Proceedings of the Eleventh International Conference on Urban Pests 2025
AF-Borgen, Academic Society, Lund, Sweden
William H Robinson, editor

ARTHROPOD FAUNA IN A NATURAL HISTORY MUSEUM

[1]REINER POSPISCHIL AND [2]PASCAL QUERNER

[1] PMP-Biosolutions, 50129 Bergheim, Germany, reiner.pospischil@t-online.de
[2] Natural History Museum Vienna, 1. Zoology, Burgring 7, 1010 Vienna, Austria

Abstract Many insect species use dry organic materials as food. This is an important ecological function in nature to recycle nutrients in the ecological cycles. However, if these subjects are to be preserved for posterity in museums, this degradation by insects is undesirable. Protecting stored goods against destruction by insects is therefore a constant challenge for museums. In a large natural history museum, 1,527 sticky traps were set up in many areas from the basement to the attic as part of a pest survey from winter 2021/22 until autumn 2022. About 200 Arthropod species were found on the traps. The number of captured individuals was >15,574. Four species of the family Lepismatidae were found on the traps, with *Ctenolepisma calvum* being the most prominent one followed by *Ctenolepisma longicaudatum. Ctenolepisma lineatum* and *Lepisma saccharinum* were only slightly represented on the traps. The Coleoptera were mainly represented by Dermestid species on the traps, especially *Attagenus smirnovi*, *Anthrenus verbasci*, *Anthrenus olgae* and *Thylodrias contractus*. In addition, a large number of non pest species were also found, that accidentally entered the museum from the surrounding area.

Key words museum pests, Dermestidae, Tinidae, Lepismatidae

INTRODUCTION

Natural history museums are important witnesses in a constantly changing environment and important testimonies for posterity. Protecting the exhibits stored in the museums is therefore an important, urgent task (Pinniger et al., 2016). Depending on their orientation, architecture and special microclimate museums accommodate different arthropod faunal elements with a focus on wood destroying species, stored product pests or on species that feed primarily on dry materials of animal origin, including those that develop on keratin-containing food (Brimblecombe et al 2024). These pests are often accompanied by predators or parasitoid species. In addition, there are arthropods that migrate from the surrounding area into the building without causing further damage, as well as small arthropods which are passively transported by the air and introduced through open doors and windows into buildings.

MATERIAL AND METHODS

An study of the arthropod fauna in the Natural History Museum in Vienna was carried out in 2021 and 2022 as part of the Integrated Pest Management in museums. It is a three-story

building with a basement plus an attic, that contains collections and exhibitions on entomology, anthropology, mammals, birds and botany. 1527 commercially available sticky traps were distributed throughout the entire building. Different numbers of traps were set up depending on the size and use of the rooms, making a direct comparison of the number of individuals difficult. Due to the relatively long time the traps were left standing, it was only possible to identify the specimens to a limited extent down to the species. Some of these individuals were covered with glue or parts of the specimens were missing. Larger insects that died on the traps had an attractive effect in particular on dermestids and were destroyed by larvae of the genera *Anthrenus*, *Reesa*, and *Attagenus.* The adults and larvae of these Dermestidae were identified according to (Háva 2021, Klausnitzer 2001 and Rees 2004). The following results primarily deal with species that may cause damage to the exhibits. Species that accidentally migrate into the building and do not cause damage are only mentioned in passing.

RESULTS AND DISCUSSION

Approximately 15,000 individuals were found on the traps, which could be assigned to around 200 species. A large proportion were species that develop on dry materials of animal or plant origin. 1595 individuals (10,2 %) belong to the Dermestidae, which are a particular threat to protein and keratin-containing exhibits of animal origin. 944 individuals (59.2% of the Dermestidae) are assigned to *Attagenus smirnovi*, 15.1% to *Anthrenus olgae* Kalík, 1946, and 13.7% to *Thylodrias contractus* Motschulsky, 1839*,* respectively (Table 1). The species *Reesa vespulae* (Milliron, 1939) accounts for 2.3%, *Attagenus unicolor* (Brahm, 1791) for 1.6%, and *Anthrenus verbasci* for 1.5%. The remaining 6% are larvae that belong to the Dermestidae but cannot be identified further Heinze 1983, Háva 2021).

Table 1. Distribution of Dermestidae in the different museum sections (Numbers of individuals larvae an d adults)

Sections	*Thylodrias contractus*	*Attagenus smirnovi*	*Attagenus unicolor*	*Reesa vespulae*	*Anthrenus olgae*	*Anthrenus verbasci*	No. of Traps
Botany	2	2	0	4	15	0	217
Entomology	0	196	10	26	64	9	292
Ornithology	128	19	5	3	18	0	184
Mammels	4	46	3	0	54	1	181
Anthropology	6	39	0	0	1	0	29
Prehistory	45	97	6	0	5	0	115
Exhibition	28	208	0	0	56	2	166
Library	0	331	0	2	10	7	146
Archive	0	3	0	0	2	0	29
Dissection	20	2	0	2	3	1	41
Basement	0	2	1	1	13	4	127
Total	223	944	25	38	241	24	1527
%*	1.43	6.10	0.16	0.24	1.55	0.15	

*% from totat amount of registered specimens

Attagenus smirnovi Zhantiev, 1973 was found in all sections of the museum, with a focus on the library, exhibition and entomology. After the first discovery in the western part of Central Europe (Switzerland 2007 and Northrhine Westfalia 2008) this species became one of the 4 most common dermestid species in buildings, together with *Trogoderma angustum* (Solier, 1850),

Anthrenocerus australis (Hope, 1843) and *Anthrenus verbasci* (Linnaeus, 1767). *T. angustum* and *A. australis* were not found in this study. *A. verbasci* was only present in small numbers at 6 stations, in contrast to the closely related species *Anthrenus olgae*, which was found in all sectors. *Thylodrias contractus* was found on the sticky traps in 7 stations, with a focus on ornithology, prehistory and the exhibition rooms. Males, wingless females and various larval stages were found on the sticky traps, which are difficult to detect during visual inspection due to their small size. The larvae of Reesa vespulae pupate in the last larval case over the months and the beetles hatch weeks later. Since the species reproduces parthenogenetically (Brimblecombe and Querner 2024). 10 larvae hatched from a female that was removed from the adhesive surface of a trap in October 2023 and glued to a plate for further processing. They burrowed into the Styrofoam base of the box as the 2nd stage. The larvae developed on dried insects and began to pupate from August 2024. The adult beetles hatched about 3 weeks later and died within a month after laying eggs. 736 individuals (=4,7% of the total number) belonged to the family Tineidae with 715 specimens of *Tineola biselliella* (Hummel, 1823) and 21 specimens of *Monopis crocicapitella* (Clemens, 1859).

Lepismatidae make up 5.2% of the all registrated specimens with 811 individuals measured against the total number of arthropods found (Table 2). *Ctenolepisma calvum* (Ritter, 1910) is by far the most common species with 489 individuals and make up more than half of all Lepismatidae found. and are present in almost all rooms with the highest abundance in the library. The second most common species is *Ctenolepisma longicaudatum* Escherich, 1905 with 182 individuals and a maximum in the basement followed by *Lepisma saccharinum* Linnaeus, 1758 with 97 individuals and *Ctenolepisma lineatum* (Fabricius, 1775) with 42 individuals (Pospischil 2020, Pospischil & Querner 2022, Querner 2022). *C. calvum* has so far only been found indoors. They prefer dry apartments with underfloor heating, which ensure constant temperatures of over 20°C even in winter. The exact climatic requirements of the species are still unknown (Querner et al 2022).

Table 1. Distribution of Dermestidae in the different museum sections (Numbers of individuals larvae an d adults)

Sections	*Thylodrias contractus*	*Attagenus smirnovi*	*Attagenus unicolor*	*Reesa vespulae*	*Anthrenus olgae*	*Anthrenus verbasci*	No. of Traps
Botany	2	2	0	4	15	0	217
Entomology	0	196	10	26	64	9	292
Ornithology	128	19	5	3	18	0	184
Mammels	4	46	3	0	54	1	181
Anthropology	6	39	0	0	1	0	29
Prehistory	45	97	6	0	5	0	115
Exhibition	28	208	0	0	56	2	166
Library	0	331	0	2	10	7	146
Archive	0	3	0	0	2	0	29
Dissection	20	2	0	2	3	1	41
Basement	0	2	1	1	13	4	127
Total	223	944	25	38	241	24	1527
%*	1.43	6.10	0.16	0.24	1.55	0.15	

*% from totat amount of registered specimens

Booklice (Psocoptera) represent the largest proportion of captured arthropods with more than 40% of the total number of individuals. In addition to wingless individuals, winged specimens were also present. More than 30% are small, winged insects that come mainlyfrom the surroundings of the building and are transported into the interior as so called air plankton without causing any damage (including small species of beetles, flies, aphids, bugs and cicadas). These individuals are present in proportion to the number of open windows in the rooms and do not cause any damage on the stored exhibits.

The captured ground beetles belong to the species that are common in green spaces around buildings. Most of these species are capable of flight. *Harpalus pubescens* (De Geer, 1774) accounts for the largest proportion with 850 individuals (5,5% of the total arthropod counts), followed by *Trechus quadristriatus* Clairville, 1806 with 18 individuals. Ground beetles (Carabidae) enter buildings accidentally and do not cause any damage to the exhibits.

Dry wood destroying species were not found on the sticky traps in this study. Only a few individuals of *Stegobium paniceum* (Linnaeus, 1758) and *Lasioderme serricorne* (Fabricius, 1792) which belong to the subfamily Anobiinae) were found, which infest stored products of plant and animal origin. The species are not evenly distributed across the traps in the departments of the building. Even within the rooms, the species are sometimes distributed over small areas.

CONCLUSION

The results presented clearly show that the challenges facing museums due to newly introduced or immigrated arthropod species have changed fundamentally in recent decades. Their biology often differs from Central European species. Detailed descriptions of the economically important species, which are mentioned in this survey, can often be found in their countries of origin. In order to achieve effective control of these "exotic" pests, an exchange of experiences between affected museums is desirable.

To avoid the introduction of these species into museums, pallets, corrugated cardboard boxes and filling material must not be brought into the museum. Exhibits should be inspected upon arrival. Quarantine rooms and continuous monitoring including precise visual inspections offer an optimal solution. The correct identification of the species also with DNA metabarcoding is the basic prerequisite for effective control and protection of the exhibits (Querner et al 2024).

ACKNOWLEDGEMENTS

This research was funded by the Austrian Academy of Science, grant number: Heritage_2020-043_Modeling-Museum.

REFERENCES CITED

Brimblecombe, P., Bibl, A., Fischer, C., Pristacz, H. and Querner, P. 2024. Microclimate of the Natural History Museum, Vienna. Online at: *Preprints.org* DOI:10.20944/preprints202410.1235.v1

Brimblecombe, P. and Querner, P. 2024. Catch of *Reesa vespulae* in Heritage Environments. Insects 15,6: 405.

Heinze, K. 1983. Vorrats- und Materialschädlinge (Vorratsschutz). Bd IV (Leitfaden der Schädlingsbekämpfung), Wissenschaftliche Verlagsgesellschaft mbH Stuttgart; 348pp.

Háva, J. 2021. Beetles of the family Dermestidae of the Czech and Slovak Republics. Academia Praha, 127pp

Klausnitzer, B. 2001. Familie: Dermestidae. In: Die Käfer Mitteleuropas Bd. 6 Larven Spektrum Akademischer Verlag Heidelberg, Berlin. 11-49

Pinniger, D., Landsberger, B., Meyer, A. and P. Querner. 2016. Integriertes Schädlingsmanagement in Museen, Archiven und historischen Gebäuden, Gebr, Mann Verlag, Berlin, 168pp

Pospischil, R. and P. Querner. 2022. Identifizierung der in Mitteleuropa vorkommenden Borstenschwänze. Der praktische Schädlingsbekämpfer, 73 (01), 26-28.

Pospischil, R. 2020. Papierfischchen sind Globalisierungsgewinner. Der praktische Schädlingsbekkämpfer, 72 (12), 12-14.

Querner, P., Szucsich, N., Landsberger, B., Erlacher, S., Trebicki, L., Grabowski, M. And Brimblecombe, P. 2022. Identification and spread of the Ghost Silverfish (*Ctenolepisma calvum*) among museums and homes in Europe. in Insects, special issue on Advances in Urban Pest Management in Europe, 13(9), 855. https://doi.org/10.3390/insects13090855

Querner, P. 2022. The Grey Silverfish *Ctenolepisma longicaudata* and other species of Lepismatidae in Austrian museums. in Proceeding of the ICUP Conference, Barcelona, Spain, 27–29 June 2022.

Querner, P., Szucsich, N., Landsberger, B. and Brimblecombe, P. 2024. DNA Metabarcoding Analysis of Arthropod Diversity in Dust from the Natural History Museum, Vienna. Diversity 16,8: 476. https://doi.org/10.3390/d16080476

Rees, D. 2004. Insects of stored products. Manson Publishing CSIRO Australia, 181pp