

Supplementary Materials for

Disparate compound eyes of Cambrian radiodonts reveal their developmental growth mode and diverse visual ecology

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Tables S1 to S6

Table S1. Emu Bay Shale compound eye types, including specimen sizes and lens data.

SAM P number	Eye type	Max. preserved diameter across long axis (mm)	Max. preserved diameter across short axis (mm)	Est. total number of lenses	Approx. lens diameter range (μm)	Notes
P 48375	Acute zone-type	23.5	17.0	N/A	N/A	Too poorly preserved for lens data
P 48377	Acute zone-type	25.7	19.8	N/A	AZ: 290–335; margin: N/A	Visual surface too incomplete to estimate total number of lenses
P 52901	Acute zone-type	14.4	12.9	7066	AZ: 215–230; margin: N/A	
P 54248	Acute zone-type	30.0	18.0	N/A	AZ: 260–320; margin: 95–115	Too incomplete to estimate total number of lenses
P 54853	Acute zone-type	26.5	17.8	7910	AZ: 270–320; margin: 80–170	
P 55428	Acute zone-type	12.2	8.9	5559	AZ: 175–200; margin: 45–65	
P 57421	Acute zone-type	25.9	17.6	13248	AZ: 210–250; margin: N/A	
P 43629	Acute zone-type	8.9	5.8	3424	AZ: up to 200; margin: 60	
P 43687	Acute zone-type	7.9	5.0	4045	AZ: up to 190; margin: 30–40	
P 49070	<i>Anomalocaris</i> -type	38.6	10.0	N/A	295–325	Too incomplete to estimate total number of lenses
P 52893	<i>Anomalocaris</i> -type	22.3	10.6	N/A	125–160	Too incomplete to estimate total number of lenses

Table S2. Emu Bay Shale compound eye lens count data.

SAM P number	Eye type	TOTAL		Acute zone				Intermediate zone				Marginal zone				Counts per zone	Total lenses counted
		Visual area (mm ²)	Total lenses	Area (mm ²)	Lenses	Lenses/mm ²	Avg. lens size (mm ²)	Area (mm ²)	Lenses	Lenses/mm ²	Avg. lens size (mm ²)	Area (mm ²)	Lenses	Lenses/mm ²	Avg. lens size (mm ²)		
P 48377 *	Acute zone-type	288.51	6754	98.51	1546	15.69	0.064	104.12	2369	22.75	0.044	85.88	2839	33.06	0.030	13/6/0 → 19	133
P 52901	Acute zone-type	116.55	7066	42.31	1138	26.89	0.037	34.34	1736	50.55	0.020	39.90	4192	105.06	0.009	10/14/7 → 31	144
P 54853	Acute zone-type	360.90	7910	115.68	1850	16.00	0.063	128.44	2199	17.12	0.058	116.78	3861	33.06	0.030	9/24/17 → 50	401
P 55428	Acute zone-type	58.47	5559	17.58	810	46.10	0.022	20.67	1769	85.56	0.012	20.22	2980	147.39	0.007	14/11/12 → 37	247
P 57421	Acute zone-type	267.42	13248	87.68	2547	29.05	0.034	94.42	4508	47.75	0.021	85.32	6193	72.59	0.014	21/13/19 → 53	378
P 43629	Acute zone-type	36.88	3426	12.90	591	45.82	0.022	13.24	1020	76.91	0.013	10.74	1815	169.00	0.006	13/17/10 → 40	330
P 43687	Acute zone-type	30.21	4045	9.46	551	58.22	0.017	11.07	1216	109.83	0.009	9.68	2278	235.31	0.004	10/9/4 → 23	248

* Total and marginal zone lens count based on marginal lens density taken from P 54853 (having the most similar acute and intermediate zone lens density).

SAM P number	Eye type	Visual area (mm ²)	Total lenses	Lenses/mm ²	Avg. lens size (mm ²)	Extrapolated L (mm)	Extrapolated W (mm)	Counts	Total lenses counted
P 49070	<i>Anomalocaris</i> -type	306.00	3476	11.36	0.088	45.5	26.1	22 lines	222
P 52893	<i>Anomalocaris</i> -type	172.64	16248	94.06	0.010			35 lines	283
P 45920	<i>Anomalocaris</i> -type	190.46	24760	130.00	0.008			12 lines	~150

SAM P number	Avg. lens size (mm ²)		
	Acute zone	Intermed. zone	Marginal zone
P 48377	0.064	0.044	0.030
P 52901	0.037	0.020	0.009
P 54853	0.063	0.058	0.030
P 55428	0.022	0.012	0.007
P 57421	0.034	0.021	0.014
P 43629	0.022	0.013	0.006
P 43687	0.017	0.009	0.004

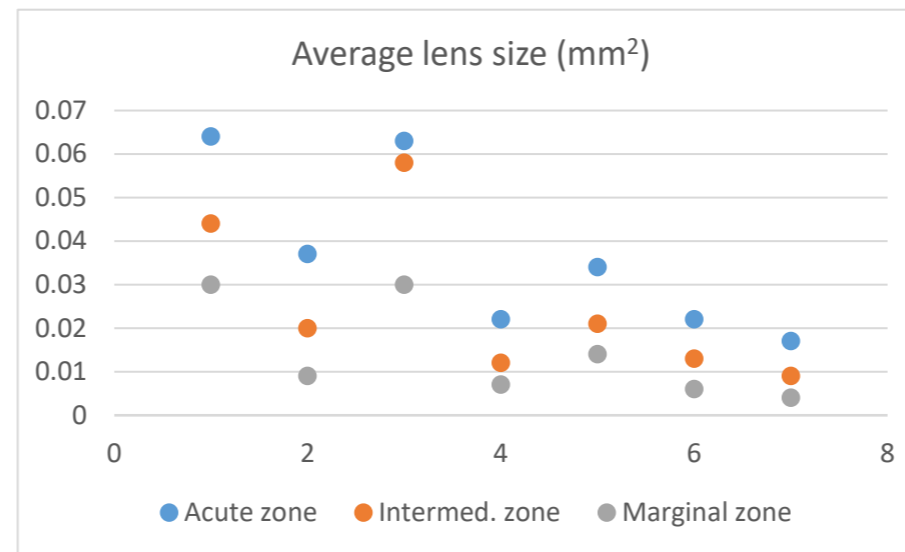


Table S3. Emu Bay Shale compound eye types and associated occurrence data.

SAM P number	Eye type	Buck Quarry level (m)	Figured
P 43687	Acute zone-type	11.4	Fig. 1b and SI fig. 3 in (21); fig. 4b in (25)
P 43445	Acute zone-type	10.8	SI fig. 2d in (21)
P 43629	Acute zone-type	11.0	Figs 1a, 2 and SI fig. 1 in (21); fig. 4a in (25)
P 43658	Acute zone-type	9.8	Fig. 1c in (21)
P 44368	Acute zone-type	11.7	SI fig. 2c in (21)
P 45170	Acute zone-type	11.6	SI fig. 2a in (21)
P 45913	Acute zone-type	11.5	SI fig. 2b in (21)
P 45920	<i>Anomalocaris</i> -type	10.4	Figs 1 and 2a in (20); fig. 4c, d in (25); fig. 1B, E, H in (22)
P 46330	<i>Anomalocaris</i> -type	11.3	Fig. 2b and SI fig. 1a–e in (20); fig. 1G, I in (22)
P 47154	<i>Anomalocaris</i> -type	11.0	
P 48161	Acute zone-type	11.3	
P 48375	Acute zone-type	9.9	
P 49070	<i>Anomalocaris</i> -type	11.5	Figure 4A, B (herein)
P 48377	Acute zone-type	9.8	Figure 1E, F (herein)
P 49139	Acute zone-type	9.8	
P 49647	Acute zone-type	11.0	
P 49703	Acute zone-type	9.8	
P 50341	<i>Anomalocaris</i> -type	9.8	
P 52893	<i>Anomalocaris</i> -type	10.9	Figure 4C (herein)
P 52901	Acute zone-type	10.8	Figure 2E, F (herein)
P 53812	<i>Anomalocaris</i> -type	9.8	
P 54244	<i>Anomalocaris</i> -type	9.8	
P 54248	Acute zone-type	11.1	Figure 2A–D (herein)
P 54778	Acute zone-type	10.7	
P 54853	Acute zone-type	10.7	Figure 1A–C (herein)
P 54862	<i>Anomalocaris</i> -type	9.8	
P 55428	Acute zone-type	11.2	Figure 2G (herein)
P 55429	Acute zone-type	11.0	
P 55623	<i>Anomalocaris</i> -type	11.1	
P 56715	<i>Anomalocaris</i> -type	10.1	
P 57408	<i>Anomalocaris</i> -type	11.4	
P 57421	Acute zone-type	11.2	Figure 1D (herein)
P 51334	Acute zone-type	11.5	

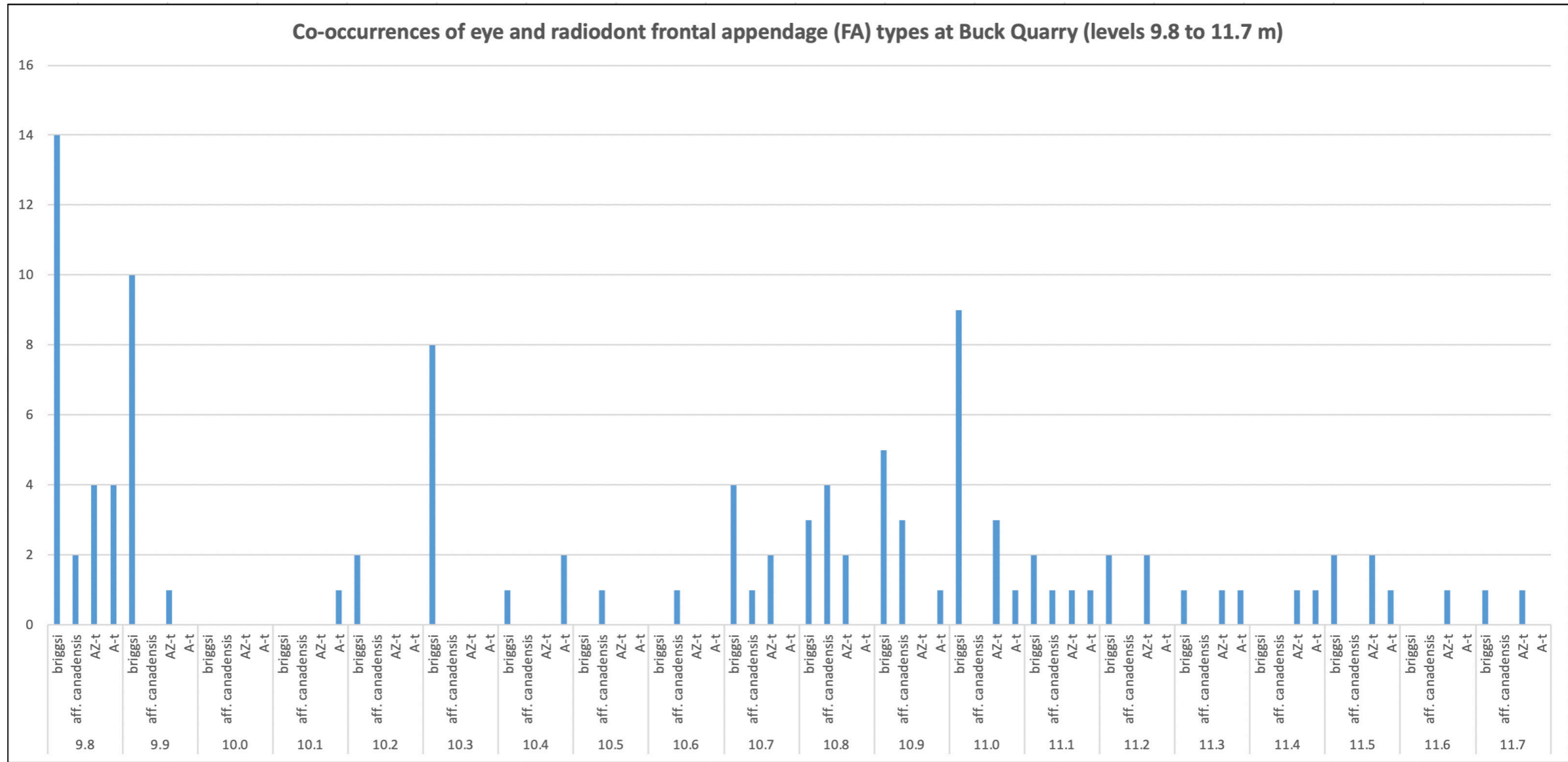
Table S4. Emu Bay Shale radiodont frontal appendage data.

SAM P number	Radiodont species	Description	Buck Quarry level (m)
P 15003	<i>briggsi</i>	frontal appendage	10.2
P 15165	<i>briggsi</i>	frontal appendage	9.9
P 15338	<i>briggsi</i>	frontal appendage	10.7
P 15375	<i>briggsi</i>	frontal appendage	11.3
P 43508	<i>briggsi</i>	frontal appendage	9.8
P 43616	<i>aff. canadensis</i>	frontal appendage	10.8
P 43641	<i>briggsi</i>	frontal appendage	9.8
P 43661	<i>briggsi</i>	frontal appendage	10.3
P 43724	<i>briggsi</i>	frontal appendage	9.8
P 44367	<i>briggsi</i>	frontal appendage	11.7
P 45231	<i>briggsi</i>	frontal appendage	11.0
P 45232	<i>briggsi</i>	frontal appendage	10.3
P 45385	<i>briggsi</i>	frontal appendage (associated w/P 45386)	11.0
P 45386	<i>briggsi</i>	frontal appendage (associated w/P 45385)	11.0
P 45632	<i>briggsi</i>	frontal appendage	11.5
P 45633	<i>briggsi</i>	frontal appendage	9.8
P 45749	<i>aff. canadensis</i>	frontal appendage	10.6
P 46161	<i>briggsi</i>	frontal appendage	9.7
P 46169	<i>briggsi</i>	frontal appendage	11.0
P 46274	<i>briggsi</i>	frontal appendage	10.8
P 46925	<i>briggsi</i>	frontal appendage	10.7
P 46948	<i>briggsi</i>	frontal appendage	10.9
P 46984	<i>briggsi</i>	frontal appendage	10.3
P 46989	<i>briggsi</i>	frontal appendage	10.3
P 47020	<i>briggsi</i>	frontal appendage	10.4
P 47035	<i>briggsi</i>	frontal appendage	10.8
P 47165	<i>briggsi</i>	frontal appendage	10.3
P 48107	<i>briggsi</i>	frontal appendage	10.2
P 48158	<i>aff. canadensis</i>	frontal appendage	10.5
P 48159	<i>briggsi</i>	frontal appendage	9.9
P 48160	<i>briggsi</i>	frontal appendage	10.3
P 48162	<i>briggsi</i>	frontal appendage	10.7
P 48163	<i>briggsi</i>	frontal appendage	10.3
P 48164	<i>aff. canadensis</i>	frontal appendage	10.9
P 48167	<i>briggsi</i>	frontal appendage	9.8
P 48309	<i>briggsi</i>	frontal appendage	9.8
P 48371	<i>briggsi</i>	frontal appendage	10.9
P 48384	<i>aff. canadensis</i>	frontal appendage	10.8
P 48390	<i>briggsi</i>	frontal appendage	9.9
P 48961	<i>briggsi</i>	frontal appendage	9.9
P 48975	<i>briggsi</i>	frontal appendage	10.9
P 48986	<i>briggsi</i>	frontal appendage	10.8
P 49109	<i>briggsi</i>	frontal appendage	9.9
P 49110	<i>briggsi</i>	frontal appendage	9.9
P 49119	<i>briggsi</i>	frontal appendage	9.8
P 49127	<i>aff. canadensis</i>	frontal appendage	10.8
P 49140	<i>briggsi</i>	frontal appendage	9.8
P 49151	<i>briggsi</i>	frontal appendage	9.8
P 49154	<i>briggsi</i>	paired frontal appendage associated w/P 49155	9.9
P 49155	<i>briggsi</i>	paired frontal appendage associated w/P 49154	9.9

SAM P number	Radiodont species	Description	Buck Quarry level (m)
P 49162	<i>briggsi</i>	frontal appendage	9.9
P 49673	<i>briggsi</i>	frontal appendage	9.8
P 49683	<i>briggsi</i>	frontal appendage	9.6
P 49687	<i>aff. canadensis</i>	frontal appendage	10.7
P 49688	<i>briggsi</i>	frontal appendage	9.7
P 49718	<i>briggsi</i>	frontal appendage	9.8
P 50360	<i>briggsi</i>	frontal appendage	11.0
P 51374	<i>briggsi</i>	frontal appendage	9.7
P 51398	<i>aff. canadensis</i>	pair of frontal appendages w/oral cone	10.9
P 51398	<i>aff. canadensis</i>	[second entry to account for 2nd FA]	10.9
P 52730	<i>briggsi</i>	frontal appendage	11.1
P 52771	<i>aff. canadensis</i>	frontal appendage	11.1
P 52782	<i>briggsi</i>	frontal appendage	11.0
P 52815	<i>briggsi</i>	frontal appendage	11.2
P 52886	<i>briggsi</i>	frontal appendage	11.0
P 52896	<i>briggsi</i>	frontal appendage	10.9
P 53798	<i>briggsi</i>	frontal appendage	10.9
P 53805	<i>briggsi</i>	frontal appendage	11.0
P 54214	<i>briggsi</i>	frontal appendage	11.5
P 54530	<i>briggsi</i>	frontal appendage	9.9
P 54535	<i>briggsi</i>	frontal appendage	11.1
P 54790	<i>briggsi</i>	frontal appendage	11.0
P 54835	<i>briggsi</i>	frontal appendage	9.8
P 54844	<i>aff. canadensis</i>	pair of frontal appendages w/oral cone	9.8
P 54844	<i>aff. canadensis</i>	[second entry to account for 2nd FA]	9.8
P 54876	<i>briggsi</i>	frontal appendage	10.7
P 54916	<i>briggsi</i>	frontal appendage	9.8
P 54930	<i>briggsi</i>	frontal appendage	9.8
P 54933	<i>briggsi</i>	frontal appendage	10.3
P 54959	<i>briggsi</i>	frontal appendage	11.2
P 55619	<i>aff. canadensis</i>	frontal appendage	10.8

Table S5. Emu Bay Shale eye and radiodont frontal appendage co-occurrence data.

BQ level (m)	FA & eye types	Count
9.8	<i>briggsi</i>	14
	<i>aff. canadensis</i>	2
	AZ-t	4
	A-t	4
9.9	<i>briggsi</i>	10
	<i>aff. canadensis</i>	0
	AZ-t	1
	A-t	0
10.0	<i>briggsi</i>	0
	<i>aff. canadensis</i>	0
	AZ-t	0
	A-t	0
10.1	<i>briggsi</i>	0
	<i>aff. canadensis</i>	0
	AZ-t	0
	A-t	1
10.2	<i>briggsi</i>	2
	<i>aff. canadensis</i>	0
	AZ-t	0
	A-t	0
10.3	<i>briggsi</i>	8
	<i>aff. canadensis</i>	0
	AZ-t	0
	A-t	0
10.4	<i>briggsi</i>	1
	<i>aff. canadensis</i>	0
	AZ-t	0
	A-t	2
10.5	<i>briggsi</i>	0
	<i>aff. canadensis</i>	1
	AZ-t	0
	A-t	0
10.6	<i>briggsi</i>	0
	<i>aff. canadensis</i>	1
	AZ-t	0
	A-t	0
10.7	<i>briggsi</i>	4
	<i>aff. canadensis</i>	1
	AZ-t	2
	A-t	0
10.8	<i>briggsi</i>	3
	<i>aff. canadensis</i>	4
	AZ-t	2
	A-t	0
10.9	<i>briggsi</i>	5
	<i>aff. canadensis</i>	3
	AZ-t	0
	A-t	1



BQ level (m)	FA & eye types	Count
11.0	<i>briggsi</i>	9
	<i>aff. canadensis</i>	0
	AZ-t	3
	A-t	1
11.1	<i>briggsi</i>	2
	<i>aff. canadensis</i>	1
	AZ-t	1
	A-t	1
11.2	<i>briggsi</i>	2
	<i>aff. canadensis</i>	0
	AZ-t	2
	A-t	0
11.3	<i>briggsi</i>	1
	<i>aff. canadensis</i>	0
	AZ-t	1
	A-t	1

BQ level (m)	FA & eye types	Count
11.4	<i>briggsi</i>	0
	<i>aff. canadensis</i>	0
	AZ-t	1
	A-t	1
11.5	<i>briggsi</i>	2
	<i>aff. canadensis</i>	0
	AZ-t	2
	A-t	1
11.6	<i>briggsi</i>	0
	<i>aff. canadensis</i>	0
	AZ-t	1
	A-t	0
11.7	<i>briggsi</i>	1
	<i>aff. canadensis</i>	0
	AZ-t	1
	A-t	0

Abbreviations: AZ-t = Acute zone-type eye
A-t = *Anomalocaris*-type eye

Note: A single frontal appendage or eye is counted as one specimen, even if it is preserved as part of an associated pair.

Table S6. 2-sample tests for equality of proportions between Emu Bay Shale radiodont frontal appendages and eye types.

Tests were performed using the prop.test() function from the R 'stats' package.

Assuming the two radiodont frontal appendage types are associated with the two eye types, the proportions of the appendage types and eye types should be approximately equal (assuming consistent preservation between taxa). There are two hypotheses: (A) '*Anomalocaris briggsi*'/total appendages = Acute zone-type (AZ-t)/total eyes; and (B) '*Anomalocaris briggsi*'/total appendages = *Anomalocaris* -type (A-t)/total eyes. The outputs below are modified from the output of the prop.test() function.

Results: In both cases, the proportions are shown to be unequal. However, in (B) the difference is much greater than in (A), and the extremely low p-value suggests that we can discount (B) as a possible association.

(A) 2-sample test for equality of proportions ('*Anomalocaris briggsi*'/total appendages = AZ-t/total eyes)

```
Data: c(68, 21) out of c(81, 34)
X-squared = 6.7368, df = 1, p-value = 0.009444
Alternative hypothesis: two-sided
Sample estimates:
prop 1    prop 2
0.839506 0.617647
```

(B) 2-sample test for equality of proportions ('*Anomalocaris briggsi*'/total appendages = A-t/total eyes)

```
Data: c(68, 13) out of c(81, 34)
X-squared = 24.034, df = 1, p-value = 9.466e-07
Alternative hypothesis: two-sided
Sample estimates:
prop 1    prop 2
0.839506 0.382353
```