



Ecology/Écologie

Bat aggregation mediates the functional structure of ant assemblages



La concentration de chauves-souris influence la structure fonctionnelle des assemblages de fourmis

Alain Dejean ^{a,*,b,c}, Sarah Groc ^c, Bruno Hérault ^d, Héctor Rodriguez-Pérez ^c, Axel Touchard ^c, Régis Céréghino ^{a,b}, Jacques H.C. Delabie ^e, Bruno Corbara ^{f,g}

^a Laboratoire « écologie fonctionnelle et environnement », université de Toulouse, UPS, INP, 118, route de Narbonne, 31062 Toulouse, France

^b CNRS (UMR CNRS 5245), Ecolab, 31062 Toulouse, France

^c CNRS (UMR CNRS 8172), « Écologie des forêts de Guyane » (Ecofog), campus agronomique, BP 316, 97387 Kourou cedex, France

^d CIRAD (UMR-CIRAD 93) ; Ecofog, 97387 Kourou cedex, France

^e U.P.A. Laboratório de Mirmecologia, Convênio UESC/CEPLAC, C.P. 7, 45600-970 Itabuna, Bahia, Brazil

^f CNRS (UMR-CNRS 6023) ; LMGE, université Blaise-Pascal, complexe scientifique des Cèzeaux, 63177 Aubière cedex, France

^g Laboratoire « microorganismes, génome et environnement », université Clermont-Auvergne, université Blaise-Pascal, BP 10448, 63000 Clermont-Ferrand, France

ARTICLE INFO

Article history:

Received 28 February 2015

Accepted after revision 15 June 2015

Available online 21 August 2015

Keywords:

Ant functional groups

Bat roosts

Biogeochemical hotspots

Bioindicators

Stable isotopes

Mots clés :

Groupes fonctionnels de fourmis

Nichoirs de chauves-souris

Zones de concentration biogéochimiques

Indicateurs biologiques

Isotopes stables

ABSTRACT

In the Guianese rainforest, we examined the impact of the presence of guano in and around a bat roosting site (a cave). We used ant communities as an indicator to evaluate this impact because they occupy a central place in the functioning of tropical rainforest ecosystems and they play different roles in the food web as they can be herbivores, generalists, scavengers or predators. The ant species richness around the cave did not differ from a control sample situated 500 m away. Yet, the comparison of functional groups resulted in significantly greater numbers of detritivorous fungus-growing and predatory ant colonies around the cave compared to the control, the contrary being true for nectar and honeydew feeders. The role of bats, through their guano, was shown using stable isotope analyses as we noted significantly greater $\delta^{15}\text{N}$ values for the ant species captured in and around the cave compared to controls.

© 2015 Académie des sciences. Published by Elsevier Masson SAS. All rights reserved.

R É S U M É

En forêt de Guyane française, nous avons examiné l'impact de l'accumulation de guano autour et dans une grotte servant de nichoir pour des chauves-souris, en prenant les fourmis comme bio-indicateur. En effet, les fourmis occupent une place centrale dans le fonctionnement de l'écosystème forestier, car elles jouent plusieurs rôles dans le réseau trophique ; elles peuvent être herbivores, généralistes, détritivores ou prédateurs. La richesse spécifique autour de la grotte n'est pas différente de celle d'une zone témoin située 500 m plus loin, mais la distribution des groupes fonctionnels diffère avec plus de fourmis prédatrices et de champignonnistes détritivores autour de la grotte ; c'est le

* Corresponding author.

E-mail address: alain.dejean@wanadoo.fr (A. Dejean).

contraire pour les nectarivores et celles qui élèvent des hémiptères. L'impact des chauves-souris, via leur guano, a été illustré en utilisant des isotopes stables. Les valeurs en $\delta^{15}\text{N}$ pour les espèces de fourmis prises autour et dans la grotte sont significativement plus fortes que pour les contrôles.

© 2015 Académie des sciences. Publié par Elsevier Masson SAS. Tous droits réservés.

1. Introduction

Due to the tendency to move over large areas, megafauna fulfil a comparatively important function in the horizontal transfer of nutrients across landscapes through the dissemination of their waste (i.e. urine and feces). Furthermore, when large groups of animals remain in one place for a period of time, they produce vast amounts of waste that subsequently concentrate nutrients into “biogeochemical hotspots” [1,2]. These hotspots, defined as small areas within a landscape matrix that show comparably high reaction rates relative to the surrounding areas [1], can also be due to decaying carcasses; they have been noted in both terrestrial and aquatic ecosystems [1,3–7].

In their roosting sites (i.e. caves, abandoned mines and large trees), bats can form one of the largest animal aggregations with thousands to 20 million individuals for the Brazilian free-tailed bat in Texas [8]. Due to these numbers, bats play an ecological role in soil fertility and nutrient distribution within ecosystems via the guano they spread while foraging at night. For instance, a large colony of Brazilian free-tailed bats redistributes 22 kg of nitrogen per year in the form of guano [9]. Also, bat guano provides the primary organic input in caves, supporting a great diversity of organisms belonging to different trophic levels [10–15].

Because they occupy a central place in the functioning of entire tropical rainforest ecosystems, we used ants as ecological indicators to study the impact of bats around their roosting sites. Indeed, ants generally constitute the largest fraction of the animal biomass, are ubiquitous and play different roles in the food web as they can be herbivores, fungus growers, generalists, scavengers or predators [16,17]. We hypothesized that the high density of guano dropped inside and around a dry cave serving as a bat roosting site in a Guianese tropical rainforest might positively affect the detritus-based brown food web through an increase in feces-consuming detritivores and their predators, including ants. There could also be an indirect effect through nitrogen absorption by plant roots followed by its incorporation in plant tissues, including leaves (favoring leaf-cutting, fungus-growing ants) and exudates (favoring ants attending hemipterans for their honeydew and nectarivorous ants). Also, nitrogen fertilization might increase leaf-litter quantity and quality with more fallen leaves meaning more habitats available for litter-dwelling organisms.

We firstly aimed to verify if the large amount of bat guano around the focal cave favors ant species richness and/or certain ant functional groups. In a context of using ants as bioindicators, functional groups can provide a predictive understanding of community responses to

modifications to the environment because they are related to ecological functions [18–20]. Second, using stable isotopes, we aimed to determine the impact of bat guano along the trophic chain. Because the ratios of the heavy to light stable isotopes of consumers reflect the isotopic compositions of their diets [21,22], we verified if the tissues of ants from the focal cave and its immediate surroundings had different levels of ^{15}N compared to ants from a distant, control area.

2. Methods

2.1. Study site

Kaw Mountain rises up over the French Guianese coastline, facing the Atlantic Ocean between the villages of Roura (04°43'42"N; 52°19'27" W) and Kaw (04°36'33"N; 52°7'2"W). Covering an area of 38,200 ha, this 40-km-long series of hills more than 300 m in height peaks at 462 m. This is one of French Guiana's wettest areas with 4000 mm to 8000 mm of precipitation on the uppermost parts of the slopes facing the ocean and so directly exposed to the trade winds [23,24].

The rock shelters and dry caves formed by the hard lateritic crust in Kaw Mountain have a specific invertebrate fauna and provide shelter to the Guianese cock-of-the-rock (*Rupicola rupicola*), an emblematic bird, and numerous bat species [25]. The bat species, which make extensive use of these caves as nursery roosts, include: *Pteronotus parnellii* (by far the most frequent; insectivorous, feeds primarily on moths and beetles), *Lonchorhina inusitata* (aerial insectivore), *Furipterus horrens* (insectivorous, mainly preys on Lepidoptera), *Anoura geoffroyi* (feeds on nectar, fruit, pollen and insects) and *Lionycteris spurrellii* (nectar-feeder) [26,27]. Classically, oligochaetes and several types of arthropods including isopods, millipedes, centipedes, amblypygids, pseudoscorpions, spiders, mites, cockroaches, crickets and ants develop on bat guano in this cave ([27]; BC and AD pers. obs.; for Neotropical cave fauna developing on bat guano, see [14] and papers cited therein).

The present study focused on the sole dry cave in the area which is not located in a nature reserve and does not open out onto a cliff side and so has easy access and permits comparisons between the immediate surroundings and control areas. Situated in the middle of the rainforest, this cave serves as a bat nursery roost composed of two wide chambers (ca. 27 × 30 m and 19 × 58 m) separated by a wall, plus different smaller cavities and a third, circular area (ca. 10 m in diameter) whose ceiling collapsed, permitting some trees to take root on the mass of fallen rocks and sediments below. This area initially inter-connected the two wide chambers.

Download English Version:

<https://daneshyari.com/en/article/2783315>

Download Persian Version:

<https://daneshyari.com/article/2783315>

[Daneshyari.com](https://daneshyari.com)