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SUPPORTING INFORMATION

Dung beetle-megafauna trophic networks in Singapore's fragmented forests

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17 TABLE S1. Vegetation type, fragment size, isolation rank (1: most isolated to 5: least isolated), coordinates of grids, and megafauna species
 18 present in each study site.

Site name	Nature reserve	Vegetation type ^a	Size (ha) ^b	Isolation rank	Coordinates of grid (G)	Megafauna species ^c
BKE	Central Catchment Nature Reserve	Young secondary forest	14	3	G1: 1°21'27" N, 103°47'7" E G2: 1°21'35" N, 103°47'8" E	Dog, long-tailed macaque, Sunda pangolin, common palm civet, Sambar deer, wild boar, clouded monitor, water monitor
Bukit Batok	N.A.	Young secondary forest	38	1	G1: 1°21'4" N, 103°45'47" E G2: 1°21'8" N, 103°45'46" E	Dog, long-tailed macaque, Sunda pangolin, common palm civet, wild boar, clouded monitor
Bukit Timah	Bukit Timah Nature Reserve	Old secondary forest	145	2	G1: 1°21'17" N, 103°46'56" E G2: 1°21'28" N, 103°46'51" E	Dog, long-tailed macaque, Sunda pangolin, common palm civet, clouded monitor, water monitor
Chestnut	Central Catchment Nature Reserve	Old secondary forest	1,000 (inc. Nee Soon Swamp Forest)	5	G1: 1°22'39" N, 103°47'17" E G2: 1°22'43" N, 103°47'19" E	Dog, long-tailed macaque, Sunda pangolin, banded leaf monkey, Sambar deer, wild boar
MacRitchie	Central Catchment Nature Reserve	Old secondary forest	484	4	G1: 1°21'11" N, 103°48'44" E G2: 1°21'13" N, 103°48'47" E	Long-tailed macaque, Sunda pangolin, common palm civet, wild boar, clouded monitor

19 ^aObtained from Yee et al. 2011.

20 ^bObtained from Castelletta et al. 2005 and Nature Society (Singapore) 2013.

21 ^cBased on camera trap data. Obtained with permission from National Parks Board.

22 TABLE S2. Megafauna species, status for Singapore, and dietary group for dung used in this
 23 study.

Species	Singapore status	Dietary group
<i>Tapirus indicus</i> (Desmarest) Malayan tapir	Extinct	Herbivore
<i>Rusa unicolor</i> (Keer) Sambar deer	Extant	Herbivore
<i>Panthera tigris tigris</i> (Linnaeus) Malayan tiger	Extinct	Carnivore
<i>Malayopython reticulatus</i> (Schneider) Reticulated python	Extant	Carnivore
<i>Helarctos malayanus</i> (Raffles) Malayan sun bear	Extinct	Omnivore
<i>Paradoxurus hermaphroditus</i> (Pallas) Common palm civet	Extant	Omnivore

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25 TABLE S3. Number and species of dung beetles collected from each dung type in each study site. Dung type abbreviations: TP: Tapir, SD: Sambar deer, TG:
 26 Tiger, RP: Reticulated python, SB: Sun bear, PC: Common palm civet.

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Species	Sites																												Total		
	BKE						Bukit Batok						Bukit Timah						Chestnut						MacRitchie						
	TP	SD	TG	RP	SB	PC	TP	SD	TG	RP	SB	PC	TP	SD	TG	RP	SB	PC	TP	SD	TG	RP	SB	PC	TP	SD	TG	RP		SB	PC
<i>Catharsius molossus</i>	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	4
<i>Onthophagus angustatus</i>	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
<i>Onthophagus babirussa</i>	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
<i>Onthophagus crassicollis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
<i>Onthophagus leusermontis</i>	6	0	7	0	5	18	3	0	9	0	4	7	6	0	3	0	2	11	4	0	0	0	3	7	17	0	0	0	8	18	138
<i>Onthophagus</i> cf. <i>pacificus</i>	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
<i>Onthophagus semifex</i>	1	0	45	7	3	72	0	0	2	0	0	0	2	0	12	1	1	13	8	0	18	7	21	45	1	2	50	1	4	15	331
<i>Onthophagus rutilans</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	2	0	0	0	0	0	7
<i>Onthophagus pedator</i>	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	5
<i>Onthophagus</i> sp.1	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	6
<i>Onthophagus</i> sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	3
<i>Paragymnopleurus maurus</i>	18	0	4	0	7	2	0	0	0	0	0	0	5	0	2	0	0	1	17	0	0	0	1	2	1	0	0	0	0	0	60
Individuals	31	0	56	7	16	93	4	0	11	0	4	10	16	0	18	1	3	25	37	0	18	7	25	54	26	2	50	1	13	33	561
Species	6	0	3	1	4	4	2	0	2	0	1	3	5	0	4	1	2	3	6	0	1	1	3	3	8	1	1	1	3	2	12

TABLE S4. Observed (Obs) and mean null model (Mean) network level indices (L/S: links per species; H₂': specialism; nestedness) of each site, ordered from least to most isolated site. Δ represents observed minus mean null model values. P-values (P) represent significance test of observed versus null model values.

Site	Isolation rank	Size (ha)	L/S				H ₂ '				Nestedness			
			Obs	Mean	Δ	P	Obs	Mean	Δ	P	Obs	Mean	Δ	P
Chestnut	5	1,000	1.273	1.792	-0.519	<0.001	0.346	0.062	0.284	<0.001	1.048	12.837	-11.789	0.158
MacRitchie	4	484	1.142	1.321	-0.179	0.018	0.509	0.052	0.457	<0.001	9.001	13.629	-4.628	0.098
BKE	3	14	1.5	1.74	-0.24	0.02	0.379	0.049	0.33	<0.001	7.718	13.128	-5.41	0.279
Bukit Timah	2	145	1.5	1.512	-0.012	0.36	0.184	0.087	0.097	0.022	0	10.77	-10.77	0.11
Bukit Batok	1	38	0.889	1.05	-0.161	0.073	0.3	0.197	0.103	0.125	21.355	18.058	3.297	0.312

32 Table S5. Specialization levels (d') of each dung type in each site

Dung	Site				
	BKE	Bukit Batok	Bukit Timah	Chestnut	MacRitchie
Tapir	0.544	0.127	0.248	0.431	0.471
Sambar deer	-	-	-	-	0.106
Tiger	0.067	0.141	0.100	0.160	0.576
Reticulated python	0.124	-	0.000	0.098	0.000
Sun bear	0.193	0.000	0.044	0.057	0.094
Common palm civet	0.178	0.153	0.126	0.126	0.076

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FIGURE S1. Site locations in the five nature reserves. Top inset: Map of Singapore (by Teo Siyang). Bottom inset: Diagram showing hexagonal grid arrangement of pitfall traps. Star symbol represents a central tree. Dung type abbreviations: TP: Tapir, SD: Sambar deer, TG: Tiger, RP: Reticulated python, SB: Sun bear, PC: Common palm civet.

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40 FIGURE S2. Sampling completeness curves within (a) dung types (reticulated python and
 41 sambar deer not shown as only one species was attracted) and (b) study sites. Dashed lines
 42 represent extrapolated numbers.

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44 FIGURE S3. Cumulative attractiveness curves of (a) all dung beetle species attracted to the six different dung types and of species with more
 45 than 10 individuals caught: (b) *Onthophagus leusermontis*; (c) *O. semifex*; (d) *Paragymnopleurus maurus*. Scale bar represents 5 mm.

FIGURE S4. Observed and mean null model network level indices (L/S: links per species; H2: specialism; N: nestedness) of each site, ordered from (a) smallest to largest fragment size and (b) least to most isolated site.