Internship report: Faculty of Environmental and Forest Sciences, Agricultural University of Iceland

In the summer 2024 I participated in an Erasmus+ internship, at the Faculty of Environmental and Forest Sciences at the Agricultural University of Iceland. The main areas of research conducted at the faculty are ecological restoration, ecosystem ecology, land use change, wetland ecology, and soil and atmospheric sciences.

The internship was a part of a bigger project called *Assisted development of biological soil crust for ecosystem restoration*, funded by the Energy research fund (Orkurannsóknasjóður, Landsvirkjun). The project is run by Dr. Alejandro Salazar (specialized in soil science and microbiology), whom was my main supervisor and the colleague I worked the closest with, and Prof. Ása L. Aradótti (specialized in ecology and ecosystem conservation/restoration).

The overall aim of the project is to study the possibilities of developing biological soil crust, also termed biocrust, on eroded and nutrient poor soils in Iceland. Earlier studies shows that seedlings of vascular plants, like birch and willow, favors soils covered with biocrust compared to bare soils (Havrilla, Leslie, Di Biase, & Barger, 2020; Aradottir & Arnalds, 2001). Biocrust, which forms in the first few millimeters-to-centimeters of the topsoil, is rich in microscopic (cyanobacteria, fungi, algae and bacteria) and macroscopic (lichens, mosses and microarthropods) organisms. The combination and abundance of species varies between types of biocrusts. In general, biocrusts stabilize soils, fix C and N, retain water, and create rough surfaces for wind protection (e.g. for seeds and small plants) (Belnap, Weber, & Büdel, 2016). Biocrusts are often seen as pioneers in ecosystem after land disturbances (Gall, Nebel, Quandt, Scholten, & Seitz, 2022; García-Carmona & et-al., 2022), in arid and semiarid environments with limited water access (Roncero-Ramos, Román, C. Gómez-Serrano, Cantón, & Acién, 2019), or when colonizing new land like after glacial retreat (Breen & Lévesque, 2006). The main aims of the research are 1) to compare different methods for developing biocrust on eroded soils in Iceland, and 2) to assess the potential of mature biocrusts in Iceland to facilitate the establishment and growth of seedling of birch and willow, two species of interest for restoration in Iceland and elsewhere.

My assignment

I participated in two experiments, each related to one of the two main research goals. In both experiments I got the main responsibility of executing and monitor them, under regular supervision and assistant of Alejandro and Ása. This is the first time I have been provided with such a level of responsibility when conducting research. It has really shown me the reality of research, how many elements that all need to come together to execute your plans and time schedules. The first experiment was set up in a growth chamber where 20 soil samples were given four different treatments, this included, among other things, cultivation of cyanobacteria in sterilized conditions. The experiment was monitored and will continue to be monitored until spring 2025. I measured C fluxes, including soil respiration as a proxy for microbial activity, with a LI-COR 7810 attached to a dark soil gas chamber; and Normalized Difference Vegetation Index (NDVI), as proxy for primary productivity. In the second experiment we had together collected 15 samples of mature biocrust from three different areas in Iceland and 15 corresponding bare soils (i.e. controls) from the same three areas (n=30). These samples were then seeded with 20 willow and 20 birch seeds each, which we had to collect in nature (willow) and borrow from earlier experiments (birch). Most of the data gathering for this experiment will be performed in spring 2025 with destructive methods (e.g., elemental analysis).

In the beginning of the summer, I also participated in meetings with the Tundra Ecology Lab (https://tundraecology.hi.is/), a cross-institutional group in Iceland with focus on ecosystem processes in tundra environments. Here I got the chance of presenting the planned experiments to the group, which was both good practice and an amazing opportunity to prop the minds of such a knowledgeable group.

It was originally hoped that over the summer I would also help supervising a student from the GRÓ program (https://www.lbhi.is/study-programmes/other-studies/gro-lrt-land-reclamation-school), and that this student should have been a part of our project team, but unfortunately I did not get to have this learning experience since none of the GRÓ students chose our project to work with.

My experience with the job

Earlier experiments I have participated in, in lab or in field during university courses, have all been short termed and assignments more or less formulated by the professors, who might have

been conducting them for the last 10 years as part of the curriculum. They were already structured for me, and all necessary equipment provided. This time I had to figure out what was needed, what could be done with the available resources and how to coordinate the use of instruments, that other researchers might also be using. I was of course in the beginning presented with an overall outline of how the two experiments should be performed but the details and execution were up to me in close teamwork with Alejandro. It has both been exciting and instructive to stand with the decision-making. Not only have I learned more about the choices and unpredicted difficulties of research, but also how I personally react to these. For the first experiment, I ran into problems with the growth chambers, which I then had to solve with a technician in China. The laboratories autoclave malfunctioned which meant finding and arranging a visit from another technician and together with Alejandro I had to coordinate using the autoclave at the University of Iceland. I also experienced the need for readjusting original experiment setup when I saw that they in reality were not sustainable for a long-term project. This was mainly the watering of the samples of experiment 1. The growth chamber did not have any hydration options and the original plan turned out to be time consuming and with risks of altering the soil surface. I then had to build a hydration system in the chamber and figure out a solution where we could control exactly how much water was given a day and which would be easy to maintain when I left Iceland.

In writing these things seems trivial, but after I have worked with this all summer, I have been surprised about how time-consuming tackling these day-to-day problems can be, and how many small decisions and adjustments research requires. Of course, I am also relatively inexperienced and if I continue my career within science, I can probably make these decisions much faster and more confidently.

Feeling more like a part of the university team and less like a student was also fruitful. It opened the doors to participate in the Tundra Ecology Lab meetings and more naturally having lunch with the professors and PhD students, which allowed for further helpful talks and networking.

In sum up, I have been very happy with this internship experience; it has shown me more clearly what is required when doing research and given me a much more realistic idea about the timeframe needed for different elements and that extra time might be required in the overall schedule due to unpredicted difficulties. As the internship comes to an end, I feel like I have contributed with good problem solving and even made the initial experimental designs stronger and more self-maintained for the coming months.

Summary

During the summer of 2024, I completed an Erasmus+ internship at the Faculty of Environmental and Forest Sciences at the Agricultural University of Iceland. This internship was part of a larger project focused on the assisted development of biological soil crust (biocrust) for ecosystem restoration, overseen by Dr. Alejandro Salazar and Prof. Ása L. Aradóttir. The aim of the project is to explore the development of biocrust on eroded, nutrient-poor soils in Iceland to support the regeneration of native birch and willow forests.

Biocrusts, comprising microscopic and macroscopic organisms, can stabilize soils, retain water, and protect seeds and small plants. Biocrusts are often pioneers of ecosystems in arid environments and in areas recovering from disturbances.

During my internship, I was responsible for the establishment of two experiments. The first one was a comparison of three different methods for assisting the development of biocrust on eroded soil. The second experiment involved collecting mature biocrust and bare soil (i.e. control) samples from various locations in Iceland and planting willow and birch seeds in them to study seedling establishment and growth.

During my internship, I engaged with the Tundra Ecology Lab, presenting our planned experiments, and participating in discussions.

Overall, the internship provided me with a realistic understanding of the complexities and time requirements of scientific research, enhancing my problem-solving skills and making me feel more integrated into the academic community. I gained significant hands-on experience in research design and execution, troubleshooting, and teamwork.

Bibliography

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