THE MANAGEMENT OF WEEDS ON ABORIGINAL LAND WITH SPECIAL REFERENCE TO *MIMOSA PIGRA*

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Summary. Aboriginal land owners recognise that land degradation by weeds is unfavourable to their traditional way of life and to their efforts to become self sufficient. A large isolated infestation of *Mimosa pigra* occurs on the East Alligator River floodplain in Arnhem Land, posing a threat to the region. Control started in 1983 with the release of biological control agents followed by intermittent chemical control. In 1991 the infestation was 8,200 ha of dense to scattered plants, and chemical and mechanical control commenced on the entire infestation. Follow-up work is essential to achieve the objectives of the program.

INTRODUCTION

Weed management is becoming an increasingly important issue on Aboriginal land in the Northern Territory (NT) (2,12). About 47% of the NT is Aboriginal land or is under claim by Aborigines, either through the land rights process or through purchase of pastoral properties and subsequent conversion to Aboriginal freehold. Noxious weeds are found from the Top End to Central Australia. They cause losses in pastoral production, pollution of water supplies and degradation of the natural environment. On Aboriginal land, the owners recognise that land degradation by weeds is unfavourable to their traditional way of life and their efforts to become self sufficient.

Weeds on Aboriginal land. It is generally believed that Aborigines have occupied Australia for 40,000 years. Being hunters and gatherers, rather than farmers, the traditional Aboriginal lifestyle does not include weeding. Europeans (Portuguese and Dutch) have been visiting the Northern Territory since the 16th or 17th century (11). Macassans and other south-east Asian people may have been visiting our shores for 1200 years, so there has been ample opportunity for exotic species to be transported and become established in the north. For example, the tamarind (*Tamarindus indicus*) was introduced to Arnhem Land well before the first British exploration of the east coast (11).

It is not known when the first exotic weeds were introduced to the Northern Territory, but while weeds such as water lettuce (*Pistia stratiotes*) and needle bush (*Acacia farnesiana*) are considered to be native (6,7) they may well have been introduced prior to European settlement. Hyptis (*Hyptis suaveolens*) was found by the explorer Ludwig Leichhardt in 1845 (3). Many other weeds were introduced to Darwin in the late 1800s (7), for example, candle bush (*Senna alata*), mimosa (*Mimosa pigra*), thornapples (*Datura* spp.) and snake weeds (*Stachytarpheta* spp.).

Examples of noxious weeds which now occur on Aboriginal land include mimosa, salvinia (*Salvinia molesta*), spinyhead sida (*Sida acuta*) and hyptis in the Darwin Region, parkinsonia (*Parkinsonia aculeata*), lion's tail (*Leonotis nepetifolia*), caltrop (*Tribulus* spp.) and khaki weed (*Alternanthera pungens*) in the Katherine Region, and parkinsonia, rubber bush (*Calotropis procera*) and Athel pine (*Tamarix aphylla*) in the Southern Region.

Mimosa, in particular, poses a threat to traditional lifestyles and economic development (2). It forms dense impenetrable monocultures on floodplains (8,9) which are traditional hunting and gathering areas for magpie geese, file snakes, goannas, turtles and water lilies, access to fishing areas is prevented, tourist operations may be hampered, and pastures for cattle and buffalo enterprises on the floodplains are lost.

Responsibility for control. Aborigines have been employed for weed control in Darwin since early this century (1). However, the major issues facing weed control on their own land are funding and the enforcement of the *Noxious Weeds Act*. As is the case with other land, the responsibility for weed control on Aboriginal land is that of the owners or managers of the land. Aboriginal land owners are encouraged to control weeds but, as with other landholders, the success varies from place to place. Aboriginal land owners generally believe that funding of weed control rests with Government as they do not have the physical, financial and technical resources to control weeds. In many cases, their land is not productive in a European sense and therefore does not produce income, and the presence of weeds on their land may be the result of introductions by Europeans. This philosophy has sometimes been accepted by Government.

Apart from using their own funds, Aborigines in the NT are sometimes able to access grants from various sources. NT Government funds are spent on weed control in some key areas, for example, control of mimosa in the Daly River/Port Keats Aboriginal Land Trust and in Arnhem Land, control of lion's tail at Yarralin in the Victoria River District and control of Athel pine in the Alice Springs District. Some other landholders also receive a similar service, but the NT Government is hesitant to expand funding specifically for Aboriginal land as other landholders would expect the same treatment. There are also funds available from Commonwealth Government sources such as the Department of Employment Education and Training, the Bureau of Rural Sciences, the Australian National Parks and Wildlife Service (ANPWS) Contract Employment Program for Aborigines in Natural and Cultural resource Management, and the National Landcare Program.

Under the NT *Noxious Weeds Act* eradication or control can be enforced. This Act can be applied to Aboriginal land if it does not conflict with the Commonwealth *Aboriginal Land Rights Act*, but the *Noxious Weeds Act* has never been applied to Aboriginal land. Even if it is applied, there does not appear to be a means to enforce an action to a conclusion, because those areas which are held under Aboriginal inalienable freehold title cannot be sold, mortgaged or dealt with to recover debts for compulsory control carried out by the Government, as is empowered under the *Noxious Weeds Act*.

MIMOSA CONTROL IN ARNHEM LAND

The eastern and western extremities of mimosa in Australia are on Aboriginal land. The largest infestation in Arnhem Land occurs on the East Alligator River floodplains north of the community of Oenpelli (Gunbalanya), posing a threat to the region, in particular Kakadu National Park. This infestation started before 1983, the seed probably being accidentally brought by buffalo catchers or buffaloes themselves. Limited resources were available to control this small infestation of about 200 ha. Between August 1983 and June 1985 releases were made of seed feeding beetles, biological control agents for mimosa. Other agents are now available, but while prospects for control are promising (5), biological control has still to reach a high level of effectiveness.

In 1986 twelve Aborigines controlled isolated plants on the plain under a Commonwealth Employment Program. Dense areas were aerially sprayed with dicamba. This exercise succeeded in increasing the awareness of the local community about the mimosa problem, but its short-term nature meant that it achieved minimal control. Similar short-term, intermittent, jointly funded projects involving the Northern Land Council (NLC), the Department of Primary Industry and Fisheries (DPIF), the former Department of Aboriginal Affairs and the ANPWS took place on part of the infestation between 1988 and 1990, but the infestation at Oenpelli increased to about 8,200 ha of dense to scattered mimosa.

Control proposal. An inter-agency meeting in May 1990 resolved to develop a program to control mimosa on all Aboriginal land in the Northern Territory. A Public Environment Report (PER) was completed in April 1991 (2). The then Commonwealth Department of the Arts, Sport, the Environment, Tourism and Territories invited public submissions on this proposal and an 'Environment Assessment Report' supporting the proposal was published in June 1991.

The proposal was to control mimosa by following a five year action plan (subject to major review after three years) aimed at preventing the spread of mimosa in three key areas: the Oenpelli floodplains in western Arnhem Land, the Daly River/Port Keats Aboriginal Land Trust, and Wagait Reserve. A five year program was proposed as it was unlikely that biological control would be effective within that time. Funding for the proposal was sought from the Commonwealth under a specific grant, separate from the ongoing mimosa control program funded by the NT. In 1991/92 the Commonwealth provided a direct grant of $2 million, and in 1992/93 a further $1.046 million, for control of the Oenpelli infestation. Funding was recently committed for a further three years amounting to $3.5 million. No commitment was made for funding to control mimosa in the Daly River area and Wagait Reserve.

Responsibility for the program. An inter-agency Steering Committee has prime responsibility for the program which has been implemented by the Weeds Branch of the NT DPIF, the NLC, the ANPWS and Gunbalanya Council. A research and monitoring program is carried out by CSIRO Division of Wildlife and Ecology.

METHODS

Site preparation. In 1991, 50 km of tracks were cleared with a bulldozer and road grader to allow for ground marking during aerial application of herbicide. The tracks were carefully sited to prevent future erosion or damage to any sacred sites in the area. This latter problem was avoided by using local Aboriginal operators. Areas for herbicide storage, fuel dumps, and a waste dump were selected.

Aerial application. The dry pelleted herbicide, tebuthiuron, made up most of the herbicide applied at a recommended rate of 1.5 kg a.i./ha (9,10). It was necessary to have the work completed by December before the floodplains became too wet for tebuthiuron application, and so that vehicle access could be guaranteed.

The tebuthiuron was applied by a Bell Jetranger helicopter using an Isolair application unit in November 1991. Runs were marked using 6 m high banners attached to four-wheel drive vehicles, although large areas were flown with reduced marking where banners were hidden in the trees and in some areas marking was not possible. Calibration of the equipment was carried out twice a day and when a new batch of herbicide was opened. Some variability was found

within the batches and humidity affected the rate of application throughout the day. A total of 12,436 kg of tebuthiuron (62,180 kg of Graslan®), in 194 loads, were applied at an average rate of 1.53 kg/ha. One bay, which had been treated in previous years, was treated at 1.0 kg/ha. Flying time was 115.2 hours. A follow-up application of tebuthiuron was made to approximately 2,000 ha of the leading edge in December 1992.

The foliar-applied liquid herbicide, fluroxypyr, was used to control mimosa growing in the palaeochannels and areas not treated with tebuthiuron. Fluroxypyr is effective on mimosa at 600 g a.i./ha (10). All herbicide and fuel was placed on site before the wet season and staff flew in each day to carry out the application. Applications were carried out in March and May 1992 on 1,321 ha of the project site, at outlying areas in Arnhem Land, and isolated plants scattered across the floodplain towards the boundary of Kakadu National Park.

No flagging was possible as the floodplain was inundated. A total of 789 kg of fluroxypyr (2631 L of Starane®) was applied and 57.6 spraying hours were spent in this phase of the operation. Approximately 2% of the total area could not be treated due to wet weather and shortages of herbicide. Follow-up applications of fluroxypyr were made in March and April 1993.

Ground control. The key to successful mimosa control is to control isolated plants surrounding and away from the main infestation. Fourteen Aborigines living at Gunbalanya have been employed for this work. Over 7% of the budget was spent directly on Aboriginal employment and this proportion will increase as the major infestation is brought under control.

The ground teams were equipped with two 4 x 4 vehicles, two trailers and four quad bikes to allow access to the area. Application equipment comprised of strong lopping shears, 9 L knapsack sprayers and appropriate safety equipment for each individual. Isolated mimosa plants were cut off close to the ground and fluroxypyr mixed in diesel was applied to the cut surface. If the plant had seeded, or if a large number of seedlings were found, tebuthiuron pellets were applied by hand over the area.

Mechanical control. Between October and December approximately 2,000 ha of the treated mimosa was chained using two low ground pressure D4 bulldozers.

RESULTS AND DISCUSSION

Aerial application. Mimosa is relatively sensitive to tebuthiuron compared to other species. Within one month after application, tip chlorosis and tip browning of the foliage of mimosa can be noted, and complete defoliation is usually obtained within three months (9). An inspection was carried out on 8 January 1992. Tip chlorosis was apparent over a wide area. A further inspection on 20 February 1992, after necrosis and defoliation had commenced, indicated that striping had occurred over most bays. It was always understood that some striping may occur (2) and that only a partial kill would be achieved in the palaeochannels as the herbicide dissolves without being absorbed. The foliar herbicide, fluroxypyr, was on site to cover this contingency. The degree of striping was greater than anticipated and was probably due to calibration errors, changes in wind direction and speed, and long runs between markers.

Application of the fluroxypyr achieved necrosis and defoliation of the mimosa. The mimosa plants that were sprayed during March were flowering and bearing green pods. Seed production

may have been reduced as the herbicide generally produces visible effects within ten days. However, in areas where spraying was delayed until May, the mimosa produced mature seed. After being sprayed with fluroxypyr, most of the mimosa on the plain was either dead or dying.

Ground control. The boundary between the infestation and the woodland is longer than 60 km and there are six major drainage lines feeding the area. It took from May until September 1992 for the teams to cover the paper bark fringe and treat all mimosa plants. The rest of the season was spent on the open floodplain searching for plants and re-treating the fringe.

Mechanical control. In May 1993 the chained area which had received two applications of tebuthiuron was virtually free of mimosa. Regeneration by native grasses and sedges and the introduced para grass (*Brachiaria mutica*) which has been on the plain for at least 70 years, was occurring. Mimosa is difficult to burn, but fire has a place in control programs (9). Whether chaining is necessary is debatable, and trials are planned to test whether compaction of the mimosa fuel assists in its burning and assists in the regeneration of understorey vegetation.

Cost-effectiveness. If a decision is made to control a large mimosa infestation, there is no current alternative to aerial application of herbicides. The total cost of applying tebuthiuron to mimosa was $114/ha. These costs do not include freight or staff costs etc. Fluroxypyr application at $89.40/ha is comparable to costs in spraying mimosa with this herbicide in other areas. It is difficult to estimate the cost of losing the floodplains of Arnhem Land and Kakadu National Park to mimosa. and this program is planned to continue for five years. It is therefore too early to measure final effectiveness, but the program achieved its first year objectives.

Research and environmental monitoring. A preliminary report (4) concluded that tebuthiuron is unlikely to have a deleterious effect on aquatic fauna and suggested steps to improve the efficiency of the program.

Conclusion. The control of large areas of weeds on Aboriginal land, integrating different control methods and work teams, is possible without undue damage to the environment. The Oenpelli program was the largest single aerial application of herbicide ever undertaken in the NT, the largest single application of herbicide to mimosa in the world, the largest single tebuthiuron operation ever undertaken in Australia and probably the largest single application of tebuthiuron to a wetland environment in the world. Provided that funding for the program continues the objectives of this program on Aboriginal land can be achieved.

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REFERENCES

1. Allen, C.E.F. 1915. Northern Territory of Australia. Report of the Administrator for the Year 1914-15. p 43.
2. Anon. 1991. Public Environment Report, Northern Land Council.

3. Bentham 1870. Flora Australiensis: a description of the plants of the Australian Territory. L. Reeve and Co., London. p 80.
4. Cook, G.D. 1992. Preliminary report to the Steering Committee of the Program to Control Mimosa on Aboriginal Lands in the Northern Territory. CSIRO Division of Wildlife & Ecology.
5. Forno, I.W. 1992. In: A Guide to the management of *Mimosa pigra*. (ed. K.L.S. Harley) (CSIRO: Canberra). pp 38-42.
6. Gillett, J.D., Dunlop, C.R. and Miller, I.L. 1988. Plant Protection Quarterly 3, 144-148.
7. Holtze, M. 1892. Transactions of the Royal Society of South Australia. 15, 1-4.
8. Lonsdale, W.M., Miller, I.L. and Forno, I.W. 1989. Plant Protection Quarterly 4, 119-131.
9. Miller, I.L. 1988. M.Sc.Agr. Thesis, University of Sydney, 248pp.
10. Miller, I.L. and Siriworakul, M. 1992. In: A Guide to the management of *Mimosa pigra*. (ed. K.L.S. Harley) (CSIRO: Canberra). pp 86-91.
11. Mitchell A.S. 1978. Proc. 1st Conf. of the Council of Australian Weed Sci. Socs., pp 145-153.
12. Young, Y., Ross, H., Johnson, J. and Kesteven, J. 1990. Australian National Parks and Wildlife Service.