

A Juvenile index from Biomass survey data

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Introduction

A number (12) of biomass surveys has been completed thus far at each of the four islands of the Tristan da Cunha group of islands. For each season there is usually a Leg 1 survey conducted around Aug/Sept and then a further Leg 2 survey conducted around Feb/Mar. This document aims at providing a brief summary of the number of juveniles either <60mm or <70mm CL in each sample (for Nightingale, Inaccessible and Tristan), and <70mm or <75mm CL for Gough.

Note that the March 2011 surveys at the inner islands were conducted just prior to the OLIVA incident.

Methods

At each island a number of transects are set (e.g. Tristan has eight transects, Nightingale has four). The total number of lobsters at either 5mm or 1mm size class intervals caught from each of the nine traps (per transect) has been recorded by James Glass (pers. comm.).

For each transect (s) the total number of juveniles (either <60mm or <70mm CL) in the catch is calculated ($\bar{J}_s^{\#<60}$ and $\bar{J}_s^{\#<70}$). (This analysis treats transects rather than traps as the sampling unit, both because of possible spatial correlation (non-independence) along a transect, and because lobster density may vary with depth so that the survey design is such as allows this variation to be integrated out.)

If n is the number of transects, then the following are calculated for each survey:

$$\text{Mean } \bar{J} \text{ index (for } <60\text{mm CL)} = \bar{J} = \frac{\sum_s \bar{J}_s^{\#<60}}{n}$$

$$\text{Standard deviation} \quad \text{sd} = \sqrt{\frac{n \sum (\bar{J}_s^{\#<60})^2 - (\sum \bar{J}_s^{\#<60})^2}{n(n-1)}}$$

$$\text{Standard error} = \frac{\text{sd}}{\sqrt{n}}$$

To avoid confidence intervals overlapping zero, the assumption has been made of distribution lognormality with $CV = \frac{se_m}{\bar{J}}$

i.e. where $\sigma = \sqrt{\ln(1 + CV^2)}$ with the upper 95% CI = $\bar{J}e^{1.96\sigma}$ and the lower 95% CI = $\bar{J}e^{-1.96\sigma}$

Results

Tables 1a-d and Figures 1a-d report the survey samples sizes for Nightingale, Inaccessible, Gough and Tristan respectively.

Tables 2-d report the #<60mm CL (top) and #<70mm CL (bottom) showing values for each transect, the average value for that season, and the associated CV.

The juvenile indices (<60mm and <70mm CL) for each island and each Leg are plotted in Figures 2a-d showing the mean, and lower and upper 95% CIs.

Discussion

It is planned to investigate the utility of these indices as measures of incoming recruitment strength in potential formulae for TACs to be considered in Management Procedure (MP) evaluations for the fisheries at these islands.

Table 1a: **Nightingale** sample sizes: for each transect and total.

	T1	T2	T3	T4	Total
Sep 06	222	191	540	394	1347
Feb 07	249	293	218	117	877
Sep 07	617	501	540	351	2009
Mar 08	212	38	351	170	771
Sep 08					
Feb 09	238	159	380	408	1185
Sep 09	431	480	745	510	2166
Mar 10	302	154	599	505	1560
Sep 10	619	280	884	647	2430
Mar 11	222	127	101	175	625
Aug 11	350	32	13	221	616
Feb 12	136	183	19	321	659
Aug 12	518	347	262	597	1724
Feb 13	300	52	489	415	1256

Table 1b: **Inaccessible** sample sizes: for each transect and in total.

	T1	T2	T3	T4	T5	Total
Sep 06	764	402	775	412	112	2465
Feb 07	340	44	281	279	83	1027
Sep 07	895	806	377	641	102	2821
Mar 08	538	0	477	299	135	1449
Sep 08						
Feb 09	562	1	496	209	80	1348
Sep 09	986	18	720	633	316	2673
Mar 10	1094	0	223	381	378	2076
Sep 10	874	911	67	34	16	1902
Mar 11	478	0	255	273	162	1168
Aug 11	825	775	812	610	203	3225
Feb 12	574	116	473	229	155	1547
Aug 12	775	523	589	390	102	2379
Feb 13	428	3	430	264	172	1297

Table 1c: **Gough** sample sizes: for each transect and total.

	T1	T2	T3	T4	T5	T6	T7	T8	Total
Sep 06	374	202	319	19	45	8	357	43	1367
Feb 07	118	94	146	0	2	92	2	129	583
Sep 07	129	0	434	435	21	561	217	133	1930
Mar 08	44	0	77	294	27	101	108	0	651
Sep 08									
Feb 09	192	0	109	69	1	1	105	32	509
Sep 09	772	0	905	874	12	747	600	382	4292
Mar 10	243	0	229	130	50	187	232	5	1076
Sep 10	439	0	300	297	5	412	594	1	2048
Mar 11	100	0	191	306	0	155	150	0	902
Aug 11	565	0	495	486	0	567	807	175	3095
Feb 12	210	0	82	291	1	123	138	1	846
Aug 12	210	0	82	291	1	123	138	1	846
Feb 13	168	0	135	103	5	150	136	1	698

Table 1d: **Tristan** sample sizes: for each transect and in total.

	T1	T2	T3	T4	T5	T6	T7	T8	Total
Sep 06	658	381	255	963	293	641	806	724	4721
Feb 07	482	463	650	375	539	579	733	605	4426
Sep 07	959	471	773	870	957	678	915	932	6555
Mar 08	218	376	583	400	401	688	230	439	3335
Sep 08									
Feb 09	431	518	432	799	359	577	678	462	4256
Sep 09	685	613	117	889	790	833	811	757	5495
Mar 10	650	403	404	801	373	729	453	680	4493
Sep 10	909	386	557	883	543	923	789	216	5206
Mar 11	385	542	728	797	186	664	709	383	4394
Aug 11	971	516	686	792	740	944	1043	1014	6706
Feb 12	625	244	372	750	572	687	768	50	4068
Aug 12	581	422	434	794	873	930	829	968	5831
Feb 13	631	623	202	558	473	591	707	475	4260

Table 2a: Nightingale #<60mm CL (top) and #<70mm CL (bottom) showing values for each transect (T1-T4), the average value for that season, and the associated CV.

	#<60mm CL					
	T1	T2	T3	T4	Average	CV
Sep 06	0	0	1	1	0.5	0.58
Feb 07	1	1	0	0	2	0.58
Sep 07	1	0	0	0	0.25	1.00
Mar 08	1	1	17	2	5.25	0.75
Sep 08						
Feb 09	0	0	10	4	3.5	0.68
Sep 09	3	2	59	18	20.5	0.65
Mar 10	5	2	49	35	22.75	0.51
Sep 10	3	0	53	15	17.75	0.69
Mar 11	0	0	0	1	0.25	1.00
Aug 11	3	2	1	2	2	0.20
Feb 12	1	0	0	0	0.25	1.00
Aug 12	1	0	0	0	0.25	1.00
Feb 13	0	0	0	0	0	0
	#<70mm CL					
	T1	T2	T3	T4	Average	CV
Sep 06	4	3	67	24	24.50	0.61
Feb 07	11	3	39	17	1940	0.44
Sep 07	7	5	39	17	17.00	0.46
Mar 08	12	8	141	25	56.50	0.68
Sep 08						
Feb 09	34	26	173	147	95.00	0.40
Sep 09	44	31	367	140	145.50	0.53
Mar 10	40	27	390	204	165.25	0.51
Sep 10	95	25	421	241	195.50	0.45
Mar 11	13	5	16	31	16.25	0.34
Aug 11	43	7	6	19	18.75	0.46
Feb 12	6	9	2	4	5.25	0.28
Aug 12	8	3	3	12	6.50	0.34
Feb 13	6	0	25	7	9.50	0.57

Table 2b: Inaccessible #<60mm CL (top) and #<70mm CL (bottom) showing values for each transect (T1-T4), the average value for that season, and the associated CV.

	#<60mm CL						
	T1	T2	T3	T4	T5	Average	CV
Sep 06	90	12	31	45	2	36.0	0.43
Feb 07	20	2	33	10	2	13.4	0.44
Sep 07	48	90	8	13	2	32.2	0.51
Mar 08	29	0	29	17	7	16.4	0.35
Sep 08							
Feb 09	95	0	32	5	6	27.6	0.64
Sep 09	109	0	79	46	34	53.6	0.34
Mar 10	310	0	36	27	94	93.4	0.60
Sep 10	246	428	10	4	4	138.4	0.62
Mar 11	65	0	34	18	15	26.4	0.42
Aug 11	106	212	55	34	7	82.8	0.44
Feb 12	110	26	49	9	19	42.6	0.42
Aug 12	76	143	29	16	7	54.2	0.46
Feb 13	37	0	48	8	5	19.6	0.49
	#<70mm CL						
	T1	T2	T3	T4	T5	Average	CV
Sep 06	404	75	212	143	14	169.6	0.40
Feb 07	197	7	136	60	10	82.0	0.45
Sep 07	407	535	65	91	14	222.4	0.47
Mar 08	282	0	192	90	46	122.0	0.42
Sep 08							
Feb 09	452	1	231	66	24	154.8	0.54
Sep 09	607	4	355	202	90	251.6	0.42
Mar 10	872	0	147	169	232	284.0	0.53
Sep 10	644	792	46	15	8	301.0	0.57
Mar 11	369	0	146	115	50	136.0	0.47
Aug 11	542	595	427	214	37	363.0	0.29
Feb 12	425	82	279	73	66	185.0	0.39
Aug 12	410	367	239	118	24	231.6	0.31
Feb 13	274	2	239	94	42	130.2	0.41

Table 2c: Gough #<70mm CL (top) and #<75mm CL (bottom) showing values for each transect (T1-T4), the average value for that season, and the associated CV.

	#<70mm CL									
	T1	T2	T3	T4	T5	T6	T7	T8	Average	CV
Sep 06	10	8	3	9	0	0	29	0	7.4	0.47
Feb 07	1	1	2	0	0	7	0	0	1.4	0.61
Sep 07	0	0	0	0	0	0	3	0	0.38	1.00
Mar 08	0	0	1	0	0	0	0	0	0.13	1.00
Sep 08										
Feb 09	0	0	0	0	0	0	3	0	0.38	1.00
Sep 09	18	0	11	5	0	4	20	3	7.63	0.36
Mar 10	2	0	0	1	0	0	6	0	1.13	0.66
Sep 10	7	0	3	4	0	3	25	0	5.25	0.56
Mar 11	0	0	0	3	0	0	5	0	1.00	0.68
Aug 11	2	0	2	1	0	2	13	0	2.50	0.61
Feb 12	0	0	0	1	0	0	0	0	0.13	1.00
Aug 12	3	0	0	6	0	0	1	0	1.25	0.62
Feb 13	0	0	0	0	0	0	0	0	0	0
	#<75mm CL									
	T1	T2	T3	T4	T5	T6	T7	T8	Average	CV
Sep 06	58	18	25	14	0	0	72	1	23.5	0.41
Feb 07	2	4	7	0	0	17	0	0	3.75	0.56
Sep 07	1	0	16	6	0	14	15	1	6.63	0.38
Mar 08	0	0	1	2	0	0	0	0	0.13	0.70
Sep 08										
Feb 09	2	0	2	4	0	0	11	0	2.38	0.56
Sep 09	83	0	101	58	0	49	131	12	54.25	0.32
Mar 10	7	0	20	1	0	12	20	0	7.50	0.42
Sep 10	34	0	18	24	0	14	129	0	27.38	0.55
Mar 11	0	0	9	21	0	4	31	0	8.13	0.51
Aug 11	22	0	16	11	0	15	101	0	20.63	0.58
Feb 12	0	0	1	4	0	1	3	0	1.13	0.49
Aug 12	24	0	11	22	0	1	35	0	11.63	0.42
Aug 13	1	0	0	0	0	0	0	0	0.13	1.00

Table 2d: Tristan %<60mm CL (top) and %<70mm CL (bottom) showing values for each transect (T1-T8), the average value for that season, and the associated CV.

	%<60mm CL									
	T1	T2	T3	T4	T5	T6	T7	T8	Average	CV
Sep 06	4	1	0	17	4	3	0	8	4.63	0.43
Feb 07	4	0	2	3	0	0	2	0	1.38	0.41
Sep 07	1	5	5	2	2	2	0	2	2.38	0.26
Mar 08	1	1	7	5	8	3	0	0	3.13	0.36
Sep 08										
Feb 09	0	0	1	0	3	0	0	1	0.63	0.60
Sep 09	10	18	6	14	5	7	24	4	11.00	0.23
Mar 10	2	1	0	2	1	1	4	5	2.00	0.30
Sep 10	19	5	21	39	1	21	22	5	16.63	0.27
Mar 11	0	1	13	14	0	0	2	2	4.00	0.52
Aug 11	17	31	61	34	5	8	17	18	23.88	0.27
Feb 12	8	6	22	11	13	12	4	0	9.50	0.25
Aug 12	8	23	52	45	9	25	79	103	43.00	0.28
Feb 13	20	0	7	18	21	23	8	16	14.13	0.20
	%<70mm CL									
	T1	T2	T3	T4	T5	T6	T7	T8	Average	CV
Sep 06	47	38	76	137	20	53	22	67	57.50	0.23
Feb 07	37	31	26	39	4	17	64	14	29.00	0.23
Sep 07	47	41	124	120	33	52	47	33	62.13	0.21
Mar 08	24	19	49	59	100	86	45	10	49.00	0.23
Sep 08										
Feb 09	12	48	59	37	78	16	50	27	40.88	0.19
Sep 09	80	171	37	170	70	135	202	97	120.25	0.17
Mar 10	54	33	12	141	16	51	66	102	59.38	0.26
Sep 10	189	131	225	312	60	205	217	35	171.75	0.19
Mar 11	47	75	105	216	23	79	88	38	83.88	0.25
Aug 11	180	210	324	248	135	141	230	169	204.63	0.11
Feb 12	70	63	139	149	202	114	133	5	109.38	0.20
Aug 12	133	140	242	314	189	318	338	470	268.00	0.15
Feb 13	183	86	74	179	194	207	175	177	159.38	0.11

Figure 1a: Survey samples sizes at Nightingale.

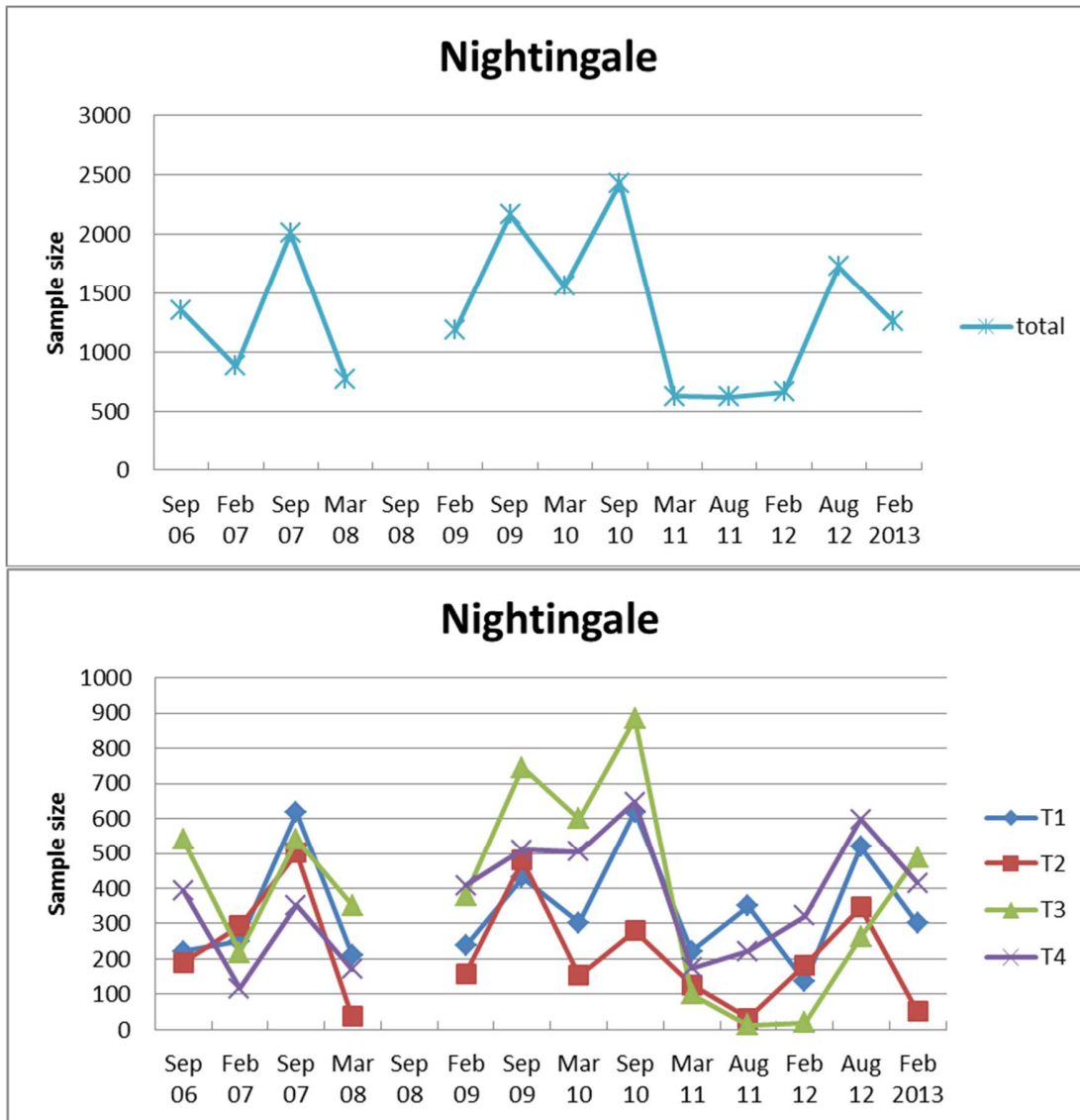


Figure 1b: Survey sample sizes at Inaccessible.

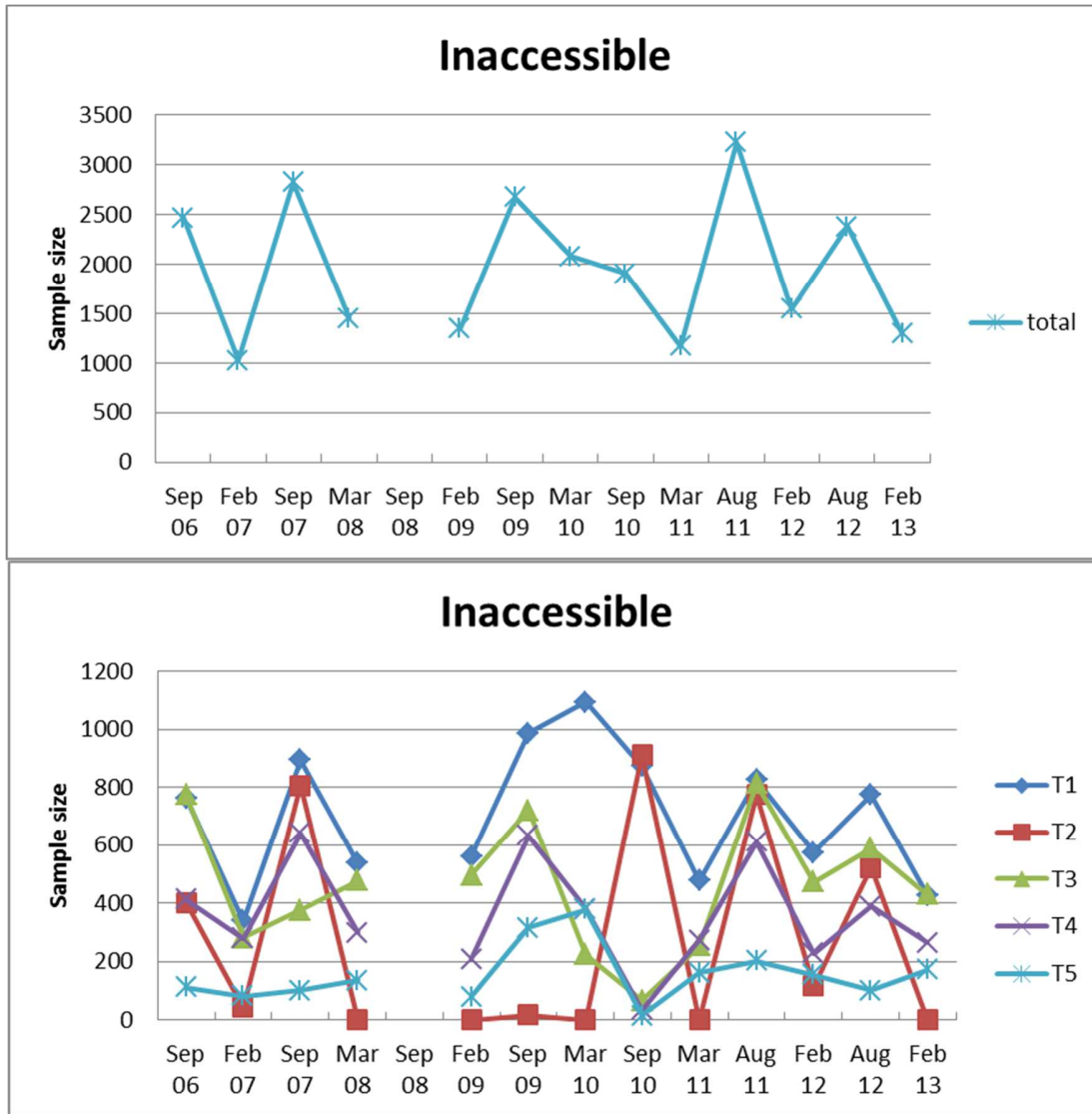


Figure 1c: Survey sample sizes at Gough.

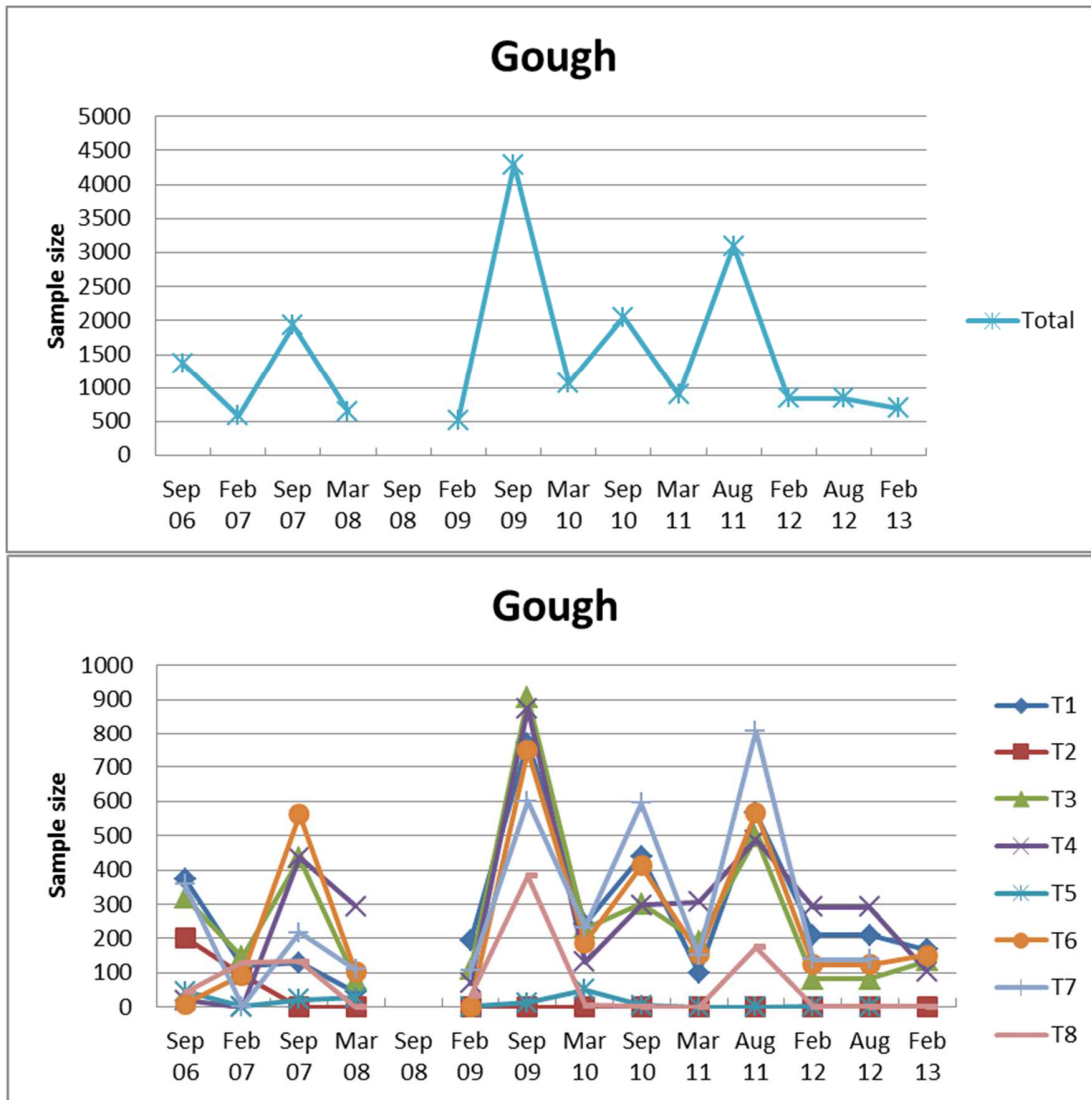


Figure 1d: Survey sample sizes at Tristan.

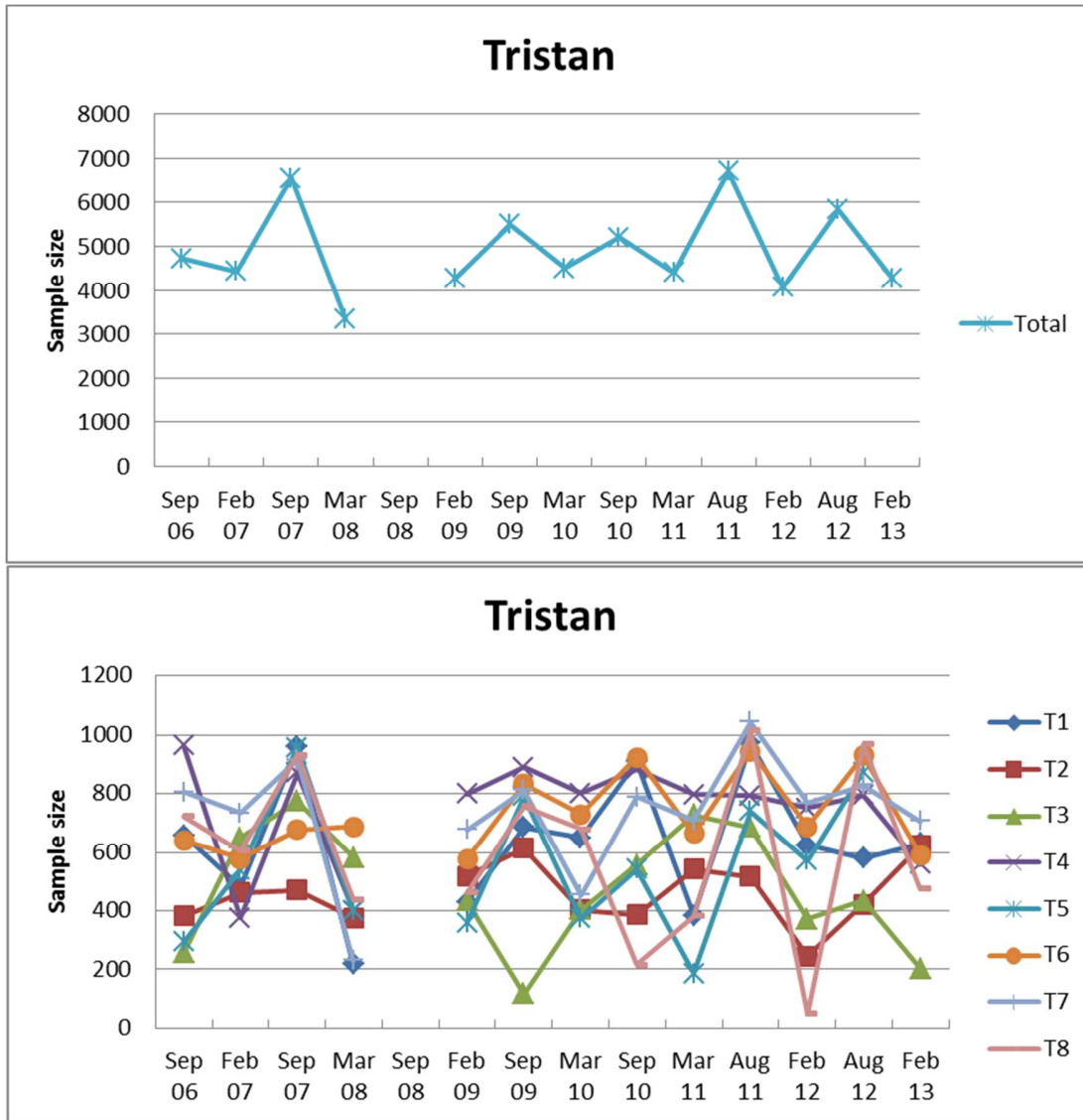


Figure 2a: The juvenile indices (<60mm and <70mm CL) for Nightingale. Average, lower and upper 95% CIs shown. Note that the vertical arrow indicates time of OLIVA incident.

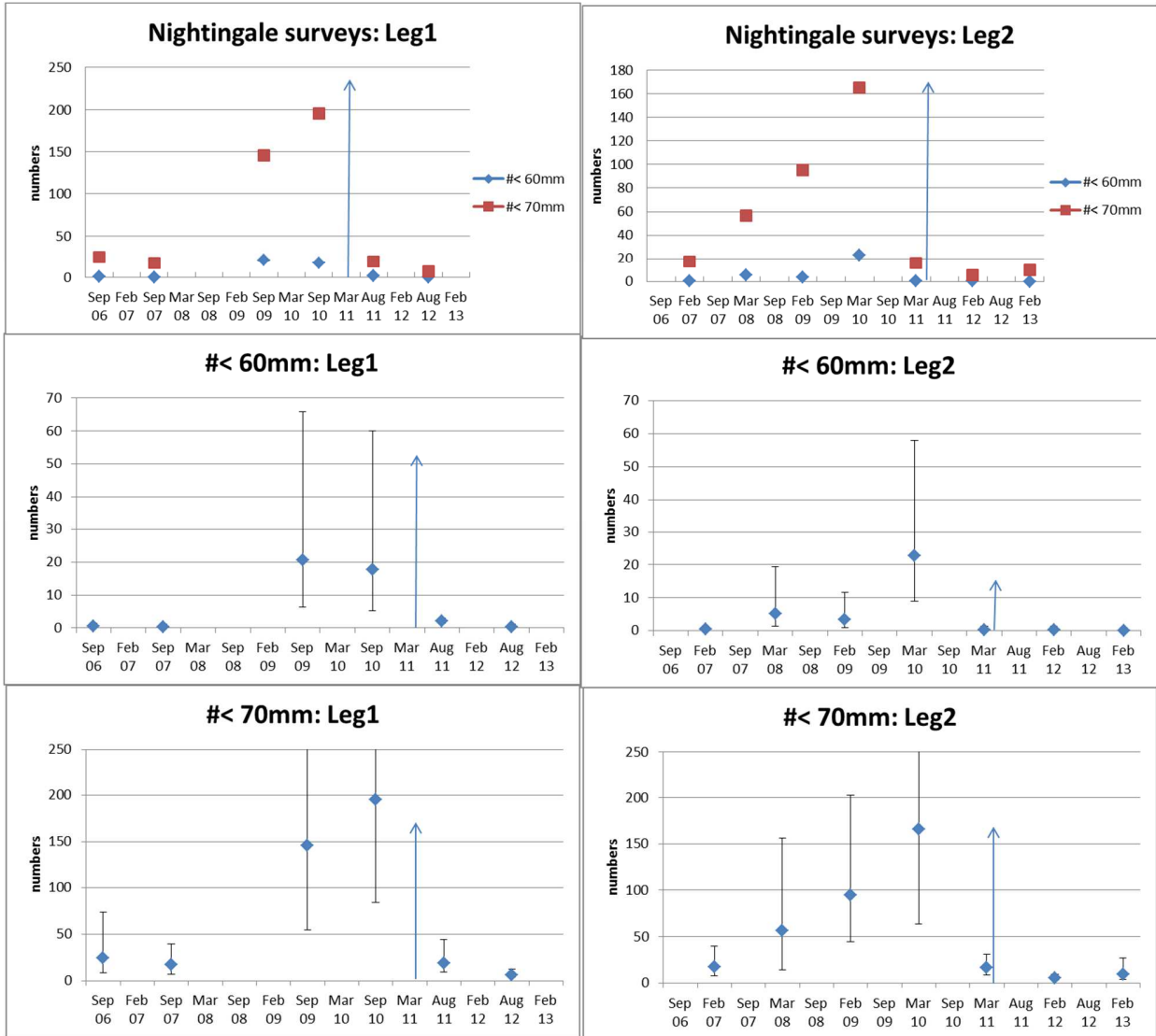


Figure 2b: The juvenile indices (<60mm and <70mm CL) for Inaccessible. Average, lower and upper 95% CIs shown. Note that the vertical arrow indicates time of OLIVA incident.

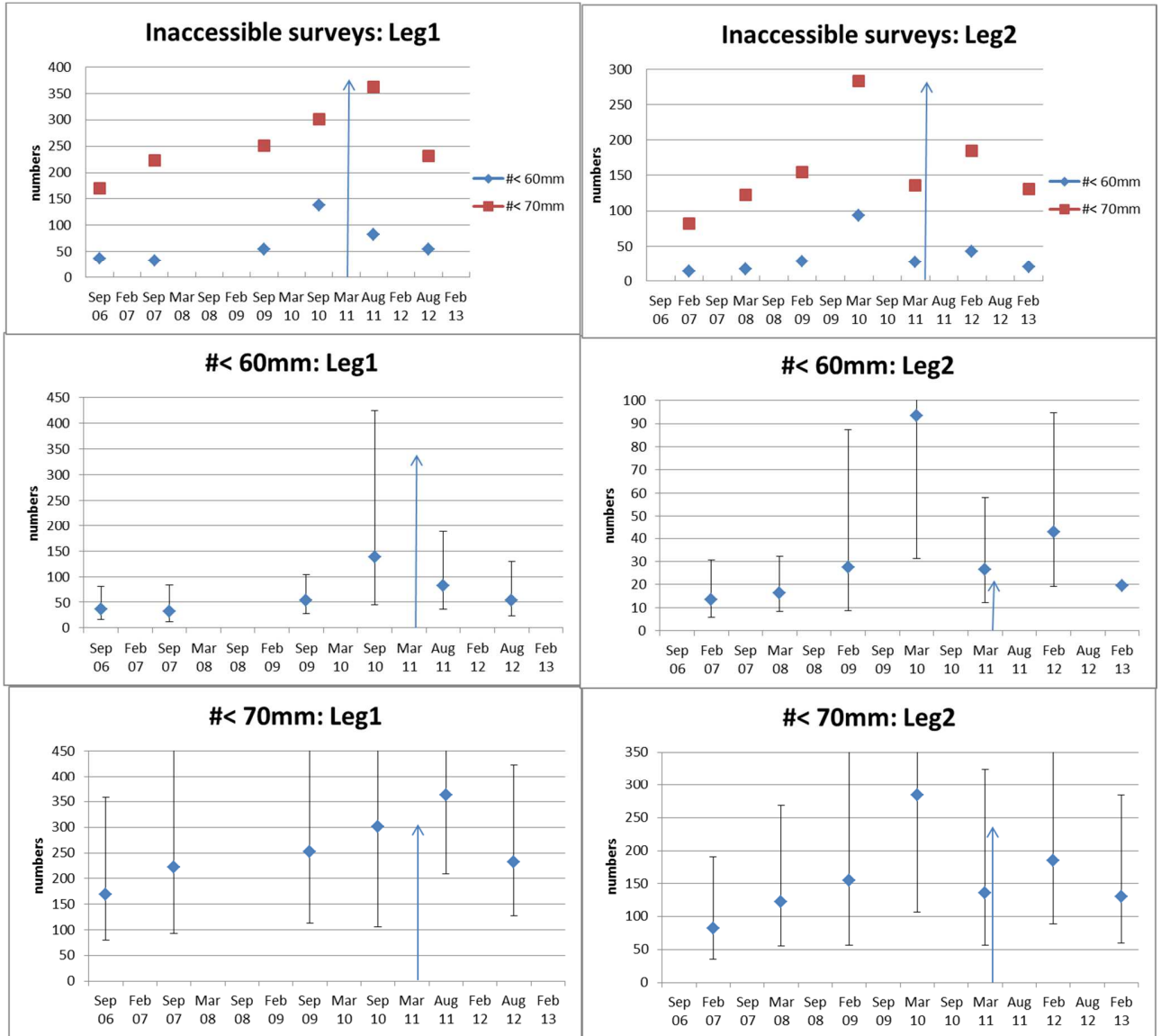


Figure 2c: The juvenile indices (<70mm and <75mm CL) for Gough. Average, lower and upper 95% CIs shown. Note that the vertical arrow indicates time of OLIVA incident.

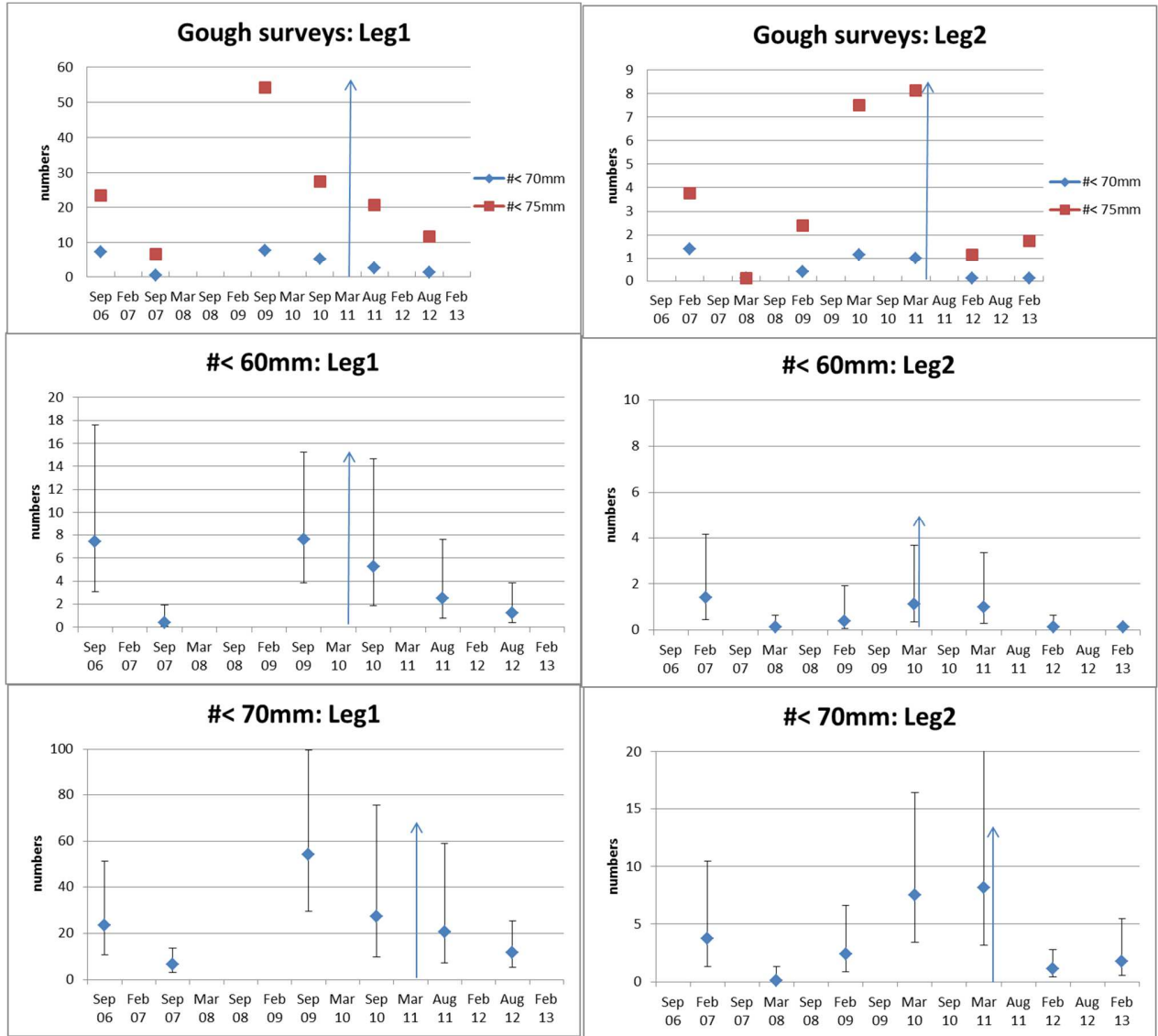


Figure 2d: The juvenile indices (<60mm and <70mm CL) for Tristan. Average, lower and upper 95% CIs shown. Note that the vertical arrow indicates time of OLIVA incident.

