Flower power - Modelling the number of flowers for pollinators of wild cherry trees based on 3D data

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Introduction

- Current **pollinator declines** [1,2] threaten the provision of pollination services [3,4], thus endangering the global food supply [5]
- Trees in agricultural landscape can support pollinators by providing **foraging resources** [6,7], i.e. nectar & pollen
- Quantification of the floral abundance of trees is scarce and **allometric models** are lacking
- **Main goal: Modelling floral resources** provided by wild cherry trees (*Prunus avium* L.) per branch & per tree based on branch & tree parameters

abbreviations
R^2_c - conditional R^2
R^2_m - marginal R^2
DBH - diameter at breast height

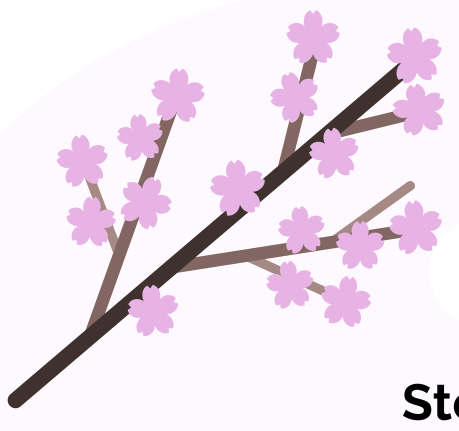
Methods

Study site
widely spaced plantation
Breisach am Rhein, Germany

Trees - Field data
n = 16, DBH 9–31 cm

Trees - TLS data
n = 39, DBH 9–28 cm

Step 1
Measuring flower distribution & density on branches in spring



Step 2
Modelling flowers per branch based on branch diameter & crown position

Step 3
Acquiring 3D point clouds in winter using terrestrial laser scanning (TLS)

Step 4
Reconstructing quantitative structure models (QSMs) from 3D point clouds [8]

Step 5
Upscaling flowers per branch to flowers per tree using the branch model & QSMs

Step 6
Modelling flowers per tree based on stem diameter or crown volume

Step 7
Estimating nectar, pollen & number of supported bee larvae per tree


Cherry flowers


Cutting down branches


Terrestrial laser scanning

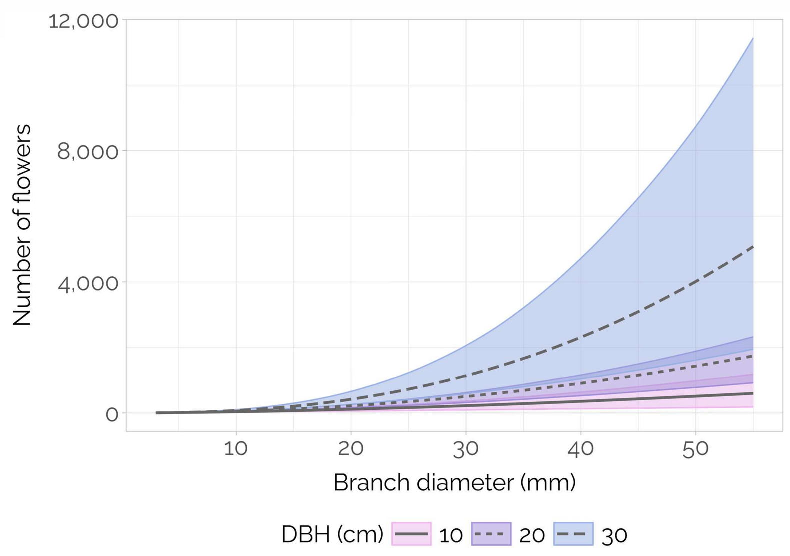
Results

Branch level

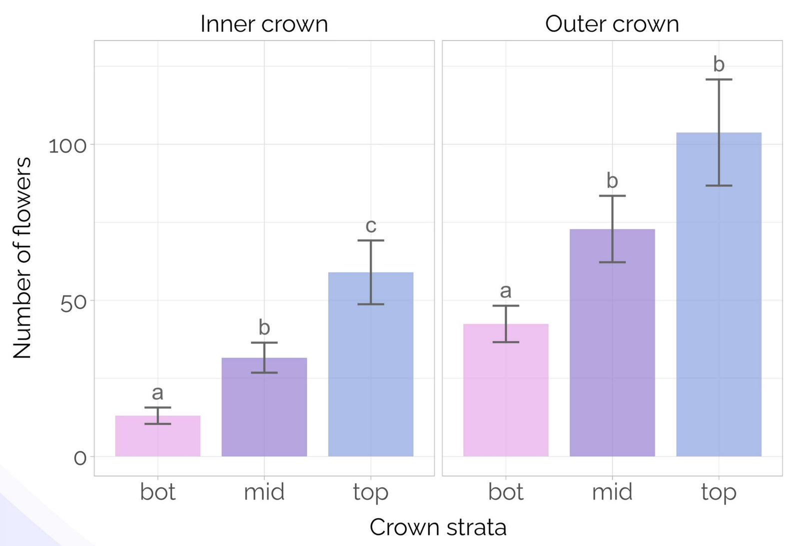
Probability of flower occurrence:
$R^2_c = 0.52$, $R^2_m = 0.50$

Number of flowers:
$R^2_c = 0.88$, $R^2_m = 0.84$

Exponential relationship between branch diameter & number of flowers



Heterogeneity within the crown

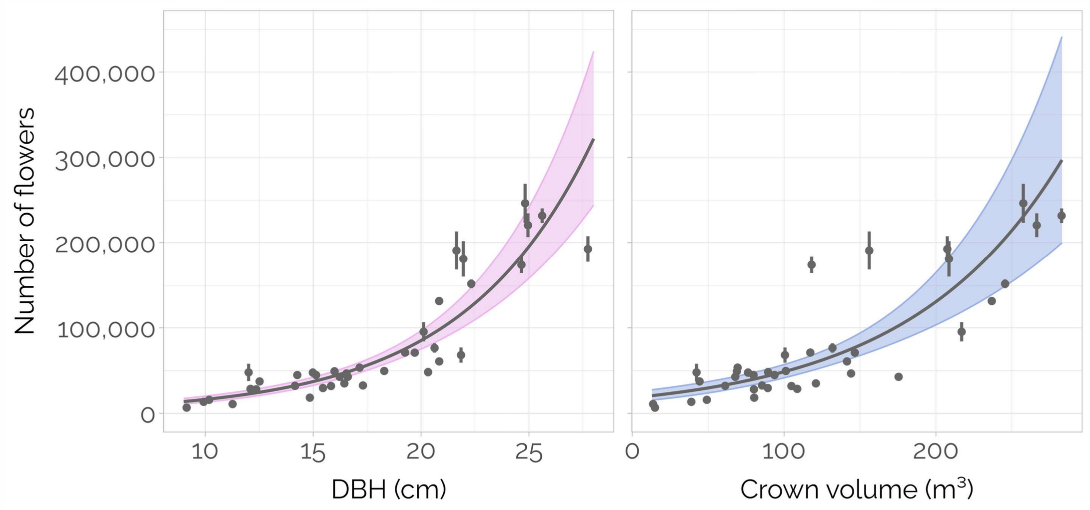


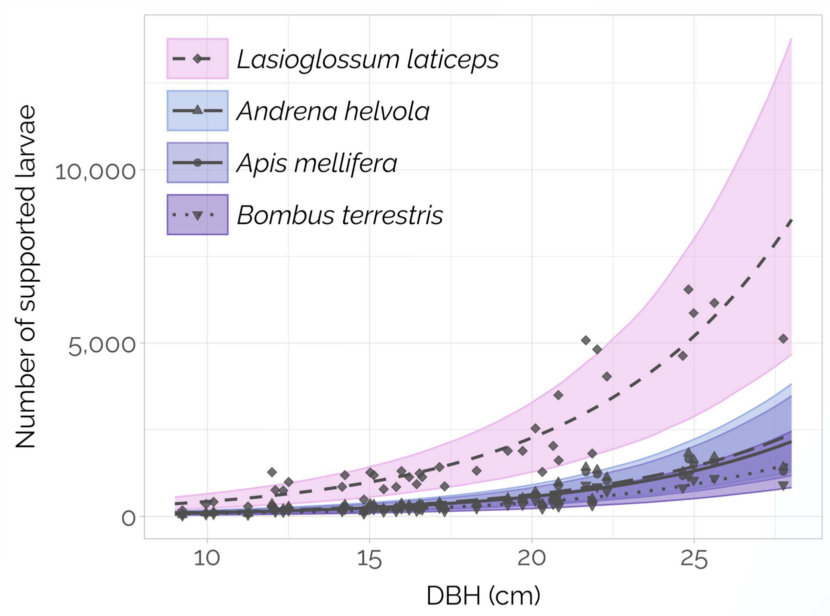
Tree level

Number of flowers based on DBH:
$R^2 = 0.83$

Number of flowers based on crown volume:
$R^2 = 0.68$

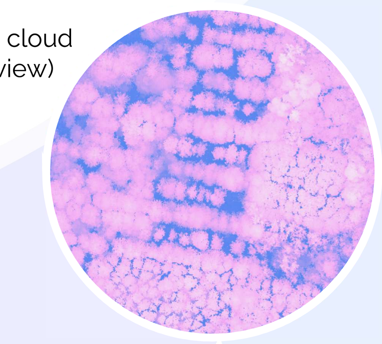
Exponential relationship between DBH or crown volume & number of flowers or supported bee larvae

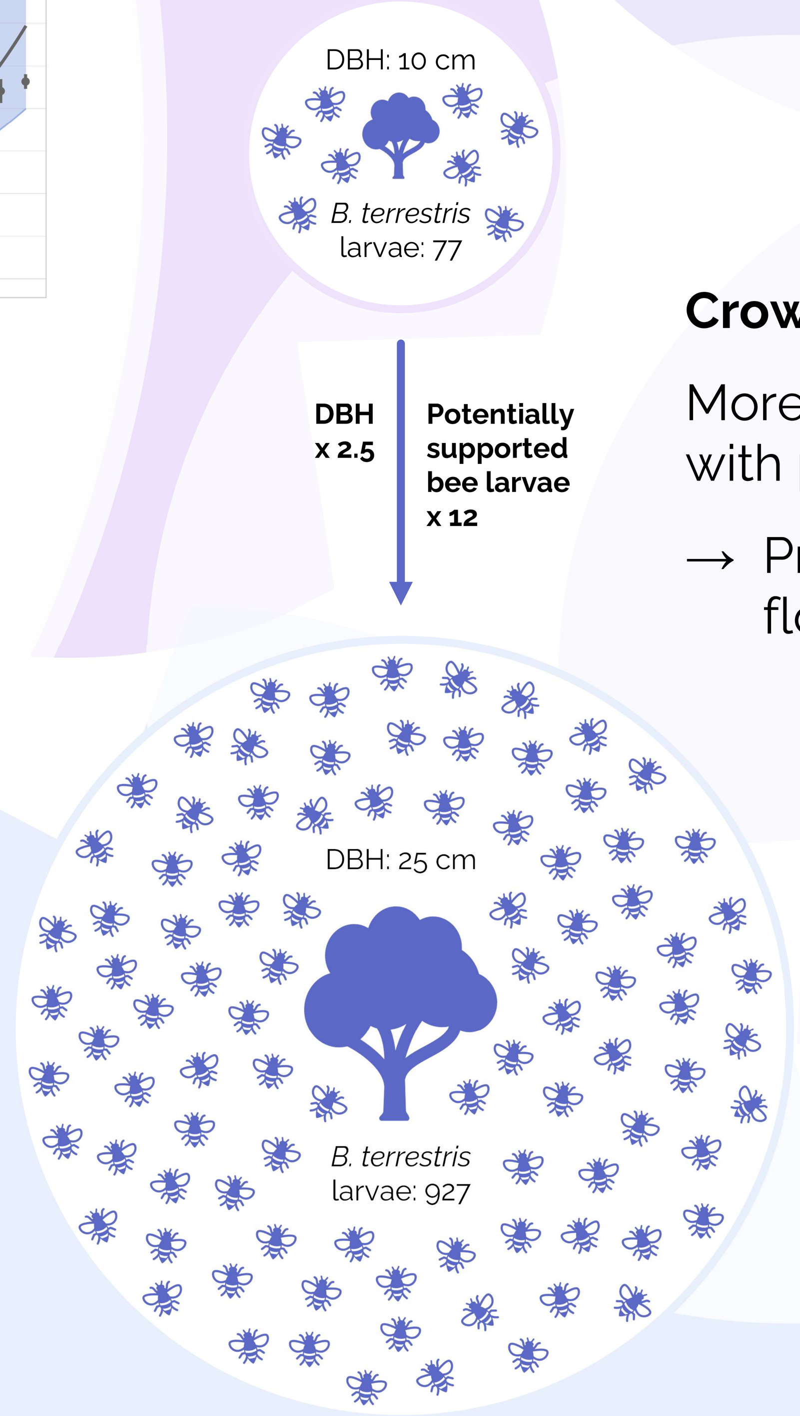




Point cloud (side view)

Point cloud (top view)





Discussion

Crown heterogeneity

More flowers per branch in crown sections with potentially higher **light availability** [9,10]

→ Previous studies assuming homogenous flower distribution are likely **biased** [11,12]

Exponential relationship

Trees with larger DBH or crown volume bear **disproportionately** more flowers

→ To maximize pollination services, trees should be allowed to grow **old & large** [13]

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Related paper:
Schindler *et al.* (2025) Flower Power: Modeling Floral Resources of Wild Cherry (*Prunus avium* L.) for Bee Pollinators Based on 3D Data. *Ecology 106(5):* e70103.

Photos

Paper

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