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Article

Coleoptera related to xylotrophic fungi of the genus *Fomitopsis* (Fr.) P. Kumm. (Basidiomycetes, Agaricales) in the South Urals

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Abstract. The research was conducted in the territories of 22 municipal districts of the Chelyabinsk region, including 11 protected natural areas at different times from 1990 to 2024. It has been established that in the South Urals 48 species of beetles from 17 families are associated with 4 species of xylotrophic basidial fungi of the genus *Fomitopsis* (Fr.) P. Kumm. (*F. betulina*, *F. cajanderi*, *F. pinicola*, *F. rosea*). The maximum number of species (38) has been identified for *F. betulina*, but 18 species from 7 families are developing in them. There are 34 species of Coleoptera associated with *F. pinicola* fungi, 20 of which develop in (on) basidiomas. In *F. cajanderi* fungi, 6 species from 4 families were found (5 species develop in fruit bodies), in *F. rosea* fungi – 5 species from 3 families (4 species develop in fruit bodies). In terms of occurrence rates, the hidden-living mycetosaprophages *Dacne bipustulata* (Erotylidae) and *Diaperis boleti* (Tenebrionidae) predominate in the fungi *F. betulina* and *F. pinicola*; *Cis jacquemarti*, *Dolichocis laricinus, Ennearthron cornutum*, *Rhopalodontus strandi* (Ciidae), *Thymalus oblongus* (Trogossitidae) and the open-living mycetophage *Scaphisoma agaricinum* (Staphylinidae) have a slightly lower specific significance. The fungi *F. rosea* and *F. cajanderi* are dominated by *C. jacquemarti*, *D. laricinus* and *E. cornutum*, characteristic of all the species of the genus *Fomitopsis* studied by us. Only at the imago stage 23 species from 15 families were found on (in) fungi. Among them, a special place is occupied by xylomycetophilic beetles developing in the mycelial layer of fungi of the genus *Fomitopsis* and some other woody fungi. These are 13 species from the families Carabidae, Staphylinidae, Trogossitidae, Cerylonidae, Cucujidae, Nitidulidae, Monotomidae, Colydiidae, Melandryidae and enebrionidae). The main dietary regimes in this group are obligate mycetophagy and myxomycetophagy, myxophagy (mycetophagy and predation, sapro-xylo-mycetophagy, sapro-xylo-mycetophagy and necrophagia), predation, detritophagy and facultative sapro-mycetophagy. The remaining 10 species from the families Staphylinidae, Geotrupidae, Scirtidae, Nitidulidae, Latridiidae, Ciidae, Mycetophagidae are either obligate mycetophages of other fungal species, or facultative mycetophages, sometimes using fungi of the genus *Fomitopsis* as an additional food resource.

Keywords: insects, basidial fungi, microsuccessions, relationships, ecological and trophic groupings

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Научная статья

Жесткокрылые (Coleoptera), связанные с ксилотрофными грибами рода *Fomitopsis* (Fr.) P. Kumm. (Basidiomycetes, Agaricales) на Южном Урале

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Аннотация. Исследования проводились на территориях 22 муниципальных районов Челябинской области, в том числе и на 11 ООПТ, в разное время с 1990 по 2024 гг. Установлено, что на Южном Урале с 4 видами ксилотрофных базидиальных грибов рода *Fomitopsis* (Fr.) P. Kumm. (*F. betulina*, *F. cajanderi*, *F.pinicola*, *F. rosea*) связано 48 видов жуков из 17 семейств. Максимальное число видов (38) выявлено для *F. betulina*, однако развитие в их плодовых телах проходят только 18 видов из 7 семейств. С грибами *F. pinicola* связано 34 вида жесткокрылых, 20 из которых развиваются в (на) базидиомах. В грибах *F. cajanderi* обнаружено 6 видов из 4 семейств (в плодовых телах развиваются 5 видов), в грибах *F. rosea* – 5 видов из 3 семейств (в плодовых телах развиваются 4 вида). По показателям встречаемости в грибах *F. betulina* и *F. pinicola* преобладают скрытноживущие мицетосапрофаги *Dacne bipustulata* (Erotylidae) и *Diaperis boleti* (Tenebrionidae), несколько меньшее удельное значение имеют *Cis jacquemarti*, *Dolichocis laricinus*, *Ennearthron cornutum*, *Rhopalodontus strandi* (Ciidae), *Thymalus oblongus* (Trogossitidae) и открытоживущий мицетофаг *Scaphisoma agaricinum* (Staphylinidae). В грибах *F. rosea* и *F. cajanderi* доминируют *C. jacquemarti*, *D. laricinus* и *E. cornutum*, характерные для всех изученных нами видов рода *Fomitopsis*. 23 вида из 15 семейств обнаружены на (в) грибах только на стадии имаго. Среди них особое место занимают ксило-мицетофильные жуки, развивающиеся в мицелиальном слое грибов рода *Fomitopsis* и некоторых других древесных грибов. Это 13 видов из семейств Carabidae, Staphylinidae, Trogossitidae, Cerylonidae, Cucujidae, Nitidulidae, Monotomidae, Colydiidae, Melandryidae и Tenebrionidae. Основные пищевые режимы в этой группе – облигатная мицетофагия и миксомицетофагия, миксофагия (мицетофагия и хищничество, сапро-ксило-мицетофагия, сапро-ксило-мицетофагия и некрофагия), хищничество, детритофагия и факультативная сапро-мицетофагия. Остальные 10 видов из семейств Staphylinidae, Geotrupidae, Scirtidae, Nitidulidae, Latridiidae, Ciidae, Mycetophagidae являются либо облигатными мицетофагами других видов грибов, либо факультативными мицетофагами, иногда использующими грибы рода *Fomitopsis* как дополнительный пищевой ресурс.

Ключевые слова: насекомые, базидиальные грибы, микросукцессии, взаимоотношения, эколого-трофические группировки

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Introduction

Relevance of the work and objects of research

The article highlights the results of long-term studies (1985–2023) of Coleoptera complexes associated with xylotrophic basidial fungi (Basidiomycetes, Hymenomycetidae) in the Urals and Westn Siberia. In the South Urals, research began in 1990 and has now been carried out in the Ilmen Nature Reserve, Arshinskii, Ashinskii, Karagayskii, Nyazepetrovskii, Serpievskii, Troitskii, Uyskii, Chernoborskii sanctuaries, in the vicinity of Chelyabinsk (natural monuments "Chelyabinsk forest", "Kashtaksky forest"), in the territories of Argazinskii, Argayashskii, Bredinskii, Varna, Verkhneuralskii, Kaslinskii, Katav-Ivanovskii, Kizilskii, Krasnoarmeyskii, Kunashakskii, Kusinskii, Nagaybakskii, Oktyabrskii, Satkinskii Sosnovskii and Chebarkulskii districts (Fig. 1). The main results are presented in a series of publications (Krasutsky, 1990, 1994, 1995, 1996a, b, 1997a, b, 2000, 2001, 2005, 2007a, b, 2010, 2013a, b, 2014, 2018, 2020, 2021a, b, 2022a, b, 2023a, b).

The purpose of this work is a detailed analysis of the composition and structural features of the community of mycetophilic Coleoptera in the fungi of the genus *Fomitopsis* (Fr.) (Basidiomycota, Agaricomycetes, Polyporales, Fomitopsidaceae).

The relevance of this research at this stage lies not only in significantly expanding the knowledge about the species composition and bioecological characteristics of beetles associated with these fungi in the Southern Urals, but also in more fully understanding the dynamics of insect assemblages within the fruiting bodies of fungi and clarifying the feeding specialization of beetles. Furthermore, one of the new objectives of the work in recent years has been to study the interactions between xylotrophic fungi and insects colonizing the wood of the main forest-forming species permeated with fungal mycelium.

There are 6 species of fungi of the genus *Fomitopsis* in the South Urals: *F. betulina* (Bull.) B.K. Cui, M.L. Han et Y.C. Dai (birch tinder), *F. pinicola* (Sw.) P. Karst. (bordered tinder), *F. cajanderi* (P. Karst.) Kotl. et Pouzar (Kayandery tinder), *F. rosea* (Alb. et Schwein.) P. Karst. (pink tinder), *F. officinalis* (Vill.) Bondartsev et Singer (medicinal tinder) and *F. epileucina* (Pilat) Gilbertson et Ryvarden (white tinder) (Bondartseva, 1998), but we have not found the latter during the entire time of research.

Fomitopsis betulina (formerly known as *Piptoporus betulinus* (Bull.: Fr.) P. Karst.) is a common and widespread mushroom in the South Urals with annual fruit bodies of a leathery-fleshy (monomitic hyphal system), and when dying, a cork (dimitic hyphal system) consistency. It inhabits exclusively trees of the genus *Betula*, causes brown rot.

Fomitopsis pinicola is also a widespread, common species in the South Urals with perennial fruit bodies of a cork-woody consistency and a dimitic hyphae system. It often settles as a parasite on damaged trees, and then continues to grow as a saprophyte. It occurs on deciduous (*Alnus*, *Betula*, *Padus*, *Populus*, *Tilia*) and coniferous (*Abies*, *Picea*, *Pinus*) trees, causing brown rot.

Fomitopsis cajanderi is a boreal species rare in the South Urals with perennial fruit bodies of a leathery-corky consistency and a dimitic hyphae system. It grows on stumps and dead trunks of coniferous trees (*Abies*, *Larix*, *Picea*), causes brown cubic rot.

Fomitopsis rosea is also a boreal species quite rare in the South Urals with perennial fruit bodies of a cork-woody consistency and a dimitic hyphae system. It grows on dry and fallen trunks and stumps of coniferous species (*Abies*, *Larix*, *Picea*, *Pinus*), causes brown rot.

Fomitopsis officinalis is a very rare, protected, mostly boreal species in many regions with perennial fruit bodies of a rather soft consistency when fresh, hardening and crumbling with age. The hyphal system is also dimitic. It settles on live *Larix*, less often on *Pinus*, and causes brown cubic core rot.

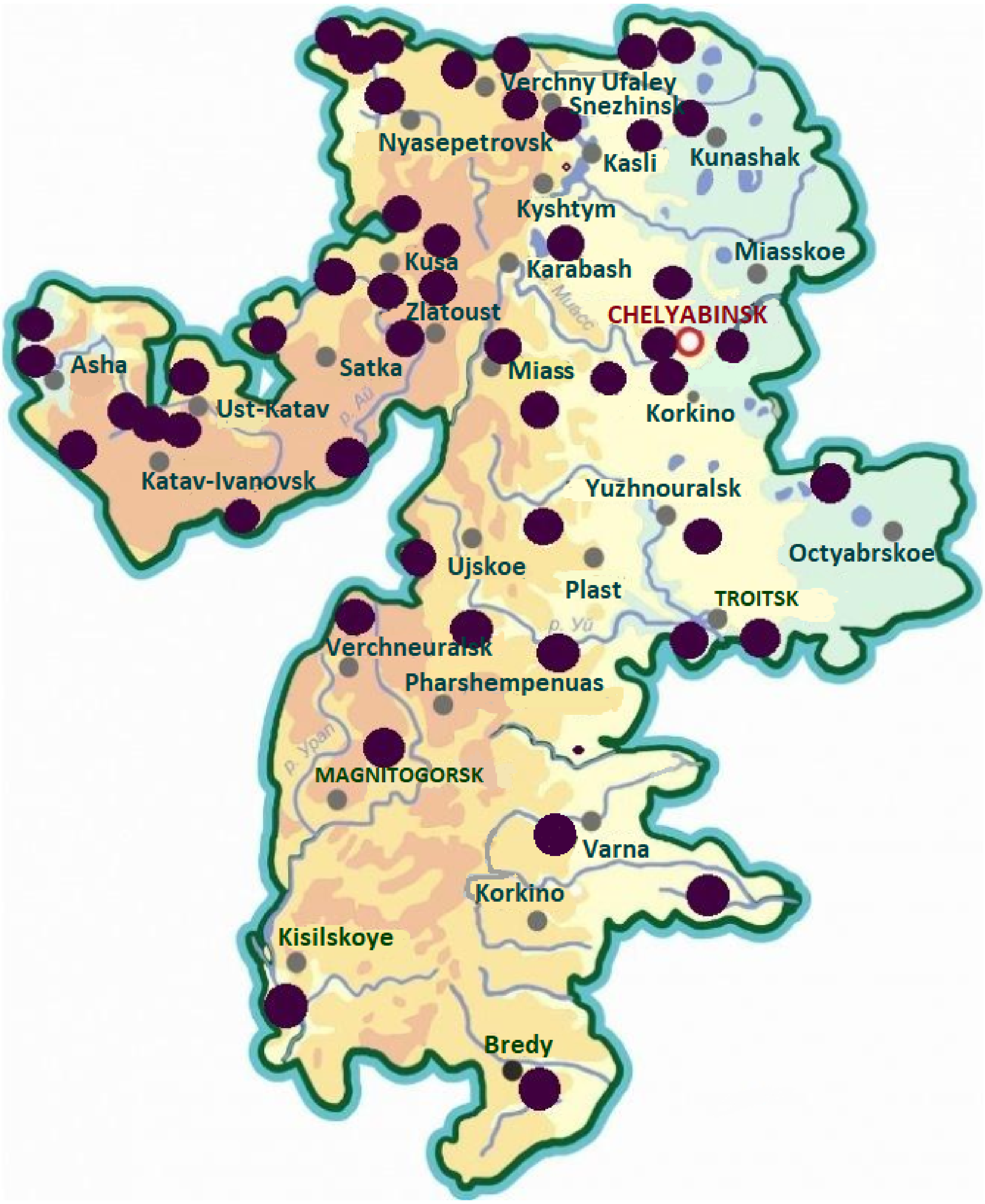

Fig. 1. Research sites in the Chelyabinsk region.

A brief review of studies of entomocomplexes of fungi of the genus Fomitopsis in Russia and in some adjacent territories

The summary by L. Benick (1952) provides a general description of the composition of Coleoptera of three species of the genus *Fomitopsis* in Central Europe. According to his generalized data, 96 species from 20 families are associated with birch tinder, 6 species from 6 families are associated with bordered tinder, and only one is associated with pink tinder. Staphylinidae predominate, especially species of the genus *Atheta* Thomson, 1858, and individual representatives of the families Ciidae, Erotylidae, Nitidulidae, Mycetophagidae and Tenebrionidae.

In a review on Palearctic fungi beetles (Erotylidae), S.M. Jablokoff-Khnzorian (1975) reports the occurrence of *Aulacochilus sibiricus* (Reitter, 1872) in the fungi *F. pinicola* and *Dacne japonica* Crotch, 1873 – in *F. officinalis*. Note that for *Fomitopsis officinalis*, this is the only mention of its inhabitants to date.

A.V. Kompantsev (1982, 1984), studying mycetophilous beetles in certain areas of the European part of Russia (Kostroma region), the Caucasus, Central Asia, the Amur region, Khabarovsk and Primorsky territories, and Kunashir Island, named the rove beetle *Scaphisoma agaricinum* (L.) (Staphylinidae), woodworms of the genus *Dorcatoma* Herbst, 1792 (Anobiidae), the tinder beetles *Cis jacquemarti* Mel. (Ciidae), and the darkling beetle *Diaperis boleti* (L.) (Tenebrionidae) as characteristic inhabitants of *F. pinicola*. For *F. betulina*, he lists the placoderm *Thymalus limbatus* (Fabricius, 1787) (Trogossitidae), the mushroom beetles *Dacne bipustulata* (Thunb.), and *D. notata* Gmel. (Erotylidae), the tinder beetles *Ennearthron cornutum* (Gyll.) and the darkling beetle *D. boleti*. Continuing special research in this area in Eastern Siberia and the Far East together with A.I. Zaitsev and N.B. Nikitsky, he reports on six species of beetles from 5 families, developing in the fruit bodies of *F. betulina* (Nikitsky and Kompantsev, 1995; Zaitsev and Kompantsev, 1987). Having studied in detail the morpho-ecological features of xylophilous and mycetophilous darkling beetles, T.V. Kompantseva (1987) characterizes the adaptations of the larvae of *Diaperis boleti*, *D. lewisi* Bates, 1873 to living in the thickness of the basidiomes of *F. betulina*; *D. niponensis* Lewis, 1887 – to living in *F. pinicola*.

In the Prioksko-Terrasny Nature Reserve, N.B. Nikitsky and a group of other scientists discovered 23 species of Coleoptera in the fungi *F. betulina*, 17 species in *F. pinicola* and one (*Dolichocis laricinus* (Mel.)) in *F. rosea*. The entomocomplex of the first two fungi is quite diverse and includes representatives of 12 families with the largest number of species (10) in the family Staphylinidae (Nikitsky et al., 1996).

Significant material on mycetophilic Coleoptera of the East European Plain and Crimea was obtained by D.S. Shchigel as a result of long-term (1995–2000) research. In one of his early works, he analyses the composition of groups of inhabitants of 49 species of xylotrophic fungi, differing in shape, size, consistency of basidiomes and the duration of their existence. In the fungi of *F. betulina*, he finds 14 species of beetles from 7 families, in *F. pinicola* – 10 species from 5 families (Shchigel, 2002). The author also discusses the directions of insect food specialization and some patterns of changes in the complexes of fungal inhabitants along the gradient of latitudinal zonality.

During the same time period and later, together with N.B. Nikitsky and independently, D.S. Shchigel studied in detail the entomocomplexes of a large number of species of fungi in the European part of Russia in general and the Moscow region in particular. For example, in the Moscow region, for *F. betulina*, both researchers note 57 species of beetles from 14 families, for *F. pinicola* – 29 species from 9 families (Nikitsky and Schigel, 2004). In subsequent years, D.S. Shchigel continued to collect materials in Finland (Schigel, 2005, 2006, 2009, 2011a, b), and N.B. Nikitsky and other entomologists continued to collect materials in the Komi Republic (Ishkaeva and Nikitsky, 2017; Nikitsky and Ishkayeva, 2022; Nikitsky and Tatarinova, 2002, 2003), in Chuvashia (Egorov et al., 2009a, b), in Yaroslavl (Vlasov and Nikitsky, 2014, 2015, 2017, 2018; Vlasov et al., 2018) and Moscow (Nikitsky, 2016, 2019; Nikitsky and Semenov, 2001) regions, in south Karelia (Polevoy and Nikitsky, 2019). As a result, in the most studied Moscow region, the number of beetles in the *F. betulina* entomocomplex reaches 116 species from 23 families, *F. pinicola* – 64 species from 17 families, *F. rosea* – 6 species from 4 families (Nikitsky, 2016, 2019). The Staphylinidae (over 60 species) and Ciidae (16 species) are the most richly represented. In the relatively less studied Yaroslavl region, 15 species from 6 families of *F. betulina* have been identified so far, and 13 species from 5 families of *F. pinicola* (Vlasov, 2023; Vlasov and Nikitsky, 2014, 2015, 2017, 2018; Vlasov et al., 2018). In the Prisursky State Nature Reserve (Republic of Chuvashia), 8 species from 5 families were found in the *F. betulina* mycetobiont complex, and 7 beetle species from 5 families were found in the *F. pinicola* entomocomplex (Egorov et al., 2009a, b).

In Belarus, V.A. Tsinkevich (2004) notes 20 species of Coleoptera from 12 families in the complex of *F. pinicola* inhabitants and 10 species from 8 families in *F. betulina* inhabitants, emphasizing the leading role of some Ciidae (*C. jacquemarti*, *E. cornutum*, *Octothemnus glabriculus* (Gyll.), *Rhopalodontus strandi* (Lohse)) and Tenebrionidae (*D. boleti*) in the destruction of fruit bodies. 15 years later, M.A. Lukashenya (2019) reports on 37 species of beetles from 12 families related to *F. betulina* and *F. pinicola* (no specific species are given), noting *Dorcatoma punctulata* Muls. (Anobiidae) as a specific inhabitant of the last grinder.

For the territory of Ukraine, A.N. Drogvalenko, using literary data, names 5 species from 3 families in the *F. betulina* entomocomplex and 9 species from 2 families for *F. pinicola*. The author identifies common beetle species among the inhabitants of these fungi: *Cis bidentatus* (Olivier, 1792), *C. castaneus* Herbst, 1793, and *E. cornutum* (Ciidae) (Drogvalenko, 1997a, b, 2002, 2005, 2008).

In Southeastern Kazakhstan, I.I. Temreshev studies the fauna of mushroom-eater beetles (Mycetophagidae) and notes 7 species from 3 genera in its composition. He names *Mycetophagus multipunctatus* F. and *Litargus connexus* (Geoffr.) as inhabitants of *F. betulina* (Temreshev, 2019).

Special study of tinder beetles (Ciidae) as the most characteristic inhabitants of many xylotrophic fungi, it is carried out in a number of European countries. In Norway, three species are identified as permanent inhabitants of *F. betulina*: *Cis bidentatus*, *C. jacquemarti,* and *C. lineatocribratus* Mellie, 1848 (Fossli and Anderson, 1998). In Germany, 11 species are found in fungi *F. betulina*, 10 species in *F. pinicola*, and two species in *F. rosea* (Reibnitz, 1999). In Switzerland, for *F. betulina* – *Cis fagi* Waltl, 1838, *C. glabratus* Mellie, 1848, for *F. pinicola* – *Cis dentatus* Mellie, 1848, *C. quadridens* Mellie, 1848, *C. fagi* and *C. glabratus* (Reibnitz et al., 2013).

Characterizing the complexes of inhabitants of decaying and rotten wood in Great Britain and Ireland, K. Alexander (2002) mentions, among other things, Coleoptera associated with some xylotrophic fungi. According to his data, 10 species of beetles from the families Staphylinidae (*Atheta boletophila* (Thomson, 1856), *A. picipes* (Thomson, 1856), *Bolitochara mulsanti* Sharp, 1875), Nitidulidae (*Epuraea variegata* (Hbst.), Erotylidae (*D. bipustulata*), Latridiidae (*Latridius consimilis* Mnnh.), Ciidae (*Cis bidentatus*, *C. dentatus*, *C. nitidus* (Fabricius, 1792), Tenebrionidae (*D. boleti*), are found in *F. betulina* fungi.

In Finland, A. Komonen and D. Schigel study communities of xylomycetophilic Coleoptera, associated with many xylotrophic fungi. The characteristic inhabitants of *F. betulina* here are 23 species of beetles from 10 families, *F. pinicola* – 14 species from 5 families, *F. rosea* – 18 species from 7 families. For *F. rosea*, this is still the most complete description of the composition of its inhabitants (Kommonen, 2001, 2005). *C. glabratus* (Ciidae) develops in the fruit bodies of all three species (Schigel, 2005, 2011a, b).

Norwegian scientists S. Hägvar and R. Steen consider the patterns of succession of groups of Coleoptera and armored mites (Acari, Oribatida) in the fruit bodies of *F. pinicola* (Hägvar and Steen, 2013). They discovered 15 species of beetles from 5 families and found that 14 species (except *Thymalus limbatus*) inhabit already dead basidiomes.

In Poland, P. Chachula and co-authors found 3 species from 3 families (Leiodidae, Monotomidae, Ciidae) in the fungi *F. betulina*, 16 species from 10 families in *F. pinicola*, and two species: *C. glabratus* (Ciidae), *Gyrophaena boleti* (L.) (Staphylinidae) in *F. rosea*. In this work, the authors examine in detail the entomocomplexes of a total of 60 species of fungi (Chachula et al., 2019).

Thus, most researchers consider the tinder beetles *Cis dentatus*, *C. glabratus*, *C. quadridens*, *D. laricinus*, and *Rh. strandi* to be the main inhabitants and destroyers of the fruit bodies of the fungi *Fomitopsis betulina*, *F. pinicola* and *F. rosea*. The entomocomplex of *F. betulina* and *F. pinicola*, in addition to them, includes such active mycetophages as *Cis bidentatus*, *C. jacquemarti*, *E. cornutum* (Ciidae), *Th. limbatus* (Trogossitidae), *D. bipustulata* (Erotylidae) and *D. boleti* (Tenebrionidae). There is no information about mycetobionts of *F. cajanderi* in the literature.

A general overview of the species composition and ecological groupings of beetles in the entomocomplexes of three species of fungi of the genus *Fomitopsis* in general for the Urals and Trans-Urals was given in separate works by the author of this article. A relationship was established between 37 beetle species from 16 families and *F. betulina* (Krasutsky, 2005, 2006), 34 species from 14 families and *F. pinicola* (Krasutsky, 2005, 2007b), and 4 species from 3 families and *F. rosea* (Krasutsky, 2005). New materials have been obtained that significantly expand our understanding of not only the species composition but also the patterns of formation and dynamics of assemblages of basidiomycetes and the mycelial layer of four representatives of the genus *Fomitopsis* in the South Urals.

Material and methods

The study methods were described in detail in a series of previously published papers (Krasutsky, 2005, 2020, 2021a, b, 2022a, b, 2023a). Let us note the features of its application for the study of entomocomplexes of fungi of the genus *Fomitopsis*.

The material was Coleoptera, collected at various stages of ontogenesis from the surface and from the thickness of the fruit bodies of four species of fungi of different ages, conditions and degrees of insect damage, as well as from areas of bark and wood adjacent to the basidiomas. In some cases, insects were additionally collected from clusters of fungal spores on surrounding substrates (large leaves of herbaceous plants, forest litter) and fruit bodies that had fallen off tree trunks.

Field studies were conducted primarily using the route method in diverse natural forests and, to some extent, in forest cultures specific to specific areas. The beetle populations on fungi were assessed (the ratio of the number of colonized basidiomes to the total number examined), open-living species were collected, fruiting body samples were collected, as well as bark and wood fragments, for subsequent analysis of the composition of their inhabitants under stationary conditions. In the wild, the behavior of beetles and their feeding habits were observed. When adult reproduction was necessary, some of the fruiting bodies were placed in standard cages with sawdust or fragments of wood substrate. This allowed for a more comprehensive study of the beetle trophism and some aspects of their life cycles.

The specificity of the entomocomplexes of basidiomes was noted at the following stages of their existence:

Stage 1 – living fruit bodies in the phases of growth and spore production, undamaged;

Stage 2 – fruit bodies that have completed growth and spore production and are beginning to die of. At the end of this stage, minor damage (up to 25% of the volume) is often already noticeable;

Stage 3 – dead fruit bodies, destroyed to a medium degree (up to 50% of the volume), but still retaining their structural properties;

Stage 4 – dead fruit bodies, strongly or almost completely destroyed (over 75% of the volume). All the parts of the basidiomes are damaged and have lost their structural properties. At the end of stage 4, the destruction process is completed and mineralization of the remains of fruiting bodies that have fallen into the litter begins.

When describing the nature of the relationship between insects and fungi, the following criteria were used:

1) the general nature of beetle-fungi relationships (obligate, facultative);

2) features of the larval and imago lifestyle (open-living, secretive-living);

3) the nutritional relationships of insects with fungi and with each other throughout their life cycle (the spectrum of inhabited fungi, nutrition with living or dead tissues, the presence of other nutrients along with mycophagy, for example saproxylophagy, predation, necrophagy, etc.).

When analyzing the nutritional relations of beetles with fungi, preference coefficients (K_p) were used, reflecting the proportion of specific species of fungi in the total insect diet (Krasutsky, 2005, 2020, 2021a, b, 2022a, b, 2023a).

The study of the food relationships of xylophilic beetles is often complicated by the fact that one woody substrate (a fallen or dry trunk of a dead tree, a stump) can be inhabited by different species of fungi (basidiomycetes, ascomycetes, anamorphic fungi) and myxomycetes. Therefore, we conducted the study of the trophism of such insects, whenever possible, on “clean” substrates populated only by fungi of the genus *Fomitopsis* and took into account the localization of beetles in areas of wood densely permeated with the mycelium of these fungi (usually directly under the fruiting bodies). Observations were conducted primarily in natural conditions, as adults of certain beetle species, absent at the time of sample collection, rarely appeared in containers containing wood fragments. It should also be noted that the presence of individual xylophilic species in the mycelial layer did not always indicate their feeding on fungi: this could be due to easy access to prey (for predators) or a large number of dead insects (for necrophages), as well as more favorable microclimatic conditions (higher temperature and higher humidity) arising from the fungal decomposition of bark and wood components.

A total of 1435 fruiting bodies of fungi of the genus *Fomitopsis* and 53 samples of the substrates inhabited by them (trunks of birch, aspen, pine and spruce) were studied.

Results and discussion

Indicators of the population of fungi of the genus Fomitopsis, species composition and occurrence of related Coleoptera

Insects were found on the surface and/or in the thickness of 685 fruit bodies and in 17 examined woody substrates (mainly birch and spruce), and many species of beetles were found in (on) 131 basidiomes of 4 species of fungi only at the imago stage.

The level of colonization of fruit bodies (taking into account the fact of any presence of beetles) turned out to be the maximum for *Fomitopsis betulina* – 54.37% and the minimum for *F. cajanderi* – 19.35%; beetles were not found in the fruit bodies of *F. officinalis*, which may be explained by the small sample of basidiomas due to the extreme rarity of this species (Table 1). However, the samples of *F. rosea* and *F. cajanderi* fruit bodies were also relatively small, due to the distribution of these fungi only in the forest zone of the South Urals and their occurrence here almost exclusively on spruce.

The maximum number of beetle species (38) has been identified for *F. betulina*, but approximately 18 species from 7 families are developing in them. There are 34 species of Coleoptera associated with *F. pinicola*, 20 of which develop in (on) basidiomes. In *F. cajanderi* 6 species from 4 families were found (5 species develop in fruit bodies), in *F. rosea* – 5 species from 3 families (4 species develop in fruit bodies). Only at the adult stage 23 species from 15 families were found on (in) fungi, but it should be noted that the development of 13 species from the families Carabidae, Staphylinidae, Trogossitidae, Cerylonidae, Cucujidae, Nitidulidae, Monotomidae, Colydiidae, Melandryidae, Tenebrionidae occurs in wood susceptible to fungal destruction (Table 2).

An assessment of the similarity (difference) in the species composition of beetles whose larvae develop in the basidiomes of fungi of the genus *Fomitopsis* using the Czekanowski–Sørensen similarity index and the cluster analysis method allows us to identify two clusters: in one of them, *F. cajanderi* and *F. rosea* are combined at a high similarity level of 0.89, and in the other, *F. betulina* and *F. pinicola* are combined at a level of 0.68. The intercluster similarity is only 0.40 and is mainly due to the presence of common species of tinder beetles (Table 2, Fig. 2).

According to the indicators of occurrence in the fungi *F. betulina* and *F. pinicola*, black-bodied beetles (Tenebrionidae) and fungi beetles (Erotylidae) predominate, tinder beetles (Ciidae) and thyroid beetles (Trogossitidae) are of lesser importance. In total, these families account for more than 75% of all inhabited fruit bodies of these fungi. On the contrary, the fungi *F. rosea* and *F. cajanderi* are dominated by the tinder beetles *Cis jacquemarti*, *Dolichocis laricinus*, and *Ennearthron cornutum*, which are characteristic of all the species of the genus *Fomitopsis* studied by us (Fig. 3).

Table 1. The number of studied fruiting bodies of fungi of the genus Fomitopsis and indicators of their colonization in the South Urals.

Species of fungi	Number of fruit bodies examined	The number of fruit bodies, inhabited only by imago beetles	Total number of fruit bodies inhabited by beetles	Level of colonization (%)
Fomitopsis betulina	710	53	386	54.37
Fomitopsis pinicola	624	70	222	35.58
Fomitopsis rosea	64	4	13	20.31
Fomitopsis cajanderi	31	4	6	19.35
Fomitopsis officinalis	6	–	–	0.00

Table 2. Beetles (Coleoptera) associated with fungi of the genus Fomitopsis in the South Urals. * – beetles are found only in the imago phase; ** – beetles, whose larvae develop under the bark and in wood, often in the mycelial layer of fungi, their imagos are sometimes found on fruit bodies (the occurrence of these species is indicated by imago on fungi); "+" – the occurrence is less than 0.50. The taxonomy of beetles is given by N.B. Nikitsky (2016, 2019).

Families and species of beetles	Occurrence of beetles in (on) fungi of the genus Fomitopsis (% of populated basidiomes of all studied)			
	F. betulina	*F. pinicola*	*F. rosea*	*F. cajanderi*
Carabidae Latreille, 1802				
1. *Tachyta nana* (Gyllenhal, 1810)**	+	–	–	–
Staphylinidae Latreille, 1802				
2. *Atheta crassicornis* (Fabricius, 1792)	+	–	–	–
3. *Atheta gagatina* (Baudi, 1848)	0.56	–	–	–
4. *Bolitochara obliqua* Erichson, 1837	+	+	–	–
5. *Dinaraea aequata* (Erichson, 1837)	–	+	–	–
6. *Gyrophaena boleti* (L., 1758)	–	4.01	–	6.90
7. *Lordithon lunulatus* (L., 1762)*	–	1.28	–	–
8. *Megarthrus hemipterus* (Illiger, 1794)**	–	+	–	–
9. *Scaphisoma agaricinum* (L., 1758)	1.69	2.24	–	–
10. *Scaphisoma inopinatum* (Löbl, 1967)	+	3.53	–	–
11. *Scaphisoma subalpinum* Reitter, 1881	–	+	–	–
12. *Sepedophilus bipustulatus* (Gravenhorst, 1802)	–	3.04	–	–
Geotrupidae Latreille, 1802				
13. *Anoplotrupes stercorosus* (Scriba, 1791)*	+	–	–	–
Scirtidae Fleming, 1821				
14. *Cyphon pubescens* (Fabricius, 1792)*	+	–	–	–
Anobiidae Kirby, 1837				
15. *Dorcatoma dresdensis* Herbst, 1792	–	0.97	–	–
16. *Dorcatoma lomnickii* Reitter, 1903	–	2.88	–	–
Trogossitidae Latreille, 1802				
17. *Ostoma ferruginea* (L., 1758)**	–	0.64	1.56	3.45
18. *Peltis grossa* (L., 1758)**	2.39	3.04	–	–
19. *Thymalus oblongus* Reitter, 1889	9.15	0.80	–	–
Cerylonidae Billberg, 1820				
20. *Cerylon ferrugineum* Stephens, 1830**	–	0.64	–	–
21. *Cerylon histeroides* (Fabricius, 1792)**	+	+	–	–
Cucujidae Latreille, 1802				
22. *Cucujus haematodes* (Erichson,)**	0.56	–	–	–
Erotylidae Latreille, 1802				
23. *Dacne bipustulata* (Thunberg, 1781)	26.06	7.70	–	–
24. *Dacne notata* (Gmelin, 1790)	+	–	–	–

Families and species of beetles	Occurrence of beetles in (on) fungi of the genus Fomitopsis (% of populated basidiomes of all studied)			
	F. betulina	*F. pinicola*	*F. rosea*	*F. cajanderi*
Nitidulidae Latreille, 1802				
25. *Cyllodes ater* (Herbst, 1792)*	+	+	–	–
26. *Epuraea variegata* (Herbst, 1793)	1.27	1.92	1.56	3.45
27. *Glischrochilus hortensis* (Geoffroy, 1785)**	+	+	–	–
28. *Glischrochilus quadripunctatus* (L., 1758)**	+	+	–	–
Monotomidae Laporte, 1840				
29. *Rhizophagus bipustulatus* (Fabricius, 1792)**	+	+	–	–
Latridiidae Erichson, 1842				
30. *Corticarina similata* (Gyllenhal, 1827)*	+	–	–	–
31. *Stephostethus pandellei* (Brisout de Barneville, 1863)*	0.99	–	–	–
Ciidae Leach, 1815				
32. *Cis boleti* (Scopoli, 1763)*	+	+	–	–
33. *Cis comptus* Gyllenhal,1827*	+	–	–	–
34. *Cis jacquemarti* Mellie, 1848	1.86	4.17	4.92	3.45
35. *Dolichocis laricinus* (Mellie, 1848)	0.85	1.28	11.47	13.80
36. *Ennearthron cornutum* (Gyllenhal, 1827)	1.83	1.76	10.93	13.80
37. *Octotemnus glabriculus* (Gyllenhal, 1827)	+	1.44	–	–
38. *Rhopalodontus strandi* (Lohse, 1969)	1.69	1.12	–	–
39. *Sulcacis nitidus* (Gyllenhal, 1827)	0.56	–	–	–
Colydiidae Erichson, 1845				
40. *Bitoma crenata* (Fabricius, 1755)**	1.13	0.64	–	–
Melandryidae Leach, 1815				
41. *Melandrya dubia* (Schaller, 1783)**	1.13	0.80	–	–
Mycetophagidae Leach, 1815				
42. *Litargus connexus* (Geoofroy,)	1.97	1.92	–	–
43. *Mycetophagus decempunctatus* Fabricius, 1801*	0.96	–	–	–
44. *Mycetophagus multipunctatus* Fabricius, 1792	1.83	–	–	–
45. *Mycetophagus piceus* (Fabricius, 1777)	3.94	1.12	–	–
46. *Mycetophagus quadripustulatus* (L., 1761)*	1.13	–	–	–
Tenebrionidae Latreille, 1802				
47. *Diaperis boleti* (L., 1758)	25.35	7.37	–	–
48. *Upis ceramboides* (L., 1758)**	1.70	0.96	–	–
Всего семейств/видов				
17/48	**16/38**	**12/34**	**3/5**	**4/6**

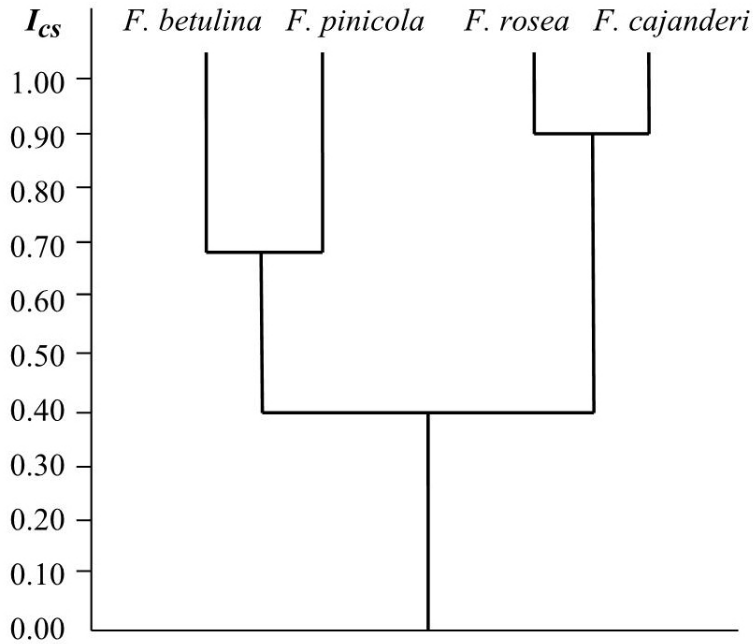

Fig. 2. Dendrogram of the similarity of the species composition of beetles developing in fungi of the genus *Fomitopsis* (Fr.) P. Kumm.

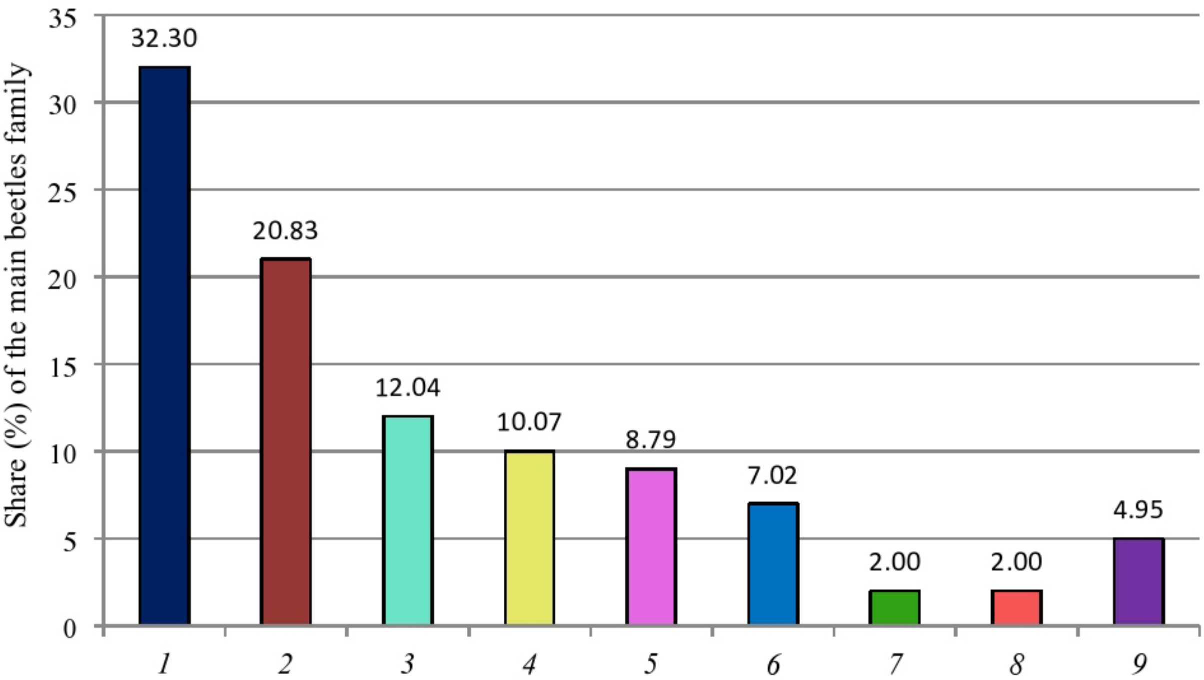

Fig. 3. The proportion of the main beetle families in the entomocomplex of fungi of the genus *Fomitopsis*: 1 – Tenebrionidae, 2 – Erotylidae, 3 – Ciidae, 4 – Trogossitidae, 5 – Staphylinidae, 6 – Mycetophagidae, 7 – Nitidulidae, 8 – Anobiidae, 9 – other families, all discovered beetle species of which are found only at the imago stage.

Patterns of formation of complexes of inhabitants of fungi of the genus Fomitopsis at various stages of their fruiting bodies development

Biochemical, anatomical and morphological features of the fruiting bodies of fungi, their lifetime and some other factors determine the quantitative and qualitative composition of the entomocomplexes, associated with them. Their combined influence leads to the fact that some species of fungi are quite actively populated by species-rich beetle communities, such as *Daedaleopsis confragosa* (Bolt.: Fr.) Schroet, *Fomes fomentarius* (L.: Fr.) Fr., *Lenzites betulinus* (L.: Fr.) Fr., species of genera *Pleurotus* (Fr.) P. Kumm., *Trametes* Fr. (Krasutsky, 2007a, b, 2021a, b, 2022a); others are to a moderate and weak extent, and the complexes of their inhabitants are poor in the number of species: *Bjerkandera adusta* (Willd.: Fr.) Karst., *Cerrena unicolor* (Bull.: Fr.) Murr., *Ganoderma applanatum* (Wallr.) Pat., species of the genus *Gloeophyllum* P. Karst, *Trichaptum abietinum* (Pers.: Fr.) Ryv., *T. laricinum* (P. Karst.) Ryv., *Gloeoporus dichrous* (Fr.: Fr.) Bres., *Schizophyllum commune* (Fr.) Fr., *Stereum hirsutum* (Willd.: Fr.) Fr. (Krasutsky, 2005, 2020, 2023a); still others are practically not inhabited by beetles: *Ganoderma lucidum* (Leyss.: Fr.) Karst., *Hymenochaete tabacina* (Sow.: Fr.) Lev., *Phellinus laevigatus* (Fr.) Bourd. et Galz., *Punctularia strigosozonata* (Sch.) Talbot (Krasutsky, 2005). In addition to these factors, the condition of basidiomas plays an important role, depending on their age, position on the substrate, weather and microclimatic conditions, and the degree of destruction. Changes in the condition of fruit bodies are accompanied by a change in the composition of the groupings of their inhabitants (the so-called microsuccessions). They are caused primarily by differences in the nutritional needs of insects, their ability to develop in (on) living or in dying and dead basidiomes.

Such microoccessions have been described in sufficient detail for some of the most common fungi, mainly the subtaiga of West Siberia (Pripyshminsky forests): *D. confragosa*, *F. fomentarius*, *F. betulina*, *F. pinicola*, *Trichaptum biforme* (Fr.) Ryv., species of the genera *Pleurotus* and *Trametes* (Krasutsky, 2005, 2006, 2007a, b, 2010). Today, we have significant material on the South Urals, which makes it possible not only to significantly clarify the dynamics of entomocomplexes in some fungi (including species of the genera *Fomitopsis*, *Pleurotus*, *Trametes*), but also to characterize microsuccessions for poorly studied xylotrophic fungi in this regard – *G. applanatum*, *L. betulinus*, *B. adusta* (Krasutsky, 2020, 2021a, b, 2022a, 2023a).

Microsuccessions of beetle groups in (on) Fomitopsis betulina

Unlike other species of the genus *Fomitopsis*, which have perennial, woody fruit bodies, the birch tinder has annual basidiomes, leathery and fleshy in the living state, and after dying off, they have a corky consistency.

Young, growing basidiomas (stage 1) are very rarely inhabited by beetles, the occurrence of which is low. During this stage, the staphylines *Atheta crassicornis* (1.31% of the entomocomplex at this stage), *A. gagatina* (4.68%), *Corticarina similata* (0.52%) and *Stephostethus pandellei* (0.52%) are found on the hymenophore of fungi in the imago phase. With the beginning of fungal sporulation (end of stage 1), the number of visitors increases due to the appearance of staphylinids *Scaphisoma agaricinum* (15.91%), *S. inopinatum* (1.31%), *Cyphon pubescens* bog beetle (0.52%), cerylonid *Cerylon histeroides* (1.04%), narrow-bodied *Bitoma crenata* (8.78%), flat-bodied *Cucujus haematodes* (0.52%), shiny beetles *Cyllodes ater* (1.04%), *Epuraea variegata* (1.31%), *Glischrochilus hortensis* (1.04%), *Gl. quadripunctatus* (0.52%), mushroom-eater beetles *Litargus connexus* (16.74%), *Mycetophagus decempunctatus* (5.34%), *M. multipunctatus* (14.32%), *M. quadripustulatus* (8.66%). These beetles additionally feed on spores (and even roaming clusters of spores, which we observed in *Cyphon pubescens*, *L. connexus* and *E. variegata*) on the surface of fruit bodies and on various substrates in their immediate vicinity (Fig. 4). The attractiveness of fungi at the stage of sporulation is primarily due to the high content of nitrogen in the spores necessary for insects. M. Martin (1979) provides, in particular, the following information: the nitrogen content in the primary mycelium is about 0.23%, in secondary increases to 3.27–7.00%, in fruit bodies – 0.72–1.13%, in spores – 3.00%.

The fruit bodies that have completed growth and sporulation die off, become drier and denser in consistency due to the formation of the dimitic hyphae system (stage 2). Thyroid *Thymalus oblongus* (9.01%), tinder beetles *Cis boleti* (isolated), *C. comptus* (isolated), *C. jacquemarti* (2.21%), *Dolichocis laricinus* (2.21%), *Ennearthron cornutum* (0.52%), *Rhopalodontus strandi* (0.52%), fungi beetles *Dacne bipustulata* (12.96 %), *D. notata* (1.04%), mushroom-eating beetles *Mycetophagus piceus* (4.42%), *M. multipunctatus* (1.03%) and darcling *Diaperis boleti* (36.92%) penetrating into the fruit bodies for egg laying. These species may be accompanied by *Peltis grossa* thyroid (7.02%), which eats fungal

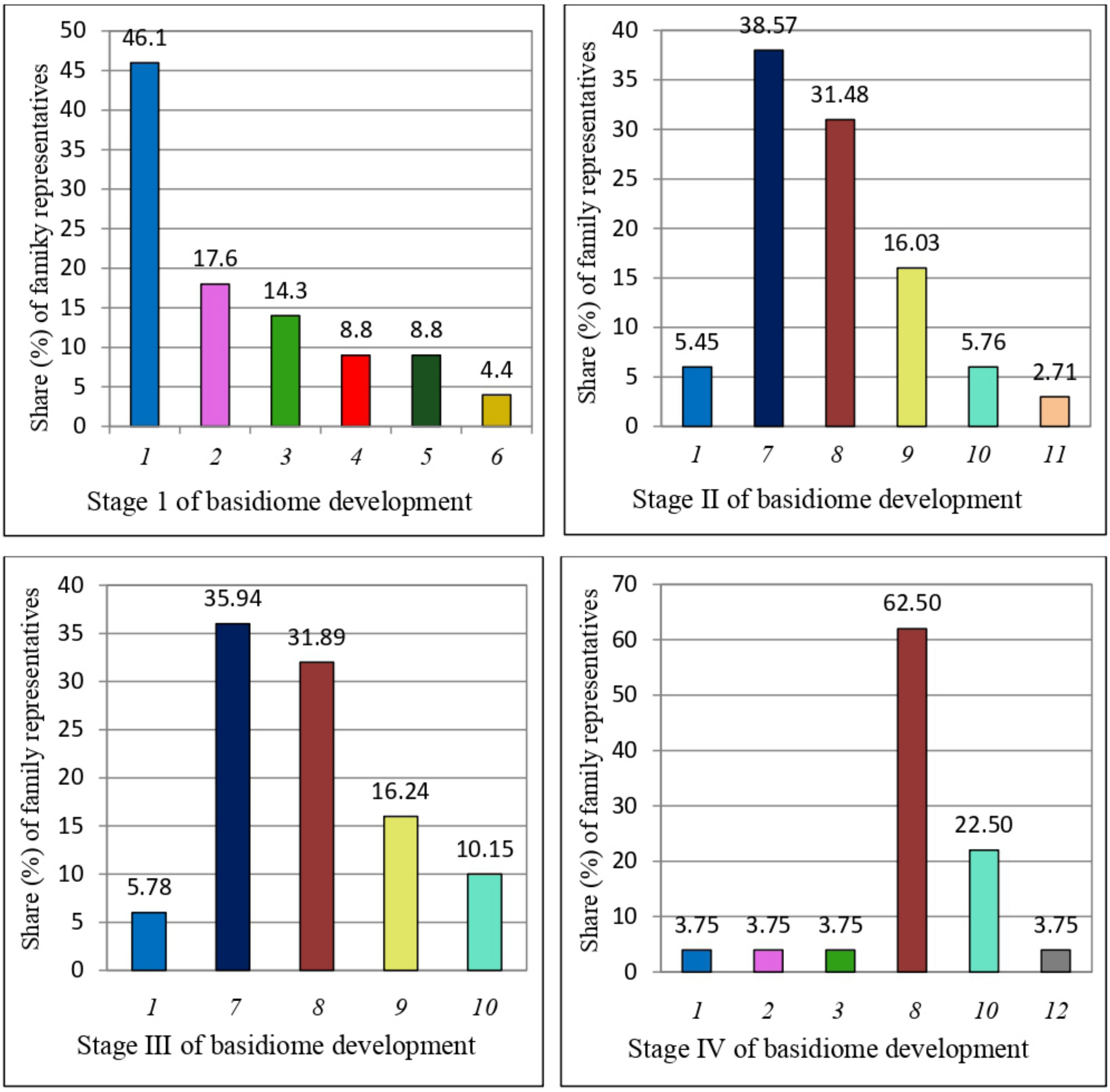

Fig. 4. Microsuccession of the main beetle families in the entomocomplex of fungi *Fomitopsis betulina*: 1 – Mycetophagidae, 2 – Staphylinidae, 3 – Nitidulidae, 4 – Latridiidae, 5 – Colydiidae, 6 – Scirtidae, Cerylonidae, Cucujidae, 7 – Tenebrionidae, 8 – Erotylidae, 9 – Trogossitidae, 10 – Ciidae, 11 – Melandryidae, 12 – Geotrupidae.

hymenophores at the imago stage, as well as *Melandrya dubia* (2.71%) and darcling beetles *Upis ceramboides* (1.65%), which undergo additional nutrition on fungi.

Stage 3 of the fruiting body development is characterized by the predominance of both larvae and imago of *D. boleti* (35.94%) and *D. bipustulata* (31.89%). Basidiomes that are usually not inhabited by *D. boleti* are actively eaten by the tinder beetles *C. jacquemarti*, *D. laricinus*, *E. cornutum* and *Rh. strandi* (16.24%), as well as the thyroid glands of *Th. oblongus* (10.15%). These species form a complex of the main destructors of fungi, bringing their fruit bodies to almost complete destruction (only fragments of the cortical part remain intact). Sometimes, imagoes of the tinder beetle *S. nitidus* are encountered individually.

At stage 4, the fruit bodies lose all structural properties. In their dry fragments, larvae and imagos of *D. bipustulata* are more common than others (62.50%); less often, in the imago phase, tinder beetles *C. boleti*, *C. jacquemarti*, *O. glabriculus* and *Rh. strandi* (total occurrence (22.50%), as well as mushroom-eater beetles *M. piceus* (3.75%). In the moistened, moldy remnants of basidiomas on tree trunks, *A. gagatina* (3.75%) and *E. variegata* (3.75%), and moisture-saturated fragments of fruit bodies that come into contact with the litter or fall on it can be eaten by the dung beetle *Anoplotrupes stercorosus* (3.75%).

Thus, mushroom-eating beetles (Mycetophagidae) are present at all stages of microsuccession, but their species composition is not constant, and at the first stage they occur only at the imago stage. On spore-bearing fungi, they are accompanied by specialized open-living mycetophages and some eurytopic, mainly xylophilic, species. The main complex of destroyers is formed after the death of basidiomas, when fungi are actively populated by beetles of the families Tenebrionidae (*D. boleti*), Erotylidae (*D. bipustulata*), Trogossitidae (*Th. oblongus*), as well as some Ciidae (mainly *Rh. strandi*), passing through the entire life cycle in the thickness of fruit bodies. At the stage of disposal of moldy fruit bodies, some Staphylinidae (*A. gagatina*) and Nitidulidae (*E. variegata*) characteristic of the first stage appear.

Microsuccessions of beetle groups in (on) Fomitopsis pinicola

On young, growing fruit bodies (stage 1) beetles are rare and occur at the imago stage. At this time, only the number of staphylines of *Gyrophaena boleti* may be high on some fungi.

During the period of fungal sporulation (the end of stage 1), the number and occurrence of their inhabitants increases dramatically. Individual staphylines of the genus *Scaphisoma* Leach, 1815 (28.15%), *G. boleti* (18.52%) dominate, *Sepedophilus bipustulatus* (14.07%) and *L. lunulatus* (5.93%) are somewhat less common. There are numerous mushroom-eating *L. connexus* (11.85%) and shiny beetles *E. variegata* (5.93%). Abundantly spore-bearing fungi are sometimes visited by cerylonids of the genus *Cerylon* Latreille, 1802 (3.70%), *C. ater* (1.48%), *Gl. hortensis* (1.48%), *Gl. quadripunctatus* (1.48%) and the monotomids *Rhizophagus bipustulatus* (1.48%), probably feeding on spores on the surface of fruit bodies and other substrates (Fig. 5).

The fruit bodies that have completed growth and passed all the sporulation die off, lose their characteristic pungent odor and become harder, woody in consistency (stage 2). The number of species of their visitors and inhabitants is increasing. *Dorcatoma dresdensis* (1.27%) and *D. lomnickii* (2.53%), *Th. oblongus* (1.26%), *D. bipustulata* (10.13%), *C. jacquemarti* (2.53%), *D. laricinus* (3.80%), *E. cornutum* (5.06%), *Octotemnus glabriculus* (1.48%), *Rh. strandi* (1.48%), and *D. boleti* (24.05%), penetrating into fruit bodies for egg laying. Imago of *M. piceus* is sometimes found (2.53%). They are accompanied by imago of *Ostoma ferrugineum* (5.06%), *P. grossa* (24.05%), which eat the hymenophore of fungi, as well as *Rh. bipustulatus* (1.48%), better known as inhabitants of brown wood rots.

At the 3rd stage of existence of fruiting bodies, both larvae and imagoes of the fungi beetles *D. bipustulata* (40.87%), tinder beetles *C. jacquemarti* (8.65%), *D. laricinus* (2.88%), *E. cornutum* (3.85%), *O. glabriculus* (2.88%), *Rh. strandi* (2.88%) and darkling beetles *D. boleti* (24.04%) predominate, playing a major role in the destruction of fungi up to their complete destruction. In dry basidiomes, grinders of the genus *Dorcatoma* (4.86%) also develop, less often – plaice beetles *Th. oblongus* (0.96%), mushroom-eating beetles *L. connexus* (1.92%) and *M. piceus* (0.96%).

Fruit bodies at stage 4 are severely destroyed, but usually still remain on the woody substrate. They may contain the fungi beetles *D. bipustulata* (16.13%), the tinder beetles *C. jacquemarti* (19.35%), *D. laricinus* (3.22%), *E. cornutum* (6.45%), *O. glabriculus* (6.45%), the mushroom-eating beetle *M. piceus* (6.45%) and the darkling beetle *D. boleti* (22.58%). Moist basidiomas on tree trunks are home to rove beetles *Megarthrus hemipterus* (6.45%) and scaly beetles *E. variegata* (12.90%). These beetle species (especially *E. variegata*) are sometimes also found on dead, old, damp, moldy, but undamaged fruiting bodies of not only species of the genus *Fomitopsis* but also other xylotrophic fungi.

Thus, the complexes of inhabitants of living and dead basidiomas differ significantly, although individual representatives of the family Mycetophagidae (*L. connexus*) are present at all stages of microsuccession. As in the fungi of *F. betulina*, *D. bipustulata* (Erotylidae), *D. boleti* (Tenebrionidae) and a similar complex of Ciidae develop in the dead basidiomes of *F. pinicola*. The fundamental difference is due to the participation of *D. dresdensis* and *D. lomnickii* (Anobiidae) in the destruction of fruit bodies and the significantly smaller role of *Th. oblongus* (Trogossitidae) in this process. Some species of Staphylinidae (*M. hemipterus*) and Nitidulidae (*E. variegata*) are also found in old, moldy fungi.

As for the fungi *Fomitopsis rosea* and *F. cajanderi*, the main complex of their inhabitants is formed in already dead fruit bodies. The entire life cycle of the tinder beetles *C. jacquemarti*, *D. laricinus* and *E. cornutum* takes place in them (the latter two species predominate). On the hymenophore of living basidiomas, *E. variegata* and *Ostoma ferrugineum* can sometimes be found, and on *F. cajanderi* – *G. boleti* staphylinid.

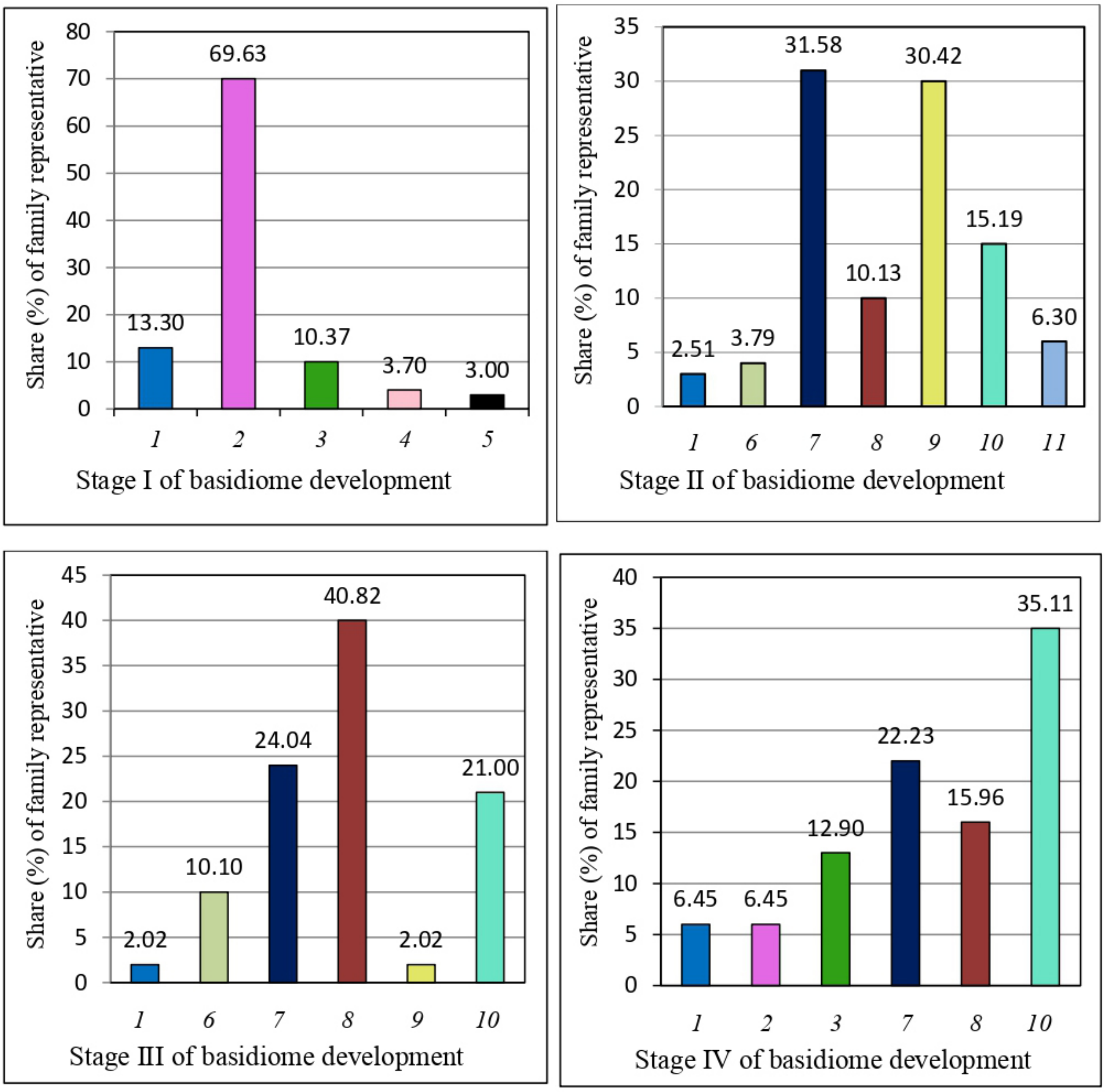

Fig. 5. Microsuccession of the main beetle families in the entomocomplex of fungi *Fomitopsis pinicola*: 1 – Mycetophagidae, 2 – Staphylinidae, 3 – Nitidulidae, 4 – Cerylonidae, 5 – Colydiidae, Monotomidae, 6 – Anobiidae, 7 – Tenebrionidae, 8 – Erotylidae, 9 – Trogossitidae, 10 – Ciidae, 11 – Melandryidae.

Features of food relations of Coleoptera and the structure of the mycetophilic community of fungi of the genus Fomitopsis in the South Urals

With the exception of *Tachyta nana* (Carabidae), food relations with fungi of the genus *Fomitopsis* (fruit bodies, spores, or mycelium) in one form or another (short-term trophic contacts or more stable, permanent food relations) are found in all related beetle species, but only 25 species out of 8 families (Staphylinidae, Anobiidae, Trogossitidae, Erotylidae, Nitidulidae, Ciidae, Mycetophagidae, Tenebrionidae) develop in these fungi. Most of them are specialized mycetobionts, obligate mycetophages that prefer to develop in the fruiting bodies of fungi, and some also in the plasmodia of myxomycetes. Below, based on our own and literary data, their ecological and trophic specialization is considered.

Coleoptera developing in (on) the fruit bodies of fungi of the genus *Fomitopsis*

This group contains 25 species from 8 families. It should be noted that some beetles in this group can also colonize other substrates colonized by various fungi. Thus, being mycetophages, they are not always obligate carpophorophages. A more detailed description of food relations using preference coefficients (K_p) is given here specifically for consumers of fruit bodies.

Family Staphylinidae Latreille, 1802

Atheta crassicornis is a West-Central Palearctic, mainly forested, mycetophilic species (Nikitsky, 2016). It inhabits not only a wide variety of woody fungi (Benick, 1952; Nikitsky, 2016; Nikitsky and Schigel, 2004; Nikitsky et al., 1996), including sometimes *F. betulina*, but also various substrates, susceptible to fungal decomposition (Nikitsky, 2016).

A. gagatina is a Euro-Caucasian-West-Central Asian mycetophagous species (Nikitsky, 2016). In the South Urals, *F. betulina* sometimes develops on the hymenophore. It inhabits a wide variety of fungi, both ground and woody, and is also found in decomposing plant and animal remains (Benick, 1952; Nikitsky, 2016; Nikitsky and Schigel, 2004; Nikitsky et al., 1996).

Bolitochara obliqua is a Euro-Caucasian-Near Asian mycetophilic forest species (Nikitsky, 2016). It is rare on fungi *F. betulina* and *F. pinicola*, and occurs on some ground-based (genus *Amanita* Pers.), xylophilic fungi (*Cerioporus squamosus* (Huds.) Quel., *Daedalea quercina* (L.) Fr., *F. fomentarius*, *Phellinus igniarius* (L.) Quel., *Pl. pulmonarius*) and myxomycetes *Lycogala epidendrum* (L.) Fr. (Benick, 1952; Nikitsky, 2016; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Tsinkevich, 2004). It often develops under the bark of dead trees (Nikitsky, 2016; Nikitsky et al., 1996).

Dinaraea aequata is a Trans-Eurasian forest species (Nikitsky, 2016). *F. pinicola* fungi are very rarely inhabited. It lives mainly under the bark of trees and in many woody fungi: *Armillaria mellea* (Vahl.) P. Kumm., *B. adusta*, *C. unicolor*, *Ceriporia purpurea* (Fr.) Donk, *C. squamosus*, species of the genus *Daedaleopsis* J. Schröt., *Datronia mollis* (Sommerf.) Donk, *Exidia glandulosa* (Bull.) Fr., *F. fomentarius*, *F. pinicola*, *G. applanatum*, *Hymenochaete rubiginosa* (Dicks.) Lev., *L. betulinus*, *Megacollybia platyphylla* (Pers.) Kotl. et Pouz., *Phaeolepiota aurea* (Matt.) Maire, *Phaeolus schweinitzii* (Fr.) Pat., *Polyporus tuberaster* (Jacques ex Persoon) Fries., *Postia lateritia* Renvall, *Trametes versicolor* (L.) Lloyd, *T. ochracea* (Pers.) Gilb. et Ryvarden, *Coriolopsis trogii* (Berk.) Domansky, *Trichaptum biforme* (Fr.) Kunn., *Tyromyces chioneus* (Fr.) P. Karst., *T. lacteus* (Fr.) Murr., *Xanthoporia radiata* (Sowerby) Tura, Zmitr., Wasser, Raats & Nevo (Benick, 1952; Nikitsky, 2016; Nikitsky and Schigel, 2004; Schigel, 2009; Schigel et al., 2004).

Gyrophaena boleti is a Euro-Caucasian-Kazakh-Siberian-Far Eastern mycetophagous forest species (Nikitsky, 1996). Beetles are very numerous on the living fruit bodies of *F. pinicola* (Fig. 6). In other regions they are found on fungi *F. fomentarius*, species of the genera *Polyporus* (P. Micheli ex Adans.), *Trametes* Fr. (Nikitsky, 2016; Nikitsky and Schigel, 2004; Nikitsky et al., 1996), as well as on *Schizophyllum commune* (Fr.) Fr. (Egorov et al., 2009b).

Scaphisoma agaricinum is a Euro-Caucasian-Siberian-Far Eastern species (Nikitsky, 2016). This forest species is known as a specialized mycetophage, associated in its main and additional nutrition with many xylophilic, less often ground fungi (Benick, 1952; Kompantsev, 1984; Nikitsky, 2016; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Shchigel, 2002, 2009; Tsinkevich, 2004; Vlasov and Nikitsky, 2017). It occurs infrequently on *F. betulina* and *F. pinicola*; it usually develops on *F. fomentarius* and *G. applanatum*, very rarely on *Inocutis rheades* (Pers.) Fiasson & Niemela (Fig. 6) and ocasionally on *Lentinus cyathiformis* (Schuff.: Fr.) Bres. (Krasutsky, 2005, 2020, 2022a). It feeds, like other members of the genus *Scaphisoma* Leach., on spores and, possibly, elements of hymenium.

S. inopinatum is a Euro-Siberian-Far Eastern species (Nikitsky, 2016). The forest species is a mycetophage found on many xylophilic fungi (Nikitsky, 2016; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Schigel, 2002, 2006, 2009; Schigel et al., 2004. Tsinkevich, 2004; Vlasov and Nikitsky, 2017). It develops on *F. pinicola*, but more often on *F. fomentarius*, *G. applanatum*, sometimes on *I. rheades* and species of the genus *Daedaleopsis* (Fig. 6).

S. subalpinum is a Trans-Eurasian mycetophagous forest species (Nikitsky, 2016). *F. pinicola* is very rare on fungi in the Southern Urals; it usually develops on *F. fomentarius* and *I. rheades*. It can occur not only on many xylophilic fungi (Benick, 1952; Nikitsky, 2016; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Schigel, 2002, 2006, 2009; Schigel et al., 2004; Tsinkevich, 2004; Vlasov and Nikitsky, 2017), but also under fungal-infested bark or on wood (Nikitsky, 2016).

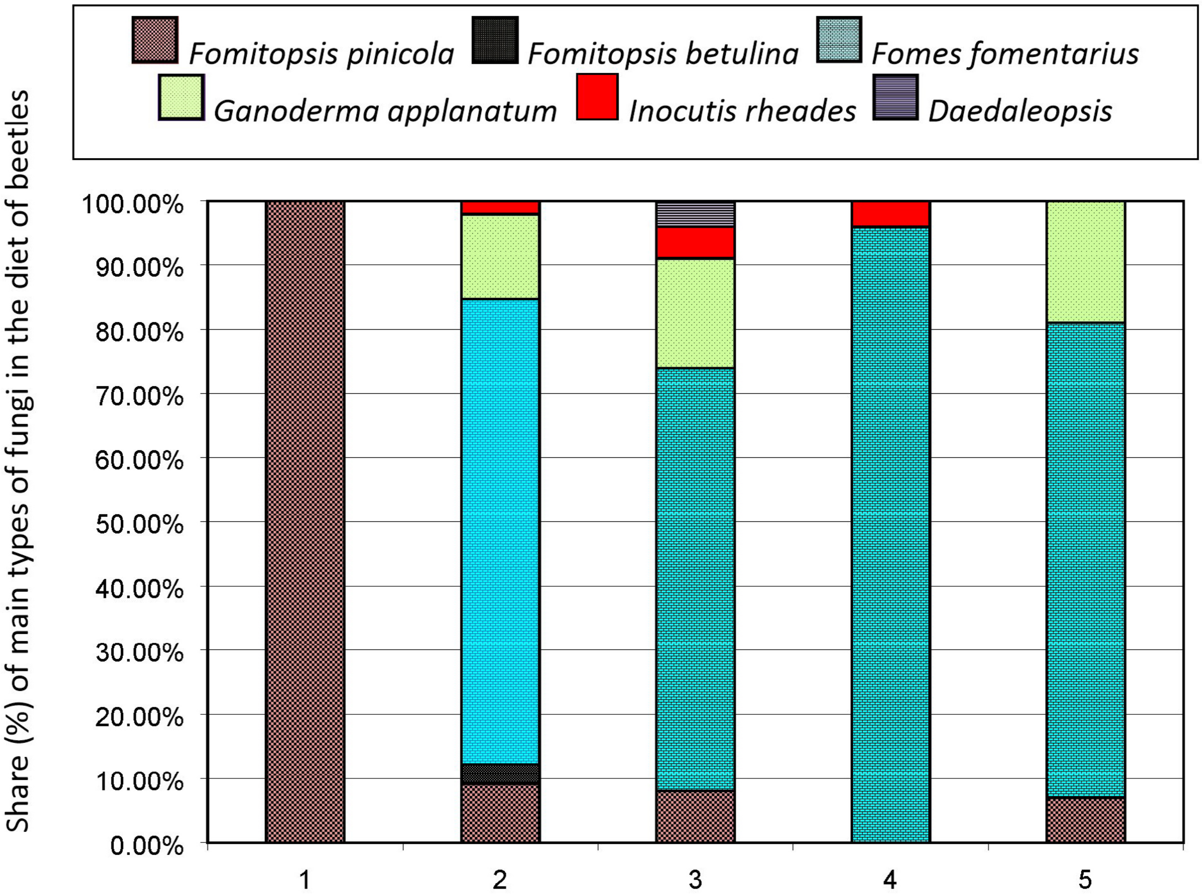

Fig. 6. Food preferences (K_p × 100) of beetles of the family Staphylinidae – the main inhabitants of fungi of the genus *Fomitopsis*: 1 – *Gyrophaena boleti*, 2 – *Scaphisoma agaricinum*, 3 – *S. inopinatum*, 4 – *S. subalpinum*, 5 – *Sepedophilus bipustulatus*.

Sepedophilus bipustulatus is a Trans-Eurasian mycetophagous forest species (Nikitsky, 2016). It prefers spore-bearing fungi, mainly such species as *F. fomentarius*, *G. applanatum*, and *F. pinicola* (Fig. 6). It has also been observed on *A. mellea* (Benick, 1952; Nikitsky, 2016; Nikitsky et al., 1996).

Family Anobiidae Kirby, 1837

Dorcatoma dresdensis is a Euro-Caucasian-Siberian-Far Eastern mycetophagous forest species (Nikitsky, 2016). In the Southern Urals, it is mainly inhabited by *F. fomentarius, F. pinicola* and *G. applanatum* (Fig. 7). It also develops in other woody fungi on hardwoods: *C. squamosus, Climacocystis borealis* (Fr.) Kotl. et Pouz., species of the genus *Inonotus* (P. Karst.), *Phellinus lindelii* Niemela, *Ph. populicola* Niemela, *X. radiata* (Benick, 1952; Nikitsky, 2016; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Schigel, 2002, 2006, 2009; Schigel et al., 2004; Tsinkevich, 2004).

D. lomnickii is a Northeastern Euro-Siberian-Far Eastern mycetophagous forest species (Nikitsky, 2016). It develops in fungi *F. pinicola*, less often *F. fomentarius* and *Ph. igniarius* (Fig. 7), and in the European part of Russia also in *G. applanatum* (Nikitsky, 2016; Nikitsky et al., 1996; Nikitsky and Schigel, 2004; Shchigel, 2002).

Family Trogossitidae Latreille, 1802

Thymalus oblongus is a Northeastern Euro-Siberian-Far Eastern mycetophagous forest species (Nikitsky, 2019). It prefers fungi *F. betulina* and species of the genus *Daedaleopsis* for its development, less often *F. pinicola* (Fig. 7). It is found on other woody fungi – *B. adusta*, *C. unicolor*, *Daedalea quercina* (L.) Pers., *F. fomentarius*, *Hapalopilus rutilans* (Pers.) Murr., *Hymenochaetopsis tabacina* (Sowerby) S.H. He & Jiao Yang, *Panellus stipticus* (Bull.) P. Karst., fungi of the genus *Pleurotus*, *T. biforme*, fungi of the genus *Trametes* (Krasutsky, 2005; Nikitsky, 2019; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Shchigel, 2002). Characterizing the food connections of this beetle, it should be noted that its larvae

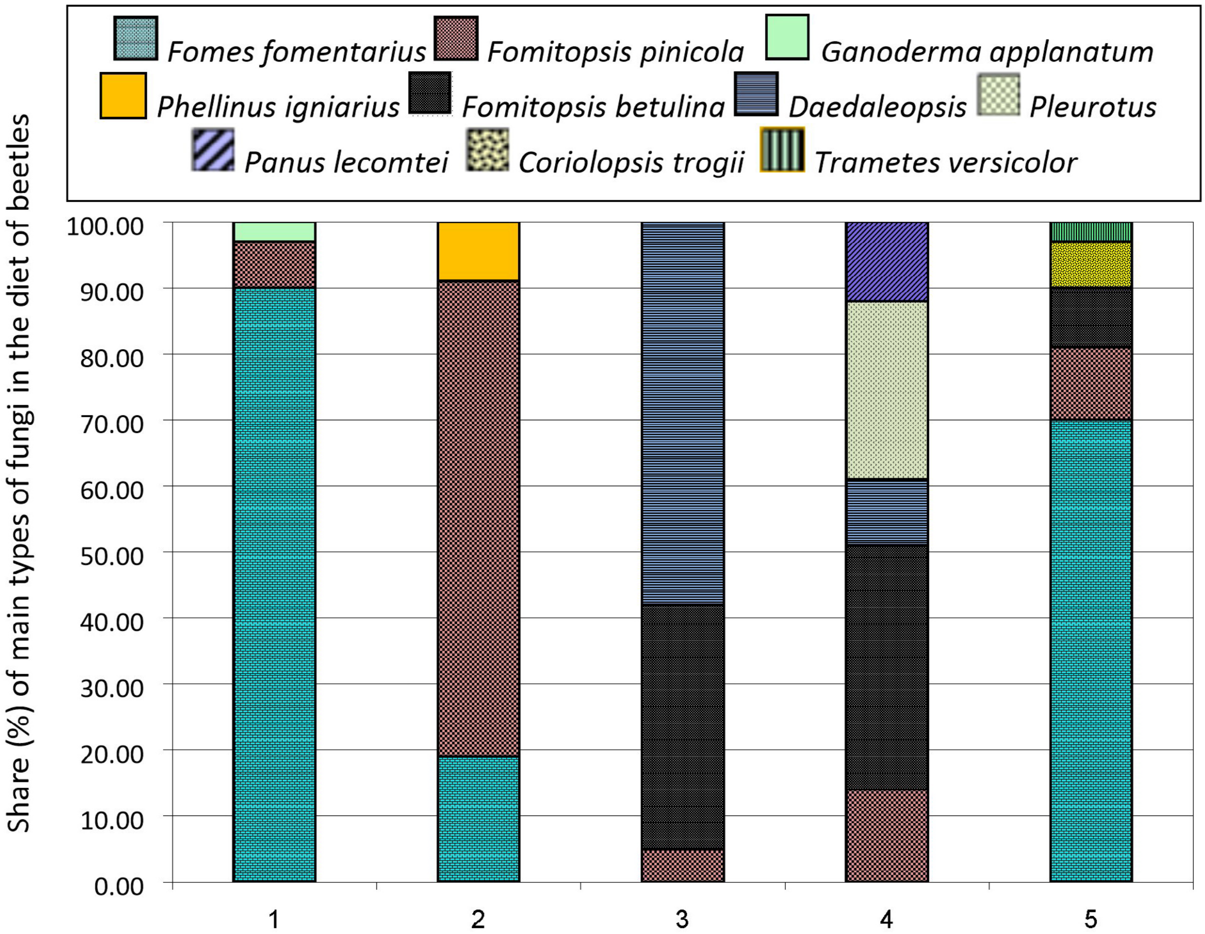

Fig. 7. Food preferences (K_p × 100) of beetles of the families Anobiidae, Trogossitidae, Erotylidae, Nitidulidae – the main inhabitants of the fungi of the genus *Fomitopsis*: 1– *Dorcatoma dresdensis*, 2 – *D. lomnickii*, 3 – *Thymalus oblongus*, 4 – *Dacne bipustulata*, 5 – *Epuraea variegata*.

can successfully develop in rotten hardwood due to the mycelium of various xylotrophic fungi. Probably, using the example of this species, we observe a fragment of the process of adaptationogenesis: the transition from living in wood to living in the basidiomes of fungi.

Family Erotylidae Latreille, 1802

Dacne bipustulata is a Euro-Caucasian-Siberian-Far Eastern mycetophagous forest species (Nikitsky, 2019). It has a wide polyphagy and inhabits many woody fungi, among which *F. betulina*, species of the genus *Pleurotus*, *F. pinicola*, *Panus lecomtei* (Fr.) Corner and fungi of the genus *Daedaleopsis* predominate (Fig. 7). In other regions, this species has been found on *B. adusta*, *C. squamosus,* and fungi of the genera *Inonotus*, *Lentinus* (Fr.), *Trametes*, *Laetiporus sulphureus* (Bull.) Murr., *Spongipellis litschaueri* Lohwag and *T. biforme* (Jablokoff-Khnzorian, 1975; Khalidov, 1984; Kompantsev, 1982; Krasutsky, 2005; Nikitsky, 2019; Nikitsky and Kompansev, 1995; Nikitsky and Schigel, 2004; Tsinkevich, 2004).

D. notata is a Trans-Eurasian, predominantly forest mycetophagous species. In the South Urals it inhabits the *F. betulina*, sometimes species of the genus *Pleurotus*. In the Far East, it can develop in *Inonotus obliquus* (Pers.) Pil., *Pleurotus citrinopileatus* Sing, *Pl. ostreatus*, *Pl. pulmonarius* and is also found on *Ischnoderma benzoinum* (Wahlenb.) P. Karst. and fungi of the genus *Trametes* (Nikitsky and Kompantsev, 1995; Zaitsev and Kompantsev, 1987), and in Western Siberia on *F.fomentarius* (Krasutsky, 2005).

Family Nitidulidae Latreille, 1802

Epuraea variegata is a Euro-Caucasian-Siberian mycetophagous forest species (Nikitsky, 2019). It is associated with many woody fungi, but it usually develops on *F. fomentarius*, *F. pinicola*, *F. betulina*, *C. trogii*, *T. versicolor* (Fig. 7), and in other regions also on *Antrodia serialis* (Fr.) Donk and *L. sulphureus* (Nikitsky, 2019; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Tsinkevich, 2004). It often develops on the fermented sap of deciduous trees due to fungi of the genera *Saccharomyces* (Meyen) and *Endomyces* Reess (Alexander, 2002; Nikitsky, 2019; Nikitsky and Tatarinova, 2003; Nikitsky et al., 1996).

Family Ciidae Leach, 1819

Cis jacquemarti is a Trans-Eurasian forest species (Nikitsky, 2019). It is a typical inhabitant of wood-destroying basidial fungi with a wide range of food objects. In the South Urals it develops in fungi *F. fomentarius*, *F. betulina*, *F. pinicola*, *G. applanatum*, fungi of the genus *Daedaleopsis*, sometimes *L. betulinus* and species of the genus *Trametes* (Fig. 8). On the territory of the European part of Russia, it also inhabits *B. adusta*, *Cerioporus varius* (Pers.) Zmitr. & Kovalenko, *Phellinus igniarius* (L.) Quel., *Ph. tremulae* (Bond.) Bond. et Boris., *S. hirsutum*, *T. biforme*, *X. radiata* (Egorov et al., 2009a; Kompantsev, 1984; Krasutsky, 2005, 2006; Nikitsky, 2019; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Vlasov and Nikitsky, 2015), and in West Siberia – *Schizophyllum commune* Fr. (Krasutsky, 2005). In Europe, it is also associated with such fungi as *Amylocystis lapponica* (Romell) Bond. et Sing., *A. pallescens*, *C. borealis*, *Inocutis dryophila* (Berk.) Fiasson et Niemela, *I. benzoinum, Porodaedalea pini* (Brot.) Murrill (Benick, 1952; Komonen, 2005; Nikitsky, 2019; Schigel, 2006, 2009).

Dolichocis laricinus is a Holarctic forest species (Nikitsky, 2019). It develops in fungi of the genus *Fomitopsis* (*F. betulina*, *F. pinicola*, *F. rosea*, *F. cajanderi*), and also sometimes in *C. trogii* (Fig. 8). In addition, larval development was noted in fungi *Antrodia pulvinascens* (Pilat) Niemela, *A. serialis*, *Anthoporia albobrunnea* Karasiński & Niemelä, *Amyloporia sinuosa* (Fr.) Rajchenb., Gorjón & Pildain, *A. lapponica*, *B. adusta*, *Cerioporus leptocephalus* (Jacq.) Zmitr., *C. borealis*, *F. fomentarius*, *Fomitiporia robusta* (P. Karst.) Bourdot et Galzin, *Haploporus odorus* (Sommerf.: Fr.) Bond. et Sing., *I. obliquus*, *L. sulphureus*, *Leptoporus mollis* (Pers.) Quél., *P. pini, Pycnoporellus fulgens* (Fr.) Donk, selected species of the genus *Trametes* (Benick, 1952; Nikitsky, 2019; Nikitsky and Schigel, 2004).

Ennearthron cornutum is a Trans-Eurasian forest species (Nikitsky, 2019). It inhabits a wide variety of xylophilic fungi. In the South Urals, it develops in the fruit bodies of *F. betulina*, *F. pinicola*, *F. rosea*, *F. cajanderi*, in fungi of the genus *Daedaleopsis*, sometimes *Ph. igniarius* and *T. biforme* (Fig. 8). In other regions (Moscow, Kostroma, Yaroslavl regions, Crimea, Republic of Belarus), in addition to these species, it inhabit *A. sinuosa*, *A. serialis*, *B. adusta*, *C. squamosus*, *C. borealis*, *D. mollis*, *F. fomentarius*, *F. robusta*, *Fuscoporia ferruginosa* (Schrad.) Murrill, *G. applanatum*, *Chondrostereum purpureum* (Fr.) Pouz*., C. trogii*, *Gl. sepiarium*, *H. rutilans*, *H. rubiginosa*, *H. tabacina*, *I. hispidus*, *I. obliquus*, *I. rheades*, *L. sulphureus*, *Ph. schweinitzii*, *Phellinus alni* (Bond.) Parmasto, *Ph. tremulae*, *P. fulgens*, *T. gibbosa*, *S. commune*, *X. radiata* (Kompantsev, 1984; Nikitsky, 2019; Shchigel, 2002; Tsinkevich, 2004; Vlasov and Nikitsky, 2015). It is known from the fungi *A. lapponica*, *A. albobrunnea*, *Coriolopsis gallica* (Fr.) Ryv., *Fistulina hepatica* (Schaeff.) With., *Fuscoporia torulosa* (Pers.) T. Wagner & M. Fisch, *Haploporus odorus* (Sommerf.: Fr.) Bond. et Sing., *Hypsizygus ulmarius* (Bull.) Redhead, *Perenniporia fraxinea* (Bull.) Ryv., *Phellinus lindelii* Niemelä, *Phellinus viticola* (Schwein. in Fr.) Donk, *Phellinus chrysoloma* (Fr.) Donk, *Phellinus pomaceus* (Pers.) Maire, *P. pini*, *Postia balsamea* (Peck) Julich, *S. odora* (Benick, 1952; Nikitsky, 2019; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Shchigel, 2002).

Octothemnus glabriculus is a Holarctic forest species (Nikitsky, 2019). It often develops in the fruit bodies of fungi of the genus *Trametes* and some other representatives of the Polyporaceae family, especially *L. betulinus* (L.) Fr. (Fig. 8). Sometimes it inhabits the basidiomes of *F. pinicola*, much less often *F. betulina*, and also (in Western Siberia) fungi of the genus *Daedaleopsis*, *G. applanatum*, *B. adusta* and *Stereum hirsutum* (Willd.: Fr.) Fr. (Krasutsky, 2005). On the territory of the European part of Russia, it can develop into *C. trogii* (Nikitsky, 2019; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Vlasov and Nikitsky, 2015). It has also been observed in fungi *Antrodia juniperina* (Murrill) Niemelä & Ryv., *A. serialis* and *Antrodiella pallescens* (Pil.) Niemelä & Miettinen, *C. unicolor*, *Ceriporiopsis resinascens* (Romell) Domansky, *D. quercina*, *Ph. viticola*, *S. commune*, *T. laricinum* (Benick, 1952; Krasutsky, 2005; Shchigel, 2002, 2009; Tsinkevich, 2004).

Rhopalodontus strandi is a northeastern Euro-Siberian-Far Eastern forest species (Nikitsky, 2019). It develops most often in *F. fomentarius*, less often in *G. applanatum*, *F. betulina*, *F. pinicola*, *L. betulinus*, and *T. biforme* (Fig. 8); in the European part of Russia, it is also inhabited by *L. sulphureus*, *I. rheades*, and fungi of the genus *Trametes* (Kompantsev, 1984; Nikitsky, 2019; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Vlasov, 2023; Vlasov and Nikitsky, 2015; Tsinkevich, 2004), and in Western Siberia, in addition to them, by fungi of the genus *Daedaleopsis* and *Trichaptum fuscoviolaceum* (Ehrenb.) Ryv. (Krasutsky, 2005).

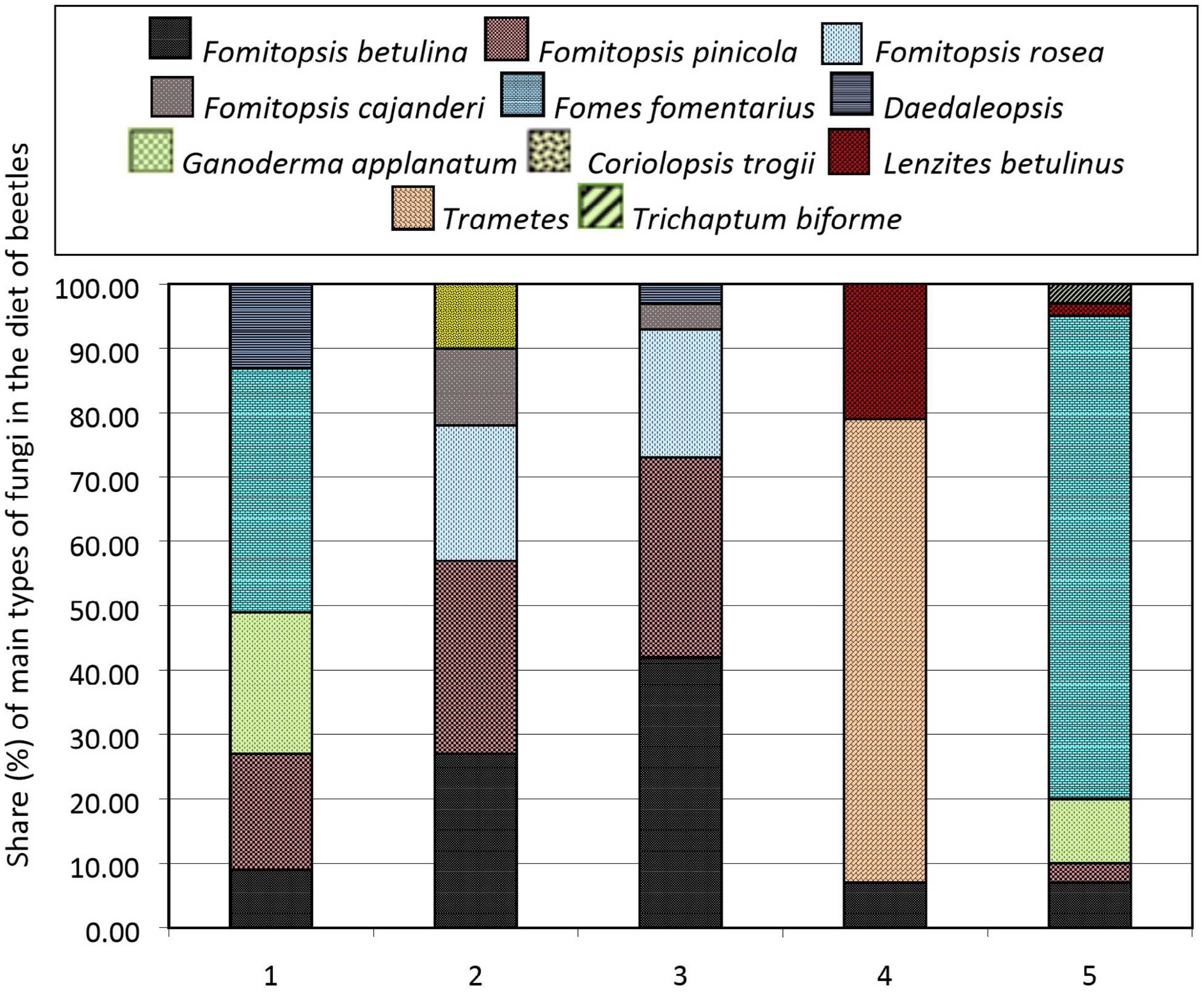

Fig. 8. Food preferences (K_p × 100) of beetles of the family Ciidae – the main inhabitants of fungi of the genus *Fomitopsis*: 1 – *Cis jacquemarti*, 2 – *Dolichocis laricinus*, 3 – *Ennearthron cornutum*, 4 – *Octothemnus glabriculus*, 5 – *Rhopalodontus strandi.*

Sulcacis nitidus is a Euro-Caucasian-Siberian-Far Eastern forest species (Nikitsky, 2019). It is a widespread species that develops in various woody fungi, but is very rare in the entomocomplex of fungi of the genus *Fomitopsis* (noted only in *F. betulina*). It inhabits all species of the genus *Trametes*, and besides them – *L. betulinus*, fungi of the genus *Daedaleopsis*, sometimes *B. adusta*, *C. unicolor*, *C. trogii*, *Pycnoporus cinnabarinus* (Jacq.) P. Karst., *T. biforme*. On the territory of the European Part of Russia, *L. sulphureus* and *H. rutilans* are also developing in fungi (Nikitsky, 2019; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Vlasov, 2023; Vlasov and Nikitsky, 2015). It has been recorded in the fungi *C. leptocephalus*, *D. quercina*, *Favolus pseudobetulinus* (Murashk. ex Pilat) Sotome & T. Hatt., *F. fomentarius*, *G. applanatum*, *Phellinopsis conchata* (Pers.) Y.C. Dai. (Benick, 1952; Komonen, 2005; Nikitsky, 2019; Schigel, 2006, 2009).

Family Mycetophagidae Leach, 1815

Litargus connexus is a Transpalearctic, predominantly forest mycetophagous species (Nikitsky, 2019). It prefers fungi of the genus *Daedaleopsis*, less often *F. betulina*, *F. pinicola* and *F. fomentarius* for its development. It sometimes develops in fungi of the genera *Pleurotus* and *Pholiota* (Fig. 9). According to Nikitsky (1993, 2019), it is also closely related in its development to the ascomycete fungi *Daldinia concentrica* (Bolton) Cesati & de Notaris, *Nummularia bulliardi* Tul. & C. Tul., fungi of the genera *Diatrype* (Fr.) and *Hypoxylon* Bull.

Mycetophagus multipunctatus is a Euro-Caucasian-Kazakh-Siberian-Near Asian mycetophagus forest species (Nikitsky, 2019). It is more common in fungi of the genus *Daedaleopsis*, somewhat less common in fungi of the genus *Pleurotus* (Fig. 9). During sporulation, it visits the basidiomes of *F. betulina*,

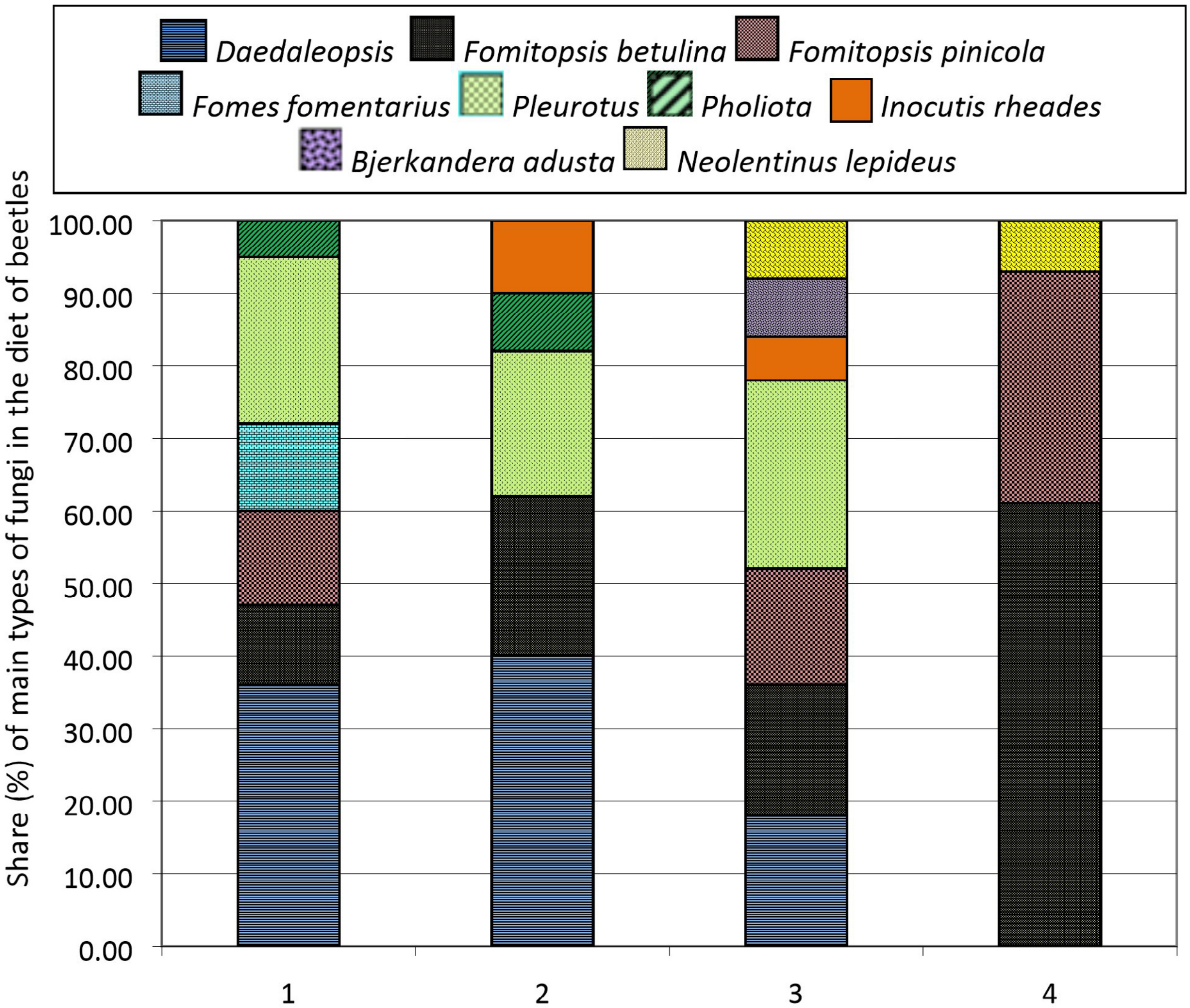

Fig. 9. Food preferences (K_p × 100) of beetles of the families Mycetophagidae and Tenebrionidae – the main inhabitants of fungi of the genus *Fomitopsis*: 1 – *Litargus connexus*, 2 – *Mycetophagus multipunctatus*, 3 – *M. piceus*, 4 – *Diaperis boleti.*

but develops in dying fruit bodies. It sometimes inhabits *I. rheades* and fungi of the genus *Pholiota*. In other regions of Russia, it is also associated with *C. squamosus*, *C. borealis*, *Hericium coralloides* (Scop.), *L. sulphureus*, *Ph. adiposa*, *X. radiata*, and some other fungi (Nikitsky, 1993, 2019; Nikitsky and Schigel, 2004; Shchigel, 2002; Tsinkevich, 2004; Vlasov, 2023).

Mycetophagus piceus is a West-Central Palearctic mycetophagus forest species (Nikitsky, 2019). It develops more often in fungi of the genus *Pleurotus*, less often in the genus *Daedaleopsis*, *F. betulina*, *F. pinicola*, sometimes *B. adusta*, *N. lepideus* and *I. rheades* (Fig. 9). In other regions, it can develop in *C. squamosus*, fungi of the genus *Inonotus*, *L. sulphureus*, *L. cyathiformis*, *Lentinus tigrinus* (Bull.) Fr., *Panus neostrigosus* Drechsler-Santos & Wartchow, *P. fulgens*, *P. squamosus*, *X. radiata* (Krasutsky, 2005; Nikitsky, 1993, 2019; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Tsinkevich, 2004). Imago beetles are found on a wide variety of woody fungi, for example, *A. mellea*, *C. trogii*, *D. quercina*, *F. hepatica*, *G. applanatum*, *H. rutilans*, *Hypholoma fasciculare* (Huds.) P. Kumm., *Phlebia tremellosa* (Schrad.) Nacasone et Burds., *Polyporus brumalis* (Pers.) Fr., *T. biforme*, *Volvariella bombycina* (Schaeff.) Sing. (Benick, 1952; Krasutsky, 2005; Nikitsky, 1993, 2019; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Tsinkevich, 2004).

Family Tenebrionidae Latreille, 1802

Diaperis boleti is a Transpalearctic forest species (Nikitsky, 2019). Obligate mycetophage. It develops in the fungi *F. betulina*, *F. pinicola*, *Neolentinus lepideus* (Fr.) Redhead et Ginss. (Fig. 9), and in Europe and the European part of Russia, also in *C. squamosus*, *C. borealis*, *F. hepatica*, *L. sulphureus* and *Ph. schweinitzii* (Benik, 1952; Kompantsev, 1984; Kompantseva, 1987; Nikitsky, 2019; Nikitsky and Shigel, 2004; Nikitsky et al., 1996; Tsinkevich, 2004; Vlasov, 2023). At the stage of development, imago was observed on other tree fungi (fungi of the genus *Daedaleopsis*, *F. fomentarius*, *G. lucidum*, *I. rheades*, *N. cyathiformis*, *T. versicolor*) (Benick, 1952; Krasutsky, 2005; Nikitsky, 2019; Tsinkevich, 2004) and ground-based (*Boletus edulis* Bull., *Leccinum scabrum* (Bull.) Gray) (Khalidov, 1984).

Coleoptera undergoing additional feeding on the fruiting bodies of fungi of the genus *Fomitopsis*

This group includes 10 species from 7 families. These are Coleoptera found on the basidiomes of fungi of the genus *Fomitopsis* only at the imago stage. They either develop in other fungi (obligate mycophages), or sometimes use fungi as an additional food resource (facultative mycophages).

Family Staphylinidae Latreille, 1802

Lordithon lunulatus is a Euro-Caucasian-Siberian species, apparently mainly mycetophagous (Nikitsky, 2016). It is related to many ground plants (from the genera *Agaricus* L., *Amanita*, *Boletus* L., *Clitocybe* (Fr.) Staude, *Collybia* (Fr.) Staude, *Coprinellus* (P. Karst.), *Lactarius* (Pers.), *Leccinum* Gray, *Macrolepiota* (Scop.: Fr.) Sing., *Paxillus* Fr., *Pheolepiota* Maire ex Konrad & Maubl., *Russula* Pers, *Suillus* Gray) and arboreal (*Armillaria* (Fr.) Staude, *Cerioporus* P. Micheli ex Adans, *F. fomentarius*, *F. betulina*, *F. pinicola*, *G. applanatum*, *Hypholoma fasciculare* (Huds.) P. Kumm., *Inonotus* P. Karst., *Kuechneromyces mutabilis* (Schaeff.) Sing. & A.H. Sm., *L. sulphureus*, *Meripilus giganteus* P. Karst., *Neolentinus* Redhead & Ginns, *Oxyporus* (Bourdot & Galzin) Donk, *Pholiota* (Fr.) P. Kumm., *Pleurotus*, *Pluteus* Fr., *Postia* Fr.) fungi (Benick, 1952; Khalidov, 1984; Krasutsky, 2005, 2022; Nikitsky et al., 1996; Nikitsky and Schigel, 2004; Schigel, 2009).

The family Geotrupidae Latreille, 1802

Anoplotrupes stercorosus is a Euro-Caucasian-Kazakh-Siberian-Near Asian species (Nikitsky, 2016). It is well known as a coprophage forest species. Imagos can occur on old, rotten fungi, both ground-based (*Boletus*, *Lactarius*, *Marasmius* Fr., *Paxillus*, *Phallus impudicus* L., *Russula*, *Suillus*, *Tricholoma* (Fr.) Staude) and woody (*A. mellea*, *C. squamosus*, *F. betulina*, *F. pinicola*, *H. fasciculare*, *I. obliquus*, *L. sulphureus*) (Benick, 1952; Khalidov, 1984; Krasutsky, 2005; Nikitsky, 2016). Thus, the species can be characterized as a facultative mycophagus or even a myxophagus, since coprophagy involves feeding not only on the droppings of herbivorous animals, but also on the coprophilic fungi themselves.

Family Scirtidae Fleming, 1821

Cyphon pubescens is a Holarctic hygrophilous species (Nikitsky, 2016). On fungi *F. betulina* is sometimes found during the sporulation period. In other regions, it has also been observed on dead, moldy basidiomes of fungi of the genus *Daedaleopsis* and spore-bearing *F. fomentarius* (Krasutsky, 2005, 2007a, b). Probably saprophage and facultative mycophage.

Family Nitidulidae Latreille, 1802

Cyllodes ater is a Trans-Eurasian mycetophagous forest species (Nikitsky, 2019). Its main food objects are fungi of the genus *Pleurotus* (Kompantsev, 1984; Krasutsky, 1996, 2005, 2022; Nikitsky et al., 1996; Nikitsky and Schigel, 2004; Zaitsev and Kompantsev, 1987), but imagos can often undergo additional nutrition on a wide variety of fungi, especially spore-bearing ones: *A. mellea*, *Daedaleopsis* sp., *D. mollis*, *F. fomentarius*, *F. betulina*, *F. pinicola*, *G. applanatum*, *L. sulphureus*, *N. lepideus*, *Ph. igniarius*, *Pholiota aurivella* (Batsch) P. Kumm., *Pluteus cervinus* (Schaeff.) P. Kumm., *Trametes* sp., *Tremella mesenterica* Retz., *T. biforme* (Krasutsky, 2005, 2007a, b, 2022a, b; Nikitsky et al., 1996, 2019; Nikitsky and Schigel, 2004).

Family Latridiidae Erichson, 1842

Corticarina similata is a Transpalearctic eurytopic mycetophagous species (Nikitsky, 2019). It inhabits various substrates of plant origin, colonized by fungi. It can sometimes occur on sporocarriers *F. betulina*, as well as on *C. squamosus*, *Daedaleopsis* sp., *F. fomentarius*, *T. biforme* (Benick, 1952; Krasutsky, 1996, 2005; Nikitsky, 2019).

Stephostethus pandellei is a Euro-Caucasian-Siberian-Far Eastern mycetophagous forest species (Nikitsky, 2019). It usually visits spore-bearing fungi *C. unicolor*, *Daedaleopsis* sp., *F. fomentarius*, *F. betulina*, *Ganoderma* sp., *Pleurotus* sp., *Trametes* sp. (Krasutsky, 1996, 2005; Nikitsky, 2019; Nikitsky and Tatarinova, 2002). According to literature data, it is related in its development to *Cladosporium macrocarpum* Preuss., as well as to fungi from the genera *Penicillium* Link and *Trichoderma* Pers., growing on different tree species (Nikitsky, 2019; Nikitsky et al., 1996; Nikitsky and Tatarinova, 2002).

Family Ciidae Leach, 1819

Cis boleti is a Transpalearctic mycetophagous forest species (Nikitsky, 2019). He especially prefers fungi of the genus *Trametes*. It is quite actively populated by *B. adusta*, *C. unicolor*, *L. betulinus*, and sometimes fungi of the genus *Daedaleopsis* (Kompantsev, 1984; Krasutsky, 2005, 2021a, 2023a, b; Nikitsky, 2019; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Vlasov and Nikitsky, 2015). It is also found on *A. serialis*, *C. squamosus*, *Favolus pseudobetulinus* (Murashk. ex Pilat) Sotome & T. Hatt., *F. fomentarius*, *F. betulina*, *F. pinicola*, *G. applanatum*, *Ph. conchatus*, *Ph. igniarius*, *S. commune*, *X. radiata* (Krasutsky, 2005; Nikitsky, 2019; Schigel, 2009).

C. comptus is a Transpalearctic forest mycetophagous species with broad polyphagy (Nikitsky, 2019). It actively inhabits fungi of the genus *Trametes*, *L. betulinus*, less often *B. adusta*, *C. unicolor*, *C. trogii*, *Daedaleopsis* sp., *Gloeoporus dichrous*, *T. biforme*. *F. fomentarius*, *F. betulina*, *H. rutilans*, *Pl. calyptratus*, *S. hirsutum*, *T. fuscoviolaceum*, and *T. laricinum* are visited by imago (Krasutsky, 1996, 2005, 2021a, 2022a, b, 2023a, b). On the territory of the European part of Russia and Crimea, it also develops in fungi *C. borealis*, *P. cinnabarinus*, *G. applanatum*, *S. hirsutum*, *Chondrostereum purpureum* (Pers.) Pouzar, *Oxyporus obducens* (Pers.) Donk, *Schizopora flavipora* (Berk. et M.A. Curtis ex Cooke), *Phellinus ferruginosus* (Schrad.) Murr., *X. radiata* and visits many other woody fungi (Kompantsev, 1984; Nikitsky, 2019; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Shchigel, 2002; Vlasov and Nikitsky, 2015).

Family Mycetophagidae Leach, 1815

Mycetophagus decempunctatus is a Euro-Caucasian-Kazakh-Siberian-Near Asian mycetophagus forest species (Nikitsky, 2019). Despite the fact that in West Siberia this beetle successfully develops in the fruit bodies of *F. betulina*, we have not yet found its larvae in birch tinder in the Southern Urals. In the European part of Russia and Crimea, it prefers *C. squamosus*, *I. obliquus* and *L. sulphureus*, and additionally feeds on the fungi *F. fomentarius*, *G. applanatum*, *I. rheades*, *X. radiata* (Nikitsky, 1993, 2019; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Schigel, 2002).

M. quadripustulatus is a West-Central Palearctic mycetophagous forest species (Nikitsky, 2019). It can probably develop in *F. betulina* together with *M. piceus*, since imagos have sometimes been found in cages with birch tinder fruit bodies, but this fact requires new confirmation. In the South Urals, it especially prefers fungi of the genera *Pleurotus*, *Daedaleopsis*, and *Lentinus* Fr. It also develops in the fruit bodies of *N. lepideus*, *I. rheades*, and *B. adusta* (Krasutsky, 2005). In other regions, it develops in the fungi *C. squamosus*, *Coprinellus micaceus* (Bull.: Fr.) Vilgalys, Hopple. & Jacq. Johnson, *I. obliquus*, *L. sulphureus*, *Ph. schweinitzii* (Khalidov, 1984; Nikitsky, 1993, 2019; Nikitsky et al., 1996; Tsinkevich, 2004). Imagos are visiting many fungi, for example, *Agaricus bitorquis* (Quel.) Sacc., *Bjerkandera fumosa* (Pers.) P. Karst., *Cortinarius purpurascens* Fr., *D. confragosa*, *Flammulina velutipes* (Curtis) Sing., *F. fomentarius*, *H. fasciculare*, *H. ulmarius*, *Lepista personata* (Fr.) Cooke, *N. cyathiformis*, *Pholiota adiposa* (Batsch.) P. Kumm., *Ph. tremellosa*, *Psathyrella piluliformis* (Bull.) P.D. Orton, *T. biforme*, *V. bombycina* (Krasutsky, 2005; Nikitsky, 1993, 2019; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Temreshev, 2019; Tsinkevich, 2004).

Coleoptera that develop under bark and in wood in the mycelial layer of fungi of the genus *Fomitopsis*

This group unites 13 species from 10 families. This includes xylophilic Coleoptera, which in their diet are associated with many arboreal fungi, including fungi of the genus *Fomitopsis* (obligate mycetophages). Some may use wood destroyed by fungi (sapro-xylophages), insects that live (died). under the bark and in the wood (predators and necrophages). Individual Coleoptera are myxophagous and combine various types of nutrition, one of which is mycetophagy.

Family Carabidae Latreille, 1802

Tachyta nana is a Holarctic forest species (Nikitsky, 2016). It sometimes inhabits the mycelial layer of *F. betulina* and some other fungi on deciduous trees – *D. confragosa*, *F. fomentarius*, *P. cinnabarinus*, *T. biforme*, and in West Siberia also *F. rosea*. Imagos are found in the fruit bodies of fungi of the genus *Pleurotus* (Krasutsky, 2005, 2022a). According to N.B. Nikitsky (2016), it develops under the bark of deciduous and coniferous trees, inhabited by other xylobionts, and probably feeds on small invertebrates, various organic remains, and possibly subcortical fungi.

Family Staphylinidae Latreille, 1802

Megarthrus hemipterus is a Euro-Siberian-Far Eastern mycetophilic forest species (Nikitsky, 2016). Sometimes it inhabits the mycelial layer of *F. pinicola*. In the Southern Urals, *Pl. pulmonarius* can develop in decomposing fungi (Krasutsky, 1996, 2005, 2022), and in the European part of Russia and Central

Europe, in *Pl. ostreatus* (Benick, 1952; Nikitsky, 2016; Nikitsky et al., 1996). Imagos can occur on some other xylophilic fungi: *C. squamosus*, *F. hepatica*, *I. obliquus*, *K. mutabilis*, *L. sulphureus* (Benick, 1952; Krasutsky, 2005; Nikitsky, 2016; Nikitsky et al., 1996; Nikitsky and Schigel, 2004). Probably, saprophage and mycetosaprophage.

Family Trogossitidae Latreille, 1802

Peltis grossa is a Euro-Caucasian-Kazakh-Siberian-Near Asian mycetophilic forest species (Nikitsky, 2019). It develops in brown rot of wood, usually in the mycelial layer of *F. betulina* and *F. pinicola*, sometimes in white rot of birch and aspen caused by *F. fomentarius* (Krasutsky, 2005). Imagoes often undergo additional feeding on the fruiting bodies of *F. betulina*, *F. pinicola*, and gnaw out the hymenophore of fungi. According to N.B. Nikitsky (2016), larvae are more likely to be sapro-xylo-mycetophages, and imago – mycetophages.

Ostoma ferruginea is a Holarctic forest species (Nikitsky, 2019). In the South Urals, it develops in the brown rot of spruce, less often pine, in the mycelial layer of *F. pinicola*, *F. rosea*, and *F. cajanderi*, as well as fungi of the genus *Gloeophyllum* P. Karst., *P. fulgens* and *T. laricinum* (Krasutsky, 1996a, b, 1997a, b, 2005; Nikitsky, 2019; Nikitsky et al., 1996). Imago may have additional nutrition on fungi of the genus *Lentinus*, *Pl. calyptratus*, *Postia guttulata* (Peck ex Sacc.) Julich (Krasutsky, 2005). In other regions of Russia, it has been recorded on *B. adusta*, *Postia tephroleuca* (Fr.) Julich (Nikitsky, 2019; Nikitsky and Schigel, 2004; Shchigel, 2002), and in Northern Europe – on *A. lapponica*, *A. albobrunnea*, *A. sinuosa*, *A. serialis*, *Inonotus leporinus* (Fr.) Gilb. & Ryv., *Rhodonia placenta* (Schigel, 2009). According to N.B. Nikitsky (2016), larvae are more likely to be sapro-xylo-mycetophages, while imagos are more likely to be mycetophages or sapro-mycophages.

Family Cerylonidae Billberg, 1820

Cerylon ferrugineum is a Euro-Caucasian-Kazakh-Siberian-Far Eastern forest species (Nikitsky, 2019). Sometimes it inhabits the mycelial layer of *F. pinicola* on birch, at the adult stage it additionally feeds on many fungi that cause white rot in deciduous trees: *C. unicolor*, *C. trogii*, *D. confragosa*, *F. fomentarius*, *G. applanatum*, *H. ulmarius*, *Pleurotus* sp., *Trametes* sp. (Krasutsky, 1996, 2005, 2021a, b, 2022a; Nikitsky, 2019; Nikitsky and Schigel, 2004; Nikitsky et al., 1996; Tsinkevich, 2004). The larvae often live in places where plasmodium of the myxomycetes *Physarum polycephalum* Schwein, *Trichia varia* (Pers.) Pers. and ascomycete fungi, as well as anamorphic fungi associated with ascomycetes (Nikitsky, 2019; Nikitsky et al., 1996).

C. histeroides is a Euro-Caucasian-Siberian-Far Eastern forest species (Nikitsky, 2019). It sometimes inhabits the mycelial layer of *F. betulina, F. pinicola*, but is more common in the white rot of deciduous trees, which occurs under the influence of such xylotrophic fungi as *B. adusta*, *C. unicolor*, *F. fomentarius*, *G. applanatum*, *L. sulphureus*, *L. betulinus*, *T. biforme*, *V. bombycina*, fungi of the genera *Daedaleopsis*, *Pleurotus*, *Trametes* (Krasutsky, 1996, 2005, 2022a, b; Nikitsky, 2019; Nikitsky and Schigel, 2004: Nikitsky et al., 1996). In its development, it is related to the myxomycetes *Fuligo septica* (L.) F.H. Wigg., *Ph polycephalum*, *T. varia*, as well as with some ascomycetes and deuteromycetes (Nikitsky and Schigel, 2004; Nikitsky et al., 1996, 2019).

Family Cucujidae Latreille, 1802

Cucujus haematodes is a Euro-Caucasian-Siberian-Far Eastern forest species (Nikitsky, 2019). It sometimes develops in the mycelial layer of *F. betulina* and *T. ochracea*. At the imago stage, it was observed on fungi *C. squamosus*, *F. fomentarius*, *L. sulphureus*, *Ph. igniarius* (Krasutsky, 1996a, b, 2005, 2021a, b; Nikitsky et al., 1996, 2019; Tsinkevich, 2004). According to Nikitsky (2019), the larvae feed on rotten phloem, covered with a layer of ascomycetes (for example, *Ceratocystis* sp.) and associated anamorphic fungi (*Aspergillus* sp., *Trichoderma* sp.); along the way, they can eat the remains of larvae of various subcortical insects.

Family Nitidulidae Latreille, 1802

Glischrochilus hortensis is a Trans-Eurasian forest species (Nikitsky, 2019). It can develop in the mycelial layer of *F. betulina*, *F. pinicola*, and sometimes *T. ochracea* under the very moist bark of exclusively deciduous trees, mainly birch, which is also inhabited by fungi of the genus *Pleurotus*. Imagos can use fermented clusters of spores of these and some other fungi, especially *F. fomentarius*, for food. It has also been recorded on the fungi *Amanita muscaria* (L.) Hook, *A. mellea*, *C. squamosus*, *L. sulphureus*, *Ph. impudicus*, *Russula delica* Grey (Benick, 1952; Khalidov, 1984; Tsinkevich, 2004). In general, the species is probably characterized by mycetophagy, saprophagy, and facultative predation (Krasutsky, 2005, 2021a, b; Nikitsky, 2019; Nikitsky et al., 1996).

Gl. quadripunctatus is a Trans-Eurasian forest species (Nikitsky, 2019). It can develop in the mycelial layer of *F. betulina* and *F. pinicola* under the peeling, damp bark of deciduous trees, mainly birch, also populated by *Pl. calyptratus*. Adult beetles visit the spore-bearing basidiomes of the named fungi and the spore-bearing *F. fomentarius* on fallen trunks. In Central Europe, it was also found on fungi *C. squamosus*, *F. hepatica* and *L. sulphureus* (Benick, 1952). It probably combines various dietary regimes with a predominance of facultative mycophagy, facultative predation, and possibly necrophagy (Krasutsky, 2005; Nikitsky, 2019; Nikitsky et al., 1996).

Family Monotomidae Laport de Castelnau, 1840

Rhizophagus bipustulatus is a West-Central Palearctic forest species (Nikitsky, 2019). It occurs under the bark of deciduous trees, where it can feed on the mycelium of many basidial fungi, including *F. betulina* and *F. pinicola*, but mainly, according to N.B. Nikitsky (2019), it uses some ascomycetes (from the genera *Ceratocystis*, *Ophiostoma* Syd & P. Syd) and deuteromycetes for food. At the imago stage, visits many xylophilic fungi: *A. mellea*, *B. adusta*, *C. squamosus*, *Daedaleopsis* sp., *F. fomentarius*, *F. hepatica*, *G. applanatum*, *K. mutabilis*, *Ph. igniarius*, *Pl. pulmonarius*, *Trametes* sp. (Benick, 1952; Krasutsky, 1996, 2005, 2021a, b, 2022a, 2023; Nikitsky et al., 1996; Tsinkevich, 2004). It is probably a mycetophagous and facultative predator with elements of necrophagy (Alexander, 2002; Nikitsky, 2019).

Family Colydiidae Erichson, 1845

Bitoma crenata is a Holarctic forest species (Nikitsky, 2019). In the South Urals, *F. betulina*, *F. pinicola*, as well as *F. fomentarius*, *L. betulinus*, *P. lecomtei*, *P. cinnabarinus*, *S. commune*, *T. biforme*, fungi of the genera *Pleurotus* and *Trametes* often develop in the mycelial layer, and during sporulation they visit the basidiomes of some xylotrophic basidiomycetes – *C. unicolor*, *C. trogii*, *Daedaleopsis* sp. (Krasutsky, 2005, 2020, 2021a, b, 2022a). According to some authors, the main diet of the species consists of ascomycetes of the genus *Hypoxylon*, deuteromycetes of the genera *Penicillium* and *Trichoderma* (Nikitsky, 2019; Nikitsky et al., 1996). By type of nutrition, it is an optional sapromycophagus.

Family Melandryidae Leach, 1815

Melandrya dubia is a Euro-Siberian-Far Eastern xylobiont forest species (Nikitsky, 2019). It develops in the white rot of deciduous trees (mainly birch and aspen) in the mycelial layers of fungi *F. betulina*, *F. pinicola*, as well as *Daedaleopsis* sp., *F. fomentarius*, *L. betulinus*, *Pleurotus*sp., *S. hirsutum*, *T. biforme*. At the imago stage, it visits the fruit bodies of these and some other fungi, for example, *C. unicolor*, *I. obliquus*, *Ph. igniarius* (Nikitsky, 2019; Nikitsky and Schigel, 2004; Nikitsky et al., 1996). It probably combines saproxylophagy with mycetophagy, i.e. it is a myxophagus.

Family Tenebrionidae Latreille, 1802

Upis ceramboides is a Holarctic forest xylobiont species (Nikitsky, 2019). The larvae develop in birch wood, which is destroyed by the type of white rot under the influence of fungi *F. betulina*, *F. pinicola*, as well as *Daedaleopsis* sp., *F. fomentarius*, *P. lecomtei*, *Pleurotus* sp., *T. biforme*. Imagos are found on these and some other fungi, such as *F. velutipes* and *H. fasciculare* (Krasutsky, 2005). The larvae are saproxilophages and mycetophages (mixophages), the imagos are mainly mycetophages (Kompantsev, 1984; Kompantseva, 1987; Krasutsky, 2005; Nikitsky, 2019).

Conclusion

The community of Coleoptera, related to fungi of the genus *Fomitopsis* in the Southern Urals, includes 48 species from 17 families and is characterized by a variety of ecological and trophic groupings of insects. Taking into account the main directions of the food specialization of Coleoptera, its structure can be represented as follows.

Specialized mycetophages are 25 species of beetles from 8 families. These species are present in (on) fungi at all stages of the life cycle.

In (on) *Fomitopsis betulina* fungi, 18 (out of 38) species from 7 families develop, in (on) *F. pinicola* fungi, 20 (out of 34) species from 8 families develop. The index of similarity in the composition of their inhabitants (according to Chekanovsky–Sorensen) is 0.68. Significant differences are associated with the presence in the *F. pinicola* entomocomplex of such species as *Gyrophaena boleti*, *Scaphisoma inopinatum*, *Sepedophilus bipustulatus* (Staphylinidae), *Dorcatoma dresdensis*, *D. lomnickii* (Anobiidae) and *Mycetophagus multipunctatus* (Mycetophagidae). The complex of common, leading destroyers of these fungi includes *Thymalus oblongus* (Trogossitidae), *Dacne bipustulata* (Erotylidae), *Cis jacquemarti*, *Dolichocis laricinus*, *Ennearthron cornutum*, *Rhopalodontus strandi* (Ciidae), *Litargus connexus*, *Mycetophagus piceus* (Mycetophagidae) and *Diaperis boleti* (Tenebrionidae).

In *F. cajanderi* fungi, 5 (out of 6) species from 4 families develop, and in *F. rosea* fungi, 4 (out of 5) species from 2 families develop. The complex of the main destroyers of their fruit bodies includes *C. jacquemarti*, *D. laricinus* and *E. cornutum*, and the Chekanovsky–Sorensen similarity index between them is high and amounts to 0.89.

The composition of the inhabitants depends on the condition of the basidiomes (spore-bearing, living or dead, dry or moistened, slimy, decomposing, covered with mold or not), their position on the substrate. Therefore, during the death of fruit bodies, in combination with the influence of abiotic factors (temperature and humidity) on them, the appearance of mold fungi on them, and falling into the litter, significant changes in entomocomplexes are observed, which can be characterized as microsuccessions. Such microsuccessions are especially pronounced in the fungi *F. betulina* and *F. pinicola*. During the sporulation period, the basidiomes of these fungi are attractive to many mycetophages that are not specialized only in relation to them: *Scaphisoma agaricinum*, *S. inopinatum*, *S. subalpinum*, *Sepedophilus bipustulatus*, *Cyllodes ater*, *Epuraea variegata* (Nitidulidae), *Stephostethus pandellei* (Latridiidae), *Litargus connexus*, as well as some xylophilic species: *Cerylon histeroides* (Cerylonidae), *Bitoma crenata* (Colydiidae), *Glischrochilus hortensis*, *Gl. quadripunctatus* (Nitidulidae). In dying and dead fruit bodies, secretive mycetophages develop as rather highly specialized (*D. lomnickii*, *Dacne notata*), and with a wider range of food bonds (*Thymalus oblongus*, *D. bipustulata*, *C. jacquemartii*, *D. laricinus*, *E. cornutum*, *Rh. strandi*, *D. boleti*), which can completely destroy fungi. In dead, waterlogged, and moldy basidiomas that have lost their structural properties, eurybiont species are found, including those characteristic of various decomposing substrates: *Atheta gagatina*, *Megarthrus hemipterus* (Staphylinidae), *Anoplotrupes stercorosus* (Geotrupidae), *Epuraea variegata*, *Stephostethus pandellei* and some others.

Only at the imago stage 23 species from 15 families were found in (on) fungi, but among them stands out a complex of xylomycetophilic Coleoptera inhabiting the mycelial layer of fungi of the genus *Fomitopsis* and, in some cases, their accompanying other fungi. It includes 13 species from 10 families: *Tachyta nana* (Carabidae), *Megarthrus hemipterus* (Staphylinidae), *Ostoma ferruginea*, *Piltis grossa* (Trogossitidae), *Cerylon ferrugineum*, *C. histeroides* (Cerylonidae), *Cucujus haematodes* (Cucujidae), *Glischrochilus hortensis*, *Gl. quadripunctatus* (Nitidulidae), *Rhizophagus bipustulatus* (Monotomidae), *Bitoma crenata* (Colydiidae), *Melandrya dubia* (Melandryidae), *Upis ceramboides* (Tenebrionidae). The main dietary regimes in this group are obligate mycophagy and myxomycetophagy, mixophagy (mycophagy and predation, sapro-xylo-mycetophagy, sapro-xylo-mycetophagy and necrophagy), predation, detritophagy and facultative sapro-mycophagy.

The remaining 10 species from 7 families are *Lordithon lunulatus* (Staphylinidae), *Anoplotrupes stercorosus* (Geotrupidae), *Cyphon pubescens* (Scirtidae), *Cyllodes ater* (Nitidulidae), *Corticarina similata*, *Stephostethus pandellei* (Latridiidae), *Cis boleti*, *C. comptus* (Ciidae), *Mycetophagus decempunctatus*, *M. quadripustulatus* (Mycetophagidae) – are either obligate mycetophages of other fungal species, or facultative mycetophages, sometimes using fungi of the genus *Fomitopsis* as an additional food resource.

It should be noted that we have not found beetles associated exclusively with fungi of the genus *Fomitopsis* in the Southern Urals.

In comparison with the subtaiga of Western Siberia (and according to its natural conditions, the territory of the forest zone and partly the forest-steppe of the Southern Urals is quite comparable with it), the complex of inhabitants of fungi of the genus Fomitopsis in the Southern Urals differs insignificantly. Thus, 43 species of beetles from 22 families have been identified for these fungi in the Pripyshminsky Bory National Park (Talitsky district, Sverdlovsk Region). The difference in the number of families, although seemingly significant, is offset by the fact that finds of representatives of these families are rare. Here in (on) the fruit bodies of *F. betulina*, in particular, imago *Anisotoma humeralis* (Fabricius, 1792) (Leiodidae), *Euplectus signatus* (Reichenbach, 1816) (Pselaphidae), *Arthrolips obscurus* (Sahlberg, 1833) (Corylophidae), *Prosternon tesselatum* (Linnaeus, 1758) (Elateridae), *Dienerella filum* (Aube, 1850) (Latridiidae), and *F. pinicola* contains the imago *Platycis minutus* (Fabricius, 1787) (Lycidae) and *Atomaria linearis* Stephens, 1830 (Cryptophagidae) (Krasutsky, 2022b). More significantly, specialized mycetophage *Dorcatoma punctulata* Mulsant et Rey, 1864 (Anobiidae) has not yet been detected in the Southern Urals in *F. pinicola*, and the *Mycetophagus decempunctatus* in *F. betulina* fungi was found only at the imago stage, while in the Trans-Urals it develops in these fungi. Another feature is that in the Southern Urals, the young fruit bodies of *F. pinicola* and *F. cajanderi* are populated by the staphylin *Gyrophaena boleti*, the dying and dead basidiomes of *F. betulina* are inhabited by the *Mycetophagus multipunctatus*, and in the mycelial layer of both species *Cerylon ferrugineum*, *C. histeroides* and *Glischrochilus hortensis* and *Gl. quadripunctatus*. In the Pripyshminsky forests, all the listed beetle species are associated with other xylophilic fungi.

In comparison with the Moscow region, which has been studied as fully as possible in relation to Coleoptera, where more than 130 species of beetles have been found in the entomocomplex of fungi of the genus *Fomitopsis* (Nikitsky, 2016, 2019), it should be recognized that we still have not sufficiently studied the species composition of the fungal Staphylinidae (Staphylinidae), including almost half of all species found in these (and many other) mushrooms. And since this family generally contains the maximum number of mycetophilic Coleoptera, special attention should be paid to staphylinids in future studies.

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