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SHORT NOTE

The Plesiobiontic Association of *Formica lemani* Bondroit with *Lasius flavus* (Fabricius) (Hymenoptera, Formicidae) in Norway

GM Kvifte[1], TA Legøy[2], J Soulé[2]

1 - Department of Natural History, University Museum of Bergen, University of Bergen, Norway
2 - Institute of Biology, University of Bergen, Norway

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Corresponding author
Gunnar Mikalsen Kvifte
Dept. of Natural History, University of Bergen
University Museum of Bergen
P.O. Box 7800 N-5040 Bergen, Norway
E-Mail: gunnar.kvifte@uib.no

Abstract

Three compound nests of *Formica lemani* Bondroit, 1917 and *Lasius flavus* (Fabricius, 1782) are reported from Lygra, Western Norway. This is the first plesiobiontic relationship reported for *F. lemani* and the 9th for *L. flavus*. Behavioural and landscape ecological traits associated with plesiobiosis are discussed.

Introduction

Interspecific nesting associations in ants are common, and can take several different forms including brood parasitism, cleptoparasitism and mutualism. However, in many compound nests the association appears to be fully commensal, as different species may occur together in the same nest without interacting biologically. Such associations are typically called plesiobiontic or plesiobiotic relationships (See Kanizsai et al., 2013 for a review).

Plesiobiontic ant species pairs tend to be dissimilar in e.g. size, morphology and behaviour (Kanizsai et al., 2013), and Czechowski (2004) suggested that plesiobioses primarily form in landscapes where suitable nesting habitats are scarce. In their review of plesiobiosis in Holarctic ants, Kanizsai et al. (2013) noted that the ants most frequently involved in plesiobiontic relationships tend to be comparatively less aggressive ants, and that plesiobiont partners tend to show little overlap in foraging strategies.

The most frequently plesiobiont species in the Holarctic region is *Formica fusca* L., 1758; which forms part of more than 60% of observed plesiobiontic relationships (Kanizsai et al., 2013). Despite the two species *Formica lemani* Bondroit, 1917 and *F. gagatoides* Ruzsky, 1904 being overall very similar to *F. fusca* in behaviour and biology (Collingwood, 1979), no plesiobiontic associations of either species were listed by Kanizsai et al. (2013).

In this note we document the first record of plesiobiosis in the ant species *Formica lemani,* from a nest shared with *Lasius flavus* (Fabricius, 1782) in a heathland ecosystem in Norway. The observations contribute the 50th observed plesiobiont species and the 49th observed species association pair in Holarctic ants.

Material and methods

Ant nests were searched for under rocks and roots and in bryophytes on august 18th and 26th, 2015, at Lyngheisenteret, Lygra, Western Norway. The area is part of an open heathland landscape which is grazed by sheep through the year and managed by controlled burnings approximately once a decade. A total of nine people were involved in the search, which spanned around 100 m^2 of area surrounding 60.700736° N, 5.100393° E. Three different compound nests and one single-species nest were found, all under rocks, and voucher specimens of pupae and workers from each compound nest were collected for subsequent identification.

Specimens were identified using Douwes et al. (2012). Adult and pupal voucher specimens from two nests are stored in alcohol in the entomological collections at the University Museum of Bergen (ZMUB, collection numbers A-47723–A-47728, see table 1 for details).

Table 1. Voucher material preserved in this study.

Museum ID	Nest #	Species	Number of specimens	Collection date
A-47723	1	*Lasius flavus*	2 workers, 5 pupae	18.VIII.2015
A-47724	1	*Formica lemani*	7 workers	18.VIII.2015
A-47725	2	*Lasius flavus*	3 workers, 3 pupae	18.VIII.2015
A-47726	2	*Formica lemani*	1 worker, 1 pupa	18.VIII.2015
A-47727	2	*Lasius flavus*	6 alates, 5 workers, 1 pupa	26.VIII.2015
A-47728	2	*Formica lemani*	1 worker, 1 pupa	26.VIII.2015

Results and Discussion

All three compound nests were found under rocks and contained workers and pupae of both *Lasius flavus* and *Formica lemani*. In one of the nests, six alate *L. flavus* were collected as well.

In each nest, pupae of the different species were found in different clusters, separated by a few centimeters (Fig 1). When the nests were uncovered, worker ants evacuated the pupae via apparently different systems of soil corridors. Apart from this small separation, no difference in microhabitat use could be observed. Adult workers could be observed among pupal clusters of different species, however this may be due to our disturbance of the colonies (Fig 1).

Our observations are the first of *F. lemani* in a plesiobiontic relationship with another ant species. However, some of Morley's (1945) observations of plesiobiontic *F. fusca*

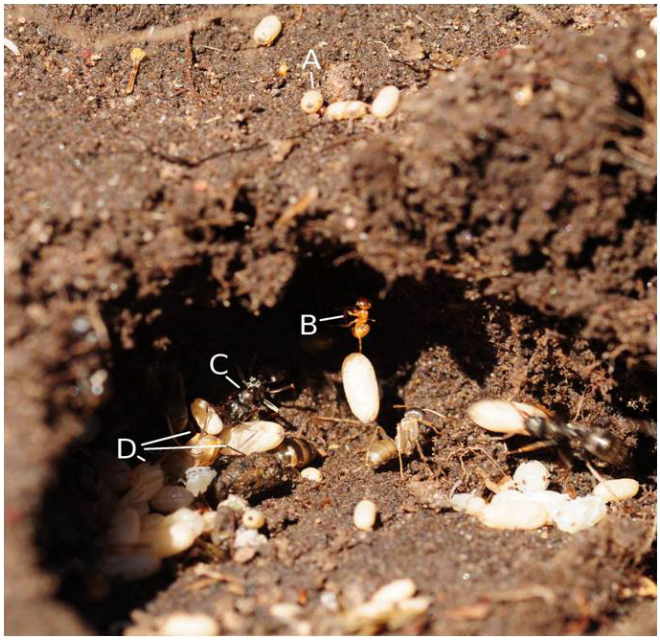

Fig 1. Detail of ant nest after removal of stone. A, *Lasius flavus* pupae, B, *Lasius flavus* worker, C, *Formica lemani* worker, D, *Formica lemani* pupae.

may represent misidentified *F. lemani* since the observations were made prior to Yarrow's (1954) revision. Nevertheless our observations represent the first confirmed case of *F. lemani* in a plesiobiontic relationship with another ant species, providing further evidence for Collingwood's (1979) claim that the habits of *F. lemani* are similar to *F. fusca* – the most frequently recorded plesiobiont in the Palearctic region (Kaniszai et al., 2013).

Workers of *Formica lemani* and *Lasius flavus* differ markedly in size and foraging behaviour. Whereas *F. lemani* is a free-living and active predacious, aphidicolous and nectarivorous species, *L. flavus* is mostly subterranean and feeds on smaller arthropods and honeydew from root feeding aphids (Collingwood, 1979; Douwes et al., 2012). The resources exploited by each species thus show little overlap, permitting coexistence without competition. This follows the general pattern outlined for plesiobiontic relationships by Kanizsai et al. (2013). Colony sizes of the two species are listed in the literature as a few Hundred to a few thousand for *F. lemani* and up to 100 000 workers for *L. flavus* (Douwes et al., 2012).

On the landscape level at the study site at Lygra, our observation matches well with Czechowski's (2004) suggestion that plesiobiontic nests develop when the limiting factor controlling ant abundances is nesting site availability rather than food resources. Our study area is dominated by *Calluna vulgaris* heathlands with scattered moorlands, and all ant colonies we found were limited to a small rocky outcrop. It is thus likely that plesiobiontic relationships are common in the area, and further plesiobiont associations may well be observed here in the future.

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