Non-destructive estimation of *Oecophylla smaragdina* colony biomass

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Introduction

Ants have a significant influence on ecosystem functioning [1]. Feeding on several trophic levels, ants serve as conduits for the flow of nutrients [2]. However, a fully understanding of their functional importance has been hampered by limited availability of data on ant abundance.

The weaver ant *Oecophylla smaragdina* is a predatory species that construct nests of leaves in the canopy. The colonies can reach huge population sizes, span large territories and may consist of hundreds of nests [3]. The nests are distinctive, exposed and can readily be sampled for measurement of volume and nest content. Quantifying the abundance of *O. smaragdina* can provide a general insight into the environmental impact of ants.

Objective

Develop a swift method by which the biomass of *O. smaragdina* colonies could be estimated non-destructively.

Methods

O. smaragdina biomass was estimated by means of two sub-models:

Model 1) Predicting the total ant nest volume in a host tree by scoring the number of ant trails according to their density in 16 trees and subsequently measuring the volume of all the nests in the trees (figure 1).

Model 2) Predicting the biomass content as a function of nest volume by measuring the volume of 77 nests and subsequently determine their biomass content (figure 2).

The end product was a method with by direct assessment of colony size (biomass) could be performed by assessing the trail score in trees inhabited by *O. smaragdina*. Through a Bayesian latent variable model, quantitative assessments of the uncertainties in the estimates were made.

Based on the developed model, the biomass in all trees hosting *O. smaragdina* was estimated in a mango plantation in Darwin, Australia.

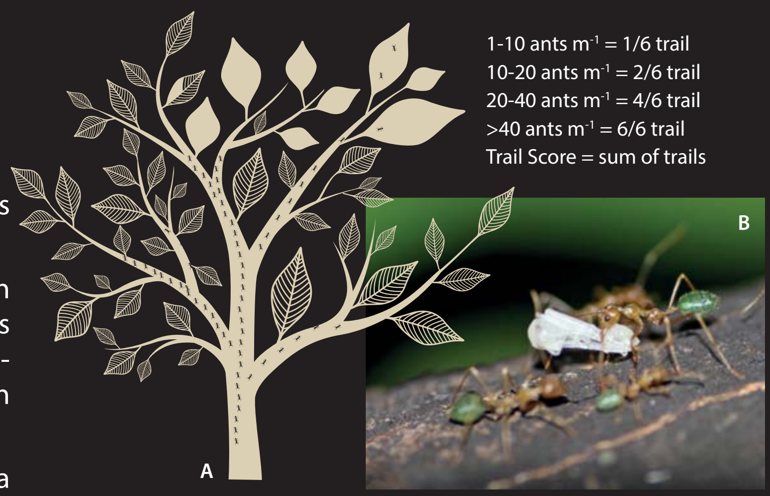

Figure 1. A) Schematic representation of a tree with ant trails. **B)** Ant trail on a branch.

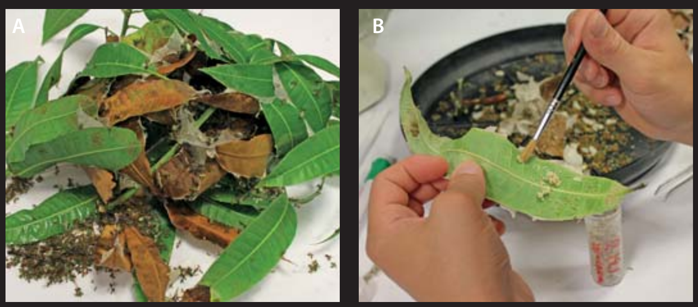

Figure 2. A) An *O. smaragdina* nest. **B)** sorting nest content.

Results

Trail scores ranged from 0.5 on trees with few and low density ant trails, to 5 on trees where almost every branch were occupied by an ant trail (figure 3).

The relation between nest volume and biomass content (figure 4) was best described by a power function as smaller nests contained relatively less biomass. The majority of the biomass was composed of workers (roughly 75%) with the remaining part being brood and sexuals.

The final model (figure 5) produced estimates of ant biomass (table 1) with a 95% credibility interval of approximately 75% of the estimated median value.

Figure 3. Relation between trail score and total active nest volume in the tree (n= 16, R^2= 0.85).

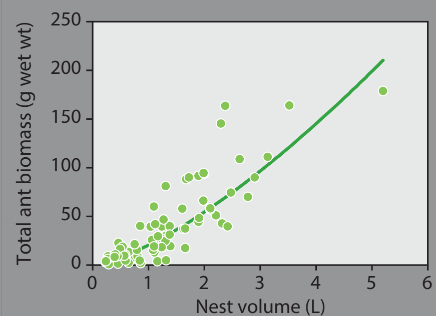

Figure 4. Relation between nest volume and total ant biomass (n=77, R^2=0.67).

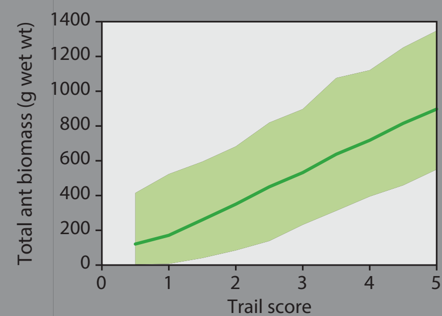

Figure 5. Total ant biomass as a function of trail score. Thick line represents median value and shaded area represents 95% credible interval.

Table 1. Number of colonies, trees occupied, estimated biomass and number of workers in the plantation. Values in parentheses represent standard deviation and square brackets represent colony range.

Plantation data		Number of colonies	Trees occupied	Total biomass (g wet weight)	Number of workers*
Area (ha)	# Trees	5	40	8,428 (834)	1,065,931 (105,969)
0.42	76		[2-14]	[666-2,977]	[84,578-376,635]

*Numbers of workers has been calculated from the mean weights of major and minor workers.

Acknowledgement

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Discussion and conclusion

The combined biomass of the five colonies in the plantation was 20 kg fresh wt ha^{-1}. For comparison, the amount of animal biomass in an Amazonian rainforest has been estimated to be about 200 kg ha^{-1} [4]. It is remarkable that a single ant species in a mango plantation can attain a biomass corresponding to 10% of the entire animal biomass in a rainforest. As opposed to destructive assessments, which are a snapshot of ant abundance, our method will allow a continuous assessment of *O. smaragdina* biomass dynamics. Thereby, laboratory measurements on physiological per capita rates can be scaled to ecosystem level: E.g the flow of nutrients from host tree to ants and vice versa can be estimated from per capita rates of ant carbohydrate consumption or waste product excretion. Hence, *O. smaragdina* can be utilised to assess the impact of ants in a tropical ecosystem, which at present is poorly understood.

References

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