

Biyolojik gözlem (Biological observation)

**Egg parasitoids of *Malacosoma neustria*
(Linnaeus, 1758) (Lepidoptera: Lasiocampidae) in
Erzurum province of Turkey**

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Summary

Malacosoma neustria (Linnaeus, 1758) (Lepidoptera: Lasiocampidae), a pest of various fruit and bushes, were studied in Erzurum Province, during 2004-2005 with the goal of identifying potential biological control agents of the moth, which reaches outbreak levels in several year-intervals. Eight species of parasitoids in four families of Hymenoptera were obtained from the eggs of *M. neustria* collected from three locations. *Telenomus laevisculus* (Ratzeburg, 1844) (Scelionidae) was the most prevalent species occurring at all collecting sites and accounted for 51% of the parasitoids. *Baryscapus oophagus* (Otten, 1942) and *Baryscapus nigriviolaceus* (Nees, 1834) (Eulophidae) accounted for 24% and 21% respectively of the total parasitoids found. *Pronotalia carlinarum* (Szelényi & Erdős, 1951) (Eulophidae), *Anastatus bifasciatus* (Geoffroy, 1785) (Eupelmidae), *Trichogramma buluti* Bulut & Kilincer, 1991 (Trichogrammatidae), *Ooencyrtus neustriae* (Mercet, 1925) (Encyrtidae) and *Baryscapus evonymella* (Bouche, 1834) (Eulophidae) were also obtained, but at very low numbers. *Telenomus laevisculus* has potential in the biological control of this particular pest. Overall parasitism rate was 21.81%.

Key words: Egg parasitoids, *Malacosoma neustria*, European tent caterpillar, Erzurum, Turkey

Anahtar sözcükler: Yumurta parazitoitleri, *Malacosoma neustria*, Yüzükkelebeği, Erzurum, Türkiye

Introduction

Malacosoma neustria (Linnaeus, 1758) (Lepidoptera: Lasiocampidae), known as "Yüzükkelebeği" in Turkish, is an important defoliator of various fruit trees, such as apple (*Malus communis* L.), pear (*Pyrus communis* L.), plum (*Prunus* spp.), wild and ornamental trees and shrubs, including oak species (*Quercus* spp.), rose species (*Rosa* spp.), oleaster (*Elaeagnus angustifolia* L.), sea buckthorn (*Hippophae rhamnoides* L.), barberry (*Berberis* spp.), elm trees (*Ulmus* spp.), willow (*Salix* spp.), poplar and aspen (*Populus* spp), and birch

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(*Betula* spp.), particularly in eastern and central Turkey (Bodenheimer, 1958; Iren, 1977; Özbek et al., 1996; Coruh & Özbek, 2002; Özbek & Calmasur, 2005). *Malacosoma neustria* is univoltine and overwinters as egg masses on twigs of the host plants (Çoruh & Özbek, 2002).

Although the outbreak periods are irregular, since 1970 outbreaks have been observed occurring at about 3-7 year intervals in the province of Erzurum. Following several consecutive years of defoliation at any one locality, leaves of susceptible host plants, especially *Rosa canina* L., *Berberis vulgaris* L., and *Hippophae rhamnoides* L. were completely defoliated and the twigs and/or whole plants very often dried. Defoliation was very severe in some districts. Recently these plants have attracted considerable attention in horticulture, biochemistry and pharmacology because of the fragrance of the flowers (*Rosa* spp.) and the high contents of biologically active substances in their fruits and other organs with high contents of vitamin C, carotenoids, flavanoids, minerals, and certain enzymes, as well as vitamins B₁, B₂, E and K given rise to a high antioxidant capacity (Li & Schroeder, 1996; Kupeli et al., 2002; Melnicova et al., 2002; Demir, 2005a, b). This is also worthy to indicate that for promoting wildlife, these plants may be very valuable, especially in their native range; many animals use their leaves and fruits for food and shelter.

Climatic conditions, natural enemies, and other factors should be considered in the ending of outbreaks of insects. Parry (1995) pointed out that elevated levels of parasitism have been associated often with the collapse of outbreaks. Nuclear polyhedrosis virus (NPV) is also important as an outbreak regulating factor in various lepidopterous defoliators (Orlovskaja, 1970; Urban & Sedivy, 1997).

Despite its importance as a pest on various trees and shrubs, studies on natural enemies of *M. neustria* in Turkey are limited. Iren & Gürkan (1971) obtained *Telenomus laevisculus* (Ratzeburg, 1844) (Hymenoptera: Scelionidae) from the eggs of *M. neustria* in Ankara Province. Bulut (1991) recorded seven species of egg parasitoids belonging to four different families of Hymenoptera (one Scelionidae, four Encyrtidae, one Eupelmidae and one Trichogrammatidae) in Ankara and neighboring provinces. Rates of apparent egg parasitism recorded in this study were 18.7 % and 22.5 % in 1981 and 1982, respectively. *Telenomus laevisculus* was the most abundant parasitoid species. There is no any information about egg parasitoids of *M. neustria* in the eastern Turkey (Eastern Anatolia).

The objectives of the present study were to determine the identities of the parasitoids attacking eggs of *M. neustria* in Erzurum province, located in eastern Turkey, detect natural parasitism rates, and suggest possible parasitoid(s) for biological control of these particular species.

Material and Methods

Collecting sites

This study area includes three collecting sites: the campus of Atatürk University, Tortum District and Oltu District (Figure 1).

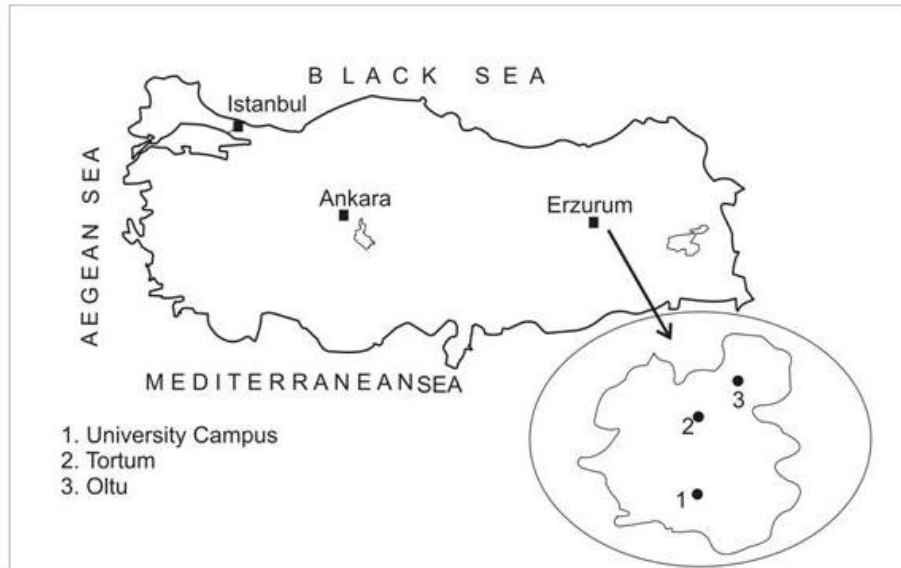


Figure 1. Sampling sites of eggs of *Malacosama neustria* (L.) in the Erzurum province of Turkey.

The first collecting site is the campus of Atatürk University in the city, more than 2000 acres of wooded area with grass lands at an altitude of 1850 m. Although the trees are predominantly *Pinus* sp. there are various deciduous trees and bushes, among them the most abundant hosts are *Rosa canina* L. (Rosaceae), *Elaeagnus angustifolia* L. (Elaeagnaceae), and *Betula verrucosa* (Youngii) (Betulaceae). *Elaeagnus angustifolia* is not abundant, occurs sporadically. The second collecting site is about 80 km northeast of Erzurum in Aksu village (Tortum district) and can be characterized as hilly, uncultivated land ranging from 1950-2000 m. Common barberry, *B. vulgaris* and *R. canina* are the most abundant host plants scattered among various species of shrubs and pines. The third collecting site is about 100 km northeast of Erzurum, between Çamlıbel and Sarısaz villages (Oltu district), a cultivated land at about 1300-1400 m in altitude. Two attractive hosts, sea buckthorn (*Hippophae rhamnoides* L.) and wild plum (*Prunus* sp.) are abundant and mixed with various species of deciduous trees and shrubs along the borders of fields. Some growers make insecticide applications in potato and sugar beet fields mostly once in a year. However, in general, growers apply four year-rotation for both of these plants. Therefore the negative affect of insecticides to the beneficial insect can be negligible.

In the third collecting site (Oltu), as Doğanlar et al. (1982) indicated, besides to *M. neustria* the other *Malacosoma* species, *Malacosoma franconica* (Denis & Schiffermuller, 1775) also occurs. These two species have similar egg-laying habits; both of them lay eggs as masses around small twigs or branches of the host plants. However, the egg masses of *M. franconica* are covered with a mass of light gray substance, having the appearance of hardened, stiff, shiny cover. The egg masses of *M. neustria* are naked, uncovered any substance, eggs can be counted with naked eye. Therefore, in the field separating the egg masses of these two *Malacosoma* species is easily possible. Additionally, *M. franconica* is not abundant in the research area.

Egg collection

Collections were conducted during the period 2004-2005. Collections at each site were usually made at the same location. The egg masses were collected two times each year: for overwintered egg masses the first collecting period was April 8-15, the second April 20-28; for newly laid egg masses the first collecting period was August 12-20, the second September 1-10 both in 2004 and 2005. Egg masses were collected from the randomly chosen host plants by cutting the infected branches with pruning scissor, placed in labeled paper bags and brought to the laboratory. One egg mass was inserted in a test tube and covered with a cotton stopper. The test tubes were incubated at growth chamber ($25 \pm 2^{\circ}\text{C}$ and 60-70 % RH) and checked every one or two days and emerging parasitoids were aspirated, killed by ether, prepared for identification. Emerging larvae in tubes were removed using a fine brush. The adults of parasitoids are stored in the Entomology Museum, Erzurum, Turkey (EMET).

Results

From total of 7959 eggs collected during this study, eight species of parasitoids in the families Encyrtidae, Eulophidae, Scelionidae, and Trichogrammatidae (Hymenoptera) were found to be associated with the eggs of *M. neustria* in Erzurum province (Table 1).

Table1. Species of egg parasitoids obtained from *Malacosoma neustria* (Linnaeus, 1758) in the Erzurum Province of Turkey

Parasitoid species	Parasitoids obtained from <i>Malacosoma neustria</i>			Collecting sites		
	Overwintered eggs	New laid eggs	Overwintered and new eggs	Campus	Tortum	Oltu
<i>Baryscapus nigroviolaceus</i>		•		•		
<i>Trichogramma buluti</i>		•		•		
<i>Anastatus bifasciatus</i>			•	•		
<i>Telenomus laevisculus</i>	•			•	•	•
<i>Ooencyrtus neustriae</i>	•					•
<i>Baryscapus oophagus</i>	•			•	•	•
<i>Baryscapus evonymella</i>	•					•
<i>Pronotalia carlinarum</i>	•				•	

Five parasitoid species, *Telenomus laevisculus* (Ratzeburg, 1844) (Scelionidae), *Ooencyrtus neustriiae* (Mercet, 1925) (Encyrtidae), *Baryscapus oophagus* (Otten, 1942) (Eulophidae), *B. evonymella* (Bouche, 1834) and *Pronotalia carlinarum* (Szelényi & Erdős, 1951) (Eulophidae) were obtained from the overwintered eggs. Two species, *Baryscapus nigriviolaceus* (Nees, 1834) (Eulophidae) and *Trichogramma buluti* Kostadinov (Trichogrammatidae) were obtained from newly laid eggs. Only one species, *Anastatus bifasciatus* (Geoffroy, 1785) (Eupelmidae), was obtained from both overwintered and newly laid eggs. Five species, *T. laevisculus*, *B. nigriviolaceus*, *B. oophagus*, *T. buluti* and *A. bifasciatus* were found at the first collecting site (Atatürk University). Three species, *T. laevisculus*, *B. oophagus*, and *P. carlinarum* were found from the second collecting site in Aksu Village (Tortum). Four species, *T. laevisculus*, *B. oophagus*, *O. neustriiae* and *B. evonymella* were found from the third collecting site in Oltu (Table 1). *Baryscapus nigriviolaceus*, *T. buluti* and *A. bifasciatus*, occurred only at the university campus. *Pronotalia carlinarum* occurred only at second collecting site (Aksu Village, Tortum). *Ooencyrtus neustriiae* and *B. evonymella* occurred only at third collecting site (Oltu). *Telenomus laevisculus* and *B. oophagus* occurred at three collecting sites.

Among the parasitoid species, the three species, *T. laevisculus*, *B. oophagus* and *B. nigriviolaceus* showed the highest number of *M. neustria* parasitoids in the collected egg samples. Of these, *T. laevisculus* was the most numerous parasitoid, recorded at three collecting sites, and accounted for 51% of the parasitoids. *Baryscapus oophagus* occupied the position as the second most abundant parasitoid of *M. neustria*. This species was also occurred at all collecting sites and accounted for 24% of the parasitoids. Although *B. nigriviolaceus* occurred only at the university campus and it accounted for about 21% of all the parasitoids.

Pronotalia carlinarum accounted for about 3% of parasitoids. *Anastatus bifasciatus*, *T. buluti*, *O. neustriiae* and *B. evonymella* were recorded in much lower numbers, accounting for only 1% of the egg parasitoids of *M. neustria*. Although *A. bifasciatus* was obtained from both overwintered and newly-laid eggs, it was found only at the university campus in Erzurum. Both *O. neustriiae*, and *B. evonymella* were found at third collecting site in Oltu.

The rate of total parasitism was 21.81% (ranged 18.08-23.77%) for two years for all host plants in all location sites. The mean parasitism rates of the eggs collected from various host plants was quite different; the highest parasitism was 22.7% in the eggs collected from rose hip (*Rosa canina* L.), the lowest parasitism was 18.08% in the eggs collected from birch (Table 2). In all regions studied, small number of eggs showed no hole. In these eggs parasitoids died as adult, pupa or larva. The rate of this type of mortality was very low, less than 1%.

Table 2. Number of sampled eggs of *Malacosoma neustria* (Linnaeus, 1758) (combined in 2004 and 2005) in different collecting sites, host plants and rate of parasitism

Localities	Host Plants	Sampled eggs	Parasitized eggs	Parasitism
		Number	Number	%
University Campus	Rose hip	732	174	23.77
	Apple	1052	217	20.62
	Birch	962	174	18.08
	Oleaster	816	180	22.05
	Total	3562	745	21.13
Tortum	Barberry	996	221	22.18
	Rose hip	1096	260	23.72
	Total	2092	481	22.95
Oltu	Plume	1168	259	22.17
	Sea buckthorn	1137	249	21.89
	Total	2305	508	22.03
General Total		7959	1734	21.81

Discussion

Bulut (1991) studied the egg parasitoids of *M. neustria* in Ankara and neighboring provinces (Central Turkey) and obtained seven species: *Telenomus laevisculus* (Ratzburg, 1844), *Trichogramma buluti* Bulut & Kilincer, 1991, *Anastatus bifasciatus* (Geoffroy, 1785), *Ooencyrtus neustriae* (Mercet, 1925), *Ooencyrtus tardus* (Ratzeburg, 1844), *Ooencyrtus masii* (Mercet, 1921), *Ooencyrtus* sp. The first four species were found also in the present study, the rest of them were not recorded from Erzurum province (Eastern Turkey). Bulut (1991) had similar results for *T. laevisculus*: he found *T. laevisculus* in all sampling localities where it was the most common and abundant parasitoid attacking *M. neustria*, accounting for over 66% of total parasitoids. However, it is interesting that he did not encounter *Baryscapus oophagus* (Otten, 1942) and *Baryscapus nigriviolaceus* (Nees, 1834) in Ankara and neighboring provinces. He obtained *A. bifasciatus*, *T. buluti* and *O. neustriae* from the eggs of *M. neustria*, the first one was more abundant than the others and accounted for about 1.4% of the all parasitoids, other two species were less abundant and accounted for less than 1% of the parasitoids.

Semetulskis (1974) noted that *T. laevisculus* parasitized 11.8-86.7% of the eggs of *M. neustria* in Lithuania. Dyadechko et al. (2001) pointed out that more than 100 species were listed as natural enemies of *M. neustria* in Ukraine, among them *T. laevisculus* was the only species that overlapped. The founding in the present study and other studies (Semetulskis, 1974, Bulut, 1991; Dyadechko et al., 2001) revealed that *T. laevisculus* is host-specific to *M. neustria* and could be a potential candidate in its biological control.

Although *B. oophagus* was determined to be an egg parasitoid of *M. neustria*, Otten (1942) gave this species as larval parasitoid of *Diprion* spp. (Hymenoptera: Dirionidae). Similarly *B. nigriviolaceus* is documented as a larval parasitoid of the horse chestnut leaf minor, *Cameraria ohridella* Deschka &

Dimic (Lepidoptera: Gracillariidae) (Hellrigl, 2001; Freise et al., 2002). Similarly, Vikberg (2005) reared *Pronotalia carlinarum* (Szelenyi & Erdős, 1921) from the larva of *Urophora cardui* (Linnaeus, 1758) (Diptera: Tephritidae) galling stems of thistle in Finland.

Anastatus bifasciatus was the only species obtained from both new-laid and overwintered eggs; its population was very low and was account for less than 1% of the all parasitoids. Bulut (1991) noted that *A. bifasciatus* constituted 1.3% of all the egg parasitoids of *M. neustria*. Bin & Tiberi (1983) found that *A. bifasciatus* overwintered as first instar larva in the eggs of the hosts. *Anastatus bifasciatus* also parasitizes eggs of *Thaumetopoea pityocampa* (Denis & Schiffermüller, 1775) (Lepidoptera: Thaumetopoeidae) in Turkey (Mirchev et al., 2004) and in various countries, such as in Italy (Tiberi, 1984; 1990), in Bulgaria (Tsankov, 1990), in Israel (Halperin, 1990), in Greece (Tsankov et al., 1999) and in Iberian Peninsula (Schmidt et al., 1999). Stefanescu et al. (2003) reported that *A. bifasciatus* was one of the egg parasitoids of *Iphiclides podalirius feisthamelii* (Duponchel, 1832) (Lepidoptera: Papilionidae) in Spain. Crossman (1925) reported this species as an egg parasitoid of the gypsy moth, *Lymantria dispar* (Linnaeus, 1758). This species was reported as an egg parasitoid of *Eurygaster* spp. and some other pentatomids (Nikolskaya, 1952; Popov et al., 1980).

Three species, *Baryscapus evonymella* (Bouche, 1834), *T. buluti* and *O. neustriiae* had very low populations; their abundance totaled 0.5% of the parasitoids. *Baryscapus evonymella* was determined by Gencer (2003) to hyperparasitize *Yponomeuta malinellus* Zeller, 1838 (Lepidoptera: Yponomeutidae) in Sivas (Turkey). We could not detect whether it is a primary parasitoid or hyper-parasitoid of *M. neustria*. Bulut (1991) obtained *O. neustriiae* and *T. buluti* from the eggs of *M. neustria*. He indicated that *O. neustriiae* parasitized *Malacosoma castrensis* (Linnaeus, 1758) too. Thomson (1946) listed *O. neustriiae* among the egg parasitoids of *M. neustria*. Present results and Bulut (1991)'s findings suggest that these three egg parasitoids are of very little consequence in the dynamics of *M. neustria* populations in Turkey.

The rate of total parasitism was 21.81% for two years for all host plants in all location sites. Parasitism rate in all location sites was similar; 21.13%, 22.95% and 22.03% in the university campus, Tortum and Oltu respectively, probably due to having high number of *T. laevisculus* and *B. oophagus* in three location sites in two years. Parasitism rates of the eggs collected from birch was the lowest (18.08%) those of *Rosa* sp. were highest, 22.7% both on the campus and Tortum (Table 2).

It could be concluded that the composition of egg parasitoid species *M. neustria* was quite diverse in Turkey but, of these *T. laevisculus* is the most common and abundant species having a potential in the biological control of this particular pest.

Özet

Erzurum ilinde Yüzükkelebeği, *Malacosoma neustria* (Linnaeus, 1758) (Lepidoptera: Lasiocampidae)'nın yumurta parazitoidleri

Değişik dönemlerde salgınlar yaparak birçok meyve ve çalı türlerinde önemli derecede zararlara neden olan Yüzükkelebeği, *Malacosoma neustria* (Linnaeus, 1758) (Lepidoptera: Lasiocampidae)'nın yumurta parazitoidlerinin saptanması ve potansiyel biyolojik mücadele etmenlerinin belirlenmesi amacıyla Erzurum ilinde 2004-2005 yıllarında çalışılmıştır. Üç ayrı yöreden alınan yumurta örneklerinden Hymenoptera takımında dört familyaya bağlı sekiz parazitoid türü elde edilmiştir. Bunlardan *Telenomus laevisculus* (Ratzeburg, 1844) (Scelionidae) her üç yöreden de elde edilen ve en fazla yoğunluk oluşturan tür olup tüm parazitoidlerin %51'ini teşkil etmektedir. *Baryscapus oophagus* (Otten, 1942) ve *Baryscapus nigriviolaceus* (Nees, 1834) (Eulophidae) ise toplam parazitoidlerin sırasıyla %24 ve %21'ini oluşturmaktadır. *Pronotalia carlinarum* (Szelényi & Erdős, 1951) (Eulophidae), *Anastatus bifasciatus* (Geoffroy, 1785) (Eupelmidae), *Trichogramma buluti* Bulut & Kilincer, 1991 (Trichogrammatidae), *Ooencyrtus neustriæ* (Mercet, 1925) (Encyrtidae) ve *Baryscapus evonymella* (Bouche, 1834) (Eulophidae) bu çalışmada elde edilen örnek sayıları çok düşük türlerdir. *Telenomus laevisculus* bu zararlı ile biyolojik mücadelede en fazla potansiyele sahip olan türdür. Elde edilen parazitoidlerin doğal parazitlenme oranı %21.81 olmuştur.

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