

SHORT COMMUNICATION

Honeybees (*Apis mellifera*) collect latex of Azores bellflowers (*Azorina vidalii*, Campanulaceae)

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The Azores bellflower (*Azorina vidalii* (H.C.Wats.) Feer, synonym: *Campanula vidalii* H.C.Wats.) is a small shrub in the bellflower family, Campanulaceae, which is endemic to the Azores archipelago. Its habitats are coastal rocks and cliffs, often with elevated nitrogen levels (sewage water, rubbish) and close to settlements. *Azorina* is found on all nine islands of the Azores archipelago but is most common on the western islands of Flores and Corvo (Schaefer 2003). The pollination biology of *Azorina* is still a bit of a mystery: while flower morphology would fit best to bird pollination, birds have never been observed visiting its flowers and today's avifauna of the archipelago does not include any obvious candidate species. The first author therefore performed an extensive field study in the summer of 2015, mainly on Corvo but also on Flores and Pico islands, in order to identify the pollinators of this enigmatic endemic.

During this fieldwork, we observed on August 6 at the beach of Fajã Grande, Flores Island, several honeybees on an old *Azorina* plant. The bees did not visit the open flowers of the plant but instead went directly for the lower parts of the stems. They landed on the stem and then searched for small wounds where latex had recently been produced by the plant. They actively collected the sticky substance with their proboscis, middle and hind legs (Fig. 1a) and then flew off, often having trouble to get away from the gluey surface

(Fig. 1b). During 30 minutes of observation time (5:58-6:28 PM), we saw five honeybee workers collecting latex. No other insects showed interest in the latex, even though the flowers received visits by bumblebees and several dipterans.

Bellflower latex coagulates very rapidly (Bauer et al. 2014) and its main function is probably sealing of wounds and defence against herbivores (Konno 2011). Sytwala et al. (2015) analysed latex of *Azorina* and 22 other Campanulaceae and found in all but one species protease activity, more specifically serine proteases. This indicates that the latex has antimicrobial properties. Back in the hive, the bees very likely turned the latex into propolis, a mixture of plant substances, bees wax and pollen used mainly by honeybees, stingless bees and megachilid bees (Willmer 2011) to coat the inside of the hive and cells and anything that cannot be transported outside the hive, e.g. carcasses of small mammals. Propolis is the main way for a bee colony to achieve social immunity (Simone-Finstrom & Spivak 2010). The bees collect a variety of plant exudates including cuticular waxes, mucilages, gums, resins, and latices. Propolis varies considerably in composition depending on the locally available plants but has usually significant antibacterial, antifungal, antiviral, cytotoxic, antioxidant and anti-inflammatory activity (Bankova et al. 2014; Kujumgiev et al. 1999).



Fig. 1. a) Honeybee worker collecting latex on old stem of *Azorina vidalii*, Flores Island, Azores; b) Honeybee worker trying to fly off an *Azorina vidalii* stem with propolis still attached to the plant stem by white latex string (photographs by J.A. Weissmann).

Because of this, propolis has also been used for centuries in traditional medicine as remedy to treat e.g., wounds, burns, and sore throats (Bankova 2005). Phytochemical analyses of propolis and the determination of its pollen content can help to classify it in different types (Bankova et al. 2014; Kumazawa et al. 2003). Since different plants can be used by the bees depending on the local flora and the season, the composition and activity of propolis and propolis products are in general quite variable (Bankova et al. 2014) and detailed knowledge about the source plants is important. Falcão et al. (2013) compared propolis samples from different parts of Portugal including Azores and Madeira and found them to differ significantly from region to region with Azores samples especially rich in flavones. We hypothesize that this difference is at least partly due to Azorean endemic plants like *Azorina* and perhaps the Azores juniper (*Juniperus brevifolia*) as latex and resin sources and encourage for more bee observation studies because this direct evidence is the most reliable approach to understand different composition and properties of propolis.

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REFERENCES

- Bankova, V. 2005. Recent trends and important developments in propolis research. *eCAM* 2: 29-32.
- Bankova, V., M. Popova & B. Trusheva 2014. Propolis volatile compounds: chemical diversity and biological activity: a review. *Chemistry Central Journal* 8: 28.
- Bauer, G., S. N. Gorb, M.- C. Klein, A. Nellesen, M. von Tapavicza & T. Speck 2014. Comparative study on plant latex particles and latex coagulation in *Ficus benjamina*, *Campanula glomerata* and three *Euphorbia* species. *PLoS ONE* 9(11): e113336. doi:10.1371/journal.pone.0113336
- Falcão, S.I., A. Tomás, N. Vale, P. Gomes, C. Freire & M. Vilas-Boas 2013. Phenolic quantification and botanical origin of Portuguese propolis. *Industrial Crops and Products* 49: 805-812.
- Konno, K. 2011. Plant latex and other exudates as plant defense systems: Roles of various defense chemicals and proteins contained therein. *Phytochemistry* 72: 1510-1530.
- Kujumgiev, A., I. Tsvetkova, Y. Serkedjieva, V. Bankova, R. Christov. & S. Popov 1999. Antibacterial, antifungal and antiviral activity of propolis from different geographic origin. *Journal of Ethnopharmacology* 64: 235-240.
- Kumazawa, S., M. Yoneda, I. Shibata, J. Kanaeda, T. Hamasaka & T. Nakayama 2003. Direct evidence for the plant origin of Brazilian propolis by the observation of Honeybee behavior and phytochemical analysis. *Chemical and Pharmaceutical Bulletin* 51: 740-742.
- Schaefer, H. 2003. Chorology and diversity of the Azorean flora. *Dissertationes Botanicae* 374: part I: 1-130, part II: 1-580.
- Simone-Finstrom, M. & M. Spivak 2010. Propolis and bee health: the natural history and significance of resin use by honey bees. *Apidologie* 41: 295-311.
- Sytwala, S., A. Domsalla & M.F. Melzig 2015. Investigation of plant latices of Asteraceae and Campanulaceae regarding proteolytic activity. *Plant Physiology and Biochemistry* 97: 117-123.
- Willmer, P. 2011. *Pollination and Floral Ecology*. Princeton University Press, 778 pp.
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