FIMS length composition and percentage of females of the west coast rock lobster resource of South Africa

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Introduction

Length frequency distributions obtained from the FIMS of the west coast rock lobster constitute one of data inputs into the assessment as well as an estimate of the percentage of females. The length composition of the catch for each station and leg is obtained from measurements of a sub-sample of the catch, or sometimes the whole catch is measured. Nominal length frequencies (un-weighted frequencies pooled across stations) for males and females have been used previously as inputs to the assessment model of the rock lobster resource. The same is the case for the percentage of females. If the sampling of rock lobsters for measurement represents a random sample from a station and the sample is representative of the size composition of rock lobsters, then no weighting of the data is necessary. However if this is not the case, then the length frequencies should be weighted before pooling. This paper investigates length frequency distributions of rock lobster by sex obtained in various ways. A method is suggested that should be used in constructing length frequency distributions to be used as an input to the assessment model. Annual estimates of the female percentage of rock lobster, weighted in a similar way to that of the length frequency distributions, are also given.

In the FIMS database there are several records that have the total number of rock lobsters measured greater than the total number of rock lobsters caught. Some of these records have been corrected, but for some this was not possible as the error also occurred in the original records. For the analyses presented in this paper, this error has been ignored and the values given as the total number of measured rock lobsters have been taken as being correct.

Data and Methodology

Carapace length measurements from the FIMS surveys carried out over the period 1992/93 to 2009/10 are available for analysis. Figure 1 shows the number of length measurements obtained by station for the Cape Point Zone in the 2009/10 season as well as the proportion of measured lobsters. This Figure is a typical example of the variation in the sampling effort across stations, regardless of season or Zone. Also, the stations in the survey represent areas of different sizes. Four alternative methods of obtaining length distributions for rock lobsters are detailed below, in which some or all of these issues are addressed. To increase the number of measured lobsters in each season, length distributions obtained for each leg of the survey were combined.

The method used to obtain length distributions for rock lobsters by sex that is currently being used as an input into the assessment model is to calculate the nominal frequencies, which are given by:

$$N_{\ell}^{m/f} = \sum_{L}\sum_{s} n_{\ell,s}^{m/f}$$

where:

$N_{\ell}^{m/f}$ is the male or female nominal frequency for the ℓ^{th} length bin,

$n_{\ell,s}^{m/f}$ is the number of male or female rock lobsters in the ℓ^{th} length bin and station s,

L is the leg of the survey, and

m/f represents either males or females.

This method does not take into account different measurement effort across stations. To account for this, nominal proportions were calculated, given by:

$$P_{\ell}^{m/f} = \sum_{L}\sum_{s} \frac{n_{\ell,s}^{m/f}}{\sum_{\ell'} n_{\ell',s}^{m/f}} = \sum_{L}\sum_{s} p_{\ell,s}^{m/f}$$

where:

$P_{\ell}^{m/f}$ is the male or female nominal proportion for the ℓ^{th} length bin.

Although the variation in effort across stations is taken into consideration by this method, the differences in the areas of the transect sections within which the stations are positioned is not taken into account. Therefore, the length proportions were weighted by the area of the transect within which each station lies. Weighted proportions are given by:

$$P(w)_{\ell}^{m/f} = \sum_{L}\sum_{s} w_s p_{\ell,s}^{m/f}$$

where:

$P(w)_{\ell}^{m/f}$ is the male or female weighted proportion for the ℓ^{th} length bin, and

w_s is the area of the transect section within which station *s* is positioned.

Both proportion and weighted proportion length distributions have a potential problem in the present survey in that if few lobsters are caught and measured and the majority of the measured lengths fall within a length bin, the result will be an exaggerated peak in the length distribution at that length bin. To account for this the weighted proportion length distributions were adjusted for small sample sizes:

$$P_{adj}(w)_{\ell}^{m/f} = \sum_{L}\sum_{s} X(n_s) w_s p_{\ell,s}^{m/f}$$

where:

$P_{adj}(w)_{\ell}^{m/f}$ is the male or female adjusted weighted proportion for the ℓ^{th} length bin, and

$X(n_s)$ is a function that linearly down weights proportions from samples that are smaller than 40 lobsters, given by:

$$X(n_s) = \begin{cases} n_s/40 & \text{for } n_s < 40 \\ 1 & \text{for } n_s \geq 40 \end{cases},$$

n_s is the total number of rock lobsters measured in station *s*.

Each of the rock lobster length distributions were normalised so that they sum to 1.

The percentage number of females, weighted by the area of the transect of each station and adjusted for small sample sizes, are given by:

$$F\% = \frac{\sum_{L}\sum_{s} X(n_s) w_s n_s^f}{\sum_{L}\sum_{s} X(n_s) w_s n_s}$$

where:

$F\%$ is the percentage of female rock lobsters, and

n_s^f is the total number of female rock lobsters measured in station *s*.

Results and Conclusions

Figures 2–4 show the comparison of four alternative annual length distributions of rock lobsters for each Zone. Figures (a) show the length distributions for males, while Figures (b) are those for female rock lobsters. Differences between the four alternative length distributions are less pronounced for the Cape Point Zone where the number of lobsters measured is much higher than for the other Zones, especially compared to the Dassen Island and Lambert's Bay Zones. It is clear that nominal proportions-at-length can display high peaks for some length bins (see Figure 3b in

2003). This occurs in cases where very few lobsters were measured and most of the lengths fall within one length bin, and does not necessarily mean that the size structure of lobsters has changed. The method of obtaining length distributions whereby proportions are weighted and adjusted for small sample sizes provides the more appropriate length distributions in that the variation in the effort across stations, the variation in the area that each station represents and the effect of small sample sizes are taken into account. This results in length distributions that have spurious high contribution in the tails being pulled towards the centre of the distribution. Tables 1 – 4 give the length distributions of rock lobsters for each Zone, with tables (a) giving those for males, while Tables (b) give those for female rock lobsters.

Table 5 gives estimates of the annual percentage female rock lobsters for each Zone. Figure 5 shows these values and compares them with the percentage female previously used in the rock lobster assessment.

Table 1a. Carapace length distribution of male rock lobster for Cape Point.

Year	<45	45-50	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100	100-105	105-110	110-115	115-120	120-125	125-130	130-135	135-140
1992/93	0.000	0.000	0.002	0.014	0.113	0.251	0.226	0.182	0.117	0.065	0.021	0.007	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000
1993/94	0.000	0.000	0.004	0.029	0.142	0.248	0.252	0.181	0.094	0.034	0.012	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1994/95	0.000	0.000	0.005	0.028	0.164	0.244	0.281	0.164	0.068	0.032	0.010	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995/96	0.000	0.000	0.005	0.025	0.134	0.264	0.282	0.186	0.070	0.023	0.007	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996/97	0.000	0.000	0.003	0.018	0.087	0.222	0.294	0.218	0.108	0.036	0.010	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997/98	0.000	0.000	0.005	0.028	0.126	0.210	0.258	0.208	0.107	0.040	0.012	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1998/99	0.000	0.001	0.011	0.046	0.177	0.241	0.218	0.163	0.089	0.035	0.011	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1999/00*	0.000	0.001	0.010	0.037	0.137	0.269	0.268	0.158	0.081	0.028	0.009	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2000/01	0.000	0.000	0.002	0.022	0.096	0.206	0.293	0.201	0.104	0.049	0.019	0.006	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2001/02	0.000	0.000	0.003	0.024	0.099	0.194	0.268	0.232	0.105	0.043	0.021	0.009	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000
2002/03	0.000	0.000	0.003	0.019	0.089	0.206	0.245	0.222	0.134	0.055	0.019	0.006	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2003/04	0.000	0.000	0.002	0.015	0.103	0.203	0.236	0.206	0.136	0.065	0.023	0.007	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000
2004/05	0.000	0.000	0.004	0.021	0.094	0.210	0.287	0.207	0.106	0.044	0.015	0.008	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000
2005/06	0.000	0.001	0.011	0.029	0.094	0.222	0.293	0.207	0.097	0.031	0.010	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006/07	0.000	0.000	0.008	0.041	0.127	0.176	0.257	0.215	0.114	0.043	0.014	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007/08	0.000	0.001	0.012	0.049	0.147	0.217	0.254	0.178	0.095	0.032	0.010	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008/09	0.000	0.000	0.004	0.025	0.111	0.221	0.307	0.192	0.095	0.031	0.010	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009/10	0.000	0.000	0.004	0.018	0.101	0.175	0.310	0.201	0.121	0.046	0.018	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000

* Based on only one leg of the survey.

Table 1b. Carapace length distribution of female rock lobster for Cape Point.

Year	<45	45-50	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100	100-105	105-110	110-115	115-120	120-125	125-130	130-135	135-140
1992/93	0.000	0.000	0.010	0.089	0.423	0.379	0.082	0.013	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1993/94	0.000	0.002	0.019	0.133	0.485	0.290	0.062	0.007	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1994/95	0.000	0.001	0.017	0.105	0.458	0.344	0.058	0.014	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995/96	0.000	0.001	0.016	0.145	0.501	0.281	0.048	0.007	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996/97	0.000	0.003	0.020	0.161	0.489	0.277	0.043	0.006	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997/98	0.000	0.005	0.032	0.183	0.475	0.261	0.038	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1998/99	0.000	0.006	0.044	0.197	0.477	0.211	0.040	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1999/00*	0.000	0.002	0.035	0.168	0.484	0.267	0.038	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2000/01	0.000	0.002	0.019	0.136	0.510	0.276	0.050	0.006	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2001/02	0.000	0.001	0.040	0.208	0.472	0.235	0.038	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2002/03	0.000	0.002	0.036	0.200	0.476	0.245	0.036	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2003/04	0.000	0.002	0.021	0.162	0.501	0.266	0.043	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2004/05	0.000	0.002	0.037	0.174	0.461	0.275	0.044	0.006	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005/06	0.001	0.010	0.057	0.205	0.460	0.235	0.030	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006/07	0.000	0.004	0.045	0.174	0.447	0.288	0.035	0.004	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007/08	0.000	0.005	0.047	0.163	0.372	0.270	0.091	0.037	0.013	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008/09	0.000	0.001	0.029	0.126	0.457	0.322	0.056	0.007	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009/10	0.000	0.001	0.022	0.122	0.484	0.303	0.055	0.011	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

* Based on only one leg of the survey.

Table 2a. Carapace length distribution of male rock lobster for Dassen Island.

Year	<45	45-50	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100	100-105	105-110	110-115	115-120	120-125	125-130	130-135	135-140
1992/93	0.000	0.000	0.001	0.024	0.119	0.193	0.232	0.232	0.127	0.054	0.014	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1993/94	0.000	0.000	0.000	0.008	0.049	0.146	0.315	0.278	0.142	0.049	0.013	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1994/95	0.000	0.000	0.002	0.017	0.097	0.208	0.292	0.206	0.086	0.066	0.014	0.009	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
1995/96	0.002	0.000	0.001	0.003	0.037	0.182	0.314	0.274	0.146	0.038	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996/97	0.000	0.000	0.005	0.015	0.059	0.125	0.315	0.262	0.144	0.058	0.014	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997/98	0.000	0.000	0.002	0.028	0.106	0.099	0.156	0.245	0.198	0.102	0.047	0.013	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1998/99	0.000	0.000	0.002	0.034	0.141	0.165	0.125	0.152	0.160	0.112	0.065	0.028	0.013	0.003	0.000	0.000	0.000	0.000	0.000	0.000
1999/00	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
2000/01	0.000	0.000	0.000	0.004	0.025	0.093	0.253	0.317	0.174	0.091	0.032	0.011	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2001/02	0.000	0.000	0.000	0.002	0.033	0.150	0.264	0.242	0.184	0.086	0.026	0.009	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2002/03	0.000	0.072	0.206	0.245	0.213	0.167	0.051	0.026	0.010	0.005	0.003	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2003/04	0.000	0.000	0.000	0.015	0.086	0.139	0.166	0.179	0.174	0.119	0.083	0.034	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000
2004/05	0.000	0.000	0.000	0.003	0.034	0.164	0.236	0.216	0.156	0.095	0.060	0.030	0.007	0.001	0.000	0.000	0.000	0.000	0.000	0.000
2005/06	0.000	0.000	0.002	0.016	0.093	0.212	0.351	0.206	0.066	0.038	0.012	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006/07	0.000	0.000	0.004	0.059	0.116	0.145	0.303	0.235	0.089	0.030	0.010	0.007	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000
2007/08	0.000	0.000	0.009	0.042	0.212	0.323	0.239	0.120	0.040	0.011	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008/09	0.000	0.000	0.004	0.023	0.118	0.229	0.357	0.184	0.060	0.010	0.011	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009/10	0.001	0.001	0.005	0.047	0.130	0.179	0.332	0.217	0.074	0.011	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 2b. Carapace length distribution of female rock lobster for Dassen Island.

Year	<45	45-50	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100	100-105	105-110	110-115	115-120	120-125	125-130	130-135	135-140
1992/93	0.000	0.001	0.011	0.080	0.295	0.401	0.181	0.029	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1993/94	0.000	0.000	0.003	0.047	0.311	0.435	0.175	0.027	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1994/95	0.000	0.000	0.002	0.067	0.191	0.284	0.344	0.102	0.010	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995/96	0.003	0.000	0.000	0.027	0.254	0.447	0.226	0.043	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996/97	0.000	0.001	0.026	0.147	0.215	0.390	0.179	0.041	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997/98	0.000	0.003	0.010	0.112	0.260	0.331	0.217	0.053	0.006	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1998/99	0.000	0.000	0.014	0.161	0.344	0.315	0.132	0.028	0.004	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1999/00	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
2000/01	0.000	0.000	0.008	0.095	0.375	0.349	0.147	0.024	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2001/02	0.000	0.000	0.002	0.020	0.236	0.450	0.222	0.058	0.009	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2002/03	0.037	0.144	0.230	0.211	0.206	0.137	0.030	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2003/04	0.000	0.000	0.006	0.059	0.265	0.427	0.197	0.041	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2004/05	0.000	0.000	0.000	0.029	0.226	0.443	0.238	0.051	0.007	0.001	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005/06	0.000	0.000	0.007	0.093	0.362	0.379	0.137	0.022	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006/07	0.000	0.000	0.010	0.109	0.268	0.396	0.192	0.024	0.001	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007/08	0.000	0.005	0.034	0.175	0.388	0.265	0.096	0.035	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008/09	0.000	0.000	0.018	0.174	0.358	0.290	0.128	0.023	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009/10	0.000	0.013	0.081	0.302	0.293	0.211	0.086	0.013	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 3a. Carapace length distribution of male rock lobster for Saldanha Bay.

Year	<45	45-50	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100	100-105	105-110	110-115	115-120	120-125	125-130	130-135	135-140
1992/93	0.005	0.004	0.034	0.156	0.306	0.215	0.108	0.049	0.037	0.050	0.022	0.009	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1993/94	0.000	0.002	0.021	0.097	0.261	0.247	0.134	0.055	0.042	0.066	0.049	0.016	0.007	0.004	0.000	0.000	0.000	0.000	0.000	0.000
1994/95	0.000	0.002	0.015	0.115	0.320	0.241	0.106	0.050	0.040	0.045	0.031	0.024	0.008	0.002	0.000	0.000	0.000	0.000	0.000	0.000
1995/96	0.000	0.001	0.014	0.097	0.309	0.268	0.109	0.047	0.043	0.040	0.034	0.024	0.011	0.003	0.000	0.000	0.000	0.000	0.000	0.000
1996/97	0.003	0.011	0.033	0.110	0.299	0.247	0.109	0.048	0.039	0.036	0.031	0.020	0.011	0.001	0.000	0.000	0.000	0.000	0.000	0.000
1997/98	0.003	0.012	0.037	0.121	0.304	0.232	0.101	0.044	0.041	0.038	0.034	0.022	0.011	0.001	0.000	0.000	0.000	0.000	0.000	0.000
1998/99	0.003	0.009	0.032	0.133	0.323	0.240	0.095	0.037	0.033	0.032	0.029	0.019	0.012	0.002	0.001	0.001	0.000	0.000	0.000	0.000
1999/00	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
2000/01	0.003	0.010	0.033	0.124	0.310	0.235	0.101	0.041	0.037	0.036	0.032	0.021	0.013	0.002	0.000	0.000	0.000	0.000	0.000	0.000
2001/02	0.003	0.010	0.033	0.122	0.306	0.231	0.104	0.041	0.038	0.039	0.034	0.021	0.014	0.002	0.000	0.001	0.001	0.000	0.000	0.000
2002/03	0.004	0.043	0.063	0.126	0.286	0.206	0.091	0.037	0.033	0.034	0.029	0.018	0.012	0.002	0.000	0.001	0.001	0.000	0.000	0.016
2003/04	0.004	0.020	0.036	0.124	0.298	0.224	0.102	0.041	0.037	0.039	0.033	0.022	0.015	0.003	0.002	0.001	0.001	0.000	0.000	0.000
2004/05	0.004	0.019	0.034	0.122	0.293	0.220	0.100	0.040	0.038	0.039	0.038	0.026	0.016	0.005	0.002	0.001	0.002	0.000	0.000	0.000
2005/06	0.003	0.018	0.032	0.124	0.301	0.225	0.100	0.042	0.035	0.037	0.034	0.025	0.013	0.006	0.002	0.001	0.001	0.000	0.000	0.000
2006/07	0.003	0.018	0.033	0.121	0.296	0.220	0.100	0.044	0.041	0.038	0.035	0.026	0.014	0.007	0.002	0.001	0.001	0.000	0.000	0.000
2007/08	0.005	0.021	0.037	0.117	0.295	0.219	0.105	0.043	0.039	0.036	0.034	0.024	0.014	0.006	0.002	0.002	0.001	0.000	0.000	0.000
2008/09	0.004	0.018	0.037	0.133	0.303	0.211	0.101	0.042	0.041	0.034	0.032	0.022	0.012	0.006	0.002	0.002	0.001	0.000	0.000	0.000
2009/10	0.004	0.019	0.036	0.123	0.298	0.212	0.104	0.044	0.043	0.036	0.033	0.022	0.013	0.007	0.002	0.002	0.001	0.000	0.000	0.000

Table 3b. Carapace length distribution of female rock lobster for Saldanha Bay.

Year	<45	45-50	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100	100-105	105-110	110-115	115-120	120-125	125-130	130-135	135-140
1992/93	0.002	0.008	0.088	0.338	0.272	0.139	0.103	0.043	0.004	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1993/94	0.001	0.004	0.054	0.315	0.321	0.161	0.079	0.049	0.011	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1994/95	0.001	0.002	0.057	0.342	0.358	0.141	0.063	0.029	0.006	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995/96	0.001	0.002	0.057	0.325	0.364	0.152	0.056	0.034	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996/97	0.005	0.030	0.094	0.306	0.311	0.156	0.054	0.034	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997/98	0.006	0.031	0.103	0.303	0.307	0.151	0.053	0.038	0.007	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1998/99	0.004	0.026	0.102	0.341	0.300	0.139	0.043	0.033	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1999/00	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
2000/01	0.005	0.027	0.090	0.308	0.319	0.149	0.051	0.037	0.012	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2001/02	0.005	0.027	0.091	0.298	0.312	0.156	0.053	0.040	0.015	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2002/03	0.071	0.064	0.093	0.268	0.272	0.136	0.046	0.035	0.012	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2003/04	0.021	0.043	0.092	0.290	0.302	0.145	0.051	0.037	0.013	0.003	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2004/05	0.021	0.042	0.090	0.288	0.300	0.146	0.052	0.038	0.015	0.002	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005/06	0.019	0.039	0.093	0.304	0.308	0.136	0.047	0.034	0.014	0.002	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006/07	0.020	0.040	0.093	0.291	0.302	0.144	0.052	0.037	0.015	0.002	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007/08	0.020	0.042	0.096	0.282	0.305	0.146	0.050	0.036	0.014	0.003	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008/09	0.017	0.035	0.104	0.305	0.294	0.141	0.046	0.038	0.012	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009/10	0.018	0.037	0.094	0.290	0.303	0.145	0.051	0.038	0.014	0.005	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 4a. Carapace length distribution of male rock lobster for Lambert's Bay.

Year	<45	45-50	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100	100-105	105-110	110-115	115-120	120-125	125-130	130-135	135-140
1992/93	0.000	0.000	0.005	0.082	0.193	0.135	0.153	0.119	0.086	0.116	0.071	0.027	0.007	0.000	0.005	0.000	0.000	0.000	0.000	0.000
1993/94	0.000	0.000	0.011	0.052	0.224	0.131	0.019	0.037	0.012	0.112	0.060	0.116	0.129	0.061	0.006	0.000	0.000	0.028	0.000	0.000
1994/95	0.000	0.002	0.037	0.190	0.354	0.205	0.077	0.019	0.025	0.025	0.011	0.019	0.032	0.005	0.000	0.001	0.000	0.000	0.000	0.000
1995/96	0.000	0.000	0.006	0.106	0.323	0.303	0.140	0.065	0.036	0.008	0.009	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996/97	0.000	0.001	0.032	0.155	0.245	0.136	0.120	0.127	0.116	0.058	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997/98	0.000	0.000	0.000	0.183	0.272	0.167	0.051	0.044	0.131	0.048	0.040	0.010	0.005	0.012	0.018	0.020	0.000	0.000	0.000	0.000
1998/99	0.000	0.000	0.006	0.047	0.149	0.250	0.220	0.115	0.121	0.056	0.026	0.006	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000
1999/00	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
2000/01	0.000	0.000	0.001	0.010	0.145	0.295	0.354	0.144	0.034	0.011	0.007	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2001/02	0.000	0.000	0.000	0.043	0.094	0.170	0.148	0.262	0.198	0.055	0.026	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2002/03	0.000	0.000	0.004	0.059	0.086	0.064	0.154	0.203	0.222	0.159	0.045	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2003/04	0.000	0.000	0.005	0.015	0.045	0.069	0.095	0.187	0.271	0.190	0.116	0.008	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
2004/05	0.000	0.000	0.000	0.000	0.167	0.235	0.153	0.183	0.124	0.103	0.032	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005/06	0.000	0.000	0.024	0.220	0.300	0.236	0.126	0.066	0.022	0.003	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006/07	0.000	0.001	0.059	0.314	0.341	0.175	0.063	0.037	0.005	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007/08	0.000	0.000	0.000	0.015	0.025	0.240	0.245	0.231	0.195	0.029	0.004	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008/09	0.000	0.016	0.083	0.172	0.224	0.185	0.144	0.082	0.074	0.017	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009/10	0.000	0.000	0.000	0.066	0.243	0.000	0.000	0.000	0.345	0.345	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 4b. Carapace length distribution of female rock lobster for Lambert's Bay.

Year	<45	45-50	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100	100-105	105-110	110-115	115-120	120-125	125-130	130-135	135-140
1992/93	0.000	0.003	0.044	0.173	0.210	0.163	0.231	0.130	0.030	0.016	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1993/94	0.000	0.000	0.031	0.271	0.435	0.095	0.060	0.038	0.047	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1994/95	0.000	0.001	0.120	0.443	0.253	0.105	0.013	0.030	0.024	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995/96	0.000	0.005	0.062	0.309	0.340	0.191	0.054	0.021	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996/97	0.000	0.005	0.135	0.367	0.280	0.140	0.049	0.018	0.004	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997/98	0.000	0.000	0.150	0.372	0.255	0.115	0.074	0.009	0.015	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1998/99	0.000	0.003	0.069	0.139	0.294	0.304	0.162	0.026	0.001	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1999/00	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
2000/01	0.000	0.006	0.020	0.078	0.312	0.373	0.176	0.030	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2001/02	0.000	0.000	0.011	0.247	0.275	0.251	0.191	0.005	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2002/03	0.000	0.000	0.104	0.262	0.191	0.291	0.114	0.029	0.007	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2003/04	0.000	0.000	0.010	0.143	0.265	0.265	0.249	0.061	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2004/05	0.000	0.000	0.000	0.000	0.500	0.000	0.000	0.435	0.065	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005/06	0.000	0.001	0.107	0.252	0.376	0.182	0.068	0.012	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006/07	0.002	0.018	0.263	0.343	0.251	0.060	0.058	0.002	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007/08	0.000	0.000	0.000	0.034	0.250	0.459	0.123	0.113	0.017	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008/09	0.000	0.003	0.056	0.157	0.340	0.258	0.100	0.059	0.015	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009/10	0.000	0.000	0.000	0.677	0.162	0.162	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 5. Percentage female west coast rock lobster for each Zone.

Year	Cape Point	Dassen Island	Saldanha Bay	Lambert's Bay
1992/93	0.245	0.486	0.424	0.379
1993/94	0.275	0.401	0.388	0.418
1994/95	0.242	0.473	0.388	0.547
1995/96	0.252	0.326	0.374	0.459
1996/97	0.217	0.224	0.397	0.334
1997/98	0.296	0.340	0.399	0.549
1998/99	0.308	0.321	0.381	0.394
1999/00	0.172	—	—	—
2000/01	0.217	0.085	0.399	0.393
2001/02	0.229	0.342	0.400	0.186
2002/03	0.176	0.499	0.404	0.157
2003/04	0.207	0.552	0.403	0.314
2004/05	0.229	0.295	0.403	0.001
2005/06	0.238	0.316	0.405	0.615
2006/07	0.274	0.366	0.400	0.363
2007/08	0.292	0.370	0.399	0.419
2008/09	0.237	0.203	0.405	0.190
2009/10	0.234	0.144	0.403	0.370

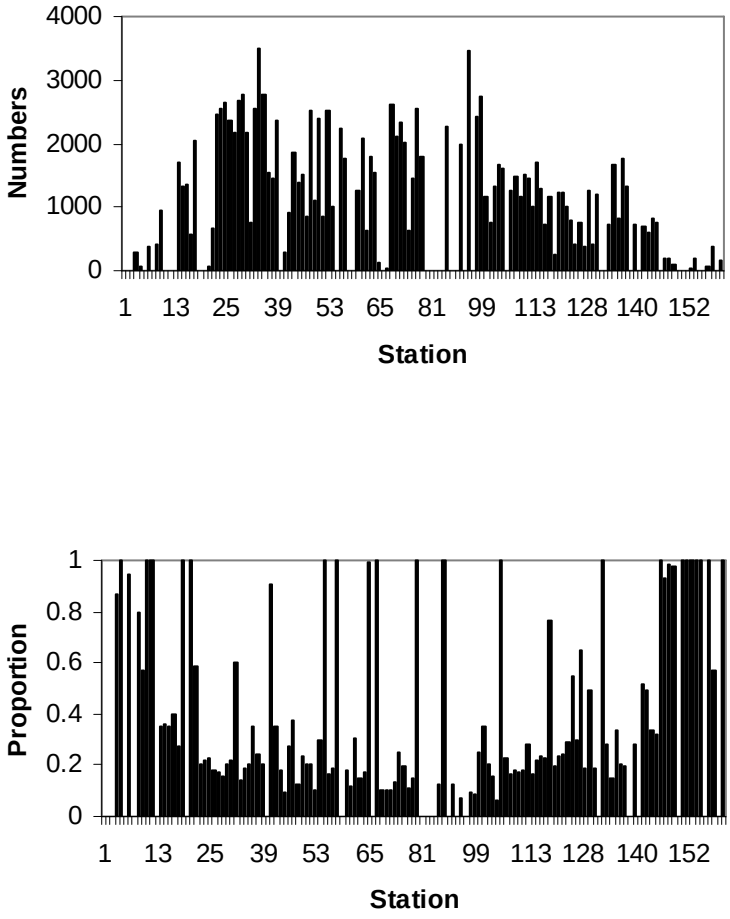

Figure 1. Number (above) and proportion (below) of lobster measured for carapace length in the FIMS at Cape Point during the 2009/10 season (both legs combined).

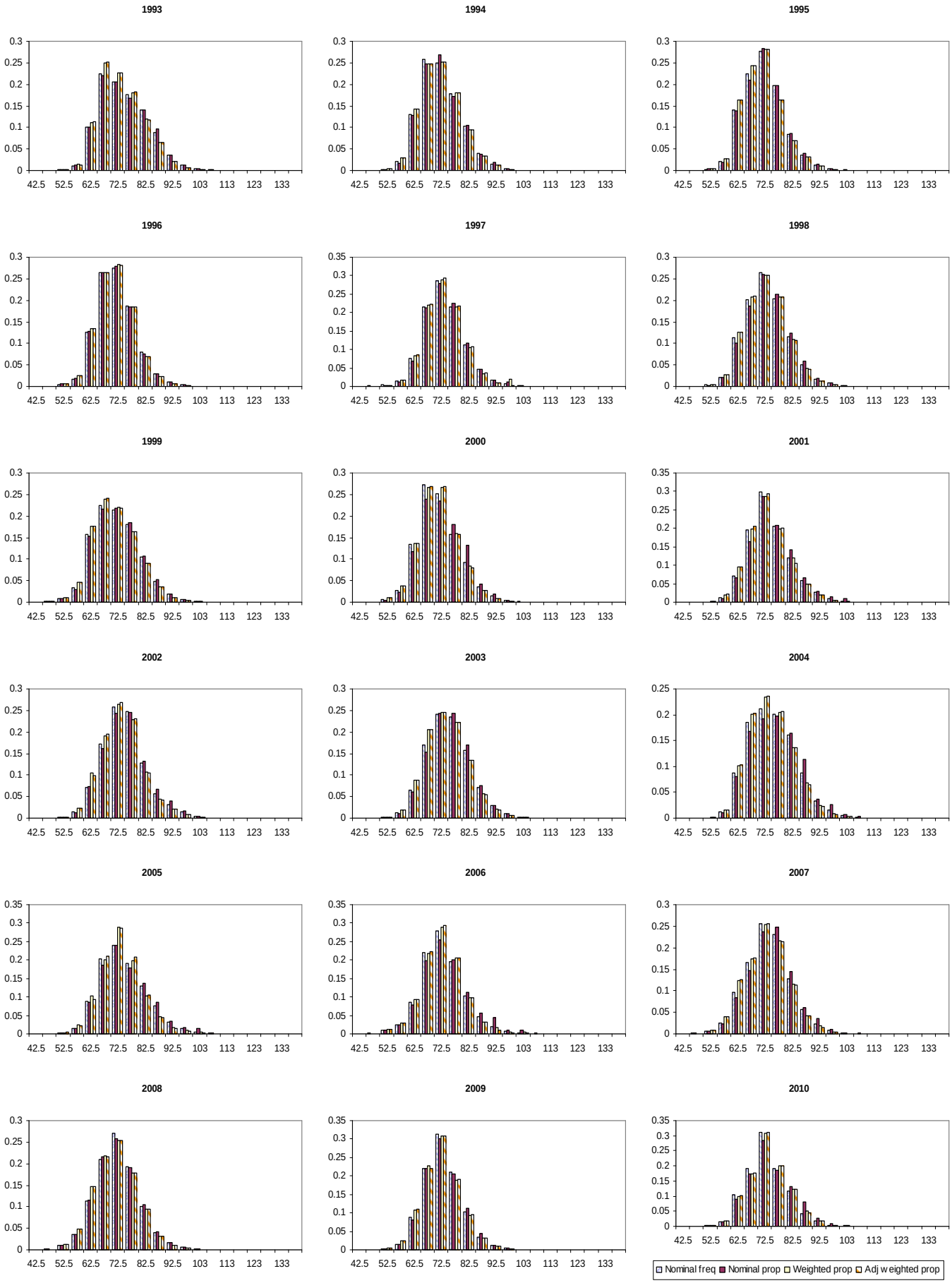

Figure 2a. Comparison of four alternative length distributions for male rock lobsters for the Cape Point.

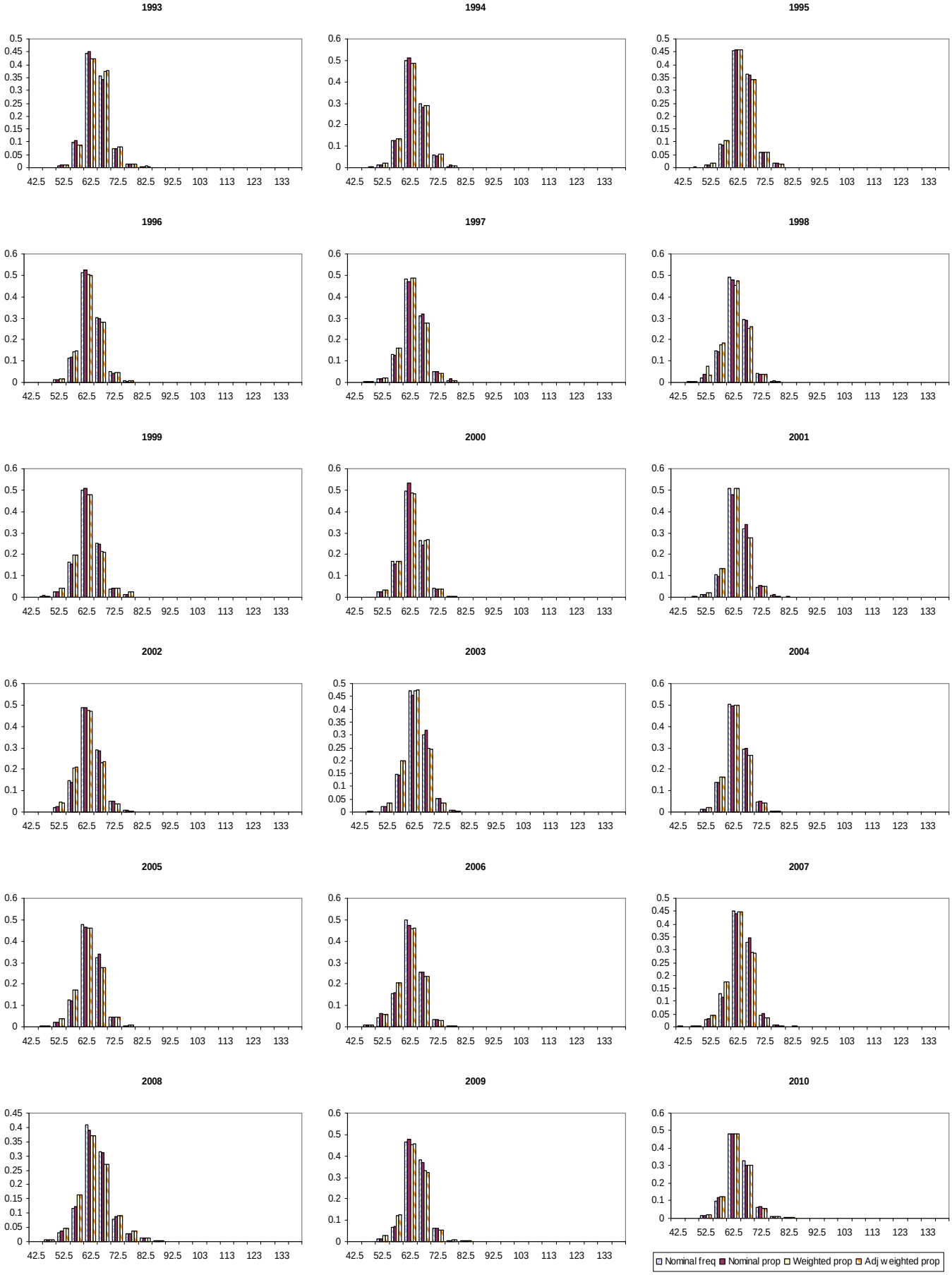

Figure 2b. Comparison of four alternative length distributions for female rock lobsters for the Cape Point.

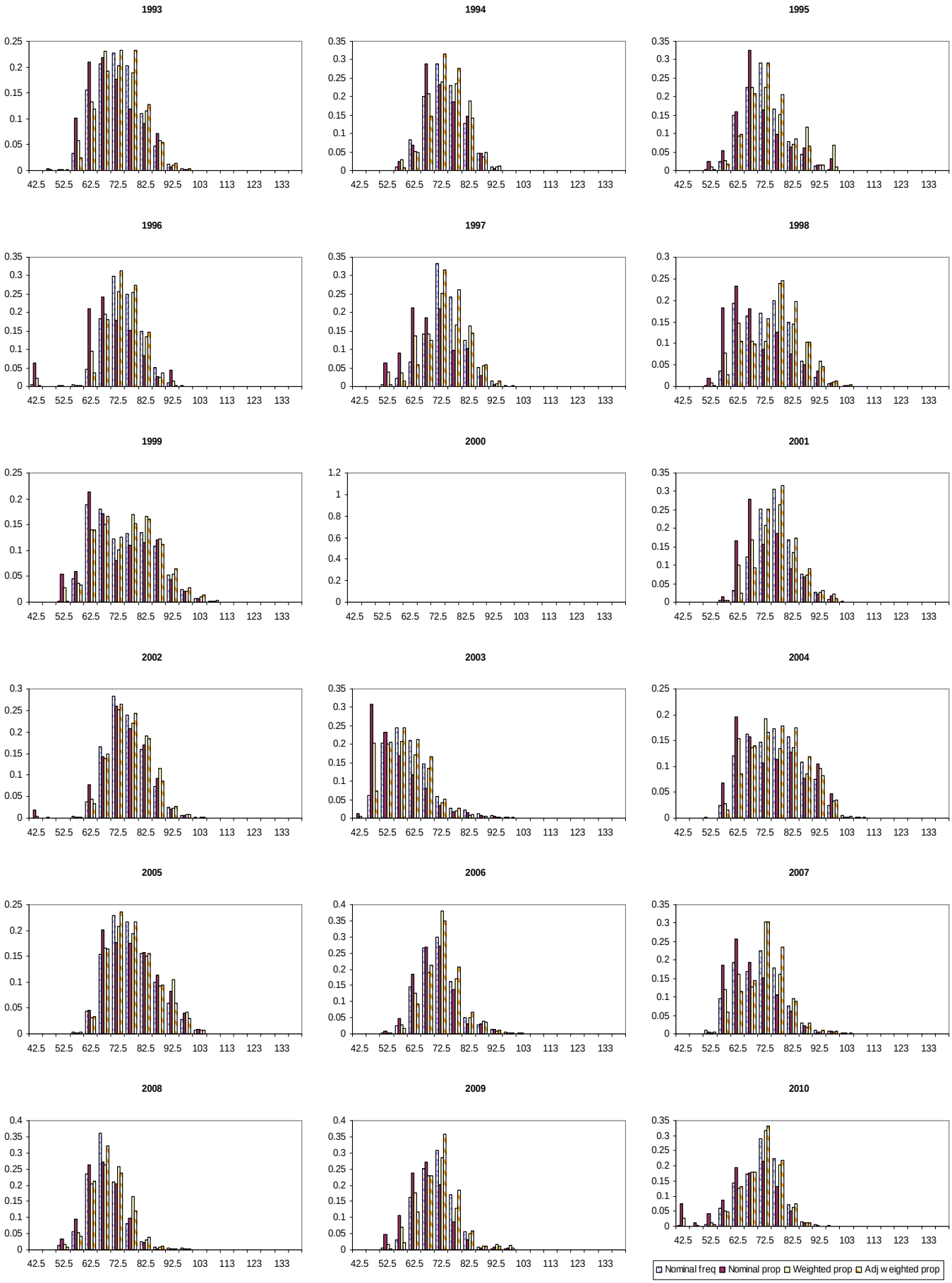

Figure 3a. Comparison of four alternative length distributions for male rock lobsters for the Dassen Island.

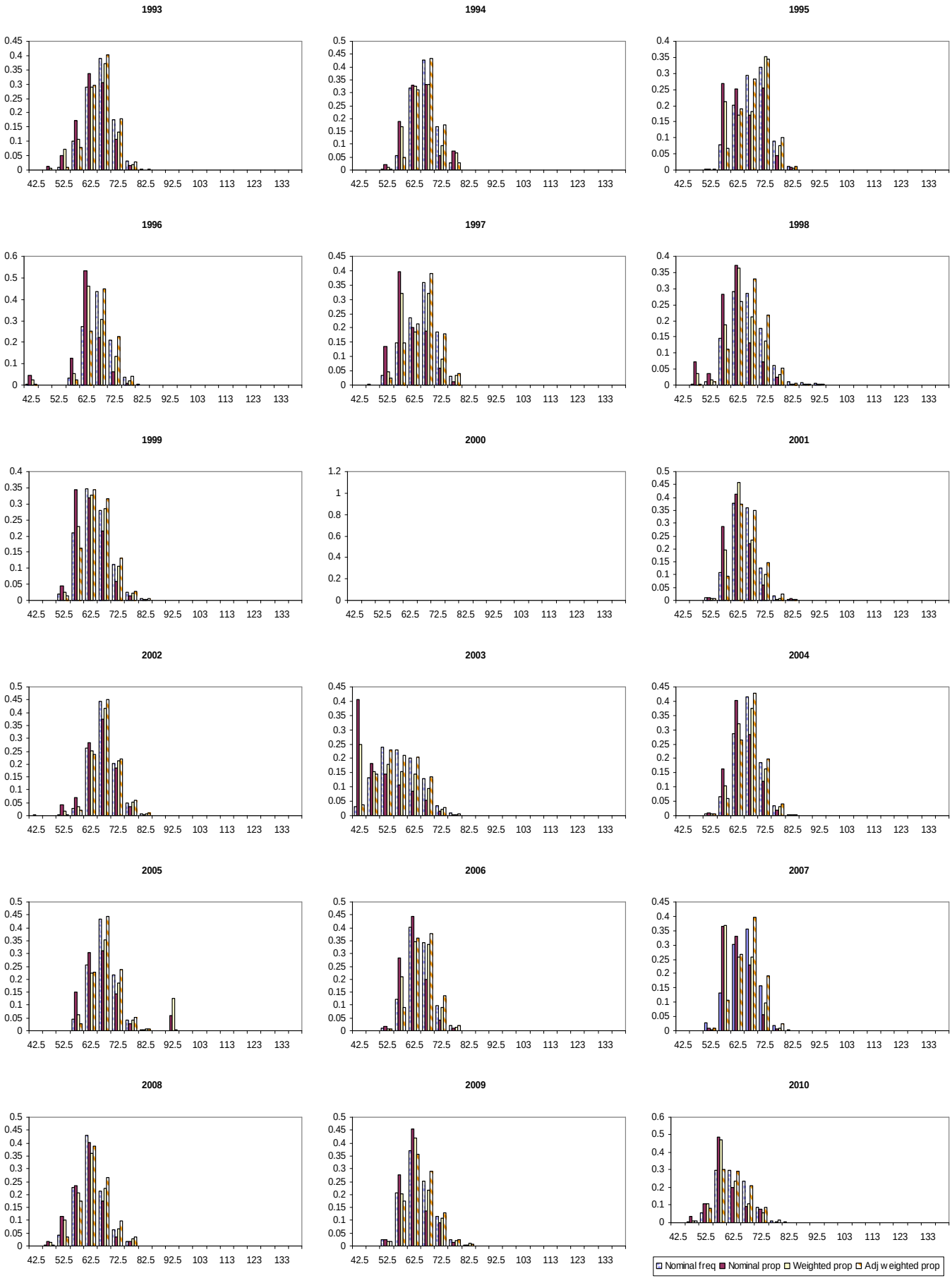

Figure 3b. Comparison of four alternative length distributions for female rock lobsters for the Dassen Island.

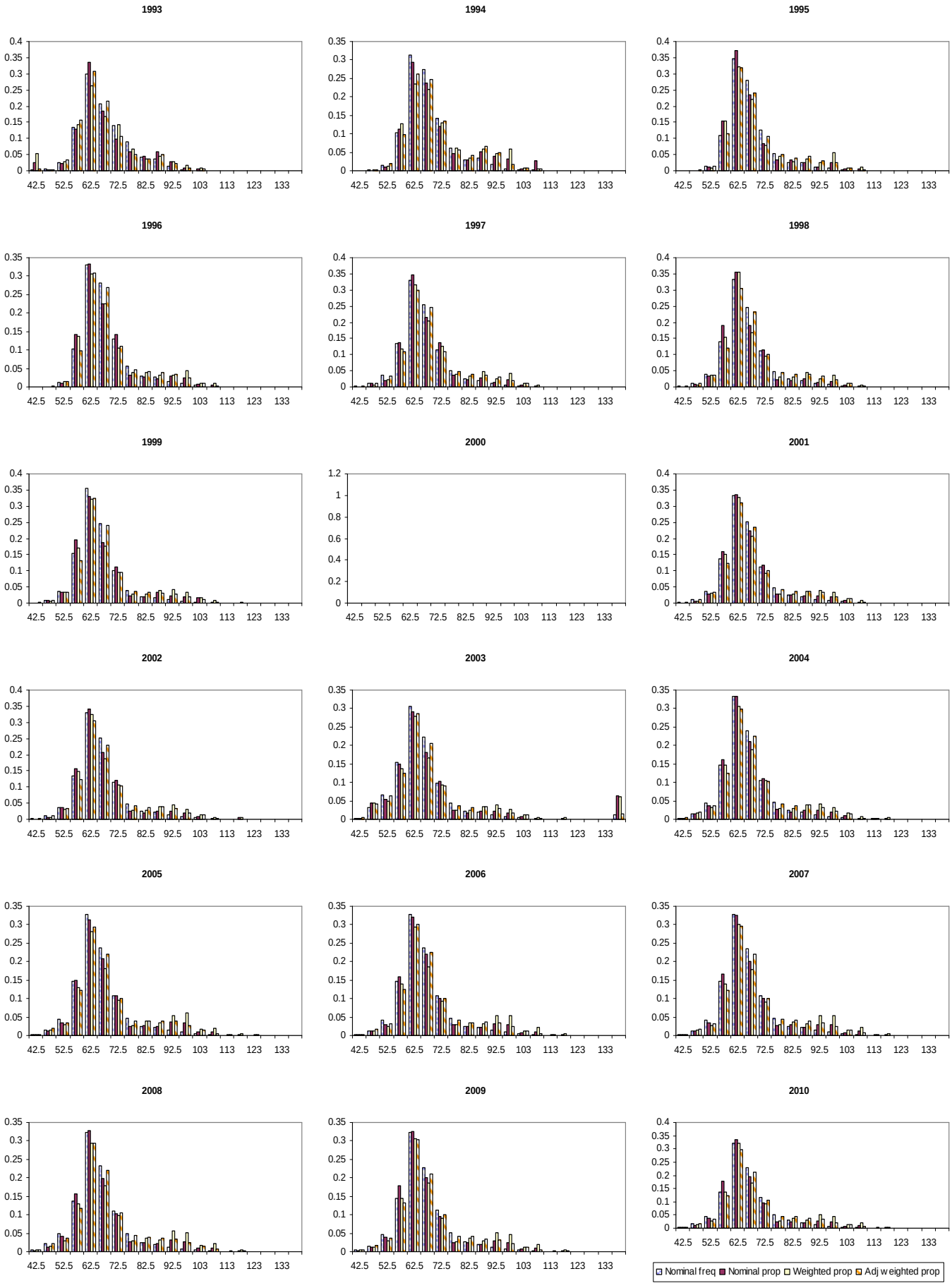

Figure 4a. Comparison of four alternative length distributions for male rock lobsters for the Saldanha Bay.

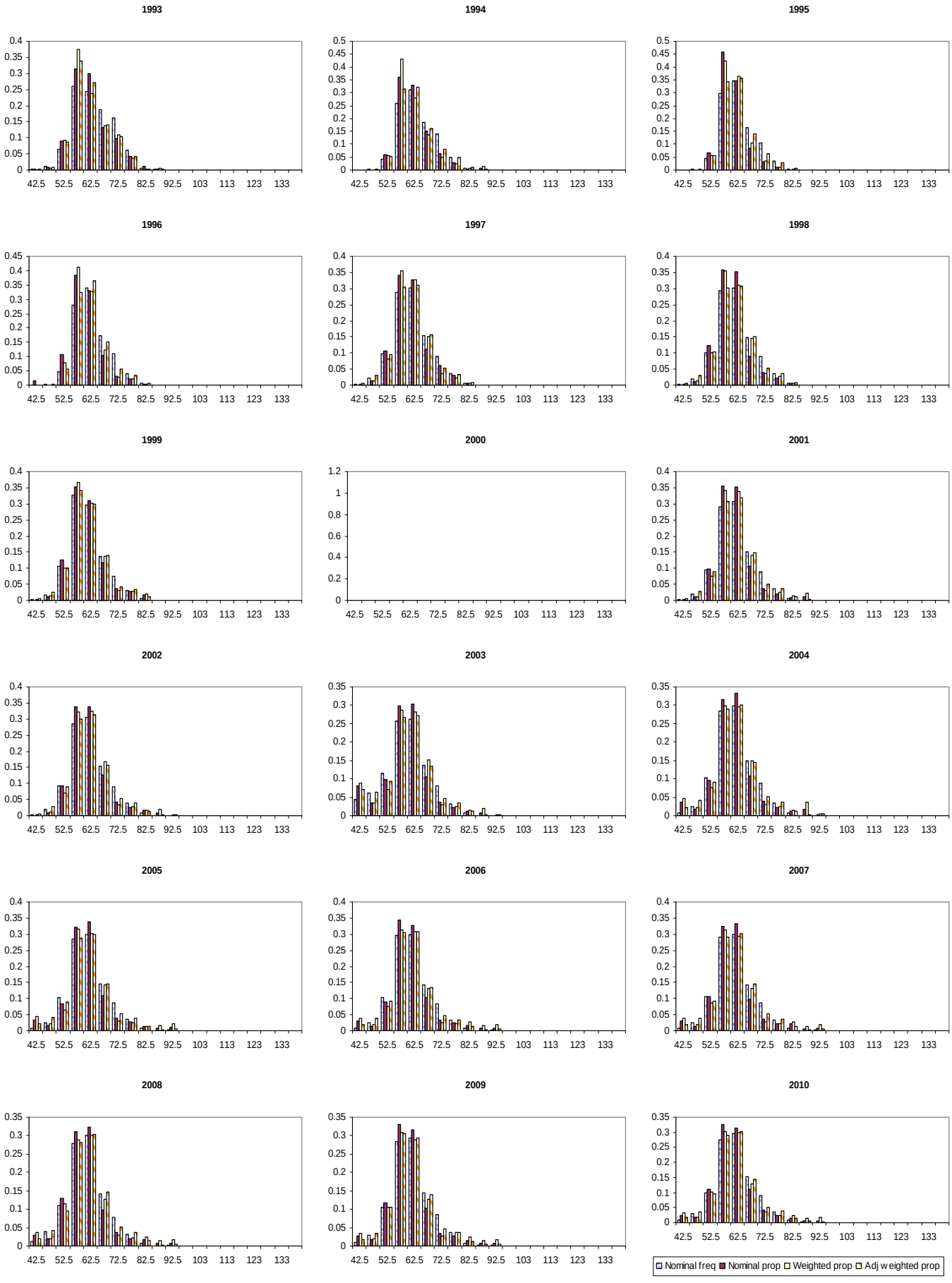

Figure 4b. Comparison of four alternative length distributions for female rock lobsters for the Saldanha Bay.

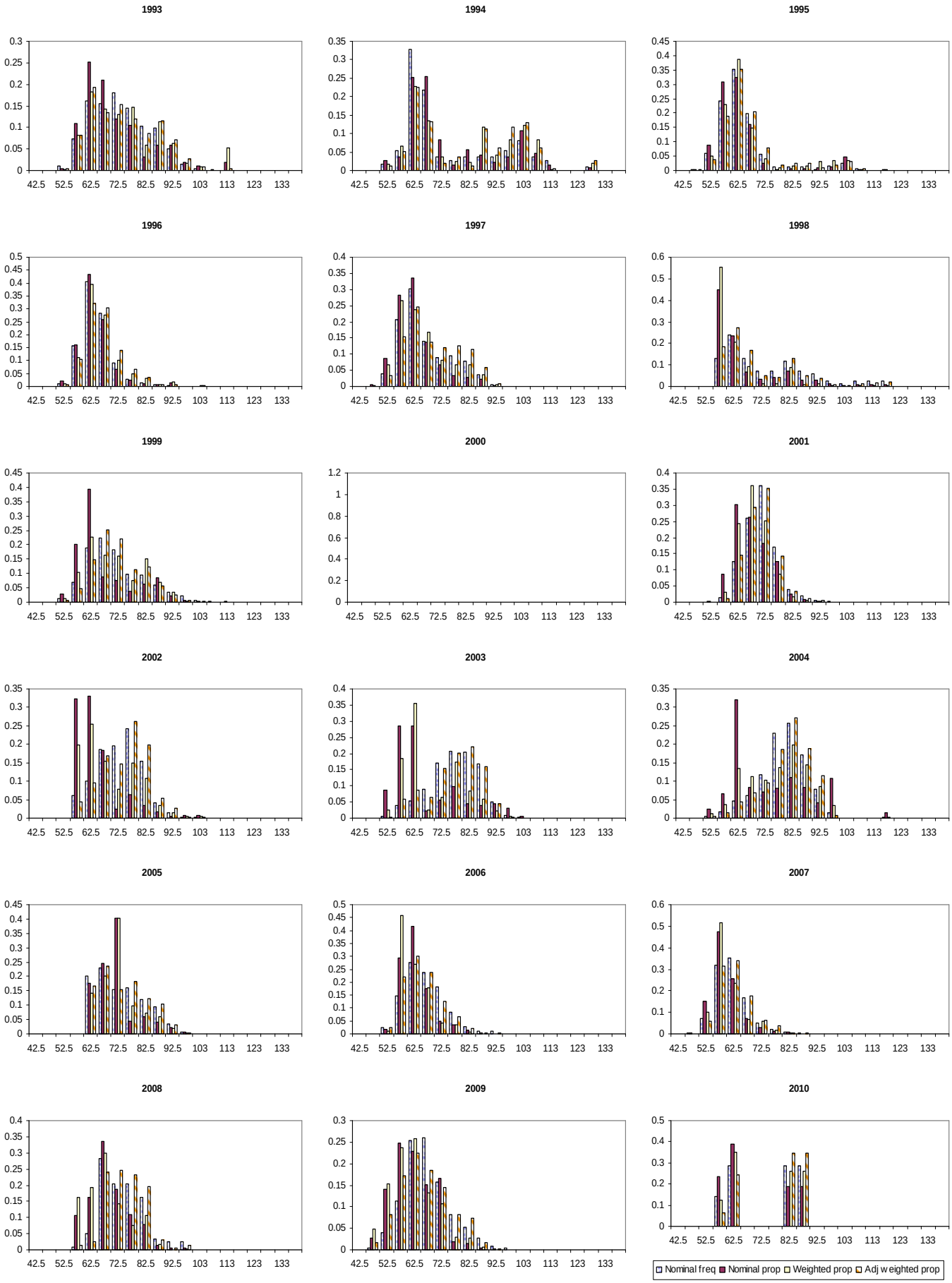

Figure 5a. Comparison of four alternative length distributions for male rock lobsters for the Lambert's Bay.

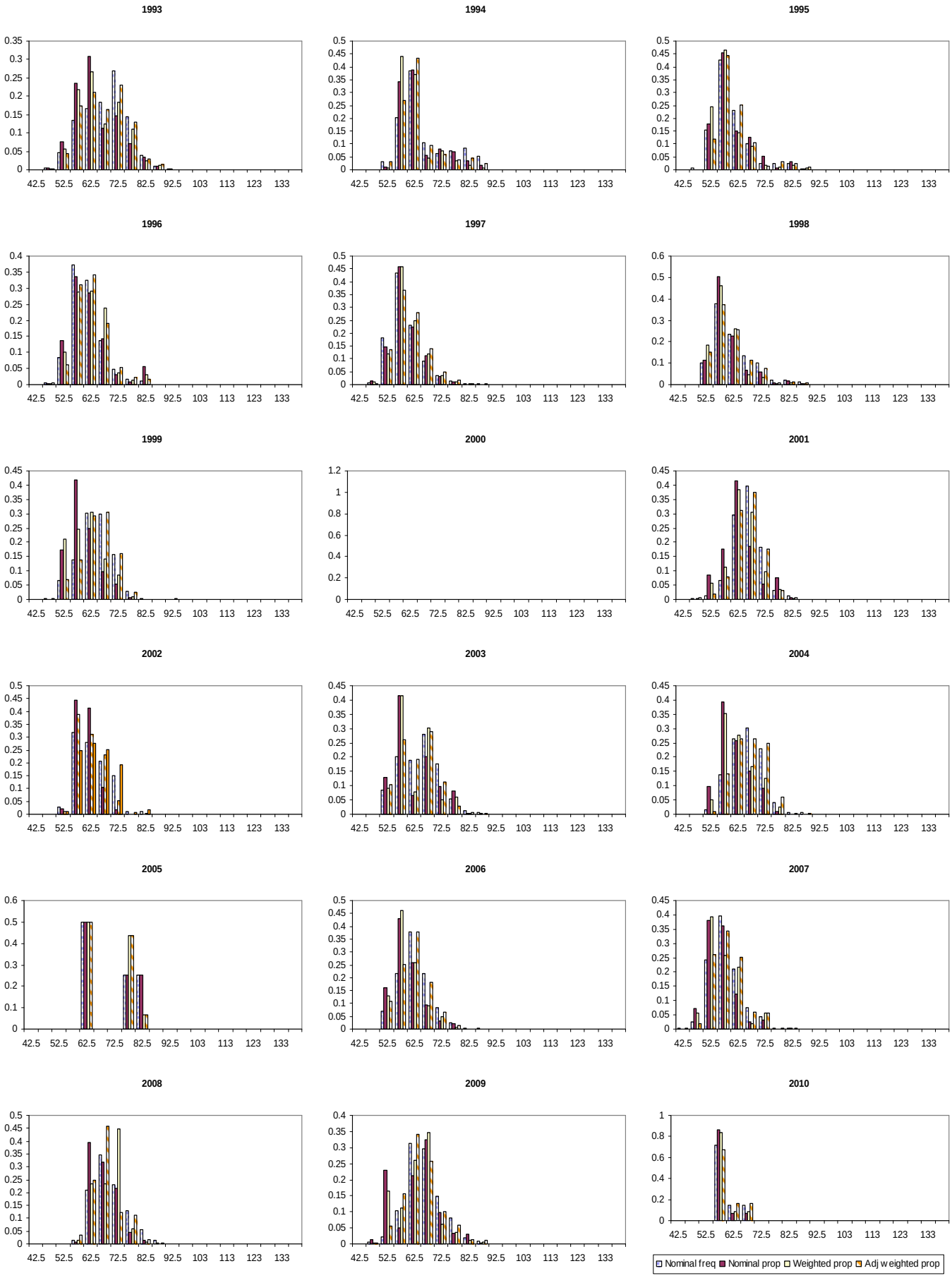

Figure 5b. Comparison of four alternative length distributions for female rock lobsters for the Lambert's Bay.

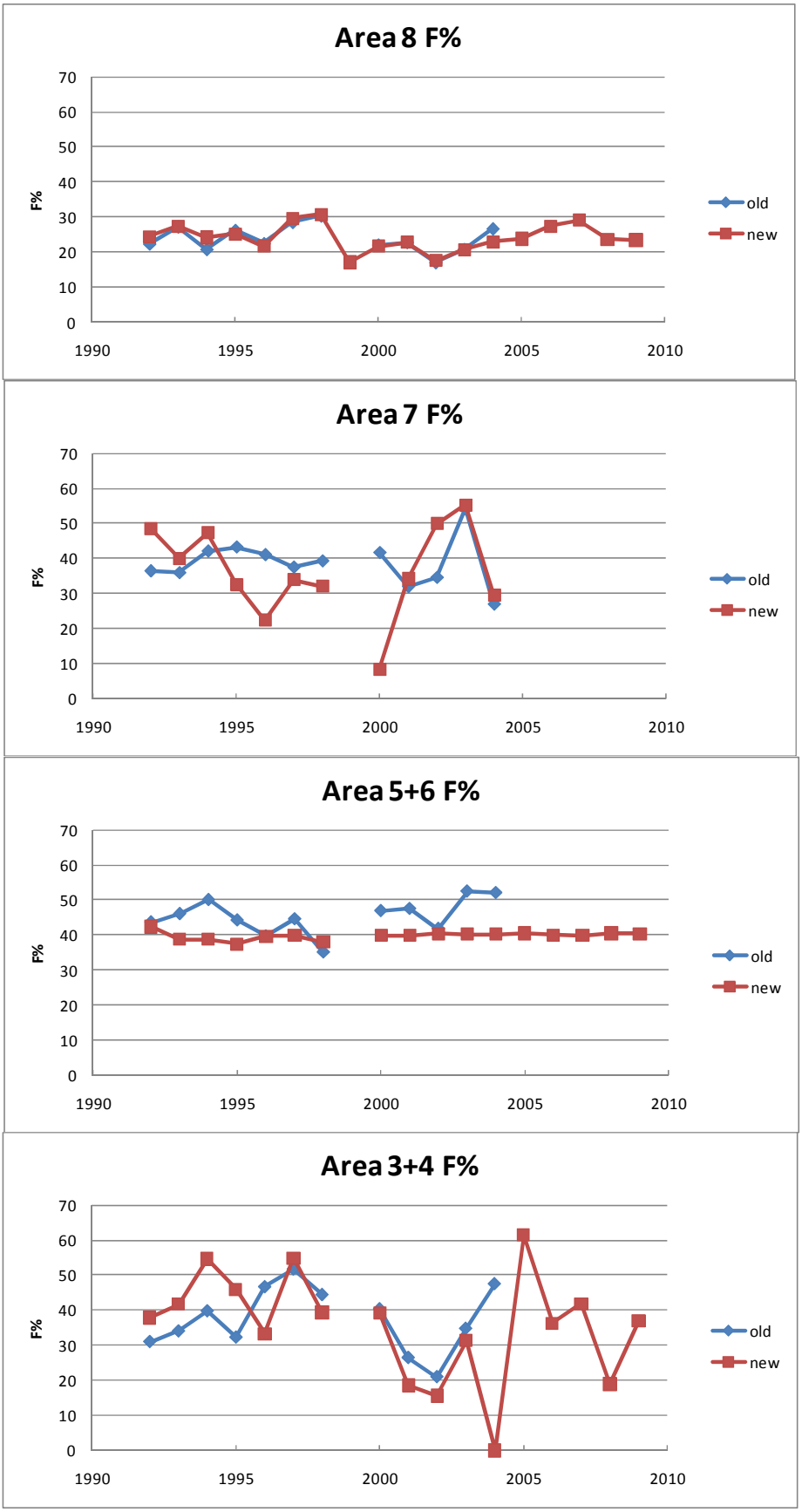

Figure 6. Comparison between estimates of percentage female rock lobsters and those previously used in the population assessment model for each Zone.