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Research Article

Ants as Carcasses Consumers a Case Study Undertaken Inside a Greenhouse (Lanzarote, Canary Islands, Spain)

Salona-Bordas MI[1]*, Salona-Bordas JL[1] and Tinaut A[2]

[1]Department of Zoology and Animal Cell Biology, University of the Basque Country, Spain

[2]Department of Zoology, University of Granada, Spain

***Corresponding author:** Salona-Bordas MI, Department of Zoology and Animal Cell Biology. Faculty of Science and Technology, University of the Basque Country, UPV/EHU, Barrio de Sarriena s/n, Leioa, 48940 Bizkaia, Spain, Tel: 3494605543; Fax: 34946013500; Email: m.salona@ehu.es

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Abstract

We report the reduction of mice carcasses by a single species of ant *Pheidole megacephala* (Hymenoptera, Formicidae). The carcasses of drowned mice were placed inside a greenhouse and remained under observation until reduced to a skeleton. The access of external fauna into the greenhouse was limited and no fly or other necrophagous insect colonised the remains of the first animal, except ants invading the greenhouse through the floor and reducing the mouse to a skeleton after a few days, beginning through the head and trunk. The ants were identified as *Pheidole megacephala,* a pest that has been introduced to temperate countries through the trade in exotic plants. Once the soft tissues had been consumed, the ants transported the bones to the nest under the greenhouse structure eliminating any possible evidence of the corpse at the scene. When a barrier blocked the access of the ants to the carcass, blowflies colonised and developed successfully in the carcass; post feeding maggots were reared under laboratory conditions and emerged adults identified as *Calliphora vicina* and *Lucilia sericata* (Diptera, Calliphoridae). This is the first time that *P. megacephala* has been reported in association with carcass reduction.

Keywords: Mouse/Mice; Carcass reduction; *Pheidole megacephala;* Formicidae; Calliphoridae

Introduction

A case study using mouse carcasses has been developed inside a greenhouse in Lanzarote (Gran Canaria, Canary Islands). A colony of ants established inside the greenhouse reduced the carcasses into bones, removed any evidence from scene in few days and delayed the blowfly colonisation of the carcass. Moreover, when blowfly oviposition occurred due to an artificial barrier that prevented the access of the ants to the carcass, ants altered the blowfly cycle producing a migration in advance and shortening it, with the emergency of smaller adults.

Ants are considered opportunistic within sarcosaprophagous communities [1, 2] although they have been the most important taxon in previous studies carried out in the Iberian Peninsula [3]. In these cases, Formicidae was considered to be opportunistic necrophilous species that use carcasses not only as a refuge for warmth or moisture, but as food source [1]. Some ant species can predate on human skin, soft tissues, maggots and other necrophagous larvae [4] or feed on significant sources of organic material such as saprophyte remains. Moreover, some species of ants are extremely aggressive, i.e. the red imported fire ant *Solenopsis invicta* Bueren, 1972, and may produce specific injuries in suspects and inspectors that should not be ignored.

Their opportunistic status may explain the presence of ant species associated with carcasses, which theoretically have different specific food requirements; such as is the case of *Messor* Forel, 1890 species that usually feeds on grain but has been collected in association with rabbit [5] and chicken carcasses [3] among others. It should be noticed that Fernández-Escudero & Tinaut [6] demonstrated through field experiments that *M. barbarus* (Linnaeus, 1767) and *M. bouvieri* Bondroit, 1918 preferred insect corpses to seeds, which are the theoretical food source of these ants. The authors concluded that seeds could be chosen as an easy and less competitive option, rather than real innate food specificity. *Pheidole* Westwood, 1839 has a highly varied food pattern, from seeds to vegetable fluids [7]. Nevertheless, it has been also considered opportunistic as it has been recorded in relation to carcasses in tropical areas, being the most abundant genus in the sarcosaprophagous community associated to chicken carcasses [3].

We used mouse carcasses to check the capability of ants to alter a scene and to reduce to skeleton a carcass of small size.

Material and Methods

We assessed both the importance of the ant community as carcass consumers as well as their influence on fly colonisation of the corpses using the data from three mouse carcasses (*Mus musculus* Linnaeus, 1758) inside a greenhouse under different conditions.

The first mouse was found dead and placed inside a greenhouse on June 17th, 2007. A replicate of this situation was carried out with a second mouse placed on the greenhouse on May 1st, 2009; a third corpse was placed one day later, at a distance of 1 metre from the second carcass and isolated from the floor by a recipient full of water. The water acted as a barrier against the colonisation of the carcass by ants.

Environmental temperature and humidity were recorded during the second and third replicates of the experiment.

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Results

Ants colonised the first and second carcass within the first minutes of exposure. There was only one species involved, identified as *Pheidole megacephala* (Fabricius, 1793). Water acted as an effective barrier against ants, and the third carcass was only colonised by blowflies identified as *Calliphora vicina* Robineau-Desvoidy, 1830 and *Lucilia sericata* (Meigen, 1826) (Diptera, Calliporidae), after rearing the maggots collected from the carcass. It was not possible to record any environmental data for the first case. However, temperature (minimum and maximum) and humidity were recorded for cases 2 and 3 as detailed in Table 1.

Case 1

Carcass reduction occurred within the first five days (D0-D5). Ants removed all the soft tissues and hair from the skull (D3) and body (D2-D5). During this first experiment, a fly was observed on D0 resting inside the greenhouse, but no attempt at colonisation of the carcass was observed and the fly was not seen again in the following days. The skull was found in a different position on D4, and removed from the scene one day later (D5). A visual inspection confirmed that the ants were removing the skeleton remains and taking the bones, skull included, into the anthill.

As no environmental data were recorded during the first experiment, two replicates were set up under controlled conditions.

Case 2

A mouse carcass was placed on the floor of the greenhouse, in similar conditions to Case 1. Ants colonised the carcass a few minutes after it had been placed on the floor. Reduction of the carcass to its skeleton occurred in 7 to 8 days. However, on this occasion the skeleton remains were not taken to the anthill, probably due to the presence of a new food source, soft and nourishing, namely the maggots developing on the third carcass.

Case 3

Another mouse carcass was placed close to case 2 but on a plate isolated from the floor by a recipient full of water to prevent the access of the ants to the carcass. Several blowflies were observed inside the greenhouse a few hours after carcass deposition. Egg lying began within the first hours of D0. Maggot activity was confirmed on D1 and D2. On D4, a maggot mass was moving beneath the tissue paper placed under the carcass. The dish full of water was replaced by earth to give an adequate substrate for pupation. That also allowed the ants to find their way to colonise the 3rd carcass, abandoning the skeleton remains of the second case and feeding directly on the maggots.

Table 1: Environmental values for replicate experiments carried out in May 2009 with mice carcasses.

May 2009	1	2	3	4	5	6	7	8	9	10
Case 2	D0	D1	D2	D3	D4	D5	D6	D7	D8	D9
Case 3	-	D0	D1	D2	D3	D4	D5	D6	D7	D8
T.m. ºC	24	22	18	17	19	19	19	18	17	15
T.M. ºC	-	34	33	35	36	36	37	37	36	24
HR %	70	70	70	70	70	70	70	70	70	70

T: Temperature; m: minimum; M: Maximum; HR: Relative Humidity; - no data recorded,
D0, D1, D2 ... = number of days after the beginning of the experiment).

The ant invasion of the 3rd carcass produced a massive migration of the surviving maggots away from the carcass. A sample of the migrating population was reared under controlled conditions (22ºC) to confirm the species after the emergence of the adults. As pupation occurred in advance due to the stress conditions produced by the ants invasion, small adults (0.5-0.8 cm) emerged in May 22nd from underfed maggots (0.6-1.2 cm), developed in a shortened lifecycle (20 days). This confirms the observations made previously under laboratory conditions with the blowfly, *Calliphora vicina*, reared under starvation conditions in our facilities [8].

Discussion

Ants are known to be associated to carcass environments and to develop injuries in the corpse surface that can be misidentified during a crime investigation [4]. Moreover, their presence can delay other insects' oviposition, as blowflies, and therefore introduce errors in the estimation of the post-mortem interval [1]. Nevertheless, they may be overlooked during a crime scene inspection due to their small size and their lucifugous habits. Therefore, they may be present in soil under a corpse and if an adequate collection of soil samples are not taken during a crime scene investigation, importance evidence may be missed [9]. Furthermore, their capability to act as a super organism [10] allow to a group of ants to remove from scene small-medium evidence that can be missed if the area surrounded the corpse is not deeply inspected.

In this work, we have observed that Formicidae may have a greater preference for corpses as a source of food than previously expected [3]. We also report that scene can be altered by the activity of some arthropods, as bones were being withdrawn to the nest in two of the three experiments and maggots forced to migrate in advance. In the third case, though the ants abandoned the skeleton remains, they did so in favour of a clearly richer and more nutritious food source, indicating that they are able to continuously calibrate the benefits of different types of food found during their daily activity. It is especially interesting to note that this change occurred even in absence of any competing species. *Pheidole* include species with a wide food range, feeding on nectar, seeds or arthropod remains [7]. In the particular *P. megacephala,* is an invader species and acts very aggressively toward other species, managing to develop large super colonies in some insular systems [7]. This tends to result in the disappearance of other species from the surroundings, and can have a substantial effect on the autochthonous fauna. Moreover, greenhouses have both a direct impact after their installation as well as an indirect one due to their management and exploitation, producing important disturbances on the environment that help invading species to become established inside them or in the surroundings. Furthermore, as is the case of the species under study, these ants tend to be very aggressive and the possibility that they became the only species in the area is very high. These characteristics probably explain why it was the only ant species feeding on the mouse carcasses. The food status of ant species (Formicidae) has not been studied in detail. Never the less, these three experiments, undertaken with mouse carcasses inside a greenhouse in a subtropical area (Canary Islands), point to the importance of this ant species as carcass consumer. At least, they seem to feed on small corpses such as rodents, reducing them to skeleton remains in a matter of days (5-8 days), and removing any remains from the area of death. We also confirm the capability of ants to delay blowflies' oviposition and to feed on maggots, introducing important alterations in the decomposition process when they are close to area of a corpse, and potentially leading to incorrect conclusions being drawn in a forensic investigation when ignored. This is the first time that the necrophagous capability is reported for the ant *Pheidole megacephala*.

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