Newsletter

of the

Alaska Entomological Society

Volume 11, Issue 1, August 2018

In this issue:

Microarthropods and other soil fauna of Tanana River floodplain soils: a primer 1
Larger insect collection specimens are not more likely to show evidence of apparent feeding damage by dermestids (Coleoptera: Dermestidae) 5
DNA barcoding Alaskan willow rosette gall makers (Diptera: Cecidomyiidae: *Rabdophaga*) 8
How heating affects growth rate of Dubia roaches 14
Review of the eleventh annual meeting 16

Microarthropods and other soil fauna of Tanana River floodplain soils: a primer

doi:10.7299/X7HM58SN

by Robin N. Andrews[1]

Though largely unseen, tiny microarthropods form soils, influence rates of decomposition, and shape bacterial, fungal, and plant communities (Seastedt, 1984; Wall and Moore, 1999; Walter and Proctor, 2013). Difficult to see without a microscope, most microarthropods are between a 0.1 and 2 mm in length. Though they exist much deeper, microarthropods are most abundant in first 5 centimeters of soil where they can reach 70,000 per square meter in early successional alder stages and a million per square meter in mature white spruce stands. These arthropods occupy at least the first couple meters in unfrozen boreal soil decreasing in numbers with depth. We are studying the development of microarthropod communities in three forest stand types along the Tanana River floodplain: early-succession alder, mid-succesion balsam poplar, and late-succession white spruce. Preliminary results indicate increasing abundance and richness of microarthropod taxa as succession progresses.

Alaskan microarthopod communities are primarily composed of mites, collembolans, and proturans, but their communities intersect with larger arthropods like myriapods, spiders, and insects. The soil and litter dwelling mites, formerly known as Acari, are a diverse assemblage composed of species from the superorder Parasitiformes containing members of order Mesostigmata, and superorder Acariformes composed of the suborders Endeostigmata, Prostigmata, and Oribatida (Krantz and Walter, 2009).

Figure 1: Mesostigmata: Ologamasidae: *Gamasellus* sp.

Soil Mesostigmata, a taxonomic distant cousins of ticks, are primarily predators of nematodes and small arthropods (Walter and Proctor, 2013). The Mesostigmata above (Figure 1) is an undescribed species of genus *Gamasellus* (Ologamasidae) found in abundance in our early-succession alder stands.

[1]Ph.D student, Department of Biology and Wildlife, University of Alaska Fairbanks

Endeostigmatan mites often appear little changed from forms seen in the Devonian era, over 400 million years ago, displaying primitive morphological characters like the visible segmentation seen in these Alycidae. The segmentation may make them appear similar to Opiliones (daddy long-legs) but they are only very distantly related (Krantz and Walter, 2009; Dunlop et al., 2014). The Alycidae below (Figure 2) is the mite of the year for 2018. It is purplish, the color of the year. (I informally announce the Mite of the year on New Year's Eve each year begining in 2016: the year of *Gamasellus*).

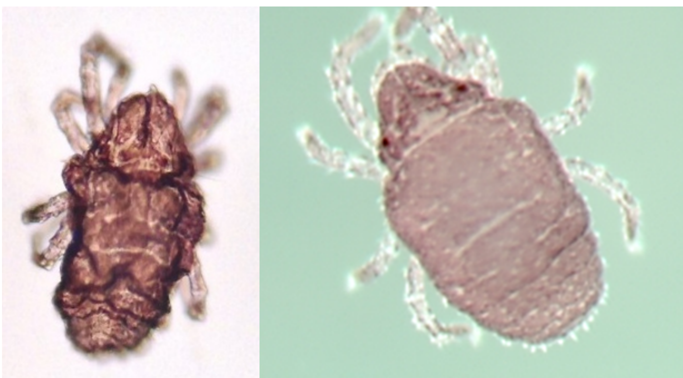

Figure 2: Endeostigmata: Alycidae: *Alycus* sp.

Prostigmata are diverse in form and play many ecological roles among them herbivores, fungivores, detritivores, parasites, and predators. Many have complex life cycles in which they switch their feeding strategy during development, for example from parasites to predators. The Cunaxidae (Figure 3, left) seen here is a predator. The Microdispidae (Figure 3, right) is a fungivore and appears to be carrying a spore, a behavior known from many families of cohort Heterostigmatina. Some Heterostigmatans are thought to farm fungi in a manner similar to ants. (Krantz and Walter, 2009; Walter and Proctor, 2013).

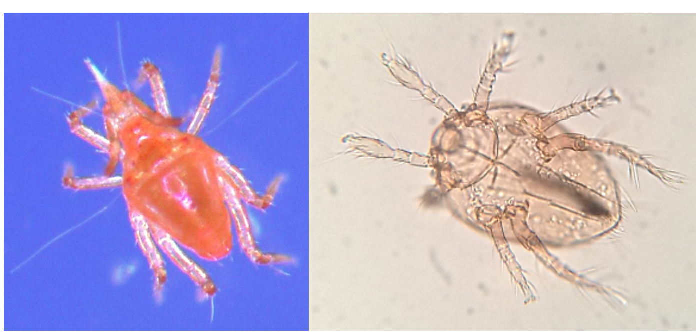

Figure 3: Prostigmata: Cunaxidae (left) and Microdispidae (right)

The suborder Oribatida may be the best-known group of mites and contains some of the most common terrestrial arthropods in the world like *Oppiella nova*[2]. Brachychthoniidae (Figure 4, right) is the most abundant family of Oribatida at our sites. They are early colonizers in the Tanana River's riparian zone while Tectocepheidae (Figure 4, left) appear in much lower abundances, mostly in successional stages dominated by balsam poplar and white spruce. In general, oribatid communities are richer and more abundant later in succession in deeper more developed soils.

Figure 4: Oribatida: Tectocepheidae (left) and Brachychthoniidae (right)

Collembolans, or springtails, and Proturans are taxonomically Hexapoda closely related to insects (Dindal, 1990; Hopkin, 1997; Pass and Szucsich, 2011). Collembolans are found in all successional stages along the river, but similar to oribatid mites, they increase in abundance and diversity in the balsam poplar and white spruce stages. Collembola are thought to be mostly fungivores but may eat litter, bacteria, nematodes, and scavenge other animal foods (Chahartaghi et al., 2005). Collembolans similar to the white one (Figure 5, left) occur in great abundance in our the balsam poplar stands. Entomobryomorph collembolans like the purple one (Figure 5, right) are found most often in the upper litter layers.

Figure 5: Collembola

[2]See https://www.humansandnature.org/unseen-commonest-animal

Proturans (Figure 6) are common in some of our white spruce stands. Conifers form intimate relationships with ectomycorrhizal fungi. Proturans have been observed to eat mycorrhizal fungi and are often found in proximity to mycorrhizal species (Dindal, 1990; Pass and Szucsich, 2011; Zieger et al., 2017). The possible impact of proturans grazing on mycorrhizal fungi and its consequences to ecosystem functions are unknown.

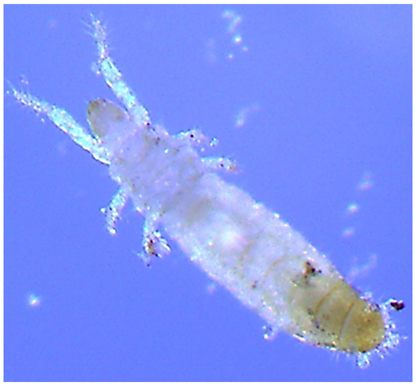

Figure 6: Protura

Pauropods (Figure 7) are small myriapods related to millipedes and centipedes. Along with many pairs of legs (9-11 pairs in the adult), pauropods have branched antennae. These small myriapods are likely fungivores and are found in the balsam poplar and white spruce stage riparian zones (Dindal, 1990).

Figure 7: Pauropoda

Root Aphids (Figure 8) are a group of small insects from the order Hemiptera. While aphids can look a lot alike, different forms can be found in alder, balsam poplar, and white spruce stages along the river floodplain. Aphids with their piercing, sucking mouthparts are known to be important vectors of plant diseases spreading infections and weakening plant defenses (Dixon, 2012). We found aphids in relatively high abundance at an alder site infected with a fungal canker but possible relationships between aphids and infected trees remain to be explored.

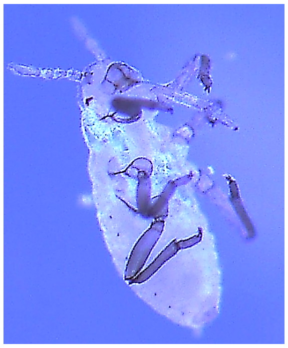

Figure 8: Hemiptera: Aphidoidea

Finally, we found an exotic worm (*Eiseniella tetraedra*) at one study site along the Tanana River floodplain (see Booysen et al., 2018). Worms were collected in summers 2016 and 2017 suggesting that they successfully overwintered in the warm floodplain soils. The spread of exotic worms is a major cause for concern in North America (Callaham et al., 2006) especially Canada (Addison, 2009; Langor et al., 2014). Earthworm spread is well known in more southern regions of Alaska (Costello et al., 2011; Saltmarsh et al., 2016) but relatively new to interior Alaska and more sightings are happening yearly (personal observation). Invasive worms have been shown to negatively influence microarthropod communities (González et al., 2003; Eisenhauer, 2010; Cameron et al., 2013; Schlaghamerský et al., 2014) and may affect other soil fauna (Schlaghamerský et al., 2014; Ferlian et al., 2017) and decomposition rates (González et al., 2003). Below (Figure 9) is a native pot worm, an enchytraeid (Clitellata). Enchytraeids are distant cousins of the better known earthworms in the family Lumbricidae (Erséus et al., 2010). One feature distinguishing them from earthworms is their much wider segmentation. Segments are much longer relative to their width in enchytraeids than in earthworms (Dindal, 1990, Thomas Peham, personal communication).

Figure 9: Enchytraeidae

Stay tuned for future developments!

References

Addison, J. A. 2009. Distribution and impacts of invasive earthworms in Canadian forest ecosystems. Pp. 59–79 *in* D. W. Langor and J. Sweeney, editors. Ecological Impacts of Non-Native Invertebrates and Fungi on Terrestrial Ecosystems. Springer Netherlands, Dordrecht. doi:10.1007/978-1-4020-9680-8_5.

Booysen, M., D. Sikes, M. L. Bowser, and R. Andrews. 2018. Earthworms (Oligochaeta: Lumbricidae) of Interior Alaska. Biodiversity Data Journal **6**:e27427. doi:10.3897/BDJ.6.e27427.

Callaham, M. A., G. González, C. M. Hale, L. Heneghan, S. L. Lachnicht, and X. Zou. 2006. Policy and management responses to earthworm invasions in North America. Biological Invasions **8**:1317–1329. doi:10.1007/s10530-006-9016-6.

Cameron, E. K., K. M. Knysh, H. C. Proctor, and E. M. Bayne. 2013. Influence of two exotic earthworm species with different foraging strategies on abundance and composition of boreal microarthropods. Soil Biology and Biochemistry **57**:334–340. doi:10.1016/j.soilbio.2012.07.010.

Chahartaghi, M., R. Langel, S. Scheu, and L. Ruess. 2005. Feeding guilds in Collembola based on nitrogen stable isotope ratios. Soil Biology and Biochemistry **37**:1718–1725. doi:10.1016/j.soilbio.2005.02.006.

Costello, D. M., S. D. Tiegs, and G. A. Lamberti. 2011. Do non-native earthworms in Southeast Alaska use streams as invasional corridors in watersheds harvested for timber? Biological Invasions **13**:177–187. doi:10.1007/s10530-010-9800-1.

Dindal, D. L., editor. 1990. Soil Biology Guide. Wiley and Sons, New York.

Dixon, A. 2012. Aphid Ecology An optimization approach. Second edition. Springer Netherlands, Dordrecht, Netherlands. doi:10.1007/978-94-011-5868-8.

Dunlop, J., J. Borner, and T. Burmester. 2014. Phylogeny of the Chelicerates: Morphological and molecular evidence. Chapter 16, pp. 399–412 *in* J. W. Wägele and T. Bartolomaeus, editors. Deep Metazoan Phylogeny: The Backbone of the Tree of Life. New insights from analyses of molecules, morphology, and theory of data analysis. De Gruyter, Berlin. doi:10.1515/9783110277524.399.

Eisenhauer, N. 2010. The action of an animal ecosystem engineer: Identification of the main mechanisms of earthworm impacts on soil microarthropods. Pedobiologia **53**:343–352. doi:10.1016/j.pedobi.2010.04.003.

Erséus, C., E. Rota, L. Matamoros, and P. D. Wit. 2010. Molecular phylogeny of Enchytraeidae (Annelida, Clitellata). Molecular Phylogenetics and Evolution **57**:849–858. doi:https://doi.org/10.1016/j.ympev.2010.07.005.

Ferlian, O., N. Eisenhauer, M. Aguirrebengoa, M. Camara, I. Ramirez-Rojas, F. Santos, K. Tanalgo, M. P. Thakur, and M. Rodriguez-Cabal. 2017. Invasive earthworms erode soil biodiversity: A meta-analysis. Journal of Animal Ecology **87**:162–172. doi:10.1111/1365-2656.12746.

González, G., T. R. Seastedt, and Z. Donato. 2003. Earthworms, arthropods and plant litter decomposition in aspen (*Populus tremuloides*) and lodgepole pine (*Pinus contorta*) forests in Colorado, USA: The 7th international symposium on earthworm ecology · Cardiff · Wales · 2002. Pedobiologia **47**:863–869. doi:10.1078/0031-4056-00272.

Hopkin, S. P. 1997. Biology of Springtails (Insecta: Collembola). Oxford University Press, Oxford, U.K.

Krantz, G., and D. Walter. 2009. A Manual of Acarology. Texas Tech University Press, Lubbock, Texas.

Langor, D. W., E. K. Cameron, C. J. K. MacQuarrie, A. McBeath, A. McClay, B. Peter, M. Pybus, T. Ramsfield, K. Ryall, T. Scarr, D. Yemshanov, I. DeMerchant, R. Foottit, and G. R. Pohl. 2014. Non-native species in Canada's boreal zone: diversity, impacts, and risk. Environmental Reviews **22**:372–420. doi:10.1139/er-2013-0083.

Pass, G., and N. U. Szucsich. 2011. 100 years of research on the Protura: many secrets still retained. Soil Organisms **83**:309–334. URL `http://www.senckenberg.de/files/content/forschung/publikationen/soilorganisms/volume_83_3/01_artikel_passszucsich_83-3-18.pdf`.

Saltmarsh, D. M., M. L. Bowser, J. M. Morton, S. Lang, D. Shain, and R. Dial. 2016. Distribution and abundance of exotic earthworms within a boreal forest system in southcentral Alaska. NeoBiota **28**:67–86. doi:10.3897/neobiota.28.5503.

Schlaghamerský, J., N. Eisenhauer, and L. E. Frelich. 2014. Earthworm invasion alters enchytraeid community composition and individual biomass in northern hardwood forests of North America. Applied Soil Ecology **83**:159–169. doi:10.1016/j.apsoil.2013.09.005.

Seastedt, T. R. 1984. The role of microarthropods in decomposition and mineralization processes. Annual Review of Entomology **29**:25–46. doi:10.1146/annurev.en.29.010184.000325.

Wall, D. H., and J. C. Moore. 1999. Interactions underground: Soil biodiversity, mutualism, and ecosystem processes. BioScience **49**:109–117. doi:10.2307/1313536.

Walter, D. E., and H. Proctor. 2013. Mites: Ecology, Evolution & Behaviour. Second edition. Springer Netherlands. doi:10.1007/978-94-007-7164-2.

Zieger, S. L., S. Ammerschubert, A. Polle, and S. Scheu. 2017. Root-derived carbon and nitrogen from beech and ash trees differentially fuel soil animal food webs of deciduous forests. PLOS ONE **12**:1–14. doi:10.1371/journal.pone.0189502.

Larger insect collection specimens are not more likely to show evidence of apparent feeding damage by dermestids (Coleoptera: Dermestidae)

doi:10.7299/X7CV4J2B

by Joel Stone[1] and Derek S. Sikes[1]

Abstract

Dermestids can not only cause damage to museum insect specimens but if left unchecked can ruin museum collections. This study aimed to determine whether larger insect specimens are more likely to show evidence of apparent feeding damage by dermestids than smaller specimens. We examined 366 specimens of various taxa in the Kenelm W. Philip collection, currently housed in the University of Alaska Museum Insect Collection. We measured the size of each specimen and examined each specimen for evidence of dermestid feeding under magnification. The median specimen sizes of the damaged and undamaged groups were compared using a Mann-Whitney U-test. We could not reject the null hypothesis ($p = 0.0878$) that all sizes of specimens are equally likely to show apparent feeding damage.

Introduction

Many different fields of research regularly use museums specimens for a variety of topics from ecology to phylogenetics (Suarez and Tsutsui, 2004; Andersen and Mills, 2012). Because of this, it is important to ensure the long-term preservation and protection of these specimens. Dermestidae are a family of beetles (Coleoptera) that feed on protein-rich, dry animal and plant material. In nature, dermestids provide a key ecosystem function as decomposers, but they are commonly considered pests in museums because they feed on specimens and can be difficult to control (Burges, 1959; Gilberg and Brokerhof, 1991). Many studies have looked at effective ways to protect specimens from this damage (Zaitseva, 1987; Su and Scheffrahn, 1990). But much remains to learned about the behavior of dermestids that feed on museum specimens. The purpose of this study was to determine if dermestids show a size preference in their choice of specimens. However, because live dermestids were not used and we had to assume dermestids were the causitive agents of the observed damage, we tested the null hypothesis that the median sizes of apparent feeding-damaged and undamaged specimens would not be significantly different (with no specification of the causitive agent of the damage).

[1]University of Alaska Museum, Fairbanks, Alaska, 99775-6960, USA

Methods

One drawer of specimens in the Kenelm W. Philip collection, currently held at the University of Alaska Museum Insect Collection, that had obvious signs of dermestid damaged specimens was used (Figure 1). This drawer had exuvia of dermestid larvae, feeding detritus, and obvious holes chewed in specimens, and contained 366 dried, pinned insect specimens of various sizes and insect taxa (misc. orders, specimens thought to have been collected by W. C. Frohne or at least part of Frohne's collection). Size mea-