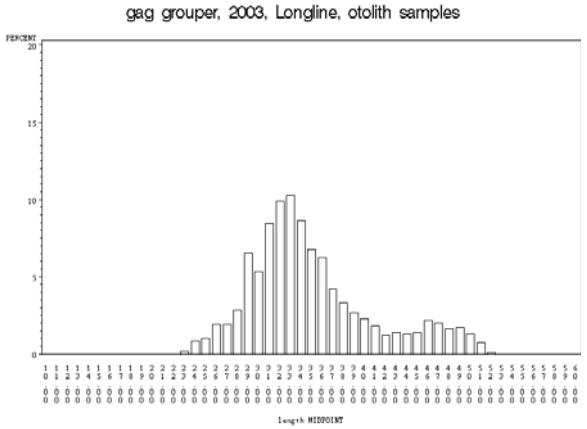
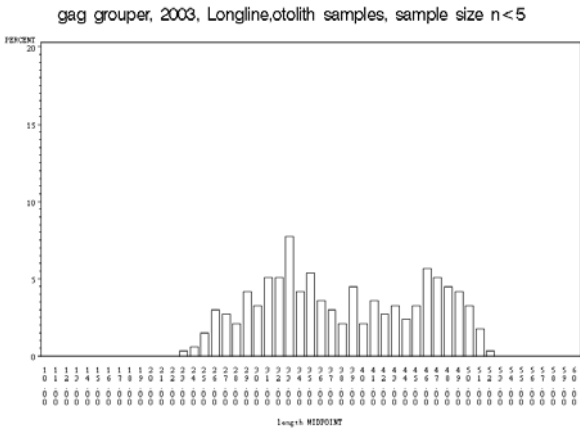
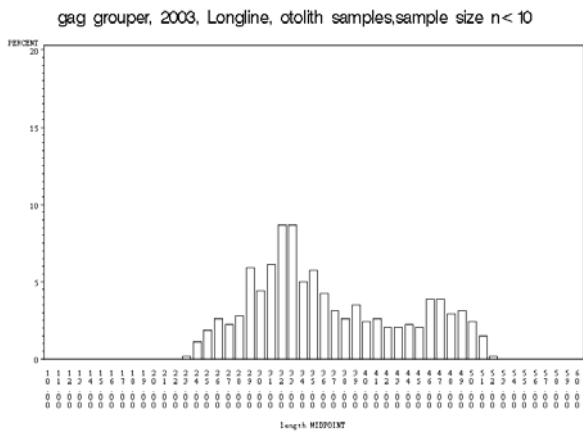
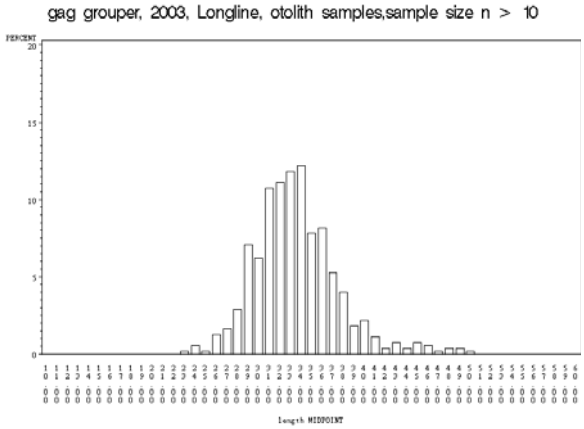


Fig 10. Comparison of length distributions for otolith samples with different sample sizes from longline landings in 2003.









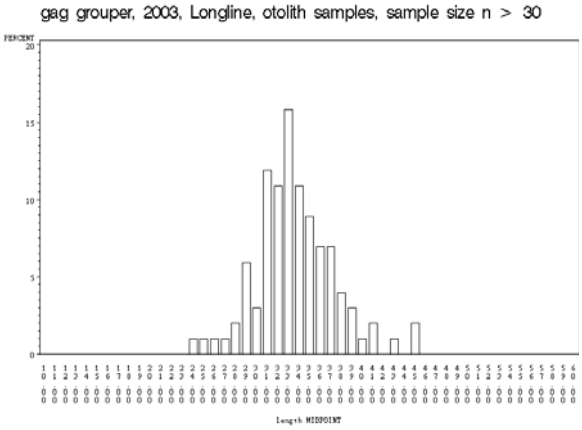


Fig 11. Comparison of length distributions for length samples with different sample sizes from landings in 1998.

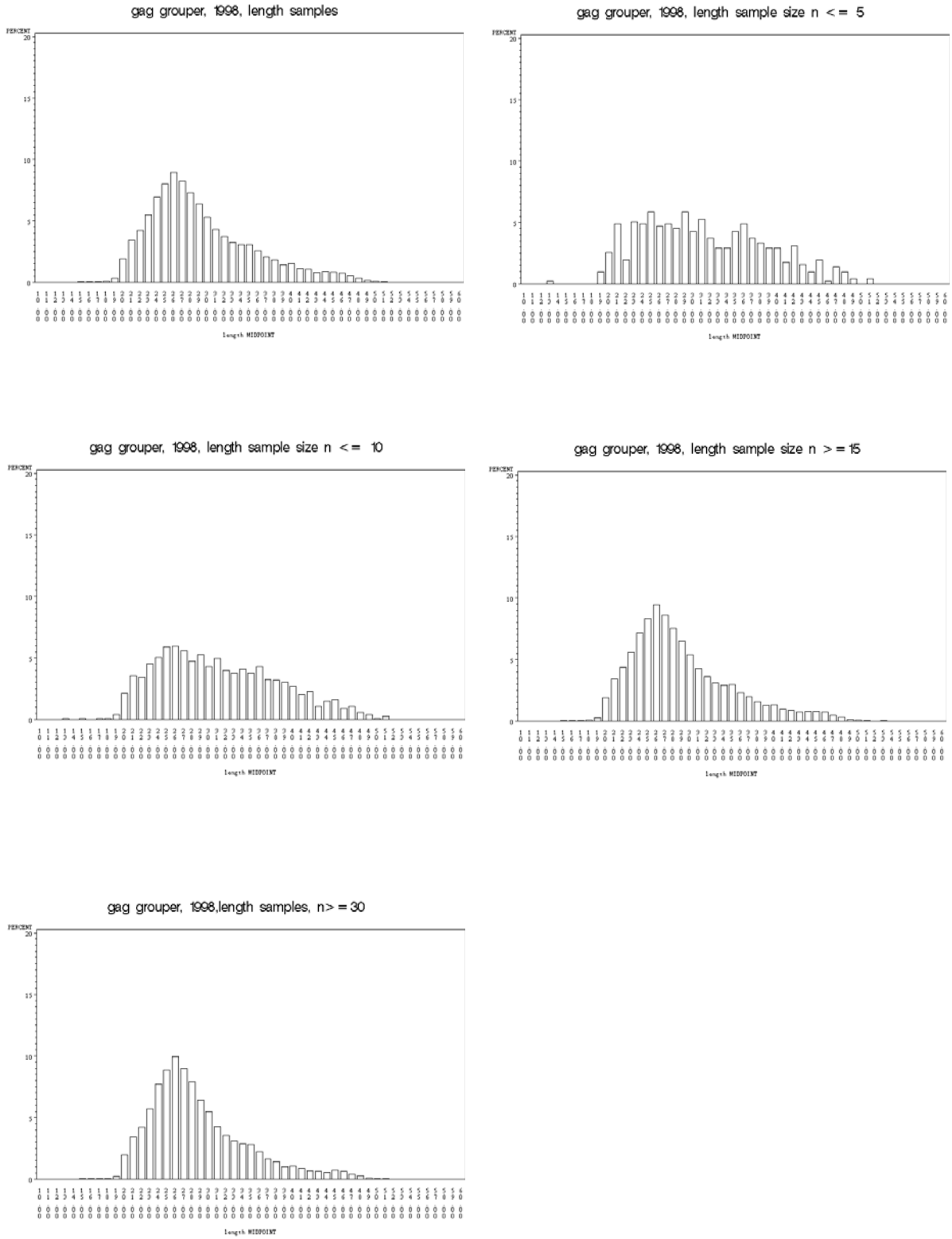


Fig 12. Comparison of length distributions for length samples with different sample sizes from handline landings in 2003 (ss-sample size, lw-landing weight, see section II for details).

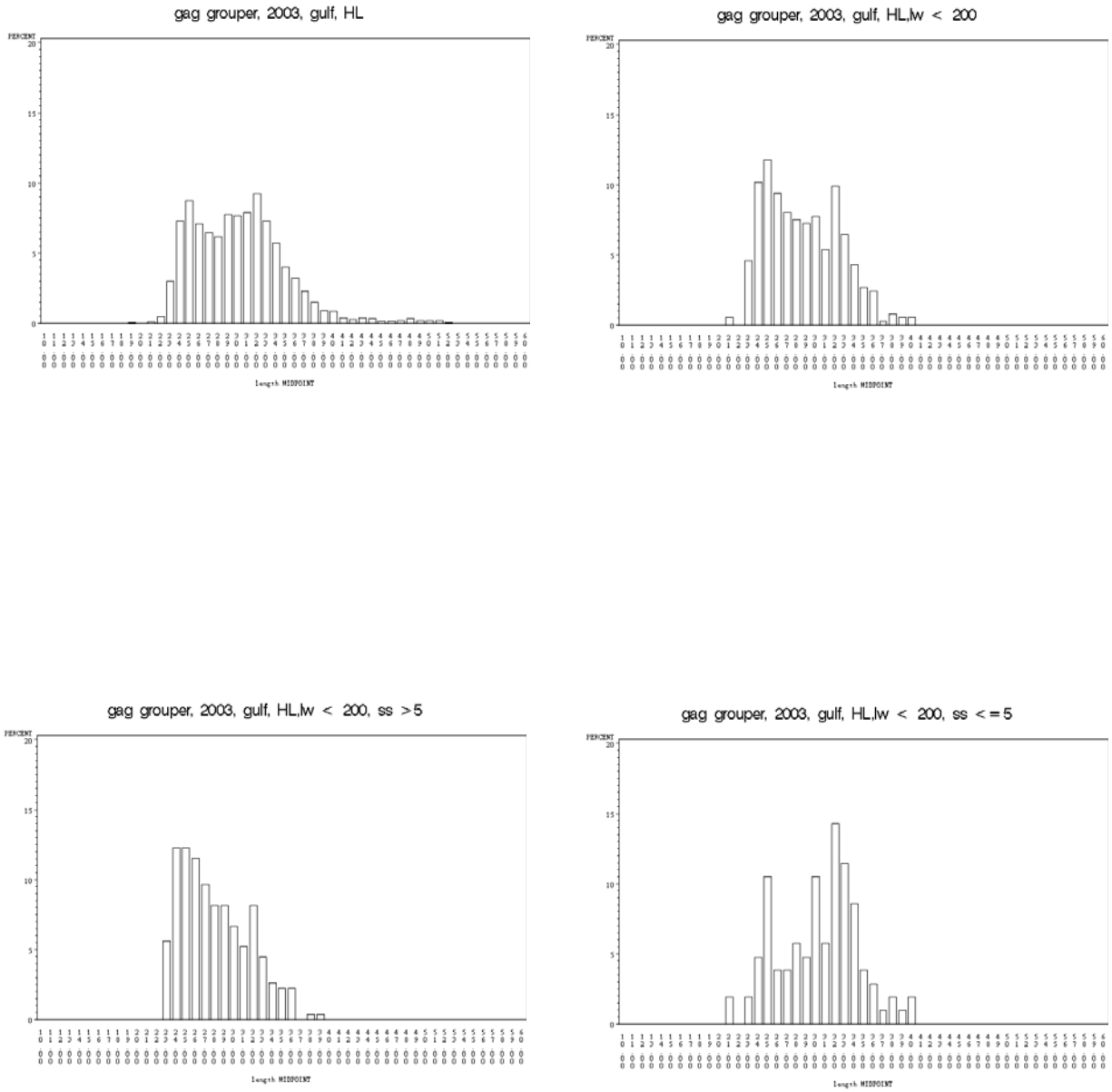
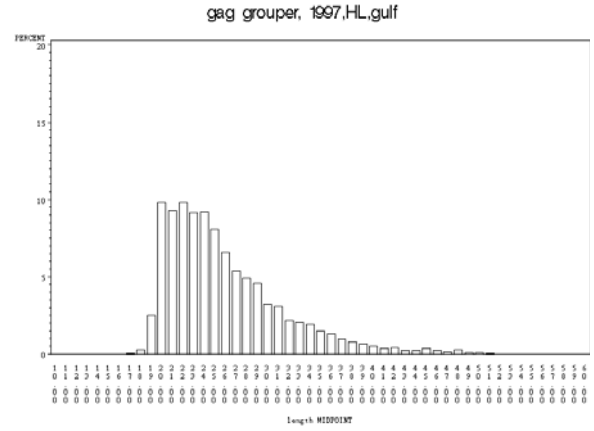
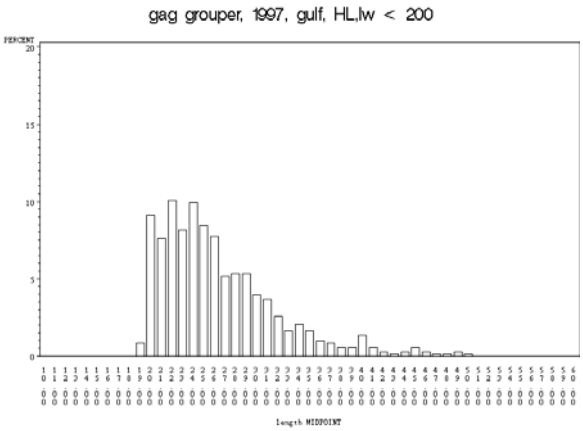
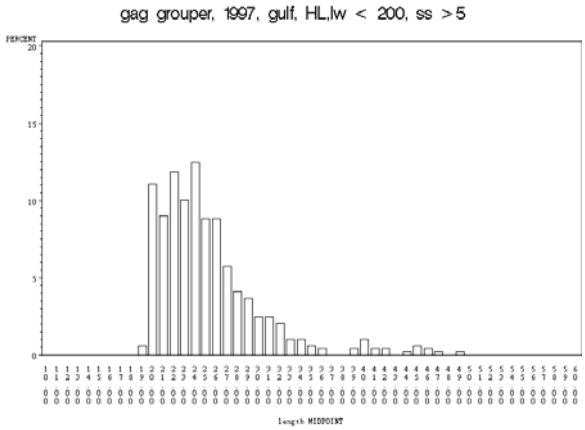


Fig 13. Comparison of length distributions for length samples with different sample sizes from handline landings in 1997 (ss-sample size, lw-landing weight, see section II for details).







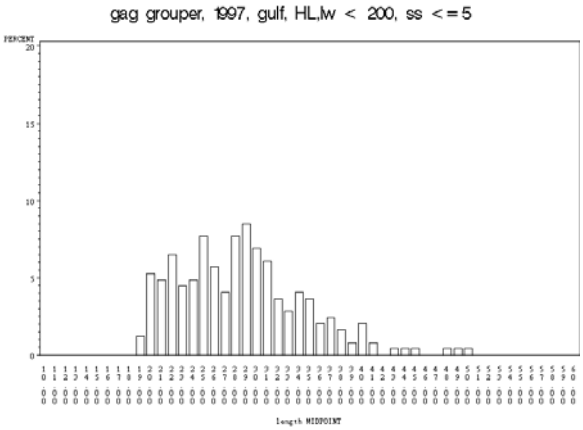
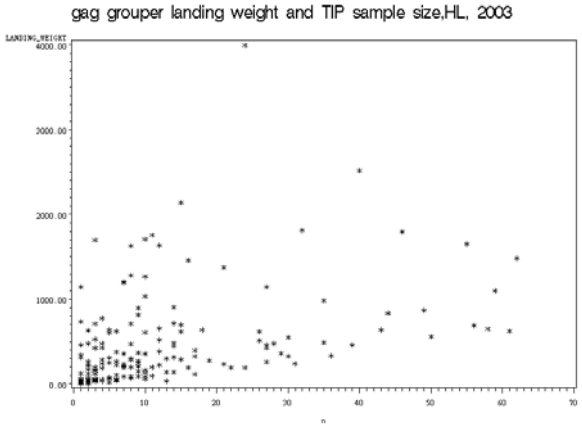
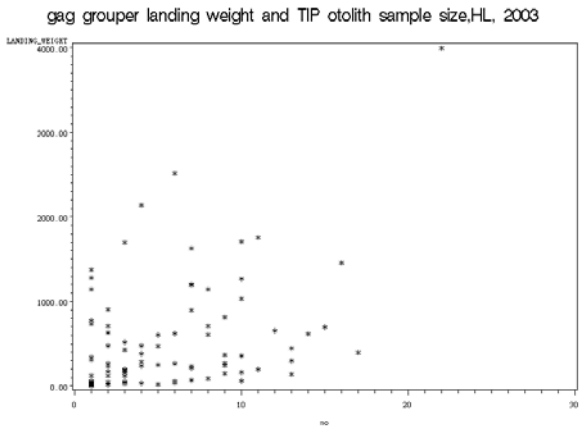
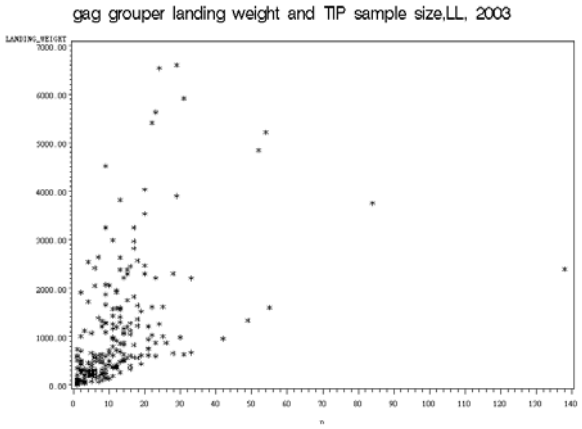


Fig 14. The relationship of landing weight to sample size in gag grouper TIP samples collected from landings caught by handline and longline in 2003.







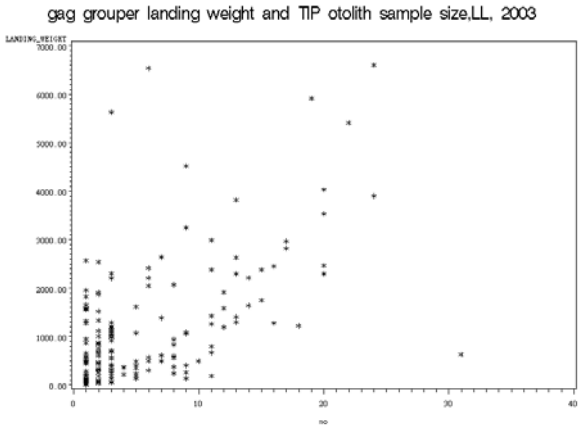
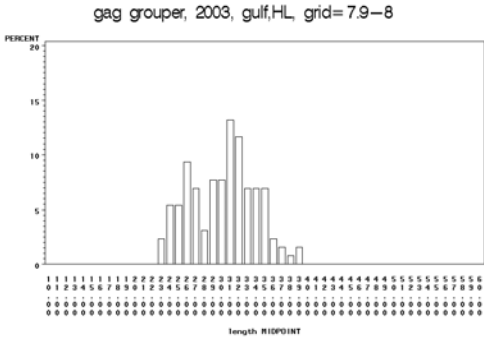
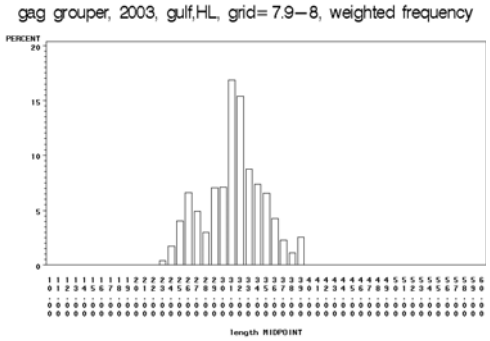


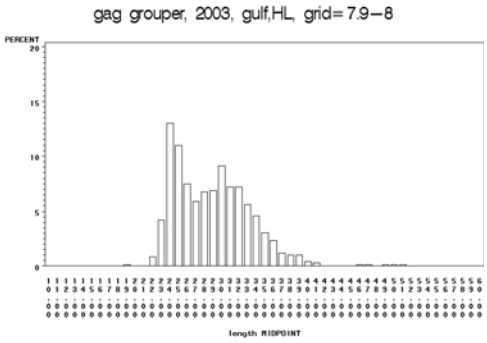
Fig 15. Effect of weighting by landing weight on the length distributions of samples collected by individual samplers and collected at grid 7.9-8.

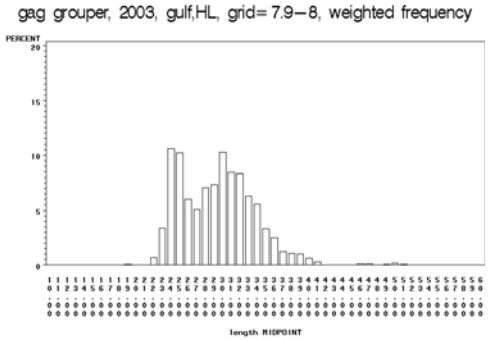
(1) Agent A, grid 7.9-8.



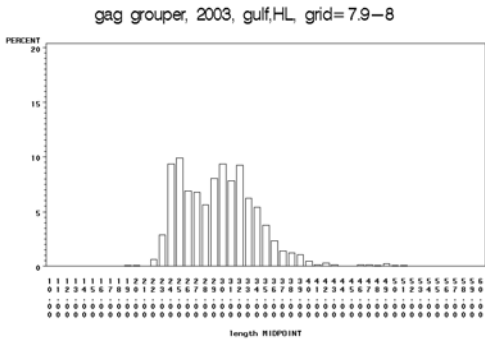


(2) Agent B, grid 7.9-8.





(3). All agents, grid 7.9-8.



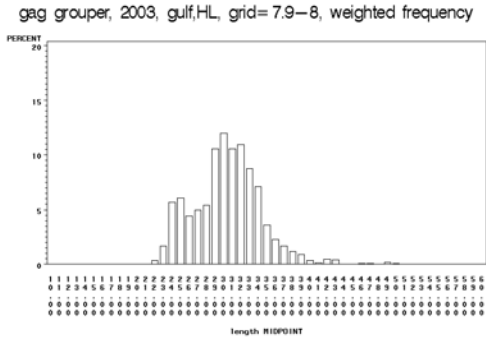
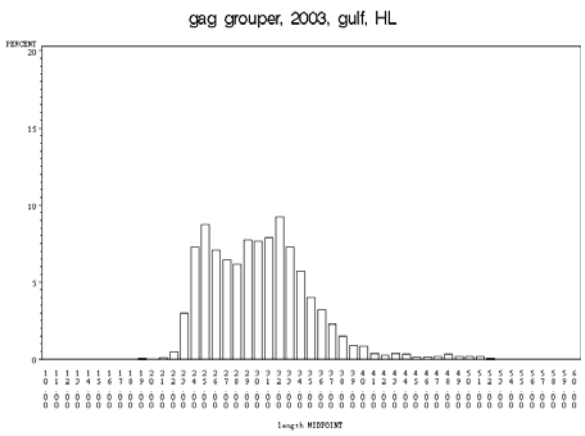
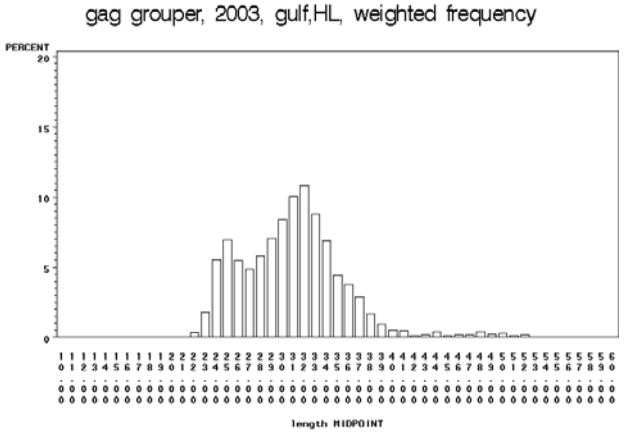
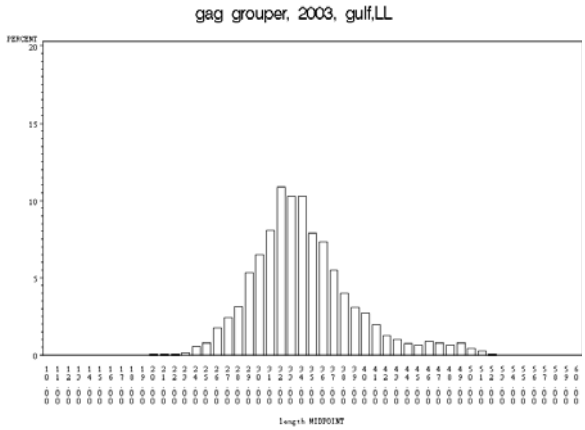
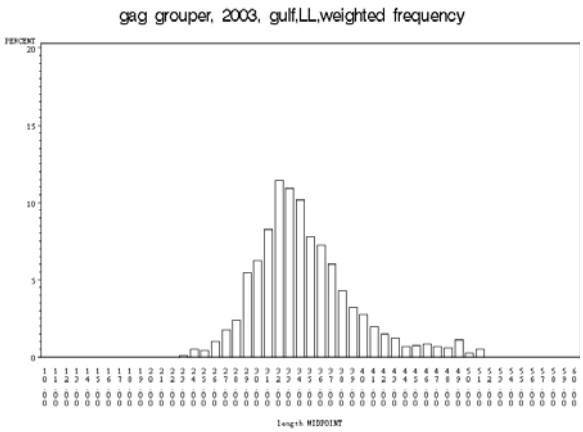


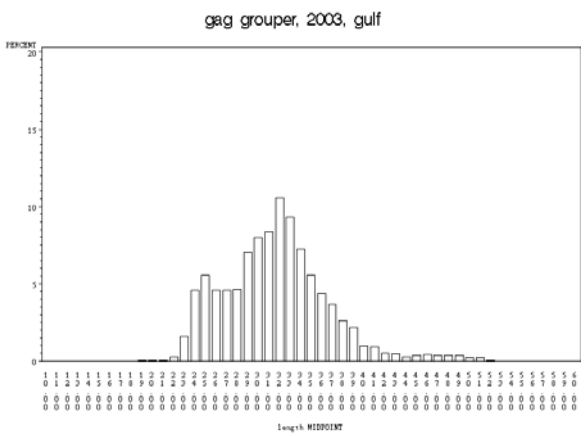
Fig 16. Effect of weighting by landing weight on the length distributions of length samples collected in the Gulf of Mexico during 2003.











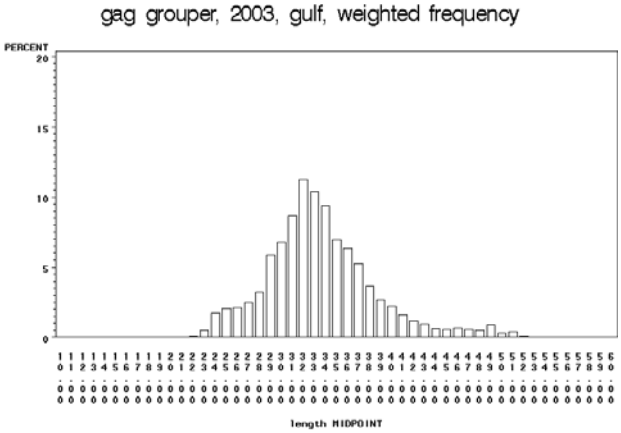


Fig 17. Effect of weighting by landing weight on the length distributions of length samples collected in the Gulf of Mexico during 2000.

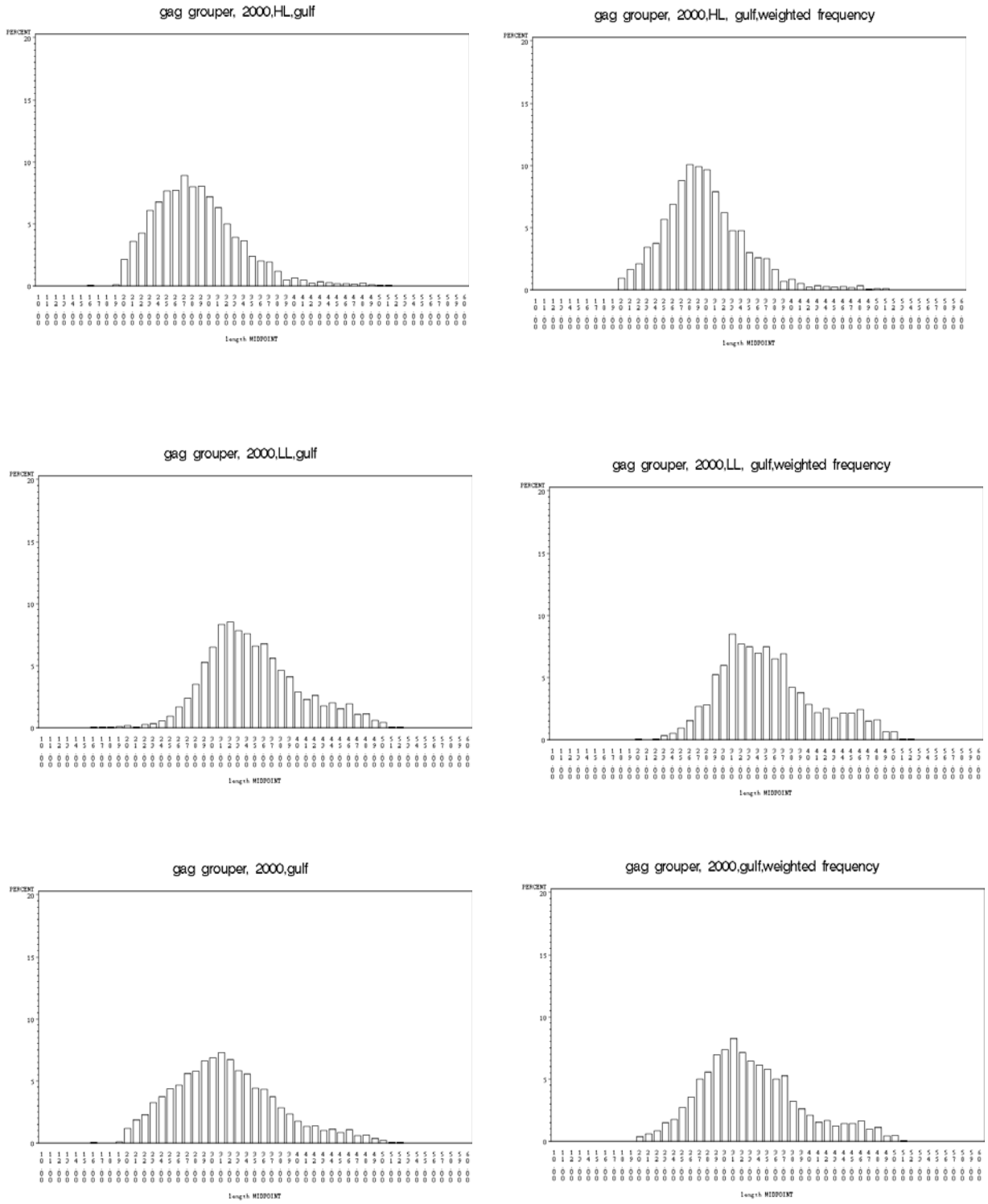


Fig18. Comparison of length distributions for gag grouper TIP samples from landings caught by handline and longline in 1990.

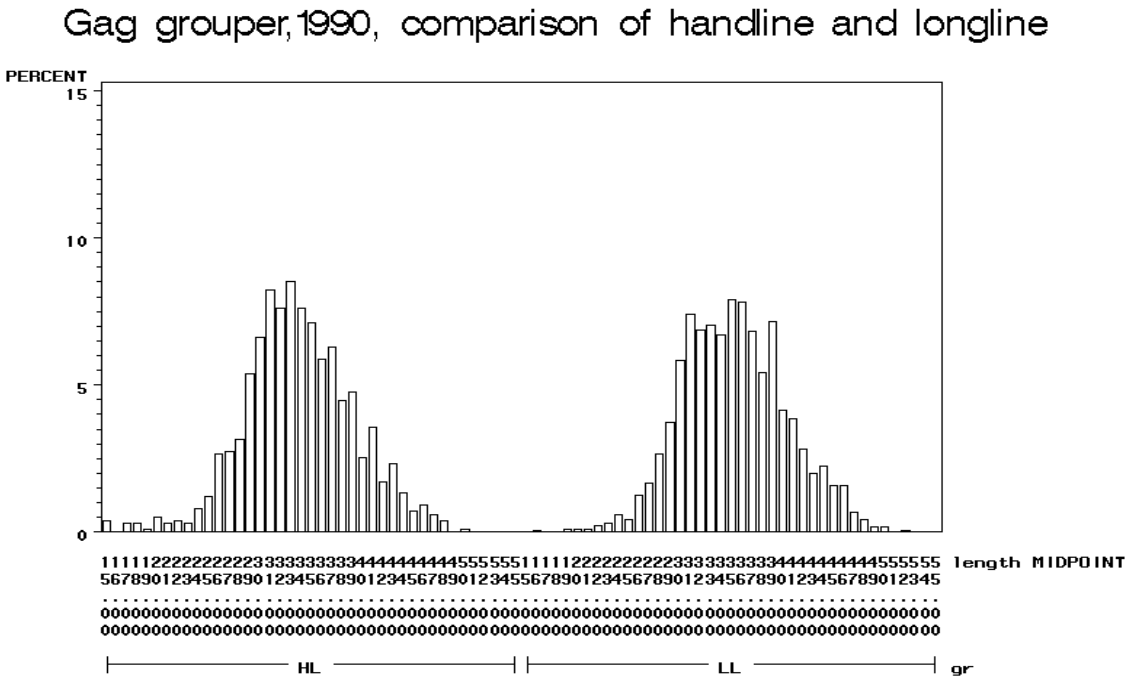


Fig19. Comparison of length distributions for gag grouper TIP samples from landings caught by handline and longline in 1991.

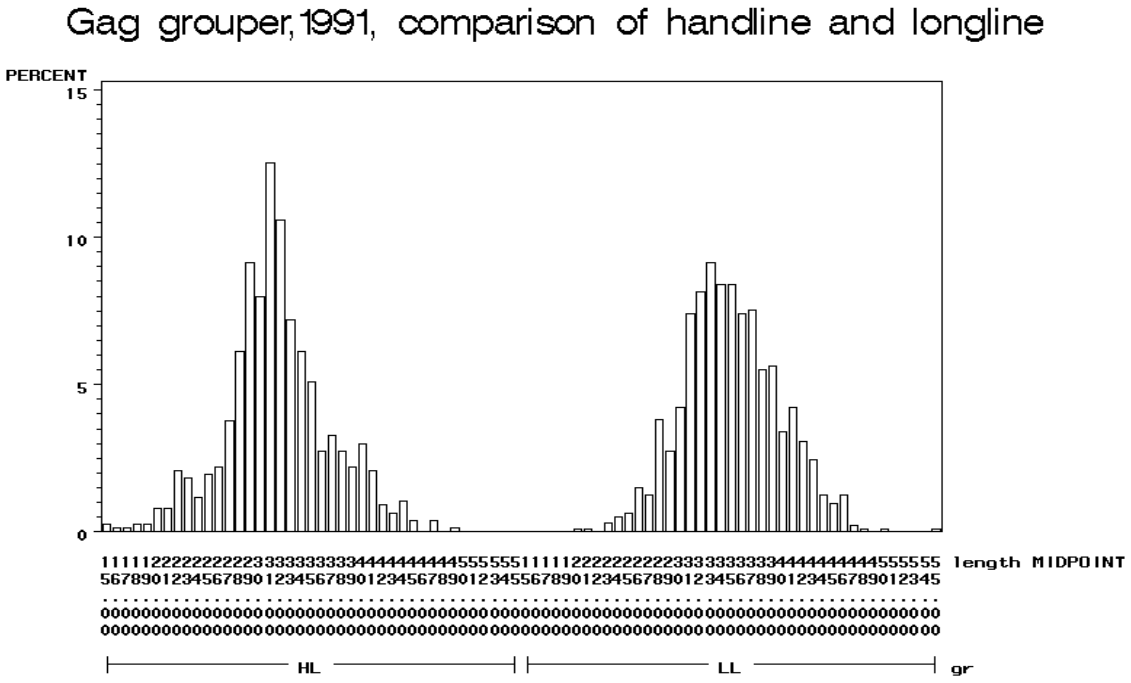


Fig 20. Comparison of length distributions for gag grouper TIP samples from landings caught by handline and longline in 1992.

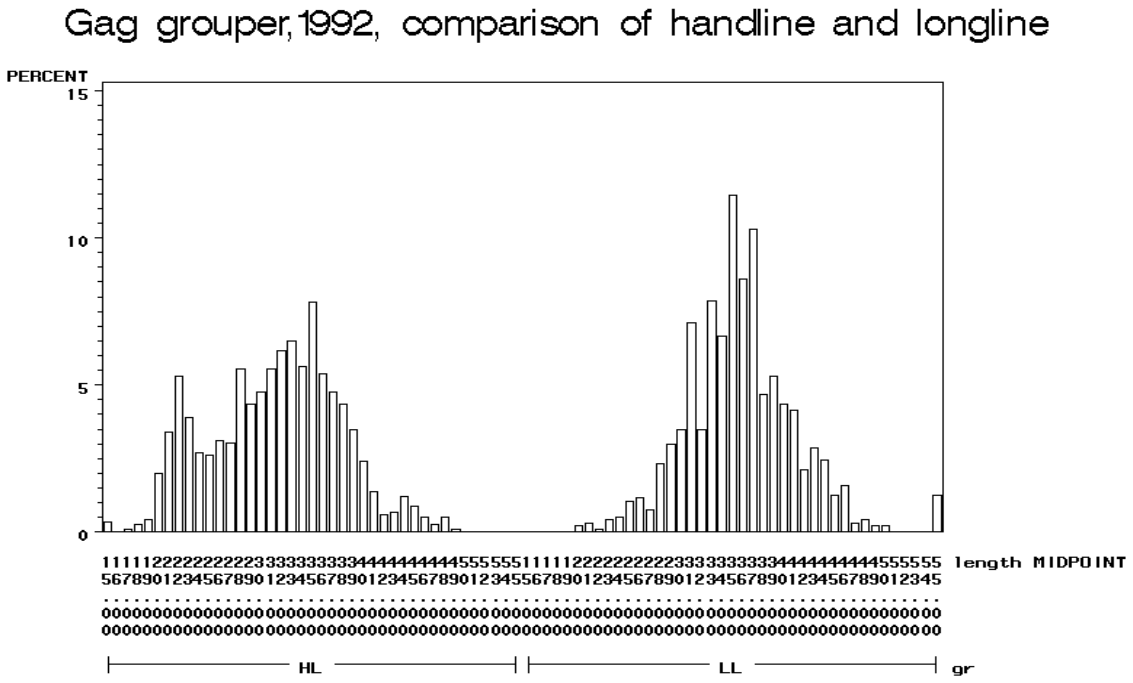


Fig 21. Comparison of length distributions for gag grouper TIP samples from landings caught by handline and longline in 1993.

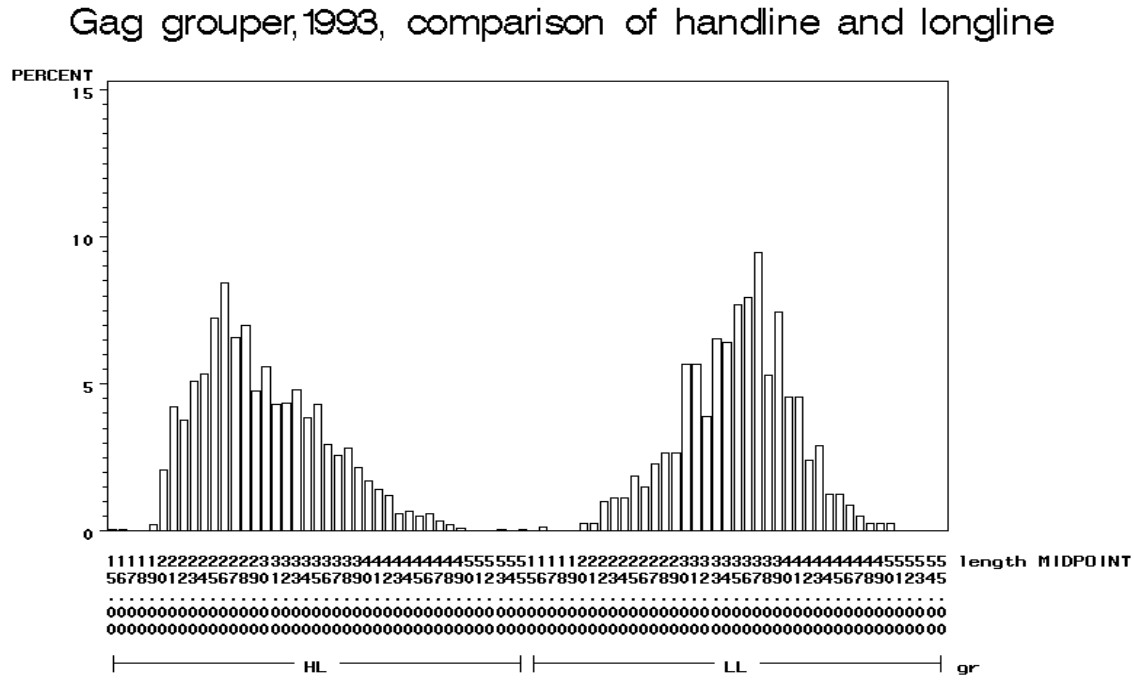


Fig 22. Comparison of length distributions for gag grouper TIP samples from landings caught by handline and longline in 1994.

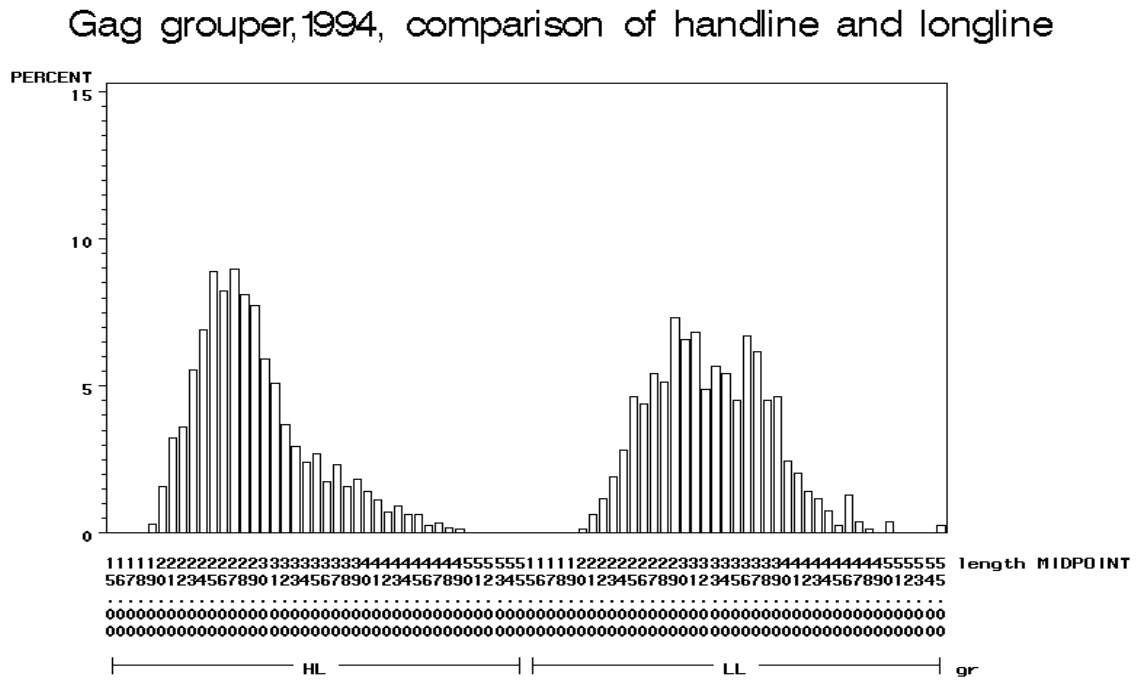


Fig 23. Comparison of length distributions for gag grouper TIP samples from landings caught by handline and longline in 1995.

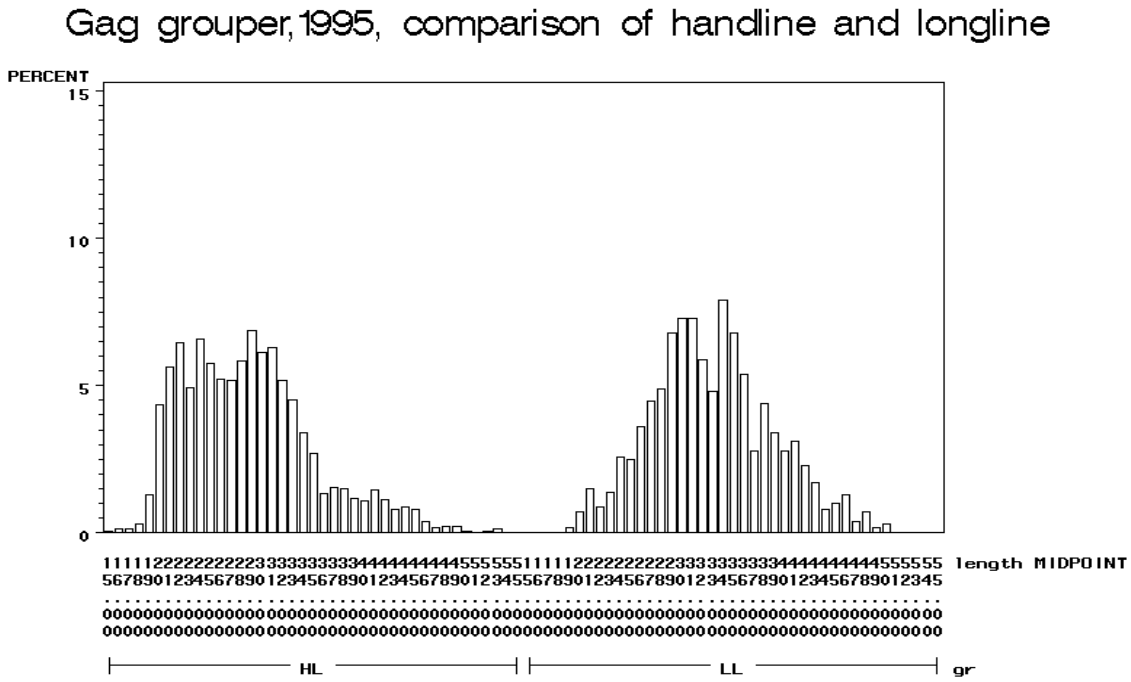


Fig 24. Comparison of length distributions for gag grouper TIP samples from landings caught by handline and longline in 1996.

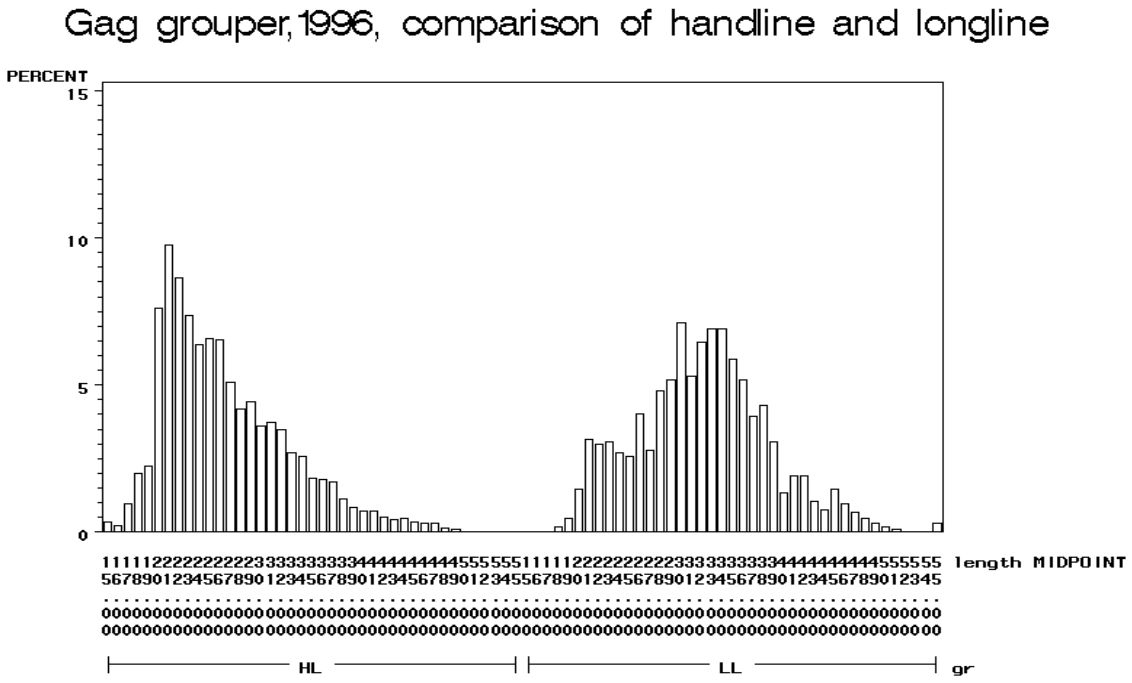


Fig 25. Comparison of length distributions for gag grouper TIP samples from landings caught by handline and longline in 1997.

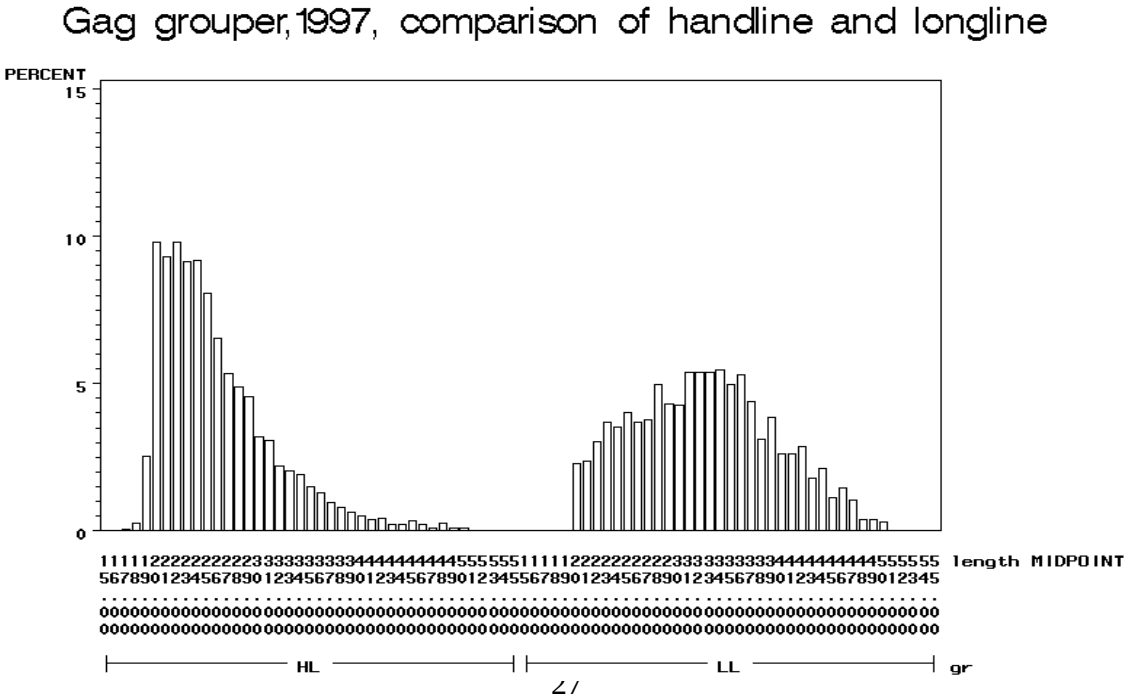


Fig 26. Comparison of length distributions for gag grouper TIP samples from landings caught by handline and longline in 1998.

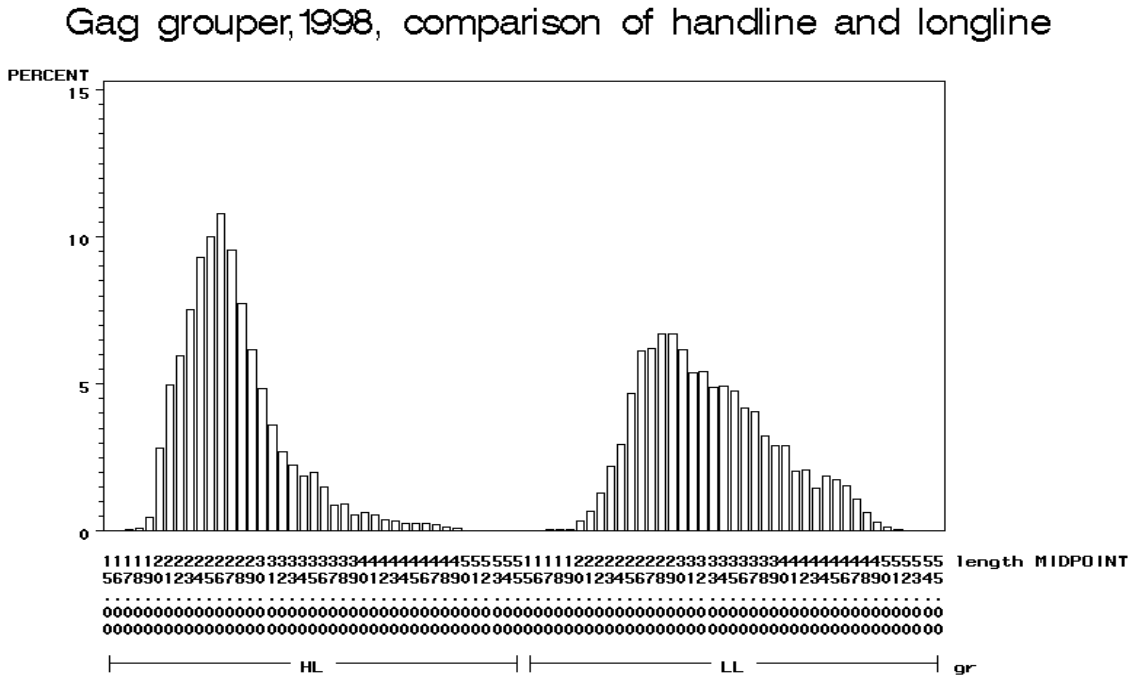


Fig 27. Comparison of length distributions for gag grouper TIP samples from landings caught by handline and longline in 1999.

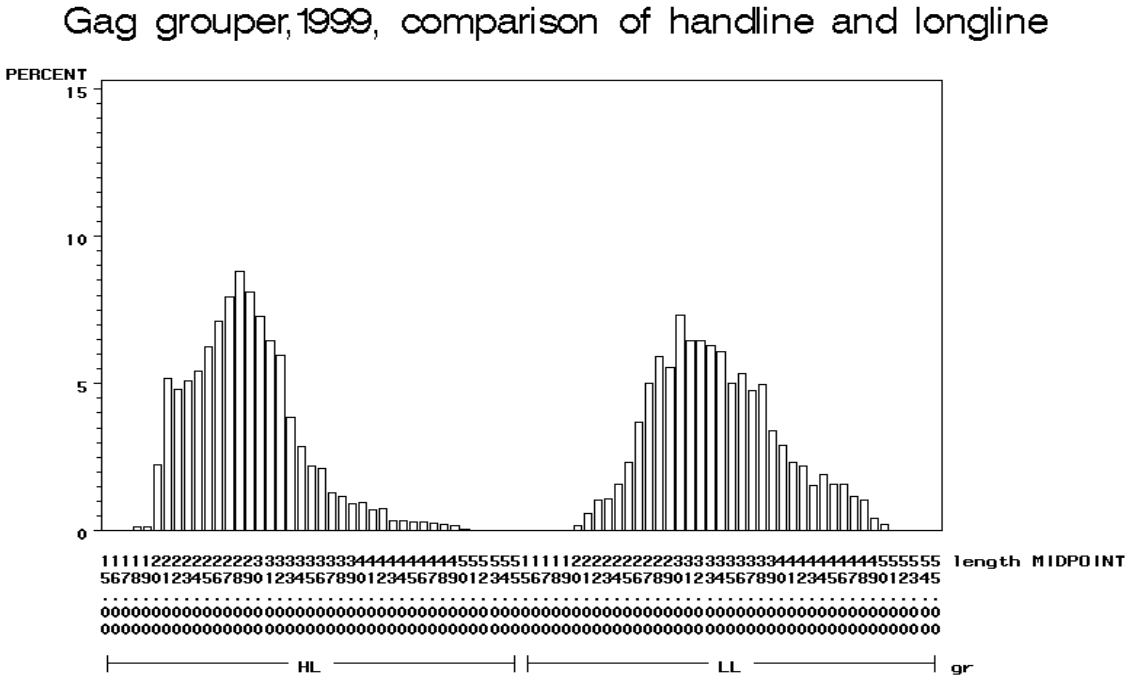


Fig 28. Comparison of length distributions for gag grouper TIP samples from landings caught by handline and longline in 2000.

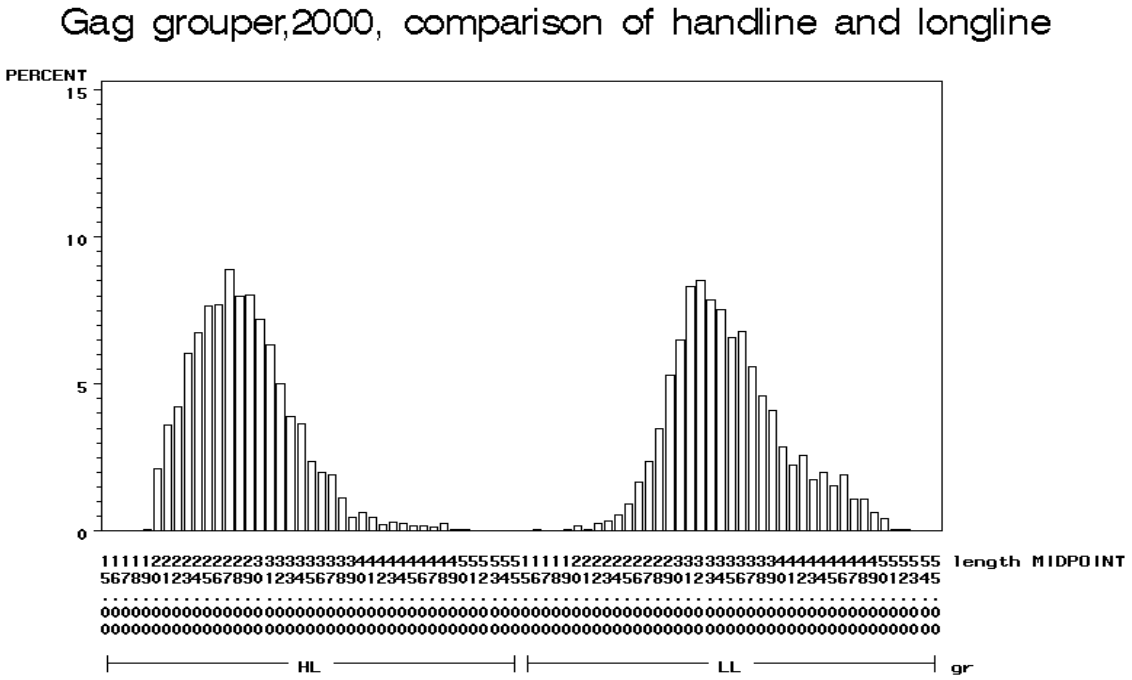


Fig 29. Comparison of length distributions for gag grouper TIP samples from landings caught by handline and longline in 2001.

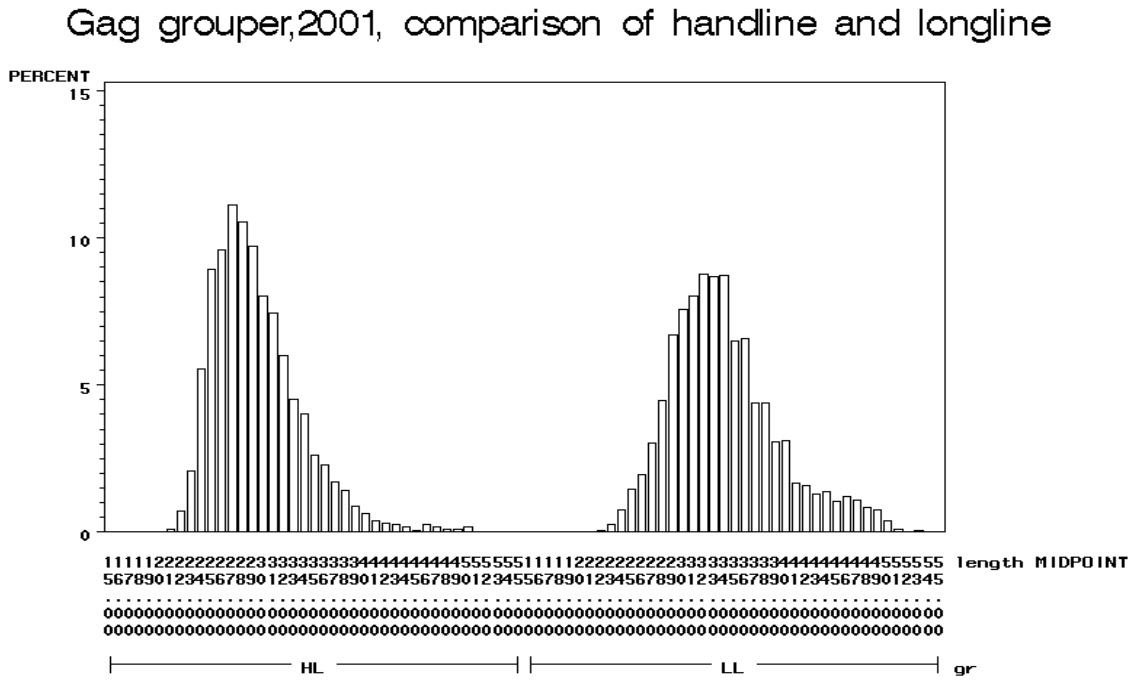


Fig 30. Comparison of length distributions for gag grouper TIP samples from landings caught by handline and longline in 2002.

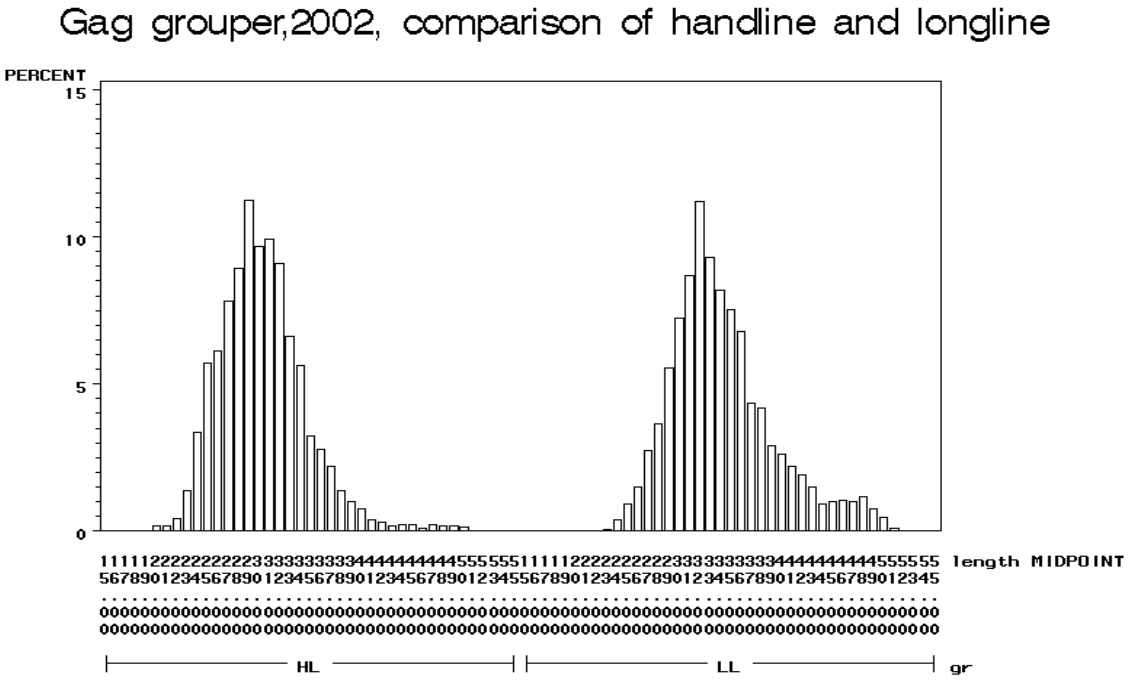


Fig 31. Comparison of length distributions for gag grouper TIP samples from landings caught by handline and longline in 2003.

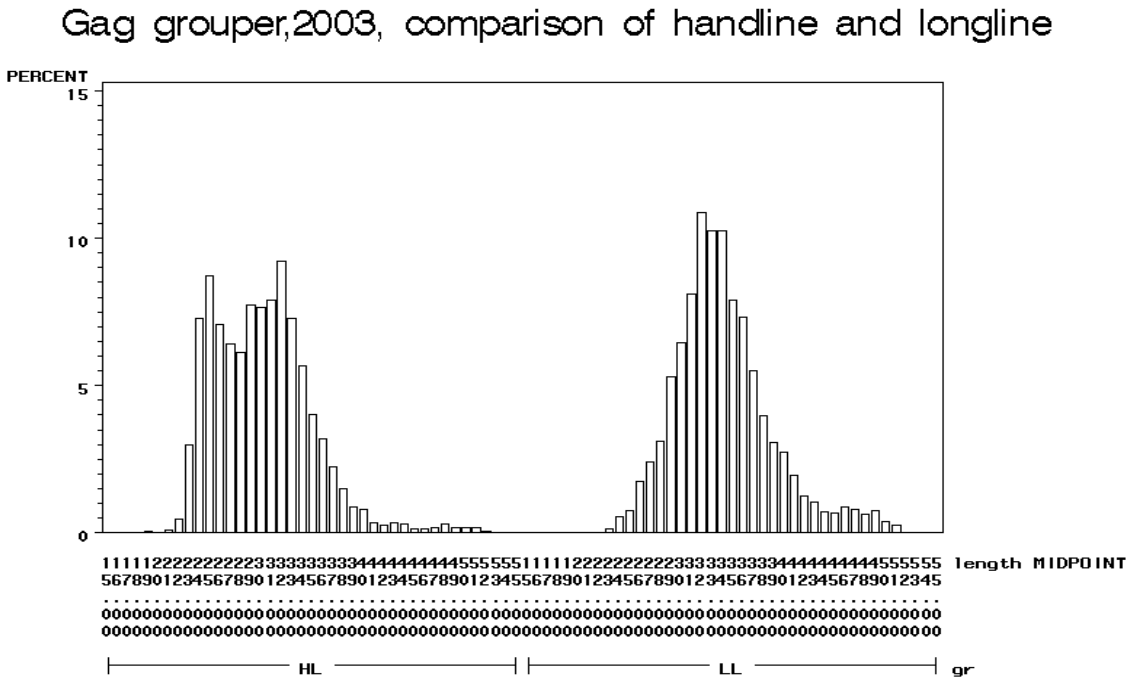


Fig 32. Comparison of length distributions for gag grouper TIP samples from landings caught by handline and longline in 2004.

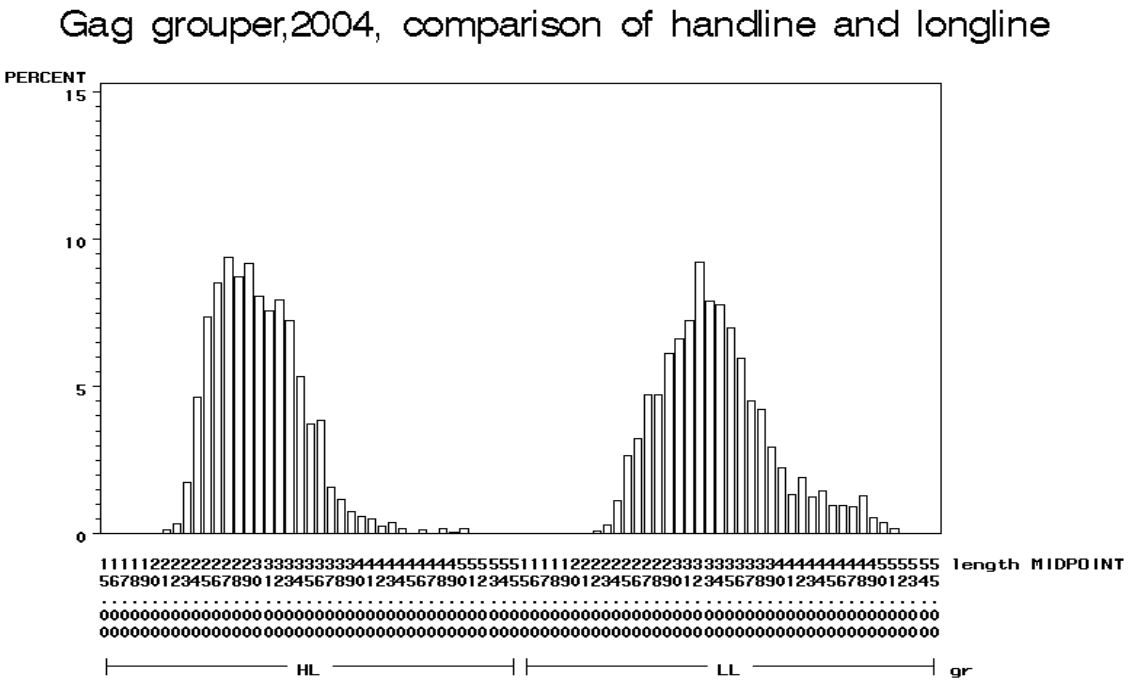


Table 1. Number of length and otolith samples for gag groupers collected by TIP samplers in the Gulf of Mexico during 1984-2004.

YEAR	#otoliths	# of lengths (excluding otoliths)	# of lengths (Handline)	# of lengths (Longline)	# of otoliths (Handline)	# of otoliths (Longline)
1984		1288	830	458		
1985		1463	795	597		
1986		1534	360	1133		
1987		1244	559	685		
1988		451	175	276		
1989		233	42	170		
1990		2645	984	1660		
1991	130	1611	766	943	123	7
1992	101	2050	1153	943	82	19
1993	449	2284	1911	793	434	13
1994	523	3154	2867	777	517	3
1995	377	3079	2449	1002	335	42
1996	294	3930	3145	1040	230	61
1997	88	4931	3403	1224	78	10
1998	232	13055	8074	5068	134	95
1999	226	10809	6070	4659	65	159
2000	302	8110	4021	4201	198	98
2001	1528	8350	5431	4160	684	841
2002	1852	6701	4116	4149	797	1038
2003	1619	4627	2214	3930	525	1091
2004	2215	3328	2790	2738	853	1362

Table 2. Number and percent of trips sampled by TIP samplers that had sample sizes less than five and that had sample sizes less than 10 during 1984-2004

YEAR	# of trips	#of trips length ss<=5	#of trips otolith ss<=5	#of trips length ss<=10	#of trips otolith ss<=10
1984	57	21.05%		40.35%	
1985	102	42.16%		53.92%	
1986	106	28.30%		51.89%	
1987	57	17.54%		33.33%	
1988	25	8.00%		40.00%	
1989	10			40.00%	
1990	143	31.47%		44.76%	
1991	241	62.24%	42.86%	77.18%	66.67%
1992	240	59.17%	91.43%	70.42%	94.29%
1993	326	60.12%	75.82%	76.07%	85.71%
1994	309	54.69%	42.31%	69.26%	61.54%
1995	342	56.43%	64.29%	72.22%	82.14%
1996	370	51.08%	54.55%	68.65%	72.73%
1997	398	57.29%	80.00%	71.36%	86.67%
1998	594	31.82%	63.64%	46.63%	81.82%
1999	604	37.25%	80.00%	56.29%	92.73%
2000	509	40.86%	68.33%	56.97%	86.67%
2001	500	33.40%	53.67%	48.20%	75.23%
2002	528	33.33%	57.42%	51.89%	76.17%
2003	527	37.57%	68.54%	59.77%	85.36%
2004	458	42.58%	53.66%	65.72%	79.27%

Table 3. Total TIP sample numbers for trips with different sample sizes during 1984-2004.

YEAR	total n	ss <=5	% ss<=5	ss <=10	% ss<=10	ss > 15	% ss >15	ss > 30	% ss > 30
1984	1288	30	2.33%	119	9.24%	1080	83.85%	748	58.07%
1985	1463	89	6.08%	183	12.51%	1137	77.72%	690	47.16%
1986	1534	83	5.41%	285	18.58%	1045	68.12%	563	36.70%
1987	1244	19	1.53%	92	7.40%	1058	85.05%	656	52.73%
1988	451	4	0.89%	62	13.75%	314	69.62%	183	40.58%
1989	233			32	13.73%	201	86.27%	164	70.39%
1990	2645	103	3.89%	238	9.00%	2161	81.70%	1409	53.27%
1991	1741	331	19.01%	585	33.60%	945	54.28%	448	25.73%
1992	2151	290	13.48%	498	23.15%	1402	65.18%	689	32.03%
1993	2733	462	16.90%	861	31.50%	1505	55.07%	866	31.69%
1994	3677	355	9.65%	700	19.04%	2599	70.68%	1863	50.67%
1995	3456	484	14.00%	884	25.58%	2203	63.74%	1345	38.92%
1996	4224	401	9.49%	908	21.50%	2969	70.29%	1849	43.77%
1997	5019	520	10.36%	942	18.77%	3716	74.04%	2860	56.98%
1998	13287	513	3.86%	1224	9.21%	11364	85.53%	9172	69.03%
1999	11035	575	5.21%	1461	13.24%	8723	79.05%	7039	63.79%
2000	8412	524	6.23%	1167	13.87%	6702	79.67%	4853	57.69%
2001	9878	450	4.56%	1039	10.52%	7934	80.32%	5999	60.73%
2002	8553	432	5.05%	1199	14.02%	6345	74.18%	3994	46.70%
2003	6246	495	7.93%	1423	22.78%	3676	58.85%	1828	29.27%
2004	5543	494	8.91%	1335	24.08%	3419	61.68%	2075	37.43%

Table 4. Number and percentage of gag grouper TIP sampling trips with landing weight information during 1984-2004.

YEAR	# of trips	# of trips with landing weight information	% trips with laniding weight information
1984	48	57	84.21%
1985	83	104	79.81%
1986	97	107	90.65%
1987	54	58	93.10%
1988	21	25	84.00%
1989	10	10	100.00%
1990	125	143	87.41%
1991	200	241	82.99%
1992	220	241	91.29%
1993	241	327	73.70%
1994	254	312	81.41%
1995	282	343	82.22%
1996	338	370	91.35%
1997	353	399	88.47%
1998	561	596	94.13%
1999	569	610	93.28%
2000	482	513	93.96%
2001	479	503	95.23%
2002	463	528	87.69%
2003	430	527	81.59%
2004	441	462	95.45%

Table 5. Comparison of the total landing weights of gag groupers from handline and longline trips sampled by TIP samplers in the Gulf of Mexico (HL- handline, LL- longline, n- sample number, lw- landing weight). Note that the ratios of landing weights between handline and longline trips are very different from the ratios of sample numbers.

YEAR	lw, HL	lw, LL	n, HL	n, LL	HL/LL, lw	HL/LL, n
1984	27075	17256	830	458	1.57	1.81
1985	30229	21092	795	597	1.43	1.33
1986	14190	23195	360	1133	0.61	0.32
1987	16400	21805	559	685	0.75	0.82
1988	2943	8866	175	276	0.33	0.63
1989	819	4222	42	170	0.19	0.25
1990	32249	57265	984	1660	0.56	0.59
1991	19290	28046	766	943	0.69	0.81
1992	20499	38191	1153	943	0.54	1.22
1993	38939	28335	1911	793	1.37	2.41
1994	45436	26003	2867	777	1.75	3.69
1995	64197	37251	2449	1002	1.72	2.44
1996	59344	35539	3145	1040	1.67	3.02
1997	50923	44176	3403	1224	1.15	2.78
1998	150036	146025	8074	5068	1.03	1.59
1999	108743	134927	6070	4659	0.81	1.30
2000	77314	122278	4021	4201	0.63	0.96
2001	139838	217839	5431	4160	0.64	1.31
2002	151676	252436	4116	4149	0.60	0.99
2003	78814	247194	2214	3930	0.32	0.56
2004	140328	300471	2790	2738	0.47	1.02