Companion to Kimberley Rainforests Australia

by

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From the book "Kimberley Rainforests, Australia"
Edited by N. L. McKenzie, R. B. Johnston and P. G. Kendrick (1991)
Surrey Beatty & Sons Pty Ltd, Chipping Norton, New South Wales

Published by
Surrey Beatty & Sons Pty Ltd
Chipping Norton, New South Wales, Australia



Sandstone gorge rainforest on the Moran River, north-west Kimberley (18/2). (Photo N. L. McKenzie.)

This booklet is available from the publishers at a cost of $1.00 per copy plus postage

The National Library of Australia
Cataloguing-in-Publication entry:

Kenneally, Kevin Francis, 1945– .
Companion to Kimberley Rainforests Australia.

ISBN 0 949324 41 8.

1. Forest Conservation — Western Australia — Kimberley.
2. Rainforests — Western Australia — Kimberley.
I. McKenzie, N. L. II. Title. III. Title: Kimberley Rainforests Australia.

333.784

Plate numbers are those used in Kimberley Rainforests Australia

PREFACE

This booklet summarizes conservation aspects of "Kimberley Rainforests, Australia". In particular, it identifies the practical steps that are necessary to protect the complexity and richness that is indigenous to Western Australia's rainforest communities. We hope that it will assist educators, local government authorities, the pastoral, tourism and mining industries, and amateur conservation groups to understand the threats to rainforests as well as their conservation values. Ultimately, people determine land-use; the persistence of the Kimberley rainforests lies in your hands.

Rainforests are often continuous with mangrove, the only other extensive closed-canopy community in the region (25/3). (Photo N. L. McKenzie.) ▷

The Kimberley

The Kimberley is one of the last great wilderness areas of the world. In splendid isolation, it extends northwards from the red dunefields of the Great Sandy Desert to the uplands and rugged escarpments and coastal and oceanic islands of the sub-humid north Kimberley. Its rich tapestry of tropical plants and animals and the great complexity of its landscapes are attracting increasing numbers of tourists.

Rivers lined with stately groves of paperbarks and screwpines rise in the vast savannahs of the Kimberley Plateau. Most flow north or westwards, incising sandstone gorges in their descent to the mangrove-fringed estuaries of the Arafura and Timor Seas. In draining the inland margins of the Kimberley Plateau, other rivers have formed extensive alluvial plains that separate the uplands from the desert.

Much of the Kimberley is dominated by open-canopied savannah woodland of varying composition with a prominent ground layer of grasses. Only three closed-canopy vegetation types are found in the wet-dry tropics of Western Australia: rain (monsoon) forests, mangroves, and riverine forests.



Exploration and Exploitation

The region is sparsely settled even today. Its north-west is so rugged and trackless that the composition and distribution of its flora and vertebrate fauna have only been fully revealed during the last 25 years. Indeed, the presence of rainforests in Western Australia was not recognized until 1965. As tiny patches of raingreen forest, they are folded into less than 0.005 per cent of the Kimberley landscape.

Remote does not imply pristine. At first glance, the size of this ancient, often massive Kimberley landscape can mask its fragility. Against a backdrop of Late Quaternary climatic fluctuations, 40 000 years of exploitation by humans have seen the demise of its megafauna. During the last century, a pastoral industry has pervaded the extensive plains in the south and east Kimberley. The spread of cattle has caused the most overt change of post-European times, and has been accompanied by a wave of extinctions among "medium-sized" mammals.

In contrast, no post-European extinctions are known from the northwestern Kimberley. Pastoral development barely penetrated this district until the early 1960s, and feral stock were scarce in its furthermost corners until the 1980s. Riverine forest and rainforest margins have been among the first north-west Kimberley habitats degraded by stock; rainforests damaged by cattle were noted as early as 1976.



Australian Rainforests

Australia has about 1.6 million hectares of tropical rainforest and 0.5 million hectares of temperate rainforest. This is less than the area cleared in the Amazon River Basin every year. The term is usually associated with the "evergreen" jungles of South America, Africa or Southeast Asia; areas that have high rainfall throughout the year. These days, the term includes monsoon forests (or semi-deciduous vine thickets) that are distinguished from "evergreen" forests as more or less leafless (deciduous) during the dry season, "raingreen" during the wet season, less lofty than "evergreen" rainforest and lacking woody epiphytes.

In reality, much of the tropical rainforest found across northern Australia corresponds to monsoon forest. It occurs as small, seasonally sparse, "raingreen" patches confined to gullies and scree-slopes in rugged terrain. Although their floristic relationships are with rainforests, the distinctive structural features of the "evergreen" rainforest are sparse or absent and annual herbs are often present.

Australia's dry "monsoon" rainforests are part of a great corridor of monsoon forests that extend through the areas of Australasia that have seasonally dry climates. They are thought to be part of a formerly more widespread palaeotropical flora that has evolved through a series of extreme palaeo-climates, possibly through the inland adaptation of littoral floras. These dry rainforests are characterized as much by their relatively high proportion of mobile, cosmopolitan genera as by their largely deciduous canopy.

It has also been estimated that several hundred thousand hectares of dry tropical rainforest remain in Australia, of which all but a few thousand hectares are brigalow vegetation rather than "monsoon" forest. Up to 75 per cent of Australia's rainforests are believed to have been destroyed since European settlement, mainly for agriculture. Australia's dry rainforests have been disappearing at an almost exponential rate. Yet, unlike many other countries, Australia is not forced to sacrifice rainforest for either arable land or export dollars.

◁ *Grass-invaded patch in pastoral country. Parts of the patch had recently been burned by fire from the adjacent savannah (Theda Cattle Station). (Photo N. L. McKenzie.)*

Kimberley Rainforests

By 1984, the decline of Australian rainforests had become a matter of national concern, so the Australian Government established a working group to advise on a conservation strategy. Yet the conservation status and significance of these Kimberley rainforests could not be assessed, either in a Western Australian or a national context. Rainforest was considered to be rare in the Kimberley; a scatter of tiny patches in an area of 170 000 square kilometres. Very few were mapped and less than 20 had been visited by biologists. There had been no attempt to count the number of patches present in the region, and no systematic survey of even the most accessible patches. In fact, no serious attempt had been made to appraise the fauna and ephemeral flora at even a single patch. The available data did not even provide a basis from which to appraise future trends in patch persistence under the disturbance regimes that were being imposed by the pastoral industry (frequent fire and cattle). It was derived from specific or opportunistic studies involving less than 1 per cent of the existing patches

In December 1986, the Department of Conservation and Land Management (CALM) was given funds under the National Rainforest Conservation Programme to substantially increase knowledge of Western Australia's tropical rainforests. Future land-use and management decisions would need to have a rational basis, so a detailed ecological survey of the rainforest resource was required.

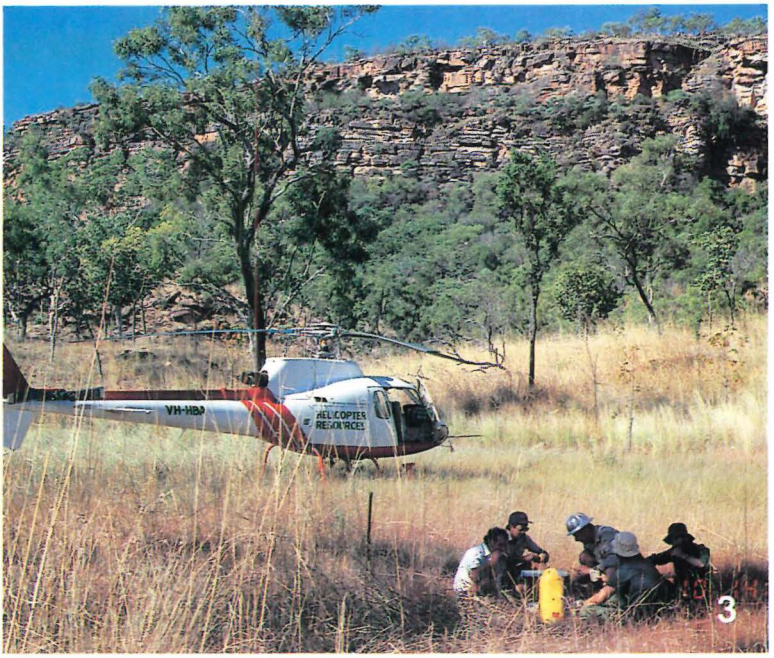
The problems of scale and complexity that are normally associated with broad-scale ecological survey were exacerbated by a series of factors: the dispersed nature of the community, the tiny area of most patches, their preference for sites in the shadow of gorges and sheer cliffs or among massive rock screes, and the trackless nature of the terrain. These logistical problems were overcome by using satellite imagery to discriminate and map the patches, and by adopting an ecological survey strategy based on a series of field expeditions. A helicopter was chartered to transport personnel, supplies and equipment between rainforest patches. The field sampling programme involved both wet and dry season studies, and was carried out over three years (1987–1989).

The logistics were particularly complex because economical use of the helicopter demanded a rigorous timetable. To minimize costs, the expeditions operated from isolated basecamps and had to be almost totally self-sufficient. The isolation of the Kimberley became very real when a bizarre triple murder on the Pentecost River threatened to disrupt the timetable of the June 1987 sampling programme. We were warned by radio that a gunman, armed with a high-powered rifle, may have taken refuge in the vicinity of our King Edward River basecamp, so our shift to Mt Hart Station, the second basecamp, was

made in convoy (under police instruction) and a day behind schedule. Six days later, the gunman was located near Fitzroy Crossing and killed in a shoot-out with police.

We now know that there are more than 1 500 rainforest patches scattered across 170 000 square kilometres of the Kimberley (p. 16). They are small and isolated. The average patch has an area of less than four hectares and few exceed 20 hectares. Even so, they are rich in species not found in the region's other communities.

To investigate their pattern of occurrence and provide a basis for future monitoring, 95 patches were sampled, representing the geographic range of the community, its geological and topographic variety, and the size-range of the patches. To provide a perspective on the entire community, we made an inventory of the perennial plants, birds and land snails at each patch. In analysing these data each species was given equal weighting irrespective of whether it was an enormous fig tree, a gloriously plumaged bird, or a tiny brown snail hidden in the litter.



The 1987 survey team at lunch below the Carson Escarpment. (Photo N. L. Mckenzie.)

Twenty-eight assemblages of species were distinguished from the numerical classification analysis, and strong patterns of species composition and richness were found. These patterns in species occurrence correlated with climatic (temperature range, rainfall), substrate (lithology, soil phosphorus), topographic (moisture availability in the dry season, aspect), geographic (distance separating patches) and biological (patch size, canopy height) factors. Even so, the average rainforest "specialist" was found in 38 per cent (mean) of the Kimberley patches sampled. Such "high ubiquity" is a feature of rain-green forests elsewhere. It seems that the nutrient-poor soils allow mobile species to colonize a variety of substrates, except where soil phosphorus is low.

The richest and most extensive tropical rainforests of the Kimberley occur along the north-west coastline, the area of highest rainfall. They can be found on most lithologies, but patches on basalt and dolerite rock-types are richer. In drier areas they were found only in sites with favourable hydrological conditions that are also protected from fire. None was recorded in areas receiving less than 580 mm rainfall annually.



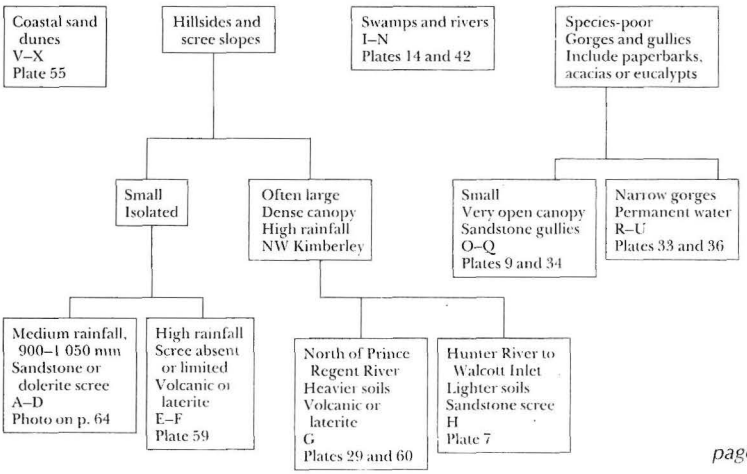
Eastern end of Prince Frederick Harbour. An example of the image product with embedded rainforest classes in yellow. The final maps represent a 1:100 000 topographic map sheet.

We recognize four major categories of rainforest in the Kimberley: those on hillsides and scree slopes, along swamps and rivers, patches on coastal sand dunes, and in gorges and gullies (below).

Only one locally endemic perennial plant species *(Hibiscus peralbus)* is restricted to rainforest patches, although the situation may be different for plants that only appear in the wet season. Almost all the plant, bird and non-camaenid land snail species recorded in Kimberley rainforests are also known from Northern Territory and/or Queensland rainforests. These include the canopy trees that protect the rest of the community during the protracted dry season. The biogeographic affinities and lack of endemism in these sorts of taxa do not suggest prolonged isolation. Instead, they indicate that rainforest communities have re-colonized the Kimberley from the Northern Territory following arid periods such as the last glacial maximum, most recently with the return of more mesic conditions during the mid-Holocene *ca.* 6 000 years ago. For the plants and land snails, the recolonization would have involved dispersal agents such as birds and fruit bats.

However, many of the small organisms are endemic to Kimberley rainforests, mainly those that are not readily dispersed by other species, and have poor mobility. Examples include the majority of the camaenid land snails and earthworms, certain lizards, and a few small mammals and birds. These sorts of species appear to have survived the last glacial aridity in Kimberley refugia associated with riverine, mangrove and/or sandstone habitats. This arid period ended about 7 000 years ago. For instance, the White-browed Robin and the lizard *Carlia johnstoni* inhabit rainforest and riverine vegetation, the Brown-tailed Flycatcher and the rodent *Melomys burtoni* are confined to mangroves and rainforest, and the White-lined Honeyeater favours sandstone escarpments that are peripheral to rainforest patches.

A simplified guide to the tropical raingreen forests of the Kimberley (A–X refer to classification groups).





Fleshy fruits of the rainforest tree Aglaia elaeagnoidea *are bird dispersed.*



Confined to closed-canopy vegetations in the Kimberley, Carlia johnstoni *forages among the leaf litter of the rainforest floor. (Photo R. E. Johnstone.)*

Fire, Feral Stock and Rainforest

There is little doubt that fire has had a strong influence on the localized distribution and boundary characteristics of dry rainforests across northern Australia. The size and shape of persisting patches often reflect the level of protection offered by surrounding landforms and vegetation. Patches surrounded by rock outcrops or ocean are less often burned than those adjacent to savannah woodlands, with their seasonally dry grasses. Patches used by feral stock are the most frequently burned.

As rainforests were prime food-gathering areas, Aborigines would not burn them, and would try to protect them from fires by burning the grassland around a rainforest patch early in the dry season. If these protective fires were lit every year the rainforests would never burn.

Conservation of Kimberley Rainforests

The aim of nature conservation is to ensure the survival of the native plants and animals in a region. Too often our concern for the environment has come long after ecosystems have been severely disturbed. We have the opportunity in the Kimberley to anticipate the effects of disturbances and plan to manage them.

Why should we conserve these rainforests? Tropical rainforests are among the most complex and species-rich ecosystems to have existed on earth. The dense canopy maintains a cool, humid micro-climate in the understorey that is essential for the survival of many rainforest species. Some measure of the importance of these patches to conservation in the Kimberley can be gained by the following figures: 453 plant species were recorded in the rainforests. This is about 25 per cent of the Kimberley flora, even though the total area of rainforest is less than 8 000 ha. About 30 per cent of these species depend on the patches for their persistence in the region. Unlike the savannah communities that dominate the region, a high proportion of rainforest plants produce succulent fruits that are an essential food resource for many of the region's animals.

A total of 141 bird species was recorded in Kimberley rainforests, about 45 per cent of the Kimberley land-bird fauna. The following table lists species whose populations rely on the patches for their persistence in the region (Table 1). Many of them rely on the year-round availability of rainforest fruits, or forage amongst the deep litter that characterizes the floor of these forests. They include some of the most colourful of Western Australia's birds. As well, Kimberley

rainforests are part of a great corridor of monsoon forests extending through Southeast Asia and into Australia that is important for the seasonal migration of birds such as Koels and Channel-billed Cuckoos.

TABLE 1. **Kimberley rainforest birds.**

Rainforest only	Rainforest and riverine forest	Rainforest and mangroves
Rufous Owl	Oriental Cuckoo	Little Bronze-Cuckoo
Figbird	Brush Cuckoo	Mangrove Golden Whistler
Yellow Oriole	Common Koel	Rufous Fantail
Cicadabird	White-browed Robin	Broad-bill Flycatcher
Spangled Drongo		Shining Flycatcher
Rainbow Pitta		
Orange-footed Scrubfowl		
Varied Triller		
Little Shrike-thrush		
Green-backed Flyeater		
Green-winged Pigeon		
Torres Strait Pigeon		
Red-crowned Pigeon		



Many of the small immobile species endemic to the region have only been recorded in its rainforest patches. This includes 90 per cent of the earthworms and 48 per cent of the land snails that were recorded in the patches.

The rainforest survey was designed to provide the data needed to select a representative nature conservation reserve system, set priorities among various on-ground management options, and provide a baseline for future monitoring

Although the total area of rainforest in the region is small, the patches are too dispersed and compositionally dissimilar to be adequately represented by existing Kimberley conservation reserves. To overcome this situation a series of conservation reserves have been proposed to ensure adequate representation of Kimberley rainforest types. However the community is so dispersed that the persistence of its component species in the region cannot be guaranteed by any feasible reserve network. There must be active management and protection of patches both inside and outside conservation reserves.

Unfortunately, the small size of the patches has made them particularly vulnerable to disturbance. Patches in cattle country are being trampled, opened, invaded by savannah grasses, and are contracting in size. A monitoring programme has been commenced by CALM at Mitchell Plateau to provide the baseline data on disturbance-recovery cycles that is needed if management priorities are to be set objectively. In the interim the reserve system proposed is optimized for a "benign neglect" strategy of land management.

◁ *Typical example of a contracting rainforest patch (09/1). The rainforest vegetation has been replaced by grasses of the surrounding savannah such as* Heteropogon contortus. *(Photo N. L. McKenzie.)*

The Role of the Community

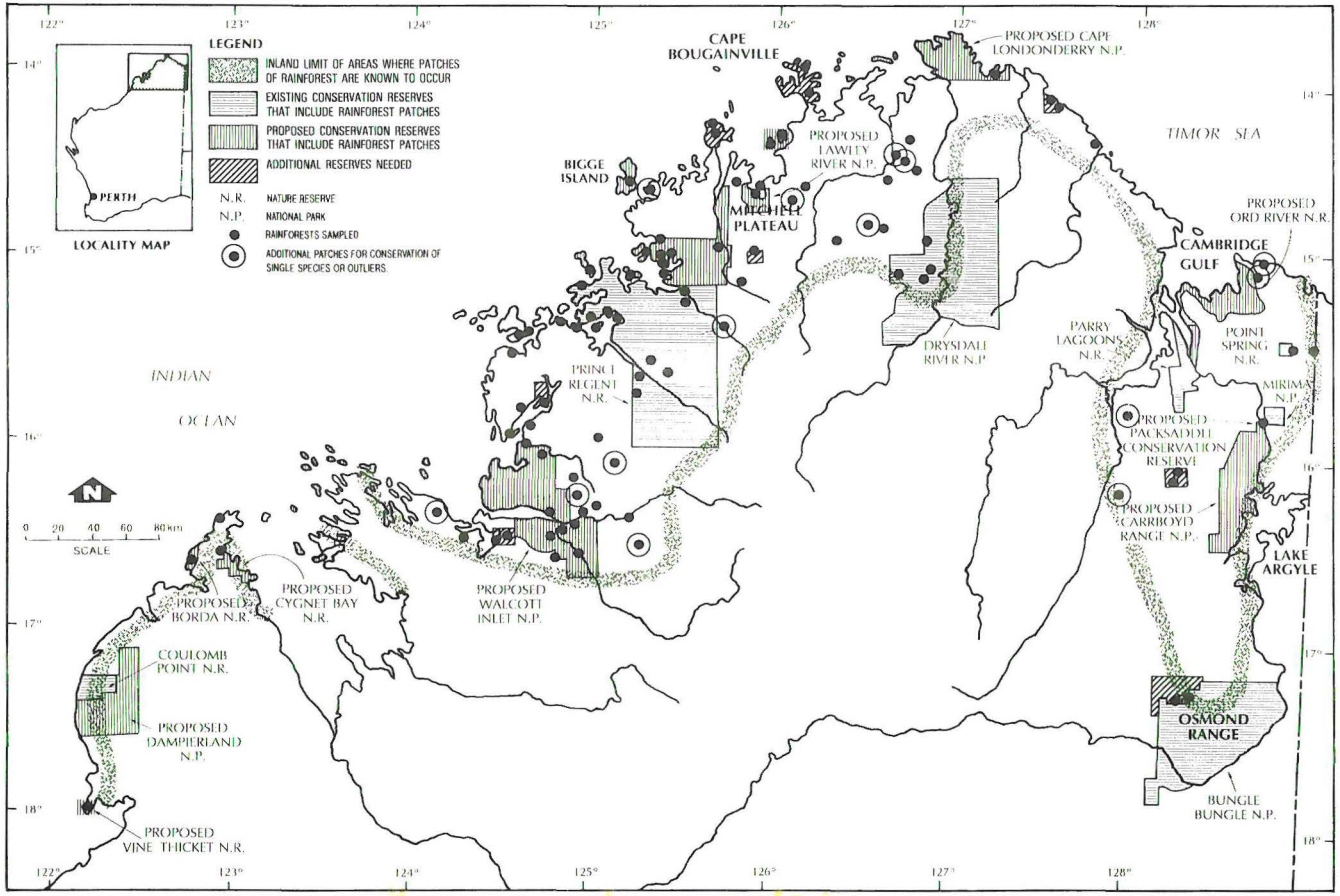
Nature conservation is a community activity. The following assistance will need to be provided by individuals, local government and industry if Kimberley rainforests are to be protected.

1. Take part in the collection and collation of information by becoming a CALM volunteer, by joining a suitable local group (e.g., field naturalists' clubs, Royal Australasian Ornithologists' Union, Association of Societies for Growing Australian Plants, or the Broome Botanical Society) or by reporting rainforest bird observations to the WA Museum.
2. Bring the value of rainforest patches to the attention of all appropriate management bodies and record and advise CALM when disturbance is noted.
3. Raise awareness of the value of regional conservation reserves through community education: utilize local media, library displays, schools and liaise with CALM.
4. Minimize any adverse effects on rainforest patches generated by adjacent land-use, for example, fence to exclude grazing stock, and manage burning regimes to prevent wildfires penetrating and damaging patches. Funds may be available for volunteer conservation groups (e.g., Landcare, Greening Australia, Save the Bush Programme and Gordon Reid Foundation for Conservation) to assist with fencing rainforest. Where rainforest patches occur in their areas of responsibility or development, local governments and corporations such as mining companies could help by providing funds, transport, personnel and equipment.
5. Avoid disturbing rainforest patches when clearing easements such as grid lines, fire breaks and access tracks. It reduces their area and richness and opens them to invasion by weeds and savannah grasses that dry and carry fires into the patch.
6. Implement washdown hygiene on heavy earthmoving equipment in the Kimberley to minimize the transport of weeds (and perhaps soil borne fungi) that can either invade rainforests (e.g., the Mint Weed *Hyptis suaveolens*, and the Giant Sensitive Plant *Mimosa pigra*) or form dense, seasonally dry zones on rainforest perimeters that carry fire into the patch (e.g., the Golden Grasses *Pennisetum pedicellatum* and *P. polystachion*).

7. Be aware that some horticultural species currently being cultivated in northern Australia can become troublesome weeds in rainforest (e.g., the introduced vines *Cryptostegia grandiflora* and *Protasparagus africanus,* and the scrambling shrub *Lantana camara*). The seeds of species such as these can be spread over great distances by wind, birds or stock, so they should not be grown in the Kimberley. If in doubt check with a CALM office. Rainforest patches at Point Spring near Kununurra and on the King Edward River at Kalumburu are already infested with weeds.
8. Support efforts by government authorities to eradicate feral animals such as donkeys, cattle, pigs and cats, and ensure all domestic cats are sterilized.
9. Encourage plant nurseries to cultivate local rainforest species — many have horticultural potential (note that seed collection requires a permit from CALM).
10. Encourage local government authorities to plant local rainforest species as ornamentals in parks, gardens and along streets (e.g., the Banyan Fig *Ficus virens,* the Kimberley Sapote *Mimusops elengi* and the Gubinge trees *Terminalia petiolaris* and *T. ferdinandiana*). These species have edible fruits and are regarded by Aboriginal communities as traditional bushfood.
11. Avoid dumping rubbish or garden prunings in local rainforest areas, (e.g., Gubinge Road vine thicket, Broome). These practices not only degrade the rainforests' conservation values but also encourage the establishment of exotic weed and burr species.
12. Rainforests are major habitats for native animals. Ensure domestic dogs are prevented from entering rainforest patches and harrassing wildlife.
13. Certain rainforest patches (e.g., near Lombadina and One Arm Point) have significance in Aboriginal law and culture, e.g., they may be law sites and/or may be taboo to women. Always ask local Aboriginal communities before entering these areas. It is not only good manners, but avoids creating offence however unintended.

Acknowledgement

We thank everybody associated with the Kimberley rainforest survey for allowing us access to their data.



Existing and proposed conservation reserves in the area of the Kimberley where rainforests occur. The map also shows the amendments needed to represent rainforest diversity.

Kimberley Rainforests

Edited by N. L. McKenzie, R. B. Johnston and P. G. Kendrick



WORLD-WIDE interest and concern about rainforests is reflected in the spate of recent publications on the subject. This book comprises 21 refereed papers reporting aspects of a three-year study of the ecology of a remote, poorly known region of Western Australia. Prior to this study, little was known about the 1 500+ patches of "raingreen forest" that occur in the region.

The ecological study was carried out by fifteen Australian scientists, specialists in remote sensing, botany, zoology, soils, conservation ecology and biogeography. The results are interpreted into the available scientific literature, current at December 1989.

The book is also intended as a source reference for future research, monitoring and management. Aboriginal names are listed for many of the plants and animals. Soils, climatic and landform data are provided for each patch, and analysed in relation to biological patterns. With these data, professional users can re-interpret its findings for themselves, or make quantitative comparisons with their own data.

490 pp. plus xvi, illustrated colour, A4, case bound, $93.00 plus postage.

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Fleshy fruit of a common Kimberley rainforest vine, Adenia heterophylla.
(Photo K. F. Kenneally.)

PRINTED BY SURREY BEATTY & SONS PTY LTD

ISBN 0 949324 41 8