Microarthropods from birds' plumage: lifetime collecting method

Микроартроподы из оперения птиц: прижизненный метод сбора

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Key words: lifetime collecting method, microarthropods, birds' plumage.
Ключевые слова: прижизненный метод сбора, микроартроподы, оперение птиц.

Abstract. The original lifetime method of microarthropods collecting, including non- parasitic, from birds' plumage, on the basis of application of a household vacuum cleaner with the demountable filter is described in this publication. The researches were carried out on the East Murman. With the help of this method, the authors collected soil microarthropods, including 5 oribatid mite species (adult individuals of *Liebstadia similis* (Michael, 1888), *Parachipteria punctata* (Nicolet, 1855), *Microppia minus* (Paoli, 1908), larva of *Limnozetes* sp. and *Camisia* sp.), Bdellidae and other mites, and also collembolans from the plumage of 107 individuals of 14 species of birds. Till now, non-parasitic microarthropods were taken only from the plumage of the dead birds when body or skin were settled down on Berlese-Tullgren' funnels. This classic for soil-zoological researches method allowed finding various non-parasitic microfauna into the plumage of birds. However, the comparative analysis of efficiency of two methods showed low efficiency of a lifetime method in comparison with the one used earlier.

Резюме. Описывается оригинальный прижизненный метод сбора микроартропод, в том числе непаразитических, из оперения птиц на основе применения бытового пылесоса со съемным фильтром. Исследования были проведены на Восточном Мурмане. С помощью данного метода авторам удалось собрать из оперения 107 особей 14 видов птиц почвенных микроартропод, в том числе 5 видов орибатид (взрослых особей *Liebstadia similis* (Michael, 1888), *Parachipteria punctata* (Nicolet, 1855), *Microppia minus* (Paoli, 1908), личинок *Limnozetes* sp. и *Camisia* sp.), краснотелковых и других клещей, а также ногохвосток. Прежде непаразитических микроартропод извлекали только из оперения добытых птиц, располагая тушку или шкурку на эклекторах Берлезе-Туллгрена. Этот метод – стандартный для почвенно-зоологических исследований – позволил выявить разнообразную непаразитическую микрофауну оперения птиц. Однако сравнительный анализ эффективности двух методов показал низкую эффективность прижизненного метода по сравнению с применявшимся ранее.

Introduction

On the boundary of XX–XXI centuries, Krivolutsky and Lebedeva published the first data that birds' plumage is regularly inhabited by non-parasitic microarthropods, particularly by soil invertebrates [Krivolutsky, Lebedeva, 1999, 2002]. Later, several thousands of 170 bird species were surveyed; and many groups of non-parasitic microarthropods (more than 160 species of oribatid mites, predatory gamasid (Gamazida), prostigmatid (Prostigmata) and Trombidiiformes mites, collembolans (Collembola)

and other groups of free living edaphic inhabitants) are found in their plumage [Krivolutsky, Lebedeva, 2004a, b; Lebedeva, 2005].

In parasitology for the study of birds and mammals' ectoparasites superficial survey of plumage, potential places of localization of parasitic arthropods etc. is used [Dubinina, 1955]. This method is not suitable for studying non-parasitic microarthropods. The experience of the use of a vacuum cleaner for mite collecting out of domestic dust and for detection of allergenic mites in it [Dubinina, Pletnev, 1977] is well known. In this case the authors used replaceable filters which were inserted in addition to tissue dust collector inside of a vacuum cleaner.

To collect microarthropods in soil zoology rather effective method of extraction of microarthropods with Berlese-Tullgren funnels under electric lamps [Methods…, 1975] is usually used. The method supposes that the studied substratum (soil, litter) is placed on the sieve located on the funnel. As the substratum dries, microarthropods go deep into it, then microarthropods get on the slippery funnel walls by which fall downwards in fixative fluid (70% ethanol). We used the same method offered by D.A. Krivolutsky [Krivolutsky, Lebedeva, 1999] for extraction of small non-parasitic arthropods from the plumage of birds. We placed the whole bodies of small birds or skins (plumage downwards) on Berlese-Tullgren funnels under an electrical lamp for 2–3 days. This method, however, has significant disadvantage – extraction of microarthropods is carried out only from a dead bird. We have tried to develop other technique which would allow collecting invertebrates of soil microfauna from alive birds.

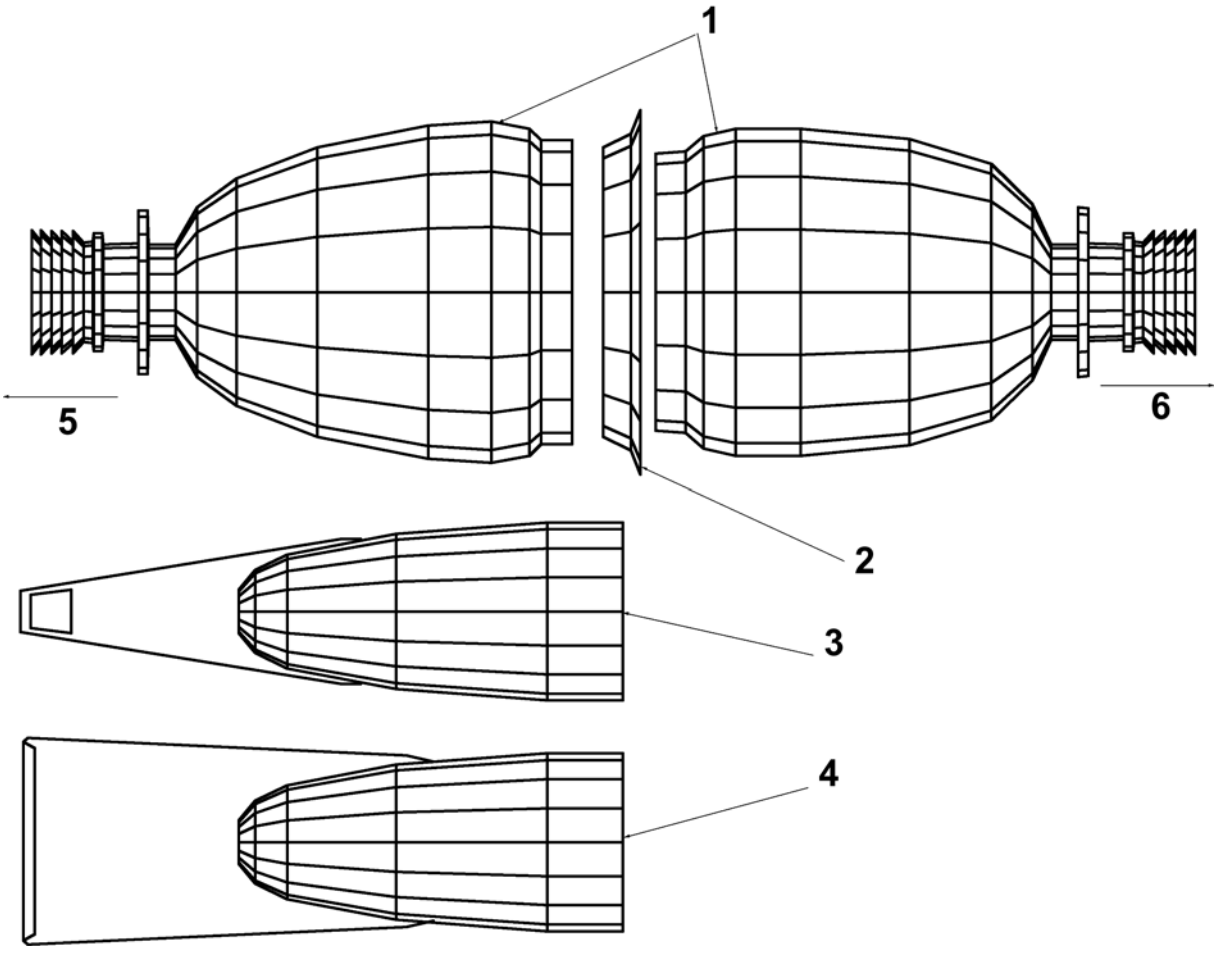

Fig. 1. Tools for microarthropods' collecting from alive birds with the help of a vacuum cleaner.
1 – the demountable transparent chamber – a clip for the filter (is manufactured of two different plastic bottles; in a working position the parts of the chamber densely nestle to each other with the help of an elastic band); 2 – the replaceable cotton-gauze filter; 3 – a mounting attachment for microarthropods' collecting from small passerine birds and waders; 4 – a mounting attachment for microarthropods' collecting from middle size and large waders, gulls and other large birds; 5 - bonding with a mounting attachment; 6 - to a soaking up branch pipe of a vacuum cleaner.

Рис.1. Приспособление для сбора микроартропод с живых птиц с помощью пылесоса.
1 – Разъемная прозрачная камера – зажим для фильтра (изготовлена из двух различных пластиковых бутылок; в рабочем положении части камеры плотно прижимаются друг к другу с помощью резинового жгута); 2 – сменный ватно-марлевый фильтр; 3 – насадка для сбора микроартропод с мелких воробьиных птиц и куликов; 4 – насадка для сбора микроартропод со средних и крупных куликов, чаек и других крупных птиц; 5 – соединение с насадкой; 6 – к всасывающему патрубку пылесоса.

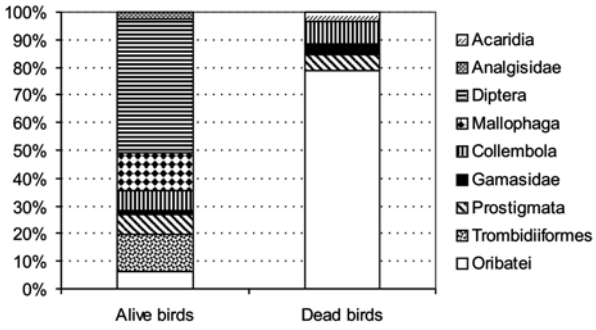

Fig.2. Proportion of invertebrate groups collected from alive and dead birds by different methods.

Рис.2. Соотношение групп членистоногих, собранных с живых и добытых птиц разными методами.

Materials and methods

Researches were carried out from July, 26 till July, 31, 2003 in the vicinity of a biological research station of Murmansk Marine Biological Institute (MMBI) (a settlement of Dalniye Zelentsy, the coast of the Barents Sea, Kola Peninsula, 69°N / 36°E).

The plumage of 107 individuals of 14 species of birds were surveyed: Ringed plover *Charadrius hiaticula* (n=3), Ruff *Philomachus pugnax* (n=1), Little stint *Calidris minuta* (n=4), Dunlin *Calidris alpina* (n=7), Common gull *Larus canus* (n=1), Meadow pipit *Anthus pratensis* (n=7), Red-throated pipit *Anthus cervinus* (n=6), Pied wagtail *Motacilla alba* (n=8), Bluethroat *Luscinia svecica* (n=3), Wheatear *Oenanthe oenanthe* (n=2), Redpoll *Acanthis flammea* (n=61), Arctic redpoll *Acanthis hornemanni* (n=1), Reed bunting *Emberiza schoeniclus* (n=3), Snow bunting *Plectrophenax nivalis* (n=1). All birds, except fledglings of the Red-throated pipit (were taken and then returned to the nest), as well as fortnight age nestling of the Common gull (it was found dead in water), were caught by web nets. Alive birds were examined, measured, ringed; microarthropods were collected from their plumage by a vacuum cleaner, and the birds were set free.

For the microarthropods' collection from alive birds household vacuum cleaner with power 250 Wt was used. It was supplied with a special tool, allowing to collect individual samples (fig. 1). The demountable transparent chamber with the filter was joined to a soaking up branch pipe of a vacuum cleaner with the help of a long flexible goffered hose. Filters were made from two layers of gauze and one flake of cotton wool between them. The design allowed to use the individual filter for each bird.

The birds for the research were captured by the web nets placed on ornithogenous meadow close to a littoral. Each caught bird was identified. The condition of plumage (molting), age and sex (if possible) were evaluated. After ringing, the microfauna from each individual bird was collected with the help of a vacuum cleaner. Holding a bird in the left hand, and a nozzle from a vacuum cleaner in the right, the explorer cautiously ran the end of nozzles over all feather tracts and to apteriums of a bird. It is important to note, that the procedure of microarthropods' collection has never brought to birds' death. No cases of traumatism and strong stress during the processing of more than 100 individuals of different species passerine birds and waders of the different sizes were registered. After processing and returning into biotope some individuals repeatedly got into web nets again. This fact confirmed good birds' tolerance to this procedure.

After careful processing of plumage by a vacuum cleaner the filter was removed and placed on Berlese-Tullgren' funnels. Separation of microarthropods was carried out during two days under an electrical lamp.

Collections of microarthropods were fixed and stored in 70% ethanol. Identification of microarthropods was carried out under D.A. Krivolutsky review.

Results and discussion

63 individuals of parasitic and non-parasitic microarthropods and 29 bloodsucking dipterous parasitic flies (Hippoboscidae) have been collected from the birds. By a used method, microarthropods were not found in the plumage of 49 individuals (46%) of different birds' species.

By a lifetime method we collected from 0 up to 8 individuals of parasitic and non-parasitic microarthropods per one bird, that averaged – 0.6 individuals (n=110) excluding flies. In our previous researches the number of oribatid mites in feathers of one bird from the East Murman counted usually 1–2 individuals and varied from 0 up to 21 [Lebedeva, Lebedev, 2008]. The maximum quantity of oribatid mites (94 individuals) was registered on one individual of the Swan goose *Cygnopsis cygnoides* from the Far East [Lebedeva, 2005].

The structure of the microarthropods collected from alive and dead birds by both methods was significantly different (χ^2 = 2339.4 df = 4 P <0.0001) (fig. 2).

Let's consider some important results of application of a lifetime method of the microarthropods' collecting: 1) in total it was collected considerably less microarthropods, including oribatid mites, from one bird; 2) the percentage of oribatid mites collected from the plumage in the structure of all microarthropods decreased approximately in 15 times, gamasid mites – in 3 times; 3) the percentage of collected collembolans and prostigmatic mites did not change; 4) percentage of Bdellidae and Acaridia mites in the sample significantly increased; 5) Analgesidae, Mallophaga and Diptera (bloodsucking dipterous parasitic flies, Hippoboscidae) appeared in the sample from the plumage.

We believed, that unlike ectoparasites, edaphic microarthropods which do not have specialized attachable structures to the host animal, will be caught more effectively on the filter with the help of a vacuum cleaner. However, the lifetime method allowed collecting more successfully only Bdellidae mites in comparison with other groups of soil microarthropods.

The list of oribatid mites' species, collected by lifetime method was rather modest (5 species): adult mites *Liebstadia similis* (Michael, 1888) (Dunlin, Redpoll), *Parachipteria punctata* (Nicolet, 1855) and *Microppia minus* (Paoli, 1908) (Meadow pipit), larvae of *Limnozetes* sp. (Redpoll), *Camisia* sp. (Reed bunting) and non-identified individuals of oribatid mites (Pied wagtail). For the first time these species of oribatid mites were found by us in the mentioned species of birds [Lebedeva, Krivolutsky, 2003].

It is interesting, that on birds of the East Murman a mite *Microppia minus,* a typical invertebrate of "euedaphoton",

Composition of invertebrates selected from plumage of alive birds.
Состав членистоногих, извлеченных из оперения живых птиц.

Bird species Виды птиц	Oribatei	Trombidiiformes	Prostigmata	Gamasidae	Collembola	Mallophaga	Diptera	Analgisidae	Total / Всего
Ringed plover/ Галстучник	–	2	–	–	1	–	6	–	9
Ruff/ Турухтан	–	–	1	–	–	2	–	–	3
Little stint/ Кулик-воробей	–	–	–	–	–	1	–	–	1
Dunlin/ Чернозобик	1	1	1	–	3	2	1	–	11
Common gull/ Сизая чайка	–	3	–	–	2	3	–	–	8
Meadow pipit/ Луговой конек	1	–	1	–	–	–	–	–	2
Red-throated pipit/ Краснозобый конек	–	1	–	–	–	–	1	–	2
Pied wagtail/ Белая трясогузка	3	3	1	–	3	–	8	–	18
Bluethroat/ Варакушка	–	1	–	–	–	–	8	–	9
Wheatear/ Обыкновенная каменка	–	1	3	–	–	–	7	–	11
Redpoll/ Обыкновенная чечетка	2	5	2	–	–	9	31	3	52
Reed bunting/ Тростниковая овсянка	1	–	–	1	–	–	–	–	2
Snow bunting/ Пуночка	–	–	–	1	–	–	–	–	1

was recorded by us again. This species dwells not only in a forest litter, but also in deep horizons of soil. It has never been recorded in soils of this geographical zone that confirms transport of soil microarthropods by birds far beyond their geographic areas [Lebedeva, Krivolutsky, 2003].

In summary, it is possible to make the following conclusions. The new method despite its low efficacy allows to keep birds alive and at the same time obtain the new data about soil microarthropods in the plumage of birds. Hence, this method could be applied in researches when the possibilities to eliminate birds are excluded.

Acknowledgements

Authors thank E. Apryshko for help in English correction.

References

Dubinina M.N. 1955. Parasitological study of birds. Moscow–Leningrad: USSR' Academy of Sciences Publ. 135 p. [In Russian].

Dubinina E.V., Pletnev B.D. 1977. Methods of detection and identification of allergenic mites of domestic dust. Leningrad: Nauka Publ. 52 p. [In Russian].

Krivolutsky D.A., Lebedeva N.V. 1999. Distribution of soil microarthropods by birds // Strepet. Rostov-on-Don: BIOS Publ. 4: 23–24 [In Russian].

Krivolutsky D.A., Lebedeva N.V. 2002. The oribatid mites in the bird feathers // Studies on Soil Fauna in Central Europe (Tajovsky K., Balik V., Pizl V., eds.). ISB AS CR, Ceske Budejovice. 101–104.

Krivolutsky D.A., Lebedeva N.V. 2004a. Oribatid mites (Oribatei, Acariformes) in bird feathers: Non-Passerines //Acta Zooologica Lituanica. 14(1): 26–47.

Krivolutsky D.A., Lebedeva N.V. 2004b. Oribatid mites (Oribatei) in bird feathers. Part 2. Passeriformes //Acta Zooologica Lituanica. 14(2): 19–38.

Lebedeva N.V. 2005. Role of Anceriformes in distribution of soil microarthropodes // Uspekhi sovremennoj biologii. 125: 214–220 [In Russian].

Lebedeva N.V., Lebedev V.D. 2008. Transport of oribatid mites to the Polar areas by birds // Integrative Acarology. (M. Bertrand, S. Kreiter, A. Migeon, M. Navajas, M.-S. Tixier, L. Vial eds.). Monpeiller: EURAAC Publ.: 359–367.

Lebedeva N.V., Krivolutsky D.A. 2003. Bird spread soil microarthropods to Arctic Islands // Doklady. Biological Sciences. 391(1–6): 329–332.

Methods of soil-zoological researches. 1975. Moscow: Nauka Publ. 280 p. [In Russian].

References

Dubinina M.N. 1955. Parazitologicheskoe issledovanie ptits [Parasitological study of birds]. Moscow – Leningrad: Academy of Sciences of the USSR Publ. 135 p. (in Russian).

Dubinina E.V., Pletnev B.D. 1977. Metody obnaruzheniya i opredeleniya allergennykh kleshchey domashney pyli [Methods of detection and identification of allergenic mites of domestic dust]. Leningrad: Nauka. 52 p. (in Russian).

Krivolutsky D.A., Lebedeva N.V. 1999. Distribution of soil microarthropods by birds. *Strepet.* 4: 23–24 (in Russian).

Krivolutsky D.A., Lebedeva N.V. 2002. The oribatid mites in the bird feathers. *In:* Studies on Soil Fauna in Central Europe (K. Tajovsky, V. Balik, V. Pizl eds.). České Budějovice: ISB AS CR Publ.: 101–104.

Krivolutsky D.A., Lebedeva N.V. 2004a. Oribatid mites (Oribatei, Acariformes) in bird feathers: Non-Passerines. *Acta Zooologica Lituanica.* 14(1): 26–47.

Krivolutsky D.A., Lebedeva N.V. 2004b. Oribatid mites (Oribatei) in bird feathers. Part 2. Passeriformes. *Acta Zooologica Lituanica.* 14(2): 19–38.

Lebedeva N.V. 2005. Role of Anceriformes in distribution of soil microarthropodes. *Uspekhi sovremennoi biologii.* 125: 214–220 (in Russian).

Lebedeva N.V., Lebedev V.D. 2008. Transport of oribatid mites to the Polar areas by birds. *In:* Integrative Acarology (M. Bertrand, S. Kreiter, A. Migeon, M. Navajas, M.-S. Tixier, L. Vial eds.). Monpeiller: EURAAC Publ.: 359–367.

Lebedeva N.V., Krivolutsky D.A. 2003. Bird spread soil microarthropods to Arctic Islands. *Doklady Biological Sciences.* 391(1–6): 329–332.

Methods of soil-zoological researches. 1975. Moscow: Nauka. 280 p. (in Russian).