Appendix A: Supplementary information of material and methods

A.1. Trait imputation

We had information of traits on 506 out of the 799 plant species. In species with traits, we had full information of diameter and lipid content in 348 species, whereas in 75 and 83 of them we had partial information (only diameter and lipid content, respectively). Thus, to evaluate trait-matching across the 59 communities studied, we needed to impute data on fruit diameter and lipid content on 48 and 47 percent of plant species. To evaluate if data imputation was reasonable, we tested two methods—random forest with the MissForest algorithm (Stekhoven & Bühlmann 2012) and mean genus-level values (Torres *et al.* 2023). To this end, we worked with the full dataset assembled, which contained information of 1830 plant species from 155 different families and divided it into training and out-of-sampled data. To estimate the accuracy of imputation methods, we randomly removed a number of species that corresponded to 10, 30, 50 and 70% of the dataset. We used the remaining data to train models and test the performance of data imputation. We quantified the linear relationship between observed and predicted values as well as root-mean-square error of the estimates. For each level of missing species, we repeated the process 50 times and obtained mean values and confidence intervals of accuracy estimates.

The MissForest algorithm makes iterative imputation of missing data using information of other traits and phylogeny as covariates (Debastiani *et al.* 2021). To make the process of data imputation more efficient, we first selected which fruit characteristics were correlated with our target traits (estimate>0.5 and $P<0.05$). In the case of fruit diameter (mm), we used fruit fresh mass (g), dry mass of pulp per fruit (g), dry mass of seed(s) per fruit (g), seed width (mm) and total energy per fruit (KJ) as covariates. To test the performance of data imputation we worked with the quantitative measure of lipid content of fruits (proportion of the pulp). In this case, we only used specific energy content of pulp (KJ/g). We also used phylogenetic eigenvectors (PVR) of the phylogenetic tree as covariates of the random forest model. Alternatively, we predicted fruit diameter and lipid content based on average values of species of the same genus. In our data with 1830 plant species the distribution of both traits was highly skewed, hence, we log-transformed their values before data imputation.

Data imputation at the genus-level mean outperformed the MissForest algorithm for fruit diameter and lipid content irrespective of the proportion of missing data (Fig. A1A-B). Probably this occurred because we also had information deficits in traits that were covariates in the random forest algorithm. Overall, imputing traits as genus-level mean yielded a good match between observed and predicted values (Fig. 1E-F). In the case of lipid content, we had three different scenarios for data imputation—we had information on (i) the proportion of lipids, (ii) the lipid score or (iii) we had mixed information. Whenever we had information on the proportion of lipids, we calculated mean genus-level values and then transformed it into lipid score. If we only had the lipid score (1: <10% of content, 2: 10-20%, 3: >20%), we obtained mean values and rounded them.

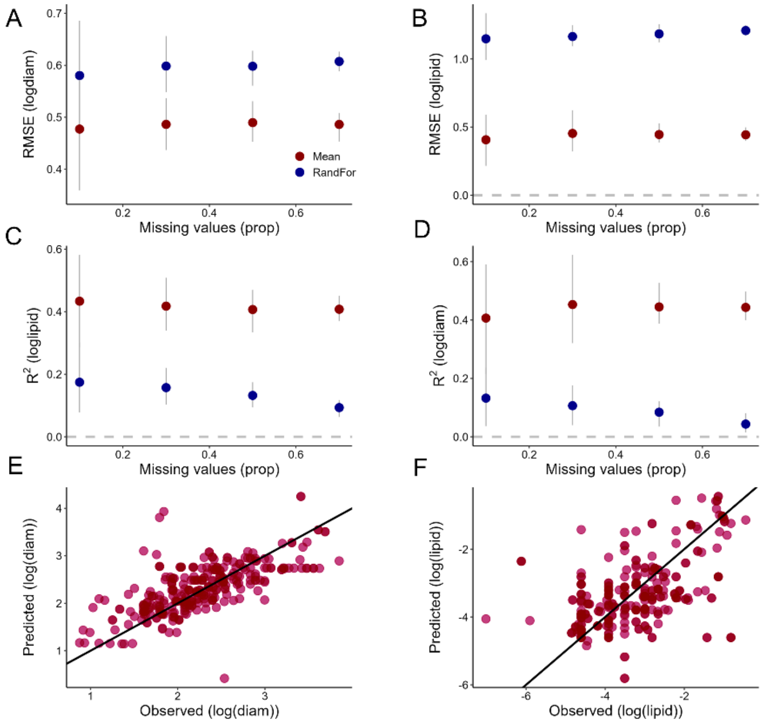

Fig. A1. Results of data imputation. (A-B) Root-mean-square error (RMSE) and (C-D) R^2 between observed and predicted values for fruit diameter (mm) and lipid content (prop) (log-transformed in both cases). Points depict mean values across 50 iterations and lines 0.95 quantiles. Relationship between predicted and observed values for (E) fruit diameter and (F) lipid content. For illustrative purposes we randomly selected 300 species out of the dataset of simulations with 50% of missing data (i.e., 10% higher information deficits than in our global dataset). Black line depicts 1:1 relationship (perfect match).

Plants with imputed data corresponded to, on average, 8.7 and 9 percent of species within communities for fruit diameter and lipid content, respectively. We did not find any trend with respect to the proportion of imputed data and latitude though it was slightly higher on islands (FigA2).

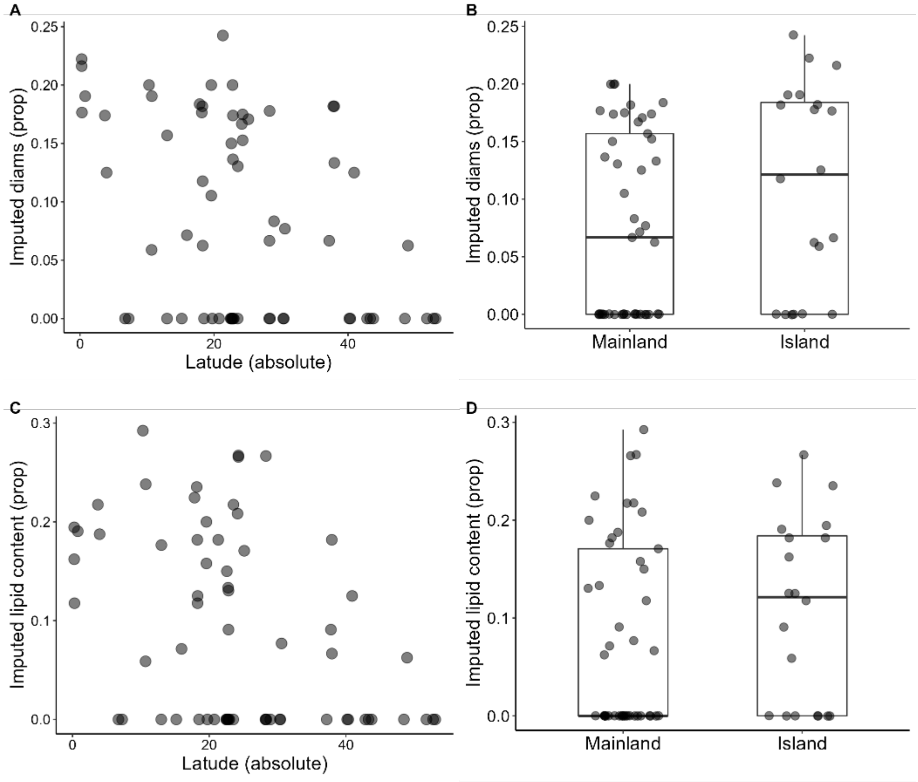

Fig. A2. Proportion of species within networks (N=59) with imputed fruit diameter and lipid content and its relationship with latitude (A, C) and insularity (B, D).

A.2. Proxies of relative abundance

To account for neutral process, the probability of an interaction to occur depended on the normalized degree of plants and frugivores (i.e., number of partners divided by the number of potential partners) which is usually assumed to reflect species abundances (Fricke *et al.* 2022; Vázquez *et al.* 2009). To evaluate if such an assumption was reasonable, in our quantitative networks (N=25) we estimated the proportion of observations of each i-th bird (and j-th plant) species with respect to the total number of observations recorded. This metric based on interaction frequencies is expected to be a more accurate measure of species relative abundances. We found a strong correlation between normalized degree and relative frequency of interactions (Fig. A3). In the case of plants, the number of observations can emerge from the interplay between relative abundance of fruits and the preference of dominant frugivorous species. Thus, we made an additional test to evaluate if direct measurements of fruit relative abundances were correlated with the normalized degree of plant species. To this end we used data from Schlautmann (2021) and found that normalized degree in plants was correlated with the relative abundance of fruits (Fig. A4).

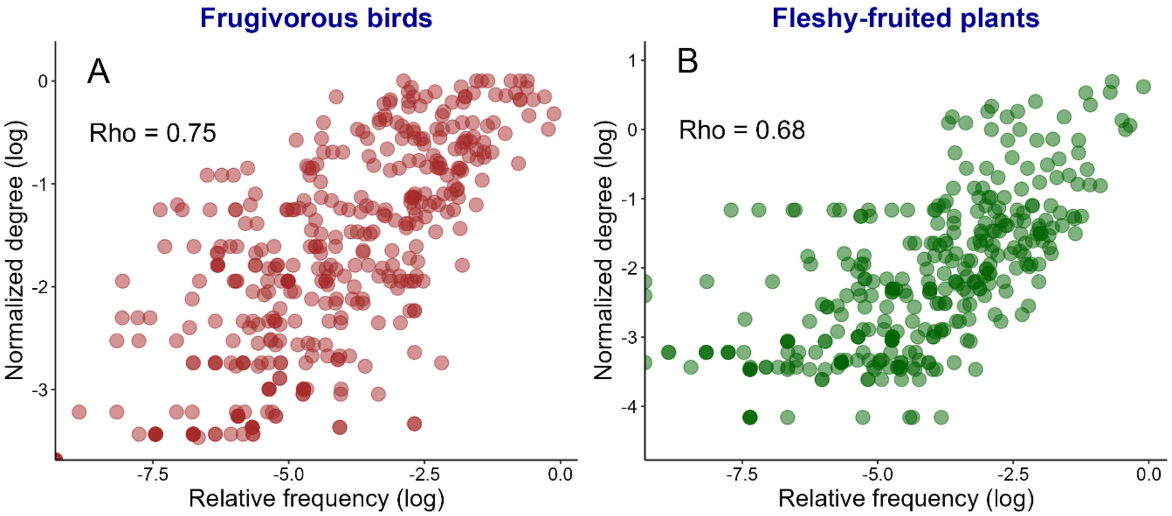

Fig. A3 Relationship between the relative frequency of interactions of bird and plant species and their normalized degree. Relative frequency of interactions is the sum of interactions observed for the n-th species (frugivore or plant) divided by the number of interactions observed in the k-th community. Normalized degree is the number of realized partners of the n-th species divided by the number of potential partners (i.e., total number of species in the other trophic levels).

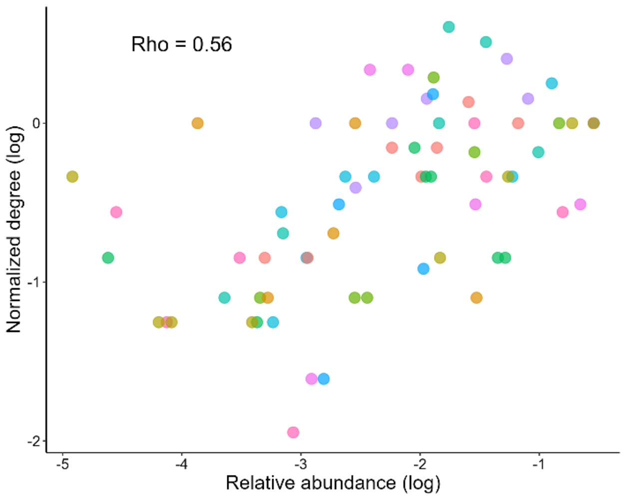

Fig. A4. Scatterplot of the relationship between fruit relative abundance and normalized degree in plant species from 11 sites located in the Białowieża Forest (Schlautmann *et al.* 2021). Sites are represented in different colors.

Even though normalized degree is related to species abundances, it can also capture other processes including trait-matching. Hence, we evaluated if these effects were minor, and hence, allowed us to estimate trait-matching across communities. We evaluated if normalized degree could be related to species traits causing a higher number of forbidden interactions (Olesen *et al.* 2011) or a higher degree of generalization (Dalsgaard *et al.* 2017). In the studied communities ND was not correlated with fruit diameter, bird beak width and degree of frugivory in 90%, 97% and 80% of them.

In addition, we performed simulations of interaction assembly to evaluate (i) how much of variability of normalized degree depended on abundance compared to trait-matching and (ii) if using normalized degree as a proxy of abundances could compromise model identifiability. In both cases, we simulated a dataset of 200 bird and plant species distributed across 50 communities with contrasting richness. We sampled community richness from a normal distribution with mean =20, sd = 10 truncated between 5 and 70 species. Within communities we simulated species abundances with a lognormal distribution (mean = 10 sd = 3, log-transformed) and sampled plant and bird species traits from a normal distribution with mean = 0 and sd = 1.

We simulated interaction assembly within communities changing the strength of neutral processes and trait-matching. The strength of neutral processes ranged between 0.5 and 4 so that it included a wider range of values to those estimated in our communities (1.93 on average [1.25, 2.59], $q_{0.05}$, $q_{0.95}$, respectively). Trait-matching strength ranged from 0.25 to 2 so that its lower bound was comparable to average values of trait-matching in our communities (0.30 and 0.15 for morphological and nutritional trait-matching, respectively). Thus, we simulated scenarios of interaction assembly in which trait-matching strength was similar or higher to that found in our studied communities. In this way, we were conservative when evaluating the suitability of ND as a proxy of species abundances. For each combination of neutral and trait-matching parameters, we simulated interactions including only neutral processes (null model) and including both neutral and trait-matching effects (full model). We repeated the process 30 times. In each iteration, we regressed the normalized degree of species within communities predicted by the full model against that of the null model and estimated the R^2. Then, we averaged R^2 across communities to estimate the proportion of variance of ND explained by neutral processes. In addition, we quantified the correlation between ND predicted by the full model and species abundances and traits.

As expected, the proportion of variance explained by ND increased with the strength of neutral processes. In the range of values of neutral and trait-matching strength found in our communities (i.e., values of 2 and 0.25, respectively), the null model explained 59% and 64% of variance of ND (Fig. A5, red asterisk) and both metrics were closely related (Fig. A6). In addition, in the full model ND was mainly correlated with species abundances and not to species traits (Fig. A7).

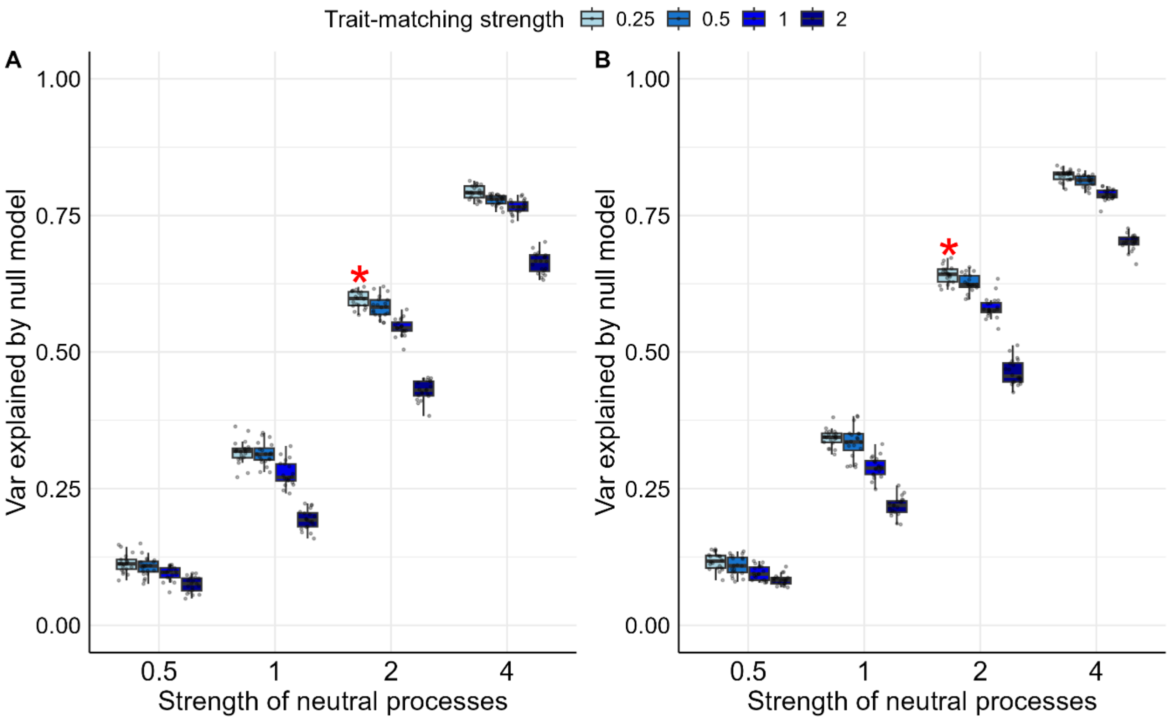

Fig. A5. Proportion of variance of normalized degree explained by species abundances in different scenarios of strength of neutral processes and trait-matching. The red asterisk depicts parameter values similar to those estimated in the studied communities. (A) Corresponds to birds and (B) to plants.

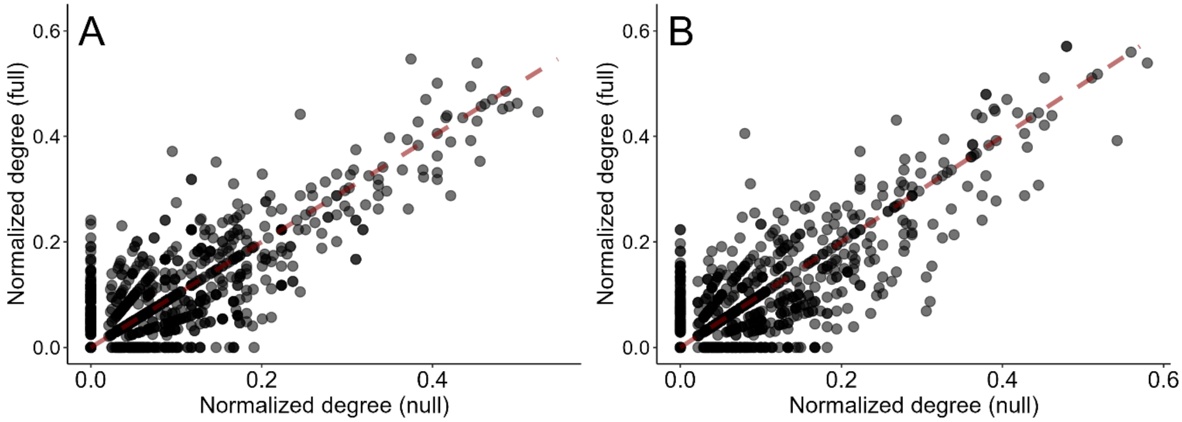

Fig. A6. Normalized degree of (A) birds and (B) plants estimated by the full and the null model in a scenario of neutral process strength of 2, and trait-matching strength of 0.25 (similar values to those estimated in the studied communities). The red lines depict 1:1 relationship (i.e., perfect match).

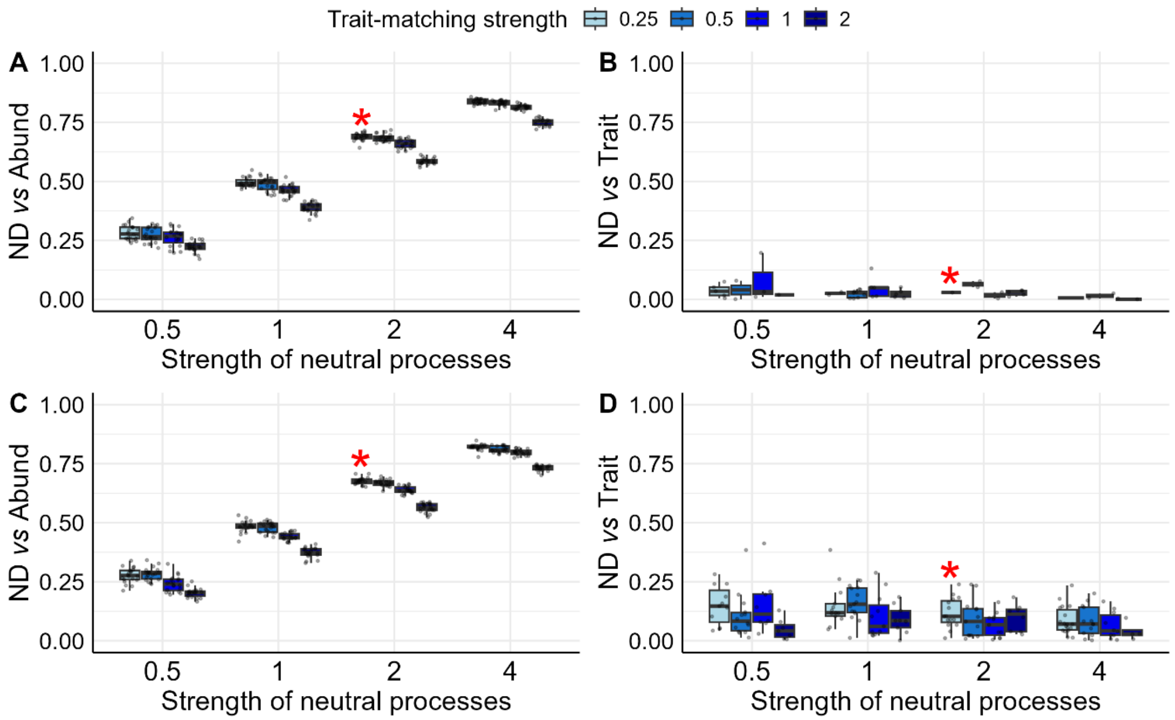

Fig. A7. Rho values of spearman correlation between normalized degree and species abundances (left panels) and species traits (right panels). Upper panels correspond to birds, lower to plants. The red asterisks depict parameter values similar to those estimated in our model with observed data.

Finally, to evaluate if using normalized degree as a proxy of species abundance could compromise our ability to estimate trait-matching and its latitudinal trends we simulated datasets following the same processes as those reflected in our joint species frugivory model (Appendix B). As above, we simulated interaction assembly in 50 communities harboring a total of 200 species. In these simulations communities were located across an environmental gradient (of mean = 0 and sd = 1) that modified trait-matching strength. In each community, after simulating pairwise interactions we recorded the normalized degree of each plant and bird species and used it as a proxy of their abundances to fit the joint species model. Then, we evaluated our ability to recover bird responses to fruit traits (beta parameters, Appendix B eq. B2), trait-matching parameters (eq. B6) and the effect of environmental covariates on these trait-matching parameters (alpha parameters, eq. B8). In all cases, we could recover our model parameters correctly (Fig. A8). Thus, normalized degree did not compromise the identifiability of our model.

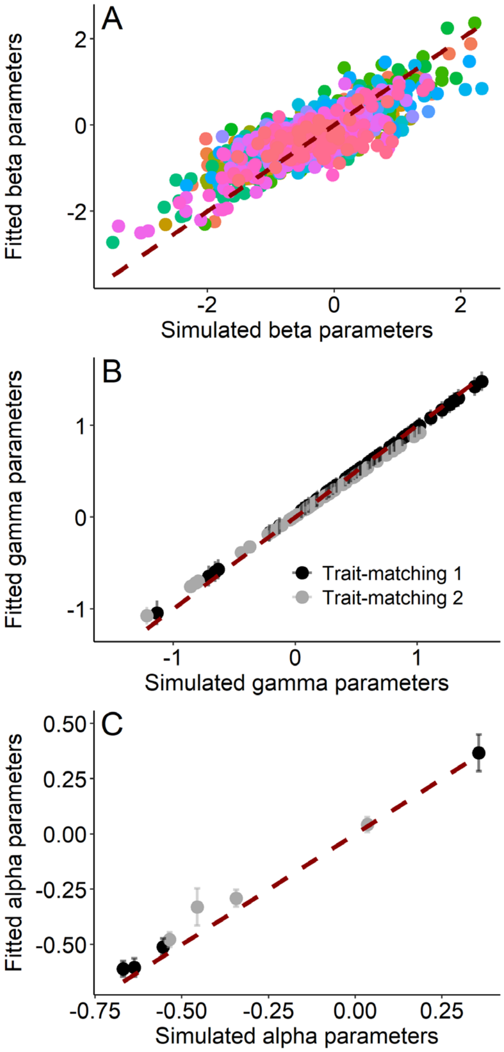

Fig. A8. Relationship between simulated and fitted parameters of (A) species responses to plant traits (i.e., beta in eq. B2). Each point represents mean values of posterior distributions for one bird species within a community. Communities are represented in different colors (N=50). (B) Effects of bird traits on their responses to plant traits (i.e., gamma parameters, eq. B6) and (C) effects of environmental covariates on trait-matching parameters (alpha parameters, eq. B8). In figure B and C, grey and black points depict parameters related to trait-matching rule 1 and 2 (e.g., morphological and nutritional trait-matching). Points depict mean values of posterior distributions and lines 90% credible intervals. In all panels dotted red line depicts 1:1 relationship (i.e., perfect match between simulated and fitted values).

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Appendix B

B.1. Model specifications

We modified the HMSC-frugivory model (Pizo *et al.* 2021) to consider the effects of biogeographical context (latitude and insularity) on trait-matching. We modeled the presence of an interaction between the *i*-th bird and the j-th plant species pertaining to the f-th family in the *k*-th network (Y_{ij_k}) as follows:

$$Y_{ij_k} \sim \mathrm{Bernoulli}(p_{ij_k}) \qquad \text{eq.B1}$$

$$\mathrm{logit}(p_{ij_k}) = \beta_{0k} + \beta_{1k}\hat{A}_{i_k}\hat{A}_{j_k} + \beta_{2i_k}D_j + \beta_{3i_k}L_j + e_{j_f} \qquad \text{eq.B2}$$

the probability that the interaction was recorded (p_{ij_k}) depended on the normalized degree of both species (i.e., number of observed partners divided by the number of potential partners, $\beta_{1k}\hat{A}_{i_k}\hat{A}_{j_k}$) and how the *i*-th bird responded to the diameter (β_{2i}) and lipid content (β_{3i}) of fruits. Normalized degree (log-transformed) is often related to the relative abundance of species, thus the term $\beta_{1k}\hat{A}_{i_k}\hat{A}_{j_k}$ was used as a proxy of abundance-driven neutral processes in interaction probabilities (Fricke et al., 2022; Vázquez et al., 2009, see Appendix A.2). In equation B2 we introduced network ID as a random effect in the intercept (β_{0k}) to account for different sampling effort across studies. It was also included in the effect of neutral processes (β_{1k}) because their strength may vary with the number of species present in communities (Vázquez *et al.* 2009). In addition, we included plant species phylogeny as an error term (e_{j_f}) as follows:

$$e_{j_f} \sim NMV(0, S) \qquad \text{Eq. B3}$$

$$S_{f1f2} = \omega \exp\left(-\delta D_{f1f2}^{2}\right) + \varphi \qquad \text{Eq. B4}$$

e_{j_f} was sampled from a multivariate normal centered in 0 and with a variance within genus determined by $\omega + \varphi$. The covariance between plant species decayed with the phylogenetic distance at the family-level (D^2_{f1f2}) according to the δ parameter. As δ parameter is higher the covariance of plant genus in the error term decays more rapidly with distance (McElreath, 2023). This noise structure considers traits that could affect interaction assembly, for which we did not have enough information (e.g., secondary compounds, Cipollini, 2000) but could share a common evolutionary history (Hartmann 2007).

$$\beta_{..k} \sim NMV(\mu_{..k}, \Sigma) \qquad \text{eq. B5}$$

$$\mu_{it_k} = \gamma_{0t_k} + \gamma_{1t_k} B_i + \gamma_{2t_k} F_i \qquad \text{eq. B6}$$

$$\Sigma = V \otimes [\rho C + (1 - \rho) I] \qquad \text{eq. B7}$$

$$\gamma_{lt_k} = \alpha_{0lt} + \alpha_{1lt} Lat_k + \alpha_{2lt} I_k + \alpha_{3lt} Lat_k I_k \qquad \text{eq. B8}$$

We sampled the response of birds to fruit traits (β_{2i_k} and β_{3i_k}) from a multivariate normal whose expected values depended on their beak width (mm, B_i) and their degree of frugivory (proportion, F_i). Therefore, we quantified morphological trait-matching as γ_{11_k} (i.e., beak width effects on frugivores' responses to fruit diameter); and nutritional trait-matching as γ_{22_k} (i.e., effect of the degree of frugivory on frugivores' responses to lipid-poor fruits). A positive value of morphological trait-matching implies that as beak width is larger there is an increase in the slope relating fruit width with the probability of interaction. The same applies for nutritional trait-matching. As γ_{11_k} (or γ_{22_k}) parameters increase, the effects of frugivores' traits on their responses to plant traits intensifies, reflecting a stronger trait-matching (Fig. B1). The multivariate normal from which we sampled bird responses to fruit traits had a variance-covariance matrix that was constructed as the Kronecker product between the variance-covariance matrix of environmental effects (V) and the term $[\rho C + (1 - \rho) I]$, which depends on the matrix of species phylogenetic correlations (C), an identity matrix with same size a species within the community (I) and the term ρ. Rho (ρ) ranges between 0 and 1, higher values imply a stronger phylogenetic signal on species responses. In other words, close phylogenetic relatives behave more similarly than expected only based on their traits.

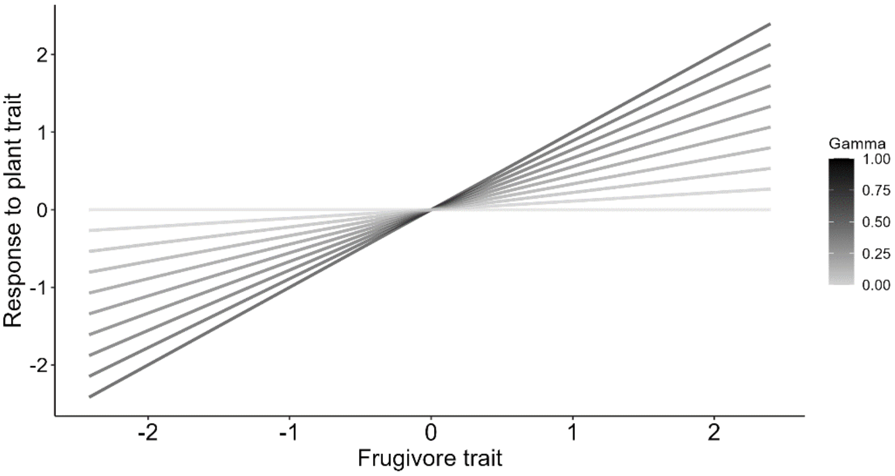

Fig. B1. Conceptual figure of the impact of gamma (trait-matching parameter) on the response of frugivores to plant traits. As the gamma parameter increases the effect of bird traits on how they respond to plant traits is stronger.

In this work, we were interested in quantifying the effects of the biogeographical context on the strength of trait-matching. Thus, the intercept and the effect of bird traits on their response to plant traits (i.e., γ_{0t_k} and γ_{lt_k} parameters), depended on the latitude of the community ($\alpha_{1lt}Lat_k$), its insularity ($\alpha_{2lt}I_k$) and their interaction ($\alpha_{3lt}Lat_kI_k$) (eq. B8).

To parameterize the model, we used weakly informative priors. Biogeographical context effects (αs in eq. B8) were sampled from a normal distribution with mean 0 and 1 standard deviation. The scales of variance-covariance were sampled from a student t with η=3, μ=0, σ=10 and correlations from a Cholesky LKJ correlation distribution with parameter 1. The strength of phylogenetic signal on bird species responses (ρ, eq.

B7) had as prior a beta distribution with shape1 = 2 and shape2= 2. To construct the Gaussian decaying covariance matrix reflecting the effects of plant phylogeny (eq. B4), we set priors for ω and δ as exponential distributions with lambda 0.5 and 2 respectively, and the extra variation term (φ) had as prior a student t with η=3, μ=0, σ=10. Finally, mean values of community-level random effects (β_{0k}, β_{1k}) had normally distributed priors (mean = 0 and sd= 1) and their standard deviations had student t with η=3, μ=0, σ=10 as priors.

Before fitting the model, we log-transformed beak-width, degree of frugivory (plus one), fruit diameter and the result of multiplication of the normalized degree of species ($\hat{A}_{i_k}\hat{A}_{j_k}$). Then, we scaled (mean=0, sd = 1) all covariates of eq. B2, B6 and B8. We fitted the model with Stan through R (Carpenter *et al.* 2017). After running two chains during 50,000 iterations (half of them for warmup), we checked for convergence (Rhat < 1.01) and effective sample size of posterior distributions (mean = 46404, [36182, 52144] q_{005} and q_{095}, respectively). To estimate model fit, we performed a posterior-predictive check by simulating 1,000 times frugivory in each community. In each simulation and for each community we calculated the number of realized *vs* potential interactions (i.e., network connectance), we then averaged predicted values across 1,000 simulations and compared them to observed values. We found an almost perfect match across communities (Fig. B2A). In addition, we evaluated model performance with respect to pairwise interactions within communities (i.e., who interacts with whom). For each simulation and community, we calculated the proportion of times that our model predicted well the observed interactions (i.e., model accuracy) and averaged these values across 1,000 simulations. Across communities, our model predicted well 77% of times specific pairwise interactions (Fig, B2B).

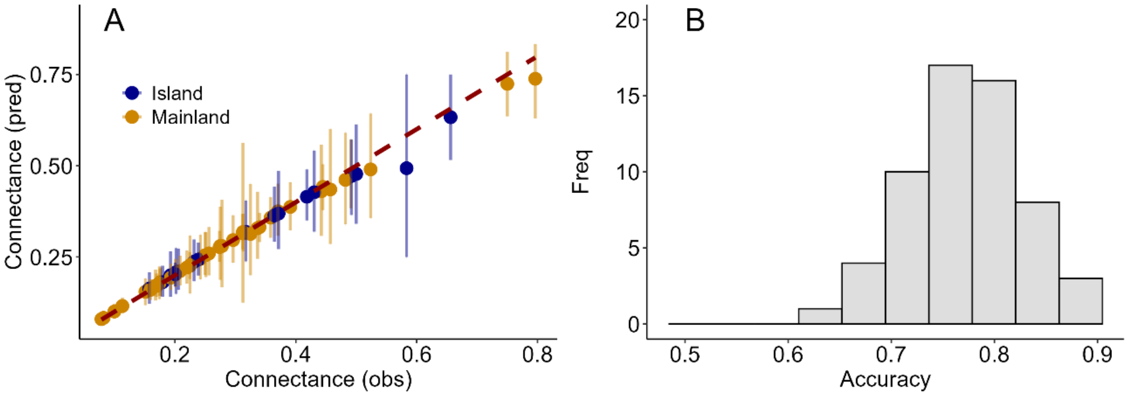

Fig. B2. Posterior-predictive check of the HMSC-Frugivory model. (A) Relationship between predicted and observed realized interactions within communities (i.e., network connectance). Each point represents mean values across 1000 simulations in each network and lines 0.90 credible intervals. Dashed line represents the 1:1 relationship (perfect match between observed and predicted values). (B) Histogram of model accuracy with respect to pairwise interactions within networks. Mean accuracy was 0.77 with 0.68 and 0.85 being 0.05 and 0.95 quantiles.

B.2. Frugivory simulations

To measure the functional consequences of trait-matching in terms of bird species irreplaceability and complementarity, we simulated frugivory based on the posterior distributions of interaction probabilities. We sought for a number of foraging events large enough to account for the occurrence of interactions with low probability. Thus, in each community we identified the rarest pairwise interactions (i.e., those with a value lower than the 0.05 quantile of mean interaction probabilities). Then, we simulated frugivory distributing 100, 1,000, 10,000 and 100,000 events, and for each of these numbers we run 1,000 simulations. For each community we quantified (i) the variance across simulations in the frequency of rare interactions and (ii) the mean weighted network connectance (i.e., number of realized interactions weighted by their interaction frequencies). When we simulated 10,000 foraging events our model outputs were more reproducible (i.e., variance is reduced and stabilized) and rare events within communities took place (i.e., they generate a network with a high connectance) (Fig. B3).

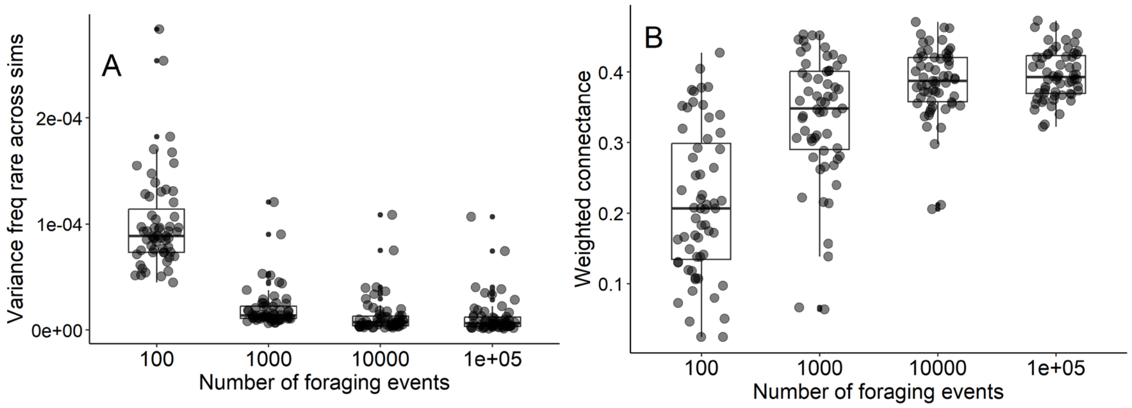

Fig. B3. (A) Variance in the proportion of foraging events occurring in rare pairwise interactions (probabilities < q_{005}) and (B) mean weighted connectance of generated networks when distributing an increasing number of foraging events within communities. In both panels each point represents one community (N=59).

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Appendix C

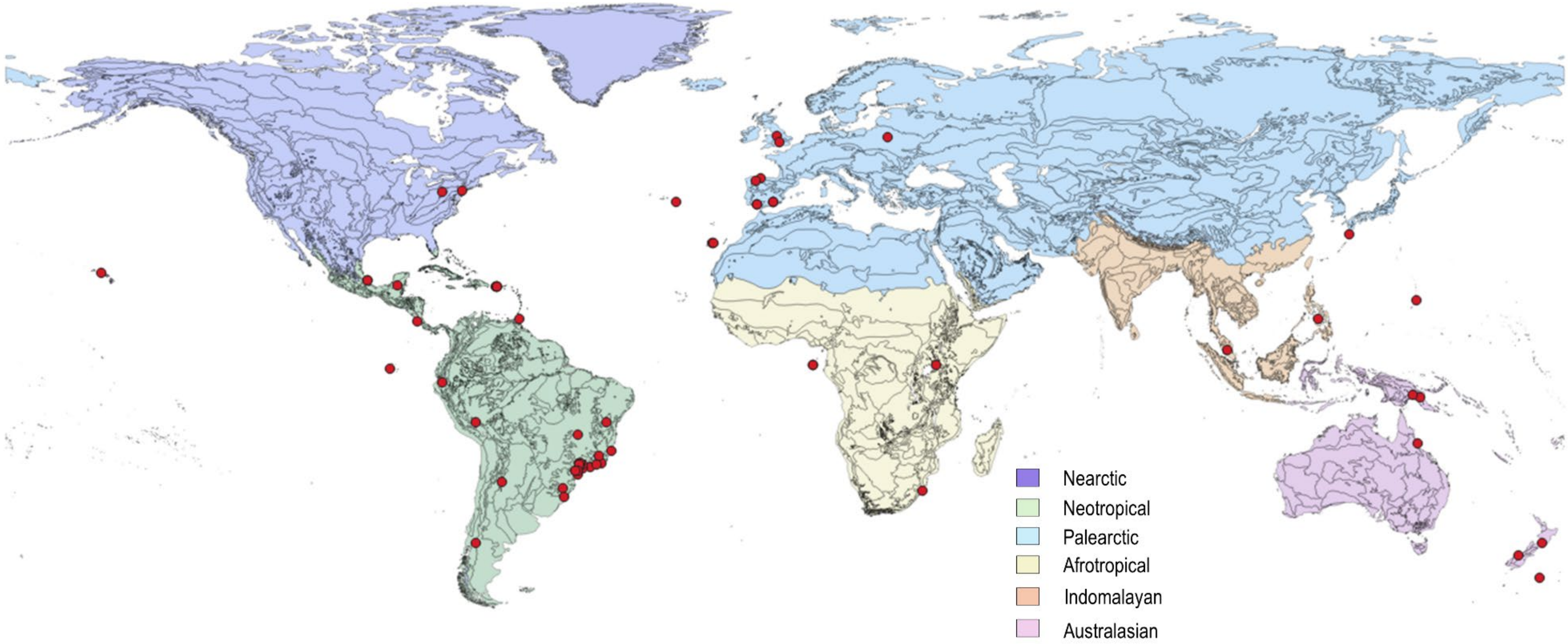

Fig. C1. Map of the studied networks. Colors depict different biogeographical realms (lines within them depict frontiers between ecoregions within them).

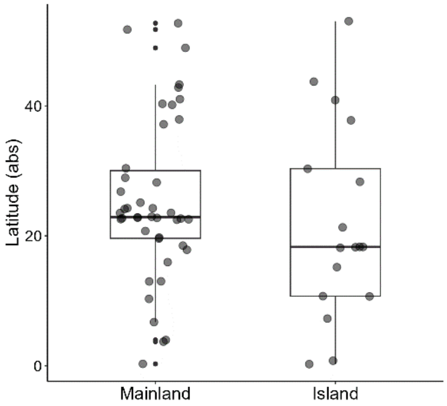

Fig. C2. Boxplot of latitude (in absolute values) of studied communities according to their location in mainland and on islands.

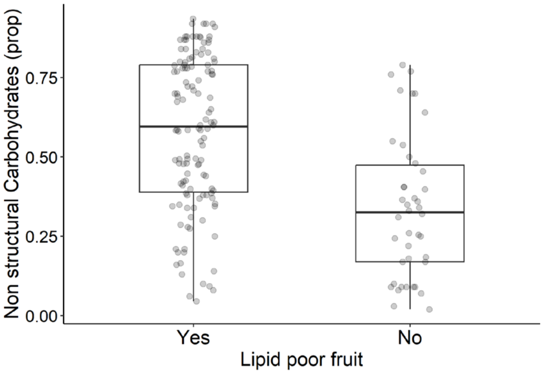

Fig. C3. Boxplot of the content of non-structural carbohydrates in the pulp (proportion) of fruits classified as lipid-poor (<10% of pulp content) or not. Points depict plant species located in our communities for which information we had information on both fruit traits.

C.1. Community characteristics

Table C1. Spearman correlation results between latitude and community characteristics. Significant values in bold.

Variable	Rho	P-value
Plant richness (log)	**-0.26**	**0.05**
Bird richness (log)	**-0.26**	**0.05**
Fruit diam (mean)	**-0.39**	**<0.01**
Beak width (mean)	**-0.4**	**<0.01**
Low-lipid fruits (prop)	0.16	0.23
Degree of frugivory (mean)	**-0.48**	**<0.01**
Fruit diam (range, log)	**-0.35**	**<0.01**
Beak width (range, log)	**-0.34**	**<0.01**
Degree of frugivory (range, log)	**-0.51**	**<0.01**

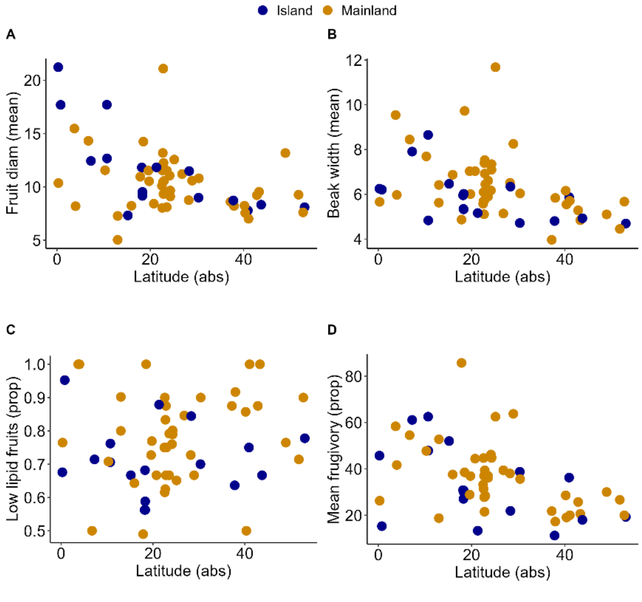

Fig. C4. Relationship between the characteristics of the fruiting and bird assemblage and latitude in our studied communities. Average (A) fruit diameter (mm), (B) beak width (mm) and (D) degree of frugivory (%) of birds. (C) Proportion of fruit species with low lipid content (<10% of pulp).

C.2. Complementary results

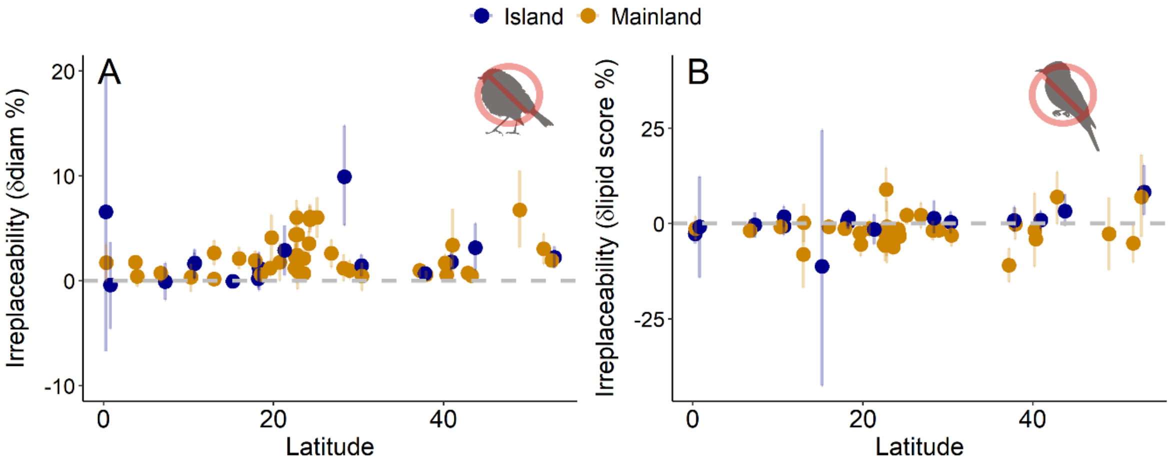

Fig. C5. Irreplaceability of (A) narrowest-beaked and (D) most insectivorous birds measured as changes in the mean diameter and lipid score of fruits consumed by the bird assemblage after removing their interactions. Greater changes imply a higher irreplaceability. In all panels points depict mean values across 1,000 simulations and lines 90% credible intervals. Silhouettes: (A) *Erithracus* (B) *Tyrannus.* Source of silhouettes: www.phylopic.org.

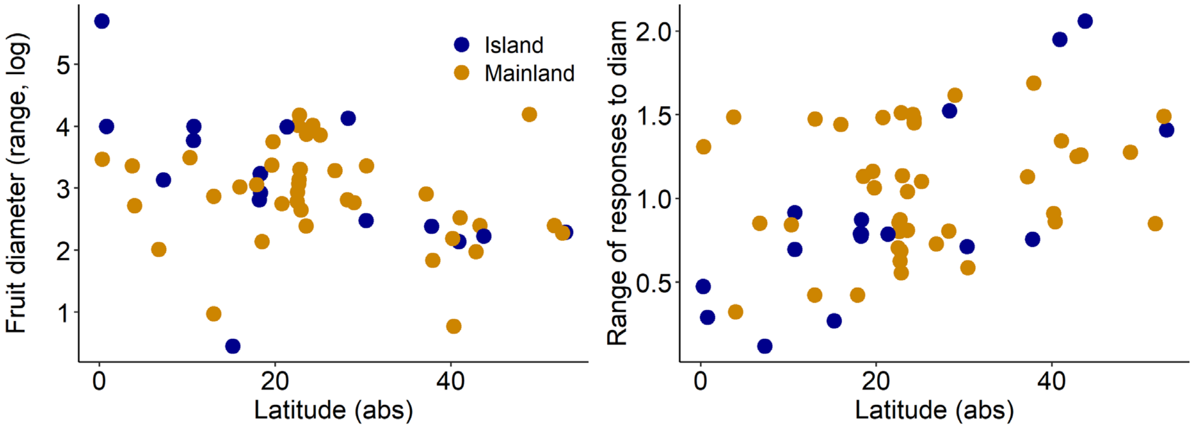

Fig. C6. Range of (A) fruit diameters (log-transformed) and (B) of responses of frugivores to this fruit trait within communities. Each point represents a studied community (N = 59).

Table C2. References of the networks used in this study as well as longitude, latitude, realm, insularity and the possibility to obtain quantitative information of interaction frequency. For further details (links/doi, sources, and other environmental covariates please visit zenodo files).

Reference	Latitude	Longitude	Realm	Island	Quantitative
Kaizer Alves, José Ferreira (2007) Composiçao da avifauna e frugivoria por aves em um mosaico sucessional na mata Atlântica. PhD thesis. Universidad Estadual Paulista	-23.52	-45.02	Neotropic	No	No
Argel-de-Oliveira, M. M. (1999) Frugivoria por aves em um fragmento de floresta de restinga no. Estado do Espírito Santo, Brasil, PhD Thesis, UNICAMP, Campinas, Brasil	-19.7415	-39.9961	Neotropic	No	No
Athie, S. (2009) Composição da avifauna e frugivoria por aves em um mosaico de vegetação secundária em Rio Claro, região Centro-Leste do Estado de São Paulo. MSc Dissertation. Universidade Federal del São Carlos	-22.4833	-47.5923	Neotropic	No	No
Blendinger, P. G., Jiménez, J., Macchi, L., Martín, E., Sánchez, M. S., & Ayup, M. M. (2015). Scale_dependent spatial match between fruits and fruit_eating birds during the breeding season in Yungas Andean forests.Biotropica,47(6), 702-711.	-26.8061	-65.3472	Neotropic	No	No
Burns, K. C. (2013). What causes size coupling in fruit?frugivore interaction webs? Ecology, 94(2), 295-300.	-40.9006	174.886	Australasia	Yes	Yes
Carlo (2020) Spatially-explicit avian frugivory, fruit availability, and seed rain in a latitudinal gradient of the Americas	40.17743	-79.2277	Nearctic	No	Yes
Castro (2007) Fenologia reprodutiva da palmito Euterpe edulis (Arecaceae) e sua influência na abundância de aves frugívoras na floresta Atlântica	-25.1219	-47.858	Neotropic	No	No
Correria, JMS(1997) Utilizaçao de especies frutiferas da mata Atlantica na alimentaçao da avifauna da Reserva Biologica de Poços das Antas, RJ. MSc Dissertation. UNB Brasilia	-22.5532	-42.2805	Neotropic	No	No
Dehling, D. M., Fritz, S. A., Töpfer, T., Päckert, M., Estler, P., B?hning_Gaese, K., & Schleuning, M. (2014). Functional and phylogenetic diversity and assemblage structure of frugivorous birds along an elevational gradient in the tropical Andes.Ecography,37(11), 1047-1055.	-13.002	-71.4225	Neotropic	No	No
Fadinia RF and De Marco Jr P (2004) Interações entre aves frugívoras e plantas em um fragmento de mata atlântica de Minas Gerais. Ararajuba 12 (2):97-103.	-20.75	-42.88	Neotropic	No	No
Faustino T.C. and Machado C.G. (2004) Frugivoria por aves em uma área de campo rupestre na Chapada Diamantina, BA. Revista Brasileira de Ornitologia 14 (2) 137-143	-12.9883	-41.3408	Neotropic	No	No
Fricke, E. C., Tewksbury, J. J., & Rogers, H. S. (2018). Defaunation leads to interaction deficits, not interaction compensation, in an island seed dispersal network. Global Change Biology, 24(1), e190-e200.	15.1833	145.75	Oceania	Yes	Yes

Reference	Latitude	Longitude	Realm	Island	Quantitative
Galetti, M., Pizo, M.A. 1996. Fruit eating birds in a forest fragment in southeastern Brazil. Ararajuba, Revista Brasileira de Ornitologia, 4: 71-79.	-22.8167	-47.1	Neotropic	No	Yes
García, D., Martínez, D., Stouffer, D. B., & Tylianakis, J. M. (2014). Exotic birds increase generalization and compensate for native bird decline in plant-frugivore assemblages. Journal of Animal Ecology, 83(6), 1441?1450.	-48.9376	174.4018	Australasia	No	Yes
García, D. (2016). Birds in ecological networks: insights from bird-plant mutualistic interactions. Ardeola, 63(1), 151?180.	43.2977	-5.5011	Palearctic	No	Yes
Hasui, E., & Hofling, E. (1998). Food Preference Of The Frugivorous Birds In A Fragment Of Semideciduous Forest, Sao Paulo.Iheringia Série Zoologia ,84:43-64.	-23.5468	-46.7213	Neotropic	No	No
Heleno, R. H., Mendes, F., Coelho, A. P., Ramos, J. A., Palmeirim, J. M., Rainho, A., & de Lima, R. F. (2022). The upsizing of the São Tome seed dispersal network by introduced animals. Oikos, 2022(2).	0.2554	6.6028	Afrotropic	Yes	Yes
Kindel, A. (1996) Interações entre plantas ornitocóricas e aves frugívoras na Estação Ecológica de Aracuri, Muitos Capões, RS. MSc thesis, Universidade Federal do Rio Grande do Sul, Brazil.	-28.2258	-51.1688	Neotropic	No	No
Baird, J.W. 1980. The selection and use of fruit by birds in an eastern forest. Wilson Bulletin 92: 63-73.	40.33193	-74.6667	Nearctic	No	Yes
Beehler, B. 1983. Frugivory and polygamy in birds of paradise. Auk, 100: 1-12.	-7.26667	146.7	Australasia	Yes	Yes
Source: web-of-life. M_SD_003. Carlo et al. (2003) Avian fruit preferences across a Puerto Rican forested landscape: pattern consistency and implications for seed removal. Oecologia 134: 119-131.	18.29694	-66.7819	Neotropic	Yes	Yes
Source: web-of-life. M_SD_004. Carlo et al. (2003) Avian fruit preferences across a Puerto Rican forested landscape: pattern consistency and implications for seed removal. Oecologia 134: 119-132	18.25833	-66.5356	Neotropic	Yes	Yes
Source: web-of-life. M_SD_005. Carlo et al. (2003) Avian fruit preferences across a Puerto Rican forested landscape: pattern consistency and implications for seed removal. Oecologia 134: 119-133	18.1725	-66.5919	Neotropic	Yes	Yes
Carlo et al. (2003) Avian fruit preferences across a Puerto Rican forested landscape: pattern consistency and implications for seed removal. Oecologia 134: 119-134	18.30833	-66.5586	Neotropic	Yes	Yes
Crome, F.H.J. 1975. The ecology of fruit pigeons in tropical Northern Queensland. Australian Journal of Wildlife Research, 2: 155-185.	-17.85	146.0833	Australasia	No	No

Reference	**Latitude**	**Longitude**	**Realm**	**Island**	**Quantitative**
Frost, P.G.H. 1980. Fruit-frugivore interactions in a South African coastal dune forest. Pages 1179-1184 in: R. Noring (ed.). Acta XVII Congresus Internationalis Ornithologici, Deutsches Ornithologische Gessenshaft, Berlin.	-28.95	31.75	Afrotropic	No	Yes
Snow, B.K., Snow, D.W. 1971. The feeding ecology of tanagers and honeycreepers in Trinidad. Auk, 88: 291-322.	10.71667	-61.3	Neotropic	Yes	Yes
Snow, B. and Snow, D. (1988). Birds and berries, Calton, England.	53.05689	-1.85137	Palearctic	Yes	Yes
Hammann, A. & Curio, B. (1999) Interactions among frugivores and fleshy fruit trees in a Philippine submontane rainforest. Convervation biology, 13(4), 766-773.	10.68333	123.1833	Indomalayan	Yes	No
González-Castro, A., Yang, S., Nogales, M., & Carlo, T. A. (2012). What determines the temporal changes of species degree and strength in an oceanic island plant-disperser network?.PLoS ONE 7(7): e41385.//Jordano P. (1985) El ciclo anual de los paseriformes frugívoros en el matorral mediterráneo del sur de España: importancia de su invernada y variaciones interanuales. Ardeola, 32, 69-94.	37.18045	-6.32404	Palearctic	No	Yes
Kantak, G.E. 1979. Observations on some fruit-eating birds in Mexico. Auk, 96: 183-186.	18.50698	-89.4862	Neotropic	No	No
Lambert F. (1989). Fig-eating by birds in a Malaysian lowland rain forest. Journal of Tropical Ecology, 5, 401-412.	3.716667	102.2833	Indomalayan	No	No
Mack, AL and Wright, DD. (1996) Notes on occurrence and feeding of birds at Crater Mountain Biological Research Station, Papua New Guinea. Emu 96: 89-101.	-6.72333	145.0933	Australasia	No	No
Wheelwright, N.T., Haber, W.A., Murray, K.G., Guindon, C. 1984. Tropical fruit-eating birds and their food plants: a survey of a Costa Rican lower montane forest. Biotropica, 16: 173-192.	10.3	-84.8	Neotropic	No	No
P. Jordano, unpubl. Source: web-of-life.org (M_SD_020; M_SD_021)	37.93418	-2.82954	Palearctic	No	Yes
Silva, W.R., P. De Marco, E. Hasui, and V.S.M. Gomes (2002) Patterns of fruit-frugivores interactions in two Atlantic Forest bird communities of South-eastern Brazil: implications for conservation. Pp. 423-435. In: D.J. Levey, W.R. Silva and M. Galetti (eds.) Seed dispersal and frugivory: ecology, evolution and conservation. Wallinford: CAB International.	-24.2653	-48.4069	Neotropic	No	No
Noma, N. 1997. Annual fluctuations of sapfruits production and synchronization within and inter species in a warm temperate forest on Yakushima Island, Japan. Tropics, 6: 441-449.	30.33333	130.5	Indomalayan	Yes	Yes
Guitián, J. (1983). Relaciones entre los frutos y los passeriformes en un bosque montano de la cordillera cantábrica occidental. PhD Thesis, Univ. Santiago, Spain.	42.84	-6.83	Palearctic	No	No
Sorensen, A. E. (1981). Interactions between birds and fruit in a temperate woodland. Oecologia 50: 242-249.	51.76667	-1.33333	Palearctic	No	Yes

Reference	Latitude	Longitude	Realm	Island	Quantitative
Heleno Ruben H., Ramos Jaime A., Memmott Jane (2013). Integration of exotic seeds into an Azorean seed dispersal network. Biological Invasions. 15, 5, 1143-1154.	37.79502	-25.1854	Palearctic	Yes	Yes
Matthias Schleuning, Nico Blüthgen, Martina Flörchinger, Julius Braun, H. Martin Schaefer, Katrin Böhning-Gaese,(2011)Specialization and interaction strength in a tropical plant–frugivore network differ among forest strata, Ecology, 92(1): 26-36.	0.295833	34.78611	Afrotropic	No	Yes
Motta Junior, J.C. 1991.A exploração de frutos como alimento por aves de mata ciliar numa região do Distrito Federal. Rio Claro Dissertaçao de mestrado, Universidade Estadual Paulista, Rio Claro.	-15.9519	-47.9701	Neotropic	No	No
Nogales, M., Heleno, R., Rumeu, B., González-Castro, A., Traveset, A., Vargas, P., & Olesen, J. M. (2016). Seed dispersal networks on the Canaries and the Galápagos archipelagos: interaction modules as biogeographical entities. Global Ecology and Biogeography, 25(7), 912?922.//González-Castro, A., Morán-López, T., Nogales, M., & Traveset, A. (2022). Changes in the structure of seed dispersal networks when including interaction outcomes from both plant and animal perspectives. Oikos. Issue 2.	28.32473	-16.7455	Palearctic	Yes	Yes
Nogales, M., Heleno, R., Rumeu, B., Gonz?lez?Castro, A., Traveset, A., Vargas, P., & Olesen, J. M. (2016). Seed dispersal networks on the Canaries and the Galápagos archipelagos: interaction modules as biogeographical entities. Global Ecology and Biogeograpy, 25(7), 912-922.	-0.77726	-91.1426	Neotropic	Yes	No
O' Donnel, C. F. J., & Dilks, P. J. (1994). Foods and foraging of forest birds in temperate rainforest, South Westland, New Zealand. New Zealand Journal of Ecology, 87?107.	-43.75	169.4	Australasia	Yes	Yes
Pizo M.A. (2004) Frugivory and habitat use by fruit-eating birds in a fragmented landscape of southeast Brazil. Ornitologia Neotropical. 15, 117-126.	-22.9433	-46.7499	Neotropic	No	No
Ramos-Robles, M., Andresen, E., & Díaz-Castelazo, C. (2016). Temporal changes in the structure of a plant-frugivore network are influenced by bird migration and fruit availability.PeerJ, e2048.//Ramos-Robles, M., Dáttilo, W., Díaz-Castelazo, C., & Andresen, E. (2018). Fruit traits and temporal abundance shape plant-frugivore interaction networks in a seasonal tropical forest. The Science of Nature,105(3-4), 29.	19.59	-96.38	Neotropic	No	No

Reference	Latitude	Longitude	Realm	Island	Quantitative
Ribeiro_15. Unpublished Source: Bello et al. (2017) Atlantic frugivory: a plant-frugivore interaction data set for the Atlantic forest, Ecology 98 (6) 1729-1729	-22.83	-47.38	Neotropic	No	No
Ribeiro_25 Unpublished. Source: Bello et al. (2017) Atlantic frugivory: a plant-frugivore interaction data set for the Atlantic forest, Ecology 98 (6) 1729-1729	-22.58	-47.51	Neotropic	No	No
Ribeiro_57. Unpublished Source: Bello et al. (2017) Atlantic frugivory: a plant-frugivore interaction data set for the Atlantic forest, Ecology 98 (6) 1729-1729	-22.67	-47.21	Neotropic	No	No
Robinson V. (2015) Índice de importância de diferentes espécies de plantas na atraçao de aves para uma área reflorestada em piracicaba. Trabalho de Conclusão de Curso. Universidade Estadual Paulista	-22.71	-47.61	Neotropic	No	No
Rodrigues S.B.M. (2015) Rede de interações entre aves frugívoras e plantas em uma área de Mata Atlântica no sudeste do Brasil. Master thesis. UFSCAR Sorocaba.	-24.1414	-47.974	Neotropic	No	No
Scherer A., Maraschin-Silva F., Moura Baptista L.R. (2007).Patterns of mutualistic interactions between tree species and frugivorous birds in a restinga community at Itapuã State Park, Rio Grande do Sul, Brazil. Acta Botanica Brasilica, 21 (1)	-30.3998	-50.9682	Neotropic	No	No
Schlautmann, J., Rehling, F., Albrecht, J., Jaroszewicz, B., Schabo, D. G., & Farwig, N. (2021). Observing frugivores or collecting scats: a method comparison to construct quantitative seed dispersal networks. Oikos, 130(8), 1359-1369.	52.73689	23.77518	Palearctic	No	Yes
Silva R.F.M. (2007) Interações entre plantas e aves frugívoras no campus da Universidade Federal Rural do Rio de Janeiro,	-22.7667	-43.6833	Neotropic	No	No
Vitali, A., Sasal, Y., Vázquez, D. P., Miguel, M. F., & Rodríguez-Cabal, M. A. (2022). The disruption of a keystone interaction erodes pollination and seed dispersal networks. Ecology, 103(1), e03547.	-41.0458	-71.5545	Neotropic	No	Yes
Vizentin-Bugoni, J., Sperry, J. H., Kelley, J. P., Gleditsch, J. M., Foster, J. T., Drake, D. R., Tarwater, C. E. (2021). Ecological correlates of species roles in highly invaded seed dispersal networks. Proceedings of the National Academy of Sciences, 118(4).	21.3156	-157.858	Oceania	Yes	No

Reference	Latitude	Longitude	Realm	Island	Quantitative
Wesley, S., Silva, P. M., Hausi, E., & Mota Gomes, V. (2002). Patterns of fruit-frugivore interactions in two Atlantic forest bird communities of south-eastern Brazil: implications for conservation. In Seed dispersal and frugivory: ecology, evolution and conservation. Third International Symposium-Workshop on Frugivores and Seed Dispersal, SÂ¸o Pedro, Brazil, 6-11 August 2000. CABI Publishing.	-24.2653	-48.4069	Neotropic	No	No
Zamora Delgado, J. L. (2008).Dispersión de semillas por aves y murciélagos frugívoros en claros naturales del bosque montano en la estribación suroriental de los Andes del Ecuador. Thesis. Universidad del Azuay, Ecuador.	-3.97	-79.08	Neotropic	No	No