Tree encroachment in the south Okanagan and lower Similkameen valleys of British Columbia

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INTRODUCTION

Loss of grassland in the Cariboo-Chilcotin has been related to encroachment and ingrowth of Douglas-fir (*Pseudotsuga menziesii*) and lodgepole pine (*Pinus contorta*). Strang and Parminter (1980) found that a combination of fire suppression, lack of grass competition, and particular microsite conditions were the contributing factors to tree encroachment. The Cariboo-Chilcotin region has a moister, cooler climate than that of the south Okanagan and lower Similkameen valleys, where the average annual precipitation is only about 300 mm. It is unknown whether tree encroachment, in this case by ponderosa pine (*Pinus ponderosa*), is also a problem in these semi-desert grassland habitats of the southern Interior. Here, the conservation concern over tree encroachment is even more urgent because of the high biodiversity of the area, and the great number of species at risk.

This study shows that tree encroachment and ingrowth are occurring in the hottest and driest habitats of the south Okanagan and Similkameen valleys. We also show that fire reverses this trend, which supports efforts to reintroduce fire to these regions.

METHODS AND STUDY AREA

Fifty study sites in the Ponderosa Pine and Bunchgrass biogeoclimatic zones were chosen from aerial photographs taken in 1938, 1985, and 1996. A count of the total stems was taken for each site using a stereoscope. All conifers that could be distinguished on the photographs were counted, but deciduous trees were not included.

The 1985 and 1996 photographs were scanned into digital (raster) format and then geo-referenced using TRIM data of roads and water features (Albers projection). ERDAS Imagine® spatial analyst software was used to geo-reference the scanned photos. This was done to minimize distortion of the photographs for a more accurate spatial determination. Similar landscape features between years were selected and stored into the ERDAS program as ground control points. At least six control points were located for each of the photographs.

A paired *t*-test was conducted to determine whether a change in tree density occurred between 1938 and 1985, and 1985 and 1996. Tree density was standardized for site size before analysis with SAS (1990). Sites that experienced burns in the 1940s were considered "unburned" because of the intervening time to 1985. The *t*-tests were analyzed separately for burned and unburned sites. A three-way ANCOVA was used to determine the significance of different factors influencing tree ingrowth. The co-variable was site size;

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the three factors were biogeoclimatic zone, latitude (north versus south), and whether or not the site burned in the intervening period.

RESULTS AND DISCUSSION

Significant tree ingrowth was evident at unburned sites, both between 1938 and 1985 ($t = 6.84$, $p = 0.0001$, $df = 2, 40$), and between 1985 and 1996 ($t = 3.85$, $p = 0.0005$, $df = 2, 35$).

Not surprisingly, tree encroachment was higher between 1938 and 1985 than between 1985 and 1996, but the rate was not different (mean rates = 0.125 stems per hectare per year [± 0.175 SE, $n = 41$] and 0.122 stems per hectare per year [± 0.213], respectively; $t = 0.089$, $p > 0.5$, $df = 2, 77$). Sites that experienced fire showed decreases in tree density between 1938 and 1985 ($t = -3.04$, $p = 0.0005$, $df = 2, 8$). Only two sites burned between 1985 and 1996. At one, tree density decreased from 565 stems per hectare in 1985 to 311 stems per hectare in 1996. At the other, tree density decreased from 29 stems per hectare in 1985 to 22 stems per hectare in 1996.

Fire was the only factor influencing the amount of tree ingrowth between 1938 and 1985 ($F = 14.18$, $p = 0.0005$) and between 1985 and 1996 ($F = 6.62$, $p = 0.0149$). Through all years, more trees occurred in the north than in the south, and in the Ponderosa Pine zone than in the Bunchgrass zone. However, tree ingrowth was not less in the hotter biogeoclimatic zone, nor further south in the study.

Significant tree encroachment and ingrowth has occurred on unburned areas of the south Okanagan and lower Similkameen grasslands over the past 60 years. A study in the Chilcotin grasslands of British Columbia (Strang and Parminter 1980) also found that tree encroachment was a result of fire suppression, but it occurred in combination with other factors such as intensive livestock grazing and seedling establishment on favourable microsites.

The results of the ANCOVA show that no elevational difference was evident in tree encroachment and ingrowth. This is surprising, as one would expect more encroachment in the higher-elevation areas of the Ponderosa Pine biogeoclimatic zone, where environmental conditions are more suitable to seedling establishment and survival. However, Rummel (1951) found that heavy livestock grazing can be linked to higher levels of encroachment. Tisdale (1947) found that more intensive domestic livestock grazing occurs in lower valley regions because of their close proximity to human habitation. These areas also contain a higher proportion of grassland vegetation preferred by domestic livestock (Gayton 1996).

As would be expected, fewer trees were apparent in 1985 than in 1938 on burned sites. Fire suppression in the southern Interior of British Columbia can therefore be linked to tree encroachment into the grasslands of the south Okanagan and lower Similkameen valleys. Because of the importance of grassland habitats in the south Okanagan to biodiversity and endangered species, these results strongly support the need for the reintroduction of fire, or at least prescribed burns, in these semi-desert habitats.

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