

Geospatial Analysis of Optimal GNSS Placement in Precision Forestry

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Abstract

- Forest inventorying requires precise tree location information
- GNSS (Global Navigation Satellite System) provides an accessible and affordable tracking option
- The accuracy of GNSS measurements varies due to terrain, canopy, and signal strength
- We are evaluating precision under changing leaf density and at different distances

Introduction



- Locating individual trees spatially is a critical component of efficient forest management
- While most of the tree location measurements are carried out using handheld GPS, the accuracy of the tree location measurements can vary due to terrain conditions, canopy structure and signal strength.
- Because of such variations, there is a need to evaluate the accuracy of such handheld GPS instruments under varying leaf density conditions and at different distances from a tree.

Research Questions:

- Does distance from a tree influence the accuracy of location measurements?
- Does leaf growth in spring influence the location measurement accuracy?

Study Area

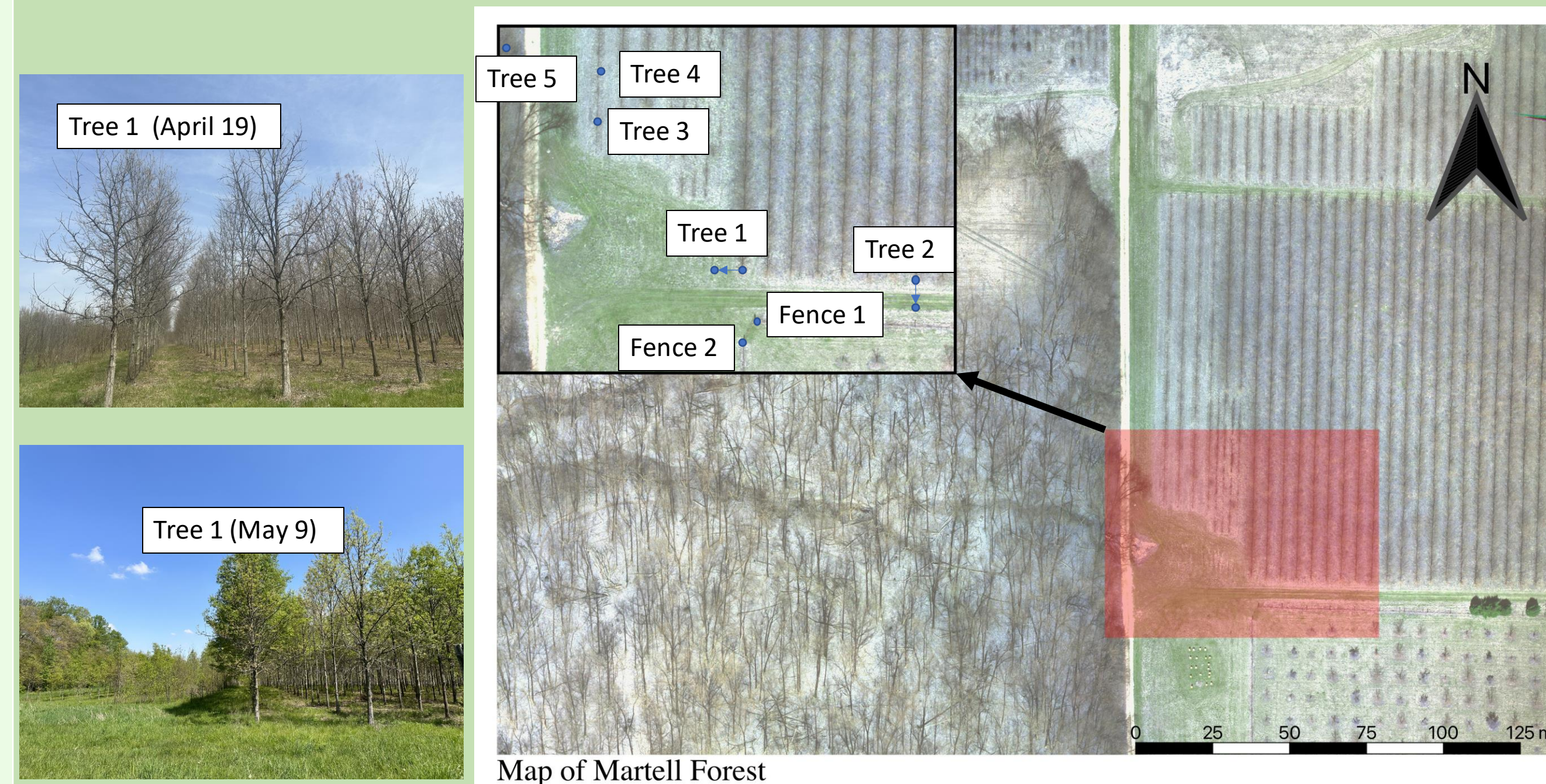


Figure 1. Over the course of April and May, we have been conducting our tests at the Red Oak tree plantation in Martell forest

Methods and Equipment

- Set up an experiment to measure tree location using handheld Garmin 64S.
- Survey grade GNSS- Emlid used as reference to analyze precision of handheld GPS measurement.
- Took 50 measurements at each location using Garmin 64S at different dates to capture effect of leaf-out
- Measure at progressive intervals to gauge canopy interference
- Compare handheld GPS Garmin device against survey-grade GNSS Emlid Reach RS2 with purpose of determining accuracy



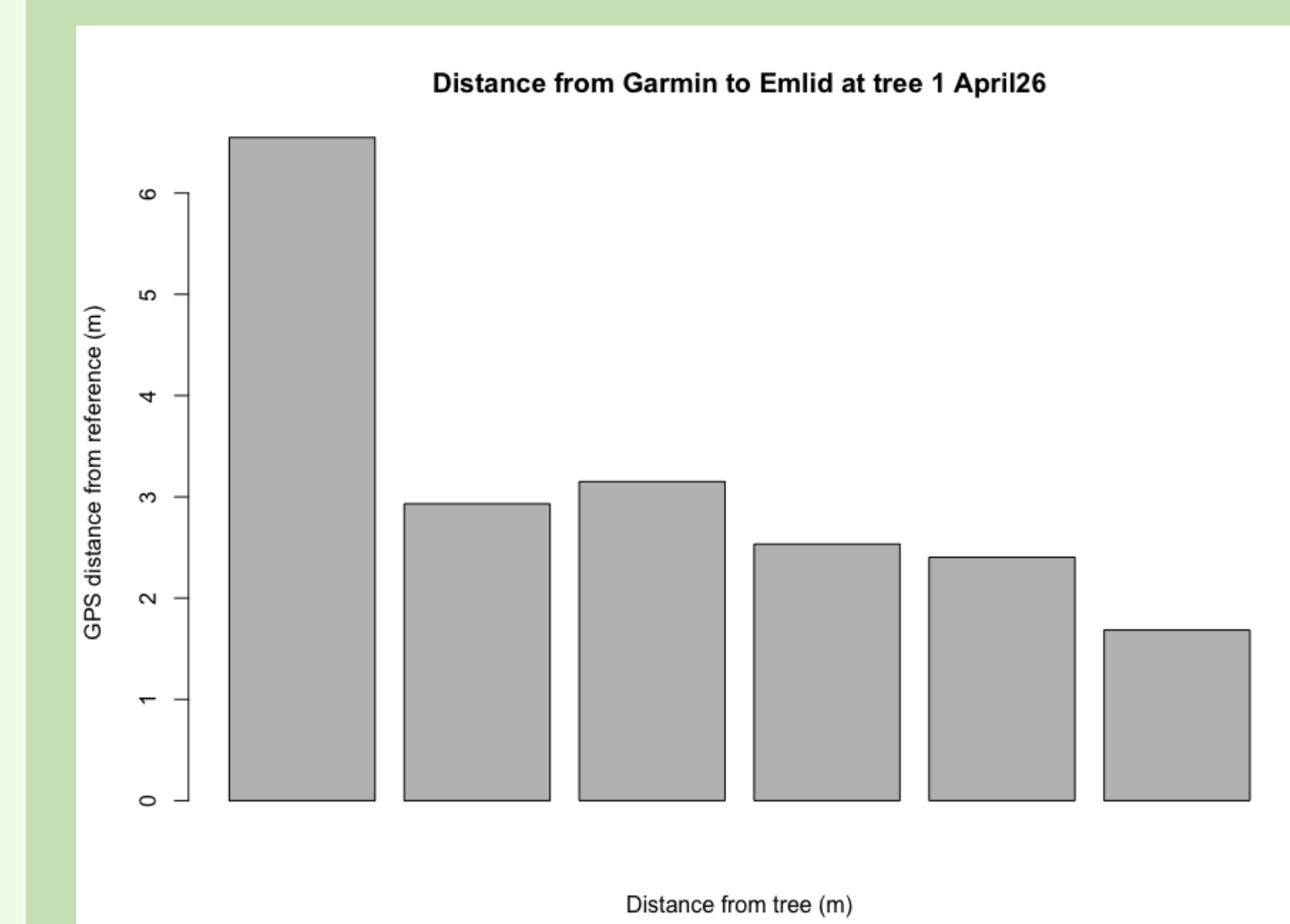
Figure 2. Handheld GPS devices are easily confused by signal-blockers



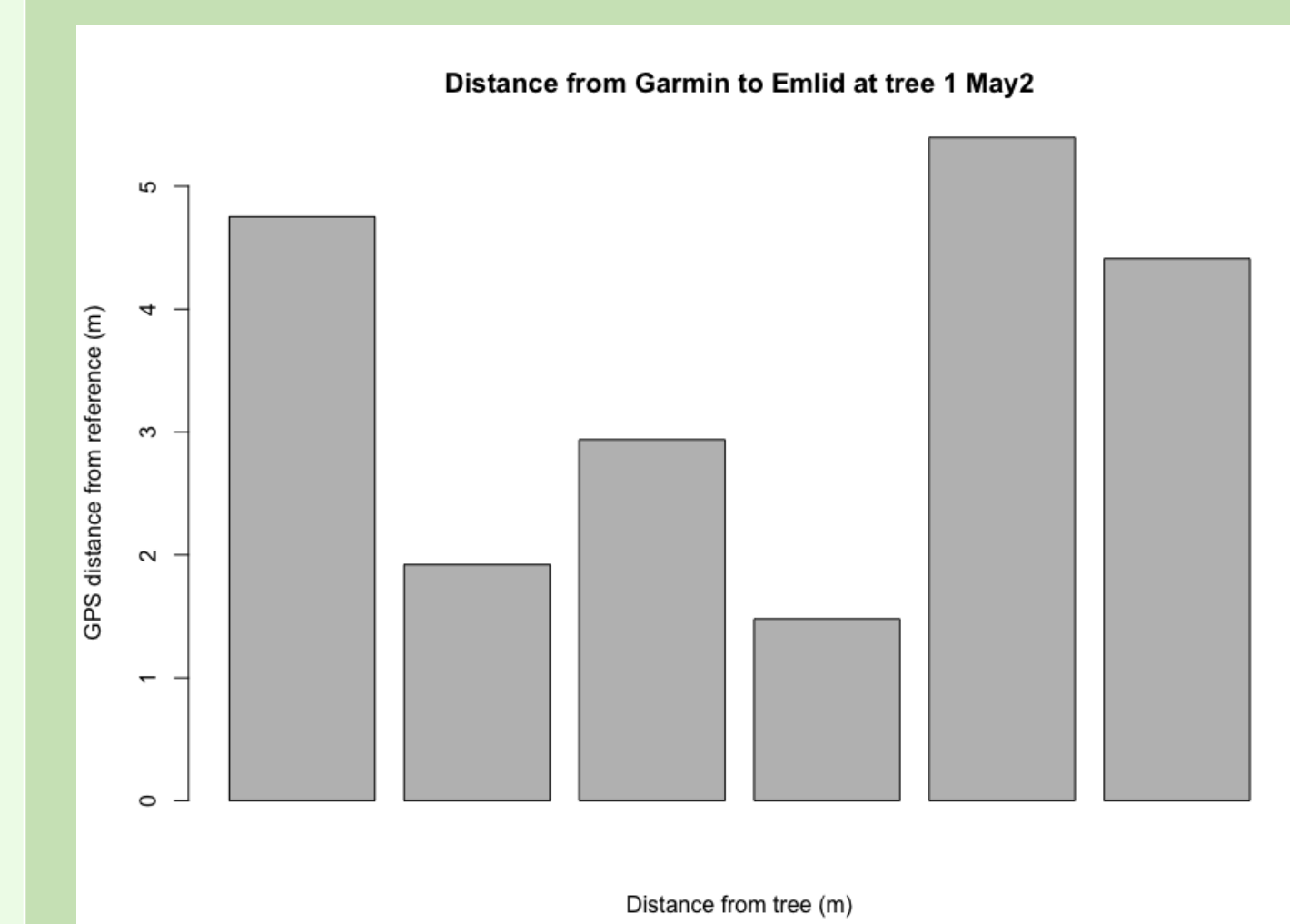
Figure 3. Survey-grade GNSS units can be used as a reference for determining accuracy

Results and Discussion

Results of location measurements for Tree 1 at different distance up to 5 meters to test for possible interference from overhead canopies as the seasons progressed.

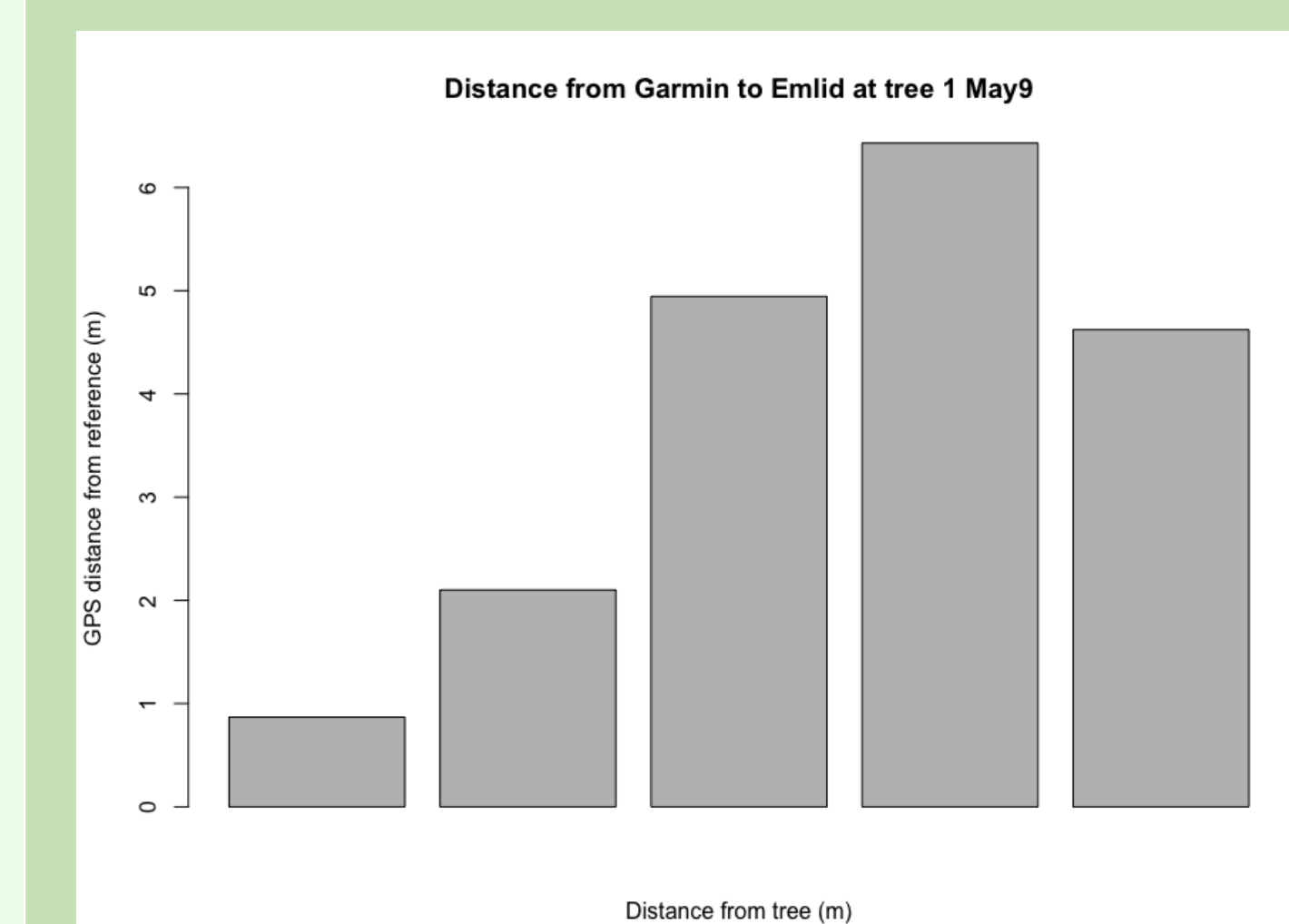


Since the beginning of April to the beginning of May, we have been going to Martell Forest and taking measurements with both the Emlid and the Garmin.



Results demonstrated that as we moved away from the tree (at 5m) the location accuracy of the Garmin 64S improved by 4.5 m (RMSE reduced from 6 m to 1.5 m).

We also found that the accuracy of GPS instruments can vary depending on the time of year, with an increase in location measurement error from 1.5 m to 4.5 m (RMSE) as we progressed into the growing season.



Acknowledgements

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