# Assessing the Effectiveness of Prescribed Fire in Creating Bison Pasture in Heart Lake, Alberta

Greg Baxter and Sebastian Hetsch

February 2008

## Introduction

Bison are an important resource and cultural value at the Heart Lake Indian Reserve north of Lac La Biche, and quality grass pasture is important to the success of the herd. A spruce and aspen stand was harvested in 1995, and regenerated to aspen. The Heart Lake Indian Band decided to convert this area to buffalo pasture. A burn was prescribed to remove the regenerating aspen and harvesting debris piles, and to allow the area to re-colonize with grass (Figure 1). At the time of the burn, the area was fully stocked with aspen suckers 3–6 m in height. The burn was conducted by staff from the Lac La Biche office of Alberta Sustainable Resource Development on May 15 2003, for the Heart Lake Indian Band.

FPInnovations - Feric Division monitored the burn to correlate pre-burn fuel loading and fire weather data with actual fire behaviour. In August of 2007, Feric revisited the site to assess the long-term effectiveness of the burn treatment in killing the aspen. The results of these studies are presented in this report.

Figure 1. Bison grazing on Heart Lake reserve.

## Methods

Prior to the burn, fuel loading was measured using a standard fuel triangle. The percentage of cured grass was calculated with the collection of physical samples. During the burn, fire rates of spread were observed and documented, and fire weather data were collected on site and from the nearest fire tower. Still photographs and video footage of the burn were also taken.

The site was revisited two months following the burn on July 17, 2003 and re-measurements were taken. The fuel triangle was used to re-sample surface fuel loads on the site. Aspen mortality was sampled using 18 line transects (30 m long and 1 m wide). Burned trees, living trees, and new shoots that had sprouted from roots were counted along the line.

On August 23, 2007 the site was visited again to count the number of living aspen stems in order to document long-term effects of the burn on aspen regeneration. Eighteen transects (in six plots) were placed in the burned area and the number of live stems were counted along the transects.

## Results and discussion

### Fire weather

The fire weather observations taken on the site (Table 1) and those calculated from the Heart Lake tower (Table 2) both indicated a high fire danger rating. These conditions suggested that an intense surface fire was possible.

Table 1. On-site weather observations recorded on day of burn

| Time | Temp (deg. C) | Wind speed (km/h) | Relative humidity (%) |
|---|---|---|---|
| 1520 | 21 | 18 | 20 |
| 1540 | 22.7 | 9 | 18.5 |
| 1600 | 21.2 | 16 | 19 |
| 1620 | 22.2 | 17 | 14.3 |
| 1640 | 23.3 | 7.6 | 17 |
| 1700 | 22.7 | 12.6 | 17 |
| 1710 | n.a. | 9.6 | n.a. |
| 1730 | 23 | 11.3 | 13 |
| 1745 | 23.2 | 6.1 | 15 |
| 1812 | 24 | 2.2 | 16 |
| 1900 | 21.7 | 12.4 | 17 |
| 1912 | 24.8 | 1.5 | 19 |

Table 2. Fire Weather Index (FWI) values taken from Heart Lake tower on day of burn

| | |
|---|---|
| Fine Fuel Moisture Code (FFMC) | 90 |
| Duff Moisture Code (DMC) | 20 |
| Drought Code (DC) | 177 |
| Slash Index (SI) | 11.3 |
| Fire Weather Index (FWI) | 19 |

The post-fire fuel load measurements showed that little of the woody material on the ground had burned; however, the cured grass (estimated at 5 t/ha) and the debris piles had burned completely. The litter and duff layers were for the most part unburned. This was probably due to the wet spring soils at the time of the burn. These observations indicate that the intensity of the fire was low, contrary to predictions by the Canadian Fire Behaviour Prediction (FBP) model in grass fuels. Although some flare-ups were observed, flames were about 1 m in height (Figure 2), indicating intensity values <500 kW/m. The intensity values predicted using the FBP system were 2000–3000 kW/m, rated as very high.

### Aspen mortality

#### 2003 measurements

The literature reports that aspen mortality in a low intensity fire is often low, and that aspen regeneration following such fires can be vigorous, especially in the first two years following the fire (Brown and DeByle 1987 and 1987; Ryan 1982). This was the outcome observed after the Heart Lake burn. Even though the tops of almost all (99.6%) of the aspen stems died in the fire (Figure 3), the stem density increased from 15 833 to 18 574 stems/ha (117%) two months after the burn (Table 3). New shoots developed from either the roots (Figure 4), or from the stem just below the burning of the cambium (Figure 5).

Figure 2. Fire behaviour in grass fuels at the Heart Lake burn.

Figure 3. Post-burn site conditions: aspen stems with dead tops and dense suckering.

Figures 4 and 5. Shoots developing from the roots and from the stem.

Table 3. Aspen stocking on transects two months following the burn

| **Transect line reference** | **Stems with live tops (no.)** | **Stems with dead tops (no.)** | **New shoots on dead top stems (no.)** | **Post-burn stocking change (%)** |
|---|---|---|---|---|
| F1 | 0 | 70 | 76 | 109 |
| F2 | 0 | 63 | 68 | 108 |
| F3 | 0 | 53 | 38 | 72 |
| R1 | 0 | 96 | 102 | 106 |
| R2 | 0 | 42 | 51 | 121 |
| R3 | 0 | 73 | 106 | 145 |
| S1 | 2 | 32 | 40 | 118 |
| S2 | 2 | 26 | 65 | 232 |
| S3 | 1 | 53 | 59 | 109 |
| B1 | 0 | 23 | 27 | 117 |
| B2 | 0 | 5 | 18 | 360 |
| B3 | 0 | 15 | 10 | 67 |
| P1 | 0 | 63 | 55 | 87 |
| P2 | 0 | 89 | 71 | 80 |
| P3 | 0 | 47 | 40 | 85 |
| P4 | 0 | 41 | 56 | 137 |
| P5 | 0 | 45 | 67 | 149 |
| P6 | 0 | 19 | 54 | 284 |
| *sum* | *5* | *855* | *1 003* | |
| *average* | | *48* | *56* | *117* |
| *stems/ha* | *93* | *15 833* | *18 574* | |

**2007 measurements**

Table 4 presents the results of the 2007 survey for each transect. The average of 46.2 stems per line or 15 400 stems per hectare is very close to the number of stems that were originally counted on the site (Table 3), but is less than the number of new shoots that were counted two months following the burn. In plots 1–3, the aspen averaged 3.0 m in height, whereas in plots 4–6 the average height of the aspen was 1.5 m.

No aspen were regenerating on the areas where the piles had burned. Instead, these areas were covered by grasses and shrubs as well as weeds over the entire area of the pile.

Table 4. Aspen stocking on transects four years following the burn

| Plot | Line A (no. aspen stems) | Line B (no. aspen stems) | Line C (no. aspen stems) |
|---|---|---|---|
| 1 | 44 | 29 | 46 |
| 2 | 35 | 46 | 38 |
| 3 | 61 | 31 | 58 |
| 4 | 49 | 47 | 50 |
| 5 | 26 | 50 | 75 |
| 6 | 43 | 54 | 50 |

## Conclusions

The initial post-burn stocking survey at the Heart Lake prescribed burn found the treatment to be ineffective in killing aspen. Aspen density initially increased by 117% as a result of the treatment, but then decreased to original densities four years following the burn. These results were to be expected; it is common in succession to have an immediate increase in the number of stems following fire as more than one stem can grow from a root system.

Over time these numbers decrease as the dominant stems out-compete others from the root and numbers return to pre-disturbance values.

It is believed the spring soil conditions had an impact on fire behaviour as compared to the behaviour predicted by the Canadian FBP model. The soil was likely wetter than the moisture conditions used in the model and thus fire behaviour was less intense than predicted. Aspen is adapted to regenerating following disturbance by sprouting from its root system. A very intense ground fire over a large area would be required to reduce stem densities.

## Implementation

This prescribed burn showed that a more intense fire is required to remove aspen from a site and to leave only grass and shrubs for grazing. A fire intensity of greater than 500 kW/m is required.

Moisture content of the deeper layers should be sampled to improve model predictions and to assist fire managers in determining when burning should be carried out. Samples of the duff layer (down to 5 cm in depth) could be collected to initialize the Fire Weather Index (FWI) model, as these values are then used in the FBP model.

### References

Brown, James K.; DeByle, Norbert V. 1987. Fire damage, mortality and suckering in aspen. Canadian Journal of Forest Research 17:1100–1109.

Brown, James K.; DeByle, Norbert V. 1989. Effects of prescribed fires on biomass and plant succession in western aspen. USDA Forest Service Research Paper INT-412. 16 pp.

Ryan, K.C. 1982. Evaluating potential tree mortality from prescribed burning. Pages 167–179 *in* D. M. Baumgartner, editor. Site preparation and fuel management on steep terrain. Washington State University, Cooperative Extension, Pullman, Wash.

### Acknowledgements

Acknowledgements go out to the following for their valuable assistance on this project:

The Heart Lake Indian Band for providing access to the site and helping us get back from the site!

Alberta Sustainable Resource Development (SRD), Lac La Biche staff including Ferenc Scobie (SRD), Wes Nimco (SRD) and Todd Lynch for helping with the logistics.

If you want more information about this study, please call Greg Baxter at 780 868 6342.