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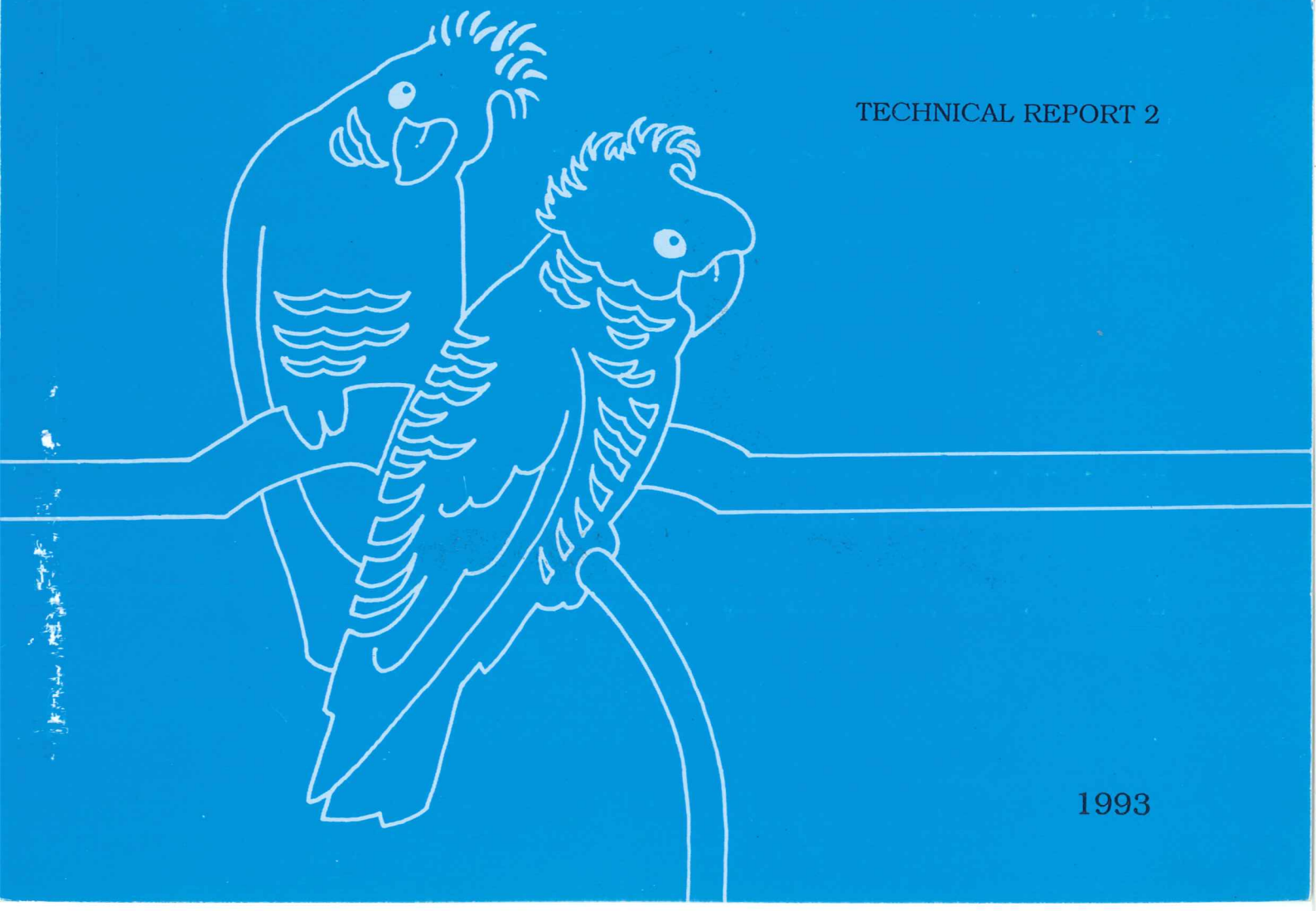
PETER ORMAY AND FRANK INGWERSEN



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MANAGEMENT OF *XANTHORRHOEA AUSTRALIS* IN TIDBINBILLA NATURE RESERVE

INTRODUCTION

Concerns have been expressed by management of Tidbinbilla Nature Reserve (TNR) about the long term survival and visual amenity of the stands of *Xanthorrhoea australis* on the north-west side of Mt Eliza and adjacent to the Gibraltar fire trail (Fig 1).

Xanthorrhoea is a widespread genus of 28 species endemic in Australia commonly known as grasstrees, yaccas or blackboys (Bedford 1986). Two species *Xanthorrhoea australis* and *X. glauca* are known from the ACT (Adams unpublished data). *Xanthorrhoea australis* occurs at a number of locations at Tidbinbilla Nature Reserve. The stand most visible to the public is on the lower slopes of Mt Eliza between the main entrance to the reserve and the Visitors Centre (Plates 1 and 2).

Xanthorrhoea australis is not a grassland species but "grows on stony slopes in dry sclerophyll forest or on areas from which this type of forest has been removed" (Burbidge and Gray 1970). Their presence at the sites above probably is due to the former occupants of the land not regarding them as seriously affecting stock carrying capacity and therefore not worth clearing. The presence of logs in the Mt Eliza and Gibraltar fire trail xanthorrhoea stands is indicative of the former woodland or forest structure of these sites (Plates 3 and 4).

Xanthorrhoea australis occurs in more natural conditions along the Fishing Gap fire trail in the reserve, along the forestry road through the former Gilmours' property adjacent to the reserve and along the first three kilometres of the Brindabella Road from the Cotter Reserve.

BIOLOGY

Contractile roots

All species of xanthorrhoea have contractile roots (Bedford 1986) which pull the apical meristem (growing tip of the core) 10 cm or more below the soil surface protecting them from fire during an extended subterranean period of 15-25 years. The leaves protrude above the soil surface during this period and carry out their normal photosynthetic function.

The leaf bases (the lower 5 cm) are thickened and tightly packed around the stem of the mature plant which reduces air circulation and resists burning. These thickened leaf bases develop below ground level as well as in the aerial stage and protect the growing tip of the plant throughout its life (Gill and Ingwersen 1976).

Plate 1. Mt Eliza xanthorrhoea stand clearly visible from the road. Note clear areas above and below and tea-trees at left of xanthorrhoeas. Also low silver wattle *Acacia dealbata* thickets across middle foreground (23 Feb. 1984).

Plate 2. Xanthorrhoeas as in photo above 8 years 7 months later with tea-tree *Kunzea ericoides* invasion below, in and above the xanthorrhoeas. Note tea-trees in foreground which will block the view from the road in 10 to 15 years if not controlled (28 Sept. 1992).

Plate 3. Logs indicative of former forest or woodland structure in the xanthorrhoeas adjacent to the Gibraltar fire trail. Aspect is NW. Note lack of regeneration (21 Aug. 1992).

Plate 4. Logs in Mt Eliza xanthorrhoea stand indicative of former forest or woodland structure. Note the tea-trees and tea-tree seedlings amongst and in front of the xanthorrhoeas. These will obscure the view of the xanthorrhoeas in 10 to 15 years if not controlled (21 Aug. 1992).

Growth rates adult

The average growth rate of the adult plants has been measured as 36 cm in 40 years at Pierces Creek (9 mm per year) (Gill and Ingwersen 1976). The age of the largest xanthorrhoeas at Tidbinbilla therefore may be up to 350 years since emergence from the soil.

Growth rates seedlings

No information is available for the growth rate of seedlings in the wild. However, according to Mulcahy (pers. comm.), under nursery conditions they grow two to four leaves in two to four years. This is probably equivalent to two to six years in the wild, depending on conditions. Under nursery conditions the apical meristem emerges above ground level after 15 years and probably after 15 to 25 years in the wild.

Flowering in relation to fire

Gill and Ingwersen (1976) investigated the stand of xanthorrhoeas along the Gibraltar fire trail. They subjected them to one of four treatments in 1972: burning, ethylene, cutting of leaves and no treatment. They found that flowering in *X. australis* is stimulated by fire although it will flower in the absence of fire. These xanthorrhoeas have not been burnt since those studies were carried out. Flowering occurred following firing in 1972 and some seed was produced as indicated by some 15 to 25 year old plants (with their growing tip just emerging from the soil) mainly in the enclosure.

Flowering occurs 265-395 days after fire and seed dispersal about 490 days after fire (Fig 2). Plants that flower in winter set very few or no seeds, probably due to the inactivity of pollinators (Gill and Ingwersen, 1976).

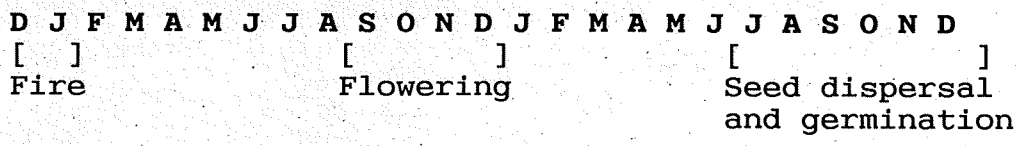

Figure 2. Flowering and seed dispersal after summer fire. (After Gill and Ingwersen 1976).

From this it follows that burning in summer will give optimum flowering in spring, followed by seedset, dispersal and possible germination in the following autumn to spring, 16 to 19 months after firing.

STUDY SITE

This study was conducted in an exclosure approximately 11 m x 11 m with a NE aspect set up in 1974 in the stand of xanthorrhoeas adjacent to the Gibraltar fire trail to monitor the effect of rabbit grazing on the regeneration of xanthorrhoea. Wire netting is suspended from a smooth top wire 75 cm above the ground and buried in the ground at the bottom. The rest of the stand and that on the slopes of Mt Eliza have never been fenced to protect them from grazing.

The original vegetation was probably eucalypt woodland or forest as was indicated by the existence of logs inside and outside the exclosure in the Gibraltar fire trail and Mt Eliza stands (Plates 3,4,5 and 6) and some scattered apple box trees *Eucalyptus bridgesiana* in the area. Ground cover was dominated by kangaroo grass *Themeda australis* (syn. *triandra*).

METHOD

In April 1991, a transect 22 m x 2 m was delineated incorporating equal areas inside and outside the exclosure for comparison. Xanthorrhoea seedlings were recognised by their erect slightly glaucous leaves protruding through the thatch of kangaroo grass *Themeda australis* and other vegetation. The location of each plant (adult and seedling) was measured using a steel tape and recorded. The location of logs, fence posts, fence strainers and wire netting was also recorded. An inspection of the rest of the stand and those on Mt Eliza was carried out to ascertain regeneration.

RESULTS

Regeneration

Results of the survey are shown in Figure 3. Regeneration adjacent to the exclosure was found to be 9.4 per cent of that inside the exclosure. Downslope of the exclosure and to the north on the same aspect regeneration was about the same as the part of the transect outside the exclosure. Across the Gibraltar fire trail on the north west aspect and on the lower part of the Mt Eliza stand there was virtually no regeneration (Plates 3 and 4). There was a steady increase in seedlings from around 20 years of age to two to six years of age with the majority (85%) in the latter category.

Seedlings were densest in sheltered spots inside as well as outside the exclosure. These were adjacent to or under logs and strainers, posts and under the crown of adult xanthorrhoeas but occurred also in thick vegetation, depressions and along fence lines (Plates 5,6,7 and 8). These sites give some protection against grazing and trampling and accumulate litter and moisture.

Plate 5 Xanthorrhoea seedlings growing in the shelter of logs and thick vegetation inside the rabbit exclosure (21 Aug. 92).

Plate 6. Xanthorrhoea seedlings growing in the shelter of logs outside the rabbit exclosure visible in the background. Aspect north-east (21 Aug. 92).

Plate 7. Xanthorrhoea seedlings growing in shelter of fence inside rabbit exclosure. Note some seedlings outside. Aspect north-east (21 Aug.92).

Plate 8. Xanthorrhoea seedlings growing on the south side of a fence stay inside the rabbit exclosure (21 Aug. 92).

Logs, strainer posts and the drip-line of adult xanthorrhoeas are associated with much higher than normal moisture runoff. As this is a forest species some shading may be beneficial during the seedling stage.

Effects of rabbits and kangaroos

There was no evidence of rabbits getting into the exclosure such as holes in the fence or runways nor droppings inside. Kangaroos were able to get in as was indicated by their droppings. The fence or the smallness of the exclosure had some deterrent effect on kangaroos and their grazing pressure was considered to be slightly lighter inside the exclosure than outside.

The grass was cropped very close to the ground outside with an average sward height of two centimetres but higher around obstructions such as logs and adult xanthorrhoeas. Some sheet erosion about two centimetres deep was evident outside the fence on the north and east sides. This may be due in part to increased traffic of kangaroos and possibly rabbits around this side of the exclosure as the other side has more obstructions such as shrubs and adult xanthorrhoeas. Inside the exclosure the grass was moderately dense with a sward height of 15 cm.

Although at the time of the survey kangaroos were having a greater effect than rabbits on the grassland, the fact that they were grazing within the exclosure almost as much as outside, together with the greater than ten-fold increase in seedlings in the exclosure suggested that rabbit grazing over the previous 18 years was most likely to have been the cause of seedling failure.

Tea-tree invasion

There has been a marked proliferation of tea-tree *Kunzea ericoides* (previously *Leptospermum phylicoides*) in and around the xanthorrhoea stand on the north-west side of Mt Eliza in the past 15 years which has partially obscured the xanthorrhoeas (Plates 1,2,4,9 and 10). Most of this tea-tree is less than ten years old, that is under two metres tall judging by growth rates described by Kirschbaum and Williams (1991). Up to about 1985 the xanthorrhoeas were clearly visible from the road but have become progressively obscured since and will be difficult to see in ten to twenty years unless the tea-tree is controlled.

Tea-tree invasion is not evident among the xanthorrhoeas on the Gibraltar fire trail generally (Plates 11 and 12), except in the western end of the stand (Plates 13 and 14). However tea-tree seedlings are present mainly in the uphill part of the stand and above it (Plates 15 and 16). This is a strategic location for the seeds to be washed downhill to invade the xanthorrhoeas.

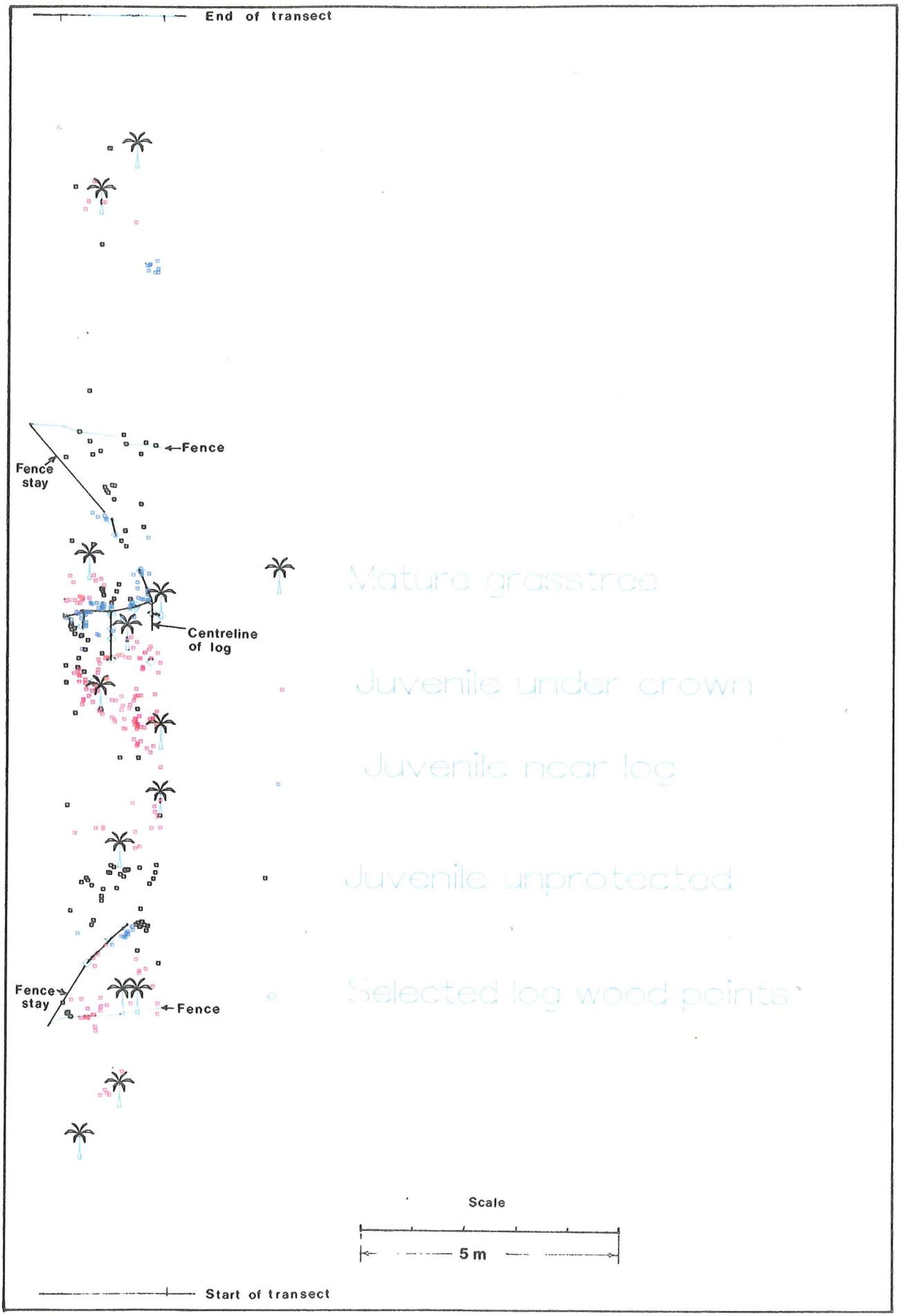

Figure 3. Locations of *Xanthorrhoea* plants on a transect through the rabbit exclosure adjacent to the Gibraltar fire trail in Tidbinbilla Nature Reserve ACT. (18 April 1991).

Plate 9. Rough tree-fern *Cyathea australis* upslope from the xanthorrhoeas on Mt Eliza surrounded by tea-tree seedlings (1 Dec. 1979).

Plate 10. Same view as in the above photo. The *Cyathea australis* smothered and dead and the rock completely obscured by tea-tree *Kunzea ericoides* and broad-leaf hickory *Acacia falciformis*. The broad-leaf hickory is still visible above the rock (see arrows) (21 Aug. 92).

Plate 11 Xanthorrhoea stand adjacent to Gibraltar fire trail on north-west aspect with Wallaby Rocks in background. ca. 1974-75.

Plate 12 View as in the above photograph showing no apparent tea-tree invasion but some seedlings are present mainly near the top of the xanthorrhoeas. Note invasion by broad-leaf hickory *Acacia falciformis* in top left of photo (28 Sept 92).

Plate 13 Southern side of the xanthorrhoea stand along the Gibraltar fire trail, view north (30 Dec. 1980).

Plate 14 View as in the above photo showing tea-tree *Kunzea ericoides* invasion (28 Sept. 1992).

Plate 15 Tea-tree *Kunzea ericoides* invasion along the Gibraltar fire trail upslope of the xanthorrhoea stand from parent tree in center right (21 Aug. 1992).

Plate 16 Tea-tree *Kunzea ericoides* and silver wattle *Acacia dealbata* in the xanthorrhoea stand along the Gibraltar fire trail near the pitfall and small mammal trapping site 3 (21 Aug. 1992).

DISCUSSION

Visual amenity

Xanthorrhoeas are as "Australian" as kangaroos and koalas and the reserve has a visitation rate in excess of 154,000 per annum (1990-91 figures). Many of these visitors are from overseas on a short duration visit and the reserve is the only place where they are likely to see xanthorrhoeas. It is therefore highly desirable that the visual amenity of the xanthorrhoeas on the side of Mt Eliza be maintained.

Effects of rabbit and kangaroo grazing.

Observations indicate that there is a greater than ten-fold regeneration of xanthorrhoeas inside the exclosure than outside. Kangaroos hop in and out of the exclosure as is indicated by their droppings but appear to have no significant effect on regeneration.

Outside the exclosure and in the Mt Eliza stand, rabbit grazing has prevented regeneration almost completely since the establishment of the reserve in 1964. Prior to that, the combination of rabbits and sheep had prevented regeneration completely.

Although rabbit populations recently have been kept well below the levels of the early 1970s by consistent control activity, this has not been sufficient to enable a new generation of xanthorrhoeas to establish.

Seedling vulnerability to grazing

In an experiment in the Australian arid zone in South Australia, Lange and Graham (1983) found that rabbit density of as low as 0.5-1.0 per hectare, which is almost imperceptible to the casual observer, prevented the regeneration of western myall *Acacia papyrocarpa* and said that "there may be no safe rabbit density for some seedlings."

Results of the present study indicate that xanthorrhoea seedlings are vulnerable to grazing by rabbits but tolerant of kangaroos. They appear to be most vulnerable from zero to 15 to 25 years of age when a protective cover of coarse leaves has developed around the apical meristem and it is emerging above ground level. This vulnerable period may possibly extend to 65 years or more when the apical meristem is 36 cm or more above ground and may be out of reach of rabbits.

All stages of growth up to 65+ years would probably be vulnerable to rabbits after fire as it exposes the young shoots and makes them accessible to rabbits.

To have a reasonable chance of getting a new generation of xanthorrhoeas established the numbers of rabbits would have to be kept to a very low level for a minimum of about 15

years and possibly over 65 years. It would be unrealistic to expect a consistently high pressure of rabbit control to be maintained over such long periods and therefore fencing is essential.

Fire

Firing the grasstrees is not necessary as is indicated by the good regeneration in the present exclosure without such firing but could be an advantage. Firing may weaken seedlings and open the site for tea-tree invasion. However if it is deemed desirable to speed up regeneration it could be tried on a small area first. It would be best carried out in December or January and at six to ten year intervals thereafter.

Firing is not recommended until fencing is complete as it exposes the green shoots to rabbit grazing.

Monitoring

The effectiveness of placing some cut tea-trees on bare areas to encourage regeneration should be assessed at five to seven years after such placement. Likewise placing some logs or sleepers or digging trenches similar to those in the present exclosure could be tried. However it should be borne in mind that some areas adjacent to the present extent of the xanthorrhoeas may not be suitable for their growth because of other factors such as excessive moisture .

RECOMMENDATIONS

Management should aim to :

- Maintain the xanthorrhoea stands along the Gibraltar fire trail and on Mt Eliza in perpetuity; and
- Maintain the visual amenity of the Mt Eliza stand.

Fencing

Fencing must be constructed and maintained in perpetuity around the Mt Eliza and the Gibraltar fire trail xanthorrhoea stands. It is recommended that both stands be fenced to exclude rabbits with fencing similar in design to the existing exclosure. The fence should be at least 15 m from the nearest xanthorrhoea on the sides and upslope and 30 m or more downslope of the stands. The area surrounding the stand on Mt Eliza should be searched to ensure the inclusion of scattered xanthorrhoeas particularly to the NE.

To avoid a paddock-like appearance the exclosure need not be rectangular. Stiles or a treated log over the top wire should be provided in an obvious location for public access.

The xanthorrhoea stand along the Gibraltar fire trail may be fenced separately on each side of the fire trail or fenced together and the fire trail relocated.

Clearing in excess of the above distances from the xanthorrhoeas is preferable. Provision should be made to hide the fence. The edges of the clearing around the xanthorrhoeas should be irregular so that it will not be so obvious and clearing along the fence should be no wider than necessary to get the fence through. The fence could be painted green like some other fences in the reserve.

Tea-tree control

It is recommended that:

- The tea-tree within 10 m on the sides and upslope and 20 m downslope of any grasstree be cut as close to the ground as possible to minimise hazard to humans.
- The stumps be poisoned with a non-residual herbicide.
- The cut tea-trees be laid horizontally across the stumps and in bare areas to accumulate litter, control erosion and to provide shelter for xanthorrhoea seedlings.
- If the cut tea-trees become dislodged due to macropod or human traffic they be pegged down with wire pegs or ungalvanised wire netting.
- Seedlings should be pulled annually by hand after rain if possible.

Recommendations cont.

- If seedlings are too hard to pull or they snap off they could be sprayed with non residual herbicide with a funnel or bell shaped fitting (available at hardware stores) fitted over the nozzle to confine the spray to the target plants.

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