

The history and effects of alien plant control in the Cape of Good Hope Nature Reserve, 1941-1987

I.A.W. Macdonald*, D.L. Clark¹ and H.C. Taylor

Percy FitzPatrick Institute of African Ornithology, University of Cape Town, Rondebosch, 7700 Republic of South Africa; Cape of Good Hope Nature Reserve, Divisional Council of the Cape, P.O. Box 1035, Cape Town, 8000 Republic of South Africa and Botanical Research Institute, P.O. Box 13, Clanwilliam, 8135 Republic of South Africa

Present address: ¹Department of Agriculture and Nature Conservation, Private Bag 2050, Keetmanshoop, 9000 South West Africa/Namibia

Accepted 12 July 1988

Concern about the invasion of this reserve by alien trees and shrubs, principally *Acacia cyclops*, *A. saligna*, *A. longifolia*, *Eucalyptus lehmannii* and *Pinus pinaster*, was first expressed in 1941, 2 years after its proclamation. Control operations were started by 1943 and were almost totally ineffective for at least the first 35 years; no systematic control strategy was implemented, follow-up control work was inadequate to prevent re-establishment of felled thickets and the supervision of control teams was deficient. Linkage of control operations to firewood production was a significant factor in this failure. In 1974 a 10-year control strategy was drawn up and in the late 1970's began to be effectively implemented. Surveys of 40 plots in the centre of the reserve in 1966, 1976-80 and 1986 showed increasing densities of species other than the easily controlled *P. pinaster* up to 1976-80. Since then almost all individuals > 1,8 m in height have been eliminated and indications from smaller height classes are that seed banks are being depleted. Explanations are advanced for the successes and failures experienced during the 47 years of control. Some of the side-effects of these invasions and their control are discussed. One conclusion is that this reserve requires a qualified ecologist on its staff.

Bekommernis oor die indringing van uitheemse bome en struik, veral *Acacia cyclops*, *A. saligna*, *A. longifolia*, *Eucalyptus lehmannii* en *Pinus pinaster*, was reeds in 1941 uitgespreek, 2 jaar na die proklamasie van die reservaat. Beheeroperasies was in 1943 begin en was heeltemal onsuksesvol vir 35 jaar; daar was geen sistematiese beheerplan nie, opvolgwerk was onvoldoende en gevolglik het afgekapte bome weer gegroei. Die toesighouding oor die beheerspanne was ook onvoldoende. Die besluit om die beheeroperasies te gebruik om brandhout te kry was skynbaar een rede vir die mislukking van die vroeë pogings. Gedurende 1974 was 'n 10-jaar-beheerstrategie geformuleer en dit was uiteindelik in die laaste jare van die dekade doeltreffend geïmplementeer. Opnames van 40 persele in die middel van die reservaat was in 1966, 1976-80 en 1986 uitgevoer. Die digtheid van al die spesies behalwe *P. pinaster* het tot 1976-80 vermeerder. Sedertdien was amper al die plante met hoogte > 1,8 m uitgeroei en dit lyk asof die saadbank verminder het. Redes vir die suksesse en mislukkings van die program word voorgestel. Sommige van die ekologiese gevolge van die indringings en hulle beheer word bespreek. Die aanstelling van 'n vakkundige ekoloog as lid van die reservaat se personeel word aanbeveel.

Keywords: Alien plants, Cape, control strategies, fynbos, reserve management

*To whom correspondence should be addressed

Introduction

The invasion of fynbos vegetation by alien trees and shrubs is considered by several authorities to pose a serious threat to the long-term survival of its constituent species (Wicht 1945; Adamson 1953; Taylor 1977a; Hall 1978). Much has now been published on the extent of the problem (see references in Macdonald 1984) and on control measures for individual alien species, e.g. *Hakea sericea* (Fenn 1980; Fugler 1983; Kluge & Richardson 1983), *Pinus pinaster* (Kruger 1977; Donald 1982) and *Acacia longifolia* (Dennill 1985; Pieterse & Cairns 1986). Little published information is available on the results of field-scale control operations; quantitative data being available only for repeat surveys of sample plots in the northern Cape Peninsula mountains (McLachlan *et al.* 1980) and the Cape of Good Hope Nature Reserve (Taylor *et al.* 1985). The extensive field experience that

has been accumulated by fynbos managers has recently been drawn together in the report of a workshop meeting (Macdonald *et al.* 1985).

This paper describes the history of alien plant control operations in the Cape of Good Hope Nature Reserve and attempts to quantify their successes and failures.

The study area

The Cape of Good Hope Nature Reserve, 7 750 ha, is situated at 34°15'S 18°25'E and comprises the southern tip of the Cape Peninsula. The reserve's main topographic feature is a low plateau of sandstone rising from 60 m.a.s.l. on the west to peaks up to 360 m on the east, from where the terrain falls steeply to the sea. Mean annual rainfall in the reserve ranges from 330 mm in the south to 660 mm in the north-east. Soils in the reserve range from the deep calcareous sands of recent

sand dunes to well-drained, highly leached, shallow, sandy lithosols on hillslopes. Much of the central plateau has marshy humic soils with impeded drainage. The vegetation is mainly Mesic Mountain Fynbos (*sensu* Moll *et al.* 1984) with small intrusions of elements from the West Coast Strandveld and Kaffrarian Thicket along the coastal strip. The vegetation is described in detail by Taylor (1983, 1984). The reserve has a vascular plant flora of exceptional diversity (1 052 species) and unusually high endemism with 12 species being restricted to the reserve (Taylor 1985). In 1939 the southern area was proclaimed a local authority nature reserve under the control of the then Divisional Council of the Cape (now the Western Cape Regional Services Council). By 1965 all the farms comprising the current reserve had been acquired. For about 120 years prior to proclamation, the area had been subjected to domestic livestock grazing and frequent burning while small areas had been cultivated or intensively disturbed around the scattered homesteads and military installations (Opie 1967; Taylor 1969; Clark 1985).

The intentional and unintentional introduction of a range of alien plant species has resulted in certain of these species invading areas of natural vegetation within the reserve (Macdonald *et al.* 1987). The most important alien species in the reserve are Rooikrans *Acacia cyclops* A. Cunn. ex G. Don, Port Jackson *Acacia saligna* (Labill.) Wendl., Cluster pine *Pinus pinaster* Ait., Long-leaved wattle *Acacia longifolia* (Andr.) Willd. and Spider gum *Eucalyptus lehmannii* (Schau.) Benth.

The management of the reserve is planned and implemented by the reserve's full-time staff. Management policies and strategies are evaluated prior to implementation by an advisory board which comprises representatives of natural resource management agencies, research bodies and special interest groups.

Methods

The early history of alien plant control in the reserve was mainly determined from the reserve's files and, in particular, from the minutes of meetings of the reserve's advisory board. A detailed history of control operations was extracted from the files, rangers reports and Chief Warden's reports for the period 1966 to 1983 by Dr S.A. Macdonald (Macdonald 1983).

The area of mapped control operations and infestations was measured by clipping and weighing the different mapped categories on photostat copies of the relevant maps. Corrections were made for different densities of photocopy ink on the various mapped categories. No corrections were made for angle of slope, all 'areas' being simple vertical projections. This will result in underestimations of the actual ground surface area infested, as many of the dense infestations, particularly of *A. cyclops*, occur on steep slopes.

The quantitative evaluation of the effects of recent control operations was based on a third survey, carried out from March to June 1986, of 40 of the 99 permanently marked monitoring plots (Figure 1) located on a 1 000-yard (914-m) grid throughout the reserve by

Taylor (Taylor & Macdonald 1985). The first and second surveys were conducted in 1966 and 1976–80 respectively (Taylor *et al.* 1985). Each of these 10,5-ha plots is circular with a 200-yard (183-m) radius centred on a permanent marker peg. (Plot relocation forms and original survey data are archived in the library of the Percy FitzPatrick Institute of African Ornithology). These plots fell in that portion of the reserve systematically cleared of alien plants since 1975 that had not been accidentally burned in early 1986. Of the 3 200-ha central section of the reserve covered by these 40 plots, approximately 404 ha (i.e. 12,6%) were included within the survey plots (not all of them were full circles due to topographic features, e.g. coastlines and sheer cliffs).

On each plot alien trees were classified by species and height class (0 to 0,3 m, > 0,3 m to 1,8 m and > 1,8 m) and counted until the number of individuals of a particular species in a height class exceeded 400; above this the density was given as > 400 plants plot⁻¹ (Taylor & Macdonald 1985). The time taken to search an area was related to the density of the native vegetation and the alien plants. Search times ranged from 10,4 man min ha⁻¹ in low, open vegetation to 52,6 man min ha⁻¹ in densely infested, tall, closed-canopy, marshy fynbos. The mean search time over all 40 plots was 19,7 man min ha⁻¹.

Differences between surveys were tested for using Chi-squared tests of the number of the 40 plots in the different density classes as defined by Taylor *et al.* (1985). Wherever possible, these analyses were carried out separately for each of the alien plant control blocks to see whether those blocks cleared earlier in the programme, and which had therefore received more follow-up clearings, showed greater reductions in alien plant populations.

The history of alien vegetation control

The early period: 1941–1959

The earliest documented evidence of the recognition of the alien vegetation problem by the reserve authorities dates from an advisory board meeting in January 1941 during which a member, P. Hare, advised that *Acacia cyclops* should be controlled (Anonymous 1941). Official attempts at eradication appear to have started between 1941 and 1943. Virtually all these initial efforts at control were made in the southern section of the reserve which, at that time, was designated a 'fauna reserve' as opposed to the northern area which was a 'flora reserve'.

The meagre resources of both funds and labour were ill spent. Most of the initial clearing was done in order to make fire breaks, to supply firewood, or for 'cosmetic' purposes (e.g. to reduce the visual impact of invasions along roads) and concentrated on the dense stands of mature *A. cyclops*. Follow-up work was ignored. This is demonstrated by the Buffels Bay infestation which was reported by the Divisional Council's engineer to have been completely cleared in both 1945 and 1959 (Anonymous 1945, 1959a). However, in 1981, before clearing operations had started there again, the area had reverted

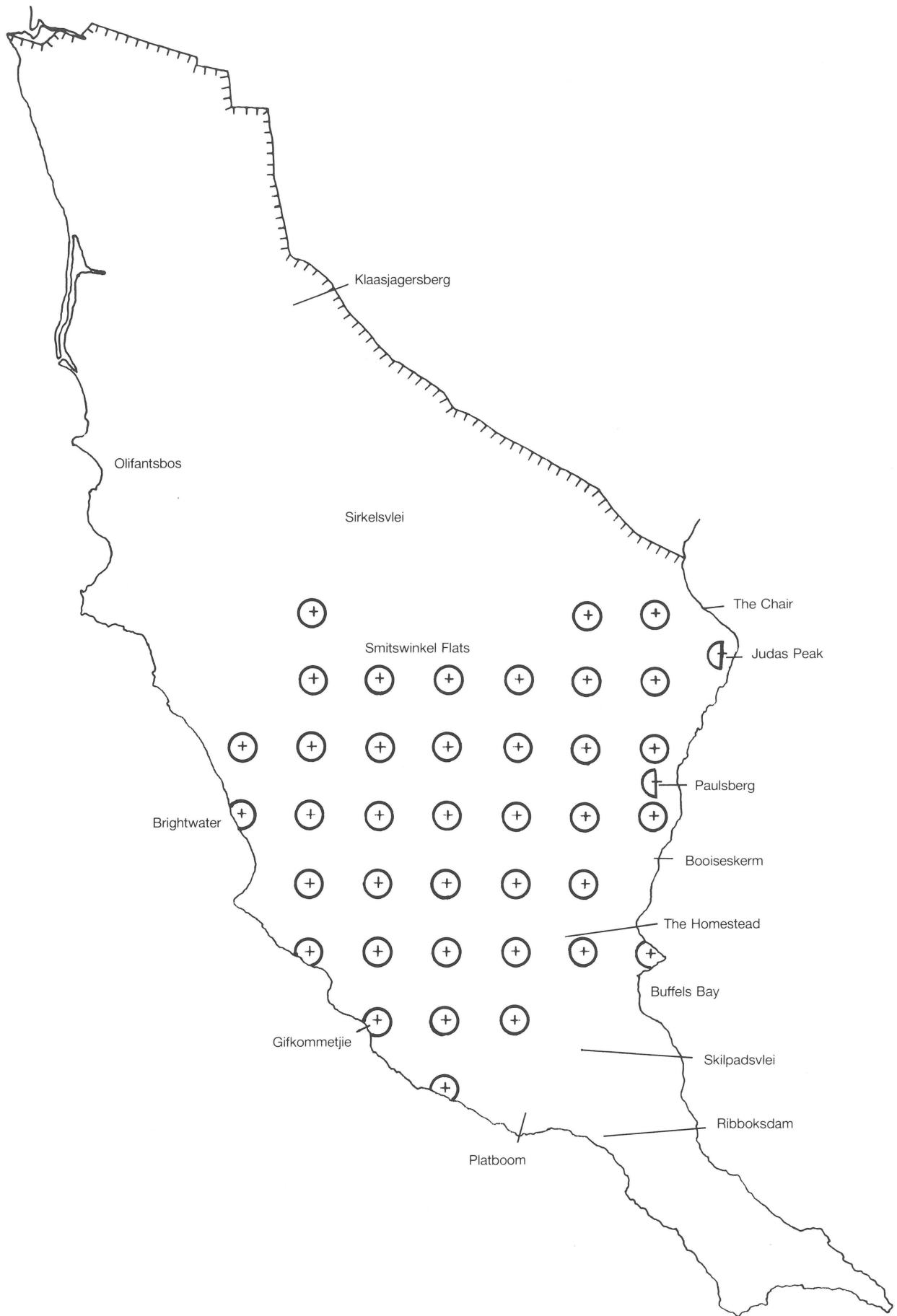


Figure 1 A map of the Cape of Good Hope Nature Reserve showing the locations of the sample plots resurveyed in 1986 and of places named in the text.

to a 100% infestation of adult trees. Piles of cut trees were found in the centre of this dense thicket, mute evidence of these earlier, wasted efforts at control. Another such example is provided by Coke (1961) who states that *A. cyclops* was almost eradicated from the area between Skilpadsvlei and Ribboksdam between 1952 and 1958. Currently this is one of the most densely infested areas in the reserve.

Possibly the major achievement of this phase was the gradual and, occasionally, reluctant acceptance by the Divisional Council of the Cape and by the reserve's advisory board and managers, that alien vegetation encroachment was in fact a major problem. This reached the point where, in September 1957, the advisory board recommended to the Council that a definite programme for the eradication of *A. cyclops* be prepared and implemented (Anonymous 1957a). Unfortunately no action was taken on this recommendation (Anonymous 1957b).

The second period: 1960–1974

From 1960 to 1974 more effort began to be put into the control of alien vegetation. Most of this was still aimed at the large, dense infestations in the south, although a large number of pine trees (mostly *Pinus pinaster*) were also felled throughout the reserve during this period.

Coke (1961), in a report which should have alerted the reserve authorities to the problem posed by *A. cyclops*, showed that it had spread dramatically between 1952 and 1961 (Figures 2 & 3). Although his aerial photographic interpretation was not perfect (Coke 1961), his maps allow for rough estimates to be made of the extent of *A. cyclops* infestations at these two dates (Table 1). There was also an increasing awareness that species other than *A. cyclops* were important, following Taylor's first survey of alien plant infestations in the reserve (Taylor 1967). Of the 99 plots he surveyed, only eight were free of aliens and these were all in areas which had not previously been cleared. It appears, therefore, that 24 years of control operations had failed to eradicate aliens from any area. However, these early control operations may have had value in that they possibly slowed down the rate of spread of the infestations.

Funds, labour and time spent on control operations were still inadequate despite having improved. The supply of firewood to picnic sites and 'cosmetic' considerations were still determining where clearing activities were carried out. This made adequate follow-up work impossible, and many infestations actually increased in density, while in only a few areas, for example the dune veld inland from Smith's farm (currently the Homestead Restaurant, see Figure 1) to near Brightwater, was there any marked improvement. The vegetation map drawn up by Taylor in 1969 based on his 1966 field work (Taylor 1969, 1984), showed only the larger and denser alien plant infestations (Figure 4). However, even these covered some 6,8% of the reserve's total area (Table 1). The 1966 plot survey showed that 13% of the 5-m×10-m quadrats and 92% of the 10,5-ha plots had at least one alien plant in them

(Taylor & Macdonald 1985). These figures indicate the widespread occurrence of low-density stands of alien trees and shrubs in the reserve at this time.

Taylor (1967) urged the authorities to adopt a systematic approach to the problem. He stressed the importance of establishing priorities (the control of outlying thickets and lightly infested areas to be accorded high priority), of sustaining the control operations and of maintaining constant vigilance to prevent the reinvasion of cleared areas. He suggested that a control team of 15 labourers working 2 or 3 days a month could clear the lightly infested areas within 5 years. He subsequently amended this to 4 days a month and calculated that this would entail a recurrent expenditure of R2 500 per annum (=R12 750 in 1984 rands). He concluded that the slow removal of dense infestations would require larger resources of labour and funds and suggested numerous approaches for obtaining these resources (e.g. use of military trainees, voluntary groups, etc.). Later in 1967, Opie (1967) submitted his report on the reserve's history. In it he once again highlighted poor definition of priorities, the failure to sustain control programmes and the lack of follow-up operations as the reasons for the overwhelming failure of past control efforts.

For several years after these two reports were written, little improvement in the *modus operandi* of the reserve managers was apparent (Macdonald 1983). One of the factors militating against the effective implementation of any control programme during this period was the low level of motivation amongst the members of the clearing team and their inadequate supervision. For example, one of the rangers reported that on three occasions during the month of April 1970 he carried out spot checks on the team in the field and found them 'either fast asleep or sitting talking' (Tomkinson 1970). It is

Table 1 The area of dense alien woody plant infestations in the Cape of Good Hope Nature Reserve as determined from maps created by researchers and reserve staff

| Year | Species | Area (ha) | As % of total reserve (7 750 ha) | Source |
|-------------|------------------------------------|-----------|----------------------------------|--------------------|
| 1952 | <i>Acacia cyclops</i> | 105 | 1,4 | Coke (1961) |
| 1961 | <i>Acacia cyclops</i> | 292 | 3,8 | Coke (1961) |
| 1969 | All species | 462 | 6,8 | Taylor (1984) |
| 1977–78 | <i>Acacia cyclops</i> | 908 | 11,7 | Naude (1978) |
| 1977–78 | All species | 1 633 | 21,1 | Naude (1978) |
| 1984 | All species | 592* | 7,6 | Clark (1985) |
| 1987 (July) | All species (= <i>A. cyclops</i>) | 422 | 5,4 | Clark (this study) |

*This estimate includes all 'medium to 100% infestation' densities and is thought to be more closely equivalent to Naude's (1978) 'dense' infestation than to Taylor's (1984) mapping unit. The statement that 'approximately 900 ha is 100% infested' at the end of 1985 (Anonymous 1986) is, presumably, an error



Figure 2 The distribution of dense stands of *Acacia cyclops* in 1952 as mapped from aerial photographs (after Coke 1961).

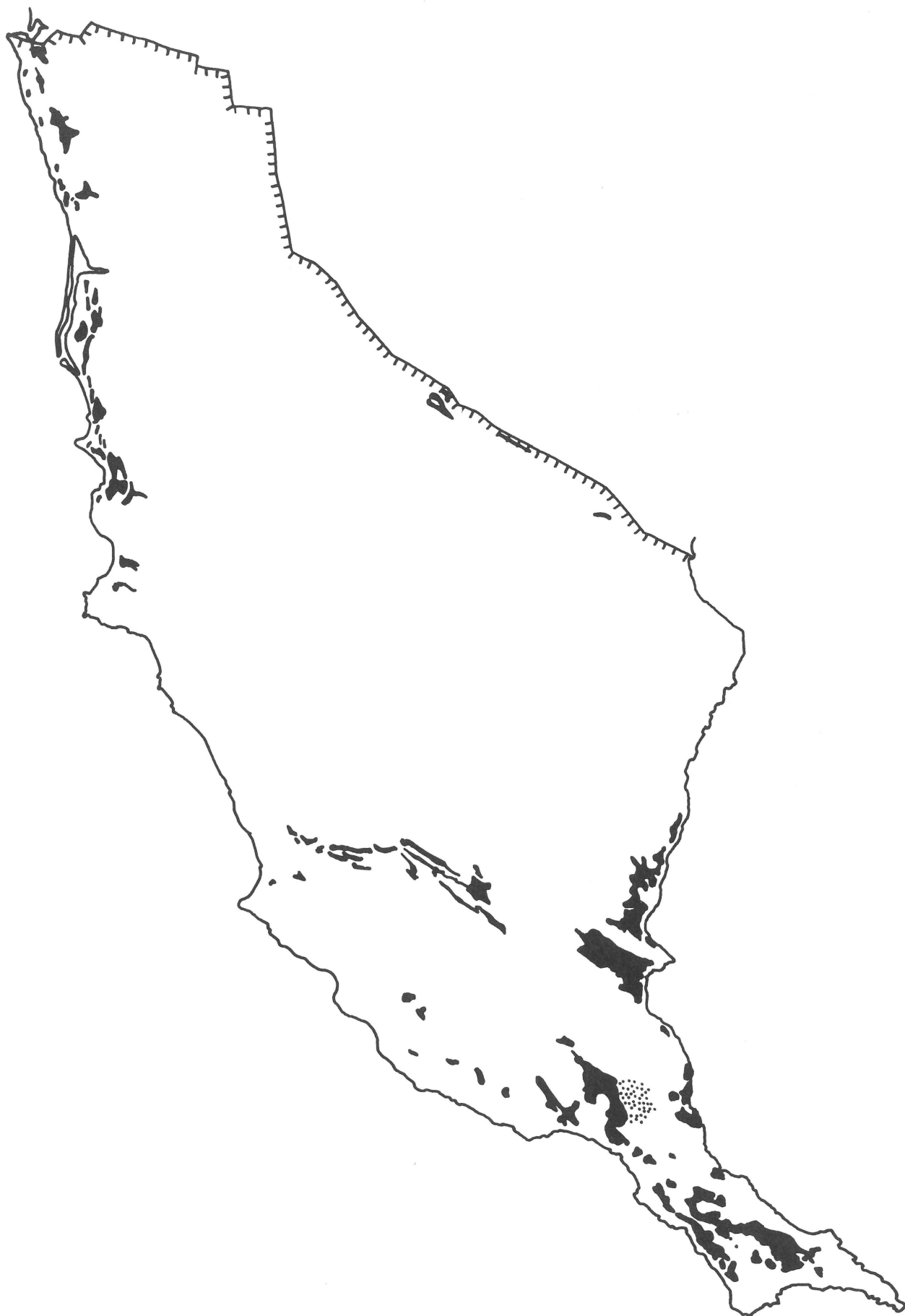


Figure 3 The distribution of dense stands of *Acacia cyclops* in 1961 as mapped from aerial photographs (after Coke 1961).

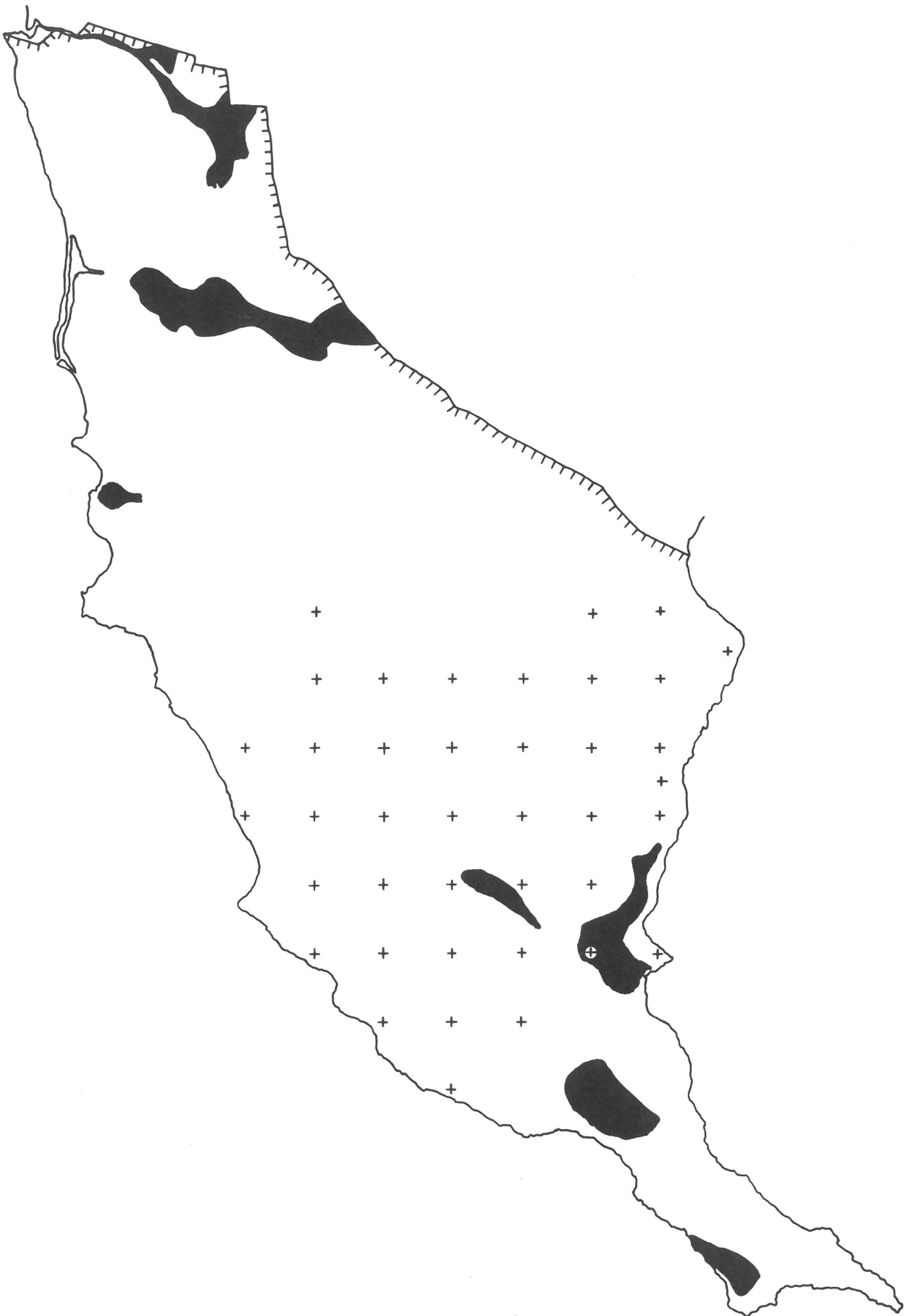


Figure 4 The distribution of the main thickets of alien woody plants in 1969 (after Taylor 1984) showing how the plots resurveyed in 1986 fell mainly in lightly infested areas of the reserve.

little wonder that during this period the reserve staff's reports began to take on a note of pessimism. For example, the Chief Warden reported in October 1969 that 'the labourers have been working full-time but little progress has been made' (Chief Warden 1969) and another of the rangers noted that 'the only way to make any impression on the dense growth of Rooikrantz and Port Jackson is to allow woodcutters to enter the reserve and to cart off as much as they can cut' (Langley 1969). This same ranger, reporting on a month's progress, went so far as to state that 'the gang of labourers continued to make their futile efforts to combat the ever-reaching *Acacia*' (Langley 1970). A year later the same sentiment was still being expressed; 'I sincerely do not think that we are going forward with the eradication of alien vegetation.....There are not more than 10 labourers working on the eradication of alien vegetation. It appears as if we are actually going forward but I think we are not even on neutral ground as the Rooikrantz and Port Jackson seeds are germinating all over the reserve and, while we are concentrating on certain basic areas, the total amount.....cut down does not equal the amount growing throughout the reserve' (Gubb 1971). This ranger then highlighted the inability of the control team to carry out follow-up weeding on all the small patches of initial clearing that were occurring scattered throughout the reserve and concluded that 'if something definite is not done in the near future, who can count the number of years.....it will take before the reserve is overgrown with alien vegetation' (Gubb 1971).

In April 1970 the first management plan for the reserve was produced by the professional staff of the Cape Department of Nature and Environmental Conservation (at that time called the Department of Nature Conservation of the Cape) which subsidizes the running of the reserve (Millar 1970). This plan drew attention to the 'haphazard approach' being used for alien plant control, the fallacy that firewood production resulted in alien plant control and the fact that approximately 45% of the working time of the team of 13 labourers responsible for veld management was actually being spent in chopping firewood, cleaning picnic sites and tidal pools and in other activities unrelated to alien plant control. The report recommended the drawing up of a 'predetermined plan' of alien plant control and that at least five and preferably 10 labourers should be allocated full-time to its implementation. It was predicted that unless such 'drastic action' was taken, these plants 'will take over the reserve completely within about 20 years' (Millar 1970). Finally, in 1974, a '10-year' plan for the systematic clearance of alien infestations in the central portion of the reserve was drawn up (Anonymous 1974), approved and, in 1975, implementation began.

The third period: 1975–1980

The introduction of this plan should, by rights, have heralded a new era of effective alien plant control in the reserve. The area was divided up into eight compartments (Figure 5). Each block was to be burned and then cleared, and follow-up work would be done on a regular

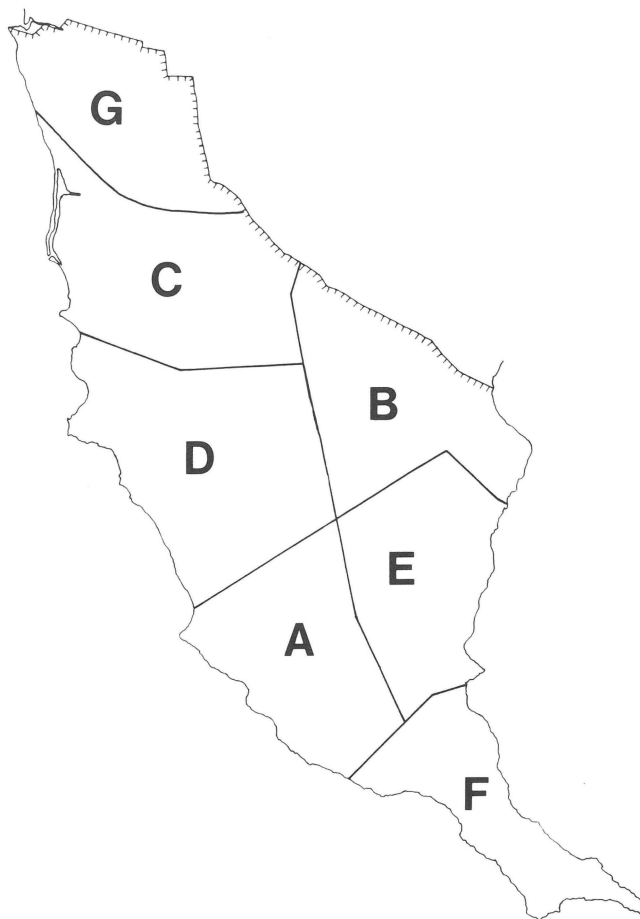


Figure 5 The layout of the blocks as given in the 1974 proposal for a systematic control plan. Blocks were scheduled to be burnt in alphabetical order at 2-year intervals with most of the clearing effort occurring after the fire and follow-up weeding to be repeated annually in each cleared block for at least a decade thereafter (after Anonymous 1974).

basis. Due to an unplanned fire in February 1975, the boundaries and the order of treatment of these blocks was changed and clearing was started in the compartment with the least aliens (see Figure 6). A substantial modification of the original proposal was the decision to fell all the alien trees in a block prior to burning. No documented reason for this highly significant modification is given but it appears that the provision of the maximum amount of firewood from the clearing operations was a factor. In later years it transpired that this decision might have been a wise one: where dense alien infestations were burned standing, subsequent follow-up weeding was made difficult by the lattice of burned and fallen stems. The ecological effects of the alternative clearing and burning strategies were apparently not taken into account when this decision was taken (see Discussion). Although the plan was drawn up in 1974, the system was not effectively implemented until 1980/81.

Just how haphazard the control operations continued to be, is illustrated by a series of monthly maps drawn by the ranger in charge of this activity for the period July 1974 to November 1976. Although these maps were

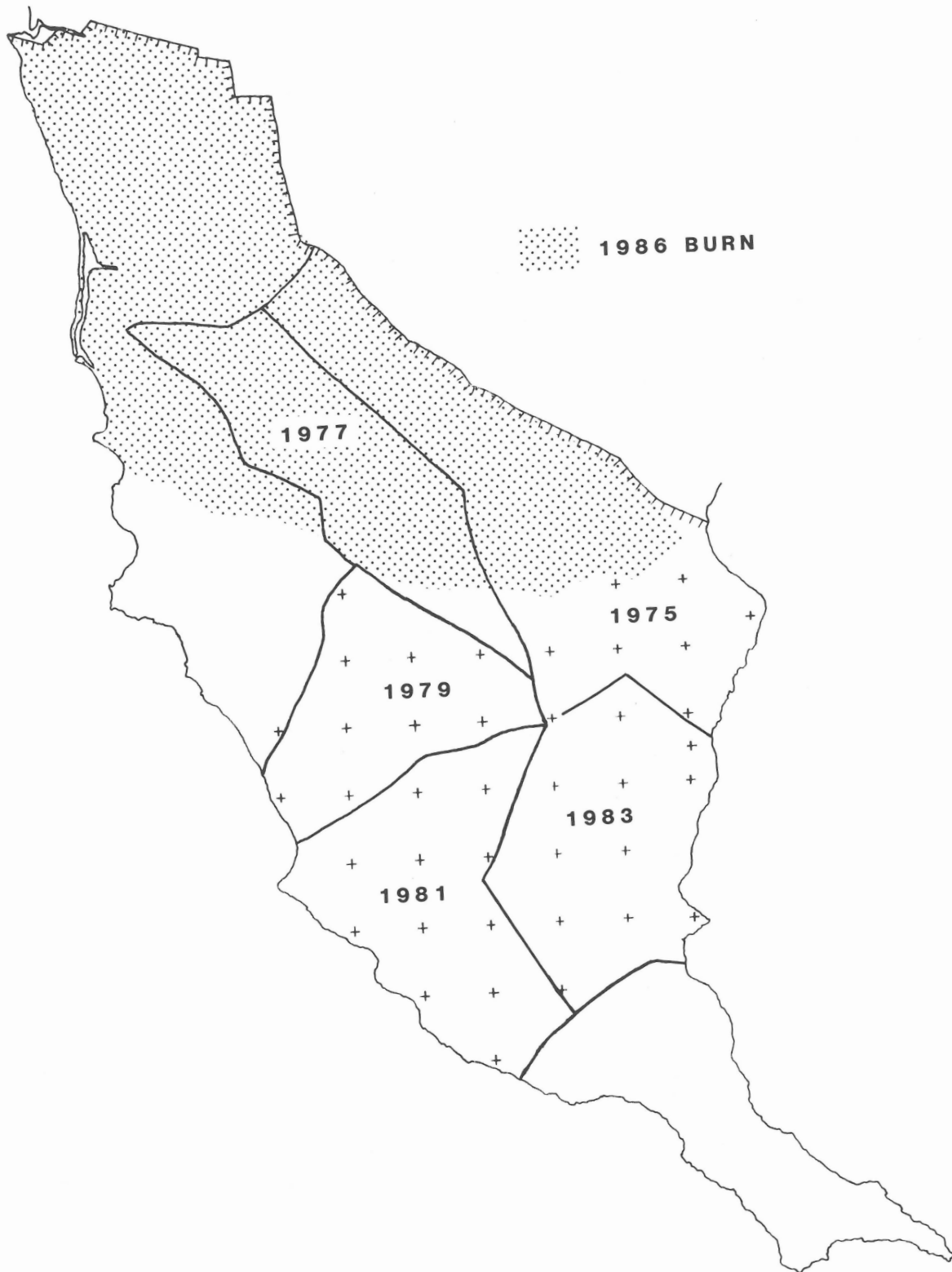


Figure 6 The layout of the alien plant control blocks as implemented in the systematic control programme 1975 to 1986. The extent of the February 1986 wildfire and the location of the plots resurveyed in 1986 are also shown.

drawn on too small a scale for accurate plotting of the operations, they do illustrate the chaotic dispersion of effort and the low level of compliance with the plan over this period (Figure 7). These maps do not show the recurrent clearing of alien plants along roads which served to dissipate further the energies of the control team.

Due to this haphazard initial clearing, a systematic follow-up programme could not be maintained. After the first clearing of alien *Acacia* species, follow-ups must be repeated for more than 10 years to ensure that the stand does not become re-established from the soil-stored seed bank (Milton & Hall 1981; Macdonald & Jarman 1984; Macdonald *et al.* 1985). Consequently, in the Cape Point reserve where clearing of *Acacia* species had been in progress for a considerable time by the mid 1970's, the area of follow-ups should have greatly exceeded the area of initial clearing. In reality this was only the case during the last 5 months of the 29-month period and, for the period as a whole, the total area of follow-up operations was only slightly more than half the area initially cleared (Table 2). The maps for this period (Figure 8) show that although mature trees were removed from 642 ha, only 117 ha of this area were subjected to follow-up weeding. Comparison of Figure 8 with Figure 7a shows that most of the area cleared in the south of the reserve in 1974-75 had been re-cleared at least once by November 1976. However, several of the

Table 2 The extent of initial clearing and follow-up operations as determined from the monthly maps of the alien plant control team's activities

| Period | Area of initial clearing operations | | Area of follow-up operations | |
|----------------------------|-------------------------------------|---------------------|------------------------------|---------------------|
| | (ha) | % of reserve's area | (ha) | % of reserve's area |
| July 1974 to June 1975 | 158 | 2,0 | 148 | 2,0 |
| July 1975 to June 1976* | 418 | 5,4 | 158 | 2,0 |
| July 1976 to November 1976 | 113 | 1,5 | 224 | 3,0 |
| July 1974 to November 1976 | 642 | 8,3 | 363 | 4,7 |

*No reports could be located for the months of May and June 1976 so this period is effectively July 1975 to April 1976. It is not certain that any control work did actually take place in these two missing months as sometimes the entire control team were used on other projects (Macdonald 1983)

scattered smaller areas had apparently not been re-cleared for at least 17 months following initial clearing. Thus this basic flaw in the reserve's approach to alien plant control, pinpointed a decade earlier by Taylor (1967) and recognized by reserve staff at least 5 years



Figure 7 The location of initial clearing operations in the periods (a) July 1974 to June 1975, (b) July 1975 to June 1976 and (c) July 1976 to November 1976. [After maps included in Macdonald (1983), see footnote to Table 2].



Figure 8 The areas subjected to initial clearing and follow-up weeding over the period July 1974 to November 1976 showing the extent of overlap of these two operations (source as for Figure 7). Key: Black = initial clearing only; stipple = follow-up weeding only; crosshatching = initial clearing and follow-up.

and poorly implemented control operations. In 1957 the reserve's advisory board, which in those days contained several natural scientists of standing, recommended the appointment of an academically trained professional ecologist to supervise research and biological management in the reserve (Anonymous 1958). This recommendation was never implemented, ostensibly because of a lack of funds, but correspondence on file indicates that the fear that such an appointee would dictate management to the reserve's untrained staff and to the Council itself was also a significant factor (Anonymous 1959b). A decade later Taylor (1967) reiterated this recommendation in his report to the advisory board on the alien plant problem. In the first management plan drawn up for the reserve (Millar 1970), the appointment of a trained ecologist to the reserve's staff was once again recommended. By this stage the complexity of managing the reserve was so apparent that it was further recommended that a professionally qualified person also be appointed to head the reserve's management staff. To date, neither of these recommendations has been implemented. It is our considered opinion, based on the detailed analysis of this one management activity (and it is but one component of an extraordinarily complex set of interconnected and sometimes conflicting management activities occurring within this important reserve), that the appointment of full-time professionals to the reserve's staff is long overdue. Had such an appointment been made in the late 1950's it is likely that this paper need never have been written.

Acknowledgements

We thank all those who at one time or another have helped the authors survey the monitoring plots, in particular Sonja Steinhobel, Sonia Bredenkamp, Christa van Aswegen and Pat Cannan, all of whom made major contributions to the 1986 survey. Susan Macdonald is thanked for providing the authors with a most useful summary of the archival material from 1966 to 1983. Andrea Pulfrich is thanked for drawing some of the figures and Pauline Solomon for word-processing the text.

The senior author's research is funded by the Nature Conservation Research Committee of the CSIR's National Programme for Ecosystem Research. The Divisional Council of the Cape is thanked for allowing this study to be undertaken in the reserve.

References

- ADAMSON, R.S. 1953. Can we preserve the Cape flora? *J. Bot. Soc. S. Afr.* 39: 11–12.
- ANONYMOUS 1941. Minutes of the Cape of Good Hope Nature Reserve Advisory Board Meeting, 17/01/1941. Divisional Council of the Cape Archives, Cape Town.
- ANONYMOUS 1945. Internal Report; Engineer to Secretary of Divisional Council, 25/01/1945. Divisional Council of the Cape Archives, Cape Town.
- ANONYMOUS 1957a. Minutes of the Cape of Good Hope Nature Reserve Advisory Board Meeting, 09/09/1957. Divisional Council of the Cape Archives, Cape Town.
- ANONYMOUS 1957b. Internal report; Secretary of Divisional Council to Chairman of the Advisory Board, 19/9/1957. Divisional Council of the Cape Archives, Cape Town.
- ANONYMOUS 1958. Minutes of a special meeting of the Cape of Good Hope Nature Reserve Advisory Board, 8/10/1958. Divisional Council of the Cape Archives, Cape Town.
- ANONYMOUS 1959a. Internal Report; Engineer to Secretary of Divisional Council, 18/05/1959. Divisional Council of the Cape Archives, Cape Town.
- ANONYMOUS 1959b. Memorandum from the Chief Clerk to the Secretary of Divisional Council entitled Appointment of Ecologist, 15/07/1959. Divisional Council of the Cape Archives, Cape Town.
- ANONYMOUS 1974. A proposed burning and alien eradication plan for the Cape of Good Hope Nature Reserve. Divisional Council of the Cape Archives, Cape Town.
- ANONYMOUS 1986. Cape of Good Hope Nature Reserve Annual Report No. 2/1984–85. Divisional Council of the Cape Archives, Cape Town.
- BRITS, G.J. & VON BROEMBSSEN, S. 1978. Protea cultivation: *Phytophthora* root and collar rot. *Farming in South Africa*. Flower and Ornamental Shrubs Bulletin 6.1.
- CHIEF WARDEN 1969. Monthly report of the Chief Warden for October 1969. Divisional Council of the Cape Archives, Cape Town.
- CHIEF WARDEN 1980. Monthly report of the Chief Warden for November 1980. Divisional Council of the Cape Archives, Cape Town.
- CHIEF WARDEN 1982. Monthly report of the Chief Warden for March 1982. Divisional Council of the Cape Archives, Cape Town.
- CLARK, D.L. 1985. Alien plant control by official bodies in smaller nature reserves in the fynbos biome. 3. Cape Divisional Council: Cape of Good Hope Nature Reserve. In: Management of invasive alien plants in the fynbos biome, eds Macdonald, I.A.W., Jarman, M.L. & Beeston, P., S. Afr. Nat. Sci. Prog. Report 111, pp. 38–41.
- CLARK, N.J. 1977. Monthly report on veld management programme. Divisional Council of the Cape Archives, Cape Town.
- COKE, M. 1961. *Acacia cyclops* — An ecological study of its extent of infestation in the Cape of Good Hope Nature Reserve and its spread over the years 1952–1961. Botany Project, Univ. of Cape Town.
- DAVIDGE, C. 1978. Ecology of baboons (*Papio ursinus*) at Cape Point. *Zool. Afr.* 13: 329–350.
- DENNILL, G.B. 1985. The effect of the gall wasp *Trichilogaster acaciaelongifoliae* (Hymenoptera: Pteromalidae) on reproductive potential and vegetative growth of the weed *Acacia longifolia*. *Agriculture, Ecosystems and Environment* 14: 53–61.
- DONALD, D.G.M. 1982. The control of *Pinus pinaster* in the fynbos biome. *S. Afr. For. J.* 123: 3–7.
- FENN, J.A. 1980. Control of *Hakea* in the western Cape. In: Proceedings of the third national weeds conference of South Africa, eds Neser, S. & Cairns, A.L.P., pp. 167–173, Balkema, Cape Town.
- FUGLER, S.R. 1983. The control of silky *Hakea* in South Africa. *Bothalia* 14: 977–980.
- GUBB, A.A. 1971. Monthly Rangers Report for March 1971. Divisional Council of the Cape Archives, Cape Town.
- HALL, A.V. 1978. Endangered species in a rising tide of

- human population growth. *Trans. R. Soc. S. Afr.* 43: 37-49.
- HALL, A.V. & VELDHUIS, H.A. 1985. South African red data book: Plants — Fynbos and Karoo biomes. S. Afr. Nat. Sci. Prog. Report 117, pp. 1-160.
- HOLMES, P.M., MACDONALD, I.A.W. & JURITZ, J. 1987. Effects of clearing treatment on seed banks of the alien invasive shrubs *Acacia saligna* and *Acacia cyclops* in the south-western and southern Cape, South Africa. *J. Appl. Ecol.* 24: 1045-1051.
- KLUGE, R.L. & RICHARDSON, D.M. 1983. Progress in the fight against *Hakea*. *Veld & Flora* 69: 136-138.
- KRUGER, F.J. 1977. Invasive woody plants in the Cape fynbos with special reference to the biology and control of *Pinus pinaster*. In: Proceedings of the second national weeds conference of South Africa, pp. 57-74, Balkema, Cape Town.
- KRUGER, F.J. 1978. A description of the Fynbos Biome Project. S. Afr. Nat. Sci. Prog. Report 28, pp. 1-23.
- LANGLEY, H. 1969. Monthly Rangers Report for December 1969. Divisional Council of the Cape Archives, Cape Town.
- LANGLEY, H. 1970. Monthly Rangers Report for April 1970. Divisional Council of the Cape Archives, Cape Town.
- LANGLEY, H. 1976. Alien vegetation and birds in the Cape Point Nature Reserve. *Cape Bird Club Newsletter* 121: 8-9.
- MACDONALD, I.A.W. 1984. Is the fynbos biome especially susceptible to invasion by alien plants? A re-analysis of available data. *S. Afr. J. Sci.* 80: 369-377.
- MACDONALD, I.A.W. 1986. Range expansion in the pied barbet and the spread of alien tree species in southern Africa. *Ostrich* 57: 75-94.
- MACDONALD, I.A.W. (in press). Strategies for limiting the invasion of protected areas by introduced organisms. In: Proceedings of the conference on botanical research and management in Galapagos, eds Lawesson, J.E. & Hamann, O., Missouri Botanical Gardens, St. Louis.
- MACDONALD, I.A.W., CLARK, D.L. & TAYLOR, H.C. 1987. The alien flora of the Cape of Good Hope Nature Reserve. *S. Afr. J. Bot.* 53: 398-404.
- MACDONALD, I.A.W., GRABER, D.M., DeBENNETTI, S., GROVES, R.H. & FUENTES, E.R. 1988. Introduced species in nature reserves in mediterranean-type climatic regions of the world. *Biol. Conserv.* 44: 37-66.
- MACDONALD, I.A.W. & JARMAN, M.L. (eds) 1984. Invasive alien organisms in the terrestrial ecosystems of the fynbos biome, South Africa. S. Afr. Nat. Sci. Prog. Report 85, 72 pp.
- MACDONALD, I.A.W., JARMAN, M.L. & BEESTON, P. (eds) 1985. Management of invasive alien plants in the fynbos biome. S. Afr. Nat. Sci. Prog. Report 111, 140 pp.
- MACDONALD, I.A.W. & RICHARDSON, D.M. 1986. Alien species in terrestrial ecosystems of the fynbos biome. In: The ecology and management of biological invasions in southern Africa, eds Macdonald, I.A.W., Kruger, F.J. & Ferrar, A.A., pp. 77-91, Oxford University Press, Cape Town.
- MACDONALD, S.A. 1983. The history of alien plant control operations in the Cape of Good Hope Nature Reserve: 1966-1983. 46 pp., appendices & maps, Bolus Herbarium, Univ. of Cape Town.
- MCLACHLAN, D., MOLL, E.J. & HALL, A.V. 1980. Re-survey of the alien vegetation in the Cape Peninsula. *S. Afr. J. Bot.* 46: 127-146.
- MILLAR, J.C.G. 1970. The Cape of Good Hope Nature Reserve, a report and management plan. Dept. of Nature and Environmental Conservation, Cape Town. Roneoed report, 35 pp.
- MILTON, S.J. & HALL, A.V. 1981. Reproductive biology of Australian *Acacias* in the south-western Cape Province, South Africa. *Trans. R. Soc. S. Afr.* 44: 465-487.
- MOLL, E.J., CAMPBELL, B.M., COWLING, R.M., BOSSI, L., JARMAN, M.L. & BOUCHER, C. 1984. A description of major vegetation categories in and adjacent to the fynbos biome. S. Afr. Nat. Sci. Prog. Report 83, 29 pp.
- NAUDE, D.J. 1978. Memorandum to the Chief Warden entitled Distribution of alien vegetation in the reserve, 21/7/78. Divisional Council of the Cape Archives, Cape Town.
- OPIE, F.W.J. 1967. The ecology and geographical development of Cape Point. B.Sc. (Hons) thesis, Dept. of Geography, Univ. of Cape Town.
- PICKER, M.D. 1985. Hybridization and habitat selection in *Xenopus gilli* and *Xenopus laevis* in the south-western Cape Province. *Copeia* 3: 574-580.
- PIETERSE, P.J. & CAIRNS, A.L.P. 1986. The effect of fire on an *Acacia longifolia* seed bank in the south-western Cape. *S. Afr. J. Bot.* 52: 233-236.
- STIRTON, C.H. (ed.) 1978. Plant invaders: beautiful, but dangerous. Cape Department of Nature and Environmental Conservation, Cape Town.
- TAYLOR, H.C. 1967. Alien vegetation on the Cape of Good Hope Nature Reserve: summary of an address to the Advisory Board on 13 March 1967. Unpublished report, 4/4/67, Divisional Council of the Cape Archives, Cape Town.
- TAYLOR, H.C. 1969. A vegetation survey of the Cape of Good Hope Nature Reserve. M.Sc. thesis, Univ. of Cape Town.
- TAYLOR, H.C. 1977a. The Cape floral kingdom an ecological view. In: Proceedings of the second national weeds conference of South Africa, pp. 19-33, Balkema, Cape Town.
- TAYLOR, H.C. 1977b. Aspects of the ecology of the Cape of Good Hope Nature Reserve in relation to fire and conservation. In: Proceedings of the symposium on the environmental consequences of fire and fuel management in mediterranean ecosystems. U.S.D.A. For. Serv. Gen. Tech. Report WO-3. pp. 483-487.
- TAYLOR, H.C. 1983. Vegetation of the Cape of Good Hope Nature Reserve. *Bothalia* 14: 779-784.
- TAYLOR, H.C. 1984. A vegetation survey of the Cape of Good Hope Nature Reserve. 2. Descriptive account. *Bothalia* 15: 259-291.
- TAYLOR, H.C. 1985. An analysis of the flowering plants and ferns of the Cape of Good Hope Nature Reserve. *S. Afr. J. Bot.* 51: 1-13.
- TAYLOR, H.C. & MACDONALD, S.A. 1985. Invasive alien woody plants in the Cape of Good Hope Nature Reserve. I. Results of a first survey in 1966. *S. Afr. J. Bot.* 51: 14-20.
- TAYLOR, H.C., MACDONALD, S.A. & MACDONALD, I.A.W. 1985. Invasive alien woody plants in the Cape of Good Hope Nature Reserve. II. Results of a second survey from 1976 to 1980. *S. Afr. J. Bot.* 51: 21-29.
- TOMKINSON, A.J. 1970. Monthly Rangers Report for April 1970. Divisional Council of the Cape Archives, Cape Town.

- VAN DER MERWE, P. 1975. Impossible to save the Marsh Rose Protea? *Veld & Flora* 61: 4-5.
- VON BROEMBSSEN, S.L. & KRUGER, F.J. 1985. *Phytophthora cinnamomi* associated with mortality in native vegetation in South Africa. *Plant Disease* 69: 715-717.
- VON KASCHKE, O.M. 1981. Monthly Rangers Report for July 1981. Divisional Council of the Cape Archives, Cape

- Town.
- WICHT, C.L. 1945. Preservation of the vegetation of the south-western Cape. Special publication of the Royal Society of South Africa, 55 pp.
- WRIGHT, G.E.P. 1980. Memorandum to the Secretary of the Divisional Council entitled Cape of Good Hope Nature Reserve: Veld Management — 10-year programme, 7/2/80. Divisional Council of the Cape Archives, Cape Town.