Mites (Acari: Mesostigmata) inhabiting nests of the white-tailed sea eagle *Haliaeetus albicilla* (L.) in Poland

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During 1997–2002, 105 samples of mites were collected from 34 nests of the white-tailed sea eagle in Poland. The material included 9,724 specimens of Mesostigmata belonging to 86 species. The mite communities were dominated by species of the families Parasitidae, Macrochelidae and Ascidae. The most abundant species were *Alliphis halleri*, *Androlaelaps casalis*, *Parasitus fimetorum* and *Macrocheles merdarius* that altogether made up 48% of all the specimens collected. *Alliphis halleri* and *Androlaelaps casalis* were also the two most frequently found mites. A summary is presented on the biology and distribution of the abundant species.

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1. Introduction

Birds' nests provide microhabitats that are inhabited by diverse groups of invertebrates, especially arthropods (Fenda & Pinowski 1997, Fenda *et al.* 1998, Fenda & Schniererová 2004, Krumpál *et al.* 2000–2001, Cyprich *et al.* 2000, Tryjanowski *et al.* 2001). Many of these species are potential carriers of disease for both animals and humans. However, the mite fauna of the nests of large birds of prey is poorly known, mainly as a result of the difficulty in collecting material.

The relationships among a host bird, its ectoparasites, and the accompanying fauna occupying the nest are based on a combination of specific trophic and environmental factors and phoretic associations. Clear co-evolutionary links among components of the resulting fauna can sometimes be discerned. In a particular area there may be parallel adaptations of the host to life in the prevailing local environmental conditions, of the parasites to a given host species, in regard to both the host and its nest, and the transformation of free-living arthropod species into specific nidicoles that are adapted to life in this specific microhabitat (Vysotskaya & Daniel 1973). These factors would suggest that the nests of different species of birds that have different patterns of behaviour with respect to nest building could produce differing faunas of nidicolous mites. In the present paper we examine this phenomenon by surveying the mite fauna of the nests of the white-tailed sea eagle *Haliaeetus albicilla*, which has a quite different pattern of nesting behaviour from the white stork *Ciconia ciconia*, which we have examined previously (Błoszyk *et al.* 2005). In particular, the nests of the white-tailed sea eagle create for invertebrates a specific niche that is characterised by less seasonal variation than those of the white stork.

The large, old nests of the white-tailed sea eagle – the largest Polish bird of prey – are an interesting subject for research. Our earlier observations (Gwiazdowicz *et al.* 2005) showed that the species composition and community structure of the Mesostigmata in these nests are highly variable over successive years of nesting. The breeding season of the eagle begins in the spring, during February–March, earlier than that of the white stork, and the eagle does not seasonally abandon its nest. It is associated with aquatic environments and occurs near lakes, fish ponds and river valleys where it can feed, build nests, and live after the breeding season. During winter the eagles concentrate around rivers and flood plains. In Poland, the nests of the white-tailed sea eagle are situated exclusively in trees, most frequently in old pines and beeches. The nest is systematically built up over many years and reaches a size of up to 4 m in height and 2.5 m in diameter. Its mass can reach as much as 1,000 kg. One-year-old nests are considerably smaller, about 0.6 m high and 0.8–1.2 m in diameter. A single pair of eagles may have one or more nests, usually 2–3. The birds remain near their nests throughout the year. Nests built by the eagle are isolated from each other and from other habitats that are commonly inhabited by mites, such as forest litter and soil. It is therefore interesting to study the dispersal mechanisms that allow mites to move into nests or from one nest to another.

The work presented here continues a study on the mite fauna of avian nests in Poland. Previous papers in this series are Błoszyk & Olszanowski (1985, 1986), Tryjanowski *et al.* (2001), Błoszyk *et al.* (2005), and Gwiazdowicz *et al.* (2005). Here, we aim at describing the mite fauna associated with the nests of the white-tailed sea eagle.

2. Material and methods

Between 1997 and 2002, we collected 105 samples from 34 nests of the white-tailed sea eagle from different parts of Poland. Samples of nest material, each 0.5–0.8 l, were collected during May and June each year. The material was extracted in Tullgren funnels for 7 days and the collected mites were preserved in 75% ethyl alcohol. Specimens were cleared in lactic acid or lactophenol and identified using the keys of Karg (1989, 1993). Values of the dominance (*D*) and occurrence coefficient (*C*) were calculated following Błoszyk (1999). The dominance coefficient *D* is a measure of the relative abundance of each species, calculated as $D = (n_a/n) * 100$, where n_a = number of specimens of species a in all samples, and n = total number of specimens of all species in all samples.

The occurrence coefficient *C* is a measure of the frequency with which each species is found in the collected samples, calculated as $C = (q/Q) * 100$, where q = the number of samples in which a particular species occurred, and Q = total number of samples. Regarding dominance (*D*), species were grouped into the following classes: eudominant (D5), >30.0%; dominant (D4), 15.1–30.0%; subdominant (D3), 7.1–15.0%; recedent (D2), 3.0–7.0%; and subrecedent (D1), <3.0%. For frequency (*C*), species were grouped into euconstant (C5), >50.0%; constant (C4), 30.1–50.0%; subconstant (C3), 15.1–30.0%; accessory species (C2), 5.0–15.0%; and accidental species (C1), <5.0%.

All the material is deposited in "The Invertebrate Fauna Bank", Department of Animal Taxonomy and Ecology, Adam Mickiewicz University, Poznań, Poland.

3. Results

The study yielded a total of 9,724 specimens of Mesostigmata belonging to 86 species, including representatives of the suborders Gamasina (78 species) and Uropodina (8 species) (Table 1). Among the species represented, 13 were characterised by a high dominance coefficient. A short description of 10 of them is given below, citing their geographical distribution and most commonly occupied microhabitats. *Parasitus fimetorum, Macrocheles glaber* and *M. merdarius* were also abundant, but accounts on the biology of these species have already been presented in the paper on mites in white stork nests (Błoszyk *et al.* 2005).

Cornigamasus lunaris (Berlese, 1882)
A species found in compost, decomposing organic material, excrement, and the nests of ants, such as *Lasius fuliginosus* (Hyatt 1980; Karg 1993). It occurs all over Europe.

Macrocheles ancyleus Krauss, 1970
Found in dead wood, and also in old nests of birds of prey (Krauss 1970, Gwiazdowicz *et al.* 1999, Gwiazdowicz 2003b, Mašán 2003). So far known only from Central Europe.

Alliphis halleri (G. & R. Canestrini, 1881)
Most commonly found in decomposing organic material, compost and excrement (Karg 1993). The species occurs in Europe and Asia.

Proctolaelaps pygmaeus (Müller, 1860)
A cosmopolitan species that occurs in soil, moss, decomposing organic material and in the nests of small mammals (Bregetova 1977b).

Iphidozercon gibbus Berlese, 1903
A species most frequently found in soil, forest litter, humus and in the nests of small mammals (Bregetova 1977b). Occurs in Europe and in North Africa.

Androlaelaps casalis (Berlese, 1887)
A species found in forest litter, humus, and soil, but most commonly in the nests of small mammals and birds (Karg 1993). Occurs in the entire Palaearctic region and North America.

Dendrolaelaps strenzkei Hirschmann, 1960
This species has been found, among other places, in rotting wood, under bark, in the nests of *Formica rufa* ants, and also in soil, forest litter and compost (Hirschmann & Wiśniewski 1982, Karg 1993). It occurs all over Europe, from Italy in the South, to Finland in the North, from Spain in the West, to Russia in the East.

Uroseius infirmus (Berlese, 1887)
A species found in decomposing plant remains, tree trunks and tree holes, but most commonly in birds' nests, with known phoresy on beetles (Wiśniewski & Hirschmann 1993, Mašán 2001, Błoszyk *et al.* 2005). Its range includes Europe, Kazakhstan and Mongolia.

Nenteria pandioni Wiśniewski & Hirschmann, 1985
A species most commonly occurring in old birds' nests (Gwiazdowicz *et al.* 2000, Gwiazdowicz 2003a). The species has been found in Poland and Slovakia.

Trichouropoda ovalis (C. L. Koch, 1839)
This species has been found in many micro-habitats, such as among mosses, forest litter, mushrooms, rotting wood, tree holes, insect nests and burrows, and the nests of mammals and birds (Wiśniewski & Hirschmann 1993; Błoszyk 1999). A widespread European species.

4. Discussion

The nests of the white-tailed sea eagle contain an exceptionally rich fauna of Mesostigmata. The number of species in these nests is much greater than in the nests of any other bird species reported in previous studies on mite faunas of avian nests. This is a result not only of the large number of nests examined, but also because the nests of the white-tailed sea eagle are genuinely characterised by a high degree of acarofauna species variabil-

Table 1. List of mite species occurring in the nests of *Haliaeetus albicilla*. Legend: F – female, M – male, D – deutonymph, P – protonymph, L – larva, D% – dominance, C% – occurrence coefficient.

Taxon	Total	F	M	D	P	L	D%	C%
ANTENNOPHORINA								
Celaenopsidae								
Celaenopsis badius C. L. Koch, 1839	1	–	1	–	–	–	0.01	0.95
GAMASINA								
Zerconidae								
Prozercon kochi Sellnick, 1943	1	1	–	–	–	–	0.01	0.95
Zercon curiosus TrägÍrdh, 1910	2	2	–	–	–	–	0.02	0.95
Zercon peltatus peltatus C. L. Koch, 1836	27	20	7	–	–	–	0.28	5.71
Zercon triangularis C. L. Koch, 1836	*3*	*3*	–	–	–	–	*0.03*	*0.95*
Zercon zelawaiensis Sellnick, 1944	2	1	1	–	–	–	0.02	0.95
Parasitidae								
Cornigamasus lunaris (Berlese, 1882)	376	59	12	305	–	–	3.87	11.43
Parasitus coleoptratorum (Linnaeus, 1758)	81	10	5	66	–	–	0.83	5.71
Parasitus consanguineus Voigts &d Oudemans, 1904	50	9	5	36	–	–	0.51	5.71
Parasitus fimetorum (Berlese, 1904)	1132	157	68	906	1	–	11.64	29.52
Parasitus mustelarum Oudemans, 1903	21	1	20	–	–	–	0.22	4.76
Poecilochirus carabi G. & R. Canestrini, 1882	3	–	–	3	–	–	0.03	1.90
Vulgarogamasus kraepelini (Berlese, 1904)	20	18	1	1	–	–	0.21	2.86
Holoparasitus calcaratus (C. L. Koch, 1839)	1	–	1	–	–	–	0.01	0.95
Paragamasus brevipes (Berlese, 1905)	13	7	6	–	–	–	0.13	0.95
Paragamasus misellus (Berlese, 1903)	50	21	29	–	–	–	0.51	0.95
Paragamasus runciger (Berlese, 1903)	11	5	5	1	–	–	0.11	0.95
Paragamasus vagabundus (Karg, 1968)	17	8	3	–	–	–	0.17	3.81
Pergamasus brevicornis Berlese, 1903	2	1	5	–	–	–	0.02	1.90
Pergamasus mediocris Berlese, 1904	12	2	–	–	–	–	0.12	0.95
Macrochelidae								
Geholaspis longispinosus (Kramer, 1876)	2	2	–	–	–	–	0.02	1.90
Macrocheles ancyleus Krauss, 1970	626	475	148	3	–	–	6.44	23.81
Macrocheles carinatus (C. L. Koch, 1839)	2	2	–	–	–	–	0.02	0.95
Macrocheles copridis Mašán, 2003	4	4	–	–	–	–	0.04	0.95
Macrocheles decoloratus (C. L. Koch, 1839)	11	7	4	–	–	–	0.11	0.95
Macrocheles glaber (Müller, 1860)	257	208	47	2	–	–	2.64	26.67
Macrocheles merdarius (Berlese, 1889)	1132	1092	40	–	–	–	11.64	24.76
Macrocheles muscaedomesticae (Scopoli, 1771)	13	12	1	–	–	–	0.13	0.95
Macrocheles penicilliger (Berlese, 1904)	11	11	–	–	–	–	0.11	0.95
Macrocheles perglaber Filipponi & Pegazzano, 1962	36	33	3	–	–	–	0.37	3.81
Macrocheles rotundiscutis Bregetova & Koroleva, 1960	4	3	1	–	–	–	0.04	0.95
Macrocheles tridentinus (G. & R. Canestrini, 1882)	2	2	–	–	–	–	0.02	1.90
Macrocheles sp.	45	–	44	1	–	–	0.46	1.90
Eviphididae								
Alliphis halleri (G. & R. Canestrini, 1881)	1268	873	308	87	–	–	13.04	37.14
Ascidae								
Arctoseius elegans Bernhard, 1963	3	3	–	–	–	–	0.03	0.95
Arctoseius insularis (Willmann, 1952)	1	1	–	–	–	–	0.01	0.95
Arctoseius semiscissus (Berlese, 1892)	14	14	–	–	–	–	0.14	0.95
Asca aphidioides (Linnaeus, 1758)	1	1	–	–	–	–	0.01	0.95
Asca bicornis (Canestrini & Fanzago, 1887)	12	12	–	–	–	–	0.12	3.81
Blattisocius dentriticus (Berlese, 1918)	2	2	–	–	–	–	0.02	1.90
Gamasellodes bicolor (Berlese, 1918)	12	12	–	–	–	–	0.12	3.81
Iphidozercon corticalis Evans, 1958	1	1	–	–	–	–	0.01	0.95
Iphidozercon gibbus Berlese, 1903	106	106	–	–	–	–	1.09	2.86
Lasioseius furcisetosus Athias–Henriot, 1961	4	4	–	–	–	–	0.04	0.95

Taxon	Total	F	M	D	P	L	D%	C%
Lasioseius ometes (Oudemans, 1903)	2	2	–	–	–	–	0.02	1.90
Lasioseius ometisimilis Hirschmann, 1963	1	1	–	–	–	–	0.01	0.95
Lasioseius youcefi Athias–Henriot, 1959	1	1	–	–	–	–	0.01	0.95
Leioseius minusculus Berlese, 1905	10	9	1	–	–	–	0.10	0.95
Leioseius sp.	2	–	–	1	1	–	0.02	1.90
Neojordensia sinuata Athias–Henriot, 1973	1	1	–	–	–	–	0.01	0.95
Proctolaelaps hystrix (Vitzthum, 1923)	4	4	–	–	–	–	0.04	0.95
Proctolaelaps pygmaeus (Müller, 1860)	642	639	2	1	–	–	6.60	28.57
Laelapidae								
Eulaelaps stabularis (C. L. Koch, 1839)	3	1	2	–	–	–	0.03	1.90
Haemogamasus horridus Michael, 1892	2	–	2	–	–	–	0.02	0.95
Androlaelaps casalis (Berlese, 1887)	1213	947	202	22	10	32	12.47	46.67
Hypoaspis austriacus Sellnick, 1935	1	1	–	–	–	–	0.01	0.95
Hypoaspis brevipilis Hirschmann 1969	29	29	–	–	–	–	0.30	2.86
Hypoaspis lubrica Voigts & Oudemans, 1904	1	1	–	–	–	–	0.01	0.95
Hypoaspis oblonga (Halbert, 1915)	1	1	–	–	–	–	0.01	0.95
Dermanyssidae								
Dermanyssus gallinae De Geer, 1778	1	1	–	–	–	–	0.01	0.95
Veigaiidae								
Gamasolaelaps excisus (C. L. Koch, 1879)	31	14	4	13	–	–	0.32	0.95
Veigaia nemorensis (C. L. Koch, 1839)	6	4	–	2	–	–	0.06	3.81
Halolaelapidae								
Halolaelaps sp.	482	142	24	316	–	–	4.96	12.38
Pachylaelapidae								
Pachylaelaps furcifer Oudemans, 1903	1	1	–	–	–	–	0.01	0.95
Digamasellidae								
Dendrolaelaps arvicolus (Leitner, 1949)	1	1	–	–	–	–	0.01	0.95
Dendrolaelaps fallax (Leitner, 1949)	44	30	14	–	–	–	0.45	9.52
Dendrolaelaps latior (Leitner, 1949)	14	12	1	1	–	–	0.14	1.90
Dendrolaelaps longiusculus (Leitner, 1949)	3	1	2	–	–	–	0.03	1.90
Dendrolaelaps presepum (Berlese, 1918)	4	3	1	–	–	–	0.04	0.04
Dendrolaelaps strenzkei Hirschmann, 1960	163	100	23	38	1	1	1.68	17.14
Dendrolaelaps wengrisae Wiśniewski, 1979	2	–	–	–	1	1	0.02	0.95
Dendrolaelaps zwoelferi Hirschmann, 1960	1	1	–	–	–	–	0.01	0.95
Ameroseiidae								
Ameroseius apodius (Karg, 1971)	75	75	–	–	–	–	0.77	3.81
Ameroseius corbiculus (Sowerby, 1806)	1	1	–	–	–	–	0.01	0.95
Ameroseius longitrichus Hirschmann, 1963	1	1	–	–	–	–	0.01	0.95
Ameroseius sp.	5	5	–	–	–	–	0.05	2.86
Phytoseiidae								
Amblyseius sp.	2	2	–	–	–	–	0.02	0.95
Typhlodromus pyri Scheuten, 1857	1	1	–	–	–	–	0.01	0.95
UROPODINA								
Polyaspidae								
Uroseius infirmus (Berlese, 1887)	773	227	175	360	11	–	7.95	26.67
Trematuridae								
Nenteria pandioni Wiśniewski & Hirschmann, 1985	624	169	120	265	70	–	6.42	31.43
Trichouropoda orbicularis (C. L. Koch, 1839)	3	2	–	–	1	–	0.03	1.90
Trichouropoda ovalis (C. L. Koch, 1839)	124	48	48	21	6	1	1.28	20.95
Urodinychidae								
Dinychus sp.	2	1	1	–	–	–	0.02	0.95
Uroobovella marginata (C. L. Koch, 1839)	1	–	–	1	–	–	0.01	0.95
Uroobovella pyriformis (Berlese, 1920)	7	–	2	4	1	–	0.07	0.95
Uropodidae								
Uropoda orbicularis (Müller, 1776)	45	9	5	29	2	–	0.46	6.67

ity, even over a short period of time (Gwiazdowicz *et al.* 2005).

The species composition and community structure of the Mesostigmata found in the white-tailed sea eagle nests are clearly different from those encountered in white stork nests, even though both build nests that are maintained for many years (Błoszyk *et al.* 2005). Many species occurring in great numbers in the eagle nests have not been found in stork nests. An example is *Alliphis halleri* that was the most abundant species in the eagle nests but was not found at all in the nests of the white stork. *Androlaelaps casalis* was also very numerous in the eagle nests, but was infrequent and never abundant in stork nests. *Cornigamasus lunaris* (Parasitidae) occurred in high numbers in the nests of the white-tailed sea eagle (Table 1), and it has been reported as being abundant also in the nests of other birds of prey (Gwiazdowicz 2003a), but it is considered uncommon in the nests of the white stork (Błoszyk *et al.* 2005). Similarly, *Macrocheles ancyleus* (Macrochelidae) has been found mainly in the nests of birds of prey (Gwiazdowicz *et al.* 1999; Gwiazdowicz 2003a, present study), whereas in the nests of other bird species it has been recorded only sporadically.

The most species-rich mite families in the nests of the white-tailed sea eagle were Parasitidae (14 species), Macrochelidae (13 species) and Ascidae (18 species). The rich fauna of Ascidae is particularly striking, because they have only rarely been found in avian nests before. *Proctolaelaps pygmaeus* has been found in bird nests before, but never in great numbers (Fenda *et al.* 1998). The same is true for *Iphidozercon gibbus* that has most frequently been found in soil environments. It is also worth noting the occurrence of great numbers of *Ameroseius apodius* (75 individuals). This species is most commonly found in forest litter and compost heaps (Bregetova 1977a). In Poland it has been observed only sporadically, usually as sigletons.

Species regarded as being parasitic occurred in the eagle nests only sporadically and never in great numbers, even though over 100 samples were taken: *Eulaelaps stabularis* (3 individuals), *Haemogamasus horridus* (2 individuals) and *Dermanyssus gallinae* (1 individual). Compared to the nests of swallows – where the number of parasitic mites can be very high – the small number of parasites in the nests of the white-tailed sea eagle is peculiar. It is perhaps most likely connected to the unfavourable micro-climatic conditions that can have a direct influence on the fauna inhabiting an open nest.

The presence of species that are known to most frequently occur in soil (e.g. *Zercon* spp., *Paragamasus* spp. and *Pergamasus* spp.), live in rotting wood, or be associated with other insects (e.g. *Dendrolaelaps* spp.), can be explained by specimens being carried by the bird to the nest together with the nest-building material. This may also explain the presence of many mite species represented by singletons. Many of these mite species occur perhaps most frequently on the soil surface or in dead wood.

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