

## Supplementary materials

**Table S1.** Brief characteristics of the sampling sites in three urban parks (BA – Baoan, NS – Nanshan, YAL – Yanziling).

Park	Slope position	Crown position	Latitude (°N)	Longitude (°E)	Altitude (m)
BA	Summit	CC	22.589	113.898	113
BA	Summit	MC	22.589	113.898	113
BA	Summit	EC	22.589	113.898	113
BA	Summit	CC	22.589	113.898	113
BA	Summit	MC	22.589	113.898	113
BA	Summit	EC	22.589	113.898	113
BA	Summit	CC	22.590	113.898	117
BA	Summit	MC	22.590	113.898	117
BA	Summit	EC	22.590	113.898	117
BA	Slope	CC	22.589	113.899	91
BA	Slope	MC	22.589	113.899	91
BA	Slope	EC	22.589	113.899	91
BA	Slope	CC	22.589	113.899	83
BA	Slope	MC	22.589	113.899	83
BA	Slope	EC	22.589	113.899	83
BA	Slope	CC	22.589	113.899	83
BA	Slope	MC	22.589	113.899	83
BA	Slope	EC	22.589	113.899	83
BA	Foot	CC	22.588	113.900	71
BA	Foot	MC	22.588	113.900	71
BA	Foot	EC	22.588	113.900	71
BA	Foot	CC	22.588	113.900	71
BA	Foot	MC	22.588	113.900	71
BA	Foot	EC	22.588	113.900	71
BA	Foot	CC	22.588	113.900	71
BA	Foot	MC	22.588	113.900	71
BA	Foot	EC	22.588	113.900	71
NS	Summit	CC	22.501	113.904	312
NS	Summit	MC	22.501	113.904	312
NS	Summit	EC	22.501	113.904	312
NS	Summit	CC	22.501	113.904	312
NS	Summit	MC	22.501	113.904	312
NS	Summit	EC	22.501	113.904	312

NS	Summit	CC	22.501	113.904	312
NS	Summit	MC	22.501	113.904	312
NS	Summit	EC	22.501	113.904	312
NS	Slope	CC	22.502	113.908	217
NS	Slope	MC	22.502	113.908	217
NS	Slope	EC	22.502	113.908	217
NS	Slope	CC	22.502	113.908	217
NS	Slope	MC	22.502	113.908	217
NS	Slope	EC	22.502	113.908	217
NS	Slope	CC	22.502	113.908	220
NS	Slope	MC	22.502	113.908	220
NS	Slope	EC	22.502	113.908	220
NS	Foot	CC	22.502	113.910	121
NS	Foot	MC	22.502	113.910	121
NS	Foot	EC	22.502	113.910	121
NS	Foot	CC	22.502	113.910	121
NS	Foot	MC	22.502	113.910	121
NS	Foot	EC	22.502	113.910	121
NS	Foot	CC	22.502	113.910	114
NS	Foot	MC	22.502	113.910	114
NS	Foot	EC	22.502	113.910	114
YZL	Summit	CC	22.702	114.355	111
YZL	Summit	MC	22.702	114.355	111
YZL	Summit	EC	22.702	114.355	111
YZL	Summit	CC	22.702	114.355	111
YZL	Summit	MC	22.702	114.355	111
YZL	Summit	EC	22.702	114.355	111
YZL	Summit	CC	22.702	114.355	106
YZL	Summit	MC	22.702	114.355	106
YZL	Summit	EC	22.702	114.355	106
YZL	Slope	CC	22.703	114.356	86
YZL	Slope	MC	22.703	114.356	86
YZL	Slope	EC	22.703	114.356	86
YZL	Slope	CC	22.704	114.356	86
YZL	Slope	MC	22.704	114.356	86
YZL	Slope	EC	22.704	114.356	86
YZL	Slope	CC	22.704	114.356	86
YZL	Slope	MC	22.704	114.356	86

YZL	Slope	EC	22.704	114.356	86
YZL	Foot	CC	22.705	114.356	45
YZL	Foot	MC	22.705	114.356	45
YZL	Foot	EC	22.705	114.356	45
YZL	Foot	CC	22.705	114.356	45
YZL	Foot	MC	22.705	114.356	45
YZL	Foot	EC	22.705	114.356	45
YZL	Foot	CC	22.705	114.356	45
YZL	Foot	MC	22.705	114.356	45
YZL	Foot	EC	22.705	114.356	45

**Table S2.** Species relative abundance (%) and occurrence (%) under three crown positions.

Species	Relative abundance (%)			Occurrence (%)		
	CC	MC	EC	CC	MC	EC
<i>Arcella rotundata</i>	1.02	0.39	0.26	40.74	37.04	24.00
<i>Centropyxis aerophila</i>	0.89	2.49	1.89	55.56	55.56	48.00
<i>Centropyxis constricta</i>	0.61	1.31	0.65	29.63	51.85	24.00
<i>Centropyxis elongata</i>	1.45	0.72	1.91	44.44	14.81	44.00
<i>Centropyxis minuta</i>	0.14	1.19	0.16	18.52	37.04	12.00
<i>Centropyxis orbicularis</i>	1.4	1.44	2.01	66.67	29.63	32.00
<i>Centropyxis platystoma</i>	1.89	3.17	2.43	74.07	62.96	32.00
<i>Centropyxis sphagnicola</i>	2.92	1.73	1.43	48.15	48.15	52.00
<i>Centropyxis sylvatica</i>	3.64	1.81	3.52	85.19	62.96	28.00
<i>Corythion delamarei</i>	0.56	1.05	0.84	33.33	29.63	28.00
<i>Corythion dubium</i>	3.32	1.84	1.08	74.07	37.04	32.00
<i>Cryptodiffugia oviformis</i>	0.21	0.7	0.32	11.11	33.33	16.00
<i>Cyclopyxis eurytoma</i>	2.74	4.13	0.67	51.85	74.07	28.00
<i>Cyclopyxis kahli</i>	0.67	0.31	1.22	29.63	14.81	32.00
<i>Diffugia lucida</i>	0.04	1.09	4.2	7.41	44.44	68.00
<i>Diffugia oblonga</i>	0.14	1.34	8.04	7.41	29.63	76.00
<i>Euglypha ciliata</i>	3.01	0.92	0.9	81.48	29.63	32.00
<i>Euglypha compressa</i>	2.99	1.91	1.24	81.48	51.85	40.00
<i>Euglypha denticulata</i>	0.89	1.85	3.1	33.33	44.44	64.00
<i>Euglypha filifera</i>	2.62	0.6	1.19	62.96	18.52	20.00
<i>Euglypha laevis</i>	0.98	1.08	1	33.33	33.33	16.00
<i>Euglypha rotunda</i>	3.02	1.62	1.24	85.19	33.33	24.00
<i>Euglypha simplex</i>	0.91	4.82	4.01	18.52	55.56	60.00
<i>Euglypha strigosa</i>	3.76	3.36	1.99	70.37	55.56	32.00
<i>Galeripora arenaria</i>	2.68	0.96	1.18	66.67	40.74	40.00
<i>Galeripora artocrea</i>	1.88	0.82	0.84	66.67	55.56	28.00
<i>Heleopera petricola</i>	4.09	1.72	0.54	100	40.74	24.00
<i>Heleopera sylvatica</i>	1.95	6.66	8.48	29.63	81.48	72.00

<i>Hyalosphenia subflava</i>	5.31	5.15	1.99	77.78	66.67	52.00
<i>Phryganella acropodia</i>	4	3.27	2.73	59.26	59.26	36.00
<i>Placocista glabra</i>	3.13	3.25	1.95	48.15	40.74	28.00
<i>Plagiopyxis callida</i>	3.33	4.91	6.31	88.89	66.67	80.00
<i>Plagiopyxis declivis</i>	3.85	2.67	0.95	48.15	62.96	24.00
<i>Pseudodiffugia compressa</i>	4.13	6.34	5.53	51.85	81.48	64.00
<i>Pseudodiffugia gracilis</i>	6.5	2.02	1.85	96.3	51.85	40.00
<i>Quadrullella symmetrica</i>	0.8	2.18	1.03	44.44	48.15	28.00
<i>Schoenbornia humicola</i>	0.13	1.3	0.83	11.11	44.44	16.00
<i>Trigonopyxis arcula</i>	5.48	2.06	2.08	92.59	51.85	36.00
<i>Trinema complanatum</i>	4.15	4.34	6.59	88.89	77.78	80.00
<i>Trinema enchelys</i>	5.3	6.27	6.68	85.19	88.89	80.00
<i>Trinema lineare</i>	1.6	3.37	5.05	55.56	66.67	56.00
<i>Trinema penardi</i>	1.88	1.84	0.1	66.67	48.15	8.00

Table S3. Species relative abundance (%) and occurrence (%) at three hillside positions.

Species	Relative abundance (%)			Occurrence (%)		
	Summit	Slope	Foot	Summit	Slope	Foot
<i>Arcella rotundata</i>	1.43	0.6	0.54	26.92	23.08	51.85
<i>Centropyxis aerophila</i>	1.29	2.36	1.39	34.62	57.69	66.67
<i>Centropyxis constricta</i>	1.63	1.42	0.48	34.62	46.15	25.93
<i>Centropyxis elongata</i>	1.23	1.51	1.22	30.77	34.62	37.04
<i>Centropyxis minuta</i>	1.04	0.49	0.4	34.62	23.08	11.11
<i>Centropyxis orbicularis</i>	1.26	1.08	1.79	30.77	38.46	59.26
<i>Centropyxis platystoma</i>	2.92	1.67	2.67	46.15	53.85	70.37
<i>Centropyxis sphagnicola</i>	1.96	1.67	2.48	34.62	34.62	77.78
<i>Centropyxis sylvatica</i>	2.41	2.53	3.31	46.15	65.38	66.67
<i>Corythion delamarei</i>	1.09	1.16	0.57	26.92	26.92	37.04
<i>Corythion dubium</i>	3.62	3.22	1.77	50	50	44.44
<i>Cryptodiffugia oviformis</i>	0.76	0.65	0.23	30.77	19.23	11.11
<i>Cyclopyxis eurystoma</i>	2.75	2.07	3.07	50	42.31	62.96
<i>Cyclopyxis kahli</i>	1.04	1.13	0.4	26.92	30.77	18.52
<i>Diffugia lucida</i>	1.01	0.94	1.45	34.62	26.92	55.56
<i>Diffugia oblonga</i>	1.54	1.28	2.71	30.77	34.62	44.44
<i>Euglypha ciliata</i>	2.02	2.82	1.43	50	57.69	37.04
<i>Euglypha compressa</i>	2.95	1.71	2.38	50	50	74.07
<i>Euglypha denticulata</i>	1.63	1.56	1.73	42.31	46.15	51.85
<i>Euglypha filifera</i>	2.16	2.02	1.4	34.62	38.46	29.63
<i>Euglypha laevis</i>	1.15	2.58	0.33	26.92	38.46	18.52
<i>Euglypha rotunda</i>	2.89	4.51	1.06	46.15	53.85	44.44
<i>Euglypha simplex</i>	0.84	2.67	3.31	34.62	42.31	55.56
<i>Euglypha strigosa</i>	4.66	2.63	3.28	57.69	34.62	66.67
<i>Galeripora arenaria</i>	1.35	1.03	2.19	38.46	34.62	74.07
<i>Galeripora artocrea</i>	1.04	1.17	1.41	34.62	34.62	81.48

<i>Heleopera petricola</i>	2.97	3	2.28	57.69	57.69	51.85
<i>Heleopera sylvatica</i>	3.79	2.95	5.92	50	53.85	77.78
<i>Hyalosphenia subflava</i>	3.23	4.09	4.99	53.85	65.38	77.78
<i>Phryganella acropodia</i>	3.03	3.94	3.37	46.15	50	59.26
<i>Placocista glabra</i>	4.29	4.18	2.14	42.31	46.15	29.63
<i>Plagiopyxis callida</i>	4.04	5.15	4.27	76.92	69.23	88.89
<i>Plagiopyxis declivis</i>	2.27	4.02	2.45	42.31	46.15	48.15
<i>Pseudodiffugia compressa</i>	3.98	3.06	6.27	50	57.69	88.89
<i>Pseudodiffugia gracilis</i>	4.52	3.34	4.23	50	61.54	77.78
<i>Quadrulella symmetrica</i>	2.08	1.58	1.06	42.31	46.15	33.33
<i>Schoenbornia humicola</i>	1.4	1.07	0.37	26.92	30.77	14.81
<i>Trigonopyxis arcula</i>	4.01	3.05	3.8	53.85	53.85	74.07
<i>Trinema complanatum</i>	3.98	3.05	5.57	80.77	65.38	100
<i>Trinema enchelys</i>	4.91	5.96	6.07	65.38	88.46	100
<i>Trinema lineare</i>	1.43	3.47	2.94	46.15	65.38	66.67
<i>Trinema penardi</i>	2.41	1.61	1.29	42.31	38.46	44.44

Table S4. Environmental characteristics of the samples.

Sample ID	Soil moisture (%)	pH	Thickness of leaf litter (cm)
BAPT-1-1	13.3	6.8	2
BAPT-1-2	12.3	6.8	1
BAPT-1-3	13.2	6.8	1
BAPT-2-1	11.5	6.9	1
BAPT-2-2	11.1	6.9	2
BAPT-2-3	13.2	6.8	2
BAPT-3-1	7.4	6.8	3
BAPT-3-2	7.7	6.9	0
BAPT-3-3	14.8	6.8	0
BAPM-1-1	9.4	6.9	4
BAPM-1-2	9.8	6.9	0.5
BAPM-1-3	11.1	6.9	0.5
BAPM-2-1	7.2	6.8	2
BAPM-2-2	8	6.7	2
BAPM-2-3	6.3	6.8	2
BAPM-3-1	6.6	6.9	3
BAPM-3-2	3.5	7	0
BAPM-3-3	3.6	7	0
BAPB-1-1	15.9	6.7	2
BAPB-1-2	12.7	6.7	2
BAPB-1-3	8	6.7	2
BAPB-2-1	7.5	6.9	3
BAPB-2-2	8.2	6.9	3
BAPB-2-3	11.3	6.8	2
BAPB-3-1	11.3	6.6	2
BAPB-3-2	8.9	6.7	2
BAPB-3-3	8.3	6.6	2

NSPT-1-1	5.7	7	1.5
NSPT-1-2	4	7	1.5
NSPT-1-3	7.7	7	1.5
NSPT-2-1	3.8	7	1.5
NSPT-2-2	3.6	7	1.5
NSPT-2-3	5.4	7	1.5
NSPT-3-1	5.8	6.9	3
NSPT-3-2	10	6.9	3
NSPT-3-3	7	7	3
NSPM-1-1	5.6	6.9	0
NSPM-1-2	4.3	6.9	0
NSPM-1-3	1.7	6.9	0
NSPM-2-1	3.6	6.9	1
NSPM-2-2	12.3	7	3
NSPM-2-3	8.5	6.9	1
NSPM-3-1	5.7	6.9	3
NSPM-3-2	8.6	6.9	3
NSPM-3-3	7.5	6.9	3
NSPB-1-1	8.3	6.9	3
NSPB-1-2	5.6	6.9	3
NSPB-1-3	8	6.9	3
NSPB-2-1	6.3	6.9	3
NSPB-2-2	4.3	6.9	3
NSPB-2-3	5.7	7	3
NSPB-3-1	5.7	6.9	0
NSPB-3-2	5.2	6.9	0
NSPB-3-3	16.3	6.9	0
YZLPT-1-1	17.6	6.9	1.5
YZLPT-1-2	14.3	7	1.5
YZLPT-1-3	11.3	7	1.5
YZLPT-2-1	15.7	6.9	1.5
YZLPT-2-2	15	6.9	1.5
YZLPT-2-3	18.2	6.9	1.5
YZLPT-3-1	9.3	6.9	3
YZLPT-3-2	12.2	7	2.5
YZLPT-3-3	14	6.9	3
YZLPM-1-1	6.3	6.9	5
YZLPM-1-2	5.9	7	5
YZLPM-1-3	6.3	6.9	5
YZLPM-2-1	5.8	6.9	0
YZLPM-2-2	6.6	6.9	0
YZLPM-2-3	6.9	6.9	0
YZLPM-3-1	7.5	6.9	0
YZLPM-3-2	5.2	6.9	0
YZLPM-3-3	7.8	7	0
YZLPB-1-1	8.2	6.9	2.5
YZLPB-1-2	17.5	7	2.5
YZLPB-1-3	10.7	6.9	2.5
YZLPB-2-1	11.1	6.9	2.5

YZLPB-2-2	11.4	6.9	1.5
YZLPB-2-3	7.3	7	1.5
YZLPB-3-1	11.1	6.9	3
YZLPB-3-2	9.3	6.9	3
YZLPB-3-3	8.8	6.9	4

Table S5. TA species functional traits.

Species	Pseudopod type	Aperture position
<i>Arcella rotundata</i>	Lobose	Axial
<i>Centropyxis aerophila</i>	Lobose	Plagiostomic
<i>Centropyxis constricta</i>	Lobose	Plagiostomic
<i>Centropyxis elongata</i>	Lobose	Plagiostomic
<i>Centropyxis minuta</i>	Lobose	Plagiostomic
<i>Centropyxis orbicularis</i>	Lobose	Plagiostomic
<i>Centropyxis platystoma</i>	Lobose	Plagiostomic
<i>Centropyxis sphagnicola</i>	Lobose	Plagiostomic
<i>Centropyxis sylvatica</i>	Lobose	Plagiostomic
<i>Corythion delamarei</i>	Filose	Plagiostomic
<i>Corythion dubium</i>	Filose	Plagiostomic
<i>Cryptodiffugia oviformis</i>	Lobose	Acrostomic
<i>Cyclopyxis eurystoma</i>	Lobose	Acrostomic
<i>Cyclopyxis kahli</i>	Lobose	Acrostomic
<i>Diffugia lucida</i>	Lobose	Acrostomic
<i>Diffugia oblonga</i>	Lobose	Acrostomic
<i>Euglypha ciliata</i>	Filose	Acrostomic
<i>Euglypha compressa</i>	Filose	Acrostomic
<i>Euglypha denticulata</i>	Filose	Acrostomic
<i>Euglypha filifera</i>	Filose	Acrostomic
<i>Euglypha laevis</i>	Filose	Acrostomic
<i>Euglypha rotunda</i>	Filose	Acrostomic
<i>Euglypha simplex</i>	Filose	Acrostomic
<i>Euglypha strigosa</i>	Filose	Acrostomic
<i>Galeripora arenaria</i>	Lobose	Axial
<i>Galeripora artocrea</i>	Lobose	Axial
<i>Heleopera petricola</i>	Lobose	Acrostomic
<i>Heleopera sylvatica</i>	Lobose	Acrostomic
<i>Hyalosphenia subflava</i>	Lobose	Acrostomic
<i>Phryganella acropodia</i>	Lobose	Acrostomic
<i>Placocista glabra</i>	Filose	Acrostomic
<i>Plagiopyxis callida</i>	Filose	Plagiostomic
<i>Plagiopyxis declivis</i>	Filose	Plagiostomic
<i>Pseudodiffugia compressa</i>	Filose	Acrostomic
<i>Pseudodiffugia gracilis</i>	Filose	Acrostomic
<i>Quadrullella symmetrica</i>	Lobose	Acrostomic
<i>Schoenbornia humicola</i>	Lobose	Acrostomic
<i>Trigonopyxis arcula</i>	Lobose	Axial
<i>Trinema complanatum</i>	Filose	Plagiostomic
<i>Trinema enchelys</i>	Filose	Plagiostomic
<i>Trinema lineare</i>	Filose	Plagiostomic

*Trinema penardi*

## Filose

## Plagiostomic

**Table S6.** Environmental characteristics (mean  $\pm$  SE) at the three crown positions (CC – center of the crown, MC – middle of the crown, EC – edge of the crown).

	CC	MC	EC	F value	P value
	N=27	N=27	N=25		P = 0.05
Soil moisture (%)	8.64 $\pm$ 0.71	8.80 $\pm$ 0.74	9.58 $\pm$ 0.74	0.47	0.628
pH	6.88 $\pm$ 0.02	6.90 $\pm$ 0.02	6.89 $\pm$ 0.02	0.56	0.573
The thickness of leaf litter (cm)	2.11 $\pm$ 0.24	1.78 $\pm$ 0.25	1.80 $\pm$ 0.27	0.55	0.577

**Table S7.** Environmental characteristics (mean  $\pm$  SE) at the three hillside positions

	Summit	Slope	Foot	F value	P value
	N = 26	N = 26	N = 27		P = 0.05
Soil moisture (%)	10.67 $\pm$ 0.85	6.92 $\pm$ 0.43	9.37 $\pm$ 0.65		0.002
pH	6.91 $\pm$ 0.02	6.90 $\pm$ 0.01	6.86 $\pm$ 0.02	3.20	0.046
The thickness of leaf litter (cm)	1.77 $\pm$ 0.17	1.65 $\pm$ 0.35	2.26 $\pm$ 0.19		0.073

**Table S8.** Pairwise PerMANOVA results for differences in TA assemblage composition at three crown positions.

	F value	R <sup>2</sup>	P value
			P = 0.05
CC vs MC	8.41	0.14	0.001
CC vs EC	13.24	0.21	0.001
MC vs EC	3.82	0.07	0.001

**Table S9.** The significance of RDA constraints.

	Variance	F value	P value
			P = 0.05
Moisture	0.005	0.87	0.581
pH	0.005	0.91	0.543
The thickness of leaf litter	0.008	1.35	0.137
Crown position	0.053	8.80	0.001
Slope position	0.014	2.34	0.006