FOREST DETECTIVES

HÅKAN BERGSTEDT EXPLAINS HOW HE USES MOBILE GIS TO HELP FOREST LANDOWNERS IN SWEDEN TO WORK OUT WHERE THEIR LAND ACTUALLY IS

Together with a partner, I run a consultancy firm, MittNorr Skog & Fastighet AB, in Östersund, mid-Sweden. We offer a full service for forest owners, helping them to plan and implement their forestry in an economical way that complies with biological conditions, regulations and their own goals. We also offer services for investors by finding, controlling and evaluating forest properties. Visible and precise boundaries are essential for our business. We simply must know which land we are managing.

Bad boundaries are a never-ending issue in mid Swedish forestry. In 1628, Sweden started to build a register of landowners and to mark up their properties in the country.

Since then, many of the old boundaries and properties have been altered for various reasons. That means the register of today has become a puzzle – it is sometimes necessary to go back to the 17th century to find information about what is legally correct. Digital boundary maps available are approximate and the boundaries are normally only accurate to 20m.

There are legally binding boundary markings in the forest consisting of stone-piles. However, many landowners have not maintained these physical boundaries, which are often overgrown by vegetation and so not visible. Many markings have also been destroyed by machines when logging, and if the forests are at a similar age on both sides of the boundary, it truly becomes a challenge to identify the boundary.

Previously, the Swedish Land Registry offered a service to help landowners detect and mark their boundaries, but this service was shut down in 2017. This has opened a new market for private companies such as ours. In the beginning, we used simple methods to establish the position of the boundaries. With compass, low-precision GPS and a lot of experience, we could manage most boundaries, but pretty soon we got stuck. We solved the problem with a rented Network RTK-GPS (Satlab 300) with centimetre accuracy. However, we were not satisfied with the way we had to work with the GPS since we had to spend a lot of time to get a positional fix in the woods; the user interface was also outdated.

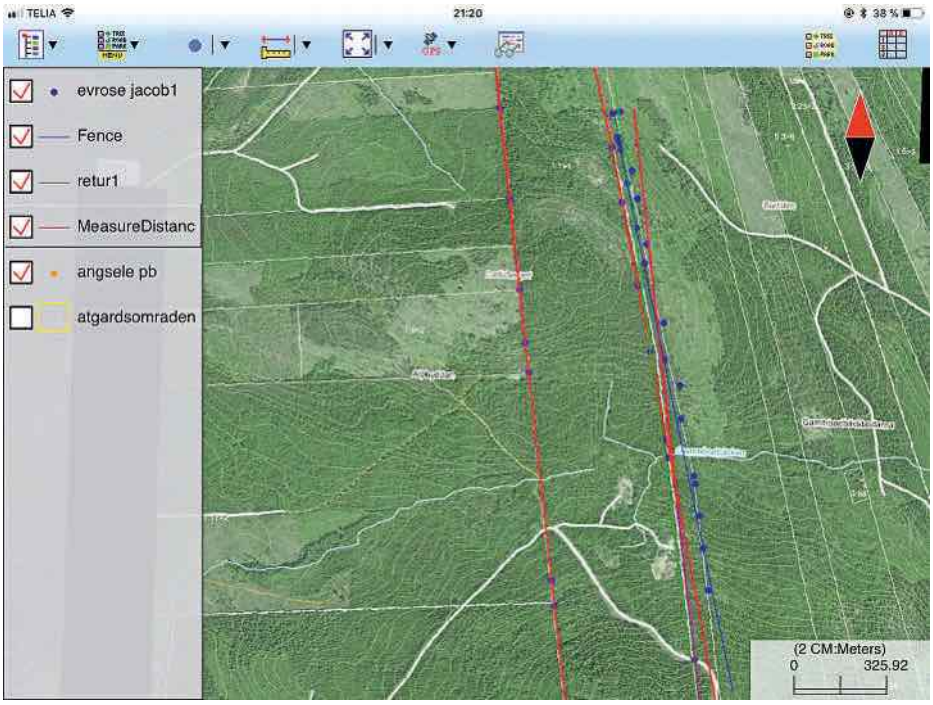
Our replacements

After some research – with expert assistance from the Swedish GIS-supplier Forest IT Design AB – we chose EOS Arrow 100, which uses all the available GNSS satellite constellations: GPS, Gallileo, Glonass and BeiDou.

We primarily using the Arrow with DGNSS-corrections via LTE from SWEPOS, to provide sub-metre accuracy even under heavy canopy and in hilly terrain. SWEPOS is the Swedish Land Registry's satellite positioning support system, which provides corrections for DGNSS and Network RTK. An option when LTE coverage is poor is to use DGNSS corrections from EGNOS, a European support system via geostationary satellites. This provides sufficient accuracy, but as the satellites are so far south of our work area, a clear view of the south is required to receive the signals well.

We scanned the market for available apps to run on the iPads we already had. We looked closely at ArcGIS, TerraGo and iCMTGIS Pro. Our survey is primarily based on establishing a straight line between two fixed points and extending the line beyond the points. That could easily be done in all three apps, but in the end, we chose iCMTGIS Pro as we found it straightforward to use and it only requires a one-off purchase rather than a subscription. Also worth mentioning is the good help we received during this process from Corvallis Microtechnology.

We are using the app in an iPad Air protected by a LifeProof Fré case. The battery consumption using EOS Tools Pro and iCMTGIS Pro is rather high, the built-in battery lasting for about 4-5 hours at 10-15°C. To use the iPad for a full-day, we use a power bank, which works well down to -15°C if constantly charged.



Sometimes it is not easy to sort out which markings are the real ones.

In the field

A mid-Swedish forest property can have many different shapes, but an average is about 200m wide and 2,500m long, with four or more corners. In the corners and at every 100m along the straight lines, there are the same type of markings. Older boundaries created before the metric system was adopted have markings located at other distances. Normally each marking consists of a standing tongue-shaped stone supported by two or more other stones around it. However, there are also other types of markings. Therefore it's sometimes hard to know if a stone pile we've found really is a marking. The distance between markings is the only way

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to make sure it is indeed a legal marking. Another complication is that sometimes landowners have illegally expanded their properties by moving the markings. Therefore, it is absolutely necessary to make accurate measurements to determine the actual location of the boundary.

To get started with a boundary survey requires a little sleuthing. First, we look through the Land Registry archives to see what has transpired at the actual boundary through the years. It is also important to get information about the neighbouring properties to avoid making unnecessary mistakes.

Satellite maps that includes boundary lines are downloaded from the Land Registry using a web service provider Timmerweb as georeferenced JPEGs. We convert the JPEG to GeoTIFF and create SHP files from the boundaries we need as guide lines, using a Mac, running QGIS. We then export these to iCMTGIS Pro using iTunes.

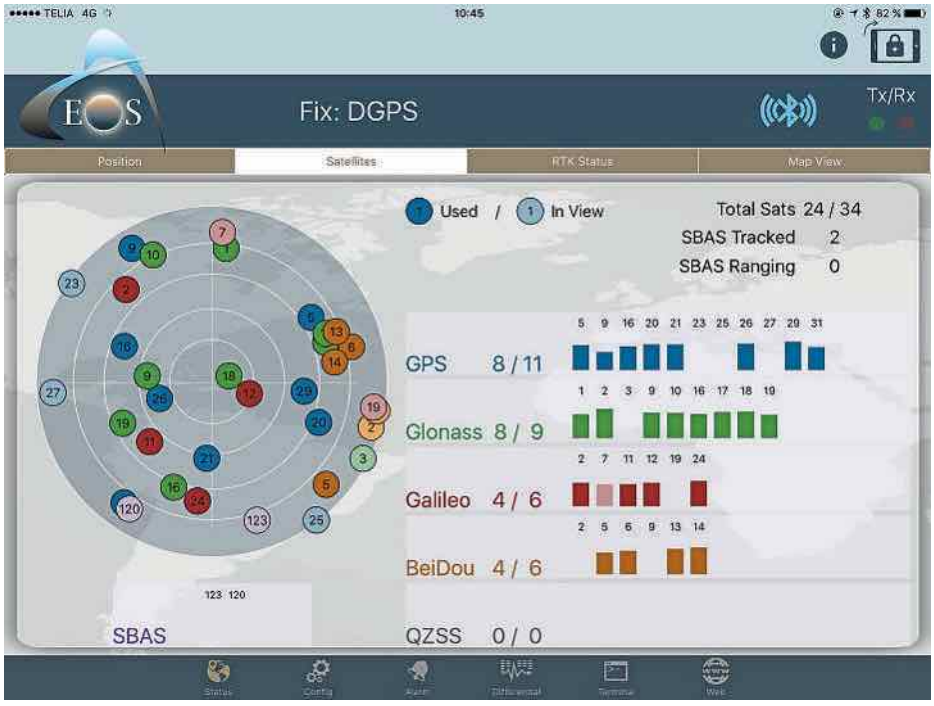
In the forest, we first have to find at least two markings to get a starting point and to confirm the distance between the markings. When a line is digitally created, it is simple to follow, even if invisible, when using an accurate positioning instrument like the EOS Arrow and the iCMTGIS Pro. A time-saving function in the app is the ability to set it to beep if you deviate more than 1m from the line, so it is only necessary to look at the display when fine-tuning the boundary. When following the line, more markings are searched to continue the work. Ribbons are used to mark along the identified line so that contractors later can clear and paint the boundary to make it visible.

If a corner marking is not to be found, there are two possible solutions. You can let the Land Registry make a cadastral to establish a legal marking. This is a really expensive procedure, so the most common solution is instead for a company like MittNorr to accurately measure the corner, which the landowners then agree to in writing.

With its know-how and the appropriate equipment MittNorr is proud to be part of the important process of cleaning up the boundary surveys in Sweden.

Håkan Bergstedt is co-founder of MittNorr Skog & Fastighet AB (www.mittnorr.se)

Clearing the boundary with a special saw – a hybrid between a brush cutter and a pole saw



Typical satellite view using EOS 100