Metadata for data used in the case study of “Trait-based inference of ecological network assembly: a conceptual framework and methodological toolbox”

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Background information about the plant–frugivore interaction data used in the case study

The data are provided as an RData file (named “dataSet1.RData”) that contains a list (named “dataSet1”) of three data frames: (1) pT (plant traits), (2) aT (animal traits), and (3) N (data on pairwise plant–animal interactions across six study sites to construct the plant–frugivore networks). The metadata describing the information contained in each of these data frames is provided in Tables 1, 2 and 3 in this documentation.

Study area and design

The study area was located in and around Podocarpus National Park and the San Francisco reserve at the Eastern Cordillera of the Andes in southern Ecuador. The study sites were located in three different tropical montane forest types at three elevational bands: evergreen premontane forest (ca 1000 m a.s.l., 4°6′S, 78°58′W), lower montane forest (ca 2000 m a.s.l., 3°58′S, 79°4′W) and upper montane forest (ca 3000 m a.s.l., 4°6′S, 79°10′W; Quitián et al. 2018, 2019; Santillán et al. 2018a, 2018b, Homeier et al. 2008). The study area is characterized by a humid tropical climate. Mean annual temperature ranges from 19.4°C in the lowlands to 9.4°C in the highlands, and mean annual precipitation ranges from 2000 mm in the lowlands to 4500 mm in the highlands (Quitián et al. 2018, 2019; Santillán et al. 2018a, 2018b and references therein). The forest within Podocarpus National Park and San Francisco reserve remains mostly undisturbed by human activities. In the area around the National Park, forest fragments are embedded in an agricultural matrix consisting mainly of cattle pastures.

Fleshy-fruited plants constitute more than 90% of woody plants at the study sites, e.g., the widespread and abundant members of the genus *Miconia* (Melastomataceae). Other common taxa vary between forest types. In the evergreen premontane forest, common genera with fleshy-fruited plants are *Cecropia* (Urticaceae), *Schefflera* (Araliaceae) and *Piper* (Piperaceae). In the lower montane forest, common genera are *Cecropia* (Urticaceae), *Isertia* (Rubiaceae), *Viburnum* (Adoxaceae) and *Palicourea* (Rubiaceae). In the upper montane forest, common genera are *Clusia* (Clusiaceae), *Solanum* (Solanaceae) and *Schefflera* (Araliaceae) (Quitián et al. 2018, 2019; Santillán et al. 2018a, 2018b).

Observations of plant–frugivore interactions

We sampled plant–frugivore networks at six study sites covering the three elevations and two habitat types at each elevation (continuous forest, forest fragments). At each study site, seed-dispersal interactions were observed on three plots with an area of 30 x 100 m². We sampled each plot four times in 2014 and 2015. The day before each observation period, we marked all fruiting plants to allow the observer to focus on fruiting plants while walking freely through the plot during the observations. These plant species were identified to species or morphospecies level by an expert botanist.

During each observation period, we observed seed removal by frugivorous birds on all fruiting plants on four consecutive days for a total of 25 h per plot. The three plots of each study site were simultaneously observed by three expert ornithologists. Overall, each study site was observed for 300 h (25 hours x 4 observation periods x 3 plots). Observations were pooled to build one network for each study site, which yielded networks with a high degree of sampling completeness (Quitián et al. 2018).

Interactions between fruiting plants and frugivorous birds were recorded by direct observations with binoculars. A visit to a fruiting plant was recorded whenever a bird was observed to consume at least one fruit of a plant. We considered three different ways of fruit consumption by birds: swallowing (94% of the considered interaction events), pecking (5%) and transporting the fruit (1%). We excluded observations of seed predation by birds (< 1% of all observations). Thus, the visits included in the analyses represent legitimate seed dispersal events. In the exceptional case that the bird species could not be determined (1.5% of the total number of interactions), we excluded the interaction event. We used the number of visits of each frugivore species to each plant species to construct quantitative interaction networks between plants and animals.

Plant and bird traits

The selection of functional plant and bird traits was based on Dehling *et al*. (2014). The four functional traits measured on fleshy-fruited plant species were: fruit length, fruit width, crop mass (mean fruit mass multiplied by mean crop size) and plant height. Plant traits were measured on plant individuals growing and fruiting on the study plots. The four functional bird traits were: bill length, bill width (*akin* gape width), Kipp's index (Kipp's distance divided by wing length) and body mass. Morphometric traits were measured on at least two male and two female bird skins on museum specimens. Body mass data were derived from the literature (Dunning 2007). Further details about trait measurements and definitions are provided in Dehling *et al.* (2014).

Table 1. Information about plant traits included in the dataset (data frame 'pT' in RData file and the file plant_traits.csv).

Variable	Type	Unit	Range	Description
plantCode	Character	-	-	Unique seven-character code specifying the identity of each plant taxon included in the data.
plantSpecies	Character	-	-	Scientific name of plant species included in the study. Often these are morphospecies that

				have been identified to genus level.
fruitLength	Numeric	[mm]	0.772—213	Fruit length is based on the mean across measurements of 15 fruits per plant species.
fruitWidth	Numeric	[mm]	0.1—25.1	Fruit width is based on the mean across measurements of 15 fruits per plant species.
CropMass	Numeric	[g]	0.508—24.7×10^{4}	Crop mass is the product of mean fruit mass (based on the mean across measurements of the fresh mass of 15 fruits per plant species) and mean crop size (the number of fruits) on a plant individual.
plantHeight	Numeric	[m]	0.1—27	In the field, we estimated the height of every individual fruiting plant to calculate the average height of each fruiting plant species.

Table 2. Information about animal traits included in the dataset (data frame 'aT' in RData file and the file animal_traits.csv).

Variable	Type	Unit	Range	Description
animalCode	Character	-	-	Unique seven-character code specifying the identity of each bird taxon included in the data.
animalSpecies	Character	-	-	Scientific name of bird species that have been recorded during observations.
billLength	Numeric	[mm]	7.85—75.6	Bill length is based on the mean across measurements of four specimens per species (two females and two males) in museum collections.
billWidth	Numeric	[mm]	4.82—26.6	Bill width (*akin* gape width) is based on the mean across measurements of four specimens per species (two females and two males) in museum collections.

bodyMass	Numeric	[g]	$6.2—11.8\times10^{2}$	The body mass of the bird species was obtained from Dunning (2007).
kippsIndex	Numeric	unitless ratio [mm/mm]	0.0816—0.377	Kipp's distance divided by wing length (i.e., hand-wing index *sensu* Sheard et al. 2020). Kipp's distance is defined as distance between tip of the first secondary and tip of the longest primary of the folded wing. Wing length is defined as distance between the bend of the wing and the tip of the longest primary feather. Wing measurements were based on four specimens per species (two females and two males) in museum collections.

Table 3. Information about plant–frugivore interactions included in the dataset (data frame 'N' in RData file and the file plant_animal_interactions.csv).

Variable	Type	Unit	Range	Description
site	Character	-	-	Identifier for each of the six study sites on which data have been collected across the elevational gradient.
elevation	Numeric	[m a.s.l.]	1000—3000	Elevation above sea level
plantCode	Character	-	-	Unique seven-character code specifying the identity of each plant taxon included in the data.
plantSpecies	Character	-	-	Scientific name of plant species included in the study. Often these are morphospecies that have been identified to genus level.
animalCode	Character	-	-	Unique seven-character code specifying the identity of each bird taxon included in the data.
animalSpecies	Character	-	-	Scientific name of bird species that have been recorded during observations.

frequency	binary	[visit incidence per 300 hours]	1	Each single interaction event between a pair of a plant and a bird species at each site is given in a separate row. The summed frequency of interaction incidences for each species pair at each site yields the interaction frequencies per 300 hours of observation time.

Literature

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