Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Ecology Department
Ecosystem Ecology group

Master's Thesis Project

Ecological interactions between a fallow deer (*Dama dama*) population and soil fertility assessed through plant community structure

Location: Koberg hunting reserve, southern Sweden (Trollhättan)
Main supervisor: Lorenzo Menichetti

Main scope of the project:

1. Developing a **methodology to asses soil fertility based on plant communities**
2. Describe the **effect of deer grazing** (two different intensities) **on plant-based soil fertility**

Project scope description:

There is a close link network between the activity of big mammals, soil nutrients and plant communities. This project is part of a bigger project examining the ecological influences of a population of fallow deer (*Dama dama*) on soil fertility and plant communities. This master project is focused on the last two, and in particular on the development of a new technique for predicting soil fertility by analyzing plant communities. This new tool will allow exploring the relationship between deer activity and soil fertility, and understanding better the influence of these mammals on nutrient fluxes.
The link between plant community structures and soil fertility is well known and used in the literature through categorical indicators such as the Ellenberg indicator

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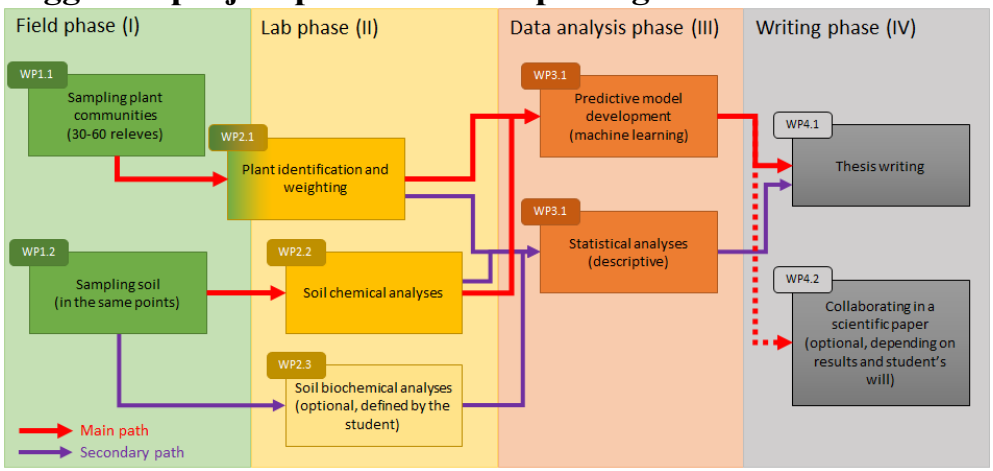
values (EIV) [1], but this method is based on German and British plant communities studies and it is on a relatively simple linear system considering only binary absence/presence. A plant community structure, with biomass weight per species, contains more information and is comparable to a spectrum.
From here, the idea of utilizing machine learning techniques originally developed for spectral chemistry (such as partial least square regression, PLS[2]) for predicting soil fertility based on plant community studies. These techniques will be applied to a dataset composed by plant community structure and measured soil fertility indicators for a series of GPS points distributed over the study area. The main deliverable of the project will be a method able to predict soil fertility based on plant community structure, that can then be used outside the studied area and possibly extended (after proper validation and testing) to southern Sweden. The method will be compared with a more conventional Ellenberg indicator and fine-tuned for southern Sweden.
The impact of the project, although in the context of a bigger effort, is therefore possibly quite relevant on a national scale.

Suggested project plan and work packages:



Student inputs

During the field phase

The student is expected to perform the samplings on the field of soil and plant communities. The plant species will be identified in the field; plant biomass will then be weighted in the lab.

During the lab phase

The student is expected to perform the weighting of the plant, to check the plant identification and to perform all the soil chemical analyses related to soil fertility. Depending on the student's interest, more soil analyses can be discussed.

During the data analysis phase

The student is expected to perform the descriptive statistical analysis of the data, and to collaborate with the main supervisor to develop the predictive model.

During the writing phase

The student is expected to write his master thesis autonomously (under guidance of the main supervisor). Depending on the quality of the results and the student's interest and will, there is the possibility to collaborate to a scientific manuscript.

Main supervisor input

The main supervisor will follow the student across all the activities of the project, but will help in particular with all the activities related to more advanced data

analysis and machine learning. The student will be required to learn some basic R programming skills in order to be able to read the provided code and discuss the principles on a peer level, but the coding technicalities will be developed mainly by the supervisor with the interaction of the student.
The student will be required to learn and perform the basic descriptive statistic (e.g. ANOVA), although the main supervisor will guide the learning process.

Requirements for the project

- Good botany knowledge, familiarity with Swedish flora
- Familiarity with plant taxonomic keys
- Interest in soil science
- Interest for ecosystem ecology
- Willingness to learn basic scientific programming and perform statistics
- Interest for data analysis methods

Time plan

The field phase of the project must be performed during late spring/summer 2018.The project is allocated for a total of 30 credits, of which 7.5 are for sampling activities, 7.5 are for lab activities, and the remaining 15 for data analysis and writing.

For more information please contact Dr. Lorenzo Menichetti, Lorenzo.Menichetti@slu.se