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From the Editor

What does it actually mean to measure a sample plot in forest?

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Sample plot measurement is one of the basic operations in forest sciences. A plot is delineated and usually some forest level information is gathered. A certain minimum size in tree level measurements is often applied. Nowadays electronic devices including hypsometer and caliper are utilized when a human is measuring trees. Tally tree measurement usually include diameter at breast height (DBH), tree classifications (living or dead, tree storey, health, timber assortment) and registration of tree species. Tree height is also measured at least from chosen sample trees from which also other attributes, such as age, crown height and growth, are considered. There may be also many other measurements, but this is a basic set of information for forest resource calculation or field reference of remote sensing-based modelling of forest attributes. The purpose of a sample plot measurement may, of course, be other than determining growing stock, for example soil, ground vegetation and health to mention a few, but tree stock measurement is typically needed in those cases, too.

Recently, many remote sensing-based systems have been used in field measurements. These include, e.g., terrestrial and mobile laser scanning (TLS and MLS, respectively). Smartphone based applications, such as Trestima have also been widely applied. Even unmanned aerial vehicles has been experimented. TLS can provide highly detailed information on recognized tree trunks and crowns (Luoma 2022) – partly information, which has never been available earlier or at least these measurements have been very slow and expensive to carry out. TLS information has many different scientific uses. Correspondingly, MLS operated from a harvester will provide in the near future a completely new type of information in forest operations. Although these information sources provide detailed data, the interpretation result of these data should be considered as an accurate forest resource estimate, not a sample plot measurement. This is due to a couple of facts. In a remote sensing-based interpretation, only a proportion of trees is recognized. By applying remote sensing, it is impossible to find all trees in all type of forests. On the other hand, sample plot measurement requires measurement of all trees belonging to a stratum. Of course, some trees may be forgotten to be measured in the "traditional field work" but this refers to single cases. Another, even more serious bottleneck is tree species recognition. In Finland, remote sensing-based interpretation usually provides information on Scots pine (*Pinus sylvestris* L.), Norway spruce (*Picea abies* (L.) Karst.) and combined broadleaved species class. However, this information is not correct. In a sample plot measurement, species should be correctly registered. Especially in the National Forest Inventory type of measurements this refers to all species. If there is, for example, bird

cherry (*Prunus padus* L.) in a plot, it must be registered or should be recognized. In an Austrian field data set, there were over 20 tree species (Gollob 2022). It is not possible to recognize all of them by TLS data, for example.

Despite these problems, I still see possibilities for remote sensing-based sample plot measurement. This is not my research topic, but my personal opinion is that personal laser scanning (PLS) could be a tool for that. PLS is an approach where the laser scanner is operated by a human. Sample plot measurement can be organized so that each tree in a plot is walked around (Gollob 2022). This removes the problem of tree recognition with the exception of some tree groups. During the scanning, the operator can register tree species correctly. Nowadays, there are already rather cheap tablet or smartphone-based applications of PLS. The accuracy of these devices in tree trunk dimension estimation may need to be still improved, but this an obvious step towards remote sensing-based sample plot measurement. One may still ask, what is the benefit of walking around all trees with tablet compared to traditional field work. At least the provided point clouds offer more versatile information on trees and close surroundings around them – not only the DBH.

Matti Maltamo
Editor-in-Chief

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