

MALES OF *ANDRICUS HYSTRIX* TROTTER, A NEW SEXUAL FORM OF CYNIPIDAE (HYMENOPTERA)

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Abstract: The paper shows the experimental closing of the heterogonic life-cycle (alternation of an asexual generation with a sexual generation) of the gall-wasp *Andricus hystrix* Trotter, 1899. The males and the gall of the sexual form are described, data on the distribution and biology of this species are given and the morphological characters of other males of the genus *Andricus* Hartig, 1840 (closely related to *A. hystrix* males) are discussed.

Key words: Hymenoptera, Cynipidae, *Andricus hystrix*, sexual form, biology, distribution.

Los machos de *Andricus hystrix* Trotter, una nueva forma sexual de Cynipidae (Hymenoptera)

Resumen: El estudio presenta el cierre experimental del ciclo heterogónico (alternancia de generación asexual con una generación sexual) de la abeja gallicola *Andricus hystrix* Trotter, 1899. Se describen los machos y la agalla de la forma sexual, se proporcionan datos sobre la distribución y biología de la especie y se discuten los caracteres morfológicos de otros machos del género *Andricus* Hartig, 1840, estrechamente emparentados con los machos de *A. hystrix*.

Palabras clave: Hymenoptera, Cynipidae, *Andricus hystrix*, forma sexual, biología, distribución.

Introduction

In 1897, Kieffer (Kieffer, 1897-1901: 78) described, but did not name, *Andricus hystrix* from gall material collected in Milan (Italy) and sent by Magretti. Magretti had not been able to obtain adults from this material. Afterwards, Trotter (1899: 297-298) described this species and Kieffer (1897-1901: 497-498) re-described again it. Some authors consider that Kieffer is the original descriptor because usually Kieffer described a certain species from the notes of another author, and he used to assign that author as the descriptor of the species but in this case it is a mistake. For this reason appears in Dalla Torre & Kieffer (1910: 500) this species as *Andricus histrix* Trotter, 1897, but the correct assignation is *Andricus histrix* Trotter, 1899.

To close the cycle of a cynipid species is not easy, and it is often just a matter of chance, because we know neither the correct host nor the organ where the gall is found (Pujade-Villar *et al.*, 2001). Moreover, not all trees have a similar probability of hosting cynipid galls, as there are intraspecific preferences (Stone *et al.*, 2002). For this reason, when a biological cycle is closed this datum is remarkable in the context of entomological research. Finally, checking a known cycle is easier because several unknown elements are under control.

The sexual form of *A. hystrix* was named as *Andricus hystrix follioti* in Melika, Csóka & Pujade-Villar (2000), but this is a *nomen nudum*.

Material and methods

Galls of the asexual form of *Andricus hystrix* were collected on *Quercus pubescens* in Fiesole (Bencistà) near Florence (Italy) in July. At that time the mature galls, 3-4 mm in diameter and exhibiting numerous spines, were still fresh in

appearance and more or less reddish. Asexual females emerged from the galls from July to September. Some parasitoids emerged also in August and September. Observations and experiments with the insects were made near La Rochelle (France), in Baillac. At first the behaviour of the asexual females was observed in the presence of different boughs of *Quercus cerris* and *Q. pubescens* in a glass jar. These females did not initially show a lot of interest in the oak material. However, after two days a female was seen probing a *Q. cerris* bud. Outdoor experiments on branches of *Q. cerris* and *Q. pubescens* trees were undertaken. Single asexual females were placed in bags on branches of different types. Some females were transferred from a bag on *Q. cerris* to a bag on *Q. pubescens*. One female who induced galls on *Q. cerris* (which were seen during the following spring –see below) was seen also probing a *Q. pubescens* vegetative bud and later a supposed floriferous bud of the same oak species. Finally, *A. hystrix* asexual females do not probe oak buds readily and its behavioural preference for *Q. cerris* in controlled conditions is not completely strict.

The current terminology of morphological adult structures follows Gibson (1985), Ronquist & Nordlander (1989), and Fergusson (1995). Abbreviations for forewing venation follow Ronquist & Nordlander (1989). The measurements and abbreviations used herein include: F1 - F12, first and subsequent flagellomeres; POD (post-ocellar distance), the distance between the inner margins of the posterior ocelli; OOL (ocellar-ocular distance), the distance from the outer edge of the lateral ocellus to the inner margin of the compound eye; LOL, the distance between lateral and frontal ocellus; transfacial line, distance between inner margins of compound eyes measured across toruli.

The experimental material has been deposited in the collection of Juli Pujade-Villar (Barcelona University). The SEM pictures were made without coating the specimens at low voltage in order to preserve the type material. Wing and gall pictures were taken with a digital camera.

Experimental results

In different experiments with *A. hystrix* asexual form, carried out in August:

- two females placed only on *Q. pubescens* did not produce anything;
- one female placed on *Q. cerris* did not produce any galls;
- two females placed on *Q. cerris* and later on *Q. pubescens* did not produce any galls on *Q. pubescens* but produced respectively three and one bud galls the following March on *Q. cerris*.

Three males emerged, from April 1 to 7, from the three galls induced by one of the two latter females. The resulting *Q. cerris* bud galls look, at first glance, like the *Andricus kollari* (Hartig, 1843) sexual form (= *circulans* Mayr, 1870) gall. The two *A. hystrix* asexual females had been placed on *Q. cerris* in August, in bags which had been previously put out at the beginning of July. At that time *A. kollari* asexual females of the same year are still in their galls. Only some of the females from the previous year's galls can emerge earlier. Among other *Andricus* species galling *Q. cerris* buds in a comparable way, *Andricus lignicolus* (Hartig, 1840) is very uncommon in the La Rochelle area and *Andricus corruptrix* (Schlechtendal, 1870) is unknown there.

It appears that galls and insects of the *Andricus hystrix* sexual form develop in buds of *Q. cerris*.

Description of the sexual form of *A. hystrix*

Length: 1.8-2.1 mm (for males); females unknown.

Colour: Head and mesosoma chestnut to black, metasoma lighter; wing veins dark brown, legs and first antennomeres testaceous, remaining antennomeres darker.

Head (figs. 1a-b). With short whitish pubescence; in dorsal view around 2.1 times wider than long and 1.3 wider than high in frontal view. Genae coriaceous-alutaceous, not broadened behind the compound eyes. POD three times OOL; ocelli very large, OOL slightly shorter than lateral ocelli diameter and lateral ocelli diameter more or less equal to LOL (ratio POD:OOL:LOL:lateral ocelli diameter is 6:2:3:3). Coriaceous-alutaceous sculpture on the whole of the head. Clypeus conspicuous and quadrangular in shape. Face with only some very short and weak irradiating striation around the clypeus, never reaching the antennal foramina or the compound eye's lateral margin. Transfacial line subequal to eye height, a little shorter. Diameter of toruli around twice their separation and slightly smaller than the distance between toruli and eye margin.

Antenna (fig. 1h). Presumably with 14 segments (only 13 remain), slightly longer than body length; pedicel around 2 times longer than wide; first flagellomere 1.25 times longer than F2 and around 2 times longer than the pedicel; following flagellomeres gradually decreasing in length, F11 two times longer than wide.

Mesosoma (figs. 1c-e). Glabrous except for some hairy areas in the propodeum and scutellum. Sculptured, coriaceous-alutaceous, in some areas weakly so. Notauli complete and deep over their entire length, always reaching the pronotal margin, posteriorly wide and strongly convergent (distance between them at most three times the width of the basal notauli), delimiting an area with weak longitudinally striated sculpture. Median scutal line almost absent. Pronotum laterally striated. Mesopleuron striated in its middle part, smooth and shiny in the rest. Scutellum longer than wide, with rugose sculpture, with a conspicuous lateral margin and without posterior lobes; scutellar foveae oval, with a transversal orientation, smooth, shiny and lacking any inner pubescence, not delimited posteriorly by a carina and separated from each other by a septum. Lateral carinae of propodeum thin, with a uniform thickness, subparallel or slightly curved, delimiting a shiny, smooth internal area devoid of pubescence.

Wings (fig. 1g). Hyaline; forewing with short scattered setae on its anterior margin; radial cell 4 times longer than broad; vein 2r angled; areolet inconspicuous.

Legs. Tarsal claws with a basal tooth.

Metasoma. Slightly shorter than head and mesosoma together; without pubescence except for some scattered pubescence on the basis of the 2nd abdominal tergite. Second tergite covering 4/5 of metasoma in dorsal view.

DIAGNOSIS: The morphology of the males of *A. hystrix* is closely related to that of *A. singularis* Mayr, 1870, *A. cryptobius* Wachtl 1880, and *A. cydoniae* Giraud, 1859. These species share a common shape of F1 (curved, dorsally flattened, basally excavated and wider distally), a reticulate vertex, a marginally ciliated forewing, an OOL distance which is smaller than POD and similar to the diameter of a lateral ocellus, and slightly curved to more or less arcuated propodeal carinae. Nevertheless, we can differentiate these species using the following key:

1. Scutellum rounded, as broad as long. Scutum alutaceous with shining areas. Mesopleuron finely striate in 2/3, rest of the surface smooth and shining. Head and mesosoma reddish to black *A. singularis* Mayr
 - Scutellum longer than broad. Scutum coriaceous reticulate; sculpturing more deeply impressed, with only the notaular depressions shining. Mesopleuron sculpturing variable, usually the smooth areas reduced. Head and mesosoma black, sides of the pronotum usually brown 2
2. POD nearly as long as lateral ocellus, ocelli large *A. cryptobius* Wachtl
 - POD at least 2.0 times as long as lateral ocellus, ocelli smaller 3
3. Most of the mesopleuron finely striate, only the lower area is almost smooth. Pronotum usually yellow-brown laterally, rarely black. Posterior part of mesoscutum, between the notauli, reticulate. Scutellar foveae transversal, oval *A. cydoniae* Giraud
 - Mesopleuron with long smooth areas basally and posteriorly. Pronotum black. Posterior part of mesoscutum, between the notauli, weakly striated. Scutellar foveae larger, circular *A. hystrix* Trotter

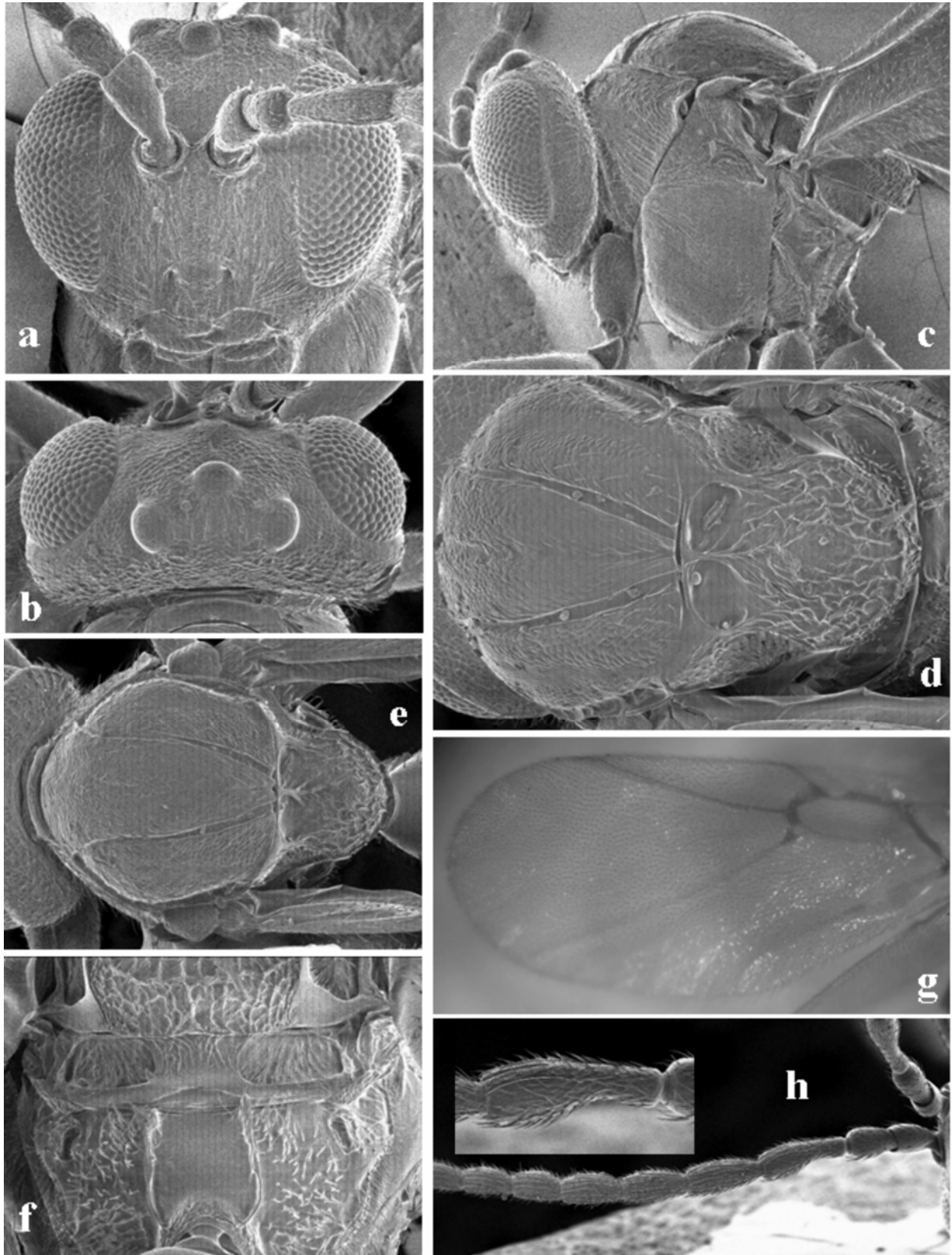


Fig. 1. Morphological features of the males of *Andricus hystrix*. (a) Head in frontal view, (b) head in dorsal view, (c) head and mesosoma in lateral view, (d, e) mesosoma in dorsal view, (f) propodeum, (g) forewing, and (h) first antennomeres and close-up view of F1.

Fig. 1. Caracteres morfológicos de los machos de *Andricus hystrix*. (a) Cabeza en vista frontal, (b) cabeza en vista dorsal, (c) cabeza y mesosoma en vista lateral, (d, e) mesosoma en vista dorsal, (f) propodeo, (g) ala anterior y (h) primeros antenómeros y detalle de F1.

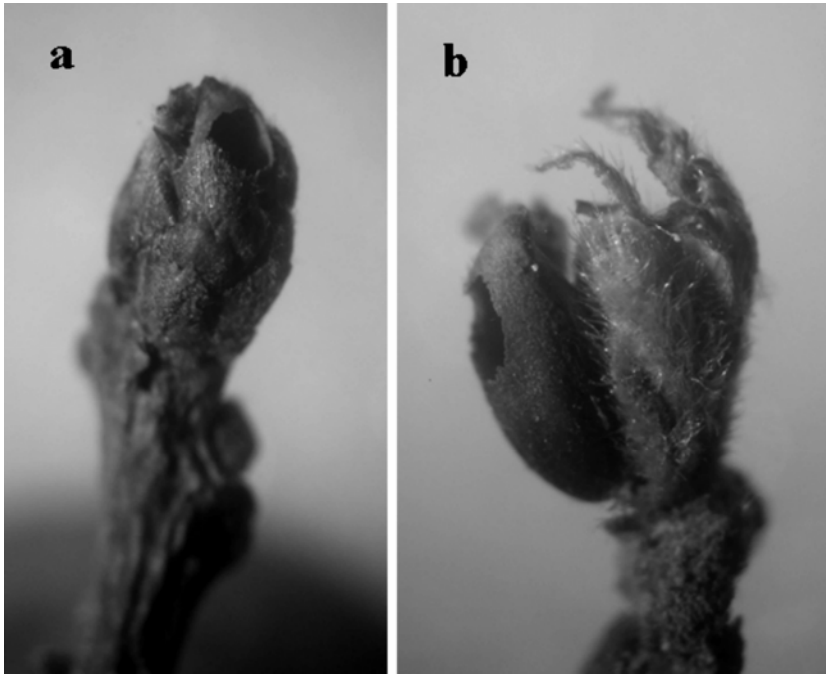


Fig. 2. Bud gall of sexual form of *Andricus hystrix*. (a) General aspect of the gall, and (b) gall without bud scales.

Fig. 2. Agalla de la forma sexual de *Andricus hystrix*. (a) Aspecto general de la agalla y (b) agalla sin las escamas de la yema.

GALL (fig. 2). Unilocular and solitary. Small, 2.8mm x 1.3mm, with nearly the entire gall inside the bud scales. The wall is very thin. Gall surface smooth, light brown to brown or orangish-brown. The gall is usually twice as tall as broad and its tip has a blunt irregular point and a lateral carina. Adults leave the gall through a large round lateral hole below the top. These galls could potentially be confused with the known sexual generation galls of several other host-alternating *Andricus* species, including *A. lignicolus*, *A. kollari*, *A. corruptrix* and *A. improprius* Bellido & Pujade-Villar, 2004, when they are alone in a bud. Nevertheless, the galls of the sexual generation of *A. hystrix* have a lateral carina, while the above species do not present this character.

PHENOLOGY. This species has a heteroecic cycle (the two generations form galls on two different oak species). The sexual adults emerge between April and May from *Q. cerris* galls; these galls appears before the oak bud itself develops. The asexual generations are found in axillary bud galls, often on young shrubs or regrowth shoots close to the ground, of *Q. petraea*, *Q. pubescens*, *Q. robur* and *Q. infectoria*; these galls develop through the summer and mature in July, with the adult emerging from late July to September.

DISTRIBUTION. Even though the asexual form of *A. hystrix* is unmistakable, this species is uncommon and easily overlooked, found from southern central Europe into Asia Minor but recorded only rarely. It has been recorded from Bulgaria, France, Greece, Italy, Hungary, Moldova, Romania and Turkey (Dalla Torre & Kieffer 1910; Ionescu 1973; Melika *et al.*, 2000; and <http://www.faunaeur.org>).

References

- DALLA TORRE, K. W. & J. J. KIEFFER 1910. Cynipidae. *Das Tierreich*, 24. Berlin, Friedlander & Sohn, 891 pp.
- FERGUSON, N. D. M. 1995. The cynipoid families. pp. 247-265. — In: Hanson, P. E. & Gauld, I. D. (eds): *The Hymenoptera of Costa Rica*. New York, Oxford University Press. xx + 893 pp.
- GIBSON, G. A. P. 1985. Some pro- and mesothoracic structures important for phylogenetic analysis of Hymenoptera, with a review of terms used for the structures. *The Canadian Entomologist*, **117**: 1395-1443.
- IONESCU, M. A. 1973. *Biologia Galelor. Monografie Cecidologica*. [Biology of Gall inducers. Monograph on Cecidology] Academiei Republicii Socialiste Romania Press, Bucuresti, 178 pp. [In Romanian].
- KIEFFER, J. J. 1897-1901. *Monographie des Cynipides d'Europe et d'Algerie. Ibalynae et Cynipinae*. Vol. I. Librairie Sc. A. Hermann, Paris.
- MELIKA, G., GY. CSÓKA & J. PUJADE-VILLAR 2000. Check-list of oak gall wasps of Hungary, with some taxonomic notes (Hymenoptera: Cynipidae, Cynipinae, Cynipini). *Annales Historico-Naturales Musei Nationalis Hungarici*, **92**: 265-296.
- PUJADE-VILLAR, J., D. BELLIDO, G. SEGÚ & G. MELIKA 2001. Current state of knowledge of heterogeny in Cynipidae (Hymenoptera, Cynipoidea). *Sessió Conjunta d'Entomologia de l'Institució Catalana d'Història Natural i la Societat Catalana de Lepidopterologia*, **11**(1999): 97-107.
- RONQUIST, F. & G. NORDLANDER 1989. Skeletal morphology of an archaic cynipoid, *Ibalia rufipes* (Hymenoptera: Ibalidae). *Entomologica Scandinavica* (Supplement), **33**: 1-60.
- STONE, G., K. SCHÖNRÖGGE, R. J. ATKINSON, D. BELLIDO & J. PUJADE-VILLAR 2002. The population biology of oak gall wasps (Hymenoptera: Cynipidae). *Annual Review of Entomology*, **47**: 633-668.
- TROTTER, A. 1899. Contributo alla conoscenza degli entomoceci-dii italiani con la descrizione de due sp. n. di *Andricus*. *Rivista di Patologia Vegetale*, **7**: 281-311.