

A new gall midge species, *Etsuhoa thuriferae* sp. n. (Diptera: Cecidomyiidae), from galls on *Juniperus thurifera* L. (Cupressaceae) in Spain

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Abstract

Etsuhoa thuriferae sp. n. is described, illustrated and differentiated from related taxa. The larvae cause bud galls on *Juniperus thurifera* L. (Cupressaceae) in Monegros, northern Spain. Data about its life cycle, parasites and distribution are given.

Key words: Taxonomy, Diptera, Cecidomyiidae, *Etsuhoa thuriferae* sp. n., *Juniperus thurifera*, Spain.

Resumen

Se describe e ilustra *Etsuhoa thuriferae* sp. n., diferenciándose de taxones próximos. Las larvas producen agallas en los brotes terminales de *Juniperus thurifera* L. (Cupressaceae) en Los Monegros, en el Norte de España. Se proporcionan datos sobre su ciclo vital, parásitos y área de distribución.

Palabras clave: Taxonomía, Diptera, Cecidomyiidae, *Etsuhoa thuriferae* sp. n., *Juniperus thurifera*, España.

INTRODUCTION

HOUARD (1918) was the first to find bud galls on the branch tips of *Juniperus thurifera* in Morocco, northern Africa, and presumed them to be caused by gall midges of the genus *Oligotrophus* Latreille, 1805. In 1991 similar galls on the same host plant species were found in the area of Monegros, in Aragon, northern Spain, by J. Blasco-Zumeta, during his intensive research on faunal composition. Partial results dealing with Cecidomyiidae have been published (SKUHRAVÁ, BLASCO-ZUMETA & SKUHRAVY, 1993). In 1994, J. Blasco-Zumeta succeeded in rearing adults from the above mentioned galls. The adults do not belong to the genus *Oligotrophus*, of the supertribe Oligotrophidi, but to the genus *Etsuhoa* Inouye, 1959, of the supertribe Cecidomyiidi, four species of which are known from Japan and central Asia.

RESULTS

Etsuhoa thuriferae sp. n.

Description:

Male (fig. 1):

Body size: 2 mm (including head and terminalia). Head broad in frontal view, with large holoptic eyes; eye-bridge five facets broad; facets circular, contiguous; mouthparts reduced. Occiput rounded without a postvertical peak but with a patch of about 100 µm long setae. Antennae 2+12 segmented, flagellomeres separate (not fused), each flagellomere consisting of two slightly unequal nodes and relatively short stems; scapus and pedicel not visible in

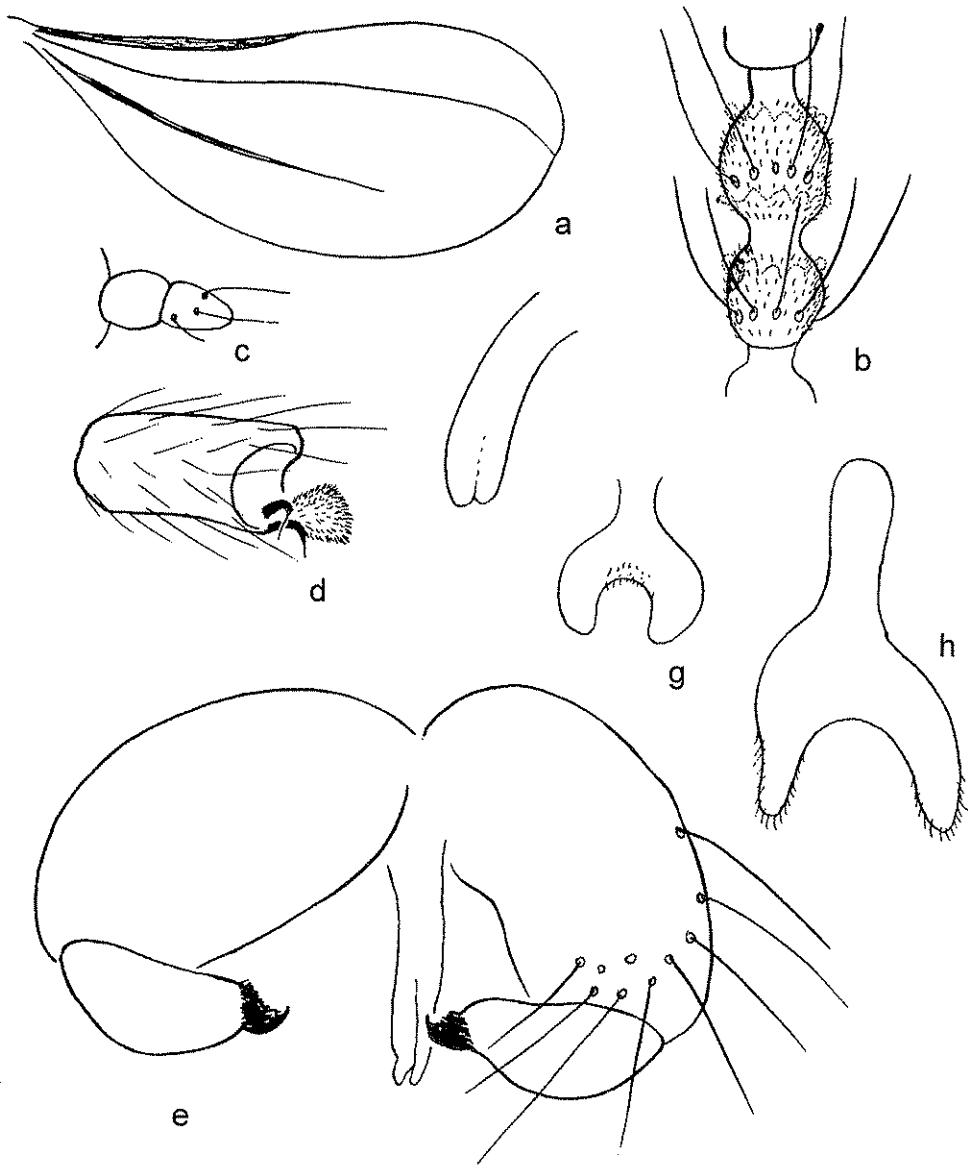


Fig. 1. *Etsuhooa thuriferae* sp. n., male: a) wing; b) fifth flagellomere; c) maxillary palp; d) fifth tarsomere with claws in lateral view; e) terminalia in dorsal view, hypoproct and cercus separated; f) aedeagus in lateral view; g) hypoproct (lower lamella); h) cercus (upper lamella).

Etsuhooa thuriferae sp. n., macho: a) ala; b) quinto flagelómero; c) palpo maxilar; d) quinto tarsómero con uñas, aspecto lateral; e) terminalia, aspecto dorsal, con hipoprocto y cerco separados; f) edeago, aspecto lateral; g) hipoprocto (lamella inferior); h) cerco (lamella superior).

the holotype. First flagellomere: proximal node 62 μm long and 37 μm broad; stem 6 μm long and 25 μm broad; distal node 55 μm long and 43 μm broad; stem 6 μm long and 20 μm broad. Second flagellomere: proximal node 43 μm long, 43 μm broad, stem 12 μm long and 20 μm broad; distal node 43 μm long, 43 μm broad, stem 12 μm long and 18 μm broad. Fifth flagellomere: proximal node 31 μm long and 37 μm broad, stem 12 μm long and 18 μm broad; distal node 43 μm long and 37 μm broad; stem 12 μm long and 15 μm broad. Flagellomeres beyond the eighth are broken in the holotype.

Each node of binodal flagellomeres is sparsely covered with microtrichia and each bears a single whorl of 90-100 μm long setae. The whorls of circumfilar loops are visible only with a scanning microscope. The proximal node has one whorl of very short circumfilar loops in the upper part, the distal node has two whorls.

Mouthparts strongly reduced. Maxillary palps two-segmented, with the segments very short; the first segment is 25 μm long and 20 μm broad; the second segment 30 μm long and 20 μm broad. Both segments are densely covered with short hairs, the second segment with three 30 μm long setae.

Wings relatively large and broad; costa not interrupted at the point of junction with R_5 ; subcosta visible only in the basal part; R_1 reaches to the middle of the anterior margin, forming with the costa a dark area which is densely covered with microtrichia and has sparse small sockets, sometimes with hairs. R_2 is in the last third slightly bent backwards and joins the costa beyond the wing apex. M_2 simple; it is strongly developed from the base up to the half of the wing and then suddenly disappears. Cu is absent. The veins are sparsely covered with hairs.

Legs long, all parts covered with thin hairs. Claws simple, very small, thin, 12 μm long, slightly bent; the empodium is large, triangular, 25 μm long, and looks like a rod in lateral view.

Terminalia thick, gonostyli conspicuously dark. Gonocoxites 170 μm long and 140 μm broad, gonostyli 95 μm long and 44 μm broad, apically with a large dark claw which has a crested margin. Aedeagus strongly curved, 12 μm broad, apically cut lengthwise; it is shorter than the gonocoxites. Cercus (upper lamella, superior lamella, tenth tergite) 95 μm broad, with a triangular 30 μm deep excision. Hypoproct (lower lamella, inferior lamella, tenth sternite) semilunar in shape, 60 μm broad, with 18 μm deep excisions. All parts of the terminalia densely covered with microtrichia.

Holotype: σ^7 , Retuerta de Pina (Pina de Ebro), Monegros (Zaragoza province), Spain, UTM location 30TYL29, 2-V-94, slide n $^\circ$ 6688, reared from *Juniperus thurifera* L., leg. J. Blasco-Zumeta. Paratypes: 10 $\sigma^7\sigma^7$ and 10 qq , same data; all in the M. Skuhrová collection, in the National Museum, Prague, Czech Republic.

Female (fig. 2):

Body size: 1.8 mm, antennae 0.6 mm long. Head broad in frontal view. Antennae: 2+12 segmented; flagellomeres cylindrical, without stems, segments gradually shortening towards the antennal apex. Scapus subconical, 43 μm long, 49 μm broad, with several setae; pedicel subglobular, 49 μm in diameter; first and second flagellomeres separate, not fused; first flagellomere 100 μm long, second flagellomere 75 μm long, fifth flagellomere 55 μm long, last flagellomere 50 μm long. All flagellomeres 30 μm broad. Each flagellomere is sparsely covered with microtrichia and bears one set of long setae in the basal third and several long setae in the central part. Two rings of irregular wavy circumfilar are visible on each flagellomere (only with a scanning microscope).

Mouthparts greatly reduced. Palps two-segmented; first segment 20 μm long, 19 μm broad; second segment 30 μm long and 19 μm broad.

Legs long, claws simple, slightly bent, 12 μm long, empodium large, triangular, 24 μm long.

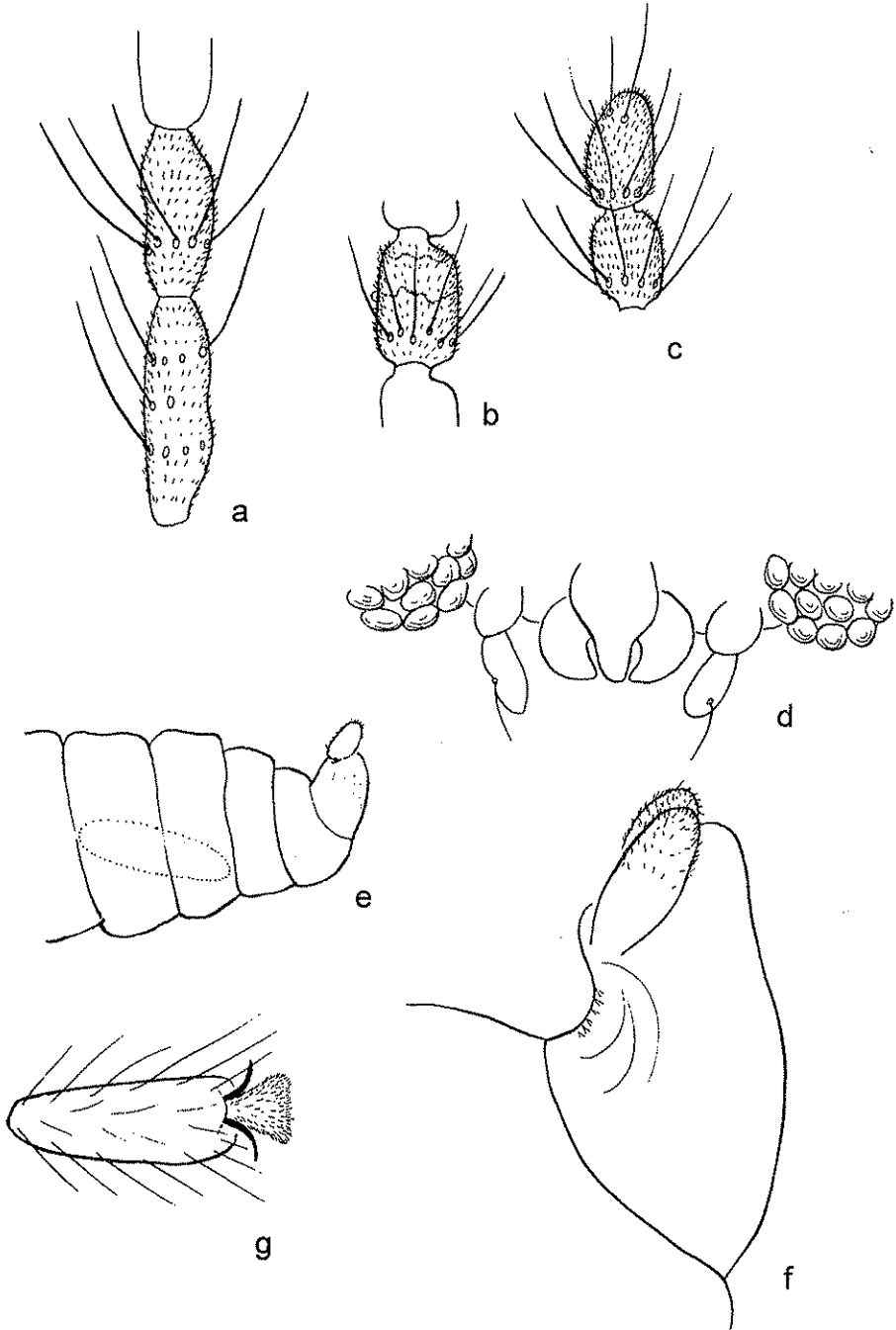


Fig.2. *Etsuhia thuriferae* sp. n., female: a) first and second flagellomeres; b) fifth flagellomere; c) eleventh and twelfth flagellomeres; d) lower part of the head; e) end part of abdomen with one egg inside; f) ovipositor; g) fifth tarsomere with claws in ventral view.

Etsuhia thuriferae sp. n., hembra: a) flagelómeros primero y segundo; b) quinto flagelómero; c) flagelómeros XI-XII; d) parte inferior de la cabeza; e) extremo del abdomen con un huevo en su interior; f) ovipositor; g) quinto tarsómero con uñas, aspecto ventral.

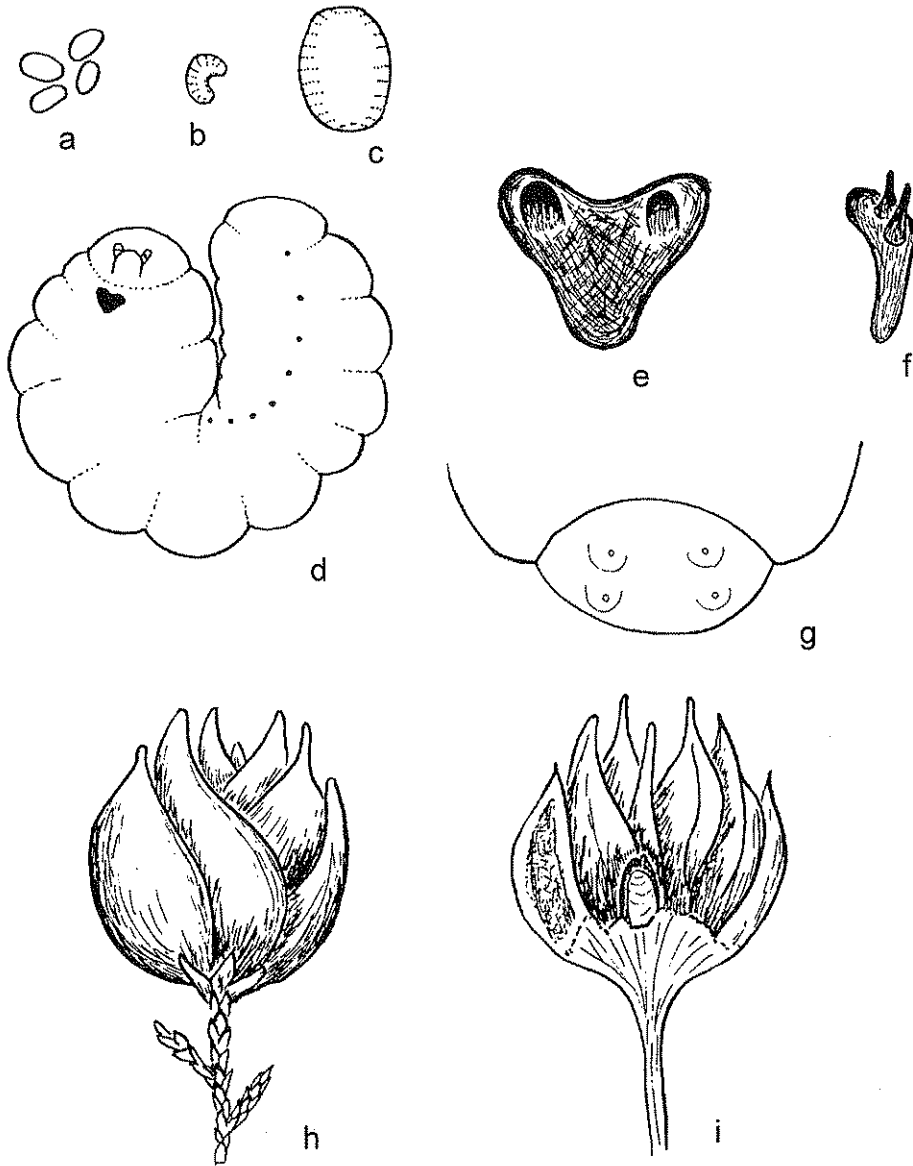


Fig. 3. *Etsuhia thuriferae* sp. n.: a) group of eggs; b-g) larva: b) first instar; c) second instar; d) third instar; e) spatula sternalis in frontal view; f) spatula sternalis in lateral view; g) anal segment of larva; h) terminal part of a branch of *Juniperus thurifera* which has changed into a gall and two normal lower branches, without galls; i) cross section of the gall showing, in a small chamber, a larva of *E. thuriferae*.

Etsuhia thuriferae sp. n.: a) grupo de huevos; b-g) larva: b) primera fase; c) segunda fase; d) tercera fase; e) espátula esternal, aspecto frontal; f) espátula esternal, aspecto lateral; g) segmento anal; h) extremo de una rama de *Juniperus thurifera* que se ha transformado en agalla y dos ramas inferiores normales, sin agallas; i) sección transversal de la agalla en la que se puede apreciar, en una pequeña cámara, una larva de *E. thuriferae*.

Ovipositor thick, the apical part arched, not protrusile; 8th segment tapering, 9th segment, at the base of the lower side, a little swollen, obliquely striated, with a pair of ovoid lamellae, each 93 μm long and 30 μm broad; both lamellae densely covered with microtrichia.

Egg:

The eggs are very small, ovoid in shape and whitish, about 150 μm long and 60 μm broad.

Larva (fig. 3):

The larval development includes three larval instars. First- instar larvae small and whitish, 200 μm long and 100 μm broad, growing to 300 μm long and 150 μm broad. The larval skin is smooth, without papillae.

Second-instar larvae also whitish; they grow inside the galls from 300 μm long and 150 μm broad, to 600 μm long and 300 μm broad. There is no spatula sternalis.

The third-instar larvae are orange in colour and have a spatula sternalis on the ventral side of the prothoracic segment. At the beginning of the instar the larvae are 600 μm long and 300 μm broad, the large larvae at the end of their development (so called «mature larvae») are 2.2 mm long and 0.9 mm broad.

The spatula sternalis is dark brown, and has an unusual shape: it is triangular, with the anterior margin slightly emarginate. The total length of the spatula sternalis of mature larvae is 70 μm ; the incision is 10 μm deep; span of the anterior margin of spatula, 80 μm . Inside the anterior part of the spatula there is a pair of horn-shaped processes 25-30 μm in length; they are most visible in lateral view (see fig. 3f).

Prothoracic segment and first to eighth abdominal segments each with a pair of spiracles. Integument of the larval body smooth, without papillae or other structures. Only the anal segment bears two pairs of terminal papillae without setae.

Pupa:

The pupa is ovoid in shape and does not lie in a U-bent position in the gall, as the larva did. The pupal body is thick, 1.8 mm long and 0.9 mm broad. Newly hatched pupae are orange-red in colour, with slightly brownish eyes. During further development, sometimes within a few hours, the eyes and the sheaths of wings and antennae gradually turn black. At the end of pupation, shortly before the emergence of the adults, the anterior part of the pupal bodies, i.e. the eyes, the sheaths of antennae, legs and wings and the dorsal part of the thorax are very dark to black, and only the abdominal segments are orange or orange-red. The basal part of the antennal sheaths bears no protuberances.

The apical part of the pupa is formed by the well-developed, protuberant and sclerotized prothoracic part, which leads the way when the adult emerges from the gall where pupation took place.

The skin of the pupal body is smooth, practically without any structures, and bears only patches of small spines in the vicinity of the spiracles, in the pleural part of abdominal segments I-VI (figs. 4-5).

Differential diagnosis:

Etsuhua thuriferae sp. n. is distinguished in the adult stage from the other species of *Etsuhua* by its two-segmented palps, by the presence of the dark area in the anterior margin of the wings between the costa and R_1 , and by the absence of the vein Cu . In the larval stage, *E. thuriferae* differs from all other species of *Etsuhua* by having a triangular spatula sternalis with a pair of horn-shaped processes.

Gall:

Rounded or ovoid galls of various sizes may be present on one shrub of *Juniperus thurifera* simultaneously. The largest galls are 10 mm long and 7 mm broad across their widest diameter, the smallest galls are about 3.5 mm up to 5 mm in diameter. The galls are situated at the branch tips and include a shortened shoot. Each gall consists of six pairs of imbricated and deformed needles.

The needles of an unattacked branch are scale-like, green, very small and thin, about 1.4 mm long and 1 mm broad. The scale-like needles of the gall vary in size and shape. The needles of the lower part of the gall are only a little enlarged, the needles of the central part of the gall are strongly enlarged, 5 mm long and 5 mm broad. The needles of the inner part of the gall are yellowish white, very small and thin. They form a small chamber, whose cavity is completely filled by the body of a single larva. Only very rarely two larvae occur in one gall. The larvae lie with the head pointing downwards to suck liquids at the tip of the vegetative top.

The strongly swollen needles of the second and third whorls form the vault of the gall and protect developing larvae with their strong walls from the negative influences of the environment, mainly from high temperatures and dry air.

The galls on trees and shrubs are green at first and then turn grey or brown when the larvae inside are mature or after the emergence of the adults. Dry and empty galls may remain on the host plants for several years.

Life cycle:

Etsuhoa thuriferae is a monovoltine species. Adults emerge from galls at the end of April through to the middle of May, depending on the weather. The females lay their eggs on buds. The hatched larvae get into the buds at the vegetative top, suck sap from these tissues, prevent the development of the branch and cause the formation of galls. Only one larva develops in each gall, inside a chamber which is fully filled by the larva's body. The larvae lie in the chamber bent like a horse-shoe. The larvae overwinter in galls and pupate there in the spring. In 1994 the adults emerged from the galls between 29 April and 13 May.

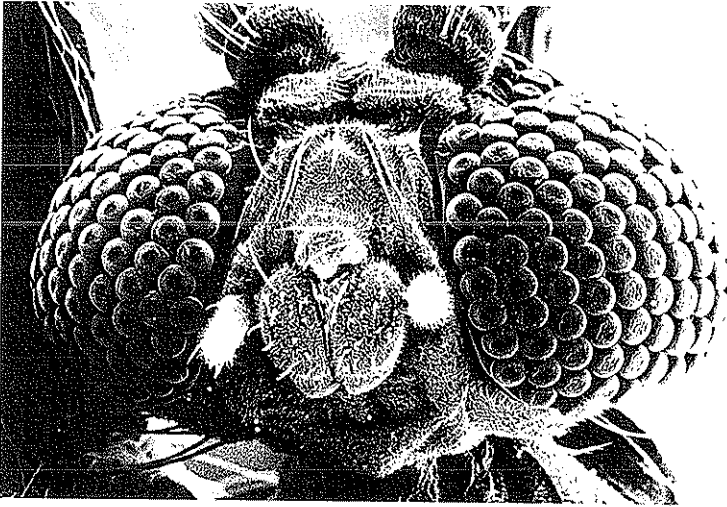
Specimens of a small moth, *Pammene juniperana* (Millière, 1858) (Lepidoptera: Tortricidae) (Dr W. Sauter *det.*, J. Blasco-Zumeta *leg.*) were reared from *E. thuriferae* galls. The caterpillars develop inside the strongly enlarged and sappy needles of these midges' galls and eat their tissues (GIJSWIJT, 1993).

Several specimens of *Hemisemidalis pallida* (Withycombe, 1924) (Neuroptera: Coniopterygidae) (Dr V. Monserrat *det.*, J. Blasco-Zumeta *leg.*) have also been reared from these galls, although it is not known whether they had preyed upon the larvae of *E. thuriferae* or merely had been using the gall as a convenient pupation chamber.

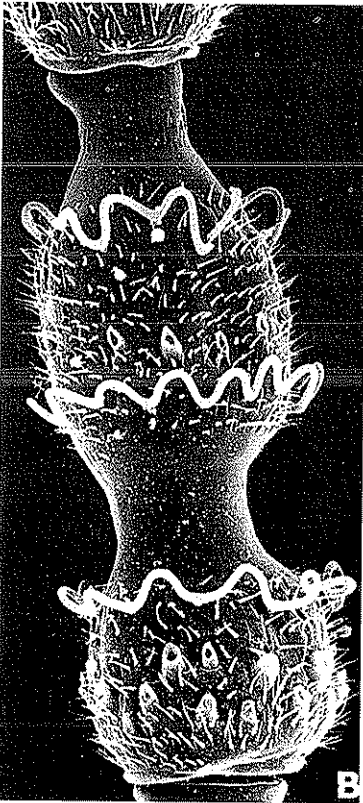
Parasites:

Many parasites belonging to various genera and species of Hymenoptera were obtained from bud galls of *E. thuriferae* during J. Blasco-Zumeta's research in the Monegros area; most of these have not been determined yet. Several of them seem to be new to science (R.R. Askew, in preparation). Quite a few specimens of one species, *Rhopalicus nudicoxalis* Askew, 1994 (Chalcidoidea, Pteromalidae) have also been reared from these galls (ASKEW, 1994).

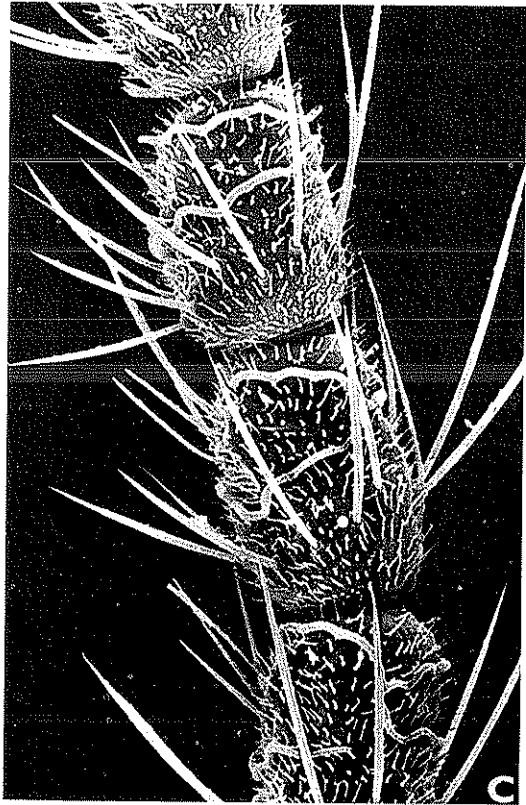
The following two species of parasitic Hymenoptera were reared from galls of *E. thuriferae* (at that time named as «Cecidomyiid galls») which were collected by M.J. Gijswijt in the province of Soria, northern Spain: *Thureonella punctata* Gijswijt, 1990 (Pteromalidae) and *Eupelmus pallicornis* Gijswijt, 1993 (Eupelmidae) (GIJSWIJT, 1990, 1993). The two species



A



B



C

Fig. 4. *Etsuhoo thuriferae* sp. n.: a) head of female; b) fifth flagellomere of male with three whorls of circumfilar loops (sensorial thread); c) third to sixth flagellomeres of female, each with two rings of sensorial thread.

Etsuhoo thuriferae sp. n.: a) cabeza de la hembra; b) quinto flagelómero del macho con tres círculos de anillos circumfilares (filamento sensorial); c) flagelómeros III-VI de la hembra, cada uno con dos círculos de filamento sensorial.

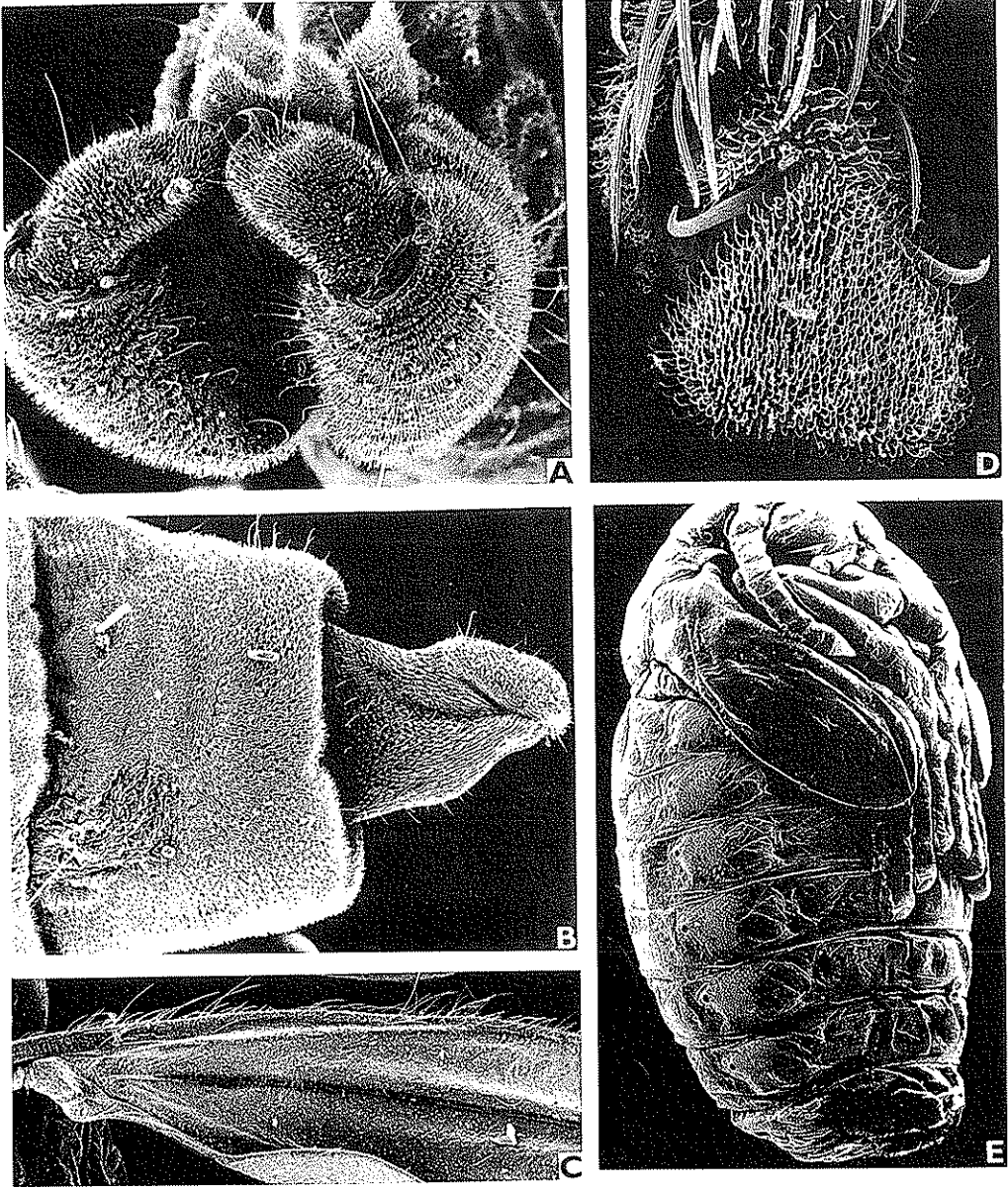


Fig. 5. *Etsuhooa thuriferae* sp. n.: a) terminalia of male; b) terminal part of ovipositor; c) basal part of a wing showing a dark area between costa and R_1 ; d) terminal part of fifth tarsomere with simple claws and empodium; e) pupa in lateral view.

Etsuhooa thuriferae sp. n.: a) terminalia del macho; b) extremo del ovipositor; c) base de un ala, donde se aprecia una zona oscura entre la costa y R_1 ; d) extremo del quinto tarsómero con uñas simples y empodium; e) pupa, aspecto lateral.

have also been collected by J. Blasco-Zumeta in the Monegros juniper forests by means of various trapping techniques (Dr R.R. Askew *det.*).

Distribution:

About 60 species of the genus *Juniperus* L. (Cupressaceae) occur in the northern hemisphere. Some are present from the northern part of Eurasia to northern Africa and from northern North America down to Central America. One species, *Juniperus communis* L., has a larger range, with a practically holarctic distribution, while most of the other species have smaller distribution areas (MEUSEL et al., 1967).

More than twenty gall midge species belonging to various genera have been described as gall producers on various host plants of the genus *Juniperus* in the Holarctic (Barnes, 1951). Many species causing galls on various junipers are still undescribed. Some species have been named and described on the basis of the galls alone, and the actual midges which produced them remain unknown; unfortunately, such names must be used as valid names.

In the Nearctic region eight gall midge species develop on various species of *Juniperus*. They belong to the genera *Oligotrophus* Latreille, 1805 (3 spp.), *Walshomyia* Felt, 1908 (4 spp.) and *Contarinia* Rondani, 1860 (1 sp.) (GAGNÉ, 1989).

In the western part of the Palaearctic region fifteen gall midge species have been described, of which five belong to *Oligotrophus*, four to *Etsuhoa* Inouye, 1959, two to *Arceuthomyia* Kieffer, 1913, and one each to *Schmidtella* Rübsaamen, 1914, *Aschistonyx* Rübsaamen, 1914, *Contarinia* Rondani, 1860, and *Rhopalomyia* Rübsaamen, 1892. Six species occur in the western part of the Palaearctic region, five have been described from Japan and four occur in central Asia (YUKAWA, 1971; SKUHRAVÁ, 1986). Among all the above mentioned gall midges, *Oligotrophus juniperinus* (Linné, 1758), which causes galls on *Juniperus communis* L., has the largest range in the Euro-Siberian subregion of the Palaearctic region (SKUHRAVÁ, 1987; SKUHRAVÁ & SKUHRAVY, 1993).

Juniperus thurifera L., the host species of *Etsuhoa thuriferae*, has a relatively small distribution area in south-western Europe and the northernmost part of Africa. It occurs in small «islands» in eastern Spain and the southernmost part of France up to the Western Alps, and also on Corsica and in Morocco. Galls of *E. thuriferae* have been found in the northern half of Spain - Monegros (by J. Blasco-Zumeta) and the province of Soria (by M.J. Gijswijt) and in Morocco (by C. Houard). This gall midge probably occurs, too, in other parts of its host plant's range (fig. 6.B).

The occurrence of *E. thuriferae* is the first record of the genus *Etsuhoa* in the west of the Palaearctic region. Other species of the genus *Etsuhoa* occur in the eastern part of the region and are associated there with different hosts of the genus *Juniperus*. *E. okayamana* Inouye, 1959 causes galls on the needles of *Juniperus rigida* Sieb. & Zucc. in Japan; *E. tjanshanica* Marikovskij, 1969 and *E. severtzovi* Marikovskij, 1969 produce bud galls on *Juniperus semiglobosa* Rgl. in Kazakhstan and *E. renifolia* Fedotova, 1985 causes bud galls on *Juniperus pseudosabina* Fisch. et Mey., also in Kazakhstan.

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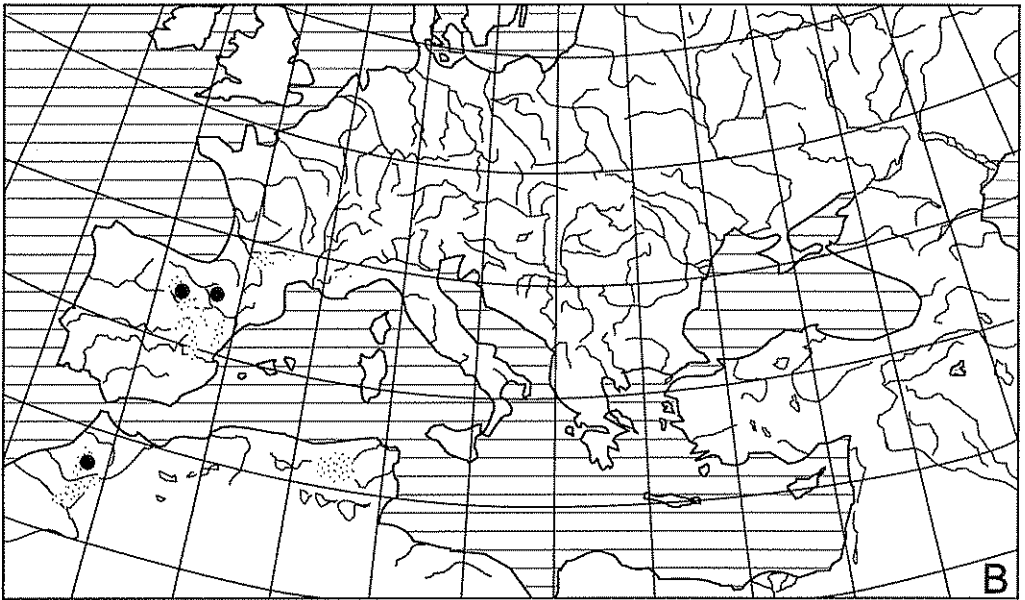
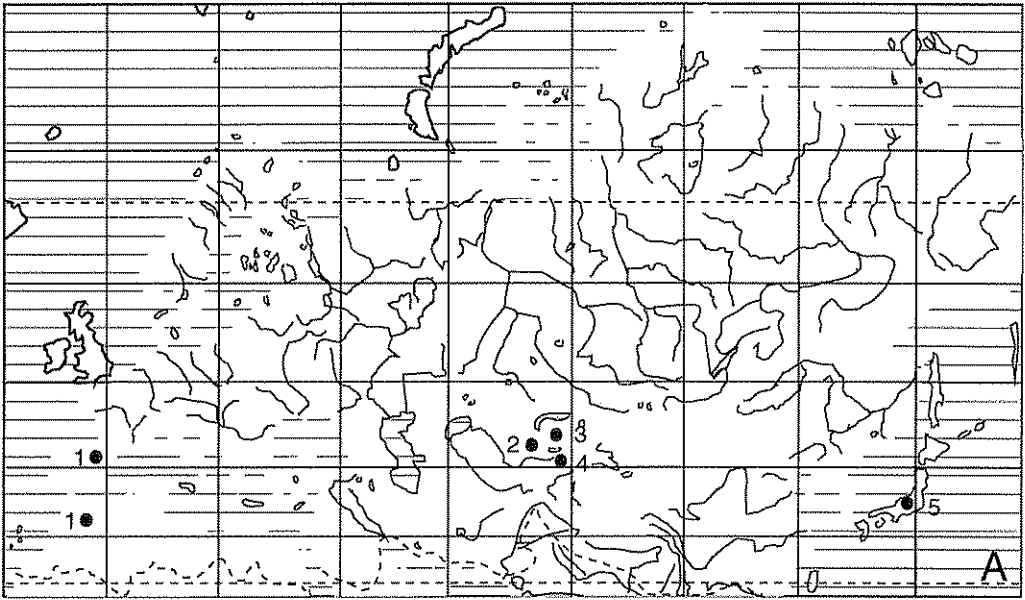


Fig. 6. a) Occurrence of gall midge species of the genus *Etsuhoa* Inouye, 1959 in the Palearctic region: 1. *E. thuriferae* sp. n.; 2. *E. renifolia* Fedotova, 1985; 3. *E. severtzovi* Marikovskij, 1969; 4. *E. tjanshanica* Marikovskij, 1969; *E. okayamana* Inouye, 1959; b) Distribution area of *Juniperus thurifera* L. in southern Europe and northern Africa (pointed), and localities where galls of *E. thuriferae* sp. n. have been found (black circles).

a) Distribución de los cecidomiidos del género *Etsuhoa* Inouye, 1959 en la región paleártica: 1. *E. thuriferae* sp. n.; 2. *E. renifolia* Fedotova, 1985; 3. *E. severtzovi* Marikovskij, 1969; 4. *E. tjanshanica* Marikovskij, 1969; *E. okayamana* Inouye, 1959; b) Distribución de *Juniperus thurifera* L. en Europa meridional y norte de África (punteado), y localidades en que se han encontrado agallas de *E. thuriferae* sp. n. (círculos negros).

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