

Wing color and pattern variations in the Turkish population of *Ypsolopha ustella* (Clerck, 1759) on oak and some additional notes (Lepidoptera, Ypsolophidae)

Selma Seven Çalışkan^{a,*} , Özge Torun Aytaç^a 

Abstract: The genus *Ypsolopha* Latreille, [1796] is known with 21 species in Türkiye. Known records are generally based on a few faunistic studies limited to a few provinces and there are almost no studies on their biology. In this study, the Turkish populations of *Ypsolopha ustella* (Clerck, 1759) were evaluated for the first time. Larvae of the species, whose faunistic record is known only from Ankara province in Türkiye, collected from the oak forest of Beypazarı district, were examined. Larvae collected from *Quercus pubescens* Willd were fed with laeves of host plants in the laboratory. All larvae entered the pupal stage. The pupal stage lasted an average of 18 days. Its larval, pupal and adult stages were described and photographed. Wing colors and pattern variations of adult moths were presented.

Keywords: Morphology, Türkiye, Variation, *Ypsolopha ustella*

Meşe üzerindeki *Ypsolopha ustella*'nın (Clerck, 1759) Türkiye popülasyonunda kanat rengi ve desen varyasyonları ve bazı ek notlar (Lepidoptera, Ypsolophidae)

Öz: *Ypsolopha* Latreille [1796] cinsi Türkiye'de 21 tür ile bilinir. Bilinen kayıtlar genellikle birkaç il ile sınırlı birkaç faunistik çalışmaya dayanmaktadır ve biyolojileri hakkında hemen hemen hiç çalışma yoktur. Bu çalışmada, *Ypsolopha ustella* (Clerck, 1759)'nın Türkiye popülasyonları ilk kez değerlendirilmiştir. Faunistik kaydı Türkiye'de sadece Ankara ilinden bilinen türün, Beypazarı ilçesi meşe ormanından toplanan larvaları incelenmiştir. *Quercus pubescens* Willd ağaçlarından toplanan larvalar laboratuvarında konukçu ağacın yapraklarıyla beslenmiştir. Larvaların hepsi pupa evresine girmiştir. Pupa evresi ortalama 18 gün sürmüştür. Larval, pupa ve ergin evreleri tanımlanmış ve fotoğraflanmıştır. Ergin güvelerin kanat renkleri ve desen varyasyonları ortaya konulmuştur.

Anahtar kelimeler: Morfoloji, Türkiye, Varyasyon, *Ypsolopha ustella*

1. Introduction

Ypsolopha Latreille, [1796] is the largest genus of the family Ypsolophidae, consisting of nearly 140 described species worldwide. About 100 species are distributed in the Palearctic and Oriental regions (Jin et al., 2013). The Ypsolophidae family includes some strikingly camouflaged species that can be mistaken for a dead piece of bark when resting. All species attach themselves to bushes and trees during the larval stage. The moths hide in the bushes during the day. When disturbed, some species prefer to fall to the ground rather than fly (Hellers, 2019). In recent years, taxonomic studies and new species related to the *Ypsolopha* genus have attracted attention (Baraniak, 2005, 2007; Jin et al., 2013; Sachkov and Zolotuhin, 2020). However, despite the interest shown in this group in the last twenty years, studies on the species diversity have not yet been completed (Margarita et al., 2013). 21 species of this genus are known in Türkiye. Known records are generally limited to a few provinces. The most common species is *Ypsolopha persicella* (Fabricius, 1787), recorded in 7 provinces (Koçak and Kemal, 2018). *Y. asperella* (Linnaeus, 1761) from Bursa

(Mann, 1864), *Y. excisella* (Lederer, 1855) from Ankara (Koçak and Kemal, 2018), Bitlis (Kemal and Koçak, 2017), Van (Koçak and Kemal, 2014), *Y. instabilella* (Mann, 1866) from Amasya (Staudinger, 1879), Mardin (Baraniak, et al., 2014) and Kırıkkale (Seven, 2000), *Y. kristalleniae* (Rebel, 1916) from Kahramanmaraş (Koçak and Kemal, 2018), *Y. manniella* (Staudinger, 1879) from Amasya (Staudinger, 1879), *Y. mucronella* (Scopoli, 1763) from Bursa (Mann, 1862), *Y. nervosella* (Zerny, 1940) from Ankara (Baraniak et al., 2014), Bitlis (Kemal and Koçak, 2017), *Y. satellitella* (Staudinger, 1871) from Van (Koçak and Kemal, 2018), *Y. sculpturella* [Herrich-Schäffer, (1854)] from Amasya (Staudinger, 1879), Kırıkkale (Seven, 2000), *Y. semitessella* (Mann, 1861) from Amasya (Mann, 1861; Staudinger, 1879; Baraniak et al., 2014), *Y. sequella* (Clerck, 1759) from Bursa (Mann, 1864; Staudinger, 1879), Kleinasien (Burmman, 1985), *Y. trichonella* (Mann, 1861) from Amasya (Staudinger, 1879; Baraniak et al., 2014), Kırıkkale (Seven, 2000), *Y. vittella* (Linnaeus, 1758) from Kleinasien (Burmman, 1985), Ankara (Koçak and Kemal, 2018) and Bursa (Staudinger, 1879) are known. Although the taxa *Y. scabrella* (Linnaeus, 1761), *Y. nebulella* (Staudinger, 1871),

✉ ^a Gazi University, Faculty of Science, Department of Biology, Ankara, Türkiye

@ ^{*} **Corresponding author** (İletişim yazarı): selma@gazi.edu.tr

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Y. horridella (Treitschke, 1835), *Y. dentella* (Fabricius, 1775) and *Y. parenthesesella* (Linnaeus, 1761) are given in the Turkish list, their recorded locations are unknown (Koçak and Kemal, 2018). Seven (2000) gave 3 species and 1 genus in her study and presented information about the ecology as well as the faunistic records of the species.

Ypsolopha ustella (Clerck, 1759) is an extremely variable species with dark yellow-brown wing colors and is easy to be confused with other members of the genus. It hibernates at adult stage, often hiding under the exposed bark of dead, standing tree trunks, sometimes even deeper in decaying wood (Rennwald, 2019). It can fly towards the light from the beginning of April (Hellers, 2019). Adults fly from mid-July to April in Western Europe, but still can fly almost year-round depending on location. Larvae feed on the upper surface of leaves of *Quercus* species. They live under a light web. Pupation occurs in a whitish boat-shaped cocoon on a leaf, stem, or leaf litter on the ground (Döring, 2022). In Türkiye, it is known only in Ankara (Koçak and Kemal, 2018). The larvae feed on oak like many other species of this genus. Kulfan et al. (2006) reported larvae from *Q. cerris*, while Kulfan et al. (2018) reported larvae from *Q. pubescens*. According to Kula (2007), 24% of *Y. ustella* larvae feed on *Quercus petraea* (Matt.). Torun and Seven (2014) reported this species from *Q. pubescens* in their study. Hellers (2019) reported that 17 *Y. ustella* individuals were collected on *Q. pubescens* leaves in an oak forest.

Although it is known as an important pest in oak forests in Europe (Forest Pests Europe, 2025) very few studies on this species have been found in Türkiye. This study aims to contribute to the developmental periods of *Ypsolopha ustella* and to reveal its wing variations in Turkish populations. For this purpose, larvae collected from oak trees were fed with the leaves of host plants in the laboratory environment and their developmental periods were examined. It is also thought that this study will help identify this species, which shows such variation, from other locations in Türkiye.

2. Materials and methods

The specimens examined in the study were collected from the leaves of oak trees in Beypazarı district of Ankara province. Larva specimens were collected from trees with clamps or by hand together with the leaves. Also shaking off method was applied (Kıyak, 2000). The samples were cultured at a room temperature in a laboratory environment and fed with leaves of host plants. Samples were fed with nutritional plants (oak leaves) to achieve pupa and adolescent stages in laboratory environment. Larva and pupa stages of the samples were photographed with LEICA Z16 APO model microscope and adolescent samples were photographed with Canon brand EOS 550D model camera. The species were identified based on male genital characters. For genital dissection, the abdomens of moths are heated in a 10 % aqueous solution of Potassium Hydroxide (KOH) and cleaned by sequential immersion in water and alcohol. The specimens are coated with entellan and a permanent preparation is prepared. The samples examined in the study are the second author's Master's thesis samples.

3. Results

Eight larvae samples were taken from an oak forest (*Quercus pubescens*) in Beypazarı district of Ankara on 03.05.2014, and the larvae pupated on 05-15.05.2014. The samples that pupated formed boat-shaped cocoons on oak leaves. The developmental period of the larvae that pupated on different days was determined to be approximately 15-20 days (ex pupa: 20-30.05.2014).

Superfamilia: Yponomeutoidea Stephens, 1829

Familia: Ypsolophidae Guenée, 1845

Subfamilia: Ypsolophinae Guenée, 1845

Genus: *Ypsolopha* Latreille, 1796

***Ypsolopha ustella* (Clerck, 1759)**

Synonym: #*ustella* Clerck, 1759; *ciliella* (Denis & Schiffermüller), 1775; *radiatella* Donovan, 1794 nec Fourc., 1785; *variella* Hübner, 1796; nec (Denis & Schiffermüller), 1775; *fissella* Hübner, 1796; *cornutus* Fabricius, 1798; *unguiculatus* Fabricius, 1798; *parallela* Panzer, 1799; *byssinella* Hübner, [1813]; *quinquepunctatus* Haworth, 1828; *lutosus* Haworth, 1828; *flaviciliatus* Haworth, 1828; *varians* Haworth, 1828; *fissus* Haworth, 1828; *radiatus* Haworth, 1828; *fulvella* Duponchel, 1839.

Distribution in Türkiye: Ankara (Koçak and Kemal, 2006; Torun and Seven, 2014).

Distribution: Albania, Austria, Belgium, Great Britain, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lichtenstein, Lithuania, Luxembourg, Macedonia, Norway, Poland, Portugal, Romania, Belarus, Russia, Serbia, Slovakia, Spain, Sweden, Switzerland, The Netherlands, Ukraine, Türkiye, İran (Koçak and Kemal, 2018; Scalercio, 2022).

Host plants: *Quercus* sp. (Agassiz, 1996), *Q. cerris* (Kulfan et al., 2006), *Q. pubescens* (Kulfan et al., 2018; Torun and Seven, 2014), *Quercus* sp., *Tilia* sp. (Parenti, 2000); *Q. robur* and *Salix* sp. (Kettner, 2004)

Habitat: Widespread in several habitat types at very different altitude. Found in chestnut, mixed, pine, cork oak, and other forest types (Scalercio, 2022).

Larvae (Figure 1a): Larvae are green. Head is reddish yellowish or light brownish. There are two yellowish white stripes on the dorsal part. The segments are separated by a yellowish band. They have short hairs on them (Figure 1a).

Pupae (Figure 1b): The larvae form a yellowish boat-shaped cocoon of silky web on oak leaves, in which they pupate. The pupae are initially green and then turn yellowish brown (Figure 1b).

Adult (Figure 2a): The wingspan is 15-20 mm. The wing ground color varies from cream to reddish brown. Sometimes there is a longitudinal black line from the base to the terminus on the forewing, sometimes this line does not reach the terminus. In one specimen, this black line is surrounded by a white line. There are fewer black spots on the forewing in individuals with stripes, and more in individuals without

stripes. The fringes are slightly darker brown than the wing color. The hindwing is blackish gray. The head varies from light brown to brown (Figure 3). The thorax is usually light. The antennae are filiform with segments arranged alternately in black and white. The eyes are far apart. The vertex of the head is densely covered with hair-like setae (Figure 3). The palpus labialis is covered with long scales, light and dark, except for the terminal segment (Figure 3). The maxillary palpus is located above the labial segment, with a white base. The base of the ommatidium is surrounded by cilia. Color and pattern variations are noticeable on the wings of adults (Figure 4).

Male genitalia (Figure 2b): The costal valva is smoothly arched. At its apex, there is a small dentiform process. Uncus is rectangular, as wide as the vinculum, with almost straight posterior margin. Vinculum has posterolateral processes. The valva is more or less obovate, rounded distally, and markedly narrows towards the base. Saccus is slightly broader and shorter than the uncus. It bears a needle-like cornu, shorter than the coecum. Aedeagus is long and slightly curved. Apex ends pointed. Two long cornus, half or slightly longer than the aedeagus.

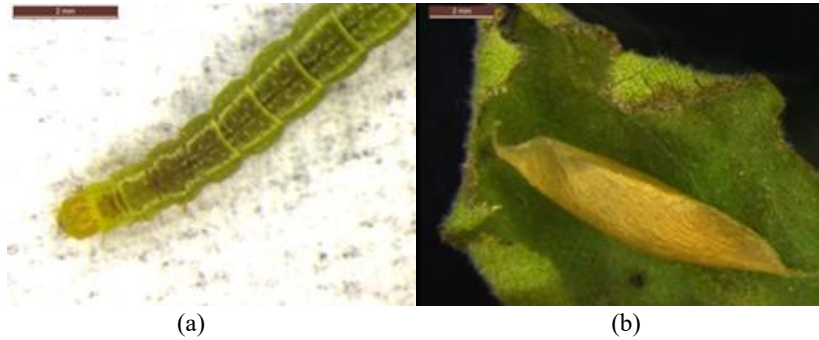


Figure 1. General appearance of the larva (a) and pupa of *Ypsolopha ustella* (Clerck, 1759) (b) (Torun & Seven, 2014)

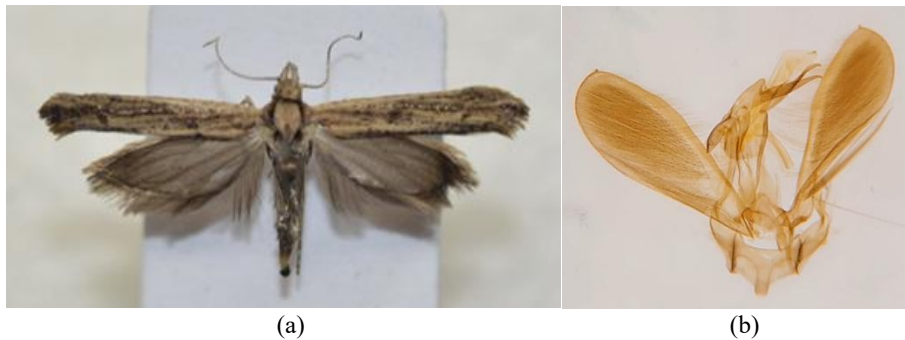


Figure 2. The habitus of adult (a) and male genitalia (b) of *Ypsolopha ustella* (Clerck, 1759)



Figure 3. The head view from above and side of *Ypsolopha ustella* (Clerck, 1759)

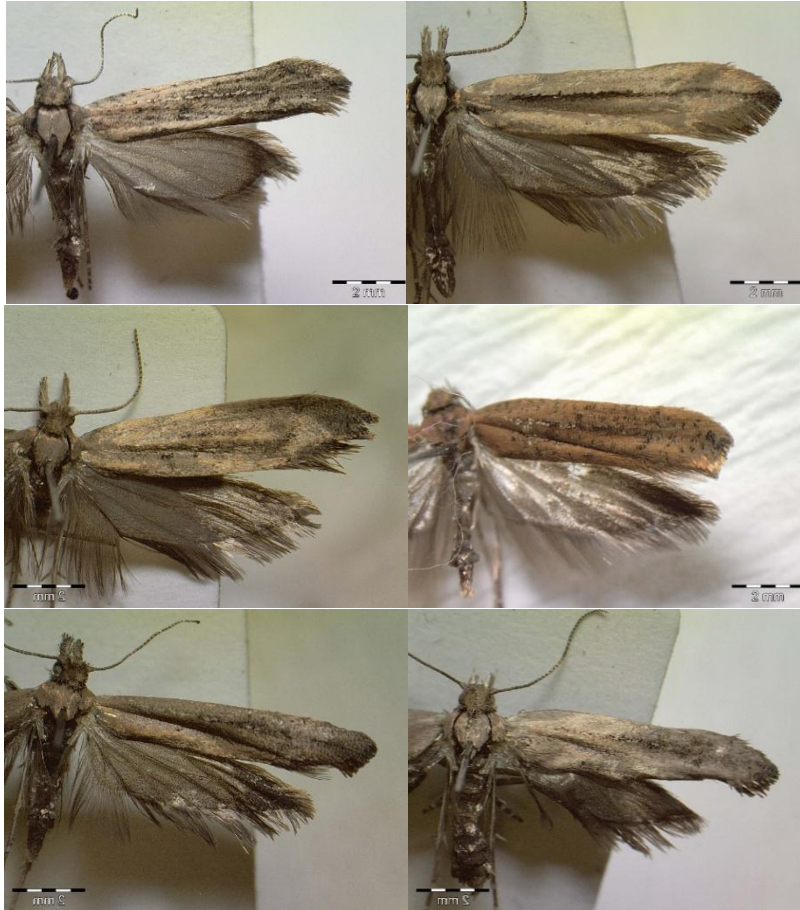


Figure 4. Wing colors and pattern variations in adult of *Ypsolopha ustella* (Clerck, 1759)

4. Discussion and conclusions

It is known that species belonging to the *Ypsolopha* genus form boat-shaped cocoons in their pupal stages (Alford, 2012). The specimens examined in this study also formed a characteristic boat-shaped cocoon in their pupal stage. Adults can be distinguished from other species of the genus by their narrow wings. Color variation is observed in the wings of adults. It has been observed that the wings vary from light brown to dark brown and the transverse stripe seen in the middle band is weak in some individuals. Meyrick (1895) describes this variability as follows: “Head, reddish yellowish or gray. Forewings narrower than in *Ypsolopha parenthesella* (Linn., 1761), pale gray or pale grayish-reddish to dark reddish yellowish or dark bronze; sometimes with a few small dark spots or indistinct longitudinal lines of whitish irradiation or dark gray median longitudinal stripe from base to apex; a dark gray spot on the top of the tornus”. In the specimens examined, the head is generally similar to the ground color of the wing. The dark gray spot on the tornus mentioned in Meyrick’s study was seen in only a few of the examined specimens. The head and mouth parts are similar in all examined individuals. The variation is only noticeable in the wing colors and patterns.

Color variations within the same species might be caused by different reasons. The most studied functions of the color in animals include mimicry, predator avoidance, mate recognition and sexual selection, and these functions are thought to affect diversification (Chazot et al., 2014; Jiggins,

2008; Kemp, 2007; Obara and Majerus, 2000). Nucleotide changes in color genes are responsible for different pigmentations that have various effects such as predation avoidance, conspicuous attraction or optical stimulation. Different pigmentation may allow adaptations to different environments and may even lead to speciation (Hofreiter and Schöneberg, 2010). At the microevolutionary level, butterfly wing patterns show significant genetic polymorphism within species and are closely attributed to survival strategies. Other predator avoidance strategies of butterflies, such as crypsis and masquerade, have also involved intraspecific genetic polymorphism (Teng and Zhang, 2024). Oakleaf butterflies exhibit intraspecific wing phenotype polymorphism with at least ten distinct leaf wing shapes (Wang et al., 2022). *Ypsolopha ustella* also exhibits polymorphism in wing color and pattern, but not in wing shape. Considering that the studied specimens were collected from the same tree and on the same date, it is thought that the main reason for this variation is not due to feeding on different host plants or generation differences as in species that produce multiple generations. The larvae of this group exhibit gregarious life by weaving webs on trees as a kind of defense strategy. Probably, adults also show color adaptation to avoid predators in a similar way. This adaptation is a great advantage for the species to avoid predators and adapt to its environment. The wing variations and male genitalia of the members of this genus, many of which are known to be harmful to trees, cause confusion in diagnosis. The lack of data on the *Ypsolopha* genus prevents the clarification of the

problem and the determination of species distribution. The current situation shows that studies on the species on this genus are needed. Comparison of the wing colors and patterns of individuals from different geographies with the samples in Türkiye will make important contributions in terms of determining the limits of color variation.

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