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STSM Final Report

Project Title 'Identification and Functional morphology of predatory mites in bird nests'

This STSM is within the framework of the ongoing projects 'COREMI (*FA COST Action FA1404*)' and Israelic national project entitled 'Development of a sustainable management program for the control of the poultry mites *Ornithonyssus sylviarum* and *Dermanyssus gallinae*', in collaboration with the Newe-Ya'ar Research Center (supervision by Dr. Eric Palevsky) which deals with 'Integrated control of mites', 'Conservational bio-control in outdoor systems using acarine (mite) predators', 'Food provisioning for the enhancement of acarine bio-control agents', 'Acarine-fungal pathogen-plant interactions'.

As part of the COREMI project (*FA COST Action FA1404*), initiated to improve the current understanding and research for sustainable control of the poultry red mite *Dermanyssus gallinae*, and as part of the Israelic national project entitled 'Development of a sustainable management program for the control of the poultry mites *Ornithonyssus sylviarum* and *Dermanyssus gallinae*', we screened nest contents obtained from wild bird nests (Great tits *Parus major*, and Blue tits *Cyanistes caeruleus*) for predatory mites. These two bird species are among the most abundant European songbird species of woodlands and gardens, from which *Dermanyssus* species - among other mite species - have been isolated. The prime aim was to find candidate predatory mite species that can be used as bio-control measure against poultry mites, by the means of classical light microscopy, 3D scanning stereo-microscopy, scanning electronic microscopy (SEM) photography and DNA-fingerprinting tools. This collaboration with the University of Antwerp has expanded their current survey of poultry houses (from backyards to commercial farms) with mite communities inside nest boxes (i.e. the bird's breeding and roosting spots) from urban and rural areas that were collected (2006-2008 and 2012-2015) as part of a long-term population monitoring project on host-arthropod interactions in hole-breeding songbirds.

At the Newe-Ya'ar Research Center, the arthropod communities obtained via standardized Berlese-Funnel extractions, were sorted out to separate the relevant portion of mites. By means of stereo-microscopic techniques, and the expert knowledge of Dr. Eric Palevsky - we identified 20 isomorphic species groups ('morpho-species'). The 96 specimen could be subdivided over the following families: Laelapidae, Macrochelidae, Uropodidae and Parasitidae. The specimen subdivided according morpho-species, were scanned with a Leica 6VM 3D stereo-microscope, and morphological measurements on these scans were registered in order to ease the morpho-species subdivision (see example, Figure 1). Subsequently, they were placed in the well plate for Barcoding-DNA extraction. The sealed 96-well plate will be sent to Dr. Monica R. Young (Biodiversity Institute of Ontario and Department of Integrative Biology, University of Guelph, Ontario, Canada) for analyses. To ascertain further morphological studies of the specimen after being processed for Bar-coding purposes, we took special care in that the specimen were not damaged by any means. We note that that the barcoding will be done on the mite's hemolymph only, such that the exo-skeletons of the mites remain intact.

Of those morpho-species we had many duplicates, specimen were set aside for making SEM studs, and light microscopy slides. We were able to make a first attempt in the identification

of common morpho-species (*Androlaelaps casalis*, *Macrocheles muscadomesticae*), using the book “A Manual of Acarology” (Krantz, G. W. , and Walter, D. E. (EDS.) 2009. Third Edition. Texas Tech University Press)” and identification key “Taxonomy and biology of soil dwelling acarine predators as potential agents for the biocontrol of agricultural pests” (Compiled and presented by Dr. E.A. Ueckermann, Dr. Eric Palevsky and Prof. Uri Gerson). We emphasize that the final identifications of all specimen will be done by Prof. Dr. E.A. Ueckermann (ARC-Plant Protection Research Institute, South Africa). In the final stage of the project, this world expert in mite identification will make an identification key for all the sampled European predatory mites associated with bird environments where red poultry mites have been found. Together with Eric, they will organize the COST workshop on mite identification, taking place in Israel in September 2016. By then, we will have the report on the Bar-coding results, which will enable us to explicitly focus on un-described/poorly described species, that have a high potential for bio-control measures. Based on a visual screening, the Belgian samples collected during 2006-2008 did not seem (although molecularly not proven) in good condition for DNA analyses. We therefore did not process them further, however, most of the samples are still useful for morphological identification and will be used as study material for the participants of the COST-workshop



Figure 1: 3D-scanning stereo-microscopy photograph of *Androlaelaps casalis*.

The final outcomes and results of this collaboration will form the basis for several publications and future collaborations:

A straightforward outcome of the bar-coding study, will - more than likely - be the discovery of undescribed predatory mite species that are linked with populations of red poultry mites (see above). These new species will be described (morphological and molecular) in scientific publications. Furthermore: the interest of the Evolutionary Ecology Group (University of Antwerp) is the study of the variety of arthropods inside nest boxes at different spatial and trophic levels, by focussing on: parasitic lifestyles, dispersal capacity, host dependence and general life history. The crucial basis for this, is a correct species identification. Hereto, the STSM project's advancements will improve the data quality of observational studies on the population dynamics of arthropods (and mites in particular). Eventually, outcomes on joint (i.e. collaborations between Neve-Ya'ar Research Center and the Evolutionary Ecology group) experimental studies that focus on the capacity of potential predatory mites as bio-control agents (including predation efficiency, functional morphology and dispersal capacity) may result in future publications, although this will be on the long term.

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