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# Invasive alien woody plants of Natal and the north-eastern Orange Free State

L. HENDERSON*

**Keywords**: alien, coastal communities, forest, grassland, KwaZulu, Natal, Orange Free State, savanna, survey, invasive plants (woody)

ABSTRACT

The frequency and abundance of invasive alien woody plants were recorded along roadsides and at watercourse crossings in 87% (152/175) of the quarter degree squares in the study area. The survey yielded 130 species of which the most prominent species (in order of prominence) in roadside and veld habitats were: *Chromolaena odorata*, *Solanum mauritianum*, *Psidium guajava*, *Rubus* spp., *Acacia mearnsii* and *Lantana camara*. The most prominent species (in order of prominence) in streambank habitats were: *Acacia dealbata*, *A. mearnsii* and *Salix babylonica*.

The greatest intensity of invasion was recorded in the Natal midlands and in the coastal belt of southern Natal, including the metropolitan areas of Pietermaritzburg and Durban. There was relatively little invasion in the north-eastern lowlands of Natal but the potential for expansion is great. Little invasion was recorded in the north-eastern Orange Free State except along some watercourses.

UITTREKSEL

Die frekwensie en volopheid van uitheemse houtagtige indringerplante is langs paaie en by oorgange oor waterlope in 87% (152/175) van die kwartgradevierkante in die studiegebied aangeteken. Daar is 130 indringers aangetref waarvan die mees prominente (in volgorde van prominensie) *Chromolaena odorata*, *Solanum mauritianum*, *Psidium guajava*, *Rubus* spp., *Acacia mearnsii* en *Lantana camara* langs paaie en in veldhabitats was. Die mees prominente spesies (in volgorde van prominensie) langs stroomoewers was *Acacia dealbata*, *A. mearnsii* en *Salix babylonica*.

Die ergste indringing is in die Natal middelland en in die kusstreke van suid-Natal aangetref, met insluiting van die stedelike gebiede van Pietermaritzburg en Durban. Daar was betreklik min indringing in die noordoostelike laagland van Natal maar die potensiaal vir uitbreiding is groot. Behalwe langs waterstrome, is daar min indringing in die noordoostelike Oranje-Vrystaat aangeteken.

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* Plant Protection Research Institute, Department of Agriculture and Water Supply; stationed at Botanical Research Institute, Private Bag X101, Pretoria 0001.
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## INTRODUCTION

### Survey history and objectives

This study, which covers Natal and the adjacent north-eastern Orange Free State is the second of eight regional surveys which together are designed to reflect invasion by woody alien plants in the Republic of South Africa as a whole. The survey method was developed during a study of the south central region of the Transvaal (Wells *et al.* 1980) and then used in a survey of the rest of the Transvaal (Henderson & Musil 1984). This survey of Natal and the north-eastern Orange Free State was undertaken during the 1986/87 summer season.

The objectives of the survey are: to produce a checklist of the major invasive alien woody plants of streambank,

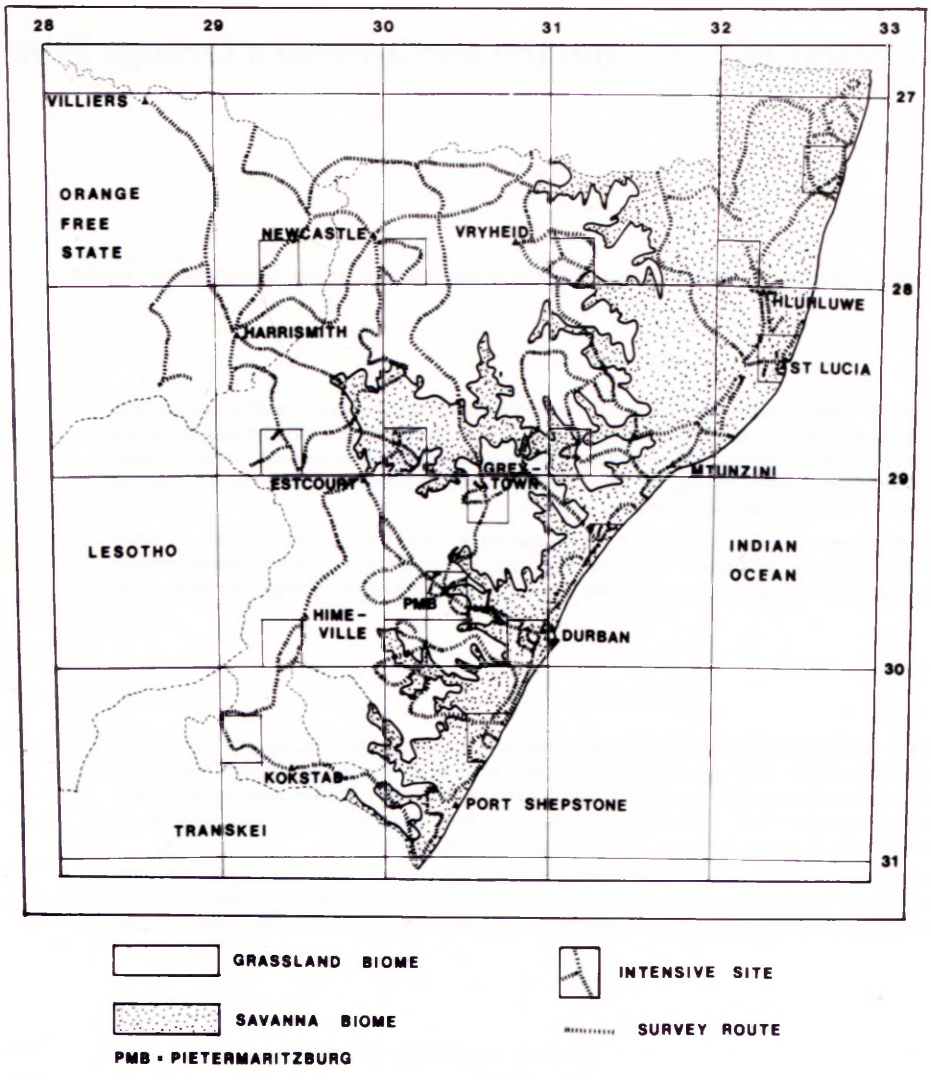


FIGURE 1.—The study area, Grassland and Savanna Biomes, intensive sites and survey routes.

roadside and veld habitats in the study area; to determine the pattern of alien woody invasion as a whole and for individual species; to attempt to relate distribution to environmental factors and to determine which are the most prominent and potentially important invaders.

## The study area

The study area comprises Natal, including KwaZulu, which together occupy an area of 86 967 km$^2$ (Macdonald & Jarman 1985) and the extreme north-eastern Orange Free State which covers an area of approximately 17 400 km$^2$. It lies between latitudes 26° and 31°S and longitudes 28° and 33°E (Figure 1). From east to west the altitude rises rapidly, from sea level on the Indian Ocean coastline of Natal, in a series of terraces more or less parallel to the coast, to greater than 3 000 m on the Drakensberg escarpment. The western boundary of Natal is formed by the Drakensberg mountain range. The north-eastern Orange Free State lies to the west of the Drakensberg range at elevations of 1 500 m to 1 800 m on the highveld plateau.

The landscape of Natal is rugged and dissected by the valleys of 11 major rivers which arise in or adjacent to the province. The terrain is level in the north-eastern coastal region where numerous pans and lakes have developed.

Rainfall varies from 300 to 600 mm in some of the drier river valleys and in the north-eastern interior region to over 1 500 mm along the coast and on some of the peaks in the Drakensberg. Rain falls mostly in summer from November to March but on the coast up to one third of the rain falls during the winter period (Haigh & Wilhelmij 1973; Francis 1977).

The climate of the coastal belt and lowland interior is subtropical to tropical. From east to west, with rising altitude, the climate becomes progressively more temperate. The incidence of frost varies from light to moderate in the mistbelt (600–1 200 m) and moderate to severe in higher areas [Poynton (1972)—silvicultural map of the Republic of South Africa]. Snow falls most years at elevations of over 1 200 m and is a regular winter feature along the Drakensberg (Haigh & Wilhelmij 1973).

There are two major indigenous vegetation types or biomes, Savanna and Grassland, in the study area (Rutherford & Westfall 1986) (Figure 1). Twenty Acocks Veld Types (Acocks 1988) occur in the study area and have been grouped into six veld type categories for the purposes of this survey. These are temperate grassland, moist subtropical grassland, dry subtropical grassland, mistbelt grassland, all falling within the Grassland Biome; tropical bush and savanna, and tropical forest (Table 1 and Figure 2) are classified under the Savanna Biome.

TABLE 1.—Veld type categories in the study area and the equivalent Acocks Veld Type groupings and Veld Type numbers

| Veld type category | Acocks Veld Type grouping | Acocks Veld Type No. |
|---|---|---|
| Temperate grassland | Pure grassveld types | 48, 53, 54, 56, 57,58 |
| Moist subtropical grassland | Temperate forest and scrub type | 44 |
| Dry subtropical grassland | False grassveld types | 63, 64, 65, 66 |
| Mistbelt grassland | Coastal tropical forest type | 5 |
| | Transitional forest and scrub type | 45 |
| Tropical bush and savanna | Tropical bush and savanna types | 10, 11 |
| | Karroid type | 23 |
| Tropical forest | Coastal tropical forest types | 1, 3, 6 |
| | Inland tropical forest type | 8 |

Temperate grassland occupies the highest and coldest parts of the study area at elevations of 1 500 m to greater than 3 000 m. Rainfall ranges from 700–1 000 mm per annum. Moist subtropical grassland occurs on the eastern slopes and foothills of the Drakensberg from about 1 350 m to 2 150 m. Rainfall ranges from 750–1 500 mm per annum. Dry subtropical grassland lies at elevations of between 900 and 1 500 m and rainfall ranges from 600–1 000 mm per annum. This grassland has been invaded by woody thornveld species especially in its drier parts (Edwards 1967). Mistbelt grassland occupies rolling misty country at elevations of between 450 and 1 350 m. Rainfall ranges from 750–1 300 mm per annum. Tropical bush and savanna occupies the hot and dry river valleys and the north-eastern interior lowlands. Rainfall ranges from 300–800 mm per annum. Tropical forest is the major vegetation type of the warm and moist coastal belt. Rainfall ranges from 900–1 500 mm per annum. Little remains of the forest between Durban and the Transkei border to the south, but extensive patches exist on the north coast, particularly north of Lake St Lucia Estuary.

## METHOD

### Sampling method

The method used in this survey was basically the same as that used in the Transvaal (Henderson & Musil 1984)

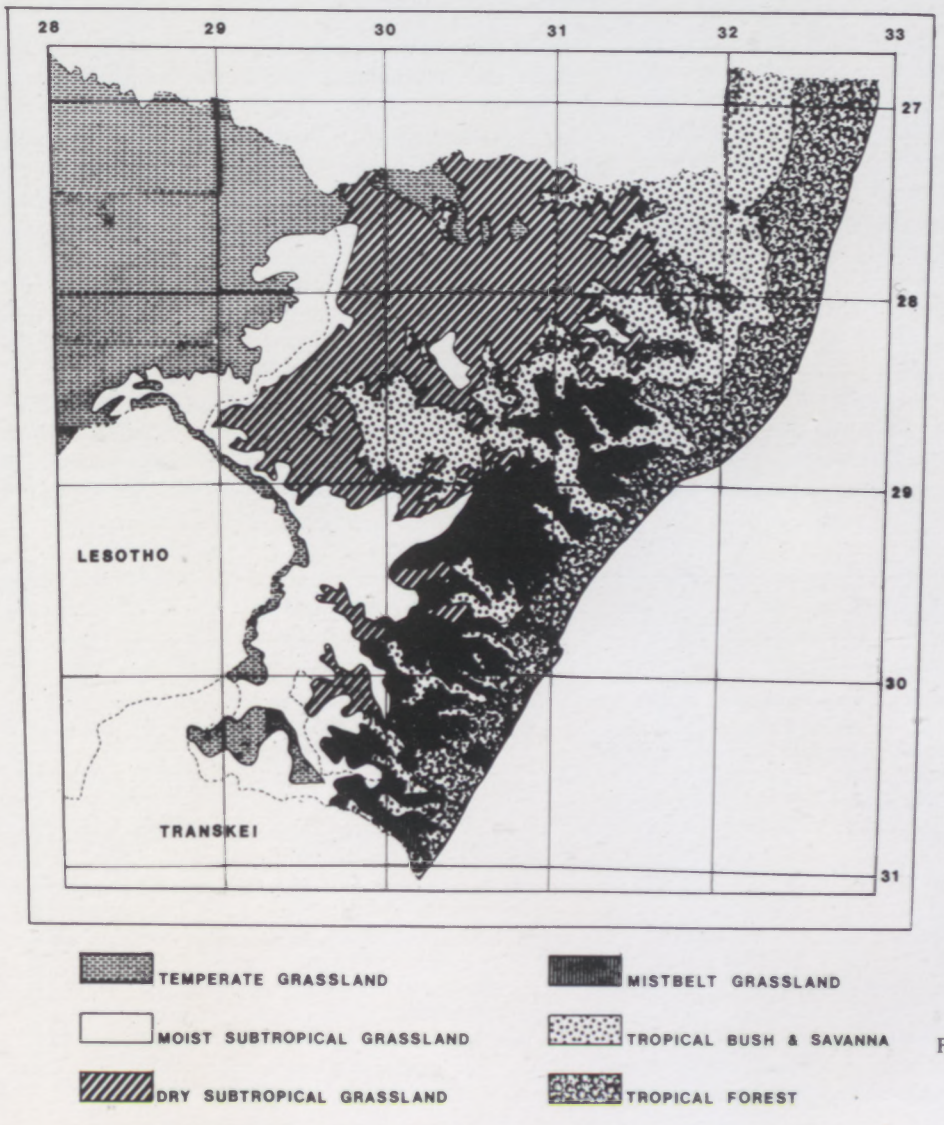


FIGURE 2.—The six broad veld type categories in the study area (after Acocks 1988).

but with minor changes to the abundance ratings (see next subheading). The presence and abundance of all naturalized alien trees, shrubs and conspicuous climbers were recorded for each veld type category, habitat type (roadsides and adjoining veld, and streambanks) and quarter degree square traversed by road. Although the objective of the survey was to record woody species, other large non-woody and succulent species were included rather than lose valuable information.

Recordings of roadside and veld invaders were made from a moving vehicle whereas recordings of streambank invaders were made at watercourse crossings. Abundance estimates of roadside and veld invaders were based on frequency of encounter within road transects of five to ten kilometres in length. Abundance estimates of streambank invaders were based on estimates at specific sites.

The width of road transects and length of watercourses scanned for invaders varied according to local conditions. Usually no more than 50 m of veld and 100 m of streambank habitat were scanned on either side of the road for invaders. Species occurring beyond these ranges and along watercourses which were not crossed were recorded as present in the given habitat type and veld type category but were not included within the formal recordings.

Although Henderson & Musil (1984) suggested the use of a single road transect length of ten kilometres, a variable transect length of between five and ten kilometres was found to be more practical. This applied particularly in the highly dissected veld type categories in the midlands and lowlands of Natal. In these regions it was often not possible to accommodate ten kilometre transects and where there was much invasion a shorter transect length proved to be more manageable. Since all road transects were plotted on maps the survey is easily repeatable despite the use of variable transect lengths.

Seventeen quarter degree squares were selected for more intensive surveying (Figure 1). These intensive sites were selected primarily to ensure that representative parts of each veld type category and geographical region in the study area were well sampled. They may also be used at a later date for a quick resurvey of the study area to assess any changes that may have taken place. In each of the seventeen sites abundance recordings of roadside and veld invaders were made along a total road length of approximately 30 km (six transects each five km long). Recordings were made at virtually all watercourse crossings. Herbarium specimens of all invader species which were flowering or fruiting, were collected.

Survey routes and road transects were plotted on 1:250 000 maps (general survey area) and 1:50 000 maps (intensive sites) before a field trip was undertaken. Wherever possible two or more road transects were plotted per quarter degree square. In most instances road transects were not contiguous but were separated by a distance of between five and ten kilometres. This approach was adopted mainly due to time considerations since abundance estimates along road transects can be very time-consuming depending on the intensity of invasion. In addition, it was necessary to have a breathing space between transects not only to avert eye strain but to free one's attention from the immediate roadside and to observe invasion further afield. Road transects along national roads and other routes with heavy traffic were kept to a minimum. All road transects to be sampled were plotted before a field trip was undertaken to ensure non-selective recording in the field. Recordings were made at most bridges over watercourses but some were omitted because of time constraints and traffic considerations.

## Abundance ratings

Minor changes were made to the abundance ratings for roadside and veld habitats used in the Transvaal survey (Henderson & Musil 1984). The two ratings below the old rating '1' were removed. These ratings became obsolete as a result of the standardization of road transect length from 5–10 km. The abundance ratings for roadside and veld habitats and streambank habitats are given in Table 2.

## Sampling level envisaged and achieved

The sampling level envisaged was at least 60% of the total quarter degree squares at an average of 33 km per square which was achieved in the Transvaal (Henderson & Musil 1984). The sampling level achieved in this survey was 87% (152 of the total 175 quarter degree squares) at an average of 38 km travelled per square. An average of

TABLE 2.—Abundance ratings

| Rating | Roadsides and veld | No.* | Streambanks | Rating |
|---|---|---|---|---|
| 9 | A virtually continuous, almost pure stand | 1000+ | A virtually continuous, almost pure stand | 7 |
| 8 | The commonest species in a generally continuous tree or shrub layer | 500–999 | The commonest species in a generally continuous tree or shrub layer | 6 |
| 7 | Less abundant than above but greater than 20 individuals or groups per km | 200–499 | | |
| 6 | 10–20 individuals or groups per km | 100–199 | | |
| 5 | 5–10 individuals or groups per km | 50–99 | 1 of the 2–3 commonest species in a generally continuous tree or shrub layer | 5 |
| 4 | 2–5 individuals or groups per km | 20–49 | ! of the 4–6 commonest species in a generally continuous tree or shrub layer | 4 |
| 3 | ± 1 individual or group per km | 5–19 | 1 of the 7–11 commonest species in a generally continuous tree or shrub layer | 3 |
| 2 | Less abundant than above but more than 1 individual or group per 5 km | 2–4 | Less abundant than above but more than 1 individual present | 2 |
| 1 | 1 plant or group per 5–10 km | 1 | 1 plant in a sample | 1 |

* Approximate numbers of individuals/groups per 10 km transect.

TABLE 3.—Sampling coverage in each veld type category, biome and the study area

| Veld type category and biome | ¼ degree squares | Road transects | Distance (km)* | Watercourse recordings |
|---|---|---|---|---|
| **Savanna Biome** | 69 | 139 | 1 004 | 209 |
| Tropical forest | 40 | 80 | 556 | 94 |
| Tropical bush and savanna | 39 | 59 | 448 | 115 |
| **Grassland Biome** | 104 | 211 | 1 619 | 369 |
| Temperate grassland | 30 | 43 | 370 | 75 |
| Dry subtropical grassland | 40 | 72 | 510 | 173 |
| Moist subtropical grassland | 33 | 45 | 361 | 85 |
| Mistbelt grassland | 29 | 51 | 378 | 36 |
| Study area | 152 | 350 | 2 623 | 578 |

* This represents the distance along which abundance recordings were made. Total distance along which observations were made is approximately twice that given.

17 km of road transects were sampled per quarter degree square for abundance estimates of roadside and veld invaders.

The veld type coverage in terms of quarter degree squares and road transects sampled, kilometres travelled and watercourse recordings made, is given in Table 3.

## Data treatment—formulae used

### *Frequency*

The percentage frequency of occurrence of a species x in veld type category y was calculated as follows:

$$\text{frequency} = \frac{\text{no. of watercourse recordings/road transects in veld type y having species x}}{\text{total no. of watercourse recordings/road transects in veld type y}} \times 100$$

### *Prominence value*

Prominence is used here in preference to the term Importance defined by Henderson & Musil (1984). The prominence value, which has been derived from Curtis' Importance Value (Mueller-Dombois & Ellenberg 1974), is a measure of the prominence (in terms of frequency and abundance) of a species in a vegetation category relative to all other species in the same category. Other aspects, such as rate of spread and difficulty of control, which should be taken into account when assessing species importance, are not included here, hence the preferred use of the term prominence.

In *streambank habitats* the prominence value for a species x in veld type category y was calculated as follows:

$$\text{prominence value} = \frac{\text{frequency of species x in veld type y scoring 5, 6 or 7}}{\text{sum frequency of all species in veld type y scoring 5, 6 or 7}} \times 100 + \frac{\text{frequency of species x in veld type y}}{\text{sum frequency of all species in veld type y}} \times 100$$

* each abundance rating was expressed in numbers of individuals/groups recorded per transect (see Table 2). To be both conservative and consistent the minimum number was used in each instance, e.g. an abundance rating of 5 over ten kilometres = 50 and an abundance rating of 5 over five kilometres = 25.

** mean no. of individuals/groups per 10 km converted to rating (see Table 2).

The selection of abundance rating 5 as the cut-off point is arbitrary but one at which a species can be regarded as locally prominent (see definition in Table 2). A formula using all abundance ratings would be preferable if each rating could be converted to an absolute value.

In *roadside and veld habitats* the prominence value for a species x in veld type category y was calculated as follows:

$$\text{prominence value} = \frac{\text{total abundance* of a species x in veld type y}}{\text{sum of the abundances* of all species in veld type y}} \times 100 + \frac{\text{frequency of a species x in veld type y}}{\text{sum frequency of all species in veld type y}} \times 100$$

The highest prominence values in a given category which add up to approximately 160 points out of a total of 200 are printed in bold in Tables 6 and 7. The cut-off point of 160 points is arbitrary but represents 80% of the summed prominence values.

### *Mean species abundance rating in roadside and veld habitats* (see Table 7)

The mean abundance rating** of species x in veld type category y was calculated as follows:

$$\text{mean no. of individuals/groups per 10 km} = \frac{\text{total no. of individuals/groups of species x in veld type y}}{\text{total distance along which species x was rated in veld type y}} \times 10$$

### *Mean abundance of invaders per km in roadside and veld habitats* (see Table 5 and Figure 5)

The mean abundance of invaders per kilometre in veld type category y/quarter degree square z was calculated as follows:

$$\text{mean abundance} = \frac{\text{total abundance* of all species in veld type y/quarter degree square z}}{\text{total kilometres rated for abundance estimates in veld type y/quarter degree square z}}$$

TABLE 4.—Streambank statistics for each veld type category, biome and the study area

| Veld type category and biome | Total no. of spp. | Average no. of spp./crossing | Max. no. of spp./crossing | % crossings heavily invaded* | % crossings invaded** |
|---|---|---|---|---|---|
| **Savanna Biome** | 66 | 3,3 | 13 | 16,9 | 82,3 |
| Tropical forest | 47 | 4,4 | 12 | 24,7 | 98,0 |
| South of Durban | 28 | 6,1 | 12 | 50,0 | 100,0 |
| Tropical bush and savanna | 44 | 2,3 | 13 | 11,3 | 70,0 |
| **Grassland Biome** | 52 | 2,0 | 7 | 29,3 | 81,3 |
| Temperate grassland | 15 | 1,3 | 4 | 24,0 | 85,3 |
| Dry subtropical grassland | 35 | 2,1 | 7 | 25,4 | 78,0 |
| Moist subtropical grassland | 26 | 1,6 | 7 | 36,9 | 76,5 |
| Mistbelt grassland | 34 | 3,9 | 7 | 41,7 | 100,0 |
| Study area | 90 | 2,4 | 13 | 24,9 | 81,7 |

* 1 or more species scored 5 or more. ** invaders present.

## RESULTS

The survey yielded 130 naturalized alien species. These species are listed in the Appendix together with a further 50 species which were obtained from various literature and other sources. The distributions and high abundance areas of 32 of the most prominent species are given in Figures 6 & 7 (see Appendix).

### The streambank habitat

#### *The whole study area*

Five hundred and seventy eight watercourse crossings were sampled in which 90 species were recorded, with up to 13 species in one sample (Table 4). Invaders were present at 81.7% of all crossings and 24,9% of all crossings were heavily invaded (Table 4).

#### *Analysis according to veld type*

More alien species were recorded in the Savanna Biome than in the Grassland Biome. The most species were recorded in tropical forest and the least in temperate grassland.

In the Grassland Biome there was a progressive increase in the severity of invasion in terms of percentage crossings heavily invaded with decreasing elevation from the montane region (temperate grassland) to the mistbelt. The rivers in mistbelt grassland and tropical forest south of Durban were the most invaded in terms of percentage crossings heavily invaded and percentage crossings invaded. The rivers of tropical bush and savanna were the least invaded (Table 4).

#### *Analysis according to species*

##### Frequency

Only eight species were recorded at 10% or more crossings in the whole study area (Table 6). *Acacia dealbata* and *Salix babylonica* were the most frequently encountered species.

In the Grassland Biome the most frequently recorded species were *Acacia dealbata*, *Salix babylonica* and *Acacia mearnsii*. *Ricinus communis* was by far the most frequent invader in the Savanna Biome followed by *Psidium guajava*, *Chromolaena odorata*, *Solanum mauritianum* and *Melia azedarach* which were almost equally frequent.

The highest percentage frequency recorded was 73% for *Salix babylonica* in temperate grassland.

TABLE 5.—Statistics for roadside and veld habitats in each veld type category, biome and the study area

| Veld type category and biome | Total no. of spp. | Average no. of spp./¼° sq. | Max. no. of spp./¼° sq. | % transects invaded | % transects heavily invaded* | Mean abundance** (nos of individuals/ groups per km) |
|---|---|---|---|---|---|---|
| **Savanna biome** | 79 | 9,9 | 44 | 95,7 | 36,7 | 17,0 |
| Tropical forest | 68 | 13,6 | 44 | 95,0 | 55,0 | 27,5 |
| Tropical bush and savanna | 40 | 6,2 | 13 | 96,6 | 11,9 | 4,0 |
| **Grassland Biome** | 81 | 6,9 | 36 | 92,4 | 26,5 | 7,4 |
| Temperate grassland | 26 | 4,3 | 12 | 79,1 | 0,0 | 0,5 |
| Dry subtropical grassland | 43 | 6,4 | 16 | 91,7 | 12,5 | 2,0 |
| Moist subtropical grassland | 31 | 5,9 | 11 | 97,8 | 44,4 | 11,1 |
| Mistbelt grassland | 60 | 11,4 | 36 | 100,0 | 52,9 | 18,1 |
| Study area | 116 | 9,5 | 44 | 93,7 | 30,6 | 11,1 |

* 1 or more species scored 5 or more. ** See data treatment—formulae used.

Prominence

The most prominent invader in the study area was *Acacia dealbata*, followed by *A. mearnsii* and *Salix babylonica* (Table 6). *A. dealbata* was very common to abundant (i.e. scored a 5, 6 or 7) at 10% (60/578) of all river crossings in the study area. *A. mearnsii* and *Salix babylonica* were very common to abundant at 4% (24/578) and 3% (19/578) respectively (Table 6).

In the Grassland Biome *A. dealbata* was by far the most prominent invader followed by *Salix babylonica* and *A. mearnsii*. *Salix babylonica* was prominent in temperate grassland, *A. dealbata* most prominent in moist subtropical grassland and both *Acacia* spp. were prominent in dry subtropical grassland and mistbelt grassland.

In the Savanna Biome *Chromolaena odorata*, *Lantana camara* and *Ricinus communis* were the most prominent invaders. The first two species were most prominent in tropical forest and although they were not the most frequently recorded species they formed dense stands more often than did any other species. *Ricinus communis* rarely formed dense stands, its prominence being largely attributable to its high percentage frequency. *Sesbania punicea* and *Melia azedarach* were the most prominent species in tropical bush and savanna.

## Roadside and veld habitats

*The whole study area*

One hundred and fifty two quarter degree squares and 350 road transects were sampled in which 116 species were recorded. Up to 44 species were recorded per quarter degree square. Invaders were recorded in 93,7% of all transects sampled and 30,6% of all transects were heavily invaded (see Table 5).

*Analysis according to veld type*

Tropical forest was the most heavily invaded in terms of species diversity and abundance of invaders (Table 5). Mistbelt grassland was the next most heavily invaded. Within these veld type categories the Pietermaritzburg, Durban and particularly the south coast were the most heavily invaded (Figures 4 & 5). Temperate grassland was the least invaded.

*Analysis according to species*

Frequency

The most frequently recorded species in the study area were *Melia azedarach*, *Acacia mearnsii*, *Solanum mauritianum* and *Ricinus communis* (Table 7). Only about 14 spp. were recorded in more than 10% of all transects.

The most frequently recorded invader in the Grassland Biome was *Acacia mearnsii*, followed by *A. dealbata*, *Eucalyptus* spp., *Solanum mauritianum*, *Melia azedarach*, *Prunus persica* and *Rubus* spp. (mainly *R. cuneifolius*).

In the Savanna Biome *Ricinus communis*, *Melia azedarach* and *Psidium guajava* were the most frequently recorded invaders, followed by *Solanum mauritianum*, *Chromolaena odorata* and *Lantana camara*. *Opuntia ficus-indica* was the most frequent invader in tropical bush and savanna.

Prominence

*Chromolaena odorata*, despite the fact that it was almost entirely confined to the coastal belt, scored the highest prominence value in the study area (Table 7). It had the highest mean abundance rating (7) of all species in the study area (Table 7). The next most prominent species in order (mean abundance ratings in brackets) were *Solanum mauritianum* (5), *Psidium guajava* (5), *Rubus* spp., mainly *R. cuneifolius* (5), *Acacia mearnsii* (4) and *Lantana camara* (5).

In the Grassland Biome *Rubus* spp., *Solanum mauritianum* and *Acacia mearnsii* were the most prominent species. In the Savanna Biome *Chromolaena odorata*, *Psidium guajava* and *Lantana camara* were the most prominent species.

*Acacia dealbata* deserves mention as the second most prominent invader after *Rubus* spp. in moist subtropical grassland. *Opuntia ficus-indica* rated second most prominent after *Lantana camara* in bush and savanna. *Melia azedarach* rated second most prominent after *Acacia mearnsii* in dry subtropical grassland.

Patterns of invasion

Most invasion in terms of species diversity and abundance of invaders was recorded in the coastal belt and adjacent midlands. Within this zone most invasion occurs in and around towns and cities particularly Pietermaritzburg and Durban. The coastal belt is heavily invaded south of Durban as well as in the north around Mtunzini and Lake St Lucia (Figure 5). The north-eastern coastal plains and bushveld north of Lake St Lucia have little invasion except along the perennial rivers such as the Pongola.

A comparison of Figures 3 and 4, indicating the severity of invasion in streambank and roadside and veld habitats respectively, shows similar patterns except that in the uplands there is more severe invasion of the streambank habitat than of roadside and veld habitats. This pattern of streambank invasion in the uplands is mainly the result of *Acacia dealbata* invasions (Figure 6A) and, to a lesser extent, that of *Salix babylonica* (Figure 7K).

# DISCUSSION

## Sampling

As mentioned previously (Henderson & Musil 1984) the sampling method has its limitations, such as the under-sampling of certain habitats which are inaccessible by road, and the less distinctive species. The results reflect only the situation along road verges, which are highly disturbed sites, and a small strip of veld and watercourse visible from the road. Despite these limitations the method has proved successful and economical in obtaining information that otherwise would be unobtainable.

One recommendation with regard to the abundance ratings is that the seven point scale used for streambank habitats be revised or replaced with a cover-abundance scale such as used in the Braun-Blanquet method of vegetation analysis (see Mueller-Dombois & Ellenberg 1974). The present scale is unsatisfactory as it cannot cope

TABLE 6.—Alien species occurring in streambank habitats

| Veld type category and biome | Savanna Biome | | | | | | | | | Grassland Biome | | | | | | | | | | | | | Total study area | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tropical forest | | | Tropical bush & savanna | | | Total | | | Temperate grassland | | | Dry sub-tropical grassland | | | Moist sub-tropical grassland | | | Mistbelt grassland | | | Total | | | | | |
| No. watercourse crossings | 94 | | | 115 | | | 209 | | | 75 | | | 173 | | | 85 | | | 36 | | | 369 | | | 578 | | |
| | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P |
| *Acacia* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *dealbata* | | | | 7,8 | | 3,4 | 4,3 | | 1,4 | 16,0 | 5,3 | **32,4** | 33,7 | 14,5 | **58,1** | 51,8 | 28,2 | **94,8** | 58,3 | 19,4 | **45,8** | 36,6 | 16,3 | **62,2** | 24,9 | 10,3 | **43,0** |
| *decurrens* | | | | | | | | | | | | | 2,3 | | 1,1 | 2,4 | | 1,5 | | | | 1,6 | | 0,8 | 1,0 | | 0,4 |
| *longifolia* | | | | 0,9 | | 0,4 | 0,5 | | 0,2 | | | | | | | 1,2 | | 0,7 | 2,8 | | 0,7 | 0,5 | | 0,3 | 0,5 | | 0,2 |
| *mearnsii* | 4,3 | | 1,0 | 7,8 | | 3,4 | 6,2 | | 2,0 | 1,3 | | 1,0 | 38,4 | 9,3 | **45,4** | 9,4 | 2,4 | **11,1** | 63,9 | 16,7 | **43,0** | 26,6 | 6,5 | **30,9** | 19,2 | 4,2 | **21,4** |
| *melanoxylon* | | | | | | | | | | | | | * | | | * | | | * | | | * | | | * | | |
| *podalyriifolia* | | | | | | | | | | | | | | | | 1,2 | | 0,7 | | | | 0,3 | | 0,2 | 0,2 | | 0,1 |
| *Agave* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *americana* | | | | 1,7 | | 0,7 | 1,0 | | 0,3 | | | | 1,2 | | 0,6 | | | | | | | 0,5 | | 0,3 | 0,7 | | 0,3 |
| *sisalana* | | | | 2,6 | | 1,1 | 1,4 | | 0,5 | | | | | | | | | | | | | | | | 0,5 | | 0,2 |
| sp. | * | | | | | | * | | | | | | | | | | | | | | | | | | * | | |
| *Ageratina* | | | | | | | | | | | | | | | | | | | * | | | * | | | * | | |
| *adenophora* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Arundo* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *donax* | 18,0 | 3,2 | **13,8** | 6,1 | | 2,7 | 11,5 | 1,4 | **10,1** | * | | | 1,7 | | 0,8 | | | | * | | | 0,8 | | 0,4 | 4,7 | 0,5 | 3,6 |
| *Bambusa* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *balcooa* | 8,5 | | 1,9 | | | | 3,8 | | 1,2 | | | | * | | | | | | * | | | * | | | 1,4 | | 0,6 |
| Bambuseae sp. | | | | | | | | | | | | | | | | | | | * | | | * | | | * | | |
| Bambuseae sp. | 1,1 | | 0,3 | | | | 0,5 | | 0,2 | | | | | | | | | | | | | | | | 0,2 | | 0,1 |
| *Caesalpinia* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *decapetala* | 10,6 | | 2,4 | 7,0 | 0,9 | **10,0** | 8,6 | 0,5 | 5,1 | | | | 1,7 | 0,6 | 2,6 | | | | 13,9 | | 3,7 | 2,2 | 0,3 | 1,9 | 4,5 | 0,3 | 2,9 |
| *Canna* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *indica* | * | | | | | | * | | | | | | | | | | | | | | | | | | * | | |
| *Cardiospermum* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *grandiflorum* | * | | | 0,9 | | 0,4 | 0,5 | | 0,2 | | | | | | | | | | | | | | | | 0,2 | | 0,1 |
| *Carica* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *papaya* | 1,1 | | 0,3 | | | | 0,5 | | 0,2 | | | | | | | | | | | | | | | | 0,2 | | 0,1 |
| *Cassia* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *bicapsularis* | 5,3 | | 1,2 | 1,7 | | 0,7 | 3,3 | | 1,1 | | | | | | | | | | | | | | | | 1,2 | | 0,5 |
| *coluteoides* | | | | * | | | * | | | | | | | | | | | | | | | | | | * | | |
| *didymobotrya* | 28,7 | 3,2 | **16,2** | 9,6 | 0,9 | **11,1** | 18,2 | 1,9 | **14,6** | | | | | | | | | | 2,8 | | 0,7 | 0,3 | | 0,2 | 6,7 | 0,7 | **5,0** |
| *floribunda* | | | | | | | | | | | | | 1,7 | | 0,8 | | | | | | | 0,8 | | 0,4 | 0,5 | | 0,2 |
| *hirsuta* | * | | | | | | * | | | | | | | | | | | | | | | | | | * | | |
| sp. | 1,1 | | 0,3 | | | | 0,5 | | 0,2 | | | | | | | | | | | | | | | | 0,2 | | 0,1 |

F = % frequency of occurrence; I = % crossings heavily invaded; P = prominence value; * = species occurring in the given category but not included in a formal recording at a watercourse crossing; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 6.—Alien species occurring in streambank habitats (continued)

| Veld type category and biome | Savanna Biome | | | | | | | | | Grassland Biome | | | | | | | | | | | | | Total study area | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tropical forest | | | Tropical bush & savanna | | | Total | | | Temperate grassland | | | Dry sub-tropical grassland | | | Moist sub-tropical grassland | | | Mistbelt grassland | | | Total | | | | | |
| No. watercourse crossings | 94 | | | 115 | | | 209 | | | 75 | | | 173 | | | 85 | | | 36 | | | 369 | | | 578 | | |
| | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P |
| *Casuarina* sp. cf. *cunninghamiana* | | | | | | | | | | | | | * | | | | | | | | | * | | | * | | |
| *Cereus peruvianus* | | | | 0,9 | | 0,4 | 0,5 | | 0,2 | | | | | | | | | | | | | | | | 0,2 | | 0,1 |
| *Cestrum laevigatum* | | | | 0,9 | | 0,4 | 0,5 | | 0,2 | | | | | | | | | | | | | | | | 0,2 | | 0,1 |
| *Chromolaena odorata* | 45,7 | 11,7 | **45,6** | 7,8 | 0,9 | **10,3** | 24,9 | 5,7 | **34,1** | | | | | | | | | | * | | | * | | | 9,0 | 2,1 | **10,4** |
| *Cinnamomum camphora* | * | | | | | | * | | | | | | | | | | | | | | | | | | * | | |
| *Cryptomeria japonica* | | | | | | | | | | | | | | | | | | | * | | | * | | | * | | |
| *Cupressus* sp. cf. *arizonica* | | | | | | | | | | | | | | | | * | | | | | | * | | | * | | |
| *Cupressus* spp. | | | | | | | | | | | | | | | | | | | * | | | * | | | * | | |
| *Eucalyptus camaldulensis* | 1,1 | | 0,3 | | | | 0,5 | | 0,2 | | | | | | | | | | | | | | | | 0,2 | | 0,1 |
| *Eucalyptus robusta* | 1,1 | | 0,3 | | | | 0,5 | | 0,2 | | | | | | | | | | | | | | | | 0,2 | | 0,1 |
| *Eucalyptus* spp. | 8,5 | | 1,9 | 3,5 | | 1,5 | 5,7 | | 1,9 | * | | | 7,6 | 1,7 | **8,6** | 2,4 | | 1,5 | 11,1 | | 2,9 | 4,9 | 0,8 | 4,6 | 5,4 | 0,5 | 3,9 |
| *Gleditsia triacanthos* | | | | | | | | | | 1,3 | | 1,0 | 1,2 | | 0,6 | * | | | | | | 0,8 | | 0,4 | 0,5 | | 0,2 |
| *Hedychium coronarium* | * | | | | | | * | | | | | | | | | | | | * | | | * | | | * | | |
| *Hedychium flavum* | * | | | | | | * | | | | | | | | | | | | | | | | | | * | | |
| *Ipomoea alba* | | | | 0,9 | | 0,4 | 0,5 | | 0,2 | | | | | | | | | | | | | | | | 0,2 | | 0,1 |
| *Ipomoea congesta/purpurea* | 10,6 | | 2,4 | 0,9 | | 0,4 | 5,3 | | 1,7 | | | | 1,2 | | 0,6 | | | | | | | 0,5 | | 0,3 | 2,2 | | 0,9 |
| *Ipomoea fistulosa* | * | | | * | | | * | | | | | | | | | | | | | | | | | | * | | |
| *Jacaranda mimosifolia* | * | | | 1,7 | | 0,7 | 1,0 | | 0,3 | | | | | | | | | | 2,8 | | 0,7 | 0,3 | | 0,2 | 0,5 | | 0,2 |
| *Lantana camara* | 27,7 | 8,5 | **32,1** | 7,0 | 1,7 | **16,1** | 16,3 | 4,8 | **27,2** | | | | 4,1 | 0,6 | 3,7 | | | | 5,6 | | 1,5 | 2,4 | 0,3 | 2,0 | 7,4 | 1,9 | **9,1** |
| *Leucaena leucocephala* | | | | 1,7 | | 0,7 | 1,0 | | 0,3 | | | | | | | | | | | | | | | | 0,3 | | 0,1 |

F = % frequency of occurrence; I = % crossings heavily invaded; P = prominence value; * = species occurring in the given category but not included in a formal recording at a watercourse crossing; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 6.—Alien species occurring in streambank habitats (continued)

| Veld type category and biome | Savanna Biome | | | | | | | | | Grassland Biome | | | | | | | | | | | | | Total study area | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tropical forest | | | Tropical bush & savanna | | | Total | | | Temperate grassland | | | Dry sub-tropical grassland | | | Moist sub-tropical grassland | | | Mistbelt grassland | | | Total | | | | | |
| No. watercourse crossings | 94 | | | 115 | | | 209 | | | * 75 | | | 173 | | | 85 | | | 36 | | | 369 | | | 578 | | |
| | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P |
| *Mangifera indica* | 4,3 | | 1,0 | 0,9 | | 0,4 | 2,4 | | 0,8 | | | | | | | | | | | | | | | | 0,9 | | 0,4 |
| *Manihot* sp. | 1,1 | | 0,3 | | | | 0,5 | | 0,2 | | | | | | | | | | | | | | | | 0,2 | | 0,1 |
| *Melia azedarach* | 42,6 | | **9,7** | 39,1 | 2,6 | **37,1** | 23,0 | 1,4 | **13,9** | | | | 19,8 | | **9,6** | 1,2 | | 0,7 | 22,2 | | **5,9** | 11,7 | | 6,0 | 15,7 | 0,5 | **8,2** |
| *Metasequoia glyptostroboides* | | | | | | | | | | | | | 0,6 | | 0,3 | | | | * | | | 0,3 | | 0,2 | 0,2 | | 0,1 |
| *Monstera deliciosa* | * | | | | | | * | | | | | | | | | | | | | | | | | | * | | |
| *Montanoa hibiscifolia* | 4,3 | | 1,0 | | | | 1,9 | | 0,6 | | | | | | | | | | | | | | | | 0,7 | | 0,3 |
| *Morus alba* | 5,3 | | 1,2 | 7,0 | 0,9 | **10,0** | 6,2 | 0,5 | 4,3 | | | | 3,5 | | 1,7 | 1,2 | | 0,7 | 8,3 | | 2,2 | 2,7 | | 1,2 | 4,0 | 0,2 | 2,3 |
| *Musa* sp. | 3,2 | | 0,7 | * | | | 1,4 | | 0,5 | | | | | | | | | | | | | | | | 0,5 | | 0,2 |
| *Nicotiana glauca* | | | | 2,6 | | 1,1 | 1,4 | | 0,5 | | | | | | | | | | | | | | | | 0,5 | | 0,2 |
| *Opuntia ficus-indica* | 1,1 | | 0,3 | 3,5 | | 1,5 | 2,4 | | 0,8 | | | | 2,3 | | 1,1 | 1,2 | | 0,7 | | | | 1,1 | | 0,7 | 1,6 | | 0,7 |
| *stricta* | | | | 0,9 | | 0,4 | 0,5 | | 0,2 | | | | 0,6 | | 0,3 | | | | | | | 0,3 | | 0,2 | 0,3 | | 0,1 |
| *Pandanus* sp. | * | | | | | | * | | | | | | | | | | | | | | | | | | * | | |
| *Pennisetum purpureum* | 10,6 | 2,1 | **8,8** | | | | 4,8 | 1,0 | 6,1 | | | | | | | | | | | | | | | | 1,7 | 0,3 | 1,7 |
| *Pinus elliottii/taeda* | | | | | | | | | | | | | | | | | | | * | | | * | | | * | | |
| *patula* | | | | | | | | | | | | | 0,6 | | 0,3 | 1,2 | | 0,7 | | | | 0,5 | | 0,3 | 0,3 | | 0,1 |
| spp. | * | | | | | | * | | | | | | | | | 1,2 | | 0,7 | * | | | 0,3 | | 0,2 | 0,2 | | 0,1 |
| *Populus* × *canescens* | | | | 2,6 | | 1,1 | 1,4 | | 0,5 | 8,0 | 1,3 | 11,1 | 9,9 | 2,9 | **13,2** | 3,5 | | 2,2 | 2,8 | 2,8 | 5,1 | 7,3 | 1,9 | **8,8** | 5,2 | 1,2 | **6,0** |
| *deltoides* | | | | 0,9 | | 0,4 | 0,5 | | 0,2 | * | | | 2,9 | 0,6 | 3,1 | * | | | 13,9 | | 3,7 | 2,7 | 0,3 | 2,2 | 1,9 | 0,2 | 1,4 |
| *nigra* | | | | | | | | | | 1,3 | | 1,0 | 0,6 | | 0,3 | 1,2 | | 0,7 | | | | 0,8 | | 0,4 | 0,5 | | 0,2 |
| *Prunus persica* | | | | 4,3 | | 1,9 | 2,4 | | 0,8 | 5,3 | | 4,1 | 8,7 | | 4.2 | 11,8 | | 7,3 | 33,3 | | **8,8** | 11,1 | | 5,7 | 8,0 | | 3,4 |

F = % frequency of occurrence; I = % crossings heavily invaded; P = prominence value; * = species occurring in the given category but not included in a formal recording at a watercourse crossing; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 6.—Alien species occurring in streambank habitats (continued)

| Veld type category and biome | Savanna Biome | | | | | | | | | Grassland Biome | | | | | | | | | | | | | Total study area | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tropical forest | | | Tropical bush & savanna | | | Total | | | Temperate grassland | | | Dry sub-tropical grassland | | | Moist sub-tropical grassland | | | Mistbelt grassland | | | Total | | | | | |
| No. watercourse crossings | 94 | | | 115 | | | 209 | | | 75 | | | 173 | | | 85 | | | 36 | | | 369 | | | 578 | | |
| | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P | F | I | P |
| *Psidium guajava* | 52,1 | 1,1 | **15,2** | 3,5 | | 1,5 | 25,4 | 0,5 | **10,6** | | | | 2,3 | | 1,1 | | | | 5,6 | | 1,5 | 1,6 | | 0,8 | 10,2 | 0,2 | **5,0** |
| *Punica granatum* | | | | | | | | | | | | | 0,6 | | 0,3 | | | | | | | 0,3 | | 0,2 | 0,2 | | 0,1 |
| *Pyracantha angustifolia* | | | | 1,7 | | 0,7 | 1,0 | | 0,3 | 5,3 | | 4,1 | 1,7 | | 0,8 | * | | | | | | 1,9 | | 1,0 | 1,6 | | 0,7 |
| *Quercus robur* | | | | | | | | | | | | | | | | • 1,2 | | 0,7 | | | | 0,3 | | 0,2 | 0,2 | | 0,1 |
| *Ricinus communis* | 61,7 | 2,1 | **20,4** | 41,7 | 0,9 | **25,2** | 50,7 | 1,4 | **23,0** | | | | 5,2 | | 2,5 | | | | 8,3 | | 2,2 | 3,3 | | 1,7 | 20,4 | 0,5 | **10,2** |
| *Rosa eglanteria* | | | | | | | | | | 2,7 | | 2,1 | | | | | | | | | | 0,5 | | 0,3 | 0,3 | | 0,1 |
| *odorata* | 1,1 | | 0,3 | | | | 0,5 | | 0,2 | | | | | | | | | | | | | | | | 0,2 | | 0,1 |
| *Rubus affinis* | 2,1 | | 0,5 | | | | 1,0 | | 0,3 | | | | | | | | | | 2,8 | | 0,7 | 0,3 | | 0,2 | 0,5 | | 0,2 |
| sp. cf. *cuneifolius* | | | | 0,9 | | 0,4 | 0,5 | | 0,2 | | | | 1,2 | | 0,6 | 9,4 | 1,2 | 8,5 | 30,6 | 8,3 | **21,1** | 5,7 | 1,1 | 5,8 | 3,8 | 0,7 | 3,8 |
| spp. | | | | | | | | | | | | | 0,6 | | 0,3 | | | | 2,8 | | 0,7 | 0,5 | | 0,3 | 0,3 | | 0,1 |
| *Saccharum officinarum* | 7,4 | | 1,7 | 0,9 | | 0,4 | 3,8 | | 1,2 | | | | | | | | | | | | | | | | 1,4 | | 0,6 |
| *Salix babylonica* | 1,1 | | 0,3 | 6,1 | | 2,6 | 3,8 | | 1,2 | 73,3 | 14,7 | **112,6** | 19,8 | 1,7 | **14,5** | 45,9 | 7,1 | **44,1** | 16,7 | | 4,4 | 36,3 | 5,1 | **32,2** | 24,6 | 3,3 | **20,8** |
| *caprea* | | | | | | | | | | | | | | | | 3,5 | | 2,2 | | | | 0,8 | | 0,4 | 0,5 | | 0,2 |
| *lasiandra* | | | | 0,9 | | 0,4 | 0,5 | | 0,2 | 10,7 | 4,0 | **23,4** | 7,0 | | 3,4 | 7,1 | 5,9 | **17,5** | 2,8 | 2,8 | 5,1 | 7,3 | 2,2 | **9,6** | 4,8 | 1,4 | 6,4 |
| *Sambucus canadensis* | | | | | | | | | | | | | | | | | | | 2,8 | 2,8 | 5,1 | 0,3 | 0,3 | 1,0 | 0,2 | 0,2 | 0,7 |
| *Schinus terebinthifolius* | 7,4 | 1,1 | 5,0 | | | | 3,3 | 0,5 | 3,4 | | | | | | | | | | | | | | | | 1,2 | 0,2 | 1,1 |
| *Sesbania punicea* | 18,1 | | 4,1 | 20,0 | 4,3 | **41,6** | 19,1 | 2,4 | **17,2** | 2,7 | 1,3 | 7,0 | 14,5 | 2,3 | **13,7** | * | | | **5,6** | **2,8** | **5,9** | 7,9 | 1,6 | **8,3** | 11,9 | 1,9 | **11,0** |
| *Solanum mauritianum* | 34,0 | | 7,7 | 15,7 | | 6,9 | 23,9 | | **7,8** | | | | 8,1 | 0,6 | 5,7 | 4,7 | | 2,9 | 58,3 | 8,3 | **28,4** | 10,6 | 0,8 | **7,6** | 15,4 | 0,5 | **8,1** |
| *Tithonia diversifolia* | 5,3 | | 1,2 | | | | 2,4 | | 0,8 | | | | | | | | | | | | | | | | 0,9 | | 0,4 |
| *Yucca* sp. cf. *aloifolia* | | | | 0,9 | | 0,4 | 0,5 | | 0,2 | | | | | | | | | | | | | | | | 0,2 | | 0,1 |

F = % frequency of occurrence; I = % crossings heavily invaded; P = prominence value; * = species occurring in the given category but not included in a formal recording at a watercourse crossing; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 7.—Alien species occurring in roadside and veld habitats

| Veld type category and biome | Savanna Biome | | | | | | | | | Grassland Biome | | | | | | | | | | | | | | | Total study area | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tropical forest | | | Tropical bush & savanna | | | Total | | | Temperate grassland | | | Dry sub-tropical grassland | | | Moist sub-tropical grassland | | | Mistbelt grassland | | | Total | | | | | |
| No. road transects | 80 | | | 59 | | | 139 | | | 43 | | | 72 | | | 45 | | | 51 | | | 211 | | | 350 | | |
| | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P |
| *Acacia dealbata* | | | | | | | | | | 48,8 | 2,0 | **53,9** | 27,8 | 3,0 | **20,0** | 73,3 | 4,0 | **40,0** | 19,6 | 3,0 | 4,8 | 39,8 | 3,0 | **19,0** | 24,0 | 3,0 | **9,0** |
| *decurrens* | | | | | | | | | | 4,7 | 1,0 | 3,1 | 5,6 | 3,0 | 3,2 | 11,1 | 3,0 | 3,8 | * | | | 5,2 | 3,0 | 1,7 | 3,1 | 3,0 | 0,8 |
| *longifolia* | 3,8 | 1,0 | 0,6 | | | | 2,2 | 1,0 | 0,4 | | | | 1,4 | 2,0 | 0,5 | | | | 7,8 | 2,0 | 1,3 | 2,4 | 2,0 | 0,7 | 2,3 | 2,0 | 0,5 |
| *mearnsii* | 18,8 | 3,0 | 3,2 | 11,9 | 3,0 | 5,5 | 15,8 | 3,0 | **3,5** | 7,0 | 3,0 | **11,1** | 62,5 | 3,0 | **50,1** | 55,6 | 4,0 | **31,8** | 96,1 | 4,0 | **30,2** | 57,8 | 4,0 | **31,5** | 41,1 | 4,0 | **16,4** |
| *melanoxylon* | * | | | | | | * | | | 2,3 | 1,0 | 1,5 | * | | | 8,9 | 4,0 | 5,1 | 5,9 | 3,0 | 1,3 | 3,8 | 3,0 | 2,0 | 2,3 | 3,0 | 0,9 |
| *podalyriifolia* | 5,0 | 2,0 | 0,8 | | | | 2,9 | 2,0 | 0,6 | | | | 1,4 | 1,0 | 0,5 | * | | | 2,0 | 2,0 | 0,3 | 0,9 | 1,0 | 0,2 | 1,7 | 2,0 | 0,4 |
| *Agave americana* | | | | 13,6 | 2,0 | 4,5 | 5,8 | 2,0 | 1,2 | 4,7 | 1,0 | 3,1 | 12,5 | 1,0 | 4,4 | * | | | * | | | 5,2 | 1,0 | 1,4 | 5,4 | 1,0 | 1,3 |
| *sisalana* | 10,0 | 2,0 | 1,6 | 18,6 | 2,0 | **7,6** | 13,7 | 2,0 | 2,9 | | | | | | | | | | 3,9 | 1,0 | 0,7 | 0,9 | 1,0 | 0,3 | 6,0 | 2,0 | 1,5 |
| sp. | 1,3 | 2,0 | 0,2 | | | | 0,7 | 2,0 | 0,1 | | | | | | | | | | | | | | | | 0,3 | 2,0 | 0,1 |
| *Ageratina adenophora* | | | | | | | | | | | | | | | | | | | * | | | * | | | * | | |
| *Ailanthus altissima* | * | | | | | | * | | | | | | | | | | | | * | | | * | | | * | | |
| *Antigonon leptopus* | 1,3 | 4,0 | 0,3 | | | | 0,7 | 4,0 | 0,2 | | | | | | | | | | | | | | | | 0,3 | 4,0 | 0,1 |
| *Arundo donax* | 10,0 | 2,0 | 1,6 | * | | | 5,8 | 2,0 | 1,2 | | | | 1,4 | 2,0 | 0,6 | | | | 2,0 | 1,0 | 0,3 | 0,9 | 1,0 | 0,3 | 2,9 | 2,0 | 0,7 |
| *Bambusa balcooa* | 2,5 | 2,0 | 0,4 | | | | 1,4 | 2,0 | 0,3 | | | | | | | | | | 2,0 | 1,0 | 0,3 | 0,5 | 1,0 | 0,1 | 0,9 | 2,0 | 0,2 |
| Bambuseae sp. | 1,3 | 2,0 | 0,2 | | | | 0,7 | 2,0 | 0,1 | | | | | | | | | | | | | | | | 0,3 | 2,0 | 0,1 |
| *Bauhinia variegata* | * | | | | | | * | | | | | | | | | | | | * | | | * | | | * | | |
| *Caesalpinia decapetala* | 13,8 | 3,0 | 2,3 | 6,8 | 3,0 | 3,2 | 10,8 | 3,0 | 2,4 | | | | 1,4 | 3,0 | 0,9 | 2,2 | 1,0 | 0,6 | 23,5 | 3,0 | 4,4 | 6,6 | 3,0 | 2,1 | 8,3 | 3,0 | 2,3 |
| *Canna indica* | * | | | | | | * | | | | | | | | | | | | * | | | * | | | * | | |
| *Cardiospermum grandiflorum* | * | | | | | | * | | | | | | | | | | | | * | | | * | | | * | | |
| *Carica papaya* | 1,3 | 2,0 | 0,2 | | | | 0,7 | 2,0 | 0,1 | | | | | | | | | | | | | | | | 0,3 | 2,0 | 0,1 |
| *Cassia bicapsularis* | 5,0 | 2,0 | 0,8 | 1,7 | 2,0 | 0,6 | 3,6 | 2,0 | 0,7 | | | | | | | | | | | | | | | | 1,4 | 2,0 | 0,3 |

F = % frequency of occurrence; A = mean abundance rating; P = prominence value; * = species occurring in the given category but not included in a formal recording in a road transect; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 7.—Alien species occurring in roadside and veld habitats (continued)

| Veld type category and biome | Savanna Biome | | | | | | | | | Grassland Biome | | | | | | | | | | | | | Total study area | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tropical forest | | | Tropical bush & savanna | | | Total | | | Temperate grassland | | | Dry sub-tropical grassland | | | Moist sub-tropical grassland | | | Mistbelt grassland | | | Total | | | | | |
| No. road transects | 80 | | | 59 | | | 139 | | | 43 | | | 72 | | | 45 | | | 51 | | | 211 | | | 350 | | |
| | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P |
| *Cassia coluteoides* | | | | 3,4 | 1,0 | 1,1 | 1,4 | 1,0 | 0,3 | | | | | | | | | | | | | | | | 0,6 | 1,0 | 0,1 |
| *didymobotrya* | 25,0 | 4,0 | **6,5** | 8,5 | 3,0 | 4,3 | 18,0 | 4,0 | **6,0** | | | | 2,8 | 1,0 | 0,9 | | | | 13,7 | 2,0 | 2,3 | 4,3 | 2,0 | 1,2 | 9,7 | 4,0 | 3,8 |
| *floribunda* | | | | | | | | | | | | | 2,8 | 2,0 | 0,9 | | | | * | | | 0,9 | 2,0 | 0,2 | 0,6 | 2,0 | 0,1 |
| *hirsuta* | 3,8 | 2,0 | 0,6 | | | | 2,2 | 2,0 | 0,5 | | | | | | | | | | | | | | | | 0,9 | 2,0 | 0,2 |
| sp. | 1,3 | 2,0 | 0,2 | 1,7 | 1,0 | 0,5 | 1,4 | 1,0 | 0,3 | | | | | | | | | | | | | | | | 0,6 | 1,0 | 0,1 |
| *Casuarina equisetifolia* | 2,5 | 2,0 | 0,4 | | | | 1,4 | 2,0 | 0,3 | | | | | | | | | | | | | | | | 0,6 | 2,0 | 0,1 |
| sp. cf. *cunninghamiana* | | | | | | | | | | | | | | | | | | | * | | | * | | | * | | |
| *Cedrus deodara* | | | | | | | | | | * | | | | | | | | | | | | * | | | * | | |
| *Cereus peruvianus* | | | | 1,7 | 1,0 | 0,5 | 0,7 | 1,0 | 0,1 | | | | | | | | | | | | | | | | 0,3 | 1,0 | 0,1 |
| *Cestrum aurantiacum* | | | | | | | | | | | | | | | | | | | * | | | * | | | * | | |
| *laevigatum* | 1,3 | 4,0 | 0,3 | | | | 0,7 | 4,0 | 0,2 | | | | | | | | | | * | | | * | | | 0,3 | 4,0 | 0,1 |
| *Chromolaena odorata* | 56,3 | 7,0 | **49,6** | 8,5 | 6,0 | **17,3** | 36,0 | 7,0 | **45,2** | | | | | | | | | | 9,8 | 3,0 | 2,6 | 2,4 | 3,0 | 1,2 | 15,7 | 7,0 | **26,3** |
| *Cinnamomum camphora* | * | | | | | | * | | | | | | | | | | | | | | | | | | * | | |
| *Cotoneaster franchetii* | | | | | | | | | | | | | * | | | | | | | | | * | | | * | | |
| spp. | | | | * | | | * | | | | | | | | | 2,2 | 1,0 | 0,6 | * | | | 0,5 | 1,0 | 0,1 | 0,3 | 1,0 | 0,1 |
| *Crotalaria agatiflora* | | | | | | | | | | | | | | | | | | | * | | | * | | | * | | |
| *Cupressus* sp. cf. *arizonica* | | | | | | | | | | | | | | | | * | | | | | | * | | | * | | |
| spp. | | | | | | | | | | 2,3 | 1,0 | 1,5 | | | | | | | * | | | 0,5 | 1,0 | 0,1 | 0,3 | 1,0 | 0,1 |
| *Cytisus scoparius* | | | | | | | | | | | | | | | | 2,2 | 2,0 | 0,7 | | | | 0,5 | 2,0 | 0,1 | 0,3 | 2,0 | 0,1 |
| *Dahlia imperialis* | | | | | | | | | | | | | | | | | | | * | | | * | | | * | | |
| *Delonix regia* | 1,3 | 2,0 | 0,2 | | | | 0,7 | 2,0 | 0,1 | | | | | | | | | | | | | | | | 0,3 | 2,0 | 0,1 |

F = % frequency of occurrence; A = mean abundance rating; P = prominence value; * = species occurring in the given category but not included in a formal recording in a road transect; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 7.—Alien species occurring in roadside and veld habitats (continued)

| Veld type category and biome | Savanna Biome | | | | | | | | | Grassland Biome | | | | | | | | | | | | | Total study area | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tropical forest | | | Tropical bush & savanna | | | Total | | | Temperate grassland | | | Dry sub-tropical grassland | | | Moist sub-tropical grassland | | | Mistbelt grassland | | | Total | | | | | |
| No. road transects | 80 | | | 59 | | | 139 | | | 43 | | | 72 | | | 45 | | | 51 | | | 211 | | | 350 | | |
| | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P |
| *Eucalyptus cinerea* spp. | 22,5 | 3,0 | 3,7 | 3,4 | 1,0 | 1,1 | 14,4 | 2,0 | 3,0 | 30,2 | 1,0 | **25,2** | 41,7 | 2,0 | **16,8** | 2,2<br>22,2 | 1,0<br>3,0 | 0,6<br>7,3 | 2,0<br>43,1 | 2,0<br>3,0 | 0,3<br>**8,3** | 0,9<br>35,5 | 1,0<br>2,0 | 0,3<br>**10,8** | 0,6<br>27,1 | 1,0<br>2,0 | 0,1<br>**6,9** |
| *Euphorbia pulcherrima* | * | | | | | | * | | | | | | | | | | | | * | | | * | | | * | | |
| *Gleditsia triacanthos* | | | | | | | | | | * | | | 1,4 | 2,0 | 0,6 | | | | * | | | 0,5 | 2,0 | 0,1 | 0,3 | 2,0 | 0,1 |
| *Grevillea robusta* | 1,3 | 2,0 | 0,2 | | | | 0,7 | 2,0 | 0,1 | | | | | | | | | | 2,0 | 1,0 | 0,3 | 0,5 | 1,0 | 0,1 | 0,6 | 1,0 | 0,1 |
| *Hedychium coronarium* | * | | | | | | * | | | | | | | | | | | | * | | | * | | | * | | |
| *flavum* | * | | | | | | * | | | | | | | | | | | | * | | | * | | | * | | |
| *Hylocereus* sp. | * | | | | | | * | | | | | | | | | | | | | | | | | | * | | |
| *Ipomoea alba* | * | | | | | | * | | | | | | | | | | | | | | | | | | * | | |
| *congesta/purpurea* | 3,8 | 3,0 | 0,7 | 3,4 | 2,0 | 1,1 | 3,6 | 3,0 | 0,8 | | | | | | | | | | | | | | | | 1,4 | 3,0 | 0,4 |
| *fistulosa* | 8,8 | 1,0 | 1,4 | 5,1 | 2,0 | 1,8 | 7,2 | 2,0 | 1,5 | | | | | | | | | | | | | | | | 2,8 | 2,0 | 0,7 |
| *Jacaranda mimosifolia* | 7,5 | 2,0 | 1,2 | 10,2 | 1,0 | 3,3 | 8,6 | 2,0 | 1,8 | | | | 11,1 | 2,0 | 4,3 | | | | 13,7 | 2,0 | 2,3 | 7,1 | 2,0 | 2,0 | 7,7 | 2,0 | 1,8 |
| *Jatropha* sp. | | | | * | | | * | | | | | | | | | | | | | | | | | | * | | |
| *Lagerstroemia indica* | * | | | | | | * | | | | | | | | | | | | | | | | | | * | | |
| *Lantana camara* | 47,5 | 6,0 | **21,2** | 16,9 | 5,0 | **40,4** | 34,5 | 5,0 | **22,8** | | | | 5,6 | 3,0 | 3,2 | | | | 25,5 | 4,0 | **9,0** | 8,1 | 4,0 | **5,0** | 18,6 | 5,0 | **14,9** |
| *Leucaena leucocephala* | 3,8 | 3,0 | 0,7 | | | | 2,2 | 3,0 | 0,6 | | | | | | | | | | | | | | | | 0,8 | 3,0 | 0,3 |
| *Mangifera indica* | 7,5 | 1,0 | 1,2 | | | | 4,3 | 1,0 | 0,9 | | | | | | | | | | | | | | | | 1,7 | 1,0 | 0,4 |
| *Manihot* sp. | 1,3 | 1,0 | 0,2 | | | | 0,7 | 1,0 | 0,1 | | | | | | | | | | * | | | * | | | 0,3 | 1,0 | 0,1 |
| *Melia azedarach* | 62,5 | 3,0 | **11,3** | 54,2 | 2,0 | **20,7** | 59,0 | 3,0 | **13,3** | * | | | 52,8 | 2,0 | **24,9** | 8,9 | 1,0 | 2,6 | 54,9 | 3,0 | **10,1** | 33,2 | 2,0 | **10,2** | 43,4 | 3,0 | **11,7** |
| *Montanoa hibiscifolia* | 11,3 | 4,0 | 2,9 | | | | 6,5 | 4,0 | 2,3 | | | | | | | | | | * | | | | | | 2,5 | 4,0 | 1,2 |

F = % frequency of occurrence; A = mean abundance rating; P = prominence value; * = species occurring in the given category but not included in a formal recording in a road transect; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 7.—Alien species occurring in roadside and veld habitats (continued)

| Veld type category and biome | Savanna Biome | | | | | | | | | Grassland Biome | | | | | | | | | | | | | Total study area | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tropical forest | | | Tropical bush & savanna | | | Total | | | Temperate grassland | | | Dry sub-tropical grassland | | | Moist sub-tropical grassland | | | Mistbelt grassland | | | Total | | | | | |
| No. road transects | 80 | | | 59 | | | 139 | | | 43 | | | 72 | | | 45 | | | 51 | | | 211 | | | 350 | | |
| | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P |
| *Morus alba* | 7,5 | 3,0 | 1,2 | 5,1 | 2,0 | 1,6 | 6,5 | 2,0 | 1,4 | | | | 2,8 | 1,0 | 0,9 | | | | 2,0 | 3,0 | 0,4 | 1,4 | 2,0 | 0,4 | 3,4 | 2,0 | 0,8 |
| *Nerium oleander* | | | | | | | | | | | | | 1,4 | 2,0 | 0,6 | | | | | | | 0,5 | 2,0 | 0,1 | 0,3 | 2,0 | 0,1 |
| *Nicotiana glauca* | | | | 1,7 | 2,0 | 0,5 | 0,7 | 2,0 | 0,1 | | | | | | | | | | | | | | | | 0,3 | 2,0 | 0,1 |
| *Opuntia ficus-indica* | 6,3 | 2,0 | 1,0 | 61,0 | 3,0 | **28,1** | 29,5 | 3,0 | **6,7** | 11,6 | 1,0 | 8,8 | 22,2 | 1,0 | **8,3** | 4,4 | 2,0 | 1,3 | 7,8 | 1,0 | 1,3 | 12,8 | 1,0 | 3,5 | 19,4 | 2,0 | 5,1 |
| *spinulifera* | | | | 1,7 | 2,0 | 0,5 | 0,7 | 2,0 | 0,1 | | | | 2,8 | 1,0 | 0,9 | 2,2 | * 1,0 | 0,6 | | | | 1,4 | 1,0 | 0,4 | 1,1 | 1,0 | 0,3 |
| *stricta* | | | | 13,6 | 3,0 | 5,7 | 5,8 | 3,0 | 1,3 | | | | * | | | | | | | | | * | | | 2,3 | 3,0 | 0,6 |
| *vulgaris* | 10,0 | 1,0 | 1,5 | 1,7 | 2,0 | 0,5 | 6,5 | 1,0 | 1,3 | | | | 1,4 | 2,0 | 0,5 | | | | | | | 0,5 | 2,0 | 0,1 | 2,8 | 1,0 | 0,7 |
| *Pandanus* sp. | * | | | | | | * | | | | | | | | | | | | | | | | | | * | | |
| *Passiflora edulis* | 2,5 | 2,0 | 0,4 | | | | 1,4 | 2,0 | 0,3 | | | | | | | | | | | | | | | | 0,6 | 2,0 | 0,1 |
| *foetida* | * | | | | | | * | | | | | | | | | | | | | | | | | | * | | |
| *Pennisetum purpureum* | 13,8 | 3,0 | 2,3 | * | | | 7,9 | 3,0 | 1,7 | | | | 1,4 | 1,0 | 0,5 | | | | 7,8 | 1,0 | 1,3 | 2,4 | 1,0 | 0,7 | 4,6 | 2,0 | 1,1 |
| *Pereskia aculeata* | 1,3 | 2,0 | 0,2 | | | | 0,7 | 2,0 | 0,1 | | | | | | | | | | | | | | | | 0,3 | 2,0 | 0,1 |
| *Pinus canariensis* | 5,0 | 2,0 | 0,8 | | | | 3,6 | 2,0 | 0,7 | | | | | | | | | | | | | | | | 1,1 | 2,0 | 0,3 |
| *elliottii/taeda* | 17,5 | 4,0 | **4,6** | * | | | 10,1 | 4,0 | **3,7** | 2,3 | 1,0 | 1,5 | * | | | 2,2 | 1,0 | 0,6 | 7,8 | 2,0 | 1,3 | 2,8 | 2,0 | 0,8 | 5,7 | 4,0 | 1,7 |
| *patula* | | | | 1,7 | 2,0 | 0,5 | 0,7 | 2,0 | 0,1 | 2,3 | 1,0 | 1,5 | 2,8 | 2,0 | 1,3 | 22,2 * | 2,0 | 7,1 | 2,0 | 4,0 | 0,6 | 6,6 * | 3,0 | 2,2 | 4,3 * | 3,0 | 1,2 |
| sp. cf. *uncinata* spp. | | | | 1,7 | 1,0 | 0,5 | 0,7 | 1,0 | 0,1 | | | | 1,4 | 1,0 | 0,5 | * | | | 2,0 | 4,0 | 0,5 | 0,9 | 3,0 | 0,3 | 0,9 | 3,0 | 0,2 |
| *Populus* × *canescens* | * | | | 1,7 | 2,0 | 0,5 | 0,7 | 2,0 | 0,1 | 14,0 * | 1,0 | 9,4 | 12,5 * | 1,0 | 4,3 | 2,2 | 1,0 | 0,6 | * | | | 7,6 * | 1,0 | 2,1 | 4,8 * | 1,0 | 1,1 |
| *deltoides nigra* | | | | | | | | | | 2,3 | 2,0 | 2,0 | | | | | | | | | | 0,5 | 2,0 | 0,1 | 0,3 | 2,0 | 0,1 |
| *Prunus armeniaca* | | | | | | | | | | 2,3 | 1,0 | 1,5 | | | | * | | | | | | 0,5 | 1,0 | 0,1 | 0,3 | 1,0 | 0,1 |
| *persica* | 1,3 | 2,0 | 0,2 | 6,8 | 2,0 | 2,3 | 3,6 | 2,0 | 0,7 | 37,2 | 2,0 | **36,2** | 22,2 | 2,0 | **8,9** | 37,8 | 2,0 | **11,7** | 41,2 | 2,0 | **7,2** | 33,2 | 2,0 | **9,7** | 21,4 | 2,0 | **5,3** |
| *Psidium guajava* | 73,8 | 6,0 | **35,2** | 20,3 | 3,0 | **8,6** | 51,1 | 5,0 | **31,5** | | | | 8,3 | 3,0 | **7,0** | | | | 31,4 | 3,0 | 6,9 | 10,4 | 3,0 | 4,2 | 26,6 | 5,0 | **19,4** |

F = % frequency of occurrence; A = mean abundance rating; P = prominence value; * = species occurring in the given category but not included in a formal recording in a road transect; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 7.—Alien species occurring in roadside and veld habitats (continued)

| Veld type category and biome | Savanna Biome | | | | | | | | | Grassland Biome | | | | | | | | | | | | | | | Total study area | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tropical forest | | | Tropical bush & savanna | | | Total | | | Temperate grassland | | | Dry sub-tropical grassland | | | Moist sub-tropical grassland | | | Mistbelt grassland | | | Total | | | | | |
| No. road transects | 80 | | | 59 | | | 139 | | | 43 | | | 72 | | | 45 | | | 51 | | | 211 | | | 350 | | |
| | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P |
| *Punica granatum* | | | | | | | | | | | | | 1,4 | 1,0 | 0,5 | | | | | | | 0,5 | 1,0 | 0,1 | 0,3 | 1,0 | 0,1 |
| *Pyracantha angustifolia* | | | | | | | | | | 23,3 | 1,0 | **18,1** | 5,6 | 1,0 | 2,0 | 4,4 | 1,0 | 1,3 | 2,0 | 1,0 | 0,3 | 8,1 | 1,0 | 2,2 | 4,8 | 1,0 | 1,1 |
| *fortuneana* | | | | | | | | | | * | | | | | | * | | | | | | * | | | * | | |
| *rogersiana* | | | | | | | | | | 2,3 | 1,0 | 1,5 | | | | | | | | | | 0,5 | 1,0 | 0,1 | 0,3 | 1,0 | 0,1 |
| sp. cf. *coccinea* | * | | | | | | * | | | | | | | | | * | | | | | | * | | | * | | |
| *Quercus robur* | | | | | | | | | | | | | | | | * | | | 2,0 | 2,0 | 0,3 | 0,5 | 2,0 | 0,1 | 0,3 | 2,0 | 0,1 |
| *Ricinus communis* | 72,5 | 3,0 | **14,0** | 47,5 | 3,0 | **26,8** | 61,9 | 3,0 | **15,8** | | | | 9,7 | 2,0 | **4,5** | | | | 33,3 | 2,0 | 5,7 | 11,4 | 2,0 | 3,3 | 31,4 | 3,0 | **9,6** |
| *Robinia pseudo-acacia* | | | | | | | | | | * | | | 1,4 | 2,0 | 0,5 | | | | 2,0 | 1,0 | 0,3 | 0,9 | 1,0 | 0,2 | 0,6 | 1,0 | 0,1 |
| *Rosa eglanteria* | | | | | | | | | | 16,3 | 2,0 | **16,8** | | | | 8,9 | 2,0 | 2,8 | | | | 5,2 | 2,0 | 1,5 | 3,1 | 2,0 | 0,8 |
| *odorata* | | | | | | | | | | | | | | | | | | | * | | | * | | | * | | |
| *Rubus affinis* | | | | | | | | | | | | | 6,9 | 1,0 | 2,3 | * | | | 2,0 | 1,0 | 0,3 | 2,8 | 1,0 | 0,8 | 1,7 | 1,0 | 0,4 |
| sp. cf. *cuneifolius* | | | | 1,7 | 2,0 | 0,6 | 0,7 | 2,0 | 0,1 | 2,3 | 1,0 | 1,5 | 2,8 | 3,0 | 1,4 | 57,8 | 5,0 | **53,9** | 64,7 | 6,0 | **47,3** | 28,9 | 5,0 | **40,9** | 17,7 | 5,0 | **17,8** |
| *Saccharum officinarum* | 5,0 | 3,0 | 1,0 | | | | 2,9 | 3,0 | 0,7 | | | | | | | | | | | | | | | | 1,1 | 3,0 | 0,3 |
| *Schinus molle* | | | | * | | | * | | | | | | * | | | | | | | | | * | | | * | | |
| *terebinthifolius* | 16,3 | 3,0 | 3,0 | | | | 9,4 | 3,0 | 2,2 | | | | | | | | | | | | | | | | 3,7 | 3,0 | 1,1 |
| *Sesbania punicea* | 25,0 | 3,0 | **4,3** | 1,7 | 2,0 | 0,5 | 15,1 | 3,0 | 3,4 | 2,3 | 1,0 | 1,5 | 11,1 | 1,0 | 4,1 | * | | | 9,8 | 1,0 | 1,6 | 6,6 | 1,0 | 1,8 | 10,0 | 3,0 | 2,6 |
| *Solanum hermannii* | 1,3 | 4,0 | 0,3 | | | | 0,7 | 4,0 | 0,2 | | | | | | | | | | | | | | | | 0,3 | 4,0 | 0,1 |
| *mauritianum* | 56,3 | 4,0 | **12,7** | 20,3 | 3,0 | **8,5** | 41,0 | 4,0 | **11,8** | | | | 20,8 | 3,0 | **18,6** | 22,2 | 6,0 | **26,0** | 92,2 | 5,0 | **44,9** | 34,1 | 5,0 | **33,5** | 36,9 | 5,0 | **20,9** |
| *pseudocapsicum* | | | | | | | | | | | | | | | | | | | * | | | * | | | * | | |
| *seaforthianum* | * | | | | | | * | | | | | | | | | | | | | | | | | | * | | |
| *Spathodea campanulata* | * | | | | | | * | | | | | | | | | | | | | | | | | | * | | |
| *Spiraea cantoniensis* | | | | | | | | | | | | | | | | | | | 2,0 | 1,0 | 0,3 | 0,5 | 1,0 | 0,1 | 0,3 | 1,0 | 0,1 |

F = % frequency of occurrence; A = mean abundance rating; P = prominence value; * = species occurring in the given category but not included in a formal recording in a road transect; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 7.—Alien species occurring in roadside and veld habitats (continued)

| Veld type category and biome | Savanna Biome | | | | | | | | | Grassland Biome | | | | | | | | | | | | | Total study area | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tropical forest | | | Tropical bush & savanna | | | Total | | | Temperate grassland | | | Dry sub-tropical grassland | | | Moist sub-tropical grassland | | | Mistbeit grassland | | | Total | | | | | |
| No. road transects | 80 | | | 59 | | | 139 | | | 43 | | | 72 | | | 45 | | | 51 | | | 211 | | | 350 | | |
| | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P | F | A | P |
| *Syzygium cuminii* | * | | | 1,7 | 2,0 | 0,5 | 0,7 | 2,0 | 0,1 | | | | | | | | | | | | | | | | 0,3 | 2,0 | 0,1 |
| *Thevetia peruviana* | 5,0 | 1,0 | 0,8 | * | | | 2,9 | 1,0 | 0,6 | | | | | | | | | | | | | | | | 1,1 | 1,0 | 0,3 |
| *Tipuana tipu* | | | | | | | | | | | | | | | | | | | * | | | * | | | * | | |
| *Tithonia diversifolia* | 10,0 | 3,0 | 1,8 | * | | | 5,8 | 3,0 | 1,3 | | | | | | | | | | * | | | * | | | 2,3 | 3,0 | 0,7 |
| *Ulex europaeus* | | | | | | | | | | | | | | | | 2,2 | 2,0 | 0,7 | | | | 0,5 | 2,0 | 0,1 | 0,3 | 2,0 | 0,1 |
| *Yucca* sp. cf. *aloifolia* | 2,5 | 2,0 | 0,4 | | | | 1,4 | 2,0 | 0,3 | | | | 1,4 | 2,0 | 0,6 | | | | 2,0 | 1,0 | 0,3 | 0,9 | 1,0 | 0,3 | 1,1 | 1,0 | 0,3 |

F = % frequency of occurrence; A = mean abundance rating; P = prominence value; * = species occurring in the given category but not included in a formal recording in a road transect; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

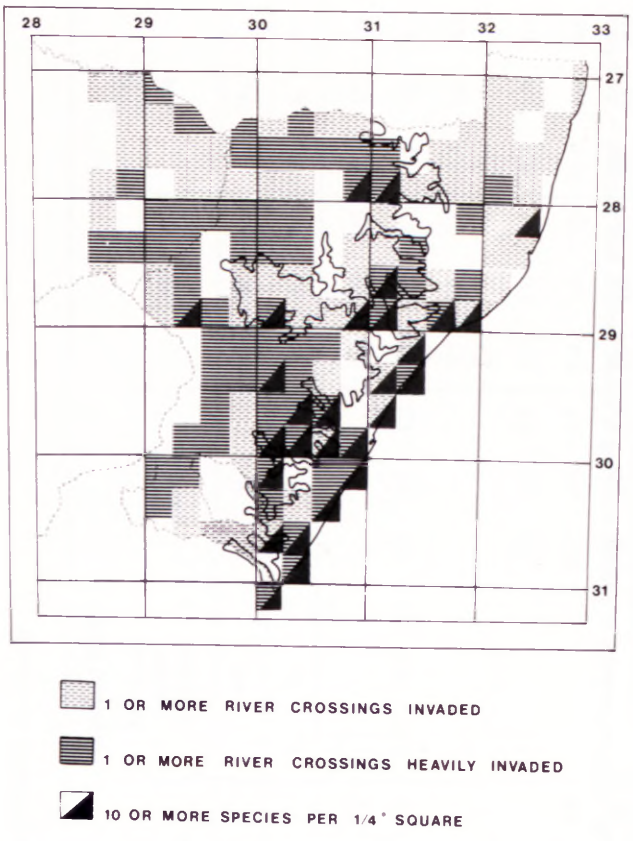


FIGURE 3.—Invasion in streambank habitats in terms of the intensity of invasion of watercourse crossings and species diversity per quarter degree square.

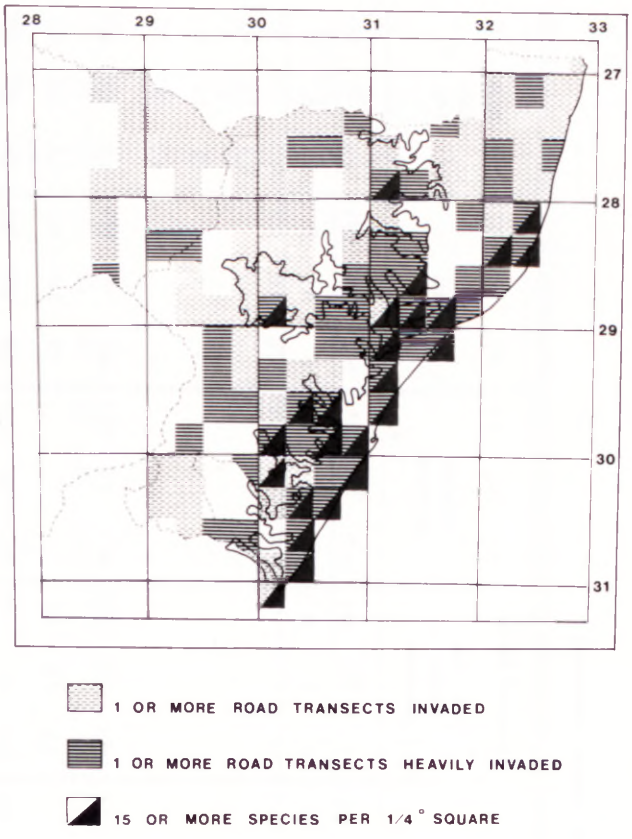


FIGURE 4.—Invasion in roadside and veld habitats in terms of the intensity of invasion of road transects and species diversity per quarter degree square.

with all situations and especially where only one species is present. The term 'commonest species' has not been defined but has been subjectively evaluated in terms of cover and density.

## Prominent and potentially important species

Although 130 species were recorded in the study area, most invasion can be attributed to the following species: *Chromolaena odorata*, *Psidium guajava* and *Lantana camara* in the Savanna Biome and *Acacia dealbata*, *A. mearnsii*, *Solanum mauritianum* and *Rubus* spp. in the Grassland Biome.

*Chromolaena odorata* is the most outstanding invader in Natal. Its vigorous growth, prolific seed production (1 300 000 seeds annually per plant have been recorded) and efficient dispersal mechanism have enabled it to rapidly encroach large areas (Erasmus 1986). It is thought to have been unintentionally introduced to Durban during the Second World War (1939–1945). By 1950 it was conspicuous as a weed and had spread 120 km north of Durban (Liggitt 1983). By 1962 it was spreading 'virulently' along the Natal coast (Erasmus 1986). By 1981 it was recorded from Kosi Bay just south of the Mozambique border and by the mid 1980's it was recorded as far south as Hluleka Nature Reserve on the Transkei coast (about 300 km south of Durban) and in the Wolkberg in the north-eastern Transvaal (about 650 km north of Durban) (Macdonald 1984).

In the study area *C. odorata* is virtually confined to the narrow, hot and moist coastal belt of Natal (Figure 6J) where it forms dense monospecific thickets. It accounts for 23% of the total invasion recorded in roadside and veld habitats in the whole study area. From Mtunzini southwards it is exceedingly abundant, especially along

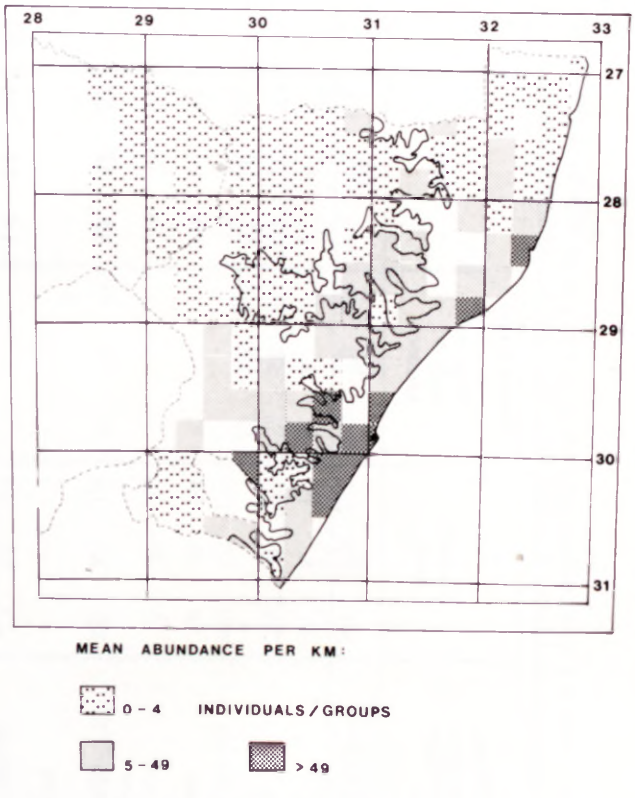


FIGURE 5.—Invasion in roadside and veld habitats in terms of the mean abundance of invaders per kilometre in each quarter degree square.

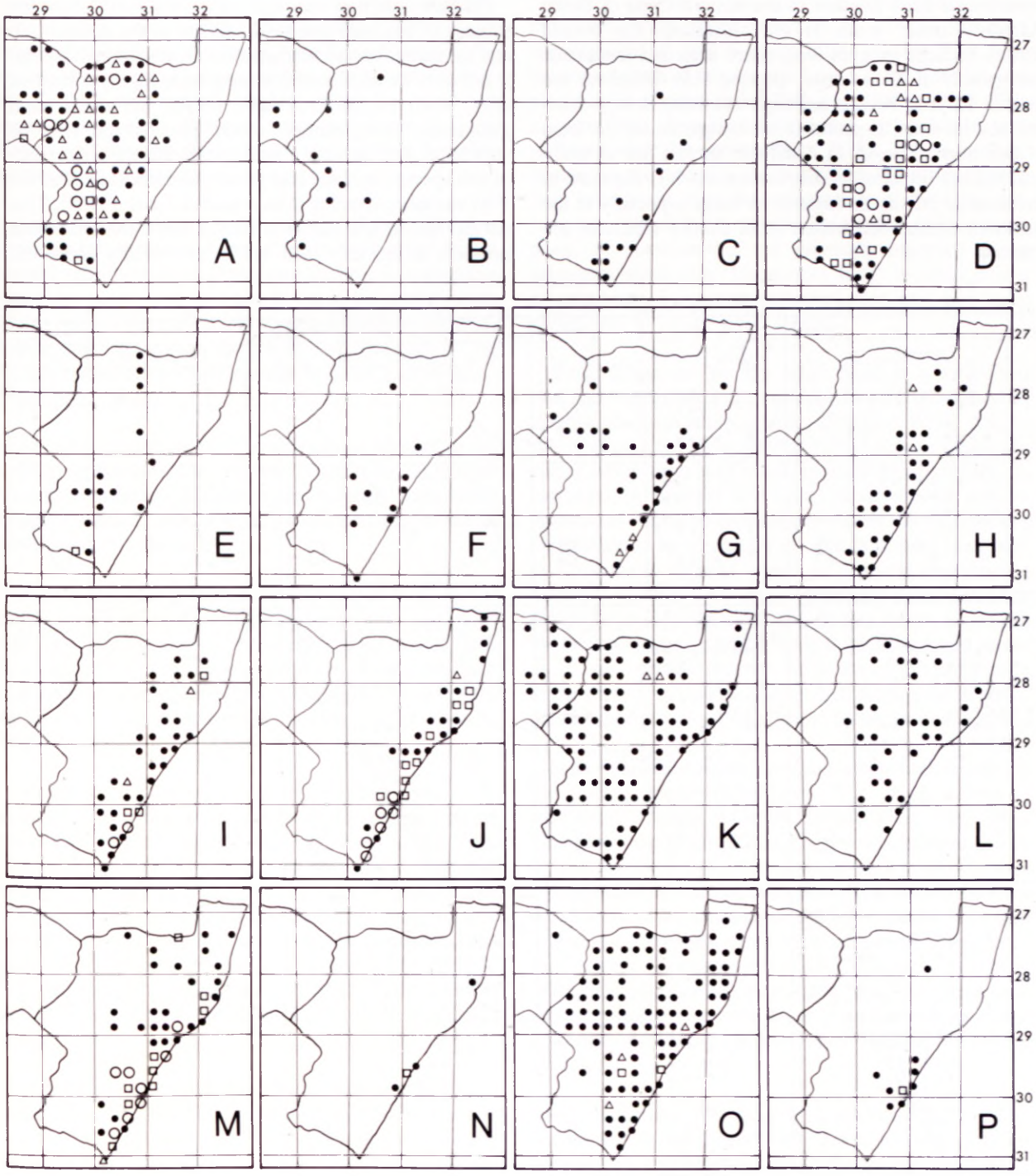


FIGURE 6.—Distribution and high abundance areas of the most prominent species: A, *Acacia dealbata*; B, *A. decurrens*; C, *A. longifolia*; D, *A. mearnsii*; E, *A. melanoxylon*; F, *A. podalyriifolia*; G, *Arundo donax*; H, *Caesalpinia decapetala*; I, *Cassia didymobotrya*; J, *Chromolaena odorata*; K, *Eucalyptus* spp.; L, *Jacaranda mimosifolia*; M, *Lantana camara*; N, *Leucaena leucocephala*; O, *Melia azedarach*; P, *Montanoa hibiscifolia*. Roadside and veld habitats, □, highest abundance rating of 5 or more; streambank habitat, Δ, highest abundance rating of 5 or more; streambank, roadside and veld habitats, ○, with the aforementioned values.

roadsides where it forms continuous stands. It frequently forms a dense margin to bush clumps and forest patches. North of Mtunzini it is locally abundant on the western shores of Lake St Lucia. Further north it is relatively scarce but has been observed at Manzengwenya and at Manguzi about 15 km south of the Mozambique border (M.C. Ward pers. comm.). It is absent from dry bush and savanna except where it has made incursions along watercourses.

*C. odorata* is native to a large area which includes Central and South America and the Caribbean Islands. According to preliminary findings the Natal plants are morphologically most similar to plants growing at Manaus (Amazonian region) in northern Brazil (R.L. Kluge pers. comm.). Based on these findings and the rampant growth of *C. odorata* in the tropical coastal belt of Natal it is predicted that it has the potential to invade the tropical East African coast up to Somalia. It is already present in equatorial West Africa in the Ivory Coast (Erasmus 1986), Cameroon (National Herbarium, Pretoria), Ghana and Nigeria (Holm *et al.* 1979). Its southern limit as a major weed is likely to be defined by Acocks's Veld Type, Coastal Forest and Thornveld (to which it is almost confined in

Natal) near East London in the eastern Cape of South Africa. Further south to Port Elizabeth the coastal forests become progressively more arid and unsuitable for growth of *C. odorata*. Beyond Port Elizabeth the coastal Knysna Forest, although receiving a high rainfall and no frost, is probably too temperate for the likes of this tropical weed. In Natal this species has virtually reached the limits of its distribution but it is expected to increase in density throughout its range especially in the northern coastal belt unless strict control measures are exerted.

*Psidium guajava* was the most frequently recorded invader of roadside and veld habitats in the coastal belt and the second most abundant after *Chromolaena odorata*. It not only invades roadsides and other highly disturbed sites, where it can form dense stands, but also coastal grasslands, bush clumps, forest patches and riverine vegetation. It is the author's contention that the importance of this species in Natal was greatly underestimated at the 1984 workshop meeting (Macdonald & Jarman 1985). This survey has shown that it is one of the most prominent invaders in the very land use types—utility areas and

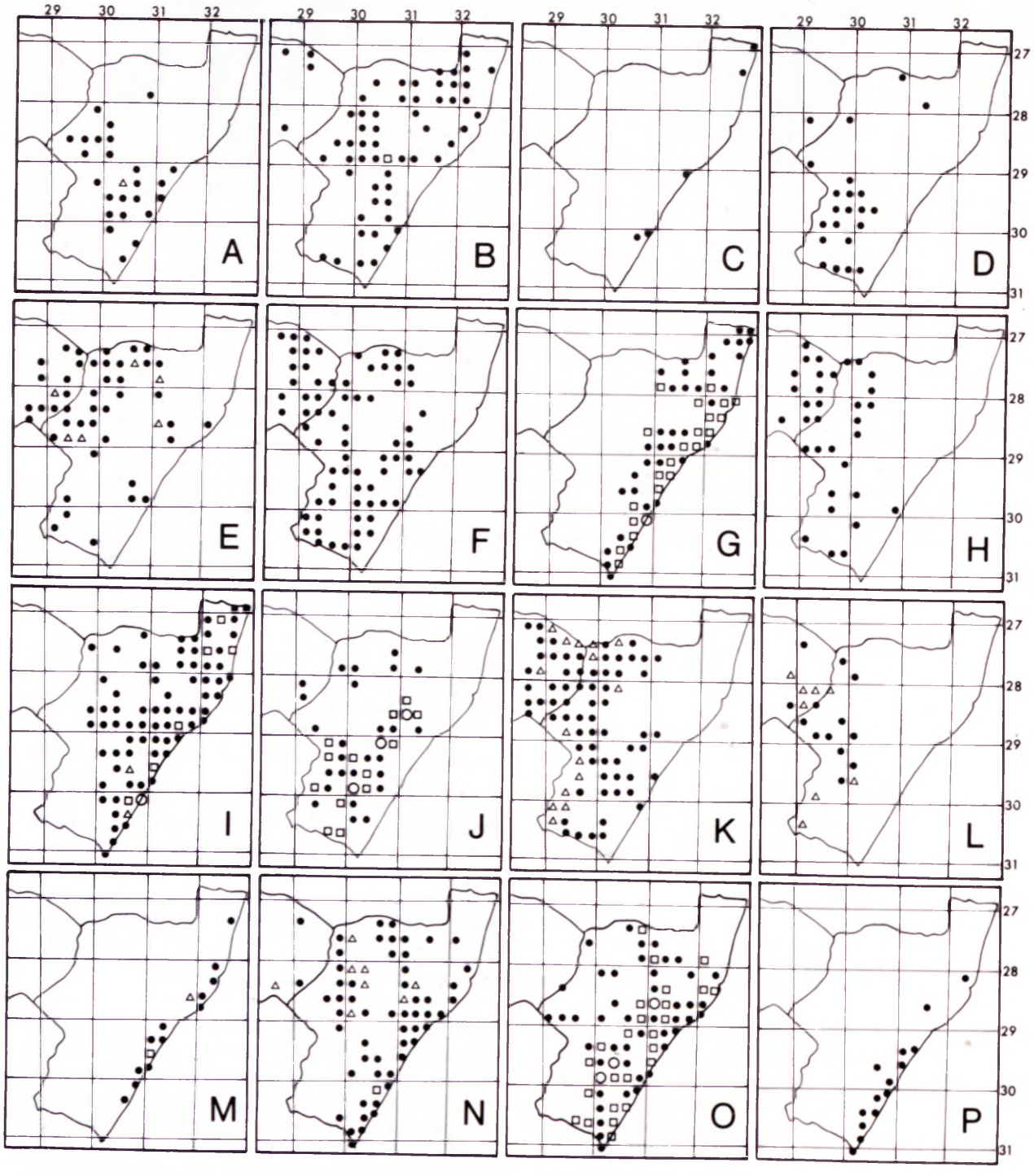


FIGURE 7.—Distribution and high abundance areas of the most prominent species: A, *Morus alba*; B, *Opuntia ficus-indica*; C, *Pereskia aculeata*; D, *Pinus patula*; E, *Populus* × *canescens*; F, *Prunus persica*; G, *Psidium guajava*; H, *Pyracantha* spp.; I, *Ricinus communis*; J, *Rubus* spp.; K, *Salix babylonica*; L, *S. lasiandra*; M, *Schinus terebinthifolius*; N, *Sesbania punicea*; O, *Solanum mauritianum*; P, *Tithonia diversifolia*. Roadside and veld habitats, □, highest abundance rating of 5 or more; streambank habitat, ▲, highest abundance rating of 5 or more; streambank, roadside and veld habitats, ○, with the aforementioned values.

coastal urban open space—where it was considered unimportant and which significantly lowered its importance ranking. As could have been expected, the survey showed that *Psidium guajava* was not abundant in the Durban metropolitan area on which the workshop based their coastal urban open space judgements. It is not known why this area differs in this respect from the other urban areas in the coastal zone.

*Lantana camara* has a wider climatic tolerance than the previous two species but grows best in the hot and humid coastal belt where it can form dense thickets. It is abundant along the coast south of Lake St Lucia but scarce north of this point (Figure 6M). It is abundant along the Pongola, Usutu and Ingwavuma Gorges in the aftermath of the floods caused by cyclone Demoina in January 1984 (M.C. Ward pers. comm.).

*Solanum mauritianum* is a widespread invader in the mistbelt and coastal belt of Natal (Figure 7O). It is most abundant in mistbelt grassland where it forms dense stands along roadsides and is a major understorey weed of plantations (Le Roux 1982).

*Acacia mearnsii* is widely naturalized in Natal but is most abundant in the midlands where it has been commercially planted on a vast scale (Figure 6D). It is least abundant in the high grasslands, coastal belt and tropical bush and savanna. In the whole study area it rated as the second most prominent riverine invader after *A. dealbata*.

*Acacia dealbata* is a widespread invader in the study area. Its distribution stretches from the temperate grasslands of the Orange Free State down to the Natal Mistbelt and even into the rivers of tropical bush and savanna (Figure 6A). It is by far the most serious invader of watercourses in the Grassland Biome. Its massive seed production and efficient downstream dispersal have enabled it to penetrate watercourses far from plantings. It rated equally prominent as *A. mearnsii* in mistbelt grassland although it has been planted there to a much lesser degree.

*Rubus* spp., mainly *R. cuneifolius*, are most abundant in the Natal mistbelt and foothills of the Drakensberg in southern Natal (Figure 7J). They are major understorey weeds in Pine plantations (Le Roux 1982) and form dense stands in open grassland and along road verges.

The aforementioned seven most prominent species in the study area are not likely to greatly increase their distribution ranges. *Solanum mauritianum* can be expected to invade the coastal plains north of Lake St Lucia. *Chromolaena odorata*, *Psidium guajava* and *Lantana camara* are all expected to expand their distributions in the same region. Further expansion by all seven species will probably occur in marginally suitable areas. All species can be expected to increase in density within their ranges.

*Melia azedarach* and *Ricinus communis* are widespread but most common in the coastal belt (Figures 6O & 7I). They are considerably less abundant than the species already mentioned and therefore received lower prominence rankings.

*Ricinus communis* has always been regarded as an introduced weed from elsewhere in Africa. However, recent archaeological diggings in the eastern Cape have unearthed seeds of this species from a grass-lined storage pit dating back more than 1 200 years (Brink 1988). This suggests that, if indeed introduced, primitive hunter-gatherers were the agents (Brink 1988). This is in sharp contrast to the majority of our foreign weeds which have been introduced since the colonization of the Cape 300 years ago. Whether it is classified as an alien or indigenous plant, *R. communis* is not generally regarded as an important weed (e.g. Macdonald 1983) because it is a pioneer plant, colonizing disturbed sites, and eventually giving way to longer-lived species.

*Melia azedarach* on the other hand is a long-lived tree and can grow to a considerable size (12–23 m in height and a spreading canopy) (Poynton 1972). Add to this its production of vast quantities of berries which are dispersed by birds and water, its high germinability, its hardiness to drought and cold, rapid growth and its response to felling by coppicing profusely, then it deserves recognition as an important invader. It is most important in streambank habitats where its efficient downstream dispersal enables it to invade protected areas far from source areas (Macdonald 1983). In this survey it rated as the most prominent tree species in tropical bush and savanna. It has virtually reached the limits of its distribution in the study area but can be expected to increase in abundance especially along river banks in the Savanna Biome.

*Salix babylonica* is a widespread streambank invader in the upland grasslands (Figure 7K). It is unable to reproduce sexually as only female trees have been introduced into South Africa, but reproduces vegetatively from branches which are torn from trees by floodwaters and deposited downstream (Poynton 1973). It does not form dense stands like the *Acacia* spp. but a single large tree probably achieves the same basal area as 10, 20 or more *Acacia* trees. It can also effectively exclude the growth of other species under its canopy (pers. obs.). In places such as along the Umzimvubu River in south-western Natal, it forms continuous stands which stretch for many kilometres.

*Salix lasiandra*, referred to by Immelman (1987), is less widely distributed (Figure 7L) than *S. babylonica* but it too can form continuous stands in places. It is particularly abundant along the Wilge River near Harrismith. It is more widely distributed and abundant in southern Natal than shown in Figure 7L but the data are not available as it was mistaken for an indigenous *Salix* species during this part of the survey.

*Sesbania punicea* was the fourth most prominent streambank invader in the study area. It was locally abundant along watercourses in the interior and along roadsides in the humid coastal belt (Figure 7N). Three species of herbivorous weevils have been imported for biological control of this weed. Already one of the weevils has made an outstanding contribution to the biological control of *S. punicea* and, in combination with the two other species, is expected to halt the invasive spread of this plant in South Africa (Hoffmann & Moran 1988).

*Opuntia* spp. are widely distributed in the study area but occur mainly as scattered plants. *Opuntia ficus-indica* (Figure 7B) and *O. stricta* are locally abundant in the Tugela River valley and elsewhere in tropical bush and savanna. *Opuntia vulgaris* occurs as widely scattered plants in the coastal belt. All these species have been the subjects of biological control campaigns and their numbers have been greatly reduced. They are no longer considered a threat but may still form localized infestations (Zimmermann *et al.* 1986).

*Cassia didymobotrya* (Figure 6I) and *Caesalpinia decapetala* (Figure 6H) are fairly widespread in the coastal belt and mistbelt of Natal. They are locally abundant, particularly in disturbed sites around kraals, villages, along roadsides and riverbanks. *Cassia didymobotrya* is a central African plant and although very abundant in places it is mainly a pioneer plant. Flowering specimens are invariably host to a caterpillar which may help to control the spread of this species. *Caesalpinia decapetala* is a vigorous-growing, exceedingly thorny woody shrub or climber that can form a dense canopy that smothers the existing vegetation and excludes other species. It is particularly troublesome as an invader of forest margins. It is easily overlooked during a roadside survey when not flowering and thus is likely to be more widely distributed and abundant than shown.

Less widespread species which are locally abundant and can form dense stands include: *Arundo donax* (Figure 6G), *Pereskia aculeata* (Figure 7C), *Pinus elliottii* (Macdonald & Jarman 1985), *Schinus terebinthifolius* (Figure 7M) and *Solanum seaforthianum* in the coastal belt; *Tithonia diversifolia* (Figure 7P), *Montanoa hibiscifolia* (Figure 6P) and *Leucaena leucocephala* (Figure 6N) around Durban; *Cardiospermum grandiflorum* and *Cestrum laevigatum* in the Pietermaritzburg, Durban and coastal areas and *Populus* × *canescens* (Figure 7E) along streambanks in the Grassland Biome. *Ulex europaeus* and *Cytisus scoparius* have been known to form dense stands in moist subtropical grassland at the Highmoor Forest Estate (National Herbarium specimens collected by D. Edwards in 1961).

*Arundo donax*, the giant reed, has invaded streambank habitats largely unnoticed because it is similar in appearance to the indigenous reeds (*Phragmites* spp.). In the Natal coastal belt, where it forms dense stands in places and flowers prolifically, it can be easily recognised by its large inflorescence with dense ascending branches. Suitable habitat for this species occurs along river banks throughout the Savanna Biome. It can be expected to expand its distribution in this region.

*Schinus terebinthifolius* is a popular ornamental and hedge plant in the coastal belt and produces large numbers of berries. There have been observations of seed predation by insects which has probably prevented it from becoming a serious weed (S. Neser pers. comm.). It should nevertheless be regarded as a potentially important invader since it has become a pest in other parts of the world, can thrive at the outer limits of vegetation exposed to salt spray and has even invaded mangroves in Florida, USA (Morton 1978; Toufexis 1985). Dense stands of this species were observed in the Umgeni River in Durban North just upstream of the Beachwood Mangroves Nature Reserve. If seed is made available *S. terebinthifolius* may even threaten the swamp forests of Maputaland in north-eastern Natal. This habitat is of very limited extent and according to Macdonald & Jarman (1985) is the least invaded of any habitat in Natal. However several species are being cultivated in these swamps, namely *Mangifera indica*, *Carica papaya*, *Musa* sp. and *Ananas* sp. *M. indica* is naturalized in the swamp forest at Kosi Bay.

Concern has been expressed about the invasiveness of *Litsea glutinosa* in the coastal lowlands of Natal (Macdonald & Jarman 1985). According to records in the National Herbarium it has been much planted in Durban, regenerates easily from seed and it was recorded as naturalized in the Eshowe District as far back as 1937. It is regarded as a weed on the island of Mauritius (Holm *et al.* 1979).

*Pereskia aculeata* is potentially a very serious invader of coastal forests. It is a very thorny vigorous-growing climbing cactus which can smother and kill the trees it overtops. Its current widespread distribution in the conservation areas of the coastal lowlands in northern Natal is mainly thought to be the result of previous intentional plantings around kraals and burial sites (Macdonald & Jarman 1985). Natural spread from these sites of previous introduction has in many localities been surprisingly limited given its bird-dispersed fruit. But the rate at which it can be spread by frugivorous animals and by vegetative reproduction, is potentially rapid (Macdonald & Jarman 1985). Campbell (1988) reports that the seed is geared for rapid germination in a range of habitats but that the soil seed bank is likely to deteriorate rapidly, with the occurrence of either germination or seed death.

*P. aculeata* is a difficult weed to control as any part of the plant which survives treatment can reproduce vegetatively and restart the thicket. Control methods involving slashing, poisoning and burning can result in the total destruction of all vegetation in the affected area (Bruton 1981). However, in several KwaZulu nature reserves infestations have been hand-cleared with as little disturbance as possible. Hand-weeding and herbicide treatments are necessary in follow-up operations (Macdonald & Jarman 1985).

**Relation of invasion to environmental factors**

Alien invasion is related to indigenous veld type categories and broad climatic factors. There is a general trend for more invasion in terms of species diversity and abundance with decreasing elevation from the cold upland grasslands to the warm coastal belt. Most invasion occurs in the humid to subhumid coast (tropical forest) and mistbelt (mistbelt grassland) where there is little or no incidence of frost. There is considerably less invasion, particularly in roadside and veld habitats, in the colder and drier veld types.

The limited invasion of the northern coastal belt relative to that in the south of the province is interpreted as being a result of less disturbance and fewer plantings of alien species. Localized infestations, for example around Lake St Lucia, indicate that this region is vulnerable to invasion. According to Liggitt (1983) *Chromolaena odorata* is spreading rapidly in the north where up to 2000%

increases in vegetation cover have been recorded in the Dukuduku plantations during a time span of five years.

The distributions of some species correspond well with broad climatic zones. For example *Chromolaena odorata* is virtually restricted to the frost-free and moist coastal belt, although, being wind-dispersed, it has a potentially wide distribution. Members of the Rosaceae, such as *Rubus, Rosa, Prunus, Pyracantha* and *Cotoneaster* spp., are most evident in the cold high-lying grasslands. This may be attributable to a dormancy mechanism in their seeds which is terminated by cold winter temperatures (Dean *et al.* 1986).

Watercourses have played an important role in the dispersal of species and in particular those which otherwise have a limited dispersal range. For example *Acacia dealbata, A. mearnsii, Sesbania punicea* and *Caesalpinia decapetala* have rather immobile and hard seeds but which are readily transported by water. The abrasion which the seeds receive along their journey may well promote germination.

Watercourses have also enabled the long-range vegetative dispersal of species such as *Salix babylonica* and *Opuntia* spp. The spread of suckering species such as *Populus* × *canescens* and *Robinia pseudoacacia* is also promoted by stream flow.

Some of the important invader species are dispersed by birds enabling them to invade relatively undisturbed sites and far afield from parent plants. Notable species include *Lantana camara, Solanum mauritianum, Melia azedarach, Pyracantha* spp., *Psidium guajava, Rosa* spp. and *Rubus* spp. In the grassland regions bird-dispersed species are clearly associated with perching sites, such as fence lines, rocky outcrops, bush clumps and plantations. In the mistbelt *Solanum mauritianum* and *Rubus cuneifolius* form dense thickets in the understoreys of plantations.

## CONCLUSION

The intensity of alien plant invasion is expected to increase in all parts of the study area and particularly in the coastal and mistbelts of Natal. Top priority should be given to the control of invaders, especially *Chromolaena odorata*, in north-eastern Natal [see Macdonald & Jarman (1985), where a possible control strategy is detailed] which is an important conservation area and where the potential for expansion is great.

Shortly after completion of this survey, in September/October 1987, Natal experienced devastating widespread floods. Most of the major river valleys as well as the floodplains along the coast were severely affected. Vast tracts of riverine vegetation that used to grow within the flood line were swept away. The long-term consequences of the floods remain to be seen but in the short-term it can be expected that an explosion of pioneer and other fast-growing plants will occur.

In the coastal belt *Chromolaena odorata* can be expected to rapidly invade floodplains, river banks and any other exposed land. *Ricinus communis* is likely to greatly increase in abundance especially in riverbeds as it did in the Pongola River after the floods caused by cyclone Demoina in January 1984. The floods are also expected to promote the downstream spread of water-dispersed species such as *Acacia dealbata, A. mearnsii, Melia azedarach* and *Salix babylonica*. The floods, together with the prospect of a wetter climatic cycle ahead (Tyson 1986), could result in the spread of species into areas which previously were too dry and inhospitable. In this respect there is a danger that *A. dealbata* and *C. odorata* will become more widely established and abundant in bush and savanna.

An assessment of the ecological consequences of streambank invasion, particularly pertaining to water usage and soil conservation, is considered to be extremely important in the motivation for the control of streambank invaders. *Acacia dealbata* and *A. mearnsii*, although declared invaders, have spread uncontrolled throughout the Grassland Biome from the upland grasslands along the Drakensberg escarpment down into the mistbelt. In the case of *A. mearnsii* it has even spread into the coastal belt.

Apart from a few notable exceptions most of the important alien woody invader species in Natal and the rest of South Africa (Henderson & Musil 1984; Macdonald & Jarman 1984; Macdonald *et al.* 1986; Stirton 1978) have been cultivated either on a grand scale in plantations, or as barrier plantings, cover/binders, shelterbelts and ornamentals in gardens. This raises the issue of screening alien plant species for potential invasiveness before they are allowed to be propagated on a grand scale. This applies particularly to the establishment of plantations of species new to the region belonging to the genera *Acacia* and *Pinus*, many species of which have become serious invaders in South Africa.

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## APPENDIX

The names of 180 species of naturalized alien trees, shrubs and climbers are listed. Some non-woody species are included. Names and dates in brackets: literature references. (PRE): cited on National Herbarium specimen labels.

*Acacia*
*dealbata* Link, silver wattle
*decurrens* Willd., green wattle
*farnesiana* (L.) Willd. (Ross 1972), sweet acacia
*longifolia* (Andr.) Willd., long-leaved wattle
*mearnsii* De Wild., black wattle
*melanoxylon* R. Br., blackwood
*podalyriifolia* A. Cunn. ex G. Don, pearl acacia
*saligna* (Labill.) Wendl. (MacDonald & Jarman 1985), Port Jackson willow
*Agave*
*americana* L., century plant
*sisalana* Perrine, sisal
*Ageratina adenophora* (Spreng.) R.M. King & H. Robinson, crofton weed
*Ailanthus altissima* (Mill.) Swingle, tree-of-heaven
*Albizia*
*lebbeck* (L.) Benth. (Ross 1972), lebbeck tree
*procera* (Roxb.) Benth. (Ross 1972), false lebbeck
*Anacardium occidentale* L. (Ross 1972), cashew
*Anredera*
*baselloides* (H.B.K.) Baill. (Ross 1972)
*cordifolia* (Ten.) Steenis (PRE), Madeira vine
*Antigonon leptopus* Hook. & Arn., Mexican creeper
*Araujia sericifera* Brot. (PRE), moth catcher
*Arundo donax* L., giant reed
*Bambusa balcooa* Roxb. ex Roxb., common bamboo
Bambuseae spp., (two small spp., one possibly *Phyllostachys* sp.), bamboos
*Basella paniculata* Volkens (Ross 1972)
*Bauhinia variegata* L., white orchid tree
*Caesalpinia decapetala* (Roth) Alston, Mauritius thorn
*Cajanus cajan* (L.) Millsp. (Ross 1972), Congo pea
*Canna*
*edulis* L. (MacDonald & Jarman 1985), edible canna
*indica* L., canna
*Cardiospermum grandiflorum* Schwartz, balloon vine
*Carica papaya* L., papaya
*Cassia*
*bicapsularis* L.
*coluteoides* Collad.
*corymbosa* Lam. (PRE), autumn cassia
*didymobotrya* Fresen., peanut-butter cassia
*floribunda* Cav., arsenic bush
*hirsuta* L.
*occidentalis* L., wild coffee
*Casuarina*
*equisetifolia* G. Forst., horsetail tree
sp. cf. *C. cunninghamiana* Miq., beefwood
*Cedrela odorata* L. (PRE), West Indian Cedar
*Cedrus deodara* (Roxb.) G. Don, deodar
*Ceiba pentandra* (L.) Gaertn. (Ross 1972), kapok tree
*Cereus peruvianus* (L.) Mill., queen of the night
*Cestrum*
*aurantiacum* Lindl., yellow cestrum
*laevigatum* Schlechtd., inkberry
*Chromolaena odorata* (L.) R.M. King & H. Robinson, triffid weed
*Cinnamomum camphora* (L.) J. Presl, camphor tree
*Citrus*
*aurantium* L. (MacDonald & Jarman 1985), sour orange
*limon* (L.) Burm. f. (MacDonald & Jarman 1985), lemon
*reticulata* Blanco (MacDonald & Jarman 1985), mandarin
*Colocasia esculenta* (L.) Schott, taro
*Cortaderia* sp., pampas grass
*Cotoneaster franchetii* Bois, orange cotoneaster

*Cotoneaster* sp., cotoneaster
*Crataegus phaenopyrum* (L. f.) Medic., Washington thorn
*Crotalaria agatiflora* Schweinf. subsp. *imperialis* (Taub.) Polhill, canary-bird bush
*Cryptomeria japonica* (L. f.) D. Don, Japanese cedar
*Cupressus* sp. cf. *C. arizonica* Greene, Arizona cypress
*Cupressus* spp., cypresses
*Cyphomandra betacea* (Cav.) Sendtn. (PRE), tree tomato
*Cytisus scoparius* L., Scotch broom
*Dahlia imperialis* Roezl. ex Ortg., tree dahlia
*Delonix regia* (Bojer) Raf., flamboyant
*Duranta erecta* L. (= *D. repens* L.) (Ross 1972), forget-me-not-tree
*Eriobotrya japonica* (Thunb.) Lindl. (MacDonald & Jarman 1985), loquat
*Eucalyptus*
*elata* Dehnh. (= *E. andreana* Naud.) (Ward 1980), river peppermint
*camaldulensis* Dehnh., red gum
*cinerea* F.J. Muell. ex Benth., florist's gum
*grandis* W. Hill ex Maid. (MacDonald & Jarman 1985), saligna gum
*robusta* Sm., swamp mahogany gum
*Eucalyptus* spp., gums
*Euphorbia pulcherrima* Willd. ex Klotzsch, poinsettia
*Gleditsia triacanthos* L., honey locust
*Gmelina arborea* Roxb. (Dyer 1975), white teak
*Grevillea robusta* A. Cunn., Australian silky oak
*Hakea sericea* Schrad. (= *H. tenuifolia* (Salisb.) Domin) (Moll 1981), silky hakea
*Harrisia martinii* (Labouret) Britton (Henderson *et al.* 1987), moon cactus
*Hedychium*
*coronarium* J. König, butterfly ginger
*flavum* Roxb.
*Hylocereus undatus* (Haw.) Britt. & Rose (PRE), night-blooming cereus
*Ipomoea*
*alba* L., moon flower
*coccinea* L. (Ross 1972), red morning-glory
*congesta* R. Br.
*fistulosa* Choisy
*nil* (L.) Roth (Ross 1972)
*purpurea* (L.) Roth (Ross 1972), common morning-glory
*Jacaranda mimosifolia* D. Don, jacaranda
*Jatropha curcas* L. (PRE), physic nut
*Lagerstroemia indica* L., pride-of-India
*Lantana camara* L., lantana
*Lespedeza cuneata* (Du Mont) G. Don (Ross 1972), bush clover
*Leucaena leucocephala* (Lam.) De Wit, leucaena
*Ligustrum ovalifolium* Hassk. (PRE), California privet
*Litsea glutinosa* (Lour.) C.B. Robinson (= *L. sebifera* Pers.) (MacDonald & Jarman 1985), Indian laurel
*Macfadyena unguis-cati* (L.) A. Gentry (PRE), cat's-claw creeper
*Mangifera indica* L., mango
*Manihot* sp., cassava
*Melia azedarach* L., syringa
*Metasequoia glyptostroboides* H.H. Hu & Cheng, dawn redwood
*Monstera deliciosa* Liebm., Swiss-cheese plant
*Montanoa*
*bipinnatifida* (Kunth) C. Koch (Moll 1981), tree daisy
*hibiscifolia* Benth.
*Morus*
*alba* L., white mulberry
*alba* L. var. *multicaulis*
*Musa* sp., banana
*Nerium oleander* L., oleander
*Nicotiana glauca* R.C. Grah., wild tobacco
*Opuntia*
*dillenii* (Ker-Gawl.) Haw. (Henderson *et al.* 1987), pipestem prickly pear
*exaltata* A. Berger (Henderson *et al.* 1987), long-spine cactus
*ficus-indica* (L.) Mill., sweet prickly pear
*imbricata* (Haw.) DC. (Henderson *et al.* 1987), chain-link cactus
*spinulifera* Salm-Dyck, large round-leaved prickly pear
*stricta* Haw., pest pear of Australia
*vulgaris* Mill., cochineal prickly pear
*Pandanus* spp., screw-pines
*Paraserianthes lophantha* (Willd.) Nielsen subsp. *lophantha* (= *Albizia lophantha* (Willd.) Benth.) (Ross 1972), stinkbean
*Parkinsonia aculeata* L. (Ross 1972), Jerusalem thorn
*Passiflora*
*edulis* Sims, purple granadilla
*foetida* L., love-in-a-mist
*suberosa* L. (Ross 1972)
*subpeltata* Ortega (Ross 1972), granadina
*Pennisetum purpureum* Schumach., elephant grass
*Pereskia aculeata* Mill., Barbados gooseberry
*Persea americana* Mill. (PRE), avocado pear
*Pinus*
*canariensis* Sweet ex K. Spreng., Canary pine
*elliottii* Engelm. (MacDonald & Jarman 1985), slash pine
*patula* Schlechtd. & Cham., patula pine
? *taeda* L., loblolly pine
sp. cf. *P. uncinata* Mill. ex Mirb.
*Pinus* spp., pines
*Populus*
× *canescens* (Ait.) J.E. Sm., grey poplar
*deltoides* Bartr. ex Marsh., match poplar
*nigra* L. var. *italica* Muenchh., Lombardy poplar
*Prunus*
*armeniaca* L., common apricot
*persica* (L.) Batsch., peach
*Psidium*
*guajava* L., common guava
*littorale* Raddi var. *longipes* (O. Berg) Fosb. (= *P. cattleianum* Sabine) (Ross 1972), strawberry guava
*Punica granatum* L., pomegranate
*Pyracantha*
*angustifolia* (Franch.) C.K. Schneid., yellow firethorn
*fortuneana* (Maxim.) H.L. Li
*rogersiana* (A.B. Jacks.) Bean
sp. cf. *P. coccinea* M.J. Roem., red firethorn
*Quercus robur* L., English oak
*Robinia pseudoacacia* L., black locust
*Rosa*
*eglanteria* L., eglantine
*odorata* (Andr.) Sweet, tea rose
sp. cf. *R. multiflora* Thunb. ex J. Murr. (PRE), baby rose
*Rubus*
*affinis* Wight & Arn., blackberry
*cuneifolius* Pursh., American bramble
*phoenicolasius* Maxim. (Spies & Du Plessis 1985), wineberry
*Saccharum officinarum* L., sugar cane
*Salix*
*babylonica* L., weeping willow
*caprea* L., pussy willow
*lasiandra* Benth.
*Sambucus*
*canadensis* L., American elder
*nigra* L. (PRE), European elder
*Schinus*
*molle* L., pepper tree
*terebinthifolius* Raddi var. *acutifolius* Engl., Brazilian pepper tree
*Sesbania*
*bispinosa* (Jacq.) W.F. Wight var. *bispinosa* (Ross 1972), spiny sesbania
*punicea* (Cav.) Benth., red sesbania
*Solanum*
*hermannii* Dun., bitter apple
*mauritianum* Scop., bug tree
*pseudocapsicum* L., Jerusalem cherry
*seaforthianum* Andr., potato creeper
*Spathodea campanulata* Beauv., African flame tree
*Spiraea cantoniensis* Lour., Reeves spiraea
*Syncarpia glomulifera* (Sm.) Niedenzu (MacDonald & Jarman 1985), turpentine tree
*Syzygium cumini* (L.) Skeels, Java plum
*Thevetia peruviana* (Pers.) K. Schum., yellow oleander
*Tipuana tipu* (Benth.) O. Kuntze, tipu tree
*Tithonia*
*diversifolia* (Hemsl.) A. Gray, Mexican sunflower
*rotundifolia* (Mill.) S.F. Blake (Ross 1972)
*Toona ciliata* M.J. Roem. (MacDonald & Jarman 1985), toon tree
*Ulex europaeus* L., gorse
*Vitex trifolia* L. (Ross 1972)
*Yucca* sp. cf. *Y. aloifolia* L., Spanish bayonet