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Parasitoids (Hymenoptera: Chalcidoidea) associated with oak gall wasps (Hymenoptera: Cynipidae) in northeastern Algeria

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Abstract

Cynipid galls on oak (Fagaceae: *Quercus*) are natural microcosms that support many insect species, including the gall inducers (Hymenoptera: Cynipidae, Cynipini), cynipid inquilines, and chalcid parasitoids (Hymenoptera: Chalcidoidea). Little is known about these communities in North Africa, and here we report the results of the first systematic surveys in northeastern Algeria. Thirteen Cynipini species gall generations were reared from 999 galls on *Quercus suber* L. and *Q. faginea* Lam. collected between 2022 and 2024. A total of 242 parasitoids representing 19 chalcid species in seven families were reared, six of which (*Aulogymnus trilineatus* (Mayr), *Eurytoma setigera* Mayr, *Sycophila iracemae* Nieves-Aldrey, *Sycophila variegata* (Curtis), *Ormyrus pomaceus* (Geoffroy), and *Torymus affinis* (Fonscolombe)) are recorded for the first time from North Africa. Similarities in parasitoid assemblage composition between cynipid galls with similar morphology that develop on the same host tree organ, and differences among host galls that differ morphologically, structurally, and phenologically are documented, corroborating previous research.

Key words: Cynipini, cynipid galls, chalcid, *Quercus*, North Africa

Resumé

Les galles de cynipides sur chêne (Fagaceae : *Quercus*) sont des microcosmes naturels qui abritent de nombreuses espèces d'insectes, y compris les inducteurs de galles (Hymenoptera : Cynipidae, Cynipini), les inquilins de cynipidés et les parasitoïdes de chalcides (Hymenoptera : Chalcidoidea). On sait peu de choses sur ces communautés en Afrique du Nord, et nous rapportons ici les résultats des premières études systématiques dans le nord-est de l'Algérie. Treize générations de galles d'espèces de Cynipini ont été élevées à partir de 999 galles sur *Quercus suber* L. et *Q. faginea* Lam. Collectés entre 2022 et 2024. Un total de 242 parasitoïdes représentant 19 espèces de chalcides dans sept familles ont été élevés, dont six (*Aulogymnus trilineatus* (Mayr), *Eurytoma setigera* Mayr, *Sycophila iracemae* Nieves-Aldrey, *Sycophila variegata* (Curtis), *Ormyrus pomaceus* (Geoffroy) et *Torymus affinis* (Fonscolombe)) sont enregistrés pour la première fois en Afrique du Nord. Des similitudes dans la composition de l'assemblage de parasitoïdes entre les galles de cynipides de morphologie similaire qui se développent sur le même organe d'arbre hôte, et des différences entre les galles hôtes qui diffèrent morphologiquement, structurellement et phénologiquement sont documentées, corroborant les recherches antérieures.

Mots clés: Cynipini, galles cynipidés, chalcides, *Quercus*, Afrique du Nord

Introduction

Many organisms from various animal, plant, and microbial taxa can manipulate plant structures and induce galls (Giron *et al*. 2016; Harris & Pitzschke 2020; Mani 1964); however, galls induced by Hymenoptera, especially

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species belonging to the family Cynipidae, have attracted much attention from scientists and ecologists due to their remarkable morphological and structural diversity (Csóka *et al*. 2005). The higher classification of the family Cynipidae has undergone many taxonomic revisions in recent decades due to significant advances in phylogenetic systematics. As a result, the number of tribes within this family has increased from eight to 13, of which three tribes, namely Cynipini, Synergini (*s. str.*), and Ceroptresini, are associated with *Quercus* (Fagaceace) (Liljeblad *et al.* 2011; Lobato-Vila *et al.* 2022; Ronquist *et al.* 2015; Ward *et al.* 2022).

Oak galls serve as significant food and shelter sources for multiple insect guilds—including the cynipid gall inducers, cynipid inquilines, gallivores including weevils (Coleoptera) and tortricid moths (Lepidoptera), and their associated natural enemies (Csóka *et al*. 2005; Hayward & Stone 2005; Serrano-Muñoz *et al*. 2022; Ward *et al.* 2022). The cynipid inhabitants are attacked by rich and guild-specific assemblages of chalcid parasitoids (Hymenoptera: Chalcidoidea) (Askew *et al*. 2013; Hayward & Stone 2005; Ward *et al.* 2022). The Enemy Hypothesis posits that selection by natural enemies promotes modifications in gall morphology that reduce parasitoid attack rates and enhance the survival of gall inducers, hence explaining the significant structural and morphological diversity observed in oak galls (Stone & Cook 1998; Stone & Schönrogge 2003). For instance, increased thickness of the gall wall slows or excludes parasitoids oviposition (Bailey *et al*. 2009; Egan & Ott 2007). Zargaran *et al.* (2011) demonstrated a negative correlation between the gall thickness of asexual generation galls of *Cynips quercusfolii* L. and parasitism rate. Other morphological characteristics such as coatings of adhesive resin, spines on the gall surface, and interstitial spaces between larval chambers may also have defensive purposes (Quicke *et al*. 1994; Stone *et al.* 2002). Nectar secretion by galls, which attracts ants, may indirectly contribute to repelling parasitoid attacks (Inouye & Agrawal 2004; Nicholls *et al*. 2017; Warren *et al*. 2022; Washburn 1984).

In addition to gall morphology, other gall phenotypic traits, such as habitat, location on the host tree and phenology influence the composition of parasitoid assemblages. Zargaran *et al.* (2011) demonstrated in Iran that south-facing cynipid galls experienced lower parasitoid attack rates than those orientated in other directions. Galls from mesic habitats are more susceptible to parasitoid attacks than those from xeric environments (Fernandes & Price 1992). Gall host plant, phenology, and host plant organ also influence parasitoid assemblage composition (Bailey *et al.* 2009; Fang *et al.* 2024; Zhang *et al*. 2022).

The superfamily Chalcidoidea is widely recognized as one of the most diverse hymenopteran superfamilies structurally, morphologically, and biologically (Cruaud *et al.* 2024). Currently, this taxonomic group has over 27,000 species classified in 53 families (Woolley & Heraty 2025); approximately 100 species of Chalcidoidea parasitoids are associated with Cynipini galls on *Quercus* trees in the Western Palearctic, which represents around half of the 200 insect species directly associated with Cynipidae galls (Askew *et al*. 2013).

Algeria was one of the first countries to host study of oak cynipid galls and their associated parasitoid communities, thanks to the work of Kieffer (1897) and Marchal (1897, 1900) in the late 19th century and the significant studies of Askew *et al.* (2013). However, no study on these parasitoid communities has since been undertaken. Here we report the results of systematic surveys of chalcid parasitoids sampled from 999 oak cynipid galls on *Quercus faginea* Lam. and *Q. suber* L. in three regional forests in the northeastern region of Algeria. The objective was to identify this region's parasitoid species and study them through their galls.

Materials and methods

Oak cynipid galls were collected and reared in three forests in the north-east of Algeria (Figure 1): (i) three sample sites (Mellah Lake, Mechta Ain Chaara, and Djbel El Ghorra) in the El-Kala National Park in El Taref; (ii) two sample sites (Mghassel and Gliaa) in the high mountain region of Machrouha in Souk-Ahras; and (iii) three sample sites (Edough, Dar Smair, and Bouzizi) in the Seraidi Massif in Annaba. The characteristics of these three regional forests are summarised in Table 1.

At each study site available cynipid galls were collected haphazardly from different organs of *Quercus suber* (cork oak, *Quercus* subgenus *Cerris,* section Cerris; n = 458 galls of 5 types) and the *Quercus faginea* (*Quercus* subgenus *Quercus,* section *Quercus* n = 541 galls of 8 types) in 2022 and 2024 (Table 3). Galls were reared individually in containers with fine mesh lids to reduce mould. All emerging insects were preserved in 70% ethanol.

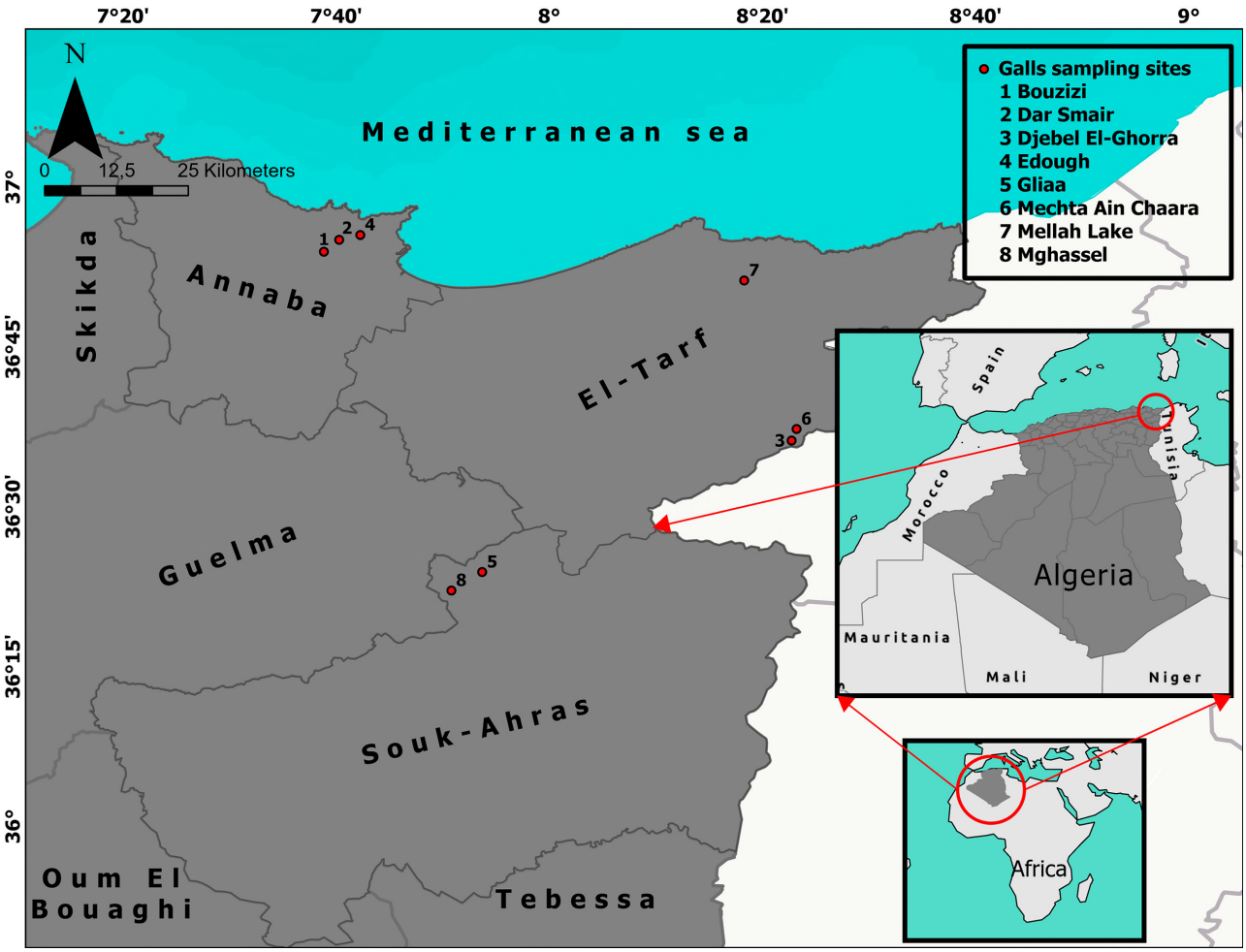

FIGURE 1. Localities of sampling sites where galls were collected on *Quercus* in northeastern Algeria.

TABLE 1. Sites where galls were collected on *Quercus* in north-east Algeria and their geographical coordinates.

N°	Sampling site	Latitude	Longitude	Altitude(m)	Oak species
1	Bouzizi	36°53'55"N	7°38'51"E	951	*Q. faginea*
2	Dar Smair	36°55'02"N	7°40'17"E	805	*Q. faginea*
3	Djebel El-Ghorra	36°36'12"N	8°22'44"E	1050	*Q. faginea*
4	Edough	36°55'29"N	7°42'16"E	663	*Q. faginea* *Q. suber*
5	Gliaa	36°23'52"N	7°53'42"E	1054	*Q. faginea*
6	Mechta Ain Chaara	36°37'17"N	8°23'12"E	611	*Q. suber*
7	Mellah Lake	36°51'13"N	8°18'17"E	208	*Q. suber*
8	Mghassel	36°22'08"N	7°50'49"E	733	*Q. suber*

Parasitoids were identified using the following taxonomic resources: **Eulophidae:** Askew (1968), Gauthier *et al.* (2000), Jara-Chiquito & Pujade Villar (2022) and Williams (2007); **Eupelmidae:** Al Khatib *et al*. (2014), Askew & Nieves-Aldrey (2000, 2017), Gibson (1995) and Gibson & Fusu (2016); **Eurytomidae:** Lotfalizadeh *et al*. (2008), Nieves Aldrey (1984), Zerova & Seryogina (2006, 2009); **Megastigmidae:** Askew (1966), Doğanlar (2011), Janšta *et al*. (2018) and Williams (2007); **Ormyridae**: Doğanlar (1991), Jara-Chiquito & Pujade Villar (2022), Lotfalizadeh *et al*. (2012), Pujade-Villar (1989) and Zerova *et al.* (2021); **Pteromalidae:** Askew (1975), Burks *et al.* (2022), Jara-Chiquito & Pujade Villar (2022), Ko *et al.* (2018, 2018), Pujade-Villar (1994) and Williams

(2007); **Torymidae:** De Vere Graham & Gijswijt (1998), Janšta *et al.* (2018), Jara-Chiquito & Pujade Villar (2022), Matsuo (2020) and Viciriuc *et al.* (2023).

Oak cynipids commonly have cyclically parthenogenetic lifecycles, with obligate alternation between two generations each year—a spring sexual generation (abbreviated S below) and an autumn asexual generation (abbreviated A below)—although many species are known from only one of these generations (Nicholls *et al.* 2022; Stone *et al.* 2008). In the following account we separate parasitoid assemblages by both generation and species (as in Askew *et al*. 2013 and Ward *et al.* 2022). Parasitoids also attack cynipid galls whose development is taken over at a very early stage by inquiline cynipids in the genus *Synophrus* Hartig. The development of these 'hijacked' galls is substantially modified, to the extent that they are regarded as distinct gall types (Pénzes *et al.* 2009). All *Synophrus* galls are of a sexual generation, and no A or S abbreviation is used for them. In the following account, the gall from which the parasitoid is reared is an association, and does not mean that the parasitoid fed directly on the gall inducer.

Results

We reared 242 specimens of Chalcidoidea from 999 galls on *Quercus faginia* and *Quercus suber* (107 associated with *Quercus faginea* and 135 associated with *Quercus suber*). The specimens were identified as 19 species representing seven families: Eulophidae (1 species), Eupelmidae (2 species), Eurytomidae (5 species), Megastigmidae (2 species), Ormyridae (2 species), Pteromalidae (4 species) and Torymidae (3 species).

Eulophidae

Aulogymnus trilineatus (Mayr, 1877)

Global distribution. Western Palaearctic (UCD community 2025).

Distribution in Algeria and North Africa. New record for North Africa.

Material examined. Bouzizi, *Q. faginea*, ex *Andricus quercustozae* (Bosc, 1792) (A), 01.iv.2023: 1♀ & 1♂; ex *Andricus coriarius* (Hartig, 1843) (A), 08.iv.2023: 1♀; Gliaa, *Q. faginea*, ex *Andricus grossulariae* Giraud, 1859 (A), 13.iv.2023: 1♀.

Eupelmidae

Eupelmus azureus Ratzeburg, 1844

Global distribution. Western Palaearctic and Nearctic (UCD community 2025).

Distribution in Algeria and North Africa. Recorded in Algeria by Marchal (1900) ex *Biorhiza pallida* (Olivier, 1791) (S) and *Plagiotrochus quercusilicis* (Fabricius, 1798) (S) under the name *Eupelmus spongipartus* Förster, 1860.

Material examined. Djebel El-Ghorra, *Q. faginea*, ex *Andricus pictus* (Hartig, 1856) (A), 04.iv.2023: 1♀; Dar Smair, *Q. faginea*, ex *Andricus quercustozae* (Bosc, 1792) (A), 19.iv.2023: 1♀; Gliaa, *Q. faginea*, ex *Andricus quercustozae* (Bosc, 1792) (A), 06.iv.2024: 2♀ & 1♂.

Eupelmus cerris Förster, 1860

Global distribution. Palaearctic (UCD community 2025).

Distribution in Algeria and North Africa. Recorded in Algeria by Marchal (1900) ex, *Andricus quercustozae* (Bosc, 1792) (A), Gibson & Fusu (2016) ex *Synophrus olivieri* Kieffer 1898, and from Tunisia ex *Synophrus olivieri* Kieffer 1898 by Pujade Villar *et al*. (2010).

Material examined. Mghassel, *Q. suber*, ex *Synophrus olivieri* Kieffer 1898, 12.vi.2023: 3♀ & 2♂; Mechta Ain Chaara, *Q. suber*, ex *Synophrus olivieri*, Kieffer 1898 25.v.2023: 3♀ & 1♂; Edough, *Q. suber*, ex *Synophrus olivieri* Kieffer 1898, 04.vi.2023: 15♀ & 5♂; Mellah Lake, *Q. suber*, ex *Synophrus olivieri* Kieffer 1898, 29.v.2023: 4♀ & 2♂.

Eurytomidae

Eurytoma brunniventris Ratzeburg, 1852

Global distribution. Palaearctic (UCD community 2025).

Distribution in Algeria and North Africa. Recorded in Morroco from *Andricus pictus* (Hartig, 1856) (A) by Askew *et al.* (2013). New record for Algeria.

Material examined. Djebel El-Ghorra, *Q. faginea,* ex *Andricus grossulariae* Giraud, 1859 (A), 26.iii.2023: 1♂; ex *Cynips quercus* (Fourcroy, 1785) (A), 5.iv.2023: 1♂; ex *Andricus quercustozae* (Bosc, 1792) (A), 12.iii.2024: 1♀; ex *Andricus hispanicus* (Hartig, 1856) (A), 14.iii.2024: 1♀; ex *Andricus pictus* (Hartig, 1856*)* (A), 18.iii.2024: 1♀; Bouzizi, *Q. faginea,* ex *Andricus coriarius* (Hartig, 1843) (A), 3.iii.2023: 1♀ & 1♂; ex *Andricus grossulariae* Giraud, 1859 (A), 2.iv.2023: 1♀; Dar Smair, *Q. faginea,* ex *Andricus quercustozae* (Bosc, 1792) (A), 19.iii.2023: 1♀ & 2♂; Edough, *Q. faginea*, ex *Neuroterus quercusbaccarum* (Linnaeus, 1758) (A), 9.iii.2023: 2♀; Edough, *Q. suber*, ex *Andricus grossulariae* Giraud, 1859 (S), 1.iv.2023: 2♀; Mghassel, *Q. suber,* ex *Pseudoneuroterus saliens* (Kollar, 1857) (S), 20.iv.2023: 1♀ & 1♂; ex *Andricus grossulariae* Giraud, 1859 (S), 15.iii.2024: 2♀ & 2♂.

Note. Marchal (1900) mentions *Eurytoma rosae* Nees, 1834 in *Biorhiza pallida* (Olivier, 1791) (S). *Eurytoma brunniventris* Ratzeburg, 1852 is much more common in oak cynipid galls, and *E. rosae* is much more common in rose cynipid galls. These two species can be confused and consequently, Marchal's mention may have corresponded to *A. brunniventris*.

Eurytoma setigera Mayr, 1878

Global distribution. Palaearctic (UCD community 2025).

Distribution in Algeria and North Africa. New record for North Africa.

Material examined. Bouzizi, *Q. faginea,* ex *Andricus coriarius* (Hartig, 1843) (A) 23.iii. 2023: 2♀; Djebel El-Ghorra, *Q. faginea*, ex *Andricus hispanicus* (Hartig, 1856) (A), 17.iii.2024: 1♀; Mghassel, *Q. suber,* ex *Synophrus olivieri* Kieffer 1898, 15.iv.2023: 2♀.

Sycophila biguttata (Swederus, 1795)

Global distribution. Eastern and Western Palearctic (UCD community 2025).

Distribution in Algeria and North Africa. Recorded in Algeria by Marchal (1900) under the name *Decatoma biguttata* (Swederus, 1795) ex *Andricus quercustozae* (Bosc, 1792) (A), and from Tunisia ex *Synophrus olivieri* Kieffer 1898 by Pujade Villar *et al.* (2010).

Material examined. Bouzizi, *Q. faginea,* ex *Andricus pictus* (Hartig, 1856) (A), 19.iii.2023: 1♀; ex *Andricus coriarius* (Hartig, 1843) (A), 26.iii.2023: 2♀; Dar Smair, *Q. faginea*, ex *Andricus quercustozae* (Bosc, 1792) *(*A), 24.iii.2023: 2♀; Djebel El-Ghorra, *Q. faginea,* ex *Andricus quercustozae* (Bosc, 1792*)* (A), 20.iii.2024: 1♀; Edough, *Q. suber*, ex *Synophrus olivieri* Kieffer 1898, 15.iv.2023: 3♀; Mechta Ain Chaara, *Q. suber*, ex *Synophrus olivier*i Kieffer 1898, 17.iv.2023: 1♀; Mghassel, *Q. suber*, ex Andricus grossulariae Giraud,1859 (S), 28.iv.2024: 3♀.

Sycophila iracemae Nieves-Aldrey, 1984

Global distribution. Western Palaearctic and Iran (UCD community 2025).

Distribution in Algeria and North Africa. New record for North Africa.

Material examined. Bouzizi, *Q. faginea*, ex *Andricus hispanicus* (Hartig, 1856) (A), 10.iii.2023: 1♂ & 2♀; Djebel El-Ghorra, *Q. faginea*, ex *Andricus quercustozae* (Bosc, 1792) (A), 5.iv.2023: 1♂ & 1♀; ex *Andricus grossulariae* Giraud, 1859(A), 20.iv.2023: 1♂ & 1♀; Dar Smair, *Q. faginea*, ex *Andricus quercustozae* (Bosc, 1792) (A), 25.iii.2024: 2♂ & 1♀; Gliaa, *Q. faginea*, ex *Andricus quercustozae* (Bosc, 1792) (A), 26.iii.2024: 2♀.

Sycophila variegata (Curtis, 1831)

Global distribution. Palaearctic (UCD community 2025).

Distribution in Algeria and North Africa. New record for North Africa.

Material examined. Djebel El-Ghorra, *Q. faginea*, ex *Andricus coriarius* (Hartig, 1843) (A), 2.iv.2023: 1♀; Mechta Ain Chaara, *Q. suber*, ex *Synophrus olivieri* Kieffer 1898, 8.iv.2023: 1♂ & 2♀; ex *Andricus grossulariae* Giraud, 1859 (S), 2.v.2024: 2♀; Mghassel, *Q. suber*, ex *Andricus grossulariae* Giraud, 1859 (S), 09.iv.2023: 1♀; ex *Synophrus olivieri* Kieffer 1898, 24.iv.2023: 2♀; Edough, *Q. suber*, ex *Andricus grossulariae* Giraud, 1859 (S), 15.iv.2023: 2♀; ex *Synophrus olivieri* Kieffer 1898, 15.iv.2024: 2♂ & 2♀.

Megastigmidae

Bootanomyia dorsalis (Fabricius, 1798)

Global distribution. Oriental Region and Palaearctic (UCD community 2025).

Distribution in Algeria and North Africa. Recorded in Tunisia ex *Synophrus olivieri* Kieffer 1898 by Pujade Villar *et al.* (2010) under the name *Megastigmus dorsalis* (Fabricius, 1798).

Material examined. Gliaa, *Q. faginea*, ex *Andricus quercustozae* (Bosc, 1792) (A), 20.iii.2023: 1♀; Bouzizi, *Q. faginea*, ex *Andricus quercustozae* (Bosc, 1792) (A), 28.iii.2024: 1♀ & 1♂; Edough, *Q. suber*, ex *Synophrus olivieri* Kieffer 1898, 2.iv.2023: 1♀; Mghassel, *Q. suber*, ex *Synophrus olivieri* Kieffer 1898, 5.iv.2023: 1♀ & 1♂.

Bootanomyia stigmatizans (Fabricius, 1798)

Global distribution. Palaearctic (UCD community 2025).

Distribution in Algeria and North Africa. Recorded in Morocco ex *Andricus quercustozae* (Bosc, 1792) (A) and *Andricus hispanicus* (Hartig, 1856) (A) by Askew *et al.* (2013) under the name *Megastigmus stigmatizans* (Fabricius, 1798); Delucchi (1962) ex host gall unknown, and Kissayi *et al*. (2020) ex host gall unknown.

Material examined. Gliaa, *Q. faginea*, ex *Andricus pictus* (Hartig, 1856) (A), 20.iii.2023: 1♀; ex *Andricus quercustozae* (Bosc, 1792) (A), 08.iv.2023: 1♂; Bouzizi, *Q. faginea*, ex *Andricus pictus* (Hartig, 1856) (A), 29.iii.2023: 1♀; ex *Andricus coriarius* (Hartig, 1843) (A), 22.iv.2023: 1♀; ex *Andricus quercustozae* (Bosc, 1792) (A), 26.ii.2024: 1♀; Djebel El-Ghorra, *Q. faginea*, ex *Andricus hispanicus* (Hartig, 1856) (A), 29.iii.2023: 2♀ & 1♂; Dar Smair, *Q. faginea*, ex *Andricus hispanicus* (Hartig, 1856) (A), 23.iv.2023: 1♀; Mellah Lake, *Q. suber*, ex *Synophrus hispanicus*, 25.ii.2023: 1♀.

Ormyridae

Ormyrus nitidulus (Fabricius, 1804)

Global distribution. Nearctic and Palaearctic (UCD community 2025).

Distribution in Algeria and North Africa. Recorded in Algeria by Fabricius (1804) under the name *Ormyrus tubulosus* (Fonscolombe, 1832) ex host gall unknown, and by Marchal (1897) under the name *Ormyrus tubulosus* (Fonscolombe, 1832) ex *Andricus quercustozae* (Bosc, 1792) (A).

Material examined. Gliaa, *Q. faginea*, ex *Andricus hispanicus* (Hartig, 1856) (A), 01.iv.2023: 1♀; Djebel El-Ghorra, *Q. faginea*, ex *Andricus quercustozae* (Bosc, 1792) (A), 02.iv.2023: 1♀; Bouzizi, *Q. faginea*, ex *Andricus quercustozae* (Bosc, 1792) (A), 10.iv.2023: 1♀.

Ormyrus pomaceus (Geoffroy, 1785)

Global distribution. Palaearctic (UCD community 2025).

Distribution in Algeria and North Africa. New record for North Africa.

Material examined. Djebel El-Ghorra, *Q. faginea*, ex *Andricus hispanicus* (Hartig, 1856) (A), 11-14.iii.2023: 5♀; ex *Andricus quercustozae* (Bosc, 1792) (A), 19.iii.2024: 2♀; Dar Smair, *Q. faginea*, ex *Andricus grossulariae* Giraud, 1859 (A), 19.iii.2023: 1♀ & 1♂; Bouzizi, *Q. faginea*, ex *Andricus quercustozae* (Bosc, 1792) (A): 3♀ & 1♂; ex *Andricus grossulariae* Giraud, 1859 (A), 01.iv.2023: 2♀ & 1♂; Gliaa, *Q. faginea*, ex *Andricus grossulariae* Giraud, 1859 (A), 06.iv.2023: 3♀; Mechta Ain Chaara, *Q. suber*, ex *Plagiotrochus amenti* Kieffer, 1901 (A), 01.iv.2023: 1♀.

Note. In Algeria, Marchal (1900) reported *Ormyrus cosmozonus* Foerster, 1860 ex *Andricus quercustozae* (Bosc, 1792) (A), but the record probably corresponds to *Ormyrus pomaceus* (Geoffroy, 1785).

Pteromalidae

Cecidostiba fungosa (Geoffroy, 1785)

Global distribution. Palaearctic (UCD community 2025).

Distribution in Algeria and North Africa. Recorded in Morocco by Delucchi (1962) ex host gall unknown, Kissayi *et al.* (2021) ex host gall unknown, in Tunisia ex *Synophrus olivieri* Kieffer 1898 by Pujade Villar *et al*. (2010). New record for Algeria.

Material examined. Bouzizi, *Q. faginea*, ex *Andricus hispanicus* (Hartig, 1856) (A), 01.iv.2023: 3♀; ex *Andricus coriarius* (Hartig, 1843) (A), 06.iv.2023: 2♀; ex *Andricus quercustozae* (Bosc, 1792) (A), 04.v.2023: 1♀ & 1♂; Dar Smair, *Q. faginea*, ex *Andricus grossulariae* Giraud, 1859 (A), 06.iv.2023: 2♀; Gliaa, *Q. faginea*, ex *Andricus grossulariae* Giraud, 1859 (A), 06.iv.2023: 2♀; ex *Andricus coriarius* (Hartig, 1843) (A), 01.v.2023: 1♀ & 1♂; Djebel El-Ghorra, *Q. faginea*, ex *Andricus quercustozae* (Bosc, 1792) (A), 01.v.2024: 1♀ & 1♂.

Cecidostiba semifascia (Walker, 1835)

Global distribution. Western Palaearctic and Japan (UCD community 2025).

Distribution in Algeria and North Africa. Recorded in Algeria by Marchal (1900) ex *Biorhiza pallida* (Olivier, 1791) (S) under the name *Pteromalus gallicus* Ratzeburg, 1848.

Material examined. Djebel El-Ghorra, *Q. faginea*, ex *Andricus pictus* (Hartig, 1856) (A), 19.iii.2023: 1♀; Bouzizi, *Q. faginea*, ex *Andricus hispanicus* (Hartig, 1856) (A), 02.v.2023: 1♀; Gliaa, *Q. faginea*, ex *Andricus hispanicus* (Hartig, 1856) (A), 05.v.2023: 1♀.

Mesopolobus amaenus (Walker, 1834)

Global distribution. Indo-Australian region, Palaearctic (UCD community 2025).

Distribution in Algeria and North Africa. Recorded in Morocco by Kissayi *et al.* (2021) ex host gall unknown, Benyahia (2016) ex host gall unknown, and new record for Algeria.

Material examined. Gliaa, *Q. faginea*, ex (Hartig, 1843) (A), 20.iii.2023: 1♀; Bouzizi, *Q. faginea*, ex *Andricus coriarius* (Hartig, 1843) (A), 29.iii.2023: 2♂.

***Mesopolobus lichtensteini* (Mayr, 1903)**

Global distribution. Palaearctic (UCD community 2025).

Distribution in Algeria and North Africa. Recorded in Algeria by Pujade-Villar (1994) ex *Dryomyia lichtensteinii* (Löw, 1878) and Garrido Torres & Nieves-Aldrey (1999) ex *Dryomyia lichtensteinii* (F. Löw, 1878).

Material examined. Gliaa, *Q. faginea*, ex *Andricus quercustozae* (Bosc, 1792) (A), 01.iii.2023: 1♂.

Torymidae

***Torymus affinis* (Fonscolombe, 1832)**

Global distribution. Western Palaearctic (UCD community 2025).

Distribution in Algeria and North Africa. New record for North Africa.

Material examined. Gliaa, *Q. faginea*, ex *Biorhiza pallida* (Olivier, 1791) (S), 02.iii.2023: 2♀ & 1♂; Dar Smair, *Q. faginea,* ex *Biorhiza pallida* (Olivier, 1791*)* (S), 2.iii.2024: 2♀ & 1♂.

***Torymus auratus* (Müller, 1764)**

Global distribution. Nearctic (introduced) and Western Palaearctic (UCD community 2025).

Distribution in Algeria and North Africa. Recorded in Morocco ex *Andricus quercustozae* (Bosc, 1792) (A) and *Cynips quercus* (Fourcroy, 1785) (A) (Askew *et al*. 2013), and in Algeria ex *Synophrus olivieri* Kieffer 1898 by Kieffer (1897) under the name *Torymus regius* Nees, 1834.

Material examined. Djebel El-Ghorra, *Q. faginea*, ex *Andricus hispanicus* (Hartig, 1856) (A), 1.iv.2023: 1♀.

Note. We believe that Kieffer's (1897) identification of *Torymus auratus* (Müller, 1764) emerging from *Synophrus olivieri* galls in Algeria could be a mistaken identification of *Torymus cerri*, which was abundant in our rearings of *S. olivieri* but with no *Torymus auratus*; this observation has also been reported in Tunisia by Pujade Villar *et al*. (2010).

***Torymus cerri* (Mayr, 1874)**

Global distribution. Western Palaearctic (UCD community 2025).

Distribution in Algeria and North Africa. Recorded in Tunisia ex *Synophrus olivieri* Kieffer 1898 by Pujade Villar *et al*. (2010). New record for Algeria.

Material examined. Mechta Ain Chaara, *Q. suber*, ex *Synophrus olivieri* Kieffer 1898, 2.iii.2023: 10♀ & 5♂; Mellah Lake, *Q. suber*, ex *Synophrus olivier* Kieffer 1898 *i*, 27.ii.2024: 7♀ & 3♂; Edough, *Q. suber*, ex *Synophrus olivieri* Kieffer 1898, 29.iii.2023: 15♀ *&* 12♂; Mghassel*, Q. suber*, ex *Synophrus olivieri* Kieffer 1898 29.iii.2024: 8 4♂.

Discussion

Our surveys recorded 19 species of chalcidoid parasitoids associated with cynipid galls on *Quercus* in northeastern Algeria, including six recorded for the first time in the North African region: *Aulogymnus trilineatus, Eurytoma setigera, Sycophila iracemae, S. variegata, Ormyrus pomaceus,* and *Torymus affinis.* This represents a significant increase in the regional diversity of cynipid-associated parasitoids.

For specialist parasitoids, presence in an assemblage is contingent upon the availability of suitable hosts, resulting in closely linked parasitoid and host distributions (Sheikh *et al*. 2022; Zhang *et al.* 2022). However, most parasitoids in Western Palaearctic oak cynipid galls are not specialists but attack multiple hosts sharing similarities in

characteristics, including gall morphology and host tree, that are compatible with parasitoid behavior and morphology (particularly ovipositor length) (Gomez *et al*. 2006; Bailey *et al*. 2009; Askew *et al.* 2013). Though our total sample size of parasitoids is small, our results suggest similarities in parasitoid species composition across structurally similar galls on the same host plant organ (Table 2, Table S1). For example, woody galls on *Quercus faginea* buds (particularly *Andricus quercustozae* (A) and *A hispanicus* (A)) support similar assemblages of parasitoids dominated by *Bootanomyia stigmatizans, Eurytoma brunniventris, Ormyrus pomaceus, O. nitidulus* and *Sycophila iracemae*.

TABLE 2. Parasitoid species associated with each species of oak cynipid gall.

Cynipid species (Generation)	Parasitoids emerged	Parasitoid sample size		
		Female (♀)	Male (♂)	Total
Andricus coriarius (Asexual)	*Aulogymnus trilineatus*	1	/	1
	Bootanomyia stigmatizans	1	/	1
	Cecidostiba fungosa	3	1	4
	Eurytoma brunniventris	1	1	2
	Eurytoma setigera	2	/	2
	Mesopolobus amaenus	1	2	3
	Sycophila biguttata	2	/	2
	Sycophila variegata	1	/	1
Andricus grossulariae (Asexual)	*Aulogymnus trilineatus*	1	/	1
	Cecidostiba fungosa	7	/	7
	Cecidostiba semifascia	1	/	1
	Eurytoma brunniventris	1	1	2
	Ormyrus pomaceus	6	2	8
	Sycophila iracemae	1	1	2
Andricus grossulariae (Sexual)	*Eurytoma brunniventris*	4	2	6
	Sycophila biguttata	3	/	3
	Sycophila variegata	5	/	5
Andricus hispanicus (Asexual)	*Bootanomyia stigmatizans*	3	1	4
	Cecidostiba semifascia	1	/	1
	Eurytoma brunniventris	1	/	1
	Eurytoma setigera	1	/	1
	Ormyrus nitidulus	1	/	1
	Ormyrus pomaceus	5	/	5
	Sycophila iracemae	2	1	3
	Torymus auratus	1	/	1
Andricus pictus (Asexual)	*Bootanomyia stigmatizans*	2	/	2
	Cecidostiba semifascia	1	/	1
	Eupelmus azureus	1	/	1
	Eurytoma brunniventris	1	/	1
	Sycophila biguttata	1	/	1

.....continued on the next page

TABLE 2. (Continued)

Cynipid species (Generation)	Parasitoids emerged	Parasitoid sample size		
		Female (♀)	Male (♂)	Total
Andricus quercustozae (Asexual)	*Aulogymnus trilineatus*	1	1	2
	Bootanomyia dorsalis	2	1	3
	Bootanomyia stigmatizans	1	1	2
	Cecidostiba fungosa	2	2	4
	Eupelmus azureus	3	1	4
	Eurytoma brunniventris	2	2	4
	Mesopolobus lichtensteini	/	1	1
	Ormyrus nitidulus	2	/	2
	Ormyrus pomaceus	5	1	6
	Sycophila biguttata	3	/	3
	Sycophila iracemae	4	3	7
Biorhiza pallida (Sexual)	*Torymus affinis*	4	2	6
Cynips quercus (Asexual)	*Eurytoma brunniventris*	/	1	1
Neuroterus quercusbaccarum (Asexual)	*Eurytoma brunniventris*	2	/	2
Plagiotrochus amenti (Asexual)	*Ormyrus pomaceus*	1	/	1
Pseudoneuroterus saliens (Sexual)	*Eurytoma brunniventris*	1	1	2
Synophrus hispanicus	*Bootanomyia stigmatizans*	1	/	1
Synophrus olivieri	*Bootanomyia dorsalis*	2	1	3
	Eupelmus cerris	25	10	35
	Eurytoma setigera	2	/	2
	Sycophila biguttata	4	/	4
	Sycophila variegata	6	3	9
	Torymus cerri	40	24	64
Total		**175**	**67**	**242**

We reared the largest numbers of insects per gall from large woody galls such as *Andricus quercustozae* (A) and *Andricus hispanicus*(A) (Table 3). This may in part be due to small sample sizes of smaller leaf galls such as *N. quercusbaccarum* (A) and the difficulty in rearing occupants from these smaller galls. Assuming equal rearing success, the observed pattern could also be due to variation in the richness and abundance of alternative inquiline cynipid hosts in different cynipid galls (Askew *et al*. 2013). Larger cynipid galls typically harbor both multiple peripheral larval chambers of non-lethal cynipid inquilines, and lethal inquilines that develop within the gall inducer larval chamber. In contrast, small galls often support only a solitary lethal inquiline. Addition of peripheral non-lethal inquilines substantially increases both the abundance and species richness of associated chalcid parasitoids, some of which only attack the inquilines in a given host gall (Hails *et al*. 1990; Schönrogge *et al.* 1995, 1996; Stone *et al*. 1995). The same difference in available parasitoid niche space may explain the difference in parasitoid richness per gall observed between the smaller, more rapidly developing sexual generation gall and the larger, slower developing asexual generation gall of *Andricus grossulariae*.

We also found higher per-gall emergence rates of parasitoids in *Synophrus olivieri* than *Synophrus hispanicus* (Table 3). These two galls differ in that *Synophrus olivieri* develops in a multi-chambered (multilocular) gall offering many aggregated hosts for parasitoids (Pénzes *et al*. 2009), while *S. hispanicus* provides only a single host. Multilocality of *S. olivieri* is likely due to laying of multiple eggs by a single female *Synophrus* within the same host gall (Atkinson *et al*. 2002). Though our sample sizes (particularly *of S. hispanicus)* are small, we hypothesise that higher per-gall density of hosts in *Synophrus olivieri* galls may draw more parasitoids to this gall than to *Synophrus hispanicus*.

TABLE 3. The number and emergence rate of parasitoids from each gall (the emergence rate of parasitoids from each gall was calculated by the ratio of the number of parasitoids emerging to the number of corresponding galls).

species of cynipini galls	Number of parasitoids emerging	Number of sampled galls	Mean per gall emergence rate of parasitoids
Andricus coriarius (Asexual)	16	43	0.38 ± 0.09
Andricus grossulariae (Asexual)	17	41	0.40 ± 0.11
Andricus grossulariae (Sexual)	14	120	0.15 ± 0.02
Andricus hispanicus (Asexual)	21	55	0.58 ± 0.29
Andricus pictus (Asexual)	6	66	0.10 ± 0.01
Andricus quercustozae (Asexual)	38	143	0.46 ± 0.14
Biorhiza pallida (Sexual)	6	32	0.18 ± 0.03
Cynips quercus (Asexual)	1	20	0.05 ± 0.05
Neuroterus quercusbaccarum (Asexual)	2	141	0.02 ± 0.01
Plagiotrochus amenti (Asexual)	1	6	0.02 ± 0.01
Pseudoneuroterus saliens (Sexual)	2	70	0.03 ± 0.02
Synophrus hispanicus	1	20	0.02 ± 0.01
Synophrus olivieri	117	242	1.13 ± 0.69

TABLE 4. Richness of host gall types from which parasitoids were recorded.

Parasitoid species	Total richness of host gall types (species/generation)
Aulogymnus trilineatus	3
Bootanomyia dorsalis	2
Bootanomyia stigmatizans	5
Cecidostiba fungosa	4
Cecidostiba semifascia	2
Eupelmus azureus	2
Eupelmus cerris	1
Eurytoma brunniventris	8
Eurytoma setigera	3
Mesopolobus amaenus	1
Mesopolobus lichtensteini	1
Ormyrus nitidulus	2
Ormyrus pomaceus	4
Sycophila biguttata	5
Sycophila iracemae	3
Sycophila variegata	3
Torymus affinis	1
Torymus auratus	1
Torymus cerri	1

Our rearings showed some parasitoid species to be generalists, attacking multiple gall types developing on both *Q. suber* and *Q. faginea. Eurytoma brunniventris* exhibited the broadest array of host gall species (8 host gall types; Table 4), while *Bootanomyia dorsalis, B. stigmatizans, Ormyrus pomaceus* and *Sycophila biguttata* were all found on hosts on both sampled oak species. These levels of polyphagy match what is known for these parasitoids in much larger scale sampling across the Western Palaearctic (Askew *et al.* 2013); *E. brunniventris* has been reared from 100 gall types, *S. biguttata* from 80, *O. pomaceus* from 96 and *B. dorsalis* from 65 cynipid gall types. *Cecidostiba fungosa,* which we recorded from four of eight sampled gall types on *Q. faginea,* is also a highly generalist species,

reared from 64 oak cynipid galls (Askew *et al*. 2013). In contrast, we reared *Torymus cerri* and *Eupelmus cerri* only from *Synophrus olivieri*. This is consistent with the specificity of these species to host galls on *Quercus suber* recorded in other studies (Askew *et al*. 2013).

Algerian oaks are experiencing a concerning reduction, this phenomenon arising from the gradual deterioration of their habitats, attributed to events such as deforestation, habitat loss, and fires, which can affect oaks and their associated insects (Alia *et al*. 2024; Chouiter & Malika 2024; Hamza *et al*. 2014; Younsi *et al*. 2021). Consequently, investigations of oak habitats and regular health assessments of Algerian oak forests are essential.

Conclusion

This study extended what is known about a very understudied parasitoid fauna in Algeria and North Africa in general. Further research and faunal inventories across diverse geographical regions and on a larger scale are required throughout North Africa, where many oak habitats are under threat from climate change and habitat loss. In the future, it would be valuable to investigate the influence of phenology, size, and position of each gall species on parasitoid and inquiline communities and standardize sampling methodologies when comparing these communities across their respective galls.

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Supplementary Materials. The following supporting information can be downloaded at the DOI landing page of this paper:

TABLE S1. Summary of gall sampling and parasitoid emergence for each site.