Low beta diversity of herbivorous insects in tropical forests

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Supplementary Material

Supplementary Results

Species distribution and host specificity

The maximum possible geographic span for a particular herbivore species is a function of the combined distributions of all recorded hosts. It amounted to the entire 513 km span for all 76 Lepidoptera species analyzed. However, not all host species were sampled at all eight sites even when present, so the maximum geographic span we could observe for different Lepidoptera species ranged from 352 to 513 km (Supplementary Appendix S2). This maximum distribution was reached by 50 out of 76 Lepidoptera species while the remaining 26 species occupied 31 – 97% (median 88%) of the geographic span permitted by the distribution of their host plants.

Supplementary Figures

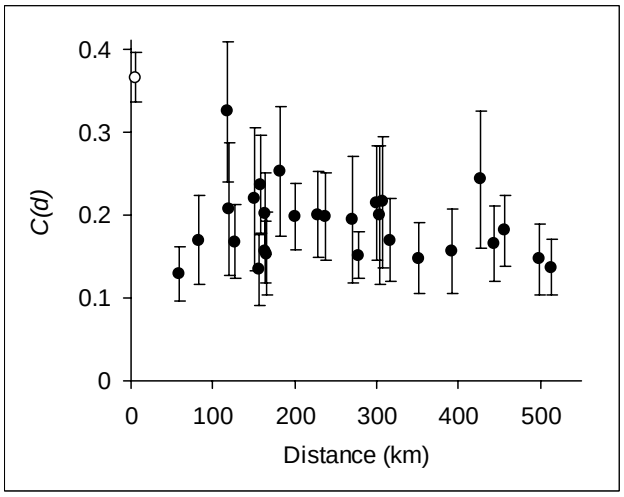

Fig. S1. The probability *C(d*) that caterpillars are conspecific when randomly selected from the same host plant species at study sites separated by the distance *d* as a function of distance. Mean (± S.E.) values were calculated for caterpillar communities from 5–12 plant species sampled simultaneously at each pair of study sites. *C(d)* was not a function of distance (Pearson *r*, P>0.2). The intrasite *C(d)* where *d* = 0-5 km is shown but was not included in the correlation.

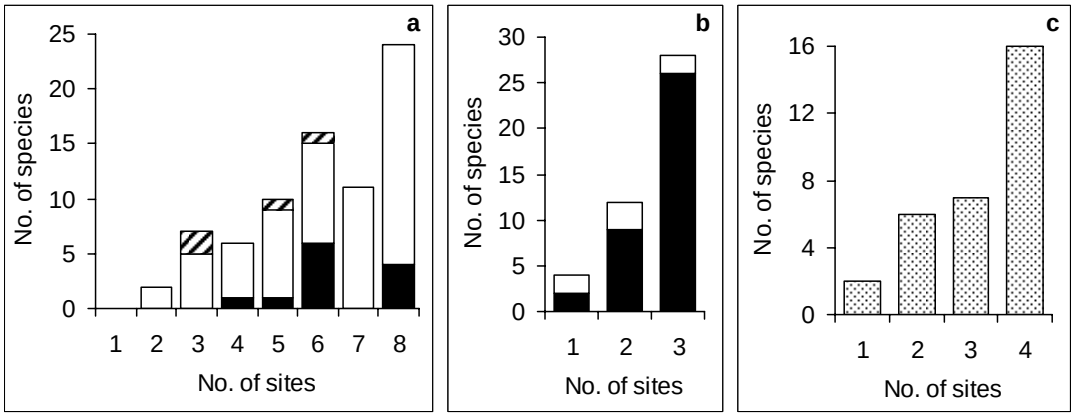

Fig. S2. Geographic distribution of caterpillar (a), ambrosia beetle (b) and fruit fly (c) species in New Guinea lowland rain forests. Geographic distribution was quantified as the number of sites occupied from eight sites sampled for caterpillars, three sites for ambrosia beetles and four sites for fruit flies. Only caterpillar species with ≥23, ambrosia beetle species with ≥8 and fruit flies with ≥11 reared individuals were included (see Supplementary Methods for the justification of these abundance thresholds). Species were classified as generalists, feeding on >1 study genus (black), clade specialists, feeding on >1 species from a single genus (white), and monophages, feeding on a single plant species (hatched). The host range of fruit flies (stippled) was not known as they were not reared from their hosts. Note that monophages could be recognised only in the caterpillars as the ambrosia beetles were not sampled from multiple congeneric tree species. Host specificity was not correlated with geographic distribution (caterpillars: Spearman *r*, P>0.05, ambrosia beetles: Mann-Whitney test, P>0.05). The herbivore species are listed in Supplementary Appendices S2 – S4.

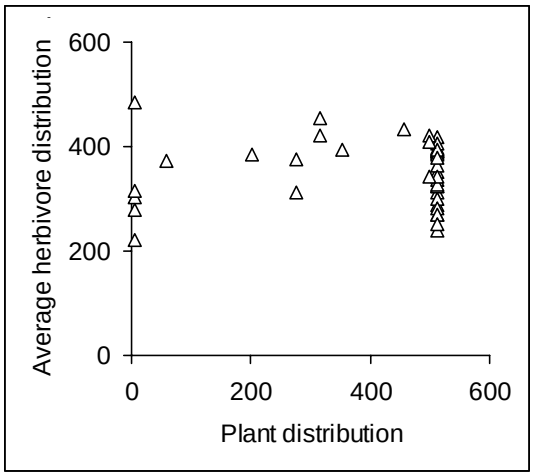

Fig. S3. Relationship between the geographic distribution of plant species and the average geographic distribution of their caterpillar species. The plant and herbivore distribution was measured as the distance between the two most distant occurrences of the species (in km); the average value was calculated for all caterpillar species sufficiently abundant to be analysed and feeding on each plant species. There was no relationship between the range size of the plant species and the range sizes of their herbivore species (Spearman *r*, P>0.4).

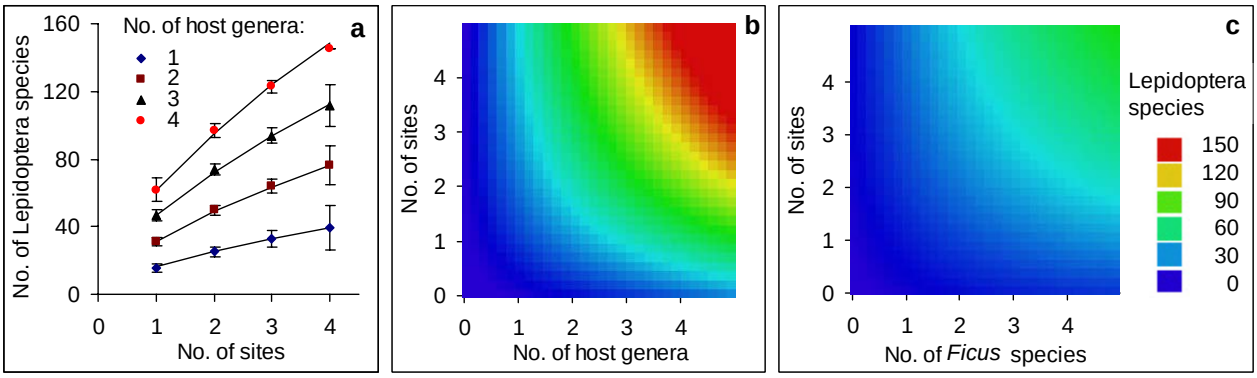

Fig. S4. Accumulation of Lepidoptera species with plant species and area. The number of Lepidoptera species (*S*) feeding on all possible combinations of 1–4 host species sampled at 1–4 sites was predicted as *log S = 1.208 [±0.004] + 0.964 [±0.006] log (host genera) + 0.637 [±0.006] log(sites)* for host species from four genera and *log S = 1.023 [±0.003] + 0.715 [±0.007] log (host species) + 0.568 [±0.007] log(sites)* for *Ficus* species ($R^2 > 0.99$ and N = 16 for both models, S. E. for each parameter is in parentheses, interaction between the two independent variables was not significant). Supplementary Table S2 lists the plant species and localities used in the analysis. Model predictions (solid lines) for hosts from different genera and the mean observed values (markers with S.E. bars) are shown in (a), expected herbivore richness for different host genera in (b) and expected herbivore richness for different *Ficus* species in (c). Note that herbivore species accumulated more rapidly with the addition of hosts than with the addition of sites.

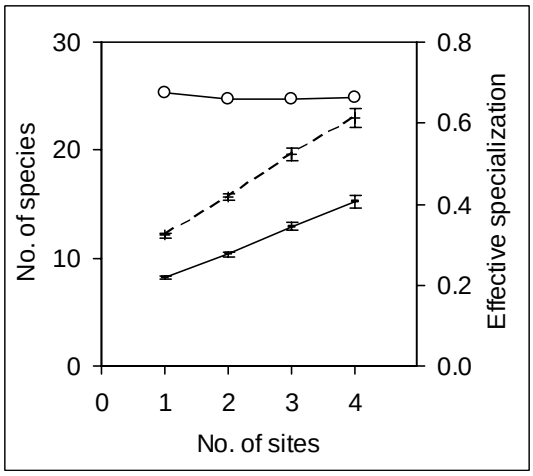

Fig. S5. The effect of geographic scale on the effective specialization and species richness of Lepidoptera feeding on *Ficus* trees. The effective specialization (circles), the number of species per host plant species (dashed line), and the number of unique species per host plant species (solid line) were estimated for Lepidoptera feeding on four species of *Ficus* sampled at 1 – 4 sites (see Table S2 for the list of plant species and sites). The mean (± S. E.) values of species richness were calculated from four *Ficus* species studied. The values for 2 and 3 sites were estimated as means from all possible combinations of sites from the four studied. The effective specialization, i.e. the proportion of herbivorous species feeding on a particular host plant that is unique to that plant, was estimated as the ratio of the total number of herbivorous species found on all four hosts studied, divided by the number of host-plant records involving these hosts[24]. The number of herbivore species unique for a particular plant species is a product of the effective specialization and the number of species recorded on this plant species.

Supplementary Tables

Table S1. Community similarity and geographic distance for plants and Lepidoptera in New Guinea lowland rain forest. The relationship between community similarity and geographic distance was tested for (i) species in four plant genera and (ii) Lepidoptera species feeding on conspecific hosts at eight study sites. Similarity (Sørensen index I_s for plants and Chao-Sørensen index I_c for Lepidoptera) as a linear, exponential, power or logarithmic function of distance d was tested by the Mantel procedure. The explained variance (r^2) is given for the best fitting function when significant ($P<0.05$). Only plant species sampled at $s > 3$ surveys were included in the analysis of caterpillar community similarity.

	r^2	Similarity function	s
Plant genus:			
Ficus	N. S.		8
Macaranga	0.13	$I_s = 0.603 – 0.0004\ d$	8
Psychotria	N. S.		8
Syzygium	N. S.		8
All genera	N. S.		8
Caterpillars on host species:			
Ficus bernaysii	N. S.		9
Ficus conocephalifolia	0.32	$I_c = 0.941 - 0.0012\ d$	6
Ficus copiosa	0.19	$I_c = 0.964 - 0.0002\ d$	9
Ficus dammaropsis	N. S.		4
Ficus pachyrrhachis	N. S.		6
Ficus phaeosyce	0.91	$I_c = 0.974 - 0.0019\ d$	4
Ficus pungens	0.25	$I_c = 0.860 - 0.0008\ d$	6
Macaranga aleuritoides	N. S.		9
Macaranga brachytricha	N. S.		4
Macaranga clavata	0.74	$I_c = 1.027 - 0.0013\ d$	5
Macaranga fallacina	0.34	$I_c = 0.814 - 0.0006\ d$	6
Macaranga quadriglandulosa	0.83	$I_c = 1.001 - 0.0003\ d$	4
Macaranga novoguineensis	N. S.		7
Macaranga tsonane	N. S.		4
Psychotria micrococca	N. S.		7
Syzigium longipes	N. S.		4
Syzygium nr. "*stipulare*"	0.12	$I_c = 0.810 – 0.0601\ \ln(d+1)$	9
Syzygium sp.	0.28	$I_c = 0.953 – 0.0465\ \ln(d+1)$	5

Table S2. Plant species sampled for caterpillars at eight sites. The study site names (Fig. 1b) are abbreviated to their first three letters. Abbreviations: ⊕ = species sampled for herbivores, + = species present but not sampled, - = species absent; *D* = geographic distribution (the longest distance between two occurrences, in km); *d* = maximum geographic span sampled for caterpillars (in km), *N* = the number of caterpillars, *S* = the number of Lepidoptera species; [a] sampled for herbivore species accumulation and effective specialization among congeneric *Ficus* at Ohu, Elem, Wamangu and Yapsiei; [b] sampled for herbivore species accumulation among plant genera at Ohu, Elem, Wamangu and Utai.

	Ohu	Wan	Mor	Ele	Wam	Nik	Uta	Yap	*D*	*d*	*N*	*S*
Ficus bernaysii [a]	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	513	513	4,604	48
Ficus conocephalifolia	⊕	⊕	+	⊕	⊕	-	⊕	+	513	498	2,843	41
Ficus copiosa [a b]	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	513	513	7,296	49
Ficus dammaropsis	⊕	-	⊕	-	+	-	⊕	+	513	498	2,212	30
Ficus hispidioides	⊕	⊕	-	-	+	-	-	-	277	59	2,019	24
Ficus pachyrrhachis [a]	⊕	+	+	⊕	⊕	⊕	-	⊕	513	513	4,030	32
Ficus phaeosyce	⊕	⊕	⊕	-	-	+	-	-	352	118	1,694	25
Ficus pungens [a]	⊕	+	+	⊕	⊕	⊕	⊕	⊕	513	513	3,203	41
Macaranga aleuritoides [b]	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	513	513	7,406	78
Macaranga brachytricha	⊕	⊕	+	⊕	-	-	+	-	498	201	3,094	46
Macaranga clavata	⊕	+	+	-	-	⊕	⊕	⊕	513	513	3,356	50
Macaranga dulcis	⊕	-	+	+	⊕	-	+	+	513	277	2,049	35
Macaranga fallacina	⊕	+	⊕	+	-	+	⊕	⊕	513	513	2,999	71
Macaranga fragrans	+	-	⊕	-	+	-	-	+	513	5	566	23
Macaranga novoguineensis	⊕	⊕	⊕	+	⊕	⊕	+	⊕	513	513	3,424	65
Macaranga nr. *hispida*	-	-	-	⊕	-	⊕	+	+	317	156	1,074	27
Macaranga quadriglandulosa	⊕	+	⊕	+	⊕	-	-	-	277	277	3,632	62
Macaranga tsonane	-	-	-	⊕	-	⊕	⊕	⊕	317	317	2,594	50
Psychotria micrococca [b]	⊕	⊕	⊕	⊕	⊕	-	⊕	-	498	498	3,209	35
Psychotria nr. *ectasiphylla*	-	-	-	-	-	-	-	⊕	5	5	407	11
Psychotria nr. *hollandiae*	-	-	-	-	-	-	-	⊕	5	5	466	13
Psychotria ramuensis	⊕	+	-	-	+	-	⊕	-	498	498	2,046	18
Psychotria sp.	-	-	-	-	-	⊕	-	-	5	5	657	2
Syzigium longipes	⊕	⊕	-	⊕	+	-	+	+	513	201	2,067	72
Syzygium nr. *"stipulare"* [b]	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	513	513	3,670	145
Syzygium sp.	⊕	-	⊕	+	⊕	-	⊕	+	513	498	3,567	111
	26,4		6,88	5,56		7,02	5,21	7,63				
n	60	7,528	8	5	7,864	9	8	2			74,184	
S	182	109	139	111	146	93	107	123				370

Table S3. Species richness (S) and basal area (BA) of four plant genera at eight lowland rain forests in New Guinea. Species richness was based on qualitative floristic surveys of approximately 25 km^2 of primary and secondary forests at each site. BA was estimated by enumeration of all plants >1.5m high in 50 plots, 400 m^2 each, equally distributed between primary and secondary forest vegetation at each site. All parameters are given as means ± S. E. Abbreviations: S_{total} = the total number of species across all sites; S_{local} = the average number of species per site; $\%S_{sampled}$ = the percentage of local congeners sampled for herbivores; BA_{local} = the average combined basal area (in cm^2/ha) of all congeners per site; $\%BA_{sampledG}$ = the average percentage of basal area per site represented by species sampled for herbivores out of local congeners; $\%BA_{sampledT}$ = the average percentage of basal area per site represented by species sampled for herbivores out of the woody vegetation .

Genus	S_{total}	S_{local}	$\%S_{samled}$	BA_{local}	$\%BA_{sampledG}$	$\%BA_{sampledT}$
Ficus	87	43.1 ± 2.17	11 ± 0.9	14600 ± 5073	40 ± 10.4	1.7 ± 0.68
Macaranga	35	13.3 ± 0.88	37 ± 4.9	6203 ± 2176	86 ± 7.2	2.0 ± 0.53
Psychotria	21	4.5 ± 0.76	35 ± 5.1	469 ± 190	46 ± 13.8	0.1 ± 0.02
Syzygium	32	7.3 ± 1.50	39 ± 10.6	1425 ± 680	69 ± 10.6	0.4 ± 0.18
Total	175	68.1 ± 2.90	19 ± 1.2	22698 ± 5677	56 ± 10.8	4.2 ± 1.03

Supplementary Appendices

Appendix S1. Species composition of *Ficus*, *Macaranga*, *Psychotria* and *Syzygium* at eight study sites in Papua New Guinea. The study site names (Fig. 1) are abbreviated to their first three letters. The number of sites where the species occurred (*n*) and the longest distance between two occurrences in km (*D*) is reported. Voucher specimens are deposited at the University of Minnesota Herbarium (MIN) and Lae Herbarium (LAE).

Species	Ohu	Wan	Mor	Ele	Wam	Nik	Uta	Yap	*n*	*D*
Ficus adelpha Laut. et K.Schum.	√	√	√		√	√		√	6	513
Ficus adenosperma Miq.	√		√		√		√	√	5	513
Ficus alocarpa Diels			√	√	√		√		4	392
Ficus amblisyce Corner		√							1	5
Ficus ampelas Burm. f.	√				√				2	277
Ficus arbuscula Laut. et K.Schum.	√	√		√		√		√	5	513
Ficus archiboldiana Summerh.		√		√	√		√		4	443
Ficus arfakensis King	√	√	√	√	√	√	√	√	8	513
Ficus austrina Corner	√		√	√				√	4	513
Ficus badiopurpurea Diels						√	√	√	3	158
Ficus baeuerlenii King	√		√	√	√	√	√	√	7	513
Ficus benjamina L.			√		√				2	163
Ficus benjaminoides Corner			√			√			2	270
Ficus bernaysii King	√	√	√	√	√	√	√	√	8	513
Ficus botryocarpa Miq.	√	√	√		√		√	√	6	513
Ficus caesaroides King				√					1	5
Ficus caulocarpa Miq.			√		√				2	163
Ficus comitis King			√		√				2	163
Ficus congesta Roxb.	√	√	√	√	√	√	√	√	8	513
Ficus conocephalifolia Ridley	√	√	√	√	√	√	√	√	8	513
Ficus copiosa Steud.	√	√	√	√	√	√	√	√	8	513
Ficus crassiramea Miq.	√	√	√	√	√				5	277
Ficus dammaropsis Diels	√		√		√		√	√	5	513
Ficus disticha Bl.			√	√	√	√			4	270
Ficus drupacea Thunb.	√	√	√	√	√		√	√	7	513
Ficus edelfeltii King	√		√			√		√	4	513
Ficus erythrosperma Miq.	√		√	√	√	√	√	√	7	513
Ficus glaberrima Bl.					√				1	5
Ficus glandulifera Wall ex Miq.				√		√			2	156
Ficus gracillima Diels	√					√			2	352
Ficus gul Laut. et K.Schum.	√		√		√				3	277
Ficus hadroneura Diels				√					1	5
Ficus hesperiidiformis King	√	√	√	√	√		√		6	498
Ficus hispidioides S. Moore	√	√			√				3	277
Ficus hombroniana Corner		√	√	√			√	√	5	456
Ficus itoana Diels	√					√	√		3	498
Ficus jimiensis C. C. Berg	√			√			√		3	498
Ficus leptodictya Diels			√		√				2	163
Ficus macrorrhyncha Laut. et K.Schum.	√		√						2	118
Ficus melinocarpa Bl.	√	√	√	√	√	√	√	√	8	513
Ficus microcarpa L.			√		√				2	163
Ficus mollior Bl.	√	√	√	√		√	√	√	7	513
Ficus morobensis C. C. Berg	√			√			√	√	4	513
Ficus nodosa Teysm. et Binn.	√	√	√	√	√	√	√	√	8	513
Ficus novoguineensis Corner	√		√	√				√	4	513
Ficus odoardi King	√	√		√	√	√	√	√	7	513
Ficus pachyrrhachis Laut. et K.Schum.	√	√	√	√	√	√		√	7	513
Ficus pantoniana King			√	√			√		3	392
Ficus phaeosyce Laut. et K.Schum.	√	√	√			√			4	352
Ficus pilulifera Corner				√					1	5
Ficus polyantha Warb.	√	√	√	√	√	√	√	√	8	513
Ficus porphorochaete Corner						√			1	5
Ficus prasinicarpa Elm.	√								1	5
Ficus primaria Corner	√	√	√		√				4	277
Ficus pseudojaca Corner		√	√	√	√				4	229
Ficus pungens Reinw. ex Bl.	√	√	√	√	√	√	√	√	8	513
Ficus robusta Corner	√				√		√		3	498
Ficus saurauioides Diels						√	√	√	3	158
Ficus scratchleyana King				√				√	2	317
Ficus semivestita Corner	√	√	√		√		√	√	6	513
Ficus septica Burm f.	√				√	√	√	√	5	513

Appendix S1 continued	Ohu	Wan	Mor	Ele	Wam	Nik	Uta	Yap	*n*	*D*
Ficus subcuneata Miq.	√		√		√		√	√	5	513
Ficus subtrinervia Laut. et K.Schum.	√	√	√	√	√	√		√	7	513
Ficus subulata Bl.	√	√	√	√	√	√	√	√	8	513
Ficus tinctoria Forst. f.					√				1	5
Ficus tonsa Miq.						√			1	5
Ficus trachypison K.Schum.	√	√	√	√	√	√		√	7	513
Ficus variegata Bl.	√	√	√	√	√	√	√	√	8	513
Ficus virens Ait.	√	√	√	√	√	√	√	√	8	513
Ficus virgata Reinw.	√	√	√	√			√	√	6	513
Ficus wassa Roxb.	√	√		√	√	√	√	√	7	513
Ficus xylosycia Diels	√	√			√		√		4	498
Ficus sp. 1 cf. *erythrosperma* Miq.			√		√	√			3	270
Ficus sp. 2 cf. *subcuneata* Miq.								√	1	5
Ficus sp. 3 cf. *ternatana* Miq.	√		√	√			√	√	5	513
Ficus sp. 4								√	1	5
Ficus sp. 5						√			1	5
Ficus sp. 6					√				1	5
Ficus sp. 7			√						1	5
Ficus sp. 8			√						1	5
Ficus sp. 9					√				1	5
Ficus sp. 10				√					1	5
Ficus sp. 11								√	1	5
Ficus sp. nov. 12					√				1	5
Ficus sp. nov. 13 cf. *erythrosperma* Miq.	√								1	5
Ficus sp. nov. 14		√				√	√		3	443
Macaranga aleuritoides F. Muell.	√	√	√	√	√	√	√	√	8	513
Macaranga clavata Warb.	√	√	√			√	√	√	6	513
Macaranga densiflora Warb.						√	√	√	3	158
Macaranga ducis Whitmore	√		√	√	√		√	√	6	513
Macaranga fallacina Pax & K. Hoffm.	√	√	√	√		√	√	√	7	513
Macaranga fragrans Perry	√				√			√	3	513
Macaranga galorei Whitmore	√								1	5
Macaranga glaberrima (Hassk.) Airy Shaw		√							1	5
Macaranga hispida Muell. Arg.				√		√	√	√	4	317
Macaranga novo-guineensis J. J. Smith	√	√	√	√	√	√	√	√	8	513
Macaranga papuana (J.J. Smith) Pax & Hoffm.	√			√		√			3	352
Macaranga punctata K. Schum.	√	√			√			√	4	513
Macaranga quadriglandulosa Warb.	√	√	√	√	√				5	277
Macaranga tanarius (L.) Muell. Arg.		√		√	√	√	√	√	6	456
Macaranga tsonane Whitmore				√		√	√	√	4	317
Macaranga sp. 1 cf. *papuana* Pax & K. Hoffm.				√		√	√	√	4	317
Macaranga sp. 2 cf. *brachytricha* Airy Shaw	√	√	√	√			√		5	498
Macaranga sp. 3 cf. *densiflora* Warb.	√				√				2	277
Macaranga sp. 4 cf. *magnifolia* Perry							√		1	5
Macaranga sp. 5 cf. *fallacina* Pax. & K. Hoffm.					√				1	5
Macaranga sp. 6		√							1	5
Macaranga sp. 7 cf. *clavata* Warb.					√				1	5
Macaranga sp. 8 cf. *strigosa* Pax. & K. Hoffm.						√	√	√	3	158
Macaranga sp. 9		√	√		√				3	229
Macaranga sp. 10							√	√	2	150
Macaranga sp. 11			√	√					2	119
Macaranga sp. 12		√							1	5
Macaranga sp. 13						√			1	5
Macaranga sp. 14				√					1	5
Macaranga sp. 15								√	1	5
Macaranga sp. 16		√							1	5
Macaranga sp. 17		√							1	5
Macaranga sp. 18 *dioca* complex		√					√		2	443
Macaranga sp. 19						√	√	√	3	158
Psychotria dipteropoda Laut. & K. Schum.			√						1	5
Psychotria katikii Sohmer							√		1	5
Psychotria leptothyrsa Miq.	√	√	√			√	√	√	6	513
Psychotria membranifolia Bartl. ex DC.			√						1	5
Psychotria micralabastra (Laut. & Schum.) Val.	√								1	5
Psychotria micrococca (Laut. & Schum.) Val.	√	√	√	√	√		√		6	498
Psychotria ramuensis Sohmer	√	√			√		√		4	498
Psychotria sp. 1							√		1	5
Psychotria sp. 2 cf. *ectasiphylla* Laut. & K. Schum.								√	1	5
Psychotria sp. 3								√	1	5
Psychotria sp. 4 cf. *micrococca* (Laut. & Schum.) Val.						√	√	√	3	158
Psychotria sp. 5 cf. *hollandiae* Valeton								√	1	5
Psychotria sp. 6						√			1	5
Psychotria sp. 7		√							1	5

Appendix S1 continued	Ohu	Wan	Mor	Ele	Wam	Nik	Uta	Yap	*n*	*D*
Psychotria sp. 8		√							1	5
Psychotria sp. 9		√							1	5
Psychotria sp. 10				√					1	5
Psychotria sp. 11							√		1	5
Psychotria sp. 12			√						1	5
Psychotria sp. 13			√						1	5
Psychotria sp. 14							√		1	5
Syzygium aqueum Alston	√								1	5
Syzygium longipes (Warb.) Merrill & Perry	√	√		√	√		√	√	6	513
Syzygium malaccense Merr. & Perry	√								1	5
Syzygium subalatum (Ridl.) Merr. & L. M. Perry			√						1	5
Syzygium tierneyanum (F.Muell.) Hartley & Perry	√			√					2	201
Syzygium sp. 1							√		1	5
Syzygium sp. 2 cf. *longipes* (Warb.) Merrill & Perry							√		1	5
Syzygium sp. 3							√		1	5
Syzygium sp. 4 cf. *"stipulare"* Craven	√	√	√	√	√	√	√	√	8	513
Syzygium sp. 5							√	√	2	150
Syzygium sp. 6							√		1	5
Syzygium sp. 7							√		1	5
Syzygium sp. 8							√		1	5
Syzygium sp. 9		√							1	5
Syzygium sp. 10				√					1	5
Syzygium sp. 11								√	1	5
Syzygium sp. 12								√	1	5
Syzygium sp. 13			√						1	5
Syzygium sp. 14			√						1	5
Syzygium sp. 15			√						1	5
Syzygium sp. 16			√						1	5
Syzygium sp. 17					√				1	5
Syzygium sp. 18					√		√		2	237
Syzygium sp. 19				√					1	5
Syzygium sp. 20				√					1	5
Syzygium sp. 21 *"gelpkeoid"* complex	√		√	√			√		4	498
Syzygium sp. 22	√			√	√			√	4	513
Syzygium sp. 23	√		√	√	√		√	√	6	513
Syzygium sp. 24							√		1	5
Syzygium sp. 25							√		1	5
Syzygium sp. 26 *trivene* complex	√								1	5
Syzygium sp. 27							√		1	5

Appendix S2. Geographic distribution of Lepidoptera in the New Guinea lowland rain forest study area. *N* = the number of individuals reared from eight study sites (only species with $N \geq 23$ included; see Supplementary Methods); *n* = the number of sites where a species was recorded; *G* = predicted geographic distribution, based on occurrence of known hosts sampled for herbivores; *D* = observed geographic distribution (the longest distance between two occurrences, in km). Morphotype codes are reported for unidentified species. Insect vouchers are deposited at the Smithsonian Institution, Washington, DC, and the National Agriculture Research Institute in Port Moresby.

Species	Family	*N*	Host range	*n*	*G*	*D*
Addaea pusilla (Butler)	Thyrididae	910	*Macaranga*	8	513	513
Addaea sp. nr. *probolopsis* Meyrick [CRAM083]	Thyrididae	205	*Macaranga*	6	513	513
Adoxophyes fasciculana (Walker)	Tortricidae	23	Generalist	4	513	498
Adoxophyes nebrodes Diakonoff	Tortricidae	36	Generalist	6	513	513
Adoxophyes cf. *orana* (Fischer v. Roeslerstamm) [TORT094, 066]	Tortricidae	75	Generalist	8	513	513
Adoxophyes tripselia (Lower)	Tortricidae	54	Generalist	6	513	498
Agrotera ignepictoides Rothschild	Crambidae	47	*Syzygium*	5	513	352
Agrotera sp. nr. *basinotata* Hampson [CRAM098]	Crambidae	44	*Syzygium*	4	513	277
Agrotera cf. *effertalis* Walker [PYRA012]	Crambidae	61	*Syzygium*	7	513	513
Albinospila syntyche Prout	Geometridae	182	*Macaranga*	8	513	513
Arctornis sp. nr. *intacta* Walker [LYMA007]	Lymantriidae	203	Generalist	8	513	513
Asota carica (F.)	Noctuidae	301	*Ficus*	5	513	513
Asota plana Walker	Noctuidae	150	*Ficus*	5	513	513
Asota versicolor F.	Noctuidae	29	*Ficus*	4	513	277
Brenthia sp. [CHOR002]	Choreutidae	849	*Ficus*	8	513	513
Brenthia sp. [CHOR008]	Choreutidae	240	*Macaranga*	6	513	498
Brenthia sp. [CHOR015]	Choreutidae	65	*Ficus*	3	513	304
Brenthia sp. [CHOR016]	Choreutidae	599	*F. dammaropsis*	3	498	498
Brenthia sp. nov. [CHOR001]	Choreutidae	365	*Ficus*	5	513	277
Chora huntei Warren	Nolidae	24	*Syzygium*	4	498	498
Choreutis basalis (Felder & Rogenhofer)	Choreutidae	366	*Ficus*	8	513	513
Choreutis lutescens (Felder & Rogenhofer)	Choreutidae	439	*Ficus*	8	513	513
Choreutis sp. [CHOR011]	Choreutidae	59	*Ficus*	3	513	201
Choreutis sp. [CHOR014]	Choreutidae	202	*Ficus*	5	513	513
Choreutis sp. nr. *anthorma* (Meyrick) [TORT005]	Choreutidae	736	*Ficus*	8	513	513
Chrysocraspeda sp. nr. *inundata* Warren [GEOM110]	Geometridae	203	*Syzygium*	2	498	277
"*Coelorhycidia*" *nitidalis* Hampson	Crambidae	324	*Psychotria*	7	513	513
"*Coelorhycidia*" *purpurea* Hampson	Crambidae	1178	*Psychotria*	8	513	513
"*Coelorhycidia*" sp. complex [CRAM041]	Crambidae	1048	*Psychotria*	7	513	513
Cyrestis acilia Godart	Nymphalidae	28	*Ficus*	6	513	513
Dichomeris ochreoviridella (Pagenstecher)	Gelechiidae	1069	*Macaranga*	8	513	513
Dichomeris sp. [XXXX068]	Gelechiidae	907	*Macaranga*	8	513	513
Dichomeris sp. [XXXX120]	Gelechiidae	77	*Macaranga*	7	513	513
Dudua sp. nov. nr. *aprobola* (Meyrick) [TORT143]	Tortricidae	160	*Syzygium*	5	513	498
Gen. nov. nr. "*Loboschiza*" sp. nov. [TORT172]	Tortricidae	59	*Syzygium*	8	513	513
Glyphodes margaritaria (Cramer)	Crambidae	225	*Ficus*	8	513	513
Homona mermerodes Meyrick	Tortricidae	49	Generalist	6	513	498
Homona phanaea Meyrick	Tortricidae	40	Generalist	6	513	513
Idiophantis sp. nov. [TORT163]	Gelechiidae	70	*Syzygium*	7	513	513
Macarostola sp. [XXXX139]	Gracillariidae	36	*Syzygium*	4	513	513
Macarostola sp. [XXXX154]	Gracillariidae	31	*Syzygium*	2	513	277
Macroglossum melas pullius Rothschild & Jordan	Sphingidae	76	*Psychotria*	7	513	513
Mecistoptera sp. nov. [XXXX092]	Noctuidae	30	Generalist	6	513	498
Mellea hieroglyphica (Warren)	Thyrididae	112	*Macaranga*	7	513	456
Mellea nitida (Pagenstecher)	Thyrididae	357	*Macaranga*	8	513	513
Mellea ordinaria (Warren)	Thyrididae	1283	*Macaranga*	8	513	513
Mellea ramifera (Warren)	Thyrididae	361	*Macaranga*	6	513	513
Mellea sp. [THYR012]	Thyrididae	101	*Macaranga*	8	513	513
Mellea sp. nov. [THYR019]	Thyrididae	64	*Macaranga*	3	513	427
Mellea sp. nr. *ramifera* (Warren) [THYR016]	Thyrididae	246	*Macaranga*	6	513	513
Mellea sp. nr. *ordinaria* (Warren) [THYR013]	Thyrididae	44	*Macaranga*	6	513	456
Mellea sp. nr. *ordinaria* (Warren) [THYR014]	Thyrididae	27	*Macaranga*	6	513	456
Mellea sp. nr. *rectiviata* (Warren) [THYR018]	Thyrididae	115	*Macaranga*	3	352	270
Moca congrualis (Walsingham)	Immidae	27	Generalist	8	513	513
Nycteola indicatana (Walker)	Tortricidae	52	*Syzygium*	7	513	513
Oenospila sp. nr. *flavilinea* Warren [GEOM150]	Geometridae	88	*Syzygium*	6	498	498
Ophiorrhabda deceptor Diakonoff	Tortricidae	267	*Syzygium*	8	513	513
Ophyx crinipes Felder	Noctuidae	31	*Ficus*	5	513	513
Orthaga sp. nr. *percnodes* Turner [NOCT020]	Pyralidae	23	Generalist	5	513	498
Paraphomia disjuncta Whalley	Noctuidae	394	*M. aleuritoides*	6	513	456
Pharambora splendida (Butler)	Thyrididae	1208	*Macaranga*	8	513	513
Philiris helena helena (Snellen)	Lycaenidae	189	*Macaranga*	8	513	513
Philiris moira Grose-Smith	Lycaenidae	85	*Ficus*	5	513	513
"*Pseudocera*" nr. *trissosticha* (Turner) [CRAM067]	Crambidae	82	*Syzygium*	3	498	277

Appendix S2 continued	Family	*N*	Host range	*n*	*G*	*d*
Pyrophractis isotherma Meyrick	Oecophoridae	59	*S.* nr. *stipulare*	3	513	158
Rhodoneura aurata (Butler)	Thyrididae	484	*Macaranga*	7	513	513
Talanga deliciosa (Butler)	Crambidae	290	*Ficus*	7	513	498
Talanga excelsalis moresbyensis (Strand)	Crambidae	1275	*Ficus*	8	513	513
Talanga polyzonalis (Hampson)	Crambidae	85	*Ficus*	6	513	513
Talanga sexpunctalis (Moore)	Crambidae	543	*Ficus*	8	513	513
Tamba kebea Bethune-Baker	Geometridae	176	*S.* nr. *stipulare*	5	513	443
Thalassodes (s.l.) *albifusa* (Warren)	Geometridae	247	Generalist	8	513	513
Unadophanes trissomita (Turner)	Pyralidae	482	*Macaranga*	8	513	513
Xenothictis gnetivora Brown, Miller & Horak	Tortricidae	36	Generalist	6	513	513
Holocola sp. nov. [TORT170]	Tortricidae	24	*Syzygium*	4	513	513
Zeugma recusataria Walker	Geometridae	550	*Syzygium*	7	513	498

Appendix S3. Geographic distribution of ambrosia beetles (Coleoptera, Curculionidae: Scolytinae, Platypodinae) in the New Guinea lowland rain forest study area.

N = the number of individuals sampled from three study sites (only species with $N \geq 8$ included; see Supplementary Methods); *n* = the number of sites where a species was recorded; *D* = observed geographic distribution (the longest distance between two occurrences, in km). Insect vouchers are deposited at the Natural History Museum, London, Michigan State University, East Lansing, and the National Agriculture Research Institute in Port Moresby.

Species	Subfamily	*N*	Host range	*n*	*D*
Arixyleborus sp. nr. *morio* Eggers	Scolytinae	17	*Artocarpus*, *Ficus*	3	950
Arixyleborus canaliculatus (*Eggers*)	Scolytinae	10	generalist	3	950
Coptodryas popondettae Browne	Scolytinae	24	generalist	2	950
Crossotarsus kuntzei (Schedl)	Platypodinae	101	generalist	3	950
Crossotarsus lacordairei Chapuis	Platypodinae	20	generalist	2	500
Crossotarsus minusculus Chapuis	Platypodinae	20	generalist	3	950
Crossotarsus mnizsechi Chapuis	Platypodinae	40	generalist	3	950
Cyclorhipidion agnatum (Eggers)	Scolytinae	30	generalist	3	950
Diapus pussilimus Chapuis	Platypodinae	272	generalist	3	950
Diapus quinquespinatus Chapuis	Platypodinae	24	generalist	3	950
Dinoplatypus sp. *#481*	Platypodinae	74	*Nauclea*	1	5
Dinoplatypus chevrolati (Chapuis)	Platypodinae	411	generalist	2	950
Dinoplatypus pallidus Chapuis	Platypodinae	2381	generalist	3	950
Eccoptopterus gracilipes Eichhoff	Scolytinae	90	generalist	3	950
Eccoptopterus spinosus Oliv.	Scolytinae	29	generalist	2	500
Euwallacea bicolor (Blandford)	Scolytinae	249	generalist	3	950
Euwallacea destruens Blandford	Scolytinae	15	*Artocarpus*, *Ficus*	2	500
Euwallacea fornicatus (Eichhoff)	Scolytinae	350	generalist	3	950
Euwallacea piceus (Motschulsky)	Scolytinae	187	generalist	3	950
Euwallacea talumalai (Browne)	Scolytinae	22	generalist	3	950
Euwallacea wallacei Blandford	Scolytinae	18	generalist	3	950
Euwallacea xanthopus-fraternus (Blandford)	Scolytinae	56	*Artocarpus*, *Ficus*	2	950
Leptoxyleborus concisus (Blandford)	Scolytinae	212	generalist	3	950
Microperus sp. nr. *libra* (Eggers)	Scolytinae	58	generalist	3	950
Microperus diversicolor (Eggers)	Scolytinae	156	generalist	3	950
Platypus sp. *#279*	Platypodinae	11	*Ficus*	3	950
Platypus jansoni Chapuis	Platypodinae	562	generalist	3	950
Platypus lunati Schedl	Platypodinae	85	generalist	2	500
Platypus nr. *selysi* Chapuis	Platypodinae	10	*Artocarpus*, *Ficus*	1	5
Platypus sulcinodis Schedl	Platypodinae	12	*Leea*	2	500
Treptoplatypus solidus (Walker)	Platypodinae	274	generalist	3	950
Xyleborinus perexiquus Schedl	Scolytinae	387	generalist	3	950
Xyleborus sp. *#126*	Scolytinae	10	generalist	1	5
Xyleborus affinis Eichhoff	Scolytinae	550	generalist	3	950
Xyleborus approximatus Schedl	Scolytinae	10	generalist	2	500
Xyleborus duodecimspinatus Schedl	Scolytinae	47	generalist	2	500
Xyleborus fallax Eichhoff	Scolytinae	177	generalist	3	950
Xyleborus ferrugineus F.	Scolytinae	9	generalist	2	500
Xyleborus immersus Schedl	Scolytinae	439	generalist	3	950
Xyleborus perforans Wollaston	Scolytinae	2304	generalist	3	950
Xyleborus pumilus Eggers	Scolytinae	511	generalist	3	950
Xyleborus similis Ferrari	Scolytinae	99	generalist	3	950
Xylosandrus crassiusculus (Motschulsky)	Scolytinae	115	generalist	1	5
Xylosandrus morigerus (Blandford)	Scolytinae	11	generalist	2	500

Appendix S4. Geographic distribution of fruit flies (Diptera, Tephritidae) in the New Guinea lowland rain forest study area.

N = the number of individuals sampled from four study sites (only species with $N \geq 11$ included; see Supplementary Methods); *n* = the number of sites where a species was recorded; *D* = observed geographic distribution (the longest distance between two occurrences, in km). Insect vouchers are deposited at Griffith University in Brisbane and the National Agriculture Research Institute in Port Moresby.

Species	*N*	*n*	*D*
Bactrocera abdonigella (Drew)	1638	4	950
Bactrocera abdopallescens (Drew)	29	2	392
Bactrocera aurantiaca (Drew & Hancock)	212	4	950
Bactrocera brevistriata (Drew)	31	4	950
Bactrocera circamusae Drew	11	2	82
Bactrocera contermina Drew	12	1	5
Bactrocera curreyi Drew	13	3	443
Bactrocera curvifera (Walker)	1329	4	950
Bactrocera enochra (Drew)	297	4	950
Bactrocera frauenfeldi (Schiner)	13	2	950
Bactrocera fulvicauda (Perkins)	1584	4	950
Bactrocera furfurosa Drew	86	3	585
Bactrocera furvilineata Drew	61	3	950
Bactrocera latissima Drew	74	4	950
Bactrocera lineata (Perkins)	505	4	950
Bactrocera macrovittata Drew	66	1	5
Bactrocera moluccensis (Perkins)	74	4	950
Bactrocera morobiensis Drew	145	3	443
Bactrocera musae (Tryon)	22812	4	950
Bactrocera neocheesmanae (Drew)	96	3	585
Bactrocera paramusae Drew	1266	4	950
Bactrocera recurrens (Hering)	528	4	950
Bactrocera resima (Drew)	25	3	443
Bactrocera sandaracina Drew	187	4	950
Bactrocera strigifinis (Walker)	25	2	392
Bactrocera tinomiscii Drew	95	2	82
Bactrocera trivialis (Drew)	238	4	950
Bactrocera umbrosa (Fabricius)	2335	4	950
Bactrocera vulgaris (Drew)	2927	4	950
Dacus impar Drew	13	3	950
Dacus melanohumeralis Drew	47	2	82