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AI-based approach to foster access and scale to real-time ground forest analytics

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biodiversityX REAL-TIME FOREST ANALYTICS

INTRODUCTION & AIM

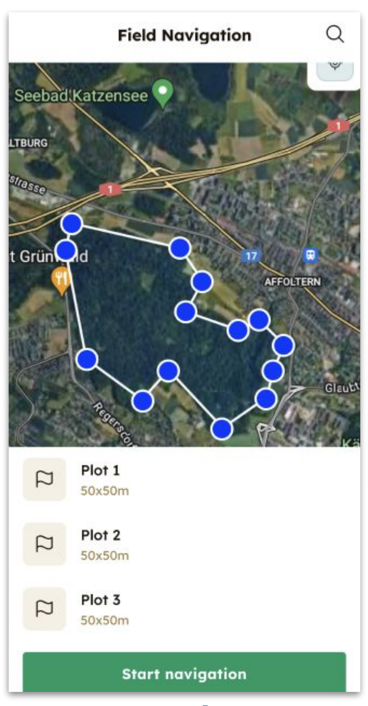
Forestry inventories are essential for sustainable forest management, policy and decision making, economic development and environmental protection.

A scientific approach to forestry was introduced in 1713 in Germany, and regulatory marks include US' Act of 1928 to implement forest surveys and Brazil's forest regulation from 1934. With deep historical and largely unchanged scientific roots, the mandate for forest inventory remains vital.

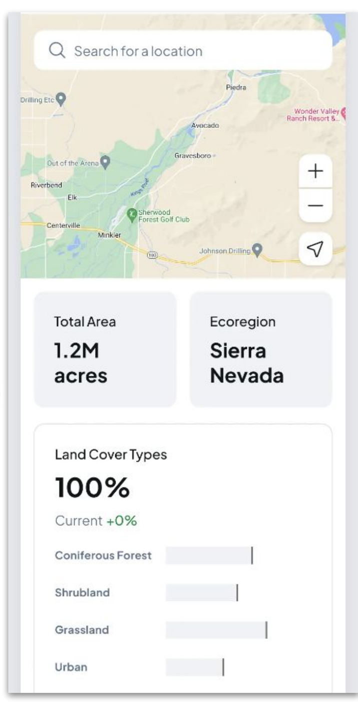
Recent factors driving its **growing importance** include the rising demand for corporate emissions offsets within nature-based carbon markets, the emergence of nature financing mechanisms, stricter regulatory requirements, and the increasing need for forest-dependent supply chain intelligence. While markets require a degree of scale and efficiency that traditional ground techniques cannot provide, there's a global **decline of 15% in forestry field workers**. Remote sensing, while valuable, struggles to capture crucial under-canopy details.

This study aims to introduce applied technology (mobile, AI and satellites) towards forests ground measurements leading to scalable, accessible and globally harmonized real-time forest analytics.

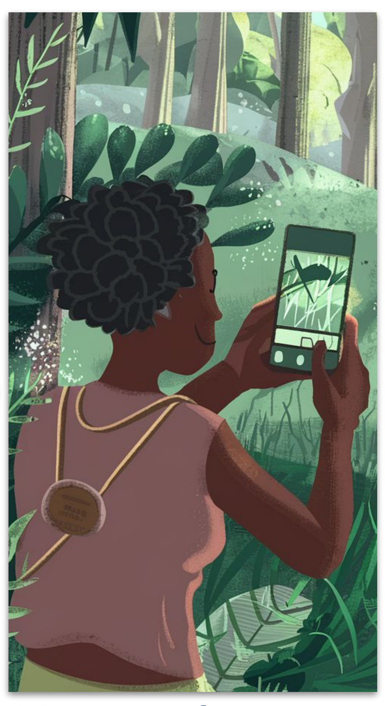
METHOD



Users select an area to be measured and generate real-time forest analytics



*App runs ground **sampling** algorithm: min. ground inputs for optimal outputs*



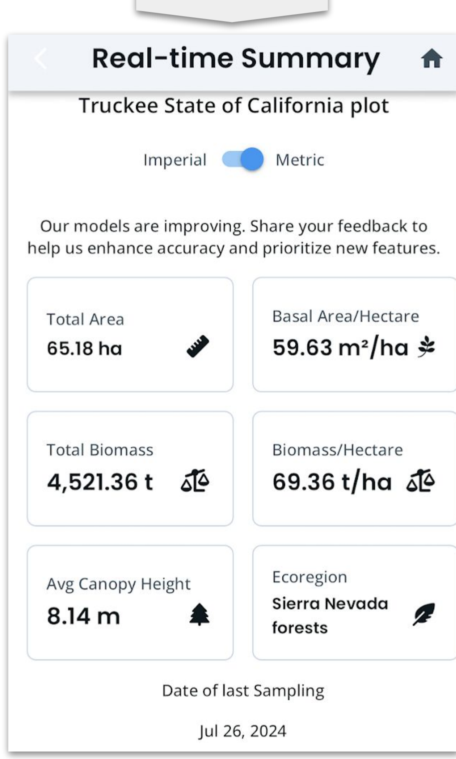
*Users take 4 pictures from each point. The phone now acts as an **angle gauge***

AI/computer vision models run Point Sampling ground science paired with satellite data

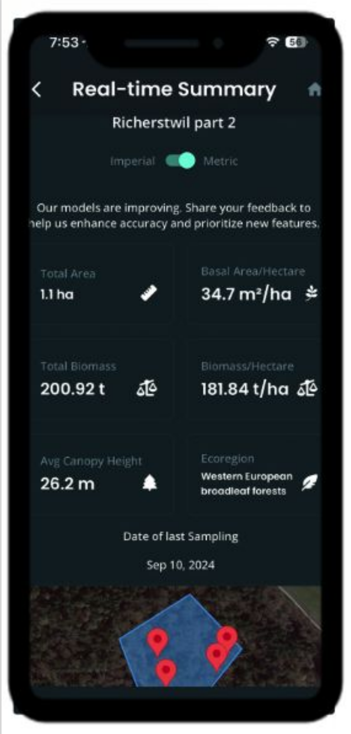
Field data collection that is accessible for everyone without training, equipment and with real-time results

AI-empowered backend that follows forestry science while making the processes faster, inclusive and auditable

Real-time basal area & biomass measurement *tailored to ecoregions. Ground inputs also inform vegetation structure and biodiversity insights.*



RESULTS & DISCUSSION



H2H **VALIDATION**

Location	Baseline method	Baseline	biodiversityX
Richerstwil	Marteloscope	**33.2 m2/hec**	**34.7 m2/hec**
Honggerberg	Marteloscope	**26.1m2/hec**	**27.19 m2/hec**
Truckee	Angle Gauge	**191.4 sq ft/acre**	**204.9 sq ft/acre**

BIODIVERSITY MODEL **TESTING**

Common Species Name	Scientific Species Name (Likely)	Visual Traits Leading to Classification
European Beech	*Fagus sylvatica*	Smooth, grey bark on mature trees; broad, oval leaves with toothed margins (visible on some trees in the background)
Norway Spruce	*Picea abies*	Conical shape; needle-like leaves; presence of cones (though not clearly visible in this image)
Possibly: European Larch	*Larix decidua*	Needle-like leaves in clusters; deciduous nature (if needles are absent in winter photos)
Possibly: Common Ivy	*Hedera helix*	Vining habit; dark green, lobed leaves (seen climbing on some trees)

Healthy mixed forest, multi-layered structure with a dense understory of shade-tolerant plants, indicative of good habitat quality. Diverse age structure and ongoing regeneration. While the fire risk is generally low due to the moist climate and vegetation type, it can increase during dry periods with accumulated leaf litter.

- **Data Accuracy:** test demonstrated **+93%** accuracy in basal area compared with established methods
- **Time Savings:** The full process from data collection to outputs could take less than 30 minutes. The same forested area would take over 2.5 hours for a rapid inventory. Results were available to the user in real-time.
- **Cost-effectiveness** is a byproduct of time savings, expertise and technology required. No training was needed to use biodiversityX. All equipment needed was a smartphone (any model, Android or iOS). Enabling remote auditing also reduces future potential costs.
- Further user testing showed similar results, with the exception of system reliability in the absence of internet connection. Enabling offline navigation and photo uploads was the main area for improvement deployed in the following app version which is currently launched.

CONCLUSION

Convergence of AI and geospatial advancements created a unique opportunity for innovation in forestry science. biodiversityX is on a path to empower all users to perform high integrity and cost-effective ground forest measurement.

FUTURE WORK / REFERENCES

Deploy refined models and data inputs for species and land delineation elevating current forestry methods and outputs.

The authors, as co-founders of biodiversityX, declare interest to improve the methods and make it relevant.