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Coleoptera Fauna Beetles of Nest Birds of the Northern Caucasus

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ABSTRACT

In this article, we present a faunistic list of species of the order Coleoptera from 13 families: 40 species collected from the nests of 24 bird species in the North Caucasus. To our previously published data, the list of coleopteran species has increased by 2 species. We were able to identify about 20 optional species that got into the bird's nest by accident. These species are not covered and discussed in this article. The rest of the species have complex biocenotic relationships with the host's nest. The transition of species to habitat under conditions of microbiocenosis, which is the nest, is an important evolutionary step. Which deserves a thorough study. In terms of its geographical position, the North Caucasus is a refugium for birds; many species are sedentary throughout the year. This has resulted in a high level of biodiversity of nidicolous Coleoptera compared to the northern geographic regions. The material presented in the article served to create a database on the species of Coleoptera living in nests of birds, this will allow in the future to analyze the seasonal dynamics of the number, as well as the association with one or another host. This work is relevant in the light of the latest data on climate change as well as anthropogenic pressure on natural ecosystems. The species composition of birds is decreasing, while the number of synanthropic species is increasing. Accordingly, we can predict the number of nidicolous species, some of them are of great sanitary and epidemiological significance.

Keywords: Nidicolous, Bird nest, Beetles, Coleoptera.

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INTRODUCTION

Among the non-parasitic insects, beetles were the first arthropods that attracted attention in the study of nidicolous animal fauna [1-10]. The mention of beetles as nest dwellers is known as early as the last century [1, 2, 4-8, 11-13]. The first attempts to systematically study beetles from bird nests, as well as to identify the biological relationship between the owner and the inhabitants of his nest, are given in the works of the authors [1-7, 14-19]. We have published the following articles on the study of this issue [20-25].

At present, more than 200 species of beetles are known for which infestation with helminth larvae has been established [3-7, 14-16, 26], which increases interest not only in clarifying the species composition of beetles but also in studying their biology as components of the nest microbiocenosis. For Dermestidae species, the possibility of transferring pathogens has been established [8, 24, 25]. Gamasids are phoresiaphoresizedtic on adults of necrobiont species; according to our research, the following species of gamasid mites have been identified - *Poecilochirus necrophori, Parasitus ssp.*. These species are capable of tolerating rickettsioses [24, 25].

An interesting direction in the study of the role of the avi vector in the dispersal of alien species of beetles Dermestidae and others associated with bird nests may be the comparison of the primary habitats of beetles recorded as phoronts with migrations of birds.

MATERIALS AND METHODS

The collection of material was carried out in the regions of the North Caucasus: Stavropol Territory: (Novoaleksandrovsk, Krasnogvardeisky, Izobilnensky, Shpakovsky, Kochubeevsky, Andropovsky, Grachevsky, Mineralovodsky, Predgorny, Levokumsky, Ipatovsky districts), Krasnodar Territory, with. Novopavlovka village), Rostov region: (Rostov-on-Don, Rasypnoe village, Zhukovskoe village), North-Ossetia: (Mozdok town), Kalmykia: (Khurulyun estuary, Tsaryk lake, Solenoe village, Lake Manych). Stationary studies were carried out on the territory of the Stavropol Upland from 2000 to July 2020. The paper presents material on the order of beetles, which in the study area constitute the backbone of the nidicolous fauna of 13 families. The rest of the coleopteran species found in the nests are not presented in this work but are considered as a nidicolophilicnidicolophilic factor in the biology of these species.

We have analyzed ornithological articles in order to understand which species of birds are most visited by Coleoptera [27-37].

RESULTS AND DISCUSSION

In the beginning, it should be noted that environmental pollution leads to a decrease in the number of nesting birds, and therefore negatively affects the fauna of nidicolles among beetles [11, 12, 19, 26-29, 38-40].

The collection of beetles was carried out from bird nests **(Table 1)**. A total of 390 nests were examined. 2711 beetles, 350 larvae, and 42 pupae were collected. The dynamics of the distribution of species by host nests are shown in **Table 1**. In some cases, the presence of insects in the nests is difficult to explain and, probably, is associated with random reasons. However, if the detected beetles are classified according to the type of nutrition, it turns out that 24 are polyphages, 20 are necrophages, 20 are keratophages, 16 are coprophages, 12 are detritophages, 8 %% are saproxylophages. The trophic specialization of preimaginals may differ; cannibalism is a characteristic of the species of the genera *Thanatophilus* and *Dermestes* [19, 25].

Table 1. The confinement of beetles to bird nests (North Caucasus)

list of beetle species	Host species in a systematic manner																							
	Anser fabalis	Anas platyrgynchos	Pernis apivorus	Circus macrourus	Accipiter gentilis	Falco subbuteo	Perdix perdix	Columba livia	Streptopelia decaocto	S. turtur	Otus scopus	Merops apister	Ptyonoprogne rupestris	Hirundo rustica	Galerida cristata	Lanius collurio	Pica pica	Corvus frugilegus	C. cornix	Sylviacommunis	Passer domesticus	P. montanus	Emberiza calandra	E. citrinela
SILPHIDAE																								
Nicrophorus				+		+					+					+								
vespillo L.				+																				
N. fossor Er.						+					+					+								
N. vespilloides					+				+										+					
Hbst.	+									+					+	+	+					+		+
Silpha obscura L.		+				+														+				
Silpha obscura	+									+				+			+					+		
(larva)			+			+					+								+					
S. carinata Hbst.				+		+	+	+	+	+														
S. carinata (larva)					+																			
Tanatophilus							+																	
sinuatus F.			+			+		+			+	+	+	+	+	+	+	+	+			+	+	+
T. sinuatus (larva)					+						+	+				+		+	+	+	+			
T. terminatus					+						+					+			+		+			
Humm.					+						+		+	+		+	+	+	+		+			

DERMESTIDAE				+		+		+	+		+		+		+	+						+		
Dermestes frischi																								
(larva)																								
D. bicolor (larva)																								
D. bicolor (pup.)																								
D. bicolor F.																								
D. coronatus Stev.																								
D. lardarius L.																								
D. murinus L.																								
Attagenus																								
schaefferi Hbst.																								
A.sylvaticus																								
Anthrenus																								
scrophulariae L.																								
Orphilus niger Er.																								
TROGIDAE																								
Trox scaber L.																								
T. hispidus niger																					+			
Rossi																								
T. eversmanni Kryn									+															
T. eversmanni																								
(larva)																								
SCARABAEIDAE						+																		
Aphodius putridus			+																					
Fourcroy						+				+														
Onthophagus													+	+				+						
vitulus F.								+										+					+	
O. leucostigma											+													
Stev.														+		+	+							
CATOPIDAE			+		+							+					+	+	+					
Catops picipes F.						+			+		+	+												
C. fuscus Panz.												+							+					
Catops sp. (larva)		+			+																			
C. coniciollis Rtt.	+		+	+							+					+								
C. nigrita Er.						+			+	+		+									+			
PTINIDAE									+	+						+			+					
Ptinus fur L.	+															+	+							
Niptus holoieucus	+					+												+						
Fald.																								
BYRRHIDAE	+					+																		
Byrrhus pilula L.												+					+							+
HYDROPHILIDAE			+																+					
Sphaeridium																	+							
scarabaeoides L.		+												+				+						
HISTERIDAE					+							+					+		+					
Hister helluo		+												+		+		+						
Truqui,								+																
Paralister		+												+				+						
carbonarius Ill.,				+							+													
Margarinotus																							+	
bipustulatus			+			+				+														
Schrnk.	+												+							+				+
CRYPTOPHAGID							+																	
AE									+															
Cryptophagus															+									
acutangulus Gyll.																					+	+		
NITIDULIDAE																								
Necrobia violacea																								
L.,																								
Nitidula bipunctata																								
L.,																								
TENEBRIONIDAE																								
Tribolium confusum																								
Duv.,																								
Tenebrio molitor L.																								

The phenology of the found species of beetles - 48% are species with a spring-summer cycle of reproduction, 44% - a summer cycle, 8% - have a multi-seasonal type of reproduction. Beetles start breeding earlier in the semi-desert and steppe zones of the study area.

The daily activity of most species falls under the description of morning-evening activity (8-10; 18-21 hours), *D. bicolor* is characterized by twilight activity (6-8; 19-22 hours) [9, 41].

Encounters of adults, larvae, and pupae in nests in all seasons of the year are proof of their good adaptation to the nidicolous way of life (feeding, reproduction) in the specific conditions of the microbiocenosis of the host nest.

Species of the genera *Anthrenus, Attagerus, Trox*- developed during their evolution in the nests special morphological and behavioral features, a special case is *D. bicolor*, which never leaves the nest.

We found 298 *D. bicolor* larvae of different ages in the *Otus scops* nest. Nidicolas often serve as food for their hosts. We have established the feeding of *S. obscura, S. carinata. Th. sinuatus. D. frischi* bird species: *Corvus frugilegus, Pica pica, Corvus corax, Garrulus glandarius*. The species confinement of beetles to different hosts and their nests is shown in **Table 1**.

Nidicolas play the role of bluebirds in the nest, but according to our observations, with a large number and density of settlement in the nest, they can attack 1-2-day-old chicks (especially weak and inactive ones). The adults and larvae plunge into the ear and eye openings and kill the chicks under the wings. Corpses of chicks, spoiled eggs attract obligate necrophages (*Nicrophorus)* to the nest. The species of the genus feed in the nest, but do not lay eggs (this can be observed in the nests of large birds of prey, which we have not been examined). Detritivores and saproxylophages develop on the host's food debris, coprophages - excrement, and bird pellets. Keratophages - feathers, down, feather caps.

In the imaginal phase, the species of the genera Attagenus and Anthrenus require additional nutrition on the flowers of angiosperms. Inspection of nests of various birds showed that the species composition and the number of beetles depend primarily on the design of the nest and the nature of the food contained in it. Dermestidae and Trogidae prefer closed nests since their larvae are better protected in them from adverse external conditions. Such nests do not overheat in the sun, daily temperature fluctuations are less pronounced in them, the humidity is constant, the conditions of winter diapause are better. Silphidae and Catopidae were dominant in open nests, near the shores of water bodies and rivers. Scarabaeidae - Found in all types of nests. The material from which the nest is built is of no less importance. Dermestidae never colonizes nests built from plant debris (except for nests of birds of prey). Family species: Ptinidae, Byrrhidae, Hydrophilidae represent the saproxyl block of the nest population. For them, the presence of plant protein is important, but species of the Tenebrionidae family can feed on animal protein.

The life of all nidicolles is associated with the life of the host, however, in *Dermestes* species this relationship is more pronounced than in keratophages (*Attagenus, Anthrenus, Trox*) and other groups; this is explained by the fact that *Dermestes* species feed mainly on foods brought to chicks, the intake of which ends after leaving nests.

Thus, the developmental cycle of Dermestidae is associated with the developmental cycle of the nest host. This is the reason for the monovoltness of Dermestidae - nidicolles, their larvae develop successfully during the feeding of the chicks, and the young beetles appearing in the middle of summer begin to reproduce only in the spring of next year. The dependence of keratophages and other trophic groups is not so great. Wool and feathers - the food of keratophages - persist for an extremely long time (especially in the steppe and semi-desert). Usually, keratophages appear in nests immediately after their construction and reproduce in them throughout the warm part of the year. Keratin feeding leads to the fact that larval development can last 2 years. Separately, it should be said about the species of the family Nitidulidae, which feed on food brought to the nest and show the nest in search of additional food.

At first glance, it seems strange that in such limited microbiotopes as nests, larvae of different nidicol species can develop simultaneously on the same food. It would be natural to expect that intense competition should arise between these groups, which would lead to the displacement of one of the groups of beetles. With a careful analysis of the nests, we managed to resolve this contradiction using the example of the families Dermestidae and Trogidae. It turned out that despite the relatively small size of the nests, the adults and larvae of *Dermestes, Anthrenus, Attagenus,* and *Trox* are territorially separated in them. The larvae of the latter genus live in the lower packed layers, where they move due to the fusiform shape of the body; in the same place, larvae and adults of *Anthrenus* are more often observed only on the surface of the substrate of the nest, in its upper loose layer. Dermestids live in the nest along the outer boundaries, that is, directly in the litter, on the outer walls of the nest. *Trox* is found around the entire perimeter of the nest. Species of other families may leave the nest for some time, but they will definitely return to it.

According to our observations, Catopidae develops in rotten and spoiled eggs; species (*Catops picipes, C. nigrita*) lay eggs inside the egg, the larvae feed on its contents and do not leave the shell until pupation.

The synanthropic species *D. lardarius*, develops within the cities and villages of the region, in the nests of synanthropic birds, and in the attics of houses with a sufficient sum of positive temperatures (not lower than +11 °C), egg-laying was observed even in December. Mrochkovsky, 1955, indicated the great harm caused by synanthropic kozheedy in pigeons and chicken coops in Poland [17]. It can often be found in the attics of houses, where it can develop year-round.

We expect that our material will be replenished with Latridiidae species discovered by the authors of the article [37, 41, 42].

CONCLUSION

The transition to habitat in nesting microbiotopes, in our opinion, meant the development of new econiches, the emergence of new interspecific relationships - the process was accompanied by intense speciation, which led to the emergence of new ecobiomorphs: nidicolles not found in other habitats, highly specialized to nest conditions and the nature of food. Nesting microbiocenoses as elementary systems of the supraorganism level are of great interest for understanding biocenological structures in their simplest form.

In the next article, we will reveal the mechanisms of dividing the ecological niche of nidicolous animals. And also we will consider the paths of evolution of the nidicolous fauna [33-36].

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