Grass and flowers sourced locally

March 21 2016

Colourful, low-intensity grasslands not only look attractive, they also offer valuable habitat for many plants and animals. Yet they have become rare in many places. To create more environments that contain grass and herbs, it is usually necessary to sow the appropriate plants. But which seeds should be used? Many scientists and environmentalists are speaking out in favour of seed from the same region as that in which the future grassland will lie. Ecologists from the Helmholtz Centre for Environmental Research (UFZ) in Halle (Saale), Germany, have carried out a joint study with colleagues from the universities of Tübingen and Münster, and TUM (Technische Universität München), to investigate the suitability of this approach. Two studies in the *Journal of Applied Ecology* have shown that using indigenous seed actually does bring benefits.

For many years now, foresters have not just used any random seed when planting new trees. They have long known that not every European beech or Common oak tree is the same. In fact, every species has many variants which have adapted to suit the specific challenges of their environment. Some might, for example, withstand drought better than others, while others might survive harsh winters or thrive in poor soils. For this reason, German forestry has regulations that specify exactly which region the seed must come from, for a particular planting.

"To date, there have been no similar regulations for grassland plants", said Dr. Walter Durka, a biologist working at the UFZ. Anyone wanting to create a wildflower meadow in their garden or plant a new grassland habitat as part of a nature conservation project will find a huge range of

seed mixtures available for purchase. These will definitely come from native plant species, but might theoretically have been produced anywhere in the world. In 2007 and 2008 alone, Germany imported 13,000 tonnes of grass seed and 280 tonnes of herb seed. "It may be cheaper to buy this seed abroad", he explained, "but the plants may then have adapted to suit conditions somewhere like New Zealand, for example, and not German regions such as Bavaria or Brandenburg".

For this reason, many ecologists are speaking out in favour of also using seed from locally grown grassland plants. Scientists from the University of Hanover have also already developed a concept in which Germany is divided up into 22 areas of origin, using different geographical criteria. These areas of origin are then grouped in eight production zones. Several companies are already offering seed whose areas of origin can be precisely traced. Demand for this kind of seed is likely to continue to rise in future. The reason is that, from 2020, only indigenous seed of this kind can be used in Germany for recultivating grasslands in open countryside.

Does the regional seed concept make sense?

Until recently there has simply been insufficient data to provide a well-informed answer to this question. The extent of the actual genetic differences between members of the same species from different areas of origin was simply unknown. And that's without even mentioning whether such differences actually affect how the plants flourish. This is precisely the knowledge gap that the researchers at UFZ wanted to close.

Working together with colleagues at TUM (Technische Universität München), and the universities in Tübingen and Münster, they investigated seven common grassland plants that came from eight of the 22 German areas of origin. "We found genetic differences between the regions for all the species", summed up Walter Durka. However, how

big these genetic differences are depends on the biology of the particular plant.

For example, grasses that are pollinated by the wind, and cannot fertilise themselves, exchange their genetic information over relatively large distances. For this reason, the researchers found the extremely common false oatgrass to have the smallest genetic difference between the regions. The opposite applied in the case of ragged robin. This species uses insects to distribute its pollen, sometimes even between flowers on the same plant. In addition, it is much rarer than false oatgrass. "This all leads to a low gene flow, which results in large genetic differences between populations", explained Walter Durka.

In the case of some species such as white bedstraw, the researchers also discovered a definite trend: the genetic differences become ever greater, the further the areas of origin are apart, and the more their climates differ. According to Durka, this is a clear indicator that these plants have adapted to their regional conditions. They should therefore be more successful close to their origin than in other parts of Germany.

The team tested whether this hypothesis is correct in a second study. To do so, the researchers sowed the seven species from the eight regions in Freising, Tübingen, Halle (Saale) and Münster, and observed how well they grew, and when they flowered. "In the case of many of the grassland species examined, it was indeed the case that plants that had the same regional origin grew better", reported Dr. Anna Bucharova and Prof. Oliver Bossdorf from the University of Tübingen. For example, on average, regional plants produced seven percent more biomass and ten percent more inflorescences than members of the same species that came from other regions of origin.

Reactions to climate change

Even the unusually warm temperatures in summer 2013, when the tests were carried out, had no effect on the test results. Critics of the regional seed concept often argue that it is not future-proof in a time of climate change: their argument is that, as temperatures increase, plants from the south are more likely to succeed than plants from the same region. However, the researchers found no indicators that this is the case: although temperatures in the experimental gardens in 2013 were 1.5 to two degrees above the average, calculated over many years, the plants from warmer regions had no advantage. This may be due to the fact that it is not only the temperature that is the decisive factor in whether growth is better or worse. The length of the days, or the composition of the microbial communities at the particular location, might also play an important role. If the regional plants are better adapted to suit such factors, then they can obviously also make use of their inherent relative strengths in warm years.

Yet it was not only the plant itself that profited from its adaptation to regional conditions. The researchers also discovered that the individual variants also flower at different times. Brown knapweed of different origins flowered up to 17 days apart. In the case of white bedstraw the difference was as much as 23 days. "From an ecological point of view, that is a huge difference", said Anna Bucharova. It should also be remembered that many animal species, from the pollinators to the inhabitants of the flower heads to the seed eaters, operate on the time plan that is usual for the region. "Scientifically, there is a real danger that this entire ecosystem could get into difficulties if plants from a different region flowered at the wrong time", she said. This is yet another reason for fostering the use of seed originating from the same region.

More information: Walter Durka et al. Genetic differentiation within multiple common grassland plants supports seed transfer zones for ecological restoration, *Journal of Applied Ecology* (2016). DOI: 10.1111/1365-2664.12636

Anna Bucharova et al. Genetic differentiation and regional adaptation among seed origins used for grassland restoration: lessons from a multi-species transplant experiment, *Journal of Applied Ecology* (2016). DOI: 10.1111/1365-2664.12645