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Supplementary material

Size, depth and position affect the diversity and structure of rock pool communities in an urban estuary

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Table S1. Salinity and temperature measurements from Sydney Harbour at the four sites on each sampling event (B, Balmain; BIR, Berry Island Reserve; BH, Bradleys Head; D, Delwood; S1-S8, sampling event 1–8)

Air temperatures were rounded ranges in daily maxima during the sampling periods acquired from weather station 066196 (Wedding Cake West) from the Bureau of Meteorology, Australia

	Salinity				Water temperature (°C)				Air temperature (°C)
	Inner Zone		Outer Zone		Inner Zone		Outer Zone		Sydney
	B	BIR	BH	D	B	BIR	BH	D	Wedding Cake West
S1	33	34	34	34	18	22	18	18	17–19
S2	34	34	34	35	14	17	14	16	17–19
S3	34	34	34	35	17	17	17	18	17–20
S4	35	35	35	35	23	22	22	20	19–26
S5	34	34	35	35	23	23	23	22	22–27
S6	30	30	33	34	26	26	23	23	25–30
S7	34	34	32	35	24	24	21	22	21–27
S8	36	35	35	35	21	22	21	20	22–25

Table S2. Size ranges of pools within each zone

Width (mm)	100–249	250–399	400–549	550–699
Inner	6	9	8	1
Outer	5	7	7	3
Depth (mm)	0–39	40–79	80–119	120–159
Inner	5	9	9	1
Outer	3	16	3	0
Volume (L)	0–3.74	3.75–7.49	7.5–11.24	11.25–14.75
Inner	20	3	1	0
Outer	17	2	1	2
Height on shore (m)	0.8–0.94	0.95–1.09	1.1–1.24	1.25–1.39
Inner	1	14	8	1
Outer	5	13	2	2

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Table S3. Number of quadrats assessed per rock pool at each site

Asterisks indicate rock pools only used in analyses for taxa richness. NA, no quadrat assessed

Balmain		Berry Island		Bradleys Head		Delwood	
Pool	Number of quadrats	Pool	Number of quadrats	Pool	Number of quadrats	Pool	Number of quadrats
B_8	2	BIR_3	2	BH_3	4	D_2	6
B_CBP1	3	BIR_CBP3	4	BH_4	2	D_CBP4	6
B_CBP8	2	BIR_CBP6	2	BH_5	4	D_CBP7	2
B_FC	4	BIR_CBR6	3	BH_R12	5	D_CBR8	6
B_FCP1	3	BIR_DFP8	3	BH_R13	4	D_FCP7	3
B_FCP3	4	BIR_FC	2	BH_WR8	2	D_R3	3
B_FCP4	2	BIR_R2	4	BH_11*	NA	D_R6	4
B_FCP8	4	BIR_R11	2	BH_47*	NA	D_R15	4
B_R4	4	BIR_WP	5	BH_DFP12*	NA	D_WP	3
B_R13	3	BIR_WR3	4			D_WR5	3
B_FCP5*	NA	BIR_WR9	4			D_WP3	4
		BIR_FC1	3			D_WP4	3
		BIR_CBR5*	NA			D_CBP11*	NA

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Table S4. Mean and standard error (SE) of sessile and mobile taxa richness at the four sites on each sampling event (B, Balmain; BIR, Berry Island; BH, Bradleys Head; D, Delwood; S1-S8, sampling event 1–8)

Sessile taxa	B		BIR		BH		D	
	Mean	s.e.	Mean	s.e.	Mean	s.e.	Mean	s.e.
S1	8.1	0.5	6.7	0.4	8.8	1.4	10.5	1.0
S2	8.6	0.6	6.5	0.4	9.1	1.1	10.5	0.6
S3	7.3	0.5	7.2	0.3	9.3	1.3	10.5	1.0
S4	8.4	0.7	6.5	0.3	9.1	1.0	11.2	1.0
S5	7.3	0.3	5.5	0.4	8.2	1.0	8.3	0.8
S6	6.5	0.5	5.8	0.3	8.3	1.2	8.7	0.9
S7	7.1	0.4	5.9	0.4	6.9	1.3	9.4	0.7
S8	6.9	0.3	6.1	0.4	7.3	1.3	8.8	0.8
Mobile taxa	B		BIR		BH		D	
S1	3.5	0.3	4.7	0.2	5.9	1.2	7.4	0.4
S2	3.7	0.3	4.6	0.3	5.0	0.7	6.8	0.5
S3	3.6	0.4	5.1	0.3	5.2	0.7	7.5	0.5
S4	4.0	0.2	4.7	0.2	6.3	1.0	8.4	0.3
S5	3.3	0.2	4.6	0.3	5.1	0.8	6.9	0.4
S6	2.7	0.3	3.8	0.3	5.4	0.6	7.3	0.4
S7	3.3	0.3	5.0	0.3	4.4	0.6	6.2	0.5
S8	3.5	0.2	4.5	0.2	4.2	0.8	6.4	0.5

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Table S5. Presence (1) or absence (0) of sessile taxa collected in rock pools in the inner or outer zone in each season

	Inner Zone				Outer Zone			
Taxon	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn
Corallina spp.	1	1	1	1	1	1	1	1
Non-geniculate *Corallina*[B]	0	0	0	0	1	1	1	1
Red fuzz	1	1	1	1	1	1	1	1
Hormosira banksii[B]	0	0	0	0	1	1	1	1
Sargassum spp.[B]	0	0	0	0	1	1	1	1
Petalonia spp.	1	1	0	0	1	1	0	0
Colpomenia spp.[B]	0	0	0	0	1	1	0	0
Dictyota spp.[B]	0	0	0	0	1	1	0	0
Padina spp.[B]	0	0	0	0	0	0	1	0
Codium spp.[B]	0	0	0	0	0	1	1	1
Ulva spp.	1	1	1	1	1	1	1	1
Turfing	1	1	1	1	1	1	1	1
Ralfsia spp.[B]	0	0	0	0	1	1	1	1
Encrusting coralline[B]	0	0	0	0	1	1	1	1
Amorphous crust	1	1	1	1	1	1	1	1
Oulactis muscosa	1	1	0	1	1	1	1	1
Actinia tenebrosa[B]	0	0	0	0	1	1	1	1
White anemone[B]	0	0	0	0	1	1	0	0
Yellow anemone[A]	1	1	0	0	0	0	0	0
Balanus trigonus	0	1	0	0	1	1	0	0
Tetraclitella purpurascens[B]	0	0	0	0	1	1	1	1
Amphibalanus variegatus[A]	1	1	1	0	0	0	0	0
Austrobalanus imperator[B]	0	0	0	0	1	1	1	1
Megabalanus coccopoma[B]	0	0	0	0	0	1	0	0
Other barnacles	1	1	1	1	1	1	1	1
Oysters	1	1	1	1	1	1	1	1
Mussels	1	1	1	1	1	1	0	1
Galeolaria caespitosa	1	0	0	1	1	1	1	1
Spirorbid polychaetes[B]	0	0	0	0	1	1	1	1
Hydroides[A]	1	0	0	1	0	0	0	0
Polychaete species a[B]	0	0	0	0	1	1	1	1
Watersipora spp.[B]	0	0	0	0	1	1	1	1
Cryptosula pallasiana[B]	0	0	0	0	0	1	1	1
Ascidian a[B]	0	0	0	0	1	1	1	0
Ascidian b	0	0	0	1	1	0	0	0
Sponges	0	1	0	1	1	1	1	1

[A]Taxa unique to the inner zone.

[B]Taxa unique to the outer zone.

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Table S6. Presence (1) or absence (0) of mobile taxa collected in rock pools in the inner or outer zone in each season

	Inner Zone				Outer Zone			
Taxon	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn
Bembicium nanum	1	1	1	1	1	1	1	1
Bembicium auratum[A]	1	1	1	1	0	0	0	0
Austrocochlea porcata	1	1	1	1	1	1	1	1
Nerita atramentosa[B]	0	0	0	0	1	1	1	1
Austrolittorina unifasciata[B]	0	0	0	0	1	1	1	0
Afrolittorina acutispira[B]	0	0	0	0	0	1	1	1
Gastropod species a[B]	0	0	0	0	0	1	0	0
Onchidium daemelli	0	0	0	1	1	0	0	0
Nudibranchia species a[B]	0	0	0	0	0	1	0	0
Elysia species a[A]	1	0	0	1	0	0	0	0
Elysia species b[B]	0	0	0	0	0	0	0	1
Cellana tramoserica	1	0	1	0	1	1	1	1
Montfortula rugosa	1	0	0	1	1	1	1	1
Patelloida spp.	1	1	1	1	1	1	1	1
Notoacmea spp.	1	0	0	0	0	1	0	0
Siphonaria spp.	1	1	1	1	1	1	1	0
Tenguella marginalba	1	0	0	1	1	1	1	1
Gastropod species b[B]	0	0	0	0	0	1	0	0
Sypharochiton pelliserpentes	0	0	0	1	1	1	1	1
Acantochiton spp.[B]	0	0	0	0	1	1	1	1
Ischnochiton spp.[B]	0	0	0	0	1	1	0	0
Parvulastra exigua	0	0	0	1	1	1	1	1
Brittlestar[B]	0	0	0	0	0	1	0	1
Platyhelminthes[B]	0	0	0	0	1	0	1	0
Gammaridae[B]	0	0	0	0	0	1	1	1
Crab	1	1	1	1	1	1	1	1
Shrimp	0	1	0	0	0	1	1	0
Fish	1	1	1	1	1	1	0	0
Jellyfish	0	1	0	0	0	0	0	0
Ctenophora[A]	0	0	0	0	0	0	1	0

[A]Taxa unique to the inner zone.

[B]Taxa unique to the outer zone.

Table S7. PERMANOVA results for differences in the structure of sessile and mobile assemblages

Analyses used Bray–Curtis similarities from square root transformed data, with significance determined from 9999 permutations of the data under a reduced model (*, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.001$). Abbreviations: maxW, maximum Width; maxD, maximum Depth; Vo, Volume; Zo, Zone; Si, Site; Sa, Sampling Event; Res, Residuals

	Sessile assemblages			Mobile assemblages		
Source	d.f.	Pseudo-*F*	*P*(perm)	d.f.	Pseudo-*F*	*P*(perm)
maxW	1	29.598	0.001***	1	17.369	0.0001***
maxD	1	4.5497	0.0019**	1	2.0653	0.0975
Vo	1	2.041	0.1071	1	1.3362	0.2528
Zo	1	6.82	0.0067**	1	3.1962	0.0628
Sa	7	1.9065	0.0201	7	2.0279	0.0081
Si(Zo)	2	30.37	0.0001***	2	52.413	0.0001***
Zo × Sa	7	1.7474	0.0362*	7	1.3625	0.1657*
Si(Zo) × Sa	14	0.79391	0.85	14	0.53199	0.9966
Res	269			285		

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Table S8. Results of SIMPER analysis for dissimilarities between zones for sessile taxa and debris, sand and bare rock

Taxon	Group Inner Av.Abund	Group Outer Av.Abund	Av.Diss	Diss/s.d.	Contrib%	Cum.%
Ralfsia spp.	0.94	5.37	4.7	3.05	19.06	19.06
Corallina spp.	4.05	1.12	3.18	1.66	12.9	31.96
Bare rock	3.62	4.35	2.15	1.44	8.73	40.69
Live oyster.	2.75	1.13	1.89	1.4	7.67	48.36
Turfing	2.43	1.63	1.85	0.98	7.49	55.85
Dead oyster.	2.63	1.01	1.77	1.46	7.18	63.03
Watersipora spp.	0.94	1.83	1.05	0.68	4.25	67.28
Galeolaria caespitosa	0.94	1.76	0.95	1.01	3.85	71.13
Debris	1.64	1.02	0.88	0.81	3.57	74.7
Unknown	0.94	1.63	0.8	0.93	3.26	77.96
Amorphus crust	1.33	1.03	0.6	0.7	2.45	80.41
Sand	1.13	0.9	0.34	0.49	1.37	81.78
Austrobalanus imperator	0.94	1.13	0.33	0.77	1.33	83.11
Non-geniculate *Corallina*	0.94	1.06	0.31	0.58	1.25	84.36
Red.fuzz	1.07	0.93	0.29	0.6	1.17	85.54
Ulva	1.01	0.99	0.26	0.77	1.04	86.57
Sponges	0.94	1.03	0.25	0.64	1.03	87.6
Other barnacles	0.98	0.97	0.24	0.66	0.98	88.58
Actinia tenebrosa	0.94	1.04	0.24	0.82	0.97	89.54
Encrusting coralline	0.94	0.94	0.18	0.66	0.73	90.28
Colpomenia spp.	0.94	0.93	0.17	0.68	0.7	90.98
Oulactis muscosa	0.94	0.93	0.17	0.91	0.69	91.67
Mussels	0.98	0.87	0.16	0.89	0.67	92.33
Petalonia spp.	0.95	0.87	0.13	1.12	0.54	92.88
White anemone	0.94	0.88	0.13	1.11	0.53	93.41
Ascidian a	0.94	0.87	0.13	1.15	0.52	93.93
Dictyota spp.	0.94	0.87	0.13	1.22	0.51	94.45
Polychaete species a	0.94	0.87	0.13	1.24	0.51	94.96
Padina spp.	0.94	0.87	0.12	1.25	0.5	95.46
Yellow anemone	0.94	0.87	0.12	1.25	0.5	95.96
Balanus trigonus	0.94	0.87	0.12	1.25	0.5	96.47
Tetraclitella purpurascens	0.94	0.87	0.12	1.25	0.5	96.97
Amphibalanus variegatus	0.94	0.87	0.12	1.25	0.5	97.48
Megabalanus coccopoma	0.94	0.87	0.12	1.25	0.5	97.98
Spirorbid polychaetes	0.94	0.87	0.12	1.25	0.5	98.49
Hydroides	0.94	0.87	0.12	1.25	0.5	98.99
Cryptosula pallasiana	0.94	0.87	0.12	1.25	0.5	99.5
Ascidian b	0.94	0.87	0.12	1.25	0.5	100

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Table S9. Results of SIMPER analysis for dissimilarities between zones for mobile taxa

Taxon	Group Inner Av.Abund	Group Outer Av.Abund	Av.Diss	Diss/s.d.	Contrib%	Cum.%
Bembicium nanum	1.65	3.26	1.55	1.13	13.35	13.35
Patelloida spp.	3.1	1.51	1.47	1.47	12.68	26.03
Bembicium auratum	2.99	1.49	1.39	1.27	11.99	38.02
Austrocochlea porcata	1.8	2.57	0.94	1.15	8.1	46.12
Parvulastra exigua	1.59	2.05	0.55	0.99	4.72	50.84
Tenguella marginalba	1.56	2.01	0.51	1	4.38	55.22
Montfortula rugosa	1.56	2	0.49	0.9	4.2	59.41
Siphonaria spp.	1.88	1.52	0.41	0.88	3.52	62.93
Nerita atramentosa	1.56	1.82	0.35	0.64	3.03	65.96
Cellana tramoserica	1.57	1.68	0.27	1.02	2.28	68.24
Sypharochiton pelliserpentes	1.56	1.64	0.23	1.07	1.97	70.21
Acantochiton spp.	1.56	1.54	0.17	1.22	1.51	71.72
Austrolittorina unifasciata	1.56	1.52	0.17	0.81	1.5	73.22
Crab	1.58	1.49	0.17	1.08	1.43	74.66
Brittlestar	1.56	1.49	0.16	1.23	1.36	76.02
Afrolittorina acutispira	1.56	1.49	0.15	1.25	1.33	77.35
Nodlittorina pyramidalis	1.56	1.49	0.15	1.25	1.33	78.68
Cerinthium corallium	1.56	1.49	0.15	1.25	1.33	80.02
Gastropod species a	1.56	1.49	0.15	1.25	1.33	81.35
Gastropod species b	1.56	1.49	0.15	1.25	1.33	82.68
Gastropod species c	1.56	1.49	0.15	1.25	1.33	84.01
Onchidium daemelli	1.56	1.49	0.15	1.25	1.33	85.34
Nudibranchia species a	1.56	1.49	0.15	1.25	1.33	86.68
Elysia species a	1.56	1.49	0.15	1.25	1.33	88.01
Elysia species b	1.56	1.49	0.15	1.25	1.33	89.34
Notoacmea spp.	1.56	1.49	0.15	1.25	1.33	90.67
Ischnochiton spp.	1.56	1.49	0.15	1.25	1.33	92.01
Platyhelminthes	1.56	1.49	0.15	1.25	1.33	93.34
Gammaridae	1.56	1.49	0.15	1.25	1.33	94.67
Shrimp	1.56	1.49	0.15	1.25	1.33	96
Fish	1.56	1.49	0.15	1.25	1.33	97.34
Jellyfish	1.56	1.49	0.15	1.25	1.33	98.67
Ctenophora	1.56	1.49	0.15	1.25	1.33	100

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Table S10. Model selection table using GLMMs to predict the total number of sessile and mobile taxa, total cover of sessile taxa and the total abundance of mobile taxa in both zones

Xs denote variables used in each model. Lower AIC values indicate higher support for the model. The best model is highlighted in bold. Abbreviations: W, width; D, depth; V, volume; H, height on shore; Z, zone

Model	W	D	V	H	Z	Z*W	Z*D	Z*V	Z*H	AIC	ΔAIC
Sessile taxa richness											
M1	X			X	X	X			X	1517.8	0.0
M2	X	X		X	X	X	X		X	1518.3	0.5
M3	X	X		X	X	X			X	1519.4	1.6
M4	**X**			X	**X**	**X**				**1519.5**	**1.8**
M5	X	X	X	X	X	X	X		X	1519.9	2.1
M6	X	X	X	X	X	X	X	X	X	1521.8	4.1
Mobile taxa richness											
M1	**X**	**X**	**X**		**X**		**X**			**1365.4**	**0.0**
M2	X	X	X	X	X		X			1366.5	1.0
M3	X	X	X	X	X		X	X		1367.2	1.8
M4	X	X	X	X	X		X	X	X	1367.9	2.4
M5	X	X	X	X	X	X	X	X	X	1369.9	4.4
Total cover of sessile taxa											
M1		X	X	X	X				X	3849.6	0.0
M2		**X**		**X**	**X**				**X**	**3850.3**	**0.7**
M3		X	X	X	X		X		X	3850.8	1.2
M4	X	X	X	X	X		X		X	3852.8	3.2
M5	X	X	X	X	X		X	X	X	3854.8	5.2
M6	X	X	X	X	X	X	X	X	X	3856.8	7.2
Total abundance of mobile taxa											
M1	**X**		**X**	**X**	**X**			**X**		**1928.7**	**0.0**
M2	X		X	X	X			X	X	1929.7	1.0
M3	X	X	X	X	X			X	X	1931.6	2.9
M4	X	X	X	X	X		X	X	X	1933.1	4.4
M5	X	X	X	X	X	X	X	X	X	1935.1	6.4

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Table S11. Model selection table using GLMMs to predict the total number of sessile and mobile taxa, the total cover of sessile taxa, and the total abundance of mobile taxa in the outer zone only with canopy cover as an additional predictor

Xs denote variables used in each model. Lower AIC values indicate higher support for the model. The best model is highlighted in bold. Abbreviations: W, width; D, depth; V, volume; H, height on shore; C, canopy cover

Model	W	D	V	H	C	AIC	ΔAIC
Sessile taxa richness							
M1	**X**			**X**		**793.1**	**0.0**
M2	X	X		X	X	793.3	0.3
M3	X			X	X	793.7	0.7
M4	X	X	X	X	X	795.1	2.1
Mobile taxa richness							
M1	X	X	X			723.8	0.0
M2	X	X	X	X		725.4	1.6
M3		**X**	**X**			**725.5**	**1.7**
M4	X	X	X	X	X	727.3	3.6
Total cover of sessile taxa							
M1						**260.1**	**0**
M2					X	260.9	0.8
M3	X				X	262.5	2.4
M4	X	X			X	264.4	4.3
M5	X	X		X	X	266.3	6.2
M6	X	X	X	X	X	268.3	8.2
Total abundance of mobile taxa							
M1	X	X		X	X	887.6	0.0
M2	**X**			**X**	**X**	**888.8**	**1.2**
M3	X	X	X	X	X	889.5	1.9

Table S12. Model selection table using GLMMs to predict canopy cover in the outer zone only

Xs denote variables used in each model. Lower AIC values indicate higher support for the model. The best model is highlighted in bold. Abbreviations: W, width; D, depth; V, volume; Si, site; Se, season; H, height on shore; C, canopy cover

Model	W	D	V	H	AIC	ΔAIC
Canopy cover						
M1				**X**	**1628.4**	**0.0**
M2			X	X	1628.9	0.5
M3		X	X	X	1630.8	2.4
M4	X	X	X	X	1632.8	4.4