*Article*

# First record of *Megaselia scalaris* (Loew) (Diptera: Phoridae) infesting laboratory stocks of mantids (*Parastagmatoptera tessellata,* Saussure)

N. Mongiardino Koch, P. Fontanarrosa, J. Padró, I. M. Soto

Instituto de Ecología, Genética y Evolución de Buenos Aires (IEGEBA – CONICET), Departamento de Ecología, Genética y Evolución. Facultad de Ciencias Exactas y Naturales. Universidad de Buenos Aires. Ciudad Universitaria, Pabellón II (C1428 EHA), Buenos Aires, Argentina

E-mail: soto@ege.fcen.uba.ar

*Received 16 November 2012; Accepted 18 December 2012; Published online 1 March 2013*

IAEES

**Abstract**

We report the first record of *Megaselia scalaris* (Loew) infesting laboratory stocks of the praying mantis (*Parastagmatoptera tessellata,* Saussure). *M. scalaris,* the scuttle fly, is a cosmopolitan species with a broad niche as it performs as detritivore, facultative parasite, and parasitoid. *M. scalaris* larvae were found feeding inside adult mantids and, when development was completed, pupae were found inside the abdominal cavity and around the body. We discuss the presence of colonies of crickets bred as prey for the mantids as a facilitator of *M. scalaris* infestation.

**Keywords** scuttle fly; mantid; opportunistic parasitoid; cricket; laboratory rearing.

## 1 Introduction

The genus *Megaselia* includes around 1,400 species of flies distributed in tropical and subtropical areas. *Megaselia scalaris* (Loew) is a cosmopolitan, human-associated scuttle fly with broad feeding and ecological habits (Borgmeier, 1968). It can be found in every biogeographic region, utilizing habitats as diverse as tropical rainforests and urban buildings (Disney, 2008). The larvae of *M. scalaris* have been described as detritivore, parasite, facultative parasite, and parasitoid, consuming a wider spectrum of organic materials of both animal and plant origin than any other insect (Tumrasvin et al, 1997; Koller et al, 2003; Disney, 2008). As an adult, *M. scalaris* has been reported as a polyphagous organism, generally acting as saprophagous, sarcophagous or necrophagous (Costa et al, 2007). Therefore, it is not surprising that this species is easily maintained in laboratory conditions.

The parasitoid behaviour of the larvae of *M. scalaris* is most likely triggered by overcrowded conditions. Field reports have demonstrated the ability of this fly to feed on a wide range of living arthropods, including members of the following orders: Orthoptera (de Gregorio and Leonide, 1980), Diptera (Batista-Da-Silva, 2012), Lepidoptera (Ulloa and Hernandez 1981; Robinson, 1971), Coleoptera (Harrison and Gardner 1991; Arrendo-Bernal and Trujillo-Arriaga, 1994), Himenoptera (Zanon, 1991) Ixodida (Andreotti et al, 2003) and Araneae (Disney, 1994), some of which are of agronomic importance. Its extraordinary ecological plasticity has also led to the establishment of *M. scalaris* as a laboratory pest, having been reported to infest laboratory cultures of invertebrates such as cockroaches (Robinson, 1975; Miller, 1979), flies (Zwart et al, 2005) and triatomines (Costa et al, 2007).

Given the necrophagous and synanthropic habits of *M. scalaris,* the species is of profound value in the field of forensic entomology, sometimes providing an estimate of the post-mortem interval (Miller et al, 1994). Gravid females are among the first wave of insects visiting corpses indoors (Oliva, 2004), and as first colonizers may have a deep impact on the carrion-breeding Diptera community (Kneidel, 1983).

Cases of parasitism have also been frequently reported, including attacks on both plant and animal organisms. Among the first are cases of infestation of corn fields (Walter and Wene, 1951), seed deposits (Disney, 1994) and bananas (Karunaweera et al, 2002). On the other hand, cases of myiasis appear frequently in bibliography, including the infestation of a viper (*Crotalus durissus terrificus*) in Brazil (Silva et al, 1999), and several reports of human infestation from around the globe (see references in Disney, 2008). Some of these cases were of nosocomial etiology, and all of them were interpreted as facultative or accidental infestations.

We present here the first report of *M. scalaris* infesting laboratory stocks of *Parastagmatoptera tessellata* (Saussure and Zehntner, 1894), a common neotropical mantid from Argentina. The fly invaded meshed plastic containers where adult individuals of *P. tessellata* were being reared under controlled laboratory conditions. Mantids were found dead with larvae residing within their abdomen, feeding on their internal organs. Carcasses were kept, and the flies emerging from them were identified as *M. scalaris* according to Disney (1994). Kept in the same rearing chamber were stocks of several drosofilid species and of the cricket *Acheta domesticus* (Linnaeus, 1758), used as food source for the mantids.

## 2 Material and Methods

Oothecae of *Parastagmatoptera tessellate* were collected from parks and from the Buenos Aires University campus in the city of Buenos Aires and placed in the rearing chamber of the Department of Genetics, Ecology and Evolution (Faculty of Exact and Natural Sciences, Buenos Aires University). Temperature, humidity and photoperiod in the rearing chamber were continuously controlled (25 ± 2 °C, 50 – 75 % relative humidity and 12:12 light/dark hours respectively).

After 4 weeks mantids emerged from their oothecae and each individual was housed in individual plastic enclosures of 450 ml. Containers were equipped with two wooden sticks for perching. The floor of these containers was replaced with a mesh that allowed ventilation and avoided the accumulation of feces. Nymphs were fed with *Drosophila* and the last nymphal stage and adults had access to 2-3 small crickets (*Acheta domesticus*) three times a week. Access to water was *ad libitum* through moist cotton embedded with sterilized water.

## 3 Results and Discussion

A few weeks after eclosion, mantids were found excessively motionless, lacking appetite and with abnormal liquid defecation. In the subsequent days five adults were found dead.

Two specimens were dissected and internally observed using a stereoscopic microscope. We were able to confirm the presence of larvae of *M. scalaris* feeding inside *P. tessellata* adults (Fig. 1). This fly occurs naturally in Buenos Aires. The ante-mortem symptomatology observed on the mantids and the relatively advanced developmental stage of the larvae (registered a single day after death) suggested that the infection took place while the mantids were still alive. The individuals had their internal organs consumed or destroyed, and in one of them not only the abdomen but also the thorax was compromised (Fig. 2).

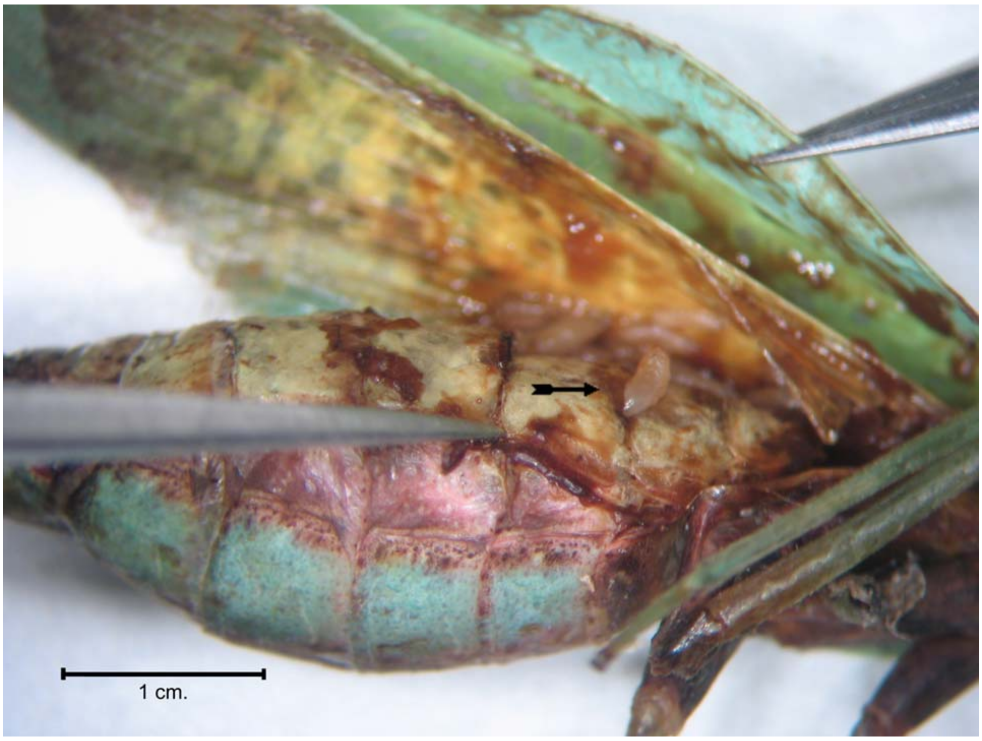


**Fig. 1** *P. tessellata* specimen with several *M. scalaris* larvae emerging from the abdomen.


**Fig. 2** Thoracic opening in *P. tessellate* specimen (arrow) made by *M. scalaris* larvae (a). Detail of the cavity showing the larvae (arrows) allocated inside the mantid feeding on the internal organs (b).

Three dead specimens were isolated in plastic containers in order to allow the complete development of *M. scalaris* larvae. Five days later adult flies began to emerge, and were daily collected and sexed under light $CO_2$ anesthesia. After 4 days no new adults were collected. The final count was 28, 30 and 36 adults of *M. scalaris* from each dead mantid (45 males and 49 females). We ignore if these were the progeny of solitary females, although reported fecundities give numbers up to 100 eggs per female fly under optimal nutritional conditions (Disney, 2008). Pupae were found inside the abdominal cavity as well as in the exterior, attached to the mantid abdomen.

It has been argued that overcrowding of insect stocks may induce facultative parasitoidism by *M. scalaris* (Disney, 2008). Despite the fact that mantids were kept in individual containers, the crickets used as live prey were being bred at high densities in the same room. We cannot rule out the possibility that *M. scalaris* individuals were originally attracted by the high density colonies of crickets, with the bug's food and excrements serving as bait, and afterwards, opportunistically locating already dying mantids (e.g. previously affected by a bacterial infection). Coincidently, larvae of *M. scalaris* were also found in the cricket tanks, feeding on the food (pet rabbit food). Furthermore, events of *M. scalaris* parasiting crickets have already been reported in the literature (de Gregorio and Leonide, 1980). As noted by Disney (2008), *M. scalaris* is capable of finding moribund insects in the laboratory, easily infesting unsupervised cultures. Some statements in the literature point to the fact that these species facultative parasitoid behaviour could rather be underestimations of this ability (Disney, 1983).

*M. scalaris* is known for overpassing double layers of organdy cloth or fine meshes with their ovipositors leading to larvae invading insect containers (Garris, 1983; Costa et al, 2007). This could be the case for the mantid infestation, as no scuttle fly adults were observed inside the containers. Occasional infestations of *Drosophila* stocks by *M. scalaris* had already been observed, with several lines being displaced by the invading scuttle flies. In those cases the scuttle flies made their way through the cotton caps and further contaminations were avoided with tighter plugs with more cotton (Soto, personal observation). However, this further attests for the highly opportunistic behavior and invading capabilities of *M. scalaris*.

Since *M. scalaris*' life cycle requires considerable levels of moisture to allow larval development (Trumple and Pienkowsky, 1979) we suggest drier rearing conditions and a thorough control of water availability in order to prevent infestations.

Maintaining the cricket colonies under low population densities and augmenting the frequency of container cleaning may also help to minimize the risk of infestation, as they might function as the main lure for the adults *M. scalaris*. These measures were taken into account and no further infestations were observed in the months that followed.

**Acknowledgments**

The authors wish to thank L Patitucci for species confirmation. This work was supported by grants from ANPCyT and Universidad de Buenos Aires. P Fontanarrosa and N Mongiardino Koch are student fellows of Universidad de Buenos Aires. J Padró is a posgraduate fellow of CONICET. IMS is a member of Carrera del Investigador Científico (CONICET). The authors have no conflict of interests to declare.

## References


Andreotti R, Koller WW, Tadei WJ, et al. 2003. Ocurrence of the *Megaselia scalaris* (Loew, 1866) (Diptera, Phoridae) as a parasitoid of *Boophilus microplus* in Campo Grande, MS, Brazil. Revista Brasileira de Parasitologia, 12: 46-47

Arredondo-Bernal HC, Trujillo-Arriaga J. 1994. Primer report de *Megaselia scalaris* (Diptera: Phoridae) como parasitoide de *Macrodactylus murinus* (Coleoptera: Scarabaeidae). Vedalia, 1: 27

Batista-Da-Silva JA . 2012. Phoretic association and facultative parasitoidism between *Megaselia scalaris* and blowflies, Under Natural Conditions. OnLine Journal of Biological Sciences, 12(1): 34-37

Borgmeier TA. 1968. A Catalogue of the Phoridae of the World (Diptera, Phoridae). Studia Entomologica, 11: 1-367

Costa J, Almeida CE, Esperança GM, et al. 2007. First record of *Megaselia scalaris* (Loew) (Diptera: Phoridae) infesting laboratory colonies of *Triatoma brasiliensis* Neiva (Hemiptera: Reduviidae). Neotropical Entomology, 36: 987-989

de Gregorio R, Leonide JC. 1980. Un nouveau cas de phoride parasite d'Orthopteres adultes (Dipt.). Bulletin de la Société entomologique de France, 85:103-105

Disney RHL. 1983. Scuttle flies Diptera, Phoridae (except *Megaselia*). Handbooks for the Identification of British Insects, 10(6): 1-81

Disney RHL. 1994. Scuttle Flies: The Phoridae. Chapman & Hall, London, UK

Disney RHL. 2008. Natural history of the scuttle fly, *Megaselia scalaris*. Annual Review of Entomology, 53: 39-60

Garris GI. 1983. *Megaselia scalaris* (Diptera: Phoridae) infesting laboratory tick colonies. Journal of Medical Entomology, 20: 688

Harrison RD, Gardner WA. 1991. Parasitism of the pecan weevil (Coleoptera: Curculionidae) by *Megaselia scalaris* (Diptera: Phoridae). Journal of Entomological Science, 26: 301-302

Karunaweera ND, Ihalamulla RL, Kumarasinghe SP. 2002. *Megaselia scalaris* (Diptera: Phoridae) can live on ripe bananas—a potential health hazard? Ceylon Medical Journal, 47: 9-10

Kneidel KA. 1985. Patchiness, aggregation, and the coexistence of competitors for ephemeral resources. Ecological Entomology, 10: 441-448

Koller WW, Andreotti R, Zanon AM, et al. 2003. Mosca *Megaselia scalaris* (Loew) (Diptera: Phoridae), parasita do carrapato bovino *Boophilus microplus* (Canestrini): Uma revisão. Campo Grande, Embrapa Gado de Corte (Embrapa Gado de Corte. Documentos, 142)

Miller PL. 1979. Intraspecific phorid phoresy. Entomologist's Monthly Magazine, 114: 211-214

Miller ML, Lord WD, Goff ML, et al. 1994. Isolation of amitryptilline and nortryptilline from fl y puparia (Phoridae) and beetle exuviae (Dermestidae) associated with mummified remains. Journal of Forensic Science 39: 1305-1313

Oliva A. 2004. Insects of forensic interest in Buenos Aires (Argentina), addenda et corrigenda, 1. Phoridae (Diptera: Brachycera). Physis (Buenos Aires) Secc. C, 60: 43-50

Robinson WH. 1971. Old and new biologies of *Megaselia* (M.) *scalaris* (Diptera, Phoridae). Studia Entomologica, 14: 321-348

Robinson WH, 1975. *Megaselia scalaris* (Diptera: Phoridae) associated with laboratory cockroach colonies. Proceedings of the Entomological Society of Washington, 77: 384-390

Silva RJ, Prado AP, Rodrigues RR, et al. 1999. *Megaselia scalaris* (Diptera: Phoridae) causing myiasis in

*Crotalus durissus terrifi cus* (Serpentes: Viperidae) in Brazil. Journal of Medical Entomology, 36: 630

Trumple J, Pienkowsky RL. 1979. Developmental and survival of *Megaselia scalaris* (Diptera: Phoridae) at selected temperatures and photoperiods. Proceedings of the Entomological Society of Washington, 81: 207-210

Tumrasvin W, Sucharit S, Vutikes S. 1997. Studies on the life history of *Megaselia scalaris* (Loew) in Thailand. Southeast Asian Journal of Tropical Medicine and Public Health, 8: 74-76

Ulloa P, Hernandez M. 1981. Biología y control natural de *Peridroma saucia*, plaga de la flor de la curuba. Revista Colombiana de Entomología, 7: 47-53

Walter EV, Wene GP. 1951. Tests of insecticides to control larvae of *Euxesta stigmatias* and *Megaselia scalaris*. Journal of Economic Entomology, 44: 998-999

Zanon AM. 1991. Efeitos genéticos na variabilidade e fertilidade de *Megaselia scalaris* (Diptera, Phoridae), e sua influência em colônias de *Apis mellifera*. PhD Thesis, Instituto de Biociências, UNESP, Rio Claro, SP, Brazil

Zwart P, Disney RHL, de Batist P, et al. 2005. The phorid “scuttle fly” (*Megaselia scalaris*): a threat to zoological collections and especially to amphibians? British Veterinary Zoological Society, 5: 27-30