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Egg Parasitoid Species and Rates of *Thaumetopoea pityocampa* (Lepidoptera: Thaumetopoeidae) in Uşak Provience*

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Abstract— The study was carried out in forest areas in the center and districts of Uşak Province in 2019 and 2020. The aim of the study is to determine the egg parasitoids and their presence of *Thaumetopoea pityocampa* (Den. & Schiff.) (Lepidoptera: Thaumetopoeidae), which is harmful in pine and larch forests. For this purpose, egg batches belonging to the pest were collected from October 2019 until November 2020. Egg batches kept in room conditions in the laboratory were checked once a week and parasitoid emergences were observed. Parasitization rate was 6.72% in 536 egg batches collected in the center and districts within two years. From the parasitezed eggs, *Anastatus bifasciatus* (Geoffroy) (Hymenoptera: Eupelmidae), *Ooencyrtus pityocampae* (Mercet) (Hymenoptera: Encyrtidae), *Baryscapus servadeii* (Domenichini) (Hymenoptera: Eulophidae), and *Trichogramma embryophagum* (Hartig) (Hymenoptera: Trichogrammatidae) species have been identified. Considering the rate of presence of parasitoids, it was understood that they were approximately 61% *B.servadeii*, 26% *O. pityocampa*, 12% *T. embryophagum* and 1% *A. bifasciatus*.

Index Terms— Anastatus, Baryscapus, Pine processionary moth, Thaumetopoea, Ooencyrtus, Egg parasitoid

1 Introduction

The Forests are an ecosystem that is very important for the whole world. With the living and non-living factors it contains, forests benefit from many important areas such as water, biological diversity, medicine, mine, soil and food in terms of economic and daily life. The presence of extreme elevations such as Mount Ararat and Amik plain in Turkey causes forest diversity to be quite different [1]. There are many insect species in the forests of our country that harm plants. These insects cause damage by feeding on leaves, buds, cones and roots [2]. In studies examining the distribution of *Thaumetopoea pityocampa* (Den. & Schiff.) and *Thaumetopoea wilkinsoni* (Tams) (Lepidoptera: Thaumetopoeidae). *T. wilkinsoni* is found in Turkey, Cyprus, the Greek islands of Crete, Rhodes, Samos and the Mediterranean coast of the Middle East, while *T. pityocampa* is found in Europe, North Africa and Turkey and it has been seen that the common point is Turkey [3].

Its damage usually occurs as a result of eating the needles of pine and cedar trees. In addition to the direct damage caused by eating the needles, it also causes indirect damage as a result of the attack of the secondary pests due to the weakening of the plants if the damage is repeated for several years. The life cycle of this pest is completed in 4 stages. These are in the form of eggs, larvae, pupae and adults, respectively. The larvae molt 4 times until they reach the pupal stage, and their damage increases from each stage to the next. In addition to these damages to pine trees, they are also harmful as a result of allergies in humans and animals by the hairs on the larvae [4].

It is of great importance to control *T. pityocampa* in the larval stage, as it causes the greatest damage in this period [5]. This pest has many natural enemies that limit the population in its natural environment. Various studies have been carried out on the natural enemies of *T. pityocampa* in our country. Doğanlar et al. [6] in and around Hatay province, Avcı and Oğurlu [7] in the Lakes region, Can and Özçankaya [8] in the Aegean region, Mirchev et al. [9] in the provinces of Isparta, İskenderun and Muğla, Şimşek et al. [10] in Çankırı, Voyvot [11] in the Mediterranean, Aegean and Marmara regions, Erkaya [12] in Isparta, Burdur, Antalya and Muğla, and Şahin et al. [13] conducted studies in Çanakkale Province.
In this study, the egg parasitoid species of the pest and their prevalence in forest areas in the center and districts of Uşak were determined. It will shed light on future studies on methods of controlling this pest.

2. MATERIAL AND METHODS

The material of the research consists of egg batches belonging to pine processionary moth collected from forest areas in Uşak province and its districts, as well as plastic bags, 11x1.6 cm glass tubes, petri dishes, pure water and sterile cotton.

The study was carried out in the forest areas in the center of Uşak and its districts (Banaz, Ulubey, Karahallı, Sivaslı and Eşme) from September 2019 to October 2020. As a result of the survey studies, parasitoid species and parasitization rates were determined in the collected egg batches of *T. pityocampa*. The survey areas where the study was carried out are given in Figure 1.

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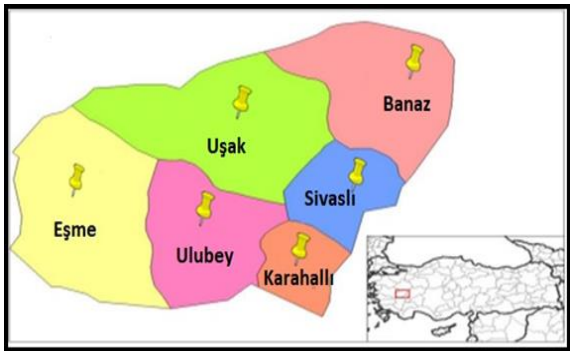

Figure 1. Survey areas in Uşak Province (Survey area)

Egg batches were collected from larch and red pine trees in 6 regions by going to forest areas from Uşak and its districts. A total of 536 egg batches, 240 in the first year and 296 in the second year, were collected on pine trees in the survey area. These were brought to the laboratory in plastic bags and each was taken into separate glass tubes. These tubes are numbered and labeled according to the regions and put in separate bags. Moisture requirement was provided by placing sterile cotton moistened with pure water in these bags. These bags were kept in room conditions in the laboratory and observations were made until the parasitoid emergences were finished. As a result of the observations and counts, the parasitization rates in the eggs in the egg batches were calculated. Obtained parasitoid species and their detection rates were determined as a result of their identification by needling appropriately.

The taxonomic distinction of parasitoid species was made by the second author, taking into account the available literature. In the study, egg packages and parasitoids were examined with the help of an Olympus SZX10 stereo microscope and an integrated Olympus SC30 camera.

3. RESULTS

The result of data on parasitoid species obtained from eggs of T. pityocampa was presented in Table 1. As seen here, four species belonging to four different families belonging to the order Hymenoptera were identified. In the areas where the experiment was carried out, a total of 536 egg batches were collected. Of these, the emergence of parasitoids was observed in 140 egg batches in the first year and 123 egg batches in the second year. The average parasitization rate from these eggs was calculated as 6.72%. There are some previous studies in different regions of Turkey. Of these, Acatay [14] determined the parasitization rate as 18.0% in the province of Istanbul. Avcı and Oğurlu [7] reported that the natural activity of parasitoids in the red pine and black pine forests in the Lakes Region is 22% on average. Doğanlar et al. [6] calculated the average parasitization rate as 43.52%, 45.67% and 43.02% in Antakya, Kırıkhan and Hassa, respectively. Simsek et al. [10] determined the parasitization rate as 10.92% in Çankırı larch forests and in another study Şahin et al. [13] reported that the average interference rate was 18.16% in their study in Çanakkale.

Table 1. Parasitoid species obtained from the eggs of *Thaumetopoea pityocampa*

Order	Family	Parasitoid species
Hymenoptera	Encyrtidae	*Ooencyrtus pityocampae* (Mercet, 1921)
	Eulophidae	*Baryscapus servadeii* (Domenichini, 1965).
	Trichogrammatidae	*Trichogramma embryophagum* Hartig, 1838
	Eupelmidae	*Anastatus bifasciatus* (Geoffroy, 1785)

And also the prevalence rates of these species were given in Figure 2. When the prevalence of parasitoid species obtained from the eggs of T. pityocampa is examined, it is understood that the most common species is *Baryscapus servadeii* (Domenichini, 1965) (Hymenoptera: Eulophidae), followed by *Ooencyrtus pityocampae* (Mercet) (Hymenoptera: Encyrtidae). The least common egg parasitoid species is *Anastatus bifasciatus* (Geoffroy) (Hymenoptera: Eupelmidae). In addition, a species belonging to the Eulophidae was found at a low rate, but has not yet been identified. Considering the studies on this subject, Can and Özçankaya [15], calculating the parasitization rates according to the altitude steps, stated that the species with the most activity were O. pityocampae and *B. servadeii*, and *A. bifasciatus* was very less effective. *Trichogramma* sp. reported that species were never found in the research area. Mirchev et al. [9] reported that 94% of all eggs were parasitized by *O. pityocampae* and *B. servadeii*. Voyvot [11] determined in the study that 51.48% was *B. servadeii*, 47.27% was O. pityocampa, 1.1% was *Trichogramma embryophagum* (Hartig) (Hymenoptera: Trichogrammatidae) and 0.1% was *A. bifasciatus*. Erkaya [12] reported that the most common egg parasitoid species in egg cobs are 20.45% *Trichogramma* sp., 16.51% *O. pityocampae* and 1.69% *A. bifasciatus*. In addition, Şahin et al. [13] determined the presence of egg parasitoids obtained in their study in Çanakkale as 26% *A. bifasciatus*, 32% *B. servadeii* and 42% *O. pityocampae.*

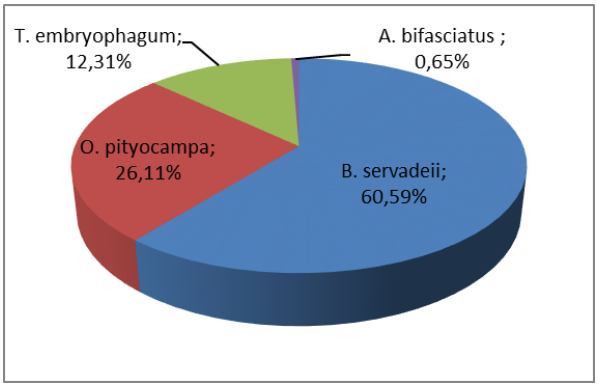

Figure 2. The rates (%) of parasitoid species obtained from the eggs of *Thaumetopoea pityocampa*

When the results obtained in the studies conducted in Uşak

province and its districts are compared with each other, it is understood that there are differences due to different years and different regions.

4. DISCUSSION

According to the data obtained in the study on the determination and density of egg parasitoids of *T. pityocampa* was carried out in the center and districts of Uşak Province in 2019-2020, and the density and the number of parasitoid species were determined. Detection of egg parasitoid species among natural enemies is necessary and important in terms of forest areas, since the population of the pest can be high in the center and in all districts. Because, in the future, it is important to collect the parasitoid species determined in this study and to leave them to other undetected areas in the control of this pest. In addition, the use of methods of control that should not be affected by natural enemies, and the avoidance of chemical control in order to protect natural enemies, if preferred, the choice of chemicals that will not harm these natural enemies will make a positive contribution to nature and the environment.

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