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The first report of some Aphelinidae and Azotidae (Hymenoptera: Chalcidoidea) of Morocco

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Résumé : Six espèces sont signalées pour la première fois au Maroc, venant s'ajouter à la faune des familles Aphelinidae et Azotidae (Hymenoptra: Chalcidoidea). Ces découvertes sont le fruit de recherches menées au sein de la forêt de chêne-liège de la Maâmora et de découvertes faites lors de visites aux musées. Il s'agit pour chaque famille des espèces suivantes : ***Aphelinus abdominalis*** (Dalman, 1820), ***Encarsia berlesei*** (Howard, 1906), ***E. lutea*** (Masi, 1909), ***E. mineoi*** Viggiani, 1982, ***Eretmocerus emiratus*** Zolnerowich & Rose, 1998 et ***Ablerus perspeciosus*** Girault, 1916.
Mots clés: Chalcidoidea, Aphelinidae, Azotidae, nouvelles données, faunistique, Maâmora, Maroc.

Abstract: Six species are reported for the first time in Morocco, adding to the fauna of the families Aphelinidae and Azotidae (Hymenoptra: Chalcidoidea). (Hymenoptera: Chalcidoidea). These findings are the result of research conducted in the cork oak Maâmora forest and discoveries made during visits to museums. Each family includes the following species: ***Aphelinus abdominalis*** (Dalman, 1820), ***Encarsia berlesei*** (Howard, 1906), ***E. lutea*** (Masi, 1909), ***E. mineoi*** Viggiani, 1982, ***Eretmocerus emiratus*** Zolnerowich & Rose, 1998, and ***Ablerus perspeciosus*** Girault, 1916.
Keys Word: Chalcidoidea, Aphelinidae, Azotidae, new data, faunistic, Maâmora, Morocco.

INTRODUCTION

The Aphelinidae hymenopteran chalcids are a moderate-sized family of tiny parasitic wasps, with over 1,422 described species in some 43 genera (Noyes, 2019). These tiny insects constitute one of the most important families utilized in biological control with more than 90 successful entomophagous. Aphelinids are commonly reared from a large variety of homopteran hosts. Most are primary ectoparasites or endoparasites and sometimes obligatory or facultative hyperparasites of Sternorrhyncha Hemiptera. However, others attack eggs of these groups or of Lepidoptera, Hymenoptera, Orthoptera or immature stages of Diptera (Yasnosh, 1979; Hayat, 1998; Kim & Heraty, 2012). In Morocco, several species of this group of chalcids have been used in biological control against several pests by installing insectariums since the 1960s (Bénassy & Euverte, 1966, 1967a, 1967b, 1968). However, numerous species have been recorded in the country and others have been introduced to minimize the damage caused by the pests on citrus, olive trees and other

plants (Hanafi *et al.*, 1995; Onillon *et al.*, 2004; Hmimina, 2009; Smaili *et al.*, 2013). A list of all Aphelinidae species in the Moroccan fauna was established by Kissayi *et al.* (2017).
The Azotidae is a family comprising 93 species divided into a single genus *Ablerus* Howard, 1894 (UCD Community, 2023). The members of these tiny wasps are normally hyperparasitoids associated with Aleyrodidae and Coccoidea as well as the eggs of a variety of other insects. (Abd-Rabou, 2014; Wang *et al.*, 2016; Avendaño *et al.*, 2024). This family, unlike Aphelinidae has one species in Morocco that Ghesquière identified in 1960.
The purpose of this study is to add new data that has been recorded for the first time to the list of Moroccan Aphelinidae and Azotidae in order to update and improve it.

MATERIALS AND METHODS

Study sites

The material examined was collected from four stations selected within the world's largest cork oak Maâmora forest (**fig. 1**): Taïcha station (S1) in canton A, western Maâmora, near the Taïcha forestry post, commune Sidi Taïbi, coordinates 34°13′29.5″N 6°39′04.8″W, elevation 36 m; Al Maha station (S2) in canton D, southeastern Maâmora, commune Aïn Johra, coordinates 34°06′34.2″N 6°19′04.0″W, elevation 175 m; Aïn Assou station (S3) in canton D, northeastern Maâmora, near the Aïn Assou forestry post, commune Kceïbia, coordinates 34°12′07.9″N 6°15′10.8″W, elevation 84 m; and Bled Dandoune station (S4) in canton A, western Maâmora, commune Sidi Taïbi, coordinates 34°07′38″N 6°38′01″W, elevation 120 m.
The general climate of the Maâmora forest is thermo-Mediterranean, subhumid for stations 1 and 4, semi-arid with a temperate winter for stations 2 and 3 (Métro & Sauvage, 1955).
Geographic positions are given using coordinates in the Mercich geographic reference system.
This study was completed by a consultation of collections deposited at museums.

Data collection

The samples were collected once a week using Malaise traps (**fig. 2**) during the following periods: from 20 June 2022 to 02 September 2022 and from 05 June 2023 to 04 September 2023. After sorting, the specimens were preserved in alcohol at 70º for identification. The Aphelinidae and Azotidae species were identified under stereomicroscope.

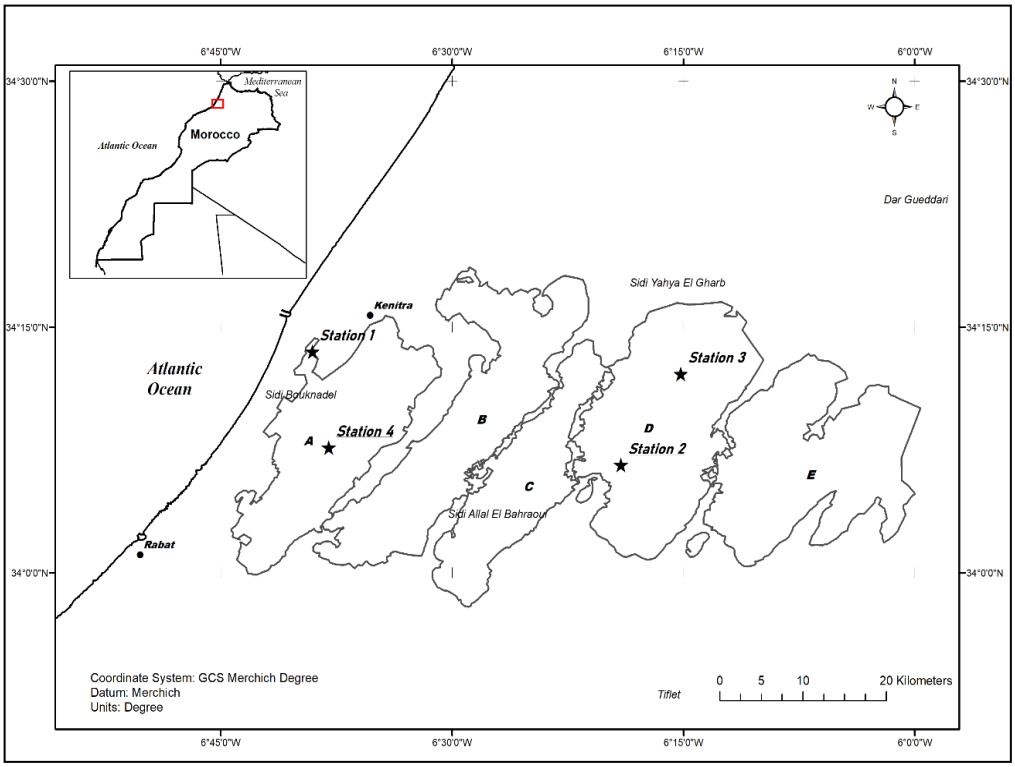

Figure 1: Location of the cork oak Maâmora forest in Morocco with its different cantons (A, B, C, D and E) and the study stations (star).

Figure 2: Malaise trap installed in Al Maha locality (station 2) in June 2022

Identifications

Classifications of generic levels were done using the terminology referred in Hayat (1983, 2008). Aphelinidae species were identified using terminology and keys identifications related to Ferrière (1965), Hayat (1998), Polaszek *et al.* (1999), Abd-Rabou (2002, 2014), Japoshvili & Hansen (2014). The confirmations of these species were done by comparison with collections samples from CIRAD (Montpellier, France) and those personal by Gérard Delvare (CIRAD, Montpellier, France).

Abbreviations used in the text

CIRAD: International Center for Research for Agronomic Development, Montpellier, France; **RBINS**: Royal Belgian Institute if Natural Sciences, Brussels, Belgium.

Results

In this paper, the list of these newly reported Moroccan chalcids is given in alphabetical order as follows: distribution preceded by region of each species in Morocco followed by that in the world and the hosts in Morocco.

The species marked with a single asterisk were found during museum visits and two newly collected.

Family Aphelinidae Thomson, 1876
Subfamily Aphelininae Thomson, 1876
Genus *Aphelinus* Dalman, 1820

1. *Aphelinus abdominalis* (Dalman, 1820)**

Examined material: ***Rabat-Salé-Kénitra:*** cork oak Maâmora forest, Sidi Taïbi commune, Bled Dandoune, 34°07′38″N 6°38′01″W, 120 m, 1 ♀, 24.vii.2023, K. Kissayi leg.

Distribution: Argentina, Australia, Austria, Belgium, Brazil, Canary Islands, Chile, China, Croatia, Cuba, Czech Republic, Denmark, Egypt, England, France, Georgia, Germany, Hungary, India, Iraq, Ireland, Italy, Japan, Kazakhstan, Nakhichevan, Netherlands, Norway, Pakistan, Poland, Portugal, Russia, Serbia, Slovakia, South Africa, Spain, Sweden, Switzerland, Transcaucasia, United Kingdom, United States, Zimbabwe and Morocco (**new record**).

Hosts. In Morocco, biology is unknown as far.

Subfamily Coccophaginae Förster, 1878
Genus *Coccophagus* Howard, 1894

2. *Encarsia berlesei* (Howard, 1906)*

Examined material: ***Rabat-Salé-Kénitra:*** Rabat, 1 ♀, 28.iii.1949, W Smirnoff leg. (RBINS) (Personal observation).

Distribution: Brazil, Caucasus, China, Colombia, Dominican Republic, Egypt, France, Germany, Greece, Hungary, Iran, Italy, Korea, Samoa, South Korea, Sri Lanka, Switzerland, Turkey, United Kingdom, United States and Morocco (**new record**).

Hosts. In Morocco, this species has been obtained in puparium of *Parlatoria ziziphi* (Lucas, 1853) (Hemiptera: Diaspididae) according to the labels on the specimen deposited at the RBINS collection.

3. *Encarsia lutea* (Masi, 1909)*

Examined material: *Souss-Massa*: Agadir, horticultural complex, 22.v.2002 (CIRAD, code: 17962, 17963), A. Lachghiri leg.; Aït Amira, Rosalie domain, CMV 809, 01.IV. 2003, L. Abaha and G. Delvare leg. (CIRAD, code: 18018); Agadir, electrician's village, 02.IV.2003, Delvare G. (CIRAD, code: 18022).
Distribution: Australia, Bangladesh, Brazil, Canary Islands, Caucasus, China, Cook Islands, Cyprus, Czech Republic, Egypt, France, Greece, India, Iran, Israel, Italy, Japan, Kazakhstan, Korea, Moldova, Pakistan, Russia, Serbia, Slovakia, South Korea, Spain, Sudan, Syria, United Kingdom, United States, Zimbabwe and Morocco (**new record**).
Hosts. In Morocco, according to the labels of the specimens deposited at CIRAD, this species has been obtained on *Bemisia tabaci* (Gennadius, 1889) (Hemiptera: Aleyrodidae) living on *Euphorbia pulcherrima* Willdenow ex Klotzsch, 1834 (Euphorbiaceae), *Solanum lycopersicum* Linnaeus, 1753 (= *Lycopersicum esculentum* Miller, 1768) (Solanaceae) and on *Lantana camara* Linnaeus, 1753 (Verbenaceae).

4. *Encarsia mineoi* Viggiani, 1982*
Examined material: *Souss-Massa:* Agadir, village of the electrician, 02.iv.2003, G. Delvare leg. (CIRAD, code: 18023).
Distribution: Australia (Queensland), Egypt, Iran, Israel, Libya, Spain, Sudan and Morocco (**new record**).
Hosts. In Morocco, this species was reported on *Bemisia tabaci* (Gennadius, 1889) (Hemiptera: Aleyrodidae) living on *Lantana camara* Linnaeus, 1753 (Verbenaceae).

Subfamily Eretmocerinae Shafee and Khan, 1978
Genus *Eretmocerus* Haldeman, 1850

5. *Eretmocerus emiratus* Zolnerowich & Rose, 1998*
Examined material: *Souss-Massa:* Agadir, village of the electrician, 02.iv.2003, G. Delvare leg. (CIRAD, code 18057).
Distribution: Egypt, Ethiopia, Mexico, United Arab Emirates, United States and Morocco (**new record**).
Hosts. Unknown in Morocco.
6. *Eretmocerus ? eremicus* Rose & Zolnerowich, 1997*
Examined material: *Fez-Meknes:* Fez, Douïet domain, 30.xi.2001, A. Lachghiri leg. (CIRAD, code 17973).
Comments. This species seems to be doubtful according to the identifications by G. Delvare (com. pers.). Additionally, the specimens were obtained from *Trialeurodes vaporariorum* (Westwood, 1856) (Hemiptera: Aleyrodidae) living on *Solanum melongena* Linnaeus, 1853 (Solanaceae) (G. Delvare, personal communication).

Family Azotidae Nikol'skaya & Yasnosh, 1966
Genus *Ablerus* Howard, 1894

7. *Ablerus perspeciosus* Girault, 1916**
Examined material: *Rabat-Salé-Kénitra:* Maâmora forest, Sidi Taïbi commune, Bled Dandoune, 34°07′38″N 6°38′01″W, 120 m, 1 ♀, 13.vii.2022, K. Kissayi leg.
Distribution: Argentina, China, Columbia, Egypt, France, India, Israel, Italy, Japan, Serbia, South Korea, Thailand, Turkey, United States and Morocco (**new record**).
Hosts. It's unknown.

CONCLUSION

The Moroccan fauna of Aphelinidae and Azotidae has been enriched by five binomial species respectively adding to the 34 species already recorded in Morocco (Kissayi *et al.*, 2017) in addition to one doubtful species and one single species. The number of species of this Moroccan hymenopteran fauna that are known to exist is still quite small. Nonetheless, considering the significance of these Chalcidian in biological control, we want to take out additional collections in the future.

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