Supplementary Information

Airborne LiDAR Detects Selectively Logged Tropical Forest Even in an Advanced Stage of Recovery

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Crown Shape Correction for Canopy Trees

In order to account for crown shape in estimating canopy weighted tree height in the permanent field plots, we need to know the vertical distance × from the top of the tree to the point at which half of the crown's surface area is above and half below that point. This allows us to calculate the average crown height given a tree's height. To do this we used the following crown shape function developed by [1,2]:

$$R = R_{max}\left(\frac{H-h}{H}\right)^{\beta} \quad (1)$$

where R_{max} is the projected radius at ground level and H is tree height, β is the crown shape parameter, and h is the height of interest. This equation is highly flexible, and can describe the shape of variable crown shapes.

Cumulative surface area of a crown, from top down to height *h*, is:

$$CA = \pi {R^2}_{max}\int_0^h \left(\frac{H-h}{H}\right)^{2\beta} dh \quad (2)$$

which, when integrated, gives:

$$CA = -\frac{\pi {R^2}_{max}}{(2b+1)H^{2\beta}}\left[(H-h)^{2\beta+1}\right] \quad (3)$$

where the limits of the integration are 0 and h. We are interested in finding the vertical distance × from the top of the tree to the point at which half of the crown's surface area is above and half below that point. If d is crown depth then:

$$\frac{\pi {R^2}_{max}}{(2b+1)H^{2\beta}}\left[(H-x)^{2\beta+1}-(H)^{2\beta+1}\right] = \frac{\pi {R^2}_{max}}{2(2b+1)H^{2\beta}}\left[(H-d)^{2\beta+1}-(H)^{2\beta+1}\right] \quad (4)$$

And thus:

$$2\left[(H-x)^{2\beta+1}-(H)^{2\beta+1}\right] = \left[(H-d)^{2\beta+1}-(H)^{2\beta+1}\right] \quad (5)$$

We do not have crown shape parameter values for our field site. Spriggs *et al*. [1] found that β (crown shape parameter) of dominant angiosperm species in their study was 0.23, and Osunkoya *et al*. [2] found that typical crown depth d of canopy trees in their study of Malaysian forests was 0.33*H*. Assigning these values into equation 5 gives × as a proportion of *H* of 0.16. Thus, we multiplied our field plot height estimates by 0.84.

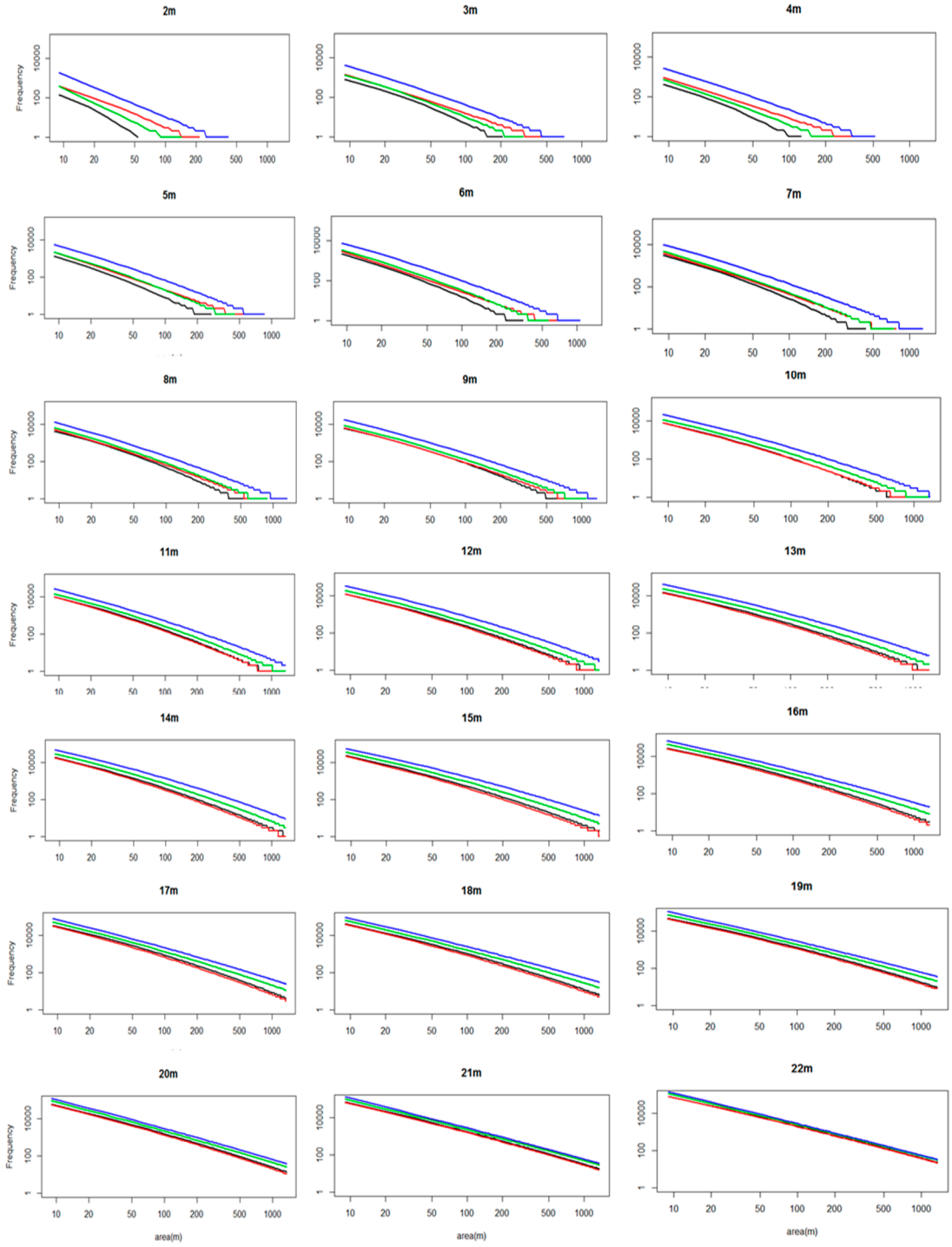

Figure S1. Predictive curves of gap-size distribution in each height band (2–22 m) in the logged and old-growth plots in Gola. Color scheme follows Figure 2

References

1. Spriggs, R.; Vanderwel, M.; Jones, T.; Caspersen, J.; Coomes, D. A simple area-based model for predicting airborne LiDAR first returns from stem diameter distributions: An example study in an uneven aged, mixed temperate forest. *Can. J. For. Res.* **2015**, *2015*, doi:10.1139/cjfr-2015-0018..

2. Osunkoya, O.; Omar-Ali, K.; Amit, N.; Dayan, J.; Daud, D.; Sheng, T. Comparative Height Crown Allometry and Mechanical Design in 22 Tree Species of Kuala Belalong Rainforest, Brunei, Borneo. *Am. J. Bot.* **2007**, *94*, 1951–1962.