The short-term effect of fire, boer goats and cattle on the woody component of the Sourish Mixed Bushveld in the Northern Province of South Africa.

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Abstract
A trial was conducted on the Towombo Agricultural Development Centre near Warmbaths, South Africa during the period 1990 to 1992 to determine the short-term effect of different browsing and grazing treatments in the presence and absence of fire on the woody component of the Sourish Mixed Bushveld. Treatments involved continuous browsing, rotational browsing and grazing, rotational browsing and zero browsing or grazng in the presence of a hot September burn and continuous browsing, rotational browsing and grazing, zero browsing or grazing, rotational grazing and rotational browsing in the absence of fire. No treatment could control bush in the short term. Fire reduced tree height, but stimulated tree production in the lower strata and led to bush seedling establishment. Grazing had no effect on the woody component. Lower tree strata of the woody component were utilised where goats were incorporated in the absence of fire. Continuous browsing by boer goats in combination with fire was the only treatment that partially suppressed bush encroachment. Rotational grazing and browsing in combination with fire suppressed bush to a lesser extent.

Introduction
The use of boer goats as bush utilisers and bush controllers have been well documented by researchers in the Eastern Cape (Du Toit 1972; Aucamp 1976; Teague et al., 1981; Trollope 1983; Trollope 1984; Trollope 1989). On the other hand, research regarding boer goats in the Northern Province was undertaken by single researchers such as Donaldson (1979), who supplied data regarding the use of goats as bush utilises. Since work by Trollope (1984) indicated that bush encroachment was one of the main factors that depressed carrying capacity, new interest developed in the use of goats and fire as a method of bush control in the Northern Province. Negative publicity, the misuse of fire and post-fire mismanagement of veld in the past however led to a large percentage of farmers still blaming goats and fire for veld degradation. This trial was thus started as a demonstration trial in which the influence of goats, cattle and fire on the woody component could be studied and illustrated.

Experimental site
The trial was conducted at the Towombo Agricultural Development Centre, situated near Warmbaths, South Africa (28°21'E, 24°25'S; 1 184m elevation), during the period September 1990 to September 1992. The long-term annual rainfall for the experimental site is 630mm per annum. The rainy season usually extends from October to March, but rainfall distribution is irregular and unpredictable. The long-term daily average maximum and minimum temperatures vary between 30.2°C and 17.6°C for December and 21.0°C and 3.0°C for July respectively. The vegetation type is classified as Sourish Mixed Bushveld by Acocks (1988). The woody layer of the plant community is dominated by Dichrostachys cinerea and Acacia gerrardii, and the grass layer by Eragrostis rigidior, Panicum maximum, Themeda triandra and
Heteropogon contortus. The soil is of the Hutton form (Shorrocks series) (MacVicar et al., 1977).

Procedures
Treatments involved different combinations of burning, grazing and browsing of eight sites, each 1.5 ha in size. Three adjacent sites were burned with a moderately hot head fire during September 1988. The influence of this fire on the woody component was described by Jordaan (1995). The same sites were rested during 1988 and 1989 and again burned with a head fire during late September 1990. A pre-burn grass fuel load of 2.2, 2.8 and 3.8 tons ha⁻¹ was respectively estimated on the different sites by clipping 20 1m x 1m randomly placed quadrates per site during early September 1990. The sites were burned at noon. An air temperature of 30.7°C, relative humidity of 34% and wind speed of 17 km h⁻¹ was recorded during burning at the weather station, which was situated within 200 m of the experimental sites. Fire intensities were calculated as 2484 (hot), 3372 (extremely hot) and 4496 kJ s⁻¹ m⁻¹ (extremely hot) for the three sites respectively (Trollope and Potgieter 1985). A 20m x 5m goatproof enclosure was erected on each of the burned sites after the fire. The other five sites were rested during 1988 and 1989. The eight sites were then subjected to the following nine browsing and grazing treatments during the 1991 and 1992 seasons:

- Burned plus continuous browsing by Boer goats (F+G(c)).
- Burned plus rotational browsing by Boer goats and cattle (F+G(r)+C(r)).
- Burned plus rotational grazing by cattle (F+C(r)).
- Burned plus zero grazing or browsing (enclosures) (F).
- Unburned plus continuous browsing by Boer goats (G(c)).
- Unburned plus rotational browsing by Boer goats and cattle (G(r)+C(r)).
- Unburned plus rotational grazing by cattle (C(r)).
- Unburned plus rotational browsing by Boer goats (G(r)).
- Unburned plus zero grazing or browsing (Z).

Grazing and browsing treatments were applied during the growing season only. Sites were grazed and browsed from the first week of January till the last week of May. In the continuously browsed treatments, four mature goats per site were used. Rotational browsing was applied by a flock of 20 mature Boer goats to the point where major diet changes from the woody component to the grass component were observed. Rotational grazing was applied by a herd of 30 steers to the visual point of more or less 60% defoliation of palatable grass species (Panicum maximum, Brachiaria nigropedata and Schmidtia pappophoroides (Jordaan, 1991)). Browsers and grazers were readmitted after visual confirmation of full recovery of the woody and grass components.

Two randomly placed, 50m x 2m strip transects were permanently marked per site. Bush density, evapotranspiration tree equivalents (ETTE), tree volume, leaf volume, leaf mass, available browse and tree height were determined by using the BECVOL-model, developed by Smit (1989a and 1998b), during September 1988 (pre-burn), October 1988 (post-burn), September 1989 (post-burn) and September 1990 (post-burn). All trees were monitored in the enclosures.

Results and discussion
The influence of the fire on the woody component was similar to the results encountered by Jordaan (1995). The fire resulted in immediate post-burn decreases in ETTE, tree volume, leaf volume, leaf production, available browse and tree height in all four burned treatments. Recovery of the woody component of burned treatments thereafter depended on the grazing or browsing treatments that followed.

In the absence of goats in unburned treatments, grazers had no effect on the woody component and tree growth continued normally.

Overall, ETTE, tree volume, leaf volume, leaf production and available browse decreased in all treatments where goats were present. Decreases in ETTE, tree volume, leaf volume, leaf production and available browse that were encountered in treatments where goats were present and fire absent were due to the utilisation of browse within the reach of goats. The woody component above the browse line was not affected.

Decreases in abovementioned tree characteristics were enhanced where goats were used in combination with fire. The F+G(c) treatment led to severe degeneration of the lower strata of the woody component. This was the only treatment where continuous downward trends in ETTE, tree volume, leaf volume, leaf production and available browse were observed. Other treatments that involved fire were less destructive. Although the F+G(r)+C(r) treatment depressed regrowth to a bigger extent than the F+C(r) and F treatments, trees of the lower strata of this treatment remained vigorous.

Post-burn recovery of the woody component of burned treatments where goats were absent was similar to results as obtained by Jordaan (1995). In these treatments, unutilised regrowth after the initial fire resulted in volume and production increases in the lower tree strata as post-burn recovery commenced. Tree height was however not affected to such an extent than where goats were present.

Different trends in regeneration rates of the woody component were observed between the F and F+C(r) treatments. Where grass layer competition was reduced through grazing (F+C(r)), regeneration was much faster than where grass layer competition was maintained (F).

Bush density increased in all treatments. High increases were encountered in treatments where fire was present. Where fire depressed bush in the short-term, seedling establishment was propagated (Jordaan, 1995). Tree seedlings on burned treatments were partially controlled where goats were present in the absence of grazers, but propagated where goats were absent (F treatment) or where the grass layer was removed (F+G(r)+C(r) and F+C(r) treatments). Minor increases in bush density occurred in treatments where fire was absent. In these treatments, grass layer competition was maintained through the early part of the growing season and no compensatory growth was needed to overcome the effect of the fire.

None of the treatments resulted in total control of smaller trees in the short term. However, partial bush control was obtained by the F+G(c) treatment during the two-year trial period.
Conclusions
Results indicate that fire must be used in combination with goats in the long term if bush control is the objective. In this sense, a well-planned post-burn management system, with special reference to stocking rate, the continuation of the burning and browsing programme and a seasonal post-burn rest period of the grass layer is of utter importance. Removal of goats or fire out of such a programme would promote re-encroachment.

A combination of fire, cattle and goats would promote red meat production form both the grass and woody component, the last being a disadvantage rather than an advantage in the Northern Province. This type of management programme could thus be of great value as an after-care programme following chemical bush control, or as a long-term means of biological bush control.

References


Trollope, W.S.W., 1983. Control of bush encroachment with fire in the arid savannas of South-eastern Africa. Phd-tesis, University of Natal.

