

A Contribution to the Knowledge of the Sesiidae of Turkey (Lepidoptera)

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Abstract: On the basis of the material collected and the observations made in the summer of 2003 in Turkey –mainly in eastern Anatolia– and some samples in the collection of Atatürk University, Entomology Museum, Erzurum, Turkey (EMET), an overview is given of the observed clearwing moths (Sesiidae) in Turkey from faunistic, distributional, and agro-economical points of view. Thirty-six species and subspecies in 11 genera have been recorded, of which *Sesia pimplaeformis* Oberthür, *Paranthrene diaphana* Dalla Torre & Strand, *Synanthedon andrenaeformis tenuicingulata* Špatenka and *Pyropteron cingula* (Bartel, 1912) are classified as endangered species and should be added to the red list. *Bembecia syzjovi kappadocica* Špatenka, *Dipchasphecia sertavula* Bartsch & Špatenka, *D. kopica* Gorbunov & Špatenka, and *Chamaesphecia ruficoronata* Kallies, Petersen & Riefenstahl are endemic to Turkey. The species having an agro-economical importance as a pest in cultivated plants and as biocontrol agents on weeds are also indicated.

Key Words: Lepidoptera, Sesiidae, fauna, pest, biocontrol agent, distribution, red list

Türkiye'nin Sesiidae Faunasına Katkılar (Lepidoptera)

Özet: Başta Doğu Anadolu Bölgesi olmak üzere, ülkenin değişik yörelerinde 2003 yılında sürdürulen çalışmalarla elde edilen materyal ve yapılan gözlemlere ek olarak; Atatürk Üniversitesi Entomoloji Müzesi (EMET)'nde bulunan Sesiidae örnekleri de incelenerek bu familya; fauna, dağılış ve tarımsal açılarından değerlendirilmiştir. Çalışma sonunda 11 cinsde 36 tür ve alt tür belirlenmiştir. Bunlardan *Sesia pimplaeformis* Oberthür, *Paranthrene diaphana* Dalla Torre & Strand, ve *Synanthedon andrenaeformis tenuicingulata* Špatenka ve *Pyropteron cingula* (Bartel)'nın nadir görülen türler durumuna düşükleri için kırmızı liste (red-list)'de yer almaları gerektiği sonucuna varılmıştır. Ayrıca *Bembecia syzjovi kappadocica* Špatenka, *Dipchasphecia sertavula* Bartsch & Špatenka, ve *D. kopica* Gorbunov & Špatenka ve *Chamaesphecia ruficoronata* Kallies, Petersen & Riefenstahl türlerinin ülkemiz için endemik oldukları vurgulanmıştır. Saptanan türler arasında tarımsal açıdan önemli olanlar, kültür bitkilerinde zarar yapanlar ve yabancı otalarla biyolojik mücadelede kullanılma potansiyeline sahip olanlara deñinilmiştir.

Anahtar Sözcükler: Lepidoptera, Sesiidae, fauna, zararlı, biyokontrol ajent, dağılış, kırmızı liste

Introduction

The family Sesiidae (Lepidoptera), known as clearwing moths, are very remarkable insects, many of them resembling wasps due to the partial absence of scales on both fronts, and hind wings and often showing a wasp-like contrasting color pattern on the abdomen.

If one checks entomological reference collections, either private or belonging to museums or universities, it is striking that there is in general little data on Sesiidae. In addition, in the entomological literature, papers dealing with this family were, until 10 to 15 years ago, rare compared to other groups of Lepidoptera. As a

consequence, the knowledge about bionomics and especially the geographical distribution of Sesiidae was rather fragmentary. There are multiple reasons for this lack of sufficient data. The representatives of this family are, apart from a few exceptions, small and inconspicuous animals. They are day-active moths and show a strong mimicry by imitating species of other insect groups, mostly wasps. Because Sesiidae do not belong to the butterflies, the number of interested entomologists is limited. The fact they are not active during the night means they are not studied by moth researchers either, and scientists investigating the Microlepidoptera seldom include the Sesiidae in their studies.

Nonetheless, and not only due to their peculiar bionomics, the Sesiidae are worthy of investigation. Often, important parts of the wings are without scales, contributing to their wasp mimicry, and their fast and nervous way of flying and the contrasting coloration of the body accentuate this resemblance. All larvae of Sesiidae live, without exception, inside different parts of plants and not on the plants. Some species live in the roots of trees, the trunks or twigs but an important number inhabit the roots or rootstocks of various herbaceous plants. Many species are strictly monophagous, a number are oligophagous and polyphagous species are exceptional (Špatenka et al., 1999; Laštůvka and Laštůvka, 2001). This hidden way of life complicates research on the bionomics of the different species and it is obvious that the discovery of the food plant of certain species is difficult. Even if the host plant is known, finding an infested plant can be a hard task, and the pupae remain inside the plant until the moment of hatching.

All of these indicate that making a reliable overview of a particular Sesiidae fauna and in particular the study of their distribution causes difficulties to such an extent that, due to the lack of sufficient data, it seems impracticable. Fortunately, rather recently, a powerful tool became available to overcome these restraints: the use of artificial sex-pheromones. The discovery of several components, constituting the chemical substances excreted by the females in order to attract sexually the males, led to laboratory made artificial pheromone compositions. Although the male response to the pheromones is species-specific, it appears that different species are lured by the same pheromone composition. In nature this does not necessarily cause problems since these species have another flight period or inhabit a completely different kind of biotope. Further, it is well known that artificial pheromone lures usually contain only the main components of the natural pheromones but often lack other components that are responsible for the 'fine tuning' of the sexual attraction or repulsion. It is evident that the use of these artificial pheromones facilitates to a large extent research on Sesiidae, in particular their presence in certain areas and therefore their distribution. Pheromones are nowadays also used to monitor agro-economically important species. The original objective of capturing the majority of the males, preventing in this way the fertilization of the females, and reducing the

propagation capabilities of the population was never achieved. The disruption of the males searching for females by saturating the environment with artificial pheromone also failed. On the other hand, pheromones appeared very useful for determining the exact flying period in situ and thus the exact moments that pesticides can be used (Voerman et al., 1983; Priesner et al.; 1986).

This paper deals with the study of the Sesiidae fauna of Turkey, especially that in the eastern part of the country, where different bio-geographical zones meet each other. Study of these interaction regions can shed new light on several problems concerning taxonomy, host plants, ecology, etc. For this reason, this study was started.

Špatenka et al. (1999), Laštůvka and Laštůvka (2001) and Kallies and Špatenka (2003a, 2003b) recently had excellent publications on Sesiidae in Europe and the Palaearctic region in general, including Iran, a neighboring country of Turkey. However, despite numerous publications containing taxonomic descriptions of Sesiidae from Turkey, there are only very few general studies on the distribution and bionomics of Sesiidae in this country. So far only De Freina (1994) and Bakowski (1998) have published papers on the faunistics of Sesiidae of Asia Minor although there are some additional studies dealing with a number of pest species (Altay, 1968; Tamer and Özer, 1990; Gültekin and Güçlü, 1997; Kışmali and Turanlı, 2002). Altay (1968) investigated the biology and control of *Synanthedon myopaeformis* on apple trees in the Marmara region. Tamer and Özer (1990) performed similar studies on *Bembecia scopigera* on sainfoin (*Onobrychis viciifolia*) in the province of Ankara. Gültekin and Güçlü (1997) investigated the bioecology of *B. scopigera* on the same host plant in the province of Erzurum. Researche was conducted on *Negotinthia myrmosaeformis* investigated whether this species is a potential biocontrol agent of sulphur cinquefoil, *Potentilla recta* L. (Rice et al., 1991; Schaffner and Turanlı, 1996; Kışmali and Turanlı, 2002).

Materials and Methods

To investigate the presence of certain Sesiidae species 4 different methods were applied.

1. As the most important tool pheromones were used to attract the males. These pheromones were supplied by The *Plant Research International B.V.Pherobank* (Wageningen, The Netherlands). Both commercially

available pheromones and custom-made lures were used. The basic components, all aliphatic hydrocarbons with a chain length of 18 carbon atoms and with 2 double bonds, constituting the different final pheromone lures are summarized below.

- A. (E,Z)-2,13-Octadecadienyl acetate
- B. (E,Z)-3,13-Octadecadienyl acetate
- C. (Z,Z)-2,13-Octadecadienyl acetate
- D. (Z,Z)-3,13-Octadecadienyl acetate
- E. (E,Z)-2,13-Octadecadien-1 -ol
- F. (E,Z)-3,13-Octadecadien-1 -ol
- G. (Z,Z)-2,13-Octadecadien-1 -ol
- H.(Z,Z)-3,13-Octadecadien-1 -ol

Using pheromones one has to take into account the fact that the pheromone response of almost all species is restricted to a certain period of the day.

The presence of the double bonds causes the possibility of enantiomers. High demands are made on the purity of the compounds since even low concentrations of the wrong enantiomer can cause a complete loss of the luring properties (Voerman et al., 1983; Voerman et al., 1984; Priesner et al., 1986).

2. Flowering plants were carefully inspected for nectar gathering Sesiidae. This method, a suitable one to observe females as well, is not always possible since some genera of Sesiidae –or even some species within a genus– do not have a proboscis. Evidently, this approach is not as remunerative as the previous one concerning the number of observed specimens.

3. Host plants were always carefully inspected for the presence of ovipositing females. For some species the host plants –and even the female– are still unknown. In these cases, when the presence of the males was demonstrated using pheromones, special attention was paid to this procedure to discover the food plant and/or the female.

4. Known host plants and sometimes also other plants were checked for caterpillars or other signs of previous infestation by Sesiidae. In this way it was possible to demonstrate the presence of several species although their flight period appeared to be over already. In most cases the exuviae remain in the infested plants for longer. The typical damage caused by the caterpillar can also be a useful tool. This study was carried out for three

purposes: faunistic study, distributional study, and agro-economical study. The results of the first two will be treated together.

The moth samples were deposited in Atatürk University, Entomology Museum, Erzurum, Turkey, and in the collection of Garrevoets.

Results

Faunistic and distributional study

In the 'pheromone reaction' the most attractive blend of compounds (list as given above) is indicated; further the time of the day and the strength of the attraction are described (+, weakly attracted, ++, well attracted, +++ strong attraction, males try to mate).

Tinthia brosiformis (Hübner, [1813])

This small species is widespread and lives in the roots of *Convolvulus* species. It is well attracted to artificial pheromones. It was found in Yumaklı (Prov. Erzurum), on the campus of Atatürk University (Prov. Erzurum), Altıparmak (Prov. Artvin) and Hayrangöl (Prov. Ağrı). It is not an endangered species.

Pheromone reaction: B + D (90:10), attracted mostly in the late afternoon, ++.

Distribution: this species occurs from the eastern part of the Mediterranean through the Middle East towards Central Asia.

Negotinthia myrmosaeformis (Herrich-Schäffer, 1846)

This small species is more local than the previous one in eastern Anatolia. It lives in the roots of *Potentilla* species. It is well attracted to artificial pheromones and is not rare in the biotopes where the food plant occurs. It was found in Sarıkamış (Prov. Kars). It is not an endangered species.

Pheromone reaction: B + D (90:10), attracted mostly before midday, +++.

Distribution: this species occurs in the countries around the Black Sea.

Negotinthia hoplisiformis (Mann, 1864)

This species is somewhat more robust than the previous 2 species. It is rather local and is thought to live as larva in the roots of *Poterum* sp. It was found in Gevaş (Prov. Van) and on Güzeldere Geçidi (Prov. Van). It is well

attracted to artificial pheromones. The rarity of the species seems to vary from year to year. It is not an endangered species.

Pheromone reaction: A + B (95:5), attracted mostly from early morning to noon, ++.

Distribution: Greece, Turkey and the countries of the Middle East.

***Pennisetia hylaeiformis* (Laspeyres, 1801)**

This clearwing moth, rather common in Europe, seems to be very local in Turkey. The larva lives in the roots of *Rubus idaeus* and most probably also *Rubus fruticosus*. It was found only high in the mountains north of Yusufeli (Yaylalar, Prov. Artvin). It is well attracted to artificial pheromones. It is not an endangered species.

Pheromone reaction: B + F (50:50), attracted in the afternoon to early evening, +++.

Distribution: this species has a Palaearctic distribution, partly because of the widespread occurrence of the economically important host plant. In the southern parts of its range it is restricted to mountain ranges.

***Eusphecia pimplaeformis* Oberthür, 1872**

This large clearwing moth is apparently very local in Turkey. The larva lives only in the trunks of old *Populus alba* trees (rarely in *Salix*). It was found as exuvia only in the trees along the roadside from Erzurum to Pasinler (Prov. Erzurum). Unfortunately, all these trees were cut down to widen this road in 2003. Only a few trees were left and hopefully this will be sufficient for the survival of the species.

We should emphasize that this species should be added to the red list and its biotopes should be protected.

Pheromone behavior: no data, available.

Pheromone composition: no artificial pheromone available.

Distribution: Greece, Macedonia, southern Bulgaria, Turkey, Iran, all Caucasian states and Iraq.

***Paranthrene tabaniformis* (Rambur, [1866])**

This species is very common where *Populus* trees are present. The larva lives in the branches or trunks of these trees. In Europe it can be damaging to plantations of this tree but the density of this species seems to be much lower in Turkey. Therefore, it is not to be considered a detrimental species. It was observed (but not caught) in

many provinces. It is well attracted to artificial pheromones and is not an endangered species.

Pheromone behavior: attracted very well in the afternoon to the evening.

Pheromone composition: F + H (97:3) Response: +++.

Distribution: widespread in the northern hemisphere.

***Paranthrene diaphana* Dalla Torre & Strand, 1925**

This species also inhabits *Populus* trees (and also *Salix*). The females preferably deposit their eggs in injured parts of the tree. It is a rare and local species that is previously mentioned from Pasinler (Prov. Erzurum) (Kallies, pers. comm.). At the same location, external signs of larval activity were observed on a tree injury but this does not prove the presence of this species because there are too many other species with similar feeding behavior, e.g., *S. formicaeformis* and *P. tabaniformis*, both present and more common in the same region. The species was poorly attracted by pheromones in Gevaş (Prov. Van).

This species should probably be added to the red list.

Pheromone behavior: poorly attracted in the afternoon.

Pheromone composition: D + A (95:5) or F + H (97:3) Response: +.

Distribution: known from Serbia, Bosnia, Macedonia, Turkey, Azerbaijan and Iran.

***Euhagena palariformis* palariformis (Lederer, 1858)**

From this species, flying rather early in the summer, scattered observations are reported from southern and eastern Turkey. The food plant is still unknown but is thought to be an *Eryngium* species (Kallies and Špatenka, 2003a). An adult was found in Bahçe (Prov. Osmaniye).

Pheromone behavior: responds to artificial pheromone in the late morning (Kallies and Špatenka, 2003a).

Pheromone composition: optimal artificial pheromone unknown to the authors.

Distribution: Turkey, Azerbaijan, Armenia, Iran, Iraq, Syria and Lebanon.

Synanthedon stomoxiformis amasina (Staudinger, 1856)

This species lives as a larva in *Frangula alnus* and *Rhamnus cathartica*. In springtime, the larva constructs a very characteristic exit tube from the root to ground level. These tubes were observed in Sarıkamış, (Prov. Kars). The flight period of the adults was apparently over already. This species is known to be attracted by artificial pheromones. Taking into account the fact that this species prefers steep slopes where the food plant is well exposed to the sun, the biotopes (and thus the species) are not endangered.

Pheromone behavior: attracted before noon.

Pheromone composition: D + A (95:5) Response: ++.

Distribution: this subspecies only occurs in Turkey and its neighboring countries.

Synanthedon andrenaeformis tenuicingulata Špatenka, 1997

This subspecies lives as a larva in *Viburnum* sp. It is apparently a very local and rare species that occurs in low population densities. The presence of the species was demonstrated by the typical exit holes in the branches of the food plants in Sarıkamış (Prov. Kars) and in Hayrangoł (Prov. Ağrı). These holes stay visible for many years and can be used to estimate the population density.

Considering all this and the very local distribution (of the food plant also) it is advisable to include this species in the red list.

Pheromone behavior: attracted before noon.

Pheromone composition: B + D (90:10) Response: +.

Distribution: known only from Turkey (prov. Erzincan, Kars and Ağrı) and Armenia.

Synanthedon vespiformis (Linnaeus, 1761)

This species is rather polyphagous but prefers *Quercus* sp. It is usually common where the food plants occur. *S. vespiformis* is very well attracted by artificial pheromones and was observed on Kop Geçidi (Prov. Erzurum) and Güneysınır, Gürağaç (Prov. Konya). It is not an endangered species.

Pheromone behavior: very well attracted from late afternoon to sunset.

Pheromone composition: B + D (90:10) Response: +++.

Distribution: widely distributed in Europe and Anatolia.

Synanthedon myopaiformis (Borkhausen, 1789)

This is known to be a widespread species as an apple pest in Turkey (Altay, 1968). Damage caused by the larvae was observed on the trunks of apple trees in various orchards in Oltu (Prov. Erzurum).

Pheromone behavior: strongly attracted before noon.

Pheromone composition: D + A (95:5) Response: +++.

Distribution: widespread in Europe and the Near East.

Synanthedon colchidensis Špatenka & Gorbunov, 1992

This species, restricted to the Caucasus region, was found (only one specimen) north of Yusufeli, Yaylalar (Prov. Artvin). The host plant is *Abies nordmanniana* where the larva lives in swellings caused by a fungus. Its bionomics closely resembles those of *Synanthedon cephaliformis* (Ochsenheimer, 1808) in Europe.

Pheromone behavior: no data available.

Pheromone composition: no artificial pheromone available.

Distribution: restricted to the Caucasian mountain range.

Bembecia ichneumoniformis ([Denis & Schiffermüller], 1775)

This is a widespread species in Europe but is apparently rather local in Turkey. It inhabits as larva in the roots of a variety of Fabaceae species. This species was observed in Duranlı (Prov. Kars). It is very well attracted by artificial pheromones.

Pheromone behavior: strongly attracted before noon.

Pheromone composition: H + F (99:1) Response: +++.

Distribution: from the whole of Europe through Turkey towards Central Asia.

Bembecia lomatiaeformis (Lederer, 1853)

This rather large and robust species is known in Europe from only 2 localities. In Turkey it is much more widespread; it lives on higher altitudes, linked to the occurrence of its food plants, i.e. *Astragalus* species. *B. lomatiaeformis* was attracted to pheromones on Sertavul

Geçidi (Prov. İçel). It is not an endangered species since the larva is well protected by the spiny food plant, and is never eaten by goats or sheep.

Pheromone behavior: attracted from, early morning to about 11.00 AM.

Pheromone composition: F + H (97:3) Response: ++.

Distribution: Turkey and very local in Greece.

***Bembecia stiziformis stiziformis* (Herrich-Schaffer, 1851)**

This nice and variable species is widespread in Turkey and lives, as the previous species, in spiny *Astragalus* species. Therefore, it is also bound to higher altitudes; where it can be attracted to pheromones. *B. stiziformis* was observed in Gevaş (Prov. Van) and in Duranlı (Prov. Kars). As for the previous species and for the same reasons it is not an endangered species. The species is attracted by pheromones but exhibits very shy behavior.

Pheromone behavior: poorly attracted from early morning to about 10.00 AM.

Pheromone composition: B + D (90:10) Response: +.

Distribution: Turkey to Iran, Turkmenistan and Pakistan.

***Bembecia syzjovi syzjovi* Gorbunov, 1989**

B. syzjovi is a species flying in late August and in September. For this reason, no imagines were seen but the presence of caterpillars could be observed in the roots of a large and spineless *Astragalus* (*A. ponticus*). Considering the very local distribution of this food plant, often along roadsides, it should be protected against mowing and the gluttony of goats and sheep. Only in Yumaklı (Prov. Erzurum) the food plant and the presence of larvae could be observed. No pheromone data are available.

Pheromone behavior: no data available.

Pheromone composition: no artificial pheromone available.

Distribution: Turkey and Georgia.

***Bembecia syzjovi kappadocica* Špatenka, 1997**

This subspecies flies, as the nominal form treated above, in late August and in September. The same remarks as for the nominal species are valid. The foodplant and the presence of larvae were observed in Göreme (Prov. Nevşehir).

Pheromone behavior: no data available.

Pheromone composition: no artificial pheromone available.

Distribution: Endemic to Turkish Kappadocia.

***Bembecia scopigera* (Scopoli, 1763)**

This species was observed, many times in the Erzurum area by the third author, where it can be a pest to its food plant sainfoin (*Onobrychis viciifolia*). The determination of the material was verified by genitalia preparations. The species was till now not observed by means of pheromones in the area studied, although, in general, it shows a good response to artificial pheromones. Apparently, in this region, it is a species reaching higher densities only in cultivated areas where large fields of its food plant are grown.

Pheromone behavior: normally attracted before noon.

Pheromone composition: D + A (95:5) Response: ++.

Distribution: From, central Spain over most of southwestern and central Europe, the Balkans, Greece, southern Russia and Ukraine to Turkey (Špatenka et al, 1999).

***Bembecia priesneri* Kallies, Petersen & Riefenstahl, 1998**

This species, discovered and described recently, flies in late August and in September. The larvae inhabit the roots of an *Ononis* species (looks like *Ononis spinosa*). The presence of the larvae was observed in Göreme (Prov. Nevşehir). It is not an endangered species.

Pheromone behavior: no data available.

Pheromone composition: no artificial pheromone available.

Distribution: Turkey (Kappadocia and Taurus Mountains) and Greece (Rhodes).

***Bembecia staryi* Špatenka and Gorbunov, 1992**

The female of this species is still unknown to science (as are the bionomics) (Špatenka et al., 1999) and is reported by other entomologists only from the Kaçkar mountains north of Yusufeli, Yaylalar (Prov. Artvin) (Kallies, pers. comm.). This valley has a very rich and specific fauna and flora and should be protected at all costs. The species was described from Georgia and clearly belongs to the Caucasian fauna. One of the goals of a future expedition will be to clarify the bionomics of this species and to discover the female.

Pheromone behavior: sparingly attracted before noon.

Pheromone composition: B + D (90:10) Response: +.

Distribution: Georgia and Turkey.

***Bembecia gegamica* Gorbunov, 1992**

This species is thought to live in spiny *Astragalus* plants. It is a rare and very local species unlike the presumed host plant. One much worn male was captured in Yumaklı (Prov. Erzurum) on the pheromones but released afterwards since it had no beneficial value, neither for the reference collection nor for additional investigations. Females of this species are very rare, as far as we know; only 3 specimens have ever been captured.

Pheromone behavior: sparingly attracted before noon.

Pheromone composition: D + A (95:5) Response: +.

Distribution: Armenia and Turkey.

***Bembecia pontica* (Staudinger, 1891)**

B. pontica lives in the same *Astragalus* species as *Bembecia syzjovi*, discussed before. Often both species inhabit the same plant. It was observed in Yumaklı (Prov. Erzurum). The same remarks considering the vulnerability of the food plants as mentioned for *B. syzjovi* are valid here. The species was rarely attracted by the pheromones used in this study.

Pheromone behavior: sparingly attracted from early morning to noon.

Pheromone composition: D + A (95:5) Response: +.

Distribution: Turkey and Syria.

***Bembecia sanguinolenta* (Lederer, 1853)**

This species lives in the same *Astragalus* species as *Bembecia syzjovi* and *B. pontica*, discussed before. Presumably it also accepts other *Astragalus* species since this species is much more common and widespread than the two others. The species is well attracted by pheromones and was observed in Yumaklı (Prov. Erzurum), Gevaş (Prov. Van) and Karabaklı (Prov. İçel). It is not an endangered species.

Pheromone behavior: attracted from early morning to noon.

Pheromone composition: D + A (95:5) Response: ++.

Distribution: SWBulgaria, Greece, Macedonia, Turkey, Armenia and Syria.

***Pyropteron triannuliformis* (Freyer, 1842)**

This species is widespread, also in Europe. In Turkey, it can be seen in all localities where the food plant (*Rumex* sp.) occurs. The larvae live, as most of the Sesiidae larvae, in the dryer climates of the Palaearctic region, in the roots of the plant. Imagines were attracted by pheromones in Yuvalı (Prov. Bitlis), Hayranel (Prov. Ağrı), Duranlı (Prov. Kars), Kop Geçidi (Prov. Erzurum) and Sarıkamış, (Prov. Kars). It is obviously not an endangered species.

Pheromone behavior: attracted in the late afternoon.

Pheromone composition: H + F (99:1) Response: +++.

Distribution: from most parts of Eastern Europe towards the Near East and Central Asia.

***Pyropteron cingisa* (Bartel, 1912)**

This species lives as a larva in *Limonium* sp., a halophile plant growing on salt-planes. The flight period was over already at the time (mid July) the expedition visited a suitable location at Develi Ovası (Prov. Kayseri). Nevertheless, the presence could be demonstrated by the exuviae protruding from the stem bases. The food plant of this very local species is sometimes almost completely eaten by sheep. The effect of this on the population remains unclear for now. This species should be added to the red list because it is restricted to these inland salty biotopes and many of these habitats are severely endangered and have vanished already to a large extent in Turkey due to human interference.

Pheromone behavior: attracted, before noon.

Pheromone composition: D + A (95:5) Response: +++.

Distribution: Poorly known, distribution with only a few scattered localities in Romania, Moldavia, Southern Russia, Azerbaijan, Turkey, Turkmenistan and Kazakhstan.

***Dipchasphecia sertavula* Bartsch & Špatenka, 2002**

This species was newly described, and lives as a larva in the roots of *Acantholimon* sp., a spiny plant growing on higher altitudes, often together with *Astragalus* species. For this species also the flight period was over

(mid July) but the characteristic exit tubes protruding from the roots demonstrated the presence. As the name suggests, the species is known only from Sertavul Geçidi (Prov. İçel). It is possible that this species is restricted to this region and is therefore extremely vulnerable considering measurements altering its biotope. No pheromone observations are available and insufficient data are at hand to consider this species endangered.

Pheromone behavior: no data available.

Pheromone composition: no artificial pheromone available.

Distribution: only known from Sertavul Geçidi (Prov. İçel) in southern Turkey.

***Dipchasphecia kopica* Gorbunov & Špatenka, 2001**

This member of the genus *Dipchasphecia* was recently discovered and described, and the larva lives, as the previous species, in the roots of an *Acantholimon* sp. As for the previous species the flight period was over (end of July) but also for this species also the exit tubes demonstrated its presence. It is known only from Kop Geçidi (Prov. Erzurum). At this locality, at least 2 species of *Acantholimon* are present. As far as the authors could observe, only one species was accepted as the host plant. The same remarks considering pheromones and vulnerability as for the previous species are valid here too.

Pheromone behavior: according to Gorbunov & Spatenka, (2001) the males of the type-series were attracted at 2-4 PM (4).

Pheromone composition: F + H (50:50) Response: ? (4).

Distribution: only known from Kop Geçidi (prov. Erzurum) in north-eastern Turkey.

***Chamaesphecia turbida* Le Cerf, 1937**

This species inhabits as a larva the roots of different species of *Euphorbia*. It is widespread and not uncommon where the food plant is abundant. *C. turbida* is well attracted to artificial pheromones and was captured on Kop Geçidi (Prov. Erzurum) and observed on several other locations. It was found on the campus of Atatürk University too. It is not an endangered species.

Pheromone behavior: attracted before noon.

Pheromone composition: D + A (95:5) Response: ++.

Distribution: this species occurs in Eastern Turkey, Iran and the Caucasian states.

***Chamaesphecia elampiformis* elampiformis (Herrich-Schäffer, 1851)**

This is a very rare and local species inhabiting the roots of (most likely) *Stachys inflata* or a related plant species. Only one specimen was observed on a very steep south-facing slope in Sarıkamış (Prov. Kars). Further research is necessary to verify whether the food plant mentioned is the correct one. So far, this species has never been reported to respond to the artificial pheromones commonly used for Sesiidae investigations. This item needs additional research as well to clarify its pheromone response. Insufficient data are available to make conclusions about the vulnerability of this species, but its apparent preference for steep, almost inaccessible slopes presumably indicates it is not an endangered species.

Pheromone behavior: no data available.

Pheromone composition: no artificial pheromone available.

Distribution: This very rare species is known from Turkey and the Transcaucasian region.

***Chamaesphecia doryceraeformis* (Lederer 1853)**

A yellow flowering *Phlomis* species is the food plant of this species, which belongs to a difficult complex of several closely related species. We observed this species in Kırkağıl (Prov. Bingöl). Males were often seen feeding on flowers or resting on *Astragalus* plants; females mostly were found in the vicinity of the food plant, where on several occasions ovipositing was observed. None of the available pheromones invoked a response. As long as grazing pressure by goats and sheep is not too high, the species is not endangered.

Pheromone behavior: the observed specimens were not attracted by the available artificial pheromones.

Pheromone composition: no artificial pheromone available.

Distribution: Turkey, Iran and Transcaucasia.

***Chamaesphecia anatolica* Schwingenschuss, 1938**

This species inhabits as a larva the roots of *Nepeta* species. At Yumaklı, Tortum (Prov. Erzurum), a much worn male was attracted by pheromones indicating the presence of the species and this lead to the discovery of several exuviae on this *Nepeta*.

In suitable biotopes, this species is probably rather common and therefore not endangered.

Pheromone behavior: well attracted in the late afternoon.

Pheromone composition: B + D (90:10) Response: ++.

Distribution: Turkey and Greece.

***Chamaesphecia diabarensis* Gorbunov, 1987**

A *Marrubium* species is the host plant for this Sesiidae species that is well attracted to pheromones. It was captured only in Yumaklı, Tortum (Prov. Erzurum). Therefore this species apparently is very local and sensitive to the destruction of its biotope.

As long as its biotopes are kept intact, this species has not to be added to the red list.

Pheromone behavior: well attracted in the late afternoon.

Pheromone composition: B + D (90:10) Response: ++.

Distribution: NE Turkey, Azerbaijan and Armenia.

***Chamaesphecia schwingenschussi* Le Cerv, 1937**

This species is widespread in eastern Turkey. Its larvae infest *Thymus* plants and so its occurrence is restricted to places where a minimal amount of water allows this plant to grow. *C. schwingenschussi* was attracted in Duranlı (Prov. Kars) and Hayrangöl (Prov. Ağrı) by pheromones and is not endangered.

Pheromone behavior: attracted in the late afternoon.

Pheromone composition: D + A (95:5) and also B + D (90:10) Response: ++.

Distribution: Turkey, Transcaucasia and Iran.

***Chamaesphecia gorbunovi* Špatenka, 1992**

This is an often unnoticed and very small species infesting a species of *Scutellaria*. It is widespread in eastern Turkey and is attracted by pheromones very late in the afternoon at sunset. It was observed in Yumaklı, Tortum (Prov. Erzurum) and Karakurt (Prov. Kars). Considering the occurrence of the food plant, *C. gorbunovi* does not to be considered as an endangered species.

Pheromone behavior: well attracted in the late afternoon till sunset.

Pheromone composition: B + D (90:10) Response: +++.

Distribution: Turkey, Azerbaijan and Armenia.

***Chamaesphecia ruficoronata* Kallies, Petersen & Riefenstahl, 1998**

It is surprising that this rather recently described species was not discovered before since it can not be confused with any other species. Furthermore, it is almost completely black, making it clearly visible during flight. We observed a female ovipositing on blue-flowering *Salvia* proving this to be the food plant and confirming the supposition made by Kallies (pers. comm.). The species was also attracted by means of pheromones in Sarıkamış (Prov. Kars) and Hayrangöl (Prov. Ağrı). The species is not endangered.

Pheromone behavior: reasonably attracted in the morning to about 11.00 AM.

Pheromone composition: responds to various artificial pheromones. Response: +.

Distribution: Only known from eastern Turkey.

Agro-economical study

From all the observed species of Sesiidae in the present study only a few infest plants that are important from an agricultural point of view. On the other hand, there are a few species living in plants considered weeds. In this part we will briefly discuss these species and their relation with the respective host plants.

Species infesting plants of economical importance

***Pennisetia hylaeiformis*:** The host plant is predominantly *Rubus idaeus*. This plant is rarely cultivated in eastern Turkey and occurs naturally only in a few places. Therefore we can consider *P. hylaeiformis* an innoxious species. However, when the cultivation area of this plant increases this species has the potential to become a pest for this plant.

***Sesia pimplaeformis*:** Because this species only infests very old *Populus alba* trees while Turkish people almost exclusively use wood from relatively young *Populus* trees, this clearwing species can also be considered harmless. Furthermore, although it is a relatively large species, the larva causes minimal and superficial damage to the wood of its host because it does not feed on the wood but it is a sap-feeder. The influence of this on large trees is negligible. Quite the contrary, as

stated before, this species should be protected and added to the red list. Old *Populus alba* trees, being a host, should not be cut down unless there is no other reasonable solution and even then, not all trees in a biotope should be felled together.

***Paranthrene tabaniformis*:** The damage caused by this species to *Populus* trees can be considerable in some European countries. Although the species is not uncommon in Turkey, the density of the populations in eastern Turkey is, according to our observations, significantly lower than that in most European countries. Therefore, the damage caused to the trees is most likely rather minimal. Furthermore, since the larva lives in the trunk or branches, it is almost impossible to fight this infestation.

***Paranthrene diaphana*:** Considering the low density and very local character of this species, it is very unlikely that it causes damage worth mentioning to its host plant (*Populus* trees).

***Synanthedon vespiformis*:** Since the species of *Quercus* (the host plant of this clearwing) occurring in eastern Turkey are usually not considered as furniture wood, the damage caused by this relatively small species is also negligible. However, it should be kept in mind that this species can be a pest of *Quercus* trees.

***Synanthedon colchidensis*:** This species, occurring in Turkey only in the north-east, infests *Abies nordmanniana* trees. Because only trees that are already weakened by a specific fungus –causing sometimes severe swellings– are chosen for ovipositing by the females of this species, they are not harmful to the healthy trees. Furthermore, the density of this species seems to be fairly low.

***Bembecia scopigera*:** This species infests sainfoin, *Onobrychis viciifolia* and occasionally also other species of *Onobrychis*. It can reach higher densities in arid areas where the food plant is growing. Several studies have already been performed to investigate the influence of this species on the food plants (Tamer and Özer, 1990; Gültekin. and Güçlü, 1997). Certainly in the area of Erzurum, even in the research fields of the University, this *Bembecia* is very common. Whether it causes significant damage to the host plants needs further investigation.

Species infesting weed plants

For obvious reasons, only weeds occurring sometimes in a massive predominant way are discussed.

***Astragalus* spp.:** several Sesiidae species infest this mostly spiny genus of Fabaceae that is sometimes the most common plant at higher altitude, particularly in eastern Turkey. The species living in these plants are *Bembecia lomatiaeformis*, *B. stiziformis stiziformis* and other *Bembecia* species. These species; though belonging to the larger sized Sesiidae, are not capable of eradicating the *Astragalus* plants: there is probably a 'natural equilibrium that keeps the plants and their predators in balance', and so one should assume that *Bembecia* species to some degree control the *Astragalus* population. To our knowledge, there are also no foreign species that capable of wiping out the complete *Astragalus* flora.

***Euphorbia* spp.:** one of the commonest representatives of Sesiidae infesting the weeds in this genus is *Chamaesphecia turbida*. *Ch. bibioniformis* - a very common species as well and *Ch. palustris* – a large species – infest *Euphorbia* species. For *Euphorbia*, the same remarks as for the genus *Astragalus* are valid.

***Potentilla* spp.:** The larvae of *Negotinthia myrmosaeformis* live in the stems and roots of *Potentilla recta* L, which is an important weed in pastures and range lands in Turkey as well as in the USA and Canada (Rice et al, 1991; Schaffner and Turanlı, 1996; Kışmali and Turanlı, 2002). It is a potential bio-control agent of this weed plant.

Conclusion

Since it was foreseen in the project that several years would be necessary to obtain a good insight into the entomological fauna of Turkey (especially the richness and variety of eastern Turkey), the research will continue and focus on the problems and questions already mentioned and dealt with above. To achieve this, it is essential that the entomological fauna of especially the north-eastern and south-eastern part of Turkey are studied in more detail since in these areas the influences and interactions with respectively the Caucasian and Iranian fauna are very important to achieve a good understanding of the taxonomic evolution of the Turkish Sesiidae in general.

Concerning the weed plants discussed in this paper, one must realize that these plant groups occur predominantly in places where their presence is not annoying for human activities. The species capable of infesting the plants concerned are already present but apparently there is a natural equilibrium which, keeps the plants and their predators within acceptable limits. One must also take into account the fact that introducing foreign species into a biotope can cause an irreversible disturbance of an ecosystem that took millennia to arise. There are manifold examples of introductions of non-native animals or plants that turned out to cause more damage and problems than benefits.

Special attention should be paid to the Kaçkar Mountains area since this region accommodates many species only occurring here and nowhere else in Turkey. This region should be maintained in its present state to prevent many species disappearing due to destruction of their habitats.

Concerning the red list species, it is important to emphasize that it is useless to protect only the animals. The only solution to prevent an eventual extinction of these species is to protect their biotopes. This is true, not only for insects, but for all flora and fauna.

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Finally we would like to stress that urgent measures are necessary for consciousness-raising in Turkey people concerning the discarding of rubbish everywhere in nature. Due to this behavior caused by ignorance the environment is becoming polluted rapidly and this is really a pity considering the extreme beauty and richness of the nature of Turkey.

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