

Review of Female New Zealand Sea Lion Tag-resight Data Collected on Enderby Island

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Data summary

The total number of sightings, number of unique individuals, number of individuals with 3 or more sightings and the mean number of sightings per individual each year was extracted from the New Zealand sea lion database for the 1998-2010 field seasons (years denoted by the January portion of the field season). This was done for all individuals, and separately for those individuals that had been identified in the database as confirmed breeders (status = 3). To investigate the potential effect of shortening the field season, the same information was compiled by only using the sightings between the 3-week period of 12 January – 2 February or the 5-week period of 12 January – 16 February.

Table 1 presents a comparison of the data summary under the 3 different scenarios considered for all available individuals. The number of individuals with 3 or more sightings per year is also presented in Figure 1, while Figure 2 presents the fraction of females from the full data set that would have been observed under the 3-week and 5-week sampling periods. The difference in the mean number of sightings per individual for the 3-week and 5-week periods, relative to the full data, is presented in Figure 3.

Clearly, there would be a greater loss of information had only a 3-week season been used, with minimal information loss from using a 5-week season. From Figure 2, approximately 82% of the individuals in the full data set would have been sighted on average in a 3-week field season. The standard error of parameter estimates tend to be ultimately inversely related to the square-root of the sample size, hence it could be predicted that the standard errors might increase by a factor of $1/\sqrt{0.82} = 1.10$, or 10% greater, for the 3-week season. For a 5-week season, the fraction of individuals observed is very close to 100% hence any change in the standard error is predicted to be relatively minor (e.g., < 3%).

Focusing on the females that had been confirmed as breeders, Table 2 presents a comparison of the data summary for the full data, the 3-week and 5-week field seasons. The number of females that had been identified as breeders with 3 or more sightings is also presented in Figure 4, and the fraction of females in the full data set that would be observed in the 3-week and 5-week field seasons is presented in Figure

5. The difference in the mean number of sightings per female for the 3-week and 5-week periods, relative to the full data, is presented in Figure 6.

As above, there would be minimal loss of information by using the 5-week field season and while there is a greater level of loss with a 3-week season it does not appear to be as great a loss when focusing on individuals that had been identified as breeders compared to all individuals. The fraction of individuals with 3 or more sightings using the 3-week field season is approximately 94% of the individuals in the full data, implying an approximate increase in the standard errors of about 3%.

Survival analyses

To further investigate the potential effect of reducing the duration of the field season basic survival analyses were conducted within Program MARK to provide some indication of the expected change in precision of survival estimates. It should be made clear that the purpose of these analyses were primarily to evaluate the likely magnitude of a change in the standard error and not intended as detailed analysis to provide realistic survival estimates.

Mark-recapture datasets were developed indicating whether tagged individuals were sighted each year. Whether the females were resighted as juveniles (0-3 years) or adults (4+ years) was identified to enable juvenile and adult survival to be separately estimated using multi-state mark-recapture models. Data sets were created from the full database, and the shortened 3-week and 5-week field seasons for comparison. A model was fit to the data which assumed constant annual resighting probabilities and survival probabilities that varied annually with a consistent difference (on the logistic scale) between juvenile and adults.

The standard errors of the survival estimates from the shortened field seasons relative to the full dataset are presented in Figures 7 and 8 for juveniles and adults respectively. Using a 3-week field season resulted in standard errors that were approximately 10%-12% greater (on average) than the full data for juveniles and 7%-8% greater for adults. The standard errors for the 5-week season are only minimally greater than those obtained from the full data set.

Conclusion

Reducing the field season to 5 weeks would appear to have only a relatively minor effect on the precision of estimated demographic parameters, while using a 3-week season may increase the standard errors by approximately 10%.

Tables

Table 1: Summaries of the tag-resight data for all individuals using the full data (Full), the 3-week (3-w) and 5-week (5-w) field seasons.

Season	Total Sightings			Unique Individuals			Individuals with 3+ Sightings			Mean Sightings		
	Full	3-w	5-w	Full	3-w	5-w	Full	3-w	5-w	Full	3-w	5-w
1998	298	298	298	296	296	296	0	0	0	1.01	1.01	1.01
1999	751	553	720	819	742	812	58	33	53	0.92	0.75	0.89
2000	2206	1573	2126	1255	1197	1235	195	164	189	1.76	1.31	1.72
2001	3250	2311	3177	1675	1591	1650	228	203	227	1.94	1.45	1.93
2002	4940	3288	4673	1909	1814	1878	318	274	307	2.59	1.81	2.49
2003	6118	4042	5572	2163	2051	2131	332	287	309	2.83	1.97	2.61
2004	6062	4483	5833	2447	2334	2414	339	313	331	2.48	1.92	2.42
2005	3985	2785	3885	2756	2627	2724	309	239	301	1.45	1.06	1.43
2006	4070	2653	3930	3058	2907	3027	317	252	314	1.33	0.91	1.30
2007	5072	3478	4929	3350	3191	3322	388	324	385	1.51	1.09	1.48
2008	4722	3248	4617	3640	3452	3609	334	296	330	1.30	0.94	1.28
2009	3985	2630	3871	3874	3680	3844	367	276	360	1.03	0.71	1.01
2010	4723	3231	4586	4141	3932	4110	394	322	391	1.14	0.82	1.12

Table 2: Summaries of the tag-resight data for individuals identified as breeders using the full data (Full), the 3-week (3-w) and 5-week (5-w) field seasons.

Season	Total Sightings			Unique Individuals			Individuals with 3+ Sightings			Mean Sightings		
	Full	3-w	5-w	Full	3-w	5-w	Full	3-w	5-w	Full	3-w	5-w
1998	16	16	16	16	16	16	0	0	0	1.00	1.00	1.00
1999	279	166	277	204	141	204	24	9	24	1.37	1.18	1.36
2000	1226	841	1225	373	332	373	137	115	137	3.29	2.53	3.28
2001	1946	1267	1940	475	418	475	158	141	157	4.10	3.03	4.08
2002	2619	1772	2600	491	436	491	147	141	147	5.33	4.06	5.30
2003	3366	2241	3199	505	451	505	148	142	147	6.67	4.97	6.33
2004	3126	2239	3118	533	480	533	155	151	155	5.86	4.66	5.85
2005	1839	1279	1839	564	508	564	109	106	109	3.26	2.52	3.26
2006	1553	1024	1553	594	537	594	107	103	107	2.61	1.91	2.61
2007	2210	1523	2203	638	581	638	132	128	132	3.46	2.62	3.45
2008	2209	1477	2204	686	629	686	158	153	158	3.22	2.35	3.21
2009	1733	1135	1730	726	669	726	134	119	133	2.39	1.70	2.38
2010	2336	1571	2325	771	716	770	180	161	180	3.03	2.19	3.02

Figures

Figure 1: Number of individuals with 3 or more sightings each year from the full data and the shortened 3-week and 5-week periods.

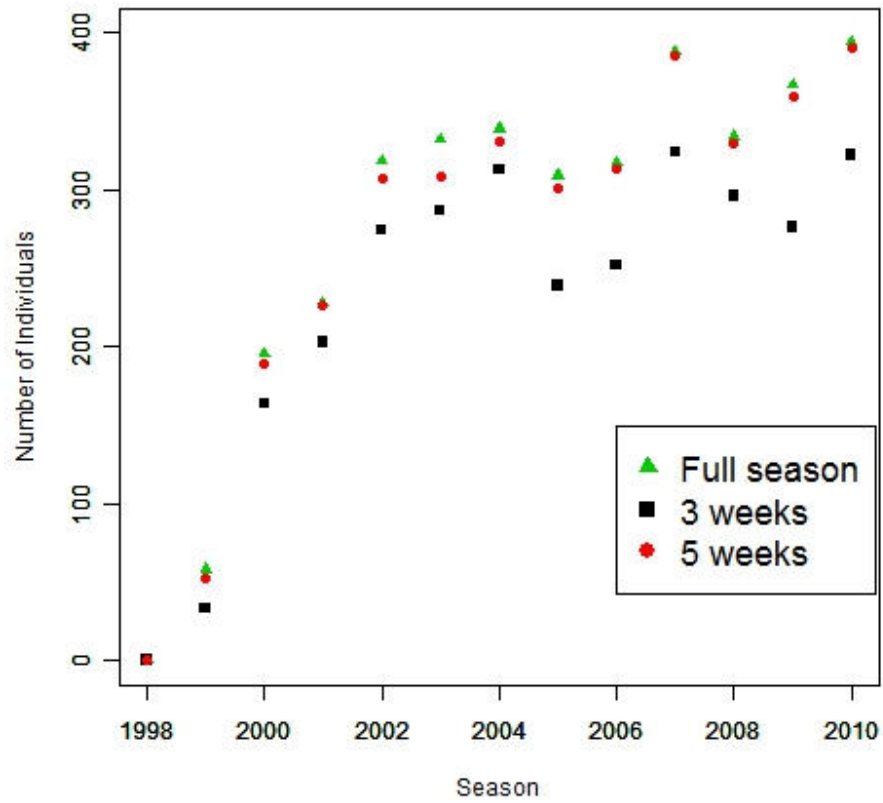


Figure 2: Fraction of individuals in the full data set that would have been observed using the proposed 3-week and 5-week field seasons.

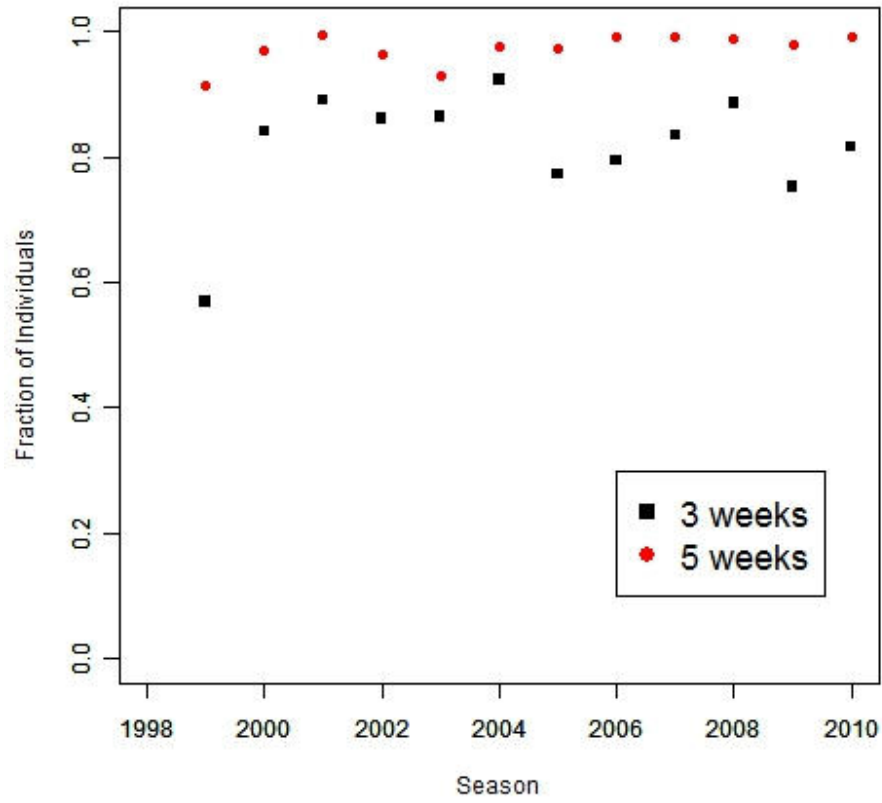


Figure 3: Difference in the mean number of sightings per individual for the shortened 3-week and 5-week seasons, relative to the full season.

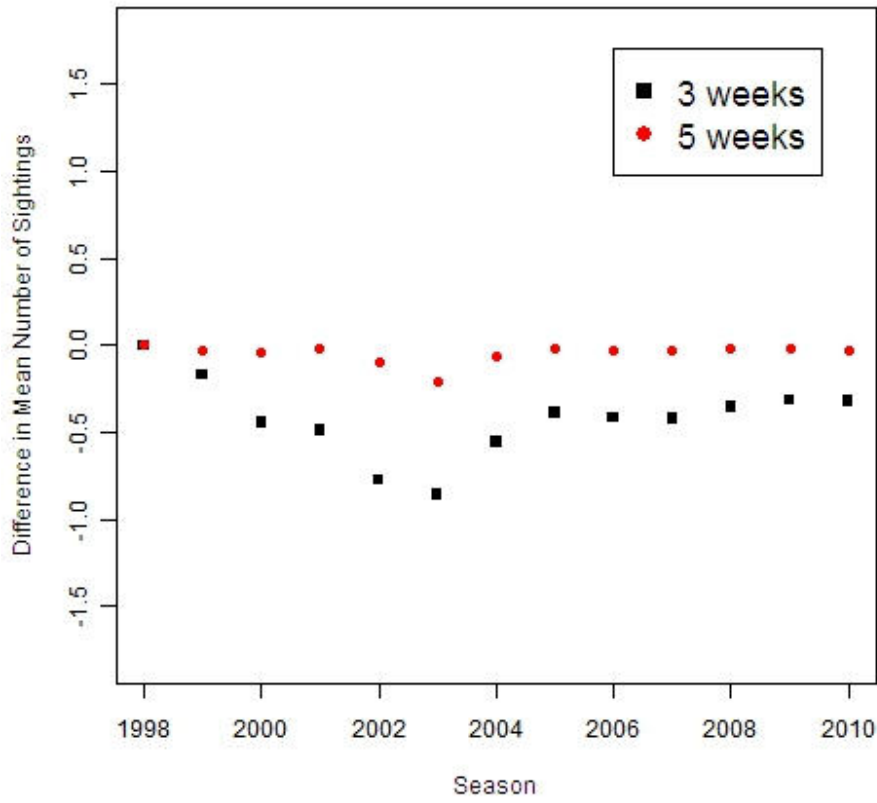


Figure 4: Number of individuals identified as breeders with 3 or more sightings each year from the full data and the shortened 3-week and 5-week periods.

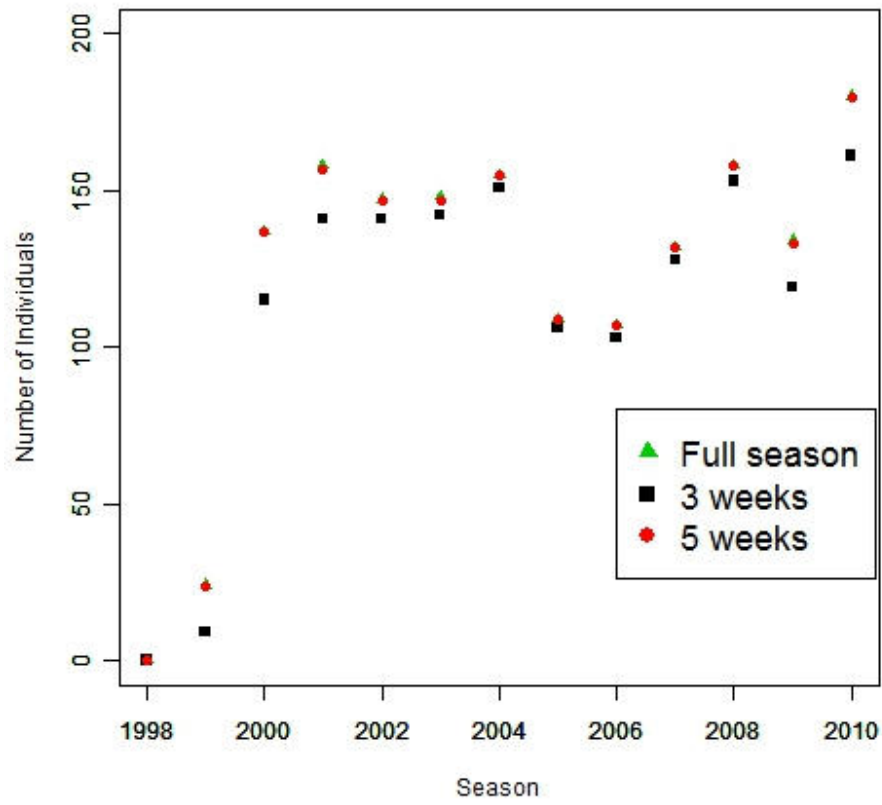


Figure 5: Fraction of individuals identified as breeders in the full data set that would have been observed using the proposed 3-week and 5-week field seasons.

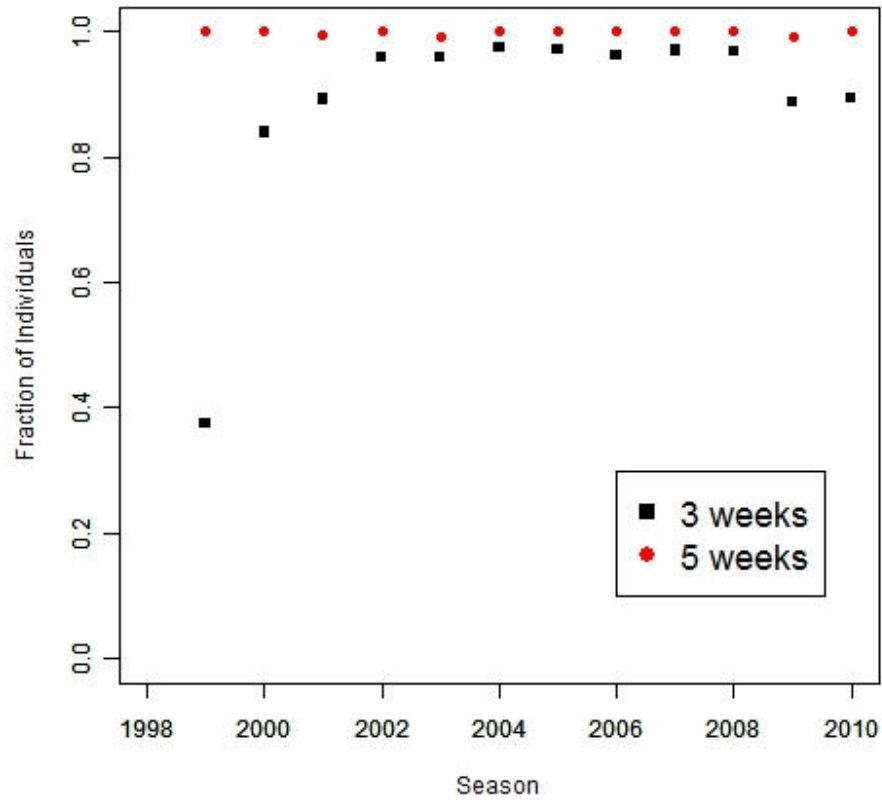


Figure 6: Difference in the mean number of sightings per individual for those identified as breeders for the shortened 3-week and 5-week seasons, relative to the full season.

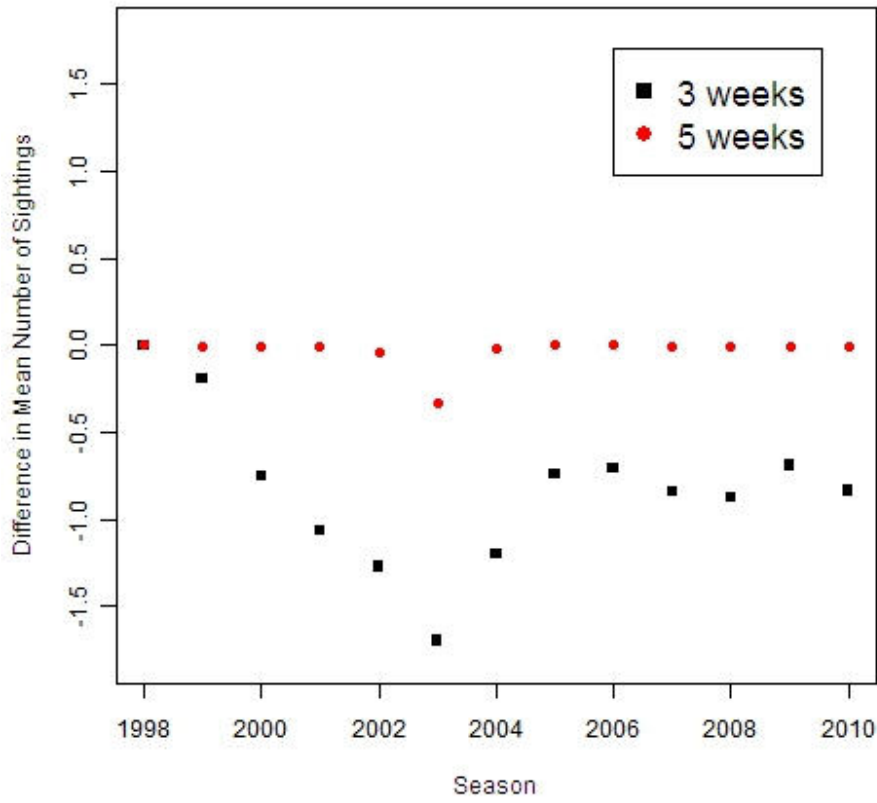


Figure 7: Standard errors for the shortened 3-week and 5-week field seasons relative to the full data for juvenile survival estimates.

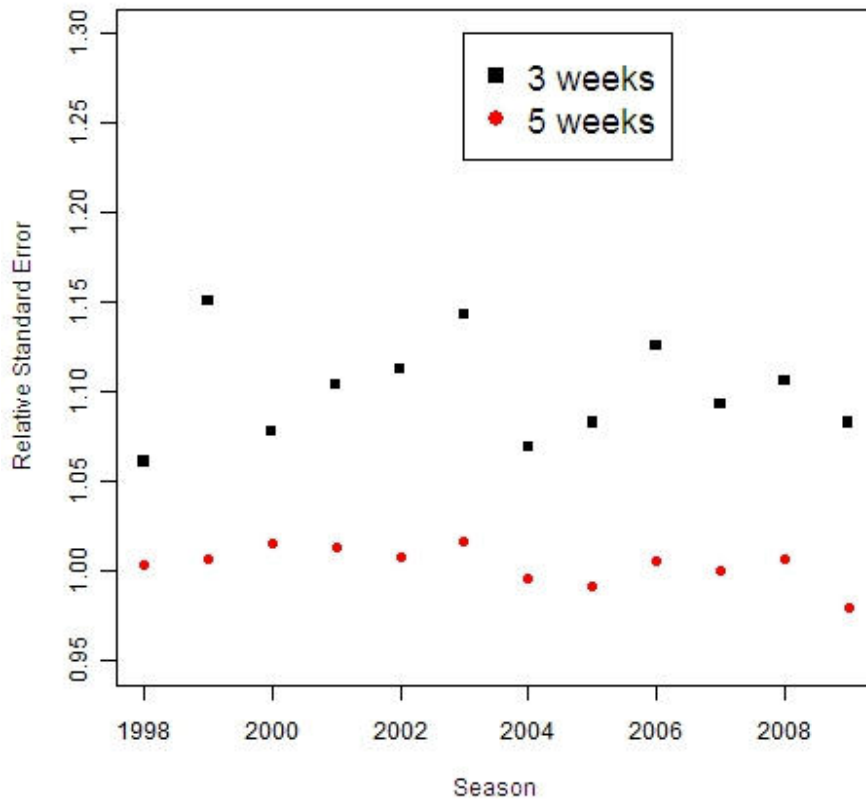


Figure 8: Standard errors for the shortened 3-week and 5-week field seasons relative to the full data for adult survival estimates.

