ACADEMIA ROMÂNĂ

SCOSAAR

Anexa nr.6

SUMMARY OF THE HABILITATION THESIS

ECOLOGY OF MITE COMMUNITIES FROM TERRESTRIAL ECOSYSTEMS UNDER DIFFERENT LAND‑USE PRACTICES

Habilitation Domain: *Biology*

Author: Dr. Minodora MANU

My habilitation thesis contains the research activity developed over a 19-year career in scientific research, from 2012, when I obtained my PhD in biology, until the beginning of 2026. The habilitation thesis contains four chapters, which describes: (1) scientific, professional and academic achievements; (2) academic career and scientific profile; (3) contributions to the didactic activity and (4): future perspectives in research and academic fields.

Chapter 1. Scientific, professional and academic achievements

The first chapter highlights my comprehensive contribution to the ecology of mite communities from different type of terrestrial ecosystems. The main directions in my research were: communities' compositions, structures and dynamics of mites from soils of Romania; soil mites as bioindicators of land use type and management practices and modern techniques used in mite's monitoring.

Subchapter 1.1 Community composition, structure, and dynamics of mites across different land‑use types.

In the first part of my habilitation thesis, I emphasize that my studies were developed at national level and international, presenting more complex studies focused on the structure, distribution, dispersal rate of soil mite populations from natural and anthropized (urban) terrestrial ecosystems, some of them less studied in Romania, as well as at international level, in Europe (shrubs, cliffs, urban ecosystems). My researches highlight the mites' spatial heterogeneity at local scales (habitats and microhabitats) and their relationship with specific soil environmental conditions. In natural ecosystems, factor as soil type, vegetation cover, soil temperature, and soil moisture content influenced the soil mite communities, even at species level. In the same time I demonstrated that the dispersal rates of mite communities from one studied plot to other were higher in the grasslands, where the soil communities were characterized by the euconstant and constant species. Mite communities had spatial variability that change over time and that biotic and abiotic factors exert regulatory effects. This response of the mite communities could constitute an important tool to predict the impact of habitat changes on specific soil organisms depending on their ecologies.

New and original information and scientific data about ecology of phoretic mites had been pointed out by my researches, developed through the years. These studies were focused on the diversity of phoretic mites living in the bodies of bark beetles or their galleries in the trees, in the natural and planted Norway spruce forests from Romania. These results are very useful in the field of forestry management and forest pathology

because these mites could be a useful biological control tool for bark beetles, the Acari being able to feed on their eggs and larvae.

I improved the current state of knowledge regarding the spatial structural patterns of soil mite communities through my research.

Simultaneously, this study is important for future modelling of soil biological processes at ecosystem scales, providing a natural ecological model, as support for conservation planning or for soil ecological reconstruction.

Subchapter 1.2. Soil mites as bioindicators of land use type and management practices.

This subchapter prominently features new robust scientific evidence that soil mites' communities could be used as bioindicators for the different type of ecosystems management and to demonstrate that human intervention causes important quantitative and qualitative changes of the invertebrate populations from the affected ecosystems in comparison with those from natural areas.

My main contribution in the field of soil mite ecology was to fill the gaps which exists at European level: few studies focused on the ecological aspect of soil mite communities in relation to urban environmental factors. In this context I focused my research on the soil mite communities from managed, unmanaged urban areas and one urban protected area, through a more extensive and original study. The main hypothesis of this research were to investigate: (1): the effect of management regime in urban areas on the community structure, abundance and species richness of soil mites; (2) some key urban environmental variables; and (3) the influence of the selected abiotic parameters on the structure of mite communities in the ecosystems studied.

Through this study I demonstrated that each type of urban areas was characterized by a specifically structure and composition of soil mite fauna. The unmanaged urban areas provided favorable environmental conditions for mite development, due to the soil undisturbed structure and composition, clay soil, which have a large specific surface and predominantly negatively charged, retaining nutrients against leaching and buffering the soil against extreme pH changes. The spatial dynamic of the investigated parameters of soil mite communities related to environmental factors constitute a response of this invertebrate group to the specific conditions of urban green areas under different types of management scenario and under anthropogenic pressure.

Using a modern technique of analysis (X-ray fluorescence spectrometer) I demonstrated that the soil mites are valuable indicators to the heavy metal pollution. Thus, I conducted comprehensive studies, whose main themes were to establish the pollution level of the soil, and to highlight the impact of this phenomenon on soil mite communities from twelve grassland, taking into account the distance from the pollution

source, the degree of pollution, the cumulative influence of heavy metals and an increased number of environmental variables, such as: soil temperature, soil humidity, soil acidity, carbon content, nitrogen total, C/N ratio, slope, altitude, percent of vegetation cover, exposition and soil type.

My main contribution in the research field was to highlight that each grassland ecosystems were defined by a characteristic structure of the soil mite populations. All heavy metals exceed the reference legal values concentrations in almost all investigated grasslands. The heavy metal concentrations increased with the proximity to the pollution source. The degree of pollution with heavy metal from soil in investigated areas and the distance from pollution source were the main variables that influenced the soil invertebrates. The mite communities from the most polluted areas, as well as from the ecosystems situated closest to the pollution source, were distinguishable from those from less polluted grasslands, further away from the source of pollution. Heavy metals as Cu, As, Zn and Pb influence the soil mites from highly polluted ecosystems. At the same time, the influence of some heavy metals on mite populations is correlated with other environmental variables, as soil humidity, soil temperature, altitude, slope, exposure and type of soil, Nt and C/N.

This studied highlighted that the soil mite communities are affected by heavy metal pollution, as well as investigated environmental variables, , resulting in modified species diversity, and altered numerical abundance and species composition. Therefore, these very important results allow the use of the soil mite fauna as a valuable biological tool for heavy metal impact assessment from polluted ecosystems.

Subchapter 1.3. Modern techniques used in mites' monitoring from terrestrial ecosystems under varied land-use practices.

The concept of ecological sustainability means the protection of the diversity and functioning of natural ecosystems, as well as the preservation of ecosystem services they provide for future generations. Sustainability relies on equilibrium between nature conservation and economic production and involves the recognition and monitoring of critical areas.

Monitoring of biodiversity, in natural/protected and disturbed areas can be performed using modern techniques such as remote sensing coupled with GIS. Large-scale inventories and monitoring studies are time consuming, costly, and rarely very accurate. Most often, specialists must study each individual organism, considering at the same time its relationship with environmental variables and the spatial and temporal dynamics. In addition, in many types of ecosystems, monitoring can be risky due to challenging environmental or socio-political conditions.

Studies making use of satellite remote sensing for monitoring terrestrial arthropods are scarce. In most ecological studies taking advantage of satellite remote sensing, biodiversity was assessed using indices of alpha or beta-diversity. Many of the remote sensing studies did not directly address standard biological metrics of species diversity, but instead assessed biodiversity indirectly by characterizing habitats, the dominant vegetation, or vegetation functional traits, which requires careful consideration of temporal, spatial, spectral and biological scales.

The main aim of the present research was to evaluate on a global scale, whether remote sensing is appropriate for mites monitoring, assuming that invertebrates are indirectly dependent on some features that remote sensing is able to capture.

I brought new insides about using remote sensing techniques for understanding mite ecology and application in monitoring and management, and also about the modernization of monitoring methods (scalable, non-invasive).

According to my research, I discovered that remote sensing techniques were mainly studied in the USA in different types of ecosystems and in different economical fields, but were used in many other countries as well. These techniques were used to detect and diagnose mite-pest infestations in agricultural fields, orchards or greenhouse plants, investigating and characterising the possible associations between crop leaf reflectance and unique pest-induced changes in plant compositional traits. Most mite species that have been investigated have economic importance or are species with great impact on human health. Remote sensing is an indirect method for the quantification of mite density, revealing the degree of infestation of plants by these arthropods.

I discovered that the transfer of this method into practical management requires a) determination of the scale on which mite invasion can reliably be estimated; b) better standardisation of aerial imagery; c) taking into account of the environmental factors that affect the imagery; and d) ground-level research. Considering the scale of this monitoring method, we observed that in the agriculture field the majority of the used remote sensing indices were applied mainly at local scale (glasshouses, greenhouses or plantations). Considering the mites with impact on human health, these indices were used at regional scale (different types of ecosystems, districts areas). On the other hand the remote sensing technique is the most feasible for the mite species which damage plants health and less proper for mites which are involved in decomposing process. Before this remote-sensing methodology can be transferred into practical management, I discovered that an absolute scale must be determined, on which mite invasion can reliably be estimated. If such a scale can be found, remote sensing could become a useful tool for early detection of mite damage. A better standardisation of aerial imagery and accounting for those environmental factors that affect the imagery will be necessary for making this technique applicable for early plant or habitat detection affected by mites.

With some precautions, remote sensing offer reliable and effective tools for the analysis, management, planning, policy-making and decision-making needed to pursue the goal of sustainability, even if we consider these small soil invertebrates (mites), which are involved in human and ecosystems health. Successful application of remote-sensing methods to practical management would also facilitate adaptive approaches, allow sustainable land usage and avoid long-term damage and degradation of agricultural land.

Chapter 2. Academic career and scientific profile.

In this chapter I present my academic career, during of 19 years of research activity.

After doctoral studies my research was focused on ecology and taxonomy of soil invertebrates, from different types of natural-protected and man-affected ecosystems (using them as bioindicators for terrestrial ecosystems under impact of different land use types).

In Romania, soil fauna from anthropogenic areas were very poorly studied that why I was focused in my research on this modern field to highlight the impact of heavy metal, chemical fertilizers or airborne pollution on soil mite communities.

I studied ecology of soil fauna from urban ecosystems, industrial areas, anthropized grasslands, highlighting the modification on its structure and dynamics, considering the land type use and anthropogenic pressures.

In the same time correlations between biotic/ abiotic factors and soil fauna were established, even at small scale.

My findings focused on unmanaged urban green areas as “hotspots” of soil mites’ diversity.

Another modern research field where I activate is to integrate soil biodiversity to ecosystem services, being recently involved in a European project financed through European Union's Horizon 2020 - Research and Innovation Framework Program, entitled “Integrating Soil Biodiversity to Ecosystem Services: testing cost-effectiveness of soil indicators to build better land management solutions that effectively implement the soil health and food mission”.

As senior researcher- expert in soil biodiversity I will participate in a national program “Romanian Centre of Excellence on Biodiversity, Ecosystem Services and Society (0124), financed by the UEFISCDI in the period 2026 - 2031, whose purpose is : targets biodiversity, ecosystem restoration and ecosystem services, through its four research objectives, focused on: theoretical understanding of ecosystems, applied ecology, pathways for co-production of ecosystem services and governance structures for human-nature reconnection.

First time in Romania, my research in the last 10 years developed at international level focused on the assessment of the interrelationships between soil mite biodiversity and ecosystem services for representative soil types, land use types and intensity and pedoclimatic regions.

At national and European levels, I contributed greatly to the integration of soil biodiversity (mites especially) as bioindicators into comprehensive monitoring and land management planning. Through the research projects, I am involved in developing management practices to enhance soil biodiversity linked to these ecosystem services.

During the last 19 years, I collaborated with more than 30 national specialists, from 29 national research institutions. At international level, I developed collaborations with 26 research institutions from the world, from 18 countries. I also published *46 WOS Core Collection-ISI indexed papers* (from which 7 papers ranked in Q1 and 7 papers in Q2), *40 papers in international data based papers* (BDI), 9 books, 8 book chapters and 35 other national papers. According to WOS (all data base) my *Hirsch index = 11,* WOS Core Collection my *Hirsch index = 10* and to Google scholar, *h-index=17.*

I was scientific reviewer for: *42 ISI indexes journals* (79 scientific papers) for famous publishers, as: *Springer Nature; Elsevier: Taylor & Francis Online; Wiley Online Library; PLOS One*, etc.; 6 BDI indexed journals (9 scientific papers); and 3 national journals. I participated at 80 international conferences (with 107 presentations) and at 24 national conferences (with 73 presentations). I participated at 9 international and 18 national research projected (in 2 as project manager), financed by Romanian Academy or by Romanian Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI).

Chapter 3. Contribution to the didactic activity.

My contribution to the didactic activity was classified as following: university level (*3 PhD students*; *13 scientific papers*; 30 presentations at international conferences; 8 presentations at national conferences; 8 years of collaboration)/project manager and facilitator for youth within international projects financed by the *EU, program Erasmus +* (4 international projects; *165 trained teenagers; 9 countries*; 13 years of didactic experience)/ environmental professional trainer (3 training courses; 77 trained participants; national level)/ pre-university level (coordinator of 2 collaboration agreements; 60 trained school children).

Chapter 4. Future perspective in research and academic fields.

My future perspective in research and academic fields is based on some strengths: my excellent expertise in participating at existing projects that starts recently in the Institute of Biology Bucharest and also to participate at the competitions for obtaining

new ones, engagement as volunteer in both international and national research initiatives, along with the development of exploratory and conceptual research ideas

The future research topics are:

- integrating soil biodiversity to ecosystem services;
- national monitoring program of the soil biological quality;
- "European Atlas of Soil Fauna"- as a tool for the conservation of soil biodiversity;
- global Oribatida community data collection from the world;
- the influence of the stand characteristics on the mite communities from Romania;
- effects of beekeeping practices and use of acaricides on *Varroa destructor* infestation levels in Romanian apiaries;
- soil mite fauna-bioindicator of urbanization in forest ecosystems;
- soil fauna as bioindicators of agricultural management practices; etc.

I highlight that all these future proposals are opened to many others national and international collaborators, and I am looking forward for students with different university degrees. All these collaborators are absolutely necessary for a research that in Romania should equal the international standards and even to exceed them.

As a responsible of Posada Research Centre (Stationary) - Institute of Biology Bucharest, Romanian Academy, I will have the opportunity to collaborate with students and with specialists from the field of ecology, but also from other specializations (forestry, biochemistry, soil science, climatology, geography, etc). The purpose of this research Centre is to provide an open, favorable research environment for collaboration on various research topics, being included in ERRIS platform (https://eertis.eu/ersv-2400-003v-4814 and https://eertis.eu/ersv-2400-003f-4815).

My professional expertise offers me the capacity to participate at future comprehensive studies not only on mite fauna but also to be involved in numerous inter- and trans-disciplinary research projects at national and international levels.