# Individual Tree AGB Estimation of *Malania oleifera* Based on UAV-RGB Imagery and Mask R-CNN

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**Abstract:** Forest aboveground biomass (AGB) is an important research topic in the field of forestry, with implications for carbon cycles and carbon sinks. *Malania oleifera* Chun et S. K. Lee (*M. oleifera*) is a valuable plant species that is listed on the National Second-Class Protected Plant checklist and has received global attention for its conservation and resource utilization. To obtain accurate AGB of individual *M. oleifera* trees in a fast, low-finance-cost and low-labor-cost way, this study first attempted to estimate individual *M. oleifera* tree AGB by combining the centimeter-level resolution RGB imagery derived from unmanned aerial vehicles (UAVs) and the deep learning model of Mask R-CNN. Firstly, canopy area (CA) was obtained from the 3.5 cm high-resolution UAV-RGB imagery using the Mask R-CNN; secondly, to establish an allometric growth model between the diameter at breast height (DBH) and CA, the correlation analysis of both was conducted; thirdly, the AGB estimation method of individual *M. oleifera* trees was presented based on an empirical equation. The study showed that: (1) The deep learning model of Mask R-CNN achieved an average segmentation accuracy of 90% in the mixed forests to the extraction of the canopy of *M. oleifera* trees from UAV-RGB imagery. (2) The correlation between the extracted CA and field-measured DBH reached an $R^2$ of 0.755 (n = 96). (3) The *t*-test method was used to verify the predicted and observed values of the CA-DBH model presented in this study, and the difference in deviation was not significant ($p > 0.05$). (4) AGB of individual *M. oleifera* was estimated for the first time. This study provides a reference method for the estimation of individual tree AGB of *M. oleifera* based on centimeter-level resolution UAV-RGB images and the Mask R-CNN deep learning.

**Keywords:** *Malania oleifera*; aboveground biomass; UAV; Mask R-CNN; allometric growth model

## 1. Introduction

*Malania oleifera* Chun & S. K. Lee (*M. oleifera*) is a rare, high-value, and protected species of evergreen broad-leaved trees found in arid regions. It belongs to the genus *Malania* within the Olacaceae family and is highly valued for its fruits, leaves, and trunk [1]. The kernels of *M. oleifera* contain over 60% oil and can be used to extract edible and aromatic oils [2]. Its fruit oil is also rich in neuronic acid, an important material for treating neurological diseases and promoting brain growth and nerve regulation [2]. *M.*

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104° ~ 107°E    22° ~ 26°N
( AUC)        0.9。 MaxEnt                                4                                :
( 39.6%) 、            ( 16.7%) 、            ( 13.7%) 、                ( 11.5%) 。 【    】
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# Suitable regions forecasting and environmental influencing factors of *Malania oleifera* in Yunnan and Guangxi

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**Abstract** 【Objective】 *Malania oleifera* is an endangered plant with high economic and ecological value. This study focuses on discovering the spatial distribution pattern of potential suitable areas of *M. oleifera*  and finding its main environmental affecting factors  laying a solid theory foundation for its conservation and utilization. 【Method】 This study got 136 sampling points of *M. oleifera* by field investigations  specimens of the digital library  and the global biodiversity information network. Based on the ArcGIS geographic information system platform and the maximum entropy model ( MaxEnt) with parameters of 20 common main environmental factors  the prediction model of *M. oleifera* potential suitable areas was built to simulate the *M. oleifera* distribution in Yunnan Province and Guangxi Zhuang Nationality Autonomous Prefecture ( Guangxi) . 【Result】 The results showed that of *M. oleifera* is mainly distributed in the longitude of 104°−107°E and the latitude of 22°−26°N. The area under the curve ( AUC) of potential suitable areas predicted by