European Bison Conservation Newsletter Vol 4 (2011) pp: 81–88

Taxonomic and faunistic study of chewing lice from European bison and other ungulate mammals in Poland

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Abstract: Specific chewing lice from European bison and some selected species of common European ungulate mammals – cattle, horses, goats, roe deer, red deer, were examined. The faunistic research was on four species of chewing lice, including *Bisonicola sedecimdecembrii* from European bison (prevalence – 46%, mean intensity – 11 specimens), *Bovicola bovis* from cattle (29%, 5), *Bovicola caprae* from goat (17%, 75), *Werneckiella equi* from horse (4%, 76). Chewing lice from the examined animal species showed topographic specificity on their hosts and preferred the body sides (in European bison) or the neck and back area (in the other hosts). Individual species were characterized by distinct seasonal dynamics, and the greatest intensity of infestation was usually observed in winter. The morphological studies included seven species of chewing lice: *Bisonicola sedecimdecembrii, Bovicola bovis, B. caprae, B. longicornis, Damalinia meyeri, D. ovis, Werneckiella equi*. Chewing lice of ungulate mammals have considerable morphological similarity, however, the range of variation of morphometric traits and differences in body proportions are significant.

Key words: chewing lice, ungulates, mallophagosis

Introduction

Chewing lice (Phthiraptera: Amblycera, Ischnocera) are obligatory keratophagic parasites of birds and some mammals (ungulates, carnivores, rodents). Species of the family Trichodectidae, subfamily Bovicolinae, inhabit specific ungulate mammals. Chewing lice from European bison, *Bisonicola sedecimdecembrii*, is one of the three specific parasites that survived in the present populations of this mammal. This chewing lice was described by Eichler (1946) as *Bovicola sedecimdecembrii* on the basis of the museum specimen of a female prepared from the material obtained from Bialowieza European bison in 1918. Then Hopkins (1960) completed the description with characterization of a male and a female obtained from American bison and the name *Damalinia sedecimdecembrii* was used in the studies on the parasitic fauna of *Bison bison* (Hopkins 1960, Fuller 1966, McHugh 1972). Furthermore, Blagoveščenskij (1967) on the basis of several specimens from Bialowieza European bison (including a male) and the description by Hopkins regarded chewing lice from American bison and European bison as separate subspecies *B. sedecimdecembrii bison* and *B.*

sedecimdecembrii sedecimdecembrii. Finally, Lyal (1985), who used the cladistic analysis, classified chewing lice of this species as a separate genus – *Bisonicola*, by some authors (e.g. Price *et al.* 2003) rather considered as a subgenus, and subspecies from European bison and American bison as synonyms.

While chewing lice inhabiting American bison are little known (they are mentioned only in several studies on diseases and parasitic fauna), chewing lice from European bison have been repeatedly noted – firstly in the Bialowieza population (Kadulski 1977, Izdebska 2000; 2001b; 2003) and then in other free-ranging herds, breeding centres and zoological gardens (Izdebska 2001a; 2001b), and in European bison from the Lowland-Caucasian line in the Bieszczady mountains (Izdebska 2001c). At present it seems that they are common parasites of European bison populations, however, the intensity of their occurrence is usually low. Mass appearances accompanied by the symptoms of mallophagosis have been rarely noted. Therefore parasitological parameters of chewing lice infestation of bison populations were described (Izdebska 2003). However, so far there is no detailed morphological characterisation of chewing lice, as the existing characterisation performed on the basis of only several specimens does not take into account neither the individual variation nor the description of sexual dimorphism. Also chewing lice from other ungulate mammals have not been a frequent object of study (Kadulski 2002).

Although chewing lice of European bison are considered as closely related to chewing lice of other ungulates, as stationary and specific (monoxenic) parasites, closely associated with its host and adapted to live in its coat, they should exhibit a range of morphological, biological or ecological differences.

Material and methods

Origin of the material

The research was on the material collected in the years 1991–2011, obtained from common ungulate mammals of the Pomerania region and from European bison from free-ranging herds (the Bialowieza Primeval Forest, the Bieszczady mountains), breeding centres (Niepolomice, Smardzewice, the nature reserve in the Bialowieza Primeval Forest, zoological gardens) and with the use of the standardized methods of arthropod detection in the hair and on the skin of large mammals (Kadulski, Izdebska 2006). The found chewing lice were preserved in 70% ethanol solution, and then permanent preparations were made in polyvinyl lactophenol.

Faunistic analysis

The research material came from 256 *Bison bonasus*, 195 specimens of *Bos taurus*, 138 *Equus caballus,* 24 *Capra hircus*. The research included analysis of

basic parasitic parameters, such as prevalence of infestation (percentage of hosts infested with parasites in the examined population) and mean intensity of infestation (mean number of parasites in infested hosts).

Taxonomic analysis

For morphological studies were used chewing lice of seven species: *Bisonicola sedecimdecembrii* (Eichler, 1946), *Bovicola bovis* Linnaeus, 1758, *B. caprae* Gurlt, 1843, *B. longicornis* (Nitzsch, 1818), *D. meyeri* (Taschenberg, 1882), *Damalinia ovis* (Schrank, 1781), *Werneckiella equi* (Denny, 1842). The morphometric analysis included respectively 100 specimens of females and males of *Bisonicola sedecimdecembrii* from European bison, 100 females and 2 males of *Bovicola bovis* from cattle, 80 females and 25 males of *B. caprae* from domestic goat, and 50 females, 1 male of *Werneckiella equi* from horse.

Results and discussion

Faunistic analysis

Chewing lice species specific to individual species of ungulate mammals were found. Thus *Bisonicola sedecimdecembrii* was observed in 46% of European bison with mean intensity of infestation amounting to 11 specimens. *Bovicola bovis* was found in cattle with prevalence of infestation of 29% and mean intensity of infestation of 5. *Werneckiella equi* chewing lice was present in 4% of horses with mean intensity of infestation of 76. *Bovicola caprae* was found in 17% of goats (mean intensity of infestation amounting to 75). Hence chewing lice in European bison showed the greatest prevalence of infestation, however, high intensity of infestation was rather occasional. Similar tendencies were observed in chewing lice from Cervidae (Kadulski 1975; 1989; 1996). Significantly higher intensity parameters were found in horses or goats, where chewing lice were observed in individual hosts, however, they often showed high intensity of infestation and symptoms of mallophagosis.

It is difficult to trace the full seasonal dynamics of chewing lice population in European bison because the material can be obtained only during planned elimination of European bison (selective and reduction culling), that is mainly in winter – from December to March. In the material collected during a dozen or so years of research, the number of females was similar to the total number of nymph stages (the ratio of ♀♀ to NN – 1:1.2), while males were less prevalent (the ratio of ♂♂ to ♀♀ – 1:2.5). A similar tendency was observed in the population of *B. caprae*, where there were 25 males to 96 females (the ratio of ♂♂ to ♀♀ – 1:3.8) and 179 nymphs. In other species of Bovicolinae, males are significantly rarer – e.g. sometimes in *Bovicola bovis* from cattle no male is noted per a few thousand of specimens (Eichler 1963). In such cases,

parthenogenesis is presumed to occur (Złotorzycka 1994). In the present study, there was only two males per 188 imagines of *B. bovis* and 95 nymphs. Similarly, only one male was found in the population of *W. equi* per 175 females and 244 nymphs.

The value of infestation with chewing lice showed a growing tendency in European bison from December to March, and the proportion of juvenile stages in the population structure was increasing in the subsequent months. Thus a higher number of imaginal stages and great amount of eggs were noted in December, while in the next months the proportion of the subsequent juvenile stages increased so that nearly 70% of the chewing lice population of European bison examined in March were nymphs. One of the factors that conditions multiplication of chewing lice in mammals may be the state of host coat, which in European bison is much more abundant in winter. Also research by some other authors have shown that most Bovicolinae species from large mammals are the most prevalent exactly in the winter season (among others Kadulski 1975; 1996; Złotorzycka 1994). It is confirmed by the present observations of seasonal dynamics of *B. bovis* from cattle, where the highest intensity of infestation was observed in autumn and winter, whereas in summer a marked decrease in the intensity was noted. Similarly, the symptoms of mallophagosis were observed in horses in winter months.

Chewing lice in ungulates show very distinct topographic specificity. In European bison they are the most prevalent on the body sides, while in cattle, sheep and horses they occur in great numbers on the neck. In cattle they were numerous also at the base of the horns, along the back and on the rump. In horses the parasites were found in the mane and on the body sides as well, and in goats at the base of the tail. Chewing lice from European bison are usually located at the base of the hair, next to the skin. However, presumably they can change their location along hair depending on environmental conditions (temperature, humidity), similarly as other Bovicolinae species. Nevertheless, observations of *B. sedecimdecembrii* behaviour were made mainly in winter months, so there is no data on their location in warmer seasons of the year. However, *B. bovis* from cattle, which also prefer location at the base of the hair in winter, since March move to its distal part.

Taxonomic analysis

Morphological differences between chewing lice from Bovicolinae specific to ungulates lie especially in the structure and shape of head. Thus in *B. sedecimdecembrii* and *W. equi* clypeus is convex on the front, while in *B. caprae* – the whole front of head margin is slightly concave, and in *B. bovis* only a part of front head margin is concave. However, in *D. meyeri* from roe deer front head margin is evidently concave. The shape of head varies from round to trapezoid. In *B. sedecimdecembrii, B. bovis* and *B. caprae* head width is usually

Table 1. Comparison of adult chewing lice from Bovicolinae.

Features	*B. sedecim-decembrii*		*B. bovis*		*B. caprae*		*W. equi*	
	Male	Female	Male	Female	Male	Female	Male	Female
Ratio of body length to width	2.7	2.5	2.5	2.4	2.6	2.3	2.8	2.6
Ratio of head length to total length	0.22	0.21	0.28	0.26	0.25	0.25	0.23	0.24
Ratio of abdomen length to total length	0.63	0.63	0.58	0.61	0.60	0.63	0.62	0.67
Ratio of head length to head width	0.91	0.87	0.97	0.92	0.95	0.91	1.05	1.0

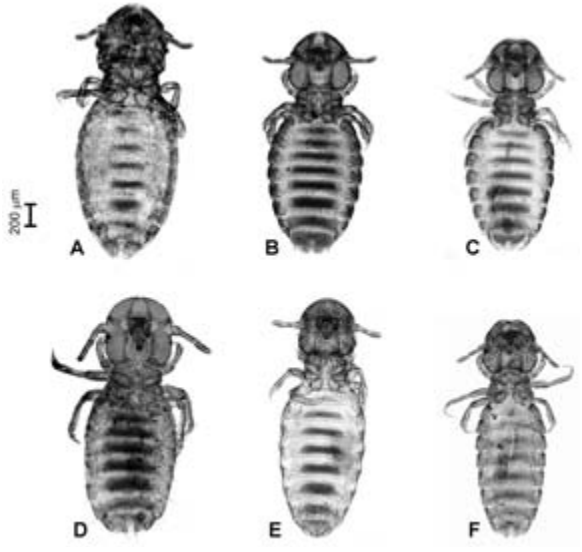

Figure 1. Females of Bovicolinae; A – *Bisonicola sedecimdecembrii*, B – *Bovicola bovis*, C – *Bovicola caprae,* D – *Bovicola longicornis*, E – *Werneckiella equi*, F – *Damalinia meyeri*

greater than head length, in *W. equi* the length and the width are similar, and in *D. meyeri* and *D. ovis* head length is greater than its width. Some differences can be observed also in legs. *B. sedecimdecembrii*, similarly as *B. bovis*, *B. capre, W. equi* and *D. meyeri,* have one-segment anterior tarsusi, short and thick in comparison with legs of the other species, e.g. *B. longicornis* from red deer have long, slender legs with two-segment tarsusi. Also the body measurements of all the examined species are similar, however, different ranges of variation can still be found (Tabl. 1, Figs. 1–2).

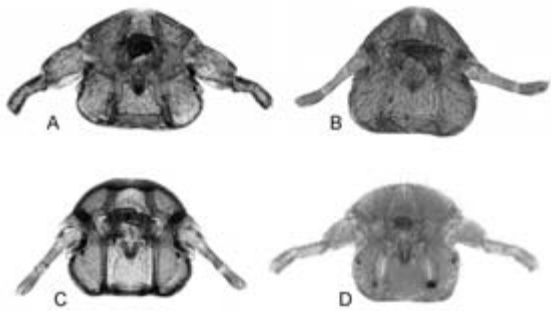

Figure 2. Male heads of different chewing lice from Bovicolinae A – *Bisonicola sedecimdecembrii*, B – *Bovicola bovis*, C – *Bovicola caprae*, D – *Damalinia ovis*

Table 2. The measurements of males from Bovicolinae

Features	***B. sedecim-decembrii*** [n=100]	***B. bovis*** [n=2]	***B. caprae*** [n=25]	***W. equi*** [n=1]
Length of head	0.42 [0.38–0.47] SD 0.03	0.33 [0.32-.33] SD 0.01	0.35 [0.32–0.41] SD 0.02	0.44
Width of head	0.46 [0.36–0.50] SD 0.04	0.33 [0.32–0.34] SD 0.01	0.37 [0.34–0.43] SD 0.02	0.42
Length of thorax	0.30 [0.20–0.37] SD 0.06	0.16 SD 0.00	0.19 [0.17–0.23] SD 0.02	0.32
Width of thorax	0.43 [0.36–0.49] SD 0.03	0.30 SD 0.00	0.30 [0.26–0.38] SD 0.07	0.34
Length of abdomen	1.19 [0.77–1.40] SD 0.17	0.59 [0.50–0.67] SD 0.12	0.83 [0.77–0.92] SD 0.04	1.17
Width of abdomen	0.70 [0.59–0.80] SD 0.08	0.48 [0.47–0.48] SD 0.01	0.53 [0.47–0.60] SD 0.03	0.68
Total length of body	1.90 [1.60–2.21] SD 0.20	1.07 [0.98–1.16] SD 0.13	1.38 [1.27–1.52] SD 0.06	1.9

Sexual dimorphism manifests itself especially clearly in *B. sedecimdecembrii* in the structure of antennae – the first segment of male antennae is wider and longer than the other segments, while in female it is only a little thickened. This characteristic is less distinctive in *W. equi*, *D. ovis* and *D. meyeri*, and in the other species (*B. caprae*, *B. bovis*, *B. longicornis*) the first segment of male antennae is only slightly wider than the other segments (Fig. 2).

Table 3. The measurements of females from Bovicolinae

Features	***B. sedecim-decembrii*** [n=100]	***B. bovis*** [n=100]	***B. caprae*** [n=80]	***W. equi*** [n=50]
Length of head	0.45 [0.37–0.51] SD 0.04	0.44 [0.39–0.48] SD 0.02	0.42 [0.39–0.48] SD 0.02	0.48 [0.40–0.55] SD 0.03
Width of head	0.52 [0.48–0.59] SD 0.04	0.48 [0.43–0.53] SD 0.02	0.46 [0.42–0.51] SD 0.02	0.48 [0.40–0.55] SD 0.03
Length of thorax	0.33 [0.24–0.40] SD 0.06	0.23 [0.19–0.26] SD 0.01	0.22 [0.18–0.26] SD 0.02	0.27 [0.20–0.41] SD 0.05
Width of thorax	0.47 [0.41–0.53] SD 0.05	0.42 [0.36–0.45] SD 0.02	0.40 [0.37–0.45] SD 0.02	0.41 [0.33–0.46] SD 0.03
Length of abdomen	1.33 [0.99–1.50] SD 0.13	1.04 [0.87–1.19 SD 0.06	1.05 [0.95–1.24] SD 0.06	1.34 [1.15–1.57] SD 0.12
Width of abdomen	0.87 [0.65–1.02] SD 0.08	0.72 [0.61–0.80] SD 0.04	0.72 [0.61–0.81] SD 0.05	0.76 [0.69–0.91] SD 0.05
Total length of body	2.14 [1.83–2.34] SD 0.15	1.70 [1.44–1.91] SD 0.09	1.70 [1.56–1.99] SD 0.11	2.00 [1.80–2.40] SD 0.09

B. sedecimdecembrii from European bison show relatively small morphological and morphometric variation. According to Clay (1958), chewing lice show rather small individual variation when compared to other insects. Nevertheless, its range in chewing lice from European bison seems to be narrower also in comparison with the other chewing lice. Presumably the reason is that the present population derives from a small founding group, and probably only some of the animals obtained from vivarium conditions were infested with chewing lice.

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Badania taksonomiczne i faunistyczne wszołów z żubra i innych ssaków kopytnych w Polsce

Streszczenie: Badano specyficzne wszoły żubra i wybranych gatunków pospolitych europejskich ssaków kopytnych – bydła, koni, kóz, saren, jeleni. Badaniami faunistycznymi objęto cztery gatunki wszołów, w tym *Bisonicola sedecimdecembrii* z żubra (ekstensywność 46%, średnia intensywność 11 osobników), *Bovicola bovis* z bydła (29%, 5), *Bovicola caprae* z kozy (17%, 75), *Werneckiella equi* z konia (4%, 76). Wszoły z tych gatunków wykazywały w obrębie swoich żywicieli specyficzność topograficzną preferując boki ciała (u żubra), czy okolice karku i grzbietu (u pozostałych żywicieli). Poszczególne gatunki cechuje wyraźna dynamika sezonowa, przy czym zwykle największe nasilenie zarażenia obserwowano zimą. Badaniami morfologicznymi objęto siedem gatunków wszołów: *Bisonicola sedecimdecembrii, Bovicola bovis, B. caprae, B. longicornis, Damalinia meyeri, D. ovis, Werneckiella equi*. Stwierdzono, że wszoły ssaków kopytnych wykazują znaczne podobieństwo morfologiczne, jakkolwiek wyraźne zróżnicowanie proporcji ciała i zakresu zmienności cech morfometrycznych.