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Materials on the Fauna of Micetobiont and Mycetophilic Beetles (Coleoptera) Ciscaucasus

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ABSTRACT

In the present study, for the first time in the territory of Ciscaucasia, data are presented on the species diversity of beetles living in the fruit bodies of fungi belonging to 2 orders (Polyporales and Agaricales). A total of 58 species of 17 families of the Coleoptera order were identified. Material was collected by the author Pushkin, SV.

Keywords: *Micota, Mycetophages, Mycetobionts, Coleoptera, Ciscaucasia.*

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INTRODUCTION

Mushrooms are the only food source for many species of Coleoptera. Some beetles spend their entire life cycle -from an egg to an imago- inside the fruit bodies of mushrooms and for others, the surface of fungi is the most common substrate. There are ecological groups of beetles that specifically grow in mushroom plantations to feed their larvae. Finally, unicellular mushrooms act as vital endosymbionts of beetles, developing in the stomach or intestines, and participate in food processing. The role of mushrooms in the life of beetles is reflected even in the Russian names of the beetle families: mushroom eaters, mushroom pickers, mold eaters, tinder beetles, and rotten animals [1-5].

The relationship between mushrooms and beetles is very diverse and sometimes they acquire quite complex consorting relationships; beetles feed on inanimate organics, one way or another, consume mushrooms, or use symbiotic mushrooms to decompose it. More than 100 beetle families are more or less associated with fungi; some are exclusively confined to them, some are the inhabitants of fungi and substrates with fungal components (e.g. mycetophages), and some others are predators (Carabidae, Histeridae, Trogossitidae, etc.). The separation of insects into myceto- (or myco-) and sapro- (detrito- or schizo-phage) phages cannot be carried out quite clearly due to the fact that in many cases, it is difficult to establish whether the food itself is fungi or their metabolic products. The term mycetophagy (or mycophagy) is used in a broad sense, which also includes sapro- and detritophagy, although mycetophagy often refers only to the nutrition of the fungi themselves. Sometimes, macromyceto- and micromycetophagia are also distinguished, using the first term when eating large mushroom particles, and the second when feeding small dispersed mushroom particles. In addition, it is often distinguished as a special diet - sporophagy - in cases where both sexual spores and conidia (asexual spores) predominate in the diet. Among the mycetophages, one can also distinguish a group that sucks the contents of fungi or myceteresorptors (the term is proposed for the first time) without external digestion (e.g., some Cerylonidae) or after injection of digestive juices into the mushroom substrate (e.g., some Oxyporinae from Staphylinidae). Beetles' characteristic of bark and wood affected by ambrosia can be called ambrosiephages (the term is proposed for the first time). In addition, beetles living in a protein-depleted environment (such as wood) often make up for deficiency in the diet by eating dead animals or even active predation [6-10].

Very often, spores, conidia, and mycelium particles are carried by bugs on the surface of their body, in relatively large depressions of the elytra puncture. However, additional large external impressions - mycangia or mycetangia, often develop and become specialized containers for portable fungi. Finally, some beetles carry fungi in specialized internal organs - mycetomas, which are usually located along the intestine with access to its lumen or at the base of the ovipositor with access to the female excretory ducts. Mycetophagous beetles are found in all habitats, in places rich in decaying organics, primarily in subcrustal spaces, decaying wood, leaf litter, dead animals, etc. [11-16].

The relationships between beetles and fungi, as well as the structural coadaptations of both groups of organisms to each other, are reflected in many publications, especially in the field of forest entomology. Comparatively, detailed reviews of these relationships and structural features can be found in the works of Benik [5, 11-13, 17-19]. Studies on the physiology and digestion biochemistry of mushroom-eating beetles have been considered in many works [5 ,11-13, 17-22], especially in recent works on bark beetles and works on the physiology of laboratory species of carobophilus lustraceae, starting from classical publications [6, 16, 22] to numerous articles of the last decade [9, 10, 14]. More recently, it has been established that some mycetophages are as capable of extraintestinal digestion as predators [18]. For the territory of Ciscaucasia, such a study was carried out for the first time. The species composition of fungi, in whole or in part, is presented in [1, 23].

MATERIAL AND METHODS

Figure 1; photographs of beetles inhabited in Micota. 1, 2, 3- The order of Polyporales; 4, 5, 6- The order of Agaricales (numbers left to right).

The material was collected by S.V. Pushkin from different areas of the territory of Ciscaucasia during 2017-2019. The collection was carried out by generally accepted methods. The determination of the species of fungi, beetles, and Staphylinidae was done by V.N. Belousom, S.V. Pushkin, and V.B. Semenov, respectively. The main representatives of the fungi populated by beetles are shown in Figure 1.

Our beetles were found on the fruiting bodies of woody mushrooms Laetiporus sulphureus and Polyporus squamosus (Polyporales) and some of them on the hat mushrooms from the Agaricales order.

RESULTS AND DISCUSSION

As a result of processing the collected material, a list of mycetophilous beetles was compiled in the study area. Taxonomy was adopted according to the "Catalog of Palaearctic Coleoptera" [9, 10, 14]. The results of the study are shown in Table 1.

Table 1. Distribution of mycetophilous beetles on the fungi inhabited by them (order). New species for the fauna of the Ciscaucasia are marked *

Coleoptera		Micota	
Family	Species	Polyporales	Agaricales
Carabidae	Tachyta nana		+
Scaphidiidae	Scaphidium sp.	+	+
Leiodidae	Sciodrepoides watsoni		+
	Agathidium arcticum		+
	A.confusum*		+
	A.discoideum*		+

	A.mandibulare		+
	A.nigripenne*		+
	A.pisanum*		+
	A.rotundatum*		+
	A.varians*	+	+
Silphidae	Silpha carinata		+
	Oiceoptoma toracicum		+
	Thanatophilus rugosus		+
	Nicrophorus humator		+
Staphylinidae	Oxyporus mannerheimi	+	+
	Sepedophilus bipustulatus	+	+
	Aleochara curtula*	+	
	A.moerens*	+	
	Atheta basicornis*		+
	A.boleticola		+
	A.crassicornis	+	
	A.gagatina	+	+
	A.orphana	+	+
	Dinaraea aequata	+	
	D.arcana	+	
	Gyrophaena bihamata	+	+
	G.fasciata*	+	+
	Bolitochara obliqua	+	+
Pselaphidae	Euplectus brunneus*	+	
Histeridae	Margarinotus striola*	+	+
	M.ventralis*	+	+
	Platysoma deplanatum*	+	+
	P.minor*	+	+
Elateridae	Prosternon tesselatum*	+	
	Ampedus pomonae*		+
Dermestidae	Globicornis emarginata*	+	
	Orphilus niger	+	
Geotrupidae	Geotrupes stercorosus*		+
Trogossitidae	Peltis grossa**	+	
	Ostoma ferrugineum**	+	+
Cryptophagidae	Cryptophagus abietis*	+	+
	C.tuberculosus*	+	
Nitidulidae	Epuraea angustula*	+	
	E.biguttata	+	+
	E.binotata*	+	+

	E.placida*	+	+
Cisidae	Cis bidentatus	+	
Mordellidae	Mordella holomelaena**	+	+
Mycetophagidae	Mycetophagus ater	+	+
	M.decempunctatus	+	
	M.multipunctatus	+	
	M.populi		+
	M.tschitscherini	+	
Tenebrionidae	Bolitophagus reticulatus	+	+
	Scaphidema metallicum**	+	+
	Mycetochara flavipes	+	+
	Diaperis boleti	+	+
Total: 17	58	40	42

Families of Staphylinidae and Leiodidae with 14 and 9 species, respectively, are characterized by the greatest species diversity. However, the number of species per 1 fungus does not exceed 3-4. The number of individuals on large bodies of mushrooms can reach 300-500 individuals.

At *Polyporus squamosus* in the fall of 2018, we identified 250 specimens of imago and 150 specimens of larvae from the species *Mycetochara flavipes*, and 70 specimens of the species *Diaperis boleti* from the family Tenebrionidae.

A further collection of beetles in the study area should replenish this list. Especially when exploring the hard-to-reach mountainous regions of Ingushetia, the Chechen and Kabardino Balkaria.

Conflict of interest

The work was carried out by the authors on their own without the use of any support.

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