

## **II.1. INTRODUCTION**

### **a. State Party**

Australia.

### **b. Name of World Heritage property**

Wet Tropics of Queensland.

### **c. Geographical coordinates to the nearest second**

Between latitudes 15 degrees 39 minutes south and 19 degrees 17 minutes south, and longitudes 144 degrees 58 minutes east and 146 degrees and 27 minutes east.

### **d. Date of inscription on the World Heritage List**

9 December 1988.

### **e. Organization(s) or entity(ies) responsible for the preparation of the report**

Environment Australia, in conjunction with the Wet Tropics Management Authority.

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### **f. Date of report**

### **g. Signature on behalf of State Party**

## II.2. STATEMENT OF SIGNIFICANCE

### Criteria

The Wet Tropics of Queensland met all four World Heritage criteria for a natural property. The criteria current at the time of listing (1988) and specified in the nomination were:

1. Outstanding examples representing the major stages of the earth's evolutionary history
2. Outstanding examples representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment
3. Superlative natural phenomena, formations or features or areas of exceptional natural beauty
4. The most important and significant natural habitats where threatened species of plants and animals of outstanding universal value from the point of view of science and conservation still survive.

### Statement of Significance

An explicit summary 'statement of significance' was not included at the time of the Queensland Wet Tropics nomination. The following two paragraphs distil the essential values which formed the basis of the Wet Tropics nomination.

The Property is of universal significance because it contains most of the relicts that exist on Earth of the flora of the forests which were part of the super continent Gondwana. The rainforests which constitute about 80% of the Property have more taxa with primitive characteristics than any other area on Earth. The ancestry of all of Australia's unique marsupials and most of its other animals originated in rainforest ecosystems of which the Wet Tropics still contains many of the closest surviving members (DASETT 1987). One of the outstanding features of the Property is that it contains a high diversity of ancient taxa representing long evolutionary lineages which preserve a greater degree of evolutionary heritage than places with a similar number of species but containing a succession of closely allied forms.

The Wet Tropics provides an unparalleled living record of the ecological and evolutionary processes that shaped the flora and fauna of Australia over the past 415 million years when first it was part of the Pangaeian landmass, then the ancient continent Gondwana, and for the past 50 million years an island continent. During this 415 million years of evolution, the processes of speciation, extinction and adaptation have been determined by history, particularly continental drift and cycles of climatic change.

### Justification for listing

At the time of the Wet Tropics listing the wording and emphasis of the Criteria for nomination differed from the current natural value Criteria. The following section updates the Wet Tropics nomination (DASETT 1987) based on the present version of the Criteria. In the following section:

- the original 1988 nomination information is presented in normal font;
- those parts of the original nomination which have been superseded by new or better information are indicated by ~~striketrough~~ font; and
- new or amended information is presented in **bold** font.

### **Description and Inventory**

**The Wet Tropics of Queensland World Heritage Area** ~~The area nominated as the Wet Tropical Rainforests of North-east Australia is shown on Maps 1 and 2. The area covers 894,420 ha about 9000 square kilometres and extends from just south of Cooktown to just north of Townsville.~~

The ~~wet tropical~~ rainforests of ~~North-east Australia~~ **the Wet Tropics of Queensland** are a relict of a vegetation type which was once much more widespread. Fossil pollen records have indicated that the whole of Australia was covered by closed forests some 50 to 100 million years ago. Today the Australian rainforests are restricted to a series of discontinuous pockets extending for more than 6000 km across

northern Australia and along the east coast to Tasmania. Representatives of the sub-tropical and temperate rainforests are included in the ~~Australian East Coast Temperate and Sub-Tropical Rainforest Parks World Heritage Area~~ **Central eastern Rainforests Reserve** in New South Wales and **south east Queensland** and the cool temperate rainforests are included in the ~~Western Tasmania Wilderness National Parks World Heritage Area~~.

It is estimated that rainforests today cover only **3.6 million hectares (NFI 1998)**, ~~20,000 square kilometres (Webb and Tracey, 1984)~~ which is about ~~0.2~~ **0.4** per cent of the area of Australia. There ~~is~~ **are** approximately 7800 square kilometres of wet tropical rainforest in north-east Australia (Winter *et al.* 1987) and of that about 90 per cent is within the ~~nominated area~~ **World Heritage Area**.

#### (i) **Climate and hydrology**

Many of the distinctive features of the region relate to the high rainfall and diverse terrain. The mean annual rainfall ranges from about 1200 to over 4000 millimetres with some sites having much higher falls. The wettest region lies between Cairns and Tully on the coast and subcoastal ranges where the mean annual rainfall is generally over 3000 millimetres.

Even in the wettest areas between Tully and Cairns there is a distinctly seasonal precipitation regime with over 60 per cent falling in the summer months (December to March) followed by a relatively dry season in mid-year. Tropical low pressure cells and cyclones that develop in the monsoonal trough commonly produce more than 250 millimetres of rain in a day during the wet season. Mt Bellenden Ker has received 1140 millimetres of rain in a 24-hour period.

By comparison with other tropical rainforest areas in the world, the wetter parts of the region lie at the 'wet' to 'extremely wet' end of the hydrological spectrum. During the wet season when soil profiles are often saturated, high intensity rainfall may not be absorbed by the soil, and widespread overland flow can occur even on relatively steep slopes. The common occurrence of widespread overland flow, as distinct from highly localised saturation overland flow in valley bottoms, channel margins and stream head locations, appears to be rare in other wet tropical rainforests of the world; indeed its absence has been regarded as characteristic. In this respect, the rainforests of ~~the Wet Tropics North-east Queensland~~ appear to be exceptional (Walsh 1980).

On the coast, mean daily temperatures range from a maximum of 31°C to a minimum of 23°C. During winter the mean daily maximum and minimum temperature, are about 5°C lower. The tablelands and uplands are cooler, with mean daily summer temperatures ranging from a maximum of 28°C to a minimum of 17°C. During winter, the mean daily maximum and minimum temperatures are 22°C and 9°C respectively. Coastal humidity during the summer months is on average 78 per cent, but there are numerous days when it reaches into the high nineties.

#### (ii) **Geology and geomorphology**

The main rainforest occurrence in North Queensland lies astride three major geomorphic regions: the tablelands of the Great Divide, the lower coastal belt, and the intermediate Great Escarpment.

The undulating tablelands are remnants of an elevated and warped landscape. The highlands rise to altitudes of 900 m with isolated peaks up to 1622 m. To the east, the Great Escarpment marks the limit of headwards erosion into these tablelands from the coastal plain. It is a zone of rugged topography, rapid geomorphic processes and diverse environments. The escarpment is deeply incised by many gorges, and there are numerous waterfalls.

The history of the geomorphology of the region is summarised in Appendix 2. The main rock types (slates and greywackes to greenschist facies) beneath the region are the marine Silurian, Devonian and Carboniferous sediments of the Hodgkinson Basin and of the Broken River Embayment. The Barnard Metamorphics of largely schist and gneiss occupy some south-east coastal outcrops and may be part of the Hodgkinson Basin. The distinct nature of the Barnard Metamorphics is emphasised by the presence nearby of the rare Babalangee Amphibolite.

The greatest concentration of volcanics and granite occurs at the southern end of the known Hodgkinson Basin where it intersects the trend of the Broken River Embayment. This area lies west of the Barnard Metamorphics making the Innisfail area and its hinterland the most diverse and complicated of the region.

Many of the granites were probably exposed by the end of the Palaeozoic or the beginning of the Mesozoic. Uplift of the tablelands shed drainage north-west during the Jurassic to the Tertiary period. Climatic change and geomorphic processes during the Quaternary led to repeated coastal retreat and marine submergence. These events influenced the reversal of stream flow to the east.

One of the most striking elements of the present landscape is the Great Escarpment. Catastrophic erosion and slope failure of poor soils resulted in the retreat of many faces of the Escarpment. Only where basalt flows have run down valleys have the gradients of the Escarpment been locally reduced. In the Johnstone River valley system the escarpment is breached by a ramp of moderate slope.

The vulcanism of the Atherton Tablelands and adjacent volcanic provinces is characterised by scoria cones, lava cones and maars. Lakes Eacham and Barrine occupy the youngest maars. The tablelands and some coastal areas were greatly disturbed by basalt flows throughout the Pliocene-Pleistocene. However, the high nutrient status of the developing basalt soils may have proved advantageous to the rainforest in resisting stresses during the fluctuating climatic conditions associated with the Pleistocene glacial cycles.

### (iii) Fringing reefs

Fringing reefs occur along much of the coastline of the northern section of the region, adjoining rainforest. The reefs are included in the Great Barrier Reef World Heritage Area.

### (iv) Vegetation types

The major vegetation type in the ~~nominated area~~ **Wet Tropics World Heritage Area** is tropical rainforest but this is fringed and to some extent dissected by sclerophyll forests and woodlands, mangroves and swamps. The vegetation types in the region are described below.

#### *Rainforest*

The rainforests of the ~~Australian wet tropics~~ **Wet Tropics of Queensland** occur across a diverse range of rainfall, soil type and drainage, altitude and evolutionary history. As a result there is a spectrum of rainforest plant communities and habitats recognised as being floristically and structurally the most diverse in Australia (Tracey 1982).

The rainforests of the wet tropics have been classified into 13 major structural types including two which have sclerophyll (*Eucalyptus* and *Acacia*) components. The major types have further been classified into 27 broad communities correlating with climatic zones and soil parent material. All these communities occur in the Property and are listed in Appendix 3. The wet tropical region comprises a mosaic of rainforest types reflecting the environmental conditions. The floristic composition within the types varies from place to place; therefore it is important to conserve the types throughout the ~~nominated area~~ **Wet Tropics** in order to ensure preservation of all species.

On the slopes and summits of the high peaks where there is frequent cloud cover and strong winds there exist the wet submontane forests known as simply microphyll vine-fern forests and thickets. There is a high regional endemism of species in the floristic composition of these upland areas. Above 1500 m on the Bellenden Ker Range the canopy, sometimes with the endemic *Leptospermum woornooran* dominant, is often low and dense and shows the streamlining effects of strong winds. On the summits there are many narrowly restricted species including *Dracophyllum sayeri*, *Cinnamomum propinquum*, *Rhododendron lochae*, *Flindersia oppositifolia*, *Orites fragrans* and *Uromyrtus metrosideros*,

The montane forests of the Mt Lewis and Mt Spurgeon area are also classified as simple microphyll vine-fern forests. However these forests, having many of their own endemics, differ floristically from those of the Bellenden Ker area. These include in the family Proteaceae, *Helicia recurva* and *Austromuellera trinervia*; *Prumnopitys ladei* in the family Podocarpaceae; the striking pink-flowered *Aceratium ferrugineum* in the family Elaeocarpaceae and the undescribed palm *Archontophoenix* 'Mt Lewis'.

Floristically, the upland simple microphyll vine-fern forests and thickets are very different to the other rainforest types in the ~~nominated area~~ **Wet Tropics**, but they show a floristic affinity with the Australian temperate rainforests at higher latitudes and with montane rainforests of New Guinea and Indonesia. Shared genera with southern Australia include *Trochocarpa* and *Eucryphia*. *Rhododendron* and *Agapetes*, which are each represented in the ~~nominated area~~ **Wet Tropics** by a single species, are shared with New Guinea and Indonesia.

The most highly developed Australian rainforests occur on the wet lowlands. These complex mesophyll vine forests on colluvial footslopes and alluvial soils, are represented in the ~~nominated area~~ **Wet Tropics** by small patches between Innisfail and Cape Tribulation. Characteristic trees include *Acmena graveolens*, *Backhousia bancroftii*, *Argyrodendron peralatum* and *Ristantia pachysperma*. Local endemism and disjunctions are common and are exemplified by *Storkiella australiensis* and *Idiospermum australiense*.

One of the most striking rainforest types is that dominated by the endemic Fan Palm, *Licuala ramsayi*. The type is restricted to small patches on poorly drained soils on the lowlands. Most has been cleared for sugarcane farming and only a few square kilometres remain. Small patches of these palm forests are included in the ~~nominated area~~ **World Heritage Area** near Cowley Beach, Mission Beach, Yarrabah and north of the Daintree River.

Complex notophyll vine forests on the basalt soils of the Atherton Tablelands have by now been mostly cleared. What remains includes restricted and disjunct species such as *Athertonia diversifolia*, *Austromuelleria trinervia* and *Austrobaileya scandens*. The drier remnant of the type is conserved in the ~~nominated area~~ **World Heritage Area** at the Curtain Fig (State Forest 452) and Severin Creek (State Forest 185). The wetter type is accessible at Mt Hypipamee - The Crater National Park. The overlap of the wet and dry types are preserved in National Parks at Lake Barrine and Lake Eacham.

Complex mesophyll vine forest on very wet lowlands on beach sands is now extremely rare. The major occurrences at Kurrimine Beach and near the mouth of the Daintree River and at Noah Creek near Cape Tribulation have all been included in the ~~nominated area~~ **World Heritage Area**. Palms found in this type include *Arenga appendiculata*, *Archontophoenix alexandrae*, *Hydriosteles wendlandiana*, *Licuala ramsayi*, *Ptychosperma elegans* and in the Noah Creek area the narrowly restricted endemic *Normanbya normanbyi*. Conspicuous trees in the type include *Calophyllum inophyllum* on the beach front; *Calophyllum sil*, *Syzygium forte*, *Acmena hemilampra* and *Podocarpus grayi* on the dunes; and in the wetter swales *Dillenia alata*, *Syzygium angophoroides* and *Randia fitzalani*. *Backhousia hughesii* is common in the community at Noah Creek.

In addition to these rarer forest types the ~~nominated area~~ **World Heritage Area** contains outstanding and extensive occurrences of mesophyll vine forests and simple notophyll vine forests of the moist uplands and highlands.

#### *Tall Open Forests*

Adjacent to the rainforest ~~margins~~ on the western ~~edge~~ **margin** of the ~~nominated area~~ **World Heritage Area** are the tall open forests (wet sclerophyll forests) dominated by *Eucalyptus grandis* (Rose Gum), - ~~Other tall species common in the type include~~ *E. resinifera* (Red Stringybark), *E. acmenioides* (White Stringybark), *E. intermedia* (Pink Bloodwood), *Lophostemon confertus* (Brush Box) and *Syncarpia glomulifera* (Turpentine). Variation in species composition and concentration within these forests ~~is~~ **in** ~~corelation to~~ **with** soil type, rainfall and fire frequency; as well these factors are reflected in understoreys of different compositions ranging from well developed rainforest elements to dense grass.

There is a striking contrast in the structure of the adjoining rainforest and wet sclerophyll forests of north Queensland. This extraordinary ecological situation is very different from rainforests and "campos cerrados" of Brazil and the moist evergreen-dry deciduous forests of India (Webb and Tracey 1981).

The narrow strip of tall open forest where it occurs adjacent to rainforest is important for the conservation of **one of the mammals restricted to the World Heritage Area, the endangered *Bettongia tropica* (Northern Bettong)** and the northern population of ~~three~~ **two other** species of mammals restricted to this forest type - *Petaurus australis* (~~Yellow-bellied~~ **Fluffy Glider**), *Bettongia penicillata* (~~Brush-tailed~~ **Bettong**) and *Rattus lutreolus* (Swamp Rat).

### *Medium and Low Woodlands*

Areas of medium and low ~~Eucalyptus eucalypt~~ woodlands have been included in the ~~nominated area~~ **World Heritage Area**. These are examples of widespread vegetation types found today over most of tropical Australia. Their inclusion will preserve the ecotones between rainforest and sclerophyll elements. The species compositions of both canopy and understorey differ in to rainfall, soil type, fire frequency and vegetation history over the long term.

### *Paperbank Swamps*

*Melaleuca* spp. (paperbanks) occur as the dominant tree species in poorly drained lowland coastal areas where the water table is near to or above ground level for most of the year. They usually occur as components of vegetation mosaics reflecting specific habitats including the *Melaleuca leucodendra* and *M. dealbata* complex in freshwater and brackish swales in old beach ridge systems; *M. quinquenervia* dominant in fresh water swamps; and *M. viridiflora* on sodic and saline sand plains. Their inclusion in the ~~nominated area~~ **World Heritage Area** preserves the pattern of their evolution in relation to the rainforest of North-east Australia. The *Melaleuca* communities often have distinct species including the epiphytes *Dischidia*, *Hydrophytum* and the Tea Tree Orchid, *Dendrobium canaliculatum*.

### *Mangroves*

A high degree of species diversity of mangroves trees and shrubs (c. 30 species) occurs in North-east Australia, comparable to the diversity of those of New Guinea and Southeast Asia which are acclaimed as some of the richest mangrove areas in the world. Major areas include the Hinchinbrook Channel, the north bank of the Daintree River and Alexandra Bay north of the Daintree River, all of which are included in the ~~nominated area~~ **World Heritage Area**.

The rainforest intergrades with the mangroves, sharing many species at the interface including *Diospyros littorea*, a species found only on the landward side of the mangroves.

The mangrove zone has a rich and varied epiphytic flora including ferns of the genus *Drynaria* and orchids of the genus *Dendrobium* and the Ant Plant, *Myrmecodia beccarii*. The ant *Iridomyrmex cordatus* which inhabits the *Myrmecodia* tends the larvae of the rare butterfly *Hypochrysops apollo*.

### **(v) Flora**

Within the ~~nominated area~~ **Wet Tropics** there over 3000 species of vascular plants, representing 1164 genera and 210 families. Of the genera, 75 are endemic to Australia and 43 are restricted to the ~~wet tropical area of North-east Australia~~ **Queensland's Wet Tropics**. More than 700 species, or 23 per cent of the total, are found only in this area.

The ~~nominated area~~ **Wet Tropics of Queensland World Heritage Area** plays a vital role in the conservation of the Australian members of the Southern Hemisphere family Proteaceae. At least thirteen genera (some of which are still to be described) out of a world total of 76 occur in the ~~nominated area~~ **Wet Tropics** and 40 species are restricted to the Property. The rainforest members of the Proteaceae, living or extinct, are claimed (Johnson and Briggs 1975) to be the ancestors of the sclerophyll species such as *Grevillea* and *Persoonia* that today form such an important part of the Australian vegetation. *Placospermum coriaceum*, one of the most primitive plants of the Proteaceae, occurs only in the ~~nominated area~~ **Wet Tropics**.

Many examples of isolated populations of tree species occur throughout the rainforests of the ~~nominated area~~ **World Heritage Area**, both on the lowlands and in the uplands. Species included on the lowlands are *Storkiella australiensis* and *Noahdendron nicholasii* which are restricted to near Cape Tribulation; *Idiospermum australiense* and *Lindsayomyrtus brachyandrus* have a disjunct distribution between the Cape Tribulation area and the Harveys Creek–Russell River area south of Cairns, both very wet humid tropical lowland areas. On the uplands *Sphalmium racemosum* and *Stenocarpus davalloides* have populations restricted to the Mt Carbine Tableland in the northern section of the ~~nominated area~~ **World Heritage Area**, whereas *Lomatia fraxinifolia*, *Darlingia darlingiana* and *Cardwellia sublimis* are widespread. Much is yet unknown of the species distribution patterns in the tropical rainforests of North-east Australia.

The Property has a rich orchid flora. Of some 90 species present, about 59 have a restricted distribution with 43 having an extremely small range. *Dendrobium fleckeri*, *D. adae*, *D. carrii* with its creeping rhizome, *Bulbophyllum boonjie* and *Saccolabiopsis rectifolia* are a few examples of the restricted epiphytic orchids. Terrestrial orchids are also represented in the Property. The endemic Jewel Orchid, *Anoectochilus yatesiae*, is only found in the darkest, dense upland rainforests of this region.

The Property is also the home of one of the world's largest cycads, as well as one of the smallest. *Lepidozamia hopei* may grow to a height of about 20m. Its population today is scattered and disjunct. The small fern-like cycad, *Bowenia spectabilis*, is common in the understorey of rainforest-associated communities. The related *B. serrulata* is represented in the ~~nominated area~~ **World Heritage Area** by small disjunct populations usually associated with *Agathis robusta*.

The richest concentrations of ferns and fern allies in Australia are found in the ~~nominated area~~ **Wet Tropics**. Of more than 240 species occurring in these rainforests, 46 are entirely restricted to the Property. Some 17 species have extremely restricted distributions within the Property. Of the five Australian endemic fern genera (Page and Clifford 1981), four occur in the ~~nominated area~~ **Wet Tropics** (*Coveniella*, *Neurosoria*, *Pteridoblechnum* and *Platyzoma*). *Pteridoblechnum* is the only endemic fern genus restricted to the tropical area of northeast Australia and is represented by *P. acuminatum* at Mt Spurgeon and Mossman Gorge and the widely distributed *P. neglectum*.

#### (vi) Fauna

Although the ~~nominated area~~ **Wet Tropics of Queensland World Heritage Area** represents **only** about 0.1 per cent of the land surface of the continent, it has a large and diverse fauna. Within the Property occur ~~30~~ **35** per cent of Australia's mammal species (**including 30 per cent of the marsupial species, 58 per cent of the bat species and 25 per cent of the rodent species**), ~~50~~ **48** per cent of the bird species, ~~30~~ **26** per cent of the frog species, ~~23~~ **17** per cent of the reptile species, **41 per cent of the freshwater fish species** and about ~~62~~ **58** per cent of the butterfly species of Australia. ~~Eighteen per cent of Australia's bird species occur in these rainforests.~~ There are ~~54~~ **at least 70** species of vertebrate animals unique to the ~~nominated area~~ **Wet Tropics**. **In addition, there are numerous invertebrate species endemic to the Property. In terms of species diversity and endemism, no area in Australia appears to have greater biological significance than the tropical rainforest of north Queensland (Switzer 1991, Williams et al 1996, WTMA 2001).**

#### *Mammals*

The mammal fauna includes 2 monotremes, ~~37~~ **41** marsupials, ~~46~~ **15** rodents and 36 bats. ~~About nine mammal species are endemic to the wet tropical rainforests of North east Australia area. (In one or two cases, the whole of the habitat is not contained within the World Heritage Area boundaries.)~~ ~~(assuming the two formerly recognised races of the Herbert River Ringtail Possum to be separate species)~~ **Of the thirteen endemic species, only the Mahogany Glider and Tropical Bettong are not rainforest dependent. Most of the rainforest-dependent endemics are restricted to the uplands and, as a consequence, they occur as a number of isolated populations (Winter 1991). One example is the Lemuroid Ringtail Possum which occurs only above 550 m with the larger population in the Atherton Uplands and a smaller population on Mt Carbine Tableland, the two being separated by the Black Mountain Corridor. The Mt Carbine Tableland population of the Lemuroid Ringtail Possum occurs only above about 1000 m and is characterised by a much higher proportion of pale-furred individuals ('white' lemuroids) (Trenerry and Werren 1993). The endemic species include one antechinus (Atherton Antechinus, *Antechinus godmani*), four ringtail possums (Lemuroid Ringtail Possum, *Hemibelideus lemuroides*; Green Ringtail Possum, *Pseudocheirops archeri*; Herbert River Ringtail Possum, *Pseudocheirus herbertensis*; Daintree River Ringtail Possum, *P. cinereus*), one glider (Mahogany Glider, *Petaurus gracilis*), one rat-kangaroo (Musky Rat-kangaroo, *Hypsiprymnodon moschatus*), Australia's only two tree-kangaroos (Lumholtz's Tree-kangaroo, *Dendrolagus lumholtzi*; Bennett's Tree-kangaroo, *D. benettianus*), one bettong (Northern Bettong, *Bettongia tropica*) and one rodent (Masked white-tailed Rat, *Uromys hadrourus*).**

Winter *et al.* (1984) defined two distinct sub-regions for the distribution of the endemic rainforest mammals of The Wet Tropics, the southern one centred on the Atherton Uplands and the northern one on Thornton Peak, with Mt Carbine Tableland representing an overlap area. The Atherton

*Antechinus* occurs only in the southern sub-region as does the Herbert River Ringtail Possum, though the latter also has an isolated population on the Seaview Range towards the southern end of the World Heritage Area. The Daintree River Ringtail Possum occurs in the northern sub-region and on Mt Carbine and Mt Windsor Tablelands. The distributions of the two tree-kangaroos do not overlap as far as is known. *Dendrolagus lumholtzi* occurs in the southern sub-region and on Mt Carbine Tableland, while *D. bennettianus* occurs in the northern sub-region and on Mt Windsor Tableland.

Of particular interest is *Hypsiprymnodon moschatus*, the Musky Rat-kangaroo is of particular interest. It is the smallest and, in many respects, the most primitive of the kangaroo group, and represents an early stage in the evolution of kangaroos from an arboreal possum-like stock. Australia's only two tree kangaroo species, *Dendrolagus lumholtzi* (Lumholtz's Tree kangaroo) and *D. bennettianus* (Bennett's Tree kangaroo) also occur as restricted populations in the nominated area.

The Mahogany Glider (*Petaurus gracilis*) was already endangered by the time it was rediscovered in 1989 after having been essentially forgotten for more than a century (Van Dyck 1993). It has been found only at a few localities in lowland woodland between Ingham and Tully. Over 80% of its habitat had been cleared for sugar cane, plantation pine, bananas and cattle. There are estimated to be only 2000 – 3000 Mahogany Gliders left in the wild ([http://www.qmuseum.qld.gov.au/features/endangered/animals/mag\\_glider.asp](http://www.qmuseum.qld.gov.au/features/endangered/animals/mag_glider.asp))

At the time of listing the Northern Bettong (*Bettongia tropica*) was considered to be a subspecies of the Brush-tailed Bettong, *Bettongia penicillata*. That species is restricted to the southwestern corner of Australia. Northern Bettongs are listed as endangered under the Queensland *Nature Conservation (Wildlife) Regulation 1994* and under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. Northern Bettongs were once widely distributed in a range of tall and medium sclerophyll habitats in the uplands of the Wet Tropics region but are known to currently occur at only three locations: Mt Carbine Tableland (a very small, restricted and low density population), Lamb Range (including the Davies Creek, Emu Creek and Tinaroo sub-populations which are genetically distinct but geographically close) (Pope 2000) and Coane Range (a recently discovered small disjunct population in the southern section of the region. A total north-south spread of 340km.

In addition to the endemic species, there are at least eight subspecies of mammals restricted to the region (Werren 1992). These include the Yellow-footed Antechinus, *Antechinus flavipes rubeculus*, Brown Antechinus, *A. stuartii adustus*, Common Dunnart, *Sminthopsis murina tatei*, Godman's Rock-wallaby, *Petrogale godmani godmani*, Swamp Wallaby, *Wallabia bicolor mastersii*, Bush Rat, *Rattus fuscipes coracius*, Cape York Rat, *Rattus leucopus cooktownensis* and Swamp Rat, *Rattus lutreolus lacus*. In addition, a subspecies of the Long-tailed Pygmy-possum, *Cercartetus caudatus macrurus*, a tiny marsupial with a head and body length of about 10 cm, is restricted to the Wet Tropics with another subspecies occurring in New Guinea (Atherton and Haffenden 1991).

Diversity in the Australian bat fauna reaches its peak in The Wet Tropics (Richards 1991). At least 36 species have been recorded (Williams et al 1996), virtually all of which make use of rainforest for roosting or foraging or both (Richards 1991). Several species are considered endangered or vulnerable. The Golden-tipped Bat, *Kerivoula papuensis*, has a distinctive dark brown woolly fur with golden tips to the hairs. It occurs in New Guinea and in a few widely disjunct locations along the eastern Australian coast. A small bat with a body length of 5–6 cm, it is unique among Australian bats in being an intra-canopy aerial insectivore feeding almost exclusively on orb-weaving spiders. The Greater Broad-nosed Bat, *Scoteanax rueppellii*, is the only member of the genus and is endemic to Australia, occurring in rainforests and wet sclerophyll forests on the central Australian coast with a widely disjunct occurrence in the Wet Tropics.

An outstanding example of disjunct occurrence is provided by the White-footed Dunnart, *Sminthopsis leucopus*, which has been recorded from the Atherton Uplands. It is otherwise found only in south-eastern Australia and Tasmania.

There are several species of mammals occurring here in populations that are isolated from the major occurrence of the species, in two cases by over 2000 kilometres. One of these isolated species the Spotted-tailed Quoll, is one of the largest and most ferocious of the carnivorous marsupials.

## Birds

The avifauna of the rainforests of the the ~~nominated area~~ **Wet Tropics** is regarded as diverse. More than 370 species have been recorded. There are ~~137~~ **more than 130** species that principally inhabit the closed forests, including mangroves, in addition to other less rainforest-dependent species. Twenty-three species are either endemic to the region or have their Australian distributions largely confined to the region. The majority of the thirteen endemic species are confined to the upland rainforests. These include the Tooth-billed ~~Catbird~~ **Bowerbird** (*Scenopoeetes dentirostris*), Golden Bowerbird (*Prionodura newtoniana*), Bridled Honeyeater (*Lichenostomus frenatus*), ~~Australian Fernwren~~ (~~*Craterocephalus*~~ **Oreoscopus gutturalis**), Atherton Scrubwren (*Sericornis kerri*), Mountain Thornbill (*Acanthiza katherina*), **Grey-headed Robin** (*Heteromyias albispecularis*), Northern Logrunner or Chowchilla (*Orthonyx spaldingii*) ~~the Little Freecreeper~~, (~~*Climacteris minor*~~) and Bower's Shrike-thrush (*Colluricincla ~~megarhyncha~~ boweri*).

Another four bird species that are restricted to the the ~~wet tropical rainforests of North east Australia~~ **Wet Tropics** but not confined to higher altitudes are the Lesser Sooty Owl (*Tyto multipunctata*), Macleay's Honeyeater (*Xanthotis macleayana*), Victoria's Riflebird (*Ptiloris victoriae*) and the Pied Monarch (*Arses kaupii*).

**It has been noted that the number of bird species endemic to Wet Tropics belies the richness of the avifauna (Crome and Nix 1991). Many other species have most of their range within the Property and at least another ten birds have subspecies restricted to the Wet Tropics. These include the Australian King Parrot (*Alisterus scapularis minor*), Double-eyed Fig-Parrot (*Cyclopsitta diophthalma macleayana*), Pale-yellow Robin (*Tregellasia capito nana*), Yellow-breasted Boatbill (*Machaerirhynchus flaviventer secundus*), Grey Fantail (*Rhipidura fuliginosa frerei*), Eastern Whipbird (*Psophodes olivaceus lateralis*), Brown Gerygone (*Gerygone mouki mouki*), Spotted Catbird (*Ailuroedus melanotis maculosus*), Satin Bowerbird (*Ptilonorhynchus violaceus minor*) and Boobook Owl (*Ninox novaeseelandiae lurida*).**

Included among the birds of the ~~nominated area~~ **World Heritage Area** is one of the largest birds in the world, the flightless *Casuarus casuarus johnsonii*, (~~Australian Cassowary~~) **the Australian subspecies of the Southern Cassowary**. Standing up to two metres in height, it is one of only three species of cassowary in the world, **all of which occur in New Guinea. The majority of the Australian distribution is in the Wet Tropics with a lesser occurrence in Cape York Peninsula. The cassowary is an important 'keystone' species, being responsible for dispersal of many large-fruited rainforest plants (Crome and Moore 1988). It is considered endangered and recovery plans are under way.**

**The Golden Bowerbird is the only Australian member of a small group of bowerbirds, otherwise restricted to New Guinea, that build 'maypole' bowers. The bower is based around two towers that may be up to three metres high and one metre apart with a display pole perched between them (Frith 1976). The Golden Bowerbird is of special conservation concern due to its natural sparseness in parts of its range. Its bowers have been a target for tourism activities and some of these on the Atherton Tableland have disappeared in recent years, possibly impacting on its breeding success (Werren 1993).**

Many of the birds of the Wet Tropics have close relatives in New Guinea. One such species is the Grey-headed Robin which is often considered to be conspecific with *Heteromyias (Poecilodryas) albispecularis*, the Ashy Robin of the central highlands of New Guinea (Sibley and Monroe 1990).

There are just two members of the logrunner family, Orthonychidae. *Orthonyx spaldingii* is restricted to the Wet Tropics while *O. temminckii* occurs in New Guinea and in central eastern Australia, the two sites being around 2500 kilometres apart. A similar pattern is seen in the case of the Lesser Sooty Owl, one of the Wet Tropics endemics, and the Sooty Owl (*Tyto tenebricosa*) which occurs in New Guinea and southeastern Australia.

One species shared with New Guinea is the Buff-breasted Paradise-Kingfisher (*Tanysiptera sylvia*) which migrates in the wet season to breed in Australia, where it is largely restricted to the Wet Tropics and Cape York Peninsula.

## Frogs and Reptiles

The Wet Tropics of Queensland has the highest frog and reptile species endemism known for any part of Australia (Covacevich and McDonald 1993). At least 43 species are endemic to the region, the majority of which are rainforest-dependent.

There are about 47 53 species of frogs found in the Wet Tropics, giving it the highest diversity in Australia. Twenty-Three species are rainforest-dependent. Twenty-two species, or about 10 per cent of Australia's frogs, are endemic to the Wet Tropics, giving the Property the highest level of endemism of any vertebrate group in the Australian rainforests (McDonald 1991). All but two of the endemic species are rainforest-dependent; the exceptions are the Black Mountain Frog (*Cophixalus saxatilis*) and the Magnificent Brood Frog (*Pseudophryne covacevichae*). *Cophixalus saxatilis* inhabits the granite boulder areas of the Black Trevethan Range while *Pseudophryne covacevichae* has a very restricted distribution and is only found in seepage areas in open eucalypt forest near Ravenshoe. Of the rainforest frogs found in the region, 76 per cent are endemic. Included among these are some very restricted species. One species of tree-frog, *Litoria lorica*, has been recorded only from about 450 m altitude in the Thornton Peak area. One of the Narrow-mouthed Frogs, *Cophixalus neglectus*, occurs only on the Bellenden Ker Range while *C. bombiens* is restricted to the Mt Windsor Tableland; *C. hosmeri* is restricted to the Carbine Tableland and *C. exiguus* to the Mt Finnigan area. Another rare frog *Taudactylus rheophilus* is found only on the Bellenden Ker Range, Lamb Range, Mt Carbine Tableland and Thornton Peak. Adding to the level of endemism, the myobatrachid frog *Mixophyes shevilli* has been shown to represent three species although the work has not yet been formally published.

There are about 460 131 species of reptiles within the nominated Property (Williams et al 1996). Twenty-two species are endemic to the region. They include 20 of the 30 rainforest species, giving a level of endemism of 66 per cent within this group which is "extremely high by Australian standards" (Covacevich 1993). These include several species with primitive characteristics, such as *Carphodactylus laevis* (Chameleon Gecko) and *Phyllurus cornutus* (Northern Leaf-tailed Gecko). About twelve species that are restricted to the wet tropical rainforests also occur within the nominated area.

One of the larger and most striking of the reptiles endemic to the Wet Tropics is the colourful Boyd's Forest Dragon, *Hypsilurus boydii*. Growing to a length of half a metre, it has a row of large tooth-like spines running under the 'throat' with prominent flattened scales along the back, those behind the neck being greatly enlarged. Of the 60 or more species of dragons (agamids) in Australia, *H. boydii* and *H. spinipes* are the only rainforest species, the latter being confined to rainforests around the Queensland-New South Wales border. The Eastern Water Dragon, *Physignathus lesueurii*, occurs along the eastern coast of Australia in a range of moist habitats, but only in the Wet Tropics is it confined to rainforest (Covacevich 1993).

Three species of gecko are endemic to the Wet Tropics. The Chameleon Gecko, *Carphodactylus laevis*, is a presumed old, relict species, and the only member of the genus. The Northern Leaf-tailed Gecko, *Saltuarius cornutus*, is another relict species which was separated from *Phyllurus* and placed in a new Australian endemic genus of four species (Couper et al. 1993). The Black Mountain Gecko, *Nactus galgajuga*, is confined to the massive black boulders and associated vine thickets of the Black Trevethan Range, at the northern end of the World Heritage Area. A second species in the genus, *N. pelagicus*, occurs in the Wet Tropics but extends through Cape York Peninsula to many islands in the western and central Pacific, while a third species is confined to the north coast of New Guinea and the fourth species to the Mascarene Islands in the Indian Ocean.

The skinks are a particularly diverse group within the Wet Tropics area, and include several rare and very restricted species. One species restricted to the region is the skink *Leiopisma jigurru*. This agile, fast moving posturing skink has been found only near the summit of Mt Bartle Frere on rocky isolates surrounded by dense rainforest. The finding of this species in the cool montane habitat on Mt Bartle Frere is the first record of a temperate 'relict' species among the vertebrates of the area (Covacevich 1984). Sixteen species are endemic to the region. Apart from the Black Mountain Rainbow-skink, *Carlia scirtetis*, confined to the granite boulders of the Black Trevethan Range, and *Menetia koslandae*, confined to the Shiptons Flat area, the endemic skinks are rainforest species. They include several species with highly restricted occurrences. The agile, fast-moving, posturing Bartle Frere Skink, *Bartleia jigurru*, is restricted to granite boulder fields and associated dense rainforest on the frequently cloudy summit of Mt Bartle Frere, the highest mountain in Queensland. The only member of this genus, it is regarded as a temperate forest relict (Covacevich 1984, Covacevich and McDonald 1991b).

*Eulamprus frerei* is also confined to the summit of Mt Bartle Frere. The Thornton Peak Skink, *Calyptotis thorntonensis*, is known only from a few localities on Thornton Peak. These three Wet Tropics endemics, together with *Pseudemoia palfreymani* from the island of Pedra Branca south of Tasmania, have been described as “the four most geographically restricted lizards in Australia” (Greer 1992).

Skinks of the slender *Sphenomorphus* type have been placed in the genus *Glaphyromorphus* and, with one exception, they are confined to northern coastal Australia. Seven of the fourteen species occur in the Wet Tropics region and two species, *G. fuscicaudis* and *G. mjobergi*, are endemic to the World Heritage area. This group of skinks which inhabit darkened places such as under stones, bark or leaf litter, are considered relatively primitive (Greer 1989).

Another skink genus of about eight species, all confined to moist habitats on the east coast of Australia, is *Saprosincus* which is represented in the Wet Tropics by two species endemic to the region, *S. czechurai* and *S. tetradactyla* and *S. spectabilis* which extends further north and also has a disjunct population in mid-eastern Queensland.

The Prickly Forest Skink, *Gnypetoscincus queenslandiae*, has been described as probably the most unusual looking skink in Australia (Greer 1989). It is the only member of the genus and is confined to the Wet Tropics. Whereas the scales of most skinks are smooth or keeled, those of *G. queenslandiae* are bluntly pointed and bead-like. They apparently serve to rapidly disperse moisture over the body surface. This skink, which grows to a length of 15 to 18 centimetres, lives only in rotting logs in the dampest parts of the rainforest and is rarely seen. Studies have shown this species to be genetically diverse over its range to the extent that the northern and southern populations should be considered as separate species for the purpose of management [See ‘Justification’ Section, Criterion (ii).].

A rare and very poorly known species of legless lizard, *Delma mitella*, is known only from a few sites on the Atherton Tableland and at Paluma. Growing to a total length of 75 cm, it is the largest of the delmas and among the largest of all legless lizards. Delmas, of which there are about 17 species, are found only in Australia. In fact, the legless lizards (Pygopodidae) represent the only family of reptiles confined to the Australian region, with just two species occurring outside the Australian continent (in New Guinea) (Cogger 1992).

Of the more than 50 species of snakes recorded from the Wet Tropics, only one, the elapid Northern Dwarf Crowned Snake, *Cacophis churchilli*, is endemic to the region. It is common from Thornton Peak to Mt Spec. *Cacophis* is an Australian endemic genus of just four species restricted to moist habitats along the eastern coast. The Rough-scaled Snake, *Tropidechis carinatus*, is the only member of the genus and has a disjunct distribution along the eastern coast of Australia. The occurrence in the Wet Tropics is about 1000 kilometres from the next nearest occurrence on World-Heritage-listed Fraser Island.

### *Fishes*

The Wet Tropics region has a greater diversity of freshwater fishes than any other in Australia (Trennery and Werren 1991). Of around 190 species in Australia, over 70 occur in streams of the Wet Tropics (Pusey 2001). To date, nine endemic species have been identified. The endemic species cover a wide range of taxa including: rainbowfish (*Cairnsichthys rhombosomoides*, *Melanotaenia eachamensis*), catfishes (*Tandanus* sp.), grunters (*Hephaestus tulliensis*), cod (*Guyu wujalwujalensis*), and gobies (*Stiphodon allen*, *Glossogobius* sp. and *Schismatogobius* sp.) Many species are yet to be formally described (Pusey 2001).

### *Invertebrates*

The Wet Tropics has the richest insect fauna in Australia. A transect of five sites along an altitudinal gradient on the Bellenden Ker Range found more than 4000 species (Monteith and Davies 1991). Of particular biogeographic interest is the fauna preserved in the upland rainforests of the Property, where the climate is relatively cool and commonly moist. Many of the taxa occurring in these sites show links with southern hemisphere taxa that suggest Gondwanan origins. There are many primitive, relict species that are isolated from their nearest relatives by at least 1500 kilometres. One species, the large stag beetle,

*Sphaenognathus queenslandicus*, which is found only on Mt Lewis and Mt Windsor Tableland, has its closest relatives in South America.

The highly diverse and numerous moth fauna of the Property includes many rainforest endemic species including the brilliantly coloured *Aenetus monabilis*, one of the largest moths with a wing span up to 18cm, and the very restricted *Douea xanthopygus* and *Polyeuta callimorpha* which are only known from several collections. The most spectacular of Australia's moths, the Hercules Moth (*Coscinocera hercules*), one of the largest moths in the world with a wing span up to 25 cm, occurs in the ~~nominated area~~ **Wet Tropics** and further north to Iron Range.

~~Butterflies are also well represented in the area and include~~ **There are more than 230 species of butterflies recorded from the Wet Tropics, including** many restricted species such as the evening flying Purple Brown Eye (*Chaetocneme porphyropis*) and the Australian Hedge Blue (*Udara tenella*) ~~and the Cairns Birdwing (Ornithoptera priamus euphorion)~~. One of the more spectacular more widespread species found in the region includes the brilliant blue and black Ulysses Butterfly (*Papilio ulysses joesa*). **The Cairns Birdwing, *Troides priamus*, which occurs in the Wet Tropics, the mid-eastern coast of Queensland and on Cape York Peninsula, is the largest butterfly in Australia.**

The insects show clearly a striking phenomenon of the montane biota of the Wet Tropics, namely, the restriction of many species to specific mountain massifs such that each mountain top has its own unique suite of species. Studies on the flightless carabid beetles have been particularly significant in identifying important mountain systems (Monteith 1994, 1996). The Bellenden Ker Range and the Mt Carbine Tableland have been identified as particularly significant (Monteith 1996).

The Wet Tropics is also an outstanding area for wetas or giant king crickets. Twenty-six species occur in the region which is half of the Australian total. Four of the nine genera found in the Wet Tropics, involving eight species, are endemic to the Property. All the known winged species, including the two most primitive in the world, occur in the Wet Tropics (Johns 1994).

The insect fauna probably remains largely undescribed as is the case for tropical rainforests elsewhere in the world. This is well illustrated by a recent revision of a genus of carabid beetles, *Tachys*, which was previously known from only one specimen collected on Thornton Peak. It is expected that there will be a new genus containing 31 new species from the Wet Tropics, with only two species occurring elsewhere (Baehr, in preparation).

The spider fauna of the Wet Tropics is also diverse. The transect of the Bellenden Ker Range referred to above found more than 300 species of spiders (Monteith and Davies 1991). The spiders show a similar distribution to that of the insects and other fauna with numerous species restricted to mountain tops. For example, species restricted to the Bellenden Ker Range include the 'trapdoor' spiders *Namea nebulosa*, *N. olympus* and *Ozicrypta wrightae*, a new species (and new genus) in the family Barychelidae (Raven 1994), and the 'true' spiders *Spinanapis ker*, *S. frere*, *Otira summa*, *O. aquilonaria*, *Manjala pallida*, *Bakala episinoides*, *Jacksonoides distinctus*, *Sondra variabilis*, *Tauala alveolatus*, *T. lepidus*, *Australomimetes andreae*, *Mimetes hannemanni*, *M. catulli* and *Tasmanoonops septentrionalis*.

Seven species of a tiny spider from rainforest litter in the Wet Tropics have recently been described. Their affinities with other taxa are unclear and they may form the basis of a new sub-family or even family (Davies, in press).

Among the 'true' spiders of the Wet Tropics there are some particularly primitive species, including *Tarlia daviesae*, *T. simipes* and *Macrogradungula moonya*. Apart from some taxa in southeast Australia, the nearest relatives are in South America and New Zealand.

~~The fauna of the freshwater streams~~ **invertebrate fauna of the freshwater streams of the Wet Tropics is largely unstudied. However, three species of Euastacus (Blue Crayfish) are restricted to the nominated area not well known. Studies on crayfish show there are at least six species of crayfish restricted to cool, permanent streams above 800 m in the Property. *Euastacus fleckeri* is found only above 1000 m on Mt Carbine Tableland, *E. robertsi* above 1000 m on Mt Finnigan and Thornton Peak, and an undescribed species on the Bellenden Ker Range and reflects parallels similar distributions among plants and other fauna reflecting a long history of isolation on these mountain summits (Winter, 1987) *E. balanensis* on the**

Bellenden Ker Range and Lamb Range, and *E. yigara*, *Cherax parvus* and an undescribed species of *Macrobrachium* all in the upper Tully River on the Cardwell Range (Morgan 1991, Short and Davie 1993). *E. bindal* is recorded only from Mt Elliott which currently lies outside the boundary of the World Heritage Area. The highly restricted distribution of these 'temperate relicts' parallels similar distributions among plants and other fauna reflecting a long history of isolation on these mountain summits (Winter 1987). Of particular interest is the newly described *Cherax parvus*. *Cherax* is widespread in Australia but *C. parvus* is the only species restricted to a cool, wet highland environment, an occurrence that parallels that of a distinctive *Cherax* species group in the highlands of New Guinea. A number of unique features of *C. parvus* suggest a long period of geographic isolation (Short and Davie 1993).

Land snails form an extraordinarily diverse group within the fauna of the Wet Tropics. A recent analysis by the Queensland Museum identified 217 native species, of which 185 (85 per cent) are endemic to the region (Stanisic *et al.* 1994). More than half the species occur in the Atherton Uplands. Predictably, other centres of diversity include Mt Carbine Tableland and Thornton Peak, but also less predictably Malbon Thompson Range and Mt Bakers Blue.

## Justification

### Cultural property

The wet tropics of North east Australia ~~Wet Tropics of Queensland~~ preserves the only recognized extant Aboriginal rainforest culture and is therefore a major component of the cultural record of an Aboriginal society which has a long continuous history in the nominated ~~World Heritage~~ area for at least 40000 years. (note: the Wet Tropics of Queensland was only listed as a natural property)

### Natural property

The ~~nominated area~~ **Wet Tropics of Queensland** fulfils all four criteria described for inclusion of properties on the World Heritage List as a 'natural heritage' **as defined under the World Heritage Convention.**

#### (1) *Outstanding examples representing the major stages of the earth's evolutionary history*

The Australian wet tropics region conserves in its biota elements that relate to 8 major stages in the earth's evolutionary history: (a) The Age of the Pteridophytes, (b) The Age of the Conifers and Cycads, (c) The Age of the Angiosperms, (d) the final break-up of Gondwana, (e) the origins of the Australian sclerophyll flora and marsupial fauna, (6) the origin and radiation of the songbirds, (7) the mixing of the continental biota of the Australian and Asian continental plates and (8) the extreme effects of the Pleistocene glacial periods on tropical rainforest vegetation. It contains the most complete and diverse living record of the major stages in the evolutionary history of land plants (from the very first plants on land to the higher plants, the Gymnosperms and the Angiosperms), as well as one of the most important living records of the history of the marsupials and the world's songbirds. ~~For reference to the geological time scales see Appendix 5.~~

##### (a) **The Age of the Pteridophytes**

One of the most significant evolutionary events on this planet was the adaptation in the Palaeozoic (or Ancient) Era of plants to life on the land (White 1986). The earliest known (plant) forms were from the Silurian Period more than 400 million years ago. These were spore-producing plants which reached their greatest development 100 million years later during the Carboniferous Period. This stage of the earth's evolutionary history, involving the proliferation of clubmosses (lycopods) and ferns, is commonly described as the Age of the Pteridophytes. The range of primitive relict genera representative of the major and **most** ancient evolutionary groups of pteridophytes occurring in the Wet Tropics is equalled only in the more extensive New Guinea rainforests that were once continuous with those of the ~~nominated listed~~ Property (Clifford and Constantine 1980; Jones and Clemesha 1980).

These include all but one of the surviving genera of the ancient Classes of Psilotopsida (*Psilotum*, *Tmesipteris*) and Lycopsidea (Lycopodiaceae, Selaginellaceae and Isoetaceae) that represent the earliest living ancestors of the two main branches of land plants. *Huperzia squarrosom*, the most primitive living lycopod most closely resembles *Baragwanathia longifolia*, the 415-million-year-old Silurian fossil lycopod from the famous Baragwanathia Flora at Yea in Victoria (Sporne 1975; White 1986). **The Wet Tropics is a major centre of endemism and diversity for lycopods and the Selaginellaceae in Australia. Most *Huperzia* species in the Wet Tropics are now endangered or vulnerable to extinction.**

**The majority of today's ferns do not appear in the fossil record before the angiosperms (Kramer 1993). Only seven families of true ferns from the world's existing flora of about 36 families can be traced back to the earliest fossil record in the Early Carboniferous when most land lay in the tropical and subtropical zones within the one continent, Pangea (Scott *et al.* 1985, Galtier and Scott 1985) . The greatest evolutionary diversity for these seven ancient families (Lycopodiaceae, Selaginellaceae, Ophioglossaceae, Marattiaceae, Osmundaceae, Schizaeaceae and Gleicheniaceae) occurs in the Wet Tropics. Eighteen out of the 27 genera from all seven families are represented in the region by 41 species. ~~Also present are~~ These include the most primitive members of ancestral or ancient orders of ferns (Class Pteropsida) such as the Marattiales (*Angiopteris*, Marattia), Ophioglossales (*Botrychium*, *Helminthostachys*, *Ophioglossum*) and Osmundales (*Leptopteris*, *Todea*). **The Osmundales is the sole survivor of the two true fern orders first detectable in the fossil record and is considered to have originated in the Australian portion of Pangea (Dettman and Clifford 1991). This extremely****

ancient order which occupies an isolated position among the ferns (Sporne 1975, Clifford and Constantine 1980) has survived relatively unchanged to the present day. Two of the three genera in the order are restricted to the Southern Hemisphere. *Leptopteris* comprises seven species restricted to western Pacific countries originally part of Gondwanan Australia or its Pacific terranes (Polynesia, New Zealand, New Guinea and eastern Australia). The single Australian species, *L. fraseri* (Filmy King Fern) is restricted to the summit of Mt Bellenden Ker in the Wet Tropics and isolated warm temperate rainforests in New South Wales and Victoria.

The homosporous Ophioglossaceae are considered by some scientists to be living pro-gymnosperms and part of an evolutionary line leading to flowering plants via the gymnosperms (Kato 1988, 1990, 1991). Three of the four surviving genera occur in the Wet Tropics. The Ophioglossaceae appear in the Australian fossil record in the Late Tertiary (Dettman and Clifford 1991).

The Schizaeaceae and Gleicheniaceae are the oldest and most primitive families of the largest group of pteridophytes, the Filicales. All four genera of the Gleicheniaceae and three of the four genera of the Schizaeaceae occur in the Wet Tropics. *Actinostachys* is the most primitive genus in the Schizaeaceae and has a relict distribution in the Wet Tropics of Australia and Madagascar as well as occurring in tropical Asia. It first appears in the Australian fossil record in the Late Cretaceous. The Gleicheniaceae appears earlier in the Australian fossil record in the Middle Triassic (Dettman and Clifford 1991).

The Wet Tropics, in fact, has the highest diversity of ferns in Australia and one of the highest levels of genetic diversity in the world. Thirty-one (86 per cent) of the 36 known families and 111 of the 364 described genera (30 per cent) of pteridophytes occur in the Wet Tropics. The Wet Tropics contains 64 per cent of species and 88 per cent of the genera of ferns occurring in Australia.

The level of diversity and endemism among East Gondwanan fern taxa is exceptional. East Gondwanan fern genera include the monotypic endemic genus *Coveniella*, *Lastreopsis*, *Polystichum* (Aspleniaceae), the monotypic endemic genera *Pteridoblechnum* and *Steenisoblechnum* (Blechnaceae), *Oenotrichia* (Dennstaedtiaceae), *Leptopteris*, *Todea* (Osmundaceae), *Tmesipteris* (Tmesipteridaceae/Psilotaceae), and the Australian endemics *Lycopodiella* and *Huperzia* (Lycopodiaceae). The Wet Tropics is the major centre of endemism for *Huperzia* with 9 of the 12 known species occurring there. Seven of these are either endangered or vulnerable to extinction, with the Wet Tropics being the only known location for *H. lockyeri* and *H. marsupiformis*.

The nominated area Wet Tropics of Queensland is therefore an important centre one of the most significant centres of evolutionary diversity and survival for these relict populations of these the most primitive and relict members of ancestral or ancient orders of spore-producing plants. As such the fern assemblages contribute the earliest chapter to one of the most complete living records of the evolution of land plants.

#### (b) The Age of the Conifers and Cycads

The origin of seed plants over 320 million years ago (Farjon *et al.* 1993) was one of the most significant events in the evolution of terrestrial vegetation, an adaptive breakthrough that allowed colonization of habitats that were inhospitable to spore-producing plants and triggered a Lower Carboniferous diversification of vascular plants. This event also significantly facilitated the evolutionary radiation of other terrestrial organisms (Rothwell and Erwin 1987). The cone-bearing Cycads and Southern Conifers are the most ancient of living seed plants, little changed from ancestors that flourished in the Jurassic Period, termed the 'Age of the Conifers and Cycads' between 136 and 195 million years ago (White 1986; Norstog 1987). The flora of this Period was a cosmopolitan flora of conifers, cycads, ferns, seed-ferns, ginkgos, herbaceous lycopods and horsetails. Jurassic fossils from the Talbragar Fish Beds near Gulgong in New South Wales reveal forests comprising *Agathis* and *Podocarpus* conifers with an understorey of the Cycadophyte, *Pentoxylon australica*. The closest modern counterpart of these forests occurs in the nominated World Heritage area with a rare assemblage of *Agathis robusta*, *Podocarpus grayi* and *Lepidozamia hopei*.

The nominated World Heritage area is a major centre of survival for the cycads. Ten genera and 101-121 species in three families of cycads are all that remain of a group that has been in existence relatively unchanged for at least 200 million years with the majority of species now considered as rare and threatened (Sporne 1965, Norstog 1987, Jones 1993). Two of these families (Cycadaceae, Zamaceae) and

three genera (*Cycas*, *Lepidozamia*, *Bowenia*) occur in the nominated area representing one of the highest concentrations of cycad groups

Cycads as a group are thought to have originated in the East Gondwanan sector of Pangaea prior to its breakup. The cycads contain more primitive features than any other living group of gymnosperms. Cycads are the only gymnosperm known to fix nitrogen from the atmosphere which is achieved through a symbiotic relationship with blue-green algae in specialized root structure called coralloid roots (Jones 1993). The production of motile sperm cells is unique to cycads and one other gymnosperm, *Ginkgo biloba*. The discovery of this feature in 1896 was hailed as one of the most exciting botanical discoveries of all time, since it provided the missing link between gymnosperms and the ferns and fern allies (Jones 1993). The pollination syndrome of cycads involving primitive groups of insect vectors is believed to represent the most primitive pollination system known and the earliest examples of insect-plant symbiosis. The insect vectors involve ancestral beetle families such as Curculionidae (weevils) and Tenebrionidae (tenebrionid beetles), Languriidae, Anthribidae (mortar and carpenter bees), Boganiidae and Nitidulidae (Jones 1993). *Cycas media* is pollinated by native bees from the genus *Trigona*. This genus is the oldest known bee with fossil records from the Cretaceous Period preceding the origin of flowering plants.

Two of the three cycad families (Cycadaceae, Zamiaceae) and three genera (*Cycas*, *Lepidozamia*, *Bowenia*) occur in the World Heritage area representing the highest diversity of cycad genera in Australia and the greatest diversity of major cycad groups anywhere in the world.

The genus *Cycas* is the most primitive of all the known cycads (Chase *et al.* 1993) with earliest fossils dated from the Lower Permian. It separated very early from other cycad genera as a distinct and isolated line of evolution. Australia has the highest diversity of *Cycas* species in the world with about 20 of the world's total of 30 species occurring there (Hill 1992). The most species rich area is along the east coast of Queensland north from Rockhampton. About 10 species occur in China and with single species in Malesia, Japan and south-east Asia, and in Polynesia, Madagascar and East Africa (Hill 1992). Most *Cycas* species are geographically isolated. All but two of the 9 *Cycas* species occurring in Queensland are rare (2) or vulnerable to extinction (5). One species occur within the Wet Tropics World Heritage area (*C. media*). Warm humid environments are thought to be the ancestral habitat of *Cycas*. Seasonally dry habitats are regarded as more recent.

The palm-like *Lepidozamia hopei*, restricted to the nominated World Heritage area, is the tallest of all living cycads growing to heights of 20 metres (Johnston 1959; Clifford and Constantine 1980). A rare assemblage of *Lepidozamia hopei*, podocarp (*Podocarpus grayi*) and the araucarian, *Agathis robusta* in the World Heritage area represents the closest living counterpart of Jurassic forests fossilised remains of which are found in the Talbragar Fish Beds of New South Wales (White 1986). The Southern Cassowary, believed to have evolved in the Early Tertiary, is known to be significant for long distance dispersal of *Lepidozamia hopei*.

The fauna associated with these modern-day Jurassic forest analogues are equally ancient mostly dating from the same era. Larvae of the very 'primitive' south-west Pacific moth family Agathiphagidae (kauri moths), the only surviving family within the entire suborder Aglossata, feed only on the seeds of *Agathis* (Robinson and Tuck 1976). Only two species survive — *A. queenslandicus* restricted to eastern Queensland, and *A. vitiensis* in the south-west Pacific. An endemic Australian subfamily of cynipoid wasps (Austrocynipinae) is associated with the seeds of *Araucaria*. A group of 'primitive' southern hemisphere weevils (Nemonychidae: Rhinorhynchinae) feed on the pollen of Araucariaceae and Podocarpaceae (Kuschel 1983, 1994). This family, the most primitive of the weevils, is now relict after having been the dominant group amongst all phytophagous beetles in the Upper Jurassic some 200 million years ago. The rainforests of the Wet Tropics and those of south-east Queensland contain the greatest known evolutionary diversity within this group. Members of the Tribe Rhinorhynchini within the subfamily Rhinorhynchinae resemble almost unchanged their fossil counterparts of the Upper Jurassic (Kuschel 1994).

Beetles of the subfamily Paracucujinae (family Boganiidae) are restricted to the Cycadaceae, feeding on pollen as both larvae and adults.

One of the smallest cycads in the world, also occurs in the nominated area restricted to rainforest and wet sclerophyll forests in the World Heritage area and McIlwraith Range on Cape York, is the fern-

like *Bowenia spectabilis*. Fossil species of both *Bowenia* and *Lepidozamia* have only been recorded from Eocene deposits at Anglesea, Victoria (*B. oecenica* resembling *B. spectabilis*), Bacchus Marsh, Victoria (*L. hopeites* resembling *L. hopei*) and at Nerriga in New South Wales (*B. papillosa*, *L. foveolata*). *Bowenia* is the only known cycad with pinnate leaves which, from the fossil record, appear not to have changed over 45 million years (Jones 1993). The genus is endemic to Australia. Two species occur in the Wet Tropics. *Bowenia* sp. 'Tinaroo', restricted to the Tinaroo Range of the Atherton Tableland above 700 m, has newly been recognised as distinct from *B. serrulata* which is endemic to the Byfield area in central-eastern Queensland. *Lepidozamia* is considered the more primitive of the two genera (Chase *et al.* 1993).

Forests containing the gymnosperm (~~conifer~~) group, the araucarians, are of immense interest to science for they are among the most ancient and primitive of the world's surviving conifers. **The Australian sector of Gondwana is considered to have been the site of origin of these austral conifers. Both the Araucariaceae and Podocarpaceae dominate the Australian pre-Tertiary fossil record with a great diversity of species in the Jurassic and Cretaceous (Dettman 1994). They are regarded as the ancestral core of present-day perhumid rainforests which arose through progressive addition of angiosperms throughout the Cretaceous and Early Tertiary (Dettmann 1994).**

Only two araucarian genera survive today. ~~With the~~ **The greatest diversity of surviving evolutionary lineages of *Araucaria* and *Agathis* occurring in the nominated listed area. Two species of *Agathis* endemic to the World Heritage area are rare. This area is also an overlap area for species the most significant centre of survival for the major genetic lineages of *Prumnopitys* and *Podocarpus*, the most dominant and closely related relict genera of the Podocarpaceae. At least 50 per cent of species in these two genera world wide are now rare or at serious risk of extinction. The three endemic species of *Prumnopitys* and *Podocarpus* in the Wet Tropics area are considered rare with very small ranges and at therefore at risk (Farjon and Page 1993).**

#### (c) The Age of the Angiosperms

The emergence of the angiosperms some 200 million years after the first appearance of the gymnosperms marked the beginning of one of the most fundamental changes in biological diversity on this planet. **By late Cretaceous gymnosperms had largely been replaced by angiosperms, although the beginnings of the modern flora did not emerge until the Tertiary. The current estimates of 235 000 species of flowering plants represents 88.7 per cent of all plant species on earth (Raven 1987). The majority of flowering plants are dicotyledons (class Magnoliopsida), with 180000 species in six subclasses — the Magnoliidae, Hamamelidae, Caryophyllidae, Dilleniidae, Rosidae and Asteridae (Cronquist 1988). According to the classification of Cronquist dicotyledons are organised into 321 families in 64 orders and the 55 000 species of monocotyledons (class Liliopsida) are arranged within five subclasses containing about 66 families in 19 orders (Cronquist 1988) although the actual organisation of many families between the subclasses is still in a state of flux (Liden 1992).**

**The origin of these flowering plants is one of the major unsolved questions of botany. East gondwanan countries are known to contain the greatest concentration of archaic and relict taxa relating to the origins of flowering plants (Takhtajan 1987). The distribution of relict taxa in the individual continents reflects the timing of origin and spread of the different plant groups in relation to the rifting and drifting of continents once part of Gondwana.**

**The radiation of floras, as recorded in the fossil record, has occurred in discrete waves. The Australian wet tropics region contains outstanding examples representing 5 major elements in the history of the angiosperms.**

Australia was once part of the southern supercontinent Gondwana. Other parts of that landmass were made up of the continents now known as Africa and South America (West Gondwana) and Antarctica, the subcontinent of India and the now island fragments including New Zealand, New Caledonia, New Guinea and Madagascar. Australia, New Zealand and New Guinea were part of East Gondwana.

A West Gondwanan origin has been proposed for the angiosperms (Raven and Axelrod 1974). Evidence suggests that diversification occurred quite rapidly and that a significant number of taxa had arisen before the break-up of Gondwana began about 120 million years ago. By this stage, angiosperms had appeared in the northern hemisphere and in South America and Southeast Gondwana (Antarctica and Australasia) and were apparently spreading in two essentially separate, diversifying streams (Schuster

1972, 1976). A significant part of the southern stream became essentially isolated in Australia when, about 50 million years ago, it finally broke away from Antarctica and rafted towards the tropics.

**However, distributed throughout the Indo-Pacific regions are numerous fragments, or terranes, derived from the northern margin of the Australian section of Gondwana (Audley-Charles 1987, 1988, 1990, 1991; Hutchison 1989; Burrett *et al.* 1991; Harbury *et al.* 1990; Metcalf 1990; Veevers 1991a, 1991b). These fragments now form parts of South-east Asia, Indonesia and some Pacific islands. Audley-Charles (1987) has suggested that those terranes that rifted during the Cretaceous when angiosperms first evolved, acted as 'Noah's Arks', carrying with them an evolving Gondwanan angiosperm flora.**

(i) *The richest assemblage of families of primitive flowering plants*

The first recognizable angiosperm pollen was *Clavatipollenites hughesii* described from the **late Barremian and Aptian** (Early Cretaceous) of southern England (Couper 1958) and has been found in southern Australia from the same time period at Koonwarra (Dettman 1986). It closely resembles that of the living New Caledonian genus *Ascarina* of the Chloranthaceae (Walker and Walker 1984) and *Austrobaileya* of the Austrobaileyaceae, a monotypic (having only one **representative species**) family found only in the ~~nominated area~~ **Wet Tropics** (Endress and Honegger 1980). The most **primitive and ancient** orders of living flowering plants are the Magnoliales and Laurales. Of the 19 angiosperm families described as the most **ancient primitive** (Walker 1976), 12 occur in the wet tropics, giving it the highest concentration of such families on earth. These families are: Annonaceae, Austrobaileyaceae, Eupomatiaceae, Himantandraceae, Myristicaceae and Winteraceae of the order Magnoliales; Atherospermataceae, Gyrocarpaceae, Hernandiaceae, Idiospermaceae, Lauraceae and Monimiaceae of the order Laurales.

(ii) *Species belonging to small, relict primitive angiosperm families*

The Australian ~~wet tropical region~~ **Wet Tropics** has ~~a high~~ **the highest** concentration of small, relict and virtually extinct, **ancient primitive** angiosperm families **in the world** (Endress 1983). These are Austrobaileyaceae, Eupomatiaceae, Idiospermaceae and Himantandraceae. Two of these, the monospecific Austrobaileyaceae and Idiospermaceae, are restricted to the region. The ditypic (having only two **representative species**) Eupomatiaceae and Himantandraceae extend outside of Australia, only to New Guinea and East Malesia (the Moluccas) respectively. They are probably the last few remnants of an ancient assemblage that have survived the attrition of rainforest during dry cycles of the last ice ages in the Pleistocene. ***Eupomatia* fossils derive from the Cretaceous and have been discovered in America indicating a much larger former range.**

(iii) *Orders occupying nodal positions in the evolution of the angiosperms*

Higher dicotyledonous angiosperms form five major groups accounting for 70 per cent of all living flowering plants (Cronquist 1981). The initial major radiation of these groups occurred in the Cretaceous with ancient members of the sub-classes Hamamelidales and Rosales being especially important (Crane *et al.* 1986). The orders Hamamelidales, Rosales, Euphorbiales, Dilleniales, Violales, Theales, Celastrales and Gentianales, are considered to occupy major nodal positions in the evolution of the angiosperms (Takhtajan 1980; Cronquist 1981). Within these orders, key families with a relict distribution are of considerable importance. Those represented in the Wet Tropics are: Hamamelidales - Hamamelidaceae; Rosales - Alseuosmiaceae, Cunoniaceae, Davidsoniaceae, Escalloniaceae, Eucryphiaceae, Pittosporaceae; Celastrales - Aquifoliaceae, Icacinaceae, Celastraceae; Euphorbiales - Euphorbiaceae; Dilleniales - Dilleniaceae; Violales - Flacourtiaceae; Theales - Ochnaceae; Gentianales - Apocynaceae.

(iv) *Gondwanan Angiosperm families of Cretaceous origin*

One of the most sudden and significant transformations of terrestrial plant life occurred in the Mid-Cretaceous leading to a vast and rapid spread of flowering plants throughout the world. Catastrophic events around the Cretaceous–Tertiary boundary led to major extinctions of angiosperm taxa. **An estimated 75 per cent of all living species were lost, particularly in the northern hemisphere (Crowley and North 1991, Collinson 1990, Wolfe 1990).** However, East Gondwana **in the southern hemisphere** was relatively unaffected (Muller 1984, Collinson 1990), and consequently the highest concentrations of Cretaceous angiosperm families survived in that region, many of which were still

present on the Australian landmass when it finally broke away from Antarctica. Today, the highest concentration of relict taxa from Cretaceous angiosperm families survive in the Australian Wet Tropics. **Cretaceous families include the Cunoniaceae, Proteaceae, Winteraceae, Myrtaceae, Monimiaceae (Raven and Axelrod 1974, Carpenter and Buchanan 1993), Rutaceae, Platanaceae, Sapindaceae, Aquifoliaceae, Callitrichaceae, Chloranthaceae, Gunneraceae, Trimeniaceae, Epacridaceae, Olacaceae and Loranthaceae (Dettman 1994).**

**Pollen similar to that of *Syzygium* and *Eugenia* (Myrtaceae) occurs in Campanian and Maastrichtian sediments on the Antarctic Peninsula (Dettman 1989) and the Paleocene of Australia (Dettman 1994). *Eugenia* is now represented in Australia by a single species endemic to the Wet Tropics. It is the largest genus in the Myrtaceae (~1000 species), concentrated today in tropical America, and the only genus shared between the Old World and New World. *Syzygium*, the second largest genus (~500 species), on the other hand occurs exclusively in the Old World with 55 species still remaining in Australia. The Wet Tropics is the most significant is the most significant centre of survival in Australia with 31 species, 16 being endemic to the Property . Australia is also the outstanding centre of diversity and endemism for the entire family (73 of the world's 140 genera and 1361 out of the world's total of 3350 species. Africa is depauperate with 5 genera and 12 species and the New World 48 genera 1889 species. The Myrtaceae family are now represented in the Wet Tropics by 41 genera and 124 species. Four mono- or ditypic genera are endemic to the wet tropics — *Barongia* (1sp.), *Sphaerantia* (2 spp.) and two undescribed monotypic genera. All are rare or vulnerable to extinction.**

(v) *East Gondwanan Families or Genera*

East Gondwana which included Australia, New Guinea, New Zealand and New Caledonia was a key area for the early radiations of flowering plants. Significant numbers of taxa believed to have originated in East Gondwana still survive in rainforests within these areas. The Australian wet tropics has a special position as the area with the longest continuous history as part of the parent landmass.

Angiosperm taxa recorded from the Wet Tropics and believed to have originated in East Gondwana includes 153 genera in 43 families .

**(d) The Final Break-up of Gondwana**

The final stage in the break-up of Gondwana had a profound effect on global climates and consequently on the evolution of all subsequent life forms (Kemp 1978). When Australia was still attached to Antarctica, warm equatorial currents reaching polewards ensured a generally more equably wet and warm climate. The detachment and northward drift of the Australian continent allowed the development of circumpolar currents. Temperature gradients between the equator and the poles increased dramatically and the Antarctic ice cap began to form. Forest types once mixed or closely juxtaposed now mostly became geographically separated and extensive regional extinctions of species occurred.. However, the effects of global cooling and accompanying aridity were maximally compensated for in the Australian wet tropics region by the northward drift of Australia towards the tropics. As a consequence of this **and a wide range of available altitudinal gradients**, the ~~nominated-area~~ **Wet Tropics of Queensland** is the only large part of the entire Australasian region where rainforests have persisted continuously since Gondwanan times (Barlow 1986), preserving in the living flora the closest modern-day counterpart of the Gondwanan forests (Christophel, Collinson 1992).

Several groups regarded as likely relicts, ~~or closely related to relicts,~~ **or early descendents** of the Gondwanan fauna at the time of the final break-up are represented in the ~~nominated-area~~ **Wet Tropics**. [Note that the flora that fall into this category have been included in parts (c) or (d).]

Of Australia's ~~three~~ **four** families of frogs, the Myobatrachidae and Hylidae are believed to have had Gondwanan origins (Duellman and Trueb 1986; ~~White 1984~~ **Tyler 1989, Roberts and Watson 1993**). Close relatives are found in South America. **Fossils from both families are found in Oligo-Miocene deposits at Riversleigh in northwestern Queensland.**

**Contrary to earlier beliefs, molecular studies suggest that the major generic-level splits in the Australian frog fauna are very old (Roberts and Maxson 1985, 1989). Among the oldest lineages are**

*Mixophyes* and *Taudactylus* (Heyer and Liem 1976). Primitive species within these families are found in the nominated area in the genera *Mixophyes*, *Taudactylus*, *Litoria* and *Nyctimystes*.

Of the five six species in the genus *Taudactylus*, one of the most primitive groups of frogs in Australia, two are restricted to the Wet Tropics. *T. rheophilus* had been recorded only from the Mt Bellenden Ker, Mt Lewis Bellenden Ker Range, Lamb Range, Carbine Tableland and Thornton Peak, all recognised refugial areas but has suffered massive declines over its entire former range. Prior to 1988, *T. acutirostris* occurred in upland streams throughout the World Heritage Area. However, it has since suffered a dramatic decline in numbers and its status is considered critical (Ingram and McDonald 1993)[See below, Criterion (iv)]. The catastrophic amphibian declines which have occurred in the Wet Tropics has recently been attributed to an amphibian fungal disease caused by *Batrachochytrium dendrobatidis*. *Mixophyes* is represented in the Wet Tropics by *M. schevilli*, the Northern Barred Frog. Molecular studies have shown *M. shevilli* to represent three species, each well differentiated (M. Mahony, pers. comm.; Donnellan *et al.* 1993). The ranges for the three species overlap with all three species occurring in the Mt Windsor Tableland–Cape Tribulation area.

Among the Australian reptile fauna, the geckoes of the subfamily Diplodactylinae and the endemic family of legless lizards (Pygopodidae) are generally accepted as having Gondwanan origins. Within the Wet Tropics, the diplodactyline geckoes are represented by *Carphodactylus*, *Diplodactylus*, *Nephrurus*, *Oedura*, *Phyllurus* and *Saltuarius*. The apparent antiquity of the rainforest geckoes *Phyllurus* and *Carphodactylus* has been used as evidence for Gondwanan origin (Kikkawa *et al.* 1981). *Carphodactylus laevis*, the Chameleon Gecko, is the only member of the genus and is restricted to the Wet Tropics. *Saltuarius*, a newly described genus of just four species, is represented in the Wet Tropics by the Northern Leaf-tailed Gecko, *S. cornutus*, which is endemic to the region (Couper *et al.* 1993).

It has long been held that other groups within the Australian reptile fauna, including skinks and agamid lizards (dragons), have had a northern origin and entered Australia from Asia in relatively recent times. This view appears likely to change as further fossil evidence is uncovered and combined with evidence from molecular studies.

Fossils from the Riversleigh deposits show that dragons were present in Australia at least 15–20 million years ago (Covacevich *et al.* 1990). Australian dragons form two groups, one adapted to more mesic environments on the eastern coast and including *Hypsilurus* and *Physignathus*, and the other adapted to drier conditions including arid inland environments. Molecular studies suggest that the split between these two groups probably occurred between 15 and 20 million years ago with Australian *Hypsilurus* and *Physignathus* diverging at about the same time (Baverstock and Donnellan 1990). The fossil evidence shows that extant *P. lesueurii* has changed little from forms living in the rainforests of the Riversleigh area about 20 million years ago (Covacevich *et al.* 1990). *P. lesueurii*, the Eastern Water Dragon, occurs along the eastern Australian coast and is recorded from many locations in the Wet Tropics.

*Hypsilurus*, of which Australian species were formerly considered to belong to the predominantly Asian genus, *Gonocephalus*, and *Physignathus* are among the Australian dragons considered to have had an Asian origin. However, immunological studies of plasma albumin suggest that Australasian *Hypsilurus* are more closely related to other Australian dragons than to Asian *Gonocephalus* (Baverstock and Donnellan 1990). When considered together with the evidence from Riversleigh fossils, these data provide support for an Australian origin for *Hypsilurus* and *Physignathus* from a Gondwanan ancestor. There are just two species of *Hypsilurus* in Australia: Boyd's Forest Dragon, *H. boydii*, is confined to the Wet Tropics and the Southern Angle-headed Dragon, *H. spinipes*, is endemic to the rainforests of the central Australian coastal region. Other species occur in New Guinea, Moluccas and Solomon Islands.

Australian skinks fall into three groups, the *Sphenomorphus* group, *Egernia* group and *Eugongylus* group. All three groups are represented in the Oligo-Miocene fossil fauna of Riversleigh, and some taxa are practically indistinguishable from living forms (Hutchinson 1992). The Riversleigh fossils indicate that the Australian skink fauna has arisen from evolution within Australia rather from a series of invasions as has been previously proposed. The fossil evidence, together with that from serum albumin studies (Baverstock and Donnellan 1990), suggest that the three major groups of skinks arose in the early Tertiary, around 60 million years ago. The *Egernia* and *Eugongylus*

groups, which are almost entirely confined to the Australian region, may have arisen in Australian Gondwana (Hutchinson and Donnellan 1993). Hutchinson (1992) has compared the Riversleigh skink fauna with those of the rainforests of northeastern and southeastern Queensland. All three faunas are dominated by the *Sphenomorphus* group with the *Egernia* group present as a minor component. Of interest is the presence of the slender *Sphenomorphus* type at Riversleigh. Living members of this type have been placed in the genus *Glaphyromorphus* and, with one exception, they are confined to northern coastal Australia. Seven of the fourteen species occur in the Wet Tropics region and two species, *G. fuscicaudis* and *G. mjobergi*, are endemic to the World Heritage area. The similarity of the Riversleigh fossil of this type with *G. mjobergi* has been noted (Hutchinson 1992).

Of the birds occurring in the rainforests of the ~~nominated-area~~ **Wet Tropics**, those with accepted Gondwanan origins include the Southern Cassowary (one of the world's few surviving flightless birds, the ratites) and the megapodes (mound-builders). Fossil records show that cassowaries were once much more widespread across Australia, but they are now restricted to north-east Australia and New Guinea. Of the three megapodes in Australia, two are found in the rainforests of the ~~nominated-area~~ **Wet Tropics** - the Orange-footed Scrubfowl (*Megapodius reinwardt*) and the Australian Brush-turkey (*Alectura lathamii*).

**Songbirds of the Wet Tropics belonging to groups of likely Gondwanan origin are considered under (f) below.**

Many primitive insects have been conserved **in the Wet Tropics** as relicts of the Gondwanan fauna, mainly in the upland areas. The moss bug, *Hackeriella taylori*, belongs to a small family found only in eastern Australia, New Zealand, New Caledonia and South America. The wingless water bug, *Austrovelia queenslandica*, is known only from Mt Sorrow–Mt Pieter Botte. The only other species in the genus is in New Caledonia (Malipatil and Monteith 1983). The relict wingless genus of bark bugs, *Kumaressa*, which belongs to the small primitive subfamily Chinamyersiinae, is confined to Australia. *K. storeyi* occurs on Mt Bellenden Ker, Mt Bartle Frere and Mt Carbine Tableland. Two other species occur in the rainforests of central eastern Australia. The nearest relatives are in New Zealand. An ancient origin for the large stag beetle, *Sphaenognathus queenslandicus*, found only on Mt Lewis and Mt Windsor Tableland, is indicated by the occurrence of its closest relatives in South America. The flightless leaf-hopper genus, *Myerslopella*, known only from a few mountain tops in the ~~nominated-area~~ **Wet Tropics**, belongs to a tribe otherwise known only from Madagascar, New Zealand and Juan Fernandez (Evans 1977). **The small cockroach genus, *Tryonicus*, is represented in the Wet Tropics by the endemic species, *T. mackerrasae* and *T. montheithi*. *T. parvus* is found in the central eastern rainforests of Australia and the only other members of the genus are in New Caledonia.**

**The present-day distribution of most of these insects suggest their origins pre-date the separation of Australia and New Caledonia and New Zealand about 80 million years ago.**

Even more ancient origins are indicated for a water beetle, *Terradessus caecus*, found only on Mt Sorrow and Thornton Peak and adapted for a terrestrial life (Watts 1982). The only other recorded occurrences of similarly adapted water beetles are in the highland forests of the Southern Himalayas and in the montane moss forests of New Caledonia (Brancucci 1985).

The presence of these ancient, relict insect taxa demonstrates the great antiquity of uninterrupted rainforest habitat in the ~~nominated-area~~ **Wet Tropics** (Kikkawa *et al.* 1981).

**The spider fauna of the Wet Tropics also includes many relict Gondwanan taxa. Australian spiders belong to two infra-orders, the Mygalomorphae ('trapdoor' spiders) and Araneomorphae ('true' spiders). Apart from one group now restricted to southeast Asia, the mygalomorphs are considered to be the most ancient and primitive group of spiders (Platnick and Sedgwick 1984). Of the 55 or so genera of 'trapdoor' spiders in Australia, more than 35 inhabit rainforest. Seventeen are recorded from the Wet Tropics. They include *Sason*, *Trittame*, *Cethegus*, *Masteria*, *Namireia*, *Cataxia*, *Homogona*, *Aname*, *Ixamatus*, *Namea*, *Xamiatus*, *Idiactis*, *Idiommata*, *Zophorame* and the newly described genera (Raven 1994), *Mandjelia*, *Moruga* and *Ozicrypta*.**

**Among the most primitive of the 'true' spiders (Araneomorphae) are members of the family Gradungulidae which is known only from New Zealand and Australia (Forster *et al.* 1987). The**

nearest relatives occur in South America. Of the twelve species in the family, three are restricted to the Wet Tropics. *Tarlina daviesae* is known only from Mt Finnigan at more than 1000 metres. *T. simipes* has been found at a few elevated sites between Cairns and Ravenshoe. A remarkably primitive spider has recently been discovered on the summit of the Walter Hill Range, near Tully, where it lives in cave-like spaces between granite boulders. Its relatives seem to be cave spiders from New Zealand, Tasmania and mid New South Wales (Forster & Platnick, in prep.). The monotypic *Macrogradungula* is known only from Boulder Creek on the Walter Hill Range (*M. moonya*).

Another relict genus of 'true' spiders of likely Gondwanan origin is *Otira*. Six species occur in New Zealand, one in Tasmania and two (*O. summa* and *O. aquilonaria*) are recorded only from Bellenden Ker Range above 1000 m altitude (Davies 1986).

The Wet Tropics land snail fauna contains remarkably high numbers of the Gondwanan family Charopidae which occurs in southeastern Australia, New Zealand and some subantarctic islands (Stanisic 1990). There are 86 species in the Wet Tropics (77 are undescribed), mainly in the cool uplands and especially on the mountain tops (Stanisic 1994). The refugial role of upland sites in the Property is indicated by a number of major disjunctions among relict taxa. The genus *Lenwebbia* contains just two species, one from the Bulburin area in southeastern Queensland and the recently described *L. paluma* known only from the type locality in Mt Spec National Park in the Wet Tropics. Of the three species in the genus *Hedleyoconcha*, *H. ailaketoae* is recorded from Mt Bellenden Ker, while *H. delta* occurs at a number of sites from the central New South Wales coast to the Bunya Mountains and *H. addita* is found only on Lord Howe Island (Stanisic 1990).

(e) **Biological evolution and radiation during 35 million years of isolated rafting of the Australian continental plate**

Australia was an isolated landmass during several million critical years when the extant flora was being shaped (Hill 1993, Truswell 1993). Climate change was a major influencing factor. After separation of the Australian landmass from Antarctica and during its isolated drift towards the equator, there was a general increase in aridity. At this time, major evolutionary radiations took place within the flora, particularly in the plant families Proteaceae, and Myrtaceae, **Casuarinaceae, Epacridaceae and Rutaceae**, and within the marsupials. The wet tropics region contains the highest concentration of the surviving remnants of the ancestral stock from which evolved the sclerophyll flora and marsupial fauna that now dominate the Australian landscape. The rainforests of the region also contain a number of bird species that may represent the ancestral forms from which certain dry-adapted taxa have evolved (the Tumbunan avifauna)(Schodde 1982). [The passerine avifauna is considered in Section (f).]

Whilst sclerophylly *per se* originated from rainforest stock during the early Tertiary as an adaptation to infertile soils (Barlow 1981) evolution of features related to aridity and fire did not appear in the fossil record until the Middle to Late Miocene (Martin 1994)

Primitive genera of the Proteaceae, the remnants of ancient Gondwanan origins, are found in the Wet Tropics. In this family that now comprises a very important component of Australia's sclerophyll flora, ~~42~~ seven (~~16 per cent~~) of the genera are restricted to the wet tropics. At least three of these, *Placospermum*, *Sphalmium* and *Carnarvonia* are considered primitive. *Placospermum coriaceum* has the greatest array of primitive features of any living Proteaceous genus.

The important Casuarinaceae family which has its centre of diversity in Australia occupies habitats ranging from beaches to arid regions, with one genus occurring in rainforest. Fossil evidence indicates that the ancestral form was the East Gondwanan rainforest genus *Gymnostoma*, which was widespread in Australia during the early Tertiary (Hill 1987). *Gymnostoma* now has a relict distribution in Australia with just one species that is restricted to the Roaring Meg–Alexandra Creek valleys in the ~~nominated area~~ **Wet Tropics. The earliest evidence of sclerophyll communities involving Casuarinaceae date from the Early–Middle Miocene (Macphail et al. 1994).**

**Most of the primitive members of the large Rutaceae family (150 genera, 1800 species) occur in rainforests (Stace et al. 1993). The family is considered to have originated in Gondwana (Armstrong 1983) before the Tertiary (Smith-White 1954, 1959).** The Tribe Zanthoxyleae of the Rutaceae family is considered to have given rise to the Tribe Boronieae, a long isolated group of 20 genera occurring in Australia and New Caledonia (Waterman and Grundon 1983). There are 245 Australian species in the

Boroniaceae which now so characterise this continent's sclerophyllous heathlands (Morley and Toelken 1983). **The Five species of the small genus *Euodia* together with the endemic genus *Medicosma* (5 species) occurring in the Wet Tropics from within the Zanthoxyleae Tribe with the have closest affinities to the ancestors of *Boronia* and occurring in the nominated area are five from the small genus *Euodia*, the largest and most widespread genus in the tribe Boroniaceae all 15 members of which have radiated out into open forest and heathland communities around Australia (Waterman and Grundon 1983, Stace *et al.* 1993).**

The most primitive of the Australian marsupials are the dasyuroids, a basically carnivorous group that, **probably**, are preceded in the evolutionary history of the marsupials only by the didelphoids of South America. **Immunological studies of albumins suggest that this group diverged from the diprotodont marsupials about 40 million years ago (Baverstock *et al.* 1990).** Nine species of dasyuroids are found in the ~~nominated area~~ **Wet Tropics** including one restricted species, the Atherton Antechinus (*Antechinus godmani*), which is considered a relict species (Van Dyck 1982).

~~It has been proposed~~ **More than two decades ago, it was proposed that the earliest marsupials evolved in 'rainforests' on the basis that extant rainforest-dependent species are among the most primitive of their respective groups (Schodde and Calaby 1972). This is now generally accepted and the Oligo-Miocene rainforests have been described as the "Green Cradle" for Australia's dry-adapted marsupials (Archer *et al.* 1989). The Riversleigh deposits are rich in marsupial fossils including taxa closely related to those living in the rainforests of the Wet Tropics. Indeed, the rainforests of the Wet Tropics represent the best surviving equivalent of the Oligo-Miocene rainforests of Riversleigh. They share several mammalian genera with the Oligo-Miocene Upper Site of Riversleigh, including *Hypsiprymnodon*, *Cercatetus*, *Pseudocheirus* and *Trichosurus* (Archer *et al.* 1989). An example is the Green Ringtail Possum, *Pseudocheirus archeri*, which is regarded as the most primitive member of the genus and which is restricted to the nominated area. Another primitive possum restricted to the wet tropics is the Lemuroid Ringtail, *Hemibelideus lemuroides*. Also, one of the recent discoveries from the fossil beds of Riversleigh, in north western Queensland, has been an ancestor for the Marsupial Moles (in the family Notoryctidae) from deposits accumulated in lowland rainforest environment. Today the Marsupial Moles are restricted to the inland sandy deserts.**

The Musky Rat-kangaroo, *Hypsiprymnodon moschatus*, which is restricted to the ~~nominated area~~ **World Heritage Area**, is probably the most primitive of the kangaroos and the only living member of the group that has retained the mobile first toe on the hind foot, a characteristic of possums. It is unique in representing an early stage of evolution of macropods from an arboreal possum-like stock (Johnson and Strahan 1982).

**The Wet Tropics area is particularly significant for the ringtail possums. Of the six species in Australia, five occur in the Wet Tropics World Heritage Area and the four rainforest-dependent species are all found only there. The Lemuroid Ringtail, *Hemibelideus lemuroides*, the only member of the genus, forms a single lineage with the Greater Glider, *Petauroides volans*, sharing a common ancestor with the remainder of the ringtails, *Pseudocheirus* and *Pseudocheirops* species (Baverstock *et al.* 1990).**

Birds confined to upland forests of eastern Australia and New Guinea (the Tumbunan fauna) are considered to include forms ancestral to dry-adapted species. Such ancestral forms occurring in the ~~nominated area~~ **Wet Tropics** include the Southern Cassowary, Australian Brush-turkey, Emerald Dove and Australian King-Parrot (Schodde 1982).

#### **(f) The origin and radiation of the songbirds**

In the light of a generally poor fossil record, the Australian bird fauna has been considered to be derived from relatively recent invasions. However, recent work using modern techniques for studying phylogeny have suggested that the majority of Australia's songbirds (passerines) have evolved locally (Sibley & Ahlquist 1982a, d, 1985; Sibley *et al.* 1984; Schodde & Christidis 1987). The most recent studies indicate that Eurasian songbirds appeared later than the primary Australian stock and so it has been tentatively suggested that the world's songbirds may have evolved from ancestors that emigrated from Australia (Schodde & Christidis 1987).

The Australian wet tropics region contains the highest number of rainforest inhabiting species extant in Australia with the groups of birds considered to represent the ancestral stocks from which Australia's, and possibly the world's, songbirds evolved. Whereas only some of these species can be identified as relict forms, all that primarily inhabit rainforest in the wet tropics need to be considered in the context of their relationship to ancestral rainforest forms. Although only some of these species may prove to be the nearest surviving relatives of ancient taxa, rainforest birds of the Australian wet tropics, in general, hold vital clues to the origin, evolution and biogeography of songbirds within Australia and the world.

The groups considered to be primary and secondary Australian stocks (Schodde & Christidis 1987) are represented in the nominated area by at least 30 species, all of which are primarily rainforest inhabitants (See Appendix X.). Nine of these species and a further 9 or 10 subspecies within these groups are restricted to the wet tropics.

In the light of a generally poor fossil record, Australian songbirds (oscine passerines) were long thought to have been derived from relatively recent invasions from the northern hemisphere. Over the last decade or so, views on the origins of this group have changed dramatically, largely as a result of molecular-level studies of phylogeny using DNA-DNA hybridisation and protein electrophoresis (Sibley and Ahlquist 1985, 1990; Christidis and Schodde 1991).

On the basis of protein electrophoretic studies, Christidis and Schodde (1991) speculate that the passerines may have originated in Gondwana where the order diverged in two major radiations, the suboscines in west Gondwana (South America) and the oscines in east Gondwana (Australasia).

DNA-DNA hybridisation studies by researchers at Yale University have led to a proposed new classification that divides the oscine passerines into two major groups (parvorders), Corvida and Passerida. The studies suggest that the two groups diverged about 60 million years ago, when Australia was still part of Gondwana, and that the Corvida probably originated in that part of Gondwana that is now Australia (Sibley and Ahlquist 1985). As discussed earlier, the vegetation of Australasian Gondwana was then dominated by rainforest.

The Corvida includes 40 per cent of the world's songbird families. Most of the living members are confined to Australia and New Guinea. However, groups such as crows, jays, shrikes and cuckoo-shrikes have radiated to Eurasia and the Americas.

The Wet Tropics of Queensland is the most important area for several lineages of Australo-Papuan songbirds, eg the bowerbirds and the scrubwrens, thornbills and gerygones.

Bowerbirds, which are confined to Australia and New Guinea, are the only birds known to decorate their courting grounds (Slater 1974). There are about twenty species of bowerbirds, eight of which are endemic to Australia, ten to New Guinea and two shared. Five species are found in the Wet Tropics giving the region the highest diversity for the bowerbirds of any area in Australia. Two species, the Golden Bowerbird (*Prionodura newtoniana*) and Tooth-billed Catbird (*Ailuroedus dentirostris*), are endemic to higher altitude areas in the Wet Tropics. *Ailuroedus* may be the most ancient genus; the DNA-DNA hybridisation data suggest that *Ailuroedus* diverged from *Ptilonorhynchus* and *Chlamydia* more than 20 million years ago, although no data were provided for the other genera (Sibley and Ahlquist 1985).

The scrubwrens, mouse-warblers, gerygones and thornbills have generally been placed in the family Acanthizidae, but Sibley and Moore (1990) place them in the Pardalotidae (subfamily Acanthizinae). There are about 60 species, most being confined to Australia. Kikkawa (1991) lists 16 species as inhabiting closed forests. Ten of these occur in the Wet Tropics which is more than twice the number found in any other area in Australia. Three are endemic to uplands of the Property: the Fernwren (*Oreoscopus gutteralis*), Atherton Scrubwren (*Sericornis kerri*) and Mountain Thornbill (*Acanthiza katherina*).

A likely relict species endemic to the Wet Tropics is the Chowchilla or Northern Logrunner, *Orthonyx spaldingii*. The only other species in the genus, *O. temminckii*, is found only in the rainforests of Central Eastern Australia and the highlands of New Guinea. On the basis of DNA-DNA hybridisation studies, *Orthonyx* has been placed in a separate family (Sibley and Ahlquist

1990, Sibley and Monroe 1990). Fossils of *Orthonyx* have been found in late Oligocene deposits (~25 million years) at Riversleigh in north-west Queensland (Boles 1993).

The ~~nominated area~~ **Wet Tropics of Queensland** is also of ~~central~~ **major** importance in understanding the derivation of New Guinea's birds, ~~origins of the diverse bird fauna of New Guinea~~. Geologically, the stage for evolution of its diverse avifauna, which is rich in old genera such as cassowaries, howeillias and kingfishers. New Guinea's avifauna is largely a reflection of speciation which occurred in ancestral rainforests of Australia. Particularly interesting examples are the Little Treecreeper, *Climacteris minor*, which is confined to upland rainforests within the Australian wet tropics and is closely related to the Papuan Treecreeper (*Climacteris placens*) which inhabits mountain rainforests of New Guinea, and the Grey-headed Robin (*Poecilodryas albispecularis*) which occurs as two subspecies, one restricted to upland forests of the Australian wet tropics and the other to mountain forests of New Guinea. Many genera are shared between the two areas. In at least some cases, this would appear to be the result of relatively ancient connections. One example is *Orthonyx* as discussed above. Another is the robin genus, *Heteromyias*. *H. cinereifrons* is endemic to the uplands of the Wet Tropics, whereas the only other species in the genus, *H. albispecularis*, is restricted to the highlands of New Guinea.

(g) **The mixing of the continental biota of the Australian and Asian plates after 80 million years of separation**

The ~~nominated area~~ **Wet Tropics** contains a unique record of a mixing of two continental floras and faunas **that has no known parallel**. This mixing occurred following the collision of the Australian and Asian continental plates about 15 million years ago. This collision was a unique event in that it mixed two evolutionary streams (both flora and fauna), ~~of likely in some cases of~~ common origin, that had been largely separated for at least 80 million years. Whereas other continental collisions that led to a mixing of the biota have occurred, e.g., that of North and South America, none of those continents had such a long period of separation prior to collision.

Unlike New Guinea, parts of the Australian wet tropics represent a stable fragment of Gondwana in which rainforest has existed continuously and whose extant flora, together with fossil pollen deposits of **unparalleled continuity and resolution**, provide a unique record of the mixing of long separated floras. Genera considered to have been of Gondwanan or Laurasian descent but to have entered Australia following the collision of the Australian and Asian continental plates and occurring in the Wet Tropics include *Alangium*, *Allophylus*, *Althoffia*, *Alyxia*, *Anthocephalus*, *Barringtonia*, *Berrya*, *Bombax*, *Bulbophyllum*, *Calophyllum*, *Canthium*, *Celtis*, *Cordia*, *Epipogium*, *Garcinia*, *Gardinia*, *Leea*, *Lethedon*, *Melia*, *Oreodendron*, *Phaleria*, *Securinega*, *Trema* (Truswell et al., in press).

~~Among the fauna, the microhylid frogs are believed to have originated in Gondwana but to have arrived in Australia via India when landbridges became available in the Miocene. Of the 16 species in Australia, 12 occur in the wet tropics and all are restricted thereto.~~

**Among the fauna, two families of frogs provide outstanding examples of the impact on the biota of the collision of the Australian and Asian plates. These are the Microhylidae and Ranidae.**

**The microhylids occur in South America, Madagascar, southern Asia and New Guinea with just two genera occurring in Australia. Views are divided on the origins of the Australian microhylids. Savage (1973) proposed a Gondwanan origin with radiation in Australia and subsequent invasion of Asia via New Guinea, followed by extinction in Australia and a Pliocene reinvasion of northern Australia from New Guinea. Tyler (1979) proposed an Asian origin and entry into Australia via New Guinea. Australian microhylids are from two genera, *Cophixalus* and *Sphenophryne*. Not surprisingly, fifteen of the sixteen species are confined to northeastern Australia with one species in the Northern Territory. Twelve species are endemic to the Wet Tropics region, although one (*C. mcdonaldi*) is restricted to Mt Elliott which lies just to the south of the World Heritage Area. All but one are rainforest species, the exception being *Cophixalus saxatilis* which lives among the boulder piles of the Black Trevelyan Range.**

**The only Australian member of the cosmopolitan family Ranidae is *Rana daemeli* which is restricted to Cape York Peninsula and eastern Arnhem Land and occurs throughout lower altitude areas in the Wet Tropics.**

The origin of the Australian skinks is not clear, but it appears that they arrived in Australia from the north during the Tertiary, apparently from the time of the earliest connections between the Australasian and Asian continental plates (Cogger & Heatwole 1981). Rainforest dependent skink species restricted to the nominated area are *Anomalopus frontalis*, *Calypototis thornstonensis*, *Lampropholis basiliscus*, *L. ezechurae*, *L. delicata*, *L. tetradactyla*, *Sphenomorphus fuscicaudis*, *S. mjobergi*, *S. tigrinus* and *Tropidophorus queenslandiae*.

Recent reassessment of the origins of Australia's native birds suggest that only a few groups (other than migratory birds) have entered from Asia. Those belonging to this category are the Yellow-bellied Sunbird, Singing Bushlark, Mistletoe Bird, Metallic Starling, Silvereye, Pale White-eye, Yellow White-eye and White's Thrush (Schodde 1986; Schodde and Christidis 1987). With the exception of the Pale White-eye which occurs on islands of the Torres Strait, all are recorded from the Wet Tropics.

Of the Australian mammals, the rodents and bats are considered to have entered since connections with the Asian plate were established. Sixty per cent of Australia's bat species are found in the Wet Tropics. A 'second wave' of rodent entry into Australia from the north (via New Guinea) and forming part of the 'Old Endemics' is believed to have included *Hydromys*, *Uromys* and *Melomys* groups, all of which are represented in the nominated area. Several of the Australian rodent genera, including *Hydromys*, *Pogonomys*, *Uromys* and *Melomys*, have their centres of diversity in New Guinea and have entered Australia relatively recently. They represent a second wave of the "Old Endemics" among the rodents. *Melomys* has five species in Australia although one of these, found only on Bramble Cay in Torres Strait, may only be a variant of the Cape York *Melomys* which occurs only around the tip of Cape York Peninsula. The other three species occur in the Wet Tropics and one, *M. hadrourus*, is found only in the Thornton Peak area and Mt Carbine Tableland. *Pogonomys* and *Uromys* have only one species in Australia. The Giant White-tailed Rat, *U. caudimaculatus*, occurs on the eastern side of Cape York Peninsula including the Wet Tropics. The Prehensile-tailed Rat, *P. mollipilosus*, occurs as two disjunct populations, one in the Iron Range area on Cape York Peninsula and the other in the Wet Tropics.

#### (h) The extreme effects of the Pleistocene glacial periods on tropical rainforest vegetation

Even though marked changes in global climates had occurred during the Tertiary, it was not until about 2.5 million years ago, that a series of dramatic changes of climate, the Pleistocene ice ages, began, which changed the face of the earth, causing extinctions, speciations and profound distributions of plants and animals (Livingstone and van der Hammen 1978). Fossil-based data from Southern Hemisphere continents suggest that the effects of Pleistocene glacial periods were greatest in Australia (Kershaw 1984). Fossil pollen records going back over 200000 years, of unparalleled continuity and resolution for this period, from three sites within the nominated area Wet Tropics region, Butcher's Creek, Lynch's Crater and Lake Euramoo, indicate that the rainforest underwent severe contractions during the Pleistocene glacial periods. Uniquely among tropical rainforest areas, there were many extinctions and near extinctions within the nominated area Wet Tropics (*Nothofagus* c.f. *brassii*, *Phyllocladus* spp., and *Dacrydium* spp. - all large, long-lived trees). Outstanding examples of ancient taxa that survived and persist as relicts within the Australian wet tropics Wet Tropics of Queensland World Heritage Area today include the Araucariaceae (5 species) and Podocarpaceae (67 species) and Casuarinaceae (1 species, *Gymnostoma*).

The fossil pollen records held in sediments at the above mentioned sites within the nominated area remain to be fully studied. However, Lynch's Crater, is known to hold records going back 2000,000 years.

The peak of glaciation occurred at 18 000 BP, sea levels were at their lowest for the past 150 000 years (Kershaw 1989).

#### ~~(2) Outstanding examples representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment~~

#### (2) Outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial ecosystems and communities of plants

Geological history involving the separation and drifting of continents, vulcanism, mountain building and erosion has profoundly influenced the evolutionary history of life on earth. The tropical rainforests, in particular, are one of the most significant biomes harbouring the majority of the earth's genetic diversity (Raven 1983, Walker 1986).

Processes resulting in areas of exceptional species richness or of high endemism are of outstanding scientific interest.

Much of the world's humid tropics is of 'recent origin', the newly expanding environments generating areas of exceptional species richness such as in the equably wet, lowland humid regions of peninsular Malaysia, New Guinea, the African Cameroons and the north-western and eastern foothills of the Andes (Ashton 1981). Endemism in these areas of species richness is surprisingly low.

However, the long-isolated ancient floras of New Caledonia, Madagascar and the Australian wet tropics have exceptionally high levels of endemism. These centres of endemism are not only historically important but also significant as diverse pools of unique genetic material retaining elements over the widest evolutionary time span and of potential significance in new radiations in a world of changing global climates and ongoing continental drift.

The Australian wet tropics centre of endemism is unique as part of an ancient continental as opposed to island landscape, uplifted more than 100 million years ago and tectonically stable for the greater part of the period of angiosperm evolution.

The level of endemism within the rainforest flora of the Australian wet tropics (43 genera and 500 species 7000 square kilometres of rainforest)(White 1983). The Australian wet tropics is second only to New Caledonia in the number of endemic genera conserved per unit area (Webb and Tracey 1981, Morat *et al.* 1986, **1993**). The former suffered the greater degree of Pleistocene extinctions which was exacerbated by the Aboriginal use of fire (Kershaw 1984). Of the surviving endemic genera 75 per cent are monotypic and none contain more than a few species.

Many of the endemic species and genera are narrowly restricted within the ~~nominated area~~ **Wet Tropics** and several local centres of endemism have been identified (Keto 1986). All encompass altitudinal gradients within the most equably wet climatic zones allowing for mobility of refugia and survival of relict taxa during climatic fluctuations on geological time scales (Nix 1980).

**The rapid and ongoing ecological, biological and geological processes occurring in the Australian wet tropics region have left many species restricted to upland areas and divided by altitudinal barriers into two or more disjunct allopatric populations. As allopatry is an important mechanism of speciation, these species may be regarded as potential examples of ongoing evolution.**

Among the plants, genera best exhibiting allopatric (occupying different areas) speciation include *Haplostichanthus*, ***Pseuduvaria***, *Elaeocarpus*, ***Ceratopetalum***, ***Polyosma***, *Endiandra*, *Uromyrtus*, *Pilidiostigma*, *Buckinghamia*, *Orites*, *Stenocarpus*, ***Sarcotoechia***, ***Bubbia***, *Planchonella* and *Symplocos*. Some outstanding examples of disjunctions that may eventually lead to new species are *Denhamia viridissima* (Mts Lewis, Bellenden Ker and Bartle Frere), *Elaeocarpus linsmithii* (Mts Lewis and Bartle Frere), ***E. thelmae* (Alexandra Creek and Mt Windsor Tableland)**, ***Trochocarpa bellendenkerensis* (Thornton Peak, Mts Bellenden Ker and Bartle Frere)**, *Glochidion pruinosum* (Thornton Peak and Mt Bellenden Ker), *Flindersia oppositifolia* (Thornton Peak and Mt Bellenden Ker), ***Endiandra* sp. 'Boonjie' (Mt Lewis and the Boonjie area)**, ***Litsea* sp. 'Mt Lewis' (Thornton Peak and Carbine Tableland)**, *Orites fragrans* (Thornton Peak, Mts Lewis, Bellenden Ker and Bartle Frere, and Boonjie), ***Triana montana* (Mts Spurgeon, Lewis, Bellenden Ker and Bartle Frere)**, ***Wendlandia connata* (Mts Hemmant and Spurgeon)**, ***W. urceolata* (Thornton Peak, Mts Spurgeon and Bartle Frere)**, ***Bubbia queenslandica* subspecies *queenslandica* (Noah Creek, Mts Spurgeon and Lewis)** and *Symplocos ampulliformis* (Mt Hemmant, Mt Windsor Tableland and Mts Spurgeon and Lewis).

Several species of fauna restricted to the ~~nominated area~~ **Wet Tropics** also occur as two or more disjunct populations: **the Mountain Mistfrog, *Litoria nyakalensis*, has been recorded from a number of localities between the McDowall Range and Kirrama Range, all at altitudes above about 400 metres; the Northern Tinkerfrog, *Taudactylus rheophilus*, occurs as four allopatric populations on Thornton Peak, Carbine Tableland, Lamb Range and Bellenden Ker Range, all at altitudes above**

900 metres (*L. nyakalensis* and *T. rheophilus* were not found at any site during a survey in 1991–92.); the Lemuroid Ringtail Possum (*Hemibelideus lemuroides*) occurs on the Atherton Uplands and Mt Carbine Tableland and differences between these isolated populations have been noted (Trenerry and Werren 1993); Lumholtz's Tree-kangaroo (*Dendrolagus lumholtzi*) also occurs on the Atherton Uplands and at Mt Carbine Tableland; the Thornton Peak Melomys (*Melomys hadrourus*) occurs at Thornton Peak and Mt Carbine Tableland. These include the frogs *Taudactylus rheophilus*, *Cophixalus concinnus*, *Litoria nannotis* and *L. nyakalensis*, the skink *Lampropholis ezechurae*, the Herbert River Ringtail Possum (*Pseudocheirus herbertensis*) and the Lemuroid Ringtail Possum (*Pseudocheirus lemuroides*).

Species with disjunct populations outside the wet tropics similarly have potential for allopatric speciation. There are numerous examples among the plants including ~~*Fecomanthe hillii*~~, *Maytenus bilocularis*, *Cassia marksiana*, *Pseudoweinmannia lachnocarpa*, *Pollia crispata*, *Dysoxylum fraserianum*, *Premna lignum-vitae*, *Ixora beckleri*, *Euodia micrococca*, *Ripogonum discolor*, *R. elseyanum* and *Phaleria chermsideana*. Among the animals the following species occur in the Wet Tropics as populations isolated by ecological barriers and many of which are recognised as subspecies:

Brown Antechinus (*Antechinus stuartii adustus*)  
 Yellow-footed Antechinus (*Antechinus flavipes rubeculus*)  
 Common Dunnart (*Sminthopsis murina tatei*)  
 Red-cheeked Dunnart (*Sminthopsis virginiae virginiae*)  
 White-footed Dunnart (*Sminthopsis leucopus*)  
 Spotted-tailed Quoll (*Dasyrurus maculatus gracilis*)  
 Koala (*Phascolarctus cinereus adustus*)  
 Fluffy Glider (*Petaurus australis reginae*)  
 Long-tailed Pygmy-possum (*Cercatetus caudatus macrurus*)  
 Red-legged Pademelon (*Thylogale stigmata*)  
 Little Cave Bat [*Vespadelus (Eptesicus) pumilus*]  
 Golden-tipped Bat (*Kerivoula papuensis*)  
 Bush Rat (*Rattus fuscipes coracius*)  
 Cape York Rat (*Rattus leucopus cooktownensis*)  
 Swamp Rat (*Rattus lutreolus lacus*)  
 Australian King Parrot (*Alisterus scapularis minor*)  
 Double-eyed Fig-Parrot (*Cyclopsitta diophthalma macleayana*)  
 Pale-yellow Robin (*Tregellasia capito nana*)  
 Yellow-breasted Boatbill (*Machaerirhynchus flaviventer secundus*)  
 Brown Gerygone (*Gerygone mouki mouki*)  
 Grey Fantail (*Rhipidura fuliginosa frerei*)  
 Eastern Whiplingbird (*Psophodes olivaceus lateralis*)  
 Spotted Catbird (*Ailuroedus melanotis maculosus*)  
 Satin Bowerbird (*Ptilonorhynchus violaceus minor*)  
 and the Brush-tailed Bettong (*Bettongia penicillata*). In all of these cases the disjunction is at least 1000 km.

Recent studies have shown a surprising level of genetic diversity within the Prickly Forest Skink, *Gnypetoscincus queenslandiae*. The studies were directed at determining the level of variation within mitochondrial DNA and a range of enzymes from specimens collected at seven different sites throughout the species range of 275 kilometres. The results show a major genetic break, clearly separating it into northern (Cape Tribulation to Mt Lewis) and southern (Mt Bartle Frere to Mt Sullivan) populations (Moritz *et al.* 1993). The authors conclude that the northern and southern populations “appear to represent very distinct evolutionary lineages that should be considered separately in any analyses of ecology, biogeography and conservation status”. The magnitude of the genetic difference between the two populations is of such an order that geographic separation probably occurred more than 5 million years ago (Moritz *et al.* 1993). There is every reason from a management point of view to consider the two populations as separate species.

Also conserved in the ~~nominated area~~ **Wet Tropics** are communities of forests considered to be early segregates from rainforests. The Tall Open Forests on the drier western margins of the rainforest are significant as part of an evolutionary continuum of rainforest and sclerophyll forests. Eucalypts that now dominate the Australian landscape are considered to have evolved from rainforest stock and radiated into

drier environments from the margins of closed forests (Gill *et al.* 1985). **The first appearance of these wet sclerophyll forests in the fossil record was by the late Miocene (Truswell 1993).**

Within the ~~nominated~~ **listed** area, especially at the Cowley–Kurramine Beach area and the mouth of the Murray River, active geological processes including coastline progradation have produced dynamic mosaics of rainforests, melaleuca and mangrove forests, and sandridge and swale communities. These complexes contain some of the oldest extant roots of an evolutionary continuum that originated from ancestral rainforests.

The ~~nominated area of the Australian wet tropics~~ **Wet Tropics of Queensland** includes variations in elevation above sea level and changes in topography and soil types and thus conserves the full diversity and complexity of the rainforest and associated communities present.

~~(3) *Superlative natural phenomena, formations or features or areas of exceptional natural beauty*~~

**(3) *Superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance***

The ~~Australian wet tropic regions~~ **Wet Tropics of Queensland World Heritage Area** is one of the most significant regional ecosystems in the world. Despite its relatively small size, the exceptionally high genetic diversity and endemism make it a superlative example of tropical rainforest. It has been described as a key to the origins and ancient habitats of primitive flowering plants; as a key to the processes of past climatic sifting of taxa and community types; and as a biological link with temperate and other tropical zones (Webb 1984).

Northern Australia has been postulated as a major centre of evolution of rainforest flora (Kershaw *et al.* 1984). The living history of this evolution is best conserved in the ~~nominated~~ **listed** area.

Apart from the diverse tropical rainforests that present a complex array of life forms, there are outstanding features of natural beauty and magnificent sweeping landscapes.

Between the Daintree River and Cedar Bay there is exceptional coastal scenery that combines tropical rainforest, white sandy beaches and fringing reefs just offshore. Considering the extent of the fringing reef, adjacent as it is to a rainforested continental coastline, this rainforest–reef association is probably unique in the world.

Rugged mountain peaks and gorges are among the dominating superlative features of the landscape. The stark peak of Mt Pieter Botte with its massive granite outcrops provides extensive vistas of undisturbed forest and the valley of the magnificent Roaring Meg Creek which in its lower reaches descends rapidly through a series of spectacular waterfalls and cascades. The region between the Bellenden Ker Range and the Atherton Uplands including the Walter Hill Range contains superb gorge scenery with swiftly flowing rivers. The Russell, Mulgrave and Johnstone Rivers are wild rivers and have become popular with canoeists.

In this area of high rainfall and rugged topography, spectacular waterfalls abound. Wallaman Falls on Stony Creek, dropping 278 metres into a deep canyon, has the longest single drop of any waterfall in Australia.

The winding channels of the Hinchinbrook Channel contain the most extensive mangroves in the region, providing a rich visual mosaic of rainforest and mangroves. The view to the east from this part of the Wet Tropics is backed by the magnificent scenery of Hinchinbrook Island, part of the Great Barrier Reef World Heritage Area.

~~(4) *The most important and significant natural habitats where threatened species of plants and animals of outstanding universal value from the point of view of science and conservation still survive*~~

**(4) *The most important and significant habitats for in situ conservation of biological diversity, including those containing threatened species of plants and animals of outstanding universal value from the point of view of science and conservation***

The Wet Tropics conserves an extraordinary degree of biological diversity as well as providing the major habitat for numerous threatened species of outstanding universal significance. Although accounting for only 0.26 percent of the Australian continent, the Wet Tropics conserves much of Australia's biodiversity (Table \*).

**Table \*. Importance of the Wet Tropics to Australia's biodiversity**

<b>Taxonomic group</b>	<b>Percentage of Australia's total</b>
<b>Plants</b>	
fern species	65
Cycad species	21
conifer species	37
orchid species	30
vascular plant species	30
<b>Animals</b>	
mammal species	35
including:	
• marsupials	30
• bats	58
• rodents	25
bird species	48
frog species	26
reptile species	17
freshwater fish species	45
butterfly species	58
dung beetle species	42
barkbug species	46
weta species	50

Within the Wet Tropics there are over 4,660 known species of vascular plants, representing 1,164 genera and 210 families. Seventy-five genera are endemic to Australia and 43 are restricted to the Wet Tropics. Over 700 species are restricted to the Wet Tropics of Queensland. The outstanding significance of the Property is that it contains many taxa representing long, distinct lineages preserving a greater degree of evolutionary heritage than places with a similar number of species but containing a succession of closely allied forms. This is reflected in the very high plant diversity at the higher taxonomic levels such as numbers of plant genera and families represented in the Wet Tropics.

The area has been described as having a greater biological significance than any other in Australia. Although the Wet Tropics represents less than one tenth of one per cent of the land surface of the continent it contains—

- 65 per cent of Australia's fern species,
- 21 per cent of Australia's cycad species,
- 37 per cent of Australia's conifer species,
- 30 per cent of Australia's orchid species,
- 36 per cent of Australia's mammal species (including 30 per cent of the marsupial species, 58 per cent of the bat species and 25 per cent of the rodent species),
- 50 per cent of Australia's bird species,
- 25 per cent of Australia's frog species,
- 23 per cent of Australia's reptile species,
- 37 per cent of Australia's freshwater fish species, and
- about 60 per cent of Australia's butterfly species.

Endemism is particularly high in 33 angiosperm and six gymnosperm and fern families, most of which are old, primitive or relict and with a high proportion of species that are geographically rare and/or threatened. The majority of plants in the rainforests of the nominated area Wet Tropics have a restricted distribution either as isolated or disjunct populations. High concentrations of monotypic genera reflecting the refugial nature of the rainforests are found at several locations. Of the 49 monotypic genera in the Property (represented by a single surviving species), 19 are considered rare.

The nominated area is the only habitat for numerous species of plants and animals that are regarded as rare, vulnerable or endangered. The Wet Tropics has a total of 351 plant species that are officially listed as rare or threatened under Queensland legislation (Table \*). They are listed in Appendix 9. Of the 29 recognised recent plant extinctions in Queensland, 17 were formally endemic to the Wet Tropics. The presumed extinct species, in general, have not been recorded for over 50 years.

Table \*. Rare and threatened Wet Tropics plants<sup>1</sup>.

Class	Extinct	Endangered	Vulnerable	Rare
Whisk ferns	1	0	0	0
Ferns	5	3	8	27
Club mosses	2	4	4	1
Cycads	0	0	1	0
Conifers	0	0	0	3
Dicots	6	19	29	170
Monocots	3	16	12	37
<b>Total</b>	<b>17</b>	<b>42</b>	<b>54</b>	<b>238</b>

<sup>1</sup>Nature Conservation (Wildlife) Regulation 1994 (includes all amendments up to SL No. 354 of 2000)

Included in the list are many rare and very restricted species belonging to the primitive angiosperm families referred to earlier in relation to The Age of the Angiosperms. These include *Idiospermum australiense* (Idiospermaceae), ~~three~~ **eight** undescribed species of *Haplosticanthus* (Annonaceae), *Wilkiea wardelli* and *Tetrasynandra* sp. (Monimiaceae), *Endiandra anthropophagorum* and *E. microneura* (Lauraceae). There are also rare species within two undescribed genera in the Myrtaceae family, both with very restricted distributions. As noted earlier, ~~these genera~~ **the recently described genera, Barongia, Ristantia and Sphaerantia** may have considerable significance in relation to the evolution of sclerophyllous Myrtaceae taxa.

The list of rare and threatened species includes ~~nine~~ **16** monotypic genera restricted to the wet tropics. They are *Austromuellera trinervia* (R), *Baileyoxydon lanceolatum* (R), *Barongia lophandra* (R) *Crispiloba disperma* (R), *Hexaspora pubescens* (V), *Kuntheria pedunculata* (R), *Lenbrassia australiana* (R), *Mitrantia bilocularis* (V), **Gen. nov. Q2** (V), *Neostrearia fleckeri* (R), *Noahdendron nicholasii* (R), *Normanbya normanbyi* (V), *Oreodendron biflorum* (V), *Ostrearia australiana* (R), *Spahlmium racimosum* (R) and *Whyanbeelia terraereginae* (R). **Rare species in endemic ditypic genera include Buckinghamia ferruginiflora, Darlingia ferruginea, Hypsophila halleyana, Peripentadenia mearsii, P. phelpsii, Sphaerantia chartacea and S. discolor.**

Within the Proteaceae there are several rare and very restricted species including *Alloxylon flammeum*, *Helicia blakei*, *H. recurva*, and undescribed species of *Austromuellera* and *Buckinghamia Carnarvonia*, *Orites* and two entirely new genera.

There are at least 70 species recorded only from the type locality and another 80 or so restricted endemic species for which current records indicate a north-south distribution of less than 25 kilometres.

The outstanding biological diversity of the Wet Tropics in regard to the fauna has been described in the 'Description and Inventory' section. The Property has the highest diversity in Australia for many groups, including rainforest mammals and frogs, bats, freshwater fish, insects and land snails. It also has the highest level of endemism for several groups, particularly rainforest frogs and reptiles.

Most of the Wet Tropic's endemic faunal complement are confined to the cooler, upland rainforests and many are considered to be relicts from formerly widespread temperate environments (Switzer

1991). At least 663 terrestrial vertebrate species have been recorded (DASETT, 1987; Williams *et al* 1996) which represents 32% of Australia's terrestrial vertebrate fauna (Table \*).

**Table \*. Comparative Wet Tropics vertebrate diversity**

Vertebrate Group	No. of Wet Tropics species	% of Australian total	No of endemic species	Level of regional endemism
Mammals	109	35%	13	12%
Birds	370	48%	13	4%
Reptiles	131	17%	27	21%
Frogs	53	26%	24	40%
Freshwater fish	78	41%	8	10%
Total	741	33%	85	11%
Terrestrial Total	663	32%	77	12%

Source: Williams *et al.* (1996), DASETT (1987), Pussey & Kennard (1994), EPA (1999)

A breakdown of the number of endemic species in each habitat is presented in Table\*. Although the dry sclerophyll forests contain the highest overall diversity of vertebrate species, there is low proportional regional endemism (4%). In contrast, the rainforest fauna includes 66 species which are found only in the Wet Tropics or 25% of the rainforest terrestrial vertebrate species are endemic to the region (Williams *et al* 1996).

**Table \*. Number of Wet Tropics bioregional terrestrial faunal species by broad habitat type.**

	closed forest	wet sclerophyll	dry sclerophyll forest & woodland	grassland	rocky outcrops	caves	freshwater	mangroves
mammals	51	43	71	13	8	9	3	8
birds	112	107	174	48	3	-	73	63
reptiles	65	61	108	24	27	1	16	14
frogs	31	16	35	20	1	-	30	2
total	259	227	388	105	39	10	124	87
% regional endemism	25%	7%	4%	0%	21%	0%	4%	2%

(after Williams *et al.*, 1996).

Of the thirteen mammal species endemic to the region, all except the Mahogany Glider and Tropical Bettong are rainforest dependent. Most of the rainforest dependent endemics are restricted to the uplands and, as a consequence, occur as a number of isolated populations. In addition to the endemic species, there are at least eight subspecies of mammals restricted to the Property. The Property contains the habitats of 35% of Australia's mammal species, including 30% of Australia's marsupial species, 58% of Australia's bat species and 25% of Australia's rodent species.

More than 370 bird species are either confined to, or have part or most of their range in the region (Dasett, 1987). Of these, 112 are principally rainforests rainforest specialist species. The majority of the thirteen endemic species are confined to the upland rainforests. A further ten species have their Australian distributions largely confined to the region and at least another ten bird subspecies are restricted to the Wet Tropics. Of the 13 endemic species, nine are restricted to the uplands, with the remaining four being widespread throughout the region. All 13 endemic species have close relatives in the highlands of New Guinea. The Property contains the habitats of 48% of Australia's bird species

The Wet Tropics contains the most diverse rainforest frog assemblage in Australia with very high levels of regional endemism. Upland areas between 600 and 1,000 metres are particularly important. There are 53 species of frog in the region, 24 of which are regional endemics. Twenty-one of the 26 rainforest dependent frogs are only found in the Wet Tropics. The Property contains the habitats of 26% of Australia's frog species,

The Wet Tropics reptile fauna consists of a mixture of old endemics (Gondwanic) and recent invaders from New Guinea. There are about 131 species of reptiles within the Wet Tropics. About 50 species of reptile have been recorded in rainforests. Of these, 29 are rainforest specialists with 20 species being endemic to the region, making the level of reptile endemism in the Wet Tropics the highest in Australian rainforests. The skinks are a particularly diverse group within the Wet

Tropics with sixteen locally endemic species (Covacevich & Couper, 1994). The Property contains the habitats of 17% of Australia's reptile species.

The Wet Tropics region has a greater diversity of freshwater fishes than any other in Australia. Of around 190 species in Australia, 78 occur in streams of the Wet Tropics. Eight freshwater fish species are endemic to the region. The region contains 70 per cent of the continent's fish genera and 70 per cent of Australia's 35 freshwater fish families (Pusey 2001). This extraordinary diversity reflects the diversity of stream habitats and the highly variable but predictable seasonal flow rates. Nine endemic freshwater fish species have been identified (Pusey 2001). The Property contains the habitats of 45% of Australia's freshwater fish species.

Although the invertebrate fauna of the Wet Tropics is relatively poorly studied it is undoubtedly the richest of any comparable region in Australia. This is demonstrated by statistics which are available for certain diverse groups of insects such as the butterflies, for which the Wet Tropics has about 230 species or about 58% of all Australian species; the dung beetles, for which the Wet Tropics has 135 species or about 42% of all Australian species; the barkbugs, for which the Wet Tropics has 42 species, or 46% of the continent's total. Twenty-six species of wetas (giant king crickets) occur in the Property which is half of the Australian total. Four of the nine genera found in the Wet Tropics, involving eight species, are endemic to the Property. There are at least six species of crayfish restricted to cool, permanent streams above 800 m altitude. Certain invertebrate groups have diversified greatly in the Wet Tropics, for example the carabid beetle genus *Philippis* has 33 species in the Wet Tropics while only two elsewhere. The richest overall insect fauna yet studied in Australia lies in the Bellenden Ker Range where an intensive survey yielded 4,029 species of insects including 1,514 species of beetles alone (Monteith 1994) in addition to more than 300 species of spiders. Land snails form an extraordinarily diverse group within the fauna of the Wet Tropics. An analysis by the Queensland Museum identified 217 native species, of which 185 (85%) are endemic to the region (Stanisic *et al.* 1994). Two Wet Tropics streams, Yuccabine Creek and Birthday Creek, have recorded the highest diversity of stream invertebrates anywhere on earth (Pearson pers. com).

The Wet Tropics has a total of 82 animal species officially listed as either rare or threatened. Endangered fauna include seven frog species, three marsupials, one bird and two butterflies (Table \*). A further 16 vertebrate species are classified as vulnerable.

Table \*. Rare and threatened Wet Tropics animals<sup>1</sup>.

Status	Mammals	Birds	Reptiles	Frogs	Fish	Butterflies	Total
Endangered	3	1	0	7	0	2	13
Vulnerable	6	7	3	0	0	2	18
Rare	16	9	15	11	0	0	51
<b>Total</b>	<b>25</b>	<b>17</b>	<b>18</b>	<b>18</b>	<b>0</b>	<b>4</b>	<b>82</b>

<sup>1</sup> *Nature Conservation (Wildlife) Regulation 1994* (including all amendments up to SL No. 354 of 2000), *EPA Wildnet (2001)*

Among the fauna, there are several species with highly restricted distributions. These include the marsupials Atherton Antechinus (*Antechinus godmani*) and Thornton Peak Melomys (*Melomys hadrourus*), the frogs *Taudactylus rheophilus*, *Litoria lorica*, *Cophixalus bombiens*, *C. exiguus* and *C. saxatilis* and the reptiles *Calyptotis thornntonensis* and *Leiopisma jigurru*.

The Southern Cassowary (*Casuarius casuarius*) is considered vulnerable. The lowland populations are dependent on relatively small and, to some extent, discontinuous areas of rainforest and associated melaleuca forests. These forests were severely affected by a cyclone in February 1986 and the cassowary populations suffered significant losses.

The Musky Rat kangaroo (*Hypsiprymnodon moschatus*), a species of considerable evolutionary significance and restricted to the rainforests of the Wet Tropics, has a very patchy distribution therein. Little is known of its biology and the need for further studies is indicated.

Also within the nominated area are isolated populations of three marsupial species that are considered rare or vulnerable. They are the spotted tailed Quoll (*Dasyurus maculatus*), the Yellow bellied Glider (*Petaurus australis*) and the Brush tailed Bettong (*Bettongia penicillata*). The Spotted-tailed Quoll is

believed to be affected by the invasion of parts of its habitat by the introduced Cane Toad (*Bufo marinus*) which it eats and which is toxic to it.

## **Additional information on significance since listing**

### *Natural Heritage*

Additional or updated information on the natural values for which the Property was listed are indicated in bold font in the preceding sections. Current research by the Rainforest CRC and the Authority's regional vegetation mapping program are identifying significant natural heritage values which extend outside the boundaries of the Property which may well warrant further studies of their potential World Heritage values.

### *Cultural Heritage*

Although the Wet Tropics of Queensland World Heritage Area was not listed for its cultural values the area between Cooktown and Cardwell contains the only recognised existing Australian Aboriginal rainforest culture. The oral pre-history of surviving Aboriginal rainforest culture is the oldest known for any indigenous people without a written language.

Rainforest Aboriginal people have indicated they wish to have the Property recognised as a living cultural landscape. The Aboriginal world-view is that the natural values and cultural values cannot be separated. Cultural values include the living, continuous traditions of the Aboriginal peoples who are associated with the Wet Tropics. For this reason, Aboriginal people see their involvement in land management as essential to maintaining their culture. Many Aboriginal people want the Property to be renominated for World Heritage listing on cultural grounds, in addition to natural grounds.

Physical evidence of past Aboriginal occupation exists today with sites containing stone tools, carved trees and rock and cave paintings. Many of these places are not properly recorded and their cultural values, archaeological potential and management requirements have not yet been assessed.

Aboriginal occupation in the area between Cooktown and Cardwell is thought to date back to at least 40,000 years ago (Sing *et al.*, 1980; Sluiter and Kershaw, 1983). The northern tribes (Barrineans) are considered to represent the first wave of the Aboriginal occupation of Australia, making theirs the oldest rainforest culture in the world (DASETT, 1987). Rainforest culture differed markedly from that of most other Australian Aboriginal tribes, with its heavy dependence on arboreal skills, everyday use of toxic plants and unique weapons (Horsfall, 1984). Archaeological studies in Jiyeer Cave in the remote Russell valley have suggested occupation as far back as 5000 years and the valley is believed to hold records dating back more than 10 000 years (Toyne 1994).

Any decision to renominate the Property based on cultural criteria is the responsibility of the State (ie Commonwealth Government). The Rainforest CRC is presently collating information and undertaking research into whether there is a substantive case for a renomination of the Property, in whole or part, on cultural grounds.

## **II.3. STATEMENT OF AUTHENTICITY/INTEGRITY**

### **Authenticity/Integrity**

At the time of inscription, the condition of the Property ranged from pristine to various stages of regeneration resulting from a range of human activities. One year after Dalrymple's 1873 expedition and subsequent descriptions of the forest resources of the region, timber cutters commenced the exploitation of red cedar (*Toona ciliata*) and kauri pine (*Agathis* spp) including most of the more accessible parts of what is now the World Heritage Area. Following the establishment of the Sub-Department of Forestry in the 1930s a structured timber industry was established based on the polycyclic selective removal of commercial timber species. At one time or another about 160 rainforest species have been milled. Long-term average yields from the Property were 63,000 cubic metres of timber per annum from a productive

area of 158,000 hectares. Up until listing, therefore, parts of the Property had been available to a 70 year history of selection logging of varying intensity.

At the time of inscription, clearings within the Property totalled 7,538 ha most of which were associated with the provision of community infrastructure (Table \*). Linear service corridor clearings accounted for 4,475 ha of which 2,406 ha are still maintained clearings providing community and management access and electricity distribution. Patch clearings accounted for a further 2,733 ha, the largest contributor to this total (2,129 ha) was the result of habitat drowning caused by three artificial dams and impoundments (Paluma Dam, Koombooloomba Dam and Copperlode Falls Dam) which were present prior to listing. Boundary anomalies include slivers of agricultural land which were included in the nomination for a range of reasons, but primarily to produce a sensible management boundary.

**Table \*.** Extent of habitat loss within the World Heritage Area at the time of listing.

<b>Clearing Type</b>	<b>Total Area (ha)</b>
<b>Linear service corridor clearings</b>	
powerlines	772
roads	3679
railways	22
cableways	2
<b><i>total linear clearings</i></b>	<b>4,475</b>
<b>Patch clearings</b>	
quarries	43
inundation (dams)	2129
recreation areas	45
settlements	120
communication facilities	3
fire degraded hillslopes	105
other	288
<b><i>total patch clearings</i></b>	<b>2733</b>
<b>Boundary anomalies</b>	
paddocks	197
sugarcane	65
pine plantations	36
orchards & plantations	32
<b><i>total boundary anomalies</i></b>	<b>330</b>
Extent of pre-listing clearing (%)	0.84

### **Maintenance and enhancement of values**

Logging has been a prohibited activity in the Property since 1987 and infrastructure associated with this industry has been phased-out, including the closing of over 6,500 km of logging roads and snigging tracks which had a combined cleared area footprint of approximately 2,070 ha.

There have been no clearings associated with new powerline or road construction within the Property since listing. Powerline upgrades have been designed to either straddle the Property (eg Rex Range alignment of the Turkinje-Port Douglas line) or have been constructed on very tall towers negating the need for maintenance clearing under the line, while allowing for the re-establishment of canopy connectivity across existing clearings (eg Chalumbin-Woree 275KV powerline).

There has been a progressive conversion of land tenures within the Property to national park (eg from 28% in 1992 to 32% in 2000) and a progressive reduction in the area of various lease tenures from 143,140 ha in 1992 to 90,146 ha in 2000. In November 2001 a further 320,000 ha of State Forest was

converted to Forest Reserve, a protected area holding tenure (under the *Nature Conservation Act 1992*) before eventual conversion to national park.

A statutory management plan for the Property is in place in which 461,620 ha has been identified as remote from human disturbances and zoned to ensure its protection; a further 414,372 ha has been identified as in a mostly natural state and has been zoned to promote its restoration wherever practical, by relocating disturbances to land where they will have less impact, or to rehabilitate the land over time where opportunities arise; 18,259 ha has been identified on which, or adjacent to which, there is existing infrastructure needed for community services. Such areas have been zoned and regulated to ensure that the impact of activities associated with community services is managed to minimise the effect on the integrity of the Property.

In the Daintree section of the Property a strategic freehold land acquisition program has been implemented. Approximately 2,500 hectares of land adjacent to, and/or with complementary habitat connectivity with, the World Heritage property has been procured through voluntary surrender agreements and/or direct purchase. Of this total, 1640 hectares have been procured through the Daintree Rescue Program. Other desirable parcels of land, which contain viable habitat, have been identified in the Daintree Futures Study and will continue to be targeted for purchase through other government funding initiatives. The Australian Rainforest Foundation (ARF) a community-based organisation will also, in consultation with the Wet Tropics Management Authority, effect land purchases to help consolidate the Property.

*Not complete need to include other land acquisition info*

Complementary to these measures has been the development of covenants with land-holders. These are designed to ensure that activities on private land are sympathetic with maintaining important habitat, and to afford protection for wildlife, including the unimpeded migration of wildlife between satellite portions of the Property and its main core habitat areas. Other significant conservation measures have included a recovery program for the endangered southern cassowary.

There is an active program of rainforest rehabilitation occurring within the Wet Tropics region supported or encouraged by the Authority. The Authority has been

Aboriginal interests in the Wet Tropics are represented through the Interim Negotiating Forum. This forum has been established to ensure that Aboriginals' views, interests and concerns are taken into consideration in planning and day-to-day management activities. The forum comprises representatives of Aboriginal land councils and Aboriginal community groups who have traditional association with the Wet Tropics area.

### **Boundaries review**

N/A

### **Buffer zone/mechanisms**

There are more than 2500 individual blocks of land neighbouring the Property's 3000 kilometre boundary. Both the *Wet Tropics World Heritage Protection and Management Act 1993* and the statutory *Wet Tropics Management Plan 1998* apply only to lands within the boundaries of the World Heritage Area and not to neighbouring properties. However, a co-operative approach to management is being actively pursued with neighbours in an attempt to maximise the benefits and minimise any negative impacts (both for neighbours and the Property). This includes co-operative approaches to concerns, such as control of feral pigs, and weed and fire management.

Co-operative management agreements are also actively canvassed with land holders, Aboriginal peoples and other parties within and outside the Property as a means of giving the greatest possible effect to the Primary Goal and minimising impacts upon neighbours.

The Wet Tropics Management Authority contributes to reviews of local government planning schemes in accordance with the *Local Government (Planning and Environment) Act 1990* and the *Integrated Planning Act 1997*. The Authority also assists local government, Aboriginal community councils and Aboriginal organisations with their planning activities to ensure World Heritage values are adequately protected.

In August 1999 the Authority commissioned an independent survey of immediate neighbours of the Property. The telephone survey involved 500 neighbours. The results showed 66% were satisfied with being an immediate neighbour with just 15% dissatisfied. Those less likely to be satisfied or supportive included the owners of properties larger than 40ha (52% support), owners of multiple properties (55%), non-resident property owners (52%), primary producers (47%), owners of properties for more than 20 years (52%) and those over 55 years of age (56%). The groups most supportive included owners of properties of less than 4ha (77%), owners of the property for less than 10 years (75%), less than 55 years old (70% for 18-39 years, 74% for 40-54 years), female (76%) and owners of residential land (78%). In response to these findings the Authority has instigated a good neighbour program, has formed a Landholder and Neighbour Liaison Group chaired by an Authority Board member to achieve more direct and meaningful communication and regularly provides information and contact details of land managers through a posted newsletter.

## II.4. MANAGEMENT

### National legislation and controls

From July 2000, Australia's World Heritage Properties have been protected under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) <http://www.ea.gov.au/epbc/about/index.html>. This Act provides automatic protection for World Heritage Properties by ensuring that an environmental impact assessment process is undertaken for proposed actions that will, or are likely to, have a significant impact on the World Heritage values of a declared World Heritage Property. This process allows the Commonwealth Minister for the Environment and Heritage to grant or refuse approval to take an action, and to impose conditions on the taking of an action.

The EPBC Act imposes substantial civil and criminal penalties on a person who takes an unlawful action.

All properties that have been inscribed on the World Heritage list are automatically 'declared World Heritage Properties' and are therefore protected. The EPBC Act also gives the Commonwealth Minister for the Environment and Heritage the power to declare other properties where:

- the property has been nominated for, but not yet inscribed on the World Heritage list; or
- the property has not been nominated for World Heritage listing but the Minister believes that the property contains World Heritage values that are under threat.

Historically, the protection and management of many of Australia's World Heritage Properties has involved a cooperative approach between the Commonwealth Government and State Governments, with relevant State agencies taking responsibility for on-ground management. The EPBC Act creates a mechanism for the Commonwealth and a State to enter bilateral agreements to achieve the requirements of the Act and to remove duplication of regulatory processes. This provides an avenue for formalising existing cooperative arrangements through Commonwealth accreditation of State World Heritage management plans and environmental impact assessment processes. In order to be accredited, the relevant State plan or process must be consistent with the Australian World Heritage management principles, which are regulations made under the EPBC Act.

The EPBC Act replaces and significantly improves on the World Heritage Properties Conservation Act 1983 (WHPC Act). The WHPC Act enabled the Commonwealth to make regulations to protect Australia's World Heritage Properties from threatening actions identified in the regulations. This legislation, in effect, operated as a last resort mechanism for stopping specific actions. In contrast, the EPBC ensures up-front protection and improved management for the world heritage values of Australia's World Heritage Properties.

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The Commonwealth *Wet Tropics of Queensland World Heritage Area Conservation Act 1994* (<http://scaleplus.law.gov.au/html/pasteact/2/1151/top.htm>) gives effect to the 1990 State-Commonwealth World Heritage Area Management Scheme. The scheme outlines broad structural and funding arrangements for the management of the Property and states the Primary Goal of the scheme is “to provide for the implementation of Australia’s international duty for the protection, conservation, presentation, rehabilitation and transmission to future generations of the Wet Tropics of Queensland World Heritage Area, within the meaning of the World Heritage Convention.” Under the scheme the Authority has a coordinating, planning and assessment function (see below).

### **State legislation and controls**

The *Wet Tropics World Heritage Protection and Management Act 1993* ([http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/W/WetTropicsA93\\_03B.pdf](http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/W/WetTropicsA93_03B.pdf)) together with its subordinate statute, the *Wet Tropics Management Plan 1998* ([http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/W/WetTropMgmtPlan98\\_01\\_.pdf](http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/W/WetTropMgmtPlan98_01_.pdf)) provide the legal framework and mechanisms for management of the Property. In general, the legislation regulates activities within the Property that have the potential to impact on World Heritage values including destruction or disturbance to native vegetation, watercourses or earth ([http://www.wettropics.gov.au/mlr/laws\\_protecting.htm](http://www.wettropics.gov.au/mlr/laws_protecting.htm)).

The Department of Environment, under the *Nature Conservation Act 1992* ([http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/N/NatureConA92\\_03\\_.pdf](http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/N/NatureConA92_03_.pdf)) (and consistent with the *Wet Tropics Management Plan 1998*), has primary responsibility for nature conservation in Queensland. In accordance with its roles under the Act, the Department:

- dedicates and declares protected areas;
- protects native wildlife and habitats;
- regulates the use of protected wildlife;
- manages protected areas;
- manages commercial tour operations (including permit issue);
- maintains infrastructure and public contact in areas under its management; and
- has responsibility for the protection of cultural heritage including identification, recording, and protection of particular cultural sites.

Over the past year the Queensland Government has begun implementing vegetation clearing control on lands outside of the World Heritage Area, which will aid in the buffering and protection of the Property’s natural values ([http://www.nrm.qld.gov.au/resourcenet/veg/veg\\_management/index.html](http://www.nrm.qld.gov.au/resourcenet/veg/veg_management/index.html)). Although there is no blanket ban on clearing in the region, landholders now require approval in most cases to clear native vegetation on freehold land and leasehold land. The *Vegetation Management Act 1999* ([http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/V/VegetManA99\\_01A.pdf](http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/V/VegetManA99_01A.pdf)) (and the *Vegetation Management Regulation 2000*) ([http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/V/VegetManR00\\_002.pdf](http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/V/VegetManR00_002.pdf)), makes vegetation clearing on freehold land assessable under the *Integrated Planning Act 1997* ([http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/I/IntegPlanA97\\_04B.pdf](http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/I/IntegPlanA97_04B.pdf)) while the *Land Act 1994* (and associated regulation) governs vegetation management on leasehold and other state land ([http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/L/LandA94\\_05B.pdf](http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/L/LandA94_05B.pdf)) ([http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/L/LandR95\\_03B.pdf](http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/L/LandR95_03B.pdf))

In the largest known illegal logging operation in the Property since listing, 15 logs were removed from the Herberton State Forest section of the World Heritage Area in January 2001. The offender was charged under the *Wet Tropics World Heritage Protection and Management Act 1993* and in December 2001 was sentenced to 12 months imprisonment. The judge in his closing statement recognised both the criminal acts performed and the significant environmental harm caused to rainforest of international significance.

### **Strategic Planning**

The non-statutory FNQ 2010 Regional Planning Process (<http://www.dlqp.qld.gov.au/internet/corporate/publications/planning/projects/#fnqstratrep>) is a cooperative, whole-of-government exercise involving Commonwealth, State and Local Governments, as well as business, tourism, environment, development, primary production, human services and Aboriginal

and Torres Strait Islander groups. FNQ2010's purpose is to ensure that growth and development in the Wet Tropics region is managed with due consideration given to environmental, social and economic opportunities and constraints. The FNQ 2010 Regional Plan and process has a pivotal role in guiding regional planning decisions under the *Integrated Planning Act 1997* and provides a significant opportunity for World Heritage management interests to be properly considered within the bioregional context. Key initiatives include:

- a regional growth management strategy
- identification of priority biodiversity and rehabilitation areas within the region
- regional level studies with respect to water infrastructure demands and road access.

FNQ2010 and the *Wet Tropics Management Plan 1998* have different but complementary purposes. FNQ2010 is a non statutory plan which sets out broad regional priorities and strategies. The Wet Tropics Plan is a statutory Plan with the specific purpose of regulating activities to protect World Heritage values. Notwithstanding the different focus and legal status of the documents, it is intended that they should be mutually supportive. To help achieve this, the Authority is represented on the FNQ 2010 Implementation Coordination Group. In addition, the Authority is a referral agency providing terms of reference for Environmental Impact Statements for all developments on properties having a common boundary with the World Heritage Area

### **Regional and Local government controls**

Fourteen local authority municipalities cover the Wet Tropics World Heritage Area. Local government is responsible for preparing and implementing local government planning schemes and local laws and making decisions on development applications. Under the *Local Government (Planning and Environment) Act 1990* the Authority is a referral agency for private development proposals both within and adjoining the Property. Maintenance of Local Government community infrastructure such as Shire roads and water supplies is being managed under agreed codes of practice developed co-operatively between the Authority and Local Government.

Where there is inconsistency between a management plan prepared under the *Wet Tropics World Heritage Protection and Management Act 1993* and a local government planning scheme, the Wet Tropics Plan prevails over the planning scheme to the extent of the inconsistency

Local Governments may apply to have the Wet Tropics Management Plan amended should the need arise to place critical community infrastructure in areas currently zoned B. The amendment process would involve public exhibition of an EIS and approval from the Wet Tropics Ministerial Council.

All local government jurisdictions within the region have developed Pest Management Plans which identify and target the major environmental and agricultural weeds and pest animals found within different sections of the region.

### **Administrative and contractual arrangements**

The Wet Tropics Management Authority is a body corporate, with statutory powers defined under the *Wet Tropics World Heritage Protection and Management Act 1993*. The Authority's functions are defined under s.10 of the Act and include:

- developing and implementing policies and programs within the Wet Tropics Area
- making recommendations to Ministerial Council
- preparing management plans
- administering funding
- facilitating and entering into cooperative management agreements
- rehabilitation
- education through the gathering and dissemination of information.

A Commonwealth/State intergovernmental agreement provides for a Wet Tropics Ministerial Council, comprising two Commonwealth and two State ministers. The Queensland Minister for Environment chairs the Council. A board of directors is also set up under the Act and consists of six directors, five of these are private citizens who serve as directors in a part-time capacity. Two are nominated by the Commonwealth and two by the State. The chairperson is jointly nominated. The executive director of the

Authority is a non-voting director of the Board ([http://www.wettropics.gov.au/mlr/what\\_is\\_WT\\_management.htm](http://www.wettropics.gov.au/mlr/what_is_WT_management.htm)).

In addition to its two statutory advisory committees - the Community Consultative Committee and the Scientific Advisory Committee, the Authority has also established four major stakeholder groups - Aboriginal, Landholders and Neighbours, Tourism Industry and the Conservation Sector Liaison Groups.

The Authority falls within the portfolio of the Queensland Minister for Environment and as part of the Queensland public sector the Authority is subject to established public sector legislation, regulations, standards and guidelines governing administrative functions and arrangements.

The Authority fulfils a planning, coordinating, funding and monitoring role in ensuring that management activities are complementary and contribute to achieving the Primary Goal, but it does not have day-to-day field management responsibilities. Day-to-day management of the Property is primarily the responsibility of land managers (mostly State Government land management agencies such as the Queensland Parks and Wildlife Service).

A network of community-based volunteers has been set up throughout the World Heritage Area with coordination provided by the local Queensland Parks and Wildlife Service office. Volunteer activities are diverse and can include bird counts, revegetation, cleanup days, walking track maintenance, interpretative walks, displays, kid's activities, producing newsletters and other handouts, helping customers at information counters and public education. The volunteers are provided with year-round training in guiding walks, wildlife handling and care, front counter skills and First Aid.

The Australian Wet Tropics Rainforest Foundation ([http://www.wettropics.gov.au/mlr/WT\\_foundation.htm](http://www.wettropics.gov.au/mlr/WT_foundation.htm)) is a charitable organisation specifically designed to facilitate the involvement of Australian corporations in the conservation and management of the Wet Tropics World Heritage Area. The Foundation is a not-for-profit organisation overseen by an independent Board of Directors recruited from the business community. A key role of the Foundation is to identify opportunities for corporate involvement in the conservation of the tropical rainforest of north Queensland through:

- the acquisition or protection of land for fauna/flora sanctuaries;
- the expansion of facilities to assist access by visitors;
- the establishment of visitor information centres and provision of education materials;
- the support of scientific research related to the protection of rare and endangered species.

Other community groups assist in the management and maintenance of the World Heritage Area through initiatives such as community reforestation. The Authority endeavours to develop co-operative arrangements with the conservation sector that ensure an effective level of policy consultation and information exchange in particular through the Wet Tropics Conservation Sector Liaison Group and the Cassowary Advisory Group.

### **Traditional Protective measures**

The long-standing association of Aboriginal peoples with land in the Property is recognised, as is the need to work with Aboriginal peoples in keeping with the principles of self-determination

There are about 16 Aboriginal language groups and associated communities in the Property. These communities have a traditional duty for managing their cultural heritage, which includes the natural environment. Yarrabah and Wujal Wujal are two Deed of Grant in Trust (DOGIT) communities which have statutory land management rights and responsibilities under the *Community Services (Aborigines) Act 1984*. Many other Aboriginal communities also wish to be meaningfully involved in managing the Property.

There is growing support for increased Aboriginal involvement in managing the Property. This has been acknowledged by the Queensland Government. For example, The preamble of the *Wet Tropics World Heritage Protection and Management Act 1993* states:

“(8) It is also the intention of the Parliament to acknowledge the significant contribution that Aboriginal people can make to the future management of cultural and natural heritage within the Property, particularly through joint management agreements”.

Mechanisms for achieving greater Aboriginal involvement in management are provided under legislation such as the *Aboriginal Land Act 1991*, ([http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/A/AborLandA91\\_04C.pdf](http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/A/AborLandA91_04C.pdf)) the *Commonwealth Native Title Act 1993*, the *Native Title (Qld) Act 1993*, ([http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/N/NativeTitleQA93\\_01\\_.pdf](http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/N/NativeTitleQA93_01_.pdf)) or where the land is owned by Aboriginal peoples (e.g. DOGIT, freehold, etc.). These can range from information sharing and consultation arrangements between Aboriginal peoples and management agencies through to joint decision-making power. The *Nature Conservation Act 1992* and the *Wet Tropics World Heritage Protection and Management Act 1993* require the Department of Environment and the Wet Tropics Management Authority to perform their functions, as far as practicable, in consultation and co-operation with Aboriginal peoples.

Approximately 80% of the Property is considered potentially claimable under native title legislation. The *Wet Tropics Management Plan* is designed to support native title negotiation processes and provides for management agreements with Aboriginal interests under Part 3 Division 5 ‘Negotiations and variation of controls under agreements’.

The Authority has undertaken a Review of Aboriginal Involvement in Management of the Property which was endorsed by Ministerial Council in March 1999. One of the key recommendations of the review was the establishment of an interim negotiation forum whose objective is to negotiate solutions to difficult management issues identified in the review. The key issues to be discussed within the interim negotiating forum are:

- recognition of the cultural values of the Property
- native title
- Aboriginal involvement in policy, planning and management
- development of meaningful management agreements
- traditional resource use, and the use of ecological knowledge.

A facilitator to head the forum was appointed in 2001. The first management agreement with the Djabugay Tribal Aboriginal Corporation under section 42 of the *Wet Tropics Management Plan* also occurred in 2001.

The Authority’s Aboriginal Resource Management Program (ARM) is responsible for helping the Authority build partnerships with rainforest Aboriginal peoples to facilitate their involvement in the management of the Property. ARM also has the role of mainstreaming Aboriginal perspectives into other Authority programs. The program works closely with, and assists, Aboriginal representative organisations such as ATSIC (Aboriginal and Torres Strait Islander Commission), North Queensland, Cape York and Central Queensland Land Councils, Bama Wabu and Giringun Elders and Reference Group and key tribal organisations such as Djabugay Tribal Aboriginal Corporation and the Burungu Aboriginal Corporation operating within the Property.

The major role of ARM is to ensure that effective and appropriate communication, negotiation and consultation occurs between the Authority, land management agencies and the rainforest Aboriginal community. The Authority has contracted the Giringun Elders and Reference Group and North Queensland Land Council to provide three Aboriginal community liaison officers (CLOs) to work with the ARM program to facilitate the involvement of rainforest Aboriginal people in the management of the Property.

*Insert: Interim protocols eg permits etc*

## **Management Plan**

An obligation for the Authority, under both the intergovernmental agreement and the Act, was the preparation of a management plan for the Property. Many people reflecting a range of communities and interests were involved in the planning process. An extensive community consultation program was implemented during all phases of plan development. For example, this program involved:

- three community attitudes surveys undertaken in 1992, 1994 and 1996;
- a questionnaire was distributed throughout the region in March 1992 which asked respondents to identify and rate the issues they felt were most important in managing the Property;
- in August 1992 48 regional and special interest workshops involving more than 800 participants;
- release for public comment of the Wet Tropics Strategic Directions document in 1992 with public workshops, a free telephone service, invitations to provide comments and suggestions and a free postal comment form;
- release for public comment of the Draft Wet Tropics Plan in 1995 with public meetings and workshops, a free telephone service, invitations to provide comments and suggestions and a free postal comment form. The Draft Plan remained on public exhibition for over six months; and
- following the close of public exhibition in April 1996, further rounds of consultation and negotiation took place with representative bodies of major community sectors as well as government land management agencies, continuing up to the time of finalisation of the Plan.

The Wet Tropics Plan addresses issues which were raised consistently during all phases of consultation. The comments and suggestions received during the public exhibition period of the draft Plan were taken into account in the final Plan. To demonstrate the transparency of this process, a report documenting the major comments and suggestions and how these were dealt with in the final plan was also produced.

The final *Wet Tropics Management Plan 1998* is subordinate legislation under the *Wet Tropics World Heritage Protection and Management Act 1993*. Key components of this statutory Plan include:

#### 1. Zoning System

The Plan divides the Property into four management zones, based on a “distance from disturbance” model (Table \*). Part 3 of the Plan describes those activities which are allowed, or subject to a permit, in the different zones. A zoning scheme with associated land use controls for activities occurring or proposed for each zone is the most practical means of providing an appropriate level of protection for the natural values of the Property, and for managing activities which have the potential for adverse impact on those natural values while recognising legitimate uses and activities. The zoning scheme also designates road classes and associated use within the Property.

#### 2. Permit System

The Plan incorporates a permit system for consideration of applications for regulated activities. The most important consideration in assessing permit applications is the likely impact of the proposed activity on the Property’s integrity.

#### 3. Permit Assessment Guidelines

Section 62 of the Plan allows the Authority to prepare guidelines relevant to decision making and may include guidelines for flora and fauna conservation, scenic amenity, visitor management, seed collection and community consultation on permit applications. The Authority or its delegates must have regard to the information in the guidelines when considering a permit application.

#### 4. Co-operative Management Agreements

The *Wet Tropics World Heritage Protection and Management Act 1993* provides for the Authority to enter into, and facilitate the entering into of, voluntary co-operative management agreements (CMAs), including joint management agreements, with land holders, Aboriginal peoples particularly concerned with land in the Property and other persons. CMAs play an important role in facilitating good management of the Property and may make provision for financial, scientific, technical or other assistance in relation to management of the Property. They may occur over lands inside or neighbouring the Property but only with the agreement of the relevant land holder. CMAs provide for variation of standard controls prescribed under the Plan. Twelve CMAs were finalised in 2000-2001 in the Daintree area. The total number of approved CMAs in the World Heritage Area is currently 42.

**Table \*. Zoning Scheme Summary**

	Zone A	Zone B	Zone C	Zone D
<b>Physical condition</b>	Remote from disturbance and in a mostly natural state.	Not remote from disturbance but still in a mostly natural state.	Land on which or adjacent to which there is existing infrastructure	Land on which there are, or are proposed to be, significant developed

	Zone A	Zone B	Zone C	Zone D
<b>Physical and social setting</b>	A natural area remote from disturbances associated with modern technological society. Visitors may expect opportunities for solitude and self reliance without an obvious management presence.	A natural area, which may be undergoing recovery or rehabilitation towards its natural state. An area where a visitor may expect opportunities for solitude and self reliance with a limited management presence.	An area with some disturbance by activities associated with modern technological society. A visitor may expect low key opportunities for nature appreciation and social interaction in a natural setting. Management presence may be obvious.	A mostly natural area with visitor facilities integrated into the surrounding landscape. Visitors may expect many opportunities to appreciate and enjoy the Property in a natural setting. A management presence may be obvious.
<b>Management intent</b>	To protect land in its natural state. If land is disturbed, to remove disturbance and restore land to its natural state.	To restore land to its natural state wherever practical, by relocating disturbances to land where they will have less impact, or to rehabilitate the land over time where opportunities arise.	To accommodate community services. To ensure that the impact of activities associated with community services is managed to minimise the effect on the integrity of the Property.	To accommodate developed visitor facilities to enable visitors to appreciate and enjoy the Property. To ensure that the impact of visitor infrastructure is managed to minimise the effect on the integrity of the Property.
<b>Total Area</b>	461,620 ha	414,372 ha	18,259 ha	168 ha

The Authority also operates under a policy document, *Protection Through Partnerships* (WTMA 1997), which outlines policies, guidelines and actions for achieving desired management outcomes. It provides a framework for guiding management decisions made by the Authority. Table \* lists the key policy areas covered in this document.

**Table \*.** Key components of *Protection Through Partnerships*

Management Processes	Conservation Practice and Land Protection	World Heritage Presentation, Visitor Management and Enjoyment	Managing Resource Use
<ul style="list-style-type: none"> <li>management partnerships</li> <li>codes of practice</li> <li>Aboriginal interests</li> <li>co-ordinated planning</li> <li>land tenure</li> <li>boundary management</li> </ul>	<ul style="list-style-type: none"> <li>flora and fauna conservation</li> <li>feral animals</li> <li>weeds and diseases</li> <li>rehabilitation</li> <li>fire</li> <li>scenic management</li> <li>cultural heritage</li> </ul>	<ul style="list-style-type: none"> <li>presentation, information and interpretation</li> <li>visitor research</li> <li>walking opportunities</li> </ul>	<ul style="list-style-type: none"> <li>collecting plants and animals</li> <li>private land use</li> <li>defence use</li> <li>communication facilities</li> <li>grazing</li> <li>beekeeping</li> <li>farming</li> <li>water storage, diversion and extraction</li> <li>electricity infrastructure</li> <li>roads and access</li> </ul>

#### *Community services infrastructure management*

The *Wet Tropics Management Plan 1998* requires that the carrying out of activities, such as infrastructure maintenance, which may cause environmental harm, be undertaken with due regard to avoiding or minimising that harm. One tool employed by the Authority and infrastructure agencies to achieve this is the use of environmental Codes of Practice for management and maintenance of community infrastructure. The objective of these codes is to minimise environmental harm. These codes are also applied as conditions of Wet Tropics permits required by government or semi-government agencies with responsibilities for managing infrastructure in the Property. Codes of Practice have been produced for road, electricity and water infrastructure maintenance activities.

In addition to general Code of Practice provisions, the Authority now requires Environmental Management Plans (EMP) be developed as an additional condition of some permits to allow more explicit

compliance monitoring. For example, EMPs are now a requirement for permits associated with the maintenance of all major powerline easements within the Property. The intention of these EMPs is to provide detailed prevention, minimisation and mitigation strategies for controlling environmental impacts of powerline easement maintenance activities at specific sites. Their purpose is to identify and map both environmental values and potential maintenance activity impacts to those values; to specify mitigation strategies together with appropriate monitoring; and if an undesirable or unforeseen level of impact occurs, specify the appropriate corrective action.

#### *Threatened species management*

Species listed in the *Nature Conservation (Wildlife) Regulation 1994* are afforded statutory protection under the *Nature Conservation Act (1992)*.

The Commonwealth's *EPBC Act 1999* lists nationally threatened species and provides for the development and implementation of species recovery plans. Environment Australia's Endangered Species Program is implemented through parallel programs run by the State (QPWS). Recovery Plans comprehensively describe, schedule and cost actions assessed as necessary to support the recovery of threatened species. Recovery plans are presently being formulated for the following Wet Tropics species:

- frogs (seven species),
- northern bettong,
- mahogany glider,
- spotted tailed quoll, and
- southern cassowary

The Cassowary Advisory Group is a community-based group provided with administrative and technical support by the Authority. The group has been active in the known cassowary hotspots of Mission Beach, the Daintree lowlands and Kuranda. Intensive field surveys have been undertaken in these areas to identify individual cassowaries, their habitats and threats to their survival. On ground recovery actions to minimise the identified threats have been initiated in partnership with community groups, other government agencies and local government.

### **Changes in Land Ownership and/or Legal Status**

The Wet Tropics World Heritage Area comprises a variety of land tenures including freehold, leasehold, unallocated State land, State forest, timber reserve and national park and a corresponding range of government agencies and private land holders with responsibilities for managing these tenures under different legislation. World Heritage listing of this Property does not affect land ownership. Land management agencies are still responsible for issuing permits on land under their control.

Under the Wet Tropics Management Plan 1998, landholders may have certain special rights. These rights apply to:

- Landholders (ordinary title holders)
- Native title holders or persons acting with their permission
- Government landholders

These rights include s.29 'allowed activities':

- an activity for protection, conservation or rehabilitation
- operating a motor vehicle on a lawful access road
- disposing of waste (if no regular removal service and at least 20km from the nearest facility)

and ss.35, 63 'domestic activities for which a permit is guaranteed (conditions may apply)':

- building a residence
- building an access
- establishing a garden or orchard
- extracting water for domestic use.

Transfer of ownership of leasehold or privately-owned land is not restricted. However, the Authority's general policy is to support the conversion of land tenure within the Property to achieve a higher order of protection where opportunities arise. The outcome of this policy has seen the area of national park

increase by 35,878 ha since 1992, state forests have also increased by 26,510 ha over this period while the total area of leases and freehold land has been reduced by 53,055 ha (Tables \* & \*). There is an active program of conversion of State Forests within the Property to the protected area estate. Approximately 320,000 ha of State Forest is currently in the process of staged tenure transfer under the Nature Conservation Act 1992, representing almost 36% of the World Heritage Area.

**Table \*.** Trends in areas of different land tenures in the Wet Tropics World Heritage Area.

Tenure	Area (ha)						
	1992	1995	1996	1997	1998	1999	2000
National parks	249,866	250,318	266,588	266,707	269,827	269,827	285,744
State forests	320,790	331,215	339,937	339,931	348,049	348,049	347,300
Timber reserves	84,280	73,822	73,951	73,949	73,949	73,949	74,163
Various reserves & dams	10,707	10,566	10,202	10,207	10,207	10,207	10,207
Unallocated State Land	58,162	65,980	56,224	70,330	70,501	70,501	60,515
Leasehold	143,140	135,749	120,708	106,872	95,363	95,243	90,146
Freehold & similar	17,402	17,560	17,614	17,401	17,499	17,629	17,341
Roads, Esplanades, Railways	5,903	5,903	5,889	5,716	5,718	5,718	5,696
Rivers	3,307	3,307	3,307	3,307	3,307	3,307	3 308
Total	894,420	894,420	894,420	894,420	894,420	894,420	894,420

**Table \*.** Proportional trends in land tenure in the Wet Tropics World Heritage Area.

Tenure	Percentage of WHA					
	1992	1995	1997	1998	1999	2000
National parks	28	28	30	30	30	32
State forests	36	38	38	38	38	39
Timber reserves	9	8	8	8	8	8
Various reserves & dams	1	1	1	1	1	1
Unallocated State Land	7	7	8	8	8	7
Leasehold	16	15	12	12	12	10
Freehold & similar	2	2	2	2	2	2
Rivers, roads, esplanades, railways	1	1	1	1	1	1
Total	100	100	100	100	100	100

The creation, subdivision or extension of privately-owned or leased land tenure in the Property is generally not supported. Exceptions may include:

- recognition of native title rights over native title land;
- tenures over land vested in Aboriginal communities under the *Aboriginal Land Act 1991*, *Aboriginal and Torres Strait Islander (Land holding) Act 1985* and the *Community Services (Aborigines) Act 1984*;
- where the new tenure will not adversely affect, or will positively contribute to the Primary Goal; and
- additions to the Property.

Table \* provides a measure of land subject to formal tenure associated with Aboriginal interests or subject to agreements under various statutes.

**Table \*.** Land (ha) formally under Indigenous management

Form of management	October 1992	June 2000	June 2001
Deed of Grant in Trust	8,055	8,055	8,055
Leasehold/Trusteeship*	5,011	16,791	16,791
Determined Native Title	0	7	7
Cooperative Management Agreements	0	0	1,600
<b>TOTAL</b>	<b>13,066</b>	<b>24,853</b>	<b>26,453</b>

\* Note the trusteeship incorporates Reserves under Aboriginal Trustee

Acquisition priorities for lands within or adjoining the Property have been developed by the Authority in consultation with the Department of Environment. The Wet Tropics Management Authority land acquisition policy for land both within and external to the World Heritage Area is supported by a Board

adopted guideline (Resolution #30/5.1 - August 1998), which provides criteria for assessment of offers of land and for determining priorities between different offers.

Land acquisition priorities are established through the application of assessment criteria approved by the Board and focus on acquisition opportunities where:

- land is within the Property and public ownership is considered to be desirable for protection of World Heritage values, the provision of visitor facilities or to achieve more effective management of the surrounding area;
- land is adjacent to the Property and contains World Heritage values;
- land is adjacent to the Property and is important for the protection and management of the Property; or
- land in proximity to the Property and has a nexus with lands inside the Property (such as a wildlife corridor).

The main factors for the selection of land for acquisition are:

- the protection of World Heritage values, especially where threatened;
- contribution to sound management of the Area;
- resolution of land tenure and WHA boundary anomalies.

To encourage a positive and cooperative atmosphere with land holders, the Authority only pursues voluntary land acquisition. The Authority only enters into land acquisition negotiations where funds are available and other avenues for protecting World Heritage values have been considered and found to be inappropriate or unachievable. Other protection mechanisms might include:

- cooperative management agreements;
- Nature Refuge declarations;
- tenure related dealings (eg. lease conditions, property management plans etc);
- conditions applied to development consents;
- facilitated land transfers to ownership supportive of the protection of natural values;
- land swaps where alternative properties are available; and
- possible future conservation incentives such as rate/tax rebates

### **Contact details of manager**

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### **Staffing, financial and training resources**

The Wet Tropics Management Authority has 30 permanent staff positions with total funding of \$7.428 million for 2000/2001 which included \$0.534 million for the completion of the Daintree Rescue Program. Funding was provided to the Authority principally by the Commonwealth and Queensland governments. A significant proportion of the Authority's budget is provided to Queensland land management agencies (eg Queensland Parks and Wildlife and Queensland Department of Natural Resources and Mines) (Tables \* & \*).

Table \* Summary of Authority expenditure by program

<b>Program</b>	<b>2000/2001</b>	<b>1999/2000</b>	<b>1998/1999</b>	<b>1997/1998</b>	<b>1996/1997</b>
Environmental Protection Agency	635,057	-	-	-	-
Corporate Services	1,286,132	1,462,404	1,175,500	1,087,009	1,152,196
Aboriginal Resource Management	599,000	508,294	355,000	351,000	276,570
Area Conservation	2,326,474	2,878,653	2,819,181	2,853,800	2,369,009
Planning & Research	988,662	1,027,524	1,209,996	848,947	601,847
Community Relations	1,058,222	1,345,419	1,086,841	1,007,705	1,206,572
Daintree Rescue	534,000	1,012,000	4,501,000	7,580,544	8,832,709
<b>Total</b>	<b>7,427,548</b>	<b>8,234,293</b>	<b>11,147,518</b>	<b>13,729,005</b>	<b>14,438,903</b>

In addition to the Authority's staff, the Property has a range of on-ground management staff employed by land management agencies such as Queensland Parks and Wildlife (QPWS). The Authority supplies funding to these land management agencies to undertake special projects for the benefit of the World Heritage Area, over and above normal or routine operational expenses. Therefore, routine operational expenses are additional to the figures presented in these tables.

Table \* Summary of Authority expenditure by agency

Agency	2000/2001	1999/2000	1998/1999	1997/1998	1996/1997
Wet Tropics Management Authority	4,685,612	4,305,339	3,551,228	3,875,524	3,091,757
Queensland Parks & Wildlife Service	1,275,879	1,625,554	1,885,191	1,632,312	1,755,612
Environmental Protection Agency	635,057	336,000	105,500	-	-
Department of Natural Resources	831,000	955,400	1,096,250	945,000	953,500
Daintree Planning Co-ordination		1,012,000	4,312,179	6,444,169	7,747,634
Other Organisations			197,170	832,000	890,400
Total	7,427,548	8,234,293	11,147,518	13,729,005	14,438,903

The Authority participates as a member of the regional training and human resource network. Expenditure for staff training and development increased from \$44,000 in 1999/2000 to \$50,000 in 2000/2001. In addition in-house training was provided to authority staff in a range of areas including workforce diversity, cross cultural awareness and technical skills such as GIS. Table \* provides data available since the 1993-1994 financial year.

Table \*. Expenditure on Wet Tropics Management Authority staff training and development

	Financial Year							
	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
Expenditure (\$)	53,000	52,030	75,300	12,750	22,600	28,050	44,000	50,000
Number of permanent staff	19	19	18	23	30	30	30	30

## Scientific and technical studies

The *Wet Tropics Research and Information Needs Report* (WTMA 2000; <http://www.wettropics.gov.au/mlr/pdf/Information%20Needs%202000.pdf>) provides an outline of the management areas, issues and priorities the Authority and its land management partners have identified as important and identifies research and associated activities it would like seen undertaken over the next seven years. The Authority has been a partner in the Rainforest CRC (Cooperative Research Centre for Tropical Rainforest Ecology and Management <http://www.rainforest-crc.jcu.edu.au/>) since its inception in 1993. This Centre brings together the research capabilities and facilities of:

- CSIRO
- James Cook University
- Griffith University
- The University of Queensland

The seven research programs of the Rainforest CRC include:

1. Environmental planning and management in tropical rainforests
2. Functional ecology: evaluating ecosystem goods and services in a dynamic landscape
3. Rainforest visitation and business
4. Rainforest access: managing and monitoring impacts
5. Rehabilitation and restoration
6. Conservation principles and management
7. Aboriginal and collaborative management

The outcomes of the Rainforest CRC's research programs are being progressively utilised and incorporated into planning and management. The *Wet Tropics Research and Information Needs Report* is being used as a key component in promoting World Heritage research priorities within the Rainforest CRC and with other research organisations.

The Rainforest CRC is the primary means of acquiring accurate, current, relevant and accessible information for management purposes. This arrangement is resulting in a very large scientific research effort being directed specifically at assisting and improving the management capability of the Wet Tropics World Heritage Area and the broader region. The Authority is represented on both the Governing Board and the Executive of the Rainforest CRC, is a core supporting partner, is represented on all Program Support Groups and commits a minimum of \$150,000 annually to support the research of the centre.

**Attachment 1a** lists the scientific research projects supported by the Authority between 1992 and 1996 when the Authority ran a Research Grants Scheme to support and promote research of benefit to understanding and managing the Property. This grants scheme was superseded by the Authority's involvement and partnership arrangements with the Rainforest CRC. **Attachment 1b** lists some of the journal and report outputs generated by Rainforest CRC researchers since 1993.

## Visitation

The Property is an internationally acclaimed visitor destination. A survey of visitors revealed nearly half the respondents (45.6%) nominated rainforest experiences as one of their three main reasons for visiting the region. In 1998, over 48% of Queensland's nature based tourism operators were based in Tropical North Queensland, and 210 companies had permits to visit the Property. The only detailed source of information on visitor numbers was a 1993 survey which estimated 4.77 million visits (3.4 million visitor days) were made to over 180 sites in the Property (Driml 1997).

The Wet Tropics has experienced substantial increases in both domestic and international visitors over the past two decades. Between 1985 and 1995 the annual number of visitors to the region increased from 840,000 to around 2 million (FNQ Regional Plan 2000). Visitor trends and projections (Table \*) forecast in the FNQ Regional Plan (2000) predict a linear rate of increase resulting in an almost doubling of total visitors to the region by 2016 with an increasing trend in the numbers of international visitors being a major contributing factor.

**Table \*.** Wet Tropics visitor trends and projections between 1993 -2016

Visitor Details	Trends			Projections			
	1993	1996	1999	2001	2006	2011	2016
<i>Domestic</i>							
Increase	123	184	317	127	280	270	250
Number ('000)	1,456	1,640	1,773	1,900	2,180	2,450	2,700
Average per day	19,147	20,219	21,859	23,425	26,877	30,205	33,288
<i>International</i>							
Increase	-	101	296	103	310	300	300
Number ('000)	541	642	837	940	1,250	1,550	1,850
Average per day	10,375	11,611	1,405	16,740	22,260	27,630	32,945
<i>Total visitors ('000)</i>							
Average per day	1,997	2,292	2,610	2,840	3,430	4,000	4,550
	29,523	31,830	36,764	40,164	49,137	57,808	66,233

Source: FNQ Regional Plan - Supporting Technical Document - Tourism

The tourism industry is recognised as an ambassador for the Property and a major presenter of its attributes. Co-operative partnerships with the tourism industry are being made in order to ensure that tourism developments and activities are ecologically sustainable and benefit the Property. The Wet Tropics Tourism Liaison Group has been set up as a forum for liaison between the Authority, tourism operators and land managers.

The Wet Tropics Nature Based Tourism Strategy (WTMA 2000) (<http://www.wettropics.gov.au/mlr/nature.pdf>) was finalised in August 2000 and provides a regional framework for management of nature-based tourism. The Strategy will be implemented through an integrated package of mutually supporting mechanisms, primarily:

- partnership arrangements to promote the active involvement of all stakeholders in tourism planning, management and review,
- research to provide the basis for continuous improvement in appropriate environmental practices,
- better information management to enable stakeholders to make informed decisions and promote understanding based on quality information,
- precinct and site planning to determine appropriate types, levels and conditions of visitation consistent with World Heritage zoning,
- marketing guidelines to ensure accurate and appropriate marketing of Wet Tropics sites,
- precautionary management, monitoring and reporting arrangements to ensure regular review and adjustment of management regimes, including contingency plans,
- accreditation systems linked to commercial tourism activity permits to establish best practice for the nature based tourism industry that encourages continuous improvement,
- efficient, equitable cost recovery and administrative systems,
- an infrastructure development program designed to enhance Wet Tropics presentation and minimise impacts associated with tourism, and
- a process for ongoing implementation and review of the Strategy according to new information or changing conditions.

The Wet Tropics Nature Based Tourism Strategy also provides the framework for the Wet Tropics Walking Strategy (WTMA 2001) which establishes priorities and standards for the development and maintenance of a world class walking track network.

The Authority undertook a major study in collaboration with the tourism industry aimed at establishing a brand, appropriate and accurate images and text for use by tourism operators using the Property. The production of a style manual, logo specifications and a range of images and text have been distributed to tourism operators in the region.

*Insert: WHA signage, Educational programs, accreditation etc*

## **Education, interpretation and awareness raising**

### *Website*

The Wet Tropics website was launched in late 1999 (<http://www.wettropics.gov.au>) and is currently attracting more than 4,000 sessions per month.

### *Newspaper*

The Authority publishes two editions of the Wet Tropics Newspaper each year with 130,000 copies of each edition circulated through regional newspapers and visitor centres.

### *Annual Cassowary Awards*

To mark the 10<sup>th</sup> anniversary of the Property's World Heritage listing, the Board initiated the 'Cassowary Awards' to recognise those community members making outstanding contributions to the management and protection of the Wet Tropics. These awards are now an annual event and are presented at a special ceremony attended by the Queensland and Commonwealth Environment Ministers.

### *Public Contact Rangers and Wet Tropics Volunteers*

The Authority funds QPWS public contact rangers in Townsville, Cardwell, Lake Eacham, Innisfail and Cairns. A network of about 150 community-based volunteers has been set up throughout the World Heritage Area with coordination provided by public contact rangers and the local QPWS office. Volunteer activities are diverse and can include bird counts, revegetation, cleanup days, walking track maintenance, interpretative walks, displays, children's activities, producing newsletters and other handouts, helping customers at information counters and public education.

### *Accredited Wet Tropics Visitor Centres*

Rainforest Habitat, Port Douglas displays a wide cross-section of Wet Tropics flora and fauna in three extensive rainforest, wetland and grassland environments. There are 1,200 animals representing 150 species most of which the visitor can freely interact with. Rainforest Habitat offers visitors a range of services including tours with experienced guides and information on what to see and where to go. It is a privately owned interpretive centre with an admission charge. [www.rainforesthabitat.com.au](http://www.rainforesthabitat.com.au)

The Daintree Rainforest Environmental Centre is thirty minutes drive from the Daintree River ferry. The Centre has a large indoor display area, touchscreen technology, two theatres, a rainforest boardwalk and guided tours led by experienced naturalists. It also features a 25 metre Canopy Tower which offers five different platforms with views of the rainforest canopy and beyond. It is a privately owned interpretive centre with an admission charge.

Cape Tribulation Environment Centre is a small interpretive centre staffed by volunteers. It is the 'shopfront' for the Australian Tropical Research Foundation (AUSTROP) which operates a research station at Cape Tribulation. The station provides educational opportunities to university students through internships but researchers can also make arrangements to use the facilities. Current research includes alternative technology for the tropics, cluster figs, blossom bats and their relatives, and the genetic diversity of the Daintree Coast's rare plants. The Environment Centre charges a small entry fee to fund research activities and the yearly rescue of orphaned spectacled flying foxes.

Volunteers staff the Hinchinbrook Visitor Centre in Ingham providing information on local World Heritage attractions. A major theme of this Centre's display are the high diversity of local birds.

The Reef and Rainforest Centre in Cardwell is run by Queensland Parks and Wildlife staff with assistance from the Wet Tropics Volunteers. The Centre houses displays by regional artists. Gurrimay, Jiddabul and Banjin cultures are also a feature of the Centre.

Ravenshoe Visitor Centre is run by local volunteers. The centre features the diverse mix of high altitude rainforest, wet and dry sclerophyll forests and the high diversity of possum species in this locality and the local Aboriginal people (the Jiddabul), and early settlers. Markets are also held monthly in the grounds of this visitor centre.

The Malanda Environmental Centre display features the Atherton Tablelands' violent volcanic past using models, sensory lighting and an audio show to recreate the sulphur pits and rumbling fireworks of the Tableland's dormant volcanoes. Another display shows how rainforest animals have adapted to the changing environment. Another display describes the history and survival of the Ngadjon-jii people. Local volunteers staff the centre.

The Mission Beach Wet Tropics Visitor Centre is a joint project run by the Community for Coastal and Cassowary Conservation (C4) and the local tourism industry. One building has displays on local wildlife and their habitats and another building provides information on local walking tracks, tours and commercial enterprises. The endangered southern cassowary is a major feature of the displays.

## **Cultural and social effects**

The World Heritage listing of the Property undoubtedly precipitated wide-ranging social impacts. In 1987 it was anticipated that listing of the Property would result in the almost complete collapse of the region's timber industry. It was also expected that such a dramatic contraction of a core regional industry would result in marked negative social impacts in those communities most heavily dependent upon the timber industry. Two social impact assessments were conducted of the region affected by World Heritage listing of the Property; one conducted in 1987 immediately prior to listing, and one conducted four years later to assess the effectiveness of the strategies implemented to address listing-related social impacts.

Prior to listing, the Commonwealth Government implemented a comprehensive Social Impact Assessment (SIA) which was used as the basis of a compensation package designed to ensure forcibly retrenched timber workers would not be unfairly disadvantaged. In this way, the costs associated with preserving an international asset could be borne by the wider Australian community. The (then) Commonwealth Department of the Arts, Sport, Environment, Territories and Tourism (DASETT) was charged with the responsibility of overseeing the initial assessment while the (then) Resource Assessment Commission (RAC) undertook the follow-up assessment in order to determine the extent to which the government had successfully minimised the negative social impacts associated with listing.

In early 1988 the Commonwealth Government began implementing a Structural Adjustment Package (SAP) in order to address the potential negative social problems identified from the 1987 studies. The three components of the SAP were job creation, business compensation and financial assistance for

forcibly displaced timber workers. The sum of \$75.3 million was set aside for the SAP, with \$50.9 million designated for employment-related programs and \$24.4 million designated for business compensation. The job creation component comprised public works projects, tree planting projects, private sector initiatives and local community initiatives. Assistance for displaced workers included a dislocation allowance, an early retirement package, a retraining subsidy and a relocation allowance.

By 1991 there were only two licensed mills operating in the Atherton and Ingham forestry districts, whereas prior to listing there were 12 mills in operation employing 486 timber workers. By 1991 413 of these timber mill workers had been made redundant. In the same period, the number of independent timber logging contractors declined from 48 to 13 and the number of special purpose sawmillers declined from 16 to 10. In terms of the actual amounts of timber processed in the region following the cessation of logging within the Property, between September 1987 and June 1990, there was a 98% reduction in the amount of timber processed in Atherton, a 94% reduction in Mareeba and a 74% reduction in Eacham.

The town of Ravenshoe, in particular, was singled out as being especially susceptible to negative social impacts due to the combined factors of heavy dependency on the timber industry, high proportion of single parent families, high unemployment and the highest proportion of young people employed in the timber industry. In 1987, the general expectation in Ravenshoe was that listing would signal the death of the community. The reality in late 1990 was that Ravenshoe was experiencing a population increase and new businesses had opened (Lynch-Blosse et al 1991). This finding was unexpected and was largely uninfluenced by the SAP. Because Ravenshoe was seen to be in such dire straits in 1987, land values fell and this resulted in large tracts of land in the Ravenshoe district being subdivided and sold as 'house and land packages' for as little as \$1000. These packages attracted an influx of new residents and stimulated associated economic growth in the district (Lynch 2000).

The 1991 study concluded that the SAP was flawed in that it was short-term in its effects. For example the Dislocation Allowance was successfully delivered and operated as intended, but this was no more than short-term financial support. The Early Retirement assistance was not well accepted with many recipients believing the maximum payout of \$30,000 did not represent fair compensation for the premature termination of a working life. The Public Sector projects, which essentially entailed local councils employing displaced timber workers was more successful.

While listing certainly caused significant social impacts at the individual level, at the community level any impacts appear to have been swamped by changes in other areas of the regional economic base (see also Economic Effects section below).

### **Economic effects**

A number of socio economic analyses were commissioned by the Queensland Government, the timber industry and the Commonwealth Government to assess the possible social and economic dislocation that might result from the World Heritage listing of the Wet Tropics.

The timber industry was a major contributor to the North Queensland economy since settlement of the region and the effects of this industry permeated many aspects of regional activity including production, income, employment, land and house prices, taxation levels, income redistribution, retail and wholesale trade amongst others.

The gross value of sales of timber from the region was around \$26 million in 1986 dollars, which is equivalent to \$34 million in 1994 dollars (Driml 1991). This figure is then directly comparable with the gross expenditure on tourism of \$443 million (Table \*; Driml 1997). It can be seen that the gross expenditure on tourism is around ten times the gross value of logging and timber production in the year logging ceased in the Property.

The tourism industry contributes significantly to the economy at both a local and regional scale. Direct tourism use of the Property was estimated to generate over \$179 million in 1993, based on expenditure associated with commercial tours, hire cars and running costs for private vehicles (Table \*). Total gross expenditure for the region (which includes flow-on effects to the local economy) is estimated to be \$753 million (Driml 1997).

Table \*. Gross expenditure in Wet Tropics region by visitors to the Property (Driml 1997)

<b>Expenditure</b>	<b>\$ million</b>
Gross expenditure on visits to the Property	179
Gross expenditure on accommodation etc	264
Total gross expenditure (output)	443
Direct and indirect output contribution with 1.7 multiplier	753

The growth in tourism since listing has more than offset, at the regional level, the negative economic impacts of the cessation of logging (Driml 2000). It must be acknowledged, however, that tourism did not provide an alternative for many individuals and communities previously dependent on the timber industry.

## **II.5. FACTORS AFFECTING THE PROPERTY**

### **Development pressure**

#### *Regional population growth*

The Wet Tropics region is the most populated of northern tropical Australia with most inhabitants living within 50km of the Property boundaries in the expanding communities of the major cities of Cairns and Townsville, smaller coastal towns and the closely settled farming areas of the Atherton Tableland. Australian Bureau of Statistics Census data (1981-1996) show the regional population associated with the local government areas within the Wet Tropics increased from 253,818 in 1981 to 374,814 in 1996. The regional population in the decade 1986-96 increased by 29.67 percent. Population growth during 1998-99 was 1.5% in the Far Northern Statistical Division with Cairns being the major driving force of population growth in the region. Regional population growth over the past decade has been high particularly for the local authority areas of Douglas, Thuringowa and Cairns. The outlook for annual population growth over the next decade has been forecast at 1.9%, with Cairns contributing an average of 1.3% points of this growth per annum (AECgroup 2000).

#### *Tenure within World Heritage Area*

The Property includes within its 3,125 km boundaries almost 730 separate parcels of land, including freehold property, national parks, state forests and a range of leases and reserves (Table \*).

**Table \*.** Land tenure in the Wet Tropics World Heritage Area.

<b>Tenure</b>	<b>Parcels</b>	<b>Area (ha)</b>	<b>Percentage of WHA</b>
National parks	21	285,744	32
State forests	32	347,300	39
Timber reserves	5	74,163	8
Various reserves & dams	64	10,207	1
Unallocated State Land	203	60,515	7
Leasehold:			
Perpetual leases	11	132	0.01
Expiring leases	138	86,897	10
Mines & energy	6	24	0.003
DPI & EPA	43	3,093	0.35
Freehold & similar	204	17,341	2
Roads, Esplanades, Railways		5,696	0.6
Rivers		3 308	0.4
Total	727	894,420	100

Use rights and responsibilities associated with land tenure have significant implications for management of the Property.

Approximately 80% of the Property is considered potentially claimable under Native Title legislation. Presently 282,966 ha or 32% of the Property is under claim.

### *Regional Clearing Patterns & Trends*

For the period 1991 to 1995 the clearing rate for the entire Wet Tropics bioregion was 3,583 ha per year. Total clearing reduced very substantially for the period 1997 to 1999 where the average clearing rate was almost a third (1,275 ha per year) of the 1991-95 rate (DNR 2000) .

Although these clearing data relate to areas external to the World Heritage Area, clearings, changing land uses and an array of associated impacts surrounding the Property are major underlying threats to the overall long-term integrity of the Property. Some of the associated impacts include fragmentation of habitat, severing of natural wildlife corridors, increased demand for water, and introductions and spread of pest plants, animals and diseases.

### *Community Services Infrastructure*

Essential services supplied by community infrastructure are important for regional development but the construction and maintenance of infrastructure also impacts significantly on the condition of the natural environment. One of the most significant impacts associated with infrastructure corridors, particularly through rainforests, is their array of habitat fragmentation effects.

### *Electricity Supply*

Within the World Heritage Area are an assortment of electricity supply facilities including three hydro-electric schemes with power stations and associated dams, tunnels and other works, 222 km of power transmission lines, 98 km of power distribution lines, 1 substation, 6 communication facilities, and various ancillary facilities such as roads, buildings, houses and workshops.

### *Roads*

The network of roads and access tracks which traverse the Property were constructed for many purposes. Table \* provides a summary of roads and access tracks within the Property which remain available for use under the *Wet Tropics Management Plan 1998*.

**Table \*.** Extent, types and purpose of maintained roads in the Property

<b>Road class and purpose</b>	<b>Length (km)</b>
<b>State controlled roads</b> (roads which form part of the State's road network)	101
<b>Community access roads</b> (local community transport roads)	150
<b>Presentation unrestricted</b> (roads which provide vehicle-based presentation opportunities)	230
<b>Presentation restricted</b> (roads where public access may be restricted and a permit is required)	234
<b>Landholder access</b> (provide legal access to properties in or adjacent to the Property)	153
<b>Management</b> (provide access for management activities including the service of public utilities)	345
<b>Total</b>	1213

### *Water supply and storage*

Rainfall over the bioregion, although the highest in Australia, is highly seasonal, with more than 90% of annual totals falling between November and April creating a need for water storages. Demand on the region's water resources is increasing as agricultural, urban and industrial needs expand in line with population growth and rapidly changing land-uses.

There are three dams in the Property: Copperlode Falls Dam, Paluma Dam and Koombooloomba Dam. The first two supply the urban water requirements of the Cairns and Townsville regions while

Koombooloomba provides a water source for hydroelectric power generation. Eight local authorities have 22 intakes within the Property, each with associated pipelines, access roads and powerlines.

## **Environmental pressure**

### *Global warming*

Almost nothing is known about how global warming will impact the Property's unique ecosystems and biodiversity. Predicted warming for coastal north east Queensland is 1.4 to 5.8° C by 2100, relative to 1990 with +4% to -10% changes in rainfall per degree of warming (Walsh et al 2000). More El Nino-like conditions through this century are likely and tropical cyclone intensity may increase (Walsh & Ryan 2000). Computer simulations suggest that the relative humidity surface will shift upwards on tropical mountains by hundreds of metres during the winter dry season (Still et al 1999) and cloud forests are particularly likely to display climate change effects in the very near future (Foster 2001).

Due to this observed and predicted rapid climate change, the biodiversity and locally endemic and spatially restricted species that are keystone elements of the Property's World Heritage values are predicted to be under severe threat over the next few decades. Preliminary analyses by CSIRO (Hilbert et al 2001) suggest that the regions rainforests are extremely sensitive to climate change. Preliminary unpublished modelling results presently indicate that it is possible that up to 66% of all the Wet Tropics endemic fauna species may be lost over the next 50 to 100 years (Hilbert & Williams pers com).

At present we do not know the full extent of what might be threatened by rapid climate change, where the threats might be greatest, the long term effects of these threats, how climate change might interact with other threats such as regional clearing patterns, weeds and feral animals, and whether or where some areas may provide continued habitat or new areas of habitat in the future.

### *Direct pressures*

There are a range of contemporary human activities occurring within the Property that have the potential to impact negatively on the condition of World Heritage values. Examples are listed in Table\*.

**Table \*.** Examples of environmental issues and direct pressure indicators

<b>Factor</b>	<b>Direct pressure example</b>
<b>Clearing</b>	<ul style="list-style-type: none"> <li>• linear service corridors</li> <li>• impoundments</li> <li>• patch clearings</li> <li>• boundary anomalies</li> </ul>
<b>Fragmentation</b>	<ul style="list-style-type: none"> <li>• powerlines</li> <li>• roads</li> <li>• railways</li> <li>• impoundments</li> <li>• cableways</li> </ul>
<b>Altered Drainage Patterns and Flow Regimes</b>	<ul style="list-style-type: none"> <li>• drainage of swamps and low lying areas</li> <li>• water extraction and impoundments</li> <li>• stream fragmentation</li> </ul>
<b>Environmental Pests</b>	<ul style="list-style-type: none"> <li>• environmental weeds</li> <li>• invasive exotic animals</li> <li>• exotic plant and animal diseases</li> </ul>
<b>Undesirable Habitat alteration/degradation</b>	<ul style="list-style-type: none"> <li>• forest dieback</li> <li>• altered fire regime</li> </ul>

### *Post-listing clearings*

Although there have been no clearings associated with new roads in the Property since listing, there have been several road upgrades and emergency repairs which have resulted in the removal of some trees and an increased road footprint, contributing to increased fragmentation of habitat (the fragmentation impact is probably of greater ecological concern than the loss of trees *per se*). Additional passing lanes have been constructed on the Cook, Kennedy and Gillies Highways. Corners and sharp curves have been straightened to allow passage of B-Double road transports on the Rex and Kennedy Highways. A major upgrade of the Tully-Mission Beach Road has been completed. Cyclone, flood, landslip and slumping damage has resulted in small sections of major repair works being undertaken on the Palmerston, Kennedy and Gillies Highways, the Alexander Range Road, 'Southedge' management road and many more minor access roads within the Property. It is estimated that the combined post-listing clearing resulting from road upgrades and major repairs amount to less than 10ha.

Prior to the commencement of the Wet Tropics Management Plan approximately 15ha of forested freehold land within the WHA was cleared and converted to sugar cane. A further 69ha of freehold native forest was converted to pasture. Two small clearings totalling 1 ha have also been recorded in the Daintree lowlands section of the Property. The expansion of the Herberton water supply resulted in the inundation of 5ha of open eucalypt forest and a further 1ha was cleared in upgrading the South Mission Beach water supply pipeline.

#### *Fragmentation*

Most pre-listing clearings within the Property were associated with the network of community infrastructure such as powerline easements, roads, water pipelines, water impoundments, weirs and culverts all of which cause internal habitat fragmentation to forest blocks and watercourses. The impacts of internal fragmentation are greatest in closed canopied rainforest communities and can be amplified by human use, for example, several components of a road act as a barrier to wildlife movement including the exposed bare road surface and the altered verge habitat. The habitat fragmentation impacts of road infrastructure can be amplified by road use (eg vehicles) resulting in noise, vibration, movement, dust, emissions, and lights which can interfere with wildlife activities and behaviour. Road use can also be a significant source of mortality for wildlife. For some species, particularly those that are rare, road carnage can have a significant effect on their conservation status (eg cassowary). The length and cleared area associated with linear community infrastructure is presented elsewhere in this report.

#### *Altered drainage patterns and flow regimes*

Dams, weirs and culverts are major landscape modifiers resulting in the direct loss of both terrestrial and aquatic habitats through drowning, in the introduction of water barriers to terrestrial fauna movement and acting as barriers to the upstream or downstream movement of fishes and aquatic invertebrates. Such barriers may also interfere with successful reproduction or recruitment of juveniles into adult habitats. Streams below impoundments often become choked with sediments due to altered flow dynamics.

Although there has been no increase in the number of impoundments on watercourses inside the Property since listing, there have been the following changes:

- 5ha enlargement to the Herberton water supply and
- increases in the off-take capacity for the Mossman, Cairns, Mission Beach, Cardwell and Crystal Creek water supplies.

There are also many impacts on stream flows originating from outside the World Heritage Area which affect the condition of watercourses in the Property.

#### *Environmental Pests*

The Wet Tropics is seen as particularly vulnerable to the threat of invasive pest species. For millions of years natural ocean barriers provided the isolation essential for the Wet Tropics' unique species and ecosystems to evolve. In just over a hundred years this natural barrier has been rendered partially ineffective and millions of years of biological isolation has inadvertently come to an end.

In the World Heritage Area many pest invasions are closely related to human activity disturbances, particularly clearings associated with linear service corridors such as roads and powerline easements which act as conduits for pest dispersal.

Within the Wet Tropics bioregion, 508 exotic plant taxa have been identified as having become naturalised (Werren 2001), which amounts to almost 11% of the region's native flora and represents almost 44% of Queensland's naturalised alien plant species total. About 40 of these regional naturalisations are currently considered environmental weeds within the World Heritage Area.

Harrison & Congdon (2001) assessed the status of vertebrate pests within the Wet Tropics region and found that the current major vertebrate pests are the pig, cat, cane toad and dog/dingo. These species ranked high primarily due to their current levels of ecological impacts and because of the current lack of feasible control options. Species with moderate current impacts but substantial future potential included the fox, gambusia, two tilapia species, swordtail, guppy and platy. Translocations of native fish species into artificial impoundments and watercourses in the region as part of recreational fish stocking programs is of growing concern.

#### *Undesirable habitat alteration/degradation*

Two processes which are responsible for widespread habitat alteration in the Property include changes to historic fire regimes in non-rainforest ecosystems and forest dieback in the bioregion's rainforests.

Most of the Wet Tropic's non-rainforest ecosystems evolved under the influence of fire and rely on particular fire regimes for their long-term persistence. The ecological effects of a given fire regime vary depending on intensity, frequency, the season of the burn and the nature of the forest. Open forest plants and animals have evolved with a pre-existing, pre-European fire regime and alterations to this regime are having a range of ecological impacts. Interpreting appropriate fire regimes to protect World Heritage values is difficult because of:

- the difficulties in determining pre-European fire regimes,
- the lack of scientific information on the effects of fire intensity, frequency and timing, or
- the impact of introduced species altering fuel loads and burning characteristics.

The Authority's ongoing vegetation mapping program recently located numerous patches of rainforest dieback across parts of the Property. Soil sampling of affected forest patches by the Rainforest CRC has detected the presence of the soil pathogen *Phytophthora cinnamomi* whose effects in rainforests appear to vary from no visible impact to slight loss of canopy leaves in susceptible species to the death of all plants in virulent outbreaks. Where vulnerability and susceptibility occur together in the presence of the pathogen, the anticipated consequences include:

- major disruption to ecological community structure
- local extinction of populations of some plant species
- a massive reduction in primary productivity
- loss or degradation of habitat for dependent plants and animals.

A total of 190 dieback patches have so far been identified. Research by the Rainforest CRC (Gadek *et al* 2001) suggests that notophyll rainforest types on acid igneous rocks at an altitude between 750 and 1050 metres are particularly susceptible to the current virulent dieback outbreak. Based on these preliminary findings, approximately 14 percent of the World Heritage Area may be susceptible and at risk from rainforest dieback.

*Insert: Pressures from outside - eg urban expansion*

*Insert: Cassowaries & Frogs as case studies*

*Insert: Past Issues eg Tully Millstream & Flaggy Creek*

*Insert: Active Proposals eg Kuranda Road, Cook Highway, Tully Powerline, Quaid Road*

### **Natural and Human-originated disasters and preparedness**

N/A

### **Visitor/tourism pressure**

## Illegal activity

## Number of inhabitants living within the Property

### II.6. MONITORING

#### Current monitoring program

The Authority's major monitoring program is linked to its annual reporting requirements. State of the Wet Tropics reporting is a statutory requirement under the *Wet Tropics World Heritage Protection and Management Act 1993*. Section 63(1) of the Act requires the Authority to present to the Queensland Commonwealth governments an annual report which includes a report on the state of the Wet Tropics Area. The set of key indicator themes were approved by the Board in 1999 (WTMA 1999) from which indicators have been developed. All the indicators chosen are applicable at the regional or landscape scale of resolution. The core set of indicators are designed to be supplemented by additional indicators to accommodate particular management, scale or environmental issues as necessary or for specific, smaller scale monitoring. The core indicators relate solely to measuring changes in natural values. Role in the life of the community socio-economic and cultural indicators are currently being developed in collaboration with the Rainforest CRC.

The generalised core indicator themes presently being employed are summarised in Table \*.

Table \*. Summary of core indicator themes employed in State of the Wet Tropics Reporting

<b>Status of natural values</b>	<b>Factors affecting natural values</b>	<b>Management of factors affecting natural values</b>
<b>Biodiversity</b> <ul style="list-style-type: none"> <li>• ecological communities</li> <li>• plant species</li> <li>• vertebrate species</li> <li>• invertebrate species</li> <li>• rare &amp; threatened ecosystems</li> <li>• rare &amp; threatened plants</li> <li>• rare &amp; threatened animals</li> </ul>	<b>Clearing</b> <ul style="list-style-type: none"> <li>• regional clearing external to Property</li> <li>• clearing within Property</li> </ul> <b>Fragmentation</b> <ul style="list-style-type: none"> <li>• external fragmentation (of Property isolates)</li> <li>• internal fragmentation (within Property)</li> </ul> <b>Habitat alteration/degradation</b> <ul style="list-style-type: none"> <li>• forest dieback</li> <li>• altered fire regimes</li> </ul> <b>Pests</b> <ul style="list-style-type: none"> <li>• environmental weeds</li> <li>• vertebrate pests</li> <li>• invertebrate pests</li> <li>• exotic diseases</li> </ul> <b>Altered flow regimes</b> <ul style="list-style-type: none"> <li>• impoundments</li> <li>• water extraction</li> </ul> <b>Community infrastructure</b> <ul style="list-style-type: none"> <li>• powerlines</li> <li>• roads</li> </ul>	<b>Statutes</b> <ul style="list-style-type: none"> <li>• State &amp; Commonwealth Acts</li> <li>• subordinate legislation</li> </ul> <b>Policy</b> <ul style="list-style-type: none"> <li>• plans</li> <li>• guidelines</li> <li>• codes</li> </ul> <b>Land ownership</b> <ul style="list-style-type: none"> <li>• State tenures</li> <li>• IUCN protected area categories</li> </ul> <b>Aboriginal interests in land</b> <ul style="list-style-type: none"> <li>• claims</li> <li>• Aboriginal land ownership</li> <li>• joint management</li> </ul> <b>Rehabilitation</b> <ul style="list-style-type: none"> <li>• tree planting/landscape restoration</li> <li>• species recovery programs</li> </ul>

- 
- telecommunications

#### **Tourism & recreation**

- visitor numbers
- economics of visitation

#### **Regional demographics**

- subregional population patterns and trends
- 

At the site level, the Authority in collaboration with the Rainforest CRC has instigated a visitor monitoring system incorporating both biophysical and psychosocial components.

*Insert: Site level visitor monitoring system*

*Insert: Social surveys*

### **Results of current monitoring program and of Key Indicator measurement**

The following are some of the key issues and findings selected from the 2000-2001 State of the Wet Tropics Report which highlight some of the more significant and current issues or pressures affecting protection and management of the Property (<http://www.wettropics.gov.au/docs/2001-annual-report.pdf>).

#### *Tenure trends*

The increase in higher order land protection within the Property has been significant since listing with an average increasing trend over the past eight years of 4,500 ha per year being added to the national park estate. Over this same period there was an average 3,300 ha per year increase in the area of state forests unencumbered by leases and an average reduction of 6,600 ha per year in the area of leases and freehold land within the Property.

During 2000/01 a program to transfer State Forests within the Property to the protected area estate under the *Nature Conservation Act 1992* was initiated by the State Government. Approximately 320,000 ha (36% of the World Heritage Area) is proposed for staged or progressive transfer to a tenure of higher protection.

#### *Management Agreements*

Eighty percent of the Property is potentially subject to Native Title Rights under native title legislation. Currently a total of 282,966 ha of the 894,000 ha World Heritage Area is under claim. Land formally under indigenous management has increased by an average of 1,170 ha per year over the past eight years and presently totals 26,453 ha.

The first management agreement with Aboriginal peoples in the Property was signed in 2000 with the Djabugay Tribal Aboriginal Corporation under section 42 of the *Wet Tropics Management Plan 1998*. This will ensure positive management of the Mona Mona Reserve's World Heritage values by the Mona Mona community living within the Property.

#### *Regional population*

Regional population growth is 1.5% which is greater than the national average. The annual population growth for the region over the next decade has been forecast at 1.9%. Development associated with a rapidly increasing regional population is leading to greater pressures being placed on the Property. These pressures include demands for energy supplies and distribution corridors, telecommunication facilities, the upgrading and duplication of transport corridors and increased demands for water supplies for domestic, agricultural and industrial uses.

#### *Regional tourism*

The Wet Tropics is an outstanding visitor destination and tourism plays a key role in presenting the Property's values to millions of visitors each year. Based on 1997 figures, tourism in the World Heritage Area is estimated to generate over \$750 million each year.

It is estimated that the annual number of visitors to the region is presently around 2.8 million. Visitor trends and projections forecast an increase in total visitors to approximately 4.5 million by 2016 with an increasing trend in the numbers of international visitors being a major contributing factor.

Increases in the resident and tourist population is placing greater demands on the Property for recreation and tourism pursuits particularly with regards road access, walking tracks, more developed visitor sites, camping grounds, picnic areas, lookouts and other visitor facilities.

The Wet Tropics Nature Based Tourism Strategy (2000) and Wet Tropics Walking Strategy (2001) now provide a strategic regional framework for management of pressures associated with visitor use, coordinated management of nature based tourism, and presentation of the Property.

#### *Community infrastructure*

Ecological fragmentation associated with community service infrastructure is one of the major ecological impacts originating from within the Property. Electricity supply infrastructure is having the most significant fragmentation impact.

An environmental impact study into the feasibility and environmental impacts of alternate routes for the upgrading of the Tully-Innisfail powerline has been undertaken and is presently at the public consultation stage. A coastal route avoiding the Property appears to be a prudent and feasible option. Such an option would result in the eventual decommissioning and rehabilitation of at least 35km of an existing 132KV transmission line and its associated 60 metre wide swathe clearing which presently dissects the Palmerston section of the Property. This would be a major gain for the management of the Property, especially with respect to reduced ecological fragmentation.

The Flaggy Creek and Davies Creek water storage proposals which had direct impact implications for the Property have recently been rejected in favour of more prudent and feasible alternatives.

Codes of practice have been prepared for management and maintenance of road, electricity and water infrastructure in the Property. These codes of practice are in the process of being implemented by service providers. Environmental Management Plans are being employed by infrastructure agencies to avoid or minimise environmental harm and to reduce current levels of impact.

#### *Vegetation Clearing*

With the introduction of the *Wet Tropics Management Plan 1998* clearing without a Wet Tropics Permit is now prohibited. Most existing clearings within the Property are related to activities and infrastructure which were in place at the time of listing. There are currently 2,406 ha of maintained linear clearings in the Property providing vehicle access and electricity distribution. A further 2,129 ha of clearing is due to artificial dams and impoundments which were present prior to World Heritage listing. Since listing there has been a total of 101 ha of new clearings, 85 ha on freehold land with the remaining 16 ha associated with community infrastructure.

Clearing of native vegetation outside the Property but within the Wet Tropics bioregion remains a concern, however it is noted it has slowed from an average rate of 3,583ha per year between 1991-95 to 1,275ha per year between 1997-99. The largest areas cleared between 1997 and 1999 were on the upland tablelands. Although external to the Property these clearings and related changes in land uses are potentially major underlying threats to the long-term integrity of parts of the Property. Some of the associated impacts include the fragmentation of habitat, the severing of natural wildlife corridors, and the introduction and spread of pest plants, animals and diseases.

A number of rehabilitation projects are being undertaken throughout the bioregion by a range of organisations. These projects are achieving significant improvements to the region's environment and in time should contribute to the gradual re-establishment of ecosystem processes. The Authority has been supporting initiatives designed to:

- link outlying parts of the Property such as the Crater Lakes with the main block of World Heritage listed rainforest; and
- establish connections across linear infrastructure corridors within the Property such as the road and power line corridors in the Palmerston and Woree sections of the Property.

#### *Threatened species*

Although covering only about 1 percent of Queensland, the Wet Tropics bioregion was home to 59% of the State's presumed extinct plants, and is presently the habitat for 28% of Queensland's endangered plants, 19% of its vulnerable plants and 34% of its rare plants. The Wet Tropics has a total of 98 animal species listed as rare or threatened, including seven endangered frog species, and the endangered cassowary, mahogany glider, northern bettong, spotted tail quoll and two butterflies. A further 16 vertebrate species are classified as vulnerable.

Of the endangered species, recovery plans are currently being formulated for seven frog species, the northern bettong, mahogany glider, spotted tailed quoll and cassowary. The Authority is represented on the frog, spotted tailed quoll and northern bettong recovery teams and the Cassowary Advisory Group.

Of particular concern is the dramatic decline in population numbers of seven species of frogs over recent years. These frogs are endemic to the Wet Tropics and have disappeared from streams above 450 metres altitude in seemingly pristine environments over the last two decades. Recent research findings attribute the decline to the amphibian fungus, *Batrachochytrium dendrobatidis*. Agreement on management strategies aimed at decreasing the risk of communicable diseases to amphibians was one of the practical outcomes of a recent conference on amphibian diseases. The conference and associated workshop was hosted by the Rainforest CRC in collaboration with James Cook University, Environment Australia, WWF and several government bodies.

Population numbers of the Southern Cassowary also appear to be in decline with estimates of fewer than 1,500 adult cassowaries remaining in the Wet Tropics bioregion. A recent study in the Mission Beach area identified a total of 110 cassowaries (49 adults) with an average loss of 2% of the adult population per year since 1988. Of these deaths, one bird was shot, six died from disease, 13 were killed by dogs and 42 died in collisions with vehicles on the roads. An additional pressure is loss of habitat, with the estimated clearing of 18% of available cassowary habitat in the Mission Beach district between 1992-1998. Cassowary conservation is vital as they play an essential role in sustaining a functioning forest ecosystem. The community-based Cassowary Advisory Group is provided with administrative and technical support by the Authority. The group's efforts have been concentrated in the known cassowary 'hotspots' of Mission Beach, the Daintree lowlands and Kuranda. In these areas intensive field surveys and on-ground recovery actions have been undertaken to minimise the identified threats. This work was initiated in partnership with community groups, other government agencies and local government.

#### *Pest species*

In 2001 the Authority commissioned the Rainforest CRC to develop 'risk assessment systems' for both environmental weeds and vertebrate pests. These systems gauge the potential environmental impact of weeds and vertebrate pests on World Heritage values and will be used to focus pest management resources.

The rapid increase in naturalised plant species (ie introduced species which have formed self sustaining populations in the wild) in the Wet Tropics region is of concern. In the past decade the number of naturalised species recorded for the region has increased from 320 to over 500. The number of environmental weeds (naturalised species which enter and disrupt natural systems) has also increased. The risk assessment process has presently identified 27 terrestrial and 7 aquatic species which are considered to be of particular concern to the ecology of the Property.

Although the number of vertebrate pest species (28) has remained stable for several years, their population numbers, distribution and ecological impacts are poorly understood. The feral pig, cat, cane toad and dog have been assessed as the current major threats. Pest species with substantial future impact potential include the fox and six exotic freshwater fish species. The translocation of large predatory native fish outside their natural range as part of recreational fish stocking projects is an emerging serious concern. The Authority supports regional feral pig trapping program destroyed a total of 6,500 pigs

between 1994 and 1999. It has been estimated that there are in the vicinity of 27,000 feral pigs in the region.

*Rainforest dieback*

The recent discovery of many small scattered patches of dead rainforest is a potentially serious issue. Rainforest dieback, attributable to *Phytophthora cinnamomi* now appears to be much more widespread than previously expected. Preliminary findings suggest that up to 14 percent of the Property may be at risk. The Authority is working with the Rainforest CRC to further investigate these recently identified outbreaks so that informed management decisions can be made. After an initial assessment, a more comprehensive rainforest dieback research program is now being undertaken.

**World Heritage Values monitoring - Monitoring Matrix and identification of additional indicators needed to allow comprehensive assessment of the condition of World Heritage values of the Property**

**Report on outcomes of World Heritage Committee or Bureau State of Conservation Reports**

**Report on outcome of ACIUCN Reactive Monitoring reports**

As per State response.

**II.7. CONCLUSIONS AND RECOMMENDED ACTION**

- a. Main conclusions regarding the state of the World Heritage values of the Property (see items II.2. and II.3. above)**
- b. Main conclusions regarding the management and factors affecting the Property (see Items II.4 and II.5. above)**
- c. Proposed future action/actions**
- d. Responsible implementing agency/agencies**
- e. Timeframe for implementation**
- f. Needs for international assistance.**
- g. Experience relevant to other states parties**

**ATTACHMENTS**



**Projects funded under the Wet Tropics Management Authority Research Grants Scheme (1992-1996)**

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