Come on (Bar)bie! The effect of multiple disturbance mechanisms on longleaf pine (*Pinus palustris*) seedling water potential and biomass allocation

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Introduction

The longleaf pine savanna ecosystem, while once extensive throughout the Southeast United States, has been reduced to 3% of its original range.[1] This drastic range reduction is attributed to anthropogenic disturbances such as land use alteration, fire-suppression regimes, and exploitation of the ecosystem for its natural resources.[2] In the recent decades, increasing interest in restoring this ecosystem has been hindered by a paucity of information relating to how many of its endemic species respond to stressors. To better assist the restoration efforts, additional understanding of the ways in which longleaf pine (*Pinus palustris*) seedlings respond to various pressures is of vital importance. Using commercially available seedlings, three separate pilot experiments were performed utilizing the UNCG Teaching Greenhouse to explore how *P. palustris* seedlings respond to various stressors.

Methods and Materials

Trampling: To explore the effect of damage caused by the trampling and resting of deer, a filled Nalgene water bottle was either placed upon the seeding overnight or dropped upon the seedling four times in succession to simulate deer resting or trampling behavior, respectively. This repeated for one month until water potential measurements were taken.

Raking: To explore the effects of mechanical damage caused by raking, seedlings (*P. palustris* and *S. scoparium*) were raked from four cardinal directions with either a 3-pronged fork or a fine-toothed cat comb to simulate either low or high intensity raking. Plants were regularly harvested during which water potential measurements were taken.

Drought and Nutrients: To explore the effect of drought and nutrient addition on *P. palustris* health, drought, nutrient addition (20g aqueous K), and combined treatments were established. Plants were regularly harvested during which water potential measurements were taken.

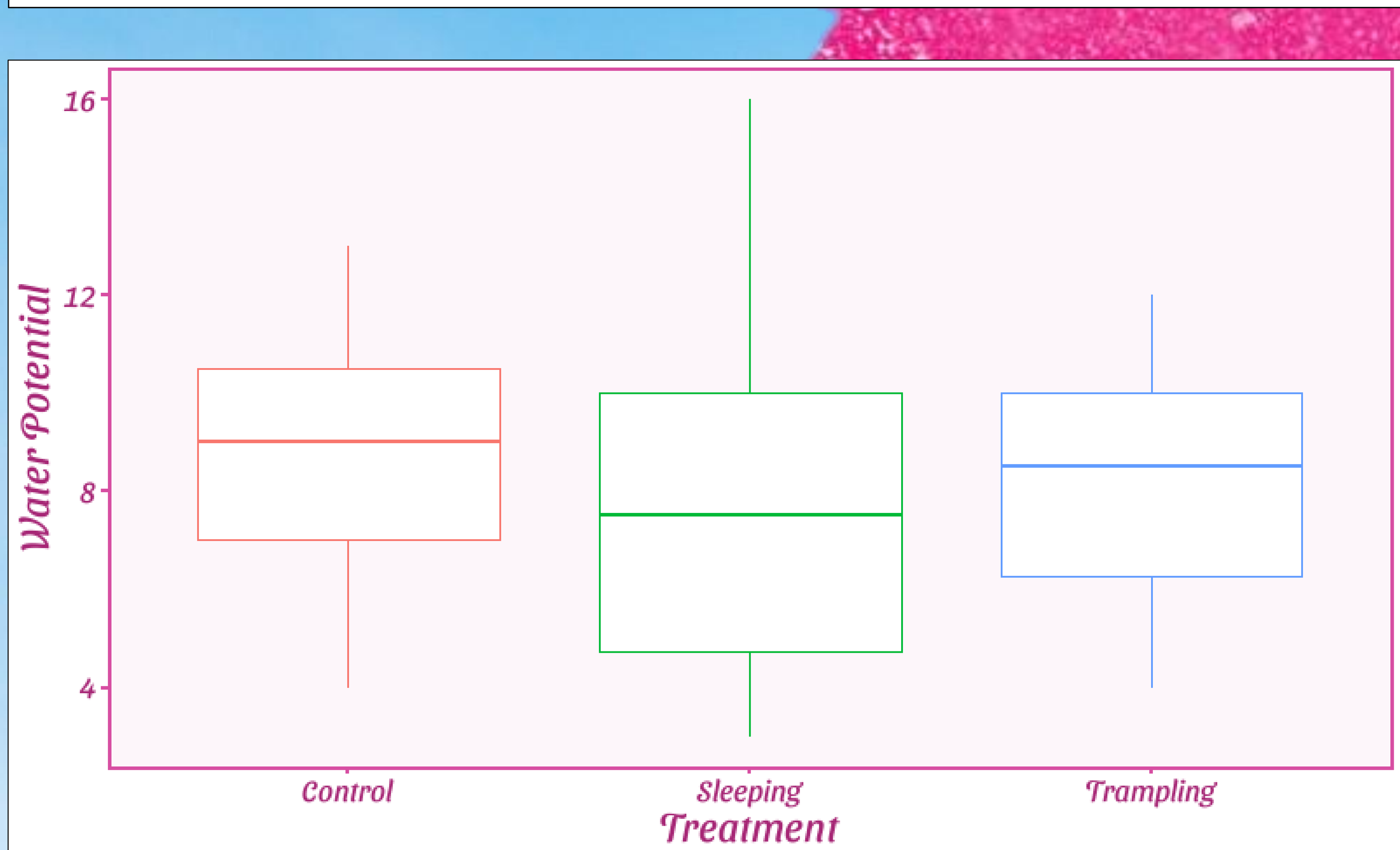

Fig I. Boxplots showing the water potential (bar) of *P. palustris* after one month of sleeping and trampling treatments. (KW, $\chi = 0.39$, df = 2, p = 0.82)

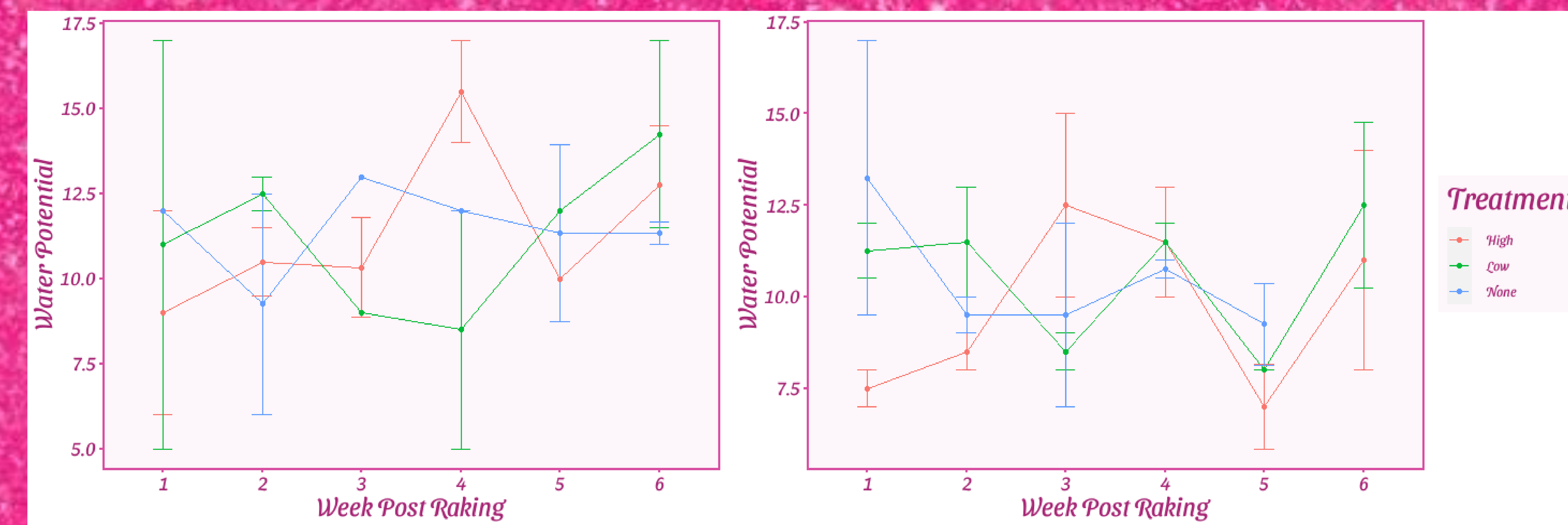

Fig 2. Line graphs showing the water potential (bar) of *S. scoparium* (left) *and P. palustris* (right) post raking treatment. * denotes weeks where groups were significantly different from one another.

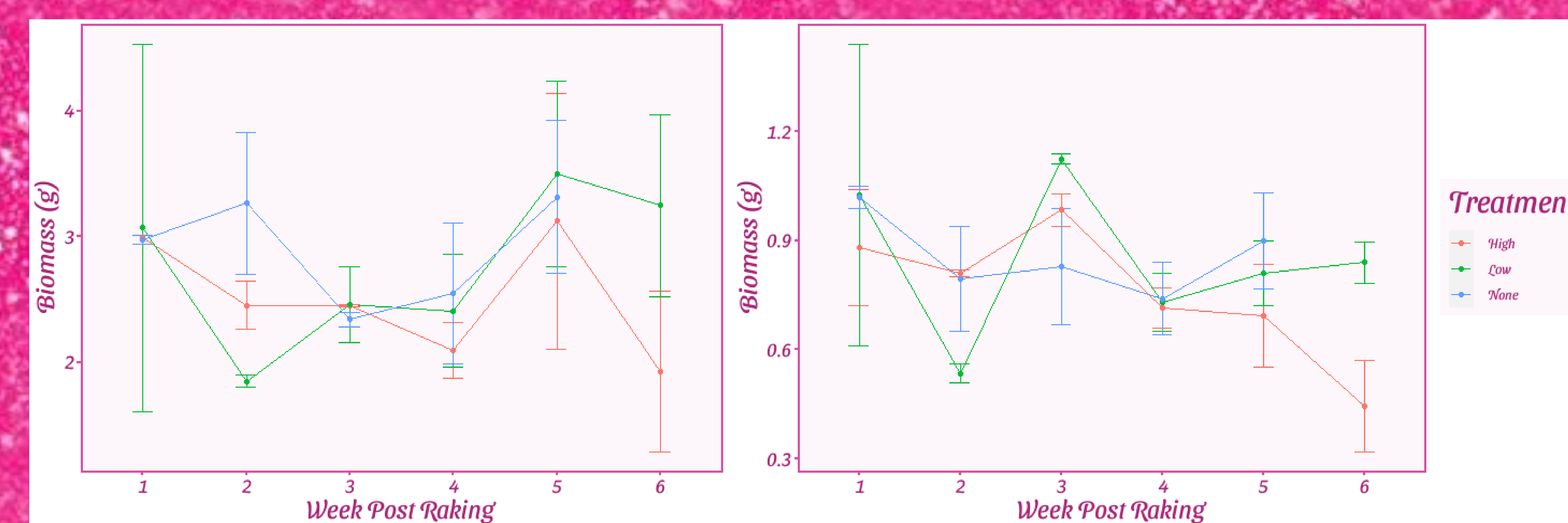

Fig 3. Line graphs showing the aboveground (left) and belowground (right) biomass allocation of *P. palustris* post raking treatment. No weeks were significantly different from one another.

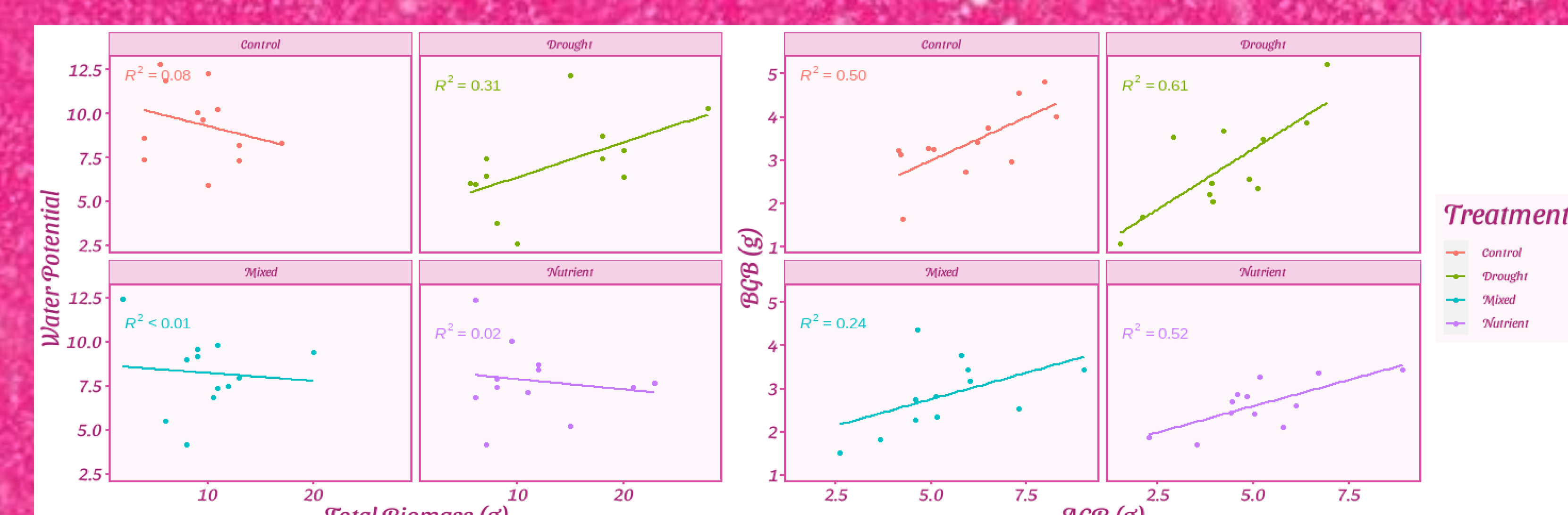

Fig 4. Scatter plots and linear regression of water potential (bar) against total biomass (left) and belowground and aboveground biomass (g) (right) of *P. palustris.*

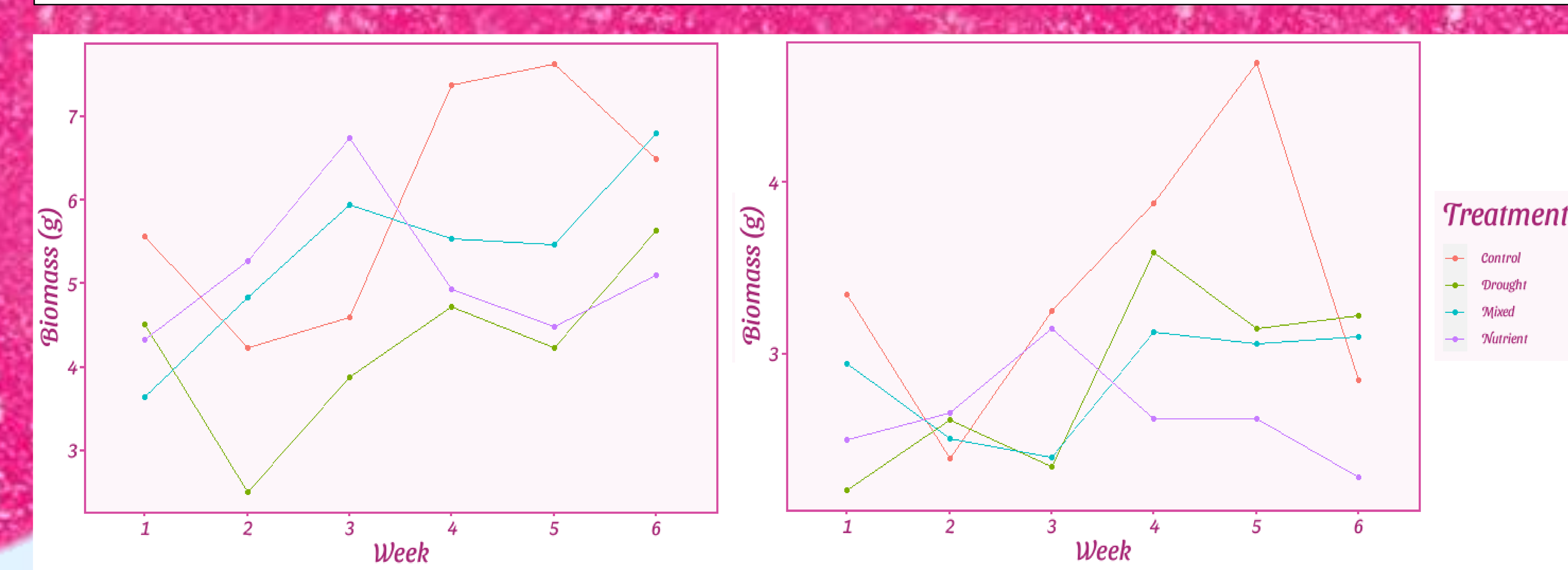

Fig 5. Line graphs depicting the aboveground (left) and belowground (right) biomass allocation of *P. palustris* though time post treatment.

Results

Trampling: After one month of applying sleeping and trampling treatments, no significant differences were found in the water potential of P. palustris between treatments.

Raking: No major differences were noted in either the water potential or the aboveground and belowground biomass allocation of P. palustris between raking treatments.

Drought and Nutrients: While no major differences were observed in the aboveground or belowground biomass allocation of P. palustris following treatment application. However, a weak relationship between drought and total biomass were noted in conjunction with slight differences in the AGB:BGB ratios of the drought group. Interestingly, these relationships are not seen in the mixed treatment group.

Conclusion

- *Pinus palustris* seedlings appear to be resistant to physiological change mediated by mechanical damage as demonstrated through the lack of differences in either the ***Trampling*** or ***Raking*** experiments.
- Drought appears to play a stronger role in mediating physiological alterations, as suggested by the ***Drought and Nutrients*** experiment. These changes may also depend on the presence or addition of additional nutrients into the system.
- As many stakeholders rely on pine straw harvesting to maintain LLP ecosystems[3], it is promising that *P. palustris* seedling appear to be resistant to mechanical damage. The effects of drought on these seedlings should be further explored as our climate continues to change and more extreme weather events are predicted to occur.

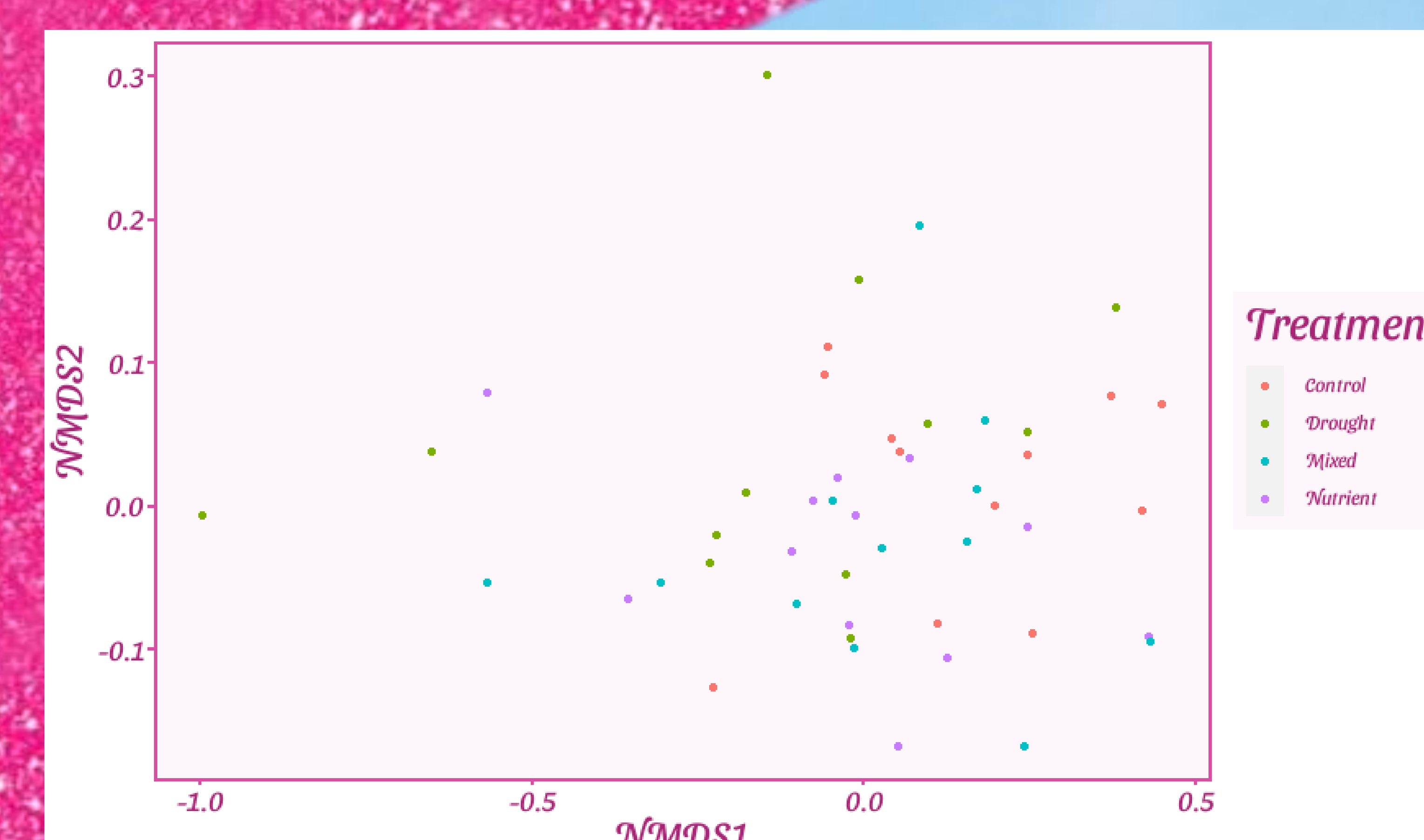

Fig 6. NMDS showing the spatial distribution of the AGB:BGB ratio for each treatment. ANOVA showed marginal significance (ANOVA, F = 2.36, df = 4, p = 0.08)

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