

Mosses used to evaluate atmospheric conditions in urban areas

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Bryophytes covering rocky cliffs along a river in Tomakomai City in Hokkaido. Bryophytes can absorb moisture and nutrients directly from the air, allowing them to grow on non-soil surfaces. Credit: Hokkaido University

Researchers have developed a method to evaluate atmospheric

conditions using mosses (bryophytes) in urban areas, a development that could facilitate broader evaluations of atmospheric environments.

Many [urban areas](#) face atmospheric problems such as pollution and the heat island effect. With the need to evaluate [atmospheric conditions](#), bioindicators—organisms whose response to [environmental changes](#) indicates the health of an ecosystem—have attracted considerable attention. Their merits include being able to evaluate an environment over a wide area at a low cost; detect environmental changes over an extended period; and assess these changes' effects on the ecosystem. Bryophytes are one such group of plants known to be sensitive to environmental changes, in particular to atmospheric conditions.

The research team led by Yoshitaka Oishi of Fukui Prefectural University and Professor Tsutomu Hiura of Hokkaido University's Field Science Center for Northern Biosphere studied how bryophytes can be a tool for evaluating complex atmospheric conditions in urban areas.

The team examined Tokyo's Hachioji City, which has diverse environments ranging from developed urban areas to remote, mountainous areas. They used bryophytes to calculate four metrics related to atmospheric problems: severity of nitrogen pollution; degree of pollution from nitrogen oxides (NO_x); index of atmospheric purity; and drought stress that accompanies urbanization.



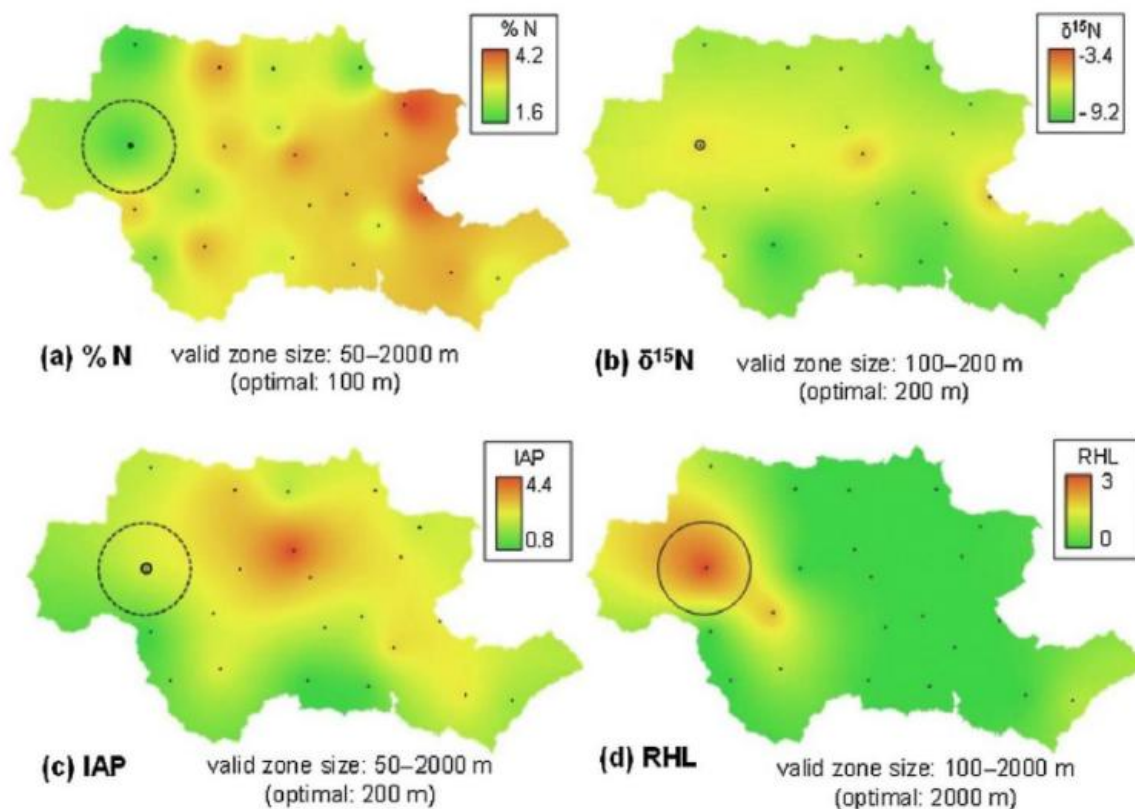
Fissidens nobilis, a simple-structured moss that is sensitive to environmental changes. Credit: Hokkaido University

The team first analyzed the responsiveness of bryophytes to the four metrics based on distribution patterns, the [nitrogen content](#) and the stable isotope ratio in bryophytes. They then factored in the type of land at the surveyed points through linear and generalized linear models to examine the usefulness and limitations of bryophytes as a bioindicator.

The team found that the degree of [nitrogen pollution](#), which is worsening in urban areas, can be evaluated by analyzing the [nitrogen](#) content and the stable isotope ratio in bryophytes. They also found that drought-sensitive bryophytes can indicate the level of drought, which is influenced by the heat island effect. However, the team found no

effective model to evaluate atmospheric purity.

"Simultaneous use of bryophyte metrics can be useful in examining the interrelations of atmospheric problems. We hope our method will enhance broader evaluations of atmospheric conditions, which could eventually prompt people to take actions that reduce their impact on the environment," says Tsutomu Hiura.



Atmospheric evaluation maps using bryophytes (Hachioji City, Tokyo). In these images, green indicates a low value and red indicates a high value. (a) Severity of nitrogen pollution evaluated by the percentage of nitrogen content (N%), (b) Degree of NO_x pollution evaluated by the stable isotope ratio of nitrogen in bryophytes ($\delta^{15}\text{N}$), (c) Index of atmospheric purity evaluated by biodiversity and the cover of bryophytes, (d) Increase of drought stress accompanying

urbanization evaluated by the distribution of drought-sensitive bryophyte species.
Credit: Hokkaido University

More information: Yoshitaka Oishi et al. Bryophytes as bioindicators of the atmospheric environment in urban-forest landscapes, *Landscape and Urban Planning* (2017). [DOI: 10.1016/j.landurbplan.2017.07.010](https://doi.org/10.1016/j.landurbplan.2017.07.010)

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