

## **Results from the February/March 2024 hydroacoustic pelagic biomass survey**

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Small Pelagic Scientific Working Group  
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### **Introduction**

The Department was unable to conduct the regular hydroacoustic pelagic summer biomass survey during October/November 2023 owing to mechanical failure of the R.S. Africana. Instead, the Fishing Vessel Compass Challenger was chartered to conduct a survey, covering the standard survey area between Hondeklip Bay and Port Alfred out to a depth of at least 200m between the 16<sup>th</sup> of February and 17<sup>th</sup> of March 2024.

### **Methods**

The Simrad EK60 acoustic system, including the ES38B transducer and 38kHz General Purpose Transceiver (GPT, supplied by DFFE) was successfully calibrated in Table Bay on the 14<sup>th</sup> of February 2024. Three independent analyses methods were applied to the calibration data and given consistency between those results, a calibration correction of 1.25 was applied to correct for the ~ 1 dB change in system sensitivity since June 2023 (Appendix A). A total of 54 acoustic transects were sampled between Hondeklip Bay and Port Alfred (Figure 1), comprising 447 acoustic intervals. The survey was split into two legs with the first covering the area between Hondeklip Bay and Cape Agulhas and the second the area between Port Alfred and Cape Agulhas. Species identification and length frequencies were based on 86 trawl samples obtained using the R.S Africana pelagic trawl gear. 94 trawls were attempted, but 8 of these had no pelagic trawl catch.

Weather conditions were conducive to acoustic surveying for most of the survey, with 2 days lost during the first leg and 1.5 days during the second leg. To prevent further loss of survey time at the start of the second leg, the bad weather window was used to steam to Port Alfred so that stratum E was surveyed before stratum D. The mean nautical area backscattering coefficient for each acoustic interval, apart from offshore transits between transects, was converted to fish density, and scaled up to biomass using the measured survey area.

Although previously reported results for the first leg up to Cape Agulhas were adjusted to represent the biomass of fish > 6cm only (FISHERIES/2024/MAR/SWG-PEL/06), further investigation suggests that the calibration adjustment (FISHERIES/2024/JAN/SWG-PEL/01) to account for the difference in timing of this survey compared to previous surveys already takes account of 0-year-old fish and hence total biomass results from this survey, which includes 0-year-old fish are now reported.

To account for the difference in timing of this survey compared to previous pelagic biomass surveys, a calibration adjustment factor based on the average ratios of 1 November (or 15th November for round herring) to 1 March model predicted biomass over the most recent 10 assessed years have been used (FISHERIES/2024/JAN/SWG-PEL/01). Estimates of biomass obtained here have therefore been multiplied by factors of 0.98, 0.91, 1.07 and 0.97 for anchovy, sardine west of Cape Agulhas, sardine east of Cape Agulhas and round herring, respectively (Table 2). The CV of the adjusted biomass  $CV_{\bar{B}}$  was calculated from the standard deviation of the average ratio  $\bar{R}$  over the most recent 10 years as follows:

$$CV_{\bar{B}} = \sqrt{(CV_{\bar{R}})^2 + (CV_B)^2}$$

$$\text{where } (CV_{\bar{R}})^2 = \left\{ [sd(\bar{R})]^2 \times 1 + \frac{1}{n} \right\} / (\bar{R})^2,$$

$CV_B$  is the observed CV reported in Table 1 above and  $sd(\bar{R})$  is 0.171 for anchovy, 0.101 for sardine west of Cape Agulhas, 0.172 for sardine east of Cape Agulhas and 0.047 for round herring (FISHERIES/2024/JAN/SWG-PEL/01).

## Results

Biomass estimates and measures of their precision (CVs) for each of the strata surveyed are provided in Table 1 for anchovy, sardine and round herring. Estimates adjusted for the timing of this survey are provided in Table 2 and these adjusted estimates of biomass and CVs are compared to previous estimates in Tables 3 and 4. Maps of the distribution and relative abundance of anchovy, sardine and round herring are shown in Figures 2-4. Acoustically-weighted length frequencies per stratum and for the full survey area for anchovy, sardine and round herring are shown in Figures 5-7. Distribution maps of other species are included in Appendix B.

### 1. Anchovy

Moderate densities (25-100 g m<sup>-2</sup>) of 0-year-old anchovy (modal length of 4.5 cm) were observed in Stratum A from close inshore to about 40 nmi offshore. These juvenile fish account for about 36 % of the anchovy total biomass (Table 1). A dense patch of adult anchovy was encountered just south of Dassen Island in Stratum B, accounting for more than half of the total anchovy biomass and greatly increasing the CV of the anchovy estimate. Very few anchovy were found in Stratum C and in Stratum D, adult anchovy were confined to the inshore areas to the east of Cape Infanta. The anchovy found in stratum E were located close inshore off Mossel Bay and Bird Island in Algoa Bay. The total anchovy biomass of just over 1 million tonnes had a relatively high CV of 0.485, and once adjusted for the timing of the survey, decreased to 993.5 thousand tonnes with a CV of 0.518 (Table 2). This estimate is well below both the long-term and short-term average (Table 3) and the CV of this estimate is the highest on record. Of this biomass, 83% was located to the west of Cape Agulhas (Table 4), the highest proportion observed for this region since 1987.

## 2. Sardine

In stratum A, sardine occurred in three patches, the largest comprising adult sardine in the mid-shelf area north of Doring Bay, whereas those sardines just south of Hondeklip Bay and in St Helena Bay were mostly smaller with modal lengths of 4 and 10 cm, respectively. Like anchovy, a dense patch of small sardine (modal length 9.5cm) was located just south of Dassen Island in stratum B, however, the sardine off Cape Point were larger fish (>17 cm). Sardine were also found in low to moderate densities in False Bay and further offshore and in an almost continuous inshore band between Walker Bay and just east of Mossel Bay. A low-density offshore extension of sardine off Mossel Bay comprised large sardine. Sardine densities were highest in stratum E east of Plettenberg Bay and in the area around Bird Island in Algoa Bay. The total biomass estimate of 995 thousand tonnes (Table 1) increased to just under 1 million tonnes after correcting for the timing of the survey, with a relatively low CV of 0.35 (Table 2). This biomass estimate is the highest observed since 2011 and well above both the short-term and long-term average for sardine. The major portion of the sardine biomass continues to be on the South Coast, with only 37% located to the west of Cape Agulhas (Table 4).

## 3. Round herring

Round herring located in stratum A and B were mostly small (<10 cm), although further offshore, north of Doring Bay large round herring (>14 cm) overlapped with the distribution of adult sardine. Densities of round herring increased in the Cape Point region of stratum B from where a continuous band stretched across the inshore to mid-shelf region of stratum C, D and E as far as Cape St Francis. The length frequency for the total population is bimodal with roughly equal amounts of juvenile and adult fish. The total biomass estimate of 1.6 million tonnes (Table 1) decreased slightly to 1.56 million tonnes after calibrating for the survey's timing and had a very good CV of 0.135 (Table 2). This estimate is similar to that of 2022 and the recent average, but well above the long-term average (Table 3). As expected the bulk of the round herring biomass is located to the east of Cape Agulhas with only 28% located to the west of Cape Agulhas (Table 4).

## Discussion

The distribution of anchovy has contracted to inshore areas and the biomass is well below the average for the recent past. More than half of the observed biomass is attributed to recruits of the year and the estimate is driven mainly by two very high densities observed in stratum B. There is no basis for the removal of these two interval density estimates, but this information is included here as an example of how sensitive reported biomass estimates are to the 'hit or miss' of high density areas and has implications for reducing survey effort to cut costs. The reduced distribution and biomass are most likely a consequence of the very low recruitment observed in 2023. The estimates for sardine and round herring are above both the short and long-term averages and the distribution of sardine is less patchy than observed in the recent past. Despite the altered timing of this survey, the entire distribution

of all three species appears to have been covered and there was no indication of altered behaviour, which might have influenced the acoustic bias factor. The direction of sampling was different on the south coast, with transects being sampled from east to west rather than from west to east. This should have no bearing on the reliability of the survey estimates of any of the species and was a necessary change to ensure completion of the survey. In fact, this sampling strategy should be considered in the future as it alleviates surveying offshore transits against the Agulhas Current, thereby saving valuable survey time.

**Table 1.** Total biomass estimates (tonnes) and their associated CVs for anchovy, sardine and round herring per stratum, summed for the areas to the west and east of Cape Agulhas and for the total standard survey area between Hondeklip Bay and Port Alfred.

Stratum	Anchovy		Sardine		Round herring	
	Biomass	CV	Biomass	CV	Biomass	CV
A. Hondeklip Bay to C. Columbine	361 365	0.333	104 152	0.791	78 302	0.428
B. C. Columbine to Cape Point	483 441	0.973	164 997	0.938	177 445	0.566
C. Cape Point to Cape Agulhas	1 052	0.556	139 007	0.374	245 772	0.293
D. Cape Agulhas to Mossel Bay	101 920	0.503	88 809	0.540	644 393	0.194
E. Mossel Bay to Port Alfred	66 050	0.864	498 330	0.529	460 019	0.196
West of Cape Agulhas	845 858	0.574	408 156	0.448	501 518	0.255
East of Cape Agulhas	167 970	0.457	587 139	0.456	1 104 412	0.140
<b>Total</b>	<b>1 013 827</b>	<b>0.485</b>	<b>995 294</b>	<b>0.326</b>	<b>1 605 930</b>	<b>0.125</b>

**Table 2.** Adjusted Total biomass estimates (tonnes) and their adjusted CVs for anchovy, sardine and round herring for the total standard survey area between Hondeklip Bay and Port Alfred (anchovy and round herring) and for the areas to the west and east of Cape Agulhas (sardine).

Area	Anchovy		Sardine		Round herring	
	Biomass	CV	Biomass	CV	Biomass	CV
West of Cape Agulhas			<b>371 422</b>	<b>0.463</b>		
East of Cape Agulhas			<b>628 238</b>	<b>0.486</b>		
<b>Total</b>	<b>993 551</b>	<b>0.518</b>	999 660	0.351	<b>1 557 752</b>	<b>0.135</b>

**Table 3.** Biomass estimates and CVs of anchovy, sardine and round herring from summer biomass surveys for the standard survey area.

Year	anchovy	CV	sardine	CV	redeye	CV
	anchovy	CV	sardine	CV	redeye	CV
1984	1 336 482	0.267	39 224	0.993	70 214	0.338
1985	1 327 710	0.156	43 286	0.460	250 466	0.215
1986	2 568 625	0.148	299 797	0.696	344 474	0.297
1987	2 108 771	0.132	111 285	0.402	544 997	0.197
1988	1 607 060	0.204	134 362	0.715	376 858	0.318
1989	751 529	0.143	256 655	0.225	841 362	0.253
1990	651 711	0.167	289 876	0.276	441 478	0.171
1991	2 327 834	0.140	597 858	0.308	624 712	0.242
1992	2 088 025	0.140	494 157	0.488	715 475	0.160
1993	916 359	0.190	560 019	0.316	521 417	0.216
1994	617 276	0.136	518 354	0.280	283 002	0.208
1995	601 271	0.192	844 727	0.514	571 104	0.132
1996	162 048	0.391	529 456	0.359	575 790	0.145
1997	1 482 633	0.267	1 224 632	0.244	591 219	0.280
1998	1 229 132	0.217	1 607 328	0.251	1 247 966	0.149
1999	2 052 156	0.156	1 635 410	0.212	1 398 329	0.171
2000	4 653 779	0.125	2 292 380	0.500	1 420 454	0.169
2001	6 720 287	0.107	2 309 600	0.142	1 045 517	0.131
2002	3 867 649	0.154	4 206 250	0.227	917 853	0.189
2003	3 563 232	0.236	3 564 171	0.197	1 761 631	0.108
2004	2 037 011	0.131	2 619 301	0.333	1 471 802	0.100
2005	3 077 001	0.144	1 048 991	0.300	1 616 260	0.130
2006	2 106 273	0.136	712 557	0.346	1 229 156	0.106
2007	2 505 655	0.157	252 199	0.351	1 634 965	0.151
2008	3 598 790	0.120	384 080	0.422	1 221 470	0.127
2009	3 792 547	0.136	501 575	0.271	1 981 467	0.108
2010	2 058 185	0.144	501 494	0.239	1 084 972	0.134
2011	754 124	0.204	1 037 060	0.235	1 961 814	0.100
2012	3 187 964	0.116	345 054	0.345	795 643	0.145
2013	3 819 666	0.102	611 763	0.346	959 376	0.130
2014	2 970 760	0.137	444 500	0.291	1 428 864	0.178
2015	1 944 258	0.157	363 230	0.297	1 315 183	0.136
2016	1 733 040	0.227	258 575	0.353	1 419 173	0.191
2017	1 568 398	0.196	334 804	0.449	1 101 658	0.169
2018	1 559 546	0.235	90 768	0.502	1 406 888	0.147
2019	843 745	0.205	193 630	0.523	2 252 641	0.146
2020	2 556 598	0.164	248 942	0.504	1 828 903	0.125
2021	No Survey					
2022	1 021 069	0.220	569 478	0.379	1 631 864	0.110
<b>2023<sup>1</sup></b>	<b>993 551</b>	<b>0.518</b>	<b>999 660</b>	<b>0.351</b>	<b>1 557 752</b>	<b>0.135</b>
Ave (all)	2 151 795	0.174	844 127	0.376	1 075 958	0.172
Ave (5 yr)	1 509 871	0.204	287 524	0.471	1 644 391	0.139

<sup>1</sup> No survey in Nov/Dec 2023. A delayed survey was conducted in Feb/March 2024. Biomass estimates and CVs are adjusted for the difference in timing of the Feb/March 2024 survey (FISHERIES/2024/JAN/SWG-PEL/01).

**Table 4.** Biomass estimates of anchovy, sardine and round herring from summer biomass surveys for the area to the west and east of Cape Agulhas.

Year	Anchovy			Sardine			Round herring		
	West	East	Pwest	West	East	Pwest	West	East	Pwest
1984	611 049	725 432	0.46	36 453	2 771	0.93	10 334	59 880	0.15
1985	967 004	360 706	0.73	23 433	19 853	0.54	137 977	112 489	0.55
1986	1 978 652	589 973	0.77	238 230	61 566	0.79	87 991	256 483	0.26
1987	1 866 430	242 341	0.89	94 165	17 120	0.85	147 156	397 841	0.27
1988	1 289 624	317 436	0.80	128 043	6 319	0.95	166 632	210 226	0.44
1989	517 293	234 236	0.69	198 328	58 327	0.77	355 098	486 264	0.42
1990	342 812	308 899	0.53	248 855	41 020	0.86	67 136	374 342	0.15
1991	1 254 359	1 073	0.54	517 180	80 678	0.87	339 445	285 268	0.54
1992	1 036 580	1 051	0.50	247 756	246 401	0.50	67 282	648 193	0.09
1993	439 121	477 238	0.48	480 822	79 198	0.86	157 007	364 411	0.30
1994	309 981	307 294	0.50	389 730	128 624	0.75	114 845	168 157	0.41
1995	468 678	132 593	0.78	364 324	480 402	0.43	144 946	426 159	0.25
1996	29 748	132 300	0.18	257 763	271 693	0.49	134 460	441 330	0.23
1997	377 663	1 104	0.25	964 835	259 797	0.79	174 979	416 240	0.30
1998	206 586	1 022	0.17	1 082	524 781	0.67	744 245	503 721	0.60
1999	741 961	1 310	0.36	708 029	927 381	0.43	388 649	1 009 680	0.28
2000	1 960 122	2 693	0.42	726 230	1 566 150	0.32	422 241	998 213	0.30
2001	2 301 999	4 418	0.34	669 617	1 639 983	0.29	393 295	652 222	0.38
2002	2 018 570	1 849	0.52	1 184	3 021 538	0.28	223 614	694 239	0.24
2003	1 181 111	2 382	0.33	1 343	2 221 053	0.38	297 488	1 464 143	0.17
2004	729 369	1 307	0.36	296 108	2 323 193	0.11	248 376	1 223 426	0.17
2005	670 730	2 406	0.22	75 604	973 386	0.07	233 285	1 382 975	0.14
2006	1 027 009	1 079	0.49	177 889	534 667	0.25	311 267	917 888	0.25
2007	887 831	1 617	0.35	53 138	199 061	0.21	464 974	1 169 991	0.28
2008	1 314 490	2 284	0.37	211 871	172 209	0.55	596 131	625 339	0.49
2009	2 098 253	1 694	0.55	262 175	239 400	0.52	537 711	1 443 756	0.27
2010	335 298	1 722	0.16	302 597	198 897	0.60	337 774	747 198	0.31
2011	173 390	580 734	0.23	182 825	854 235	0.18	279 298	1 682 516	0.14
2012	1 022 472	2 165	0.32	186 109	158 945	0.54	209 939	585 704	0.26
2013	1 161 192	2 658	0.30	467 613	144 150	0.76	112 122	847 254	0.12
2014	1 298 929	1 671	0.44	195 786	248 715	0.44	172 350	1 256 514	0.12
2015	654 540	1 289	0.34	98 467	264 763	0.27	386 029	929 154	0.29
2016	1 337 305	395 736	0.77	183 356	75 219	0.71	661 936	757 238	0.47
2017	820 377	748 022	0.52	107 173	227 631	0.32	376 487	725 171	0.34
2018	356 113	1 203	0.23	34 845	55 922	0.38	308 509	1 098 380	0.22
2019	481 291	362 454	0.57	43 619	150 010	0.23	611 506	1 641 135	0.27
2020	1 526 611	1 029	0.60	51 678	197 263	0.21	389 228	1 439 675	0.21
2021	No survey								
2022	441 571	579 498	0.43	221 492	347 987	0.39	562 326	1 069 538	0.34
<b>2023<sup>2</sup></b>	<b>828 940</b>	<b>164 610</b>	<b>0.83</b>	<b>371 422</b>	<b>628 238</b>	<b>0.37</b>	<b>486 473</b>	<b>1 071 280</b>	<b>0.31</b>
Ave (all)	953 582	1 198	0.46	343 593	500 535	0.51	299 317	776 641	0.29
Ave (5	725 193	784 679	0.47	91 762	195 763	0.31	449 611	1 194 780	0.28

<sup>2</sup> No survey in Nov/Dec 2023. A delayed survey was conducted in Feb/March 2024. Biomass estimates and CVs are adjusted for the difference in timing of the Feb/March 2024 survey (FISHERIES/2024/JAN/SWG-PEL/01).

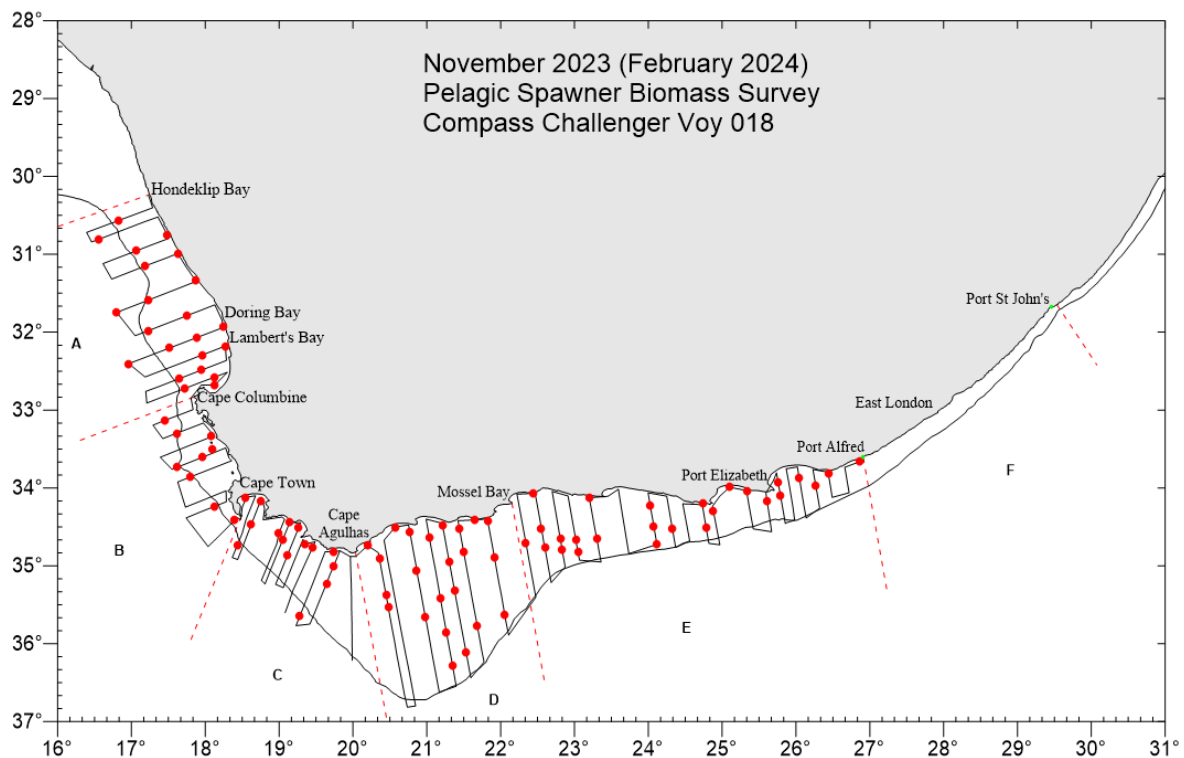


Figure 1. Position of transects and sampling trawls for the full survey area.

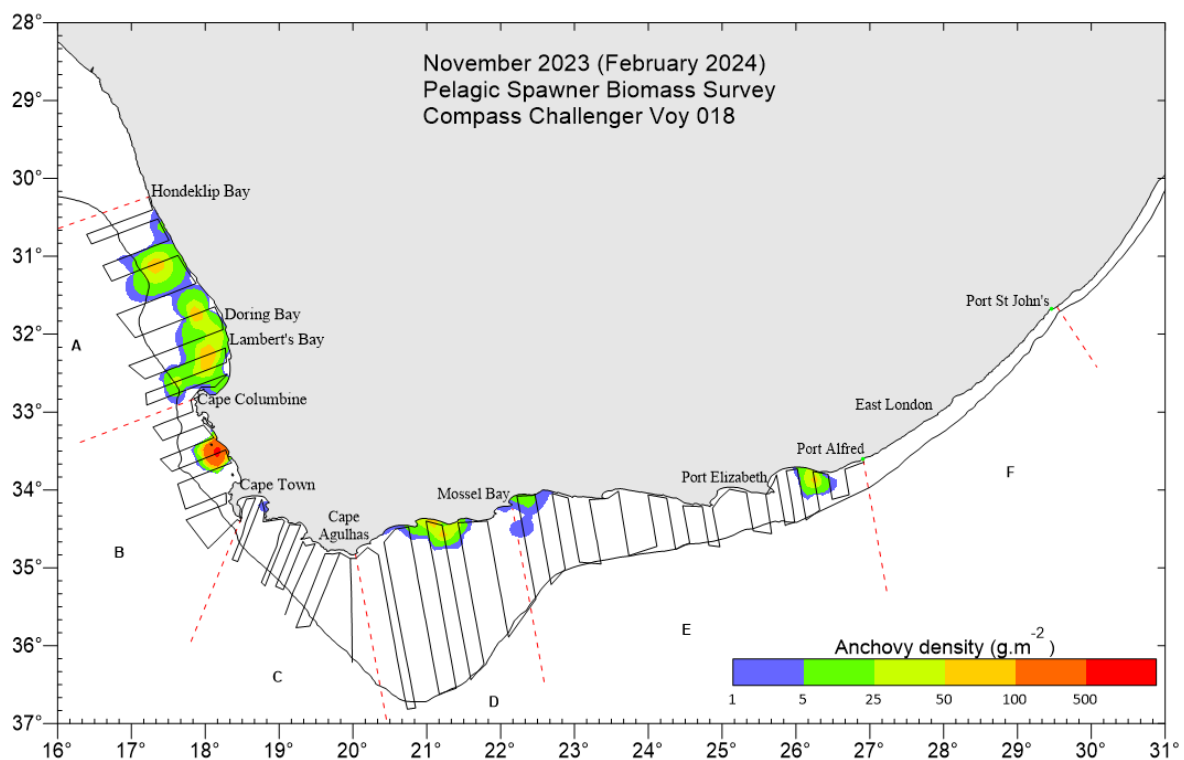


Figure 2. Distribution and relative abundance of anchovy (total, adults and juveniles)

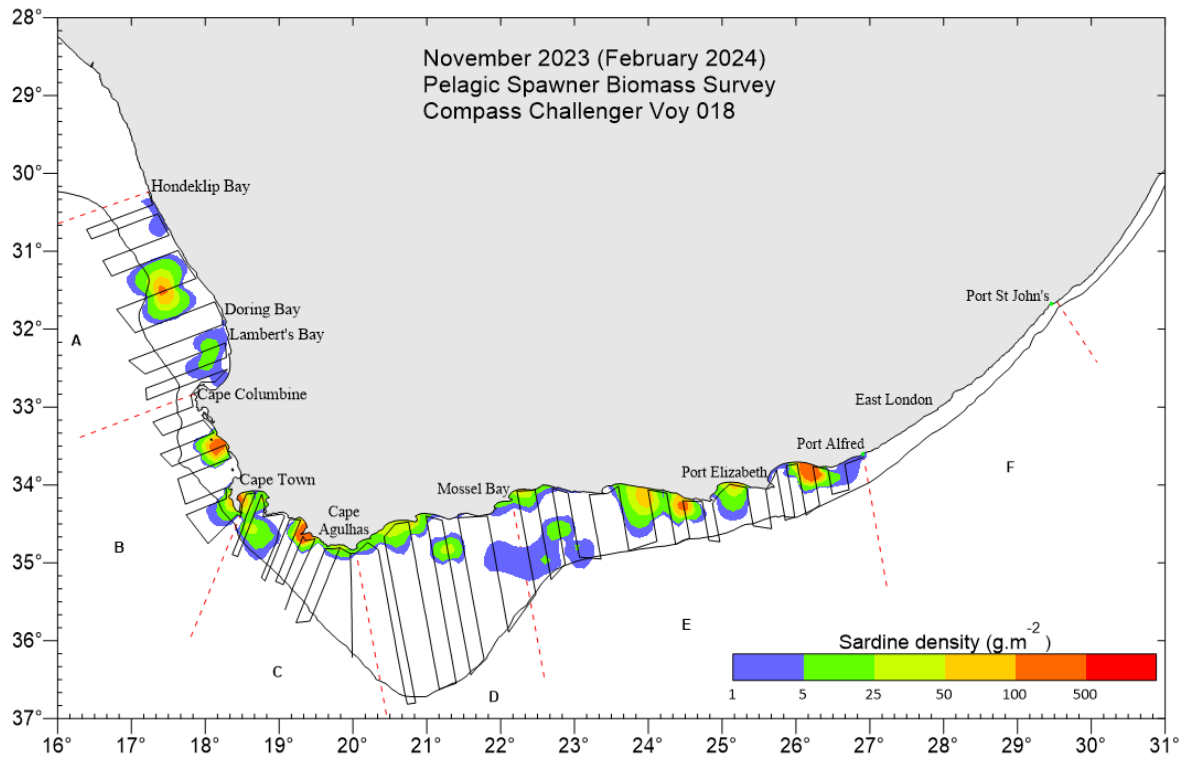


Figure 3. Distribution and relative abundance of sardine

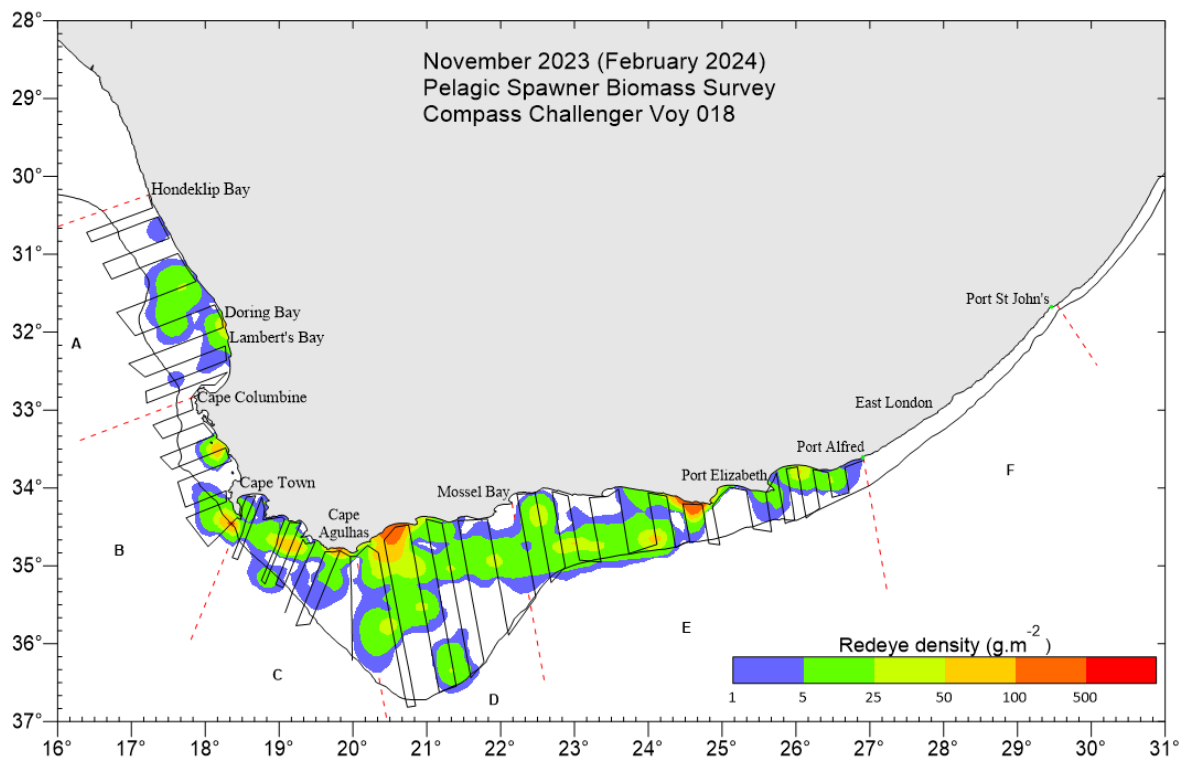


Figure 4. Distribution and relative abundance of round herring.



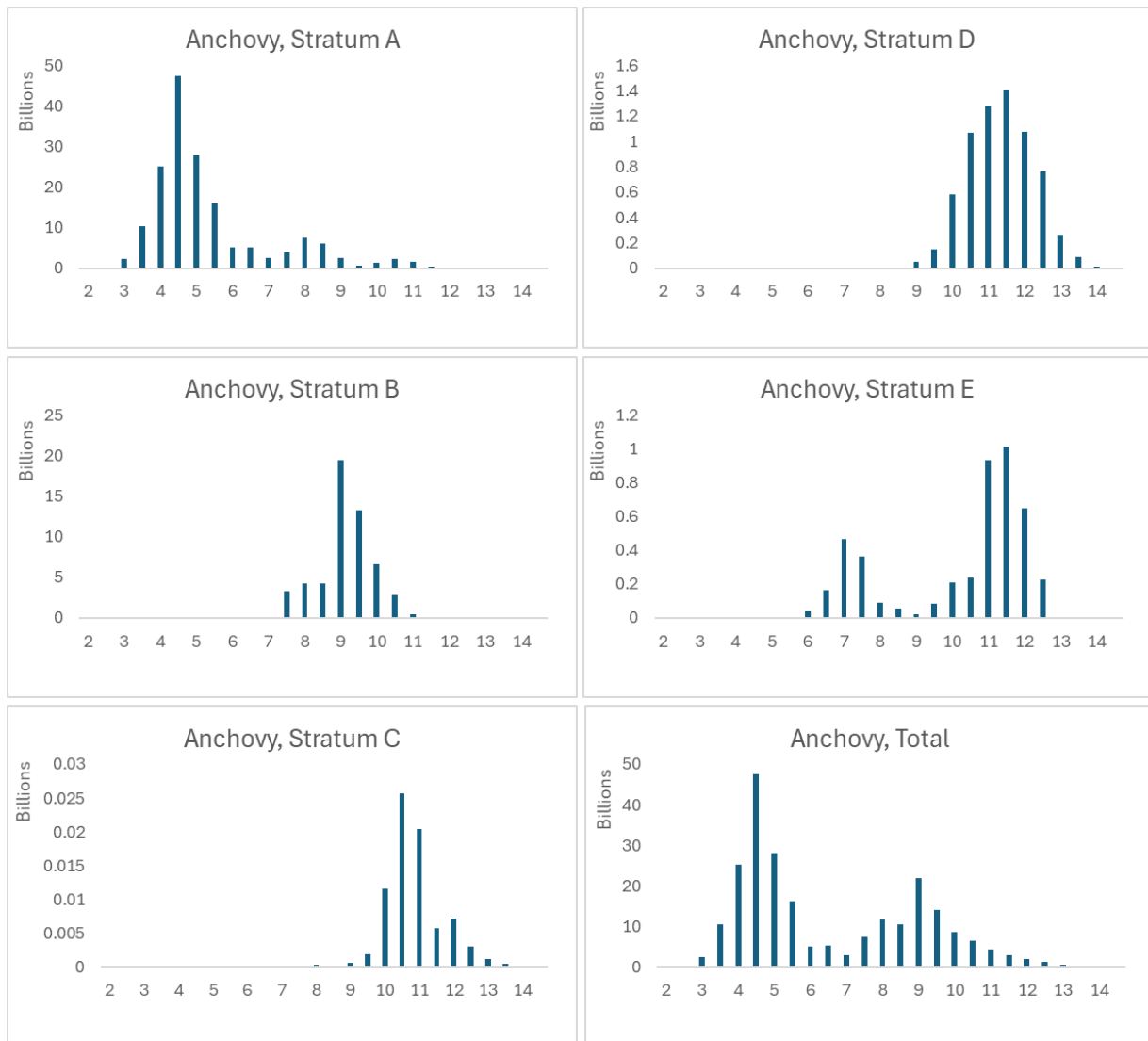


Figure 5. Weighted length frequencies per stratum for Anchovy and for the full survey area.

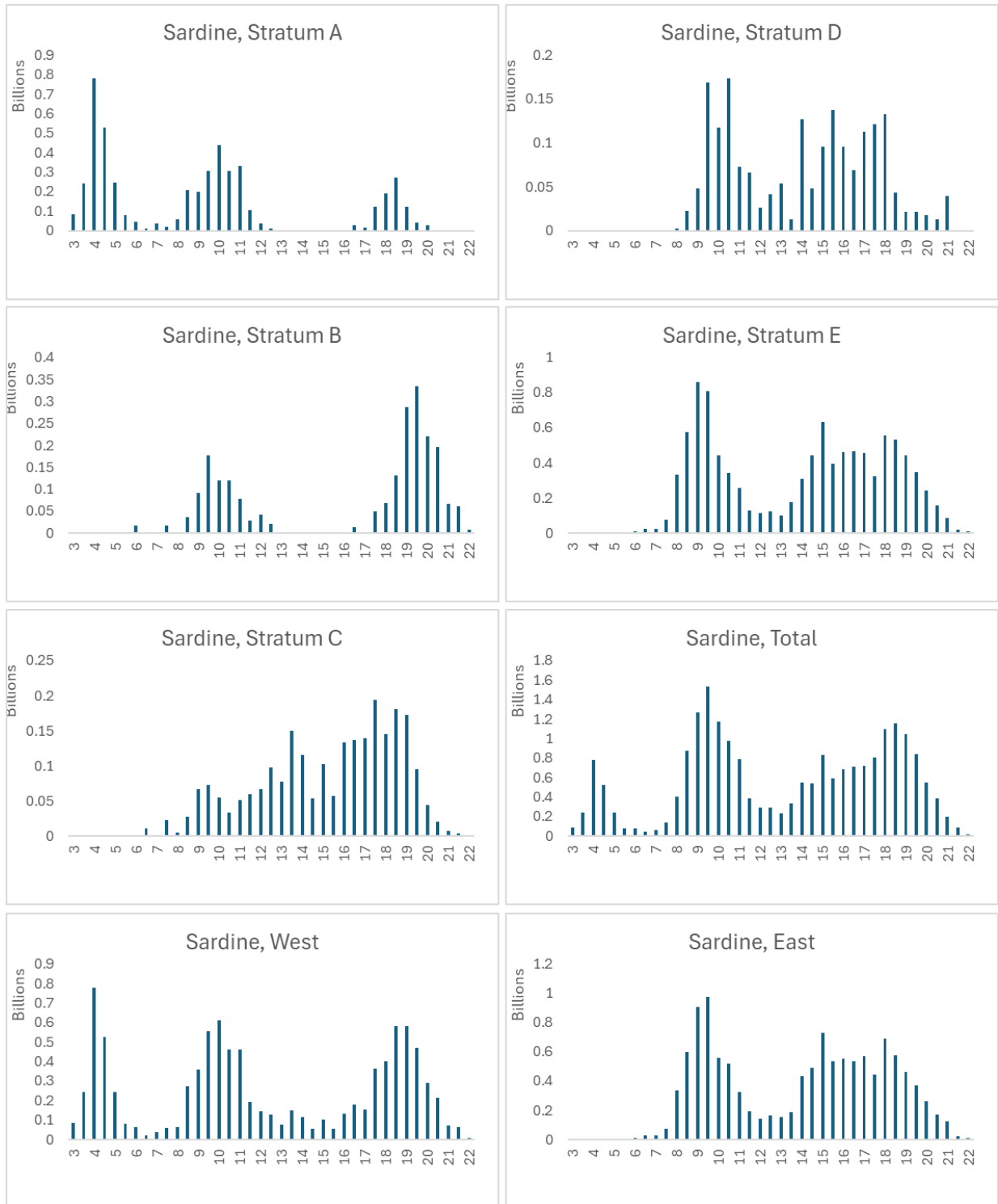


Figure 6. Weighted length frequencies per stratum for Sardine

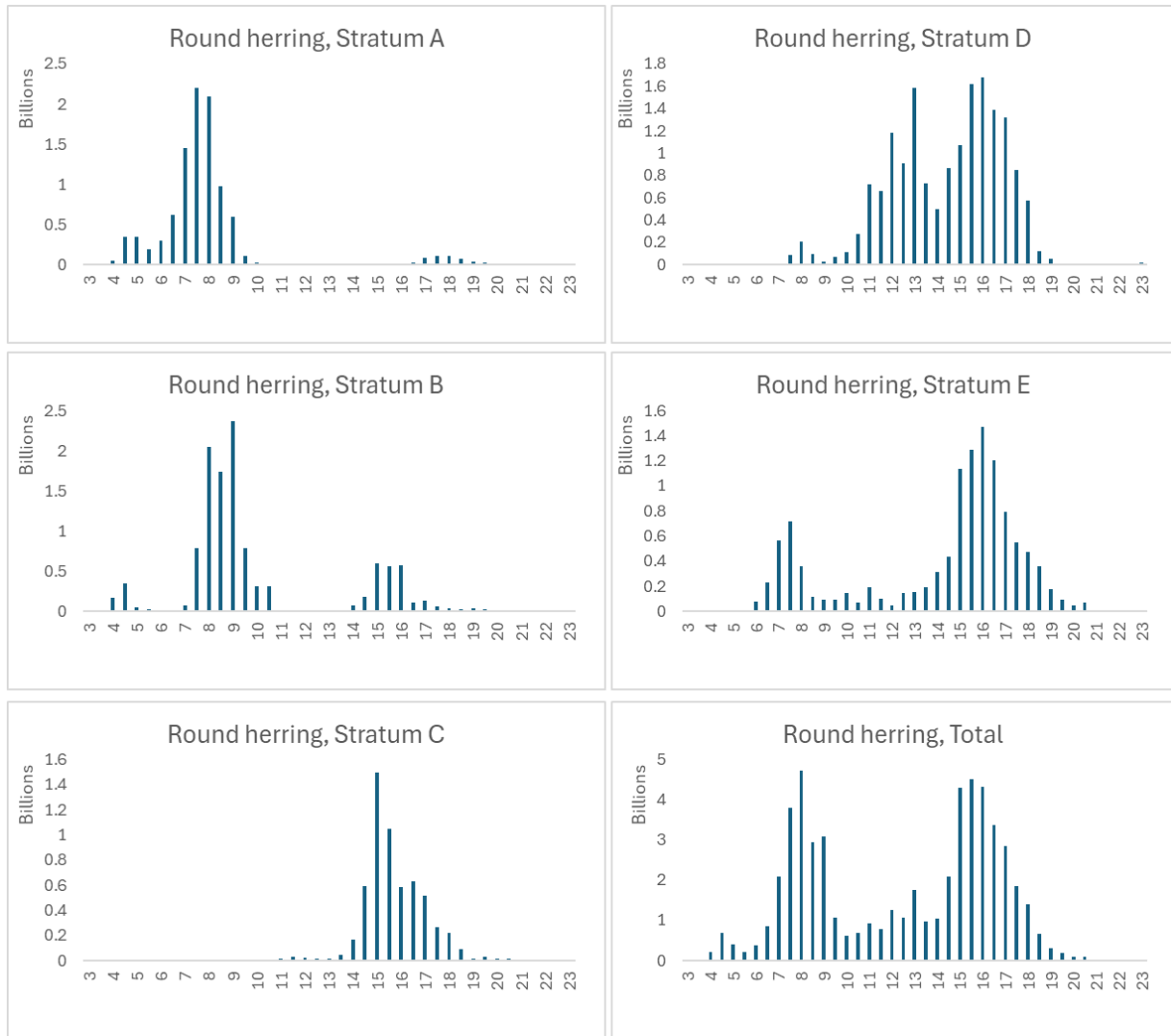


Figure 7. Weighted length frequencies per stratum for round herring

## Appendix A

### Compass Challenger Calibration Result – 14 February 2024

The analysis obtained from the results of the calibration exercise conducted on Compass Challenger on 14 February 2024 are presented in Table 1 Below.

Method	G <sub>0</sub>	s <sub>A</sub> corr	s <sub>V</sub> Gain	Along	Athwart	Devn Beam	Devn Poly
<b>LOBE</b>	24.25	-0.51	23.74	7.06 (-0.01)	6.91 (+0.01)	0.40	0.36
<b>Graphical</b>	24.26	-0.51 *	23.75	X	X		
<b>Echoview (Manual)</b>	24.25	-0.51	23.74				
<b>E/View Cal Assistant</b>	24.25	-0.52	23.73	7.09 (-0.04)	7.02 (-0.01)	0.29	

\* Averaged from the Lobe, Echoview (manual) and Cal Assistant correction factors.

**Table 1:** An analysis of the results obtained from the calibration of the Simrad EK60 38kHz Split Beam scientific echo sounder (utilizing the vessels ES38B Transducer) installed on the F/V Compass Challenger on 14 Feb. 2024 is presented above. Four different methods of analysis were used to generate estimates of the system gain. The results were almost identical.

The average Sv Gain estimate obtained for the calibration is **23.74 dB**

As the survey was conducted with the initial EK60 transceiver settings (Fig. 1 below) the correction to be applied to the data collected during the surveys is;

$$\text{Linear Correction Factor} = 10^{\left( \left( \left( 24.77 - 0.55 \right) - 23.74 \right) * 2 \right) / 10} = 1.25$$

## Appendix B

Distribution maps for horse mackerel, chub mackerel, lantern fish and light fish (in order from top to bottom).

