

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

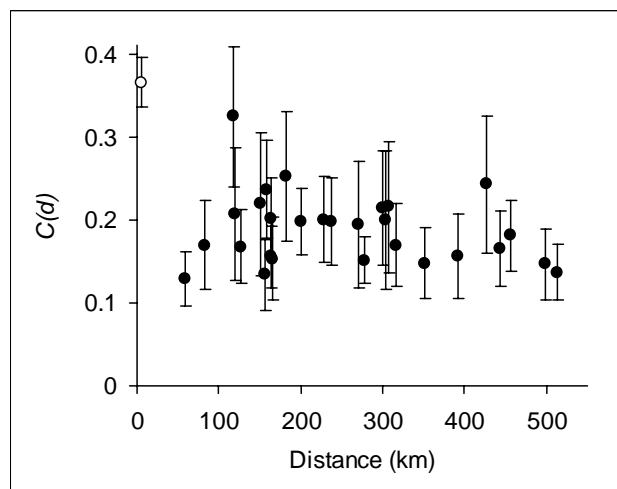


Fig. S1. The probability $C(d)$ that caterpillars are conspecific when randomly selected from the same host plant species at study sites separated by the distance d as a function of distance. Mean (\pm S.E.) values were calculated for caterpillar communities from 5–12 plant species sampled simultaneously 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.

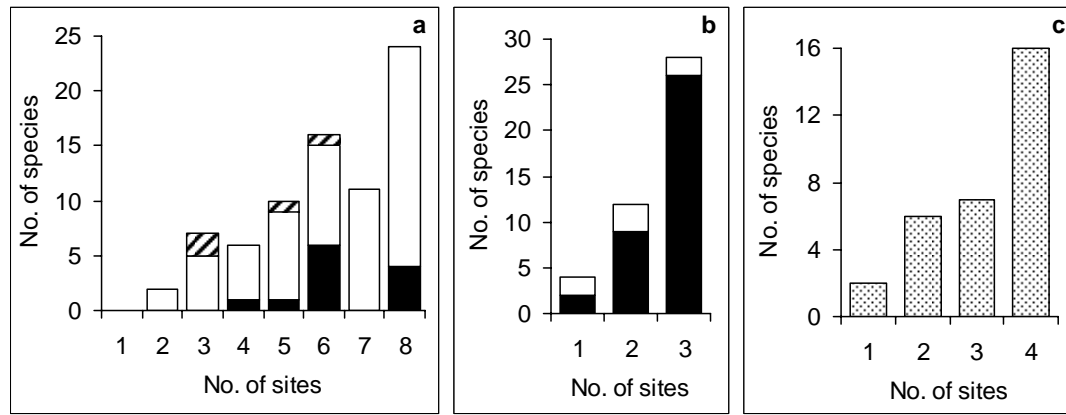


Fig. S2. Geographic distribution of caterpillar (a), ambrosia beetle (b) and fruit fly (c) species in New Guinea lowland rain forests. Geographic distribution was quantified as the number of sites occupied from eight sites sampled for caterpillars, three sites for ambrosia beetles and four sites for 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.

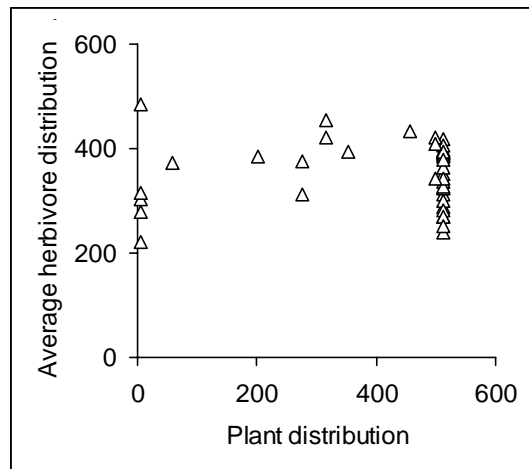


Fig. S3. Relationship between the geographic distribution of plant species and the average geographic distribution of their caterpillar species. The plant and herbivore distribution was measured as the distance between the two most distant occurrences of the species (in km); the average value was calculated 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 , $P > 0.4$).

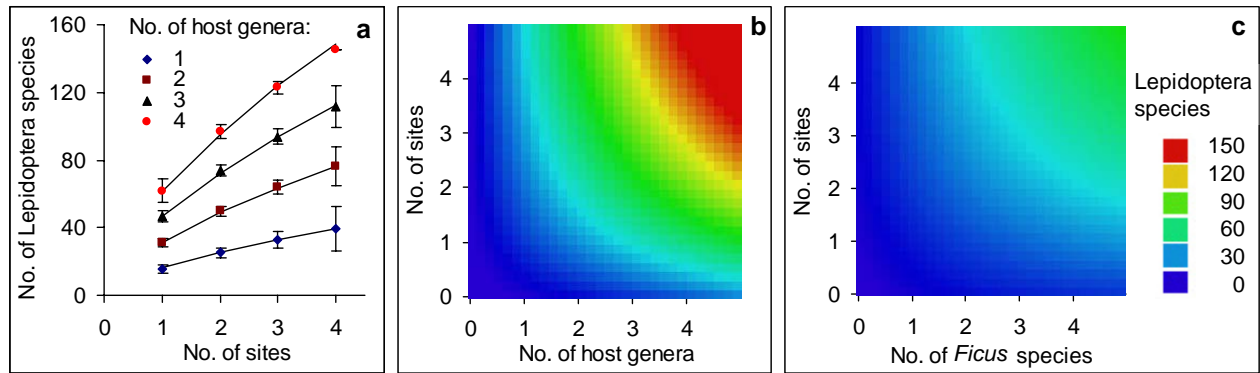


Fig. S4. Accumulation of Lepidoptera species with plant species and area. The number of Lepidoptera species (S) feeding on all possible combinations of 1–4 host species sampled at 1–4 sites was predicted as $\log S = 1.208 [\pm 0.004] + 0.964 [\pm 0.006] \log(\text{host genera}) + 0.637 [\pm 0.006] \log(\text{sites})$ for host species from four genera and $\log S = 1.023 [\pm 0.003] + 0.715 [\pm 0.007] \log(\text{host species}) + 0.568 [\pm 0.007] \log(\text{sites})$ 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.

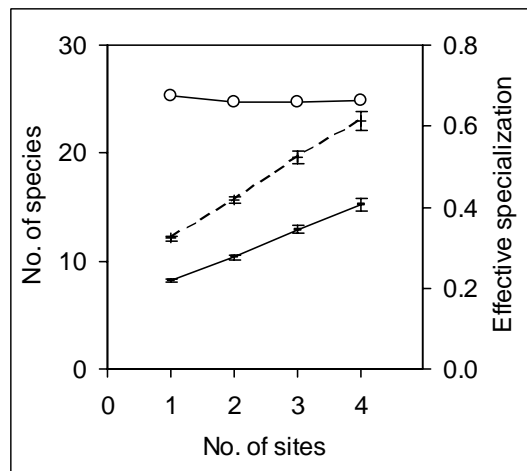


Fig. S5. The effect of geographic scale on the effective specialization and species richness of Lepidoptera feeding on *Ficus* trees. The effective specialization (circles), the number of species per host plant species (dashed line), and the number of unique species per host plant species (solid line) 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 (\pm 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 hosts²⁴. 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:			
<i>Ficus</i>	N. S.		8
<i>Macaranga</i>	0.13	$I_s = 0.603 - 0.0004 d$	8
<i>Psychotria</i>	N. S.		8
<i>Syzygium</i>	N. S.		8
All genera	N. S.		8
Caterpillars on host species:			
<i>Ficus bernaysii</i>	N. S.		9
<i>Ficus conocephalifolia</i>	0.32	$I_c = 0.941 - 0.0012 d$	6
<i>Ficus copiosa</i>	0.19	$I_c = 0.964 - 0.0002 d$	9
<i>Ficus dammaropsis</i>	N. S.		4
<i>Ficus pachyrrhachis</i>	N. S.		6
<i>Ficus phaeosyce</i>	0.91	$I_c = 0.974 - 0.0019 d$	4
<i>Ficus pungens</i>	0.25	$I_c = 0.860 - 0.0008 d$	6
<i>Macaranga aleuritoides</i>	N. S.		9
<i>Macaranga brachytricha</i>	N. S.		4
<i>Macaranga clavata</i>	0.74	$I_c = 1.027 - 0.0013 d$	5
<i>Macaranga fallacina</i>	0.34	$I_c = 0.814 - 0.0006 d$	6
<i>Macaranga quadriglandulosa</i>	0.83	$I_c = 1.001 - 0.0003 d$	4
<i>Macaranga novoguineensis</i>	N. S.		7
<i>Macaranga tsonane</i>	N. S.		4
<i>Psychotria micrococca</i>	N. S.		7
<i>Syzygium longipes</i>	N. S.		4
<i>Syzygium</i> nr. " <i>stipulare</i> "	0.12	$I_c = 0.810 - 0.0601 \ln(d+1)$	9
<i>Syzygium</i> 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: \oplus = 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
<i>Ficus bernaysii</i> $_a$	\oplus	\oplus	\oplus	\oplus	\oplus	\oplus	\oplus	\oplus	513	513	4,604	48
<i>Ficus conocephalifolia</i>	\oplus	\oplus	+	\oplus	\oplus	-	\oplus	+	513	498	2,843	41
<i>Ficus copiosa</i> $_a$ $_b$	\oplus	\oplus	\oplus	\oplus	\oplus	\oplus	\oplus	\oplus	513	513	7,296	49
<i>Ficus dammaropsis</i>	\oplus	-	\oplus	-	+	-	\oplus	+	513	498	2,212	30
<i>Ficus hispidioides</i>	\oplus	\oplus	-	-	+	-	-	-	277	59	2,019	24
<i>Ficus pachyrrhachis</i> $_a$	\oplus	+	+	\oplus	\oplus	\oplus	-	\oplus	513	513	4,030	32
<i>Ficus phaeosyce</i>	\oplus	\oplus	\oplus	-	-	+	-	-	352	118	1,694	25
<i>Ficus pungens</i> $_a$	\oplus	+	+	\oplus	\oplus	\oplus	\oplus	\oplus	513	513	3,203	41
<i>Macaranga aleuritoides</i> $_b$	\oplus	\oplus	\oplus	\oplus	\oplus	\oplus	\oplus	\oplus	513	513	7,406	78
<i>Macaranga brachytricha</i>	\oplus	\oplus	+	\oplus	-	-	+	-	498	201	3,094	46
<i>Macaranga clavata</i>	\oplus	+	+	-	-	\oplus	\oplus	\oplus	513	513	3,356	50
<i>Macaranga dulcis</i>	\oplus	-	+	+	\oplus	-	+	+	513	277	2,049	35
<i>Macaranga fallacina</i>	\oplus	+	\oplus	+	-	+	\oplus	\oplus	513	513	2,999	71
<i>Macaranga fragrans</i>	+	-	\oplus	-	+	-	-	+	513	5	566	23
<i>Macaranga novoguineensis</i>	\oplus	\oplus	\oplus	+	\oplus	\oplus	+	\oplus	513	513	3,424	65
<i>Macaranga</i> nr. <i>hispida</i>	-	-	-	\oplus	-	\oplus	+	+	317	156	1,074	27
<i>Macaranga quadriglandulosa</i>	\oplus	+	\oplus	+	\oplus	-	-	-	277	277	3,632	62
<i>Macaranga tsonane</i>	-	-	-	\oplus	-	\oplus	\oplus	\oplus	317	317	2,594	50
<i>Psychotria micrococca</i> $_b$	\oplus	\oplus	\oplus	\oplus	\oplus	-	\oplus	-	498	498	3,209	35
<i>Psychotria</i> nr. <i>ectasiphylla</i>	-	-	-	-	-	-	-	\oplus	5	5	407	11
<i>Psychotria</i> nr. <i>hollandiae</i>	-	-	-	-	-	-	-	\oplus	5	5	466	13
<i>Psychotria ramuensis</i>	\oplus	+	-	-	+	-	\oplus	-	498	498	2,046	18
<i>Psychotria</i> sp.	-	-	-	-	-	\oplus	-	-	5	5	657	2
<i>Syzygium longipes</i>	\oplus	\oplus	-	\oplus	+	-	+	+	513	201	2,067	72
<i>Syzygium</i> nr. " <i>stipulare</i> " $_b$	\oplus	\oplus	\oplus	\oplus	\oplus	\oplus	\oplus	\oplus	513	513	3,670	145
<i>Syzygium</i> sp.	\oplus	-	\oplus	+	\oplus	-	\oplus	+	513	498	3,567	111
n	26,4		6,88	5,56		7,02	5,21	7,63				
S	60	7,528	8	5	7,864	9	8	2			74,184	
	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 km² of primary and secondary forests at each site. BA was estimated by enumeration of all plants >1.5m high in 50 plots, 400 m² each, equally distributed between primary and secondary forest vegetation at each site. All parameters are given as means \pm 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 cm²/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}	$\%S_{sampled}$	BA_{local}	$\%BA_{sampledG}$	$\%BA_{sampledT}$
<i>Ficus</i>	87	43.1 \pm 2.17	11 \pm 0.9	14600 \pm 5073	40 \pm 10.4	1.7 \pm 0.68
<i>Macaranga</i>	35	13.3 \pm 0.88	37 \pm 4.9	6203 \pm 2176	86 \pm 7.2	2.0 \pm 0.53
<i>Psychotria</i>	21	4.5 \pm 0.76	35 \pm 5.1	469 \pm 190	46 \pm 13.8	0.1 \pm 0.02
<i>Syzygium</i>	32	7.3 \pm 1.50	39 \pm 10.6	1425 \pm 680	69 \pm 10.6	0.4 \pm 0.18
Total	175	68.1 \pm 2.90	19 \pm 1.2	22698 \pm 5677	56 \pm 10.8	4.2 \pm 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
<i>Ficus adelpha</i> Laut. et K.Schum.	√	√	√		√	√		√	6	513
<i>Ficus adenosperma</i> Miq.	√		√		√		√	√	5	513
<i>Ficus alocarpa</i> Diels			√	√	√		√		4	392
<i>Ficus amblysyce</i> Corner		√							1	5
<i>Ficus ampelas</i> Burm. f.	√				√				2	277
<i>Ficus arbuscula</i> Laut. et K.Schum.	√	√		√		√		√	5	513
<i>Ficus archiboldiana</i> Summerh.		√		√	√		√		4	443
<i>Ficus arfakensis</i> King	√	√	√	√	√	√	√	√	8	513
<i>Ficus austrina</i> Corner	√		√	√				√	4	513
<i>Ficus badiopurpurea</i> Diels						√	√	√	3	158
<i>Ficus baeuerlenii</i> King	√		√	√	√	√	√	√	7	513
<i>Ficus benjamina</i> L.			√		√				2	163
<i>Ficus benjaminoides</i> Corner			√			√			2	270
<i>Ficus bernaysii</i> King	√	√	√	√	√	√	√	√	8	513
<i>Ficus botryocarpa</i> Miq.	√	√	√		√		√	√	6	513
<i>Ficus caesaroides</i> King				√					1	5
<i>Ficus caulocarpa</i> Miq.			√		√				2	163
<i>Ficus comitis</i> King			√		√				2	163
<i>Ficus congesta</i> Roxb.	√	√	√	√	√	√	√	√	8	513
<i>Ficus conocephalifolia</i> Ridley	√	√	√	√	√	√	√	√	8	513
<i>Ficus copiosa</i> Steud.	√	√	√	√	√	√	√	√	8	513
<i>Ficus crassiramea</i> Miq.	√	√	√	√	√				5	277
<i>Ficus dammaropsis</i> Diels	√		√		√		√	√	5	513
<i>Ficus disticha</i> Bl.			√	√	√	√			4	270
<i>Ficus drupacea</i> Thunb.	√	√	√	√	√		√	√	7	513
<i>Ficus edelfeltii</i> King	√		√			√		√	4	513
<i>Ficus erythrosperma</i> Miq.	√		√	√	√	√	√	√	7	513
<i>Ficus glaberrima</i> Bl.					√				1	5
<i>Ficus glandulifera</i> Wall ex Miq.				√		√			2	156
<i>Ficus gracillima</i> Diels	√					√			2	352
<i>Ficus gul</i> Laut. et K.Schum.	√		√		√				3	277
<i>Ficus hadroneura</i> Diels				√					1	5
<i>Ficus hesperidiformis</i> King	√	√	√	√	√		√		6	498
<i>Ficus hispidooides</i> S. Moore	√	√			√				3	277
<i>Ficus hombroniana</i> Corner		√	√	√			√	√	5	456
<i>Ficus itoana</i> Diels	√					√	√		3	498
<i>Ficus jimienis</i> C. C. Berg	√			√			√		3	498
<i>Ficus leptodictya</i> Diels			√		√				2	163
<i>Ficus macrorrhyncha</i> Laut. et K.Schum.	√		√						2	118
<i>Ficus melinocarpa</i> Bl.	√	√	√	√	√	√	√	√	8	513
<i>Ficus microcarpa</i> L.			√		√				2	163
<i>Ficus mollior</i> Bl.	√	√	√	√		√	√	√	7	513
<i>Ficus morobensis</i> C. C. Berg	√			√			√	√	4	513
<i>Ficus nodosa</i> Teysm. et Binn.	√	√	√	√	√	√	√	√	8	513
<i>Ficus novoguineensis</i> Corner	√		√	√				√	4	513
<i>Ficus odoardi</i> King	√	√	√	√	√	√	√	√	7	513
<i>Ficus pachyrrhachis</i> Laut. et K.Schum.	√	√	√	√	√	√		√	7	513
<i>Ficus pantoniana</i> King			√	√			√		3	392
<i>Ficus phaeosyce</i> Laut. et K.Schum.	√	√	√			√			4	352
<i>Ficus pilulifera</i> Corner				√					1	5
<i>Ficus polyantha</i> Warb.	√	√	√	√	√	√	√	√	8	513
<i>Ficus porphorochaete</i> Corner						√			1	5
<i>Ficus prasinicarpa</i> Elm.	√								1	5
<i>Ficus primaria</i> Corner	√		√		√				4	277
<i>Ficus pseudojaca</i> Corner		√	√	√	√				4	229
<i>Ficus pungens</i> Reinw. ex Bl.	√	√	√	√	√	√	√	√	8	513
<i>Ficus robusta</i> Corner	√				√		√		3	498
<i>Ficus saurauioides</i> Diels						√	√	√	3	158
<i>Ficus scratchleyana</i> King				√				√	2	317
<i>Ficus semivestita</i> Corner	√	√	√		√		√	√	6	513
<i>Ficus septica</i> Burm. f.	√				√	√	√	√	5	513

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

Appendix S1 continued	Ohu	Wan	Mor	Ele	Wam	Nik	Uta	Yap	<i>n</i>	<i>D</i>
<i>Psychotria</i> sp. 8		√							1	5
<i>Psychotria</i> sp. 9		√							1	5
<i>Psychotria</i> sp. 10				√					1	5
<i>Psychotria</i> sp. 11							√		1	5
<i>Psychotria</i> sp. 12			√						1	5
<i>Psychotria</i> sp. 13			√						1	5
<i>Psychotria</i> sp. 14							√		1	5
<i>Syzygium aqueum</i> Alston	√								1	5
<i>Syzygium longipes</i> (Warb.) Merrill & Perry	√	√		√	√		√	√	6	513
<i>Syzygium malaccense</i> Merr. & Perry	√								1	5
<i>Syzygium subalatum</i> (Ridl.) Merr. & L. M. Perry			√						1	5
<i>Syzygium tierneyanum</i> (F.Muell.) Hartley & Perry	√			√					2	201
<i>Syzygium</i> sp. 1							√		1	5
<i>Syzygium</i> sp. 2 cf. <i>longipes</i> (Warb.) Merrill & Perry							√		1	5
<i>Syzygium</i> sp. 3							√		1	5
<i>Syzygium</i> sp. 4 cf. " <i>stipulare</i> " Craven	√	√	√	√	√	√	√	√	8	513
<i>Syzygium</i> sp. 5							√	√	2	150
<i>Syzygium</i> sp. 6							√		1	5
<i>Syzygium</i> sp. 7							√		1	5
<i>Syzygium</i> sp. 8							√		1	5
<i>Syzygium</i> sp. 9		√							1	5
<i>Syzygium</i> sp. 10				√					1	5
<i>Syzygium</i> sp. 11								√	1	5
<i>Syzygium</i> sp. 12								√	1	5
<i>Syzygium</i> sp. 13			√						1	5
<i>Syzygium</i> sp. 14			√						1	5
<i>Syzygium</i> sp. 15			√						1	5
<i>Syzygium</i> sp. 16			√						1	5
<i>Syzygium</i> sp. 17					√				1	5
<i>Syzygium</i> sp. 18					√		√		2	237
<i>Syzygium</i> sp. 19				√					1	5
<i>Syzygium</i> sp. 20				√					1	5
<i>Syzygium</i> sp. 21 " <i>gelpkeoid</i> " complex	√		√	√			√		4	498
<i>Syzygium</i> sp. 22	√			√	√			√	4	513
<i>Syzygium</i> sp. 23	√		√	√	√		√	√	6	513
<i>Syzygium</i> sp. 24							√		1	5
<i>Syzygium</i> sp. 25							√		1	5
<i>Syzygium</i> sp. 26 <i>trivene</i> complex	√								1	5
<i>Syzygium</i> 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
<i>Addaea pusilla</i> (Butler)	Thyrididae	910	<i>Macaranga</i>	8	513	513
<i>Addaea</i> sp. nr. <i>probolopsis</i> Meyrick [CRAM083]	Thyrididae	205	<i>Macaranga</i>	6	513	513
<i>Adoxophyes fasciculana</i> (Walker)	Tortricidae	23	Generalist	4	513	498
<i>Adoxophyes nebrodes</i> Diakonoff	Tortricidae	36	Generalist	6	513	513
<i>Adoxophyes</i> cf. <i>orana</i> (Fischer v. Roeslerstamm) [TORT094, 066]	Tortricidae	75	Generalist	8	513	513
<i>Adoxophyes tripselia</i> (Lower)	Tortricidae	54	Generalist	6	513	498
<i>Agrotera ignepictoides</i> Rothschild	Crambidae	47	<i>Syzygium</i>	5	513	352
<i>Agrotera</i> sp. nr. <i>basinotata</i> Hampson [CRAM098]	Crambidae	44	<i>Syzygium</i>	4	513	277
<i>Agrotera</i> cf. <i>effertalis</i> Walker [PYRA012]	Crambidae	61	<i>Syzygium</i>	7	513	513
<i>Albinospila syntyche</i> Prout	Geometridae	182	<i>Macaranga</i>	8	513	513
<i>Arctornis</i> sp. nr. <i>intacta</i> Walker [LYMA007]	Lymantriidae	203	Generalist	8	513	513
<i>Asota carica</i> (F.)	Noctuidae	301	<i>Ficus</i>	5	513	513
<i>Asota plana</i> Walker	Noctuidae	150	<i>Ficus</i>	5	513	513
<i>Asota versicolor</i> F.	Noctuidae	29	<i>Ficus</i>	4	513	277
<i>Brenthia</i> sp. [CHOR002]	Choreutidae	849	<i>Ficus</i>	8	513	513
<i>Brenthia</i> sp. [CHOR008]	Choreutidae	240	<i>Macaranga</i>	6	513	498
<i>Brenthia</i> sp. [CHOR015]	Choreutidae	65	<i>Ficus</i>	3	513	304
<i>Brenthia</i> sp. [CHOR016]	Choreutidae	599	<i>F. dammaropsis</i>	3	498	498
<i>Brenthia</i> sp. nov. [CHOR001]	Choreutidae	365	<i>Ficus</i>	5	513	277
<i>Chora hunttei</i> Warren	Nolidae	24	<i>Syzygium</i>	4	498	498
<i>Choreutis basalis</i> (Felder & Rogenhofer)	Choreutidae	366	<i>Ficus</i>	8	513	513
<i>Choreutis lutescens</i> (Felder & Rogenhofer)	Choreutidae	439	<i>Ficus</i>	8	513	513
<i>Choreutis</i> sp. [CHOR011]	Choreutidae	59	<i>Ficus</i>	3	513	201
<i>Choreutis</i> sp. [CHOR014]	Choreutidae	202	<i>Ficus</i>	5	513	513
<i>Choreutis</i> sp. nr. <i>anthorma</i> (Meyrick) [TORT005]	Choreutidae	736	<i>Ficus</i>	8	513	513
<i>Chrysocraspeda</i> sp. nr. <i>inundata</i> Warren [GEOM110]	Geometridae	203	<i>Syzygium</i>	2	498	277
" <i>Coelorrhycidia</i> " <i>nitidalis</i> Hampson	Crambidae	324	<i>Psychotria</i>	7	513	513
" <i>Coelorrhycidia</i> " <i>purpurea</i> Hampson	Crambidae	1178	<i>Psychotria</i>	8	513	513
" <i>Coelorrhycidia</i> " sp. complex [CRAM041]	Crambidae	1048	<i>Psychotria</i>	7	513	513
<i>Cyrestis acilia</i> Godart	Nymphalidae	28	<i>Ficus</i>	6	513	513
<i>Dichomeris ochreoviridella</i> (Pagenstecher)	Gelechiidae	1069	<i>Macaranga</i>	8	513	513
<i>Dichomeris</i> sp. [XXXX068]	Gelechiidae	907	<i>Macaranga</i>	8	513	513
<i>Dichomeris</i> sp. [XXXX120]	Gelechiidae	77	<i>Macaranga</i>	7	513	513
<i>Dudua</i> sp. nov. nr. <i>aprobola</i> (Meyrick) [TORT143]	Tortricidae	160	<i>Syzygium</i>	5	513	498
Gen. nov. nr. " <i>Loboschiza</i> " sp. nov. [TORT172]	Tortricidae	59	<i>Syzygium</i>	8	513	513
<i>Glyphodes margaritaria</i> (Cramer)	Crambidae	225	<i>Ficus</i>	8	513	513
<i>Homona mermerodes</i> Meyrick	Tortricidae	49	Generalist	6	513	498
<i>Homona phanaea</i> Meyrick	Tortricidae	40	Generalist	6	513	513
<i>Idiophantis</i> sp. nov. [TORT163]	Gelechiidae	70	<i>Syzygium</i>	7	513	513
<i>Macarostola</i> sp. [XXXX139]	Gracillariidae	36	<i>Syzygium</i>	4	513	513
<i>Macarostola</i> sp. [XXXX154]	Gracillariidae	31	<i>Syzygium</i>	2	513	277
<i>Macroglossum melas pullius</i> Rothschild & Jordan	Sphingidae	76	<i>Psychotria</i>	7	513	513
<i>Mecistoptera</i> sp. nov. [XXXX092]	Noctuidae	30	Generalist	6	513	498
<i>Mellea hieroglyphica</i> (Warren)	Thyrididae	112	<i>Macaranga</i>	7	513	456
<i>Mellea nitida</i> (Pagenstecher)	Thyrididae	357	<i>Macaranga</i>	8	513	513
<i>Mellea ordinaria</i> (Warren)	Thyrididae	1283	<i>Macaranga</i>	8	513	513
<i>Mellea ramifera</i> (Warren)	Thyrididae	361	<i>Macaranga</i>	6	513	513
<i>Mellea</i> sp. [THYR012]	Thyrididae	101	<i>Macaranga</i>	8	513	513
<i>Mellea</i> sp. nov. [THYR019]	Thyrididae	64	<i>Macaranga</i>	3	513	427
<i>Mellea</i> sp. nr. <i>ramifera</i> (Warren) [THYR016]	Thyrididae	246	<i>Macaranga</i>	6	513	513
<i>Mellea</i> sp. nr. <i>ordinaria</i> (Warren) [THYR013]	Thyrididae	44	<i>Macaranga</i>	6	513	456
<i>Mellea</i> sp. nr. <i>ordinaria</i> (Warren) [THYR014]	Thyrididae	27	<i>Macaranga</i>	6	513	456
<i>Mellea</i> sp. nr. <i>rectiviata</i> (Warren) [THYR018]	Thyrididae	115	<i>Macaranga</i>	3	352	270
<i>Moca congrualis</i> (Walsingham)	Immidae	27	Generalist	8	513	513
<i>Nycteola indicatana</i> (Walker)	Tortricidae	52	<i>Syzygium</i>	7	513	513
<i>Oenospila</i> sp. nr. <i>flavilinea</i> Warren [GEOM150]	Geometridae	88	<i>Syzygium</i>	6	498	498
<i>Ophiorrhada deceptor</i> Diakonoff	Tortricidae	267	<i>Syzygium</i>	8	513	513
<i>Ophyx crinipes</i> Felder	Noctuidae	31	<i>Ficus</i>	5	513	513
<i>Orthaga</i> sp. nr. <i>percnodes</i> Turner [NOCT020]	Pyrilidae	23	Generalist	5	513	498
<i>Paraphomia disjuncta</i> Whalley	Noctuidae	394	<i>M. aleuritoides</i>	6	513	456
<i>Pharambora splendida</i> (Butler)	Thyrididae	1208	<i>Macaranga</i>	8	513	513
<i>Philiris helena helena</i> (Snellen)	Lycaenidae	189	<i>Macaranga</i>	8	513	513
<i>Philiris moira</i> Grose-Smith	Lycaenidae	85	<i>Ficus</i>	5	513	513
" <i>Pseudocera</i> " nr. <i>trissosticha</i> (Turner) [CRAM067]	Crambidae	82	<i>Syzygium</i>	3	498	277

Appendix S2 continued	Family	<i>N</i>	Host range	<i>n</i>	<i>G</i>	<i>d</i>
<i>Pyrophractis isotherma</i> Meyrick	Oecophoridae	59	<i>S. nr. stipulare</i>	3	513	158
<i>Rhodoneura aurata</i> (Butler)	Thyrididae	484	<i>Macaranga</i>	7	513	513
<i>Talanga deliciosa</i> (Butler)	Crambidae	290	<i>Ficus</i>	7	513	498
<i>Talanga excelsalis moresbyensis</i> (Strand)	Crambidae	1275	<i>Ficus</i>	8	513	513
<i>Talanga polyzonalis</i> (Hampson)	Crambidae	85	<i>Ficus</i>	6	513	513
<i>Talanga sexpunctalis</i> (Moore)	Crambidae	543	<i>Ficus</i>	8	513	513
<i>Tamba kebea</i> Bethune-Baker	Geometridae	176	<i>S. nr. stipulare</i>	5	513	443
<i>Thalassodes</i> (s.l.) <i>albifusa</i> (Warren)	Geometridae	247	Generalist	8	513	513
<i>Unadophanes trissomita</i> (Turner)	Pyralidae	482	<i>Macaranga</i>	8	513	513
<i>Xenothictis gnetivora</i> Brown, Miller & Horak	Tortricidae	36	Generalist	6	513	513
<i>Holocola</i> sp. nov. [TORT170]	Tortricidae	24	<i>Syzygium</i>	4	513	513
<i>Zeugma recusataria</i> Walker	Geometridae	550	<i>Syzygium</i>	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* ≥ 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	<i>N</i>	Host range	<i>n</i>	<i>D</i>
<i>Arixyleborus</i> sp. nr. <i>morio</i> Eggers	Scolytinae	17	<i>Artocarpus, Ficus</i>	3	950
<i>Arixyleborus canaliculatus</i> (Eggers)	Scolytinae	10	generalist	3	950
<i>Coptodryas popondettae</i> Browne	Scolytinae	24	generalist	2	950
<i>Crossotarsus kuntzei</i> (Schedl)	Platypodinae	101	generalist	3	950
<i>Crossotarsus lacordairei</i> Chapuis	Platypodinae	20	generalist	2	500
<i>Crossotarsus minusculus</i> Chapuis	Platypodinae	20	generalist	3	950
<i>Crossotarsus mnizsechi</i> Chapuis	Platypodinae	40	generalist	3	950
<i>Cyclorhipidion agnatum</i> (Eggers)	Scolytinae	30	generalist	3	950
<i>Diapus pussilimus</i> Chapuis	Platypodinae	272	generalist	3	950
<i>Diapus quinquespinatus</i> Chapuis	Platypodinae	24	generalist	3	950
<i>Dinoplatypus</i> sp. #481	Platypodinae	74	<i>Nauclea</i>	1	5
<i>Dinoplatypus chevrolati</i> (Chapuis)	Platypodinae	411	generalist	2	950
<i>Dinoplatypus pallidus</i> Chapuis	Platypodinae	2381	generalist	3	950
<i>Eccoptopterus gracilipes</i> Eichhoff	Scolytinae	90	generalist	3	950
<i>Eccoptopterus spinosus</i> Oliv.	Scolytinae	29	generalist	2	500
<i>Euwallacea bicolor</i> (Blandford)	Scolytinae	249	generalist	3	950
<i>Euwallacea destruens</i> Blandford	Scolytinae	15	<i>Artocarpus, Ficus</i>	2	500
<i>Euwallacea fornicatus</i> (Eichhoff)	Scolytinae	350	generalist	3	950
<i>Euwallacea piceus</i> (Motschulsky)	Scolytinae	187	generalist	3	950
<i>Euwallacea talumalai</i> (Browne)	Scolytinae	22	generalist	3	950
<i>Euwallacea wallacei</i> Blandford	Scolytinae	18	generalist	3	950
<i>Euwallacea xanthopus-fraternus</i> (Blandford)	Scolytinae	56	<i>Artocarpus, Ficus</i>	2	950
<i>Leptoxyleborus concisus</i> (Blandford)	Scolytinae	212	generalist	3	950
<i>Microperus</i> sp. nr. <i>libra</i> (Eggers)	Scolytinae	58	generalist	3	950
<i>Microperus diversicolor</i> (Eggers)	Scolytinae	156	generalist	3	950
<i>Platypus</i> sp. #279	Platypodinae	11	<i>Ficus</i>	3	950
<i>Platypus jansonii</i> Chapuis	Platypodinae	562	generalist	3	950
<i>Platypus lunati</i> Schedl	Platypodinae	85	generalist	2	500
<i>Platypus</i> nr. <i>selysi</i> Chapuis	Platypodinae	10	<i>Artocarpus, Ficus</i>	1	5
<i>Platypus sulcinodis</i> Schedl	Platypodinae	12	<i>Leea</i>	2	500
<i>Treptoplatypus solidus</i> (Walker)	Platypodinae	274	generalist	3	950
<i>Xyleborinus perexiguus</i> Schedl	Scolytinae	387	generalist	3	950
<i>Xyleborus</i> sp. #126	Scolytinae	10	generalist	1	5
<i>Xyleborus affinis</i> Eichhoff	Scolytinae	550	generalist	3	950
<i>Xyleborus approximatus</i> Schedl	Scolytinae	10	generalist	2	500
<i>Xyleborus duodecimspinatus</i> Schedl	Scolytinae	47	generalist	2	500
<i>Xyleborus fallax</i> Eichhoff	Scolytinae	177	generalist	3	950
<i>Xyleborus ferrugineus</i> F.	Scolytinae	9	generalist	2	500
<i>Xyleborus immersus</i> Schedl	Scolytinae	439	generalist	3	950
<i>Xyleborus perforans</i> Wollaston	Scolytinae	2304	generalist	3	950
<i>Xyleborus pumilus</i> Eggers	Scolytinae	511	generalist	3	950
<i>Xyleborus similis</i> Ferrari	Scolytinae	99	generalist	3	950
<i>Xylosandrus crassiusculus</i> (Motschulsky)	Scolytinae	115	generalist	1	5
<i>Xylosandrus morigerus</i> (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
<i>Bactrocera abdorigella</i> (Drew)	1638	4	950
<i>Bactrocera abdopallescens</i> (Drew)	29	2	392
<i>Bactrocera aurantiaca</i> (Drew & Hancock)	212	4	950
<i>Bactrocera brevistriata</i> (Drew)	31	4	950
<i>Bactrocera circumusae</i> Drew	11	2	82
<i>Bactrocera contermina</i> Drew	12	1	5
<i>Bactrocera curreyi</i> Drew	13	3	443
<i>Bactrocera curvifera</i> (Walker)	1329	4	950
<i>Bactrocera enochra</i> (Drew)	297	4	950
<i>Bactrocera frauenfeldi</i> (Schiner)	13	2	950
<i>Bactrocera fulvicauda</i> (Perkins)	1584	4	950
<i>Bactrocera fufurosa</i> Drew	86	3	585
<i>Bactrocera furvilineata</i> Drew	61	3	950
<i>Bactrocera latissima</i> Drew	74	4	950
<i>Bactrocera lineata</i> (Perkins)	505	4	950
<i>Bactrocera macrovittata</i> Drew	66	1	5
<i>Bactrocera moluccensis</i> (Perkins)	74	4	950
<i>Bactrocera morobiensis</i> Drew	145	3	443
<i>Bactrocera musae</i> (Tryon)	22812	4	950
<i>Bactrocera neocheesmanae</i> (Drew)	96	3	585
<i>Bactrocera paramusae</i> Drew	1266	4	950
<i>Bactrocera recurrens</i> (Hering)	528	4	950
<i>Bactrocera resima</i> (Drew)	25	3	443
<i>Bactrocera sandracina</i> Drew	187	4	950
<i>Bactrocera strigifinis</i> (Walker)	25	2	392
<i>Bactrocera tinomiscii</i> Drew	95	2	82
<i>Bactrocera trivialis</i> (Drew)	238	4	950
<i>Bactrocera umbrosa</i> (Fabricius)	2335	4	950
<i>Bactrocera vulgaris</i> (Drew)	2927	4	950
<i>Dacus impar</i> Drew	13	3	950
<i>Dacus melanothumeralis</i> Drew	47	2	82