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Orijinal Makale

Cuticular Morphology of *Anoplius viaticus* (Hymenoptera: Pompilidae) Collected From Different Altitudes of Kars Plateau

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Abstract: In this study totally 55 female samples of *Anoplius viaticus* (Pompilidae: Hymenoptera) were collected by an insect net from different localities in Kars (1850 m), Kars-Kağızman (Kötek deresi 1400 m) and Kars-Allahuekber Mountains (2800 m). Head, thorax and abdomens of the samples were photographed on an electron microscope (SEM) in which their hair covering and cuticle morphologies were compared. Bristles on the head, antenna, thorax, and abdomen of the samples were observed to increase depending on the altitude.

1. INTRODUCTION

Hymenoptera, is one of the largest insect order which is represented by 4000-4500 species in the world (Day, 1988). Pompilidae family, also known as 'spider wasps' are generally dark colored (Rodriguez–Jimenez and Sarmiento, 2008) solitary wasps in this order. The body cover of insects consists of a single row of cells of the epidermis and a cuticle layer located just above it (Wiglesworth, 1974). When it is examined by light microscopy, it seems as a flat structure but actually the cuticle structure is unique to species which can be seen by an electron microscopy (Demirsoy, 1997).

Members of Pompilidae family have long thorny legs and their bodies are cylindrical shaped (Rodriguez – Jimenez and Sarmiento, 2008). Adults are usually encountered when they are searching for prey on the ground or on the flowers. Female spider wasps generally sting and paralyze spiders belonging to Lycosidae family to provision for their larvae (Darry, 1979). After that, the female lays one egg on the paralyzed individual by carrying it to the spider nest which is dug on the ground (Coello, 2000). Some of the wasp larvae feed by sucking the prey's body fluid. Most of the

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adult spider wasps take nectar from flowers of Compositae, Euphorbiaceae and Umbelliferae families.

Head of Pompilidae, is orthognant type with two compound eyes and three ocelli. There is one or more sharp teeth on the mandible. Antennas located on head and consist of 12 segments in females, 13 segments in males. After female dies, cleat like curl on antenna is the most important characteristic of this family (Bohart and Menke, 1976).

Pompilid thorax consists of three distinct segments, namely prothorax, mesothorax and metathorax respectively. The last segment of the thorax and the first segment of abdomen combines and takes the name ‘propodeum’ (Goulet and Huber,1993).

The abdomen in Pompilids, there are 6 visible segment in females and 7 visible segment in males. The first segment of abdomen, propodeum, combined with the thorax. The second segment forms the waist of the wasp. Abdomen is generally black or red colored.

1.1. The structure of the cuticle

Insect integument consists of a single row of cells of the epidermis and cuticle located just above the epidermis. Cuticle layer is of ectodermal origin, secreted by epidermal cells. Epidermal cells takes a prismatic shape while secreting the new cuticle. Histologically, the body cover consist of four layers from inside to outside; the epidermis, the endocuticle, exocuticle and epicuticle. Although the cuticle unique to species its content varies by age.

Trichonemas protruding from the body wall are composed of materials that make up the cuticle. These structures are not connected to the epidermis and are composed of setae (makrotricha). Setae consist of exo- and epicuticle. It connects to the cuticle with a membrane and links with the epidermis.

In this study, cuticle surface of the specimens of Anoplius viaticus collected from different altitudes, were examined with Scanning Electron Microscope (SEM). It is aimed to compare cuticular morphology, including hair structure, of these specimens and determine vertical variations between them.

Distribution of species in the world; Germany, Scandinavian countries, Baltic, Poland, Czechoslovakia, Austria, Italy, France, Spain, Great Britain, Romania (Scobiol – Paladin; 1967; Wolf, 1971, 1995).

Distribution of species in Turkey; Adıyaman, Amasya, Ankara, Antakya, Antalya, Artvin, Bayburt, Bilecik, Bingöl, Bitlis, Bursa, Denizli, Diyarbakır, Edirne, Elazığ, Erzincan, Erzurum, Hakkari, Iğdır, Isparta, İçel, İstanbul, İzmir, Kahramanmaraş, Karabük, Kars, Kayseri, Kırıkkale, Kırklareli, Konya, Kütahya, Malatya, Mardin, Nevşehir, Niğde, Osmaniye, Samsun, Sivas, Şanlıurfa, Tokat, Uşak, Van (Özbek et al., 2000; Priesner, 1968; Kırpık, 2005).

2. MATERIALS AND METHODS

Totally 55 adult female specimens, 20 from Kars-Kağızman area Kötek Stream (1400 m), 20 from Kars-Center (1850 m) and 15 from Kars-Allahuekber Mountains (2800 m), were collected by an insect net. They were killed in bottles containing ethyl acetate and then brought to the laboratory under appropriate conditions. After identification each samples were placed on the stubs and examined by scanning electron microscopy, (ZEISS-EVO 50). Head, thorax and abdomen of three samples collected from different altitudes were photographed and one of the best photos of each altitude has been selected. Regions photographed in a) Head: second flagellomere, mouth parts, distance between eyes in vertex, and distance between ocelli; b) Thorax: 1-3rd segments, front leg; c) Abdomen: 1-5th segments.

3. RESULTS

In this study, the photos were taken from the head of the specimens collected from different altitudes; which are; 2. segment of antenna, mouth and mouth parts, distance between eyes and the distance between ocelli. 1-3. segment of the thorax with front leg were filmed. First 5 segments of the abdomen was photographed. Photographed regions of the samples collected from different heights were compared in terms of their morphology and cuticular hairs overlap between ratios.

3.1. Head: Ocellus The distance between the side ocelli samples collected from three different altitudes in the region, the frequency of sensilla, differences between the sensilla and morphologic structure of cuticle were evaluated.

Distance between the eyes: samples were measured from the closest distance between each other eyes which are collected from the areas belonging to three different altitudes.

Mouth parts: The mouth and the mouth parts of samples which are collected from three different regions were evaluated whether there is a difference between sensilla or not.

Antenna: The frequency of the hair and hair type of 1. segment of the flagellum samples collected from three different regions were evaluated.

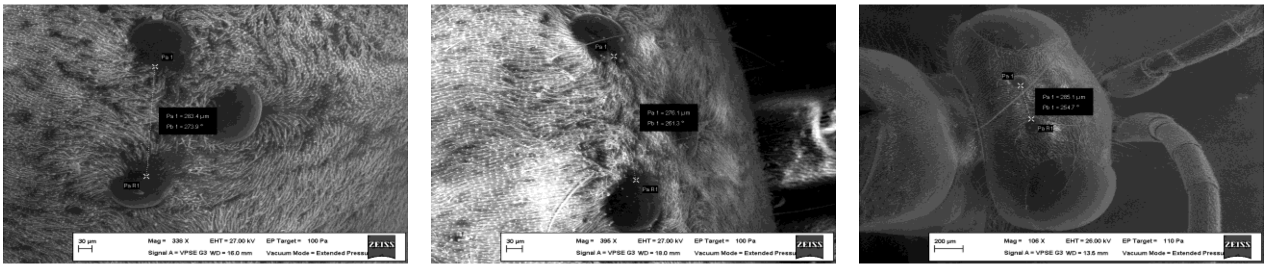
3. 2. Thorax

Third Tergite of thorax: 3. tergite has same feature for three samples and there is no differences in the outermost layer of the cuticle. For all samples, there are images available that shows some structure of cuticles are flat, some are tile-shaped.

Front legs and Macrotrichia: In Pompilidae family, the front legs are used in digging, so the number of makrotrichia in each sample collected from three different regions were evaluated for whether there is a morphological difference or not.

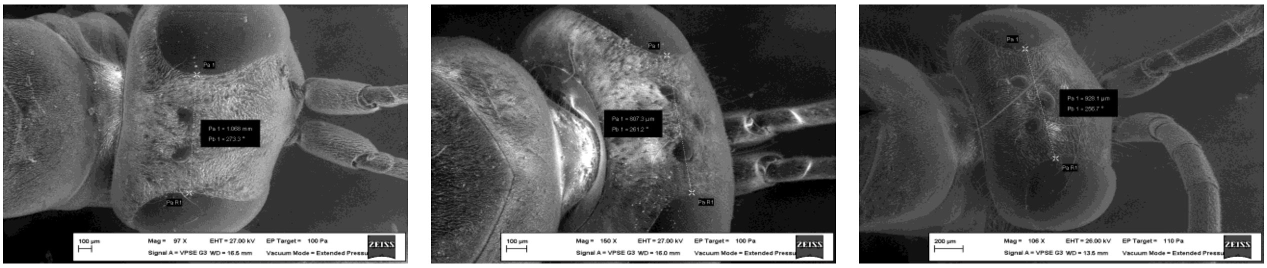
3.Abdominal tergites: First 5 segments of abdomen pictures were evaluated because there is colouring especially on abdomen.

Tergite of the abdomen; it is identified that there is direct proportion between altitude and hair covering rates (frequency), the length of the hair and the darkness of hair.



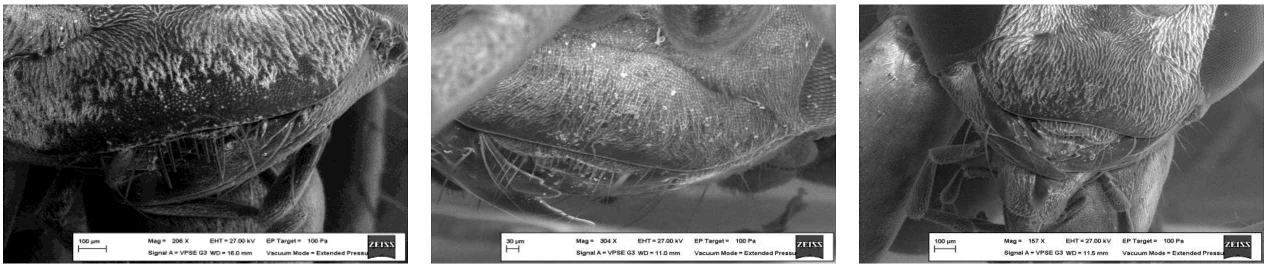
A B C

Picture 1. Ocelli eye structure of samples collected from locations (A; Kağızman Kötek 1400 m, B; Central Kars 1850 m, C; Allhuekber montains 2800 m)



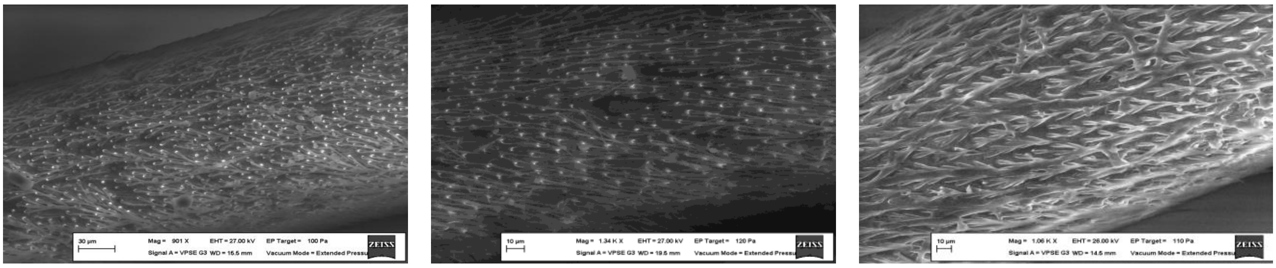
A B C

Picture 2. Distance between eyes belonging to samples collected from locations (A; Kağızman Kötek 1400 m, B; Central Kars 1850 m, C; Allhuekber montains 2800 m)



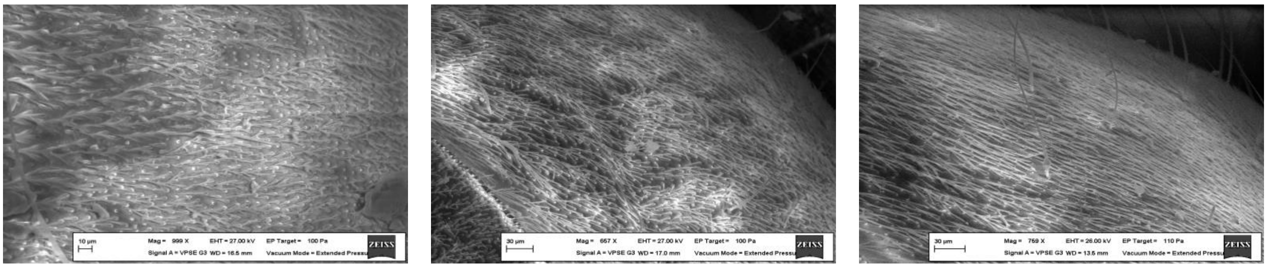
A **B** **C**

Picture 3. Mouth and mouth parts of samples collected from locations (A; Kağızman Kötek 1400 m, B; Central Kars 1850 m, C; Allhuekber montains 2800 m)



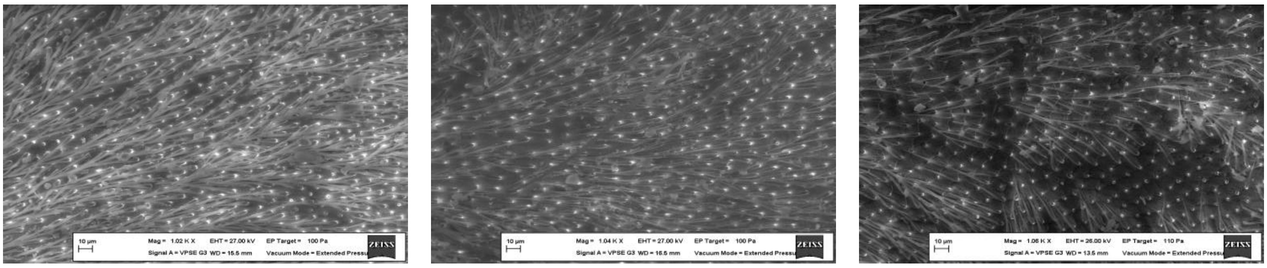
A **B** **C**

Picture 4. Structure of antenna of samples collected from locations (A; Kağızman Kötek 1400 m, B; Central Kars 1850 m, C; Allhuekber montains 2800 m)



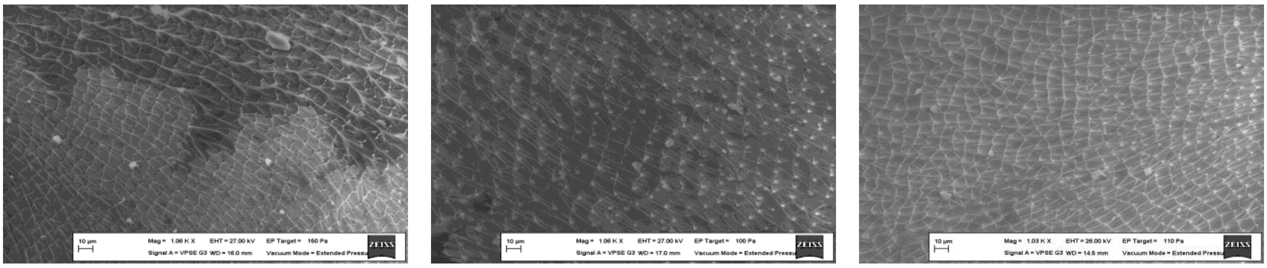
A **B** **C**

Picture 5. 1.tergite of thorax of the sample collected from locations (A; Kağızman Kötek 1400 m, B; Central Kars 1850 m, C; Allhuekber montains 2800 m)



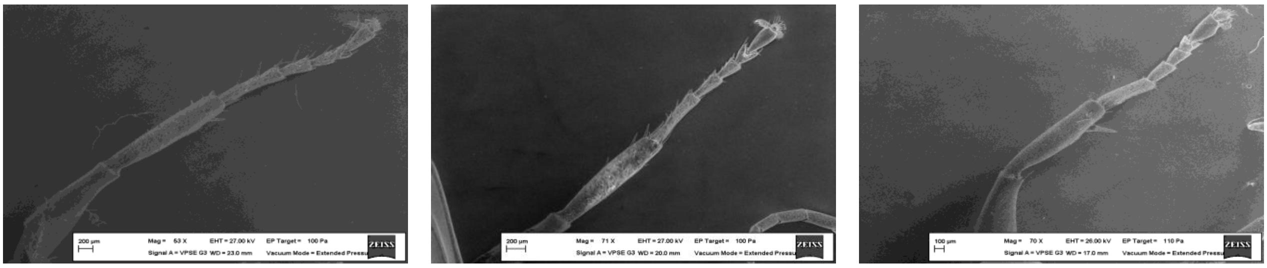
A **B** **C**

Picture 6. 2.tergite of thorax of the sample collected from locations (A; Kağızman Kötek 1400 m, B; Central Kars 1850 m, C; Allhuekber montains 2800 m)



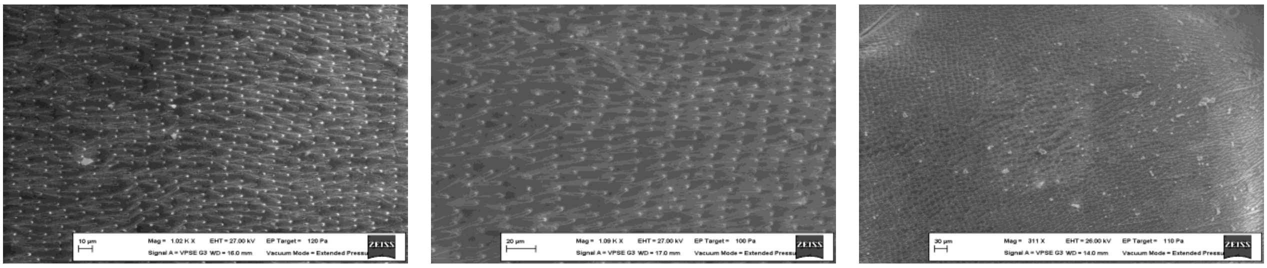
A **B** **C**

Picture 7. 3.tergite of thorax of the sample collected from locations (A; Kağızman Kötek 1400 m, B; Central Kars 1850 m, C; Allhuekber montains 2800 m)



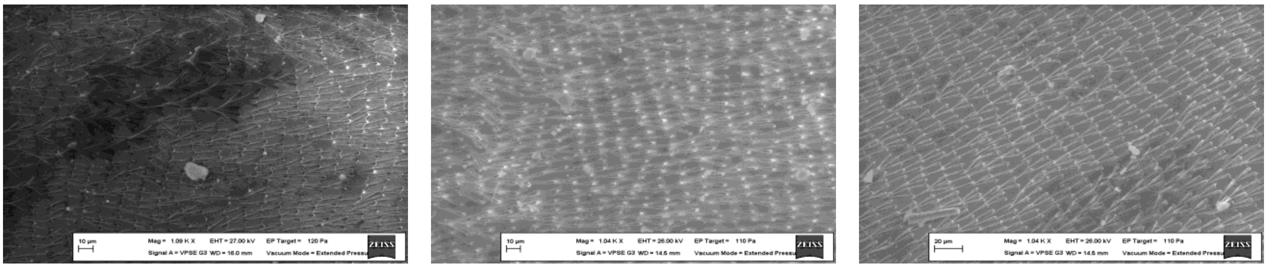
A **B** **C**

Picture 8. Front leg of sample collected from locations (A; Kağızman Kötek 1400 m, B; Central Kars 1850 m, C; Allhuekber montains 2800 m)



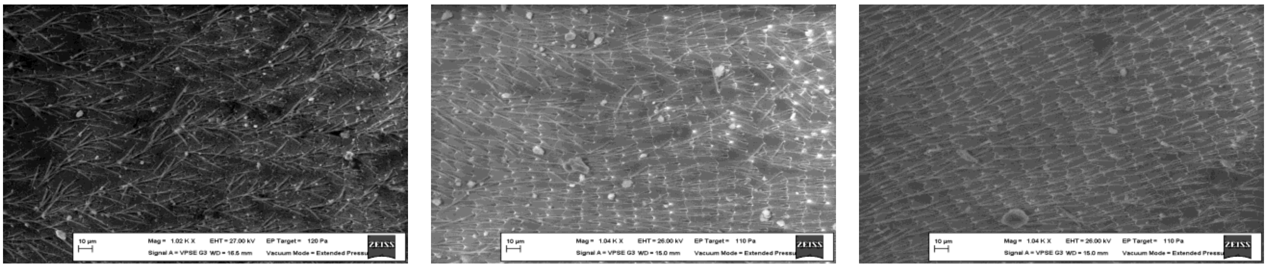
A **B** **C**

Picture 9. 1.tergite of abdomen of sample collected from locations (A; Kağızman Kötek 1400 m, B; Central Kars 1850 m, C; Allhuekber montains 2800 m)



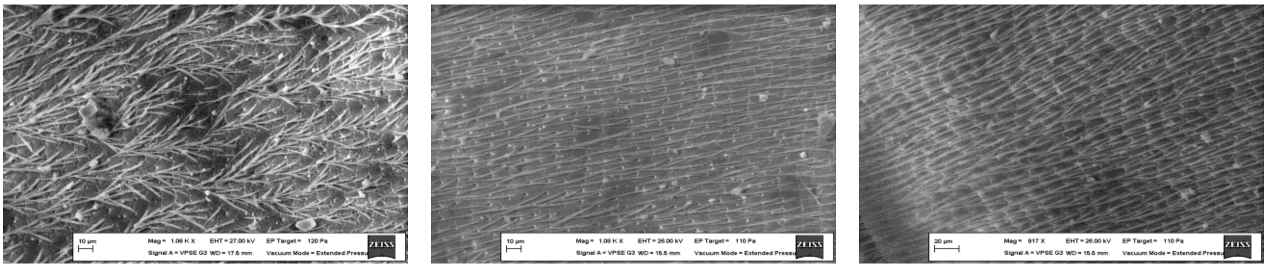
A **B** **C**

Picture 10. 2.tergite of abdomen of sample collected from locations (A; Kağızman Kötek 1400 m, B; Central Kars 1850 m, C; Allhuekber montains 2800 m)



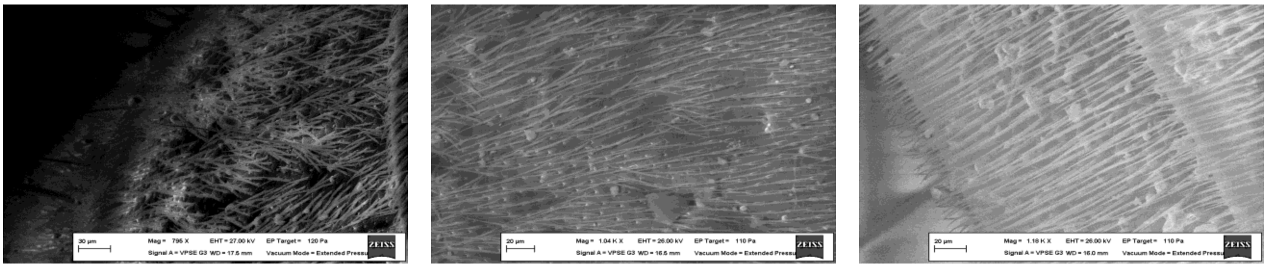
A B C

Picture 11. 3.tergite of abdomen of sample collected from locations (A; Kağızman Kötek 1400 m, B; Central Kars 1850 m, C; Allhuekber montains 2800 m)



A B C

Picture 11. 4.tergite of abdomen of sample collected from locations (A; Kağızman Kötek 1400 m, B; Central Kars 1850 m, C; Allhuekber montains 2800 m)



A B C

Picture 12. 5.tergite of abdomen of sample collected from locations (A; Kağızman Kötek 1400 m, B; Central Kars 1850 m, C; Allhuekber montains 2800 m)

4. DISCUSSION AND CONCLUSION

Cuticular morphology of specimens belonging to *Anoplius viaticus* were examined for the first time. Since no study was found with Pompilidae family members, the data obtained in the study were compared with those of general insect and arthropods.

Hair coverage in the area between the ocelli is intensive in our samples, compatible with that of Jimenez and Sarmiento (2008), probably because of heat insulation. The increase in the distance between the ocelli depending on the altitude conforms to the rules of James (Rench 1938), which is also defined as Extended Bergman (1847) rules.

Although there was no regular increase in the distance between the eyes of samples collected from different heights, the distance between the eyes of the Kağızman (Kötek Deresi 1400 m) samples was larger than that of Kars samples (center 1850 m) which can be related to the rich vegetation. Partridge and Coyne (1997) stated that body size may be affected by factors other than temperature and height. The data obtained in the study is similar to that of Partridge and Coyne (1997).

Our findings showed that there is an increase in hairiness and coloration of the thorax segments depending on the altitude which can be evaluated for heat insulation and sunlight utilization of insects, compatible to that of Angulleta and Dunham (2003).

No significant difference was found in the morphology of the front legs among samples. Jimenez et al. (2008) noted that there was a reduction in the size of the hind legs of socially living wasps, depending on altitude. Since the pompilid wasps use front legs rather than the hind legs to dig their nests, their front legs were assessed in the study. When the data are evaluated in this respect, there is no significant difference in the front legs of the samples collected at three different localities. However, the number of sensilla and spurs on the leg of Kağızman (Kötek Deresi 1400 m) samples is significantly higher than the others.

Although the hair structure on the 1st segment of the flagellum depending on the altitude, the difference does not increase or decrease regularly.

Kırpık (2005) reported that hair density, patterning and coloring of abdomen tergites of pompilids are important characters used systematics. The hair density and coloring of abdomens in all samples was found to be increased in proportion to the altitude. This founding is similar to Kingsolver (1985) in terms of protecting the body heat and isolation. In this study, electron microscopy was used because detailed images could not be obtained in light microscope and stereo microscope Electron microscopy is a good method to study insects morphologically, to overcome systematical problems and also to determine individual variations among samples.

5. ACKNOWLEGMENT

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