Ecography

ECOG-02780

Coelho, M. T. P., Rodrigues, J. F. M. and Rangel, T. F. 2016. Neutral biogeography of phylogenetically structured interaction networks. – Ecography doi: 10.1111/ecog.02780

Appendix 1

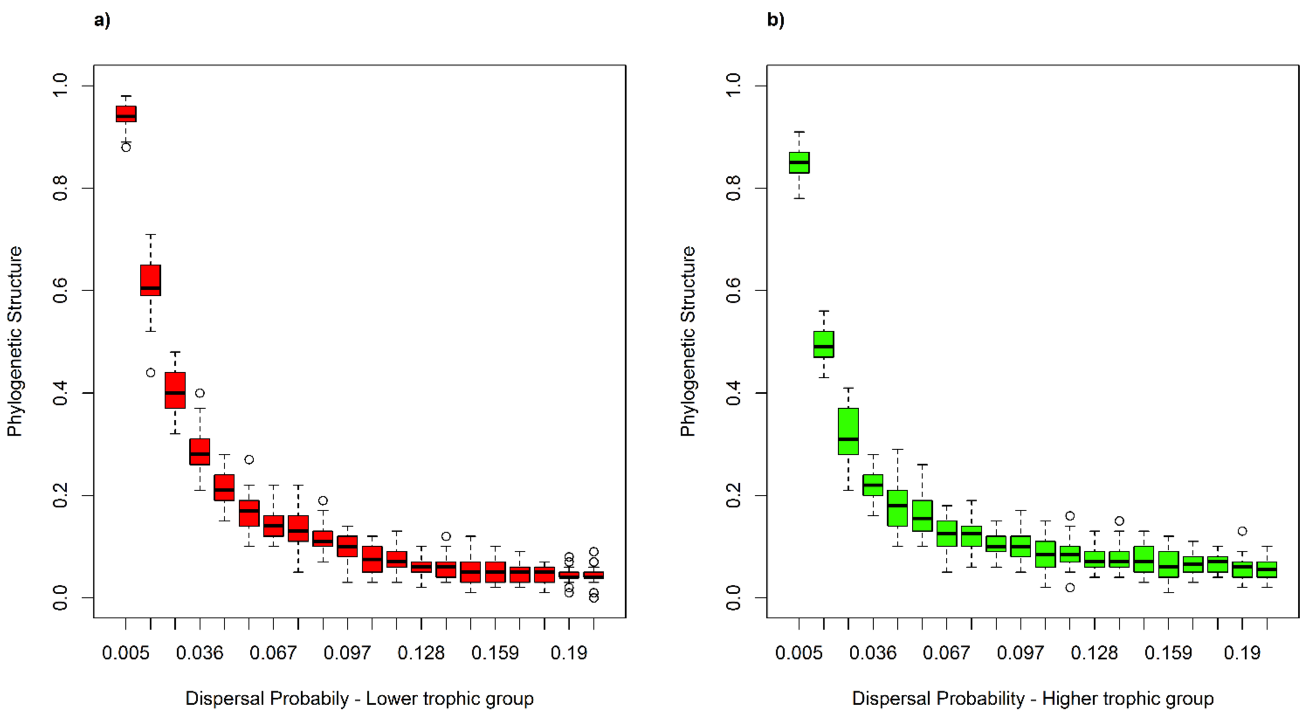

Figure A1. Phylogenetic structure for the two lower (a) and higher (b) interaction groups with varing dispersal rates. Phylogenetic structure is measured by the frequency of positive and significant correlation between simulated phylogenetic and ecological distance based on 100 simulation replicates. Speciation and interaction probability were constant, while only dispersal was varied independently for each trophic group (υ_i = 0.001, υ_j = 0.0014, τ = 0.4, mode = point mutation).

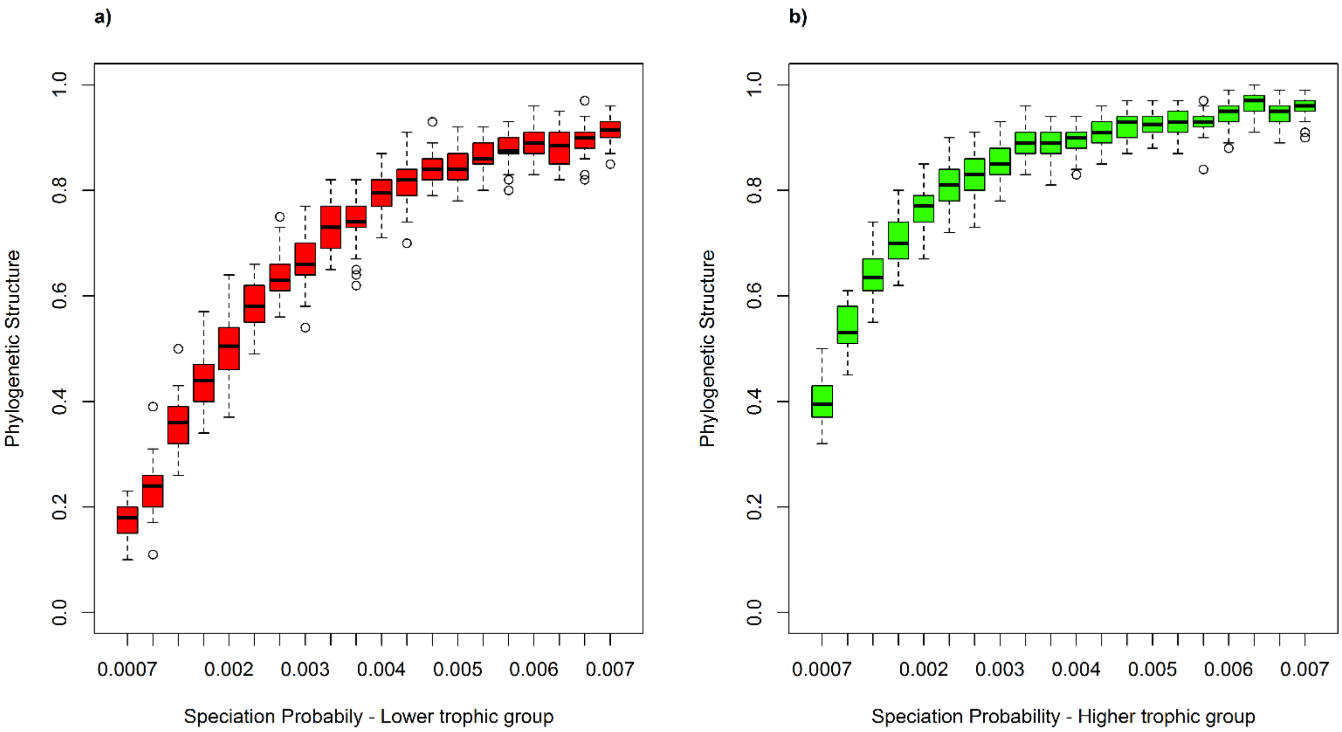

Figure A2. Phylogenetic structure for the two lower (a) and higher (b) interaction groups with varing speciation probability. Phylogenetic structure is measured by the frequency of positive and significant correlation between simulated phylogenetic and ecological distance based on 100 simulation replicates. Dispersal and interaction probability were constant, while only speciation was independently varied for each trophic group ($m_i = 0.04$, $m_j = 0.01$, $\upsilon_i = 0.001$, $\upsilon_j = 0.0014$, mode = point mutation).

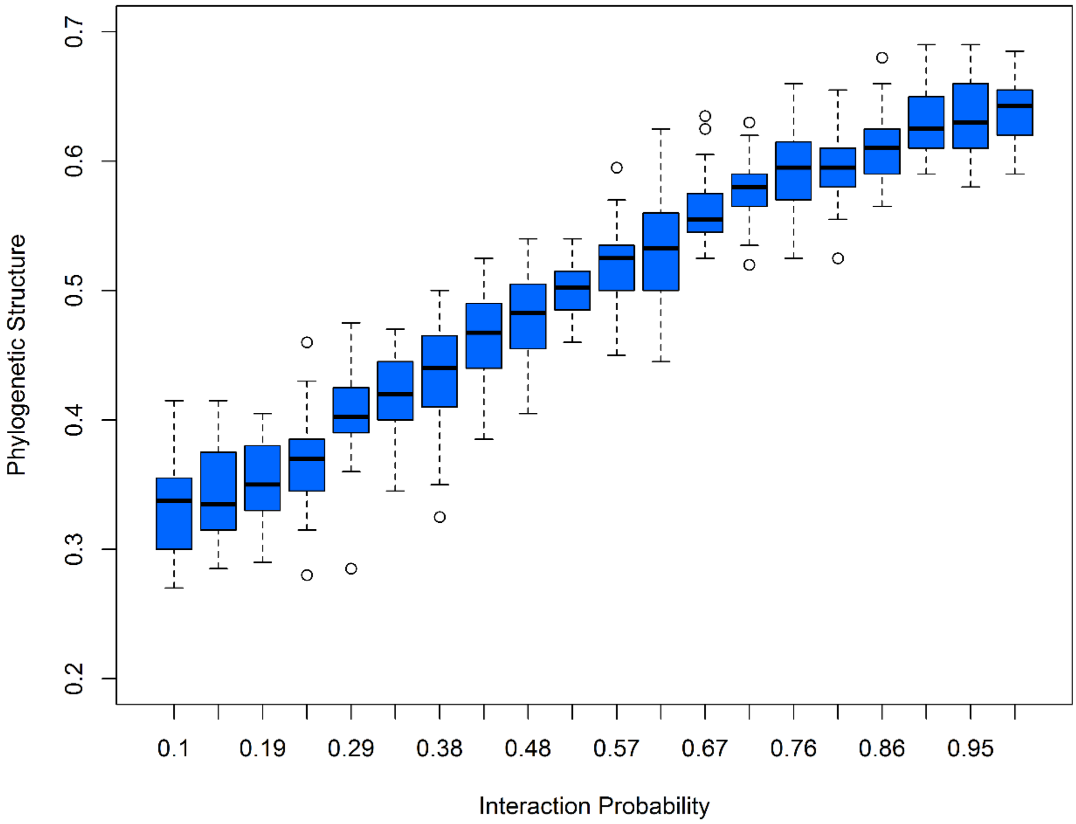

Figure A3. Phylogenetic structure with varing interaction probabilty. Phylogenetic structure is measured as the frequency of positive and significant correlation between simulated phylogenetic and ecological distance based on 100 simulated networks. Dispersal and speciation probability were constant, while only dispersal was independently varied for each trophic group (m_i = 0.04, m_j = 0.01, τ = 0.4, mode = point mutation).

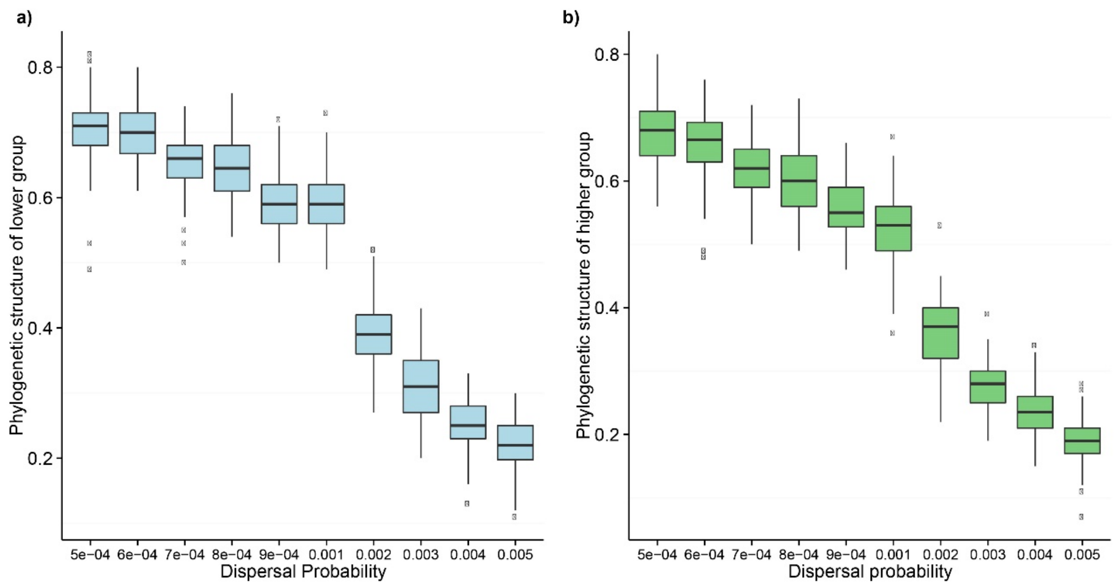

Figure A4. Phylogenetic structure for the two lower (a) and higher (b) interaction groups with varing dispersal rates. Phylogenetic structure is measured by the frequency of positive and significant correlation between simulated phylogenetic and ecological distance. Speciation and interaction probability were constant, while only dispersal was varied independently for each trophic group ($\upsilon_i = 2 \times 10^{-6}$, $\upsilon_j = 2 \times 10^{-6}$, $\tau = 0.4$, mode = allopatric speciation).

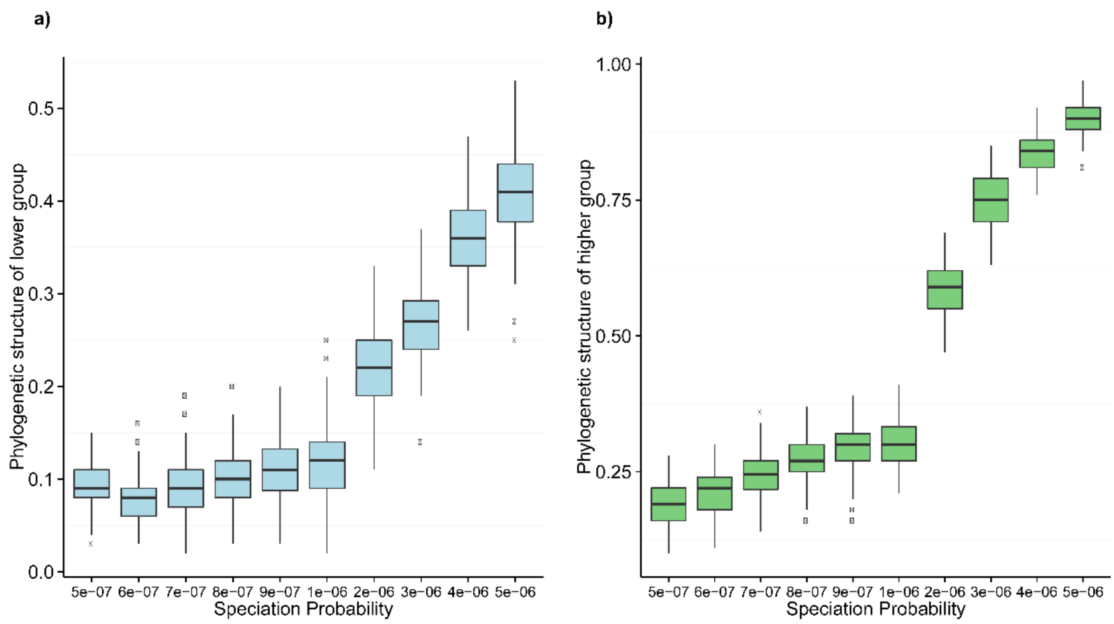

Figure A5. Phylogenetic structure for the two lower (a) and higher (b) interaction groups with varing speciation probability. Phylogenetic structure is measured by the frequency of positive and significant correlation between simulated phylogenetic and ecological distance. Dispersal and interaction probability were constant, while only speciation was independently varied for each trophic group ($m_i = 0.04$, $m_j = 0.01$, $\tau = 0.4$, mode = allopatric speciation).

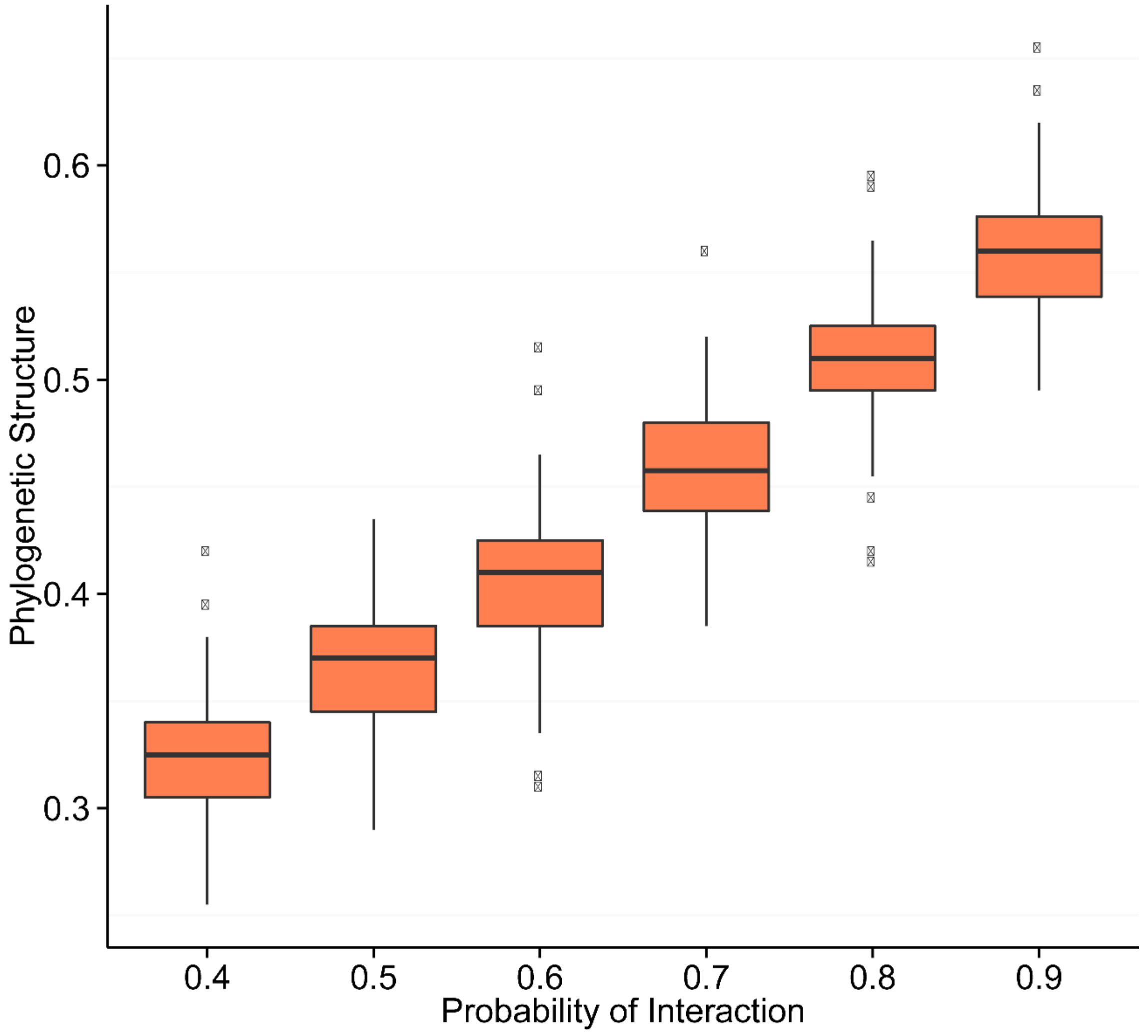

Figure A6. Phylogenetic structure with varing interaction probabilty. Phylogenetic structure is measured as the frequency of positive and significant correlation between simulated phylogenetic and ecological distance. Dispersal and speciation probability were constant, while only interaction probability was independently varied for each trophic group ($m_i = 0.04$, $m_j = 0.01$, $\tau = 0.4$, mode = allopatric speciation).

Table A1. Pollination and seed dispersal networks compiled from Rezende et al (2007). The data includes 59 mutualistic networks sampled across the world obtained from a series of studies listed here.

Lower interaction group	Higher interaction group	Network code	Pollination or frugivory	Locality	Source
Insects	Plant	ARR1	P	Cordón del Cepo, Chile	Arroyo, M. T. K. et al. 1982. Community studies in pollination ecology in the high temperate Andes of central Chile. I. Pollination mechanisms and altitudinal variation. – Am. J. Bot. 69: 82–97.
Insects	Plant	ARR2	P	Cordón del Cepo, Chile	Arroyo, M. T. K. et al. 1982. Community studies in pollination ecology in the high temperate Andes of central Chile. I. Pollination mechanisms and altitudinal variation. – Am. J. Bot. 69: 82–97.
Insects	Plant	ARR3	P	Cordón del Cepo, Chile	Arroyo, M. T. K. et al. 1982. Community studies in pollination ecology in the high temperate Andes of central Chile. I. Pollination mechanisms and altitudinal variation. – Am. J. Bot. 69: 82–97.
Insects	Plant	BAHE	P	Central New Brunswick, Canada	Barrett, S. C. H. and Helenurm, K. 1987. The reproductive-biology of boreal forest herbs.1. Breeding systems and pollination. – Can. J. Bot. 65: 2036–2046.
Birds	Plant	BAIR	F	Princeton, Mercer, New Jersey, USA	Baird, J.W. 1980. The selection and use of fruit by birds in an eastern forest. – Wilson Bull. 92: 63–73.

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Birds	Plant	BEEH	F	Mount Missim, 9 km N-NE Wau, Morobe Prov., New Guinea	Beehler, B. 1983. Frugivory and polygamy in birds of paradise. – Auk 100: 1-12.
Birds	Plant	CACG	F	Caguana, Puerto Rico	Carlo, T. A. et al. 2003. Avian fruit preferences across a Puerto Rican forested landscape: pattern consistency and implications for seed removal. – Oecologia 134: 119–131.
Birds	Plant	CACI	F	Cialitos, Puerto Rico	Carlo, T. A. et al. 2003. Avian fruit preferences across a Puerto Rican forested landscape: pattern consistency and implications for seed removal. – Oecologia 134: 119–131.
Birds	Plant	CACO	F	Cordillera, Puerto Rico	Carlo, T. A. et al. 2003. Avian fruit preferences across a Puerto Rican forested landscape: pattern consistency and implications for seed removal. – Oecologia 134: 119–131.
Birds	Plant	CAFR	F	Fronton, Puerto Rico	Carlo, T. A. et al. 2003. Avian fruit preferences across a Puerto Rican forested landscape: pattern consistency and implications for seed removal. – Oecologia 134: 119–131.
Insects	Plant	CLLO	P	Pikes Peak, Colorado, USA	Clements, R. E. and Long, F. L. 1923. Experimental pollination. An outline of the ecology of flowers and insects. – Carnegie Inst. of Washington.

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Birds	Plant	CROM	F	Tropical rainforest. Queensland, Australia.	Crome, F. H. J. 1975. The ecology of fruit pigeons in tropical Northern Queensland. Australian – J. Wildl. Res. 2: 155–185.
Insects	Plant	DIHI	P	Hickling, Norfolk, UK	Dicks, L. V. et al. 2002. Compartmentalization in plant–insect flower visitor webs. – J. Anim. Ecol. 71: 32–43.
Insects	Plant	DISH	P	Shelfanger, Norfolk, UK	Dicks, L. V. et al. 2002. Compartmentalization in plant–insect flower visitor webs. – J. Anim. Ecol. 71: 32–43.
Insects	Plant	DUPO	P	Tenerife, Canary Islands	Dupont, Y. L. et al. 2003. Structure of a plant–flower-visitor network in the high-altitude sub-alpine desert of Tenerife, Canary Islands. – Ecography 26: 301–310.
Insects	Plant	EOL	P	Latnjajaure, Abisko, Sweden	Elberling, H. and Olesen, J. M.. 1999. The structure of a high latitude plant–flower visitor system: the dominance of flies. – Ecography 22: 314–323.
Insects	Plant	EOLZ	P	Zackenberg	Elberling and Olesen unpubl.
Insects	Plant	ESKI	P	Mauritius Island	Eskildsen et al. unpubl.

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Lower interaction group	Higher interaction group	Network code	Pollination or frugivory	Locality	Source
Birds	Plant	FROS	F	Mtunzini, South Africa	Frost, P. G. H. 1980. Fruit-frugivore interactions in a South African coastal dune forest. – In: Noring, R. (ed.), Acta XVII Congresus Internationalis Ornithologici, Deutsches Ornithologische Gessenshaft, Berlin, pp. 1179–1184.
Birds	Plant	GEN1	F	Santa Genebra Reserve T1. SE Brazil	Galetti, M. and Pizo, M. A. 1996. Fruit eating birds in a forest fragment in southeastern Brazil. Ararajuba, – Rev. Bras. Ornitol. 4: 71–79.
Birds	Plant	GEN2	F	Santa Genebra Reserve T2. SE Brazil	Galetti, M. and Pizo, M. A. 1996. Fruit eating birds in a forest fragment in southeastern Brazil. Ararajuba, – Rev. Bras. Ornitol. 4: 71–79.
Birds	Plant	HAMM	F	North Negros Forest Reserve, Central Philippine Islands	Hammann, A. and Curio, B. 1999. Interactions among frugivores and fleshy fruit trees in a Philippine submontane rainforest
Insects	Plant	HERR	P	Doñana Nat. Park, Spain	Herrera, J. 1988. Pollination relatioships in southern spanish mediterranean shrublands. – J. Ecol. 76: 274–287.

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Insects	Plant	HOCK	P	Hazen Camp, Ellesmere Island, Canada	Hocking, B. 1968. Insect-flower associations in the high Arctic with special reference to nectar. – Oikos 19: 359–388.
Birds	Plant	HRAT	F	Hato Ratón, Sevilla. Spain	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.
Insects	Plant	INPK	P	Snowy Mountains, Australia	Inouye, D. W. and Pyke, G. H. 1988. Pollination biology in the Snowy Mountains of Australia: comparisons with montane Colorado, USA. – Aust. J. Ecol. 13: 191–210.
Birds	Plant	KANT	F	Campeche state, Mexico	Kantak, G. E. 1979. Observations on some fruit-eating birds in Mexico. – Auk 96: 183–186.
Insects	Plant	KEVN	P	Hazen Camp, Ellesmere Island, Canada	Kevan P. G. 1970. High Arctic insect-flower relations: the interrelationships of arthropods and flowers at Lake Hazen, Ellesmere Island, Northwest Territories, Canada. – PhD thesis, Univ. of Alberta, Edmonton.

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Lower interaction group	Higher interaction group	Network code	Pollination or frugivory	Locality	Source
Insects	Plant	KT90	P	Ashu, Kyoto, Japan	Kato, M. et al. 1990. Insect–flower relationship in the primary beech forest of Ashu, Kyoto: an overview of the flowering phenology and the seasonal pattern of insect visits. – Contrib. Biol. Lab., Kyoto, Univ., 27: 309–375.
Birds	Plant	LAMB	F	Kuala Lompat, Krau Game Reserve.	Lambert, F. 1989. Fig-eating by birds in a Malaysian lowland rain forest. – J. Trop. Ecol. 5: 401-412.
Mammals	Plant	LOPE	F	Gabon, Africa	Tutin, C. E. G. et al. 1997. The primate community of the Lopé Reserve, Gabon: diets, responses to fruit scarcity, and effects on biomass. – Am. J. Primatol. 42: 1–24.
Birds	Plant	MACK	F	Crater Mountain Biological Research Station, Chimbu Province, Papua New Guinea	Mack, A. L. and Wright, D. D. 1996. Notes on occurrence and feeding of birds at Crater Mountain Biological Research Station, Papua New Guinea. – Emu 96: 89–101.

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Lower interaction group	Higher interaction group	Network code	Pollination or frugivory	Locality	Source
Insects	Plant	MED1	P	Laguna Diamante, Mendoza, Argentina	Medan, D. et al. 2002. Plant–pollinator relationships at two altitudes in the Andes of Mendoza, Argentina. – Arct. Antarct. Alp. Res. 34: 233–241.
Insects	Plant	MED2	P	Rio Blanco, Mendoza, Argentina	Medan, D. et al. 2002. Plant–pollinator relationships at two altitudes in the Andes of Mendoza, Argentina. – Arct. Antarct. Alp. Res. 34: 233–241.
Insects	Plant	MEMM	P	Bristol, England	Memmott J. 1999. The structure of a plant-pollinator food web. – Ecol. Lett. 2: 276–280.
Insects	Plant	MOMA	P	Melville Island, Canada	Mosquin, T. and Martin, J. E. H. 1967. Observations on the pollination biology of plants on Melville Island, N.W.T., Canada. – Can. Field Nat. 81: 201–205.
Birds	Plant	MONT	F	Monteverde, Costa Rica	Wheelwright, N. T. et al. 1984. Tropical fruit-eating birds and their food plants: a survey of a Costa Rican lower montane forest. – Biotropica 16: 173–192.
Insects	Plant	MOTT	P	North Carolina, USA	Motten, A. F. 1982. Pollination ecology of the spring wildflower community in the deciduous forests of Piedmont North Carolina. – PhD thesis, Duke Univ., Duhram, North Carolina, USA; Motten, A. F. 1986. Pollination ecology of the spring wildflower community of a temperate deciduous forest. – Ecol. Monogr. 56: 21–42.
Insects	Plant	MULL	P	Galapagos	McMullen 1993

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Lower interaction group	Higher interaction group	Network code	Pollination or frugivory	Locality	Source
Birds	Plant	NCOR	F	Nava Correhuelas. S. Cazorla, SE Spain.	P. Jordano, unpubl.
Birds	Plant	NNOG	F	Nava Noguera, Sierra de Cazorla, SE Spain	P. Jordano, unpubl.
Insects	Plant	OFLO	P	Flores, Açores	Olesen unpubl.
Insects	Plant	OFST	P	Hestehaven, Denmark	Olesen unpubl.
Insects	Plant	OLAU	P	Garajonay, Gomera, Spain	Olesen unpubl.
Insects	Plant	OLLE	P	KwaZulu-Natal region, South Africa	Ollerton, J. et al. 2003. The pollination ecology of an assemblage of grassland asclepiads in South Africa. – Ann. Bot. 92: 807–834.
Insects	Plant	PERC	P	Jamaica	Percival, M. 1974. Floral ecology of coastal scrub in southeast Jamaica. – Biotropica 6: 104–129.

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Lower interaction Group	Higher Interaction Group	Network Code	Pollination or Frugivory	Locality	Source
Insects	Plant	PRAP	P	Arthur's Pass, New Zealand	Primack, R. B. 1983. Insect pollination in the New Zealand mountain flora. – N. Z. J. Bot. 21: 317–333, AB.
Insects	Plant	PRCA	P	Cass, New Zealand	Primack, R. B. 1983. Insect pollination in the New Zealand mountain flora. – N. Z. J. Bot. 21: 317–333. Cass
Insects	Plant	PRCG	P	Craigieburn, New Zealand	Primack, R. B. 198). Insect pollination in the New Zealand mountain flora. – N. Z. J. Bot. 21: 317–333. Craigieb.
Insects	Plant	PTND	P	Daphní, Athens, Greece	Petanidou, T. 1991. Pollination ecology in a phryganic ecosystem. Unpub. PhD thesis, Aristotelian Univ., Thessaloniki.
Insects	Plant	RABR	P	Guarico State, Venezuela	Ramirez, N. and Brito, Y. 1992. Pollination biology in a palm swamp community in the Venezuelan Central Plains. – Bot. J. Linn. Soc. 110: 277–302.
Insects	Plant	RMRZ	P	Canaima Nat. Park, Venezuela	Ramirez, N. 1989. Biología de polinización en una comunidad arbustiva tropical de la alta Guyana Venezolana. – Biotropica 21: 319–330.
Birds	Plant	SAPF	F	Yakushima Island, Japan	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.
Insects	Plant	SCHM	P	Brownfield, Illinois, USA	Schemske, D. W. et al. 1978. Flowering ecology of some spring woodland herbs. – Ecology 59: 351–366.

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Lower interaction Group	Higher Interaction Group	Network Code	Pollination or Frugivory	Locality	Source
Insects	Plant	SMAL	P	Ottawa, Canada	Small, E. 1976. Insect pollinators of the Mer Bleue peat bog of Ottawa. – Can. Field Nat. 90: 22–28.
Insects	Plant	SMRA	P	Chiloe, Chile	Smith-Ramírez C. et al. 2005. Diversity, flower visitation frequency and generalism of pollinators in temperate rain forests of Chiloé Island,Chile. – Bot. J. Linn. Soc. 147: 399–416.
Birds	Plant	SNOW	F	Tropical rainforest. Trinidad.	Snow, B. K.and Snow, D. W. 1971. The feeding ecology of tanagers and honeycreepers in Trinidad. – Auk 88: 291–322.
Birds	Plant	WES	F	Intervales and Saibadela, São Paulo, Brazil	Silva, W. R. et al. 2002. Patterns of fruit-frugivores interactions in two Atlantic Forest bird communities of south-eastern Brazil: implications for conservation. – In: Levey, D. J. et al. (eds), Seed dispersal and frugivory: ecology, evolution and conservation. CAB Int., pp 423–435
Birds	Plant	WYTH	F	Great Britain	Snow B. K. and Snow D. W. 1988. Birds and berries. – Calton, England.

Table A2. Capacity of different parameter sets to reproduce empirical patterns of mutualistic networks. Different combinations of dispersal and speciation are capable of replicating the empirical phylogenetically structured networks. Dispersal rate may be set as a constant for both trophic groups as differences in evolutionary rate is able to generate empirical observations of phylogenetically structured networks. Conversely, evolutionary rate may be set constant between trophic groups, as differences in dispersal capacity is able to generate empirical observations of phylogenetically structured networks. PS*:* phylogenetic structure of the network. It represents the percentage of networks with positive and significant correlations between phylogenetic distance and ecological distance; PS animals: phylogenetic structure of animals in mutualistic networks; PS plants: phylogenetic structure of plants in mutualistic networks; m_i:dispersal rate of the higher trophic group; m_j: dispersal rate of the higher trophic group; υ_i: speciation rate of the higher trophic group; υ_j: speciation rate of the lower trophic group; τ: interaction probability; Mean PS: mean phylogenetic structure of simulated networks based on 100 replications. Mean Psi: mean phylogenetic structure of the *i* trophic group based on 100 replications. Mean Psj: mean phylogenetic structure of the *j* interaction group based on 100 replications. Mean P.Sig: mean frequency of phylogenetic signal based on 100 replications Var: variance of each one of each phylogenetic structure measured

Rezende's (2007) results													
						PS (%)		PS Animals (%)		PS Plants (%)		P.Sig (%)	
						0.427		0.608		0.25		0.248	
Allpatric speciation													
	m_i	m_j	υ_i	υ_j	τ	Mean PS (%)	Var	Mean PSi	Var	Mean PSj	Var	Mean P.Sig (%)	Var
	0.0008	0.005	0.000002	0.000002	0.6	0.41405	0.001035199	0.5988	0.002321778	0.2293	0.001362131	0.1867	0.000649
	0.0007	0.0007	0.000002	0.0000005	0.6	0.4246	0.000975091	0.6334	0.002265091	0.2158	0.001798343	0.16435	0.000659
	0.0009	0.0007	0.000002	0.0000005	0.6	0.39205	0.001156109	0.5844	0.002744081	0.1997	0.001877687	0.2109	0.00093
	0.002	0.0008	0.000004	0.0000009	0.6	0.46555	0.000972169	0.6167	0.001994051	0.3144	0.001942061	0.18285	0.000547
Point mutation													
	0.01	0.01	0.0014	0.001	0.4	0.43585	0.00107225	0.6256	0.002489535	0.2461	0.001456354	0.0011	5.85E-06
	0.005	0.07	0.0008	0.0014	0.4	0.409	0.000919697	0.6056	0.002152162	0.2124	0.001539636	0.00635	3.23E-05
	0.008	0.04	0.0009	0.0009	0.4	0.4111	0.001212414	0.5589	0.003290697	0.2633	0.001699101	0.0034	1.86E-05
Equal split													
	0.01	0.01	0.0014	0.001	0.4	0.4424	0.001025495	0.6327	0.002094657	0.25210	0.002008677	0.00145	6.21E-06
	0.005	0.07	0.0008	0.0014	0.4	0.41085	0.00102023	0.6093	0.002624758	0.2124	0.001507313	0.00705	3.39E-05
	0.008	0.04	0.0009	0.0009	0.4	0.40985	0.000857806	0.5567	0.002115263	0.263	0.001552525	0.00275	1.43E-05
Random fission mode													
	0.01	0.01	0.0014	0.001	0.4	0.43895	0.001003179	0.6285	0.002160354	0.2494	0.002349131	0.0012	6.12E-06
	0.005	0.07	0.0008	0.0014	0.4	0.40535	0.001149119	0.5958	0.002125616	0.2149	0.001762616	0.00595	3.01E-05
	0.008	0.04	0.0009	0.0009	0.4	0.41755	0.00095025	0.5664	0.002558626	0.2687	0.002106374	0.0033	1.73E-05