

SHORT COMMUNICATION

Epizoochorous dispersal by bats in French Guiana

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In neotropical forests many species of plant depend on animals for pollination and seed dispersal and it has been well documented that bats play an essential role in dispersal of many flowering plants (Gardner 1977). Bats are responsible for colonization of plants into forest gaps because they often disperse the seeds of plants adapted for growth in disturbed areas. Species of *Cecropia*, *Piper*, *Solanum* and *Vismia* are especially important pioneer plants, and bats play a critical role in the dispersal of these secondary woody species into both secondary and primary forests, and into the seed bank (de Foresta *et al.* 1984, Loba *et al.* 2003).

The database of Mori & Blanchard (URL: <http://www.botanypages.org/>) includes 400 neotropical plant species reported to be bat dispersed. Many of these records concern endozoochorous seed dispersal because it is the most easily studied. In this type of dispersal, the bat consumes the fruit or parts of the infructescence, digests the fleshy pericarp, perianth or receptacle (syconium of *Ficus*), and defecates the seeds or fruits in flight or at a roost. In addition, there are frequent reports of bats carrying away fruits or seeds in their mouths for later consumption of the fleshy pericarp or edible seed parts (e.g. arils and sarcotestas) at their roosts (Charles-Dominique 1986, 1993; Charles-Dominique & Cooper 1986). In this exozoochorous type of dispersal, the diaspores are usually dropped under the roosts or by accident during flight.

Epizoochorous dispersal, in which diaspores are attached to the fur of an animal by adhesion, has not yet been reported for bats. This type of dispersal, if facilitated by barbs or hooks, has been called epizoochory by burrs (Sorensen 1986) and is relatively infrequent, especially in lowland tropical forests. For example, only 1.5% of the flowering plants in the flora of central French Guiana

are known to have epizoochorous seed dispersal by burrs (Mori & Brown 1998).

As part of a study of seed dispersal, bats were caught near the village of Saül in central French Guiana during August and September 2000. They were captured in primary and secondary forest in ground-level mist nets and placed in clean cloth bags until they defecated. The bats were identified using Emmons (1990) and then released unharmed. Fruits and seeds from the faeces were air-dried in glassine envelopes, identified, and voucher collections archived at The New York Botanical Garden.

Four hundred and sixty bats representing 35 species, including 13 frugivores, were caught during 22 netting nights, and 290 seed/fruit-containing faecal samples were obtained. The fruits/seeds of species of *Cecropia*, *Ficus*, *Markea*, *Philodendron*, *Piper*, *Pothomorphe* and *Solanum* were collected from the faeces of *Artibeus gnomus*, *A. jamaicensis*, *A. lituratus*, *A. obscurus*, *Carollia brevicauda*, *C. perspicillata*, *Chiroderma villosum*, *Lonchophylla thomasi*, *Platyrrhinus helleri*, *Rhinophylla pumilio*, *Sturnira lilium*, *S. tildae* and *Uroderma bilobatum*.

Eight of the samples included 1–4 diaspores of *Cyathula prostrata* (L.) Blume (Amaranthaceae). The diaspore consists of the fruiting glomerule, which is broadly ovoid or globoid, 1.5–3 mm long, dark yellow and without fleshy parts. The glomerule usually consists of two fertile fruits, one sterile flower, four rudimentary flowers and five oblong-lanceolate tepals (DeFilippis & Maina 2002). The rudimentary flowers are reduced to 4–19 hooked hairs *c.* 1–1.7 mm long (voucher specimen = Mori *et al.* 22074). The tepals are covered by long hairs. The fertile fruit is an indehiscent, glabrous utricle *c.* 1.3 mm long with a thin and semi-translucent wall. The seed is ovoid, 0.9–1.2 × 0.6–0.8 mm, light brown, shiny and with a smooth surface.

The diaspores of *Cyathula prostrata* were found in faecal samples of *Sturnira tildae* (five samples) and *S. lilium* (three

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samples). The fruiting glomerules were intact and this suggests that they had not passed through the digestive tracts of the bats, but were present in the collected samples because they had stuck to the bat fur. Moreover, it is highly unlikely that a bat would eat the diaspore of *C. prostrata* because, in contrast to all other bat-consumed fruits or infructescences, there are no fleshy edible parts associated with the glomerule.

Seven of the eight faecal samples which contained *C. prostrata* diaspores also contained numerous seeds of *Solanum torvum* Sw.; the eighth sample also had seeds of *Piper bartlingianum* (Miq.) C. DC. The fruits of *Solanum* and *Piper* are considered a staple food for species of *Sturnira* (Fleming 1986), but these bats also utilize many other plants (Mori & Blanchard, URL: <http://www.botanypages.org/>).

There is a possibility that the presence of diaspores of *C. prostrata* in the samples may have been the result of inadvertent contamination of the bags used to hold captured bats because of inadequate cleaning between uses. This, however, is unlikely, because the bags were carefully cleaned after each use. Moreover, the probability of contaminating only those bags used to hold two species of *Sturnira* of the 13 species of frugivorous bats captured, and only those with seeds from *Solanum torvum* collected on four different nights is extremely low.

Cyathula prostrata is a common, weedy, perennial herb reaching 0.5–1 m in central French Guiana and is distributed throughout the tropics. *Solanum torvum* and *P. bartlingianum* are common in disturbed areas in central French Guiana where they grow as shrubs 1–2.5 m and 1–4 m tall, respectively (Görts-van Rijn 2002, Nee 2002). The diaspores of *C. prostrata* probably became attached to the fur of bats when they were foraging for food from *S. torvum* and *P. bartlingianum*, species that grow in the same habitat and strata of *C. prostrata*.

Although it is apparent that the diaspores of *Cyathula prostrata* are adapted to epizoochorous dispersal by burrs (Mori & Brown 1998), this is the first report of a specific animal dispersal agent for this species in the Neotropics and the first report of bats dispersing seeds epizoochorously. The contribution of bats in the dispersal of plants with burrs, however, is insignificant compared with the important ecological role they play in the dispersal of seeds from fleshy fruits, seeds with arils or sarcotestas, or fruits with fleshy tissue derived from the perianth or receptacle.

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