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Soil transplantations for nature restoration on former arable fields – next steps

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Nature restoration on former arable fields represent one of the few opportunities to not only protect nature, but strengthen it by providing new habitat and connecting existing nature areas. However, natural succession is a notoriously slow process that depends in part – as it is now becoming clear – on the interactions of plants with their soil communities. Soil biota are the crucial players in many ecosystem processes and the composition of this community is also subject to successional changes. Soil transplantation may provide an effective measure to shortcut natural succession if well-developed soil communities are transplanted to sites that are to be restored.

In the last Biodiversity works newsletter¹ we introduced the large-scale soil transplantation experiment we conducted at the Reijerscamp - a former arable field on sandy soil. We showed that in combination with top-soil removal – to reduce the high nutrient loads – transplantation of heathland soil, in particular, resulted in a vegetation that was much more similar to the target vegetation within six years. Now we have also completed our belowground survey of bacteria, fungi, nematodes and mites – all of them major components of the soil food web. Surveys on belowground natural succession show that soil communities shift over time from bacteria- to fungal-dominated systems and our data show that with soil transplantation the fungal community is much richer in fungi than without. In addition, soil transplantation substantially rehabilitated the nematode and mite communities that suffered heavily from top-soil removal. In total we found 61 nematode (roundworms) genera, 22 springtail species and 16 other groups including beetles, spiders and various insects. All in all, there is a lot going on belowground!

The next question we are now tackling is whether the soil community drives the successful changes in vegetation we observed in the field. Transplantation of bulk soil not only leads to the transfer of soil organisms to the new site, but seeds are concomitantly introduced as well. This summer we set up a greenhouse experiment – that is still ongoing – where we sowed standardised seed mixtures of 30 plant species into pots that were inoculated with the different soil communities found in the field experiment (Figure 1). The selected plant species are all typical for vegetations on sandy soils, covering the entire range from early-successional ruderal plants to target species from species-rich grasslands and dry heathlands. Through the use of standardised seed mixtures, the seeds available for germination are the same across all treatments. Consequently, when we find clear differences in plant community composition, in line with those found in the field, then this is clear evidence of the potential of soil biotic communities to aid nature restoration through soil transplantation.

For nature managers the exact mechanism is much less relevant – as long as the method works. To share our results with our stakeholders and other parties that collected biodiversity data in the area we held a ‘data-meeting’ this year (Figure 2). During this meeting the observations on various groups of organisms were discussed and together they form the basis of an evaluation report, which we are working on, that synthesises the experience of our stakeholders and us with this large-scale experiment. In addition, we are also very happy with the exposure of our work in popular media, in books (Abels et al ‘Wild en bijster land. Planken Wambuis’), radio (Vroege vogels²) and television in the Netherlands (Labyrinth³) and abroad (SAT3/nano ZDF⁴).

1 <http://www.nwo.nl/onderzoek-en-resultaten/programmas/onderzoeksprogramma+biodiversiteit+werkt/Nieuwsbrief>

2 [http://vroegevogels.vara.nl/Fragment.202.0.html?tx_felogin_pi1\[forgot\]=1&tx_ttnews\[tt_news\]=359858](http://vroegevogels.vara.nl/Fragment.202.0.html?tx_felogin_pi1[forgot]=1&tx_ttnews[tt_news]=359858)

3 <http://www.npowetenschap.nl/programmas/labyrint/labyrint-tv/2012/oktober/Sponzen.html>

4 <http://www.3sat.de/mediathek/?mode=play&obj=43441>



Figure 1 | Although the soil transplantations were done slightly differently, this involved trucks and manure spreaders, a lot of soil still has to be collected for experiments in the greenhouse (left). However, after all that work there is only one image even more reassuring than seeing your plants growing and competing happily in their pots (right) – and that is seeing all the data in a spreadsheet.

As one of the next steps we will present our findings at the First Global Soil Biodiversity Initiative (GSBI) conference⁵, one of the largest gatherings of soil ecologists worldwide, in December 2014. At that conference a large international group of early career scientists will present a statement on the critical need to consider and implement strategies for the sustainable management of soil biodiversity. We made important contributions to the drafting of that statement.

Next year, we plan to organise a national symposium on the science and practice of soil transplantations. We hope and think this will be a very successful meeting, especially since we have already identified 24 other projects in the Netherlands where soil transplantations are now being carried out.

In addition to our more applied science in the context of nature restoration, we are also working on improving our fundamental understanding of the consequences of plant-soil biotic interactions for plant communities in spatially explicit settings. While the results of this work are less easily translated into management practice, we nevertheless find the outcomes very interesting and hope to inform you on this in the future.



Figure 2 | During the 'data meeting' nature manager Machiel Bosch (Verening Natuurmonumenten) introduces the history of the Reijerscamp, the site of the field experiment (left). At the end of the day there was time for a field excursion where, for example, the permanent quadrats of one of the participants were inspected (right).

⁵ <http://www.gsbiconference.elsevier.com/>