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Materials for the study of entomofauna of protected areas of Altai Krai: Ikonnikov Island

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Abstract. Altai Krai is characterized by a low degree of knowledge of entomofauna of the protected areas (specially protected natural areas). The article presents, for the first time, the results of a study of necrophilous beetles on the territory of the natural monument “The confluence of the Biya and Katun rivers (Ikonnikov Island)”. The collection of the material was carried out using soil baited pitfall traps. There were discovered 64 species from 7 families of Coleoptera. The most abundant in species was Staphylinidae (43.77% of the total number of species). Families Silphidae and Histeridae have significantly less number of species (20.31% and 12.5% respectively), as well as other families (Scarabaeidae, Leiodidae, Dermestidae, Hydrophilidae), which were represented by 3-5 species each. The most abundant in the number of specimens was Silphidae (*Nicrophorus vespillo*, *N. vespilloides*, *Oiceoptoma thoracicum*). Common and numerous were *Anoplotrupes stercorosus*, *Aphodius rectus* (Scarabaeidae), *Sciodrepoides watsoni* (Leiodidae), *Hister unicolor*, *Saprinus semistriatus* (Histeridae), *Creophylus maxilosus* (Staphylinidae). The estimation of the species richness, degree of dominance and evenness of species in the community of necrophilous Coleoptera showed medium values of Shannon index ($H=2.6$), Berger-Parker index ($D=0.26$) and Pielou's evenness index ($E=0.44$).

1. Introduction

According to most ecologists, we must protect not species themselves, whose fate is determined by evolutionary processes, but their natural habitats, communities, and geosystems of regional and local levels. This is why protected areas (Specially Protected Natural Areas — SPNA) are created. There are 107 different protected areas in Altai Krai; a systematic study of the entomofauna of such places is an important task in terms of organization of monitoring of the status of protected areas in general. Meanwhile, information about the fauna of not only insects of protected areas of Altai Krai, but also of invertebrates in general, is extremely scarce, and covers only a small number of taxa. From the current data, a summary of the Tigirekskiy Nature Reserve is worth to pay attention. Entomological studies have been systematically carried out here for about twenty years, including about 1760 species of insects [1].

Our report is devoted to necrophilous beetles, which are an integral element of the destructive block of ecosystems and contribute to their normal functioning, performing various functions, depending on trophic specialization — from participating in the mineralization of dead organics, to regulating the



population of other invertebrates associated with carrion. Information on the fauna of necrophilous beetles of the regional protected areas is scarce [2, 3, 4].

2. Materials and methods

The studies were conducted on the territory of the natural monument "The confluence of the Biya and Katun rivers (Ikonnikov Island)", which acquired this status in 2000. The island is located in the Smolensky District of Altai Krai between the villages of Smolenskoye and Tochilnoye, at the confluence of the Biya and Katun rivers. This natural monument was created for the preservation of the territory for scientific, water protection, recreational, educational and aesthetic purposes [5]. The area occupied by the natural monument is 1240 ha. The vegetation of the island is grass, mixed-grass and sedge shrubby meadows in combination with poplar and willow thickets. The central part of the island is currently occupied by crops. About 160 species of plants grow here. Some of them are from the Red List (adder's-tongue (*Ophioglossum vulgatum* Linnaeus, 1753)). The fauna of the territory is studied only in general terms.

In order to study the fauna of necrophilous beetles during 2015 and 2017 we investigated various sectors of the floodplain forest and ecotone zone along the periphery (shoreline) of the island. The collection of material was carried out using soil baited pitfall traps with meat or fish bait. Installed traps worked during 357 trap-days. 1293 specimens of necrophilous beetles from seven families were collected. Species of Carabidae and other families not belonging to the studied ecological group were not taken into account.

For the estimation of the relative abundance of species we used a 5-point scale, based on a logarithm [6]. The upper boundaries of a series of abundance class intervals (at step a) were calculated by the formula:

$$N^{a/k}, (a = 1, 2, \dots, k),$$

where N is the volume of the entire sample, a is the step of the scale, k is the number of classes.

The value of the a class interval (the length of the interval of the a step of the scale) was calculated by the formula:

$$b_a = N^{a/k} - N^{(a-1)/k}$$

As a result, the following abundance classes were distinguished (table 1).

Table 1. A five-point logarithmic scale of the estimation of the relative abundance of necrophilous Coleoptera of the protected area "Ikonnikov Island".

Point, a	Bound of the class interval		Characteristics of abundance
	lower	upper	
1	1	4	rare
2	5	17	small
3	18	73	common
4	74	307	numerous
5	308	1293	dominant

For the estimation of the species richness, degree of dominance, and evenness of species in the necrophilous Coleoptera community, we used indices recognized by the ecologists — the Shannon index (H), the Berger-Parker index (D), and the Pielou's evenness index (E) (Pesenko, 1982)

3. Results and discussion

Information on the species composition and abundance of separate species of necrophilous beetles is given in table 2:

Table 2. Species composition of necrophilous Coleoptera of the protected area “Ikonnikov Island”.

	Coleoptera	Point of abundance
	SILPHIDAE	
1.	<i>Necrodes littoralis</i> Linnaeus, 1758	3
2.	<i>Silpha carinata</i> Herbst, 1783	1
3.	<i>Silpha obscura</i> Linnaeus, 1758	1
4.	<i>Oiceoptoma thoracicum</i> Linnaeus, 1758	4
5.	<i>Thanatophilus rugosus</i> Linnaeus, 1758	2
6.	<i>Thanatophilus sinuatus</i> Fabricius, 1775	2
7.	<i>Nicrophorus investigator</i> Zetterstedt, 1824	3
8.	<i>Nicrophorus vespillo</i> Linnaeus, 1758	5
9.	<i>Nicrophorus vespilloides</i> Herbst, 1784	4
10.	<i>Nicrophorus sepultor</i> Charpentier, 1825	3
11.	<i>Nicrophorus fossor</i> Erichson, 1837	2
12.	<i>Nicrophorus vestigator</i> Hershel, 1807	1
13.	<i>Nicrophorus antennatus</i> Reitter, 1884	1
	SCARABAEIDAE	
14.	<i>Anoplotrupes stercorosus</i> Scriba, 1791	4
15.	<i>Onthophagus nuchicornis</i> Linnaeus, 1758	1
16.	<i>Onthophagus gibbulus</i> Pallas, 1781	1
17.	<i>Aphodius rectus</i> Motschulsky, 1866	3
18.	<i>Aphodius fimetarius</i> Linnaeus, 1758	1
	LEIODIDAE	
19.	<i>Sciodrepoides</i> sp.	1
20.	<i>Sciodrepoides watsoni</i> Spence, 1813	3
21.	<i>Catops morio</i> Fabricius, 1787	2
	DERMESTIDAE	
22.	<i>Dermestes lanarius</i> Illiger, 1801	1
23.	<i>Dermestes murinus</i> Linnaeus, 1758	1
24.	<i>Dermestes depressus</i> Gebler, 1830	1
	HISTERIDAE	
25.	<i>Hister unicolor</i> Linnaeus, 1758	3
26.	<i>Saprinus semistriatus</i> Scriba, 1790	3
27.	<i>Saprinus aeneus</i> Fabricius, 1775	1
28.	<i>Saprinus immundus</i> Gyllenhal, 1827	1
29.	<i>Saprinus planiusculus</i> Motschulsky, 1849	1
30.	<i>Saprinus subnitescens</i> Bickhardt, 1909	2
31.	<i>Margarinotus silantjevi</i> Schirjajev, 1903	1
32.	<i>Margarinotus striola</i> C.Sahlberg, 1819	1
	HYDROPHYLIDAE	
33.	<i>Cercyon</i> sp. (?pygmaeus Illiger, 1801)	1
34.	<i>Pachysternum haemorrhoum</i> Motschulsky, 1866	2
35.	<i>Sphaeridium lunatum</i> Fabricius, 1792	1
36.	<i>Sphaeridium bipustulatum</i> Fabricius, 1781	1
	STAPHYLINIDAE	
37.	<i>Anotylus rugosus</i> Fabricius, 1775	1
38.	<i>Stenus</i> sp.	1
39.	<i>Paederus riparius</i> Linnaeus, 1758	1

40.	<i>Leptacinus</i> sp.	1
41.	<i>Gyrophypnus fracticornis</i> O. Mueller, 1776	1
42.	<i>Philonthus addendus</i> Sharp, 1867	2
43.	<i>Philonthus decorus</i> Gravenhorst, 1802	1
44.	<i>Philonthus cruentatus</i> Gmelin, 1790	1
45.	<i>Philonthus ebeninus</i> Gravenhorst, 1802 (= <i>setosus</i> J. Sahlberg)	1
46.	<i>Philonthus marginatus</i> O. Muller, 1764 (= <i>marginatus</i> Strom)	1
47.	<i>Philonthus nitidus</i> Fabricius, 1787	1
48.	<i>Philonthus quisquiliarius</i> Gyllenhal, 1810	1
49.	<i>Philonthus parvicornis</i> Gravenhorst, 1802 (= <i>agilis</i> Gravenhorst)	1
50.	<i>Philonthus politus</i> Linnaeus, 1758	1
51.	<i>Philonthus rotundicollis</i> Menetries, 1832	1
52.	<i>Philonthus spinipes</i> Sharp, 1874	1
53.	<i>Philonthus splendens</i> Fabricius, 1793	2
54.	<i>Staphylinus erythropterus</i> Linnaeus, 1758.	2
55.	<i>Creophylus maxilosus</i> Linnaeus, 1758	3
56.	<i>Ontholestes murinus</i> Linnaeus, 1758	3
57.	<i>Ontholestes tessellatus</i> Fourc.	1
58.	<i>Lordithon lunulatus</i> Linnaeus, 1760	1
59.	<i>Tachinus rufipes</i> Linnaeus, 1758 (= <i>signatus</i> Gravenhorst)	1
60.	<i>Tachinus laticollis</i> Gravenhorst, 1802	1
61.	<i>Aleochara curtula</i> Goeze, 1777	1
62.	<i>Aleochara</i> sp.	1
63.	<i>Drusilla canaliculata</i> Fabricius, 1787	2
64.	<i>Aleocharinae</i> gen. spp.	3

The most numerous in the number of species were Staphylinidae (43.77% of the total number of species). Silphidae and Histeridae (20.31% and 12.5%, respectively), and other families have significantly smaller number of species. The species richness of the community of necrophilous beetles was evaluated using the Shannon index (H), which characterizes the diversity and evenness in the community, i.e. than more species in the community and the less they differ in numbers, than higher the index value. The Shannon index usually varies from 1.5 to 3.5, very rarely exceeding 4.5. For the territory we studied, the Shannon index was 2.6, which corresponds to the average value.

Estimation of the relative abundance of species gave the slightly changed picture (table 2). Most of the common and numerous species (3-4 points of abundance) belonged to Silphidae (*Nicrophorus vespilloides*, *Oiceoptoma thoracicum*), and the dominant species (*Nicrophorus vespillo*) belongs to the same family. *Anoplotrupes stercorosus*, *Aphodius rectus* (Scarabaeidae), *Sciodrepoides watsoni* (Leiodidae), *Hister unicolor* and *Saprinus semistriatus* (Histeridae) were common and numerous. Of the 27 species of staphylinids, only *Creophylus maxilosus* was usual, while the vast majority of the remaining species of the family were rare and small (from 1 to 6 individuals).

The Berger-Parker Index (D) shows the degree of dominance of only one, the most numerous species. This index takes values from 0 to 1 — than higher the index, than less diversity and higher the proportion of the dominant species. The value of the Berger-Parker index for our sample was 0.26, which indicates a relatively even abundance of the most of the species.

Based on the Shannon index, it is possible to calculate the Pielou's index (E), which characterizes the evenness of species in the community. The value of the Pielou's index varies from 0 to 1. When it

equals to 1 — the community is characterized by an equal abundance of all species. In our case, the Pielou's Index is 0.44, which can also be considered as an average value.

4. Conclusion

Estimating the whole fauna of necrophilous Coleoptera of the examined areas of the island, it can be noted that it is typical for the region, however, the species composition of families and the number of individual species are slightly differing from those in areas that are more subject to anthropogenic pressure. So, for example, *Necrodes littoralis* (abundance class 3) is common on the island. Forest floor predatory staphylinids (carion attracts them as a place of food concentration) are widely represented in the number of species — *Gyrophypnus fracticornis*, *Philonthus decorus*, *Ph. ebeninus*, *Staphylinus erythropterus*, *Lordithon lunulatus*, *Tachinus rufipes*, etc. We didn't notice those species (or they are rare) in the suburban area of Biysk.

At the same time, species of Coleoptera (abundance class 3) are common in the collection. But they are also numerous in anthropogenic landscapes — *Creophylus maxilosus*, *Ontholestes murinus* (*Staphylinidae*), *Hister unicolor*, *Saprinus semistriatus* (*Histeridae*), *Sciodrepoides watsoni* and some others. This can be explained by the fact that the confluence of Biya and Katun is attractive as a place of water recreation, as well as the growth of the construction of the summer cottages on the opposite bank of the Biysky Channel, which leads to accumulation of garbage including the food waste — substrate, similar in its properties to carrion and giving food and the possibility of reproduction for necrophilous species.

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