Actes Inst. Agron. Vet. (Maroc) 2003, Vol. 23(2-4): 163-183

Ouvrages & Thèses : Revue — Books & Thesis : Review

Preliminary inventory of Hymenopteran egg parasitoids from Morocco

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جرد تمهيدي لطفيليات البيض بالمغرب

تنتمي طفيليات البيض بالمغرب إلى 18 صنفا من أربع عائلات من chalcidoidea و27 صنفا (من بينها 6 من نوع Telenamus لم تصنف بعد) من عائلتين من Proctotrupoidea. لائحة الأصناف والتي تحمل أيضا معلومات حول الشكل، وأحيانا حول الأنزيمات المدروسة بتقنية l'éléctrophorèse والتوزيع الجغرافي وكذلك بيولوجيا هذه الأصناف، بينت أن هناك 9 أصناف جديدة بالمغرب، أكثرها تتواجد في أوراسيا أو في أوربا (74%)، أو في منطقة جغرافية واسعة (10%)، غير أن 13% منها مستوطنة بالمغرب و 3% غير مستوطنة ولكن تعيش فقط في إفريقيا. جرد طفيليات البيض المغربية لازال جد ناقصا، وهنا تكمن ضرورة البحث وجمع الطفيليات التي تكشف عن فرص جديدة في المقاومة البيولوجية.

الكلمات المفتاحية : توزيع جغرافي – مضيق – الشكل – علم التصنيف

Inventaire préliminaire des parasitoïdes oophages du Maroc

Le but de ce travail était de dresser la liste des parasitoïdes oophages du Maroc. Ceux-ci appartiennent à 18 espèces incluses dans quatre familles de *Chalcidoidea* et à 27 espèces, dont six espèces de *Telenomus* non décrites, incluses dans deux familles de Proctotrupoidea. Cette liste est accompagnée d'informations (qui sont nouvelles ou issues des travaux de divers auteurs) portant sur la morphologie, quelquefois sur des enzymes étudiées par électrophorèse, sur la distribution et sur la biologie de ces espèces, dont 9 sont nouvelles pour le Maroc. La plupart des espèces vivent aussi en Eurasie ou en Europe (74%) ou dans une zone géographique encore plus large (10%). Toutefois, 13% des espèces semblent endémiques au Maroc. Parmi les espèces non endémiques seules 3% vivent en Afrique. L'inventaire des parasitoïdes oophages marocains est encore très incomplet: il nécessite donc d'autres récoltes qui pourront révéler de nouveaux moyens de lutte biologique.

Mot clés: Électrophorèse - Ditribution géographique - Hôtes - Morphologie - Systématique - Mymaridae - Encyrtidae - Eulophidae - Platygastridae - Scelionidae - Trichogrammatidae

Preliminary inventory of Hymenopteran egg parasitoids from Morocco

Egg parasitoids from Morocco, belonging to 18 species of four Chalcidoidea families and 27 species (including six undescribed species of *Telenomus*) of two Proctotrupoidea families, are listed. Information (either new data or from authors) about morphology, sometimes enzymes studied by electrophoresis, distribution and biology of these species, including 9 new ones for Morocco, is provided. Most of the species also occur in Eurasia or Europe (74%), or in a larger geographical area (10%). However, 13% of the species seem endemic to Morocco, and 3% of the non-endemic species live only in Africa. The inventory of Moroccan egg parasitoids needs other collections to be more complete and to offer new biological control opportunities.

Key words: Electrophoresis - Geographical distribution - Hosts - Morphology - Systematics - Encyrtidae - Eulophidae - Mymaridae - Platygastridae - Scelionidae - Trichogrammatidae

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INTRODUCTION

Hymenopteran egg parasitoids belong to three superfamilies (Evanoidea, Chalcidoidea and Proctotrupoidea) and 13 families. Nevertheless, they mainly form the three families Mymaridae, Trichogrammatidae and Scelionidae. These parasitoids are of great interest in biological control of agricultural and forestry pests.

Before using egg parasitoids in a biological control program, an inventory of the available species has to be carried out in the zoogeographical area. In Morocco, up to now, such an inventory only concerned the parasitoids of several Heteroptera Pentatomidae (Voegelé, 1969) and Lepidoptera Noctuidae (Bourarach, 1988). The aim of this paper is to synthesize and to complement our knowledge of Moroccan egg parasitoids. Collection being insufficient, the list of native species we furnish is only preliminary.

In the list, species or supra-specific taxa new for Morocco are indicated by *. For each species, we note names placed in synonymy by different authors (see cited authors for the justification of synonymies). Then, characters of systematic interest are furnished (either references or new data). With regard to morphology, we mainly focuse on illustrations of antenna, forewing and male genitalia. Electrophoretic data (new or from authors) sometimes complement the morphological ones. The distribution of species is noted in Morocco and other countries or geographical regions. Localities in Morocco indicated in the text are reported on a map (Figure 1). Finally, biological information is provided, especially the host records.

Although there are clearly several undescribed species of *Telenomus* in Morocco, it seems difficult at this stage in our knowledge of the taxonomy of this genus to publish new scientific names. Often without host records and without a sufficient number of individuals, we prefer to list six *Telenomus* species only by the code appearing in the Villeurbanne collection.

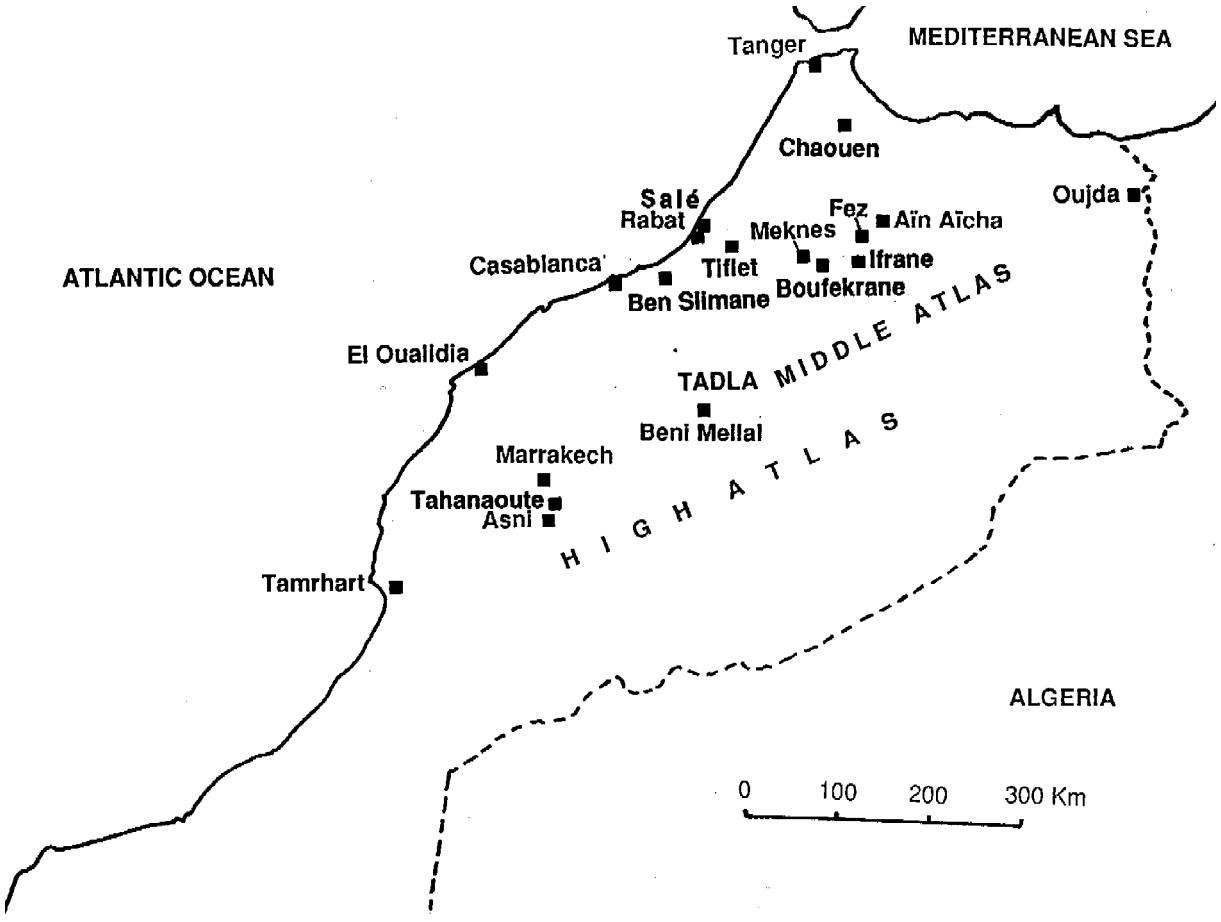

Figure 1. Localities in Morocco where egg parasitoids were collected

LIST OF EGG PARASITOIDS

CHALCIDOIDEA

Encyrtidae

Ooencyrtus Ashmead

O. fecundus Ferrière & Voegelé

Systematic characters : morphology (antenna and forewing) was illustrated by Ferrière & Voegelé (1961). Male genitalia are unknown.

Distribution : Fez, Ifrane, Marrakech, Meknes and Middle Atlas in Morocco (Voegelé, 1969). The species is present in Middle East (Ebrahimi, 1995).

Biology : hosts known are Pentatomidae such as *Aelia sp*. and *Eurygaster sp*. (Ferrière & Voegelé, 1961; Voegelé, 1969). The species is sometimes hyperparasite (Ferrière & Voegelé, 1961). Sex ratio variations were studied by Laraichi (1978).

O. masii (Mercet)*

Systematic characters : female morphology was illustrated by Mercet (1921) and Zerova *et al*. (1992). Nevertheless, some differences (general aspect of forewing, length of clava) were noted and new drawings appear in figure 2.

Distribution : Rabat in Morocco (discovered by B. Pintureau). The species is present in Europe (Mercet, 1921; Tryapitsyn, 1988a; Roversi *et al*., 1991).

Biology : hosts unknown in Morocco (one female found in a yellow trap at Rabat, 23.10.92).

O. nigerrimus Ferrière & Voegelé

Systematic characters : morphology (antenna and forewing) was illustrated by Ferrière & Voegelé (1961). Male genitalia are unknown.

Distribution : Ifrane and Middle Atlas in Morocco (Voegelé, 1969). The species is present in Middle East (Ebrahimi, 1995).

Biology : hosts known are Pentatomidae such as *Aelia sp*. and *Eurygaster sp*. (Ferrière & Voegelé, 1961; Voegelé, 1969). The species is sometimes hyperparasite (Ferrière & Voegelé, 1961).

O. pityocampae (Mercet)

Systematic characters : female morphology was illustrated by Mercet (1921). Nevertheless, some differences (general aspect of forewing, length of pedicellus) were noted and new drawings appear in figure 2. This figure shows also the male morphology.

Distribution : Tahanaoute (Schmidt *et al*., 1997) and Oujda (discovery by K. Bourarach) in Morocco. The species is present in Europe (Mercet, 1921; Biliotti, 1958; Roversi *et al*., 1991), Middle East and Tunisia (Tryapitsyn, 1988a; Ebrahimi, 1995).

Biology : hosts known in Morocco are *Lymantria dispar* L. (Lymantriidae) (Voegelé, 1969) and *Thaumetopoea pityocampa* (Denis & Schiffermüller) (Notodontidae) (Schmidt *et al*., 1997; individuals examined, July 1990). Biological characters were studied by some authors such as Tiberi & Roversi (1987), Tiberi *et al.* (1991) and Schmidt *et al*. (1997). The latter authors indicate that the species is uniparental in Morocco, but it is not the case in the population from Oujda (population examined).

O. telenomicida Vassiliev

Synonym : *flavofasciatus* Mercet.

Systematic characters : morphology (antenna and forewing) was illustrated by Mercet (1921) and Ferrière & Voegelé (1961). Male genitalia are unknown.

Distribution : High Atlas (Ferrière & Voegelé, 1961) and Middle Atlas (Voegelé, 1969) in Morocco. The species is present in Europe and Middle East (Mercet, 1921; Ferrière & Voegelé, 1961; Ebrahimi, 1995).

Biology : hosts known in Morocco are Pentatomidae such as *Aelia sp*. and *Eurygaster sp*. (Ferrière & Voegelé, 1961).

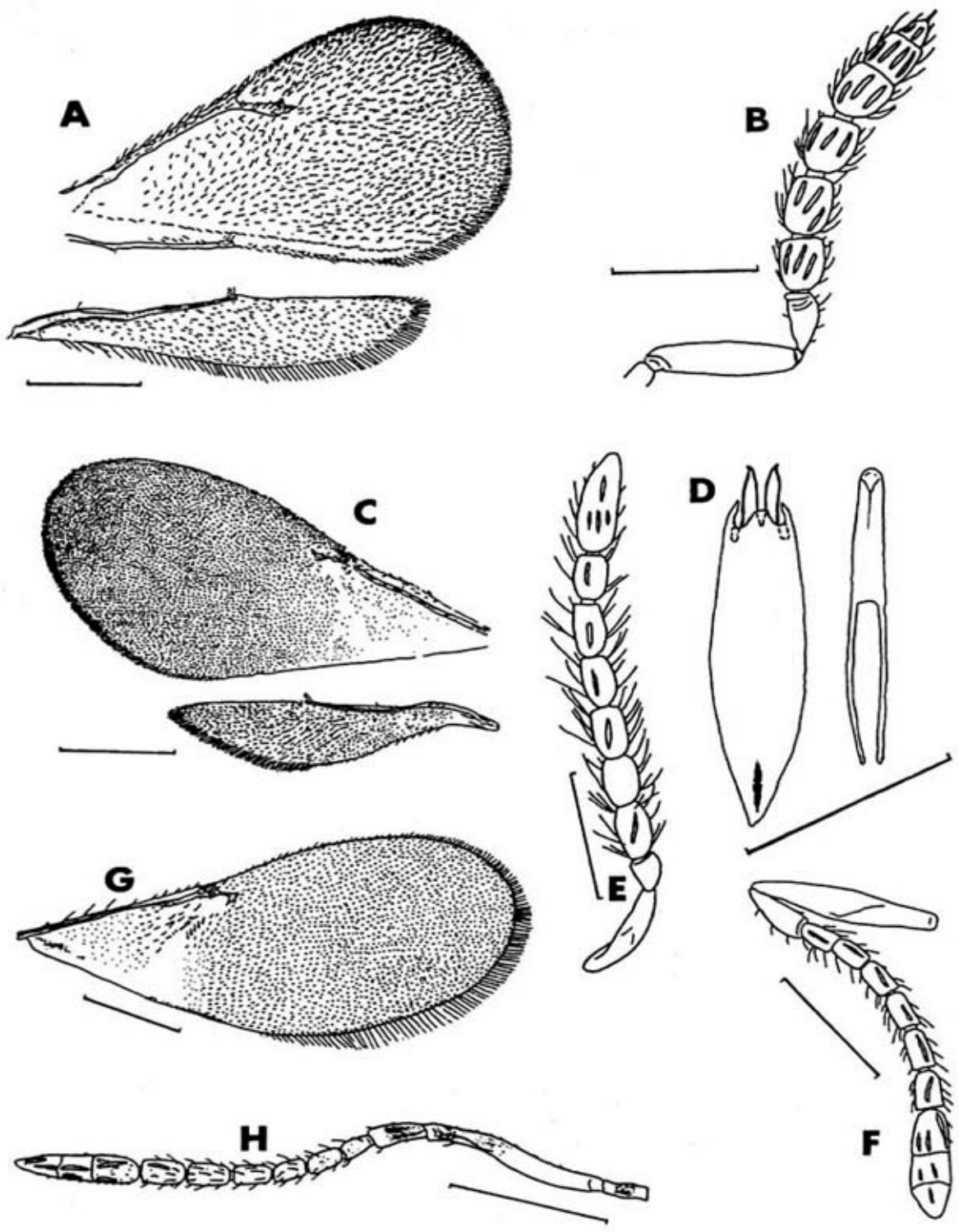

Figure 2. A, B: *Baryscapus servadeii*; A: fore and hindwings; B: female antenna. C-F: *Ooencyrtus pityocampae*; C: fore and hindwings; D: male genitalia; E: male antenna; F: female antenna. G, H: *Ooencyrtus masii*; G: forewing; H: female antenna. Bars = 0.1 mm.

Eulophidae (Tetrastichinae, Tetrastichini)

Baryscapus Foerster

B. servadeii (Domenichini)

Systematic characters : morphology is illustrated in Figure 2.

Distribution : Tahanaoute (Schmidt *et al.*, 1997), Oujda (discovered by K. Bourarach) and another locality unknown in Morocco (individuals sent in France by M.L. Ben Jamaa). The species is present in Tunisia, Middle East and Europe (Domenichini, 1964-65; Roversi *et al.*, 1991; Kitt & Schmidt, 1993).

Biology : host known in Morocco is *Thaumetopoea pityocampa* (Notodontidae) (Schmidt *et al.*, 1997; individuals examined, July 1990 and August 1991). Biological characters were studied by some authors such as Biliotti (1958), Tiberi (1978), Tiberi & Roversi (1987), Masutti *et al.* (1993) and Schmidt *et al.* (1997). The species is uniparental, with very rare males (Domenichini, 1964-65) not observed.

Mymaridae*

Mymarinae*

Mymarini*

Mymar Curtis*

M. taprobanicum Ward*

Synonyms : *aegyptiaca* Soyka, *antillanum* Dozier, ?*indicum* Mani, *tyndalli* Girault.

Systematic characters : female morphology was illustrated by Annecke (1961), Viggiani (1966) and Pintureau & Iglesias Calvín (1996).

Distribution : Rabat in Morocco (discovered by B. Pintureau). The species is present in Asia, Australia, West Indies, Azores, South Africa, southern Europe and Egypt (Annecke, 1961; Viggiani, 1966; Pintureau & Iglesias Calvín, 1996).

Biology : host unknown in Morocco (two females found in a yellow trap at Rabat, 21 and 23.10.92).

Anagrini*

Anagrus Haliday* (*Anagrus* subgenus)

A. atomus (L.)* (*atomus* group)

Synonyms : *bartheli* Tullgren, *devius* Soyka, *gabitzi* Soyka, *hundsheimensis* Soyka, *kressbachi* Soyka, *lemonicolor* Soyka, *levis* Soyka, *minimus* Menozzi, *stammeri* Soyka, *tullgreni* Hedqvist, *varius* Soyka.

Systematic characters : morphology was illustrated by Debauche (1948), Viggiani (1970, 1972-73, 1988), Tryapitsyn (1988b) and Chiappini (1989). Morphometric characters were studied by Chiappini & Curto (1988).

Distribution : Rabat in Morocco (discovered by B. Pintureau). The species is present in Europe (Debauche, 1948; Hincks, 1960; Tryapitsyn, 1988b; Chiappini, 1989).

Biology : hosts unknown in Morocco (one female found in a yellow trap at Rabat, 21.10.92). Biological characters were studied by Whalley (1956, 1969).

Anaphini*

Anaphes Haliday* (*Anaphes* subgenus)

A. euryale Debauche* (*crassicornis* group)

Systematic characters : female morphology was illustrated by Debauche (1948). Male antenna and genitalia appear in figure 3.

Distribution : Meknes and Rabat in Morocco (discovered by B. Pintureau). The species is present in Europe (Debauche, 1948; Hellén, 1974; Tryapitsyn, 1988b).

Biology : hosts unknown in Morocco (one female and two males found in a yellow trap, 22 and 23.10.92 at Meknes and Rabat, respectively).

Gonatocerinae, Gonatocerini*

Gonatocerus Nees*

G. litoralis (Haliday)* (*litoralis* group)

Synonyms : *arduennae* Mathot, *cunctator* Mathot, *effusi* Bakkendorf, *paludis* Debauche, *pulchellus* Hellén, *radiculatus* Ahlberg, *rhacodes* Debauche.

Systematic characters : female

Figure 3. A, B: *Anaphes euryale*; A: male antenna; B: male genitalia. C, D: *Gonatocerus litoralis*; C: male antenna; D: male genitalia with separated aedeagus. Bars = 0.1 mm (antennae) or 0.05 mm (genitalia).

morphology was illustrated by Debauche (1948), Matthews (1986) and Tryapitsyn (1988b). Male antenna and genitalia appear in figure 3.

Distribution : Rabat in Morocco (discovered by B. Pintureau). The species is present in Europe (Debauche, 1948; Mathot, 1969; Graham, 1973; Hellén, 1974; Matthews, 1986; Tryapitsyn, 1988b).

Biology : hosts unknown in Morocco (one male found in a yellow trap at Rabat, 23.10.92).

Trichogrammatidae

Trichogrammatinae, Trichogrammatini

Trichogramma Westwood (*Trichogramma* subgenus)

T. bourarachae Pintureau & Babault (*perkinsi* group)

Systematic characters : morphology was illustrated by Pintureau & Babault (1988). Different enzymes were analyzed by Bourarach (1985, 1990), Pintureau & Babault (1988), Mimouni (1990), and Pintureau (1993a). Table 1 shows new data on esterases of three strains from a Moroccan population, where no supplementary alleles are identified but some allelic frequencies are different from those so far computed. Morphometric characters were studied by Bourarach & El Ghanmi (1990), Bourarach (1990) and Rohi & Pintureau (2003).

Distribution : El Oualidia (Bourarach, 1985, 1988, 1990; Pintureau & Babault, 1988; Bourarach & El Ghanmi, 1990; Mimouni, 1991; Pompanon *et al*., 1993) and Tadla (Bourarach, 1990; Mimouni, 1991; Pompanon *et al*., 1993; Rohi, 1993) in Morocco. The species is present in Portugal (Silva *et al*., 1999).

Biology : hosts known are Noctuidae such as *Helicoverpa armigera* Hübner (Bourarach, 1985, 1988, 1990; Pintureau & Babault, 1988; Mimouni, 1991) and Nymphalidae such as *Vanessa cardui* L. (Bourarach, 1990; Mimouni, 1991).

Table1. Allelic frequencies of esterase loci in three strains of *Trichogramma bourarachae* from Tadla (T1A, T1B, T1C) and one strain of *Trichogrammatoidea lutea* from Tadla (T2B). n: number of analyzed samples (homogenates of 20 adult descendants of one virgin female)

Loci	Alleles	..... *T. bourarachae*			*T. lutea*
	T1A	T1B	T1C	T2B	
Est 1	0	1	1	1	
	0.16				1
		n=36	n=57	n=34	n=36
Est 2	0				1
	0.15	0.542		0.338	
	0.16bis	0.458	1	0.662	
		n=36	n=57	n=34	n=36
Est 4	0				1
	0.51bis	1	1	1	
		n=19	n=19	n=20	n=36
Est 4'	0	1	1	1	
	0.28-0.30-0.32-0.34				0.132
	0.43-0.46-0.49-0.52				0.868
		n=36	n=57	n=34	n=34
Est 5'	0				1
	0.44-0.47	0.556		0.397	
	0.46-0.49	0.444	1	0.603	
		n=36	n=57	n=34	n=36
Est 8	0	1	1	1	
	0.59bis				1
		n=36	n=57	n=34	n=36

Biological and behavioral characters were studied by Bourarach (1985, 1990), Mimouni (1990, 1991), Pompanon *et al*. (1993) and Rohi (1993, 2002).

T. cacoeciae Marchal (*pretiosum* group)

Synonyms : *flavum* Marchal, *telengai* Sorokina; the nomen nudum *T. neustadt* Xie & Zhu corresponds to this species.

Systematic characters : morphology was illustrated by Sorokina (1977a) who named the species "*T. embryophagum* (Hartig), thelytokous form". Different enzymes were analyzed by Pintureau (1993a, b) and some other authors (Bourarach, 1985; etc.).

Distribution : El Oualidia in Morocco (Bourarach, 1985, 1988, 1990; Pintureau & Babault, 1988). The species is present in all Europe (Pintureau, 1990) and in Asia (Pintureau, 1987).

Biology : hosts known in Morocco are

Noctuidae such as *Scotia segetum* Schiffermüller (Bourarach, 1985, 1988). Biological characters, behavior and population dynamics were studied by numerous authors (Bourarach, 1985, 1990; etc.).

T. cordubensis Vargas & Cabello (*minutum* group)

Systematic characters : morphology was illustrated by Vargas & Cabello (1985). Different enzymes were analyzed by Pintureau *et al.* (1991) and Pintureau (1993a).

Distribution : El Oualidia in Morocco (Bourarach, 1985, 1988, 1990; Pintureau & Babault, 1988). The species is also present in Spain (Pintureau, 1990), Algeria (Pintureau & Babault, 1988) and Azores (Pintureau *et al*., 1991).

Biology : hosts known in Morocco are Noctuidae such as *Helicoverpa armigera* (Bourarach, 1985, 1988, 1990). Biological characters were studied by Bourarach (1985, 1990).

T. embryophagum (Hartig) (*pretiosum* group)*

Synonym : *bezdencovii* Bezdenko.

Systematic characters : morphology was illustrated by Sorokina (1977a) who named the species "*T. embryophagum* (Hartig), arrhenotokous form". Esterases were analyzed by Walter (1985).

Distribution : Chaouen, Fez, Ifrane, Meknes, Oujda and Tanger in Morocco (pers. comm. and individuals sent in France by M.H. Ben Jamaa; Questinne & Miermont, 1979). The species is present in several European countries (Pintureau, 1990) and in Asia (Sorokina, 1977b).

Biology : host known in Morocco is *Thaumetopoea pityocampa* (Notodontidae) (individuals examined, August 1991). Biological characters were studied by some authors such as Tiberi & Roversi (1987) and Tiberi *et al.* (1991).

T. voegelei Pintureau (*evanescens* group)

Systematic characters : morphology was illustrated by Pintureau & Voegelé (1980) who named the species *T. evanescens* Westwood. Different enzymes were analyzed by Mimouni (1990) and Pintureau (1993a,b). Morphometric characters were studied by Bourarach (1990), Bourarach & El Ghanmi (1990) and Pintureau (1993c).

Distribution : El Oualidia (Bourarach, 1988, 1990), Tadla (Bourarach, 1988, 1990; Bourarach & El Ghanmi, 1990; Mimouni, 1991; Pompanon *et al*., 1993; Rohi, 1993), Beni Mellal (Pintureau & Babault, 1988) and Meknes (Mimouni, 1991; Pompanon *et al*., 1993) in Morocco. The species is also present in South of France (Pintureau, 1990).

Biology : hosts known in Morocco are Noctuidae such as *Helicoverpa armigera* (Bourarach, 1988) and Nymphalidae such as *Vanessa cardui* (Bourarach, 1990; Mimouni, 1991; Rohi, 1993). Biological and behavioral characters were studied by Bourarach (1990), Mimouni (1990, 1991), Fleury *et al*. (1991), Pompanon *et al.* (1993) and Rohi (2002).

Trichogrammatoidea Girault*

T. lutea Girault (*lutea* group)*

Systematic characters : morphology was illustrated by Nagaraja (1978). Different enzymes were analyzed by Pintureau (1993a). Table 1 shows data on esterases of a Moroccan strain, where two supplementary alleles (Est 2^{0}, Est $4'^{0.28\text{-}0.30\text{-}0.32\text{-}0.34}$) are identified. The Moroccan strain is similar to the four strains already studied (Ivory Coast, Mali, Senegal, Rep. South Africa) at Est 1, different to these four strains at Est 2, partially similar to the strain from Ivory Coast at Est 4', similar to the strains from Mali, Senegal and Rep. South Africa at Est 7 (null allele), and partially similar to the strain from Rep. South Africa at Est 8. Morphometric characters were studied by Nagaraja (1978).

Distribution : Tadla in Morocco (discovery by L. Rohi) which is the unique locality known in the palearctic region. The species is present in several Afrotropical countries (Pintureau & Babault, 1988).

Biology : host known in Morocco is *Vanessa cardui* (Nymphalidae) (individuals examined, autumn 1992). Biological characters were studied by some authors as Bourarach & Hawlitzky (1989).

Oligositinae

Oligositini

Oligosita Walker (*Oligosita* subgenus)

O. anomala Viggiani (*collina* group)

Systematic characters : morphology was illustrated by Viggiani (1981a).

Distribution : Rabat and Salé in Morocco (Viggiani, 1981a). The species is also present in Italy (Viggiani, 1981a).

Biology : although this species is oophagous (eggs of Orthoptera Ephippigeridae are presumed hosts in Italy), the host known in Morocco is the puparium of *Phytophaga destructor* (Say) (Dipt. Cecidomyidae) (Viggiani, 1981a, b).

Chaetostrichini*

Uscana Girault*

U. senex (Grese)*

Synonym : *bruchocida* Vassiliev.

Systematic characters : morphology was illustrated by Fursov (1987).

Distribution : Ben Slimane in Morocco (discovery by K. Bourarach) which is the unique locality known in Africa. The species is present in Central and West Europe (Steffan, 1954; Fursov, 1987, 1995).

Biology : host collected in Morocco is *Bruchus rufimanus* Boheman (Bruchidae) (individuals examined, April 1990).

PROCTOTRUPOIDEA

Platygastridae

Sceliotrachelinae, Fidiobiini

Platystasius Nixon

P. transversus (Thomson)

Synonyms : *janssoni* Sundholm, *strangaliophagus* Nixon.

Systematic characters : morphology (antenna) was illustrated by Kozlov (1988a). Male genitalia are unknown, and forewing was not illustrated.

Distribution : Rabat in Morocco (Fraval & Haddan, 1988). The species is present in Europe (Kozlov, 1971, 1988a; Fraval & Haddan, 1988).

Biology : host known in Morocco is *Phoracantha semipunctata* (F.) (Cerambycidae) (Fraval & Haddan, 1988).

Scelionidae

Scelioninae, Gryonini

Encyrtoscelio Dodd

E. turneri Waterston

Systematic characters : morphology (only male antenna) was illustrated by Caleca & Bin (1995).

Distribution : Tamrhart, near Agadir, in Morocco (Caleca & Bin, 1995). The species is present in South Europe, Africa and Israel (Caleca & Bin, 1995).

Biology : hosts unknown in Morocco.

Gryon Haliday

G. monspeliensis (Picard) (*monspeliensis* group)

Synonyms : *afanassievi* Meyer, *telengai* Rjachovsky. Moroccan individuals were included in another species, *G. laraichii* Mineo. However, Mineo (1979) furnished no "description or definition that states in words characters that are purported to differentiate the taxon" (international code of zoological nomenclature). In contrast, the author wrote "I am not able to find strong morphological differences between the two species" (*monspeliensis* and *laraichii*), *laraichii* being only named from failed mating experiments (unpublished results). So, *laraichii* is a *nomen nudum*.

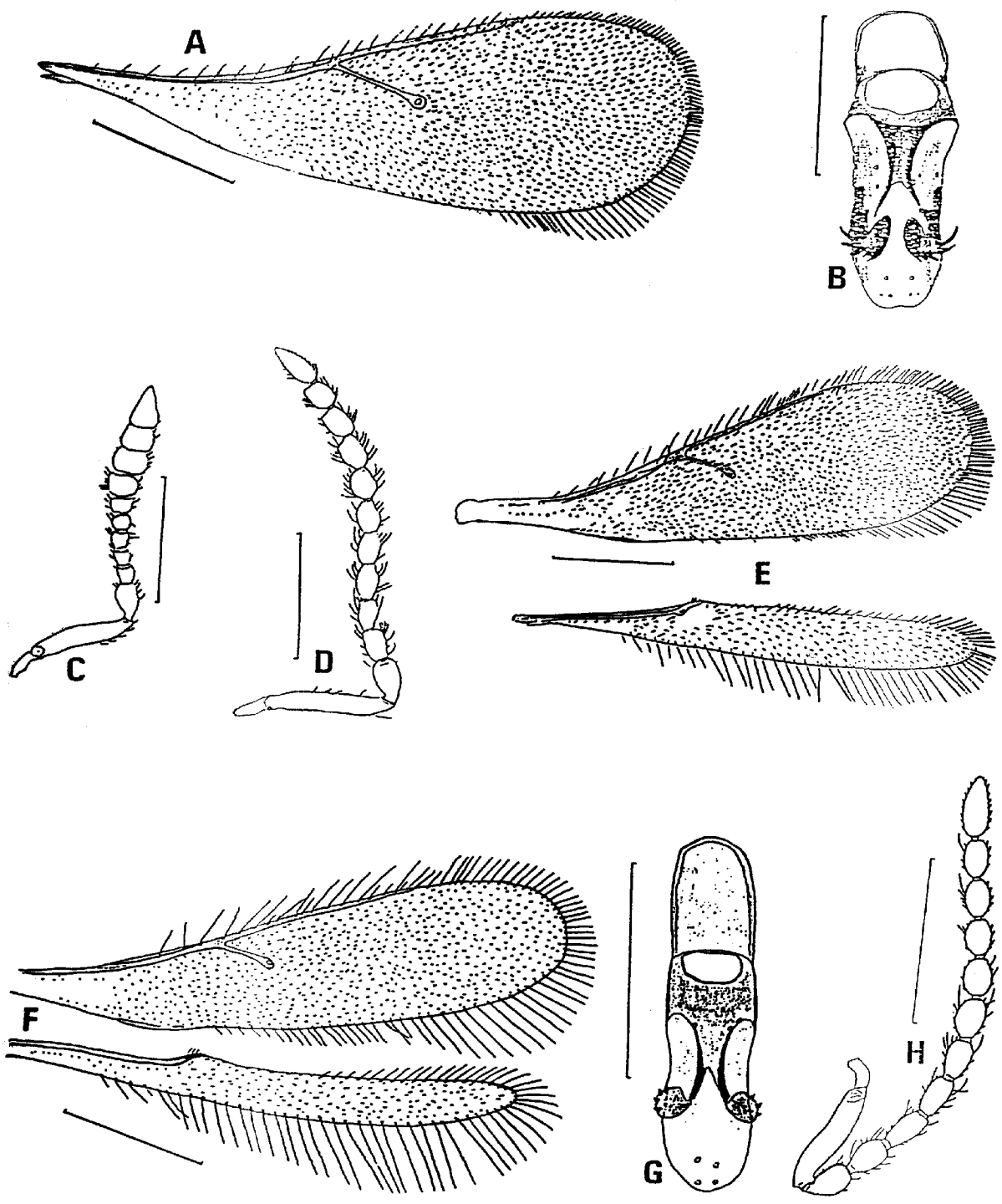

Figure 4. A: forewing of *Telenomus tetratomus*. B-E: *Telenomus laeviceps*; B: male genitalia; C: female antenna; D: male antenna; E: fore and hindwings. F-H: *Telenomus* sp. M1; F: fore and hindwings; G: male genitalia; H: male antenna. Bars=0.1 mm (wings and antennae) or 0.05 mm (genitalia).

Systematic characters : morphology (female and male antennae and wings of *monspeliensis*, male antenna and genitalia of *laraichii*) was illustrated by Mineo (1979) and Kozlov & Kononova (1990).

Distribution : Meknes and Middle Atlas in Morocco (Voegelé, 1969). The species is present in Europe and Middle East (Kozlov, 1971; Mineo, 1979; Kozlov & Kononova, 1990; Ebrahimi, 1995).

Biology : hosts known in Morocco are Pentatomidae such as *Aelia sp.* (Voegelé, 1969). Biological characters were studied by Mineo (1977).

Telenominae, Telenomini

Telenomus Haliday (*Telenomus* subgenus)

T. busseolae Gahan (*californicus* group)

Synonym : *hylas* Nixon.

Systematic characters : morphology was illustrated by Nixon (1935), Fergusson (1983), Polaszek & Kimani (1990) and Polaszek *et al.* (1993).

Distribution : El Oualidia in Morocco (Bourarach, 1988). The species is present in Egypt, South Europe, Africa, Middle East and Asia (Fergusson, 1983; Polaszek & Kimani, 1990; Polaszek *et al*., 1993; Ebrahimi, 1995).

Biology : hosts known in Morocco are Noctuidae such as *Sesamia nonagrioides* Lef., *Spodoptera littoralis* B. and perhaps *Busseola fusca* (Fuller) (Bourarach, 1988; Polaszek *et al*., 1993). Biological characters were studied by Moutia & Courtois (1952).

T. chloropus (Thomson) (*podisi* group)

Synonyms : *gifuensis* Ashmead, *mayri* Sokolov, *sokolovi* Kieffer, *sokolovi* Mayr, *tischleri* Nixon.

Systematic characters : morphology was illustrated by Javahery (1968), Kozlov & Kononova (1983), Ryu & Hirashima (1985a, b) and Zerova *et al.* (1992).

Distribution : Meknes and Middle Atlas in Morocco (Voegelé, 1969). The species is present in Europe, Middle East and East Asia (Javahery, 1968; Kozlov, 1971; Kozlov & Kononova, 1983; Ryu & Hirashima, 1985a; Ebrahimi, 1995).

Biology : hosts known in Morocco are Pentatomidae such as *Aelia sp*. (Voegelé, 1969). The species is sometimes hyperparasite (Kozlov, 1988b).

T. heydeni Mayr (*podisi* group)

Systematic characters : morphology (antenna and forewing) was illustrated by Kozlov & Kononova (1983). Male genitalia are unknown.

Distribution : Meknes and Middle Atlas in Morocco (Voegelé, 1969). The species is present in East Europe (Kozlov, 1971, 1988b).

Biology : hosts known in Morocco are Pentatomidae such as *Aelia sp*. (Voegelé, 1969).

T. laeviceps Foerster* (*californicus* group)

Systematic characters : female and male antennae were illustrated by Kozlov & Kononova (1983) and Kozlov (1988b). Morphology appears in figure 4.

Distribution : Tadla in Morocco (discovered by L. Rohi). The species is present in East Europe (Kozlov & Kononova, 1983), France and Azores (discovered by B. Pintureau).

Biology : host known in Morocco is *Vanessa cardui* (Nymphalidae). The species was reared in the laboratory on *Mamestra oleracea* L. (Noctuidae) (individuals examined, April 1990 and automn 1991). Biological characters were studied by Rohi (1993, 2002) and Rohi *et al*. (2002a, b).

T. punctatissimus (Ratzeburg) (*californicus* group)

Systematic characters : morphology (female antenna, forewing, male genitalia) was illustrated by Fabritius (1974) and Kozlov & Kononova (1983). Male antenna was not illustrated.

Distribution : El Oualidia (Bourarach,

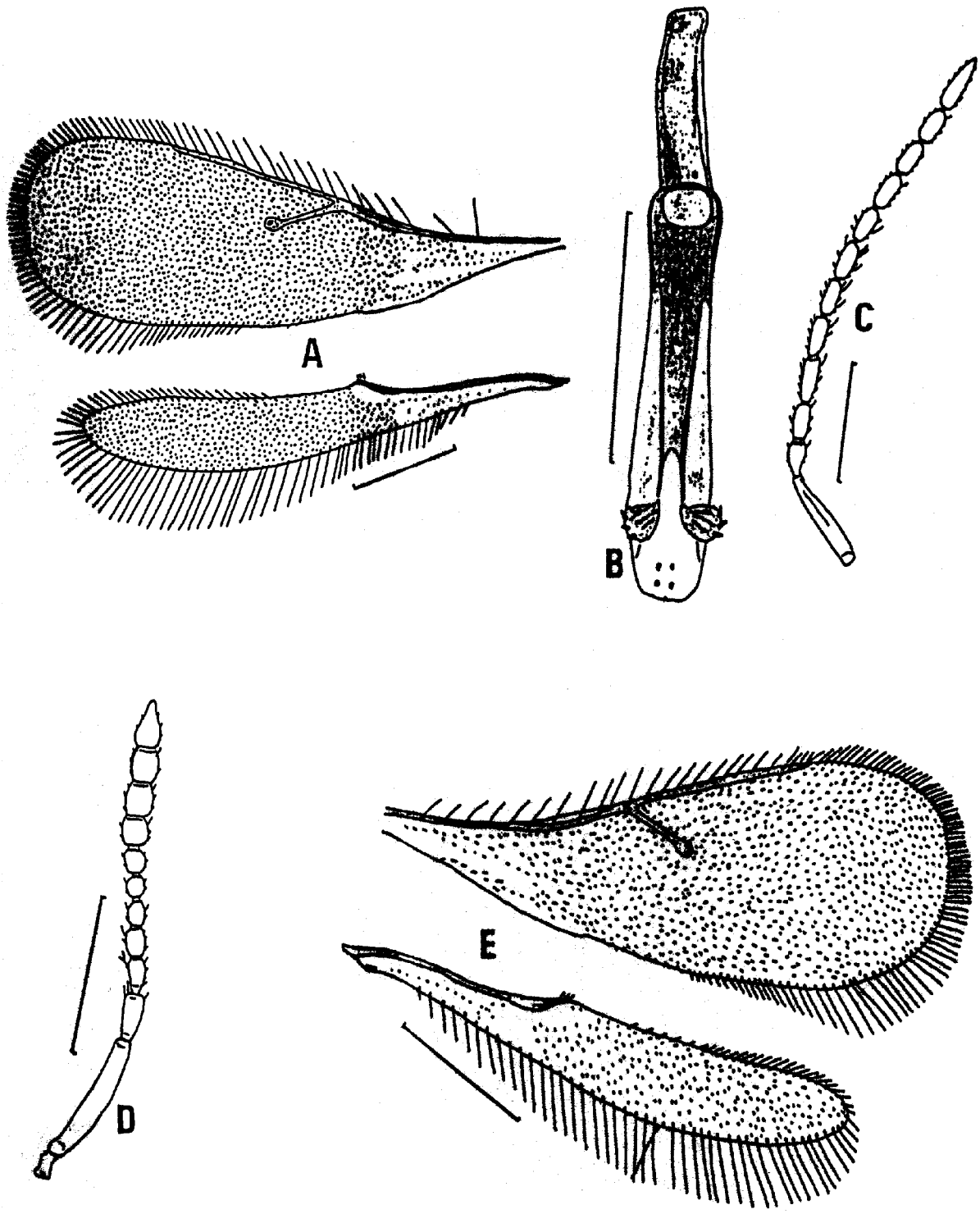

Figure 5. A-C: *Telenomus* sp. M2; A: fore and hindwings; B: male genitalia; C: male antenna. D, E: *Telenomus* sp. M3; D: female antenna; E: fore and hindwings. Bars = 0.1 mm (wings and antennae) or 0.05 mm (genitalia)

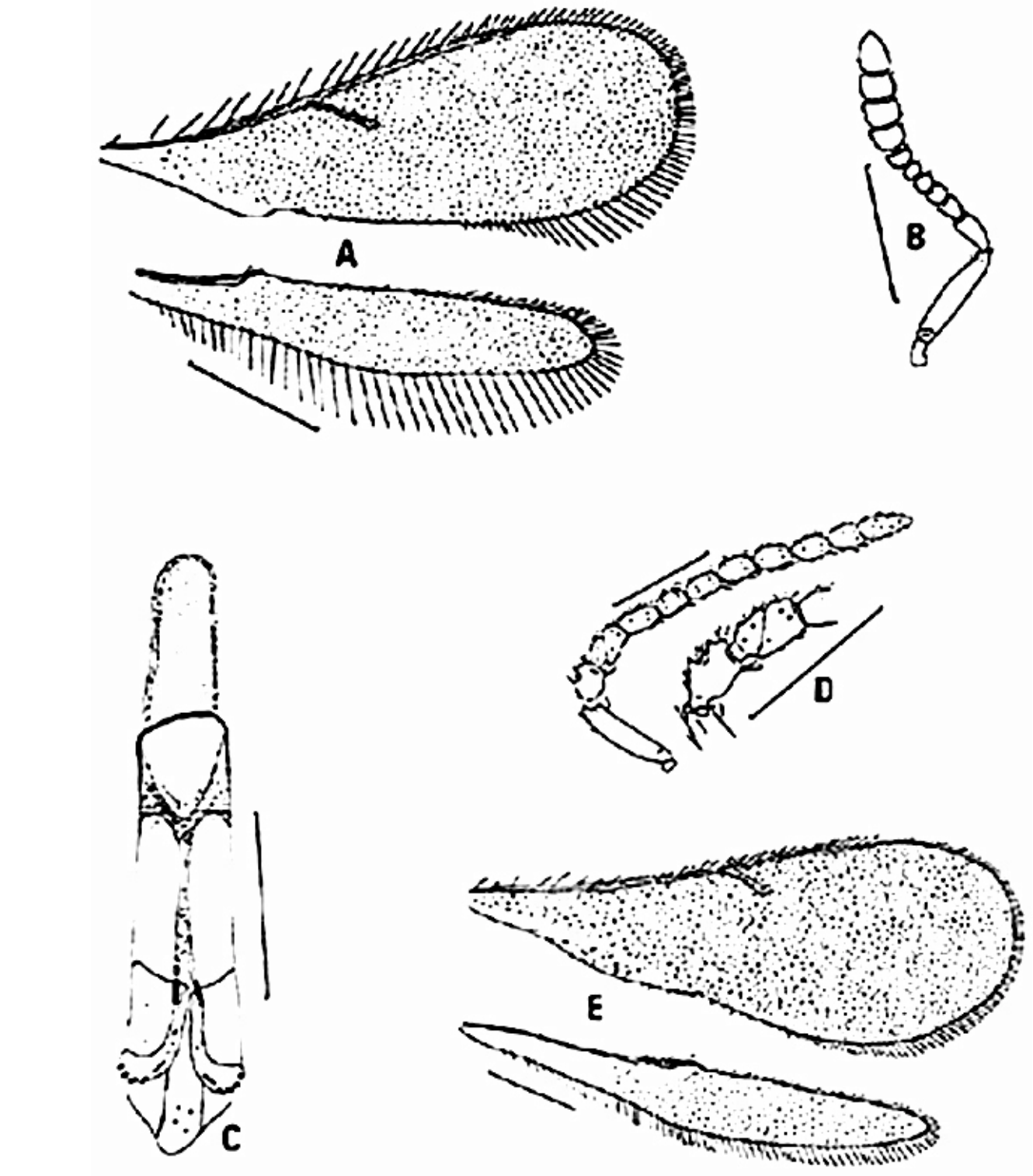

Figure 6. A, B: *Telenomus* sp. M4; A: fore and hindwings; B: female antenna. C-E: *Telenomus* sp. M5; C: male genitalia; D: male antenna with details of pedicellus and two first funicular segments; E: fore and hindwings. Bars = 0.1 mm (wings and antennae) or 0.05 mm (genitalia).

1988, 1990) and Tadla (Bourarach, 1990) in Morocco. The species is present in East Europe (Kozlov, 1971, 1988b; Fabritius, 1974).

Biology : hosts known in Morocco are Noctuidae such as *Helicoverpa armigera* and *Scotia segetum* (Bourarach, 1988, 1990) and Nymphalidae such as *Vanessa cardui* (Bourarach, 1990).

T. tetratomus Thomson* (*californicus* group)

Synonyms : *bombycis* Mayr, *gracilis* Mayr, *verticillatus* Kieffer.

Systematic characters : morphology (female and male antennae, male genitalia) was illustrated by Fabritius (1974), Kozlov & Kononova (1983) and Kozlov (1988b). Forewing appears in figure 4.

Distribution : Rabat in Morocco (discovered by B. Pintureau). The species is present in Europe and Asia (Kozlov, 1971, 1988b; Fabritius, 1974; Kozlov & Kononova, 1983; Kononova, 1994).

Biology : host unknown in Morocco (one female found in a yellow trap at Rabat, 23.10.92).

T. truncatus Nees (*podisi* group)

Systematic characters : morphology was illustrated by Javahery (1968) and Fabritius (1974).

Distribution : Ifrane in Morocco (Voegelé, 1969). The species is present in Europe (Javahery, 1968; Fabritius, 1974).

Biology : hosts known in Morocco are Pentatomidae such as *Aelia sp*. (Voegelé, 1969).

T. sp. M1* and *T.* sp. M2*

Systematic characters : male morphology appears in figures 4 and 5.

Distribution : Rabat in Morocco (discovered by B. Pintureau).

Biology : hosts unknown (one male of each species found in a yellow trap at Rabat, 23.10.92).

T. sp. M3* and *T.* sp. M4*

Systematic characters : female morphology appears in figures 5 and 6.

Distribution : Rabat in Morocco (discovered by B. Pintureau).

Biology : hosts unknown (one female of each species found in a yellow trap at Rabat, 21.10.92 for *T.* sp. M3 and 23.10.92 for *T.* sp. M4).

T. sp. M5*

Systematic characters : male morphology appears in figure 6. This species seems to belong to the genus *Telenomus* in spite of very particular antennae and genitalia.

Distribution : Meknes in Morocco (discovered by B. Pintureau).

Biology : hosts unknown (one male found in a yellow trap at Meknes, 22.10.92).

Trissolcus Ashmead

T. basalis (Wollaston) (*semistriatus* group)

Synonyms : *maderensis* Wollaston, *megacephalus* Ashmead, *piceipes* Dodd.

Systematic characters : morphology (antenna and forewing) was illustrated by Nixon (1935), Voegelé (1962, 1965a), Kozlov & Kononova (1983) and Kozlov (1988b). Male genitalia are unknown.

Distribution : localities not specified in Morocco (Delucchi, 1961; Delucchi & Voegelé, 1961; Voegelé, 1969). The species is present in Central and North America, Africa, Europe and Middle East (Nixon, 1935; Delucchi, 1961; Ebrahimi, 1995).

Biology : hosts known in Morocco are Pentatomidae such as *Aelia acuminata* L., *A. cognata* Fieber, *A. germari* Kuester, *Carpocoris fuscispinus* Boheman, *Eurydema ornata* L., *Eurygaster austriaca* Schrank, *Graphosoma semipunctata* Fabricius, *Nezara viridula* L. and *Odontotarsus grammicus* L. (Delucchi, 1961).

T. djadetchko (Rjachovsky) (*semistriatus* group)

Synonym : *nigribasalis* Voegelé.
Systematic characters : morphology was illustrated by Voegelé (1962, 1965a), Javahery (1968) and Kozlov & Kononova (1983).
Distribution : Meknes, Middle Atlas (Djaba forest) and Tiflet in Morocco (Voegelé, 1962, 1969). The species is present in East and Central Europe and East and Central Asia (Kozlov, 1971, 1988b).
Biology : hosts known in Morocco are Pentatomidae such as *Aelia sp.*, *Eurydema sp.*, *Eurygaster sp.* and *Graphosoma sp.* (Voegelé, 1962, 1969).

T. ghorfii (Deluchi & Voegelé) (*simoni* group)
Systematic characters : morphology (antenna and forewing) was illustrated by Delucchi (1961), Voegelé (1965a, b) and Kozlov & Kononova (1983). Male genitalia are unknown. Morphometric characters were studied by Voegelé (1965b).
Distribution : Meknes and High Atlas in Morocco (Delucchi, 1961; Delucchi & Voegelé, 1961; Voegelé, 1969).
Biology : hosts known are Pentatomidae such as *Aelia acuminata*, *A. cognata*, *A. germari* and *Eurygaster austriaca* (Delucchi, 1961; Delucchi & Voegelé, 1961).

T. grandis (Thomson) (*semistriatus* group)
Synonyms : *frontalis* Thomson, *nigripes* Thomson, *nigritus* Thomson, *nixomartini* Javahery, *semistriatus* Nixon, *silwoodensis* Javahery.
Systematic characters : morphology was illustrated by Delucchi (1961), Javahery (1968), Kozlov & Kononova (1983) and Zerova *et al.* (1992). Bin & Dessart (1983) examined the frontal pit.
Distribution : Boufekrane, Ifrane, Meknes, Middle Atlas and Tiflet in Morocco (Voegelé, 1969). The species is present in other North African countries, Europe, Middle East and Central Asia (Delucchi, 1961; Kozlov, 1971; Kozlov & Kononova, 1983; Ebrahimi, 1995).
Biology : hosts known in Morocco are Pentatomidae such as *Aelia acuminata*, *A. cognata*, *A. germari* and *Eurygaster austriaca* (Delucchi, 1961) and Planipennia (Voegelé, 1969).

T. histani (Voegelé) (*simoni* group)
Systematic characters : morphology (male antenna and forewing) was illustrated by Voegelé (1965b) and Kozlov & Kononova (1983). Male genitalia are unknown, and female antenna was not illustrated. Bin (1977) examined the frontal pit. Morphometric characters were studied by Voegelé (1965b).
Distribution : Asni, Casablanca, Ifrane, Meknes, Middle Atlas, Oujda and Tanger in Morocco (Voegelé, 1965b, 1969). The species was introduced in Russia (Kozlov, 1988b).
Biology : hosts known in Morocco are Pentatomidae such as *Aelia germari* (Voegelé, 1965b).

T. pseudoturesis (Rjachovsky) (*semistriatus* group)
Synonyms : *bennisi* Voegelé, *rossicus* Rjachovsky.
Systematic characters : morphology was illustrated by Voegelé (1965a), Javahery (1968) and Kozlov & Kononova (1983).
Distribution : Aïn Aïcha (Fes region) and Meknes in Morocco (Voegelé, 1964, 1969). The species is present in East Europe and Asia (Kozlov, 1971; Kozlov & Kononova, 1983).
Biology : hosts known in Morocco are Pentatomidae such as *Graphosoma lineata* L. (Voegelé, 1964).

T. rufiventris (Mayr) (*semistriatus* group)
Synonyms : *anitus* Nixon, *rubriventris* Szabò, *stshepetilnikovae* Roubtsov.
Systematic characters : morphology was illustrated by Nixon (1939), Delucchi

(1961), Voegelé (1969), Kozlov & Kononova (1983) and Zerova *et al.* (1992).
Distribution : Meknes and Middle Atlas in Morocco (Voegelé, 1969). The species is present in Europe, Middle East and Central Asia (Nixon, 1939; Delucchi, 1961; Kozlov, 1971; Kozlov & Kononova, 1983; Kononova, 1994; Ebrahimi, 1995).
Biology : hosts known in Morocco are Pentatomidae such as *Aelia acuminata*, *A. germari*, *Eurygaster sp.*, *Graphosoma lineata* and *Odontotarsus grammicus* (Delucchi, 1961; Delucchi & Voegelé, 1961).

T. rungsi (Voegelé) (*semistriatus* group)
Systematic characters : morphology (male antenna, male genitalia and forewing) was illustrated by Voegelé (1965a), Javahery (1968) and Kozlov & Kononova (1983). Female antenna was not illustrated. Bin (1977) examined the frontal pit.
Distribution : Boufekrane, Ifrane, Meknes, Middle Atlas and Tiflet in Morocco (Voegelé, 1969).
Biology : hosts known are Pentatomidae such as *Aelia germari* (Voegelé, 1965a).

T. scutellaris (Thomson) (*simoni* group)
Systematic characters : morphology (female antenna and forewing) was illustrated by Kozlov & Kononova (1983). Male genitalia are unknown, and male antenna was not illustrated.
Distribution : localities not specified in Morocco (Voegelé, 1969). The species is present in East Europe and East and Central Asia (Kozlov, 1971; Kozlov & Kononova, 1983; Kononova, 1994).
Biology : hosts known in Morocco are Pentatomidae such as *Aelia sp.* (Voegelé, 1969).

T. semistriatus (Nees) (*semistriatus* group)
Systematic characters : morphology was illustrated by Nixon (1939), Delucchi (1961), Javahery (1968) and Kozlov & Kononova (1983). Bin (1977) examined the frontal pit.
Distribution : Asni, Boufekrane, Ifrane, Meknes, Middle Atlas and Tiflet in Morocco (Voegelé, 1969). The species is present in Europe, Middle East and East and Central Asia (Nixon, 1939; Delucchi, 1961; Javahery, 1968; Kozlov & Kononova, 1983; Kononova, 1994).
Biology : hosts known in Morocco are Pentatomidae such as *Aelia acuminata*, *A. cognata*, *A. germari*, *Eurydema ornata*, *Eurygaster austriaca*, *Graphosoma lineata* and *G. semipunctata* (Delucchi, 1961).

T. simoni (Mayr) (*simoni* group)
Synonyms : *reticulatus* Delucchi, *vassilievi* Viktorov.
Systematic characters : morphology (antenna and forewing) was illustrated by Voegelé (1965b) and Kozlov & Kononova (1983). Male genitalia are unknown. Bin & Farnesi (1979) and Bin & Dessart (1983) examined the frontal pit. Morphometric characters were studied by Voegelé (1965b).
Distribution : Ifrane, Meknes (Voegelé, 1969) and Middle Atlas (Jaaba forest) (Delucchi, 1963) in Morocco. The species is present in Europe and Middle East (Delucchi, 1961, 1963; Kozlov, 1971, 1988b; Ebrahimi, 1995).
Biology : hosts known in Morocco are Pentatomidae such as *Aelia sp.* and *Graphosoma lineata* (Delucchi, 1963; Voegelé, 1969).

T. vassilievi (Mayr) (*simoni* group)
Synonyms : *choaspes* Nixon, *chtchepetilnicovae* Meier.
Systematic characters : morphology (antenna and forewing) was illustrated by Nixon (1939), Delucchi (1961), Voegelé (1965b), Kozlov (1971) and Kozlov & Kononova (1983). Male genitalia are unknown. Morphometric characters were studied by Voegelé (1965b).
Distribution : Ifrane, Meknes and

Middle Atlas in Morocco (Voegelé, 1969). The species is present in Europe, Middle East and Central Asia (Nixon, 1939; Delucchi, 1961; Kozlov, 1971; Kozlov & Kononova, 1983).

Biology : hosts known in Morocco are Pentatomidae such as *Aelia sp.* (Voegelé, 1969).

CONCLUSION

The inventory of egg parasitoids is far to be completed in Morocco. Only 18 species of Chalcidoidea (four families) and 27 species (including six undescribed species of *Telenomus*) of Proctotrupoidea (two families) are known in this country.

One new family and 9 new species for Morocco were listed. Numerous new data (morphology, electrophoresis, localities, some hosts) were provided but an intense collection has to be undertaken to improve the possibilities of biological control in this and other northern African countries.

Among the 39 described species, five seem endemic to Morocco (13%): the two Chalcidoidea *Ooencyrtus fecundus* and *O. nigerrimus*, and the three Proctotrupoidea *Trissolcus ghorfii*, *T. histani* and *T. rungsi*. Most species are also known from Eurasia: 29 species (74 %) including five species only living in Europe and Middle East, nine species only living in Europe and four species restricted to southern Europe. The five other non endemic species (13%) occur worldwide (*Mymar taprobanicum*) or nearly (*Trissolcus basalis*), live in Eurasia and Africa (*Encyrtoscelio turneri*, *Telenomus busseolae*) or only in Africa (*Trichogrammatoidea lutea*).

The egg parasitoid fauna from Morocco is thus very similar to the European one in spite of some African or endemic species.

ACKNOWLEDGEMENTS

The authors thank Christiane Nardon (INSA-Villeurbanne) for the drawings of Chalcidoidea wings and Bernard Delobel (INSA-Villeurbanne) for reviewing the English translation.

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