## Manuscript Draft

# What is long-distance dispersal? And a taxonomy of dispersal events

## Supplementary Material

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#### <sub>1</sub> Methods

**Species and Study Site.** The tree species we use as a case study to illustrate different types of dispersal events, Prunus mahaleb (L.) (Rosaceae), is a shrub or small tree that produces fleshy fruits that are consumed by frugivores, who disperse seeds after regurgitating or defecating them. This species is frequently visited during July to mid-August by small- and medium-sized birds and carnivorous mammals that include fruits in their diets during late summer to winter (Jordano & Schupp, 2000). P. mahaleb occurs in a patchy distribution at the regional scale, with relatively isolated populations consisting of dozens to hundreds of trees. Our study population included a total of 196 adult reproductive trees distributed over an area of 26 ha in patches of variable density. Other populations within 20 km 11 exist as scattered patches of 10–150 trees, with some containing  $\geq 1,000$  trees. The nearest population is 1.5 km away. Additional information on the study population 13 and description of methodological apporaches is reported by Jordano et al. (2007) and Garcia et al. (2009) and references therein.

Sampling dispersed seeds. To estimate the relative contribution of each dispersal vector to the different categories of dispersal events defined in Table 1, we first collected dispersed seeds, following different sampling schemes according 18 to the functional group of dispersal vector. We used this grouping of frugivores 19 giving the difficulties of resolving the identification of scats, pellets and regurgitated seeds down to species level just based on visual cues. We differentiated four 21 major frugivore types: large carnivorous mammals (such as foxes, badgers, and stone martens); two species of medium- and large-sized frugivorous birds, mistle thrushes (*T. viscivorus*), and carrion crows (*C. corone*); and a pool of small-sized 24 frugivorous birds, including warblers, redstarts, and robins (Jordano et al., 2007). Seeds were collected in 1997–1999 and 2003–2005. The sampling schemes are described in detail elsewhere (Jordano et al., 2007; Garcia et al., 2009) and include 27 a combination of seed traps and direct sampling of mammal feces along fixed transects. We haphazardly collected 130 samples of mammal feces during the P. mahaleb fruit ripening period and recorded their location relative to potential source trees. Overall, we genotyped 167 seeds from 20 fecal samples. Most samples were from red fox (*Vulpes vulpes*) and stone marten (*Martes foina*); some (10 samples) were from badger (*Meles meles*) (Jordano *et al.*, 2007).

In addition we sampled directly the pellets of large corvids ( $Corvus\ corone$ ) and from  $Turdus\ viscivorus$ , the latter by direct sampling beneath pine trees and scats from seed traps (see Jordano  $et\ al.$ , 2007, for details). Finally, a seed sample directly from seed traps included seeds dispersed by small- and medium-sized passerines, such as  $Phoenicurus\ ochruros$ ,  $Turdus\ merula$ ,  $Erithacus\ rubecula$ ,  $Sylvia\ communis$ ,  $Sylvia\ atricapilla$ , etc. (Jordano  $et\ al.$ , 2007). The total seed sample thus consisted of seed endocarps collected from the seed traps (mostly small passerines) (n=465), mammal scats (n=167), and  $C.\ corone\ pellets\ (<math>n=23$ ) (see Table 1 in Jordano  $et\ al.$ , 2007).

**Seed genotyping.** We used material described in Jordano et al. (2007), and genotyping methods described in detail in previous work (Godoy & Jordano, 2001; 44 Garcia et al., 2007, 2009). Briefly, we used a set of 10 polymorphic microsatellite markers (simple DNA sequence repeats) (Godoy & Jordano, 2001) to obtain the multilocus genotypes of both of the adult trees (candidate source trees from the 47 study population) and the sample of seed endocarps. Given that all adult trees in the population had a distinct multilocus genotype, an unambiguous assignment of each seed to its source tree could be made. When a full match between the endocarp genotype and any of the adult-tree genotypes in the population was not 51 possible, we assumed that the seed came from another population. To assess the effect of genotyping errors, we reexamined the exclusion of genotypes due to a single locus mismatch, two loci mismatches, etc. At the analysis level, any exclusion of identity between a seed and a potential mother tree based on mismatches of only one or two loci was rechecked. We used GIMLET software (Valière, 2002) to find the matching adult multilocus genotype for each endocarp with eight or more loci successfully typed. Because each seed belonged to one of the four groups of 58 dispersers, we could thus derive the relative contribution of each frugivore group to different classes of seed dispersal events and to seed immigration.

Contribution of dispersal vectors to types of dispersal events. We considered each dispersed seed as an independent replicate, because each represented a dispersal event from the perspective of plant population genetics, i.e., an independent "arrival" event resulting from the dispersal process mediated by the frugivore.

Once the maternal source tree of each individual seed was identified (or its provenance from outside the study population determined) we assessed the dispersal 67 distance and grouped the seeds separately as coming from trees located within 68 or outside the population. In addition, for seeds originating from local trees we determined whether dispersal distances were  $\geq 45$  m to sort out  $LDD_{loc}$  dispersal events from  $SDD_{loc}$  events. All the events involving immigrant seeds were con-71 sidered  $LDD_{ss}$  by definition, given that the neighborhood size was very reduced (radius= 0.045 km) relative to the geographic limits of the study population (max-73 imum length for a within-population dispersal event: 1220 m)(Garcia et al., 2009). Along this reasoning,  $LDD_{neigh}$  events were considered non-existent in this particular case study given that neighborhood size area was smaller than the population area.

Table S1. Summary of neighborhood area sizes and estimated neighborhood radius for tree species with different

| combinations of dispersal modes. Data from Nason et al. (1998); Garcia et al. (2005, 2007) and present study. | modes. Data | from Nason et al. | (1998); Garcia et o | ul. (2005, 2007) and pres  | sent study. |
|---|-------------|-------------------|---------------------|--|-------------|
| Species   | Pollinator  | Seed disperser    | Density $(ha^{-1})$ | Pollinator Seed disperser Density $(ha^{-1})$ Breeding unit $(km^2)$ Radius $(km)$ | Radius (km) |
| Ficus dugandii  | Fig wasp    | Vertebrates       | 0.004               | 631.7  | 14.2        |
| $Ficus\ obtusifolia$  | Fig wasp    | Vertebrates       | 0.072               | 105.9  | 5.8         |
| $Prunus\ mahaleb$   | Bees, flies | Vertebrates       | 0.003               | 0.87   | 0.042       |
| Frangula alnus  | Bees, flies | Vertebrates       | 0.0004              | 0.45   | 0.013       |
| Astrocaryum mexicanum   | Beetle      | Vertebrates       | 1364.0              | 0.011  | 90.0        |
| Calophyllum longifolium   | Bees        | Vertebrates       | 0.28                | 1.241  | 0.629       |
| Platypodium elegans   | Bees        | Wind              | 0.78                | 0.866  | 0.525       |
| $Cedrus\ atlantica$   | Wind        | Wind              | 61.7                | 0.151  | 0.22        |
| Fraxinus americana  | Wind        | Wind              | 24.7                | 0.008  | 0.05        |
| Pseudotsuga menziesii   | Wind        | Wind              | 25.0                | 0.078  | 0.158       |

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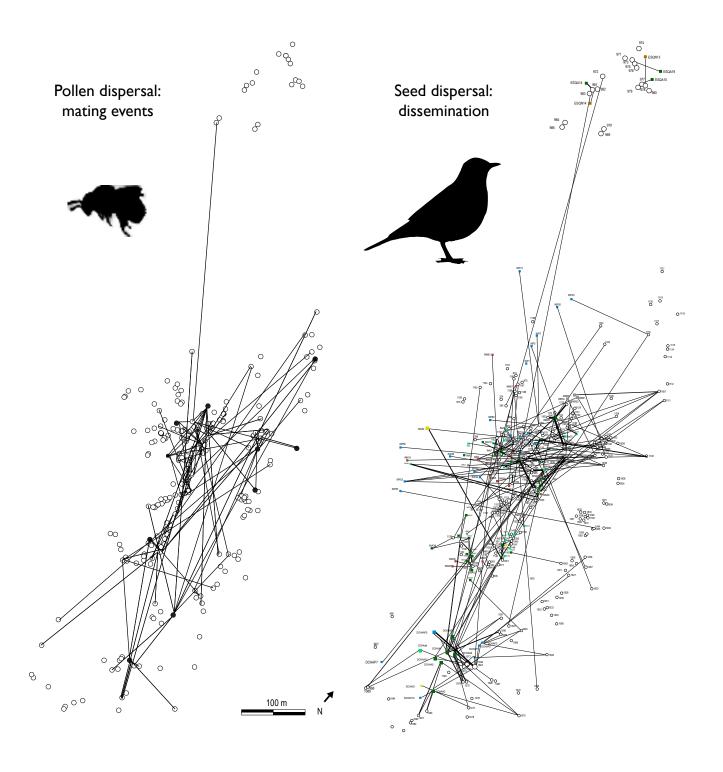


Figure S1. Dispersal events for pollen (left) and seeds (right) traced for *Prunus mahaleb* trees (white dots). All the adult, reproductive, trees in the population are mapped. Lines indicate mating events of pollen dispersal among trees (left) or seed dissemination events from source fruiting trees to seed traps (squares; right). Line thickness is proportional to the number of events recorded.

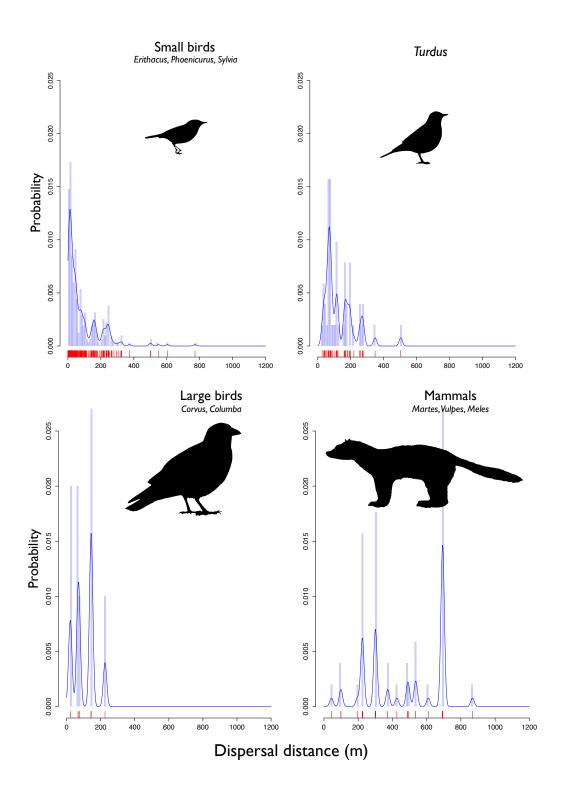


Figure S2. Differential contributions of functional groups of frugivores to the short- $(SDD_{loc})$  and long-distance  $(LDD_{loc})$  local seed dispersal events for *Prunus mahaleb*.