Global comparison shows that soil transplantation boosts nature restoration

February 13 2023

Soil transplantation projects worldwide come in all shapes and sizes, but what works and why? It is important to treat donor areas wisely and respectfully. From upper left, clockwise: 1) control-treatment comparison restoring semi-dry grassland near Munich, Germany in 2015, 20 years post-treatment. 2) soil translocation in action, triggering tropical dry forest regeneration, near Brasilia, Brazil. 3) Reference vegetation on a Quercus rotundifolia dehesa soil in

Salamanca, Spain. 4) Soil receiver site preparation to restore coastal sage scrub in Orange County, southern California, USA. Credit: Wolfgang von Brackel, Maxmiller Ferreira, Ignacio Santa-Regina/Irnasa-CSIC and Megan Lulow/UCI-Nature / Collage: NIOO-KNAW

A new study comparing 46 field experiments in 17 countries across four continents clearly spells it out: Areas in need of nature restoration benefit from soil transplantation. The global results were collected by an international research team coordinated by Jasper Wubs from the Netherlands Institute of Ecology (NIOO-KNAW). Their findings are published today in the *Journal of Applied Ecology*.

From boreal grasslands to tropical forests, the gamut of nature to be restored on our planet is wide. There's an urgent call for effective restoration methods, but what actually works? In many places, nature could do with a transplant; not of vital organs but of soil, with healthy natural areas as donors.

It sounds almost too good to be true: You take some healthy soil including the associated soil life and plant seeds, and you "make a donation" in an area where nature is degraded. Following this soil transplantation, natural life will recover at an accelerated pace, sustained by soil that is alive and healthy once more.

NIOO ecologists had already demonstrated the efficacy of the treatment in the Netherlands, using a layer of soil not even half a centimeter thick. But how well does it work worldwide? No overview had been available until an international team led by NIOO expert Jasper Wubs started digging into this, and unearthing hopeful results.

Better chances

The team's main conclusion is that soil transplantation does work around the world. "From the tropics to the tundras, soil transplantation substantially improves the chances of restoring vegetations with species of high conservation value," explains Wubs, "particularly if it's applied over larger spatial areas."

Vegetation on sites with transplanted soil (including its associated soil organisms) blossoms literally and metaphorically in terms of species count and diversity. Soil transplantation increased the similarity to the reference vegetation by an average of 40% compared to hay addition.

However, the differences between experiments were substantial. Wubs notes, "We observed that soil transplantation would either become more and more successful in the longer term or just the opposite." Success was more likely on loamy soils, the researchers found, and when the treatment was implemented over areas of 180m^2 or larger.

Nature restoration law

What does that mean in practical terms for nature management and policy? "It means that we are now better able to restore biodiverse ecosystems in places where natural regeneration is not enough," says Wubs. "At the same time, our analysis shows that we need to figure out why restoration is more successful in some cases than in others. The glass is half full, but it could be fuller."

Nature managers and policymakers should be paying close attention, especially considering the huge backlog of large-scale nature restoration projects, which would greatly benefit biodiversity and all the "ecosystem services" that nature is providing.

This is why the United Nations has declared a Decade of Ecosystem

Restoration, and the European Union is coming up with a Nature Restoration Law. But such initiatives can't be successful without effective restoration measures (i.e. with a lasting effect) and effective ways to benchmark the techniques, as has now been done for soil transplantation.

"Ecological recovery is tricky and often unpredictable," Wubs puts it in a nutshell. "People usually only look at above-ground recovery, but we have demonstrated that the groundwork for success is laid below ground."

More information: Gijs M. Gerrits et al, Synthesis on the effectiveness of soil translocation for plant community restoration, *Journal of Applied Ecology* (2023). DOI: 10.1111/1365-2664.14364

Provided by Netherlands Institute of Ecology