Invasive alien plants in the terrestrial ecosystems of Natal, South Africa

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A report of the National Programme for Ecosystems Research

Produced as part of the South African contribution to the international SCOPE project on the Ecology of Biological Invasions

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PREFACE

Natal is one of the most highly developed areas within South Africa: agricultural, sylvicultural, industrial and urban developments have already transformed a large proportion of the province's land surface. Certain of the area's vegetation types and particular habitats within these are threatened with total extinction. It is against this background that the invasion of the remaining areas of natural and seminatural vegetation by alien plants assumes exceptional significance.

However, it is not only in Natal that alien plants are important. The invasive spread of plants, animals and micro-organisms into regions remote from their centres of origin, is a process of increasing global significance. As a result an international programme on "The Ecology of Biological Invasions" was launched by SCOPE (Scientific Committee on Problems of the Environment) in 1982. SCOPE is the body set up in 1969 by ICSU (International Council for Scientific Unions) to act as a focus of non-governmental international scientific effort in the environmental field. A description of the 'South African programme for the SCOPE project on the ecology of biological invasions' has been drawn up (Ferrar and Kruger 1983).

SCOPE's role is particularly suited to multi-disciplinary topics with an emphasis on short-term synthesis and appraisal activities. Its products are intended as a source of advice, of benefit to governments and non-governmental bodies, where there is some promise of responsive action. SCOPE has been active in such fields as environmental monitoring, impact assessment, biogeochemical cycling and ecotoxicology.

South Africa's contributions to SCOPE are coordinated by the National Programme for Ecosystem Research (NPES) which is administered by the CSIR. This workshop was organized as a collaborative undertaking of the Working Group for Invasive Biota of the Nature Conservation Research Committee and the Natal Parks, Game and Fish Preservation Board. Workshops of this nature are used regularly within the NPES in order to serve as a mechanism for synthesizing local knowledge, and establishing contact between researchers.

ACKNOWLEDGEMENTS

The following are acknowledged for their roles in the workshop organization, and in seeing the report finalized: Dr Ortie Bourquin (Natal Parks Board), Fifi Bierman, Margaret Orton and Elma Mantle (the latter two who undertook the typography of the report) of the CSIR, Foundation for Research Development, and Fiona Powrie who drew the original of Figure 3.

We are grateful to the Natal Parks Board for allowing us to use the Queen Elizabeth Park Offices as a workshop venue; and for catering for the influx of workshop participants during the one-and-a-half days of workshop duration.

ABSTRACT

This report consists of two types of chapters. Most of the chapters are short syntheses of particular aspects of the alien plant problem in Natal, written by groups of participants during the workshop meeting. They are brief accounts of the state of knowledge on the various topics and rely heavily on tabulations. They cover the following topics: the distribution of the species; the relative importance of the different species, their research requirements, strategies and techniques for their control; and the rôles legislation, education and inter-organizational liaison could play in improving their control. In addition, two of the chapters consist of short, individually authored accounts of the extent of the problem and control programmes as experienced by some of the land management agencies in Natal. A list of all the alien plant species mentioned in the report together with their common names is appended.

SAMEVATTING

Hierdie verslag bestaan uit twee tipe hoofstukke. Die meeste hoofstukke bestaan uit kort sintese oor spesiale aspekte van die indringer probleem in Natal deur groepe deelnemers gedurende die werksessie geskryf. Die hoofstukke is dikwels verkort en maak groot staat op tabelle. Hulle omhels die verspreiding van spesies, die relatiewe belangrikheid van verskillende spesies, die navorsings vereistes, strategieë en tegnieke vir hulle beheer en die rol wat wetgewing, voorligting en interorganisasie verbinding tot die verbetering van beheer kon speel. Twee van die hoofstukke bestaan uit kort relase deur individuele skrywers oor die omvang van die probleem en beheer programme deur sommige van die landbestuur agente van Natal ondervind. 'n Lys van al die indringerplantspesies saam met hulle gewone name wat in die verslag voorkom, is aangeheg.

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INTRODUCTION

Natal (including KwaZulu) occupies an area of 86 967 km^2 on the eastern seaboard of South Africa between latitudes 26° and 31°S and longitudes 28° and 32°E. From the coast the altitude increases rapidly to 3 377 m above sea level on the Drakensberg escarpment which forms the western boundary of the province. The landscape of Natal is deeply dissected by the valleys of eleven major rivers which rise in or adjacent to the province. Only on the northern coastal plains is the terrain flat enough for the rivers to be slow-flowing and for numerous lakes and pans to be present. Mean annual rainfall ranges from about 650 mm in some of the drier river valleys and in the north-eastern interior regions to about 1 500 mm at Mtunzini on the coast and at Cathkin Peak in the Drakensberg. Rain falls mainly during the summer months from November to March. The area's soils are extremely diverse, being derived from virtually every geological substrate found in southern Africa and having been formed under a wide variety of climatic and topographical conditions.

The environmental heterogeneity of Natal has resulted in it providing suitable conditions for an exceptionally diverse indigenous fauna and flora. The flora is known to contain some 4 506 indigenous species (Ross 1972). This contrasts, for example, with the 3 125 species known from the much bigger (825 200 km^2) territory of South West Africa/Namibia that lies on the western seaboard of the subcontinent (Gibbs Russell 1975). However, the diverse environmental conditions of Natal have also proved suitable for the establishment of a wide variety of alien species (312 species are listed as being "naturalized" within the province by Ross (1972)).

While the problems posed by alien plants in the fynbos biome of southern Africa have been relatively well documented and researched (for example, the bibliography in Macdonald and Jarman 1984), those in Natal have received far less attention.

The objective of the workshop meeting, held in Pietermaritzburg in May 1984, was to synthesize local, generally unpublished, knowledge on invasive alien plants in Natal. As most of this knowledge relates to the management of these plants, and most of the workshop participants were managers, management forms the main focus of the report. This is in contrast to the first workshop held on invasives in the fynbos biome (Macdonald and Jarman 1984), where research formed the central focus. However, the second workshop on invasives in the fynbos provides some comparable information (Macdonald et al 1985). The results of the workshop meeting on invasive alien organisms in SWA/Namibia (Brown et al 1985) also provide comparable information for this arid portion of the subcontinent.

CHAPTER 1. THE INVASIVE ALIEN SPECIES OF NATAL

All workshop participants

THE SPECIES AND WHERE THEY OCCUR

Throughout this report, the distribution of alien plants has been expressed in terms of the bioclimatic regions of Natal (Phillips 1973). This regional subdivision scheme is presented in Figure 1.

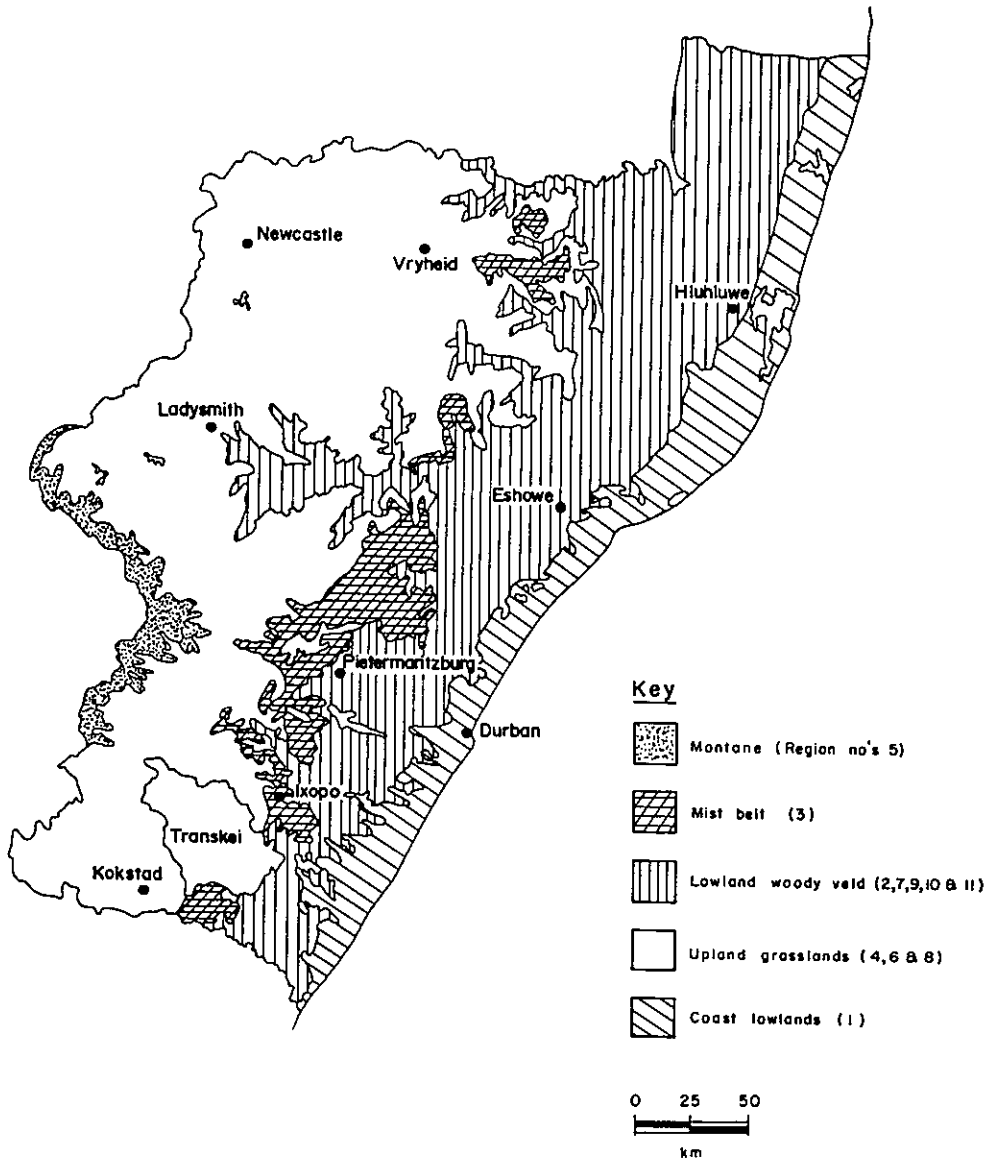

FIGURE 1. The bioclimatic regions of Natal (after Phillips 1973).

The major biogeographic regions are known to include habitats which differ in their proneness to invasion. The group therefore used a coarse habitat classification for each region to provide further information on the patterns of invasion. The initial classification was as follows:

- **coastal lowland :** swamp forest; coastal forest; plains (grasslands - including hygrophilous grasslands, woodlands and riverine habitat); dunes (grassland and scrub).
- **lowland woody veld :** riverine habitat; forest; forest gaps and ecotones; woodland; scarps and screes.
- **mist belt :** riverine habitat; forest gaps and forest ecotones; grassland.
- **upland grassland :** riverine habitat; forest gaps and forest ecotones; grassland.
- **montane region :** riverine habitat; forest gaps and forest ecotones; grassland

Only those species of alien plants which had established self-sustaining populations in areas of indigenous vegetation and which were considered to be having significant environmental or economic impacts were included.

The extent of the infestations of each species in each habitat was rated according to a scale of severity as follows: 3 (very severe), 2 (moderately severe) and 1 (present). These ratings were done in the light of operational priorities and expert opinion. The results are summarized in Tables 1 and 2.

AN ANALYSIS BY REGIONS AND HABITATS

From this exercise, it is evident that the coastal lowland region and lowland woody veld have the largest number of invasive alien plant species. The montane region has the lowest number of species. Furthermore, habitats were ranked as follows with regards to perceived severity of the invasion problem:

1. riverine habitat (lowland woody veld);
2. forest gaps and ecotones (lowland woody veld);
3. coastal forest (coastal lowland);
4. riverine habitat (mist belt);
5. plains - grassland (coastal lowland)
6. woodland (lowland woody veld);
7. grassland (upland grassland);
8. dunes (coastal lowland);
9. scarps and screes (lowland woody veld);
10. forest gaps and ecotone (mist belt);
11. grassland (mist belt);
12. riverine habitat (upland grassland);
13. forest gaps and ecotones (lowland woody veld);
14. riverine habitat (montane region);
15. grassland (montane region);
16. forest gaps and ecotones (upland grassland) and forest gaps and ecotones (montane region);
18. swamp forest (coastal lowland).

There is evidence of a major geographic pattern in the invasions, with the coastal lowland, lowland woody veld and mist belt being the most invaded regions. However, these patterns are possibly the results of historical factors rather than of intrinsic differences in invasion susceptibility at a regional level. For example, Natal Parks Board have most problems in their coastal and Zululand reserves with fewer problems in the inland reserves. By contrast, the northern KwaZulu reserves have few problems; whereas invasions in their southern coastal reserves are serious. This appears to relate to past land use patterns and the history of alien plant introductions to these areas.

At the level of habitats the general trend emerges that riverine habitats are those most severely infested within a region, except, apparently, in the upland grassland region. Forest gaps and ecotones are considerably more infested than are the forests themselves, with swamp forest being the least invaded of any habitat within the province. It is noteworthy that this specialized habitat is of very limited extent in Natal with most of it being located in Maputaland where few alien plant species have been introduced. Only in the upland grassland region, and to a lesser extent in the mist belt, are grassland habitats invaded to the same extent as the comparable forest edge and riverine habitats. It is in these regions that the grasslands have been most heavily disturbed by agricultural and sylvicultural practices. The riverine habitat is progressively invaded by a wider variety of alien species and with increased severity as one progresses from the montane region to the coastal lowland region (the riverine category in lowland woody veld being considered to include riverine habitats in the coastal region as well).

TABLE 1. The alien plant invaders of Natal : species by region and ecosystem matrix

REGIONS	Coastal lowland				Lowland woody veld					Mist belt			Upland grassland			Montane		
ECOSYSTEMS	Swamp Forst	For-est	Plains	Dunes	Riv	For-est	For Gap	Wood-land	Scarp Scree	Riv	for-est	Grass	Riv	For-est	Grass	Riv	For--est	Grass
SPECIES																		
Acacia dealbata					1				1	3	1	3	3	1	3	3	1	3
Acacia decurrens										3		2	1					
Acacia longifolia					1				1	1	2							
Acacia mearnsii		1	1		2		2	1	1	3	2	3	3	1	3	3		3
Acacia melanoxylon							1			2	2	1	1	2		1	1	1
Acacia saligna		1																
Acacia podalyriifolia					1													
Agave sisalana			1					1										
Albizia lebbeck			1															
Amaranthus spinosus			1		2			1										
Argemone ochroleuca					2			1										
Arundo donax	1	1	1		2			1										
Bidens pilosa		1	1		1		1	1										
Caesalpinia decapetala		2	1		2		3	1	2	2								
Cardiospermum grandiflorum		3	1															
Cassia bicapsularis					2		1											
Cassia didymobotrya		1	1		2		2		1									
Cassia floribunda		1	1				1											
Cassia occidentalis					1			2										
Casuarina equisetifolia				1														
Catharanthus roseus			1		1			1										
Cedrella odorata							1											
Cestrum laevigatum		3	1		2		1	1	1	1								
Chromolaena odorata	1	3	3	3	3	3	3	2	3		1							
Cirsium vulgare			1		1		1	2				2			1			
Citrus limon					1		1											
Cotoneaster spp										1						1		
Datura ferox					2													
Datura stramonium					2													
Eriocereus martinii									1					1				1
Eucalyptus cinerea					1													
Eucalyptus grandis					1					1	2	1						
Eucalyptus species		1	1		1	1	1	1	1	1	1				1	1	1	1
Eupatorium adenophorum							1		1	1	1	1						
Grevillea robusta							1*								1**			
Hypericum minima										1	1			11				
Jacaranda mimosifolia		1			1	2	2	1			1							
Lantana camara		3	3	3	3	1	3	2	2	1	1	1		1	1			
Leucaena leucocephala		1	1	1	2													
Litsea sebifera		2	1	1			2											
Mangifera indica		1	1		2			1										
Melia azedarach		2	1	1	3	1	2	1	2	2				2				
Montanoa hibiscifolia				2			2				1							
Morus alba					1					2								
Opuntia aurantiaca							2	3							1			
Opuntia ficus-indica		1			2			2	2						3			
Opuntia stricta					1			1	1									
Opuntia vulgaris					2													
Passiflora edulis				1														
Pereskia aculeata		2	1	1		1		1										
Pinus elliotii		3	3	1			1											
Pinus patula										2	1	2			1	2	1	2
Populus alba/canescens					1					2				2		2		
Psidium guajava		3	2	3	3	2	2	2	1									
Pyracantha species									1	1		1			1**			
Richardia brasiliensis				1														
Ricinus communis		1	1		2	1				1							1	
Rivina humilis				1														
Robinia pseudo-acacia					1			1		1								
Rubus cuneifolius							1			2	2	2	2	2	2	2	2	2
Salix babylonica					1					1			1			1		
Schinus terebinthifolius		2	2															
Sesbania punicea		2	1		3			1		2			3		1			
Solanum mauritianum		2	2	2	2	2	2	2	1	3	2	1	1	1	1	1	2	1
Solanum seaforthianum		2			3	3	3				1							
Spartium junceum																		1***
Syncarpia glomulifera							1											
Tagetes minuta					1		1	1	1			1			2			
Tithonia diversifolia		2	2	3			3											
Toona ciliata							1*											
Ulex europaeus															2****			1****
Xanthium spinosum			1			1		1				1			1			
Xanthium strumarium					3													

* Ngoye Forest
** Vryheid Nature Reserve
*** Highmoor State Forest
**** Game Pass farm at 1700 m a.s.l. and Highmoor State Forest where almost eradicated

Each cell of the table rated as: 1 = present, but not seriously infested, 2 = moderately severe infestation, 3 = very severe infestation

TABLE 2. Alien plant invasions of Natal's regions and habitats

Region	Habitat	Severity ranking	No of species	Sum of scores	Species total/ region
COASTAL LOWLAND	swamp forest	18	2	2	38
	coastal forest	3	27	48	
	plains, grassland	5	29	39	
	dunes, grassland	8	15	25	
LOWLAND WOODY VELD	riverine habitat	1	41	71	57
	forest	13	11	18	
	forest gaps and ecotones	2	30	49	
	woodland	6	27	36	
	scarps and scree	9	18	24	
MIST BELT	riverine habitat	4	24	40	31
	forest gaps and ecotones	10	16	22	
	grassland	11	14	22	
UPLAND GRASSLAND	riverine habitat	12	12	21	23
	forest gaps and ecotones	16	7	9	
	grassland	7	16	25	
MONTANE REGION	riverine habitat	14	10	17	14
	forest gaps and ecotones	16	7	9	
	grassland	15	10	16	

CHAPTER 2. THE CURRENT EXTENT OF ALIEN INFESTATIONS

KWAZULU AREAS
M C Ward - KwaZulu Bureau of Natural Resources

The alien plant problem in KwaZulu has reached serious proportions and over most of the areas the presence and spread of invasive plants continues unchecked. The KwaZulu Bureau of Natural Resources has identified alien plants as a major problem and over the past year has done much to assess the infestations within its top priority conservation areas and to carry out control work to combat the problem in these areas.

Although no overall detailed survey to assess the alien problem has been carried out throughout KwaZulu, the research section of the Bureau has been assessing indigenous forest areas for conservation potential; one of the main parameters in this assessment has been the extent of alien infestation in each of the areas and the main species involved. The alien problem in the forest reserves has been observed to be similar to that in surrounding areas. Detailed surveys have been undertaken of the Amatikulu Nature Reserve, the Ngoye Forest Reserve, Lake Sibaya, Kosi Bay and the Tembe Elephant Reserve and general notes have been made on the problem in the other reserves (refer to Figure 2 for the distribution of KwaZulu areas and the localities of specific areas mentioned in the text).

The following account of the extent of the problem deals with KwaZulu areas in sequence from south to north. Table 3 summarizes the information.

Southern KwaZulu areas 4 and 10

Along the coast severe infestations of Lantana camara and Chromolaena odorata occur in many areas. These two species have been found in virtually all habitats within the coastal lowland and lowland woody veld bioclimatic regions (Figure 1). Their invasion is unchecked and they are reducing the extent of grasslands and invading forests.

Other major species found in the above-mentioned bioclimatic regions, whose invasion is locally severe include the following:

- Caesalpinia decapetala - found along watercourses, around kraal sites and spread into adjacent woodland and grassland areas, particularly inland where it is a serious invader.

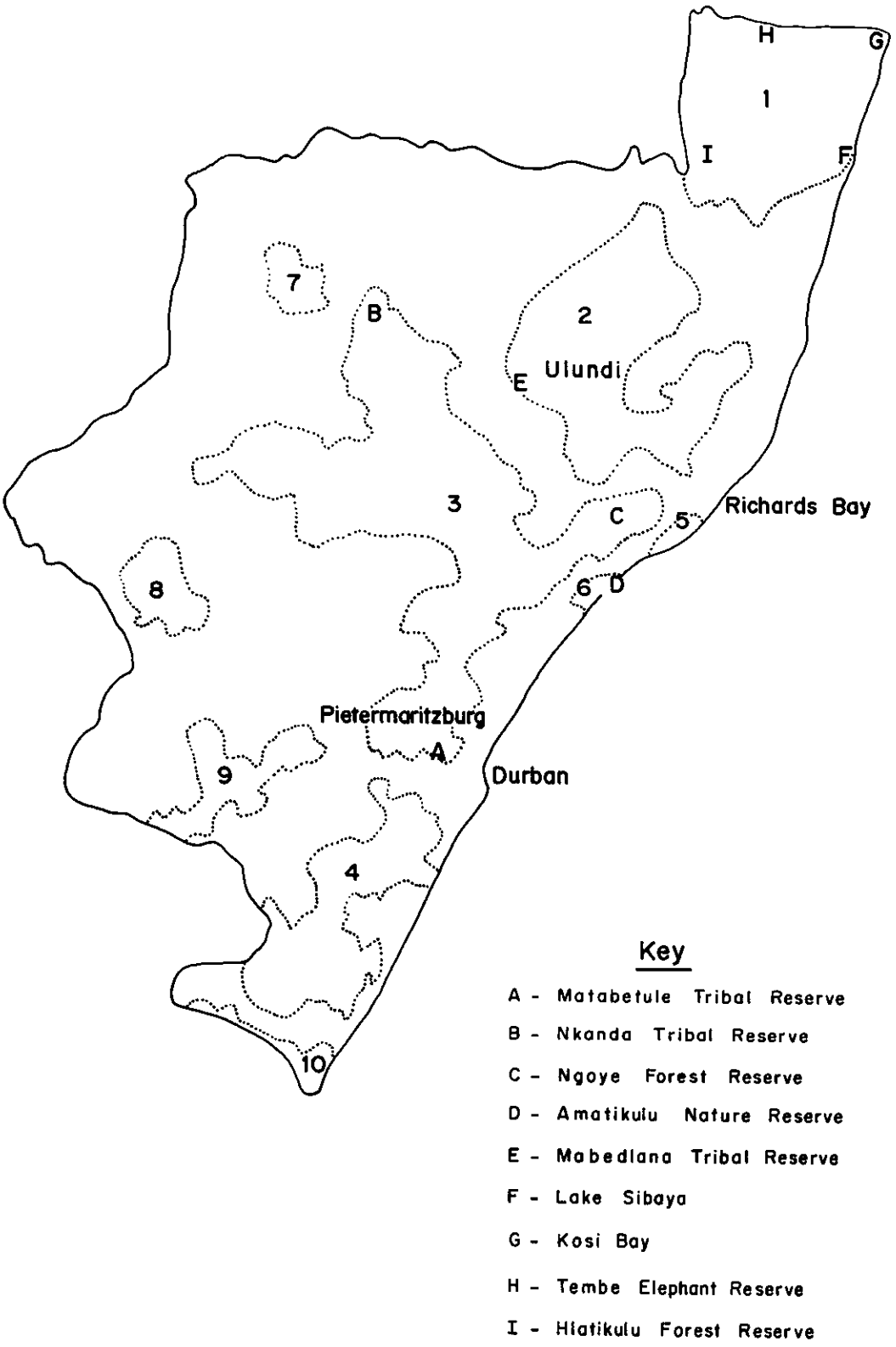

FIGURE 2. KwaZulu areas 1-10 in relation to the rest of Natal.

TABLE 3. Summary of information on the extent of alien plant invasions in KwaZulu areas

	SOUTHERN KWAZULU AREAS 4 & 10[1]				INLAND KWAZULU AREA 9[1]			KWAZULU AREA 3[1]			KWAZULU AREA 6	KWAZULU AREA 2[1]		KWAZULU AREA 1[1]			
Region	Coastal			Inland	Coastal	Inland		Coastal	Inland		Coastal	Coast		Coast		Inland	
Sub Regions	Low-lands	Valley Bush-veld	Hinter-land	Mist-belt	Hinter-land	Mist-belt	High-land Sour-veld	Hinter-land	Tall Dry Grass-land			Valley Bush-veld	Tall Dry Grass-land			Zululand Bushveld	Valley Bushveld
Reserves								Matabetule Tribal Reserve 3A	Nkandla Tribal Reserve 3B	Ngoye[2] Forest Reserve 3C	Amatikulu[2] Nature Reserve 6D	Mabedlana Tribal Reserve 2E		Lake[2] Sibaya 1F	Kosi Bay[2] 1G	Tembe[2] Elephant Reserve	Hlati-kulu Forest Reserve
Acacia mearnsii			+	+++		++	++		++	+							++
Acacia melanoxylon										+							
Agave species															+	++	
Amaranthus hybridus																	+
Amaranthus spinosus											+			+	+	+	
Anacardium occidentale															+	+	
Argemone ochroleuca											+					+	
Arundo donax											+						
Bidens pilosa											+			+	+	+	
Caesalpinia decapetala	+	++	+++							++							++
Canna edulis																	+
Cardiospermum grandiflorum											+						
Carica papaya															+	+	
Cassia didymobotrya	++	++	++								++						
Cassia floribunda										+							
Casuarina equisetifolia										+	+			+	++		
Catharanthus roseus											+			+	+	+	
Cedrella odorata										+							
Cereus peruvianus																+	
Cestrum laevigatum											++			+	+		
Chromolaena odorata	+++	+++	+++					++		++	+++						
Ciraium vulgare											+						
Citrus aurantium														+	+		
Citrus limon										+					+		
Citrus reticulata										+							
Eriobotrya japonica										+							
Eucalyptus species										+	+				+		++
Grevillea robusta										+							
Lantana camara	+++	+++	+++		+			++		++	+++						++
Leucaena leucocephala	++	++	++														
Litsea sebifera	+	+	+														
Lycopersicon species											+			+		+	
Mangifera indica														+	++		
Melia azedarach	+	+	+							+	++	++				+	++
Morus alba															+		
Nicandra physaloides																	+
Opuntia species											+	++			++	++	
Passiflora edulis										+	+						
Pereskia aculeata											+++			+++	+++	+++	++
Pinus species										+					+		
Prunus persica										+							
Psidium guajava	++	+	+							++	+			+	++		
Richardia brasiliensis											+						
Ricinus communis										+	+			++	+	+	
Rivina humilis											+						
Schinus terebinthifolius															+		
Solanum mauritianum	+	+		++						+++	++						++
Solanum sodomaeum											+						
Tagetes minuta																	++
Tectona grandis										+							
Toona ciliata										+							

1 Limited information available
2 Detailed survey done

\+ = light infestation (species known to be present?)
++ = species common
+++ = severe infestation

- Leucaena leucocephala - found along watercourses, in riverine thickets and in coastal thickets. This species grows rapidly, produces large quantities of seeds, and competes with indigenous species.
- Psidium guajava - individual trees and small dense stands are found in most habitats along the coast. Forms a popular food source for the locals who undoubtedly aid in its spread.
- Cassia didymobotrya - found in grasslands, on wooded hill slopes, along watercourses and around kraals.
- Melia azedarach - large trees are widespread in this area, occurring along watercourses, on hill slopes and in forests.
- Sesbania punicea - commonly found along watercourses and in bottomland areas.

The inland regions of KwaZulu in areas 4 and 10 fall essentially within the mistbelt bioclimatic region (Figure 1) and are infested mainly by Acacia mearnsii and Solanum mauritianum. A mearnsii is found in open grasslands, along watercourses and gullies, as woodlots and invading margins of indigenous forests. This species causes a marked reduction of ground cover, leading to soil erosion and bare, sterile areas. S mauritianum is found within the indigenous forest patches and along the margins of forests.

Inland KwaZulu area 9

This area has not been surveyed in any detail therefore the full nature of the problem is not yet known. The area visited falls within the mistbelt and montane bioclimatic regions and the main invader is A mearnsii which is spreading across grasslands, along watercourses and erosion gullies. Although the species is used for firewood, the younger trees are not chopped and thickets develop which cause deterioration of veld cover and promote erosion. Lantana camara is invading lower altitude areas.

KwaZulu area 3 - north of Durban to Tugela River

Apart from the Matabetule-Inanda area, no information on the extent of the problem in the rest of the area exists. In the vicinity of the proposed Matabetule Tribal Reserve (Figure 2,A), L camara and Chromolaena odorata are the main invaders. The area falls within the lowland woody veld bioclimatic region and the habitats invaded are grassland, bush clump woodland, valley woodland and forests.

KwaZulu area 3 - inland

In this region attention has been centred on the proposed Nkanda Tribal Reserve (Figure 2,B), which lies in the upland grasslands bioclimatic region. The main invasive alien is A mearnsii which, despite being a valuable wood source in the area, has spread into the grasslands and woodland on hill slopes. Grassland reduction has occurred and erosion is commonly associated with the trees. Personnel at an adjoining prison farm have become concerned over the invasion of this species into their farmlands and are eradicating some stands.

Ngoye Forest Reserve - KwaZulu area 3

Ngoye Forest (Figure 2,C) is one of the finest examples of forest in KwaZulu, yet alien plants have invaded it, unchecked. Earlier attempts by foresters to exploit the area accelerated the invasion which has resulted in the serious problem that occurs today. A survey to determine the extent of infestation is soon to be undertaken, but preliminary visits have revealed the presence of the following 26 alien species: Acacia mearnsii, A melanoxylon, Citrus limon, C reticulata, Casuarina equisetifolia, Eucalyptus grandis, E maculata, Pinus elliottii, Tectona grandis, Toona ciliata, Cedrella odorata, Grevillea robusta, Lagerostaemia indica, Araucaria columnaris, A cunninghamii, Prunus persica, Passiflora edulis, Eriobotrya japonica, Chromolaena odorata, Lantana camara, Melia azedarach, Psidium guajava, Solanum mauritianum, Caesalpinia decapetala, Cassia floribunda, and Ricinus communis.

The first 18 species listed above (A mearnsii to E japonica) were introduced by earlier foresters and planted in the grasslands adjacent to the forest and/or in clearings within the forest. Subsequent eradication attempts aggravated the situation and provided suitable opportunities for other aliens to invade. Habitats which are being invaded are natural grasslands, forest and wetlands of the Ngoye range. Concentrated eradication efforts are being carried out and many of the species have been either removed altogether or are under control.

Amatikulu Nature Reserve - KwaZulu area 6

This area (Figure 2,D) is where the most detailed survey has been carried out and where concentrated control work is occurring. The reserve is approximately 1 400 ha in extent and each hectare block will ultimately be surveyed as to type and degree of infestation. One quarter of the reserve has been surveyed to date and 25 alien plant species identified (Table 4). Of these Lantana camara, Chromolaena odorata and Pereskia aculeata are the most vigorous and control work has been concentrated on their removal. Other alien species encountered while clearing these species are dealt with, but no control work is aimed specifically at these (except for the hydrophyte Eichhornia crassipes).

L camara has invaded all the habitats in the reserve, forming dense impenetrable stands in many places. Areas which have been cleared show little, if any, germination of indigenous seedlings. Chromolaena odorata also forms dense stands which show poor indigenous plant germination after clearing. Although it has not yet been found in pioneer dune vegetation, it is present in dune scrub, but does not seem to be as successful there as is Lantana camara.

Pereskia aculeata is a vigorous climber which, once established, forms dense coverings over other plants. It smothers trees on which it climbs and the weight of the plants eventually causes the supporting trees to collapse and die. The infestation radiates into the surrounding vegetation and the destruction spreads. The control of this species is a primary concern in our conservation areas.

Cestrum laevigatum has the ability to form dense stands especially as an undershrub in Acacia karroo woodland. It is widespread and, if uncontrolled, becomes a well-established small tree (up to 4,5 m tall).

TABLE 4. Alien plant species in Amatikulu Nature Reserve and the habitats which they have invaded

Species/Habitats	Hygrophilous grassland	Coastal grassland	Hygro-philous forest	Coastal bush clump	Transi-tional forest	Coastal forest	Riverine woodland	Dune pioneer	Dune scrub	Secondary woodland
Amaranthus spinosus				X			X			
Argemone ochroleuca							X			
Arundo donax							X			
Bidens pilosa		X		X			X			
Cardiospermum grandiflorum							X			
Cassia didymobotrya						X				
Casuarina equisetifolia								X	X	
Catharanthus roseus							X			
Chromolaena odorata	X	X	X	X	X	X	X		X	X
Cestrum laevigatum	X		X	X	X	X	X			X
Eucalyptus species					X		X			
Lantana camara	X	X	X	X	X	X	X	X	X	X
Melia azedarach				X	X	X	X			X
Opuntia species							X			
Passiflora edulis				X						
Pereskia aculeata				X	X					
Psidium guajava		X		X	X		X			X
Ricinus communis							X			
Sesbania punicea	X						X			
Solanum mauritianum	X			X	X	X	X			X
Rivina humilis							X	X		
Richardia brasiliensis		X		X	X		X			X

Melia azedarach develops into sizeable trees (up to approximately nine metres tall) and, since its fruit is popular with certain frugivorous birds, it is spread rapidly and possibly preferentially. It grows quickly and successfully competes with indigenous species in suitable habitats.

KwaZulu area 2

In the vicinity of Ulundi is the Mabedlana Tribal Reserve (Figure 2,E) where the main alien invader is Opuntia species. The area falls within two bioclimatic regions namely lowland woody veld and upland grasslands and the habitats affected are riverine and valley thornveld. The habit of the plant makes areas inaccessible and it competes vigorously with indigenous vegetation. Melia azedarach is also widespread in the area.

Maputaland - KwaZulu area 1

In the Lake Sibaya area (Figure 2,F) Pereskia aculeata is found in the dune forest and coastal woodland of the coast lowlands bioclimatic region. Localized dense infestations occur. Eradication work served to open up the area, allowing for initial invasion by other aliens, particularly Ricinus communis. However, subsequent regrowth of the indigenous forest seems to be occurring.

Chromolaena odorata occurs in the Mbazwane and Manzengwenya plantations, as a mild infestation. Annually forestry staff go through the plantations, removing this alien. A minor infestation of Lantana camara occurs at Mbazwane in plantations and in indigenous coastal scrub. Mild infestations of Psidium guajava, Casuarina equisetifolia and Schinus terebinthifolius occur around Manzengwenya with the species invading coastal scrub and grassland communities.

At Kosi Bay (Figure 2,G) infestations of Pereskia aculeata have been found and dealt with by Bureau staff. The plant occurs in coastal forest and woodland communities and was destroying indigenous plants.

Other aliens noted in the Kosi area are Schinus, Casuarina and Eucalyptus species. Although they have not spread to any noticeable degree, they have the potential to spread and will be eradicated.

The Tembe Elephant Reserve (Figure 2,H) falls within the Zululand Bushveld and Valley Bushveld forms of the lowland woody veld, with most of the aliens being found in the former group. A preliminary survey has revealed that Pereskia aculeata is the main threat. It is found in numerous dense clumps in sandveld woodland and control of its invasion is currently being undertaken. Opuntia species also occur, associated with old kraals, and spreading into various areas of sandveld woodland and lalapalm veld where small impenetrable stands occur at margins of bush clumps.

Along the Kosi drainage system a localized clump of Melia azedarach occurs on an island within the swamp. The trees are large and mature, and totally dominate the small community. An isolated clump of Agave species occurs in sandveld woodland.

Finally, in the Hlatikulu Forest Reserve (Figure 2,I) which is situated on the Lebombo mountains and falls within the coastal lowland bioclimatic region, alien plant species are invading the forest and encroaching on the Lebombo bushveld. The main problem species are Pereskia aculeata, Lantana camara, Acacia mearnsii, Eucalyptus species, Solanum mauritianum, Caesalpinia decapetala and Tagetes minuta.

The alien problem in KwaZulu is widespread and critical. Plants are invading, mostly unchecked, and in many areas the infestations have reached epidemic proportions. The Bureau is deeply concerned with the alien plant threat and control work in conservation priority areas is an essential function. The work, however, is just beginning. As the problem is so extensive, it will be only through systematic clearing and perseverence that this problem will be controlled.

NATAL PARKS BOARD RESERVES
R N Porter - Natal Parks Board

The Natal Parks Board has some 52 proclaimed nature reserves and resorts under its control. These areas represent approximately three per cent of the area of the province. The invasion of alien plants into these areas is a serious problem. The stated duty of the Natal Parks Board (Ordinance 15/1974 Chapter 2 paragraph 11) is to "Control, manage and maintain all parks, game and nature reserves, for the exhibition, propagation, protection and preservation therein of wild animal life, wild vegetation .... and objects of scientific interest". It is axiomatic that this duty can only be fulfilled in the absence of alien plant infestations.

The number of alien plant invader species giving rise to major infestations in the Tongaland, Zululand, St Lucia, Drakensberg and "Southern" regions is given in Table 5. It is apparent that the reserves in the "Southern" region have the highest number of such species. There are at least 27 species which are alien invaders in Natal Parks Board areas. In the Hluhluwe, Umfolozi, Mkuzi and Itala reserves alien species have been mapped. The presence of alien species was mapped on a 1 km^2 grid in the case of Itala Nature Reserve, but for the other reserves listed in Table 6, this was done on a $\frac{1}{4}$ km^2 grid. Species forming extensive infestations in these reserves (Table 6) have been described in detailed reports on the alien plant problem in two of these areas (Macdonald 1983, Porter 1983). However, for most reserves such data is not available. Therefore, to enable nature reserves in different regions of Natal to be compared, alien plant infestations in these areas were rated on a three-point scale. A score of three indicates extensive infestations, two moderate infestations and one that light infestations are present. These data are given in Table 7. It is apparent that 11 species are present in extensive infestations and eight species in moderate infestations in one or more nature reserves in Natal.

All nature reserves in Natal are threatened to some extent by one or more alien plant species and in certain reserves extensive infestations of alien plants are having an undesirable impact on nature conservation interests.

STATE FOREST LANDS
W R Bainbridge - Department of Environment Affairs

The Directorate of Forestry has custody of extensive natural areas throughout Natal. The organization of management of these areas is divided. The Regional Director, Natal Region manages the areas in the south of the Province (more or less south of the Tugela), while the Regional Director Zululand manages the areas in the north.

The Directorate has responsibility for the following principal types of natural area: mountain catchment areas; areas of indigenous forest; coastal ecosystems (including forests and drift sand areas); and natural areas attached to timber plantations.

TABLE 5. The number of alien plant species giving rise to major infestations in Natal Parks Board reserves

Region	Area (ha)	Number of reserves	Number of alien invader species
TONGALAND	35 028		
Mkuzi Game Reserve		2	15
Ndumu Game Reserve			9
ZULULAND (Hluhluwe-Umfolozi Complex)	90 000	3	15
ST LUCIA COMPLEX	65 000	4	
West			12
East			11
DRAKENSBERG	57 586	10	12
"SOUTHERN" REGION	37 265	19	
Itala Nature Reserve			16
Other reserves			18

TABLE 6. Alien plant species forming extensive infestations in Itala, Hluhluwe, Umfolozi and Mkuzi Game Reserves

	% Grid blocks known to be infested			
	Grid size	1 km^2	¼ km^2	
Species	Reserve	Itala N R	Hluhluwe G R	Umfolozi G R	Mkuzi G R
Acacia mearnsii		22,0	-	-	-
Caesalpinia decapetala		13,7	-	0,8	-
Chromolaena odorata			12,0	1,0	2,8
Lantana camara		20,6	-	-	0,4
Melia azedarach		23,1	1,0	3,3	5,1
Opuntia species		16,3	-	4,3	1,8
Psidium guajava		3,1	1,0	0,5	0,1
Sesbania punicea		25,7	-	-	4,7
Solanum mauritianum		-	5,0	1,2	1,0
Solanum seaforthianum		-	2,6	-	2,5

TABLE 7. Alien plant species responsible for major infestations in various Natal Parks Board areas

Species	Mkuzi G R	Ndumu G R	Hluhluwe-Umfolozi Complex	St Lucia		Itala N R	Reserves	
				West	East		Section South	Drakensberg
Acacia mearnsii	.	.	.	.	.	3	3	2
Caesalpinia decapetala	.	.	1	.	.	3	1	.
Chromolaena odorata	3	.	3	3	2	.	3	.
Lantana camara	1	1	1	2	1	3	2	1
Mangifera indica	1	3	.	.	.	.	.	.
Melia azedarach	3	3	3	2	1	1	1	1
Pinus elliotii	.	.	.	3	3	.	.	.
Psidium guajava	1	3	2	3	3	1	1	1
Ricinus communis	.	3	1	.	.	1	1	.
Sesbania punicea	3	.	.	.	.	3	1	1
Solanum seaforthianum	3	2	1	2	1	.	1	.
Agave sisalana	2	1	1	1	1	1	.	1
Cassia species	.	2	1	.	.	.	1	.
Jacaranda mimosifolia	1	.	1	.	.	1	2	.
Opuntia species	2	2	1	1	1	2	2	1
Pereskia aculeata	.	.	.	1	2	.	2	.
Rubus cuneifolius	.	.	.	.	.	1	2	.
Solanum mauritianum	2	.	2	2	1	1	2	.
Schinus terebinthifolius	.	.	.	2	1	.	.	.
Acacia melanoxylon	.	.	.	.	.	.	.	1
Arundo donax	.	.	.	1	.	.	.	.
Cassia didymobotrya	.	.	1	.	.	1	1	.
Cotoneaster species	.	.	.	.	.	.	.	1
Eucalyptus grandis	.	.	.	.	.	1	1	1
Montanoa hibiscifolia	.	.	1	.	.	.	.	.
Morus alba	.	.	1	.	.	1	1	.
Pinus patula	.	.	.	.	.	.	1	1

G R = Game Reserve
N R = Nature Reserve

The principal Veld Types (Acocks 1975) conserved in the State forests are: Veld Type (VT) 1 Coastal Forest and Thornveld; VT 8 North-eastern Mountain Sourveld; VT 44 Highland Sourveld; VT 45 Natal Ngongoni Veld; VT 58 Themeda-Festuca Alpine Veld; and VT 65 Southern Tall Grassveld.

Table 8 lists the alien plant species considered to constitute management problems in the Drakensberg State forests. These are to a large extent those that are problematic elsewhere in the Natal Region and particularly in natural areas in the Natal Midlands such as Weza, Nkonzo and Dargle.

Table 9 lists the principal problem plant species of the Zululand Region State forests.

Natal Region

It is an unfortunate fact of life that many of the species listed in the tables are escapees from timber plantations. Examples are Pinus species, Acacia species and Eucalyptus species. The other species are mainly garden escapees.

Plantations tend to form seed source centres, especially for species which are wind-blown (eg Pinus species) or which are dispersed by birds (eg Solanum mauritianum). It follows that natural areas closely associated with timber plantations may be regarded as areas with a high potential invasion threat.

Any visitor to a timber plantation soon becomes aware of the seriousness of the plantation weed problem. To a large extent, the problem is occasioned by the lack of fire as a management tool. While this does not always follow, it is frequently the case that natural areas (eg grasslands) that are maintained by fire, tend to suffer less from invasion than other areas of natural vegetation. Areas that are protected from fire are the most vulnerable.

It is fortunate that many of the most important natural areas in the custody of the Directorate of Natal are relatively free of alien plant invader species, in comparison with other natural areas. For example, the Drakensberg State forests have locally serious infestations of Acacia species, Rubus cuneifolius and other problem plants, but the infested areas are localized. Over 90% of the Drakensberg catchment area in the custody of the Directorate is almost free of invasive weed species.

The Directorate does not have reliable estimates of the extent of infestation, but is currently involved in a detailed assessment exercise.

Zululand Region

The problem is noticeably more acute in Zululand, although there are still very extensive areas of fire-maintained grasslands which are in excellent condition, relatively free of invasive species.

Potentially dangerous species include Chromolaena odorata, Psidium guajava and Melia azedarach in semiwooded areas. The presence of Pereskia aculeata in indigenous forest areas requires intensive monitoring.

TABLE 8. Principal problem alien plant species of the Drakensberg State forests

Seed species	Method of spread	Notes
Major problem plants		
1. Pinus species, mainly Pinus patula	Seed (wind blown)	Seed is carried long distances by convection currents and strong winds. Invades areas of woody vegetation not subjected to regular veld fires, or vegetation sheltered in fire refuge areas. Trees can however, withstand moderate fires, and cannot be controlled by veld burning alone. Once individuals sufficiently old to set seed are established, the rate of infestation becomes exponential.
2. Acacia species, mainly Acacia mearnsii A dealbata A decurrens	Seed (gravity and water)	Seed remains viable for over 50 years. Over 20 000 seeds m^2 can accumulate in the litter under a single large tree. Fire stimulates germination. Prefer deep soil along stream courses but will occupy shallow soil sites in high-rainfall areas.
3. Rubus cuneifolius*	Seed (frugivorous birds and mammals) suckers	Mainly confined to areas of deeper soil in valleys and in the immediate vicinity of buildings or on disturbed sites. Forms dense stands under exotic trees. Will spread to protected sites such as under fences, trees.
Minor problem plants		
1. Cotoneaster species	Seed (frugivorous birds and mammals)	In sites near habitation and areas protected from fire.
2. Populus canescens	Suckers	Confined to moist sites where it was originally planted for erosion control.
3. Solanum mauritianum*	Seed (frugivorous birds) and suckers	In sheltered or disturbed sites, eg under exotic trees, and on forest margins.
4. Ulex europaeus	Seed (gravity)	Confined to limited areas on the Little Berg at Highmoor.
5. Spartium junceum	Seed (gravity)	Confined to limited areas on the Little Berg at Highmoor.
6. Sesbania punicea*	Seed (water)	Confined to lower valleys.
7. Pyracantha species	Seed (frutivorous birds)	Potential weed. Some slight spread in Mooi River, Underberg areas.

Footnote: 1. The weed species are ordered in approximate rank according to their aggression rates. Alien species that are not aggressive (such as ornamentals, windbreak species or weeds of cultivation and old settlements) are not listed.

2.* Proclaimed noxious weed.

TABLE 9. Principal problem alien plant species of the Zululand Region State forests (Ngome and the coastal natural areas)

Species	Effect on natural vegetation
Acacia species	XXX
Caesalpinia decapetala	XXX
Chromolaena odorata	XXX
Eucalyptus species	X
Melia azedarach	XX
Pinus species	XXX
Solanum mauritianum	XXX

Severity of problem: X - mild
XX - moderate
XXX - severe

CHAPTER 3. RANKING THE SPECIES ACCORDING TO THEIR IMPORTANCE

In this section the meeting was subdivided into five working groups based on the principal types of land use affected by alien plant invaders in Natal. These usages were grouped as the nature conservation estate, agricultural grazing lands, the sylvicultural estate, utility areas (roadsides, railway lines, power lines etc) and urban open space. Each group was requested to rank their most important 15 alien species according to five parameters. The parameters were the current extent of infestations in the areas with which the group was concerned (A, that with the most extensive infestations ranked 1, the smallest ranked 15), the difficulty with which the species could be controlled using available control technology (B, the most difficult ranked 1, the easiest 15), the extent of potential habitat for the species in the area concerned (C, 1 the greatest extent, 15 the least), the potential rate of spread (D, 1 the fastest, 15 the slowest) and the impact of the species on the area invaded (E, 1 the highest impact, 15 the lowest). Whenever two or more species were considered to be of equal rank the mean rank position was calculated and allotted to each species ie if the second and third species were considered equal both were rated 2,5. The importance value (I) for each species was calculated as:

$$I = \frac{A}{2} + \frac{B}{2} + 2C + D + E \qquad (1)$$

Thus the current extent of infestations and current control difficulty were considered to be of lesser significance in defining a species' importance than were its rate of spread and ecological impact. All these factors were considered of less importance than the potential extent of the species habitat ie a species only capable of invading one particular habitat type of limited extent in the area concerned, was rated as much less important than a species capable of invading a wide range of habitats of large extent occurring throughout the area. The approach was initially developed and applied in the first fynbos invasives workshop meeting (Macdonald and Jarman 1984 pp 6-8).

The results of the five groups' ratings for each of the parameters are presented in Tables 10 to 14. In the case of the urban open space group the rankings were carried out independently for coastal and inland urban areas. There are thus six land usage zones in each table. The ordering of the columns in each table reflects the relative extent of the natural and seminatural vegetation areas falling within each of these zones ie the greatest area is comprised of agricultural grazing lands while inland urban open space is the smallest area. The sylvicultural estate is

considered to have a smaller area under natural vegetation than is present in the utility areas of the province. The unimproved mountain catchment areas administered by the Directorate of Forestry are considered to fall into the nature conservation estate rather than the sylvicultural estate.

TABLE 10. Ranking the alien plant species according to the current extent of infestations in five land use areas within Natal

Alien species	Agricultural grazing lands	Nature conservation estate	Utility areas	Sylvicultural estate	Urban open-space	
					Coastal	Inland
Acacia dealbata	3	10	5	5		5
Acacia decurrens	15		11			
Acacia longifolia			11		15	
Acacia mearnsii	3	2	2	6		5
Acacia melanoxylon				10		7
Caesalpinia decapetala	8	11	8	7		5
Cardiospermum grandiflorum					5	
Cassia didymobotrya					4	
Cestrum laevigatum		14		13	6,5	
Chromolaena odorata	3	1	7	4	1,5	
Cotoneaster species						13,5
Eupatorium adenophorum	13		14			
Lantana camara	5	3	6	3	1,5	
Leucaena leucocephala					6,5	
Litsea sebifera					11,5	
Melia azedarach	12	6	2	13	11,5	9,5
Montanoa hibiscifolia					8	
Opuntia aurantiaca	7		14			12
Opuntia ficus-indica	9	5				11
Pereskia aculeata		13		9	9	
Pinus patula		9		8		8
Populus alba/canescens			11			9,5
Psidium (complex)	10	8		13	13	
Pyracantha species						13,5
Ricinus communis				13		
Rubus cuneifolius	1	7	9	2		1
Salix babylonica						15
Schinus terebinthifolius	14		14			
Sesbania punicea	6	12	4	13	10	2
Solanum mauritianum	11	4	2	1	14	3
Solanum seaforthianum		15				
Tithonia diversifolia					3	

TABLE 11. Ranking the alien plant species according to the potential extent of infestations in five land use areas within Natal

Alien species	Agricultural grazing lands	Nature conservation estate	Utility areas	Sylvicultural estate	Urban open-space	
					Coastal	Inland
Acacia dealbata	3	4	3	2,5		5
Acacia decurrens	10		11,5			
Acacia longifolia			11,5		12	
Acacia mearnsii	1,5	3	3	2,5		5
Acacia melanoxylon				2,5		12,5
Caesalpinia decapetala	8	8	11,5	7,5		12,5
Cardiospermum grandiflorum					4,5	
Cassia didymobotrya					12	
Cestrum laevigatum		14		7,5	4,5	
Chromolaena odorata	5	1	6,5	7,5	4,5	
Cotoneaster species						5
Eupatorium adenophorum	11,5		11,5			
Lantana camará	4	2	8,5	7,5	4,5	
Leucaena leucocephala					12	
Litsea sebifera					12	
Melia azedarach	9	6	3	14,5	12	5
Montanoa hibiscifolia					4,5	
Opuntia aurantiaca	6		14			5
Opuntia ficus-indica	13	11				5
Pereskia aculeata		5		7,5	4,5	
Pinus patula		12		12,5		5
Populus alba/canescens			8,5			12,5
Psidium (complex)	15	7		7,5	12	
Pyracantha species						5
Ricinus communis				12,5		
Rubus cuneifolius	1,5	9	6,5	12,5		5
Salix babylonica						12,5
Schinus terebinthifoliu	14		15			
Sesbania punicea	7	13	3	14,5	12	12,5
Solanum mauritianum	11,5	10	3	2,5	4,5	12,5
Solanum seaforthianum		15				
Tithonia diversifolia					4,5	

TABLE 12. Ranking the alien plant species according to the difficulty with which they can be controlled in five land use areas within Natal

Alien species	Agricultural grazing lands	Nature conservation estate	Utility areas	Sylvicultural estate	Urban open-space	
					Coastal	Inland
Acacia dealbata	3	8	4	10		7,5
Acacia decurrens	3		11,5			
Acacia longifolia			11,5		7	
Acacia mearnsii	3	7	11,5	10		7,5
Acacia melanoxylon				10		7,5
Caesalpinia decapetala	7	3	11,5	2		7,5
Cardiospermum grandiflorum					3	
Cassia didymobotrya					12,5	
Cestrum laevigatum		12		14,5	12,5	
Chromolaena odorata	6	9	4	4	3	
Cotoneaster species						11,5
Eupatorium adenophorum	15		11,5			
Lantana camara	5	4	4	5	3	
Leucaena leucocephala					7	
Litsea sebifera					7	
Melia azedarach	12	5	11,5	10	12,5	11,5
Montanoa hibiscifolia					12,5	
Opuntia aurantiaca	10		4			3
Opuntia ficus-indica	11	11				3
Pereskia aculeata		1		1	1	
Pinus patula		15		14,5		14,5
Populus alba/canescens			4			3
Psidium (complex)	8	2		10	7	
Pyracantha species						11,5
Ricinus communis				10		
Rubus cuneifolius	1	6	4	3		3
Salix babylonica						14,5
Schinus terebinthifolius	14		11,5			
Sesbania punicea	13	13	4	10	7	3
Solanum mauritianum	9	10	11,5	6	12,5	11,5
Solanum seaforthianum		14				
Tithonia diversifolia					12,5	

TABLE 13. Ranking the alien plant species according to the potential rate of spread in five land use areas within Natal

Alien species	Agricultural grazing lands	Nature conservation estate	Utility areas	Sylvicultural estate	Urban open-space	
					Coastal	Inland
Acacia dealbata	13	6,5	7,5	12		7,5
Acacia decurrens	13		13			
Acacia longifolia			7,5		6,5	
Acacia mearnsii	13	6,5	9	12		7,5
Acacia melanoxylon				12		7,5
Caesalpinia decapetala	15	14	13	12		7,5
Cardiospermum grandiflorum					6,5	
Cassia didymobotrya					6,5	
Cestrum laevigatum		12		5	11,5	
Chromolaena odorata	1	1	2	1	2	
Cotoneaster species						11,5
Eupatorium adenophorum	2		10,5			
Lantana camara	6	8	4,5	5	2	
Leucaena leucocephala					6,5	
Litsea sebifera					11,5	
Melia azedarach	6	9,5	2	12	11,5	7,5
Montanoa hibiscifolia					14,5	
Opuntia aurantiaca	10		13			2,5
Opuntia ficus-indica	6	15				2,5
Pereskia aculeata		3,5		5	2	
Pinus patula		11		5		14
Populus alba/canescens			15			13
Psidium (complex)	6	5		5	11,5	
Pyracantha species						11,5
Ricinus communis				12		
Rubus cuneifolius	6	13	6	5		2,5
Salix babylonica						15
Schinus terebinthifolius	6		10,5			
Sesbania punicea	11	9,5	2	12	6,5	7,5
Solanum mauritianum	6	2	4,5	5	6,5	2,5
Solanum seaforthianum		3,5				
Tithonia diversifolia					14,5	

TABLE 14. Ranking the alien plant species according to their ecological impacts in five land use areas within Natal

Alien species	Agricultural grazing lands	Nature conservation estate	Utility areas	Sylvicultural estate	Urban open-space	
					Coastal	Inland
Acacia dealbata	3	3,5	4,5	8		10
Acacia decurrens	3		4,5			
Acacia longifolia			4,5		11,5	
Acacia mearnsii	3	3,5	4,5	8		10
Acacia melanoxylon				8		10
Caesalpinia decapetala	9	7	4,5	3		3,5
Cardiospermum grandiflorum					4	
Cassia didymobotrya					11,5	
Cestrum laevigatum		14		13	11,5	
Chromolaena odorata	14	1	4,5	3	4	
Cotoneaster species						14
Eupatorium adenophorum	9		11			
Lantana camara	14	5	4,5	3	4	
Leucaena leucocephala					4	
Litsea sebifera					11,5	
Melia azedarach	14	9	14,5	13	11,5	10
Montanoa hibiscifolia					4	
Opuntia aurantiaca	9		12			3,5
Opuntia ficus-indica	9	8				3,5
Pereskia aculeata		2		3	4	
Pinus patula		10		13		10
Populus alba/canescens			4,5			3,5
Psidium (complex)	9	11		13	11,5	
Pyracantha species						14
Ricinus communis				13		
Rubus cuneifolius	3	6	4,5	3		3,5
Salix babylonica						14
Schinus terebinthifolius	9		14,5			
Sesbania punicea	3	12	10	8	11,5	3,5
Solanum mauritianum	9	14	13	8	11,5	3,5
Solanum seaforthianum		14				
Tithonia diversifolia						

THE NATURE CONSERVATION ESTATE
I A W Macdonald, J Scotcher, M Ward, J Wyatt, G Zaloumis and D Freeman

The group rated what were regarded as the top 15 alien plant species in terms of their invasiveness, on the criteria shown in Tables 10 to 14. The following account is an elaboration of the ratings for the six top priority species, in order of priority.

1. Chromolaena odorata was ranked as the most serious alien invader of the nature conservation estate of Natal. This ranking was based on it currently having the greatest total extent of infestation, coupled with the largest potential infestation (the species occupies all habitats within the coastal lowlands and lowland woody veld with the exception of the foredunes and seasonally waterlogged sites), and the most rapid rate of spread. (Following its introduction at Durban in 1949 the species had reached virtually all areas in its potential range within Natal by 1983). In terms of ease of control this species was rated as being moderately easy to remove but requiring repeated follow-up operations.

2. Acacia mearnsii. This invasive is widespread in Natal, occurring in all its bioclimatic regions. Once established in heavy densities it will exclude all other plants resulting in soil erosion from lack of sufficient ground cover. The rate of spread into forests, woodlands and grasslands is moderate but along watercourses establishment can be rapid. Control of the species is moderately difficult except where density is very high and it becomes time consuming - follow-up is essential. Lantana camara (ranked as equally important) occurs extensively in most frost-free areas. Its rate of dispersal is moderate and is by frugivorous animals and water. It is fairly easily controlled but follow-up operations are necessary. It has a serious effect on the vegetation where it has invaded. Fortunately biocontrol looks promising.

4. Pereskia aculeata occurs in restricted areas but is possibly more widely distributed than realized as it is difficult to detect due to its growth form and preferred habitat ie forest and woodland. It is extremely difficult to control as it occurs in dense vegetation, it fragments easily while being removed and has the ability to regenerate vegetatively from small pieces. The rate at which it can be spread by frugivorous animals and by vegetative reproduction, is potentially rapid. Its current widespread distribution in the conservation areas of the coastal lowlands is mainly thought to be the result of previous intentional plantings (kraal hedges, grave sites). Spread from these sites of previous introductions has in many localities been surprisingly limited given its bird-dispersed fruit. The recent rapid increase in its 'known' distribution is possibly the result of its having been previously overlooked. It has a serious effect on its preferred habitat - usually killing all plants it smothers.

5. Acacia dealbata is similar to Acacia mearnsii but due to the smaller extent of suitable habitat for this species within the conservation estate it received a lower rating than Acacia mearnsii.

6. Psidium guajava is extremely difficult to kill as it regenerates readily from underground parts by suckering. Penetration by herbicides is limited by a waxy cuticle on the leaves. It is spread by frugivorous animals (particularly man). It has invaded most frost-free areas and occurs in localized areas of high densities along the coast. It is an aggressive invader of grasslands but at present only presents a serious problem in areas such as floodplains and forest margins. The possibility that the invasive form is actually a hybrid requires further investigation.

AGRICULTURAL GRAZING LANDS
S Neser, D J Erasmus, W Pitchford, F Shone, A Wood, C J Ward and H Zimmerman

The important species

The following procedural steps were taken by the working group in rating alien species in agricultural grazing lands of Natal.

Alien plant species regarded as of no particular importance or threat to these areas were deleted from the original workshop species list, and the following species were added, as it was deemed possible that they might qualify for ranking after consideration of all the paramaters: Acacia decurrens, Cirsium vulgare and Xanthium spinosum. This left 25 species. It was decided to include all these, as some, which might have been excluded had only 15 been considered, could have eventually scored high ratings, especially since 'extent of potential habitat' carried a double weight in rating (as compared to a half weight for 'presently infested area') and 'potential rate of spread in future' also carried a relatively high weighting.

To facilitate ranking under each heading, the species were first sorted into three groups, for example very bad, medium or not so bad, and ones in the same group were then compared to arrive at the rating of 1-25, again on a consensus basis.

For **current infested area** , the actual area infested was estimated as the area covered, ie roughly the amount of shade cast by the infestation(s), and not as the extent of areas carrying infestations. For **control difficulty** , consideration was given to whether satisfactory control measures were known, and whether regeneration eg from roots, seed-store or seeds carried in to treated areas, presented problems. **Extent of potential habitat** was largely influenced by the size of the area of suitable habitat for the species. **Potential rate of spread** presented problems, because both innate potential rate for spread, ie how fast it would spread in an area where there would be hardly any limit on suitable sites, and rate of spread observed in the past were both considered important criteria. It was felt that some weeds recently introduced/established may not have reached the phase of apparent exponential increase that others could have reached, and could be given a lower rating than they deserve. **Impact** of different species on agriculture was difficult to evaluate, and eventually the group resorted to leaving the weeds in the original three categories, giving them all, one of three average values.

Once the importance values had been calculated for all 25 species, the top 15 species were extracted and their ranks for each parameter derived from the original table. The final rankings are presented in Tables 10 to 14.

THE SYLVICULTURAL ESTATE

R P Denny, V R Davidson, B Liggitt, A Priday, C Smithers and N Truter

The group rated what were regarded as the top 15 alien plant species in terms of their invasiveness, on the criteria shown in Tables 10 to 14. The following account gives the background to the way in which the working group operated.

All forest land viz plantations, stream banks and grassland areas in State and private forests were considered. These ranged in extent from Zululand to the Drakensberg. Plant species grown for timber are aliens, so the phenomenon of invasions in forest areas is not clearcut. Acacia mearnsii, whose seed can remain viable for up to 40 years, was considered as important (rank 6) and Pinus patula (rank 12) was included because it has a high potential rate of spread.

As such a range of climatic zones and land use types was included, it was not possible to rank exactly and groups of species were ranked equally for each of the criteria. This contributed to a limited range in the final values of the total w i ht s s, for example Solanum mauritianum (rank 1-21,5), and Melia azedarach (rank 15-65,5). The three most important species were Solanum mauritianum, Chromolaena odorata, and Lantana camara, with values of 21,5, 23,0 and 27,0 respectively.

The low rank for Rubus cuneifolius was due to the relatively small area of potential habitat when the sylvicultural estate in Natal was considered as a whole.

UTILITY AREAS

M Wells, R Grobler, W Hollstein, M L Jarman, and J B van der Breggen

The working group commenced by trying to list criteria which are specific to utility areas which motivate organizations involved in managing these areas to remove alien plants. These include obstruction of drainage (eg erosion); obstruction of visibility; obstruction of access to maintenance of utilities (eg power lines); fire and smoke hazards which constitute a danger to traffic; aesthetics and tourism; and obstruction hazards (eg tree falls across roads).

The criteria were identified by consensus within the group through discussing species which cause roadside problems to utility organizations. It was clear that ambivalence was present in attitudes to the use of some invasive species for utility area maintenance (eg Eucalyptus species and Pennisetum clandestinum). The working group worked through the total list of invasive species provided, and drew up a short list of the 15 most important species (Table 15).

The working group then rated species on the criteria identified above (Table 15); plus the originally designated criteria of area, ease of control etc (Tables 10 to 14). Separate calculations of the rankings were done for the criteria specific to utility areas and for the criteria used by all other working groups. A comparison of the rankings obtained in each instance is shown in Table 16.

TABLE 15. Ranking of alien plant species on criteria specific to utility areas

Species	Erosion hazard	Obstr. visib-ility	Obstr. access	Smoke hazard	Aesthetics and tourism	Traffic hazard
Acacia dealbata	2,5	2,5	6,5	8,5	3,5	1
Acacia mearnsii	2,5	2,5	6,5	8,5	3,5	2
Acacia decurrens	2,5	2,5	6,5	8,5	11,0	9
Acacia longifolia	2,5	2,5	6,5	8,5	11,0	9
Caesalpinia decapetala	11,5	11,5	4,0	8,5	11,0	9
Chromolaena odorata	6,0	7,0	3,0	1,0	3,5	9
Eupatorium adenophorum	11,5	14,0	12,0	8,5	11,0	9
Lantana camara	7,0	6,0	1,5	8,5	3,5	9
Melia azedarach	11,5	11,5	12,0	8,5	11,0	9
Opuntia aurantiaca	11,5	15,0	12,0	8,5	11,0	9
Populus alba/canescens	11,5	11,5	12,0	8,5	11,0	9
Rubus cuneifolius	11,5	9,0	1,5	8,5	3,5	9
Schinus terebinthifolius	11,5	11,5	12,0	8,5	11,0	9
Sesbania punicea	5,0	8,0	12,0	8,5	11,0	9
Solanum mauritianum	11,5	5,0	12,0	8,5	3,5	9

TABLE 16. Final rankings obtained for three approaches to rating species in utility areas

Species	Utility area specific criteria + general criteria		Utility area specific criteria only		General criteria only	
	Total +	Ranking	Total +	Ranking	Total	Ranking
Acacia dealbata	47,5	1	24,5	1	23,0	2
Acacia mearnsii	52,2	2	25,5	2	26,7	4
Chromolaena odorata	55,0	3	29,5	3	25,5	3
Lantana camara	67,0	4	35,5	4	31,5	8
Rubus cuneifolius	73,5	5	43,0	7	30,5	7
Sesbania punicea	75,5	6	53,5	9	22,0	1
Solanum mauritianum	79,7	7	49,5	8	30,2	6
Acacia longifolia	86,7	8	40,0	5,5	46,7	10
Acacia decurrens	92,2	9	40,0	5,5	52,2	12
Melia azedarach	92,7	10	63,5	12	29,2	5
Caesalpinia decapetala	106,2	11	55,5	10	50,7	11
Populus alba/canescens	108,0	12	63,5	12	44,5	9
Eupatorium adenophorum	123,2	13	66	14	57,2	13
Opuntia aurantiaca	129,0	14	67	15	62,0	14
Schinus terebinthifolius	131,2	15	63,5	12	67,7	15

URBAN OPEN SPACE
G Nichols, B Crook, A A Ferrar and L Henderson

Since Durban and Pietermaritzburg are the larger metropolitan areas in Natal these were the two areas concentrated on. Natal was divided into two geographical areas - inland and coastal - and for each the 15 most important species were ranked. The following species were added to the original workshop species list: Acacia longifolia (which is a problem in the coastal region along rivers); Acacia podalyriifolia; Eucalyptus cinerea; and Robinia pseudo-acacia.

The following account is an explanation of the ranking criteria used by the group. **Control difficulty** was interpreted as possibly comprising aspects of all the following elements; the degree of accessibility of the invader (both the nature of the physical terrain in which it grows and the nature of the plant growth form); the mode of regeneration of the invader species (from seed eg Chromolaena odorata, Solanum mauritianum; vegetative regrowth eg Pereskia aculeata, Opuntia species); the dispersal mechanisms of the invader species (wind, animal, water); and the time taken to control the species expressed per unit area of dense infestation.

Potential rate of spread of an invader species was considered to be a criterion dependent on: the type of seed dispersal and the degree of vegetative reproduction which it displays. Harsher environmental conditions experienced inland would hamper the spread of species. Consideration was also given to the role of stormwater drains in the dispersal of roadside species by water into riverine situations.

As far as the criterion **impact** was concerned, the aesthetic aspect of the presence of invasive species in landscapes was considered important, and in particular in riverine locations. These latter locations are important recreation areas.

Finally, as regards **extent of potential habitat** , particular attention was paid to generalist species, and riverine/moisture-loving species. The results of the rating exercises are shown in Tables 10 to 14.

FINAL IMPORTANCE RANKING

The importance values were calculated for each species (Table 17) and on the basis of these values the species' overall rankings within each land use type were established (Table 18).

In order to provide a synthetic importance value, the sum of the importance values for each species was divided by the number of land use types in which the species was rated (Table 19). Where the species was rated in both urban areas only, the lowest importance value was included and the maximum number of land use classes was thus five. The average rank was similarly calculated. The reciprocal of the mean importance value was used in order to provide the most important species with the highest numerical values. The final rankings are presented diagramatically in Figure 3.

TABLE 17. Importance values for the most important 15 alien plant species in each of five land use areas within Natal

Alien plant species	Agricultural grazing lands	Nature conservation estate	Utility areas	Sylvicultural estate	Urban open-space	
					Coastal	Inland
Acacia dealbata	25	27	23	32,5		33,7
Acacia decurrens	45		52,2			
Acacia longifolia			46,7		53	
Acacia mearnsii	22	20,5	26,7	33		33,7
Acacia melanoxylon				35		49,7
Caesalpinia decapetala	47,5	44	50,7	34,5		42,2
Cardiospermum grandiflorum					23,5	
Cassia didymobotrya					50,2	
Cestrum laevigatum		67		46,7	41,5	
Chromolaena odorata	29,5	9	25,5	23	17,2	
Cotoneaster species						48
Eupatorium adenophorum	48		57,2			
Lantana camara	33	20,5	31,5	27	17,2	
Leucaena leucocephala					41,2	
Litsea sebifera					56,2	
Melia azedarach	50	36	29,2	65,5	59	38
Montanoa hibiscifolia					37,7	
Opuntia aurantiaca	39,5		62			23,5
Opuntia ficus-indica	51	53				23
Pereskia aculeata		22,5		28	20	
Pinus patula		57		53,2		45,2
Populus alba/canescens			44,5			47,7
Psidium (complex)	54	35		44,5	57,5	
Pyracantha species						48
Ricinus communis				60,5		
Rubus cuneifolius	13	43,5	30,5	34,5		18
Salix babylonica						68,7
Schinus terebinthifolius	57		67,7			
Sesbania punicea	37,5	60	22	60,5	50,5	38,5
Solanum mauritianum	48	43	30,5	21,5	40,2	38,2
Solanum seaforthianum		62				
Tithonia diversifolia					35,2	

TABLE 18. Priority ranking of alien plant species by land use type in Natal

Alien plant species	Agricultural grazing lands	Nature conservation estate	Utility areas	Sylvicultural estate	Urban open-space	
					Coastal	Inland
Acacia dealbata	3	5	2	5		4,5
Acacia decurrens	8		12			
Acacia longifolia			10		12	
Acacia mearnsii	2	2,5	4	6		4,5
Acacia melanoxylon				9		14
Caesalpinia decapetala	9	10	11	7,5		9
Cardiospermum grandiflorum					4	
Cassia didymobotrya					10	
Cestrum laevigatum		15		11	9	
Chromolaena odorata	4	1	3	2	1,5	
Cotoneaster species						12,5
Eupatorium adenophorum	10,5		13			
Lantana camara	5	2,5	8	3	1,5	
Leucaena leucocephala					8	
Litsea sebifera					13	
Melia azedarach	12	7	5	15	15	6
Montanoa hibiscifolia					6	
Opuntia aurantiaca	7		14			3
Opuntia ficus-indica	13	11				2
Pereskia aculeata		4		4	3	
Pinus patula		12		12		10
Populus alba/canescens			9			11
Psidium (complex)	14	6		10	14	
Pyracantha species						12,5
Ricinus communis				13,5		
Rubus cuneifolius	1	9	7	7,5		1
Salix babylonica						15
Schinus terebinthifolius	15		15			
Sesbania punicea	6	13	1	13,5	11	8
Solanum mauritianum	10,5	8	6	1	7	7
Solanum seaforthianum		14				
Tithonia diversifolia					5	

TABLE 19. Joint priority ranking of invasive alien plant species in Natal

Species	No of land use classes in which species present in top 15 species	Average rank where present in top 15 species	Mean importance value (I)	Reciprocal of I X 100
Chromolaena odorata	5	2,3	20,8	4,8
Acacia mearnsii	5	3,8	27,2	3,7
Acacia dealbata	5	3,9	28,2	3,5
Lantana camara	5	4	25,8	3,9
Rubus cuneifolius	5	5,1	27,9	3,6
Solanum mauritianum	5	6,5	36,2	2,8
Sesbania punicea	5	8,3	43,7	2,3
Melia azedarach	5	9	43,7	2,3
Caesalpinia decapetala	5	9,3	43,8	2,3
Psidium (complex)	4	11	47,6	2,1
Pereskia aculeata	3	3,7	23,5	4,3
Opuntia aurantiaca	3	8	41,7	2,4
Opuntia ficus-indica	3	8,7	42,3	2,4
Pinus patula	3	11,3	51,8	1,9
Cestrum laevigatum	3	11,7	51,7	1,9
Populus alba/canescens	2	10	46,1	2,2
Acacia decurrens	2	10	48,6	2,1
Acacia longifolia	2	11	49,8	2,0
Acacia melanoxylon	2	11,5	42,3	2,4
Eupatorium adenophorum	2	11,7	52,6	1,9
Schinus terebinthifolius	2	15	62,3	1,6
Cardiospermum grandiflorum	1	4	(23,5)	4,3
Tithonia diversifolia	1	5	(35,2)	2,8
Montanoa hibiscifolia	1	6	(37,7)	2,7
Leucaena leucocephala	1	8	(41,2)	2,4
Cassia didymobotrya	1	10	(50,2)	2,0
Cotoneaster species	1	12,5	(48)	2,1
Pyracantha species	1	12,5	(48)	2,1
Litsea sebifera	1	13	(56,2)	1,8
Ricinus communis	1	13,5	(60,5)	1,7
Solanum seaforthianum	1	14	(62)	1,6
Salix babylonica	1	15	(68,7)	1,5

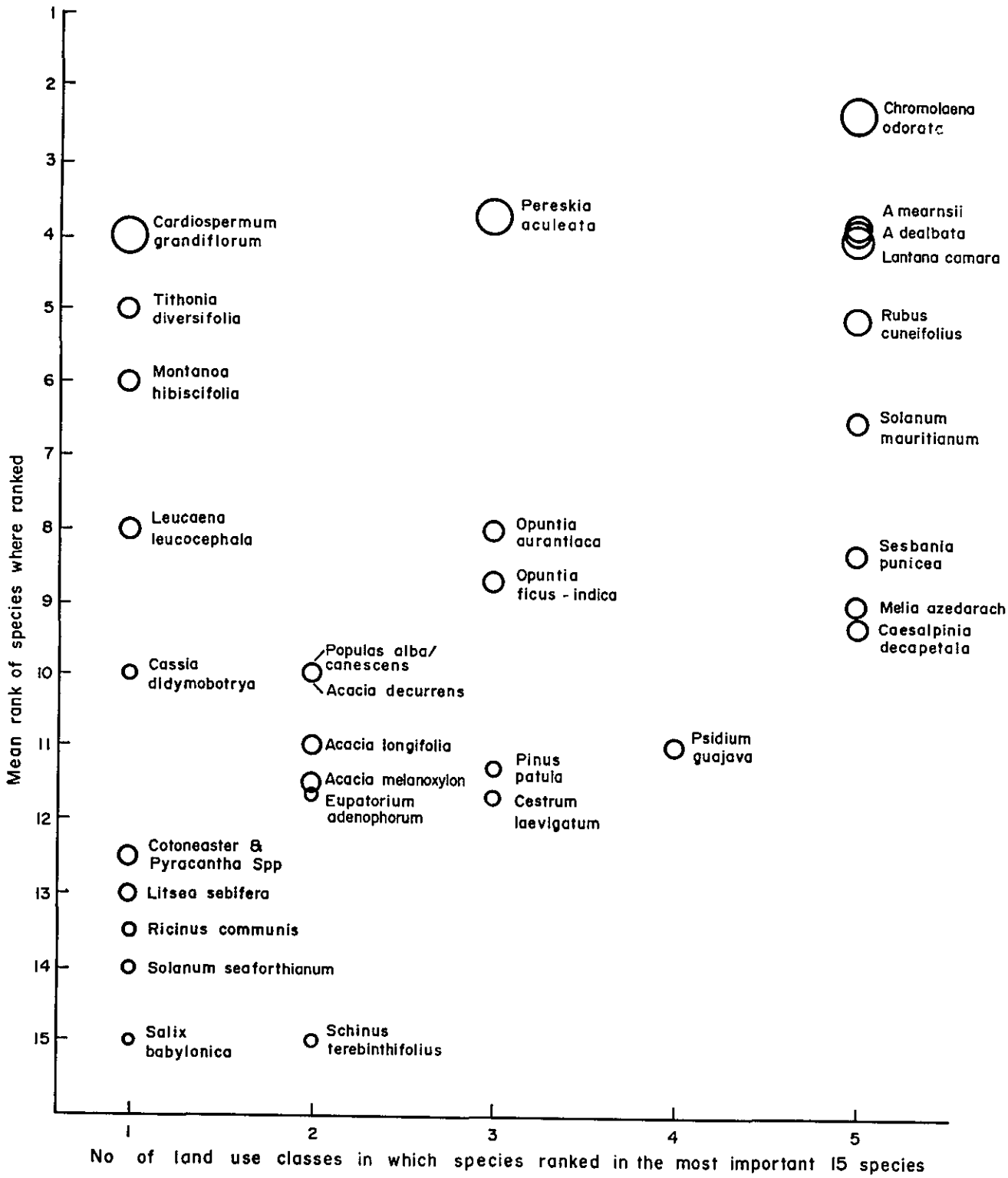

FIGURE 3. The relative importance of the main invasive alien plant species in Natal.

CHAPTER 4. CURRENT CONTROL PROGRAMMES

KWAZULU RESERVES
R A Conant - KwaZulu Bureau of Natural Resources

Alien plants are increasingly being recognized as a major threat in many of the areas controlled by the KwaZulu Bureau of Natural Resources. As such, the problem is commanding an increasing amount of time, labour and finance in the various reserve areas. While it is recognized that the elimination of established aliens from the whole of KwaZulu may well be an impossible task, the policy is to eradicate invasive aliens within reserves and to control and eliminate any new infestations. This is done in the full awareness that any hope of success will involve coordination and cooperation with other bodies who control land use (eg Forestry, Agriculture) in the region. A programme for coordinating the approach to the problem is currently being investigated.

The Bureau of Natural Resources is actively managing the alien plant problem in four areas at present. These are Amatikulu Nature Reserve, Tembe Elephant Park and the Kosi Bay area, including the Manguzi, Malangeni and Ngoye Forests.

Amatikulu Nature Reserve

In this reserve, the alien problem is by far the greatest of the above-mentioned four areas. It is also the area with greatest activity in the management of the problem. Although some 25 alien species have been identified in the reserve, three species, Lantana camara, Chromolaena odorata and Pereskia aculeata are the most serious invaders and control work has largely been focussed on these species, with other species being tackled incidentally to these.

At Amatikulu, which for alien management purposes is combined with Ngoye Forest, R35 000 was budgeted for alien control in 1984. Control work will begin in 1985 at Ngoye Forest, with clearing of forestry established species as a first priority. The professional officer initially surveys and maps alien infestations and recommends a control policy for the reserve.

In Amatikulu and Ngoye there are currently alien control teams of 12 women plus supervisors. Initially, these 12 women worked as one team, but it has subsequently been found to be more efficient to use these women as two groups of six and this may be modified to groups of four at a later date. It has been found most efficient to make each group responsible for their

own area (approximately 40 ha blocks) and the task is for the group to initially clear an area and then to do all follow-up weeding, spraying, etc in this block. New areas are not tackled until a designated area is cleared. Strict supervision would seem to be necessary and is lacking here with the result that plants have been missed during follow-up operations. The human factor is the most difficult problem with control work. After the initial clearing during which most of the plants are cut, stacked and burnt, coppice growth and surviving large plants are sprayed as follows:

Lantana camara - A three per cent solution of Roundup (Glyphosate), applied using a calibrated knapsack sprayer with a cone nozzle, has given coppice and small bush mortality rates higher than 95%. Roundup (1,5%) has given mortalities in excess of 90%. A two per cent solution has been tried but the results have not yet been evaluated.

Chromolaena odorata - Roundup (three per cent) gives greater than 95% mortality of coppice and small bushes. Roundup (1,5%) gives variable results depending on the coverage on the plant. Where low coppice growth is sprayed the plants generally die. Larger bushes wither slightly but generally survive. The results of spraying with a two per cent solution have not yet been evaluated.

Pereskia aculeata - Infestations are hand cleared with as little disturbance of the natural vegetation as possible. The climbing shoots are pulled out of trees and burnt. Hand weeding and spraying of new shoots is then carried out. Spraying results are as follows: Roundup (4%) - greater than 98% mortality of new shoots; Roundup (2,5%) - less than 15% mortality. (Most shoots withered and died at ends but survived); Roundup (1,5%) - less than five per cent die off.

Other species in Amatikulu have been dealt with as follows:

- Melia azedarach - Large trees are ringbarked. Seedlings have been sprayed with Roundup (1,5%) with 100% mortality.
- Solanum mauritianum - Large trees are chopped down. Coppice and seedlings are sprayed with Roundup (1,5%) resulting in mortality rates in excess of 90%.
- Ricinus communis - Plants are easily hand weeded. This species is seen to be a pioneer which is quickly out-competed by native plant regrowth or reinfestation by more competitive alien species. Roundup (1,5%) has given mortalities higher than 90%, although larger plants have been found to be somewhat more resistant.
- Sesbania punicea - Sprays of Roundup (1,5%) have resulted in less than 10% mortality.
- Cestrum laevigatum - Shrubs sprayed with Roundup (1,5%) were unaffected.
- Psidium guajava - Plants have been chopped down - no coppice growth has yet occurred.

Despite the considerable effort expended to date, it is estimated that less than one per cent of the alien plant problem at Amatikulu has been adequately dealt with. With the money available through Employment Opportunity, it is hoped to have a 30 women control team operating in the reserve in the future. In addition, trials with the herbicide Garlon (Triclopyr) are planned.

Tembe Elephant Park

At Tembe the alien plant problem is fortunately not too severe, being confined to isolated patches of Pereskia aculeata, Opuntia species and Melia azedarach. A full-time team of six men is currently clearing these infestations. Pereskia aculeata constitutes by far the most serious problem and has been dealt with as at Amatikulu. Six isolated infestations were controlled in 1983. Spraying of new sprouts has shown variable results, possibly due to the dry nature of the habitat. When the plants are not actively growing, spraying has been found to be less effective than following good rain. Follow-up operations have continued and several new large infestations of Pereskia aculeata are now being dealt with. With fencing of the reserve nearing completion, more labour will be available to deal with the problem in 1985. Interestingly (and sadly) at Tembe, infestations have been noted which have either grown from seed, or vegetative reproduction, with the propagules having probably been transported by animals; probably elephants.

Melia azedarach - is very localized and has been adequately dealt with by ringbarking mature trees, chopping down saplings and spraying with Roundup. Two localized infestations of Opuntia species have been adequately dealt with by hand-clearing and burning. A total of R5 900 was spent in 1983 on alien control in this reserve.

Kosi Bay area

The only alien plant species so far identified as a major threat in this area is Pereskia aculeata. Several isolated, but serious, infestations have been cleared by a team of 12 women using the method previously described for Amatikulu. Chemical spray follow-up has not been used here. Although these infestations are now under control, constant follow-up weeding has been necessary.

Alien plant control is recognized by the Bureau of Natural Resources as a major management consideration in all reserve areas and new areas such as KwaZulu Forests will be surveyed and the problem tackled as money and staff become available.

It is recognized that the problem can never be contained unless areas outside reserves are also tackled. As the areas are so extensive, it is felt that the only hope of even a degree of success is to involve the people resident in the areas concerned. To this end, a public awareness campaign is being planned by the Bureau's extension staff, stressing the potential hazard to livestock of some of these plants, as well as the fact that infested lands are rendered useless for grazing and crops. This education programme will be run in conjunction with a similar programme to be implemented by the KwaZulu Agricultural Extension Officers. KwaZulu Department of Forestry also has an active alien control programme, mainly in plantations, but including areas of natural forest as well. New ideas are welcomed.

NATAL PARKS BOARD RESERVES
R N Porter - Natal Parks Board

Alien plant infestations in Natal Parks Board reserves have been a cause of concern for several decades. Attempts have been made at various times to control or eliminate such undesirable infestations where they occur. It is a Natal Parks Board policy, as stated in the management plans for the various reserves, to maintain the diversity of indigenous plant species occurring in the reserve and to remove alien plant species outside intensive-use areas. It is only within intensive use areas that special consideration is given to plants permitted in gardens, but here the emphasis is rather on those plants indigenous to Natal. Lists of desirable and undesirable plants for gardens are drawn up for each reserve.

In several game and nature reserves where extensive alien plant infestations occur these have been surveyed and in certain cases detailed reports have been written. The findings of these investigations are presented to a management meeting which determines priority areas and species for removal.

Within the priority areas control operations are usually initiated at the head of a catchment and progress in a downstream direction. However, at Mkuzi Game Reserve a different approach is used. Blocks 25 ha in size are prepared with permanent markers at each corner and cut-lines between the markers. Search and removal of alien plants is then carried out in these blocks in a systematic manner.

Favoured removal methods are cut and/or burn, followed by digging and hand pulling of seedlings. Herbicide treatments are employed in some reserves but are not in general usage. After initial removal follow-up operations are conducted and may be repeated several times before an area is free of alien plants. Monitoring reinvasion of previously cleared areas is undertaken. This is done either along permanently marked transect lines or in 10 m x 10 m plots. Within some of the larger reserves an alien plant sighting form has been adopted as a means of recording new or previously unknown infestations of alien plants.

Funding for alien plant control in a reserve is dependent on a detailed motivation for the funds as well as the setting and accomplishment of goals. The control of alien plants has become increasingly important in Natal Parks Board areas (Table 20). For example, in the 1977/78 conservation budget 0,3% was used for this work, but had increased three fold some four years later. The amount allocated for alien control in nature reserves in the different regions is given in Table 21 from which it is apparent that 82,1% of allocated funds are being spent in the Northern (Zululand) and Southern region. Amounts allocated to some selected reserves is shown in Table 22.

For alien plant removal operations to be successful, funds must be adequate for the task and supervision of labour should be thorough and frequent. However, seed either entering the reserve from beyond the boundaries or being dispersed from infested areas within the reserve remains a serious problem for most nature reserves.

Acknowledgements

The following are thanked for their assistance: Messrs J Forrest, D Densham, P Goodman, A Wills, P le Roux, R Taylor, P Thomson and Drs O Bourquin and G Hughes.

TABLE 20. The percentage of the budget and amount spent on alien plant control in Natal Parks Board conservation areas

Funding	1977/78	1981/82	1983/84	1984/85
% of conservation budget	0,3	0,9	1,0	0,8
Amount (R)	11 570	67 890	96 295	96 090

TABLE 21. Allocation according to region of the 1984/85 funds for alien plant control in Natal Parks Board conservation areas

Region	Amount (R)	%
Northern	54 170	56,4
Southern	24 750	25,7
Western	12 120	12,6
Coastal	5 050	5,3
TOTAL	96 090	100

TABLE 22. The amount in Rand allocated to selected Natal Parks Board reserves and the number of major alien plant infestations found in these areas

Reserve	Amount (R)	No of infestations	
		Very extensive	Moderately extensive
Hluhluwe G R	16 050	2	2
Ndumu G R	13 220	4	3
Umfolozi G R	10 930	2	2
Krantzkloof N R	7 350	1	-
Vernon Crookes N R	7 000	3	-
Mkuzi G R	6 880	4	3
Charter's Creek	6 350	3	5
Itala N R	2 500	4	1

G R = Game Reserve
N R = Nature Reserve

STATE FOREST LANDS
W R Bainbridge - Department of Environment Affairs

A standard component of the policy statements for each natural area managed by the Directorate is the control of invasive alien plants. This is related to the maintenance of genetic diversity of the natural communities.

The Directorate is currently designing an environmental monitoring programme which will include determining the extent of all problem plant infestations in each management unit (compartment) and enumerating the eradication work that has been carried out.

The Directorate tends not to use residual chemicals such as Tordon (2,4-D or 2,4,5-T mixed with picloram) in natural areas. In Zululand, only mechanical measures have so far been employed. This has not proved satisfactory with some species (eg Psidium guajava) and the policy is currently under revision.

In Natal, both mechanical and chemical control methods are employed, with preference given to non-residual chemicals when chemicals are used.

Very little detailed information on costs per ha are available. These statistics are of little value due to the great variability in the degree of infestation and marked differences in control effort required for the removal of different species.

The total budget for alien plant control in the Natal Region has varied between R30 000 and R50 000 pa. In Zululand, the annual budget is in the vicinity of R15 000.

DURBAN MUNICIPALITY
G A Nicols - Parks, Recreation and Beaches Department

The Durban Parks, Recreation and Beaches Department has, since 1979, been actively involved in attempting to control and eradicate alien plant invaders on road verges and open spaces within the City. The other area where they are involved in the control of alien plants is within the urban natural park systems, and in particular since 1980, in two parks, namely Burman Bush and Pigeon Valley. In June 1983 they began working in portions of Virginia Bush in Durban North.

Since June 1984, much work has been done in eradicating aliens from the banks of the Umgeni and Umbilo Rivers. This work is being carried out along the lower reaches of the two rivers where nature trails are being developed.

In both Burman Bush and Pigeon Valley the department inherited legacies of mis-management due to the forest being cleared for one reason or another. The "rot" set in when the department did not monitor the situation closely enough during the late nineteen fifties and early sixties. In a matter of 15 years the problem had become enormous when they finally decided to try

and reverse the process in the late seventies. In Burman Bush ±13 ha of the total 50 ha was overrun with alien plant species. In Pigeon Valley ±0,5 ha of the total five hectares was infested. The 38 ha of Virginia Bush is totally infested with alien weeds and, by rough estimation, 60% of the total plant biomass is alien. The Chromolaena odorata Working Party during 1981 carried out field trials in Virginia Bush of chemical and mechanical control, plus a combination of both methods. However, these trials were not all that conclusive because there was no follow-up after the initial treatment.

However, in June 1983 a winter cutting and digging programme was instituted. This has proved to be very successful. Since spring 1983, the Plant Protection Research Institute (PPRI), through Mr Danie Erasmus, has been conducting further field trials on Chromolaena odorata involving herbicides and the replacement of C odorata by planting Chrysanthemoides monilifera in cleared areas.

A herbicide control programme has been started with the spraying of coppicing rootstocks of Lantana camara, Chromolaena odorata, Litsea sebifera and Tithonia diversifolia. This spot spraying treatment of individual plants has proved most effective in controlling the invader plants in our natural areas.

In certain areas where Chromolaena odorata and Lantana camara have been burnt either purposely or accidentally, the use of a herbicide on the coppicing rootstock or stump has been very effective. This is especially important around forest and bushclump edges, where to disturb the soil by digging up stumps would only encourage alien plant seedling growth.

The herbicides used are:

(i) Roundup (Glyphosate) at a 1,5% solution being sprayed through a hollow cone nozzle onto the leaves until visibly wet - this mixture gives a 95-100% mortality in both Lantana camara and Chromolaena odorata. Application rate used was approximately 500 litres per hectare.

(ii) Garlon (Triclopyr) at a 1% solution on Chromolaena odorata is 100% effective. However, on Lantana camara, only leaf-drop is achieved and the plants survive. A 0% effectiveness is achieved. Tests are underway using Garlon at a 0,5 % solution strength. Application rate used for both concentrations was approximately 500 litres per hectare.

The following mechanical control methods have been employed:

- Bushcutters and slashers have been used for the initial cutting down of established infestations. Mattocks and hoes have been used to dig out rootstocks.

- Selective weeding by hand-pulling seedlings that have grown since the initial clearing is usually carried out six to eight weeks after the initial clearing. This method constitutes 80% of the follow-up operation.

At the beginning of 1979 Mark Hazell began the huge task with eight labourers and during 1980 a further 10 temporary labourers were employed

to help speed up the operation. The end of 1980 saw huge areas, some as large as half to one hectare in size laid bare - this caused a fair amount of concern as the well meaning public suddenly saw the sacrosanct Burman Bush being denuded.

However, after some media publicity the work being carried out was put into perspective. These barren areas suddenly started to turn green with germinating seedlings after the first spring rains of 1980, and it was then clear that the local flora was beginning to re-establish itself.

The most common and prolific of the plants colonizing the moist shady areas are Isoglossa woodii and Asystasia gangetica. The forest grasses, of which Setaria megaphylla is the largest and most dominant pioneer, attract birds which, in turn, bring in other grasses and plants. In these moist areas along pathways and in open glades the creeping grasses appear - Setaria lindenbergiana, Panicum laticomum, Oplismenus hirtellus, Digitaria diversinervis, Pseudechinolaena polystachya.

In the drier areas Peristrophe natalensis is by far the most prolific pioneer. This attractive scrambling herb produces masses of mauve flowers in autumn and is an ideal nursery crop for the more woody colonizers. The dominant grasses in the dry areas are Panicum maximum, P deustum and Sporobolus pyrimidalis. Some interesting creeping legumes also appear in both moist and dry disturbed areas of which Rhynchosia species cf R calvescens and Glycine wightii are the most frequently found. Another legume which is very obvious when in flower is Crotalaria capensis.

In some of the initial areas cleared the pioneer forest tree Trema orientalis was planted. To date the success rate of plants surviving the first season is between 60-70%. In three years the Trema orientalis plants are standing four to five metres high and providing shade for the second wave of plantings which takes the form of the slower climax trees - like Chaetacme aristata and Xylotheca kraussiana, Mimusops obovata, Turraea floribunda to name only a few.

Now, however, areas are no longer replanted with seedlings. After comparing two separate plots, it was found that there was very little advantage in doing mass replantings as the local trees naturally re-established themselves.

During the last three years the labour has been systematically moving through the cleared areas weeding out the aliens that are still germinating. Each area has been weeded approximately once every six weeks and, as the number of aliens germinating has decreased, the turn-around time is now approximately every four weeks. These men are now experts at recognizing the seedling forms of most of the plants in Burman Bush.

The department is now at the stage of marking out trails where the public of Durban will be able to wander along and enjoy the natural coastal habitats which are not often encountered in the urban environment.

The City Council has given the department all the support it requires to make the development of the Burman Bush Nature Reserve a reality, and the Environmental Committee is anxious to see further areas, worthy of retention, developed. A Management Committee has been formed under the chairmanship of the department director, Errol Scarr, representatives of

the Natal Parks Board, Universities of Natal, Durban/Westville, Centre for the Rehabilitation of Wildlife (CROW) and the Wildlife Society. It will be this Committee's responsibilty to formulate the proposals for the development of the 50 ha nature reserve in Burman Bush which is only some eight kilometres from the City Hall.

Preliminary surveys on alien invader plant species in all natural parks have been carried out and the situation will now be monitored on a regular basis. A survey of the extent of the problem throughout the city is currently being carried out. Once this is completed the department's environmental education programme will attempt to bring the severity of the problem to the notice of the public.

At present the staff involved are two horticulturists, three wardens and 26 labourers. In the 1985/86 financial year R316 000 was budgeted for the section on the revenue vote and R180 000 on the capital vote. To date most of the funds allocated to the section have gone into controlling aliens. This is now beginning to change in the established areas. There is no longer a serious alien plant problem in Burman Bush and Pigeon Valley. All mature colonies of weeds are eradicated and the main tasks are now to keep the seedlings down and prevent reinfestation from areas outside the boundaries.

CHAPTER 5. THE MANAGEMENT OF INVASIVE ALIEN PLANTS IN THE VARIOUS COMPONENTS OF THE NATAL LANDSCAPE

In this section of the workshop the five land user groups were asked to put down, in note form, their ideas on what were the essential aspects of successful control programmes and on what were the areas in most need of improvement. The following accounts are presented by land use category.

THE NATURE CONSERVATION ESTATE

R A Conant, D Freeman, F J Kruger, I A W Macdonald, R Porter, J Scotcher, W Small, M Ward, A J Wills, J Wyatt and G Zaloumis

The politics of controlling aliens

The overall importance of adequately motivating the control requirement to the conservation authority was stressed. It should be borne in mind that control programmes will be in competition for funds with projects which show "positive" results. Quantification of extent and impact of infestations is important. Photographic records of before and after control can provide a positive result for feedback to the controlling authority. It is also extremely important that the financial requirements of the programme are adequately estimated from the outset. Underestimating the requirement will lead to programme failure and possibly to the complete discontinuation of the programme.

The prevention of new aliens

All management authorities should anticipate future invasions by alien plants. History has shown mean invasion rates of between one new species per year to one new species per four years in the Natal lowland reserves. Recent indications from the 900 km^2 Hluhluwe-Umfolozi Reserve are that the rate of inadvertent/self-dispersed arrivals is now about one per year which is greater than was the mean rate in the reserve's entire history.

There are a number of strategies that conservation organizations can employ as preventative measures:

(1) limitation of human introductions eg into gardens, with animal fodder;
(2) creation of a buffer zone of alien-free vegetation around reserves;
(3) preventative veld management, eg maintaining a healthy grass sward; and
(4) integrated catchment management with surrounding neighbours.

These approaches are elaborated below.

(1) Limiting the introduction of alien species by humans:

A large proportion of invasive alien species in conservation areas were introduced via staff living in the area. Examples include the introductions of Lantana camara, Cassia didymobotrya, Solanum seaforthianum and Jacaranda mimosifolia as garden plants. These situations can easily be avoided by not allowing alien species to be brought into the area. A statement to this effect should be documented in the management plan for the area. A list of permissible species could be drawn up, providing the species have no record of being invaders. This is largely to provide staff with the opportunity to grow vegetables for local consumption.

A further problem has been encountered in the introduction of alien species via imported vegetable material used in local construction as invariably a certain amount of seed is carried in the material. An example of this is the introduction of an alien grass species to Mkuze Game Reserve, via a load of thatch grass imported from Itala. This species is now established and spreading in Mkuze. Therefore the importation of any plant material should be strictly controlled and any waste or leftover material collected and destroyed.

(2) Creation of a buffer zone

Beyond the boundaries of all conservation areas in Natal lie large tracts of land severely infested with alien plants. These areas provide an unending source of seed which invade the reserves. This supply of seed obviously has a negative impact on any alien plant control operations that take place in the reserve as the alien plants quickly recolonize newly cleared areas. Furthermore, they rapidly colonize every available gap, slowly spreading into the reserve from the boundary fence. As a preventative measure it is essential that buffer zones be created on the reserve boundaries. These zones should be created using an integrated management approach with the boundaries of the zone being decided upon by the two (or more) authorities controlling land use on either side of the boundary line.

(3) Preventative veld management

Various management techniques may be applied:

- The maintenance of a good vegetative cover by managing herbivore populations. In particular, overutilization of the herbaceous layer, the forest understorey and ecotonal areas should be prevented.

- The maintenance of grass vigour by judicious burning, to remove excess dead material. This prevents the loss of basal cover which would result from the sward being allowed to become moribund.

- The protection of fire-sensitive forest ecotonal areas, as alien plants rapidly invade forest ecotones which have been damaged by fire.

The above management techniques could obviously be applied throughout the whole reserve to prevent the formation of any gap suitable for alien plants. However, the longevity of some alien plant seed already present in the soil would dictate the application of these preventative management techniques in the medium or long term. This in turn, may contravene stated objectives for the reserve such as "maintenance of species diversity" as indigenous pioneer species would be denied the opportunity to establish, set seed to any significant extent and thus maintain a viable population. Furthermore, such practices applied in the long or medium term may reduce the resilience of the system which is highly undesirable in conservation areas (Walker 1980). Therefore it is suggested that an "alien plant free zone" should be created just inside the perimeter of the reserve. This zone should be managed using the above preventative techniques and constantly monitored for alien plant invasions and if any do establish they should be removed before they set seed. The advantage of this technique is that it can be instantly applied and effectively creates a "buffer zone" within the reserve boundaries. Maintenance of this alien-plant-free zone can be discontinued (if desired) once a buffer zone has been created around the reserve. However, the implementation of an external buffer zone will take time due to political and logistical constraints (for example the authority controlling land use on the other side of the boundary may have different priorities or have insufficient funding to assist in the creation of the buffer zone). This alien-plant-free internal buffer zone would only be applicable to the larger conservation areas where "overabundant" herbivore populations may occur from time to time. In smaller areas where "overabundant" herbivore populations are not present these preventative management techniques should be applied throughout the area. This practice is already being implemented in some of the small Natal Parks Board areas.

(4) Integrated catchment management

Ultimately the best way to combat alien plant invasions is systematic removal of all aliens within a whole catchment. However, rarely is a single authority in control of the entire catchment area. Therefore, it is essential that the authorities controlling the catchment liaise with respect to the planning and execution of priority alien plant control operations in order to achieve the maximum benefit from their "pooled" available resources.

Management of invaded reserves

In cases where reserves are already invaded by alien plant species, policy decisions must be taken on the following points:

- whether to aim for absolute control or control to achieve acceptable levels of infestation;
- establishment of factors and principles governing acceptable control measures; and
- establishment of priority ratings of the alien species present.

The following procedural steps should then be embarked on:

(1) Survey and evaluation of levels of infestation

The minimal scale for surveying alien plants within a reserve is a function of the area of management units, ie the units relevant to the formulation of control operation plans. The sampling scale is also a function of the size and pattern of infestations, the ease of detecting these infestations and the objectives of control operations (eg the containment of infestations versus their total elimination).

The level of detection required in the survey depends on whether the invasion is incipient or established. If the former, then one needs a very high level of detection to weed out the fore-runners of what could turn into a major infestation. It is also dependent on the type of invasion site and whether the invasion is dispersed or linear.

(2) Priority allocation

Priorities must be established for control programmes. The following considerations should be borne in mind when establishing priorities:

- units should be assigned to priorities per management unit;
- sometimes it is advisable to await the development of biocontrol techniques;
- it is necessary to assess the potential for maintaining control of priority areas;
- the constraints implicit in habitat conservation imperatives should be considered;
- the priorities implied by the objective of indigenous species conservation should be considered;
- the relative cost effectiveness of embarking on a control programme should be considered;
- the role of visitor perception of the alien problem should be considered;
- the effect of alien plant species on water yield should be given primary consideration;
- identification of the source of invasion is of primary importance, as any control programme which is initiated should attack the source of invasion. Both internal and external sources and patterns of invasion should be identified.

(3) Technique selection

Techniques must then be selected for implementation of the control programme. Guiding principles for technique selection should be developed, and again the role of cost effectiveness of the various techniques available should be given primary consideration. The likely impacts of the control techniques themselves should be determined. Are they likely to be direct or indirect and will they persist with time? What are the patterns of impacts and what are the extents of the impacts? In addition it should be clear at the outset of a control programme whether the technique to be used is short or long-term and what effect this has on the costs of control operations.

An essential ingredient in a control programme, where the implementation of a technique is involved, is the effectiveness of supervision, and the associated costs.

(4) Integration with other management practices

Alien plant control is not going to be the only management practice being carried out by an organization. Integration of the control operation with other management practices for optimization of available resources of man-power, time, equipment, costs etc, is therefore imperative.

(5) Monitoring of control operations

Without adequate monitoring, it is impossible for an organization to know whether it is actually achieving anything in a control operation. The minimum information which should be collected in a monitoring exercise it that of the total cost and the time involved. However, it is recommended that density counts, or some other numerical or species basis of data collection be implemented (Macdonald and Jarman (1984), pp 7-11).

Individual species accounts

The following individual species accounts are presented to give some idea of how the above considerations are being or can be implemented on the five most important species in Natal's nature conservation areas.

Chromolaena odorata

Veld management - the guiding principle for this species is to maintain maximum indigenous plant cover. Factors which should be taken into consideration are the following:

(1) Herbivore control should be implemented in order to keep ungulate pressure low.

(2) Forest understorey vegetation, as well as ecotones, requires protection.

(3) Nyala, Tragelaphus angasi, have been identified as ungulate species of particular concern in the opening up of forest vegetation to invasion by Chromoleana odorata.

(4) In the use of fire in a management programme, care should be taken to protect ecotones and maintain the vigour of the sward. In some reserves autumn burning along the edges of forest patches is being carried out (beware of concentrating grazing pressure) in others prescribed burning is being carried out in normal seasons, but all fires are being initiated at the forest margins so as to burn away from the forest and hence have a reduced impact on forest plants.

Control - the primary aim should be to minimize seed input and re-establish indigenous plant cover on treated sites as quickly as possible.

This can be achieved by:

(1) Manual methods - hand-pulling when the soil is damp, particularly for seedlings of up to one year. In the Vernon Crooks Nature Reserve:

hand-pulled plants have been left as a litter and brush pack. In KwaZulu areas the policy has been to burn residues in heaps.
Cutting and digging out of plants larger than year-old seedlings proves effective, particularly when care is taken to remove all lateral roots.

(2) Mechanical - brush cutter (only applicable where chemical control follows)

(3) Chemical - follows mechanical control. Tordon 101 0,75% in water - spray to dripping point. Soil sterilants - generally unacceptable in reserves. Glyphosate 1,5% - 'Roundup' in water, five litres a.i. per ha - possible deleterious effects through reduction in indigenous plant regeneration unless some form of spot application is used, eg cone nozzles

(4) Biocontrol - none available - urgently needed

Lantana camara

Veld management - the guiding principle here should be to maintain maximum indigenous plant cover.

Control - the same as for Chromolaena odorata except that the KwaZulu authorities definitely recommend burning of litter as it takes too long to break down, thus inhibiting regeneration of indigenous vegetation, and seriously restricting access for follow-up weeding. The PPRI is currently stepping up work on the biocontrol of this species. Research into this has now been going on for some twenty years.

Acacia dealbata, A mearnsii

Veld management - the guiding principle here should be to maintain maximum indigenous plant cover.

Control

(1) Manual - seedlings occurring in dense stands are hand-pulled when soil is moist. Mature trees are ring-barked when the stem is above 10 cm in diameter.

(2) Mechanical - chainsaw felling and let them lie - do not burn early in dry season - preferably burn in mid-spring.

(3) Chemical - spray dense stands of seedlings preferably with selected herbicides. Scattered seedlings should be hand-pulled - (between 10 000 and 12 000 have been pulled per day by workers in the Directorate of Forestry), or sprayed with herbicide using a cone nozzle.

Plants less than 10 cm in diameter with green bark can be effectively treated by painting a 10 to 15 cm band on their stems with 2,4,5T in diesel (between 1:80 and 1:100 dilution). Herbicide should not be used if the bark is fissured.

(4) Biocontrol - urgently needed for seed store

Pereskia aculeata

Veld management - occurs in forests and woodland mostly around old kraal sites - no preventative management techniques currently used.

Control

(1) Manual - cut main stems and pull out of trees with as little damage as possible to indigenous trees. Allow to dry or spray with diesel and burn in area of P aculeata root growth. It is essential that all vegetative material be pulled from the trees in which P aculeata occurs, as any piece left behind later falls to the ground and sprouts, even after a year. Hand-pulling of sprouts requires careful follow-up for a considerable period of time.

(2) Chemical - sprouts are best sprayed with Roundup. A 4% solution is always effective; 2,5% is effective when the plant is actively growing. Follow-up over considerable time (10 years) is essential.

(3) Biocontrol - none known, urgently required to kill regrowth.

AGRICULTURAL GRAZING LANDS

D Erasmus, S Neser, W Pitchford, F Shone, A Wood, C J Ward and H Zimmerman

The working group produced Table 23, which summarizes envisaged improvements on existing control methods for the 15 species rated as being most important in the agricultural context, in Natal.

In addition they identified the following major issues:

(1) the need to improve the infrastructure for improved weed control in agriculture;
(2) the need for more financial assistance to farmers for weed control;
(3) the necessity to coordinate control between control organizations and state departments; and
(4) the need for legislation inter alia to prevent sale of weeds by nurseries.

THE SYLVICULTURAL ESTATE
V R Davidson, R P Denny, B Liggitt, A Priday, C Smithers and N Truter

Natural grasslands eg Drakensberg

The following procedural steps are recommended as prerequisites in an effective control programme:

(1) **Survey** of the extent and nature of the problem, and selection of the ideal management units to be utilized in control operations.

Management areas marked by natural boundaries eg catchment areas should be utilized. Categorization of a catchment area into river valleys, slopes and crests should be undertaken, taking into account that vegetation types are largely confined to topographical units.

(2) **Control** should be embarked upon taking cognizance of the following factors:
- low-ranked species should be manually controlled;
- an area basis for treating infested areas should be initiated;
- fire can be used as a management tool;
- follow-up operations are essential, and should take precedence over clearing new areas;
- the necessity for controlling erosion after weed clearance should be noted;
- rehabilitation of severely infested areas after clearance may be necessary eg planting grass after controlling wattle thicket; and
- that monitoring after weed clearance is essential.

TABLE 23. Identification of the need for improvement of existing control methods for the 15 most important weeds in the agricultural context

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	Priority rank
Melia azedarach	Solanum mauritianum	Psidium (complex)	Schinus terebinth	Opuntia ficus-indica	Eupatorium adenophorum	Caesacpiinia decap	Acacia decurrens	Opuntia aurantiaca	Sesbania punicea	Lantana camara	Chromolaena odorata	Acacia dealbata	Acacia mearnsii	Rubus cuneifolius	Species name
															Improvement on existing control methods
X				X				X				X	X	X	Chemical control
				X				X	X	X					Biological control
								X							Integ (=biol & chem) cont
	X		X												Mechanical
												X	X		Veld management
				X			X					X	X		Utilization
X						X		X		X				X	Motivation for control
											X		X	X	Follow-up treatments
					X			X						X	Identify/cont new infest.
Shortcomings in research															
											X			X	Weed ecology
	X					X				X	X			X	Seed germination
X*					X			X	X	X	X	X*	X*		Biocontrol* = seeds
		X								X				X	Varieties
	X	X	X				X			X	X	X	X	X	Select better and more economical herbicides
								X		X	X			X	Integr control induces effect of impr.veld mgt
(eg green fertilizer)											X	X	X		Utilization
		X												X	Effect of herbicides on varieties

Plantations

The following steps should be implemented when dealing with alien plant species in plantation situations:

(1) **Survey.** There is a need for weed maps of plantation situations, giving the species involved and the densities of occurrence.
(2) **Control.** The following factors should be taken into account:
- for the first three years following the establishment of plantation weed control is essential;
- management techniques aimed at improving young tree growth and forming early canopy will assist weed control;
- it is good policy to attempt to prevent seeding of weeds by timely control measures;
- weed control prior to felling may assist in weed control in subsequent rotation;
- streams should be incorporated into management blocks and receive similar weed control treatment as surrounding compartments;
- the possible use of planted trees or pasture grasses to facilitate weed control along watercourses should be investigated;
- the use of chemicals in stream areas should be limited by the detrimental effect these chemicals can have on environment and desirable species; and
- economics is the main dictator of specific weed control measures eg manual or chemical control.

Areas of Concern

The following major areas of concern have been identified by the working group:

(1) Weeds in watercourses are difficult to control due to steep topography and dense vegetation. The many weeds along streams provide a source of infestation for the plantation.

(2) Rising costs of manual and chemical control.

(3) Escalation in spread of weeds.

(4) Toxicity of chemicals used.

Gaps in information and suggested improvements

The following gaps in information and suggested improvements were identified:

(1) Labour is becoming expensive. There is a necessity for finding economic alternatives especially with rising cost of chemicals.

(2) The awareness of weeds and weed control among foresters and laymen should be increased.

(3) Improved extension activities and effectiveness, training and supervision among foresters and work teams is essential.

UTILITY AREAS*
*effectively only includes road reserves in the current section

M Wells, R Grobbler, W Hollstein, M L Jarman and J B Van der Breggen

Motivation

The motives of those responsible for road reserves are:

(1) The safety of the road - ensuring stability, preventing erosion.

(2) The safety of the road user - screening off headlights, providing shrubbery to reduce impact etc.

(3) Beautification.

Whilst not at this stage a primary motive, an accepted consideration is the need to prevent or combat invasion by aliens. For example the planting of suspect aliens eg Pyracantha angustifolia has been stopped. Existing, unwanted aliens are being controlled on a massive scale (both for conservation and beautification reasons, and for soil erosion control purposes) but, some aliens are being used to good advantage ie Eucalyptus grandis to stabilize and dry out roadside areas, Pennisetum clandestinum for general ground cover and binding, and various species for shade and screening.

Scope of the action

A great deal of money, manpower and organization is already channelled into the management of road reserves in Natal. This action is the subject of frequent requests from state and private organizations and from individual landowners, and a great deal of cooperative action is undertaken with the latter eg firebreaks, clearing, fertilizing.

Effectiveness of the action

The results are patchy, with 'clear' road reserves running through infested farmlands and vice versa. The best control of alien invaders is currently on roads such as the Durban ring road and Provincial main roads, the Stanger area, Richmond area, and Nottingham Road, Balgowan. The worst remaining areas are the Natal South Coast (Lantana camara, Chromolaena odorata) and Acacia species fringed secondary roads in the Midlands area (also with L camara and Rubus species). Also a cause for concern are the weed-infested areas that often occur just outside the road and (particularly) the rail reserves. Transport authorities are aware of this problem and are doing their best to see that so called 'dead corners' are sold off to landowners who can use them properly.

Within the limits imposed by available funds and manpower, those responsible claim to be able to control all the aliens in the reserves and to have the expertise to obtain their objectives, using mainly mechanical and chemical treatments. Whilst good control results with C odorata have already been obtained using Tordon, further experiments to obtain optimal control are about to begin.

The good results so far obtained are largely the result of appreciation of all the needs of a situation, with pre-assessment of the results of control and preparation for the establishment of alternative covers to limit reinvasion.

Room for improvement

Those consulted are obviously sensitive to a degree (within the limits of their mandate) to the conservation requirement of controlling aliens. They are also receptive, and geared to cooperative action.

It seems likely that they have not been in receipt of enough information and requests for cooperative effort on an on-going and planned basis. For example their reaction to individual landowners may be ad hoc and fragmented by comparison with what could be achieved through liaison with catchment associations or other groups who would set out to clean and maintain a priority area.

There is also room for more work on screening and then 'selling' the use of indigenous species, eg barrier plants, instead of aliens that may spread.

There is also need for more expert advice and research on stabilization of cuttings etc using indigenous seed mixtures, as there is constant pressure to use hydro-seed 'cocktails' incorporating overseas species (let alone chance weed seed inclusions).

Too much of the existing knowledge is vested in too few (usually senior) officers, who operate over large areas, and who do not have time to document all information gained so that it is readily available on a regional basis. In the event of retirement of these officers the 'state of the art' could receive a major setback with juniors repeating the mistakes and experiments of previous years. There is thus a great need for regional information and resource centres to bring together relevant research results from all sectors, to see that it is readily available and that research is geared to local needs and conditions.

The fact must be faced squarely that roads and railways will always be prime infestation routes or sources, because of traffic of people, vehicles and containers; because of wind and soil disturbance, and ideal germination conditions in bared areas and roadside ditches etc as well as fertilization programmes. For this reason inspection services need to be concentrated here as well as around airports and harbours to discover and eradicate new introductions and centres of distribution.

URBAN OPEN SPACE

G Nicholls, B Crook, A A Ferrar and L Henderson

This working group identified the following criteria as being of importance in the development of a management approach to the successful control of alien plant species in the urban open space land use category.

Objective

The major objective of management of alien plant species in the urban open space should be to try to contain invasive species rather than to totally eradicate them.

Awareness campaigns

Municipal campaigns to develop pride in neighbourhoods etc, which develop the concept of local responsibility should be organized. The campaigns should be directed towards young people. Use of videos and brightly-coloured posters is recommended.

It is essential to activate keen people. Once they have been got to the stage of commitment, organized work groups can be utilized to help open up areas for later chemical applications.

Hand-in-hand with the above objectives of awareness campaigns is the need to educate developers concerning the role etc of alien plant invaders.

Control methods

In order for successful management of the alien plant species problem in the urban open space land use category to be carried out there is a need to develop a strategy that suits the particular situation. This highlights the need for a preliminary survey and evaluation and assessment of the problem. This should be followed by working out a strategy to tackle the least infested areas first and then systematically tackle progressively worse infested areas. Carefully organized follow-up operations are imperative

Intergroup liaison

Cooperation between municipalities and other bodies is essential.

Ecological key-point

Do not create deserts. Do not burn if at all possible as nutrient recycling is very important. Exceptions may be made in the case of species that are persistent eg Pereskia aculeata and other cacti.

Major areas of concern

These are:

(1) The problem of privately owned land. It is clear that areas not under municipal ownership cause problems.

(2) The absence of active veld management programmes. There is no veld management of open lands in urban areas eg in upland areas grasslands that are not burnt or grazed are susceptible to woody invasion.

Gaps in information

Major gaps in the information available to management authorities involved in the control of alien plant species in the urban open space are the following:

(1) Cost effectiveness studies of alternate control methods;

(2) Best methods of control especially with regards to the speeding up of follow-up operations.

(3) Ecological impacts of the clearing operations. In particular the effect of clearing operations on the population dynamics of local fauna and flora communities.

Funding and Training

The following points were highlighted:

(1) Finances are often not made available because of the lack of tangible evidence of the deleterious impacts of invasive alien plants.

(2) Manpower shortages are usually linked to finance shortages.

(3) There is a lack of simple illustrated books to aid in the education of management.

CHAPTER 6. ZONATION AS AN AID TO THE MANAGEMENT OF INVASIVE ALIEN PLANT SPECIES IN NATAL

INTRODUCTION

One of the strategic considerations in planning any alien plant control operation is where control effort should begin. In all local control programmes this patterning of the control work is dictated by factors such as origin of the seed source, relative densities of infestations and, often, pragmatic considerations such as ease of access. On a larger scale, such as at a provincial level, the differential investment of control effort in different portions of an alien plant's distribution range has not yet been attempted. In this section three groups attempted to see how the zonation of Natal for the control of wind-dispersed, animal-dispersed and water-dispersed species could improve the chances of obtaining effective control. In the case of animal-dispersed species no effective zonation could be arrived at, most species already being scattered throughout their potential range, and the account of this group simply comprises a listing of the most important animal dispersed species and a statement of their current distribution range.

WIND DISPERSED SPECIES

R A Conant, R Grobbler, B Liggitt, I A W Macdonald and C Smithers

Zonation is proposed here as an aid to controlling the four wind-dispersed species recorded in the priority rating of invasive alien species in Natal (Table 19): Cardiospermum grandiflorum; Chromolaena odorata; Eupatorium adenophorum and Pinus patula.

Cardiospermum grandiflorum (Figure 3)

(1) Distribution and biology

To the best of our knowledge this species is localized to the Durban Metropolitan areas and adjacent coastal towns (as far south as Amanzimtoti) with less extensive populations in the Pietermaritzburg area. The ecosystems at risk are apparently coastal forest and riverine forest communities. The seed dispersal is short range (order of 100 m).

KEY TO ZONATION

1. First priority - objective total elimination
2. Second priority - eventual elimination
3. Elimination from reserved areas only

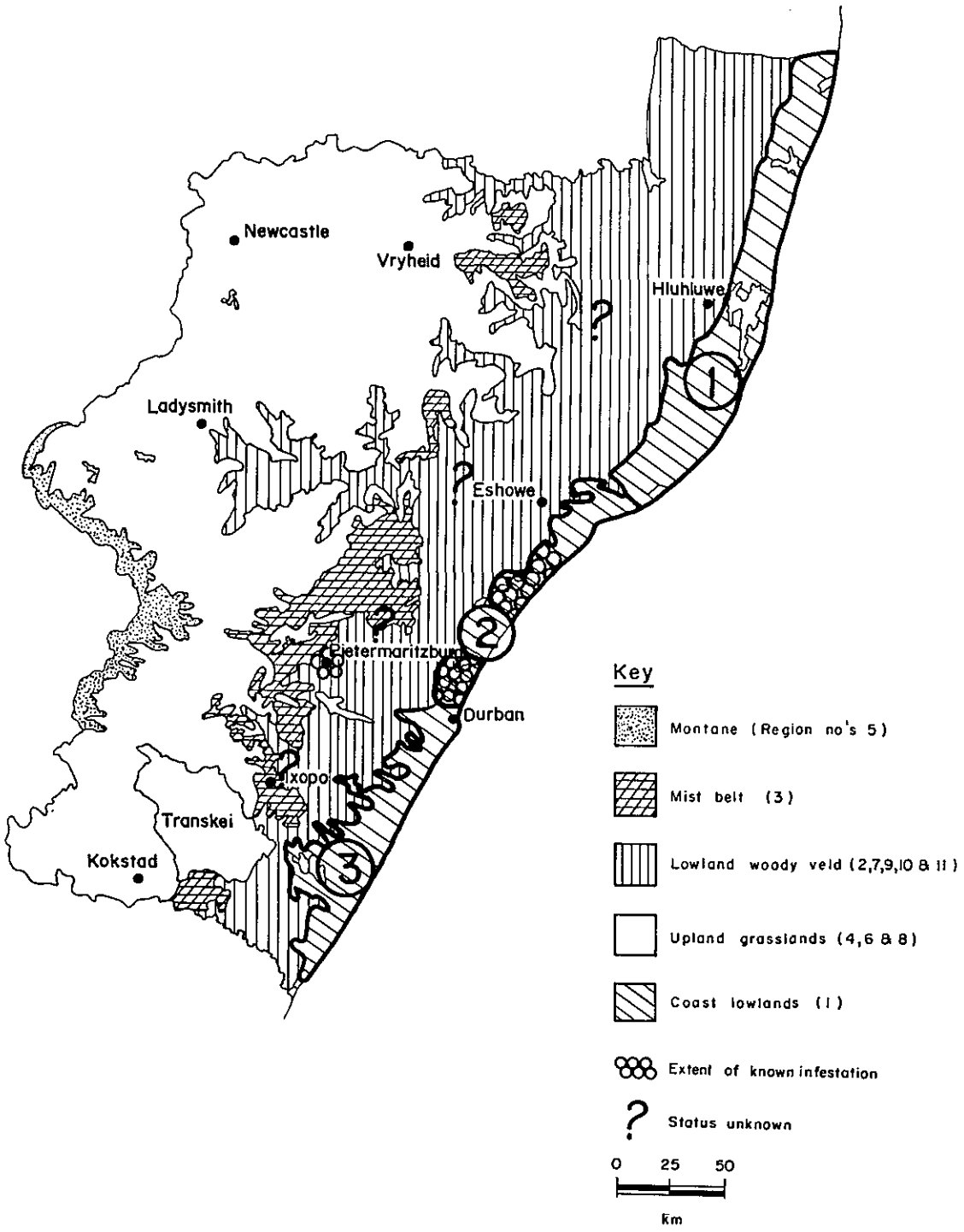

FIGURE 4. A scheme for the zonation of Natal for the control of Cardiospermum grandiflorum.

(2) Control

Zonation proposed is a belt north of existing infestations (Umlalazi Nature Reserve, Twinstreams Farm and Mtunzini inland to the Ngoye Forest); anything found in or north of this belt should be given priority control with total elimination the objective (Zone 1). Between here and Umhlanga it should be second priority rating for eventual elimination (Zone 2). South of Umhlanga the priority rating should be elimination from reserved areas (Zone 3).

Inland the policy should be to have this species declared a noxious weed in all urban areas. Possibly once the impact of this species has been fully assessed this declaration could be extended to the whole of Natal.

Chromolaena odorata (Figure 5)

(1) Distribution and biology

Chromolaena is distributed all along the Natal coastal area from the Transkei border in the south to as far north as Sordwana Bay and Lake Sibaya (? Kosi Bay) (Liggitt 1983). Outside the province it has been found along the Transkei coast, at Port Elizabeth, around Tzaneen and it has possibly been reported for Mozambique.

It appears to be controlled by frost and is not a problem west of the Natal escarpment. North of Empangeni infestations are generally fairly light, with notable exceptions at Charters Creek, Fanies Island, Hluhluwe Game Reserve and within the forestry plantations around Lake St Lucia.

(2) Control

Chromolaena odorata is so widespread that eradication is not feasible south of Empangeni. It is suggested:

- That the area north of a line drawn between Richards Bay and Ulundi be declared a priority control area since it is considered feasible to eradicate C odorata from this area. Directorate of Forestry, Natal Parks Board and other landowners should be made aware of this programme and encouraged to eliminate this alien from their land.

- A five kilometre quarantine area should be implemented along the Mozambique border. It is not possible for the KwaZulu Bureau of Natural Resources, which controls much of this area, to provide the resources necessary for the annual scouting and clearing operations which are required. Therefore a State subsidized annual clearing operation is strongly recommended.

KEY TO ZONATION

1. First priority - objective total elimination
2. Second priority - maximum suppression of infestations
X 5 km buffer zone along Mozambique border to be accorded highest priority - prevention of seed set

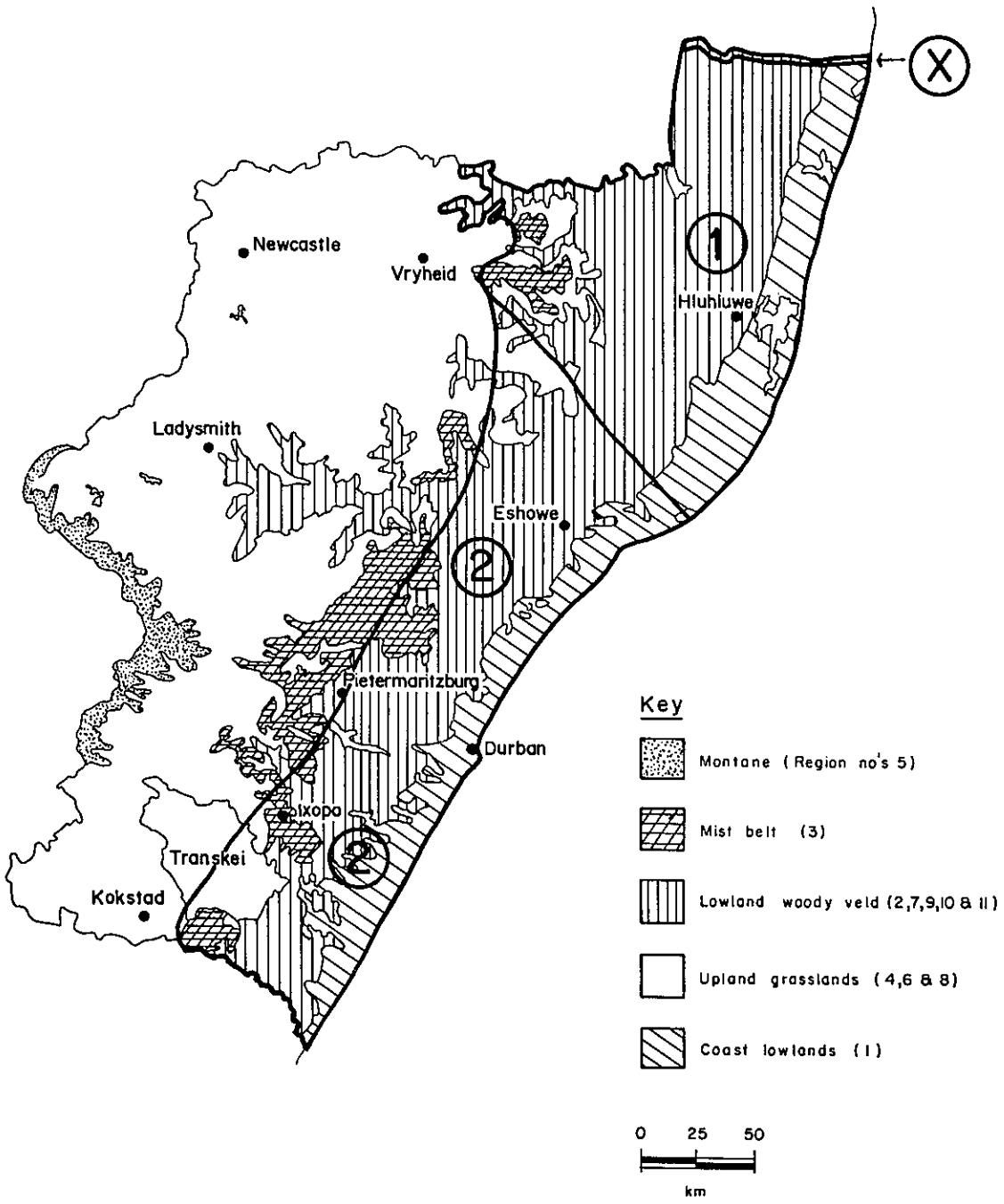

FIGURE 5. A scheme for the zonation of Natal for the control of Chromolaena odorata.

The advantages of this quarantine area are:

(a) Prevention of invasion of C odorata into Mozambique.
(b) If it does get out of control in Mozambique, the quarantine area will enable the area between Richards Bay/Ulundi and the Mozambique border to be totally cleared of this invasive alien.

- Once the priority area (Richards Bay/Ulundi to Mozambique border) has been brought under control, the conservation areas in the region south of Richards Bay should receive priority for C odorata suppression and control.

Eupatorium adenophorum (Figure 6)

(1) Distribution and biology

This species has a potential dispersal distance equivalent to that of Chromolaena odorata which has achieved a very rapid colonization of its habitat within Natal. However, this species is apparently adapted to the mist belt and lowland woody veld bioclimatic regions of Natal. Its long-term potential is thus great, particularly as so much of this area is subject to human disturbance.

(2) Control

The zonation recommended is one of total elimination by all the concerned authorities of plants in a 30 km wide belt surrounding the outer limits of its known infestation in the Pietermaritzburg area. (Utility area management authorities, plantation and urban authorities in the peripheral regions of Pietermaritzburg). The plant should be declared a noxious weed throughout Natal.

Outside this area it would also be a priority species for control but effort should not be expended here - initially a detailed survey of its distribution area should be conducted.

Pinus patula (Figure 7)

(1) Distribution and biology

As the single most important plantation species in Natal, P patula is found throughout the Province. This species has a potential dispersal of kilometres. It is not limited by altitude in its distribution and thus is a potential problem throughout the upland grasslands and mist belt regions and is one of the few species invading the montane region.

(2) Control

Zoning suggested comprises a belt including the foothills of the Drakensberg up to the alpine vegetation line; the first priority for

KEY TO ZONATION

1. First priority - objective total elimination in a 30 km wide belt surrounding the known infestations.

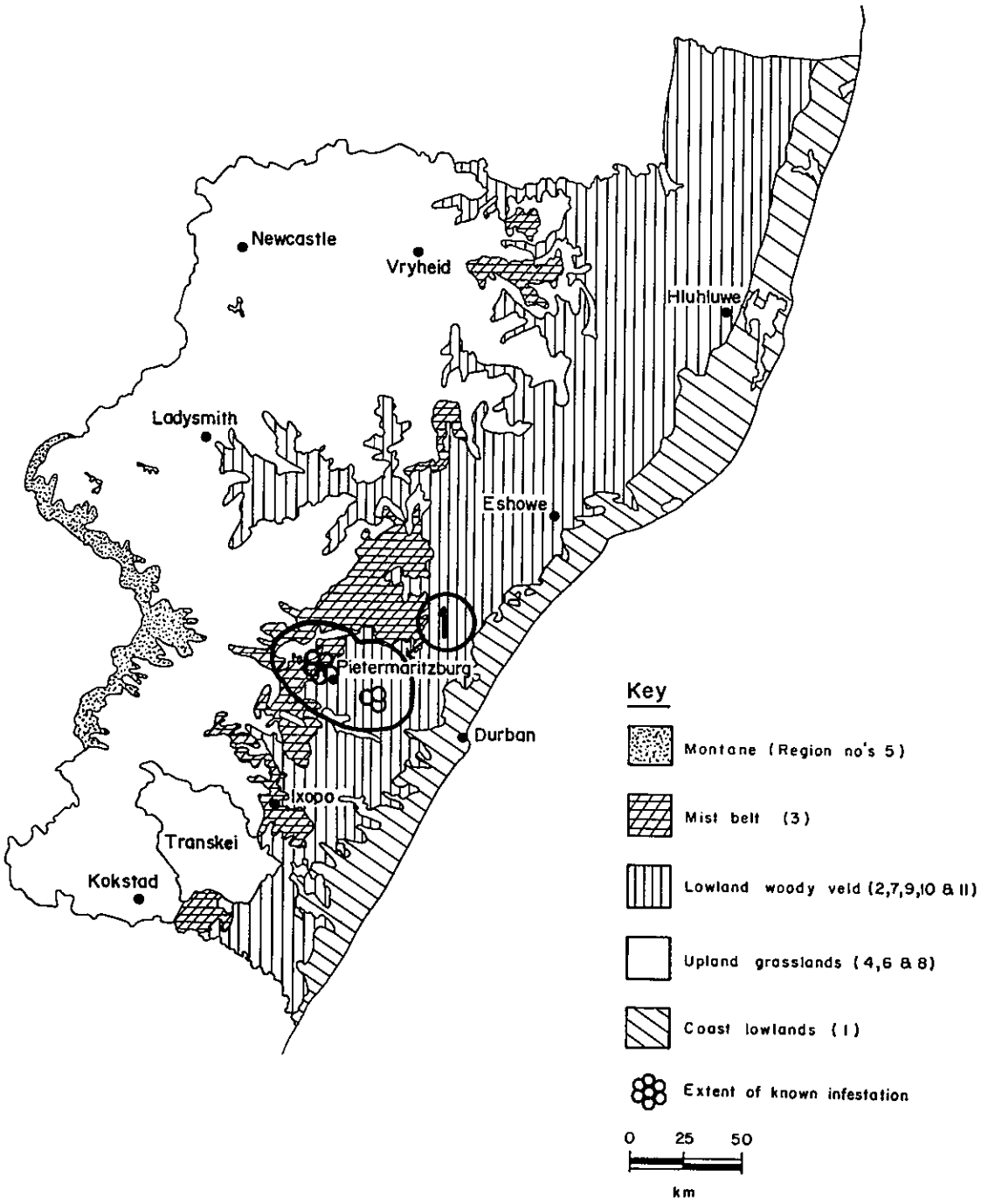

FIGURE 6. A scheme for the zonation of Natal for the control of Eupatorium adenophorum.

KEY TO ZONATION

1. First priority - maximum possible suppression of infestations.

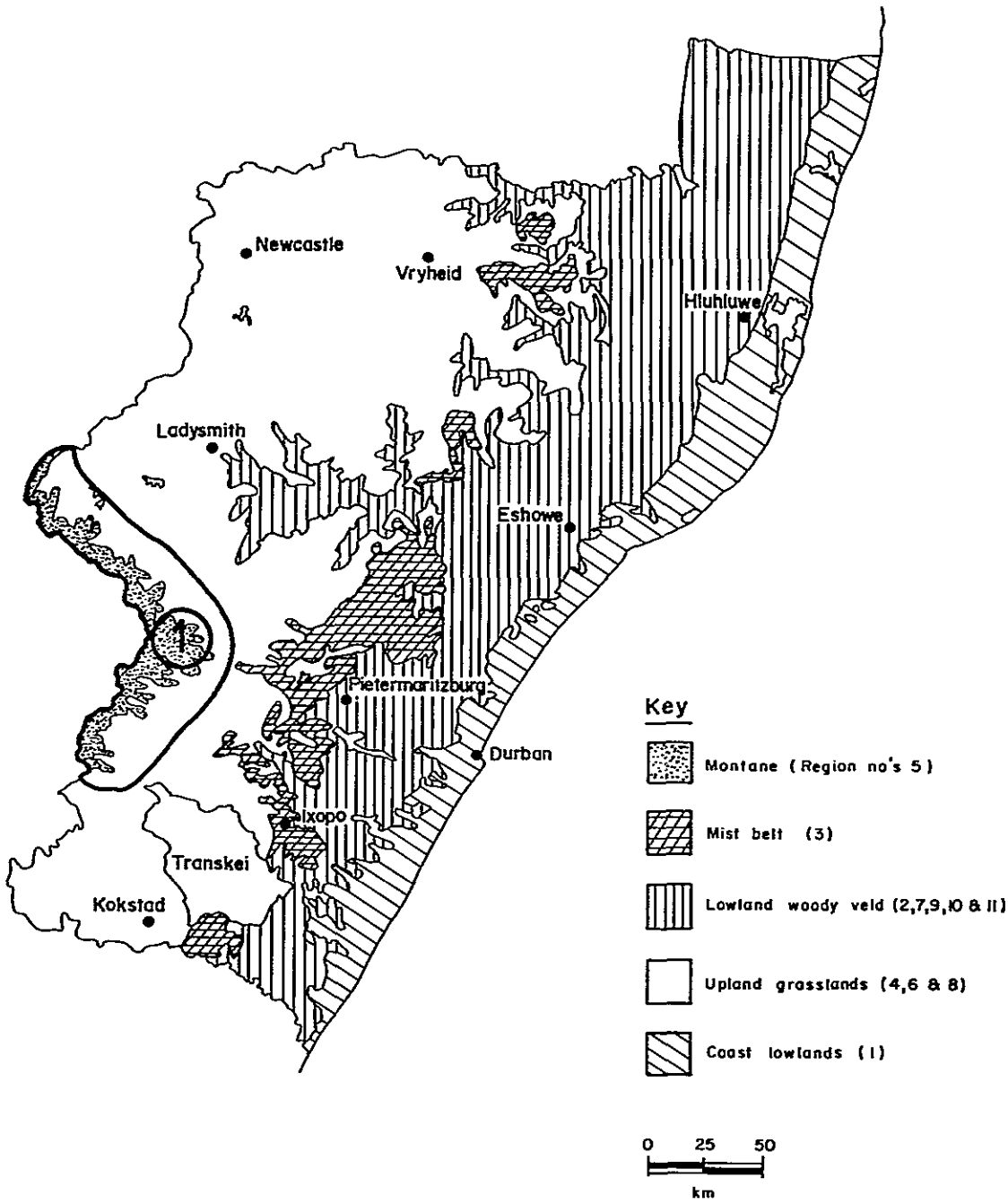

FIGURE 7. A scheme for the zonation of Natal for the control of Pinus patula.

eradication being the smaller patches and individual trees, in the northern Berg (Giant's Castle to Royal National Park); and the second priority being the southern Berg. Along the lower altitude margin of the Drakensberg conservation areas, efforts should be made to replace this species with a non-invasive analogue.

The need for public education as an aid to effective zonation

Cardiospermum grandiflorum and Eupatorium adenophorum occur in the Durban and Pietermaritzburg areas in localized concentrations at present but the potential for further spread is apparently high. In so far as these species are generally not recognized as invasive aliens by the public and by members of land-use management authorities - we recommend an intensive public education campaign be conducted, particularly for C grandiflorum which is a garden species.

ANIMAL-DISPERSED SPECIES

R P Denny, L Henderson, W Hollstein, W Pitchford, R Porter and C J Ward,

The following 16 animal dispersed alien plant species were rated as priority invasive alien plant species in Natal (Table 13). Acacia melanoxylon, Cestrum laevigatum, Cotoneaster species, Lantana camara, Litsea sebifera, Melia azedarach, Montanoa hibiscifolia, Opuntia aurantiaca, O ficus-indica, Pereskia aculeata, Psidium guajava, Pyracantha species, Rubus cuneifolius, Schinus terebinthifolius, Solanum mauritianum, S seaforthianum.

The eight most important species were then arranged in priority order and notes were made on their distribution and biology.

Lantana camara

Widespread in bioclimatic regions 1, 2 and 3 and more localized in 4. Not recorded from montane area and sparse in Maputaland. Species is most abundant in the coastal lowlands and valley bottoms.

Solanum mauritianum

Intense infestations in disturbed forest and neglected plantations in the mist belt and lowland woody veld (in particular in highlying areas and disturbed floodplains). Infestations occur throughout the rest of Natal except for the open grasslands, dryer wooded communities and montane regions. It does not appear to have reached the coastal lowlands north of Lake St Lucia.

Pereskia aculeata

Localized in the coast lowlands with extensions into the lowland woody veld particularly in Maputaland.

Rubus cuneifolius

There are widespread and intense infestations throughout the highland sourveld section of the upland grasslands and also in the mist belt and coastal hinterland of the lowland woody veld region.

Psidium species complex

Widespread throughout the coastal lowlands except for northern Maputaland and in all but the driest parts of the lowland woody veld.

Opuntia aurantiaca

Heavy infestations in rangeland areas of upland grasslands from the Tugela valley northwards with extensions into the lowland woody veld of the Tugela valley.

Melia azedarach

Widespread along rivers from upland grasslands to the coast. In coastal lowlands and lowland woody veld it occurs also marginal to forest and in disturbed areas, particularly around habitations.

Litsea sebifera

Occurs marginal to forest, disturbed parts of forest and invades forest precursor communities in coastal hinterland (particularly Eshowe area) and in the coastal lowlands, particularly in the greater Durban area.

WATER DISPERSED SPECIES

G Nichols, J Scotcher, F Shone and N Truter

Acacia dealbata and A mearnsii (Figure 8) were considered to be the most important water dispersed species. They are found mainly in inland areas; in mist belt (3) and upland grasslands (4, 6 and 8) bioclimatic regions.

They occur along all rivers in the above regions. They are also found in surrounding areas where habitat has been disturbed eg kraals, road verges, gulleys, cattle tracks and overgrazed lands. Dense infestations result in soil erosion and grazing loss in grasslands. Campaigns should be launched in farming and conservation areas.

Acacia longifolia is now encroaching in the river systems of coastal Natal in Durban metropolitan area as well as in the Weza forest and Umzimkulu area (Figure 9).

Leucaena leucocephala - coastal urban problem in Durban along waterways, stormwater drains and along small streams and rivers in the coastal towns near Durban (Figure 10).

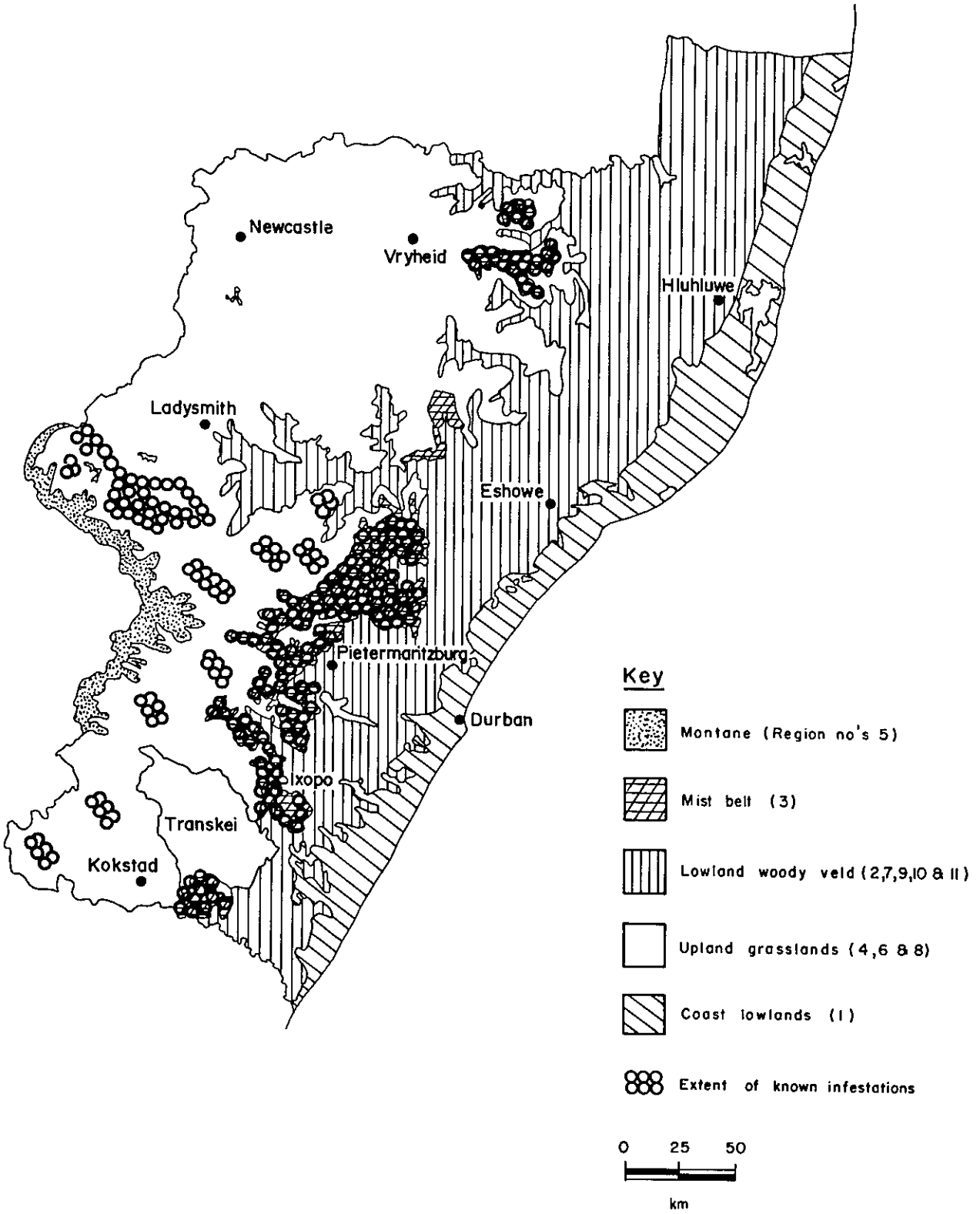

FIGURE 8. Distribution of Acacia dealbata and A mearnsii in the inland areas of Natal.

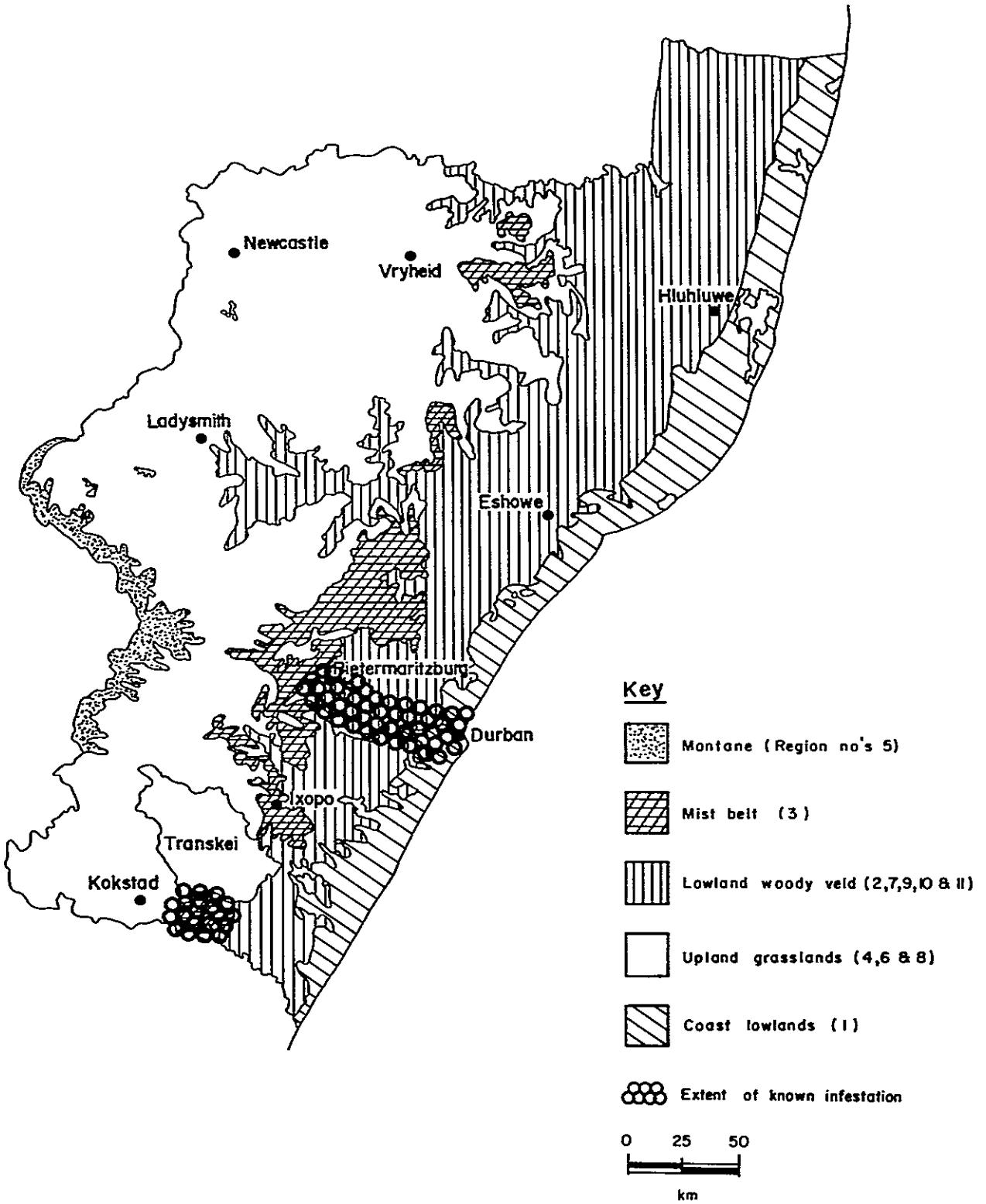

FIGURE 9. Distribution of Acacia longifolia in the Durban, Pietermaritzburg and southern Natal areas.

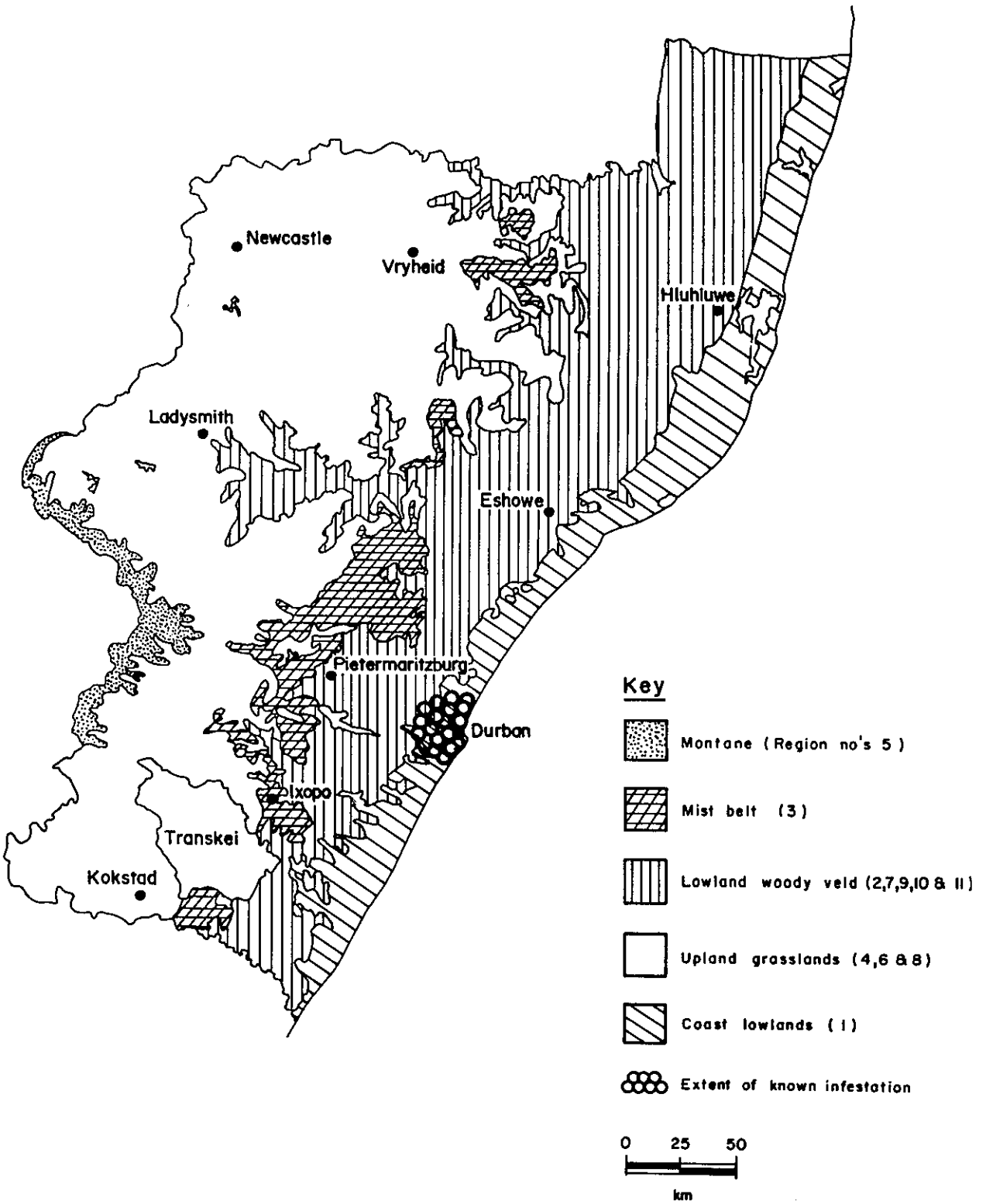

FIGURE 10. Distribution of Leuceana leucocephala in Natal - Durban area mainly.

KEY TO ZONATION

1. First priority - eliminate the infestations in the veld and phase out of urban situations in this region where the species poses a major threat to riverine vegetation.

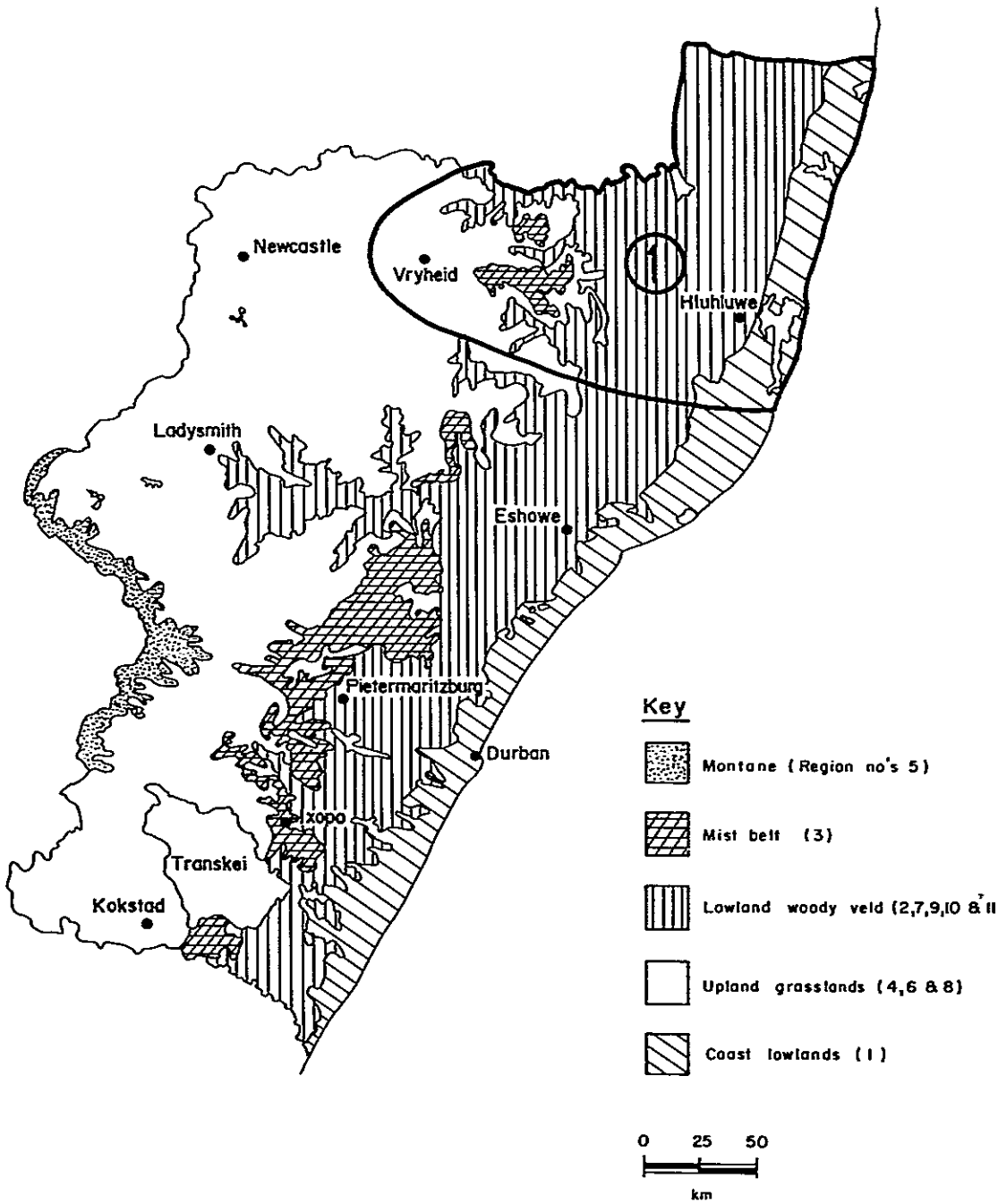

FIGURE 11. Suggested priority control area for Melia azederach in northern Natal.

KEY TO ZONATION

1. First priority - objective total elimination as not yet well established in the catchments north of Empangeni.
2. Second priority - objective total elimination as only small introductions to date in the Berg area.

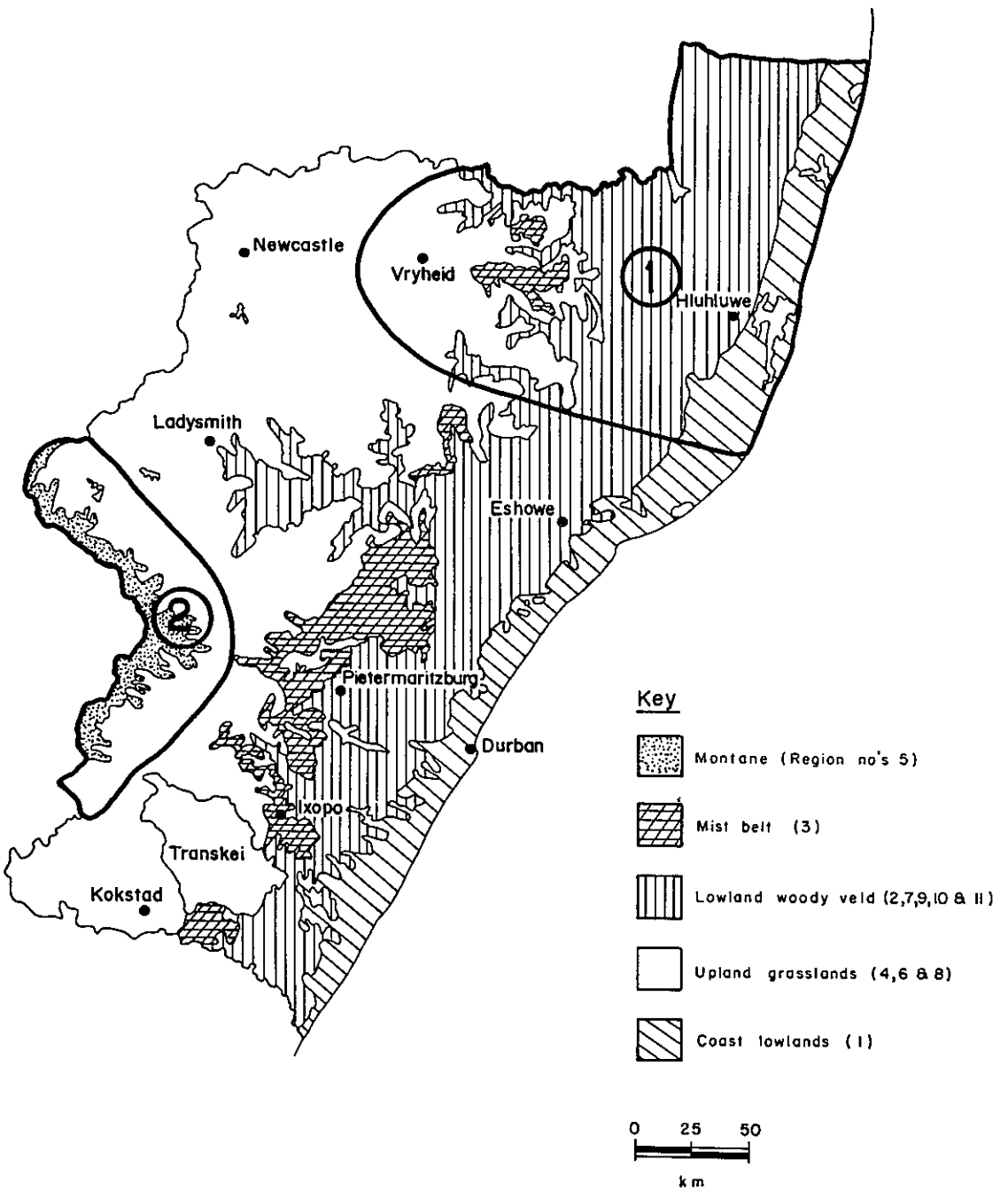

FIGURE 12. Suggested priority control areas for Sesbania punicea in Natal.

Melia azedarach - serious in Umfolozi and Tugela catchments because of major reserves in the area (Figure 11).

Sesbania punicea in both coastal and inland river systems is now becoming a problem but is easily controlled, by cutting and follow-up. Restricted to narrow band along riverbanks in the inland areas and around estuaries and lagoons in the coastal regions (Figure 12).

A logical control principle to adopt in the case of contol of water dispersed alien plant species is to start on the upper reaches of any river system and systematically work one's way downstream. However, a sound practical control method is often difficult to implement when there are many different land uses and landowners present in the catchment area.

CHAPTER 7. AN ANALYSIS OF RESEARCH REQUIREMENTS FOR INVASIVE ALIEN PLANTS IN NATAL

INTRODUCTION

The requirements for research on three different aspects of the invasive alien plant problem were analysed. In the first, the research required to elucidate the impacts these plants are having on the environments they invade were investigated. Here 13 important aliens were ranked in order of priority for research into this aspect. In the second the most important questions that need to be answered before control strategies can be scientifically based were detailed. In the final section, seven of the most important alien species (or groups of species) were analysed for gaps in information relating to their control.

THE IMPACTS OF INVASIVE ALIENS

J Wyatt, M Ward, S Neser and F J Kruger

Research requirements were considered in terms of impact on:

- ecosystem processes (A);
- the biotic community (B); and
- management factors (C).

The species shown in Table 16 were ranked in order of decreasing research importance. Leucaena and Ricinus were not rated but it was felt that research on these two species is needed.

TABLE 24. Ranking of species in terms of priority for research into the impacts of invasions

Species	A	B	C	Weighted score	Rank
Chromolaena odorata	4	5	5	14,0	1
Lantana camara	3	4	3	5,0	2
Acacia mearnsii	5	3,5	3	3,8	3
Acacia dealbata	5	3,5	3	3,3	4
Solanum mauritianum	5	5	5	2,5	5
Pereskia aculeata	5	5	5	2,4	6
Rubus cuneifolius	3	5	4	2,4	6
Caesalpinia decapetala	5	5	5	2,0	8
Psidium complex	5	5	5	1,7	9
Melia azedarach	5	5	5	1,6	11
Sesbania punicea	0	3	0	0,4	12
Leucaena leucocephala	5	5	5	-	13
Ricinus communis	5	5	3	-	14

RATING RESEARCH REQUIREMENTS: 0 - unimportant, 1 - already researched well, 2 - some research already completed, 3 - not very important but research needed, 4 - moderately important and research needed, 5 - very important research a high priority.

STRATEGIES FOR CONTROL
W Small, B Crook, D Erasmus, A Wood and A J Wills

A number of strategies were identified and research requirements for each of these were listed. The following general research requirements were identified as being necessary before any strategy could be stated to be the optimum one for any species:

(1) research into cost effective control methods;
(2) the cost effectiveness of biological control;
(3) investigation of new strategies eg perimeter sink areas, integrated control methods etc;
(4) determination of size/age at which seed is set for priority species and then the development of strategies that would enable plants to be eliminated before they set seed; and
(5) determination of the geographical range of priority species.

STRATEGY	RESEARCH REQUIREMENTS
1. Block approach	1. Season of seed release versus rainfall 2. Viability/longevity of seeds 3. Identification of propagule sources 4. Distance seeds transported by dispersal agents 5. Where animals are the dispersal agents the identification of the animals involved, their prevalence, habit and range
2. Directional approach	1. Identification of prevailing winds in the case of wind dispersed seeds 2. Viability/longevity of seeds 3. Identification of propagule sources 4. Distance seeds transported by dispersal agents 5. Where animals are the dispersal agents the identification of the animals involved, their prevalence, habit, and range 6. Season of seed release versus rainfall
3. Linear approach eg along roads and railway lines	1. Prevailing wind directions in the case of wind dispersed seeds
4. Perimeter inwards to core	1. Distance of seed dispersal by wind and animals
5. Target approach	1. Cost effectiveness ie is there any saving by attacking one species at a time as opposed to a number simultaneously
6. Monitoring and timeous identification	1. Monitoring techniques 2. Survey techniques
7. Education and propaganda	1. Identify target groups 2. Awareness and motivation techniques

CONTROL TECHNIQUES
H Zimmerman, A Priday, M Wells, G Zaloumis and D Freeman

Table 25 represents a summary of the research requirements into control methods, using the aliens Acacia spp, Chromolaena odorata, Lantana camara, Pereskia aculeata, Rubus cuneifolius, Psidium (complex) and Solanum mauritianum to develop the information.

TABLE 25. Requirements for research into control methods for seven of the important invasive alien plants of Natal

Research field	Acacia spp	Chromolaena odorata	Lantana camara	Pereskia aculeata	Rubus cuneifolius	Psidium complex	Solanum mauritianum
BASIC RESEARCH ON WEED							
Weed biology[1]	0	5	0	3	2	0	5
Propagation and dispersal	0	4	3	5	2	3	4&2
Status assessment[2] over time (=monitoring))	4	5	3	5	3	5	4
Genetic variability and habitat range	3	0	2	0	5	4	3
Succession and interrelation) or interaction with other plants	5	5	5	0	4	0	4
CONTROL METHODS							
Find and register chemicals[3]	2	5		5	2	4	4
a) selectivity studies	?			5	4	0	3
b) environmental impact	4	4		0	3	3	3
c) residue studies	5	3		0	3	0	3
Mechanical control methods	2	2		4	3	3	2
Biocontrol with nat. enemies	5	5	2	3	3	0	5
Integrated control	?		5	0	4	0	4
Comparing different control methods=cost/benefit studies[4])	4	4	3	4	4	3	5
Utilization of weed	3	0	0	0	0	0	0

RATING THE IMPORTANCE OF RESEARCH REQUIREMENTS: 0 - unimportant, 1 - already researched well, 2 - some research already completed, 3 - not very important but research needed, 4 - moderately important and research needed, 5 - very important, research a high priority.

NOTES: 1 = includes weed ecology, phenology, origin of weed, requirements for growth, allelopathy etc

2 = status assessment: this includes monitoring as well as establishing the niche which weeds occcupy in other countries and vice versa

3 = chemical control: screening of chemicals, with a view to the total impact of utilizing such chemicals on the environment. Find the selective herbicides with least environmental impact. Although many herbicides are registered for a specific weed, the best and most economical ones must be selected

4 = cost/benefit: an in-depth study into integrated systems, with due regard being given to socio-economic factors

CHAPTER 8. CAN LEGISLATION BE IMPROVED TO OBTAIN EFFECTIVE CONTROL OF INVASIVE ALIEN PLANTS IN NATAL?

Chairman: S Neser

THE OLD AND THE NEW WEEDS ACTS

The old Weeds Act (Act 43 of 1943) has a large number of declared noxious weeds - however, most of these species have become so widespread that the act has become unenforceable. Approximately 10 years have been devoted to the drawing up of a new Weeds Act which has now been passed by Parliament and which is now final (Act 43 of 1983). The new Act has two major categories of weeds - **declared weeds** which have to be removed by landowners - **invader plants** where removal is not mandatory.

The mandatory removal of a declared weed will follow on a direction from the Department of Agriculture. Inspectors will have a dual function of monitoring soil erosion and alien plants (weeds). In reality any legislation is ineffective unless it is effectively policed. The largely inneffective role of Act 43 is a result of the inadequacy of the coverage by weeds inspectors.

CONSIDERATIONS IN THE EFFECTIVENESS OF LEGISLATED CONTROL

The possibility of defining regions within which a policy of enforcing the removal of an invader plant would be followed, would markedly improve the practicality of legislative control. In particular, areas within which the weed is still just becoming a problem would be feasible areas for this to be applied. This zonation would also allow the permissible use of a species within an area where infestation is already severe, in cases where invader species are valued by one sector of society. A subsidy programme might get over the problem of enforcing the removal of "expensive to remove" aliens. The major problem of enforcement within communally owned areas was raised with particular reference to KwaZulu.

The prospect of "catchment control authorities" throughout South Africa provides a framework within which legislative control might be enacted. Development advisory committees provide a channel for integrated control ie through the use of compatible land use practices (eg the prohibition of the use of a plantation species which is highly invasive in the region) and veld management practices (eg overgrazing which accelerates invasion).

The examples of New Zealand and Europe were cited as examples of the value of "the big stick approach" to enforcing the removal of aliens. However, due to prevailing political and practical control considerations, this approach was generally considered unsuitable for Natal.

The possibility of creating a central agency to which incipient invaders could be reported, together with a method for rapidly promulgating enforcing legislation could enable pre-emptive legislative control. "Legislative control" is possibly only feasible where control is relatively inexpensive and prospects of success are great.

Legislative control could possibly be best achieved at a local authority level so that feasibility and local requirements could be adequately met. The essential requirement is that local concern would underlie the legislation and thus increase its possible success. Soil conservation committees should be required to report on invader species within their area. Regional planning authorities might be the effective level.

CONCRETE PROPOSALS FOR IMPROVING LEGISLATIVE CONTROL

1. Restricting the number of species proclaimed.

2. Restricting the areas to which the proclamation relates.

3. A mechanism for identifying invader species at an early stage of their invasion and promulgating legislation at this stage.

4. Opportunities for coordinating land use through the new Regional Advisory Boards might improve the efficacy of legislation.

5. The need for increasing the Weeds Act's effectiveness in the communally owned lands of KwaZulu.

6. The need for enabling weedicides to be used at levels of maximum cost effectiveness as distinct from the registered concentrations.

7. A considerable input from legislation is required for limiting the introduction of new invasive species into Natal (and RSA) and preventing their sale in nurseries within Natal.

CHAPTER 9. INTER-ORGANIZATION LIAISON AS AN AID TO ALIEN PLANT CONTROL: THE NATAL SITUATION

Chairman: O Bourquin

Three primary aspects of inter-organization liaison were addressed:

(1) For what purpose should such liaison be used?
(2) Which organizations should be involved?
(3) Do existing liaison systems currently function on a local, regional or national basis?

AIMS OF LIAISON

(1) To try and get an integrated strategy for adjacent land managers (local districts).
(2) To make regional data available locally - on distribution, species, control. It must include dispersal of information, ie effective extension services, including invasive potential of species - predictive and preventative information.
(3) To obtain improved identification services.
(4) To facilitate the passage of relevant information upwards where appropriate, to provincial or national levels.

THE ORGANIZATIONS INVOLVED

Existing organizations which have a potential requirement for liaison in Natal include:

State agencies (Provincial and National level):
- Regional Development Advisory Committee
  - Region E (Natal)
- Department of Agriculture, RSA
  - Plant Protection Research Institute
  - Soil Protection Division
  - Botanical Research Institute
  - Seed Control
- Department of Agriculture, KwaZulu
- Department of Forestry, KwaZulu
- Department of Environment Affairs
  - Directorate of Forestry
  - S A Forest Research Institute
  - Directorate of Water Affairs
  - S A Natural Heritage Programme

Department of Cooperation and Development
Department of Community Development
Natal Parks Board
KwaZulu Bureau of Natural Resources
Department of Transport (National and Provincial Roads)

Commercial agencies:
Forest Weeds Working Group
S A Timber Growers Association
Wattle Research Institute
H F O through Directorate of Forestry
Wattle Research Institute
H F O through Directorate of Forestry
Forest Owners Association
Weedicide (Agricultural Chemical) Companies
Local Farmers Associations
Wattle Growers Union
Natal Agricultural Union
Private forestry companies SAPPI, MONDI, etc

Academic institutions:
Natal and KwaZulu Universities
Institute of Natural Resources
Weed Science Society

Municipalities:

Noxious weeds working party
(Inter municipality group Durban metropolitan area)

Private conservation areas: eg Mblopeni Ranch, Nyala Game Ranch

Special Interest/Voluntary Organizations
Wildlife Society of Southern Africa (Natal Branch)
Mountain Club of S A (Natal Section)
Ramblers Club (Durban)
Wilderness Leadership School

EXISTING LIAISON SYSTEMS

The Department of Agriculture - Division of Soil Protection - provides an existing single discipline system - however, emphasis is on soil erosion control and not on land use management or the effects of invasive plants.

Forest Weeds Working Group provides a model liaison agency for invasive weed control associated with plantations.

EXISTING INTER-ORGANIZATION LIAISON

Division of Soil Protection (Director) Department Agriculture

National Weeds Committee

Forestry Weeds Control Working Group	Cape	Tvl	OFS	Natal	Homelands

Regional Development Committees	Nature Conservation Authorities	Soil Protection Committees	Farmers Unions	Roads Departments	Municipalities

An infrastructure, or at least the skeleton thereof, exists and should be extended to include groups hitherto not included.

CHAPTER 10. IMPROVING EDUCATION AND EXTENSION ON INVASIVE ALIEN PLANTS IN NATAL

Chairman: J Scotcher

Education is regarded as essential and should be aimed at universities, schools, conservation organizations (eg Wildlife Society, Botanical Society etc), and in particular, at the layman. The production of posters, taped slide shows and use of the mass media such as radio and television should be considered. Pamphlets can be compiled and circulated to organizations as is currently being done by the Plant Protection Research Institute.

The pamphlets should, ideally, be printed to a common format, equivalent to chapters, or sections of a book. Thus a series on individual plants (one per plant), one on techniques, one on problems in particular habitats (one per habitat), and so on, could be produced. These could be issued singly, in blocks made up to cover interests and needs of special groups (eg pasture farmers in Natal midlands), or - in a special binder - as a total package. The advantage of this aproach would be to make the information more accessible and attractive to the 'small' man. A possible disadvantage is that it would probably be more expensive as a total package than if produced as a book similar to "Beautiful but dangerous" (Stirton 1978). However, this possible disadvantage is outweighed by another advantage which is cheaper, the ability to update such a loose-leaf publication. This is an important consideration in a field such as alien plant invasions and management where improved information is rapidly becoming available.

Within the education programmes it would be desirable to stress the invasive alien plant threat in a manner such that the problem does not look hopeless. Emphasis could be on the loss of productivity and income through the effects of these plants. The format, however, must be brief, simple and without scientific jargon.

The importance of using established public relations systems was stressed and it was decided that organizations with PRO's (eg Natal Parks Board) should be used to spread the information on alien plants. A handout to all visitors to Natal Parks Board Reserves, should achieve a high 'hit' rate of interested people. It should contain a "This is important; tell your friends" message. Businesses and private entrepreneurs could also be approached to advertise the problem on their products.

A general awareness programme at all levels of society and to all organizations should be carried out. Particular attention must be given to horticulturalists and nurseries, to prevent the inadvertent spread of alien plants through these means.

INDEX OF COMMON NAMES

SPECIES	
Acacia dealbata	Silver Wattle, Silwerwattel
Acacia decurrens	Green Wattle, Groenwattel
Acacia longifolia	Long-leaved Wattle, Langblaarwattel
Acacia mearnsii	Black Wattle, Swartwattel
Acacia melanoxylon	Blackwood, Swarthout
Acacia podalyriifolia	Pearl Acacia, Vaalmimosa
Acacia saligna	Port Jackson Willow, Goudwilger
Agave sisalana	Sisal, Sisal
Albizia lebbeck	Lebbeck Tree, Lebbeckboom
Amaranthus hybridus	Common Pigweed, Gewonemisbredie
Amaranthus spinosus	Thorny Pigweed, Doringmisbredie
Ambrosia artemesiifolia	
Anacardium occidentale	Cashew, Kasjoeboom
Argemone ochroleuca (?=A mexicana)	Yellow-flowered Mexican Poppy, Geelboom-bloudissel
Araucaria columnaris	New Caledonian Pine, Nieu-Caledoniese Den
Araucaria cunninghamii	Hoop Pine, Hoepelden
Arundo donax	Giant Reed, Spaanse Riet
Bidens pilosa	Blackjack, Knapsekêrel
Caesalpinia decapetala	Mauritius Thorn, Kraaldoring
Canna edulis	Canna, Kanna
Cardiospermum grandiflorum	Balloon Vine, -
Carica papaya	Paw Paw, Papaja
Cassia bicapsularis	Autumn Shower, -
Cassia didymobotrya	Peanut Cassia, Oatmeal Cassia
Cassia floribunda	Cassia, -
Cassia occidentalis	Upright-Pod Cassia, -
Casuarina equisetifolia	Coastal Beefwood, Perdestertboom
Catharanthus roseus	Beira Daisy, Begrafnisblom
Cedrela odorata	Toon Tree, Toonboom
Cereus peruvianus	Apple Cactus, Queen-of-the-Night
Cestrum laevigatum	Inkberry, -
Chromolaena odorata	Triffid Weed, Paraffinbossie
Cirsium vulgare	Spear Thistle, Speerdissel
Citrus aurantium	Orange, Lemoen
Citrus limon	Lemon, Suurlemoen
Citrus reticulata	Mandarin, Naartjie
Cotoneaster pannosus	Silver-leaf Cotoneaster, -
Datura ferox	Large Thornapple, Grootstinkblaar
Datura stramonium	Thornapple, Stinkblaar
Eichhornia crassipes	Water Hyacynth, Waterhiasint
Eriobotrya japonica	Loquat, Lukwart
Eriocereus martinii	Harissia cactus, Harissiakaktus
Eucalyptus cinerea	Florist's Gum, Floristebloekom
Eucalyptus grandis	Saligna Gum, Salignabloekom
Eucalyptus maculata	Spotted Gum, Gevlekte Bloekom
Eucalyptus species	Gum trees, Bloekombome
Eupatorium adenophorum	Crofton Weed, -
Grevillea robusta	Silver Oak, Silky Oak; Silwereik
Hypericum minima	Cultivated species of St John's Wort
Hypericum lachinulti	
Jacaranda mimosifolia	Jacaranda, Jakaranda

Lagerstroemia indica	Pride-of-India, Skubliesroos
Lantana camara	Tickberry, Lantana
Leucaena leucocephala	Giant Leucaena, Reusewattel
Litsea sebifera	Indian Laurel, Indiese Lourier
Lycopersicon species	Tomato, Tamatie
Mangifera indica	Mango, Mango
Melia azedarach	Seringa, Maksering
Montanoa hibiscifolia	Montanoa
Morus alba	White Mulberry, Wit Moerbei
Nicandra physaloides	Apple of Peru, Basterappelliefie
Opuntia aurantiaca	Jointed Cactus, Litjieskaktus
Opuntia ficus-indica	Prickly Pear, Doringsturksvy
Opuntia stricta	Tiger Pear, Suurturksvy
Opuntia vulgaris	Sour Prickly Pear, Suurturksvy
Passiflora edulis	Purple Granadilla, Granadella
Pennisetum clandestinum	Kikuyu, Kikoejoe
Pereskia aculeata	Barbados Gooseberry; Barbadosstekelbessie
Phytolacca dioica	Belhambra, Bobbejaandruifboom
Pinus elliotii	Slash Pine, Basden
Pinus patula	Patula Pine, Patuladen
Populus alba/canescens	White Poplar, Witpopulier
Prunus persica	Peach, Perskeboom
Psidium (complex)	Guava (possibly a hydrib swarm)
Psidium guajava	Guava, Koejawel
Pyracantha angustifolia	Yellow Firethorn, Geelbranddoring
Pyracantha species	Firethorn bushes, Branddoringbosse
Richardia brasiliensis	Mexican Richardia, Mexikaanse Richardia
Ricinus communis	Castor Oil Plant, Kastorolieboom
Rivina humilis	Rouge Plant, Bloodberry, -
Robinia pseudo-acacia	Black Locust, Witakasia
Rubus cuneifolius	Sand Bramble, Sandbraam, Amerikaanse Braam
Salix babylonica	Weeping Willow, Treurwilger
Schinus terebinthifolius	Brazilian Pepper Tree, Brasiliaanse Peperboom
Sesbania punicea	Sesbania, Brazilian Glory Pea, Coffeeweed; Rooi-sesbania Brasiliaanse Glorie-ertjie
Solanum mauritianum	Bugweed, Bugtree, Luisboom
Solanum seaforthianum	Potato Creeper, -
Solanum sodomaeum	Apple of Sodom, -
Spartium junceum	Spanish Broom, Spaansebesembos
Syncarpia glomulifera	Turpentine Tree, Terpentynboom
Tagetes minuta	Khaki Weed, Kakiebos
Tectona grandis	Indian Teak, Indiese Kiaat
Tithonia diversifolia	Tithonia
Toona ciliata (?=Cedrela toona)	Toon Tree, Toonboom
Ulex europaeus	Gorse, Whin, -
Xanthium spinosum	Spiny Cocklebur, Boetebossie
Xanthium strumarium	Large Cocklebur, Kankerroos

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