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Research Article

Invasive Eucalyptus gall wasp *Ophelimus maskelli* (Hym., Eulophidae): A new challenging pest in Iran

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Abstract. The Eucalyptus gall wasp, *Ophelimus maskelli* (Ashmead, 1900) (Hym., Eulophidae) was observed for the first time on leaves of *Eucalyptus camaldulensis* in Iran. Some morphological characters of adult are included. The gall forms are compared with galls of another gall wasp, *Leptocybe invasa* Fisher & LaSalle, 2004, in the Fars region. The economic importance of this pest lies in its widespread ability to form galls, which affect leaf development, reduce vitality, and can cause significant losses in plantation value.

Keywords: Invasive species, Emerging pest, wasp, Gall, *Ophelimus*

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Introduction

One of the most important forest trees that has an unparalleled reputation in the plant world is eucalyptus, which is planted on a large scale around the world and forms dense forest stands (Haj Agha Mohammadi, 2003). The history of eucalyptus cultivation and its identification in different countries of the world and its forestry in southern Europe and North Africa began about two centuries ago. The ease of cultivation, coupled with its rapid growth rate and other advantages, caused it to spread rapidly to different parts of the world and be cultivated in many countries (Ball, 1995). Eucalyptus trees were introduced to Iran about 100 years ago and were planted in the southern plains of the country, where the environment was suitable for them, and now old trees can be seen in Fars (Haj Agha Mohammadi, 2003). *Eucalyptus camaldulensis* Dehnh.,1832 is one of the most productive and best adapted species in afforestation. This is a fast-growing species with high tolerance to harsh environmental conditions, so this species planted in many parts of Iran (Hosseinzadeh *et al*., 2000). *Eucalyptus* is a widely used tree species worldwide, outside its native land, and this has led to the rapid appearance of pest species in many countries. Eucalyptus trees in new habitats have been under constant assault by a stream of host specific phytophagous insect pests that originated in the trees' homeland (Withers, 2001).

Six major eucalyptus pests have invaded the Mediterranean region and southern Europe and other areas where eucalyptus is cultivated, including the eucalypt borer, *Phoracantha semipunctata* (Fabricius, 1775) and *Phoracantha recurva* Newman, 1842 (Coleoptera: Cerambycidae), the psyllid *Ctenarytaina eucalypti* (Maskell, 1890) (Hemiptera: Spondyliaspinidae), *Gonipterus scutellatus* Gyllenhal, 1833 (Colepotera: Curculionidae), and two gall wasps, *Leptocybe invasa* Fisher & LaSalle, 2004 and *Ophelimus maskelli* (Ashmead, 1900) (Eulophidae) (Protasov *et al*., 2007). In general, gall makers compete with plant organs for nutrients, and often destroy the galling tissues of their host (Stone & Schonrogge, 2003). Heavy galling resulted in pre-mature shedding of the leaves. Leaf senescence and abscission occur when heavy galling affects 4- month-old leaves, whereas the average survival of healthy leaves was 9 – 11 months. Heavily damaged trees are revealed by the desiccation of large parts of their crowns (Protasov *et al*., 2007). Eucalyptus gall wasp *L. invasa* was determined for the first time in the year 2000 in Mediterranean region (Mendel *et al*., 2004) and also from Iran (Hesami *et al*., 2005). In Iran, eucalyptus plantations faced heavy infestation by *L. invasa*, especially in eucalyptus nurseries. This insect lays eggs inside the tissue of leaves, petioles and stems of young eucalyptus trees, and in severe infestations, all leaves and branches of infected seedlings are deformed (Barimani Varandi & Babaei, 2017). Recently, another form of galls on eucalyptus trees was encountered in the green spaces of Shiraz, which is different from *Leptocybe invasa* Fisher & LaSalle, 2004. The aim of this work is to present the first record of *Ophelimus maskelli* (Ashmead, 1900) from Iran.

Materials and methods

Small branches whose leaves bore mature galls were taken from *E. camaldulensis* in different parts of green spaces of Shiraz, Fars province of Iran. Some Eucalyptus leaves were observed to be abnormally swollen and deformed in the midrib and petiole area, thus indicating the presence of *L. invasa* (Mendel *et al.*, 2004). Furthermore, the leaf lamina of various leaves was filled with galls indicating the presence of another species. Collection methods followed Protasov *et al.* (2007); infested leaves were cut and stored dry in sealed polyethylene bags. Reared Chalcidoidea specimens were stored in 70% ethanol for further identification under a stereomicroscope. Species identification was performed using the identification keys and species descriptions of Mendel *et al.* (2004), Protasov *et al.* (2007), Doğanlar & Mendel (2007) and Borowiec *et al.* (2019). Terminology of morphological characters follows Gibson *et al.* (1997). Collected specimens will be deposited in the Department of Entomology, Faculty of Agriculture, Islamic Azad University of Shiraz.

Results

Specimens have been reared, collected and identified as *Ophelimus maskelli* (Ashmead, 1900), a new record for the country of Iran.

Identification Key to Gall Wasps Associated with Eucalyptus in Iran

(1) Galls occurring only on leaf blades, appearing as numerous small, discrete, blister-like swellings on both adaxial and abaxial leaf surfaces; galls not involving petioles or midribs; leaves often show a speckled or pimply appearance; adult females very small (≈1.0 mm), uniformly dark brown to black; antennae with short funicle segments ……..……. *Ophelimus maskelli* (Ashmead)

(1') Galls occurring on multiple plant parts, including leaf midribs, petioles, young stems, and shoots; galls larger, swollen, pea-shaped or elongated, often causing leaf deformation, curling, or stunting of shoots; adult females larger (≈1.2–1.4 mm), brown to metallic green; antennae with elongated funicle segments ……. *Leptocybe invasa* Fisher & La Salle

Ophelimus maskelli (Ashmead, 1900) (Eulophidae: Opheliminae)

Material examined

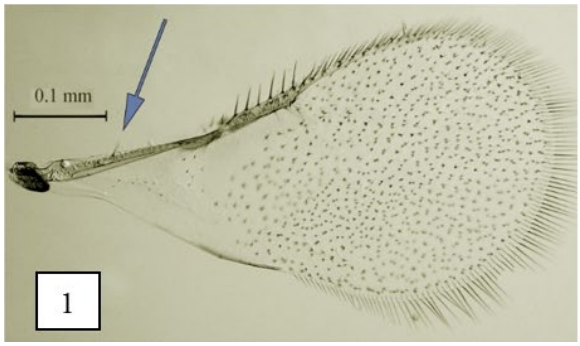
Iran: Shiraz, numerous females which emerged between the 5-28.iv.2024 from galls on *Eucalyptus camaldulensis*.

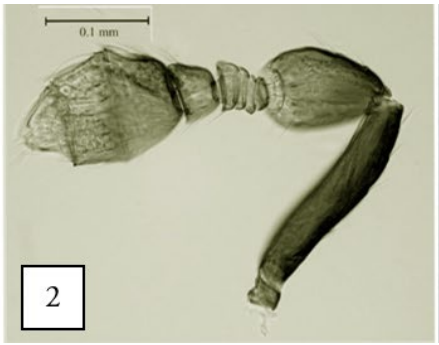
Diagnosis

Black, shining, antennae light brown, body length range from 0.70 to 1.0 mm, On the fore wings the submarginal vein and the marginal vein are completely fused, the postmarginal vein is at least 3-4 times longer than the stigmal vein, one submarginal seta on fore wing, mesoscutum about 1.3x mesoscutellum length, mesoscutum midlobe and mesoscutellum with only two pairs of small setae, antenna with four anelli and only a single funicular, the combined length of the anelli and funicle being less than the length of the club (Figs. 1-3).

Distribuiton

Algeria, Argentina, Australia, California, Chile, England, France, Greece, Indonesia, Iraq, Israel, Italy, Malta, New South Wales, New Zealand, Portugal, Sardegna, Sicily, South Africa, Spain, Syria, Tunisia, Turkey, Vietnam (Malumphy, 2018; UCD Community, 2023).





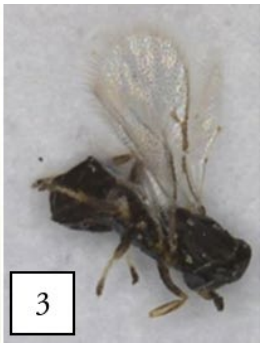


Fig. 1-3. *Ophelimus maskelli* (1), fore wing. Arrow indicates submarginal seta (2), antenna (3) Habitus

Notes

This insect species also known as Leaf Blade Gall Wasp (Aytar, 2012). *Ophelimus maskelli* is native to Australia but has spread and established various parts of world. It forms typical round flat button-shaped galls mainly on young leaves. The galls are transitioning from green to reddish as they mature and visible on both sides of the leaves. Under heavy infestation, the entire surface becomes densely covered with galls (Figs. 4 & 5). *O. maskelli* reproduces through thelytokous parthenogenesis, with females laying eggs without the need for males (Protosov *et al.*, 2007). A study conducted in Israel determined that females lay an average of 109 eggs. It was observed that females prefer the lower parts of the crown to lay eggs. It was observed that the galls become more prominent and reach their typical coloration during the third larval instar. Counts of 88 infested leaves revealed an average of 133.5 galls per leaf, with the highest density around the leaf midrib. A strong correlation was found between the number of galls per leaf and gall diameter, with gall diameters increasing as the number of galls decreases. The species has been found to have three generations: spring, summer, and autumn-winter (Protosov *et al.*, 2007). Also, *Leptocybe invasa* Fisher & LaSalle is another gall wasp of Eucalyptus of Australian origin. The galls of these two species are completely different. *Leptocybe invasa* forms typical bump-shaped galls on the leaf midribs, petioles and stems of new growth of several Eucalyptus species. Developmental stages of the wasp proceed into the gall of a mean length of about 2 mm. Intense infestations by *L. invasa* can lead to deformations of the leaves and young stems (Figs. 6 & 7).

Discussion

The genus *Ophelimus* Haliday, native of Australia, comprises approximately 55 species (UCD Community, 2023) of gall-inducing wasps. To date, four *Ophelimus* species are known to occur outside Australia attacking eucalypts. *Ophelimus eucalypti* was detected in New Zealand attacking *E. globulus* (Withers *et al.,* 2000), *O. maskelli*, is widely distributed in North America, the Mediterranean basin, and now in the Middle east attacking *E. camaldulensis* and *E. tereticornis* (Burks *et al.*, 2015a, b; Protasov *et al.*, 2007); *O. mediterraneus* occurring in France, Italy and Portugal attacking *E. globulus, E. cinerea, E. gunni* and *E. parvula* (Borowiec *et al.*, 2019) and *O. migdanorum* attacking *E. globulus* in Chile (MolinaMercader *et al.*, 2019).

Gall-inducing wasps have emerged as some of the most damaging invasive pests of *Eucalyptus* worldwide, with *Ophelimus maskelli* and *Leptocybe invasa* representing two of the most widespread and economically important species (Mendel *et al.*, 2004; Withers *et al.*, 2000). Although both species belong to the family Eulophidae and share similar reproductive strategies, including predominant thelytokous parthenogenesis, their infestation patterns, gall morphology, and impacts on host plants differ markedly, resulting in distinct ecological and management implications (Mendel *et al.*, 2004; Protasov *et al.*, 2007).

Leptocybe invasa is widely recognized as the more destructive of the two species. Its capacity to induce galls on multiple tissues—such as leaf midribs, petioles, and young shoots—directly disrupts vascular function and apical growth (Mendel *et al.*, 2004; Boavida *et al.*, 2016). Severe infestations frequently cause leaf deformation, shoot dieback, stunted growth, and, in extreme cases, mortality of seedlings and young trees, particularly in nurseries and recently established plantations (Dittrich-Schröder *et al.*, 2014).

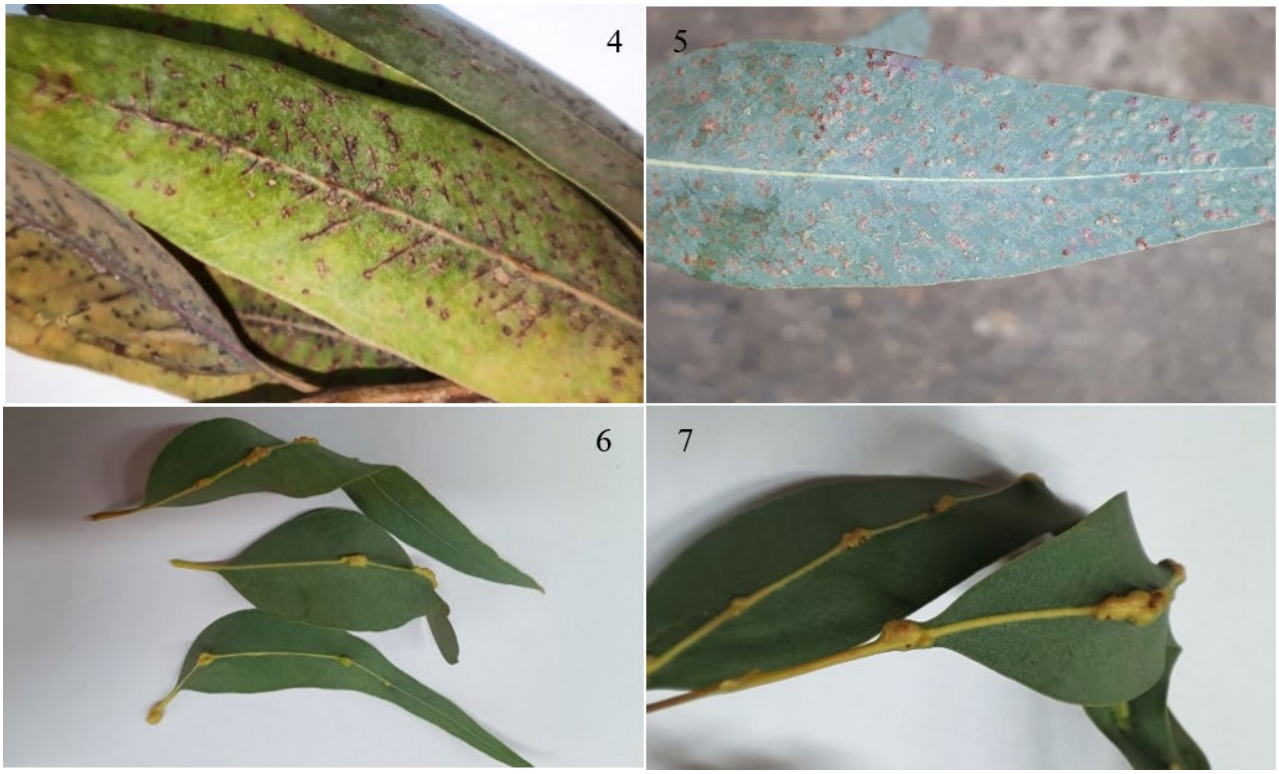


Fig. 4-7. Galls of *O. maskelli* (4 and 5) in comparison with the galls of *L. invasa* (6 and 7)

The susceptibility of fast-growing *Eucalyptus* clones further exacerbates the economic impact of this pest, making *L. invasa* a major constraint on commercial forestry in invaded regions. In contrast, *Ophelimus maskelli* induces galls that are restricted to the leaf blade, forming numerous small, blister-like swellings that may cover large portions of the leaf surface (Protasov *et al.*, 2007). Although infestations can reach very high densities, the damage caused by *O. maskelli* is generally less severe at the whole-tree level when compared to *L. invasa* (Aquino *et al.*, 2011). The principal effect of *O. maskelli* infestations is a reduction in photosynthetic capacity due to extensive galling, often leading to premature leaf senescence and partial defoliation (Withers *et al.*, 2000). Nevertheless, repeated or chronic infestations may result in growth reduction and increased vulnerability to abiotic stress, especially under drought-prone or nutrient-limited conditions. Both species exhibit biological traits that strongly facilitate invasion and rapid population growth. Thelytokous reproduction allows populations to establish from a single individual, greatly enhancing colonization success following accidental introductions (Mendel *et al.*, 2004; Protasov *et al.*, 2007). In addition, the lack of co-evolved natural enemies in newly invaded areas has historically permitted both species to reach outbreak levels before management interventions were implemented (Aquino *et al.*, 2011; Dittrich-Schröder *et al.*, 2014).

The frequent co-occurrence of *O. maskelli* and *L. invasa* on the same *Eucalyptus* hosts further complicates diagnosis and management. Accurate identification based on gall location and morphology is therefore essential, particularly in mixed infestations, as biological control agents are species-specific (Protasov *et al.*, 2007). Classical biological control programs have proven effective in reducing populations of both pests, notably through the introduction of *Closterocerus chamaeleon* against *O. maskelli* and *Selitrichodes neseri* against *L. invasa* (Protasov *et al.*, 2007; Dittrich-Schröder *et al.*, 2014). These successes emphasize the importance of integrating accurate taxonomy with long-term ecological monitoring. Overall, the introduction of *Ophelimus maskelli* to Iran represents a new challenge for eucalyptus plantation management. The pest's ability to form galls that reduce tree vitality underscores the need for continued monitoring and control measures. Also, the contrasting galling behaviors and damage profiles of *O. maskelli* and *L. invasa* highlight the need for species-specific risk assessment and management strategies in *Eucalyptus* plantations. Continued research integrating systematics, host-plant resistance, and biological control will be critical for sustainable management of these invasive gall wasps, particularly in the context of expanding *Eucalyptus* cultivation and changing climatic conditions (Boavida *et al.*, 2016; Withers *et al.*, 2000).

Author's Contributions

Shahram Hesami: The author confirms sole responsibility for the following: conceptualization, methodology, formal analysis, investigation, draft preparation, final review and edit, visualization, supervision, project administration and funding acquisition.

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Data Availability Statement

All data supporting the findings of this study are available within the paper. The specimens examined in this study are deposited in Entomology Museum, Department of Entomology, Shiraz campus, Islamic Azad University, Shiraz, Iran and are available by the author upon request.

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Ethics Approval and Consent to Participate

Insects were used in this study. All applicable international, national, and institutional guidelines for the care and use of animals were followed. This article does not contain any studies with human participants performed by the author.

Conflict of Interest

The author declares that there is no conflict of interest regarding the publication of this paper.

Generative AI statement

The author declares that no Gen AI was used in the creation of this manuscript.

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Research Article

زنبور گالزای اکالیپتوس *Ophelimus maskelli* (Ashmead) (Hym., Eulophidae): چالشی جدید در ایران

شهرام حسامی

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چکیده: زنبور *Ophelimus maskelli* (Ashmead, 1900) (Hym., Eulophidae) به عنوان زنبور گالزای اکالیپتوس برای اولین بار از ایران روی برگ های اکالیپتوس گونه *Eucalyptus camaldulensis* گزارش می‌شود. برخی ویژگی های ظاهری حشره کامل آورده شده و شکل گال های تشکیلی توسط آن با دیگر زنبور گالزای اکالیپتوس (*Leptocybe invasa* Fisher & LaSalle, 2004) در منطقه فارس مورد مقایسه قرار گرفته است. اهمیت اقتصادی این آفت در توانایی گسترده آن در تشکیل گال می باشد که بر رشد برگ تأثیر می‌گذارد، شادابی را کاهش می‌دهد و می‌تواند خسارات قابل توجهی به درخت وارد کند.

کلمات کلیدی: گونه مهاجم، آفت نوظهور، زنبور، گال، *Ophelimus*

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