

Emily Upcott<sup>1</sup>, Douglas Kelley<sup>1</sup>, Charles George<sup>1</sup>, Richard Broughton<sup>1</sup>, Rafael Barbedo<sup>1</sup>, Josh Hall<sup>1</sup>, France Gerard<sup>1</sup>.

<sup>1</sup>UK Centre for Ecology & Hydrology, Maclean Building, Benson Lane, Wallingford, Oxfordshire, OX10 8BB, ENGLAND

## 1. Background



Increasing carbon sequestration through increasing woody cover is a major component of meeting net zero emission targets<sup>1</sup>. Most research focuses on trees due to their high sequestration rates, not shrubs, which differ structurally. To calculate and monitor shrub biomass and carbon storage at scale, shrubs need separate allometric models relating biomass and carbon to structural measures we can estimate from remote sensing (RS).

**Challenge:** good biomass predictor variables for trees (e.g. diameter at breast height, DBH) are impractical for multi-stemmed shrubs, and difficult to estimate from RS.

**Aim:** for Hawthorn, develop new allometric models and use field-collected measurements to generate an allometric model predicting above-ground biomass of distinct shrubs from RS-derived height and/or crown diameter (drone LiDAR or Structure from Motion, SfM).

## 2. Approach

**Study site:** Strawberry Hill is a 150ha nature reserve of ex-arable land in Bedfordshire, England. The site has been left to naturally rewild to grass- and shrubland for 35 years. Hawthorn is the dominant shrub species.

**Literature review:** we found existing tree, shrub and hedge predictor variables and models for shrub biomass.

**Shrub measurements:** we measured 36 Hawthorn shrubs for shrub height and crown diameter (summer 2023).

**RS:** we collected drone LiDAR for the whole site and extracted average height for the 36 shrubs (spring 2024).

**Destructive sampling:** we cut and weighed 82 hawthorn shrubs (autumn 2024). Sub-samples are currently drying.

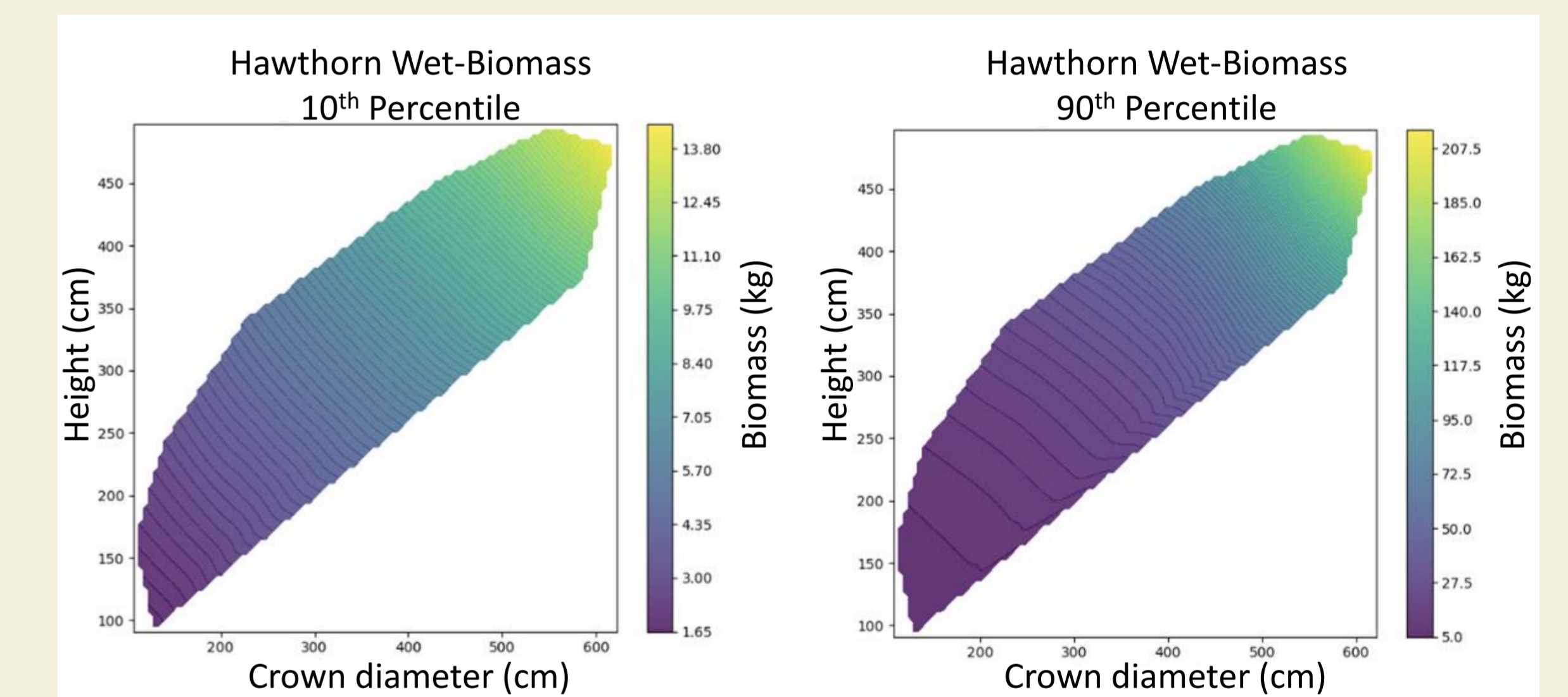
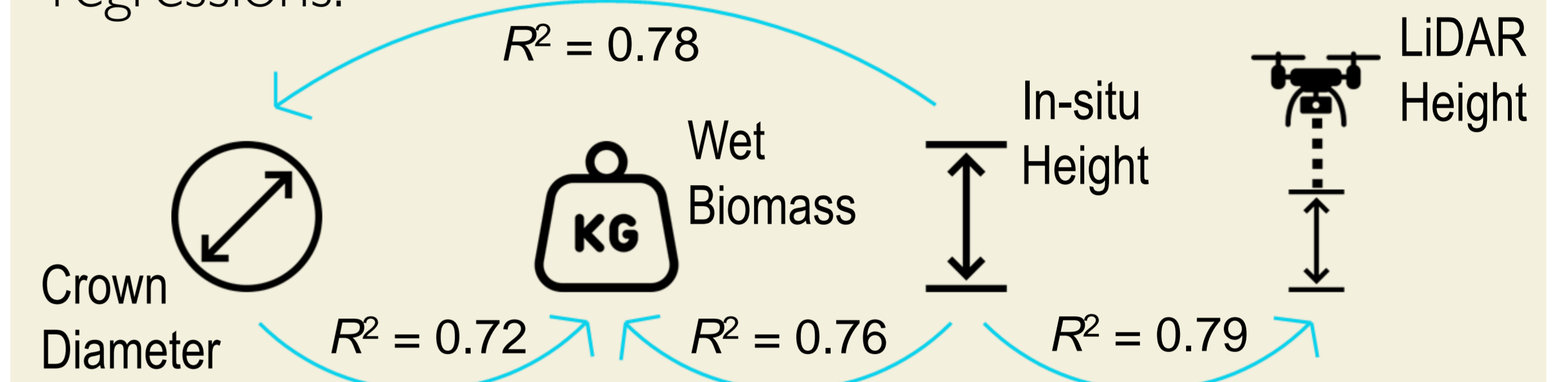


**Allometric model development:** using field & destructive sampling data to build biomass-predicting relationships based on height, crown diameter, RS-derived height

**Bayesian hierarchical approach:** model structure allows flexibility, estimating biomass confidence ranges even with limited data or missing measurements.

## 3. Preliminary results

We found **strong, positive** relationships in linear regressions:



Bayesian model output showing ranges of plausible wet biomass

Icons: flatiron.com

## 4. Future work

- Updating our analyses and modelling with dry biomass
- Combine with procedure identifying shrub species to estimate total Hawthorn biomass across the site.

We are open to discuss:

- Feedback on types of allometric relationships?
- Any applications beyond this study?

References: <sup>1</sup>[https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal\\_en](https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en)