

## A Semi-structured Citizen Science Scheme that Improves Vascular Plant Monitoring in the Netherlands

Volunteer-based ecological monitoring is traditionally based around highly structured survey designs with rigorous observation protocols and standardised counts, while the last two decades have seen a massive increase in opportunistic observations without any protocol whatsoever. Both of these extremes have their disadvantages, whereas intermediate semi-structured schemes that combine merits of both could be highly beneficial for ecological monitoring. In the Netherlands, vascular plant monitoring required such a recording scheme and a pilot was launched in 2012 to assess if detection probabilities and power to reveal declines were high enough, with the ultimate purpose being distribution trend estimates for as many native plant species as possible. We did not prescribe a strict field protocol, but instead chose to obtain basic information about how the observations were made and statistically correct for variation in observer effort with occupancy models. Moreover, on a yearly basis observers were provided with a selection of grid cells and were motivated to also focus on replicated visits to grid cells that have been surveyed earlier in the season, which is a major requirement of occupancy models. Now that the pilot has finished (2012-2019), we evaluate whether the scheme can produce proper estimates for occupancy, detection, and power. The number of occupied grid cells was estimated using single-species models with day of year, visit duration and observer experience as covariates for detection. The detection probability strongly depended on day of year and visit duration. It was possible to estimate the number of occupied grid cells quite precisely for several hundreds of species, such that the statistical power is expected to be high enough to detect changes of 10% between survey rounds. For rare species, however, the power to detect changes will be quite low. We conclude that the approach works well and that it offers a monitoring solution when structured schemes and standardised counts are difficult to organize, such as in the case of vascular plants, mosses, lichens, bees and hoverflies.