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ANTS (HYMENOPTERA FORMICIDAE) AND THE FOOD INDUSTRY: OBSERVATIONS IN FACTORY PREMISES IN CENTRAL ITALY ([1])

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Nicoli Aldini R., Anaclerio M., Cravedi P. - Ants (Hymenoptera Formicidae) and the food industry: observations in factory premises in central Italy.

Research on ants (Hymenoptera Formicidae) in a food factory in the province of Latina (Lazio, central Italy) was carried out over several years up to 2013. The investigation started during the 1990s, and was conducted principally by examining specimens caught in light traps placed indoors on the factory premises. A smaller number of ants was collected directly during periodical inspections. The present work focuses on the observations made on specimens collected during 2007 and 2008 using light traps. Besides some ant genera and species which are well known as being typical pests of the food industry, some other more unusual and sporadic species were found. Among these latter, females of the ponerine ant *Hypoponera punctatissima* were sometimes collected in dozens or hundreds during single weeks of sampling using light traps. Many specimens of *Pheidole pallidula* (males, females, workers and soldiers) and *Lasius* spp. (males) were also collected using traps. *H. eduardi*, *Cremastogaster scutellaris*, *Solenopsis fugax* and *Linepithema humile* were scarce or extremely scarce in the traps, as were species of *Myrmica, Aphaenogaster*, *Messor*, *Tetramorium*, and *Camponotus*. The causes of their presence in the food factory may differ according to genera and species, and deserve to be studied in depth.

KEY WORDS: monitoring, light traps, *Hypoponera*, *Pheidole*, *Lasius*.

INTRODUCTION

Some genera and species of ants (Hymenoptera Formicidae) are included among the most significant pests in the urban environment and in particular in the food industry, especially due to risks arising from their presence as regards the quality and safety of foodstuffs.

The damage which these insects can cause, either directly or indirectly, is usually related principally to the activity of the workers, which walk on surfaces searching for food (mainly, but not exclusively, sweets). They contaminate foodstuffs and fall into fluid or liquid substances, drowning and so polluting them. However, winged ants can also occasionally be found inside factories, being attracted by artificial light sources in the evening and at night, due to inadequate insulation from the outside, or swarming directly inside the buildings from nests in the walls or other indoor sites. The transfer of pathogenic microorganisms to food by workers is also a risk which should not be underestimated. Problems may also arise due to annoyance caused to factory staff, as well as to other risks deriving for example from the presence of nests in cavity walls, in electrical boxes, etc. (HAACK and GRANOVSKY, 1990; BEATSON CAMPBELL, 1991). Case histories deriving from certain methodologies of foodstuff analysis, such as the filth-test (DOMENICHINI, 1997), evidence the seriousness of the problem, contamination related to ants frequently being found in different kinds of foodstuffs. Contamination may consist of fragments of varying size but sometimes also of whole insects (the workers of most species which infest food factories are very small, only a few millimeters in length).

The most common species (some of which are allochthonous and invasive) reported in Italy in relation to pest management in the food industry belong to the genera *Pheidole* Westwood, 1841 (the big-headed ant, *P. pallidula* (Nylander, 1848)), *Monomorium* Mayr, 1855 (the pharaoh ant, *M. pharaonis* (Linné, 1758), introduced), *Tetramorium* Mayr, 1855 (the pavement ant, *T. caespitum* (Linné, 1758)), *Linepithema* Mayr, 1866 (the Argentine ant, *L. humile* (Mayr, 1868), introduced), *Solenopsis* Westwood, 1841 (the fire ants), and *Lasius* Fabricius, 1804 (SÜSS, 1979; LOI, 1997; SÜSS and LOCATELLI, 2001; PAGANI *et al.*, 2010; NICOLI ALDINI *et al.*, 2013, 2014). In recent years, some other exotic ants have been found in anthropic environments in Italy, due to accidental introduction by man (JUCKER *et al.*, 2008; RIGATO and ZILIOLI, 2008).

Research and publications from Italy on ants in the food industry have been relatively scarce up to now. The present work reports the relevant data obtained during a period of research carried out in a food factory in central Italy.

MATERIALS AND METHODS

The research was conducted in a factory located in the province of Latina, at Cisterna (Lazio, central Italy). Products of the factory include frozen vegetables (depending on the season, mainly spinach, potato,

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aubergine and courgette, all freshly-harvested), pasta, sauces, snacks and pizza (VILLANI *et al.*, 2008).

Investigation into insect pests and related problems, in order to monitor and control them, started at the beginning of the nineties using various devices, including light traps provided with collection trays. The monitoring activity with light traps was implemented and standardized using UV mod. Don Gilbert lamps and placing traps on the walls at the height of 35 cm from the floor. 15 locations in different manufacturing departments were chosen for these traps; each trap tray was checked weekly and collected insects were removed. Starting from 2003, regular analytical checking of the collected samples was performed (NICOLI ALDINI *et al.*, 2008) involving the identification of ants (and other insects) in the laboratory, initially with the aim of a simple qualitative survey. Subsequently, from 2005 to 2013, the aim became that of a quantitative investigation, by counting the number of specimens of each genus or species, allowing for standardization of the evaluation of the captures of ants, in order to have comparable numerical information. Given the large number of insects collected each week, only the catches of a single week per month (usually the third week) were examined for each trap.

Besides the light traps, ants were collected more occasionally and for a limited number of specimens during periodical inspections by visual observation on the premises or by direct examination of contaminated food.

In order to have an overall evaluation of the presence of ants, the numeric data obtained for each of the 15 traps during the same week were added together for the specimens of each genus or species. Thus, numeric data (Fig. I) refer to all 15 stations in the same sampling interval. The presentation of the results refers to the sampling years 2007-2008.

The identification of ants was performed up to genus and generally also species level. The works by BERNARD (1968) and KUTTER (1977, 1978) were used as main references for the identification and information on general geographic distribution of the taxa. The catalogue by BARONI URBANI (1971) and the checklist by POLDI *et al.* (1994) provided reference for the nomenclature and Italian distribution.

RESULTS AND DISCUSSION

The presence and abundance of ants in light traps was highly variable from month to month and from location to location: in most of the trap stations the number of collected specimens was small (one to a few individuals); during some weeks many traps caught no specimens, while only in a few traps the ant numbers were sometimes high, but rarely higher than 100-200 specimens per trap and week (*Hypoponera*).

The ants collected in the light traps were generally winged ants, belonging to the reproductive caste (males, females). Occasionally (but more often for *Pheidole*), ants of the sterile caste were found in the same traps, probably due to the location of the traps near the floor and the attraction of dead insects present in the collection trays.

The main genera found in the light traps were *Hypoponera* Santschi, 1938 and the above-mentioned *Pheidole* and *Lasius*; much more sporadically they included *Messor* Forel, 1890, *Cremastogaster* Lund, 1831, the above-mentioned *Solenopsis*, *Tetramorium* and *Linepithema*, as well as *Myrmica* Latreille, 1804, *Aphaenogaster* Mayr, 1853 and *Camponotus* Mayr, 1861 (Table 1).

Genus *Hypoponera* (subfamily Ponerinae) - Two species were found: *punctatissima* (Roger, 1859), sometimes very abundant, and *eduardi* (Forel, 1894), extremely sporadic.

Table 1 – Subfamilies, genera and species of ants (Hymenoptera Formicidae) collected using light traps in the food factory at Cisterna (Italy: Lazio, province of Latina) in the two-year period 2007-2008, with the total number of specimens (males, females, workers).

FORMICIDAE				
Subfamily, genus, species	males	females	workers	Total number
PONERINAE				
Hypoponera eduardi (Forel)	1	-	-	1
Hypoponera punctatissima (Roger)	-	763	-	763
MYRMICINAE				
Myrmica ?scabrinodis Nylander	-	1	-	1
Aphaenogaster sp.	1	-	-	1
Messor sp.	4	-	-	4
Pheidole pallidula (Nylander)	89	15	90*	194
Cremastogaster scutellaris (Olivier)	2	-	-	-
Solenopsis fugax (Latreille)	1	-	-	1
Tetramorium sp.	1	-	-	1
DOLICHODERINAE				
Linepithema humile (Mayr)	-	-	3	3
FORMICINAE				
Camponotus sp.	1	-	-	1
Lasius spp.	93	-	-	93
				1063

* 85 workers + 5 soldiers.

H. punctatissima is a widely distributed species, widespread in Europe and recorded for northern Italy; it is also present in the Afrotropical region and southern Asia. The male is apterous. It is generally considered to be rare, but locally abundant. Its bio-ecology is little known (BERNARD, 1968; BARONI URBANI, 1971; KUTTER, 1977; POLDI *et al*., 1994). In the food factory at Cisterna the presence of this ant was observed as of 1994. The specimens collected in light traps included only winged females, sometimes in large numbers (211 females in a single trap in the third week of March 2007). Very many individuals were found on the premises in the 'finished products' area, more specifically in the 'sauce preparation' area. 2007-2008 catches were distributed across all the months, with peaks in spring and summer (two peaks in 2007, one peak in 2008); this species comes first, as regards abundance, before *Pheidole* and *Lasius*, in the samplings made using light traps (Table 1; Fig. I). Observations indicating contamination of food, or other kinds of damage, are not available. *H. eduardi* is a species widely distributed in the Mediterranean area and reported for northern and central-southern Italy (BERNARD, 1968; BARONI URBANI, 1971; POLDI *et al*., 1994); in the two-year period only one specimen was caught in a light trap (winged male, September 2007) (Table 1). Though no workers were found and no observation of damage made, the non-occasional presence of ponerine ants in a food factory is certainly worthy of note, because, as reported by Smith, similar observations never seem to have been recorded anywhere in the world: "species of this subfamily [Ponerinae] are not known to be associated with the food industry" (SMITH, 1991).

Genus *Messor* (Myrmicinae) – The species of this genus, which is widely distributed, are granivorous and nest in the ground (BERNARD, 1968); *Messor* spp. are also known as 'harvester ants'. Some *Messor* species belong to the Italian fauna, occurring mostly in central and southern regions (POLDI *et al*., 1994). In the food factory here studied, a very few males were collected in light traps (Table 1), and other males were found during inspections on the premises. The species of this genus are not attracted by foodstuffs and therefore their presence in the plant can be considered as fortuitous.

Genus *Pheidole* (Myrmicinae) - The distribution of this genus is mostly tropical and sub-tropical. The species collected was the well-known *P. pallidula* (Nylander, 1848), occurring not infrequently in food factories. This species, indigenous in Italy including the major islands, is widespread in the Mediterranean region and central Asia. Nests are located in the ground and preferably in shallow, acidic and dry soils. It is omnivorous (BERNARD, 1968; POLDI *et al*., 1994). At Cisterna, light traps caught both specimens of the reproductive caste (mostly males, sometimes in fairly large numbers: 56 males and 6 females in the third week of July 2008) and specimens of the sterile caste (maximum 10 workers in the third week of May 2007; rarely even soldiers) (Table 1); specimens of the reproductive caste were collected from April to November. Workers were also collected during inspections of the plant. This species comes second, as regards abundance, after *H. punctatissima* and before *Lasius* spp. in the samplings carried out using light traps during the biennium (Table 1; Fig. I).

Genus *Cremastogaster* (= *Crematogaster*) (Myrmicinae) - The species collected was *C. scutellaris* (Olivier, 1791), widespread in Central Europe and in the Mediterranean

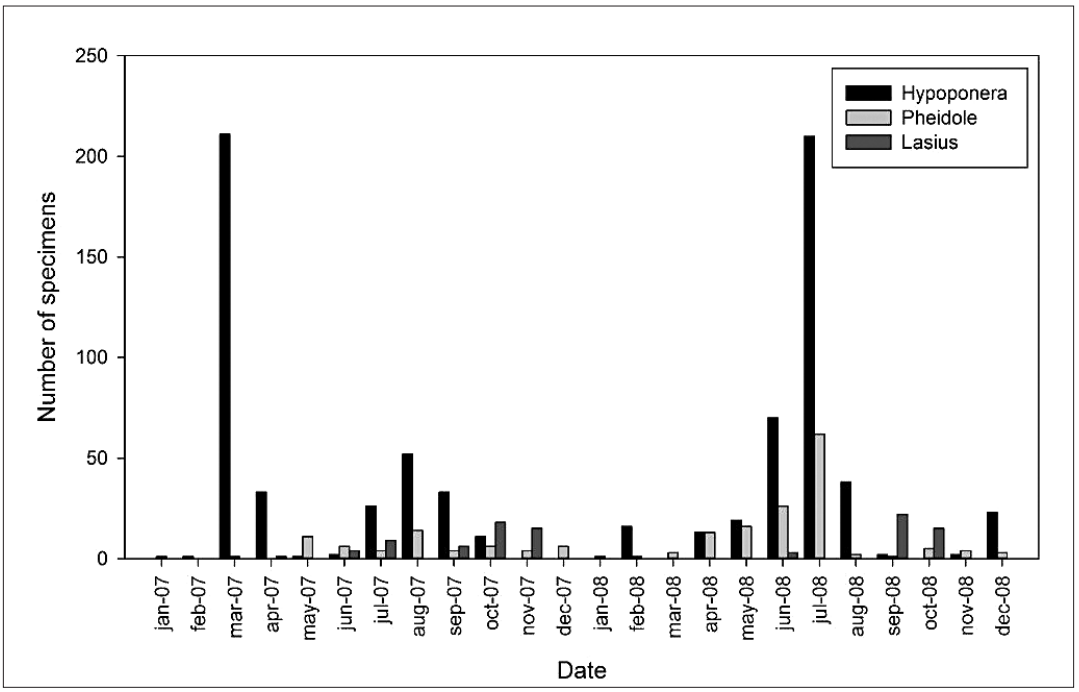

Fig. I – Specimens of *Hypoponera*, *Pheidole* e *Lasius* captured in the food factory at Cisterna (Italy: Lazio, province of Latina) in light traps in the two-year period 2007-2008. Each column corresponds to the number of specimens collected in the 15 light traps during the third week of the month in the corresponding year.

area, including Italy and the major islands (BARONI URBANI, 1971; POLDI *et al.*, 1994). This species nests mainly in tree trunks (live, decaying or dead trees) or wooden beams, sometimes in walls, even inside buildings. *C. scutellaris* is diurnal, aggressive, a predator of other arthropods (BERNARD, 1968). In food factories it is quite commonly observed, but generally it is not attracted by foodstuffs. At Cisterna, light traps caught a low number of males (Table 1).

Genus *Solenopsis* (Myrmicinae) - The genus has a cosmopolitan or sub-cosmopolitan distribution and it is present throughout Italy and the islands (BERNARD, 1968; POLDI *et al.*, 1994). Some *Solenopsis* species are of interest in the anthropic environment, invading and nesting in buildings. The species are omnivorous, sometimes with a preference for substances with high protein content (HAACK and GRANOVSKY, 1990; SMITH, 1991). In the food factory studied, a few males of *S. fugax* (Latreille, 1798) were collected by means of light traps (Table 1) and inspections.

Genus *Tetramorium* (Myrmicinae) - This genus currently has a sub-cosmopolitan distribution; some species are present in Italy, of which *T. caespitum* is also very common in the urban environment (BERNARD, 1968; HAACK and GRANOVSKY, 1990; SMITH, 1991; POLDI *et al.*, 1994; PAGANI *et al.*, 2010). At Cisterna, a single male of this genus was collected in a light trap during 2007-2008 (Table 1).

Genus *Linepithema* (= *Iridomyrmex*) (Dolichoderinae) - The collected species is the well-known *L. humile* (Mayr, 1868). Primarily Nearctic in distribution, this synanthropic species is now cosmopolitan, due to passive diffusion by man. *L. humile* is widely present in Italy and the major islands, especially along the coasts; nest location varies. This is an omnivorous ant, with a preference for sweets. It is an invasive and aggressive species, active throughout the year in conditioned (heated) environments (BERNARD, 1968; BARONI URBANI, 1971; HAACK and GRANOVSKY, 1990; BEATSON CAMPBELL, 1991; POLDI *et al.*, 1994; SÜSS and LOCATELLI, 2001; PAGANI *et al.*, 2010). In the factory studied, only workers were collected, rather rarely and not only in light traps (Table 1), but also directly during inspections, as of 1991.

Genus *Lasius* (Formicinae) – This genus, widely distributed in the northern hemisphere, also includes many species belonging to the Italian fauna (BARONI URBANI, 1971; POLDI *et al.*, 1994). Their diet consists mainly of sweets. The nests may be located near or inside buildings, in the ground, walls, etc. Sometimes the nuptial flights are impressive and the winged ants may enter buildings (BERNARD, 1968; HAACK and GRANOVSKY, 1990; SMITH, 1991; PAGANI *et al.*, 2010). A fair number of specimens were collected on the premises at Cisterna, all in light traps and all males (Table 1), belonging to at least two species of *Lasius*. As their specific identification is often difficult and rather uncertain without findings of conspecific females and workers, which are easier to identify, it seems preferable to record these species here simply as *Lasius* spp. These species come third, as regards abundance, after *H. punctatissima* and *P. pallidula*, in the samplings made using light traps during the biennium (Table 1; Fig. I).

Genera *Myrmica* and *Aphaenogaster* (Myrmicinae), genus *Camponotus* (Formicinae) - These genera are usually considered to be unrelated, or only rarely related (*Aphaenogaster*), with the food industry (SMITH, 1991). At Cisterna the presence of unidentified species in light traps (female for *Myrmica* - possibly *M. scabrinodis* Nylander, 1846 -, males for the other two genera) was extremely sporadic (single specimens during the biennium 2007-2008) and most likely accidental.

It is not possible to be sure of the causes of the trend in captures of the three most abundant species in light traps (Fig. I) during the two-year period or to establish possible correlations with the activity of the food factory or with other anthropic activity.

CONCLUSIONS

This research confirms knowledge on some genera and species which commonly occur in food factories, but has also enabled to obtain new and interesting data worthy of mention, such as the finding of the ponerine ant *H. punctatissima*. Its presence may be related both to the geographical location of the factory on the one hand and, on the other, the bio-ecology of this species, less known up to now.

It is important to point out that the presence of ants inside food factories can be due to different causes: a consequence of nest location, with incursions of workers and swarming by the reproductive caste; the attraction of internal light sources to swarming ants outside, and invasion of premises due to imperfect insulation of the indoor environment; accidental introduction of ants from the field together with foodstuffs to be processed (*e.g.* vegetables), etc. Therefore, the causes of the presence of different ants can vary depending on species and other circumstances, and deserve to be studied in depth.

Finally, it should be noted that this research is based mainly on the results of monitoring carried out using light traps. If other sampling methods (regular collecting of ants during visual inspections, use of sticky traps on the floor, etc.) had been implemented, some species, castes or sexes which were very scarce or absent in the present samplings could probably also have been found and collected in higher numbers.

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RIASSUNTO

FORMICHE E INDUSTRIE ALIMENTARI: OSSERVAZIONI IN UNO STABILIMENTO DELL'ITALIA CENTRALE

Per più anni sono stati studiati gli Imenotteri Formicidi presenti in un'industria alimentare del Lazio, situata in provincia di Latina. La ricerca, iniziata negli anni Novanta e protrattasi sino al 2013, si è basata soprattutto sull'esame delle catture effettuate negli interni con trappole luminose. Un modesto numero di esemplari è stato raccolto direttamente durante periodici sopralluoghi. Il presente lavoro

illustra le catture effettuate con trappole luminose nel biennio 2007-08. La ricerca ha permesso di accertare, accanto a generi e specie di formiche ben conosciute come tipiche infestanti di tali ambienti, anche alcune presenze più inusuali, talora occasionali e sporadiche, talora invece reperite in gran numero. Si segnala in particolare la sottofamiglia Ponerinae con la specie *Hypoponera punctatissima*: decine e talora centinaia di femmine alate di questa specie sono state raccolte con trappole luminose in singole settimane di campionamento. Seguono, per abbondanza nelle trappole, *Pheidole pallidula* (maschi, femmine, operaie, soldati) e *Lasius* spp. (maschi). Tra le altre specie rilevate vi sono *H. eduardi*, *Cremastogaster scutellaris*, *Solenopsis fugax*, *Linepithema humile*, nonché specie dei generi *Myrmica*, *Aphaenogaster*, *Messor*, *Tetramorium*, *Camponotus*. Le cause della presenza nell'industria possono essere diverse da specie a specie e meritano di essere approfondite.

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