Original Article

MOTHFLIES (DIPTERA: PSYCHODIDAE) IN HOSPITALS: A GUIDE TO THEIR IDENTIFICATION AND METHODS FOR THEIR CONTROL

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ABSTRACT

Repeated observation of "mothflies" at CHU Brugmann (Horta site hospital in Brussels) is not an isolated incident. Many public buildings have been infested by these Diptera of the Psychodidae Family. Although the species currently seen in Belgium is not a danger to human health, any infestation should be swiftly eradicated so as to limit the risks of a massive proliferation, source of hygiene problems and of potential bacterial dissemination. A good knowledge of adult and larval biology allows the potential sites of infestation to be quickly identified. The method to be envisaged to solve the problem will combine different approaches such as removing the risk factors (decomposing organic matter), monitoring egg-laying sites, applying caustic soda-based products and possibly treating with insecticide.

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INTRODUCTION

CHU Brugmann is one of the public hospitals of Brussels with 854 beds; its Horta site has a characteristic architecture in pavilions dispersed within a park. At the beginning of spring 2007, many patients noted the presence of "little worms" in a bathroom of the psychiatry department; simple hygiene measures (washing down with chlorine-based products) resolved the problem. A few weeks later "small flies" were seen on the windows in a room in another care unit some fifty metres away from the psychiatric wards. It was noted in this connection that the basement of the room had been kept abnormally damp due to a defect in the water pipes. The problem was solved by repairing the plumbing and the damage caused by the water. These larvae and flies were sent to the Functional and Evolutionary Entomology Department of the Agricultural University of Gembloux for an expert appraisal.

In addition to other better known insect pests, including cockroaches[1,2], we frequently see these strange hairy flies in sanitary installations in our houses and in any public places, which are wrongly likened to small moths. In fact, the larvae and adults of these "mothflies" are often found in places where there is a combination of organic matter and humidity, such as little-used and/or poorly cleaned shower rooms and toilets in sports centres, convalescent homes or hospitals.

Although on the old continent, these insects do not carry any known disease, when present in abundance they can sometimes exceed our hygiene tolerance limits and, in cases of a real infestation, even cause respiratory problems linked to inhaling air carrying fine particles of hair from these dead and decomposing

insects. Some past study have also shown the possibility for such flies to carry bacterial germs. Mothflies, much less known as insect pest in hospitals than cockroaches, pharaoh ants or mosquitoes, should therefore be considered as a nuisance[3]. The purpose of this article is to provide hygienists confronted with the presence of these flies with information to help confirm their identification, to provide a better understanding of their habitat and lifestyles and above all to guide them towards ways of eradicating them.

TAXONOMY AND MORPHOLOGY

The Class of Insects covers invertebrates whose body can be divided into three parts: (1) the head, which carries a pair of antennae, (2) the thorax, to which are attached three pairs of legs and two pairs of wings, and (3) the abdomen which contains most of the organs. One Order of insects is distinguished by the atrophied nature of one of the two pairs of wings: the Diptera (*di* = two; *ptera* = wings), only one of whose pairs of wings is used for flight. The term "flies" covers all insects (more than 150.000 species) belonging to the Order of Diptera.

The adult flies of the Psychodidae Family and the Psychodinae Sub-family are never more than 5 mm long (including wings) and are of a uniform colour ranging from an ivory colour to a rather dark grey[4,5] (Figure 1). In Belgium, 68 species of Psychodinae have been recorded[6] and they differ from other Diptera mainly in their shape, venation and the particular pilosity of their wings. The latter are pointed and oval in shape, generally lying flat on either side of the abdomen, and their pilosity is unique in this Order[4]. It is these characteristics that give them the name of "mothflies".

Figure 1. *Adult "mothfly" (Psychodidae – Psychodinae).*
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The apodal larvae of these flies are not hairy but have a few locomotory sensory bristles (Figure 2). They are also distinguished by the presence of a non-retractile chitinised caudal respiratory siphon[4]. The antennae protrude and ocular marks are present at the front of the head by way of eyes. The head, darker and narrower, is completely united with the thorax. In most of the species, the segments, which are non-fused, have chitinous dorsal plates.

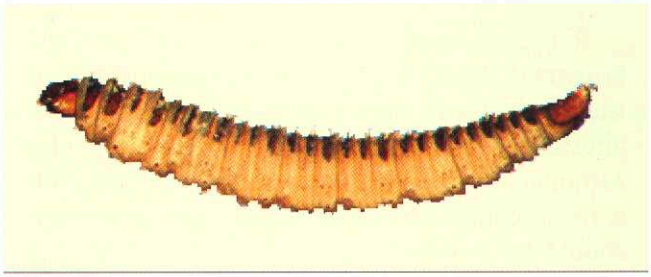

Figure 2. *"Mothfly" larva (Psychodidae – Psychodinae).*
Valley City State University (USA)

The nymphs (or pupae) are rarely seen, with the larvae generally beginning pupation in dark, damp places, such as inside waste water pipes[4]. They generally have well-developed thoracic respiratory horns. The thorax can be convex and the head is generally sunken.

HABITAT

The members of the sub-family Psychodinae or "mothflies" are generally frequent residents in our homes, and several species are considered to be domestic. The winged adults feed on liquids carrying organic particles in suspension, on sugary juices, floral nectar or even sap from wounds in trees. As is the case with drosophila, adult Psychodinae can occasionally feed on fermented matter or liquids. That is why they are often found in pipes in bathrooms, toilets, or septic tanks (Figure 3). The adults make haphazard and irregular flights over short distances and are also attracted by light.

Eggs are always laid in a wet, marshy or watery place. They are laid in clusters of several dozen held together by a glaireous substance in the apertures of waste water pipes[5]. The egg shell, normally fairly hard, is covered with a clearly visible and very irregular reticulation, sunken or convex[4]. The larvae hatch after one or two days and begin their search for food so that they can grow. They are moderately mobile and develop in very damp environments. They are coprophageous and saprophageous, i.e. they feed on both the excrement of other animals (such as man) and decomposing organic matter. Algae, fungi and bacteria also form part of the diet of Psychodinae larvae. Consequently, the insides of waste water pipes are perfect for their development.

For two weeks after they hatch, the larvae go through a succession of ecdyses during which they change their cuticle and grow in size. In the second week, the larvae pupate, a stage in their development during which they begin their metamorphosis into the adult stage. The nymph (or pupa) form is a hard and immobile form which can last two days, at the end of which the adult emerges and takes its first flight. The young adults can lay eggs during the first hours of their life, which rarely lasts more than two weeks. In all, two to four weeks are needed to complete the full development cycle, the duration of which depends on the temperature, the humidity and the amount of food available[5].

NUISANCE

"Mothflies" (Family Psychodidae, Sub-family Psychodinae) do not bite man, unlike their close cousins the Phlebotoma or "sandflies" (Family Psychodidae, Sub-family Phlebotominae) which, like mosquitoes (Diptera: Culicidae), suck the blood of numerous vertebrates. Sandflies (the vector of Leishmaniosis) however do not occur in hospitals. The Psychodinae, or mothflies, can become real nuisances when their numbers exceed the tolerance threshold. The mothflies will carry any organism contained within the gelatinous film in which they live, from bacteria or viruses to protozoan parasites. In some reported cases, they could even enhance the proliferation of other insect pests that consume their larvae, like the Roger's ants[7]. That is why in some cases substantial efforts must be made to solve the problem.

Much more familiar in our European environment, the house fly, *Musca domestica* has long been considered as a potential agent for disease transmission ever since its existence. The general truth of this assertion remains undisputed until the present day in spite of increasing awareness toward an improved sanitation and better hygiene. The habitual movement of house fly from filthy substrata such as human faeces, animal excreta, car-

Figure 3. *Risk areas which can serve as an egg-laying site for adult "mothflies".*

casses, garbage, etc. makes them ideal candidates for disease transmission such as cholera, shigellosis, salmonellosis and others when settling on food[8]. Up to now, this vector-borne transmission is considered of little importance for hospital-acquired infections in occidental industrialised countries[9]. Actually, there are very few data on the subject, and for example, looking at "Fly", "Bacteria" and "Pathogens" on Pubmed site (accessed on 6 September 2007), there were only 37 references on the subject during the last five years, and only one concerning industrialised countries[10]. Likely, the arthropod-borne transmission of classical bacteria pathogens is not sufficiently looked for in our countries.

HOW TO COMBAT THE PROBLEM ?

Although most insecticides in spray form based on pyrethrins or pyrethrinoids are effective to some extent against adults, they do not eradicate the infestation since the larvae always lurk in less accessible areas that are rich in organic matter. The key to successfully eradicating these mothflies is to find the area where the adults are laying their eggs and remove the organic matter that is present and serves to help them complete their development cycle. Getting rid of a "mothfly" infestation can therefore be a long job requiring observation, perseverance and even imagination to discover where these flies have taken up residence.

The egg-laying site is visited periodically by adults and is generally infested with larvae in different stages of development (and therefore of different sizes). One solution to confirm that a place is indeed an egg-laying site is to cover part of the pipe aperture with a piece of strong sticky tape and to come back and look at it after one night. If a winged adult is stuck there, then it is indeed an egg-laying site. It can also happen that the seal of the base of WCs can be defective in places, allowing adult flies to pass in and out. Flower pots are also an ideal place for the reproduction of adults because they are constantly damp. The same procedure can then be applied. Although some commercial products claim to be specifically designed to combat the eggs and larvae of these Diptera, applying any product based on concentrated caustic soda (NaOH) has a comparable effect, generally for a lower price. For instance, many products are available in shops initially for the purpose of unblocking pipes. The conditions for their use can be likened to those indicated for the treatment of blocked pipes. Unfortunately, if suitable hygiene conditions are not met, there is a good chance that the site that has been discovered is not the only one being used for reproduction. In addition to waste water pipes, therefore, full and/or dirty dustbins, badly cleaned sinks and shower tubs or wet mops and cloths can also be first-choice egg-laying sites for adult "mothflies". If the adults have not disappeared a week after treating the egg-laying site, it means that there is at least one more site to be discovered.

ABSTRACT

L'observation répétée de «mouches-papillons» au CHU Brugmann, site Horta, n'est pas un fait isolé. Nombreux sont les bâtiments de collectivités à être infestés par ces Diptères de la Famille des Psychodidae. Bien que les espèces actuellement observées en Belgique ne constituent pas un danger pour la santé humaine, il convient d'enrayer rapidement toute infestation afin de limiter les risques de proliférations massives sources de problèmes d'hygiène. Une bonne connaissance de la biologie larvaire permet d'identifier rapidement les sites potentiels d'infestation. Les méthodes de lutte à envisager combineront différentes approches telles la suppression des facteurs de risque (matières organiques en décomposition), la surveillance des sites de ponte, l'application de produits à base de soude et, éventuellement, la réalisation d'un traitement insecticide.

REFERENCES

1. Fotedar R, Shriniwas UB, Banerjee U, et al. Nosocomial infections: cockroaches as possible vectors of drug-resistant Klebsiella. *J Hosp Infect* 1991; 18: 155-9.
2. Van Laer F, Verdijck R, Jansens H. Ongediertebestrijding. Een ongediertebestrijdingsplan in een universitair Ziekenhuis. *Tijdschrift voor Hygiëne en Infectiepreventie* 2001; 2: 38-40.
3. Gliniewicz A, Sawicka B, Mikulak E. Pest control and pesticide use in hospitals in Poland *Indoor Built Environ* 2006; 15: 57-61.
4. Séguy E. Diptères (Nématocères piqueurs): Ptychopteridae, Orphnephilidae, Simuliidae, Culicidae, Psychodidae, Phlebotominae. *Faune de France* 1925, 109p.
5. Arnett RH. American Insects: A Handbook of the Insects of America North of Mexico. *CRC Press*, Boca Raton, Florida 2000, 1003p.
6. Grootaert P, De Bruyn L, De Meyer M. Catalogue of the Diptera of Belgium. *Working Document of the I.R.S.N.B.* 1991, 338p.
7. Gray KJ, Porter C, Hawkey PM, Compton SG, Edwards JP. Roger's ants: a new pest in hospitals. *BMJ* 1995; 311: 129.
8. Nazni WA, Seleena B, Lee HL, Jeffrey J, Rogayah TAR, Sofian MA. Bacteria fauna from the house fly, *Musca domestica*. *Trop Biomed* 2005; 22(2):225-31

9. Archibald LK, Hierholzer WJ. Principles of infectious diseases epidemiology. Definition of Transmission. In : *Hospital Epidemiology and Infection Control, 3rd edition* (Editor : C. Glen Mayhall), 2004: 5.
10. De Jesus AJ, Olsen AR, Bryce JR, Whiting RC. Quantitative contamination and transfer of Escherichia coli from foods by houseflies, *Musca domestica* L. (Diptera: Muscidae). *Int J Food Microbiol* 2004; 93(2): 259-62.