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Length frequency distributions for red groupers caught by commercial fisheries in the Gulf of Mexico from 1984 to 2005

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Introduction

Length frequency distributions for red groupers caught by commercial fisheries in the Gulf of Mexico were constructed from data extracted from the TIP (Trip Interview Program) database. Three factors that may influence length frequency distributions (gear, area and season) were examined. Also, mean gutted weights calculated with conversion factors derived from TIP data were estimated for different gear types and for different years.

This report does not include a discussion of the effects of sampling irregularities on length frequency distributions. Sampling issues seen in commercial catches are discussed in Chih, 2006.

Results & Discussion

I. Conversion of length to weight

Equations for converting fork length (FL) to total length (TL), and for converting total length to gutted (GW) or whole weight (WW), were derived from all TIP records that contained the corresponding information. Outliers were removed during the development of these equations:

$TL = 0.4896 + 1.021 * FL$ (N=1234)

$GW = 0.000291 * TL^{3.1865}$ (N=8626)

$WW = 0.0008493 * TL^{2.8731}$ (N=1201)

II. Changes in length frequency distributions from 1984 to 2005

Most TIP samples were collected from the Florida west coast below grid 7 (Table 1). The length frequency distributions for red grouper TIP samples collected from 1984 to 1989 are very different from those collected from 1990 to 2005 (Fig 2) due to changes in fishing regulations. The 18 inch minimum size regulation set by the state of Florida in 1985 appeared to have little effect on the length distributions for red grouper catches. The 20 inch minimum size regulation of 1990 clearly changed the ranges of the length distributions. In theory, when the ranges of lengths are greater, larger sample sizes are needed. However, the number of TIP samples collected before 1990 is much smaller than the number after 1990 (Table 1). The small sample numbers before 1990 may contribute to the large differences in length frequency distributions seen in grouper samples caught with different gear types and from different fishing areas.

III. Length frequency distributions for catch by different gear type

Length frequency distributions for red groupers caught with different gear types varied considerably, especially before 1990. Fig 3 shows that, before 1990, fish traps tended to catch smaller fish than handlines or longlines. This trend was usually not seen in samples collected after 1990. The Length frequency distributions for combined samples before (Fig 4(a)) and after 1990 (Fig 4(b)) clearly show that a large proportion of red groupers caught in fish traps before 1990, but not after 1990, were small. Differences in length distributions were also reflected in the mean gutted weights of fish caught with different gear types (Table 3). Before 1990, the mean weights of red groupers caught in fish traps were considerably smaller than the weights of groupers caught with handlines and longlines.

The ranges for the lengths of fish caught in fish traps varied between 11 and about 35 inches. The size of fish caught in fish traps depended on the mesh and gap sizes of the trap, which varied according to the type of fish that fishermen targeted. The size of fish caught may also depend on the depth and area (inshore, offshore) where fish traps are located. The locations where fish trap samples were obtained changed after 1990 (Table 6). Before 1990, samples from fish traps were almost exclusively from the southwest Florida coast. However, after 1990, more samples from fish traps came from the northwest coast of Florida. It should also be noted that sample numbers from trap fisheries were in general much smaller than those from handline and longline fisheries, except for 1985 and 1986 (Table 2). The small sample sizes from trap fisheries may also contribute to differences in length frequency distributions between trap samples and samples from other gear types (Fig 3). In addition, there appear to be differences in length distributions between samples from longline and handline fisheries (Fig 4(a)) taken before 1990. However, the yearly trend in these differences is not clear.

IV. Length frequency distributions for catches from different areas

Fig 5 shows length frequency distributions for red groupers caught in different fishing areas between 1984 to 2005. For the purpose of this analysis, several grid areas were combined into zones because of the problem of small sample sizes in some grid areas. Before 1990, the variations in length distributions between different zones were smaller (Fig 6). Figs 7-9 show length distributions for red groupers caught in different zones with different gear types before and after 1990. Some differences may be due to differences in the lengths of fish caught with different types of gear. For example, a large proportion of fish caught in fish traps before 1990 were smaller fish. Since most fish trap samples before 1990 were collected from zone 1 (Grids 1, 2, and 3), the larger proportion of small fish found in zone 1 may be due to a larger percentage of fish being caught in fish traps (Table 3).

V. Length frequency distributions for catches from different seasons

Fig 10 shows length frequency distributions for red grouper caught during different seasons. The length frequency distributions for fish caught in different

seasons before 1990 varied, but the trend was unclear. There is little difference in length distributions among seasons after 1990.

References

Ching-Ping Chih, 2006, Selected sampling issues regarding length/age frequency distributions for red groupers caught by commercial fisheries in the Gulf of Mexico from 1984 to 2005 (SFD-2006-28).

Table 1 - Number of red grouper TIP samples collected from commercial fisheries in different Gulf states from 1984 to 2005.

YEAR	total	FL	AL	MS	LA	TX
1984	2711	2711				
1985	5310	5310				
1986	7532	7531		1		
1987	4639	4639				
1988	2560	2560				
1989	2810	2810				
1990	12204	12204				
1991	14864	14864				
1992	11692	11691			1	
1993	12692	12682			10	
1994	11682	11682				
1995	14737	14737				
1996	13508	13508				
1997	17642	17641			1	
1998	33508	33508				
1999	52918	52918				
2000	40789	40789				
2001	30933	30933				
2002	25803	25798		5		
2003	18056	18026	20	3	7	
2004	14297	14272	25			
2005	10140	10076	62		2	

Table 2 - Number of red grouper TIP samples collected with different gear types by commercial fisheries in the Gulf of Mexico from 1984 to 2005.

YEAR	total	HL	LL	Trap	other
1984	2711	1397	1121	18	175
1985	5310	1666	1715	1929	
1986	7532	523	5761	1248	
1987	4639	1220	2651	768	
1988	2560	1152	1375	33	
1989	2810	616	1834	357	3
1990	12204	951	10888	361	4
1991	14864	1866	12571	410	17
1992	11692	2448	8398	836	10
1993	12692	2532	9694	457	9
1994	11682	3243	8228	207	4
1995	14737	3229	11158	342	8
1996	13508	3099	9665	702	42
1997	17642	2418	13668	1522	34
1998	33508	3485	28959	1060	4
1999	52918	6771	44241	1883	23
2000	40789	7757	30263	2702	67
2001	30933	6911	20027	3965	30
2002	25803	5479	18141	2178	5
2003	18056	2990	13697	1344	25
2004	14297	2880	11013	384	20
2005	10140	1890	7659	524	67

Table 3 - Mean gutted weights of red groupers sampled from commercial fisheries in the Gulf of Mexico during the period 1984-2005

YEAR	all	HL	LL	trap	other
1984	8.79	8.31	10.37	2.41	3.14
1985	5.28	7.26	6.88	2.16	
1986	5.40	8.58	5.71	2.59	
1987	5.31	6.90	5.48	2.22	
1988	3.74	3.19	4.17	5.06	
1989	6.35	3.03	8.40	2.57	1.02
1990	9.94	10.79	10.01	5.63	3.53
1991	9.01	8.43	9.20	6.15	4.56
1992	8.67	8.67	8.82	7.18	6.55
1993	8.76	8.80	8.84	7.05	5.17
1994	8.31	8.12	8.42	6.71	5.96
1995	7.93	7.73	8.02	7.08	5.32
1996	7.49	7.32	7.61	6.72	5.25
1997	7.69	7.27	7.80	7.44	6.98
1998	8.07	7.86	8.13	7.17	6.31
1999	7.91	7.80	7.95	7.50	6.56
2000	8.24	7.94	8.42	7.31	1.92
2001	7.69	7.62	7.80	7.32	2.74
2002	7.71	7.63	7.72	7.77	6.04
2003	7.69	7.23	7.86	6.93	7.38
2004	7.50	7.06	7.61	7.47	9.09
2005	7.22	7.11	7.24	7.13	8.10

Table 4 - Number of red grouper TIP samples collected from commercial fisheries at different grid areas in the Gulf of Mexico from 1984 to 2005.

YEAR	grid 1	grid 2	grid 3	grid 4	grid 5	grid 6	grid 7	grid > 8	No info
1984		328	99	448	265	204			1303
1985	1322	379	455	44	565	290			1969
1986	10	211	2170	351	344	179		35	4232
1987	34	758	1626	428	86	82			1625
1988		203	1760	142	164	104			145
1989	131	11	1158	180	204	194			932
1990	552	581	1079	4952	2707	508	93	142	1245
1991	50	699	1399	4280	6588	1081	43	30	444
1992	20	1361	1763	5293	2062	775		2	416
1993	512	613	1440	3707	3770	1889	32	81	152
1994	329	942	1136	2396	4091	1644	44	12	733
1995	32	1457	515	4403	3757	3227	107	187	693
1996	31	830	1419	2858	3034	3804	94	206	771
1997	19	1490	2209	2731	3776	5600	838	121	144
1998	66	4219	4580	4370	13428	5601	498	199	221
1999	12	4990	5872	12091	17943	9734	1792	28	265
2000	16	2123	6739	8936	12563	7491	2222	28	372
2001	19	2913	3218	7549	6872	5119	4048	358	591
2002	15	1172	1676	5514	10240	3449	3244	85	166
2003	9	1174	1245	5391	5986	2128	1524	107	187
2004	174	1534	592	4668	4519	1043	1266	165	70
2005	32	743	679	2533	2472	1735	1044	188	289

Table 5 - Number of red grouper TIP samples collected from commercial fisheries in different areas of the Gulf of Mexico from 1984 to 2005. (Zone 1 - grid 1,2 & 3, Zone 2 - grid 4 & 5, Zone 3 - grid >=6).

YEAR	zone 1	zone 2	zone 3
1984	1730	713	268
1985	4125	609	576
1986	6623	695	214
1987	4043	514	82
1988	2108	306	146
1989	2232	384	194
1990	3457	7659	1088
1991	2592	10868	1404
1992	3560	7355	777
1993	2717	7477	2498
1994	3140	6487	2055
1995	2697	8160	3880
1996	3051	5892	4565
1997	3862	6507	7273
1998	9086	17798	6624
1999	11139	30034	11745
2000	9250	21499	10040
2001	6741	14421	9771
2002	3029	15754	7020
2003	2615	11377	4064
2004	2370	9187	2740
2005	1743	5005	3392

Table 6 - Number of red grouper TIP samples collected from commercial fisheries in different areas and with different gear types in the Gulf of Mexico from 1984 to 2005.

YEAR	HL zone1	HL Zone2	HL zone3	LL zone1	LL zone2	LL zone3	Trap zone1	Trap zone2	Trap zone3
1984	948	288	161	589	425	107	18		
1985	1380	247	39	816	362	537	1929		
1986	360	153	10	5015	542	204	1248		
1987	1094	119	7	2181	395	75	768		
1988	1082	70		993	236	146	33		
1989	554	44	18	1318	340	176	357		
1990	231	631	89	2960	6929	999	262	99	
1991	893	862	111	1450	9874	1247	235	132	43
1992	589	1441	418	2427	5793	178	534	121	181
1993	388	1100	1044	1981	6271	1442	347	106	4
1994	692	1637	914	2237	4850	1141	207		
1995	434	1137	1658	2082	6854	2222	173	169	
1996	369	1509	1221	2381	4383	2901	287		415
1997	629	447	1342	2865	6060	4743	363		1159
1998	592	1627	1266	8068	16171	4720	422		638
1999	838	2685	3248	9906	27347	6988	394		1489
2000	793	4130	2834	8071	17123	5069	383	182	2137
2001	994	2602	3315	5262	11408	3357	483	385	3097
2002	894	1911	2674	1683	13801	2657	447	42	1689
2003	335	1200	1455	2192	10079	1426	84	77	1183
2004	304	1027	1549	2025	7817	1171	40	324	20
2005	389	328	1173	1313	4507	1839	38	145	341

Table 7 Number of red grouper TIP samples collected from commercial fisheries during different seasons in the Gulf of Mexico from 1984 to 2005.

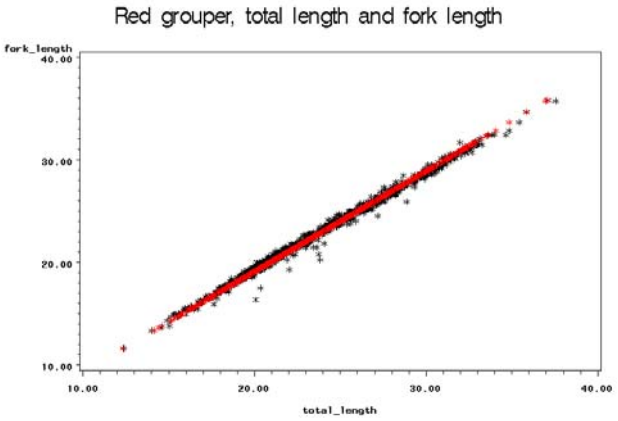
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1984				261	524	86	376	330	361	257	279	237
1985	397	397	385	155	955		897	580	225	850	187	282
1986	223	589	391	837	279	113	143	981	1217	1096	1012	651
1987	152	581	375	891	52	744	214	276	573		378	403
1988	381	97	397	235	150	574		598		1	102	25
1989	8	13	7	2	190	179	318	108	231		841	913
1990	842	1098	799	442	1020	876	1835	4270	399	517	101	5
1991	171	359	294	136	176	2839	3160	1540	1712	2759	986	732
1992	367	1976	1465	1183	1636	1436	1609	589	176	568	508	179
1993	442	746	1433	519	1520	1125	923	1275	2049	1919	471	270
1994	710	1315	960	717	1185	756	659	644	774	1471	1141	1350
1995	408	967	413	592	1810	1741	1679	1952	1620	1169	1388	998
1996	809	833	512	882	816	1597	1507	1003	1104	960	1979	1506
1997	1476	716	1451	882	1335	1583	2706	848	1299	1189	1464	2693
1998	1942	625	2463	2902	2511	2254	3989	3306	2023	3308	3709	4476
1999	3954	4626	4850	3634	3561	4569	4364	7212	3448	3229	3884	5587
2000	3519	2966	3048	3216	3436	3315	3600	1756	3200	5569	2934	4230
2001	2599	2105	1416	3361	4713	2771	3178	3377	1640	2576	1905	1292
2002	2926	2518	1407	2432	3175	3142	2024	1850	1275	2458	1217	1379
2003	1721	1592	728	1926	1760	1463	1902	1883	1372	1486	1452	771
2004	2350	1777	658	1563	1271	462	996	2012	1351	1326	530	1
2005	917	1460	497	1123	885	691	940	1858	891	877	1	

Table 8. Numbers and percentages of TIP otolith samples collected from red groupers caught by commercial fisheries in the Gulf of Mexico from 1984-2005.

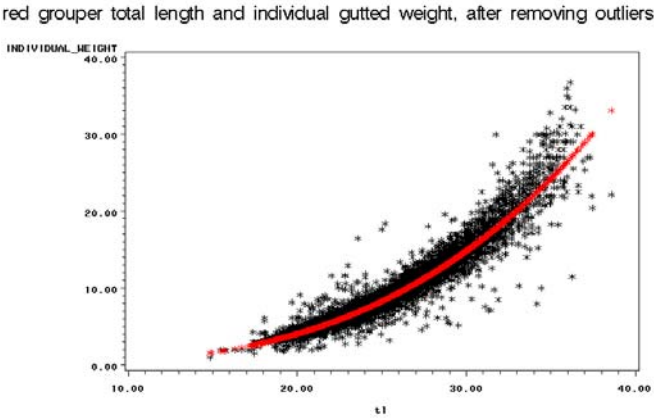
YEAR	number of length	number of otolith	percentage
1984	2711		
1985	5310		
1986	7532	3	0.04%
1987	4639		
1988	2560		
1989	2810		
1990	12204		
1991	14864	126	0.85%
1992	11692	209	1.79%
1993	12692	377	2.97%
1994	11682	412	3.53%
1995	14737	398	2.70%
1996	13508	253	1.87%
1997	17642	75	0.43%
1998	33508	191	0.57%
1999	52918	754	1.42%
2000	40789	648	1.59%
2001	30933	1732	5.60%
2002	25803	2121	8.22%
2003	18056	3001	16.62%
2004	14297	2961	20.71%
2005	10140	3597	35.47%

Fig 1 -Relationships between (a) fork length and total length (n=1234), (b) total length and gutted weight (n= 8626), and (iii) total length and whole weight (n=1201), for red groupers in commercial TIP samples.

(a).



(b).



(c).

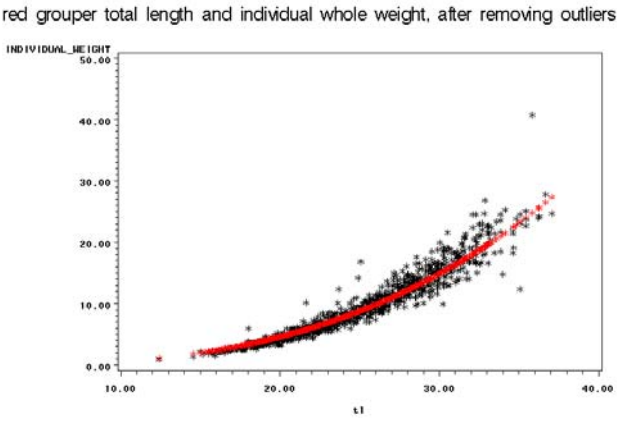
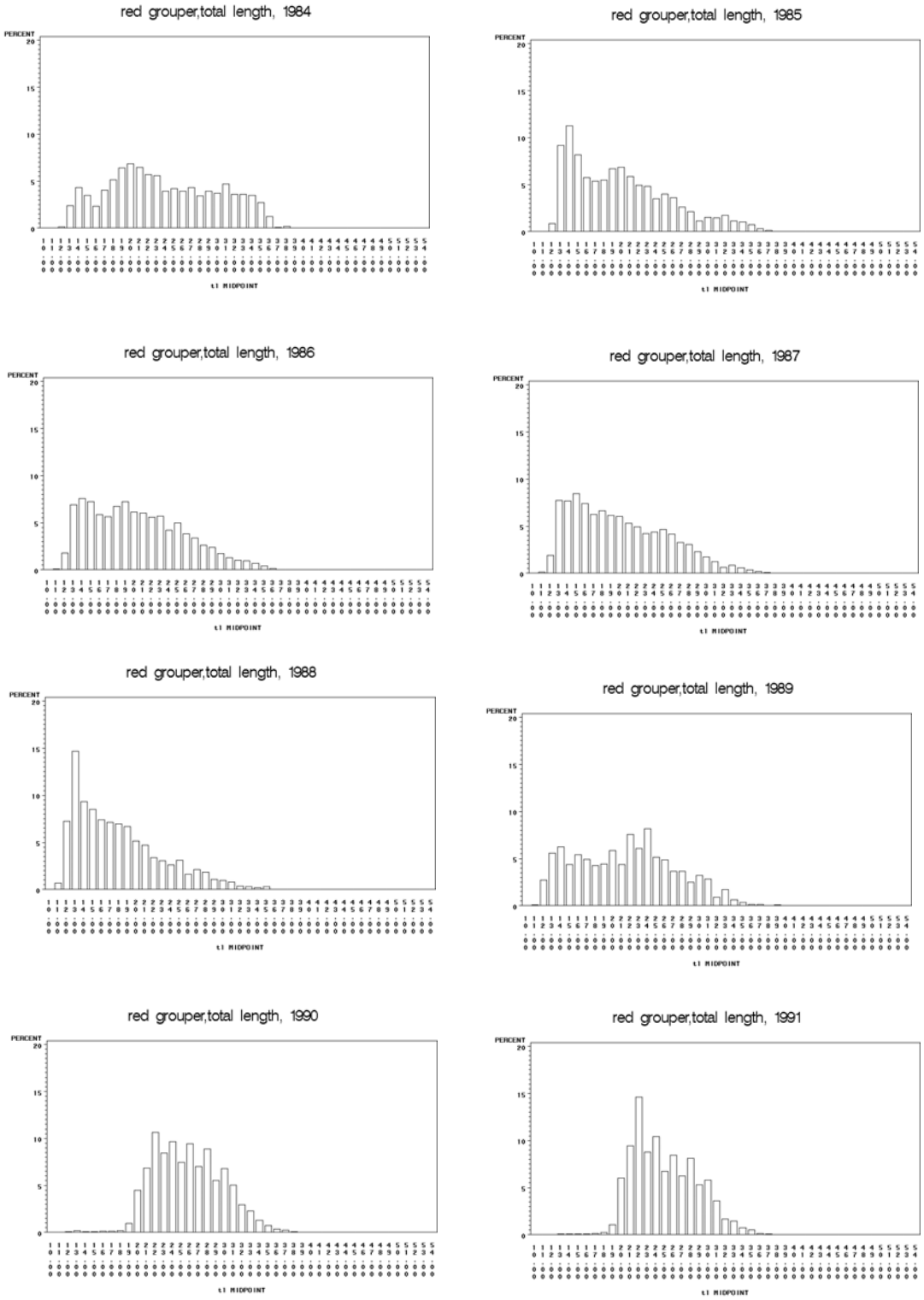


Fig 2 -Fig 2 - Length frequency distributions for TIP samples of red groupers taken by commercial fisheries in the Gulf of Mexico from 1984 to 2005.



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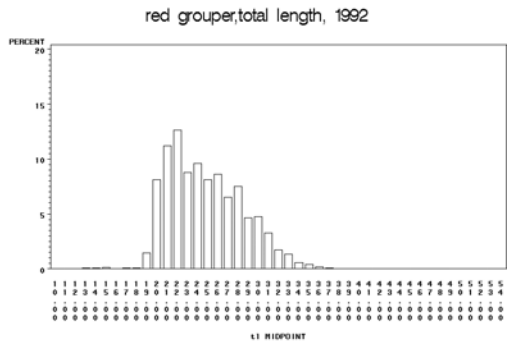

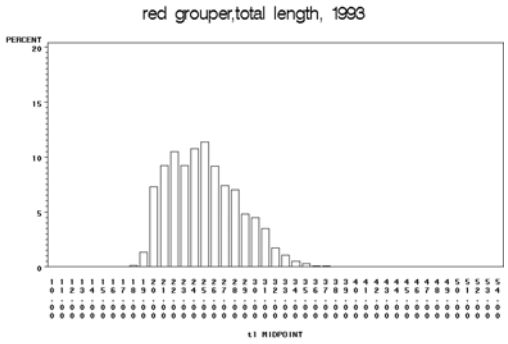

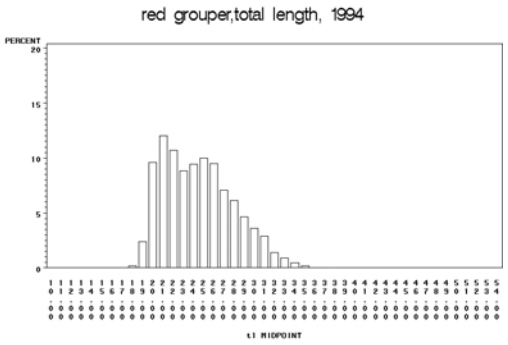

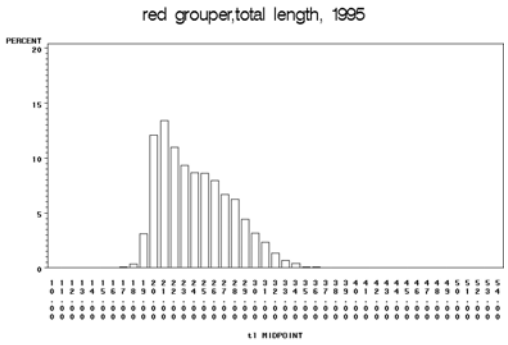

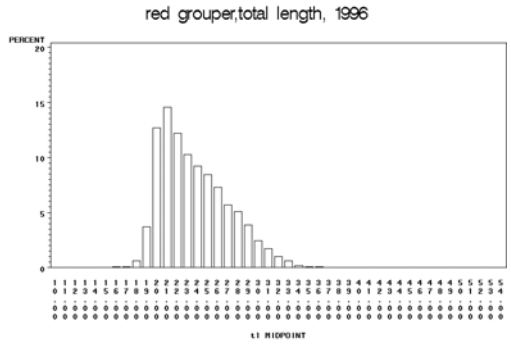

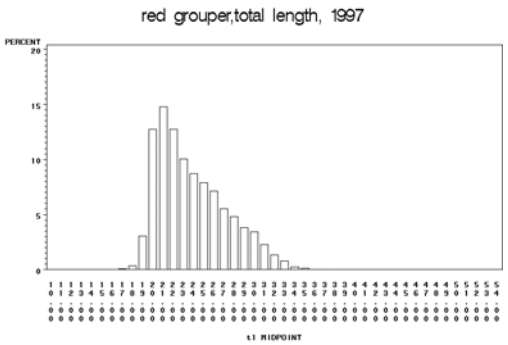

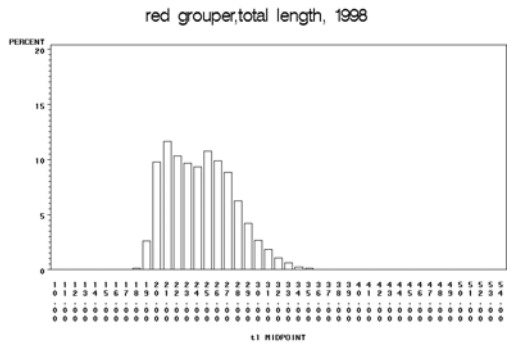

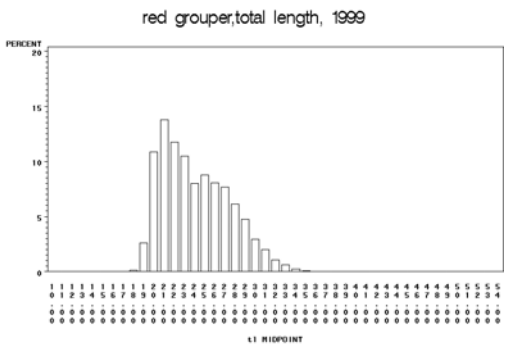

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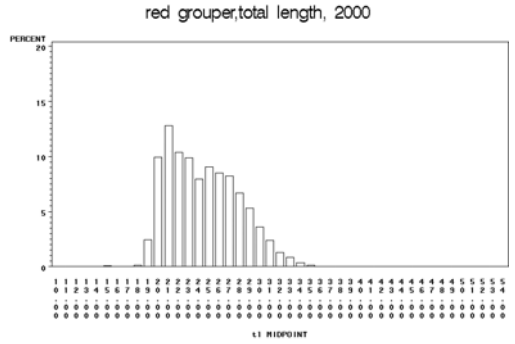
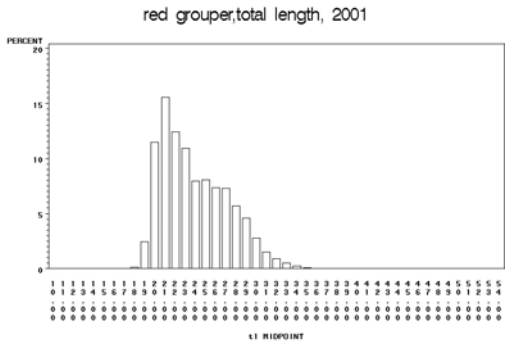
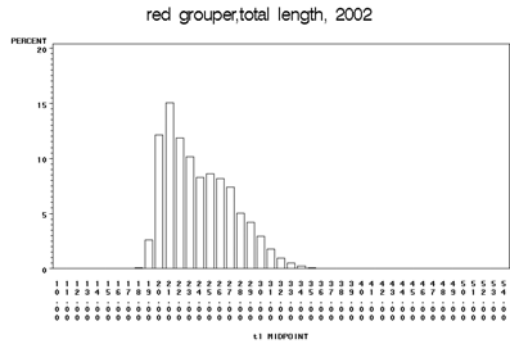
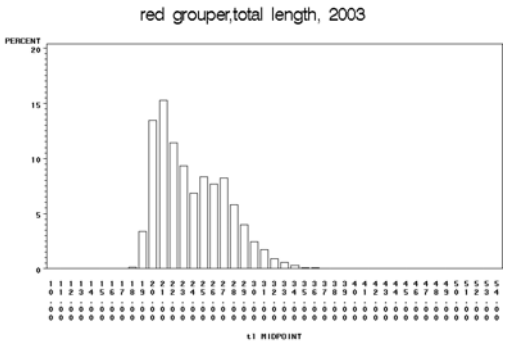
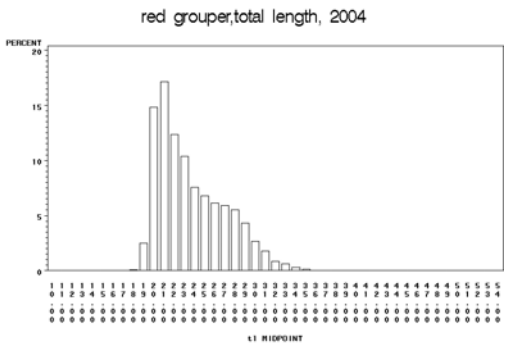










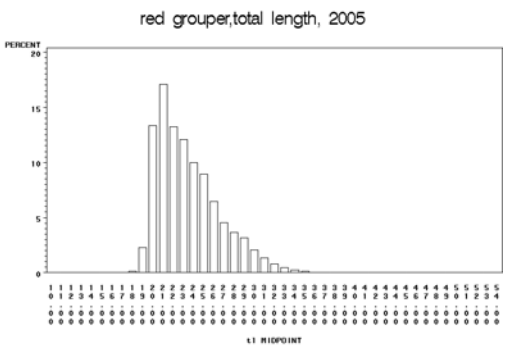
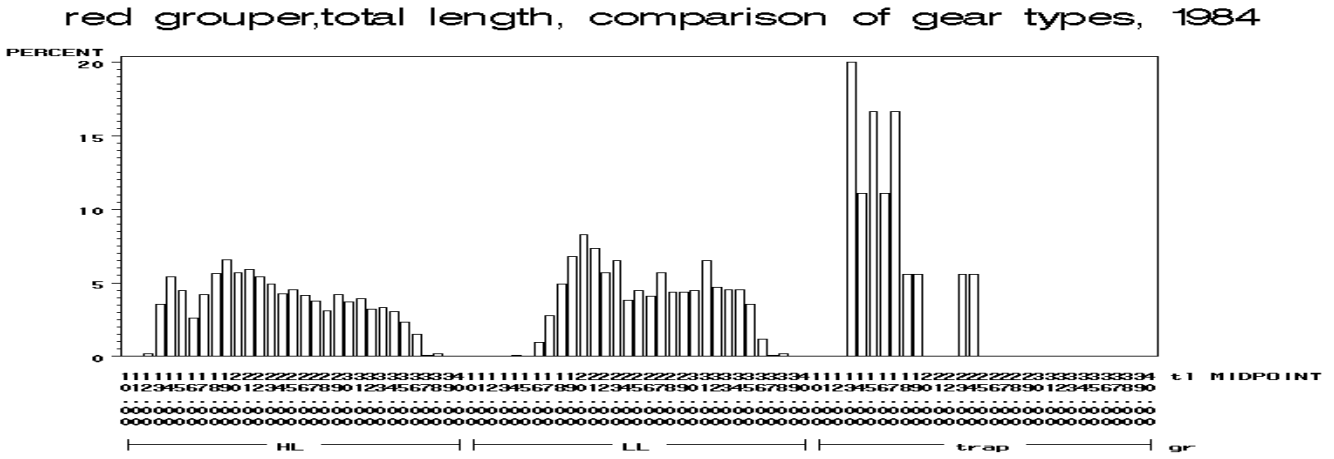
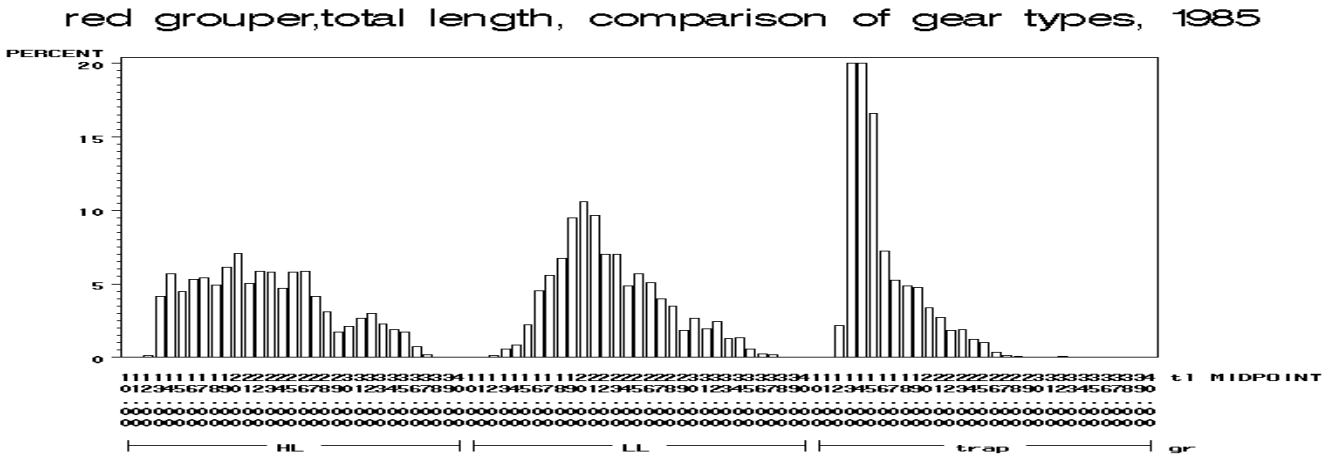
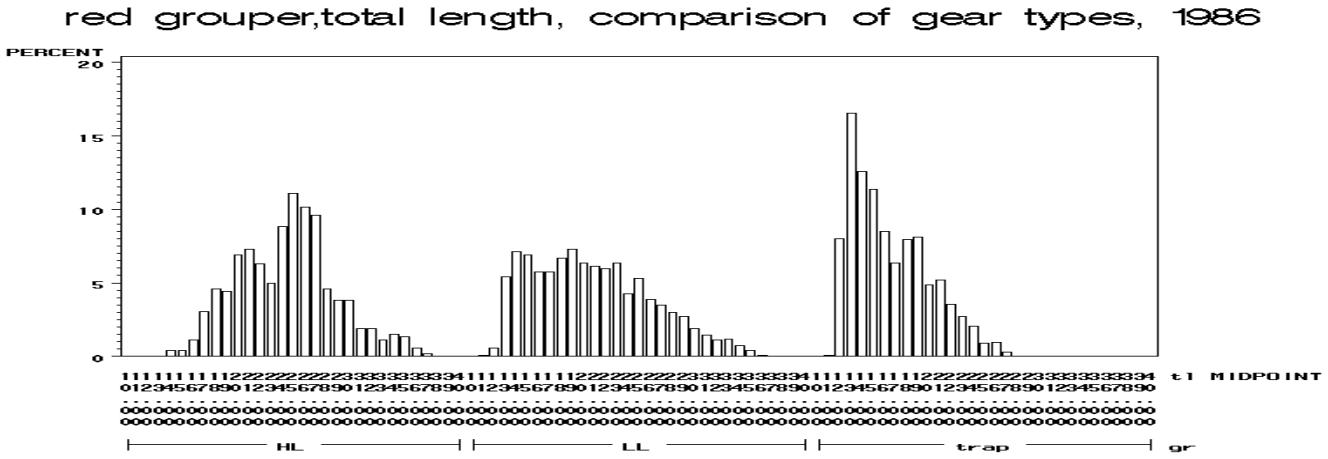


Fig 3 -Length frequency distributions for red groupers caught with different gear types in the Gulf of Mexico from 1984 to 2005 (HL-handline, LL-longline).







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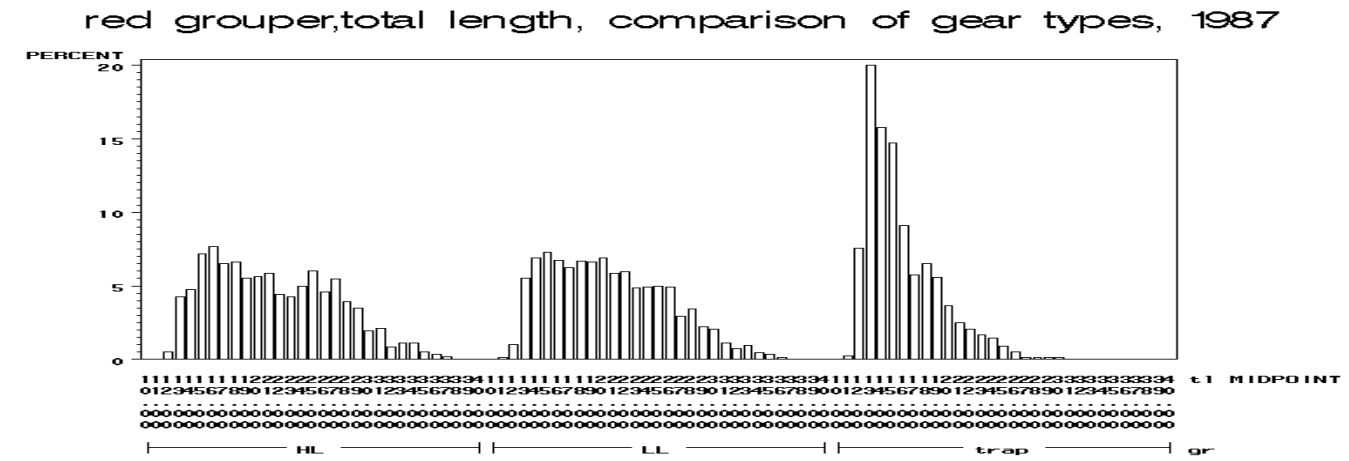

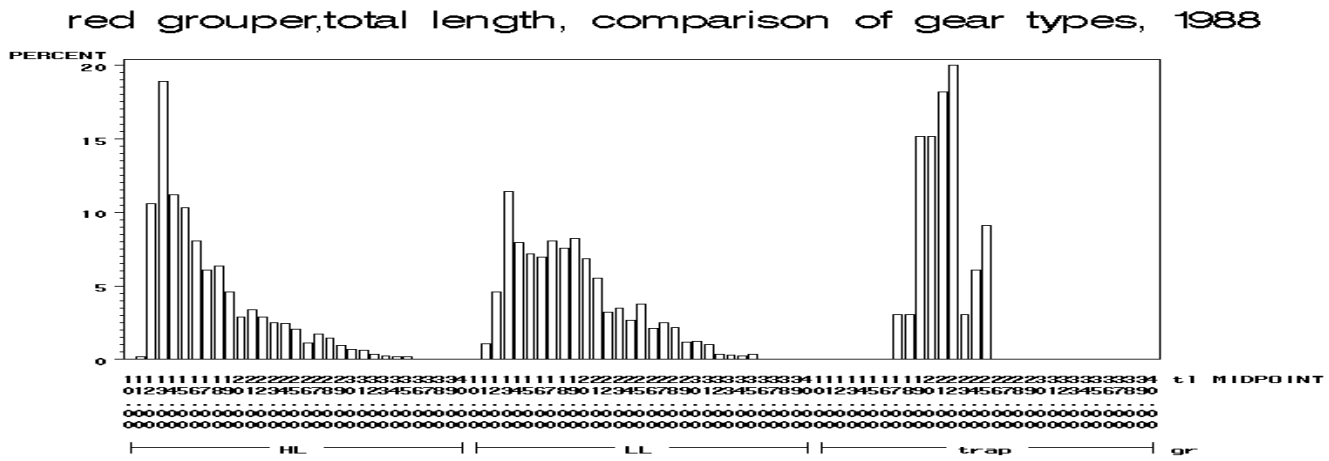

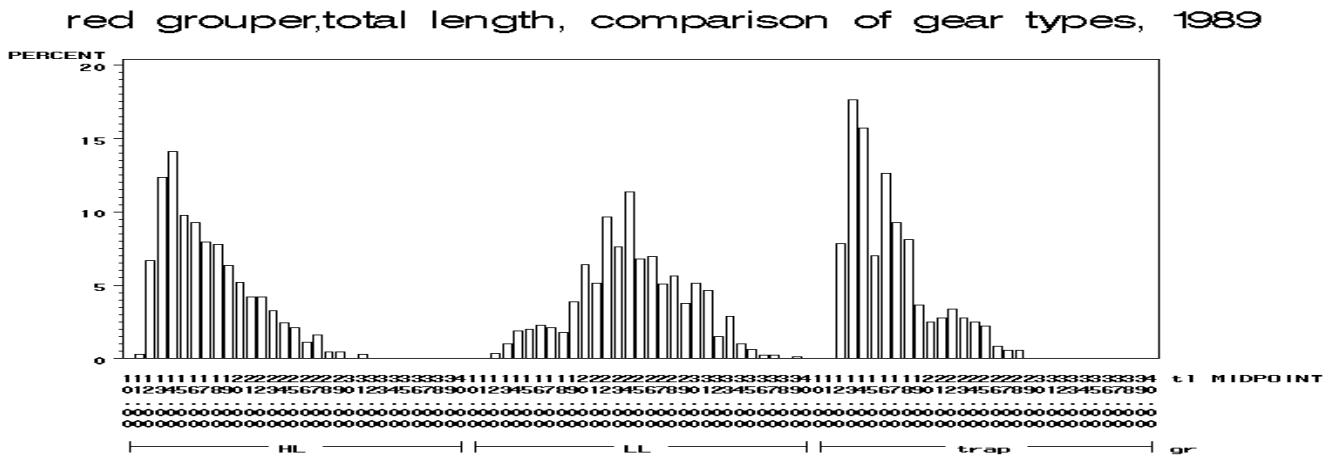

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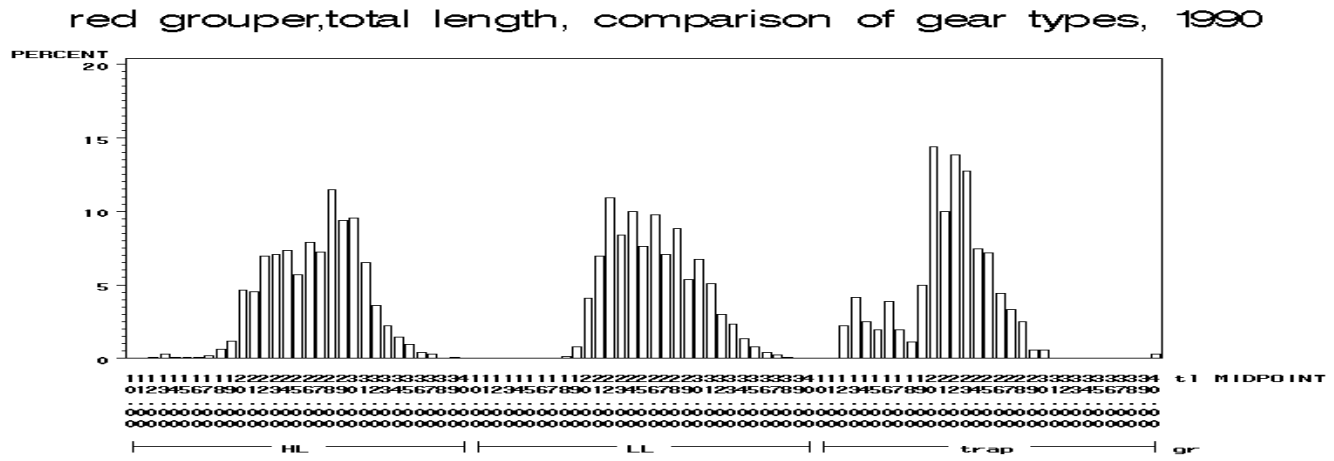
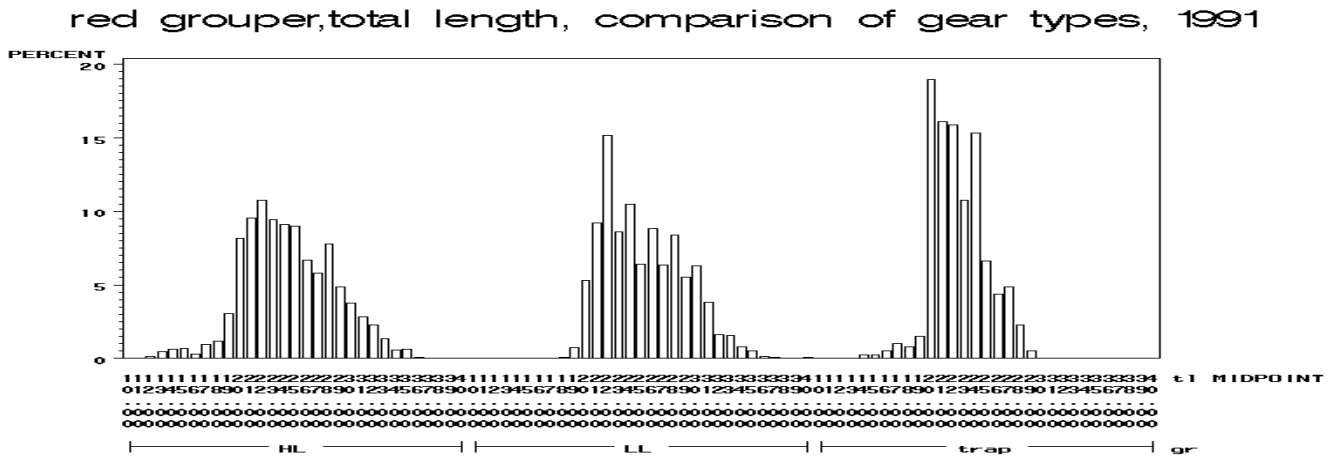




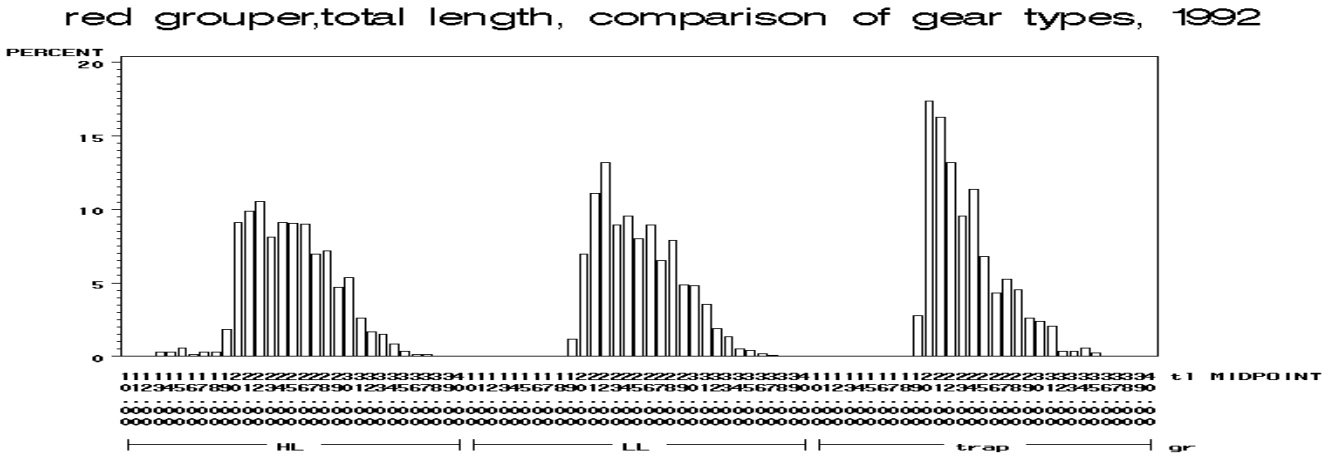
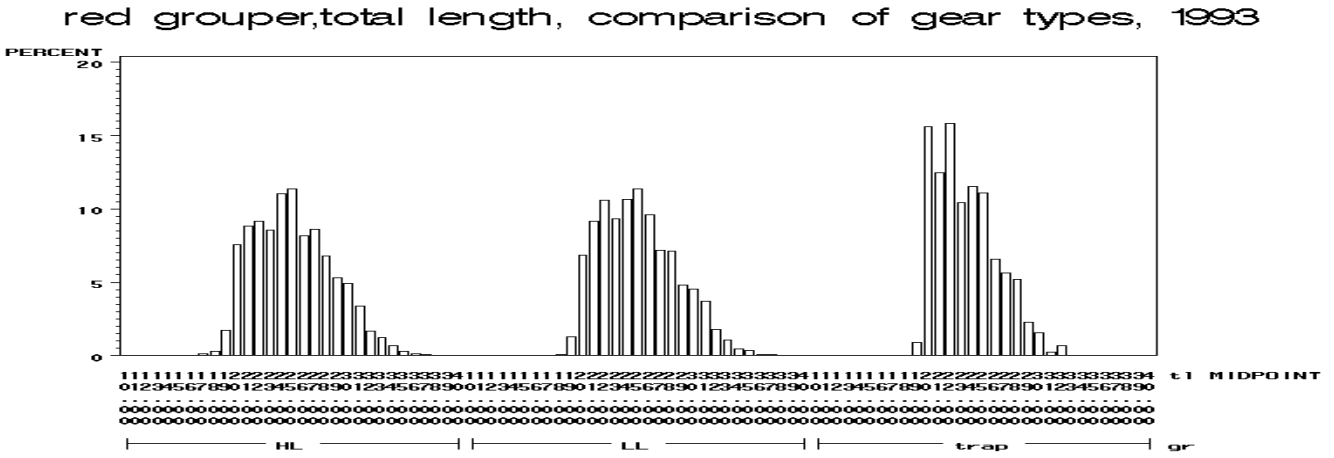
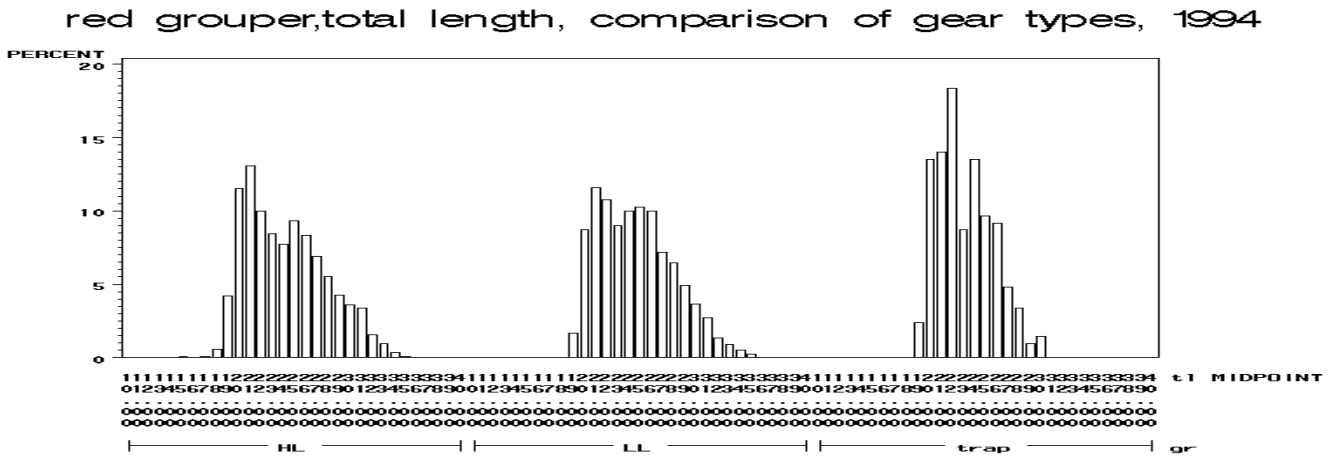


Fig 3 - Continued.





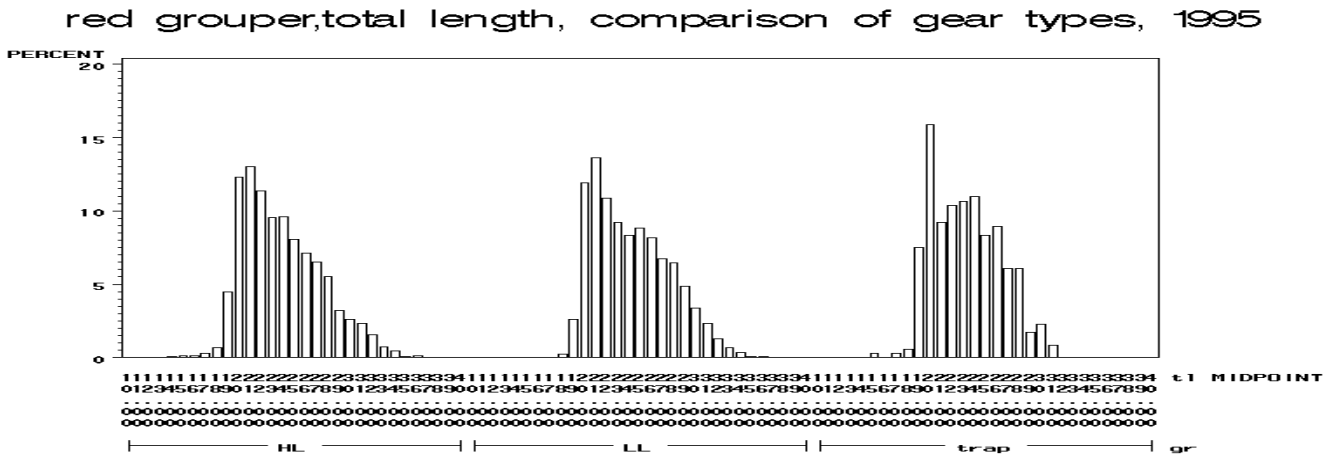
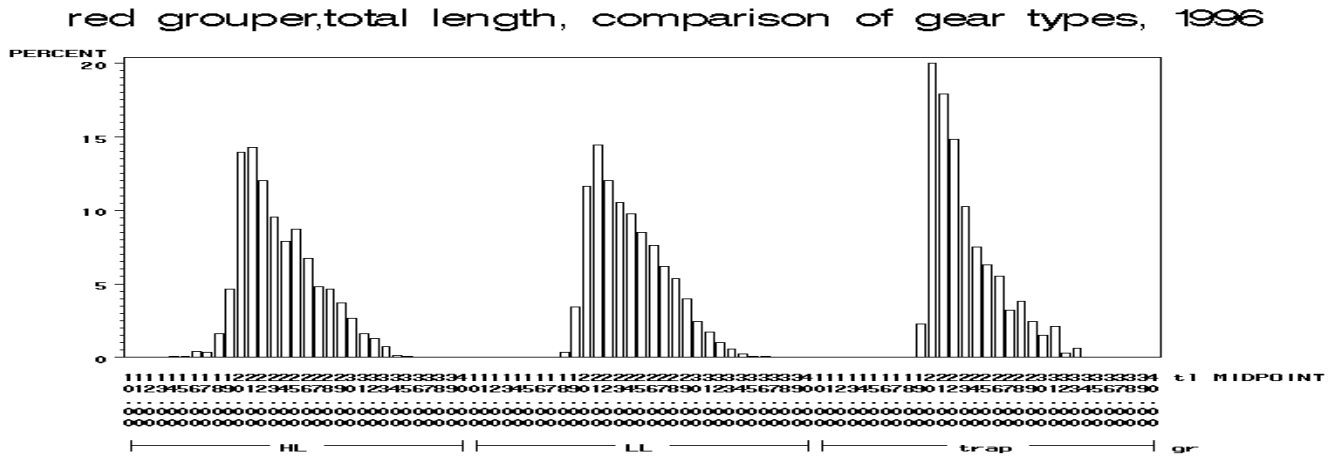
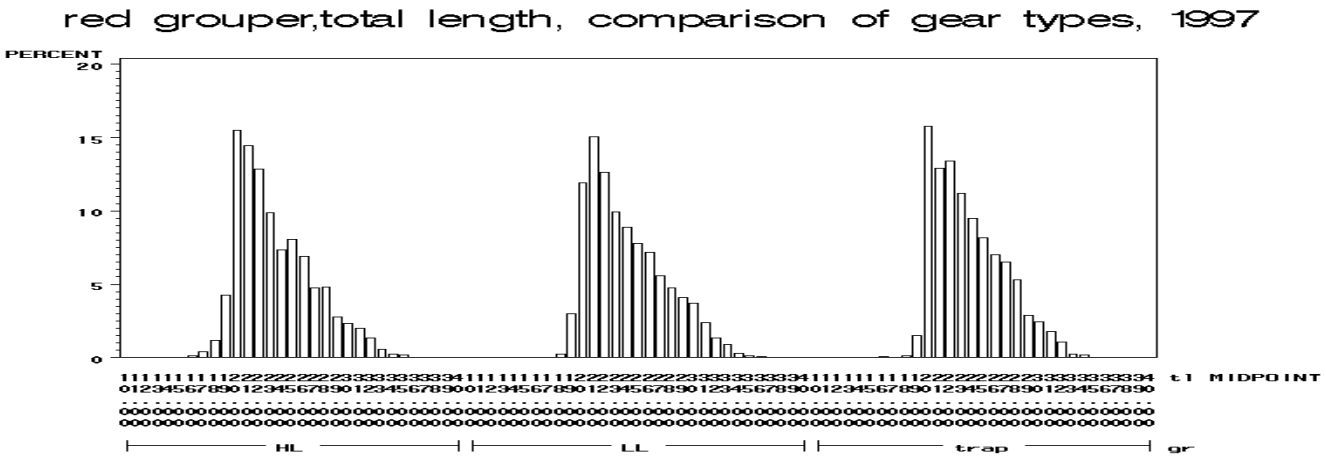


Fig 3 - Continued.





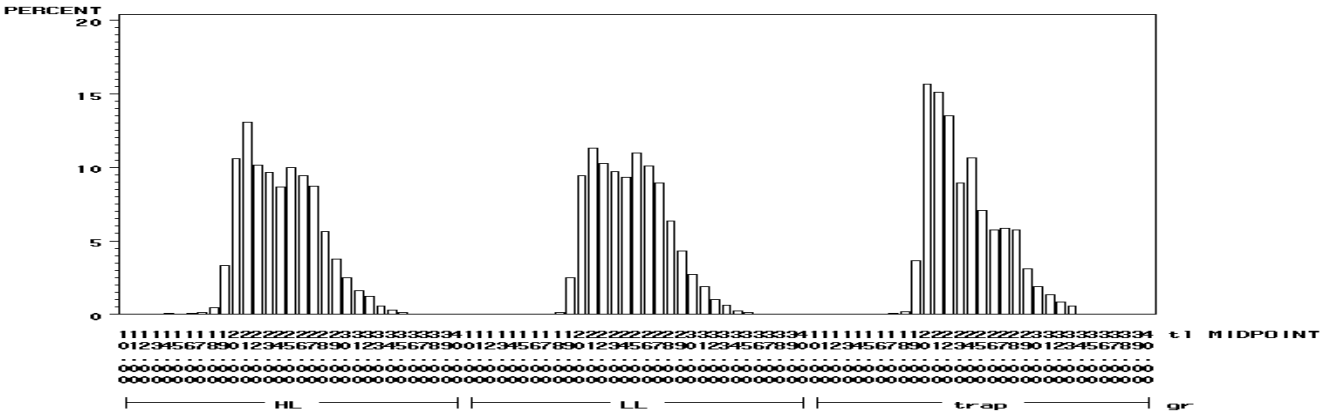
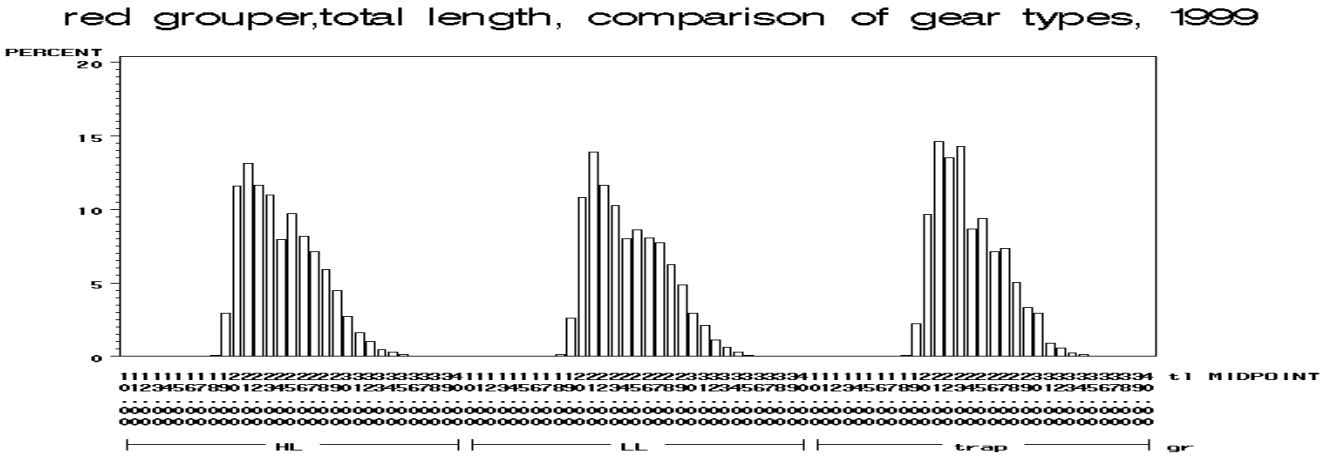
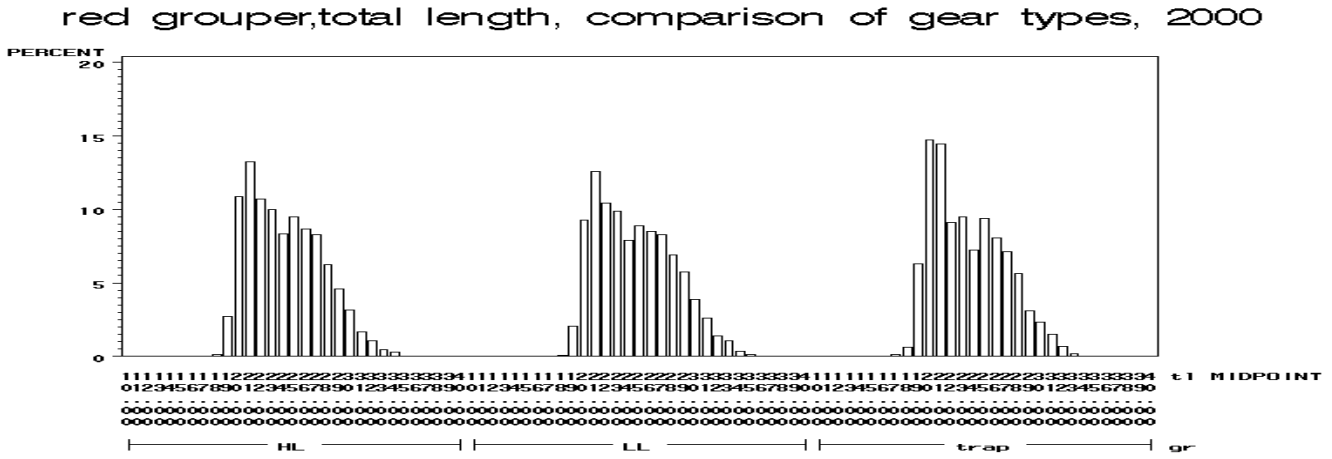


Fig 3 - Continued.





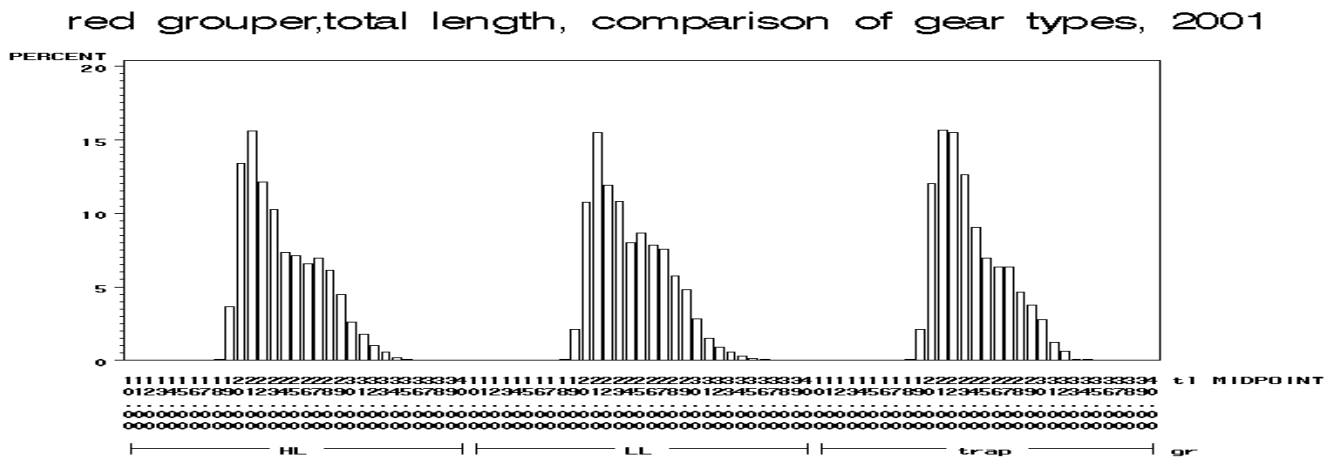
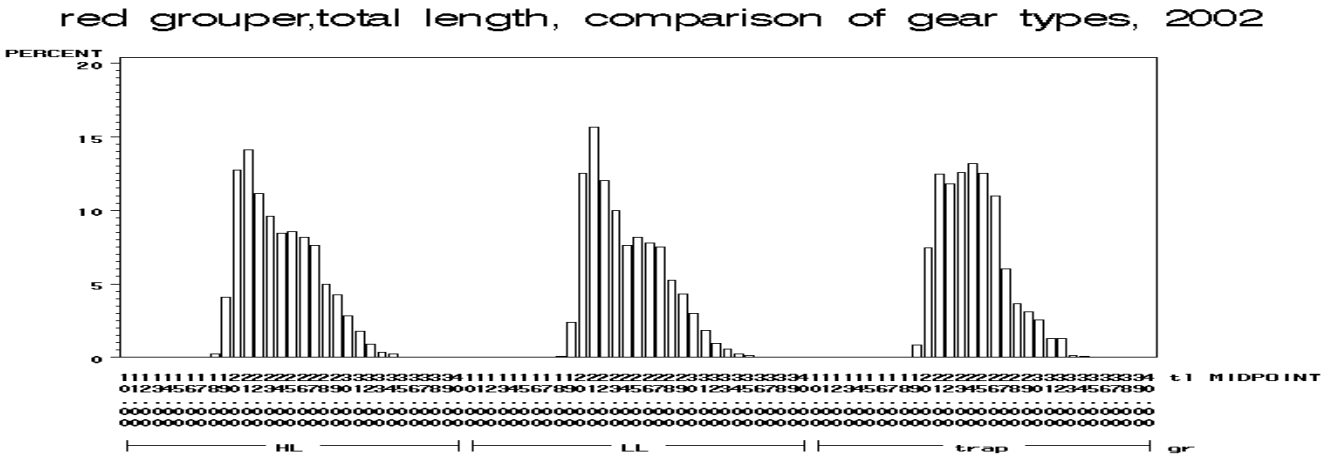


Fig 3 - Continued.



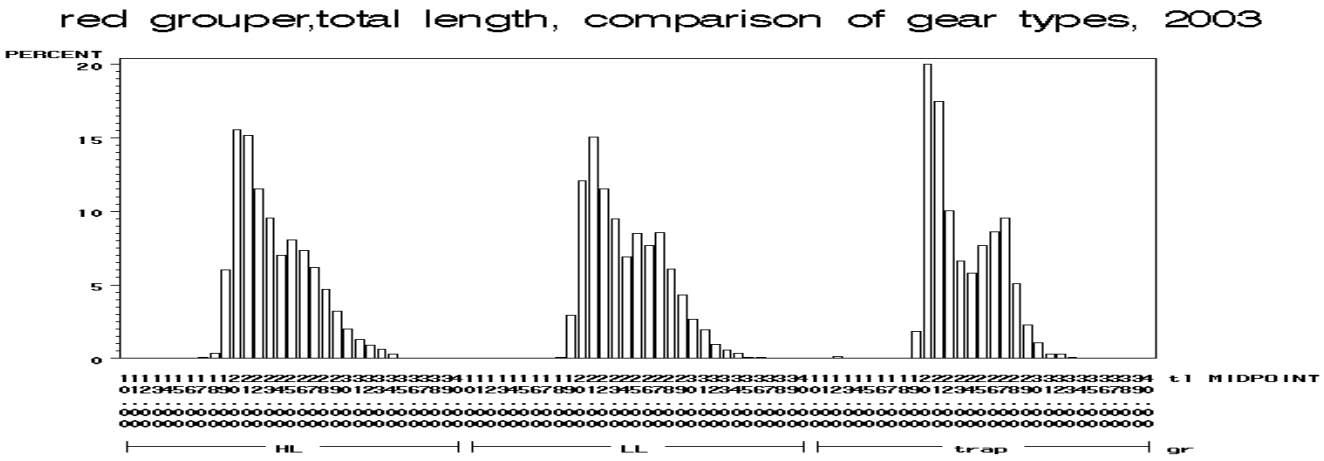
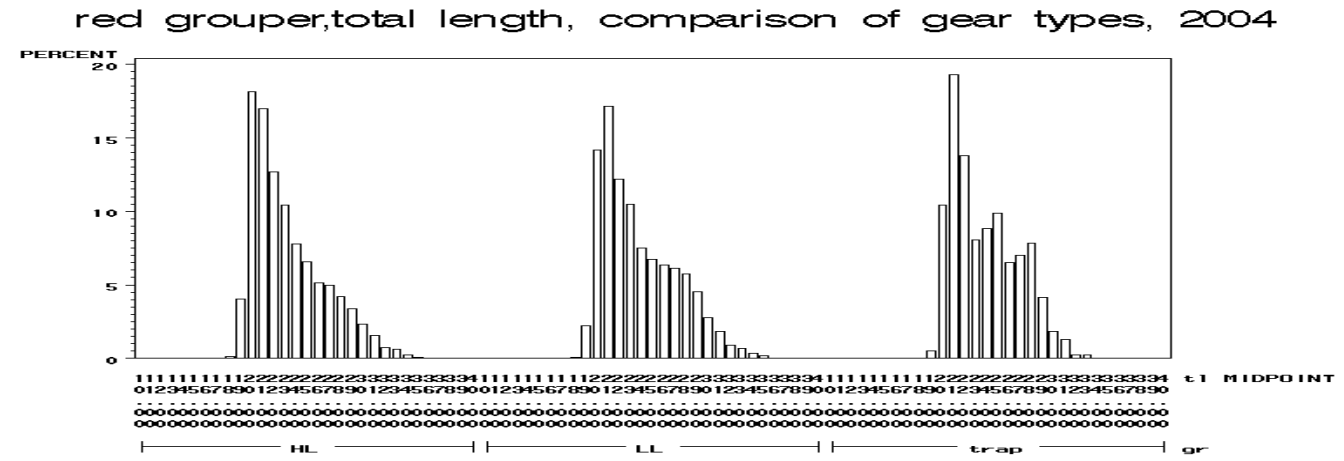


Fig 3 - Continued.



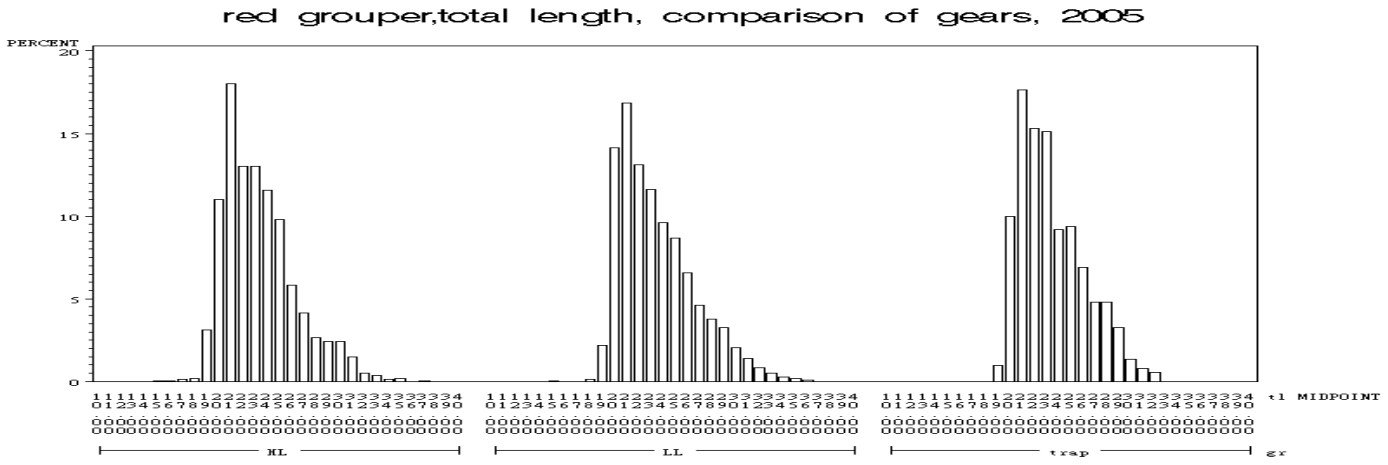
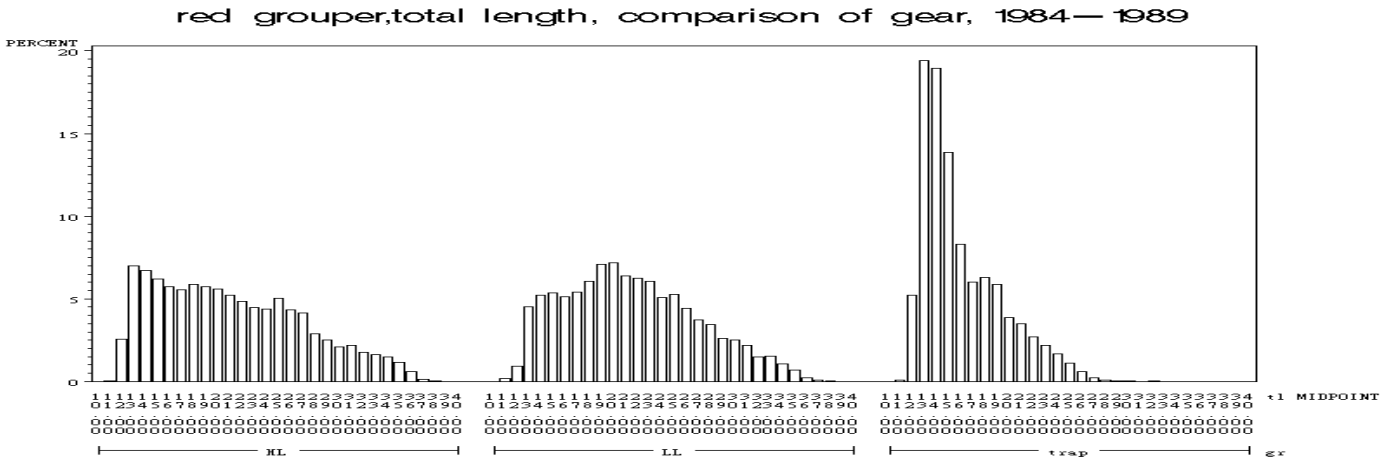


Fig 4 - Length frequency distributions for red groupers caught with different gear types in the Gulf of Mexico (a) from 1984-1989 and (b) from 1990-2005.

(a).



(b).

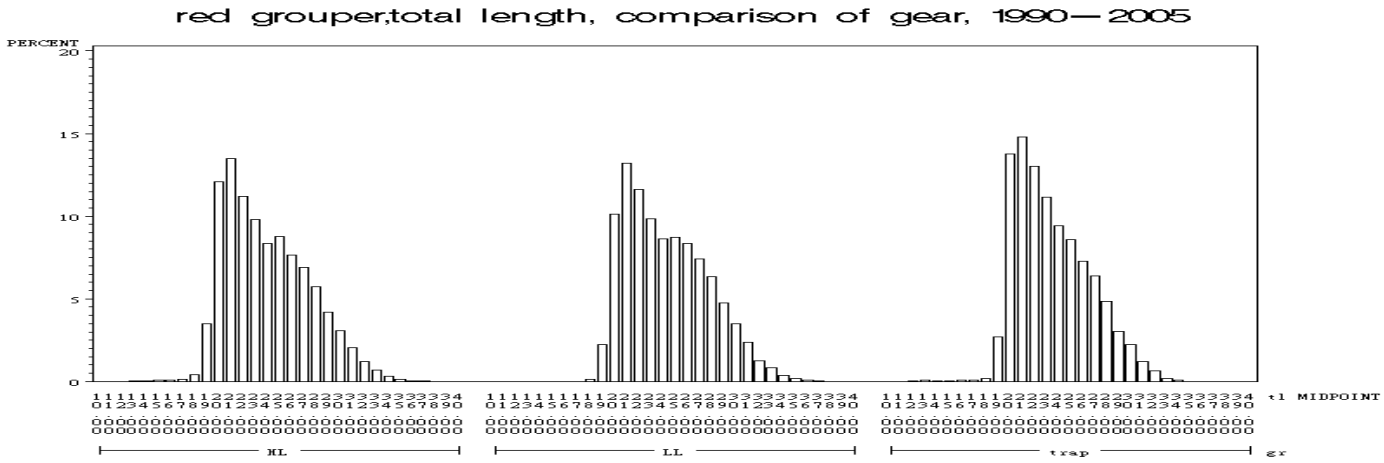
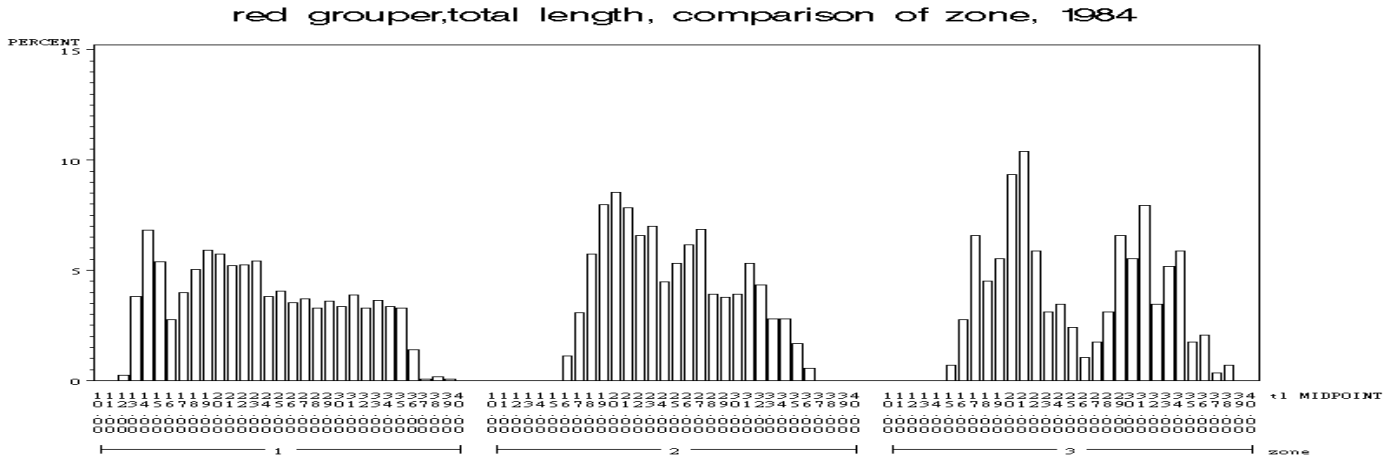
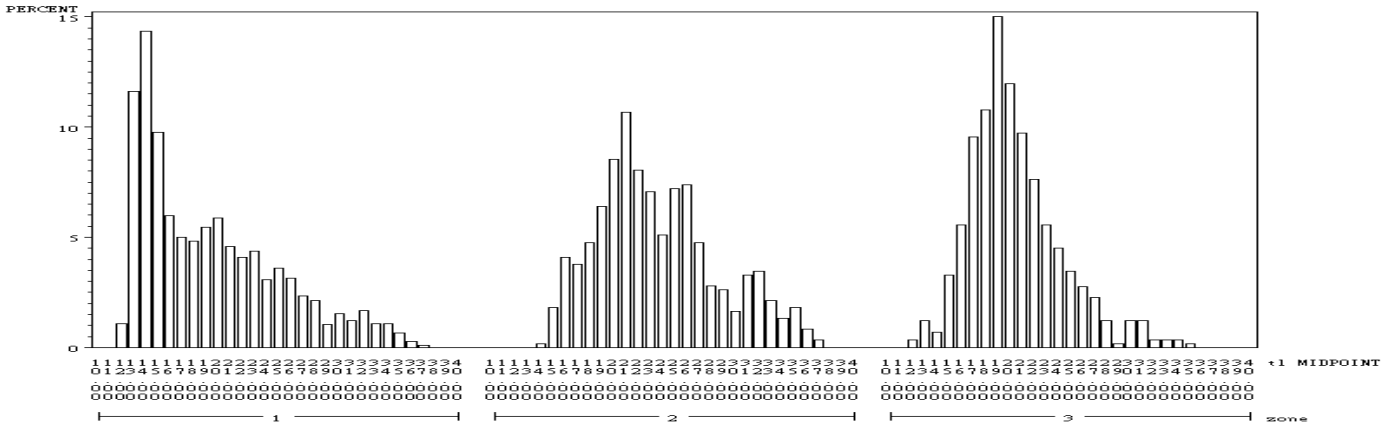


Fig 5 -Length frequency distributions for red groupers caught with different gear types in the Gulf of Mexico between 1984 and 2005. (Zone 1- grids 1,2 3; Zone 2 - grids 4, 5; Zone 3 - grids >= 6)





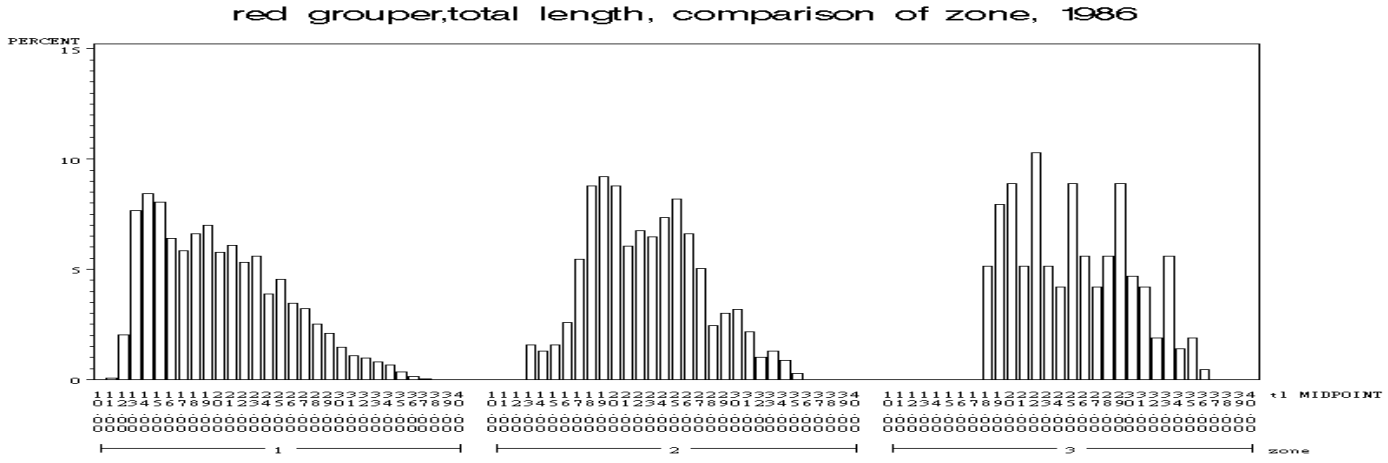
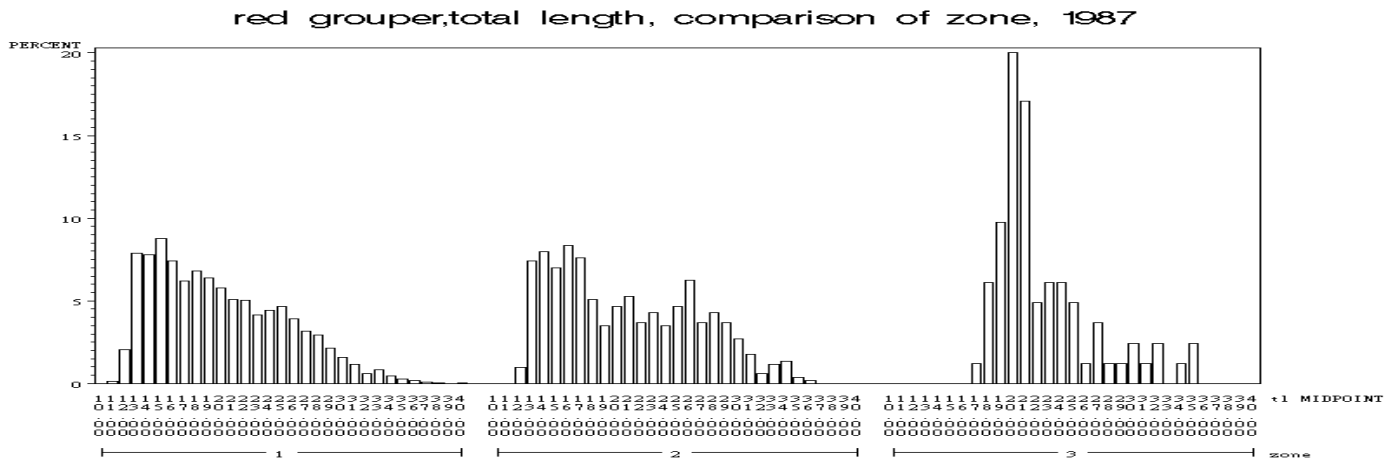
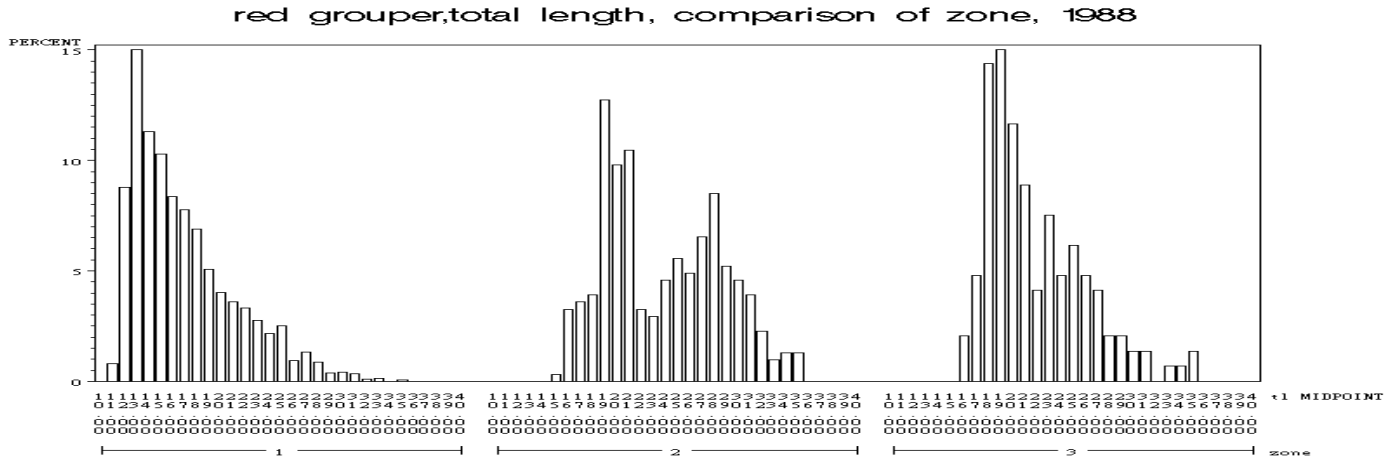


Fig 5 - Continued.





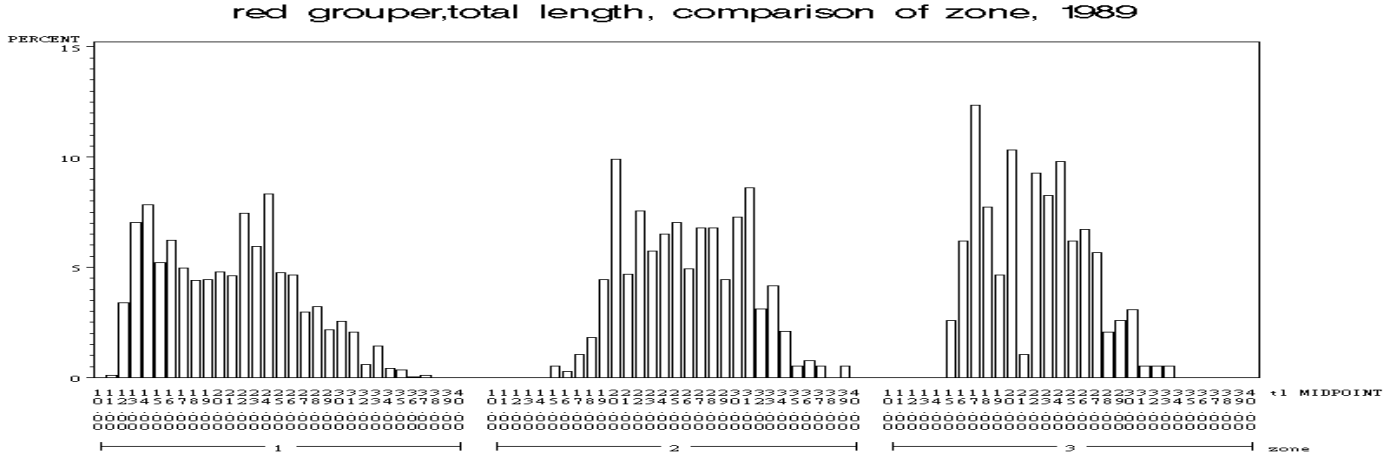
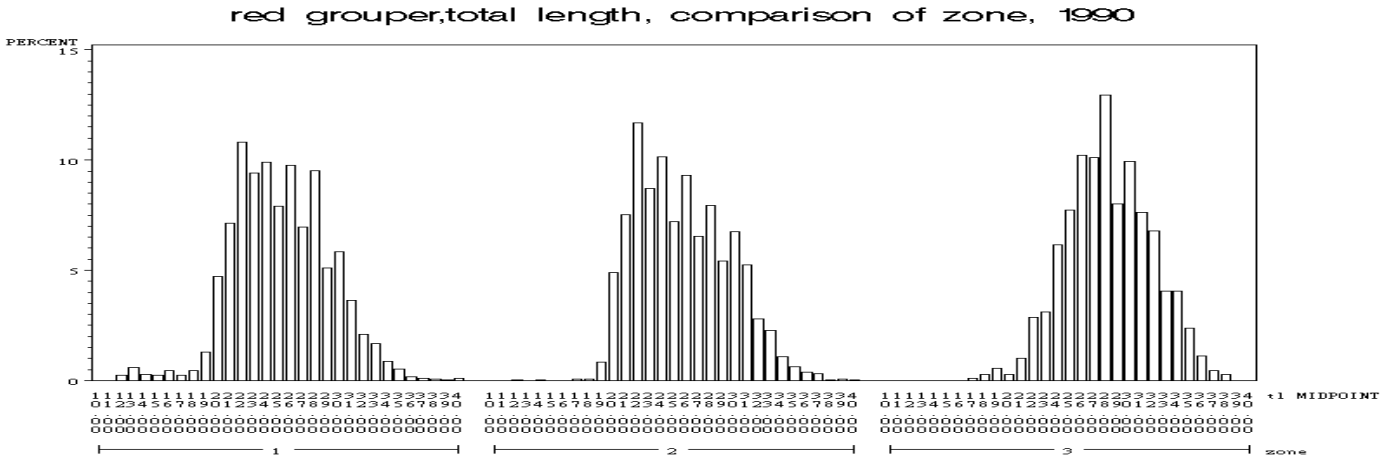
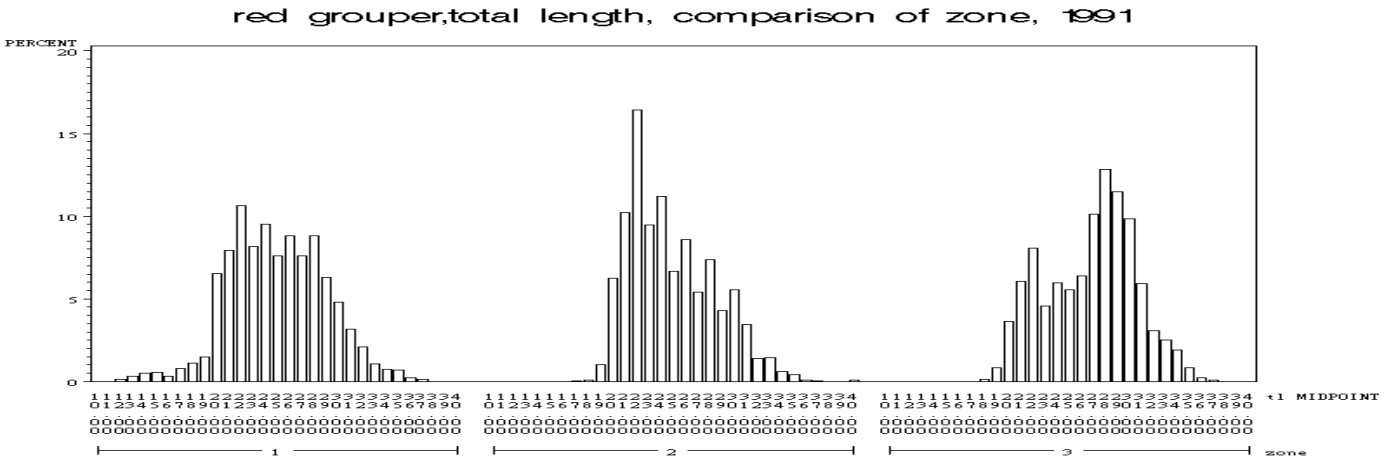


Fig 5 - Continued.





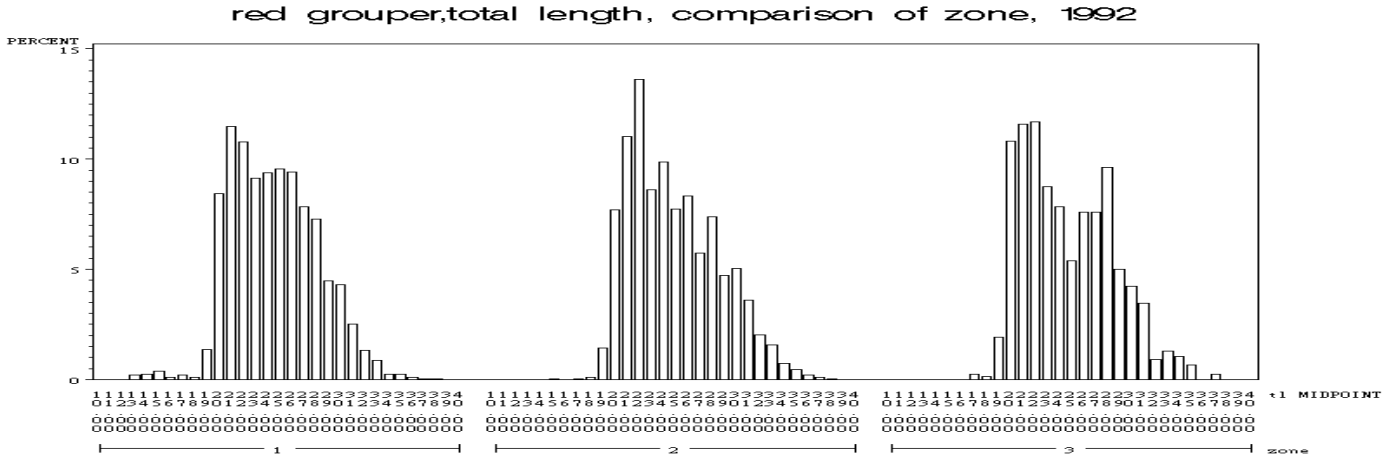
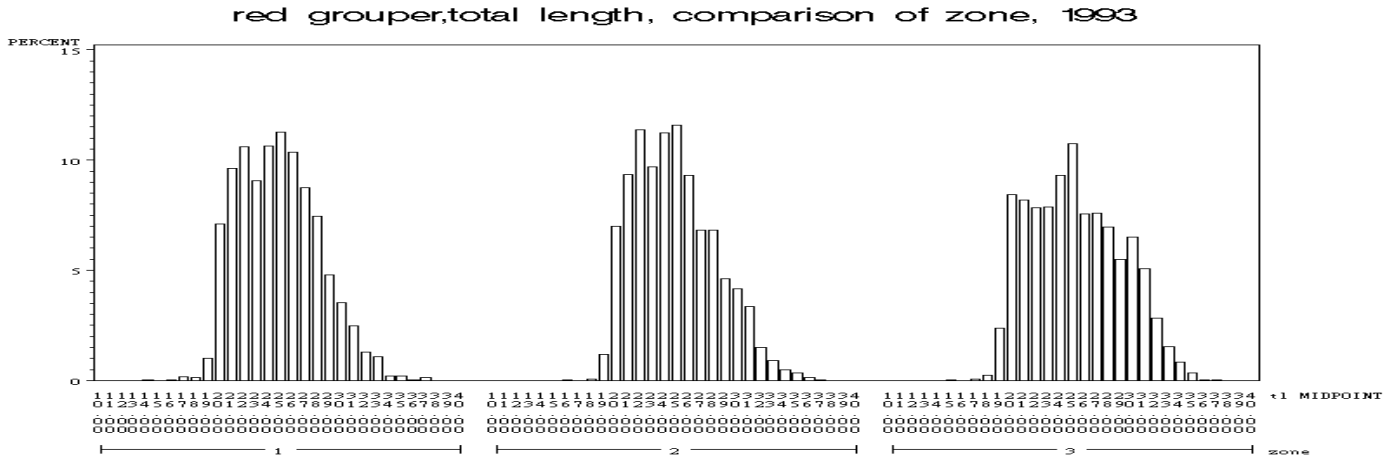
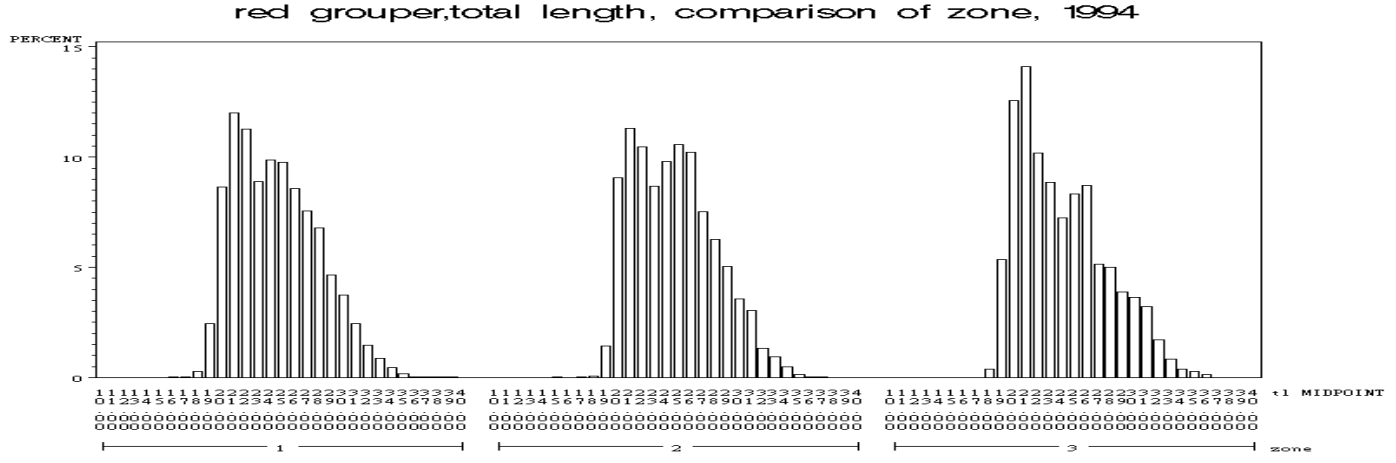


Fig 5 - Continued.





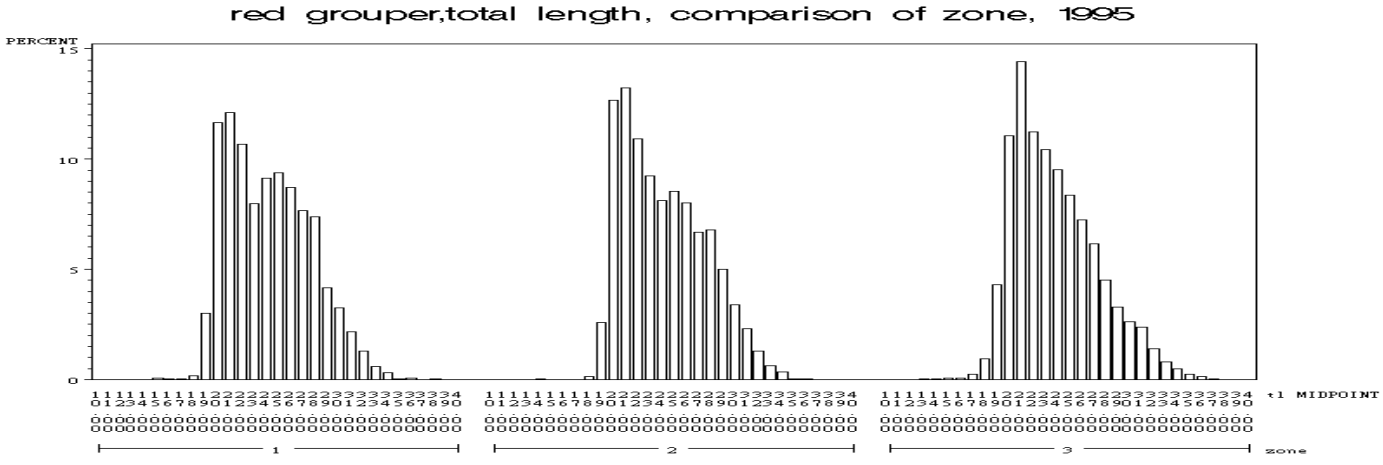
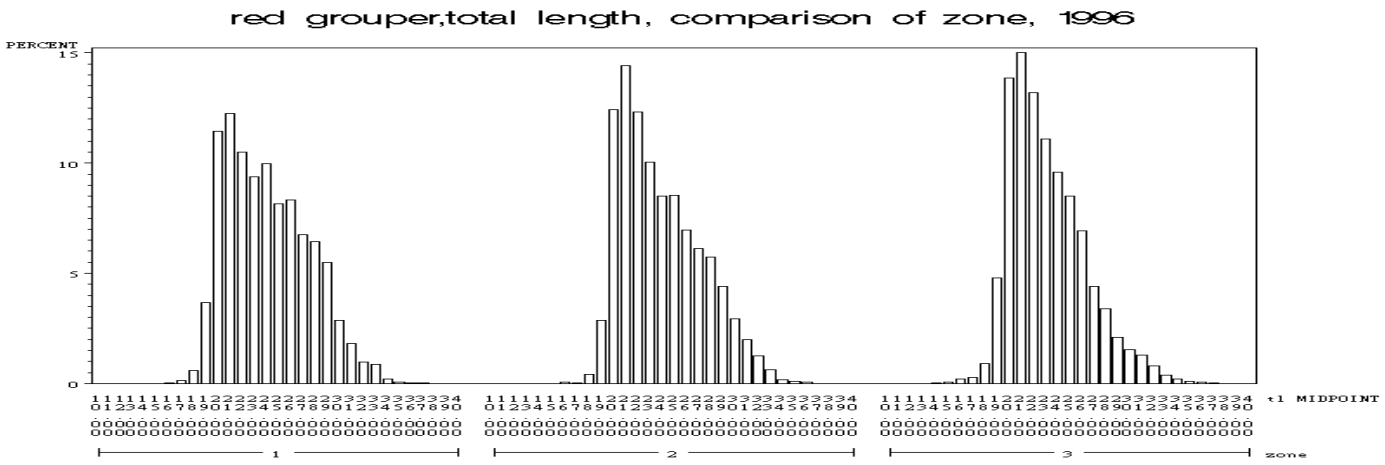
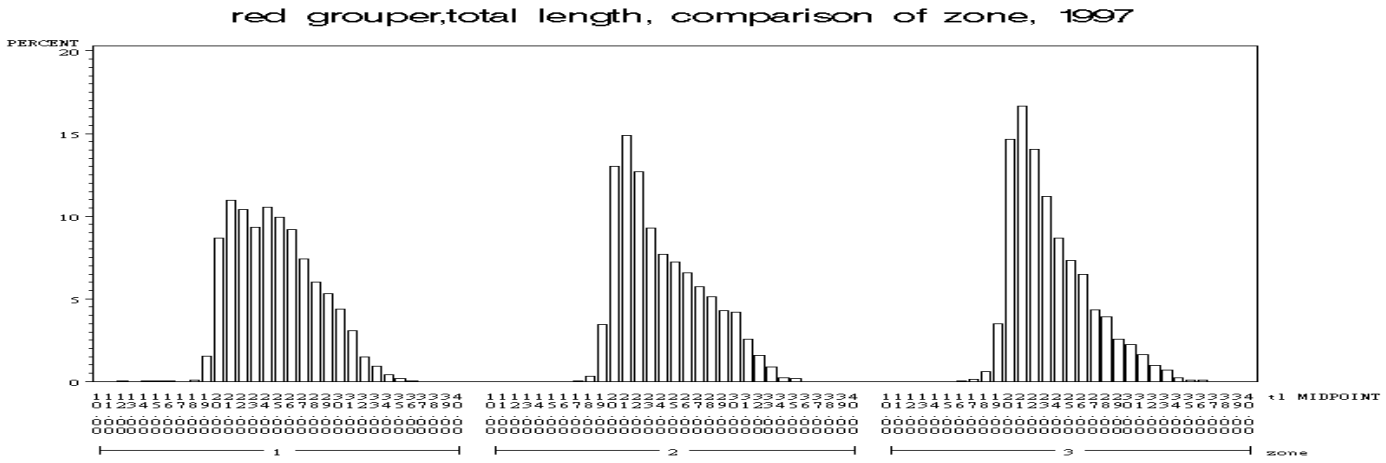


Fig 5 -Continued.





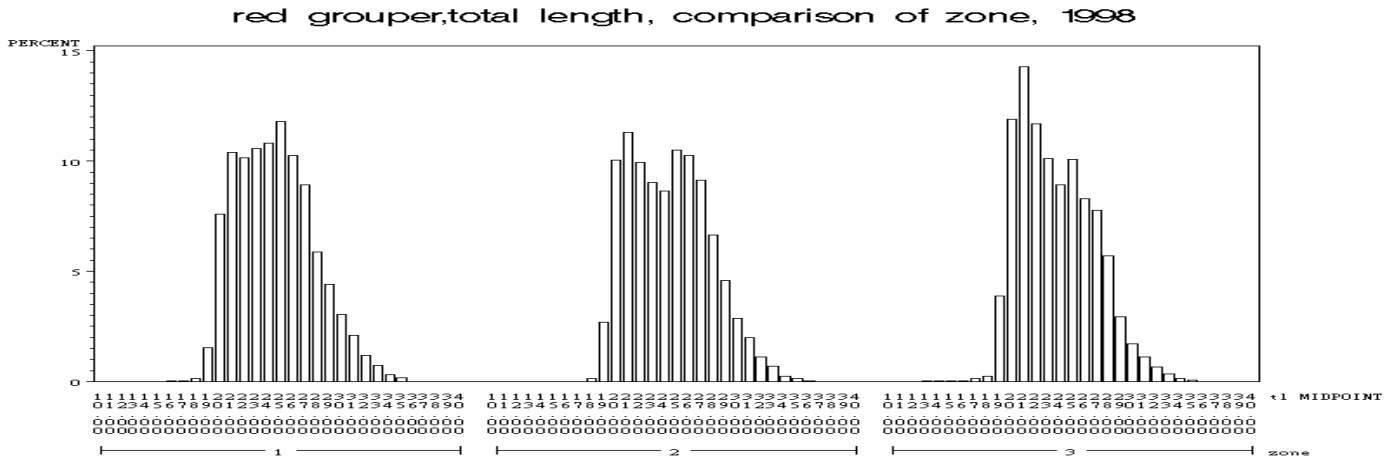
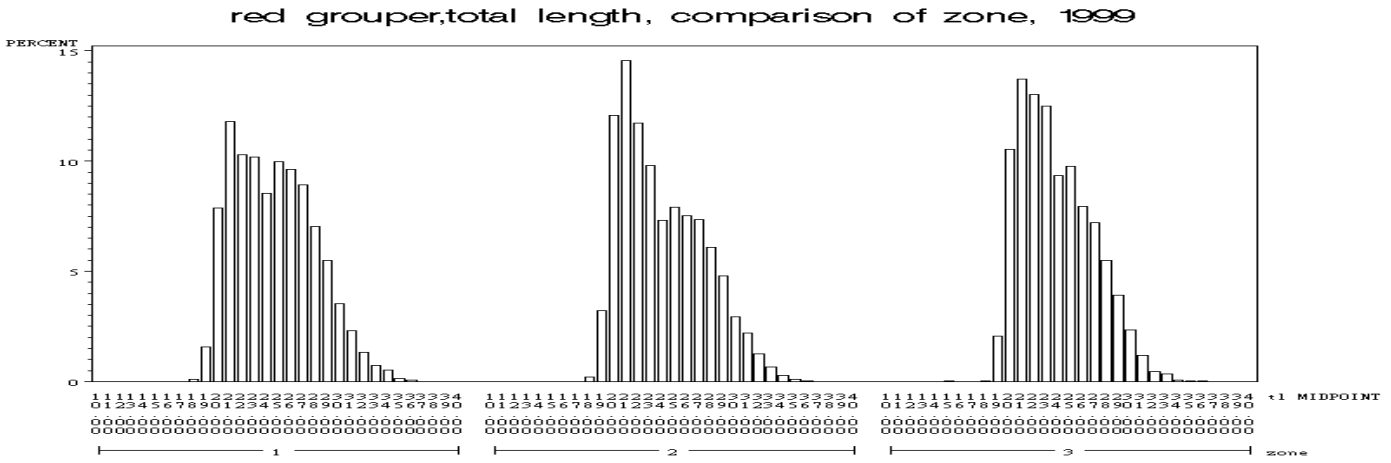
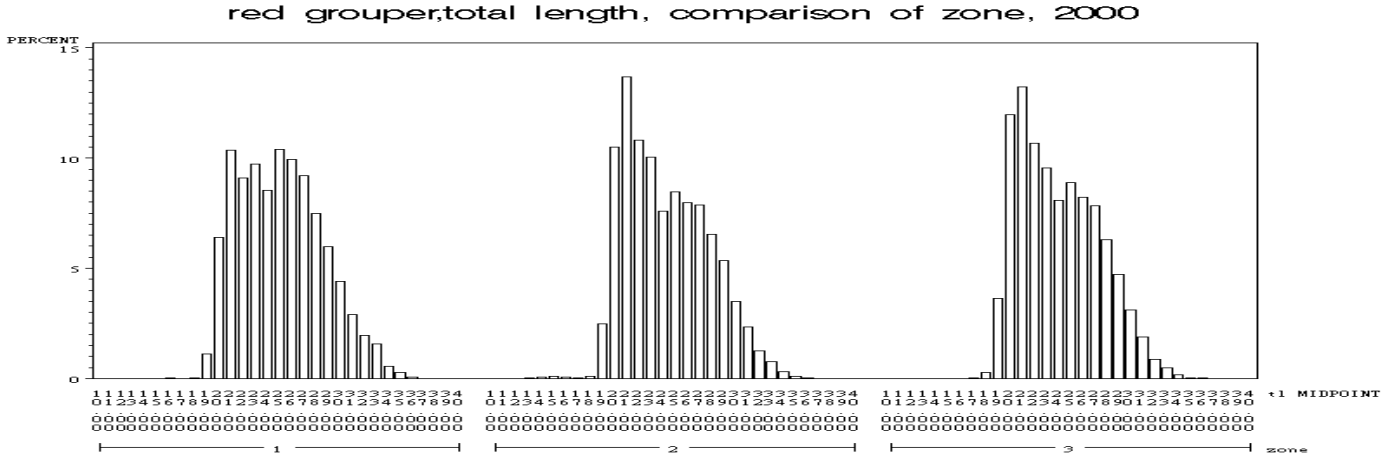
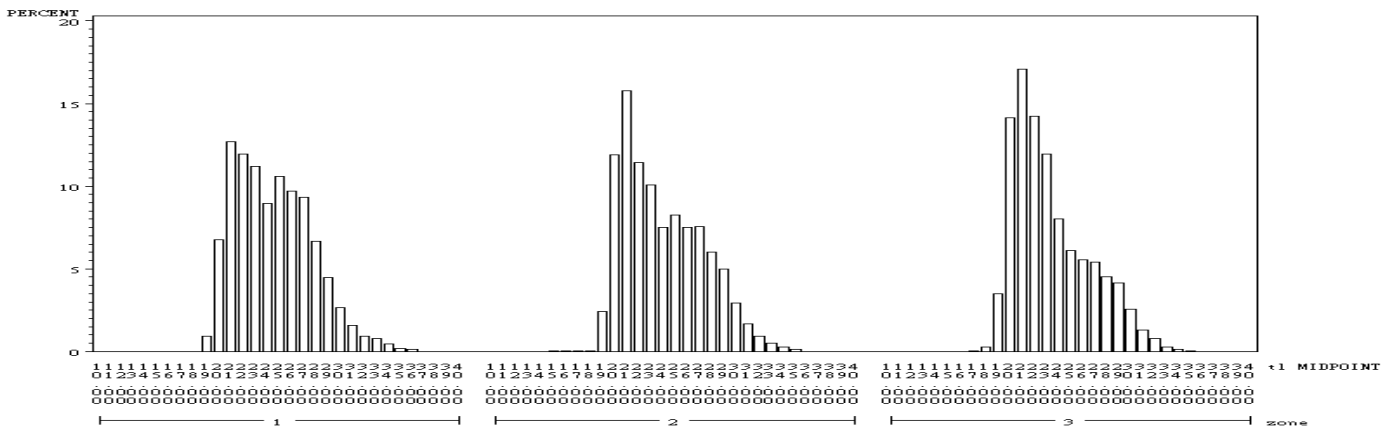


Fig 5 - Continued.







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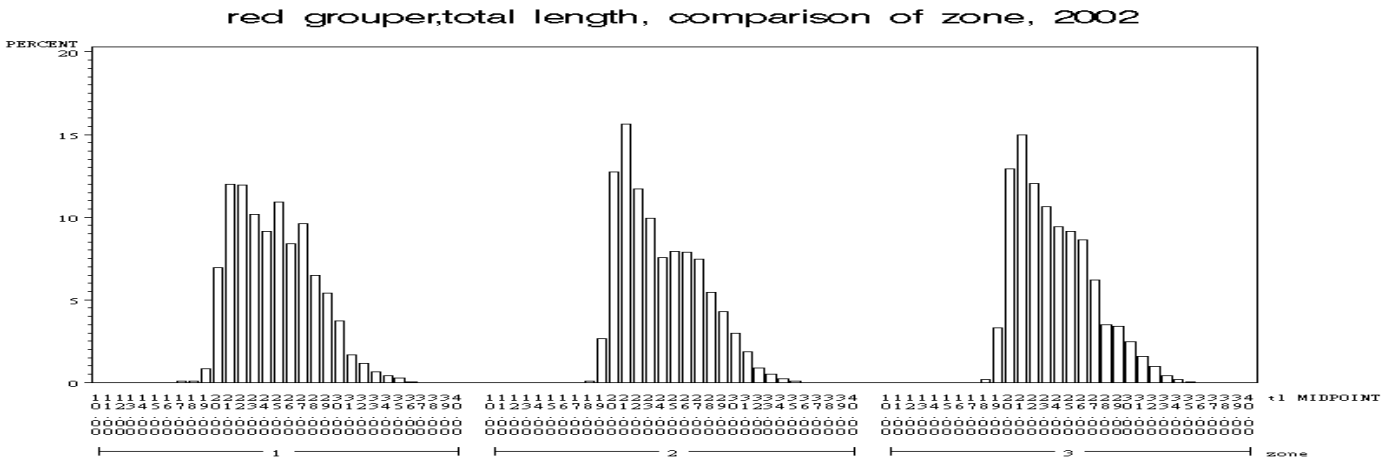


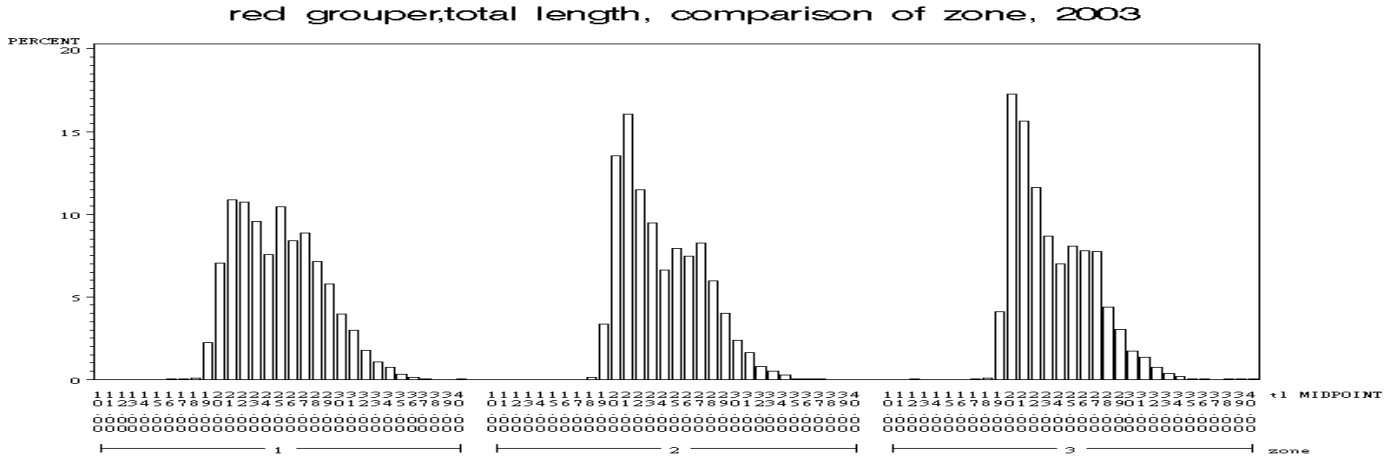
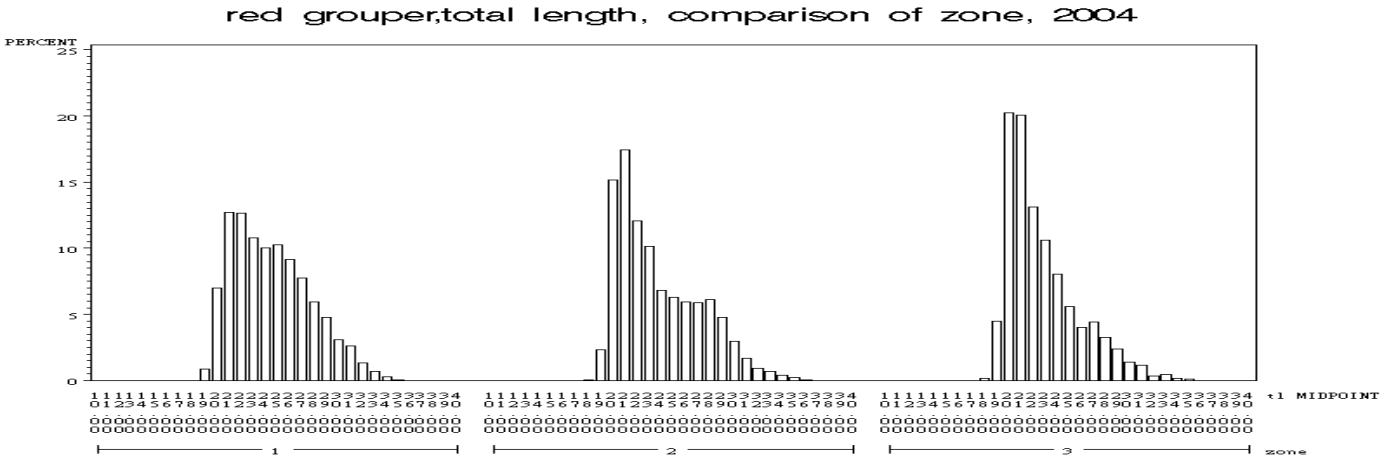


Fig 5 - Continued.



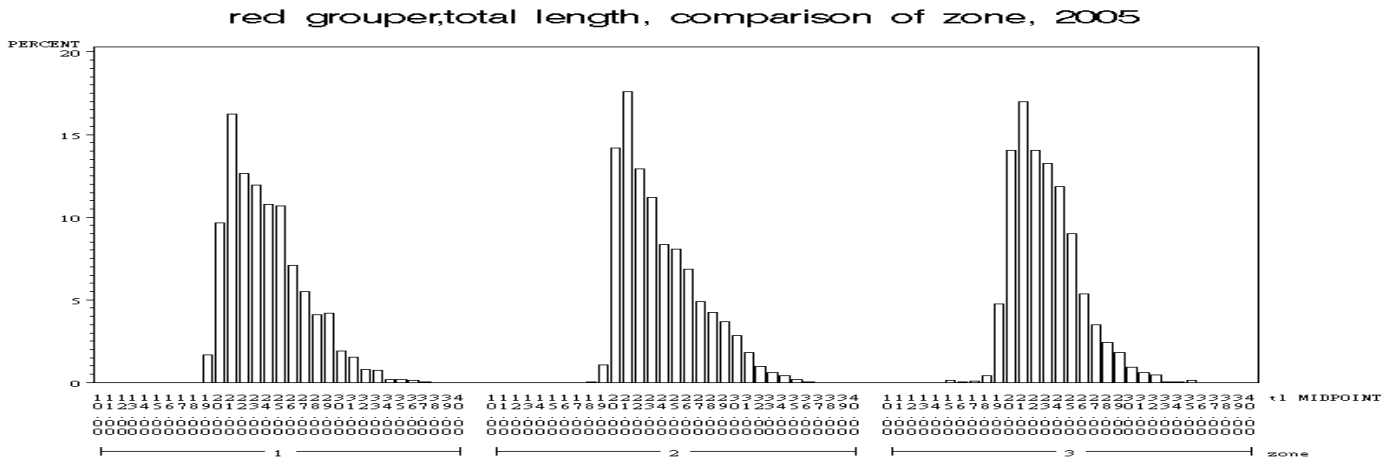
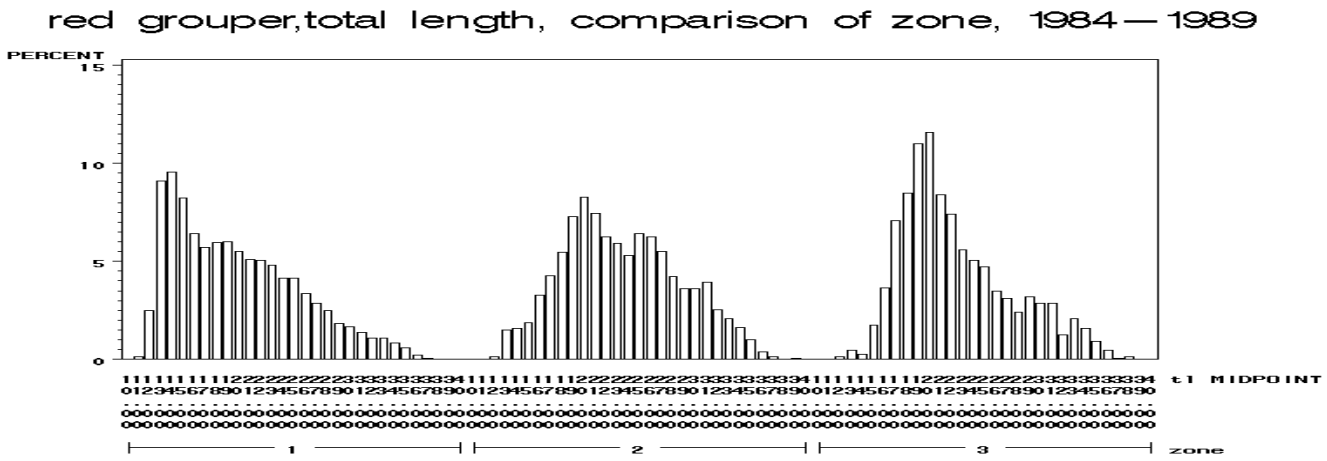


Fig 6 -Length frequency distributions for red groupers caught in different areas of the Gulf of Mexico (a) from 1984-1989 and (b) from 1990-2005. (Zone 1- grids 1,2 3; Zone 2 - grids 4, 5; Zone 3 - grids >= 6)

(a).



(b).

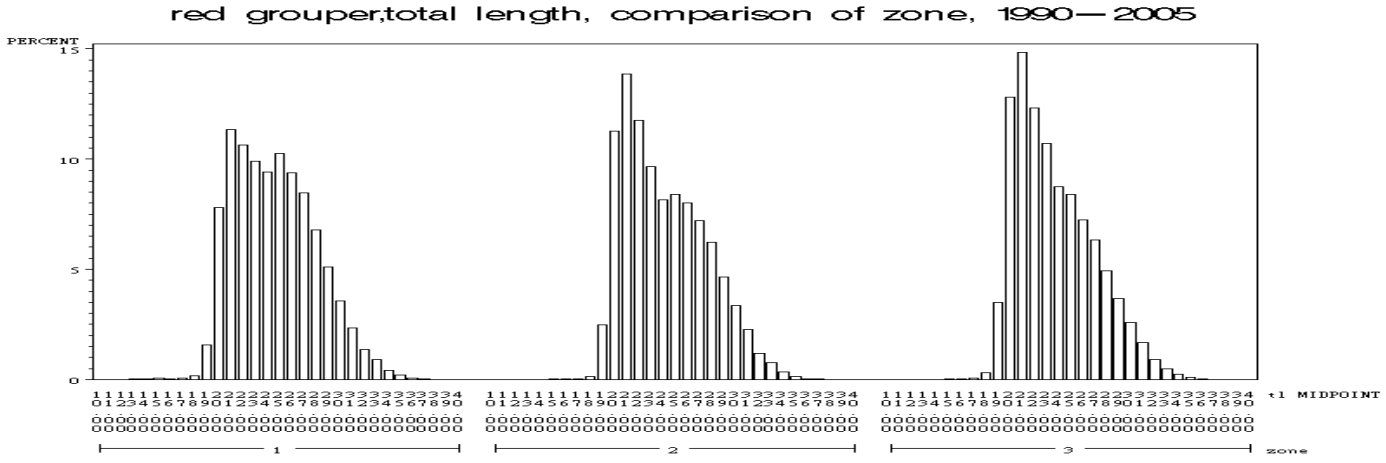
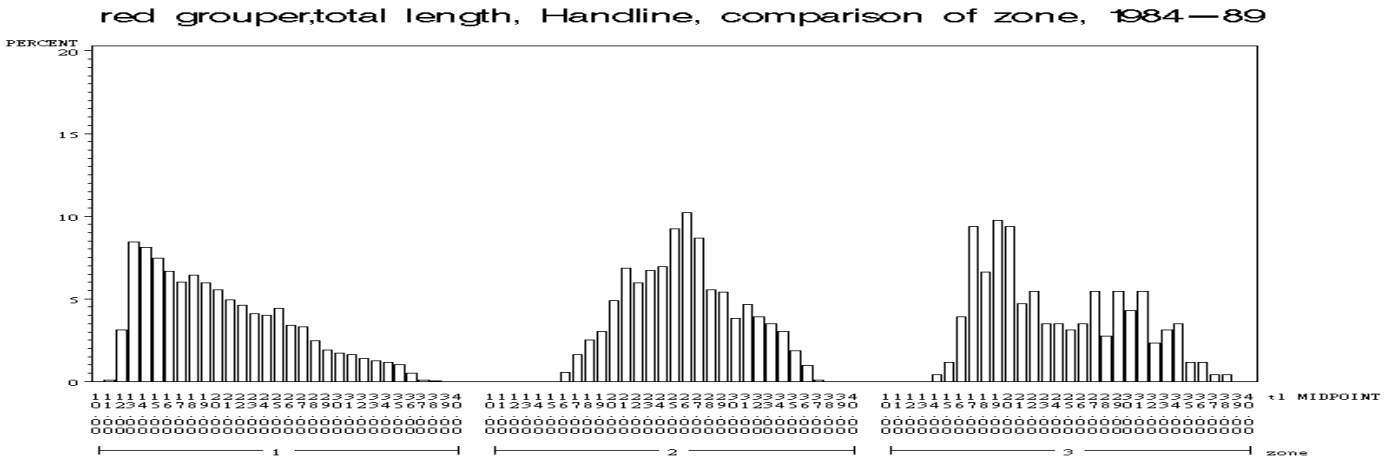


Fig 7 -Length frequency distributions for red groupers caught with handlines in different areas of the Gulf of Mexico (a) from 1984-1989 and (b) from 1990-2005. (Zone 1- grids 1,2 3; Zone 2 - grids 4, 5; Zone 3 - grids >= 6)

(a).



(b).

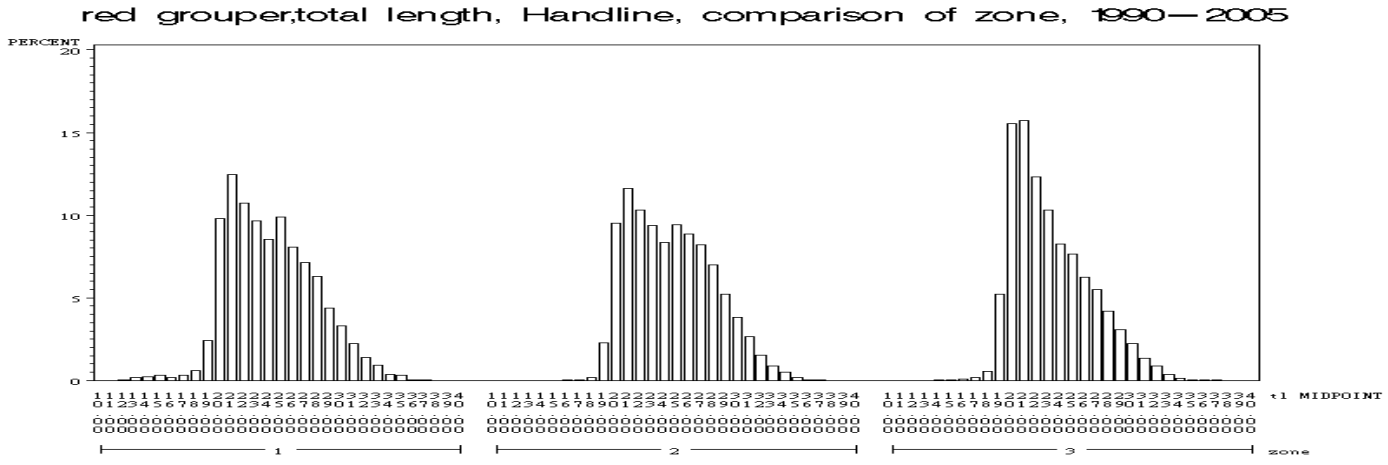
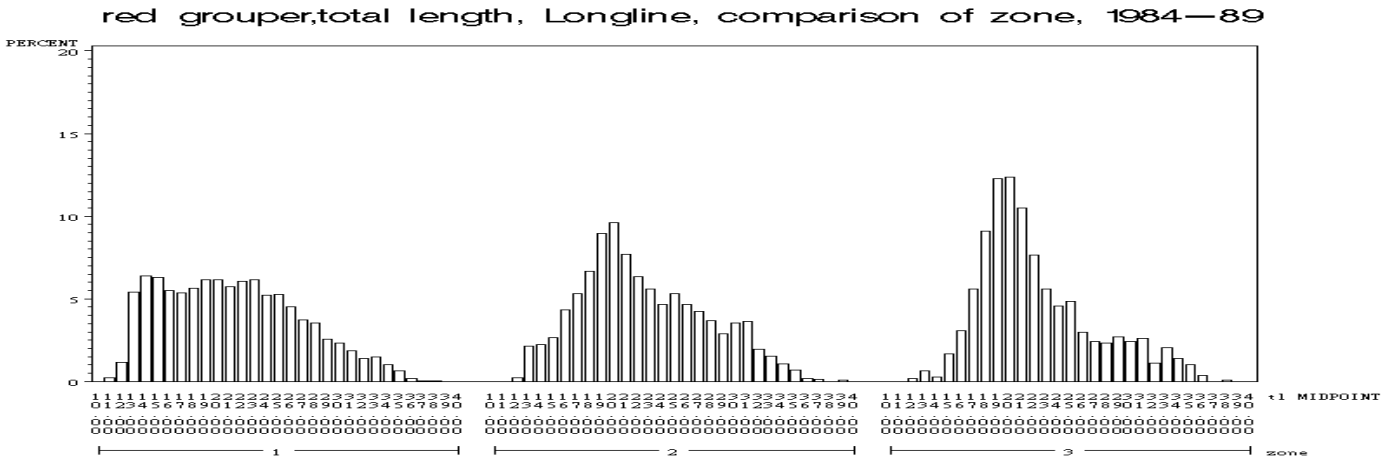


Fig 8 - Length frequency distributions for red groupers caught with longlines in different areas of the Gulf of Mexico (a) from 1984-1989 and (b) from 1990-2005. (Zone 1 - grids 1,2 3; Zone 2 - grids 4, 5; Zone 3 - grids >= 6)

(a).



(b).

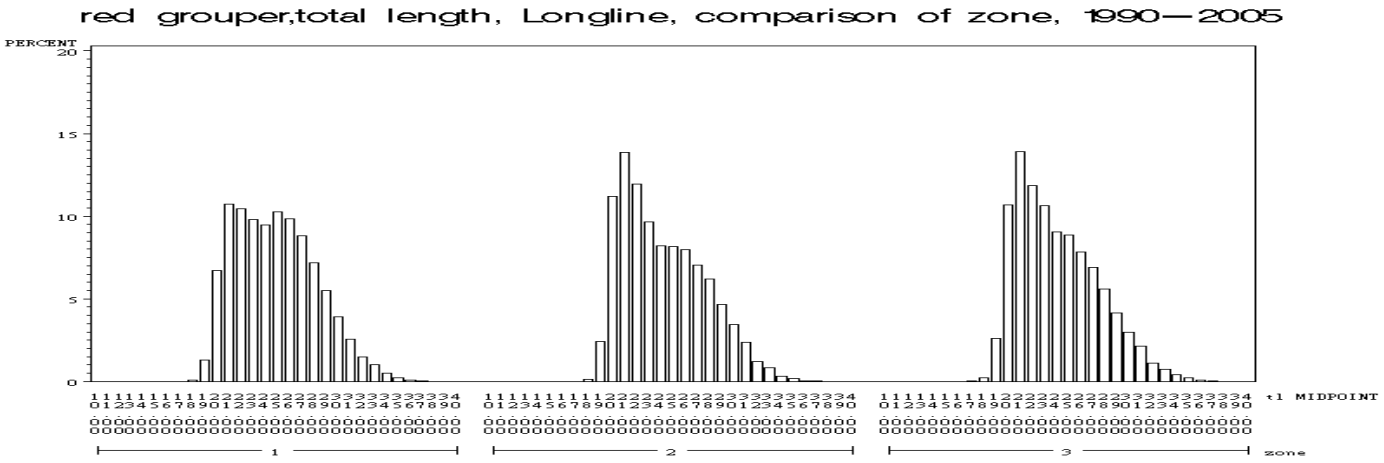
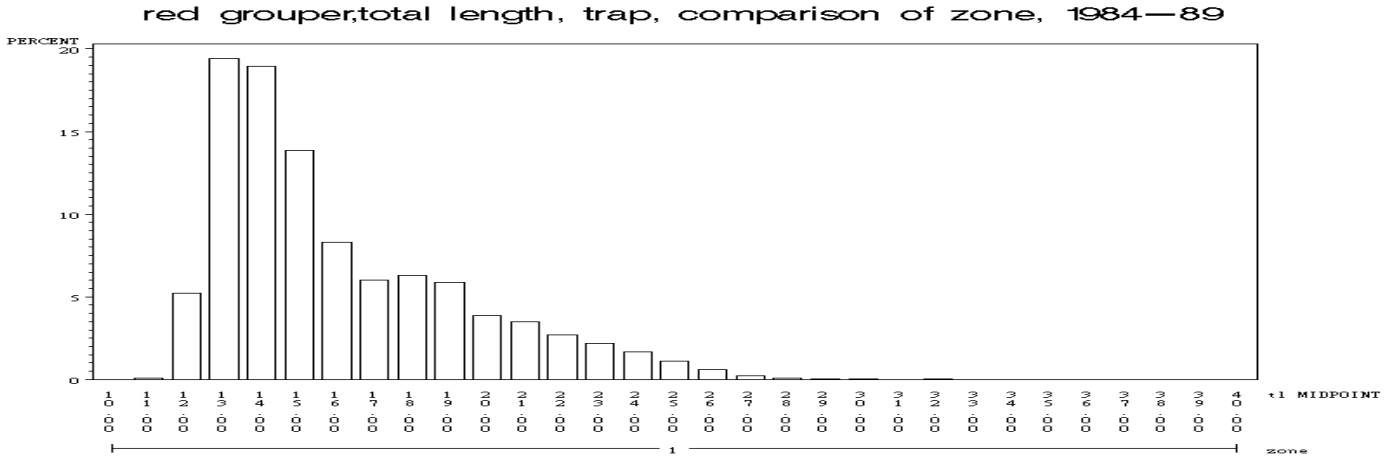


Fig 9 -Length frequency distributions for red groupers caught with fish traps in different areas of the Gulf of Mexico (a) from 1984-1989 and (b) from 1990-2005. (Zone 1 - grids 1,2 3; Zone 2 - grids 4, 5; Zone 3 - grids >= 6)

(a).



(b).

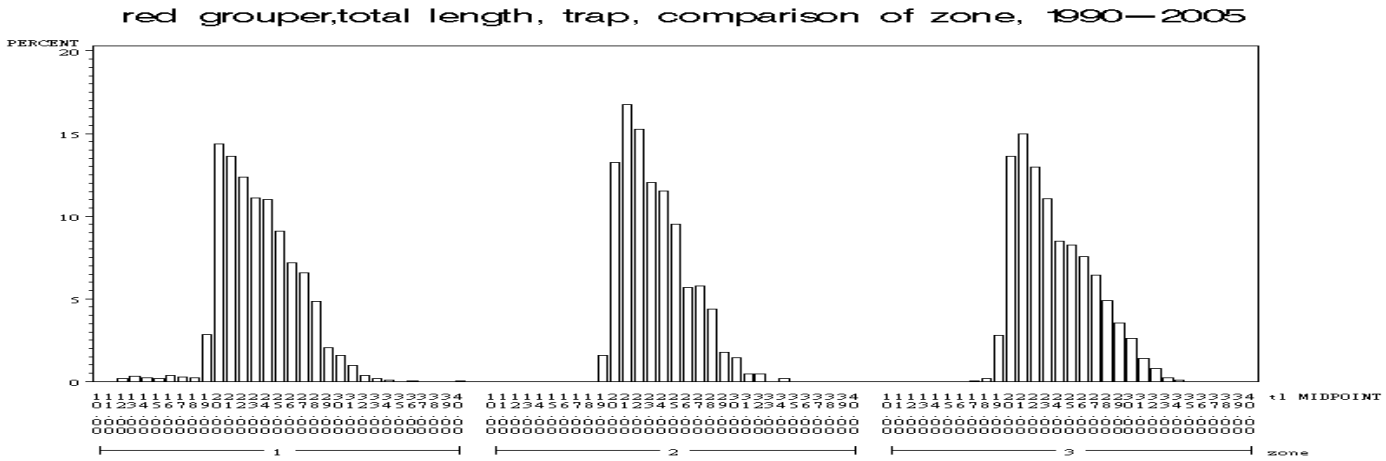
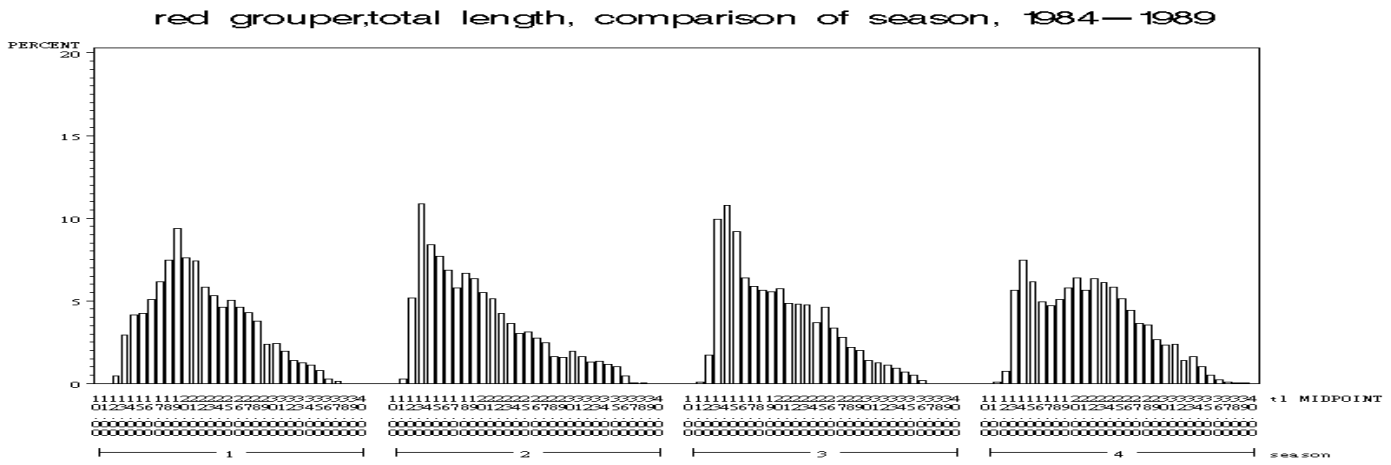


Fig 10 - Length frequency distributions for red groupers caught with fish traps in different areas of the Gulf of Mexico (a) from 1984-1989 and (b) from 1990-2005. (Season 1 - Jan, Feb, Mar; Season 2 - Apr, May, Jun; Season 3 - Jul, Aug, Sep; Season 4 - Oct, Nov. Dec)

(a).



(b).