Drivers of felling gap size and skidding impacts on canopy openness: a UAV-based assessment of certified logging disturbance in Central Africa

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ABSTRACT

Although certified selective logging operates under Reduced Impact Logging guidelines, its cumulative effects on canopy structure remain substantial and poorly quantified at fine scales. Here, we combine UAV remote sensing with field inventory data from ~4,000 harvested trees across 5 certified concessions in 3 Central African countries to :

[RESEARCH QUESTIONS]

(1) identify the key drivers of individual felling gap size during selective logging

(2) disentangle the respective impacts on canopy of felling and skidding

METHODS

DATASET CONSTRUCTION

UAV flights

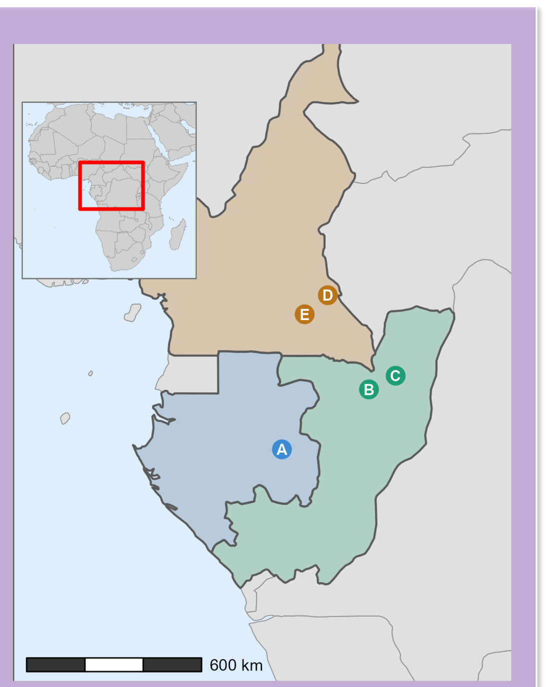
T_0·T_1· (+ T_2, sites D&E)

Fields inventory data[1]

~4,000 felled trees in 5 concessions

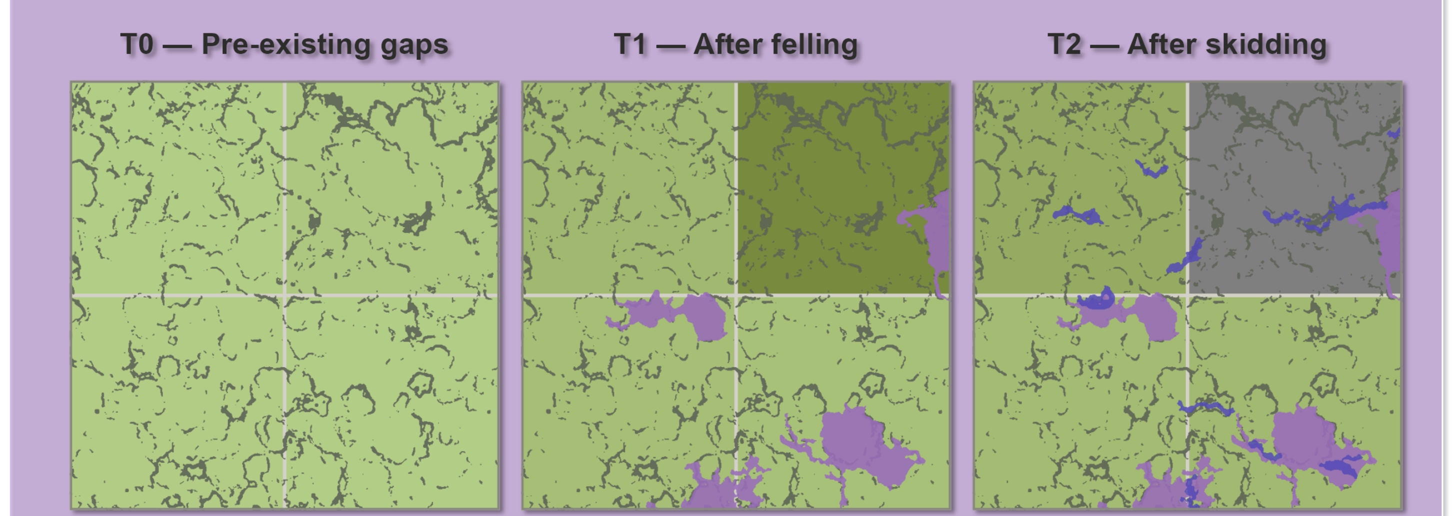
Functional traits databases[2]

CoForTraits · Tallo · TWDD



PROCESSINGS

Gaps delineation & spatial analysis



ANALYSES

(1) gap-size determinants

Mixed model (LMM) : $\log_{10}$(gap area) ~ DBH | functional traits | site context | forest type[3]

(2) felling vs. skidding

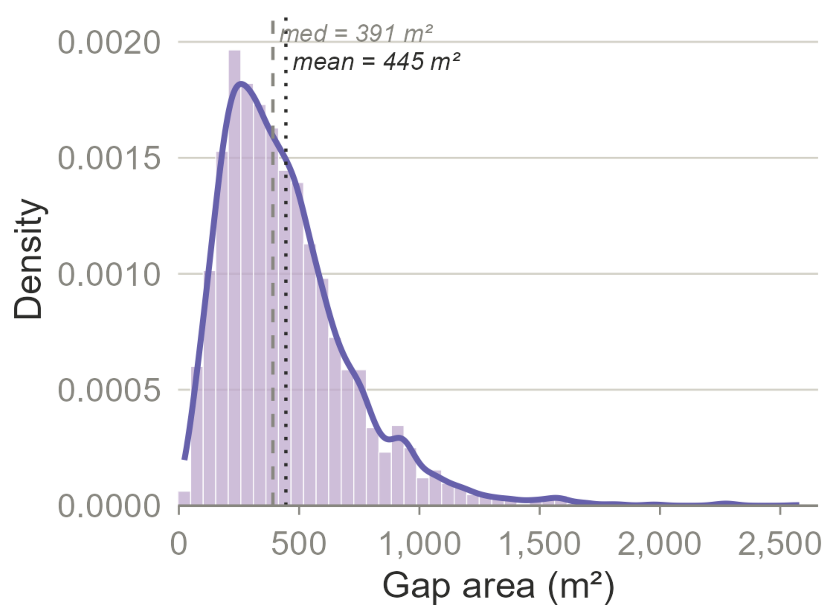
Linear regressions + ANOVA

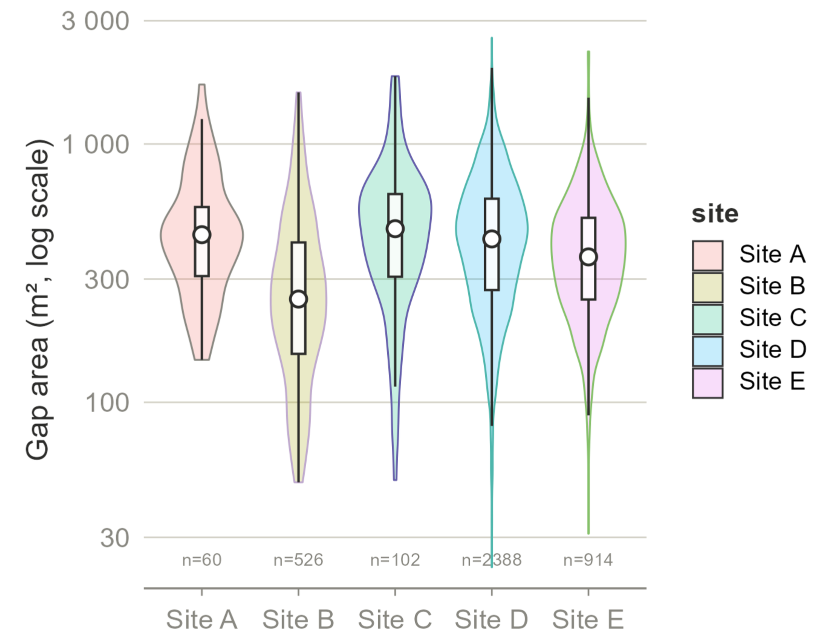
Impact ~ initial openness

Impact ~ harvested intensity

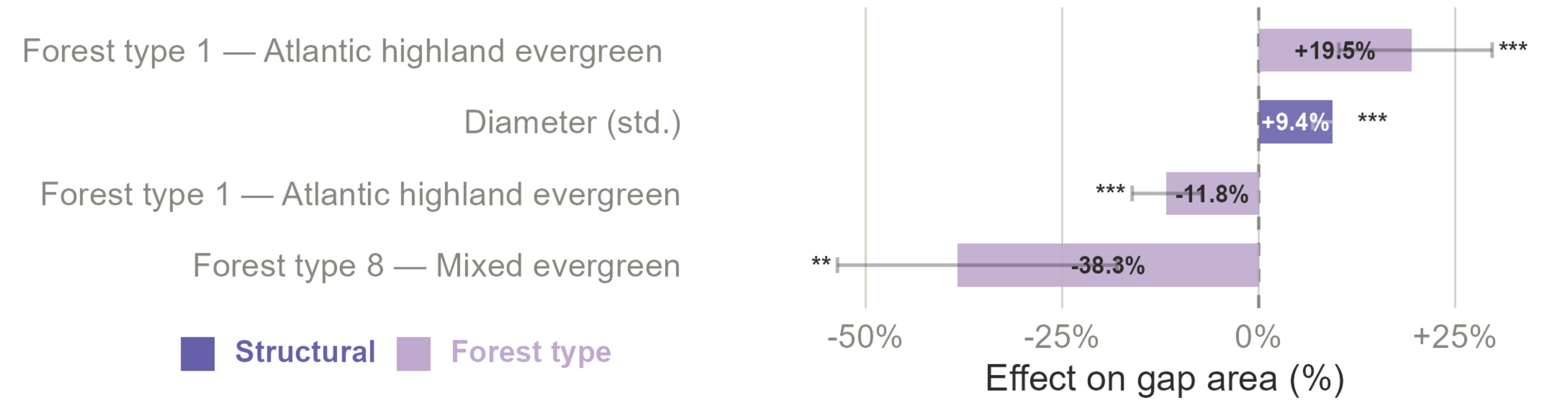
RESULTS & DISCUSSION

1 GAP SIZE DISTRIBUTION



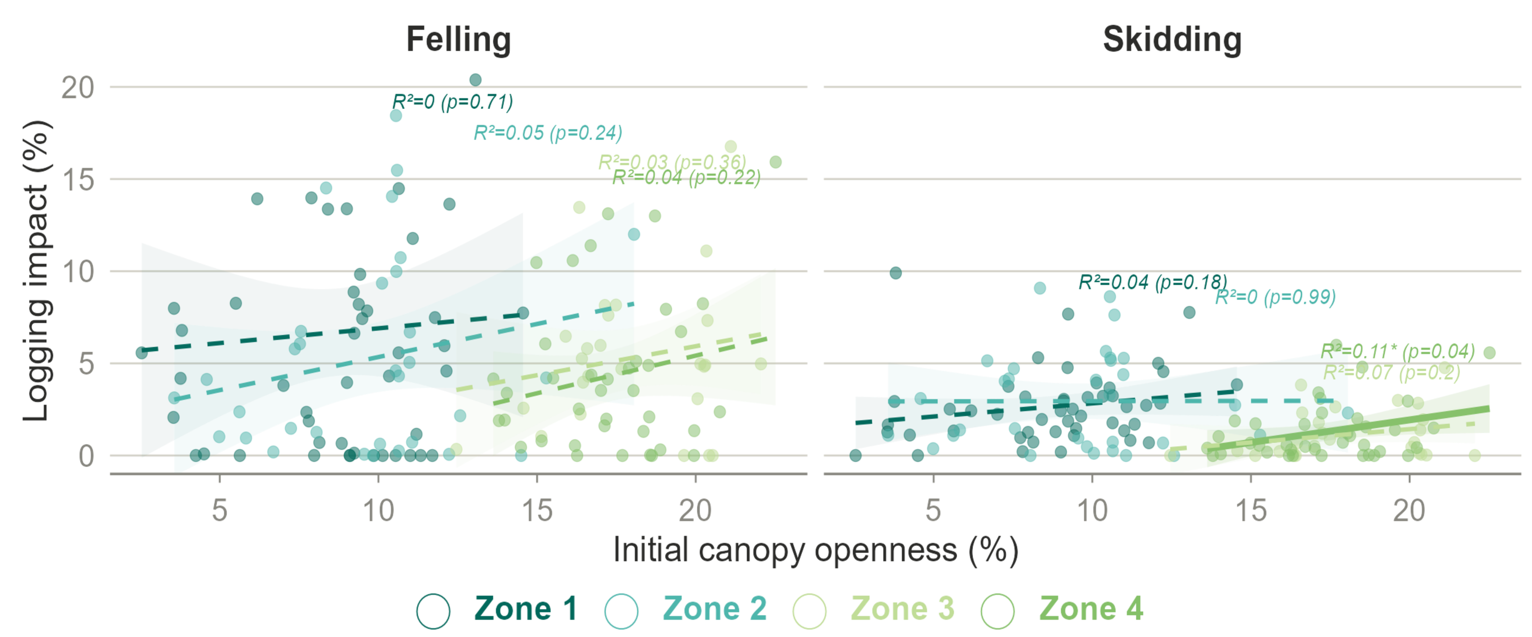


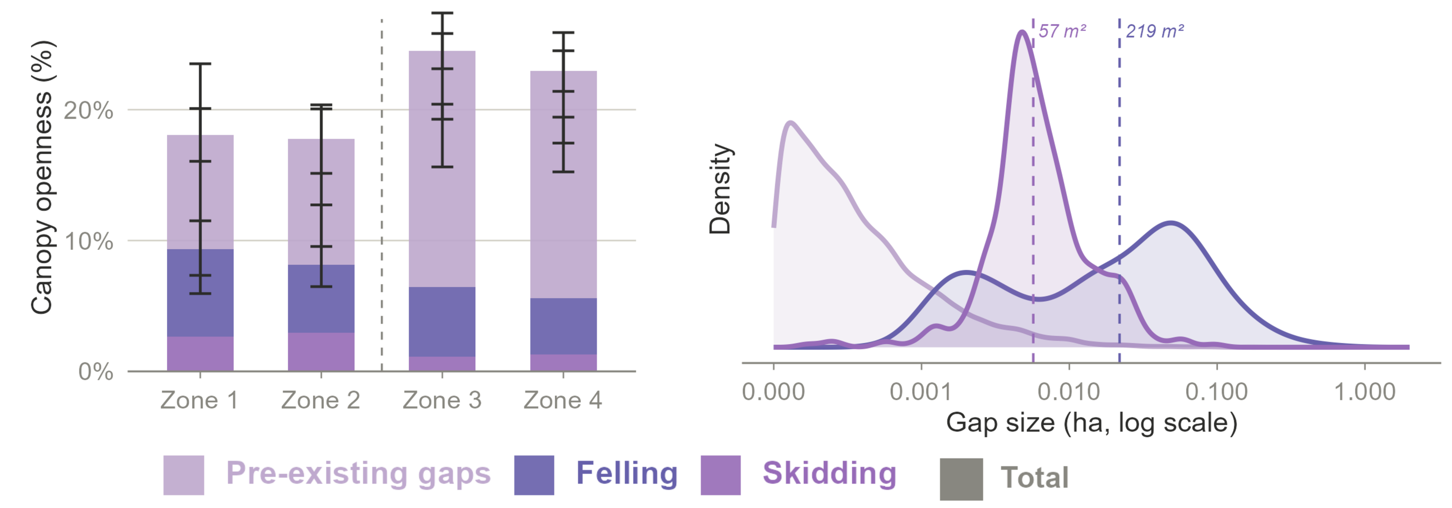
DRIVERS OF FELLING GAP SIZE 2

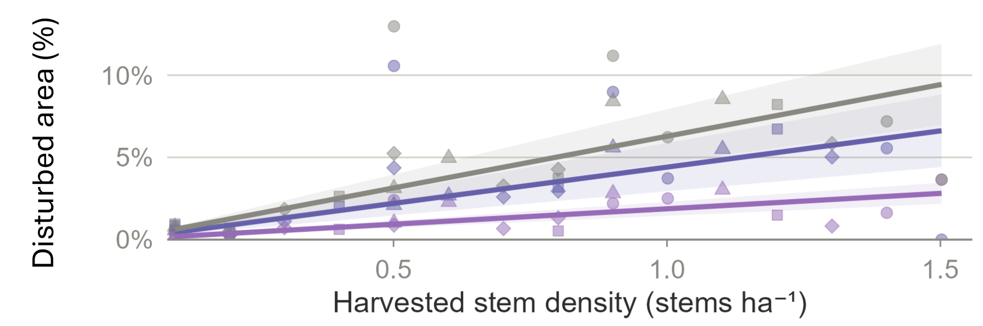


Log-normal LMM — n = 3726 trees — only p < 0.05 shown — error bars = 95%

3 FELLING VS. SKIDDING IMPACT







- Felling gaps are **variable** across the 5 sites
- Gap size is primarily driven by **tree diameter** and **forest type**
- Felling **dominates** canopy disturbance → consistent impact across sites, regardless of initial canopy state
- Skidding impact is **site-dependent** → greater where the canopy was initially more open

CONCLUSION

- Canopy disturbance is driven by a **3-way interaction**: initial forest state & type, tree attributes, concession-specific practices
- Felling dominates (68-79%), but skidding is a **context-dependent non-negligible** source of disturbance → requiring operational monitoring

⇒ These results provide an empirical foundation for **satellite-based upscaling** of disturbance estimates across Central African certified concessions

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