

ZOOGEOGRAPHICAL CHARACTERISTICS OF THE
PTEROMALID FAUNA (HYMENOPTERA: PTEROMALIDAE) OF
VITOSHA MOUNTAIN, BULGARIA

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Abstract: Distributional analysis and classification of the established fauna of Pteromalidae of Vitosha Mountain is presented. We sampled 115 localities between 916 m and 2160 m above sea level. Collected specimens were identified as 124 recently known species. In addition, 9 previously recorded, but not found in our samples species from Vitosha Mountain, were also categorized. According to the literature data and results from this study, a total of 133 species were classified in 25 chorotypes, undoubtedly dominated by taxa with European distribution (34 species, 25.6%). Other well-presented groups were Holarctic (17 spp., 12.8%), West Euro Siberian (10 spp., 7.5%), European-Anatolian (10 spp., 7.5%), West Palearctic (9 spp., 6.6%) and Palearctic-Oriental (9 spp., 6.6%). All taxa, having ranges affected by human activities, were assessed on the base of their natural distribution.

INTRODUCTION

Pteromalidae (Dalman, 1820) is a family with great species diversity and cosmopolitan distribution. The number of known pteromalid species is higher in the Holarctic region, but the family is fairly diverse also in the Australian and the Oriental regions. The pteromalid fauna of Vitosha Mountain was intensively studied during the period from 2010 to 2012 and the established data on the species composition were already published (Todorov, 2011; Todorov et al., 2012; Todorov, 2013; Todorov et al., 2014). In the present work we combine all known

distributional data for the pteromalid species, found in Vitosha, and classify these species in different zoogeographical categories.

The area of our study - Vitosha Mountain, is situated in the western Bulgaria, near Sofia, the capital of the country. The mountain covers only 278 square kilometers, but its average altitude is fairly high – 1500 m. The weather is mostly defined by the continental temperate climate, but in the highest zone (above 1850 m.) it is very cool and the average temperature in summer is about 9 -10° C (Hubenov, 1990). The vegetation is presented by grasslands, meadows and woodlands, with forests dominated by oaks (*Quercus* spp.), European beech (*Fagus sylvatica* L.) and coniferous trees (*Pinus* spp., *Abies alba* Mill. and *Picea abies* H.Karst.).

MATERIALS AND METHODS

The insects were collected from 115 localities during May-September of the years 2010, 2011 and 2012. Five different sampling techniques were used – sweeping, Malaise traps, yellow traps, hand collection and rearing. The material was stored in 70% ethyl alcohol and dried using the methods of Heraty and Hawks (1998). The taxa were identified following mainly Graham (1969), Dzhanokmen (1978), Bouček and Rasplus (1991), Graham (1992), Dzhanokmen (1996), Bouček and Heydon (1997), Gibson (2009) and Mitroiu (2010). A complete revision of the previous records of Pteromalidae from Vitosha Mountain was done and these species are also included in our analysis. All distributional data concerning the ranges of the species were obtained from the Universal Chalcidoidea Database (Noyes, 2015). The zoogeographical categories used here are specified following Lattin (1967), Taglianti et al. (1999), Semenov Tian-Shanskij (1935), Darlington (1966) and Geptner (1950).

RESULTS AND DISCUSSION

A total of 2721 pteromalid specimens were caught and over 80% of them were identified to species level. We recognized 124 species, belonging to 51 genera and 7 subfamilies. In addition, nine species, previously found in Vitosha Mountain, were also categorized (Todorov, 2014). We referred the all 133 species to 25 chorotypes (fig. 1), grouped into higher categories as follows:

1. Species distributed in the Palearctic and beyond.

1.1. Holarctic (h) - species widespread in Palearctic and Nearctic Regions. This group includes 12.8% of all pteromalids found in Vitosha. Three species with recently known Holarctic-Australian distribution are also considered as naturally Holarctic – *Dinotus cuseuapterus* (Walker, 1836) (introduced in New Zealand for biological control of Scolytidae), *Homoporus nypsius* (Walker, 1839) (probably

introduced in New Zealand) and *Mesopolobus incultus* (Walker, 1834) (probably introduced in New Zealand).

1.2. Palearctic-Oriental (po) - a group including species with Palearctic ranges and disjunctive or not completely studied Oriental ranges. Some of these species are rarely found in Southern China or Southern India. We refer to this chorotype at least 6.7% of all pteromalid species.

1.3. Holarctic-Oriental (ho) - including taxa widespread in the Holarctic region, but found also in some Oriental countries. This group includes 3.76% of the species.

1.4. Cosmopolitan (k) and Subcosmopolitan (sk) - species with worldwide distribution or spread in more than three biogeographical regions. We consider as cosmopolitan 5 pteromalid species, or 3.76% of the taxa. Subcosmopolitan are only 2 species.

The rest widespread pteromalids follow in five different chorotypes, presented with 1 species only: Holarctic-Neotropical-Oriental (hno), Holarctic-Neotropical-Afrotropical (hnat), Holarctic-Neotropical-Australian (hna), West Palearctic-Paleotropical (wppt) and Palearctic-Paleotropical (ppt) (Appendix 1).

2. Species distributed in the Palearctic region.

2.1. Palearctic type - species widespread in the Palearctic Region: Eurasia, south of the Himalayan chain, Africa north of Sahara and Macaronesia. Their ranges cover more than one Palearctic subregion. We include 13.53%, or 18 species in this group and refer them to 7 chorotypes - Holopalaearctic (hop), Transpalearctic (tp), West Palearctic (wp), Disjunct Palaearctic (dp), European-West Central Asian (ewca), European-Anatolian-Turanian (eant) and European-Iranian (ei). Two species with human affected distribution are also classified as Palearctic – the west Palearctic *Peridesmia discus* (Walker, 1835) (introduced in USA) and the Holopalaearctic *Pteromalus semotus* (Walker, 1834) (introduced in New Zealand).

2.2. Eurosiberian type - species widespread in Siberia and extending westwards to Europe, sometimes occurring in mountainous areas of Western Asia. Some species of this group are distributed in Siberia and N Europe or have boreo-mountainous (boreo-alpine) ranges. We include in this category a total of 52.6% of the taxa, or 70 species, and refer them to 7 chorotypes - Holoeurosiberian (hoes), West and Central Eurosiberian (wces), West Eurosiberian-Anatolian (wesa), West Eurosiberian (wes), Disjunct Eurosiberian (des), European-Anatolian (ean) and European (e).

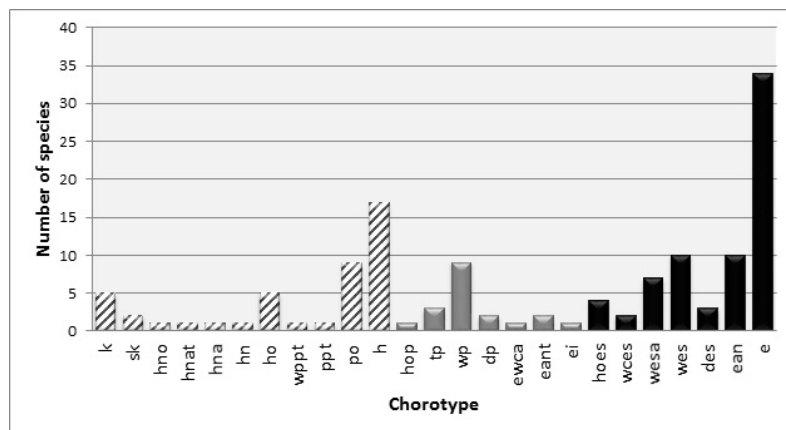


Figure 1. Comparison between specified chorotypes of the pteromalid fauna of Vitosha Mountain. Affiliations of the chorotypes to the zoogeographical categories are presented as different filling of the columns: **wide upward diagonal** - distribution in Palearctic and beyond; **dark grey** - Palearctic type; **black** - Eurosiberian type; Chorotypes: **k** – cosmopolitan; **sk** – subcosmopolitan; **hno** – Holarctic-Neotropical-Oriental; **hnat** – Holarctic-Neotropical-Afrotropical; **hna** – Holarctic-Neotropical-Australian; **hn** – Holarctic-Neotropical; **ho** – Holarctic-Oriental; **wppt** – west Palearctic-Paleotropical; **ppt** – Palearctic-Paleotropical; **po** – Palearctic-Oriental; **h** – Holarctic; **hop** – Holopalaearctic; **tp** – Transpalearctic; **wp** – west Palearctic; **dp** – disjunct Palaearctic; **ewca** – European-west central Asian; **eant** – European-Anatolian-Turanian; **ei** – European-Iranian; **hnes** – Holoeurosiberian; **wces** – west and central Eurosiberian; **wesa** – west Eurosiberian-Anatolian; **wes** – west Eurosiberian; **des** – disjunct Eurosiberian; **ean** – European-Anatolian; **e** – European.

CONCLUSIONS

Among the species having ranges in the Palearctic and beyond, the most numerous are the Holarctic (17 spp.) and the Palearctic-Oriental (9 spp.) pteromalids. On the other hand, Palearctic species are clearly dominated by taxa with European chorotype (34 spp.). West Eurosiberian (10 spp.), European-Anatolian (10 spp.) and West Palearctic (9 spp.) chorotypes are also well presented. Further distributional analysis reveals that eight pteromalid species have North European and mountainous ranges - *Callimerismus fronto* (Walker, 1833), *Semiotellus fumipennis* Thomson, 1876, *Semiotellus laevicollis* Thomson, 1876, *Gastrancistrus affinis* Graham, 1969, *Gastrancistrus clavellatus* Graham, 1969, *Coelopisthia caledonica* Askew, 1980, *Lampoterma bianellatum* Graham, 1969 and *Pteromalus temporalis* (Graham, 1969). Finally, we consider that the Eurosiberian chorotypes and especially their European component include the most of the pteromalid fauna of Vitosha Mountain.

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Appendix: List of the pteromalid species of Vitosha Mountain and their zoogeographical classification. For complete distributional references, see Noyes (2015).

* The chorotype of this species has changed based upon the literature data and our results. An arrow in the column “Chorotype” shows that changing.

bm – boreo-mountainous.

Subfamily	Species	Chorotype
Asaphinae	<i>Asaphes suspensus</i> (Nees, 1834)	Holarctic-Neotropical-Oriental
	<i>A. vulgaris</i> Walker, 1834	Subcosmopolitan
Cleonyminae	<i>Notanisus sexramosus</i> (Erdős, 1946)	European
	<i>N. versicolor</i> Walker, 1837	West Palearctic-Paleotropical
Miscogasterinae	* <i>Callimerismus fronto</i> (Walker, 1833)	North European → European (bm)
	<i>Glyphognathus convexus</i> (Delucchi, 1953)	European
	<i>Halticoptera aenea</i> (Walker, 1833)	Holarctic-Neotropical
	<i>H. circulus</i> (Walker, 1833)	Holarctic-Neotropical-Afrotropical
	<i>H. dimidiata</i> (Förster, 1841)	European-Anatolian-Turanian
	<i>H. laevigata</i> Thomson, 1876	West and Central Eurosiberian
	<i>H. polita</i> (Walker, 1834)	West and Central Eurosiberian
	<i>Merismus megapterus</i> Walker, 1833	Holarctic
	<i>M. rufipes</i> Walker, 1833	Holarctic
	<i>Miscogaster elegans</i> Walker, 1833	European-Anatolian
	<i>Rhincocoelia constans</i> (Walker, 1836)	Holarctic
	<i>Seladerma geniculatum</i> (Zetterstedt, 1838)	Holarctic
	<i>Stictomischus groschkei</i> Delucchi, 1953	Paleartic-Oriental
<i>S. tumidus</i> (Walker, 1833)	Paleartic-Oriental	
<i>Thinodytes cyzicus</i> (Walker, 1839)	Paleartic-Oriental	

Ormocerinae	<i>*Semiotellus fumipennis</i> Thomson, 1876	European → European (bm)
	<i>*S. laevicollis</i> Thomson, 1876	European → European (bm)
	<i>Systasis angustula</i> Graham, 1969	Disjunct Eurosiberian
	<i>S. encyrtoides</i> Walker, 1834	Holarctic-Oriental
	<i>S. parvula</i> Thomson, 1876	Holarctic-Oriental
Panstenoninae	<i>Panstenon oxylus</i> (Walker, 1839)	Palaearctic-Oriental
Pireninae	<i>Gastrancistrus acutus</i> Walker, 1834	West Eurosiberian
	<i>*G. affinis</i> Graham, 1969	North European → European (bm)
	<i>*G. clavellatus</i> Graham, 1969	North European → European (bm)
	<i>G. glabellus</i> (Nees, 1834)	European-Anatolian-Turanian
	<i>G. laticornis</i> Walker, 1834	European
	<i>G. puncticollis</i> (Thomson, 1876)	European
	<i>G. vulgaris</i> Walker, 1834	European
	<i>Macroglenes chalybeus</i> (Haliday, 1833)	West Palearctic
	<i>M. conjungens</i> (Graham, 1969)	West Eurosiberian
	<i>M. gramineus</i> (Haliday, 1833)	European
	<i>M. penetrans</i> (Kirby, 1800)	Holarctic-Oriental
	<i>Micradelus acutus</i> Graham, 1969	European
	<i>M. rotundus</i> Walker, 1834	European
	Pteromalinae	<i>Anogmus strobilorum</i> (Thomson, 1878)
<i>Caenacis inflexa</i> (Ratzeburg, 1848)		European-Iranian
<i>Callitula bicolor</i> Spinola, 1811		Holarctic
Pteromalinae	<i>Chlorocyttus polichna</i> (Walker, 1848)	Holoeurosiberian
	<i>Ch. spicatus</i> (Walker, 1835)	Disjunct Eurosiberian
	<i>Ch. ultonicus</i> Graham, 1965	European-Anatolian
	<i>*Coelopisthia caledonica</i> Askew, 1980	European-Anatolian → European-Anatolian(bm)
	<i>Coruna clavata</i> Walker, 1833	Holarctic-Oriental
	<i>Cyrtogaster vulgaris</i> Walker, 1833	Holarctic
	<i>Dinotiscus eupterus</i> (Walker, 1836)	Holarctic (recently Holarctic-Australian)
	<i>Euneura lachni</i> (Ashmead, 1887)	Holarctic-Oriental
	<i>E. sopolis</i> (Walker, 1844)	Disjunct Eurosiberian
	<i>Holcaeus gracilis</i> (Walker, 1836)	European
	<i>Homoporus aphaetus</i> (Walker, 1839)	Transpalearctic
	<i>H. arestor</i> (Walker, 1848)	Transpalearctic
	<i>H. febriculosus</i> (Girault, 1917)	Holarctic
	<i>H. fulviventris</i> (Walker, 1835)	Transpalearctic
	<i>H. luniger</i> (Nees, 1834)	Palaearctic-Oriental
	<i>H. nypsius</i> (Walker, 1839)	Holarctic (recently Holarctic-Australian)
	<i>H. semiluteus</i> (Walker, 1872)	European
	<i>H. subniger</i> (Walker, 1835)	Transpalearctic-Oriental

	<i>*Lampoterma bianellatum</i> Graham, 1969	European → European (bm)
	<i>Leptomeraporus nicaee</i> (Walker, 1839)	European
	<i>Meraporus graminicola</i> Walker, 1834	West Palearctic
	<i>Merisus splendidus</i> Walker, 1834	Holarctic
	<i>Mesopolobus aequus</i> (Walker, 1834)	Holarctic
	<i>M. aspilus</i> (Walker, 1835)	West Eurosiberian
	<i>M. fuscipes</i> (Walker, 1834)	European
	<i>M. graminum</i> (Hardh, 1950)	West Eurosiberian-Anatolian
	<i>M. incultus</i> (Walker, 1834)	Holarctic (recently Holarctic-Australian)
	<i>M. laticornis</i> (Walker, 1834)	European-Anatolian
	<i>M. morys</i> (Walker, 1848)	Holarctic
	<i>M. sericeus</i> (Forster, 1770)	West Palearctic
	<i>Metastenus concinnus</i> Walker, 1834	European-West and Central Asian
	<i>Norbanus obscurus</i> (Masi, 1922)	West Eurosiberian
	<i>Notoglyptus scutellaris</i> (Dodd & Girault, 1915)	Subcosmopolitan
	<i>Pachyneuron aphidis</i> (Bouché, 1834)	Cosmopolitan
	<i>P. formosum</i> Walker, 1833	Palearctic-Oriental
	<i>P. groenlandicum</i> (Holmgren, 1872)	Holarctic-Oriental
	<i>P. solitarium</i> (Hartig, 1838)	Palearctic-Oriental
	<i>Peridesmia discus</i> (Walker, 1835)	West Palearctic (recently Holarctic)
	<i>Platygermus ductilis</i> (Walker, 1836)	European
	<i>Pseudocatolaccus nitescens</i> (Walker, 1834)	West Palearctic
	<i>Psilocera concolor</i> (Thomson, 1878)	European
	<i>P. crassispina</i> (Thomson, 1878)	West Eurosiberian
	<i>P. obscura</i> Walker, 1834	West Eurosiberian-Anatolian
	<i>P. punctifrons</i> (Thomson, 1878)	West Eurosiberian
	<i>Pilonotus adamas</i> Walker, 1834	West Eurosiberian-Anatolian
	<i>Pteromalus altus</i> (Walker, 1834)	European
	<i>P. bedeguaris</i> (Thomson, 1878)	Holarctic
	<i>P. bifoveolatus</i> Förster, 1861	West Palearctic
	<i>P. cionobius</i> (Erdős, 1953)	European-Anatolian
	<i>P. dispar</i> (Curtis, 1827)	West Eurosiberian
Pteromalinae	<i>P. elevatus</i> (Walker, 1834)	West Eurosiberian
	<i>P. intermedius</i> (Walker, 1834)	West Palearctic
	<i>P. musaeus</i> Walker, 1844	European
	<i>P. myopitae</i> (Graham, 1969)	European
	<i>P. ochrocerus</i> (Thomson, 1878)	European
	<i>P. procerus</i> Graham, 1969	Disjunct Palearctic
	<i>P. semotus</i> (Walker, 1834)	Holopalaearctic (recently Palearctic- Australian)

	<i>P. sequester</i> Walker, 1835	Cosmopolitan
	* <i>P. temporalis</i> (Graham, 1969)	European → European (bm)
	<i>P. vibulenus</i> (Walker, 1839)	European
	<i>Rhaphitelus maculatus</i> Walker, 1834	Holarctic-Neotropical-Australian
	<i>Rhopalicus tutela</i> (Walker, 1836)	Holarctic
	<i>Roptrocerus xylophagorum</i> (Ratzeburg, 1844)	Cosmopolitan
	<i>Sphегigaster intersita</i> Graham, 1969	Holoeurosiberian
	<i>S. nigricornis</i> (Nees, 1834)	West Palearctic
	<i>S. pedunculiventris</i> (Spinola, 1808)	West Eurosiberian-Anatolian
	<i>S. stepicola</i> Boucek, 1965	Palearctic-Paleotropical
	<i>Spintherus dubius</i> Nees, 1834	West Eurosiberian-Anatolian
	<i>Staurothyreus cruciger</i> Graham, 1956	European
	<i>Stenomalina dives</i> (Walker, 1835)	European
	<i>S. epistena</i> (Walker, 1835)	Holoeurosiberian
	<i>S. favorinus</i> (Walker, 1839)	European-Anatolian
	<i>S. fontanus</i> (Walker, 1839)	European
	<i>S. liparae</i> (Giraud, 1863)	Disjunct Palearctic
	<i>Stenoselma nigrum</i> Delucchi, 1956	West Palearctic
	<i>Synedrus transiens</i> (Walker, 1835)	European
	<i>Syntomopus incisus</i> Thomson, 1878	Transpalearctic-Oriental
	<i>Tomicobia promulus</i> (Walker, 1840)	European-Anatolian
	<i>T. seitneri</i> (Ruschka, 1924)	Holoeurosiberian
	<i>Toxeuma fuscicorne</i> Walker, 1833	European
	<i>Trichomalus annulatus</i> (Förster, 1841)	European
	<i>T. campestris</i> (Walker, 1834)	European-Anatolian
	<i>T. fulvipes</i> (Walker, 1836)	European-Anatolian
	<i>T. helvipes</i> (Walker, 1834)	European-Anatolian
	<i>T. nanus</i> (Walker, 1836)	West Eurosiberian-Anatolian
	<i>T. rugosus</i> Delucchi & Graham, 1956	European
	<i>T. perfectus</i> (Walker, 1835)	European
	<i>T. pexatus</i> (Walker, 1835)	West Eurosiberian
	<i>T. rufinus</i> (Walker, 1835)	West Eurosiberian-Anatolian
Spalangiinae	<i>Spalangia nigra</i> Latreille, 1805	Cosmopolitan
	<i>S. nigroaenea</i> Curtis, 1839	Cosmopolitan
	<i>S. subpunctata</i> Förster, 1850	Holarctic