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NATURE'S GPS: UNILATERAL CEPHALIUM-BEARING CACTI AS BIO-COMPASSES

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Study Description

In some cactus genera, the flowers are arranged in a more or less complex structure, the cephalium. Surprisingly, we showed that different species of columnar and elongate cacti have a consistent orientation pattern of their unilateral cephalia. In the field, using a calibrated compass phone app, we surveyed many individuals from populations of several unilateral cephalium-bearing species from Brazil and one from Bolivia, and confirmed the pattern of North–Northwest orientation is consistent for most species. From these data, we hypothesize on the consistent orientation of these cephalioid structures in most species and the possible relationship with the reproductive biology of these cactus species.

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Photo 1. Section of a *Vatricania guentheri* branch showing the unilateral cephalium. In columnar species showing this structure, it may be inserted more (true cephalium) or less (pseudocephalium) deeply into the cactus branch. Photo credit: Martin Lowry.



Photo 2. Open fruits inserted in the middle of the dense bristles of the unilateral cephalium of an individual of *Micranthocereus albicephalus*. In this genus and species, the green vegetative part of the stem continues to grow, but is asymmetrically modified to one side forming a bristly and/or woolly structure called the cephalium, from which the flowers and, later, the fruits emerge. Photo credit: Martin Lowry.



Photo 3. The unilateral cephalium can be found in more than 30 species of different genera of Cactaceae from tropical America, such as *Coleocephalocereus goebelianus* (top left), *Micranthocereus purpureus* (bottom left) both species from Brazil and *Vatricania guentheri* (right) from Bolivia. Photo credit: Sinzinando Albuquerque-Lima (top and bottom left photos) and Martin Lowry (right photo).



Photo 4. Many of the cacti with unilateral cephalium are pollinated by hummingbirds and bats, as has been reported for *Pilosocereus catimbauensis*, which is pollinated by bats of the Lonchophyllinae subfamily. In these cases, the cephalium, in addition to having a possible orientation function, also performs an acoustic orientation function for bats through echolocation. Photo credit: Sinzinando Albuquerque-Lima.

These photographs illustrate the article "North by northwest: Are unilateral cephalium-bearing cacti bio-compasses?" by Sinzinando Albuquerque-Lima, Daniela C. Zappi, Nigel P. Taylor, Martin Lowry, Mats Winberg, and Isabel Cristina Machado published in *Ecology*. https://doi.org/10.1002/ecy.4058