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# **Contribution to knowledge of the true bugs species (Hemiptera: Heteroptera) in the habitats of the Berati area in Albania**

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## **Abstract**

The present study provides taxonomic information pertaining to the distribution patterns of “true bugs” insects (Hemiptera: Heteroptera), throughout the ecological systems of the Berat region in Albania. Specimens were collected from May to September spanning the years 2018 to 2020.

The data were collected from stations that exhibited ideal habitats for this specific order, encompassing regions with ample flora, cultivated fields with crops, elevated hills, and hilly terrains. In the Berat region, our inquiry has successfully identified a total of 38 species belonging to the Heteroptera suborder (Hemiptera order). Furthermore, we have furnished citations for every Heteroptera species that have been identified inside the Berat region. Before our investigation, there was a total of 47 recorded species of “true bugs” in Berat. Significantly, our research uncovers a total of 24 species that have not been previously recognized in the Berat region. As a result, our research significantly expands the documented count of Heteroptera species in Berat to 71.

## **Introduction**

The Suborder Heteroptera (Hemiptera Order) exhibits a remarkable level of diversity, as seen by the current global list of around 42,300 species, and many more await description.<sup>1</sup> The recent Catalogue of the Heteroptera of the Palaearctic Region lists approximately 3000 species for Europe.<sup>2</sup> According to McGavin, it is the most extensive group of hemimetabolous insects.<sup>3</sup> The dimensions range from around 1mm to almost 11cm. The taxonomic identification of these organisms is facilitated by the systematically relevant traits of their external morphology and coloration.<sup>4</sup> The “true bugs” possess antennae consisting of four, less frequently three or five segments. True bugs live in virtually all terrestrial and aquatic ecosystems, including rainforest canopies, the open surface of the ocean, torrential and stagnant rivers, ephemeral rain pools and phytotelmata, large lakes, and aphotic caves and man-made buildings.<sup>5,6</sup> True bugs feed on many different resources (e.g., haemolymph of insects, phloem-, xylem-, or parenchym-sap of mosses, ferns, monocotyledons, mostly dicotyledons, the endosperm of seeds, plant pollen). The mouthparts, which evolved as sucking stylets for the uptake of liquid food and the injection of secretions from the salivary gland, are among their characteristic features; they commonly observe restricted diets.<sup>7</sup> Most species are phytophagous; some feed exclusively on particular plant species, genera, or families, whereas others are polyphagous, feeding on dozens to hundreds of different host plants. Many species are predatory, while others serve as biocontrol agents against agricultural pests.<sup>8</sup> The taxonomic characterization of defensive secretory glands

located in the metathorax holds significant importance.<sup>9</sup> According to Derjanschi and Pericart, the front part of mesothoracic wings is reinforced and separated into multiple sections.<sup>10</sup> Taxonomic determination is facilitated by male genitalia, wherein the ninth segment is frequently employed due to its distinct location throughout several families.<sup>11</sup> In the majority of instances, it is feasible to differentiate between females and males due to the presence of a vertical fissure in certain abdomen segments.<sup>10</sup>

In this study, we present the true bugs species (Heteroptera) found in the area of Berat, analyzing all references pertaining to these species within our study area. The relief of this area encompasses plains intertwined with hills, southern mountain ranges, and valleys, while the climate exhibits characteristics of a hill-mountain climate, particularly evident in the variation of climatic elements with altitude. Winter temperatures range from 7°C to 3.2°C, while in summer, they fluctuate between 23.5°C and 21°C. The predominant land cover consists of brown and dark brown forested areas.

## **Materials and Methods**

Heteropteran insects were collected between 2018 and 2020 during the warm period from May to September. This period corresponds with the development of hemipteran species after overwintering and with their main flight activity.<sup>12</sup> The collection of heteropterans was carried out in the district of Berat, at stations characterized by favorable habitats for these insects, including fields, hills, and vegetation of agricultural crops.<sup>13</sup> We have collected data at Poshnja station, located at coordinates 40° 46' 49" N and 19° 50' 39" E, with altitudes ranging from 20 to 30 meters above sea level; Lapardha station, located at coordinates 40° 23' 12" N and 19° 33' 29" E, with altitudes ranging from 120 to 180 meters above sea level; Uznova station, located at coordinates 40° 41' 50" N and 19° 58' 49"E, with altitudes ranging from 50 to 85 meters above sea level; Vodica station, located at coordinates 40° 40' 36"N and 20° 0' 31"E, with altitudes ranging from 30 to 60 meters above sea level; Peshtan station, located at coordinates 40° 14' 5"N and 20° 32' 11"E, has altitudes ranging from 300 to 450 meters above sea level and Lybesh station, located at coordinates 40° 39' 49"N and 20° 6' 57"E, has altitudes ranging from 700 to 8,000 meters above sea level. Surveys were carried out by visiting each station three times, each lasting 4-5 days, under sunny weather conditions from 10<sup>00</sup> to 14<sup>00</sup> during the daytime, and samplings were performed randomly in the stations habitats. An entomological net was used for

heteropterans, considering the life cycle of heteropterans.<sup>14</sup> Plastic bottles, labeled with the date and collection site, were employed for insect storage. The insects were stored in bottles containing a solution of 70% ethanol, acetic acid, and distilled water (in 80:5:20 ratio), along with a few drops of ether.<sup>14</sup> Genitalia were prepared for observation by maceration in 10% potassium-hydroxide (KOH).<sup>15</sup> The identification of specimens was facilitated using ZEISS stereomicroscope (Uzi Seria 240/3 Model 50240003), keys specific to heteropterans,<sup>16-21</sup> as well as reference to previous collections housed at the Museum of Natural Science in Tirana. All publications with references to true bugs insects (Hemiptera: Heteroptera) in the areas of Albania were analyzed. From these references, only those publications presenting references to Heteroptera species specifically for our study area, Berat in Albania, were considered valid for our study. Based on these references, as well as the data from our previous publication on this order,<sup>10</sup> in this region, we further developed our analysis and systematic data for this order of insects.

## **Results**

We report 38 species of true bugs insects (Hemiptera: Heteroptera) for the Berat region, along with the collection station, expedition date, and whether it is referred only by us or by other reference sources. We have grouped the species according to the taxonomic classification of families and the Infraorder of these families (Supplementary Materials, Table 1).

The analysis of references related to "true bugs" (Hemiptera: Heteroptera) in Albania has been conducted.<sup>22-32</sup> In each of these publications, we have analyzed the reference stations for these insects to determine the publications that refer to these insects from our study area. Only publications that report "true bugs" (Hemiptera: Heteroptera) species for our study region, have been selected from these places. Out of all the prior papers on Albania, only one publication specifically mentions the presence of "true bugs" (Hemiptera: Heteroptera) species in our research area in Berat.<sup>26</sup> The reference has been included in the aforementioned list. In this study, we have identified 14 species that have been previously referred by Josifov,<sup>26</sup> while we have identified for the first time 24 species that were not noticed previously for their presence in this region.

## **Discussion**

The analysis conducted in this study is based on the publication authored by Josifov,<sup>26</sup> which serves as an extensive and authoritative resource for studying “true bugs” (Hemiptera: Heteroptera) species in the Berat region. This publication documents 47 Heteroptera species in the Berat area (Supplementary Materials). We observed that out of the 38 species we encountered, 14 were previously documented by Josifov,<sup>26</sup> while 24 species represent new records for this area. Out of the 38 species encountered, the family Pentatomidae, with 12 species, and the infraorder Pentatomorpha, with 28 species, exhibit the highest biodiversity; based on this, we can conclude that the habitats in the Berat area provide the best ecological conditions for these species. The habitats of the considered stations in the Berat area consisted of either agricultural farms or covered in crops, weeds, or grasses fields. There are fields planted with plantations of apples, peaches, berries, peppers, beans, and pecans, or fields planted with sorghum and cotton, which are considered field crops. After incorporating species references from our research, the cumulative number of “true bugs” (Hemiptera: Heteroptera) species recorded in the Berat region of Albania has reached 71 species.

Meanwhile, 34 Heteroptera species referenced by Josifov<sup>26</sup> for the Berat area were not encountered during our expeditions to stations in this region. We attribute this difference in species composition to several factors, including the temporal gap between the expeditions conducted by the German Entomological Institute in the 1960s and our study. Additionally, socio-economic changes in the area have likely played a role. The decline in rural populations and shifts in land use patterns, particularly following the collapse of communism in Albania in the 1990s, may have resulted in habitat degradation and loss, impacting the distribution of Heteroptera species.<sup>28</sup> Our study increases the knowledge about species diversity of “true bugs” (Hemiptera: Heteroptera) in the Berat area, giving valuable information not only for this region but also for Albania as a whole. Further research is needed to assess the impact of ongoing environmental changes on insect populations and to update our knowledge of species distributions in the region.

## **Conclusions**

Our investigation in the Berat area has revealed the presence of 38 species of “true bugs” (Hemiptera: Heteroptera). Our study contributes to the knowledge of 24 “true bugs” species for the first time in the Berat area. Consequently, following our study the total count of “true bugs”

(Hemiptera: Heteroptera) species for this region increases to 71. However, it is worth noting that we did not encounter 34 species listed in the literature references. This disparity underscores the need for further research to comprehensively document the “true bugs” (Hemiptera: Heteroptera) fauna in the Berat area.

Based on our findings, we strongly advocate for the implementation of measures and action plans aimed at preserving the natural habitats in the Berat area. This is crucial to prevent further loss of biodiversity among Heteroptera species. Additionally, we emphasize the importance of exercising caution in new construction projects in the region, as they pose a significant threat to habitat integrity and biodiversity. In conclusion, our study highlights the importance of proactive conservation efforts to safeguard the “true bugs” (Hemiptera: Heteroptera) diversity in the Berat area. By prioritizing habitat protection and minimizing anthropogenic impacts, we can work towards ensuring the long-term survival of “true bugs” (Hemiptera: Heteroptera) species in this ecologically significant region.

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## **Supplementary Materials**

**Annex 1.** List of species referred by Josifov.<sup>26</sup>

**Table 1.** Heteroptera species collected in the Berat area.

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