fire

MDPI

Supplementary materials for

A quantitative analysis of fuel break effectiveness drivers in Southern California National Forests

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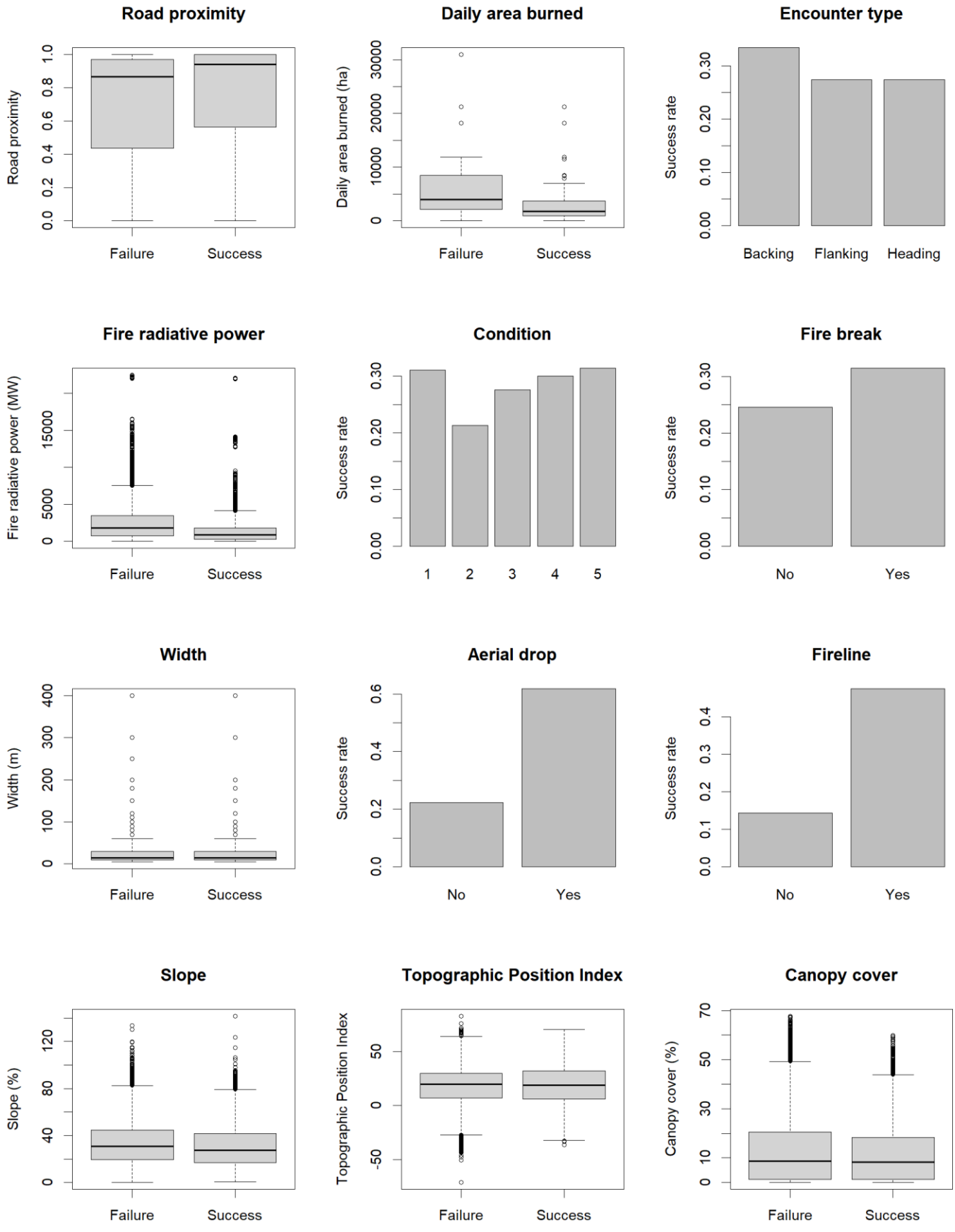
Predictor variable distributions and relationships to outcomes

Figure S1 shows the distribution of each predictor variable by fuel break outcome (held=success, burned over=failure) using boxplots for continuous variables and barplots for categorical variables.


Road proximity
Road proximity
0.0 0.2 0.4 0.6 0.8 1.0
Failure Success
Daily area burned
Daily area burned (ha)
0 10000 20000 30000
Failure Success
Encounter type
Success rate
0.00 0.10 0.20 0.30
Backing Flanking Heading
Fire radiative power
Fire radiative power (MW)
0 5000 15000
Failure Success
Condition
Success rate
0.00 0.10 0.20 0.30
1 2 3 4 5
Fire break
Success rate
0.00 0.10 0.20 0.30
No Yes
Width
Width (m)
0 100 200 300 400
Failure Success
Aerial drop
Success rate
0.0 0.2 0.4 0.6
No Yes
Fireline
Success rate
0.0 0.1 0.2 0.3 0.4
No Yes
Slope
Slope (%)
0 40 80 120
Failure Success
Topographic Position Index
Topographic Position Index
-50 0 50
Failure Success
Canopy cover
Canopy cover (%)
0 10 30 50 70
Failure Success

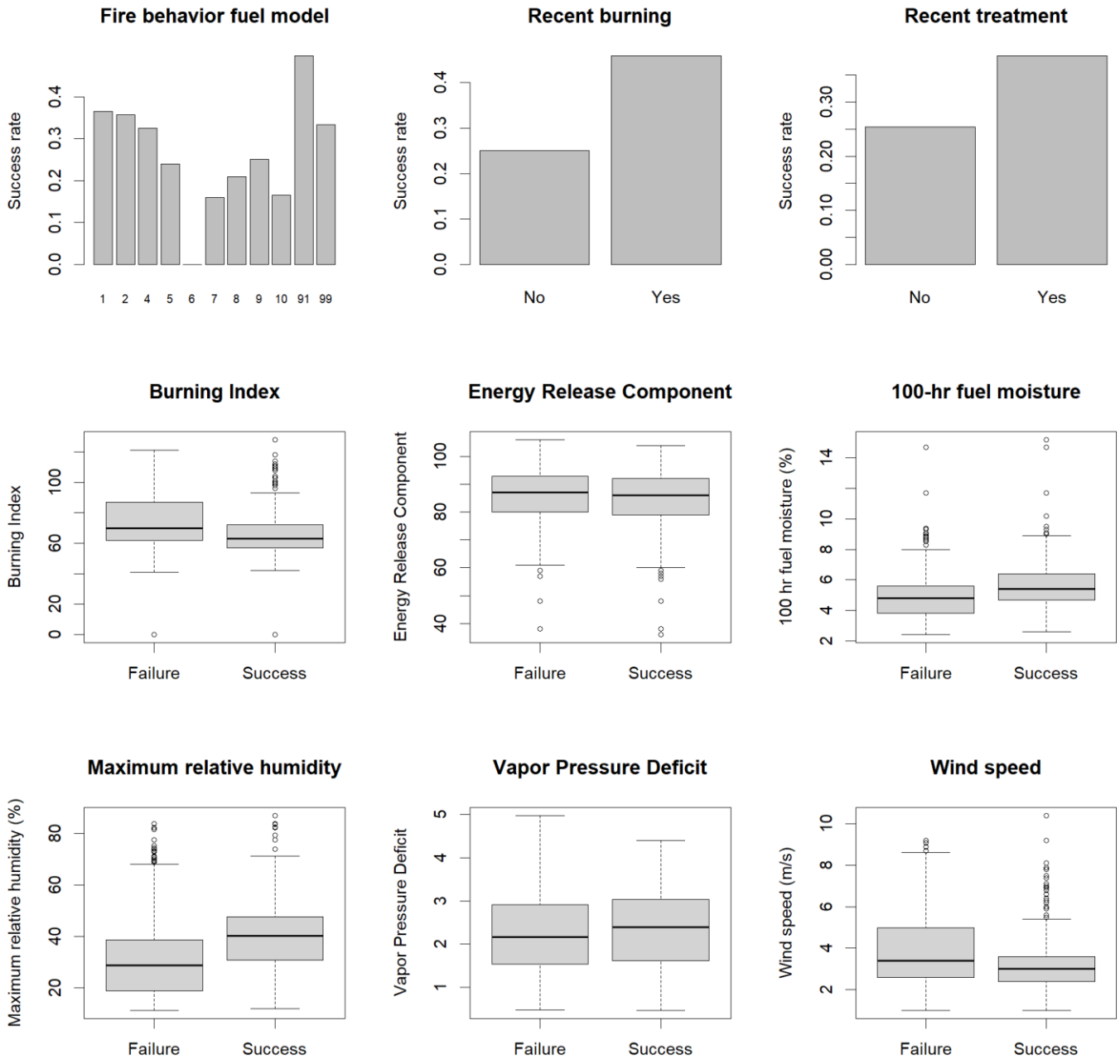


Figure S1. Predictor variable distributions for fuel break failures and successes. Continuous variables are visualized with boxplots and categorical variables are visualized with bar plots of the mean success rate by category.

Partial dependence plots for Models 1, 3, 4, and 5

Figures S2 through S5 show the partial dependence plots for Models 1, 3, 4, and 5.

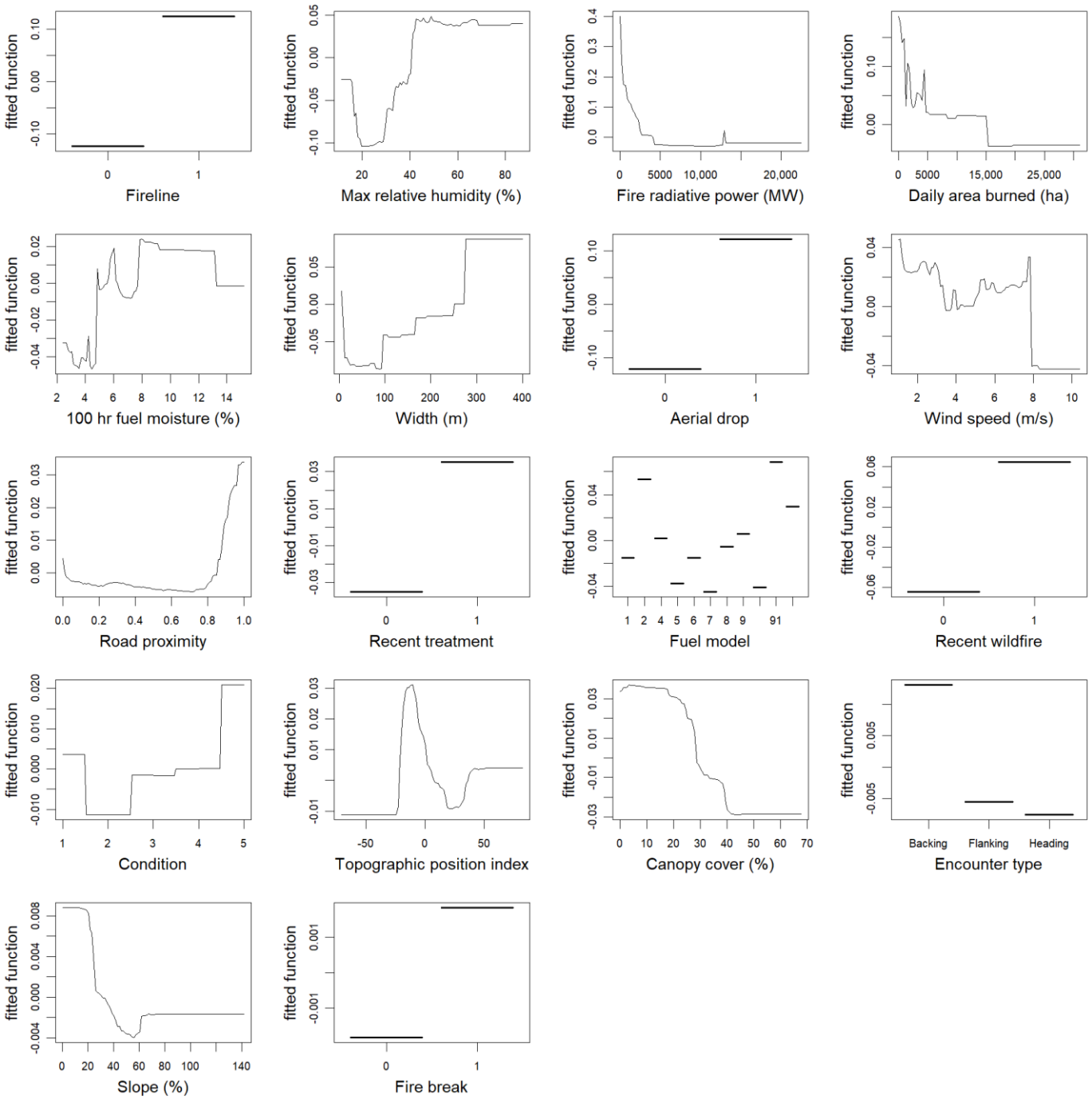


Figure S2. Partial dependence plots for Model 1 with the full training data showing the mean effect of each variable sorted in order of descending relative variable importance.

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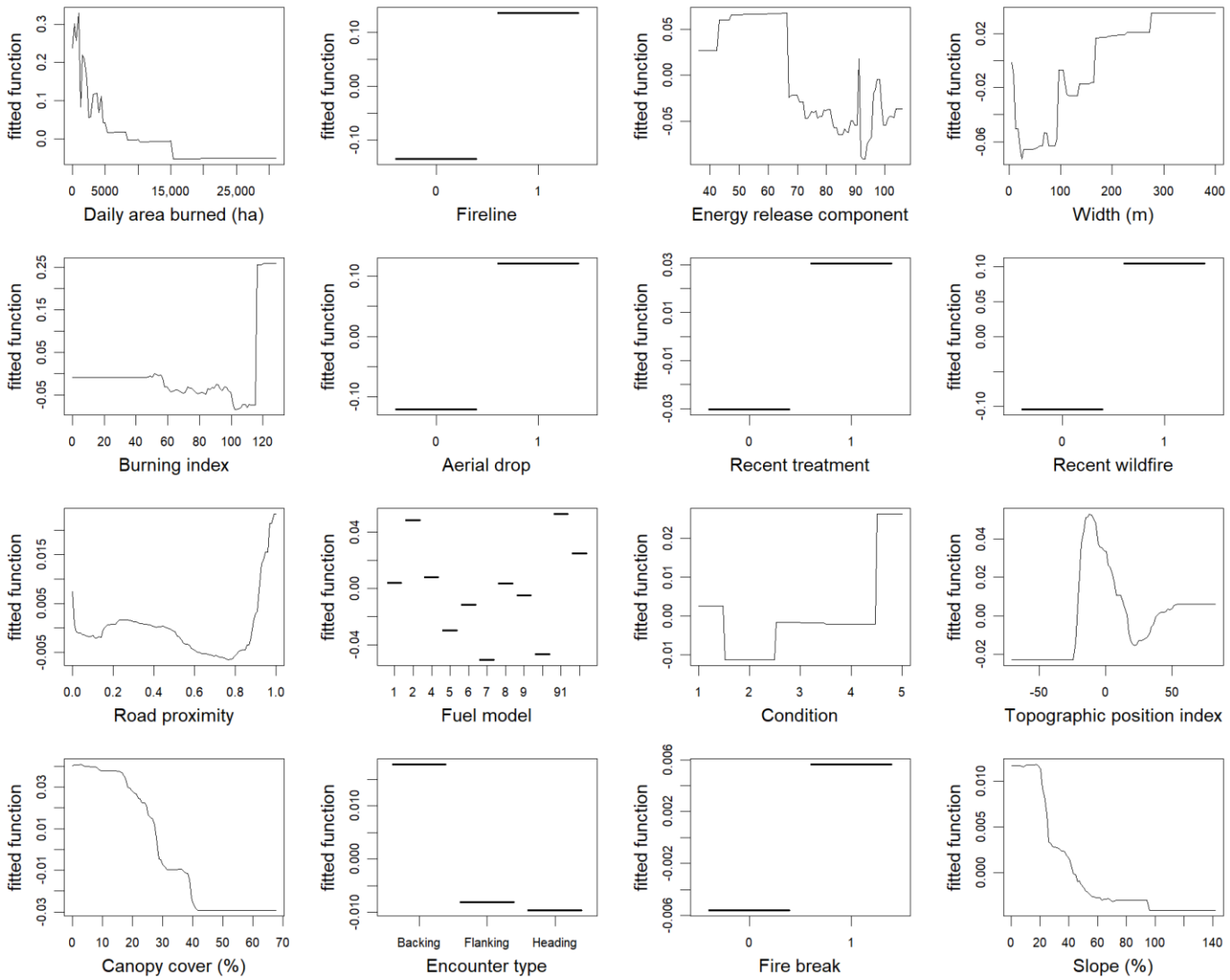

Figure S3. Partial dependence plots for Model 3 with the full training data showing the mean effect of each variable sorted in order of descending relative variable importance.

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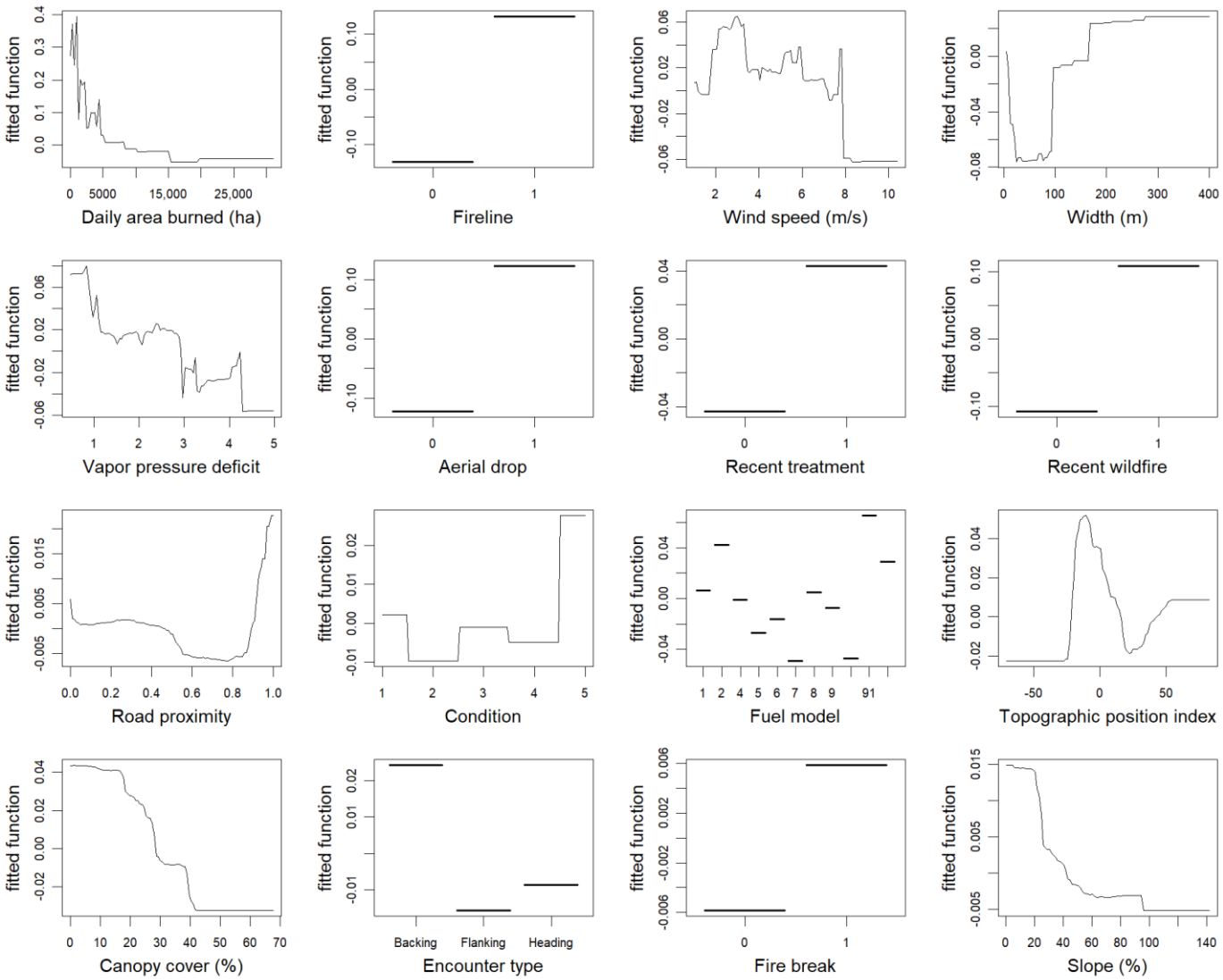

Figure S4. Partial dependence plots for Model 4 with the full training data showing the mean effect of each variable sorted in order of descending relative variable importance.

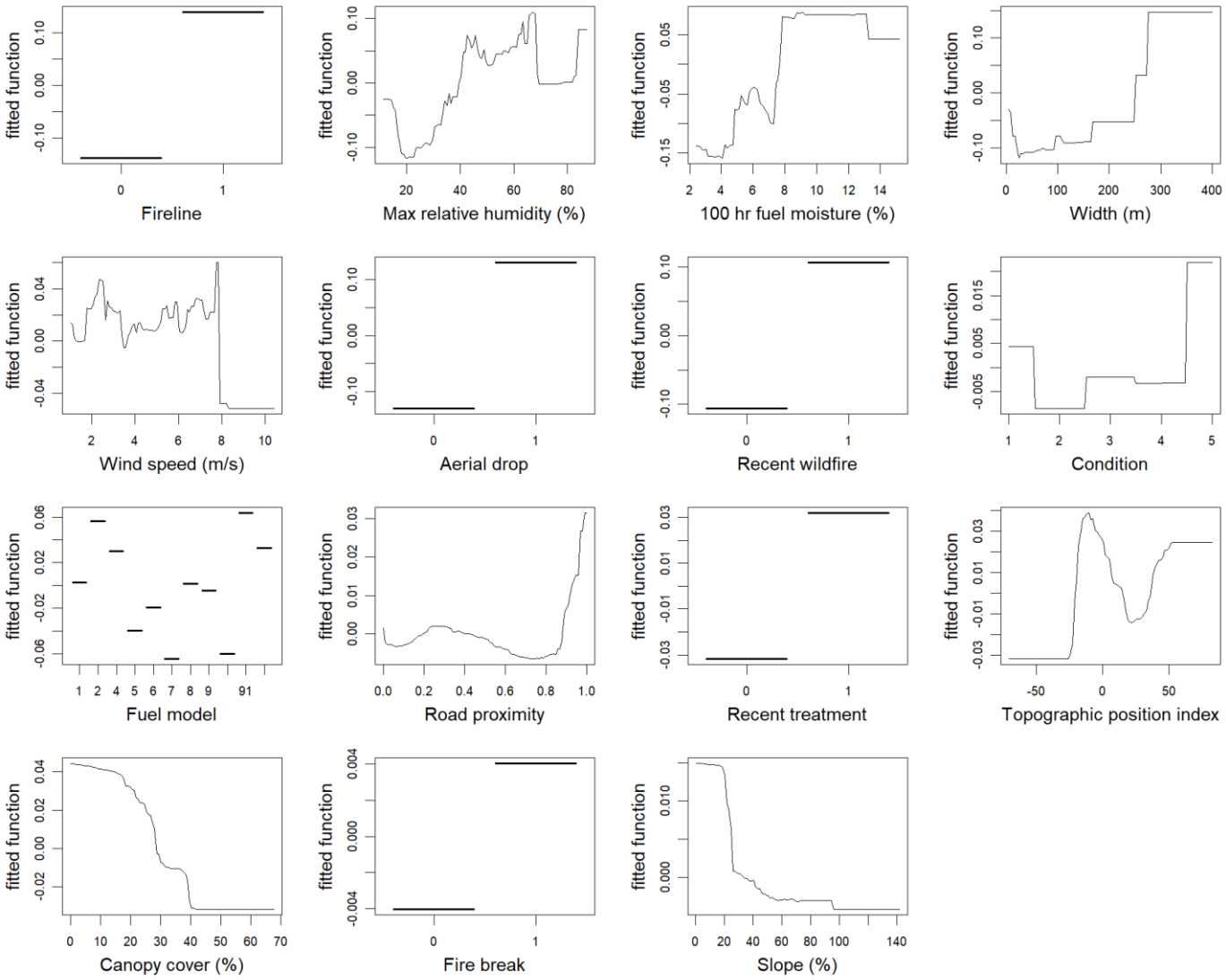

Figure S5. Partial dependence plots for Model 5 with the full training data showing the mean effect of each variable sorted in order of descending relative variable importance.

Sample spacing sensitivity analysis

Figure S6 shows the variable importance results for Model 2 trained on 20 random subsets of the full training dataset with minimum spacing distances of 50, 100, 200, and 500 m.

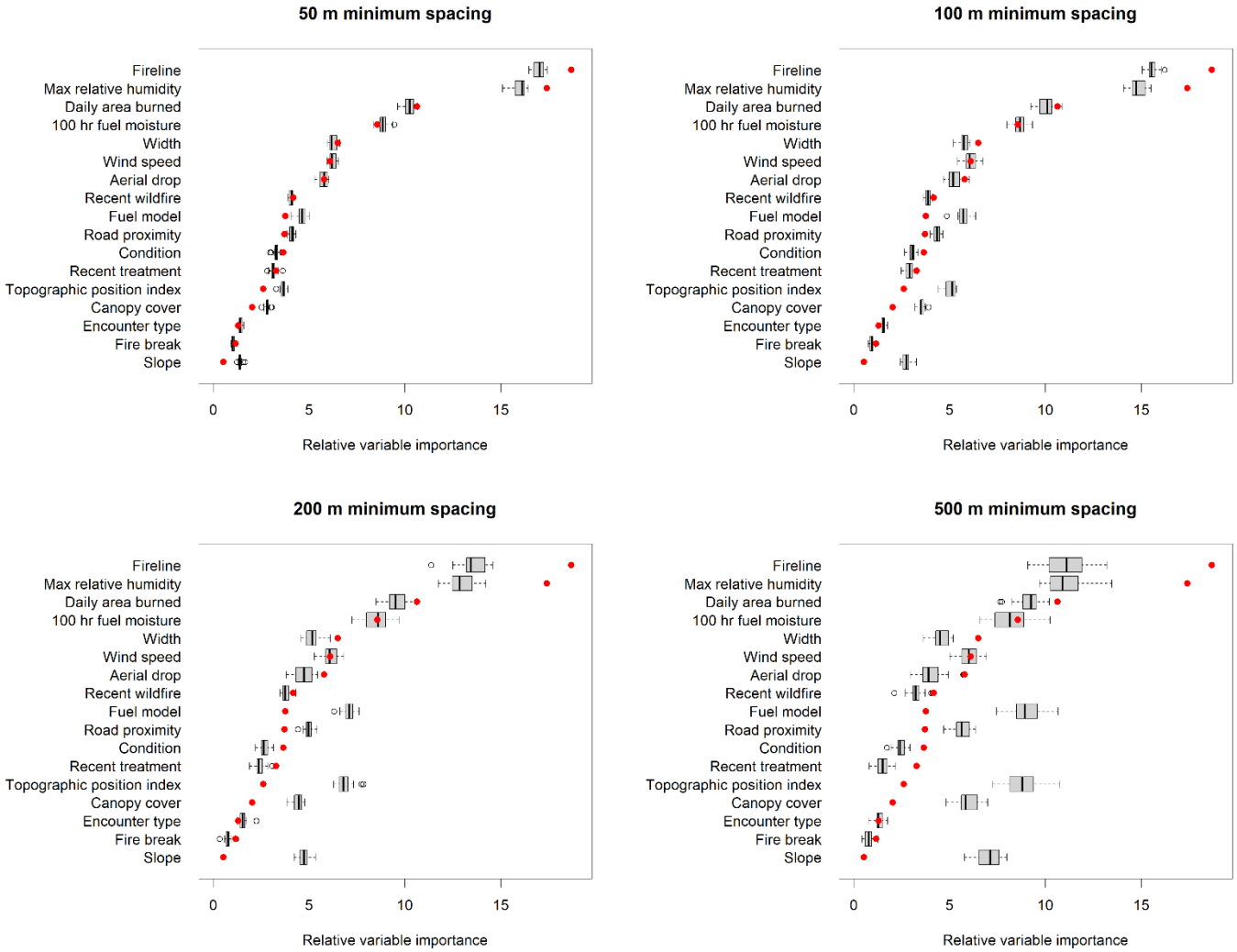

Figure S6. Relative variable importance for Model 2 with the full training data (red dots) and variation in relative variable importance for Model 2 from training the model with 20 random subsets with minimum spacings of 50, 100, 200, and 500 m.

Fuel break success spatial autocorrelation

We characterized the scale of spatial autocorrelation in our fuel break outcomes using a join counts analysis (Reich 2008) at different neighborhood distances (Figure S7). We calculated the observed number of success-success (or held-held) joins in our full dataset using pairwise comparisons of sample outcomes within fires. We limited pairwise comparisons to within fires because we assume that the major drivers of spatial autocorrelation are fire weather, behavior, and suppression, which can vary considerably between nearby fires that burned at different times. The expected number of success-success joins was calculated under the assumption of independence as the product of fuel break success probability (0.279 for our samples) and the total number of pairwise joins. Figure S7 shows that there are more success-success joins than expected up to neighborhood distances of approximately 2,000-m.

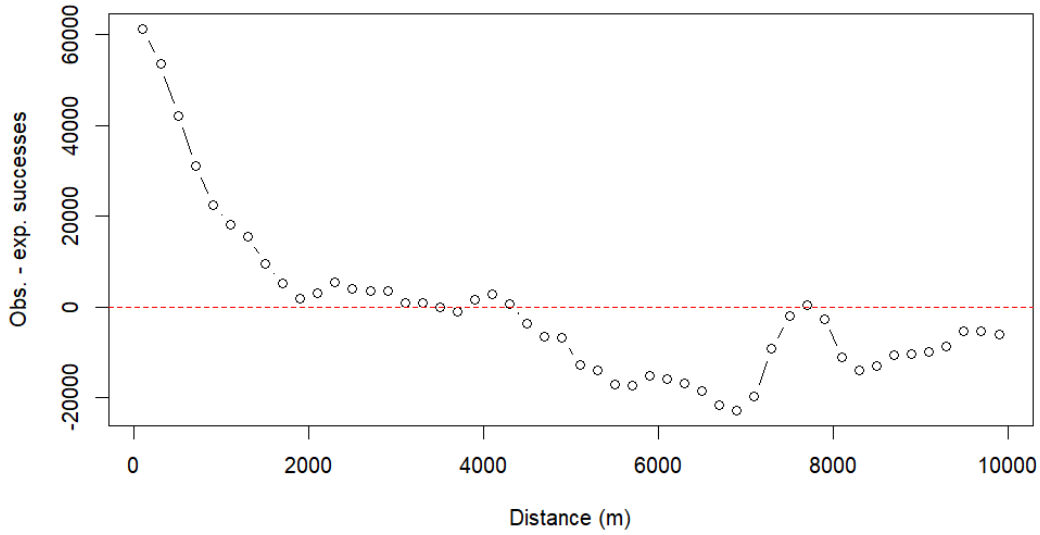

Figure S7. Observed minus expected success-success joins by distance class.

References

Reich, R.M. *Spatial statistical modeling of ecosystem resources and the environment.* Course manual; Colorado State University: Fort Collins, CO, USA, 2008.