THE EFFECT OF GOATS AND SHEEP ON THE GROWTH, FLOWERING AND LONGEVITY OF TALL, MEDIUM AND SHORT SCOTCH AND ARTICHOKE THISTLES

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Summary. Goats and sheep were grazed on temperate pasture infested with scotch and artichoke thistles during winter, spring and summer 1989. Goats substantially reduced the height and vigour of tall (mean 93 cm; range 64-119 cm) and medium (41 cm, 24-56 cm) height thistles and significantly depressed flowering. Compared to ungrazed controls, grazing by goats increased survival of tall and medium thistles over summer. Goats were ineffectual grazers of short (6 cm, 4-12 cm) thistles but grazed these plants when they grew. Sheep did not affect scotch thistle height. Goats reduced ground cover of artichoke thistles by 98% and ate artichoke flowers. Sheep consumed artichoke regrowth. Goats can be effectively managed to eliminate, control and utilize scotch and artichoke thistles.

INTRODUCTION

Goats being more flexible, adaptable and selective feeders and having a greater ability to browse can utilise a wider range of herbage than sheep (1). Goats have been successfully used to control and assist in the elimination of a wide variety of exotic weeds in Australia e.g. gorse (*Ulex europaeus*) (3), blackberries (*Rubus* spp) and briar (*Rosa rubiginosa*), (8). Goats can effectively stop regeneration of some species of indigenous Australian plants such as *Acacia armata, A. diffusa, A. pycnantha* (5) but heavy grazing of some indigenous plant communities can result in animal production losses and welfare problems (6,7).

Little detail is known of the management required to successfully use the selective grazing of goats to control weeds in the numerous plant communities found on Australian grazing lands. Holst (4) observed that while goats can destroy some species of thistle, it is uncertain if seed production is prevented. This paper reports on the effect of goats and sheep on the growth,flowering and longevity of scotch (*Onopordum acanthium*) and artichoke (*Cynara cardunculus*) thistles which infested an annual temperate pasture in southern Victoria.

METHODS

Design The study consisted of two grazing treatments x three heights of scotch thistle. The grazing treatments were ungrazed (used as the control), and grazed by goats. Within each treatment, thistles were stratified on the basis of height and 10 tall (generally flowering), 10 medium height and 10 short (basal rosettes) thistles were identified with numbered pegs. Observations were also taken on 10 artichoke thistles in the grazed treatment (none found in control treatment).

Animals, pastures and management Sixty cashmere goats, aged 4 to 5 years, mean live-weight 42 kg, and 500 adult Romney Marsh sheep were used in this study. The site at the Animal Research Institute (144°41' E, 37°54'S, elevation 46 m), 32 km west of Melbourne experiences 7 month growing seasons (April to November) and mean rainfall of 544 mm. From a 36 ha paddock, two 2.5 ha plots were fenced in March 1989. Pastures consisted of annual ryegrass (*Lolium rigidum*) and subclover (*Trifolium subterranean*). The plots were grazed by sheep during autumn and winter 1989 (mean stocking rate 10 sheep/ha) when thistles germinated. Sheep were removed from plots on 10 August. Instead of controlling thistles by spraying in August, goats (24/ha) grazed the grazed treatment plot from 21 August to 3 September. From 9 to 23 November, sheep crashed grazed both plots (100/ha). Goats (24/ha) then grazed the grazed treatment from 27 November to 7 December and the control treatment from 8 to 15 December. The grazed treatment was next grazed by goats (2.5/ha) from 13 February, 1990 until the end of observations on 6 March 1990.

Observations The density of scotch thistles was estimated by counting thistles in 100 randomly located 1 m^2 quadrats. The highest point of both thistles and the width of artichoke thistles were measured to the nearest cm with a 1.5 m steel ruler. The incidence of flowering (open florets or seeds present) and whether the plants were alive or dead were recorded. On 15 December, 5 February 1990 and 6 March if an ungrazed thistle was dead but had flowers or seeds present it was recorded as flowering. Pasture availability, tonne dry matter/ha (DM/ha) was estimated visually.

Statistical Analysis Analysis of variance, using Genstat 5 (2) was used to estimate standard errors of difference of means for effects of treatment, initial thistle height and the interaction.

RESULTS AND DISCUSSION

The density of scotch thistles was 14000/ha. Goats selectively grazed taller thistles in preference to shorter thistles. In August, within 4 days of grazing (Fig. 1), goats reduced height of tall thistles by 53 cm (P = 0.001) and medium thistles by 6 cm (P = 0.01) compared to controls. After 13 days of grazing (3 September) the height of all grazed and ungrazed short thistles was similar (P = 0.1). Tall thistles were reduced to short stumps and from mid September remained the shortest thistles (P = 0.05). Some of these stumps died within 3 weeks and the rest produced weak shoots, some of which flowered (Table 1). By 3 September ungrazed tall and medium thistles had grown 12 cm, 10 cm more (P = 0.05) than ungrazed and grazed short thistles and pasture availability had fallen from 1.5 t to 1.0 t DM/ha in the grazed plot and risen from 1.3 to 1.8 t DM/ha in the ungrazed plot. During the 8 days following removal of grazing, ungrazed tall and medium thistles grew 3 and 7 cm respectively, significantly more (P = 0.05) than grazed and short thistles (< 1 cm).

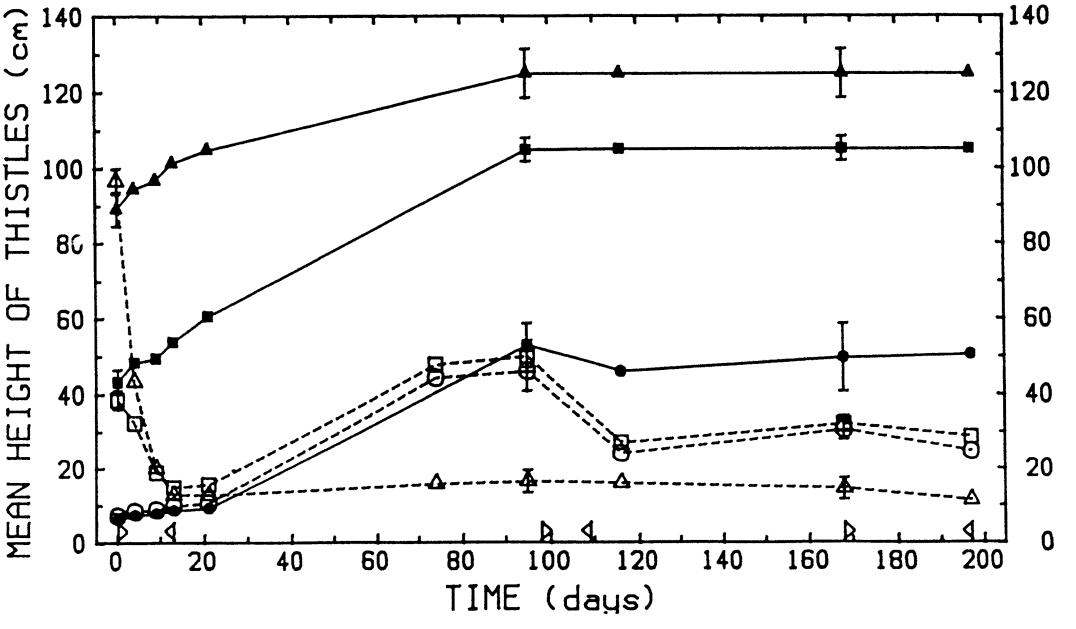

Figure 1. The changes in height of scotch thistles, which were tall (△,▲), medium (□,■), or short (○,●) on 21 August 1989, after grazing by goats (open symbols) or when ungrazed (closed symbols). (Grazing periods between ▷ ◁ on time axis, vertical bars are s.e.)

Table 1. The effect of grazing by goats and height of scotch thistles on 21 August 1989 on incidence of flowering and plant longevity[a].

Initial Height	Grazing Treatment	% Thistles flowering 18/8/89	3/11	15/12	5/2/90	6/3	% Thistles alive 15/12/89	5/2/90
Tall	ungrazed	80	100[a]	100[a]	100[a]	100[a]	0[c]	0[c]
	grazed	90	20[b]	10[c]	20[c]	0[b]	30[b]	30[bc]
	mean	85[a]						
Medium	ungrazed	0	90[ab]	100[a]	100[a]	100[a]	0[c]	0[c]
	grazed	20	60[bc]	20[bc]	50[b]	0[b]	100[a]	60[ab]
	mean	10[b]						
Short	ungrazed	0	30[cd]	40[b]	80[a]	90[a]	90[a]	90[a]
	grazed	0	60[bc]	10[c]	100[a]	0[b]	90[a]	90[a]
	mean	0[b]						
l.s.d.	P = 0.05	18	38	29	29	11	24	31
	P = 0.001	31	66	-	51	19	41	-

[a] Within columns, values with different superscripts are different (P = 0.05)

After being ungrazed for 67 days, very intensive grazing by sheep did not reduce thistle height but reduced pasture availability on both plots from 7 to 3 t DM/ha. Sheep nibbled leaves on 24 of the 25 living thistles in the grazed plot and 15 (only 1 tall thistle) of the 27 living thistles in the ungrazed plot. When goats were placed in the plots on 27 November grazed medium and all short thistles were of similar height. The goats reduced grazed medium and grazed short thistle height more than (P = 0.01) they reduced the height of short ungrazed thistles. By 15 December all tall and medium ungrazed thistles had flowered and then died during hot weather in December. When ungrazed during two summer months all short thistles and grazed medium thistles grew 5 cm. Light grazing by goats from 13 February to 6 March reduced the height of all grazed thistles by 4 cm when short ungrazed thistles grew 1 cm (P = 0.05). Throughout the study ungrazed tall thistles remained taller than ungrazed medium thistles (P = 0.01) which, from 30 August were taller (P = 0.001) than other thistles.

Grazing tall and medium thistles by goats significantly reduced the incidence of flowers by up to 100% (Table 1) and significantly increased the survival of thistles during summer. By 6 March 60% of short thistles (70% of ungrazed, 50% of grazed, NS) were still alive but only 10% of tall and medium grazed thistles (P = 0.001) were alive. Grazing short thistles tended to increase flowering when grazing was absent but significantly reduced flowering in December (P = 0.05) and eliminated flowers in February 1990 (P = 0.001) when grazing occurred. The flowers on grazed thistles were substantially fewer in number and of reduced size compared to the flowers on ungrazed thistles.

Goats reduced the height and ground cover area of artichoke thistles by 50% and 85% respectively within 4 days and by 75% and 98% respectively within 13 days of grazing (Table 2). This severe grazing killed some thistles. Goats consumed artichoke flowers and prevented these thistles flowering. Sheep did not graze artichokes in winter but destroyed thistle regrowth in late spring. In autumn 1990 only 50% of artichokes sprouted new shoots.

Table 2. The effect of grazing by goats and sheep on height and ground area cover of artichoke thistles (mean ± s.e.).

Species grazing	Sheep[a]	Goats			Ungrazed[a]	Sheep
Date	21/8	25/8	30/8	3/9	3/11	24/11
Mean height (cm)	29 ± 5	15 ± 2	9 ± 1	7 ± 1	19 ± 6[b]	0[c]
Ground area (0.1 m^2)	6.0 ± 1.6	0.9 ± 0.3	0.2 ± 0.1	0.1 ± 0.1	1.5 ± 0.8	0

[a]Plot grazed by sheep until 10/8, goats from 21/8 to 3/9, ungrazed to 3/11, sheep 9/11 to 23/11.
[b] Four thistle stumps recorded as zero,
[c]All thistles were stumps

Grazing by goats altered the growth form and shape of scotch thistles. Ungrazed thistles had a strong central stem and the numerous higher lateral branches developed flowers. Grazed thistles usually had a dead central stem and during regrowth 2 to 6 basal shoots on which flowers developed. In November these basal shoots were not as thick as the lateral branches on the ungrazed thistles. By November pasture availability underneath ungrazed tall and medium thistles had been severely depressed for distances up to 0.4 m from the stem. In the grazed treatment pasture growth adjacent to thistles was excellent and in some cases obscured thistle regrowth.

This study demonstrates that (i) goats can destroy taller scotch thistles and artichoke thistles; (ii) goats can substantially reduce the vigour of tall and medium height scotch thistles and artichoke thistles; and (iii) goats substantially reduce the incidence of flowering of scotch thistles. Goats were ineffectual grazers of shorter (mean ± s.e. 7.1 ± 2.3 cm, range 4-12 cm) scotch thistle rosettes in late winter and early spring when numerous taller thistles and pasture was available. The study indicates that to control rosette thistles as they mature and to prevent grazed thistles from flowering managers of properties should reintroduce goats at appropriate stages of thistle development. The grazing of tall and medium scotch thistles by goats prolonged thistle life during summer which (a) provided a source of highly digestible forage for goats (McGregor, unpublished data) during a period when senescent pasture had dry matter digestibilities approx. 48% and (b) provided the opportunity for thistles to re-flower and seed if not subject to further grazing. It is concluded that goats can be effectively used to eliminate, control and utilize scotch thistles and artichoke thistles.

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