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4 Determinants of the microstructure of plant-pollinator networks. *Ecology*.

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6 Appendix A: Detailed supplementary information on the methods, including tables and figures

7

8 **A.1 Plant–pollinator networks**

9 In total, 97 flower visitor taxa were recorded, of which 14 taxa, belonging to the groups of
10 spiders, crickets, true bugs (hemiptera) and ants, were excluded from the networks as they were
11 not considered pollinators of the inselberg plants. Pollinators were identified to species level for
12 28 taxa (34%) and to morpho-species level for the remaining 55 taxa (66%; hereafter all
13 pollinator taxa are referred to as ‘pollinator species’). Morpho-species were not pooled based on
14 morphological traits such as size, but they were distinguished at the smallest possible level
15 without taxonomic determination and assigned a species code. Flower visitors were recorded as
16 pollinators when they touched the sexual parts of flowers. Sampling of interactions was
17 conducted by the same three observers throughout the 8-month flowering season and sampling
18 was standardized between observers fortnightly. We used equal observation periods for all plant
19 species to reduce sampling bias and to collect data on interaction frequency independent of size
20 constraints and flower abundance (Ollerton and Cranmer 2002).

21 To assess the effect of sampling on network dissimilarities we conducted a rarefaction
22 analysis (Hurlbert 1971, Heck et al. 1975). We calculated Bray-Curtis dissimilarities (see Section
23 D below for a detailed description on dissimilarity matrices) between rarefied interaction
24 matrices sampled at four different proportions (0.8, 0.6, 0.4 and 0.2) and compared the resulting
25 mean \pm 95% CI dissimilarities of the rarefied matrices to the dissimilarity between the original
26 matrices. Sampling simulation was carried out with the function `rarefmat` in R (the code of the
27 function is provided in Appendix A.1). Interaction matrices consisted of all plant and animal
28 species in rows and columns, respectively. Cells contained a normalized measure of interaction
29 frequency, which was rounded up to the next integer to allow for rarefaction. Dissimilarities were
30 calculated based on relative frequencies in the rarefied and observed matrices. We ran a
31 subsample ($N = 86$) of all possible pairwise matrix comparisons within and across sites and time
32 periods. All comparisons showed similar results: None of the rarefied matrices were significantly
33 more or less dissimilar than the observed matrices even at low sampling proportions, and the
34 overall differences in dissimilarities between rarefied and observed matrices were relatively
35 small (Fig. B4). These findings suggest that the comparison of dissimilarities between interaction
36 matrices is robust to sampling effects.

37

38 **A.2 Plant traits – floral complexity and exotic plants**

39 To quantify floral complexity, we identified *a priori* four flower traits to describe a gradient of
40 increasing floral restrictiveness and handling complexity: (1) floral symmetry and pollen
41 presentation patterns within the flower, (2) flower dimensionality, (3) accessibility of nectar, and

42(4) flower orientation (Table A5). Scores from 0–5 were assigned to each trait reflecting an
43increasing degree of handling complexity, and added up to one single value per plant species,
44reflecting its total floral complexity. Plants with total scores close to 20 were considered
45extremely complex, restricting flower access to a small group of specialized pollinator species.
46In contrast, plants with scores close to 0 presented flowers accessible to a large variety of
47pollinator species. Pollinator species richness decreased significantly with increasing floral
48complexity (Fig. B5; linear regression: $R^2 = 0.198$, $df = 36$, $P = 0.0052$). The species included in
49this study were scored independently by three people based on photographs and handling
50experience of the flowers, and the assigned scores differed only minimally in two of 37 plant
51species (scores in Table A3). To assess the influence of the category size on the model fit, we
52conducted the same analysis with five and seven equally-sized categories which generated
53comparable statistical models. The model with five categories (width of categories: 0–3, 4–7, 8–
5411, 12–15, ≤ 16 complexity scores) had the better overall fit and we therefore used only the model
55with five categories in the analysis.

56 The proportion of exotic flowers in the communities was included as an independent
57predictor variable in our models for two reasons: (1) exotic flowers have been shown to be
58particularly attractive to pollinators as a result of their high energy nectar and attractive flowers
59(e.g., Chittka and Schürkens 2001), and (2) the attractiveness of exotic plants can be unevenly
60distributed within the pollinator community (e.g., exotic pollinators are more frequently attracted
61to exotic plants than native pollinators; Aizen et al. 2008, Kaiser-Bunbury et al. 2011). These
62properties of exotic plants are not part of plant abundance and trait variables and thus warrant
63independent inclusion in the model.

64

65 **A.3 Pollinator traits – body size**

66We used body dimensions of pollinators to define functional groups of pollinator traits. We
67recorded thorax width and total body length of invertebrates, head width and body length
68(without tail) of birds, and head width and snout to vent length of geckos (Table A4) as proxy for
69pollinator functional diversity (Stang et al. 2006). Total body length (head, thorax and abdomen)
70was recorded on straightened insects, and we used calipers to measure body dimensions to the
71nearest 0.1 mm. Thorax width and body length were highly correlated (log-transformed; $r = 0.80$,
72 $P < 0.001$, $N = 83$). To determine the optimal number of size classes, we plotted a histogram of
73thorax width (log-transformed) and selected the lowest number of equal size categories which
74created a good fit to the normal distribution. We tested the robustness of the classification by
75running the same analysis with seven, eight and nine categories, both with thorax width and body
76size. All possible combinations generated similar qualitative effects but the best fit showed the
77model with thorax width and eight size classes. Thus, we used eight size classes of pollinator
78functional groups in the analysis.

79

80 **A.4 Dissimilarity variables**

81We created 48 interaction matrices consisting of 37 plant species in rows and 83 pollinator
82species in columns. Interaction frequency between two mutualistic partners was normalized by

83dividing by total interaction frequency in the network. We computed Bray-Curtis dissimilarity
84values for all pair-wise combinations of the interaction matrices. The output was a 48×48 lower
85triangular matrix with cells containing interaction dissimilarities quantifying the degree of
86dissimilarity between every pair of interaction matrices ($D_{x,y}$). Following a similar procedure, we
87created dissimilarity matrices for all observed indicator variables. Dissimilarity matrices were
88calculated from the following matrices with 48 networks in rows: Floral and pollinator
89abundance contained plant and animal species, respectively, in columns ordered by decreasing
90relative abundance in each network, independent of species identity, and relative floral
91abundance in cells; floral composition and pollinator composition contained plant and pollinator
92species in columns and sum of floral abundance and mean interaction frequency in cells,
93respectively; the proportion of exotic flowers in each network contained the proportion of exotic
94flowers in communities +1 in one row—1 was added to avoid zero in the denominator when
95calculating dissimilarities of communities without exotic flowering plants; and plant and
96pollinator trait matrices had categories in columns and the sum of floral abundance and mean
97interaction frequency in cells, respectively. Bray-Curtis dissimilarities index ranges from 1 to 0,
98where values close to 0 are relatively similar and values close to 1 are highly dissimilar.

99 All variables except time of year and geographic location were normalized prior to
100calculating dissimilarity values by dividing each cell by the marginal sums of the rows. For time
101of year and location we calculated Euclidean distances with unnormalized number of days and
102distance in meters between network pairs, respectively. To account for a weak seasonality effect
103of species richness and abundance, we used periodic instead of a linear temporal distance
104between networks fitted to an annual cycle. That is, the maximum temporal distance between
105two networks was 182 days.

106

107 **A.5 Model fit and analysis quality**

108We employed goodness-of-fit indices using discrepancy functions, comparisons with null
109models, and information theory to assess model fit, including chi-square tests (compared to
110hypothesized and null model), adjusted goodness-of-fit index, root mean square error of
111approximation (RMSEA), Tucker-Lewis non-normed fit index (NNFI), Bentler-Bonnett normed
112fit index (NFI), Bentler comparative fit index (CFI) and standardized root mean square residual
113(SRMR). Index criteria, model fit thresholds, and index values for all three models are
114summarized in Table A6.

115 Using a correlation matrix in structural equation modelling instead of a covariance matrix
116can result in incorrect standard errors of the coefficients as they fail to take account of sampling
117variance in the standard deviations (Cudeck 1989, Grace 2006). Given the large sample size of
118our data sets and the normalized dissimilarity matrices, however, we believe that any potential
119inaccuracy in the calculation of the standard errors is of little biological relevance. The author of
120the sem library in R provided specific examples on building structural equation models on
121correlation matrices (Duncan et al. 1968 in manual to the R library ‘sem’, Fox 2012) and
122confirmed the use of Wald tests as appropriate tools to determine the statistical significance of
123model coefficients (J. Fox, pers. comm.). Further, to verify the results of our path analysis in R,

124we ran the same full model with Reticular Action Model or Near Approximation (RAMONA)
125implemented in the statistical package SYSTAT 12. Both sem and RAMONA use reticular action
126model notation (McArdle and McDonald 1984). RAMONA, however, accounts for the
127correlation matrix when fitting path analysis models and thereby avoids the potential errors
128associated to path analysis that treat a correlation matrix as if it were a covariance matrix. The
129results of the RAMONA model were comparable to those generated in R, suggesting that the
130influence of the correlation matrix on the standard errors of the coefficients was negligible.

131 The correlation between floral composition and floral complexity was non-linear and
132showed a triangular pattern (Fig. A2). The pattern arises because networks that are similar in
133floral trait composition can be similar or dissimilar in plant species composition, networks that
134are very dissimilar in flower trait composition can only be dissimilar in plant species
135composition. To address this constraint, we developed a null-model to calculate Spearman
136correlation coefficients r_s of randomly generated data (999 iterations) that were restricted by
137the limits of the observed data (the R code of the null model is provided in AppendixA.2). We
138evaluated the statistical significance of \hat{r}_s by calculating its 97.5% confidence intervals. To
139test the effect of the randomised \hat{r}_s on our SEM, we fixed the path between floral
140composition and floral complexity to \hat{r}_s (Fox 2006) and compared this model, following the
141model simplification procedure described above, to the model in which the path between floral
142composition and floral complexity is allowed to vary randomly (Shipley 2000). The model with
143the fixed parameter had a significantly worse model fit ($\Delta\text{BIC} = 13.9$; likelihood ratio test: $\chi^2 =$
14420.9, $P < 0.0001$); we thus present here results on the original model with free parameter
145estimates only.

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188TABLE A1. Relationships between ecological variables that justify paths between dissimilarity variables shown in the hypothesized models (Fig. 1
189and A1). In the hypothesized models there are directed paths from dissimilarities in variable 1 to dissimilarities in variable 2. While the justifications
190are based on ecological relationships they take into account that dissimilarities of the variables are used in the models. For definitions and detailed
191explanations on the variables see Appendix A.2-4.

192

Variable 1	Variable 2	Justification	Reference
Time	Pollinator abundance distribution	Species abundance and composition of a community are determined by species' phenophases. Networks that are closer in time are more likely to share the same species, their relative and total abundances, and, consequently, pairwise interactions than networks that are temporally further apart.	Alarcón, R., N. M. Waser, and J. Ollerton. 2008. Year-to-year variation in the topology of a plant-pollinator interaction network. <i>Oikos</i> 117:1796-1807. Herrera, J. 1988. Pollination relationships in southern Spanish Mediterranean shrublands. <i>Journal of Ecology</i> 76:274-287. Olesen, J. M., J. Bascompte, H. Elberling, and P. Jordano. 2008. Temporal dynamics in a pollination network. <i>Ecology</i> 89:1573-1582. Olesen, J. M., Y. L. Dupont, E. J. O'Gorman, T. C. Ings, K. Layer, C. J. Melian, K. Trojelsgaard, D. E. Pichler, C. Rasmussen, and G. Woodward. 2010. From Broadstone to Zackenberg: Space, Time and Hierarchies in Ecological Networks. Pages 1-69 in G. Woodward, editor. <i>Advances in Ecological Research: Ecological Networks</i> , Vol 42. Petanidou, T., A. S. Kallimanis, J. Tzanopoulos, S. P. Sgardelis, and J. D. Pantis. 2008. Long-term observation of a pollination network: fluctuation in species and interactions, relative invariance of network structure and implications for estimates of specialization. <i>Ecology Letters</i> 11:564-575. Rasmussen, C., Y. L. Dupont, J. B. Mosbacher, K. Trojelsgaard, and J. M. Olesen. 2013. Strong impact of temporal resolution on the structure of an ecological network. <i>PLoS ONE</i> 8:e81694.
	Pollinator composition		
	Interaction pattern		
	Floral composition		
	Floral abundance distribution		
Exotics dominance			
Location	Pollinator abundance distribution	Spatial distance refers to the distance in meters between two communities.	Bronstein, J. L. 1994. Our current understanding of mutualism. <i>Quarterly Review of Biology</i> 69:31-51.
	Pollinator composition	Within habitat types, the similarity of	Burkle, L. and R. Irwin. 2009. The importance of interannual

	Interaction pattern	communities in terms of species abundance and composition and exotic species dominance decreases with spatial distance. Interactions may be influenced by species abundance and composition, and we thus expect the similarity of the identity and frequency of interactions also to decrease with spatial distance.	variation and bottom-up nitrogen enrichment for plant-pollinator networks. <i>Oikos</i> 118:1816-1829. Nekola, J. C. and P. S. White. 1999. The distance decay of similarity in biogeography and ecology. <i>Journal of Biogeography</i> 26:867-878. Steffan-Dewenter, I. and T. Tscharntke. 1999. Effects of habitat isolation on pollinator communities and seed set. <i>Oecologia</i> 121:432-440;
	Floral composition		
	Floral abundance distribution		
	Exotics dominance		
Exotics dominance	Pollinator abundance distribution	Pollinator abundance and community composition can be altered by exotic plants. In the Seychelles, exotic plants attract few, generalised and mostly abundant pollinator species compared to native plant species, suggesting that networks with high levels of plant invasion, but otherwise similar plant species diversity, are more similar in pollinator abundance and composition compared to networks with few or no exotic flowers.	Cox, P. A. and T. Elmqvist. 2000. Pollinator extinction in the Pacific Islands. <i>Conservation Biology</i> 14:1237-1239. Graves, S. D. and A. M. Shapiro. 2003. Exotics as host plants of the California butterfly fauna. <i>Biological Conservation</i> 110:413-433. Kaiser-Bunbury, C. N., T. Valentin, J. Mougai, D. Matatiken, and J. Ghazoul. 2011. The tolerance of island plant-pollinator networks to alien plants. <i>Journal of Ecology</i> 99:202-213. Williams, N. M., D. Cariveau, R. Winfree, and C. Kremen. 2011. Bees in disturbed habitats use, but do not prefer, alien plants. <i>Basic and Applied Ecology</i> 12:332-341.

	Interaction pattern	Exotic plant species that have invaded natural areas compete with native species for pollination. Interaction patterns are thus influenced by exotic flowering plants through changes in pollinator behaviour.	<p>Aizen, M. A., C. L. Morales, and J. M. Morales. 2008. Invasive mutualists erode native pollination webs. <i>PLoS Biology</i> 6:396-403.</p> <p>Bjerknes, A.-L., Ø. Totland, S. J. Hegland, and A. Nielsen. 2007. Do alien plant invasions really affect pollination success in native plant species? <i>Biological Conservation</i> 138:1-12.</p> <p>Brown, B. J., R. J. Mitchell, and S. A. Graham. 2002. Competition for pollination between an invasive species (purple loosestrife) and a native congener. <i>Ecology</i> 83:2328-2336.</p> <p>Flanagan, R., R. Mitchell, and J. Karron. 2010. Increased relative abundance of an invasive competitor for pollination, <i>Lythrum salicaria</i>, reduces seed number in <i>Mimulus ringens</i>. <i>Oecologia</i> 164:445-454.</p> <p>Ghazoul, J. 2004. Alien abduction: disruption of native plant-pollinator interactions by invasive species. <i>Biotropica</i> 36:156-164.</p> <p>Morales, C. L. and A. Traveset. 2009. A meta-analysis of impacts of alien vs. native plants on pollinator visitation and reproductive success of co-flowering native plants. <i>Ecology Letters</i> 12:716-728.</p> <p>Muñoz, A. A. and L. A. Cavieres. 2008. The presence of a showy invasive plant disrupts pollinator service and reproductive output in native alpine species only at high densities. <i>Journal of Ecology</i> 96:459-467.</p>
	Floral composition	Exotic plants compete with natives for resources, light and water, thus causing displacement and changes in the plant community. Therefore, networks with similar levels of exotic dominance are likely to be more similar in floral abundance and composition.	Cox, P. A. and T. Elmqvist. 2000. Pollinator extinction in the Pacific Islands. <i>Conservation Biology</i> 14:1237-1239.
	Floral abundance distribution		Gurevitch, J. and D. K. Padilla. 2004. Are invasive species a major cause of extinctions? <i>Trends in Ecology & Evolution</i> 19:470-474.
Pollinator abundance distribution	Pollinator traits	We expect that communities with similar pollinator abundance distributions are likely to show similar body size abundance distributions.	Morse, D. R., N. E. Stork, and J. H. Lawton. 1988. Species number, species abundance and body length relationships of arboreal beetles in Bornean lowland rain forest trees. <i>Ecological Entomology</i> 13:25-37.

	Pollinator composition	Communities that are similar in pollinator abundance distribution should also be similar in terms of composition because the same species are likely to contribute equivalently to abundance.	Siemann, E., D. Tilman, and J. Haarstad. 1996. Insect species diversity, abundance and body size relationships. <i>Nature</i> 380:704-706.
	Interaction pattern	The neutrality hypothesis posits that individuals interact randomly. This implies that the abundance of species determines interaction frequency and diversity. Similarity in pollinator abundance distribution between networks should therefore correspond to similarity in interaction pattern among networks.	Vázquez, D. P., N. P. Chacoff, and L. Cagnolo. 2009. Evaluating multiple determinants of the structure of plant-animal mutualistic networks. <i>Ecology</i> 90:2039-2046. Dupont, Y. L., D. M. Hansen, and J. M. Olesen. 2003. Structure of a plant-flower-visitor network in the high-altitude sub-alpine desert of Tenerife, Canary Islands. <i>Ecography</i> 26:301-310. Ollerton, J., S. D. Johnson, L. Cranmer, and S. Kellie. 2003. The pollination ecology of an assemblage of grassland asclepiads in South Africa. <i>Annals of Botany</i> 92:807-834. Vázquez, D. P., C. J. Melian, N. M. Williams, N. Bluthgen, B. R. Krasnov, and R. Poulin. 2007. Species abundance and asymmetric interaction strength in ecological networks. <i>Oikos</i> 116:1120-1127.
Floral abundance distribution	Floral traits	Floral traits that determine the pollinator spectrum evolved depending on their relative abundance in the community. Floral traits in communities of the same habitat type are thus expected to be more similar when they show similar floral abundance distributions.	Sargent, R. D. and S. P. Otto. 2006. The role of local species abundance in the evolution of pollinator attraction in flowering plants. <i>The American Naturalist</i> 167:67-80.

	Floral composition	Communities that are more similar in the distribution of floral abundance should also be more similar in terms of composition because the same species are likely to contribute equivalently to abundance.	<p>Kunin, W. E. 1997. Population size and density effects in pollination: Pollinator foraging and plant reproductive success in experimental arrays of <i>Brassica kaber</i>. <i>Journal of Ecology</i> 85:225-234.</p> <p>Stang, M., P. G. L. Klinkhamer, and E. van der Meijden. 2006. Size constraints and flower abundance determine the number of interactions in a plant-flower visitor web. <i>Oikos</i> 112:111-121.</p> <p>Vázquez, D. P., N. P. Chacoff, and L. Cagnolo. 2009. Evaluating multiple determinants of the structure of plant-animal mutualistic networks. <i>Ecology</i> 90:2039-2046.</p>
	Interaction pattern	The neutrality hypothesis posits that individuals interact randomly. This implies that floral abundance determines interaction frequency and diversity independent of the identity of the flowering plant species. Similarity in the distribution of floral abundance between networks should therefore correspond to similarity in interaction patterns between networks.	<p>Dupont, Y. L., D. M. Hansen, and J. M. Olesen. 2003. Structure of a plant-flower-visitor network in the high-altitude sub-alpine desert of Tenerife, Canary Islands. <i>Ecography</i> 26:301-310.</p> <p>Ollerton, J., S. D. Johnson, L. Cranmer, and S. Kellie. 2003. The pollination ecology of an assemblage of grassland <i>asclepiads</i> in South Africa. <i>Annals of Botany</i> 92:807-834.</p> <p>Vázquez, D. P., C. J. Melian, N. M. Williams, N. Bluthgen, B. R. Krasnov, and R. Poulin. 2007. Species abundance and asymmetric interaction strength in ecological networks. <i>Oikos</i> 116:1120-1127.</p> <p>Vázquez, D. P., N. P. Chacoff, and L. Cagnolo. 2009. Evaluating multiple determinants of the structure of plant-animal mutualistic networks. <i>Ecology</i> 90:2039-2046.</p>
Pollinator traits	Pollinator composition	Functional traits and environmental filtering are prominent mechanisms that structure species abundance and composition. We expect that a change in composition could lead to a change in traits and a change in traits will imply a change in composition (reciprocal causation). Thus, networks with similar distributions of pollinator traits are similar in pollinator	<p>Sargent, R. D. and D. D. Ackerly. 2008. Plant-pollinator interactions and the assembly of plant communities. <i>Trends in Ecology & Evolution</i> 23:123-130.</p> <p>Stang, M., P. G. L. Klinkhamer, N. M. Waser, I. Stang, and E. van der Meijden. 2009. Size-specific Interaction pattern and size matching in a plant-pollinator interaction web. <i>Annals of Botany</i> 103:1459-1469.</p> <p>Webb, C. O., D. D. Ackerly, M. A. McPeck, and M. J. Donoghue. 2002. Phylogenies and community ecology. <i>Annual Review of Ecology and Systematics</i> 33:475-505.</p>
	Interaction pattern		

		community composition and interaction patterns	
Floral traits	Floral composition	Mechanisms such as environmental filtering based on floral traits determine the abundance and identity of flowering plant species in the community. Thus, filtering mechanism can result in communities of species that share similar morphological traits.	Sargent, R. D. and D. D. Ackerly. 2008. Plant–pollinator interactions and the assembly of plant communities. <i>Trends in Ecology & Evolution</i> 23:123-130. Webb, C. O., D. D. Ackerly, M. A. McPeck, and M. J. Donoghue. 2002. Phylogenies and community ecology. <i>Annual Review of Ecology and Systematics</i> 33:475-505.
	Interaction pattern	Floral traits determine which species in a community can interact with each other. Such phenotypic constraints drive the positive relationship in network similarity in floral traits and interactions patterns.	Gibson, M. R., D. M. Richardson, and A. Pauw. 2012. Can floral traits predict an invasive plant's impact on native plant–pollinator communities? <i>Journal of Ecology</i> 100:1216-1223. Jordano, P., J. Bascompte, and J. M. Olesen. 2003. Invariant properties in coevolutionary networks of plant-animal interactions. <i>Ecology Letters</i> 6:69-81. Lázaro, A., S. J. Hegland, and Ø. Totland. 2008. The relationships between floral traits and specificity of pollination systems in three Scandinavian plant communities. <i>Oecologia</i> 157:249-257. Rezende, E. L., P. Jordano, and J. Bascompte. 2007. Effects of phenotypic complementarity and phylogeny on the nested structure of mutualistic networks. <i>Oikos</i> 116:1919-1929. Stang, M., P. G. L. Klinkhamer, N. M. Waser, I. Stang, and E. van der Meijden. 2009. Size-specific Interaction pattern and size matching in a plant–pollinator interaction web. <i>Annals of Botany</i> 103:1459-1469.

Pollinator composition	Pollinator traits	The abundance and identity of pollinators determines the distribution of pollinator traits in the community. We expect that communities similar in pollinator composition are also similar in the distribution of pollinator traits.	Stang, M., P. G. L. Klinkhamer, and E. van der Meijden. 2006. Size constraints and flower abundance determine the number of interactions in a plant-flower visitor web. <i>Oikos</i> 112:111-121.
	Interaction pattern	Pollinator community composition determines which and how frequent co-evolved species interact, so that interaction patterns are a direct consequence of pollinator community composition.	Kaiser-Bunbury, C. N., J. Memmott, and C. B. Müller. 2009. Community structure of pollination webs of Mauritian heathland habitats. <i>Perspectives in Plant Ecology, Evolution and Systematics</i> 11:241-254.
Floral composition	Floral traits	Floral community composition determines the distribution of flower traits in the community. We therefore expect that communities similar in floral community composition are also similar in floral traits.	Stang, M., P. G. L. Klinkhamer, and E. van der Meijden. 2006. Size constraints and flower abundance determine the number of interactions in a plant-flower visitor web. <i>Oikos</i> 112:111-121.

<p>Pollinator composition</p>	<p>There is theoretical and empirical evidence that increasing resource diversity (i.e., plants) increases consumer diversity (i.e., pollinators). We predict that similarity in floral community composition is reflected by similarities in pollinator community composition as pollinators respond directly to changes in floral resources offered in the community.</p>	<p>Hegland, S. J. and L. Boeke. 2006. Relationships between the density and diversity of floral resources and flower visitor activity in a temperate grassland community. <i>Ecological Entomology</i> 31:532-538.</p> <p>Lázaro, A., A. Jakobsson, and Ø. Totland. 2013. How do pollinator visitation rate and seed set relate to species' floral traits and community context? <i>Oecologia</i> 173:881-893.</p> <p>Potts, S. G., B. Vulliamy, A. Dafni, G. Ne'eman, and P. Willmer. 2003. Linking bees and flowers: How do floral communities structure pollinator communities? <i>Ecology</i> 84:2628-2642.</p> <p>Ricketts, T. H. 2004. Tropical forest fragments enhance pollinator activity in nearby coffee crops. <i>Conservation Biology</i> 18:1262-1271.</p> <p>Siemann, E., D. Tilman, J. Haarstad, and M. Ritchie. 1998. Experimental tests of the dependence of arthropod diversity on plant diversity. <i>The American Naturalist</i> 152:738-750.</p> <p>Stang, M., P. G. L. Klinkhamer, and E. van der Meijden. 2006. Size constraints and flower abundance determine the number of interactions in a plant-flower visitor web. <i>Oikos</i> 112:111-121.</p> <p>Steffan-Dewenter, I. and T. Tschardtke. 1999. Effects of habitat isolation on pollinator communities and seed set. <i>Oecologia</i> 121:432-440.</p> <p>Steffan-Dewenter, I., A.-M. Klein, V. Gaebele, T. Alfert, and T. Tschardtke. 2006. Bee diversity and plant-pollinator interactions in fragmented landscapes. Pages 387-407 in N. M. Waser and J. Ollerton, editors. <i>Plant-Pollinator Interactions: From Specialization to Generalization</i>. University of Chicago Press, Chicago.</p>
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	Interaction pattern	Floral community composition determines the type, amount and accessibility of resources in a community, thereby directly regulating the distribution and frequency of interactions in a network. We expect that similarity in floral composition between networks entails similarity in interaction pattern between networks.	<p>Lázaro, A., A. Jakobsson, and Ø. Totland. 2013. How do pollinator visitation rate and seed set relate to species' floral traits and community context? <i>Oecologia</i> 173:881-893.</p> <p>Stang, M., P. G. L. Klinkhamer, and E. van der Meijden. 2006. Size constraints and flower abundance determine the number of interactions in a plant-flower visitor web. <i>Oikos</i> 112:111-121.</p> <p>Vázquez, D. P., C. J. Melian, N. M. Williams, N. Bluthgen, B. R. Krasnov, and R. Poulin. 2007. Species abundance and asymmetric interaction strength in ecological networks. <i>Oikos</i> 116:1120-1127.</p> <p>Vázquez, D. P., N. P. Chacoff, and L. Cagnolo. 2009. Evaluating multiple determinants of the structure of plant-animal mutualistic networks. <i>Ecology</i> 90:2039-2046.</p>
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193TABLE A2. Distances (in meters) between the six study sites.

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	Bernica	Casse Dent	Copolia	La Reserve	Tea Plantation	Trois Frères
Casse Dent	2172					
Copolia	2272	2313				
La Reserve	7681	9720	8289			
Tea Plantation	1319	876	2107	8966		
Trois Frères	3745	2314	2122	10299	2888	

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198TABLE A3. Plant species included in the study. Given are species and family names, origin, IUCN status of endangerment, floral abundance and
 199 floral complexity scores. The following species were recently renamed: *Gastonia crassa* = *Polyscias crassa*; *Canthium bibracteatum* =
 200 *Pyrostria bibracteata*; *Paraserianthes falcataria* = *Falcataria moluccana*
 201

Plant species	Family	Origin	IUCN Status*	Floral abundance across all networks [# flowers/cube]	Floral complexity scores†
<i>Alstonia macrophylla</i>	Apocynaceae	Exotic	-	0.405	12
<i>Aphloia theiformis</i> var. <i>seychellensis</i>	Flacourtiaceae	Native	NT	0.227	6
<i>Camptosperma sechellarum</i>	Anacardiaceae	Endemic	CR	0.126	5
<i>Chrysobalanus icaco</i>	Chrysobalanaceae	Exotic	-	1.116	6
<i>Cinnamomum verum</i>	Lauraceae	Exotic	-	0.707	9
<i>Colea sechellarum</i>	Bignoniaceae	Endemic	EN	0.016	16
<i>Craterispermum microdon</i>	Rubiaceae	Endemic	EN	0.100	11
<i>Deckenia nobilis</i>	Palmae	Endemic	NT	0.383	3
<i>Dillenia ferruginea</i>	Dilleniaceae	Endemic	NT	0.189	8
<i>Dillenia suffruticosa</i>	Dilleniaceae	Exotic	-	0.031	8
<i>Diospyros sechellarum</i>	Ebenaceae	Endemic	NT	0.064	9
<i>Dracaena reflexa</i>	Dracenaceae	Native	LC	0.047	9
<i>Erythroxylum sechellarum</i>	Erythroxylaceae	Endemic	LC	0.762	8
<i>Euphorbia pyrifolia</i>	Euphorbiaceae	Native	LC	0.039	7
<i>Excoecaria benthiamiana</i>	Euphorbiaceae	Endemic	VU	0.329	7
<i>Falcataria moluccana</i>	Mimosaceae	Exotic	-	0.105	11
<i>Glionnetia sericea</i>	Rubiaceae	Endemic	EN	0.024	13
<i>Ixora pudica</i>	Rubiaceae	Endemic	NT	0.038	11
<i>Medusagyne oppositifolia</i>	Medusagynaceae	Endemic	CR	0.522	10
<i>Memecylon eleagni</i>	Melastomataceae	Endemic	LC	1.994	4
<i>Mimusops sechellarum</i>	Sapotaceae	Endemic	NT	0.122	13
<i>Nepenthes pervillei</i>	Nepentaceae	Endemic	NT	0.658	4
<i>Nephrosperma vanhoutteanum</i>	Palmae	Endemic	VU	2.928	3
<i>Northea hornei</i>	Sapotaceae	Endemic	VU	0.101	12

<i>Ochna kirkii</i>	Ochnaceae	Exotic	-	0.219	6
<i>Paragenipa wrightii</i>	Rubiaceae	Endemic	NT	0.958	13
<i>Phoenicophorium borsigianum</i>	Palmae	Endemic	LC	2.674	3
<i>Pittosporum senacia</i> subsp. <i>wrightii</i>	Pittosporaceae	Native	VU	0.070	7
<i>Polyscias crassa</i>	Araliaceae	Endemic	VU	0.109	6
<i>Premna serratifolia</i>	Lamiaceae	Native	LC	0.056	1
<i>Psidium cattleianum</i>	Myrtaceae	Exotic	-	0.030	5
<i>Psychotria pervillei</i>	Rubiaceae	Endemic	VU	0.246	10
<i>Pyrostria bibracteata</i>	Rubiaceae	Endemic	LC	4.048	10
<i>Roscheria melanochaetes</i>	Palmae	Endemic	NT	1.660	3
<i>Soulamea terminaloides</i>	Simaroubaceae	Endemic	VU	0.380	6
<i>Syzygium wrightii</i>	Myrtaceae	Endemic	VU	0.323	15
<i>Timonius sechellensis</i>	Rubiaceae	Endemic	VU	0.077	11

202* LC = least concern, NT = near threatened, VU = vulnerable, EN = endangered, CR = critically endangered; - = exotic species, not listed.

203† Describes the floral resource accessibility and floral morphology on an ordinal scale. Values range from 0–20, with 0 describing very simple and

204 easily accessible flowers (TABLE A5)

205TABLE A4. Pollinator taxa included in the study. Shown are species and orders where possible, total number of visits across the entire 8 month study
 206 period, thorax width and body length, and the size class used to categorize pollinator taxa by morphological traits. Pollinators that could not
 207 be identified to species level due to size or lack of taxonomic expertise were assigned a species code. Taxa IDs correspond to pollinator codes
 208 that can be provided for FIG. B1.
 209

I	D Pollinator taxa	Class/Order	Visits	Thorax width [mm]	Body length [mm]	Size class (1-8)
48	<i>Foudia madagascariensis</i>	Aves	1	8.5*	130.0	8
68	<i>Cinnyris dussumieri</i>	Aves	199	9.5*	120.0	8
7	Beetle sp1	Coleoptera	5	0.5	2.8	3
25	Beetle sp10	Coleoptera	64	0.8	1.6	4
88	Beetle sp13	Coleoptera	20	0.6	1.8	4
57	Beetle sp14	Coleoptera	79	0.9	2.0	4
4	Beetle sp4	Coleoptera	257	0.8	1.9	4
5	Beetle sp5	Coleoptera	325	0.9	3.2	4
17	Beetle sp6	Coleoptera	3	0.3	2.1	3
77	Beetle sp7	Coleoptera	5	0.2	2.5	2
14	Beetle sp8	Coleoptera	1	0.9	2.1	4
41	Beetle sp9	Coleoptera	2	0.2	2.6	2
92	<i>Cratopus aurostriatus</i>	Coleoptera	60	2.3	10.0	6
36	Curculionidae sp12	Coleoptera	51	0.6	2.9	4
27	Elateroidea sp2	Coleoptera	26	0.8	3.4	4
19	Elateroidea sp3	Coleoptera	12	0.6	3.0	4
18	Mordellidae sp11	Coleoptera	26	0.6	2.7	4
78	<i>Perissoma aenescens</i>	Coleoptera	2	4.0	9.9	7
75	<i>Eristalinus vicarians</i>	Diptera	29	4.1	11.3	7
37	<i>Eristalodes seychellarum</i>	Diptera	1	4.4	10.9	7
3	Fly sp1	Diptera	184	0.3	2.9	3
82	Fly sp10	Diptera	10	1.6	7.8	5
80	Fly sp11	Diptera	22	2.1	5.3	6
10	Fly sp12	Diptera	1	0.6	2.8	4

15	Fly sp13	Diptera	3	0.5	2.5	3
54	Fly sp14	Diptera	24	2.9	7.1	6
34	Fly sp15	Diptera	218	2.6	6.5	6
26	Fly sp16	Diptera	177	0.1	0.8	1
28	Fly sp17	Diptera	13	0.1	0.2	1
30	Fly sp18	Diptera	59	0.2	1.0	2
31	Fly sp19	Diptera	3	0.2	2.2	2
8	Fly sp2	Diptera	1	0.7	1.8	4
39	Fly sp20	Diptera	1	0.2	1.6	2
43	Fly sp21	Diptera	1	1.2	4.3	5
44	Fly sp22	Diptera	1	0.1	2.4	1
51	Fly sp23	Diptera	2	1.2	4.3	5
56	Fly sp24	Diptera	26	0.3	1.3	3
58	Fly sp25	Diptera	18	0.1	0.3	1
59	Fly sp26	Diptera	12	0.1	0.2	1
83	Fly sp27	Diptera	28	1.1	3.0	5
94	Fly sp28	Diptera	1	0.1	2.1	1
16	Fly sp3	Diptera	164	0.1	1.9	1
6	Fly sp30	Diptera	24	0.1	0.1	1
62	Fly sp31	Diptera	13	0.1	0.1	1
66	Fly sp32	Diptera	1	0.1	0.1	1
96	Fly sp33	Diptera	1	0.1	0.2	1
95	Fly sp34	Diptera	1	0.1	0.2	1
12	Fly sp35	Diptera	6	0.4	1.8	3
81	Fly sp4	Diptera	17	0.1	1.1	1
73	Fly sp5	Diptera	28	0.6	2.4	4
55	Fly sp6	Diptera	8	1.1	4.1	5
24	Fly sp7	Diptera	1	1.0	4.8	5
74	Fly sp8	Diptera	37	1.6	5.8	5
23	Fly sp9	Diptera	3	1.8	6.1	5
21	<i>Hemipyrellia</i> sp.	Diptera	73	3.1	8.4	6

89	<i>Melanostoma annulipes</i>	Diptera	19	1.6	8.1	5
79	<i>Neavella albipectus</i>	Diptera	13	3.4	11.3	6
72	<i>Ornidia obesa</i>	Diptera	224	4.7	10.6	7
91	<i>Sarcophagidae</i> sp.	Diptera	3	2.4	12.0	6
52	<i>Simosyrphus aegyptius</i>	Diptera	25	1.6	7.7	5
29	<i>Allodapini</i> sp.	Hymenoptera	31	1.0	5.3	5
50	<i>Apis mellifera adansonii</i>	Hymenoptera	3180	3.6	10.3	6
2	Bee sp1	Hymenoptera	1	1.5	6.2	5
32	Bee sp3	Hymenoptera	4	1.5	6.2	5
47	Bee sp4	Hymenoptera	10	0.4	2.0	3
53	Bee sp5	Hymenoptera	14	0.1	0.6	1
35	<i>Ceratina tabescens</i>	Hymenoptera	39	1.2	5.6	5
22	<i>Chalicodoma disjuncta</i>	Hymenoptera	20	4.6	14.3	7
90	<i>Euodynerus cylindricus</i>	Hymenoptera	3	2.4	10.2	6
38	<i>Lasioglossum mahense</i>	Hymenoptera	2218	1.5	6.2	5
20	<i>Megachile seychellensis</i>	Hymenoptera	135	3.0	10.6	6
65	<i>Polistes olivaceus</i>	Hymenoptera	29	4.1	17.2	7
86	<i>Rhynchium brunneum</i>	Hymenoptera	63	4.8	16.4	7
70	<i>Trypoxylon errans</i>	Hymenoptera	3	1.8	10.0	5
97	<i>Xylocopa caffra</i>	Hymenoptera	114	8.5	18.6	8
49	<i>Agrius convolvuli</i>	Lepidoptera	8	11.9	44.8	8
1	<i>Cenophodes tamsi</i>	Lepidoptera	1	10.0	45.0	8
87	<i>Eagris sabadius maheta</i>	Lepidoptera	8	4.6	15.1	7
84	<i>Lampides boeticus</i>	Lepidoptera	3	1.5	9.6	5
46	<i>Leptotes pirithous</i>	Lepidoptera	5	1.8	8.2	5
63	<i>Phalanta phalantha aethiopica</i>	Lepidoptera	1	6.0	26.0	7
67	<i>Mabuya sechellensis</i>	Lizard	34	11.5†	84.0†	8
64	<i>Phelsuma astriata</i>	Lizard	156	8.2†	55.0†	8

* Head width (G. Rocomora, pers. com.; Craig A. (2010). Ploceidae. In del Hoyo, J., Elliott, A. and Christie D. Handbook of the birds of the World. Volume 15. Lynx Edicions, Barcelona, Spain)

† Head width and snout to vent length (S. Rocha and A. Perera, unpubl. data)

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TABLE A5. Floral complexity scoring table based on four traits of a flower complexity index (M. Stang, unpublished data). Total floral complexity scores are obtained by adding the scores for each of the four traits. Each category is scored independently within and between species.

Scores	Pollen presentation pattern*	Flower dimensionality**	Accessibility of nectar†	Flower orientation
0	Diffuse (many portions without regular presentation pattern)	2D (e.g., dish-shaped)	Open and easy	Upright (0°)
1	Diffuse to marginal (many portions in 2-3 circles)	2-3D (e.g., bowl-shaped)	Open but not easy, concealed behind hairs or in wide shallow cups (max. depth 1-3 mm)	Upright to horizontal (0-90°)
2	Marginal (many portions in one marginal circle)	2D and 3D (e.g., flat rim with tube, flat heads with tubes)	Semi-concealed in 1-4 mm deep tubes, partly flexible or wide	Upright to pendant; variable (45-135°)
3	Marginal to central (several portions more centralized presented)	3D with minimal crawling (e.g., funnel, tubes or brush)	Concealed in 4-10 mm flexible, wide or funnel-shaped tubes	Horizontal (90°)
4	Pollen presentation central	3D with short crawling (e.g., funnel, bell, gullet, flag)	Concealed in 8-20 mm narrow or angled tubes or in 10-30 mm very narrow tubes	Horizontal to pendant (90-135°)
5	Pollen presentation more or less excentric, corolla often zygomorphic	3D with deep crawling or closed entrance (e.g., bell, gullet or flag, traps)	Concealed in 8-20 mm narrow tubes with crawling access or with closed entrance or in extremely deep tubes (> 30 mm)	Pendant (135-180°)

* Pollen presentation pattern based on the degree of centralization and position in relation to floral center

** Corolla dimensionality without considering symmetry (with examples of corresponding traditional flower shape types)

† Nectar tube depth and width

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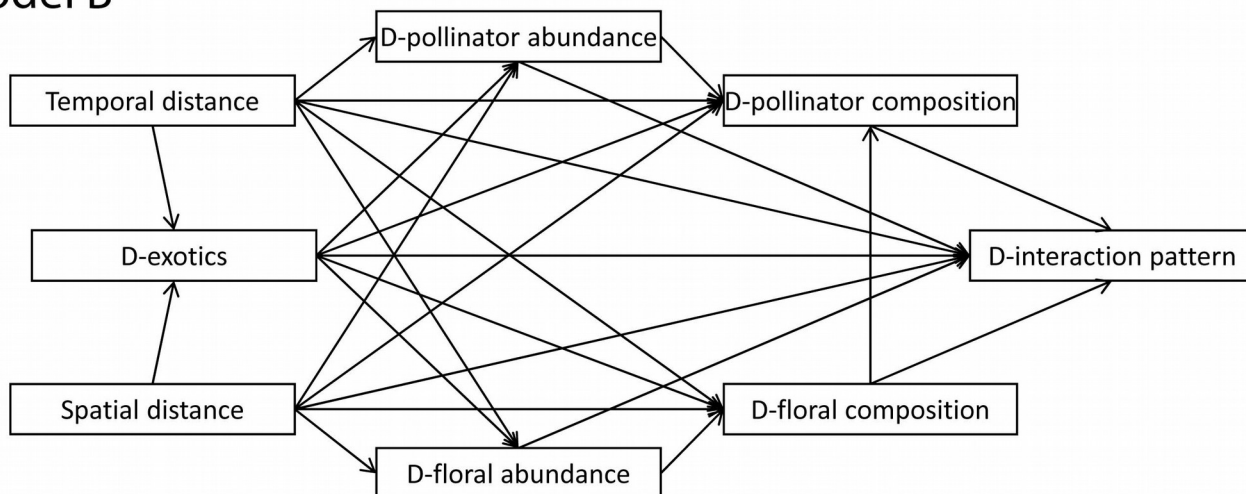
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TABLE A6. Goodness-of-fit indices for structural equation modelling and the modelling indices of Models A-C.

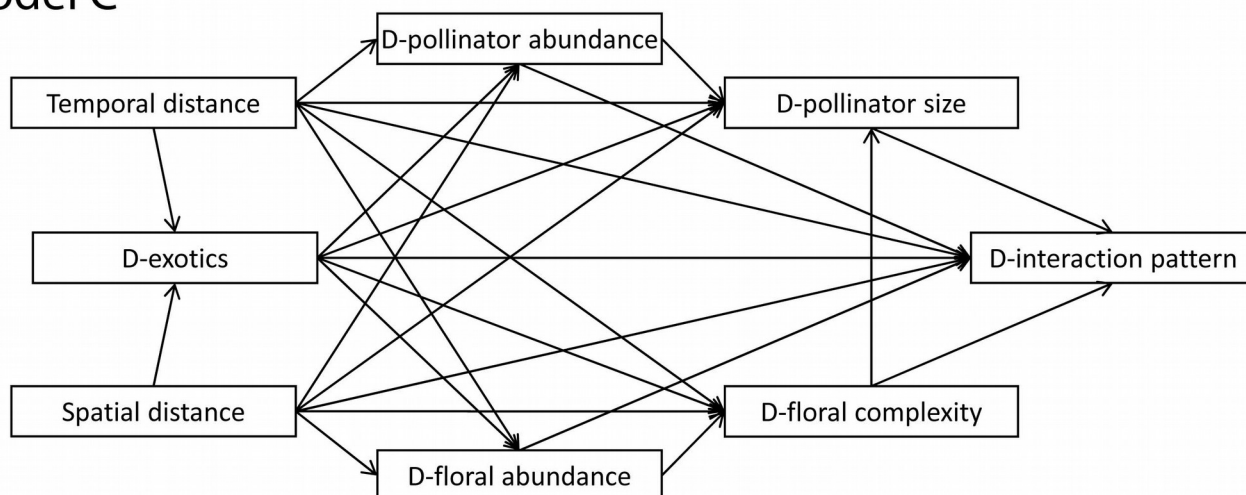
Index name	Model A	Model B	Model C	Threshold	Model fit	Reference
NFI	0.9897	0.9856	0.9842	> 0.95	acceptable fit	Bentler and Bonnett 1980, Schumacker and Lomax 2004
NNFI	0.9950	0.9903	1.0	> 0.95	acceptable fit	Hu and Bentler 1998
RMSEA	0.0195	0.0231	0.0001	0.01–0.05	excellent–good fit	MacCallum et al. 1996
CFI	0.9969	0.9945	1.0	close to 1	acceptable fit	Bentler 1990
SRMR	0.0247	0.0233	0.0177	< 0.08	good fit	Hu and Bentler 1998

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Model B



Model C

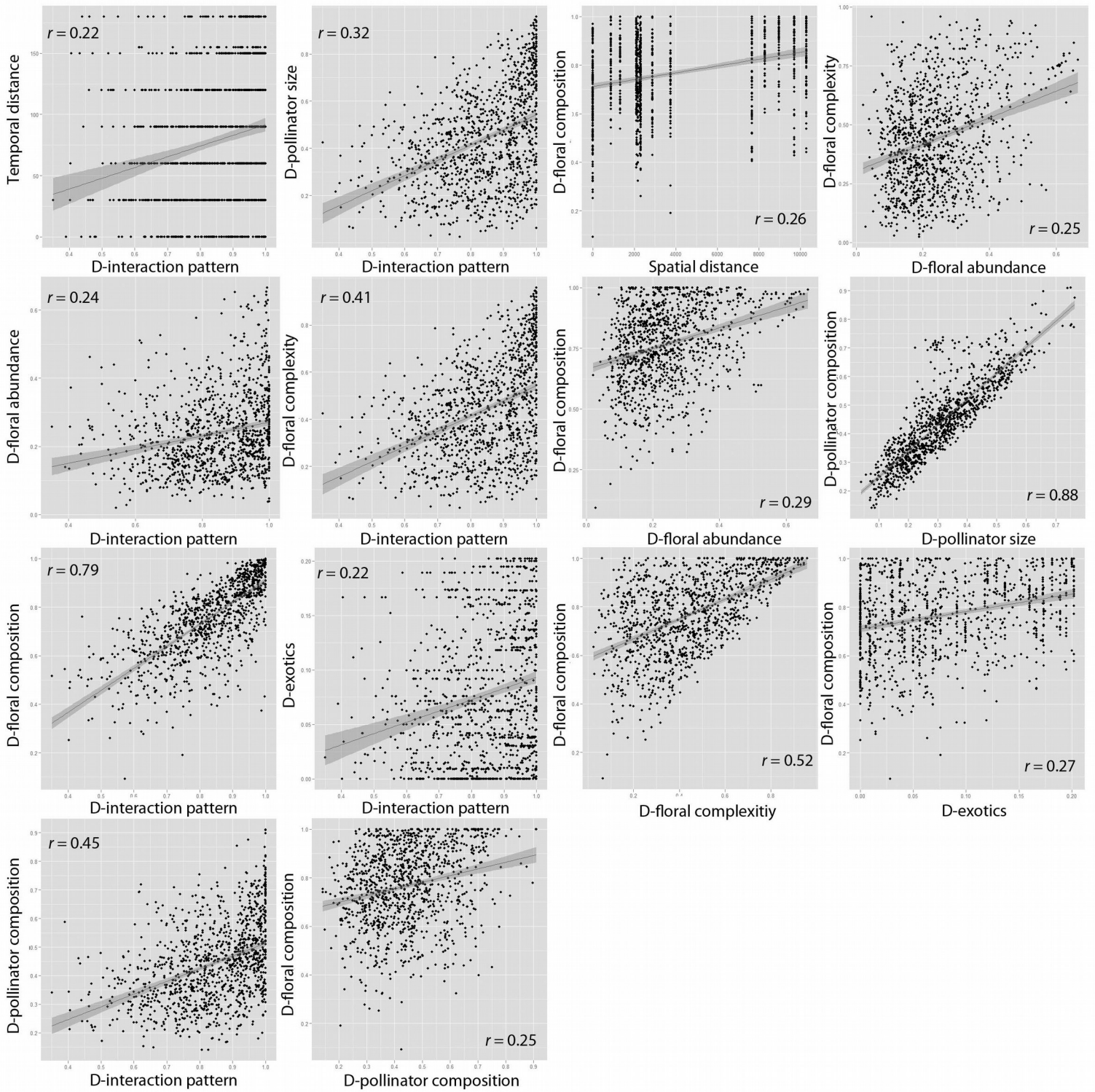


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230FIG. A1. Path diagram describing two reduced (nested) hypothesized models of the relationships of
 231dissimilarities, in which either community composition (model B) or trait variables (model C) were entered
 232separately. See FIG. 1 for a depiction of the complete model. Path justifications are provided in TABLE A1.

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235 FIG. A2. Correlation plots depict bivariate relationship between dissimilarities (range 0-1) and temporal and
 236 spatial distances (days and meters, respectively) of variables across networks and the best-fit line with its
 237 standard error (dark shade surround lines). Shown are only significant Spearman correlations at a Bonferroni-
 238 corrected α of 0.001; for all bivariate relationships refer to TABLE B2. Note the triangular relationship between
 239 networks in D-floral composition and D-floral complexity.

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Christopher N. Kaiser-Bunbury, Diego P. Vázquez, Martina Stang, and Jaboury Ghazoul. 2014. Determinants of the microstructure of plant-pollinator networks. *Ecology*.

APPENDIX B: Supplementary figures and table supporting the results.

TABLE B1. Summary statistics of the 48 pollination networks. Numbers shown for each network include number of plant and pollinator taxa, number of visits (pollinator individuals observed visiting flowers), number of links between species in a network, total interaction frequency, floral abundance (total number of flowers per sample cube) and the proportion of exotic flowers in a network. Network size is the number of possible links (number of plant species times the number of pollinator species).

Site	Month	Plant species	Pollinator taxa	Visits	Links	Network size	Interaction frequency	Floral abundance across all species [# flowers/cube]	Proportion of exotic flowers
Bernica	September	5	20	100	35	100	0.29	0.12	0
	October	5	22	135	35	110	0.40	0.23	0
	November	8	18	172	32	144	0.96	0.51	0.40
	December	8	15	219	30	120	1.95	1.08	0
	January	12	24	261	55	288	0.91	1.03	0
	February	11	27	317	62	297	1.16	0.76	0
	March	9	25	373	66	225	2.77	0.92	0.15
	April	6	22	174	37	132	2.12	0.60	0
Casse Dent	September	7	15	38	22	105	0.13	0.23	0.08
	October	6	18	75	28	108	0.12	0.11	0
	November	6	14	156	20	84	1.24	0.81	0.27
	December	7	14	128	27	98	1.00	0.69	0.03
	January	10	22	230	44	220	1.71	0.62	0
	February	6	12	188	19	72	0.35	0.21	0.15

	March	8	21	218	37	168	0.90	0.23	0
	April	8	22	216	44	176	1.02	0.51	0
Copolia	September	11	21	61	50	231	0.27	0.25	0.32
	October	12	23	129	53	276	0.31	0.37	0
	November	12	24	176	47	288	0.54	0.53	0.08
	December	12	16	110	27	192	1.00	1.00	0
	January	12	19	288	47	228	1.11	0.45	0
	February	10	20	136	30	200	0.29	0.23	0
	March	11	27	264	46	297	0.24	0.08	0.09
	April	11	20	240	48	220	0.59	0.25	0
La Reserve	September	6	17	72	34	102	0.33	0.23	0.27
	October	7	18	130	47	126	0.53	0.64	0.30
	November	6	17	155	28	102	0.29	0.14	0.55
	December	8	21	299	38	168	5.59	1.78	0.08
	January	8	21	277	44	168	0.17	0.18	0.47
	February	9	15	209	32	135	0.50	0.38	0.09
	March	6	21	268	37	126	0.47	0.3	0.13
	April	6	19	195	29	114	1.07	0.88	0.02
Tea Plantation	September	4	9	18	11	36	0.14	0.15	0.44
	October	3	8	46	10	24	0.23	0.11	0.50
	November	11	16	82	22	176	0.23	0.41	0.38
	December	9	23	161	38	207	0.53	0.42	0
	January	11	20	214	44	220	0.62	0.37	0.22
	February	10	28	185	54	280	0.65	0.30	0.11
	March	10	24	245	48	240	0.93	0.37	0.42
	April	9	27	397	59	243	2.70	0.59	0.48
Trois Frères	September	4	13	31	18	52	0.20	0.25	0
	October	6	16	121	27	96	0.58	0.29	0.16

November	10	18	149	30	180	0.90	0.53	0.12
December	11	14	139	27	154	0.38	0.45	0.20
January	12	26	317	56	312	0.59	0.32	0.02
February	13	22	202	46	286	1.51	0.47	0.06
March	10	28	260	61	280	0.62	0.33	0.14
April	9	16	138	34	144	0.58	0.30	0.42

TABLE B2. Correlation matrix showing non-parametric Spearman coefficients between dissimilarity matrices; numbers in bold are significant at a Bonferroni-corrected α of 0.001. Significant correlations are depicted in FIG. A2.

	D-interaction pattern	Temporal distance	Spatial distance	D-exotics	D-floral abundance	D-pollinator abundance	D-floral composition	D-pollinator composition	D-floral complexity
Temporal distance	0.218								
Spatial distance	0.191	-0.048							
D-exotics	0.216	0.031	0.020						
D-floral abundance	0.243	0.054	0.109	-0.003					
D-pollinator abundance	0.085	0.040	-0.043	0.071	0.051				
D-floral composition	0.790	0.199	0.256	0.267	0.294	0.263			
D-pollinator composition	0.446	0.166	0.100	0.025	0.062	0.119	0.247		
D-floral complexity	0.414	0.088	0.173	0.164	0.249	0.041	0.517	0.085	
D-pollinator size	0.319	0.069	0.073	0.012	0.021	0.144	0.150	0.876	0.053

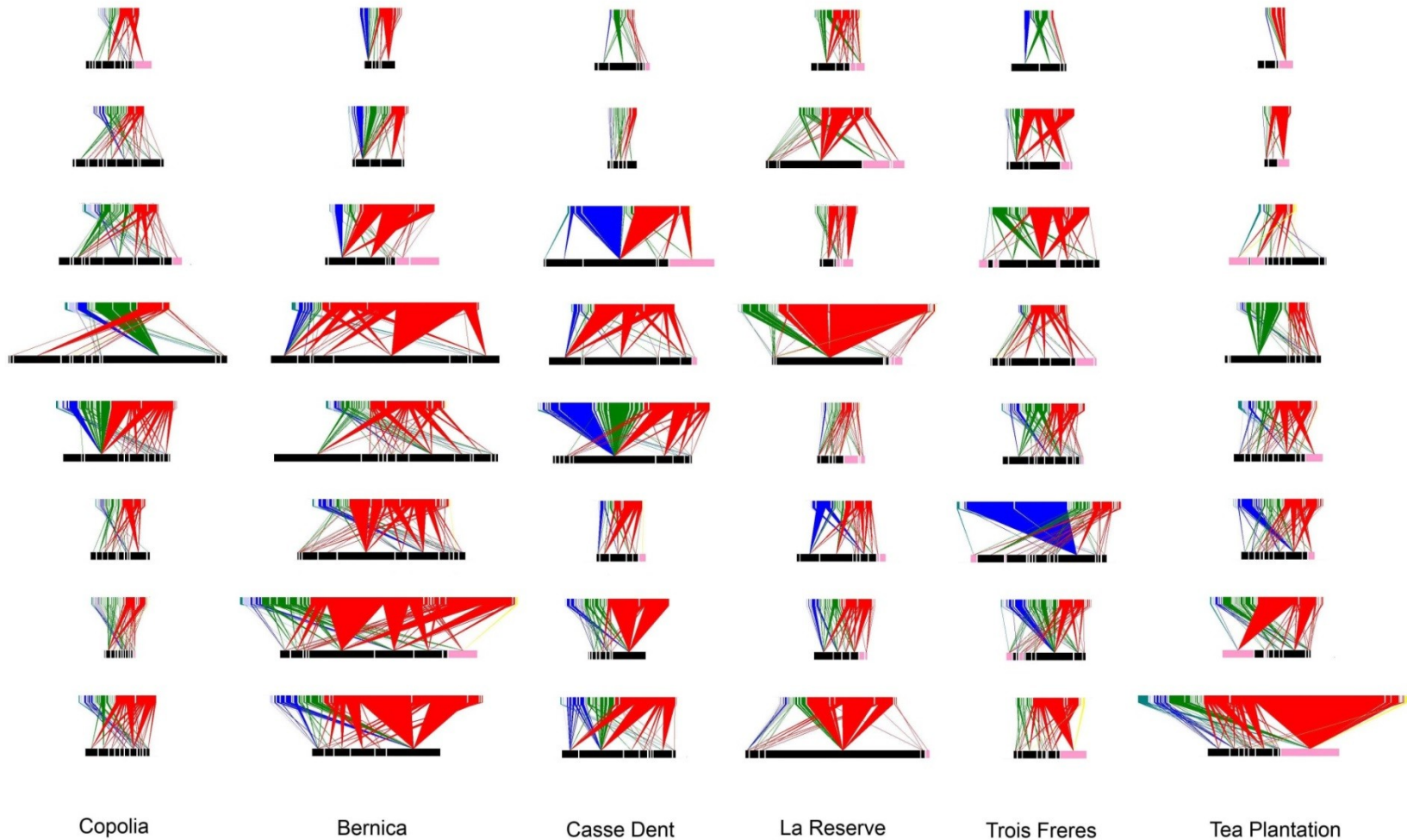


FIG. B1. Pollination webs of all 48 plant–pollinator networks arranged across time (vertical; from September to April) and space (horizontal; six sites). Pollinators are shown as rectangles at the top and plant species are shown at the bottom (light red rectangles depict introduced plant species). The width of the rectangles reflects the relative abundance of pollinators and flowers. Links represent interactions between species, and the width of the lines indicates the interaction frequency between species. Webs are drawn to the same scale except for the December network at La Reserve, which was drawn at half scale. Species names for all webs can be

provided on request. Webs were drawn with Visual Basic in MS Office Excel (C. Kaiser-Bunbury, unpublished data). Webs are arranged by increasing plant invasion intensity (from left to right; see Kaiser-Bunbury et al. 2011). Blue green: birds, light blue: Geckos and skinks, dark blue: beetles, green: flies, red: bees and wasps, and yellow: butterflies and moths.

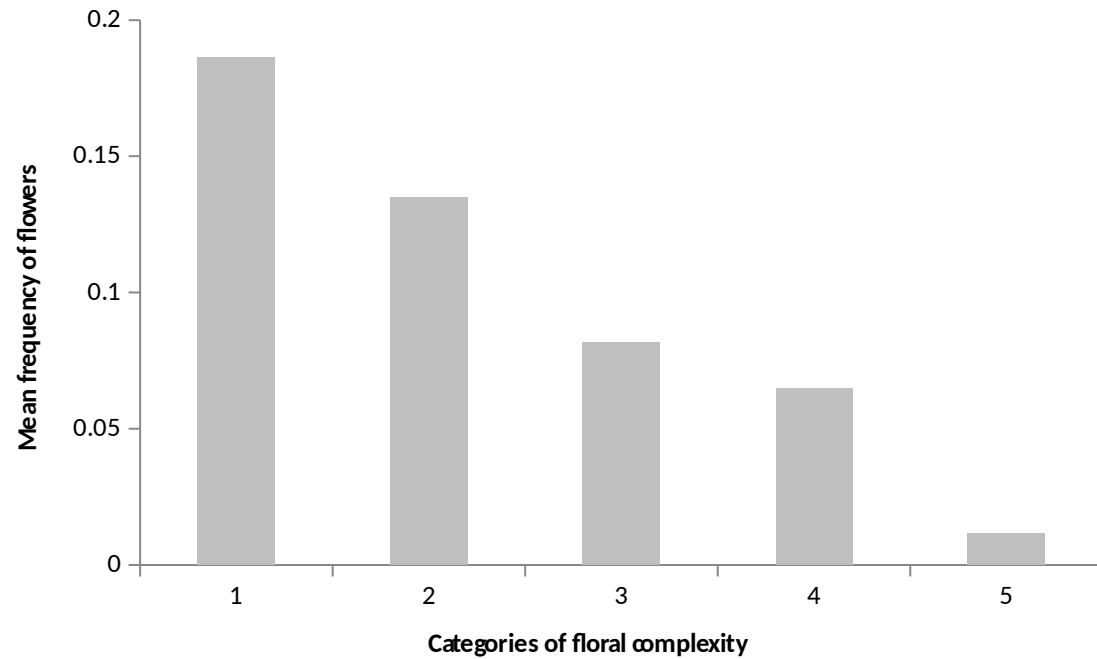


FIG. B2. Mean (\pm SE) frequency of floral complexity categories across networks. The frequency distribution is based on relative abundance of flowers in a floral complexity category per network. The numbers in the bars show the number of cases (species across networks) in each category. Floral complexity across networks is, on average, low, which may explain weak constraints expressed by floral morphology.

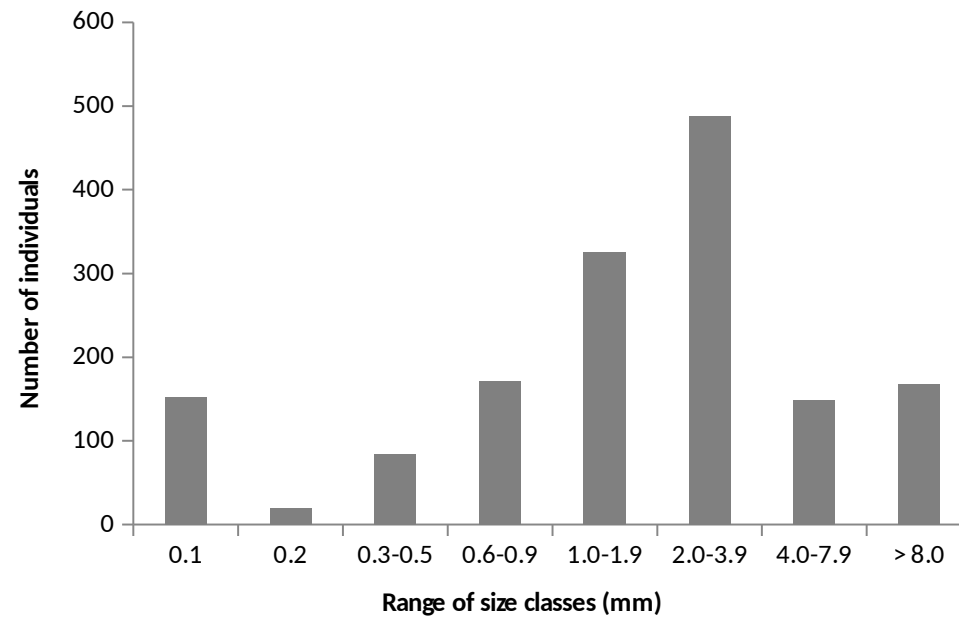


FIG. B3. Distribution of pollinator size (thorax width) of all observed individuals across the size classes. Pollinator size was categorized based on a logarithmic scale, hence the increasing range in size classes with increasing pollinator size.

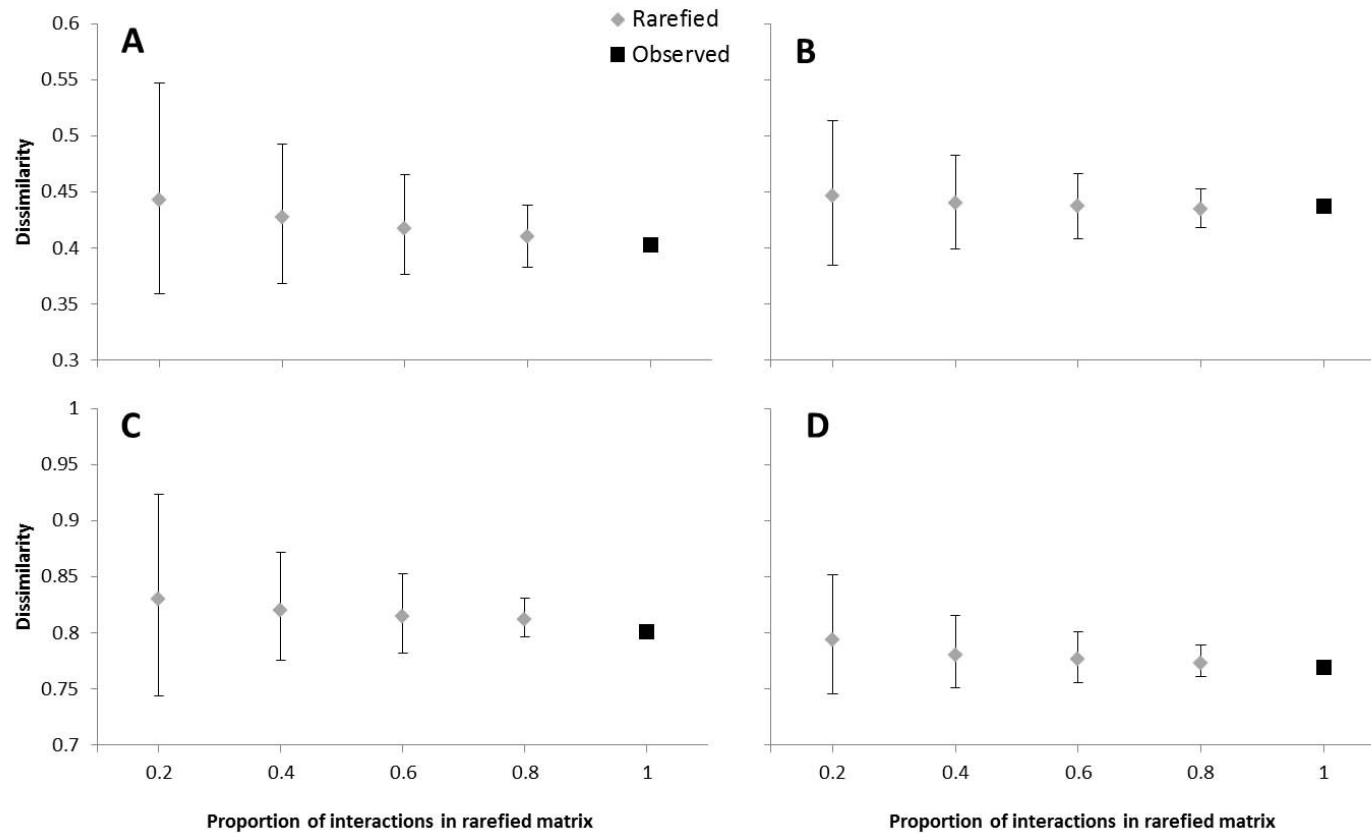


FIG. B4. Dissimilarities (mean \pm 95% CI for rarefied matrices) in interaction patterns between four network pairs of original and rarefied matrices. The rarefied matrices were sampled at four subsamples representing 0.8, 0.6., 0.4 and 0.2 of the full sample size. The observed dissimilarities between original matrices were similar to the rarefied dissimilarities. The graphs represent typical examples of within-site (A: Bernica 1 vs Bernica 2; C: Bernica 1 vs Bernica 7) and within-time period comparisons (B: Bernica 3 vs Trois Frères 3; D : Casse Dent 5 vs Tea Plantation 5). Further, shown are comparisons of networks of similar size with a relatively low level of dissimilarity (A and B) and networks of different size, which are relatively dissimilar (C and D).

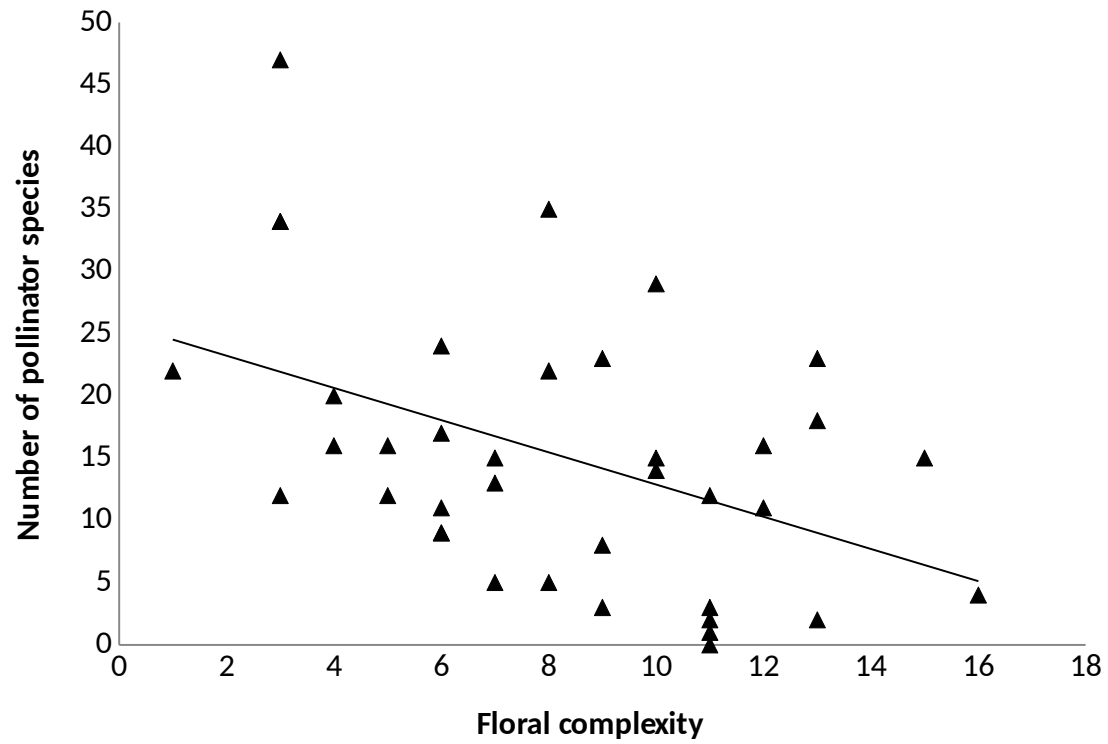


FIG. B5. Relationship between floral complexity scores and pollinator species richness across networks. Each data point represents one plant species. ** $P < 0.01$

Christopher N. Kaiser-Bunbury, Diego P. Vázquez, Martina Stang, and Jaboury Ghazoul. 2014. Determinants of the microstructure of plant-pollinator networks. *Ecology*.

APPENDIX C: R functions used for the rarefaction analysis and null model code to assess data constraints

C.1 Function *rarefmat* in R. The function compares the Bray-Curtis dissimilarities between two matrices of the same dimensions, and rarefies one by sampling a given proportion of interactions (0.8, 0.6, 0.4 and 0.2). It returns the observed dissimilarity between the original matrices and the mean and confidence limits of dissimilarities of rarefied matrices for each level of sampling.

```
rarefmat<-function(mat,mat2, raref.prop=c(0.8,0.6,0.4,0.2),iter=1000,
method="bray", rel.freqs=TRUE){
  L=sum(mat) #Total number of interactions in matrix
  L.raref=round(L*raref.prop) #Rarefaction sample sizes
  i=which(mat>0) #Index of matrix cells with non-zero values
  probs=mat[i]/sum(mat[i]) #Probability matrix for selecting interactions
  rar.dist=matrix(0,iter,length(raref.prop)) #Matrix to store similarities
  colnames(rar.dist)=raref.prop #Label columns with raref.prop values
  k=0 #Index variable

  for (rp in raref.prop){
    k=k+1
    for (it in 1:iter){
      mat.s=matrix(0,nrow(mat),ncol(mat)) #Matrix to store sampled interactions
      ints.v=rep.int(i,mat[i]) #Vector of indices of interactions to sample
      ints.s=sort(sample(ints.v,L.raref[k],replace=FALSE)) #Sampled indices
      ints.t=table(ints.s) #Number of interactions sampled per cell
      mat.s[as.integer(names(ints.t))]=ceiling(ints.t) #Rounded sampled
        interactions
      if (rel.freqs==FALSE) rar.dist[it,k]=vegdist(rbind(array(mat.s),
        array(mat2)),method=method) #Matrix with rarefied similarities
      if (rel.freqs==TRUE) rar.dist[it,k]=vegdist(rbind(array(mat.s)/sum(mat.s),
        array(mat2)/sum(mat2)),method=method) #Matrix with rarefied similarities
    }
  }
  if (rel.freqs==FALSE) obs.dist=vegdist(rbind(array(mat),array(mat2)),method=method)
  #Similarity with observed (unrarefied) matrix
  if (rel.freqs==TRUE) obs.dist=vegdist(rbind(array(mat)/sum(mat),
    array(mat2)/sum(mat2)),method=method) #Similarity with observed matrix
  rar.dist.upper.cl=apply(rar.dist,2,quantile,probs=0.975)
  rar.dist.mean=apply(rar.dist,2,mean)
  rar.dist.lower.cl=apply(rar.dist,2,quantile,probs=0.025)

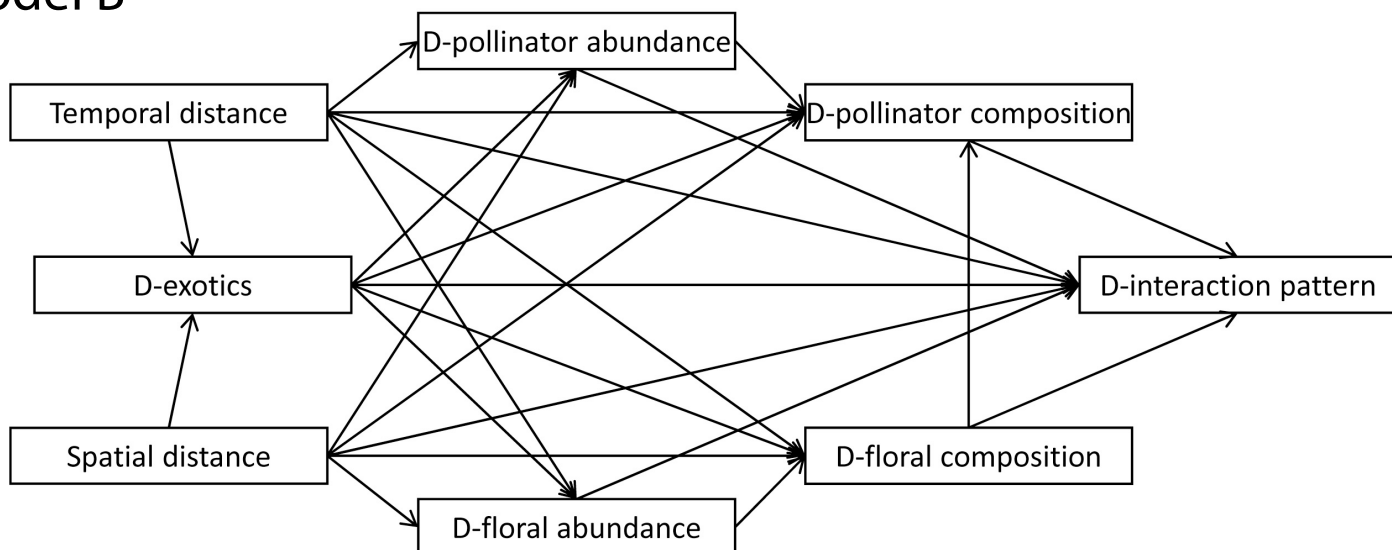
  rar.dist.summary=rbind(rar.dist.upper.cl,rar.dist.mean,rar.dist.lower.cl)
```

```
results=list()  
results$obs.dist=as.numeric(obs.dist)  
results$rar.dist=rar.dist.summary  
results  
}
```

C.2 Null model in R. R code of the null model to assess the constraints of a triangular pattern in the relationship between floral composition and flower traits. The null-model calculates Spearman correlation coefficients r_s of randomly generated data (999 iterations) that were restricted by the limits of the observed data

```
# C = vector of dissimilarity of floral complexity
# y_ran = Random y variable uncorrelated with x, with triangular relationship
      with x
iter=999 #Number of iterations for randomization
n=length(C) #Sample size of the original variables
r.ran=array(0,iter) #Array to store results of randomization
for (i in 1:iter){
  y_ran=C*runif(n, min=min(C), max=max(C))
  y_ran=max(C)-(max(C)-C)*runif(n,min=min(C),max=max(C))
  r.ran[i]=cor(C, y_ran, method=c("spearman"))
}
r.new=mean(r.ran)
r.new
```

Model B



Model C

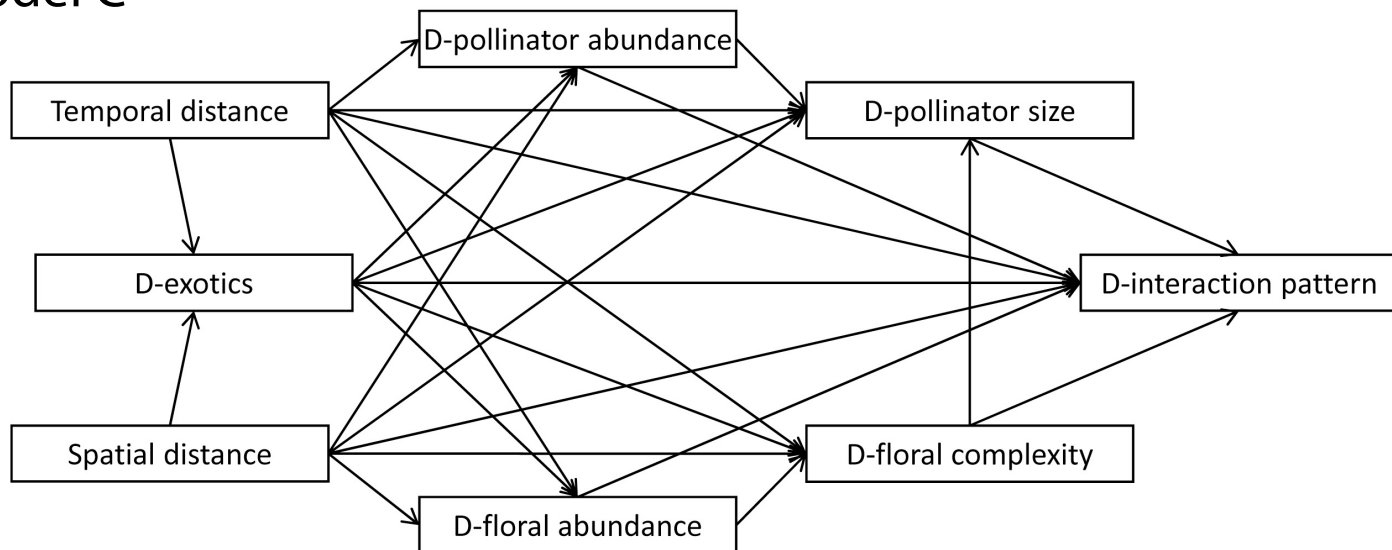


FIG. A1. Path diagram describing two reduced (nested) hypothesized models of the relationships of dissimilarities, in which either community composition (model B) or trait variables (model C) were entered separately. See FIG. 1 for a depiction of the complete model. Path justifications are provided in TABLE A1.

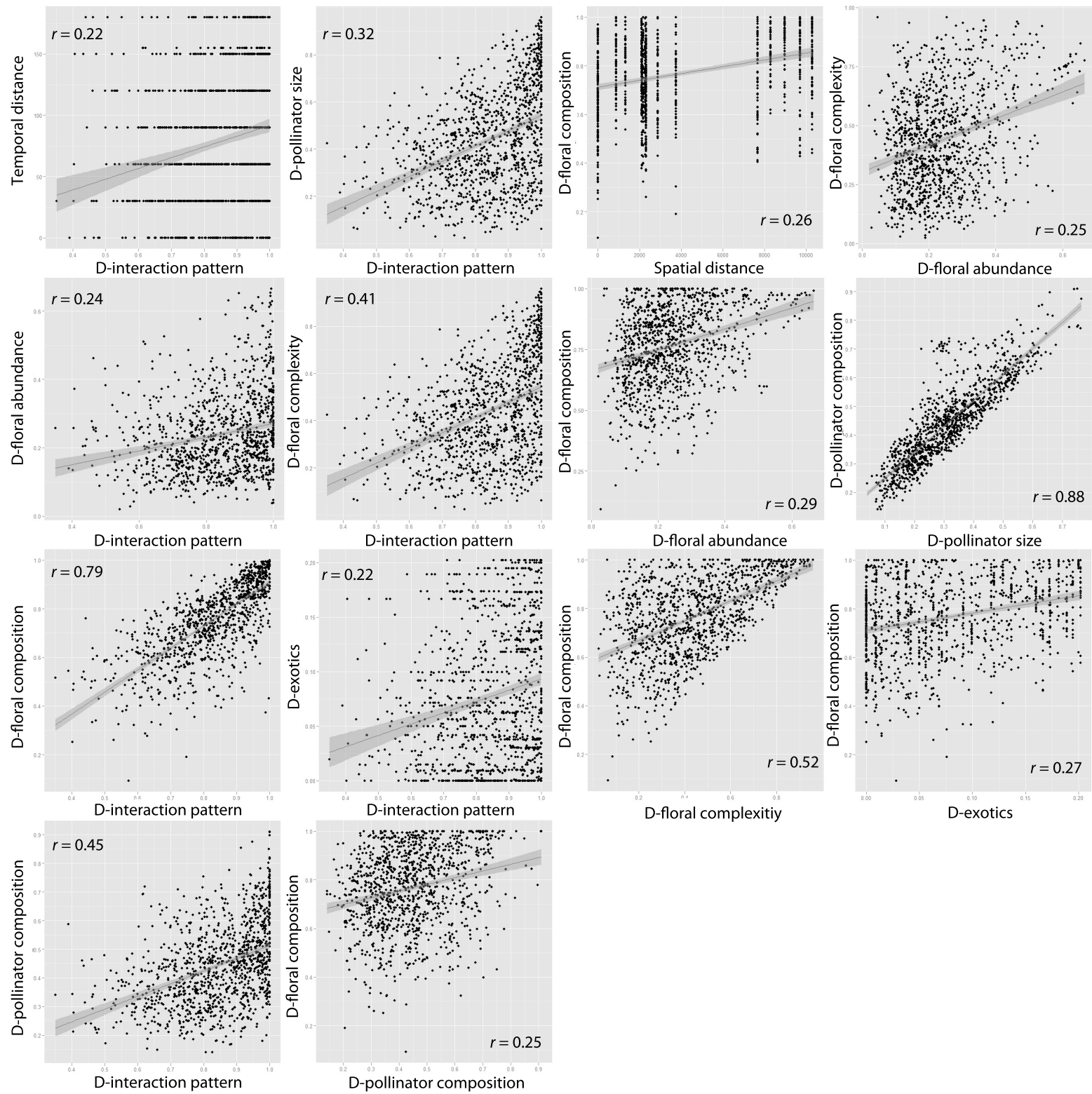


FIG. A2. Correlation plots depict bivariate relationship between dissimilarities (range 0-1) and temporal and spatial distances (days and meters, respectively) of variables across networks and the best-fit line with its standard error (dark shade surround lines). Shown are only significant Spearman correlations at a Bonferroni-corrected α of 0.001; for all bivariate relationships refer to TABLE B2. Note the triangular relationship between networks in D-floral composition and D-floral complexity.