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sDiv working group meeting summary

”sROOT”

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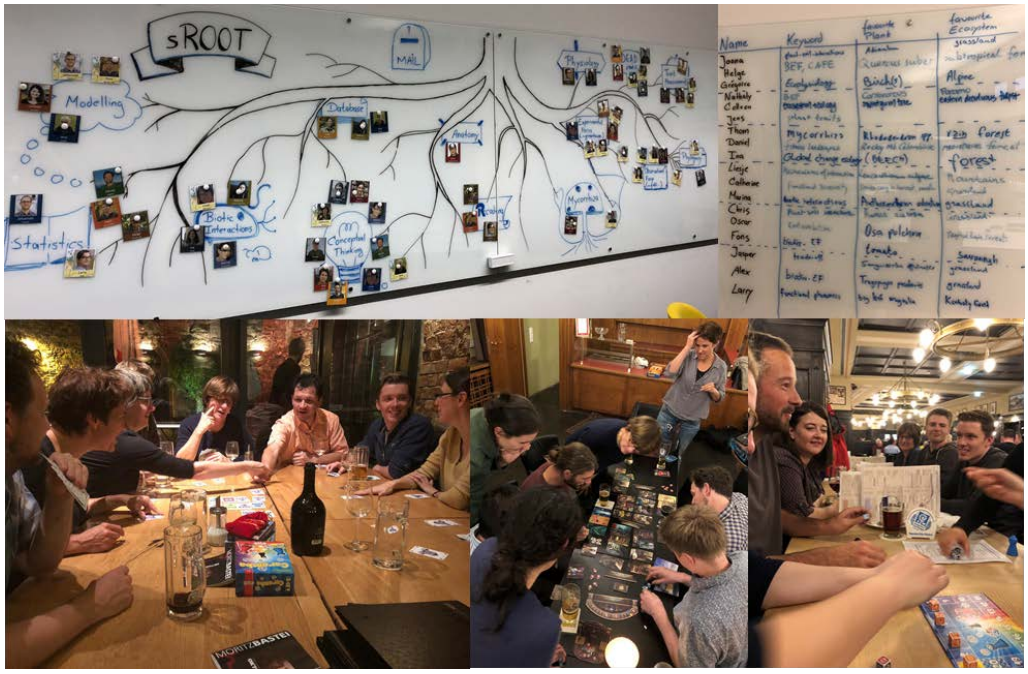
The first of three sROOT workshops was held in October 2018 with 18 participants, many of which had not met before in person. The main goals of this workshops were (1) to form a group spirit of trust and mutual respect that would allow open and critical discussions during this and future workshops, (2) in depths discussions of the concept of multidimensional root trait variation – the key topic of the working group, (3) supportive work and discussions on the sROOT database of fine root traits and (4) an outline of paper projects and future workshop contents.

We approached our **first goal** with a combination of classical and innovative ideas on working in groups starting with a speed-dating round on non-scientific content in the courtyard of the building as an ice-breaker. Instead of a formal scientific introduction of all participants we had people pin there prepared pictures to a whiteboard indicating different areas of expertise as well as filling a list with keywords and favorite ecosystems. In addition we took socializing as an important primary task and organized board games on the first evening which was so positively received that the majority of participants ended up playing some game whenever we went out for dinner together (see pictures below). In addition we assigned individual tasks to all the participants which supported the group spirit and overall feeling of usefulness.



Our **second goal** was started with a critical discussion of four selected key papers on the topic in smaller groups as well as an overview over the scientific background given by the PIs. Subsequent discussions centered around two main axes of root trait variation with specific root length (SRL) against root diameter (RD) forming the first

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axis and root nitrogen (RN) versus root tissue density (RTD) on an orthogonal second axis and how these traits might be linked to the importance of mycorrhizal colonization of roots. We expected some biophysical constraints which dictate to some degree how root tissue can be constructed: thin roots that are low in density may be too feeble while roots that are too thick and too dense may be to costly to construct. However, recent papers show that RTD and RD vary relatively independently which might be due to the relationship between the diameter of the stele and the cortex (C:S ratio). The dense stele tissue has higher carbon construction costs, lower cell size and higher lignin concentration while cortex cells have higher metabolic rates with higher N content and offer space for mycorrhizal colonization. Our conceptual idea after many hours of discussion in separate groups suggests that root economic spans two important trade-offs that were generated by different selective pressures. The first is a strong tradeoff between diameter and SRL which represents a gradient in collaboration with fungal partners (high root diameter outsource resource acquisition to fungal partners whereas high SRL have a do-it-yourself strategy). The second is a tradeoff between RTD and RN with represents a gradient of tissue construction costs. These two trade-offs span the economic dimensions of root form and function. We started to test this idea with our fine root database during the workshop and found at least the main axes were as expected.
Every day, we had asked one of the more senior scientists to present a vision of the day. The scientists took this task seriously, and did terrific jobs in summarizing the discussions of the day before and setting the stage for the new day.

The **database (goal 3)** was a clear priority of the first workshop and we were able to hire a short term postdoc, Nathaly Guerrero-Ramirez, to do most of the work before we started. However, a multitude of decisions and detailed questions concerning the database were still open at the beginning of the workshop and there always was a small group of participants to help Nathaly solve these problems. In addition, there was a “data cruncher” subgroup starting to write R code to answer our key questions which put the preliminary database to a rigorous test and clarified many features of the database for subsequent analysis. We were able to test some of our key hypotheses with our preliminary database during the workshop and shortly after. Among other things, this strongly indicated that we have very limiting data on one of our key traits, the cortex:stele ratio of fine roots. We decided as a group effort to increase data points on this trait and agreed on a simplified measurement protocol for the trait during the workshop. With this we provided a list of species asking all participants to measure cortex:stele ratio for at least a number of species on that list until the second sROOT workshop. Many participants have engaged in this action and our data is constantly growing, also now when the participants are back in their offices.

sROOT participants identified **four individual paper projects (goal 4)** as outcome for the group. The first will be a data paper of the sROOT database lead by Nathaly Guerrero-Ramirez with all sROOT participants and all data contributors as co-authors. The second will be a high ranking paper on “The economic consequences of outsourcing: Moving toward a root economics space”. We produced the first version of an abstract together with a bullet point outline of this paper and some preliminary results based on the database during the workshop. This paper is led by Joana Bergmann who already finished a first draft of the introduction and intends to present a full draft of the paper at the second workshop in May 2019. Data analysis for this paper is led by Alfons van der Plas together with Larry York. We intend to have time for intensive text work and discussion during the second workshop and submit this paper before August 2019. Our third paper will focus on the link between trait-

coordination and environmental gradients. This paper will be led by Daniel Laughlin and will be the main goal of the second sROOT workshop. We already discussed the data needs and some of the main statistical approaches for this paper and are currently preparing the data necessary for this goal together with finishing the database in general. Paper number four will most likely focus on above-belowground trait correlations and the link between the two economic spectrums. So far Luke McCormack and Oscar Valverde-Barrantes are interested in taking this lead but this still awaits a final decision. This topic, together with finalizing paper three (together with potential revisions of papers one and two) will be the focus of sROOT workshop 3 in January 2020.

Overall, we are very content with the course and output of the first workshop. The sDiv team was incredibly supportive and forthcoming with all our requests. They even went through substantial additional work to allow for money transfer from our side so we could hire a short term postdoc for the working group database. This proved extremely helpful for the overall success of the group.