Fire Effects on Rangeland
FACTSHEET

BRITISH COLUMBIA
Ministry of Agriculture, Food and Fisheries

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Factsheet 5 of 6 in the Fire Effects on Rangeland Factsheet Series

# Fire Effects on Livestock and Wildlife

This factsheet will focus on how fire affects domestic livestock and wildlife including immediate effects (direct) and long-term effects (secondary). These effects will vary depending on fire type, timing, size, severity, and intensity and while direct effects can be significant, secondary effects generally have the greatest amount of impact on livestock and wildlife. In general, fire effects on livestock and wildlife are either:

- **Immediate:** Immediate impacts include direct injury or mortality to plants and animals, animals fleeing (insects, small mammals, and birds) or seeking refuge.
- **Secondary:** Secondary impacts include an alteration of forage productivity, availability and quality, and animal performance as well as creating, destroying, enhancing, or degrading various habitat attributes such as cover, shelter, structure, and natal/breeding.

**IMMEDIATE EFFECTS**

***Animals:*** Most livestock and wildlife are directly impacted by a fire and respond relatively predictably to its passage. The degree of impact is dependant on numerous factors including mobility as well as fire uniformity, severity, size and duration. Even though relatively few livestock and wildlife are directly killed or injured by fire, it can and does happen. Various deaths and injuries were reported following British Columbia's 2003 fire season including cattle mortality, hoof (cattle), and paw (black bear) injuries as well as other injuries such as burned udders .

In general, an ambient temperature of over 63 $^{o}$C is needed to result in animal mortality. While most fires have the potential to injure and kill animals it is generally season of burn and fire intensity and severity that determines whether or not this occurs. Season of burn can be an important variable in determining mortality. For example, a fire that occurs when animals are nesting or have young with limited mobility (especially small mammals) may cause significant mortality. This effect would be dependant on nesting characteristics, with those species who construct surface-level nests (harvest mice, woodrats) being more vulnerable to fire than deeper-nesting species. Generally, when compared to other species smaller mammals, such as mice and voles, due to their limited mobility, are more vulnerable to fire. Livestock and larger mammals, due to their size, must escape a fire by seeking refuge, either in an unburned patch within a fire or outside the extent of the fire. They are more likely to be caught in a fire when the fire is actively crowning, its fronts are wide, and it is fast moving with thick ground smoke present. For example, the large fires of 1988 in the Greater Yellowstone area killed about 1 percent of the area's total elk population, with most of these deaths being attributed to smoke inhalation. When subjected to fire, some studies have observed that small animals appear to panic more readily than large, highly mobile animals. In fact, larger mammals are often described as moving calmly around the fire perimeter. For example, in Smith (2000) no large mammals were observed fleeing the Yellowstone fires, with most appearing "indifferent" even to crowning fires. In fact, some species including bison and elk were described as grazing and resting within 100 meters of burning trees. The 2003 British Columbia wildfires did result in livestock mortality north of Kamloops. The picture on the left shows cattle carcasses found following the McClure wildfire.

***Plants:*** Fire also impacts forage availability by directly consuming plant material. Thus, when considering the effect of fire on all forms of livestock and wildlife, it is important to consider the lag in forage availability. For example, if a fire occurs during late summer or fall, forage availability in the burned areas will often be non-existent or decreased significantly until at least the following growing season.

**SECONDARY EFFECTS**

***Forage Productivity-*** Increased productivity tends to be short-lived and generally results from a variety of factors including, fire-induced vegetative reproduction and regeneration, fire-enhanced seedling germination and establishment, improvements in soil nutrient regime, and increases in soil temperature. There are numerous benefits associated with increased productivity. These include increased forage productivity (due to canopy removal and nutrient increases) which can benefit mammals by increasing habitat availability. For example, increased productivity can facilitate population dispersal of bighorn sheep which may subsequently result in a reduced incidence of lungworm infections. Most of the productivity research has revolved around tree, grass, and forb productivity.

<u>Trees and Shrubs</u>**-** The growth of many shrubs and trees is often facilitated by fire. Examples include Saskatoon, chokecherry, mock orange, snowberry, rabbitbrush, paper birch and aspen.

<u>Forbs</u>**-** The effect of fire on forb productivity appears to be highly variable and dependant on a variety of factors including, fire-induced vegetative reproduction and regeneration, fire-enhanced seedling germination and establishment, improvements in soil nutrient regime, and increases in soil temperature. Examples of increased production exist throughout the literature. For example, one study found total herbaceous production to average 2.2 times higher on burns compared to controls (two to three years after burning). The author of this study however, didn’t attribute this increase solely to the fire. Mesic site conditions and specific plant competitive characteristics were also hypothesized as causing this increase. Other studies have also found fire-induced growth to exceed, both pre-burn and not burned levels. This effect however, is generally short-lived, often disappearing by the second year, and may often be caused by above average precipitation. Finally, other studies have found the production of numerous species, including western yarrow, longleaf phlox, and purple daisy fleabane, to double within three to four years following fire. This increase continued even after twelve years (following the fire), where total forb production was still found to be considerably higher on all burn intensities when compared to areas that were not burned. Numerous rhizomatous perennials accounted for this increase including western yarrow, Aster sp., fleabane, and goldenrods as well as other forbs including little-leaf pussytoes and sticky geranium (especially on light and moderate burns).

<u>Grass</u>**-** The effect of fire on grass productivity is also variable. For example, studies have found the production of burned bluebunch wheatgrass, on sites in the Pacific Northwest, to increase by 24%, whereas others have only showed minor changes. Furthermore, others have reported initial declines in bluebunch wheatgrass production of up to 50%, with recovery time ranging between three and 12 years. Reduced productivity can result from a variety of factors including plant mortality, reduction in basal area of grasses, forbs, and shrubs, changes in species composition to less productive plants, and reduced availability of soil nutrients. These changes are generally short-term and dependent on the relationship between species involved, fire intensity and severity.

In addition to those mentioned above, increases in productivity may also be related to pre-burn site condition and reduced competition. For example, increased herbaceous production is described as increasing most often on range sites in high fair or better range condition (e.g., presence of large bunchgrasses) whereas others have attributed increases to reduced competition. That is, in some areas the elimination of big sage in perennial shrub-steppe grassland has increased grass production by 155% the following summer after the burn and 336% during the second summer. It is important to recognize however, that the precise influence that reduced competition had on these studies was unclear.

***Forage Availability-*** Besides considering the direct effect that fire has on forage availability (see above), fire can also have secondary impacts on forage availability. For example, if a fire occurs early in the growing season, forage will not only be available in the same year as the fire, it may also hold its quality longer into the late summer and fall. The removal of vegetative cover (including trees and shrubs) by fire can also increase snow crusting and accumulation, both of which may reduce forage availability. For example, wind crusting of snow has been described as a common problem on some deer winter ranges. Snow accumulation was also described as increasing on some burns, when compared to areas not burned. The significance of this accumulation however does reduce, due to wind scour, when burn size exceeds approximately four times the height of surrounding tree cover. In general, fire will increase forage availability by:

- **Removing obstacles to grazing-** this includes the removal of dead plant material such as plant residue (stubble) and litter as well as fallen trees and shrubs, all of which may allow animal access to food resources that may have been unavailable prior to the fire. On a landscape level, this effect may include the removal of natural range barriers.
- **Increasing forage availability-** this includes reducing the size of shrubs and/or trees so that they are more accessible to the reach of grazing mammals.

***Livestock Management-*** In addition to the immediate loss of forage; the availability of livestock forage is also commonly reduced during the first growing season following a fire. This reduction is primarily a management decision needed to accelerate plant recovery following a fire. For more information, please see **Factsheet 6** of the Fire Effects on Rangeland Factsheet Series.

***Forage Quality***- Most of the research centered on forage quality has revolved around grasses and forbs. Shrub forage quality has been largely overlooked and as a result has been purposely excluded from this section. The effect of fire on forage quality is variable and determined by seasonality, species involved and the pre-fire condition of that species. For example, crude protein of bluebunch wheatgrass and various forbs averaged 60% higher on burned sites. These increases however, were generally short-lived, lasting less than two years and were significantly higher in the first year following the burn when compared to the second year. In general, most improvements in forage quality can be attributed to earlier growth, increased rates of growth, and delayed senescence. For example, enhanced growth generally improves forage quality by increasing readily digestible cell solubles relative to cell wall constituents. Furthermore, decreases in forage quality after two years may be attributed to increases in plant density, as density often forms an inverse relationship with forage quality in many plant communities. Overall, since animals have the ability to feed selectively, it is often unreliable to relate improvements in forage quality directly to improvements in animal diets. Feed selectivity may dramatically improve the nutritional makeup of an ungulates diet which otherwise would be severely underestimated by looking at improvements in the forage alone. However, it appears that fire-induced changes in forage quality may benefit ungulates by creating two distinct flushes of nutritious plant tissue in the spring and fall and thus shorten periods of nutritional deprivation.

***Animal Performance***

**Livestock-** Exactly how fire influences animal performance is still relatively unknown and there appears to be no data in British Columbia that confirms that the preferential use of burned grasslands by grazing animals will result in measured, increased animal performance. Any improvement in livestock performance is generally dependant on management and the amount, quality and availability of the forage produced following a fire and the forage quality throughout the grazing season.

**Ungulates-** Studies often contradict one another and practices such as prescribed burning do not always correlate to increased bighorn sheep populations. Prescribed burning in fact may actually deteriorate bighorn sheep ranges by reducing total nutrient availability, especially in grasslands with low cation exchange capacities (i.e., reduced ability to hold nutrients). In order for any changes in habitat parameters to be beneficial to the large mammal in question, the improved parameter must have first been somewhat lacking in the pre-fire habitat. That is, if the mammal in question is not limited by forage production, forage quality, or forage availability, and if other limiting factors remain unaltered, fire will not theoretically improve mammal performance or increase mammal populations. Both bighorn sheep and mule deer have been found to utilize burned bluebunch wheatgrass on a Wyoming big sagebrush/bluebunch wheatgrass winter range site significantly more than adjacent not-burned areas.

**OTHER ANIMALS**

**Predators and Omnivores-** The response of carnivores to fire is primarily dependant on herbivore response. That is, if prey populations increase, so will the population of carnivores. For example, a study highlighted in Smith (2000), determined that a decline in small mammals following a fire resulted in a subsequent decline in American badger numbers. Other predators, such as the pine marten, have been known to be negatively impacted by fires, as fires are typically detrimental to their prey and overall habitat. High severity fires that result in fauna mortality will benefit carnivores and scavengers including grizzly bears, black bears, coyotes, bald eagles golden eagles, and common ravens. For example, following the 2003 British Columbia fire season, black bear were observed feeding on

livestock carcasses in the Barriere area. In addition to increased carcass availability, fire effects on omnivorous mammals, such as bears, are dependant on how habitat attributes such as other food sources and bedding sites are affected. For example, bears are often impacted when den sites are created or destroyed (i.e. increase in windfalls, hollow trees or destruction of den sites) or forage availability is increased through the re- sprouting of berry-producing shrubs.

**BIRDS**

In general, fire effects on birds are typically secondary in nature. Direct effects are typically dependant on season, fire uniformity, and severity. Due to their mobility, mortality of adult birds is usually considered minor. If the fire occurs during nesting however, nestling and fledgling mortality will occur. In addition to seasonality, severity also determines whether or not nests are damaged. While ground-nesters are vulnerable to most understory fires, canopy nesters can also be injured by moderately to severe surface and crown fires. In general, fire impacts on birds can be summarized by using the following classification system taken from National Wildfire Coordinating Group (2001):

- Fire-intolerant species decrease in abundance after fire and as a result are present only in areas characterized by very low fire frequencies and severities. These species are closely associated with closed canopy forests and generally prefer dense nesting and foraging cover. This includes ground-nesting birds that become fire-intolerant when fire eliminates insect resources, destroys existing nests, and removes the protective cover necessary for constructing new ones. Examples of fire-intolerant species include, hermit thrush, red-breasted nuthatch and brown creeper.
- Fire-impervious bird species are unaffected by fire, that is, they neither increase nor decrease after fire. These species often have niches that include both shade-intolerant and shade-tolerant plant communities. Due to these generalist and opportunistic qualities, these species often show the highest flexibility in response to fire. Examples include crows, ravens, robins and many waterfowl.
- Fire-adapted bird species increase in abundance following a fire, due to their preference for fire-opened habitat. Many songbirds, raptors, woodpeckers and secondary cavity nesters fall into this category. For example, as described in Smith (2000), following a burn, pre-fire infected and decaying trees, often provide nesting and perching sites, initially for woodpeckers and then for secondary cavity nesters. Once these snags fall, alternative nesting sites are provided as other fire-killed trees decay (Smith 2000). Examples of fire-adapted species include, western bluebird, vesper, Brewer's and Savanna sparrows, Cooper's hawk, downy, hairy and three-toed woodpeckers.
- Fire-dependent bird species only occur in early succession areas such as those influenced by fire. Examples of fire-dependant species include blue grouse, sandhill crane and wild turkey.

**REPTILES AND AMPHIBIANS**- Very little research has measured the effect of fire on reptiles and amphibians. As with other wildlife, the influence of fire on reptiles and amphibians appears to be predominately secondary. That is, the influence of fire on habitat attributes, such as plant species composition and structure, appear to be the primary factor in determining immigration and emigration. For example, species that prefer open sites may benefit and increase following fire whereas species that prefer or tolerate dense vegetation often decrease.

**REFERENCES**

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