ASPECTS OF THE ECOLOGY OF AFRICAN BOXTHORN, *LYCIUM FEROCISSIMUM*

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Summary. Little is known of the ecology and biology of the woody weed African boxthorn. A study of some aspects of the ecology of boxthorn was carried out on a coastal reserve on the west coast of South Australia. No clear evidence was found of boxthorn displacing native vegetation. Fruit production per plant varied but no link between fruit production and plant height was established. A positive, linear relationship exists between boxthorn fruit size and the number of seeds per fruit. Further ecological studies of boxthorn are recommended.

INTRODUCTION

Ecological studies are important for weed control planning. They can assist authorities establish the significance of a weed, its potential to spread (8,12) and provide an objective basis for decisions on quarantine and other legislative responses (1,12,13,16). Such research can also assist the development of control techniques, particularly biological control (3,17), and appropriate control strategies (4). A number of authors have criticised the paucity of ecological studies of weeds and have urged that more work be done in this area (3,6,8,11,16).

African boxthorn, *Lycium ferocissimum* (Miers), is regarded as a serious threat to native plant communities in Australia (10,18) and as a weed of grazing land (7,14,19). It is a declared noxious weed in all Australian states and the Northern Territory (14). Considerable public and private resources are directed to control programs for the plant. Despite this, very little has been published on boxthorn biology and ecology. Clearly ecological research would allow better informed decisions to be made on the status and control of boxthorn.

This paper will describe an initial effort to gather information on the ecology of boxthorn. Results of studies on the impact of boxthorn on coastal vegetation and aspects of its fruit and seed production are presented and discussed.

METHODS

Field measurements for the study were taken on a well established infestation of boxthorn on a coastal reserve at Cape Bauer, 32° 43'S, 134° 03'E, some 20 km northwest of Streaky Bay, South Australia. Two rectangular study sites, each consisting of 52 10x20 m cells, were pegged out. The location of each individual boxthorn was mapped and measurements of height and projected ground cover taken.

Impact studies. To see if there were any differences in vegetation between areas of 'high' and 'low' boxthorn density, a 2x2 m quadrat was sampled in each cell; the quadrats were positioned using the transect/baseline method (2). The number and total % ground cover was recorded for each perennial species. The total % cover of all annual species and % of bare ground was also recorded. The data was then analysed, using a two sample T-test, for differences in mean % cover of perennials, annuals and bare ground and high/low % cover of boxthorn. Differences in the mean number of perennials between high/low numbers of boxthorn were analysed in the same fashion. Significant results were examined further using simple linear regressions.

Fruit production. Two boxthorn plants were randomly selected from five height categories, a total of ten boxthorns. When most fruit were ripe, each plant was progressively felled and its fruit stripped and counted. A one way analysis of variance was used to compare fruit production between the five height categories.

Fruit size/seed number. The relationship between fruit size and the number of seeds per fruit was explored. Eleven boxthorn plants were randomly selected and 20 ripe fruit, representing a range of sizes, were sampled from each. Each fruit was measured for volume and diameter and then dissected and the seeds extracted and counted. Linear regression was then used to examine the relationship between volume and seed number and diameter and seed number.

RESULTS AND DISCUSSION

Impact studies. Results of measurements carried out on vegetation in quadrats classified as high or low for boxthorn are presented in Table 1.

Table 1. Effect of African boxthorn density on other vegetation at Cape Bauer.

Vegetation component	% Cover		Number of individuals (count per 4 m^2)	
	High[a]	Low[a]	High[b]	Low[b]
Atriplex cinerea	6.13	4.21	1.76[f]	1.18[f]
Danthonia spp.	0.26	0.15	1.56	0.60
Lycium australe	0.23	0.32	0.07[g]	0.32[g]
Marieana erioclada	0.13	0.09	0.0	0.0
Marieana oppositifolia	9.06[c]	4.27[c]	0.87	1.20
Nitraria billardierei	6.44	7.95	1.30[h]	0.58[h]
Olearia axillaris	0.21	0.91	0.17	0.32
Sclerolaena parallelicuspis	1.69	1.27	0.82	0.88
Stipa spp.	0.29	0.27	0.87	1.08
Other perennial herbs	0.11	0.43	0.21	0.46
Other perennial shrubs	0.60	4.72	0.56[i]	0.27[i]
Total perennials	26.45	23.92	7.55	7.00
Total annuals-	58.40[d]	37.57[d]	-	-
Bare ground	14.54[e]	36.55[e]	-	-

[a] 'High' boxthorn >2% cover (mean=4.9%), 'low' boxthorn <=2% cover (mean=0.45%)
[b] 'High' boxthorn >2 individuals (mean=5.54), 'low' boxthorn <=2 individuals (mean=0.68)
[c,d,e,f,g,h,i] Means significantly different at P=0.05

Regression analysis was then carried for those vegetation components which showed a significant result (Table 1), to determine if there was any clear relationship between the level of the component and the level of boxthorn. While this produced a number of significant (P=0.05) results, between boxthorn and annuals and boxthorn and bare ground for % cover and boxthorn and coast saltbush, *Atriplex cinerea*, nitre bush, *Nitraria billardierei* and other shrubs for number of individuals, r^2 values indicated a high level of variation in the data. The significant results should therefore be regarded with extreme caution.

As stated earlier, boxthorn is regarded as a serious threat to native plant communities in Australia. It has been suggested that boxthorn is displacing nitre bush on islands off the South and Western Australian coasts (10). However the results presented in table 1 provide no clear evidence of differences in vegetation between areas of high and low boxthorn density. Therefore it would be difficult to reach a conclusion on whether or not boxthorn has displaced native vegetation at this site. A more likely explanation for boxthorn's invasion of this site is that it has taken advantage of a past disturbance (5,9) and is exploiting resources formerly used by other plants that were present prior to the disturbance. Given that the site was grazed by sheep in the past and is currently subject to grazing by rabbits, this is most likely to be the case. Further studies need to be carried out before it can be established what, if any, impact boxthorn is having on native plant communities. Research effort should be directed toward those environments where boxthorn is regarded to pose the most serious threat and where most control resources are currently being directed; for example coastal areas and offshore islands (10,18).

Fruit production. Fruit produced per boxthorn plant ranged from 0 to 535; the mean being 223. This is in contrast to a study in southern Victoria where fruit production ranged from 730 to 4219 over ten plants (Hildebrand, unpublished thesis). The higher figures in the Victorian study are likely to be due to the different environment and the more intensive methodology used.

There was no difference (P=0.05) in the number of fruits produced by plants of different heights. More observations are required before the relationship between plant size and fruit production can be determined.

Fruit size/seed number. Results of boxthorn fruit size and seed number measurements are summarised in Table 2.

Table 2. Size and number of seeds of boxthorn fruit collected at Cape Bauer.

	Volume (cm^3)	Diameter (mm)	Number of seeds
Range	0.1 to 1.0	4 to 12	2 to 67
Median	0.2	7	20
Mean	2.86	7.41	21.40

The range of fruit diameters measured were similar to the 5 to 10 mm reported by Purdie *et al.* (15); however the number of seeds counted per fruit in this study showed wider variation than the 35 to 70 reported by the same authors.

Regression analysis revealed significant (P=0.05) positive linear relationships between fruit volume, diameter and the number of seeds per fruit. However low r^2 values showed some variation in the nature of these relationships between individual boxthorn. Further analysis revealed that these relationships were not significantly different for eight of the eleven plants sampled. Two of the other three plants also showed positive linear relationships but significantly different from the other eight. Thus, further measurements will be required to clearly establish the relationships between volume and seed number and width and seed number. Coupled with a better understanding of fruit production per plant, including the proportion of different sized fruit, knowledge of the nature of the relationship between fruit size and seed

number may allow a model to be developed which could estimate the number of propagules produced by an individual or stand of boxthorn.

This study has taken some of the first steps toward a better understanding of boxthorn. It has provided some evidence that boxthorn may not be as clearly detrimental to native vegetation as first thought. Fruit production per plant varies widely and no link between fruit production and plant height has yet been established. There is a positive, linear relationship between boxthorn fruit size and the number of seeds per fruit but further measurements are required to establish the exact nature of these relationships. While the information presented here will not immediately change the way we view boxthorn or its control, it does provide a basis for future ecological studies of this plant. As well as further work on the aspects described above, useful work could be done on dispersal ecology and the germination characteristics of boxthorn seed. Much remains to be discovered about this plant that would be of value to weed control authorities, managers of conservation areas and primary producers.

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