



Conference Abstract

# Hyperparasitism in caves: bats, bat flies and ectoparasitic fungus

Katrine M. Jensen<sup>‡</sup>, Luísa Rodrigues<sup>§</sup>, Thomas Pape<sup>|</sup>, Anders Garm<sup>‡</sup>, Sergi Santamaria<sup>¶</sup>, Ana Sofia P. S. Reboleira<sup>#</sup>

<sup>‡</sup> University of Copenhagen, Copenhagen, Denmark

<sup>§</sup> Instituto de Conservação da Natureza e das Florestas, Lisbon, Portugal

<sup>|</sup> Natural History Museum of Denmark, Copenhagen, Denmark

<sup>¶</sup> Universitat Autònoma de Barcelona, Barcelona, Spain

<sup>#</sup> Natural History Museum of Denmark, University of Copenhagen, Copenhagen, Denmark

Corresponding author: Ana Sofia P. S. Reboleira ([sofiarebol@gmail.com](mailto:sofiarebol@gmail.com))

Received: 21 Sep 2018 | Published: 21 Sep 2018

Citation: Jensen K, Rodrigues L, Pape T, Garm A, Santamaria S, Reboleira A (2018) Hyperparasitism in caves: bats, bat flies and ectoparasitic fungus. ARPHA Conference Abstracts 1: e29967.

<https://doi.org/10.3897/aca.1.e29967>

## Abstract

Bat flies (Nycteribiidae) of the order Diptera are highly specialized bloodsucking ectoparasites living on bats. The life-cycle of the bat flies emphasizes their obligate relationship with their hosts as they spend almost their entire life on bats. Upon mating, the female bat fly carries the larvae internally until the 3<sup>rd</sup>-instar when it deposits the larvae on the ceiling of the roost occupied by bats. The larvae then form a puparium. After 3-4 weeks the adult bat fly emerges from the puparium and starts searching for a host bat to colonize.

Some of these ectoparasitic bat flies themselves are infected with an ectoparasitic fungus of the genus *Arthrorhynchus* (Laboulbeniales). Ascospores of the fungi attach themselves to the cuticle of the bat fly and develop a very conspicuous haustorium that penetrates into the soft tissues from where it presumably extract nutrition from the hemolymph of the bat flies. This interaction converts the fungus into a hyperparasite. Both the parasite and hyperparasite are obligates and cannot live separate from their hosts. This peculiar case of hyperparasitism remains highly unknown.

The bat flies were collected in caves of Portugal, in maternity and hibernation bat seasons, and in the autumn migration period. The most common species of cave-dwelling bat species in Portugal is *Miniopterus schreibersii*, frequently parasitized with *Nycteribia schmidlii* and *Penicillidia conspicua* bat flies. We have studied the prevalence of the Laboulbeniales of the genus *Arthrorhynchus* in natural populations of bat flies. The site and position of the fungus on male and female bat flies unveils the mechanism of fungal transmission among bat flies, indicating that it occurs during mating behavior. This study is the starting point towards the understanding of this unique case of fungus-insect-vertebrate hyperparasitism interaction. See Suppl. material 1.

## Presenting author

Ana Sofia P. S. Reboleira

## Presented at

24th International Conference on Subterranean Biology

## Funding program

This work was supported by a research grant (15471) from the VILLUM FONDEN.

## Ethics and security

All specimens were collected under permits of the Instituto de Conservação da Natureza e das Florestas, Portugal.

## Supplementary material

### Suppl. material 1: Hyperparasitism in caves: bats, bat flies and ectoparasitic fungus

[doi](#)

**Authors:** Jensen, K.M.; Rodrigues, L.; Pape, T.; Garm, A.; Santamaria, S.; Reboleira, A.S.P.S.

**Data type:** Poster presented at the 24th International Conference on Subterranean Biology

**Filename:** Poster\_Jensen et al 2018.pdf - [Download file](#) (250.09 kb)