Climate change: Diseqilibrium will become the norm in the plant communities of the future

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Heartleaf Oxeye is an example of a species that has not yet returned to Northern Europe since the last Ice Age, but which we have helped along by planting in our gardens. Here it was found in the Danish countryside. Credit: Jens-Christian Svenning, Aarhus University

Global climate change will induce large changes to the plant communities on Earth, but these will typically occur with major time lags. This has been demonstrated by a new analysis carried out by

researchers at Aarhus University. Many plants will remain long after the climate has become unfavorable—and many new species can take thousands of years to make an appearance. Humans will play a key role in such disequilibrium dynamics.

The forest we are used to looking at is not at all in equilibrium. Since the Ice Age, a number of plants have been 'missing' in Northern Europe, i.e. species that have not yet arrived. The same applies in many other parts of the world. Similarly, there is evidence that—even today—it often takes a very long time before plants follow when glaciers retreat, or the climate changes. In future, such disequilibrium will become the norm in the plant communities on Earth. This has been demonstrated by a new synthesis carried out by two researchers at Aarhus University—Professor of Biology Jens-Christian Svenning and Assistant Professor Brody Sandel.

Professor Svenning explains: "In the climate debate, even researchers have had a tendency to overlook the fact that ecological dynamics can be slow. However, our forests take an extremely long time to adapt. For example, we still have a small amount of small-leaved lime in Denmark, which has held on since the warm period during the Bronze Age, i.e. about 3000 years. Perhaps it will now get another chance to spread when the summers once more get warmer. However, such expansion would take a long time, as lime is not a particularly fast-growing tree or particularly good at dispersing, even under optimum conditions. The climate will change considerably in the course of a single tree generation so we should not assume that the forest we're looking at in a given place is suitable for the climate. Future climate will constantly shift, which will increasingly result in these strange situations of disequilibrium."

The challenges we face

"Consequently, if you're trying to practise natural forest management

with natural regeneration, you may see completely different plants regenerating compared with what you had before, because the climate has shifted to become suitable for another set of species. This also makes it challenging to adhere to a management plan granting preservation status to a particular type of nature at a certain site. At such a site, the existence of a large number of fully grown specimens of an endangered species is no guarantee that there will be a next generation.

This would be challenging for everyone—for the managers, for the people who use the countryside in one way or another, and also for the researchers who are used to working with ecosystems that are much more balanced. Plant life and ecosystems will become much more dynamic and often out of sync with the climate.

We're causing so many changes to the climate, but at the same time nature is SO slow. Just think of a tree generation. Our entire culture is based on something that was, if not in complete equilibrium, then at least relatively predictable. We're used to a situation where flora, fauna and climate are reasonably well matched. In future, this equilibrium will shift on an ongoing basis, and there will be plenty of mismatches. That's what we'll have to work with."

Professor Svenning also calls for caution: "With nature in such a state of disequilibrium, human introduction of new species will play a key role. Take cherry laurel, for example, which we see in many gardens in Denmark. It's ready to spread throughout the Danish countryside. If it were to migrate unaided from its nearest native site in South-East Europe to Denmark, it would take thousands of years. Horticulturists now help it along. This will help the species survive, but can also cause northern species in Denmark to become extinct more rapidly. The cherry laurel is an evergreen, and if it disperses on the forest floor, it may create too much shade for the existing flora on the forest floor to survive. At the same time, the disequilibrium presents the advantage that

such dispersal will take decades despite the contribution of horticulturists," Professor Svenning concludes.

Cherry laurel is another example of a species that has not yet returned to Northern Europe since the last Ice Age, but which we have helped along by planting in our gardens. Here it was found in the English countryside. Photo: Jens-Christian Svenning, Aarhus University.

More information: Disequilibrium vegetation dynamics under future climate change. J-C. Svenning and B. Sandel, *American Journal of Botany* 100(7), 2013.

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