

The natural vegetation of Bents Basin State Recreation Area

D.H. Benson, J. Thomas and J. Burkitt

Abstract

Benson, D.H., Thomas,* J., & Burkitt, J. (National Herbarium of New South Wales. Royal Botanic Gardens. Sydney, Australia. 2000) 1990. The natural vegetation of Bents Basin State Recreation Area. *Cunninghamia* 2(2): 223-262. The natural vegetation of Bents Basin State Recreation Area (S.R.A.) (lat. 33°56'S, long. 150°37'E) on the Nepean River west of Sydney is described and mapped from air photos and ground survey. The S.R.A. covers 391 ha with 25 plant communities related to geology (sandstone, shale, alluvium) and topography (gorges, plateaus). A list of 362 species (309 native, 53 exotic) is provided. Eight native species are of particular significance, including *Hibbertia hermanniifolia* & *Eucalyptus benthamii*. Floristic and structural diversity is high due to the varied geology and physiography. The increasing isolation of the vegetation of Bents Basin State Recreation Area as a result of clearing for agriculture and housing is an important factor for management.

Introduction

Bents Basin, a large pool formed on the Nepean River at the efflux of an impressive sandstone gorge, is on the western outskirts of Sydney 25 km south of Penrith (lat. 33°56'S, long. 150°37'E). Bents Basin is the focus of recreational activity for the State Recreation Area (S.R.A.) of which, with the exception of a nearby cleared 20 ha area, the remainder has natural vegetation (Figure 1). Bents Basin S.R.A. totals 391 ha in area and is managed by the National Parks and Wildlife Service of New South Wales.

Bents Basin was discovered in 1804 by the botanist George Caley, who named it 'Dovedale' (Currey 1966) though this name was not retained, and has been a popular place for botanists since the late nineteenth century. Collections of a number of rare plants have been made there.

The Bents Basin State Recreation Area was established in 1981, despite years of lobbying by the local and scientific community for specific dedication of the area as a Nature Reserve. The newly appointed S.R.A. Trust, faced with increasing recreational demands and potential conflicts with nature conservation, commissioned studies on archaeology, fauna and vegetation as a basis for a future Plan of Management. This paper is based on a vegetation survey (Thomas, Burkitt & Benson 1984) undertaken in 1983 to determine the distribution of plant communities within the S.R.A. and to recommend management guidelines and priorities.

Topography and geology

Bents Basin S.R.A. is on the eastern escarpment of the Blue Mountains plateau,

* Present address: National Parks & Wildlife Service, 154 Russell Street, Bathurst, NSW 2795

adjacent to the western edge of the Cumberland Plain. Here the Nepean River has cut a deep gorge through the distinctive Hawkesbury Sandstone. The S.R.A. can be divided into a number of topographic regions (Figure 2) Bents Basin itself; the Nepean River and Forest Hill Creek gorges; and the Little Mountain and Forest Hill creek plateaus.

Bents Basin is a circular pool about 120 m across, formed at the efflux of the Nepean River from the Hawkesbury Sandstone gorge. Its particular configuration may be attributed to the underlying presence of a volcanic neck (W. Holland, L. Fowler pers. comm.). To the east of the Basin is a cleared undulating (20 ha) paddock on the clay soils from the Wianamatta Shale of the Cumberland Plain now developed for visitor parking and picnicking. Two small creeks cross this area. Upstream of the Basin the narrow Nepean River gorge has separated the Hawkesbury Sandstone plateau of Little Mountain from the main plateau further west. Little Mountain is up to 160 m in elevation and has remnant caps of Wianamatta Shale. The eastern edge of Little Mountain rises steeply from the cleared Wianamatta Shale country of the Cumberland Plain along the Lapstone Monocline-Nepean Fault (Herbert & Helby 1980).

The south-western arm of the S.R.A. follows Forest Hill Creek which drains a similar plateau. Its gorge is narrower and more sheltered than the Nepean River gorge. There are two alluvial deposits where the Nepean River changes direction; at Campbells Ford at the southern end of Little Mountain and on the eastern margin of Bents Basin.

Average annual rainfall at Wallacia is 952 mm (Bureau of Meteorology 1979) with a peak in summer. Average maximum temperature for January is 29°C and average minimum temperature for July is 1–2°C.

Methods

Black and white aerial photography (N.S.W. Department of Lands 1:16 000, County of Cumberland Series 1978) was used to identify plant community boundaries. These were confirmed during extensive field, reconnaissance and a vegetation map (Figures 3a & b) prepared. In the field community recognition was based on dominant species and habitat. With limited time available and a diverse area to deal with, traditional subjective procedures were considered the most efficient. Within each recognised community, data were collected from circular samples, each with an area of 400 square metres. There were 21 sites marked permanently to enable further recording. Information collected at each quadrat included species present and their abundance, physiography (location, geology, aspect, elevation, slope and topography), a general description of the community (height and percentage cover for main species of each stratum) and a note of any disturbance. Vegetation structure was classified using height of the dominant stratum and projective foliage cover (Specht 1981). The distribution of the rare species, *Hibbertia hermanniifolia*, was examined separately and height, width and number of stems of 53 plants were measured.



Figure 1. The Nepean River gorge with Bents Basin in the foreground and Little Mountain to the left as it appeared after drought in 1982.

Description of plant communities

1. Tall open-forest – *Eucalyptus benthamii*

On the eastern half of the sand deposit, east of the Basin is tall open-forest of *E. benthamii* with trees originally up to 40 m in height but seriously damaged by fire in 1979 (see Benson, 1985). There are also smaller trees of *E. elata*. The shrub understorey is quite dense in places and consists mostly of *Acacia binervia*, *Bursaria spinosa* and *Hymenanthera dentata*. Much of this layer and the ground cover is overrun by the climbing exotics **Senecio mikanioides*, **Asparagus asparagoides* and **Araujia hortorum*. The sandbank is not level here and there are a number of slight hollows in which **Tradescantia albiflora* forms a dense ground-covering mat. Native climbing and trailing species include *Clematis glycinoides*, *C. aristata* and *Cayratia clematidea*. These are not as abundant as the exotic species. On higher ground *Pteridium esculentum*, **Cynodon dactylon* and **Conyza albida* are prominent.

2. Tall open-forest – *Eucalyptus deanei*

At Campbells Ford where the Nepean River swings around the southern end of the Little Mountain plateau is a small alluvial deposit with a tall open-forest of *Eucalyptus deanei*, *E. elata* and *Angophora subvelutina*. Part of this has been cleared and the ground cover has *Imperata cylindrica*, *Pteridium esculentum*

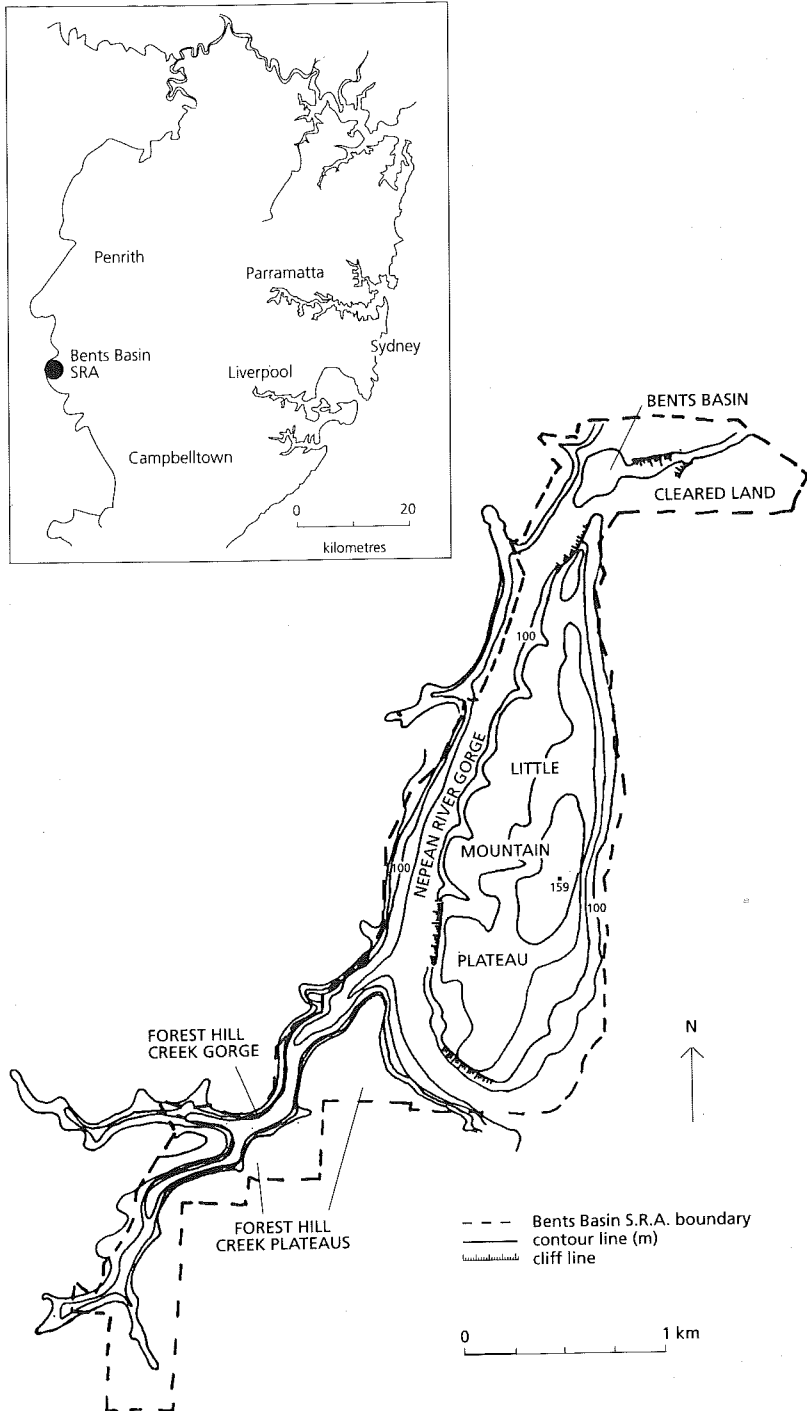


Figure 2. Map of Bents Basin S.R.A. showing major topographic regions.

and various exotic species. There are shrubs of *Clerodendrum tomentosum* and *Eucalyptus elata* saplings.

3. Tall open-forest – *Angophora subvelutina*, *E. deanei*

On the north-western edge of the Basin a tall open-forest of *Angophora subvelutina*, *Eucalyptus pilularis* and *E. deanei* is confined to a sheltered southern aspect with colluvial soils on the lower slopes of the sandstone hillside. A prominent feature of this community is the dense understorey of *Backhousia myrtifolia*.

The ground cover is quite diverse. *Hydrocotyle acutiloba* forms a thick carpet-like growth in places, while on rock outcrops *Doodia aspera* is common. Other ground species include *Pratia purpurascens*, *Asplenium flabellifolium*, *Adiantum aethiopicum*, *Oplismenus imbecillis* and *Microlaena stipoides*.

4. Open-forest – *Syncarpia glomulifera*, *Glochidion ferdinandi*, *Ceratopetalum apetalum*, *Backhousia myrtifolia*

The Forest Hill Creek gorge drops 20 to 50 metres in elevation along its length of 800 m and in combination with its narrow width (5 to 15 m) and sheltered south-easterly aspect, this results in vegetation being distinctly different from the vegetation along the Nepean River gorge (Community 20). There is a dense canopy of small trees *Glochidion ferdinandi*, *Backhousia myrtifolia*, *Notelaea longifolia*, *Ceratopetalum apetalum*, *Syncarpia glomulifera* and *Tristaniopsis laurina* with virtually no shrub layer. The most striking feature is the high number of ferns and orchids. Ferns include *Sticherus flabellatus*, *Todea barbata*, *Davallia pyxidata*, *Adiantum aethiopicum*, *A. hispidulum* and *Asplenium flabellifolium*, *Cyathea australis* and *Culcita dubia* occur but are less common. Orchids recorded in the gorge were *Dendrobium speciosum*, *D. linguiforme*, *Liparis reflexa* and *Bulbophyllum exiguum*. One plant of *Dendrobium pugioniforme* was found. The sedge *Schoenus melanostachys* was common on the rock walls. Vines were also common and included *Smilax glycyphylla* and *Eustrephus latifolius*.

5. Open-forest – *Eucalyptus crebra*

At the southern end of Little Mountain plateau on a remnant of Wianamatta Shale is open-forest of the ironbarks *Eucalyptus crebra* and *E. fibrosa* with *E. punctata*, *E. eugenioides*, with *Allocasuarina torulosa* and *Persoonia linearis*. The grassy ground cover of *Themeda australis*, *Panicum* sp. and various herbs shows the shale influence.

6. Open-forest – *Allocasuarina torulosa*, *Eucalyptus pilularis*, *E. eximia*, *E. punctata*, *E. eugenioides*

Open-forest found on the middle of the Little Mountain plateau also shows a shale influence. Conspicuous is *Allocasuarina torulosa*, which occurs as a thick sub-canopy layer under the taller trees, *Eucalyptus eximia*, *E. pilularis*, *E. punctata* & *E. eugenioides*. Shrub species include *Persoonia linearis* and *Leucopogon muticus*. Ground cover consists of *Xanthorrhoea minor*, *Panicum simile*, *Entolasia stricta*, *Pomax umbellata* and a variety of other grasses and herbs.

COMMUNITY STRUCTURE	MAIN SPECIES
1 TALL OPEN-FOREST	<i>Eucalyptus benthamii</i> , <i>Eucalyptus elata</i>
2	<i>Eucalyptus deanei</i> , <i>Angophora subvelutina</i> , <i>Eucalyptus elata</i>
3	<i>Eucalyptus deanei</i> , <i>Angophora subvelutina</i>
4 FOREST	<i>Syncarpia glomulifera</i> , <i>Glochidion ferdinandi</i> <i>Ceratopetalum apetalum</i> , <i>Backhousia myrtifolia</i>
5 OPEN-FOREST	<i>Eucalyptus crebra</i>
6	<i>Allocasuarina torulosa</i> , <i>Eucalyptus pilularis</i> , <i>Eucalyptus eximia</i> , <i>Eucalyptus punctata</i> , <i>Eucalyptus eugenioides</i>
7	<i>Eucalyptus tereticornis</i>
8 TALL WOODLAND / OPEN-FOREST	<i>Eucalyptus pilularis</i> , <i>Syncarpia glomulifera</i> , <i>Angophora costata</i>
9 WOODLAND	<i>Eucalyptus gummifera</i>
10	<i>Eucalyptus gummifera</i> , <i>Angophora costata</i> , <i>Eucalyptus pilularis</i> , <i>Allocasuarina torulosa</i>
11	<i>Eucalyptus eximia</i>
12	<i>Eucalyptus eximia</i> , <i>Angophora costata</i> , <i>Eucalyptus pilularis</i> , <i>Eucalyptus punctata</i>
13	<i>Eucalyptus punctata</i> , <i>Eucalyptus eugenioides</i> , <i>Eucalyptus pilularis</i> , <i>Allocasuarina littoralis</i>
14	<i>Eucalyptus punctata</i> , <i>Eucalyptus eugenioides</i>
15	<i>Eucalyptus maculata</i> , <i>Eucalyptus fibrosa</i>
16	<i>Eucalyptus maculata</i> , <i>Eucalyptus punctata</i> , <i>Eucalyptus eugenioides</i> , <i>Angophora costata</i>
17	<i>Eucalyptus sparsifolia</i> (oblonga), <i>Eucalyptus gummifera</i> , <i>Angophora costata</i>
18	<i>Eucalyptus notabilis</i> , <i>Eucalyptus eugenioides</i> , <i>Eucalyptus gummifera</i> , <i>Eucalyptus pilularis</i>
19	<i>Melaleuca styphelioides</i>
20	<i>Tristaniopsis laurina</i> , <i>Casuarina cunninghamiana</i>
21 SCRUB	<i>Leptospermum flavescens</i> , <i>Kunzea ambigua</i>
22 SEDGE / SHRUBLAND	<i>Banksia spinulosa</i> , <i>Hakea dactyloides</i> , <i>Lepyrodia muelleri</i> , <i>Anisopogon avenaceus</i>
23 GRASSLAND	<i>Cynodon dactylon</i>
24	* <i>Paspalum dilatatum</i> , <i>Themeda australis</i> , * <i>Lolium rigidum</i>
25 REGENERATING	Various, according to location

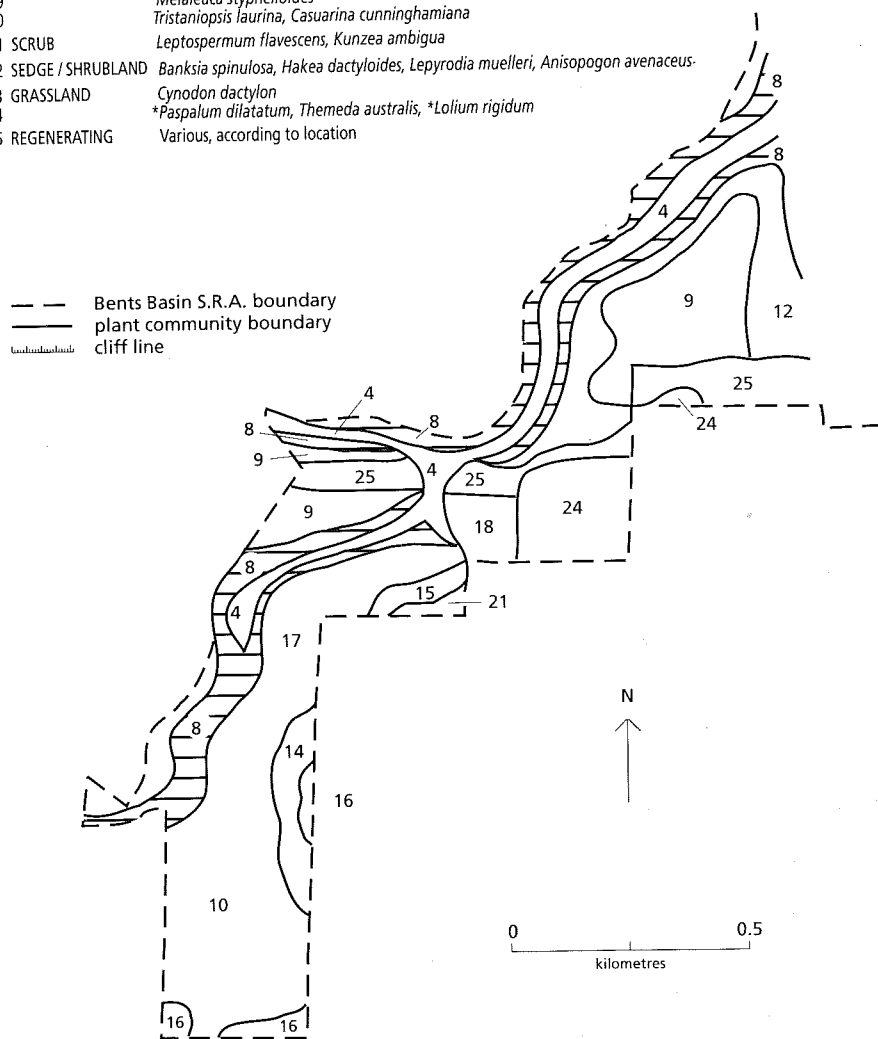
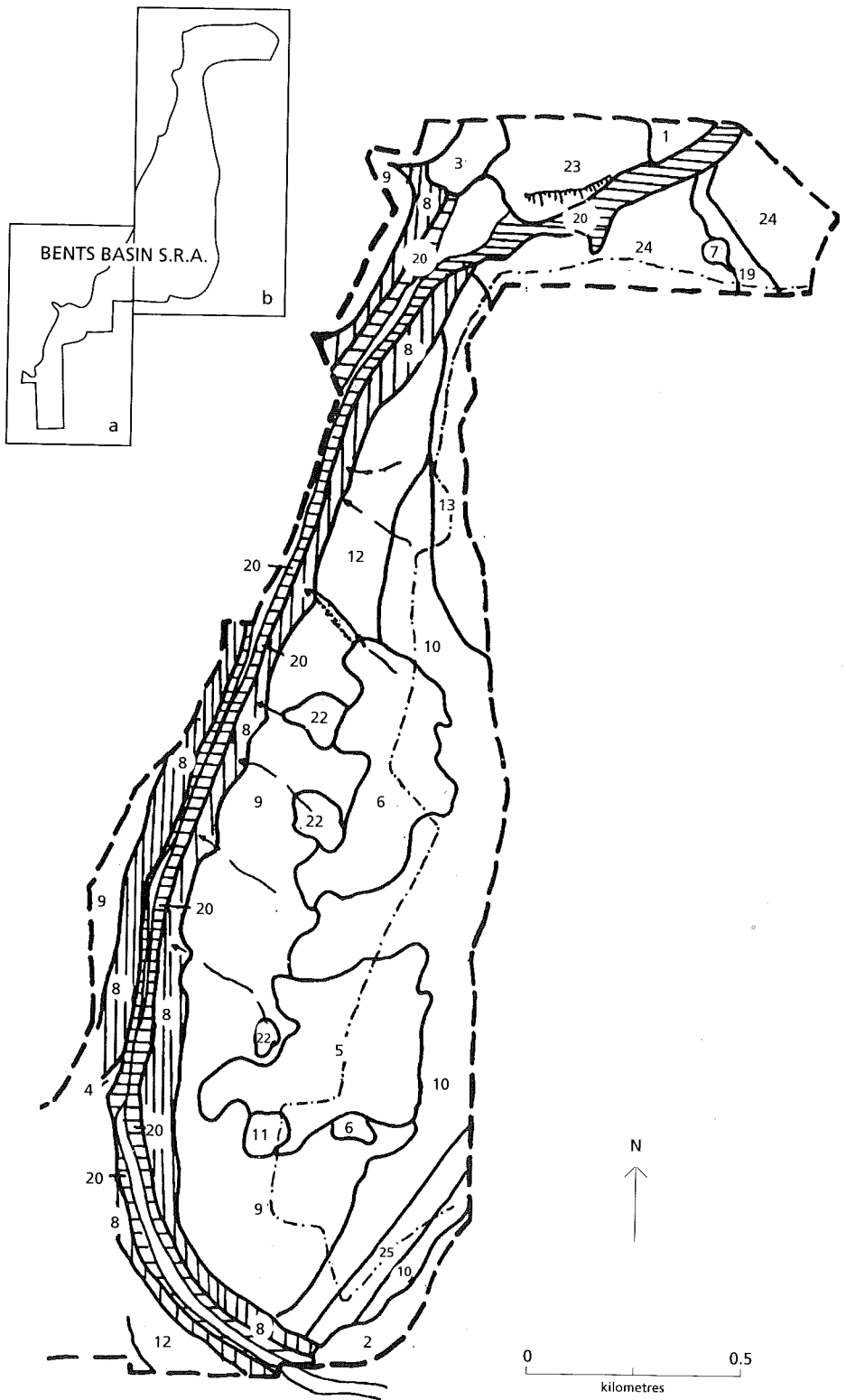


Figure 3. The plant communities of Bents Basin S.R.A. showing (a) Forest Hill Creek section and (b) Little Mountain section.



7. Open-forest - *Eucalyptus tereticornis*

A small stand of young *Eucalyptus tereticornis* grows close to the creek near the north-eastern (Wolstenholme Drive) entrance to the S.R.A. The stand is characterised by a few older trees and a mixture of young trees and seedlings. There are only a few shrubs including *Bursaria spinosa* and **Olea europaea* subsp. *africana*. The ground cover is sparse and is similar in species composition to the *Melaleuca styphelioides* woodland (Community 19).

8. Tall woodland/Open-forest - *Eucalyptus pilularis*, *Syncarpia glomulifera*

The rocky upper slopes of the gorge of the Nepean River and Forest Hill Creek support open-forest dominated by *E. pilularis*. Towards the top of these slopes is woodland vegetation with scattered trees of *E. eximia* while further down the slope *E. pilularis* and *Angophora costata* are more common. *Syncarpia glomulifera* is more common closer to the river. There also appear to be a few trees of *Eucalyptus agglomerata* opposite the junction of Forest Hill Creek. The large open areas of rock and the thin skeletal soil result in a sparse shrub understorey consisting mainly of *Bossiaea rhombifolia*, *Persoonia linearis* and *Leptospermum attenuatum*. Ground plants include *Lomandra confertifolia* subsp. *rubiginosa*, *Pomax umbellata* and *Phyllanthus thymoides* (Figure 4).

9. Woodland - *Eucalyptus gummifera*

On the south-western side of the Little Mountain plateau is woodland of *Eucalyptus gummifera* and *E. punctata* with some *E. eugenioides* and *Angophora costata*. The understorey is dense, with *Lambertia formosa*, *Petrophile pedunculata*, *Leptospermum attenuatum* and *Leucopogon muticus*. *Caustis flexuosa* is the most prominent ground species amongst various herbs and grasses.

Similar vegetation occurs on the Forest Hill Creek plateau above the junction of Forest Hill Creek and Nepean River and above the junction of the two arms of Forest Hill Creek.

10. Woodland - *Eucalyptus gummifera*, *Angophora costata*, *E. pilularis*, *Allocasuarina torulosa*

This occurs on the south-eastern side of Little Mountain and the upper part of Forest Hill Creek. The understorey is not as dense as the western side, and consists of shrubs of *Persoonia linearis*, *Leucopogon muticus* and patches of *Acacia falciformis*. The ground cover is thick, with *Pteridium esculentum*, *Stypandra glauca* and *Xanthorrhoea minor*.

11. Woodland - *Eucalyptus eximia*

On top of Little Mountain near the shale/sandstone junction is a small area of *E. eximia* woodland. The shrub understorey is sparse with *Leucopogon muticus* and *Persoonia linearis*. The ground cover is characterised by grasses such as *Themeda australis* and *Anisopogon avenaceus*. Localised soil conditions appear to be related to its occurrence.



Figure 4. The rocky bed of the Nepean River with woodland of *Tristaniopsis laurina* and *Casuarina cunninghamiana* (Community 20) and further up the slopes Tall Woodland/Open-forest supporting *Eucalyptus pilularis* and *Syncarpia glomulifera* (Community 8).

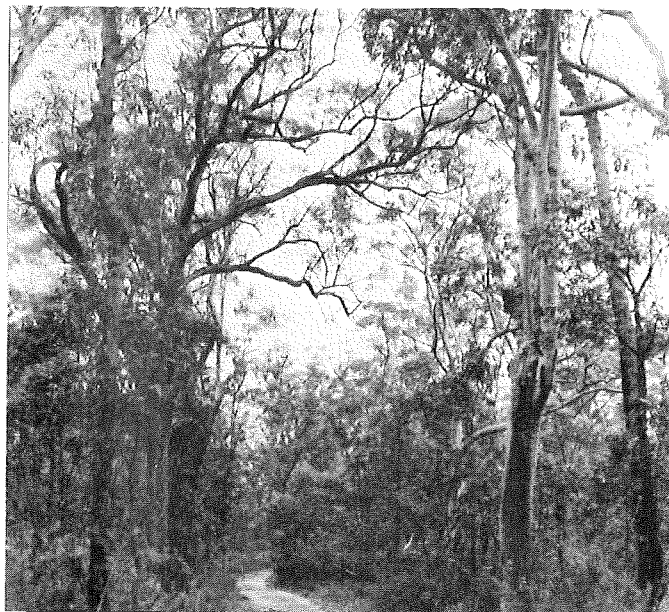


Figure 5. Woodland of *Eucalyptus eximia*, *Angophora costata*, *E. pilularis* and *E. punctata* (Community 12) growing on the north-western end of the Little Mountain plateau.

**12. Woodland – *Eucalyptus eximia*, *Angophora costata*, *E. pilularis*,
*E. punctata***

The vegetation on the north-western end of the Little Mountain plateau differs from that further south. The plateau becomes narrower and slopes gently to the west. In these areas *Eucalyptus eximia* becomes more prominent than *E. gummifera*. Other trees such as *Angophora costata*, *E. pilularis* and *E. punctata* are common. In small gullies running in a north-westerly and westerly direction, the vegetation is more sheltered and *Syncarpia glomulifera* is prominent with shrubs of *Astrotricha latifolia* and *Banksia spinulosa* (Figure 5).

Similar woodland occurs on the upper slopes and exposed rocky parts of Forest Hill Creek, especially on the southern side. In places *E. eximia* occurs alone but over most of the area it is associated with *A. costata*, *E. pilularis*, *E. eugenioides* and the occasional *E. punctata* and *Syncarpia glomulifera*. The shrub layer is floristically similar to the *E. gummifera* woodland but it is much less dense.

**13. Woodland – *Eucalyptus punctata*, *E. eugenioides*, *E. pilularis*,
*Allocasuarina littoralis***

On the north-eastern slope of Little Mountain is woodland of *E. punctata* with some *E. eugenioides* and *E. pilularis*. *Allocasuarina littoralis* and *Exocarpos cupressiformis* are common tall shrub species. *Imperata cylindrica* is a common ground cover species, together with various herbs, *Wahlenbergia gracilis*, *Kennedia rubicunda*, **Conyza albida* and *Solanum prinophyllum*.

14. Woodland – *Eucalyptus punctata*, *E. eugenioides*

On the flat areas near the south-eastern border of the Forest Hill Creek section of the S.R.A. a small area of woodland with *E. punctata* and *E. eugenioides* occurs. The shrub layer is sparse and similar to the woodland described above. The ground cover is predominantly *Themeda australis* and *Lepidosperma laterale*. This vegetation is distinctly influenced by the shale soils that occur more extensively on the adjacent cleared lands.

15. Woodland – *Eucalyptus maculata*, *E. fibrosa*

A very small area of woodland with *Eucalyptus maculata* and *Eucalyptus fibrosa* occurs on the edge of the S.R.A. in the Forest Hill Creek section. This woodland is a remnant of the vegetation of the nearby Wianamatta Shale that has been extensively cleared for agriculture. The shrub layer is sparse and consists mainly of *Leucopogon muticus*, *Daviesia ulicifolia* and *Lissanthe strigosa*. The ground cover is characterised by *Cheilanthes sieberi*, *Danthonia* sp., *Echinopogon caespitosus* and *Lomandra longifolia*.

**16. Woodland – *Eucalyptus maculata*, *E. punctata*, *E. eugenioides*,
*Angophora costata***

On the flat areas along the southern boundary of the Forest Hill Creek section of the S.R.A. woodland of *Eucalyptus maculata* with *E. punctata*, *E. eugenioides*, *Angophora costata* and *Syncarpia glomulifera* occurs. The understorey is similar to Community 15. This woodland occurs as small disjunct areas.

17. Woodland – *Eucalyptus sparsifolia (oblonga)*, *E. gummifera*, *Angophora costata*

This community is found on the eastern slope above the south arm of Forest Hill Creek. It is associated with sandstone occurring closer to the gully and contrasts with the *E. punctata*, *E. eugenioides* woodland (Community 14) found nearby on the shale/sandstone boundary. The shrub layer is dominated by *Leptospermum attenuatum* with occasional thickets of *Hakea sericea* and *Banksia spinulosa*. The ground cover is characterised by *Xanthorrhoea minor* and a variety of herbs and grasses.

18. Woodland – *Eucalyptus notabilis*, *E. gummifera*, *E. pilularis*, *E. eugenioides*

A woodland community with *E. notabilis*, *E. gummifera*, *E. pilularis* and *E. eugenioides* is associated with the shale derived-soils on the plateau areas above Forest Hill Creek. The shrub layer is diverse with the dominant species being *Leptospermum attenuatum*, *Leucopogon muticus*, and *Persoonia linearis*. The ground cover is characterised by *Xanthorrhoea minor* and *Lomandra obliqua*.

19. Woodland – *Melaleuca styphelioides*

Two creeks cross the paddocks south-east of the Basin and are lined with large *Melaleuca styphelioides*, **Gleditsea triacanthos* and **Celtis occidentalis*. On the sides of the creek the native shrub understorey has largely been replaced by exotic species such as **Ligustrum sinense*, **Tradescantia albiflora*, **Araujia hortorum*, **Rhus* sp. and **Olea europaea* subsp. *aficana*. The ground cover species consist mostly of **Paspalum dilatatum* and **Verbena bonariensis* which have taken over from *Themeda australis*. Other exotics growing in this community are **Sida rhombifolia*, **Gnaphalium sphaericum*, **Taraxacum officinale*, **Bidens pilosa*, **Phalaris minor*, **Gomphocarpus fruticosus* and **Xanthium chinense*.

20. Woodland – *Tristaniopsis laurina* and *Casuarina cunninghamiana*

This community occurs on alluvium along the Nepean River up to 10 metres either side of the river. Tree species are *Tristaniopsis laurina* and *Casuarina cunninghamiana*. The ground is sparsely covered with *Setaria geniculata* var. *pauciseta* and *Persicaria hydropiper* and the exotic species **Anonopus affinis*. Other exotic species including **Ligustrum sinense* and **Gleditsea triacanthos* occur predominantly along the river bank. On an accumulation of silt at the intersection of Bushrangers Creek and the Nepean River the exotic **Ligustrum sinense* is crowding out the native shrub/tree layer of *Glochidion ferdinandi*, *Callicoma serratifolia*, *Ceratopetalum apetalum* and *Backhousia myrtifolia*.

21. Scrub

Scrub is confined to a small poorly-drained site along the eastern boundary of the S.R.A. on the Forest Hill plateau. It is dominated by *Leptospermum flavescens* and *Kunzea ambigua*.

22. Sedge/Shrubland

At the top of several gullies running in a westerly direction from the Little Mountain plateau are poorly drained sites with sedge/shrubland. These are

dominated by sedges and grasses particularly *Anisopogon avenaceus*, *Entolasia marginata* and *Lepyrodia muelleri* and the shrubs *Banksia spinulosa* and *Hakea dactyloides*. There is a sparse tree canopy of *Eucalyptus eximia*. As the topography gets steeper and rockier towards the river, the usual woodland eucalypts as well as *Syncarpia glomulifera*, and the shrub *Astrotricha latifolia* become prominent, along the edges of intermittent watercourses.

23. Grassland - **Cynodon dactylon*

The vegetation present on the western half of the sand deposit near the Basin is characterised by the grass *Cynodon dactylon* which forms a thick ground cover stabilising the sand. Clusters of small trees of *Acacia binervia* occur with occasional *A. parramattensis* and *Backhousia myrtifolia*. At the edge of the Basin, *A. binervia*, **Gleditsea triacanthos*, *Casuarina cunninghamiana* and *Eucalyptus elata* are common. Prominent exotic species in the grassland are **Hypochoeris radicata*, **Taraxacum officinale*, **Coryza albida*, **Bidens pilosa* and *Setaria geniculata* var. *pauciseta*. Small patches of *Pteridium esculentum* and *Lomandra longifolia* are found on the sand deposit. Where the river leaves the Basin and flows along the southern side of the sand deposit the vegetation changes to *Casuarina cunninghamiana* and young *Eucalyptus elata*, **Gleditsea triacanthos*, *Acacia floribunda* and *Acacia parramattensis* grow along the river bed while on the northern side of the sand-deposit, in the flood channels, there is a tall thicket of *Acacia floribunda*.

24. Grassland - **Paspalum dilatatum*

This occurs on the cleared paddocks south-east of the Basin and on the plateau south of the junction of Forest Hill Creek and the Nepean River. The main grasses present are **Paspalum dilatatum*, **Lolium rigidum* and *Themeda australis*. They have been cleared and grazed for many years.

25. Regeneration Areas

Two sites are regenerating following disturbance. Under electricity transmission lines that cross the south-west corner of the Little Mountain plateau and Forest Hill Creek, native shrubs are regenerating after lopping. Complete recovery will not occur as they are regularly lopped. The second area is a small corridor in the Forest Hill Creek section of the S.R.A. that has been partially cleared. This area is successfully regenerating and contains many of the native species from the adjacent woodland communities including *Eucalyptus gummifera*, *E. eximia*, *Leucopogon muticus* and *Leptospermum attenuatum*. Ground cover species include *Themeda australis*, *Aristida vagans*, *Phyllanthus thymoides* and *Pomax umbellata*. Exotics are common but not abundant and included **Taraxacum officinale* and **Senecio madagascariensis*.

Discussion

Plant communities

Over 20 naturally-occurring plant communities have been identified in Bents Basin S.R.A. These range in structure from tall open-forest on the alluvial soils, to scrub and sedge/shrubland on the higher parts of the plateaus. This variation

relates firstly to the range of habitats available in a small area – there are, for example, the sheltered gorges of Forest Hill Creek, the dry exposed edges of the sandstone plateaus and the flood-prone, boulder-strewn reaches of the Nepean gorge, and secondly to the range of soil types present each of which has a strong influence on the vegetation pattern (Figure 6). The Hawkesbury Sandstone soils predominate, poor sandy soils on the edges of the plateaus, but deeper and richer on the lower hillslopes as a result of downslope movement. The more fertile clay soils of the Wianamatta Shale provide different conditions. On the Little Mountain plateau these occur as thin isolated remnants, with eroding clay material often influencing the vegetation composition on adjacent sandstone soils. The clay/sandstone interface also influences drainage conditions. In the upper part of Forest Hill Creek catchment, Wianamatta Shale formed a deeper, more extensive cover over the sandstone. This has mostly been cleared for agriculture but remnants of the plant communities are within the S.R.A., though of very limited extent. As well as soils derived from sandstone and shale there are small patches of alluvial soils at Bents Basin and Campbells Ford.

Table 1. Species of particular significance in Bents Basin S.R.A. with notes on habitat/location, significance and potential threat. (Significance Codings from Briggs & Leigh (1988)).

Species	Habitat/Location	Significance	Potential threats
<i>Hibbertia hermanniifolia</i> (Dilleniaceae)	In scattered groups on flat benches of skeletal sandy soil between rocky cliff faces, on the north-west facing ledges of Nepean River gorge at northern end of Little Mtn.	Coded 3RCa: known only from Bents Basin S.R.A., Wadbilliga National Park and East Gippsland Vic.	Heavy recreation pressures, changes in fire patterns, invasion of exotic plant species.
<i>Eucalyptus benthamii</i> (Myrtaceae)	One small population on Nepean River bank in north-eastern corner of S.R.A.	Coded 2VCi: originally occurred on flats of Nepean River and tributaries. Most of original habitat has been cleared or submerged by Lake Burragorang. Population on Kedumba Creek but only scattered individuals along Nepean River now.	Changes in flood and fire patterns, and mismanagement may destroy population at Bents Basin. Increase in height of Warragamba Dam storage will destroy population at Kedumba Creek.
<i>Gonocarpus longifolius</i> (Haloragaceae)	Found on cliffs above southern rim of the Basin growing near the <i>H. hermanniifolia</i> population. Only two plants have been recorded.	Coded 3RC-	Increased visitor usage, changes in fire patterns.

Species	Habitat/Location	Significance	Potential threats
<i>Lomandra fluviatilis</i> (Lomandraceae)	Found in sandstone crevices on the lower slopes of the Nepean gorge below flood level.	Coded 3RC-: found sporadically along creeks in sheltered sandstone gullies around Sydney, where alluvial sediment has accumulated between rock debris.	Invasion by exotic plant species, deterioration of river water quality.
<i>Lissanthe sapida</i> (Epacridaceae)	Found in Hawkesbury Sandstone woodland vegetation on Little Mtn and Forest Hill Creek plateaus.	Coded 3RCa: on sandstone plateaus and along river banks in Blue Mtns and Woronora Plateau areas.	Clearing of vegetation, changes in fire patterns, invasion by exotic plant species.
<i>Eucalyptus tereticornis</i> (Myrtaceae)	Small population near the Wolstenholme Drive entrance.	Locally interesting species once common on shale derived soils of the Cumberland Plain, extensively cleared.	Clearing of vegetation.
<i>Acacia falciformis</i> (Fabaceae)	Found on eastern side of Little Mountain growing in groups of 20 plants. Also occurs occasionally elsewhere on Little Mtn, on northern edge of the Basin and around southern rim of Forest Hill Creek.	Locally interesting species commonly found on the Tablelands, has only been recorded in the Sydney area at Bents Basin and at Menangle.	Clearing of vegetation, changes in fire patterns.
<i>Acacia uncinata</i> subsp. <i>uncinata</i> (Fabaceae)	Found on top of Nepean gorge, on the western side near electricity transmission lines.	Locally interesting species, only previous recordings of this taxon in the Central Coast botanical subdivision are from Glen Davis and just south of Putty, both locations over 80km from Bents Basin S.R.A.	Clearing of vegetation, changes in fire patterns.

Bents Basin S.R.A. is a small area of natural vegetation, becoming increasingly isolated (see below), and it is important to recognise as much potential variation as possible, as the successful long-term management of plant and animal diversity depends on the maintenance of this variation. As a result the degree of difference between plant communities varies. Some are clearly distinctive while others differ only in a number of plant species. It is important to realise that the recognition of variation depends on the scale. For example in terms of the mapping units of the Sydney Region 1:100 000 Vegetation Mapping Series (e.g. Keith & Benson 1988), the 25 communities would be allocated to about 8 map units. In fact, of the plant communities recognised here, 14 would be

included within the Hawkesbury Sandstone Complex of Keith & Benson.

Prior to European settlement, woodland and forest extended across the Wianamatta Shale hills and alluvial floodplains of the Cumberland Plain. Few remnants of these communities have survived the extensive clearing for agriculture and housing that has since taken place. The small occurrences of these communities in Bents Basin S.R.A., the open-forests with *Eucalyptus crebra* (Community 5) and of *E. tereticornis* (Community 7) and the woodlands with *E. maculata* (Communities 15, 16) and *Melaleuca styphelioides* (Community 19) the tall open-forests of *E. deanei* and *E. benthamii* (Communities 1, 2) are therefore of regional conservation significance. Being adjacent to sandstone areas in the S.R.A., many of the plant communities recognised show intergrading features in their floristic composition and provides the opportunity for studies of species interactions on these very different soil types.

The Forest Hill Creek gorge vegetation with its many ferns and orchids is significant because of its relatively undisturbed nature.

Species richness

Species richness (the number of different species found in a given area) in Bents Basin S.R.A. is high for its small area (391 ha). The 309 native plant species recorded (Table 2, Appendix I), compares with the 320 species recorded in Bouddi National Park's 1160 ha (McRae & Benson 1983) and the 620 recorded species within the 11000 ha of Brisbane Water National Park (Benson & Fallding 1981). Both these National Parks are predominantly sandstone environments.

Like the plant community variation, the high species richness in the S.R.A. appears to be related to its particular combination of geography, geology and physiography. The varied landforms, including two plateaus with associated slopes, two major gorges and a number of minor valleys, undulating pastoral land, and alluvial deposits provide a variety of habitats, differing in soil, aspect, slope and moisture with communities that differ in structure and flora. The geology leads to further variations in the flora. Although the majority of the species were those commonly found in sandstone soils, species such as *E. punctata*, *Syncarpia glomulifera*, *Acacia falciformis*, *A. filicifolia*, *A. mearnsii*, *Oxylobium ilicifolium* and a large variety of grasses reflect the shale influence on the soil.

Table 2. Total native and exotic species in Bents Basin S.R.A. in comparison with Bouddi and Brisbane Water National Parks.

	Bents Basin S.R.S.	Bouddi National Park	Brisbane Water National Park
Area (ha)	391	1160	11,000
Native species	309	320	620
Exotic species	53	38	37#

— not exhaustive

One woodland community is particularly rich in species. Community 12 with *Eucalyptus eximia*, *Angophora costata*, *E. pilularis* and *E. punctata* contains 82 plant species but covers only 6.1% of the S.R.A. area (Table 3). This community is found on soils containing both Hawkesbury Sandstone and

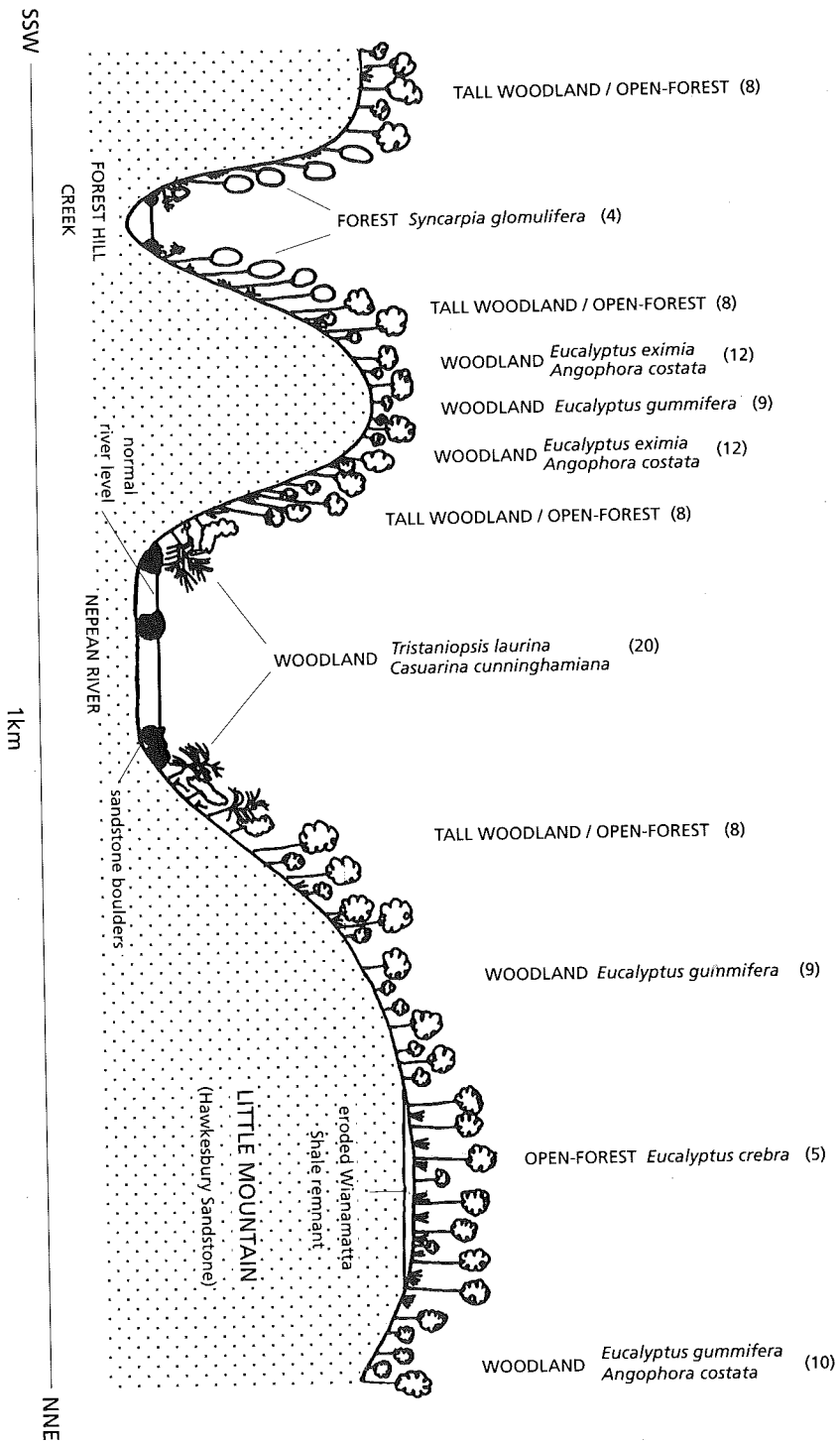


Figure 6. Schematic vegetation profile across Bents Basin S.R.A. showing relationships between plant communities, geology and topography.

Wianamatta Shale elements and this probably contributes to the variety in floristic composition of these communities.

Although the vegetation is typical of the Central Coast Botanical Subdivision, a few Central Tablelands elements (for example, *Acacia falciformis* and *Acacia uncinata* subsp. *uncinata*), contribute to the high species richness, although maximum elevation is only 160 m.

Significant species

Species of particular significance in terms of rarity or regional distribution are detailed in Table 1. The now rare Camden White Gum, *Eucalyptus benthamii* (Figure 7) (discussed by Benson 1985) occurred on the floodplain of the Nepean River system prior to European agriculture but populations are now restricted to Bents Basin and Kedumba Creek, in the Warragamba Catchment Area (Keith & Benson 1988).

The population of the shrub *Hibbertia hermanniifolia* is one of only a few occurrences of this species (the next nearest population is 300 km south in Wadbilliga National Park on the South Coast). The populations at Bents Basin S.R.A. covers 6000 square metres, with a size estimated at 500 individuals in 1984 (Thomas, Burkitt & Benson 1984). The majority of the population are between 100–150 cm high, with a few plants up to 200 cm a number of younger plants (< 50 cm), suggests recruitment in absence of fire (Figure 9). It is not known whether adult plants are killed or resprout after fire as this site has remained unburnt for at least 25 years (Figures 8, 9).

Isolated populations may indicate species that were more widespread, thousands of years ago, but as climatic conditions have changed, have become very restricted. Protecting isolated populations of species is important as further study may reveal trends in evolutionary and genetic systems.

Other species with disjunct occurrences include *Acacia falciformis* and *A. uncinata* (Table 1).

Effects of increasing isolation

Aerial photography taken since 1947 shows that Bents Basin S.R.A. is well on the way to becoming an island in an agricultural and urban landscape and that this has largely taken place in the last 25 years (Figure 10). By 1960, the woodlands of the Cumberland Plain to the east had already been cleared for more than 100 years. However, there had been much less clearing on the western side mainly because of the poorer agricultural quality of the country and Bents Basin S.R.A. remained connected with the extensive natural vegetation that still occupies the Water Board's Warragamba Catchment. This provided a reservoir and corridor for the migration of native flora and fauna. In the last 40 years, and particularly in the last 20 years increased clearing to the west has cut or reduced most of these links.

The resulting isolation is likely to have marked detrimental effects on the S.R.A.'s future species richness, both of plants and animals. The present native flora of 309 species (plus say 30 or so overlooked species) is a maximum for the area. Many species have only small populations, (e.g. *Gonocarpus longifolius*) and these species, particularly those whose original habitat has been reduced to



Figure 7. Young trees of *Eucalyptus benthamii* – a rare tree – growing on the sand deposit, east of the Basin (Community 1).

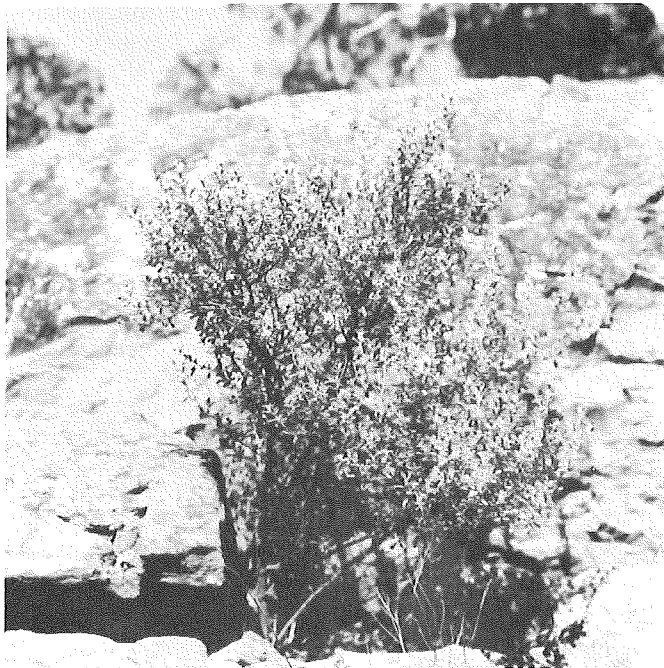


Figure 8. The rare shrub *Hibbertia hermanniifolia* found in the Tall Woodland/Open-forest of *Eucalyptus pilularis* and *Syncarpia glomulifera* on rocky ledges on north-west facing slopes of the Nepean River gorge.

marginal size, will be most vulnerable to local extinction. This may occur as a result of a reduced area of habitat available to the species as populations readjust to the changing environmental pressures resulting from isolation. These pressures include altered fire frequencies, boundary effects, nutrient increases and watercourse siltation. Added to these are the possible climatic changes related to the Greenhouse effect. The minimum population sizes needed for long-term survival is something about which little is known. Species with small populations may also be lost through accident or mismanagement. For example, the construction of a new track or picnic area may inadvertently destroy localised herb and grass species. Isolation also means that fewer areas of surrounding native vegetation are available as sources for recolonization propagules. Corridors linking nature reserves to similar areas of native vegetation increase immigration rates and maximise the chances of locally extinct species being replaced (Gorman 1979). However, it is not clear to what extent many native, particularly sclerophyllous species are readily dispersed over long distances. The destruction of corridors will decrease fauna migration (Craven 1983), and accordingly the introduction of plant propagules in animal fur or faeces will be reduced.

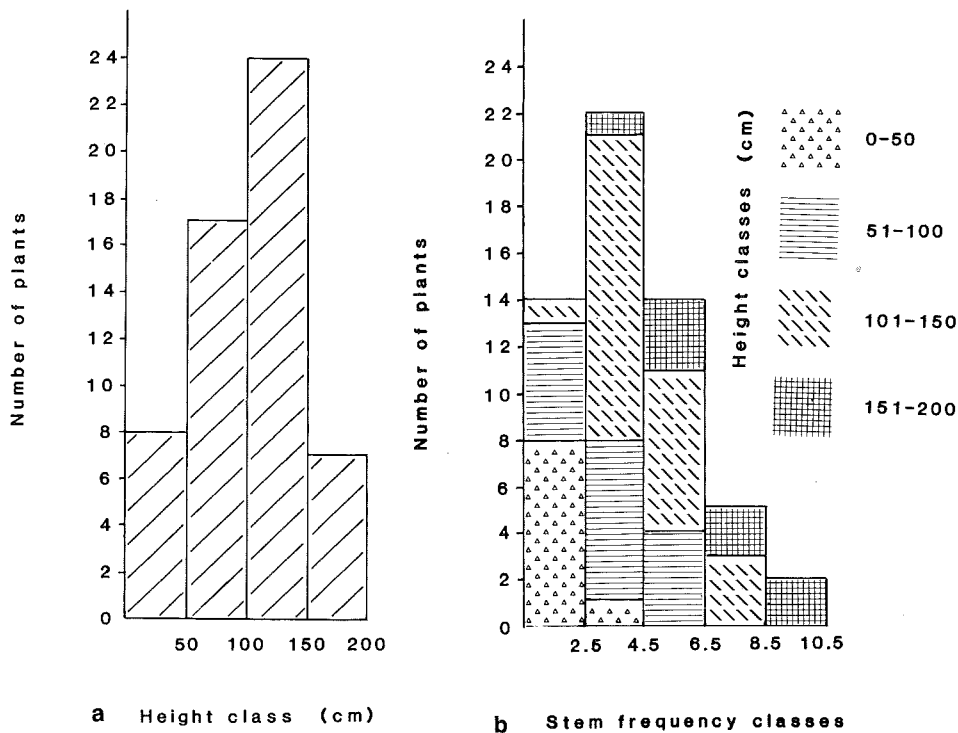


Figure 9. *Hibbertia hermanniifolia* a height class frequency and b stem frequency with height classes indicated.

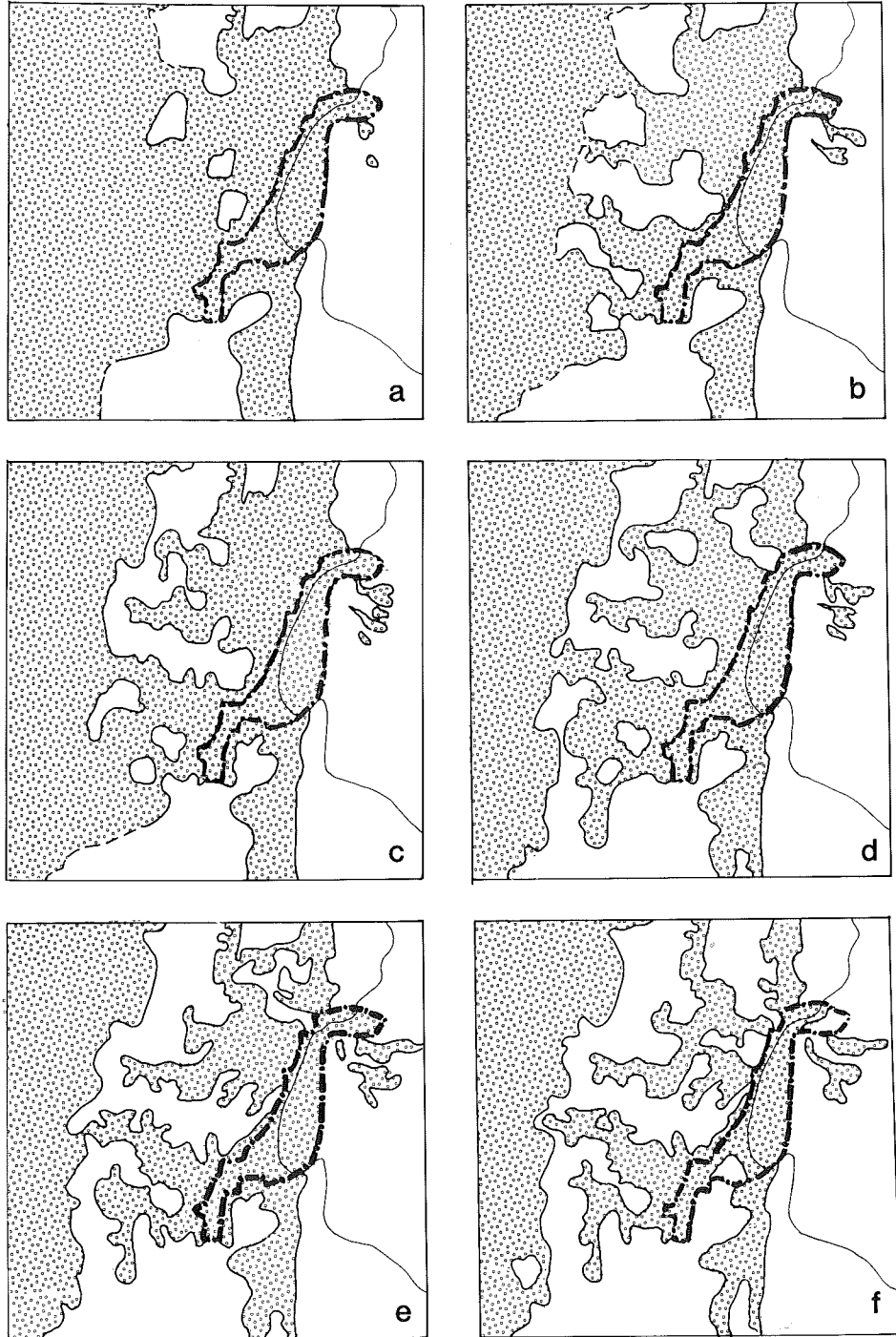


Figure 10. The gradual clearing of natural vegetation is turning Bents Basin S.R.A. into an island of native vegetation. a 1947, b 1955, c 1961, d 1972, e 1976, f 1983. On illustration hatching indicates remaining native vegetation, unmarked areas indicate cleared land, light broken line indicates undefined native vegetation boundary, light unbroken line indicates native vegetation boundary and heavy broken line indicates Bents basin S.R.A. boundary.

Exotic species

In contrast to the native component, the present exotic component of the flora (53 species) is likely to rise as exotic species from the surrounding agricultural and urban habitats move in (Gorman 1979). The type of exotic species and the extent of exotic establishment appears to depend on the type of disturbance. Most exotic species are confined to particular habitats. The 53 exotic species (Appendix II) are found in an average of only 1.7 communities, though some species occur in up to 8 communities. These species may be widespread but not necessarily aggressive. Invasion by exotic species appears to be associated mainly with boundaries and watercourses. Boundary effects, related to the proportion of perimeter to area, will generally be more significant in small areas (Buchanan 1979, Benson & Keith 1984). The long, narrow shape of Bents Basin S.R.A. makes it very vulnerable to such effects. Disturbances which promote invasion of exotic species are the addition of nutrients and sediment to watercourses, the clearing of vegetation adjacent to native bushland, floods, and to a lesser extent, fire and trampling by visitors and introduced animals. As a result, distribution of exotic species is strongly associated either with riverine habitats or with borders and tracks. Communities with many exotic species (Communities 1, 2, 20) are all associated with the Nepean River (Table 3, Appendix II).

Table 3. The number of native species, area(ha) and percentage area for each plant community in Bents Basin S.R.A.

Community	No. of native species	Area (ha)	%
1. Tall open-forest	21	1	(< 1)
2. Tall open-forest	42	4	(1)
3. Tall open-forest	31	3	(< 1)
4. Open-forest	42	7	(2)
5. Open-forest	45	20	(5)
6. Open-forest	41	16	(4)
7. Open-forest	#		(< 1)
8. Tall Woodland/Open-forest	72	40	(< 10)
9. Woodland	76	168	(43)
10. Woodland	54	60	(15)
11. Woodland	#		(< 1)
12. Woodland	82	24	(6)
13. Woodland	64	10	(3)
14. Woodland	38	3	(< 1)
15. Woodland	46	1	(< 1)
16. Woodland	14	1	(< 1)
17. Woodland	33	10	(3)
18. Woodland	#		(< 1)
19. Woodland	26	2	(< 1)
20. Woodland	15	8	(2)
21. Scrub	#		(< 1)
22. Sedge/shrubland	29	3	(< 1)
23. Grassland	8	9	(2)
24. Grassland	5		(< 1)
Total	309	391	

no detailed sampling

Management

Bents Basin S.R.A. is a small reserve when compared with National Parks like Ku-ring-gai and Brisbane Water, but because of its location near Sydney's growing western suburbs it will come under increasing pressure from bushwalkers, campers and other visitor groups. Horse-riding in Ku-ring-gai Chase National Park has caused erosion of tracks and invasion by exotic species (S. King pers. comm.) and could do so at Bents Basin. Invasion by cattle from nearby pastoral land has caused soil compaction, selective grazing of herb and shrub layers and invasion by exotic species. A succession of frequent fires may also lead to changes in species composition, and the risk of invasion by exotic species. Enlightened management of fire, exotic species, introduced animals and recreation will be needed if the present rich native flora, including the rare and interesting species in Bents Basin S.R.A., is to survive. In the long-term such management needs to be supported by ongoing research and monitoring. In the short-term plant community and habitat diversity need to be maintained. The approach here therefore has been to recognize as much of the variation in plant communities as possible. Future work may show that some units are the same and only apparently different because of past management treatments, e.g. different fire regimes. In the absence of detailed knowledge of the processes in plant communities, it is safest to assume that observed differences are intrinsic features of the vegetation.

Acknowledgements

The authors would like to thank the Trust and staff of Bents Basin State Recreation Area, and Mr R. Venables of Wallacia for their assistance in the field; also Bob Coveny and staff of the National Herbarium for plant identifications, and Angela Benn for typing.

References

- Benson, D.H. (1985). Aspects of the ecology of a rare tree species, *Eucalyptus benthamii*, at Bents Basin, Wallacia. *Cunninghamia* 1, 371-383.
- Benson, D.H. & Keith D. (1984). Small natural areas as repositories for plants, in *Small natural areas: their conservation and management*. National Trust of Australia (NSW) symposium.
- Benson, J.S. & Fallding, H. (1981). Vegetation survey of Brisbane Water National Park and environs. *Cunninghamia* 1, 79-113.
- Briggs, J.D. and Leigh, J.H. (1988). *Rare or threatened Australian plants*. Revised edition Special Publication No.14, Australian National Parks & Wildlife Service, Canberra.
- Buchanan, R.A. (1979). Edge disturbance in natural areas. *Australian Parks and Recreation*. August, pp 39-43.
- Bureau of Meteorology (1979). *Climatic survey Sydney, region 5, New South Wales*. Dept. of Science and the Environment, Canberra.
- Craven, P.J. (1983). *Faunal survey of Bents Basin State Recreation Area, N.S.W.* Bents Basin State Recreation Area Trust.
- Currey, J.E.B. (Ed.) (1966). *Reflections on the colony of New South Wales: George Caley - Explorer and natural history collector for Sir Joseph Banks*. Landsdowne Press, Melbourne.
- Gorman, M. (1979). *Outline studies in ecology - island ecology*. Chapman and Hall, Cambridge.

- Herbert, C. & Helby, R. (1980). *A guide to the Sydney Basin*, Government Printer, Sydney.
- Jacobs, S. & Pickard, J. (1981). *Plants of New South Wales*. Government Printer, Sydney.
- Keith, D.A. & Benson, D.H. (1988). The natural vegetation of the Katoomba 1:100 000 map sheet. *Cunninghamia* 2, 107-143.
- McRae, R.H.D. & Benson, D.H. (1983). Vegetation survey of Bouddi National Park. Unpub. report, Royal Botanic Gardens, Sydney.
- Specht, R.L. (1981). Foliage projective cover and standing biomass. in *Vegetation classification in Australia* (eds Gillison, A.N. and Anderson, D.J.) A.N.U. Press, Canberra.
- Thomas, J., Burkitt, J. & Benson, D.H. (1984). Vegetation survey of Bents Basin State Recreation Area. Unpub. report, Royal Botanic Gardens Sydney.

Appendix 1

List of native species recorded for Bents Basin State Recreation Area in 1988.

There were 362 species from 87 families recorded during the survey. The numbers of those species from the major taxonomic groups are as follows:

Group	Number of species	Number of exotic species	Number of families
Pteridophytes	16		9
Gymnosperms	1		1
Angiosperms			
Monocotyledons	80	10	16
Dicotyledons	265	43	61
Total	362	53	87

The floristic list is arranged hierarchically: alphabetically for species, genera and families, and systematically for higher groups.

All names are as in Jacobs, S. and Pickard, J. (1981). (Plants of New South Wales, New South Wales Government Printer), except those instances where the National Herbarium of New South Wales has since adopted other names.

Exotic species are prefixed by an asterisk (*).

The numbers in the columns on the right hand side of the table show the communities in which each species was found.

ANGIOSPERMS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
<i>Lomatia myricoides</i>																			19						
<i>Lomatia silaifolia</i>								8	9	10							17								
<i>Persoonia laevis</i>								8	9		12						17								
<i>Persoonia linearis</i>			3		5	6		8	9	10	11	12	13	14	15		17					22			
<i>Petrophile pedunculata</i>									9																
<i>Stenocarpus salignus</i>				4					9			12					17								
<i>Xylomelum pyriforme</i>																									
RANUNCULACEAE																									
<i>Clematis aristata</i>	1	2	3																						
<i>Clematis glycinoides</i>	1							8									17								
<i>Ranunculus inundatus</i>				4																					
RHAMNACEAE																									
<i>Pomaderris aspera</i>			2																						
<i>Pomaderris intermedia</i>								8																	
ROSACEAE																									
<i>Rubus parvifolius</i>																									
RUBIACEAE																									
<i>Asperula conferta</i>					5																				
<i>Morinda jasminoides</i>				4																					
<i>Opercularia aspera</i>				4																					
var. <i>aspera</i>																									
<i>Opercularia diphylla</i>						6										16									
<i>Pomax umbellata</i>					5	6		8	9	10		12	13	14	15										
RUTACEAE																									
<i>Boronia ledifolia</i>									9			12													
<i>Correa reflexa</i>								8																	
<i>Eriostemon myoporoides</i>								8																	
<i>Phebalium squamulosum</i>								8																	
<i>Zieria compacta</i>								8																	
<i>Zieria cytisoides</i>								8	9																
SANTALACEAE																									
<i>Exocarpos cupressiformis</i>			3		5	6							13												
<i>Exocarpos strictus</i>								9		10		12													
<i>Leptomeria acida</i>								9								16	17								

Appendix 2

Exotic species recorded in Bents Basin State Recreation Area in 1984.

Abundance (column 3)

- + distribution limited within one community and/or a few individuals recorded in the S.R.A.
- ++ scattered distribution throughout the S.R.A.
- +++ Common throughout the S.R.A.
- ++++ Very common or scattered distribution but intense infestation (i.e. **Tradescantia albiflora*)

Distribution (column 4)

- R Riverine associated
- B Border or track associated

FAMILY, species	Common Name	Abundance	Distribution
Dicotyledons			
ACERACEAE			
* <i>Acer negundo</i>	Box-elder Maple	+	R
ANACARDIACEAE			
* <i>Schinus areira</i>	Pepper Tree	+	B
APIACEAE			
* <i>Apium leptophyllum</i>	Slender Celery	+	R
ASCLEPIADACEAE			
* <i>Araujia hortorum</i>	White Moth Vine	+	R
* <i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush	+	R
ACTERACEAE			
* <i>Ageratina adenophora</i>	Crofton Weed	+	R
* <i>Bidens pilosa</i>	Cobblers Peg	++	R,B
* <i>Bidens subalternans</i>		++	R,B
* <i>Chondrilla juncea</i>	Skeleton Weed	+	R
* <i>Cirsium vulgare</i>	Spear Thistle	+	R
* <i>Conyza albida</i>	Tall Fleabane	++++	R,B
* <i>Conyza bonariensis</i>	Flax-leaved Fleabane	++++	R,B
* <i>Galinsoga parviflora</i>	Potato Weed	+	R
* <i>Gnaphalium americanum</i>	Cudweed	+++	R,B
* <i>Hypochoeris radicata</i>	Catsear	++	R,B
* <i>Leontodon taraxicoides</i>		++	B
* <i>Senecio madagascariensis</i>	Fireweed	++++	R,B
* <i>Senecio mikanioides</i>	Cape Ivy	+	R
* <i>Sonchus oleraceus</i>	Common Sowthistle	++	B
* <i>Taraxacum officinale</i>	Dandelion	+++	B
* <i>Tagetes minuta</i>	Stinking Roger	+	R
* <i>Xanthium chinense</i>	Noogoora Burr	+	R
CACTACEAE			
* <i>Opuntia sp.</i>	Prickly Pear	+	R
CARYOPHYLLACEAE			
* <i>Polycarpon tetraphyllum</i>	Four leaf All-seed	+	R
* <i>Stellaria media</i>	Chick Weed	+	B
CHENOPODIACEAE			
* <i>Chenopodium album</i>	Fat-hen	+	B
FABACEAE			
* <i>Gleditsia triacanthos</i>	Honey Locust	++	R
GENTIANACEAE			
* <i>Centaurium erythraea</i>	Common Centaury	+	R

FAMILY, species	Common Name	Abundance	Distribution
MALVACEAE			
* <i>Modiola caroliniana</i>	Red Flowered Mallow	+	R
* <i>Sida rhombifolia</i>	Paddys Lucerne	+++	R,B
OLEACEAE			
* <i>Ligustrum sinense</i>	Small-leaved Privet	+++	R,B
* <i>Olea europaea</i> subsp. <i>africana</i>	Wild Olive	++	R,B
*PASSIFLORACEAE			
* <i>Passiflora edulis</i>	Common Passionfruit	+	R
* <i>Passiflora subpeltata</i>		+	R
PHYTOLACCACEAE			
* <i>Phytolacca octandra</i>	Ink Weed	+	R
PLANTAGINACEAE			
* <i>Plantago lanceolata</i>	Ribwort	++	B
POLYGONACEAE			
* <i>Acetosella vulgaris</i>	Sheep Sorrel	+	B
SCROPHULARIACEAE			
* <i>Verbascum virgatum</i>	Twiggy Mullein	+	B
SOLANACEAE			
* <i>Solanum chenopodioides</i>			
* <i>Solanum pseudocapsicum</i>	Madiera Winter Cherry	+	R
ULMACEAE			
* <i>Celtis occidentalis</i>		+	R
VERBENACEAE			
* <i>Verbena bonariensis</i>	Purple Top	++	B
Monocotyledons			
ASPARAGACEAE			
* <i>Asparagus asparagoides</i>		+	R
* <i>Asparagus officinalis</i>	Asparagus	+	R
COMMELINACEAE			
* <i>Tradescantia albiflora</i>	Wandering Jew	++++	R,B
CYPERACEAE			
* <i>Cyperus eragrostis</i>	Umbrella Sedge	+	R
POACEAE			
* <i>Axonopus affinis</i>	Narrow-leaved Carpet Grass	+++	R,B
* <i>Cynodon dactylon</i>	Common Copuch	++	B
* <i>Lolium rigidum</i>	Wimmera Ryegrass	++	B
* <i>Paspalum dilatatum</i>	Paspalum	++	B
* <i>Phalaris minor</i>	Lesser Canary Grass	+	B
* <i>Setaria geniculata</i>	Slender Pigeon Grass	+++	R,B

Manuscript received 28 November 1989

Manuscript accepted 5 April 1990