Photo: Simon Hunt (Parks Canada)

THE FACTORS CONTROLLING BURN PROBABILITY IN A LARGE BOREAL LANDSCAPE

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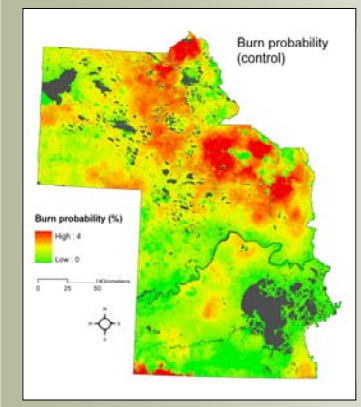
PART 1 STUDY AREA: WOOD BUFFALO NATIONAL PARK

The fire regime of Wood Buffalo National Park (WBNP), the largest park in Canada (4.5 M ha), is one of large high-intensity crown fires that undergo only minimal fire suppression. The terrain is relatively flat, with a fine-grained patchwork of coniferous, deciduous, and mixedwood forests intermixed with grasslands, wetlands, and large open water bodies. Extreme fire weather conditions only occur during a short part of the year (approx June to August) but are fairly frequent during that time.

Fig 1. Wood Buffalo National Park (WBNP) in the northern boreal plains.

PART 2 BURN PROBABILITY MODELING

The need to understand the generation and maintenance of spatially heterogeneous landscapes in fire-dominated areas provided the impetus for the development of burn probability (BP) models. These techniques combine the stochastic components of fire regimes (ignitions and weather) with sophisticated fire growth algorithms to produce high-resolution spatial estimates of BP for a snapshot in time (as opposed to models that account for vegetation succession). BP is derived by simulating a very large (e.g., >10,000) number of fires that ignite and spread under the full range of natural variability.



The Burn-P3 BP model was used to compute annual estimates of BP for WBNP based on all available fire environment parameters (Fig. 2). The fires were simulated according to:

(1) spatially and temporally heterogeneous ignition patterns

(2) variable landscape conditions (fuels and topography),

(3) variable burning conditions (weather conditions and duration of the burning period).

Fig 2. The annual burn probability of WBNP created from the full range of fire environment parameters. The areas in grey represent open water and nonfuels.

RESEARCH QUESTION

The goal of this preliminary study is to evaluate the **relative importance** of the major **environmental factors** controlling **burn probability** in a large boreal landscape in Wood Buffalo National Park, Alberta, Canada.

PART 3 ISOLATING THE INFLUENCE OF ENVIRONMENTAL FACTORS ON BP

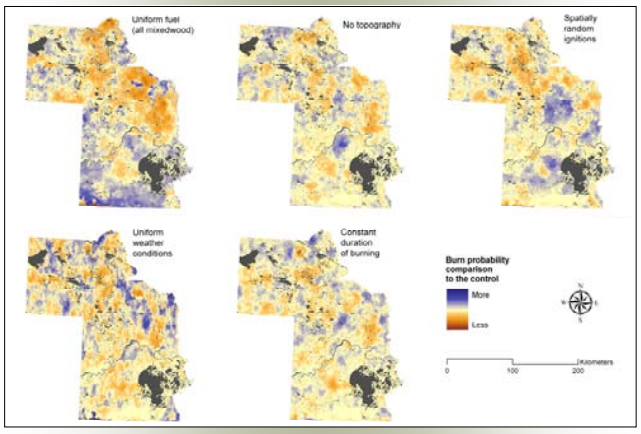


Fig 3. Maps of burn probability departures for each experimental treatment: the BP estimates produced with the environmental factor of interest "homogenized" were subtracted form the control treatment (full input set; Fig. 1). The mean BP of each treatment was standardized in order to emphasize the spatial variation in BP.

We used a jackknife-like approach, where BP patterns produced using the full set of variables (control treatment) were compared to those produced with a "homogenized" variables (experimental treatments). Subtracting the BP map of each treatment from the control BP map provided the patterns in BP explained by the homogenized environmental factor (Fig. 3).

A generalized linear model of control treatment BP (dependent variable) was parameterized according to the values of BP departure maps of the 5 treatments (Fig. 3). Partial R^2 values were used to measure the explained variance for each factor.

PART 4 FLAMMABILITY PATTERN CREATION IN THE WESTERN BOREAL FOREST

Results suggest that, at the spatial scale of WBNP, fuels represent the most important environmental control on annual BP (Table 1). However, further exploration has shown that the influence of fuels obscured the true contribution of the other environmental factors because of correlations among factors. In fact, the departure maps of Figure 3 show that all factors affect BP patterns to some extent.

Table 1. The percent contribution of environmental factors controlling burn probability patterns in WBNP. Two models were carried out: one with all factors (i.e., values from the maps of Figure 3), and one without the fuels factor.

Environmental factor	Variance explained (all treatments) (%)	Variance explained (no fuels treatment) (%)
Fuels	99.19	—
Topography	0.03	16.60
Ignition patterns	0.07	48.64
Weather	0.16	34.61
Duration of burning	0.55	0.16

A second model that did not include the effect of fuels (the "uniform fuels" treatment of Figure 3) was undertaken to measure the relative importance of the other four factors independent of fuels. Here, ignition patterns were the most influential, followed by weather and topography. The variable duration of burning, although probably somewhat influential, did not add any explanatory power to this model.

PART 5 WHAT'S NEXT…

Building on this preliminary analysis, the environmental factors will be subdivided into several components in subsequent analyses. Furthermore, the interactions among factors will be fully assessed, as these can be more important than the main effects.

We acknowledge that our results are highly contingent on the particular landscape and fire environment under study; therefore, another next step consists of undertaking the same exercise for other North American landscapes for comparison purposes.

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